EERI Policy White Paper

Earthquake Engineering Research Institute 499 14th
Street, Suite 220
Oakland, CA 94612-1934
510-451-0905
eeri@eeri.org

Mitigaton of Nonstructural Hazards in Schools

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EERI Policy Position

Students, staff, and faculty should be kept safe from injury by nonstructural items in school buildings in regions for which earthquake risk has been identified.

Background

Earthquake risk to school buildings stems not only from the hazard (location and magnitude of the event) but also from the vulnerability of the building and its components. Based on ground motion hazard alone, earthquake risk may exist if the International Building Code (IBC) Seismic Design Category is "B" or greater, or if there is a history of earthquakes in the area.

Nonstructural falling hazards pose a great risk to students, staff, and visitors in schools during earthquakes. Nonstructural items like ceiling tiles, light fixtures, bookshelves, file cabinets, computer monitors, projectors, vending machines, chimneys, parapets, large windows, and other items can fall and injure or kill occupants and block safe building egress. This has been shown in many United States and international earthquakes, including most recently in the August 2014 South Napa Earthquake in California. Some of the damage to schools could have been life-threatening had this earthquake occurred during school hours. (Gillengerten et al., 2015). While modern buildings generally met or exceeded code performance standards in this moderate Mw 6.0 event, damage to nonstructural components was the greatest contributor to property losses. (Johnson, et al., 2016). In many other earthquakes, injuries and deaths of students from these hazards have also been narrowly avoided because the earthquakes occurred outside of school hours. For example, in the 1994 earthquake in Northridge, California, light fixtures weighing up to 80 pounds each fell on students' desks in approximately 100 classrooms. Had the earthquake occurred during school hours, many students, staff, and faculty would have been injured (Reitherman et al., 1995). Another example is the 2018 Anchorage, Alaska earthquake where school buildings sustained major nonstructural damage (EERI, 2021).

Lights fell onto desks in a Northridge Junior High classroom during the 1994 Northridge earthquake. School was not in session, so no injuries occurred (photo: Gary L. McGavin, source: Reitherman et al., 1995).

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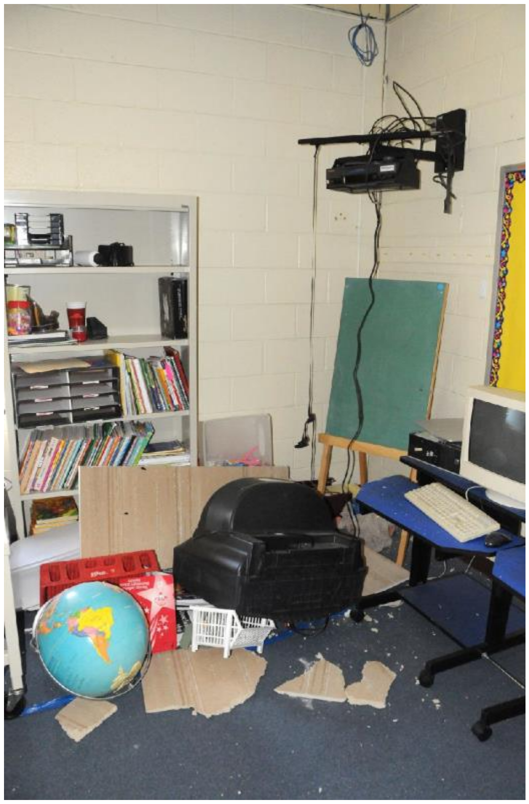

2011 5.8 M_w Mineral, Virginia earthquake. Fallen television in the classroom. (Pettit, 2014)

Damage to ceiling tiles in classroom of Eagle River Elementary School (EERI Earthquake Reconnaissance Report: M7.1 Anchorage Earthquake on November 30, 2018; photos: Chris Motter).

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Nonstructural items that can pose a falling safety hazard to students include, but are not limited to the items listed below. Many of these items can fall with great force during earthquakes, and often can limit or prevent safe building egress:

- Ceiling tiles/materials
- Light fixtures
- Bookshelves
- File cabinets and other tall cabinets
- Computer monitors, televisions, and projectors
- Vending machines or other equipment
- Chimneys
- Parapets
- Large windows

These nonstructural hazards can be found in many other buildings with other uses, but several considerations set school buildings apart from other buildings in terms of priority for seismic assessment and mitigation:

- Schools are the only high-occupancy public buildings other than prisons and courthouses whose occupants are compelled by legal mandate to be inside them.
- Students are considered to be a vulnerable population due to their age and their developmental stage. Children are dependent on adults to provide safety, whereas adults are presumed capable of consenting to and accepting risks.
- School buildings in many communities remain in use longer than comparable structures in private ownership, and tend to receive less frequent and less consistent capital renewal investment.
- Community members and public officials often hold a high (sometimes unfounded) expectation that schools will provide community shelter or host public services in the wake of a natural disaster. (Wolf and Wang, 2014).
- Schools provide de facto daycare for children, thus school closure after earthquakes limits the ability of parents to go to work, an essential part of community recovery.
- Casualties among school children are particularly devastating to communities because children are a community's future.
- Schools that have been, or are planned to be, designated as shelters fall under IBC Risk Category IV and require additional bracing of nonstructural components.

Nonstructural mitigation for many items is inexpensive and can often be completed by facility staff or volunteers (FEMA, 2017; FEMA, 2012). This is an easy first step for existing schools to take when working to identify, prioritize, and mitigate their earthquake risks. However, mitigation for many building components, such as parapets, chimneys, fire protection sprinkler systems, and egress stairways is more expensive and requires technical expertise.

During mitigation work for nonstructural items, it is also important to consider and check the following items also critical for school earthquake safety:

- Structural integrity of the building,
- Utilities and other support systems (e.g., gas, water, electric power),
- Equipment and systems needed to accelerate reopening of the school and/or facilitate use as an emergency shelter (i.e. sanitation supplies, water storage, structural engineering contract in place for safety assessment prior to reopening, etc.).

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EERI is dedicated to promoting safe buildings for school children through its School Earthquake Safety Initiative, a global and collaborative network of diverse, expert, and passionate professionals who are committed to creating and sharing knowledge and tools that enable progressive, informed decision making around school earthquake safety (EERI, 2016).

EERI also supports additional measures to increase the seismic safety of schools, beyond nonstructural mitigation. For example, the importance of mitigating all schools with vulnerable building types through retrofit or replacement is clearly stated in the Western States Seismic Policy Council's Policy Recommendation 19-10 entitled "Joint Policy for the Evaluation and Seismic Remediation of School Buildings," which is also supported by EERI.

Needed Action

To ensure that mitigation of nonstructural hazards becomes a top priority for schools, EERI advocates that legislatures, school districts, and school boards in regions for which earthquake risk has been identified should:

1. Establish programs to identify, prioritize, and mitigate nonstructural hazards in schools.
2. Establish funding mechanisms, financial assistance, and incentives to finance mitigation of nonstructural hazards. Examples include the Building Resilient Infrastructure and Communities (BRIC) program and Salt Lake City's self-funded nonstructural hazard mitigation manual.
3. Require anchoring and bracing of potential falling hazards and ensure safe egress from schools after earthquakes.
4. Encourage additional training by stakeholders for nonstructural school safety, such as the National Earthquake Technical Assistance Program's training: Classroom & Beyond: Reducing Earthquake Risk in the Classroom and Beyond: Seismic Mitigation of Nonstructural Hazards in Schools (NETAP, 2021).

Further considerations for safe schools should include a screening to assess the integrity of the school building, retrofitting or replacement of school buildings found to be vulnerable to earthquake shaking, checking of utilities and other systems important for rapid recovery after earthquakes, and creating community resilience plans that align and prioritize mitigation efforts.

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