Missouri School Seismic Safety Initiative

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Agenda

Importance of schools

MO Seismic Safety Commission (MSSC)
School Earthquake Safety Initiative

- Risk Identification
- Plan
- Actions

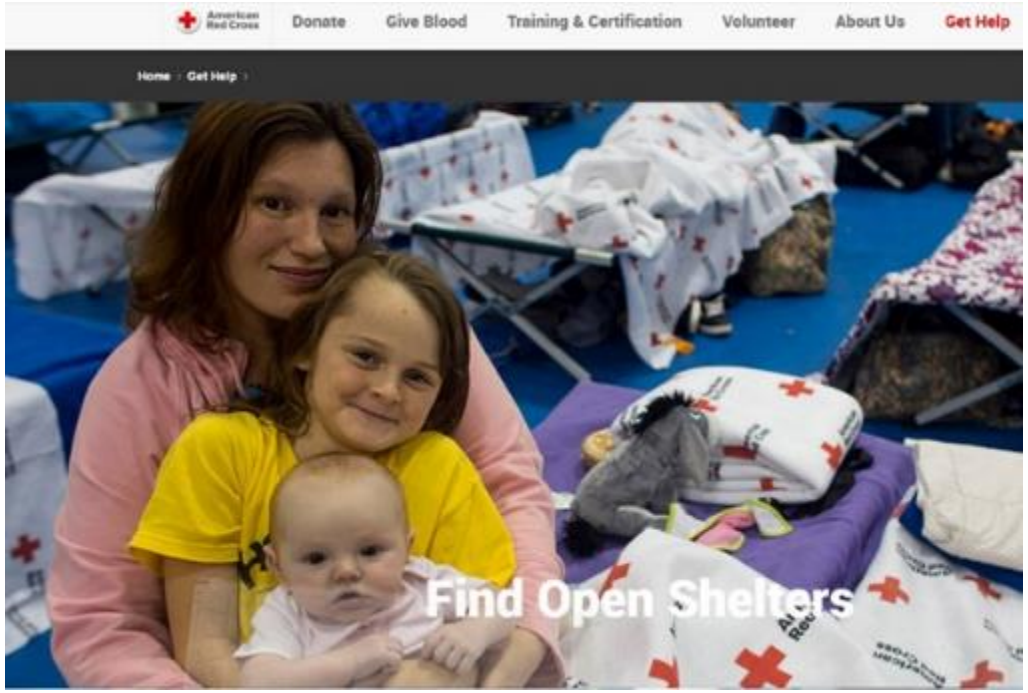
MSSC Preliminary Findings / Recommendations

Case Example – Nell Holcomb School District

Moving forward

Importance of Schools

- Education
- Disaster Shelters



Importance of Schools

- Community Resource

Elementary School

Do we truly know what the seismic risk is to our schools?

South Napa California Earthquake
School Performance – Napa Valley Unified School District

31 sites, typically 1 or 2-story wood frame or reinforced masonry

Little to no structural damage

- 1920s high school damaged (and closed) due to the 2000 Yountville earthquake (M5.0) was seismically renovated and performed well
- 1930s elementary school seismically reinforced in early 2000s was undamaged

Nonstructural content damage (dislodged light fixtures, toppled shelving, cracked wall coverings, damaged furniture, broken windows)

- Limited damage to mechanical and plumbing systems

Repairs estimated at $8 to $9 million

Most students returned to classrooms within 3 days

South Napa California EQ
Nonstructural Components

Photo by Will Kane, Politico Magazine
South Napa Earthquake, Aug. 2014 (M6.0)

2017 Mexico City Earthquake

2017 Mexico City Earthquake

- At least 21 children and four adults died at the Enrique Rébsamen School.

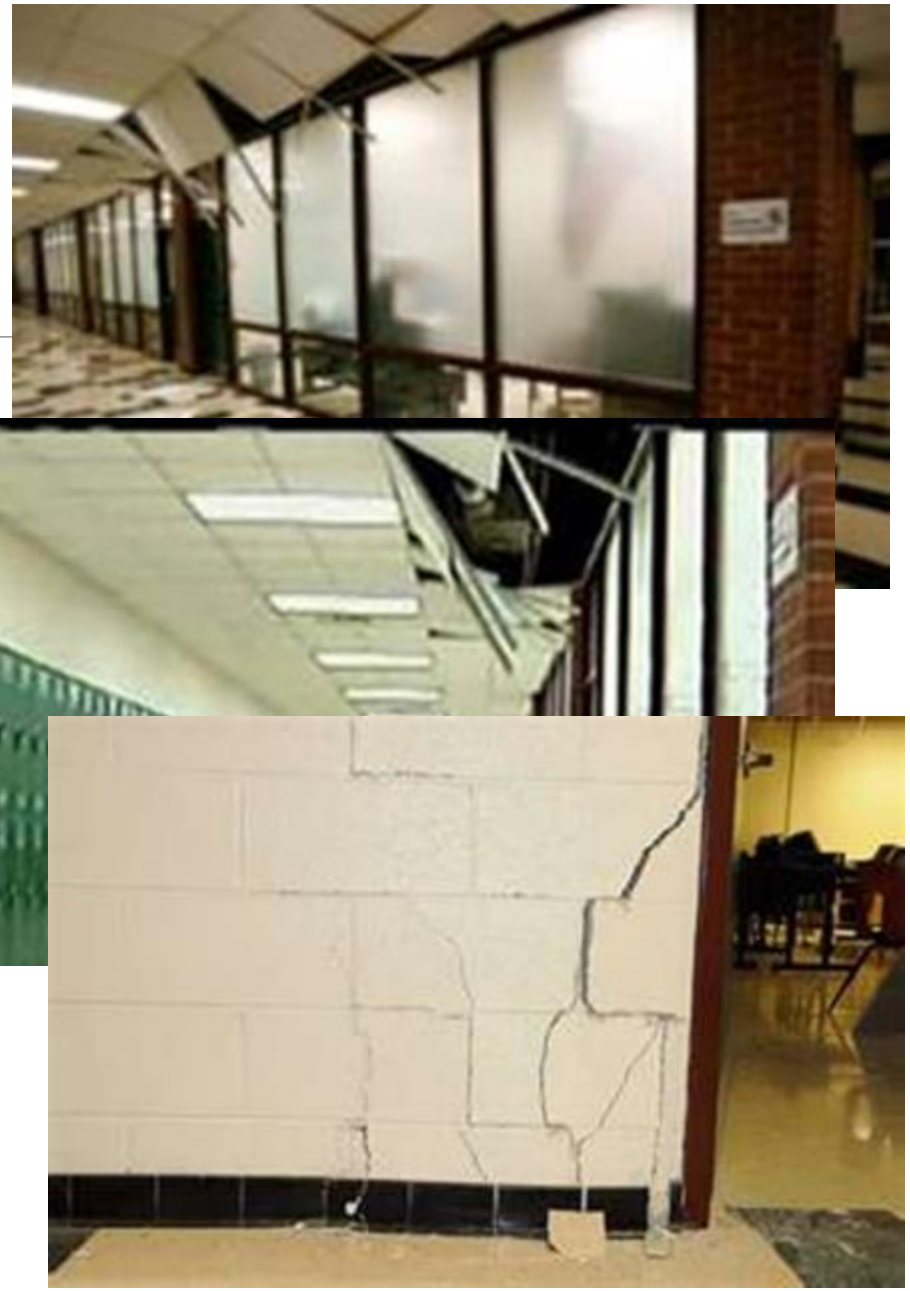
2017 Mexico City Earthquake

- Enrique Rébsamen School – Partition wall shored after the EQ

Risk Identification

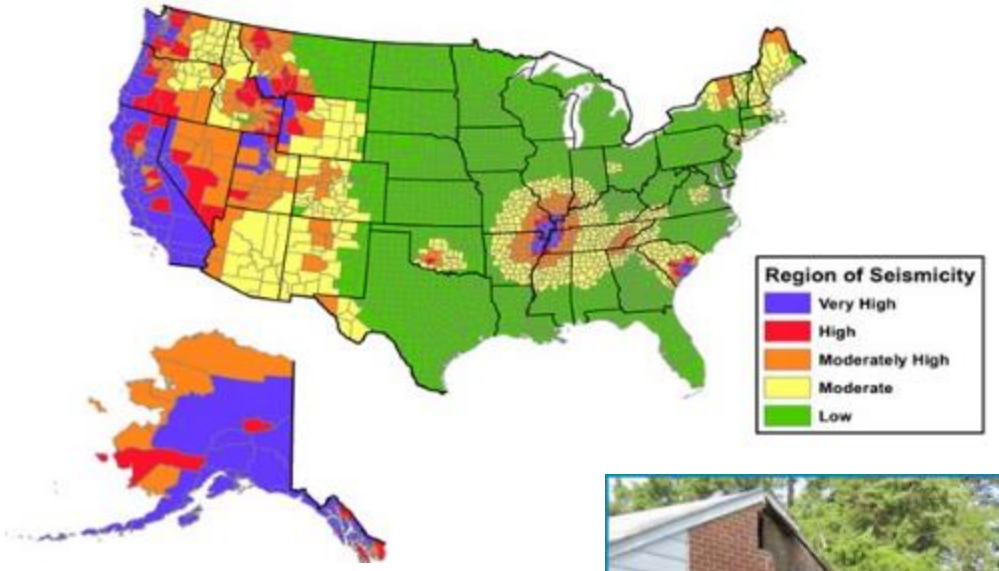
Mineral, VA Earthquake M5.8

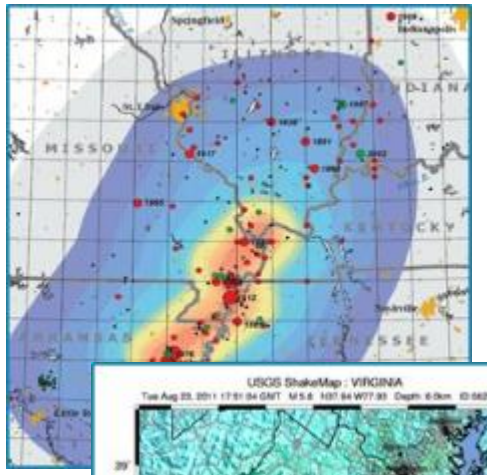
- Small magnitude event
- Region of infrequent activity for moderate and large events
- No fatalities
- 6 schools – 2 total loss (Elem & High School)
- 40% of classroom space lost
- Estimated losses $200 - $300 million
- Extensive nonstructural damage to the new Louisa County High School

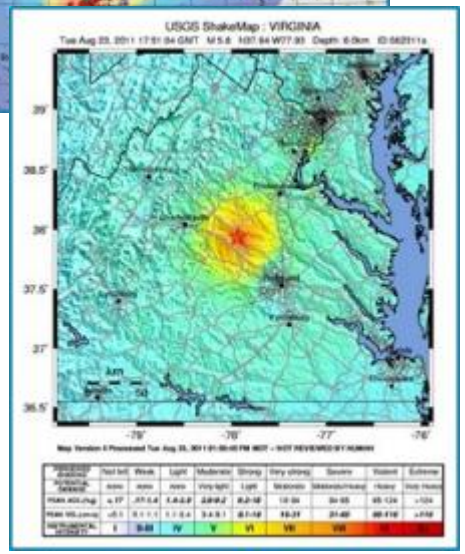


Why Missouri?

- Significant historic regional seismicity is well documented
- Probabilistic hazard reflected in the USGS ground motion maps
- Damage potential can be inferred based on typical construction







MSSC School Initiative

Modeled after similar programs

- Utah
- Oregon
- Charleston, South Carolina
- Washington State
- Wyoming

Major Difference:
MSSC program is primarily a volunteer effort!

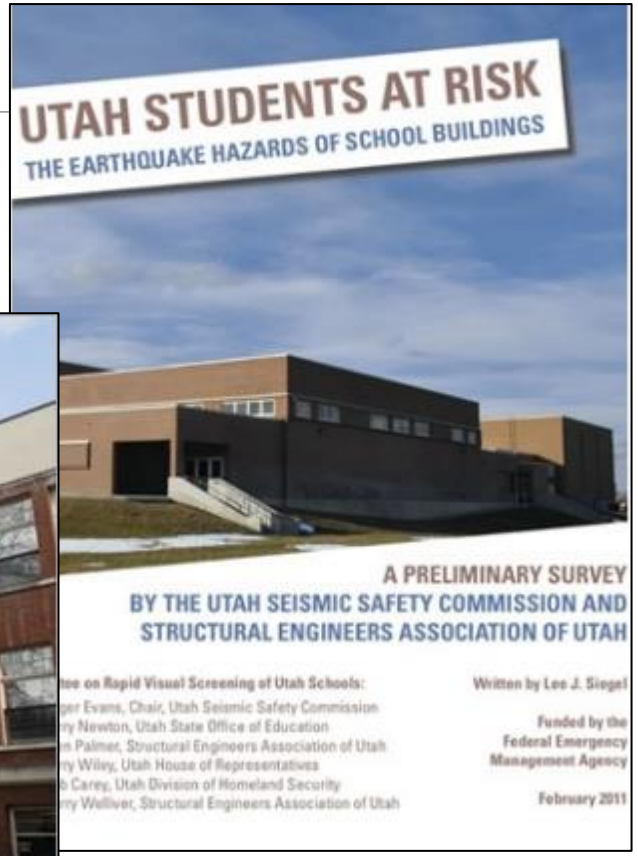


Photo by Danielle Peterson, Statesmen Journal

Initiative Objectives

- Encourage seismic safety in schools – *Risk Reduction*
- Target districts from SE Missouri to St. Louis
- 3-4 districts per year
- Kick start the risk identification process for Districts
- Offer FEMA P-154 Screening Reviews for free
- Provide summary report with further guidance in reducing seismic risk – next steps.
- Provide potential funding source opportunities for mitigation.
- Follow-up to verify improvements.

Outreach

- Banners
- Flyers
- Attendance at events with School officials

MSSC School Seismic Safety Initiative

MSSC initiative to assess school earthquake readiness:

- 2013 Pilot Study: 2 Districts in SE Missouri
- 2015 Pilot Study: 3 Districts in SE Missouri
- 2016 Pilot Study: 4 Districts in SE & Central MO
- 2017 Pilot Study: 3 Districts in Central-East MO
- 2018 Pilot Study: 3 Districts in Central-SE MO
- 2019 Pilot Study: 4 Districts targeted in SE MO

Drivers:

- Historical damage: West coast, Virginia, other countries
- Seismicity: High & Very High Seismic Region
- Damage Potential: Very High
- Risk: Life Safety, Shelters, Community Resource

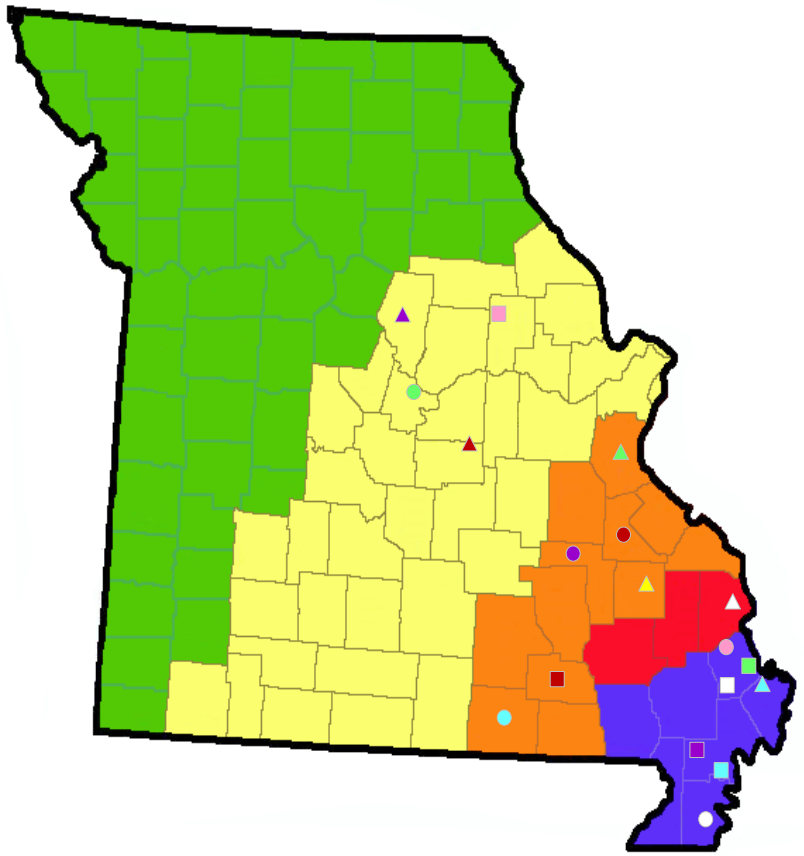
Volunteers trained to P-154 criteria to assist in performing building evaluations

Criteria: FEMA P-154 *Rapid Visual Screening of Buildings for Potential Earthquake Hazards*

MSSC FEMA 154 SUMMARY

REGION OF SEISMICITY

- Low
- Moderate
- Moderately High
- High
- Very High



SCHOOL DISTRICT

- Alton R-IV (2016)
- Belleview R-III (2016)
- Blair Oaks R-II (2018)
- Caruthersville #18 (2015)
- Central R-III (2017)
- Chaffee R-II (2013)
- Charleston R-I (2019)
- Delmar Cobble SSD (2019)
- Dunklin R-V (2016)
- Fredericktown R-I (2019)
- Maries County (2018)
- Nell Holcomb R-IV (2015)
- Portageville (2013)
- Risco R-II (2016)
- Scott County R-IV (2019)
- Sikeston R-VI (2015)
- Van Buren R-1 (2017)
- Wellsville-Middletown (2018)

MSSC Initiative Team

School Seismic Safety Initiative Team:

MSSC Chairman	- Dr. Eric Sandvol
Initiative Manager	- Dr. Phillip Gould
Supervising SE	- Michael Griffin, PE
Team Leads	- Dr. Nathan Gould, SE - Chad Schrand, SE
Volunteer Screeners	- Design professionals (Typ engineers and architects) - Building/construction trades
Volunteer commitment Requirements:	- 1-Day FEMA P-154 Training - 1-2 days of on-site school reviews (Min. 2 people/review team) - Travel, lodging and meals reimbursed

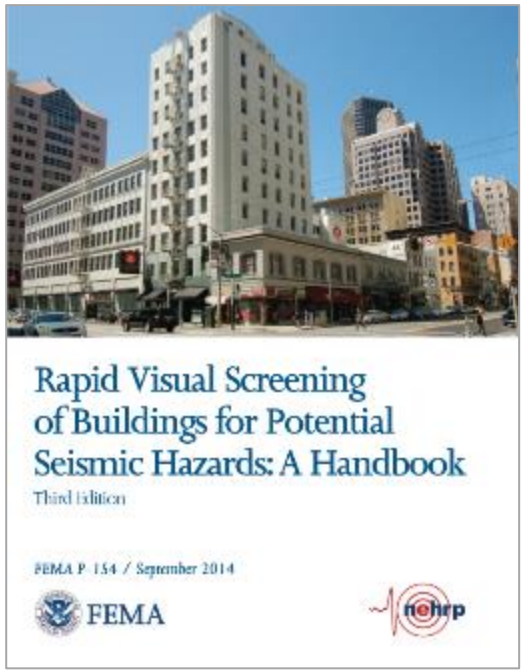
Evaluation Methodology

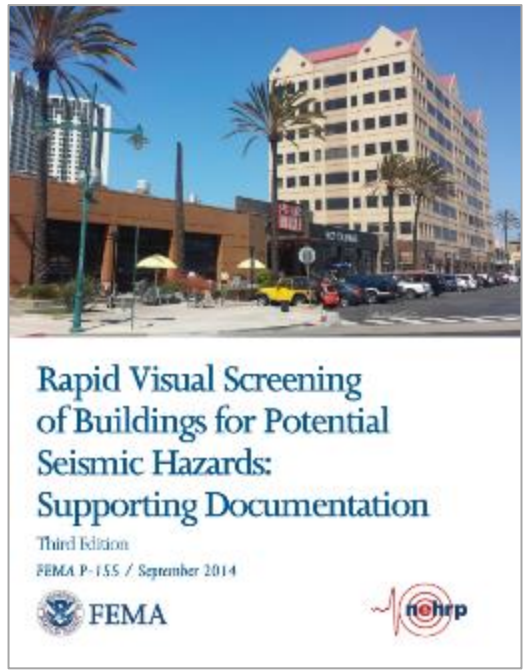
- Kick start the risk identification process for Districts
- Offer FEMA P-154 Screening Reviews free of charge to the Districts

	FEMA P-154 Screening Review	ASCE 41-13 Tier 1 Evaluation	ASCE 41-13 Tier 2 Evaluation	ASCE 41-13 Tier 3 FEMA P-807 FEMA P-58
Time Required	**Minutes**	Hours	Days	Weeks
Building Quantity	**Single to Multiple Buildings**	Single Bldg.	Single Bldg.	Single Bldg.
Relative Cost Range	**$1,000 – $15,000+**	$10,000 - $20,000	$5,000 – $20,000+	$$$$
Qualifications	**Trained building professionals**	Structural engineers experienced in seismic evaluation and design		

FEMA P-154 RVS Process

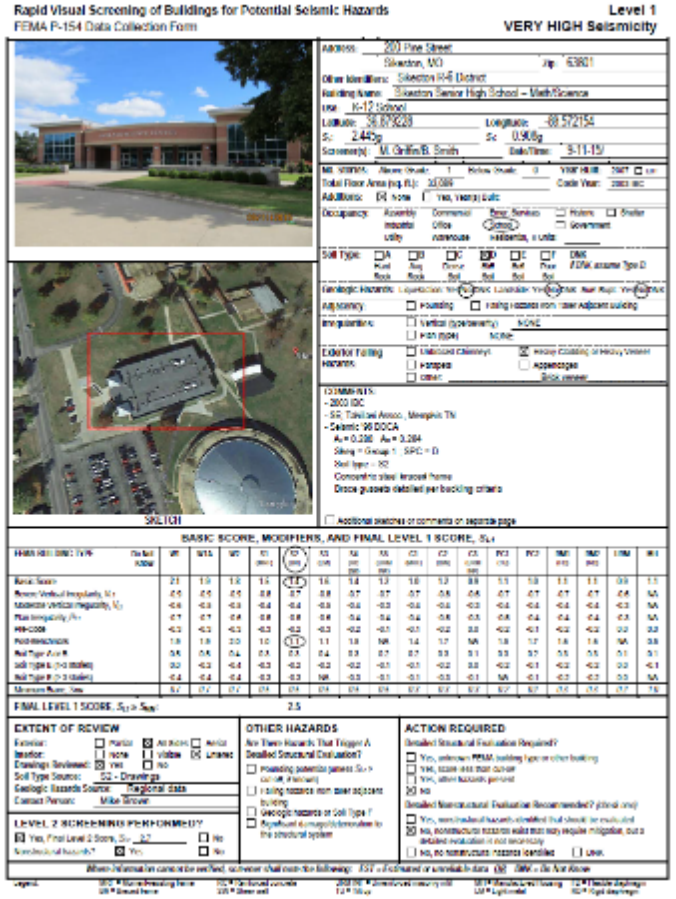
- Provide FEMA P-154 Training through FEMA NETAP Program
  - Trainer
  - Training materials and documents
- Assistance from CUSEC via FEMA Grant
- Request assistance from attending Design Professionals from MO, AR, TN to perform volunteer RVS site reviews
  - Time volunteered
  - Travel expenses reimbursed

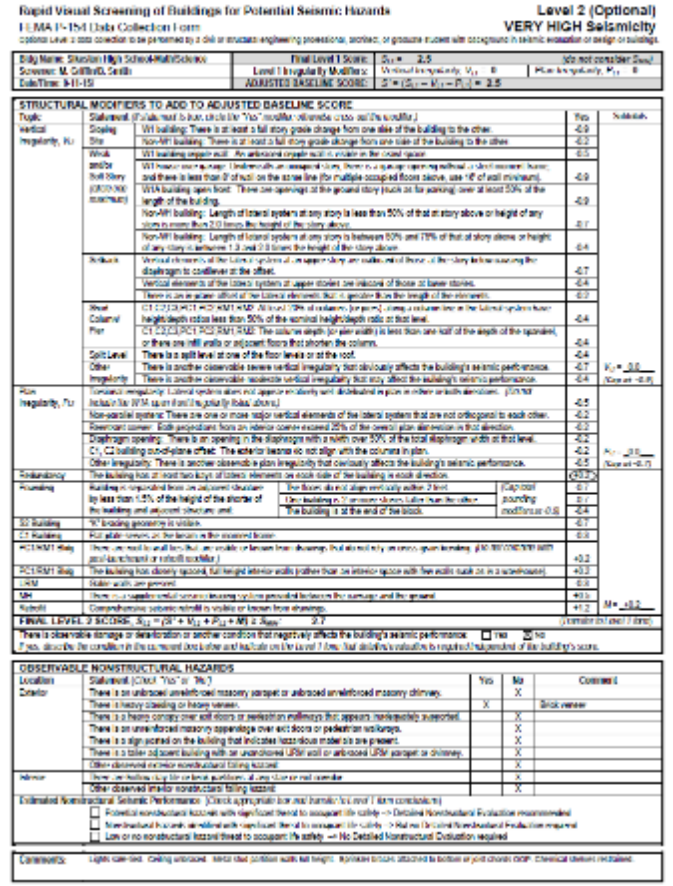




FEMA P-154 Data Collection Forms

- Level 1 Review
  - Required
- Level 2 Review
  - Optional, but required for this effort


Rapid Visual Screening of Buildings for Potential Seismic Hazards
FEMA P-154 Data Collection Form
Level 1
VERY HIGH Seismicity


Rapid Visual Screening of Buildings for Potential Seismic Hazards
FEMA P-154 Data Collection Form
Level 2 (Optional)
VERY HIGH Seismicity

Mitigation Funding Opportunities

MO SEMA Grant Program:

- Small grant program ($10K) for seismic safety improvements at schools
- Nonstructural component strengthening / 3 Districts utilized to date

MSSC/CUSEC/FEMA Nonstructural Hardware Kits

- Provide free hardware kits for non-structural
- 3 Districts have taken advantage of this program

FEMA Mitigation Grant Programs:

- Hazard Mitigation Grant Program (HMGP)
- Pre-Disaster Mitigation Program (PDM)

Capital Improvement Bonds

Preliminary findings recommendations

MSSC - Missouri School Earthquake Readiness Preliminary Findings

17 school districts in SE & Central Missouri reviewed (2013, 2015, 2016, 2017, 2018 & 2019)

137 total buildings

Vintage range: 1912 – 2015

Majority - older building stock with no seismic design attention or detailing

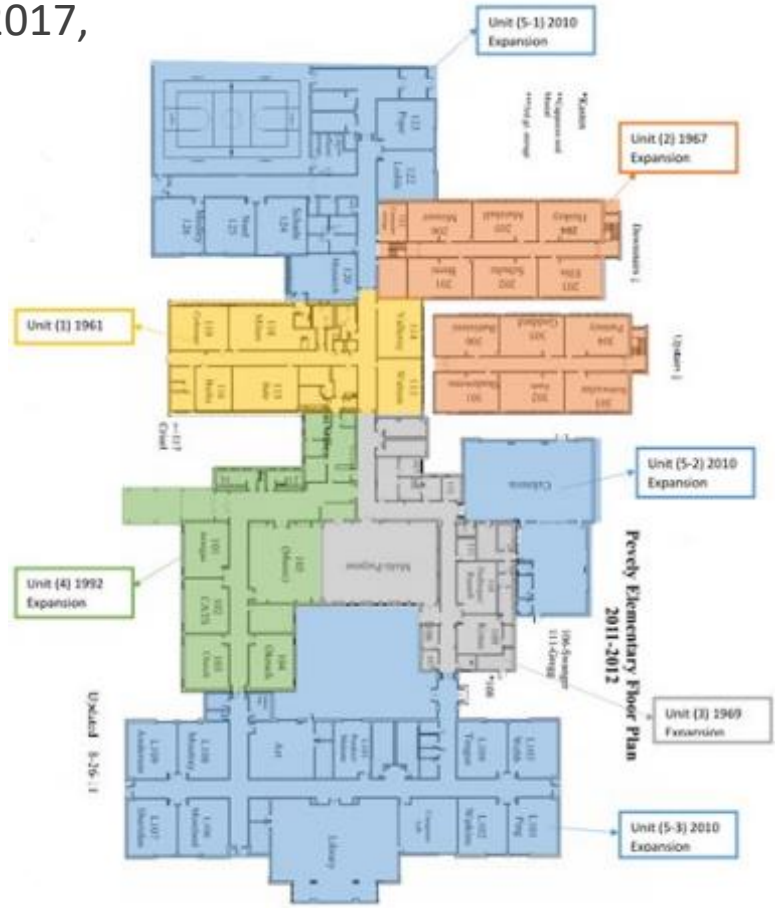
Numerous additions throughout

Masonry – predominate construction

23% Screened out (post mid-1990's construction)

Numerous nonstructural hazards identified

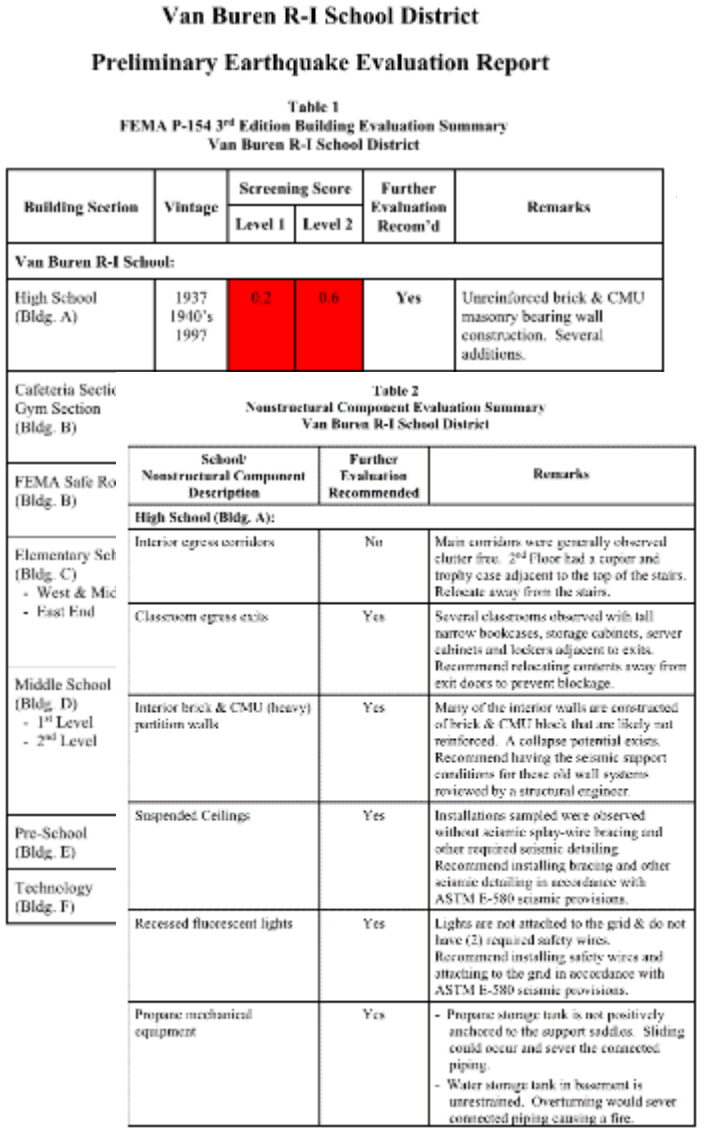
Clearly evident is that newer construction to IBC seismic provisions provides enhanced seismic safety



FEMA 154 Bldg Type	Quantity	% Requiring Further Evaluation
W1 – Wood Frame	3	66%
W2 – Wood Frame Commercial	2	0%
S1 – Steel Frame	10	90%
S2 – Steel Braced Frame	2	50%
S3 – Light Steel	15	67%
S5 – Steel w/Masonry infill	7	71%
C2 – Concrete SW	1	100%
C3 – Concrete Frame w/Masonry infill PC1- Pre-Cast Concrete Tilt-up	3 2	100% 0%
RM1 – Reinf. Masonry w/flex. diaphragms	28	50%
RM2 – Reinf. Masonry w/stiff diaphragms	3	33%
URM – Unreinforced Masonry	56	100%
MH – Manufactured Housing	5	60%
Total:	137	

MSSC Recommendations

- District Report:
  - Specific building findings
  - Specific nonstructural component findings
  - Recommendations
    - Education resources
    - Building safety improvements
    - NS component improvements
    - Mitigation funding opportunities



Van Buren R-I School District

Preliminary Earthquake Evaluation Report

Table 1
FEMA P-154 3rd Edition Building Evaluation Summary
Van Buren R-I School District

Building Section	Vintage	Screening Score		Further Evaluation Recom'd	Remarks
		Level 1	Level 2		
Van Buren R-I School:					
High School (Bldg. A)	1937 1940's 1997	0.2	0.6	Yes	Unreinforced brick & CMU masonry bearing wall construction. Several additions.
Cafeteria Sectio Gym Section (Bldg. B)					
FEMA Safe Ro (Bldg. B)					
Elementary Sch (Bldg. C) - West & Mid - East End					
Middle School (Bldg. D) - 1st Level - 2nd Level					
Pre-School (Bldg. E)					
Technology (Bldg. F)					

Table 2
Nonstructural Component Evaluation Summary
Van Buren R-I School District

School/ Nonstructural Component Description	Further Evaluation Recommended	Remarks
High School (Bldg. A):		
Interior egress corridors	No	Main corridors were generally observed clutter free. 2nd Floor had a copier and trophy case adjacent to the top of the stairs. Relocate away from the stairs.
Classroom egress exits	Yes	Several classrooms observed with tall narrow bookcases, storage cabinets, server cabinets and lockers adjacent to exits. Recommend relocating contents away from exit doors to prevent blockage.
Interior brick & CMU (heavy) partition walls	Yes	Many of the interior walls are constructed of brick & CMU block that are likely not reinforced. A collapse potential exists. Recommend having the seismic support conditions for these old wall systems reviewed by a structural engineer.
Suspended Ceilings	Yes	Installations sampled were observed without seismic splay-wire bracing and other required seismic detailing. Recommend installing bracing and other seismic detailing in accordance with ASTM E-580 seismic provisions.
Recessed fluorescent lights	Yes	Lights are not attached to the grid & do not have (2) required safety wires. Recommend installing safety wires and attaching to the grid in accordance with ASTM E-580 seismic provisions.
Propane mechanical equipment	Yes	- Propane storage tank is not positively anchored to the support saddles. Sliding could occur and sever the connected piping. - Water storage tank in basement is unrestrained. Overturning would sever connected piping causing a fire.

Case Example
Nell Holcomb R-IV School District

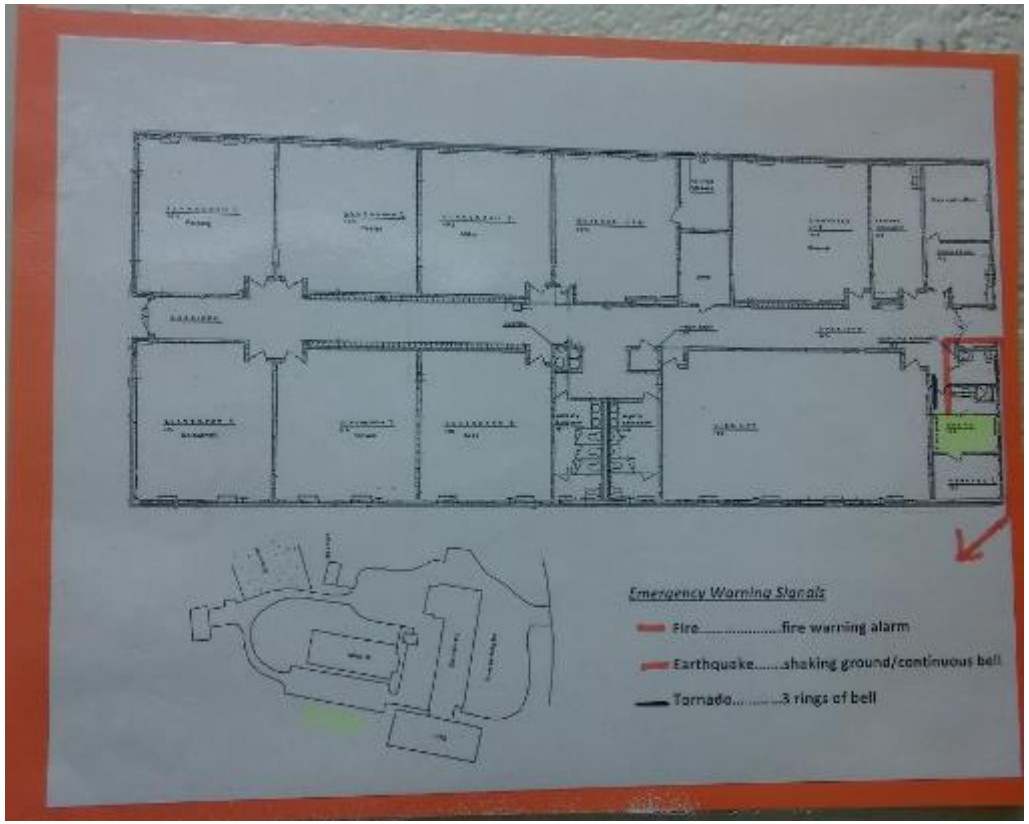
Nell Holcomb R-IV School District
challenge to achieve

- 6547 State Hwy 177, Cape Girardeau, MO
  - Elementary School, 1959 w/ additions
  - Junior High School, 1997

Nell Holcomb R-IV School District
challenge to achieve

Earthquake Plan:

- Earthquake Safety:
  - Emergency Posters/Warning Procedures
  - Bi-annual Earthquake Drills
  - Annual Great Central U.S. Shake-Out Drill
- Educational Awareness:
  Earthquake Science Posters
- Annual Classroom Housekeeping Review
- Mitigation Implementation:



Nell Holcomb R-IV School District
challenge to achieve

Earthquake Mitigation Actions:

- Participation in MSSC School Seismic Safety Initiative
- Seismic Safety Improvement Implementation:
  - **Incorporation of seismic design provisions in new construction**:
    - Junior High Addition
    - New Gym Addition
  - Performed nonstructural component mitigation

Nell Holcomb R-IV School District
challenge to achieve

MSSC School Seismic Safety Initiative Findings:

- Region of High Seismicity
- Building Structures:
  - Older construction potentially at risk
  - Newer construction – designed for higher seismic loads
- Commitment to Improvement

Building Seismic Evaluation Summary				
Building	Construction Date	FEMA P-154 Third Edition Building Score		Comments
		Level 1	Level 2	
Nell Holcomb Elementary School				
Original Construction	1959	0.5	1.8	Steel Frame w/ no definable lateral system.
Old Gymnasium	1976	0.2	1.0	Unreinforced CMU Bearing Walls
Superintendent Office Addition	1994	1.7	1.9	Steel Frame w/ Reinforced CMU Bearing Walls
New Gym Addition	2007	4.4	4.6	Combination Concrete & Mtl Stud Shear Walls
Nell Holcomb Junior High				
Original Construction	1997	2.6	2.6	Light Steel Frame Construction w/ Interior CMU Walls
	Green Indicates Building Score Above 3.0			
	Yellow Indicates Building Score Above Cut-Off Score of 2.0, Below 3.0			
	Red indicates Building Score Below Cut-Off Score of 2.0			

Nell Holcomb R-IV School District
challenge to achieve

Nonstructural components & systems seismic safety improvements implemented from MO SEMA 2012 Small Grant Program:

Moving Forward

Challenges

- District interest
- Volunteer program (FEMA/CUSEC/MSSC funding helps)
- Quality review & reporting is labor intensive
- Conveying the results to the districts
- Encouraging districts to take advantage of mitigation grant programs available
- Follow-up with districts on actionable recommendations
- New Tools will help

Follow-up Report

MSSC RVS PROGRAM

SUMMARY OF FOLLOW-UP VISIT TO SIKESTON SCHOOL DISTRICT

MAY 11, 2018

A meeting was held at the Sikeston Facilities office with Mr. Mike Brown, the Building and Grounds director and another member of his staff. Dr. Phillip Gould represented the commission. The local SEMA regional coordinator Mark Winkler also sat in. The stated purpose was to follow -up on the RVS seismic assessment performed by the MSSC in 2015. A questionnaire was provided earlier and is attached.

Mr. Brown presented me with a report consisting of a plan for seismic improvement and activities for the year and, remarkably, a large number of completed work orders that essentially addressed most if not all of the deficiencies noted in the RVS report. Most of this work dealt with such items as light fixtures, hot water heaters, film on windows, large TVs, bookcases, file cabinets and mechanical and electrical equipment.

Needless to say, this was a pleasant surprise. The only item on the questionnaire that was not addressed was the engagement of an engineering firm to do further assessment. Mark and I told them that they could receive some additional supplies from the MSSC stock. I also asked him to provide some photos of the repairs and upgrades

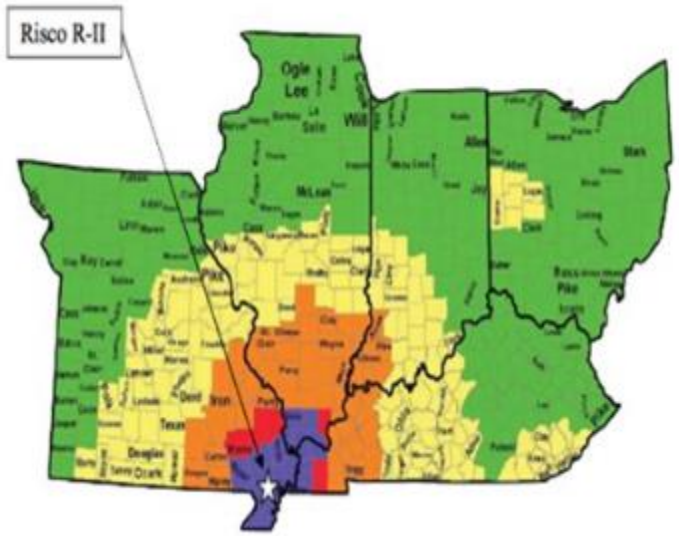
They also informed us that they are building a new elementary school building to replace the Mathews building and will follow with a replacement for the Lew Hunter building. Both buildings were evaluated in the original RVS screening and received a score of 0.9. I asked if the RVS evaluation helped in the bond issue campaign to fund the new schools. They indicated that there was possibly a connection because the campaign emphasized safety. Mr. Brown said that he would contact the architect for the new school building and ask him to provide us with some information on the seismic design considerations.

It is my feeling that the RVS assessment raised the awareness in the Sikeston district .

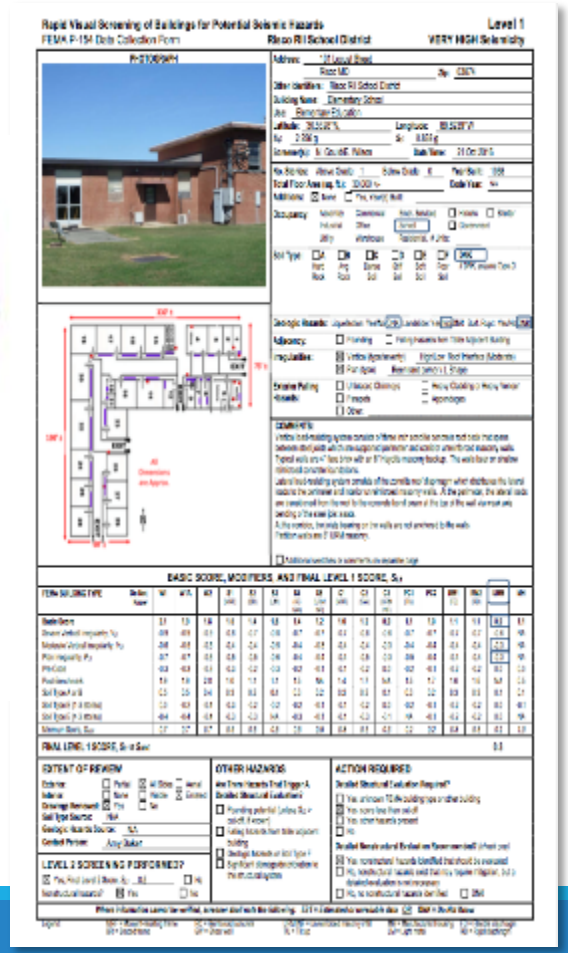
P-154 Electronic Tools

- Central U.S. Earthquake Consortium (CUSEC)
  - Web and Mobile Applications
  - Planning Applications
  - Enhanced Data Export Capabilities
- Enhances on-site reviews
- Data collection quantity and quality greater
- Evaluations more consistent across volunteer Teams
- Greatly reduces preparation time of RVS forms

Rapid Visual Screening of Buildings for Potential Seismic Hazards – Moving Forward Using Web and Mobile Apps (from CUSEC)

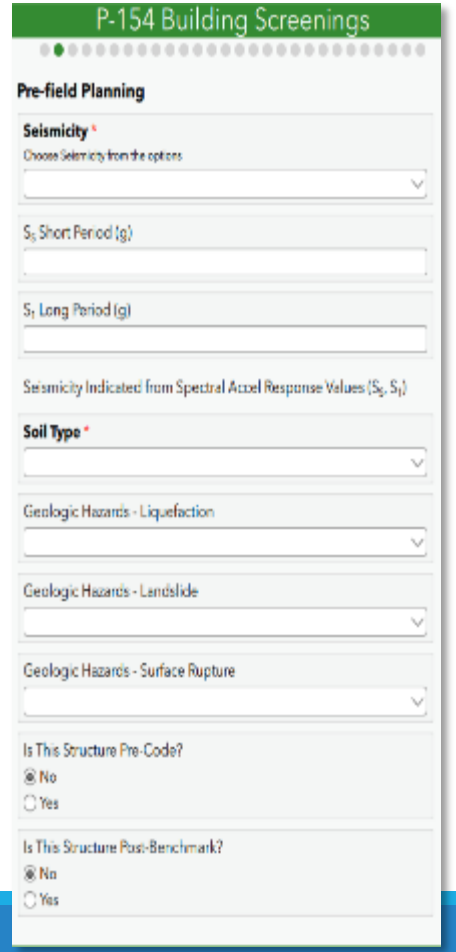


Traditional Paper Form



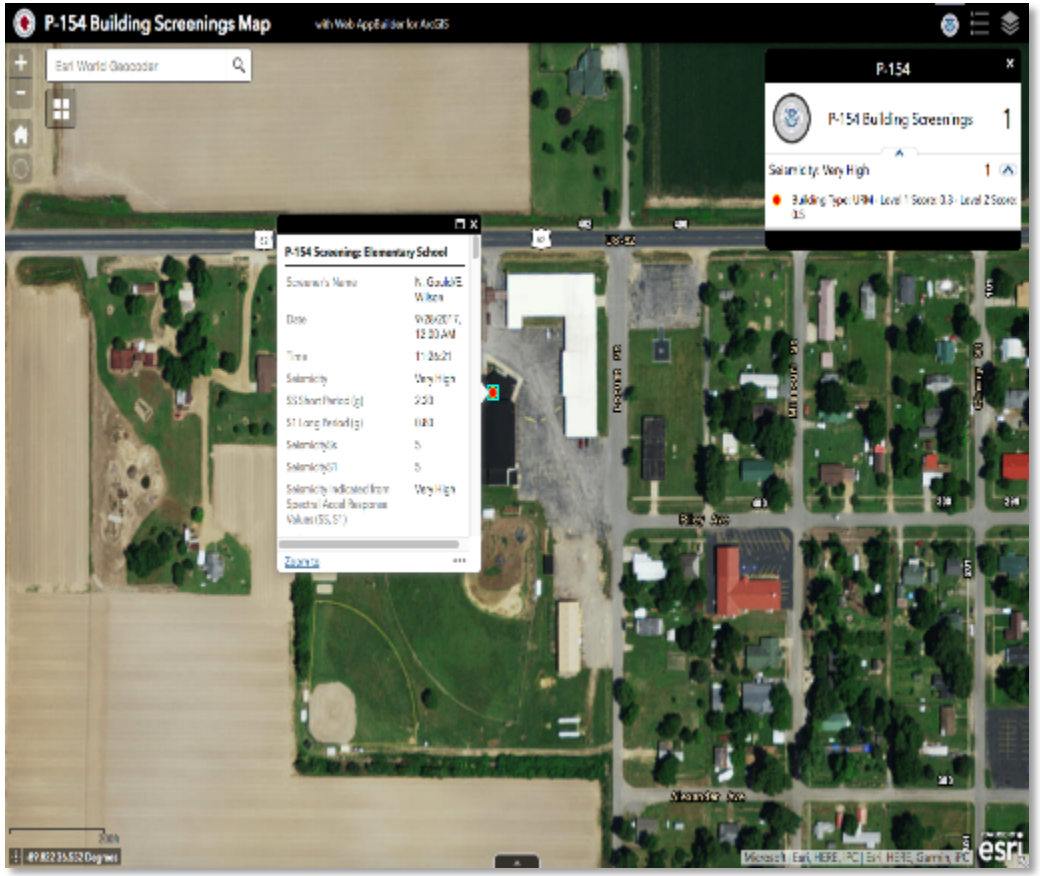
Web App

Mobile App



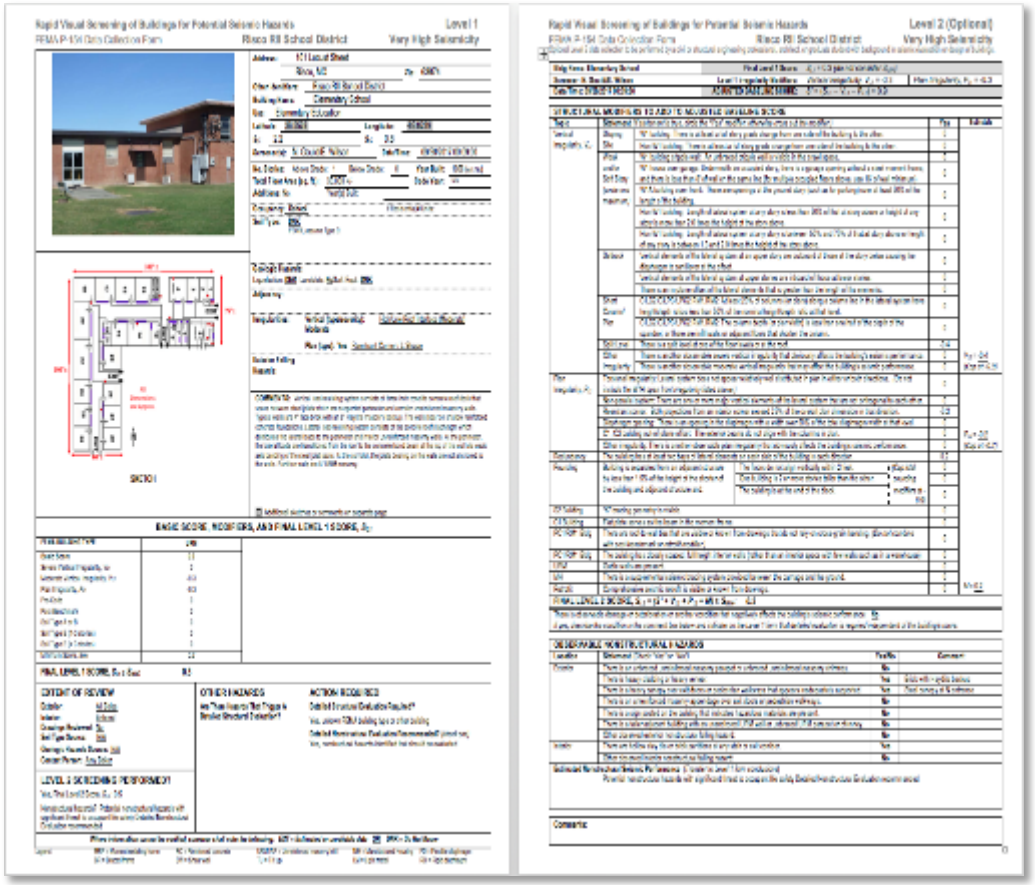
Rapid Visual Screening of Buildings for Potential Seismic Hazards

Screening Entries Available in Planning Applications

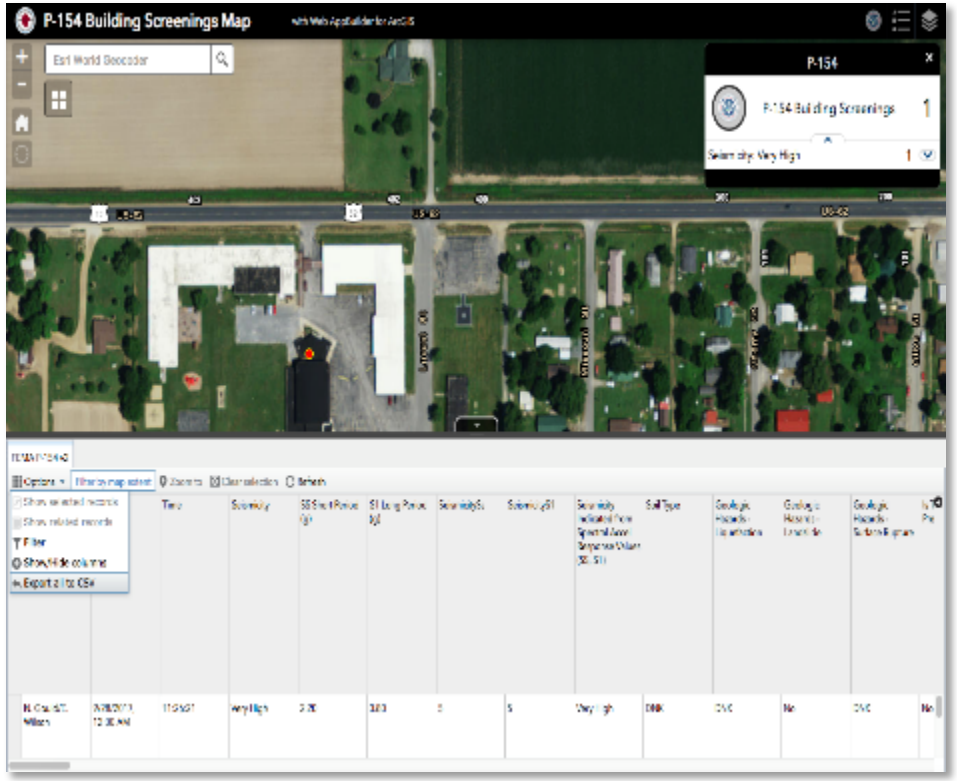


Rapid Visual Screening of Buildings for Potential Seismic Hazards

PDF Form Export



Spreadsheet Export



MSSC School Seismic Safety Initiative Future

Continue Pilot Study:

- 2013 Pilot Study: 2 Districts in SE Missouri
- 2015 Pilot Study: 3 Districts in SE Missouri
- 2016 Pilot Study: 4 Districts in SE & Central MO
- 2017 Pilot Study: 3 Districts in Central-East MO
- 2018 Pilot Study: 3 Districts in Central-East MO
- 2019 Pilot Study: 4 Districts in SE & East-Central MO
- 2020 Pilot Study: 3 Districts in SE MO targeted

Continue communicating the importance for each district to assess the potential earthquake risk to their buildings

Increase follow-up with previously reviewed districts on enacting recommendations

Push for State legislative mitigation actions (like Oregon)

Great ShakeOut drill October 19, 2017

2017 Mexico City Earthquake

Stark reminder of what this effort is all about

Manuel Bojorquez ✓
@BojorquezCBS

Follow

Names of children from #MexicoCity school that collapsed. Some are marked found, others still unaccounted for @CBSNews #MexicoEarthquake

1:14 PM - Sep 20, 2017

FEMA

HMA
Hazard Mitigation Assistance

Moving Mitigation Forward: The Building Resilient Infrastructure and Communities (BRIC) Program

Camille Crain | BRIC Section Chief
Hazard Mitigation Assistance, Mitigation Directorate | Federal Insurance and Mitigation Administration, FEMA

DRRA Section 1234: Building Resilient Infrastructure and Communities (BRIC)

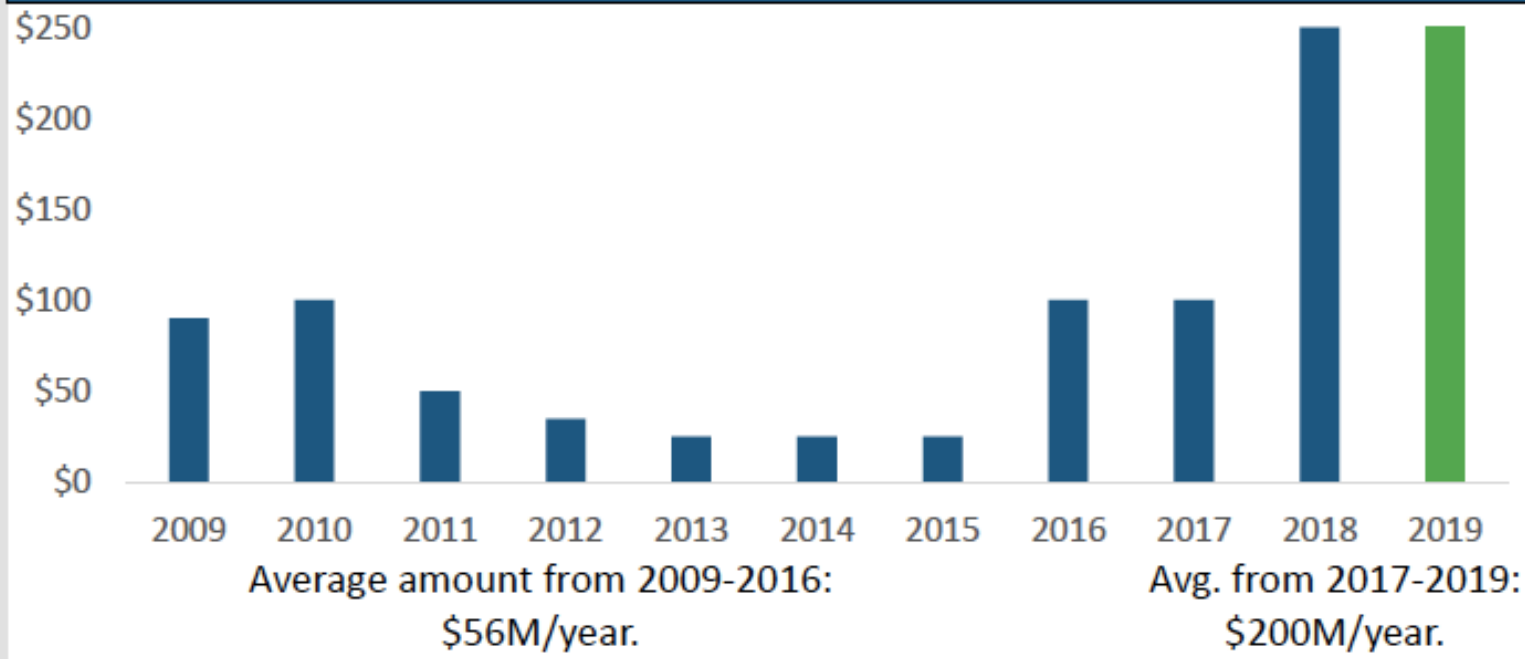
FEMA's goal is to reduce costs and loss of human life from natural hazards by building a national culture of preparedness, encouraging investments to protect our communities and infrastructure, and building mitigation capabilities to foster resilience.

BRIC Guiding Principles

- **Support communities through capability & capacity building**
- **Encourage and enable innovation**
- **Promote partnerships**
- **Enable large projects**
- **Maintain flexibility**
- **Provide consistency**

FEMA

Since 2009, FEMA has received approximately $1 billion in Pre-Disaster Mitigation grant appropriations, of which 48% has been in the last 2 years.



Funds will vary based on disasters. FIMA estimates that annual funds will average $300M-$500M per year, with significantly greater amounts following years with catastrophic disasters.