SCHOOL SAFETY INITIATIVES- NEED FOR MORE ACTIVE INTERVENTION FROM ENGINEERING COMMUNITY

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ABSTRACT :

Right to education being a fundamental right, it is incumbent on the State to ensure a safe environment for education. In spite of that, numerous schools have collapsed or been badly damaged in recent earthquakes in India and elsewhere.

Most school safety programs are presently being driven by social scientists and non-government organizations (NGOs). There are numerous projects and activities conducted by such agencies forrisk reduction. Such activities go a long way in sensitizing teachers and students. However, the need for structural strengthening of school buildings for seismic resistance does not appear to be top priority with NGOs and social scientists. This may be possibly due to lack of appreciation of the importance of safe structures or reluctance to deal with issues that are outside their domain area. The state is supportive of such non-structural initiatives as they demand much smaller investment and yield high returns in terms of outreach and visibility. In the interim, school buildings continue to collapse in earthquakes.

The challenge lies in the engineering community communicating and articulating that school safety programs are of not much value if the building is unsafe in the first place. The paper reviews the present imbalance in school safety programs in India through the Gujarat state example and suggests interventions to ensure that the school safety programs account for seismic upgradation of existing schools and seismic resistance of new schools.

KEYWORDS: School, safety, engineering, seismic, strengthening

1. BACKGROUND

Many brick masonry school buildings collapsed in the 1933 Long Beach Earthquake in California. The damage in this earthquake brought to the forefront the vulnerability of school buildings and was a precursor to school seismic safety initiatives of the future. However, despite 75 years having elapsed since, the status of seismic safety of school buildings in many countries across the world is not encouraging. Numerous schools have collapsed or been badly damaged in recent earthquakes, the latest being the Wenchuan earthquake where over 10000 school children are reported to have died. Table 1.1 list a few of the earthquakes in which school buildings have collapsed or been damaged.

2. VULNERABILITY OF SCHOOL BUILDINGS

From Table 1.1 it is fairly evident that schools and school children have been more vulnerable in earthquakes than any other single segment of society. This fact is borne out across continents, transcending divides of level of development and wealth of countries. There are many reasons for this.

- Typically, school projects are not usually large projects and do not attract top quality construction companies or structural design engineers. Hence such buildings have a construction quality which may be below average standards.

- Schools have a perennial paucity of funds and there is a tendency to make the money go a longer way by using lower grade materials or less expensive contractors and build one extra room instead which could compromise on building construction quality.

- School projects are often done in phases based on mobilization of funds. Such phase-wise construction leads to many cold joints affecting sometimes the overall integrity of the structure.

- Due to the very nature of schoolrooms, school structures have large spans. This inadvertently causes buildings to be more vulnerable.

- Functional requirements of school buildings drive the building geometry of schools. There are more reentrant corners, diaphragms discontinuities, large spans and heights and cantilevered corridors in school buildings as compared to residential or other public buildings. These features increase the vulnerability of school buildings.

- Primary school education being a mandatory requirement, even generally inaccessible areas are required to have schools. In such areas, schools are built of loose rubble masonry or brickwork with little or no mortar and without any technical support. As was seen in the 2005 Pakistan earthquake, such structures fall like a house of cards killing children under the rubble.

- Most countries where earthquakes have occurred in the past have seismic codes which cover general seismic requirements of buildings. However, there are no special requirements for school buildings in most countries in terms of additional approval requirements, independent design reviews and special testing and inspection checks. *Building codes do not acknowledge the special vulnerability of these buildings despite past history.*

Table 1.1 History of School Collapses in Earthquakes

Earthquake	Year	Type of Damage
Long Beach, CA, USA	1933	Many brick school buildings collapsed.
Helena, MT, USA	1935	High School RC building just been completed two months prior to the earthquake collapsed.
Deep Puget Sound earthquake, USA	1949	Thirty Washington schools, normally serving 10,000 students, were damaged in 1949. Ten of these schools were condemned and permanently closed.
Kern County, Ca, USA	1952	About 20 schools were damaged or destroyed.
Alaska, USA	1964	Government Hill elementary school destroyed
Tangshan, People's Republic of China	1976	Most school buildings in Tangshan were destroyed by the earthquake. More than 2000 students were killed at the dormitory of College Mining Institute,
El Asnam, Algeria	1980	Eight-five school buildings collapsed in the quake.
Mexico City	1985	Many school buildings collapsed in the earthquake.
The Spitak, Armenia	1988	Due to the widespread collapse of schools and schools being in session when the earthquake struck, more children than adults perished.
Loma Prieta, Ca, USA	1989	Destruction of Loma Prieta School
Cariaco, Venezuela	1997	Two school buildings, made of reinforced concrete, collapsed. Other one-storey buildings near the schools were not damaged.
Taiwan	1999	A three-level school collapsed
Marmara earthquake, Turkey	1999	131 schools collapsed.
Bhuj earthquake, India	2001	8000 school rooms destroyed, 42000 school rooms damaged. 25 school children, teachers dead in Ahmedabad school collapse.
San Giuliano di Puglia, Italy	2002	Twenty-six children died when an earthquake measuring 5.4 on the Richter scale hit their village causing their school to collapse, but leaving all other buildings standing.
Ankara, Turkey	2003	Boarding school in Çeltiksuyu collapsed killing 85 students and one teacher. 115 were rescued. More than 90 percent of the schools in the area were impacted by the quake, leaving thousands without facilities to continue their education.
Bachu County, China	2003	Approximately 900 classrooms collapsed.
Great Sumatra Earthquake and Indian Ocean Tsunami	2004	Tsunami destroyed 750 schools in Indonesia and damaged 2,135 more. 150,000 students without schools. 51 schools destroyed in Sri Lanka, 44 Maldives, 30 Thailand.
Bam, Iran	2005	67 of 131 schools collapsed, the remaining were heavily damaged. 32,843 students were affected.
Pakistan	2005	More than 8,000 out of 9,000 schools were either destroyed or damaged beyond repair. Over 17,000 school-age children perished in the collapsed schools, approximately 23 percent of the total deaths and over 20,000 more suffered serious injuries.
Wenchuan earthquake	2008	More than 7000 school rooms collapsed and more than 10,000 school children dead

3.0 CURRENT SCHOOL SAFETY INITIATIVES

There are numerous school safety initiatives being carried out presently across the world. During non-disaster times, funding for such initiatives is hard to come by. Hence most of the school safety initiatives are spear-headed by schools or non-governmental organizations (NGOs) with support from local bodies, governments and other stakeholders such as United Nations bodies.

Many of the recent school safety programs operate under the Hyogo Framework for Action 2005-2015.

3.1 Hyogo Framework For Action 2005-2010

Briefly the framework focuses on following:

1. Ensure that disaster risk reduction (DRR) is a national and a local priority with a strong institutional basis for implementation
2. Identify, assess and monitor disaster risks and enhance early warning
3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels
4. Reduce the underlying risk factors
5. Strengthen disaster preparedness for effective response at all levels

As can be seen above, there is scant mention about safety of school buildings in the Hyogo Framework and no clear objective of making it mandatory to have school buildings safe for earthquakes within a time schedule. School safety initiatives typically cover multiple hazards and concentrate on reducing vulnerability through non-structural options. Vulnerability to some of the hazards such as fire, floods can be greatly reduced by sensitization, awareness and training. Additionally, these are easier to implement than making structural interventions for building safety. Such an approach for school safety is understandable when a community has a paucity of funds and in the absence of adequate resources to tackle the issue of safe buildings the community, prepares its members for emergency operations. However, an earthquake does not allow the time required for effective use of risk reduction training and sensitization to save lives. Only safe buildings can do so.

The scenario could however be different after a devastating earthquake. There is access to funds. The funds have several claimants to it. It is for the State to define its priorities. For some reason retrofit of school buildings is not high on its priority. Typically in the relief and reconstruction stage, destroyed school buildings are reconstructed, damaged school buildings are hastily repaired (as against retrofitted) and those that do not show any external damage are promptly forgotten. Hence an opportunity to embark on a long-term school safety program which focuses on safety of built environment at schools is lost. Unfortunately NGOs are so acclimatized to doing awareness and sensitization projects that they inadvertently divert the program of school safety to these issues and major structural safety issues are missed out.

4.0 REVIEW OF GUJARAT SCHOOL SAFETY INITIATIVES

4.1 Gujarat School Safety Initiatives

The 2001 Bhuj earthquake in the state of Gujarat, India caused destruction of 8000 school rooms and damage of 42000 school rooms. Under the Gujarat Emergency Earthquake Reconstruction Program (GEERP), about 12000 new classrooms were constructed and about 42000 school rooms repaired. The GEERP did not include seismic retrofit of damaged rooms nor evaluation of apparently undamaged schools. Almost all Gujarat districts lie in zones of moderate to very high seismic hazard.

In the aftermath of the earthquake, initiatives for school safety were developed. The most significant was the Gujarat School Safety Initiative - Jan 2004 to Dec 2006. The initiative comprised of two parts: Gujarat School

Safety Initiative I (GSSI I) and Gujarat School Safety Initiative II (GSSI II). The project was funded by World Bank and UNDP and its conceptualisation and detailing were done through partnership of the state owned Gujarat State Disaster Management Authority (GSDMA) and a non-government organization (NGO). The implementation of the initiative was by the NGO.

The objectives of GSSI-I were to develop and validate school safety approaches, to integrate school children's concerns in Disaster Management, to involve school managements and teachers through preparations of school Disaster Management plans.

The GSSI-I conducted school based disaster management activities in 152 schools covering 100,000 students and 1500 teachers, prepared school based Disaster Management plans for all 152 schools, conducted earthquake drills in 80 schools attended by around 40,000 students and 640 teachers, assessed non structural mitigation in all schools, opened school safety clubs in all the project schools

4.1.2 GSSI – II

The objectives of GSSI-II were creation of cadre of master trainers and district pool of trained teachers and development of text books for grade 7 to 9. Under GSSI-II, a workshop was held for sensitization of education department officials, teacher administrators, teachers, students, and 86 master trainers were trained in 4 regional four day workshops and draft text books for classes 7 to 9 were prepared incorporating basics of Disaster Management

4.1.3 Comments on GSSI I and II

While every objective of the initiatives was laudable, it may be pointed out that even though the initiative was taken up in the backdrop of Bhuj 2001 earthquake, it did not address the earthquake problem holistically nor discuss the fundamental reason why buildings collapse and children die in earthquakes. So instead of discussing the core issue of seismic safety of buildings which requires large resources in terms of technical expertise for evaluation of structures and even larger funds for seismic retrofit, the initiative addressed issues of drills, sensitization, teacher training which are low in capital costs. (This despite the fact that there were large funds allocated to seismic retrofit.)

4.1.4 *International Conference On School Safety, 2007 Ahmedabad*

It was the chief minister of Gujarat who announced a program for structural audit of all school buildings by 2010 in an international conference on school safety in 2007 at the conclusion of the GSSI project. Interestingly, the conference had 150 participants from 17 nations of which less than 10 participants were engineers or architects.

5.0 ROLE OF ENGINEERING COMMUNITY IN SCHOOL SAFETY PROGRAMS

The engineering community has a pivotal role to play in seismic school safety. Unfortunately, the education, typical temperament and exposure of engineers do not make them the strongest advocates for issues they passionately believe in. Engineers normally do not possess the communicative skills of social scientists and NGOs and their point of view gets easily drowned in the cacophony of discussions when the two meet. And yet theirs is one voice which needs to be heard loud and clear if society needs to reduce the deaths and damage in schools during earthquakes.

Engineering community could, as a start, try to look at school safety as their social responsibility. This is not a novel idea and in professions such as law it is not uncommon to find the best lawyers donating time to fight pro bono for public interest litigations or for doctors to be involved in free medical camps. Corporate social responsibility has in fact become a buzz phrase of late and it is time that engineers begin to understand their role

in safety of the environment and cease to look at "projects" as those which exist only within the narrow confines of their offices.

Engineers will need to overcome their reluctance to interface with the society at large. If one has to get across issues of structural safety, they will need to reach out directly. This cannot be outsourced to social scientists and NGOs as there is ample evidence of what can go wrong in such a process. It is time engineers take over the agenda of school building safety. State-level engineering bodies form a capacity building program for school buildings safety. There need to be multi-pronged strategies. Some of them are:

- Engineering Associations must champion cause of school safety through popular media. They must establish themselves as a formidable pressure group which, by exposing society to the history of earthquakes in which school buildings have collapsed or been damaged, killing and wounding students and their teachers, generates "perception of risk". Clearly the objective must be to create a "demand" for safe school buildings from within the society.
- The ad hoc international Experts' Group on Earthquake Safety in Schools has made its recommendations to the Organisation for Economic Development and Co-operation for urgent action to establish mandatory national programs for seismic safety of schools and education systems. But there is a missing link in terms of the necessary interface between the OECD and the local communities in the absence of governments taking up the issue. This needs to be established.
- Interface directly with government stakeholders for necessary logistics support but maintain the program as a technical initiative. It is important that engineering community clearly define their scope as being limited to buildings safety and leave the non-structural issues of school safety to NGOs, social scientists and the government.
- Establish links with proactive local communities for school safety. The "families for school seismic safety" is one such group local group in Canada which had formed a formidable pressure group to get their local governments to allocate funds and also independently mobilise funds towards this end.
- Create a helpline which will provide guidance to schools and other stake holders for getting their school buildings assessed and for remedial/retrofit measures subsequently or for seismic structural safety measures for new schools.
- Prepare a monograph of existing single storeyed non-urban school typologies with typical retrofit strategies and prepare a retrofit manual with necessary disclaimers.
- Create an enabling mechanism which allows for engineers to provide technical advise or visits pro-bono or at nominal fee as part of social responsibility.
- Involve the architect community in the task of establishing the necessary communication with schools and develop typologies for rural schools based on local materials, local architecture, school needs and functions and availability or otherwise for customized solutions for the school. For the very large number of rural schools which have little or no access to technical support, a pictorial step-by step handbook for school construction could be prepared clearly outlining all specifications including those for materials, workmanship, building construction drawings with seismic detailing for set room sizes and building configurations, preferable of single storey.
- Lobby for special requirements for schools beyond a certain size such as peer review, testing and inspection.

6.0 CONCLUSION

There is a serious need for the engineering community to be proactive to reduce the vulnerability of school buildings in earthquakes. School safety programs involving government stakeholders, NGOs and social scientists will not have desired long-term benefits if they do not have strong technical underpinning. The problem is not that of adequacy of expertise; it is more about engineering community being ready to rise above their normal inclination to take a backseat and be respondents and instead take a proactive role. Without them taking over the issue of school building safety program, the number of lives and classrooms lost in earthquakes will continue to grow unabated.

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