CITY OF DULUTH
PURCHASING DIVISION
Room 100 City Hall
411 West First Street
Duluth, Minnesota 55802-1199
218/730-5340
purchasing@duluthmn.gov

Addendum # 1
File # 17-4405
Roof Replacement – Snow Removal Equipment Bldg & Hangar 103

1. The sign in sheet from the pre-bid meeting held on July 25, 2017 is attached.
2. The engineer roof investigation report is attached. Page #9, labeled Duluth Airport Maintenance Garage, is the Snow Removal Equipment (SRE) building. On this building the Airport is seeking to replace the membrane, all required flashings and any other items necessary to comply with the manufacturer's warranty. Page #10, labeled Duluth Airport, is Hangar 103. Contrary to the verbal information provided at the pre-bid, the area labeled "not part of inspection" will **not** be included in this work. The Airport is seeking to replace the membrane, all required flashings and any other items necessary to comply with the manufacturer's warranty on this portion of roof as well.

Please acknowledge receipt of this Addendum by initialing and dating Addendum #1 below the bid form on the invitation for bids.

Posted: July 27, 2017

Ryan Welch DAA 218 [illegible] 7761

Carl Gilberg A.W. Kuettel 218-391-6880

Greg Hattenberger commercial Roofing

Caleb Blomdahl Jamar 218 389 6922

218-481-5821

Rose Misiewicz JANITOR 218-269-1916

ROOF INVESTIGATION

Prepared For: David Hess
General Adjuster
FM Global
505 Highway 169 N.
Suite 375
Plymouth, MN 55441

Insured: City of Duluth

Location: 4960 Airport Approach Road (Hanger 103)
4875 Malstrom Street (Maintenance Garage)
Duluth, MN

Claim #: 459332 (Hanger) & 459333 (Garage)

DOL: July 21, 2016

Prepared By:

Roofing Consultants Ltd.

Engineers, Architects & Building Envelope Specialists

Louis Juhlmann
REGISTERED ROOF CONSULTANT
RCI
0305
RCI, Inc.

DOUGLAS W. ERNST
REGISTERED PROFESSIONAL ENGINEER
No. 24990
STATE OF MINNESOTA

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Print Name: Douglas W. Ernst
Signature: Douglas Ernst
Date: 6-13-17 License # 24990

Milwaukee, WI
P.O. Box 1305
Waukesha, WI 53187
262-549-0802

Chicago, IL
P.O. Box 4458
Skokie, IL 60076
47-965-3366

St. Louis, MO
Plaza Executive Suites
17295 Chesterfield Airport Rd.
Suite 200
Chesterfield, MO 63005
636-530-3663

Minneapolis, MN
7760 France Avenue South
11th Floor
Bloomington, MN 55435
612-238-0802

Indianapolis, IN
9465 Counselors Row
Indianapolis, IN 46240
317-584-5440

Date: June 13, 2017

Roofing Consultants, Ltd.

Engineers, Architects & Building Envelope Specialists **1-800-549-0802**

June 13, 2017

David Hess
General Adjuster
FM Global
505 Highway 169 N, Ste 375
Plymouth, MN 55441

Roof Investigation

Insured:	City of Duluth, MN		**Claim #:**
Locations:	Building 1: 4875 Malstrom Street, Building 2: 4960 Airport Approach Road (Hanger 103)		459333 459332
Contact:	Ryan Welch, 218-625-7761	**D. O. L.:**	July 21, 2016
		Loss:	Wind Damage

Abstract

Date of Inspection:	Wednesday – May 24, 2017	
Present at Inspection:	Duane Sawyer	Roofing Consultants, Ltd.
	Luke Holden	Roofing Consultants, Ltd.
	Blake Berscheid	FM Global
	Ryan Welch	Duluth Airport Facilities
Purpose of Inspection:	Determine presence & extent of wind damage to EPDM roof systems.	
Methods of Investigation:	Visual & Manual Assessment Test Cut Sampling of Roof Assembly Components	
Secondary Sources:	Historical Weather Data Information provided by Insured's representative – Ryan Welch	

BACKGROUND

The subject buildings are located on the property of the City of Duluth – Airport. Both buildings are part of the airport operations facilities and serve multiple purposes. The ages of the buildings were not established.

Both buildings have low slope roofs. The low slope roofs are covered with EPDM (single ply black rubber) roof systems. The EPDM membranes were installed in adhered applications. The ages of the roof systems were reported to be in the 14 to 18 year age range.

Each roof has suffered damage related to a loss of adhesion of the EPDM membrane from the insulation substrate. Miscellaneous repair work has been performed of varying vintages. That past damage was the focus of this investigation.

BUILDING 1 - 4875 MALSTROM STREET - ROOF CONSTRUCTION

Roof Age: 14 Years *(reported)*

Roof Area: 37,715 sq. ft. *(approximate)*

Roof Slope: 1/4":12" *(approximate)*

Roof Assembly:
- **Surfacing:** Unsurfaced
- **Membrane:** EPDM (Ethylene Propylene Diene Monomer)
  - **Thickness:** 60 mil, *(estimated)*
  - **Attachment:** Adhered
  - **Seams:** 3" Splice Tape
- **Insulation:** ½" Wood Fiber Coverboard (over)
  4 ½" Expanded Polystyrene (EPS)
  - **Attachment:** Mechanical – Screws/Plates

Roof Deck: Ribbed Structural Steel Panels

Roof Framing: Steel Bar Joists

Drainage: Internal Drains, Overflow Scuppers

Perimeter: Metal Edge Fascia

Penetrations:
Relief Vents
Stack Vents
Soil Vents
Exhaust Vents
HVAC Units
Satellite Dish
Raised Curbs

BUILDING 1 - 4875 MALSTROM STREET - GENERAL OBSERVATIONS

The subject roof consists of a single ply membrane (EPDM) adhered to a ½" wood fiber coverboard. The wood fiberboard as well as the underlying 4 ½" of EPS insulation are mechanically attached to the metal deck with screws and plates.

The roof is pitched towards the east and west eaves with a ridge running north/ south down the center. A general overview of the roof did not uncover any significant issues with the condition of the membrane itself. The EPDM is in place, generally lying flat and free of any unusual or premature deterioration. EPDM's physical properties remain virtually unchanged as it ages, so this was not surprising. There are scattered insignificant wrinkles. Generally, the seams were found to be well bonded.

No holes, tears or breaches in the EPDM membrane were observed. Isolated repairs have been installed over the years at various locations on the roof.

At the time of the inspection the wind speed was approximately 15 mph out of the west. No perceptible billowing of the membrane was noted during our inspection; however, it should be noted that significant repairs have been made to the roof to prevent further billowing of the membrane. These repairs included the mechanical attachment of a continuous batten strip, which was covered with seam tape flashing. These strips were placed in rows perpendicular to the west roof edge, approximately every five (5) feet. In addition, plates have been screwed through the membrane into the metal deck at numerous locations on the remainder of the west slope roof area. The west slope area that has suffered adhesion loss and had repairs made includes approximately 15,675 square feet. Refer to roof drawing for affected roof areas.

The membrane was manually inspected in the regions where the insured's representative reported billowing, which is also the area of repair previously noted. By lightly tapping on the membrane it could be determined whether or not it was adhered to the insulation. This process revealed that the membrane was not bonded to the insulation substrate at numerous locations within the affected area.

A test cut was made at the edge of the affected area. The test cut confirmed that the membrane was no longer adhered at this location. See roof drawing for test cut location. It was noted that the adhesive application was poor with approximately 35% of the membrane surface area appearing to have actually bonded to the wood fiber cover board at the time of its installation. At this location, manual inspection revealed that the membrane could easily be lifted away from the wood fiber board. It is clear that the installation of the EPDM roof system would generally be classified as poor.

None of the insulation boards appear to have lifted, buckled or broken. All remain attached and in place. The perimeter edge metal shows no evidence of wind damage. The edge fascia is not lifted, bent or distorted. The blocking to which the metal is fastened has not disengaged from the structural substrate.

There is no evidence of wind damage to any of the rooftop penetrations. No units have been lifted off of curbs. Curbs have not disengaged from the roof deck. Vent stacks are not bent over, dislodged or damaged in any way by wind.

Based on our observations, it is our professional opinion that the membrane in the affected area was never properly or well adhered to the wood fiber coverboard.

BUILDING 2 – 4960 AIRPORT APPROACH RD - ROOF CONSTRUCTION – AFFECTED AREAS

Roof Age:	14 – 18 Years *(reported)*	
Roof Area:	24,700 sq. ft. *(approximate)*	
Roof Slope:	3":12" *(approximate)*	
Roof Assembly:	**Surfacing:**	Unsurfaced
	Membrane:	EPDM (Ethylene Propylene Diene Monomer)
	Thickness:	45 mil, *(estimated)*
	Attachment:	Adhered
	Seams:	3" Splice Tape
	Insulation:	None above the roof deck
Roof Deck:	Plywood	
Roof Framing:	Unknown	
Drainage:	Spill over edge	
Perimeter:	Metal Edge Fascia	
Penetrations:	2 light standards	

BUILDING 2 – 4960 AIRPORT APPROACH RD - GENERAL OBSERVATIONS

The subject roof consists of a single ply membrane (EPDM) adhered to plywood. No interior inspection was performed and the insulation and structural components were not observed during our inspection.

As directed by Blake Berscheid, the focus of our investigation was the large upper roof which is pitched towards the east and west eaves with a center ridge running north/ south. A general overview of the roof did not uncover any significant issues with the condition of the membrane itself. The EPDM is in place, generally lying flat and free of any unusual or premature deterioration. EPDM's physical properties remain virtually unchanged as it ages, so this was not surprising. There are scattered insignificant wrinkles. Generally, the seams were found to be well bonded.

No holes, tears or breaches in the EPDM membrane were observed. Repairs have been installed over the years at various locations on the roof. Many of these repairs appear to have been intended to help keep the membrane from billowing and potential further detachment.

At the time of the inspection the wind speed was approximately 15 mph out of the west. Some perceptible billowing of the membrane was noted during our inspection near the ridge. However significant repairs have been made to the roof to prevent further billowing of the membrane.

These recent repairs included the mechanical attachment of continuous batten strips which were covered with flashing tape. On the east facing upper slope, these strips were placed in rows which run perpendicular to the north roof edge, approximately 5' o.c. in an area approximately 100' x 75'. In addition, individual plates have recently been screwed through the membrane into the plywood deck and covered with flashing tape at numerous locations on the west facing slope. These repairs were made in two (2) separate areas; the first area measured approximately 40' x 20' and the second area measured approximately 80 x 100. In addition, a small area, measuring approximately 15' x 25', located at the north end of the lower east facing roof slope has also had batten strips with flashing tape installed over the membrane. These have been installed in rows which are 5' o.c. running parallel to the north roof edge. The total roof area which has had recent repairs made totals approximately 16,675 SF.

It should be noted that a significant area of the west facing slope has had previous repairs made to it as well. These repairs again consisted of batten strip installation, 5' o.c. with flashing tape covering them. This area includes approximately 3,200 square feet.

Refer to attached roof drawing for affected roof area locations.

The membrane was manually inspected in the region's where the insureds representative reported billowing, which is also the area of recent repair previously noted. By lightly tapping on the membrane it could be determined whether or not it was adhered to the insulation. This process revealed that the membrane was not bonded to the plywood substrate at numerous locations within the affected areas where repairs have been made.

Two test cuts were made in the affected areas; one (1) on the upper roof - west slope and one (1) on the lower east facing slope. The test cuts indicated that the membrane was no longer adhered at either of these locations. No evidence of moisture intrusion was noted at either of the test cut locations. See roof drawing for test cut locations. At both test cut locations, it was noted that the adhesive application was very poor with approximately 25% of the membrane surface area appearing to have actually bonded to the plywood substrate at the time of its installation. At these locations, the manual inspection revealed that the membrane was loose and completely detached from the plywood substrate. It is clear that the installation of the EPDM roof system would generally be classified as very poor.

None of the plywood deck boards appear to have lifted, buckled or broken. All remain attached and in place. The perimeter edge metal shows no evidence of wind damage. The edge fascia is not lifted, bent or distorted.

Based on the observations made during our investigation, it is our professional opinion that the membrane in the affected areas was never properly adhered to the wood fiber coverboard on Building 1, nor the plywood decking on Building 2.

WIND DAMAGE

Wind damage to roofs occurs because of uplift forces (negative pressure) that are created as wind moves over and around buildings. The negative pressures attempt to lift roof systems upward. The coefficient of wind force is generally greatest at perimeter edges. Eaves with wide overhangs are particularly vulnerable to wind uplift due to additional positive pressure from below. Wind is commonly stronger at higher elevations resulting in more damage to higher roofs than lower roofs.

Wind damage to a commercial roof membrane typically falls into one or more of the following categories:

A. Lifting of the roof structure – Deck and or Framing
This normally requires extremely strong winds (hurricane or tornado), or a deficiency with the installation of the structure.

B. Lifting of the insulation off of the structural deck.
This type of damage would be most likely to occur on a roof where the insulation was adhered as opposed to mechanically fastened, though insulation may break around fasteners. It would also be more likely to occur on roofs where the insulation was wet, resulting in a loss of adhesion or corrosion

of the fasteners. This also can occur when there are 2 roof systems in place and the top system separates from the underlying system due to an inadequate bond.

C. Lifting of the membrane off of the insulation bed or underlying substrate

This is a common type of wind damage to a low slope roof. Often the membrane separates from the insulation or substrate due to an inadequate bond. The bond may be compromised if the insulation is wet. If the membrane consists of more than one ply, the cap sheet may separate from the base plies. A frequently experienced form of damage is when the membrane is adhered to polyisocyanurate insulation and the facer of the polyisocyanurate separates and lifts. This form of damage may involve only ballooning of the membrane. Often membranes will lose bond from the substrate and balloon upward but remain watertight. However, it may also be accompanied by tears and/or separated seams.

D. Loosening, tearing, dislodgement of the flashing membrane on parapet walls

The coefficient of wind uplift force is always greatest at perimeter edges. Wind moving over a parapet wall creates a vortex on the inside of the wall. Often the field membrane will remain in place. However, the negative pressure created by that vortex may pull the flashings off of the wall. This will be most common on single ply roof systems.

E. Lifting and separation of the perimeter edge metal.

The coefficient of wind uplift force is always greatest at perimeter edges. Therefore, the integrity of a roof system is closely tied to the design and installation of the perimeter edge metal (Coping Caps, Edge Fascia, Gravel Stops, Etc.). Wind damage frequently occurs due to the inadequate design and/or attachment of the metal edge system. The most common wind damage scenario is for the perimeter edge metal to lift and separate and then the roof membrane to follow. In some cases, the perimeter edge metal holds, but the underlying wood blocking fails due to deterioration or inadequate attachment to the structure.

F. Displacement of roof surfacing – Gravel, Ballast, Pavers, Etc.

Surfacing that is unattached may be dislodged from a roof. Built-up roofs with embedded gravel may suffer scouring. Roofs that rely on stone ballast or pavers for securement may suffer displacement of those items, which can then lead to subsequent lifting of the membrane and insulation.

G. Damage from wind-blown debris.

Many times, a roof system will withstand the force of strong winds but suffer damage from flying debris. The debris may be from a neighboring roof, rooftop equipment or some other source. Large and/or sharp items may puncture, tear or gouge a roof surface. This may lead to water infiltration. Metal items and HVAC equipment may be dented or more severely damaged as well.

Comments:

On both of the subject roofs the wind damage observed was limited to category C: Lifting of the membrane off of the underlying substrate. Wind moving across the roof created negative pressure that lifted the membrane off of the insulation. None of the other damage categories listed above were observed.

The Building 1 roof area which appears to have recently been affected by wind uplift forces includes approximately 15,675 sq. ft.

On Building 2, the total roof area recently affected by wind uplift forces is approximately 16,675 sq. ft. The roof area on the west slope of Building 2 that has had previous repairs completed includes approximately 3,200 sq. ft.

The fact that previous repairs were made to prevent the membrane from lifting and suffering potential additional damage indicates that the loss of adhesion has clearly been occurring for an extended period of time. The exact date the previous repairs were made was not known by the insured's representative but it was estimated that they occurred several years prior to the given date of loss.

It must be emphasized that the primary catalyst toward the lifting of the membrane on both buildings was clearly the inadequate application of adhesive.

Commercial roof systems are intended to be designed to accommodate certain wind uplift forces. Factors that affect those uplift forces include building height, building use, surrounding terrain, roof perimeter height and others. In Minnesota, and most of the non-coastal United States, the wind speed used to calculate the uplift forces is 90 mph. Most commercial roof system manufacturer warranties will warrant against damage up to at least 55 mph.

WEATHER DATA

Weather data was collected from the weather station closest to the insured's location: Data from the reported date of loss, day prior to the date of loss and the day of strongest winds in the prior month is itemized below:

Date	Max. Wind	Max. Gusts	Direction
7/21/16	43 mph	69 mph	WNW

Comments:

1) This data was collected at a weather station located adjacent to the subject building and reflects the actual conditions at the insured's location.
2) Though the sustained wind speeds and gusts were relatively strong, they were not so strong that they should have caused damage to a roof that was well installed and in good condition. As stated above, properly designed and installed roofs are intended to resist winds much stronger than those posted above.

CONCLUSIONS

Wind damage has been suffered by the subject roofs in the form of lifting of the EPDM off of the wood fiber coverboard substrate on Building 1 – and plywood substrate on Building 2. This reportedly had manifested itself in the form of billowing during recent wind events, where the membrane in the affected areas had lifted in large sections above the substrate material. The total roof areas which appear to have been recently affected by wind uplift forces on both buildings includes approximately 32,350 sq. ft..

Although the affected membrane likely did exhibit billowing during recent wind events, it is our professional opinion that the primary contributing factor was the poor installation/adhesive application techniques used during its installation. It is our professional opinion that had the membrane been properly adhered during its installation it would have been capable of withstanding significant wind forces such as those experienced on the date of loss.

DISCLAIMER

1) This inspection did not involve a structural analysis of the roof. Structural plans were not reviewed and load capacities were not calculated.
2) The observations and findings discussed above are based on visual and manual evaluation, isolated test cuts and non-destructive moisture testing. If additional information is presented at a later date, Roofing Consultants Ltd. reserves the right to review that information and amend the opinions expressed herein if deemed appropriate.

CLOSING

Please refer to the following attachments:

A. Roof Plans
B. Photographic Record

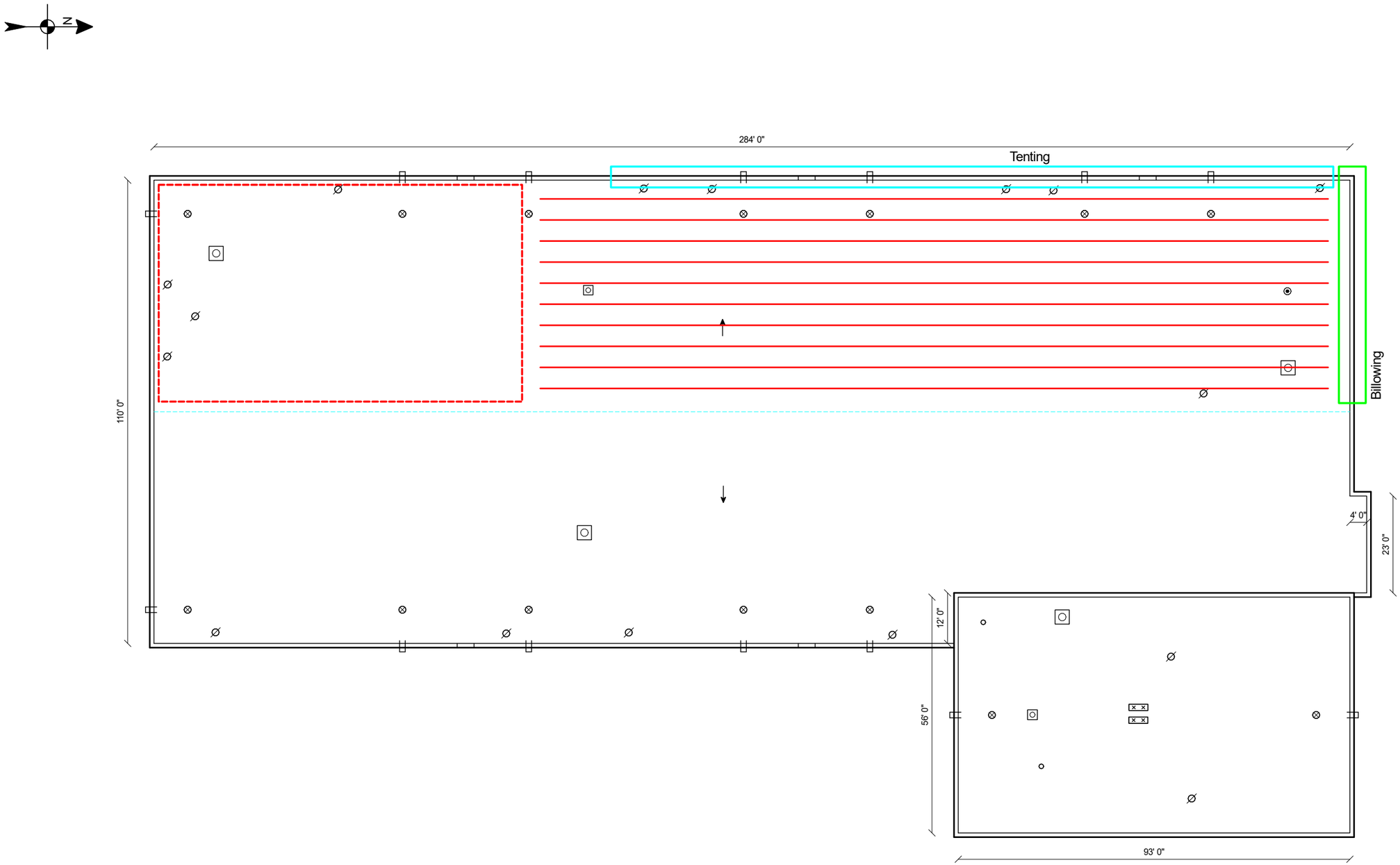
We trust that this roof investigation will prove to be useful towards the settlement of the insured's claim. If you have any questions, or if further information is necessary, please do not hesitate to contact our office.

Sincerely,

Duane Sawyer
Senior Consultant / Market Manager

Doug Ernst, PE
Professional Engineer

DS/dm



= Area With Scattered Fasteners & Plates

= Temporary Repair (Batten Bars & Fasteners 5' o.c)

Legend

←	Slope Direction	○	Soil Vent
- - - - - -	Valley	⌀	Stack Vent
⊗	Drain	▣	Power Vent
⊓	Scupper	◉	Test Cut
▭	Vent		

Roofing Consultants, Ltd.

Engineers, Architects & Building Envelope Specialists

Waukesha, WI 262-549-0802 | Indianapolis, IN 317-594-5440 | Skokie, IL 847-965-3366 | Minneapolis, MN 612-238-0802 | Chesterfield, MO 636-530-3663

Title: Roof Plan

Approx. Scale: 1"=25'-0"

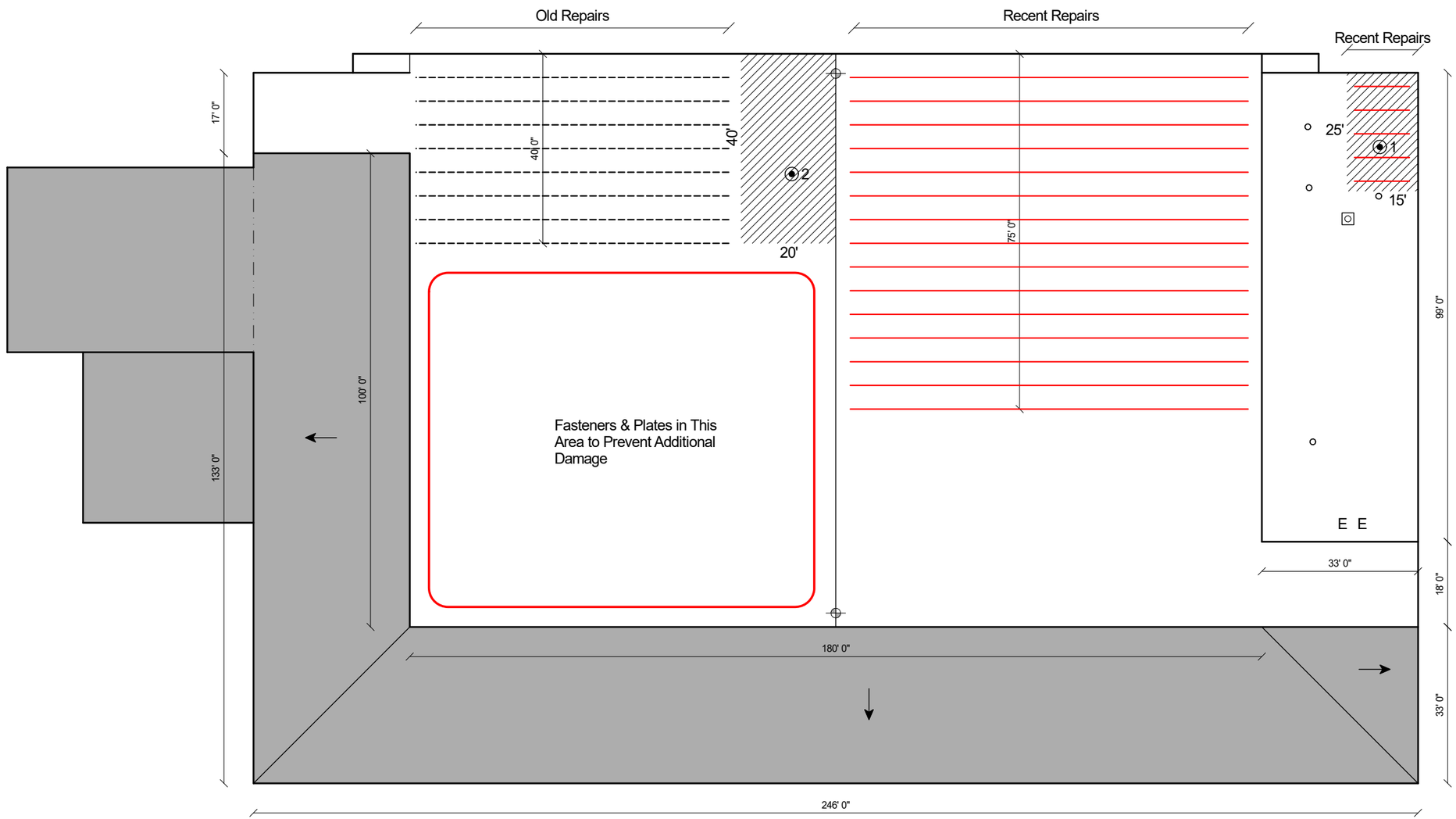
Prepared For: FM Global

Date: 6/9/17

Drawn By: PG

Duluth Airport Maintenance Garage

4875 Malstrom St
Duluth, MN 55811



= Not Part of Inspection

= New Repairs

= Batten Bars & Fasteners Every 5' o.c.

Legend

←	Slope Direction
⊕	Valley
○	Soil Vent
▣	Power Vent
E	Electrical Mast
◉	Test Cut

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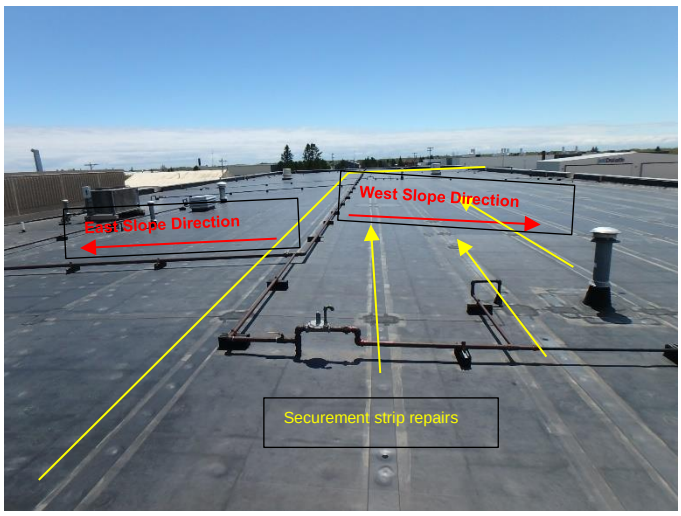
Title: Roof Plan
Approx. Scale: 1"=25'-0"
Prepared For: FM Global
Date: 6/9/17
Drawn By: PG

Duluth Airport
4960 Airport Rd.
Duluth, MN 55811

City of Duluth
4960 Airport Approach Road & 4875 Malstrom Street, Duluth, MN

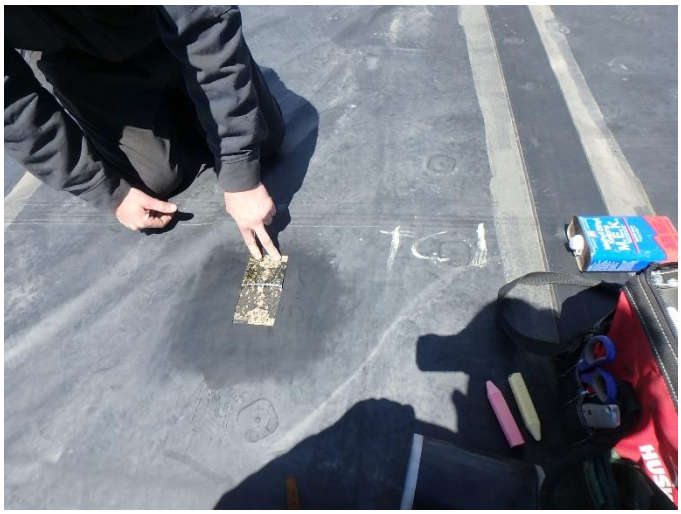
1. General site photo-Building 1 4875 Malstrom St.

2. General roof photo facing SW. Roof slope directions noted.

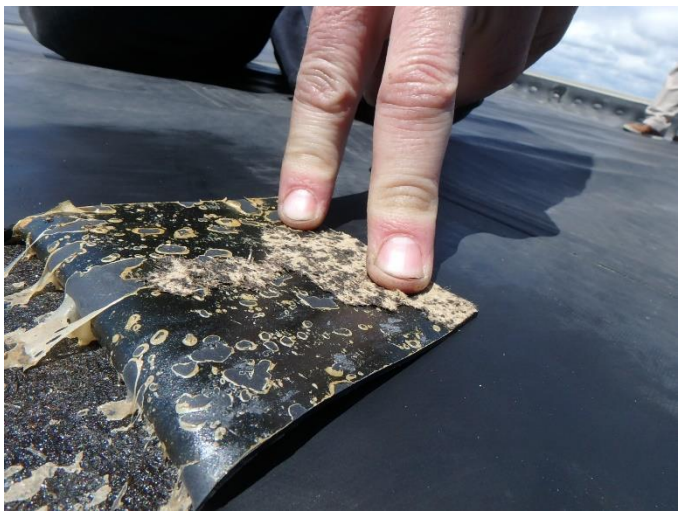


3. Additional general roof photo facing south. The membrane was found unadhered to the wood fiber cover board throughout the west slope.

4. Additional photo documenting recent securement strip repairs.



5. A test cut was performed – The membrane was not adhered at this location; no evidence of moisture was identified.



6. Close up of back side of membrane- note approximately 35% of the adhesive appears to have bonded to the wood fiber cover board.

7. A core sample reveals EPS and wood fiber layers – no moisture was identified within the substrates.

8. Additional photo documenting conditions at test cut 1.

9. General site photo Building 2 4960 Airport Approach Rd. Roof areas included in our investigation noted.

10. Repairs to lower roof slope noted.

11. Additional photo of lower roof area facing south.

12. Additional photo of lower roof area facing north.

13. East slope. Securement strips have been installed on top of the membrane with flashing tape over the top.

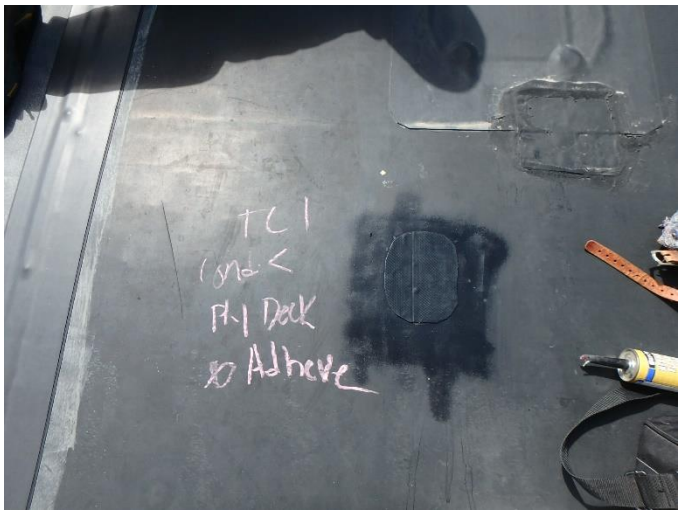
14. Additional photo of roof facing south. Note numerous plates installed on the west slope and batten strips on the east slope.

15. West slope – north end. Note new plates installed to keep roof membrane from billowing. Repairs from previous wind events noted in blue area below.

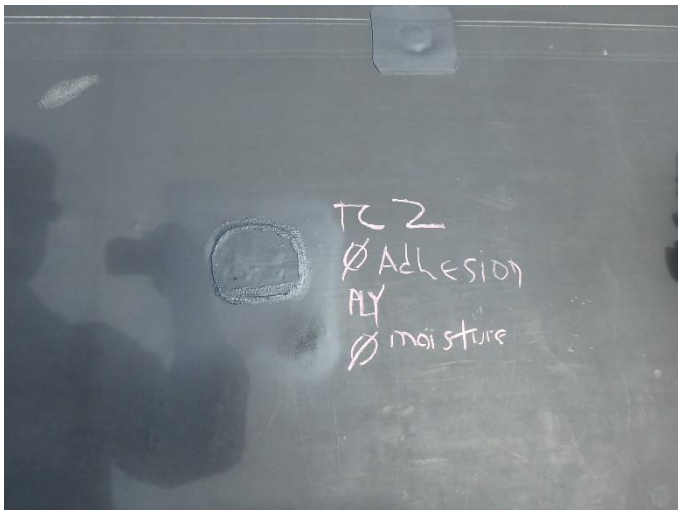
16. Photo documenting east slope south end reveals no evidence of adhesion loss.

17. Photo documenting typical repair made with plate screwed over the membrane and flashing tape covering.

18. Additional photo documenting typical repair made with plates screwed over the membrane and flashing tape covering.



19. Test cut 1 location revealed no adhesion between membrane and plywood substrate. No evidence of moisture intrusion noted.



20. Test cut 2 revealed no adhesion between membrane and plywood substrate. No evidence of moisture intrusion noted.

21. Photo documenting back of membrane – little adhesion was ever accomplished between the membrane and plywood. The membrane was completely loose at both test cut locations on Building 2.