EERI Policy White Paper

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Mitigation of Nonstructural Hazards in Schools

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EERI Policy Position

Students should be kept safe from injury from falling nonstructural items in school buildings in regions with high and moderate earthquake hazard.

Background

Nonstructural hazards pose a great risk to students, staff and visitors in schools during earthquakes. Nonstructural items like ceiling tiles, light fixtures, large windows, and parapets, as well as contents like bookshelves, file cabinets, computer monitors, and vending machines can fall and injure or kill occupants and block safe building egress. This has been shown in many US and international earthquakes, most recently in the August 2014 South Napa Earthquake in California (Gillengerten et al., 2015). In many earthquakes, injuries and deaths of students from these hazards has 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 would have been injured (Reitherman et al., 1995). Similar damage patterns were observed in the 2014 Napa earthquake. In addition to the safety risk, the performance of nonstructural components has a disproportional effect on the recovery time of any school building.

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

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

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.

Nonstructural mitigation for many items is inexpensive and can often be completed by facility staff or volunteers (FEMA, 2012). This is an easy first step for schools to take when working to identify, prioritize, and mitigate their earthquake risks. However, mitigation for some building elements, such as parapets and chimneys, is more expensive and generally 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.)

Because schools support a range of community functions, and because a return to normalcy requires the return of schoolchildren to safe and functional schools, an emphasis on nonstructural components and contents is consistent with EERI's related Policy Position on Creating Earthquake-Resilient Communities.

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 13-10 (soon to be updated to 16-10) titled "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 with high and moderate seismic hazard should:These plans are most successful when they incorporate some or all of the following principles and actions:

1. Establish programs to identify, prioritize, and mitigate nonstructural and contents hazards in schools.
2. Establish funding mechanisms, financial assistance, and incentives to finance mitigation of nonstructural and contents hazards.
3. Require nonstructural anchoring and bracing of potential falling hazards to ensure safe egress from schools after earthquakes.
4. Prioritize anchoring and bracing of recovery-critical nonstructural components to ensure acceptable recovery of normal school functions.

Further considerations for safe schools should include a screening to assess the structural integrity of the school building, retrofit or replacement of school buildings found to be vulnerable to earthquake shaking, and creating community resilience plans that align and prioritize mitigation efforts.

References and Sources for More Information

Earthquake Engineering Research Institute (EERI), 2016. School Earthquake Safety Initiative (SESI) web page, available at https://www.eeri.org/projects/schools/

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More information on this policy and EERI's Public Policy and Advocacy at: https://www.eeri.org/advocacy-and-public-policy/