

READY MIX CONCRETE: CHALLENGES & OPPORTUNITIES IN INDIA

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ABSTRACT: *This Paper represents the Initiative of the Ready Mix Concrete (RMC), its concept, the challenges faced & Opportunities in our country, India. RMC is the Concrete which is used nowadays almost in all the construction industry, where the work is to be completed in short time & more effectively.*

Almost everyone knows what is RMC, and how it is manufactured but this paper contains a Review on RMC , its initial Concept , how it is evolved & its applications in the today's world.

Although the first RMC plant operated in India in 1987, the growth of RMC has picked up only in the last decade. Most of the RMC plants are located in 7 large cities of India, where they contribute 30% to 60% of total concrete used in these cities. RMC, on all India basis contributes to about 5% of total concrete used[3]. The growing popularity of RMC in cities is for obvious reasons of constraints of construction space and need to control environmental pollution. This is inspite of about 12% to 20% higher cost as compared to site mixed concrete. The number of RMC plants in India, are growing rapidly and being relatively new ones having most up-to-date machinery and technology.

INTRODUCTION :

One of the earliest records of construction in the world is the Indus Valley Civilization, which was found buried in the soils of the regions adjacent to the River Indus. It is known to have been in a relatively mature state as early as 3000 BC. The most renowned sites are at Mohen-jo-daro in sindh, and at Harrappa in Southern Punjab[2]. The people of this time have also shown great knowledge of town planning with well laid out streets and thoroughfares, indicating a highly ordered urban culture. These magnificent cities had both wide roads and well developed drainage systems. During this period, the construction materials used showed that people had exceptional knowledge. In both of these cities the buildings were composed of burnt brick, laid in mud mortar.

Also in the seventeenth century one of the world's most famous structures, The Taj Mahal was built at Agra. This beautifully imposing building is made of white marble and the inlay work on the walls reflects the high level of craftsmanship at that time. Also made of marble is the Bahai Temple at Delhi. This lotus shaped edifice has been referred to as the 'Taj Mahal' of the 21st century[1].

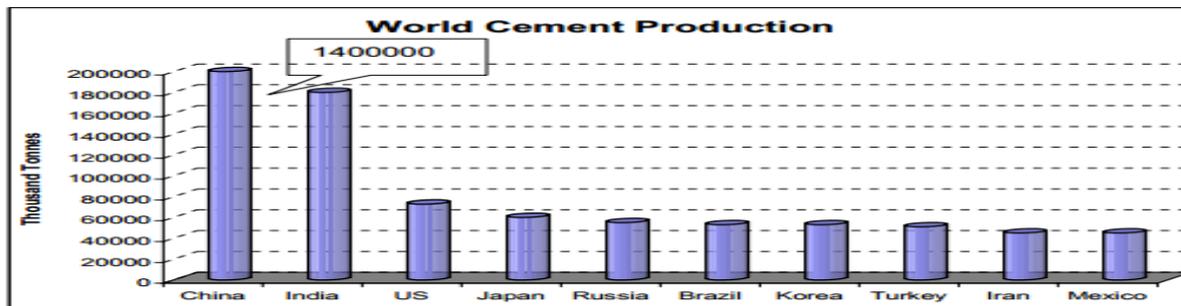
Any attempt to give an overview of the depth of Indian construction is almost certain to be an incomplete one. India’s sheer size and the mind-boggling number of monuments would make it a futile task. India has been absorbing, and in truth initializing, new ideas and utilizing innovative techniques of construction for centuries. Indeed, as a testament to the durability of the methods and materials used, some of these ancient forts still house daily ancient forts still house daily bazaars and many old palaces have been converted to five-star hotels[1].

It is very important that India should be viewed more as a continent than as a country. There are very significant variations between individual states in terms of languages, cultural habits, population distribution, economic wealth, education and availability of skilled workforce. It is against this backdrop that we examine the challenges and opportunities in developing the ready mixed concrete industry in India.

REQUIREMENTS :

India is the 2nd largest cement producer in the world. With an annual production of around 248 million tonnes (mnt), it ranks only behind China as shown in Fig1.

Per capita cement consumption is 156 kg (2008) as against world average of 396 kg. (2006). Cement technology and production cost comparable with the best in the world. Problems of Indian Cement Industry 6 industries in India have been identified as energy-intensive industries. They are Aluminium, cement, fertilizer, iron and steel, glass, and paper. Together they account for 17% of manufacturing value of output (VO) and for 39% of all fuels consumed in the manufacturing sector.



SOURCE: US Geological Survey

Fig. 1 World Cement Production [2]

So, most problems of the cement industry are related to “power”. They are as follows:

1. Drastic cut in the electricity
2. Shortage of Coal
3. Inadequate availability of wagons for transport
4. Limited availability of furnace oil.

3.1 Roads .

The national highways system needs to be lengthened. Added to this is the fact that in its state highways system, India has more unpaved roads. Also there is a need to repair and upkeep the existing network. It is an alarming fact that the number of cars in india has risen today upto 40 millions. Mumbai , seen by many Indians as the financial centre and as one of the country’s most advanced cities, has only 10% of the city area covered by road. The figure in Calcutta is even lower at 6%. So, Concrete is the main fundamental element required in construction of pavements. RMC is generally used for speedy construction & maintenance of roads[4].

3.2 Airports.

India’s passenger traffic is nearly 120 million per year. Yet India has around 12 international and 87 domestic airports. Many have runways unsuitable for large international and domestic aircrafts. Only 11 have paved runways over 3047 km and another 48 with 2438 to 3047 km [3].

3.3 Power:

It is estimated that the power demand for both the public and industry would mean a required growth of **147,815** MW over the next years. India’s present power generation only just exceeds that of Britain and it is estimated that the country will need to spend around \$10.6 billion per annum for next ten years on new capacity. So, RMC is required for the infrastructural development[4].

3.4 Ports.

It is estimated that an increase in capacity of 34 million tonnes is required to cope with the increased coastal bulk freight. So, RMC is required in ports.

3.5 Housing.

In housing alone, India is building homes day by day & demand also increases rapidly. Added to this will be the need to improve sanitation and sewerage disposal systems and to invest in water treatment works in order to provide adequate clean water supply. This position is all the more acute in the urban areas, which have large population densities. As against the national average of 410.72 persons per square kilometre. So, due to wide increase in population day by day, the demand for construction & RMC will also be increased[4].

CODES AND SPECIFICATIONS.

Most of the specifications related to civil engineering construction were based on old British standards and the construction techniques prevalent in the developed countries in the 50s. More importantly more of these codes are totally out of tune with time as can be seen from table 1. The minimum grade specified for structural concrete is M-15 (15 N/mm²) which will be shortly upgraded to M-20 and M-25 in case of coastal areas[5]. The frequency of testing and sampling of concrete is based on the variability in producing concrete manually in individual proportions of 50 Kg bags of cement. Another factor is the volume of concrete that can be produced by a gang of labourers working in an eight-hour shift. The recommended standard deviation for concrete is also very high owing to the fact that consistency in concrete is difficult to achieve by manual methods of batching, mixing and placing. This results in higher target strengths for concrete. Consequently concrete mixes specified have a very high minimum cement content[6].

Table 1 Indian Codes (concrete) and year of publishing

CODE No: B.I.S.	SPECIFICATIONS	YEAR
1199	Methods of sampling and analysis of concrete	1959
516	Methods of tests for strength of concrete	1959
3085	Methods of test for permeability of cement mortar and concrete	1965
383	Coarse and fine aggregates from natural sources for concrete	1970
4926	Ready mixed concrete	1976
456	Code of practice for plain and reinforced concrete	1978
9103	Admixtures for concrete	1978
9284	Method of test for abrasion resistance of concrete	1979
10262	Recommended guidelines for concrete mix design	1982

Source: IS 10262-2009 [10]

It is common knowledge that ready mixed concrete forms only a part of the construction chain. In the absence of good materials, form works, placing methods, specifications and good construction practices, the benefits that can be accrued by using ready mixed concrete are being negated. Also owing to the fact that contract specifications are very conservative, any possible economy from good mix design was nullified[5]. Therefore for the use of ready mixed concrete to be successful, there is a need to strike at the root of all existing construction practices in the country.

The Ready mix concrete thus follows all the procedures & is used nowadays throughout the country.

The analytic hierarchy process (AHP) is a structured technique for organizing and analyzing complex decisions, can be used in RMC which speeds up the overall process of producing RMC.

BASIC CONCEPT : READY MIX CONCRETE



Fig2. RMC Plant Overview

In the year 1990, a credible attempt was made to introduce ready mixed concrete in Pune. However this attempt failed at the hands of a skeptical market. Therefore it could be said that the use of ready mixed concrete in construction really began in India around 1994 in Mumbai (formerly Bombay).

As shown in fig2., dedicated ready mixed concrete plant was set up for Bharat Diamond Bourse Project at Bandra, by one of the cement manufacturers as a down stream activity. Simultaneously, a well known construction company, also set up a ready mixed concrete plant dedicated for the construction of a large town-ship called Hiranandani Gardens at Powai[4]. As the demands for these major projects began to decline, attempts were made to test the acceptance of ready mixed concrete in the general market.

The basic process for making ready-mixed concrete remains unchanged for the past years. Dry raw materials are measured, loaded into a bin, mixed, placed into a truck, and water is added. The modest technological advances that have occurred in the industry have come in five areas.

The first change is automated batching systems. Batching—the process of weighing and mixing the raw materials before they are loaded on the truck—was once a manual operation. An operator would mechanically control the hopper gates that regulated the flow of raw materials into the central mixing bin, weighing each component while proceeding, often by eye on an analog scale. Automated batching systems, where an operator inputs the “recipe” for a ready mixed batch into an electronic control system that handles the weighing and mixing operations automatically, began diffusing through the industry during the late 1970s and early 1980s.

Around the same time, the world’s largest ready mixed concrete supplier entered the Indian market through the setting up of an Indian company. The aim of the company was to develop

the concept and promote the use of ready mixed concrete all over India. The first city chosen by the company was Mumbai- India’s commercial capital and the premier Business City. In the first year of its concrete plants, two in the twin city of Mumbai called Navi Mumbai (New Bombay) and one in the western suburbs of Mumbai. During this initial period, some more plants were established one in Navi Mumbai and another in the north-west suburbs of Mumbai[5].

In the south of India, the city of Bangalore started experiencing the ripen effect of the steady changes that was taking place in Mumbai. A Multinational Company, set up its first ready mixed concrete plant in Bangalore.

Ready Mix Concrete (RMC) is a special material in which the cement aggregates and other ingredients are weigh-batched at the plant in a central mixer or truck mixer, before delivery to the construction site in a condition ready for placing at the site.[9]

There were 147 RMC Plants till 2005 in india in major cities as shown in table 3.

Table 3: Geographical Distribution of plants[11]

Geographical Distribution	No. of Plants	
	2001 – 2002	2004 – 2005
Bangalore – Mysore Belt	12	35
Chennai – Trichannapali	8	25
Hyderabad – Vizag	6	12
Pune	2	10
Mumbai, Navi Mumbai	12	25
Goa	1	2
Delhi, Gurgaon, Faridabad, Noida	5	25
Kolkatta	1	3
Ahemdabad, Surat	-	3
Jaipur	-	2
Sundry	-	5
Total	47	147

OPPORTUNITIES CREATED BY RMC :

Ready mix concrete has gained acceptance in Indian industry due to several advantages including quality control and overall economy. RMC plants are proliferating, especially in urban regions, not only because of the space restrictions around construction site but also due to the realisation of the advantages by engineers and construction industry

The word ‘potential’ is a much over used phrase when looking at India. As we have seen earlier the infrastructure statistics are of such mind – boggling proportions that it could be said that there is a massive potential for the growth of ready mixed concrete industry. However realising that potential will take a considerable time as companies come to terms with the unique obstacles presented in the Indian market.



Fig3.Laying of Ready Mix Concrete

In Figure 3, The only realistic view that the ready mixed concrete industry can take should be based on long term strategy. The main aim has to be the development of the awareness of the product. Presently that level of awareness is only present in a few isolated pockets and this position is not expected to change drastically in the foreseeable future. This is partly due to the fact that there is no real focus for the industry, in that the few players that exist are located in disparate markets and those that exist in the same markets have differing ideological views regarding The product and the business. For example various companies consider ready mixed concrete as a downstream activity for their cement business[5]. Others see it as a chance to support their construction division. Therefore the methods of distribution, tendering and technical development reflect this. There are various companies, presently operating, who are promoting the concept of ready mixed concrete purely on it’s own merits and have ready mixed concrete as their core business. Until this situation becomes more stable the opinions of the companies, and therefore the perception of the product, will be inconsistent in the market place[6].

An attempt to make a step in the right direction is the initial formation of a loose association of ready mixed concrete suppliers. The eight companies that operate in India meet on an infrequent basis to discuss matters such as tax issues, Indian Standards and how to popularize the concept of ready mixed concrete. So far there has been a mixed success.

Ready Mixed Concrete (RMC) is a specialized material in which cement, aggregate, and other ingredients are weight batched at a plant in a central or a truck mixer before delivery to the construction site in a condition ready for placing by the customer. RMC is manufactured at a place away from the construction site, the two locations being linked by a transport operation.[8]

Table 2 : Consumption of concrete in m3[12]

Years	GDP Growth (%)	Cement consumption growth (%)	Consumption of cement (MnT) per year	Consumption of concrete (Million m ³)
2002 – 2007	6.5	8	157.2	314
2007 – 2012	6	7	220.2	440
2012 – 2017	5.5	6	294.67	589
2017 - 2022	5	6	394.33	788

RMC gives various Opportunities to Civil Engineers because of its increase in Consumption as shown in above table 2.

The benefits of RMC includes reduced dust and noise pollution which has been previously caused due to the stacking of raw materials in public pathway and roads. This also causes nuisance to public due to site mixing and manual placing. Nowadays concrete can be delivered to a site mixing and manual directly into the contractor’s form work and the truck mixer, discharge has added benefits of reduced traffic congestion. Imparting working knowledge to the site personnel in the right use of concrete, sampling, testing and curing is also high on the company’s agenda.

Overall Benefits : Uniform and assured quality of concrete • Durability of RMC • Faster construction speed • Storage needs at Construction sites eliminated • Addition of admixtures is easier • Documentation of the mix design • Reduction in Wastage of Materials • eco-friendly

The Main Constraints are:

- a) RMC cost is likely to be slightly higher than site produced concrete of the same quality, this may be mainly due to sales taxes.
- b) RMC plants in cities are established only in remote areas so , difficulty in transportation occurs.
- c) Availability of trained and skilled manpower for operations and maintenance of plants and Equipments.
- d) Price variations of all concrete ingredients specially cement.
- e) Non availability of consistent and good quality aggregates, mineral admixtures etc.
- f) Non-availability of bulk cement supply in most of the cities where RMC is marketed.
- g) Workability retention in hot weather.
- h) Difficulty in immediate availability of spares or additional inventory carrying cost required to be kept in case of essential spares.
- i) Reinforcement layout and planning of placement, compaction and curing must be properly organized at site to suit the speed of supply and placement of RMC
- j) Plastic shrinkage cracks due to inadequate curing at site often results in blaming the RMC supplier.

CONCLUSION

The concept of RMC in the country is large & diversified. The main aim of this paper is to clarify the concept of RMC in India in a better way so that the use of RMC will increase so in turn will increase the economy & development of country. Awareness is created in minds of engineers regarding RMC, so that its productivity increases.

The Lean Mix Concrete was also used in C.C Roads at various cities. So, RMC Plays a vital role in Construction of Roads.[7]There are substantial researches that have been focused on Lean Construction theory. Some of the lean principles that are related to the construction industry are such improvements as the construction planning process, eliminating waste, construction supply chain, and downstream performance. Lean construction draws upon the principles of project-level management and upon the principles that govern production level management[7].

The Smart Concrete (made by adding various substances) can be produced by RMC.[7] which will be helpful in construction industry.

The concrete quality produced in RMC plant is highly consistent. It provides a high degree of overall strength of hardened concrete and the performance of the structure after Maturity. RMC operations are highly mechanized and fully controlled through electronic controls and hence reduces the probability of errors in various operations. It is also eco friendly and brings down pollution due to dust at construction can also be accelerate with the use of RMC. The use of RMC in civil construction is widely adopted throughout the world.

Also as discussed before, analytic hierarchy process (AHP) can be used in which RMC operations are highly mechanized and fully controlled through electronic controls and hence reduce the probability of errors in various operations[8]. Ready mix concrete has gained acceptance in Indian industry due to several advantages including quality control and overall economy[8].

The beginning made in India is in tune with the developments outside & RMC use provides numerous benefits to the consumers. Conventional approach to durable concrete structures,

namely specifying maximum water cement ratio, minimum cement content and cement type, is now always satisfactory, especially under aggressive environmental conditions. Site manufactured concrete cannot assure the same quality of concrete and that from controlled ready mix batching plant backed by advanced technology and project management.

The advantages of RMC are particularly evident in construction projects with aggressive exposure conditions. Ready mix concrete has gained acceptance in Indian industry due to several advantages including quality control and overall economy. RMC plants are proliferating, especially in urban regions, not only because of the space restrictions around construction site but also due to the realisation of the advantages by engineers and construction industry.[9]

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