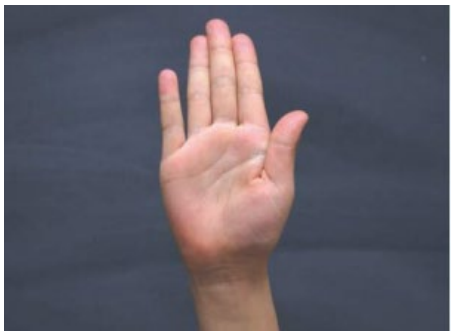
Students Lead the Way



Country: Nepal
Organisation: National NGO
Hazards: Earthquakes

"When the local first-grade classroom needed strengthening, a fifth-grade student was the first to lend support." Photo: Risk RED

Country and hazard overview

In 1999, a national NGO in Nepal dispatched an engineer to begin its first community-based safe school retrofit on the outskirts of Kathmandu. The engineer went to the school site every day and got his hands dirty. While drilling, laying and pouring with the rest of the labourers, over time, the community began to trust him. In just four months the project seemed to be a success.

On one of the last days, the engineer noticed another small building on the school grounds. He learned it was the classroom for the first and second graders. Worried about this building being overlooked in the retrofit, he called the community to a town meeting the following day.

Fifth graders create a turning-point

As the NGO's funding had been exhausted, he asked the community to donate some of their own savings to help retrofit the small school building. In his mind, the parents, teachers and friends of the first and second graders could not deny the children the safety given to the main schoolhouse. He asked the community to raise hands for a pledge.

Slowly, arms were raised – but it was the hands of the fifth graders that were in the air. They were the first to pledge their meagre savings to their younger schoolmates. A cascade of funding followed. Inspired by their children, parents pledged cash and hours of labour, while teachers and the principal each gave one month's salary. With no outside funding, the first and second grade building was reconstructed.

The schoolchildren, after learning of their own vulnerability, were the impetus for safe school construction, and became leaders in creating a culture of safety.

Post-earthquake

In the weeks after the devastating 2015 Kathmandu earthquake, the engineer anxiously called the community. A local resident reported that both the main retrofitted school building and the reconstructed first and second grade classroom had survived unscathed. Many houses around the school collapsed or were heavily damaged – but not all. Some residents had applied seismic-resistant techniques to their own homes after seeing them used in the safer school construction project. With relief, the engineer learned that those homes had withstood the earthquake.

Trade-offs in Post-Disaster Response



Country: Haiti
Organisation: Save the Children
Hazards: Earthquakes, flash floods, high winds

Country and hazard overview

In 2010, a devastating earthquake struck Haiti and damaged or destroyed 80 per cent of schools in and around the capital city, Port-au-Prince. Nearly 250,000 people were killed, and one-third of the population was displaced. Most documents from the past 204 years of Haitian governance were buried under rubble, and land tenure was almost impossible to determine.

Despite good coordination, the Haitian Ministry of Education was overwhelmed by the crisis. In this extremely difficult situation, Save the Children (who was co-leading the Education Cluster with UNICEF while working alongside other NGOs and the Haitian Ministry of Education) rushed to respond.

From both an educational and child protection perspective, returning children to the classroom was the most pressing goal. The need for immediate relief amid the post-disaster turmoil meant Save the Children had to make difficult trade-offs. Pressures from key stakeholders pushed and pulled the school construction program, sometimes in opposite directions.

A vast coordination effort

The Education Cluster run by Save the Children and UNICEF coordinated the efforts of approximately 100 organisations.

Together, they established more than 1,000 temporary learning spaces, trained more than 10,000 teachers in psycho-social support for children, enabled the return to school of more than 1 million students, and undertook cholera-prevention activities in 20,000 schools.

Save the Children alone constructed at least 100 schools, which helped thousands of children get off the street and into successful education programs. Surveys indicate that community members were extremely grateful for Save the Children's efforts.

Save the Children had to make some key trade-offs during the decision-making process

- **Speed vs quality:** *Construction speed and cost versus building lifespan: is it best to build semi-permanent or permanent?*
- **Consistency vs diversity:** *Consistent design for better compliance to safety standards versus design diversity for increased functionality and tailoring to specific site characteristics.*

- **Cost vs quantity:** *Higher costs of site-specific design versus the economy of scale that comes with a consistent design template.*
- **Quantity vs quality:** *Building more schools versus creating community ownership.*

These conflicting considerations show that prioritising time, cost, quantity or quality can only be achieved at the cost of other factors. Many of the key trade-offs were made at the design stage, which in turn dictated the program decisions that followed.

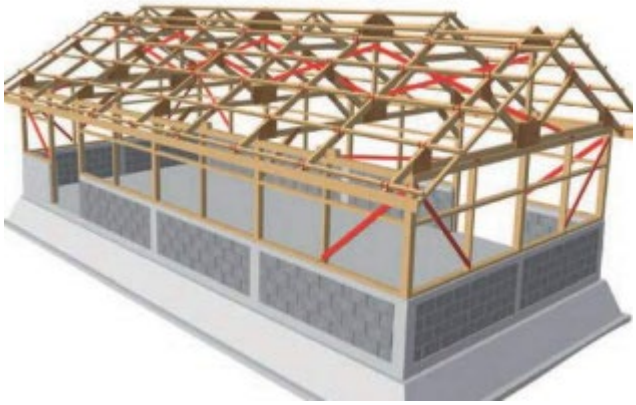
Save the Children opted for a standardised school design and a semi-permanent structure to meet donor expectations of an immediate, cost-effective response.

A semi-permanent building lifespan was seen as a middle ground. Donors were less inclined to lend money for permanent structures when the country was in the emergency and immediate recovery phase. Save the Children had its own goal to build a certain quota of schools and was contractually obligated by donors to achieve those numbers. The Haitian Ministry of Education also requested temporary, immediate construction. Even as they drafted the design, they recognised that some building elements, in particular the plywood cladding, would require maintenance and replacement.

Initially the short-term strategy made sense, but navigating the Haitian economic and political environment took so much time that the original argument for speed was lost. Through a protracted process the semi-permanent school design was approved by the Haiti government, meaning the first schools were completed in June 2011 and the last schools in early 2013; three years after the earthquake. This left Save the Children with two key lessons about trade-offs in construction lifespan: all staff need a shared definition of 'semi-permanent', and that there needs to be a well-communicated plan for upgrading schools to permanent structures when they degrade.

Ensuring technical oversight and partnership

Many school construction projects progressed well with the standardised building footprint, while some required compromise to achieve sufficient classroom numbers. In the latter cases, school administrators made informal changes, some of which compromised safety and classroom function. A five-way Memorandum Of Understanding (MOU) was established in an attempt to alleviate these changes. The MOU provided written agreement of the roles and responsibilities of each group in advance, including school staff, the Ministry of Education, Save the Children, the municipality, and the local parent-teacher association.



Schools were all single-storey with 190cm-high reinforced concrete skirt walls. The walls were topped with timber framing and clad with plywood. Corrugated metal was used for the roof. Graphic: Save the Children.

A De-centralised Approach to School Construction



Country: Indonesia
Organisation: Ministry of Education, Ministry of Public Works, Ministry of Finance, World Bank
Hazards: Earthquakes, floods, landslides, high winds, volcanic eruptions, tsunamis

Country and hazard overview

Earthquakes, volcanic eruptions, tsunamis, floods, droughts, and landslides are prevalent in Indonesia. Since 2000, the country has experienced three earthquakes with a magnitude greater than 8.0. Tectonic movements also make 76 of Indonesia's 150 volcanoes highly active, and the country's history includes a series of disastrous eruptions that have killed hundreds of thousands of people and affected global weather patterns. Flooding is also a perennial issue. These diverse hazards place about 75 percent of Indonesian schools at risk.

School construction: from a centralised to a community approach

Around 60 per cent of Indonesian schools were constructed in the 1970s and 1980s in a massive Presidential Instruction (Inpres) program, which was fully funded by the government. Understanding of building codes and hazards was low and corruption was rampant, leading to poor site selection and low construction quality. Nevertheless, with Inpres, access to basic education significantly improved and enrolment was boosted.

Recognising the monumental challenge of building, operating, maintaining, repairing and retrofitting schools in various states of disrepair across thousands of islands, in 1999 the government de-centralised education management down to the community level. In 2000, the central government established a block grant called the School Operational Fund with support from the World Bank. This allowed school management committees to directly receive and manage funding provided by the national government.

To actually give power to school management committees, the Ministry of Education and Culture and the Ministry of Finance gave each community responsibility for managing the School Operational Fund. As a block grant, the funding was flexible. It allowed committees to spend money as they saw fit. It was also allocated based on the number of students; if enrolment increased, the funds to that school would also increase.

The school management committees were flexible and consisted of a principal, treasurer, and small group of democratically elected community members. These community members typically came from the immediate area, but could be drawn from surrounding neighbourhoods or elected for special purposes. This system, in conjunction with the block grant, was intended to allow school committees to operate as school implementing units.

Addressing school vulnerability to hazards

After learning that 75 per cent of the 258,000 schools in Indonesia are in disaster risk areas, the government launched programs specifically for disaster risk-reduction education programs. They also adopted regulations to increase the hazard-resistance of school infrastructure.

The Ministry of Education and Culture then contracted a private company to determine the extent of damage of Indonesian school buildings. Considering geographic and logistical challenges, the government allowed school committees to perform basic damage assessments that were then approved at the district level. After years of surveys, the government learned that one-third of all schools (more than 89,000) fell into the heavy or medium category of damage.

In 2011 the Ministry of Finance changed the existing Special Allocation Fund (DAK) (previously used for buying computers or textbooks) to help maintain school buildings. They drastically increased the portion of the budget allotted to physical expenditures and allocated funds according to damage level and student enrolment. School management committees could use these funds to build new schools or repair existing ones as they saw fit.

Challenges to this approach

Construction was a new responsibility for school management committees around Indonesia. They had to hire their own contractors and sub-contractors to help them build new schools or to retrofit existing ones. While committees did receive some assistance from a government engineer, they did not always have the ability to start construction projects or the knowledge to prioritise school safety. As a result, DAK funds have been spent returning buildings to their original condition, rather than improving structural components to make them safer.

According to an Indonesian report prepared for the World Bank, de-centralisation of school construction increased a sense of ownership from the community and reduced costs. Where school communities were already familiar with disaster risk reduction principles and where school principals took the lead in construction, school quality increased.

The Indonesian government is still working through some challenges related to safer school construction:

- ***Technical oversight:*** The government has not yet created an appropriate technical advisory system. School communities often lack the funds to rebuild and renew buildings and hire a technical consultant. Even if consultants are hired, they often lack the appropriate information to build hazard-resistant design according to local building code by-laws.
- ***Public sector coordination:*** In Indonesia, the Ministry of Public Works is responsible for writing and enforcing building codes, including the design review and construction inspection of schools. Unfortunately, local public works offices are given the same amount of funds regardless of the number of schools in a district. With so many diverse infrastructure tasks to supervise they rarely perform thorough checks – especially if the school is single storey. In addition, public works officials rotate between departments to reduce corruption. This means they rarely develop the experience needed to thoroughly oversee school projects. Under the current DAK fund, local governments have the responsibility of financing the supervision of school projects. Because of this, each unique local political economy can influence the construction costs – potentially compromising quality assurance and

safety.Noticing these funding and capacity issues, the Ministry of Education and Culture provided a special portion of money for quality supervision to each school. Currently, this fund is only available for school construction directly financed by the ministry, and not for construction using the DAK fund.

- ***Construction speed:*** School management committees must spend DAK funds quickly, which has pressured school communities to implement projects faster than they are capable. Special allocation funds must be used within three months to receive another allocation of money across all sectors. Other departments relying on DAK funds for education materials may pressure schools to finish their work within the three-month funding window so the funds for their sectors will not be delayed. Community-based school construction policy at the national level is possible, but creating incentives that produce safer schools is a complex and lengthy process. In Indonesia, the de-centralised approach may be the only opportunity to reach all communities. At the same time, de-centralised construction and repair may be, in some cases, poor quality. And in Indonesia, where natural hazards are frequent, poor quality work is especially dangerous.

Key lessons:

- De-centralised construction methods in regions with diverse circumstances allow locals the freedom to address their unique needs.
- While school management committees can address their own needs well, they may not be immediately capable of managing a construction project.
- Technical oversight must remain a top priority, even if school management committees are given greater autonomy in construction.



Democratically elected school management committees may use funds to construct new schools or retrofit unsafe ones. Indonesia is working to developing effective systems for providing technical support to local school management committees. Photo: GFDRR.

Fostering Demand for Safer Schools



Country: Nepal
Organisation: National Society for Earthquake Technology-Nepal(NSET)
Hazards: Earthquakes

Update*: On 25 April 2015, Nepal experienced a magnitude7.8 earthquake, 77 kilometres northwest of Kathmandu. As the earthquake struck at noon on a Saturday, few were inside the thousands of classrooms that collapsed. Tragically, however, some teachers were attending teacher training sessions and were killed.*

Country and hazard overview

Nepal is beset with high seismic activity. In the last 100 years, it has weathered four major earthquakes which have claimed more than 11,000 lives. In 1934, the Nepal-Bihar earthquake claimed 8,519 lives and caused massive devastation to Nepali infrastructure and housing. The seismic record suggests earthquakes of that size have occurred, on average, every 75 years since 1250. If historical trends continue, another earthquake is imminent. Smaller and more frequent earthquakes serve as constant reminders of the looming threat.

Organizing communities

In Nepal, the National Society for Earthquake Technology-Nepal (NSET) pioneered community-based safe school construction. Since launching in 1993 with little resources, the organisation has wanted to build awareness about earthquakes and other natural hazards from the children up. At the same time NSET wanted to use a school construction project to bring about earthquake resistant construction practices.

Organising communities to build safer schools requires lengthy engagement and trust-building. A mix of low risk-awareness, limited government capacity, and limited resources drove NSET to focus on finding sites for a few successful projects. Their aim was to ensure the government, as a key participant, saw community-based safe school construction projects as an effective means to protect children, provide education, teach masons new skills and protect Nepali people and vital infrastructure investments.

School selection criteria:

- High community commitment
- Potential for publicity
- Able to be duplicated
- Enrolment
- Viable socio-economic condition
- Availability of construction materials
- Potential for training.

Selecting a school was done with care. In Nawalparasi District, all 239 schools were surveyed to see which needed new classrooms. The number of available local masons was assessed, along with the

socio-economic condition of all communities and the available construction materials. Through an analysis of these factors, NSET made a shortlist of around 20 schools.

The most resource and time-consuming part of selecting a site was how to determine which communities would most benefit from a project. The benefit would be higher in communities that did not even know they were particularly vulnerable, or where vulnerabilities were preventable. Benefit would also be high in communities where local contractors or masons failed to follow earthquake provisions mandated by the building codes because they could not read the codes. NSET was more likely to choose these communities, but only if they showed potential for sustained community engagement.

Community engagement began with town hall meetings where community members were invited to learn about hazards and earthquake technology. Initially, attendance was low. As the first few attendees chatted with their families over dinner, tea and at other gatherings, involvement increased. The potential for saving children from harm in the next earthquake proved an effective conversation piece.

Once the initial novelty of the information wore off, sustaining the interest and commitment of the community was a challenge. NSET, along with community members, organised 'shake table demonstrations' to continue conversations and demonstrate the effectiveness of hazard-resistant construction.

Shake table demonstration

These demonstrations are now widely used for teaching school communities and local masons about the effectiveness of earthquake-resistant technology. Typically, two one-tenth scale models that look like the local school are placed side-by-side on an apparatus that partially mimics a real earthquake. Although the external design of both models is the same, one of the models has earthquake-resistant features and one is a copy of current building practices. As the table vibrates, the community simultaneously witnesses the potential destruction of their own building, while they are given hope through the model that withstands the earthquake scenario.

Kalika Secondary School was ultimately chosen from all schools surveyed in the Nawalparasi District. Community members were low to middle-income, so there was potential for donations from the wealthier community members and a deep interest in a safer school. The local government was also an eager partner.



In Nepal's Nawalparasi District, NSET engineers answer questions at a shake table demonstration. Onlookers learn their traditional building may collapse in earthquakes, but that small changes in their construction practices can save their schools and their lives. Photo: NSET.

Funding and retrofitting

NSET requires communities to gather almost all the funding required for a school construction project. Their precise method for choosing communities helps make sure that community demand is very high before initiating the project. However, they do not leave schools to operate alone.

At Kalika Secondary School, NSET helped form community-based organisations (CBOs) that would spearhead school retrofit activities. NSET representatives accompanied CBO to request donations from the community and district-level government offices. Again, in the company of an NSET representative, the CBO went to the steel manufacturer asking for a tax-deductible donation, which would be part of the steel company's corporate social responsibility. As those negotiations began, NSET started to gather in-kind contributions of sand, boulders, and bamboo needed for the construction project. After developing a presence in the area, they were also able to secure some funding from a local NGO to support the project.

NSET was constantly present during construction. NSET engineers remained on the construction site throughout the process to provide on-the-job training for local masons. Training focused on how to construct earthquake-resistant structures, and why the changes produce safer school buildings.

After training masons and demolishing one of the old school buildings, a new three-storey building was completed in 2010. Since then, around 60 per cent of construction completed by the trained masons has included earthquake-resistant technology. NSET has seen masons tear down sections of their work when engineers point out deviations from the safer methods.

Challenges to this approach

Communities resisted new construction practices at first, which made financing especially difficult. Constructing a high-quality building was expensive, and NSET wanted the school to either contribute directly or be involved in gathering funds from other sources. Garnering support and community demand for the project took time before people were willing to plunge into the project and provide time-consuming support. However, after decades of work in the region, Nepal's Ministry of Education now fully supports the community approach.

Key lessons:

- While enlisting community support can be time-consuming, it can make a big difference to project viability and local procurement.
- Allocating many resources to project selection can be useful when project goals include a focus on scaling-up.
- Raising community awareness through demonstrations and public forums can generate invaluable conversations.
- Shake tables are a particularly powerful tool for creating community interest and demand for safer construction.
- If communities lack the resources to build a school, and they lack the skills to gather the funds from outside sources, involved agencies can help with conversations with public and private groups that may be willing to make donations.

Rapid visual assessment for retrofitting



Country: El Salvador
Organisations: UNESCO, University of El Salvador, University of Udine, Italy
Hazards: Earthquakes

Country and hazard overview

El Salvador is populous and seismically active. In 2001, two earthquakes caused landslides and damaged 1,700 schools: more than one in three in the country. Ten years later, many school buildings remain in disrepair and on sites that leave them vulnerable to earthquakes and other natural hazards. Many schools do not comply with seismic building codes.

School buildings in El Salvador are mostly one storey of confined or reinforced masonry. Although some buildings were traditionally constructed from adobe (mud brick), it has not been used for schools since 2001, when many children and a teacher died during an earthquake.

Existing school facilities that have not been built to withstand hazards need to be identified and strengthened. In countries like El Salvador, where resources are insufficient for a full detailed assessment of every school, a rapid visual assessment can quickly collect proxy data from a brief site visit. From these assessments, the Ministry of Education can develop school retrofitting programs. These are based on an action plan that prioritises the weakest buildings and those with the most students first. Detailed assessments can then determine whether school facilities should be retrofitted or replaced.

Using rapid visual assessment

Rapid visual assessment approaches have been developed in many countries. These assessments rely on proxy data to determine fragility and the structural integrity of a building

Originally, proxy data was collected by engineers after earthquakes or other hazards. Noting the intensity of the hazard, they recorded the damage to buildings and organised the results by the building type and other defining characteristics. Over time, enough data was collected to predict damage based on a visual assessment of a building's characteristics and the expected strength of the hazard.

Rapid visual assessment only provides a general prediction of damage. After it is conducted, engineers still need to perform in-depth assessments to develop appropriate retrofit designs, but only for those identified during the rapid assessment. This strategy reduces the cost of doing in-depth assessments for every school.

Planning rapid school retrofits with VISUS

In 2014, faculty and students of a Salvadoran engineering program and researchers from the University of Udine in Italy pilot-tested the **VISUS** tool as a rapid visual assessment method. **VISUS** is an expert method that organises and collects information for school facilities using an app on a tablet. It then uses the collected data to judge the overall safety of school facilities. **VISUS** was designed to quickly gather data with photos and prioritise the right action for achieving school safety based on risk and cost. These actions are: nothing, repair, retrofit or replacement.

While El Salvador has a fairly robust university system, civil engineering students are not required to take courses in seismic safety and evaluating existing buildings. For one month, **VISUS** developers from the University of Udine in Italy and UNESCO personnel communicated with the Salvadoran professor who spearheaded the pilot project. He provided pictures from previous earthquakes and information detailing the technical aspects of typical school construction in El Salvador. Over time, this partnership became a steering group, which maintained the project throughout its lifespan.

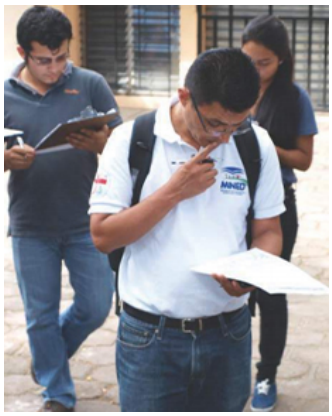
After establishing a base at the University of El Salvador, the **VISUS** developers trained more than 60 people to perform the assessment on the pilot project, including personnel from the Ministry of Education, engineers associations and a team of 15 students and 8 professors. The first half of the three-day training course was in the classroom, when the trainees learnt the concepts of rapid visual assessment and how to use the **VISUS** tablet application for collecting data. In the latter half of the training, the trainees got hands-on experience in the field. A day was added for evidence-based photography so experts could verify the team's assessments.

The **VISUS** pilot project assessed school buildings in the departments of San Salvador, La Libertad and La Paz. Overall, five groups of three university students and a professor visually assessed 100 buildings in 10 days. **VISUS** evaluation of each school took as little as a half an hour, and sometimes as long as three hours. When school staff were available to guide the team, the evaluation process was much faster.

The **VISUS** method can be divided into three broad sections: characterisation, evaluation, and prescription for school safety upgrades. Teams used tablets to photograph structural and non-structural characteristics of schools and then match what they recorded to a set of pre-defined alternatives. The method related each alternative to different damage levels the school would likely experience in an earthquake.

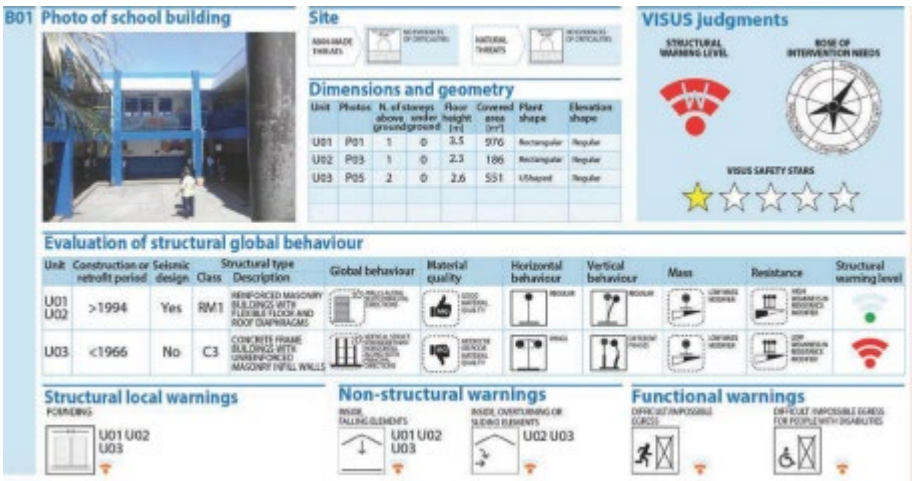
The newly trained surveying team did not always have the expertise to correctly perform the matching. However, the photos were sent to a scientific committee who approved this data and were able to fil in any gaps in experience. This double-checking helped verify the similarity of the collected data, and an algorithm then rated school buildings on a one to five star system ranked by risk and retrofit cost.

Due to its rigorous review protocol, **VISUS** was able to effectively train and immediately rely on local students and professors for site visits. By producing detailed and functional pictorial evidence, the oversight could be exported off-site, increasing speed and reducing costs.



People from the Ministry of Education, engineering associations, students, and professors of civil engineering practice rapid visual assessment of school buildings to determine which are most vulnerable to earthquakes. Photo: Jair Torres/UNESCO

A summary view of the VISUS rapid visual assessment of a school building



Using a series of screens to compare the three units to photos of different building types, and characteristics, the team can categorise each unit and consider global building behaviour, material quality, horizontal and vertical behaviour, building mass, and lateral resistance. The **VISUS** tool also asks teams to assess non-structural and functional issues. Following a rapid visual assessment, **VISUS** engineering experts review field assessments and photographs to ensure accuracy.

Challenges to this approach

In the pilot stages, the tablet app did not fully function in the field. Rather than allowing users to assess safety as issues were discovered, the tablet application forced users into a rigid linear progression of the five sections of the **VISUS** method. Quickly realising this problem, teams recorded information on paper and entered the data once they returned to university. The pictorial comparisons in the app were still essential, but the tablet app needed to be updated to function on the spot.

Rapid visual assessment is only the first step in creating safer schools. The work in El Salvador identified school buildings that were likely to be the weakest, and because the **VISUS** tool was used, it provided initial estimates for retrofitting or replacing them. While the results of the pilot study are promising, the long-term impacts to Salvadoran schools are still unknown. The Ministry of Education and other organisations still need to fund retrofitting and replacement. Engineers still

need to complete detailed assessments, including sampling materials from the schools and testing their strength, before creating retrofit or replacement designs.

Designed in Italy, **VISUS** focuses on structural types common in southern Europe. Applying this technology in other countries requires modification. The **VISUS** tool must include traditional building materials like adobe, and also needs to respond to a broader range of hazards in other settings. Currently, the team is conducting other pilot applications in Laos and Indonesia. This requires adapting the tool to entirely new building types and hazards, such as floods, tsunamis, and high winds.

Key lessons:

- Retrofitting programs can improve the hazard resistance of existing unsafe school buildings.
- When resources are limited, rapid visual assessment tools help quickly identify the weakest schools and the schools with the most vulnerable students.
- Local engineers may have little formal training in assessing existing structures for vulnerability to hazards.
- Partnering assessment experts with local universities can build the capacity of engineering students, faculty, and government officials.

School Community-Based Construction



Children play a safe construction card game, Bolikhamxay

Country: Laos
Organisation: Save the Children, Ministry of Education and Sports
Hazards: High winds, wildfires, floods

In Laos, the national Ministry of Education and Sports undertook an education sector analysis, which identified an urgent need to access information about the state and safety of school facilities and improve decision-making processes.

Save the Children supports Hazard Vulnerability and Capacity Assessment (**HVCA**) in Lao PDR. It supports this both at the community level, where it is led by the Village Disaster Management Committee and includes children, people with a disability, women and ethnic minority groups; and at the school level, led by the Village Education Development Committee and School Disaster Management focal person. Save the Children conducted these HVCAs to allow learning and sharing in the schools and communities and ensure an action plan was developed with locals.

The schools embarked on a series of activities to understand and raise awareness about hazards and vulnerabilities, as well as skills and resources. They also identified their Disaster Risk Reduction Plan (**DRR** Plan). This was guided by finding key messages for **DRR**, and activities that taught children and communities about safe construction method. This enabled communities to become familiar with risk in their environment and the structures that surround them, and to find solutions.

Once the School Disaster Management Plan (SDMP) and the community's **DRR** *Plan were drafted, a district-level technical working group was formed to review both the school and community plans, using quality checklists and markers.*

The technical working group consisted of staff from the Ministry of Education and Sports; Ministry of Natural Resources and Environment (including Department of Disaster Management and Climate Change, Department of Hydrology and Meteorology); Ministry of Public Works (including engineers); Ministry of Health; Ministry of Agriculture and Forestry; a representative from the Lao Women's Union; teachers and education staff; government officials from the provincial, district and community levels (including the village chief); NGO staff; and other relevant key experts.

Once all benchmarks were achieved, local government authorities approved the plans.

To support school safety, the Save the Children project was able to support the following activities in the DRR Plans:

- Buildings designed with hipped roofs for high winds
- Metal and clay roofs in dense foliage/forest area for wildfire resistance
- Retrofitting door hinges for safe evacuation (hinge doors to open outward)
- Ensuring functional access including access to water and sanitation and safe routes to school;
- Non-structural aspects including providing waterproof containers and brackets for shelving in flood-prone schools.

The communities themselves have contributed to completing SDMPs through school site upgrades, including digging drainage canals, planting trees on slopes for stability, regenerating riverbeds, and site clearing for evacuation.



Children and VDMC members discuss risk reduction intervention in their community, Luang Prabang

Save the Children used International **DRR** *day to create learning opportunities and promote risk reduction activities. Signposts drew attention to safety features of the construction methods, and members of the Village Disaster Management Committee (VDMC) and student leaders explained these features to the community and answered questions.*

Sustainable design: building from the ground up



Country: Republic of Ghana
Organisations: Sabre Charitable Trust, Arup International Development
Hazards: High winds, earthquakes, extreme temperature

Country and hazard overview

With a rapidly growing population, Ghana's education sector has struggled to keep up with demand. Nearly 30,000 public sector classrooms are in need of major repair and the country has a shortage of nearly 10,000 kindergarten classrooms.

In the country's de-centralised system, the process of constructing schools often begins with a parent-teacher association (PTA) or an elder petitioning the district assembly or district line ministry. The government body will then seek funds for construction, either from their own coffers, or by identifying a development agency willing to fund or even oversee a school construction project.

Communities typically contribute to building public schools by providing in-kind labour, materials, or cash to support a hired contractor. Community elders may also attempt to monitor construction to ensure contractors complete their contract, but safety remains a concern given the technical nature of the build.

Contractors failing to properly attach roof trusses to building frames is a common problem in Ghana. Many schools have lost their roofs in high winds, and similar damage can result from seismic tremors in the south of the country.

Incorporating sustainability into design

In 2008, Sabre Charitable Trust teamed up with technical experts from Arup International Development to design and construct safe, affordable, and environmentally sustainable kindergartens to meet the needs of communities living in central and western Ghana.

During design, the first step was in-depth research into local design and construction skills.

The design team ensured the materials were not just local, but also readily available, and even checked local markets to see what was for sale. They also aspired to 'build from the ground up', meaning they were literally attempting to pull resources from the earth and incorporate them into the school building.

When local building practices and conventional materials were not likely to produce a safe building, the team turned to research. They tested local materials, focusing on the strength and durability of local soil-based materials. Some communities used soil to produce bricks, but the quality of the soil

and manufacturing processes varied. These and other local practices had to be informed by tested engineering options that increased safety and durability.





An innovative facade made using pivoting bamboo shutters to allow the most t natural light and ventilation. Photos: Arup International Development and Sabre Trust.

Challenges: perceptions of local materials

Convincing communities to build with soil and other local materials proved challenging. In Ghana, communities wanted to use concrete and other materials they associated with development. Building school buildings completely out of natural and local materials, and following vernacular practices, put the school at risk of being seen as undesirable. Rather than disregarding the community's notion of progress and pushing local materials for the sake of environmental sustainability, the team had to build trust over time.

The community saw some value in vernacular design but also wanted modern materials. The team opted for a compromise in material choice consisting of a concrete frame, with traditional materials like bamboo and stabilised soil blocks used as infill walls.

At first, the prospect of building with mud seemed unappealing to the community. After training on how to improve manufacturing, which included sifting the soil and mixing it with local stabilising agents like portland cement and pozzalana, community members saw the result as an improvement. The improved soil blocks became more desirable, and proved stronger than the local concrete blocks. In addition, their involvement in the whole process of design and manufacturing gave the community a vital sense of ownership.

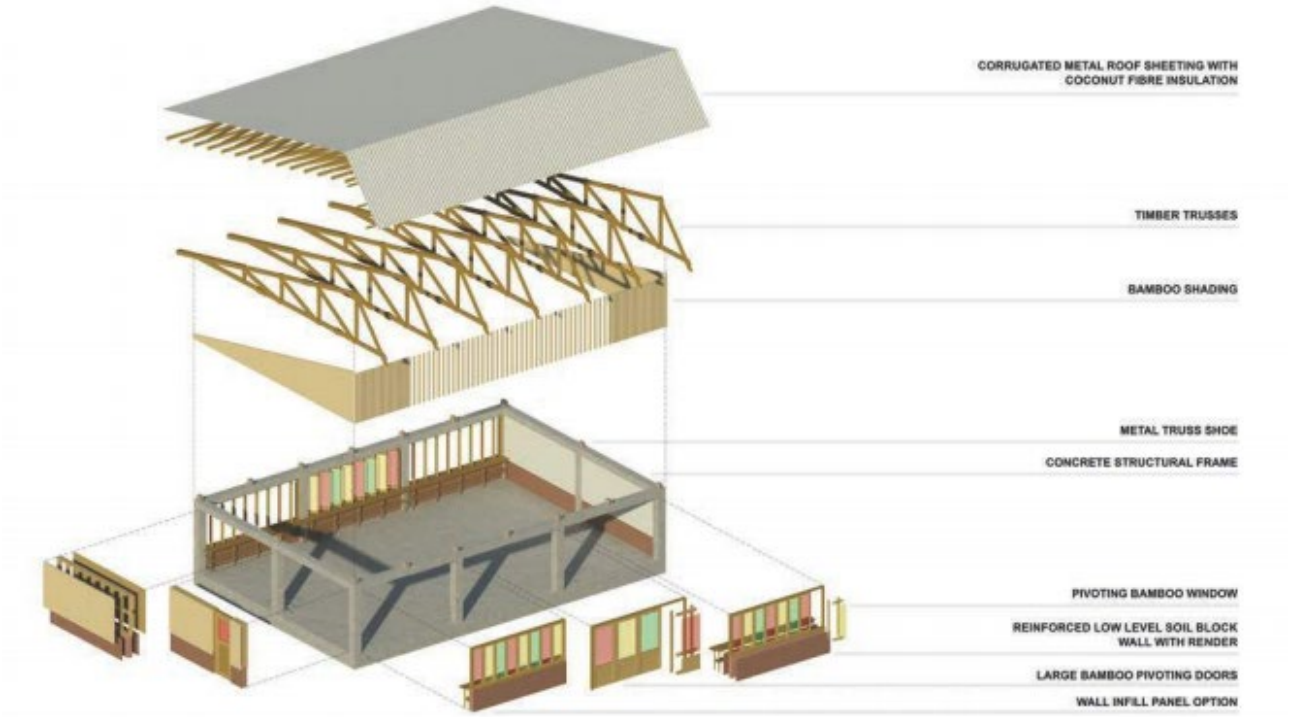
By using a concrete structural skeleton designed to resist seismic loads, infill walls could be made from renewable and local materials. This design feature, and the concrete frame's modular form, ensured the design could be scaled up and down, and duplicated. Locals were already erecting concrete frames, but at the time the construction quality was poor. The new designs allowed the community to increase local skills in creating vital structural elements for future infrastructure.

The concrete was made from using locally-sourced pozzolana (a mix of clay and palm kernels) as a 30 per cent substitute for portland cement. Using local materials for the infill walls also increased the building's sustainability and made it easier for communities to contribute to the building process and do routine maintenance. The durable concrete frame is designed to bear the force of shaking, high winds or other hazards. This provided the team with an opportunity to use different or new materials for the works without fear of compromising safety.

Design requirements focused on building for functionality as well as sustainable material choices. The design team created classroom layouts to meet performance criteria for daylight, temperature, and acoustics. This provided a high-quality learning environment without the need for external energy. Every building element had at least two functions so that no materials were wasted and add-ons were unnecessary.

Key lessons:

• Ensure the design team conducts in-depth research into local building materials, processes, and aesthetics.
• Understand the gaps in safety that may exist in traditional building techniques or current practices.
• Develop sufficient trust to show communities they can improve and refine traditional building techniques.
• When appropriate, draw materials from the natural environment. Be sure to use at a sustainable rate.



Training masons to build seismic-resistant schools



Country: India
Organisations: India's national and state governments, United Nations Development Programme (UNDP), World Bank
Hazards: Earthquakes

A state-wide school construction program

In response to the widening education gap, in 2004 the Uttar Pradesh State Government planned a massive school construction project.. At this time, the UNDP Disaster Risk Management Program (DRMP) as well as the Education for All (EFA) initiative were both underway at a national level. Some UNDP and Ministry of Education officials saw the school construction project as a chance for disaster risk reduction, and decided to teach the ministry and state government about safer schools.

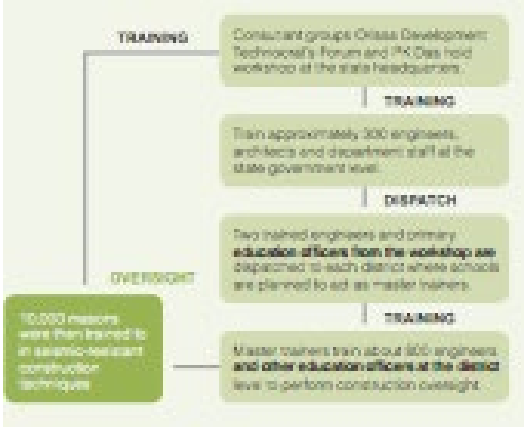
Influenced in part by devastation caused by the 2001 Gujarat earthquake (in which 15,000 schools collapsed) and two historic earthquakes in Uttar Pradesh, the state government decided to change their existing school design, which lacked earthquake safety measures. Under the DRMP, the Indian Government created the position of National Seismic Adviser, who was responsible for updating the existing design. Uttar Pradesh contained different earthquake zones, but given the large scale of the project the government decided to create a design suitable for the highest earthquake probability in the state.

The National Seismic Adviser changed simple features in the school design to increase its seismic resistance. These included:

- Moving doors 60cm from vertical joints
- Adding rebar to tie foundations and slabs together
- Placing three horizontal 'earthquake' ring beams along the walls (at the foundation, below the window, and above the window)
- Increasing the proportion of cement to sand and stone blast in the foundation.

After determining that the changes would add an additional 8 per cent to construction costs, the Ministry of Education entered a year of negotiations with the World Bank. The Ministry wanted to increase their longstanding loan that had supplemented national and state funding for EFA. With funds in hand, the state needed to train masons to build safer schools.

Challenges: training masons and inspectors in safer school construction



In 2005, the Ministry of Education and Ministry of Public Works organised a massive cascading training program (where newly-trained staff go on to train other staff) to teach hazard-resistant construction techniques to government engineers. These engineers then taught or supervised thousands of contractors and masons at the district level. Amid other DRMP activities, it took a few years to complete the training. In the process, the state government had to deal with a lack of knowledge and the huge extent of construction.



When Uttar Pradesh changed its school design to incorporate seismic-resistant features, the state needed to train masons in the new practices. Five-day training included practice on a mock building could teach one or two masons for each new school site how to construct earthquake ring beams in the walls. These trained masons then spread the knowledge to other masons on the construction site. Photo: Sanjaya Bhatia.

UNDP hired consultants to lead five-day training sessions for masons in communities where new schools were to be constructed. The first part of the training was a lecture to introduce masons to hazard-resistant construction and show them new techniques for earthquake safety. The latter part of the training was applying all-new, hazard-resistant construction techniques on a mock building, giving the masons a chance to translate the theory into practice. The mock building was only constructed to the window level, and was left in the community as a reference for masons to recall what they had learnt. During training, masons were paid their daily wages. Because of the scope of the project, only one or two masons were trained for each school construction site. However, they were able to pass their newly acquired knowledge to other masons working with them.

Tight quality control

Construction was overseen by trained engineers and applied by the trained masons. Masons and a school oversight committee knew the stages that required engineering inspection, the criteria for approval, and the tests conducted to ensure quality. Engineers monitored the masons as they poured the foundation, cast earthquake ring beams, and placed the roof.

With so much training over such a short time, the Uttar Pradesh government knew applying the new techniques would be inconsistent and would need further oversight.

To solve this problem, the team created a wordless manual with very simple pictures to show villagers what should be present at the foundation, and skill levels required. The manuals also showed community members how to determine the quality of cement. The village head was then issued pre-stamped postcards with a checklist of poor construction practices. If there was no

problem, the village head would send nothing back. If the government received a postcard, it would immediately send a trained inspector to determine whether a mistake had been made.

Through this method, many errors were caught early, and several buildings were actually demolished after finding irreversible mistakes. If the builder simply made a mistake, it was corrected. However, if the responsible party was corrupt, the builder was banned from future government construction projects.

By 2007, the state government had constructed 6,500 seismically safer schools and 40,000 additional classrooms. Programs of this scale only happen when countries attempt to fill large gaps in access to education. Even though programs on this scale are rare, they can be an opportunity to introduce new knowledge of hazard-resistant construction principles into communities and government agencies.

Key takeaways

- Countries addressing education gaps can embed hazard-resistant school construction into their rollout.
- Cascading training is an effective model for spreading new, hazard-resistant construction techniques to skilled tradespeople.
- During training, new construction techniques need to be tuned to the literacy level of skilled tradespeople
- Training programs should include hands-on practice so skilled tradespeople can apply new concepts.
- Monitoring systems via postcards can enhance traditional construction inspection in rural and remote school communities.

Influencing Comprehensive School Safety



Country: India
Organisations: SEEDS, Nayang Technical University, Ministry of Education, Ministry of Public Works, Temasek Foundation
Hazards: Earthquakes, flash floods, landslides

Creating a culture of safety

In a retrofit pilot project the NGO SEEDS used retrofitted schools as focal points to organise the community around Comprehensive School Safety. They especially focused on Pillar 2: School Disaster Management. This pilot project spanned the three Indian provinces of Himachal, Gujarat and Assam. Each state is in a moderate to high seismic risk zone and has a history of disasters.

To gain the interest of each community, SEEDS held basic orientations at schools to create awareness about Comprehensive School Safety. These orientations were a necessary introduction before building, but were also necessary to explain the school community's role in school safety, even after the retrofit was complete. The school community would be responsible for operating and maintaining the retrofitted building, improving non-structural elements,, and regularly conducting school disaster management activities. This phase often took six months in conjunction with mason training and other engagement activities. SEEDS anticipated that the school retrofit and disaster management activities would be able to promote a culture of prevention and preparedness in the local community.



The retrofit of schools in Shimla, India, is part of a broader Comprehensive School Safety approach. After retrofitting is complete, the school and wider community engage in a mock drill to test their readiness. Photo: SEEDS. I

After a school was retrofitted, SEEDS held training in disaster preparedness for community members, school staff and students. The training included search and rescue, fire safety, first-aid, safe evacuation, and creating emergency plans. Students were also trained in 'duck, cover, and hold' methods in case of earthquakes and safe evacuation. Special training was also provided to school staff to create a school disaster management plan. Together, the school retrofit and the accompanying 'soft' activities with the school community were expected to help promote a culture of prevention and preparedness in the local community.

SEEDS then formed school disaster management taskforces based on the training. There were further divided into functional groups, including search and rescue, first-aid, fire response, and a group to connect with the local government offices. The taskforce members included local leaders and representatives from parent-teacher associations and school clubs.

Establishing a Joint Action Plan

After the school community became aware of disaster risk reduction principles, SEEDS established a Joint Action Plan which connected the school taskforce with the larger community. They performed outreach to ensure the wider community knew the school could be a gathering point in a flood, earthquake, or other sustained hazard. By strengthening this connection, SEEDS wanted to ensure the community benefited from the training and disaster management planning at the school.

Even though the school was likely to operate as a safe haven (and that school taskforces would take leadership roles during a disaster), SEEDS also taught communities emergency preparedness skills and basic hazard knowledge in case the school became seriously damaged.

The Joint Action Plan was designed to help the taskforces react to disasters as well as protect children during their routine interactions with school. One proactive measure included consistent updates for parents on the whereabouts of their children. Disaster or not, if a bus was late, parents were sure to get a call explaining why.

For school communities, the experience culminated with a drill, where the school, fire department, the hospital and local government played the part they would function in a real emergency. SEEDS identified earthquake drills as the most useful exercise to see how prepared students, staff, and communities were. They encouraged the local government to mandate the drill to ensure everyone participated.

After being given a signal, students responded with ‘duck, cover, and hold’ as they had been taught during the disaster preparedness training. They then evacuated the school buildings following the practice of ‘don’t run, don’t push, don’t talk, don’t turn back’. Students left the building by class and organised at a set assembly point.

Realistic scenarios in the drill included some students that were ‘trapped’ in the school or missing. The search-and-rescue taskforce then had to respond by finding the missing people and providing aid. If the missing students were injured, they would be connected with the hospital. It was not just adults that role-played; students also practiced their response skills, and identified damaged buildings, rescued each other, performed first-aid and put out fake fires. The drills were both realistic and exciting.

The biggest challenge for students was to evacuate quickly and establish coordination among the taskforces. However, they became more efficient through multiple practices of the mock drill.

Overall, the process of community engagement, retrofitting buildings, and practicing drills took a full year. On completion of the project, SEEDS handed the project details (including the disaster management plan, guidelines for retrofit and other project details) to the local education department for implementation in other schools. The governments in several provinces have adopted the initiative for widespread duplication.

Key lessons



- Safer school construction should be integrated into a Comprehensive School Safety program.
- Lessening risk in non-structural building elements is an integral part of Comprehensive School Safety, and a part in which students and staff can actively participate.
- Safer school construction projects provide motivation for engaging communities in school disaster management.
- School drills, especially when coordinated with the wider community, can help encourage a culture of safety and provide good opportunities for practice.