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Analyzing and Evaluating the Risks of Ready-Mix Concrete Production in the Pune Region

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Abstract - The most widelyused type is concrete well-known material utilized in building and it is frequently thought to be the foremost cost-effective, strong, and long-lasting material. India's ready-mix concrete (RMC) industry is expanding at a rapid pace. This industry is exposed to risk in various concrete production processes, and it is critical to handle these risks for the industry to realize credibility and customer confidence, still on have expected profit margins. Statistical internal control proves to be the foremost important tool in ensuring concrete of desired quality so as to realize effective productivity a shot is formed during this work to spot the foremost critical failure mode within the production of concrete employing a risk assessment model and therefore the Failure Mode and Effective Analysis (FMEA) technique. The twenty-eight days characteristics cube compressive strengths on the assorted grades of concrete along with extensive information about assembly process and therefore the risks related to the assembly of RMC being collected from the active RMC sites in and around Pune region. The risks are quantified using the questionnaire survey with use of FMEA technique with the chance priority number, the failure mode within the production process is identified, like irregular grading, testing equipment problems, design variations, all of which were important factors to watch Corrective actions are investigated during this study to correct critical failures within the concrete production process.

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INTRODUCTION

Concrete is the versatile in construction materials. It does not exist as a standalone construction material because it is product of a spread of other components like cement, crushed stones, fine aggregate, and water. In step with the Indian Standard Code of Practice (IS 4926), Ready Mixed Concrete is defined as concrete supplied at the work site or into the purchaser's vehicle during a plastic state that needs notreatment deposited in the location where

it will be set and harden. As it is more environmentally friendly, ready-mix concrete is chosen over site mix concrete. It is a solution to the clumsy and time-consuming production of concrete on building sites. It gives solutions to unique consumer problems, ensures customer satisfaction, and ensures consistent quality. It also removes the need to store materials needed within the assembly of concrete on job sites. RMC is already a mature industry in both Europe and also the United States. The application of RMC is becoming increasingly popular in India. RMC is in high demand in both housing and infrastructure projects. This has had a major impact on the RMC sector in India. RMC was first employed in India in 1950 when Bhakra Nangal and Koyna dams were being built. RMC began operations in Pune in 1991, but due to a variety of setbacks and issues, the plant did not last long and was shut down. Two RMC units were established in Mumbai in 1993 to commercially sell RMC to projects where it was installed.

Risk management is a crucial part of any industrial management system. Risk management at production plants and delivery sites is expected of operation managers on RMC plants in European countries. Risk management at RMC plants in India is rarely given the attention it deserves. Risk management is an essential component of any industrial management system. In European countries, there is a greater knowledge and understanding of the importance of hazards and risk management strategies. Operations managers on RMC plants in European countries are likely to be involved in risk management at production and delivery sites. Risk management at RMC is undervalued in India. According to information acquired from various RMC facilities in India, including Mumbai, Pune, and Bangalore, a regular and proper risk management technique is not applied in the Indian RMC business. The RMC industry in India will not achieve reliability or consumer confidence unless the risks are appropriately managed, and profit margins will suffer as a result. As a result, in the RMC business, there

is a requirement for a proper and efficient risk assessment technique.

The risk connected with the manufacture of concrete must be assessed on a regular basis, and the failure mechanism during the production phase must be identified. In this paper, a study is conducted with the aid of statistical quality assurance programs, which are an important tool for improving quality and productivity in a variety of projects. It is necessary to determine the most effective risk factors for quality control in the concrete manufacturing process and to provide a model with quality controlfor ready-mix concrete (RMC).

LITERATURE REVIEW

In order to discover any research gaps in the field of concrete technologies, a literature review was conducted by referring to various national and international journals. Each paper's synopsis is provided below.

Jyoti Trivedi, Chakradhar Iyunni (April 2015), “FMEA Risk Management Technique for Quality Control of RMC production”. As per this paper, Concrete is the most extensively adopted material for construction and is frequently regarded as the most cost-effective and long-lasting. Statistical quality control (SQC) this application is an important tool because it can be utilized to use to ensure that concrete produced is of desired quality for effective improvements in quality and productivity of infrastructure projects. Whatever the major failure mode occurred in the production of Ready Mixed Concrete (RMC) FMEA is a term in identifying these failures of various grades (M20, M25, M30). This approach to evaluate risk factors for potential failure modes in the concrete production process and to take corrective measures for improvement.The outcomes of the risk priority number indicate a failure of a process in termsof grading issues and material testing prior to use in the mixing process, both of which were important factors to monitor for quality control. The study's goal is to use the failure mode effect analysis (FMEA) tool to identify effective risk factors for the concrete production process for quality control, and to propose a concept of quality controlfor ready-mix concrete (RMC). Engineers will be able to use this model to identify failures in on-process concrete production. The current study was limited to plants with RMC in and around Ahmadabad, but more research could be done for other RMC plants in Gujarat. To ensure the quality of ready-mix concrete and to improve RMC production, it can be continued by considering durability, density as a quality parameter, as well as compressive strength. The most effective tool for RMC production quality assurance was found to be the quality control chart. The quality pattern predicted by the control chart from plants 3 and 2 was within the set limits. Plant-1's quality pattern, on the contrary, was exceeding the control limits. Plant-3 was thus subjected to the FMEA technique. For various concrete grades from three different RMC plants, the Minitab software was used to generate Stewart control charts, and the 12th sample out of 39 samples crossed the upper control limit (UCL) –39.71 for M25 grade concrete for RMC-plant-1.

Vijay Baheti, D. Bhosale (2015). In the construction industry,SQC is a useful instrument for ensuring that concrete meets the specified quality standards. In the construction industry, concrete is the most widely used and widely accepted material. SQC is a useful instrument for ensuring that concrete meets the specified quality standards. In India, the ready-mix concrete business is expanding at a rapid pace. Quality control charts are useful for monitoring RMC’s quality during the process of production.The use of statistical quality control charts aids in the monitoring of during the production process at the RMC plant, the concrete quality was superb. The rigorous identification and evaluation of primary failure modes, as well as the effective handling of the results, is critical to the success of ready-mix concrete manufacturing for concrete in various grades (M20, M25, M30, M40). The Failure Mode and Effective Analysis technique is used in this paper to determine the various failure modes in the RMC production process. The different aspects in the manufacturing process, such as mix design of various grades, material grading, process and testing equipment, will aid in showing risk priority number to monitor concrete quality control.

Hanumant P. Naiknavare, Swati D. Deshpande, Rajesh D. Padhye, (May 2016), “Model Chart of Quality Control Process for Ready Mixed Concrete Plants”. In order to make certain that the concrete is of the correct quality, quality control must be done throughout the entire process, from raw material reception to delivery at the site. As a result, when considering the use of RMC, it is critical to check that the RMC supplier has implemented a quality assurance procedure. Quality control is the process where entities assess the overall quality variables throughout the production process. At the RMC factory, a quality assurance system should be implemented. The RMC Quality Assurance Program is broken into three parts: forward control, immediate control, and retrospective control. RMC manufacturers should have laboratory facilities to conduct the necessary tests to assure quality control at all stages of concrete production. This document offers a typical RMC plant model that must be implemented for quality control. The Company strictly regulates the ingredient’s quality through rigorous testing, employs stringent controls on process parameters, monitors critical qualities of fresh and hardened concrete, and employs the well-known Cusec technique to detect any changes in the properties of concrete. All of these efforts result in uniform and ensured concrete quality for clients. In contrast,typical site-mixed concrete, there is limited control over input material’s quality,ingredient’s batching, concrete mixing, resulting in poor, non-uniform, and inconsistent concrete quality. Customers who use RMC are not bound to acquire and store cement, aggregates,

sand, water, and admixtures on-site. This not only reduces the amount of space required on building sites, but it also reduces the work required customer's responsibility to buy various supplies, assure their correct storage, and periodically verify their quality standards.

Vipin V. Munot, Ashish P. Waghmare, (Dec 2014), "Compressive strength of Ready Mixed Concrete Using Soft Computing Techniques"Concrete compressive strength is a significant, and maybe the most important, mechanical property that is typically tested after a conventional curing period of 28 days. The ready mix concrete's twenty eight days compressive strength was evaluated utilising a feed forward back propagation neural network, Fuzzy Logic, and Adaptive Neuro Fuzzy Inference System (ANFIS) modelling in this study. Data for ready-mixed concretes (RMC) were gathered from the RMC batching plant. For various input scenarios, many models have been constructed. The compressive strength was modelled based on five variables, and each parameter's impact on networks for Artificial Neural Network (ANN), Fuzzy Logic, and ANFIS models were investigated. Soft computing is a new discipline that combines fuzzy logic, neural computing, evolutionary computation, machine learning, and probabilistic reasoning. Soft computing approaches offer a vast number of applications due to their high learning capacity, cognitive ability, and tolerance for ambiguity and imprecision. Soft computing techniques, in general, mirror human reasoning more closely than traditional techniques, which are primarily based on traditional logical systems include sentential, predicate logic,or depend significantly on a computer's mathematical capabilities.

Goutam Dutta, Debasis Sarkar (May 2015), "Design and Applications of Risk adjusted Cumulative Sum (RACUSUM) for online strength monitoring of ready mixed concrete".

In this study, an effort was made to create and implement a new CUSUM technique for the RMC sector that addresses the risks involved and connected with RMC production. This method is known as Risk Adjusted CUSUM (RACUSUM). The cumulative sum (CUSUM) approach is a powerful statistical process control tool for monitoring the quality of ready-mixed concrete (RMC) during the manufacturing methodology. The term "online quality monitoring" refers to the monitoring of concrete quality at the RMC plant during the manufacturing process. The 28-day characteristic cube compressive strengths of various concrete grades, as well as thorough information about the manufacturing process and the hazards it entails RMC manufacture, were collected from active facilities in and around Ahmadabad and Delhi. A likelihood-based scoring approach is used to quantify the hazards. Finally, a risk adjusted CUSUM model is created by superimposing the predicted risks' weighted scores on the standard CUSUM plot. This model is a more useful and realistic option for determining RMC strength.

METHODOLOGY OF WORK

Extensive literature survey is carried out at the starting of the research work for identifying various factors affecting the concrete production process at the RMC plant. For project analysis Concrete data is collected from different three RMC plants which are situated at Bavdhan, Baner and Manjari. Compressive Strength is of M20, M25, M30 grade of concrete is calculated. For each plant. Afterwards, the Failure Mode and Effects Analysis technique is to be used and remedial actions are to identified.

DATA ANALYSYS

In this project, FMEA method is used. The RMC plants with moderate to major effects on the operation of the plant's production process are chosen for the risk assessment technique based on the study's findings questionnaire survey. Five plants around the pune region are considered for the study and severity is measured in quantitative manner.

The mix design of various concrete grades is collected from the Bavdhan Plant.

Fig 1 RMC Plant

The statistical parameters were collected from data and it is shown in below table;

Table 1: Statistical parameters

SR. NO	RMC PLANTS	GRADE OF CONCRETE	MEAN	STANDARD DEVIATION	UCL	LCL
1	RMC PLANT 1	M20	25.07	3.39	35.24	14.9
		M25	30.20	2.89	38.9	21.5
		M30	33.84	2.48	41.27	26.4
2	RMC PLANT 2	M25	32.86	2.59	38.04	26.38
3	RMC PLANT 3	M20	22.99	1.05	26.15	19.83
		M25	28.58	1.35	32.61	24.54
		M30	33.55	1.135	36.955	30.15

CONCLUSION

In order to upgrade the concrete production in RMC plant with respect to quality, the grading of material should be done properly including proper sieve analysis and also material should be examined before taken into mix design.In general, with proper material and process management with quality and expertise knowledge helps the critical risk in production of concrete in RMC plant can be minimized. It minimizes the labour cost as well as site supervising cost.

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