





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

- o Education
- Disaster Shelters





Importance of Schools



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
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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
- o Flyers
- Attendance at events with School officials



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Protect your students and staff ...

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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:
- Risk:

Very High 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







MSSC Initiative Team

School Seismic Safety Initiative Team:

MSSC Chairman Initiative Manager Supervising SE Team Leads

Volunteer Screeners

Volunteer commitment **Requirements**:

- Dr. Eric Sandvol
- Dr. Phillip Gould
- Michael Griffin, PE
- Dr. Nathan Gould, SE
- Chad Schrand, SE
- Design professionals (Typ engineers and architects)Building/construction trades
- 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



Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook





Rapid Visual Screening of Buildings for Potential Seismic Hazards: Supporting Documentation Third Edition FEMA P-155 / September 2014

FEMA P-154 Data Collection Forms

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

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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	

Preliminary Earthquake Evaluation Report

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



MSSC Recommendations

• District Report:

- Specific building findings
- Specific nonstructural component findings
- Recommendations
 - > Education resources
 - > Building safety improvements
 - » NS component improvements
 - > Mitigation funding opportunities

Case Example Nell Holcomb R-IV School District

Nell Holcomb R-IV School District challenge to achieve

- o 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
- o Building Structures:
 - Older construction potentially at risk
 - Newer construction designed for higher seismic loads
- Commitment to Improvement

B	uilding Seis	mic Evalua	tion Summ	ary
Building	Construction	FEMA P- Edition Bui	154 Third Iding Score	Comments
	Date	Date Level 1 Level		
Nell Holcomb Eler	mentary 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 Jun	ior High			
Original Construction	1997	2.6	2.6	Light Steel Frame Construction w/ Interior CMU Walls
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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)



Fraditional	Paper	Form
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Web App P-154 Building Screenings Pre-field Planning ¹Selemicity Choose Selamidity from the option Very High 5₈ Short Period (g) 2250 S, Long Period (g) 32.22 Seismicity indicated from Spectral Accel Response Values (Sp. 81) Wry High Sel Not DAK. Geologic Hazarda - Liouafaction DAK Geologic Huzarda - Landal de Geologia Hazanta - Surface Rupture DAK is This Structure Pre-Code? (i) No 0 16 Is This Structure Port/Benchmark/ (i) No 0.76 Return to Beciming Opto End

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Rapid Visual Screening of Buildings for Potential Seismic Hazards



Screening Entries Available in Planning Applications

Central U.S. Earthquake Consortium

Rapid Visual Screening of Buildings for Potential Seismic Hazards

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Spreadsheet Export



Central U.S. Earthquake Consortium

MSSC School Seismic Safety Initiative Future

Continue Pilot Study:

2013 Pilot Study:
2015 Pilot Study:
2016 Pilot Study:
2016 Pilot Study:
2017 Pilot Study:
2018 Pilot Study:
2018 Pilot Study:
2019 Pilot Study:
2019 Pilot Study:
2020 Pilot S

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



Names of children from #MexicoCity school that collapsed. Some are marked found, others still unaccounted for @CBSNews #MexicoEarthquake 1:14 PM - Sep 20, 2017





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



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.