

Conservation of Cement Strength in India

Subha Sinha, Vybhav Gupta, Shashank Shaurabh

Abstract: Cement is the most important material for construction industry. Key raw material for cement Manufacturing is limestone and it's a non-renewal source of material. The high demand and limited reserve of limestone create a challenge to use this non-renewal source in optimum way and to reduce the wastage. To counter this challenge, RMC has been developed. However in India, its usages are limited due to lack of studies of its effectiveness in sub-continental conditions. In this work a study is made to identify the quantum of wastages and effectiveness of RMC to reduce this wastage. Suggestive measures are also discussed to overcome the constraints in the use of RMC in India. This study shows that RMC may be proved a game changer in conservation of cement strength if more emphasis can be given on development of RMC industry and to educate the stack-holders about its benefits and way of use. It is concluded that masons have measured role in house construction so lot of education certified courses are needed to implement to educate them for usage of cement and concrete batching. Government, Cement companies and RMC industries need to focus on this account to prevent wastage of extra cement by volume batching (Nominal Mix) and need to promote concrete mix design by weight.

Keywords : Volume batching (Nominal Mix), concrete mix design, Ready mix concrete (RMC), Limestone, clinker, cement, concrete compressive strength.

I. INTRODUCTION

Nearly of two billion tons of lime stone consumed annually which is used either as the basic raw material in the manufacture of cement or as flux input in the metallurgical industries. But limestone is a non-renewal source of raw material as there is a finite amount on the earth and it is being made slowly that it will not be renewed in any sensible timescale for human who cannot wait many millions of years for the new stuff. We can say limestone is same as petroleum which we needed to conserve by our process of manufacturing cement and education to concerns involved in construction in India. Not paying attention will also lead to vanish of this source too earlier than required by our future generation. In India still the percentage is higher for following crude methods for cement utilization for construction and leads to wastage of cement strength and ultimately wastage of limestone. For the upcoming decades, we have to evaluate some techniques and products that should prevent extra wastage of cement compressive strength as per the need of different type of Cement for different type

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of cement works

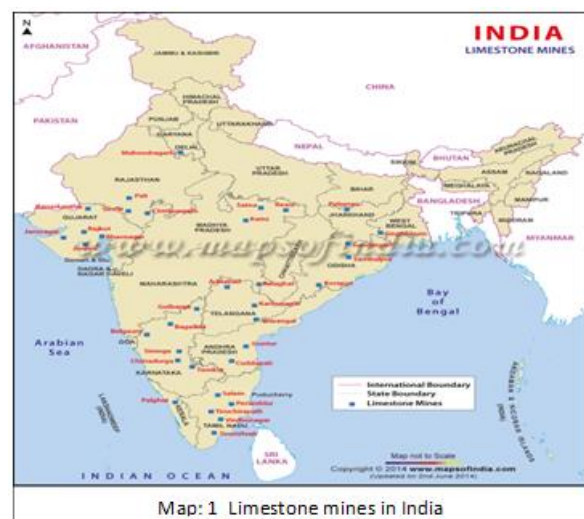
II. CURRENT LIMESTONE RESERVES IN INDIA AND STAES OF MEASURE PRODUCERS

Almost all the states in India produce some quantities of limestone but about 75 percent of total production comes from Madhya Pradesh, Chattisgarh, Andra Pradesh, Rajasthan, Gujarat and Karnataka. 25 percent of total production of limestone has been obtained from the others states like Tamil Nadu, Maharashtra, HP, Orissa; Haryana, Meghalaya, J&K and Uttar Pradesh.

Indian cement Industries has been raised hugely in last decade and overall production capacity of cement rise to nearly 390 Million Tonnes (MT) and estimated to touch 550 Million Tonnes (MT) in 2020. Currently India has 188 large cements plants which are producing 97 percent of total annual cement production.

Key concern to say that, as cement industries are increasing day by day in India for the development of infrastructure but the focus of private cum government is very much less over the optimum utilization of limestone. If we have not started to measures for the save of cement strength (Lime stone) then time will come when the limestone on the edge of depletion and easy sources material will be vanished.

Currently total estimated reserves of 93263 Million Tonnes in India means if we will produce 600 Million Tonne (MT) per year of clinker than it will be vanished in next nearby 60-70 years. Even the hundred percent abstraction of limestone is not possible due to various constraints. (Approx. Utilization of 1.5 tonnes of limestone for the production on 1 tonne of cement clinker and also based on quality of limestone obtained)



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Table No. 1

States in India for Production of Limestone		
Measure States	Percentage	Districts and other states
Madhya Pradesh	27	Jabalpur, Bilaspur, Damoh, Reva, Betul Raigarh, Durg
Andhra Pradesh	16	Cuddappah, Vishakapatnam, Kurnool, Guntur, Karimnagar, Warangal, Mahbubnagar, Nalgonda
Rajasthan	14	Ajmer, Banswara, Dungarpur, Kota, Jodhpur, Sirohi, Tonk, Bundi, Alwar, Nagaur, Pali, Udaipur
Gujarat	10	Amreli, Kachchh, Junagarh, Surat, Kheda, Panch Mahal, Sabarkantha
Karnataka	8	Bijapur, Belgaum, Shimoga, Chitradurga, Tumkor, Mysore, Gulbarga
Other States	25	Tamil Nadu, Maharashtra, Himachal Pradesh, Orissa, Haryana, Assam, Meghalaya, J&K, Uttar Pradesh

III. KEY CAUSES FOR THE WATSE OF CEMENT STRENGTH IN INDIA

- a) Since 1960, only 15 percent of Indian Rural population is converted to Urban. Due to slow deal with timely development still 67 percent of Indian population is comes under rural population. Even modernization of construction practices have also lacked in developing India. Till date mason is the most accepted person for the construction purposes in all Indian cities and rural areas. There is no exact numbers of figures available for total number of masons involved in construction activities and what average level of education they have. Still as Indian construction industry practicing with old and poor methods of construction. Especially in utilization of cement in different nature of work like, plastering, concreting etc. Mostly practicing methods for the mortar and concrete batching is by volume (Nominal Mix) only.
- b) A study says that till date only 10 % of cement production used in Ready Mix Concrete (RMC) means 90 % of cement has been using in Indian construction by only volume batched concrete. Still India is in phase I of RMC industries as total utilization of cement production is on or below 10 percent of total annual cement production. Ultimately utilization of proper proportion of cement in the nature of work is not controlled which may leading to higher loss of strength.
- c) 90 percent of annual cement production utilized in India by volume (Nominal mix) batch. Volume batch gives an approx. idea to use the cement in concrete & mortar but not the exact amount required for producing any specific grade of concrete. Ultimately result in wastage of cement

strength or maybe say under or over utilization of cement quantity.

- d) Still there is large scope of for Indian ready mix concrete to grow and cover the Indian urban and rural market for the proper design of concrete mix so that optimum utilization of cement strength in various type of construction works.
- e) Even Ready mix concrete is suffering due to absence of proper guidelines for installing ready mix concrete plants and norms to control the concrete production. Ready mix concrete also affected due to entry of various local vendors which do not have sufficient structure for the control of quality and assurance.

IV. DEVELOPMENT OF RMC IN INDIA

Ready mix concrete plants arrived in India in the early of 1950s, but their use was restricted to only major construction projects such as large dams. Bhakra and Kyona dams were some of the early projects where ready mix concrete plant was used for the production of concrete in mass scale. In 1974, a techno economic feasibility study for setting up of ready mix concrete unites in India conducted by the Central Building Research Institute (CBRI), Rourke. The study recommended setting up of ready mix concrete plants in major metropolitan towns of country. It also suggested the use of fly ash as a partial replacement of cement to affect savings. It was only after cement was fully decontrolled, and particularly since earlier of 1990s, that ready mix concrete has been talked about on a commercial basis. Initial activities of commercial ready mix concrete plant set up taken placed in Pune than other plants also started to install at Mumbai in 1994. After that numbers of commercial player started their business in ready mix concrete and thus how ready mix concrete plant started to install in India.

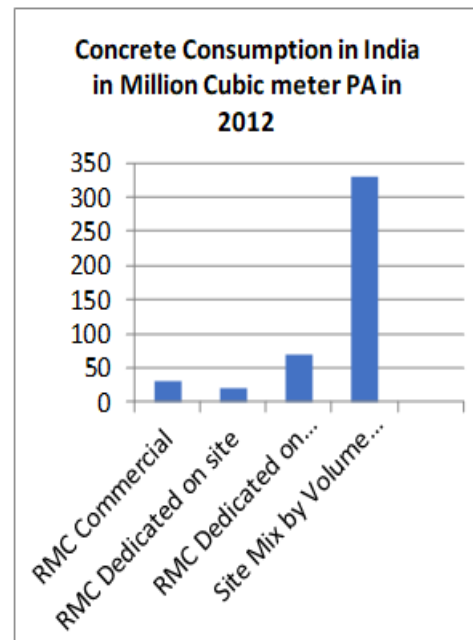


Chart 1: comparison of consumption of concrete quantities by RMC and site mix (By volume) in 2012, India



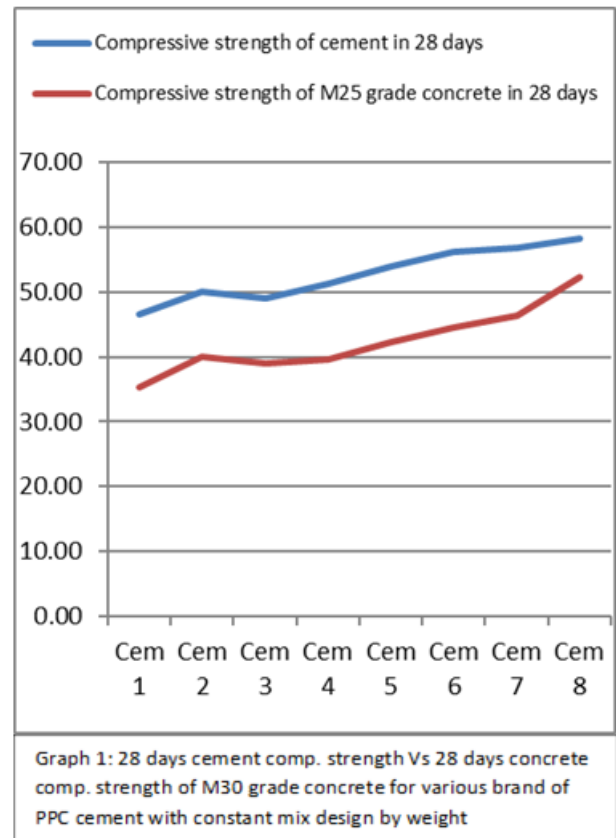
The growth of ready mix concrete industry in last 4 to 6 years had been comparably slow due to overall depression in GDP and economic growth in country. Otherwise by now ready mix concrete could have achieved 10 % consumption of total annual cement produced in the country.

Chart 1 clearly shows that 73 percent of concrete production still done by volume batch in 2012. Even after 2012 ready mix concrete industry growth was sluggish due to poor growth. Almost situation is same in 2016, if we consider consumption of annual cement at B class city market like Lucknow where construction activities are on higher side than rest of cities in north India, total annual consumption of cement is 2.4 million Tonnes (MT) and comparatively above, RMC annual cement consumption is only 0.40 Million Tonnes (MT). This also clearly suggests that we have to go miles for the optimum use of cement by a weight batching (CMD). Even the system in ready mix concrete is not so standardized; resulted general opinion of Indian consumers is that they do not have hundred percent faiths on ready mix concrete for the type of concrete mix supplied at the sites. This also shows that still Indian customers preferred to use concrete by volume batch rather than purchase of ready mix concrete suppliers.

V. STUDY OF CEMENT ULTIMATE STRENGTH OF VARIOUS MAJOR CEMENT BRANDS IN INDIA

Due to awareness in use of fly ash mostly cement manufactured produced PPC cement as per is 1489 (part1): 1991 in India. Other types of cement OPC 43, OPC 53, PSC and White cement are also part of production. In which approximately 67 percent of the cement used in housing sector, 11 percent to commercial construction, 13 percent in infrastructure development and rest in industrial construction segment. But measure area is of housing sector in which concrete produce mostly by volume batching (Nominal Mix) method only and key person to execute the construction is mason.

Here is the study of strength of PPC Cement produced by major cement players. We have hid the name of manufacturer due commercial & legal factor. The graph is drawn for 28 days compressive strength of cement Vs 28 days compressive strength of M30 grade of concrete with constant mix design.



Observation from above graph as follows:

- 1) All are PPC cement of various brands available in Indian market and having large variation in their 28 days compressive strength results.
- 2) Their 28 day's results for M30 grade of concrete with constant mix design also having the proportionate similar variation as cement strength.
- 3) Higher the 28 days cement compressive strength than higher the 28 days compressive strength of concrete.
- 4) Designing the concrete mix by weight can optimized the use of cement content in individual mix design for different cement for same targeted results.
- 5) Using of same cement content for same targeted strength with constant mix design resulted in over or under design of concrete mix i.e. wastage of cement strength.
- 6) By proper Concrete mix designing methods & evaluation, we can use optimum cement content of available cement for use.

VI. COMPARISON OF MIX DESIGN BY WEIGHT Vs VOLUME BATCHING OF CONCRETE.

If we batch concrete by volume (Nominal Mix) with above available cements with constant mix ratio of materials than similar result will be obtained as in graph no 1 for various brand PPC cement brands. There will be a huge difference between 28 days compressive strength result of concrete. As discussed in section III that 67 % of cement used in housing construction for concrete is batched by volume (Nominal Mix) irrespective of their final 28 days compressive strength than resulted in wastage of cement strength which we can say unnecessarily extra usage of limestone too.



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If we conclude the reason for the wastage of cement strength then following reasons are key concerned

- 1) Preference of volume batch over mix design of concrete.
- 2) India is largely depending upon masons, not even in rural India but also in urban area. Currently most of masons are semi-skilled and unskilled and they work with experience earned during the time.
- 3) Indian masons are far behind to have depth or general knowledge about the cement & its strength and no such infrastructure is present to educate these masons and certified them to work in construction.
- 4) No proper guidelines are available for masons in government system to ensure minimum experience and qualification to work in construction.
- 5) Key resource for concrete mix design by weight is only possible by Ready mix concrete but due to high cost they are limited to large cities and installed in measure constructions projects only.
- 6) Even in India, masons are poorly paid and they basically come from rural India where the educational system is very poor.
- 7) Government is less concern about the preservation of limestone similar to paying attention for other non-renewal sources like petroleum, electricity water etc.

VII. SUGGESTIVE MEASURES TO COME OVER CURRENT CONSTANTS

We have to go long way to come over these constraints to protect limestone and prevent unnecessary utilization of it then required. Construction industries needed skilled masons to conserve the excess usage of cement in rural areas cum urban area too. Currently cement industry is expected to grow in between 10 to 11 percent and sustainable percentage of investment also needed to in educating the persons involved in construction. Following are the basic suggesting measure to improve the condition for optimum utilization of cement content in concrete & Mortar:

- 1) Cement companies can produce various varieties of cement products depending 28 days strength, for different usage of cement in construction. For example they can differentiate the masonry cement for bricks and RCC cement for concretes.
- 2) Use of supplement material can be increased like fly ash, GGBS etc for reduction in the consumption of cement usage. For these implementation BIS has to take fast initiatives and revise the codes.
- 3) Private players of cement and construction industries can more effectivity customer service activities so that customer and mason can be educated.
- 4) Private players can setup various small concrete labs in their operating area to suggest their customer a concrete mix design with optimum cement content and local materials.
- 5) Government should start initiatives to regularize the mason certification programs a tehsil levels so that minimum criteria for mason can be fixed to work in any type of construction.
- 6) Government should promote and subsidies the portable machineries used for concrete weight batching and portable labs for design of concrete mix design.
- 7) Research work should be promoted for the availability of

alternative material that can be used in place of limestone for the production of cement.

- 8) Ready mix concrete industries should be promoted to increase concrete production in all over the India instead of volume batching (Nominal Mix).
- 9) Government should form the norms for ready mix concrete industries so that companies can be remain adhere to proper ready mix concrete plants installation and maintain quality control and assurance for satisfactory concrete.

VIII. CONCLUSION

Limestone is the key raw material for the production of cement and it is a non-renewal source of material. In current scenario 70 % of annual cement production and 90 percent of annual concrete batching is done by volume batch (Nominal Mix). Due to volume batching in India large amount of unaccounted cement get wastage in concrete production at site. By using RMC, not only we can save the cement, but also achieve the target strength easily. Thus, RMC is the best way for preventing unwanted extra usage of cement. But still RMC industries needed lot of attention to come over lot of constraints. Masons have measured role in house construction so lot of education certified courses are needed to implement to educate them for usage of cement and concrete batching. Government, Cement companies and RMC industries need to focus on this account to prevent wastage of extra cement by volume batching (Nominal Mix) and need to promote concrete mix design by weight.

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AUTHORS PROFILE



Dr. Subha Sinha, Assistant Professor, Civil Engineering Department, M.I.T. Muzaffarpur, Bihar, India.

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which contains their education details, their publications, research work, membership, achievements, with photo that will be maximum 200-400 words.