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WMSC Commissioner Brief: W-0176 – Serious Injury – Queenstown Road Repair and Maintenance Supply Storage Facility – April 25, 2022

Prepared for Washington Metrorail Safety Commission meeting on August 9, 2022

Safety event summary:

A roofing contractor at Metrorail's Queenstown Road Storage Facility fell through the roof, which was under construction as part of a replacement project. The contractor fell 28 feet to the ground. The contractor landed on the concrete floor and suffered multiple broken bones and vertebrae. The contractor was conscious, and they were taken to the hospital by ambulance. Injuries included a broken right arm, multiple fractures to the metatarsals in their right foot, and three fractured vertebrae.

The contractor's company, Patuxent Roofing, was hired to work on behalf of Metrorail to remove damaged decking made up of a top-layer of roofing material and an underlayer of decking panels and to replace the roofing with other materials. The facility is used to store supplies used to maintain the Metrorail system, primarily salt used to maintain the safety of the system and facilities in winter months.

Although personnel identified weak panel integrity as a hazard to the workers prior to work beginning, the Job Hazard Analysis was not updated to address this hazard. Only the initial fall protection measures – guardrails around the perimeter of the roof to prevent falls over the edge – were in place. Other required fall protection measures were not installed prior to the work, and Metrorail did not ensure fall protection measures were being utilized during the work. Documents for the project reviewed as part of the investigation did not mention anchoring devices that would be necessary for fall protection.

Metrorail had also not ensured that these safety requirements were part of the initial Job Hazard Analysis or related documents, despite a 2019 Field Survey Report stating concern for the existing roof during construction activities and advising consultation with structural engineers prior to undertaking work. The report included photographs showing structural damage to the roof tiles visible from inside of the building. Metrorail did not provide this 2019 Field Survey Report nor a prior 2014 Condition Assessment Report to Patuxent Roofing. Metrorail Capital Delivery (CAPD) and Multiple Task Order Award Contract (MATOC) personnel stated that the contractor could still have done their own safety inspection before work began.

Further investigation determined that Metrorail knew in at least September 2021 that the Tectum decking was not initially installed properly when roof work was done in approximately 2002. The panels were installed without required grout or fasteners, and some panels appear to have been installed upside down. Metrorail's September 7, 2021 site-survey and observations of the panels also identified the panels had been structurally weakened. This information was communicated to multiple Metrorail personnel and Patuxent Roofing.

The person who fell was wearing a personal fall arrest system, a harness that can be used to prevent a fall from leading to serious injury, but was not tethered to an anchor point as would be necessary to gain any safety benefit. They were wearing a hard hat and safety vest. They had been assigned to retrieve materials from a forklift, which was delivering materials at a location on the roof where there was no available tie-down point. There were railings next to the forklift location that were intended to prevent a fall over the exterior edge of the building only.

The contractors had been working each day beginning at 7 a.m. A WMATA safety manager said in a statement after the event that, beginning at approximately 7:47 a.m. on the day of the injury, they had communicated to the Patuxent Roofing Superintendent safety issues including blocked roof egress (flatbed truck parked near ladder), too much slack and crossed safety tethers (used in fall protection), and multiple workers on the roof not tethered to secure points at all.

At approximately 9:10 a.m., the person fell through the roof. No other WMATA personnel or contractors directly witnessed the fall, however multiple people heard the person fall and heard the person's calls for help afterward. The contractors called 911.

Inspection of the area where the contractor fell through the roof demonstrates that that section of the roof (panel/tile) was damaged before the contractor stepped on top of it. This is an example of the weak panel integrity that posed a hazard for this work. Additional inspection demonstrated other tiles with similar damage.

The hazard analysis Metrorail allowed work to begin under and Patuxent Roofing Management did not address fall protection, and Patuxent Roofing therefore said the contractor did not need to be tethered at the time of this fall because they were within the exterior railings that would prevent a fall over the edge of the building. Patuxent Roofing stated they did not anticipate structural damage to the floor.

Probable Cause:

The probable cause of this event was Metrorail's inadequate oversight of its contractors and other capital projects, including as it relates to fall protection changes and other elements requiring Job Hazard Analysis updates, leading to work being conducted without proper planning or available fall protection, and the inadequate fall protection planning by the contractor.

Corrective Actions:

Work resumed at this location on May 9, 2022 with:

- A second safety manager on site who stayed on the ground floor and monitored integrity of the roof tiles, ensured each worker's harness was inspected, and who would radio to stop work for any safety incidents or falls.
- Training and rehearsals with all personnel on safety gear
- Removal of machines from the roof that increased the weight load
- Ensuring all personnel wore all appropriate personal protective equipment including safety harness and a steel cable rigging strap
- Inspections of harnesses at the start, end, and every two hours during work
- Workers on the roof moving to the next section only after tie-off points are in place

The project was completed on June 2, 2022.

Metrorail issued a safety bulletin and conducted a safety stand down related to fall protection.

Metrorail will ensure that the Safety Department is included in site surveys.

Metrorail will review activity hazard analysis and job hazard analysis requirements to ensure each activity hazard analysis or job hazard analysis is updated and reissued as new hazards are identified.

WMSC staff observations:

The WMSC conducted additional review of Metrorail's fall protection programs, including document review and meetings and discussions with Metrorail program leadership. This review identified some positive practices. The WMSC and Metrorail's safety department are coordinating regular updates on Metrorail's occupational safety and related inspections.

This event demonstrates the importance of Metrorail ensuring that all work is done safely whether by WMATA employees or by contractors.

Washington Metro Area Transit Authority
Department of Safety and Environmental Management (SAFE)

FINAL REPORT OF INVESTIGATION A&I E22257

Date of Event:	April 25, 2022
Type of Event:	Serious Injury
Incident Time:	09:10 hours
Location:	Building T-36 (Queenstown Road Repair and Maintenance Supply Storage Facility)
Time and how received by SAFE:	09:40 hours –Contractor phone call to Construction Safety Manager
WMSC Notification Time:	13:10 hours
Responding Safety Officers:	WMATA: SAFE 705 and Construction Safety Manager WMSC: None Other: N/A
Rail Vehicle:	N/A
Injuries:	Multiple Fractured Bones and Vertebrae
Damage:	None
Emergency Responders:	Prince George's County Fire Department
SMS (Safety Measurement System) Incident/Accident Report Number	20220503#100026

Table of Contents

Abbreviations and Acronyms

AHA	Accident Hazard Analysis
ARS	Audio Recording System
CAP	Corrective Action Plan
CAPD	Office of Capital Program Delivery
JHA	Job Hazard Analysis
MAC	Mission Assurance Coordinator
MATOC	Multiple Award Task Order Contract
MOSH	Maryland Office of Safety and Health Division
MSRPH	Metrorail Safety Rules and Procedures Handbook
MTPD	Metro Transit Police Department
NOAA	National Oceanic and Atmospheric Administration
OSHA	Office of Safety and Health Administration
OSI	Office of Safety Investigations
OSO	Office of Safety Oversight
SAFE	Department of Safety and Environmental Management
SMS	Safety Measurement System
TPO	Thermoplastic Polyolefin
WMATA	Washington Metropolitan Area Transit Authority
WMSC	Washington Metrorail Safety Commission

Executive Summary

On Friday, April 25, 2022, at approximately 09:10 hours, a Contractor with Patuxent Roofing was working on Building T-36 (Queenstown Road Repair and Maintenance Supply Storage Facility), in West Hyattsville, MD, and fell through the roof approximately 28 feet, landing inside the building on a solid concrete floor.

The contractor was an employee of Patuxent Roofing (PRI), fulfilling a WMATA-awarded contract to remove damaged "Composite Decking;" a combination of a top-layer bituminous roofing and an underlayer of Tectum decking panels; a material made of wood fibers held together with cementitious binder. The second part of the contract required the replacing of both layers of this roofing with safer, more robust steel-based decking and Thermoplastic Polyolefin (TPO). The Contractor was transported to Medstar Washington Hospital/Trauma Center by Prince George's County ambulance and was reported as being conscious, breathing, and complaining of pain in their left arm and lower back. Medics on scene affixed a c-spine and moved the Contractor via stretcher before leaving for the hospital.

Prior to the commencement of work, a Job Hazard Analysis was developed for the roof demolition and repair project. During the site survey and planning phase of the project, panel integrity was identified as a hazard, and a Change Order was generated to address the failing Tectum panels; however, the original Job Hazard Analysis for the roof work was not updated to address the newly identified hazard. As such, fall protection measures were limited to guard rails around the perimeter of the roof to prevent falls over the side.

At the time of the event, the contractor was unloading materials from a forklift used to hoist material to the roof. As they were unloading the materials, one of the Tectum decking panels broke, resulting in the fall to the ground below. The Contractor was wearing a Personal Fall Arrest System (PFAS); however, they were not tethered to an anchor point.

Medics on scene treated the contractor and transported them to the hospital. The Contractor was transported to Medstar Washington Hospital/Trauma Center by Prince George's County ambulance and was reported as being conscious, breathing, and complaining of pain in their left arm and lower back. The contractor was treated and released the same day.

The probable cause for the event was an inadequate process to update and refine the Job Hazard Analysis for tasks as new hazards are identified. A contributing factor to the event was the lack of an engineered anchor point at the site of the material loading/unloading.

Incident Site

Building T-36 (Queenstown Storage Facility), West Hyattsville

Field Sketch/Schematics

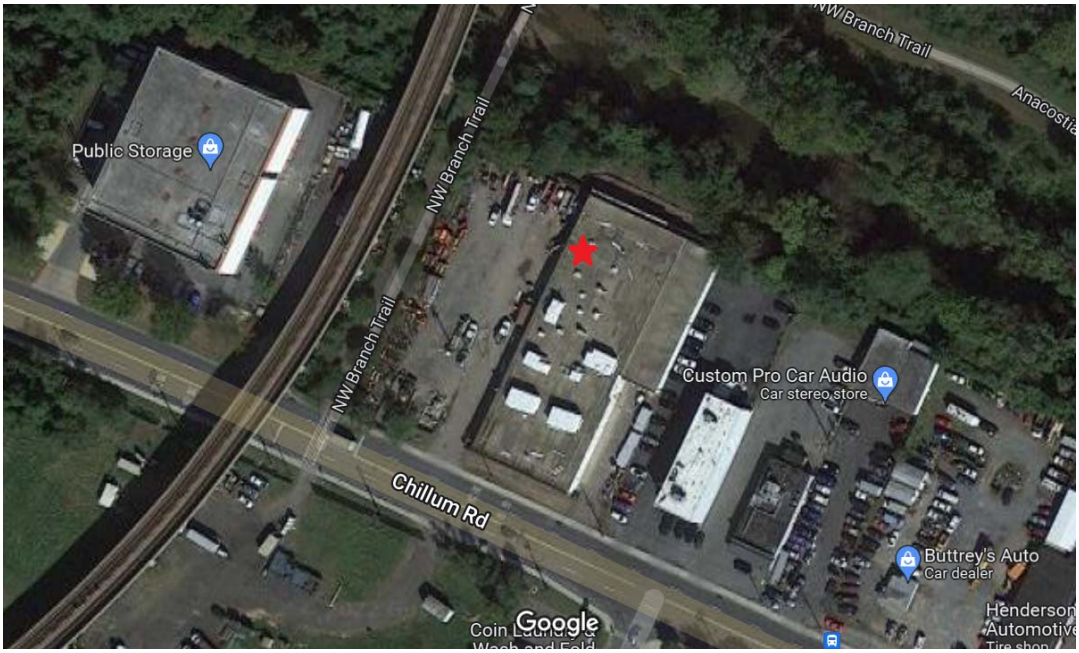


Figure 1: Incident Location. Red star marks approximately where Contractor fell through the roof.
**Not to scale. Oriented North.*

Purpose and Scope

This incident investigation and candid self-evaluation aim to collect and analyze available facts, determine the probable cause(s) of the incident, identify contributing factors, and make recommendations to prevent a recurrence.

Investigative Methods

Upon receiving notification of the Serious Injury event on April 25, 2022, SAFE dispatched a cross-functional team to assess the scene and conduct a subsequent investigation. SAFE team members worked with relevant WMATA subject matter experts to review the incident's facts and data.

The preliminary investigative methodologies included the following:

- Physical Site Assessment

- Formal Interviews – SAFE conducted a formal interview with the following personnel as part of this investigation:
  - Safety Manager Multiple Award Task Order Contract (MATOC)

- Informal Interviews – Collected through conversations with and written statements provided by individuals during the investigation to provide background and supporting information:
  - Foreman (Patuxent Roofing) – statement
  - Supervisor (Patuxent Roofing) – statement

- Mechanic #1 (Patuxent Roofing) – statement
- Mechanic #2 (Patuxent Roofing) – statement
- Safety Supervisor #1 (Patuxent Roofing) – statement
- Safety Supervisor #2 (Patuxent Roofing) – conversation
- Inspector (WMATA-MATOC) – statement
- Safety Manager (WMATA-MATOC) – statement
- Project Manager (CAPD) – conversation
- Senior Project Manager (CAPD) – conversation

- Documentation Review – A collection of relevant work history information and process documentation in Metro systems of record. These records include:
  - Employee Training Procedures & Records
  - Metro Safety Rules and Procedures handbook (MSRPH)
  - National Oceanic Atmospheric Administration (NOAA) data
  - Accident Hazard Analysis (AHA)
  - Job Hazard Analysis (JHA)
  - Condition Assessment Report (2014)
  - Field Survey Report (2019)
  - Email exchanges for planning and surveying (Patuxent Roofing)
  - Structural Engineer Correspondence (Parsons)
  - Structural Engineer Report (Parsons)
  - Certifications
  - Fall Protection Plan
  - Training Records for contractor employees
  - Design and concept drawings of the anchor system

Investigation

On Friday, April 25, 2022, at approximately 09:10 hours, a Contractor with Patuxent Roofing was working on Building T-36 (Queenstown Road Repair and Maintenance Supply Storage Facility), West Hyattsville, and fell through the roof approximately 28 feet, landing inside the building on a solid concrete floor.

The contractor was a part of Patuxent Roofing fulfilling a WMATA-awarded contract to remove damaged "Composite Decking;" a combination of a top-layer bituminous roofing and an underlayer of Tectum decking panels; a material made of wood fibers held together with cementitious binder. The second part of the contract required the replacing of both layers of this roofing with safer, more robust steel-based decking and TPO.

At the scene of the incident, it was learned from both WMATA and Patuxent Roofing employees the state of the roof was in disrepair. According to the Patuxent Roofing Safety Supervisor, the Patuxent Roofing team of laborers had been repairing the facility's roof, initially removing concrete and steel "Decking" from the roof, over the 48 hours before the incident on the east side of the building.

From 07:00 hours every day, a team of Patuxent Roofing contractors worked to remove the damaged decking, replacing it with more robust steel-based decking.

Before work began on April 25, 2022, the Safety Manager MATOC stated they observed multiple safety issues, including blocked roof egress, too much slack and crossed safety tethers, and observed multiple workers not tethered to secure points operating on the roof.

An initial written statement provided by the Safety Manager MATOC stated these issues were relayed to the Patuxent Roofing Superintendent during the commencement of work. Safety Manager MATOC also stated they believed the crew responsible for removing the damaged decking was outworking the crew replacing the decking.

The egress point of the roof was established at the west-facing wall of the north corner via the ladder. This ladder led directly to the staging area allocated for demolition and construction. Multiple tie-down points were observed for safety-tethering workers; however, the retrieval point for new building materials lacked a tie-down point.

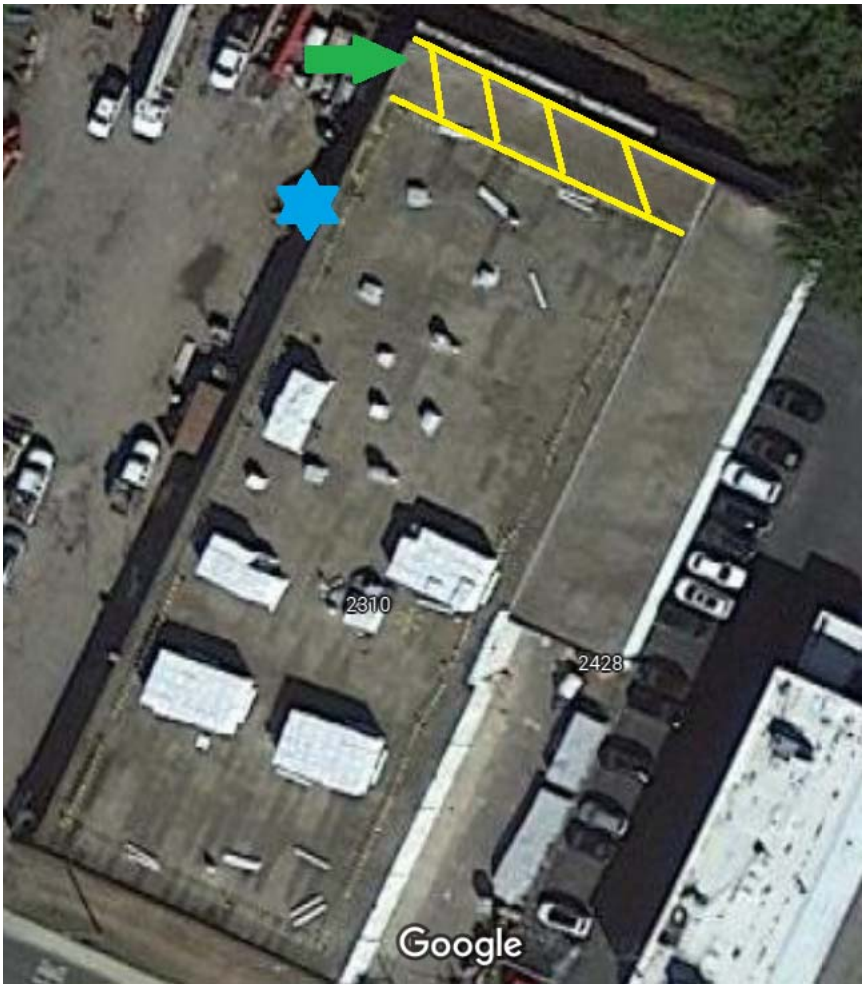


Figure 2: The egress point on to the roof, designated safety area at height and forklift are indicated by the green arrow, yellow lines, and blue star, respectively.

Figure 3: Egress ladder on to the roof, with proper three-foot overlap, located on the North-West Corner of T-36.

Figure 4: Work being conducted on the roof.

The retrieval point was positioned on the west wall to provide new materials for repairing the roof. It consisted of a forklift positioned on the ground, using its lift to overhang the roof and provide materials, as necessary. Before the fall, the Contractor was assigned to retrieve these materials from the forklift.

Figure 5: Forklift stationed on the ground with fork overhanging the roof to provide supplies.

At approximately 09:10 hours, the Contractor fell through an insecure tile on the roof, causing them to fall approximately 28 ft to the concrete slab below. By accounts of the Patuxent Roofing Foreman and various workers in the Patuxent Roofing team on the scene, including WMATA employees, no one directly observed the contractor fall through the roof; however, multiple personnel heard the event and calls for help after the fall.

The Patuxent Roofing Safety Supervisor stated he was on the roof at the time, and as soon as he learned of the fall, he called for emergency response from 911. Another contractor with WMATA stated an ambulance from Prince George's County responded and transported the Contractor to Medstar Washington Hospital/Trauma Center.

Figure 6: Northwest Corner orientated to the South, missing tile creating the hole can be observed from the safe area. Forklift can be observed to the right of the hole.

Figure 7: Close-up of the hole.

According to the Patuxent Roofing Safety Supervisor, the injured Contractor was accompanied to the hospital by their brother, another Contractor working with Patuxent Roofing.

Medstar Washington Hospital/Trauma Center determined the extent of the Contractor's injuries as a fractured right arm, various fractures to the metatarsal bones of their right foot, and three fractured vertebrae.

Inspection from the ground floor revealed the tile that broke out from underneath the Contractor was damaged prior to applying the Contractor's body weight.

Figure 8: View of the hole from inside the structure, orientated North

Figure 9: Close up of the shattered tile. Note the pre-existing damage.

Figure 10: The largest piece of the tile with visible discoloration at the weak point. This piece was estimated to be in excess of 45 lbs.

Further inspection of the roof from the ground floor revealed several visibly damaged tiles.

Figure 11: Water-damaged tile within the vicinity of the incident site.

Figure 12: Two water-damaged tiles and a structurally compromised tile near the East wall.

The JHA and Patuxent management indicated that the Contractor was not required to be tethered, as he was inside the "Hard rails;" railing designed to prevent personnel from falling over the edge of a structure. The company reported that they did not anticipate structural damage to the floor, and safety mitigations were not placed to accommodate the roofing giving way under the weight of workers on the roof.

No video of the work or event was available.

The WMATA Construction Manager placed a cease-work order on the site pending the investigation after the incident. A safety standdown was also observed by WMATA, post-incident.

A review of the pre-incident Accident Hazard Analysis (AHA) confirmed the fall mitigation interventions were limited to the hard railing, and no specific mention of anchoring devices were made throughout the documents received by SAFE.

Chronological Event Timeline

No radio or ambient microphone recordings were retrieved from Audio Recording System (ARS) due to a lack of communication with the ROCC. A review of phone calls, interviews and written reports revealed the following timeline:

Time	Description
07:00 Hours	Patuxent Roofing arrived on scene in order to commence work.
07:47 Hours	MATOC Construction Safety Manager arrived on scene and corrected a number of safety concerns she observed.
09:10 Hours	Contractor fell through the roof of T-36, approximately 28 ft.
09:13 Hours	Injured Contractor was evacuated by Prince George's County to Medstar Washington Hospital/Trauma Center.
09:40 Hours	OSO Construction Safety Manager notified OSI Director of event.
10:48 Hours	OSI Director notified the MAC of the incident.
11:48 Hours	OSI Director notified the MAC WMSC advised of incident via Everbridge.
13:10 Hours	WMSC is notified of the incident.

Interview Findings

As part of the investigation launched into the Serious Injury event, SAFE conducted one interview via Microsoft Teams, including the Investigations Team and the WMSC. The interview was conducted after the event and identified the following key findings associated with this event. Findings detailed below include reported information from interviews and written statements that may conflict with other data sources contained in the report.

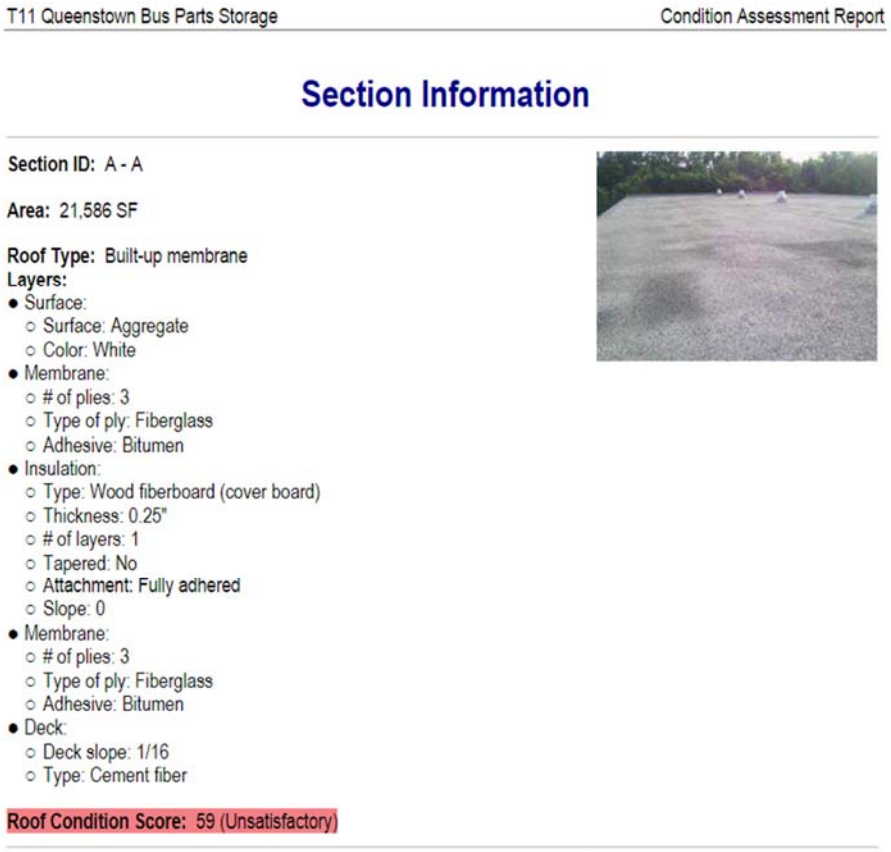
Virtual Interview of Safety Manager, MATOC:

- Arrived on scene approximately 07:45 hours to work already underway.
- Made observations of safety mitigation devices not properly employed, including hard rails too close to the edge of the roof and safety tether lines crossed and having too much slack. Stated the Site Superintendent began correcting the issues immediately.
- Also observed upper layer of the roofing was being removed faster than the lower layer of the roofing.
- Heard screaming and learned through others the Contractor had fallen from the roof.
- Contacted her own chain of command and advised of the incident.
- Observed Contractor in arrest harness, post-incident. No tether observed.
- Per JHA observed, all workers had to be equipped with an arrest harness.
- Observed water damage to the tiles, from underneath, inside the building approximately 12 months ago and reported findings to her own chain of command.

WMATA Condition Assessment Report (2014)

A Condition Assessment Report was conducted in 2014 of the T-36. Revision of the report determined the majority of the roof to be “unsatisfactory.” The report dictated the segment of roofing that collapsed under the weight of the Contractor was a part of the majority of the roofing said to have a remaining life of approximately 25-49% which equates to a Condition Score of ’59.’ The report is unclear what the remaining lifespan of the roof is, however, does indicate the most recent roof was installed in 2002; approximately 20 years ago.

The Report also alluded to the presence of significant water damage throughout the roof, citing considerable damage to the roof’s structural integrity.



T11 Queenstown Bus Parts Storage — Condition Assessment Report

Section Information

Section ID: A - A

Area: 21,586 SF

Roof Type: Built-up membrane
Layers:
- Surface:
  - Surface: Aggregate
  - Color: White
- Membrane:
  - # of plies: 3
  - Type of ply: Fiberglass
  - Adhesive: Bitumen
- Insulation:
  - Type: Wood fiberboard (cover board)
  - Thickness: 0.25"
  - # of layers: 1
  - Tapered: No
  - Attachment: Fully adhered
  - Slope: 0
- Membrane:
  - # of plies: 3
  - Type of ply: Fiberglass
  - Adhesive: Bitumen
- Deck:
  - Deck slope: 1/16
  - Type: Cement fiber

Roof Condition Score: 59 (Unsatisfactory)

Figure 13: 2014 Report summarizing the unsatisfactory condition of the roof integrity.

Roof Condition Score – Section A

#	Question (Max Value) / Notes	Score
1	Roof is less than 5 years old and in excellent condition - no observed deficiencies (0)	
2	Are there roof leaks? (5)	
3	Have the past roof leaks caused significant interior damage? (10)	
4	Have roof leaks caused significant damage to building's structural integrity? (10)	10
5	Has the roof been leaking for over 1 year? (7)	
6	Does the roof leak every time it rains in 3 or fewer places? (5)	
7	Does the roof leak every time it rains in 4 or more places? (10)	
8	Is the surface of the roofing deteriorated excessively? (4)	
9	Is there excessive patching on the roof? (8)	
10	Is roof-top equipment mounted improperly? (5)	
11	Is roof installation workmanship of medium quality? (3)	
12	Is roof installation workmanship of poor quality? (5)	
13	Remaining roof life > 75% (5)	
14	Remaining roof life 50% - 74% (10)	
15	Remaining roof life 25% - 49% (20)	20
16	Remaining roof life <25% (30)	
17	Does the flashing look deteriorated but does not appear to be letting water enter the building? (2)	
18	Does the flashing look deteriorated and appear to be letting the water enter the building in a few places? (6)	
19	Does the flashing look deteriorated and appear to be letting the water enter the building in an excessive number of places? (10)	
20	Is there a moderate number of blisters, ridging, open laps, or splits? (3)	
21	Is there an excessive number of blisters, ridging, open laps, or splits? (5)	
22	Is there a moderate number of cracks or openings in the flashing that are 4 inches or higher off of the roof level? (2)	
23	Is there an excessive number of cracks or openings in the flashing that are 4 inches or higher off of the roof level? (5)	
24	Is there indication of minimal standing water? (2)	
25	Is there indication of excessive standing water/a visual indication of the roof decking being low? (6)	6
26	Miscellaneous and other conditions - Low (5)	5
27	Miscellaneous and other conditions - Medium (10)	
28	Miscellaneous and other conditions - High (15)	
29	Roof is at the end of its life - Immediation Action Requiredl (0)	
	Total	**41**
	FINAL SCORE (100 – Total)	**59**
	ROOF CONDITION SCORE: Unsatisfactory	

Figure 14: 2014 Report broken down into individual elements pertaining to score awarded

Gannett Fleming/Parsons Field Survey Report (2019)

A Field Survey Report, conducted by Gannett Fleming/Parsons in 2019 determined the roofing, along with drains and insulation, would need to be replaced.

The report states concern for the placement of new materials on the existing roof, during construction, and advises consultation with structural engineers prior to undertaking work.

The report also showed multiple photographs taken inside T-36, showing the underside of the roofing, including at least one photograph clearly demonstrating structural damage to multiple pieces of the Tectum decking.

Figure 15: Photo retrieved from the Gannett Fleming/Parsons Report (2019)

Office of Capital Delivery Program (CAPD)

An email exchange with the Project Manager of the Roof Restoration project, from CAPD, determined neither the Condition Assessment Report (2014) nor the Field Survey Report (2019) were provided to Patuxent Roofing.

A meeting with representatives of CAPD and MATOC determined Patuxent Roofing, regardless of having possession of the above reports, was required to conduct a safety inspection of the site, prior to the commencement of work.

Representatives of CAPD and MATOC stated the original intent for the work on the roof of T-36 was to be a partial roof restoration. At the behest of reporting provided by Parsons and Patuxent Roofing, a full restoration of the roof was required, based on age, condition, and installation of the Tectum decking.

Mid Atlantic Sales and Patuxent Roofing, Pre-Incident (2021)

A review of email correspondence between the Patuxent Roofing Owner and Mid Atlantic Sales Group Representative in reference to the Tectum Decking determined the Tectum decking installed was originally provided by Mid Atlantic Sales. Further, this correspondence determined the Tectum decking was unsafe due to the result of the installation of it, atop T-36.

The Mid Atlantic Sales Representative stated the Tectum panels were installed without fasteners, and, in places, appeared to be installed upside down.

A follow-up conversation with The Mid Atlantic Sales Representative confirmed he stood by their original statement pertaining to the installation of the Tectum decking. Further, the Mid Atlantic Sales Representative stated he believed he recalled seeing and taking photographs of water damage observed on the underside of the panels, viewable from inside the building.

The Mid Atlantic Sales Representative stated the upside-down tiles were only discoverable after the bituminous layer was removed from the top of the Tectum decking.

Figure 15: Cutting of tectum from the roof of T-36.
Caption reads: "This Tectum tile is upside down and is missing the bulb t and grout."

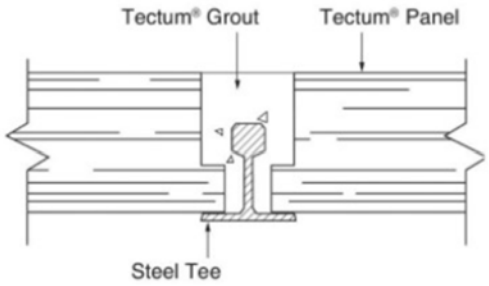


Figure 16: Diagram of how tectum should have been installed.

Parsons Structural Engineer Report

Correspondence as a result of a site inspection conducted on September 7, 2021, determined a site survey and observations of the Tectum panels were made by a Structural Engineer with Parsons; a sub-contracted company employed by WMATA in order to assist with determining safety considerations associated with the roof of T-36 and the Tectum decking.

The Structural Engineer made multiple observations in relation to the Tectum decking, to include an observation of sagging, in isolated spots, as a result of water penetration. The Structural Engineer stated the moisture accumulated in these isolated Tectum panels would have structurally weakened them.

The Structural Engineer, Patuxent Roofing Owner, Mid Atlantic Sales Representative, and a number of WMATA employees were present at the site survey and for the subsequent observations. These observations were recorded and sent via email to all aforementioned parties.

As a result of the discovery of the extent of damage, a Change Order for the scope of work was submitted to and approved by CAPD for a total replacement of the roof of T-36.

Patuxent Roofing Return to Work – Post-event

On May 9, 2022, at approximately 08:00 hours, Patuxent Roofing held a rehearsal and return to work based on a proposed, revised JHA.

Patuxent Roofing provided a revised JHA as well as a Site Safety Survey. Consultation of both of these documents and informal conversations with a second, on-coming Safety Manager on site revealed Patuxent Roofing implemented the following interventions:

- Hard rail will continue to be implemented.
- Prior to the resuming of work, all personnel will be trained and conduct rehearsals with the appropriate safety gear being implemented.
- Work will resume from the established safe zones, and be done so by hand without the aid of machines that will increase weight bearing on the roof
- 100% of employees will be required to wear all appropriate personal protective equipment to include the appropriate safety harness with a retractable strap as the primary means of fall protection and an additional 3/8” steel cable rigging strap as a fail-safe.
- The second safety manager will be responsible for the coordination of the inspection of every worker’s harness.
- Inspections of the harness will be carried out at the beginning, end and every two hours of work performed.
- The second Safety Manager will be located on the ground floor, maintaining constant situational awareness of the integrity of the roof tiles, and radio this information to the Safety Controller on the roof.
- If any safety incidents should occur, the Safety Manager is to radio the Safety Controller to cease work immediately.
- If a fall occurs, the Safety Manger will liaise with the Safety Controller to cease work, then the Safety Manager will coordinate retrieving the fallen worker/s utilizing a man lift with secure points.
- Workers on the roof will move forward to the next section of roofing only when attachment points are made available by secured workers designated for that role, who are secured during the moving of secure points.

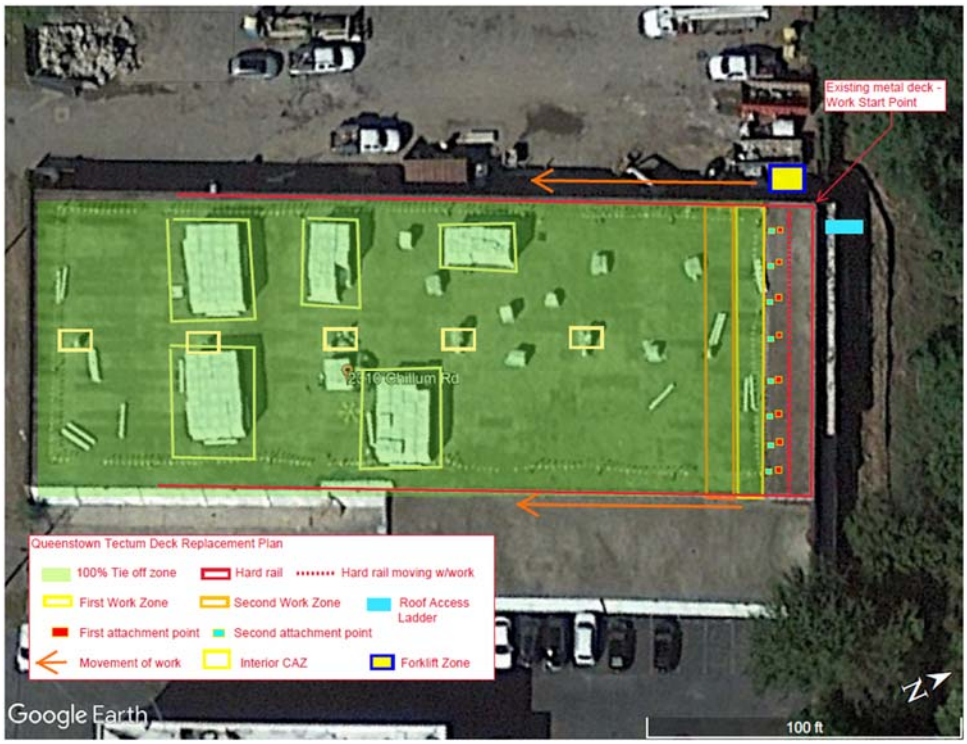


Figure 17: Diagram of Patuxent Roofing's Safety Plan and Hazard Mitigation for the site. The Arrow indicates incremental movements of 9 ft, if safe to do so.

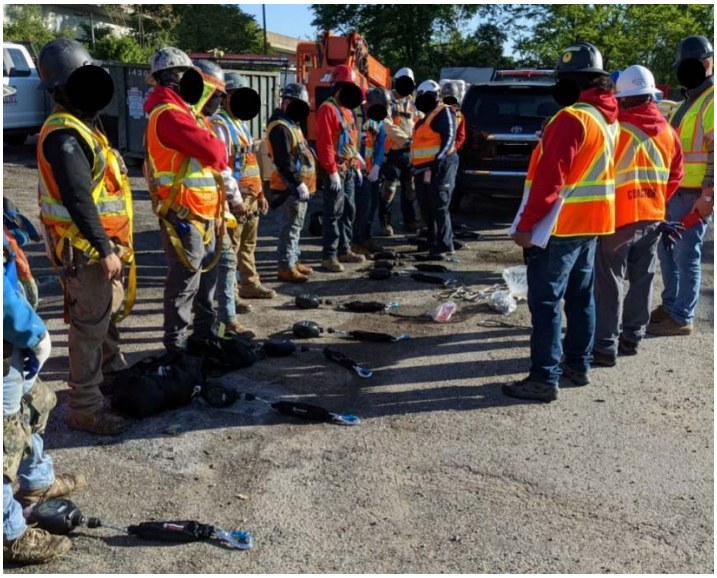


Figure 18: Patuxent Roofing Employees being instructed on the use of personal fall arrest systems as part of the rehearsal.

Figure 19: Patuxent Roofing Employees being instructed on the mounting point system.

The Second Safety Manager stated on June 2, 2022, the roofing project was finalized without any further safety incidents or injuries.

Weather

On April 25, 2022, at the time of the incident, NOAA recorded the temperature as 63° F, with significant cloud cover. The average relative humidity for the day was 71% humidity and an average windspeed of 18 MPH from the Northeast. Weather was not a contributing factor in this incident (Weather source: NOAA – Location: Washington, DC)

Human Factors

Fatigue Risk

WMATA personnel were not identified as contributory in this event. The biomathematical fatigue modeling application (SAFTE-FAST Web SFC) was not applied for this event.

Post-Incident Toxicology Testing

Post-Incident Toxicology Testing was not conducted due to emergency medical services being rendered to the injured contractor. No other personnel were identified as contributing to the event.

Findings

- The injured Contractor was wearing a hard hat, PFAS, and safety vest at the time of the event.
- There was no roof anchor present at the site; however, according to the MATOC Safety Manager, the Contractor was wearing a PFAS when she observed them being tended to post-incident.
- Patuxent Roofing stated their workers were not required to be harnessed due to the hard railing in place.

- Post-incident inspection revealed several cracked Tectum panels located under the bituminous surface, including the one that gave way out under the Contractor.
- Several safety concerns were raised by the MATOC Safety Manager, after work had commenced but were corrected prior to the incident.
- Two reports dated 2014 and 2019 both articulated structural issues with the roof, including damage to the Tectum decking.
- A site inspection conducted in September of 2021, comprising representatives of Patuxent Roofing, Mid Atlantic Sales and a Structural Engineer with Parsons concluded the Tectum Decking was installed incorrectly, without fasteners and in places, upside-down.
- The same site inspection also revealed structural weakness to the Tectum decking as a result of water damage in isolated spots, over time.

Immediate Mitigation to Prevention of Reoccurrence

- The WMATA Construction Manager placed a cease-work order on the site pending the investigation, after the incident.
- A safety-standdown was implemented by WMATA.
- Patuxent Roofing submitted a Safety Plan to return to work incorporating more appropriate fall protection.
- Patuxent Roofing's return to work incorporated several safety-focused interventions including 100% of workers operating on the roof would need to be wearing harnesses and be anchored and tethered with approved safety harnesses, with the emphasis placed on an expectation of another worker falling through the compromised Tectum decking.
- Other interventions included periodic inspections of harnesses and equipment, ground-based observation from the perimeter and inside the building, as well as a removal of excessive weight in the way of machines.
- The roofing project was finalized without any further safety incidents or injuries.

Probable Cause Statement

The probable cause for the event was an inadequate process to update and refine the Job Hazard Analysis for tasks as new hazards are identified. A contributing factor to the event was the lack of an engineered anchor point at the site of the material loading/unloading.

SAFE Recommendations/Corrective Actions

Corrective Action Code	Description	Responsible Party	Due Date
100026_SAFECAPS_SAFE_001	WMATA SAFE to distribute Safety Bulletin 22-03B, Fall Protection.	SAFE	Completed
100026_SAFECAPS_SAFE_002	Safety Stand Down to reinforce safety procedures and fall protection.	SAFE	Completed
100026_SAFECAPS_PRI_001	Replace incorrectly installed, water-damaged Tectum decking with steel-based decking	PRI	Completed
100026_SAFECAPS_PRI_002	Revised Job Hazard Analysis and Return-To-Work Site Safety Plan.	PRI	Completed

Corrective Action Code	Description	Responsible Party	Due Date
100026_SAFECAPS_PRI_003	Fall Protection Stand Down with Documented Attendance Log.	PRI	Completed
100026_SAFECAPS_CAPD_001	Update process to ensure SAFE personnel are included in site survey to assist in identifying hazards.	CAPD	9/30/2022
100026_SAFECAPS_CAPD_002	Review AHA/JHA requirements to ensure they are updated and reissued as new hazards are identified.	CAPD	9/30/2022

Appendices

Appendix A – Interview Summary

Safety Manager MATOC

The Safety Manager MATOC is a WMATA contractor employee with 43 years of experience, 30 of which with WMATA. The Safety Manager holds a Roadway Worker Protection (RWP) Level 2 certification that expires in July 2022. During the virtual interview, the Safety Manager stated that she worked with MATOC in this role for approximately three years.

The Safety Manager stated that she had arrived on scene to commence work at approximately 07:45 hours and had observed two teams of workers with Patuxent Roofing on the roof of the T-36 building. The Safety Manager stated she first observed a flatbed truck parked by the egress point to the roof. She advised Patuxent Roofing to remove the truck out of concern for limiting access to the roof.

The Safety Manager stated that when she got on top of the roof, she observed the hard guard rails were too close to the roof and had to be moved back approximately six feet, from the edge. She also observed multiple workers with too much slack in, and multiple crossed safety tether lines. The Safety Manager stated she was concerned the lines being both crossed and too long would not prevent injury, as intended.

The Safety Manager also stated she observed only two members of the removal team that were actively tethered to an engineered anchor point.

The Safety Manager stated she then relayed this information to the Superintendent on site; while on the roof, the Superintendent began disseminating the information and making the corrections immediately.

The Safety Manager observed that the team conducting the removal of the top layer of roofing was moving much faster than the team removing the bottom layer of roofing. The Safety Manager stated she also relayed this comment to the Superintendent on-site while still on the roof.

The Safety Manager then stated she began to make their way back towards the ladder when she heard screaming and was advised someone had fallen through the roof.

The Safety Manager stated she immediately called their chain of command and the Construction Safety Manager in order to inform them of the fall. The Safety Manager said she observed the WMATA Construction Inspector call emergency medical services.

The Safety Manager stated she then went to the ground level and observed the Contractor being aided by other workers on the scene. The Safety Manager stated she observed the Contractor in an arrest harness; however, she did not observe a tether or First Aid Kit on scene with them.

The Safety Manager stated that, as a precaution, per the initial Activity Hazard Analysis (AHA), all Contractors were required to be in an arrest harness, regardless of hard rails, as a precaution.

The Safety Manager stated she did not go inside the building, or under the work site to inspect the condition of the Tectum panels until after the incident had occurred. However, she said that over 12 months ago, she attended the site and noted water damage to several Tectum panels to their chain of command during their observations.

Appendix B – Pre-incident Activity Hazard Analysis (AHA)

Activity/Work Task: Roof Removal/General Roofing Activities	Overall Risk Assessment Code (RAC) (Use highest code) M					
Project Location: FQ19021-21-007 – T36 Queenstown	**Risk Assessment Code (RAC) Matrix**					
Contractor: Patuxent Roofing and Contracting	**Severity**	**Probability**				
Date Prepared: 08/10/2021		Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by: [redacted] Safety Manager	Catastrophic	**E**	**E**	**H**	**H**	**M**
	Critical	**E**	**H**	**H**	**M**	**L**
Reviewed by (Name/Title):	Marginal	**H**	**M**	**M**	**L**	**L**
	Negligible	**M**	**L**	**L**	**L**	**L**
Notes:	Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)					
	"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.	**RAC Chart**				
	"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible	**E = Extremely High**				
		H = High Risk				
	Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.	**M = Moderate Risk**				
		L = Low Risk				

Job Steps	Hazards	Controls	RAC
1. Removing roofing materials from substrate.	**1.A** Hands caught in under or between objects or materials **1.B** Falls same level resulting from walking working surfaces **1.C** Struck by moving equipment or forklift **1.D** Struck by material shifting during transport **1.E** Strains form utilizing shovels, brooms, and/or other hand tools during clean up and removal **1.F** Injury to employee from operating cutting/scrapping machines. **1.G** Back from strain from lifting **1.H** Falls from higher than six feet	**1.A** All employees will be required to wear construction attire hardhats, ANSI rated z-87 safety glasses, type II safety vest, work pants, long sleeve shirt, work gloves and safety toed boots. **1.B** Good housekeeping, including keeping the area free of tripping hazards. The onsite foreman shall designate two personnel to perform good housekeeping duties. **1.C** All employees required to wear high visibility vest, and practice good awareness of your surroundings. **1.D** Ensure properly loaded into transport taking care not to overload **1.E** Use proper ergonomics while using tools, use rotation of duties to minimize repetitive motions, and rest as needed **1.F** Employees trained in safe use of equipment, following all manufacturer recommendations. **1.G** Use proper lifting technique. Employees are not allowed to lift more than 50 pounds without assistance. Anything beyond 50lbs will require mechanical means (Forklift/mobile cart, etc.) **1.H** The fall protection will be installed prior to the initial startup of the project and checked daily by onsite foreman daily to ensure compliance.	**M**
2. General Roofing Activities	**2.A** Cuts and abrasions **2.B** Heat Illness Injury	**2.A** All employees will be required to wear construction attire hardhats, ANSI rated z-87 safety glasses, type II safety vest, work pants, long sleeve shirt, work gloves and safety toed boots.	**M**

		2.B An adequate supply of cool drinking water shall be supplied in all work areas in the form of disposable water bottles. Employees should wear breathable cotton clothing. Sunscreen is recommended.	

Equipment to be Used	Training	Inspection Requirements
Wheelbarrows, roof dolly, 4-wheel carts.	Trained in proper use of equipment.	Daily inspections of equipment.
Hand or power tools to include: Trowels, hammers, high speed drills, knives, and extension cords, shovels, digging bars.	Inspect equipment tools daily or before each use Inspect safety guards Inspect extension cords and GFCI equipment Daily inspections must be documented	Prior to start of work at the jobsite the accident prevention plan and AHA shall be reviewed. All employees must be trained in proper use of all tools/equipment.
Extension ladders (if necessary)	Employees trained in ladder safety.	Inspect ladder daily for damages, if damages are found ladders must be removed from service immediately.
Power generators	Trained in proper used of equipment.	Daily inspections of equipment.
Forklift (if necessary)	Operator certified with card in possession.	Daily inspections of the machinery and safety devices/tires, backup alarms, brakes, seat belt etc.

Appendix C: Parsons Structural Engineer Report

Summary of Site Visit on 09-07-2021

A site visit was conducted on 09-07-2021 with

[redacted]

WMATA escort.

The Tectum Rep mentioned that the existing Tectum panels were not appropriate for the span configuration for the building, existing installation was unsafe.

[redacted] mentioned that water seepage into the existing tectum panels have made it structurally weaker material which was evident from the previous site visit pictures taken at the job site

[redacted] and [redacted] mentioned that the panels (new) should be designed and installed as a roof diaphragm and to be installed with fasteners to transfer the diaphragm shear.

[redacted] mentioned his preference for metal deck with fasteners in lieu of Tectum panels as metal deck is more durable and efficient in diaphragm load transfer and can also be designed for the FM global rating I-90

Perimeter supports for the new deck was discussed with the contractor and the constructability of the details.

[redacted] was going to generate design criteria for design and installation of new deck

[redacted] was concerned about WMATA Safety requirements if all Tectum removed.

Tectum Rep to send a cost proposal for new variant of Tectum panels installation to the contractor.

Appendix D – Patuxent Roofing Documents Post-Incident

Activity/Work Task: Roof Removal – Tectum Deck	Overall Risk Assessment Code (RAC) (Use highest code)					**M**
Project Location: T36 Queenstown	**Risk Assessment Code (RAC) Matrix**					
Contract Number: FQ19021-21-005	**Severity**	**Probability**				
Date Prepared: 04/28/2022		Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by (Name/Title): [redacted]	Catastrophic	**E**	**E**	**H**	**H**	**M**
	Critical	**E**	**H**	**H**	**M**	**L**
Reviewed by (Name/Title): [redacted]	Marginal		**M**	**M**	**L**	**L**
Contractor/Subcontractor: Patuxent Roofing	Negligible	**M**	**L**	**L**	**L**	**L**
Notes: (Field Notes, Review Comments, etc.) During work, all employees shall wear PPE which includes hard hat, safety glasses, work boots, high visibility vest, long pants and long shirt, and gloves. Employees in the 100% tie off area will wear a full body harness and be connected by retractable and backup cable fall protection – See overhead for 100% tie off area – Work zone moves forward until roof is complete.	Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above). The RAC is developed after correctly identifying all of the hazards and fully implementing all controls.					
	"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.	**RAC Chart**				
	"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible	**E = Extremely High Risk**				
		H = High Risk				
	Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of JHA.	**M = Moderate Risk**				
		L = Low Risk				

Job Steps	Hazards	Controls	P	S	RAC
1. Removing roofing materials from tectum deck	1.1 Hand caught in, under, or between objects or materials	1.1.1 All employees will be required to wear construction attire hardhats, ANSI rated z-87 safety glasses, type II safety vest, work pants, long sleeve shirt, work gloves and safety toed boots.	S	Ma	L
	1.2 Falls from same level resulting from walking working surfaces	1.2.1 Good housekeeping to include keeping area free of tripping hazards	S	Ma	L
	1.3 Struck by forklift	1.3.1 Awareness of surroundings	U	Ma	L
	1.4 Strains from tearing off roofing material	1.4.1 Use equipment properly	O	Ma	M
		1.4.2 Recognize strain symptoms and rest as needed	O	Ma	M
	1.5 Back injury	1.5.1 Use of proper lifting technique for materials less than 50lbs	O	Ma	M
		1.5.2 Lifting anything more than 50lbs will require mechanical means (cart, etc.)	O	Ma	M
	1.6 Falls	1.6.1 Fall protection will be installed prior to startup and checked daily by foreman to ensure compliance.	U	Ca	M
		1.6.2 Limit work to maximum 9-foot area to reduce potential fall distance	U	Ca	M
2. Removing tectum deck	2.1 Hand caught in, under, or between objects or materials	2.1.1 All employees will be required to wear construction attire hardhats, ANSI rated z-87 safety glasses, type II safety vest, work pants, long sleeve shirt, work gloves and safety toed boots.	S	Ma	L
	2.2 Falls from same level resulting from walking working surfaces	2.2.1 Good housekeeping to include keeping area free of tripping hazards	S	Ma	L

	1.3 Struck by forklift	1.3.1 Awareness of surroundings	U	Ma	L
	1.4 Strains from lifting material	1.4.1 Use equipment properly	O	Ma	M
		1.4.2 Recognize strain symptoms and rest as needed	O	Ma	M
	1.5 Back injury	1.5.1 Use of proper lifting technique for materials less than 50lbs	O	Ma	M
		1.5.2 Lifting anything more than 50lbs will require mechanical means (cart, etc.)	O	Ma	M
	1.6 Falls	1.6.1 Fall protection will be installed prior to startup and checked daily by foreman to ensure compliance.	U	Ca	M
		1.6.2 Limit work to maximum 9-foot area to reduce potential fall distance	U	Ca	M
2.General Roofing Activities	2.1 Heat illness injury	2.1.1 An adequate supply of cool drinking water shall be supplied in all work areas	O	Ma	M
		2.1.2 Breathable cotton clothing, as well as sunscreen is recommended.	O	Ma	M
	2.2 Cuts and abrasions	2.2.1 All employees will be required to wear construction attire hardhats, ANSI rated z-87 safety glasses, type II safety vest, work pants, long sleeve shirt, work gloves and safety toed boots.	O	Ma	M

Equipment(s) to be Used	Competent Person/Personnel name(s)	Inspection Requirements
Wheelbarrows, roof dolly, 4-wheel cart	[redacted]	Daily inspection of equipment
Hand or power tools, including trowels, hammers, high speed drills, knives, extension cords, shovels, digging bars		Inspect tools daily Inspect safety guards Inspect extension cords and GFCI equipment
Fall protections to include, anchor points, retractable, cable ties with saddle clamps, and full body harness		User Inspection: Personal fall arrest systems will be inspected by the user before each use. In addition, the user should check before each use to be sure a formal inspection had been performed within the last six months. Competent Person Inspection: Personal fall arrest system must be inspected be a competent person prior to each use and monthly. Procedures for Inspection: Inspect all webbing (Straps) and stitching for cuts, fraying, pulled or broken threads, abrasions, excessive wear, altered or missing straps, burns, heat, and chemical exposures. Inspect all ropes for cuts, frays, pulled and/or broken strands, abrasion, excessive wear, burns and chemical exposures. Inspect metallic parts (d-ring, snap hooks, buckles, adjusters and grommets) for deformation, fractures, cracks, corrosion, deep pitting, sharp edges, cuts, deep nicks, missing or loose parts, improper function, evidence of burns, excessive heat and chemical burns
Forklift		Daily inspection of equipment, tires, backup alarm, brakes, seat belt, etc.

Figure 1: Revised Job Hazard Analysis

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T36 Queenstown Tectum Deck Replacement
Site Safety Plan

To facilitate the safe removal of the tectum deck the following steps will be taken. Please refer to attached overhead for visual reference.

Safety Setup

Work will begin from the Roof C the existing metal deck. There will be two D-ring tie off points for each employee. The first method of fall protection will be a full body harness attached to a Safewaze retractable. The backup fall protection will be a 3/8" steel cable rigging strap (manufactured, with rating labels. (See product data sheets attached) The employee will also be using all PPE listed in the JHA

Safety Inspections

Before work begins the competent person [redacted] will inspect the harness fit on all employees. He will inspect the attachment of all anchor points. He will inspect the connection of all D-rings from the anchor points to the employee. He will explain the procedure for work to all employees before any work begins. Two hours past this first inspection, [redacted] will stop all work, and he will re-inspect all fit and connections again.

Work Steps

100% Tie off when working on the tectum deck as noted on the overhead

Before any work begins, there will be a rehearsal on the ground of the work steps, ensuring complete understanding of all parties.

The workers will begin by tearing off roofing membrane (hand tear off, no machines) and removing the tectum deck from the work start point and move only 9 feet ahead into the first work zone. The debris will be taken back to the hard rail zone where employees will move the trash to the forklift download zone.

Then three panels of new steel deck will be set in place and fastened. Once those pieces are secured across the first work zone, work will stop, and the attachment points will move forward from Roof C and be reattached in the first work zone. The person moving the attachment points will remain attached to one of the original attachment points until the other 7 are moved. He will then attach to the relocated attachment points and move the last attachment point. Elvis will complete the safety inspections above. Once he has completed inspections, work will begin in the next 9-foot section.

The arrows indicate that work will move forward in the same manner, incrementally in 9-foot sections. The hard rail and forklift will also move forward to facilitate trash removal.

Accessing Roofing Materials

To access materials stored on the roof, three panels of side-by-side steel decking will be loose laid, creating a 9-foot-wide path. This path will begin at the edge of the steel deck to the location of the

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stored materials. The steel path will cross over the existing purlins to create a safe walk surface to and from the material. Workers using the path to move material will tied off with a rope and rope grab. All paths will be greater than six feet from the roof edge. This method will only happen at a hold point in work, and with WMATA SAFE approval at the time of use.

Interior Controlled Access Zone

Areas inside the building that are below the stored roofing material, and the vents will be coned and flagged off for safety. Once the CAZ is established, only [redacted] will be allowed in this area. He will be observing the work from afar to watch for any deck areas that appear compromised or likely to give way. If [redacted] observes anything of concern, he will radio to the safety controller above to stop all work and move all workers into the area of metal deck. Then the situation will be accessed on how to begin work again safely.

Rescue Plan

If a worker falls and is suspended below the deck [redacted] will radio to the safety person on top that all work must stop, and the workers must move back to the steel deck. A manlift inside the building will be moved to the location of the suspended worker, and the manlift will be raised to the height of the worker, who will be detached from the fall protection, secured to the man lift, and lowered down. WMATA SAFE will be notified and all equipment (harness, anchorpoint, ect) will be taken out of service. [redacted] will then escort the employee safely outside for observation.

Nearest Hospital – Medstar Washington 110 Irving St NW, Washington, DC 20010 – [redacted]

Figure 2: Revised Site Safety Plan

PATUXENT ROOFING & CONTRACTING, INC.

SAFETY INSPECTION CHECKLIST

Inspected by: ______________________ **Date:**_______________ **Time:** ______________________

ITEM	YES	NO	CORRECTIVE ACTION
1. All harnesses proper fit with D ring in correct position?			
2. D-rings have all fasteners?			
3. D-rings fastened into structural attached steel deck?			
4. All YoYo's fastened properly to harness and D-ring?			
5. Manlift positioned inside, but outside of work area?			
6.			
7.			
Inspected by: ______________________ **Date:**_______________ **Time:** ______________________			
1. All harnesses proper fit with D ring in correct position?			
2. D-rings have all fasteners?			
3. D-rings fastened into structural attached steel deck?			
4. All YoYo's fastened properly to harness and D-ring?			
5. Manlift positioned inside, but outside of work area?			
6.			
7.			
Inspected by: ______________________ **Date:**_______________ **Time:** ______________________			
1. All harnesses proper fit with D ring in correct position?			
2. D-rings have all fasteners?			
3. D-rings fastened into structural attached steel deck?			
4. All YoYo's fastened properly to harness and D-ring?			
5. Manlift positioned inside, but outside of work area?			
6.			
7.			
Inspected by: ______________________ **Date:**_______________ **Time:** ______________________			
1. All harnesses proper fit with D ring in correct position?			
2. D-rings have all fasteners?			
3. D-rings fastened into structural attached steel deck?			
4. All YoYo's fastened properly to harness and D-ring?			
5. Manlift positioned inside, but outside of work area?			
6.			
7.			

Figure 3: Blank Safety Inspection Checklist

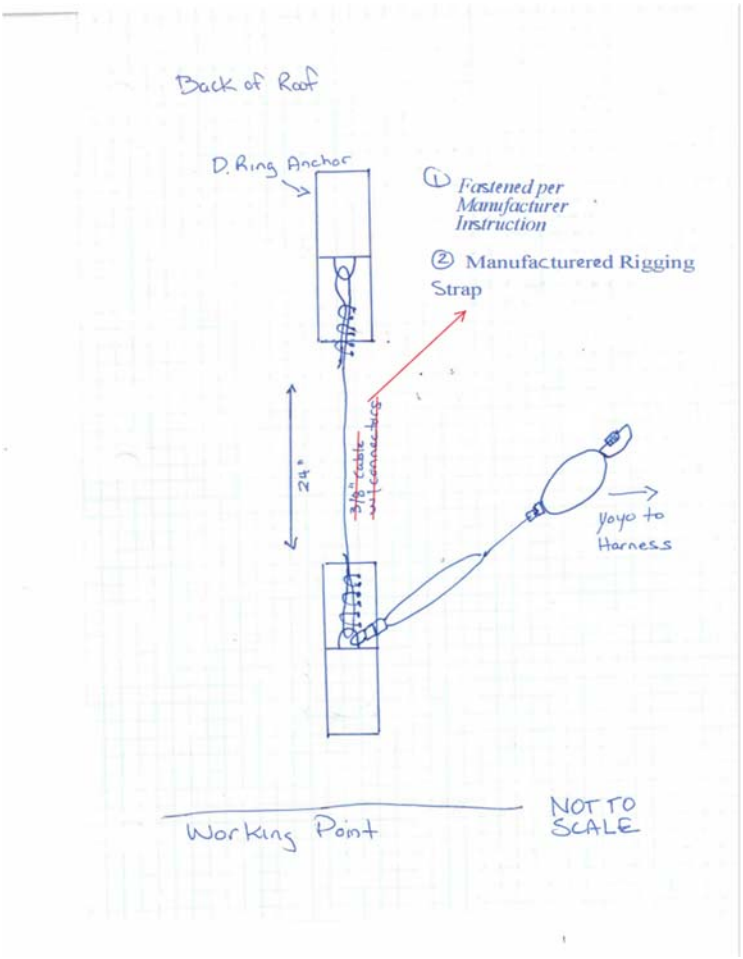


Figure 4: Concept Diagram and explanation of Anchor Point

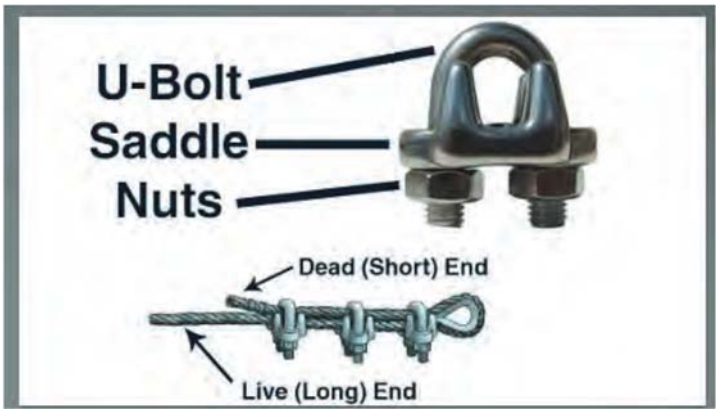


Figure 5: Mounting Bolt Diagram.

America's Largest Importer/Wholesaler of Wire Rope, Chain and Fittings!

INDUSCO WIRE ROPE & FITTINGS

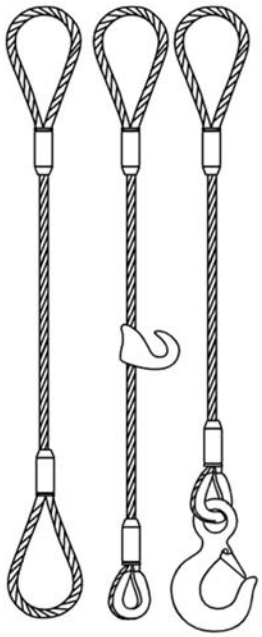
WIRE ROPE SLINGS

VERTICAL, CHOKER, VERTICAL BASKET

FLEMISH SPLICE IWRC

• Rated capacities shown below apply only to 6x19 and 6x36 classification wire rope.

Rope Diameter	Vertical		Choker		Vertical Basket	
	Rated capacity in tons of 2,000 lbs.					
	IPS	EIPS	IPS	EIPS	IPS	EIPS
1/4	0.56	0.65	0.41	0.48	1.1	1.3
5/16	0.87	1.0	0.64	0.74	1.7	2.0
3/8	1.2	1.4	0.92	1.1	2.4	2.8
7/16	1.7	1.9	1.2	1.4	3.4	3.8
1/2	2.2	2.5	1.6	1.9	4.4	5.0
9/16	2.8	3.2	2.0	2.4	5.5	6.4
5/8	3.4	3.9	2.5	2.9	6.8	7.8
3/4	4.9	5.6	3.6	4.1	9.7	11
7/8	6.6	7.6	4.8	5.6	13	15
1	8.5	9.8	6.3	7.2	17	19.6
1-1/8	10	12	7.9	9.1	20	24
1-1/4	13	15	10	11	26	30
1-3/8	15	18	12	13	30	36
1-1/2	18	21	14	16	36	42
1-3/4	25	28	19	21	50	56
2	32	37	24	28	64	74
2-1/4	39	44	30	35	78	88
2-1/2	47	54	37	42	94	108
2-3/4	57	65	44	51	114	130
3	67	77	52	60	134	154



RATED CAPACITIES BASKET HITCH BASED ON D/d* RATIO OF 25

RATED CAPACITIES BASED ON PIN DIAMETER NO LARGER THAN NATURAL EYE WIDTH OR LESS THAN THE NOMINAL SLING DIAMETER

RATED CAPACITIES BASED ON DESIGN FACTOR OF 5:1

HORIZONTAL SLING ANGLES LESS THAN 30 DEGREES SHALL NOT BE USED

*D/d= Diameter of Rope in relation to diameter of object to be lifted

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WARNING Never exceed working load limit.
See pages 4 - 10 for important safety information.
All measurements/units listed are in inches/pounds unless otherwise noted.

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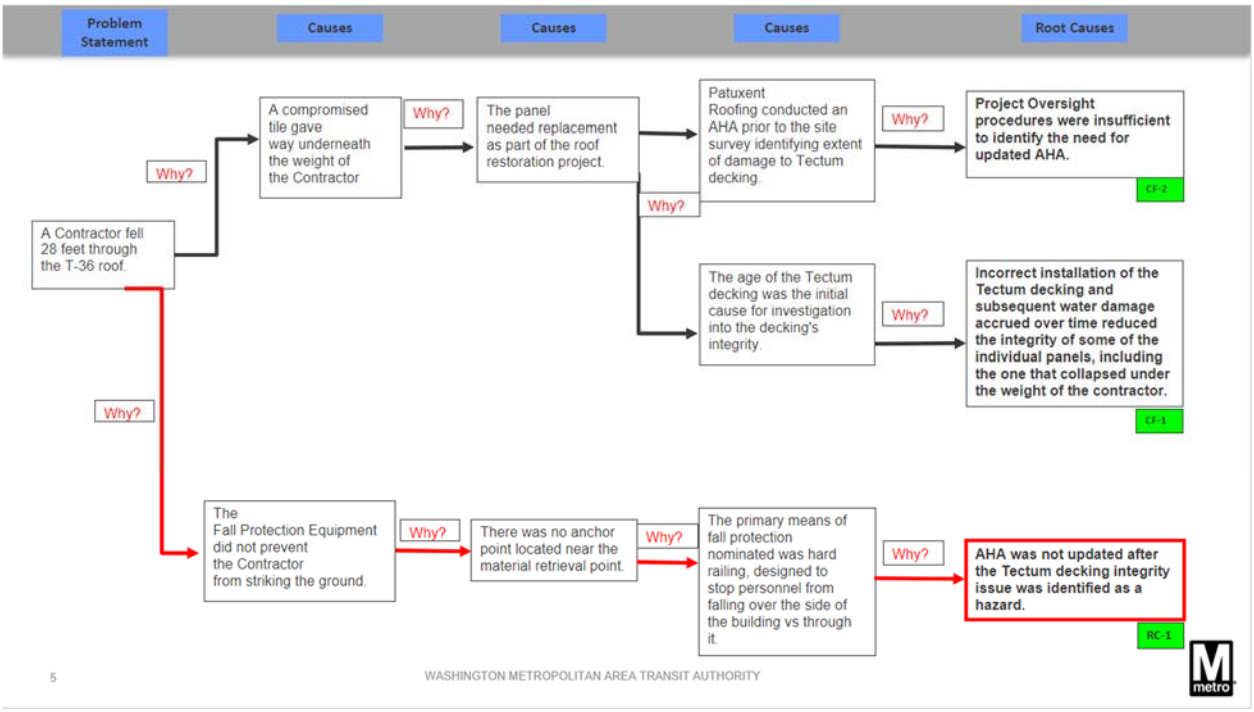
Figure 6: Wire Rope Fittings Weight Ratings

Appendix E - Root Cause Analysis


Problem Statement
Causes
Causes
Causes
Root Causes
A Contractor fell 28 feet through the T-36 roof.
Why?
A compromised tile gave way underneath the weight of the Contractor
Why?
The panel needed replacement as part of the roof restoration project.
Why?
Patuxent Roofing conducted an AHA prior to the site survey identifying extent of damage to Tectum decking.
Why?
Project Oversight procedures were insufficient to identify the need for updated AHA.
CF-2
Why?
The age of the Tectum decking was the initial cause for investigation into the decking's integrity.
Why?
Incorrect installation of the Tectum decking and subsequent water damage accrued over time reduced the integrity of some of the individual panels, including the one that collapsed under the weight of the contractor.
CF-1
Why?
The Fall Protection Equipment did not prevent the Contractor from striking the ground.
Why?
There was no anchor point located near the material retrieval point.
Why?
The primary means of fall protection nominated was hard railing, designed to stop personnel from falling over the side of the building vs through it.
Why?
AHA was not updated after the Tectum decking integrity issue was identified as a hazard.
RC-1
5
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
metro