Developing a Schools Infrastructure Inventory in a Small Island Developing State

Overview

Country: Tonga

Stakeholders: Ministry of Education, World Bank, Arup

Hazards: Tropical cyclones, Earthquakes, Tsunami, Flooding

Summary: The prioritization of school infrastructure maintenance, repair and replacement is a challenge across Tonga due to a lack of reliable data on the condition of facilities and a limited understanding of the natural hazards that pose a risk to school buildings. The Government of Tonga is embarking on a process of surveying and ranking school buildings based on their upgrade or replacement requirements. Combining existing information on school infrastructure with natural hazard data, into a comprehensive baseline inventory, will support the development of a tool to prioritizes investments in school infrastructure that is most at risk from natural hazards.

CONTEXT

Providing safe school infrastructure in a small island nation

The Kingdom of Tonga comprises of 177 islands spread across 700,000 square kilometres adjacent to the Tonga trench and within the 'cyclone belt' of the Pacific. Due to its high exposure to tropical cyclones, earthquakes and tsunami, in 2015 the United Nations University rated Tonga on its Disaster Risk Index as the second most vulnerable nation globally. Tonga has 140 Primary schools and 37 secondary schools spread across the four main island groups, which provide education to over 18,000 children. With much of the population located in low lying areas there is a high risk of inundation from tsunami and storm surge, as seen in 2009 when a magnitude 8.3 earthquake and subsequent tsunami struck the northern islands of the Nuias. Following this, in 2014, the Category 5 Cyclone Ian crossed the central Ha'apai island chain, destroying 17 schools and disrupting the education of 1300 students.

This case study is based on a diagnosis of Tonga undertaken by Arup on behalf of GPSS in 2015.

OBJECTIVES

A framework to prioritise investment in schools

The Ministry of Education and Training (MOET) is the key agency responsible for school infrastructure, and whilst there is currently no demand to increase the number of new schools, the challenge lies in prioritising the maintenance, retrofitting and replacement of existing school buildings to reduce their exposure and vulnerability to natural hazards. The World Bank have approved a US$16m grant to the Government of Tonga (GoT) through their Pacific Resilience Program (PREP), 10% of which is allocated to school facilities. This provided an opportunity to develop a decision making tool that prioritizes the 'best value' investments by evaluating all school infrastructure against key criteria on building condition and vulnerability, the number of students and the level of exposure to natural hazards. Currently data on natural hazards and school infrastructure is spread between three Ministries; MOET (school condition and valuation survey, 2015); Planning and Urban Management Agency (PUMA, hazard mapping, 2009); and Ministry of Infrastructure MoI, GIS data management system. Combining data from these three sources into a centralized geo-spatial asset management database will help the MOET to understand the risk baseline.

METHODOLOGY

Collecting and collating survey data to form a school infrastructure baseline

The first step in the development of the database is to understand the existing condition, vulnerability and exposure of schools across the islands. In 2015, a survey commissioned by the MOET assessed all school buildings nationally, assigned each building a depreciated value and quantified the nature and scale of works required to return them to a safe and serviceable condition. The survey identified structural typologies and examined the condition of components including the building fabric, finishes, power and water systems and sanitation facilities. Developed in spreadsheet and report format, the information exists as a stand-alone resource that identifies schools with the greatest infrastructure needs.

To validate data from this survey, consultants to the Global Program for Safer Schools (GPSS) developed a 'Rapid Visual Assessment' (RVA) which allowed engineers to quickly 'spot check' selected schools and capture relevant data using the tablet based app 'Fulcrum'. The spot check focussed on identifying the key structural vulnerabilities, or 'weakest links' of school buildings and collated results in a geo-located format that could be cross-checked against MOET data. By collating data on key vulnerabilities across a number of schools, patterns emerged about the way that buildings were planned, designed,

constructed and maintained across Tonga. This information can be used to inform the development of an investment program for the repair, retrofit and reconstruction of existing school infrastructure.

Similarly, the MoI, who are responsible for the engineering review of building designs and inspections during construction, maintains a geo-spatial database with information on government assets. In addition to this, PUMA, who are responsible for planning approvals, carried out a hazard analysis from which it developed inundation maps and a geo-spatial hazard database. This resource is used to understand the hazard profile of proposed building sites and inform the planning approvals process. The key opportunity arising for the GoT is the integration of these three resources into a centralised asset management database which will form the decision making tool for investment in safer schools.

Standard engineered school designs developed in 1982 following Cyclone Isaac have been shown to withstand multiple intense storms, but require urgent maintenance to ensure their long term viability.

CHALLENGES & OPPORTUNITIES

Converting information into knowledge

Collecting the survey data to establish the baseline was a relatively straightforward task due to the limited number of schools Tonga, although their dispersion across multiple island locations increased the time taken to carry out the surveys. Experienced local and international consultants were employed to populate and review the data collection. The key challenges associated with bringing information together into a consolidated, decision making tool is to present it in a format that is appropriate and accessible to the Ministry staff responsible for school infrastructure. Understanding the capacity and capability of staff, leveraging their strengths and providing training to address the gaps in knowledge will be crucial to the successful implementation of the tool.

The consideration of exposure to hazards will provide another challenge for establishing the key criteria and mitigation options for the prioritization of investments. Due to the low lying nature of the islands, many school locations are exposed to inundation from tsunami and with limited options for relocation will need to include early warning systems into their disaster preparedness strategies.

OUTCOMES

Developing a pilot program for school retrofitting

Compiling the school infrastructure baseline inventory enabled the identification of high priority buildings to be retrofitted through a pilot program as part of the PREP, which will focus on improving the safety of the most vulnerable school buildings. Utilizing observations from the RVA on the key structural vulnerabilities, the program will develop a 'retrofitting heirachy'. This heirachy will outline the critical elements required to ensure the structural integrity of buildings and assist decision makers to make informed choices on how limited amounts of funding are spent within schools. Lessons learnt from the pilot will form the basis of the longer term MOET work plans and potentially larger retrofitting programs in the future.

Work through the GPSS has highlighted the need for a coordinated approach between government ministries to make full use of the existing data that is available on existing school locations, condition and the hazard risk profile of each school site. Combining this data into a decision making tool will foster a cross-institutional awareness of hazard exposure and help the GoT to develop a targeted approach to school maintenance, repair and reconstruction.

Learning

- Developing an accurate and accessible geospatial asset management database of existing school infrastructure, with all the relevant decision making data, is vital to assist Ministries to make strategic decisions on their program priorities.
- The collection and analysis of material contained in the database is essential to identifying the patterns, trends and processes that lead to poor quality construction, and vulnerable school buildings.
- Increasing the awareness of key structural vulnerabilities is important, so that works fundamental to building integrity are addressed before the repair of non-critical building elements.
- Due to the manageable scale of this small island developing state, Tonga is in a unique position to rapidly evaluate and prioritize investments for a school infrastructure reconstruction and retrofitting program.

Find out more

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