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Case Report

A Near Miss Accident after Medium Intensity Earthquake in a Public Hospital

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Abstract: A "near miss" is an unexpected incident related to system or process failure which could have caused damage, but didn't. Near-miss provides insight into both potential failure points and weaknesses in the management system. They can be a powerful tool to reduce risk and improve system reliability. We present a near-miss case which occurred in the Central Sterile Services Department of a public hospital after a medium intensity earthquake. Although immediate cause of this near miss accident was a natural hazard (earthquake) but Steam acted as a risk factor for making ceiling of affected site softened and breakable. This incident will prompt hospitals to document and follow safety guidelines for public, patient and staff safety. Although the earthquakes are sudden and unexpected yet if safety measures are taken both before and after an earthquake, many adverse and catastrophic events can be prevented.
Keywords: Near Miss, Earthquake, Safety, CSSD, Engineering Hazard, Natural Hazard

INTRODUCTION

A "near miss" refers to an unexpected incident related to system or process failure which could have caused damage, but didn't. A near miss also called potential adverse event should be reported at the earliest so that action can be taken without delay. If delay is likely, the matter can be reported on telephone, followed by writing [1].

Investigations of many serious accidents in different fields have revealed that before every serious accident, a large number of related prior incidents occurred with limited impact and an even larger number of related incidents happened that resulted in no loss or damage. Near-misses provide insight into both potential failure points and weaknesses in the management system itself. Therefore, they can be a powerful tool to reduce risk and improve system reliability. A comprehensive Near Miss Management System includes several important implementation steps, such as identification of near-misses, disclosure and reporting, prioritization and classification, distribution of the information, analysis of causes, solution identification, dissemination of actions and knowledge, resolution, and closure of the case. Successful implementation of an NMMS requires strong management ownership, participation and reporting of as many incidents as possible, and use of quantitative tools to identify weaknesses and to improve the system [2].

Modern hospitals rely heavily upon engineering services for their efficient functioning. Any dislocation of these services, even for a short period, leads to hazardous situations and even loss of life. The planning of engineering services for a hospital building on account of its importance to society thus has to be based on zero failure concepts. Engineering hazard occur due to faulty building structures and poor maintenance of building. At the time of hospital planning certain factors e,g. physical environment, materials and building elements, hospital installations and general standards of concern if neglected will result in to engineering hazards especially in areas with natural hazards like earthquake and cyclone. For example, a high rise building for a hospital is not a welcome proposition in the context of natural disasters like high wind and seismic forces. Engineering hazards are mainly due to faulty planning and unsound structure to withstand natural calamities like cyclones, floods, earthquakes, high winds and man-made disasters like blasts. To reduce the chances of occurrence of engineering hazards, especially in high seismic zones, it is essential to chalk out a preventive maintenance programme and also appoint a hospital safety committee to look in to its strict implementation. The design of a hospital building should be such that it shall be serviceable under normal loading, including fire and floods. The building should survive minor emergency loading on account of earth

quake, high wind and blast without any sign of distress. The building should survive extremely severe emergency loading of a near miss blast, major earthquake with visible damage without collapse. A faulty system that too in a vulnerable region invariably permits or compounds the harm and should be the focus of improvement [3]. We present one such event in Central Sterile Supplies Department (CSSD) of a public hospital with the aim of identification and correction of the loopholes in the system to ensure safety of staff, patients, their attendants and equipment. Jammu and Kashmir being located in a high seismic zone and the public importance of hospital building prompted us to report this near-miss case.

METHODOLOGY

As medium intensity earthquake (Richter scale six) occurred on November 7, 2011, a near miss accident occurred when the plaster of ceiling fell on one of the worktables in packing zone of CSSD of a public hospital in Srinagar, Kashmir. A newly recruited CSSD Technician busy with packing surgical instruments for autoclaving was just working on the adjacent table. He was frightened and rushed to adjacent issue counter where his colleague was present. Fortunately, there was no damage by falling of plaster in the CSSD to any person working there or the equipment. Another fact is that the incident occurred in night shift in an area where only few people work with machinery and no public or patients are present there otherwise the picture would have been different had it occurred in a busy area where a large number of people are present, for example, patient care area. The incident was reported to hospital administrator immediately who framed a team of experts and instructed structural engineer and his team to make hazard vulnerability analysis and risk assessment and go for necessary repairs required. Jammu and Kashmir falls in Seismic Zone five [5]. A major earth quake in Jammu and Kashmir in 2005 left thousands of people dead and more than one lack injured across the line of control [6]. This fact prompted us to report this case.

Initially a preliminary hazard analysis (PAH) was carried out to identify potential hazards and to check the fundamental elements of safety system in the hospital. After preliminary hazard analysis, a team which included hospital administrator, structural engineer, safety engineer, security officer and an employee staff representative, was framed to investigate this near mishap to determine how to prevent recurrence of hazardous events in future [7]. The team conducted survey of the site to collect data regarding this near miss accident. They conducted survey of structure and sent samples of cement plaster material from both affected site as well as from control sites to a test laboratory for analysis. Control sites were selected from same structure except that steam gas was not used at control sites like manifold and AC plant. They interviewed workers regarding the event and safety measures taken. They inspected CSSD and other areas of hospital where steam gas is used besides CSSD, to checklist the equipments used, safety measures taken and vulnerability of hazards. They also checked records e.g. regarding maintenance, training, plans of workplace, workflow diagrams and took photographs. Finally the team gave their recommendations.

Hazard vulnerability analysis and risk assessment was done as per predetermined guidelines as follows.

Risk = hazard severity x likelihood of occurrence [8].

Hazard severity and likelihood of occurrence are categorized on the basis of three point scale: High, Medium and Low.

High category is condition likely to cause: Permanent disability, Loss of life, Loss of body parts, Extensive loss of plant or equipment or dangerous occurrence.

Medium category is condition likely to cause: Temporary disability with lost time of at least half day, Damage to plant, equipment or building which results in disruption of normal activities.

Low category is condition which results in minor/trivial injury or illness which involves some lost time of at least one hour but no more than half day, No injury or illness but results in some minor non disruptive damage to plant, equipment or building.

Likelihood of occurrence categories is again high, medium and low.

High frequency: A disaster event occurs more often than once every 5 years e.g., once every 2 years.

Medium frequency: A disaster event occurs less often than once every 5 years, but more often than once every 30 years e.g., once every 12 years.

Low frequency: A disaster event occurs less often than once every 30 years e.g., once every 50 years [9].

RESULTS

Hazard analysis

Preliminary hazard analysis report summarized that although the immediate cause of this near miss accident was a natural hazard (earthquake) but there were also contributory factors for example, there was not any safety system in place or any documented safety policy displayed in the department of CSSD which would guide workers to take safety precautions in case of accidents or emergencies. Safety devices were not present in the department nor was there any arrangement of safety training for workers in the organization. There is no any emergency alarm system in place so that in case accident or emergency arises that can be communicated immediately to other workers

and sites. Although there is management supervision of various levels to supervise the work but there is no any safety committee or safety management system in place.

The investigation revealed that building was constructed as per norms so far as local seismic codes are concerned and the building material was also of right quality. There was no any deviation of norms so far as structural analysis was concerned. But the cement plaster from affected site was softened and brittle and this was attributed to continuous exposure of ceiling of affected site to steam gas continuously for more than twenty years since commissioning of CSSD for steam autoclave. Steam caused dampness of cement plaster which lead to softening of concrete structure. There was an old autoclave which is leaking steam and this steam acted as a risk factor for making ceiling of affected site softened and breakable. During interview investigating team came to know that two similar incidents had occurred at the same location previously as well but these were not reported and investigated. While no one was injured in previous incidents but some new employees were unaware of the incidents until this fresh event occurred. No maintenance work has been undertaken since commissioning of CSSD. The process control was inadequate and deficient in all the areas of organization and need reinforcement so that in future during any emergency or accident impact will be less.

DISCUSSION

India has about 56.3 percent of total area amounting to 3.3 million square kilometers vulnerable to seismic activity of varying intensity. The earthquake prone areas have witnessed over 33 major earth quakes in the country. During last 80 years India has lost thousands of lives due to earthquakes. Earth quake induced ground movement subjects a building to a three dimensional dynamic force. The quantum of horizontal seismic force at each level is a function of mass, height, and the coefficient of seismicity. The importance of hospital building has been considered by the Indian standards for earth quake loading in(Indian Standards)"IS": 1893-1962 by introducing an important factor for assessment of coefficient of seismicity (alfa).The Indian Standards recommend a length to width ratio not exceeding three [3].

Seismic codes are unique to a particular region or country. They take into account the local seismology, accepted level of seismic risk, building typologies, and materials and methods used in construction. India also has its own seismic codes. The first formal seismic code in India, namely IS 1893, was published in 1962 and then revised from time to time. IS 1893 is the main code that provides the seismic zone map and specifies seismic design force. This force depends on the mass and seismic coefficient of the structure; the latter in turn depends on properties like seismic zone in which structure lies, importance of the structure, its stiffness, the soil on which it rests, and its ductility [4, 13].

Jammu and Kashmir falls in seismic zone five, making it highly vulnerable to earthquakes [5]. A major earth quake in Jammu and Kashmir in 2005 left thousands of people dead and more than one lac injured across the line of control [6]. Low intensity earthquakes are common feature in Jammu and Kashmir. During August 2011, five tremors of moderate intensity were recorded in the valley with magnitude ranging between 4.8 to 5.1. A study by a prominent US based seismologist has warned that Kashmir valley is likely to be hit by an earthquake of largest ever magnitude. But the study does not specify any particular time frame [10]. The Hazard Vulnerability Analysis of this incident reveals that the incident has potential of being a hazard of high severity because of its being a dangerous occurrence and also of high frequency.

In the case under discussion, although the immediate cause of near miss accident was a natural hazard (earthquake) but there were also contributory factors for example (a) there was not any safety system in place or any documented safety policy displayed in the department of CSSD which would guide workers to take safety precautions in case of accidents or emergencies. (b) Safety devices were not present in the department nor was there any arrangement of safety training for workers in the organization. (c) There is no any emergency alarm system in place so that in case accident or emergency arises that can be communicated immediately to other workers and sites. (d) There is no any safety committee or safety management system in place. (e) The study revealed that building was constructed as per norms so far as local seismic codes are concerned and the building material was also of right quality. (f) Steam gas acted as a risk factor for making ceiling of affected site softened and breakable.

Safety measures and mitigation measures should be taken both before and after earth quake to prevent or lessen the earth quake hazards. Mitigation measure includes activities that prevent an emergency, reduce the chance of an emergency happening, or lessen the damaging effects of unavoidable emergencies. Investing in preventive mitigation steps such as repairing deep plaster cracks in ceilings and foundations, anchoring overhead lighting fixtures to the ceiling and following local seismic building standards, will help reduce the impact of earthquakes in the future [11]. Buildings could be either strengthened or relocated in areas where a risk of an earthquake is lessened. In poorer countries, cheaper, but effective building designs could be created, which could at least withstand the worse effects of an earthquake. Through International cooperation, nations in the deadly quake zone, could build a basic emergency procedure network. Technology and expertise is presently available to create more effective and low cost solutions to protecting areas, which are

susceptible to earthquakes. One thing is clear we have to live with nature, and nature includes the real possibility of deadly earthquakes, and tsunamis. By accepting this is a natural part of life in the quake zone, perhaps we can move ahead from just helping the victims of a quake, to actually protecting them from the effects of a future earthquake [12].

All the incidents including hazards and near misses must be reported as per procedure. For any near miss with the potential for a serious injury should be reported as per Incident Reporting Procedures and should be investigated.

CONCLUSION AND RECOMMENDATIONS

Although the Earthquakes are sudden and unexpected, if proactive safety measures are taken both before and after an earthquake, many adverse events and even deaths can be prevented. It is hoped that this incident will prompt hospital administrators to document and follow safety guidelines for public, patient and staff safety. The investigating team recommended that hazards that normally are not found in the workplace may be the result of natural causes like earthquakes or due to unforeseen circumstances or events. One must become aware of possible emergencies and plan the best way of risk reduction measures including legislation and law enforcement for implementation of risk reduction measures for which there should be political will.

Some of the measures include: survey of possible emergencies, planning actions to reduce impact on the workplace, employee information and training, emergency drills as needed, hazard mapping of the area to identify safe locations, recording and reporting of near miss/adverse incidents should be statutory, safety review and learning from near misses and accidents, safety monitoring and identifying the occurrence of accidents and incidents, provision for updating the plan and its policies, adequate screening and warning systems should be established, proper maintenance and upkeep of buildings and equipment, safety and hazard control management information system should be in place and legislation and law enforcement for implementation of risk reduction measures.

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