



SEISMIC RETROFIT SOLUTIONS BUILT FOR RELIABILITY

Geological conditions and historical records of earthquakes help us to identify and classify high seismic zones. Earthquakes such as the 1971 San Fernando, 1987 Whittier, 1989 Loma Prieta, 1994 Northridge, and 2001 Nisqually Washington have caused extensive damage to thousands of wood-framed single family and multifamily homes. The resulting damage has helped to advance new products and methods that improve the structural integrity of existing buildings.

This pamphlet provides an introduction for building owners in construction techniques and products available to provide connections that have been shown to improve a structures ability to resist earthquakes. MiTek Builder Products include Hardy Frame prefabricated Shear Walls and USP Structural Connectors that are designed to resist earthquake loads. These products are intended for installation in new construction or existing structures as a retrofit to improve the buildings ability to resist earthquake forces in order to provide safety and reduce damage.

For buildings identified to need seismic strengthening, it is recommended that owners consult with a licensed professional engineer who is experienced and qualified in seismic design, and with a licensed contractor capable of performing the installations required. For help selecting a qualified engineer contact the Structural Engineers Association of California (SEAOC) at www.seaoc.org.

For walls with large openings such as garage doors, french doors and picture windows Hardy Frame® Panels, Brace Frames and Special Moment Frames are specifically designed to add strength, stiffness and ductility. For structural connections throughout the building, including anchorage to the foundation, USP® Structural Connectors offer a variety of steel products and applications to provide earthquake resistance where it is needed most. For all seismic retrofit applications please look to MiTek® Products for a complete line of economical structural components that are available from local building material suppliers. **Call us today with questions or to request further information regarding seismic retrofit projects. 800-754-3030.**



MOMENT FRAME INSTALLATION



BEFORE



AFTER

RETROFIT SOLUTIONS



SPECIAL MOMENT FRAME



HFX PANELS



FIXED BASE



PINNED BASE



COLUMN SPLICE



ANGLES FOR SHEAR TRANSFER

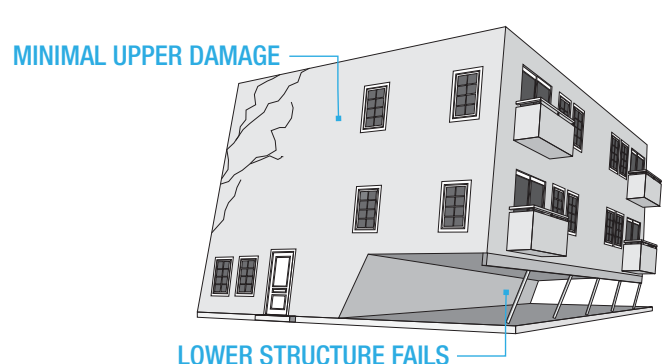
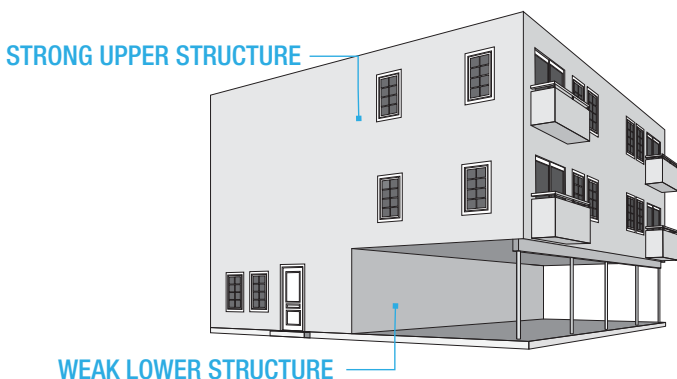


THE SOFT-STORY RETROFIT PROGRAM

The Mandatory Retrofit Program consists of multi-city ordinances passed in Los Angeles, San Francisco, Berkeley and Oakland to establish and enforce new building standards that reduce hazardous structural conditions. The purpose is life safety and injury reduction from buildings that are known to be vulnerable to earthquakes. The urgency to act has become even more apparent after witnessing the structural failures in the Loma Prieta and Northridge earthquakes as well as the devastation of wide spread human displacement from a major event such as Hurricane Katrina.

In the Northridge earthquake multi-story wood frame buildings with tuck under parking at the first floor experienced the most damage and some collapsed causing injuries and deaths. Buildings of this construction type are known as “soft-story” or “weak story”. They are typically identified as:

- Wood frame construction
- Fewer walls at the first floor than at the upper floors, primarily exterior walls only
- Large openings and open areas for car access to tuck under parking



Understanding these building deficiencies, the potential for large scale human displacement and the inevitability of seismic events brought about the multi-city ordinances.

Owners of soft-story buildings will receive an Order to Comply from the city they are located in which requires a structural analysis to determine if the building currently complies, what needs to be done to comply or a plan to demolish the structure. The time frame for compliance is

1-Year: Provide a structural analysis showing building compliance as is. Provide a structural analysis and construction plans to structurally alter for compliance. Provide plans to demolish the building

2-Years: Obtain permits

7-Years: Complete structural retrofit work altering the structure to comply with the standards

For structural connections throughout the building, including anchorage to the foundation, USP Structural Connections offer a variety of steel products and applications to provide earthquake resistance where it is needed most.

WHO AND WHAT YOU NEED TO KNOW FOR YOUR SOFT-STORY RETROFIT



1. DOCUMENTATION

Inquire at the City's Building Department for building plans or any other documentation. Having the plans and relevant documents will provide an engineer with information about current dimensions and existing building materials as well as where electrical and plumbing lines occur. Lacking this information may require additional consultations with an engineer to conduct a building investigation for assessing the structure and the application of strengthening materials.



2. RETAIN AN ENGINEER

Your civil/structural licensed engineer will provide a structural design to meet the soft-story retrofit ordinance requirements. Consider a "performance based design" that exceeds minimum soft-story retrofit requirements to further reduce building damage and minimize costly repairs. For help finding a qualified engineer, contact MiTek Builder Products/ Hardy Frame at 800-754-3030 or the Structural Engineers Association of California at seacoc.org



3. EMPLOY A CONTRACTOR

After your engineer has filed the building permit, you will need to solicit bids from licensed contractors. Your contractor will be responsible for constructing the retrofit in accordance with the engineer's design. They will also be responsible for hiring specialty subcontractors (i.e. concrete contractors, steel fabricators and steel erectors) and maintain contact with inspectors to ensure the work remains in compliance with the engineer's drawings. For help finding, a qualified and licensed contractor, ask your engineer and/ or local building material suppliers.



4. PURCHASE COST-EFFECTIVE PRODUCTS

MiTek Builder Products offers the best and most cost-effective solutions to all retrofit/soft-story applications. Your engineer's design to strengthen your building should include one or more of the Hardy Frame Special Moment Frames, Hardy Frame Damper Frames, Hardy Frame Shear Wall System and USP Structural Connectors. Learn more about MiTek Builder Product solutions at mitekbuilderproducts.com



5. INSPECTIONS

During construction your engineer will make necessary periodic inspections (i.e. foundation, groundwork and initial framing) and sign off on the structural work. The local building department will also provide inspections during construction at required intervals.

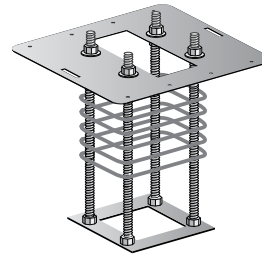


6. COMPLETION

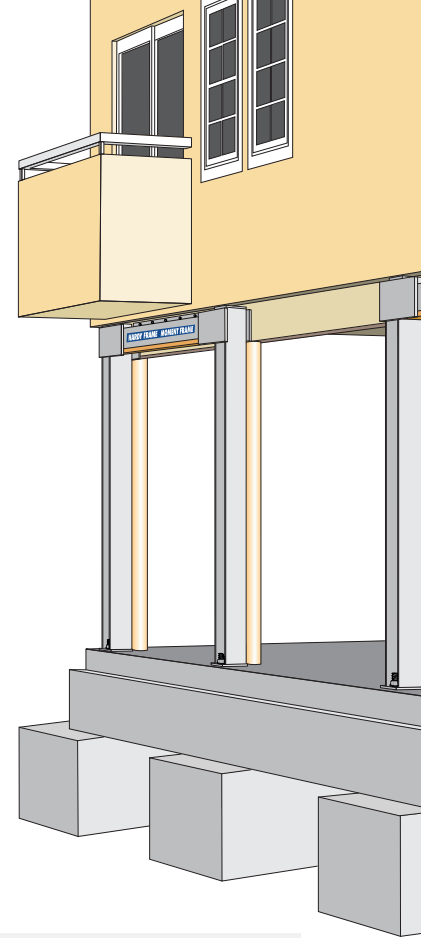
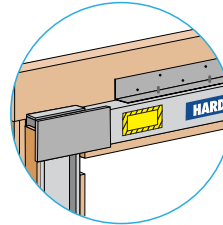
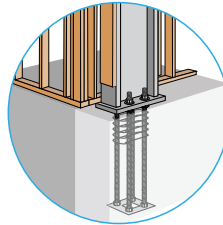
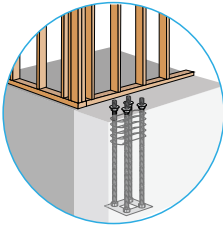
After completion of soft-story retrofit work, you or your contractor will need to contact the city for a Certificate of Compliance, or Certificate of Occupancy.

MOMENT FRAME INSTALLATION OUTSIDE THE EXISTING WALL LINE

- Moment Frame installations outside the existing wall line are expedient and cost effective solutions.
- Anchorage components are provided in a “Template Kit” that is assembled and placed into a new footing.
- Steel reinforcement per the Engineers foundation design is installed then concrete is poured.
- The Hardy Frame Special Moment Frame is placed on the anchors, and secured to the foundation.
- Connections to the existing structure are made. An angle can be used to connect the Moment Frame to the existing structure and provide adjustment.

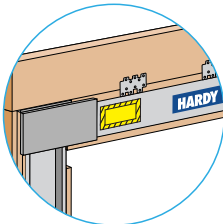
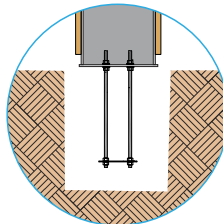
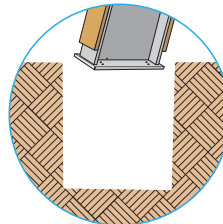


TEMPLATE KIT



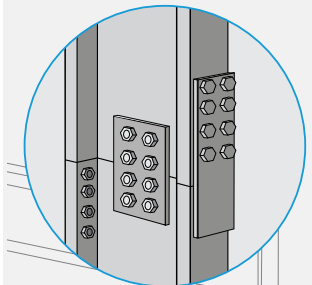
MOMENT FRAME INSTALLATION INSIDE THE EXISTING WALL LINE

- Installation of the Moment Frame inside the wall may be considered for aesthetic appearance or when vertical loads need to be considered.
- Lower the Moment Frame base plate into a new footing, raise in place, then support with wood shoring.
- The Hardy Frame Special Moment Frame is placed on the anchors, and secured to the foundation.
- Connections to the existing structure are made. An angle can be used to connect the Moment Frame to the existing structure.

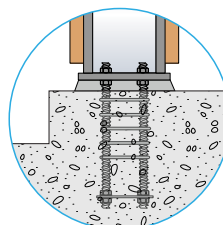


SPECIAL MOMENT FRAME COLUMN SPLICE OPTION

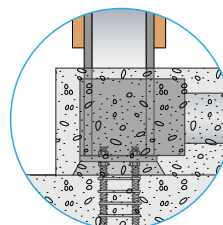
The column splice enables installations in restricted existing conditions.



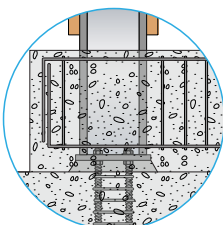
ANCHORAGE OPTIONS



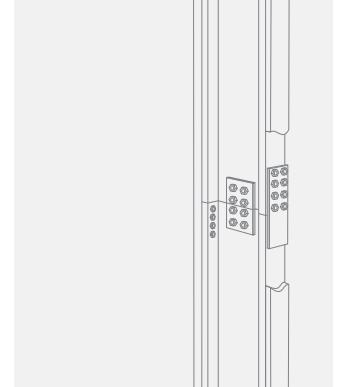
PINNED BASE

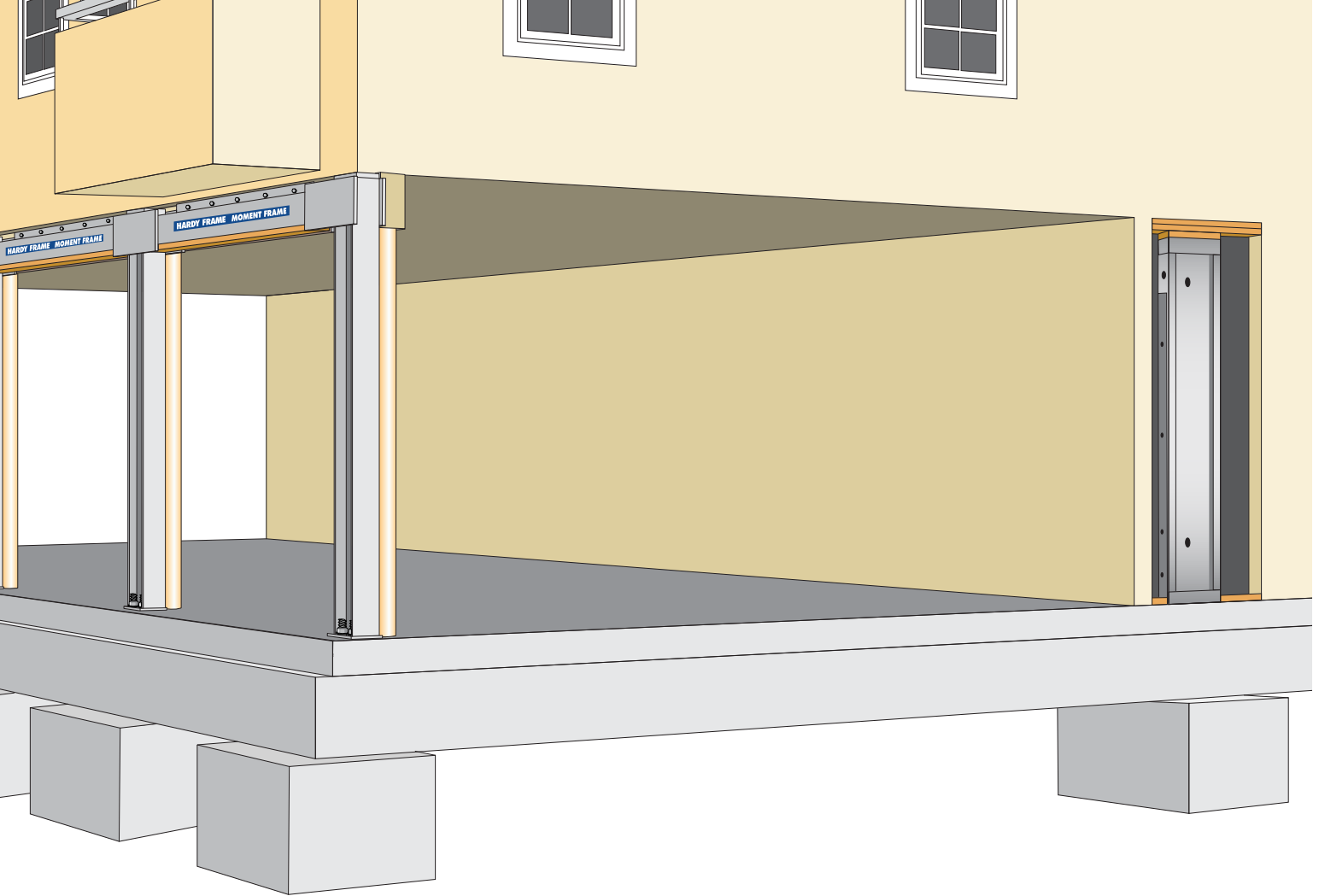


PICTURE FRAME
FIXED BASE BENEFIT WITH
PINNED BASE ANCHORAGE



FIXED BASE

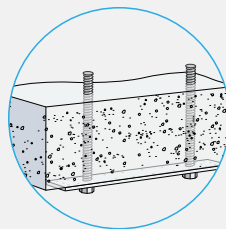




HARDY FRAME PANEL INSTALLATION AT AN EXISTING CONDITION

THRU-BOLT

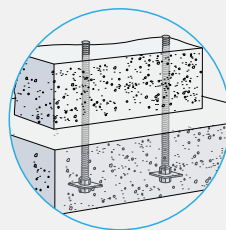
The design, including capacity of existing concrete and size of Bearing Plates below is determined by the engineer of record.



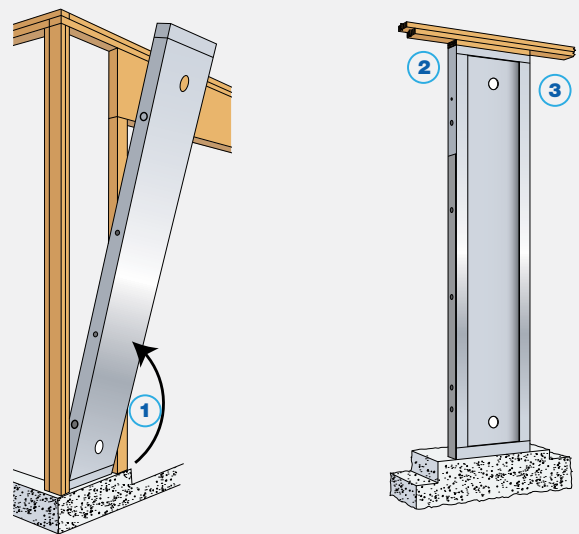
THRU-BOLT

NEW FOOTING BELOW

Hardy Frame unreinforced or reinforced anchorage solutions may be used below existing concrete or to replace existing concrete.



NEW FOOTING BELOW EXISTING



HARDY FRAME PANEL INSTALLATION

1. Tilt Panel, lift over bolts and swing into the existing space
2. Install 2x filler at 1-1/2" gap
3. Connect with 1/4 x 4-1/2 USP WS-Series Screws

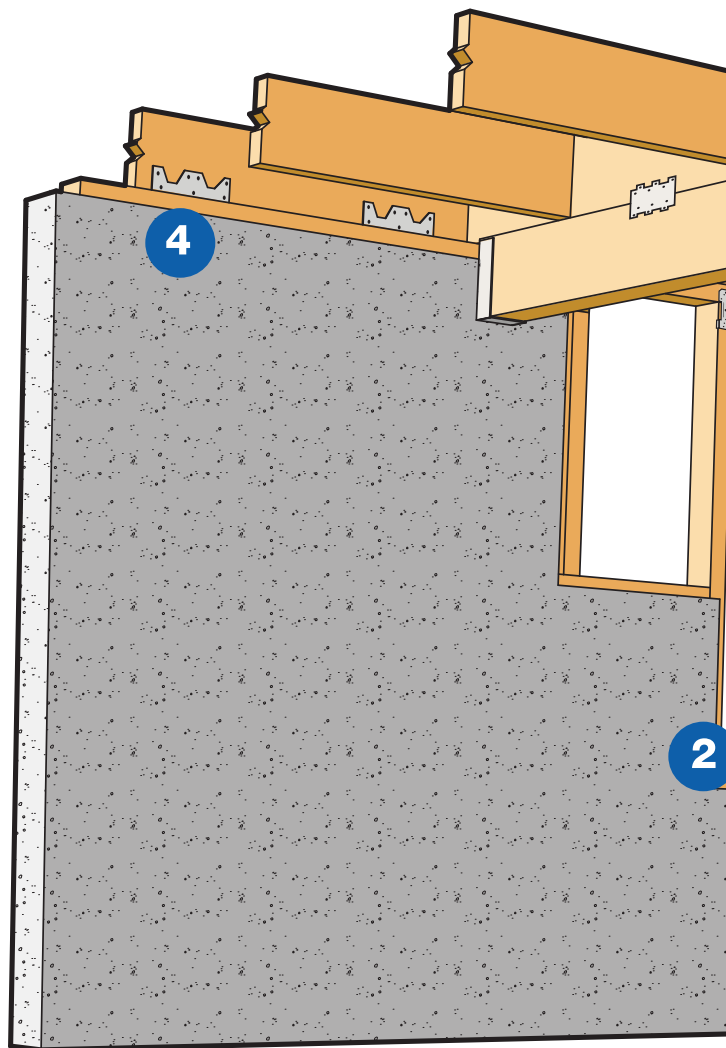
USP CONNECTORS IN RAISED FLOOR RETROFITS



Use this Retrofit Guide to assist in the selection of USP connectors that work best to strengthen and reinforce existing structures. The purpose of this structural strengthening is to help reduce damage to the structure and provide additional safety to the building occupants during typical seismic events.

Some key things to remember when retrofitting your structure:

- Earthquake forces act in all directions including up and down.
- Some connection is better than no connection.
- Best connections are designed to put fasteners in shear rather than withdrawal.
- Ductility of the connection is as important as the strength and stiffness. Connections should retain strength after movement or shifting has occurred. (No “all or nothing” connections)
- Take a visual survey of your project to determine how much access you will have for installation of the connector. Each building and foundation type will have unique challenges and make one connector the solution for one project, but a difficult install on another project.
- Determine how much room you will have to use the tools that you have. For example some spaces will make swinging a hammer nearly impossible, so a pneumatic palm nailer will need to be used instead.
- Property owners of detached, single family wood frame dwellings, please refer to FEMA P-50 and P-50-1 for more information.



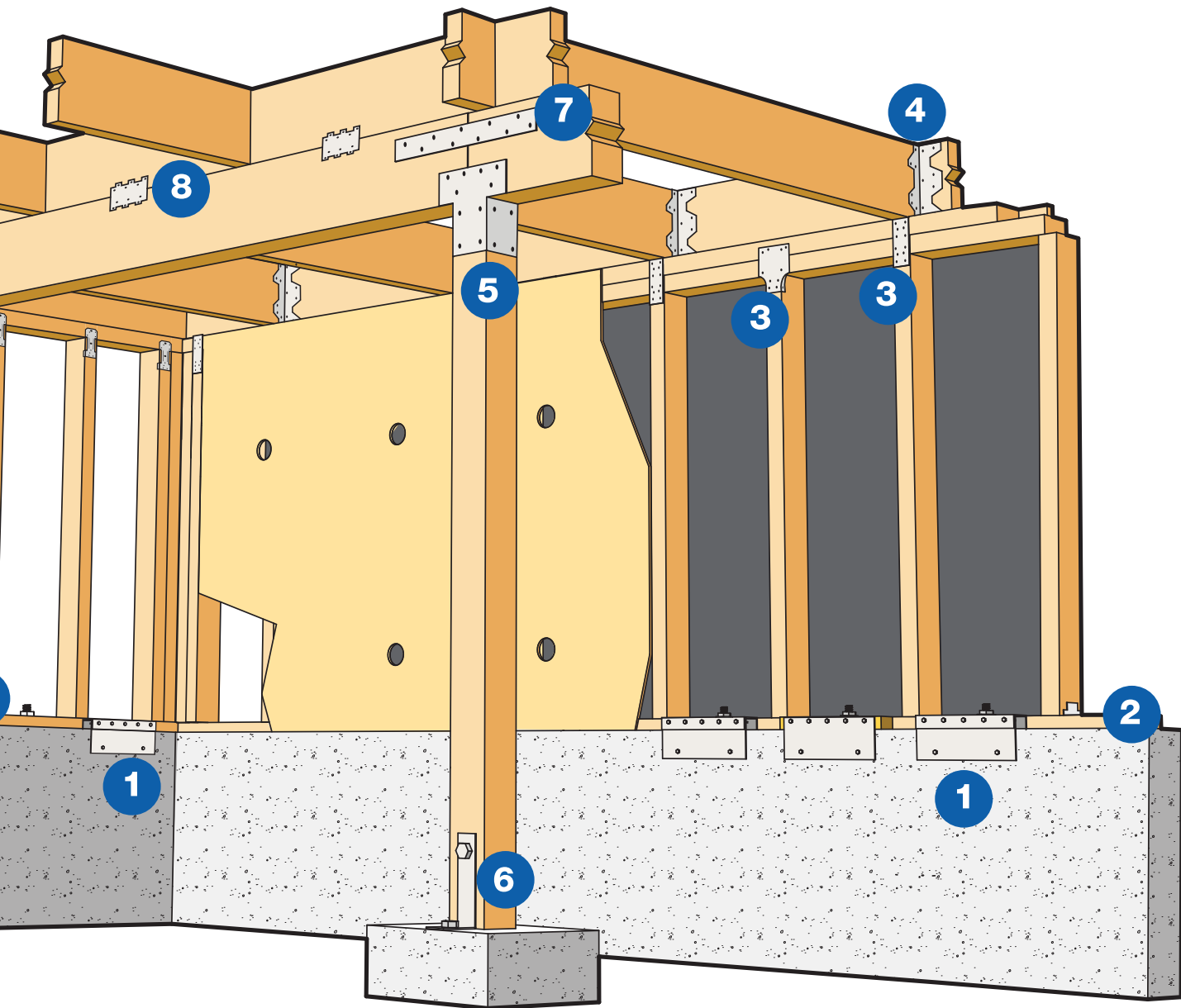
1 SILL PLATE TO FOUNDATION

SRC — Sill Retrofit Connector for conditions when the distance from the sill plate edge to the inside surface of the foundation wall is between 1/2-in and 2-1/2-in.

SRCP — Sill Retrofit Connector Plate for conditions when the distance from the sill plate edge to the inside surface of the foundation wall is between 0-in and 1/2-in. Also allows sill plate to over hang foundation wall up to 1/2-in.

2 SILL PLATE TO FOUNDATION

Threaded Anchor Rod — Installed with USP's CIA-GEL 7000-C. See local requirements for embedment depth.



3 WALL STUDS TO TOP PLATE

SPT / RSPT — Stud Plate Ties for connecting wall studs to top plates.

4 RIM BOARD TO TOP PLATE / SILL PLATE / FLOOR JOIST

MPA1 — Multi-Purpose Framing Angle to connect rim board directly to the top plate. Provides lateral resistance in all directions and uplift resistance.

5 POST BEAM CONNECTION

PB / PBS — Post Caps with 2-piece design for easy retrofit applications.

PBES — Post Cap with 2-piece design for use at the end of a beam.

6 POST TO FOUNDATION

TDL5 — Concrete Angle to secure wood post to foundation. Use 1/2-in wedge bolt to connect TDL5 to concrete.

7 CONTINUITY TENSION STRAPS

MSTC — 3-in Wide strapping available in a variety of lengths and installs with nails.

CMST14 — 3-in Wide coiled strapping can be cut to a variety of lengths and installs with nails.

8 MEMBER TO MEMBER IN-PLANE SHEAR

MP4F — Multi-Lateral Plate to transfer lateral force from one resisting element to another.

RETROFIT FREQUENTLY ASKED QUESTIONS

WHY IS THE SOFT-STORY ORDINANCE REQUIRED?

Damage observed in the Loma Prieta earthquake of 1989 and the Northridge earthquake of 1994 among others demonstrated the vulnerability of “Soft-Story” buildings (typically multi-story residential with tenant parking at the first floor) and their vulnerability to collapse in large scale seismic events. The goal of soft-story retrofit ordinances is to:

- Prevent loss of life
- Avoid displacement of the population with nowhere to shelter or live as occurred in New Orleans as a result of Hurricane Katrina
- Increase the buildings resiliency to minimize replacement and repair cost

WHAT IS REQUIRED TO COMPLY WITH THE SOFT-STORY ORDINANCE?

- A qualified Engineer is needed to evaluate the building then design a “retrofit” solution to strengthen the existing structure. Plans and details will be generated to instruct contractors of the necessary work
- Plans are submitted to the building department for review and approval
- Installation of strengthening components in accordance with the plans and manufacturer specifications is made by a qualified contractor
- When the work is complete, the city will inspect and certify the building then issue a certificate of occupancy

WHAT DOES MITEK BUILDER PRODUCTS PROVIDE FOR SOFT-STORY RETROFITS?

- Hardy Frame Panels are light gage steel, narrow shear walls that are tested and approved in all building jurisdictions. Panels are available in various sizes, are economical and they have a broad range of installations
- Hardy Frame Moment Frames are structural steel, they are typically engineered to meet job specific conditions and the “Moment” connection meets the building code. Moment Frames consist of two vertical posts and a horizontal beam that are joined at the corners with our unique SidePlate® connection. For conditions that require the narrowest shear wall available, like installations at tuck-under parking, Moment Frames will usually be required.
- USP Structural Connectors are used to make or improve connections where existing wood members join. For example where beams connect to posts or where wood walls connect to the concrete foundation

WILL INSTALLATION REQUIRE NEW CONCRETE?

Yes. Foundations are a critical part of any shear wall design. Without a well designed and built foundation the shear wall system will not perform. In older buildings it is not likely an existing foundation will be capable of performing that function.

WHAT NEEDS TO BE DONE TO STRENGTHEN MY BUILDING?

Soft or “weak” first stories can be strengthened to better resist the lateral forces of an earthquake by installing a Shear Wall System in strategic locations. Shear Walls are structural wall segments that are stiff enough to prevent the building from collapsing when horizontal forces are applied but designed to be ductile to dissipate the energy from the earthquake similar to the shock absorber on a car. MiTek Builder Products offers several types of Shear Wall Systems. The most common for soft-story retrofits will be Hardy Frame “Panels” or Special Moment Frames. Both types of systems provide lateral force resistance in narrow wall lengths.

HOW MUCH DOES A SOFT-STORY RETROFIT COST?

Costs will vary depending on the building size, architecture, available shear wall lengths and year it was built among other factors. For estimates consult with a contractor that will include the complete labor and material costs.

WHERE ARE MITEK BUILDER PRODUCTS SOLD AND WHAT IS THE LEAD TIME?

All MiTek Builder Products, including Hardy Frame Panels, Moment Frames and USP Structural Connectors are available from local lumber and hardware suppliers. The lead time for Panels is approximately 3-5 business days, for Moment Frames it can be 3-4 weeks depending on sizes and quantities. USP Connectors are stock items at many local hardware suppliers.

WILL THE PANELS OR MOMENT FRAME FIT INSIDE THE WALL OR ATTACH TO THE OUTSIDE?

Both scenarios are possible depending on the space available and the existing structural members. Consult with your engineer regarding practicality, ease of installation and the aesthetic appearance when work is completed.

WHY IS THE HARDY FRAME SPECIAL MOMENT FRAME BETTER THAN OTHERS?

Our Moment Frame uses a patented “SidePlate” connection that is very efficient and effective at reducing the size and weight of the columns and beam. Soft-Story conditions require strong structural members that are minimal size; that is what the Hardy Frame Special Moment Frame provides. Additionally, we provide completely pre-assembled Moment Frames that install quickly and reduce installation labor.

DO THE PANELS OR MOMENT FRAMES PREVENT ALL DAMAGE?

The Hardy Frame Shear Wall system will reduce horizontal movement of the structure in an earthquake reducing the damage. However, it is important to understand that designs to meet the Building Code are not intended to prevent all damage. For minimal damage we recommend consulting with your engineer about a “performance based design”. For construction to higher standards than the minimum required by code, additional installation cost will be minimal and additional material cost reasonable considering the advantages. Especially when compared to the potential cost of repairs or possible replacement due to earthquake damage. For owners the additional cost is well worth the investment.

HOW DO I KNOW WHICH SHEAR WALL SYSTEM TO BUY?

Your engineer will determine the best shear wall system based on the building shape, wall lengths available and the required resistance of lateral loading from earthquakes.

HOW DO I CHOOSE AN ENGINEER AND CONTRACTOR?

When obtaining quotes for construction materials and services it is standard industry practice to get more than one bid to assure competitive costs. Obtaining competitive bids will also provide the opportunity to select a professional that you are comfortable working with and confident in their ability to perform. To confirm reputable Engineers and Contractors ask for references and to see a portfolio of previous work. A good resource for Engineers is the Structural Engineers Association at seaosc.org. For contractor referrals consider inquiring at your local lumber or hardware supplier for customers they recommend.

WILL THE WEIGHT OF THE BUILDING REST ON THE SHEAR WALL SYSTEM?

Typically the vertical loads, including the weight of the building will continue to be supported by the existing structure. The shear wall system is installed to provide the lateral strength required.

HOW ARE MOMENT FRAMES INSTALLED AT EXISTING BUILDINGS AND HOW LONG DOES IT TAKE?

Installation depends on the building and the site conditions. For locations with easy access and with proper preparation our Moment Frame installs in about one-half hour. When placing into existing conditions the Frame is typically put in place then concrete is poured up to the base plates. This installation and temporary shoring will remain in place until concrete has sufficiently hardened. We also offer a bolted column splice option for installation at existing buildings.

CODES FOR RETROFITS

There are four codebooks and a guideline that can be used as a guide for retrofitting unsafe structures.

- FEMA P-807 Guidelines: Seismic Evaluation and Retrofit of Multi-Unit WoodFrame Buildings with weak First Stories
- ASCE 41-13, Seismic Evaluation and Rehabilitation of Existing Buildings
- ASCE 41-06, Seismic Rehabilitation of Existing Buildings
- ASCE 31-03, Seismic Evaluation of Existing Buildings
- 2012 International Existing Building Code Appendix A4 (Retrofit Only)

ADDITIONAL PUBLICATIONS FROM MITEK BUILDER PRODUCTS



Product Catalog

The Hardy Frame Product Catalog provides complete information for Engineers, Architects and Designers to specify our shear wall system. There is a complete listing of all Panels, Brace Frames and Accessories, allowable shear loads, corresponding uplift and drift, pre-engineered anchorage information, specification tips, photos and Typical Installation Details. The Installation Details in the Product Catalog conveniently match our ACad version that can be included as supplemental sheets to plan submittals.

USP Retrofit Solutions for Single Story Residences

This Retrofit Guide illustrates common framing connections and provides information for USP Connectors to provide better structural resiliency. Applications are common for single family but also applicable to all wood frame structures. Products include post installed anchorage to concrete, wall and floor framing to foundation and post to beam connections to mention a few.



USP Structural Connectors Product Catalog

The 2015-2016 USP Catalog is a comprehensive 236 page guide to the United States product line. It features all new product and application illustrations, detailed installation instructions, fastening schedules and load ratings. EWP and Plated Truss connectors are included.

Z4 Product Catalog

The Z4 product line, including the Cinch Nut, CT and T2, are now a part of the Hardy Frame family. The Cinch Nut is a self ratcheting device that is designed to maintain a tight connection in the Z4 continuous "Quick Connect" rod system. The Cinch Nut joins the CT and T2 to offer more design options than any other hold down system and are rated for Tension capacities that range from 5,000 to 60,000 lbs. In addition to continuous rod applications, the T2 can be used as a hold down in conventionally framed shear walls. info@zonefour.com.



Moment Frame Catalog

Includes instructions for designing with Hardy Frame® Moment Frames, allowable values, typical Installation details and a Non-Standard form for submittal when project conditions require a custom design.



1732 Palma Dr., Suite 200, Ventura, California 93003 800 754-3030

HardyFrame.com

©2017 MiTek All Rights Reserved