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From the Desk of Executive Director

It gives me immense pleasure in presenting the first volume of *RMC Tech Beat*. As the name suggests, this would be a kind of a technical bulletin covering developments in concrete in general and ready-mixed concrete in particular. The main objective of bringing out *RMC Tech Beat* is to disseminate information on latest developments in the field of concrete technology -both within the country and abroad. We are sure you would welcome it.



Already, a number of journals, magazines and bulletins published from India and other countries are engaged in the endeavor of providing up-to-date information on the technological progress in concrete and construction. *RMC Tech Beat* has no intention to be one of them or even pretend to be close to them. Yet, in the bewildering information explosion, the urge to communicate and comment on the topic of concrete, which is so dear to our heart, is strong. Moreover, as a responsible producer of ready-mixed concrete and aggregates, we feel it is our duty to share few latest developments with our customers. Present challenging business scenario does not permit many of our customers to spare their valuable time for

interactions with the senior members of our team. Equally important is the fact that quite a few of them are not aware about some innovative work done by us elsewhere in the country. Thus, the need to have an additional instrument for dialogue with the customers - primarily on technical matters - was being felt by us for a long time. We are hopeful that *RMC Tech Beat* will fulfill this need, at least partially.

We plan to bring out this publication quarterly and intend to hopefully minimize the frequency of its publication at a later stage. It will be available in both the electronic and print forms. However, being an environmentally-conscious company, we plan to print only a limited number of copies. Kindly therefore inform us in what format you would like to receive the copy and the same will be made available to you.

As I close this small note, it is needless to mention that we shall welcome any constructive suggestion for improving the quality and contents of *RMC Tech Beat*.

Ganesh Kaskar
Executive Director
RMC Readymix (India) -A Division of Prism Cement Limited.

Company News

RMC Readymix (India) expands its network

RMC Readymix (India) - a Division of Prism Cement Limited, is the third-largest ready-mixed concrete manufacturer in India. Set-up in 1996, it is one of the pioneers of ready-mixed concrete technology in India. The Company currently operates 87 ready-mixed concrete plants in 36 cities/towns across the country. RMC Readymix (I) has been striving hard to expand its production capacity in line with the market demand. Recently, it has added two important locations to its existing network.

Bhopal

Bhopal is truly in the heart of India. A fully computerized ready-mixed concrete plant has been set up by the Company in Govindpura Industrial Area of Bhopal recently.

The plant has an installed capacity of 56m³/ hour and is equipped with a smart central concrete lab. Concrete shall be transported by a fleet of 6 meticulously maintained transit mixers and 2 line pumps to ensure that RMC's high quality product reaches customers via high speed delivery systems, on time, every time.

Right from the inception stage, the Company's production set-up and QA/QC systems were found impressive by customers from both the private and public sector. This has helped the Company in bagging the prestigious orders for 4 major flyovers being executed by NCC Limited. With a long-term goal to be fulfilled and delivered to its citizens by 2021, the Bhopal Municipal Corporation (BMC) has formulated the City's Development Plan in a unique

Around the World

RMC Completes a Century in the USA!

Contrary to the general perception in India, ready-mixed concrete is not a new technology. It was patented in Germany, way back in 1903. But since the means of transporting it were not developed then, it took another decade for the concept to materialize. This happened in the USA, where the first delivery of ready-mixed concrete was made in Baltimore in 1913, i.e. 100-year back! The ready-mixed concrete industry in the USA thus completes a century this year. By all means, it's a great achievement. The technology of ready-mixed concrete not only survived for 100 long years in the USA, but also spread its wings in other parts of the world and is still going strong!! Incidentally, it was in 1930 that Ready Mixed Concrete Ltd. was formed in the U.K. This Company later became the RMC Group plc, the well-known multinational ready-mixed concrete company. RMC Readymix (India) was established by the RMC Group plc. in 1996.

The industry in the United States has many achievements to its credit. It grew steadily in the early half of the 20th century and reached a figure of 100 million cubic yard (76 million m³) in the second half of 1950s. The industry played an essential role in the nation's economy and development and benefited from the inter-state highway construction. The concrete boom in the USA continued through the 1960s, and 1970s. By 1980, the US industry produced 228 million cubic yards (175 million m³) of concrete, employed approximately 80,000 people, operated between 8,000 and 10,000 plants and ran 42,000 vehicles. There were some temporary setbacks; but the industry grew steadily through 1980s and 1990s and in 2006, it reached the 350 million cubic yards (267 million m³) mark – the highest achieved so far. The industry consumes about 75% of the cement shipped in the U.S.A.

The world economic crisis has had a severe effect on the ready-mixed concrete industry in the USA. The concrete production fell from the peak of 267 million m³ in 2005 to around 197 million m³ in 2010! Since then the production figures show recovery; however it is slow. The industry is reportedly on a growth track again, although in a modest way.

While wishing all the best to the US industry on its centenary, we hope that it will achieve its earlier glory once again.

(Source: NRMCA, USA)

World's first 3D-printed building planned

Two students, Jim Bredt and Tim Anderson from MIT, USA, coined the term "3D printing" in 1995 and showed that an inkjet printer can be used to extrude a binding solution onto a bed of powder, rather than ink onto paper. Since then the technology of 3-D printing has advanced considerably. 3-D printers have now been developed to produce intricate objects, by printing thin layer after layer of plastic, metal, ceramics or other materials. And the products they make can be highly customized. Some experts believe that the technology of 3-D printing may replace the conventional manufacturing in the near future.

Recently, inspired by the Earth's landscape, a Dutch architect, Janjaap Ruijssenaars, plans to construct the world's first 3D printed building.



Reporting the information, the BBC News stated that the 3D buildings will resemble a giant mobius strip — a continuous loop with only one side. Ruijssenaars is working with large-scale 3D printing expert Enrico Dini on the project. The industrial sized 3D printer uses sand and a special binding agent to create a "marble like material" stronger than cement.

The technology of conventional construction, using either cast-in-situ or precast concrete has advanced considerably in terms of both quality and speed. However, Ruijssenaars is providing a totally different approach.

It is reported that the first 3D-printed "Landscape House" which will come up in 2014, will be printed in chunks of 6 m by 9 m. Each structure will be built from the bottom up, in a series of 5mm layers of sand deposit. When the building is done, workers will brush away the loose sand to reveal the bonded sand structure underneath.

The 1,000 m² buildings would still require concrete and reinforcements, the architect said.

(Source: BBC News, Times of India)

Forum

Mix Optimization: Benefits Galore!

Concrete mixture proportioning (often termed as concrete mix design) is a process by which one can arrive at the right combination of cement, aggregates, supplementary cementitious materials (SCMs), water and chemical admixtures for producing concrete that will perform to certain pre-determined requirements. Mix design is both an art and science and it is imperative for the ready mixed concrete producer to master both.

Besides satisfying the technical requirements of workability, compressive strength and durability, it is also essential that the designed concrete mix is cost-effective. The skill of the designer lies in producing a mix which satisfies the given technical requirements and is simultaneously commercially viable. Incidentally, in a typical market place, concrete designed by the lowest cost bidder need not be cost-effective as it may lack many desirable technical and financial attributes.

Historically, it has been the practice in India to get the mix design carried out in a third-party laboratory and the same practice continues for some projects even today. Unfortunately, mixes so designed are quite often devoid of optimization, as the cement content - the costliest input in the mix - is generally on the higher side than necessary.

With the advent of ready-mixed concrete in the country, things have changed for the better. Now, the customers have the choice of using the services of expert concrete technologists from leading ready mixed concrete companies like RMC Readymix (India), possessing abundant skills in the art and science of designing concrete mixes. Unfortunately, there are many customers who are unable reap the benefits of such services. Some of them still continue to specify concrete on an *ad hoc* basis! This could be due to some previous unpleasant experience with an amateur ready mixed concrete producer in the past or it could be because of the customer's concern for the possible shortfall in the compressive strengths at 28 days.

Any optimization necessarily involves utilizing the costly inputs to the bare minimum level. In the case of concrete, this means utilizing only the required quantity of cement in the mix, without sacrificing the compressive strength or other specified requirements. RMC Readymix (I) has a two-pronged approach to effect such optimization – firstly by ensuring that the fine and coarse aggregates used in the mix provide the best particle packing and secondly, by optimizing the cementitious content through the use of SCMs like fly ash and GGBS, which is done without violating the threshold limits of SCMs permitted by the code.

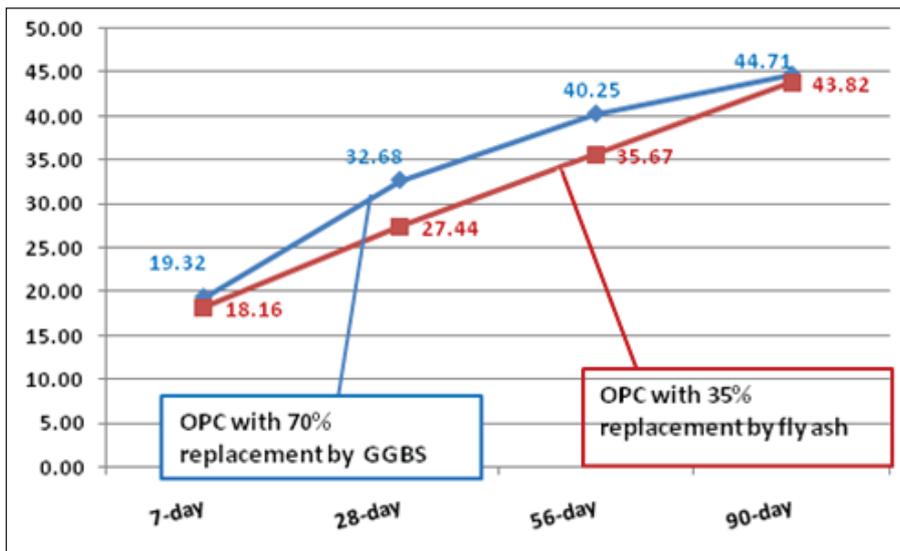


Fig 1 Wonder of mix optimization with SCMs: Compressive strength of M20 concrete doubles at 90 days!

Forum

Such optimization brings in its fold many attractive benefits for the customers, which they possibly cannot afford to ignore. The biggest advantage will be in terms of the long-term durability of the structure. There is a plethora of research to substantiate that an optimized concrete mix in which cement content is kept to the minimum level and contains good quality SCM (around 30-35% fly ash or 60-70% of GGBS) provide reduced permeability to aggressive external agents, thus improving the long-term durability. Besides this, the use of SCM leads to continued gain in compressive strength at 56, 90 days and beyond, which is clearly evident from the in-house data from RMC Readymix (I), Fig 1. It can be seen from the graph that even when the reduction in OPC content is stretched to the minimum allowable limits, the compressive strength of M20 concrete has more than doubled at 90 days! This is a gigantic bonus to the customer and users, which would not have been available to them if concrete mix was not optimized for the allowable percentage replacement of cement by SCMs.

approach the chances of strength failure are minimized drastically.

Additionally, the sustainability benefits accruing on account of the use of an optimized mix containing SCMs are amazingly substantial. According to the world-renowned concrete *guru*, there are three tools to reduce the concrete industry's carbon footprints. The first is to minimize concrete consumption through innovative architecture and structural design. The second is to specify 56- or 90-day compressive strengths whenever possible to minimize the amount of cementitious material required in a mixture. The third is to use a smart concrete mixture proportioning approach that includes the use of a high proportion of SCMs with Portland cement. This is diagrammatically represented in Fig 2. Mehta estimates that the diligent use of these methods could cut the concrete industry's carbon footprint in half over the next 20 to 30 years!

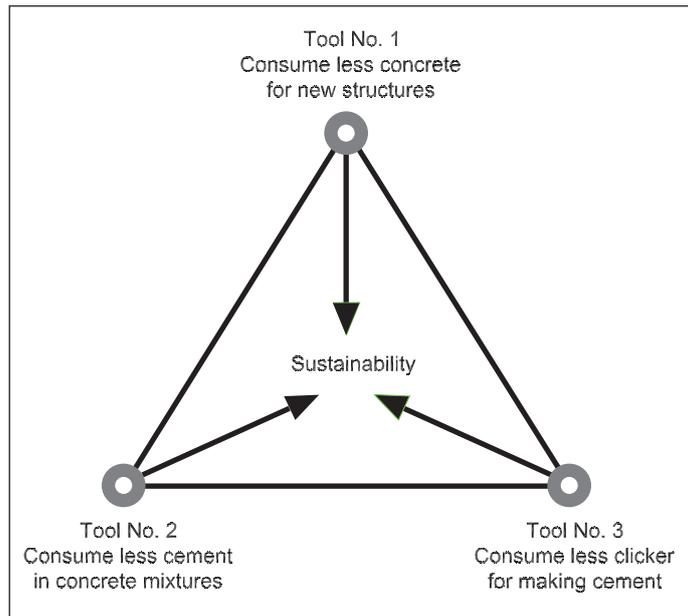


Fig 2 Tools for reducing concrete industry's carbon footprints (Source: "Global concrete industry and sustainability" by P Kumar Mehta, Concrete International, Feb. 2009)

When using SCMs, one of the major concerns of the customers seems to be the fear of possible shortfall in compressive strength at 28 days. This fear is totally unjustified when concrete is being ordered from experienced producer like the RMC Readymix (I). The company not only uses the best optimization tools, but also uses an advanced early-warning system, known as the CUSUM technique. With the adoption of this two-pronged

By virtue of having obtained experience in producing lakhs of cubic meters of concrete the expert concrete technologists from RMC Readymix (I) have now sharpened their mix design skills. It would be height of absurdity if their expertise is not utilized!

Therefore, allow RMC Readymix (I) to optimize your concrete mix and reap the benefits!

Concrete Innovation & Trends

First Radiant Cooled Commercial Building in India

Infosys - the global information services company – is setting good examples, demonstrating its strong commitments to the concept of sustainable development and efficient use of natural resources. The Company has proclaimed to achieve 50% reduction in its per capita energy consumption and become carbon neutral by 2017. With these objectives, it has initiated a number of measures such as use of renewable energy – solar, wind, and bio, reducing water consumption, use of recycled water, maximum use of natural light, among others.

In a tropical country like India, energy required in cooling office buildings or commercial complexes is substantial. Any saving in energy consumption would go a long way, ensuring sustainability as the impact of such saving for the entire life cycle of the building would be enormous.

After due considerations to the pros and cons of various available options, Infosys decided to adopt the innovative radiant cooling concept for its campus in Hyderabad. This system was used for the first time in India. The building layout is such that it is split into two identical halves (Fig 1), enabling comparison of the conventional air conditioning system installed in one half with the radiant cooling system installed in the other.

What is radiant cooling?

It is known that running chilled water is more efficient than circulating cool air as the former can reportedly carry 3400 times more energy than air for the same volume. This property of water is advantageously used in the radiant cooling system. It involves embedment of a large network of small-diameter pipes within the body of the slab during casting (Fig 2). These pipes are fixed to the reinforcement cage and the whole assembly is laid properly before concreting. Once chilled water flows within the pipe network it cools the entire slab, maintaining the surface temperature of the slab at about 20°C. Cooling inside the office space is achieved when the cool surface of the slab absorbs heat radiation generated from humans, lighting, and heat from computers and other equipment. The building is built in the North-South orientation and efficient windows helps to utilize maximum natural light, while minimizing heat ingress. Also, it needs to have efficient envelope in the form of double wall insulation and insulated roof. In addition to radiant cooling, fresh air is supplied inside the building through a Dedicated Outdoor Air System (DOAS) for controlling humidity and to maintain healthy indoor environment.



Fig 1 Infosys SDB-1 building, Hyderabad

Concrete Innovation & Trends



Fig 2 Network of Pipes (red colour) tied to reinforcement and placed in position before concreting of slab

During concreting of slabs, it is essential to take extra care to ensure that the pipes do not get damaged. Before concreting the pipes are filled with water and are connected to piezometers (Fig 3). In case there is a drop in the water pressure in any tube, a puncture can be suspected and immediately corrected. In addition, special platforms are provided for carrying construction materials and for workmen to walk over the laid reinforcement (Fig 4). This is essential to ensure that no damage takes place to the embedded pipes.



Fig 4 Platform laid on strands to carry workmen and pumping pipes



Fig 3 Piezometer connected to network of pipes

For monitoring and comparing the performance of the radiant cooling system with the conventional one, appropriate intelligent systems were fitted inside the Infosys building. Careful monitoring of the two systems over a period of one year showed that the radiant cooling system consumed 33% lesser energy than the conventional system. Further, it is interesting to note that the capital cost of the radiant cooling system was slightly lower than that of the conventional air-conditioning system.

Considering the success of the radiant cooling system, Infosys is now installing similar systems in their new buildings at several locations..

RMC Readymix (I) is proud to be the concrete supplier for the construction of the innovative radiant cooling system at Infosys campus.

(Source: Article on "First radiant cooled commercial building in India- Critical analysis of energy, comfort and cost" by Mr. Guruprakash Sastry, Infosys Ltd., Bangalore)

Company News

RMC Readymix (I) expands its network

(Continued from page no.1)

manner, warranting a high level of public participation so as 'to foresee an issueless 2021'. Hence, one can expect an impressive development of infrastructure across the city whose skyline should get metamorphosed with high rise structures in the near future.



A view of the batching plant in Bhopal

Guwahati

.....and finally the Company has taken a bold step to enter the North-Eastern part of India, by setting up a production facility at Lokhra Industrial area in Guwahati. In the Northeast India, Guwahati is recognized to be the most critical city. The city has a well-developed connectivity with the rest of the country and acts as the gateway to the entire North Eastern India. Hence, the development of the city is not only critical to the state of Assam but also to the entire Northeast. Given the criticality of the city to the entire region, it is quite evident that population of the city would continue to grow rapidly in the future.

The plant and machinery set up at our Bhopal plant has been replicated here, to ensure complete customer satisfaction.

Through a series of appraisal trials, the Company has been able to establish mixes with locally available materials and is geared up to produce M60 grade of concrete. Construction projects of Lily Hotel, Raddison and Taj Hotel have already benefitted from the services of the Company and it is the Company's earnest desire to meet all the concrete needs of the city.

Pink Coloured Concrete for Infosys at Mysore

Imagine a sprawling 20,000 sq. ft. (1858 m²) walkway expanse in pink colour concrete. Lo and behold.....you could be walking on one – at the Mysore campus of Infosys!

An erstwhile decision to pave the area with pink coloured granite was modified when the Infosys team learnt that RMC Readymix (I) can come up with something better and consistent from their palette of colours.

Producing pink colour concrete was not an easy task. It

needed careful mix proportioning involving a number of lab trials and once the mix was finalized and approved, a tight control during production to ensure that accidental mixing of deleterious materials should not mar the appearance of concrete. It also needed careful handling of concrete and necessary precautions during placing and finishing. Thanks to the joint efforts of the teams from RMC Readymix (I), and those from the contractor and client that an aesthetically pleasing colour concrete could see the light of the day!



A Panoramic view of the pathway for the Software Development Block-6, Mysore Campus of Infosys

MAIL Box

Q. I have become your customer recently. I would like to know how you guarantee the quality of your concrete delivered to us.

A.: RMC Readymix (India) attaches immense importance to provide highest level of quality assurance to its customers. The basic features of the quality systems practiced by the Company are summarized as below:

- Strict control on the quality of all input materials through rigorous in-house or third-party testing
- Stringent process control measures involving thorough inspection, good upkeep of equipment, monthly scale calibration of weighing devices, etc.
- Continuous monitoring of the key properties of concrete in the fresh and hardened states, including their statistical analysis
- Alignment of Company's QA & QC practices with the world-renowned Quality Scheme for Ready-Mixed Concrete (QSRMC) from U.K. This involves continuous monitoring on all stages of production and supply - order processing, purchase/control on input materials, concrete mix design, process control, sales, delivery and statistical quality control.
- Modern in-house central laboratory at different locations for testing of concrete and its ingredients on a regular basis
- Active involvement of well-qualified and experienced technical team trained in QA & QC practices.

Another key feature of the QA system practiced by the Company includes the use of CUSUM (cumulative summation) technique. The system assists in quick detection of changes in the properties, and indicates when action should be taken to increase the probability of meeting the specifications. This early-warning system has helped us meeting clients' requirements meticulously. RMC Readymix (I) is probably the only producer in the country to implement and use CUSUM system to ensure batch-wise consistency in concrete quality.

Ask your Question!

Readers are requested to send their technical questions/queries in writing to us. Questions pertaining to day-to-day practice and those on concrete technology would be welcome. We would give reply to one selected question in each issue.

NABL Accreditation for Whitefield Plant Lab

Since concrete is produced mostly from locally-available materials, one cannot avoid the element of variability in the properties of incoming materials, which may get reflected in the final product. Therefore, periodic testing of incoming materials and outgoing concrete assumes importance. RMC Readymix (I) has taken a conscious decision to set up fully-equipped laboratory at each location for testing aggregates and concrete. This has helped the Company in keeping a vigilant eye on the quality of incoming materials and providing quality products to its customers. Over years, the Company has achieved such a high level of proficiency in testing that many customers prefer to get their concrete tested in the Company lab, rather than getting it tested in their own or third-party labs.



In this context, the Company has added another feather in its cap. When one of its labs – attached to Whitefield Plant in Bengaluru - was subjected to NABL Certification, it could achieve the distinction of getting the Accreditation under ISO/IEC: 17025: 2005, in the field of Mechanical Testing of Aggregate and Concrete. This confidence building exercise will go a long way in assuring the Company's customers its commitment to the quality.

Hearty congratulations to the entire technical team associated with Whitefield Plant lab!

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