Building 6

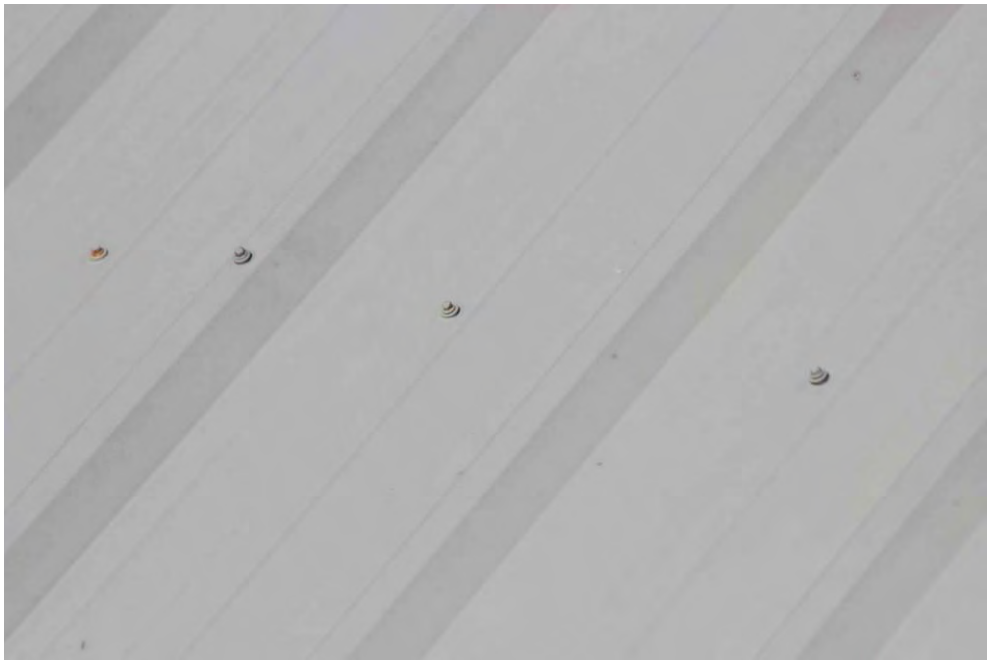
Building 5

Building 5

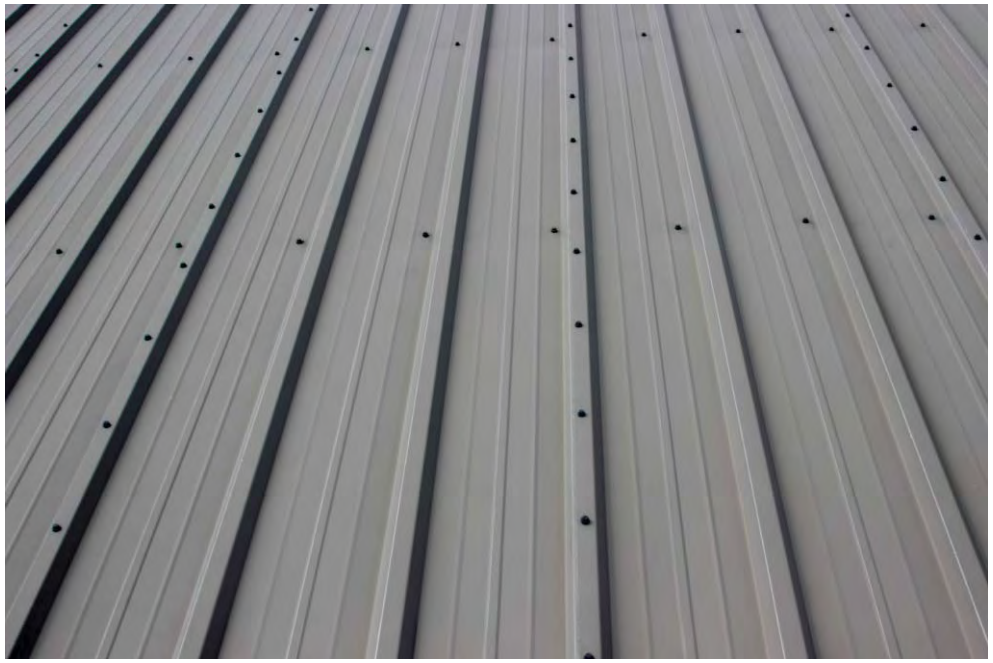
Building 4

Building 3

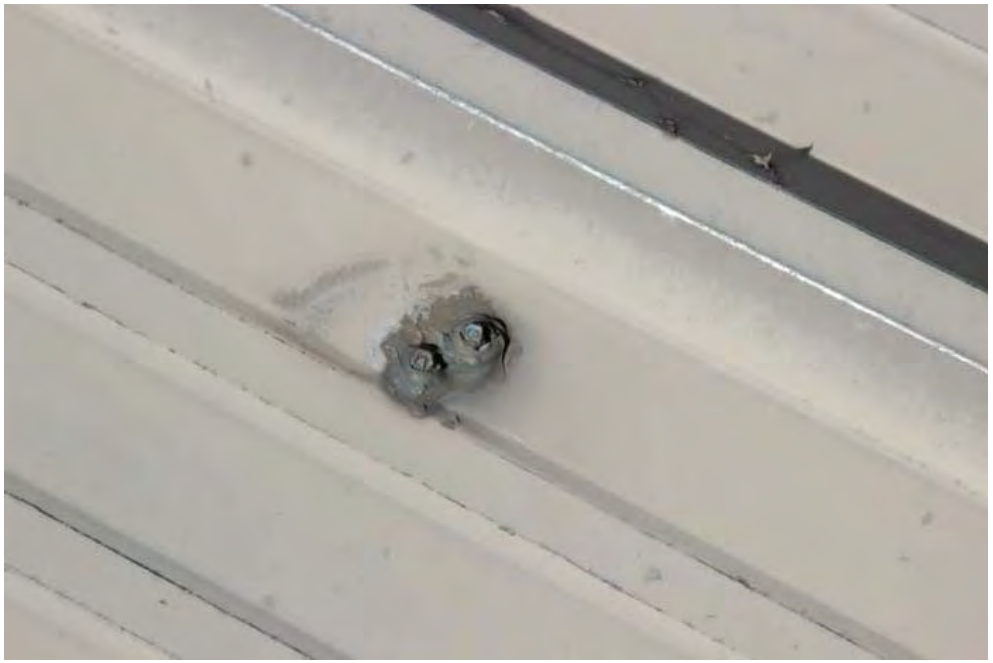
Building 1

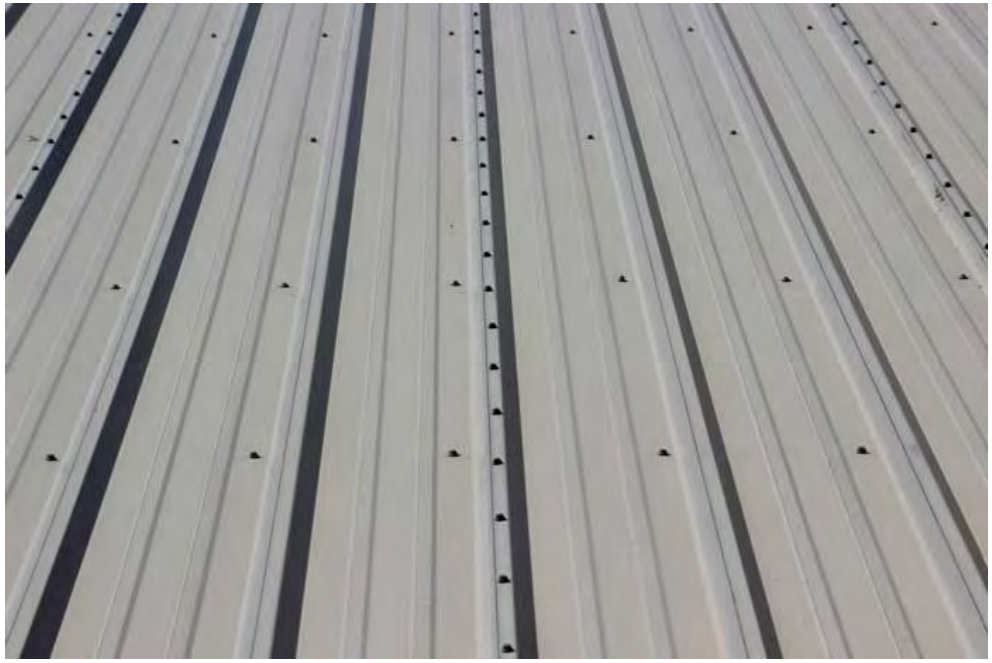


Building 14



Building 13

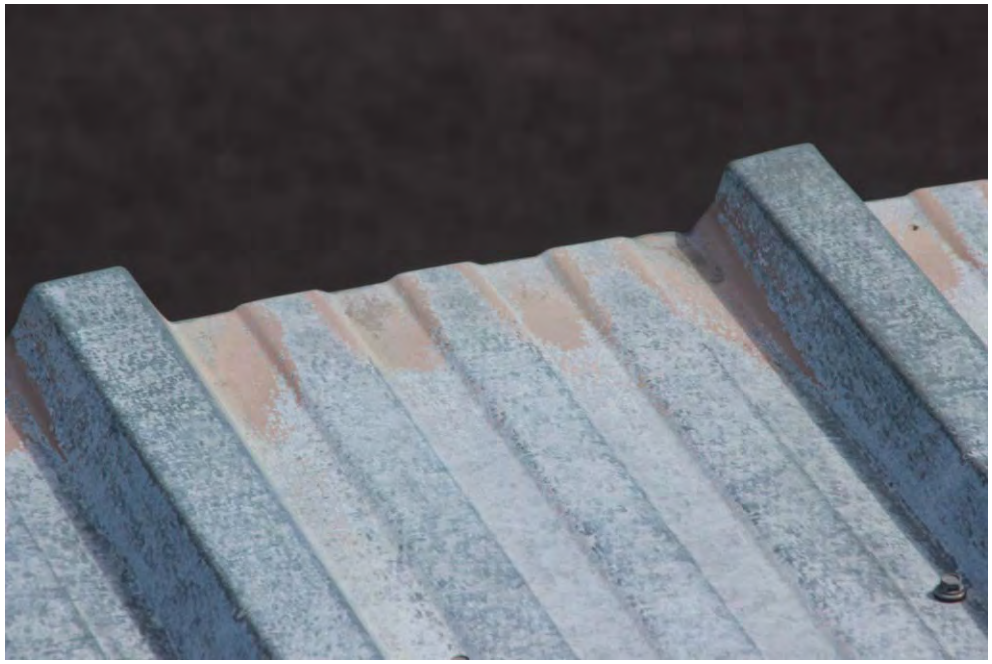




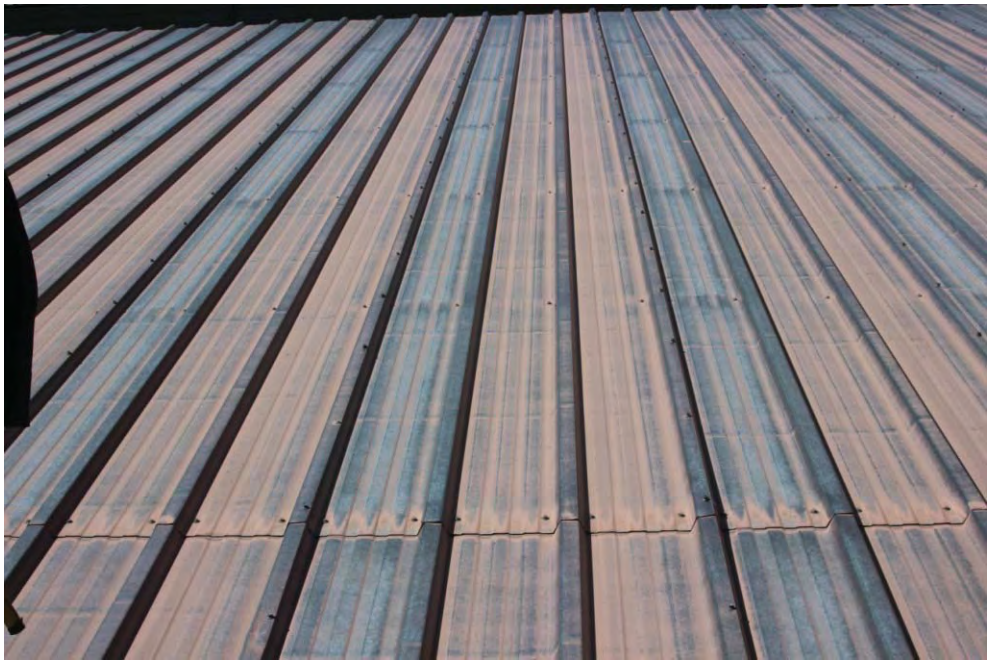
Building 12

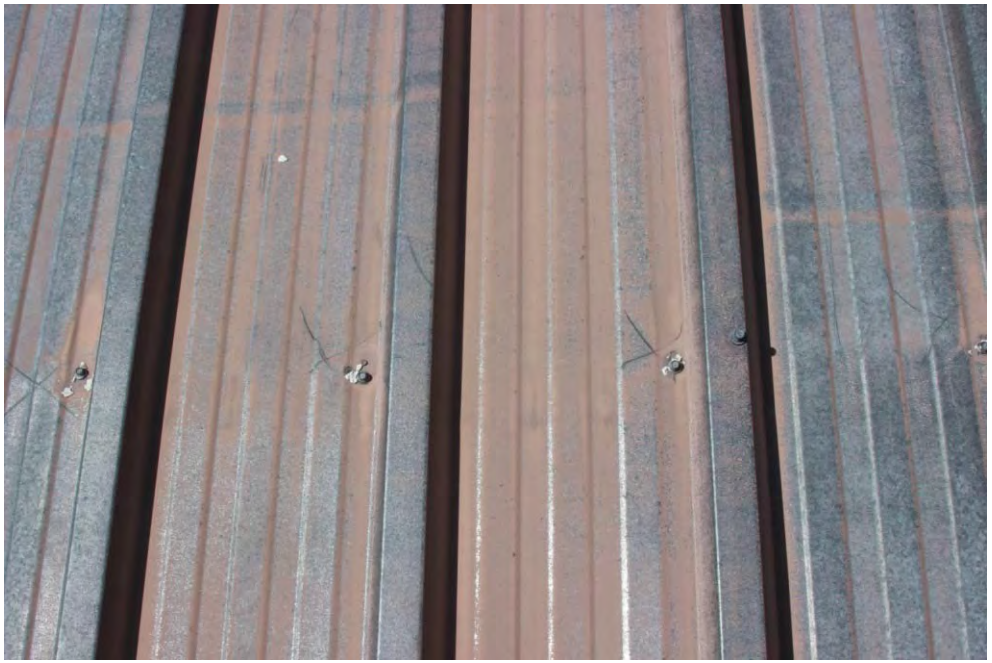
Building 12

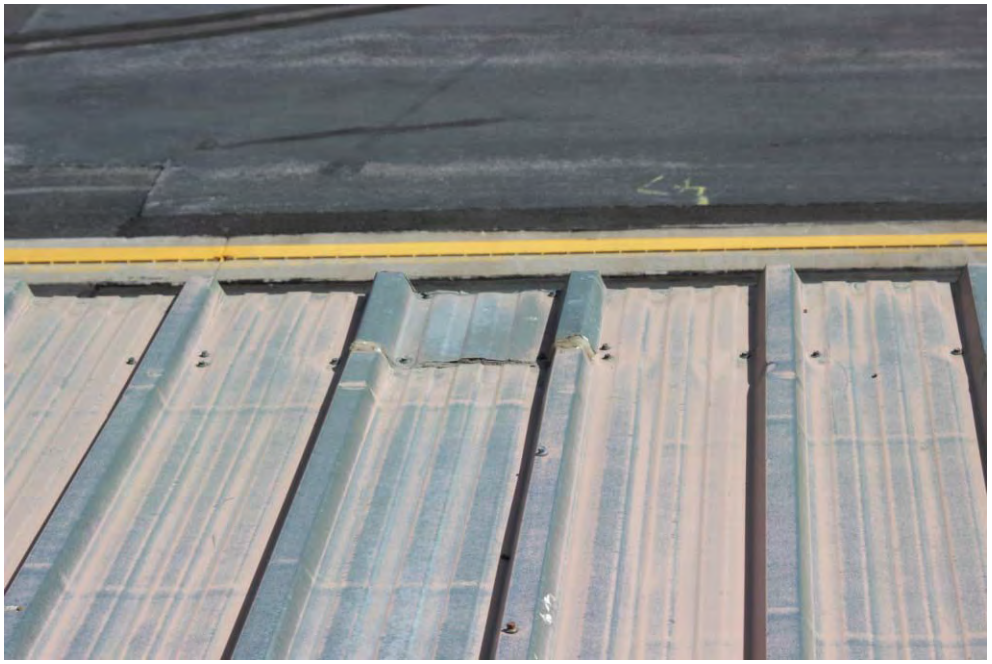
Building 11



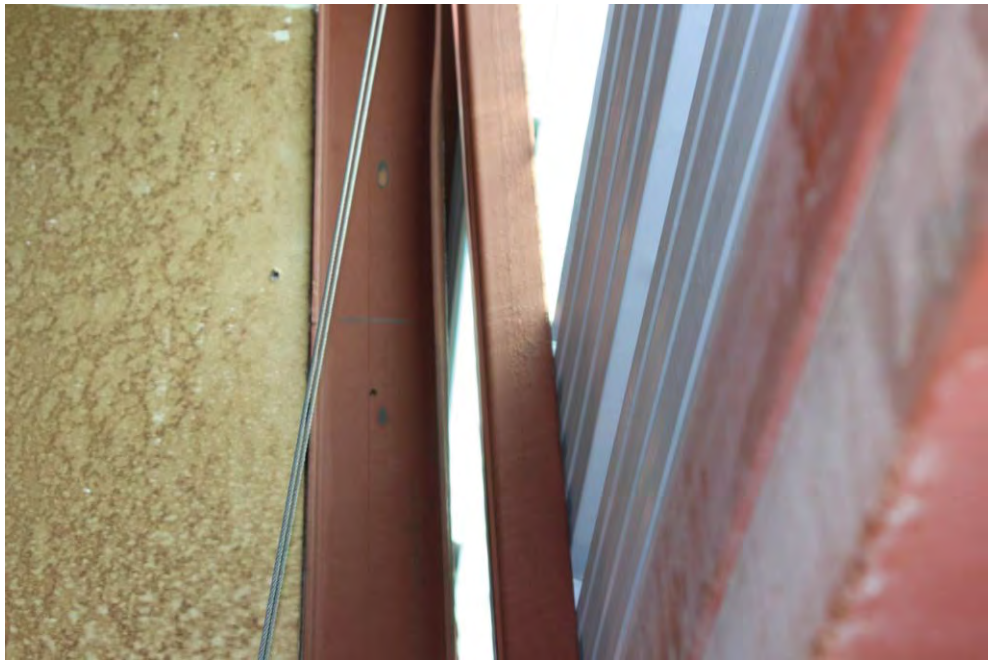
Building 10







Building 9

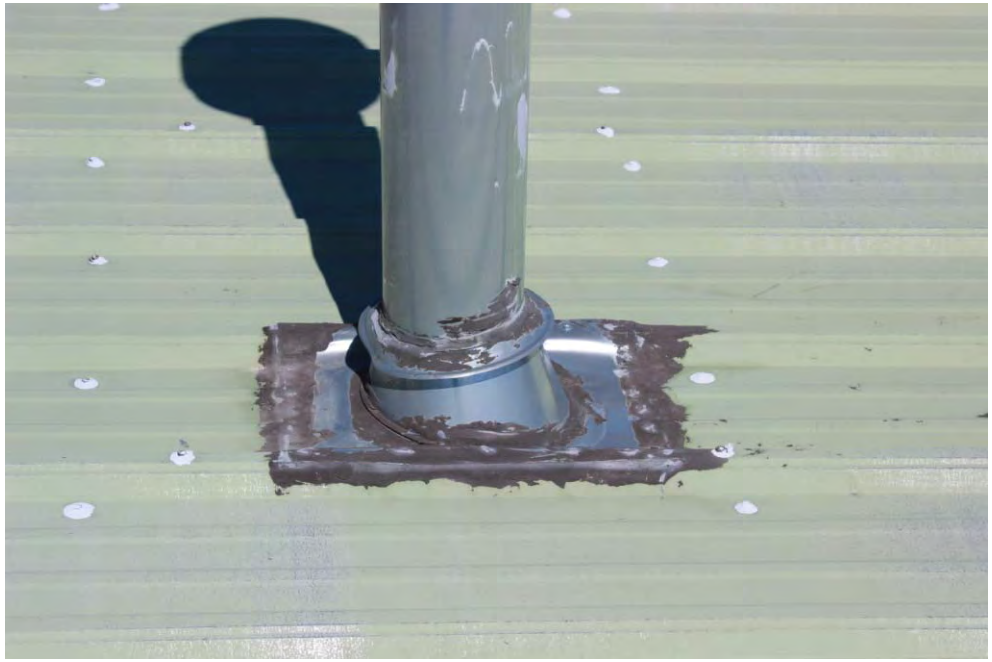


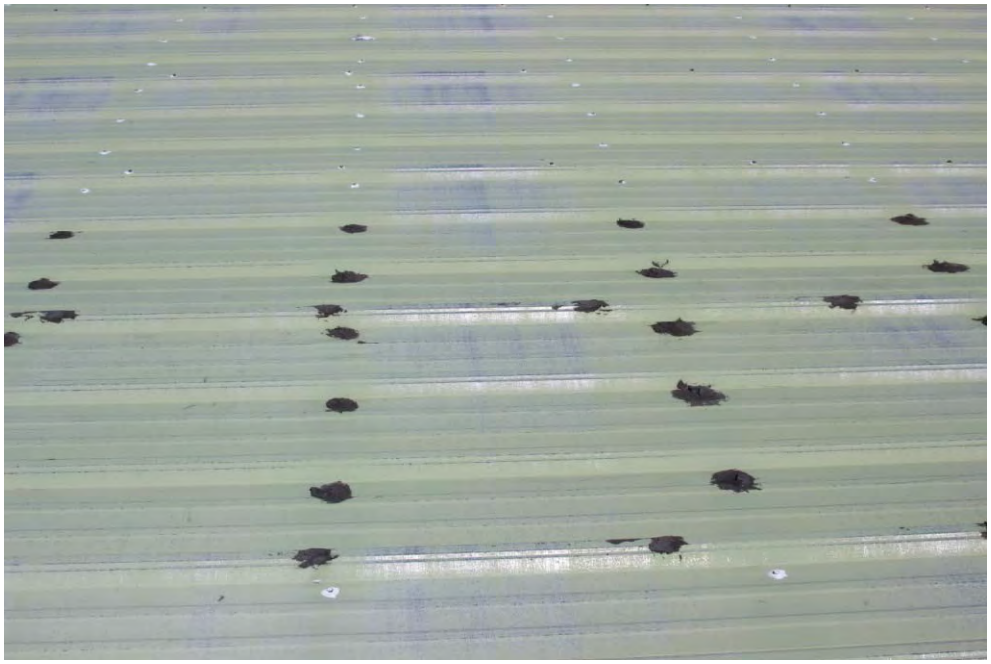
Building 9

Building 8

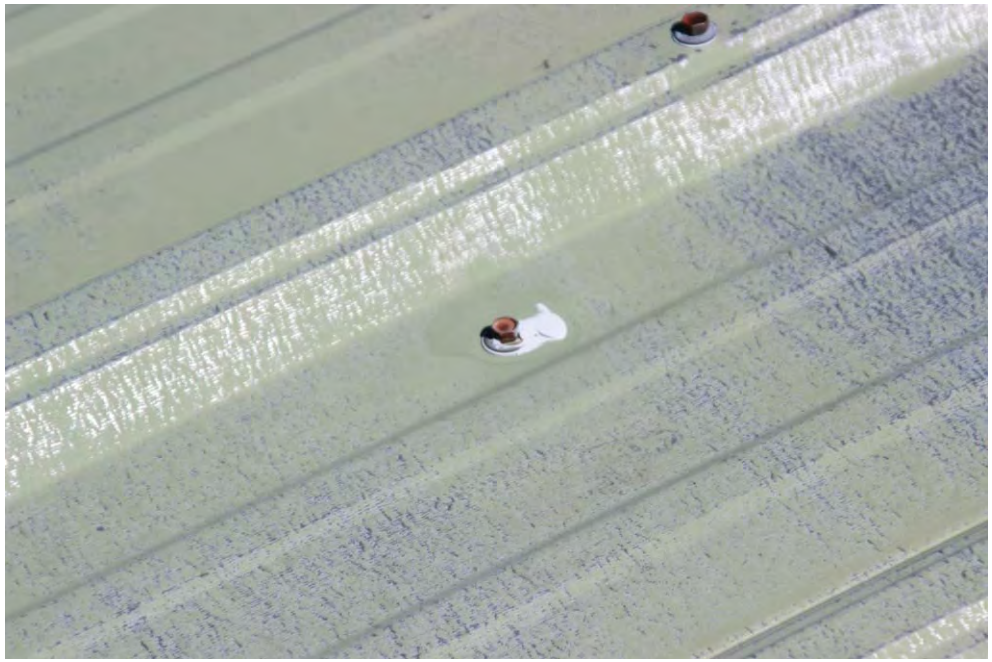
Building 7

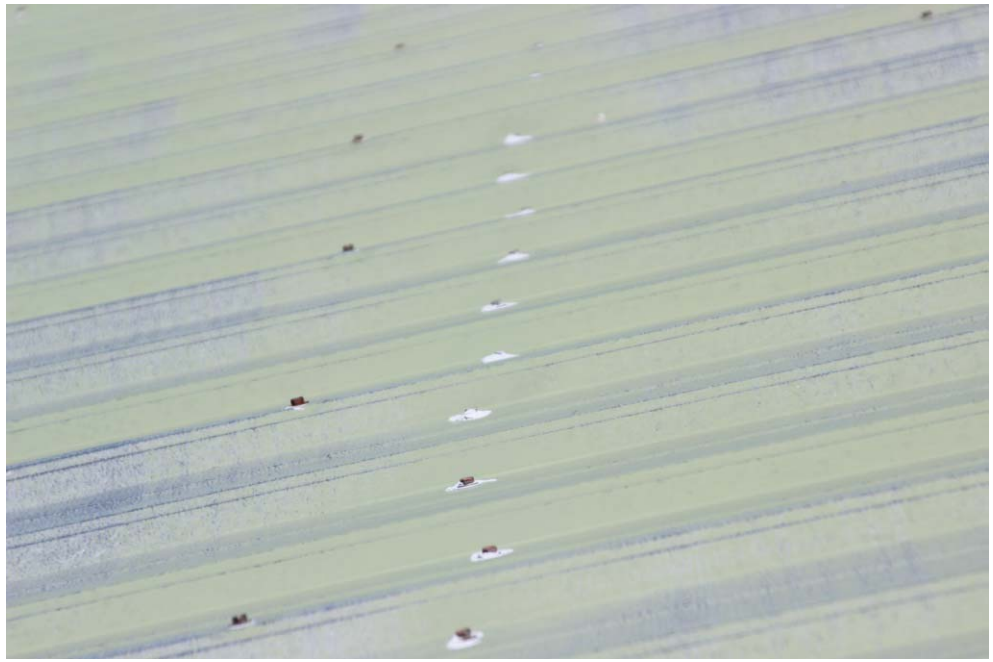
Building 7

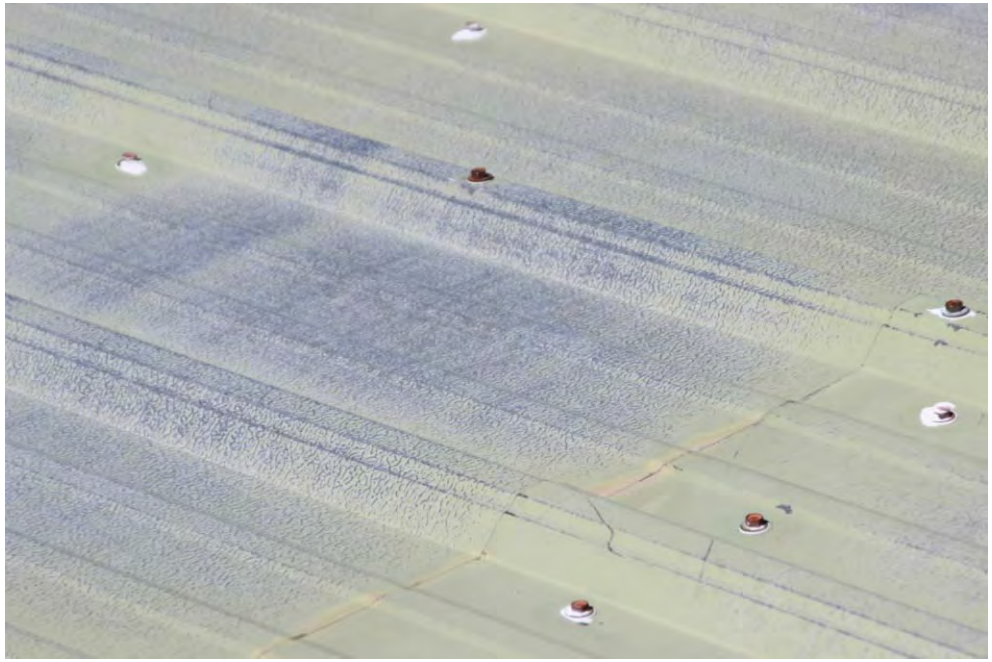




Building 7

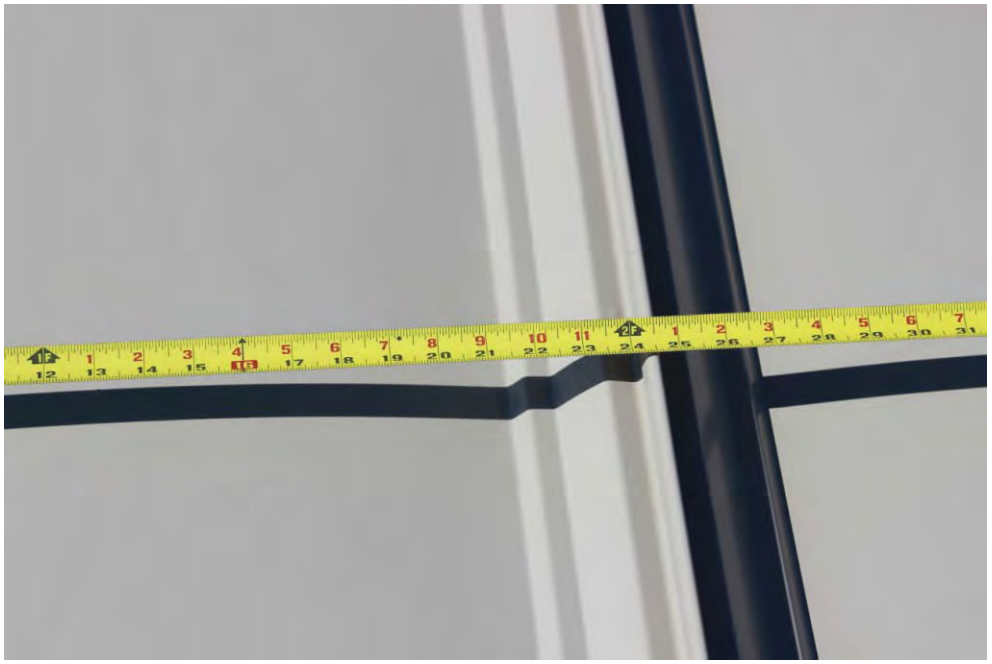




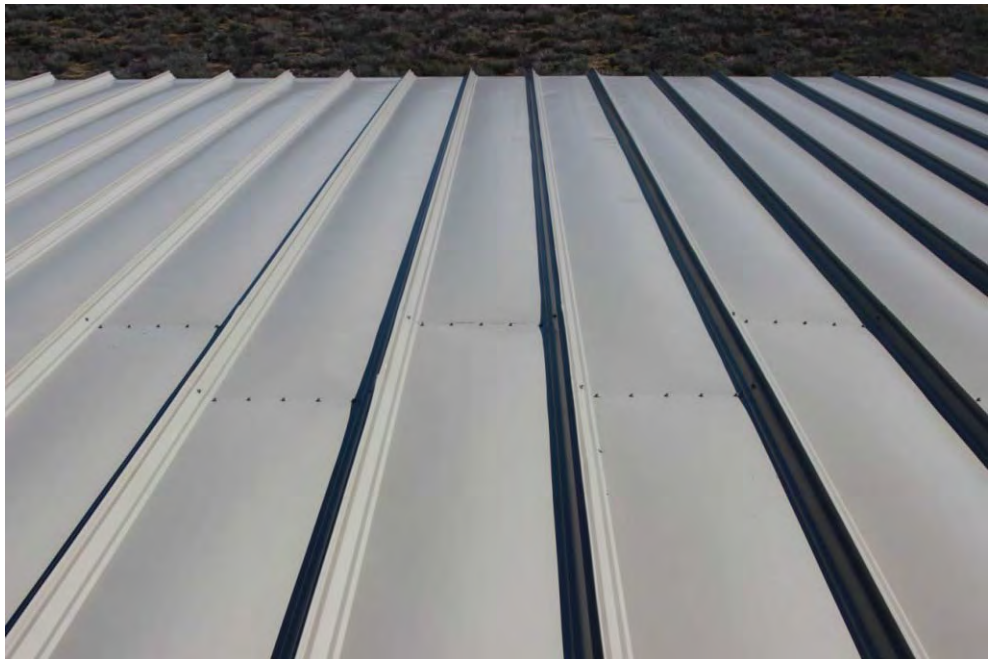


Building 19

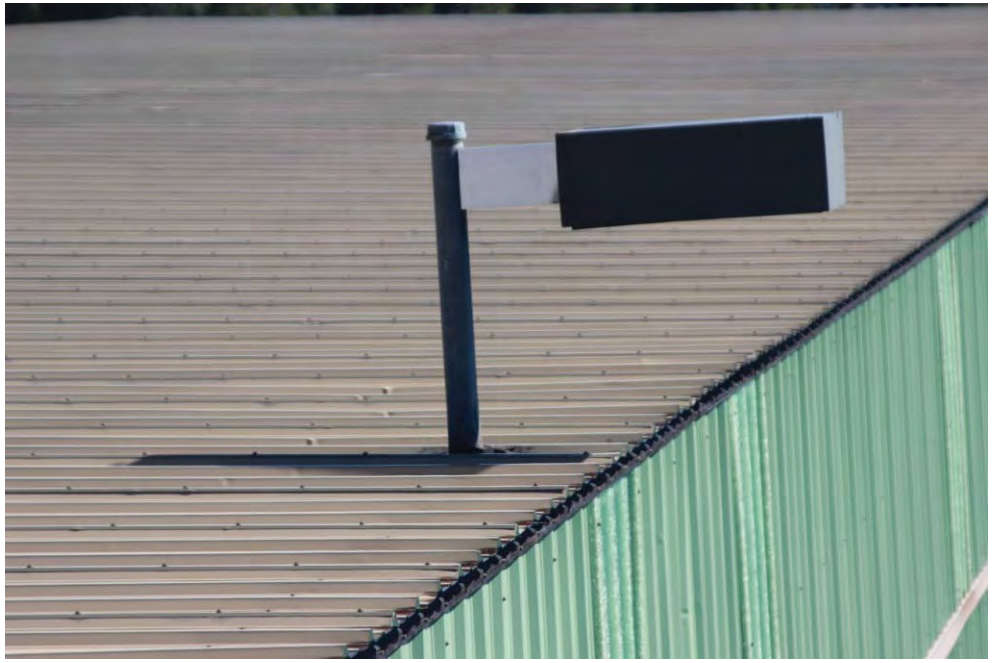
Building 19



Building 18

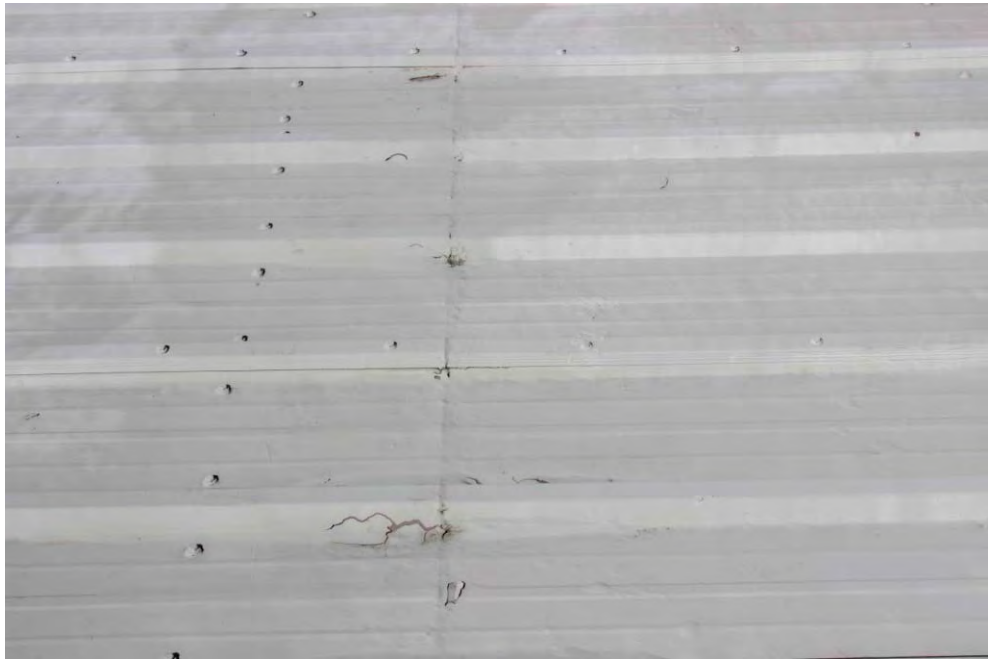


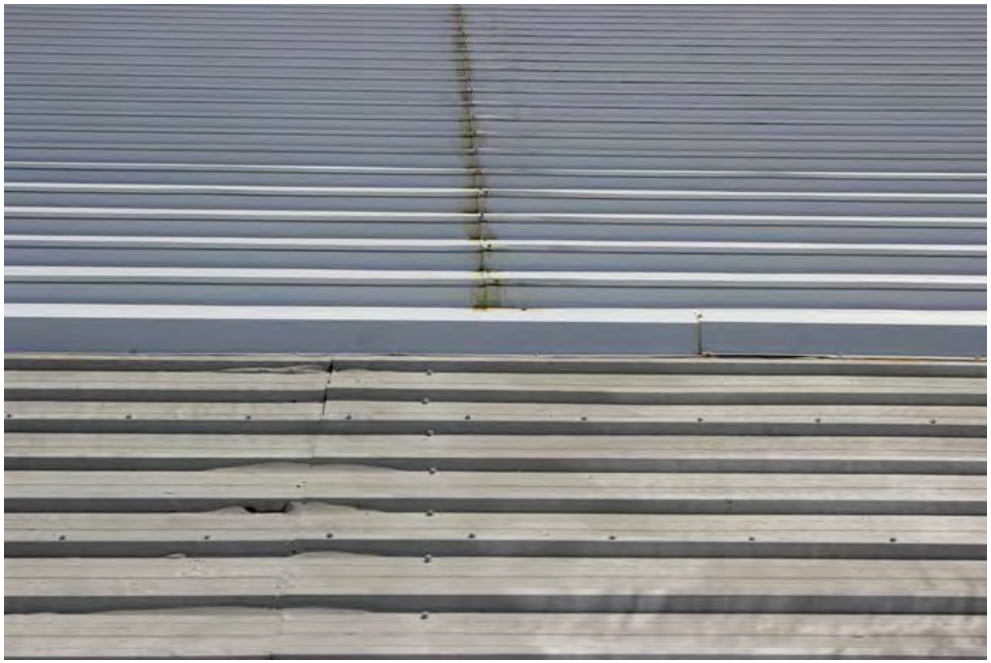
Building 17



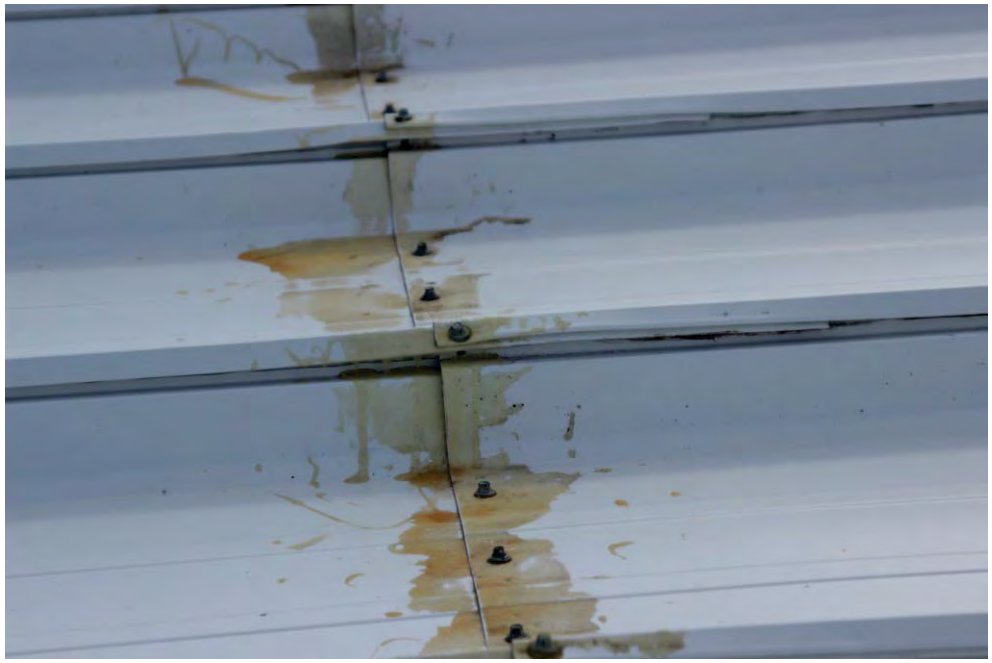
Building 16

Building 15

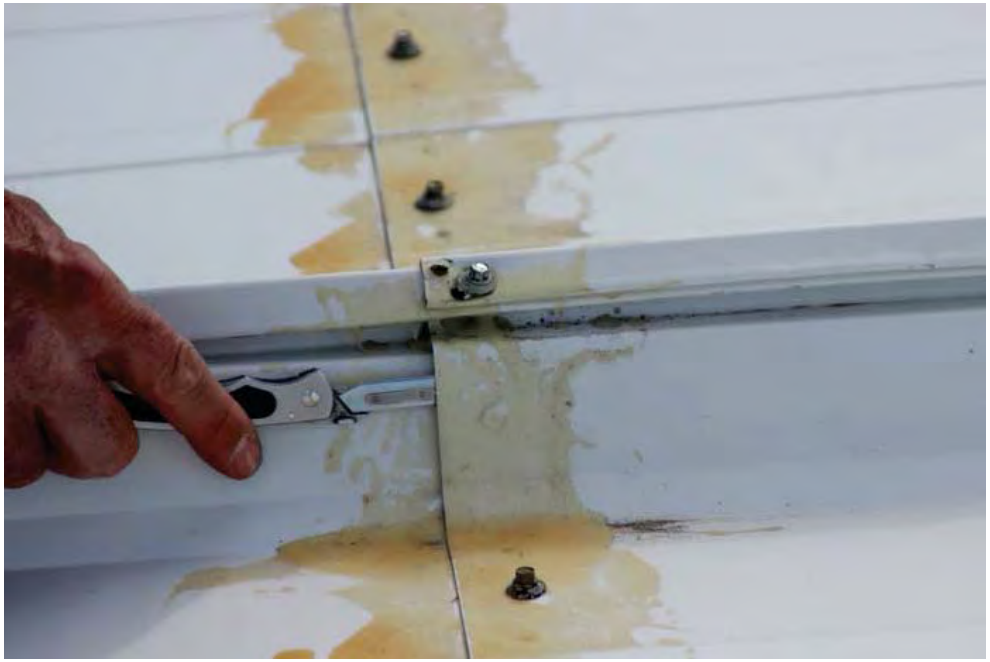




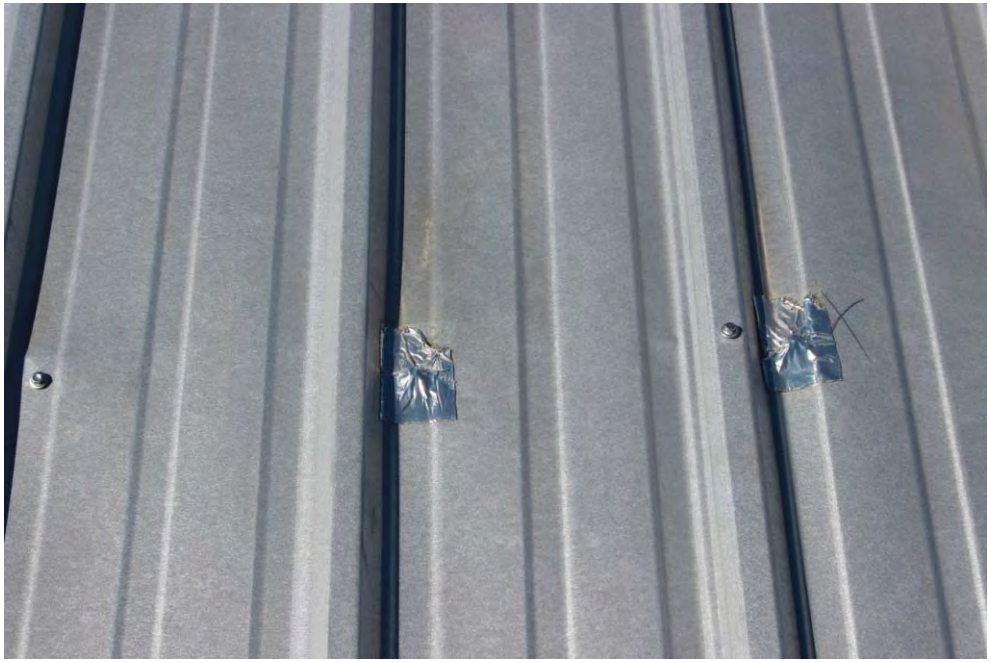
Building 15



Building 15



Building 25



Building 24

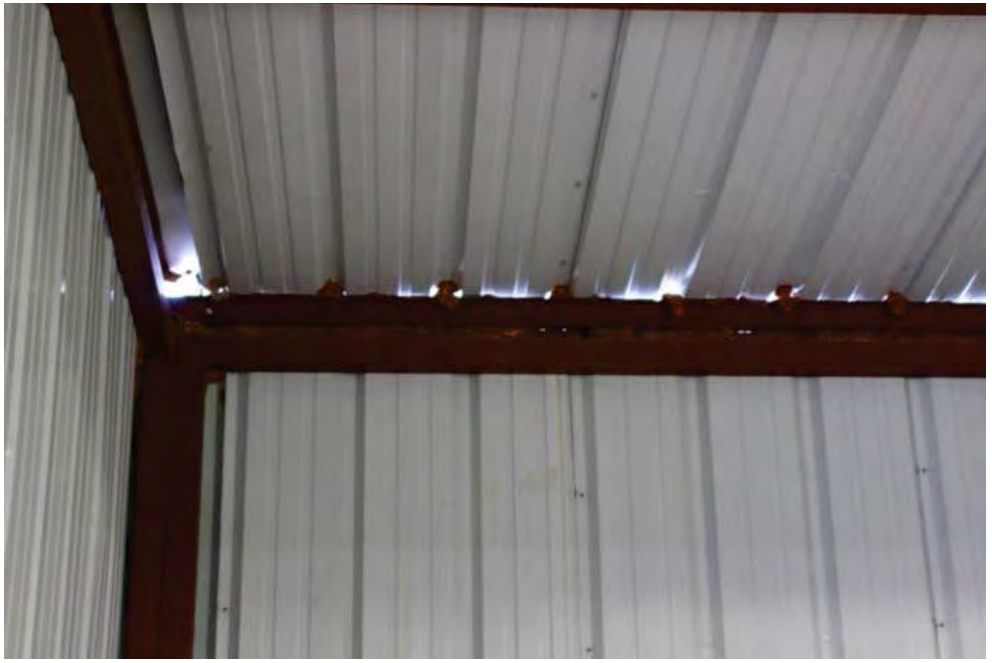
Building 23

Building 22

Building 21

Building 21

Building 20



Building 20

GABBART & WOODS
STRUCTURAL ENGINEERS
STUDIO 1 VANCE GABBART principal

May 1, 2013

Bill Quesnel, P.E.
Acumen Engineering
PO Box 3497
Truckee, CA 96160

Re: Truckee Tahoe Regional Airport
Facilities Maintenance Plan

Dear Bill,

The following is our preliminary report concerning the review of the 25 existing structures and recommendations for a short term (1-5 years) maintenance plan. A long term (5-20 years) maintenance plan was requested, but in this case, if the 5 year plan is followed, there will be minimal maintenance required for the following 15 years, thus we have not provided long term maintenance plan. We have numbered the buildings according to site map provided by your office.

OVERVIEW

There are four consistent issues associated with the buildings. The majority of the concerns are with the maintenance of the roof coverings and they will take up 95% of the discussion in this report. The other issues are the damage to the wall panels on the north side of the buildings due to snow shedding from the roof, bending of some of the steel columns flange supports from the large bi-folding hangar doors and thermal expansion of the buildings longer than 300 ft. We will address the minor issues first so they don't become lost in the long discussion about roof panel maintenance.

BUILDING THERMAL EXPANSIONS

Thermal expansion of structural steel is a well know and easily quantifiable value. The general rule of thumb for exposed structural steel, such as what we have for all the metal hangar buildings, is to allow for thermal expansions by means of a built in expansion joint for buildings longer than 300 ft. Most of the hangers in the southeast corner of the property noted as Buildings 8 through 15 are longer than 300 ft. and have reported issues with out of plumbness. The thermal expansion is linear and a function of three variables, i.e., the coefficient of expansion of the steel, the temperature differential and the length of the steel structure. Assuming a temperature differential of 50 degrees and a building length of 600 ft., the thermal expansion would be in the range of 2.3". The temperature at the time of construction and the amount of fixity at various locations in the building will all impact the final number.

The negative results of this thermal expansion are the roof panels expanding and contracting and elongating the holes where the screws attach the roof panels to the supporting structure and the overall operation of the large bi-fold doors once the structure is significantly out of plumb. Unless the owner wants to modify the existing buildings by adding and expansion joint near the middle, there is really nothing that can be done about the thermal expansion as it is an inherent physical property of the steel.

WALL PANEL DAMAGE DUE TO SLIDING SNOW

The wall panels on the north side of some of the buildings suffer damage as the snow sheds off the roof and falls to the ground. The snow rebounds against the wall panels or lateral pressure is exerted on the wall panels due the snow build up and causes considerable deformation of the panels. Buildings 5, 15, 18 and 19 have the most noticeable damage. Additional horizontal girts have been added to Buildings 18 and 19. The damage to the wall panels at building 5 is quite severe and needs to be replaced at the lower sections. Adding girts help the wall panels to resist deformation but it still allows them to be crimped. A more positive long term solution would be to provide a protective barrier of plate steel for the lower 5 ft. of the wall. This plate steel could be supported by the existing girts or an independent support system could be installed just behind the plate steel. Attached is a concept drawing, SK-1, showing an independently supported plate system.

COLUMN FLANGE BENDING AT BI-FOLD DOORS

Buildings 8 through 14 and buildings 16 and 17 have bent column flanges in some of the units at the bi-fold doors where the rollers run up and down the columns flanges when the doors are opened. There are approximately 40 units where some flange bending has been noted. A chart is attached which catalogues which units and how much the flanges appear to be bent out of plumb. Photos of the bent flanges appear in building 9 photos. This type of bending is typical for all the units noted. Most of the flange bending is located where the lower roller bears against the column flange when the door is in the open position. The top and bottom rollers create a force couple which resists the weight of the door as it is raised. As the distance between the rollers decrease, (i.e. the door is raised) the force increases thus the maximum amount of force the roller exerts on the flanges is when the door is in the raised position. This is where we see nearly all of the flange bending. It is clear the flanges are not thick enough to resist this force level. These buildings have been designed for 40 psf snow load and thus the columns are lighter sections than some of the buildings on the west side of the airport that were designed for heavier snow loads. There was no noticeable bending of the flanges at buildings 18 and 19 where the flanges are thicker. Another possible cause of flange bending in the east hangers is the thermal expansion of these longer buildings. This would cause the columns to be more out of plumb and the door rollers closer to the outside edge of the flanges. The solution is to increase the thickness of the flange by adding addition material. Adding a small angle on the inside of the column is one solution and that has already been done in Hanger B11. Another option would be to install a thicker plate full height along the outside column

flange. Detail SK-2, attached to this report, shows a schematic section of the two repair options. This should solve the problem of flange bending.

ROOF MAINTENANCE

The remainder of the report will be a discussion of anticipated required maintenance of the existing roofs and discussion of some of the problems seen with previous installations. A chart at the end of the report will summarize the recommended maintenance. Annual maintenance for all metal roofs involves checking for loose screws, tightening or replacing stripped screws with oversized screws or screws where the washer has disintegrated. This will not be noted redundantly for each building. The year the building was thought to be constructed is noted next to each building in order to facilitate the discussion.

Building 1 – (West Side Modular) - 1991. This is a wood framed building with metal roof panels screwed to the wood framing. Many of the screws are backing out.

5 Year Maintenance: Replace all wood screws with shielded wood grip screws. Maintain the wood exterior siding with timely application of a quality exterior paint.

Building 2 – (Accounting Modular) - 2003. This building has been removed from use.

Building 3 – (Maintenance Building) - 1998. The screws on this building have already been topped. Ridge screws appear to be over tightened and are not topped. The flashing on the roof penetrations dam water on the high side such that it does not drain. An ineffective sealant (black jack) has been used and its use should be discontinued.

5 Year Maintenance: Top ridge screws, extend roof penetrations flashing coatings up two purlins so that water ponds on coating and not flashing. Redo all black jack sealants with an effective coating system.

Building 4 – (Hangar 2) - 1966. This is a metal building with a lower section on the south side of wood framing. The condition of the main and low roof looks good.

5 Year Maintenance: Replace screws on lower roof.

Building 5 – (Hangar 1) - 1963. This is the oldest metal building at the airport. There is a lower section of metal panels on a wood roof on the west side of the building. The interior of the building is coated with a fibrous material probably for insulation purposes. It should be tested for asbestos or other deleterious substances as it is exposed to the interior finish space. The roof panels on this

building are near the end of their useful life. There are numerous patches. It has already been coated and the screws topped.

5 Year Maintenance: Remove and replace existing roof panels as soon as possible.

Building 6 – (Garage) - 1991. There is a gash in the rear southwest corner of the building corner trim. There is a big dented panel in the front northeast corner from some kind of impact. The roof screws are an old style of screw with neoprene washers. They will probably leak within 5 years.

5 Year maintenance: Replace all screws with shielded screws. Repair the southwest rear corner trim and replace the northeast lower section of wall panel that has been severely dented.

Building 7 – (Warehouse) - 1974. – This building is full of unbraced ceiling high shelving full of materials. There is a modular trailer supported on jacks as well. Current codes require all shelving above 4 ft. in height to be braced for seismic forces. The modular trailers need seismic restraint as well. The roof panels are in reasonable condition but the screws are an old style screw that has already been caulked. The caulking is ineffective for the long term. The screws not caulked show evidence of being over tightened or the washer has disintegrated.

5 Year Maintenance: Replace all existing screws with shielded screws. An alternative longer term repair would be to coat the entire roof with a coating system.

Building 8 – (Hangar A) - 1984. This building has a high and low roof section. The enamel coating on the roof panels is still in reasonable condition. Old style screws were used with this roof and some appear to be over tightened with washer disintegration. The light pole roof penetrations were caulked with black jack mastic which is ineffective for the long term. This situation occurs at all east side hangers A thru H.

5 Year Maintenance: Replace all screws with shielded screws. Flash light pole penetrations with Deck Tight rubber boots.

Building 9 – (Hangar B) - 1977. This is the 2nd oldest building in the east side row of hangars. The enamel coating has disintegrated leaving the bare aluminized metal exposed. There appears to be some rusting of the panels at the south end. Once the enamel coating has worn away, the roof panels still function, but will have a limited life span compared to a panel with the enamel still intact. Coating these panels will extend the life span however, at some point the coating manufacturer will not guaranteed the roof if the panels are too rusted. A coating manufacturer should evaluate these roof panels and make a recommendation

concerning how long they can be left intact before it is too late to apply a coating material.

5 Year Maintenance: Replace screws. Consider applying a coating system to extend the life of the panels. Flash all light pole penetrations with Deck Tight rubber boots.

Building 10 – (Hangar C) - 1976. This is the oldest building in the east side row of hangars. The enamel coating has disintegrated. See comments for building 9. This building has reported numerous leaks so many of the screws are no longer functioning.

5 year maintenance: Replace all screws. Consider applying a coating system to extend the life of the panels. Flash all light pole penetrations with Deck Tight rubber boots. There is a roof panel small patch at the north side of the building that needs to be redone.

Building 11 – (Hangar D) - 1981. – This building is noted on the site map as constructed in 1981 and thus is five years younger than Hangar C, however, the roof panels appear to be the oldest in the east side row of hangers. There is no enamel coating visible except at the eaves. Rust areas are quite visible on some of the panels. See comments for building 9. This roof is rapidly reaching a point where replacement may be the only long term option.

5 Year Maintenance: Replace all screws. Consider applying a coating system to extend the life of the panels. Flash all light pole penetrations with Deck Tight rubber boots.

Building 12 – (Hangar E) - 1981. The building is the same age as Building 11 and the roof panels are essentially in the same condition. The enamel coating is completely gone. The washers below the screws show numerous signs of disintegration. Rust spots are visible on the surface of the panels. See comments for Building 9 and 11. These panels are rapidly reaching a point where replacement may be the only long term option.

Additionally, the roof was struck by a small plane last summer and a large repair was installed at the damaged area. The repair was poorly done. New panels were only installed on the lower half of the building instead of from eave to ridge. There is a large gap showing at the seam between the new and existing panels.

5 Year Maintenance: Replace all screws. Consider applying a coating system to extend the life of the panels. Flash all light pole penetrations with Deck Tight rubber boots. Rework the large patch to eliminate the gap between the existing and new panels.

Building 13 – (Hangar F) - 1987. This roof is in much better condition that Building C and D with regards to the enamel finish. There is some evidence of rusting at the screw heads and some screws have been caulked. The edge trim at the north end of the building is loose in one small area.

5 Year Maintenance: Replace selected screws as they fix leaks.

Building 14 – (Hangar G) - 1988. This roof appears to be in good condition and has been installed with newer type shielded screws.

5 Year maintenance: Replace selected screws as they fix leaks.

Building 15 – (Hangar H) - 1991. This building was constructed in two sections. The older roof has been coated however; the coating has failed due to improper installation. It is questionable whether a coating manufacturer would guarantee a new coating over the top of this existing coating.

The newer roof appears to be installed with two upper ridge panels as opposed to a lower eave panel and upper ridge panel. The lap where the two panels meet is improperly installed. This building has had leak problems and it's not hard to see why based on the way the panels were originally installed.

5 Year Maintenance: Rework all laps between the upper and lower panels of the newer roof. Consider adding a new roof above the older section.

Building 16 – (Hangar J) – 1970. The roof panel construction is atypical for metal buildings. The roof panels have been coated with some type of unrecognizable coating. The roof screws have a pointed end protruding above the head and have been placed the high section of the panel ridge in lieu of the lower flat section of the panel. However, no roof leaks have been reported in this building. Despite its unusual construction we recommend leaving this roof alone until it starts to develop problems as its performance has been satisfactory. A coating manufacturer should evaluate whether an additional coating could be applied over the existing coating.

5 Year Maintenance: If problems develop, consider coating the existing roof if a manufacturer thinks it would adhere to the existing panels. If not, replace roof.

Building 17 – (Hangar K) – 1981. This roof is in poor condition with visible rust areas in the panels and at nearly all screw locations. Most of neoprene washers have disintegrated. A coating manufacturer should evaluate this roof to determine if coating is a possibility. It appears questionable.

5 Year Maintenance: Apply coating within two years if manufacturer will guarantee. If not, replace roof within 5 years.

Building 18 – (Hangar L) – 2005. This roof is in good condition.

5 Year Maintenance: Check fasteners within 5 years.

Building 19 – (Hangar M) – 2005. This building has serious leak problems due to the manner in which the roof was sloped in the long axis of the building. Snow and ice accumulate at the eave and then back up for more than 100 ft. This is a design flaw. Also the roof panels have been stretched during erection in the short direction and measure +/- 2'-1 ½" instead of the normal 2'-0". This is causing the standing seams to leak when ice dams and standing water occur. Ineffective mastic has been used to try and seal some of the leaks.

5 Year Maintenance: Recover roof with a PVC membrane material.

Building 20 – (Phoenix Hangar) – 1985. The roof panels appear worn and dented. Either skylights or metal panels have been replaced with a fiberglass translucent panel. Daylight is visible all along the inside perimeter of the roof/wall junction. Screws appear to be loose in several locations.

5 Year Maintenance: Replace roof and provide weather tight seal between roof/wall junctions.

Building 21 - (EAA Building) – 1963. This is a wood framed building with a structural metal deck. Some type of foam roof coating has been applied to the roof surface. There is probably rigid insulation on top of the roof deck. A coating manufacturer should evaluate this roof to determine if a new coating could be applied. The exterior wood siding on this building has not been maintained and needs an immediate application of a good quality exterior paint.

5 Year Maintenance: Recoat roof if possible. Paint exterior walls as needed.

Building 22 – (Generator Building) -1990. This building has an upper and lower roof. The lower roof is a standing seam metal roof and the upper roof a typical roof panel. Both appear to be in good condition. The exterior grade at the south and east side of the building has gradually been raised where it is above the finished floor and directly against the metal panels.

5 Year maintenance: Check for loose screws. Remove soil against the metal wall panels.

Building 23 – (Auto Rental Building) – 1978. This is a wood framed building with composition roofing. The hip rafters extend past the building and are exposed to the weather with a metal cap on the top edge. The paint on the exposed eaves is failing and the wood is deteriorating.

5 Year Maintenance: Coat exposed hip beam eaves with an appropriate weather coating.

Building 24 – (Self-Serve Tank) – 1999. This is a large fuel tank. The tank appears to be in good condition except for some minor rusting at the feet attached to a concrete pad.

5 Year Maintenance: Sandblast and paint the feet with an appropriate rust inhibitor coating as required.

Building 25 – (Fuel Farm Cover) – 1996. This is an open building with just a roof above the fuel tanks. The roof appears to be in good condition. Some type of foil faced adhesive patch has been applied in numerous locations. The longevity of this patch is questionable. There is evidence of rusting in the leading edge purlins at both the upper and lower eaves. This is simply due to moisture collecting on these purlins as they are exposed to weather.

5 Year Maintenance: Sand blast and repaint purlins as necessary. Review efficacy of metallic patches.

The following spreadsheet summarizes the 5 Year Maintenance Plan. We have recommended replacing or recoating most of the roof structures within five years. If these recommendations are followed there should be minimum maintenance other than annual maintenance noted at the beginning of the discussion required for the following 5 to 20 years.

CONCLUSION

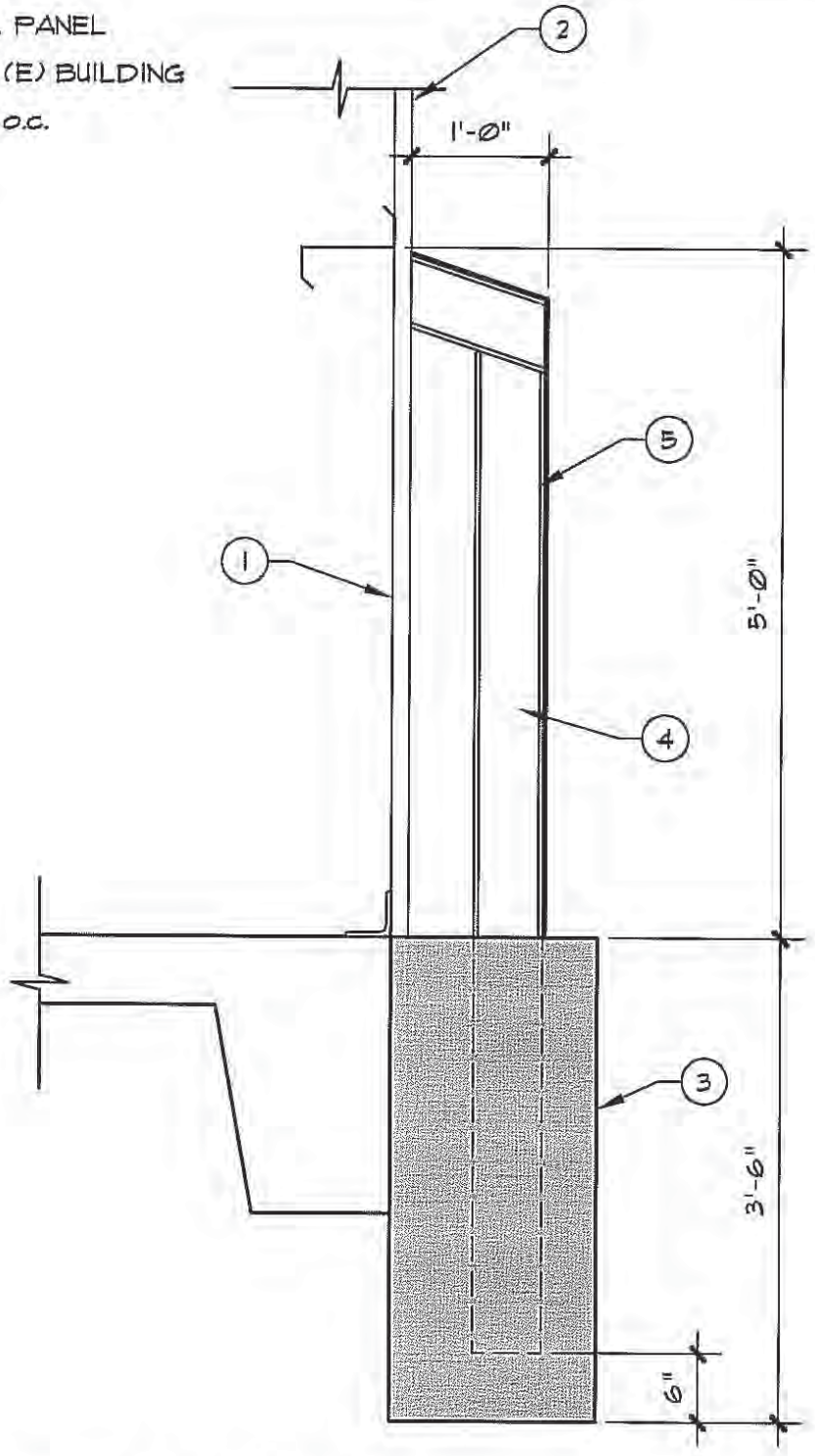
Many of the problems noted in this report are a result of poor installation technique and a lack of understanding of metal roof systems. In the future, we recommend all work be perform by licensed authorize metal building contractors, an adequate specification be provided these contractors prior to bidding and the quality control agency review their completed work prior to accepting the finished product.

This concludes our report. Please contact us if we can answer any questions or be of further assistance.

Sincerely,
GABBART & WOODS
STRUCTURAL ENGINEERS

Vance Gabbart, PE, SE

1. (E) METAL WALL PANEL
2. NORTH SIDE OF (E) BUILDING
3. 18"ϕ PIER @ 48" o.c.
4. W6 @ 48" o.c.
5. 1/4"℄ CONT.



FALLING SNOW PROTECTION

SCALE 3/4" = 1'-0"

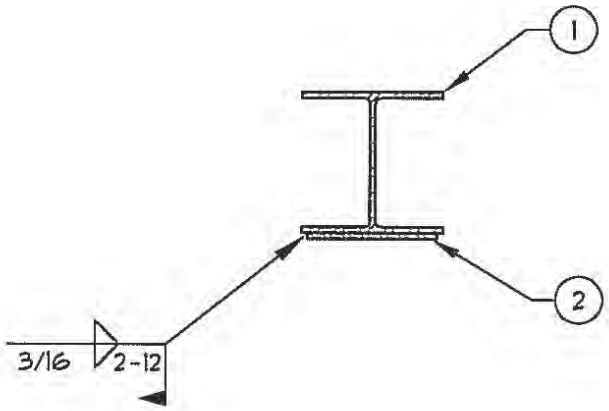
TRUCKEE TAHOE REGIONAL AIRPORT

SK-1

05/13/2013

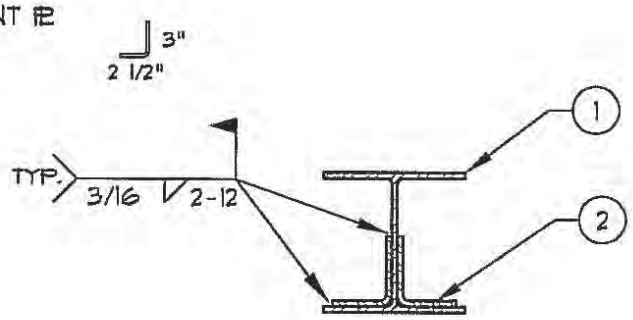
Studio 1 G&W STRUCTURAL ENGINEERS

(1) — (E) COLUMN
(2) — (N) 1/4" PL



DETAIL A

(1) — (E) COLUMN
(2) — (N) 1/4" BENT PL



DETAIL B

COLUMN FLANGE STRENGTHENING

SCALE 1 1/2" = 1'-0"

05/13/2013	TRUCKEE TAHOE REGIONAL AIRPORT	SK-2

Studio 1 C&W STRUCTURAL ENGINEERS

5 Year Maintenance Plan

Action	Building																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Tighten and/or replace selected screws													X	X				X							
Replace all screws with shielded screws	X					X	X	X																	
Replace screws on lower roof				X																					
Coat entire roof with coating system									X	X	X	X			X										
Consider coating system as alternate to replacing screws																	X				X				
Replace all roof panels					X												X			X					
Rework existing penetrations with coating system			X																						
Add PVC membrane above existing roof																			X						
Rework panel laps or repair areas										X		X			X										
Replace lower section of damaged wall panels					X	X																			
Repair corner trim						X											X								
Add steel proctective plates up to 5' on north side of building					X										X			X	X						
Sandblast and repaint rusting purlins																									X
Add seismic bracing to shelving and modular trailer							X																		
Add deck tight rubber boots to light pole penetrations								X	X	X	X	X	X	X		X	X								
Repaint Exterior Wood Siding	X																				X				
Sandblast and paint with rust inhibitor																								X	
Evaluate metallic patches																									X
Weather proof exposed wood beams																							X		
Straighten and strengthen bent column flanges								X	X	X	X	X	X	X	X	X	X								
Lower exterior grade below metal wall panels																						X			

Hangers with Bent Column Flanges

	Flange Deformation				
Unit #	1/4"	1/2"	5/8"	3/4"	1"
A17		X			
B1		X			
B5	X				
B13					X
B17	X				
B23		X			
C1					X
C13					X
D3				X	
D7		X			
D11		X			
D17		X			
E1		X			
E7	X				
E11		X			
E13	X				
E17	X				
E21	X				
E23		X			
F1		X			
F3	X				
F7			X		
F13	X				
F15	X				
F17	X				
F19			X		
F21		X			
G3	X				
G5		X			
G17		X			
G21		X			
G23		X			
G25				X	
H1					X
H2					X
H3	X				
H4		X			
H5				X	
H6					X
H7					X
H8	X				
H9		X			
J5	X				
J7	X				
K3		X			