

Forensic Engineering Investigation on a Collapsed School Building Involved Multiple Deaths: A Real Case Report

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Abstract

Forensic crime scene investigators need to have the basic knowledge of science, engineering and medicine fitted for legal or public argumentation. Only an experienced forensic crime scene investigator can handle such cases and to arrive a conclusion for the presentation in the legal system. Forensic engineering investigation is multi-disciplinary process for investigating and reporting the cause of engineering problems which may have legal ramifications. Building collapse becomes a major threat to the society and people lost the confident on constructors and government. The professionals involved in the construction, viz. engineers, builders and contractors are under severe scrutiny about their role and responsibilities in the collapses. The municipal and corporation authorities have been approving for building constructions such as apartments, schools, colleges and many others. Irrespective of town or villages, construction industry, sometimes has been operating in a chaotic manner due to inadequate legislative building codes or violating building codes. The causes of building collapse ranges from substandard building materials to corruption. The present crime scene case study investigated a collapsed school building forensically the causes of elementary school building collapse, led to the death of 5 children and many sustained injuries, the incident occurred in India, as investigated by the author and identified the cause. The author presented his testimony in the court of law and Honourable Judge accepted the forensic findings and the case ended with conviction.

Keywords: Forensic engineering, building collapse, scene investigation, elementary school, multiple deaths, India.

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INTRODUCTION

Forensic crime scene investigators need to have the basic knowledge of science, engineering and medicine fitted for legal or public argumentation. Only an experienced forensic crime scene investigator can handle such cases and arrive a conclusion for the presentation in the legal system [1]. Forensic Engineering is a specialized discipline, which is relatively new and unfamiliar field to the public and even to some investigators¹. It is the application of engineering science to the investigation of failure or performance problem and mainly concerned with the link between engineering at law, whether civil or criminal [2].

The boundary between science and engineering is diffuse, as an engineer who designs car engines accordingly scientist investigates flame propagation in compressed gases, despite the fact their work might well be linked [3]. People have constructed

buildings and other structures since prehistory. Building construction materials have been changing from perishable materials like leaves, branches, animal hides to more durable natural materials such as clay, stones, timber, and finally synthetic materials, such as brick, concrete, plastics and metals used [4]. In order to compensate the lack of enough space, permanent building structure are advancing from horizontal development to a vertical one. Building construction comes with loss of materials, health and even lives in developing countries [5].

The aim of any investigator is to find out the cause of collapse and failure in a particular material, component, product or structure. The present study is a crime scene investigation, wherein a classroom building collapsed in the daytime and five schoolchildren, studying fourth standard died in the spot itself and many sustained minor and severe injuries. The police officers immediately arrived the spot and case was registered in Tiruppuvanam police station, Tamilnadu,

South India and the service of forensic crime scene investigator was requisitioned to assist the investigation. The author, then forensic crime investigator rushed the spot and examined the school buildings and damaged buildings.

EXAMINATION OF COLLAPSED SCHOOL BUILDING BLOCK

On arrival of the forensic investigator, the Inspector of police briefed the incident and stated that there was howling wind with drizzling rain while the classes were ongoing and suddenly this building block collapsed. The fire department staff arrived the scene and with the help of public, five dead bodies of the students have been recovered under rubble. After the

police inquest, the dead bodies were sent to mortuary for autopsy examination and sent thirty seven injured to the government hospital for treatment.

Figure-1 presents the scene sketch showing the collapsed school building block of the school and nearby building. The collapsed building block was located on the eastern side of the highway, running north - south direction. It is a National Highways, NH 49 in southern India, traversed coast-to-coast linking Kochi in Kerala state with Rameswaram in Tamilnadu state, India. On the southern side of this collapsed building, there was a "building block" with classrooms without any damage.

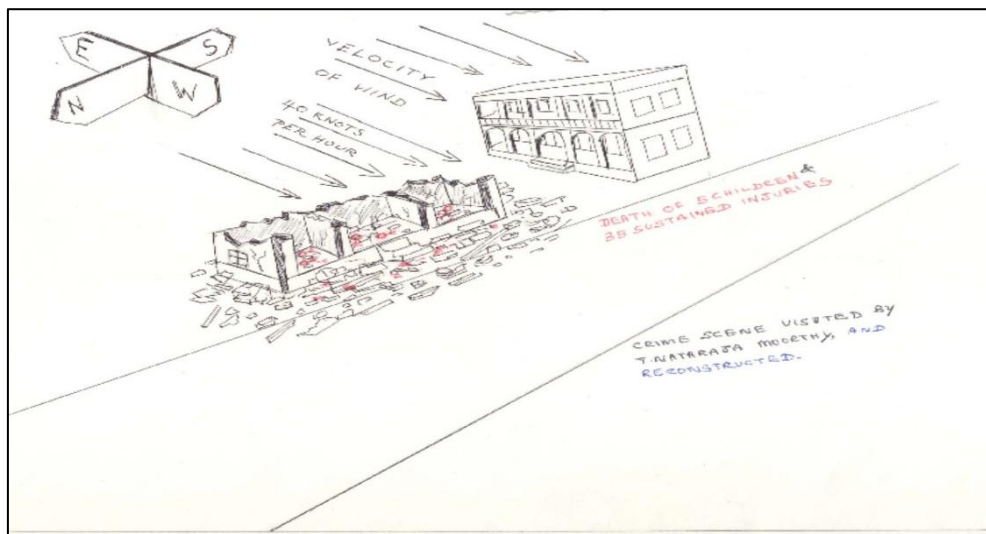


Fig-1: Sketch showing the collapsed school building block and intact building block near the high ways

The building had bonded brickwork walls. The building block used in the masonry walls was solid clay brick. The roof of the building totally collapsed with partial sidewalls. On thorough examination of the scene, I observed that the roof area collapsed and fallen towards the main road, western side of the building, as if pushed from east to west. It is a brick masonry construction, and the walls were built by placing bricks in mortar in a systematic manner. Mortar works as the glue to hold everything in the structure together. When physically examined the mortar in different collapsed areas and found easily brittle. The strength of brick masonry depends on the compressive strength of brick and mortar used. Primarily brick masonry is used as a load bearing walls to carry vertical load.

The blood stained articles in the spot, control blood samples during autopsy were collected and preserved for forensic laboratory analysis. Similarly, the concentrate and mortar samples, valuable physical evidence in various collapsed areas were collected and sent all the samples to forensic science laboratory and civil engineering laboratory, Government engineering college, Madurai, India. I have also discussed with the Head of civil engineering department.

RESULT AND DISCUSSION

As a forensic investigator, I have contacted the Government Metrological Department and ascertained the wind direction as well as velocity at the time of building collapse. They reported that the velocity of wind was 40 knots/hr. i.e. 74.08 km/ hour, from east to west direction. In addition, reports from civil engineering laboratory and forensic science laboratory showed that the cement-soil composition was improper and hence the weak wall unable to withstand the wind speed and collapsed. At the same time, similar school block present in the southern side of the building block was intact without any damage of building. Based on the above findings, the forensic scene investigator/ the author submitted a crime scene report to the police officer with a copy marked to the court. The police investigator arrested the contractor who built this collapsed building, prosecuted, and cited the author as expert witness, who presented his testimony in the court before Honourable Judge and the scientific testimony was accepted in the court and finally the case ended with conviction.

The nationally recognized U.S building code, such as the Unified Building Code (UBC) and the Building Officials and Code Administration (BOCA) code require that building be able to withstand certain minimum wind speeds without damage occurring to the roof or structure [6]. The minimum wind speed threshold required by most codes is around 135 km/hr. However, in the present case study, the wind speed was 74.08 km/hr at the time of collapse. Unfortunately, many buildings do not comply with building code standards for wind resistance. Building collapse occurs all over the world, caused by manmade or natural factors. The natural factors are mudflow, flood, landslide and human error ranging from design, construction method, building materials etc. [7, 8]. Building collapse occurs when the building could not withstand its weight (dead load) and/or the pressure imposed on it [9]. There seems to be incline in building collapse over the years because of corruption from every quarters of the stakeholders and wrong construction methodology [10]. In United States, forensic engineers are investigating the fire and explosion crime scenes to identify the origin and causes, while in Asian countries like India, forensic scientists are handling such investigations [11, 12]. During my crime scene investigation career, I used to discuss with engineers, medical officers and other experts, before submit my crime scene report.

CONCLUSION

The present building collapse investigation case report scientifically proved the cause of school building block collapse led to death of innocent school children, based on physical evidence and interpretation. It is purely on manmade error and not because of natural calamity, as informed by the contractor. In future, heavy punishment is warranted for committing manmade error, since most of the building works are carried without technical audit on the work done.

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REFERENCES

1. Nataraja Moorthy, T. (2009). Forensic engineering in crime scene investigation. International Conference on Science, Technology, Innovation

- and sustainable wellbeing. Mahasarkham University, Thailand, 965-970.
2. Mansur, H., S., Obinna, I., & Takar, K. (2020). Analysis of causes of building collapse: System thinking approach. *Jordan Journal of Civil Engineering*. 14(2), 188-197.
3. Jay, A. S., Pekka, J. S., & Geoferry, C. K. (2000). *Encyclopedia of Forensic Sciences*. Academic Press, California, USA.
4. Ayedun, C. A., Durodola, O. D., & Akinjaare, O. A. (2011). Anempirical ascertainment of the causes of building failure and collapse in Nigeria. *Mediterranean Journal of Social Sciences*. 3(1): 313-322.
5. Al-Khaburi, S., & Amouldi, O. (2018). Analysis of accident causes at construction sites in Oman. *Jordan Journal of Civil Engineering*. 12(2): 279-294.
6. Kevin, Z. T. (1999). Structural optimization for seismic leads: Pseudo-static, response spectra and time history. *Computational Mechanics in Structural Engineering*. 12(2):325-326.
7. Dimuna, K. (2010). Incessant incidents of building collapse in Nigeria: A challenge to stakeholders. *Global Journal of Research Engineering*. 75-84.
8. Hamma, A. M., Iheukwumere, O., & Kouider, T. (2020) Analysis of causes of building collapse: system thinking approach. *Jordan Journal of Civil Engineering*. 14(2): 188-197.
9. Omenihu, F. C., Onundi, L. O., & Alkali, M. A. (2016). An analysis of building collapse in Nigeria (1971-2016): Challangs for stakeholders. *University of Maiduguri Annals Borneo*. 26: 113-140.
10. Flaga, K. (2000). Advances in material applied in civil engineering. *Journal of Material Processing Technology*. 173-183.
11. Nataraja Moorthy, T.(2008) Forensic aspects of fire and explosion investigation. International Forensic Symposium. Udayana University, Bali, Indonesia.
12. Nataraja Moorthy, T., Mohmad Hadzri, Y., Reynold, V., Mohmad Taman, M., & Sivabalan, N. (2014). A Study into the Relationship between Crater Parameters and Quantities of Explosives in the Scenes of IED Explosions. *Malaysian Journal of Forensic Sciences: Mission Statement*, 5(1), 17-25.