

Risk Management of Ready mix concrete plant

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Abstract — Risk management is the identification, assessment and prioritization of risks followed by coordinated and economical application of resources. Due to the special nature of the construction industries like Readymix concrete, and the growing need of having innovative and complex projects, the risk assessment process has become more complex. In the current paper, major risk factors affecting Readymix production were assessed and prioritized using Failure Mode Effect and Criticality Analysis (FMECA) and Analytical Network Process respectively. The most critical risk associated with the strength of readymix concrete was identified and recommendations were given to reduce the prevalent issues in the readymix plant.

Keywords- Risk management, FMECA method.

I. INTRODUCTION

Risk management is an important factor of the industrial management system and fundamental to achieving effective results. It refers to the evaluation and prioritization of risk, followed by a coordinated and economic use of resources to minimize, monitor and control the impact of events or unfortunate opportunities. , The objectives of this document are: (i) to verify if the results of the actual tests are within the control limits. (ii) Determine the most critical risk associated with the production of mechanized concrete using the FMECA method. The current study can be extended by considering more number of readymix concrete plants in the area.

II. METHODOLOGY

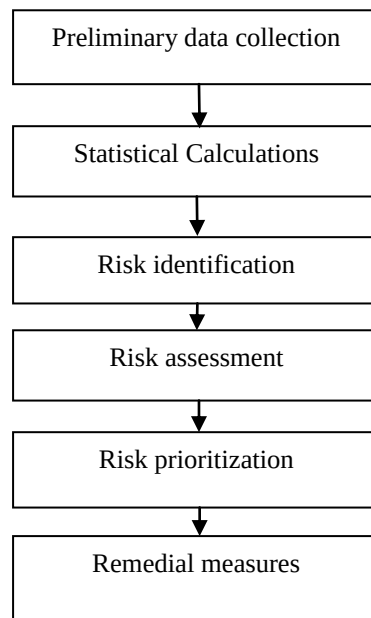


Figure 1. Methodology

III. DATA COLLECTION

The compressive strength test results of M20 and M25 Grade concretes were collected. 25 samples from each grade were considered for the evaluation. From the collected data, the statistical parameters (mean, standard deviation, upper control limit and lower control limit) were calculated, and the control charts were plotted using MS Excel.

Figure.1 depicts the control chart of M20 Grade concrete. 25 concrete samples were selected for the study. Each of these samples were casted on different days. It can be seen that one among the 25 went out of the control limit. The reason behind that was found out using FMEA method.

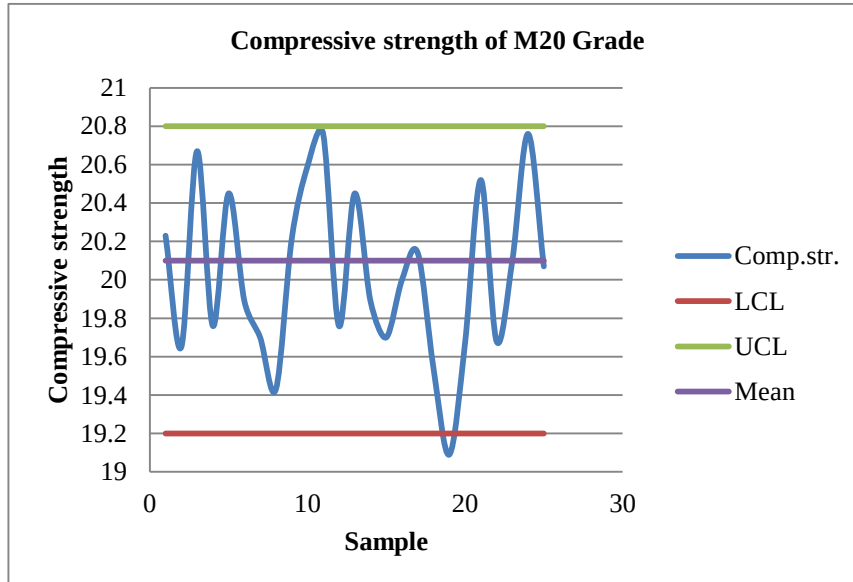


Figure 2. Control chart for M20 Grade concrete

Figure 2 depicts the control chart for M 25 Grade concrete. From the figure, it was found that none of the samples went out of the control limit. Hence risk assessment was not done for this grade.

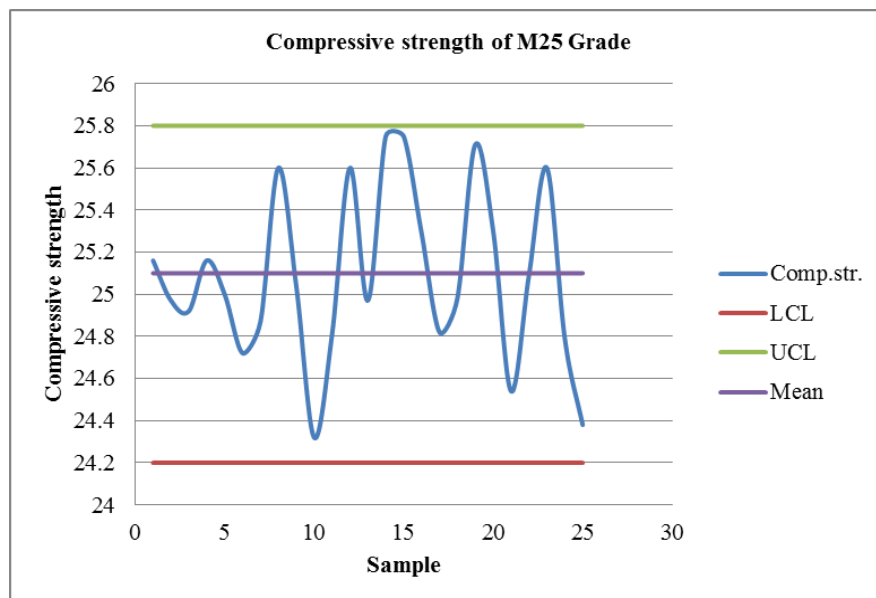


Figure 3. Control chart for M 25 Grade concrete

For M 20 Grade concrete, risk analysis was done using the standard checklist for Ready Mixed Concrete, and was analysed using FMECA method.

Risk prioritization was done using Analytical Network Process method. For the first objective, the factors which affect the failure are material, process and equipments.

Table 1. FMECA Risk Assessment

Mode of failure	Cause of Failure	Effect of failure	Severity	Occurrence	Detection	RPN
Material	Improper grading of cement, sand aggregates and admixtures.	Compressive strength, Reduced workability.	4	4	2	32
Process	Delay in placing the concrete.	Compressive strength, Reduced workability.	4	3	3	36
Equipment	Non-calibrated weighing scale	Compressive strength, Reduced workability.	3	3	3	27

For the second objective, three risks were considered i.e., quality risks, operational risks and safety risks. The number of failure modes considered under each of the risks were 6, 6 and 4 respectively.

Table 2. FMECA Worksheet

Major Risk	Failure Mode	S	O	D	RPN
Quality Risk	Error in testing and inspection.	3	4	3	36
	Varying moisture conditions.	3	3	2	18
	Improper mix design	4	3	3	36
	Inadequate storage of materials.	2	3	4	24
	Inefficient mixers.	3	2	4	24
	Not maintaining proper checklists.	3	4	3	36
Operational Risk	Lack of skilled labour in the plant	4	3	3	36
	Delay due to traffic conditions	3	4	3	36
	Break down of machinery	3	3	3	27
	Difficulty in pumping	2	3	2	12
	Site inaccessibility	4	4	2	32
	Wrongly designed plant layout	3	2	3	18
Safety Risk	Non availability of medical aid.	3	2	2	12
	Site injuries	4	2	3	24
	Improper working conditions	3	3	3	27
	Accidents during transportation	3	3	3	27

IV. RESULTS

The major factor behind the reduction in strength was the delay in placing the concrete. The Risk Priority Number obtained was the highest for the above mentioned factor. Among the identified risks, five modes of failure exhibited same value of RPN. The failure modes were error in testing and inspection, improper mix design, not maintaining proper checklists, lack of skilled labour and delay due to traffic conditions. Inorder to prioritize the above, Analytical Network Process method was adopted. Prioritization is done on the basis of normal weights. The inconsistency analysis was performed and the final ranking of the alternatives was obtained. Based on normalized and ideal weights of the alternatives, the priority ranking was done. The priority ranking obtained is as shown below:

Table 3. Final ranking of alternatives.

Alternatives	Normal weight	Ideal weight	Ranking
Delay due to traffic conditions.	0.4732	1.0000	I
Error in testing and inspection.	0.2392	0.4979	II
Improper mix design.	0.1603	0.3345	III
Lack of skilled labor in the plant.	0.0942	0.1941	IV
Not maintaining proper checklists.	0.0786	0.1546	V

4.1. Issues and recommendations

Issues	Recommendations
Delay due to traffic conditions	Using GPS and maps to choose the less traffic route.
Error in testing and inspection	Grading and material testing should be done under the supervision of an experienced concrete technologist.
Improper mix design	The mix proportions shall be selected to ensure the workability and strength of fresh and hardened concrete respectively.
Lack of skilled labour in the plant	All personnel concerned with production and delivery shall have received training appropriate to their duties.
Calibration and weighing equipment inaccuracy.	Calibration of equipment should be done at every 5000 m ³ of concrete production or every month, whichever comes first.
Inadequate sampling of concrete.	At least four samples of the delivered concrete should be tested.

V. CONCLUSIONS

In the current study, the risk factors involved in the readymix concrete was identified, assessed and prioritized. The most critical risk associated with the readymix concrete was found to be the reduction in compressive strength due to delay in the delivery of concrete. The current study is limited to a single Readymix plant. The work can be extended by considering multiple plants in different areas and also for a wide variety of concrete mixes. Future research can also be done with respect to the proportion of admixtures used, its cost as well as the impact. Also, a comparative study between site mixed and ready mixed concrete could be made.

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