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# Study on Negative Impact of Use of RMC in Major Construction Projects and Proposing Effective Measures

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***Abstract*** **- Ready Mix Concrete is continuously growing industry in India. This industry is exposed to risks during preparation, transportation and utilization of RMC. It is important to address these risks, so that industry shall gain confidence of the customers, and shall have expected profit margins. Proposed paper presents a negative impact caused during preparation, transportation and utilization of RMC plants in India. Unless the risks are addressed properly, the RMC industry in India shall not gain confidence of customers and will also cause reduction in profit margins. The risk causes can be categorized into internal risk causes and external risks causes. Thus, the risks related to RMC plants can be classified as internal as well as external risks. Internal risks and External risks cannot be avoided completely; yet, suitable strategies can definitely be adopted to manage these risks. This paper proposes an approach to mitigate risks in RMC plants in Indian context. Once risks are identified, mitigation measures can be adopted to treat the risks related issues. This shall help in achieving the objectives of RMC business in terms of production and supply cost.**

***Keywords:*** **RMC, Negative Impact, Construction Projects, Effective Measures**

## I. INTRODUCTION

IS 4926-2003 (Bureau of Indian Standard 2003) defines Ready Mix Concrete (RMC) as "Concrete delivered at site or into purchaser's vehicle in the plastic condition and requiring no further treatment before being placed in a position in which it is to be set and hardened". Ready Mix concrete is preferred over site mix concrete because it is environmental friendly. It is a solution to a messy and time consuming manufacturing of concrete at construction sites. It offers solutions to customer's specific problems, ensures customer satisfaction and provides uniform quality. It also eliminates the need to store materials used to manufacture concrete at project sites. Currently, RMC is a matured industry both in Europe and USA. The data from National Ready Mix Association (March, 2007) indicate that RMC is a $ 30 billion industry in USA, with annual output of 351 million cubic Meters. In these countries, nearly 75% consumption of cement is through the RMC route (National Ready Mix Concrete Association) R. C. Walke (2012).

In the context of India, the trend of using ready mix concrete is growing steadily. Demand of RMC is increasing in housing as well as in infrastructural projects. This has given a big flip to RMC industry in India. Anticipating huge potential for RMC in India, many organized and unorganized players are foraying in this area. Like other industries, RMC industry is exposed to various risks. In European countries, there is an awareness and understanding about importance of risks and its management. Operation managers on RMC Plants in the European countries are expected to work on risk management at production plant and delivery sites. In India, Risk Management at RMC plant is not given adequate importance.

Unless the risks are addressed properly, the RMC industry in India shall not gain credibility, confidence of customers and will also cause reduction in profit margins. The risk causes can be categorized into internal risk causes and external risks causes. Thus, the risks related to RMC plants can be classified as internal as well as external risks. Internal risks and External risks cannot be avoided completely; yet, suitable strategies can definitely be adopted to manage these risks. This paper proposes an approach to quantify risks in RMC plants in Indian context. Once risks are quantified, quantitative assessment can be done so that the appropriate risk response strategies can be adopted to treat the risks related issues. This shall help in achieving the objectives of RMC business in terms of production and supply cost.

## II. OBJECTIVES OF PROJECT

1. To identify the factors involved in preparation, transportation and utilization of RMC.
2. To find out the risks involved in preparation of RMC.
3. To find out the various methods of mitigating the risks.
4. To find out the method of effective utilization of RMC for construction project.

## III. METHODOLOGY

### *A. Risk Identification*

The proposed approach in this paper considers risk as a future event which has an adverse effect on the production and supply cost for a company running RMC plant and for which possible outcomes can be predicted on the basis of probability. As no previous record of the different types of risks in RMC plant in India is available, author had to interview a team of plant managers and key personnel working at respective RMC plants. Risk management

concept was explained to this team of plant managers and key personnel before interviewing them. The approach can be used by the RMC plant owners for deciding upon risk response strategies. It can be used fairly for decision making at the starting point of every RMC manufacturing and supply contract. It helps in identifying the high risk areas which need to be controlled and monitored for the achievement of objectives RMC business in terms of cost.

*B. Data Collected*

Data collected from various RMC plants. The grade of concrete used are,

1. M20 - 1:1.5:3
   (Cement: 320 kg/m$^3$, 20mm jelly: 683 kg/m$^3$, 12mm jelly: 455 kg/m$^3$, River sand: 794 kg/m$^3$, Total water: 176 kg/m$^3$, Admixtures: 0.7%, Fresh concrete density: 2430kg/m$^3$)
2. M25 - 1:1:2
   (Cement: 340 kg/m$^3$, 20mm jelly: 667 kg/m$^3$, 12mm jelly: 445 kg/m$^3$, River sand: 775 kg/m$^3$, Total water 185 kg/m$^3$, Admixtures: 0.6%, Fresh concrete density: 2414 kg/m$^3$)
3. M30 - 1:1:3
   (Cement: 380 kg/m$^3$, 20mm jelly: 654 kg/m$^3$, 12mm jelly: 436 kg/m$^3$, River sand: 760 kg/m$^3$, Total water: 187 kg/m$^3$, Admixtures: 0.7%, Concrete density: 2420 kg/m$^3$)
4. M35 - 1:1.6:2.907
   (Cement: 410 kg/m$^3$, 20mm jelly: 632 kg/m$^3$, 12mm jelly: 421 kg/m$^3$, River sand: 735 kg/m$^3$, Total water: 200 kg/m$^3$, Admixtures: 0.7%, Concrete density: 2400 kg/m$^3$).

a. Average production per day - 100 to 150 m$^3$
b. Capacity of transit mixer - 6m$^3$
c. Loading time for 6m3 transit mixer - 7.5 minutes
d. Silos capacity - 100 metric tons
e. Max & Min distance from Plant to site - Up to 100 kilometres
f. Min & Max speed of vehicle - 30 to 60 kmph
g. Min & Max quantity of Concrete in transit mixer - 3m$^3$ to 6m$^3$
h. Raw materials used are 20 mm, 12 mm aggregate, river sand, crusher sand

*C. Data Analysis*

Data analysis is carried out by various interviews from different RMC plants. The bar chart is prepared based on the questionnaire which shows the relationship between number of frequencies and high probability and consequence risks. Based on the bar chart prepared we can list down the negative impacts in RMC. The following Figure 1 shows the bar chart for high probability risk.

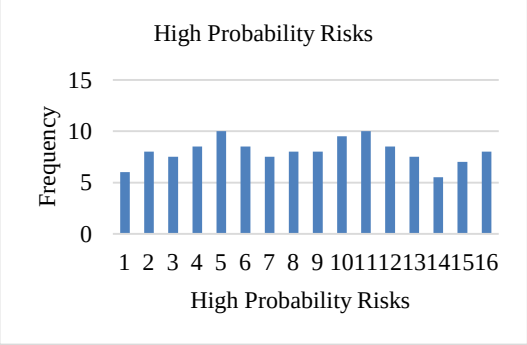


Fig. 1 Bar Chart for High Probability Risk

1. Unskilled personals
2. Incorrect mix design
3. Incorrect use of admixtures
4. Improper specification of RMC
5. Irregular quality standards
6. Non availability of safety equipment
7. Not keeping hydraulic equipment's free
8. Not doing major hauling service
9. Non availability of spare parts
10. No flow through pipes during discharge
11. Delay due to traffic during transportation
12. Frequent breakdown of machines
13. Over exertion
14. Wrongly design layout
15. Use of new technologies
16. Investment risk

The following Figure 2 shows the bar chart for high consequence risk

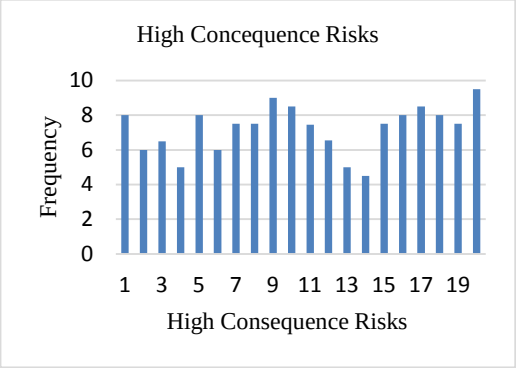


Fig. 2 Bar Chart for High Consequence Risks

1. No periodic check-up of plant and machine
2. No careful planning for repair and maintenance
3. Non-performance of labourers
4. Not doing major hauling service
5. Accidents at plant site
6. Over exertion
7. Theft at site
8. Non availability of spare parts
9. Irregular quality standards
10. Incorrect use of admixtures
11. Improper specification of RMC

12. Incorrect mix design
13. Improper moisture content
14. Mixer not maintained in efficient condition
15. No flow through pipes during discharge
16. High transportation cost
17. Unskilled personals
18. Wrongly design layout
19. Frequent breakdown of machine
20. Delay due to traffic during transportation

## IV. RESULTS AND DISCUSSION

The proposed project presents the negative impacts caused by RMC during preparation, transportation and utilization. The information is gathered through the interviews and discussion with the team of key personnel working in RMC plants.

### *A. Factors Influencing RMC Plant*

#### *1. Inappropriate Use of Admixture*

Inappropriate use of admixture is a result of lack of expertise training in concrete technology among the skilled labour. Inappropriate use of admixture also affects pumping and dispersion of concrete and hence should be properly addressed. The techniques of admixture should be thought to labour to avoid inappropriate use of admixture. Proper supervision team should be setup for checking admixture proportion in batching plant.

#### *2. Receiving Raw Materials without Verification*

Identify the component materials that your company uses in the manufacture of RMC. Component materials may include, but are not limited to Portland cement, fly ash, slag, chemical admixture, fine aggregate, coarse aggregate and water. The materials required based on the project specification or the mix design selected. The material selected should be based on economy so that it reduces the material expenses.

#### *3. Delay in Transportation on Materials*

The concrete delivery process begins when the transit mixer leaves the plant and ends when the truck returns to the plant or other designated facility. For tracking transit mixer we use computer software fleet management system. Fleet management system is fully integrated with the concrete batch computer software. All the transit mixers are equipped with GPS (Global Positioning system) which link to the fleet management software.

#### *4. Frequent Breakdown of Machine*

The equipment should be checked on a weekly basis so that to avoid breakdown of equipment. The breakdown of an equipment continues to be one of the most widespread covers within this context, together with construction. Inspect the dust collection system on accordance with the manufacturer's recommendations. For aggregate provide physical separation of aggregates.

#### *5. Non Availability of Spare Parts*

Proper maintenance avoids the need for replacement of machinery spare parts and hence the problem of no availability of spare parts can be overcome to some extent possible. Monitor the high bin indicators, anti over fill device and pressure sensors for correct operations. Monitor transfer devices, turn head limit switches, and full bin signals for correct operations. In case of chemical admixtures confirm that admixture storage containers are properly identified with the chemicals stored within.

#### *6. No Flow through Pipes during Discharge*

Concrete pump failure due to internal and external failures. Internal factors such as mechanical failures, improper maintenance, wear and tear of rolling stocks, engine failures etc. or due to external reasons such as pumping unsuitable mixes through concrete pump. In order to avoid such failure due to external factors the mix is proportioned in such a way that it is able to bind all the constituent materials together under pressure from the pump and thereby avoiding bleeding and segregation.

#### *7. Ambiguity in Specification of Mixing*

Ambiguity in specification in construction and especially for batch mixing ready mix concreting is a common problem addressed in the construction industry. This happens mainly due to human errors such as improper quoting, lack of clarity, numerical mistakes, errors in checking the specification from supplier, errors in checking the specification from the client etc. Such errors can be avoided by proper verification from supplier and client sides, computerization of data and verifications, cross checking of specifications by supervisors on regular basis such as Identify the component materials that your company uses in the manufacture of ready mixed concrete. Component materials may include, but are not limited to Portland cement, Fly ash, Slag, Silica Fume, Chemical Admixtures, Fine Aggregates, Coarse Aggregates, Fibres, Colour, and water.

#### *8. Accident at Site*

This section sets forth requirements for employers to provide fall protection systems. All fall protection required by this section shall conform to the criteria set forth by OSHA clause 1926.502. The employer shall determine if the walking/working surfaces on which its employees are to work have the strength and structural integrity to support employees safely. Employees shall be allowed to work on those surfaces only when the surfaces have the requisite strength and structural integrity. Each employee on a walking/working surface (horizontal and vertical surface)

with an unprotected side or edge which is 6 feet (1.8 m) or more above a lower level shall be protected from falling by the use of guardrail systems, safety net systems, or personal fall arrest system

If a guardrail system is chosen to provide the fall protection, and a controlled access zone has already been established for leading edge work, the control line may be used in lieu of a guardrail along the edge that parallels the leading edge. Each employee in a hoist area shall be protected from falling 6 feet (1.8 m) or more to lower levels by guardrail systems or personal fall arrest systems. If guardrail systems, [or chain, gate, or guardrail] or portions thereof, are removed to facilitate the hoisting operation (e.g., during landing of materials), and an employee must lean through the access opening or out over the edge of the access opening (to receive or guide equipment and materials, for example), that employee shall be protected from fall hazards by a personal fall arrest system.

## V. CONCLUSION

The proposed project presents the negative impacts during preparation, transportation and utilization of RMC. The information is gathered through the interviews and discussion with the team of key personnel working in RMC plants. A checklist of risk is generated as an outcome of this study. Subjective Ratings for both, probability of occurrence and consequences were also gathered from the same teams for screening the risks having substantial influence on objective of a company running RMC plants. The approach can be used by the RMC plant owners for deciding upon risk response strategies.

It can be used fairly for decision making at the starting point of every RMC manufacturing and supply contract. It helps in identifying the high risk areas which need to be controlled and monitored for the achievement of objectives RMC business in terms of cost. This approach can be made suitable for incorporating and implementing with a computer aided decision support system, provided precise data is made available. It is important to address these risks, so that industry shall gain credibility and confidence of the customers, and shall have expected profit margins. Internal risks and external risks cannot be avoided completely yet, suitable strategies can definitely be adopted to manage these risks.

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