December 31, 2013

Honorable Jay Nixon
Governor
State of Missouri

Dear Governor Nixon:

On behalf of and at the direction of the Missouri Seismic Safety Commission (MSSC), I herewith submit two requests regarding a serious problem that threatens the health and well-being of thousands of Missouri school children, teachers and other school personnel. The Commission has significant concerns that some school buildings will not be able to withstand the consequences of a large earthquake on the New Madrid fault, resulting in death and injuries to students and staff in these buildings. Due to the vulnerability of a majority of the older school facilities in the southeastern region of Missouri, the MSSC is putting forth the following requests:

Request #1  The commission requests that you support legislation that would require each school district in the 46 counties and City of St. Louis that are considered to be "at risk" from a M 7.6 earthquake to either request an enhanced Rapid Visual Assessment (RVA) screening under the auspices of MSSC using volunteer professionals provided by professional societies, or to allow the district to contract for an evaluation by a qualified engineer.

Request #2  The commission requests that you support legislation that would provide funds for SEMA to support travel expenses for the volunteers and also some staff support for SEMA to coordinate the assignments of teams for requested Rapid Visual Assessment (RVA) screening evaluations and training for the team leaders.

The MSSC believes that these steps are essential in providing school districts with information that will enable them to develop safety planning and mitigation efforts that will save lives in both seismic and high wind events.

For a more detailed description of the background information about these requests, please see the attached report.

Sincerely,

[Signature]
Raymond E. Bailey, Ph.D., R.G., P.E.
Chairman, Missouri State Seismic Safety Commission
Report on School Facilities
Vulnerability to Failure in a Seismic or High Wind Event

To: Governor Jay Nixon

From: The Missouri State Seismic Safety Commission

December 31, 2013
Special vulnerability of children in deficient school buildings

The focus of this report is school children and associated adult personnel. This group, along with some other populations that may be confined in unsafe buildings such as prisoners and hospital patients, are regarded as among the most vulnerable to the initial earthquake shock, or high wind event such as a tornado, and to the difficulties of escaping from a damaged structure. The MSSC has established earthquake safety of schools as a high priority throughout its existence and is proposing proactive measures to reduce the exposure of the precious children of our state to a potentially destructive earthquake.

General characteristics of schools in SE Missouri

Since Missouri does not have a state-wide building code, it is expected that school buildings in communities without locally adopted codes will have significant deficiencies in seismic resistance. Furthermore a school building that might appear to be a single structure is likely to be an assemblage of parts constructed in different eras. So even if a code is presently in place, parts of the building might predate the code and not possess adequate seismic resistance. A widely used construction material in older buildings is unreinforced masonry, which is regarded as particularly vulnerable to strong earthquake shaking.

For the purposes of prioritization, it is useful to rely on a list of 46 counties plus the City of St. Louis that are considered to be at risk from a M7.6 earthquake on the New Madrid fault. From the 2010 census, their combined population is about 3 million people.

This list, the so-called "at risk" schools, has been referred to in earlier legislation. In the 46+ counties, there are 242 school districts, 1023 Public schools, 309 Private schools and 15 schools for the severely disabled. Some of large schools may have several buildings. With this large number of buildings, it is essential to develop a strategy to select the order of evaluation. An obvious goal is to assess the most vulnerable buildings first, based on factors such as type and age of building, construction material and local seismicity. The MSSC has the expertise to guide this task. At the same time, it would be valuable to have representative assessments for a variety of building types and ages early on so that subsequent selections could be directed toward districts that would yield new information.

Brief description of earthquake hazard in Missouri

A series of earthquakes hit the New Madrid seismic zone (NMSZ) encompassing SE Missouri NE Arkansas and adjacent parts of Tennessee and Kentucky in December, 1811 through February,1812. These earthquakes were among the largest to strike North America since European settlement. As a basis of comparison, the main shocks affected an area 2-3 times larger than the 1964 Alaska earthquake and 10 times larger than the 1906 San Francisco earthquake. While the damage to natural features was considerable and widespread, the injuries and deaths were few as the area was sparsely settled. Obviously today the devastation would be much different affecting large parts of the eastern half of the country.

There is broad agreement in the scientific community that a continuing concern exists for a major destructive earthquake in the New Madrid region. This is based on evidence that the New Madrid seismic zone has produced major earthquakes for perhaps 4,500 years. Such high seismic hazard requires prudent measures such as adequate building codes to protect public safety and ensure the social and economic resilience of the region to future earthquakes.
Rapid Visual Assessment (RVA) as an initial evaluation tool

For the purposes of assessing the vulnerability of large groups of facilities, RVA is a widely accepted procedure based on FEMA 154. This methodology enables qualified engineers to quickly and economically identify, inventory and rank buildings that are potentially vulnerable to ground shaking. An evaluation yields a numerical score that indicates the life-safety of the building following a major earthquake. A high score suggests that the building may be seismically vulnerable and further evaluation is recommended. While this methodology is useful and supported by convenient forms and software, it is insufficient to provide the type of information that would be needed to guide the seismic upgrading of a specific facility as described in the next section.

Enhanced RVA developed for evaluation of Missouri schools

The RVA is designed as a “drive-by” operation with entry to the facility not required. The pilot MSSC school evaluation program described in the next section enhanced the RVA by 1) Requesting that the school provide a maintenance person to guide the team through the facility; 2) Requesting that the school district make drawings and other documents available to the team at the site; 3) Considering each of the major parts of the facility individually and establishing the approximate year of construction, the building type, and other detailed information. 4) Carefully examining and documenting the non-structural components in each part of the facility. Even though damage to the non-structural items are not supposed to result in collapse, they can still cause injuries or fatalities. As will be indicated in the following section, strengthening of non-structural components is a cost effective way for districts to reduce seismic hazards and can often be carried out with community volunteers and maintenance personnel.

Description and results of pilot studies carried out by MSSC

To demonstrate the application of the enhanced RVA procedure, two school districts in SE Missouri agreed to participating in a pilot project with the MSSC. The assessments were carried out by volunteer teams of engineers who are affiliated with respected professional organizations such as the Structural Engineers Association of Missouri and Kansas (SEAKM) and the Earthquake Engineering Research Institute (EERI), New Madrid Chapter. Each evaluation required two teams of two persons each and some observers from the MSSC and were carried out over a two-day period.

Detailed reports were prepared and transmitted to the districts. In general most buildings, except for a few recently constructed parts that indicated code compliance, would require further evaluation because of their age (before seismic requirements were included in applicable codes) and the high default seismicity at their location.

Also buildings constructed primarily of unreinforced masonry (URM), which is prohibited by current codes, receive a high score. Both plan and vertical irregularities resulting from building parts constructed at different times also receive high scores. In any case, adopting the default site conditions for buildings in this region in the absence of a local site study produces a high score. The detailed examination of non-structural components in the two buildings revealed that these districts have taken measures to reduce hazards by such simple procedures as anchoring bookcases and computers and tying ceiling tiles. Furthermore casual conversations with teachers and students during the visit revealed an awareness of the seismic hazard in SE Missouri. It is noted that several other school districts in SE Missouri have benefitted from small grants from FEMA through SEMA to carry out nonstructural retrofit.
Expansion of enhanced RVA evaluations for all school buildings in most vulnerable earthquake regions of Missouri

The pilot studies have shown the feasibility of carrying out enhanced RVA assessments of schools using volunteers from professional organizations and coordinated by the MSSC. The remarkable participation of Missourians in the SAVE coalition indicates that there are many engineers who would be willing to serve as volunteers. The “at-risk” schools as defined in the earlier section would receive the highest priority.

The confidentiality of the results, which the MSSC has protected with the pilot studies, is an important issue. However the commission feels that the assessments should not be voluntary. Rather each school district in the “at-risk” category should eventually participate in an assessment. The results could be kept confidential for a specified period, perhaps six months, but would then be open.