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Bridging the Safety Gap: Earthquake Desks to Protect Children in Vulnerable Schools in Nepal

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Abstract: The Earthquake Desk is a specially engineered classroom desk designed to protect schoolchildren from falling debris by providing a safety zone underneath for taking shelter during earthquakes. Unlike conventional school furniture, Earthquake Desks are built to withstand heavy loads that may fall during building damage or collapse. Initially developed in Israel, the design has since been refined and adapted for local manufacturing in Nepal, prioritizing impact absorption, affordability, and functionality in typical school environments.

Nepal-built Earthquake Desks were assessed through a series of structural evaluation tests including compression loading, shock-table simulations, and live drop demonstrations. Results show the Desks can resist at least 98 kN (22,000 lb) of compressive force while maintaining the safety zone. Dynamic, shock-table testing of full-scale stone walls and slate roof collapsing onto the Desks produced only cosmetic damage. Impressive Desk performance during live demonstrations of ~700 kg of rocks dropped onto a Desk from 3 m height generated stakeholder interest. Earthquake Desks are not a replacement for earthquake-resilient school buildings, but offer an immediate, low-cost, and scalable life-safety solution for students in vulnerable classrooms while long-term seismic risk-reduction efforts advance.

Keywords: ***Earthquake desk, School safety, Interim solution.***

Introduction

Nepal lies within a major active seismic zone, where frequent earthquakes and vulnerable infrastructure pose life-threatening risks to school-aged children. The 2015 Gorkha earthquake demonstrated this vulnerability, damaging over 35,000 classrooms (NPC, 2015; MoE, 2016). Most public schools remain unreinforced masonry or poorly detailed reinforced-concrete structures (UNDRR, 2019). Although national school safety programs are progressing, thousands of seismically vulnerable buildings will remain occupied for years due to limited funding and logistical challenges.

Given this reality, there is a need for immediate, practical, and scalable protection measures. The Earthquake Desk (hereafter EQ Desk) can provide a safety zone where children can shelter once shaking begins for protection during damage or collapse of single-story buildings made of stone in mud mortar (Figure 1). The Desks absorb vertical loads and shield against falling debris. EQ Desks are not a replacement for resilient construction but a life-saving bridge until safer schools are built.

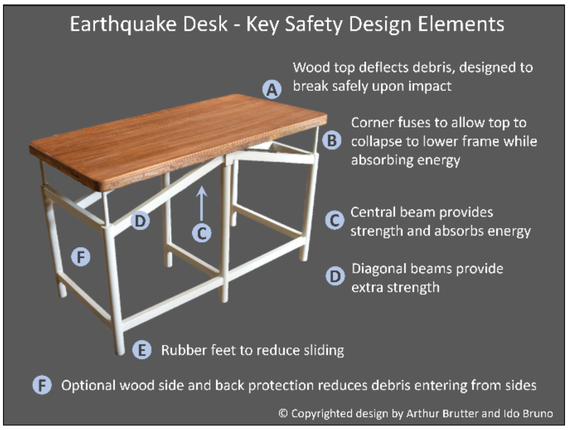

Figure 1, Key features of the Earthquake Desk.

Methodology

Design and localization in Nepal

The Earthquake Desk was originally developed in Israel and later manufactured and tested in Bhutan as a life-saving device for classrooms. In Nepal, Desks have been produced using local materials and evaluated through model simulation, physical testing, and community demonstration through collaboration with government, local engineers, and disaster risk reduction practitioners.

Key Nepal-specific modifications included:

- Use of locally sourced steel and plywood
- Side protection panels to block debris
- Size variations for primary and secondary students

Local manufacturers in Kathmandu and Nepal's Far West were trained to build the Desks, demonstrating replicability in both urban and rural markets.

Prototype design and testing

The first formal physical tests of the EQ Desks were performed at the University of Padua, Italy on Desks manufactured in Israel (Modena et al., 2012). In 2016, Bhutan manufactured EQ Desks and conducted drop-tests comparing them to standard school desks.

Physical tests of EQ Desks manufactured in Nepal were conducted to better understand how they are likely to behave in vulnerable Nepali school buildings during strong shaking. Compression and shock-table tests were designed to generate the largest reasonable demands on a Desk inside of a single-story, stone masonry school. Live demonstrations were conducted where a mass of 700 kg of rock was dropped from 3 m above (height of a typical one-story building), simulating debris impacts from a classroom roof and walls.

Results and discussion

The Earthquake Desk prototypes demonstrated strong structural performance during all test phases. Under vertical compression loading (Figure 2), Desks absorbed 98-168 kN before reaching significant deformation thresholds, depending on loading scenario and Desk size. The primary-sized Desk introduced in Nepal supported larger loads than secondary Desks.

Figure 2, Vertical compression tests (top) and shock table test (bottom) of the EQ Desks.

Desks undergoing the shock-table testing (Figure 2) revealed no structural failure, frame buckling, or joint separation. Damage was limited to minor surface-level effects, including delamination of plywood edging and small dents on steel components, none of which compromised the "safety zone" beneath the Desk. The addition of side-protection panels significantly reduced debris accumulation under the Desk, providing a meaningful safety enhancement of the EQ Desk design.

Live stakeholder drops demonstrations provided visually dramatic demonstrations of the EQ Desk's preserved safety zone, demonstrating its protective performance (Figure 3).

Unlike traditional desks, which often break, overturn, or collapse under heavy loads, the EQ Desk is engineered to absorb impacts and remain stable. For Nepal, the Desks have high potential relevance. They can be manufactured locally, supporting small and medium industries while reducing transport costs. Desk affordability and adaptability to both rural and urban school settings, makes it an appealing complement to long-term disaster risk reduction efforts.

Importantly, EQ Desks are not a substitute for earthquake-resilient school construction but can be an interim protection measure for children who remain at risk. Community demonstrations in Nepal have shown that parents, teachers, and local governments respond positively once they witness the Desk's performance.

Figure 3, Drop demonstration of EQ desks.

Conclusion

The Earthquake Desk presents a feasible, low-cost intervention to improve school safety in Nepal's high-risk seismic environment. Scaling up adoption in Nepal would require coordinated action, including pilot deployment in high-risk schools, government endorsement through the government, and investment from development partners, NGOs, and corporate social responsibility programs. Challenges remain in ensuring affordability, standardizing testing and certification, and integrating the solution into national policy frameworks. However, with support, the Earthquake Desk can play a critical role in safeguarding children in the near term while the country continues to work toward resilient school infrastructure in the long term.

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