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Study on Ready-Mix Concrete with Survey and Experiments in the Context of Bangladesh

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Abstract : The research study conducted here is focused on the ready mix concrete (RMC) in the context of Bangladesh. At present time ready mix concrete (RMC) is a very important subject of interest. In foreign countries most of the construction work is carried out by ready mix concrete. In the present study, it was tried to find out the condition of ready mix concrete company of Bangladesh and their products. Experiments as well as questionnaire survey were carried out to achieve the goal. Using a questionnaire form a detailed survey was done on several popular RMC companies of Bangladesh and their factories. The survey study dealt with a number of useful information such as the materials used for RMC, production volume, the manufacturing & transportation process etc. For experimental purpose fresh RMC of different companies was collected and afterwards tested in the Concrete Laboratory of Ahsanullah University of Science & technology. From the survey results, it is seen that in our country also the use of RMC is quite high & is being increased. Also most of the company's RMC reached the target strength as found from the test result. However, some RMC samples failed to reach target strength.

Keywords: Concrete technology, Ready mix concrete, Questionnaire survey, Quality control.

Introduction

A concrete whose constituents are weight batched at a central batching plant, mixed either at the plant itself or in truck mixers, and then transported to the construction site and delivered in a condition ready to use, is termed as READY MIXED CONCRETE (RMC) ^[1]. The technique of RMC is useful in congested sites or at diverse work places and saves the consumer from the botherations of procurement, storage and handling of concrete materials. RMC has a number of advantages over normal concrete. Due to its durability, time saving, low cost and its ability to be customized for different applications, ready mix concrete is one of the most versatile and popular building materials.

A few of the advantages is mentioned in the table 1 below.

Table 1: Advantages of RMC over Normal concrete ^[2]

Normal Concrete	Ready Mix Concrete
Quality is inconsistent because concrete is hand mix	Consistent Quality concrete is made in high tech batching plants in a computerized environment
Manual mixing is time consuming and project take longer time to finish	Construction in double quick time.
Quality of raw Material is manually checked or not checks at all.	Raw materials are chosen after strict quality check.
Take more time. Repeated mixing needs to be done for large quantities as the mixer will be too small to handle the requirement.	Large quantities of concrete can be ordered. This allows upgrading the company and handling project of any size.
High wastage of raw material due to manual mixing	No wastage of raw materials at site. Everything is premixed and based on customers need

Many ready mix concrete companies have already been developed in Bangladesh now-a-days. However, before getting the big advantages of RMC and before starting the widespread use of it, a study is felt necessary to investigate the use of RMC in Bangladesh and its strength properties. Therefore, in the present study, it was tried to find out the condition of ready mix concrete company of Bangladesh and their products. Experiments as well as questionnaire survey were carried out to achieve the goal. In this study we have carried out a detailed study on this highly demanding Ready Mix Concrete (RMC) topic.

RMC Manufacturing

RMC can be manufactured either at the plant or in the Transit truck. Admixture is usually used in RMC with the usual constituents of cement, coarse Aggregate, fine Aggregate, water. An RMC batching plant of Bangladesh is shown in Fig. 1. When RMC is mixed at the plant and then transported in a truck-mixer or agitator truck (Fig. 2), then it is termed as **Central-mixed Ready Mix Concrete**. Freshly mixed concrete is transported to the jobsite by a truck. Slight agitation of

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the concrete during transit prevents segregation of the materials and reduces the amount of slump loss. On the other hand, if the materials are batched at a central plant and are completely mixed in the truck in transit then it is termed as **Transit-mixed Ready Mix Concrete**. Transit-mixing keeps the water separate from the cement and aggregates and allows the concrete to be mixed immediately before placement at the construction site. In our country central-mixed ready mix concrete is widely used.

After producing ready mix concrete, utmost care must be given to the quality of concrete during transportation to the site. The following factors for transportation should be kept in mind:



Figure 1: RMC batching plant



Figure 2: Transit mixer

1. **Travel distance:** Since the concrete setting time is very much related to the time, so time distance between loading and pouring is very much important. For Dhaka city, it is very much important because of too much traffic jam and broken and dame road. Large travel time may hamper the quality of concrete.
2. **Transit mixers:** These are the vehicles which carry ready mix concrete from bathing plant to site. So every transit mixers should be in good condition and tested before carrying.
3. **Weather condition:** As a tropical country weather is a considerable factor for transportation of ready mix concrete. Mainly in summer season ready mix concrete should be transported with caution.

After transporting to the site, placing of ready mix concrete is done in two ways: Manual/ Bucket system and Pumping. Proper compaction of concrete should be done then to get uniform and dense concrete. Compaction is the process adopted for expelling the entrapped air from the concrete and by compaction an intimate contacts between concrete and reinforcement is ensured. Compaction may be done either by vibrator or hand compactor. All concrete requires curing in order that the internal chemical reaction can be proceed and durability, impermeability, the strength characteristic specified can be developed. Without proper moist curing the concrete may develop only a fraction of its design strength.

Survey on Some RMC Factories

During performing these study different types of data like production in each month, cost, strength range of manufacturing, target strength gain, raw materials, admixture used etc. were collected from various ready mix factories by a questionnaire form as shown in Appendix A. These data are very useful for comparing the activities of various companies. The questionnaire form and the survey data are presented in bar-chart form below.

Survey report (2010) shown as bar chart

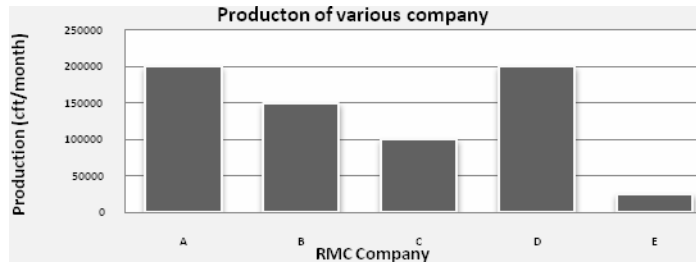


Figure 3: Bar Chart of production of various companies

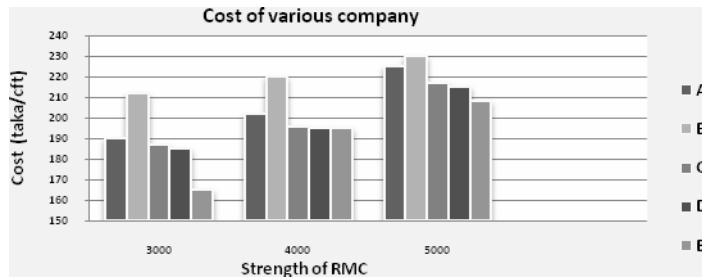


Figure 4: Bar chart of cost comparison of various companies

Table 2: No. of batching plant & transit mixer

Company	Number of Batching Plant	Transit mixer
A	3 in Dhaka 1 in Chittagong	25
B	1 in Dhaka	12
C	1 in Dhaka	10
D	1 in Dhaka	20
E	1 in Dhaka	4

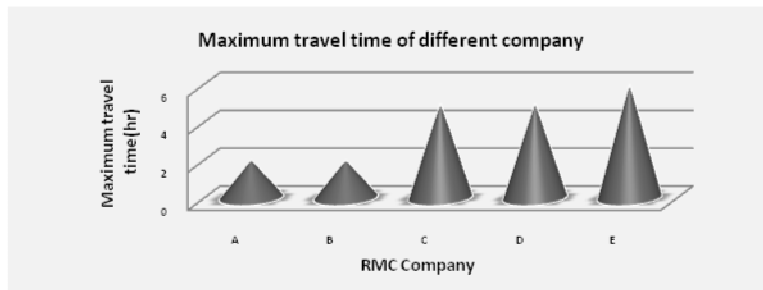


Figure 5: Bar chart of maximum travel time of various companies

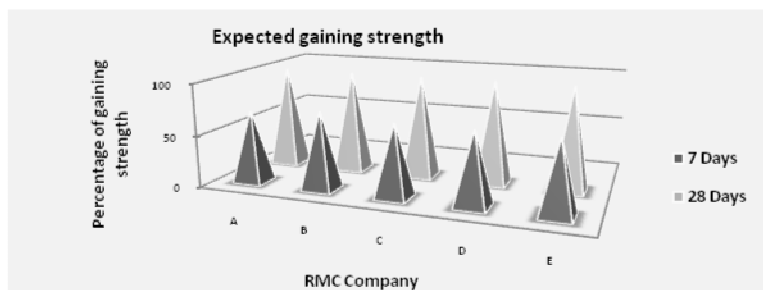


Figure 6: Bar chart of gaining strength of various companies

Raw Materials of Ready Mix Concrete
Table 3: Aggregate and Admixture used by different company

Company	Coarse aggregate	Fine Aggregate	Admixture
A	20mm downgraded volagong boulder. 20mm downgraded stone chips of same place.	Sylhet Sand (F.M.- 2.5-3.2)	Rheobild 623 of BASF (super plasticizer) RP 264 of Fesroc (Retarder)
B	Pure volagonj chips (25-33 graded)	Sylhet Sand (F.M.- 2.5up)	Rheobild 623 of BASF (super plasticizer) RP 264 of Sika (Retarder)
C	20mm downgraded stone chips of volagonj.	Sylhet Sand (F.M.- 2.5-2.8)	Rheobild 623 of BASF (super plasticizer) RP 264 of Fesroc (Retarder)
D	20mm, 12mm stone chips	Sylhet Sand (F.M.- 2.5-2.8)	Rheobild 623 of BASF (super plasticizer) Conplast Sp 432 of Fesroc
E	20mm, 12.5mm downgraded stone chips	Sylhet Sand (F.M.- 2.5up)	Sp-120 Rp-264(Retarder) G8 (super plasticizer) Rumat (water proffer)

Experimental program on RMC:

Strength testing of ready mix concrete sample is a very important.

Generally there are three types of strength test which are performed. These are:

- Slump Test
- Compressive Strength Test
- Split Cylinder test

Slump Test:

This test is performed to check the consistency of freshly made concrete. The slump test is done to make sure a concrete mix is workable. The measured slump must be within a set range, or tolerance, from the target slump ^[3]. Workability of concrete is mainly affected by consistency i.e. wetter mixes will be more workable than drier mixes, but concrete of the same consistency may vary in workability. It can also be defined as the relative plasticity of freshly mixed concrete as indicative of its workability.

Table 4: Degree of workability for different slump ^[4]

Degree of workability	Slump	
	mm	inch
Very low	0-25	0-1
Low	25-50	1-2
Medium	50-100	2-4
High	100-175	4-7

Compressive Strength Test:

The compressive strength of concrete is the ability to resist a crushing controlled by the water-cement ratio. However, the theoretical compressive strength related to a particular water-cement ratio will be attained only if the actual amount of water added is carefully regulated. Samples cast from the mix being used must be cured and tested to determine what compressive strength was actually attained ^[5]. This test is performed by compressive strength test machine after 7, 14, 28, 60 etc days curing.

Split Cylinder Test:

This ASTM test method covers the determination of the splitting tensile strength of cylindrical concrete specimens. This method consists of applying a diametric compressive force along the length of a cylindrical specimen. This loading induces tensile stresses on the plane containing the applied load^[6].

Test & analysis over some samples:

Six cylinder samples of each five ready mix concrete company were collected from sites and after 28 days curing compressive strength test of four samples and split test of rest two samples of each companies were performed in the concrete laboratory of Ahsanullah University of Science & Technology.

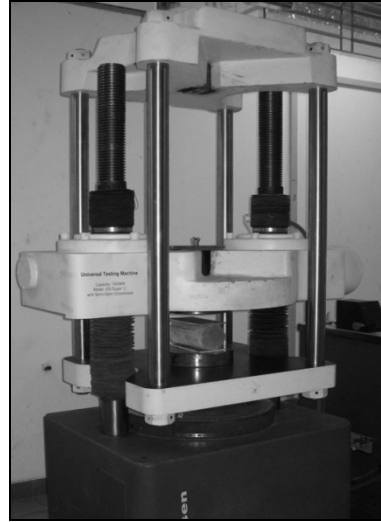


Figure 7: Compressive strength test machine Figure 8: UTM machine

Table 5: Some information of collected samples of different companies

Company	Travel time (min)	Slump value (in)	Design strength (psi)
A	15	5	3500
B	90	8	3500
C	180	7.5	3500
D	90	7	3500
E	75	6.5	3500

Table 6: Compressive strength Test results & analysis over the samples (Target strength of all companies is 3500psi)

Company	Sample no.	Tested strength (psi)	% of gained strength	Avg % of gained strength	+ ve deviation	- ve deviation	Remarks
A	1	3933.8	112.40	103.46	410	195	Overall sample Quality is good
	2	3233.5	92.40				
	3	3883.1	110.95				
	4	3433.6	98.01				
B	1	2975.4	85.01	76.80	0	883	Overall sample Quality is poor
	2	2966.7	84.76				
	3	2124.3	60.70				
	4	2684	76.70				
C	1	2731.8	78.05	79.88	0	814	Overall sample Quality is poor
	2	3468.4	99				
	3	2617.2	74.78				
	4	2369.3	67.70				

D	1	2183.7	62.40	82.78	0	765	Overall sample Quality is poor
	2	3394.4	96.98				
	3	2772.4	79.21				
	4	3237.9	92.51				
E	1	3237.9	92.51	95.50	0	190.5	Overall sample Quality is moderate
	2	3233.5	92.38				
	3	3468.4	99				
	4	3433.6	98.10				

Table 6: Split cylinder strength test result.

Company	Sample no.	Tested strength(psi)
A	1	1222.4
	2	1060
B	1	754
	2	771.1
C	1	713.4
	2	713.4
D	1	1018
	2	1036.8
E	1	771.4
	2	713.14

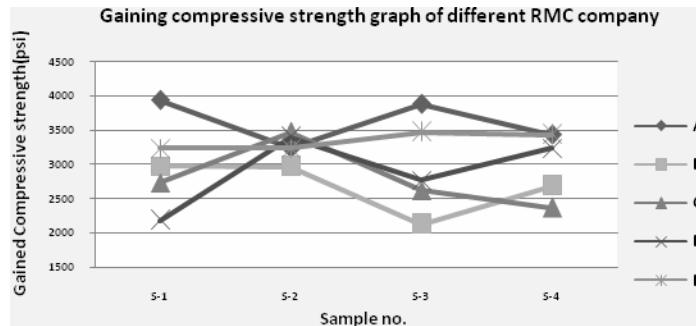


Figure 9: Graph of comparison of gaining compressive strength of four samples of 3500 psi concrete of different companies.

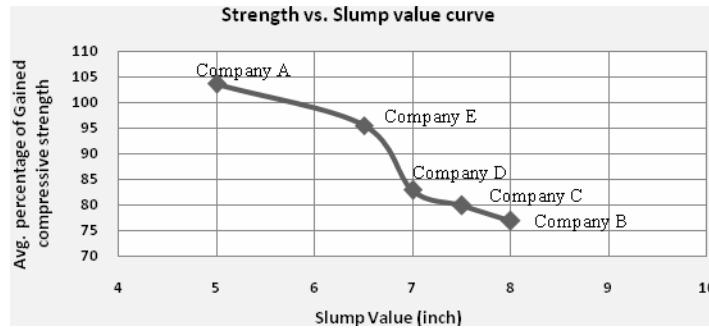


Figure 10: Graph of average percent of gained compressive strength vs. slump value

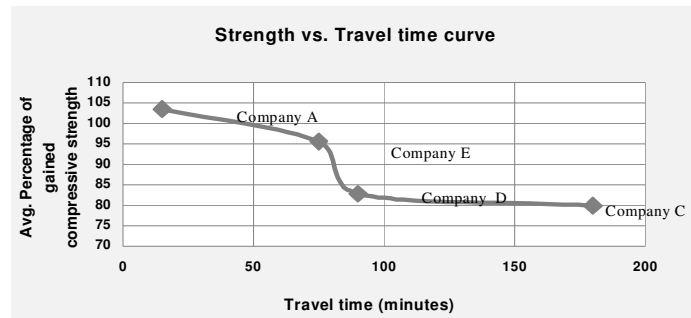


Figure 11: Graph of average percent of gained compressive strength vs. travel time.

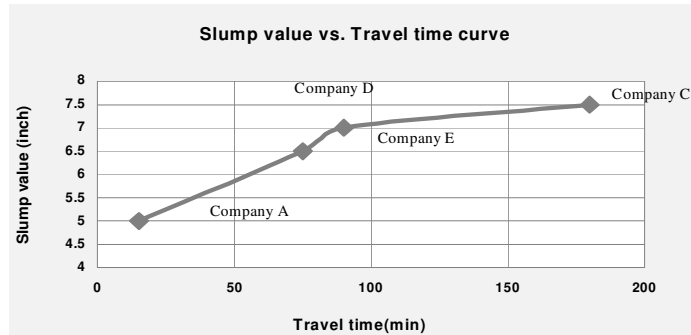


Figure 12: Graph of slump value vs. travel time.

Conclusion:

Our survey shows that, there are sufficient ready mix concrete companies in Bangladesh to meet the demand of consumers. It is evident from our study that in many cases ready mix concrete supplied by the companies fails to provide the prescribed strength. Increase of travel time might be responsible for this as our study shows increase of slump value and decrease of concrete strength with time. Nowadays use of ready mix concrete is increasing and it is used by the developer companies in most cases. General people do not have much idea and full faith on ready mix concrete. Considering its advantages its use should be increased. So the RMC companies should increase their production and maintain the quality of their concrete strictly.

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Appendix A: Survey questionnaire form

1. Production in each month:
2. Compressive strength ranges(psi):
3. No. of Batching plant and capacity:

Location	Capacity(m ³ /hr)

4. No. of Transit mixers:

Location	Capacity(m ³)	Time required to load (min)

5. RPM of Transit mixers at various condition:

Condition	RPM (revolution per min)
Loading	
Travelling	
Unloading	

6. Maximum travel time:
7. Cost of ready mix concrete:

Strength(psi)	Cost (tk.)

8. Consumers:
9. Some important structures in Bangladesh:
10. Cement used:
11. Coarse aggregate used:
12. Fine aggregate used:
13. Admixtures used:
14. Concrete proportion:
15. Strength gains:

Day	Strength (%) for OPC	Strength (%) for PCC

Signature of an officer

Signature of visitor

Signature of Advisor