



## SEISMIC RETROFITTING: WHAT IS IT?

Seismic retrofitting strengthens existing buildings to improve their resistance to earthquakes. Many older commercial structures were built before today's seismic standards, leaving them vulnerable to severe damage or failure during seismic events.

A retrofit reinforces critical areas of a building—such as roof-to-wall connections, shear walls, and foundations—to ensure they can withstand lateral and vertical earthquake forces.

The goal of a seismic retrofit is to:

- **Enhance Structural Integrity** – Strengthening weak points to prevent partial or total building collapse.
- **Improve Occupant Safety** – Reducing the risk of injuries and fatalities during an earthquake.
- **Protect Business Investments** – Minimizing downtime, repair costs, and potential liability from structural failure.
- **Meet Compliance Standards** – Adhering to modern building codes and seismic retrofit ordinances.

Seismic retrofits vary depending on the building's construction type, vulnerabilities, and location. While the primary goal is strengthening structural integrity, retrofitting also offers significant financial, legal, and operational benefits.

## WHY RETROFIT YOUR COMMERCIAL OR INDUSTRIAL BUILDING?

Beyond strengthening your building, seismic retrofitting provides financial, legal, and operational benefits. Here's why property owners invest in retrofits:

- **Increase Marketability & Lender Appeal**  
A properly retrofitted building often has a lower Scenario Upper Loss (SUL), making it more attractive to lenders and potential buyers. Many lenders require an SUL below 20 to qualify for financing—and there are many large buyers who will not even consider purchasing a building unless its SUL is already under 20. Retrofitting improves both the building's marketability and available financing options.
- **Reduce Legal and Financial Risk**  
Ignoring known structural weaknesses can expose property owners to legal liability. A seismic retrofit proactively strengthens the building and reduces the risk of costly lawsuits or damages. If you are aware that your building has structural deficiencies and choose not to address them, you could be held personally liable in the event of an injury, fatality, or significant property loss.



- **Lower Insurance Costs**

A retrofit may help lower earthquake insurance rates. However, not all insurers recognize SUL reductions, so check with your provider.

- **Secure Future Insurance Coverage**

Earthquake insurance rates have significantly increased over the past two decades, with some areas experiencing sharp premium hikes due to rising risk assessments and reinsurance costs.

- **Protect Tenants & Business Operations**

Retrofitting improves tenant confidence and business continuity, especially for commercial offices, apartment buildings, and essential facilities that depend on structural stability.

## SEISMIC RETROFIT SOLUTIONS BY BUILDING TYPE

Different types of commercial buildings require tailored retrofit solutions. Here are the most common structures and recommended retrofit methods.

### CONCRETE TILT-UP

- Add roof-to-wall anchors and continuity ties throughout the building.
- Add steel brace frames, shear walls, or concrete to reinforce structural integrity if additional strengthening is required.
- Prevent the roof from pulling apart at the perimeter, a common failure point during earthquakes.

### UNREINFORCED MASONRY (URM) BUILDINGS

- Install roof-to-wall connections and continuity ties.
- Add a plywood overlay at the roof to improve diaphragm strength (*usually needed due to existing roof sheeting*).
- Add steel brace frames, shear walls, or concrete to reinforce structural integrity if additional strengthening is required.
- Reinforce large storefront openings with moment frames or infill walls to manage shear loads.
- Strengthen walls using plywood, tube steel, gunite, or epoxy fiber wrapping to improve lateral stability.



## MULTI-STORY CONCRETE BUILDINGS (2+ STORIES)

- Install concrete shear walls and steel collectors to enhance lateral load resistance.
- Utilize gunite, column fiber wrapping, or additional structural reinforcements to mitigate risks associated with heavy concrete construction.
- Strengthen floor connections to prevent progressive collapse.

## SOFT-STORY & TUCK-UNDER APARTMENT BUILDINGS

- Strengthen the open first-floor structure (such as ground-level parking areas) to prevent collapse.
- Install steel moment frames, concrete footings, and drag lines to increase structural stability.
- Add shear walls to existing interior walls within parking areas.

## THE SEISMIC RETROFIT PROCESS

Seismic retrofitting follows a structured process to identify a building's vulnerabilities and implement solutions that improve earthquake resistance. This process includes three key steps:

- Assessing the existing structure
- Designing tailored retrofit solutions
- Implementing recommended enhancements

Each step ensures the building meets modern seismic standards while minimizing risk to occupants and assets.

### STEP 1: ASSESSING THE EXISTING STRUCTURE

The retrofit process begins with a structural assessment conducted by **engineers experienced in seismic retrofits**. This evaluation identifies areas where the building may be vulnerable to seismic forces. Key factors include:

- **Building Type & Design** – Assessing structures such as tilt-up concrete buildings, soft-story buildings, and reinforced masonry buildings to determine specific vulnerabilities.
- **Structural Connections & Load Paths** – Reviewing roof-to-wall anchors, continuity ties, and lateral force resistance to identify weak points.



- **Site-Specific Risk Factors** – Considering proximity to fault lines, soil conditions, and historical seismic activity to assess potential impact. This includes reviewing the Peak Ground Acceleration (PGA) for the building’s location. A higher PGA value typically indicates softer soils, which can amplify seismic forces and create more load.

## STEP 2: DESIGNING TAILORED RETROFIT SOLUTIONS

Once vulnerabilities are identified, engineers develop a custom retrofit plan tailored to the building’s needs. Common solutions include:

- **Strengthening Roof-to-Wall Connections** – Adding anchors, continuity ties, and steel reinforcement to improve structural integrity.
- **Adding Shear Walls & Steel Bracing** – Enhancing lateral strength to reduce building sway.
- **Installing Moment Frames** – Providing additional support in large openings such as storefronts or parking areas.
- **Securing the Foundation** – Foundation bolting prevents the structure from shifting during seismic activity. This may also include adding new footings and steel reinforcements to improve overall stability.

## STEP 3: IMPLEMENTING RECOMMENDED ENHANCEMENTS

The final step is executing the retrofit construction work according to engineering plans and local building codes. This phase often occurs while the building is occupied, requiring careful planning to minimize disruptions.

- **Strict adherence to engineering specifications** ensures the structure meets safety standards.
- **Tenant coordination and phased construction** help maintain business operations during the retrofit.

## SEISMIC RETROFIT IN ACTION: REAL-WORLD APPLICATIONS

Seismic retrofitting uses specialized techniques to strengthen buildings based on their structural vulnerabilities. The following images illustrate real-world retrofit projects, highlighting key reinforcement methods that improve earthquake resilience.

A seismic retrofit of a standard concrete tilt-up building with a panelized roof system typically includes some or all of the following key steps:

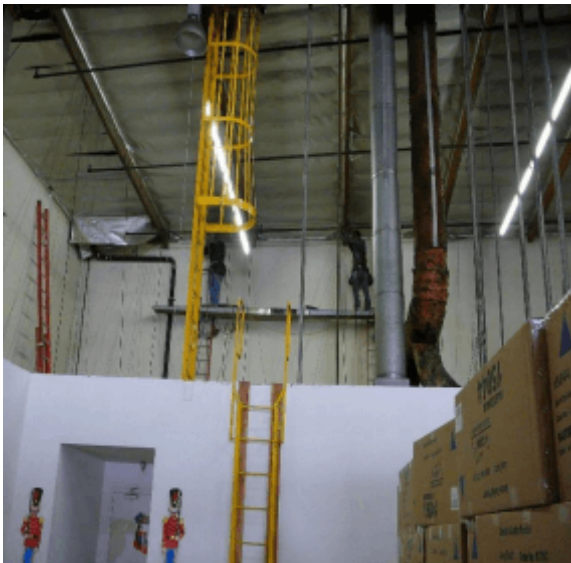




## SETTING UP AND PREPARING THE HARDWARE



## SETTING UP ABOVE OFFICES



## CREW SAFETY MEETING





## ROOF-TO-WALL ANCHORAGE

Strengthening existing connections by securing glulam beams, steel girders, purlins, and sub-purlins to prevent roof separation during seismic activity. Existing connections often lack the strength needed to resist earthquake forces.





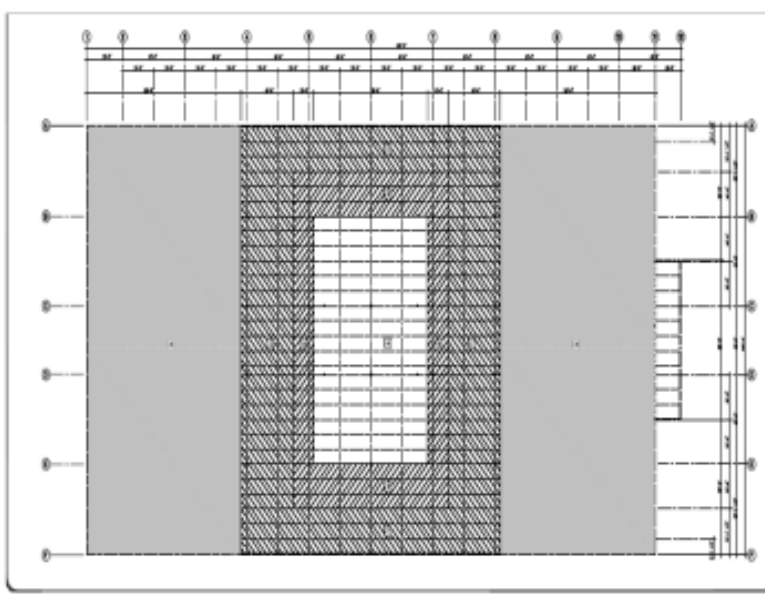
## CONTINUITY TIES

Continuity ties connect across the building, typically in rows spaced 24 feet on center.



## ROOF NAILING

If roof nailing is inadequate, additional nails may be required in the future.



### ADDITIONAL ROOF DIAPHRAGM NAILING

ADDITIONAL NAILING SCHEDULE		
AREA	CONTINUOUS CHORDS & BOUNDARIES	OTHER EDGES
(E)	-	-
(E)	4	-
(E)	2 1/2	4
(E)	SEE NOTE BELOW	

#### NOTES:

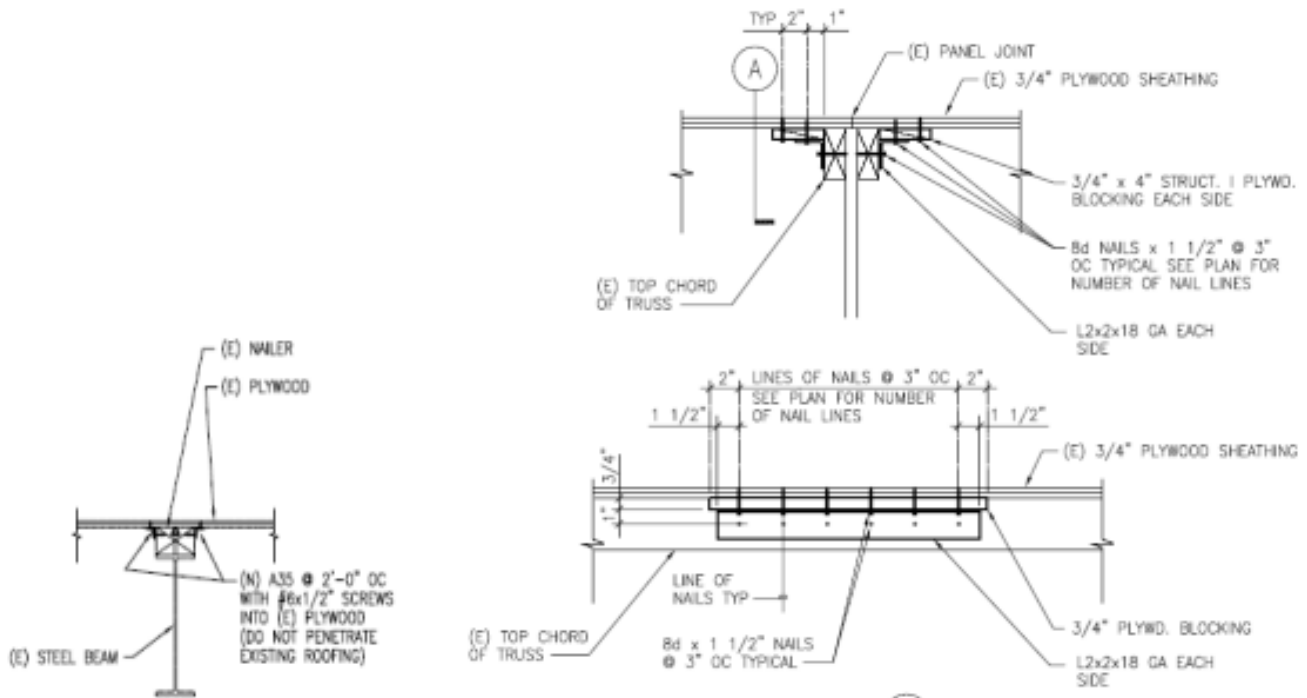
- ADDITIONAL 10d NAILS AS REQUIRED SO THAT FINAL NAILING IS AS SHOWN ON "ADDITIONAL NAILING SCHEDULE"
- (E) ROOF NAILING IS NOT WORK
- (E) ROOF SHEATHING IS 1/2" STRUCL 1 TO BE FIELD JOINTS
- CONTRACTOR SHALL VERIFY BY AIR AS NECESSARY NAILING LAYOUT BELOW. CONTRACTOR SHALL USE CARE TO PREVENT WOOD MEMBER SPLINTING.
- 2 RENDS OF 10d NAILS @ 4" O/C TO ALL JOINTS AND EDGES
- 10d NAILS AT 4" O/C TO NEW AND EXISTING SUB-PANELS WITH WALL ANCHORS, SEE DETAIL 1/10.
- NAILING SPECIFIED IN DETAILS WHERE OCCURS.
- SEE ALSO ROOF DIAPHRAGM NAILING.
- FINISH NUMBER AT PLYWOOD CONTINUOUS CHORDS AND BOUNDARIES TO BE 2-2d OR 3d AND NAILING TO BE STAGGERED.
- NEW ROOFING TO MATCH EXISTING AND TO BE 1" CLASS OR 1" CLASS MINIMUM.

FUTURE NAILING IS NOT PART OF CURRENT SCOPE OF WORK

### FUTURE ROOF DIAPHRAGM NAILING

SCALE: N.T.S.

If nailing from above is not practical, additional nailing can be done from underneath using Simpson A35s, secured to the underside of the roof sheathing with screws.



## DRAG LINES

Drag lines are needed if there is a reentrant corner—where part of the building offsets, recesses, or extends beyond the main structure.



## EQUIPMENT ANCHORING FOR FIRE SPRINKLER SYSTEMS

Four-way sway brace cables provide stability and secure fire sprinkler piping against movement during seismic events.



*Tube steel frame bolted to concrete floor for secure tank containment.*



*Four-way sway bracing for piping systems.*



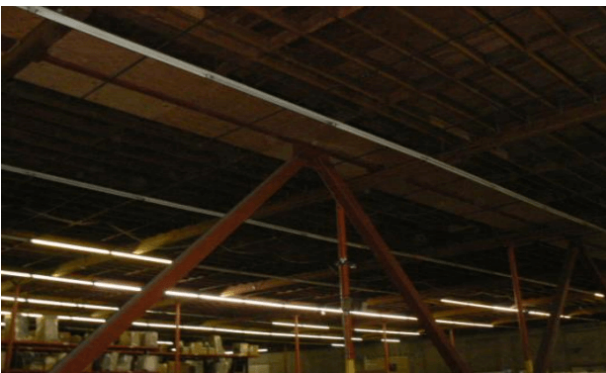
*Equipment anchoring safeguards both business operations and building integrity.*

## BRACE FRAMES AND SHEAR WALLS

When necessary, a brace frame or shear wall is added, typically when a building's length exceeds three times its width.



*Large brace frame connected to a roof drag line for force distribution.*



*Bottom section of a brace frame in an existing office area.*



## CORD PLATE REINFORCEMENT

A cord plate is used to strengthen walls that lack sufficient in-plane stability.





## EXTERIOR STEEL WALL REINFORCEMENT

When walls lack strength, exterior steel is added to enhance stability and improve structural integrity. A cord plate is used to strengthen walls that lack sufficient in-plane stability.



## SEISMIC RETROFIT AND TRUSS REPAIR

Strengthening a barrel truss roof with seismic retrofitting and structural truss repairs to improve stability and resilience.





## **VENTING FOIL TO PREVENT CONDENSATION**

Cutting back foil by 3 inches from the ends allows the cavity to breathe, reducing condensation risks. For cost efficiency, venting is best done during seismic retrofitting.



*Notice the white corrosion formed on the sub purlin hanger*



*Notice the rusting of the purlin hanger from condensation*

## **SOFT-STORY APARTMENT RETROFIT**

Strengthening apartment buildings with new shear walls, footings, reinforced support columns, continuity straps, and fresh stucco and paint—all completed by our in-house crews.



# S SAUNDERS

