RMC TECH BEAT

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Concrete Innovations & Trends

Rise of Concrete High Rise !

A recent annual review report of the Council for Tall Buildings and Urban Habitat (CTBHU) makes an interesting reading. The report reveals that the quest to go vertical is strong and continuing. It would be a pleasant surprise to many of us in India that the high-rise construction sphere, which had hitherto been the domain of steel for a long time, is now being replaced by concrete and composites!

Owing to the ripple effects of the 2007-09 global financial crises the pace of completion of tall buildings in the western world slowed down in 2012. However, this was compensated partially by the growth in the Middle-East and Asia. As a result, 66 tall buildings, taller than 200m, were completed in 2012 – the third highest in the history! What is noteworthy is the fact that there are 437 buildings taller than 200m, presently under construction globally. The CTBHU report predicts that a new record for tall buildings will possibly be set by the end of 2013.

Tall building construction has been an important driver for the revitalization of urban centres throughout the world. Over years, there has been an unprecedented rise in urbanization, which is more evident in the dramatic shift from rural to urban economies in several countries, including China, India, etc. This is one of the major factors responsible for the growth of tall buildings in major cities throughout the world. The limited availability of land is driving the prices sky high and is compelling developers to build taller in urban centres. Further, thanks to the technological advances in materials and construction technologies, the developers are now able to build taller projects in a cost-effective manner.

The CTBHU report provides an interesting analysis of World's Tallest 100 buildings. This analysis highlights following three dramatic shifts in "why, where and how" tall buildings are built:

- In the year 2000, 85 of the 100 tallest projects were office buildings. In 2012, only 49 of the top 100 buildings were constructed for offices.

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Company News

Stamped Concrete in Kochi, Kerala

Stamped concrete has the ability`` to dramatically improve the landscape and enhance aesthetics. It can be shaped, textured and coloured to achieve almost any imaginable manifestation desired by an architect. Stamped concrete can thus be effectively used for enhancing the landscape around residential, commercial and industrial complexes. In addition to the aesthetic property, stamped concrete can also be made to provide improved impact resistance, surface hardness and stain resistance.

Recently RMC Readymix (India) demonstrated its capability of producing stamped concrete by supplying Dyecrete™ to cover around 900m^2 of area for a renowned Kalamasherry Rajagiri Church at Kochi. During the supply of the special concrete, the company had to overcome many challenges including heavy rainfall. The work was completed in one-and-a-half months time. It was a very prestigious project and had the involvement of a very renowned Architect from Kerala.

Fig 1 Stamped concrete application at Kochi (Inset-Rajagiri Church)

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Around the World

USA: PCA predicts strong growth in cement

After a long recession, the residential, commercial and industrial construction markets in the United States can expect a major uplift, both in the immediate and longer term future. This prediction is made by the Portland Cement Association (PCA), USA.

Following the strongest cement consumption gains in the past seven years in 2012, PCA now expects that this growth will continue in 2013 with a 6.2 percent increase. According to the PCA's latest forecast, the majority of market recovery will occur in the second half of 2013.

PCA expects housing stocks, to reach nearly 1 million in 2013. Multi-family construction also continues to grow at a strong pace and this trend should continue as favourable fundamentals fuel the sector. Multi-family stocks recorded a 55 percent gain in 2011 and 36 percent growth in 2012. PCA expects an additional growth of 29 percent in 2013 to 318,000 units.

The accelerated consumption predicted during the second half of 2013 should carry into the following year. PCA projects an increase of 9.2 percent for 2014. PCA also upwardly revised its long-range projections for 2015-2017. Annual growth during that period is expected to be as high as 11.1 percent. PCA predicts cement consumption levels will reach 120 million metric tons by 2017.

Source: PCA News

Europe: CE marking mandatory for construction products

The construction industry in Europe is facing one of the most significant changes in a decade in the way in which construction products are sold. From July 1st 2013, under the Construction Products Regulation 2011 (CPR), it has become mandatory for manufacturers to apply CE marking to any of their products which are covered by a harmonised European standard (hEN) or European Technical Assessment (ETA). This is a major change as affixing of CE marking under the provisions of the existing Construction Products Directive (CPD) is currently voluntary. For those already using CE marking under the CPD the transition should be straightforward. Manufacturers and importers are now required to ensure that their construction products meet the CE requirements of the new Regulation.

Under the new dispensation, it is the manufacturer's responsibility to apply CE marking and declare that the product meets all appropriate provisions of the relevant legislation.

CE marking provides a consistent way of expressing a product's properties. It is effectively a 'passport' allowing a product to be placed on the market. CE marking provides evidence that the product is fit for a particular purpose.

Source: Construction Product Association, U. K.

Concrete pavement for green infrastructure

The European Commission (EC) adopted on 6 May 2013 a new strategy for encouraging the use of green infrastructure. The strategy focuses on promoting green infrastructure in the main policy areas, transport included. Concrete pavement is the most appropriate choice for inclusion within those green transport infrastructures due to its important contribution to reduce road transport's carbon footprint --thanks to the uptake of CO_2 in the hardened concrete, the light reflectivity of a concrete surface which contributes to the cooling of our planet, and the reduced fuel consumption of heavy vehicles riding on a non-deformable pavement.

Moreover, the European Commission announced that by the end of 2013, it will develop guidance to show how green infrastructure can be integrated into the implementation of these policies from 2014 to 2020. The Commission also reports that it will set up an EU (European Union) financing facility by 2014 together with the European Investment Bank to support green infrastructure projects and will carry out a study to assess the opportunities for developing an EU-wide network of green infrastructure.

Source: http://www.eupave.eu/documents

Concrete shelter from Inflatable tent

It is interesting to know that a concrete shelter can quickly be made from a canvas-like fabric that is flexible and lightweight. When water is added to the material, it hardens into concrete. The "Concrete Canvas Shelter" is a large inflatable tent made from a unique and highly functional material.

The tent which was created by a U.K.-based company was originally developed for military use. It can also be used in an event of a natural disaster where sturdy shelters need to be resurrected quickly.

In test conditions, the inflatable canvas shelter was able to be erected by two people without any training in less than an hour. Once the concrete hardens, the building is ready to be used in 24 hours!

The shelter comes delivered flat-packed in airtight and water- and rot-proof sacks. Once the electric fan is activated, it's able to blow up the plastic structure. Once the tent is fully inflated, you can simply hose down the outside with water to turn the canvas fabric into a solid material.

Source: www. psfk.com

Fig Concrete shelter from inflated canvas tent

Forum

Testing Variations in Compressive Strength: Why and How Much?

In concrete compliance testing, 28-day compressive strength is one of the most important criteria. Testing and interpreting results of compressive strength therefore become crucially important for the ready-mixed concrete producer.

During the formative years of the ready-mixed concrete industry in India, leading RMC producers in the country took the initiative of setting up testing laboratory attached to their production unit (or a group of units). This was mainly because of the lack of network of reliable third-party testing facilities in India and also owing to the dearth of trained manpower. Over years, while the laboratory personnel from leading RMC producers achieved proficiency in sampling, making test cubes and compression testing, it almost became a practice to provide an attached laboratory whenever a new RMC facility was being set up. A large number of customers took advantage of RMC producer's proficiency in this area and many of them are getting their samples tested in RMC producer's laboratory in the presence of their representatives.

Yet, there are quite a few customers who prefer to collect the samples through their own representatives and get them tested either in their own site laboratory or in a third-party laboratory. When such practice is followed, there are occasions when large variations are observed in the results of the compressive strength tested in RMC producer's lab and those in customer's site lab, leading to disputes between the customer/client and the RMC producer.

When two laboratories, which have achieved expertise in sampling and testing, make a set of cubes from the same concrete sample, the results may not match! If the difference in the expertise of the two laboratories is high, the difference in the cube results will obviously be large. This is because of the fact that the evaluation of the compressive strength of concrete is dependent upon a host of factors. The long list of well-known factors which adversely affect the strength include: errors in sampling fresh concrete, failure to re-mix the four composite samples taken from the middle portion of the transit mixer, distorted cube moulds, incomplete compaction of fresh concrete in moulds, lack of care in handling, transporting and storing the samples, lack of adequate curing and failure to maintain the curing temperature within the standard 27 ± 2°C, faulty cube location and other operating errors during testing, lack of calibration of testing machine, etc.

The effect of the above mentioned factors on the compressive strength results could be substantial and may vary from -35% to +10% as aptly highlighted by Dewar and Anderson in *Fig 1*[1]. It is therefore highly essential for the customers of RMC to ensure that the sampling and testing of cubes are entrusted to laboratories having proficiency in testing.

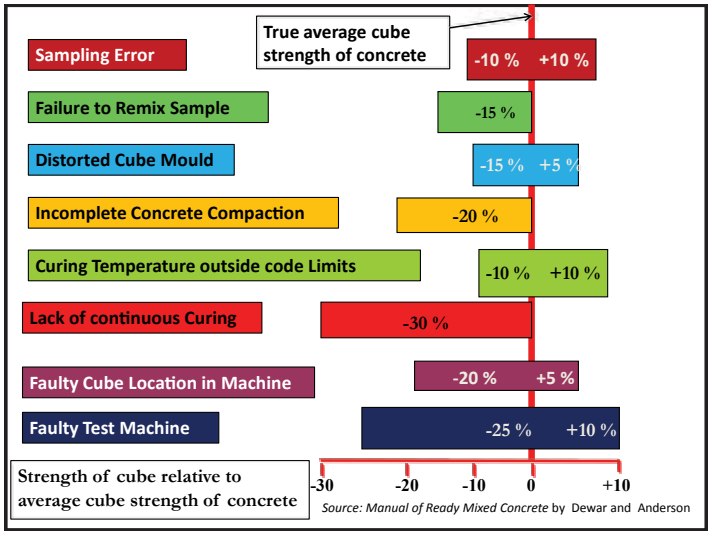

Fig 1 Effects of deviations in sampling, making cubes and testing on measured cube strength[1]

In this context, a recent article on the results of the round-robin strength testing program conducted by the Washington Area Council of Engineering Laboratories (WACEL) to evaluate the proficiency in strength testing of local laboratories, makes an interesting reading[2]. The program involved around 60 laboratories belonging to concrete producers, commercial test houses and the Department of Transportation (DOT). Two grades of concrete, namely, 4000 psi (27.6 MPa) and 7000 psi (48.3 MPa) were produced at a ready mixed concrete plant and around 150 cylinders were cast from each load. The properly prepared samples were given to the laboratories which cured and tested them in accordance with the standard ASTM practice. Each laboratory was given an ID to maintain confidentiality.

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Forum

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The results of the round-robin testing indicated that even though all laboratories received "similarly" prepared samples of concrete from the same batch, there was a large variation in the test results. The difference between two labs with acceptable strength data (eliminating outliers) was as high as 1200 psi (8.27MPa)! While the within-lab standard deviation was 3.2%, the multi-lab standard deviation was 5.5%.

Ken Day[3] reports that the Australian National Testing Association of Testing Authorities (NATA) also organizes occasional comparative tests in which a large number of specimens are cast from a single truck of concrete and distributed to many laboratories. The results indicate that compressive strength of individual samples can differ by nearly 10 MPa and a consistant average difference of up to 2 MPa can be experienced over a long period. Incidentally, Ken Day advises that any individual test result should be regarded with suspicion and recommends that an appropriate analysis of a series of test results can yield reliable conclusions.

The proficiency strength testing programs conducted in the USA and Australia thus underline the fact that cube strength results from two or more laboratories vary substantially, even when the samples are taken from the same batch and 'similarly' cured initially. If non standard procedures are followed in sampling and testing, this difference could escalate further, aggravating the risk of rejection of concrete, which may prove unfair to the producer.

RMC Readymix (India) ensures that each of its plant or a group of plants located in contiguous area has a well-equipped laboratory. The Company also ensures that the personnel involved in sampling, making cubes and testing are well trained. It would therefore be appropriate on the part of customers to leave the sampling and testing of concrete to RMC Readymix (India). However, with a view to have cross check, it would be equally essential on the part of the customer to depute his representative whenever sampling and testing are carried out by the representatives of RMC Readymix (India).

Incidentally, it would be a good idea to undertake proficiency testing exercise in India involving a large number of local laboratories. In case such an exercise will be carried out by an external agency, RMC Readymix (India) will provide full co-operation and support.

References

1. *Manual of Ready Mixed Concrete by J. D. Dewar and A. Anderson, Blackie Academic & Professional, An Imprint of Chapman & Hill, London.*
2. *"Proficiency of Strength Testing" by Colin Lobo, Concrete In Focus, September/October 2009, pp. 33-34.*
3. *Concrete Mix Design, Quality Control and Specification by Ken Day, 3rd Edition, Taylor and Francis, London.*

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Creditable Milestone in Health and Safety Management

RMC Readymix (India) is committed to achievement and maintenance of high standards of Health, Safety & Environment at all its plants and offices. Six of the Company's plants won the the prestigious Safety Trophies in a contest conducted by the National Safety Council of India. The trophies were given by our Hon'ble Minister for Labour and Employment, Mr. K. Suresh, during a function held at Scope Convention Centre, in New Delhi on 7th November 2012.

Winning plants of RMC Readymix (India) along with their rankings are:

- Nemaragomala, Hyderabad – 2nd Prize –Silver Trophy
- Ambad, MIDC, Nashik - 3rd Prize-Bronze Trophy
- Vallakottai, Chennai - 3rd Prize-Bronze Trophy
- Cochin – 3rd Prize-Bronze Trophy
- Hadapsar, Pune - 3rd Prize-Bronze Trophy
- Sonnampanhali, Bangalore - 4th Prize-Certificate

This creditable milestone of excellence in Safety was possible with the total involvement and support from each employee of the winning plants. RMC Readymix (India) now looks forward to the time to come when the Company shall be able to set new benchmarks in safety standards within the ready-mixed concrete industry in India.

The "Winning Team" of RMC Readymix (India) at the Scope Convention Centre, New Delhi

Concrete Innovations & Trends

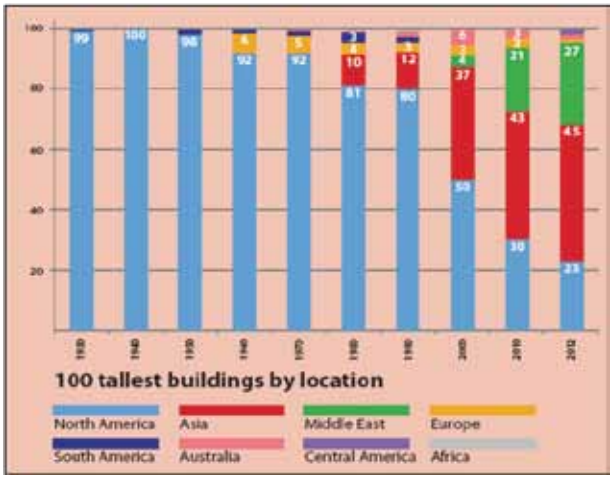

Fig 1 In the category of 100 tallest buildings in the world, while the share of North America is dipping that of Asia and Middle east is growing (Source: CTBHU Report: Tall Trends of 2012)

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- Since 1930s, North America dominated tall building construction. However, from 1990s there is a perceptible shift in this domination. In 2012, only 23 North American buildings could find place in the top 100 category (*see Fig 1*). On the other hand, the share of Asia and Middle East has been rising in the top 100 category and the combined number from the two regions stood at 72 in the year 2012.
- The use of structural steel, which dominated tall building construction from 1930s to 1970s, witnessed dramatic decline and its share in the top 100 tall buildings stood at a mere 17 in 2012! The place of steel is now being increasingly occupied by concrete and composites, with concrete leading the race! (*see Fig 2*)

Like many other developing countries, India is also experiencing the phenomenon of growing urbanization. The number of million-plus cities, which stood at 25 in 2001, more than doubled to 53 in 2011! The percentage of urban population in India was 28% of the total in 2001. This is expected to reach nearly 40% by 2025. Further, the twin consequences of urbanization, namely, limited land availability and sky-rocketing real estate prices, are also being experienced in major urban centres in India. It is therefore no wonder that tall building construction, although in its infancy in India, is now showing signs of growth

The lead in this sector is being taken by Mumbai, which witnessed construction of many 100m-plus tall buildings in the last decade. Few of these buildings, for example, the Lodha Bellissimo, Palais Royale, Imperial Tower, are more than 200m tall. Many more such buildings are under construction or are being planned in other metropolitan cities too.

It is indeed remarkable that an overwhelming majority of these buildings have been constructed using concrete as the main structural material. With a view to reduce section sizes and steel reinforcement, several tall buildings have used high-strength concrete for columns, shear walls, etc.

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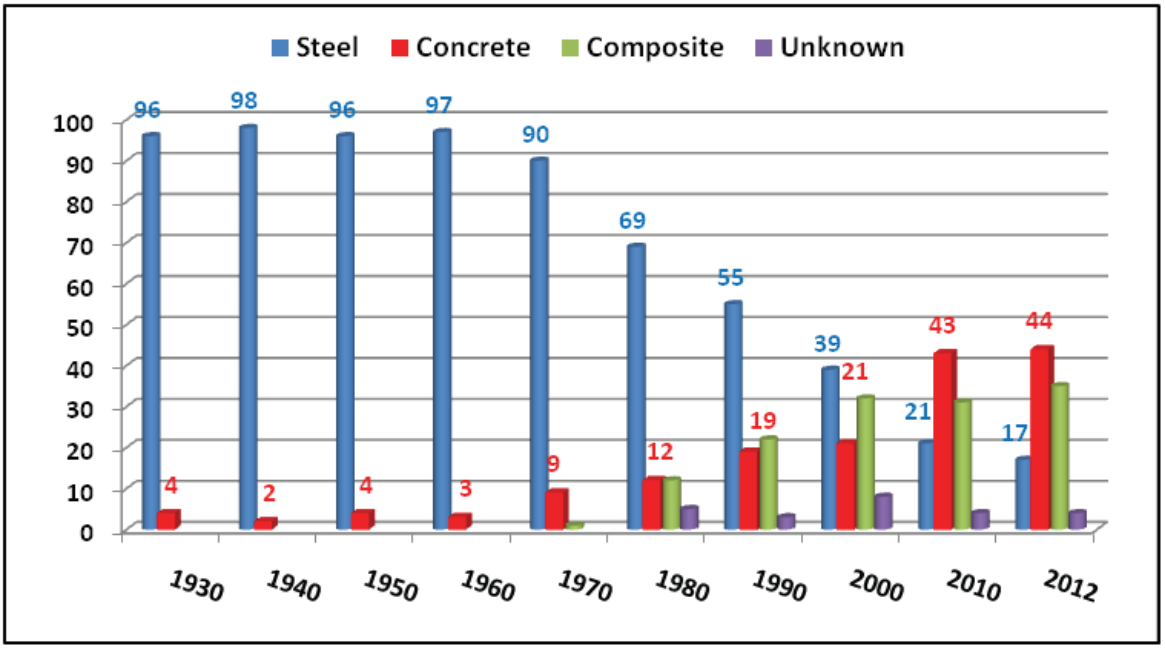

Fig 2 Share of concrete (red colour) witnessed dramatic shift since 1990s amongst 100 tallest buildings by structural material (Source: CTBHU Report: Tall Trends of 2012)

Concrete Innovations & Trends

RMC Readymix (India)'s contribution to Concrete High Rise: Some Examples

Name of Project	*Owner/Location*	*Grade of Concrete*
Orbit WTC	J S W, Kalina, Mumbai	Megacrete™ M70
Synergy	Kalpataru Ltd., Santacruz, Mumbai	Megacrete™ M65
Lodha Fiorenza	L & T Ltd. Goregaon, Mumbai	Megacrete™ M70
Residential Tower	Joginder Exports, Andheri, Mumbai	Megacrete™ M70
Urmi Estate	Lower Parel, Mumbai	Megacrete™ M60
Ambuja Reality	Salt Lake, Kolkata	Megacrete™ M60 and M70
Pioneer	Urban Echo Infra Ltd., NCR	Megacrete™ M60
Meridian	Avinash Bhosale Group, Pune	Megacrete™ M60
Meenakshi Infrastructure	Gachibowli, Hyderabad	Megacrete™ M60
Mantri Celestia	Gachibowli, Hyderabad	Megacrete™ M60
Hilton Hotel	Sarajpur Road, Bangalore	Megacrete™ M60
Brigade Pinnacle	Bejai Kavur Road, Mangalore	Megacrete™ M60
Hiranya Hotel	Manipal	Megacrete™ M60

Fig 3 Windsor, Jogeshwari: Concrete was pumped up to 35th storey

(Continued from page no.5)

RMC Readymix (India) is one of the proud suppliers of high-strength concrete to several tall buildings constructed recently. The company has not only developed expertise in designing and optimizing high-strength concrete mixes, but it also possesses skills to pump such concrete at higher location. This is evident from the large number of high-rise building projects where it has supplied HSC (see Table). The engineered high strength concrete mixes designed and optimized by RMC Readymix (India) are being marketed under the trade name Megacrete™.

Incidentally, it needs to be highlighted that the Company was successful in pumping HSC up to 42nd storey, i.e. about 140m height for the Urmi Estate Project, Lower Parel, Mumbai.

In the near future, when more and more high-rise buildings are slated to dot the urban skylines in India, RMC Readymix (India) has braced itself to cater to the needs of specialized concrete required for the construction of high rises.

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Workshops on Concrete Mix Design Principles and Special Concretes

As part of the customer education initiative, RMC Readymix (India) conducted a one day workshop on "Concrete mix design –Principles and Special concretes" on August 3rd 2013 at Company's NABL accredited central laboratory, Whitefield, Bangalore.

The workshop was attended by about 25 participants from Bangalore and Mysore region.

Mr.Raviprakash,Manager-Technical welcomed the participants and briefed them about the importance and significance of the workshop. Mr. Suresh Rao, General Manager –Technical gave presentation on concrete mix design principles as per IS 10262 with worked examples. He also spoke on "Sustainability in Concrete" Mr. L. R. Manjunatha,Sr. Manager –Marketing gave presentation on the use and applications of special concretes being offered by RMC Readymix (India) such as Megacrete™, Easycrete™ FRCcrete™ , Dyecrete™, Highdensecrete™, Thermocrete™, Pervious Concrete, etc.

The workshop also included practical demonstration of concrete mix design trials which were designed while conducting the workshop. All the workshop participants were issued the participation certificates.

Participant in Bangalore workshop

Company News

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Polished Concrete Floor at Chennai

Polished concrete is a concrete that has been treated with a chemical densifier and ground with progressively finer grinding tools. Polishing the exposed concrete improves its hardness, strength and durability - and of course the aesthetic appearance.
Polished concrete floors are low-maintenance, as they are more durable and easier to clean. It's relatively high coefficient of friction can make it non-slippery. Polished concrete reduces dust mite and allergen problems, and does not support mould growth. Anecdotal evidence suggests that highly reflective polished concrete reduces lighting needs and improves natural lighting. Mopping with warm soapy water once a week is the only maintenance required. A concrete floor that has been hardened and polished will have a long life expectancy compared to other flooring.

Recently, RMC Readymix (India) constructed a demonstration panel of polished concrete in Chennai.

Fig 2 Polished concrete panel at Chennai

Lightweight Thermal Insulating Concrete at Pune

Lightweight concrete can be produced by using artificial non-absorbent lightweight aggregates. Some artificial aggregates have good fire-resistant property and hence are used as a good thermal insulation material in building construction. At a time when energy costs are skyrocketing, the use of such concrete can be immensely beneficial to owners and users, especially in locations where the ambient temperatures are high. And of course, the benefits accruing from the reduction in the deadweight will be highly appreciated by the structural designer and architect.

RMC Readymix (India) has been producing and supplying such concrete for residential and commercial building projects in South India for quite some time. The Company is selling this concrete under the trade name Elitecrete™.

Recently, RMC Readymix (India) has supplied around 50 m^3 of Elitecrete™ to a commercial building project in Pune.

Fig 3 Elitecrete™ is a low-density, free-flowing concrete used for thermal insulation purpose for a commercial building in Pune (Inset-Elitcrete™ being unloaded)

Anti Wash-out Concrete at Mumbai

During construction of foundations it is sometimes difficult to completely dewater the excavated area. There are occasions when water seepage is so high that it becomes impossible to dewater the excavated pits. Recently, similar situation was faced by a builder in Navi Mumbai. The site was near the creek and the contractor employed five pumps for dewatering. Yet, the water was gushing up the foundations. When the builder approached RMC Readymix (India), the Company proposed an innovative solution of using anti wash-out concrete.

After a few laboratory trials, the anti wash-out concrete mix of M35 grade was finalized. Builder's representative, after witnessing the lab trial, got convinced about the product. The concrete was pumped into the foundations without any washout of the fines from the mix. When the formwork had removed, it was observed that concrete was set properly and there was no honeycombing or loss of mortar.

Fig 4: Anti wash-out concrete had set properly within 24 hours and work on further lifts could start immediately

MAIL Box

Q. In our city, the supply of river sand has dwindled and the possibility of commencement of this supply in the near future seems remote. When we approached your Company's local ready mixed concrete plant, we found that you have been using a combination of manufactured sand and crushed stone sand (CSS). Will it be technically correct to use such aggregates in our concrete? Also inform if your aggregates conform to the requirements of IS 383?

A.: It is true that strict dredging restrictions are enforced in large parts of the country. As a result, severe shortage of river sand is being felt at major locations, including your own city. Therefore, ready-mixed concrete producers are constrained to use manufactured sand or a combination of manufactured sand and crushed stone sand (CSS).

Both manufactured sand and CSS are produced from the parent rock and are inert in nature. CSS is the by-product of the primary and secondary crushing of the rock with help of jaw crushers and cone crushers. Manufactured sand is artificial sand, produced through tertiary crushing of rock. It is produced from a Vertical Shaft Impactor (VSI), wherein, three main crushing actions, namely impact, cleavage and attrition take place simultaneously to provide a consistently good quality product having uniform gradation and shape.

Both manufactured sand and CSS contain less organic and inorganic impurities, and lower levels of chlorides and sulphates as compared to natural sand. Further, the silt content which is generally high in case of river sand is comparatively low in manufactured sand and CSS. The lower levels of harmful solids in manufactured sand and CSS help in reducing the water demand in the mix, leading to improvement in its workability and workability retention for the same water content. Further, lower levels of chlorides and suphates would prove to be of greater advantage as they would minimise the possibility of deterioration of concrete owing to sulphate and chloride attack, thus improving the long-term durability of concrete. Typical values of impurities obtained in the manufactured sand and CSS used in our plant at the location you have mentioned are given in the enclosed *Table 1*. The results clearly show the better quality of manufactured sand and CSS as compared to the quality of river sand.

Concrete mix proportioning philosophy of RMC Readymix (India) is based on the principles of best particle packing of aggregates. Before selecting aggregate source, extensive trials are conducted by the Company. In particular, trials are conducted for different combination percentages of 20mm and 10mm aggregates on the one hand and on river sand and CCS or manufactured sand and CSS on the other to arrive at the best combinations that provide highest compacted densities. Various standards including the Indian standard IS 383 provide grading limits on percentages passing through various IS sieves. This is a rough method of ensuring best particle packing of aggregates. *Fig 1* shows the results of the combined aggregate grading for a combination of 40% manufactured sand 60% CSS. It can be seen from the graph that the combined aggregate grading curve lies within the upper and lower bounds specified by IS 383.

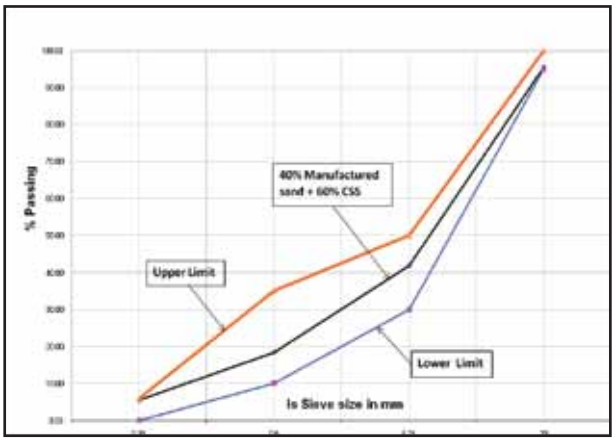

Fig 1 Typical grading curve for a combination of 40% manufactured sand and 60% CSS

From the above discussion, it would be clear that replacement of river sand by a combination of manufactured sand and CSS is not only technically superior but also appropriately fits into the requirements specified by the Indian Standards.

Table 1: Comparision of impurities

Deleterious Substance	*River Sand*		*Manufactured Sand*		*Crusher Stone Dust (CSS)*	
	Test result	*IS 383 Limit*	*Test Result*	*IS 383 Limit*	*Test Result*	*IS 383 Limit*
Fineness Modulus	4.22	-	3.05	-	3.1	-
Materials finer than 75µ, % by weight	17.0	3.0	10.5	15.0	12.0	15.0
Clay lumps, % by weight	2.1	1.0	Nil	1.0	Nil	1.0
Organic impurities, % by weight	0.1	1.0	Nil	-	Nil	-

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