



# **Seismic Safety is Foremost for California Landlord**

**Soft Story Retrofit of a 61-Unit Apartment in Goleta, CA  
Use 10 Special Moment Frames from Hardy Frame<sup>®</sup>**

## EXECUTIVE SUMMARY

- > Used in this Abrego Apartment soft-story retrofit project, Hardy Frame special moment frames (SMFs) are designed to resist significant “inelastic deformation.” SMFs are typically specified used in high Seismic Design Categories.
- > The SMFs can protect the structure from a cataclysmic collapse in a seismic event.
- > Since the soft-story Abrego Apartment had multiple stories above ground-level parking, with narrow vertical supports – and the need to keep those parking spaces – Hardy Frame’s SMFs were an ideal solution.
- > After installation, the special moment frames were painted to blend in with the building.



A Hardy Frame special moment frames was installed to protect this “soft story” garage opening. The special moment frame was painted to blend with the building.

“We decided to use the Hardy Frame SMF, because we are very familiar with the product, and we’ve found it’s easy to install. Plus, the Hardy Frame SMF is the product that offered the least disruption to the tenants.”

– Morgan Jones, consulting engineer

## RETROFIT FOR SEISMIC SAFETY

The Northridge earthquake of 1994 had its epicenter in Reseda, a neighborhood in the north-central San Fernando Valley region of Los Angeles. Sixteen fatalities occurred due to the collapse of Northridge Meadows, a multi-story apartment complex. The terrible loss of life was accompanied by the high cost to repair or even replace numerous regional buildings that were damaged in the event.

Not far from Reseda is the City of Santa Barbara which has similar geological conditions. It is also prone to seismic events where there are similar multi-family buildings that are vulnerable to the same catastrophic structural failure as Northridge Meadows. This type of building is referred to as “soft-story” construction and is identified as being wood-frame with limited walls that are typically very narrow to accommodate parking spaces for the tenants and typically have two or more floors of apartments above.

Because the upper levels have more walls to separate living rooms, kitchens, bedrooms, etc., they are stiffer than the first floor making it susceptible to collapse when experiencing horizontal forces from seismic events. Visualize a tabletop with wobbly legs supporting a lot of weight. The table will support the weight, but shaking the table from side to side will cause the legs to buckle, resulting in collapse.

“In a seismic event, soft-story buildings are prone to collapse,” said John Warkentin, a principle with KAMAP Property Management, which offers an array of apartments, townhouses and houses in Isla Vista, Goleta California, near the University of California, Santa Barbara. “I thought of this as a potential problem for our Abrego Apartment building, a 61-unit structure, built in 1968, which we often rented out to college students. Staring at the building one day recently, I asked myself: What would happen to this structure if there were an earthquake?,”

Warkentin explained. “So, I called Doyle-Morgan Structural Engineering, based here in Santa Barbara.

I engaged with Morgan Jones, an engineer with seismic experience and I asked him to solve the problem,” Warkentin said.

“With the recent ordinance in the City of Los Angeles that requires soft-story retrofits on thousands of building, we have seen a growing awareness of this issue,” said Morgan Jones, the principle with Doyle Morgan Structural Engineering, a professional engineer (PE), a structural engineer (SE), and a seismic retrofit expert with 29 years of experience.

**“Soft-story” buildings are typically wood-framed, with limited walls that are often very narrow to accommodate tenant parking on the first floor.**

“Interestingly, the Abrego Apartment building in Goleta is not subject to the current ordinances sweeping through California. Mr. Warkentin simply wanted to make his tenants safe and to assure his insurance company that his structure used the best available technology to avoid collapse.”

“That’s when we decided to make the substantial investment in a soft-story seismic retrofit,” Warkentin explained.



**Hardy Frame special moment frames (SMFs) are designed to resist significant “inelastic deformation.” The SMF shown here can be specified in high *Seismic Design Categories*.**

## WHAT SOLUTIONS ARE ACCEPTABLE?

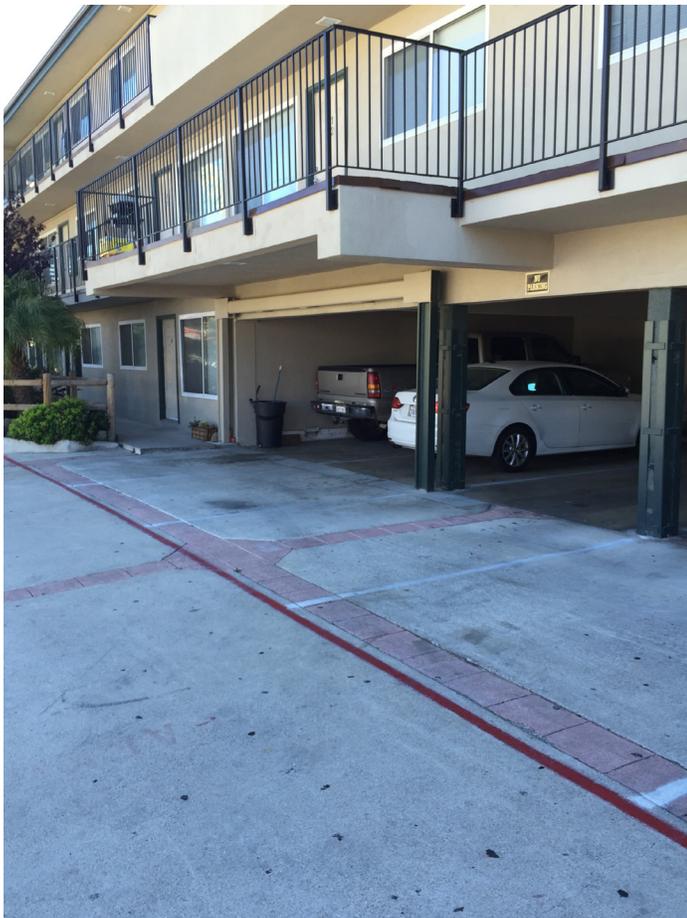
There is no single solution for all soft-story buildings, and retrofit solutions often involve more than one retrofit method. For some buildings, plywood shear walls or even pre-fabricated structural shear wall systems are appropriate. In others, like the Abrego Apartment building, pre-fabricated special moment frames were necessary. Since multi-family soft-story buildings often have two or more stories above ground level parking, with narrow vertical supports (and the need to keep those parking spaces), special moment frames are frequently the most appropriate solution, as they were in this case.

By way of definition, Moment Frames, as a general class of product, are columns and a beam joined with a “moment connection.” Loads are resisted by these frames through bending in the beam and columns. In addition to resisting lateral and vertical loads, the moment connection transfers rotational movement at the top of the column where it connects to the beam.

There are three types of moment frames: ordinary moment frames (OMF), intermediate moment frames (IMF), and special moment frames (SMF). The moment frame classification is based on how much deformation (movement) the moment frame is capable of while undergoing the expected loads and how far that movement will take it from an elastic level into the plastic level.

OMFs are expected to only resist limited inelastic deformations so they are more commonly used in lower seismic regions (defined by Seismic Design Category). IMFs are held to a higher standard and are qualified for use in low to mid Seismic Design Categories. SMFs are designed to resist significant inelastic deformation and are typically used in high Seismic Design Categories, and it was SMFs that were used by Morgan Jones and his firm.

"We decided to use the Hardy Frame SMF, because we are very familiar with the product, and we've found it's easy to install. Plus, the Hardy Frame SMF is the product that offered the least disruption to the tenants," Morgan Jones explained. "We worked hand-in-hand with a contractor that initially didn't have a great deal of experience with SMF installation, but the learning curve was very small, and by the time he completed the project, he was an expert himself." "Typically, the Hardy Frame SMFs are installed by bolting them to column base plates poured into the foundation," explained Jones. "We consulted with David Lopp from Hardy Frame's technical support and we collaborated on the SMF installation. In this case, for this three-story structure, we specified 10 Hardy Frame SMFs.



**The Abrego Apartment has multiple stories above ground-level parking, supported by narrow vertical supports, making this an ideal location for installing Hardy Frame's SMFs.**

**There is no single solution for all soft-story buildings. For some buildings, plywood shear walls or pre-fabricated structural shear wall systems are appropriate. In others, pre-fabricated special moment frames are necessary.**

However, long before installation, we ran the seismic loads, which we backed up with another firm's calculations. We discovered that we needed the column base plates, but we also needed to add a grade beam. So, we added 18x24-inch grade beam, with a cage of steel, which added to the capacity of the SMFs. This meant a potentially disruptive excavation that would block access to parking, but John Warkentin and his team put down temporary metal plates that accommodated the cars, and we were able to avoid that problem." "The Hardy Frame Special Moment Frame uses the MiTek SidePlate® connection, wide flange columns and a rectangular Hollow Structural Section (HSS) beam. The HSS advantage is that lateral bracing of the beam is not required. The SidePlate connection is very effective and very efficient. It allows for the design of smaller member sizes that don't

encroach into openings, and because they weigh less, it reduces steel costs. “For the Abrego project, connections were made from the SMF beam to the outside face of the buildings existing wood beam with a steel angle to transfer the lateral loads,” David Lopp said. “This approach to installation and connection to the structure simplified the process by making the foundation work more accessible and by enabling preassembled Special Moment Frames to be supplied.”

**“The Hardy Frame SMF is pre-assembled and welded at the factory, then delivered to the jobsite complete and ready to install,” consulting engineer Morgan Jones explained.**

“The Hardy Frame SMF is pre-assembled and welded at the factory then delivered to the jobsite complete and ready to install,” Jones explained. “In this case, after the installation was complete, we were able to simply paint the SMFs so they blended right in with the building. It gave the finished job a good clean look.”

“Yes, painting the beams really made them blend in. When we had the appraiser over to look at the building, he couldn’t even see the SMFs, until we walked him up close and pointed them out,” added John Warkentin.

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## **ABOUT MITEK BUILDER PRODUCTS**

A division of MiTek USA, Inc., MiTek Builder Products integrates a number of businesses, building products, and brands, which MiTek has assembled after a series of acquisitions. These product brands include Hardy Frame Shear Wall System, USP Structural Connectors, and the Z4 Tie-Down System as well as design software solutions for decks. Learn more: [MitekBuilderProducts.com](http://MitekBuilderProducts.com).

## **ABOUT MITEK**

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