International Journal of Engineering and Basic Sciences
Volume 01, Issue 01, July 2025
www.ijebs.com

Forensic View to Structure Failure Analysis

S Satyendra
Department of Civil Engineering, MB University, Tirupati
[1]Corresponding Author: claramsu@gmail.com

To Cite this Article
Satyendra, "Forensic View to Structure Failure Analysis", International Journal of Engineering and Basic Sciences, Vol. 01, Issue 01, July 2025, pp:09-11.

Abstract*: It is crucial to investigate the failure of the structures. In addition to being required by law or professional standards, the failure case study is also vital for learning lessons. It is now feasible to identify the underlying reason why different architectures fail thanks to the development of ideas and technology in numerous interdisciplinary scientific fields. One example of an interdisciplinary science is forensic engineering. This paper conducts an interdisciplinary investigation and systematic study of structure failure analysis from the perspective of forensic science. The National Crime Record Bureau (NCRB) reports that a large number of instances include structural problems; as a result, the crimes are investigated through chemical analysis of different construction components, such as steel, concrete, mortar, cement, etc. For these building materials, a methodical chemical analysis process is conducted, and the results are ultimately turned in to the court. In order to support the causes of the failure, this paper discusses the need of chemical analysis for cement and its different mix products.*

Keywords*: Concrete, Forensic Engineering, Structure Failures, Failure Investigation, Chemical Analysis*

I. Introduction

The study of structural breakdowns and their causes has developed into a busy area of professional practice where specialists are hired to look into the reasons of malfunctions, in addition to offering technical support to identify the underlying reason. the parties engaged in the resulting claims' lawsuit. Forensic engineers work in an adversarial field because almost all structural flaws and failures result in disputes, claims for damages, and legal entanglements. As such, in addition to their technical expertise, forensic engineers must possess at least a basic understanding of the pertinent legal procedures and be able to collaborate with the judiciary and claimants [1].

II. Structure Failures

A structure does not always collapse as a result of failure. It may render a structure inadequate or unusable. It might even result in secondary negative consequences [2]. Damage, fatalities, or even danger to humans: Formwork collapse during the pouring of concrete. Punching shear failure in concrete floors with flat slabs Collapse of a trench, 0n a damp floor, trip and fall. Structural failure can take the form of a "non-conformity with design expectations," a "catastrophic collapse," or a "poor performance." While poor performance or so-called serviceability issues are typically the result of anomalous deterioration, excessive deformation, and distress indicators, collapse is typically ascribed to insufficient strength and/or stability. The unacceptable discrepancy between expected and actual performance can be summed up as failure.

III. Forensic Engineering

Every time a building fails, the cause is discovered, allowing the investigator to determine why it failed. In addition to the legal and professional. In addition to identifying the reason of failure, it is imperative that lessons be learnt from it so that future designers, builders, or fabricators can steer clear of the failed structure's flaws and create safer substitutes. A major catastrophe shouldn't arise from this [3]. The capacity to develop a cost-effective load-bearing scheme in compliance with a set of "rules" is a fundamental requirement for structural design. Required by building codes, for a low cost of design" [4]. The designer typically considers a variety of design concepts before beginning the design process. The designer then uses an iterative approach and reducing performance assumptions to create a single design from a number of feasible options, balancing a number of conflicting considerations like cost, appropriate performance, and physical limitations. Therefore, design is a synthesis process that makes use of

assumptions about likely loads, structural behavior, and material capability. attributes [4]. These cautious presumptions have been established throughout time to create effective and generally secure institutions. It would be utterly inefficient and time-consuming to build structures by trying to accurately forecast the loads they will support, their behavior, and their material qualities. Furthermore, considering the unknowns surrounding the structure's construction and the loads it will support, it is dubious to really try to estimate these parameters with a high degree of precision throughout the design phase. As a result, managing these unknowns—rather than researching them—is a crucial component of the design process. It goes without saying that this process is crucial to the design of new structures, but it also serves a variety of other crucial functions in the overall reaction to a structural breakdown.

For instance, even in the absence of legal action, an engineering design solution can be necessary to address non-catastrophic defects and return the structure to its original intended performance. These characteristics make an engineer who frequently applies the design process seem like the best person to identify the root cause of failure. Even though the engineer may have design experience related to the structure under consideration, an analysis of several important parts of the design process reveals the reasons why challenges persist. The forensic procedure of gathering data, formulating theories of failure, comparing each theory to the data gathered, and finding the most likely reason for failure is an analytical process as opposed to a synthesis one. Noon (2000) [5] explains how the forensic approach is applied: First, meticulous and in-depth observations are made. A working hypothesis is then developed to explain the observations in light of the data. The working hypothesis's capacity for prediction is next tested through experiments or further observations. Many of the drawbacks of using a design process alone are avoided with this method. The process's goal is to determine what caused the failure, and rather than simplifying presumptions, the approach is motivated by deciding whether to accept or reject a failure hypothesis based on particular facts and widely recognized technical standards. In other words, rather than forecasting how the structure would have behaved based on the design process, the forensic method depends on comprehending how the structure really behaved.

IV. Chemical Analysis

In forensic science labs, analyzing and estimating the many sample types taken from the failure site calls for a high degree of knowledge and proficiency. In the labs, the forensic experts are analyzing these compounds chemically using a variety of techniques. The chemical analysis methods for concrete, mortar, and cement is covered in length in this chapter [1]. When taking a sample from a cement bag, it is important to take note of and incorporate the information printed on the bag as well as any other markings. In the letter of forwarding. To prevent exposure to moisture, a 1-kilogram sample of cement should be sent in an airtight plastic jar if one is available, or it should be safely wrapped in a polythene bag before being wrapped in brown paper. The process outlined in the Indian Standard Procedures for Random Sampling is followed for doing the sampling. When several cement-containing bags have identical labels on the packaging and seem to be identical, under these situations. It is necessary to group. Each group should have roughly the same number of bags, and 20% of the sample from each group, weighing 1 kilogram (in an airtight plastic jar), will be taken out and sent for examination. Fill an empty matchbox with a thick cement slurry made from around one part cement to one part water. The cement solidifies. The After a day, performance is evaluated simply by taking out the matchbox and using your fingers to feel the cement's approximate strength. If the block breaks readily, the setting property is considered bad. The performance is considered good if the block does not break when fingers are used.

V. Results and Discussion

Together with the proportion of acid insoluble, calcium oxide, and silica data, the preliminary tests such as the Thymolphthalein, Heat, and Performance tests can permit a report to be written about the percentage of cement that contains non-cementitious material and cement that is acid insoluble. When stone powder is used for adulteration, the amount of acid insoluble material for the adulteration % is higher; however, when lime or another material is used for adulteration, the quantity of calcium oxide is higher and the amount of acid insoluble is lower. The silica content can be utilized to determine the suitable cement percentage. The EDTA titration yielded a recovery of 99 percent and relative standard deviations of 0.44 percent.

VI. Conclusion

Devoted and sensitive staff with experience in structural engineering are needed to identify the underlying cause or explanation for a structure's failure. Engineering for forensic purposes. One may readily support the exact cause of the failure by doing a chemical analysis of the samples taken from the location of the structure's failure. We may conclude from the study's consecutive execution that cement is a complex combination and that testing it is a challenging undertaking. In In a forensic context, it is necessary to confirm whether the sample contains cement and,

if so, what proportion of cement it contains. The ratio of cement to sand and cement to aggregate is crucial in the case of mortar and concrete; for this reason, sample selection is crucial. Lastly, the failure may have been caused by a discrepancy between the cement content as determined by the above approach and the requirements set out by the applicable codes.

References

[1] John Diesel, Survey research on structural engineering on bridges and roads", Bridges Structures, December, Vol 5(2), 2020, 110-123.

[2] Mohan reddy, krishna mohan and sarath kumar, Forensic Engineering in Structural Design and Construction, *CD Preprints of Structural Engineers World Congress*, 13-22, July, 2018, Delhi

[3] Sean P. Brady, Role of the Forensic Process in Investigating Structural Failure, *Journal of Performance of Constructed Facilities IEEE*, 2017 Forum, 2-6.

[4] Bell, G. R., Engineering Investigating of Structural Failures, in R. T. Ratay (Ed.), *Forensic Structural Engineering Handbook*, 6 (New York: McGraw-Hill, 2000) 6.1, 6.11.

[5] F Max Savio, M Sasi Kumar. "An Effective Control Technique for an Impedance Source Inverter Based Wind Energy System". 2012 IEEE International Conference on Emerging Trends in Electrical Engineering and Energy Management (ICETEEEM-2012)

[6] Sasikumar M and Chenthur Pandian S. "Characteristics Study of ZSI For PMSG Based Wind Energy Conversion Systems". Journal of Electrical Engineering (JEE). ISSN: 1582-4594.