



Safer Schools, Resilient Communities

A Comparative Assessment
of School Safety after the
2015 Nepal Earthquakes

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Safer Schools, Resilient Communities: A Comparative Assessment of School Safety after the 2015 Nepal (Gorkha) Earthquakes



EXECUTIVE SUMMARY

BACKGROUND. Across Nepal, more than 8.5 million students attend pre-school through vocational school. As they learn, they sit in well over 82,000 school buildings at more than 35,000 school campuses. Approximately 75 percent of these campuses are public schools, built by the Ministry of Education and development partners.

Previous school safety studies carried out in the country estimated that approximately 89 percent of school buildings in Nepal are made of load-bearing masonry, a building type that is particularly vulnerable to earthquakes if no earthquake-resistant techniques are incorporated. In hilly regions more than 50 percent are the most vulnerable masonry type – rubble stone construction. A 2011 school vulnerability assessment estimated that because of Nepal's seismic risk, more than 49,000 schools needed to be retrofitted and another 12,000 needed demolition and reconstruction.¹ This was before the 2015 Gorkha Earthquake and aftershocks struck.

Nepal has undertaken efforts to address the structural vulnerability of schools. School safety retrofit and reconstruction efforts had reached about 160 schools and training had reached almost 700 masons in the Kathmandu valley – only some of these in the area affected by the April and May 2015 earthquakes. Innovative public education and mason training programs over the past two decades have included mason training, community outreach, and shake-table demonstrations as part of training and awareness programs.

On April 25, 2015, a massive M7.6 earthquake struck Western and Central Nepal, with an equally devastating aftershock of M6.8 striking in Central Nepal on May 12, 2015, as measured by Nepal's National Seismic Centre. According to

the Government of Nepal Ministry of Education, the Gorkha Earthquake caused more than 27,000 classrooms to be fully destroyed by these events, and more than 26,000 classrooms to be partially destroyed. The cost of education sector recovery is estimated at almost \$415m USD.²

PURPOSE & APPROACH. The effects of the earthquake on Nepal's educational infrastructure offer a rare opportunity to study whether previous interventions to improve building practices, combined with community engagement, have resulted in safer schools and communities. The primary questions we considered were:

- How did damage at purportedly disaster-resistant public school buildings, whether retrofitted or newly constructed, compare to damage of typical public school buildings?
- What affect, if any, did community engagement around safer schools have on risk awareness and community construction practices?

In Bhaktapur, Kathmandu, Rasuwa, and Sindupalchowk, we compared three, geographically proximal public schools:

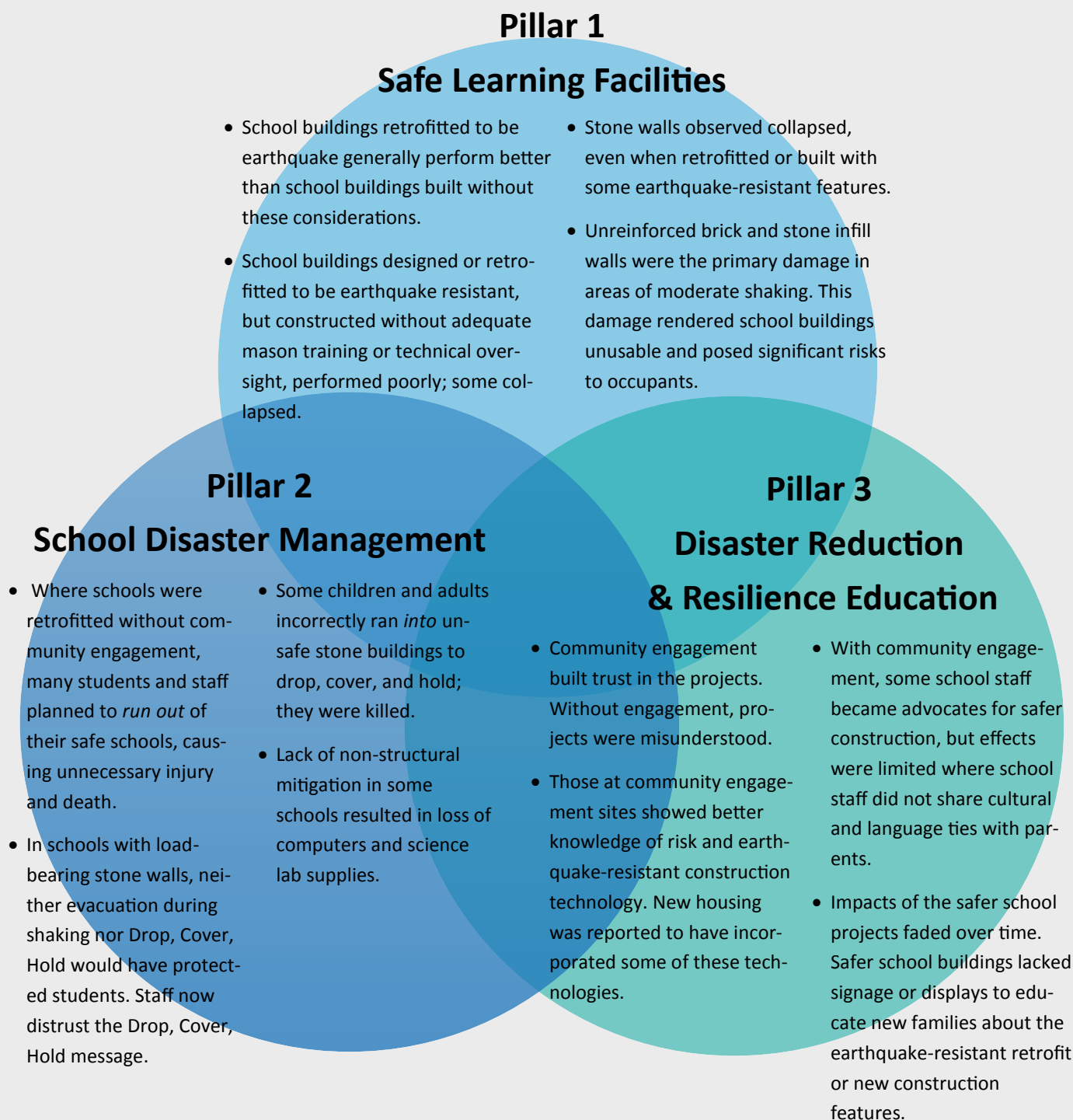
- **No intervention** — typical construction
- **Technical intervention only**— disaster-resistant design or retrofit
- **Technical and social intervention** — disaster-resistant design or retrofit, combined with community engagement

At each site, we conducted interviews with school staff and management committees, parents, and lead masons involved in school construction. We also visually assessed school buildings and 15-20 nearby houses for damage.

KEY FINDINGS

‘Comprehensive School Safety,’ a framework adopted by United Nations agencies and humanitarian organisations in the education sector, seeks to ensure children and school personnel are not killed or injured in schools, and that educational continuity is assured.

It rests on three overlapping pillars of safe learning facilities, school disaster management, and risk reduction and resilience education. Field observations are reported in relationship to these three pillars.



RECOMMENDATION HIGHLIGHTS

All children deserve safe, accessible and culturally appropriate school buildings — regardless of class, creed, gender or ability. A community-based approach to safer school construction seeks to achieve the twin goals of safer schools and more resilient communities. It treats school construction as a community learning opportunity to better under-

stand risks, collectively commit to safety, and to learn and apply strategies for safer construction.

A community-based approach builds community capacity in tandem with the laying of foundations and erecting of classroom walls. It also prepares communities to be knowledgeable caretakers of schools, able to maintain the physical safety of the structures and the culture of safety among those who use it.



MOBILISATION

- Media campaign to promote the idea that schools and housing can be built earthquake-safe
- Mobile technical resource centres in each district to showcase safer construction technology
- and provide technical assistance to school management committees and communities

PLANNING

- Review and revise school template designs
- Train district engineers in retrofit options
- Limit use of rubble-stone walls in school construction until clear guidance, training and oversight is in place
- Retrofit unsupported brick and stone infill walls

DESIGN

- Ensure all independently-funded schools are reviewed for safety
- When safe and feasible, choose construction materials familiar to community for better maintenance and technology transfer
- Limit community-level design changes to aspects that will not impact safety

CONSTRUCTION

- Mason training and certification
- Release school construction funds in stages after verification of construction quality
- Construction process videos for better public understanding of good school construction
- Public notice boards and curated site visits for parents and community
- Community checklists for disaster-resistant construction, with robust mechanism for reporting problems

POST-CONSTRUCTION

- Establish school disaster management committees and provide them with regular training and guidance
- Integrate safer community planning and construction into curriculum and school-to-community outreach
- Label school safety features prominently for enduring impact

FIELD RESEARCH APPROACH

METHODS

We selected 12 public schools, in sets of three, across four affected districts. The districts were selected for a range of social environments and earthquake impacts:

- **Bhaktapur.** A peri-urban environment in Kathmandu Valley, on the outskirts of a major district capital and part of the Kathmandu metropolitan region. Experienced moderate shaking intensity; most adobe and brick construction badly damaged. Reinforced concrete construction was generally undamaged or experienced minor cracks.
- **Kathmandu.** Semi-rural small villages at the north border of the Kathmandu Valley, but with close proximity to the capital city. Experienced mild to moderate shaking intensity; most adobe and stone construction was badly damaged. Reinforced concrete construction had minor to moderate cracking.
- **Rasuwa.** Rural and semi-remote villages in the Middle Hills region, several hours from large towns. Moderate to high intensity shaking; most stone construction collapsed.
- **Sindhupalchowk.** Rural villages in the Middle Hills region about an hour from large towns, though road access is variable. Moderate to high intensity shaking; stone construction generally collapsed and some reinforced concrete was badly damaged or collapsed.

Communities surveyed in Bhaktapur and Kathmandu are ethnically diverse. Many families engage in corn, rice, and millet farming, though often mix this with trading and selling or wage labour in the city. Education levels are high, with fierce competition between public schools and an increasing number of private schools catering to families seeking early English language instruction for their children.

Communities surveyed in Rasuwa were predominantly or exclusively *Tamang* indigenous communities, with lower levels of literacy. Children did not speak Nepali when they began school. Apart from farming corn and millet, households supplemented income by sending one or more members to provide support services to trekking companies.

Communities in Sindhupalchowk were ethnically diverse, though *Tamang* typically made up half the population. All survived on subsistence farming, though few households could fully support themselves with the corn, rice, millet, and potatoes they grew. Most households had a member working in a major Nepalese city or abroad in order to meet basic needs.

In each location, we selected three schools in close physical proximity, such that distance from the epicentre and shaking conditions could be considered substantially similar. The public schools selected represented the following cases:

- **Standard construction**, schools built through government funding and oversight using template designs
- **Technical intervention only**, schools built or retrofitted with the specific intent of being earthquake-resistant
- **Technical and social intervention**, schools built or retrofitted as an earthquake-resistant through a process that included substantial community engagement

Our breakout allowed for some comparisons across common schools, but each school site also often provided a diversity of intervention types. Schools typically had several school blocks, each built at different times, with different building technologies and funding sources. School buildings constructed to be earthquake-resistant often sat alongside a school building constructed through the standard process. This diversity allowed for a clear comparison of the two.



Photo: R. Friedman/Risk RED

¹ NSET, ADB, October 2011. *Snapshot Study for School Safety in Nepal*.

² Government of Nepal, Ministry of Education, *Post-Disaster Needs Assessment for the Education Sector*, 10 June 2015.

The selection of schools was facilitated by the National Society for Earthquake Technology-Nepal (NSET)'s database of school locations and retrofit status. From this list, we selected a retrofitted school where NSET had engaged in technical and social intervention within the selected districts.

We then located nearby public schools, typically less than 5 kilometres away. Where possible, we also matched the school enrolment size, generally selecting secondary schools whenever possible since these sites tended to have a higher number of school buildings and, therefore, better comparative potential. The designs for these standard schools were mostly dictated by Ministry of Education (MOE) school design templates, often with the District Education Office (DEO) deciding which design and what funding level would be allocated.

Ministry template designs should, in principle, meet Nepal's National Building Code (NBC) developed in 1994. This code includes seismic design and construction provisions. Some designs have even been developed through international support, specifically for earthquake resistance. However, limited oversight during construction and a design selection based primarily upon cost, not hazard exposure, meant that many of the recently built school buildings lacked sufficient seismic resistance.

We also selected a third school site that was believed to have had some form of technical intervention beyond the standard public school construction process. Some school buildings in this category were retrofitted through the Ministry of Education; others were retrofit or built through support from international donors or non-governmental organisations. At the time of selection, the degree of social intervention accompanying the technical intervention was unknown.

All school retrofits assessed occurred from 2000 to 2014 on schools that had been built in the mid- to late -1990s. Schools purportedly built as earthquake-resistant (school staff were asked whether earthquake resistance was a specific aspect of the design, as described by donors or project implementers) were built in the mid-2000s. Standard schools built without special intervention were from the mid -1990s to late-2000s. All schools built with earthquake resistance or retrofitted were assumed to follow the NBC code provision, although visual assessment and interview with local masons indicate that these provisions were not always followed. All schools were selected for proximity to each

other without knowing the damage the school had experienced.

Each school was visited for a full day of interviews and observations. At each school, we engaged in the following activities:

- **School Management Interviews.** We conducted 2-3 hour interviews at each site with school principals, teachers, and school management committee representatives. In these semi-structured interviews, we asked for details about the local community, the funding and construction management of one to three representative school buildings, and the level of community engagement in the construction of those buildings. We also asked about earthquake damage experienced, use of the school following the earthquake, and risk knowledge and practices around school disaster management.
- **Parent or Community Focus Groups.** We conducted 1.5 hour focus groups with current parents and community members in the school neighbourhood who were aware of the school and school construction process. We asked about the community's experience of the earthquake and their engagement, if any, with the school or other local organisations in disaster preparedness. We asked about their observations of the school construction process and their beliefs about its safety. To understand local knowledge of earthquake safer construction techniques, we asked about their awareness of two dozen construction techniques, based upon NBC guidelines for non-engineered and engineered construction.
- **Masons Interviews.** Where the original masons involved in school construction were available, we interviewed them about the school construction process and their training. We also asked about the earthquake damages they observed in their community and the prevalence of earthquake safer construction techniques used in the local community.
- **Visual Damage Assessment.** We measured and recorded damage of one to three school buildings at each school site.
- **Housing Transect.** We conducted a photo and GPS tagging survey of the closest 20 residential structures immediately surrounding the school. At each, we recorded the building typology, material, and damage state. For areas with extensive collapse, we asked residents about each plot to understand what existed prior to the earthquake, as many homeowners had already removed rubble or reconstructed temporary living spaces of corrugated metal sheeting and bamboo on top of, or integrated with, their collapsed homes.

LIMITATIONS

Our assessment did not explore issues of school safety within the private school sector, which constitutes over 50 percent of schools in the Kathmandu Valley. It did not address schools that had school disaster management interventions without a safer school construction project.

Our findings are based upon an initial, in-depth survey of 12 school sites in four affected districts. While field observations show consistent themes emerging from these twelve sites, experiences in other affected districts and at other sites may differ. Additional phone or in-person surveys, based upon a subset of the issues observed here, would allow for statistical analysis of findings and further deepen understanding about school construction in Nepal.



Photo: R. Friedman/Risk RED

INVESTIGATORS

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Photo: R. Friedman/Risk RED



Photo: B. Pandey/Risk RED

ACRONYMS

CBO— Community-based organisation

INGO — International non-governmental organisation

DEO—District education offices

DOE—Department of Education

MOE—Ministry of Education

NBC — National Building Code

NSET — National Society for Earthquake Technology, Nepal

RC — Reinforced concrete construction

VDC—Village Development Committee

FIELD RESEARCH FINDINGS AND KEY TAKEAWAYS

'Comprehensive School Safety' seeks to ensure children and school personnel are not killed or injured in schools, and that educational continuity is assured. The framework has been adopted by United Nations agencies, many international non-governmental organisations (INGOs) working in the education sector, and the World Bank's Global Facility for Disaster Risk Reduction and Recovery, among others. It rests on three overlapping pillars of 1) Safe Learning Facili-

ties, 2) School Disaster Management, and 3) Risk Reduction and Resilience Education.

Significantly, Pillar 1 involves attention not only to the core concerns in construction, but goes further to include the 'softer' sides -- builder training, and awareness and educational activities that overlap with Pillars 2 and 3. Field observations are reported in relationship to these three pillars.

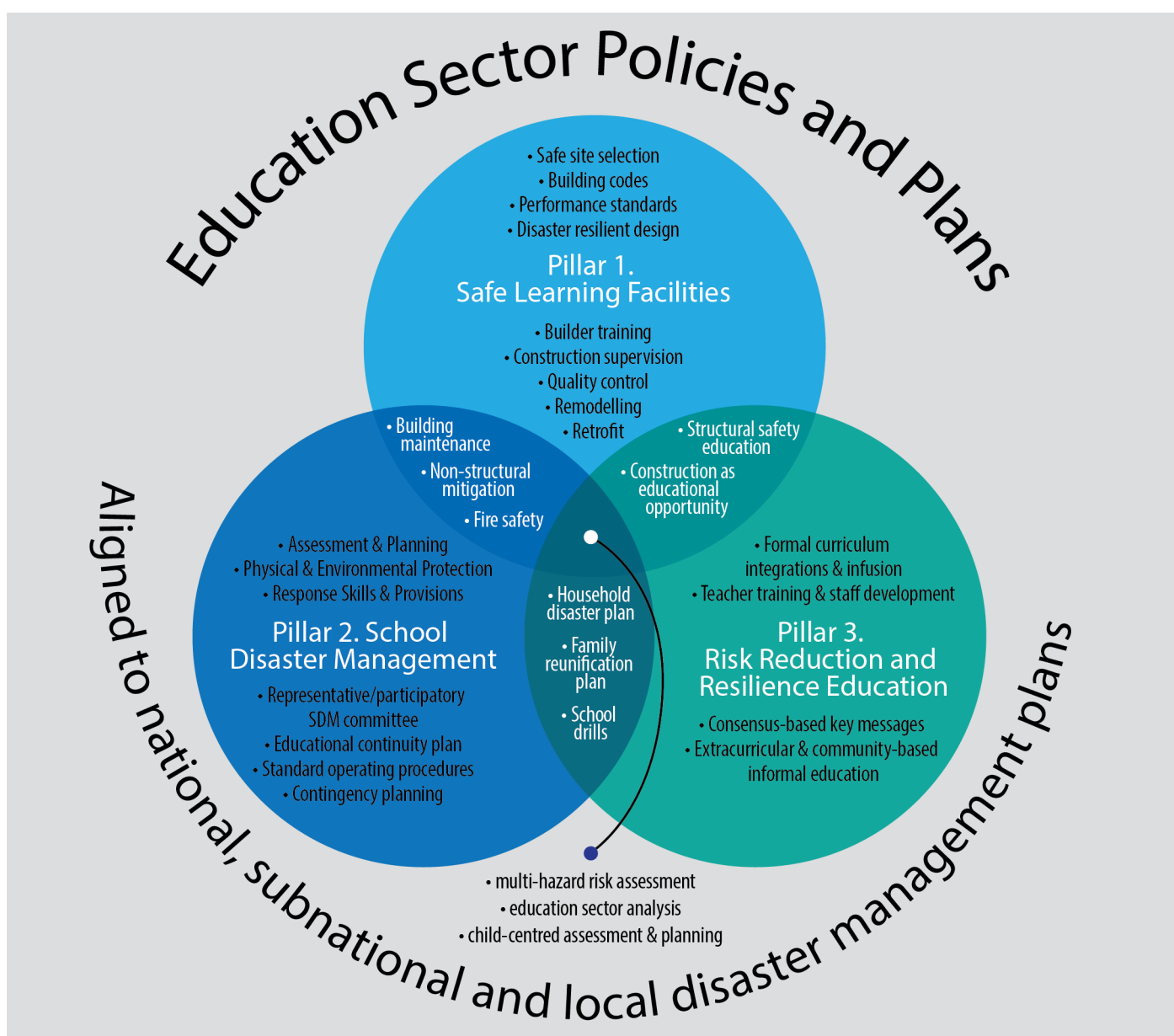


Figure 2. The Comprehensive School Safety Framework aims at bringing child-centred and evidence-based approach to disaster risk reduction in the education sector. The framework has been adopted globally by United Nations agencies, humanitarian organisations, regional networks and others. More details can be found at: <http://preventionweb.net/go/31059>



PILLAR 1

SAFE LEARNING FACILITIES

RATIONALE. At a minimum, school buildings should be designed to save lives. Children have a fundamental right, regardless of the level of economic development in a given country, to access education in a safe and secure environment. Schools constructed safely from the outset represent a wise use of development funds and can contribute to the continuity of education in the aftermath. Repair and replacement of damaged schools wastes previous development efforts and derails future development as infrastructure funds for new construction and maintenance must be diverted towards repair and replacement.

Safe learning facilities involves education authorities, planners, architects, engineers, builders, and school community members in safe site selection, design, construction and maintenance (including safe and continuous access to the facility).

FIELD OBSERVATIONS. Clearly, with over 27,000 classrooms severely damaged, most of the schools in Nepal's affected districts did not meet the basic level of life safety and child protection. Our field observations begin to explain some of the reasons for the damage and to differentiate between standard, retrofitted, and purportedly earthquake-resistant new construction.

Standard Construction. When schools were built through the standard construction process, they generally could not be immediately re-occupied. Some even collapsed, as shown in Table 1.

Reinforced concrete (RC) school construction and metal frame construction surveyed generally had minor or moderate structural damage. However, damage to the infill walls (which engineers often do not regard as 'structural') was often moderate to heavy. These damaged infill walls caused the school buildings to be closed. Stone and brick school buildings constructed through standard processes generally collapsed.



Figure 1. At a school in Kathmandu, two school buildings on the same sight performed very differently. The building on the left, a reinforced concrete frame structure with brick infill walls, was moderately damaged and received a red tag. Its frame joints and infill walls will need to be repaired before the building can be reused for classrooms. The building on the right, an adobe and stone masonry structure, was recently retrofitted with stitch banding. It was undamaged and immediately able to be reopened, despite being made of a weaker building material. The retrofit proved to be successful. Photo: R. Friedman/ Risk RED

Table 1. Observed Damage to Schools Built through the Standard Construction Process

Dist.	School building	Structural system	Wall type	Intervention	Tag ¹	Overall damage
Bhaktapur	101-1	RC Frame	Brick	None, recent engineering graduate designed	Red ²	Infill wall instability renders building unusable until repaired
	101-2	Metal Frame	CMU block	None, template design	Red	Infill wall instability renders building unusable until repaired
	101-3	Metal Frame	CMU block	None, template design	Red	Infill wall instability renders building unusable until repaired
Kathmandu	201-1	RC Frame	Brick	Unclear, INGO designed and funded	Green	none
	202-1	RC Frame	Brick	None, local engineer designed	Red*	Infill wall instability renders building unusable until repaired
	203-2	RC Frame	Brick	Unclear, INGO designed and funded	Red	Moderate damage to frame joints; Infill wall instability
Rasuwa	301-1	RC Frame	Stone/Cement	None, template design	Red	Infill wall instability renders building unusable until repaired
	301-2	Metal Frame	Stone/Mud	None, template design	Red	Collapse, exterior and partition walls
	303-1	RC Frame	Stone/Cement	None, template design	Red*	Infill wall instability renders building unusable until repaired
Sindhupalchowk	401-1	RC Frame	Brick	Unclear, INGO funded, unclear who designed	Red	Heavy, non-ductile failure of joints, collapse of parapets
	401-2	RC Frame	Brick	None, int'l donor funded, design through DDC	Red	Heavy damage, non-ductile failure of joints
	401-4	Metal Frame	Brick	None, template design	Red	Heavy damage and collapse to exterior masonry infill
	402-1	RC Frame	Brick	None, INGO funded, community designed	Red	Infill wall instability renders building unusable until repaired
	402-2	Wall	Stone/Mud	None, INGO funded, community designed	Red	Collapse, complete
	403-2	Metal Frame	Brick	None, template design	Red	Infill wall instability renders building unusable until repaired
	403-3	Metal Frame	Brick	None, template design	Red	Partial infill wall collapse
	403-4	Metal Frame	Brick	None, template design	Red	Partial infill wall collapse
	403-5	RC Frame	Brick	None, int'l donor funded, community designed	Red	Infill wall instability renders building unusable until repaired

¹ Following the Gorkha Earthquake, the Ministry of Education trained its engineering staff to visually inspect schools and assign a red or green tag to each building. A green tag indicated the school was safe enough to be immediately occupied. A red tag meant it could not be. Damage in the red tagged school buildings ranged from infill wall damage to complete collapse of the school building.

² Some parts of building were given red tag where damage was heaviest; undamaged parts were given green tag

Infill Walls. Infill walls of brick or stone are added between columns to form exterior walls or to partition classrooms. During the earthquake, many infill walls cracked where they connected with beams and columns. Others developed more noticeable damage at corners or even diagonal shear cracks.

At the schools observed, the infill walls did not have vertical or horizontal reinforcing steel to support them, a common practice prescribed by international building codes and the NBC. When they cracked, as is expected in an earthquake, they became unstable because of the lack of reinforcing or other means of holding them to the frame.

Cracks in these infill wall, although considered minor damage from a structural engineering perspective, were a serious problem in schools. Teachers and principals would demonstrate by pushing on the cracked walls, causing the walls to visibly move. With the risk that these walls could topple over and crush occupants in future aftershocks or earthquakes, many schools with infill wall damage were



Figure 2. School building 101-1, which experienced only moderate shaking in Bhaktapur, was deemed unsafe for school use because unreinforced partition walls separated from the reinforced concrete frame and became unstable. Damage to unreinforced partition or infill walls can injure or kill students and block exits. The safety of these walls is routinely ignored by engineers and communities alike. Photo: R. Paci-Green/Risk RED

Table 2. Observed Damage to Schools Built or Retrofitted with Earthquake Resistance

Dist.	School building	Structural system	Wall type	Technical intervention	Social intervention	Tag	Damage
Bhaktapur	102-1	Wall	Unreinforced brick	Retrofit: Stitch banding	None	Green	none
	103-1	Wall	Unreinforced brick	Retrofit: Stitch banding	Mason training, onsite technical oversight, community outreach	Green	none
Kathmandu	201-1	Wall	Adobe	Retrofit: Stitch banding	Mason training, onsite technical oversight, community outreach	Green	none
	203-1	RC Frame	Unreinforced brick	Retrofit: Stitch banding	None	Green	none
Rasuwa	302-1	Wall	Brick/Cement	New: Banding and vertical reinforcement	Mason training, onsite technical oversight, community outreach unsuccessful	Green	none
	303-2	Wall	Stone/Mud	Retrofit: Stitch banding in stone	Limited, trained mason sent for two days, INGO engineer inspected construction once	Red	Collapse, complete
Sindhupalchowk	401-3	RC Frame	Unreinforced brick	New: RC ductile design	INGO funds specific design development DUDBC but then modified on site, no mason training, limit gov't inspection	Red	Collapse, complete
	401-CC	Wall	Stone/Mud	New: Banding and vertical reinforcement	Community center on school compound	Red	Collapse
	403-1	Wall	Brick	New: Banding and vertical reinforcement	Mason training, onsite technical oversight, some community outreach limited by civil war	Green	None, hairline cracking

given ‘red tags’ by Ministry of Education inspectors. This seemingly minor damage relegated untold thousands of students and staff to temporary learning spaces and tents.

Two ubiquitous Ministry of Education school template designs performed particularly poorly. The first was a metal frame supporting a corrugated metal roof, a design originally developed by a major bilateral development assistance agency. While the metal frame and roof were undamaged, the communities report that they were told to build exterior walls in whatever local material was available. In moderate to high shaking, these walls partially or completely collapsed and would have killed children unnecessarily had school been in session.

In semi-urban and urban areas, communities built unreinforced brick walls around the frames; in rural areas, they often used stone and mud to build the walls. A review of the design drawings of one of these structures does show detailing for a reinforced concrete lintel band on the top of the walls and reinforcing at wall connections. However, these elements of the design were not observed in any of the six metal frame school blocks we assessed.

The second design, derived from NBC provisions and also featured in masonry guidelines in India, added vertical reinforcing bars at every corner and wall opening within stone and mud mortar walls. In all schools observed with this design, the bars proved completely useless and the stone fell away from the bars. These buildings completely collapsed. We observed wood bands used in some of the schools built with this design, but not others.

Schools with Technical Interventions: School buildings that were said to be designed or retrofitted for earthquake safety generally performed better than other buildings, but not always (See Table 2). In the moderate intensity shaking of the Kathmandu Valley, the four retrofitted schools observed were completely undamaged, even while other school buildings nearby experienced minor or moderate damage.

While the four retrofitted schools in Kathmandu and Bhaktapur were undamaged, we found several lapses in design or construction at one site. At the base of the walls, the masons had created a stitch band beam. However the band was discontinuous on one side of the block; vertical bars came down and poked out of the bottom. On the roof, vertical bars continued up through the ceiling slab and were bent over only a short distance. These ends of the vertical band bars were covered with a small 16-inch patch, leaving only 8 inches for bars to be bent in each direction. The distance was too small to allow the bars to develop their full strength during an earthquake. In a stronger earthquake, the bars would have popped through the small roof patch. More globally, the retrofit addressed the masonry walls of the school only. The retrofit did not jacket and strengthen masonry columns on the second floor balcony or add supports below the masonry columns. Without strengthening, these masonry columns could crumble in a larger earthquake, leaving the overhanging ceiling and floor slabs unsupported and in real danger of collapsing during the earthquake or when students filed out to evacuate.

In the heavier shaking of Rasuwa and Sindhupalchowk Districts, school building performance was most variable. Only



Figure 3. Metal frame template designs are common in rural and remote areas. While the frames were undamaged in the earthquake, the stone and mud mortar walls that used to enclose the school collapsed. These walls were considered non-structural. Communities were allowed to build them with available materials and without reinforcement. The vast majority of the stone walls collapsed down to about half a meter, showering the classroom with large, deadly stones. Brick walls were typically damaged and unstable, but collapsed less often. [Note: Rubble from collapsed stone and brick had already been removed when photos were taken.] Photo: R. Paci-Green/Risk RED



Figure 4. A Ministry of Education template design, which called for vertical rebar to be placed in stone walls, completely collapsed in every block assessed with this design. While now removed, after the earthquake, the classrooms were filled with stone from the collapsed walls. Photo: R. Paci-Green/Risk RED



Figure 5. While a retrofitted school in Kathmandu performed well in this earthquake, retrofit design and construction flaws may lead to unnecessary damage in larger events. In the left photo, vertical bars poke out the bottom of a retrofit band. A horizontal retrofit band at the bottom of the wall is missing on this side of the building. On the roof top, the vertical bars are secured by only small patches of concrete, partially covered in the photo by discarded school benches. The masonry columns supporting the roof overhang were not strengthened in any way and remain unsupported below the balcony overhang. Photo: B. Pandey/Risk RED

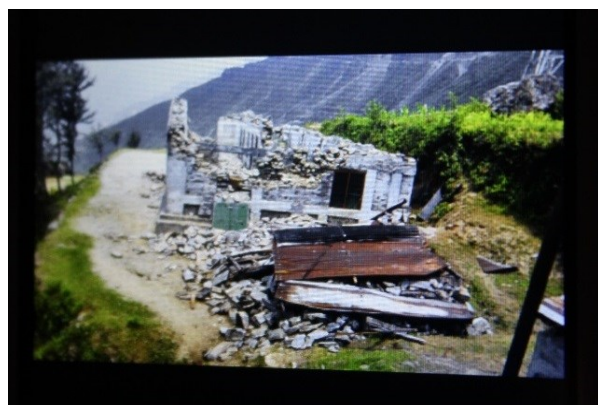


Figure 6. Donor-funded retrofit of a stone and mud mortar school in Rasuwa collapsed in the earthquake, as the principal captured and showed us on his smart phone after retrofit on the left and after the earthquake on the right. The rubble had been removed by the time of the survey. Little training of masons and nearly non-existent technical oversight ensured that when masons struggled to implement the retrofit design, the problems were not caught and rectified. The principal estimates 120 out of 140 students and staff would have died. Photos courtesy of school principal.

some of the supposedly safer schools performed better than similar school buildings nearby.

A retrofit of a rubble stone school in Rasuwa fared particularly poorly – it completely collapsed. The block had been retrofitted by a major INGO using stitch banding technology and the community had been told the school would be safer than any new construction. However, the project included little training and oversight. The donor organisation sent a trained mason to the site for only two days to train local workers, none of whom had professional training as masons. During the middle of the construction process, the donor's engineer came only once, briefly.

The failed retrofit project had even less adaptation to the limitations of the brittle stone building material. Local workers found it impossible to adapt the stitch band retrofitting technique to stone masonry; they simply could not drill through the stone walls to stitch bands together. But, the project implementation had no plan for adjusting the technology or stopping an unsafe solution. The result was a catastrophic collapse. Had technical experts been involved in ongoing community engagement, they may have better understood the challenges of stone retrofit in a remote village and may have modified or abandoned the project for something more likely to be life safe.

Where local masons were appropriately trained AND where trained engineers oversaw the construction practice by very frequent visits or continuous onsite presence, they were completely undamaged. Few signs of poor construction practice were evident. Clearly, the social supports of training and oversight, observed in this research at the sites

where NSET had retrofitted or built a new earthquake-resistant building, are crucial to achieving safer schools in Nepal.

Rubble Stone Construction. Rubble stone construction in schools is a vexing problem. It is a common local material and essentially free; in many mountain regions it is the primary construction material for schools and houses. Yet, to be used in school buildings, it must be at least life safe since attendance is mandatory and safe evacuation of all students during shaking is impossible.

Almost all stone houses completely collapsed in the communities we surveyed. Most schools built with stone and mud mortar infill or load-bearing walls also collapsed, including the retrofitted school described above school. Only when rubble-stone was used with cement mortar and as an infill wall for a reinforced concrete frame school building, did we observe rubble stone that had not partially or completely collapse.

A rubble stone teaching resource centre co-located on a school site provides additional reason for caution. The resource centre had been built with important earthquake-safer construction techniques commonly advised for load-bearing stone and brick construction. The resource centre had a lightweight roof, a reinforced concrete lintel band, and vertical reinforcement in the walls, though it did not appear to have a sill level band or corner stitches. Even with these measures, it collapsed.

The widespread collapse of rubble stone buildings, even in a case where a lintel band and vertical reinforcement had been used, suggests that constructing safely with rubble stone is fraught with difficulties.



Figure 7. This teaching resource centre on school grounds was built with stone and mud mortar. The masons employed earthquake-safety measures, such as a reinforced concrete lintel band and vertical reinforcement in the walls. However, even with these measures, the heavy shaking in Sindhupalchowk caused the stone building to collapse swiftly and completely. It may be difficult to rebuild safe schools out of this brittle material unless alternative technologies are developed, tested and extensive mason training and strict oversight are feasible during construction. Photo: R. Paci-Green/Risk RED

Further research is needed to understand how other rubble stone schools with earthquake-resistant features fared and what technical and social intervention seem to have worked well. However, until further testing or comprehensive field assessment is done, extreme care should be taken in building infill or load-bearing walls with this material in permanent, transitional, or temporary school buildings. Further, even if safer and appropriate technologies for rubble stone are identified, school reconstruction with this material will need to be carefully supported with robust programs for training, oversight and community outreach so that safety is achieved in actuality and communities can trust that these stone buildings will not collapse.

Other Hazards. In the communities surveyed in Rasuwa, seismic hazard was not the only natural hazard risk communities faced. Landslides were frequent and damaging enough that parents and committees understood the hazard and were effective in reducing the risks for their children. Two school management committees stated that their schools had previously been located in active landslide areas. The committees had purchased or received new land and built new school buildings to move their children outside of the risk area. However, even in these new locations, the committees had to terrace the sites because of the steep slope and school buildings had to be built partially on firm ground and partially on the less firm filled soil.

In Sindhupalchowk, one school was also built on a ridge. The ridgetop location may have amplified the earthquake's effects and partially contributed to the heavy damage and collapse experienced. (No study has yet documented ridgetop amplification affects in this earthquake event.) Parents

in this community mentioned building on ridgetops as one of the lessons their older generations discussed when referring to earthquakes from 1934. However, most residents had not personally experienced that event and had not retained the lesson. Much of the town's infrastructure was sited on the ridgetop.

PILLAR 1 KEY TAKEAWAYS

- School buildings retrofitted to be earthquake-resistant generally perform better when coupled with mason training and on-site technical oversight.
- A school retrofit observed, which had been implemented without trained masons and close technical oversight, collapsed.
- Stone walls with mud mortar observed collapsed. Further testing or field assessment is urgently needed to assess whether earthquake-resistant techniques used with rubble-stone construction can achieve life safety in schools.
- Unreinforced brick and stone infill walls were a primary cause of school buildings being 'red tagged' or deemed unsafe for immediate re-occupancy.
- Where landslide and rockfall hazards were frequent, communities moved schools to safer sites and proved to be effective actors in protecting their children.



Figure 8. Two neighbouring schools were both built through international donor support. The left was built without technical support. The right was built after the community was given an orientation on earthquake safe construction and local masons were trained in safer construction techniques. An engineer and lead mason, both with experience in earthquake-safe school construction, carefully oversaw the process. After the earthquake, the second was operational; even the terrace had been covered and converted into a makeshift workshop for the local community. Photo: R. Paci-Green/Risk RED



PILLAR 2

SCHOOL DISASTER MANAGEMENT

RATIONALE. School Disaster Management is established via national and sub-national education authorities and local school communities (including children and parents), working in collaboration with their disaster management counterparts at each jurisdiction, in order to maintain safe learning environments and plan for educational continuity, conforming to international standards.

FIELD OBSERVATIONS. Only two schools, both sites where there had been a school retrofit with extensive community engagement, had strong cultures of school safety and disaster management. In these schools, the students, parents and staff had acquired basic disaster awareness, and had sought out and continued classes in first aid, search and rescue and non-structural mitigation. At these schools, staff indicated they would have had students drop, cover and hold – a safe action because the schools were retrofitted well – and they expected no casualties or injuries.

At two schools in the Kathmandu Valley where retrofits had been performed *successfully*, but without extensive community engagement, staff reported there would have likely been multiple student and staff injuries and deaths had the event occurred during school hours. The retrofitted school blocks were undamaged, but the parents and teachers admitted they did not trust the retrofit process. Parents at both sites said the project was a “Western thing” and prior to the earthquake, they didn’t think it was necessary or useful. In one of the sites, parents and even a teacher indicated that they thought the retrofit project had involved corruption in the selection and construction process. Teachers at these schools generally did not engage in non-structural mitigation or regular education on disaster preparedness. They did not conduct earthquake drills, though at one school a teacher who had received school disaster management training tried to teach concepts and conduct earthquake drills with his class only. They reported that they would have tried to evacuate their students during the shaking, and that students would have stampeded.

They estimated that about 10 students at one school and 35 at another would have sustained serious injuries caused by the impromptu evacuation of these *safe* schools (See Table 3).

In Rasuwa, where stone school construction was common with heavy walls up to ceiling height, collapsing infill walls and collapsing schools would have been deadly. There, residents stated they had taken disaster preparedness training and school disaster management trainings. Some masons had also taken 5-day workshops on earthquake-resistant construction. Yet, the training seemed disconnected with actual building practice. According to the staff and parents interviewed, search and rescue training focused on reinforced concrete construction, not stone construction; disaster preparedness training focused on drop, cover and hold, without focusing first on the safety of the buildings. Of the three schools surveyed, an estimated 200 students would have died from collapsing stone infill and load bearing walls, many of them trying to drop, cover and hold while stone walls fell on them.

Notably, school staff in all three Rasuwa schools indicated that some school children that had been taught drop, cover and hold ran back into collapsing stone houses to crawl under tables and beds. The students did not understand how to protect themselves while outside. They stayed inside stone houses, when perhaps they could have exited, as there had been no instruction about how to protect themselves in the most prominent housing type – stone construction. During initial shocks, residents saw the walls of the stone buildings disintegrate, with large rubble stones crashing into and around the buildings. Upper floors were damaged most heavily and most quickly. Some lower floors or lower portions of stone walls remained standing, only to be destroyed in the May 12th earthquake. (NB. As yet there is no evidence for what may confer greater safety, specifically in this type of construction.)

Three out of the four schools with school retrofits that included community engagement had attached shelving to the walls, and strapped down important equipment and supplies. Only two out of eight schools that had *not* received school-based community engagement had done any non-structural mitigation. At schools where staff had performed non-structural mitigation, none of the staff noted losing any educational assets. At schools where non-structural mitigation had not been done, staff noted losing school computers, education records, and science and technical lab supplies.

Table 3. Expected Protective Action and Outcomes

Dist.	School	Intervention	Other trainings	EQ drills	Likely action	Est. deaths/Injuries	Comments
Bhaktapur	101	None	Some staff attended some trainings on disaster awareness and earthquake-safe construction.	No	Unsure	0/10	Stampede injuries expected by school staff
	102	Retrofit, technical intervention only	One teacher received first aid training, others risk awareness training.	No	Evacuate during shaking	0/10	Stampede injuries expected, even in retrofit block.
	103	Retrofit, technical intervention and community engagement	School project included community outreach. Street plays on disaster preparedness in neighborhood.	?	DCH then exit safely	0/0	Appropriate actions, no deaths or injuries expected
Kathmandu	201	Retrofit, technical intervention and community engagement	Staff participated in school disaster management training through district. School retrofit project include extensive community	Yes	DCH then exit safely	0/0	Appropriate actions, no deaths or injuries expected.
	202	None	Some staff attended orientations as part of community engagement outreach for nearby school retrofit. One staff trained through district education centre.	Once	Unsure	0/12	Stampede injuries expected.
	203	Retrofit, technical intervention only	One staff trained on school disaster management through district office.	No	Evacuate during shaking	0/35	Stampede and jumping injuries, even in retrofitted block.
Rasuwa	301	None	Two staff attended course on school disaster management through district office. Some staff attended disaster preparedness	Yes	Unsure	80/20	Deaths from infill wall collapse, injuries from stampede.
	302	New construction, technical intervention and community engagement	School project, plus staff active as trainer in disaster risk awareness and search and rescue.	Yes	Evacuate during shaking	0/15	Stampede and jumping injuries even in safe block; school did unauthorized story addition and no-longer
	303	Retrofit, technical intervention only	Some staff attended disaster preparedness trainings.	Yes	DCH then exit safely	120/20	Deaths and injuries in poorly retrofitted block. No action safe.
Sindhupalchowk	401	New construction, technical intervention only	Students attended junior Red Cross first aid. Outside organisation gave short disaster awareness orientation to students once.	No	Unsure	105/35	Deaths in collapsed blocks purported to be earthquake safe. Injuries from stampede.
	402	None	None	No	Unsure	210/45	Deaths in collapsed block, injuries in stampede.
	403	New construction, technical intervention and community engagement	School project, though limited by civil war	No	Unsure, Evacuate during shaking	0/50	Injuries, infill wall collapse of metal frame blocks and stampede in safe block.



Figure 9. Community engagement in school retrofitting is vitally important in establishing the links between safe school facilities and best practices in school disaster management. Both school buildings shown were successfully retrofitted and undamaged in the earthquake. However, without community outreach and engagement, the staff and parents of the school on the left indicated they would have had students attempt to run out during the shaking, likely resulting in stampedes or students jumping from the second floor. The school would have likely experienced serious injuries and possible deaths. On the right, students and staff regularly discussed and drilled earthquake safety. Staff indicated students would have stayed in place during the quake, or dropped, covered and held on. The staff expected no injuries or deaths had the event happened during school hours. Photo: R. Paci-Green/Risk RED

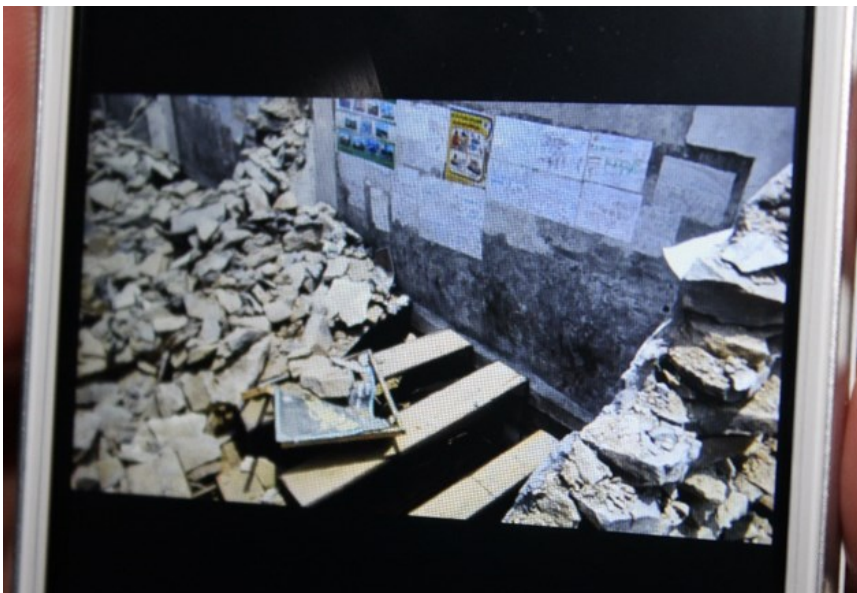


Figure 10. In Rasuwa, a poorly retrofitted stone school collapsed. Photos from the principal attest to the fact that few students would have been able to evacuate or survive the collapse.



Figure 11. School computers and lab supplies were damaged where no non-structural mitigation measures had been taken. Photo: R. Paci-Green/Risk RED



Figure 12. A mason in Bhaktapur drew how they now bent reinforcing steel into foundation footing, rather than simply cutting them at the foundation. The mason explained that he learned this technique as part of his school retrofit training. In North Kathmandu, houses near the school retrofit site were being retrofitted by adding bands and stitches two months after the event. The work was being carried out by local masons who had been trained to retrofit the school. Photo: R. Paci-Green/Risk RED

PILLAR 2 KEY TAKEAWAYS

- Where technical interventions were combined with community engagement, continuing disaster risk reduction efforts were ongoing, and would have protected students.
- Where technical interventions did not include community engagement, many students and staff would have likely tried to stampede out of safe buildings during shaking or jump from balconies, causing entirely avoidable injuries and deaths.
- In schools with load-bearing stone walls, neither evacuation during shaking nor Drop, Cover, Hold would have protected students. Staff and parents now distrust the Drop, Cover, Hold message.
- In rural districts where Drop, Cover, and Hold had been drilled and promoted in school, some children and adults incorrectly ran *into* unsafe stone buildings and were unnecessarily killed. Communities are now highly distrustful of this message.
- No schools had any standing committee with responsibility for ongoing school disaster management. Only one school had a student earthquake safety club for students; another had a Junior Red Cross club.
- Lack of non-structural mitigation in some schools resulted in loss of computers and science lab supplies. In schools that had performed non-structural mitigation, no losses were reported. Unsecured library shelving in most schools would have posed a safety risk.



PILLAR 3

RISK REDUCTION AND RESILIENCE EDUCATION

RATIONALE. Through formal curriculum and teacher training, and through informal student and community learning activities, key messages about disaster risk reduction and preparedness at home and school can be transmitted and sustained. Safer school construction or retrofit projects can be a learning opportunity for communities to better understand better construction practices.

FIELD OBSERVATIONS. At four of the eight school sites with retrofit or new earthquake-safer construction projects, the projects were accompanied by community engagement activities. A primary key component of these activities was orientations where parents and the broader community learned about their risks and strategies planned for making the new or existing school building earthquake resistant.

Mason training was a second key component of the community engagement. For schools retrofitted under the MOE's retrofit program, the DOEs held 5-day mason training workshops at district headquarters. Those that partici-

pated received related certificates issued by the training organisation. In other safer school projects, masons were trained onsite during school retrofit or new construction, both in the form of lessons and hands-on exercises. The school construction committee then selected local masons who had received training in disaster-resistant new or retrofit construction. In addition, to ensure the quality of the project, more experienced masons were often brought in during critical stages of the retrofit or new construction projects to provide additional on-the-job training. Masons stated that the onsite training was the easiest way for them to learn how to build or retrofit with the earthquake-resistant techniques.

During the construction or retrofit process, parents and community members were typically invited to the construction site several times. During these visits, the site engineer explained the process, especially the earthquake-resistant design and construction features. The potential reach and impact of community engagement was evident in field assessments. In Bhaktapur and Kathmandu at the two schools selected as having *no* safer school intervention, school staff remembered attending public orientations and construction visits *at the nearby* school being retrofitted. They stated they were aware of seismic risk, in part, because of these public orientations at neighbouring schools undergoing retrofit.

At the Kathmandu retrofit and community engagement project, standard community outreach activities were fur-



Figure 13. Both schools shown here were successful safer school projects – a new masonry building with lintel and sill bands on the left, and a retrofitted masonry building on the right. Neither provides highly visible signage to alert communities of the safer construction techniques employed, though the school on the left did paint a safe evacuation plan on the building. The lintel and sill bands are barely visible under the white paint in the left photo. The retrofit bands are highlighted in bright pink in the photo on the right, but could have been labelled as earthquake-resistant retrofit bands for an ongoing reminder of the project and of the community's exposure to earthquake risk. Photo left: R. Paci-Green/Risk RED. Photo right: R. Friedman/Risk RED

ther expanded through funding from the Village Development Committee (VDC). As a follow-up to mason training conducted during the school retrofit project, engineers conducted a five-day training for skilled and unskilled labourers at the community centre five years after the completion of the retrofit project. Community masons were then taught better construction practices for masonry and reinforced concrete new construction. While 30 attended and received certificates, over 400 people in surrounding communities dropped by and observed public demonstrations of better construction practice or attended quick orientations.

The impact of the community engagement aspects of school retrofit/new construction projects is difficult to quantify, but the field assessment suggests the impacts were real and substantial at some sites assessed.

First and foremost, community engagement built trust in safer school construction techniques. At the sites without community engagement, retrofit and newer construction techniques were viewed with suspicion or with a dismissive attitude. With community engagement, parents and staff had been convinced of the importance and effectiveness of the safer construction methods.¹ In Sindhupalchowk, parents and staff were so distrustful of the unfamiliar construction techniques, they refused to work on the project until the engineer held extensive meetings explaining the reasons behind adding bands and stitches. The ongoing construction was halted in the middle for more than a week until the engineer came to site and explained the details and reasoning of earthquake resistant features. Without engagement, the project would have been derailed entirely.

School staff and parents at schools with community engagement also showed higher risk awareness. At the Bhaktapur and Kathmandu sites, parents and staff were able to recall specific details about seismic risk from school orientation meetings and from disaster awareness media campaigns, which they seemed to be able to hear and retain better though their connection with the school retrofit project in their neighbourhood. At nearby schools without this intervention, school staff said the community was virtually unaware of seismic risk and they generally did not have specific details about the risk themselves, unless they had attended a retrofit orientation in a nearby neighbourhood.

The biggest impact of community engagement was in the local masons and local building practices. Local masons

trained through the safer school construction projects were able to apply some elements of safer construction practice to housing construction in the community — they knew the earthquake-resistant construction techniques and because of the community engagement, the local homeowners were willing to use it. In Bhaktapur and Kathmandu, the masons could not convince home owners in their neighbourhood to retrofit or add the unfamiliar and costly earthquake bands to new masonry construction, however they were able to facilitate smaller changes in houses constructed after the school retrofit projects. These changes conferred important incremental improvements in construction safety:

- In the Bhaktapur neighbourhood, the lead mason was able to convince about half of his clients to include vertical reinforcing steel bars at the intersections of walls when building new brick homes. These bars help keep walls from separating and collapsing in earthquakes.
- In the Kathmandu neighbourhood, the mason was able to convince almost all homeowners to include vertical reinforcement at wall intersections and at window openings.
- In the Bhaktapur neighbourhood, the masons began bending beam steel rebar and extending it into columns, creating a stronger beam-column connection. They also began properly bending and spacing transverse steel (earthquake shear ties) in columns and beams.
- In the Kathmandu neighbourhood, the masons were able to convince most homeowners to place columns in a symmetrical grid and to properly cure the concrete. They were also able to introduce better methods of bending and placing rebar in columns, slabs and beams. These methods included keeping rebar away from exterior surfaces by bending wire to create 'spacers' to support the rebar. This proper spacing ensured the rebar would not be exposed to water and air, which causes rapid corrosion. The masons also began splicing rebar correctly by overlapping the ends of rebar at the centres of columns and beams, away from the fragile beam-column joints.

At each site, the masons noted NSET's community engagement work — homeowners had better awareness of seismic risk and some were willing to pay for small, additional construction costs for more earthquake-resistant homes.

The masons were not the only agents of change. The school staff in Bhaktapur became ambassadors for safer construction, stopping by new construction sites and urging homeowners and masons to incorporate earthquake-resistant

design and construction techniques. They especially encouraged homeowners to keep building heights low and to avoid wide overhangs. They found lower-income homeowners were more receptive to the message because the homeowners had higher respect for public school teachers. Middle-income households, most which sent their children to private schools, did not as readily listen to the staff or change their construction plans.

Following the earthquake, those interviewed at schools with community engagement were also much more specific about how they would rebuild differently. At retrofit sites without community engagement, the parents and staff did not know how the schools had been retrofitted and had only general statements about how to build back safer, such as building shorter, smaller and with reinforced concrete. At the sites with community engagement, staff, local masons and parents spoke about needing vertical reinforcement, more earthquake shear ties, tying walls, and using stronger (stiffer) concrete mixes. Anecdotal evidence from interviews with parents and homeowners near the schools suggests that even community members with no construction experience were able to identify safer construction practices; a degree of knowledge seemed to trickle down into the general community.

In Kathmandu, we were able to observe sites where homeowners were already employing retrofit technologies to rebuild their damaged homes. The community seemed aware of how to rebuild and was beginning to do so. At other nearby sites that had not received community engagement, the atmosphere was much more tentative. Residents said they would wait and see what recommendations came out. They did not know how they would rebuild safely and thought they would remain in temporary housing for years.

School retrofit projects with community engagement also had limitations at the Bhaktapur and Kathmandu sites. School staff and parents indicated that retrofits were seen as an expensive project for public infrastructure before the earthquake, not something that could be applied easily to making local housing safer. Before the earthquake, they wanted more information about earthquake-resistant housing construction and while some of the outreach did cover new construction, they remembered the details of the retrofit project more than the formal trainings on new construction.

In all of the retrofit and safer new construction, the impacts of the projects faded with time. After several years, many

parents actively involved in the school project no longer had children attending the schools. The new parents were often unaware of why the school was safer, though many did know that it was supposed to be safer. The school buildings themselves often did not look remarkably different from unretrofitted or unsafe construction. As such, it rested upon school staff to constantly re-teach the safer school concepts, something they felt less confident remembering and communicating over time.

In the rural districts, successful community engagement was more challenging than in the Kathmandu Valley. In Sindhupalchowk, the earthquake-resistant new construction project occurred in the early 2000s right at the height of Nepal's conflict between government forces and Maoist rebels. Both parties viewed any public gathering as dangerous and curtailed the project's planned community outreach activities. Even having the site engineer stay in the community during construction was unsafe for the engineer and would have drawn unwelcome attention to the community around the school. Instead, a trained mason with extensive safer school construction experience was sent to oversee the project. The engineer came only a few times.

In Rasuwa, difficulties with community engagement cropped up for other reasons. The school construction committee and school staff was unable to interest the local parents in safer construction – when the engineer tried to provide an orientation for the community, no parents came. Notably, all but one teacher at this site was of a different ethnicity and caste than the parents; the teachers commuted to school from a larger town. Later, when the construction costs were higher than the committee expected, the committee insisted on reducing costs in order to pocket some of the remainder. After a heated argument, and possibly physical threats, the site engineer left the site right before the pouring of the concrete floor slab. He did not return. Two years later, the school added an extra floor to the building. They incorporated earthquake-resistant bands in the construction of several rooms, but dropped the technique in the construction of the last two classrooms in the upper floor. With a culture of parents not contributing to school construction, with cultural barrier between the school staff and the parents, and with low literacy levels in the community, engagement was only partially successful. The parents knew the school's first floor was safe, but didn't trust the building because of the additional floor added.

In both the Rasuwa and Sindhupalchowk communities assessed, long term impacts of the project were also curtailed by

attrition. The masons involved in the safer school construction had not stayed in their communities. With the better training, they received through the project, some left for work in the urban centres of Nepal. These sites were more comparable to the school projects that had only technical interventions – parents and staff knew the school was designed to be safe, but were unclear what exactly made it safer or how they could improve the safety of their own housing.

PILLAR 3 KEY TAKEAWAYS

- Safer school construction projects with community engagement included parent orientations, local mason training and certification, and curated community tours of the construction project.
- School projects that incorporate local masons, as opposed to using masons from outside the local community, stand a better chance of enabling the new, improved building techniques to permeate into the local building practices.
- Community engagement sites built trust in the projects – parents believed the projects were necessary and effective. Without engagement, parents misunderstood the intent of project, seeing it as unnecessary or a waste of school construction funds.
- Staff, parents, and masons at sites with community engagement showed higher risk awareness and better knowledge of earthquake-resistant construction technology.
- Around some sites that had community engagement, new housing was reported to have incorporated some earthquake-resistant construction techniques (e.g. vertical reinforcement, proper shear tie bending and spacing, rebar spacers, and better mixing and curing of concrete).
- Where livelihood options were limited, local trained masons left the community for work in urban centres or abroad where their certification brought higher wages, or they abandoned the trade.
- With community engagement, some school staff became advocates for safer construction in the neighbourhoods around the school.
- Community engagement impacts were limited at a site where school staff did not share cultural and language ties with parents.
- Impacts of the safer school project faded over time. Safer school buildings lacked signage or displays, or visual documentation, to educate new families about the earthquake-resistant retrofit or new construction features.



Photo: R. Friedman/Risk RED

OTHER CONSIDERATIONS FOR SAFER SCHOOL CONSTRUCTION

The Ministry of Education does not fully fund the construction of public schools in Nepal. Many schools have one or more buildings substantially funded by international non-governmental organisations (INGOs) or private charities. Even those funded by the Ministry of Education or its district-level offices, are not fully funded through government coffers. Communities are expected to contribute 25 percent of the school building construction cost and to donate suitable land. Communities contribute through donating unskilled labour, materials, cash, or by finding private donors. These two elements of school construction in Nepal add complexities and areas for significant intervention in school safety.

INGOs IN SCHOOL CONSTRUCTION. Some INGOs linked the school management committee with appropriate technical support, training, and on-site supervision, resulting in both safer schools and increased community capacity. However, some INGOs and international donors provided funding and perhaps support for technical design drawings, but failed to ensure local masons had training or that construction projects had qualified, on-site supervision. These projects were spectacular failures, and would have killed and injured students and staff during a school-hours event.

Local community-based organisation (CBO) partners were often tasked with managing the school construction project for INGOs. However, without technical expertise in the area of safer construction practices, CBO project managers urged or even insisted that the school management committees we interviewed skimp on materials or modify designs to lessen costs. Safety was not a criteria on which their work was judged, and thus, they did not prioritize safer school buildings when they managed school construction projects.

COMMUNITY CONTRIBUTION. Residents interviewed were generally positive about the values of community participation in school construction. It brought communities together and galvanized them around their children's education. However, in one district, a rural development project 10 years prior had been completed *without* community contribution requirements. Since that time, households in the area had refused to contribute to school construction projects. They were especially resistant when donors came to support school construction. School management staff said

that the residents could not help but notice the stark differences in resources between themselves and the donors (the large vehicles, the fancy watches and electronics, the expensive clothing, etc.). Being asked to contribute seemed unfair, so households simply refused even for publicly funded school projects. Staff and committee members interviewed lamented this. They found it challenging now to find local masons willing to work on school construction or parents willing to serve on committees or engage with the school.

Where communities could not muster the 25 percent contribution, whether because of the financial burden or because households refused to contribute, and where they were not well-connected to external sources of funding (VDC and district politicians, INGOs, wealthy community members, foreigners, private donors, etc.), some school committees interviewed stated that they engaged in deception. They fabricated contributions and attempted to cover the full cost of construction with insufficient public sector funds, undermining construction quality in the process.

The construction budget was tight for other reasons beyond insufficient community contribution. In at least one case of a privately-funded school building we assessed, the principal stated that the district office of education requested a large 'donation' to their general fund out of the money designated for construction. Interviews with others knowledgeable about school construction suggest that in some districts, district offices of education and school management committees routinely withhold portions of the school construction funds. At the community level, construction funds also serve as a rare infusion of cash for the school and may help cover more routine costs like maintenance, hiring additional teachers, or paying for even more classroom construction than the school design dictated. In other cases, the skimming appeared to directly benefit school management committee members as 'payment' for their voluntary service or to support the construction of personal dwellings. Additionally, as is common in construction, the contractor or lead masons would attempt to reduce labour and material costs in order to increase profit.

Where construction budgets were reduced from local or district level corruption, the result was inadequate funds for the school building construction process. The school committee selected the lowest cost materials and labour or material required by the design was simply left out. Safety was undoubtedly compromised.

One school site assessed suggested a strategy for reducing corruption and ensuring safety. The school management committee created two subcommittees. The first was com-

mon -- a school construction committee that managed funds to hire a lead mason and purchase construction materials. This construction committee was notable for being highly inclusive; it included parents who were not part of the school management committee. The second committee was an inspection committee, comprised of the principal and school accountant. This inspection committee reviewed purchases and construction site activities. It was also responsible for providing original receipts and a full cost breakdown to the donor funding school construction. The separate committees provided a check and balance while the inclusion of parents and receipt documentation heightened transparency.

Even where corruption was not apparent and funding sufficient, school committees struggled with the task of managing school construction. They stated they had little experience with construction, especially of public buildings. They could hire masons and purchase material, but had to trust the masons regarding professional qualifications and quality of materials. When it came to observing and checking construction, the committee members wanted to ensure the quality of the construction. When possible, they stationed a teacher or committee member on the construction site and cajoled the masons to build better. However, they readily admitted they did not know what earthquake-resistant construction was or what, specifically, they should insist upon. Many stated that even if they suggested the masons bend bars differently or add more cement to the concrete mix, the masons rebuffed them and insisted that they, the masons, were the experts on construction.

OTHER CONSIDERATIONS

KEY TAKEAWAYS

- INGOs, and their CBO partners, can inadvertently fund *unsafe* school construction when they prioritize cost or aesthetics without considering natural hazards.
- Even when INGOs provide earthquake-resistant school designs, that is not enough. INGOs and donors need to ensure masons working on schools are trained; qualified, technical staff provide on-site construction supervision; and communities are mobilised to understand and support safer school construction.
- Where INGOs support school construction through funding and technical support, the result was both a safer school building and heightened community capacity for disaster-resistant construction.
- School staff currently overseeing the hiring of construction workers, the purchasing of materials and/or the day-to-day supervision of the construction do not have the technical knowledge to do so. They need guidance to better ensure the quality of school construction.
- In some communities, 25 percent community contribution to school construction has contributed to corruption and eroded construction quality. Community contribution is still viewed positively. However, this contribution needs to be in areas that support, not undermine, school safety and needs to be carefully adjusted to community capacity.



Photo: R. Friedman/Risk RED

RECOMMENDATIONS FOR COMMUNITY-BASED CONSTRUCTION

All children deserve safe, accessible and culturally appropriate school buildings — regardless of class, creed, gender or ability. When children live in hazard-prone places, such as in Nepal where earthquakes, landslides and floods threaten them, children need schools and grounds that protect them.

Schools can be built safer and weak schools can be strengthened with concerted effort. However, achieving safety is not always straightforward.

In Nepal, building codes lag behind best practices and need to be updated based upon this most recent earthquake. While the current code does include guidelines for non-engineered construction in low-rise reinforced concrete, masonry, adobe and stone, it lacks special provisions for school construction, such as higher safety margins or the requirement of immediate occupancy. Further, many tasked with designing and constructing schools at the district and local level are unfamiliar with hazard-resistant techniques. The school construction process lacks the oversight needed to ensure such techniques are put to use. School communities are also inadvertently weakening schools through years of informal modifications or poor maintenance. The result is schools that threaten communities rather than protect them.

A community-based approach to safer school construction seeks to achieve the twin goals of safer schools and more resilient communities. It treats school construction as a community learning opportunity to better understand risks, collectively commit to safety, and to learn and apply strategies for safer construction. A community-based approach builds community capacity along with school construction. It also prepares communities to be knowledgeable caretakers of schools, able to maintain the physical safety of the structures and the culture of safety among those who use them.

Reconstructing Nepal's damaged schools using a community-based approach will necessarily require more time than a contractor-based approach. However, a community-based approach has more chance of achieving sustainable results. Through a community-based approach, local masons, school staff, parents, and even students learn that disaster-resistant construction is possible, and how to do it.

They become full partners in maintaining the safety of school buildings and promoting a culture of safety at school and beyond.

Based upon this field assessment of retrofit and earthquake-resistant school construction, we recommend several steps to help achieve safer school reconstruction in Nepal. These recommendations have been broken down into the five-stages of community-based construction, as described in *Towards Safer School Construction: A Community-Based Approach*.



ARUP



Figure 14. The 2015 publication *Towards Safer School Construction* provided guidance to program managers, donors and agencies supporting school construction in hazard-prone communities. It provides steps for engaging communities and technical experts during mobilisation, planning, design, construction, and post-construction maintenance. The publication can be accessed at: <http://preventionweb.net/go/45179>

COMMUNITY ENGAGEMENT IN SCHOOL CONSTRUCTION

Community engagement is a key component of safer school construction, especially in post-disaster reconstruction. It ensures that safer school construction is a learning opportunity where parents, staff, and school neighbours see that disaster-resistant construction is possible and understand how to apply new techniques to safer schools and housing. Community engagement also places communities at the centre of school safety; it supports communities as managers, monitors and, ultimately, caretakers of safer schools.

Effective community engagement is more than a single orientation. It is a continuous activity extending through the entire process of mobilising, planning, designing, construction, and post-construction stages of safer schools projects. Below are some important community engagement activities in each stage:

MOBILISATION

- Initiate national conversation about safer construction; safer schools can be an important focal point.
- Engage school management committees in a commitment to rebuild safe schools, whether they be repaired or retrofitted existing schools, transitional learning facilities, or newly-built permanent schools

PLANNING

- Listen to communities and identify needs and capacities around their participation in safer school construction. Develop mechanism to better support communities.

DESIGN

- Engage school management committees and broader community in school design selection. Help them understand how and why designs will be safe and what their role in protecting that safety will be.

CONSTRUCTION

- Train local masons and unskilled labor in disaster-resistant construction techniques.
- Train and support school management committee, parents and broader community in monitoring school construction.
- Orient homeowners and broader community to how safer school construction techniques transfer to housing.

POST-CONSTRUCTION

- Train and support school staff and youth in non-structural mitigation and school disaster management.
- Commemorate and document safer school construction.

COMMUNITY MOBILISATION

Currently, affected communities are trying to understand why the earthquake damaged some buildings and not others. They want to know how to rebuild safely, but most do not have even basic knowledge of disaster-resistant construction techniques. Much of past disaster risk reduction work has focused on disaster preparedness; what communities need now is awareness of safer construction. Schools and school reconstruction can provide good sites for building this knowledge. Community mobilisation can help communities better understand safer school construction. It needs to start early and continue throughout reconstruction. Recommendations for mobilising communities and stakeholders around safer schools include:

- Provide basic structural awareness training modules to VDCs and local CBOs; require local authorities take and pass trainings.
- Develop mobile technical resource centres at the district or sub-district level, with demonstration projects, samples, and technical advising.
- Develop media messaging around structural awareness – a *Talk of the Village* program where locals, engineers and masons discuss earthquake damage and how to rebuild with local materials, would provide important and relevant information for many communities lacking knowledgeable engineers and masons.
- Produce and disseminate videos showing the outcomes of traditional versus earthquake-resistant construction, using a variety of building materials.
- Produce pamphlets on safer construction techniques suitable for those even with low literacy levels and distribute through local CBOs and INGO networks and schools.
- Develop children's games teaching risk awareness, risk reduction, and structural awareness concepts for distribution in schools.
- Provide highly visual safer construction posters for schools.
- Begin documentation of school's construction history during this stage.
- Promote unified messages for safer construction and disaster risk reduction using consistent logos and symbols.

Community engagement will need to be rapidly scaled-up to the regional and national level within the next few years to mobilise communities around safer construction and safer schools. Such efforts will be most effective if integrated with local government activities in reconstruction. Community awareness of risk and disaster-resistant construction techniques will enhance the quality of both housing recovery and community oversight of school reconstruction.



Figure 15. Research by Anne Sanquini, in coordination with the Department of Education and NSET, found that videos profiling local communities that engaged in school retrofits made viewers more trustful of retrofit and willing to support it in their own communities. The trailer can be viewed here:

<https://www.youtube.com/watch?v=f5vk1NQT9cs>

PLANNING

Planning for school reconstruction in Nepal needs to be based upon evidence from this most recent earthquake. Many of the template designs and oversight processes proved ineffective at achieving life-safe school buildings. Recommendations for improving the safety of school buildings constructed include:

- Review all Ministry of Education template designs based upon damage patterns observed. Address obvious design and construction flaws – weak columns, unsupported infill, etc. Revise designs prior to authorizing reconstruction. In the review, address the non-structural hazards of unsupported infill walls and develop simple retrofit recommendations for existing infills.
- Rapidly assess rubble stone school construction, including ‘non-structural’ rubble-stone infill or perimeter walls. Assess the limitations of this material and what, if any, earthquake-resistant techniques can achieve minimum life safety. Place a temporary moratorium on rubble stone and mud mortar school construction until guidelines, training, and supervision in safer rubble stone construction have been put into effect.
- Develop continuing education training program for district department of education engineers and engineering technicians’ on disaster-resistant design and construction, in collaboration with community mobilizers and contractors. Highlight key principles and construction details that they must carefully review for safer school reconstruction (concrete mix, curing, lap splicing, transverse reinforcement, banding in masonry construction, etc.). Promote professionalism, including by reviewing pay scales.
- Develop public awareness videos on safer school construction. Patterning after reality TV programs may prove to be particularly exciting for viewers – the program could follow the construction of a safer school or home, including experts that came in to expose errors or reward those who constructed correctly. Short technical reference videos viewable on smartphones may also provide important reference material for masons and general public.
- Convene a multi-stakeholder taskforce to review community oversight and contribution to school construction. The taskforce should look for ways to preserve

Nepal’s good practice in local governance of schools, but address the challenges that have resulted in unsafe schools (e.g. unequal access to resources, local capacity, and corruption).

- Plan for transparency by developing simple guidance and checklists for budgeting and procurement tracking. Pilot and seek feedback from school management committees to understand where they most desire support. Establish a remote technical ombudsman to respond to queries and photos and to also flag concerns. (Smart phone apps may be particularly effective in this area).
- Develop mechanism for independent and external review, e.g. through an independent construction inspection firm or district office engineers.
- As a matter of policy, apply all practices associated with safer school facilities to both public and private schools for early childhood through secondary education.

DESIGN

Had the earthquake struck during school hours, much of the loss of life and injuries would have come from brick and stone walls. The engineering field has often ignored infill walls as non-structural elements that can be relegated to architectural detailing. Design engineers and even building codes have let non-technical people decide how and where to place these walls. Ignoring the performance of infill walls in earthquakes is a deadly one, as school damage shows. The Nepalese engineering community and international organisations that propose school template designs for Nepal need to fully consider these infill walls in approved designs and in construction site inspection. They must account for infill wall performance and failure in deciding whether a school building will be life safe in future earthquakes. Not to do so is to put the lives of thousands of students and staff at risk.

The DOE capacity in seismic engineering should be enhanced so that district-level engineers and sub-engineers can better assess the failures of past school construction in their districts and develop locally-feasible solutions. Capacity-building is especially needed around issues of infill walls and approaches to the retrofit of moderately damaged

schools. Discussions with district engineers indicate there is little current capacity in these two areas but a strong desire to learn.

While the designing of safer schools needs to be conducted by trained and competent engineers, community engagement is still crucial to the success of a safer school. The past practice of communities radically altering designs during construction – adding extra floors, changing the location of columns and beams – needs to stop. Communities need to understand how this past practice resulted in unsafe schools for their children. Recommendations for this stage include:

- Ensure all school designs are reviewed by knowledgeable Ministry of Education engineers or their delegates, including those built through INGO and private donor support. With this review, the Ministry should take full responsibility for the safety of its school designs.
- Create a school design review process where a panel of competent technical organisations or structural engineering firms assess the appropriateness of the selected design for the site, local materials, community capacity, and hazard exposure. Such review should apply to original designs, ministry template designs, private school designs, and designs provided by INGOs and development partners.
- Provide communities with design choices that will not impact safety (e.g. choices in architectural layout, some construction materials, architectural finishes, colour, etc.). Clearly designate and explain what design changes communities cannot make because of their impact on school safety (e.g. additional floors, changes in column/beam/bearing wall layout, construction of unsupported partition walls, etc.)
- Train district engineers charged with site supervision in techniques for explaining disaster-resistant construction methods to school committees, parents, and local masons. Provide educational props – posters, pamphlets, visual demonstrations using readily available materials or body motions.
- Whenever feasible and safe, choose school reconstruction designs using materials that are familiar to the community to enhance maintenance and transfer of concepts to housing. Where local materials are not feasible or safe, construct small demonstration buildings with local materials as part of, or in coordination with, the safer school construction project or housing reconstruction activities.



Figure 14. Untrained masons are already rebuilding school buildings without incorporating disaster-resistant construction techniques. The masons here were not measuring concrete materials accurately and were using only large aggregate in their mixture. When asked, the masons said that they learned to lay reinforcing steel bars shown from previous metal frame school construction. They were incorrectly laying rebar on the ground, without spacers, and without bar end hooks. The school buildings of which they spoke had collapsed or been badly damaged. Photo: R. Paci-Green/Risk RED

CONSTRUCTION

Good planning and design can be completely undermined during the construction stage. Much of this event's damage, especially in reinforced concrete construction, stemmed from poor construction practices – ad hoc concrete mixing, improper curing of concrete or cement mortar, improper reinforcing steel detailing, and unconsolidated concrete. Because many communities erroneously believe that concrete construction is universally safer than masonry construction, regardless of whether it has disaster-resistant design and construction detailing, the reconstruction of schools needs to build knowledge about disaster-resistant construction of all material types, but especially reinforced concrete.

Also important will be readjusting community participation expectations during the construction stage. While community support strengthens community cohesion and may be a necessity in remote and rural communities, participation should be encouraged in areas that do not negatively impact structural safety.

Where communities do contribute to crucial aspects of the construction, they will need better technical support. Community support mechanisms need to also encourage robust transparency to dampen corruption that can impact the safety of the school building constructed.

- Provide broad construction training in earthquake resistant construction and retrofitting and require certification for any masons or unskilled labourers working on school construction projects.
- Require that a certain portion of all construction workers working on school construction are local, and are trained and certified, so that good construction knowledge has a better chance of staying in the community and transferring to housing reconstruction.
- Disseminate construction process videos to build community-wide knowledge and demand for safer construction.
- Provide school committees and parents with checklists for identification and selection of high quality materials.
- Provide school committees and parents with checklists

for identifying disaster-resistant construction techniques, for a range of building typologies.

- Encourage committees and parents to contact ombudsman when low-quality materials or improper construction techniques are identified. Confirm that communities know how to access this independent review mechanism.
- Release school construction funds in stages and tie each release to the school management committee and contractor successfully demonstrating that construction to date is following design drawings, especially in regard to the detailing that impacts the safety of the completed school building.
- Ensure INGOs engaging in school construction employ on-site construction supervision, either through their own technical staff or certified construction managers.
- Focus community participation on non-technical contributions (e.g. site donation, site preparation, gathering or transporting materials, architectural finishes, documenting construction process).
- Support school management with mechanisms for transparent accounting. Include parents and older students in construction oversight to promote transparency. This will also ensure that communities learn about availability and cost of materials, information also useful for their own housing construction.
- Ensure school construction projects include regular, curated site visits for parents and community so they can closely inspect the disaster-resistant features of the school as it is being built.
- Require a public notice board at each school construction site. The board should explain in clear language the earthquake, landslide, and flood-safe features of the design.
- Where possible, apply finishes to school buildings that strongly highlight disaster-resistant elements, for example by painting columns, earthquake bands, roof ties and similar elements in bright colours.
- Document the school construction process to be part of a hard-back school construction history book, with inputs from the school community.

POST CONSTRUCTION

Following construction, communities need to maintain schools to ensure that safety is not degraded through unsanctioned modifications or poor maintenance. Communities also need to sustain the lessons they learned about safer construction even years after the completion. Commemoration events and visual reminders can help. So can strengthening school disaster management and disaster risk reduction and resilience education. Recommendations at this stage include:

- Finalize safer school projects with a disaster-resistant construction process documentation. Include the design drawings, the construction as-built drawings, maintenance schedule, and safety features of the safer school. Preserve these in a hard-bound scrapbook.
- Encourage school communities to label school safety features prominently – write the names of earthquake bands, retrofitting jackets, shear ties, lap splices and other elements directly on the building and link to earthquake safety.
- Train school communities, including older students, to engage in regular school assessments and non-structural mitigation so that occupants will be unharmed and educational supplies will be undamaged by future natural hazards.
- Review research on the causes of deaths and injuries in the Gorkha Earthquake and update school protective action messaging as needed. Be sure to teach staff, students, and communities the reasoning behind recommended actions and how actions taken in schools may need to be different than at home because of the larger number of people in a small space.
- Move away from promoting a single drop-cover-hold message as this has eclipsed the more important message of building safely, and has been incorrectly interpreted as appropriate in all circumstances.
- Prompt school management committees to regularly review school safety and to plan for all hazards.
- Integrate risk reduction and resilience education, including safer community planning and construction, into staff pre-service and continuing education, primary and secondary curriculum, and parent education and outreach.



Photo: R. Friedman/Risk RED

RECOMMENDED ROLES & RESPONSIBILITIES

A community-based approach that rebuilds safer schools and creates more resilient communities will take coordination and vision. Each stakeholder has a crucial role in setting the agenda for safer schools and ensuring its outcome. While collaboration will be key, key stakeholders may play important leadership roles in the following areas:

- **Ministry of Education/ Department of Education.** Commit to building safer schools and transitional learning centres. Ensure that transitional learning centre designs meet life safety standards, with special attention to the dangerous, unsupported ‘non-structural’ infill walls used in previous designs. Establish a focal person for school recovery and reconstruction, with adequate staff and funding, to oversee a review and revision of permanent school design, construction and inspection processes. Through this focal person, develop streamlined support mechanisms for school management committees to better procure, manage, oversee, and understand the school construction they undertake. Partner with technical societies to develop and disseminate training for district technical staff to bolster their knowledge of seismic design, inspection, and retrofit options. Partner with other stakeholders to develop in-service teacher training and curricula on disaster risk reduction, including disaster-resistant design and construction. Establish accountability of school construction across all funding sources and school types through policy and by common standards, tools and metrics for all pillars of comprehensive school safety.
- **Donor Organisations/Development Partners.** Commit to building safer schools. Fund and support effective school retrofit and reconstruction, in part by ensuring that all school projects supported are constructed by trained masons and with robust oversight. Train and hire local masons so that capacity for school building maintenance and safer housing construction remains in the community. Set aside a portion of school construction funds for community engagement; this community engagement will ensure that investments in safer schools are maintained and magnified.
- **Education and Disaster Risk Reduction Advocates and Consortia (Flagship 1 and 4).** Advocate that each school built is a safer school; monitor and report education sector construction in terms of *safer* schools built and managed with *robust community engagement*. This community engagement should orient communities to safer school construction, train local masons in disaster-resistant techniques, ensure communities understand how to transfer new concepts to housing construction, and support school management committees and the broader community in their role as community managers, monitors and, ultimately caretakers, of safer school construction. Support accountability and scale by developing common standards, tools and metrics that address comprehensive school safety. Convene multi-stakeholder taskforces to recommend changes needed to achieve safer schools. Monitor and evaluate both the technical and social aspects of safer school construction programs over time to create evidence-based strategies for building upon successes and addressing failures.
- **National Technical Organisations and Professional Societies.** Support ministry counterparts and other stakeholders through technical advising and independent technical review. Develop and scale up education and certification programs for engineers, masons and even school management committees. Provide clear guidance to donors, INGOs, and CBOs about disaster-resistant construction across a range of building typologies. Partner with them to develop dissemination strategies. Listen to and understand the public concerns and myths that have developed around safety. Promote clear, consensus messages, especially the message that buildings of any material type can be made more disaster-resistant. Keep the public focus squarely on steps they can take to build safer structures. In partnership with other stakeholders, develop and coordinate mobile technical resource centres to support both safer school and housing reconstruction.
- **International Non-Governmental Organisations.** Develop a coordinated mobilisation and community engagement strategy to support and enhance safer school construction. In partnership with technical and

professional societies, develop multi-pronged mass media campaigns around safer schools as a conduit for, and in coordination with, broader strategies to support safer housing reconstruction. Establish training programs, including consistent messaging and materials (e.g. games, phone apps, monitoring tools, street plays, facilitated forums, videos, television and radio programs, checklists, mobile clinics, curricular support, school disaster management and more), around safer construction. Train and support community mobilisers who can engage with communities during all five stages of the safer school construction process, from initial mobilisation to post construction. Monitor both the social impacts of mobilisation and safer school construction programs over time to build upon successes and address failures. When directly involved in school construction, commit to every school built being a safer school. Coordinate with ministries, technical/professional societies, and other INGOs, not only on technical construction matters, but community processes and outreach to parents, teachers, students and other community members.

- **Community-Based Organisations.** Build internal capacity around safer schools and disaster-resistant construction for building typologies in your community. Partner with INGOs and technical organisations to develop and implement a coordinated mobilisation and community engagement strategy, bringing key messages and capacity building strategies to local networks and contexts. Work with communities to support inclusion and transparency in school construction

management so that the intent of safer schools is realized in implementation.

- **Higher Education and Teachers Colleges.** Assess and bolster curricula in civil engineering and engineering technician degrees to ensure *all* graduates understand both code provisions and principles of disaster-resistant design, retrofits, and the common causes of failure in recent disasters. In partnership with technical societies, develop continuing education courses for practicing engineers. At teachers colleges, develop modules and in-service training, in partnership with other stakeholders, to teach a basic overview of disaster-resistant school construction and non-structural mitigation so that teachers and principals tasked with managing school construction and maintenance projects are better prepared to do so.
- **Communities.** Insist upon, and advocate for, safer schools in every community. Take part in mobilisation strategies to learn about safer school construction. Engage youth and civic organisations in the day-to-day monitoring of school reconstruction and the long-term maintenance and non-structural mitigation of safe school buildings. Engage in inclusive and transparent school construction management in ways that prioritize school safety. Document and commemorate safe schools and promote a living culture of safety by forming school disaster management committees. Apply lessons of safer school reconstruction to housing. Pass on the hard-earned lessons of this disaster to future generations so that they will not have to experience devastation when the next natural hazard strikes.

CONCLUSION

Children have a basic right to safety and education. From these rights stems a moral obligation to build and manage safer schools. That moral obligation falls on all duty-bearers – the donors who fund school construction, the organisations that implement it, the ministries that oversee and have ultimate responsibility for educating their young citizens, and even the communities who become caretakers of the school.

Fortunately, the April 25th Gorkha Earthquake occurred on the one day a week where public schools are not in session. Even so, 479 students died in schools or hostels according to Nepal's Education Cluster June 2015 assessment. Had the event happened on any other day, the loss would have been savage. Communities could have lost many, if not all, of their school age children in singular, horrifying collapses of school buildings.

This assessment of safer school construction projects, including the technical outcomes and the social impacts, shows that Nepal has both spectacular successes, which can be used as models moving forward, and notable shortcoming that can be improved in the post-earthquake reconstruction of schools.

The lack of damage in many retrofitted and earthquake-resistant schools shout out the important message: Nepalese communities can build schools to withstand earthquakes. Where these projects were twinned with effective community engagement communities have changed for the better. Masons have gained skills in disaster-resistant construction. Communities have come to better understand the risks they faced and how to build better to protect themselves. School staff gained confidence in their school buildings and knew how to protect students during an earthquake.

Yet, the collapse of several of the assessed schools attests to the challenges ahead. Implementation of retrofit or earthquake-resistant new construction carried out as only an engineering task is not sufficient. Without mason training and onsite supervision, one such retrofit failed in the worst way possible, in heaps of body-crushing rubble.

Even when projects are carried out with technical proficiency, a lack of community engagement can lessen im-

pacts. When staff and communities do not believe in the value of these projects, students and staff are likely to stampede out of safe buildings, resulting in wholly unnecessary injuries and death. Communities are likely to distrust undamaged school buildings and reject them as shelter during the critical days after a disaster strikes.

Most importantly, a learning opportunity is lost. Schools are central to communities and natural points for knowledge dissemination. A safer school project needs to build a safer school building, but also provide an opportunity for communities to learn about their environment and how to live safely in it. It is a project where parents, masons and even children can understand why lintel bands are added to a masonry wall or shear ties are bent to hold columns secure during shaking. They can take these ideas and apply them outside the school. Safer school projects that do so help ensure student are not only safe at school, but when they go home in the evening as well.

Yet, outside of the affected districts, Nepal's children and communities will remain in grave danger. In the coming years, much funding and programmatic focus will need to be on school reconstruction in the affected districts. Even as that work continues, care should be taken to remember the students still sitting in dangerous schools beyond the reach of this 2015 Gorkha Earthquake. The timing of the next earthquake may not be so forgiving for them. Another 70,000 schools in unaffected districts urgently need to retrofitted. Lessons learned in the affected communities need to be passed on so that all Nepal's students can go to school in safe buildings.



Photo: R. Friedman/Risk RED

ABOUT RISK RED

Risk Reduction Education for Disasters, Risk RED, is U.S.-based non-governmental organization, that has long championed the right of children to safer schools worldwide.

Risk RED's purpose is to increase the effectiveness and impact of disaster risk reduction education. This is accomplished by bridging the gaps between idea and audience, local and non-local practitioner knowledge, content and design, and research and application.

Risk RED works with credible and legitimate international agencies, regional and local partners, research and training institutions, and activists who share our belief in the value of broad and inclusive in-reach and outreach, to share, develop, localize, disseminate and evaluate the effectiveness of public education and outreach materials for disaster risk reduction.

Risk RED members hail from North America, Asia, Australia, Europe. They bring expertise from diverse fields, including education, disaster risk reduction, natural hazards science, engineering, anthropology, urban planning, psychology, and program evaluation.

Risk RED members were instrumental in the development of the Comprehensive School Safety Framework, recently adopted as the foundation for launching the Worldwide Initiative for School Safety at the World Conference on Disaster Reduction. Risk RED is a member of the Global Alliance for Disaster Risk Reduction and Resilience in the Education Sector, and works collaboratively with global stakeholders in risk reduction education, including eg. UNESCO, UNICEF, UNISDR, Save the Children, IFRC. Risk RED also has both historic and current links to other NGOs stakeholders.

In 2015 Risk RED worked with Save the Children, The World Bank's Global Facility for Disaster Reduction and Recovery, UNESCO and Arup to research and convene global experts in safer community-based school construction. The resulting publication *Towards Safer School Construction: A Community-based Approach* (GFDRR, 2015) provides guidance on community-based school construction in hazard prone places.



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