



SAUNDERS
COMMERCIAL SEISMIC RETROFIT
www.saundersseismic.com
California [License: 616856]
Oregon [License: 193670]
Washington [License: SAUNDCI953ND]

Southern California
1760 Monrovia, Unit #A-1
Costa Mesa, CA 92627
Phone: (949) 646-0034

Northern California
3710 A Charter Park Dr.
San Jose, CA 95136
Phone: (408) 267-3876

Washington
232 SW 43rd Street
Renton, WA 98057
Phone: (206) 521-3774

What is Commercial Seismic Retrofitting?

SEISMIC RETROFITTING

A Seismic Retrofit provides existing structures with more resistance to seismic activity due to earthquakes. In buildings, this process typically includes strengthening weak connections found in roof to wall connections, continuity ties, shear walls and the roof diaphragm.

In the past, building codes were less stringent compared to today's standards, thus it is a good idea to inspect buildings constructed prior to 1998, as they were built prior to current structural codes/requirements (1997 UBC).

Numerous types of structures may benefit from a seismic retrofit, including various building structures, bridges, dams, etc. This article emphasizes building structures only, including the following:

Concrete Tilt-Up & Reinforced Masonry (CMU) – A seismic retrofit for these types of building generally includes adding roof to wall anchors, and continuity ties throughout the building. Sometimes due to the size and shape of the building, steel brace frames are added to the structure. The concrete tilt-up walls used in many commercial properties are very heavy and when they move in an earthquake, they exert a great deal of force. The main purpose of a seismic retrofit for these buildings is to keep the roof from pulling apart, especially at the perimeter.

Un-reinforced Masonry (URM) – A seismic retrofit for this type of building typically requires adding roof to wall connections, continuity ties, and usually requires new plywood overlay at the roof. Usually there are too many openings or a large open storefront window, where it's common to either fill in the smaller openings or install a moment frame to handle the shear loads. Some URM's require a fix for their height over thickness of the wall. These walls can be strengthened with tube steel, gunite or epoxy fiber wrapping.

Concrete Buildings 2+ stories – These buildings exert a great deal of force, due to the weight of the buildings. A seismic retrofit to these types of buildings typically includes a combination of concrete shear walls, gunite, column fiber wrapping, steel collectors, and many other types of strengthening systems. The concept is the same as far as strengthening connections and adding shear strength.

Soft Story Conditions or Tuck Under Apartment Buildings – These buildings have an open first floor (such as ground level parking or subterranean parking) and 2nd floor above (living or business quarters). These buildings perform poorly in an earthquake due to the

shear or overturning that can occur. Strengthening these buildings usually includes adding a steel moment frame, concrete footing and drag lines to keep the 1st floor from rotating and collapsing. For apartments, shear walls are commonly added to the existing walls on the interior areas of the parking stalls.

Seismic retrofitting is done for a variety of reasons, the most common being to **ensure the safety and security of a building's employees, machinery and inventory**.

SIX MORE REASONS TO SEISMIC RETROFIT

1. **Marketability** of a building is improved

Buyers are attracted to the security a seismic retrofit provides to tenants. The number of potential **lenders** increases when the Probable Maximum Loss (PML) is low. More lenders can mean more buyers! (Not to mention, most lenders do not lend on a building with a PML over 20).

2. The **risk of injury and legal litigation** is reduced

Owners can lose substantial amounts of money if it can be proven they were aware a building needed structural work, but had no plan in place to correct the problem. No amount of insurance coverage will probably cover successful litigation against negligence. A thorough seismic retrofit provides peace of mind and asset protection.

3. **Earthquake coverage** can be reduced

A lower coverage cap can reduce premiums. (At this time, some insurance companies do not recognize the PML of a building).

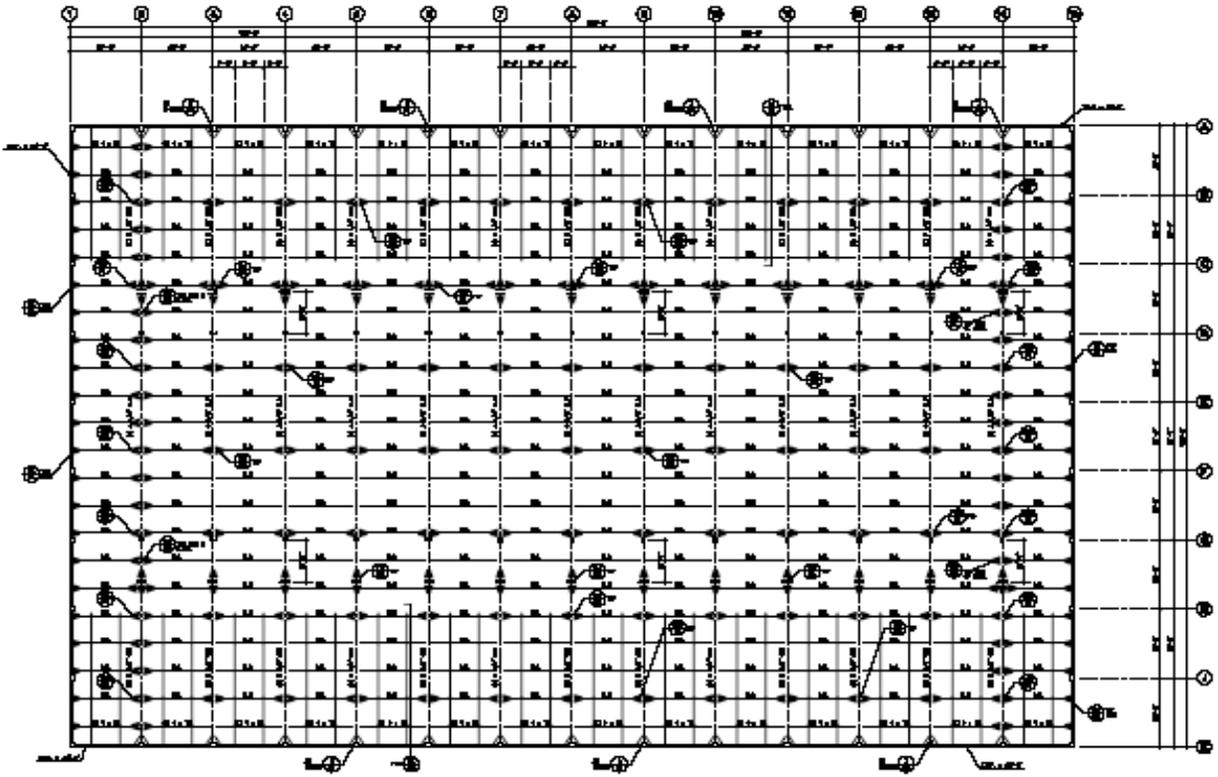
4. **Lenders** who request a PML of less than 20% are usually satisfied when a thorough and professional seismic retrofit has been completed.

5. **Insurance companies** in the future may not write coverage for earthquakes due to past losses and other events. Rates have increased 3 to 6 times the rate charged since 2005!

6. **Tenants** who consider the operation of the building critical to the survivability of their businesses feel more secure and will remain in occupancy contracts for longer periods.

EXAMPLES OF THE SEISMIC RETROFIT PROCESS

A seismic retrofit of a standard concrete tilt-up building with a panelized roof system begins with a set of engineering plans for the building. A structural engineer and construction company experienced in seismic retrofits are essential to begin the process.



GENERAL NOTES
 1. ALL DIMENSIONS ARE IN FEET AND INCHES.
 2. UNLESS OTHERWISE SPECIFIED, ALL MATERIALS SHALL BE AS SHOWN ON THE DRAWING.
 3. ALL WORK SHALL BE IN ACCORDANCE WITH THE LATEST EDITIONS OF THE INTERNATIONAL BUILDING CODE (IBC) AND THE INTERNATIONAL ROOFING CONTRACT DOCUMENTS (IRCD).

ROOF FRAMING NOTES
 1. RAFTERS SHALL BE 2x12 @ 16" O.C.
 2. JOISTS SHALL BE 2x12 @ 16" O.C.
 3. BRACKETS SHALL BE 2x4 @ 16" O.C.
 4. CEILING SHALL BE 5/8" DIA. STEEL DECK.

BY CONTRACTOR'S USE ONLY	
DATE	REVISION

ROOF FRAMING PLAN



A construction side of a seismic retrofit begins by setting up the hardware that will be required for the project.



Setting up above offices



A regularly scheduled safety meeting



A thorough and professional seismic retrofit may include the installations illustrated on the following pages.



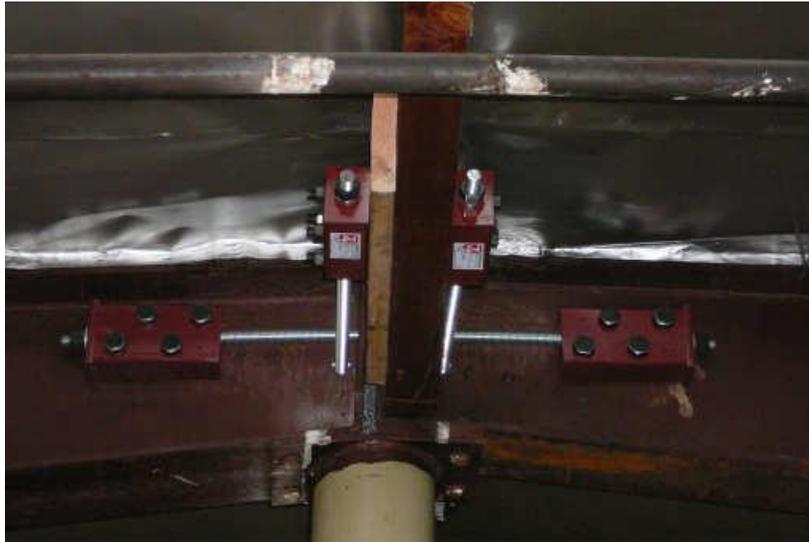
> **Roof to wall anchorage** This includes Glue Laminated beams (GLB), steel girders, purlins and sub-purlins that are used where existing connections are weak and need added strength.



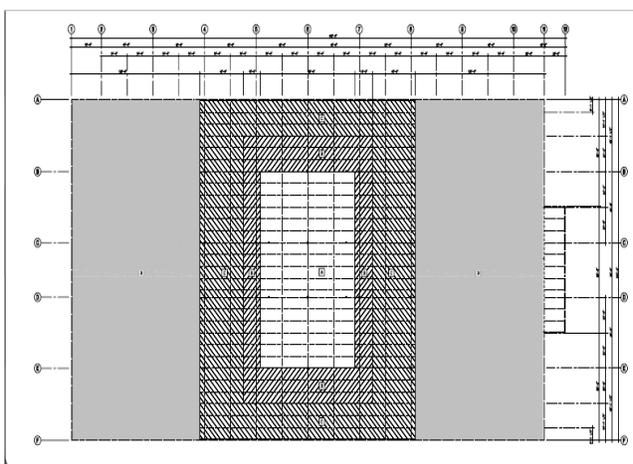
> **Continuity ties across the building** These are usually rows of connections that go across a building at 24 feet on center.







> **Roof nailing** Specialized roof nailing can repair or prevent damage from roof condensation.



ADDITIONAL ROOF DIAPHRAGM NAILING

ADDITIONAL NAILING SCHEDULE		
AREA	CONTINUOUS EDGES & BOUNDARIES	OTHER EDGES
(A)	4	4
(B)	2 1/2	4

SEE NOTE BELOW

(A) 100 NAILS PER 1/2" STRUCK 1 PLYWOOD OVER EXISTING PLYWOOD PER (B)

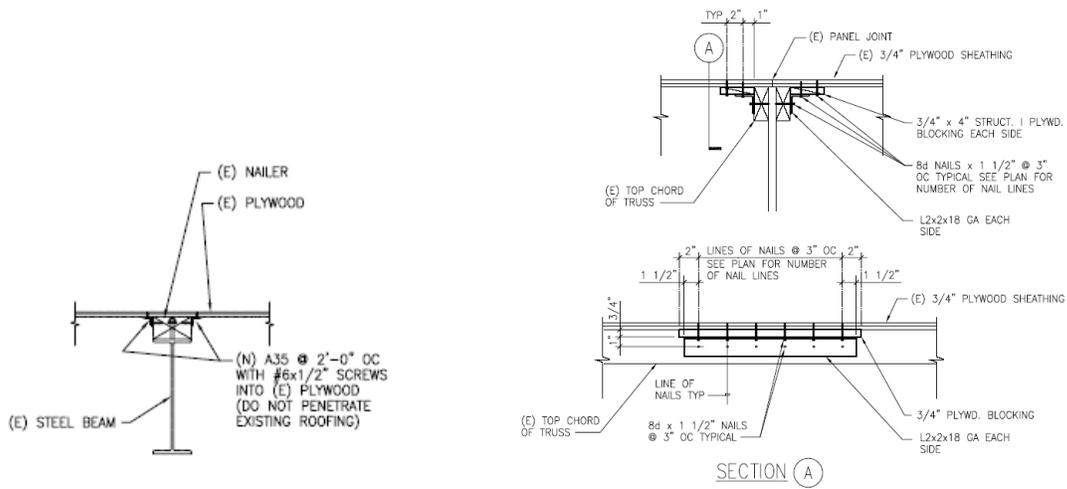
- NOTES:
1. ADDITIONAL 100 NAILS AS REQUIRED TO THAT FINAL NAILING IS AS SHOWN ON ADDITIONAL NAILING SCHEDULE.
 2. (C) ROOF NAILING IS NOT KNOWN.
 3. (D) ROOF SHADING IS 1/2" STRUCK 1 TO BE FIELD VERIFIED.
 4. CONTRACTOR SHALL VERIFY OR ADD AS NECESSARY NAILING LEVISED BELOW. CONTRACTOR SHALL USE CARE TO PREVENT WOOD MEMBER SPLITTING.
 - A. 2 ROWS OF 100 NAILS @ 4" O/C TO ALL GUY LAM BEAMS.
 - B. 100 NAILS AT 4" O/C TO NEW AND EXISTING SUB-PURLING WITH WALL ANCHORS. SEE SCALE 1/8".
 - C. NAILING SPECIFIED IN DETAILS WHERE OCCURS.
 - D. SEE ROOF/ROOF DIAPHRAGM NAILING.
 - E. FINISHING MEMBERS AT PLYWOOD CONTINUOUS EDGES AND BOUNDARIES TO BE 2-2x OR 2x AND NAILING TO BE STAGGERED.
 - F. NEW ROOFING TO MATCH EXISTING AND TO BE 1" CLASS OR 1" CLASS MINIMUM.

FUTURE NAILING IS NOT PART OF CURRENT SCOPE OF WORK

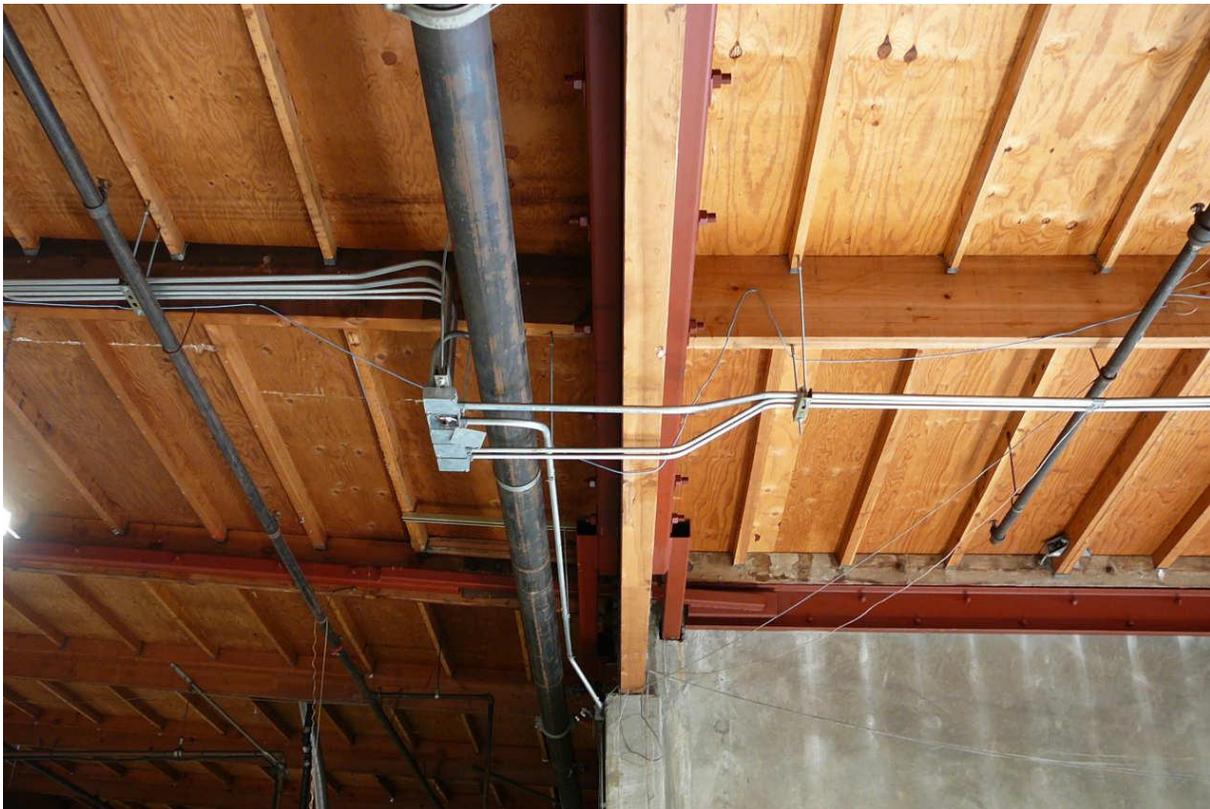
FUTURE ROOF DIAPHRAGM NAILING

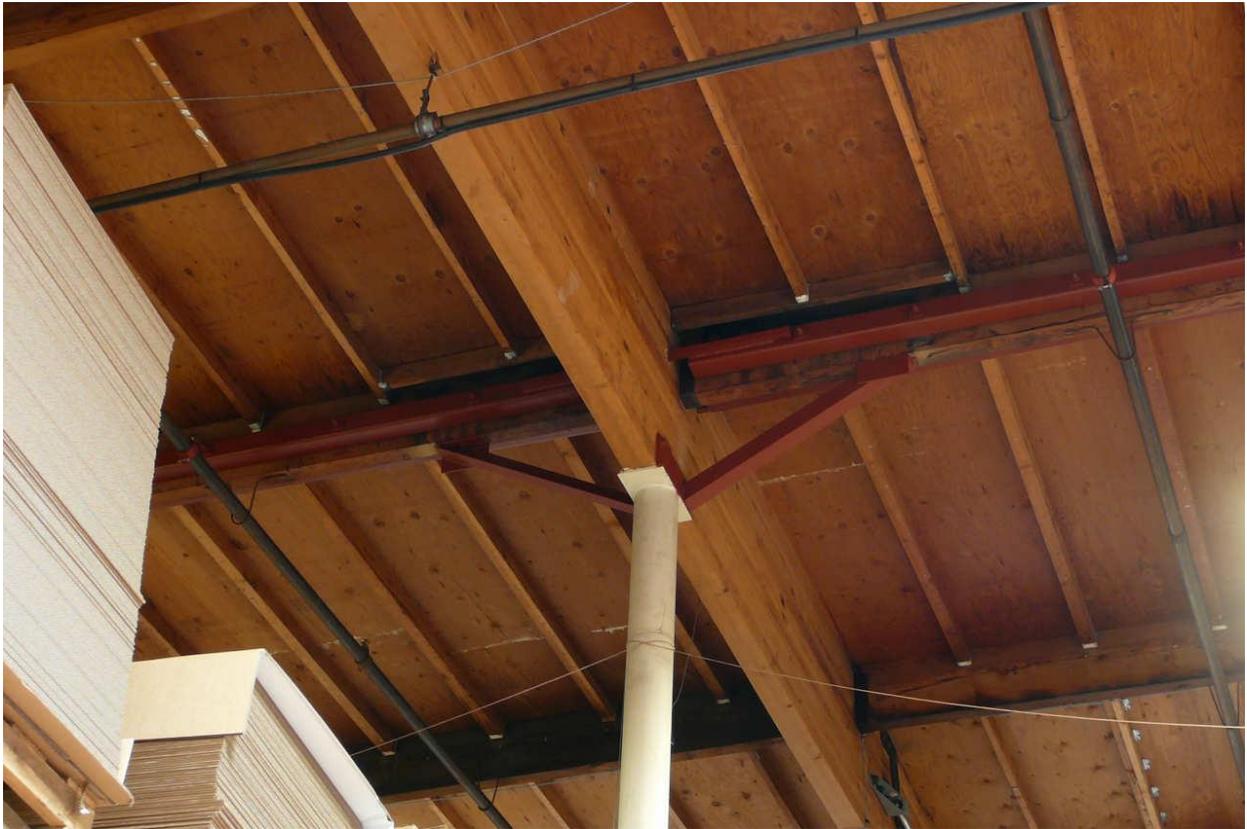
SCALE: N.T.S.

If nailing from above is not practical, there are ways to accomplish that additional nailing from underneath by using Simpson A35's and screwing to the underside of the roof sheathing.



> **Drag lines** are added if there is a *reentrant corner* (where part of the building offsets, recesses or sticks out of the plane of the structure).







> **Brace frames** or **shear walls** are added, usually when the length of a building is three times longer than its width.



Large brace frame connected to a roof drag line to distribute the forces.



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



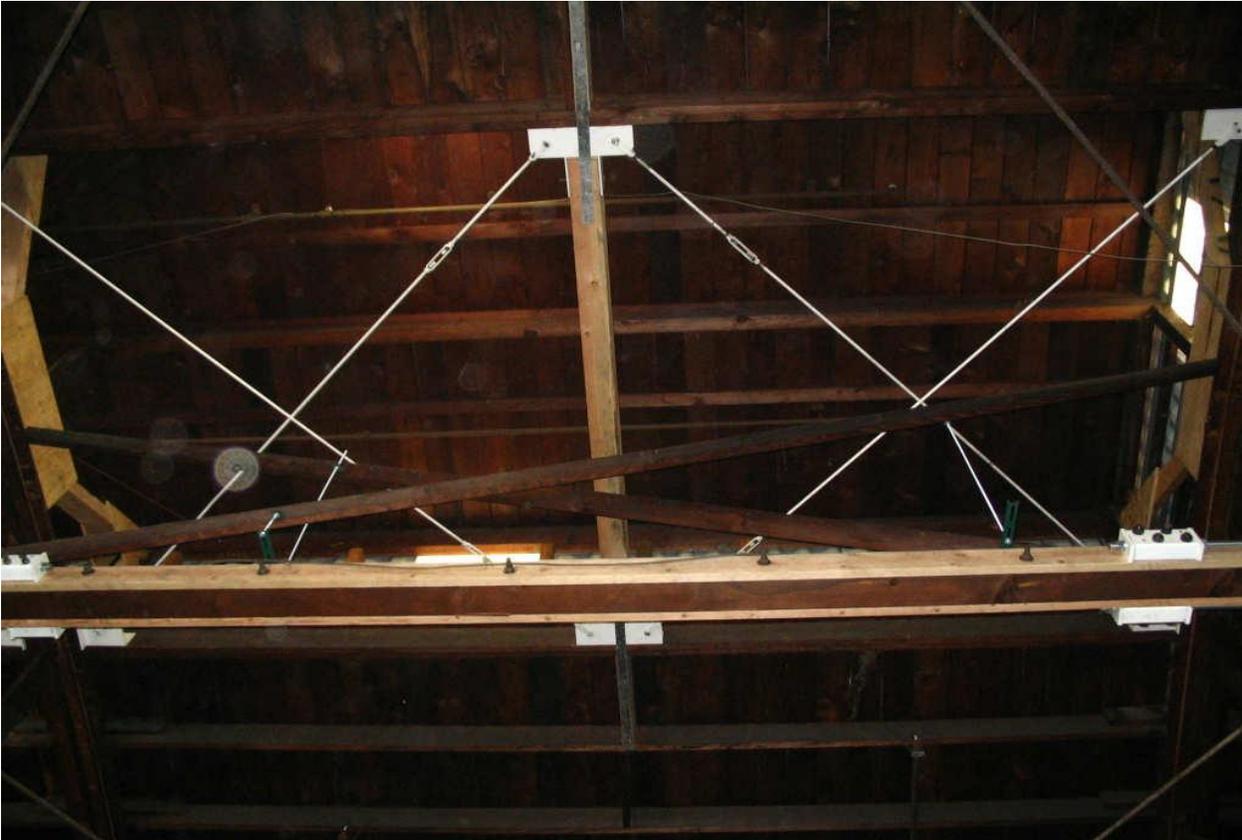
> **Cord plates** are used if the walls are weak and need to be stronger in plane.



> Exterior steel is used to strengthen walls that are weak.



> **Truss repair** can be part of a seismic retrofit on a *barrel truss roof*.



> **Venting the roofing system foil** can greatly reduce the chance of condensation problems continuing or starting. Cutting back the foil approximately 3 inches from the ends lets the cavity breathe. (If done in conjunction with a seismic retrofit work, costs for this work can be significantly reduced).



(Notice the white corrosion formed on the sub purlin hanger)



(Notice the rusting of the purlin hanger from condensation)

> **Equipment anchoring** secures and protects valuable production assets.

Four-way sway brace cables for fire sprinkler piping.



Tank strapping to the concrete floor with epoxy anchors



Tube steel frame bolted to the concrete floor for tank containment.



Four-way sway bracing for piping systems.



Protecting the operations of a business along with the building by equipment anchoring.



> **Soft story retrofitting** is done when a second story is the major structure, like an apartment complex built atop ground-level parking. Retrofitting includes installing new shear walls and footings, replacing existing support columns, continuity straps, stucco and paint.



