Study on Ready Mix Concrete

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Abstract— The Indian Construction industry has been traditionally labour oriented. The pace of mechanization in the past was very slow due to the availability of cheap and abundant labour, lack of capital investment and highly fragmented nature of the construction sector. The liberalization of Indian economy started from 1989 and paved the way for large-scale investments in infrastructure, industrial and agriculture sectors. The mega projects required speed and quality of construction compatible with international standards. It led to partial mechanization of construction industry and advent of Ready mixed concrete in India is the outcome of this development. The Ready Mixed Concrete in India on commercial basis started in 1994 and has achieved about 2% conversion from the site-mixed concrete by the year 2001. It is heartening that the acceptability of Ready mixed concrete is increasing though at a slow pace. The entry of foreign firms and major Indian cement producers in this field are likely to provide necessary boost to this industry in the future. The growth prospects of Ready-mixed concrete are enormous, provided requisite support is given by the regulatory authorities, consumers and decision makers. At the present, the cost differential between Ready-mixed concrete and site mixed concrete is proving major constraint in its growth. This problem will be resolved with the increasing awareness about the advantages of RMC by the end consumers.

Index Terms— Ready-mixed concrete, construction, site, growth, constraint, environment, advantage, cement, additives, admixtures, plant, quality, assurance.

1 INTRODUCTION

Ready mix concrete that is concrete that is manufactured in a factory or batching plant, according to a set recipe, and then delivered to a work site by truck mounted in–transit mixers. This results in a precise mixture, allowing specialty concrete mixtures to be developed and implemented on construction sites. The first ready-mix factory was built in the 1930s, but the industry did not begin to expand significantly until the 1960s, and it has continued to grow since then.

It is often preferred over on-site concrete mixing because of the precision of the mixture and reduced work site confusion.

Ready-mix concrete, or RMC as it is popularly called, refers to concrete that is specifically manufactured for delivery to the customer's construction site in a freshly mixed and plastic or unhardened state. Concrete itself is a mixture of Portland cement, water and aggregates comprising sand and gravel or crushed stone. Ready-mix concrete is bought and sold by volume - usually expressed in cubic meters (cubic yards in the US).

Ready-mix concrete is manufactured under controlled operations and transported and placed at site using sophisticated equipment and methods. In 2011, there were 2,223 companies employing 72,924 workers that produced RMC in the United States.

This was first patented in Germany in 1903; itscommercial delivery was not possible due to lack of transportation needs. The first commercial delivery was made inBaltimore USA in 1913.The first revolving drum type transitmixer was developed in 1926.

In 1931, a RMC plant was set up for the construction of Heathrow airport, London. In the mid 90's there were about1100 RMC plants in UK consuming about 45% of cement produced in that country. In Europe in 1997 there were 5850companies producing a total of 305 million cusecs of RMC.

In USA by 1990, around 72% (more than 2/3rd) of cement produced was being used by various RMC plants. In Japan firstRMC plant was set up in 1949. By 1992 Japan was the thenlargest producer of RMC, producing 18196 million tons of concrete. In many other countries of the world including some of the developing countries like Taiwan, Malaysia etc, RMC industry is well developed.

In India RMC plant arrived in 1950's and use was restricted to only major construction projects such as, Bhakra dam was thefirst projects were RMC was used. Later on RMC was used for other large projects such as construction of long span bridges, industrial complexes etc. The first RMC plant was set up in Puna in 1993 [1].

2 SCOPE OFREADY MIX CONCRETE

Long, Long years ago, their where simple houses but in 21st Century we can see houses constructed in R.C.C. Therefore-concrete got more importance then any other constructionmaterial. So the use of concrete is increasing day by day. For construction most of the contractors and builders have to collect the raw materials required for the construction before starting actual works. These materials should be stored at the site properly. This technique can be possible when there will bemore empty space at the construction site which is not possiblein congested areas. At this time there is one solution toovercome all these problems that is nothing READYMIX CONCRETE by using R.M.C we can save the time and money required for the labours. In following places ready mix concrete can beused [2]:-

1. Major concerting projects like dams, roads, bridges, tunnels, canals etc.
2. for concreting in congested areas where storage of materials is not possible.
3. Sites where intensity of traffic makes problems.

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4. When supervisor and labour staff is less.
5. To reduce the time required for construction etc.
6. Huge industrial and residential projects.

3 Material Required for Ready Mix Concrete

Fig. 1. Materials required for Ready Mix Concrete

4 ADMIXTURE

A substance added to the basic concrete mixture to alter one or more properties of the concrete; ie fibrous materials for reinforcing, water repellent treatments, and colouring compounds.
Air-entraining admixtures (mainly used in concrete exposed to freezing and thawing cycles)
Water-reducing admixtures, plasticizers (reduce the dosage of water while maintaining the workability)
Retarding admixtures (mainly used in hot weather to retard the reaction of hydration)
Accelerating admixtures (mainly used in cold weather to accelerate the reaction of hydration)
Super plasticizer or high range water-reducer (significantly reduce the dosage of water while maintaining the workability)
Miscellaneous admixtures such as corrosion inhibiting, shrinkage reducing, colouring, pumping etc.

5 Aggregate

Inert particles (i.e. gravel, sand, and stone) added to cement and water to form concrete.
Cement:-Dry powder that reacts chemically with water to bind the particles of aggregate, forming concrete. Portland cement is typically used in concrete production.
Fly ash: - Fly ash is a by-product from coal-fired electricity generating power plants. The coal used in these power plants is mainly composed of combustible elements such as carbon, hydrogen and oxygen (nitrogen and sulphur being minor elements), and non-combustible impurities (10 to 40%) usually present in the form of clay, shale, quartz, feldspar and limestone [3].

6 Equipment Required in Ready Mix Concrete

Following are the equipment required in Ready Mix Concrete
1. Batching plant
2. Transit mixer

Batching:-
Batching plants are classified as
1. Manual
2. Semiautomatic
3. Fully automatic

Storage:-
Storage of the raw materials is done by following methods: -
INLINE BINS Inert raw materials like fine & coarse aggregates are stored in bins called as "Inline Bins" where the trucks carrying fine & coarse aggregate can dump the material easily.

Fig. 2. Equipments required for Ready Mix Concrete

The aggregates required are fed by the means of aggregate belt conveyer. On the aggregate belt conveyer the aggregates are weighed automatically by means of computer form the computer room presents on the plant.

Silos:-
Cement & Flash are stored in airtight container called as "Silos". The required quantity of cement & fly ash is extracted by the silos. There are two cement silos and one silo of fly ash [4].

7 Advantage

A centralized concrete batching plant can serve a wide area. The plants are located in areas zoned for industrial use, and yet the delivery trucks can service residential districts or inner cities.
Better quality concrete is produced.
Elimination of storage space for basic materials at site.
Elimination of hiring of plant and machinery.
Wastage of basic materials is avoided.
Labours associated with production of concrete is eliminated.
Time required is greatly reduced.
Noise and dust pollution at site is reduced.

8 DISADVANTAGE

The materials are batched at a central plant, and the mixing begins at that plant, so the travelling time from the plant to site is critical over longer distances. Access roads, and site access have to be able to carry the weight of the truck and load concrete is approx 2.5tonne per cuM.

Concrete's limited time span between mixing and going-off means that ready-mix should be placed within 2hours of batching at the plant.

9 SUPER PLASTICISERS FOR READY MIX CONCRETE PLANTS

Super plasticisers are high range water reducing admixtures.Admixture is defined as a material other than cement, water and aggregate that is used as an ingredient of concrete and is added to the batch immediately before or during mixing. The development of super plasticisers is one the major breakthrough in concrete technology, which will have a significant effect on the production and use of concrete in the next millennium. Superplasticisers have been greatly responsible for development of the following connects.

1) High performance connects, 2) High strength concrete, 3) High durability concrete 4) Self compacting concrete 5) High volume flash /slag concrete 6) Fibre reinforced concrete 7) Anti washout concrete under water. A super plasticiser is one of a class of admixtures called water reducers that are use to lower the mix water requirement of the concrete. They are chemically different from normal water reducers and are capable of reducing water contents by about 30 percent. They are variously known as super plasticisers, super fluidizers, superfluidifiers, super water reducers or high range water reducers. In Japan, during the late 1960, super plasticisers were developed. Ready mix concrete incorporating water reducers and workability enhancers make use of super plasticisers and delivers increased workability without loss of ultimate strength or durability. The role of super plasticisers in ready mix concrete industry is essential where ordinary as well as high strength or high performance concrete with slump retention capability are to be produced. Super plasticisers can be used to reduce the amount of water to produce high strength concrete and to reduce the amount of cement.

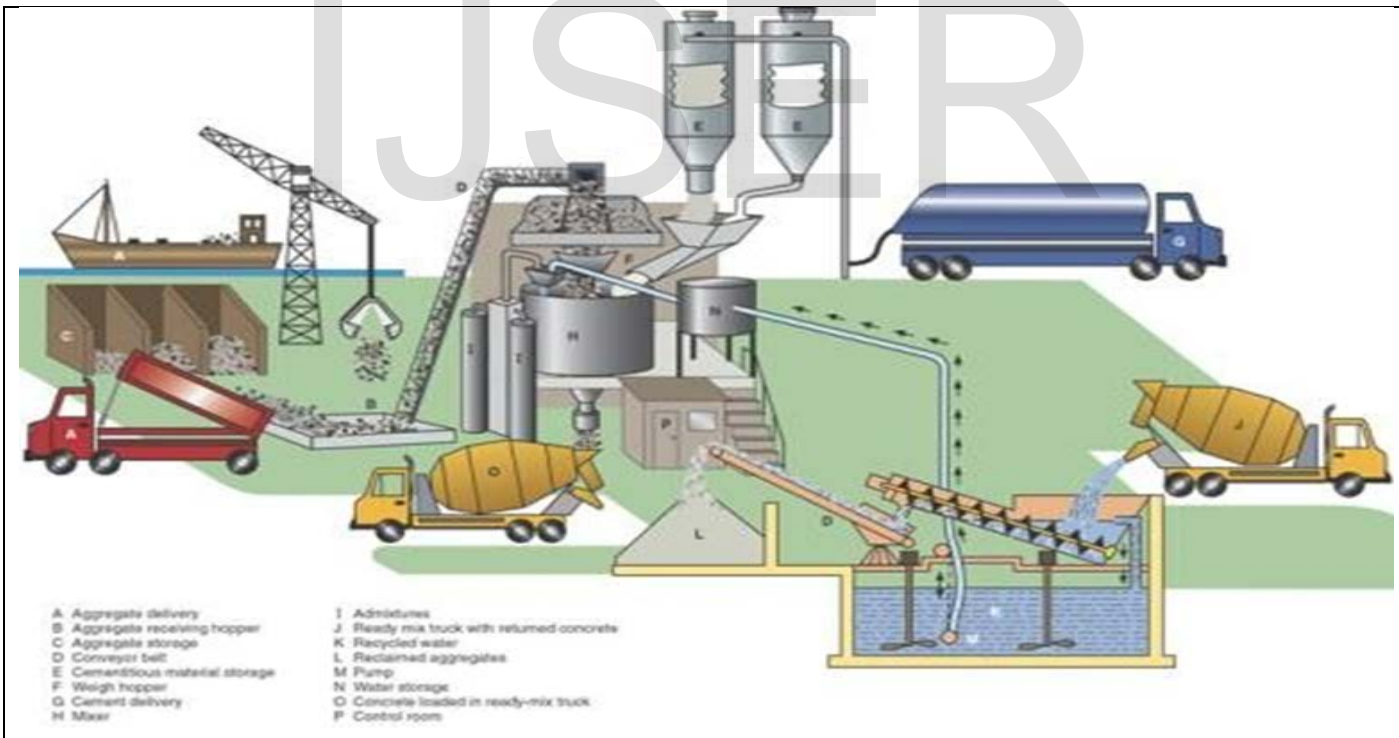

Fig. 3. Entire Sytem

10 TYPES OF READY MIX CONCRETE

There are three types of ready mix concrete (RMC) depending upon the mixing of the various ingredients as given below:

1. Transit mixed concrete
2. Shrink mixed concrete
3. Central mixed concrete

Fig. 4. Concrete Mixed

1. Transit mixed concrete

It is also called dry batched concrete because all the basic ingredients including water are charged directly into the truck mixer. The mixer drum is revolved fast at charging speed during the loading of the material and after that it continues rotating at a normal agitating speed. In this type of ready mix concrete, also three types of variations are possible as given below:

- Concrete mixed at job site:

While being transported towards the destination, the drum is revolved at a slow or agitating speed of 2 rpm, but after reaching the site just before discharging the material, it is revolved at maximum speed of 12 to 15 rpm for nearly 70 to 100 revolution for ensuring homogeneous mixing.

- Concrete mixed in transit

The drum speed is kept medium during the transit time, i.e. approximately 8 rpm for about 70 revolutions. After 70 revolutions, it is slowed down to agitating speed of 2 rpm till discharging the concrete.

- Concrete mixed in the yard

The drum is turned at high speed or 12-15 rpm for 50 revolutions. This allows a quick check of the batch. The concrete is then agitated slowly while driving to the job site. Concrete mixed in transit:

The drum is turned at medium speed or about 8 rpm for 70 revolutions while driving to the job site. The drum is then slowed to agitating speed.

2. Shrink mixed concrete

The concrete is partially mixed in the plant mixer and then balance mixing is done in the truck mounted drum mixer during transit time. The amount of mixing in transit mixer depends upon the extent of mixing done in the central mixing plant. Tests should be conducted to establish the requirement of mixing the drum mixer.

Fig. 5.Shrink Mixed Concrete

3. Central mixed concrete

Central-mixing concrete Batch plants include a stationary, plant-mounted mixer that mixes the concrete before it is discharged into a truck mixer. Central-mix plants are sometimes referred to as wet batch or pre-mix plants. The truck mixer isused primarily as an agitating haul unit at a central mixoperation. Dump trucks or other non-agitat-ing unit's aresometimes be used for low slump and mass concrete pourssupplied by central mix plants. About 20% of the concrete plantains the US use a central mixer. Principal advantages include:

•Faster production capability than a transit-mix plant
•Improved concrete quality control and consistency and
•Reduced wear on the truck mixer drums. There are several types of plant mixers, including:
•Tilt drum mixer
•Horizontal shaft paddle mixer
•Dual shaft paddle mixer
•Pan mixer
•Slurry mixer

The tilting drum mixer is the most common American central mixing unit. Many central-mix drums can accommodate up to12 yd3 and can mix in excess of 200 yd3 per hour. They are fas-tand efficient, but can be maintenance-intensive since theyinclude several moving parts that are subjected to a heavy load. Horizontal shaft mixers have a stationary shell and rotating central shaft with blades or paddles. They have either one or twomix-ing shafts that impart significantly higher horsepower inmixing than the typical drum mixer. The intensity of the mix-ing action is somewhat greater than that of the tilt drum mixer. This high energy is reported to produce higher strength concrete vi-ato thoroughly blending the ingredients and more uniformlycoating the aggregate particles with cement paste. Because of the horsepower required to mix and the short mixing cyclerequired to complete mixing, many of these mixers are 4 or 5yd3 units and two batches may be needed to load a stand-ard truck or agitator. Pan mixers are generally lower capacity mixers at about 4 to 5yd3 and are used at precast concrete plants.

Fig. 6. precast concrete plants

4. Slurry Mixing

The slurry mixer is a relative newcomer to con-crete mixing technology. It can be added onto a dry-batch plant and works by mixing cement and water that is then loaded as slurry into atruck mixer along with the aggregates. It is reported to bene-fit from high-energy mixing. Another ad-vantage is that the slurry mixer reduces the amount of cement dust that escapes into their.

11 TESTS CARRIED ON R.M.C

All the ingredients used for preparation of the concrete, are thoroughly tested for their quality and physical properties in a well equipped laboratory attached to the plant for conformity to relevant Indian standard codes. The moisture probe deter-mines the water content in the sand and aggregates. This ac-cordingly helps in fixing the proportion of water to be added for the preparation of the mix. The sand being used is passed through the mechanized sieving system, before feeding for mixing. Trial mixes are carried out and tested to ensure that each andevery batch of concrete coming out of the plant meets the parameters of client's requirements the sand being used is passed through the mechanized sieving system, before feeding for mixing.

12 TESTS ON FINE AGGREGATES

- Sieve Analysis
- Specific Gravity
- Bulk Density (Loose / Rodded)
- Silt Test by Volume / Weight
- Water Absorption
- Sulphite / Chloride / Alkali Reactivity
- Organic Impurities

13 TEST ON COARSE AGGREGATES

- Sieve Analysis
- Specific Gravity
- Aggregate Impact Value
- Bulk Density (Loose / Rodded)
- Water Absorption
- Flakiness Index
- Elongation Index
- Alkali Reactivity
- Abrassion Test
- Crushing Test

14 TEST ON WATER

- PH Value
- Chloride
- Sulphite
- Nitrite

15 TEST ON FRESH CONCRETE

- Workability
- Temperature

16 TEST ON HARDENED CONCRETE

- Compressive Strength
- Flexure Strength

17 TEST ON ADMIXTURES

- Air entrained
- Specific gravity

18 MERITS OF R. M. C.

- Better quality concrete is produced.
- Elimination of storage space for basic materials at site.
- Elimination of Procurement / Hiring of plant and machinery
- Wastage of basic materials is avoided.
- Labour associated with production of concrete is eliminated
- Time required is greatly reduced
- Noise and dust pollution at site is reduced.
- Organization at site is more streamlined
- Durable & Affordable
- No storage space required either for raw materials or for the mix
- Lower labour and supervisory cost
- No wastage at site
- Environment friendly
- Availability of concrete of any grade

19 DEMERITS OF R. M. C.

- Need huge initial investment.
- Not affordable for small projects (small quantity of concrete)
- Needs effective transportation system from R.M.C to site.

- Traffic jam or failure of vehicle creates problem if proper dose of retarder is not given.
- Labours should be ready on site to cast the concrete in position to vibrate it and compact it.

20 STANDARD READY-MIX CONCRETE VS. SITE-MIX CONCRETE

A centralized concrete batching plant can serve a wide area. Site-mix trucks can serve an even larger area including remote locations that standard trucks cannot.
The plants are located in areas zoned for industrial use, and yet the delivery trucks can service residential districts or inner cities. Site-mix trucks have the same capabilities.
Since site mixed concrete is volumetrically metered, the quality of the concrete is not on par with standard ready mixed concrete which is weighed.

CONCLUSION

Ready Mix Concrete plant is a modern technique of production of concrete in large quantities away from the actualsite of placing [5]. It is very useful in cities where demand of concrete is very high and construction sites are in congested areaswhere mixing on site is not possible. It is suitable for projects likeDam, Roads, Bridges, commercial complex, Malls and all typesof mass construction where time limit plays a vital role and wheredemand is huge.

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