Best Practices Stories

South Napa Earthquake

DR-1493-CA

FEMA Mitigation CEO- Best Practices Stories

This CD contains ten “Best Practices” stories produced by Hazard Mitigation Community Education and Outreach Best Practices Team of DR-4193-CA, the South Napa Earthquake Disaster. The incident period was from August 24, 2014 to September 7, 2014. The disaster was declared on September 11, 2014.

OVERVIEW

The Community Education and Outreach (CEO) Best Practices team was based at the California Governor's Office of Emergency Services in Mather, California with a staff of two writers. One writer demobilized following a thirty-day deployment. During a two month period, writers were tasked with the responsibility of developing and distributing "Best Practices" stories. The writers had the support of a geophysicist, an engineer and a CEO specialist with grant and insurance background. The geophysicist and engineer provided technical expertise required in story development and review. The CEO specialist validated funding sources, funding amounts, the time span of specific projects and scopes of work. Completion of the stories was a team effort.

Ten stories were written, eight stories originated in Napa County and two in Solano County (See table below).

County	Story Title	Synopsis
Solano	Adhering to Building Codes Fosters Business Owner's Investments	Business owner's real estate properties survived the earthquakes as a result of seismic retrofits executed
Solano	Enforcing Codes in Multi-Hazard Plan Improves County's CRS Ranking	Enforcing regulations set forth in Solano County's Multi-hazard Mitigation Plan has resulted in communities reaching higher rating on NFIP's Community Rating System and a lower premium rate for homeowners
Napa	Lessons Learned prompt Non-Structural Retrofit Project	Homeowner shares ideas on protecting furniture and other treasured items during an earthquake
Napa	Mitigation Saves Church from Multiple Earthquakes	51 year church was retrofitted in 1999. Project was funded by the church. It sustained very little damage following the 2014 earthquake
Napa	Pre-Disaster Mitigation Grant Helps Historic Building Survive Earthquake	Funded with FEMA's Pre-Disaster Mitigation Grant Program the 137 year-old Borreo building was seismically stabilized and retrofitted in 2001. It survived the 2014 earthquake with minimal damage.
Napa	Refurbished Historical High School Stood Strong Against the Earthquake	Formerly Napa High School, the 92 year-old Education Center which was refurbished and retrofitted with state and local funds following the 2000 earthquake, survived the 2014 earthquake
Napa	Retrofitted Fire Station Ready for the Earthquake	The Calistoga fire station was ready to meet the challenge due to both structural and non-structural retrofits through an HMGP FEMA grant.
Napa	Saving Goddess Cove	Following a flood event, homeowner used NFIP funds and an SBA loan to repair her home and strengthen it against earthquakes
Napa	Seismic Retrofit Saves Historical Building	A seismic retrofit funded with FEMA HMGP funds helped the century-old Goodman Library, which houses the Napa Historical Society, survive the 2014 earthquake.
Napa	Surviving the Earthquake	53 residential structures – site built and manufactured homes were retrofitted with funds provided by FEMA and the California Department of Insurance Earthquake Grant and Loan Program (EGL) in 2003

The team conducted site visits to discuss mitigation activities with project participants, secure written authorization prior to interviews and to photograph project participants and components. Nine of the stories documented successful earthquake mitigation and one focused on mitigation planning and implementation leading to lowering flood insurance rates.

Mitigation actions undertaken to save lives, reduce property damage and decrease the money spent on disaster recovery efforts were observed in the cities of Napa, Calistoga and Vallejo The team's objective was that of documenting and promoting these actions to the public, government decision-makers and recovery entities.

Individuals providing input in the stories and granting approval included the following: DR-1493-CA FEMA Federal Coordinating Officer, FEMA Mitigation Branch Director, Mitigation Community Education and Outreach Group Supervisor, Mitigation Hazards and Performance Analysis Group Supervisor and FEMA Region IX staff including the Environmental Officer, Mitigation Branch Director, Hazard Mitigation Assistance Group Supervisor and External Affairs Officer. The State Hazard Mitigation Officer also gave input and approval.

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Adhering to Building Codes Fosters Business Owner's Investments

The Casa de Vinci building which was refurbished and seismically retrofitted in 2004 had minimal damage to interior walls. (Photo: Emile Wong)

Solano County, Calif. – A local businessman's funeral homes, crematories and dual-purpose complexes have been threatened by Northern California earthquakes. When the latest struck in August, 2014, all but one withstood it, thanks to mitigation measures employed.

Earthquakes in California have shown the value of current building codes when it comes to construction of new buildings and the seismic retrofitting of existing ones. As understanding of earthquakes has increased, the state of California has come up with better ways of making structures sound enough to withstand seismic hazards. Unfortunately, many older buildings, in Solano County have not been seismically retrofitted, and the recent South Napa earthquake serves as a reminder that it is up to the owners to do so.

"The code demands that earthquake requirements must be addressed if we want to do any repairs or renovations to any building," said Buck Kamphausen, who owns real estate throughout the Bay Area and California. "We do everything required by the code plus some. Everything we do, we do it first class."

Kamphausen, who has been the mortuary and cremation business for more than 20 years, buys and renovates buildings and prides himself on the integrity that his buildings have when it comes to earthquakes. Some of his buildings date back to 1914. Before making renovations, he solicits the help of an architect from Napa who specializes in older buildings. He also has a local engineer on board to monitor the construction process.

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"Whenever we renovate or construct anything on a building, it's our goal to make it better. We want to make certain that the building weathers the storm," said Kamphausen. "I know what earthquakes can do. I had one building, the Raymond Building, which I had not gotten around to make much needed repairs. The earthquake came along and caused quite a bit of damage to it. Now it will take approximately two million to repair and retrofit it."

The un-retrofitted Raymond Building suffered damage to its roof and front facade along with interior damages. (Photo: Emile Wong)

The Aug. 24, 2014, 6.0 magnitude South Napa earthquake Kamphausen is alluding to rocked the Napa Valley area. It caused at least 5.2 million worth of damage in Vallejo, one of Solano County's largest cities. The un-retrofitted Raymond Building, in Vallejo, was no match for the earthquake but Kamphausen's dual-purpose retrofitted building next door, Casa de Vinci, had no damage. A 93 year-old funeral home in Vallejo, which he also owns, weathered the earthquake virtually unscathed.

Shown here is an interior diagonal frame which will dampen and transfer seismic loads in a designed path from foundation to roof. (Photo: David Look, American Institute of Architects and published by the National Park Service

"These buildings date back to 1914 or 15 and they weren't reinforced when I purchased them," said Kamphausen. "We retrofitted the Casa de Vinci building 10 years ago, the downstairs is leased to a business owner and upstairs are condos. The building is very sturdy. We followed California's seismic strengthening codes in retrofitting it. It suffered no damage during the earthquake."

The building has three sets of modular frames. The concrete floor was cut and holes were dug three feet deep in all corners. Steel frames were inserted and then concrete was poured into the holes. Since the original walls were made out of bricks, wood and concrete blocks, steel frames were connected to the walls from floor to ceiling. A new interior wall was then built over the existing wall and steel framing. New shear walls were also constructed to assist the continuous transfer of loads from the foundation to the roof. "Like building a building inside a

building," said Kamphausen. "We had planned to do the same thing with the Raymond Building but the earthquake jumped ahead of us. We knew that it required major renovations before we could lease it out."

The prime rationale for building code regulations is life safety. Damage to unreinforced masonry buildings is particularly dangerous due to the potential for collapse. After an earthquake, repairs can be expensive, even if the building survives. Even minor damage can require the closure of the building until necessary repairs are made. All three kinds of risks – injury, property damage and loss of use – are clearly greater for unreinforced masonry buildings. Reducing the risk presented by unreinforced masonry building problems through seismic retrofitting is a top priority in any community's effort to provide seismic protection.

For additional information, visit: https://www.fema.gov/earthquake/building-codes and https://www.fema.gov/earthquake-publications/earthquake-publications-building-codes-and-seismic-rehabilitation

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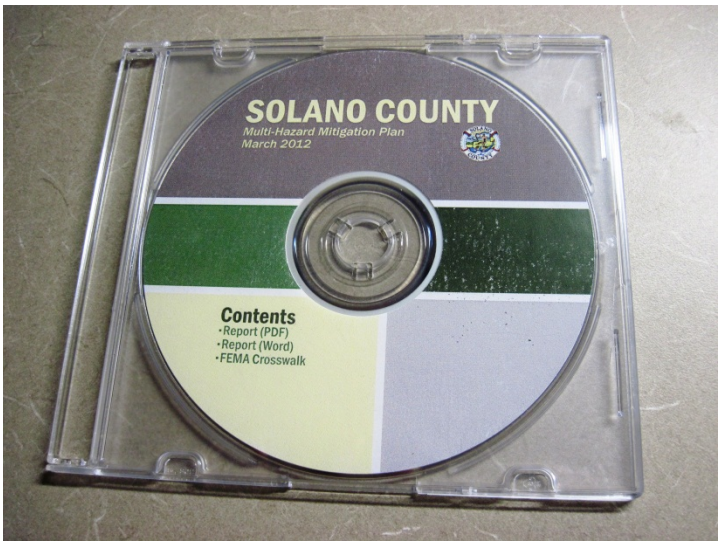
Enforcing Codes in Multi-Hazard Plan Improves County's CRS Ranking



Solano County's Multi-Hazard Mitigation Plan was updated in March 2012.

SOLANO, Calif. – Solano County's readiness is not only making its citizens safer, but is saving many of them money as well.

The Federal Emergency Management Agency requires State, Tribal, and local governments to develop hazard mitigation plans as a condition for receiving certain types of non-emergency disaster assistance. This creates a framework for risk-based decision making that reduces risks to lives, property and the economy.

Solano County officials who updated their multi-hazard mitigation plan in March 2012 have been earning their citizens a nice discount with it since 2007. That's because it sets forth National Flood Insurance's (NFIP) flood damage prevention guidelines that have improved the county's rating in the NFIP's Community Rating System (CRS).

Every five years the plan has to be updated," said Don Ryan, Solano County's Emergency Services Manager. "We gather historical data prior to any update. We look at existing properties that are at risk and we set forth guidelines. Building officials know which homeowners to contact."

The CRS is a voluntary incentive program that recognizes and encourages community Special Flood Hazard Area (SFHA) management activities that exceed the minimum NFIP requirements. It uses a Class rating system to determine flood insurance premium reductions for residents. The Classes are rated from 9 to 1, (with 1 being the best rating). Most communities enter the program

at a CRS Class 9 or Class 8 rating: Class 9 entitles residents in SFHAs to a 5 percent discount on their flood insurance premiums and a Class 8 affords a 10 percent discount. As a community engages in additional mitigation activities its residents become eligible for higher discounts as the community moves up in class. Each CRS Class improvement produces a 5 percent greater discount on flood insurance premiums for properties in the SFHA.

Solano County has been diligent about enforcing the guidelines outlined in the multi-hazard plan. A June 2014 report on the Community Rating System Eligible Communities shows the County, which joined CRS Oct. 1, 1991 as a Class 9 had been a Class 7 since Oct. 2007. That gives homeowners in SFHAs a 15 percent discount on insurance premiums. Homeowners in non-SFHAs have a five percent discount.

How did the county achieve this?

Based on the total number of points a community earns, the CRS assigns the community to one of nine classes. It gives credit for 18 different activities that fall into four series – Public Information, Mapping and Regulations, Flood Damage Reduction, and Flood Preparedness. Solano County's multi-hazard plan addresses some of the activities in all four series and local communities execute them.

"Some of the activities conducted by the county were fed into the planning process for the multi-jurisdictional plan," said Ryan. "Many of the strategies are included in existing programs that are already a part of the County's planning process through county ordinance, building and fire code enforcement and the development of the county's General Plan."

Solano County's Emergency Services Manager, Don Ryan, attributes the county's enhanced rating on the CRS to the fact that local officials are closely monitoring construction within the floodplains. (Photo: Emile Wong)

In public information, the county has developed an interactive website that property owners can visit to access information about their flood risks, including the sources of flooding and potential flood depths for their properties. They can also download disaster preparedness flyers and brochures and get information on how to create a disaster preparedness kit. Local communities are providing Flood Insurance Rate Maps to residents, especially those living in SFHAs and giving technical advice to residents inquiring about flood protection. Floodplain

managers are required to keep copies of elevation certificates for new construction in the floodplain. This information is helpful to insurance agents in that it provides data the agents need for accurate flood insurance rating.

The county now has higher regulatory standards. For example, there are certain standards that must be met in all SFHAs. Standards of construction that are addressed include: anchoring, construction materials and method of construction, elevation and flood proofing. According to guidelines regarding SFHAs, all new construction and substantial improvements must be adequately anchored to prevent flotation, collapse, or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy. There are specific anchoring standards for manufactured homes.

In addressing elevations and flood-proofing, new construction and substantial improvements of any residential structure must have at least one foot of freeboard – that is the lowest floor, including basement, must be elevated at least one foot above the base flood elevation.

Local communities in Solano County are required to use the City Watch notification system to maintain and increase the capability to assess impending threats and issue warnings to the public.

A 2006 report that included the County's flood risks, noted that 14,250 acres are in the 100 year flood plain (63.4% chance of one or more 100-year floods occurring in any 100-year period) while another 4,298 acres are in other flood-prone areas.

"Significant flooding occurs in portions of Solano County approximately every three to five years. Warnings are usually given several hours to a few days before such flood," said Ryan. "We are actively involved in mitigating most flood situations. We are continuing to identify areas of concern and are addressing mitigation measures to minimize flood risks."

For additional information, visit: http://www.solanocountynhmp.org/ and https://www.fema.gov/national-flood-insurance-program

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Lessons Learned Prompt Non-Structural Retrofit Project

Wanda Pogue shows off her tool kit which contains earthquake strapping, anchor buckles, electric screw driver, hex screws, museum putty, stud finder and an interchangeable nut driver. (Photo: Bonnie Hanchett)

NAPA, Calif. – An earthquake with a magnitude of 5.2 rattled Northern California's wine country before dawn, Sept. 4, 2000 taking place along a previously undiscovered fault line and surprising seismologists. It also surprised Wanda Pogue's parents as they experienced the heavy shaking, furniture sliding across the room and treasured items being knocked off shelves.

Looking at the face of despair on both her parents, Wanda Pogue, a retired childcare provider, vowed to do something to protect their valuables prior to the next earthquake.

"After the Yountville earthquake, I noted the damages. Their home was okay. It was seeing the damage inside the home that startled me," said Pogue. Their treasured collectibles were broken. They lost a TV and the china cabinet had shifted."

Most homeowners tend to display their treasured collectibles and other sentimental items on shelves and mantels around the home. However, if they are not secured, they can be vulnerable to breakage during an earthquake.

"I grew up with brothers who love carpentry and I love doing things with my hands. I was determined to find a way to protect my mother's collections as well as her furnishings," said Pogue. "As I was watching TV I saw an advertisement for a basic earthquake kit. I bought it and I expanded my tool box from there."

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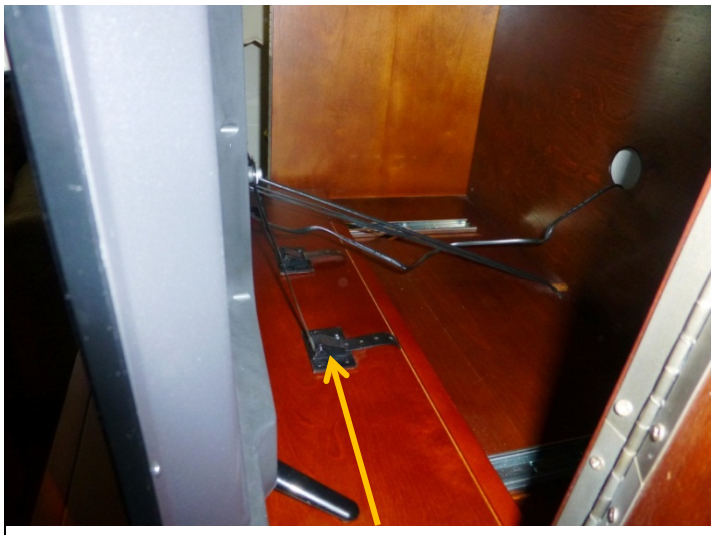
Pogue also purchased a stud finder to locate studs, a drill along with various size bits to drill holes, museum putty and an interchangeable nut driver to drive screws in place.

"You never think about things like china cabinets or TVs falling over, dishes flying out of cabinets or being trapped by a piece of furniture but those kinds of things happen during an earthquake," said Pogue. "Following the Yountville quake, there was a couple trapped in their bed because a chest of drawers fell over on them. Neighbors passing by checking on other neighbors heard them hollering and rescued them."



The television is anchored to a shelf in the entertainment center by using an anchor buckle and strap. The entertainment center is then fastened to the wall. (Photo: Emile Wong)

On large pieces of furniture, such as china cabinets and entertainment centers, Pogue uses two strappings. If the furniture is in two pieces, she bolts the top piece to the bottom then anchors the unit to the wall. Televisions located on top of furniture such as dressers and in the entertainment center are anchored to the top of the dresser or on a shelf in the entertainment center by using an anchor buckle and strap. The dresser or entertainment center is then fastened to the wall.

The china cabinet is in two pieces. The top and bottom were bolted together as a single unit and the top of the cabinet was anchored to the wall using two strappings. (Photo: Emile Wong)

"Strapping your large pieces of furniture is not just for the sake of protecting it. It's a safety thing. It's literally for your safety," said Pogue. "And if you are worried about antique pieces – yes, it will no longer be an untouched piece because you had to drill a small hole in it to strap it but you will have kept it from hitting up against the wall and shattering or toppling over on something or somebody."

Museum putty is placed under the bottom of smaller items that are on shelves. Provided the item also has a lid, a small amount of putty is placed under the lid to hold it in place.

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Pogue estimated the total project cost to be from $150 and $200.

Pogue purchased and placed spring-action friction cabinet door latches on all kitchen cabinet doors. (Photo: Emile Wong)

"You can find all of the things that you will need at most hardware stores, home building centers or stores that carry hardware," said Pogue.

The Aug. 2014, 6.0 magnitude earthquake which struck South Napa, California, tested the success of Pogue's project.

"Everything that I had anchored remained in place. Unfortunately, there were two things that I did not take into consideration. I didn't think about the fact that the kitchen cabinets did not have latches so we had some items to fall out of them. I also didn't think about anchoring small pictures on the wall, so they fell off."

Following the recent earthquake, Pogue purchased and placed spring-action friction cabinet door latches on all kitchen cabinet doors. She has also placed tremor picture hangers behind small pictures that are located on walls in the home.

"There's no guarantee that nothing will ever get broken again, but whatever you can do to protect your investment, you have to do it," said Pogue. "You don't want your heart broken by seeing your treasured items all broken up. Remember, you can't get those back."

Pogue also recommends that all homeowners be prepared for impending disasters by creating an emergency preparedness kit as well as taking an emergency preparedness class.

Tremor picture hangers are used to keep pictures secured to walls. (Photo: Emile Wong)

For additional information, visit: www.ready.gov/are-you-ready-guide, www.ready.gov/kit and www.calema.ca.gov/planningandpreparedness/.../earthquake-preparedness.

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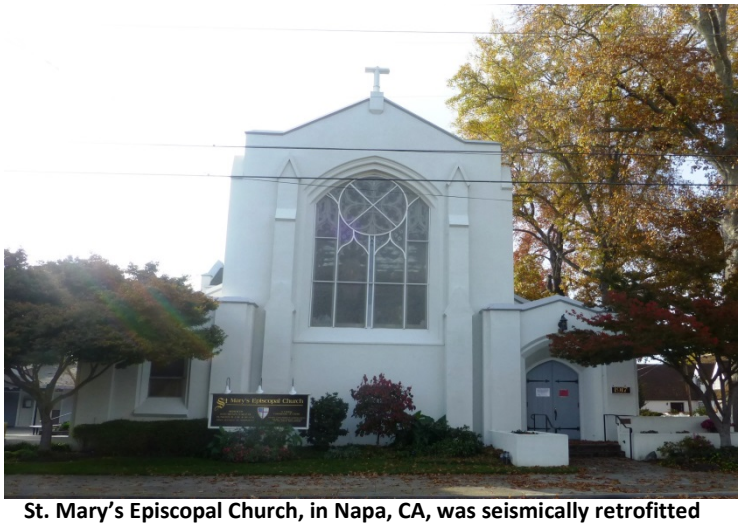
Mitigation Saves Church from Multiple Earthquakes



St. Mary's Episcopal Church, in Napa, CA, was seismically retrofitted in 1999. (Photo: Emile Wong)

NAPA, Calif. – For the last 31 years Reverend Canon Stephen Carpenter has been the rector for St. Mary's Episcopal Church in Napa, CA. His forward thinking and the mitigation measures he employed have helped the church to survive two earthquakes.

St. Mary's was an unreinforced stone masonry building built in 1931. Given the age and construction of the building, Reverend Carpenter was concerned that the church would not fare well in an earthquake. He was also concerned that the city would eventually require a seismic retrofit or the church could risk being closed.

"I knew that eventually we would have to do something. I told the congregation that we could not wait for an earthquake to happen before taking action," said Carpenter.

In the 1990s he suggested to the church that they consider undertaking a seismic retrofit. He talked to them about the benefits of a seismic retrofit and how it would ensure the building remains safe in an earthquake. Knowing that grants are not generally given to churches, he knew that they would have to pay for it on their own. They decided to start a three-

The seismic retrofit included buttresses, like the one pictured above, with Shotcrete and steel reinforcing bars. (Photo: Emile Wong)

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year campaign to raise the required funds for their seismic retrofit, and ultimately were able to raise $800,000 to fund the project.

In consultation with a structural engineer regarding the project, the seismic retrofit for the church included adding three buttresses on each sidewall of the church to protect the long walls from falling out of plane. The buried concrete footings of the buttresses extended out perpendicularly from the wall, forming an L. Beams were also added to connect the interior columns of the church to the exterior wall and the outside buttresses. Reverend Carpenter did not want the beams showing, so he had them create a more aesthetically pleasing covering to hide them. On the outside, three to four inches of Shotcrete and steel reinforcing bars were added to the outside of the church to cover the stone masonry for added strengthening and security. The seismic retrofitting project was so successful that St Mary's Episcopal Church received an award from the Napa Landmark Society.

The pipe organ at St. Mary's Episcopal Church was damaged from the South Napa Earthquake, which occurred Aug. 24, 2014. (Photo: Emile Wong)

In the 2000 Yountville earthquake, which was less than a year after the seismic retrofit, the church came through unscathed, with only minor cosmetic damage.

At 3:20 a.m. on Aug. 24, 2014, Napa was awoken by a 6.0 magnitude earthquake. Once it was daylight, the damage could be seen throughout Napa. From the outside, St. Mary's Episcopal Church appeared unscathed. The only damage to the outside of the church was to the cross on top of the church, which was not a part of the retrofit.

The consulting engineer stopped by to survey the potential damage to the church.

"I challenge the church to find any kind of crack on the outside of this building," he said. None could be found.

However, on the inside, the damage was more apparent. There was some damage to the choir screen and some of the pipe organ's pipes came down off the balcony and damaged some of the pews below. Certain traceries and statuary also suffered minor damage during the quake.

Reverend Carpenter estimated the repair work would cost about $100,000. Repairs included bringing the damaged area as close to the original condition as possible. To protect the people in the pews below, contractors installed additional bracing around the organ pipes to reduce the

chance of them falling, but without affecting the sound integrity. They also reinforced the steel bracing of the choir screen for added safety.

After the quake a church member approached Reverend Carpenter.

“It’s a shame that we spent all of this money and the retrofit didn’t work,” she said.

“Oh, but it did. It did work. Had it not worked, we wouldn’t have a church! Without the retrofit this church would be a pile of rubble,” Carpenter said.

For additional information about preparedness and mitigation measures, visit: http://www.fema.gov/media-library-data/20130726-1728-25045-2959/femap774.pdf FEMA P 774 “Unreinforced Masonry Buildings and Earthquakes – Developing Successful Risk Reduction” and http://www.countyofnapa.org/Emergencies/

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Pre-Disaster Mitigation Grant Helps Historic Building Survive Earthquake

The 9,600 square-foot Borreo Building was built in 1877 (*Photo: Christopher Mardorf, FEMA*)

NAPA, Calif. – A 137-year-old Napa landmark is still standing after a significant earthquake, thanks, in large part, to a grant provided by the Federal Emergency Management Agency (FEMA).

At the northeast corner of Third Street and Soscol Avenue is what is fondly referred to as the Borreo Building.

The Borreo Building was built in 1877 from native cut stone from Napa County, which is known for its large collection of stone arched bridges and historic buildings.

The City of Napa acquired the 9,600-square-foot, two-story commercial building in the 1970s. Its long presence along the east bank of the Napa River serves as a reminder of the town's commercial beginnings.

A 1999 evaluation found it needed a retrofit to correct its seismic deficiencies. Without a retrofit, the evaluation found, the building posed a serious health and safety risk for its occupants and passers-by. It was also determined that the building would likely collapse in an earthquake.

Steel bracing was installed and wall dowels were secured to interior stone walls. (*Photo: Bonnie Hanchett*)

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FEMA's hazard mitigation programs support state, local and tribal governments in their efforts to recover from natural disasters and to mitigate all hazards. In this case, FEMA's Pre-Disaster Mitigation Grant Program funds helped the City defray much of the project cost. The retrofit cost $872,934, but FEMA provided $654,700 of that.

A concrete elevator shaft was installed to serve as a structural pillar *(Photo: Bonnie Hanchett)*

The building was seismically stabilized and retrofitted with mitigation assistance from FEMA in 2001.

The project added two new lines of bracing to reinforce the second floor deck's diaphragm and reduce the span of the roof and floor. Plywood was installed over the existing roof sheathing to help strengthen the roof diaphragm. New blocking and adhesive anchors provided a seismic load path for the diaphragm shear forces to transfer into the stone walls. Steel bracing was installed on the first and second floor and wall dowels were secured to interior stone walls. A support beam was installed, below the existing one on the second floor, along with a footing below the beam for added stability for structural support.

About 500 square feet of the building was re-pointed with mortar in selected areas and the existing wall anchors were replaced with new, stronger anchors. A concrete elevator shaft was installed to serve as a structural pillar to provide seismic stability and the elevator meets the American with Disabilities Act (ADA) requirements.

According to California's State Mitigation Assessment Review Team (SMART), the seismic upgrade was designed to comply with building code requirements for historic buildings in effect at the time of the retrofit design. The design was anticipated to substantially reduce the likelihood of damage and risk to occupants.
"After the structural retrofit, we intended to occupy the building," said Jeff Freitas, City of Napa Real Estate Manager. "At the time, the economy was too bad. To make it occupancy ready would have been too costly. So it remained vacant after the project was completed."

Mike Mahoney, Hazard Mitigation Engineering and Architecture Specialist points to reinforced concrete beam on first floor which was added for support as Emile Wong, Hazard Mitigation Engineer, looks on. The side of the concrete elevator is visible in the background. (*Photo: Bonnie Hanchett)*

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Aug. 24, 2014, a 6.0 magnitude earthquake tested the integrity of the Borreo Building. After the disaster, SMART checked the damages to the building.

"Minor shedding of the original exterior fieldstone occurred on the north and south side," said Mike Hornick, SMART member. "Internally, the building appeared to have weathered the earthquake in good fashion."

"The retrofitting project can be considered a success from a life safety prospective," added Paul Ransom, California's State Hazard Mitigation Program Manager.

While damage still occurred in some of the buildings in Napa, the Earthquake Engineering Research Institute (EERI) reported that no retrofitted buildings collapsed.

"Most of the retrofitted buildings in Napa, including the Borreo and Goodman, performed very well, with only minor damage to the stone parapets or window arches. Had these unreinforced stone buildings not been seismically retrofitted, they would have definitely suffered partial or even complete collapse," said Mike Mahoney, Hazard Mitigation Engineering and Architecture Specialist.

"To me, the retrofit on the Borreo Building is clearly a success. The damage is pretty minor. The repairs will not be substantial," added Freistas.

For additional information, visit: http://www.fema.gov/media-library-data/20130726-1728-25045-2959/femap774.pdf FEMA P 774 "Unreinforced Masonry Buildings and Earthquakes – Developing Successful Risk Reduction" and http://www.countyofnapa.org/Emergencies/

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Best practices

Disaster Mitigation Working in California

Refurbished Historic High School Stood Strong against the Earthquake

Built in 1922 and refurbished in 2002, Napa High School is home to Napa Valley Unified School District's Education Center and hosts performances by high school students. (Photo: Mike Mahoney)

NAPA, Calif. – A retrofitted historic building stood strong against an earthquake due partly to a 2002 refurbishing and seismic retrofit project.

Fondly referred to as the old Napa High School Building, the Education Center of Napa Valley Unified School District (NVUSD) was back to "business as usual" within four hours following the 6.0 magnitude earthquake that hit South Napa California in Aug. 2014.

"Built in 1922, Napa High School was constructed to replace two smaller high schools," said Don Evans, Director of School Planning and Construction and a 1961 graduate of the school.

During its operation as a school, the historic building certainly had its share of woes. In 1937, a fire destroyed a part of the building, including the school's auditorium and in 2000 a 5.2 magnitude earthquake caused extensive damage, to the auditorium's stage walls and roof.

"The building wasn't operating as a school when the earthquake hit," said Evans. "By the 1970s, the school had a little over 3,000 students. Following the construction of the new Napa and Vintage high schools in 1976, the administrative staff moved in and the school became the Education Center. However, the auditorium continued to be used for local school productions."

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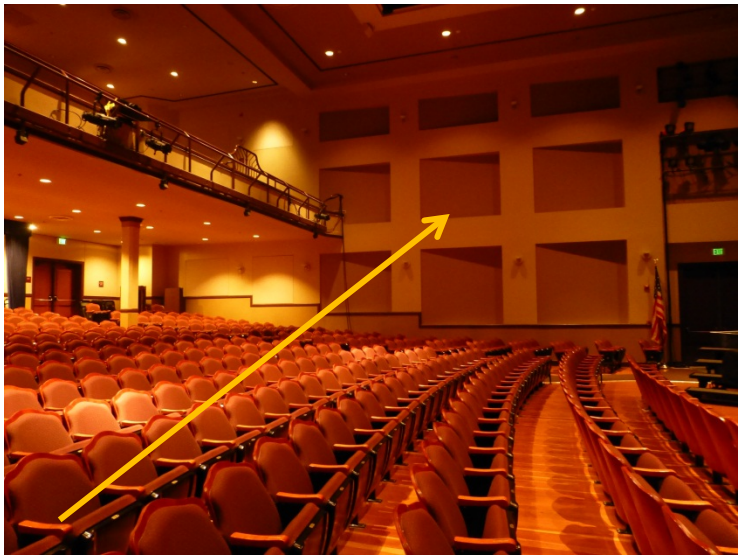
The building was repaired, completely renovated, and seismically retrofitted using $3 million in federal repair funds, a $10 million local bond and $3 million in operating funds. “We made it handicapped accessible and earthquake safe,” said Evans.

Tube steel frames were installed on both sides of the central hallway and along exterior walls. Frames were connected by steel cross members. *(Photo: Bonnie Hanchett)*

The seismic retrofit included installation of a tube steel frame on both sides of the central hallway and along the exterior walls. The frames were connected by steel cross members as well as improved wood frame connections. The 80 foot high auditorium stage walls were taken down to the damaged construction joint at 40 feet and new reinforced concrete walls were installed above, with the reinforcing steel doweled into the existing walls. A new steel roof was installed over the stage. The auditorium side walls, which were also damaged, were wrapped in carbon fiber mesh and then stucco reapplied and painted.

Aug. 24, 2014, the 6.0 magnitude earthquake hit the Napa Valley area. However, the 92 year old building stood firmly on its foundation.

“This building is sturdy,” said Evans. “We had very little damage to the building, just some minor wall cracking. We could have gone back into the building the following morning had it not been for the fact that we were without electricity for four hours.”



The auditorium’s acoustical side walls were wrapped in carbon fiber mesh to reinforce the walls. Stucco was re-applied and painted. (Photo: Emile Wong)

The refurbished, seismically retrofitted building remains an essential landmark in the Napa community. It is home to the Napa education museum. It is used as a testing site for high school students. Its auditorium hosts performances by the district’s choirs and ensembles, as well as high school plays. It also hosts the Napa Valley Unified School District Board of Education meetings twice a month.

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For additional information, visit: http://www.fema.gov/media-library-data/20130726-1728-25045-2959/femap774.pdf FEMA P 774 "Unreinforced Masonry Buildings and Earthquakes – Developing Successful Risk Reduction" and http://www.countyofnapa.org/Emergencies/

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Retrofitted Fire Station Ready for the Earthquake

Calistoga's Fire Station provides services to the city of Calistoga as well as to the unincorporated areas of Napa County. (Photo: Bonnie Hanchett)

NAPA, Calif. – Mother Nature nearly tested the City of Calistoga's Fire Station retrofitting when a 6.0-magnitude earthquake hit nearby. The station was ready for the challenge.

Constructed of concrete masonry units in 1969, the 6,100 sq. ft. building was classified as un-reinforced masonry and deemed a priority for a seismic retrofit in 1986. This is the city's only fire station and the loss of its emergency services would be a significant life safety risk for all of Calistoga's citizens.

"It would also impact the delivery of critical emergency medical and fire suppression services," said Calistoga Fire Chief Steve Campbell.

The normal population of the city of Calistoga, all 2.5 square miles of it, is 5,400. The fire station also provides services to the unincorporated areas of Napa County within 51 square miles, including 3,000 more people. On the weekends, because it is a tourist destination, the population can swell by 8,000 to 10,000 people.

The building was assessed in 1998 and 2006 by two different engineering firms. Weaknesses in the station's infrastructure, including the roof, wall and floor diaphragms, and instability in the front of apparatus doors contributed to the major seismic vulnerabilities of the building.

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A Benefit Cost Analysis in 2006, to support a HMGP proposal, determined that funding a replacement would run approximately $1.7 million. Retrofitting the existing building would only cost $646,188 plus the expense of relocating occupants and equipment for 6 months, approximately $60,900, resulting in a total project cost of $707,088. The federal share was $530,316. The city of Calistoga's pay-in was $176,772, obtained from the City Public Safety Fund.

Steel beams along with vertical bracing were added to support roof overhang. (Photo: Bonnie Hanchett)

The project involved both structural and non-structural retrofits.

Structural steel members were placed vertically and horizontally on the inside of the masonry walls (Photo: Bonnie Hanchett)

The retrofitting included digging down 16 feet to anchor the cement foundation into the bedrock, stabilizing the building. A new reinforced masonry shear wall was constructed at the north (front) elevation of the building, including footing. A new collector beam was installed to collect diaphragm forces and transfer them to the shear wall. The wall occupies half of one bay, reducing the vehicle parking from four rows to three rows. A diaphragm was nailed to the ledger plates while anchors were added to connect them to the masonry walls. Structural steel members were placed vertically on the inside of the masonry perimeter walls.

In addition, metal connectors were used to attach the beam to the wood roof diaphragm and distributed to the shear walls that are parallel to the direction of earthquakes forces. The spacing of the new walls will mitigate torsion irregularity of the existing building. The new walls were stiffened to prevent significant racking of the garage bay doors during an earthquake event to allow for unimpeded rapid egress of emergency vehicles.

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The emergency generator and its 200-gallon fuel tank were bolted down and the generator wiring was strapped to the wall,

Steve Campbell, Fire Chief calls Mike Mahoney, FEMA Geophysicist attention to the new collector beam installed to collect diaphragm forces and transfer them to new shear wall. (Photo: Bonnie Hanchett

The earthquake, which struck Aug. 24, 2014, was centered in South Napa, approximately 40 miles south-southeast of Calistoga. It was the strongest one to hit the Bay Area since the 1989 Loma Prieta temblor.

"While the Calistoga area only felt Modified Mercalli Intensity IV ground motion (strong shaking but light probability of damage), it was still strong enough to be felt by most of the town residents," said Mike Mahoney, Hazard Mitigation Engineering Specialist.

Chief Campbell shows off the emergency generator and its 200-gallon fuel tank which are bolted down and the generator wiring which is strapped to the wall. (Photo: Bonnie Hanchett)

"The firefighters that were here, at the station, described it as a rolling sensation, when the earthquake hit," added Campbell. "We were lucky. We were also ready."

For more information visit: http://www.fema.gov/media-library/assets/documents/18030, FEMA P 774, Unreinforced Masonry Buildings and Earthquakes: Developing Successful Risk

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Saving Goddess Cove

Built in 1890, Goddess Cove is a 2,128 square-feet, two-story, Victorian wood-frame home. (Photo: Emile Wong)

NAPA, Calif. – A 124 year-old Victorian home stayed firmly on its foundation in spite of the recent 6.0 magnitude Napa Valley earthquake at least in part due to a seismic retrofit during a home repair and restoration project following an earlier flood event.

The 2005 flood of record caused extensive damage in northern California. In Napa County, the Napa River and its tributary creeks overflowed their banks from Calistoga to American Canyon prompting middle-of-the-night evacuations along Napa Creek, as it poured through downtown Napa. Flooding blocked roadways, isolating communities and neighborhoods up and down the valley as well as inundating buildings, including Goddess Cove.

According to a US Geological Survey, a series of storms beginning before Christmas 2005 and ending after New Year's Day 2006 produced significant runoff over much of northern California. The storms resulted in an estimated $300 million in damages and Federal disaster declarations in 10 counties. Major flood damages were concentrated primarily in the Napa and Russian river basins in Napa and Sonoma counties.

"On Dec. 31, 2005, this place had five feet of water in it. It was leaning sideways. Part of the home had shifted off the foundation," said Colleen Moore, retired nurse case manager and owner of Goddess Cove. "There was mold and mildew everywhere and the sewer system backed up. This place was a mess. I knew it would cost a lot to fix it. But I had flood insurance. So I used that money plus I got an SBA loan to fix the place up. I also had a structural engineer who

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guided me. She told me what I needed to do to make the place stronger, after all this was my home."

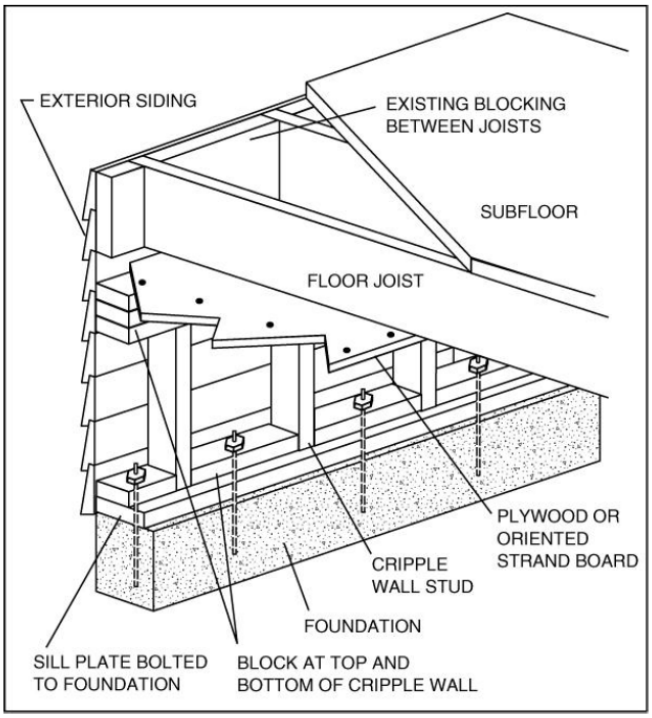
Built in 1890, the house was 108 years old when Moore moved into it in 1998. She named it Goddess Cove.

"I bought the home and had planned to take my time refurbishing it in stages," said Moore. I named it Goddess Cove because I wanted it to be a sanctuary for all those that need a safe harbor to come to during the storms of their lives. Folks just vacationing in Napa are also welcomed."

The sill plate is resting directly on top of the foundation and is secured with anchor bolts. (Photo: Emile Wong)

Following the flood, a project to repair flood damaged Goddess Cove and to strengthen the building's foundation against earthquakes began.

The 2,128-square-foot Victorian wood-frame home rests on a cripple wall and a crawl-space foundation which is approximately three and one-half feet above a concrete slab.



This illustration shows the sill plate for a structure built on a cripple wall and crawl space foundation. (Illustration provided by FEMA)

Seismic strengthening included anchoring the sill plate which rests on top of the foundation. Anchor bolts were used to secure the sill plate to the foundation. The cripple walls (short wooden wall that rests on the foundation and supports the floor and forms the exterior walls) were braced to prevent the house from shifting during an earthquake. Horizontal sill blocking that consists of 2-inch by 4-inch boards was added between the vertical studs at the top and bottom of the cripple wall. A new wood frame foundation wall was then added down the center of the structure for additional support. The wall was installed on a new poured reinforced foundation and was sheathed on both sides with plywood for added strength. Additional

wooden girders and posts were also used to brace the interior floor joist.

Total project cost was $126,000. Moore received $96,000 from the National Flood Insurance Program. Funds secured by an SBA loan defrayed the remaining cost of the project.

“I spent approximately $45,000 to strengthen the foundation. The rest of the money went into repairing the damage from the flood and replacing the roof,” said Moore.

The Aug. 2014, 6.0 magnitude earthquake, which struck South Napa, California, tested the success of Moore’s seismic strengthening project.

“I was amazed as to how well my house stood up to the earthquake. I assumed that it would have been knocked off of its foundation again, just like it had during the 2005 flood,” said Moore. “I had a lot of damage to the inside such as the computer and television falling and breaking. A couple of antique pieces were broken. The marble fireplace mantel also fell off and broke in half. But my house never moved off its foundation. I was lucky. My neighbor down the street lost everything.”

Additional wooden girders and posts were used to support the interior floor joists. (Photo: Emile Wong)

As a general recommendation, the best way to increase stability and reduce earthquake damage on homes built on cripple walls is to anchor and brace the cripple walls. The first step is to make sure the cripple wall is adequately anchored into the concrete foundation with anchor bolts and plate washers. The next step is the addition of sill blocking between the vertical studs at the top and bottom of the cripple wall. Finally plywood should be installed on the interior face of the cripple wall using properly sized nails driven every four inches into every wood stud.

For additional information, visit: http://resilience.abag.ca.gov/residents/planset/, https://www.fema.gov/earthquake-publications/index-earthquake-publications and http://www.fema.gov/library/index.jsp

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Seismic Retrofit Saves Historical Building

The Goodman Library is located in Napa, California (*Photo courtesy of Wikipedia*)

NAPA, Calif. – A seismic retrofit helped a historic building survive an earthquake.

The century-old Goodman Library in Napa sustained damage in the Aug. 24 Napa Valley earthquake, but it was clearly damaged less than other historic buildings around it.

Historically, earthquakes that plagued California have left behind destroyed homes, businesses and infrastructure. The state is always looking for ways to minimize such damages during the next earthquake.

Built in 1901, the Goodman Library is on the National Register of Historic Places and is the home of the Napa County Historical Society.

"When it opened on March 6, 1902, it served not only as a public library, but also as a tea room and social gathering spot," said Nancy Levenburg, Executive Director of Napa Historical Society. "It was constructed of native stone and is one of the few remaining stone buildings in the City of Napa."

In 1999, the city of Napa hired a consultant to perform a seismic evaluation of the library. The evaluation found that the structure needed to be seismically retrofitted to correct several deficiencies and meet Uniform Code of Building Conservation and State Historic Building Code standards.

The city of Napa applied for a grant from the Federal Emergency Management Agency's Hazard Mitigation Grant Program (HMGP). The project cost $424,243, but HMGP money ended up funding $318,187 of that.

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Workers reinforced the roof and floor diaphragms by adding a new concrete wall in the center of the building. They also added plywood over the existing roof sheathing to help strengthen the roof diaphragm. Other measures included the installation of dowels to secure the stone walls so that the walls would work as one whole unit. A concrete wall was installed by the vestibule, running from below the first floor to the top of the parapet to strengthen the front wall. Blocking and adhesive anchors were added to provide a seismic load path for the diaphragm shear forces to transfer into the stone walls. A second support beam was installed below the existing one on the second floor with a footing below the beam and metal clips at the top adding stability. Toenails were added to the base of the wood beams and posts in the crawl space below the first floor were added for strengthening.

The project also strengthened the existing parapet bracing. The concrete wall was extended to the level on the truss and existing rod connections were replaced for improved support. New adhesive dowels were added to the steel tubing securing the parapets. About half of the mortar in the parapet area was re-pointed. Some of the stones were reset and anchored; missing stones were replaced and cracks along the wall and in the mortar were filled with epoxy.

Aug. 24, 2014, at 3:20 a.m., a 6.0 magnitude earthquake jolted Napa. Damage was apparent throughout the city. Much of downtown was cluttered with broken glass and rubble. Many historic buildings sustained damage, including the Goodman Library.

However, damage to the library was minimal compared to other buildings. The top of the façade is the most noticeable damage that can be seen from outside.

"We are thrilled. The building is solid," said Levenburg. "We were concerned about the contents; however, we were pleased that the library survived with very little damage."

The top of the Goodman Library's façade was damaged by the August 24, 2014 earthquake. (*Photo: Christopher Mardorf*)

California's State Mitigation Assessment Review Team, along with Applied Technical Council structural engineers, performed a foundation to roof analysis of both interior and exterior elements following the disaster.

They agreed that the retrofit was successful and the building performed as designed. It met "life-safety" performance standards and historic elements were protected. There were observable interior and exterior cracks along grout lines and some in the pressed tin ceiling. The second floor does appear affected, but can be repaired.

A close up inspection revealed that all retrofit elements appeared to be in good condition. Unprotected areas, such as the exterior central parapet did suffer extensive damage and may need to be entirely removed.

"Without the seismic retrofit, made possible by the HMGP Funds, the damage would most assuredly have been worse," said Marcia Sully, State Hazard Mitigation Officer.

"Every earthquake is a laboratory for us, and this was the first big test of a large number of seismically retrofitted unreinforced masonry buildings," added Mike Mahoney, Hazard Mitigation Engineering and Architecture Specialist. "Most of the retrofitted buildings, including the Goodman Library performed very well, with only minor damage to the stone parapets or window arches. Had these unreinforced stone buildings not been seismically retrofitted, they would have definitely suffered partial or even complete collapse."

For additional information, visit: http://www.fema.gov/media-library-data/20130726-1728-25045-2959/femap774.pdf FEMA P 774 "Unreinforced Masonry Buildings and Earthquakes – Developing Successful Risk Reduction" and http://www.countyofnapa.org/Emergencies/

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Surviving the Earthquake

Karen Gibson's retrofitted mobile home remained virtually unscathed following a 6.0 magnitude earthquake in Napa County in 2014. (*Photo: Bonnie Hanchett)*

NAPA, Calif. – A seismic retrofit project funded 11 years before helped residential structures survive a 6.0 magnitude earthquake in 2014.

The 53 residential structures – site built and manufactured homes located in Napa County were retrofitted with funds provided by FEMA and the California Department of Insurance Earthquake Grant and Loan Program (EGL) in 2003.

Operating from 1996 to 2004, the EGL offered grants to qualified households for earthquake retrofits in the counties of Napa, San Bernardino, Santa Cruz and Kern. Grant funds could only be used for single-family properties or manufactured homes that were owner-occupied. Grantees must be low to moderate income homeowners and must have lived in the property for at least two years. Additionally, extra consideration was given to the neediest applicants living on a fixed income, the permanently disabled and those 55 years old or older.

The 6.0 magnitude earthquake caused severe damage to a mobile home that was not seismically retrofitted. (*Photo: Bonnie Hanchett)*

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Sept. 3, 2000, a 5.2 magnitude earthquake shook the Napa Valley near Yountville. According to reports, the earthquake left a 5-year-old boy hospitalized in critical condition, damaged about 200 buildings and plunged the agricultural wine country into chaos. There were accounts of ruptured water mains, dead power lines, shattered windows and collapsed chimneys. Dozens of people were left homeless.

FEMA's hazard mitigation programs support state, local and tribal governments in their efforts to recover from natural disasters and to mitigate all hazards.

Following this disaster, the California Office of Insurance received a $500,000 grant from FEMA's Hazard Mitigation Grant Program to retrofit 222 residential properties. Fifty-three of those properties were in Napa County.

The Napa County earthquake retrofit cost $224,686 but FEMA provided $168,515 of that.

Water heater was braced by strapping it securely to wall. (Photo: Madeline McClure)

Maximum grant for manufactured homes was $4,000. Retrofit for single wide manufactured homes cost $1,500 to $2000 and doublewide $1,800 to $4,000. The project included bracing water heaters, installing foundation piers, replacing pads and installing marriage locks.

Grant limit for site-built homes was $8,000, if the project required foundation repair or replacement, the limit was $30,000. Workers braced cripple walls – wooden stud walls on top of the exterior foundation used to support the house and create a crawl space. Water heaters were braced by strapping them securely to an adjacent wall. Automatic gas shut-off valves were installed. Repairs to foundation varied depending on the damage. In some cases, a structural engineer was contracted to determine severity of damage and to recommend repairs.

Aug. 24, 2014, a 6.0 magnitude earthquake tested the integrity of structures in the city of Napa.

While damages from the earthquake were noted, the success of some retrofitted projects was also documented.

"The earthquake didn't do any damage to my home," said Karen Gibson, whose manufactured home had been retrofitted. "Some plates in the kitchen fell from the cabinets. The quake hit with enough force to knock me off my feet. I suffered injuries that warranted a hospital visit."

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She has owned the home for 17 years, and recalls that FEMA retrofitted her home after the earthquake in 2000.

Another homeowner only lost the top of the un-retrofitted masonry chimney on her seismically retrofitted home. However, her neighbor's home suffered serious damage to its cripple wall foundation, requiring that the home be elevated off its foundation so that the cripple walls could be repaired.

A site visit also validated the advantages of bracing techniques for cripple walls and water heaters.

The 6.0 magnitude earthquake claimed only the chimney's top on this seismically retrofitted home (Photo: Bonnie Hanchett)

Repairs are on the way on an un-retrofitted home which suffered cripple wall failure. (Photo: Bonnie Hanchett)

Homeowners should note that retrofitting before an earthquake is relatively cheap in comparison to making major structural repairs to the home after an earthquake, which can be expensive. An appropriate seismic retrofit will reduce damage and save you money.

For additional information, please visit: http://www.fema.gov/media-library-data/20130726-1446-20490-6333/fema-530 for the "Earthquake Safety Guide for Homeowners"; and http://www.countyofnapa.org/Emergencies/ http://www.fema.gov/earthquake/building-codes

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