

Vulnerability of Some Kenai Peninsula Borough Schools to Earthquake Damage Based on Rapid Visual Screening

December 1, 2015

Prepared for: Kenai Peninsula Borough School District & Alaska Seismic Hazards Safety Commission
 Administered by: The Earthquake Engineering Research Institute
 Funded by: Federal Emergency Management Agency



FEMA

The Federal Emergency Management Agency (FEMA)



The Department of Homeland Security (DHS)



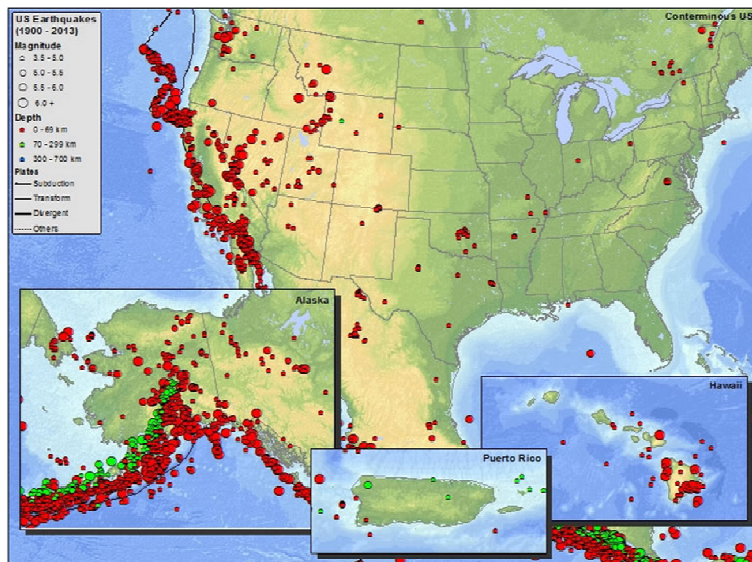
The Earthquake Engineering Research Institute (EERI)



The Alaska Seismic Hazards Safety Commission (ASHSC)

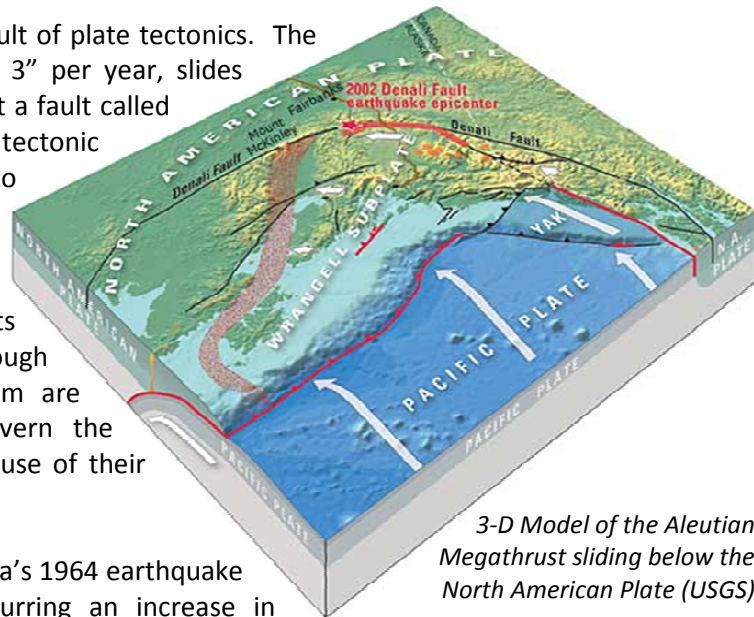
Alaskan Seismicity:

Alaska is among the most seismically active areas on Earth. Over the past 50 years, the United States Geological Survey (USGS) recorded in the United States more than 3,000 earthquakes more powerful than magnitude 5, with approximately 80% of these occurring in Alaska. Further, of the twelve most powerful earthquakes America has ever experienced, ten were situated in Alaska. These include the 1964 Great Alaska Earthquake, which remains the second most powerful ever measured on Earth.



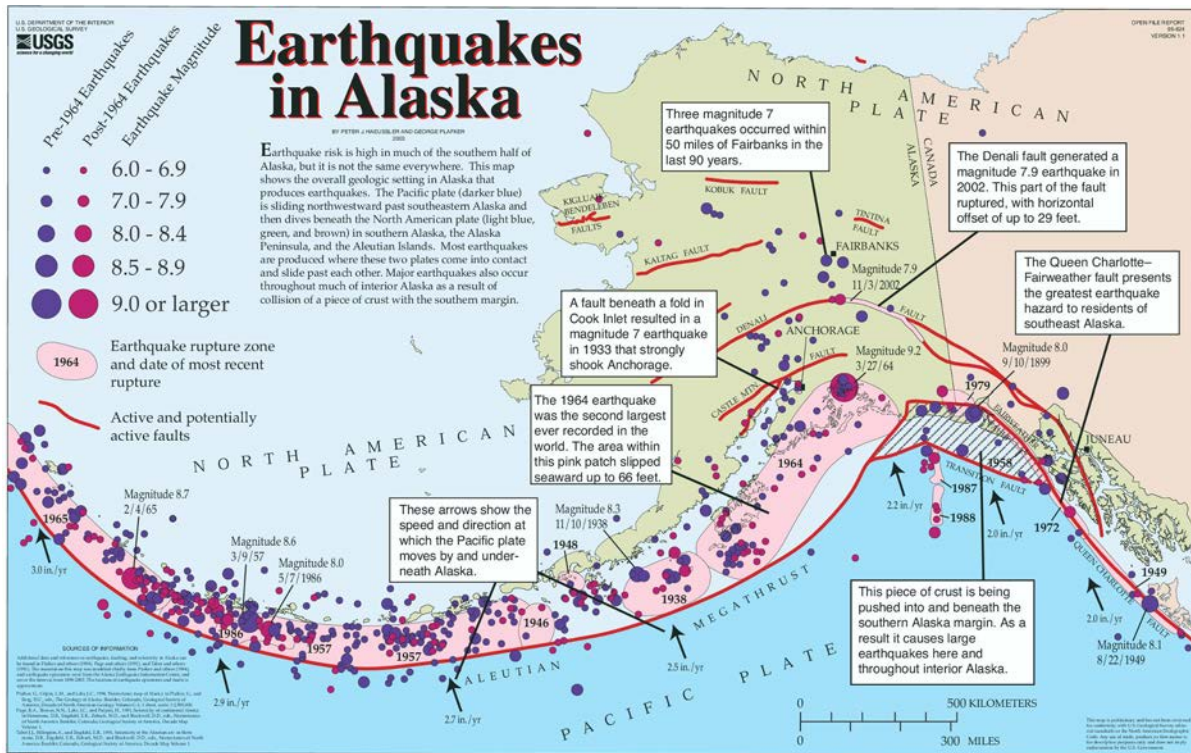
Sites of major earthquakes in the US (USGS)

Alaska's intense seismicity is a result of plate tectonics. The Pacific Plate, moving north 2" to 3" per year, slides below the North American Plate at a fault called the Aleutian Megathrust. This tectonic collision and subduction is able to produce an earthquake up to magnitude 9.2, according to the Federal Emergency Management Agency (FEMA). Many other faults occur around the state, and though earthquakes associated with them are not as powerful, they may govern the nearby ground accelerations because of their close proximity.



3-D Model of the Aleutian Megathrust sliding below the North American Plate (USGS)

The strength and duration of Alaska's 1964 earthquake shocked the scientific world, spurring an increase in research in plate tectonics and seismology. The Alaska Dispatch News has chronicled many of these changes in a March 23, 2014 article on the subject: "The 1964 event changed the way we thought about earthquakes," said Mike West, state seismologist with the [Alaska Earthquake Center] at the University of Alaska Fairbanks. 'It literally helped prove plate tectonics.'"



Alaskan seismicity: faults, earthquakes, and rupture zones (USGS)

Building Codes:

Similarly, the 1964 Alaskan earthquake substantially changed the way building structures are designed. In 1973, the Uniform Building Code was modified to add many new, specific requirements. For example, descriptions of seismic force collectors within floors and roofs were added, as were new detailing requirements for seismic safety in regions of high seismicity. Design seismic forces for braced frames effectively doubled; unreinforced masonry and concrete were now prohibited for all structural elements in regions of high seismicity; gravity-only columns now needed to be designed to have sufficient strength when swaying dramatically during a seismic event.



*Government Hill Elementary School after the 1964 Earthquake
(National Geophysical Data Center)*

Since then, building codes have continued to be modernized. In response to observations after other earthquakes, and informed by extensive testing, building code committees have continued to increase design seismic forces, establish more robust detailing requirements, and intensify inspection mandates. Schools in particular are now designed for an increased factor of safety because of their importance to their communities. Further, in some cases schools are designed to an even higher level of safety so they can be used as shelters following a major earthquake. Because of these changes and many others, buildings constructed today are much more earthquake-resistant than older buildings.

The fact that older buildings are less earthquake-resistant is significant to Alaskan schools because many of them were constructed before building code modernization began to improve the safety of building construction. As a result, older school buildings are typically less earthquake-safe than newer ones. How much less safe depends on many factors, including age and type of structural system, structural irregularities, building location, and quality of construction. School districts and managers of facilities would benefit greatly from having good information readily available regarding the safety of their facilities. This would enable them to make informed decisions regarding timing and urgency of any further structural reviews and upgrades.

Rapid Evaluation of Facilities:

To that end, FEMA developed a rapid evaluation procedure outlined in their publication P-154, "Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook." This contains a method for evaluating structures' seismic performance very quickly and without great expense, referring to it as a "sidewalk survey." It takes into account the age and type of structure, building height, irregularities in the structure that decrease reliability, and whether it was constructed before the enforcement of design codes and the implementation of construction inspection. FEMA developed this method to provide a tool to give building owners and managers good, actionable

information with minimal up-front cost. The second edition of FEMA P-154 is also available in a program called ROVER (Rapid Observation of Vulnerability and Estimation of Risk), which runs on mobile devices and uploads data and results wirelessly to a central server. An added advantage of ROVER is that the database it establishes can be used after a major earthquake. The database can contain both building plans as well as photographs of the building in its pre-earthquake condition.

The method used by FEMA P-154 and ROVER to evaluate a building is quite straightforward. It establishes an initial score for each type of structural system (wood shear walls, steel braced frame, and so forth), with a higher score indicating greater reliability. A given building's initial score is then modified (up or down) based on other factors, including the number of stories, vertical structural irregularities, plan structural irregularities, probable soil type, whether it was designed and constructed before codes were generally enforced, and whether it was designed and constructed under substantially modern codes. The user enters the building information, and ROVER adds and subtracts from the initial score to obtain the final score. FEMA carefully selected the scores and modifications so the final score could carry some readily understandable information. FEMA 154, Edition 2, notes, in section 4.1:

Fundamentally, the final S score is an estimate of the probability (or chance) that the building will collapse if ground motions occur that equal or exceed the maximum considered earthquake (MCE) ground motions (the current FEMA 310 ground motion specification for detailed seismic evaluation of buildings). These estimates of the score are based on limited observed and analytical data, and the probability of collapse is therefore approximate. For example, a final score of $S = 3$ implies there is a chance of 1 in 10^3 , or 1 in 1000, that the building will collapse if such ground motions occur. A final score of $S = 2$ implies there is a chance of 1 in 10^2 , or 1 in 100, that the building will collapse if such ground motions occur.

BBFM Engineers makes no statement about these probabilities except to note FEMA's intent in developing the scoring process. Typically a final score below 2.0 is taken as indication that a more detailed investigation is warranted, although that value can be adjusted at the outset of an evaluation project as desired by the owner of the facilities.

Importantly, these scores and risks do not take into account actual member strengths or actual connection reliability, only what is common for similar structural types of similar age. Therefore, the actual building safety may be substantially different from what the scores may indicate. Accordingly, buildings with low scores are noted as requiring further structural investigation to determine whether structural upgrade is warranted. These scores can be used appropriately to identify and rank buildings for their vulnerability to earthquake damage.

Alaskan School Safety:

As stated in 2010 by the Western States Seismic Policy Council (WSSPC), "Every community is required to educate children, and it is the responsibility of governmental agencies to design and construct safe buildings to house them. While current building codes and construction practices have recognized the effects of earthquakes and provide state-of-the-art design considerations, many older school buildings were built before these principles were understood... These older buildings have not been properly graded or passed the test of seismic safety. Consequently, many

students face significant seismic risk.” The WSSPC is a non-profit consortium of eighteen member states and territories including Alaska.

After all, since children are required to attend school and parents lack specific information about the seismic safety of different structures, it is the responsibility of the government to ensure the schools provide a safe learning environment for Alaskan children. Again, schools may be used as emergency shelters after major earthquakes, further raising the importance of the building’s successful performance during an earthquake.

According to the Alaska Department of Education, in the 2013-2014 school year there were more than 130,000 students in Alaska. School districts statewide accept as part of their mission to protect the safety of children as well as facilities whose replacement cost is many billions of dollars.

This Study:

In the interest of student safety and community resilience to earthquakes, BBFM Engineers was asked to perform a rapid visual screening of several aging schools in the Kenai Peninsula Borough School District to determine which schools warrant an in-depth seismic review, and which structures are expected to perform acceptably during a major earthquake. The screening program follows the criteria established by FEMA Publication 154, Second Edition. FEMA refers to this screening program as a “sidewalk survey” because it is intended to be a very quick review of structure type, structure age, structural discontinuities, local seismicity, and the like.

In this study, BBFM Engineers completed the screening of fifteen schools, most of which have several additions. In total, we reviewed 47 structures, including original construction and additions. Nineteen of the 47 warrant a more detailed evaluation, while further review of the remaining 28 schools is not indicated.

In addition to further review of the nineteen schools, we also recommend that similar studies be undertaken in all regions of high seismicity throughout the state, especially in light of the cost-effectiveness of the FEMA 154 process, which can be performed for just \$500 to \$700 per structure. Studies including many structures may find economies allowing them to be performed for fees near the lower end of this range, while smaller-scale studies may require a higher fee.

Objectives of this Study:

This study was funded by FEMA and managed by the Earthquake Engineering Research Institute (EERI) and the Alaska Seismic Hazards Safety Commission (ASHSC). It is the goal of FEMA and of EERI to improve earthquake safety throughout the country, and for that purpose they are sponsoring projects in various states to showcase the ease and value of rapid visual observation of schools.

Two goals reside at the core of this study: to show planners how quickly and cost effectively an initial assessment can be performed for schools using ROVER’s rapid visual assessment program, and to rate a sampling of existing schools to provide the Kenai Peninsula Borough School District information crucial to their planning purposes. Any buildings of concern can then be prioritized for further study and/or upgrade, as appropriate.

ASHSC looked for a school district with older schools constructed with a variety of structural system types and found a willing participant in the Kenai Peninsula Borough School District, home of some 7% of Alaska's K-12 students. In preparation for the review of the schools, BBFM Engineers obtained the software necessary to establish one office computer as the online server, which BBFM now maintains on behalf of ASHSC. BBFM reviewed the following fifteen schools:

- 1) Chapman School (Anchor Point, Alaska)
- 2) Cooper Landing School (Cooper Landing, Alaska)
- 3) Homer Middle School (Homer, Alaska)
- 4) Kenai Central High School (Kenai, Alaska)
- 5) Moose Pass School (Moose Pass, Alaska)
- 6) Nikolaevsk School (Nikolaevsk, Alaska)
- 7) Ninilchik School (Ninilchik, Alaska)
- 8) Paul Banks Elementary School (Homer, Alaska)
- 9) Sears-Kaleidoscope Elementary (Kenai, Alaska)
- 10) Seward High School (Seward, Alaska)
- 11) Soldotna Elementary School (Soldotna, Alaska)
- 12) Soldotna Middle School (Soldotna, Alaska)
- 13) Sterling Elementary School (Sterling, Alaska)
- 14) Susan B English School (Seldovia, Alaska)
- 15) Tustumena Elementary School (Kasilof, Alaska)

While still at the office, BBFM Engineers reviewed the available structural drawings and began an entry for each in the online server's database, inputting all available information: location in relation to known seismic faults, structural system type, year of construction, and more.

BBFM Engineers then visited fourteen of these schools, photographing their current condition and noting any conditions not shown on the drawings and materials that, during an earthquake, could become falling hazards. One school, Susan B English, was not visited by BBFM Engineers, but electronic photographs of the building were provided for review. This was an intentional proof of concept that this Rapid Visual Screening can work well for schools off the road system. The photographs arrived electronically about six weeks after our first request for them. Between these photographs and our own site visits and the building drawings, all the information necessary for the Rapid Visual Screening was obtained.

The information obtained in the field was later entered into the online server.

Cost of this Study:

The total cost of this study was \$21,250 for the review of 47 structures (original construction plus additions). Extrapolating for future studies, similar Rapid Visual Screening could be performed at a very minimal cost, approximately \$500 to \$700 per original structure or addition. This cost is based on a large number of schools being included in the study to spread out the startup and transportation costs. This cost can even be applied to schools off the road system if the school staff provides electronic photographs as Susan B English did, although a generous schedule may be necessary to ensure photographs arrive in time for related information to be included in the report.

We uploaded the available structural drawings for all the schools onto the ROVER server, as these could be very useful after a major earthquake. The uploaded files are in .jpeg format. Early on we had discussions about uploading them to another site in .pdf format and providing a link in the ROVER server. While this format would be more standard for the industry, as we discussed the ramifications of this with our Internet Service Provider and other computer experts, we learned that URL addresses can be expected to change over the decades, so at the time the files are needed, the links to the pdf files might no longer be working. For this reason, the ROVER server hosts the files themselves, and that required uploading them in the .jpeg format.

Results of the Study:

Of the forty-seven structures reviewed, the final scores range from 0.7 to 5.4. According to FEMA's guidelines, these represent estimated probabilities of partial or complete collapse of 20% and 0.0004%, respectively. These probabilities are dramatically impacted by building design and construction practices common at the time, which may differ significantly from the practices used on these particular structures.

Seventeen structures exhibited scores below 2.0, indicating a more detailed investigation of the structure is necessary, and some of these also indicated potential hazards from falling materials hazards needing to be investigated. Additionally, falling materials hazards were identified at two more structures, where the overall safety of the building was considered acceptable. In total, then, nineteen structures require some form of additional structural investigation.

Following are the results for each school, sorted in alphabetical order. Following these results, we have also sorted the schools by final score, which may assist in prioritization of further work.

- 1) Chapman School (Anchor Point, Alaska): 1958 Original Construction
 - Reinforced masonry construction
 - Final score = 0.7; FEMA estimate of collapse risk: 20%
 - [Detailed investigation is indicated for structural design and detailing, and also for the attachment of the message board, the canopy at the northeast corner of the gym, and the parapet behind the west end of the gym.](#)
- 2) Chapman School (Anchor Point, Alaska): 1982 Addition
 - Wood frame construction
 - Final score = 2.5; FEMA estimate of collapse risk: 0.3%
- 3) Cooper Landing School (Cooper Landing, Alaska): 1973 Original Construction
 - Wood frame construction
 - Final score = 4.1; FEMA estimate of collapse risk: 0.01%
- 4) Cooper Landing School (Cooper Landing, Alaska): 1983 Addition
 - Wood frame construction
 - Final score = 2.7; FEMA estimate of collapse risk: 0.2%

- 5) Homer Middle School (Homer, Alaska): 1970 Original Construction
 - Precast concrete construction
 - Final score = 1.4; FEMA estimate of collapse risk: 4%
 - Detailed investigation is indicated for structural design and detailing, and also for the attachment of the canopy above where the oil tank had been.

- 6) Kenai High School (Kenai, Alaska): 1960 Original Construction
 - Wood frame construction
 - Final score = 3.9; FEMA estimate of collapse risk: 0.01%

- 7) Kenai High School (Kenai, Alaska): 1964 Addition
 - Precast concrete construction
 - Final score = 1.5; FEMA estimate of collapse risk: 3%
 - Detailed investigation is indicated for structural design and detailing.

- 8) Kenai High School (Kenai, Alaska): 1967 Shop Addition
 - Light metal building construction
 - Final score = 2.1; FEMA estimate of collapse risk: 0.8%

- 9) Kenai High School (Kenai, Alaska): 1968 Addition
 - Reinforced masonry construction
 - Final score = 1.2; FEMA estimate of collapse risk: 6%
 - Detailed investigation is indicated for structural design and detailing.

- 10) Kenai High School (Kenai, Alaska): 1970 Voc Ed Addition
 - Reinforced masonry construction
 - Final score = 1.7; FEMA estimate of collapse risk: 2%
 - Detailed investigation is indicated for structural design and detailing.

- 11) Kenai High School (Kenai, Alaska): 1975 Addition
 - Precast concrete construction
 - Final score = 1.5; FEMA estimate of collapse risk: 3%
 - Detailed investigation is indicated for structural design and detailing.

- 12) Kenai High School (Kenai, Alaska): 1983 Addition
 - Precast concrete construction
 - Final score = 1.5; FEMA estimate of collapse risk: 3%
 - Detailed investigation is indicated for structural design and detailing.

- 13) Moose Pass School (Moose Pass, Alaska): 1935 Original Construction
 - Wood frame construction
 - Final score = 1.6; FEMA estimate of collapse risk: 3%
 - Detailed investigation is indicated for structural design and detailing.

- 14) Moose Pass School (Moose Pass, Alaska): 1953 Addition
 - Wood frame construction
 - Final score = 1.1; FEMA estimate of collapse risk: 8%
 - Detailed investigation is indicated for structural design and detailing.
- 15) Moose Pass School (Moose Pass, Alaska): 1960 Addition
 - Wood frame construction
 - Final score = 1.1; FEMA estimate of collapse risk: 8%
 - Detailed investigation is indicated for structural design and detailing.
- 16) Moose Pass School (Moose Pass, Alaska): 1974 Addition
 - Wood frame construction
 - Final score = 1.6; FEMA estimate of collapse risk: 3%
 - Detailed investigation is indicated for structural design and detailing.
- 17) Moose Pass School (Moose Pass, Alaska): 1993 Addition
 - Wood frame construction
 - Final score = 3.6; FEMA estimate of collapse risk: 0.03%
- 18) Nikolaevsk School (Nikolaevsk, Alaska): 1975 Original Construction
 - Wood frame construction
 - Final score = 3.0; FEMA estimate of collapse risk: 0.1%
 - Detailed investigation is indicated for the side exit canopy and its connection to the building, as its columns are out of plumb.
- 19) Nikolaevsk School (Nikolaevsk, Alaska): 1982 Addition
 - Wood frame construction
 - Final score = 5.4; FEMA estimate of collapse risk: 0.0004%
- 20) Ninilchik School (Ninilchik, Alaska): 1950 Original Construction
 - Steel frame with cast in place concrete shear walls
 - Final score = 2.2; FEMA estimate of collapse risk: 0.6%
- 21) Ninilchik School (Ninilchik, Alaska): 1962 Addition
 - Wood frame construction
 - Final score = 3.0; FEMA estimate of collapse risk: 0.1%
- 22) Ninilchik School (Ninilchik, Alaska): 1979 Addition
 - Concrete shear wall construction
 - Final score = 3.1; FEMA estimate of collapse risk: 0.08%
- 23) Ninilchik School (Ninilchik, Alaska): 1981 Pool Addition
 - Wood frame construction
 - Final score = 3.4; FEMA estimate of collapse risk: 0.04%

- 24) Paul Banks Elementary School (Homer, Alaska): 1964 Original Construction
 - Reinforced masonry construction
 - Final score = 2.3; FEMA estimate of collapse risk: 0.5%
- 25) Paul Banks Elementary School (Homer, Alaska): 1975 Addition
 - Reinforced masonry construction
 - Final score = 2.3; FEMA estimate of collapse risk: 0.5%
- 26) Paul Banks Elementary School (Homer, Alaska): 1984 Addition
 - Wood frame construction
 - Final score = 3.2; FEMA estimate of collapse risk: 0.06%
- 27) Sears-Kaleidoscope Elementary School (Kenai, Alaska): 1968 Original Construction
 - Precast concrete construction
 - Final score = 2.0; FEMA estimate of collapse risk: 1%
- 28) Seward High School (Seward, Alaska): 1977 Original Construction
 - Reinforced masonry construction
 - Final score = 3.2; FEMA estimate of collapse risk: 0.06%
- 29) Soldotna Elementary School (Soldotna, Alaska): 1960 Original Construction
 - Wood frame construction
 - Final score = 2.9; FEMA estimate of collapse risk: 0.1%
- 30) Soldotna Elementary School (Soldotna, Alaska): 1962 Addition
 - Wood frame construction
 - Final score = 2.9; FEMA estimate of collapse risk: 0.1%
- 31) Soldotna Elementary School (Soldotna, Alaska): 1968 Addition
 - Wood frame construction
 - Final score = 2.9; FEMA estimate of collapse risk: 0.1%
- 32) Soldotna Elementary School (Soldotna, Alaska): 1975 Addition
 - Reinforced masonry construction
 - Final score = 1.6; FEMA estimate of collapse risk: 3%
 - Detailed investigation is indicated for structural design and detailing, and also for the large canopy's attachment to the rear of the building.
- 33) Soldotna Middle School (Soldotna, Alaska): 1970 Original Construction
 - Reinforced masonry construction
 - Final score = 2.1; FEMA estimate of collapse risk: 0.8%
- 34) Soldotna Middle School (Soldotna, Alaska): 1986 Addition
 - Steel braced frame construction
 - Final score = 0.8; FEMA estimate of collapse risk: 16%
 - Detailed investigation is indicated for structural design and detailing, and also the structure of the large, open canopies at the two main entries

- 35) Sterling Elementary School (Sterling, Alaska): 1958 Original Construction
- Wood frame construction
 - Final score = 4.3; FEMA estimate of collapse risk: 0.005%
- 36) Sterling Elementary School (Sterling, Alaska): 1963 Addition
- Wood frame construction
 - Final score = 3.8; FEMA estimate of collapse risk: 0.02%
- 37) Sterling Elementary School (Sterling, Alaska): 1968 Addition
- Reinforced masonry construction
 - Final score = 2.1; FEMA estimate of collapse risk: 0.8%
- 38) Sterling Elementary School (Sterling, Alaska): 1978 Addition
- Wood frame construction
 - Final score = 5.3; FEMA estimate of collapse risk: 0.0005%
- 39) Sterling Elementary School (Sterling, Alaska): 1983 Addition
- Wood frame construction
 - Final score = 2.8; FEMA estimate of collapse risk: 0.2%
 - Detailed investigation is indicated for the attachment to the building of the side entry canopy and the canopy over the generator.
- 40) Susan B English School (Seldovia, Alaska): 1957 Original Construction
- Concrete shear wall construction
 - Final score = 2.1; FEMA estimate of collapse risk: 0.8%
- 41) Susan B English School (Seldovia, Alaska): 1972 Addition
- Precast concrete construction
 - Final score = 1.4; FEMA estimate of collapse risk: 4%
 - Detailed investigation is indicated for structural design and detailing, and also for the attachment of the second story exterior stair to the building.
- 42) Susan B English School (Seldovia, Alaska): 1983 Addition
- Reinforced masonry construction
 - Final score = 1.1; FEMA estimate of collapse risk: 8%
 - Detailed investigation is indicated for structural design and detailing.
- 43) Tustumena School (Kasilof, Alaska): 1958 Original Construction
- Wood frame construction
 - Final score = 3.0; FEMA estimate of collapse risk: 0.1%
- 44) Tustumena School (Kasilof, Alaska): 1969 Addition
- Reinforced masonry construction
 - Final score = 1.7; FEMA estimate of collapse risk: 2%
 - Detailed investigation is indicated for structural design and detailing, and also the piers under the canopy columns, as many are cracking substantially.

- 45) Tustumena School (Kasilof, Alaska): 1978 Addition
- Wood frame construction
 - Final score = 4.9; FEMA estimate of collapse risk: 0.001%

- 46) Tustumena School (Kasilof, Alaska): 1983 Addition
- Reinforced masonry construction
 - Final score = 1.7; FEMA estimate of collapse risk: 2%
 - Detailed investigation is indicated for structural design and detailing.

- 47) Tustumena School (Kasilof, Alaska): 1995 Addition
- Wood frame construction
 - Final score = 2.9; FEMA estimate of collapse risk: 0.1%

Here is a brief summary of the results for each school, sorted by final FEMA score:

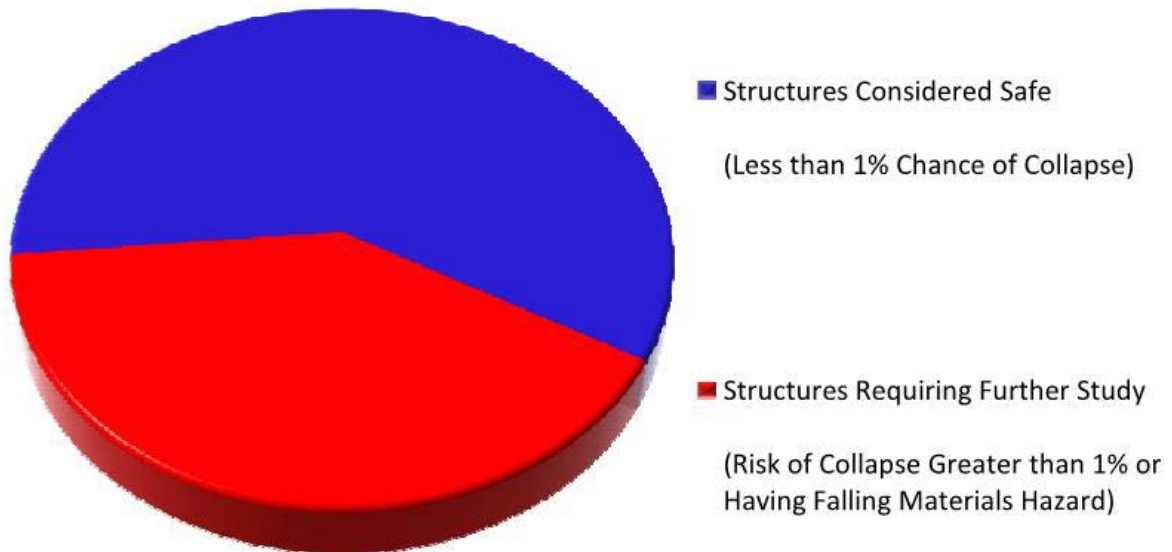
School	Score	FEMA Risk	Further Study?
Chapman School, 1958 Orig (Anchor Point, AK)	0.7	20%	Yes
1982 Addn	2.5	0.30%	No
Soldotna Middle School, 1986 Addn (Soldotna, AK)	0.8	16%	Yes
1970 Orig	2.1	0.80%	No
Susan B English School, 1983 Addn (Seldovia, AK)	1.1	8%	Yes
1972 Addn	1.4	4%	Yes
1957 Orig	2.1	0.80%	No
Moose Pass School, 1953 Addn (Moose Pass, AK)	1.1	8%	Yes
1960 Addn	1.1	8%	Yes
1935 Orig	1.6	3%	Yes
1974 Addn	1.6	3%	Yes
1993 Addn	3.6	0.03%	No
Kenai Central High School, 1968 Addn (Kenai, AK)	1.2	6%	Yes
1964 Addn	1.5	3%	Yes
1975 Addn	1.5	3%	Yes
1983 Addn	1.5	3%	Yes
1970 Addn	1.7	2%	Yes
1967 Addn	2.1	0.80%	No
1960 Orig	3.9	0.01%	No
Homer Middle School, 1970 Orig (Homer, AK)	1.4	4%	Yes
Soldotna Elementary School, 1975 Addn (Soldotna, AK)	1.6	3%	Yes
1960 Orig	2.9	0.10%	No
1962 Addn	2.9	0.10%	No
1968 Addn	2.9	0.10%	No
Tustumena Elementary School, 1969 Addn (Kasilof, AK)	1.7	2%	Yes
1983 Addn	1.7	2%	Yes
1995 Addn	2.9	0.10%	No
1958 Orig	3	0.10%	No
1978 Addn	4.9	0.00%	No

(continued on next page)

Sorted Results (continued):

<u>School</u>	<u>Score</u>	<u>FEMA Risk</u>	<u>Further Study?</u>
Sears-Kaleidoscope Elementary, 1968 Orig (Kenai, AK)	2	1%	No
Sterling Elementary School, 1968 Addn (Sterling, AK)	2.1	0.80%	No
1983 Addn	2.8	0.20%	Yes *
1963 Addn	3.8	0.02%	No
1958 Orig	4.3	0.01%	No
1978 Addn	5.3	0.00%	No
Ninilchik School, 1950 Orig (Ninilchik, AK)	2.2	0.60%	No
1962 Addn	3	0.10%	No
1979 Addn	3.1	0.08%	No
1981 Addn	3.4	0.04%	No
Paul Banks Elementary School, 1964 Orig (Homer, AK)	2.3	0.50%	No
1975 Addn	2.3	0.50%	No
1984 Addn	3.2	0.06%	No
Nikolaevsk School, 1975 Orig (Nikolaevsk, AK)	3	0.10%	Yes **
1982 Addn	5.4	0.00%	No
Seward High School, 1977 Orig (Seward, AK)	3.2	0.06%	No
Cooper Landing School, 1983 Addn (Cooper Landing, AK)	2.7	0.20%	No
1971 Orig	4.1	0.01%	No

- * At Sterling Elementary School, further structural review is recommended for the attachment to the building of the side entry canopy and the canopy over the generator.
- ** At Nikolaevsk School, the side exit canopy and its connection to the building, as its columns are out of plumb.



With relatively little time or expense, this study has identified many structures that would be expected to perform acceptably during a major earthquake, largely due to modern building code requirements and construction practices.

At the same time, this study also quickly and cost-effectively identified many other structures that may perform poorly during a major earthquake. The schools appear to pose a significant risk to students in the Kenai Peninsula School District and to the communities they serve. Of the forty-seven original buildings and additions, nineteen were flagged as requiring further structural attention. In other words, 40% of the structures reviewed in this study may pose an unacceptable risk of at least partial collapse during a major earthquake. Following FEMA Publication 154, the four largest contributors to a building's seismic risk are: a) common industry practices when the structure was built, b) type of structural system, c) the presence of and type of structural irregularities, and d) the seismicity of the region.

The study of these schools in the Kenai Peninsula Borough School District indicates there would be great value in conducting similar studies statewide, where more than 500 public schools serve kindergarten through twelfth grade. It is the responsibility of school districts and school boards, as well as local and statewide governing bodies to reduce the risk earthquakes currently pose to students and facilities alike, and this rapid evaluation method would quickly and economically identify those structures requiring further attention.

In a December 17, 2014, interview aired by the Alaska Public Radio Network, Alaska Governor Bill Walker pointed out that the tightness of today's Alaskan economy requires policymakers to be particularly focused on our state's priorities, and that education is a high priority. Fortunately, structural review and upgrade is truly one area where "a stitch in time saves nine." Over time, the cost of not upgrading a deficient structure typically exceeds the cost of improving the structure before a major earthquake hits, and even more so when lives and disruption to society are factored in.

Effectiveness of Seismic Retrofit:

Various earthquakes have shown that seismic retrofits to a building can substantially improve its performance during a major earthquake. For example, the 2001 Nisqually Earthquake near Olympia, Washington produced peak ground accelerations 10% to 30% as strong as the acceleration due to gravity. Reviewing the aftermath, the California Seismic Safety Commission determined that "One hundred and one schools and buildings had been retrofitted for structural components and seven had been retrofitted for non-structural components in the Seattle Public Schools District when the Nisqually earthquake occurred. None of the districts schools suffered significant structural damage. Non-structural damage to colleges and universities included toppling of bookcases and the localized flooding due to a ruptured water line. Some primary and secondary schools in Olympia and Seattle suffered limited structural (damaged beams and columns) and non-structural damage from strong ground shaking."

A second example is the magnitude 6 earthquake that struck Napa, California in 2014, producing peak ground accelerations of 60% to 100% as strong as the acceleration due to gravity. The earthquake and its aftershocks injured 90 people and caused approximately \$1 billion of damage. Engineering News-Record reported on September 3, 2014:

The epicenter of the American Canyon quake was at the heart of the Napa school district's 30 campuses. Subsequently, three architectural and engineering teams assessed "every room in every school" and observed no structural damage following the quake, says Mark Quattrocchi, principal of Kwok Quattrocchi Architects and one of the survey team members... The schools performed so well because they are built or retrofitted according to much stricter seismic codes than commercial and residential buildings.

"There was no structural damage to any school in the district, even the ones built to older codes in the 1940s, 1950s and 1960s," says Quattrocchi. "Part of this is because seismic upgrades at the schools are treated the same as building an entirely new facility," he adds.

Schools fared well for three reasons: seismic building codes that are more stringent than those for commercial buildings, methodical reviews by the Division of the State Architect and "full-time" state inspection on school construction sites, Quattrocchi says."

For buildings shown to be vulnerable to collapse during earthquakes, seismic retrofit can substantially improve the buildings' performance during a major earthquake.

Further, grants may be available from FEMA and other groups to facilitate seismic upgrades to school buildings.

Recommendations:

We urge planners and policymakers to implement a program to assess rapidly and inexpensively (only costing about \$500 to \$700 per structure, plus transportation as needed) the vulnerability of schools to earthquakes, both for the safety of the students and to protect financial investments across the state. An added benefit of using the ROVER program is that it develops a database of critical information readily available after a major earthquake.

We also encourage further structural review for the nineteen structures identified in this report as posing unacceptable seismic risk. That review should be performed by a qualified structural engineering firm and should include a careful review of the specific loads, members, and connection details specific to these structures. Where appropriate, this additional analysis should include preliminary recommendations for structural upgrade, which can be fleshed out under a separate contract for preparation of construction documents.

For the safety of the students and to protect financial investments across the state, we urge planners and policymakers to implement a program to assess rapidly the vulnerability of schools to earthquakes. This program can be surprisingly inexpensive, costing as little as \$500 to \$700 per structure, while effectively indicating which structures would or would not require further review. An added benefit of using the ROVER program is that it develops a database of photographs, structural plans, and other critical information readily available after a major earthquake. We also encourage further structural review and possible seismic retrofit for the nineteen structures

identified in this report as requiring a more detailed investigation.

BBFM Engineers



Dennis L Berry, President and Principal



Scott Gruhn, Principal and Project Manager



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Rapid Visual Screening of Kenai Peninsula Borough Schools for Seismic Risk

Appendix A

Scoring Sheets for ROVER

Sample of the RVS score
sheets completed

Table of Contents

<u>Page</u>	<u>School</u>	<u>Detailed Evaluation Required?</u>
A3	Chapman School, 1958 Orig (Anchor Point, Alaska)	Yes
A4	Chapman School, 1982 Addn	No
A5	Cooper Landing School, 1971 Orig (Cooper Landing, Alaska)	No
A6	Cooper Landing School, 1983 Addn	No
A7	Homer Middle School, 1970 Orig (Homer, Alaska)	Yes
A8	Kenai Central High School, 1960 Orig (Kenai, Alaska)	No
A9	Kenai Central High School, 1964 Addn	Yes
A10	Kenai Central High School, 1967 Addn	No
A11	Kenai Central High School, 1968 Addn	Yes
A12	Kenai Central High School, 1970 Addn	Yes
A13	Kenai Central High School, 1975 Addn	Yes
A14	Kenai Central High School, 1983 Addn	Yes
A15	Moose Pass School, 1935 Orig (Moose Pass, Alaska)	Yes
A16	Moose Pass School, 1953 Addn	Yes
A17	Moose Pass School, 1960 Addn	Yes
A18	Moose Pass School, 1974 Addn	Yes
A19	Moose Pass School, 1993 Addn	No
A20	Nikolaevsk School, 1975 Orig (Nikolaevsk, Alaska)	Yes
A21	Nikolaevsk School, 1982 Addn	No
A22	Ninilchik School, 1950 Orig (Ninilchik, Alaska)	No
A23	Ninilchik School, 1962 Addn	No
A24	Ninilchik School, 1979 Addn	No
A25	Ninilchik School, 1981 Addn	No
A26	Paul Banks Elementary School, 1964 Orig (Homer, Alaska)	No
A27	Paul Banks Elementary School, 1975 Addn	No
A28	Paul Banks Elementary School, 1984 Addn	No
A29	Sears-Kaleidoscope Elementary, 1968 Orig (Kenai, Alaska)	No
A30	Seward High School, 1977 Orig (Seward, Alaska)	No
A31	Soldotna Elementary School, 1960 Orig (Soldotna, Alaska)	No
A32	Soldotna Elementary School, 1962 Addn	No
A33	Soldotna Elementary School, 1968 Addn	No
A34	Soldotna Elementary School, 1975 Addn	Yes
A35	Soldotna Middle School, 1970 Orig (Soldotna, Alaska)	No
A36	Soldotna Middle School, 1986 Addn	Yes
A37	Sterling Elementary School, 1958 Orig (Sterling, Alaska)	No
A38	Sterling Elementary School, 1963 Addn	No
A39	Sterling Elementary School, 1968 Addn	No
A40	Sterling Elementary School, 1978 Addn	No
A41	Sterling Elementary School, 1983 Addn	Yes
A42	Susan B English School, 1957 Orig (Seldovia, Alaska)	No
A43	Susan B English School, 1972 Addn	Yes
A44	Susan B English School, 1983 Addn	Yes
A45	Tustumena Elementary School, 1958 Orig (Kasilof, Alaska)	No
A46	Tustumena Elementary School, 1969 Addn	Yes
A47	Tustumena Elementary School, 1978 Addn	No
A48	Tustumena Elementary School, 1983 Addn	Yes
A49	Tustumena Elementary School, 1995 Addn	No

ROVER Scoring Sheet

Chapman School: 1958 Original Construction

10/28/2015

FEMA 154

**Rapid Visual Screening of Buildings for Potential Seismic Risk
FEMA-154 Data Collection Form**

HIGH Seismicity



Address: PO Box 1109
 Zip: 99556
 Other Identifiers: Elementary
 No Stories: 1
 Year Built: 1958
 Screener: 1
 Date: None
 Total Floor Area (sq. ft.): 5808

Building Name: **Chapman 1958 Orig**
 Use: None



Name: Chapman 1958 Orig
 Screener: 1
 Date: 2002-02-19 17:01:49

Occupancy				Soil Type						Falling Hazard				
<input type="checkbox"/> Assembly	<input type="checkbox"/> Govt	<input type="checkbox"/> Office	Number of Persons <input type="checkbox"/> 0-10 <input type="checkbox"/> 11-100 <input checked="" type="checkbox"/> 101-1000 <input type="checkbox"/> 1000+	<input type="checkbox"/> A Hard Rock	<input type="checkbox"/> B Avg. Rock	<input type="checkbox"/> C Dense Soil	<input type="checkbox"/> D Stiff Soil	<input type="checkbox"/> E Soft Soil	<input type="checkbox"/> F Poor Soil	<input type="checkbox"/> Unreinforced Chimneys	<input type="checkbox"/> Parapets	<input type="checkbox"/> Cladding	Other: <input type="text" value="Check attachment of message"/>	
<input type="checkbox"/> Commercial	<input type="checkbox"/> Historic	<input type="checkbox"/> Residential		<input type="checkbox"/> Emer. Services	<input type="checkbox"/> Industrial	<input checked="" type="checkbox"/> School								

Building Type	Basic Scores, Modifiers, and Final Score, S														
	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	1.9	2.5	2.8	1.5	2.6	2.4	2.8	2.8	1.7
Mid Rise(4-7 stories)	NA	NA	0.2	0.4	NA	0.4	0.4	0.4	0.4	0.2	NA	0.2	0.4	0.4	0.0
High Rise(>7 stories)	NA	NA	0.6	0.8	NA	0.8	0.8	0.6	0.8	0.3	NA	0.4	NA	0.6	NA
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	NA	-1.0	-1.0	-1.5	-1.0	-1.0	NA	-1.0	-1.0	-1.0	-1.0
Plan Irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	+0.5	+0.5	-0.5	+0.5	+0.5
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2
Post-Benchmark	2.4	2.4	1.4	1.4	NA	1.6	NA	1.4	2.4	NA	2.4	NA	2.8	2.6	NA
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.6
Final Scores															0.7

Comments: Detailed Evaluation Required

* = Estimated, subjective or unreliable data BR = Braced Frame MRF = Moment-resisting frame SW = Shear Wall
 DNK = Do Not Know FD = Flexible Diaphragm RC = Reinforced concrete TU = Tilt Up
 LM = Light Metal RD = Rigid diaphragm URM INF = Unreinforced masonry infill

ROVER Scoring Sheet

Chapman School: 1982 Addition

10/28/2015

FEMA 154

**Rapid Visual Screening of Buildings for Potential Seismic Risk
FEMA-154 Data Collection Form**

HIGH Seismicity

<p style="text-align: center; font-size: 24px; color: gray;">No Sketch</p>	<p>Address: PO Box 1109 Zip: 99556 Other Identifiers: No Stories: 1 Year Built: 1982 Screener: 1 Date: None Total Floor Area (sq. ft.): 5200</p> <p>Building Name: Chapman School 1982 Addition Use: None</p>
<p style="text-align: center; font-size: 24px; color: gray;">No Photograph</p>	

Occupancy				Soil Type						Falling Hazard			
<input type="checkbox"/> Assembly	<input type="checkbox"/> Govt	<input type="checkbox"/> Office	Number of Persons <input type="checkbox"/> 0-10 <input type="checkbox"/> 11-100 <input checked="" type="checkbox"/> 101-1000 <input type="checkbox"/> 1000+	<input type="checkbox"/> A Hard Rock	<input type="checkbox"/> B Avg. Rock	<input type="checkbox"/> C Dense Soil	<input type="checkbox"/> D Stiff Soil	<input type="checkbox"/> E Soft Soil	<input type="checkbox"/> F Poor Soil	<input type="checkbox"/> Unreinforced Chimneys	<input type="checkbox"/> Parapets	<input type="checkbox"/> Cladding	
<input type="checkbox"/> Commercial	<input type="checkbox"/> Historic	<input type="checkbox"/> Residential									Other: <input style="width: 100%;" type="text"/>		
<input type="checkbox"/> Emer. Services	<input type="checkbox"/> Industrial	<input checked="" type="checkbox"/> School											

Basic Scores, Modifiers, and Final Score, S																
Building Type	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM	
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	1.9	2.5	2.8	1.5	2.6	2.4	2.8	2.8	1.7	
Mid Rise(4-7 stories)	<input type="checkbox"/> NA	<input type="checkbox"/> NA	<input type="checkbox"/> 0.2	<input type="checkbox"/> 0.4	<input type="checkbox"/> NA	<input type="checkbox"/> 0.4	<input type="checkbox"/> 0.4	<input type="checkbox"/> 0.4	<input type="checkbox"/> 0.4	<input type="checkbox"/> 0.2	<input type="checkbox"/> NA	<input type="checkbox"/> 0.2	<input type="checkbox"/> 0.4	<input type="checkbox"/> 0.4	<input type="checkbox"/> 0.0	
High Rise(>7 stories)	<input type="checkbox"/> NA	<input type="checkbox"/> NA	<input type="checkbox"/> 0.6	<input type="checkbox"/> 0.8	<input type="checkbox"/> NA	<input type="checkbox"/> 0.8	<input type="checkbox"/> 0.8	<input type="checkbox"/> 0.6	<input type="checkbox"/> 0.8	<input type="checkbox"/> 0.3	<input type="checkbox"/> NA	<input type="checkbox"/> 0.4	<input type="checkbox"/> NA	<input type="checkbox"/> 0.6	<input type="checkbox"/> NA	
Vertical Irregularity	<input type="checkbox"/> -2.5	<input type="checkbox"/> -2.0	<input type="checkbox"/> -1.0	<input type="checkbox"/> -1.5	<input type="checkbox"/> NA	<input type="checkbox"/> -1.0	<input type="checkbox"/> -1.0	<input type="checkbox"/> -1.5	<input type="checkbox"/> -1.0	<input type="checkbox"/> -1.0	<input type="checkbox"/> NA	<input type="checkbox"/> -1.0	<input type="checkbox"/> -1.0	<input type="checkbox"/> -1.0	<input type="checkbox"/> -1.0	
Plan Irregularity	<input type="checkbox"/> -0.5	<input checked="" type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	
Pre-Code	<input type="checkbox"/> 0.0	<input type="checkbox"/> -1.0	<input type="checkbox"/> -1.0	<input type="checkbox"/> -0.8	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.8	<input type="checkbox"/> -0.2	<input type="checkbox"/> -1.2	<input type="checkbox"/> -1.0	<input type="checkbox"/> -0.2	<input type="checkbox"/> -0.8	<input type="checkbox"/> -0.8	<input type="checkbox"/> -1.0	<input type="checkbox"/> -0.8	<input type="checkbox"/> -0.2	
Post-Benchmark	<input type="checkbox"/> 2.4	<input checked="" type="checkbox"/> 2.4	<input type="checkbox"/> 1.4	<input type="checkbox"/> 1.4	<input type="checkbox"/> NA	<input type="checkbox"/> 1.6	<input type="checkbox"/> NA	<input type="checkbox"/> 1.4	<input type="checkbox"/> 2.4	<input type="checkbox"/> NA	<input type="checkbox"/> 2.4	<input type="checkbox"/> NA	<input type="checkbox"/> 2.8	<input type="checkbox"/> 2.6	<input type="checkbox"/> NA	
Soil Type C	<input type="checkbox"/> 0.0	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	
Soil Type D	<input type="checkbox"/> 0.0	<input checked="" type="checkbox"/> -0.8	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.6	
Soil Type E	<input type="checkbox"/> 0.0	<input type="checkbox"/> -0.8	<input type="checkbox"/> -1.2	<input type="checkbox"/> -1.2	<input type="checkbox"/> -1.0	<input type="checkbox"/> -1.2	<input type="checkbox"/> -0.8	<input type="checkbox"/> -1.2	<input type="checkbox"/> -0.8	<input type="checkbox"/> -0.8	<input type="checkbox"/> -0.4	<input type="checkbox"/> -1.2	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.6	
Final Scores	2.5															

Comments:	Detailed Evaluation Required <input type="checkbox"/>
-----------	--

* = Estimated, subjective or unreliable data BR = Braced Frame MRF = Moment-resisting frame SW = Shear Wall
 DNK = Do Not Know FD = Flexible Diaphragm RC = Reinforced concrete TU = Tilt Up
 LM = Light Metal RD = Rigid diaphragm URM INF = Unreinforced masonry infill

ROVER Scoring Sheet

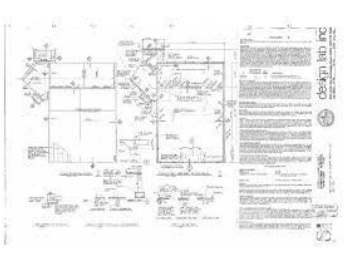
Cooper Landing School: 1971 Original Construction

10/28/2015

FEMA 154


**Rapid Visual Screening of Buildings for Potential Seismic Risk
FEMA-154 Data Collection Form**

HIGH Seismicity



Address: PO Box 990
 Zip: 99572
 Other Identifiers:
 No Stories: 1
 Year Built: 1973
 Screener: 1
 Date: None
 Total Floor Area (sq. ft.): 4300

Building Name: **Cooper Landing 1971 Original**
 Use: None



Name: Cooper Landing 1971 Original
 Screener: 1
 Date: 2002-02-19 17:32:54

Occupancy				Soil Type						Falling Hazard			
<input type="checkbox"/> Assembly	<input type="checkbox"/> Govt	<input type="checkbox"/> Office	Number of Persons <input type="checkbox"/> 0-10 <input type="checkbox"/> 11-100 <input checked="" type="checkbox"/> 101-1000 <input type="checkbox"/> 1000+	<input type="checkbox"/> A Hard Rock	<input type="checkbox"/> B Avg. Rock	<input type="checkbox"/> C Dense Soil	<input type="checkbox"/> D Stiff Soil	<input type="checkbox"/> E Soft Soil	<input type="checkbox"/> F Poor Soil	<input type="checkbox"/> Unreinforced Chimneys	<input type="checkbox"/> Parapets	<input type="checkbox"/> Cladding	
<input type="checkbox"/> Commercial	<input type="checkbox"/> Historic	<input type="checkbox"/> Residential		<input type="checkbox"/> Other:									
<input type="checkbox"/> Emer. Services	<input type="checkbox"/> Industrial	<input checked="" type="checkbox"/> School											

Building Type	Basic Scores, Modifiers, and Final Score, S															
	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM	
Basic Score	4.1	3.5	2.5	2.8	3.0	2.5	1.5	2.3	2.5	1.1	2.4	2.1	2.5	2.6	1.3	
Mid Rise(4-7 stories)	NA	NA	0.2	0.4	NA	0.4	0.4	0.4	0.4	0.2	NA	0.2	0.4	0.4	0.0	
High Rise(>7 stories)	NA	NA	0.6	0.8	NA	0.8	0.8	0.6	0.8	0.3	NA	0.4	NA	0.6	NA	
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	NA	-1.0	-1.0	-1.5	-1.0	-1.0	NA	-1.0	-1.0	-1.0	-1.0	
Plan Irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2	
Post-Benchmark	2.4	2.4	1.4	1.4	NA	1.6	NA	1.4	2.4	NA	2.4	NA	2.8	2.6	NA	
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	-0.6	-0.6	-0.6	-0.6	-0.6	
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.6	
Final Scores	4.1															

Comments:	Detailed Evaluation Required <input type="checkbox"/>
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* = Estimated, subjective or unreliable data BR = Braced Frame MRF = Moment-resisting frame SW = Shear Wall
 DNK = Do Not Know FD = Flexible Diaphragm RC = Reinforced concrete TU = Tilt Up
 LM = Light Metal RD = Rigid diaphragm URM INF = Unreinforced masonry infill

ROVER Scoring Sheet

Cooper Landing School: 1983 Addition

10/28/2015

FEMA 154

**Rapid Visual Screening of Buildings for Potential Seismic Risk
FEMA-154 Data Collection Form**

HIGH Seismicity

<p style="text-align: center; font-size: 24px; color: gray;">No Sketch</p>	<p>Address: PO Box 990 Zip: 99572 Other Identifiers: No Stories: 1 Year Built: 1983 Screener: 1 Date: None Total Floor Area (sq. ft.): 4100 Building Name: Cooper Landing 1983 Addn Use: None</p>
<p style="text-align: center; font-size: 24px; color: gray;">No Photograph</p>	

Occupancy				Soil Type						Falling Hazard		
<input type="checkbox"/> Assembly	<input type="checkbox"/> Govt	<input type="checkbox"/> Office	Number of Persons <input type="checkbox"/> 0-10 <input type="checkbox"/> 11-100 <input checked="" type="checkbox"/> 101-1000 <input type="checkbox"/> 1000+	<input type="checkbox"/> A Hard Rock	<input type="checkbox"/> B Avg. Rock	<input type="checkbox"/> C Dense Soil	<input type="checkbox"/> D Stiff Soil	<input type="checkbox"/> E Soft Soil	<input type="checkbox"/> F Poor Soil	<input type="checkbox"/> Unreinforced Chimneys	<input type="checkbox"/> Parapets	<input type="checkbox"/> Cladding
<input type="checkbox"/> Commercial	<input type="checkbox"/> Historic	<input type="checkbox"/> Residential		<input type="checkbox"/> Other: _____								
<input type="checkbox"/> Emer. Services	<input type="checkbox"/> Industrial	<input checked="" type="checkbox"/> School										

Basic Scores, Modifiers, and Final Score, S																
Building Type	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM	
Basic Score	4.1	3.5	2.5	2.8	3.0	2.5	1.5	2.3	2.5	1.1	2.4	2.1	2.5	2.6	1.3	
Mid Rise(4-7 stories)	NA	NA	0.2	0.4	NA	0.4	0.4	0.4	0.4	0.2	NA	0.2	0.4	0.4	0.0	
High Rise(>7 stories)	NA	NA	0.6	0.8	NA	0.8	0.8	0.6	0.8	0.3	NA	0.4	NA	0.6	NA	
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	NA	-1.0	-1.0	-1.5	-1.0	-1.0	NA	-1.0	-1.0	-1.0	-1.0	
Plan Irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2	
Post-Benchmark	2.4	2.4	1.4	1.4	NA	1.6	NA	1.4	2.4	NA	2.4	NA	2.8	2.6	NA	
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	
Soil Type D	0.0	0.8	0.6	0.6	0.6	0.6	0.4	0.6	0.6	0.4	0.6	0.6	0.6	0.6	0.6	
Soil Type E	0.0	0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	-0.4	-1.2	-0.4	-0.6	-0.6	
Final Scores	2.7															

Comments:	Detailed Evaluation Required <input type="checkbox"/>
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* = Estimated, subjective or unreliable data BR = Braced Frame MRF = Moment-resisting frame SW = Shear Wall
 DNK = Do Not Know FD = Flexible Diaphragm RC = Reinforced concrete TU = Tilt Up
 LM = Light Metal RD = Rigid diaphragm URM INF = Unreinforced masonry infill

ROVER Scoring Sheet

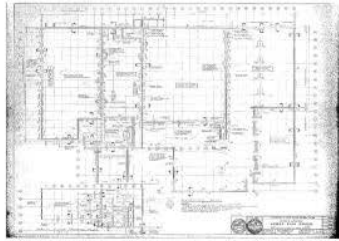
Homer Middle School: 1970 Original Construction

10/28/2015

FEMA 154


**Rapid Visual Screening of Buildings for Potential Seismic Risk
FEMA-154 Data Collection Form**

HIGH Seismicity



Address: 500 Sterling Hwy.
Zip: 99603
Other Identifiers:
No Stories: 1
Year Built: 1970
Screener: 1
Date: None
Total Floor Area (sq. ft.): 47274

Building Name: **Homer Junior High**
Use: None



Occupancy				Soil Type						Falling Hazard			
<input type="checkbox"/> Assembly	<input type="checkbox"/> Govt	<input type="checkbox"/> Office	Number of Persons <input type="checkbox"/> 0-10 <input type="checkbox"/> 11-100 <input type="checkbox"/> 101-1000 <input checked="" type="checkbox"/> 1000+	<input type="checkbox"/> A Hard Rock	<input type="checkbox"/> B Avg. Rock	<input type="checkbox"/> C Dense Soil	<input type="checkbox"/> D Stiff Soil	<input type="checkbox"/> E Soft Soil	<input type="checkbox"/> F Poor Soil	<input type="checkbox"/> Unreinforced Chimneys	<input type="checkbox"/> Parapets	<input type="checkbox"/> Cladding	Other: Canopy above former oil tank
<input type="checkbox"/> Commercial	<input type="checkbox"/> Historic	<input type="checkbox"/> Residential		<input type="checkbox"/> Other									
<input type="checkbox"/> Emer. Services	<input type="checkbox"/> Industrial	<input checked="" type="checkbox"/> School											

Basic Scores, Modifiers, and Final Score, S																
Building Type	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM	
Basic Score	4.3	3.6	2.7	2.9	3.1	2.7	1.7	2.4	2.7	1.3	2.5	2.3	2.7	2.7	1.5	
Mid Rise(4-7 stories)	NA	NA	0.2	0.4	NA	0.4	0.4	0.4	0.4	0.2	NA	0.2	0.4	0.4	0.4	0.0
High Rise(>7 stories)	NA	NA	0.6	0.8	NA	0.8	0.8	0.6	0.8	0.3	NA	0.4	NA	0.6	NA	
Vertical Irregularity	-2.5	-2.0	-1.0	-1.5	NA	-1.0	-1.0	-1.5	-1.0	-1.0	NA	-1.0	-1.0	-1.0	-1.0	
Plan Irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	0.5	0.5	0.5	0.5	0.5	
Pre-Code	0.0	-1.0	-1.0	-0.8	-0.6	-0.8	-0.2	-1.2	-1.0	-0.2	-0.8	-0.8	-1.0	-0.8	-0.2	
Post-Benchmark	2.4	2.4	1.4	1.4	NA	1.6	NA	1.4	2.4	NA	2.4	NA	2.8	2.6	NA	
Soil Type C	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	
Soil Type D	0.0	-0.8	-0.6	-0.6	-0.6	-0.6	-0.4	-0.6	-0.6	-0.4	0.6	0.6	0.6	0.6	0.6	
Soil Type E	0.0	-0.8	-1.2	-1.2	-1.0	-1.2	-0.8	-1.2	-0.8	-0.8	0.4	1.2	0.4	0.6	0.6	
Final Scores												1.4				

Comments:

Detailed Evaluation Required

* = Estimated, subjective or unreliable data
 DNK = Do Not Know
 BR = Braced Frame
 FD = Flexible Diaphragm
 LM = Light Metal
 MRF = Moment-resisting frame
 RC = Reinforced concrete
 RD = Rigid diaphragm
 SW = Shear Wall
 TU = Til: Up
 URM INF = Unreinforced masonry infill

ROVER Scoring Sheet

Kenai Central High School 1960 Addition

10/28/2015

FEMA 154

**Rapid Visual Screening of Buildings for Potential Seismic Risk
FEMA-154 Data Collection Form**

HIGH Seismicity



Address: 9583 Spur Hwy
 Zip: 99611
 Other Identifiers:
 No. Stories: 2
 Year Built: 1960
 Screener: 3
 Date: None
 Total Floor Area (sq. ft.): 1200

Building Name: **Kenai High School 1960 Addn**
 Use: None



Occupancy				Soil Type						Falling Hazard		
<input type="checkbox"/> Assembly	<input type="checkbox"/> Govt	<input type="checkbox"/> Office	Number of Persons <input type="checkbox"/> 0-10 <input type="checkbox"/> 11-100 <input type="checkbox"/> 101-1000 <input checked="" type="checkbox"/> 1000+	<input type="checkbox"/> A Hard Rock	<input type="checkbox"/> B Avg. Rock	<input type="checkbox"/> C Dense Soil	<input type="checkbox"/> D Stiff Soil	<input type="checkbox"/> E Soft Soil	<input type="checkbox"/> F Poor Soil	<input type="checkbox"/> Unreinforced Chimneys	<input type="checkbox"/> Parapets	<input type="checkbox"/> Cladding
<input type="checkbox"/> Commercial	<input type="checkbox"/> Historic	<input type="checkbox"/> Residential		Other: <input style="width: 100%;" type="text"/>								
<input type="checkbox"/> Emer. Services	<input type="checkbox"/> Industrial	<input checked="" type="checkbox"/> School										

Basic Scores, Modifiers, and Final Score, S															
Building Type	W1	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM
Basic Score	4.4	3.8	2.8	3.0	3.2	2.8	1.9	2.5	2.8	1.5	2.6	2.4	2.8	2.8	1.7
Mid Rise(4-7 stories)	<input type="checkbox"/> NA	<input type="checkbox"/> NA	<input type="checkbox"/> 0.2	<input type="checkbox"/> 0.4	<input type="checkbox"/> NA	<input type="checkbox"/> 0.4	<input type="checkbox"/> 0.4	<input type="checkbox"/> 0.4	<input type="checkbox"/> 0.4	<input type="checkbox"/> 0.2	<input type="checkbox"/> NA	<input type="checkbox"/> 0.2	<input type="checkbox"/> 0.4	<input type="checkbox"/> 0.4	<input type="checkbox"/> 0.0
High Rise(>7 stories)	<input type="checkbox"/> NA	<input type="checkbox"/> NA	<input type="checkbox"/> 0.6	<input type="checkbox"/> 0.8	<input type="checkbox"/> NA	<input type="checkbox"/> 0.8	<input type="checkbox"/> 0.8	<input type="checkbox"/> 0.6	<input type="checkbox"/> 0.8	<input type="checkbox"/> 0.3	<input type="checkbox"/> NA	<input type="checkbox"/> 0.4	<input type="checkbox"/> NA	<input type="checkbox"/> 0.6	<input type="checkbox"/> NA
Vertical Irregularity	<input type="checkbox"/> -2.5	<input type="checkbox"/> -2.0	<input type="checkbox"/> -1.0	<input type="checkbox"/> -1.5	<input type="checkbox"/> NA	<input type="checkbox"/> -1.0	<input type="checkbox"/> -1.0	<input type="checkbox"/> -1.5	<input type="checkbox"/> -1.0	<input type="checkbox"/> -1.0	<input type="checkbox"/> NA	<input type="checkbox"/> -1.0	<input type="checkbox"/> -1.0	<input type="checkbox"/> -1.0	<input type="checkbox"/> -1.0
Plan Irregularity	<input checked="" type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5	<input type="checkbox"/> -0.5
Pre-Code	<input type="checkbox"/> 0.0	<input type="checkbox"/> -1.0	<input type="checkbox"/> -1.0	<input type="checkbox"/> -0.8	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.8	<input type="checkbox"/> -0.2	<input type="checkbox"/> -1.2	<input type="checkbox"/> -1.0	<input type="checkbox"/> -0.2	<input type="checkbox"/> -0.8	<input type="checkbox"/> -0.8	<input type="checkbox"/> -1.0	<input type="checkbox"/> -0.8	<input type="checkbox"/> -0.2
Post-Benchmark	<input type="checkbox"/> 2.4	<input type="checkbox"/> 2.4	<input type="checkbox"/> 1.4	<input type="checkbox"/> 1.4	<input type="checkbox"/> NA	<input type="checkbox"/> 1.6	<input type="checkbox"/> NA	<input type="checkbox"/> 1.4	<input type="checkbox"/> 2.4	<input type="checkbox"/> NA	<input type="checkbox"/> 2.4	<input type="checkbox"/> NA	<input type="checkbox"/> 2.8	<input type="checkbox"/> 2.6	<input type="checkbox"/> NA
Soil Type C	<input type="checkbox"/> 0.0	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.4
Soil Type D	<input checked="" type="checkbox"/> 0.0	<input type="checkbox"/> -0.8	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.6
Soil Type E	<input type="checkbox"/> 0.0	<input type="checkbox"/> -0.8	<input type="checkbox"/> -1.2	<input type="checkbox"/> -1.2	<input type="checkbox"/> -1.0	<input type="checkbox"/> -1.2	<input type="checkbox"/> -0.8	<input type="checkbox"/> -1.2	<input type="checkbox"/> -0.8	<input type="checkbox"/> -0.8	<input type="checkbox"/> -0.4	<input type="checkbox"/> -1.2	<input type="checkbox"/> -0.4	<input type="checkbox"/> -0.6	<input type="checkbox"/> -0.6
Final Scores	3.9														

Comments: Detailed Evaluation Required

* = Estimated, subjective or unreliable data BR = Braced Frame MRF = Moment-resisting frame SW = Shear Wall
 DNK = Do Not Know FD = Flexible Diaphragm RC = Reinforced concrete TU = Til: Up
 LM = Light Metal RD = Rigid diaphragm URM INF = Unreinforced masonry infill