Investigation & Schematic Design Report for:

State of Washington Natural Resources Building Roof Replacement & EIFS Repairs

Project No. 2011-276 A (1)

January 19, 2012

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EXECUTIVE SUMMARY

S.M. Stemper Architects and our subconsultants *(SMSA Team)* have completed the initial investigation of the Natural Resources Building *(NRB)* Roof Replacement & Exterior Insulated Finish System *(EIFS)* Repairs project. Enclosed for your review is the **Investigation & Schematic Design Report.**

The SMSA Team was hired by the State of Washington under a competitive selection process to assess the current condition of the NRB Roof and EIFS and to prepare design solutions for the Roof Replacement & EIFS Repairs. Our observations, research, analysis and cost estimates encompass the Scope of Work as defined in the State of Washington agreement dated October 10, 2011.

Results of our review are presented and summarized in the *"Report Summary & Overview"* tabbed section. The SMSA Team's results and recommendations are elaborated in more comprehensive sections of this report as follows:

COST ESTIMATES	4 Options — ranging from a Multi-phased solution with Phase 1 that works with current MACC, to a single-phase full replacement of failed systems
ROOF EVALUATION	Forensic Test Results *(including observation, test openings of roof and insulation throughout roof areas);* Summary of Findings & Recommendations
EXTERIOR WALL & WINDOW EVALUATION	Forensic Test Results *(including observation, Infrared Thermographic and RILEM Tube Testing);* Summary of Findings & Recommendations
FALL PROTECTION REPORT	Analysis of existing window washing system; 4 Proposals for upgraded fall protection systems with cost estimates; 11 Fall Protection equipment options
ENVIRONMENTAL REPORT	Pending *(not finalized for inclusion in this report)*
APPENDIX	Project Schedule *(revised from earlier versions)*, Product Information for alternative cladding system options

While correction of the roof leak issues continues to be a primary project focus, the building envelope investigation has revealed more significant water intrusion at the windows and exterior cladding system than previously understood ***(refer to the enclosed Exterior Wall & Window Evaluation).*** Further, the presence of mold has been detected in initial BET&R investigative sampling, which was tested by the State of Washington DES Environmental Group/Officer. ***A definitive environmental report by PBS, has not been finalized.***

- Consequently, the complexity of the design solutions has increased and resulted in higher overall cost estimates ***(see Cost Estimates).***
- The primary focus and driving force of this project could shift from mitigating the roof leak issues to dealing with water intrusion of the wall and windows as well as incorporating environmental concerns into the final design.
- It will be important to prioritize project goals based on this investigation, the team's findings and evaluation and the overall available budget, in concert and collaboration with the Owner/Client.

EXECUTIVE SUMMARY *CONTINUED*

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REPORT SUMMARY & OVERVIEW

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REPORT SUMMARY & OVERVIEW

The consultant team of S.M. Stemper Architects *(SMSA)*, Building Envelope Technology and Research *(BET&R)*, Gravitec Systems Inc. *(Gravitec)*, and PBS Engineering + Environmental *(PBS, a later direct hire of Owner)* was selected by the standard state proposal request and interview process for the Natural Resources Building (NRB) Roof Replacement & EIFS Repairs Project.

Report Purpose: The purpose of the **NRB Investigation & Schematic Design Report** is to document the investigative phase that has been undertaken and to provide solution options, recommendations, and cost estimates for the project.

The investigation phase included the collection and review of the pertinent original construction drawings and specifications, an on-site review of the building and it's known building envelope failures with the maintenance staff, and the team's on-site testing and exploration of building as-built conditions.

As the data was collected the team began to analyze the information to determine the root causes of the building envelope failures. After the identification of the failure modes - possible solution options were considered and organized into repair scenarios for the building. Finally cost estimates were constructed for the various scenarios.

Report Contents: The goal of the **NRB Investigation & Schematic Design Report** is to present the documentation of these processes in a coordinated, logical manner, providing all parties involved in the decision making process, the information to select a course of action for the project to move forward through the design and construction process to the successful resolution of the existing building envelope failures.

The **NRB Investigation & Schematic Design Report** is organized into seven sections plus appendix:

Executive Summary
Report Summary & Overview *(Provides an overview of the project & the four separate scope of work reports & cost estimates. The individual reports contain detailed documentation of the investigation, findings & recommendations.)*
Cost Estimates
Roof Evaluation
Exterior Wall & Window Evaluation
Fall Protection Report
Environmental Report
Appendix

PROJECT BACKGROUND:

GENERAL:

The Natural Resources Building *(NRB)*, located at 1111 Washington Street SE, in Olympia, is owned by the State of Washington. This 352,000 sf, seven-story building *(ranges from 4-7 stories)*, was designed by C.W. Fentress/J.H Bradburn & Associates and completed in 1992. The building has been occupied by the State of Washington Natural Resources Agencies dating from 1992. An extensive, below-grade parking garage is located under the Natural Resources Building that also contains storage and laboratory space and houses a service tunnel.

REPORT SUMMARY & OVERVIEW *CONTINUED*

The Natural Resources Building has incurred minor maintenance/repair work over the years and as part of a broad energy efficiency initiative at the State Capitol in 2004, lighting fixture upgrades were made to the NRB. However there have been no additions, renovations or other major types of construction to the building that were discovered in our research.

During the investigative phase, the maintenance staff noted that leaking has occurred in roof and wall areas for much of the life of the building. There is evidence and reports from staff that maintenance attempts have been made to remedially address the problems, though we observed no large-scale patching or repair work.

PRIOR LEAK DETECTION: A review of archives shows that in recent years, there was a generally unsuccessful project by KMB Design Development (KMB), to stop leaks from the pedestrian plaza at the NE corner of the building into the parking garage and interior spaces below. Many of the original leak problems are active again. In March 2007, a "Thermographic Building Envelope Moisture Survey" was performed by Infrared Survey Consultants, Inc., as directed by KMB Design Development. Testing was conducted only at leak points on the South side of the NRB. Copies of this survey were provided at a building walk-through meeting during the consultant pre-selection process in July 2011.

Per the then State Project Manager, no further substantive investigation was commissioned at that time and no formal report was issued. The results, however, reveal evidence of potentially problematic, on-going leaking, and likely formed the basis for the larger scale project that the SMSA Team is conducting.

BUILDING CODE:

A preliminary building code analysis of affected exterior wall systems was conducted as part of the study. We communicated with the City of Olympia Building Department to discuss the scope of the project to gain a preliminary understanding of the code implications for the project. *Project details include:*

Building Location: Washington State Capitol Campus
1111 Washington Street SE
Olympia, WA 98501

Zoning Classification: Location is within the "Capitol District" *(per City of Olympia zoning department)*
Capitol District imparts no special regulations for this project
Design Review: Will require review of the Capitol Design Advisory Committee for any building cladding changes *(because of its location on the State of Washington Capitol Campus)*

Building Type: "Type 1" Construction when built *(1990-1992)*
"1 B" under IBC – *(awaiting confirmation from Olympia Building Department).* Classification change will have no impacts on any of the work of this project.

Permitting: **Roofing Repairs:** Building department requires a permit for roofing repairs only when the structural deck is impacted, which is a possibility for this project *(need to verify in Phase II design).*
Wall Cladding Repairs: Building department requires a permit for this work.

BUILDING CODE HISTORY / IMPACTS:

NRB was constructed in 1990 – 1992 under the 1988 (UBC) Uniform Building Code. Building codes have evolved and changed dramatically since that time and construction is now governed by the International Building Code (IBC) and IBC-Existing Building Code.

- The IBC contains provisions pertaining to the construction of EIFS-based systems whereas there were no such EIFS provisions in 1990-1992.

REPORT SUMMARY & OVERVIEW *CONTINUED*

- In addition, the State of Washington has adopted a state energy code that governs the energy performance of newly constructed and renovated facilities. The 2009 code is effective January 1, 2011.

This project may be considered as a maintenance and repair project and not subject to the IBC requirement of a new construction or major remodel project. However, the code provision governing the use of EIFS is noted below:

> "IBC Section 1403.2, Weather Protection. Exterior walls shall provide the building with a weather-resistant exterior wall envelop. The exterior wall envelop shall be designed and constructed in such a manner as to prevent the accumulation of water within the wall assembly by providing a water-resistive barrier behind the exterior veneer and a means of draining water that enters the assembly from the exterior."

IBC Section 1408, "Exterior Insulation and Finish Systems (EIFS)," stipulates that EIFS shall be governed by certain performance characteristics, including the design of the adequate backing substrate, weather resistance, drainage requirements, and water-resistive barrier. In addition, the EIFS is to be installed according to the manufacturer's instructions.

IBC Section 1704, "Special Inspections," stipulates that EIFS applications shall be subject to special inspections unless constructed with a water-resistive barrier.

ENERGY CODE: The 2009 Washington State Energy Code includes provisions for "Alterations and Repairs" that will pertain to any repair, alteration or recladding project undertaken at the Natural Resource Building. First, the code calls for a conformance to the current energy code, even if the project only involves an alteration or repair.

However, there are exceptions to this provision. ***Exception #4 reads:***

> *"#4 Existing roof/ceiling, wall or floor cavities exposed during construction provided that these cavities are insulated to full depths with insulation having a minimum nominal value of R-3.0 per inch installed per Sections 1311 and 1313.5."*

- In the case of the NRB, the exterior wall insulation is not subject to comply with the current wall insulation value (R-21).
- In areas where walls are constructed of metal framing with partial batt insulation or no insulation, the energy code requirement for R-21 will not be required if the framing cavities are to be filled with full depth batt insulation.
- Areas of the new roof will be required to be upgraded to the code required R-30 because the insulation is above the deck without framing cavities, if the wall framing cavity is to be filled with depth batt insulation.

NRB Roof Survey and Destructive Testing October 2011

REPORT SUMMARY & OVERVIEW *CONTINUED*

Cost Estimate Option #1 — Energy Code: Cost Estimate Option #1 allows for current energy code requirements to be met by replacing existing building envelope components with new code compliant materials providing improved building conservation over the repair of existing building envelope components called for in Cost Estimate #2.

ROOF SYSTEM EVALUATION:

In general, the survey findings indicate that the NRB's EPDM *(ethylene propylene diene-terpolymer)* roof membrane has shrunk, in specific areas significantly, resulting in bridging at the parapet walls, and exposed mechanical equipment curbs. In locations, light ballast coverage and membrane shrinkage has produced opposing sheer force strain at the seams, which are causing progressive peel and the failure of some field seams. Thus, there are scattered leaks and/or breaches in the field of the roof system on certain roof areas of the building. However, on several roof areas the roofing membrane material was found to have excess aggregate ballast, which provided shielding from the sun and weather and is generally in relatively good, serviceable condition.

Failed sealant joints and cracks in the EIFS (exterior insulation finish system) cladding and EIFS coped top of the parapet walls, has allowed moisture intrusion into the parapet, roofs, and underlying walls in locations. In some areas this water is wetting roofing materials and water is leaking into the building below as well.

RECOMMENDATIONS:

Because of the condition of the roofing components, the Design Team recommends that as much of the following work be completed in 2012 as budget *(MACC)* allows:

1. Installation of new sheet metal coping caps at most EIFS coped parapet walls. Repair and ??? additional membrane (i.e., PMMA Waterproofing) flashings are necessary where installation of sheet metal coping is not practical due to excessively wide parapets and intersecting rising columns.

2. Complete tear-off and re-roof of Roof Areas 1, 4, 5, 6,7. **Reference NRB Diagram on Page 5 for roof area locations**;

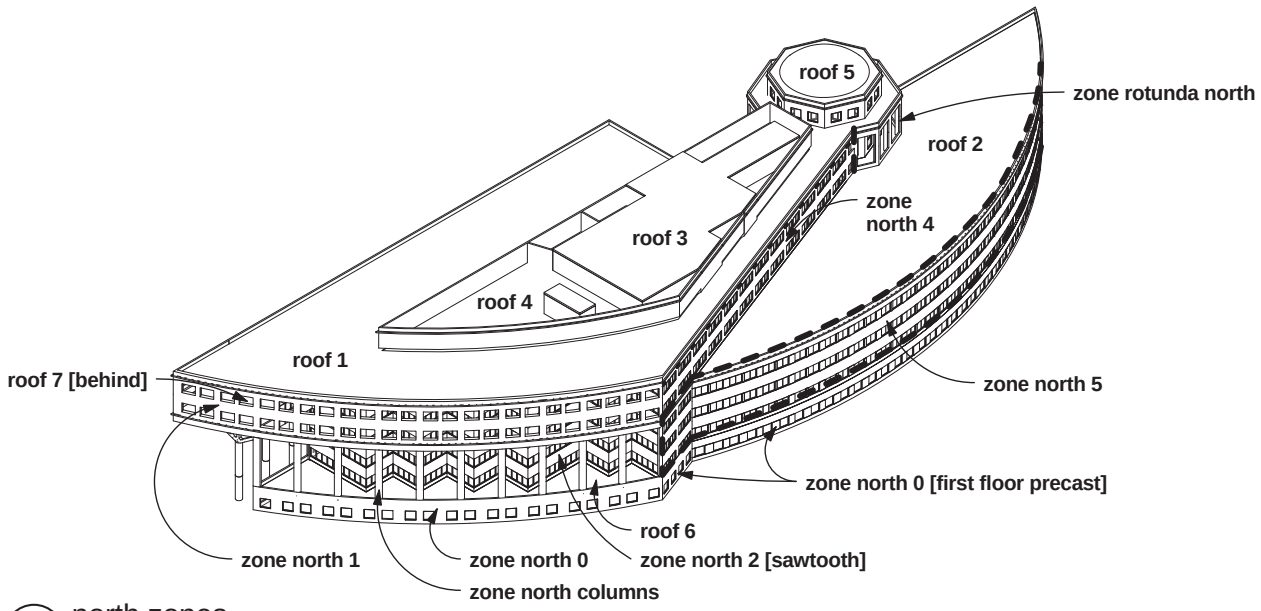
3. Repair and retrofit of Roof Areas 2 and 3 **Reference NRB Diagram on Page 5 for roof area locations**;

4. See BET&R Roofing Evaluation Report for more extensive information about the roofing investigation, findings and recommendations.

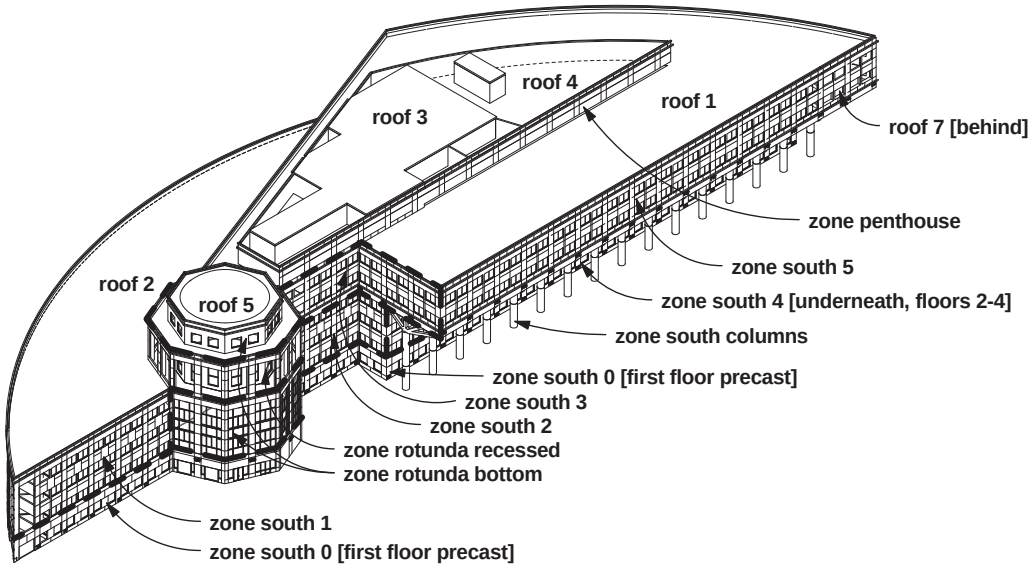
NRB Roof Survey and Testing October 2011

REPORT SUMMARY & OVERVIEW *CONTINUED*

NATURAL RESOURCES BUILDING ENVELOPE ZONE DIAGRAM:



1 north zones



2 south zones

REPORT SUMMARY & OVERVIEW *CONTINUED*

TIMING OF REPAIRS:

These priority reroofing and parapet repairs should be undertaken as soon as possible to prevent further damage to the walls' interior and interlying structure of the Building, as well as to help abate and halt further proliferation of fungal growth.

Considering the condition of the existing roof membranes and the performance of the roof as a whole, as well as the priorities of other building envelope system repairs *(i.e., particularly the cladding and walls' components)*, it is possible to reroof some roof areas, and repair some of the other existing EPDM roof areas.

With properly detailed and thorough roof repair design, these select roof areas could provide 7-12 years of additional service life.

No life cycle costing analyses has been done, but it appears that the cost of repairs on an average yearly basis is relatively comparable to the average yearly cost for new roofing membranes. New replacement roofing installations do save money over the 30-year life expectancy by eliminating the costs of designing and managing multiple projects.

Complete failure of South Elevation Soffit due to water intrusion at EIFS and Windows in wall *above*.

REPORT SUMMARY & OVERVIEW *CONTINUED*

EXTERIOR WALL AND WINDOW EVALUATION:

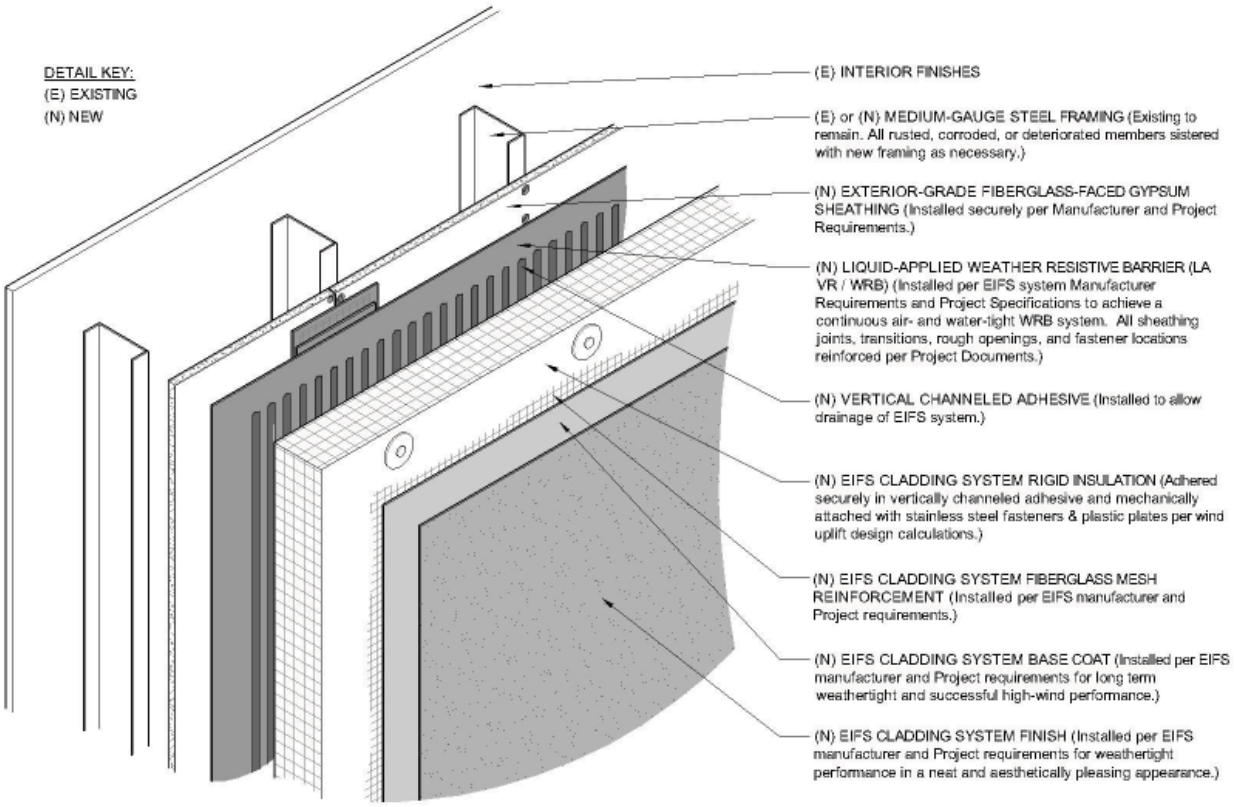
Widespread leaks have occurred along the south elevation as the result of deficiencies in the EIFS cladding and aluminum-framed window systems.

Inadequate window flashings, poorly detailed and failed sealant joints, cracks in the lamina of the EIFS *(exterior insulation finish system)* cladding at exterior walls, and failed EIFS parapet coping are allowing much water intrusion into the building's perimeter wall assemblies. And, a number of the existing window units appear to be contributing to the leakage.

As a result, and compounded by the fact that the existing cladding is an old style "barrier system" without a back-up drainage plane, wide-spread water damage has occurred, including fungal growth, damaged building materials, and corrosion of steel curtain wall framing, particularly widespread on the south elevation of the building that faces the prevailing weather. On the other elevations, which are not exposed to as much wind-driven rain, the walls appear to be in better condition resulting in less damage from water intrusion.

NRB Window & Wall Testing October 2011

Diagram below: Schematic Layout of Typical Drainage EIFS Cladding



REPORT SUMMARY & OVERVIEW *CONTINUED*

At the south elevation of the building, the exterior cladding and the underlying materials are water damaged and in poor condition. The cladding and all damaged wall components should be replaced, and the fungal growth affected materials abated, as soon as possible.

Windows at the south elevation require repair and retrofit, or replacement. At exterior wall cladding areas with less exposure to prevailing wind-driven rains and weather, it is possible to perform a relatively extensive repair and retrofit of the exterior walls and windows to gain additional cost effective service life out the materials on those wall areas.

RECOMMENDATIONS:

Because of the condition of the cladding components, the Design Team recommends that as much of the following work be completed in 2012, as budget (MACC) allows:

- Installation of new sheet metal coping caps at most EIFS coped parapet walls. Repair and additional membrane (i.e., PMMA Waterproofing) flashings are necessary where installation of sheet metal coping is not practical due to excessively wide parapets and intersecting rising columns;

- RE: EIFS Cladding:

  1. Removal and re-cladding of the EIFS-clad south elevation of the Building with a thoroughly-detailed, new drainage EIFS, *or*

  2. Other non-barrier type cladding system that incorporates a back-up drainage plane with proper flashings;

- Retrofit and/or replacement of windows, at least on the south elevation;

- Recladding of the Rotunda;

- Repair and retrofit of the existing cladding and windows at north-facing walls.

- See BET&R Exterior Wall & Window Evaluation Report for more extensive information about their investigation, findings and recommendations.

These priority recladding replacement and repairs should be undertaken as soon as possible to prevent further damage to the walls' interior and interlying structure of the building, as well as to help abate and halt further proliferation of fungal growth.

REPORT SUMMARY & OVERVIEW *CONTINUED*

FALL PROTECTION:

The fall protection consultant of the design team is Gravitec Systems Inc., of Bainbridge Island, WA. Stephen Ting, PE, Engineering Manager, is the design engineer for the NRB project.

EXISTING SYSTEMS — WINDOW WASHING: The existing fall protection systems were designed to provide fall protection for the window washing personnel/contractors or others that would have a need to work on the exterior walls of the building that are not accessible from lifts at grade around the building. The at grade access to the building for heavy equipment *(lifts that would reach the highest points on the building facades)* is quite limited due to the raised pedestrian and parking decks as well as below grade utilities in and around the exterior building wall line. ***None of the existing fall protection equipment or anchors were designed with the goal of providing the required fall protection for roof top work.***

Gravitec has tested the existing fall protection systems in place on the building. *See the Gravitec report behind the FALL PROTECTION tab for the full testing procedures, results and recommendations.*

DAVIT PEDESTALS: The testing has shown that the roof deck mounted "davit pedestals" and the "fall arrest anchors" are more than capable of resisting the required design loads and as such can be continued to be used for the window washing and possibly perform double duty by providing anchor points to be used in the roof fall protection systems.

DAVIT ARMS: There are five davit arms available to be used at any of the davit bases along the roof perimeters. The davit arms were tested and found to be incapable of supporting the rated loads *(750 lbs)* and the required safety factor of four times the rated load *(3000 lbs)*. The recommendation is that the existing davit arms be either removed from the roof or tagged out of service.

Gravitec load testing davit arm on NRB roof *(upper)*; Davit arm assembly mounted on a davit pedestal *(lower)* *(NRB October 2011)*

THROUGH ROOF ANCHORS: The "through roof anchors" which are used to access the stepped back walls below the sixth floor roof/soffit at the curving northeast façade were not tested due to a lack of structural attachment information available in the existing building drawing. Without as-built information available, the investigation team used one of the additional approved roof cuts to open the roof assemblies in a limited manner to allow the use of a borescope to view and photograph the below deck anchor fabrication and attachment to the building roof structure. The below deck view of one "through roof anchor" provided enough information about the means of attachment to building structure *(tack welds only)* to convince Gravitec to recommend that the anchors be used only as a pass-through for safety lines which impart no load on the anchor assembly.

Gravitec contacted the current window washing contractor and reviewed with the contractor the procedures that were being employed interfacing with the "through roof anchors." *A summary of the contractors work methods*

REPORT SUMMARY & OVERVIEW *CONTINUED*

is included as an appendix in the Fall Protection report. The window washing contractor is using rooftop equipment frames *(supplied by the contractor)* to fully support the primary hoist lines utilized by the swing stage meeting the requirement of no structural load on the anchors. Unfortunately, the contractor is using the "through roof" anchors as the securement point for their personnel safety lines. ***This practice will need to be discontinued in the future. We recommend tagging the existing davits with a tamper-proof, stainless steel tag that will not deteriorate from the weather (the existing plastic tags with load ratings had come unglued from the davits and were found loosely scattered on the NRB roof). Additionally, Gravitec recommends that a User Manual be developed for the current and any future system and that the window washers be provided with this guide.***

Gravitec recommends the removal of the existing D-rings on the anchors and the revision of the window washing safety plan to prohibit the use of the "through roof anchors " in any manner that imparts a fall protection load into the anchor and the supporting structure.

Typical "Through roof anchor" *(NRB October 2011)*

Fall protection for roof related access is part of the scope of the work of the NRB project. Gravitec, in conjunction with SMSA, has analyzed the site conditions and the building structure and reviewed available equipment systems to satisfy the safety requirements of the project. In the Fall Protection Report tabbed section of this report, eleven equipment options are illustrated for the various conditions found on the seven different roof areas. Four possible proposals have been formulated using various types of the available recommended equipment options to provide a complete building roof fall protection installation.

FALL PROTECTION PROPOSALS: **The four proposals "A-D"** provide different options and costs for creating a fall protection system for the NRB. Each proposed system has different characteristics which will need to be coordinated with the Owner/Client priorities related to budget, ease of use, and visual impact when viewed from the interior and exterior of the building. *Detailed proposals are located under the Fall Protection Report tab, and briefly include:*

Proposal "A" = $503,000, unharnessed access to most roof areas, some visual impact concerns.

Proposal "B" = $488,190, unharnessed access to most roof areas, visual impact concerns.

Proposal "C" = $283,340, unharnessed access to most roof areas (some areas requiring roof monitor) some visual impact concerns.

Proposal "D" = $398,340, harnessed access to all roof areas, least visual impact.

ADDITIONAL COMMENTS: Ideally each roof of the NRB should have a fall protection system designed and installed at the same time as replacing the roof. Installing a fall protection system in subsequent years after replacing the roof, requires penetrating the membrane which could lead to new leaking and could potentially negate the roof warranty.

If budget is currently unavailable to install a fall protection system for each roof, it is feasible to prioritize the most critical roof sections and schedule a phased installation over time. We strongly recommend that a "Fall Protection User's Guide" be included in the scope of work. Gravitec Systems may require another site visit to review prioritizing a phased installation. A fall protection system can be installed when making roof repairs as well.

REPORT SUMMARY & OVERVIEW *CONTINUED*

ENVIRONMENTAL:

During the on-site investigation of the exterior cladding and window systems a number of test openings were made in the exterior wall from the interior side. In each of these test openings we found evidence of water intrusion and mold growth in the wall assembly including the interior Gypsum Wall Board (GWB).

Samples of the affected building materials were collected and provided to the Owner's environmental staff for testing. It is our understanding that the tested samples were positive for several types of mold. ***The knowledge that mold containing materials are present, has expanded the scope of the project by potentially requiring remediation of biological contaminants as well as complicating the design and sequence of the building envelope repairs.***

The Owner, as of the submittal of this final report, has contracted with PBS Engineering + Environmental to work with the design team on incorporating the proper design and remediation response to the presence of mold within the wall assemblies. At the time of publication of this Investigation & Schematic Design Report, PBS' report was is in draft form and not available to include with this report.

For purposes of this report, we have made assumptions about the likely impacts of the future environmental report recommendations, based on several discussions with PBS of likely scenarios.

Assumption #1: Remove and replace 100% of the interior Gypsum Wall Board on exterior walls where the cladding is being replaced or repaired. Costs for this work are included in the Cost Estimates (#1 and #1A) found on pages 1 - 9 in the Cost Estimates tabbed section.

Interior opening at window sill. Mold at face of interior Gypsum Wall Board (GWB) — (*Upper photo - NRB South Elevation)*

Light mold at interior face of exterior GWB Sheathing — (*Center photo - NRB South Elevation - 5th Floor)*

Exterior face of GWB sheathing at rotunda showing mold and water damage — *(Below* - NRB October 2011)

Assumption #2: Design a remediation program for light mold concentrations on the interior face of the exterior Gypsum Wall Board (GWB) sheathing, *that does not require the removal of the GWB sheathing*. This assumption is critical to the concept of repairing the existing EIFS's cladding system on the non-primary weather exposure elevations of the building. If this assumption is not implemented, the cost reduction impact of Cost Estimate #2 and #2A will be negated.

Cost Estimate #1 and #1A would be the most likely scenario if the environmental recommendation is made to remove all mold in the existing exterior building wall assemblies.

Recommendations about design options for mitigating mold in the building from the environmental consultant and the decisions that the Owner/Client make in regards to those recommendations, can potentially have large impacts on the course of the design and costs of this project.

REPORT SUMMARY & OVERVIEW *CONTINUED*

COST ESTIMATES:

Cost estimating on any project is critical because cost typically is an important element of the decision making process in all phases of the project. This project currently has a MACC *(maximum allowable construction cost)* of $3,000,000 per the DES Project Manager.

For the NRB project, it became obvious during the building investigation process that the existing MACC was likely to be inadequate to address all of the deficiencies requiring consideration and solutions in a building-wide approach. This is because of the magnitude and degree of the leak impacts to the exterior wall cladding and windows.

Because the base cost estimates for Options #1 & #2 substantially exceed the current MACC, we believe there are only two scenarios to manage the budget deficit:

1. Increase the project MACC; *or*
2. Divide the project into phases to accomplish the work over an extended time frame. Given the current state budget climate we assume the most likely approach would be to divide the scope of work into discrete phases to be planned for and budgeted over time.

As a result, the SMSA Team developed several cost estimate options:

1. **Options #1 and #2** are based on replacing failed details and systems for the full building exterior envelope.
2. **Options #1A and #2A** are limited and selective replacement and repairs based on a phased approach that works with the existing $3,000,000 MACC.

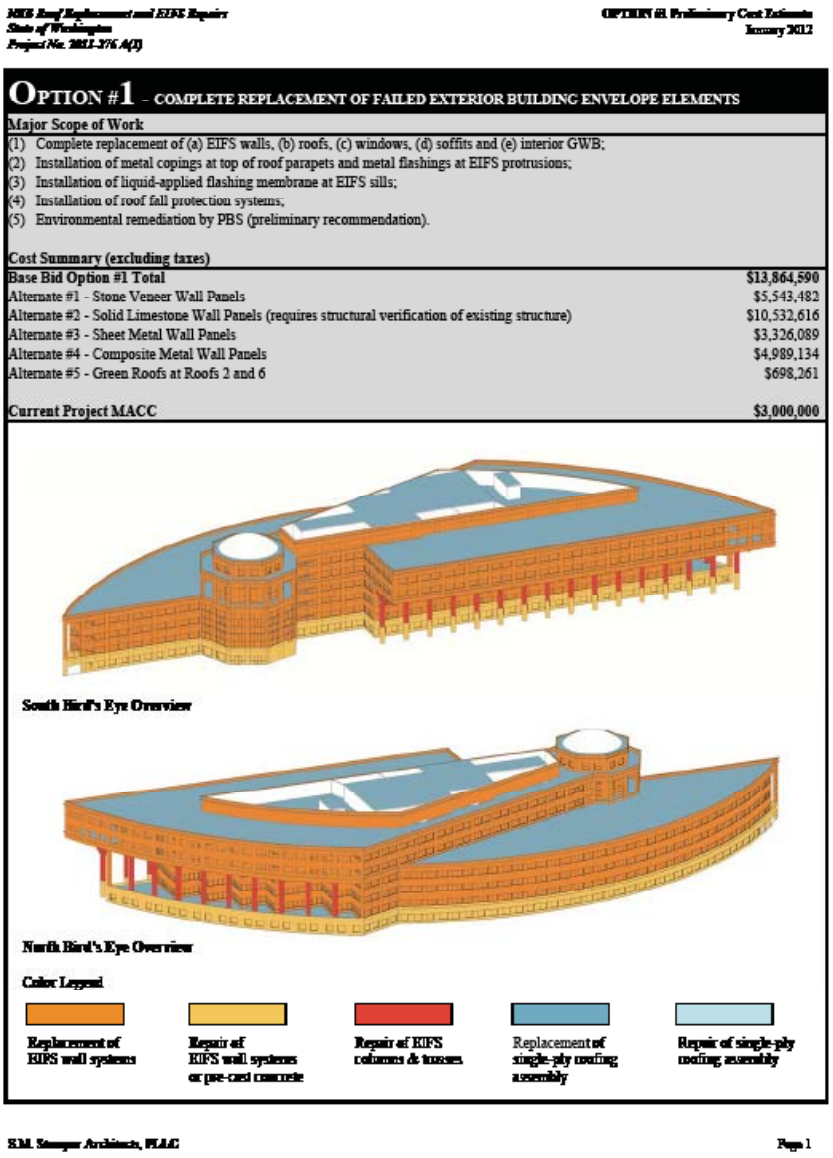
	DESCRIPTION	COST ESTIMATE
FULL BUILDING	**Option #1 (Full Building Exterior Envelope - Full replacement of failed details and systems):** Cost estimate based on addressing all identified detail or system failures in a "full system replacement" manner. This establishes a baseline cost for the building in a "like new" condition. This approach includes the impacts to the building envelope design for what we estimate to be the most restrictive environmental remediation recommendations. *Excluded are costs associated with: environmental recommendations, if any, for changes to interior finishes (not part of the exterior wall assembly) and the building HVAC systems.*	**$13,864,590**
FULL BUILDING	**Option #2 (Full Building Exterior Envelope - "Best value" repair and replacement of failed details and systems):** Cost estimate based on the "repair and replacement" recommendations from the design team generated with the concept of creating the most value for the money spent. This approach includes the impacts to the building envelope design for what we estimate to be "balanced environmental remediation recommendations." *Excluded are costs associated with: environmental recommendations, if any, for changes to interior finishes (not part of the exterior wall assembly) and the building HVAC systems.*	**$6,573,259**
MULTI-PHASED PROJECT WITH PHASE 1 BASED ON CURRENT MACC	**Option #1A (Phase 1 in a phased approach that replaces the failed details and systems over time):** This approach includes the impacts to the building envelope design for what we estimate to be the most restrictive environmental remediation recommendations. *Excluded are costs associated with: environmental recommendations, if any, for changes to interior finishes (not part of the exterior wall assembly) and the building HVAC systems.*	**$3,024,349**
MULTI-PHASED PROJECT WITH PHASE 1 BASED ON CURRENT MACC	**Option #2A (Phase 1 in a phased approach based on the current MACC — but using replacement and repair options where appropriate to provide the "best value" for repair dollars):** This approach includes the impacts to the building envelope design for what we estimate to be "balanced environmental remediation recommendations." *Excluded are costs associated with: environmental recommendations, if any, for changes to interior finishes (not part of the exterior wall assembly) and the building HVAC systems.*	**$2,845,216**

REPORT SUMMARY & OVERVIEW *CONTINUED*

OPTIONS & ALTERNATES: Cost scenarios for exterior cladding system alternatives are included in the Cost Estimates behind the Cost Estimates tabbed section of this report.

Each of the Cost Estimate Scenarios are labeled Option #1, Option #1A, Option #2 and Option #2A. Under Option #1 and Option #2 there are also Alternates 1, 2, 3, 4, and 5.

The "Alternates" are designed to be simple adds to the base cost estimate amount. As such, for simplicity of calculation, the costs for contractor profit and overhead, estimating contingency, and any base system substitution credits are included in the "Alternate."



NRB Roof Replacement and EIFS Repairs
State of Washington
Project No. 2011-276 A(1)

OPTION #1 Preliminary Cost Estimate
January 2012

OPTION #1 – COMPLETE REPLACEMENT OF FAILED EXTERIOR BUILDING ENVELOPE ELEMENTS

Major Scope of Work

(1) Complete replacement of (a) EIFS walls, (b) roofs, (c) windows, (d) soffits and (e) interior GWB;
(2) Installation of metal copings at top of roof parapets and metal flashings at EIFS protrusions;
(3) Installation of liquid-applied flashing membrane at EIFS sills;
(4) Installation of roof fall protection systems;
(5) Environmental remediation by PBS (preliminary recommendation).

Cost Summary (excluding taxes)

Base Bid Option #1 Total	**$13,864,590**
Alternate #1 - Stone Veneer Wall Panels	$5,543,482
Alternate #2 - Solid Limestone Wall Panels (requires structural verification of existing structure)	$10,532,616
Alternate #3 - Sheet Metal Wall Panels	$3,326,089
Alternate #4 - Composite Metal Wall Panels	$4,989,134
Alternate #5 - Green Roofs at Roofs 2 and 6	$698,261
Current Project MACC	**$3,000,000**

South Bird's Eye Overview

North Bird's Eye Overview

Color Legend

Replacement of EIFS wall systems | Repair of EIFS wall systems or pre-cast concrete | Repair of EIFS columns & trusses | Replacement of single-ply roofing assembly | Repair of single-ply roofing assembly

S.M. Stemper Architects, PLLC

Page 1

Cost Estimate Option #1 located on Page 1 behind the Cost Estimates tab in this report

AS AN EXAMPLE, the cost of switching Cost Estimate Option #1 from the base cladding system, drainage plane EIFS, to a traditional limestone cladding, just add the figure for "Solid Limestone Wall Panels" ($10,532,616) to the "Base Bid Option #1 Total" ($13,864,590) for a new total amount of ($24,397,206) plus WSST.

Cost estimates #1A and #2A approximate the current project MACC, ***but they do not define complete / stand alone projects because they go below our minimum recommendations.***

There are many decisions that need to be made in consultation with the Owner/Client to fine-tune the scope of work to insure that the project includes at a minimum, the highest priority repair or replacement work and the nominal work necessary to leave the building in a stable condition until additional phases of the project are implemented to complete the building envelope repairs.

COLOR CODED SYSTEM USED IN THE COST ESTIMATE GRAPHICS: All four of the cost estimates coordinate numerical cost line items with a graphic representation of the scope of the work using colored planes on isometric models of the building. Using this color code system, you should be able to tell what areas of the building are being treated with a repair or replacement approach, and how much of the building is included in the referenced cost estimate.

REPORT SUMMARY & OVERVIEW *CONTINUED*

ADDITIONAL OBSERVATIONS IN THE SMSA TEAM'S INVESTIGATION OF NRB:

During the course of analyzing the investigation data and building the cost estimates, the design team discovered the need for additional investigation in a few locations in the NRB, in order to provide adequate information to develop good design solutions that can be fully detailed and specified in the bid documents.

The areas of concern that need further investigation include:

1. Conditions in the soffit below the cantilevered 5th floor on the south building elevation
   - Extent of water damage to the GWB sheathing in the soffit assembly
   - Means of entry of "conditioned" air into interstitial space
2. Conditions in the interstitial space between the 6th floor roof deck and the soffit below it at the recessed walls at the northeast elevation
   - Structural steel in the roof cut showed heavy corrosion
   - The deterioration that we observed to the soffit on the South side of the building, leads us to question whether there is significant water intrusion in the interstitial space (or soffit assembly) or whether the corrosion to the structural steel that we observed in the roof cut is caused by condensation or water intrusion form the roof or parapets
   - The roof cut verified that there is positive air pressure in the interstitial space from the building's mechanical ventilation systems. The source of the air needs to be determined and leads us to question how "conditioned" air enters the interstitial space. This requires more analysis.
3. Condition of light gauge steel framing top plates in a typical parapet which has open cracks in the EIFS coping
4. The plaza deck waterproofing, the parking garage deck waterproofing and expansion joints, and the below-grade waterproofing were not included in the scope of this investigation, but BET&R observed that leaks from the plaza deck, parking decks and its expansion joints are significant and are causing damage to the complex's structure, interior finishes and environmental conditions.

Example of corrosion to the structural steel in the NRB parking garage *(left)*;

View above drop ceiling at 6th floor of exterior wall separating building interior space from exterior space above the soffit *(center)*;

EIFS coping cap with open joint allowing water into the system *(right)* — *NRB October 2011*

COST ESTIMATES

- COST ESTIMATING APPROACH
- OPTION 1
- OPTION 1 A
- OPTION 2
- OPTION 2 A
- OPTION 3 — *TO BE DEVELOPED WITH CLIENT AS FINAL AGREED UPON OPTION*

COST ESTIMATES *SNAPSHOT*

COST ESTIMATING APPROACH:

For a project of this nature and size, the SMSA Team initially develops two sets of cost estimates assigning different team members/ subconsultants to lead this concurrent process.

The cost estimating teams independently develop their respective cost estimates using the same investigative information generated through the investigation/schematic design phase.

QUALITY CONTROL:

Once the teams have completed their independent draft cost estimates, they review each others work. Comparing their thoughts and ideas they deliberate approach strategies, material issues, scope issues, etc. Based on mutual agreement, they blend their cost estimates to arrive at a final draft to present to clients.

COST FACTORS FOR NRB:

Existing current conditions as determined by the Team's site inspections and evaluations of the roof, exterior wall, window and window washing system are described in detail in this report under each tab:

- Report Summary & Overview
- Roof Evaluation
- Exterior Wall & Window Evaluation
- Fall Protection Report
- Environmental Report *(pending)*

COST ESTIMATES FOR NRB:

Detailed cost estimates located on the following pages were developed for several options. The following is an abbreviated snapshot of each Option:

Option	Description	Cost Estimate
Option #1	Full Building Exterior Envelope - Full replacement of failed details & systems. This establishes a baseline cost for the building in "like-new" condition. This option allows for upgrading failed systems with new systems that would meet current energy code requirements (i.e.; glazing, window frames and roof insulation).	**$13,864,590**
Option #1 A	Phase I in a phased approach that replaces the failed details & systems over time.	**$3,024,349**
Option #2	Full Building Exterior Envelope - "Best value" approach to repair & replacement of failed details & systems. Cost estimate based on prioritizing repairs & replacement obtaining "best value" for dollars spent.	**$6,573,259**
Option #2 A	Phase I in a phased approach based on the current MACC, that prioritizes repair & replacement options to provide the "best value" for dollars spent, *given available funding.*	**$2,845,216**
Option #3	(Final Phase I) Option #3 will be a blend of the highest priority items from the Options described above. Using Option #2A as a starting point, together with client input, we will formulate Option 3 to maximize project value and to stabilize the building while awaiting future phases.	***to be determined***

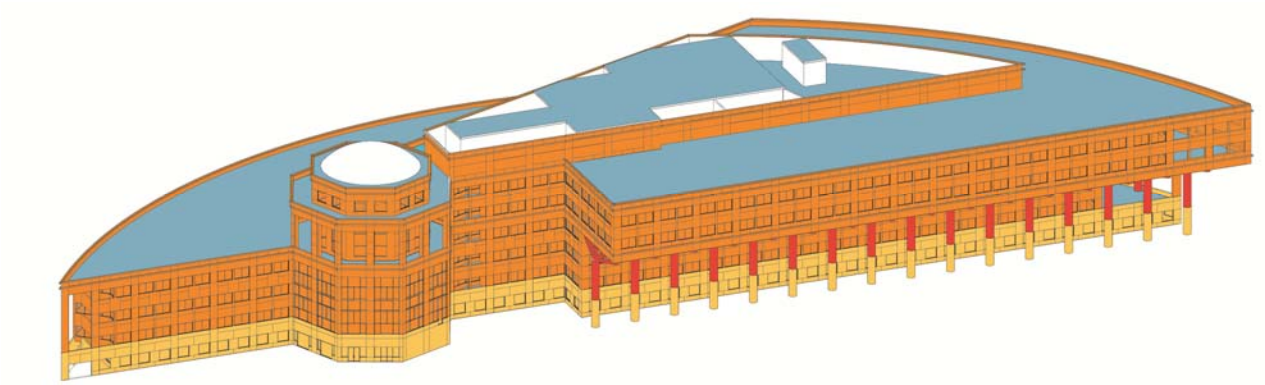
OPTION #1 - COMPLETE REPLACEMENT OF FAILED EXTERIOR BUILDING ENVELOPE ELEMENTS

Major Scope of Work

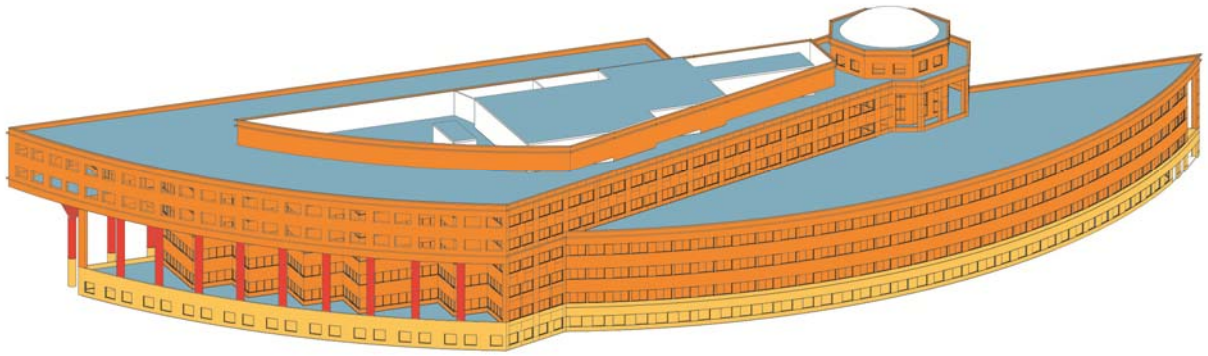
(1) Complete replacement of (a) EIFS walls, (b) roofs, (c) windows, (d) soffits and (e) interior GWB;
(2) Installation of metal copings at top of roof parapets and metal flashings at EIFS protrusions;
(3) Installation of liquid-applied flashing membrane at EIFS sills;
(4) Installation of roof fall protection systems;
(5) Environmental remediation by PBS (preliminary recommendation).

Cost Summary (excluding taxes)

Base Bid Option #1 Total	**$13,864,590**
Alternate #1 - Stone Veneer Wall Panels	$5,543,482
Alternate #2 - Solid Limestone Wall Panels (requires structural verification of existing structure)	$10,532,616
Alternate #3 - Sheet Metal Wall Panels	$3,326,089
Alternate #4 - Composite Metal Wall Panels	$4,989,134
Alternate #5 - Green Roofs at Roofs 2 and 6	$698,261
Current Project MACC	**$3,000,000**



South Bird's Eye Overview



North Bird's Eye Overview

Color Legend

Replacement of EIFS wall systems	Repair of EIFS wall systems or pre-cast concrete	Repair of EIFS columns & trusses	Replacement of single-ply roofing assembly	Repair of single-ply roofing assembly

Wall Cladding (South Elevation)				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
Scaffolding/Staging	47,627	sf	$6.00	$285,762.00
Material Hoists	1	ls	$30,000.00	$30,000.00
			Subtotal:	**$315,762.00**
Waste Disposal				
Interior GWB Dump Fees	1	ls	$7,500.00	$7,500.00
EIFS Dump Fees	1	ls	$25,000.00	$25,000.00
			Subtotal:	**$32,500.00**
EIFS Wall Replacement				
Zones South (1-5) - Replace	23,893	sf	$14.50	$346,448.50
Zone South - Columns	1,840	sf	$14.50	$26,680.00
Zone Rotunda Middle - Replace	3,903	sf	$14.50	$56,593.50
Zone Rotunda Recessed Areas - Replace	3,618	sf	$14.50	$52,461.00
Zone Rotunda Columns (all sides) - Replace	4,359	sf	$14.50	$63,205.50
Installation of Liquid-applied Flashing Membrane @ Horiz. EIFS	587	sf	$40.00	$23,490.00
			Subtotal:	**$545,388.50**
Windows				
Zones South (1-5) New Windows	9,552	sf	$90.00	$859,680.00
Zones South (Precast Conc. Base) New Windows	1,404	sf	$90.00	$126,360.00
Zone Rotunda New Windows	10,032	sf	$90.00	$902,880.00
Zones South (1-5) New Window Flashings	5,572	lf	$45.00	$250,740.00
Zones South (Precast Conc. Base) New Window Flashings	936	lf	$45.00	$42,120.00
Zone Rotunda New Window Flashings	955	lf	$45.00	$42,975.00
			Subtotal:	**$2,224,755.00**
Painting and Coating				
Restoring Precast Concrete (incl. new sealant joints & coating)	7,997	sf	$7.50	$59,977.50
Paint Trusses	10,328	sf	$4.00	$41,312.00
			Subtotal:	**$101,289.50**
Soffits				
South Misc. Soffit @ Balconies - Paint	549	sf	$5.00	$2,745.00
South Soffit Overhang	13,589	sf	$15.00	$203,835.00
Rotunda Soffit	2,063	sf	$15.00	$30,945.00
			Subtotal:	**$237,525.00**
Interior GWB Wall Replacement				
Zones South (1-5)	10,752	sf	$27.00	$290,299.95
Zone Rotunda Middle	1,756	sf	$40.00	$70,254.00
			Subtotal:	**$360,553.95**
Sheet Metal				
Sheet Metal Wrap at South Columns	920	sf	$80.00	$73,600.00
Sheet Metal Flashing at Horizontal Projections	1,806	lf	$15.00	$27,090.00
Sheet Metal Fascia	1,127	lf	$25.00	$28,175.00
			Subtotal:	**$128,865.00**
Subtotal - South Elevation:				**$3,946,639**

Wall Cladding (North Elevation)				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
Scaffolding/Staging	47,131	sf	$6.00	$282,786.00
Material Hoists	1	ls	$30,000.00	$30,000.00
			Subtotal:	**$312,786.00**
Demolition				
Interior GWB Dump Fees	1	ls	$7,500.00	$7,500.00
EIFS Dump Fees	1	ls	$25,000.00	$25,000.00
			Subtotal:	**$32,500.00**
EIFS Wall Replacement				
Zone North 1 (including back wall) - Replace	13,822	sf	$14.50	$200,419.00
Zone North 2 - Replace	9,706	sf	$14.50	$140,737.00
Zone North 4 - Replace	4,957	sf	$14.50	$71,876.50
Zone North 5 - Replace	13,185	sf	$14.50	$191,182.50
Zone North Columns - Replace	4,015	sf	$14.50	$58,217.50
Installation of Liquid-applied Flashing Membrane @ Horiz. EIFS	1,296	sf	$40.00	$51,840.00
			Subtotal:	**$714,272.50**
Windows				
Zones North (2,4 & 5) New Windows	16,578	sf	$90.00	$1,492,020.00
Zones North (Precast Conc. Base) New Windows	2,160	sf	$90.00	$194,400.00
Zones North (2,4 & 5) New Existing Window Flashings	7,698	lf	$45.00	$346,410.00
Zones North (Precast Conc. Base) New Existing Window Flashings	1,440	lf	$45.00	$64,800.00
			Subtotal:	**$2,097,630.00**
Painting and Coating				
Restoring Precast Concrete (incl. new sealant joints)	8,779	sf	$6.00	$52,674.00
			Subtotal:	**$52,674.00**
Soffits				
North Overhang Soffit @ 5th Floor	5,461	sf	$15.00	$81,915.00
			Subtotal:	**$81,915.00**
Interior GWB Wall Replacement				
Zones North (1-5)	18,886	sf	$27.00	$509,922.00
			Subtotal:	**$509,922.00**
Sheet Metal				
Sheet Metal Flashing at Horizontal Projections	1,743	lf	$15.00	$26,145.00
Sheet Metal Fascia	554	lf	$25.00	$13,850.00
			Subtotal:	**$39,995.00**
Subtotal - North Elevation				**$3,841,695**

Roofing				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Roofing Repair/Replacement (see separate cost estimates for detailed breakdowns)				
Roof 1 (6th Fl) - Roof Replacement	1	ls	$789,458.60	$789,458.60
Roof 2 (4th Fl) - Roof Replacement	1	ls	$550,405.20	$550,405.20
Roof 3 (Penthouse) - Roof Replacement	1	ls	$190,045.80	$190,045.80
Roof 4 (Mech.) - Roof Replacement	1	ls	$235,464.90	$235,464.90
Roof 5 (Rotunda) - Roof Replacement	1	ls	$77,525.00	$77,525.00
Roof 6 (2nd Fl) - Roof Replacement	1	ls	$78,290.00	$78,290.00
Roof 7 (5nd Fl) - Roof Replacement	1	ls	$27,738.55	$27,738.55
			Subtotal:	**$1,948,928.05**
Fall Protection System (see Gravitec Report)				
Appendix E - Proposal A	1	ls	503,000.00	$503,000.00
			Subtotal:	**$503,000.00**
EIFS Wall Replacement				
Zone Penthouse	9,580	sf	$14.50	$138,910.00
			Subtotal:	**$138,910.00**
Exterior Painting				
Penthouse Support & Braces	1	ls	$5,000.00	$5,000.00
Roof Top Equipment and Units	32	ea	500.00	$16,000.00
Misc. Painting	1	ls	$10,000.00	$10,000.00
			Subtotal:	**$31,000.00**
Misc				
Roof power	1	ls	$2,500.00	$2,500.00
Extend Equipment Supports	0	lf	$20.00	$0.00
Metal Stairs	3	lf	$500.00	$1,500.00
Lightning Protection Removal and Re-installation	1	ls	$2,500.00	$2,500.00
			Subtotal:	**$6,500.00**
Subtotal - Roofing				**$2,628,338**

Cost Summary - Base Bid				
South Elevation:				$3,946,639
North Elevation:				$3,841,695
Roof & Penthouse:				$2,628,338
			SUBTOTAL	$10,416,672
			10% General Conditions	$1,041,667
			SUBTOTAL	$11,458,339
			10% OH & P	$1,145,834
			SUBTOTAL	$12,604,173
			10% Design Contingency	$1,260,417
			BASE BID SUBTOTAL	**$13,864,590**
			8.7% Tax	$1,206,219
			Total	$15,070,809
Cost Summary - Alternates				
Alternate #1 - Stone Veneer Wall Panels				
Install Stone Veneer Wall Panels on the South Elevation	37613	sf	50.00	$1,880,650.00
Install Stone Veneer Wall Panels on the North Elevation	45685	sf	50.00	$2,284,250.00
			SUBTOTAL	$4,164,900.00
			33.10% (OH,P,Contingency)	$1,378,581.90
			SUBTOTAL	**$5,543,482**
			8.7% Tax	$482,283
			Total	$6,025,765
Alternate #2 - Solid Limestone Wall Panels				
*Install Solid Limestone Wall Panels on the South Elevation	37613	sf	95.00	$3,573,235.00
*Install Solid Limestone Wall Panels on the North Elevation	45685	sf	95.00	$4,340,075.00
* requires structural verification of existing structure			SUBTOTAL	$7,913,310.00
			33.10% (OH,P,Contingency)	$2,619,305.61
			SUBTOTAL	**$10,532,616**
			8.7% Tax	$916,338
			Total	$11,448,953
Alternate #3 - Sheet Metal Wall Panels				
Install Sheet Metal Wall Panels on the South Elevation	37613	sf	30.00	$1,128,390.00
Install Sheet Metal Wall Panels on the North Elevation	45685	sf	30.00	$1,370,550.00
			SUBTOTAL	$2,498,940.00
			33.10% (OH,P,Contingency)	$827,149.14
			SUBTOTAL	**$3,326,089**
			8.7% Tax	$289,370
			Total	$3,615,459
Alternate #4 - Composite Metal Wall Panels				
Install Composite Metal Wall Panels on the South Elevation	37613	sf	45.00	$1,692,585.00
Install Composite Metal Wall Panels on the North Elevation	45685	sf	45.00	$2,055,825.00
			SUBTOTAL	$3,748,410.00
			33.10% (OH,P,Contingency)	$1,240,723.71
			SUBTOTAL	**$4,989,134**
			8.7% Tax	$434,055
			Total	$5,423,188
Alternate #5 - Green Roofs at Roofs 2 and 6				
Additional Costs for Green Roof Installation	1	ls	524,613.90	$524,613.90
			SUBTOTAL	$524,613.90
			33.10% (OH,P,Contingency)	$173,647.20
			SUBTOTAL	**$698,261**
			8.7% Tax	$60,749
			Total	$759,010

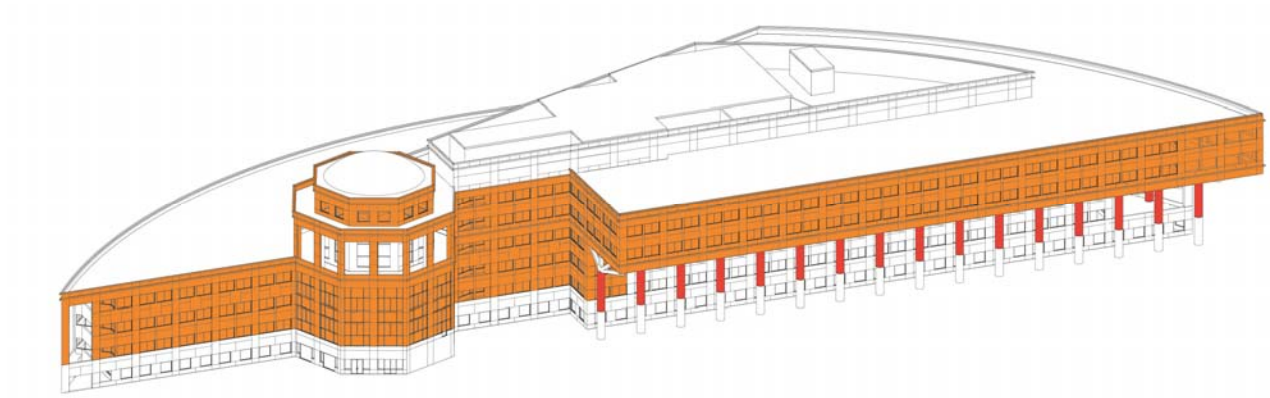
OPTION #1A - REPLACEMENT OF FAILED EXTERIOR BUILDING ENVELOPE ELEMENTS ($3M MACC)

Major Scope of Work

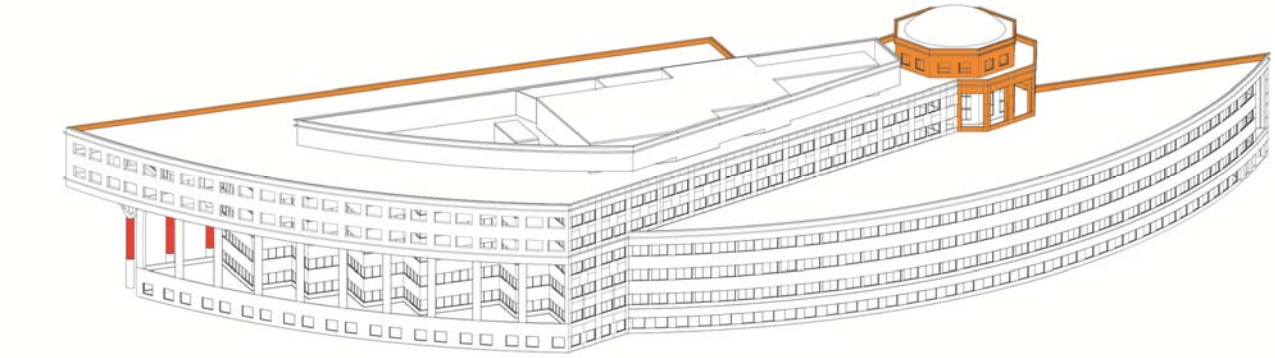
(1) Replacement of (a) EIFS walls, (b) windows, (c) soffits and (d) interior GWB;
(2) Installation of metal copings at top of roof parapets and metal flashings at EIFS protrusions;
(3) Installation of liquid-applied flashing membrane at EIFS sills;
(4) Environmental remediation by PBS (preliminary recommendation).

Cost Summary (excluding taxes)

Base Bid Option #1A Total	**$3,024,349**
Current Project MACC	**$3,000,000**



South Bird's Eye Overview



North Bird's Eye Overview

Color Legend

Replacement of EIFS wall systems	Repair of EIFS wall systems or pre-cast concrete	Repair of EIFS columns & trusses	Replacement of single-ply roofing assembly	Repair of single-ply roofing assembly

Wall Cladding (South Elevation)				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
Scaffolding/Staging	42,668	sf	$6.00	$256,008.00
Material Hoists	1	ls	$30,000.00	$30,000.00
			Subtotal:	**$286,008.00**
Waste Disposal				
Interior GWB Dump Fees	1	ls	$7,500.00	$7,500.00
EIFS Dump Fees	1	ls	$25,000.00	$25,000.00
			Subtotal:	**$32,500.00**
EIFS Wall Replacement				
* Zones South (1,2,3,5) - Replace	20,774	sf	$14.50	$301,223.00
* Zone South - Columns	0	sf	$14.50	$0.00
Zone Rotunda Middle - Replace	3,903	sf	$14.50	$56,593.50
* Zone Rotunda Recessed Areas	0	sf	$14.50	$0.00
Zone Rotunda Columns (all sides) - Replace	4,359	sf	$14.50	$63,205.50
Installation of Liquid-applied Flashing Membrane @ Horiz. EIFS	587	sf	$40.00	$23,490.00
			Subtotal:	**$421,022.00**
Windows				
Zones South (1,2,3,5) New Windows	5,808	sf	$90.00	$522,720.00
Zones South (Precast Conc. Base) New Windows	1,404	sf	$90.00	$126,360.00
* Zone Rotunda New Windows	0	sf	$90.00	$0.00
Zones South (1,2,3,5) New Window Flashings	3,388	lf	$45.00	$152,460.00
Zones South (Precast Conc. Base) New Window Flashings	936	lf	$45.00	$42,120.00
* Zone Rotunda New Window Flashings	0	lf	$45.00	$0.00
			Subtotal:	**$843,660.00**
Painting and Coating				
* Restoring Precast Concrete (incl. new sealant joints & coating)	0	sf	$7.50	$0.00
* Paint Trusses	0	sf	$4.00	$0.00
			Subtotal:	**$0.00**
Soffits				
South Misc. Soffit @ Balconies - Paint	549	sf	$5.00	$2,745.00
South Soffit Overhang	13,589	sf	$15.00	$203,835.00
Rotunda Soffit	2,063	sf	$15.00	$30,945.00
			Subtotal:	**$237,525.00**
Interior GWB Wall Replacement				
Zones South (1,2,3,5)	9,348	sf	$27.00	$252,404.10
Zone Rotunda Middle	1,756	sf	$40.00	$70,254.00
			Subtotal:	**$322,658.10**
Sheet Metal				
Sheet Metal Wrap at South Columns	920	sf	$80.00	$73,600.00
Sheet Metal Flashing at Horizontal Projections	1,806	lf	$15.00	$27,090.00
Sheet Metal Fascia	1,127	lf	$25.00	$28,175.00
			Subtotal:	**$128,865.00**
Subtotal - South Elevation:				**$2,272,238**

* denotes work that is removed or changed from Option #1

Wall Cladding (North Elevation)				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
* Scaffolding/Staging	0	sf	$6.00	$0.00
* Material Hoists	0	ls	$30,000.00	$0.00
			Subtotal:	**$0.00**
Demolition				
* Interior GWB Dump Fees	0	ls	$7,500.00	$0.00
* EIFS Dump Fees	0	ls	$25,000.00	$0.00
			Subtotal:	**$0.00**
EIFS Wall Replacement				
* Zone North 1 (including back wall) - Replace	0	sf	$14.50	$0.00
* Zone North 2 - Replace	0	sf	$14.50	$0.00
* Zone North 4 - Replace	0	sf	$14.50	$0.00
* Zone North 5 - Replace	0	sf	$14.50	$0.00
* Zone North Columns - Replace	0	sf	$14.50	$0.00
* Installation of Liquid-applied Flashing Membrane @ Horz. EIFS	0	sf	$40.00	$0.00
			Subtotal:	**$0.00**
Windows				
* Zones North (2,4 & 5) New Windows	0	sf	$90.00	$0.00
* Zones North (Precast Conc. Base) New Windows	0	sf	$90.00	$0.00
* Zones North (2,4 & 5) New Existing Window Flashings	0	lf	$45.00	$0.00
* Zones North (Precast Conc. Base) New Existing Window Flashin	0	lf	$45.00	$0.00
			Subtotal:	**$0.00**
Painting and Coating				
* Restoring Precast Concrete (incl. new sealant joints)	0	sf	$6.00	$0.00
			Subtotal:	**$0.00**
Soffits				
* North Overhang Soffit @ 5th Floor	0	sf	$15.00	$0.00
			Subtotal:	**$0.00**
Interior GWB Wall Replacement				
* Zones North (1-5)	0	sf	$27.00	$0.00
			Subtotal:	**$0.00**
Sheet Metal				
* Sheet Metal Flashing at Horizontal Projections	0	lf	$15.00	$0.00
* Sheet Metal Fascia	0	lf	$25.00	$0.00
			Subtotal:	**$0.00**
Subtotal - North Elevation				**$0**

* denotes work that is removed or changed from Option #1

Roofing				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Roofing Repair/Replacement (see separate cost estimates for detailed breakdowns)				
* Roof 1 (6th Fl) - Roof Replacement	0	ls	$789,458.60	$0.00
* Roof 2 (4th Fl) - Roof Replacement	0	ls	$550,405.20	$0.00
* Roof 3 (Penthouse) - Roof Replacement	0	ls	$190,045.80	$0.00
* Roof 4 (Mech.) - Roof Replacement	0	ls	$235,464.90	$0.00
* Roof 5 (Rotunda) - Roof Replacement	0	ls	$77,525.00	$0.00
* Roof 6 (2th Fl) - Roof Replacement	0	ls	$78,290.00	$0.00
* Roof 7 (5th Fl) - Roof Replacement	0	ls	$27,738.55	$0.00
			Subtotal:	**$0.00**
Fall Protection System (see Gravitec Report)				
* Appendix E - Proposal A	0	ls	503,000.00	$0.00
			Subtotal:	**$0.00**
EIFS Repair				
* Zone Penthouse	0	sf	$4.00	$0.00
			Subtotal:	**$0.00**
Exterior Painting				
* Penthouse Support & Braces	0	ls	$5,000.00	$0.00
* Roof Top Equipment and Units	0	ea	500.00	$0.00
* Misc. Painting	0	ls	$10,000.00	$0.00
			Subtotal:	**$0.00**
Misc				
* Roof power	0	ls	$2,500.00	$0.00
* Extend Equipment Supports	0	lf	$20.00	$0.00
* Metal Stairs	0	lf	$500.00	$0.00
* Lightning Protection Removal and Re-installation	0	ls	$2,500.00	$0.00
			Subtotal:	**$0.00**
Subtotal - Roofing				**$0**

* denotes work that is removed or changed from Option #1

Cost Summary - Base Bid		
South Elevation:		$2,272,238
North Elevation:		$0
Roof & Penthouse:		$0
	SUBTOTAL	$2,272,238
	10% General Conditions	$227,224
	SUBTOTAL	$2,499,462
	10% OH & P	$249,946
	SUBTOTAL	$2,749,408
	10% Design Contingency	$274,941
	BASE BID SUBTOTAL	**$3,024,349**
	8.7% Tax	$263,118
	Total	$3,287,467

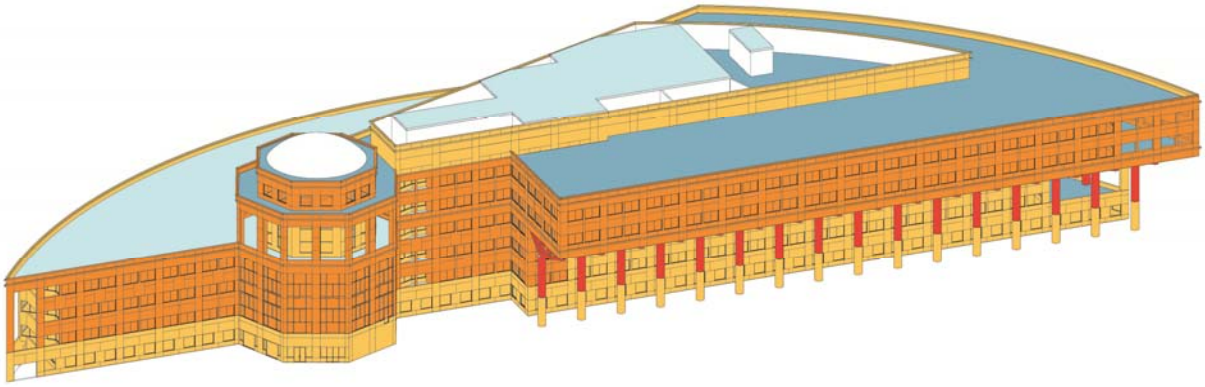
OPTION #2 - RECOMMENDED BUILDING ENVELOPE REPLACEMENT AND REPAIR WORK

Major works include:

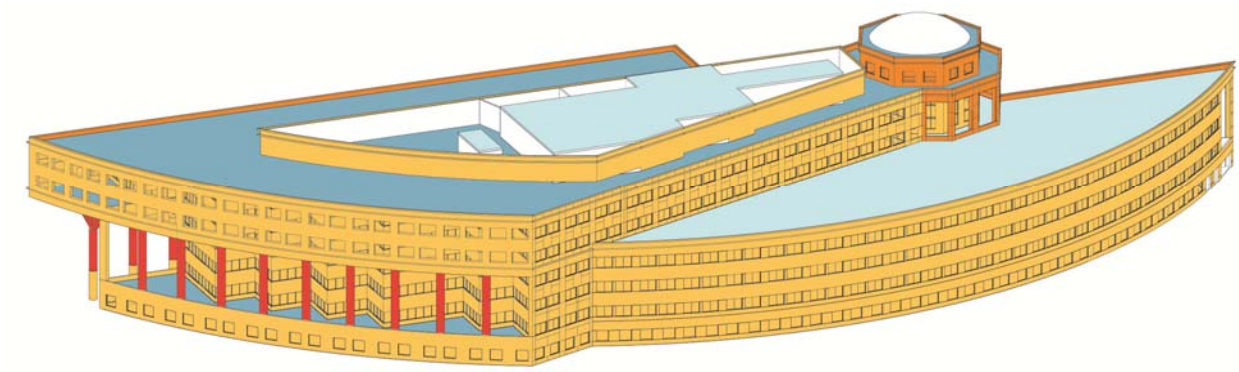
(1) Replacement or repair of (a) EIFS walls, (b) roofs, (c) window flashings and (d) interior GWB;
(2) Re-using of existing windows;
(3) Installation of metal copings at top of roof parapets and metal flashings at EIFS protrusions;
(4) Installation of liquid-applied flashing membrane at EIFS sills;
(5) Installation of roof fall protection systems;
(6) Enviromental remediation by PBS (preliminary recommendation).

Cost Summary (excluding taxes)

Base Bid Option #2 Total	**$6,573,259**
Alternate #1 - Stone Veneer Wall Panels	$5,543,482
Alternate #2 - Solid Limestone Wall Panels (requires structural verification of existing structure)	$10,532,616
Alternate #3 - Sheet Metal Wall Panels	$3,326,089
Alternate #4 - Composite Metal Wall Panels	$4,989,134
Alternate #5 - Green Roofs at Roofs 2 and 6	$698,261
Current Project MACC	**$3,000,000**



South Bird's Eye Overview



North Bird's Eye Overview

Color Legend

Replacement of EIFS wall systems	Repair of EIFS wall systems or pre-cast concrete	Repair of EIFS columns & trusses	Replacement of single-ply roofing assembly	Repair of single-ply roofing assembly

Wall Cladding (South Elevation)				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
Scaffolding/Staging	45,941	sf	$6.00	$275,646.00
Material Hoists	1	ls	$30,000.00	$30,000.00
			Subtotal:	**$305,646.00**
Waste Disposal				
Interior GWB Dump Fees	1	ls	$7,500.00	$7,500.00
EIFS Dump Fees	1	ls	$20,000.00	$20,000.00
			Subtotal:	**$27,500.00**
EIFS Wall Replacement or Repair (incl. new sealant joints)				
Zones South (1,2,3,5) - Replace	18,528	sf	$14.50	$268,656.00
Zones South (4) - Repair	5,365	sf	$6.00	$32,190.00
Zone South - Columns	1,840	sf	$8.00	$14,720.00
Zone Rotunda Middle - Replace	3,903	sf	$14.50	$56,593.50
Zone Rotunda Recessed Areas - Repair	3,618	sf	$4.00	$14,472.00
Zone Rotunda Columns (all sides)	1,388	sf	$14.50	$20,126.00
Zone Rotunda Columns (all other sides)	2,971	sf	$4.00	$11,884.00
Installation of Liquid-applied Flashing Membrane @ Horiz. EIFS	587	sf	$40.00	$23,490.00
			Subtotal:	**$442,131.50**
Windows				
Zones South (1,2,3,5) New Windows	0	sf	$90.00	$0.00
Zones South (Precast Conc. Base) New Windows	0	sf	$90.00	$0.00
Zone Rotunda New Windows	0	sf	$90.00	$0.00
Removal and Re-Installation of Existing Windows	127	ea	$500.00	$63,500.00
Zones South (1,2,3,5) New Existing Window Flashings	3,388	lf	$45.00	$152,460.00
Zones South (4-one bay only) New Existing Window Flashings	192	lf	$45.00	$8,640.00
Zone Rotunda New Existing Window Flashings	0	lf	$45.00	$0.00
			Subtotal:	**$224,600.00**
Painting and Coating				
Restoring Precast Conc. (incl. sealant joints & water repellant)	7,997	sf	$6.00	$47,982.00
Paint Trusses	10,328	sf	$4.00	$41,312.00
			Subtotal:	**$89,294.00**
Soffits				
South Misc. Soffit @ Balconies - Paint	549	sf	$2.50	$1,372.50
South Overhang Soffit @ 5th Floor - Paint	11,903	sf	$4.00	$47,612.00
South Soffit 4'-0" Overhang - Replace	1,686	sf	$20.00	$33,720.00
			Subtotal:	**$82,704.50**
Interior GWB Wall Replacement (not including furniture moving)				
Zones South (1,2,3,part of 4,5)	8,338	sf	$27.00	$225,115.20
Zone Rotunda Middle	1,756	sf	$40.00	$70,254.00
			Subtotal:	**$295,369.20**
Sheet Metal				
Sheet Metal Wrap at South Columns	920	sf	$80.00	$73,600.00
Sheet Metal Flashing at Horizontal Projections	1,806	lf	$15.00	$27,090.00
Sheet Metal Fascia	1,127	lf	$25.00	$28,175.00
			Subtotal:	**$128,865.00**
Subtotal - South Elevation:				**$1,596,110**

Wall Cladding (North Elevation)				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
Scaffolding/Staging	41,670	sf	$6.00	$250,020.00
Material Hoists	1	ls	$20,000.00	$20,000.00
			Subtotal:	**$270,020.00**
Demolition				
Interior GWB Dump Fees	1	ls	$7,500.00	$7,500.00
EIFS Dump Fees	1	ls	$5,000.00	$5,000.00
			Subtotal:	**$12,500.00**
EIFS Repair				
Zone North 1 (including back wall)	13,822	sf	$4.00	$55,288.00
Zone North 2	9,706	sf	$4.00	$38,824.00
Zone North 4	4,957	sf	$7.50	$37,177.50
Zone North 5	13,185	sf	$7.50	$98,887.50
Zone North Columns	4,015	sf	$7.50	$30,112.50
Installation of Liquid-applied Flashing Membrane @ Horiz. EIFS	1,296	sf	$40.00	$51,840.00
			Subtotal:	**$260,289.50**
Windows				
Zones North (4 & 5) New Windows	0	sf	$90.00	$0.00
Zones North (Precast Conc. Base) New Windows	0	sf	$90.00	$0.00
Removal and Re-Installation of Existing Windows	176	ea	$500.00	$88,000.00
Zones North (4 & 5) New Existing Window Flashings	4,908	lf	$45.00	$220,860.00
Zones North (Precast Conc. Base) New Existing Window Flashing	0	lf	$45.00	$0.00
			Subtotal:	**$308,860.00**
Painting and Coating				
Restoring Precast Conc. (incl. sealant joints & water repellant)	0	sf	$6.00	$0.00
Paint Trusses	0	sf	$4.00	$0.00
			Subtotal:	**$0.00**
Soffits				
North Overhang Soffit @ 4th & 6th Floors - Re-Coat Only	0	sf	$4.00	$0.00
			Subtotal:	**$0.00**
Interior GWB Wall Replacement (not including furniture moving)				
Zones North (1-5)	18,886	sf	$27.00	$509,922.00
			Subtotal:	**$509,922.00**
Sheet Metal				
Sheet Metal Flashing at Horizontal Projections	1,743	lf	$15.00	$26,145.00
Sheet Metal Fascia	554	lf	$25.00	$13,850.00
			Subtotal:	**$39,995.00**
Subtotal - North Elevation				**$1,401,587**

Roofing				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Roofing Repair/Replacement (see separate cost estimates for detailed breakdowns)				
Roof 1 (6th Fl) - Roof Replacement	1	ls	$789,458.60	$789,458.60
Roof 2 (4th Fl) - Roof Repair	1	ls	$226,005.40	$226,005.40
Roof 3 (Penthouse) - Roof Repair	1	ls	$147,247.60	$147,247.60
Roof 4 (Mech.) - Roof Replacement	1	ls	$235,464.90	$235,464.90
Roof 5 (Rotunda) - Roof Replacement	1	ls	$77,525.00	$77,525.00
Roof 6 (2nd Fl) - Roof Replacement	1	ls	$78,290.00	$78,290.00
Roof 7 (5nd Fl) - Roof Replacement	1	ls	$27,738.55	$27,738.55
			Subtotal:	**$1,581,730.05**
Fall Protection System (see Gravitec Report)				
Appendix E - Proposal C	1	ls	283,340.00	$283,340.00
			Subtotal:	**$283,340.00**
EIFS Repair				
Zone Penthouse	9,580	sf	$4.00	$38,320.00
			Subtotal:	**$38,320.00**
Exterior Painting				
Penthouse Support & Braces	1	ls	$5,000.00	$5,000.00
Roof Top Equipment and Units	32	ea	500.00	$16,000.00
Misc. Painting	1	ls	$10,000.00	$10,000.00
			Subtotal:	**$31,000.00**
Misc				
Roof power	1	ls	$2,500.00	$2,500.00
Extend Equipment Supports	0	lf	$20.00	$0.00
Metal Stairs	3	lf	$500.00	$1,500.00
Lightning Protection Removal and Re-installation	1	ls	$2,500.00	$2,500.00
			Subtotal:	**$6,500.00**
Subtotal - Roofing				**$1,940,890**

Cost Summary - Base Bid				
South Elevation:				$1,596,110
North Elevation				$1,401,587
Roof & Penthouse:				$1,940,890
			SUBTOTAL	$4,938,587
			10% General Conditions	$493,859
			10% OH & P	$543,245
			SUBTOTAL	$5,975,690
			10% Design Contingency	$597,569
			BASE BID SUBTOTAL	**$6,573,259**
			8.7% Tax	$571,874
			Total	$7,145,132
Cost Summary - Alternates				
Alternate #1 - Stone Veneer Wall Panels				
Install Stone Veneer Wall Panels on the South Elevation	37613	sf	50.00	$1,880,650.00
Install Stone Veneer Wall Panels on the North Elevation	45685	sf	50.00	$2,284,250.00
			SUBTOTAL	$4,164,900.00
			33.10% (OH,P,Contingency)	$1,378,581.90
			SUBTOTAL	**$5,543,482**
			8.7% Tax	$482,283
			Total	$6,025,765
Alternate #2 - Solid Limestone Wall Panels				
*Install Solid Limestone Wall Panels on the South Elevation	37613	sf	95.00	$3,573,235.00
*Install Solid Limestone Wall Panels on the North Elevation	45685	sf	95.00	$4,340,075.00
* requires structural verification of existing structure			SUBTOTAL	$7,913,310.00
			33.10% (OH,P,Contingency)	$2,619,305.61
			SUBTOTAL	**$10,532,616**
			8.7% Tax	$916,338
			Total	$11,448,953
Alternate #3 - Sheet Metal Wall Panels				
Install Sheet Metal Wall Panels on the South Elevation	37613	sf	30.00	$1,128,390.00
Install Sheet Metal Wall Panels on the North Elevation	45685	sf	30.00	$1,370,550.00
			SUBTOTAL	$2,498,940.00
			33.10% (OH,P,Contingency)	$827,149.14
			SUBTOTAL	**$3,326,089**
			8.7% Tax	$289,370
			Total	$3,615,459
Alternate #4 - Composite Metal Wall Panels				
Install Composite Metal Wall Panels on the South Elevation	37613	sf	45.00	$1,692,585.00
Install Composite Metal Wall Panels on the North Elevation	45685	sf	45.00	$2,055,825.00
			SUBTOTAL	$3,748,410.00
			33.10% (OH,P,Contingency)	$1,240,723.71
			SUBTOTAL	**$4,989,134**
			8.7% Tax	$434,055
			Total	$5,423,188
Alternate #5 - Green Roofs at Roofs 2 and 6				
Additional Costs for Green Roof Installation	1	ls	524,613.90	$524,613.90
			SUBTOTAL	$524,613.90
			33.10% (OH,P,Contingency)	$173,647.20
			SUBTOTAL	**$698,261**
			8.7% Tax	$60,749
			Total	$759,010

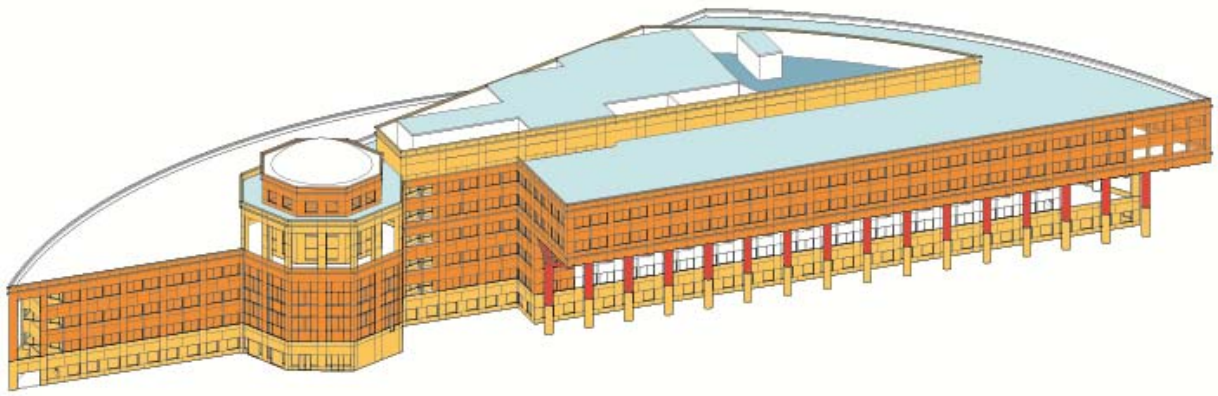
OPTION #2A - RECOMMENDED BUILDING ENVELOPE REPLACEMENT & REPAIR WORK ($3M MACC)

Major works include:

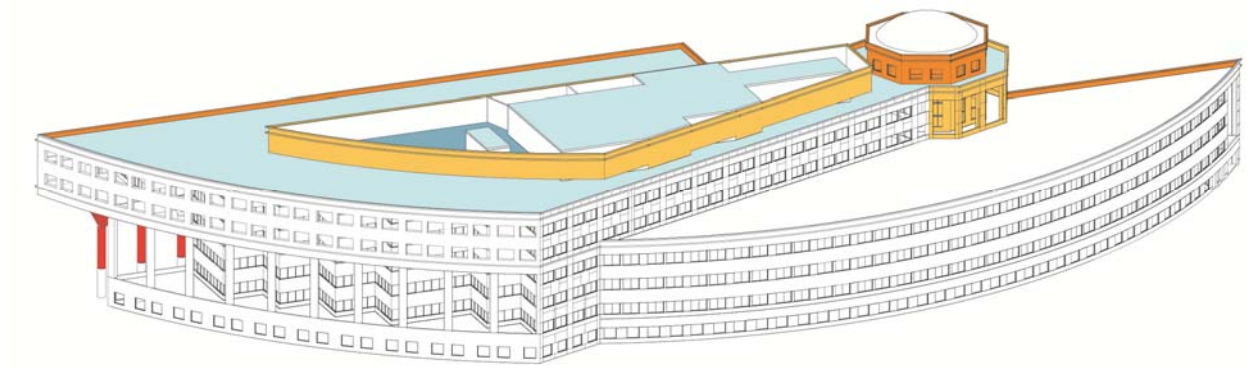
(1) Replacement or repair of (a) EIFS walls, (b) roofs, (c) window flashings and (d) interior GWB;
(2) Re-using of existing windows;
(3) Installation of metal copings at top of roof parapets and metal flashings at EIFS protrusions;
(4) Installation of liquid-applied flashing membrane at EIFS sills;
(5) Installation of roof fall protection systems;
(6) Enviromental remediation by PBS (preliminary recommendation).

Cost Summary (excluding taxes)

Base Bid Option #2A Total	**$2,845,216**
Current Project MACC	**$3,000,000**



South Bird's Eye Overview



North Bird's Eye Overview

Color Legend

Replacement of EIFS wall systems	Repair of EIFS wall systems or pre-cast concrete	Repair of EIFS columns & trusses	Replacement of single-ply roofing assembly	Repair of single-ply roofing assembly

Wall Cladding (South Elevation)				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
Scaffolding/Staging	24,271	sf	$6.00	$145,626.00
Material Hoists	1	ls	$30,000.00	$30,000.00
			Subtotal:	**$175,626.00**
Waste Disposal				
Interior GWB Dump Fees	1	ls	$7,500.00	$7,500.00
EIFS Dump Fees	1	ls	$20,000.00	$20,000.00
			Subtotal:	**$27,500.00**
EIFS Wall Replacement or Repair				
Zones South (1,2,3,5) - Replace	18,528	sf	$14.50	$268,656.00
* Zones South (4)	0	sf	$6.00	$0.00
Zone South - Columns	1,840	sf	$8.00	$14,720.00
Zone Rotunda Middle - Replace	3,903	sf	$14.50	$56,593.50
* Zone Rotunda Recessd Areas - Re-coat Only	3,618	sf	$2.50	$9,045.00
* Zone Rotunda Columns (Exterior Side) - Repair	1,388	sf	$4.00	$5,552.00
Zone Rotunda Columns (All Other Sides)	2,971	sf	$4.00	$11,884.00
Installation of Liquid-applied Flashing Membrane @ Horiz. EIFS	587	sf	$40.00	$23,490.00
			Subtotal:	**$366,450.50**
Windows				
Zones South (1,2,3,5) New Windows	0	sf	$90.00	$0.00
Zones South (Precast Conc. Base) New Windows	0	sf	$90.00	$0.00
Zone Rotunda New Windows	0	sf	$90.00	$0.00
Removal and Re-Installation of Existing Windows	127	ea	$500.00	$63,500.00
Zones South (1,2,3,5) New Existing Window Flashings	3,388	lf	$45.00	$152,460.00
Zones South (4-one bay only) New Existing Window Flashings	192	lf	$45.00	$8,640.00
Zone Rotunda New Existing Window Flashings	0	lf	$45.00	$0.00
			Subtotal:	**$224,600.00**
Painting and Coating				
* Restoring Precast Conc (incl. sealant joints & water repellant)	7,997	sf	$6.00	$47,982.00
* Paint Trusses	0	sf	$4.00	$0.00
			Subtotal:	**$47,982.00**
Soffits				
* South Misc. Soffit @ Balconies - Paint	0	sf	$2.50	$2,745.00
* South Overhang Soffit @ 5th Floor - Paint	0	sf	$4.00	$59,515.00
South Soffit 4'-0" Overhang - Replace	1,686	sf	$20.00	$25,290.00
			Subtotal:	**$87,550.00**
Interior GWB Wall Replacement (not including furniture moving)				
Zones South (1,2,3,5)	8,338	sf	$27.00	$225,115.20
Zone Rotunda Middle	1,756	sf	$40.00	$70,254.00
			Subtotal:	**$295,369.20**
Sheet Metal				
* Sheet Metal Wrap at South Columns	0	sf	$80.00	$0.00
* Sheet Metal Flashing at Horizontal Projections	0	lf	$15.00	$0.00
* Sheet Metal Fascia	0	lf	$25.00	$0.00
			Subtotal:	**$0.00**
Subtotal - South Elevation:				**$1,225,078**

* denotes work that is removed or changed from Option #2

Wall Cladding (North Elevation)				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
* Scaffolding/Staging	0	sf	$6.00	$0.00
* Material Hoists	0	ls	$20,000.00	$0.00
			Subtotal:	**$0.00**
Demolition				
* Interior GWB Dump Fees	0	ls	$7,500.00	$0.00
* EIFS Dump Fees	0	ls	$5,000.00	$0.00
			Subtotal:	**$0.00**
EIFS Repair				
* Zone North 1	0	sf	$4.00	$0.00
* Zone North 2	0	sf	$4.00	$0.00
* Zone North 4	0	sf	$7.50	$0.00
* Zone North 5	0	sf	$7.50	$0.00
* Zone North Columns	0	sf	$7.50	$0.00
* Installation of Liquid-applied Flashing Membrane @ Horz. EIFS	0	sf	$40.00	$0.00
			Subtotal:	**$0.00**
Windows				
Zones North (4 & 5) New Windows	0	sf	$90.00	$0.00
Zones North (Precast Conc. Base) New Windows	0	sf	$90.00	$0.00
* Removal and Re-Installation of (E) Windows	0	ea	$500.00	$0.00
* Zones North (4 & 5) New (E) Window Flashings	0	lf	$45.00	$0.00
Zones North (Precast Conc. Base) New (E) Window Flashings	0	lf	$45.00	$0.00
			Subtotal:	**$0.00**
Painting and Coating				
Restoring Precast Conc. (incl. sealant joints & water repellant)	0	sf	$6.00	$0.00
Paint Trusses	0	sf	$4.00	$0.00
			Subtotal:	**$0.00**
Soffits				
North Overhang Soffit @ 4th & 6th Floors - Re-Coat Only	0	sf	$4.00	$0.00
			Subtotal:	**$0.00**
Interior GWB Wall Replacement (not including furniture moving)				
* Zones North (1-5)	0	sf	$27.00	$0.00
			Subtotal:	**$0.00**
Sheet Metal				
* Sheet Metal Flashing at Horizontal Projections	0	lf	$15.00	$0.00
* Sheet Metal Fascia	0	lf	$25.00	$0.00
			Subtotal:	**$0.00**
Subtotal - North Elevation				**$0**

* denotes work that is removed or changed from Option #2

Roofing				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Roofing Repair/Replacement (see separate cost estimates for detailed breakdowns)				
* Roof 1 (6th Fl) - Roof Repair	1	ls	$307,588.04	$307,588.04
* Roof 2 (4th Fl)	0	ls	$226,005.40	$0.00
Roof 3 (Penthouse) - Roof Repair	1	ls	$147,247.60	$147,247.60
Roof 4 (Mech.) - Roof Replacement	1	ls	$235,464.90	$235,464.90
* Roof 5 (Rotunda)	0	ls	$77,525.00	$0.00
* Roof 6 (2nd Fl)	0	ls	$78,290.00	$0.00
* Roof 7 (5nd Fl)	0	ls	$27,738.55	$0.00
			Subtotal:	**$690,300.54**
Fall Protection System (see Gravitec Report)				
* Appendix E - Proposal C	0	ls	283,340.00	$0.00
			Subtotal:	**$0.00**
EIFS Repair				
Zone Penthouse	9,580	sf	$4.00	$38,320.00
			Subtotal:	**$38,320.00**
Sheet Metal				
* Metal Coping at Roofs to be Repaired	1,723	lf	$85.00	$146,455.00
			Subtotal:	**$146,455.00**
Exterior Painting				
Penthouse Support & Braces	1	ls	$5,000.00	$5,000.00
Roof Top Equipment and Units	32	ea	500.00	$16,000.00
Misc. Painting	1	ls	$10,000.00	$10,000.00
			Subtotal:	**$31,000.00**
Misc				
Roof power	1	ls	$2,500.00	$2,500.00
Extend Equipment Supports	0	lf	$20.00	$0.00
Metal Stairs	3	lf	$500.00	$1,500.00
Lightning Protection Removal and Re-installation	1	ls	$2,500.00	$2,500.00
			Subtotal:	**$6,500.00**
Subtotal - Roofing				**$912,576**

* denotes work that is removed or changed from Option #2

Cost Summary - Base Bid		
South Elevation:		$1,225,078
North Elevation		$0
Roof & Penthouse:		$912,576
	SUBTOTAL	$2,137,653
	10% General Conditions	$213,765
	10% OH & P	$235,142
	SUBTOTAL	$2,586,560
	10% Design Contingency	$258,656
	BASE BID SUBTOTAL	**$2,845,216**
	8.7% Tax	$247,534
	Total	$3,092,750

ROOF COST BREAKDOWN

ROOF ONE (6TH FLOOR) - ROOF REPLACEMENT

DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
Safety	1	ls	$7,500.00	$7,500.00
Material hoists	1	ls	$12,500.00	$12,500.00
			Subtotal:	**$20,000.00**
Demolition and Recycling of Materials				
Dump fees	150	ton	$100.00	$15,000.00
Removal/Recycle of concrete paver	3,500	sf	$1.00	$3,500.00
Removal/Recycle of aggregate	35,351	sf	$1.00	$35,351.00
Demo roofing	35,351	sf	$0.35	$12,372.85
Removal/Storage of flat insulation	35,351	sf	$0.50	$17,675.50
Removal/Storage of tapered insulation	17,676	ls	$0.50	$8,837.75
Removal of GWB	35,351	sf	$0.25	$8,837.75
Removal of fall protection anchors	0	ea	$50.00	$0.00
Demo roofing at perimeter walls/parapets	0	lf	$2.50	$0.00
			Subtotal:	**$101,574.85**
Roofing Membrane				
Roof membrane	38,886	sf	$5.00	$194,430.50
Vapor retarder incl. fastening	35,351	sf	$1.75	$61,864.25
Gypsum wall board	35,351	sf	$1.00	$35,351.00
Coverboard - Densdeck	35,351	sf	$1.25	$44,188.75
Cricket	19,443	sf	$10.00	$194,430.50
EPDM roof walkpad	200	sf	$21.00	$4,200.00
Flashing at piping or base	20	ea	$100.00	$2,000.00
Liquid-applied flashing membrane details	1	ls	$2,000.00	$2,000.00
			Subtotal:	**$538,465.00**
Roof Insulation				
Re-install existing insulation	35,351	sf	$0.75	$26,513.25
New polyiso insulation - R-10	35,351	sf	$0.50	$17,675.50
			Subtotal:	**$44,188.75**
Sheet Metal				
Install coping @ top of parapet (incl. EIFS removal & reframing)	938	lf	$85.00	$79,730.00
Scupper and conductor heads	10	ea	$550.00	$5,500.00
			Subtotal:	**$85,230.00**
Ductwork / Equipment				
Remove and reinstall exhaust fan	0	ea	$1,250.00	$0.00
Remove and reinstall smoke hatch	0	ea	$1,250.00	$0.00
			Subtotal:	**$0.00**
Subtotal - Roof One:				**$789,458.60**

ROOF ONE (6TH FLOOR) - ROOF REPAIRS				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
Safety	1	ls	$5,000.00	$5,000.00
Material hoists	1	ls	$6,000.00	$6,000.00
			Subtotal:	**$11,000.00**
Demolition and Recycling of Materials				
Mobilization/Demobilization	1	ls	$8,000.00	$8,000.00
Dump fees	10	ton	$100.00	$1,000.00
Removal/Recycle of concrete paver	1,500	sf	$1.00	$1,500.00
Removal/Re-distribute of aggregate	21,211	sf	$3.00	$63,631.80
Demo roofing at perimeter walls/parapets	594	sf	$1.00	$594.00
			Subtotal:	**$74,725.80**
Roofing Membrane				
Clean exposed roof membrane	21,211	sf	$1.50	$31,815.90
Roof membrane flashing at perimeter, corner, parapet flashings	594	lf	$70.00	$41,580.00
			Subtotal:	**$73,395.90**
Roof Membrane Joint Repair				
Cover strip existing seams	3,187	sf	$20.00	$63,736.34
Metal support for power	0	ea	$500.00	$0.00
			Subtotal:	**$63,736.34**
Sheet Metal				
Install coping @ parapet (incl. EIFS removal & reframing)	938	lf	$85.00	$79,730.00
Scupper and conductor heads	0	ea	$550.00	$0.00
			Subtotal:	**$79,730.00**
Painting and Coating				
Liquid-applied flashing membrane - labor	1	ls	$6,000.00	$6,000.00
Liquid-applied flashing membrane - materials	1	ls	$10,000.00	$10,000.00
			Subtotal:	**$16,000.00**
Subtotal - Roof Two:				**$307,588.04**

ROOF TWO (4TH FLOOR) - ROOF REPLACEMENT				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
Safety	1	ls	$8,000.00	$8,000.00
Material hoists	1	ls	$16,000.00	$16,000.00
			Subtotal:	**$24,000.00**
Demolition and Recycling of Materials				
Dump fees	150	ton	$100.00	$15,000.00
Removal/Recycle of concrete paver	1,500	sf	$1.00	$1,500.00
Removal/Recycle of aggregate	24,482	sf	$1.00	$24,482.00
Demo roofing	24,482	sf	$0.35	$8,568.70
Removal/Storage of flat insulation	24,482	sf	$0.50	$12,241.00
Removal/Storage of tapered insulation	12,241	ls	$0.50	$6,120.50
Removal of GWB	24,482	sf	$0.25	$6,120.50
Removal of fall protection anchors	0	ea	$50.00	$0.00
Demo roofing at perimeter walls/parapets	0	lf	$2.50	$0.00

			Subtotal:	**$74,032.70**
Roofing Membrane				
Roof membrane	26,930	sf	$5.00	$134,651.00
Vapor retarder incl. fastening	24,482	sf	$1.75	$42,843.50
Gypsum wall board	24,482	sf	$1.00	$24,482.00
Coverboard - Densdeck	24,482	sf	$1.25	$30,602.50
Cricket	13,465	sf	$10.00	$134,651.00
EPDM roof walkpad	200	sf	$21.00	$4,200.00
Flashing at piping or base	25	ea	$50.00	$1,250.00
Liquid-applied flashing membrane details	1	ls	$2,000.00	$2,000.00
			Subtotal:	**$374,680.00**
Roof Insulation				
Re-install existing insulation	24,482	sf	$0.75	$18,361.50
New polyiso insulation - R-10	24,482	sf	$0.50	$12,241.00
			Subtotal:	**$30,602.50**
Sheet Metal				
Install coping @ parapet (incl. EIFS removal & reframing)	554	lf	$85.00	$47,090.00
			Subtotal:	**$47,090.00**
Ductwork / Equipment				
Remove and reinstall exhaust fan/smoke hatch	0	ea	$1,250.00	$0.00
			Subtotal:	**$0.00**
Subtotal - Roof Two:				**$550,405.20**

ROOF TWO (4TH FLOOR) - ROOF REPLACEMENT W/ GREEN ROOF				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
Safety	1	ls	$8,000.00	$8,000.00
Material hoists	1	ls	$16,000.00	$16,000.00
			Subtotal:	**$24,000.00**
Demolition and Recycling of Materials				
Dump fees	150	ton	$100.00	$15,000.00
Removal/Recycle of concrete paver	1,500	sf	$1.00	$1,500.00
Removal/Recycle of aggregate	24,482	sf	$1.00	$24,482.00
Demo roofing	24,482	sf	$0.35	$8,568.70
Removal/Storage of flat insulation	24,482	sf	$0.50	$12,241.00
Removal/Storage of tapered insulation	12,241	ls	$0.50	$6,120.50
Removal of GWB	24,482	sf	$0.25	$6,120.50
Removal of fall protection anchors	0	ea	$50.00	$0.00
Demo roofing at perimeter walls/parapets	0	lf	$2.50	$0.00
			Subtotal:	**$74,032.70**
Roofing Membrane				
Green roof	24,482	sf	$21.35	$522,690.70
Vapor retarder incl. fastening	24,482	sf	$0.40	$9,792.80
Gypsum wall board	24,482	sf	$0.80	$19,585.60
Fluid-applied membrane/Drainboard	24,482	sf	$5.40	$132,202.80
Cricket	13,465	sf	$10.00	$134,651.00
EPDM roof walkpad	200	sf	$21.00	$4,200.00
Flashing at piping or base	25	ea	$50.00	$1,250.00
Roof membrane at perimeter, corner, parapet flashings	554	lf	$4.00	$2,216.00

Liquid-applied flashing membrane details	1	ls	$2,000.00	$2,000.00
			Subtotal:	**$828,588.90**
Roof Insulation				
Re-install existing insulation	24,482	sf	$0.75	$18,361.50
New polyiso insulation - R-10	24,482	sf	$0.50	$12,241.00
			Subtotal:	**$30,602.50**
Sheet Metal				
Install coping @ parapet (incl. EIFS removal & reframing)	554	lf	$85.00	$47,090.00
Scupper and conductor heads	0	ea	$550.00	$0.00
			Subtotal:	**$47,090.00**
Ductwork / Equipment				
Remove and reinstall exhaust fan	0	ea	$1,250.00	$0.00
Remove and reinstall smoke hatch	0	ea	$1,250.00	$0.00
			Subtotal:	**$0.00**
Subtotal - Roof Two:				**$1,004,314.10**

ROOF TWO (4TH FLOOR) - ROOF REPAIRS				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
Safety	1	ls	$5,000.00	$5,000.00
Material hoists	1	ls	$6,000.00	$6,000.00
			Subtotal:	**$11,000.00**
Demolition and Recycling of Materials				
Mobilization/Demobilization	1	ls	$8,000.00	$8,000.00
Dump fees	10	ton	$100.00	$1,000.00
Removal/Recycle of concrete paver	1,500	sf	$1.00	$1,500.00
Removal/Re-distribute of aggregate	14,689	sf	$3.00	$44,067.60
Demo roofing at perimeter walls/parapets	594	sf	$1.00	$594.00
			Subtotal:	**$55,161.60**
Roofing Membrane				
Clean exposed roof membrane	14,689	sf	$1.50	$22,033.80
Roof membrane flashing @ perimeter, corner & parapet	594	lf	$70.00	$41,580.00
			Subtotal:	**$63,613.80**
Roof Membrane Joint Repair				
Cover strip existing seams	2,207	sf	$20.00	$44,140.00
Metal support for power	0	ea	$500.00	$0.00
			Subtotal:	**$44,140.00**
Sheet Metal				
Install coping @ parapet (incl. EIFS removal & reframing)	554	lf	$85.00	$47,090.00
Scupper and conductor heads	0	ea	$550.00	$0.00
			Subtotal:	**$47,090.00**
Painting and Coating				
Liquid-applied flashing membrane	400	lf	$40.00	$16,000.00
			Subtotal:	**$16,000.00**
Subtotal - Roof Two:				**$226,005.40**

ROOF THREE (PENTHOUSE) - ROOF REPLACEMENT				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
Safety	1	ls	$6,000.00	$6,000.00
Material hoists	1	ls	$10,000.00	$10,000.00
			Subtotal:	**$16,000.00**
Demolition and Recycling of Materials				
Dump fees	50	ton	$100.00	$5,000.00
Removal/Recycle of concrete paver	3,500	sf	$1.00	$3,500.00
Removal/Recycle of aggregate	9,068	sf	$1.00	$9,068.00
Demo roofing	9,068	sf	$0.35	$3,173.80
Removal/Storage of flat insulation	9,068	sf	$0.50	$4,534.00
Removal/Storage of tapered insulation	4,534	ls	$0.50	$2,267.00
Removal of GWB	9,068	sf	$0.25	$2,267.00
Removal of fall protection anchors	0	ea	$50.00	$0.00
Demo roofing at perimeter walls/parapets	0	lf	$2.50	$0.00
			Subtotal:	**$29,809.80**
Roofing Membrane				
Roof membrane	9,975	sf	$5.00	$49,874.00
Vapor retarder incl. fastening	9,068	sf	$1.75	$15,869.00
Gypsum wall board	9,068	sf	$1.00	$9,068.00
Coverboard - Densdeck	9,068	sf	$1.25	$11,335.00
Cricket	0	sf	$10.00	$0.00
EPDM roof walkpad	150	sf	$21.00	$3,150.00
Flashing at piping or base	5	ea	$100.00	$500.00
Roof membrane at perimeter, corner, parapet flashings	585	lf	$4.00	$2,340.00
Liquid-applied flashing membrane details	1	ls	$2,000.00	$2,000.00
			Subtotal:	**$94,136.00**
Roof Insulation				
Re-install existing insulation	9,068	sf	$0.75	$6,801.00
New polyiso insulation - R-10	9,068	sf	$0.50	$4,534.00
			Subtotal:	**$11,335.00**
Sheet Metal				
Install coping @ parapet (incl. EIFS removal & reframing)	585	lf	$85.00	$49,725.00
Scupper and conductor heads	0	ea	$550.00	$0.00
Gutters	252	lf	$20.00	$5,040.00
Downspouts	0	lf	$0.00	$0.00
			Subtotal:	**$54,765.00**
Ductwork / Equipment				
Remove and reinstall exhaust fan	0	ea	$1,250.00	$0.00
Remove and reinstall smoke hatch	0	ea	$1,250.00	$0.00
			Subtotal:	**$0.00**
Subtotal - Roof Three (Penthouse):				**$190,045.80**

ROOF THREE (PENTHOUSE) - ROOF REPAIR				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
Safety	1	ls	$6,000.00	$6,000.00
Material hoists	1	ls	$5,000.00	$5,000.00
			Subtotal:	**$11,000.00**
Demolition and Recycling of Materials				
Dump fees	8	ton	$100.00	$800.00
Removal/Recycle of concrete paver	3,500	sf	$1.00	$3,500.00
Removal/Re-distribute of aggregate	5,441	sf	$3.00	$16,322.40
Demo roofing at perimeter walls/parapets	585	lf	$1.00	$585.00
			Subtotal:	**$21,207.40**
Roofing Membrane				
Clean exposed roof membrane	5,441	sf	$6.50	$35,365.20
Roof membrane at perimeter, corner, parapet flashings	585	lf	$70.00	$40,950.00
			Subtotal:	**$76,315.20**
Roof Membrane Joint Repair				
Cover strip existing seams	3,355	sf	$20.00	$67,103.20
Metal support for power	0	ea	$500.00	$0.00
			Subtotal:	**$67,103.20**
Sheet Metal				
Gutters	252	lf	$20.00	$5,040.00
Downspouts	0	lf	$0.00	$0.00
Install coping @ parapet (incl. EIFS removal & reframing)	585	lf	$85.00	$49,725.00
Scupper and conductor heads	0	ea	$550.00	$0.00
			Subtotal:	**$49,725.00**
Ductwork / Equipment				
Remove and reinstall exhaust fan/smoke hatch	0	ea	$1,250.00	$0.00
			Subtotal:	**$0.00**
Subtotal - Roof Three (Penthouse):				**$147,247.60**

ROOF FOUR (MECH. COURTYARD) - ROOF REPLACEMENT				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
Safety	1	ls	$2,500.00	$2,500.00
Material hoists	1	ls	$7,500.00	$7,500.00
			Subtotal:	**$10,000.00**
Demolition and Recycling of Materials				
Dump fees	100	ton	$100.00	$10,000.00
Removal/Recycle of concrete paver	3,500	sf	$1.00	$3,500.00
Removal/Recycle of aggregate	8,971	sf	$1.00	$8,971.00
Demo roofing	8,971	sf	$0.35	$3,139.85
Removal/Storage of flat insulation	8,971	sf	$0.50	$4,485.50
Removal/Storage of tapered insulation	4,486	ls	$0.50	$2,242.75
Removal of GWB	8,971	sf	$0.25	$2,242.75
Removal of fall protection anchors	0	ea	$50.00	$0.00
Demo roofing at perimeter walls/parapets	0	lf	$2.50	$0.00

			Subtotal:	**$34,581.85**
Roofing Membrane				
Roof membrane - 60 mil	9,868	sf	$8.00	$78,944.80
Vapor retarder incl. fastening	8,971	sf	$1.75	$15,699.25
Gypsum wall board	8,971	sf	$1.00	$8,971.00
Coverboard - Densdeck	8,971	sf	$1.25	$11,213.75
Cricket	4,934	sf	$10.00	$49,340.50
EPDM roof walkpad	0	sf	$21.00	$0.00
Flashing at piping or base	80	ea	$100.00	$8,000.00
Liquid-applied flashing membrane details	1	ls	$2,000.00	$2,000.00
			Subtotal:	**$174,169.30**
Roof Insulation				
Re-install existing insulation	8,971	sf	$0.75	$6,728.25
New polyiso insulation - R-10	8,971	sf	$0.50	$4,485.50
			Subtotal:	**$11,213.75**
Sheet Metal				
Install coping @ parapet (incl. EIFS removal & reframing)	0	lf	$85.00	$0.00
Scupper and conductor heads	10	ea	$550.00	$5,500.00
			Subtotal:	**$5,500.00**
Ductwork / Equipment				
Remove and reinstall exhaust fan/smoke hatch	0	ea	$1,250.00	$0.00
			Subtotal:	**$0.00**
Subtotal - Roof One:				**$235,464.90**

ROOF FIVE (ROTUNDA) - ROOF REPLACEMENT				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
Safety	1	ls	$2,500.00	$2,500.00
Material hoists	1	ls	$2,000.00	$2,000.00
			Subtotal:	**$4,500.00**
Demolition and Recycling of Materials				
Dump fees	25	ton	$100.00	$2,500.00
Removal/Recycle of concrete paver	700	sf	$1.00	$700.00
Removal/Recycle of aggregate	2,625	sf	$1.00	$2,625.00
Demo roofing	2,625	sf	$0.35	$918.75
Removal/Storage of flat insulation	2,625	sf	$0.50	$1,312.50
Removal/Storage of tapered insulation	1,313	ls	$0.50	$656.25
Removal of GWB	2,625	sf	$0.25	$656.25
Demo roofing at perimeter walls/parapets	0	lf	$2.50	$0.00
			Subtotal:	**$9,368.75**
Roofing Membrane				
Roof membrane	2,888	sf	$5.00	$14,437.50
Vapor retarder incl. fastening	2,625	sf	$1.75	$4,593.75
Gypsum wall board	2,625	sf	$1.00	$2,625.00
Coverboard - Densdeck	2,625	sf	$1.25	$3,281.25
Cricket	1,444	sf	$10.00	$14,437.50
EPDM roof walkpad	0	sf	$21.00	$0.00
Flashing at piping or base	2	ea	$100.00	$200.00
Roof membrane at perimeter, corner, parapet flashings	200	lf	$4.00	$800.00

Liquid-applied flashing membrane details	1	ls	$2,000.00	$2,000.00
			Subtotal:	**$42,375.00**
Roof Insulation				
Re-install existing insulation	2,625	sf	$0.75	$1,968.75
New polyiso insulation - R-10	2,625	sf	$0.50	$1,312.50
			Subtotal:	**$3,281.25**
Sheet Metal				
Install coping @ parapet (incl. EIFS removal & reframing)	200	lf	$85.00	$17,000.00
Scupper and conductor heads	10	ea	$550.00	$5,500.00
			Subtotal:	**$22,500.00**
Ductwork / Equipment				
Remove and reinstall exhaust fan/smoke hatch	0	ea	$1,250.00	$0.00
			Subtotal:	**$0.00**
Subtotal - Roof Five:				**$77,525.00**

ROOF SIX (2ND FLOOR) - ROOF REPLACEMENT				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
Safety	1	ls	$3,000.00	$3,000.00
Material hoists	1	ls	$5,000.00	$5,000.00
Access	1	ls	$2,000.00	$2,000.00
			Subtotal:	**$10,000.00**
Demolition and Recycling of Materials				
Dump fees	25	ton	$100.00	$2,500.00
Removal/Recycle of concrete paver	0	sf	$1.00	$0.00
Removal/Recycle of aggregate	3,900	sf	$1.00	$3,900.00
Demo roofing	3,900	sf	$0.35	$1,365.00
Removal/Storage of flat insulation	3,900	sf	$0.50	$1,950.00
Removal/Storage of tapered insulation	1,950	ls	$0.50	$975.00
Removal of GWB	3,900	sf	$0.25	$975.00
Demo roofing at perimeter walls/parapets	0	lf	$2.50	$0.00
			Subtotal:	**$11,665.00**
Roofing Membrane				
Roof membrane	4,290	sf	$5.00	$21,450.00
Vapor retarder incl. fastening	3,900	sf	$1.75	$6,825.00
Gypsum wall board	3,900	sf	$1.00	$3,900.00
Coverboard - Densdeck	3,900	sf	$1.25	$4,875.00
Cricket	2,145	sf	$10.00	$21,450.00
EPDM roof walkpad	0	sf	$21.00	$0.00
Flashing at piping or base	25	ea	$50.00	$1,250.00
Liquid-applied flashing membrane details	1	ls	$2,000.00	$2,000.00
			Subtotal:	**$61,750.00**
Roof Insulation				
Re-install existing insulation	3,900	sf	$0.75	$2,925.00
New polyiso insulation - R-10	3,900	sf	$0.50	$1,950.00
			Subtotal:	**$4,875.00**
Sheet Metal				
Install coping @ parapet (incl. EIFS removal & reframing)	0	lf	$85.00	$0.00
			Subtotal:	**$0.00**

Subtotal - Roof Six (Green Roof): **$78,290.00**

ROOF SIX (2ND FLOOR) - ROOF REPLACEMENT (GREEN ROOF)				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
Safety	1	ls	$3,000.00	$3,000.00
Material hoists	1	ls	$5,000.00	$5,000.00
Access	1	ls	$2,000.00	$2,000.00
			Subtotal:	**$10,000.00**
Demolition and Recycling of Materials				
Dump fees	25	ton	$100.00	$2,500.00
Removal/Recycle of concrete paver	0	sf	$1.00	$0.00
Removal/Recycle of aggregate	3,900	sf	$1.00	$3,900.00
Demo roofing	3,900	sf	$0.35	$1,365.00
Removal/Storage of flat insulation	3,900	sf	$0.50	$1,950.00
Removal/Storage of tapered insulation	1,950	ls	$0.50	$975.00
Removal of GWB	3,900	sf	$0.25	$975.00
Removal of fall protection anchors	0	ea	$50.00	$0.00
Demo roofing at perimeter walls/parapets	0	lf	$2.50	$0.00
			Subtotal:	**$11,665.00**
Roofing Membrane				
Green roof	3,900	sf	$21.35	$83,265.00
Vapor retarder incl. fastening	3,900	sf	$0.40	$1,560.00
Gypsum wall board	3,900	sf	$0.80	$3,120.00
Fluid-applied membrane/Drainboard	3,900	sf	$5.40	$21,060.00
Cricket	2,145	sf	$10.00	$21,450.00
EPDM roof walkpad	0	sf	$21.00	$0.00
Flashing at piping or base	0	ea	$50.00	$0.00
Roof membrane at perimeter, corner, parapet flashings	0	lf	$4.00	$0.00
Liquid-applied flashing membrane details	1	ls	$2,000.00	$2,000.00
			Subtotal:	**$132,455.00**
Roof Insulation				
Re-install existing insulation	3,900	sf	$0.75	$2,925.00
New polyiso insulation - R-10	3,900	sf	$0.50	$1,950.00
			Subtotal:	**$4,875.00**
Sheet Metal				
Install coping @ parapet (incl. EIFS removal & reframing)	0	lf	$85.00	$0.00
Scupper and conductor heads	0	ea	$550.00	$0.00
			Subtotal:	**$0.00**

Subtotal - Roof Six (Green Roof): **$148,995.00**

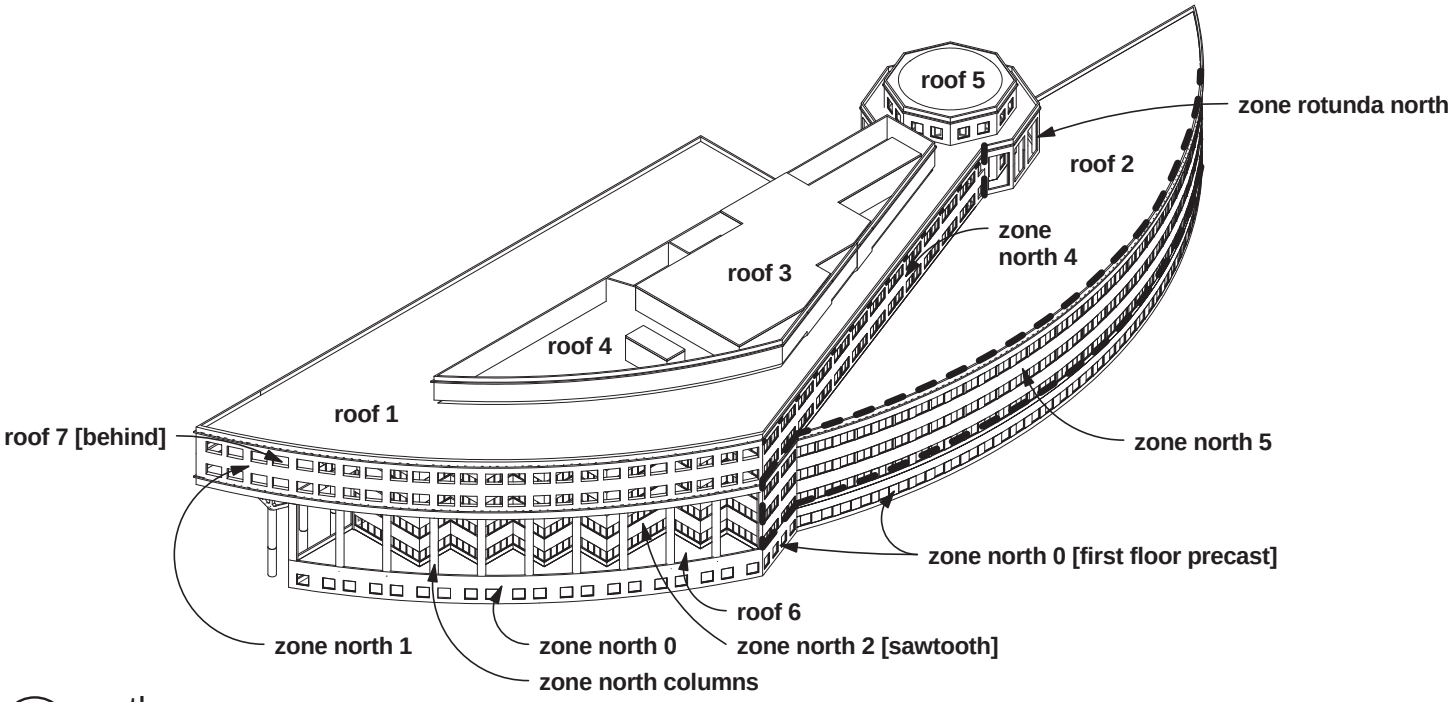
ROOF SIX (2ND FLOOR) - ROOF REPAIRS				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific General Conditions				
Safety	1	ls	$3,000.00	$3,000.00
Material hoists	1	ls	$2,000.00	$2,000.00
Access	1	ls	$2,000.00	$2,000.00
			Subtotal:	**$7,000.00**
Demolition and Recycling of Materials				
Dump fees	12	ton	$100.00	$1,200.00
Removal/recycle of concrete paver	0	sf	$1.00	$0.00
Removal/recycle of aggregate	3,900	sf	$1.00	$3,900.00
Demo roofing at perimeter walls/parapets	0	lf	$2.50	$0.00
			Subtotal:	**$5,100.00**
Roofing Membrane				
Roof membrane	0	sf	$21.35	$0.00
Roof membrane at perimeter, corner, parapet flashings	0	lf	$4.00	$0.00
			Subtotal:	**$0.00**
Roof Membrane Joint Repair				
Cover strip existing seams	700	sf	$15.00	$10,500.00
Metal support for power	0	ea	$500.00	$0.00
			Subtotal:	**$10,500.00**
Sheet Metal				
Install coping @ parapet (incl. EIFS removal & reframing)	0	lf	$85.00	$0.00
Scupper and conductor heads	0	ea	$550.00	$0.00
			Subtotal:	**$0.00**
Subtotal - Roof Six (Green Roof):				**$15,600.00**

ROOF SEVEN (5TH FLOOR) - ROOF REPLACEMENT				
DESCRIPTION	QTY.	UNITS	UNIT COST	TOTAL
Project Specific Project Specific General Conditions				
Safety	1	ls	$1,500.00	$1,500.00
Material hoists	1	ls	$1,000.00	$1,000.00
			Subtotal:	**$2,500.00**
Demolition and Recycling of Materials				
Dump fees	8	ton	$100.00	$800.00
Removal/Recycle of concrete paver	0	sf	$1.00	$0.00
Removal/Recycle of aggregate	1,323	sf	$1.00	$1,323.00
Demo roofing	1,323	sf	$0.35	$463.05
Removal/Storage of flat insulation	1,323	sf	$0.50	$661.50
Removal/Storage of tapered insulation	1,323	ls	$0.50	$661.50
Removal of GWB	1,323	sf	$0.25	$330.75
Removal of fall protection anchors	0	ea	$50.00	$0.00
Demo roofing at perimeter walls/parapets	0	lf	$2.50	$0.00
			Subtotal:	**$4,239.80**
Roofing Membrane				
Roof membrane	1,455	sf	$5.00	$7,276.50
Vapor retarder incl. fastening	1,323	sf	$1.75	$2,315.25
Gypsum wall board	1,323	sf	$1.00	$1,323.00

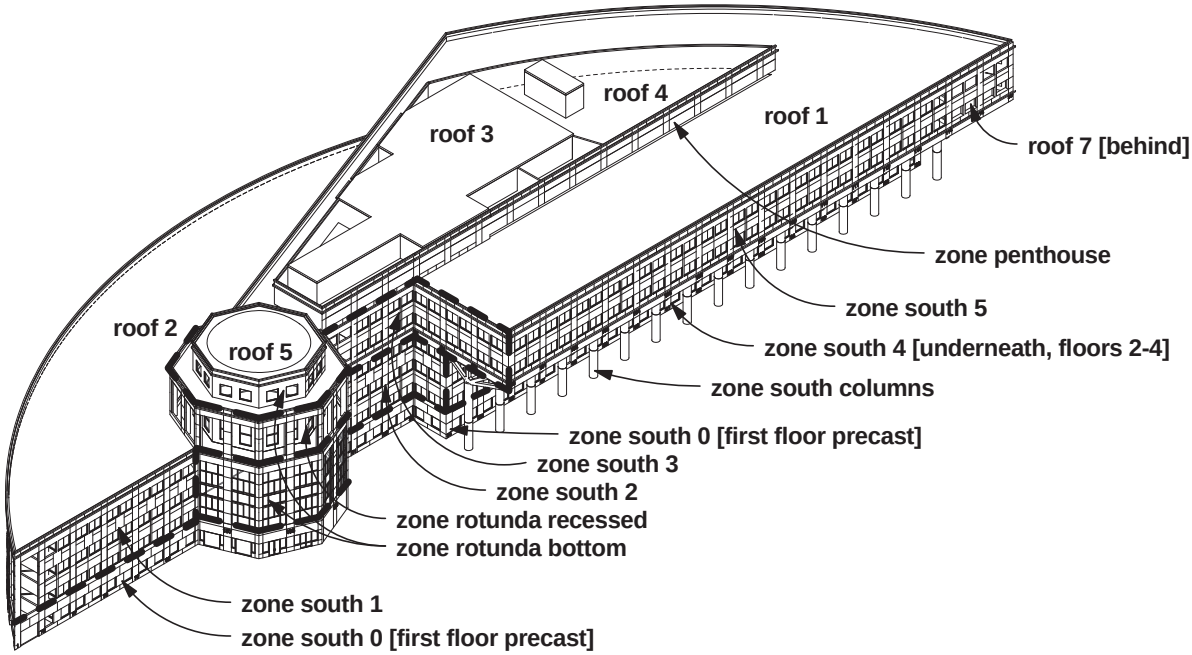
Coverboard - Densdeck	1,323	sf	$1.25	$1,653.75
Cricket	728	sf	$10.00	$7,276.50
EPDM roof walkpad	0	sf	$21.00	$0.00
Flashing at piping or base	0	ea	$50.00	$0.00
Liquid-applied flashing membrane	1	ls	$2,000.00	$2,000.00
			Subtotal:	**$21,845.00**
Roof Insulation				
Re-install existing insulation	1,323	sf	$0.75	$992.25
New polyiso insulation - R-10	1,323	sf	$0.50	$661.50
			Subtotal:	**$1,653.75**
Sheet Metal				
Install coping @ top of parapet (incl. EIFS removal & reframing)	0	lf	$85.00	$0.00
Scupper and conductor heads	0	ea	$550.00	$0.00
			Subtotal:	**$0.00**

Subtotal - Roof One: **$27,738.55**

NATURAL RESOURCES BUILDING ENVELOPE ZONE DIAGRAM:



1 north zones



2 south zones

ROOF EVALUATION

Natural Resources Building

1111 Washington St SE Olympia, WA 98501

Prepared For:

Vikki Poitra, Project Manager

(for the State of WA)

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ROOF EVALUATION

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APPENDIX

Appendix A -- Additional BET&R Investigation and Findings A-1 – A-7

INTRODUCTION

In the autumn of 2011, S.M. Stemper Architects (SMSA) and Building Envelope Technology & Research (BET&R) were engaged as a Design Team by the State of Washington Department of Enterprise Services (DES) to develop recommendations and a design to reroof and repair walls and soffits of the Washington State Natural Resources Building (NRB), located in Olympia, Washington. The first step in developing a comprehensive, integrated plan for the Building's exterior envelope, including establishing priorities for replacement vs. retrofit and/or repair, was to conduct a thorough survey of the roofs and exterior walls. The following report describes the findings of the survey, including condition of the subject roofing systems, their existing materials and configurations at various roof areas of the building, and outlines recommendations to proceed with selective, phased replacement of certain roof areas, and repair and retrofit of other roofs of the Building.

Figure 1 - Aerial Overview (from the North) of the Natural Resources Building: (excerpted from BING maps)

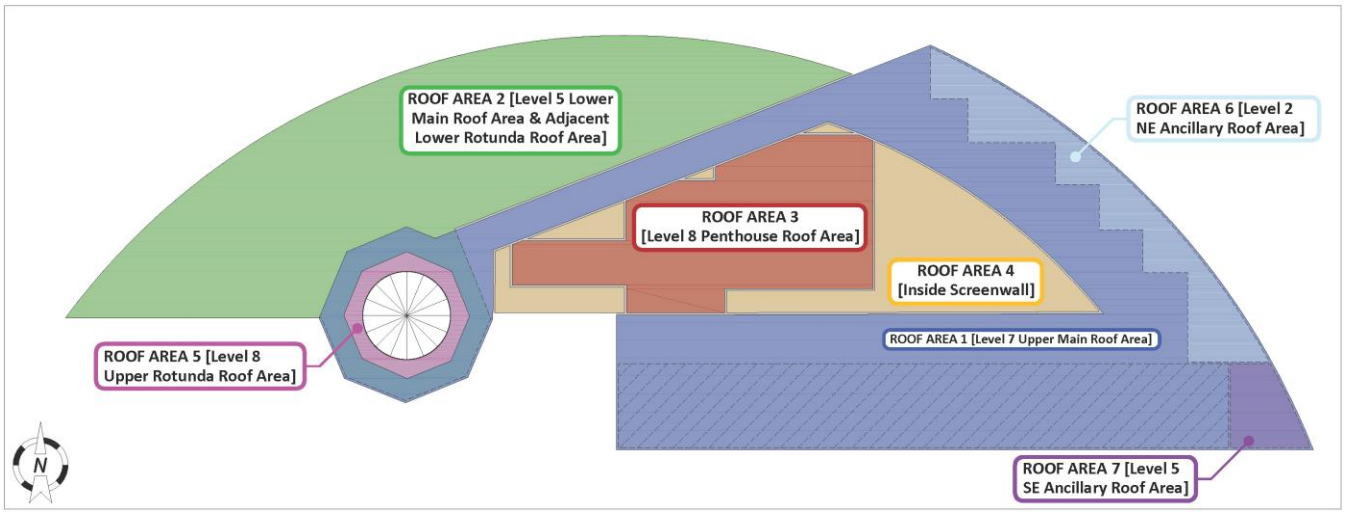


Figure 2 - Schematic Roof Plan Drawing

EXECUTIVE SUMMARY

BET&R and SMSA were retained to assess the condition of the existing roof systems on the Natural Resource Building (NRB) and to develop a schematic plan, then a design for reroofing. The Design Team was also tasked with preparing Budget Cost Estimates for various roof replacement scenarios, and prioritizing the repairs should budget constraints preclude complete reroofing.

SURVEY AND TESTING

The Roof Survey Team, composed of two of BET&R's Roof Technologists, accompanied intermittently by BET&R's Technical Director and S.M. Stemper's Principal Architect, who performed extensive visual and tactile surveys of the roof membrane and flashings of the Building's numerous roof areas, and performed ten (10) test openings through the membrane and insulation layers in various locations. These openings provided revealing information regarding the different configurations of the roof systems, as well as providing information regarding the varying conditions of the existing roofing system components, and for development of reroofing, and potential cost effective roof repair design for extending the performance of the existing roof assembly of select areas.

GENERAL SUMMARY OF FINDINGS

There are two (2) general configurations of roof assemblies on the Building, distinguished primarily by the type of structural roof deck. At Roof Areas 1, 3, and 4, the non-reinforced, 45 mil-thick EPDM (ethylene propylene diene terpolymer) membrane roof system was installed over a steel panel roof deck, which was covered with a gypsum thermal barrier board that had been incorporated into the roof system between the roof deck and the rigid roof insulation to provide internal fire-resistance. At the other roof areas, the insulated membrane roof system was installed over a concrete roof deck. In these areas, the thermal barrier was not present nor required.

The condition of the EPDM roof membrane varies throughout the different roof areas. In areas where the aggregate (i.e., rounded rock) ballast is relatively light, the membrane has aged and was found to be more weather-worn, embrittled, and crazed as a result of increased exposure to ultraviolet radiation and severe thermal cycling. However, where the EPDM roof membrane has been protected by a relatively heavy layer of ballast, the EPDM is more supple and in relatively good and serviceable condition.

At the larger roof areas (Roof Areas 1, 2, and 3) there is significant bridging of the membrane at parapet walls caused by shrinkage of the membrane, which is typical of aged, non-reinforced EPDM roofing. BET&R's Roof Technologists found that under the increasing shear stress of continued membrane shrinkage, seams in the field of the roof are beginning to peel and fail.

The south-facing parapet wall EPDM membrane flashings are craze-cracking in areas due to prolonged direct exposure to UV (Ultraviolet) and heat aging, and are stretched and bridging due to shrinkage of the adjacent field membrane. At some locations, leaks have occurred at the perimeter of Roof Area 1, as a result of the membrane base flashings bridging and being detached from the perimeter wall or curb. And, more locations of detachment, membrane-separation, and leaks should be anticipated – all due to poor original attachment design and in-field detailing.

Where the roof was opened, the other components of the roof system (i.e., the layers of rigid roof insulation, in most locations the thermal barrier board, and roof decks) were found to be in "as new" or very good condition, with only isolated areas of damage observed. At several test openings, minor areas of fungal growth were discovered on the paper facer of the original gypsum thermal barrier board. The steel roof deck was found to be

in very good condition; although a small amount of corrosion was discovered at the location of a known leak, but all other test openings indicate that this isolated damage is not wide spread, and is mostly confined to select perimeter's where the Exterior Insulation and Finish System (EIFS) coped parapets have cracked and leaked water into the roof assembly. Please note that this roof system no longer meets upgrades in the current code concerning Thermal Resistance Value (R-value), and ballasted roofs adjacent class curtain-wall clad buildings.

The Team discovered evidence that the majority of reported "roof" leaks are occurring through cracks and failed sealant joints in the EIFS parapet wall coping, combined with the EPDM shrinkage, which has pulled the membrane away from the parapet, creating open gaps; these are the roof-related items that are causing the most water damage to interlying parapet walls, its sheathing and interlying framing. But, the Building's internal air leaks at each floor line, and HVAC (heating, ventilation, and air conditioning) with occupancy generated moisture vapor drive, and deficient interior wall vapor retarder, combined with no vapor retarder in the roof system, are resulting in condensation and moisture-related issues, which have also degraded the parapets and roof perimeters. In some areas these leaks have resulted in damage to the roof system and wetting of the substrates.

GENERAL RECOMMENDATIONS

Due to shrinkage of the existing EPDM roof membrane, heat-aging, craze-cracking, prolonged UV-exposure, and deficiencies related to the parapet caps, BET&R recommends that all roofs at the NRB be selectively replaced in phases, along with construction of perimeter air stops and a roof vapor retarder that should be tied-in to the Building's perimeter walls' retrofit vapor retarder as soon as the State's budget allows. However, with potential 2011/2012 budget constraints in mind, it is possible to undertake a campaign of carefully designed roof-related repairs, mostly at roof perimeters, combined with the select reroofing of certain roof areas. Proper perimeter roof repairs and retrofit can cost effectively extend the service life of all but two (2) of the Building's roof areas.

Where the existing membrane is craze-cracking and more weather-worn and heat-aged, such as at Roof Areas R-1 and R-4, the roof system should be replaced during the summer of 2012. At other Roof Areas such as R-2 and others, where the membrane has been well-protected by the excess stone ballast, repairs are possible to extend the life of those roofs. The EPDM membrane wall flashings should be carefully cut, to free the field membrane from the parapet and rising building walls, and allow the field membrane to relax to alleviate shear strain on the seams in the field of the roof. EPDM membrane wall and base flashings should be replaced with proper design provisions for expansion and for future reroofing details taken thoroughly into account.

It is also critical that the EIFS clad parapet caps be replaced or retrofit to prevent water from migrating through cracks and failed sealant joints, and permeating through the EIFS lamina as it ages, so as to halt leaks and damage into the interior of the walls, roof perimeters, and Building. Replace EIFS coping along tops of parapets with membrane flashing and sheet metal coping or EIFS caps could be waterproofed with reinforced Polymethyl Methacrylate (PMMA) membrane flashing covers.

Reroofing would include (Tear-off and Reroof in Sections):

- Refastening of the sheet metal deck at isolated location where necessary, as may be discovered during the reroofing project;
- Reuse of existing gypsum thermal barrier board, by treating it on both faces, mechanically attaching it to the steel roof deck, and installing a new polymer modified asphalt membrane (torch-grade) vapor retarder on the primed rough-face. It is critical that the new roof vapor retarder be installed at all roof areas (i.e., where the structural roof deck is metal and where it is concrete) as each roof area is eventually reroofed;

- Reuse of all existing polystyrene roof insulation;
- Installation of additional polyisocyanurate roof insulation to meet current energy code, and overlay all roof insulation layers with a new gypsum-based coverboard (i.e., DensDeck Prime);
- Installation of new, fully adhered, 60 mil-thick EPDM roof membrane;
- Rebuilding of perimeter parapet walls and flashing of parapet walls with new membrane and sheet metal coping. Where it is impractical to install sheet metal coping, install PMMA membrane over the existing EIFS parapet cap.

Strategic Roof Repair would include:

a. Retrofit of Roof Membrane at Perimeters:
   - Shoveling back and windrowing existing aggregate ballast;
   - Cutting back the existing membrane to remove the existing perimeter EPDM membrane wall and base flashings;
   - Allowing existing EPDM field membrane to shrink back and relax, then terminate and mechanically attach securely;
   - Rebuilding parapets and bases of rising walls as necessary;
   - Installation of new fully-adhered 60-mil unreinforced EPDM roofing membrane wall and base flashings, and tie-in to existing EPDM roof membrane around the perimeter circumference at the field-to-perimeter intersection of the roof.
b. Replacement of membrane base flashings at all mechanical curbs, drains, and other penetrations.
c. Reinforce field membrane seams:
   - Shovel back and windrow existing aggregate ballast back from both sides of all membrane field seams (i.e., to expose approx. 18- to 24-inches along all seams);
   - Clean the exposed existing EPDM roofing membrane thoroughly along all seam lines;
   - Strip-in all field seams with new EPDM membrane cover stripping;
d. Rebuilding of perimeter parapet walls and flashing of parapet walls with new sheet metal coping to match roof areas being reroofed. Where it is impractical to install sheet metal coping, install PMMA membrane over the existing EIFS parapet cap.

Further details regarding our findings and recommendations are included in the following pages.

INVESTIGATION AND FINDINGS

BUILDING LAYOUT AND CONSTRUCTION

The Building is arranged in a relatively complex shape with a varied profile. The radius-architectural configured north portion of the Building is 4 stories tall, as is the western end of the Building. The central part of the building is 6 levels tall with a radius wall at the northeast elevation. At the south elevation, the eastern portion of the 5th and 6th levels is cantilevered out from the main Building. Also along the south elevation, there is a central, 7-level tall open Rotunda. The Building is constructed over an extensive below-grade structure that houses parking, occupied storage and laboratory space, and a service tunnel.

TYPICAL ROOF ASSEMBLY

A ballasted loose-laid EPDM (Ethylene Propylene Diene Terpolymer) formulated roof membrane system was observed at all NRB low-slope roof areas surveyed, with slight variations at each roof area. This loose-laid and stone ballasted EPDM roof system was a well-performing, cost-effective roof system typically installed during the 1980's 90's. In general, the ballast protected the EPDM roof membrane from wind uplift, and weathering and failure that is caused by prolonged exposure to Ultraviolet (UV) light and heat aging.

There are two general roof assemblies that exist on the NRB complex. As stated above the two general differences are the structural roof deck type (i.e., steel panel roof decking, and steel pan deck with concrete topping). However, there are three (3) specific different roof systems that were discovered as-built on the various roof areas surveyed at NRB, which are illustrated and outlined below:

*Please note, this system description drawing applies to portions of Roof Area R-1 and all of Roof Area R-3.

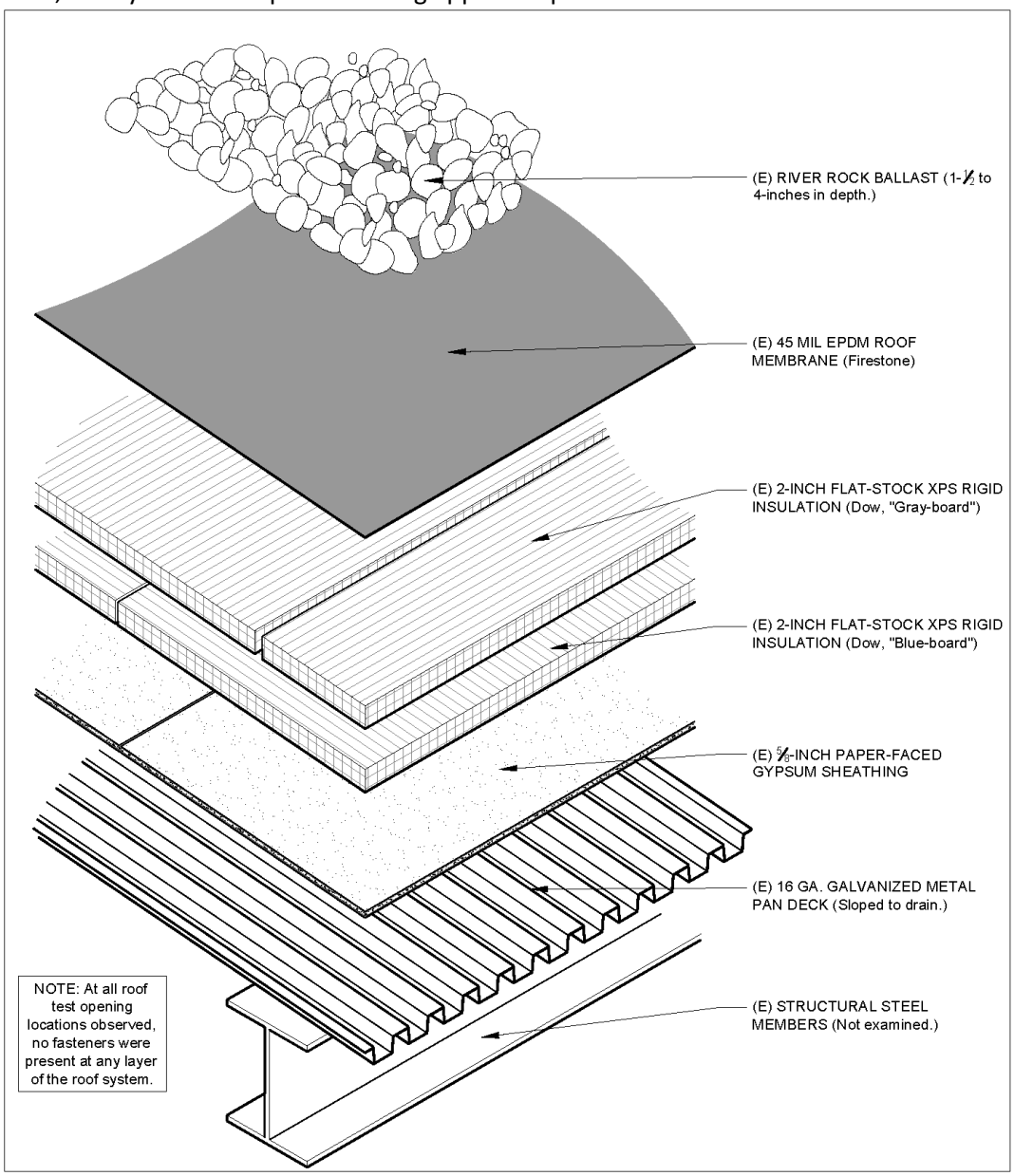


Figure 3 - Existing Roof Configuration A Description Drawing

Roof Configuration A: *From Top Down*

- River-Rounded Rock Ballast;
- EPDM Field Membrane, which is .045-inch or 45-mil thick;
- Dow, Blue Board®, Extruded Polystyrene (XPS) Rigid Insulation, 2-inch flat-stock producing an approximate Thermal Resistance Value (R-value) of 10;
- Dow, Grey Board®, Extruded Polystyrene (XPS) Rigid Insulation, 2-inch flat-stock producing an approximate Thermal Resistance Value (R-value) of 10;
- ⅝-inch thick Paper-Faced Gypsum Thermal Barrier Board;
- 16 Gauge Galvanized Steel Roof Deck, sloped to drain.

*Please note, this system description drawing applies to portions of Roof Area R-1 and all of Roof Area R-4.

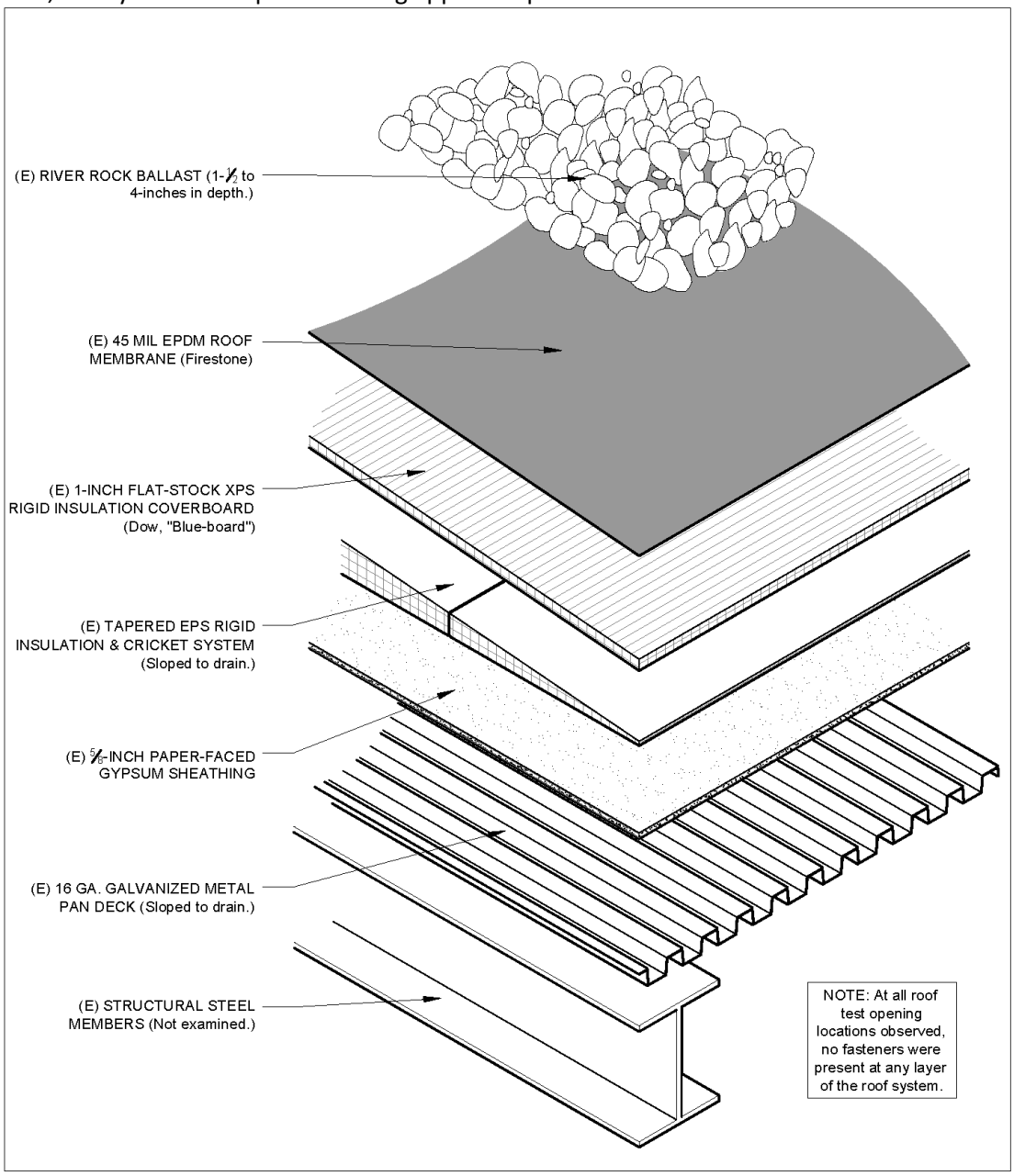


Figure 4 - Existing Roof Configuration B Description Drawing

Roof Configuration B: *From Top Down*

- River-Rounded Rock Ballast;
- EPDM Field Membrane, which is .045-inch or 45-mil thick;
- Dow, Blue Board®, Extruded Polystyrene (XPS) Rigid Insulation, 1-inch flat-stock producing an approximate Thermal Resistance Value (R-value) of 5;
- Various thicknesses of Pre-Engineered Expanded Polystyrene (EPS) Tapered Insulation/Cricket System with ¼:12 slope ratio;
- ⅝-inch thick Paper-Faced Gypsum Thermal Barrier;
- 16 Gauge Galvanized Steel Roof Deck, flat.

*Please note, this system description drawing applies to Roof Areas R-2, R-5, R-6, and R-7.

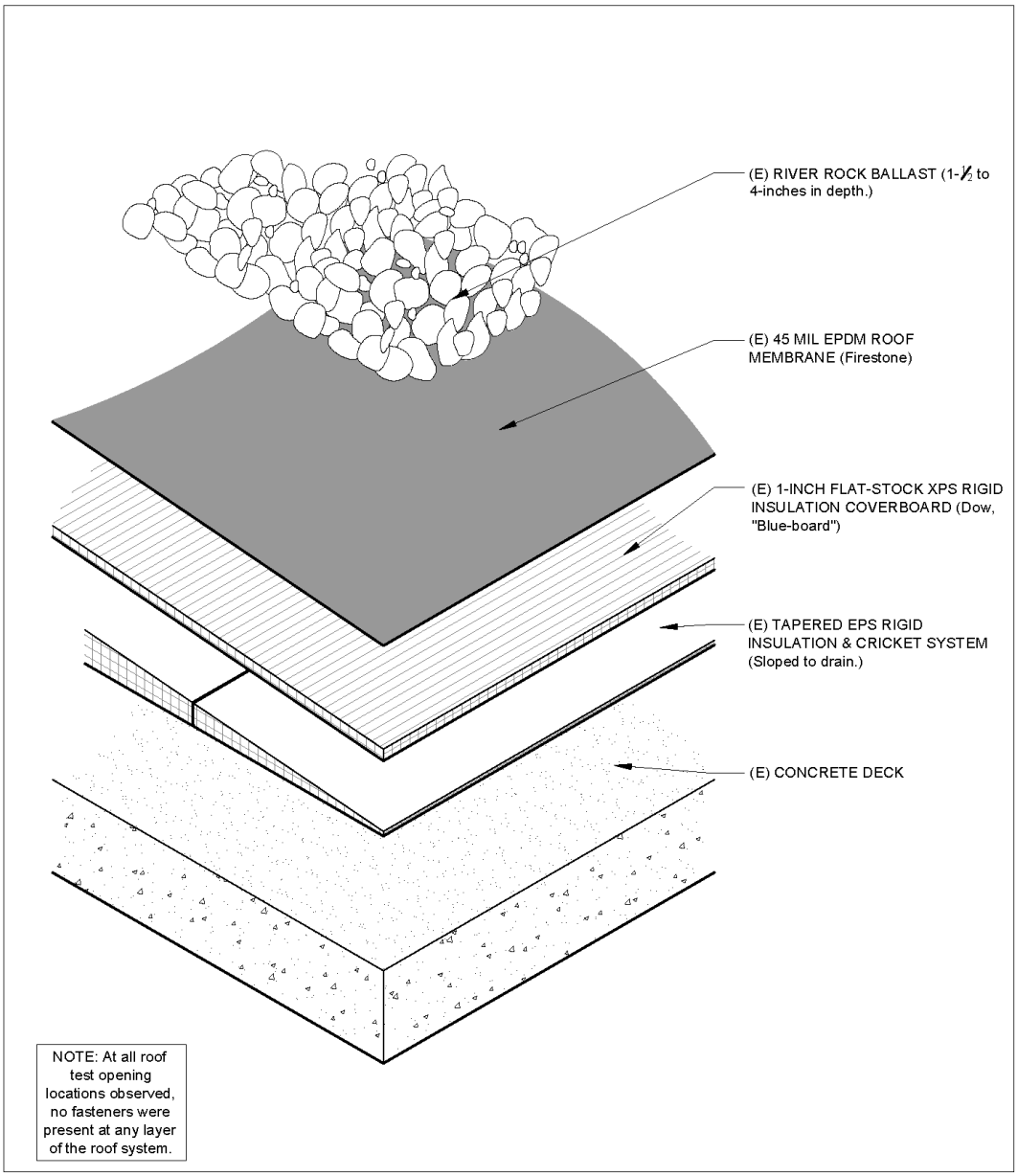


Figure 5 - Existing Roof Configuration C Description Drawing

Roof Configuration C: *From Top Down*

- River-Rounded Rock Ballast;
- EPDM Field Membrane, which is 0.45 inch or 45-mil thick;
- Dow, Blue Board®, Extruded Polystyrene (XPS) Rigid Insulation, 1-inch flat-stock producing an approximate Thermal Resistance Value (R-value) of 5;
- Various thicknesses of Pre-Engineered EPS Tapered Insulation System;
- Concrete Deck, flat.

INTERIOR VISUAL SURVEY OF REPORTED LEAK

BET&R performed a joint interior survey with SMSA, accompanied by members of DES, of all ceiling areas, located directly beneath the various roof areas of the NRB, to visually locate previously reported or currently active leak locations. During this interior visual survey, twenty-three (23) leaks were identified at the ceiling as possibly being associated with roof-related conditions. Some of the locations identified may be related to plumbing issues, as one location observed was a leaking plumbing pipe fitting, which was communicated to maintenance personnel.

SURVEY AND TESTING OVERVIEW

BET&R performed a technical survey of all the low-slope EPDM roofed areas and the Rotunda's metal dome roof at the State of Washington's Natural Resource Building. This survey included visual and tactile examination of select roof system components including: the roofing membrane, membrane and sheet metal flashings, many on-roof mechanical equipment curbs, numerous through-roof penetrations, and perimeter details. Additionally, BET&R performed invasive test openings at low-slope roof areas to examine the roof assembly cross section and components (including the condition of the insulation for its potential re-use), and to determine if a vapor retarder was originally installed. The information gathered was essential to determine the overall condition of each roof area's roof system, and to provide a complete and thorough reroofing, and phased roof repair and retrofit design.

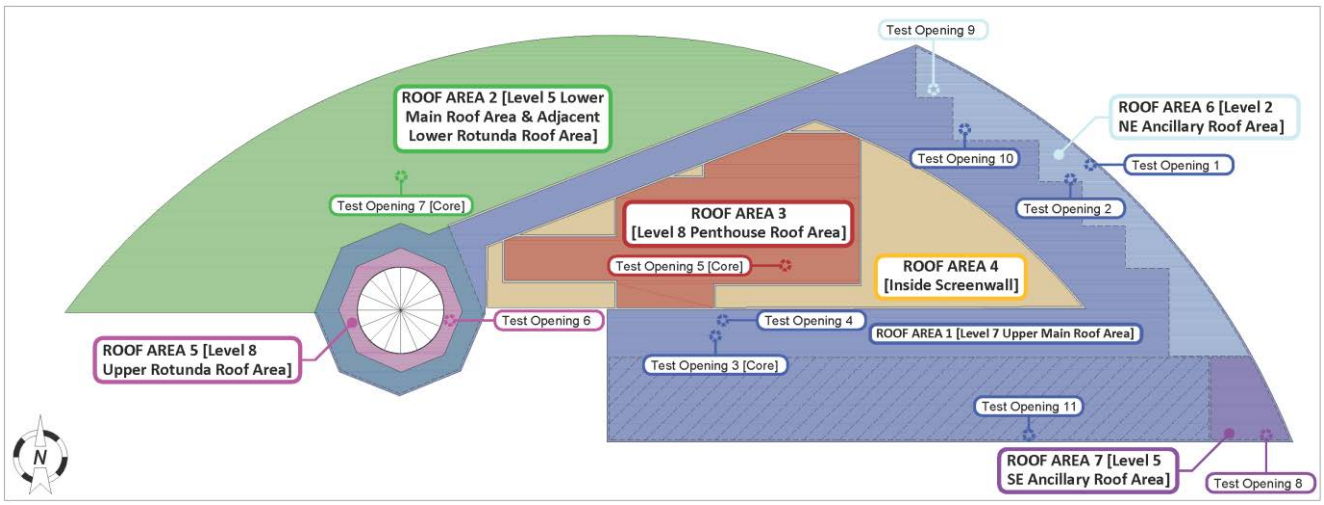


Figure 6 - Test Location and Roof Area Plan Drawing

*Please note that conditions observed are limited to the opened areas only, and do not necessarily address latent conditions which may occur at other locations. Conclusions are based upon our experience with roofs across North America and an educated assumption that the substrates and roof systems continue in the same manner where construction is generally the same. In addition, all test openings were repaired the same day opened, with a permanent double-layered (i.e., 2-ply) patch, to meet and exceed industry standards for long-term EPDM roof repair performance.

ROOF AREAS R-1 and R-4

Testing Overview:

BET&R performed six (6) investigative test openings at Roof Areas R-1 and R-4 to determine the construction, configuration, and condition of the existing building materials at this upper main roof area. Investigative Test Openings 1 and 11 were executed to contrast the north- and south-facing parapet EPDM wall flashing conditions at the south and north radiused elevations. The two large triangular openings, Investigative Test Openings 2 and 4, were made to observe the condition of the metal deck over a larger area. Investigative Test Opening 3 was executed to observe the construction of the cricketing and/or tapering system which was visually apparent during the initial walkthrough. Investigative Test Opening 10 was performed as a special targeted access area, as requested by the Project Architect, to allow Gravitec Systems, Inc. to observe structural conditions adjacent a swing stage access anchor.

*Please note that Roof Area R-4 is separated only by the screenwall from Roof Area R-1.

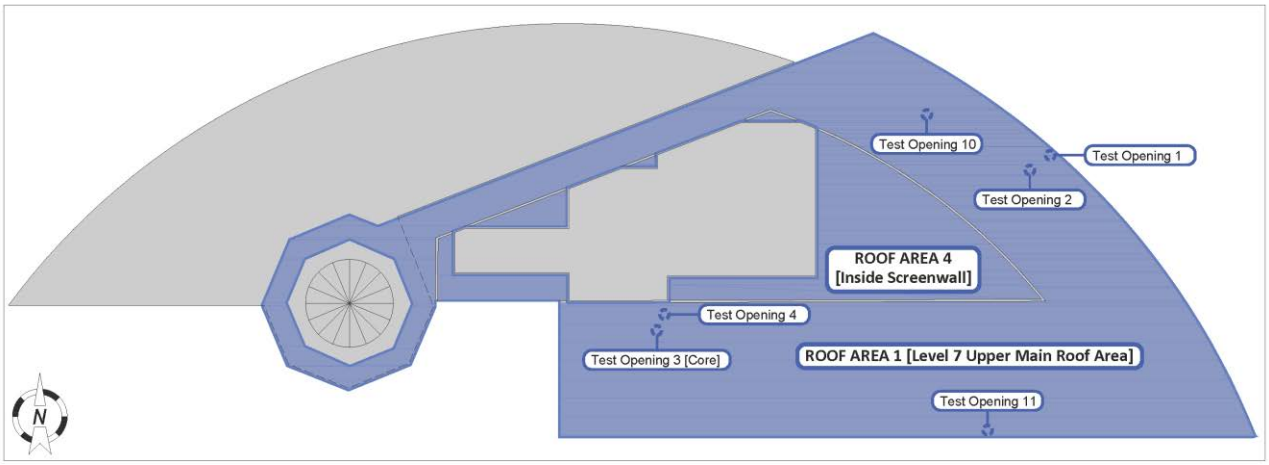


Figure 7 - Roof Area R-1 and R-4 Test Opening Location Drawing:

Figure 8 - Roof Area R-1 [Level 7 Upper Main Roof Area] Panoramic View from SE Corner:

Figure 9 - Roof Area R-4 [Inside Screenwall] Panoramic View from SW Corner of Mechanical Area:

<u>Investigative Test Opening 1:</u>

Roof Area: R-1
Roof Configuration A (See Page 6).

Figure 10 - Test Opening 1 Overview

General Description: Test Opening 1 was performed at the roof-side of the radius parapet at the Northeast Elevation (between columns 26 and 27) of Roof Area R-1. This location displayed obvious 'bridging' of the existing EPDM roof membrane, where it had pulled away from its attachment points at the radius parapet at the perimeter, which is an inherent condition related to aging and shrinkage of EPDM roof systems. The membrane has shrunk, is under tension, and has migrated toward the center of the building to the extent that the sheet metal counterflashing inadequately interfaced with the upturned skyward-facing EPDM termination. This location was selected to observe the effects of potential water intrusion into the roof system, due to the lack of a properly attached roof membrane, as well as to determine the condition and construction of the radius parapet-to-roof transition.

Parapet Wall Construction: *From Roof Side*

- 45-mil EPDM Parapet Wall Flashing fastened with Square-Capped Ring-Shank Roofing Nails installed at 12-inches O.C, and glued to;
- ½-inch Treated-Plywood fastened to Medium-Gauge Steel Framing with Phosphate-Coated Steel Drywall Screws;
- ~6-inch wide 45-mil reinforced EPDM corner securement strip to adhere the field membrane, fastened with;
- Batten Strip fastened with #10 screws at 12-inches O.C. into the plywood sheathing at the vertical;
- Medium-Gauge Steel Parapet Wall Framing;
- Steel Angle to secure the Medium-Gauge Steel Framing to the Roof Deck Structure;
- Rock-Wool Insulation installed at the roofline, and intended as an air stop;
- ⅝-inch thick Paper-Faced Gypsum Sheathing Substrate Over Top and Exterior of Medium-Gauge Framing as substrate for Exterior Insulation and Finish System (EIFS);
- 2-Piece Galvanized Fry Reglet and Counterflashing;
- Exterior Insulation and Finishing System (EIFS) Parapet Wall and Coping (sloped to inside at ~ 3.5:12).

Observations at Investigative Test Opening 1:

Figure 11 - Test Opening 1: Close-up

During the membrane in-service time, approximately 20-years, the EPDM roof membrane has aged in a typical manner that includes substantial shrinkage and surface deterioration at locations where the membrane is exposed (i.e., parapet flashing, etc.). The force of the membrane shrinkage has pulled the membrane securement nails, screws, and the batten strip away from the interior side of the parapet by approximately 6-inches at this location. Numerous other locations observed at the northeast radius parapet exhibited substantial 'bridging' of the membrane, providing additional evidence of the EPDM shrinking. It was observed that two (2) rows of 12-inch concrete pavers were arranged as the roof perimeter walk path, and placed over a sacrificial ply of 45-mil EPDM.

Substantial gaps were found between the rigid insulation board stock which can contribute to a loss of insulation value. Without a vapor retarder, these gaps allow transfer of warm moist interior air to come in contact with the underside of the cold roof membrane, which may cause condensation within the roof system, as well as a lack of continuous support for the EPDM, both prematurely stressing the membrane, particularly with its ballast overburden and typical traffic loading. BET&R's testing found moisture content to be relatively high in both the gypsum and plywood layers, at the perimeter roof deck, using a calibrated Delmhorst BD-2100 moisture meter for the testing. The slope of the roof at this location was approximately ½:12 measured with an inclinometer. There were no fasteners found in the horizontal roof system (i.e., including EPDM, [extruded polystyrene] XPS insulation, and gypsum thermal barrier layers), except at the perimeter batten strip that is outdated and failing in numerous locations. Thus, the entire roof system is relying on the river rock ballast to hold it in place.

An approximately 12-inch wide, ¾-inch thick treated-plywood and ⅝-inch treated-plywood shim was observed at the roof deck-to wall transition. These materials appeared to have been used as filler between the structural steel roof decking and the parapet framing, as it terminated roughly 12-inches inboard of the parapet. As the opening in the deck was made during this survey, warm interior air emerged from the soffit cavity below. This air movement was constant for the duration of the investigation, seemingly due to the positive pressure of the Building's HVAC, exhibited in the Level-6 ceiling cavity investigated below.

What appeared to be phosphate-coated steel drywall screws were observed to fasten the plywood sheathing to the Medium-Gauge steel framing at the parapet wall. These screws were found to have lost approximately 50% of their mass, and are in stage-three corrosion. Spot corrosion was observed on the Medium-Gauge steel parapet framing. Also, corrosion with minimum scale was found on the structural steel beam and structural steel angle, which retained the original spray-applied fireproofing on the interior side. Water staining and slight black visual fungal (i.e., mold) growth was observed on the backside of the gypsum sheathing, which is the substrate for the EIFS parapet wall and thermal barrier board. The finish coat of the EIFS coping appeared to be relatively thin and weathered, as the reinforcing pattern was visible at several locations. In addition, the sealant joints between the sections of EIFS coping have, in large part, failed and are in need of prompt correction and replacement.

Investigative Test Opening 2:

Roof Area: R-1
Roof Configuration A (See Page 6).

General Description: Test Opening 2 was performed approximately 10-feet downslope (south) from Test Opening 1, between columns 26 and 27, of Roof Area R-1. This location was chosen in the field of the roof, over the extended soffit above Level 2 northeast Ancillary Roof Area, to determine the general construction of the roof system in the field. The opening was sized to allow for assessment of the condition of the metal pan deck over a significant area.

Figure 12 - Test Opening 2 Overview

Observations at Investigative Test Opening 2:
This test opening showed the same basic elements of the roof system as found at Test Opening 1, without the aforementioned plywood in-fill believed to be used to bridge the area between the sheet metal deck and the parapet wall. As with Test Opening 1, there were no visible fasteners found in the roof system (i.e., no fasteners were found at the EPDM, XPS insulation, or gypsum thermal barrier layers), leaving the river rock ballast as the only means to secure the entire roof system. The slope of the roof at this location was approximately ½:12 as measure with an inclinometer.

Figure 13 - Test Opening 2 Close-up

The vented/perforated metal pan deck was found to be in very good condition with the galvanization providing an "as new" appearance. Puddle welds, which secure the metal pan deck to the underlying beam structure, were observed and appeared to be fully bonded and secured.

Warm, and somewhat moist air was again evident as it emanated through the perforations in the bottom rib of the steel roof decking. This air movement was constant for the duration of the investigation. There is a lack of a proper vapor retarder seal between this soffit cavity and the Level-6 office ceiling space, which is allowing warm moist air to enter the soffit cavity from the Level-6 occupied office space below; thus, the pressure differential between the warm cavity and the cooler ambient exterior temperature at this location.

Substantial gaps were again found between rigid insulation boards which can contribute to a loss of insulation value, thermal drift, and a lack of continuous support for the EPDM, prematurely stressing the membrane. Moisture content was found to be slightly elevated in the gypsum sheathing, but not currently high enough to support fungal growth. However, a small amount of visible fungal growth (i.e., mold) was observed on the underside paper-facer of the gypsum, indicating that the moisture content was at some points high enough to allow mold development.

The EPDM roof membrane retracted after being cut, indicating that the roof membrane is under tension due to the shrinkage process of ageing EPDM.

<u>Investigative Test Opening 3 [Core Analysis Only]:</u>

Roof Area R-1 and R-4
Roof Configuration B (See Page 7).

General Description: Test Opening 3 was performed approximately 10-feet upslope from the penthouse-to-screenwall junction above column 94 (Refer to Test Location Map on Page 9). This location was selected near the middle of a drainage cricket, to determine the general construction of the cricket system in the field of Roof Area R-1. This opening, due to the specific nature of the information desired, was a 2-inch diameter core to observe the cross section of the roof/cricket system. This core opening was not extended past the gypsum sheathing because Test Opening 4 would be performed, just downslope, as a large triangular opening to observed the metal deck condition.

Figure 14 - Test Opening 3 Overview

Observations at Investigative Test Opening 3:
This test opening showed a different roof system for Roof Area R-1 at this location. The presence of the tapered EPS insulation system indicates that the substrate is not sloped, with the EPS tapered system installed to direct water towards the drains. This leads BET&R to believe that there are two separate roof systems on Roof Areas R-1 and R-4. It appears that outboard of the drain centerline, the metal pan deck was sloped to drain in the original construction, and a total of 4-inches of XPS flat stock rigid installation installed. Inboard of the drains (including Roof Area R-4, and extending to the Penthouse rising wall) the metal pan deck is believed to be generally not-sloped, presumably to accommodate the concrete pour for the penthouse floor. At these locations, tapered EPS insulation was installed to provide slope to drain for the roof membrane.

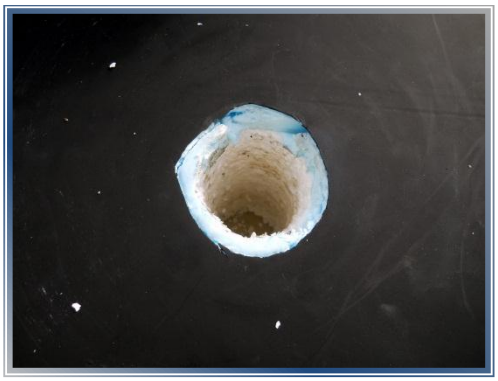


Figure 15 - Test Opening 3 Close-up

The EPDM roof membrane retracted after being cut, indicating that the roof membrane is under tension due to the shrinkage process of ageing EPDM.

During this process, a compromised field seam was observed just upslope of the test opening location, oriented to oppose migrating drainage water. This field seam was beginning to disbond, with the first ½-inch of the seam completely unbonded and open. As water flows downslope, it will continue to enter this unbonded seam; through freeze-thaw cycles, this vulnerable seam will be opened further, until moisture can travel directly into the roof system and the building interior.

Additional test openings (4, 10, 11) were performed on Roof Areas R-1 and R-4 with the same general roof components and configurations observed. The roofing materials and metal deck were found to be generally dry

and in generally fair condition. The complete documentation and detailed information pertaining to these three (3) additional test openings can be found in the appendix. For convenience, the following is a brief synopsis of the significant items found at these locations.

Investigative Test Opening 4:

Test Opening 4 was a larger triangular test cut taken just downslope of Test Opening 3 on Roof Area R-1 exhibiting Roof Configuration B, as outlined above. There was light corrosion evident on the metal pan deck at several areas at this test opening location. In addition, there appeared to be small amounts of mold, staining, and general degradation of the paper-faced gypsum thermal barrier board at the edges of the 4-ft. x 8-ft. sheet. This would indicate that the gypsum board contained a significant amount of moisture at some point during its life cycle; however, after moisture meter testing, it was determined that the gypsum board is not currently wet. The slightly worse condition of the metal pan deck and gypsum sheathing were the only significantly different findings from the previous test openings.

Investigative Test Opening 10:

Test Opening 10 was performed to allow Gravitec Systems, Inc. to investigate the structural securement of the swing stage access anchors on Roof Area R-1. The roof system at this area can be referred to as Roof Configuration A as previously outlined. After inserting a borescope through the previously drilled hole in the metal pan deck, it was determined that the swing stage access anchors were not satisfactorily secured to the structure of the Building. It is unknown whether this substandard condition is a deficiency specific to this location or a systemic problem related to all anchors of this type on Roof Area R-1.

Additional conditions observed using the borescope at this test opening location included the area between the soffit cavity and the Level-6 interior office ceiling space. It appears that a gypsum sheathed wall is present to act as a barrier between the two spaces; however, it was observed that large gaps occurred at the top of the wall where it should meet with the underside of the metal pan deck to provide an air, vapor, and fire barrier. Considering the configuration of the fluted and perforated metal pan deck, a proper vapor retarder and air stops to separate the ceiling cavity from the soffit cavity would be required, below and above, the metal pan deck to limit warm-to-cold air transfer which can lead to condensation and support the potential for biological growth.

Investigative Test Opening 11:

Test Opening 11 was performed at a north-facing parapet wall to contrast Test Opening 1, taken at a south-facing parapet wall. The roof system at this area was Roof Configuration A as previously outlined. The same 'bridging' of the EPDM roof membrane was not present at this location, presumably due to the wall flashing's orientation, which allowed the membrane to remain mostly in shade from the sun. A non-continuous vapor retarder was observed as part of the wall assembly below the parapet cavity. The plywood shim and filler at the deck-to-wall transition was not present at this location. Otherwise, the findings were relatively similar to Test Opening 1.

Summary and Conclusions for Roof Areas R-1 and R-4:

It was observed during the overview walk-through of Roof Areas R-1 and R-4 that there was a heavy overburden of river rock ballast in many locations, securing the roof assembly and protecting the ~20 year old EPDM roof membrane from excessive Ultraviolet (UV) and heat exposure. Other areas designated for heavy foot traffic such as Roof Area R-4 shown in Figure 9 have 12 by 12 by 2-inch pavers as ballast and for protection from weathering, heat-loading, and UV exposure. However, numerous locations BET&R observed river rock or concrete paver ballast was sparse or absent, leaving the EPDM roof membrane unprotected from UV exposure and radiant heat; subsequently, the EPDM roof membrane at these exposed areas showed signs of weathering and surface deterioration, including at the exposed wall and curb flashings.

As previously mentioned, the EPDM roof membrane has constricted due to shrinkage which is a typical process of ageing, and has pulled away from many roof-to-wall locations, hence the condition discovered at the leak along the northeast elevation's radius parapet wall was the most apparent. At all test opening locations, the membrane retracted significantly after being cut, demonstrating that the membrane is under tension.

In addition, it was apparent after making multiple test openings that there is no functional vapor retarder between the interior conditioned spaces and the soffit cavity, nor is there any vapor retarder in the roof. Also, EIFS cladding is used improperly as a parapet coping, and the sealant joints between EIFS coping sections were observed to be failing at multiple locations.

Due to the heat-ageing, UV exposure, and subsequent shrinkage of the EPDM roof membrane, lack of a proper vapor retarder, failed sealant joints at the EIFS coping, and other aforementioned issues, BET&R recommends, at a minimum, a complete tear-off and reroof for Roof Areas R-1 and R-4 as described in the following Recommendation section.

ROOF AREA R-2

Testing Overview:

BET&R performed one (1) investigative test opening at Roof Area R-2 to determine the construction, configuration, and condition of the existing building materials at this lower main roof area. Investigative Test Opening 7 was conducted to determine the configuration and condition of the materials in the existing roof system.

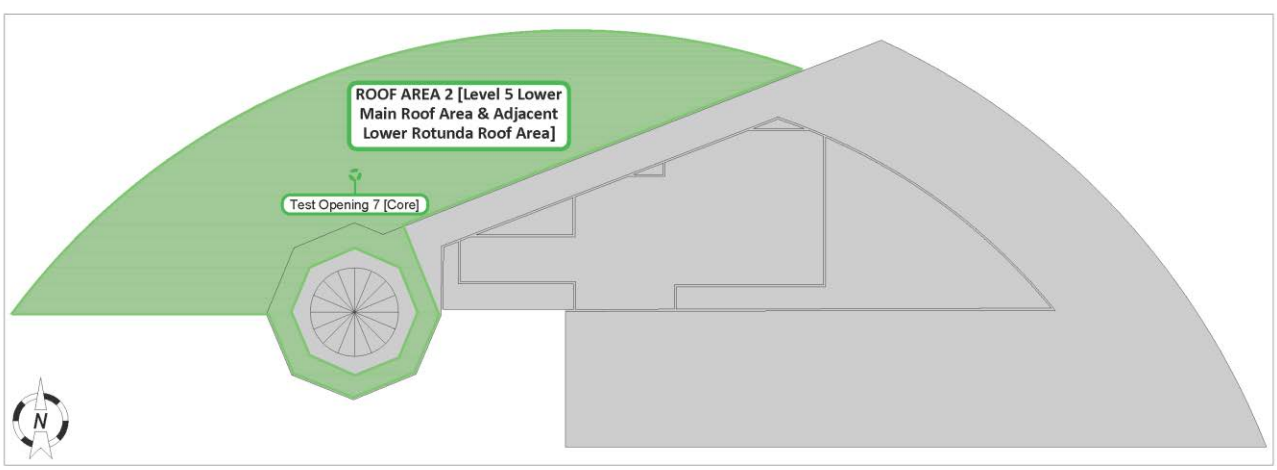


Figure 16 - Roof Area R-2 Test Opening Location Plan Drawing

Figure 17 - Roof Area R-2 [Level 5 Lower Main Roof Area and Adjacent Lower Rotunda Roof Area] Panoramic View:

<u>Investigative Test Opening 7 [Core Analysis Only]</u>:

Roof Area R-2
Roof Configuration C (See Page 7).

General Description: Roof Test Opening 7 was performed at a location approximately 30-feet upslope from the west central drain, in the field of Roof Area R-2 adjacent a high velocity exhaust vent. This location was chosen in the field of the roof, close to the apex of a sloped area, to determine the configuration of the cricket/tapered insulation system and to observe the cross section of the roof system as compared to other roof areas tested.

Figure 18 - Test Opening 7 Overview

Observations at Investigative Test Opening 7:
This test opening showed the same basic roof system exhibited at Test Opening 3, on Roof Area R-1, with the only dissimilarity being the presence of a concrete substrate instead of the sheet metal pan decking. The presence of the tapered EPS insulation system, which was installed to direct surface water to the roof drains, indicates that the concrete deck is not sloped at this area.

The roofing materials (i.e., both layers of insulation and coverboard appeared to be dry and in sound condition.

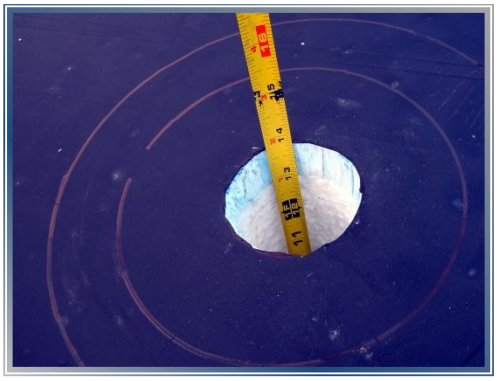


Figure 19 -Test Opening 7 Close-Up

The EPDM roof membrane retracted slightly after being cut, not quite to the same degree as at other test opening locations, indicating that the roof membrane is under tension due to the shrinkage process of ageing EPDM.

Due to the depth of insulation found at this location (approximately 14-inches), a larger opening to perform moisture meter (Tramex ®CME-4) testing was not performed. Based on moisture meter testing at the concrete deck substrate at other roof areas, moisture may currently be present.

Summary and Conclusion for Roof Area R-2:

It was observed during the overview walk-through of Roof Area R-2 that there was a relatively heavy overburden of river rock ballast at most locations, securing the roof assembly and protecting the ~20 year old EPDM roof membrane from excessive Ultraviolet (UV) and heat exposure. Other areas designated for heavy foot traffic such as Roof Area R-4 shown in Figure 9 have 12- by 12- by 2-inch pavers as ballast and for protection from weathering and UV exposure. As previously mentioned, the EPDM roof membrane has constricted due to shrinkage as a typical process of ageing and has pulled away from some roof-to-wall locations, the condition at the northwest elevation radius parapet wall being the most apparent.

No vapor retarder was observed beneath the existing roof insulation and gypsum thermal barrier board to prevent moisture vapor drive and condensation in the perimeter wall and roof system. The improper use of the EIFS cladding as a parapet coping, which requires extensive maintenance, was observed at this Roof Area R-2 as well.

Due to the relative good condition of the EPDM roof field membrane, the State's budget concerns, and in the interest of shifting funds towards the window and EIFS wall cladding-related concerns, BET&R a repair and retrofit for R-2 as described in the following Recommendation section.

ROOF AREA R-3

Testing Overview:

BET&R performed one (1) investigative test opening at Roof Area R-3 to determine the construction, configuration, and condition of the existing building materials at this Level-8 Penthouse Roof Area. Investigative Test Opening 5 was conducted to determine the configuration and condition of the materials in the existing roof system.

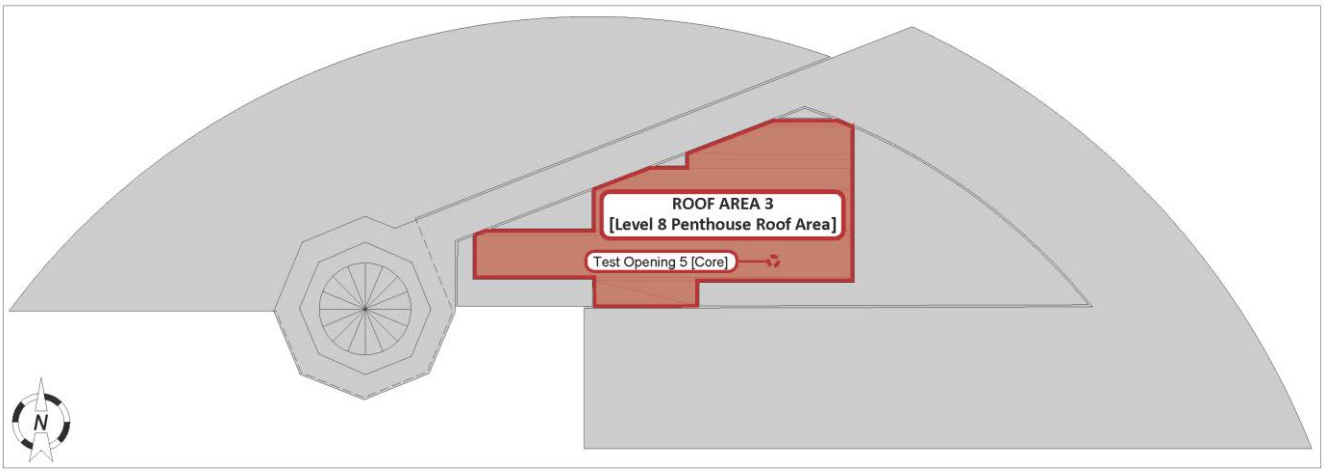


Figure 19 - Roof Area R-3 Test Opening Location Plan Drawing

Figure 20 - Roof Area R-3 [Level 8 Penthouse Roof Area] Panoramic View from Roof Area 5:

Investigative Test Opening 5:

Test Opening 5, revealed the same basic conditions already described at Test Opening 2, on Roof Area R-1, with the same general roof components and configurations observed. The roof system at this area was Roof Configuration A as previously outlined. The roofing materials and metal deck were found to be generally dry and in generally fair condition. For the sake of brevity in this Report, the complete documentation and detailed information pertaining to Test Opening 5 can be found in the appendix.

Summary and Conclusion for Roof Area R-3:

It was observed during the overview walk-through of Roof Area R-3 that there was a heavy overburden of river rock ballast at most locations, securing the roof assembly and protecting the ~20 year old EPDM roof membrane from excessive Ultraviolet (UV) and heat exposure. As previously mentioned at Roof Area R-1, the EPDM roof membrane has constricted due to shrinkage, which is a typical process of ageing and has bridged away from many roof-to-wall locations, hence the condition at the northern parapet wall being the most pronounced.

The small sections of multiple step backs in the parapet that oppose the free flow of draining water have created leak-prone details as seen in the inset photo, Figure 20. The existing gutters that act as the drainage system for this roof area show signs of advanced corrosion. Gutter joinery and downspouts were observed to leak during the roof survey. Some leaking gutter locations observed are allowing water to be deposited at locations that can stress membrane and degraded components located below.

Figure 21 - Stepped Parapet at Drainage Edge

No vapor retarder was observed beneath the existing insulation to prevent moisture vapor drive. The poor parapet design and improper use and detailing of the EIFS cladding as a coping, which requires extensive coating and sealant maintenance, was observed at this Roof Area R-3 as well. However, due to the relative good condition of the EPDM roof membrane, the state's budget concerns, and in the interest of shifting funds towards the window and EIFS cladding-related concerns, the Design Team suggests a repair and retrofit condition as described in the following Recommendation section.

ROOF AREA R-5

Testing Overview:

BET&R performed one (1) investigative test opening at Roof Area R-5 to determine the construction, configuration, and condition of the existing building materials at this Level-8 Upper Rotunda Roof Area. Investigative Test Opening 6 was conducted to determine the configuration and condition of the materials in the existing roof system.

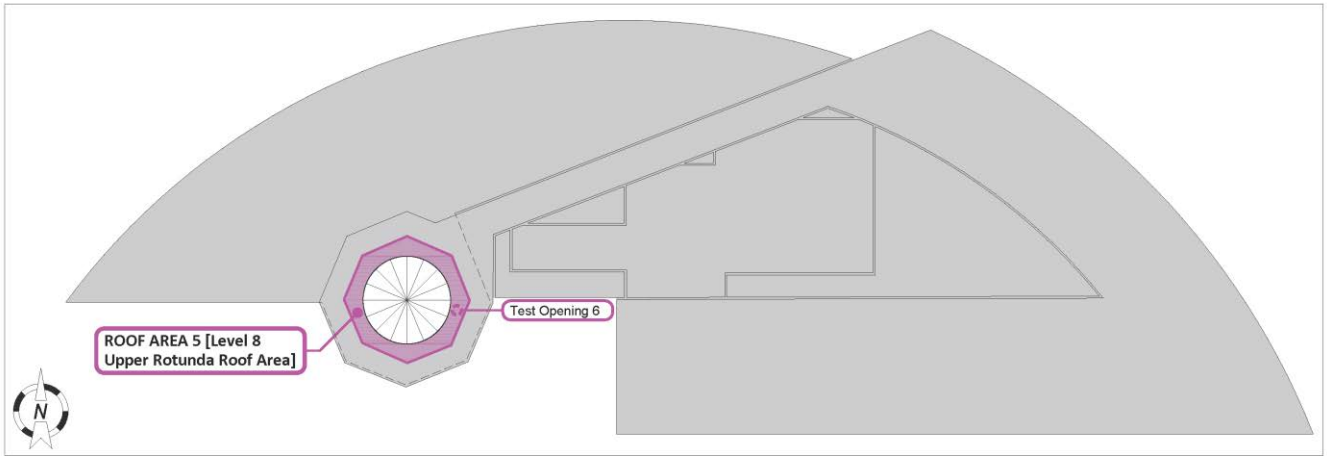


Figure 21 - Roof Area R-5 Test Opening Location Plan Drawing

Figure 22 - Roof Area R-5 [Level 8 Upper Rotunda Area] Panoramic View from Roof Area R-3:

Investigative Test Opening 6:

Test Opening 6, revealed the same basic conditions already described at Test Opening 7, on Roof Area R-2, with the same general roof components and configurations observed. The roof system at this area was Roof Configuration C, as previously outlined. The roofing materials and concrete deck were found to be generally dry and in fair condition. For the sake of brevity in this Report, the complete documentation and detailed information pertaining to Test Opening 6 can be found in the Appendix.

Summary and Conclusion for Roof Area R-5:

It was observed during the overview walk-through of Roof Area R-5 that there was a relatively heavy overburden of river rock ballast at most locations, thus protecting the ~20 year old EPDM roof membrane from excessive Ultraviolet (UV) and direct radiant heat exposure. As previously mentioned at Roof Area R-1, the EPDM roof membrane has constricted due to shrinkage which is a typical process of ageing and has pulled away from many roof-to-wall locations, hence the condition at the northern parapet wall being the most pronounced.

The sheet metal dome roof appears to be in relatively good condition with small imperfections (i.e., scratches in the finish). The dome may require a coating in the future but it is not currently necessary. However, the existing sheet metal and EPDM base flashing at the sheet metal dome roof need to be replaced. In addition, the sheet metal hip covers were relatively loose at some locations, and they should be attached during the upcoming roofing repairs.

No vapor retarder was observed beneath the existing insulation to prevent moisture vapor drive. The improper use of the EIFS cladding system as a coping, which requires extensive maintenance, was observed at this Roof Area R-5 as well. Due to the relatively small amount of EPDM roof membrane contained at this roof area, BET&R recommends a complete tear-off and reroof for Roof Area R-5 as generally outlined in the next paragraph.

Due to the shrinkage of the ageing EPDM roof membrane, lack of a proper vapor retarder, failed sealant joints at the EIFS coping, and other aforementioned issues, BET&R recommends a complete tear-off and reroof for Roof Area R-5 as described in the following Recommendation section.

ROOF AREA R-6

Testing Overview:

BET&R performed one (1) investigative test opening at Roof Area R-6 to determine the construction, configuration, and condition of the existing building materials at this Level-2 NE Ancillary Roof Area. Investigative Test Opening 9 was conducted to determine the configuration and condition of the materials in the existing roof system.

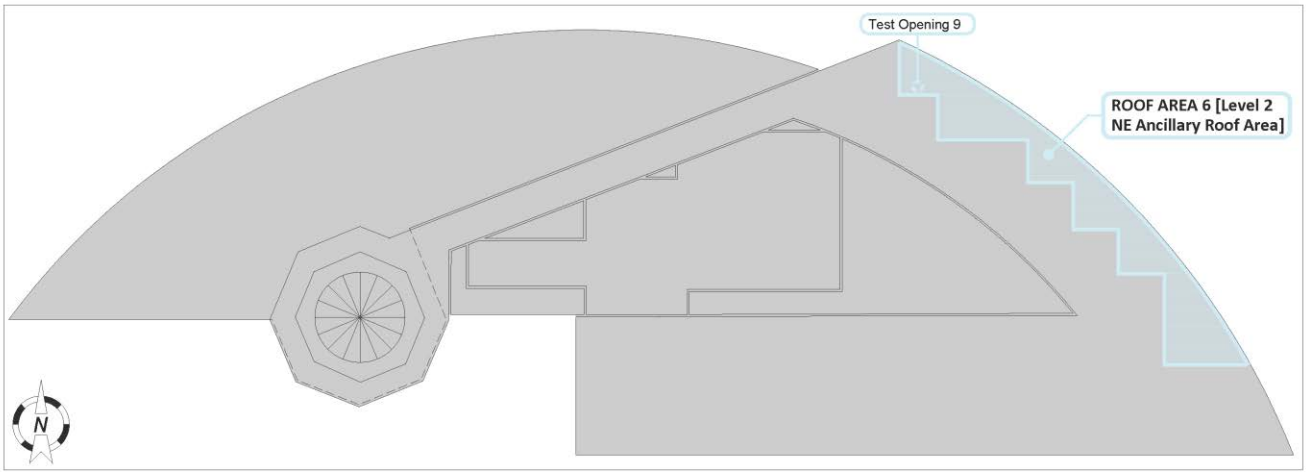


Figure 23 - Roof Area R-6 Test Opening Location Plan Drawing

Figure 24 - Level 2 NE Ancillary Roof Area Panoramic View from NW area:

Investigative Test Opening 9:

Test Opening 9, revealed the same basic conditions already described at Test Opening 7, on Roof Area R-2, with the same general roof components and configurations observed. The roof system at this area was Roof Configuration C, as previously outlined. The roofing materials and concrete deck were found to be generally dry and in fair condition. For the sake of brevity in this Report, the complete documentation and detailed information pertaining to Test Opening 9 can be found in the Appendix.

Summary and Conclusion for Roof Area R-6:

It was observed during the overview walk-through of Roof Area R-6 that there was a heavy overburden of river rock ballast at most locations, securing the roof assembly and protecting the ~20 year old EPDM roof membrane from excessive Ultraviolet (UV) and heat exposure. In addition, the protection afforded by the soffit overhang above, and this roof area's orientation, has allowed the EPDM roof membrane to remain in relatively good condition as it is shielded from much weathering. However, the EPDM roof membrane was found to retract after cutting, indicating that the roof membrane has constricted due to shrinkage as a typical process of EPDM aging.

No vapor retarder was observed beneath the existing insulation to prevent moisture vapor drive. A cast-in-place concrete parapet was observed at this location, and the EPDM base flashing was terminated inconsistently, but incorrectly at locations.

Due to the shrinkage of the ageing EPDM roof membrane, inconsistent base flashing installation, lack of a proper vapor retarder, lack of coping at concrete parapet walls, other aforementioned issues, and relatively small roof area, BET&R recommends a complete tear-off and reroof for Roof Area R-6 as described in the following Recommendation section. But, repair and retrofit are also an option due to the good condition of the field of the roof.

ROOF AREA R-7

Testing Overview:

BET&R performed one (1) investigative test opening at Roof Area R-7 to determine the construction, configuration, and condition of the existing building materials at this Level-5 SE Ancillary Roof Area. Investigative Test Opening 8 was conducted to determine the configuration and condition of the materials in the existing roof system.

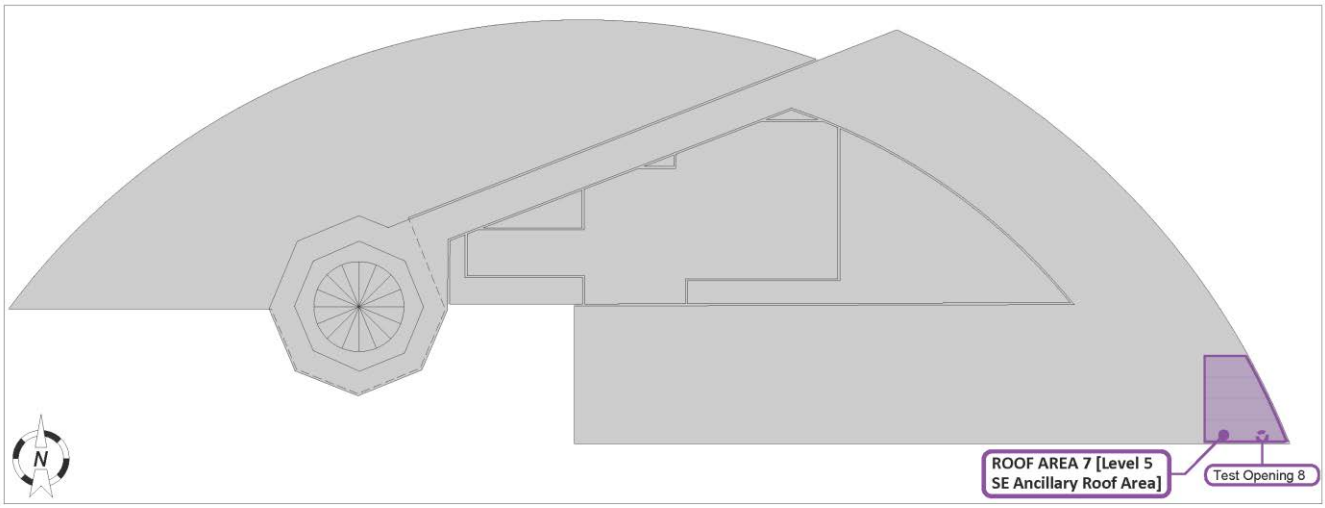


Figure 25 - Roof Area R-7 Test Opening Location Plan Drawing

Figure 26 - Level 5 SE Ancillary Roof Area Panoramic View from SW corner

Investigative Test Opening 8:

Test Opening 8, revealed the same basic conditions already described at Test Opening 7, on Roof Area R-2, with the same general roof components and configurations observed. The roof system at this area was Roof Configuration C, as previously outlined. The roofing materials were found to be generally dry and in fair-to-good condition; however, the concrete roof deck at this location was found to be damp-to-wet. The moisture on the deck at this location is believed to have come from leaks in the adjacent EIFS-clad columns and parapets at the south elevation, and the lack of a vapor retarder. For the sake of brevity in this report, the complete documentation and detailed information pertaining to Test Opening 8 can be found in the appendix.

Summary and Conclusion for Roof Area R-7:

It was observed during the initial walk-over of Roof Area R-7 that there was a relatively heavy overburden of river rock ballast at most locations, protecting the ~20 year old EPDM roof membrane from excessive Ultra Violet (UV) and direct radiant heat exposure. In addition, the protection afforded by the soffit overhang above, and the roof area's orientation, has allowed the EPDM roof membrane to remain in relatively good condition. However, the EPDM roof membrane was found to retract after cutting, indicating that the roof membrane has constricted due to shrinkage.

No vapor retarder was observed beneath the existing insulation to prevent moisture vapor drive from migrating moisture-laden interior air into the roof. At this roof area, a wide EIFS-clad column and parapet wall system was observed to have failed at many of the parapet-to-column transitions. The EPDM base flashing was terminated inconsistently and incorrectly at locations. Due to the relatively small area of EPDM roof membrane contained at this roof area, the shrinkage of the aging EPDM roof membrane, inconsistent base flashing installation, lack of a proper vapor retarder, failed sealant joints and corner reinforcement at the EIFS coping, and other aforementioned issues. The Team suggests a complete tear-off and reroof for Roof Area R-7, but a systematic repair and retrofit is feasible and cost-effective for R-7.

Figure 27 - Roof Area R-7 Overview

RECOMMENDATIONS

The following section represents BET&R's general recommendations pertaining to each of the existing low-slope ballasted EPDM roofs, as well as the Rotunda sheet metal roof, on the State of Washington's Natural Resources Building.

Note that with regard to roof areas being recommended for tear-off and reroofing, BET&R's preferred recommendation for a new membrane roof system specifically for the low-slope roof areas of the Natural Resources Building located in the marine climate of western Washington, would be a multi-ply Styrene Butadiene Styrene (SBS) (e.g., as manufactured by Siplast, Tamko, or Malarkey) or an atactic polypropylene (APP) polymer modified asphalt, multi-ply roof system (e.g., as manufactured by Derbigum). Both roof types of torch-grade polymer-modified asphalt can provide very cost effective 25 to 35 years of extended longevity and excellent durability and performance. However, in response to expressed limited budgetary resources, a fully-adhered single-ply EPDM roof system is being suggested as an initial cost effective option, and if properly designed, and thoroughly detailed with a polymer modified asphalt vapor retarder can provide a well-performing, durable roof system. As such, BET&R's recommendations for roof replacement on some roof areas, and repair and retrofit work on others are as follows:

ROOF AREAS NO. R- 1, 4, 5, 6, AND 7 (ANCILLARY ROOF AREA ON LEVEL 5) – TEAR-OFF AND REROOF

Due to the current condition of the EPDM roof membrane observed during the BET&R's roof survey work, and the extent of membrane aging, including stress on the roof membrane caused by shrinkage, as well as embrittlement resulting from the heat aging of exposed areas of existing EPDM field membrane and membrane base and wall flashings at the above-listed Roof Areas, BET&R recommends that at least Roof Areas 1 and 4 should be reroofed, generally as follows:

Tear-Off and Reroof Recommendation:

It is BET&R's recommendation that the roof system on these roof areas be torn-off and reroofed in sections. The gypsum thermal barrier board, extruded polystyrene (XPS) and expanded polystyrene (EPS) roof insulation (e.g., all crickets, tapered, and flat stock), and concrete pavers should be carefully removed and set aside for reuse in the new roof system. The existing river rock ballast could be removed from the site and disposed properly following all regulations, but it too can be reused.

At the metal roof decks on Roof Areas R-1 and R-4, inspect for condition regarding moisture induced degradation, weld deterioration, and deck securement. Install new screws to secure the roof deck to the Building's structure, including wherever deficient welds are observed. The existing gypsum thermal barrier board could be flipped so the rough side is up, and screw-fastened to the metal deck, spray prime the underside with Kilts or other fast drying fungicidal spray compound, then prime the top surface of the installed gypsum board with solvent-based asphalt roof primer, and fully-adhere a new SBS or APP Modified Asphalt Membrane (torch-grade) Vapor Retarder, to prevent warm moisture-ladened vapor in the occupied building below from entering the new roof system. If properly specified and design detailed the new vapor retarder can also serve as a temporary roof during the reroofing process.

At the concrete roof decks on Roof Areas R-5 and R-6, and the NE Ancillary Roof Area on Level 5, if the budget allows them to be reroofed, install a new SBS Modified Asphalt Membrane (torch-grade) Vapor Retarder fully-adhered directly to the concrete roof deck.

The existing layers of roof insulation should be reused and set in low-rise bulk foam adhesive over the new vapor retarder. A new layer of high-density polyisocyanurate roof insulation should be slipped in between the layers of existing roof insulation to meet the R-Value requirements in the current State of Washington Energy Code.

A new ¼-inch thick DensDeck Prime moisture-resistant gypsum-cored coverboard should then be set in low-rise foam adhesive over the roof insulation to provide an appropriate substrate for a new fully-adhered roof membrane (i.e., a multi-ply SBS, APP, or a single-ply 60 mil un-reinforced EPDM roofing membrane). If EPDM, all new 60 mil EPDM membrane base flashings should be installed at all perimeter terminations, mechanical curbs, drains and all other penetrations.

The EIFS coping at all perimeter parapet walls should be removed and the parapets rebuilt as necessary to allow a proper installation of a new membrane wall flashing, detailed to extend up and over the new parapet. New sheet metal coping fit with continuous cleat, should be fabricated to match existing conditions and configurations, and installed over the re-built and membrane flashed parapet walls.

At the wide parapet walls and intersecting columns, rising above parapets on Roof Area R-6, and Ancillary Roof Area on Level 5, grind, prepare, waterproof and flash with PMMA membrane, tint and texture to match other walls with new copings.

Roof Safety Anchors: In addition, it is BET&R's recommendation that roof safety anchors, new roof safety anchors, be installed securely per Gravitec Systems, Inc.'s recommendations.

ROOF AREAS NO. R-2 AND R-3 – REPAIR AND RETROFIT

The existing EPDM roof membrane systems observed on these roof areas appear to be in generally good and serviceable condition. BET&R suggests that with properly designed and detailed repairs and retrofit to perimeter roof areas, curbs, drains, and other roof penetrations, as well as a thorough redistribution of ballast, these roof areas should be capable of providing an additional 8-12 year of service life to State of Washington's Natural Resources Building. As such, BET&R's general recommendations for repair and retrofit at applicable roof areas are as follows:

Repair and Retrofit Recommendation:

It is BET&R's recommendation that the roof system on Roof Areas No. R-2 and R-3 be repaired and retrofit to provide an extended service life for the existing EPDM roof membrane. The existing river rock ballast should be carefully shoveled back and windrowed at all repair or retrofit areas, 6- to 8-feet at perimeters, 3- to 4-feet from around penetrations, and 18- to 24-inches centered on existing field seam splices.

The exposed existing EPDM roof membrane should be thoroughly cleaned (i.e., wet first, detergent [i.e., Spic-N-Span], scrubbed, thoroughly rinsed clean, squeegeed, and air blown and wiped dry), to prepare the membrane for a proper watertight tie-in with the new 60 mil unreinforced EPDM flashings at rising (building) walls, perimeter parapet walls, curbs, and penetration flashings. The existing EPDM membrane should be cut free and allowed to shrink back and relax, removing most of the tension currently present in the membrane, at all repair/retrofit areas to receive new flashings.

Rebuild parapets and bases of rising walls, and raise curbs, as necessary. After all wall repair and retrofit, and flashing work is completed, the river rock ballast should be redistributed evenly to provide full coverage of the repaired EPDM roof membrane.

Some Roof Areas were observed to need repair and retrofit work specific to the individual roof area, or were candidates for alternate considerations regarding reroofing options. These items are noted as follows by roof or building area:

ADDITIONAL NOTES ABOUT SPECIFIC WORK AT SELECT ROOF AREAS

Roof Area R-2:

When reroofing Roof Area No. R-2, the design should minimize the potential reflectivity from any new roof so that it does not negatively impact the adjacent offices. Roof Area No. R-2 has been identified as a potential candidate for considering a 'Green Roof' option, if the State's budget allows during 2012 or 2022 (if repaired and retrofit during 2012).

Roof Area R-3:

In addition to the general roof repair and retrofit work, BET&R recommends the repairs on this roof area also include replacement of the existing coping on the entire screen wall with new Kynar-finished sheet metal coping, as well as new perimeter edge membrane flashing, edge metal flashing, and a new gutter and downspout system.

Roof Area R-5 – Rotunda Sheet Metal Roof:

BET&R recommends that besides tear-off and reroofing of the perimeter low-slope roof, that the existing sheet metal hip covers be refastened and secured with silicon bronze screws and copper rivets to meet new ASCE-7 roof wind design criteria. All perimeter edge metal flashing should be replaced with new.

Roof Area R-6:

Besides tear-off and reroofing with a new EPDM Membrane Roofing System, the retrofit work on this roof area is recommended to include installing new fiberglass-faced, moisture-resistant, treated gypsum sheathing on the interior vertical surfaces of all perimeter parapets, new PMMA membrane coping/flashing, as well as PMMA membrane coping/flashing at columns and rising walls.
Additionally, Roof Area No. R-6 has been identified as a potential candidate for considering a 'Green Roof' option.

Roof Area R-7 (Ancillary SE Roof Area Level 5):

In addition to the general roof repair and retrofit work at the Ancillary SE. Roof Area, BET&R recommends installing new fiberglass-faced, moisture-resistant, treated gypsum sheathing on the interior vertical surfaces of all perimeter parapets, new PMMA membrane coping flashing, as well as PMMA membrane coping/flashing at columns and rising walls.
Additionally, Ancillary SE Roof Area on Level 5 has been identified as a potential candidate for considering a 'Green Roof' option.

Vapor Retarder Between Level 6 Office and Soffit Cavity:

A vapor retarder should be retrofitted between the interior conditioned spaces of the Level-6 offices and the soffit cavity above the Level 2 Northeast Ancillary Roof Area to halt the migration of moist warm interior occupancy-generated air. Work will be required both above and below the metal pan deck. See Cladding Survey Report for more information.

OTHER CONSIDERATIONS

Green Roof Option:

BET&R understands the State of Washington may be considering options for installing new above-grade vegetated waterproofing system (i.e., green roof) at Roof Area R-2, adjacent the Level-5 occupied office spaces, potentially also on Roof Area R-6, as well as the Ancillary SE Roof Area on Level 5. Regarding this option, unless only ferns and moss are desired plantings, then BET&R and SMSA recommend complete removal of all existing river rock ballast, EPDM roof membrane and related flashing, and only the reuse of XPS insulation components as BET&R deems appropriate. A new fully-adhered 3-ply APP polymer modified asphalt membrane or a properly-reinforced 60-mil EPDM roof membrane system fit with proper detailed vapor retarder should be installed watertight, as the waterproofing membrane system foundation for the remaining components of the above-grade vegetated waterproofing system (i.e., green roof). 'Green roof' components to be installed on top of the new waterproofing system may include the following: root barrier, geotextile protection fabric, combined drainage mat and filter fabric, engineered growth media, retention edges and drain restraint boxes, plants, and broadcast irrigation system.

In addition, BET&R suggests installing an above-grade vegetated waterproofing system that is provided by a major Waterproofing Membrane Manufacturer (e.g., Derbigum) as a prudent choice regarding long-term performance and the extended-life waterproofing system, as well as the acquisition and maintenance of a 20-year NDL (No Dollar Limit) system warranty.

In consideration of the State's budget for this Project, should the State choose to incorporate a green roof option, BET&R recommends installing a "built-in place" system rather than the more expensive modular tray systems. Built-in-place green roofs, refers to those green roof systems where components such as growth media (engineered planting soil) and plants are assembled on the prepared green roof sub-components in bulk across the entire roof area, or across large sections of the roof area. In contrast, "modular" or "tray" green roof systems are generally small 1-foot by 2-foot, or 2-foot by 2-foot, etc. trays, constructed of a variety of materials and installed on the roof similarly on top of prepared sub-components. These trays are usually filled with growth media and plant material in various stages of growth and coverage ranging from "just planted" plugs or cuttings, to mature "fully grown-in" tray systems. As such, this type of modular system provides the convenience of an instant green roof without the complications that can be associated with step-by-step installation. As one could anticipate, it is considerably more expensive to install a modular or tray system due to additional materials and specialized handling, as well as costs associated with buying preassembled and pre-grown products.

Also, while many options regarding the depth of the vegetative growth media could be considered, BET&R suggests these two extensive, or relatively shallow depth, options:

- The most cost effective durable green roof depth would be a "low-extensive system" (i.e., with approximately 3-inches of engineered media, plus vegetation).
- An alternate "medium-extensive" system option (i.e., with approximately 6-inches of engineered media, plus vegetation) can potentially increase storm water retention capacities, and provide a growing environment that can support a wider variety of on-roof compatible plant life.

IN CLOSING

We trust that BET&R's experienced Roof Technologists' roof survey, test cuts, roof evaluation, and progressive technical information are of assistance to SMSA, the State of Washington, and the Project Team. We appreciate the opportunity to conduct this roof study and prepare this roof survey evaluation report on your behalf. Please do not hesitate to contact us should you have questions, need additional information, or as we may be of further assistance. We look forward to providing you with future building envelope survey, testing, design, roof repair, and roof construction monitoring and consulting services.

Respectfully,

Building Envelope Technology & Research, Inc.

Attached Appendix A:

- Additional BET&R Investigation And Findings
    - Roof Area R-1 -- Test Opening 4
    - Roof Area R-1 -- Test Opening 10
    - Roof Area R-1 -- Test Opening 11
    - Roof Area R-3 -- Test Opening 5
    - Roof Area R-5 -- Test Opening 6
    - Roof Area R-6 -- Test Opening 9
    - Roof Area R-7 -- Test Opening 8
- Recommendation and Cost Pricing

REGARDING THIS REPORT

On Site Survey, Report, and Conclusions

This report, including technical analysis and recommendations, is based upon observations of the visible and apparent condition of the Building and primary exterior components investigated, viewed and examined on the date(s) of the survey. Although care has been taken in the performance of the survey, Building Envelope Technology & Research, Inc. (BET&R) (and/or its representatives) make no representations regarding latent or concealed defects that may exist, and no warranty or guarantee is expressed or implied.

BET&R reserves all rights to make refinements, changes, amendments, and additions to this report, at the sole judgment of BET&R, and as new information may be learned.

This report is made only in the best exercise of our technical ability, experience, and judgment. Conclusions in this report are based on estimates of the age and normal service life of the various materials and/or systems surveyed. Predictions of life expectancy and the balance of useful service life are generally based on industry and/or experienced comparisons. It is essential to understand that actual conditions and degree of maintenance can alter the useful life of any exterior item or building component. The weather exposure, (e.g., wetting and drying, freeze-thaw, etc.), use and misuse, irregularity of servicing, faulty manufacture, unfavorable conditions and installation, acts of God (e.g., earthquake, tornado, or other high-wind event), and unforeseen circumstances make it impossible to state precisely, to the day, when each item will require replacement**.**

Moisture Intrusion, Mold Growth, and Human Exposure to Mold

Persistent moisture intrusion, repetitive wetting, and/or the resulting elevated relative humidity in wall and roof cavities can lead to the proliferation of fungal growth (e.g., mold) and other potentially hazardous organisms and bacteria in interior spaces, which can lead to allergic reactions in susceptible individuals, as well as other potential problems (hypersensitivity, etc.). It is BET&R's understanding that the Project Team has recently engaged an Environmental Hygienist Consultant to assist with assessment, and potential abatement and remediation of any interior space biological growth.

Limitations

This report is prepared for the exclusive use of the Client and may not be relied upon by any other party. In preparing this report for the named Client (i.e., SMSA), the author assumes no duty to lenders or other third parties, none of whom are authorized to rely on its contents.

Photographs, on file in our office, were taken with the intent to document conditions and to help the Client understand on site conditions. The photographs were taken to show example areas, conditions and situations; they are not inclusive of every situation or location, but of general/typical conditions, and certain specific conditions.

This report provides an assessment/evaluation of on-site roof conditions only. It cannot be used as specifications or written instructions for conducting construction work. However, BET&R will be pleased to prepare a written scope of work, technical specifications, and/or detail drawings for reroofing, and/or repair or retrofit work.

Respectfully,

The Staff and Management of
Building Envelope Technology & Research, Inc. (BET&R)

APPENDIX A

ADDITIONAL BET&R INVESTIGATION AND FINDINGS

Investigative Test Opening 4 and 3:

Roof Area R-1

Roof Configuration B: See Typical Roof System section at the beginning of the main body of the Summary of Roof Survey for additional information.

General Description: Roof Test Opening 4 was performed approximately 10-feet downslope from Test Opening 3 on Roof Area R-1, adjacent to an active leak which was apparent at the ceiling in the Level-6 office space below. This location was selected to verify the construction of the roof system in the field, and to examine any potential degradation or damage from the recently active leak. The opening was sized to allow for assessment of the condition of the metal pan deck over a larger area. This test opening extended from the toe of the cricket to the approximate vertical plane of the mechanical screenwall.

Observations at Investigative Test Opening 4:
This test opening showed the same basic elements of the roof system as indicated at Test Opening 3 on Roof Area R-1. There were no fasteners found in the roof system (i.e. no fasteners were found at the EPDM, XPS insulation, or gypsum sheathing layers), leaving the river rock ballast to weight down and secure the entire roof assembly.

Slight air movement was evident as it emerged through the perforations in the metal pan deck. This air movement was constant for the duration of the investigation.

The metal pan deck was found to be in generally good condition; however, light corrosion was evident at several locations. These small areas of corrosion can be easily prepared and coated during the reroof process. Puddle welds, which secure the metal decking to the underlying beam structure, were observed and appeared to be fully bonded and secured.

The gypsum sheathing was observed to have been severely degraded at two locations: along the base and at the apex of the cut where the gypsum sheathing joints were located. However, moisture content was currently found to be relatively low in the gypsum. Black mold and staining was observed on the top and underside of the gypsum, indicating again that the moisture content was, at one point, high enough to support fungal growth.

Substantial gaps were again found between rigid insulation layers which can contribute to a loss of insulation value through thermal drift and also a lack of continuous support for the EPDM roof, prematurely stressing and aging the membrane. The slope of the tapered insulation at this location was approximately ¼:12 as measured with an inclinometer.

The EPDM roof membrane retracted after being cut, indicating that the roof membrane is under excessive tension due to the shrinkage process of ageing EPDM.

<u>Investigative Test Opening 10:</u>

Roof Area R-1

Roof Configuration A: See Typical Roof System section at the beginning of the main body of the Summary of Roof Survey for additional information.

General Description: Roof Test Opening 10 was performed as a targeted access area as requested by the Project Architect, to allow Gravitec Systems, Inc. to observe structural conditions adjacent a swing stage access anchor. This location was selected by Gravatec personnel to allow for observations using a borescope. The test opening was located slightly upslope from a roof anchor tube so Gravitec could observe the roof anchor tube-to-structure transition and securement within the soffit cavity for visual structural analysis to determine if stress testing could be performed. Following careful removal of the roofing materials, a hole was drilled in the metal pan deck in the field of the roof to allow the insertion of a video borescope into the soffit cavity, above the Level 2 northeast Ancillary Roof Area. The opening in the roof system was made large enough to accommodate a battery-powered drill motor, fitted with a 2-inch diameter diamond-encrusted hole saw.

Observations at Investigative Test Opening 10:

This test opening showed all of the same basic elements of the roof system as found at Test Opening 2 on Roof Area R-1. The small area of metal pan deck observed was found to be in very good condition. The slope of the roof at this location was approximately ½: 12 as measured by an inclinometer.

A minor amount of air movement was again evident as it flowed up through the hole drilled in the top flute of the metal pan deck. This air movement was constant for the duration of the investigation, seemingly due to the positive pressure of the building, exhibited in the Level-6 ceiling cavity below.

After inserting the borescope and preforming a visual survey, it was determined that a steel channel had been welded to both sides of the swing stage access anchor, but only tack-welded to the structural I-beam flanges. It is not known whether this apparent unsatisfactory condition is specific to this location or if it is a systemic issue related to all drop davits of this type on Roof Area R-1.

Additional conditions observed using the borescope at this test opening location included the area between the soffit cavity and the Level-6 interior office ceiling space. It appears that a gypsum sheathed wall is present to act as a barrier between the two spaces; however, it was observed that large gaps occurred at the top of the wall where it should meet with the underside of the metal pan deck to provide an air, vapor, and fire barrier. Considering the configuration of the fluted and perforated metal pan deck, a proper vapor retarder and air stops to separate the ceiling cavity from the soffit cavity would be required, below and above the flutes in the metal pan deck, to limit warm-to-cold air transfer which can lead to condensation and support the potential for biological growth.

<u>Investigative Test Opening 11:</u>

Roof Area R-1

Roof Configuration A: See Typical Roof System section at the beginning of the main body of the Summary of Roof Survey for additional information.

General Description: Test Opening 11 was performed at the roof-to-parapet transition and correlated directly above Exterior Cladding Test Opening2 near the northeast corner of Roof Area R-1 on the south elevation. This location was selected to determine the construction of the non-radius parapet-to-roof transition as well as a possible connection between potential leaks into the interior and soffit degradation located directly below.

Observations at Investigative Test Opening 11:

This location did not display the significant 'bridging' of the EPDM roof membrane as observed at Test Opening 1 on Roof Area R-1. The same basic elements of the roof system were present as found at Test Opening 1, with the absence of a plywood infill between the sheet metal pan decking and parapet wall the only difference. There were no fasteners found in the roof system (i.e. EPDM membrane, XPS insulation, or gypsum sheathing layers), except at the perimeter batten strip which were found intact and secured opposed to the conditions observed at Test Opening 1. As at other location the roof system relies on the river rock ballast to secure the entire roof system.

Light corrosion with minimum scale was found on the structural steel angle which connects the medium-gauge steel parapet wall framing to the structure of the building and the metal pan deck. The slope of the metal pan deck at this location was measured at approximately 1/8:12 as it appeared to have been warped downward at the outboard termination to fit the structural framing. It appears that the additional XPS rigid insulation shim found at the deck at this location was used as filler between the structural steel angle and the gypsum sheathing to attempt to continue the slope of the roof deck to the base of the parapet.

Slight rising air movement, not to the extent observed at Test Opening 1, was evident once the rock-wool insulation was temporarily removed at the roofline. This airflow was constant for the duration of the investigation, due to the positive pressure in the wall cavity below. A non-continuous vapor retarder was observed as part of the wall assembly below the parapet cavity.

Substantial gaps between sheets of rigid insulation as observed at other locations were also apparent at this location. This condition can contribute to a loss of insulation value, thermal drift and a lack of continuous support for the EPDM , prematurely stressing and aging the membrane. Moisture content was found to be relatively low in all layers at this test opening, as measured with a Delmhorst BD-2100 moisture meter.

As at Test Opening 1 a portion of the screws which fasten the plywood sheathing to the light-gauge steel framing were again found to have substantial corrosion. Spot corrosion appeared to be limited to fasteners in the light-gauge steel framing and reglet at this location. Staining and mold growth were not apparent as on Test Opening 1.

The finish coat of the EIFS coping appeared to be relatively thin and weathered, as the reinforcing pattern was visible in several locations. In addition, the sealant joints between the sections of EIFS coping have, in large part, failed and at the minimum are in need of restoration.

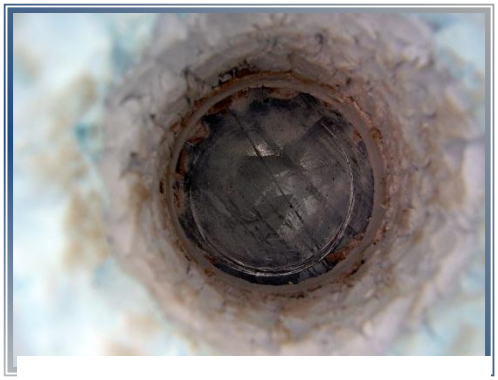
<u>Investigative Test Opening 5 and 2 [Core Analysis Only]:</u>

Roof Area R-1 and R-3

Roof Configuration A: See Typical Roof System section at the beginning of the main body of the Summary of Roof Survey for additional information.

General Description: Roof Test Opening 5 was performed approximately 20-feet to the west of the fixed access ladder, in the field of Roof Area R-3 (Penthouse) adjacent a recently installed B-gas vent. This location was selected in the field of the roof to determine the composition of the roof system at the penthouse.

Observations at Investigative Test Opening 5:
This test opening exhibited the same basic roof system as at Test Opening 2, on Roof Area R-1.



The core opening was aligned on the top of flute in the metal pan deck; however, it was observed from spaces beneath (i.e. inside the penthouse plenum) that the metal pan deck is perforated at the sides of the flutes. The metal pan deck was found to be in very good condition at the top of this flute, with the galvanized surface exhibiting an “as new” appearance.

The roofing materials (i.e. both layers of insulation and gypsum thermal barrier board) appeared to be dry and in sound condition.

The EPDM roof membrane retracted after being cut, indicating that the roof membrane is under excessive tension due to the shrinkage process of ageing EPDM.

<u>Investigative Test Opening 6 and 7:</u>

Roof Area R-2 and R-5

Roof Configuration C: See Typical Roof System section at the beginning of the main body of the Summary of Roof Survey for additional information.

General Description: Test Opening 6 was performed close to a drain to determine the substrate construction and to observe the composition of the roof system at Roof Area R-5.

Observations: This test opening showed the same basic roof system as at Test Opening 7, on Roof Area R-2. This test opening was enlarged from the original 2-inch diameter core to a ~6-inch x ~10-inch opening to allow for Tramex®CME-4 moisture meter testing. The CME-4 readings taken showed approximately 3.8% being slightly elevated from the desired level of 3.0%. Please note that only one location was opened for moisture testing and may not be representative of conditions throughout this roof substrate.

The presence of the EPS tapered system indicates that the concrete deck is not sloped at this location, as the engineered EPS insulation appeared to be installed to direct water toward the drains. The roofing materials (i.e. both layers of rigid insulation) appeared to be dry and in sound condition.

The EPDM roof membrane retracted after being cut, indicating that the roof membrane is under excessive tension due to the shrinkage process of ageing EPDM.

<u>Investigative Test Opening 9 and 7:</u>

Roof Area R-2 and R-6

Roof Configuration C: See Typical Roof System section at the beginning of the main body of the Summary of Roof Survey for additional information.

General Description: Test Opening 9 was performed at a location believed to be potentially above a leak, previously identified in the Level-1 ceiling below Roof Area R-6 during the initial interior leak survey. The purpose of this test opening was to determine the substrate construction and to observe the composition of the roof system at this ancillary roof area, and to discover any correlation to the potential leak detected in the interior.

Observations at Investigative Test Opening 9:

This test opening showed the same basic roof system as at Test Opening 7 on Roof Area R-2. This test opening was enlarged from the original 2-inch diameter core to a ~6-inch x ~10-inch opening to allow for Tramex CME-4 moisture meter testing. The CME-4 readings for this concrete deck were slightly elevated but were within the acceptable range. Please note that only one location was opened for moisture testing and may not be representative of conditions throughout this roof substrate.

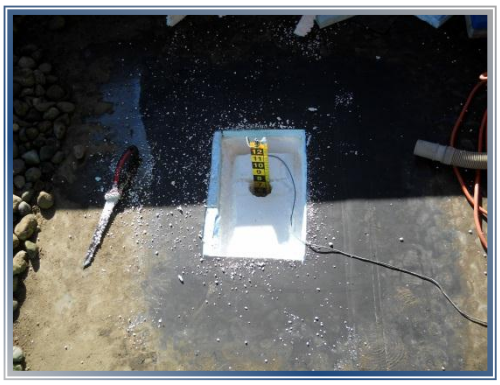
The presence of the tapered EPS tapered system indicates that the concrete deck is not sloped at this location, as the pre-engineered EPS was installed to direct water to the drains. The roofing materials (i.e. both layers of rigid insulation) appeared to be dry and in sound condition.

The EPDM roof membrane retracted after being cut, indicating that the roof membrane is under excessive tension due to the shrinkage process of ageing EPDM.

<u>Investigative Test Opening 8:</u>

Roof Area R-2

Roof Configuration C: See Typical Roof System section at the beginning of the main body of the Summary of Roof Survey for additional information.



General Description: Roof Test Opening 8 was performed at a location near to the South and East Elevations adjacent the wide parapet wall. The purpose of this test opening was to determine the make-up of tapered insulation, and to observe the composition of the roof system at this ancillary roof area.

Observations: This test opening showed the same basic roof system as at Test Openings 7 on Roof Area R-2. This opening was enlarged from the original 2-inch diameter core to a ~6-inch x ~10-inch opening to allow for Tramex CME-4 moisture meter testing. The CME-4 reading for this concrete deck was high, being approximately 5.3 percent. This moisture found at the deck did not appear to be replicated in the EPS insulation, indicating that the EIFS parapet and coping may be partially compromised and allowing moisture to enter the roof system at the concrete deck. Please note that only one location was opened for moisture testing and may not be representative of all conditions throughout this roof substrate.

The presence of the tapered EPS cricket system indicates that the concrete deck is not sloped at this location, as the EPS was installed to direct water to the drains. The roofing materials (i.e. both layers of rigid insulation) appeared to be dry and in sound condition.

The EPDM roof membrane retracted after being cut, indicating that the roof membrane is under excessive tension due to the shrinkage process of ageing EPDM.

EXTERIOR WALL & WINDOW EVALUATION

Natural Resources Building

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Prepared For:

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EXTERIOR WALL REPORT

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INTRODUCTION

During the autumn of 2011, Building Envelope Technology & Research (BET&R) and S.M. Stemper Architects (SMSA) were engaged by the State of Washington Department of Enterprise Services (DES) to develop recommendations for a plan to reroof the various roof areas and repair the exterior walls of the Washington State Natural Resources Building (NRB), located in Olympia, Washington. In order to develop a comprehensive, integrated plan for the Building's needed envelope work, and to establish priorities for such work, as limited by the State's budget, the Design Team undertook a detailed survey of the roofs and exterior walls. This Exterior Wall Survey Report is focused specifically on the condition of the windows and exterior wall assemblies, and damage that has resulted from leaks associated with those areas. The following summarizes BET&R's technical assessment regarding the condition of the exterior Cladding and wall assemblies, the windows and their defects, and outlines approaches from which to proceed with the retrofit and repairs of the exterior walls and windows of the Building.

North elevation and radius-shaped exterior wall cladding of the NRB.

Overview of the eastern elevated portion of the south elevation of the NRB that is most confronted and effected by the locals prevailing wind-driven rains.

EXECUTIVE SUMMARY

BET&R and SMSA were engaged to assess the exterior wall cladding and windows of the State of Washington Natural Resource Building (NRB) in Olympia, Washington, and to provide recommendations for repairs and/or retrofit. This assessment was performed in order to determine the extent of damage resulting from water leaks through the exterior envelope of the Building, and to determine leak sources. With the information gathered, the Team was asked to assist with prioritization of exterior envelope repairs.

Survey and Testing:

The exterior wall and window survey included:

- Interior visual, tactile, and moisture meter survey, and measuring and mapping of leaks;
- Exterior visual survey of cladding and windows;
- Survey of the exterior walls using infrared thermography
- Four (4) interior test openings;
- Six (6) exterior test openings;
- Diagnostic water testing of two (2) windows;
- Removal of one (1) window including the glazing and the aluminum window frame;

RILEM testing at twenty-one (21) locations of the exterior wall cladding, which is an efficient and effective means for measuring the rate at which water moves through relatively porous materials, such as masonry, stucco, and Exterior Insulation and Finish System (EIFS) cladding.

General Findings:

The exterior cladding at the NRB is an Exterior Insulation and Finish System (EIFS) at most wall areas, and pre-cast concrete panels at one area on the south elevation. The windows are aluminum-framed storefront type insulated glass assemblies. The exterior cladding was observed to be in generally poor to good condition. Although the EIFS cladding lamina itself tested to be relatively impervious to leaks, numerous deficiencies were discovered by BET&R in the exterior envelope. BET&R and SMSA discovered significant water and condensation related paper-faced damage from on-going leaks. Major water leak sources into the exterior wall assemblies were found to include:

- Leaks around and through window units;
- Deficient window sill pan flashings that deposit water to the inner wall, rather than shedding it outward;
- Failed sealant joints at window perimeters;
- Failed sealant joints at EIFS transitions;
- Failed sealant at pre-cast concrete panel cladding;
- Cracks through the lamina of the EIFS cladding, including at the field of the walls and at EIFS parapet caps;

Damage to the Building resulting from these leak sources has been significantly exacerbated by the fact that the type of wall cladding installed is a “barrier system” and therefore has no back-up drainage plane (referred to in the International Building Code as “weather-resistive barrier” or “water-resistive barrier”) or properly configured underlayment and flashings to direct incidental water to the exterior.

Widespread water-related damage, including deterioration of the exterior paper-faced gypsum sheathing and interior gypsum wallboard, fungal growth on paper faced gypsum board, and corrosion of light and medium-gauge steel curtain wall framing has occurred, especially at south and west-facing

walls along the south elevations of the Building. Because of the relatively "open" inner wall construction of the Building, leak water has run down the interior face of the exterior sheathing and has accumulated at the base of the exterior wall at the south elevation, resulting in widespread fungal growth, corrosion of select structural beams locations, and partial collapse of the gypsum soffit at the southeastern area of the Building.

As leaks continue, water in contact with the paper facer on the exterior gypsum sheathing can be expected to result in delamination and collapse of more portions of the existing EIFS cladding.

General Recommendations:

BET&R recommends that the exterior walls of the NRB be re-clad and retrofit with new flashings, to address ongoing water leaks and deficiencies in the exterior envelope of the building so that the intrusion issues can be addressed systemically. However, if budget constraints dictate, it may be possible to prioritize the repairs, as our preliminary assessments of damage caused by leaks indicated that weather exposure has a significant impact on the extent of water entry and resulting damage. If it is necessary to prioritize the exterior repairs to the building, the State may wish to consider a targeted repair. A potential scenario would include the following:

- Re-cladding of the EIFS-Clad west half of the south elevation of the building with a drainage EIFS or other cladding system that incorporates a back-up drainage plane;
- Re-cladding of the Rotunda;
- Re-cladding of the exposed portions of the east half of the south elevation of the Building, including the cantilevered portion. It is feasible to repair the 1st through 4th floor portion of the south elevation, which is protected by the cantilever;
- Replacement of interior gypsum wallboard at the south elevation, where exterior cladding is replaced;

Replacement or repair and retrofit of all windows, including flashing of window rough openings;

- Comprehensive replacement or repair of sealant joints;
- Repair of cracks in the EIFS lamina at the north side of the Building;
- Re-coating of all EIFS cladding with a high-quality acrylic coating system (e.g., Tnemec Series 151 and 156);
- Complete replacement of all sealant joints in the pre-cast concrete cladding;
- After all sealant work is complete, prepare, prime, and coat the pre-cast concrete panel cladding.

It is our opinion that repairs should be undertaken as soon as possible to prevent further damage to the interior and interlying structure of the Building as well as to halt further proliferation of fungal growth.

More details regarding our findings and recommendations are included in the following pages.

BACKGROUND INFORMATION

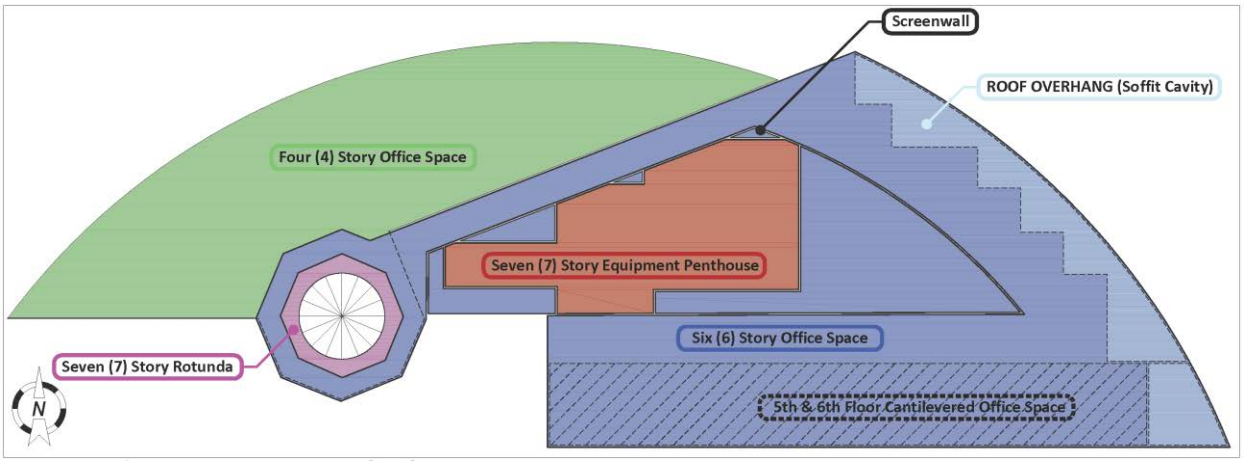
HISTORY OF REPAIRS

The Building staff reported that sealant renewal was performed along with application of an acrylic coating over the EIFS cladding in 2002. In 2006 EIFS wall cladding and soffit cladding repairs were performed, apparently in response to water-related damage to the soffit along the south elevation of the Building. We understand that some repairs to water-damaged interior finishes have been performed at the locations where damage was caused by previous leaks through the roof, as well as some due to previous leaks related to windows and cladding.

BUILDING LAYOUT AND CONSTRUCTION

The Building has a relatively complex profile. The radiused north portion of the Building is 4 stories high, as is the western end of the Building. The central part of the Building is 6 levels high. At the south elevation, the eastern portion of 5th and 6th levels is cantilevered out from the Building. Also along the south elevation, there is a central, 7-level high open rotunda. The Building is constructed over an extensive below-grade structure that houses parking, storage and laboratory space, and a service tunnel. The total floor area of the NRB is approximately 352,000 square feet.

More detailed information regarding the layout and construction of the various roof areas of the Building are described in BET&R's Roof Survey Report.



Drawing No. 1—NRB Building Layout

WALL ASSEMBLY

The majority of the exterior walls of the NRB are constructed in a curtain wall configuration. The steel wall framing members are attached to the exterior face of the structure, and are continuous floor to floor. Mineral-wool (e.g., rockwool) insulation was installed at floor lines to act as a fire break between floors. Importantly, the mineral-wool insulation does not act as an effective water or air block between floors.

The cladding assembly at the NRB is a barrier Exterior Insulation and Finish System (EIFS), which does not incorporate a secondary drainage plane, but was originally designed to confront and shed water at its exterior surface only -- thus the name "barrier cladding". See Appendix B for additional information regarding barrier EIFS. The Building's walls are typically clad with EIFS, comprised of nominal 2-inch thick, and 6-inch thick, rigid Expanded Polystyrene insulation boards (EPS), which was adhered to the paper-facer of the exterior gypsum sheathing with a trowel-applied layer of cementitious "adhesive" base coat. In some areas surveyed the cementitious base coat insulation "adhesive" is relatively heavy.

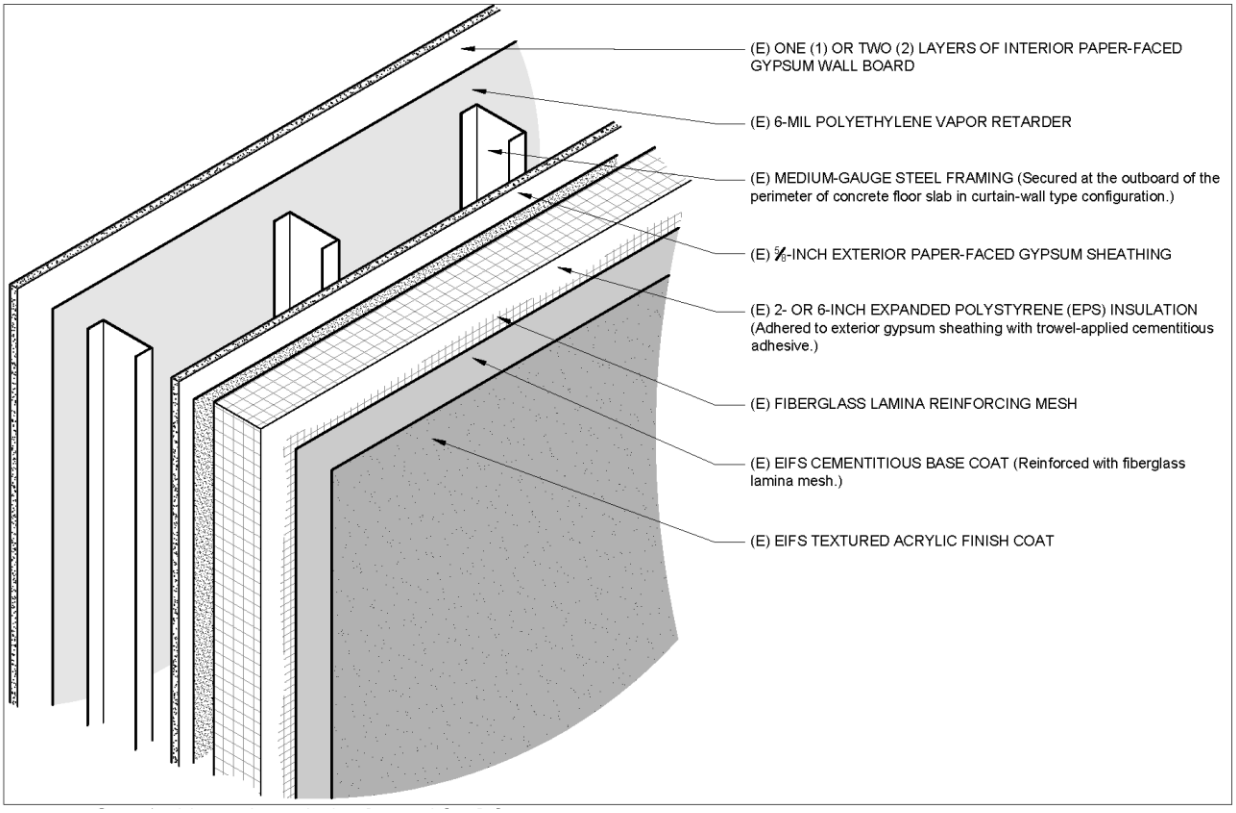
In other wall locations it is much lighter, with the original notched-trowel striations of adhesive being relatively sparse or light.

No (zero) mechanical attachment fasteners were found during BET&R's test openings. Over or outboard of the EPS insulation we discovered an ⅛-inch to $^{3}/_{16}$-inch thick EIFS lamina consisting of cementitious base coat reinforced with one (1) layer of fiberglass mesh, and coated with textured acrylic-paint finish.

Joints between EIFS panels are generally filled with backer rod and polyurethane sealant. The exterior paper- faced gypsum sheathing is, attached to light- and medium-gauge steel curtain wall-style framing.

Test opening taken on the north elevation of the Building illustrates the typical construction of the exterior walls including exterior cladding, sheathing, framing, and vapor retarder (Test Opening 3).

A 6-mil polyethylene vapor retarder is installed over the steel wall framing on the interior side of the wall assembly. Adhesive was found installed at most seams. ⅝-inch interior gypsum wallboard (drywall) is installed inboard of the vapor retarder, attached to the wall framing. Drawing No. 2 below illustrates this typical building perimeter wall assembly. In some locations, an additional ¼-inch thick layer of interior gypsum wallboard was also in place.



Drawing No. 2 – Existing Wall Assembly

At the Rotunda, the wall assembly is similar; however, the polyethylene vapor retarder was incorrectly installed at the exterior side of the metal wall framing rather than on the interior side of the framing, as was otherwise observed at all other exterior wall areas of the Building that the Team surveyed.

Fiberglass batt insulation was observed installed within the wall cavity, between the vertical framing members (studs) at only select wall locations, including at an interior test opening adjacent to a 5th floor window (Test Opening 3).

The wall construction at the lower levels of the Building consists of pre-cast concrete panels attached over a steel post-and-beam structure. Intersections between pre-cast panels and between the panels and window frames are filled with polyurethane sealant joints. Pre-cast panels were not removed during this 2011 survey.

WINDOWS

The windows are aluminum-framed storefront-type windows with two Insulated Glass Units (IGUs) per window assembly. The vertical joint between the two IGUs is butt-glazed with sealant.

The windows are designed in pairs with each set of two windows placed between six-foot wide EIFS pilaster features of the wall with an approximately 12-inch wide EIFS-clad mullion located between the two pairs of windows. The windows are generally inset in the wall with the EIFS cladding wrapping into the opening, and at most floors/levels the exterior face of the window frame is set back approximately 2 inches from the face of the EIFS.

The pilasters project another 4-inches out from the face of the field of the wall, and a projecting EIFS water table or horizontal-set building band applied even with the face of the pilasters, which provides the exterior sill for the windows.

A sheet metal sill pan sits on the water table and extends through the window-rough-opening under the window, with an upturned back dam at the interior side of the opening under the window. However, this back-dam is not fit with end dams, and as a result much leakage and water-related damage has resulted in the Building's wall assemblies. There is a sealant joint between windows' sill frame and the sill pan flashing with two weep openings per window assembly, located in the upper half of the sealant joint. Sealant joints are installed at the interface between the window jamb frames and the EIFS clad opening. A sheet metal head flashing is installed above the windows. The downward-projecting flange, over the window head, has a drip edge and the vertical flange extends up behind the EIFS cladding at the head. Sealant was generally installed between the window head frame and the drip edge of the head flashing, as well as between the flashing and the EIFS above.

The interior jambs and head of the window opening are wrapped with painted gypsum board. The interior sill is trimmed with Medium Density Overlay (MDO) consisting of pressed wood strand board overlaid with plastic laminate, making up both the interior window stool cap and the apron as a simulated one-piece trim unit. Sealant is installed at the intersections of these materials with the window frame. An extruded aluminum cap is installed at the vertical butt-glaze joint and extruded rubber gaskets are installed on the interior side of the window frame at the jambs, head, and sill between the back of the aluminum frame and the interior side of the IGUs.

INVESTIGATION AND FINDINGS

REPORTED LEAKS AND INTERIOR VISUAL SURVEY

Leaks through the roof have reportedly been occurring for some time. The Building Maintenance staff reported that there are areas where acoustical ceiling tiles have been replaced several times because of leak-related damage. As part of our survey work, BET&R performed a visual survey of the ceilings of top floor areas including removing select ceiling tiles to review the ceiling cavity and underside of the roof deck from the interior, in order to map locations where leaks and damage had occurred. Water damaged acoustical ceiling tiles were observed at 4th and 6th floors. In addition, windows from the 1st to the 6th floors were examined from the interior to identify the extensive number of window and wall leak locations, which were not previously reported by Building representatives.

BET&R personnel surveying a 6th floor window jamb where damage was observed. Damage was observed at interior finishes at numerous windows throughout the building.

During the window survey numerous locations and fairly large areas of water leak damage were identified at each floor level. Most common indications of leaks were water stains on the interior surfaces of the window frames and swelling of MDO window sill trim. In some areas, the interior gypsum wallboard was swollen and deconsolidating, and the jamb, sill and/or adjacent wall paint is peeling indicating more severe, generally long-term water leaks at and around the aluminum-framed window units.

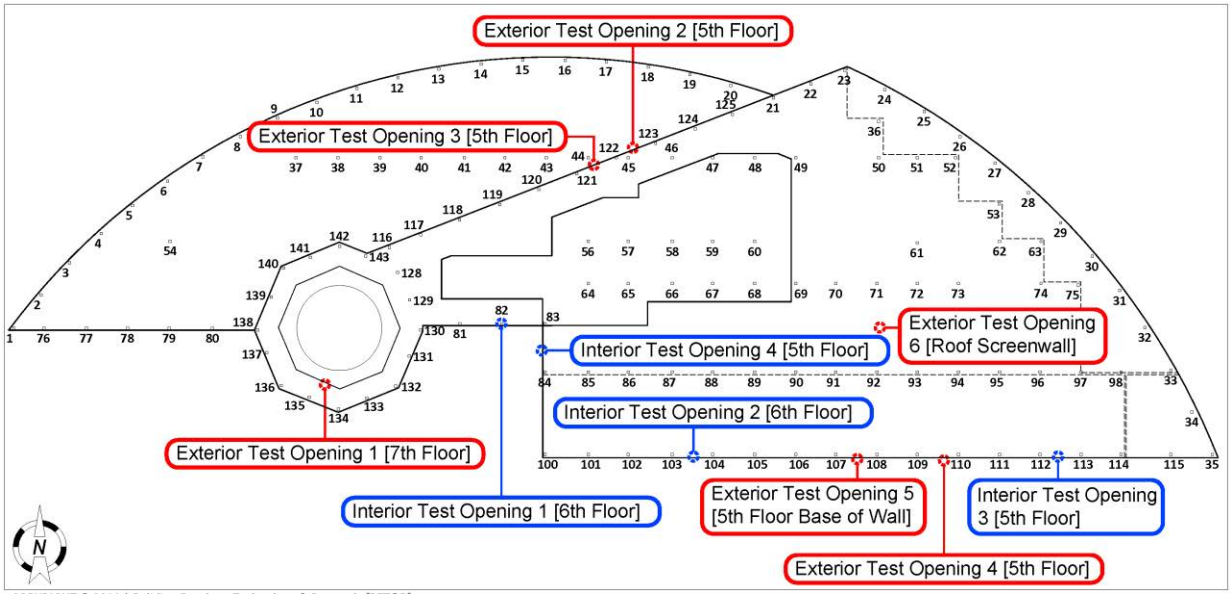
Visible evidence of leaks was most frequently observed at the upper floors along the south side of the building where the windows and exterior walls are more exposed to the prevailing weather (wind and rain).

BET&R along with Building maintenance staff reviewed leaks at a storefront window in the Rotunda below the location where the adjacent plaza intersects the south-portion of the Building at the second level. Although the plaza deck areas were not included in BET&R's assigned scope, a cursory review of the area indicates that there are numerous leaks associated with the plaza deck waterproofing and deck-to-wall flashing at this elevation, and that water from above deficiencies on top of the window frame, and subsequently to the interior of the window.

TESTING OVERVIEW

In order to gain a more complete understanding of the overall performance of the exterior walls' envelope, and the leak damage being observed in locations around the Building, S.M. Stemper Architects and BET&R undertook a relatively intense investigation of numerous aspects of the building envelope. The Team's testing included interior and exterior wall moisture testing, investigative test openings, as well as exterior and interior Infrared Thermography and RILEM testing. BET&R has identified the location of the test openings according to the column numbering system developed by the

Building staff as shown in Drawing No. 3 below. Please see Appendix A for additional information regarding each test opening.



Drawing No. 3 – Map of Columns

INTERIOR TEST OPENINGS

Interior test openings were taken at the 5th and 6th floors along the south elevation on October 12th, and 17th. These openings confirmed that leaks are occurring at the windows at the south elevation. At each of 4 locations opened during BET&R/SMSA's investigation, clear evidence of leaks and water damage were discovered. Water damaged interior gypsum wallboard and exterior wall sheathing as well as corrosion of the light-gauge steel framing was characteristic of conditions observed at the Building's perimeter wall test openings. Prolonged exposure to water leakage had resulted in fungal growth on the paper facer of the gypsum wallboard, which varied in extent at each of the test openings. Damage was most evident at the EIFS cladding-to-window sill-to-jamb intersections, although cladding and window leaks were discovered at the head-to-jamb intersections as well. Specific findings at each of the test locations are outlined below. Please Refer to Appendix A for additional information regarding these test openings.

<u>Interior Test Opening 1: 6th Floor Elevator Lobby Window – Between Columns 6-81 and 6-82</u>

General Description: Interior gypsum wallboard and trim was carefully opened and removed from the head, jamb and sill at the west edge of the window to the west of Column 6-82. The laminate surfaced engineered wood sill trim was swollen and the surfacing was delaminating as a result of prolonged water-induced deconsolidation of the trim. Blistered paint was evident at the window jamb, indicating water leaks had caused the hygroscopic wallboard to swell; however, moisture meter readings taken in the gypsum wallboard were relatively low this day, apparently to the Building's currently positively-pressurized HVAC (heating, ventilation, and air conditioning) that air-leaks copiously into the Building's perimeter wall assemblies. Removal of the two layers of existing interior gypsum wallboard, careful and temporary removal of the existing polyethylene vapor retarder, and removal of fiberglass batt insulation from the perimeter of the window frame exposed the sill-to-jamb flashing, the back of the EIFS cladding system and sealant joint, the wall cavity adjacent the window, as well as the back of the window head flashing and head-to-jamb intersection. In addition, acoustical ceiling tiles were removed in order to survey the interior face of the wall above the suspended ceiling assembly.

Observations: The sill trim at this location was significantly water-swollen at the west end of the sill. Although moisture meter readings were relatively low to moderate in the gypsum wallboard, readings taken in the wood shims that support the window sill trim were 33.5% on the wood scale (maximum is 40%) and it was evident that repetitive water leaks at the window sill-to-jamb intersection had severely damaged the wall and sill trim. Removal of the window aluminum sill trim revealed that the existing factory-fabricated window sill flashing had an adequate back dam but lacked end dams, which has allowed water to leak off the ends of the sill flashing and flow readily into the wall assembly.

As part of BET&R and SMSA testing, gypsum wallboard was removed at the west edge of the window at the head and sill adjacent Column 6-82.

When the acoustical tiles were temporarily removed, BET&R observed that the interior gypsum wallboard and vapor retarder attached to the interior face of the exterior framing stopped just above the suspended ceiling assembly, which exposes the upper part of the exterior wall assembly to warm, occupancy-generated moisture-laden interior air. Although it was not possible to verify from this test opening, considering the deficient configuration of the wall's vapor retarder and the wall, condensation conditions likely occur on the cooler surfaces near the top of the exterior walls at each floor level on cold winter days.

The interior gypsum wallboard and vapor retarder stopped just above the top of the suspended acoustical tile ceiling. Warm, moist interior air can come in contact with the exterior wall above this location.

When the interior gypsum wallboard was removed, water stains and relatively light-to-moderate fungal growth was discovered on the exterior face of the interior gypsum wallboard below the window sill-to-jamb intersection. It was apparent that leak water has regularly been somewhat trapped between the relatively impermeable wallboard and the polyethylene vapor retarder attached to the interior face of the wall framing. The paper facer of the wallboard, acting as a reservoir with the gypsum core for leak water, have caused the area to remain wet or damp, and the cellulose (paper) facer has apparently provided a ready source of food for fungal growth. Corrosion stains were also visible on the paper facer, indicating that the water is also corroding the screws and stud flanges used to secure the gypsum wallboard in place. In the wall cavity behind the vapor retarder, light water stains were evident on the interior face of the exterior sheathing beneath the subject window, and more pronounced water tracks were visible in the same vicinity, in the wall cavity beneath the adjacent window. Materials containing fungal growth that were removed at the test locations were carefully bagged, sealed, double-

bagged and double sealed for testing. The Team was directed to provide samples to the State's in-house environmental hygienist. But, the Team was not provided with the laboratory findings.

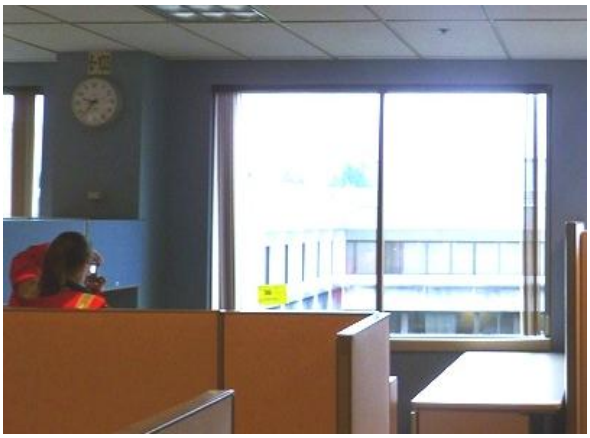
At this test opening, relatively isolated fungal growth colony formed on the paper facer of the interior gypsum wallboard where leak water was intruding into the wall assembly.

The paper facer of the exterior gypsum sheathing was water stained, and had delaminated from the gypsum core indicating repeated exposure to moisture.

The paper facer of the exterior gypsum sheathing had delaminated from the gypsum core; an indication that the sheathing had been repeatedly wetted and the core of the sheathing was compromised as a result.

There was also visible moisture on the horizontal framing track between the windows and light corrosion on portions of the light gauge steel framing, and on the drywall screws. Backer rod installed at the window jamb between the aluminum window frame and the rough opening framing stopped short of the backer rod installed at the head of the window, resulting in an improperly profiled sealant joint at the window head-to-jamb intersection.

<u>Interior Test Opening 2: 6th Floor Cubical 6177 Window – Adjacent Column 6-103</u>



Overview of the location of the window test opening at Column 6-103. Interior gypsum drywall was removed at both jambs of the window.

General Description: The window sill trim was removed from the window sill and two layers of interior gypsum wallboard (one ⅝-inch thick and one ¼-inch were removed from the east and west window jambs and a portion of the window head and sill. In addition, the polyethylene vapor retarder was removed to allow examination of the wall cavity and fiberglass insulation was removed from the gap between the window frame and the window rough opening to allow survey of the interior side of the backer rod and sealant joint at the perimeter of the window. As part of the investigation at this location, BET&R personnel performed an exterior survey of the window from a bosun's chair, and performed a diagnostic water test on the window.

Observations: There was evidence of underlying damage on the interior face of the interior gypsum wallboard, including deconsolidation, even degradation cracking in the gypsum, and excessive separation between the gypsum wallboard and the window frame. At the west jamb BET&R observed visible stains on the window sill, and water damaged, swollen sill trim.

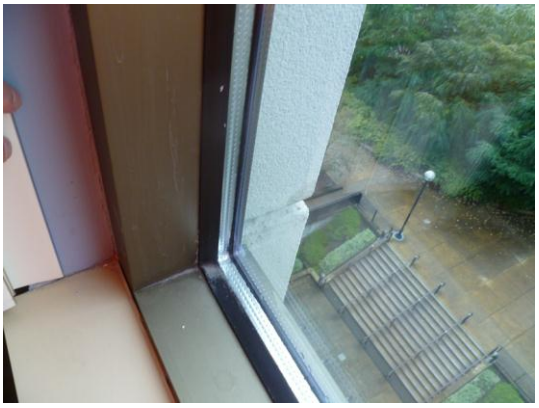
When interior finishes were removed from the west jamb-to-sill intersection of the window, visible fungal growth was discovered between layers of interior gypsum wallboard. Moisture meter readings in the paper facer of the wallboard were as high as 7.7 on a Delmhorst moisture meter set to the gypsum scale indicating the material was saturated with water (BET&R typically considers 1.0 and above to be "wet" material on the gypsum scale). Moisture meter readings in the plywood shims that support the window sill were similarly elevated with readings on the moisture meter set to the wood scale of 40% (maximum reading on the meter). Fungal growth also occurred on the paper facer of the interior gypsum wallboard where water was trapped between the wallboard and the polyethylene vapor retarder.

Fungal growth was discovered between the two existing layers of gypsum wallboard at Interior Test Opening 2. Moisture meter testing confirmed that the wallboard was saturated with leak water.

When the second layer of the interior gypsum wallboard was removed and the vapor retarder was opened to allow survey of the wall cavity, BET&R observed that the paper facer of the exterior gypsum sheathing was saturated with leak water directly below the west jamb-to-sill intersections (note that wind and raining conditions had been experienced on site the night before). Water-staining and delamination from the existing gypsum core also indicate that the interior face of the exterior sheathing had been exposed to repeated leaks. These extensive water stains on interior face of exterior gypsum wallboard indicated that chronic leaks have occurred at the sill-to-jamb intersection of the window.

Similar but less severe damage was discovered at the east jamb of the window. Fungal growth was again discovered between layers of interior gypsum sheathing beneath the sill-to-jamb intersection. Drywall screws used to secure the interior gypsum wallboard in place were corroded, and the interior face of the exterior gypsum sheathing was water stained and delaminated from exposure to leaks.

On the exterior side of the window, several potential leak paths were identified. The sealant joint between the window frame and the sill flashing had failed, as had the sealant at the jamb. In addition, sealant had failed between the window frame and the exterior cladding at the jamb-to-sill intersection. Daylight was also visible through the sealant joint at the east window jamb near the jamb-to-head intersection, and the sill flashing was not sealed to the rough opening leaving a gap beneath the sill flashing.



Water was visible on the inside face of the exterior sheathing below the west jamb-to-sill intersection. Olympia received almost an inch of rain the day before (10/11/11).

Water Testing: BET&R performed diagnostic water tests at both the east and west jambs of the window using a monarch nozzle. The water test generally followed the American Architectural Manufacturers Association (AAMA) 501.2 protocols, which is a water test procedure BET&R has used for years in window leak path tracing and fenestration issues diagnostic work. Water was applied to the window and window cladding-to-interface with the adjacent wall using a Monarch nozzle attached to a simple garden hose.

The east jamb-to-sill of the window was water tested for 5 minutes and no water was observed entering the Building. Then the east jamb-to-head intersection was tested and water leaks were observed after 1 minute. Water ran down the window jamb and accumulated on the framing at the sill-to-jamb intersection as indicated by water-finding test paper. Following testing at the east jamb, BET&R identified two areas along the window jamb where the existing sealant bond to the window frame had failed. One failure was near the head of the window, and the other near the sill. In both instances, BET&R was able to explore and insert a probe into the sealant joint at the prior points of failure.

Water-finding test paper indicated that leak water clearly was confirmed to be leaking out of the end of the sill flashing at the east jamb of the subject window.

Water was applied on the exterior to the west jamb-to-sill intersection of the window. This testing replicated the leaks that appeared to have caused damage at this window. Water from the testing recreated the leaks that had occurred during the rains the day before, wetting the interior face of the exterior sheathing below the jamb-to-will intersection. Water also accumulated slightly on the window sill framing adjacent the stained jamb-to-sill intersection. Water appeared to be migrating under the sill flashing.

<u>Interior Test Opening 3: 5th Floor South Facing Cubical Window – Adjacent Column 5-113</u>

General Description: At Interior Test Opening 3, the one existing layer of interior gypsum wallboard was removed from the east jamb of the window adjacent Column 5-113 on the 5th floor. Wallboard was removed from the underside of the suspended ceiling to approximately 4-inches above the floor. The polyethylene vapor retarder was opened to allow observation of the wall cavity.

Observations: The MDO sill trim was swollen at the intersection of the sill with the jamb adjacent Column 5-113, and the paint on the interior wallboard was blistered and peeling at the window jamb. Two cracks in the paint originated at the sill-to-jamb intersection. Visible fungal growth was evident on the paper facer of the interior gypsum wallboard when the corner bead of the gypsum wallboard was removed from adjacent the east window jamb. Fungal growth was also evident on the exterior face of the paper facer of the gypsum wallboard beneath the window sill to jamb intersection where leak water was trapped between the vapor retarder and the interior gypsum wallboard. The drywall screws securing the interior gypsum wallboard in place were observed to be corroded at the jamb of the window and beneath the east end of the window sill.

More extensive damage was visible in the wall cavity. Much of the paper facer of the exterior gypsum sheathing was delaminated from the gypsum core, and fungal growth and extensive water stains and water tracks were visible on the interior face of the exterior sheathing. Water was trapped in fireproofing placed in the light-gauge steel blocking between the window and the adjacent Column 5-113. The fireproofing was wet to the touch, and the blocking it sat in was severely corroded.

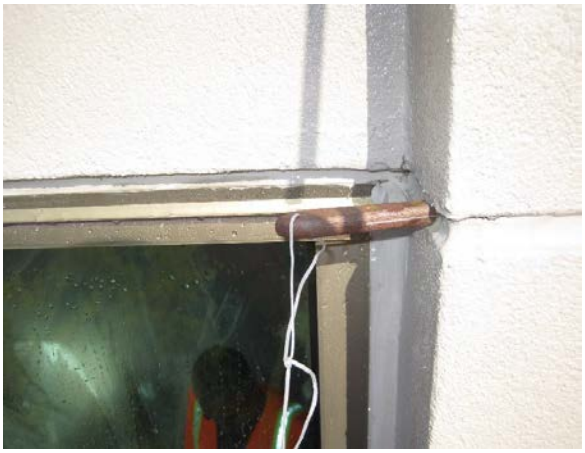
BET&R performed suspended drops with a bosun's chair at this window in order to examine the exterior of the window and perform diagnostic water testing.

Overview of interior of window at Column 5-113. A test opening was made at the east jamb of the window.

There were identifiable leak paths at the exterior of the window including failed sealant between the window sill flashing And the adjacent window jamb, failed sealant at the head of the window, and cracks in the lamina of the EIFS cladding extending to the base of the cantilevered wall.

Water damage in the building wall caused by leaks at the Interior Test Opening 3 location including corroded framing, delaminated paper facer of the exterior gypsum sheathing, and fungal growth on the interior face of the polyethylene vapor retarder.

Water Testing: Water leak path testing was performed on the window jamb for approximately 7 minutes. A diagnostic Monarch Nozzle test following the AAMA 501.2 protocol was performed. During water testing, water leaked through the window sill-to-jamb intersection and at the failed sealant joint. The water leaks replicated the staining and damage patterns observed at the interior in the open wall cavity, wetting the interior face of the exterior gypsum sheathing at the jamb and sill-to-jamb intersection, and accumulating on the window sill framing. Water testing confirmed that leaks are occurring through failed and improperly configured sealant joints in the field of the wall as well as at the interface between window frames and EIFS cladding.



It was possible to fully insert a 3-inch metal probe into a failed sealant joint immediately adjacent the window at Column 5-113. This was identified as one of the primary leak sources at the area water tested.

Interior Test Opening 4: 5th Floor West Facing Cubical Window – Between Columns 5-84 and 5-63

General Description: At Interior Test Opening 4, the interior gypsum wallboard was removed from between adjacent window jambs, at the window sills, and above the head of each window. The polyethylene vapor retarder at the interior flange of the light-gauge steel framing was opened to allow examination of the wall cavity.

Water damage to the window sill was evident at this location. Water stains also ran down the wall beneath the sill.

Observations: The sill trim was swollen and deconsolidated, and the paint was peeling from the surface on the interior gypsum wallboard at both adjacent window jambs. Water stains were also visible running down the interior surface of the wall beneath the damaged window sill. Two acoustical ceiling tiles were stained immediately above the test area, indicating that water was leaking down the wall from leaks at the windows, cladding, and/or EIFS coping above. When BET&R removed ceiling tiles to examine the ceiling cavity, it was observed that the polyethylene vapor retarder was detached between floors and had piled just above the ceiling tile. Leak water that drained down the wall was likely directed onto the top surface of the ceiling tiles, by the detached vapor retarder.

Light corrosion of the framing and visible fungal growth on the interior face of the exterior sheathing indicated that repetitive leaks through the windows and exterior cladding intersection were frequent and causing damage to the Building.

When the interior gypsum wallboard was removed, water stains were visible on the exterior face of the wallboard emanating from both windows. Water tracks on the wallboard were also visible, which appear to originate from leaks at the 6th floor windows above. In the wall cavity, fungal growth was visible on the interior face of exterior sheathing, especially near the 5th floor floor-line and the paper facer on exterior gypsum sheathing had delaminated from the gypsum core indicating that the area had been exposed to repeated wet/dry cycles. Despite the evidence of leaks, moisture meter readings were relatively low at this test opening.

EXTERIOR SURVEY OBSERVATIONS

The design team surveyed the cladding of the Natural Resources Building from a bosun's chair as well as from a swing stage (suspended scaffold) to perform a survey of representative sampling of the buildings cladding. A number of deficiencies were noted during BET&R's visual survey of the cladding and windows. The most important items included the following:

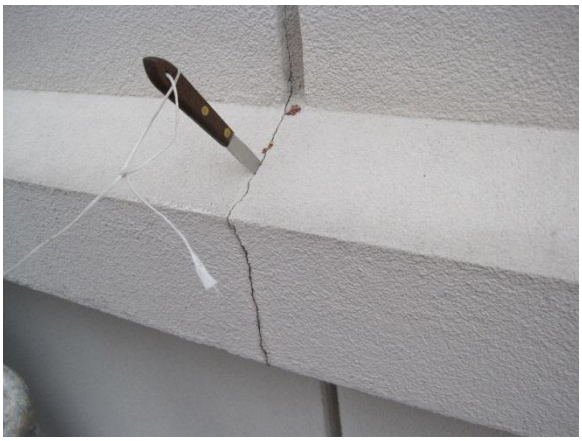
Failed Sealant Joints – Failed sealant was observed in sealant joints in several configurations throughout the cladding assembly. Sealant joints at the perimeter of select windows in locations throughout the building had failed adhesively. In some locations, the sealant was not adhered to the EIFS panels; however, the majority of the locations where the sealant has failed were observed to be at window perimeters, where the sealant had is disbonded from the aluminum window frame. These sealant failures generally may be the result of a lack of proper backing for the sealant joint and improperly profiled sealant joints, which have resulted in excessive stresses on the sealant bond face. The inadequate width of the window frame profile at the jamb results in a sealant bond to the substrates that is not strong enough to withstand the forces resulting from differential movement in between the two sides of the joint.

Photo depicts metal probe inserted into failed sealant joint at expansion joint between EIFS panels. It appears that topical sealant repairs have previously been installed at these locations and have failed.

Sealant was also observed to have failed at a number of expansion joints in the EIFS-clad walls. The skyward facing sealant joints between the EIFS panels at parapet wall coping have failed at a much higher rate than the EIFS panel joints at the remainder of the Building most likely due to their greater exposure to weather and sunlight. Sealant failures were also observed in the pre-cast concrete walls at the lower levels.

In a number of locations, including at cracks in the top of the EIFS clad parapet walls and EIFS cladding and at window sill flashing terminations, topically-applied sealant repairs were observed that had cracked and failed cohesively and/or adhesively.

Photo depicts metal probe inserted into adhesively failed sealant joint. The sealant is disbonded from the aluminum window jamb frame.



Flat metal probe inserted into existing crack through the EIFS lamina at a foam plant-on belly-band feature, which aligns with a crack in the weak underlying architectural reveal.

Photo depicts metal probe inserted into failed topically-applied sealant over a crack through the EIFS lamina at a coping-to-rising wall intersection.

Cracks in EIFS Cladding – Numerous cracks are evident through the cementitious lamina of the barrier EIFS cladding. The cracks are most prevalent at the EIFS-clad parapet caps (coping) and in the EIFS reveals and angle changes throughout the building. A very long crack was observed running the full length of the rooftop screen wall at the south elevation (see Exterior Test Opening 6). The cracks in the EIFS lamina are allowing water to enter the building wall assembly. It is evident that at many of these locations, not only is the rigid EPS foam insulation board being wetted, but water is also leaking into the building wall assembly.

Cracks in the skyward-facing EIFS coping caps at the top of the building walls appear to be a significant source of leaks. Along the north elevation, a series of leaks along the perimeter wall appear to be associated with leaks from cracks and failed sealant joints in the coping cap. At the west end of the south elevation, the Building maintenance staff has topically-applied sealant to cracks in the coping in an effort to stop leaks occurring in the offices below.

Window Sill Flashing – Anodized aluminum window sill flashing pans are installed under all of the aluminum framed storefront windows; however, the existing sill flashings have numerous deficiencies which allow water to enter the building wall assembly. Although the sill flashings were fabricated with back dams, interior test openings verified that the sill flashings lack end dams.

This allows any water draining onto the sill flashing to drain out the ends of the flashing and into the building wall instead of being directed to the exterior of the Building. The end terminations of the window sill flashing pans are open in some locations, and in other locations the termination of the sill flashing has been sealed to the adjacent EIFS with topically applied sealant, which has failed in numerous locations. These open joints and failed sealant and lack of any seal at the end of the flashing under the window sill frame allow water draining off the ends of the sill flashing to migrate under the sill flashing.

Photo depicts metal probe inserted under the disbonded, topically applied sealant at the termination of an aluminum window sill flashing.

At many locations the window sill flashing pans are not sealed (with either sealant or EIFS lamina) to the EIFS cladding panel or pre-cast concrete panel below the sill. The open gaps under the sill flashing allow water to migrate under the sill flashing and into the building wall. At the sill of the 5th floor windows the EPS insulation in the EIFS cladding changes from a nominal 2-inch thick board to a nominal 6-inches thick board, changing the profile of the building wall and creating wider sill below the 5th floor windows. The relatively wide reveal at this location is covered directly below the windows by a wider aluminum window sill flashing. This wide window sill does not have sufficient slope to the exterior and pools water against the sealant at the joint at the sill of many windows.

Photo depicts biological growth on a 5th floor window sill. This window sill does not slope away from the building and thus standing water pools on the horizontal flange of the sill pan against the sealant joint at the base of the window sill frame.

Photo depicts unsealed, open gap under an aluminum sill flashing at the 5th floor.

This standing water accelerates the deterioration of the sealant joints and the slope of the sill forces water to run off the ends of the window sills where the deficiencies described above may allow the water to enter the building walls.

Failure of Adhesion of EIFS Cladding – The existing EIFS cladding system is adhered to the paper-faced gypsum sheathing with a cementitious adhesive/base coat. The adhered EIFS cladding system relies on the integrity of the adhesives and the integrity of the paper-faced gypsum sheathing substrate to stay attached to the building walls. The cement-based adhesive appears to be well adhered to the paper-facer of the sheathing in most locations; however, leaks have led to the paper-facer delaminating from the gypsum core of the sheathing. Thus portions of the existing EIFS are no longer fully adhered to the building wall. If leaks are allowed to continue and the sheathing continues to degrade, there is a danger that portions of the existing EIFS could become detached from the building wall.

Failed Seals at Windows – The existing aluminum framed store front windows are beginning to show signs of age and weathering. At several window units the sealant joint at the vertical butt-glaze joint between the two glazing units in each window was observed to have failed. The extruded rubber gaskets at the window frame-to-glazing intersection have shrunk and deteriorated and no longer provided a watertight seal at numerous locations. These failed seals allow water to enter the window frame and migrate into the building wall.

Three failed IGUs at the east end of the 6th floor of south elevation were observed during BET&R's interior survey. As IGUs age, the seal between the two pieces of glass can fail, allowing moisture to become trapped between the layers of glass. The moisture in the IGU condenses leading to a permanently fogged window.

Photo depicts metal probe inserted through failed sealant joint at the base of a vertical butt-glaze sealant joint between two window glazing units.

Photo depicts metal probe inserted between the window glazing and aged extruded rubber gaskets at jamb-to-sill intersection at a typical aluminum framed store front window.

Damaged Soffit Areas: The soffit along the south elevation of the Building where the 5th and 6th levels are cantilevered out from the Building was severely damaged by leaks from the building walls above. The soffit is constructed over a light-gauge steel frame work to which paper-faced gypsum sheathing is mechanically fastened. The paper-faced gypsum sheathing is coated with a textured elastomeric coating.

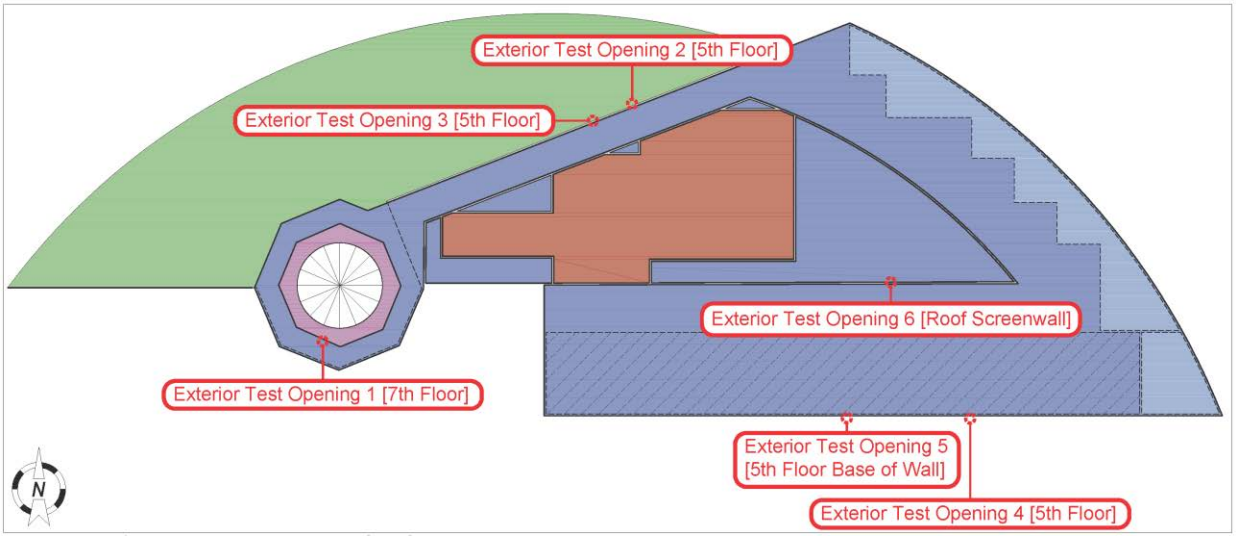
Overview of the south elevation of the Natural Resources Building. The 5th and 6th floors of the building are cantilevered out from the Building.

Areas along the outboard edge of the soffit were damaged in several large areas visible from the ground. In these areas, the paper-facer of the gypsum sheathing had delaminated from the gypsum core. The fasteners that hold the gypsum soffit sheathing in place had corroded to the point where areas of the soffit were in danger of falling. BET&R and SMSA informed the Washington State Department of Enterprise Services (DES) of these areas.

Photo depicts an area of damaged soffit below the cantilever portion of the Building at the south elevation.

EXTERIOR TEST OPENINGS

Exterior test openings were taken at the 5th, 6th, and 7th floors on October 13th, 17th, 18th, and 19th. These openings re-confirmed that leaks are occurring at the more weather-exposed south side of the Building. Evidence of water leaks were discovered along the south side of the Building in each testing location. At the north side of the Building, very limited damage to the Building wall was discovered at one location, while the other test location did not show any evidence of water intrusion. Specific findings at each of the six (6) exterior test locations are outlined below. Please Refer to Appendix A for additional information regarding these test openings.



Drawing No. 4 – Cladding Test Opening Locations

Exterior Test Opening 1 – Rotunda 7th Level Window at Sill-to-Jamb Intersection

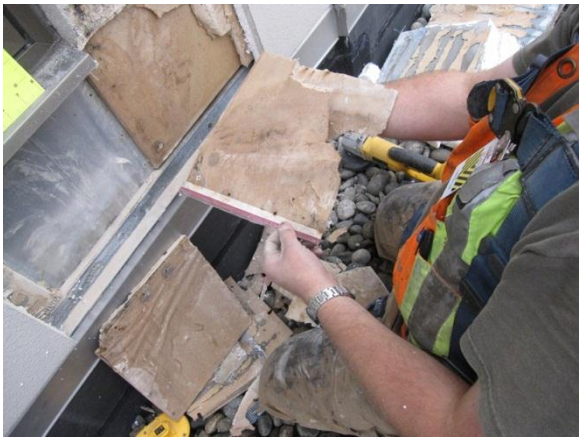
General Description: Test opening taken on the south elevation of the Rotunda at a window sill-to-jamb intersection. The test opening included removal of EIFS cladding and two layers of exterior gypsum sheathing, and slicing and peeling back of polyethylene vapor retarder.

Overview of Rotunda wall assembly, opened during the investigation revealing two-inch thick EIFS cladding, two layers of exterior gypsum sheathing, and an incorrectly placed polyethylene "vapor retarder".

Observations: At this test opening, the exterior wall consisted of EIFS lamina over nominal 2-inch thick expanded polystyrene insulation. The insulation was adhered to paper-facer of the outer layer of 2 layers of exterior gypsum sheathing with cementitious base-coat adhesive. The polyethylene "vapor retarder" was found to have been incorrectly installed over the exterior face of the metal studs, with an unidentified type of glue/adhesive installed at the seam.

The EIFS cladding was generally in serviceable condition. Hairline cracks in the EIFS lamina were evident in the vertical reveal at the corner of the window. In addition, the intersection

between the EIFS cladding and the window was not properly sealed at the corner. With the EIFS cladding removed, water stains were evident on the exterior surface of the paper-facer of both layers of exterior gypsum sheathing, originating at the corner of the window. The existing gypsum sheathing was beginning to deconsolidate (come apart) due to apparent repeated wetting and drying. The interior paper-face of the exterior sheathing was also found to be water stained, and delaminating from the gypsum core. Although the sheathing was relatively dry at the time the test opening was taken, this appeared to be an active leak.



Water stains and fungal growth on the paper-facer of the exterior gypsum sheathing

Fungal growth had formed on the paper surfaces between the layers of exterior gypsum sheathing. The damage pattern indicated that the sill-to-jamb intersection is the primary leak source; however, water-stained sheathing extended up the window jamb above the level of the test opening indicating there is an additional leak source above the top of the test opening, most likely through failed or improperly configured sealant joints at the head or jamb of the window.

Exterior Test Opening 2 – North-Elevations, 5th Floor Window Head-to-Jamb Intersection

General Description: A test opening was made at the window head-to-jamb intersection at the window between Columns 5-122 and 5-123. EIFS cladding was removed, exposing exterior sheathing and light-gauge metal framing as well as the jamb-to-head intersection of the aluminum framed window.

Observations: As was discovered at other locations, the 2-inch thick EPS insulation was adhered to the paper-faced exterior sheathing with cementitious adhesive. Sealant joints were installed at the jamb of the window and between the head flashing and the window frame.

Overview of Test Opening 2 made at the head of a window on the north elevationof the Building.

There was an area of the framing exposed as a result of a gap in the exterior sheathing at the framing line of the window header. The framing appeared in good condition, and BET&R did not observe any damage. At the head-to-jamb intersection, the backer rod was discontinuous, and as a result, the sealant joint in that location was not properly profiled. However, BET&R did not observe failure of the sealant joint related to the improperly profiled sealant joint.

The existing backer rod at the window jamb did not intersect the backer rod at the head of the window resulting in an improperly profiled sealant joint.

Exterior Test Opening 3 – North-Elevation 5th Floor Window Sill-to-Jamb Intersection

General Description: A test opening was made adjacent to the sill-to-jamb intersection of the window at Column 122 on the 5th level. At the location of the test opening an EIFS control joint intersects the window frame. EIFS cladding and gypsum sheathing was removed to expose a small portion of the steel framing and wall cavity.

Overview of Exterior Test Opening 3.

Observations: The wall construction was similar to that discovered at similar test openings along the south elevation. EIFS was adhered to 1 layer of paper-faced exterior gypsum with cementitious base coat adhesive. The exterior sheathing was attached to the steel framing with drywall screws. At this test cut, BET&R discovered batt insulation at the base of the framing adjacent the window; however, the insulation extended only approximately 1-foot up the wall and the rest of the wall cavity was empty. 6-mil polyethylene was attached to the interior face of the metal studs. The exterior face of the interior gypsum wall board was partially visible through the vapor retarder; however, the vapor retarder was not removed at this test opening.

The surface of the EIFS cladding in the EIFS reveal hue was stained, and moss had grown in the recessed groove in the EIFS, indicating that the cladding at this location stays wet for extended periods of time. As observed elsewhere, the window sill flashing pan was not sealed to the underlying EIFS, leaving a gap beneath the window. The lamina of the EIFS cladding was cracked in the reveal that extended down the wall beneath the problematic corner of the window sill flashing.

Water stains were visible in the EPS insulation adjacent the window, extending back to the surface of the exterior gypsum sheathing. The exterior sheathing fastener nearest the leak was corroded, and there was localized corrosion on the framing. Water stains on the paper-facer of the exterior gypsum sheathing appeared to indicate that water spread out from the corner of the window through capillary action (i.e., "wicking") through the paper facer. Damage to the paper facer extended approximately 8-inches from the suspected leak location at the corner of the window. There were no visible signs of water leakage in the wall cavity.

BET&R and SMSA observed water stains on/in the EPS insulation and through the failed sealant-to-EIFS lamina, and there was/is surface corrosion on the steel stud in the wall cavity as a result of on-going water leaks through the failed architectural reveal at the adjacent window sill-to-jamb intersection.

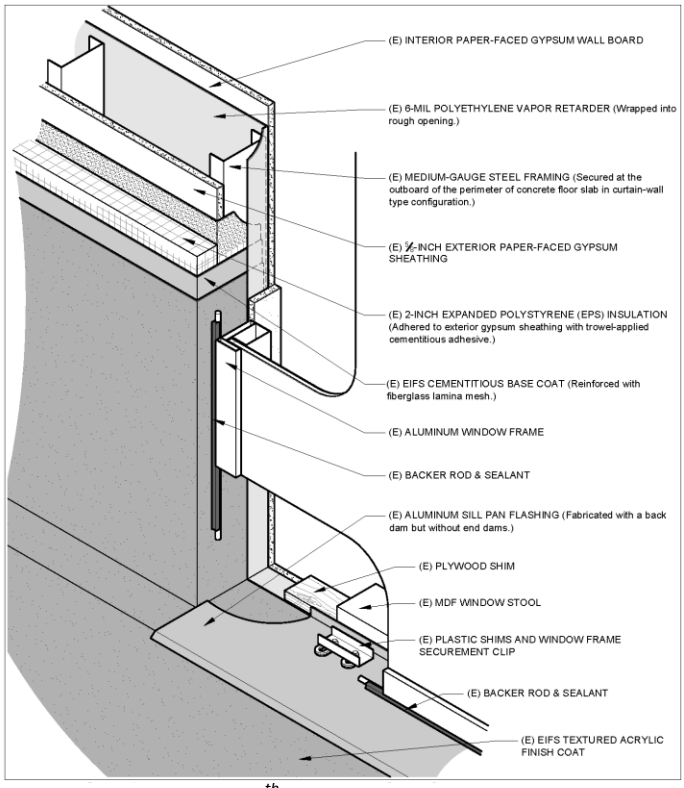
Exterior Test Opening 4 – South Elevation 5th Floor Window Sill-to-Jamb Intersection

Overview of BET&R personnel preparing to take test cut at the sill of the windows between Columns 5-109 and 5-110.

General Description: Exterior Test Opening 4 was made on the south elevation at the sill-to-jamb intersection of the windows between Columns 5-109 and 5-110. Cladding was removed above one of several areas where the gypsum soffit of the cantilevered area at the south portion of the Building appeared to be in imminent danger of falling. Following a preliminary examination of the area to identify potential leak sources and assess the general condition of the existing cladding, sealant, and windows, EIFS cladding, and exterior gypsum sheathing were carefully removed adjacent to the lower jambs and sills of two side-by-side 5th level windows.

Observations: The exterior wall consisted of EIFS lamina over nominal 2- and 6-inch expanded polystyrene insulation (test cut taken at the transition from 2-inch thick EIFS to 6-inch EIFS) adhered to 1-layer of paper-faced gypsum sheathing. The polyethylene vapor retarder, "sealed" with glue installed at the seams, was attached at the interior side of the wall framing between the interior gypsum wallboard and the wall framing.

The EIFS cladding was in serviceable condition; however, a number of leak sources during were identified. During the preliminary survey, it was observed that the window sill flashing was not sealed to the underlying cladding or rough opening framing. The sill flashing was not sloped to the exterior, allowing water to accumulate on the surface, and eventually to spill over the open, undammed ends of the flashing, and leak back into the Building wall.



Drawing No. 5 – 5th Floor Window flashing and trim.

Cracks were visible in the EIFS lamina at the sill-to-jamb intersection at both windows, and it was possible to fully insert a probe under the aluminum sill flashing at both windows.

Several apparent leak sources were observed prior to removal of exterior cladding at this location, including this failed sealant at the flashing-to-EIFS cladding intersection.

The paper-facer pulled away from the core of the gypsum sheathing during removal of the EIFS cladding, indicating that the EIFS bond to the paper-facer of the gypsum was stronger than the bond of the paper-facer was to the gypsum core of the exterior sheathing. Water tracks and stains were evident on the inside and outside faces of the exterior gypsum sheathing. In addition water appeared to accumulate against the window frame along the window sill flashing, and drain off the end of the sill flashing where it leaked into the wall assembly. It appeared that damage occurred to the interior gypsum wallboard when water accumulated between the existing vapor retarder and the exterior face of the interior wallboard.

Water also appeared to track into the wall between horizontal sill rough opening framing and the window sill flashing pan, causing incipient corrosion of the framing. Corrosion was also visible on the fasteners used to secure the exterior sheathing in place and in the light gauge steel blocking between the windows.

Leaks eminated from the window sill-to-jamb intersection at the eastern window. Water stains in the EPS insulation clearly indicated where water migrated through the cladding, through the sheathing, and into the interlying wall cavity of the Building.

Corrosion on the framing and water tracks on the interior face of the exterior sheathing indicated that water leaks into the wall cavity at this location and contributes to damage at the base of the wall.

<u>Exterior Test Opening 5 – South Elevation at Base of 5th Floor Wall</u>

General Description: EIFS cladding was removed from the base of the 5th-Floor wall between columns where the Building is cantilevered along the south elevation. The test opening was made immediately above an area where the paper-facer of the gypsum sheathing at the soffit had delaminated. The remaining gypsum core was visibly water stained and swollen.

In the area immediately above the test opening, number of leak locations were observed.

At Exterior Test Opening 5 EIFS cladding was removed from the base of the wall between Columns 5-107 and 5-108. The existing paper-faced had sloughed away from the soffit sheathing at this location.

Observations: The existing EIFS exterior wall cladding was adhered to ⅝-inch thick paper-faced gypsum sheathing with cementitious base coat/adhesive. The light-gauge steel framed exterior curtain wall stopped approximately 6-inches above the gypsum-sheathed soffit, and the EIFS cladding alone bridged the gap between the bottom of the wall framing and the soffit. At the base of the EIFS cladding, a large sealant joint was installed to close the gap between the EIFS cladding and the gypsum soffit at the base of the wall. The gypsum soffit was suspended from galvanized metal channels suspended from the underside of the 5th floor above. At the outside edge of the soffit steel support beams extend the length of the cantilevered portion of the building. The beam was wrapped with gypsum wallboard. The gypsum wallboard wrapping the beam appeared to be in imminent danger of falling during BET&R's site visit.

During BET&R's initial exterior visual survey of the cladding above the soffit, several areas were noted, which appeared to be contributing to leaks in the wall. There were cracks in the EIFS lamina in the field of the wall and at window sills. Sealant had previously been topically applied at the ends of the 5th level window sill flashing in an apparent attempt to address leaks. It was apparent that water had leaked into the wall at the windows and cracks in the EIFS parapet cap above and had run down within wall cavity and subsequently accumulated at the base of the wall. As a result the gypsum soffit sheathing was deteriorated. Water tracks were evident on the interior face of the exterior gypsum sheathing, and there were water stains and biological growth on the top surface of the soffit indicating areas where water accumulates. Water stains were visible more than 10-feet inboard of the exterior wall at this location. It was evident that the existing sealant joint prevented water from draining out of the wall assembly exacerbating the damage The horizontal beam that runs the length of the building underneath the wall did not appear to have been coated or galvanized. As a result of contact with on-going leak water, the beam had corroded significantly. BET&R informed the owner that sections of the soffit in this area appeared to be in danger of collapse.

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Water stains on the interior face of the exterior sheathing and framing, as well as water stains on the gypsum soffit, show how leak water from the wall runs down the curtain wall assembly and accumulates on the suspended gypsum soffit.

Damage to the exterior sheathing and corrosion of the light gauge framing, and structural steel were all caused by water accumulation at the base of the wall. In addition, fungal growth was evident at this test opening, and portions of the gypsum soffit appeared in danger of imminent collapse.

Exterior Test Opening 6 – South Elevation of Screen Wall at Crack in EIFS

General Description: Exterior Test Opening 6 was taken in the cladding in the field of the screen wall that encloses the roof top equipment on Roof Area 1 (the 6th Floor Roof Area). A horizontal crack through the EIFS lamina ran the length of the wall, and appeared to extend back to the sheathing.

A horizontal crack stretched the length of the equipment screen wall at Roof Area 1.

Water leaked through the crack at the seam in the EIFS cladding causing the exterior sheathing to swell and fasteners to corrode.

Observations: The wall is metal framed, in-filled with steel studs, and sheathed with paper-faced gypsum sheathing. The EPS insulation was adhered to the sheathing with a relatively heavy application of cementitious base coat adhesive.

When the lamina and insulation were removed, it was apparent that the crack in the EIFS Cladding occurred at the seam between underlying insulation panels. Lack of control joints in the EIFS combined with the southern exposure has resulted in failure of the EIFS lamina due to stress from thermal movement of the metal wall framing. The movement between the panels created a weak point that failed due to repeated differential movement from thermal cycling. The crack in the lamina had allowed water to leak into the wall. The paper-facer of the gypsum sheathing was water stained and swollen immediately adjacent to the seam in the insulation panels where thecrack occurred. The heads of the fasteners used to attach the sheathing to the underlying framing were significantly corroded. However, because of the use of adhesive to secure the insulation to the wall, water did not appear to migrate through the wall, and damage to the sheathing was localized.

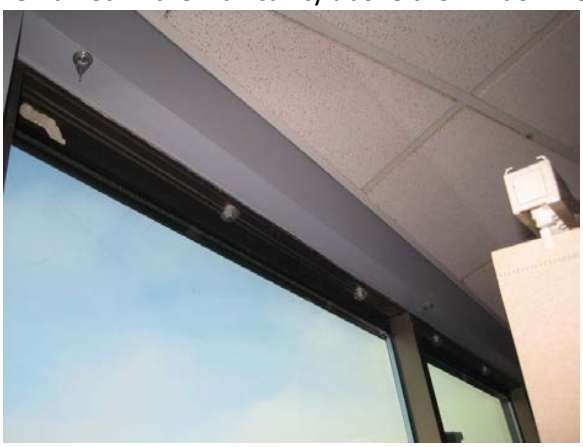
Window Removal

As part of the exterior envelope survey, BET&R and S.M. Stemper Architects senior personnel were on-site on October 29, 2011, to observe as DK Boos Glass personnel removed a window assembly at the 5th floor north elevation wall. The window was accessed on the exterior from Roof Area R2, as well as from the interior of the 5th Floor. The window was removed to provide information regarding how to remove and reinstall windows and how flashing could potentially be retrofit to prevent leaks associated with window assemblies in their present configuration.

DK Boos Glass personnel beginning to remove sealant at the window selected for removal at Roof Area R-2.

To remove the window, DK Boos personnel first cut out and removed sealant at the exterior window jamb frame-to-EIFS intersections, cut and removed sealant at the window head flashing-to-EIFS intersection, cut and removed sealant at the center vertical butt glaze joint, cut the sealant at the window head frame-to-head flashing intersection, and cut and removed sealant at the window sill frame-to-sill pan flashing intersection. With sealant removed at the exterior sill, U-shaped, plastic shims could be observed under the sill frame.

Once sealant was cut and removed at the window exterior, the workers moved to the interior and removed the extruded rubber gaskets from between the interior sill frame and the interior side of the IGU's. Sealant was cut and removed from the between the center vertical muntin and the IGUs and sealant was removed from between the jamb frames and the IGUs. A cover plate was removed at the head exposing hex head fasteners in the head frame. The fasteners were removed utilizing an electric impact wrench and were discovered to be ⅜-inch bolts. The split washers and nuts for the bolts remained in the wall cavity above the window head. The sill frame appeared to be held in place by. metal clips, which were resting on top of the previously observed plastic shims and were fastened to the sill of the window rough opening with screws.



Head of window viewed from the interior with the head cover plate removed, exposing the hex-head fasteners for the head frame connection to the wall framing.

With the fasteners removed at the head and sealant and gaskets removed at the jambs and sill, and sealant removed at the center muntin, it became possible to slide the IGUs out of the center muntin and remove them. Once the IGUs were out it was possible to remove the window frame from the opening by tipping it inward at the top and then pulling it up off the clips holding it at the sill. The fit was tight and a mallet was used to move the top of the window inward.

Photo shows the sill of the opening after removal of the window assembly. Arrows indicate the metal clips attached with screws through the metal sill pan flashing to the underlying framing. No sealant was observed to seal these penetrations through the flashing

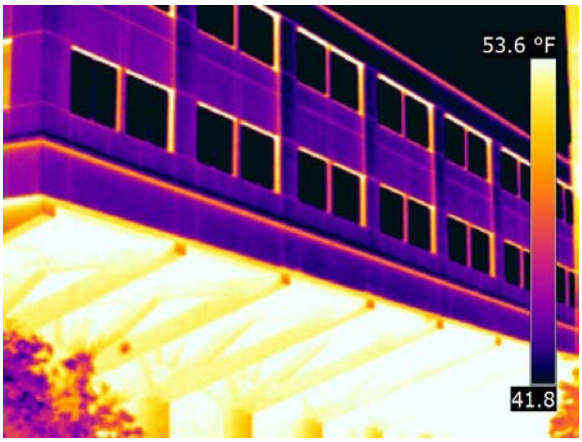
The sill pan flashing and head flashing remained in place. To put the window back together it was necessary to cut holes in the gypsum board above the window to access the nuts and washers for the head fasteners.

It was determined that the window frame assembly could be removed toward the exterior if existing EIFS cladding were cut and removed at the jambs and head of the opening. The exterior sheathing would need to be cut to access the nuts for the head fastener bolts in that scenario. Whether the window assembly is removed toward the exterior or the interior, a portion of the disassembly has to be performed from the interior, including removing the aluminum cover at the head of the window to access the fasteners and removing the IGU's.

INFRARED SURVEY

BET&R surveyed the exterior walls of the building using a Flir Systems ThermaCAM B20HS. Heat signature anomalies were detected in numerous locations along the south elevation, indicative of hidden damage associated with cladding-to-window and window-related leaks. The findings of the infrared (IR) survey were corroborated by BET&R's test openings.

Please refer to Appendix C for additional information regarding infrared thermography.



IR image taken at the west end of the cantilevered portion of the south elevation of the Building.

RILEM TESTING

BET&R performed RILEM testing in several locations on the exterior walls to test the permeability of the EIFS lamina and finish-coated cladding. RILEM testing involves sealing a graduated cylinder or tube (i.e., a RILEM tube) to the exterior of the finish-coated lamina of the cladding, then filling the tube to the appropriate depth with water to simulate the hydrostatic pressure associated with wind-driven rain against the building. The depth that the tube is filled to depends upon the wind speed that the tester wishes to simulate and test.

Please note that RILEM testing does not determine overall performance of the cladding system but rather is a snapshot of water penetration through the cladding material in that specific test location. Also refer to Appendix D for additional information. Information regarding the porosity of the substrate being tested is obtained based on whether the water remains in the tube for a given period of time or drains out from the tube as it permeates into the substrate and how quickly or slowly that water permeation/migration takes place.

A variety of different configurations were tested including vertical EIFS walls as well as transitions from vertical to horizontal EIFS cladding. The relatively low-sloped tops or EIFS coping on the parapet walls were also tested. As shown in Table Number 1 below, the results of the RILEM tube testing demonstrated that the permeability of the majority of the cladding lamina is low, and resistance to water entry is relatively good, except where the EIFS lamina is cracked or damaged.

In addition to the vertical walls, BET&R tested the relatively low-sloped top of the EIFS-clad parapet walls with RILEM Tubes.

In areas where the lamina is cracked, water leaked into the wall assembly relatively freely. RILEM Testing was also performed on the pre-cast concrete cladding at the lower floors of the building. The pre-cast concrete showed low water permeability and good resistance to water entry through the field of the cladding.

RILEM Tube Test Results

Test No.	Location	Substrate Condition	Initial Depth Reading	Final Depth Reading	Duration	Equivalent Wind Speed Resistance
1.	North elevation, 5th floor at EIFS pilaster at Column 119.	Sound substrate	5 ml	5 ml	15 Min.	98.1 MPH*
2.	North elevation, 5th floor Pilaster between Columns 119 and 120	Sound substrate	5 ml	5 ml	15 Min.	98.1 MPH*
3.	North elevation, 5th floor Brickwash between Columns 119 and 120	Sound Substrate	5 ml	5 ml	15 Min.	98.1 MPH*
4.	North elevation, 5th floor Column 120	Sound Substrate	5 ml	3.1 ml	15 Min.	82 MPH
5.	North elevation, 5th floor between Columns 120 and 121	Sound Substrate	5 ml	.5 ml	15 Min.	94.1 MPH
6.	North elevation, 5th floor Column 120	Sound Substrate	5 ml	5 ml	15 Min.	98.1 MPH*
7.	North elevation, 5th floor Brickwash between Columns 120 and 121	Sound Substrate	5 ml	5 ml	15 Min.	98.1 MPH*
8.	North elevation, 5th floor Brickwash between Columns 119 and 120	Crack in EIFS Cladding	5 ml	2.75 ml	15 Min.	78 MPH
9.	Rotunda, 7th Floor, Column 137	Sound Substrate	5 ml	4.8 ml	15 Min.	96 MPH
10.	Rotunda, 7th Floor, Column 136	Sound Substrate	5 ml	5 ml	15 Min.	98.1 MPH*
11.	Rotunda, 7th Floor, Column 135	Sound Substrate	5 ml	5 ml	15 Min.	98.1 MPH*
12.	Rotunda, 7th Floor, Column 133	Sound Substrate	5 ml	5 ml	15 Min.	98.1 MPH*
13.	Rotunda, 7th Floor, Column 132	Sound Substrate	5 ml	4.9 ml	15 Min.	
14.	Rotunda, 7th Floor, Column 131	Sound Substrate	5 ml	5 ml	15 Min.	98.1 MPH*
15.	P-1 Coping	Cracked EIFS coping substrate	Water flowed into cracked portion of EIFS within 1 min.			0 MPH
16.	P-2 Coping	Sound EIFS Coping	5 ml	5 ml	15 Min.	98.1 MPH*
17.	Vertical Wall at Roof Parapet	Sound Substrate	5 ml	5 ml	15 Min.	98.1 MPH*
18.	EIFS-clad parapet wall, North elevation	Sound Substrate	5 ml	5 ml	15 Min.	98.1 MPH*
19.	Exterior of Parapet	Sound Substrate	5 ml	5 ml	15 Min.	98.1 MPH*
20.	1st Floor, Southeast at Pre-Cast Concrete Cladding	Sound Substrate	5 ml	5 ml	15 Min.	98.1 MPH*
21.	1st Floor radius at transition, Pre-Cast Concrete Cladding.	Sound Substrate	5 ml	5 ml	15 Min.	98.1 MPH*

*Maximum performance measured by the test.

Table No. 1 – RILEM Test Results

Note: RILEM testing indicates that limited amounts of water are penetrating through the areas of sound EIFS (substrate); however cracks in the EIFS finish coat are one of numerous factors contributing to the water intrusion that NRB is experiencing.

CONCLUSIONS

PERFORMANCE OF THE EXTERIOR ENVELOPE AND LEAK SOURCES

During the survey, a variety of cladding-related issues were observed that are contributing to damage to the Building. These items generally appear to be systemic; however, our survey indicated that damage to the Building is much more severe at the weather-exposed portions of south walls. Major observations, based upon our investigative work included the following:

1. Leaks at Window Perimeters: It was evident that failed sealant joints, and deficiently detailed and installed sill flashings are allowing water to leak into the Building. In addition, inadequately sealed intersections between windows and EIFS reveals appear to allow water to leak into the walls, contributing to damage.
2. Barrier EIFS System: Unlike drainage cladding systems, where there is provision for water that may leak behind the cladding to drain to the exterior, typically including flashing at windows and other penetrations to direct water to the exterior as well as a weather-resistive barrier, as a back-up drainage plane, the existing "Barrier"-type EIFS installation does not provide for water to drain to the exterior of the wall assembly and thus imperfections in the existing barrier EIFS cladding may allow water to enter the wall and cause damage to the building materials.
3. Failed Sealant Joints: Because there is no provision for water that leaks behind the cladding to be drained to the exterior, water that leaks into the building through failed sealant joints in the field of the wall accumulates behind the cladding causing damage and contributing to the proliferation of fungal growth.
4. Cracks in EIFS Cladding: Cracks in the lamina of the EIFS cladding are widespread. They are especially prevalent at the copings at the top of the wall and at the south elevation of the equipment screen wall/penthouse wall on the roof. These cracks were identified as leak sources. The leaks in the screen wall resulted in only localized damage, but the coping leaks appear to be contributing to the damage that is occurring below the parapet walls along the north and south sides of the Building.
5. Water Accumulation at Base of Wall at Cantilevered Area: Water from window leaks, flashing leaks, leaks through cracks in the cladding and through failed sealant joints has run down the interior face of the exterior sheathing accumulating at the base of the cantilevered portion of the Building, corroding the existing steel beam, and resulting in damage to the suspended gypsum board soffit, as well as contributing to the proliferation of fungal grown on the paper facer on the top side of the gypsum soffit.
6. Air Movement Through the Walls/Condensation: In some areas opened during the investigation, the polyethylene vapor retarder was discovered to be discontinuous or unsealed. This has allowed warm, moist interior air to come in direct contact with the interior face of the exterior sheathing. Where there is inadequate wall insulation outboard of the sheathing resulting in the dew point being reached, this condition results in condensation on the exterior sheathing in the wall cavity. Because of the construction of the walls, air flows relatively freely through the Building. This construction has effectively dried the walls in some areas, but it also circulates warm, moist air in the wall cavity throughout the exterior wall assembly.

7. Fungal Growth in Walls: BET&R discovered fungal growth in the walls at all four interior test openings taken during our investigation. Leaks and condensation result in elevated moisture contents in the paper facers of both the exterior and interior gypsum board. Fungal growth is able to propagate as a result.

RECOMMENDATIONS

EIFS at South Side of Building/Rotunda: BET&R recommends that the exposed portions of the exterior walls at the south side of the Building and Rotunda be re-clad as soon as is possible. Leaks and damage will continue to occur until the cladding is removed, proper provision for drainage is installed, and a properly designed cladding system is reinstalled. It may not be necessary to repair the 1st through 4th level walls along the east end of the Building, as they appear to be well protected by the overhanging cantilevered section of the Building above. In general, a re-cladding project would include:

1. Removal and proper and legal disposal of all exterior EIFS cladding and gypsum sheathing;
2. Removal and proper and legal disposal of all interior gypsum wallboard, window sills, trim, window shims, and polyethylene vapor retarder;
3. Removal of all windows to allow installation of proper flashing at the window rough opening. Depending upon budget constraints, the windows could potentially be saved for re-use, repaired, retrofit, and reinstalled, or replaced with new as part of the re-cladding project.
4. Extensive repair and/or replacement of the soffit and beam in the cantilevered portion of the Building;
5. Installation of new, custom-cut, tight-fitting, mineral wool insulation in the stud bay, sealed with fire-resistant sealant to provide an adequate floor-to-floor fire stop;
6. Installation of new, fully-sealed and properly secured vapor retarder at the interior face of the exterior studs;
7. Installation of new, water-resistant, fiberglass-faced exterior gypsum sheathing;
8. Installation of new insulation in the framing bays and/or installation of extruded polystyrene insulation at the exterior face of wall to increase the energy efficiency and reduce the risk of water condensation in wall cavities;
9. Installation of new cladding, properly designed to prevent future damage due to leaks. The precise design would be dependent on the cladding system selected; however, regardless of exterior cladding type selected the wall assembly would include installation of weather-resistive barrier behind the cladding and proper flashings at floor lines, window rough openings and other penetrations through the cladding and properly configured sealant joints;
10. Installation of new sheet metal coping cap at the top of the parapet wall.

There are numerous options for re-cladding. Some possible systems include:

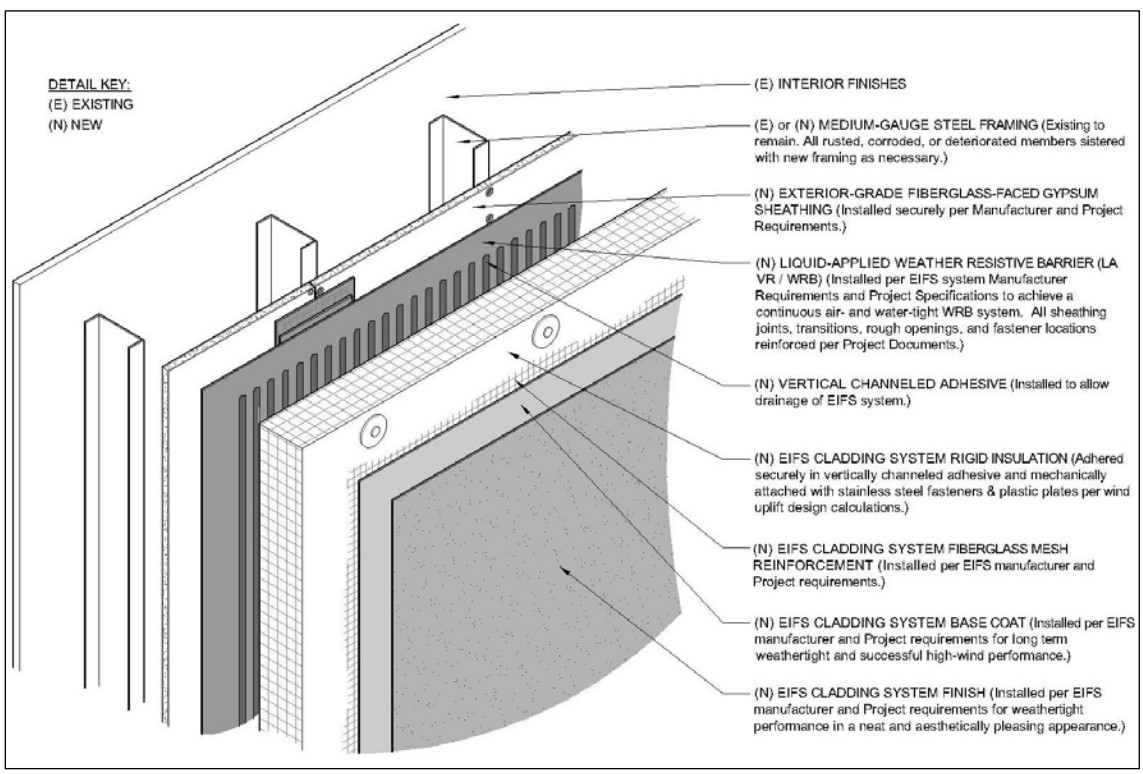
Dimensional Stone: The building was reportedly designed to support the weight of dimensional stone cladding to match many of the other Buildings on the Washington State Capitol Campus. It may be possible to return the building to that original intent; however, the current curtain wall framing does not appear strong enough to support the weight of dimensional stone cladding. Extensive upgrades to the current wall structure would likely be necessary, adding significantly to the cost of the project. In addition it would be necessary to install additional framing to match the existing look of the building adding even more potential cost to the Project.

Stone Veneer Panel: Stone veneer cladding would provide the look of dimensional stone without requiring the upgrades to the wall framing. Additional framing would be required to match the existing building façade; however, the cost would likely be significantly lower than dimensional stone.

Insulated Composite Metal Panel: Another potential re-cladding option is insulated sheet metal panels. They are very commonly used in curtain wall assemblies, and could potentially provide the necessary wall insulation while giving the Building a more modern appearance and properly designed insulated metal panel cladding would also provide water management capabilities.

Non-insulated Composite Metal Panel: If the Owner wishes to explore options that avoid full removal of the exterior components, covering the existing cladding with non-insulated composite metal panels could be explored. Theoretically, a composite metal cladding system including metal hat channels could be fastened through the existing EIFS cladding into the steel studs, alleviating the need to remove all the cladding. During our testing, BET&R established that it would be possible to remove the existing windows and flash the rough openings without removing the cladding. However, several items would need to be considered during the development of this design including repair of damage to existing steel framing and gypsum paper faced exterior gypsum sheathing as well as remediation of fungal growth on the interior face of the exterior gypsum sheathing, and code required back-up drainage system (referred to as "weather-resistive barrier" in the International Building Code).

Drainage EIFS: Depending upon the budget constraints of the Owner, it would likely be most cost effective to replace the existing cladding with a modern "drainage" EIFS cladding system. A drainage EIFS system would incorporate a weather-resistive barrier and flashings at windows, floor lines, at the base of the wall, and where necessary to manage potential water leaks behind the cladding and direct it to the exterior of the Building. With a Drainage EIFS system it would be possible to closely match the look of the existing building, which may be desirable if a Repair Project is undertaken.



Drawing 6 – Schematic Layout of Typical Drainage EIFS Cladding.

Bird Damage to Existing EIFS: Regardless of the cladding system selected, additional repairs will be required to the EIFS-clad columns where Northern Flickers have pecked holes in the EIFS lamina. The most cost-effective solution would be to cover the top band of EIFS with sheet metal. To discourage the birds from simply moving down one level, the next section down should be reinforced with additional high-impact mesh adhered with base-coat, and finished to match the existing EIFS lamina.

EIFS at North Side: The north elevation of the NRB Building has many of the same building envelope deficiencies (i.e., failed sealant joints, unsealed sill flashings, a barrier EIFS system, etc.) as the south elevation of the building. Therefore, BET&R recommends that the Owner consider re-cladding the north elevation as well (see the general scope outlined above). However, it was evident that weather exposure had significant bearing on the extent of damage in the walls. It is feasible to retrofit the north-facing windows and EIFS cladding should budget constraints require value-engineering of the project. In general, retrofit of the EIFS would include:

1. Removal of windows and window frames from the rough opening. Window frames should be marked with a unique mark, and carefully protected, and stored for re-installation into the same rough opening;
2. Remove and replace all damaged interior gypsum wall board and damaged exterior sheathing;
3. Preparation of the rough opening, including repair of damaged sheathing and framing, backing of holes in the framing to provide a continuous substrate for installation of new membrane rough opening flashing. Installation of new membrane window rough opening flashing. As part of the rough opening flashing, BET&R recommends the owner consider the use of reinforced, liquid-applied Polymethyl Methacrylate (PMMA) membrane;
4. At the 1st, 2nd, and 5th floors the existing aluminum sill pan should be shimmed to provide positive slope to the exterior of the Building and end dams should be retrofit at each end of the sill pans;
5. Installation of new sheet metal coping at the top of the parapet wall;
6. Removal of all sealant joints. Sealant and backer rod should be removed from all existing sealant joints, and the substrates should be ground and cleaned and repaired as necessary to provide an appropriate substrate for new sealant joints. New backer rod should be installed into the prepared joints and new high-quality sealant joints should be installed.
7. All cracks in the EIFS lamina should be repaired. Large cracks should be prepared and repaired with additional base-coat, reinforcing mesh and textured acrylic finish coat.
8. When all repairs are completed, the entire surface of the EIFS should be skim-coated with base coat, refinished with new textured acrylic finish and coated with a heavy-bodied acrylic coating system such as Tnemec Series 151 primer and 156 top coats.

At this time, in our very limited survey, we have not discovered wide-spread instances of fungal growth at the north elevation of the Building; however, findings of the environmental hygienist may dictate that additional repairs be performed.

Pre-cast Concrete Panels:

BET&R recommends that all windows be removed from the walls with pre-cast concrete panel cladding and the rough openings be properly flashed to mitigate flashing related leaks that have occurred at windows. Then the windows can be reinstalled or replaced with new, depending on budget related decisions. In addition, at minimum all sealant joints should be removed, the substrates ground to remove residual sealant, repaired as necessary, and then the surface should be thoroughly cleaned, primed and new backer rod and silicone sealant be installed. Once flashing is complete and sealant installation is complete, we recommend that the surface of the concrete be cladding thoroughly prepared, and coated with water repellant (Prosoco) or acrylic coating (Tnemec Series 151 primer and 156 top coat).

OTHER ITEMS

Window Replacement:

We recommend that the Owner begin to plan for future replacement of the aluminum-framed windows at the Natural Resource Building. Some considerations during the replacement process include selection of windows that provide sufficient water penetration resistance and comply with current energy codes. Proper flashing and careful installation is also critical to the successful performance of the window.

Waterproofing:

During the survey, several items were noted that were not included in the Scope of this Project. Specifically, we noted several areas in the garage where severe leaks were occurring, apparently as a result of poor detailing and failure of the plaza waterproofing systems. Significant leaks were evident in the parking garage, and as noted earlier, a leak has also occurred in the Rotunda as a result of failure of the waterproofing system at the plaza intersection with the Rotunda.

BET&R has extensive experience in investigating, locating and designing repairs for all types of above- and below-grade leaks and we would be pleased to assist the Washington State DES in addressing these leaks.

We trust this information is of assistance. Please do not hesitate to contact our office with any questions, comments, or if we may be of further assistance.

Building Envelope Technology & Research (BET&R)

REGARDING THIS REPORT

On Site Survey, Report, and Conclusions

This report, including analysis and recommendations, is based upon observations of the visible and apparent condition of the building and primary exterior components viewed and examined on the date(s) of the survey. Although care has been taken in the performance of the survey, Building Envelope Technology & Research, Inc. (BET&R) (and/or its representatives) make no representations regarding latent or concealed defects that may exist, and no warranty or guarantee is expressed or implied.

BET&R reserves all rights to make changes, amendments, and additions to this report, at the sole judgment of BET&R, and as new information may be learned.

This report is made only in the best exercise of our technical ability and judgment. Conclusions in this report are based on estimates of the age and normal service life of the various materials and/or systems surveyed. Predictions of life expectancy and the balance of useful service life are generally based on industry and/or experienced comparisons. It is essential to understand that actual conditions can alter the useful life of any item or building component. The weather exposure, (e.g., wetting and drying, freeze-thaw, etc.), use and misuse, irregularity of servicing, faulty manufacture, unfavorable conditions and installation, acts of God (e.g., earthquake), and unforeseen circumstances make it impossible to state precisely, to the day, when each item will require replacement**.**

Moisture Intrusion, Mold Growth, and Human Exposure to Mold

Persistent moisture intrusion, repetitive wetting, and/or the resulting elevated relative humidity can lead to the proliferation of fungal growth (e.g., mold) and other potentially hazardous organisms and bacteria in interior spaces, which can lead to allergic reactions in susceptible individuals, as well as other potential problems (hypersensitivity, etc.). It is BET&R's understanding that the Project Team has recently engaged an Environmental Hygienist Consultant to assist with assessment, and potential remediation of any interior biological growth.

Limitations

This report is prepared for the exclusive use of the Client and may not be relied upon by any other party. In preparing this report for the named client, the author assumes no duty to lenders or other third parties, none of whom are authorized to rely on its contents.

Photographs, on file in our office, were taken with the intent to document conditions and to help the Client understand on site conditions. The photographs were taken to show example areas, conditions and situations; they are not inclusive of every situation, but of general/typical conditions, and certain specific conditions.

This report provides an assessment/evaluation of on-site conditions only. It cannot be used as specifications or written instructions for conducting construction work. However, BET&R will be pleased to prepare a written scope of work, technical specifications, and detail drawings for repair or retrofit work.

Respectfully,

Building Envelope Technology & Research, Inc. (BET&R)

APPENDIX A

ADDITIONAL TEST OPENING DATA

Exterior Test Opening 1 – Rotunda 7th Level Window Sill-to-Jamb Intersection – Adjacent Column 7-135

Overview of the east side of the Rotunda. Exterior Test Opening 1 was located at the southwest face of the 7th level of the Rotunda, just out of site in this photo (arrow).

EIFS cladding was removed from the sill-to-jamb intersection at this southwest-facing 7th level operable emergency exit window on the Rotunda.

Photo shows open gap between sill flashing and EIFS cladding prior to removal of cladding at Exterior Test Opening 1.

Photo depicts an open keyhole in the jamb of the window frame of this operable emergency exit window. Water may be entering the window assembly through this open hole in the window frame.

Photo depicts the EIFS cladding at the base of the Rotunda wall adjacent the area opened for Test Opening No. 1.

Photo depicts EIFS cladding removed from the Rotunda wall adjacent a window sill-to-jamb intersection. Damage to the sheathing was observed at the window jamb and below the jamb-to-sill intersection.

Photo depicts the first of two layers of paper-faced gypsum sheathing removed from the left hand side of the test opening. The paper facer on the exterior layer of sheathing adjacent the sill-to-jamb intersection is delaminated from the gypsum core (oval).

Photo depicts both layers of sheathing removed from the left hand side of the test opening to reveal polyethylene vapor retarder on the exterior face of the light gauge steel framing.

Photo depicts polyethylene vapor retarder on the exterior face of the light gauge steel framing. This wall assembly, with the vapor retarder at the exterior side of the stud wall, was found to be unique to the Rotunda walls.

Photo depicts water staining and delaminating paper facer at the interior side of the second (i.e. interior) layer of sheathing removed from below the window sill at Exterior Test Opening 1.

Photo depicts water staining, visible fungal growth and delaminating paper facer at the interior side of the first (i.e. exterior) layer of sheathing removed from adjacent the window sill-to-jamb intersection at Exterior Test Opening 1.

Photo depicts contractor removing the second (i.e. interior) layer of water stained sheathing from adjacent the window sill-to-jamb intersection at Exterior Test Opening 1.

Photo depicts contractor installing fiberglass-faced gypsum sheathing to replace exterior sheathing removed at Exterior Test Opening 1.

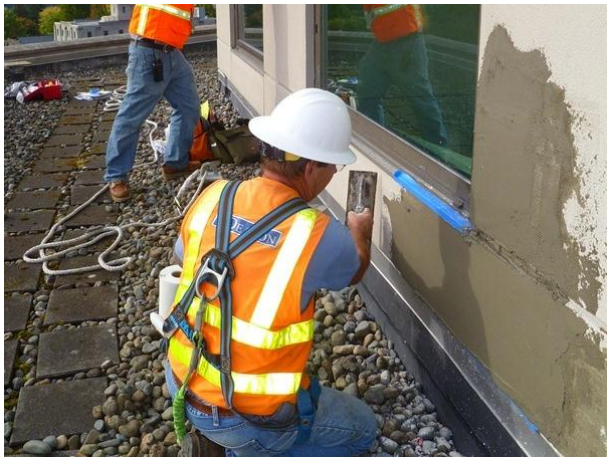


Photo depicts contractor installing reinforced cementitious base coat to the repaired EIFS cladding at Exterior Test Opening 1.

Exterior Test Opening 2 – North Elevation 5th Floor Window Head-to-Jamb Intersection – Between Columns 5-122 and 5-123

Overview of the north elevation of the Natural Resources Building as viewed from the southwest corner of the Level 5 Lower Main Roof Area (Roof Area 2). Arrow indicates the approximate location of Exterior Test Opening 2.

Overview of exterior cladding removed at a 5th floor window head-to-jamb intersection at Exterior Test Opening 2 at the north elevation (circle). Note that Exterior Test Opening. 2 is located one window to the northeast of Exterior Test Opening 3 (arrow).

Photo depicts the back side of the EIFS cladding removed at Exterior Test Opening 2.

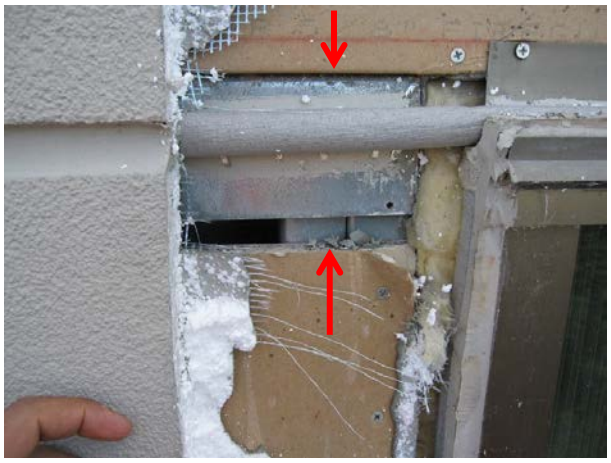


Photo depicts gap in exterior sheathing adjacent the head of the window.

Photo depicts backer rod and sealant installed at the window jamb and intersecting with the sealant joint at the EIFS panel joint adjacent the window head. The backer rod at the window jamb stops short of the backer rod installed at the head of the window, leaving a portion of the sealant that is not properly backed, resulting in an improperly profiled sealant joint at the window head-to-jamb intersection (circle).

Photo depicts nominal 2-inch thick expanded polystyrene rigid foam insulation adhered with cementitious base coat adhesive to the underlying paper-faced gypsum sheathing. The insulation is coated with polyester-mesh reinforced cementitious base coat and an elastomeric textured finish coat. This is the typical EIFS cladding assembly observed at the majority of the Natural Resources Building. Thicker expanded polystyrene insulation exists at numerous locations to add profile to the building walls.

Photo depicts temporary repair of Exterior Test Opening 2 adjacent the head-to-jamb intersection a 5th floor window at the north elevation. Note that a final, watertight repair was completed at this and all test opening locations.

Exterior Test Opening 3 – North Elevation 5th Floor Window Sill-to Jamb Intersection – Adjacent Column 5-122

Overview of exterior cladding removed at a 5th floor window sill-to-jamb intersection at Exterior Test Opening No. 3 at the north elevation adjacent Column 5-122.

Photo depicts window sill flashing-to-EIFS cladding intersection adjacent Exterior Test Opening 3.

Photo depicts expanded polystyrene insulation removed, leaving the finish coat in place adjacent the window sill-to-jamb intersection. Water staining was observed on the back side of the EIFS finish at the intersection with the window sill flashing (oval).

Photo depicts contractor removing well adhered nominal 6-inch thick expanded polystyrene insulation from the paper-faced gypsum sheathing adjacent a window sill-to-jamb intersection.

Photo depicts expanded polystyrene insulation and cementitious adhesive remaining on the wall after the removal of the EIFS at Exterior Test Opening No. 3. Upon removal of the EIFS at this test cut the expanded polystyrene insulation failed cohesively above the area of water damage adjacent the sill-to-jamb intersection indicating that the EIFS was well adhered to the sheathing at the area that was not water damaged.

Photo depicts a close-up view of a cross section of the EIFS finish which consists of a cementitious base coat (gray) with polyester-mesh reinforcing (blue) embed in it. The cementitious base coat is coated with a textured acrylic finish coat (off white).

Photo depicts one layer of paper-faced gypsum sheathing removed to expose fiberglass batt insulation in this stud bay. This wall assembly, with fiberglass batt insulation in the stud cavity, was found to be unique to this test opening.

Photo depicts corrosion observed on light gauge steel framing and exterior sheathing fasteners adjacent the leaky sill-to-jamb intersection.

Photo depicts installation of expanded polystyrene insulation to repair EIFS Exterior Test Opening 3.

Photo depicts installation of reinforced base coat to repair EIFS at Exterior Test Opening 3.

Exterior Test Opening 4 - South Elevation 5th Floor Window Sill-to-Jamb Intersection – Between Columns 5-109 and 5-110

Overview of the east end of the south elevation. Exterior Test Opening 4 (arrow) is located at the 5th floor window sill-to-jamb intersections between Columns 5-109 and 5-110. Note the soffit is damaged directly below the location of Exterior Test Opening 4 (oval).

Photo depicts EIFS cladding to be removed as part of Exterior Test Opening 4 between window sills of the south elevation windows between Columns 5-109 and 5-110.

Photo depicts metal spatula inserted under wide window sill flashing pan. Deep window sills are typical of 5th floor windows at the Natural Resources Building.

Photo depicts metal spatula inserted into failed sealant at the jamb-to-sill intersection.

Photo depicts EIFS removed from between the base of the jambs of the two windows adjacent Exterior Test Opening 4. Note that the paper facer of the gypsum sheathing came away from the wall with the adhered expanded polystyrene insulation. Arrow indicates location of close-up photo at right.

Photo depict Delmhort moisture meter reading of 0.2 taken in the gypsum sheathing indicating the sheathing was not wet at the time of the test opening. Delmhorst moisture meter reading on the gypsum scale of 1.0 and above are deemed to be "wet" material. The complete delamination of the paper facer and water staining of the gypsum sheathing are clear indications that the sheathing has been wetted repeatedly, but is able to dry back down.

Photo depicts nominal 6-inch thick expanded polystyrene insulation removed from below the window sill. The vertical stripes of cementitious EIFS adhesive came disbonded from the delaminated paper facer on the gypsum sheathing at this location.

Photo depicts delaminated paper facer easily removed from the gypsum core of the sheathing below the sill-to-jamb intersection at the east window.

Photo depicts the deconsolidated gypsum core of the sheathing easily removed from the paper facer at the interior side of the sheathing.

Photo depicts sheathing removed to expose of the light gauge steel framing, exhibiting light rusting and the polyethylene vapor retarder at the interior side of the wall framing. Visible fungal growth and water damage was observed, on the interior gypsum wallboard, through the vapor retarder.

Photo depicts multiple layers of expanded polystyrene insulation adhered in cementitious adhesive to repair Exterior Test Opening 4.

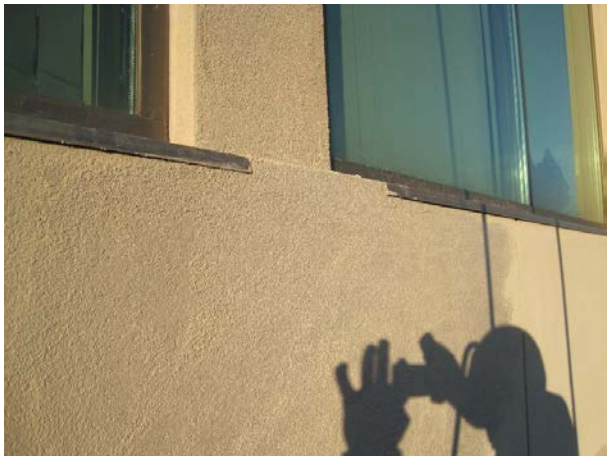


Photo depicts new textured acrylic finish coat and exterior acrylic paint applied over the repair of Exterior Test Opening 4.

Exterior Test Opening 5 – South Elevation, Base of 5th Floor – Between Columns 5-107 and 5-106

Overview of the south elevation of the Natural Resources Building. Arrow indicates the approximate location of Exterior Test Opening 5 at the base of 5th floor.

Overview of peeling finish coat at the soffit below the 5th floor at the south elevation. Exterior Test Opening 5 was taken just above this area of peeling coating.

Photo depicts EIFS removed at the base of the EIFS building wall to expose water stained and delaminated paper facer and visible fungal growth on the gypsum sheathing. Note there is an open gap between the building wall sheathing and the soffit sheathing.

Photo depicts nominal 6-inch thick expanded polystyrene insulation removed from the base of the 5th floor wall. The insulation was back wrapped with base coat and fiberglass reinforcing mesh and adhered to the sheathing with of cementitious base coat adhesive.

Photo depicts textured coating and the paper-facer peeled back from the deconsolidated gypsum core of the soffit sheathing. The soffit is sheathed with exterior paper-faced gypsum sheathing coated with a textured acrylic finish.

Photo depicts sheathing removed from just below the termination of the EIFS cladding exposing a corroded steel beam.

Photo depicts sheathing removed, exposing corrosion of the light-gauge steel framing and water staining on the interior face of the sheathing.

Photo depicts EIFS cladding and painted paper-faced gypsum board soffit cladding removed at Test Opening 5. The following three photos are taken inside the building wall in the cavity between the soffit and the 5th level floor.

Photo depicts fiberglass batt insulation and fireproofing on the underside of the 5th level floor. The frame work for the soffit is suspended from the building floor above.

Photo depicts water staining on the interior face of the building wall sheathing, on the light gauge steel framing and on the interior side of the soffit sheathing.

Photo depicts rock wool insulation in the corroded channel of the light gauge steel framing at the base of the EIFS wall.

Photo depicts textured acrylic base coat applied over the repair of Exterior Test Opening 5.

Exterior Test Opening 6 – South Elevation of Screen Wall at Crack in EIFS

Overview of the location of Exterior Test Opening 6 at the south elevation of the screen wall that divides Roof Area 1 from Roof Area 4.

Photo depicts EIFS cladding removed from the south elevation of the roof top screen wall. Test Opening 6 was located over a crack in the EIFS lamina which extends most of the length of this south-facing screen wall.

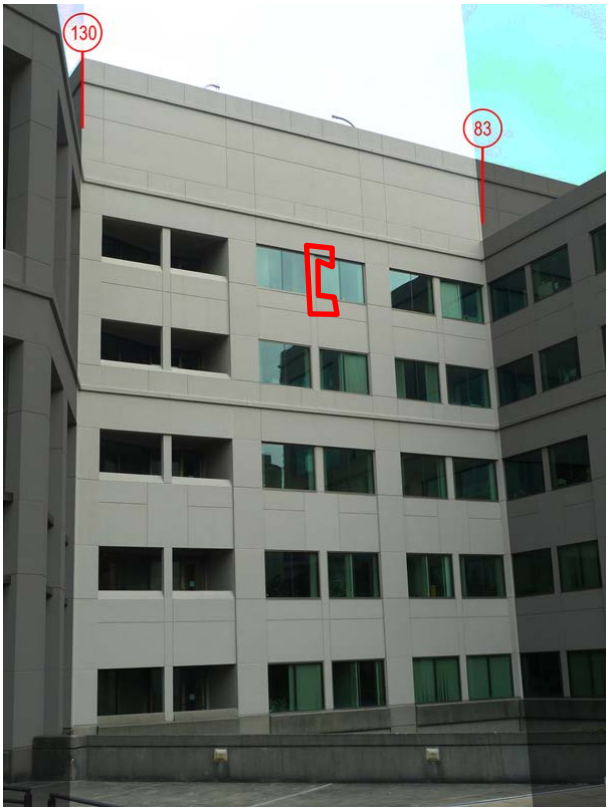
Photo depicts large crack through the existing EIFS cladding at the location of Exterior Test Opening 6. The crack in the EIFS aligns with a joint in the expanded polystyrene insulation panels.

Photo depicts a corroded fastener in the swollen paper-faced gypsum sheathing (circle). Note that the paper-facer of the sheathing tore away from the gypsum core when the adhered EIFS system was removed from the sheathing.

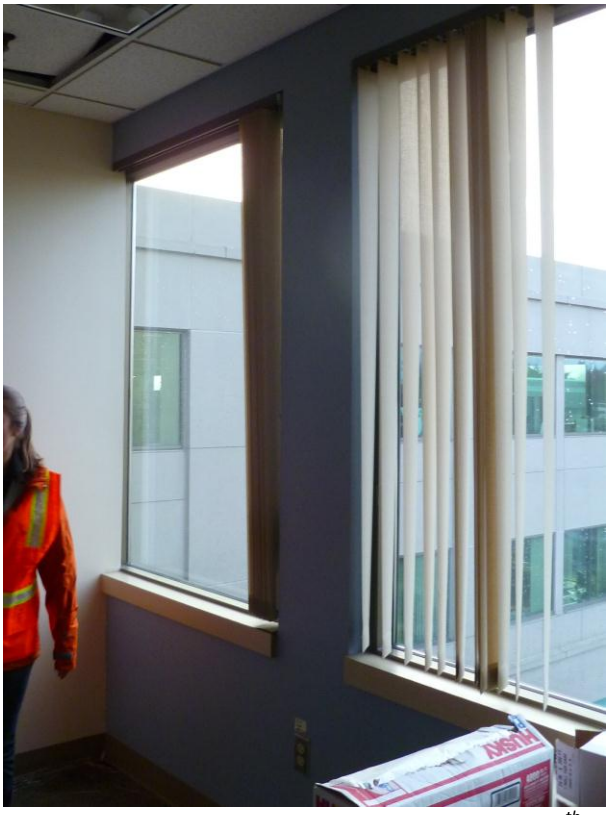
Photo depicts reinforced base coat installed to repair Exterior Test Opening 6.

Photo depicts the EIFS cladding, at the south elevation of the screen wall that divides Roof Area 1 from Roof Area 4, fully recoated following repairs at Exterior Test Opening 6.

Interior Test Opening 1 – 6th Floor Elevator Lobby Window -- Between Columns 6-81 and 6-82



Overview of a portion of the south elevation just east of the rotunda. Red shape indicates the general location of the area where interior finishes were removed at Interior Test Opening No. 1.



Overview of interior finishes between the two 6th floor windows between Columns 6-81 and 6-82. Interior finishes were removed from the window head to jamb at this location.

Photo depicts blistering paint at the window jamb prior to the removal of interior finishes at Interior Test Opening No. 1.

Photo depicts laminate disbonded from the window sill trim prior to the removal of interior finishes at Interior Test Opening No.1.

Photo depicts interior gypsum wallboard removed from below the window sill, exposing the underlying polyethylene vapor retarder. Moderate visible fungal growth was observed on the exterior face of the interior dry wall below the sill-to-jamb intersection.

Photos depicts moderate visible fungal growth on the exterior face of both layers of interior gypsum wallboard (¼-inch thick wallboard over ⅝-inch thick wallboard) removed from below the jamb-to-sill intersection. Moderate visible fungal growth was also observed on the interior face of the gypsum wallboard after the corner bead was removed at the jamb-to-wall outside corner.

Photo depicts interior finishes and polyethylene vapor retarder removed adjacent the window sill-to-jamb intersection to reveal water staining on the interior face of wall sheathing. The paper facer on the interior face of the sheathing was delaminated below the window sill. Arrow indicates the location of plywood shims adjacent sill shown in photo at right.

Photo depicts Delmhorst moisture meter reading taken in the plywood shims which were exposed by the removal of the sill trim. The reading of 33.5 indicates that the plywood adjacent the sill-to-jamb intersection is saturated.

Photo depicts ruler inserted between the window sill and the back dam of the extruded aluminum sill flashing. The factory fabricated window sill flashing includes a back dam, but lacked end dams to direct water to the exterior of the building.

Overview of the stud bay between the jambs of the two windows between columns 6-81 and 6-82. See close-up photos below.

Photo depicts water-finding test paper used to demonstrate presence of moisture on the horizontal light gauge metal framing between the windows between columns 6-81 and 6-82.

Photo depicts relatively light corrosion on the light gauge steel framing in a small area adjacent the window sill-to-jamb intersection.

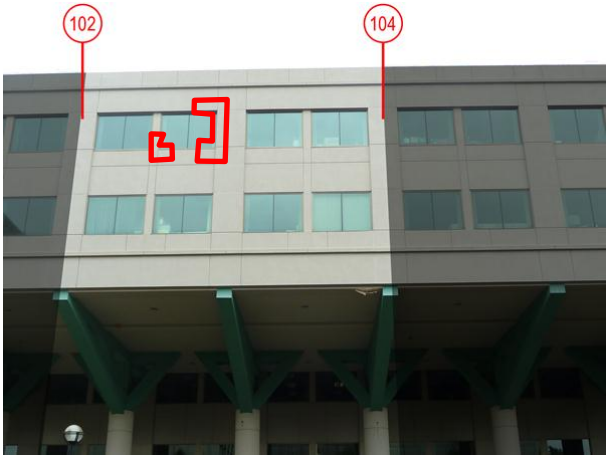
Photo depicts jamb-to-window head intersection. The backer rod inserted at the window jamb stopped short of the backer rod installed at the head of the window, leaving a portion of the sealant that is not properly backed resulting in an improperly profiled sealant joint at the window head-to-jamb intersection (arrow).

Photo depicts head of window with interior finishes removed. Although no batt insulation was observed in the stud bays, fiberglass batt insulation was observed to exist in the gap between the window frame and the light gauge steel framing at the head and jambs of the window.

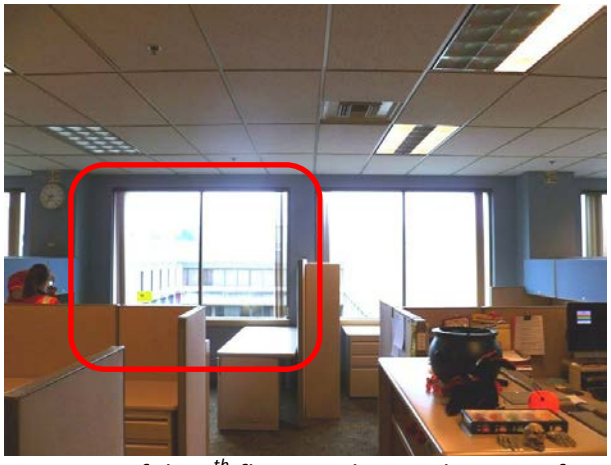
Photo depicts paper-faced gypsum sheathing which does not extend completely over the building wall. This incomplete sheathing was observed between the heads of the windows between columns 6-81 and 6-82. Above the sheathing the blue reinforcing of the EIFS base coat is visible over the EIFS cementitious adhesive.

Photo depicts repaired interior dry wall at the location of Interior Test opening No. 1.

Interior Test Opening 2 – 6th Floor Cubicle 6177 Window – Adjacent Column 6 -103



Overview of a portion of the south elevation. Red shapes indicate the general location of the area where interior finishes were removed at Interior Test Opening No. 2.



Overview of the 6th floor window to the west of column 6-103 where Interior Test Opening No. 2 was made. Interior Test Opening No. 2 included an opening adjacent the sill-to-west jamb intersection and an opening at the east jamb extending from the ceiling to the floor.

Photo depicts moisture meter reading taken in interior finishes adjacent the sill-to-east jamb intersection prior removing interior finishes at Interior Test Opening No. 2. Moisture meter readings revealed dry interior finishes and only minor water damage was observed on interior finishes at this window, prior to removing interior finishes. The sill trim was slightly swollen, cracking of the sealant joint was observed at the interior wallboard-to-window intersection, and water tracking was observed at the jambs and mullion of the window frame.

Photo depicts moderate visible fungal growth on the interior face of the second layer of ¼-inch gypsum wallboard, exposed after the first layer of interior wallboard removed adjacent the east window jamb. Moderate visible fungal growth was also observed on the on the exterior face of the ⅝-inch and ¼-inch thick gypsum wallboard.

Photo depicts interior finishes removed adjacent the east jamb-to-head intersection. Batt insulation between the light gauge steel framing and the window frame was removed at locations to examine the underlying conditions. Arrow indicates the approximate location of the photo at right.

Photo depicts base coat and reinforcing mesh of the EIFS finish wrapped on to the steel framing at the east jamb.

Photo depicts window sill-to-east jamb intersection with interior finishes, polyethylene vapor retarder, and batt insulation removed to expose the termination of the sill flashing. As is typical throughout the building, the window sill flashing lacks an end dam.

Photo depicts the wall cavity and wall sheathing below the east jamb-to-sill intersection. Fire retardant overspray was observed on the interior face of the exterior gypsum sheathing; however, the interior face of the sheathing was only minimally water damaged at this location.

Photo depicts sill trim and the first layer of interior gypsum wallboard removed below the sill-to-west jamb intersection. Heavy visible fungal growth was also observed on the exterior face of the ⅝-inch thick gypsum wallboard and on both faces of the ¼-inch thick gypsum wallboard.

Photo depicts a Delmhorst moisture meter reading of 7.7 on the gypsum scale taken in the wet, ¼-inch gypsum wallboard below the west-jam-to-sill intersection. Note that BET&R typically considers Delmhorst moisture meter reading on the gypsum scale of 1.0 and above to be "wet" material.

Photo depicts visible fungal growth on the interior face of the polyethylene vapor retarder below the west jamb-to-sill intersection.

Photo depicts a Delmhorst moisture meter reading of 7.2, as read on the gypsum scale, taken in the visibly wet, paper-faced gypsum sheathing below indicate the gypsum is wet below the west-jam-to-sill intersection.

Photo depicts water-finding test paper at the west jamb-to-sill intersection. The pink color of the water-finding test paper indicates the presence of liquid water on the framing below the window sill. The batt insulation at the window jamb was also saturated with water where it was adjacent the window sill.

Photo depicts Delmhorst moisture meter reading of 40.0 taken in the plywood shims at the west end of the window sill. 40.0 is the highest reading on the wood scale of a Delmhorst moisture meter; 27% moisture content is considered saturated.

Photo depicts a metal spatula inserted from the exterior through a failed sealant joint at the east window jamb near the window head. See photo at right from an exterior view of this condition.

Photo depicts metal spatula inserted through adhesively failed sealant between the east window jamb and the adjacent EIFS cladding. Arrow indicates clear sealant that appears to have been installed as a previous topical repair measure to address failing sealant locations.

Photo depicts metal spatula inserted through adhesively failed sealant between the east window jamb and the adjacent EIFS cladding.

Photo depicts open gap hole in sealant joint between the window sill and the window sill flashing. This typical gap appears to have been intentionally made in the sealant joint to function as a weep to allow water out of the window assembly; however, due to its location, raised above the sill flashing, this weep allows water to enter the window assembly as opposed to drain out.

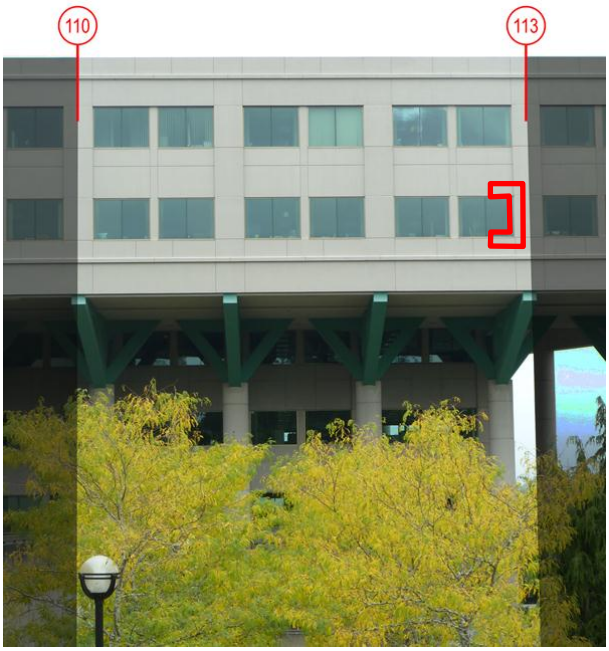
Overview of BET&R technologist performing monarch nozzle water test from at Bosun's chair at the exterior of the window where Interior Test Opening No. 2 was performed.

Photo depicts a monarch nozzle being used to spray water at the east jamb of the window just to the west of column 6-103.

Photo depicts wet (pink) water-finding test paper adjacent the east jamb-to-sill intersection during water testing of the east jamb-to-head intersection. Water entered through failed sealant joints at the east jamb during water testing at the east jamb-to-sill intersection. No water was observed to enter during testing at the east jamb-to-sill intersection.

Photo depicts water-finding test paper that was wetted during water testing at the west jamb-to-sill intersection. It was noted that water appeared to be migrating under the sill flashing and collecting on the light gauge steel framing adjacent the window sill.

Interior Test Opening 3 – 5th Floor South Facing Cubical Window – Adjacent Column 5-113



Overview of a portion of east end of the south elevation. Red shape indicates the general location of the area where interior finishes were removed at Interior Test Opening No. 3.

Photo depicts water damage at interior paint and drywall at the east jamb of the window to the west of column 5-113 and swollen and delaminating sill trim prior to removing interior finishes at this location.

Photo depicts visible fungal growth on interior gypsum wallboard exposed after removal of the corner bead from adjacent the east window jamb.

Photo depicts moderate fungal growth on the exterior face of the single layer of interior gypsum wallboard removed from below the east jamb-to-sill intersection at Interior Test Opening No. 3.

Photo depicts corrosion of the interior gypsum board fasteners (oval) and visible fungal growth on the interior face of the polyethylene vapor retarder (arrow) below the east end of the window sill.

Photo depicts severely water damaged interior gypsum wallboard removed from adjacent the window head.

Photo depicts water staining and delaminating paper-facer on the interior face of the wall sheathing below the east jamb-to-sill intersection. Circle indicates location of severely corroded light gauge metal framing shown in the close-up photo at right.

Photo depicts severe corrosion of horizontal light gauge framing just to the east of the end of the window sill. The channel of the light gauge steel framing was filled with fire retarder. The fire retarder was wet and appears to have been wetted repeatedly and is holding water against the light gauge steel framing, accelerating corrosion.

Photo depicts BET&R technologist water testing the window where interior finishes were removed as part of Interior Test Opening No. 3. Water testing was performed with a monarch nozzle from a bosun's chair.

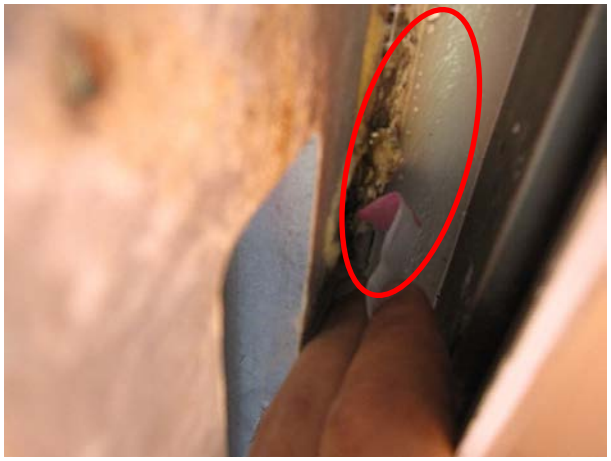
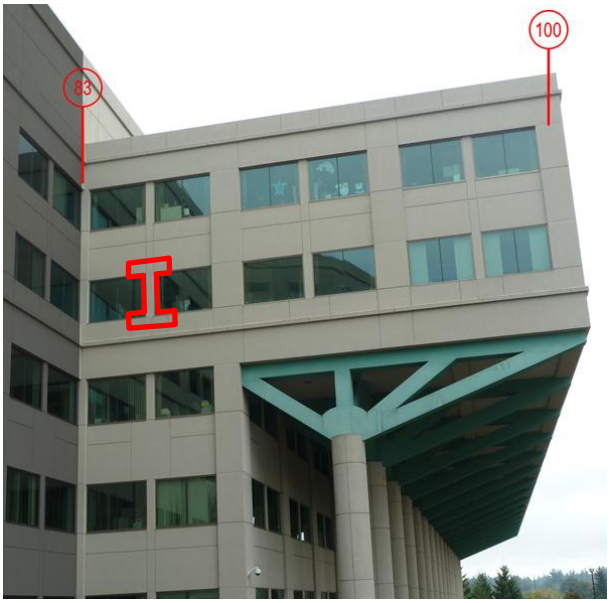


Photo depicts liquid water on the interior face of exterior sealant joint at window jamb during water testing.

Photo depicts metal spatula inserted through adhesively failed sealant joint in the EIFS cladding adjacent the head of the window to the west of Column 5-113.

Photo depicts failed sealant at the termination of the window sill flashing just to the west of Column 5-113.

Interior Test Opening 4 – 5th Floor West Facing Cubicle Window -- Between Columns 5-84 and 5-83



Overview of a portion of west elevation. Red shape indicates the general location of the area where interior finishes were removed at Interior Test Opening No. 3.

Photo depicts swollen sill trim at the windows between Columns 5-83 and 5-84. Prior to removing interior finishes, water staining was observed of the gypsum wallboards. The south sill of the window to the south of Column 5-83 was severely swollen and water damaged.

Photo depicts interior gypsum wallboard removed adjacent the head of the windows between Columns 5-84 and 5-83. Water staining was observed on the ceiling tiles in the drop ceiling above the test opening.

Photo depicts view looking up the exterior building wall above the drop ceiling. Water staining was observed on the interior face of the sheathing (oval) and corrosion was observed on the steel framing (arrow). Mineral-wool insulation was observed in the stud cavities at the floor lines at all locations opened from the interior.

Photo depicts a single layer of interior gypsum wallboard removed to expose the underlying polyethylene vapor retarder. A minimal amount of visible fungal growth was observed on the exterior face of the interior dry wall removed at this test opening location.

Photo depicts polyethylene vapor retarder pulled back to reveal visible fungal growth on the interior face of the gypsum sheathing adjacent the south jamb of the window to the south of Column 5-83.

Photo depicts visible fungal growth on the interior face of the gypsum sheathing adjacent the south jamb-to-sill intersection of the window to the south of Column 5-83.

Photo depicts water staining on the interior face of sheathing below window sill. Paper facer was observed to be delaminating from the gypsum board adjacent the floor line.

Window Removal – North Elevation – Adjacent Column 5-122

Overview DK Boos Glass personnel beginning to remove sealant at the window selected for removal at the 5th floor of the north elevation.

Overview of interior of 5th floor window to the east of Column 5-122 prior to removal of the window unit.

Photo depicts DK Boos Glass personnel cutting and removing sealant at the exterior jamb frame-to-EIFS intersection and the center butt glazed joint.

Sealant was cut at the window head frame-to-head flashing intersection (arrow).

Photo depicts sealant and backer rod being removed at the window head flashing-to-EIFS intersection. As this window was removed from the interior and the head flashing was left in place, it was discovered that it was not actually necessary to remove the backer rod and sealant joint above the head flashing.

Photo depicts exterior sill of window showing backer rod and sealant removed from the joint between the sill pan flashing and the window sill frame. The arrow points to the weep hole that was in the sealant joint.

Photo depicts plastic shims under the sill frame (arrow). With sealant removed at the exterior sill, U-shaped, plastic shims could be observed under the sill frame.

Photo depicts rubber gasket being pulled out from between the interior sill frame and the insulated glazing unit (IGU).

Photo depicts head of window viewed from the interior with the head cover plate removed, exposing the hex-head fasteners (arrow) for the head frame connection to the wall framing.

Photo depicts DK Boos Glass personnel removing fasteners at the window head from the interior.

Photo depicts one of the fastener bolts from the window head, including ferrule type spacer. The spacers were placed between the top of the window head frame and the underside of the rough opening header framing to prevent the bolts from deforming the window frame when tightened.

Photo depicts DK Boos personnel removing an IGU from the window frame.

Photo depicts the window frame being removed from the opening.

Photo depicts window opening with window removed, showing the sill-to-jam intersection at the west side of the window, adjacent Column 5-122. The EIFS appears to be back-wrapped most of the way to the location of the interior edge of the window frame. The sill pan has no upturned end dam (arrow).

Photo depicts jamb-to-head intersection at the east side of the window opening with the window removed. EIFS back wrap is discontinuous at the top of the jamb of the opening (arrow).

Photo depicts jamb-to-head intersection at the west side of the window opening.

Photo depicts sill-to-jamb intersection at the eastside of the window opening.

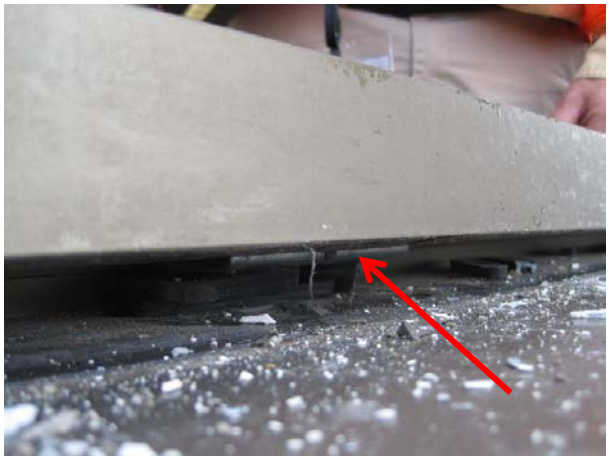


Photo depicts the sill as the window frame was tilted inward during removal. With the sill tilted inward, the metal clips came into view (arrow).

Photo depicts the sill of the opening after removal of the window assembly. Arrows indicate the metal clips attached with screws through the metal sill pan flashing to the underlying framing. No sealant was observed to seal these penetrations through the flashing.

Photo depicts head of window opening showing bolt holes for the bolts that fasten the head frame to the building. A split-washer (arrow) can be seen resting on top of the hole in the framing indicating there is also a nut.

APPENDIX B

BARRIER EIFS (EXTERIOR INSULATION AND FINISH SYSTEM)

The word "barrier" refers to a system that must manage all water at the external surface, providing no back-up drainage capability behind the cladding. In a barrier system, especially one installed over sheathed, framed walls, any failure of the system at the exterior barrier can result in water entering the wall assembly. Barrier systems are not drainage systems. Drainage systems have a backup drainage layer and can usually manage some water penetrating through an external failure. Barrier EIFS consists of rigid expanded polystyrene (EPS) foam board directly adhered to the substrate and an exterior lamina consisting of cementitious base coat and embedded fiberglass matt reinforcing coated with a textured, colored, acrylic finish. The external lamina and finish coat comprise the barrier that must, together with sealant at all penetrations and transitions, keep all water out of the system.

Barrier EIFS systems were developed in Germany in the early 1960's as an inexpensive way to retrofit insulation and attractive finishes to existing concrete or masonry buildings. Minor failures of the EIFS tended not to be problematic due to the ability of the masonry or concrete substrates to absorb a certain amount of water without causing damage and to dry down during summer months. In 1969 this system was introduced to the United States, by a company called Dryvit, where it began to be installed over framed construction and gypsum board, plywood and OSB (oriented strand board sheathing) substrates at numerous buildings around the country. The system was comparatively inexpensive and became widely popular by the end of the 1970's and into the early 1980's. As the installed systems aged it soon became evident that minor failures of the barrier EIFS could result in major damage, especially when it was installed on wood-framed buildings. Small amounts of water leaking through minor breaches in the barrier system accumulated in wall cavities and were absorbed by wood framing, fiberglass insulation, paper-faced gypsum, OSB, plywood and other elements of the wall assemblies. By the time there was any obvious evidence of a problem there could be a considerable amount of catastrophic decay of the wood elements, degradation of gypsum board, rust and corrosion of metal components and other problems like the growth of toxic molds. Repairs were usually major and expensive.

The EIFS industry became involved in many law suits and eventually responded to these problems by developing drainage EIFS systems and improving their manufacturer's specifications and installation instructions. Building codes and insurance companies followed by requiring that only drainage systems be used on residential construction. However, barrier EIFS continued to be used on some commercial buildings.

It is possible to maintain a barrier EIFS system installed over framed construction and not have water intrusion and hidden damage problems, but it requires much more diligent, frequent inspection and prompt repair then many other exterior wall cladding systems, especially in cool wet climates such as our climate in Western Washington.

More information regarding EIFS can be found in the Whole Building Design Guide provided by the National Institute of Building Sciences and available for free on their website at: www.wbdg.org

APPENDIX C

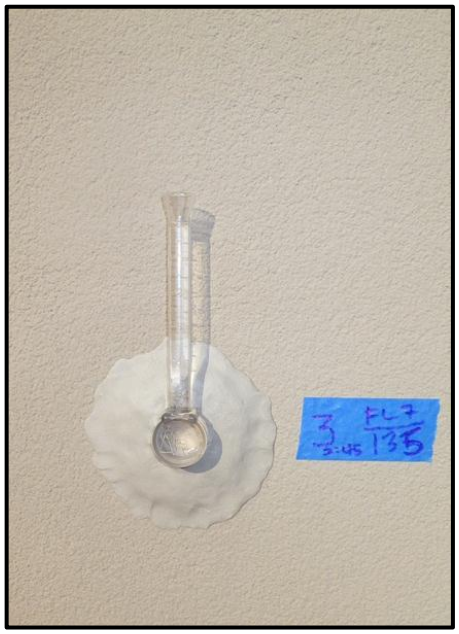
INFRARED THERMOGRAPHY

An infrared camera is a specialized device that detects infrared radiation that is generated (or emitted) by the object(s) surveyed. The amount of infrared radiation emitted by an object is related to the object's temperature. An object with a higher temperature emits more infrared radiation than the same object at a cooler temperature. Infrared cameras are used to detect anomalies (areas warmer or colder than the surrounding areas) in the heat signature of the building envelope. Due to the nature properties of water, wet roof, wall, and foundation components and/or areas absorb energy (e.g., heat from the sun) during the day and at night will retain this energy longer than the dry areas. In addition, wall surfaces containing wet, deteriorated, or missing insulation may appear warmer than the surrounding areas from the outside of the building due to heat loss from within. Infrared thermography is a powerful and extremely useful method for identifying suspect areas relatively quickly during exterior envelope surveys.

APPENDIX D

RILEM TUBE MOISTURE ABSORPTION TESTING

The Low-Pressure RILEM Tube Test is commonly used within the masonry industry to evaluate brick, concrete masonry and other types of cementitious walls' resistance to water absorption during rain. Brick and concrete block masonry, concrete, grout and other porous wall components may easily absorb water through capillary suction during wind-driven rain. Masonry Units, uniform wall areas, mortar joint cracks, and the efficacy of coatings can be evaluated. The RILEM tub diagnostic test is favored over other more involved procedures due to the ease-of-use. For the RILEM test, plastic J-shaped tubes are adhered to the concrete or masonry surface with a waterproof putty seal. Water is poured into the tube; the height of the water in the tube creates a hydrostatic pressure against the surface of the wall, simulating a wind-driven rain. Marked graduations on each of the tubes correspond to approximate wind loads. By monitoring the falling water level, the relative amount of water absorbed over time can be determined. The final water level in the tube at the end of the test period corresponds to the maximum wind speed at which the wall is able to resist water absorption. The test can be considered quantitative; however numerous tests must be conducted to provide statistically reliable results, and therefore the results are best interpreted qualitatively, in relation to each other. One can make useful assessments about the general overall water absorptive properties of a wall area based on more limited testing (if it can be assumed that the wall properties are relatively consistent throughout).



FALL PROTECTION REPORT

- SUMMARY LETTER
- INTRODUCTION
- ANCHOR LOCATIONS (APPENDIX A)
- TESTING DATA (APPENDIX B)
- WINDOW WASHING NARRATIVE (APPENDIX C)
- EQUIPMENT OPTIONS (APPENDIX D)
- SOLUTION PROPOSALS & COST ESTIMATES (APPENDIX E)

January 2012

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Scott M. Stemper
SM Stemper Architects
4000 Delridge Way SW, Suite 200
Seattle, WA 98106

RE: Fall Protection and Window Washing Systems
Natural Resources Building
Olympia, WA

Dear Mr. Stemper:

As requested, we are providing our report for the Testing of the window washing anchors at the Natural Resources Building (NRB), in addition we are also providing generalized Equipment Options and estimated costs for protecting workers at height at the Natural Resources Building (NRB). The Equipment Options and Cost Estimate Proposals are based on the results of our Testing.

Gravitec has generated 11 different Equipment Options to remediate the roof access and window washing hazards at the NRB. We have combined various Equipment Options (see Appendix D) to provide four different Cost Estimate Proposals (See Appendix E) to remediate the fall protection hazards at the NRB, they are as follows:

- Proposal A (see Appendix E, Page 1) is a combination of the Equipment Options that will allow Passive (unharnessed) roof access to the largest roof area but is the most expensive.
- Proposal B (see Appendix E, Page 2) uses an equipment option that uses non-penetrating counterweighted guardrails that is the quickest to install that will allow passive (unharnessed) access to most of the roof.
- Proposal C (see Appendix E, Page 3) is a combination of Equipment Options that is the least expensive combination of all the options that will allow passive (unharnessed) access to most of the roof but will require safety monitors in some areas.
- Proposal D (see Appendix E, Page 4) is a combination of Options that has the least visual impact to the building but only provides roof access that required the worker to be harnessed.

Each of the solutions has varying benefits and detractions that can be balanced against their estimated costs. Any of the Equipment Options can be combined or implemented to provide a complete solution.

Please note that the options are priced as a whole assuming quantity pricing, any implementation of an option less than 100' as a standalone project would have to be priced on an individual basis.
Please note that Option 7 is the only option that is given for the second floor roof and Option 10 is the only option given for the penthouse roof due to lack of available information of the structure in those locations but are very viable solutions for both. Option 11 is a general option that can be done at any unused davit base to incorporate an anchor point if desired.

In addition to the enclosures that illustrate the Equipment Options and Proposals, we have also enclosed a summary of recent window washing processes at the Natural Resources Building (See Appendix C). The generalized narrative of processes is passed on a phone conversation with Pacific Window Cleaners. You may find it useful to refer to these procedures when evaluating the proposals.

Please give me a call if you would discuss any details of the enclosed solutions.

Sincerely,

Stephen Ting, P.E.
Engineering Manager

Enclosures: Gravitec Test Report of Window Washing Anchor Testing

WINDOW WASHING ANCHOR & FALL PROTECTION ANCHOR TESTING

Natural Resources Building

OLYMPIA, WA

Project No. 2011-276 A (1), January 2012

GRAVITEC SYSTEMS INC.™

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Appendix D - Equipment Options

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INTRODUCTION

Scope

Stemper Architects requested Gravitec Systems, Inc. to determine the adequacy of the existing window washing system at the Natural Resources Building in Olympia, WA. The scope was to test approximately half of the system components with the goal of applying a loading to the components of 75% to 100% of their expected capacity. The system consists of removable davit arms, davit pedestals, through-the-roof anchorages, and fall arrest stanchions. This report describes the testing procedures, set-up, equipment, safety procedures, data collection, and analysis of the test data. In addition we were asked to provide possible equipment options to remediate the fall hazards and cost estimate proposals for overall solutions. The Equipment Options can be found in Appendix D and the Solution Proposals and Cost Estimates can be found in Appendix E of this Document.

Background

The permanent and dedicated window washing equipment for the Natural Resources Building consists of the following.

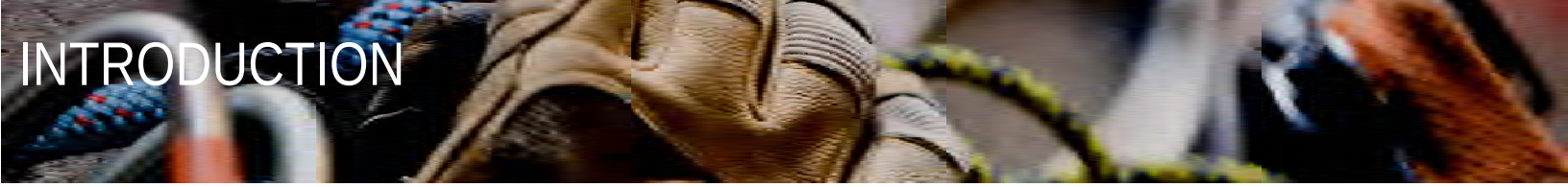
Davit Arms: Arms are 6" diameter aluminum tubing with a 90 degree radius to create a cantilevered arm of an approximate 5-foot length. The tubing is inserted into a portable steel socket/receiver that mounts onto the davit pedestals. The aluminum arm can rotate within the steel socket. Information on the intended use and rigging attachments is limited. The drawings provided for our viewing did not match the on-site equipment. Although there were similarities, there are also significant variations from the details shown on building drawings sheet no. A8.8, titled "Building Details" with plot date of 03-09-91. Labeling on the davit states that the manufacturer is Titan Staging and Engineering Inc., that the davit is part of a powered platform system, and that the system is rated for a 750 pound maximum loading.

Davit Pedestals: 12-inch square plates welded to the top of 6-inch diameter pipe stanchions are located around the perimeter of the roof, just behind the parapets, for the attachment the movable davit arms and receivers. These davit support stanchions are centered in the wall sections between window units and appear to align with building columns.

Fall Arrest Anchors: Associated with each Davit Pedestal is an anchor point for attachment of personal fall arrest equipment. These anchor points are located approximately 10 feet in from the perimeter of the roof. The anchors are 4-inch diameter pipe stanchions with welded, up-right U-rods. The stanchions appear to follow the layout of the roof framing, which would be consistent with welding of the stanchions to steel roof beams. (At the curved perimeters, the stanchions are not necessarily tangent to the roof edge.)

Through Roof Anchors: The through-the-roof anchors are pipes that penetrate the roof overhangs to create anchor points that follow the layout of the walls below. These anchorages are located in the eastern side of the building where the building walls have a zigzag foot print with that footprint inset from the curving roof edge.

GRAVITEC SYSTEMS



INTRODUCTION

Codes and Acceptance Criteria

The following codes and standards were used, when applicable, to determine the acceptance criteria for anchors tested on the Natural Resources Building.

Window Washing Anchors- ANSI IWCA 14.1(2006)

Section 9.1.1, Anchorage and Fall Protection Design Criteria
Anchorages shall be capable of sustaining a 5000 pound (2268 kg) minimum load or a minimum 4-to-1 safety factor, whichever is greater, in any direction that a load may be applied. (Anchorage intended for attachment of one lifeline.)

Section 8.1.3 (b), Minimum Inspection and General Testing Criteria
Fall arrest components shall be inspected and tested as prescribed by ANSI Z359.1 Anchorages shall be inspected in accordance with Section 8. Designated anchorages, targeted for post-installation testing, shall be tested by applying a minimum static load of twice the design load in each (primary) direction that a load may be applied. For example, an anchorage with an ultimate capacity of 5000 pounds has a four-to one safety factor. Therefore the anchor's design load is 1,250 pounds and it shall be tested to 2500 pounds.

Section 17.2.1.b Davits and Davit Fixtures
Davits may be used to support window cleaning activities providing …b) the davit has a stability factor of at least 4 to 1 against overturning. Each davit shall be designed to support an ultimate load of not less than 4 times the rated load (based upon the rated load of the hoist when supporting a powered access platform).

Fall Arrest Anchors- OSHA and ANSI Design Loads and General Testing Criteria

OSHA and ANSI state that general fall arrest anchorages shall be designed to withstand a load of 5000 pounds (based on the ultimate strength of the anchor's material). Alternately, if the fall arrest system is engineered, the anchors shall be designed to withstand twice the maximum fall arrest force with that design capacity clearly labeled on the anchor.

The maximum arrest force (MAF) for ANSI approved personal energy absorbers (PEAs) is a 900 pound average arrest force for a PEA rated for a 6-foot free fall. The MAF associated with OSHA approved PEAs is 1800 pounds.

GRAVITEC SYSTEMS

Testing Synopsis

For all tests, a dynamometer was used to record the loads placed on the anchors. This data was documented and used to produce a load versus time graph for each anchor. A test was considered successful if the anchor could resist the applied load for one minute without showing significant deflection of the anchor. The acceptance criteria for the anchors are as follows:

Window Washing Anchors and Fall Protection Anchor to be used with an ANSI Z359.13 (2009) PEA and OSHA PEAs-
Davit Arms and their associated receivers were mounted on to a Davit Pedestal and test loaded against an adjacent fall protection anchor point to load the davit system with a force in a general downward direction. The davit arms have a posted maximum rating of 750 pounds. As the test load was applied, the elastic deformation was monitored to determine the limits of the load that could be safely applied without damaging the davit system. The test load and davit behavior was evaluated to arrive at an opinion of the system performance.

Davit Pedestals and Fall Arrest Anchors were loaded to a minimum of 3600 pounds for a duration of one minute. This is the test for single point anchors designed for a 5000 pound ultimate capacity. Such anchors are suitable for use as fall arrest anchors or for attachment of manual swinging scaffolds and boatswain's chairs.

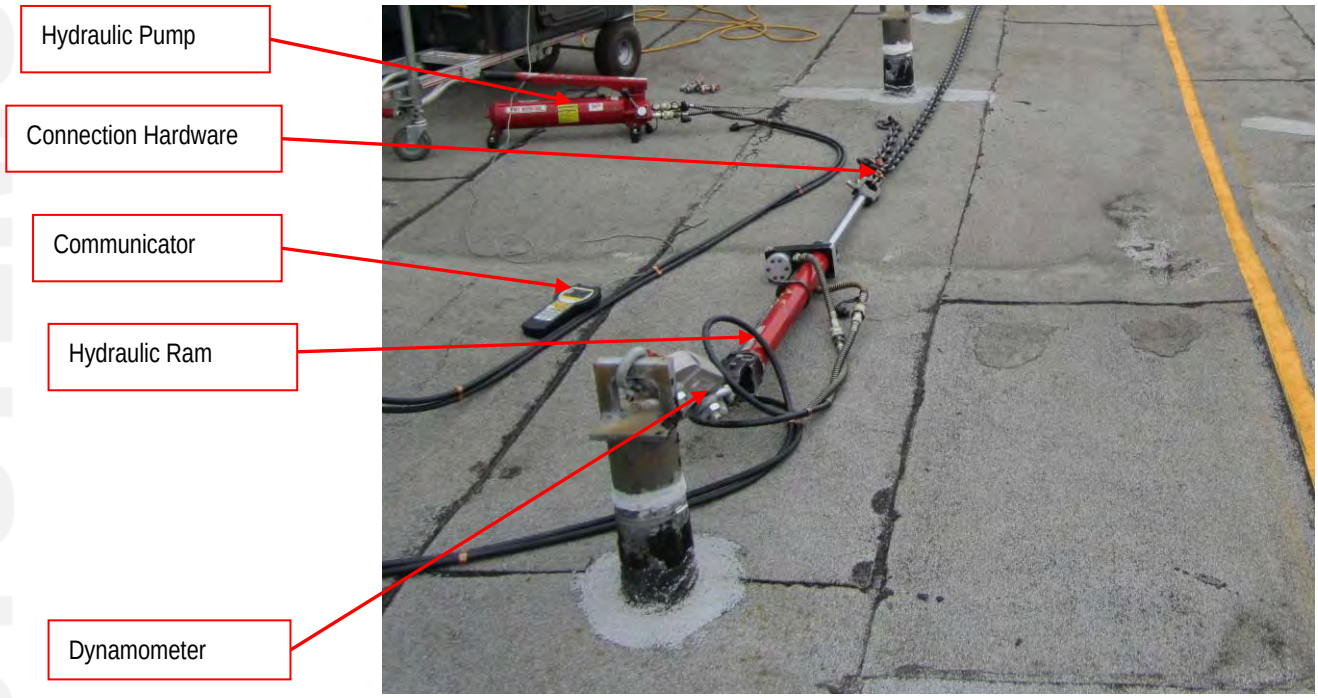
The Department of Natural Resources could not produce details about the design of these stanchions type anchors and whether the anchors had been designed to an ultimate strength of 5000 pounds as required by the code. If an anchor resists 3600 pounds with minimal deflection, the anchor would very likely have an ultimate strength (failure strength) of at least 5000 pounds. The 3600 pound loading is greater than the 2500 pound minimum testing load required by ANSI-IWCA inspection. This value of 3600 pounds also meets the minimum requirements for engineered anchors used in conjunction with an OSHA approved PEA (2x 1800 pounds). This value also exceeds 1800 pounds which meets the requirements for anchors used in conjunction with an ANSI Z359.13 (2009) approved PEA (2x 900 pound average deployment force).

Through Roof Anchors are placed in the sixth story roof to facilitate the use of a powered swing stage. These anchors do not have a posted load rating. How these anchors are intended to be used and their intended design loading is not posted. Details on the construction of the through roof anchors was not available. Therefore, at Gravitec's recommendation, a small diameter hole was drilled through the topside of the roof near one of the anchors to allow the use of an inspection scope. The anchor observed with the scope did not appear to have an adequate connection to the building structure. Because Gravitec could not verify a viable connection between the anchor and the structure, no testing of the through roof anchors was conducted.

Initially, we had planned to test a limited number of these anchors by pull testing against a weighted set-up located on the second floor level (approximately 70 feet below). Gravitec did not conduct this testing because high tension testing in this manner presents safety issues could result in significant damage to the building if an anchor suddenly fails.

GRAVITEC SYSTEMS

TESTING EQUIPMENT



Testing Equipment

Equipment

The general testing equipment used consisted of connecting hardware comprised of wire ropes, chains, and shackles.

Hydraulic Ram System:
A 20,000 pound capacity TNT R-Series hydraulic ram was used to apply the static load to the fall arrest anchors.

Data Acquisition System:
A Dillon EDxtreme dynamometer and EDX Communicator were used to collect and transmit test data. Data was transmitted to a Dell Precision M4300 laptop. Data was then recorded using custom Lab View software and stored to a Microsoft Excel 2007 file.

Still Photographs

Gravitec took photographs throughout the testing procedures. Selected photographs associated with a test are contained in Appendix B.

Safety Procedures

Gravitec established a safe testing area by restricting access to the general areas of the roof where testing was being performed. When workers are working within 6 feet of the roof edge, fall protection is used. Workers used a double legged lanyard or a VLL (vertical lifeline) to access anchors near the roof edge.

TESTING PROCEDURES

Most anchors were tested by pulling one anchor against another anchor.

For anchor locations see Appendix A

Single Point Anchors - Fall Arrest Anchors and Davit Pedestals

1. Install shackle(s) on the pair of anchor points being tested. (If two anchors are not available to test one against the other, test one anchor to existing structure of sufficient strength.)
2. Connect a ½" chain or wire rope to the shackle at one of the anchor points.
3. Connect the hydraulic ram system to the chain or wire rope.
4. Connect the load cell to the hydraulic ram system.
5. Connect the other end of the load cell to the shackle on the second anchor point to be tested (or existing structure of sufficient strength).
6. Take a measurement, using a tape measure, from a point on the top of each anchor to a fixed datum point.
7. Commence data collection.
8. Close the ram to apply a force to each anchor. Steadily apply force until a load of 3600 pounds is reached or until of signs of yielding. Maintain the load for one minute or until the anchorage breaks or shows signs of yielding. Note: Take care to monitor the anchor's deflection and for a significant drop in the recording load values to ensure the anchor is not yielding. Stop the testing if it is apparent that the anchor is starting to yield.
9. Repeat step 5 taking note of the anchors deflection while under load.
10. Release the force after a minimum of 1 minute has passed.
11. Repeat step 5 taking note if the anchor yielded and record any permanent deformation.
12. Download the test data to an Excel file.

Acceptance Criteria: Each anchorage point shall maintain a load of 3600 pounds for one minute without permanent deformation.

Davit System

1. Install shackle to the most outboard eyebolt on the cantilevered arm of the davit.
2. Connect the load cell to the shackle.
3. Connect a ½" chain (or wire rope if additional length is needed) to the load cell.
4. Connect the hydraulic ram system to the chain or wire rope.
5. Connect the hydraulic ram system to an anchorage keeping the applied force as vertical as practical. .
6. Commence data collection.
7. Close the ram to apply a force to the davit arm. Steadily apply force. The target loading is dependent on the posted capacity of the davit system. Note: Take care to monitor deflections in the davit system and for diminishing resistance to the applied test loading. Diminishing resistance and deflections are indicators that the anchor's materials may be entering their yielding phase or that the anchor is failing. Stop the testing if it is apparent that the anchor is starting to yield.
8. Maintain the load for one minute.
9. Observe deflections.
10. Release the force when a minimum of 1 minute has passed.
11. Download the test data to an Excel file.

Acceptance Criteria: The davit system shall be designed to support an ultimate load of not less than 4 times the rated load and have a stability factor of at least 4 to 1 against overturning. Test loads shall be maintained for at least one minute without permanent deformation.

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SUMMARY OF RESULTS

The following tables show testing results for tested anchors. Refer to Appendix A for anchor locations.

Davit System – 750 lb posted capacity			
Davit/ Pedestal	Pass / Fail		
	Cantilevered Arm	Socket	Pedestal for Davit Use (Overturning)
Davit 1 Pedestal 7N01 B	Fail	Inconclusive	Inconclusive
Davit 2 Pedestal 5N07 B	Fail	Inconclusive	Inconclusive
Davit 3 Pedestal 5S06 B	Fail	Inconclusive	Inconclusive

Lower Roof (5th Level over 4th Floor) Single Point Anchor - 3600 lb Proof Load			
Fall Arrest Anchor	Pass / Fail	Davit Pedestal Anchor (as Single Point Anchor)	Pass / Fail
Along North Perimeter			
5N01 A	Pass	5N01 B	Pass
5N02 A	Pass	5N02 B	Pass
5N04 A	Pass	5N04 B	Pass
5N06 A	Pass	5N06 B	Pass
5N08 A	Pass	5N08 B	Pass
5N10 A	Pass	5N10 B	Pass
5N12 A	Pass	5N12 B	Pass
5N14 A	Pass	5N14 B	Pass
5N16 A	Pass	5N16 B	Pass
5N18 A	Pass	5N18 B	Pass
5N20 A	Pass	5N20 B	Pass
--	--	5N21 B	Pass
Along South Perimeter			
5S01 A	Pass	5S01 B	Pass
5S03 A	Pass	5S03 B	Pass
5S05 A	Pass	5S05 B	Pass
5S06 A	Pass	--	--

GRAVITEC SYSTEMS

Upper Roof (7th Level over 6th Floor) Single Point Anchor - 3600 lb Proof Load			
Fall Arrest Anchor	Pass / Fail	Davit Pedestal Anchor (as Single Point Anchor)	Pass / Fail
Along North Perimeter			
7N01 A	Pass	7N01 B	Pass
7N03 A	Pass	7N03 B	Pass
At Rotundra Perimeter			
7R01 A	Pass	7R01 B	Pass
7R02 A	Pass	7R02 B	Pass
7R05 A	Pass	7R05 B	Pass
7R08 A	Pass	7R08 B	Pass
7R09 A	Pass	7R09 B	Pass
Along South Perimeter			
7S01 A	Pass	7S01 B	Pass
7S03 A	Pass	7S03 B	Pass
7S05 A	Pass	7S05 B	Pass
7S07 A	Pass	7S07 B	Pass
7S10 A	Pass	7S10 B	Pass
7S12 A	Pass	7S12 B	Pass
7S14 A	Pass	7S14 B	Pass
7S15 A	Pass	7S15 B	Pass
Along West Perimeter			
7W02 A	Pass	7W02 B	Pass
7W03 A	Pass	7W03 B	Pass

GRAVITEC SYSTEMS

OBSERVATIONS AND CONCLUSIONS

The purpose of the testing sequence is to determine if the anchors and davit system comply with OSHA and ANSI standards for fall protection and window washing. See the tables in the Testing Results section for a tabulated listing of anchors tested and testing results. See Appendix A for anchor locations. See Appendix B for photos of each test set up and the load versus time graphs. Note: Some graphs show an immediate drop and then immediate recovery in force. This indicates a temporary loss of signal between the load cell and the wireless receiver and does not indicate a failure in the anchor or an actual reduction in loading. See graph titled "Anchors 5N06A and 5N06B" for an example of two occurrences of a dropped wireless signal.

Davit System

Three Davits Arms and their sockets/receivers were mounted on the davit pedestals for testing. The tested davits were loaded to a minimum of 1875 pounds for a duration of one minute. This is 2.5 times the posted capacity. The davit system deflected approximately 8 inches at this loading. Most of the deflection appeared to be from bending of the aluminum arm. Attempts to apply more force resulted in increasing deflection with diminishing resistance to the applied test loading, which indicates that the test load is near the maximum that could be applied without damaging the davit arm. The deflection and resistance noted at this loading indicates that the davit arm does not have the required code specified 4x factor of safety, that is , the arm cannot support an ultimate load of 3000 pounds (4 x 750 pound posted capacity). The davit socket and the davit pedestal did not show significant deformation at this loading; however, the testing of these components is inconclusive at the applied test load of 1875 pounds. To test the davit pedestal for a 4 to 1 capacity against overturning, a moment loading equivalent to a 3000 pound force applied to the end of davit arm would be required.

Gravitec recommends that the davit arms and sockets be removed from the roof and tagged out of service or destroyed. This includes the davit arms attached to the top of the screen wall posts at locations 8P01 and 8P02.

Single Point Anchors (Fall Arrest and Davit Pedestals)

Gravitec tested approximately 50% of the Davit Pedestals and Fall Arrest Anchors with a minimum horizontal force of 3600 pounds for a duration of one minute and these anchors did not show any significant permanent deformation. All of the Fall Arrest Anchors that were tested meet the requirements for single point fall arrest anchorages and for window washing anchorages. All of the Davit Pedestals that were tested also meet the strength requirements for single point fall arrest anchorages and for window washing anchorages; however, the top of the pedestal should be modified for connector compatibility. Due to the consistency of the tested anchors, we expect that untested Fall Arrest Anchors and the Davit Pedestals would behave in the same manner as the tested anchors. Additionally, the Fall Arrest Anchor 7SA5 and Davit Pedestal 7SB5 pair were tested to a 5000 pound loading with no significant permanent deformation.

Through Roof Anchors

The Through Roof Anchors were not tested as discussed in the Testing Synopsis section of this report. None of these anchors (twenty in total) should be used for support of window washing equipment or for the connection of a fall arrest line. These pipe penetrations may be used as a pass-though for the routing of cables or ropes through the roof plane, but the cables or ropes shall not contact the pipe. The pipe shall not be used to support loads unless further observations and testing indicate it is safe to do so.

Gravitec recommends warning signs be installed on each pipe and the connection ring welded to the side of the pipe be removed.

GRAVITEC SYSTEMS

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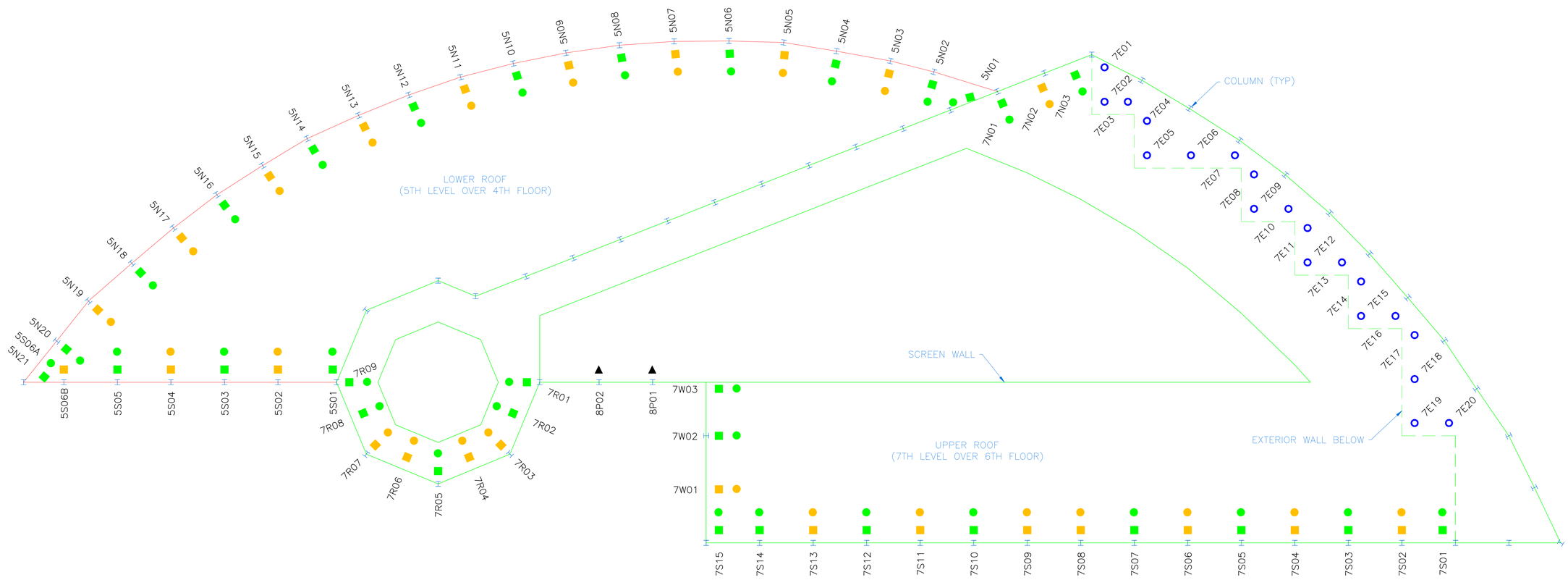
APPENDIX A - ANCHOR LOCATIONS



ANCHOR TYPE LEGEND

- ● FALL ARREST ANCHOR
- ■ DAVIT PEDESTAL
- ○ THROUGH ROOF ANCHOR
- ▲ DAVIT PEDISTAL ON SCREEN WALL

ANCHOR LABEL COLOR CODE

- TESTED AND PASSED FOR SINGLE POINT ANCHORAGE
- TESTED AND FAILED
- NOT TESTED, SIMILAR TO PASSING ANCHORS
- NOT TESTED, SUSPECTED NOT ADEQUATE

GRAVITEC SYSTEMS INC.™

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DESIGNING ENG(S): LWC	DATE DESIGNED: 10/25/2011
DRAFTED BY: JDM	DATE DRAFTED: 10/25/2011
CHECKED BY: LWC	DATE CHECKED: 10/25/2011
APPROVED BY: SST	DATE APPROVED: 10/25/2011
REVISION:	DATE REVISED:
REVISION:	DATE REVISED:
REVISION:	DATE REVISED:
REVISION:	DATE REVISED:
REVISION:	DATE REVISED:
REVISION:	DATE REVISED:

CLIENT:
STATE OF WASHINGTON
DEPARTMENT OF NATURAL RESOURCES
OLYMPIA, WA

PROJECT:
NATURAL RESOURCES BUILDING
WINDOW WASHING AND
FALL PROTECTION ANCHOR ASSESSMENT

SHEET TITLE:
TESTING RESULTS

SCALE:

PROJECT NUMBER:
110053

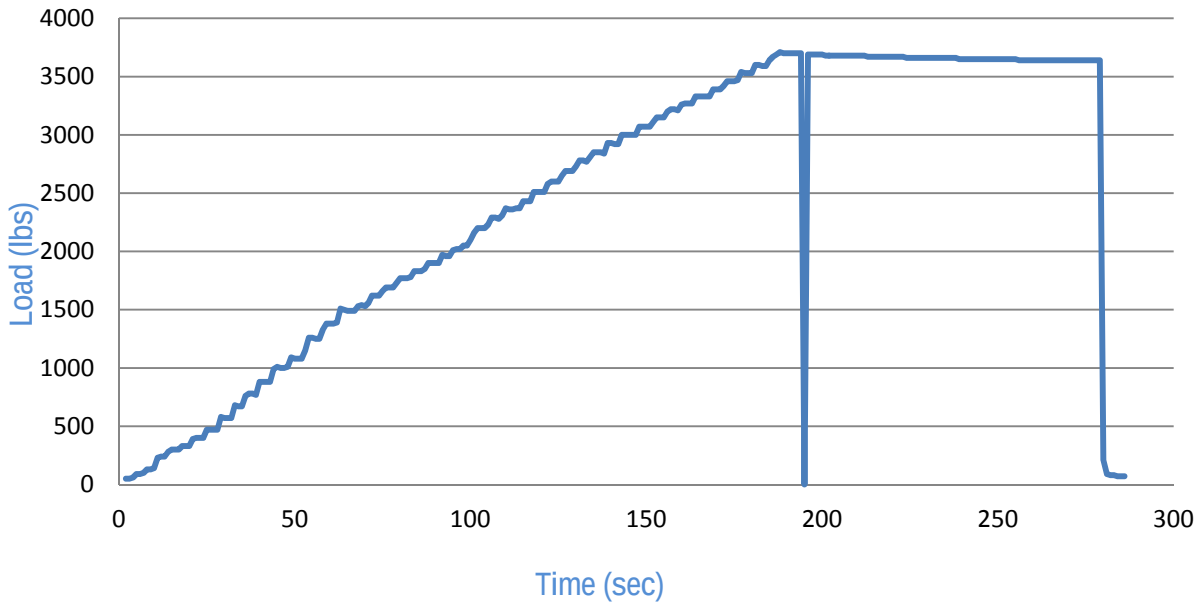
SHEET NUMBER:
G1.0

SHEET 1 OF 1

GRAVITEC SYSTEMS

APPENDIX B - TESTING DATA

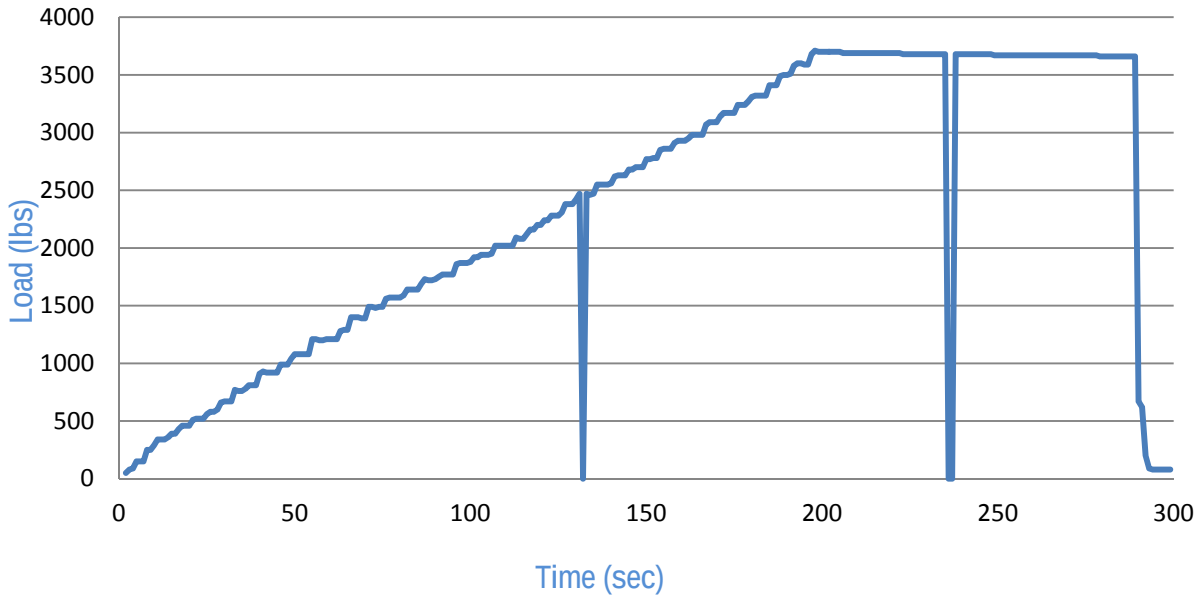
Load vs. Time - Static Load Test



Anchors 5N01A and 5N02B

GRAVITEC SYSTEMS

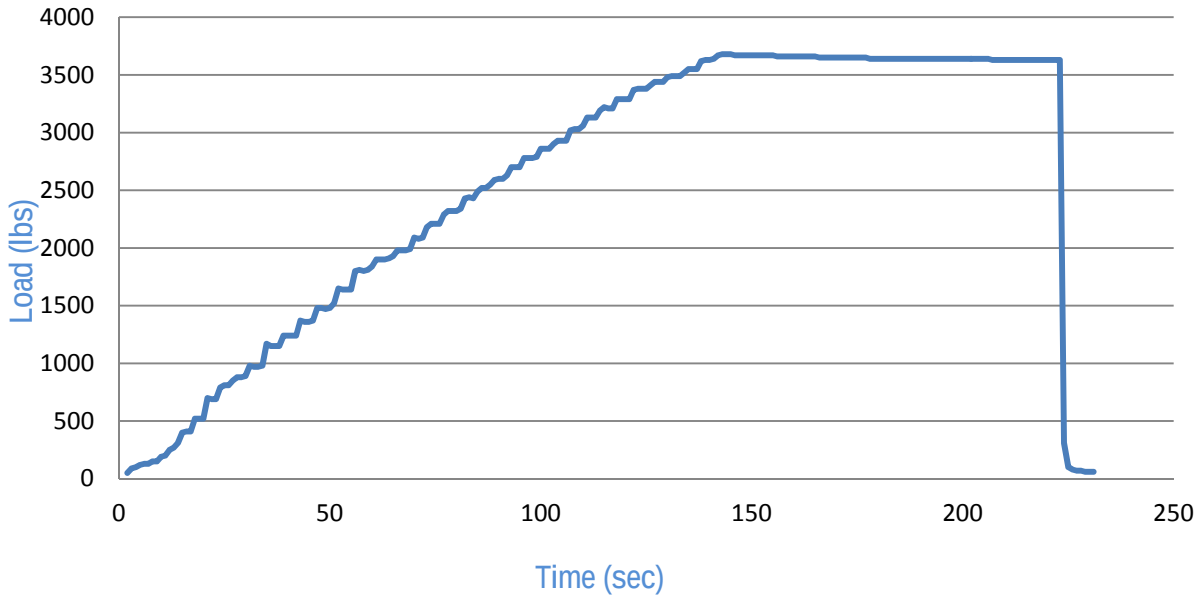
Load vs. Time - Static Load Test



Anchors 5N02A and 5N01B

GRAVITEC SYSTEMS

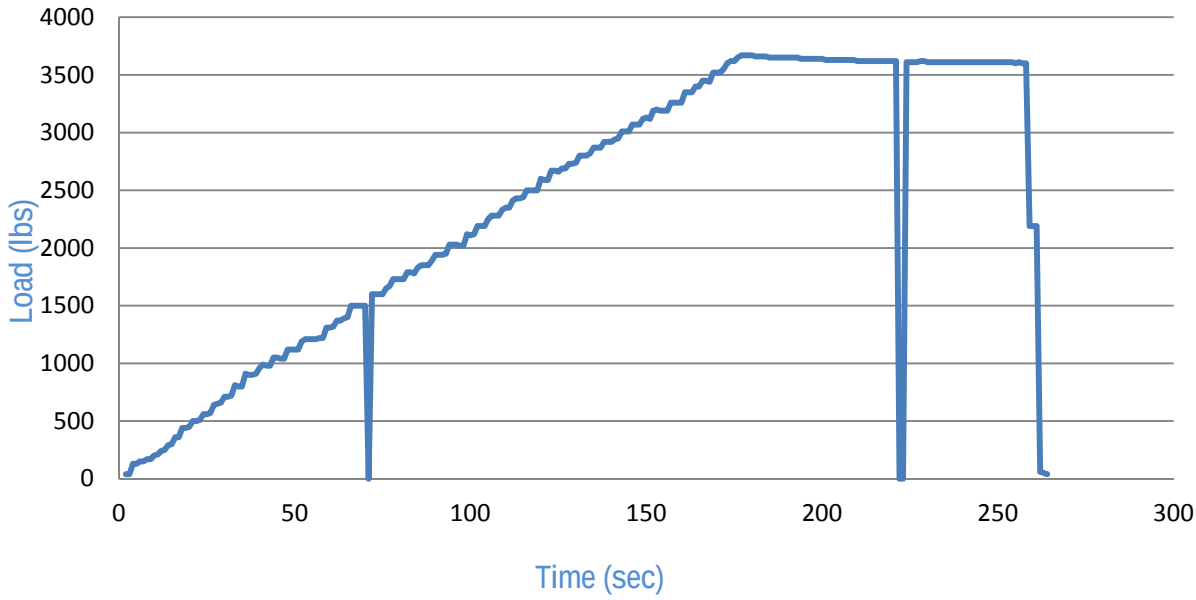
Load vs. Time - Static Load Test



Anchors 5N04A and 5N04B

GRAVITEC SYSTEMS

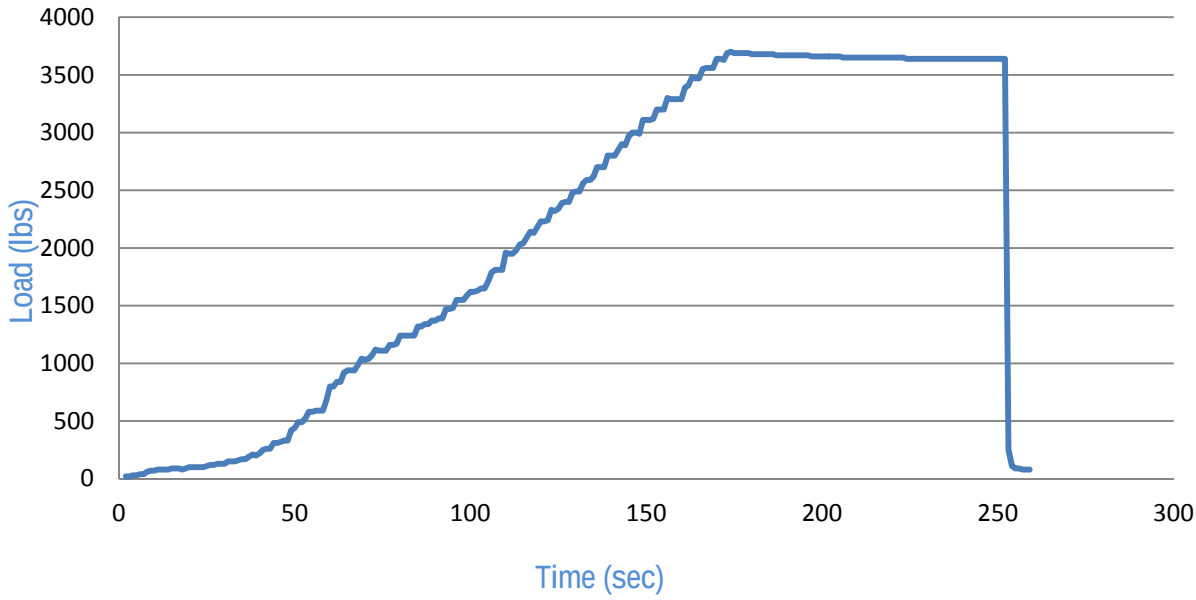
Load vs. Time - Static Load Test



Anchors 5N06A and 5N06B

GRAVITEC SYSTEMS

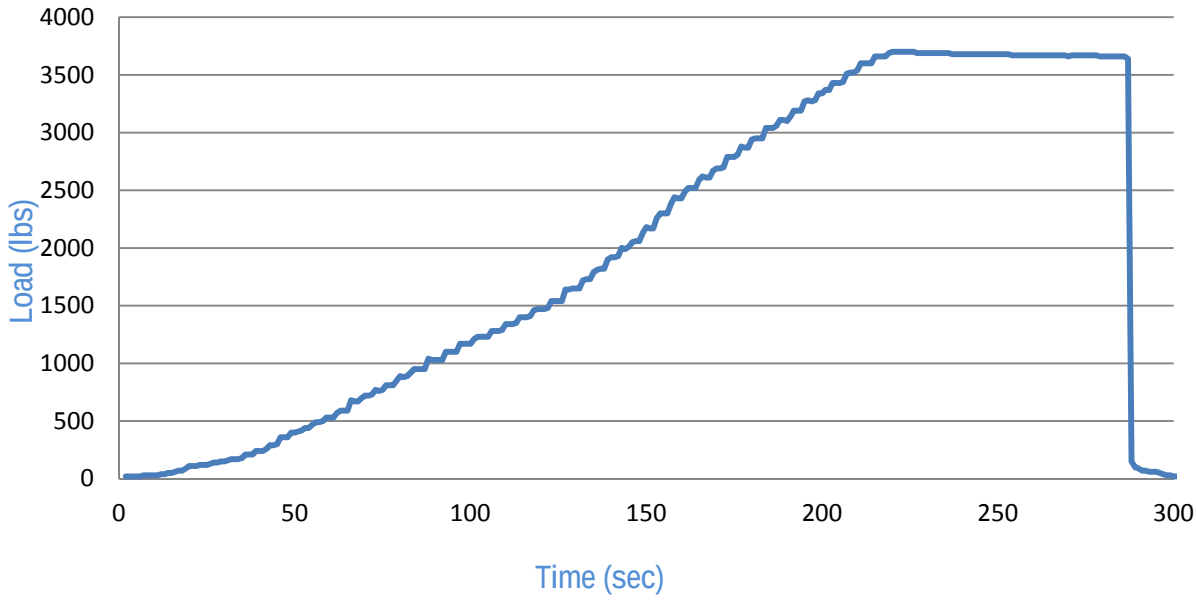
Load vs. Time - Static Load Test



Anchors 5N08A and 5N08B

GRAVITEC SYSTEMS

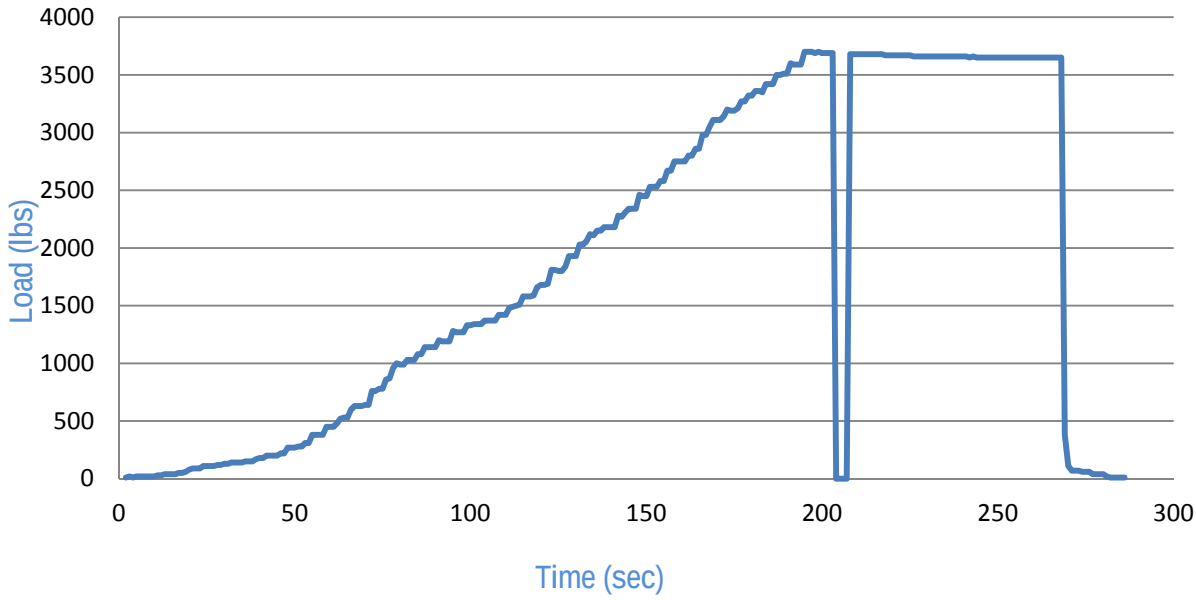
Load vs. Time - Static Load Test



Anchors 5N10A and 5N10B

GRAVITEC SYSTEMS

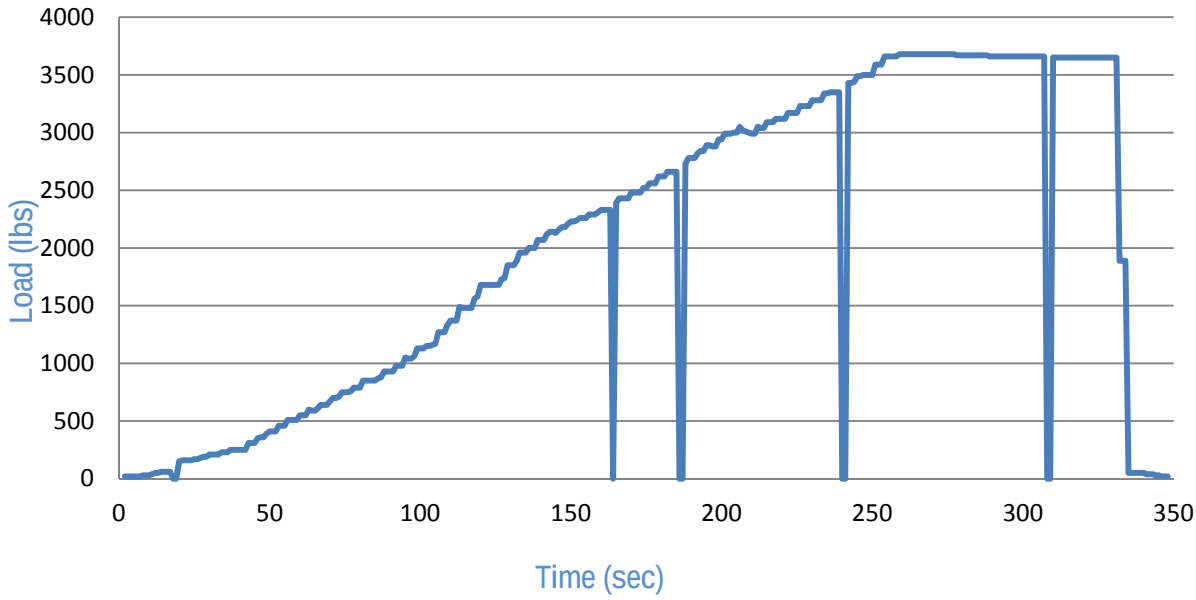
Load vs. Time - Static Load Test



Anchors 5N12A and 5N12B

GRAVITEC SYSTEMS

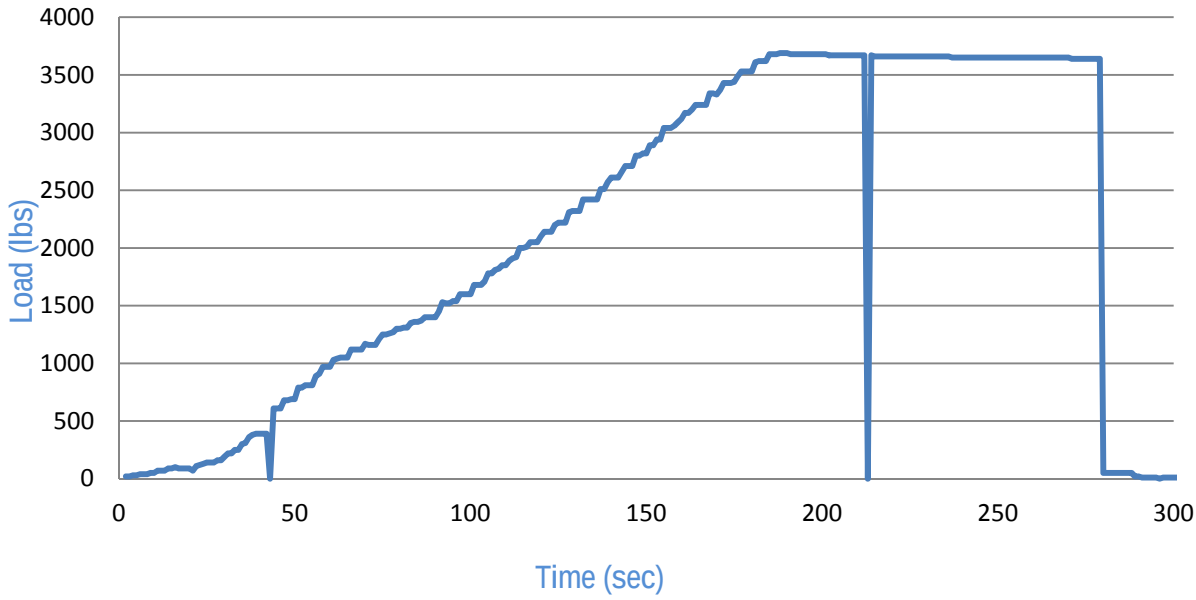
Load vs. Time - Static Load Test



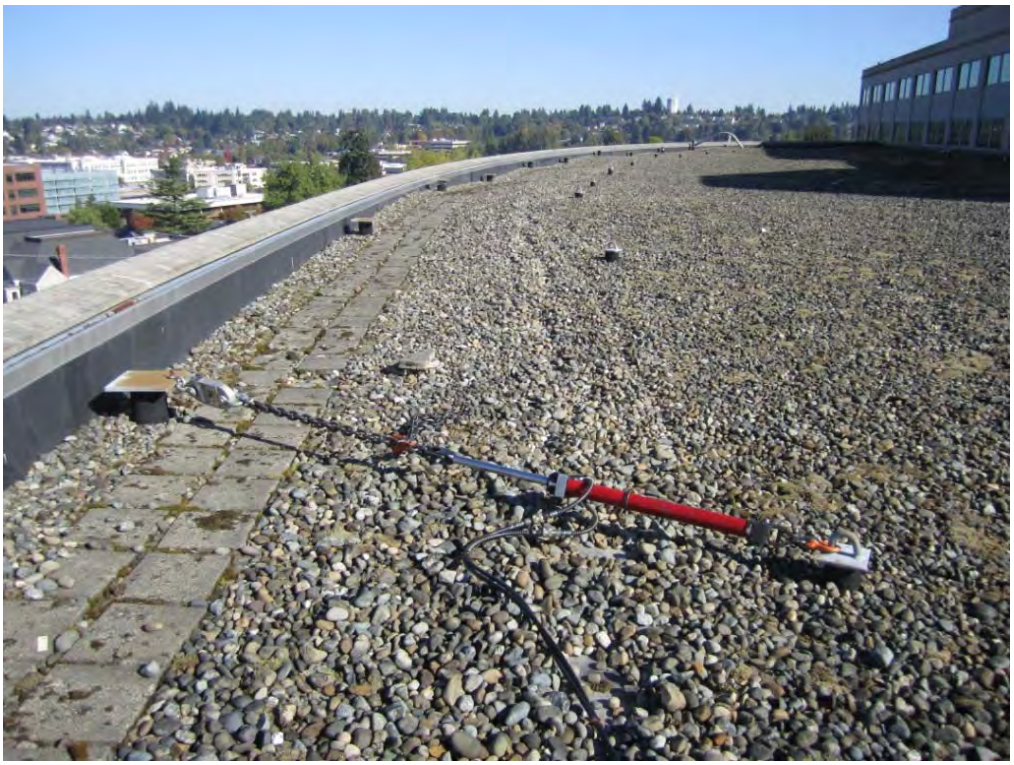
Anchors 5N14A and 5N14B

GRAVITEC SYSTEMS

Load vs. Time - Static Load Test

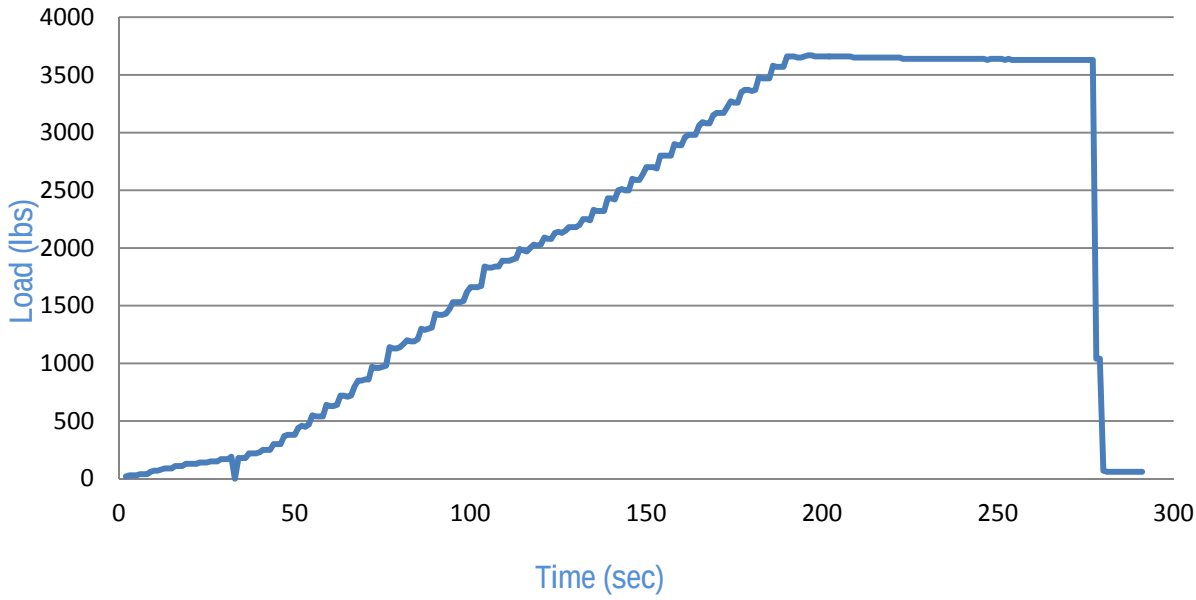


Anchors 5N16A and 5N16B



GRAVITEC SYSTEMS

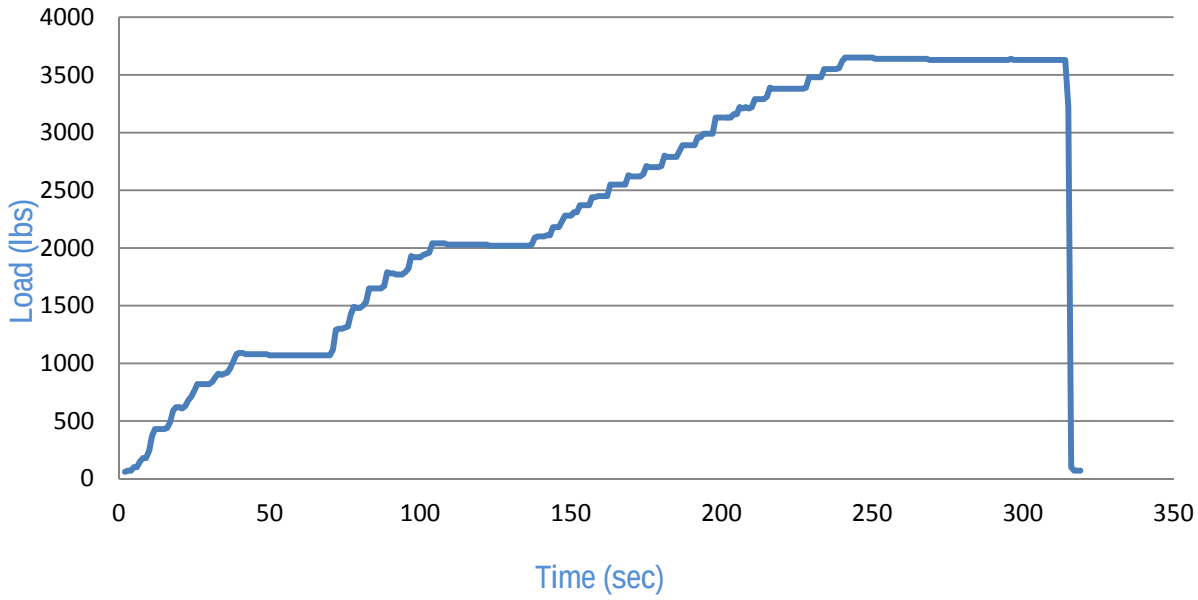
Load vs. Time - Static Load Test



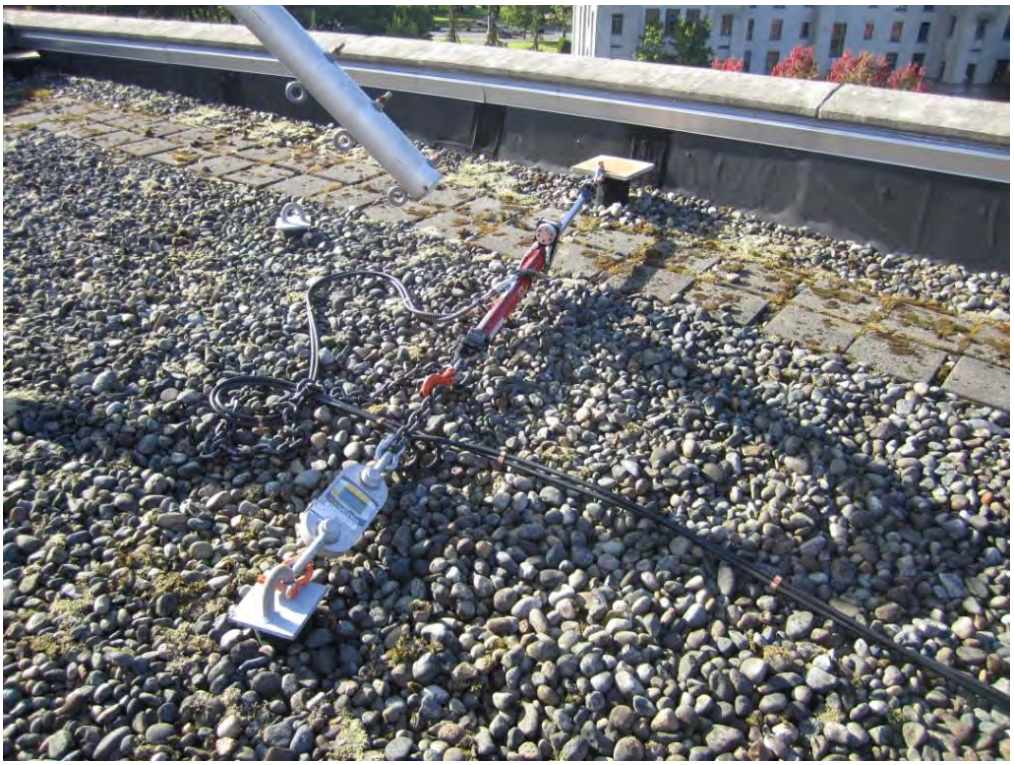
Anchors 5N18A and 5N18B

GRAVITEC SYSTEMS

Load vs. Time - Static Load Test

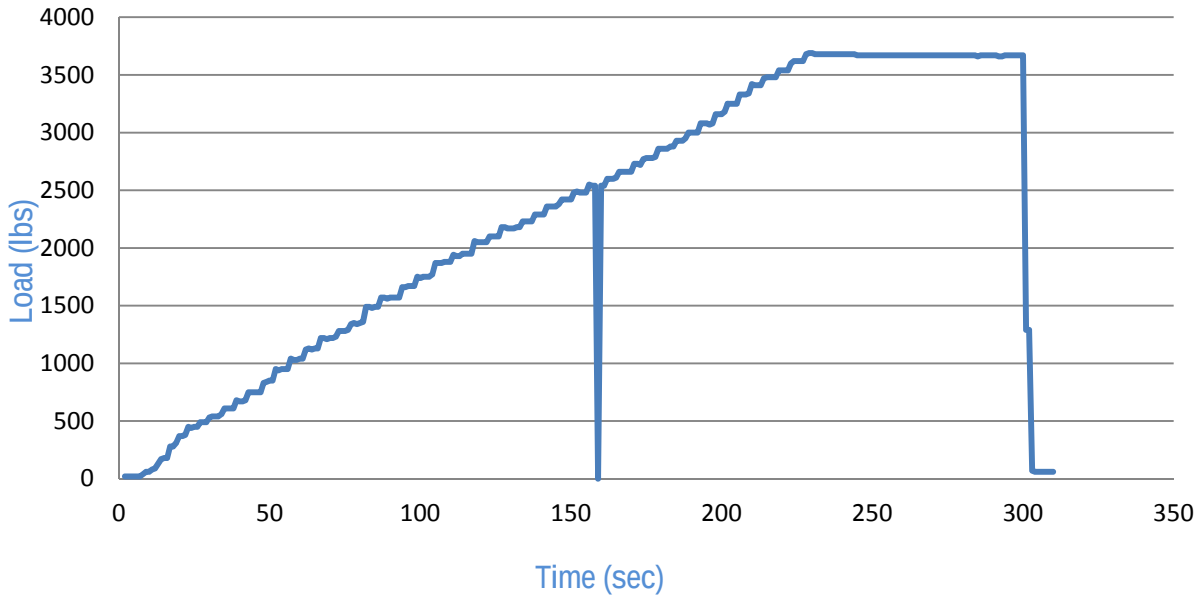


Anchors 5N20A and 5N20B



GRAVITEC SYSTEMS

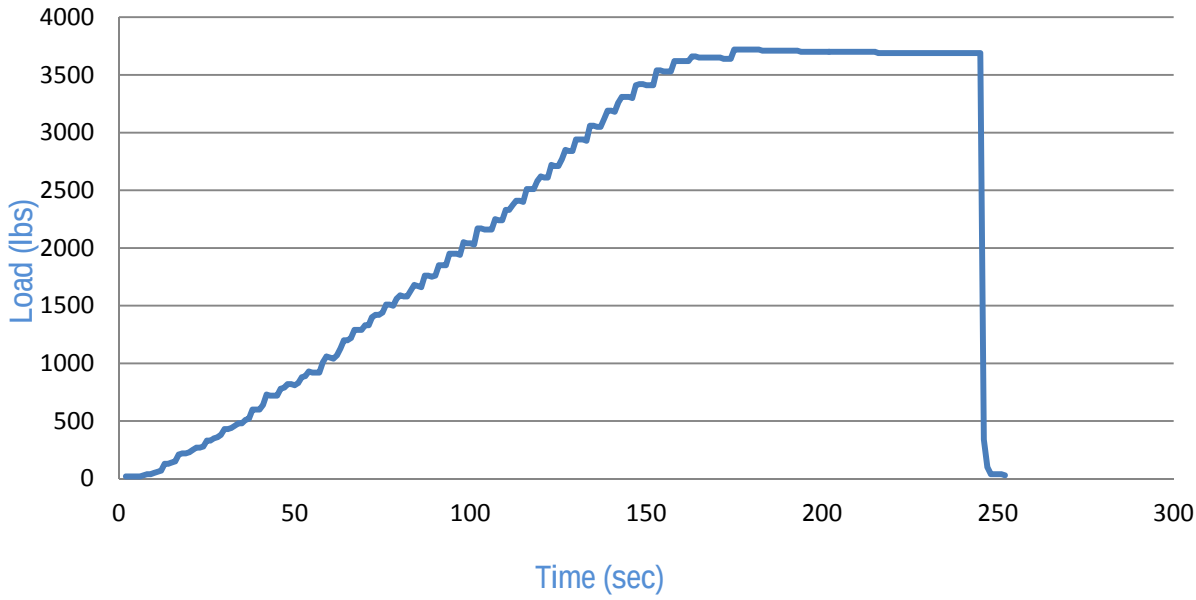
Load vs. Time - Static Load Test



Anchors 5N21B and 5S06A

GRAVITEC SYSTEMS

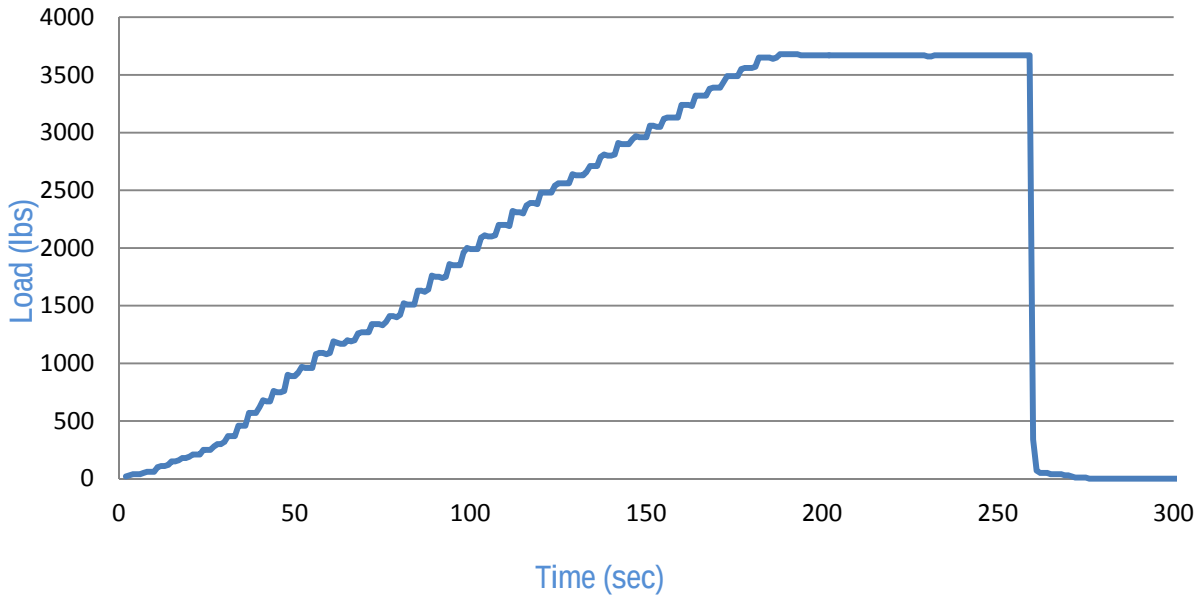
Load vs. Time - Static Load Test



Anchors 5S01A and 5S01B

GRAVITEC SYSTEMS

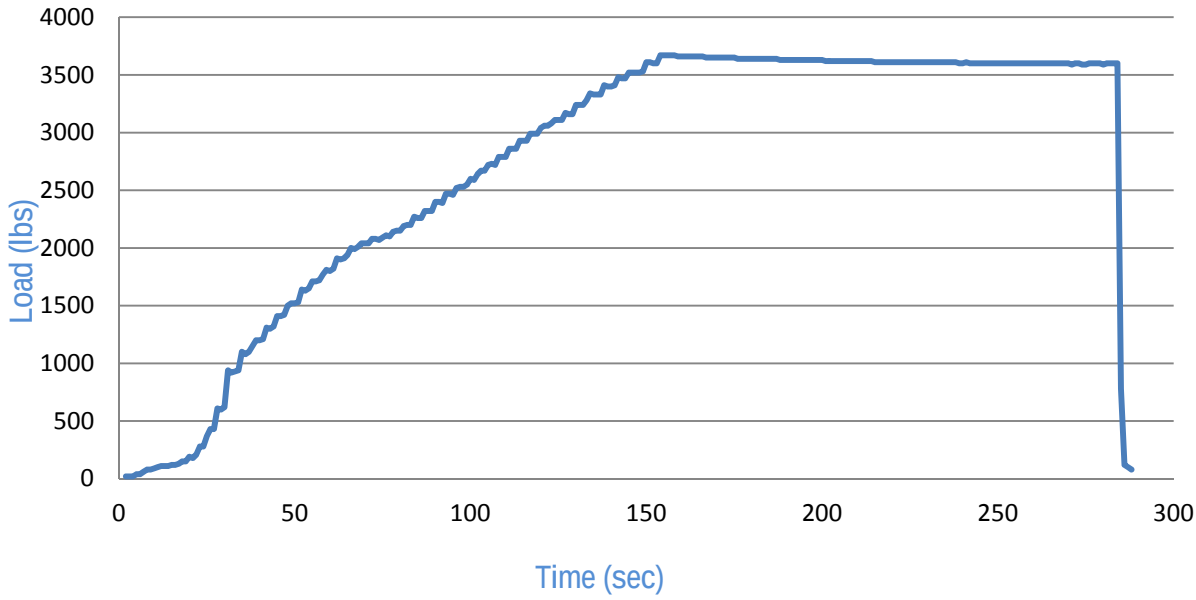
Load vs. Time - Static Load Test



Anchors 5S03A and 5S03B

GRAVITEC SYSTEMS

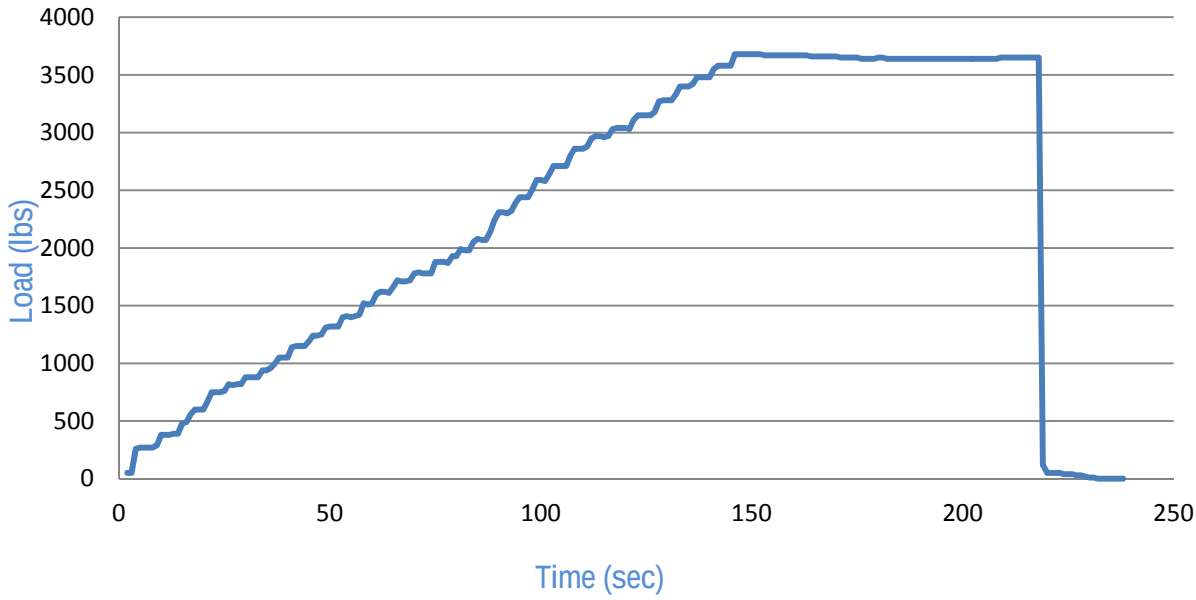
Load vs. Time - Static Load Test



Anchors 5S05A and 5S05B

GRAVITEC SYSTEMS

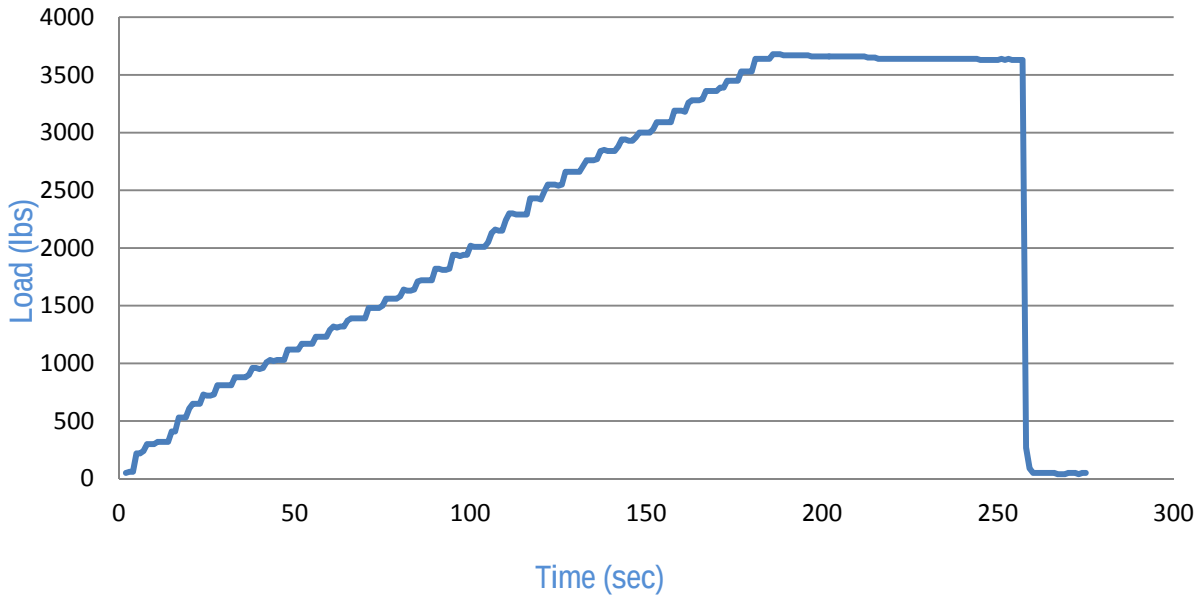
Load vs. Time - Static Load Test



Anchors 7N01A and 7N01B

GRAVITEC SYSTEMS

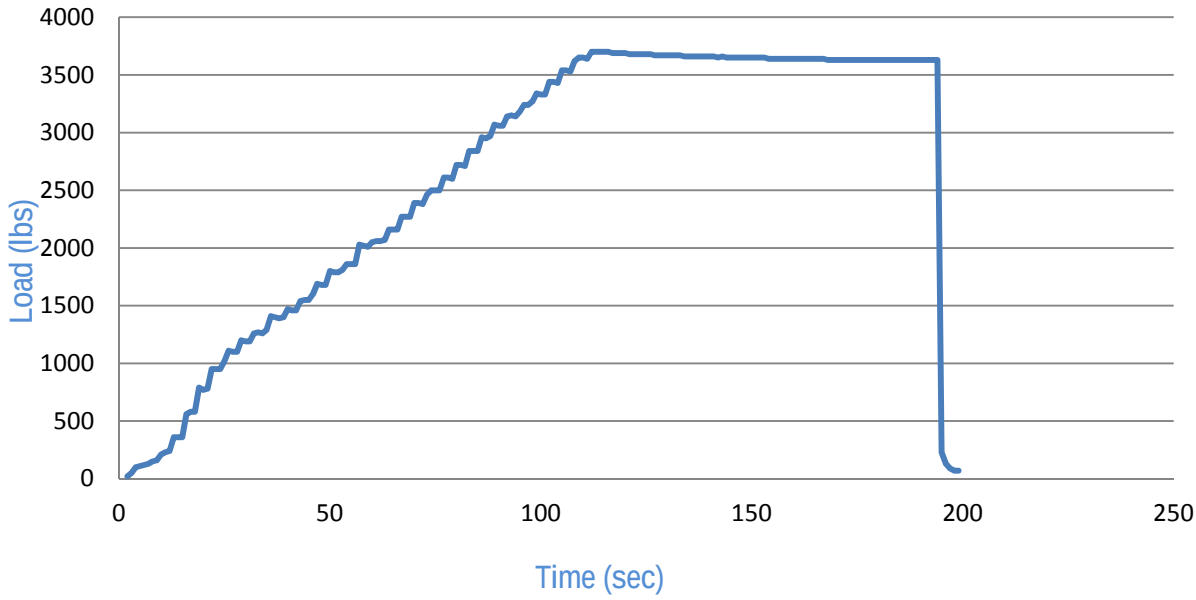
Load vs. Time - Static Load Test



Anchors 7N03A and 7N03B

GRAVITEC SYSTEMS

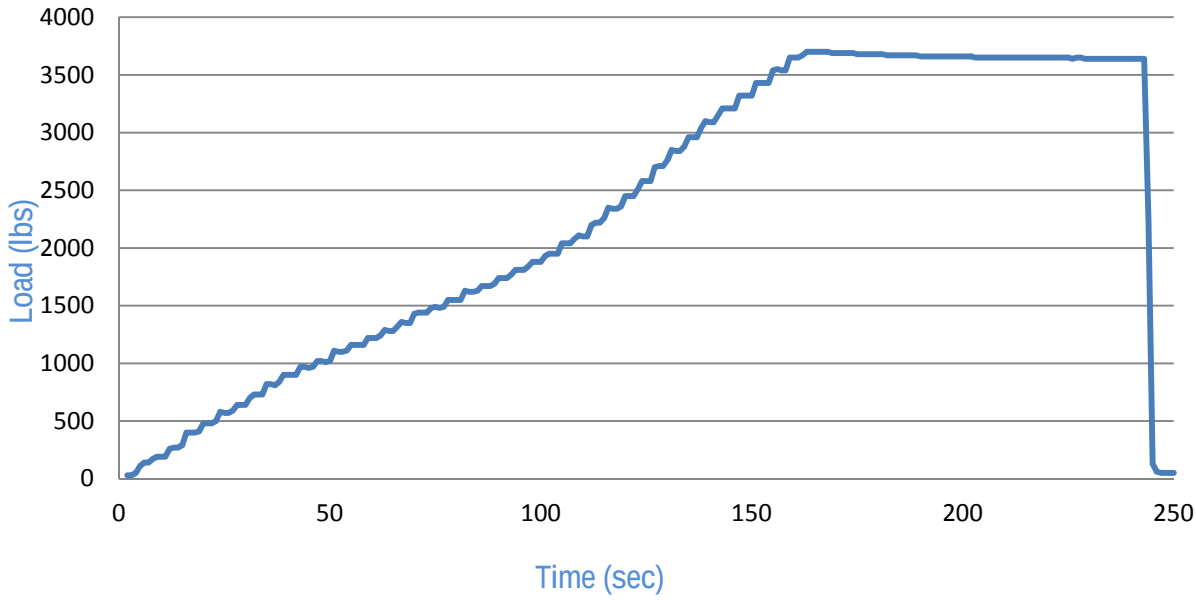
Load vs. Time - Static Load Test



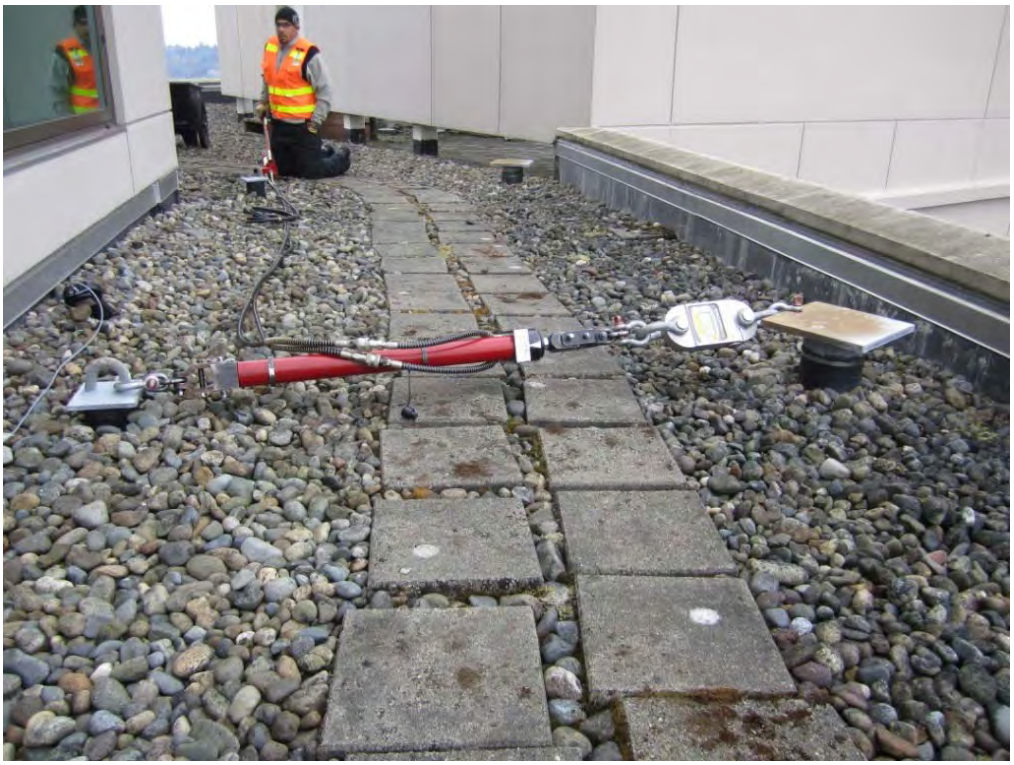
Anchors 7R01A and 7R01B

GRAVITEC SYSTEMS

Load vs. Time - Static Load Test

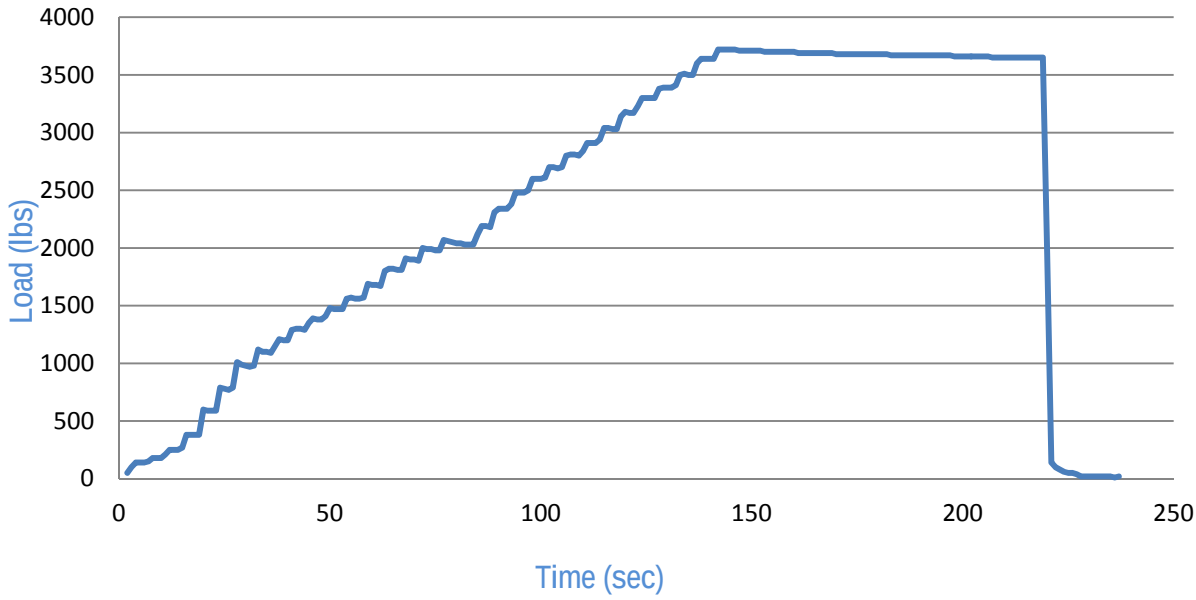


Anchors 7R02A and 7R02B



GRAVITEC SYSTEMS

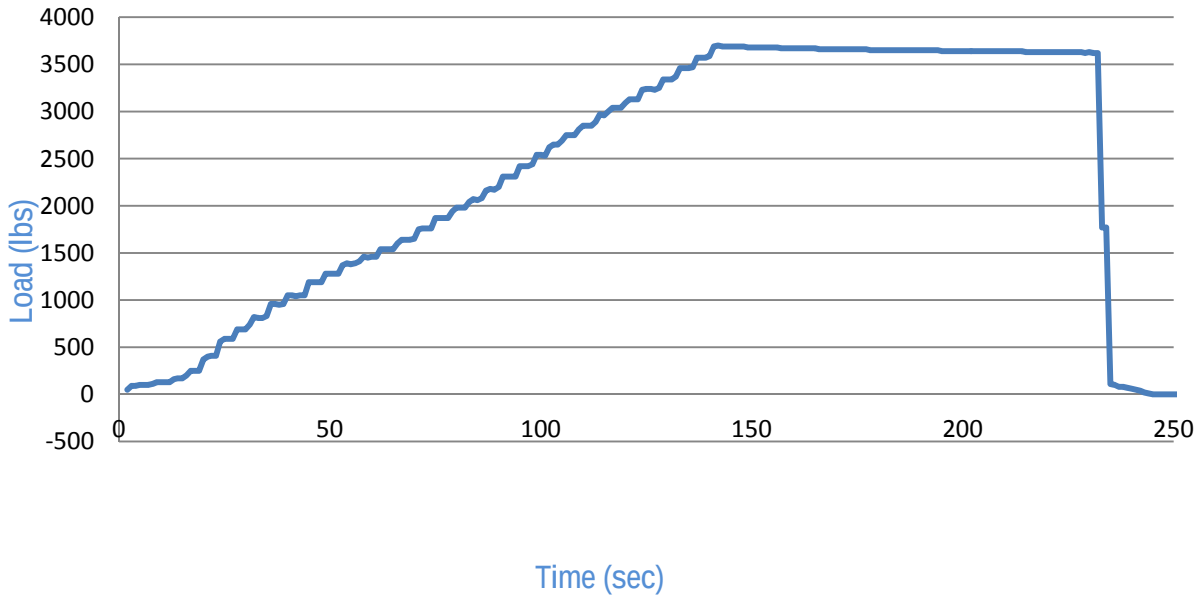
Load vs. Time - Static Load Test



Anchors 7R05A and 7R05B

GRAVITEC SYSTEMS

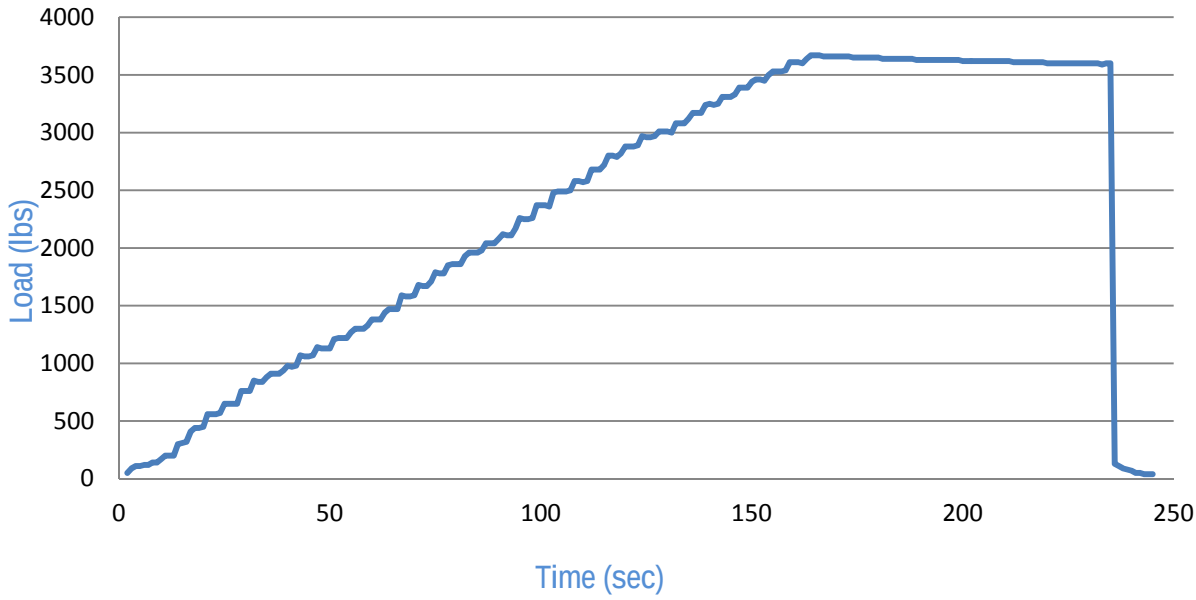
Load vs. Time - Static Load Test



Anchors 7R08A and 7R08B

GRAVITEC SYSTEMS

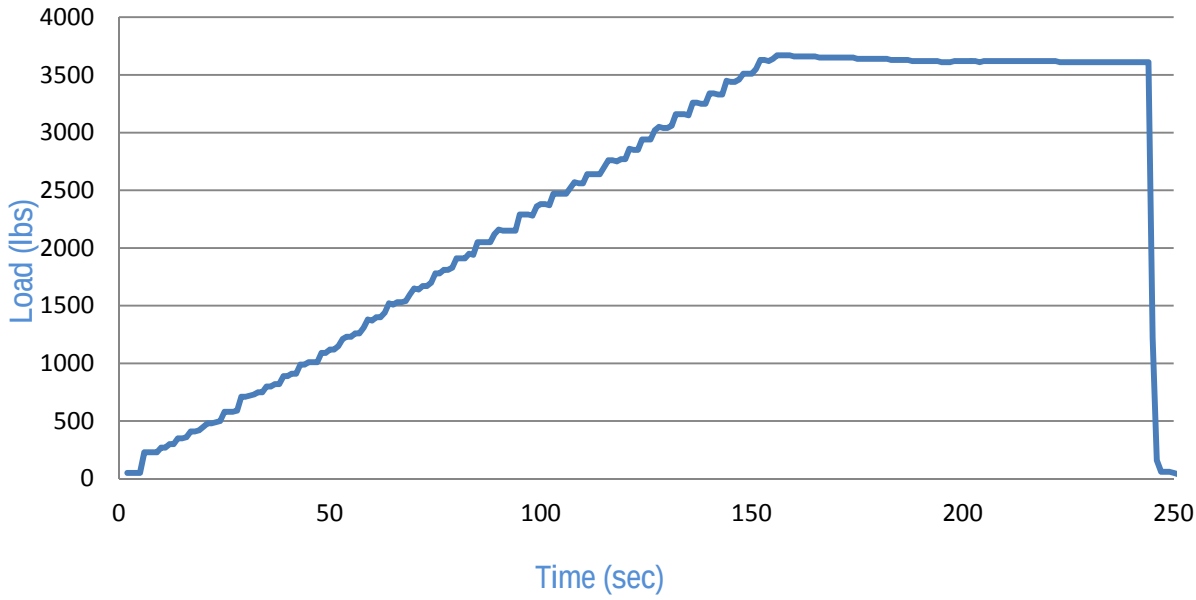
Load vs. Time - Static Load Test



Anchors 7R09A and 7R09B

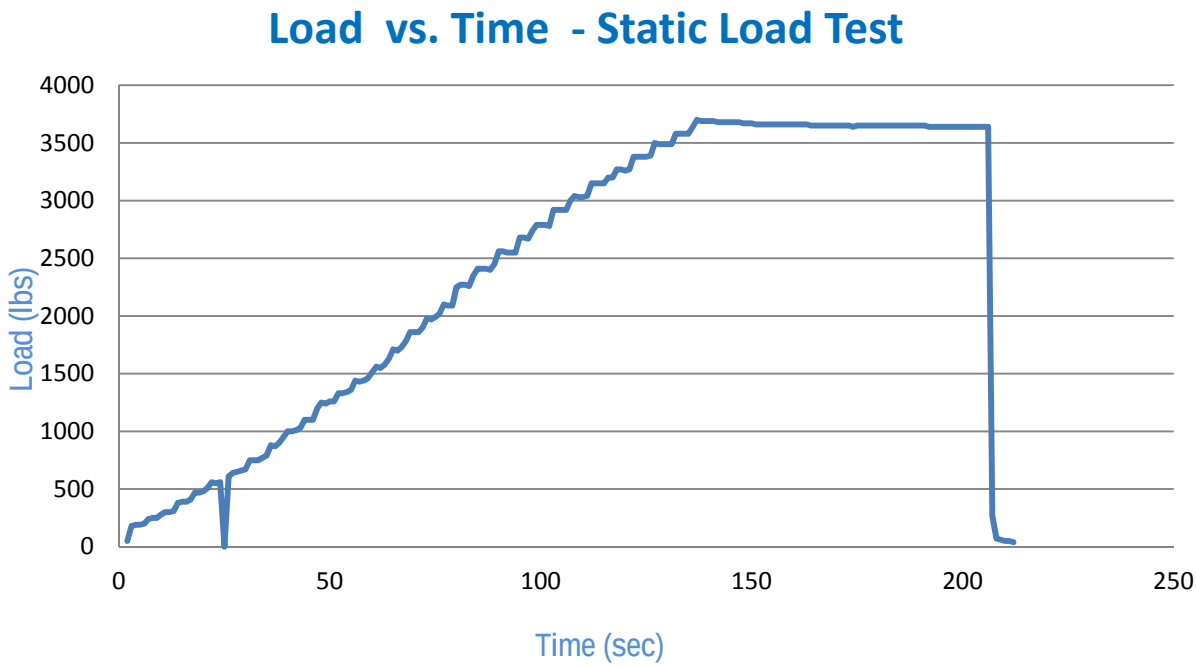
GRAVITEC SYSTEMS

Load vs. Time - Static Load Test



Anchors 7S01A and 7S01B

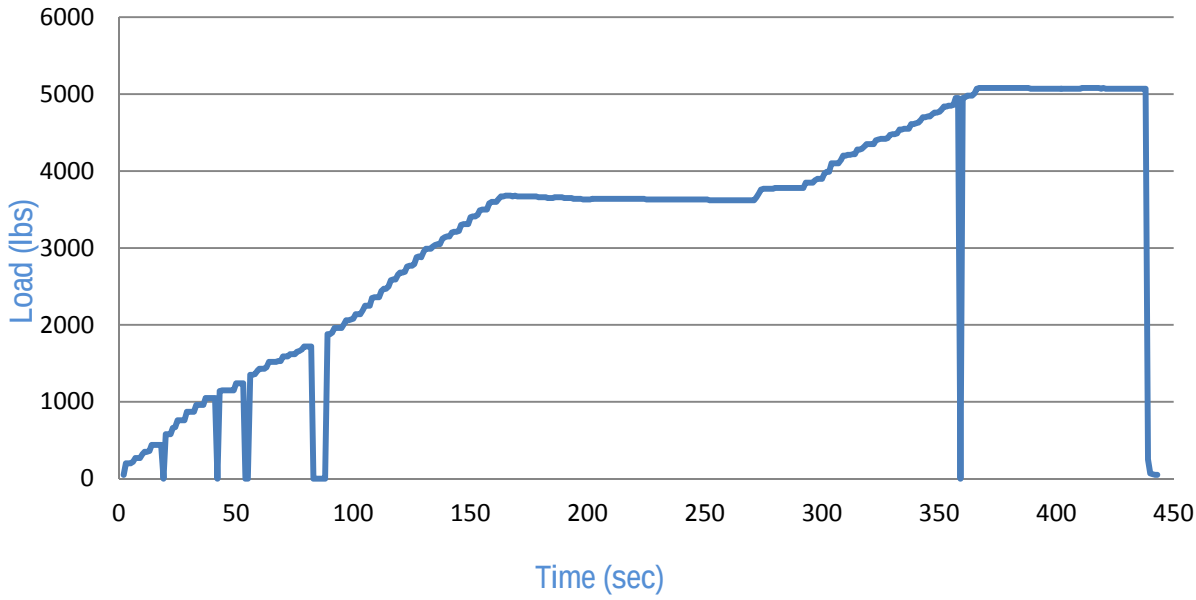
GRAVITEC SYSTEMS



Anchors 7S03A and 7S03B

GRAVITEC SYSTEMS

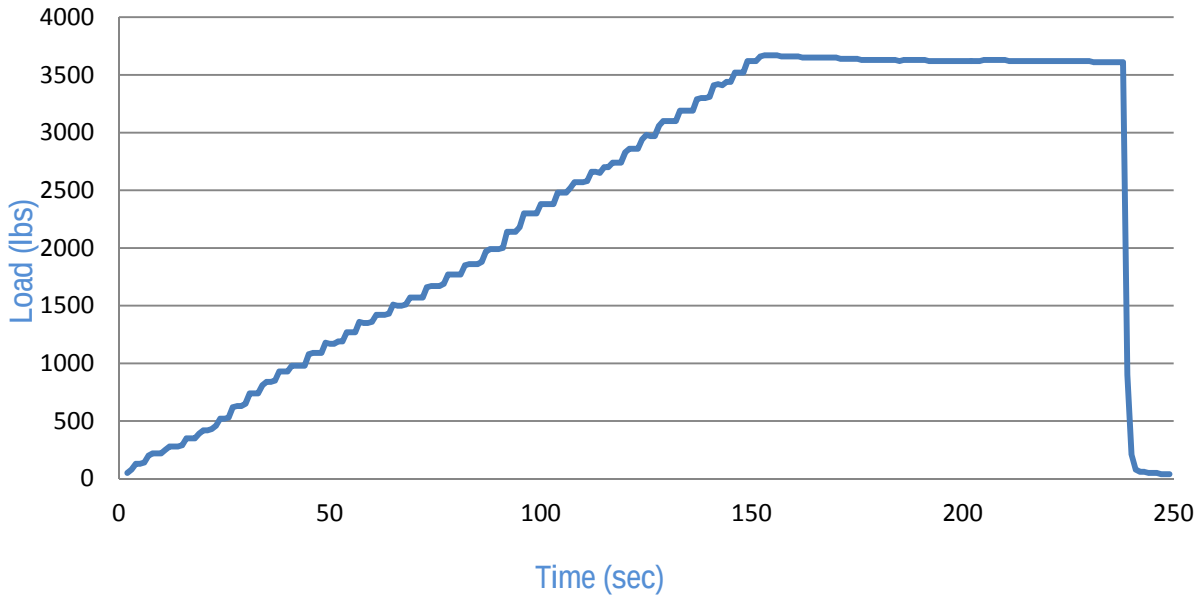
Load vs. Time - Static Load Test



Anchors 7S05A and 7S05B

GRAVITEC SYSTEMS

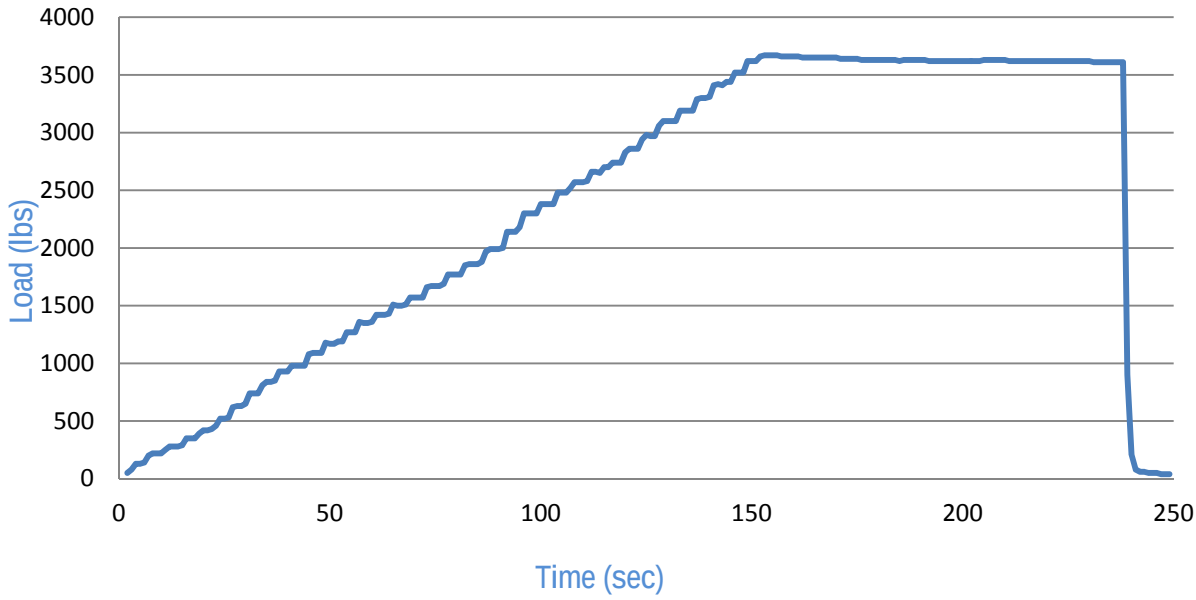
Load vs. Time - Static Load Test



Anchors 7S07A and 7S07B

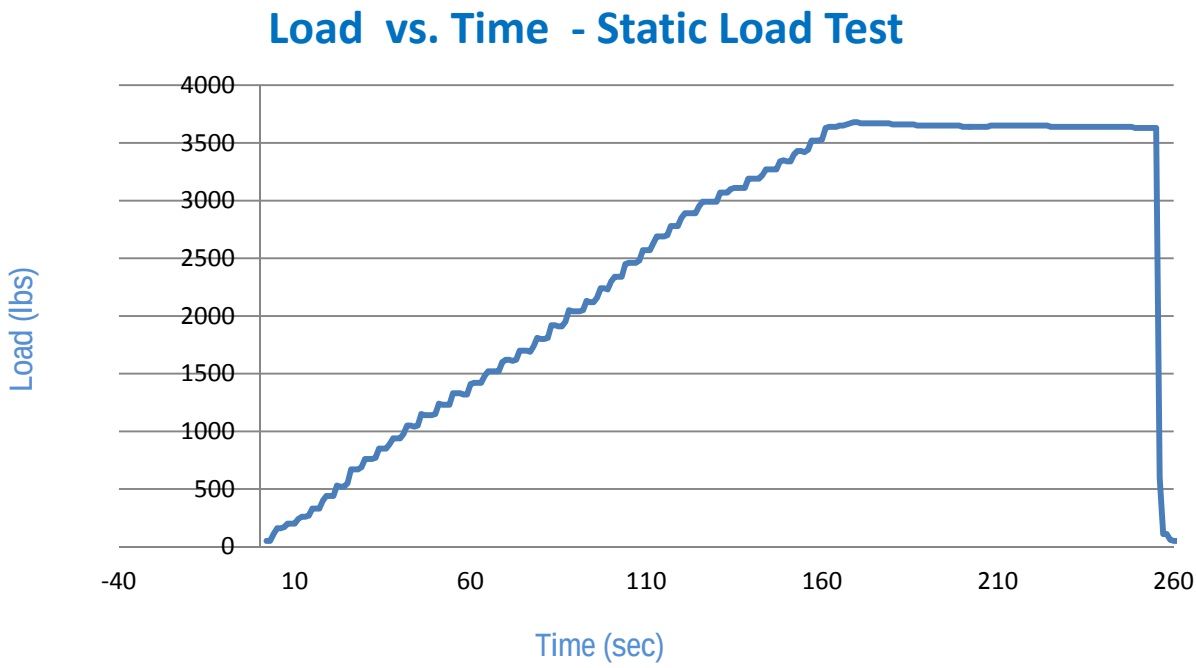
GRAVITEC SYSTEMS

Load vs. Time - Static Load Test



Anchors 7S10A and 7S10B

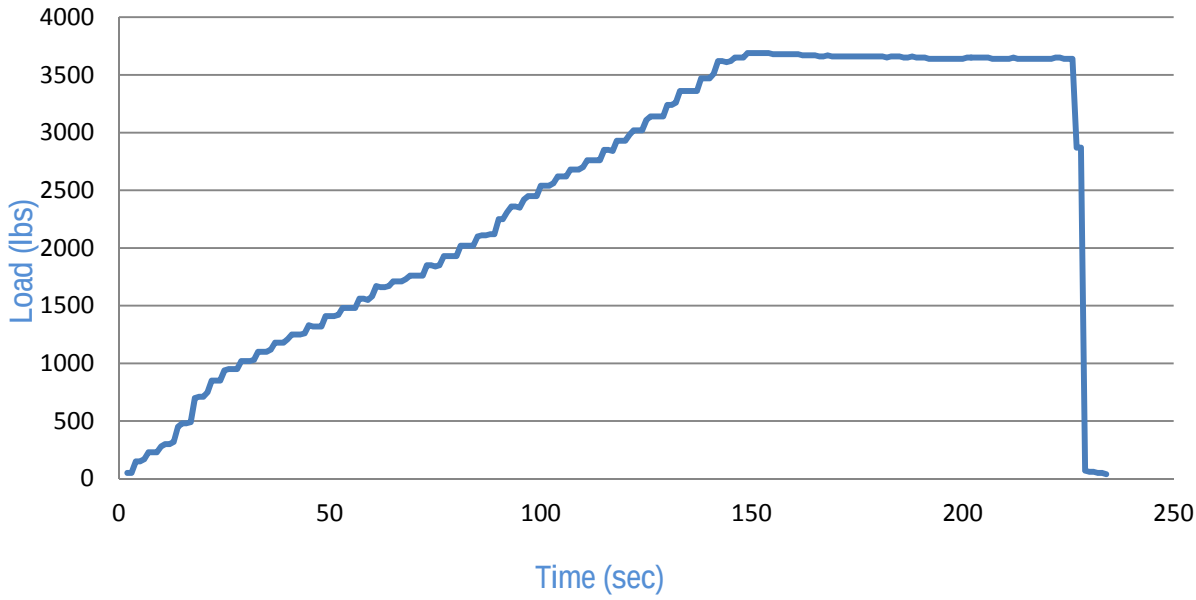
GRAVITEC SYSTEMS



Anchors 7S12A and 7S12B

GRAVITEC SYSTEMS

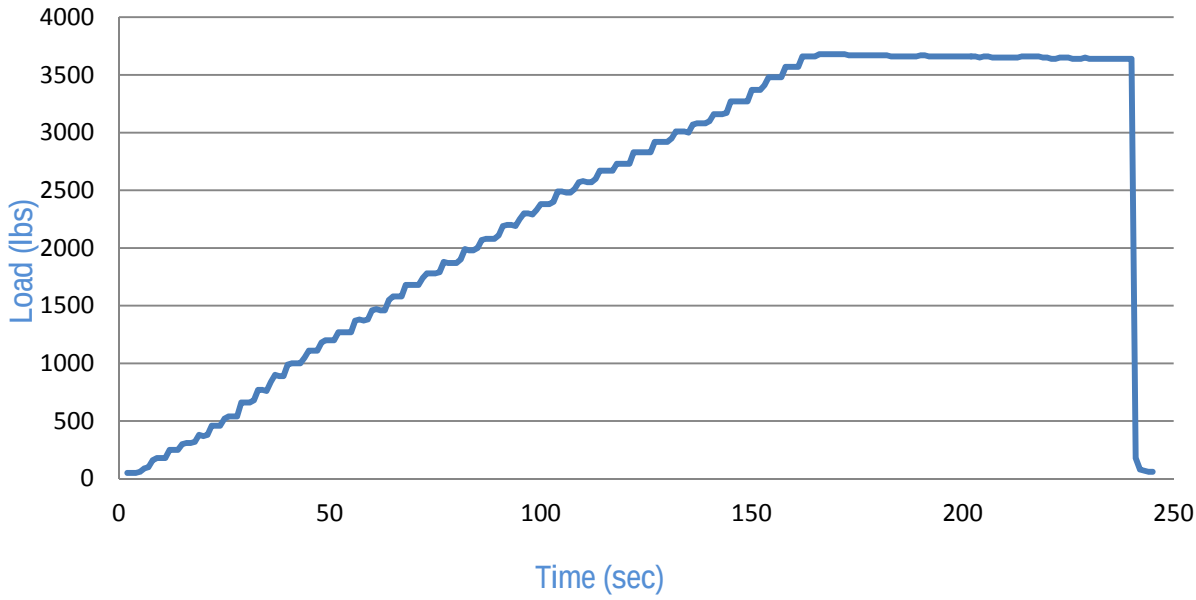
Load vs. Time - Static Load Test



Anchors 7S14A and 7S14B

GRAVITEC SYSTEMS

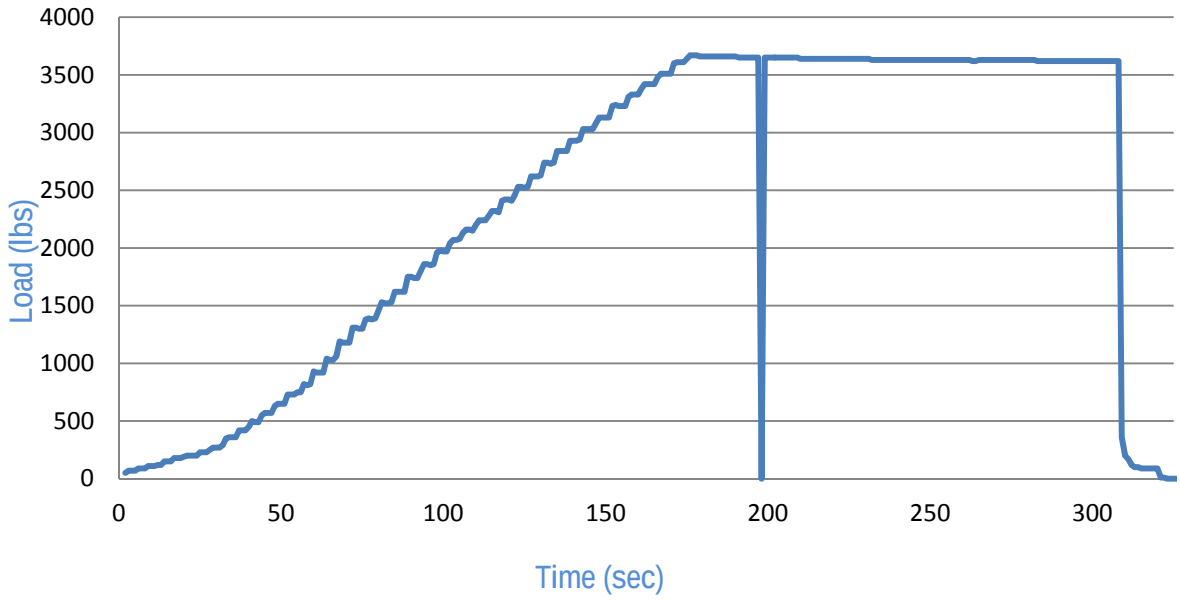
Load vs. Time - Static Load Test



Anchors 7S15A and 7S15B

GRAVITEC SYSTEMS

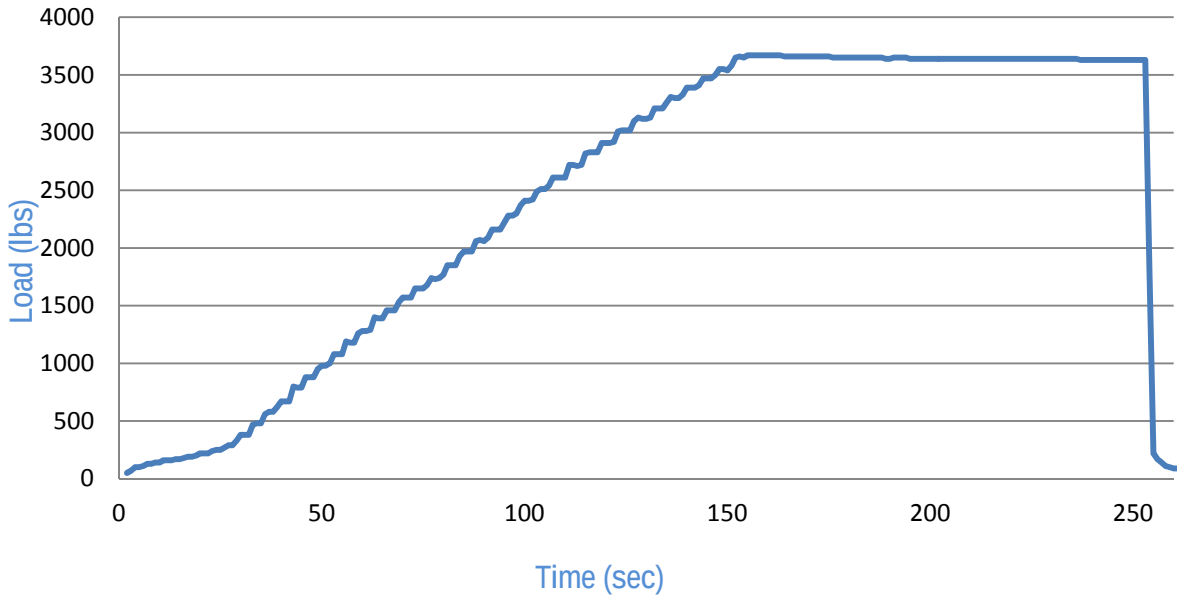
Load vs. Time - Static Load Test



Anchors 7W02A and 7W03B

GRAVITEC SYSTEMS

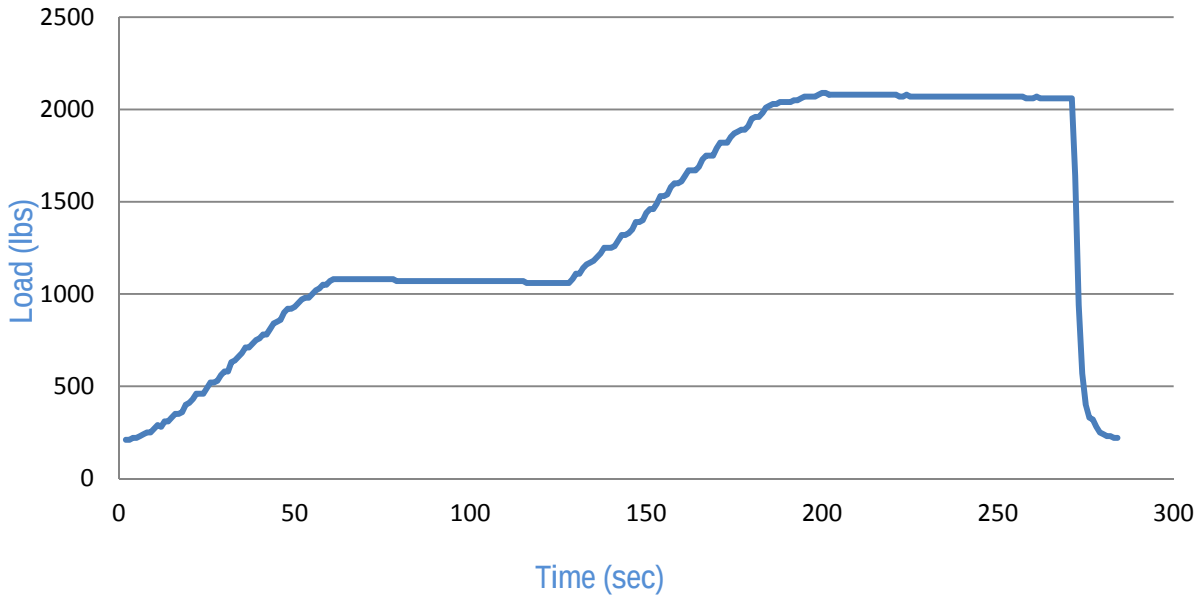
Load vs. Time - Static Load Test



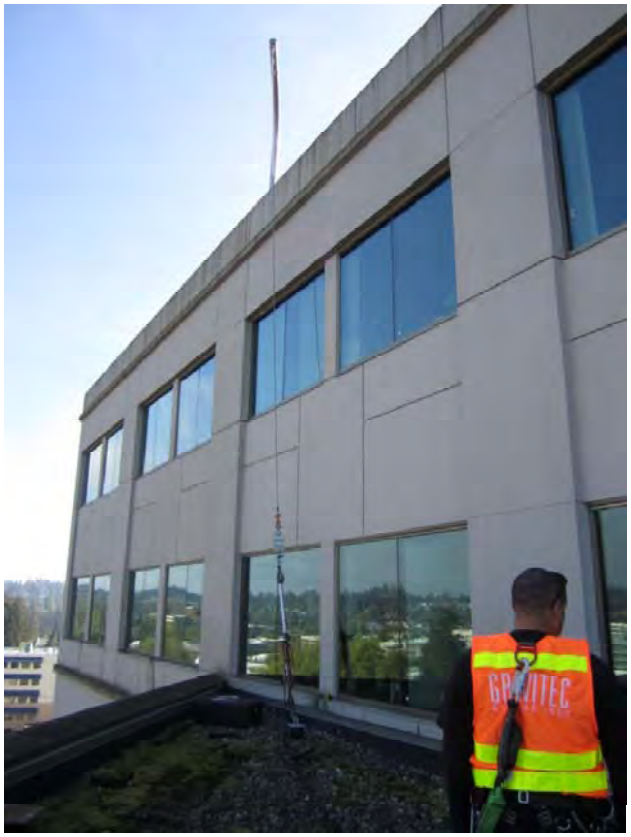
Anchors 7W03A and 7W02B

GRAVITEC SYSTEMS

Load vs. Time - Static Load Test

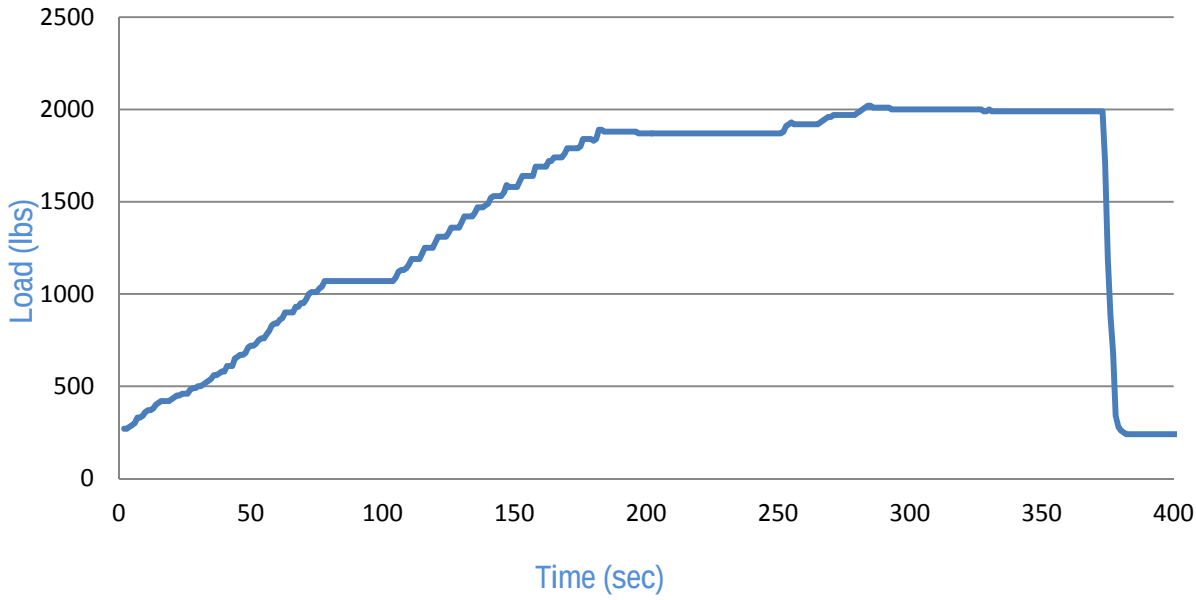


Davit 1 and Pedestal 7N01B



GRAVITEC SYSTEMS

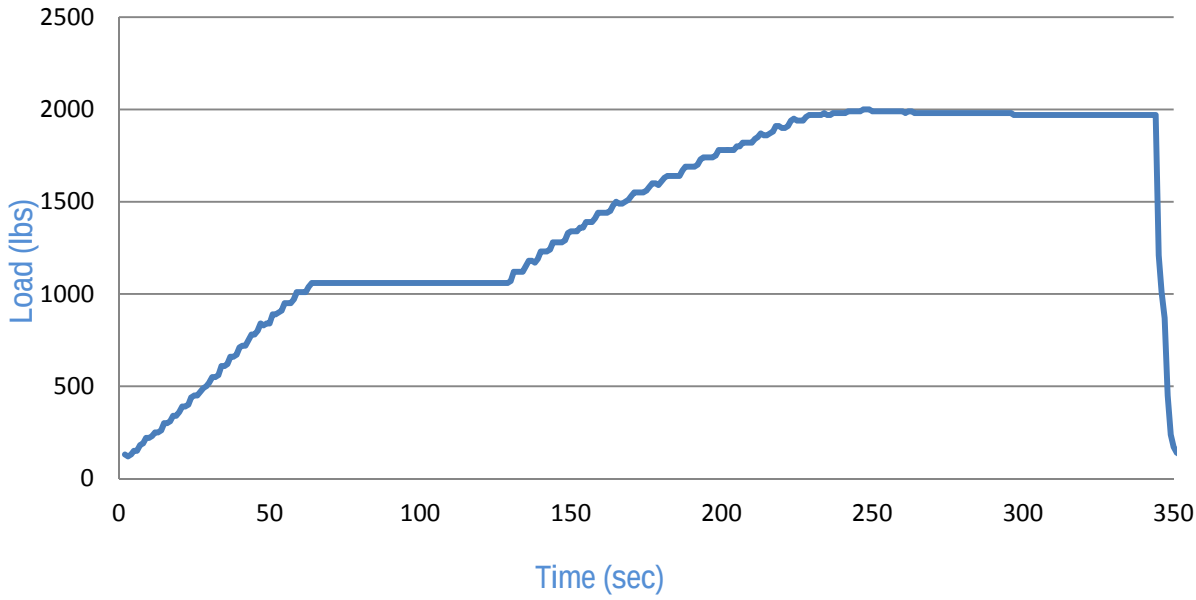
Load vs. Time - Static Load Test



Davit 2 and Pedestal 5N07B

GRAVITEC SYSTEMS

Load vs. Time - Static Load Test



Davit 3 and Pedestal 5S06B

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APPENDIX C - WINDOW WASHING NARRATIVE

Narrative of Window Washing Processes
For the Natural Resources Building

The following is general information based on a conversation with Mr. Jim Brumfield, of Pacific Window Cleaners (PWC), that describes recent processes for window washing at the Natural Resources Building. This narrative may be useful in evaluating the proposals for roof access and window washing.

1. PWC does not use the davit system to wash windows from either the low roof or from the high roof. At all locations where there are davit pedestals, PWC uses a rolling rig with a counter weighted boom for anchoring a working (primary) line for suspending a boatswain's chair over the parapet. The rolling rig is tied back to a fall arrest anchor. (The fall arrest anchor are located approximately 10 feet in from the roof edge.) The fall arrest (secondary) line is connected to the davit pedestal. GRAVITEC COMMENTS: The davit pedestals do not provide good connector compatibility. Swing falls may be an issue because the davit pedestals are located between windows rather than centered on the windows.
2. PWC currently uses only the davits attached to the top of the screen wall at locations 8P01 and 8P02. From the ground, a powered swing stage platform is connected to these two davits and raised. The swing stage is used to wash only one vertical bank of windows. (Secondary connection was not discussed with PWC.) GRAVITEC COMMENTS: The davits are tagged out of service. The secondary line attachment has not been confirmed.
3. PWC washes the fifth story rotunda windows from the fourth floor roof. The parapet at the rotunda is approximately 36" tall. GRAVITEC COMMENTS: OSHA requires a guardrail height of 42 inches, it would be relatively simple to add a Guardrail at 42" to remediate this hazard.
4. PWC washes the upper windows on the rotunda from the 6th story roof. GRAVITEC COMMENTS: Some of the options presented would remediate this current hazard.
5. PWC uses a boom supported lift to wash the rotunda windows of the fourth story and below.
6. PWC uses a boom supported lift to wash south wall windows of the fourth story and below. These windows are beneath the cantilevered fifth and sixth floors.
7. PWC uses a powered swing stage to wash the windows of the zigzagging eastern walls. Cables supporting the swing stage are routed through the through-roof-pipes. The cables are supported by a portable tripod type anchor point located over the pipe. The fall arrest (secondary) line is routed through the pipe and anchored to the pipe. GRAVITEC COMMENTS: The fall arrest (secondary) line shall not be anchored to the pipes. (Initial investigations determined that the through roof pipes shall not be used as anchor points and rigging shall not place any loads on the pipes.) Another free standing portable system can be introduced to allow PWC an adequate secondary anchor point.

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APPENDIX D - EQUIPMENT OPTIONS

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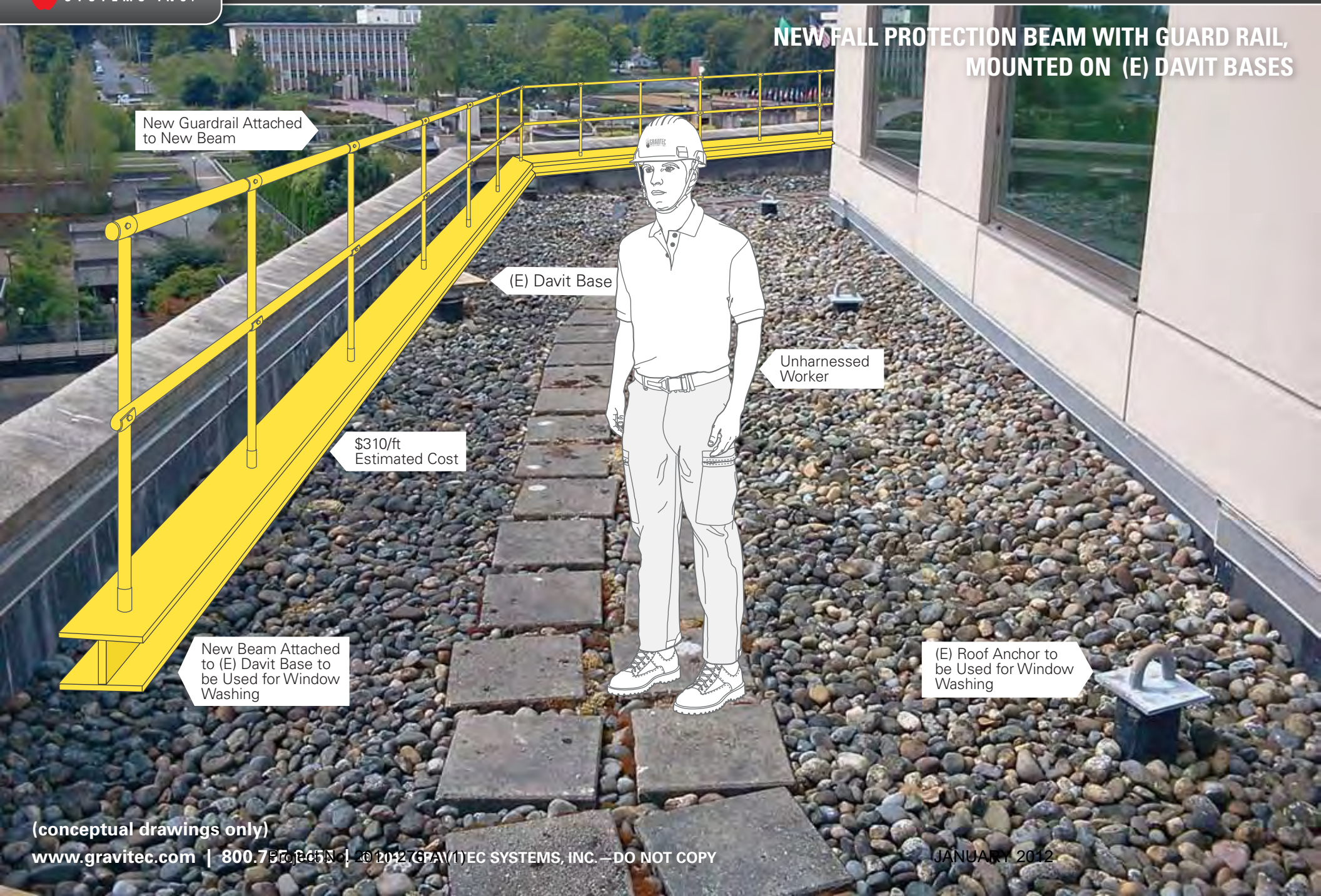
EQUIPMENT OPTION 1

NEW FALL PROTECTION BEAM WITH GUARD RAIL, MOUNTED ON (E) DAVIT BASES



(conceptual drawings only)

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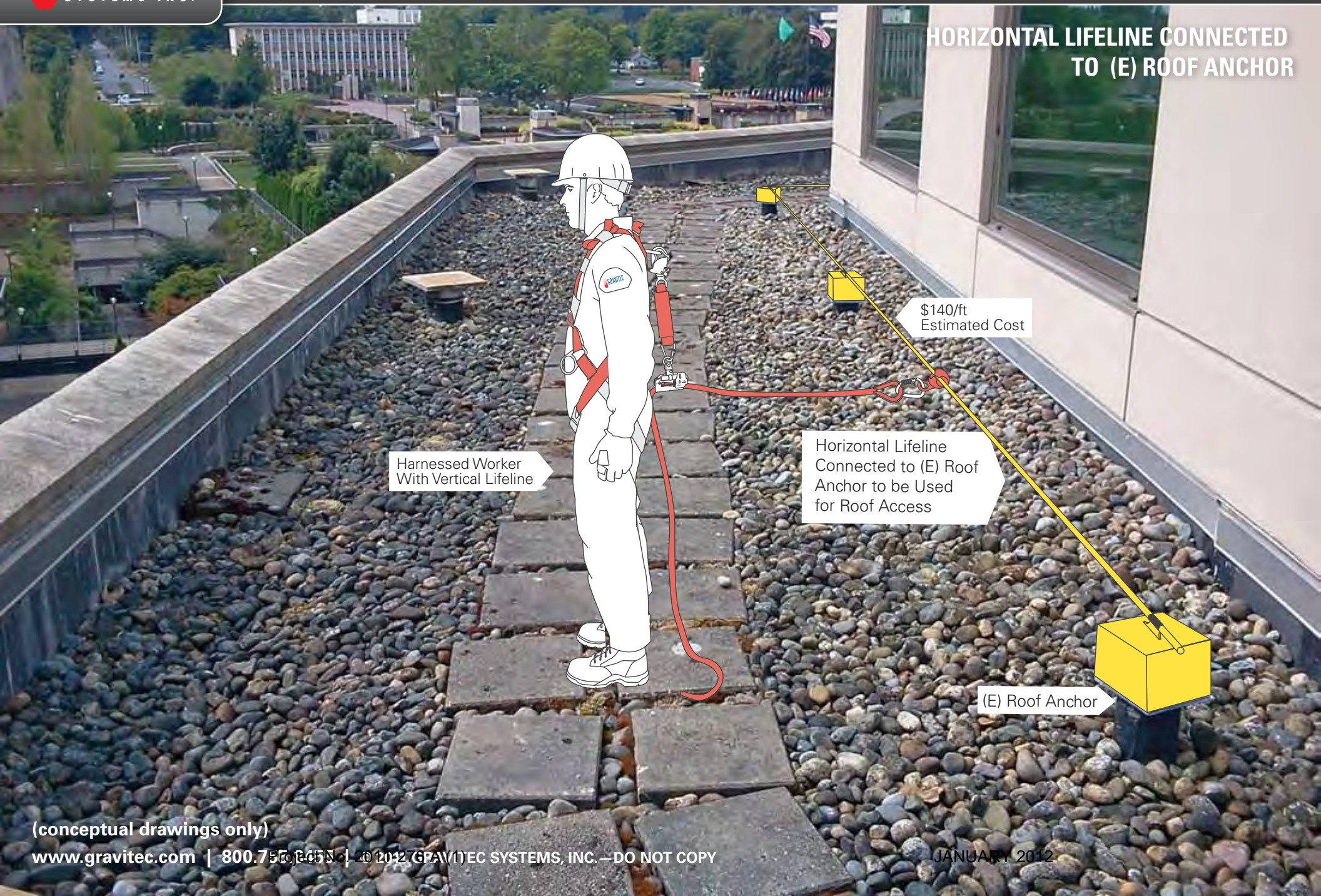
EQUIPMENT OPTION 2

HORIZONTAL LIFELINE CONNECTED TO (E) ROOF ANCHOR



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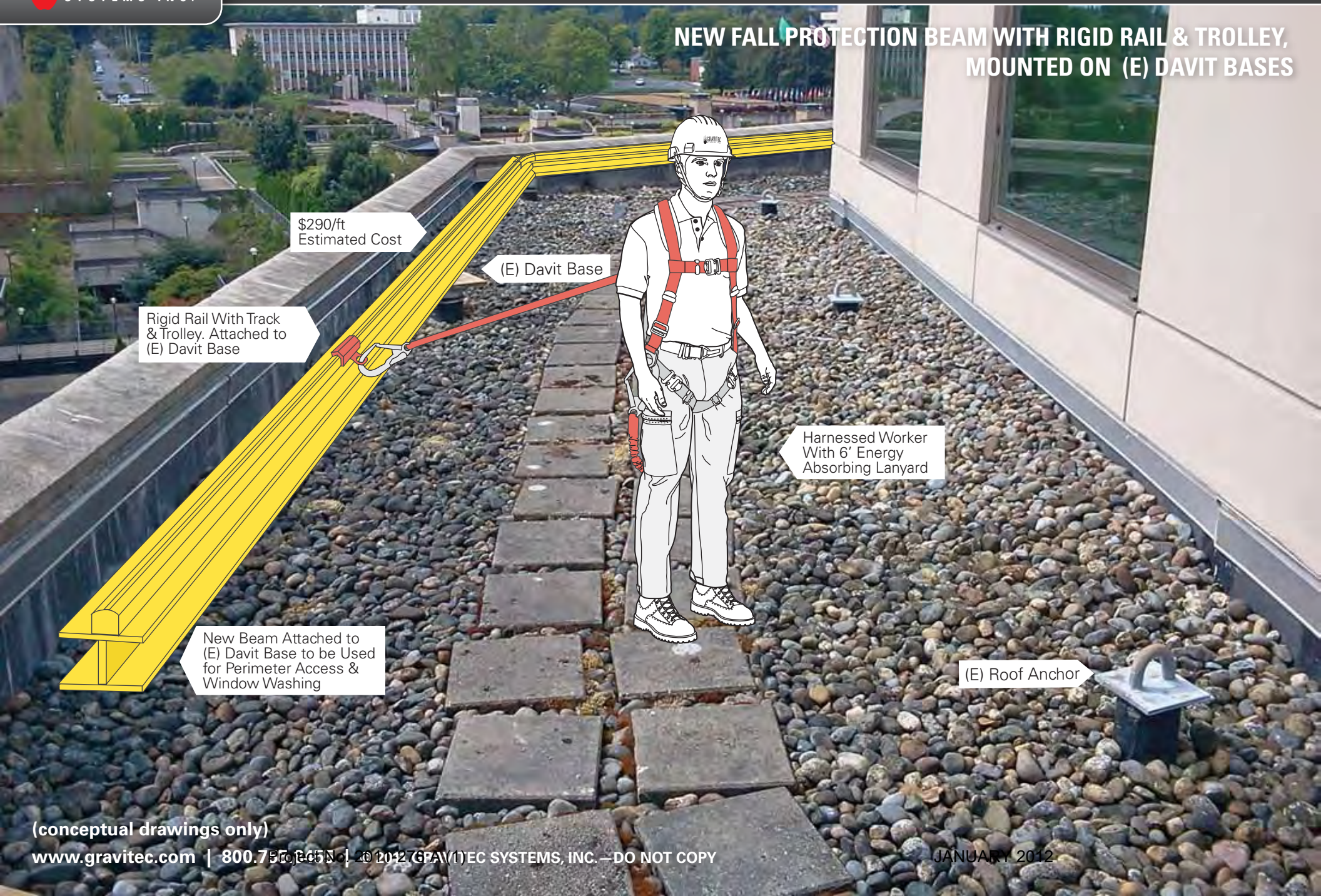
EQUIPMENT OPTION 3

NEW FALL PROTECTION BEAM WITH RIGID RAIL & TROLLEY, MOUNTED ON (E) DAVIT BASES



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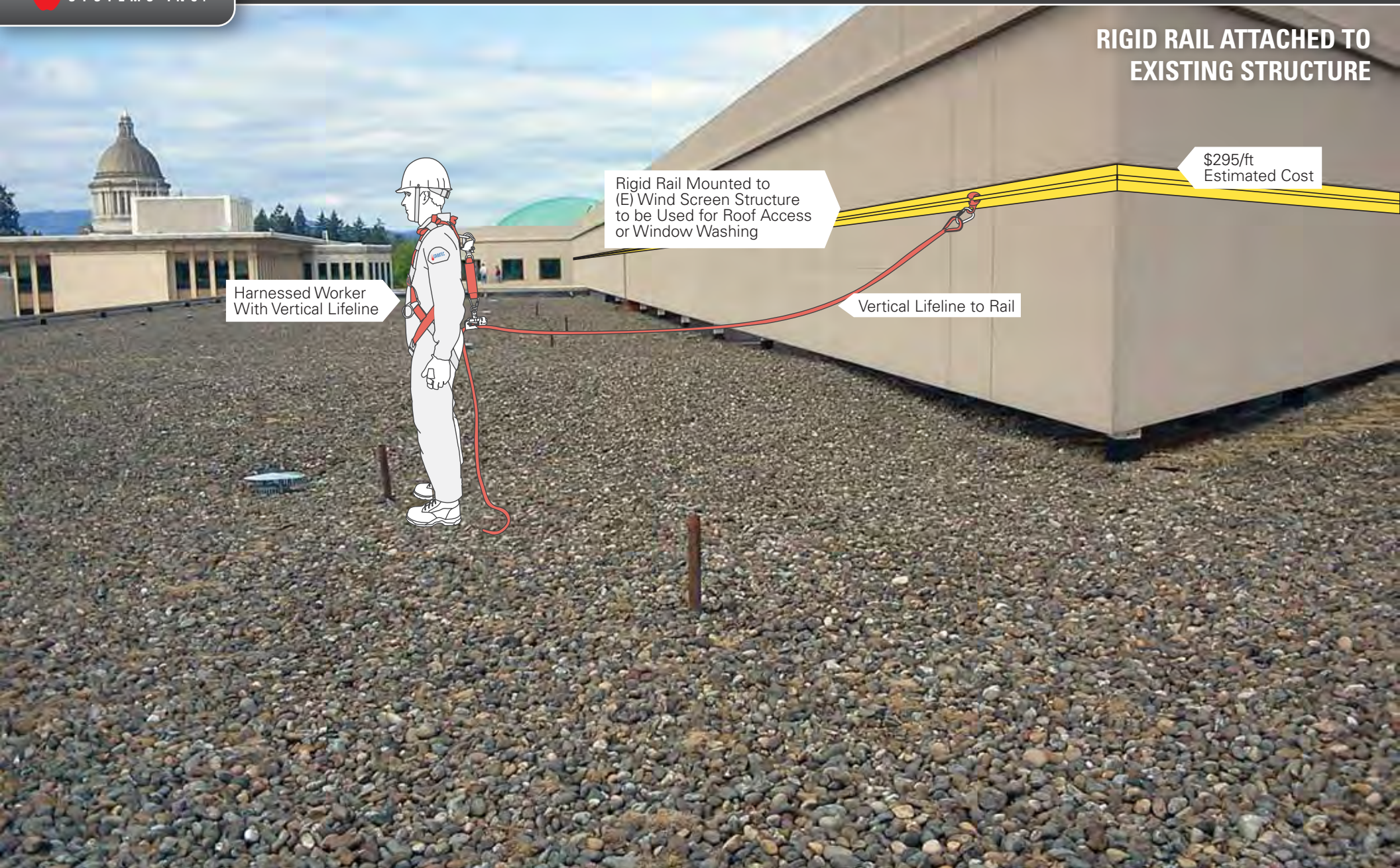
EQUIPMENT OPTION 4

RIGID RAIL ATTACHED TO EXISTING STRUCTURE



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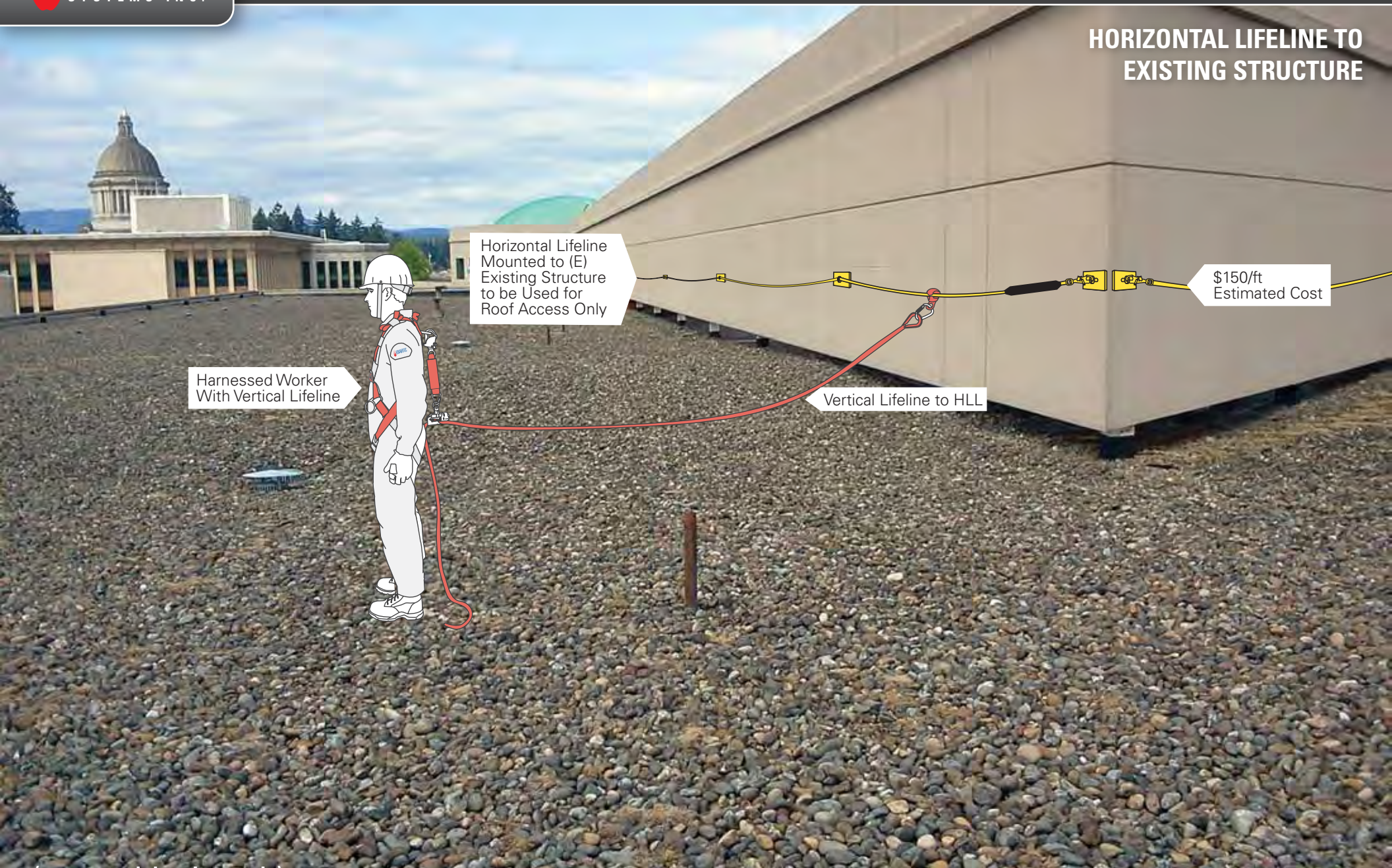
EQUIPMENT OPTION 5

HORIZONTAL LIFELINE TO EXISTING STRUCTURE



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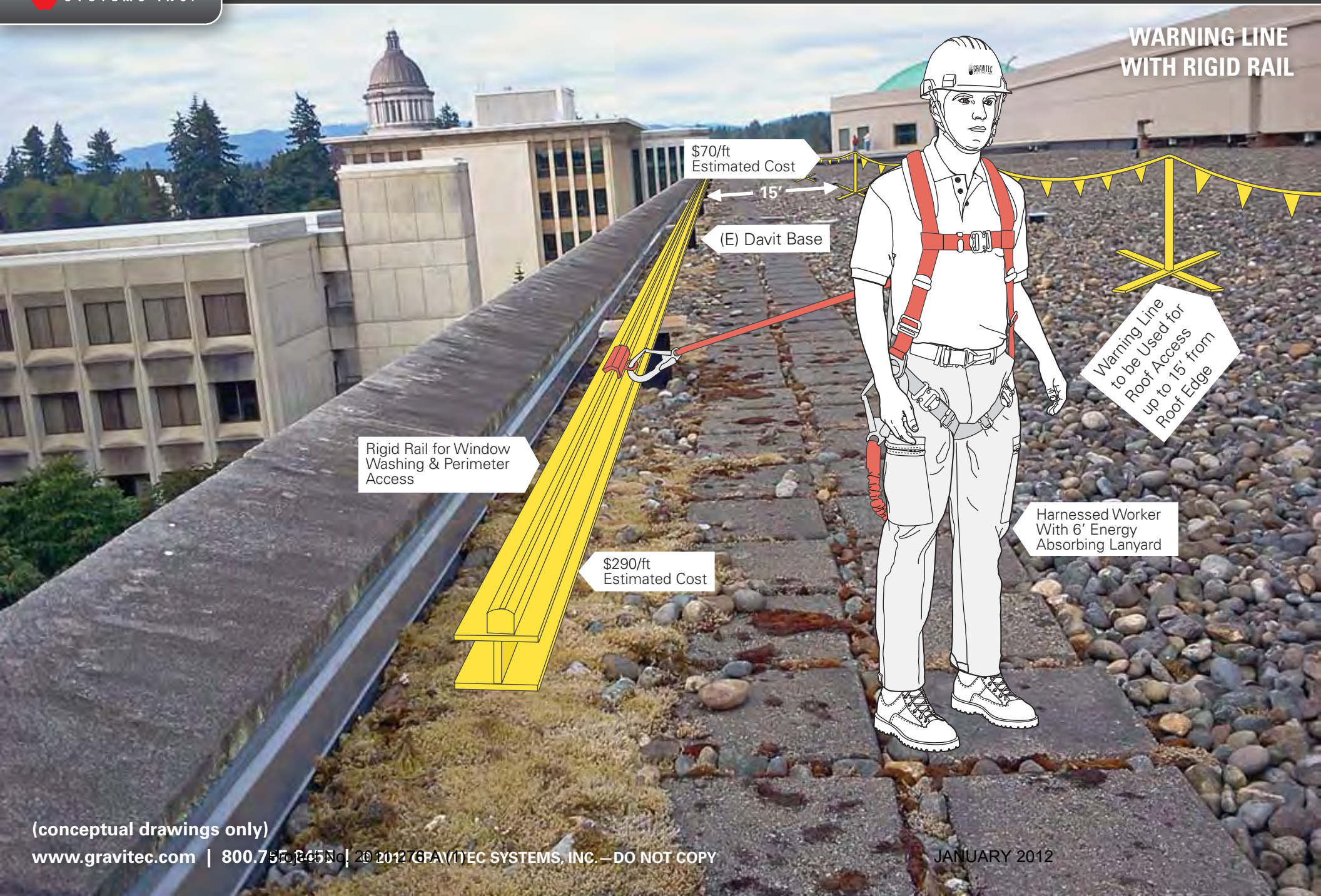
EQUIPMENT OPTION 6



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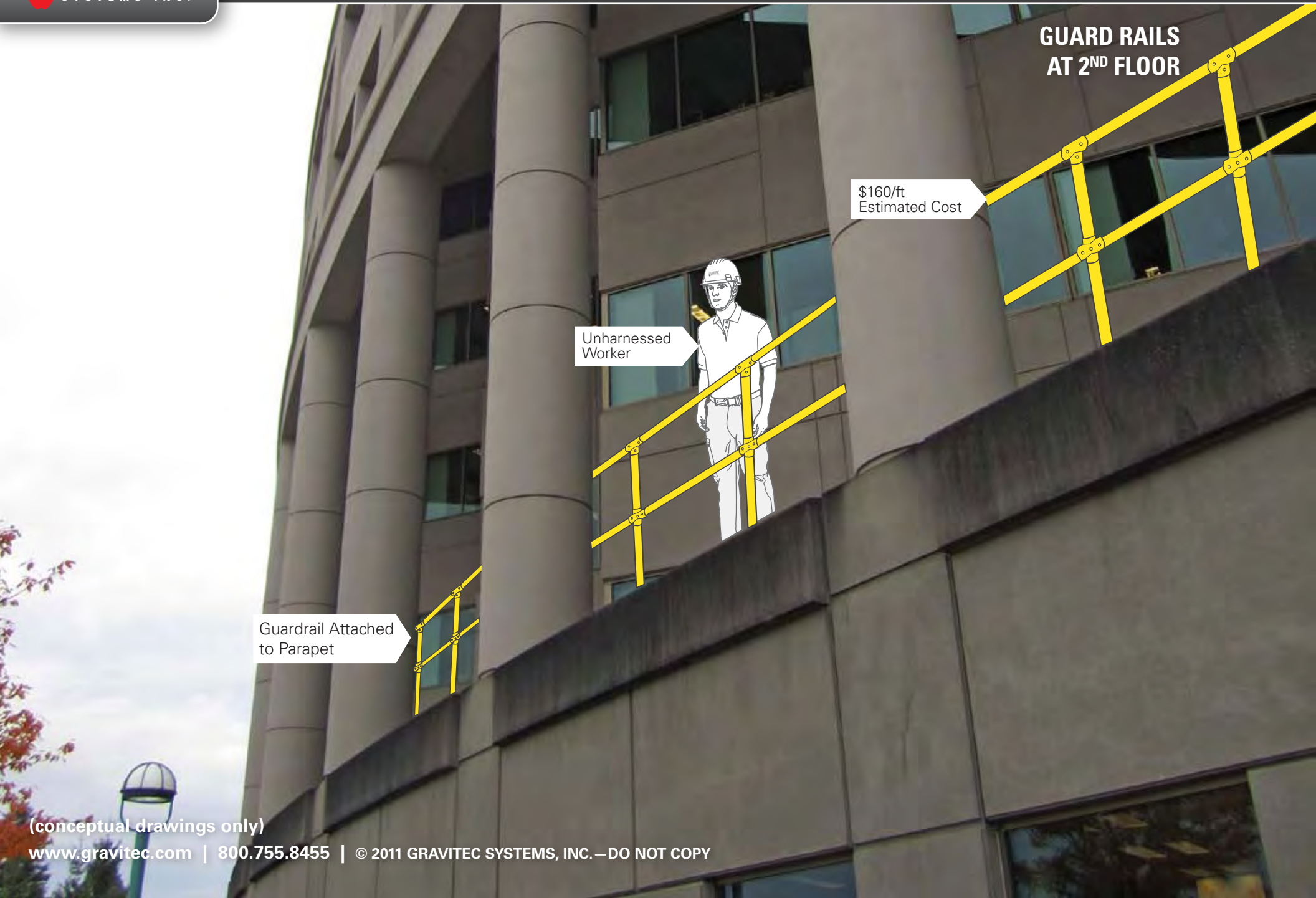
EQUIPMENT OPTION 7



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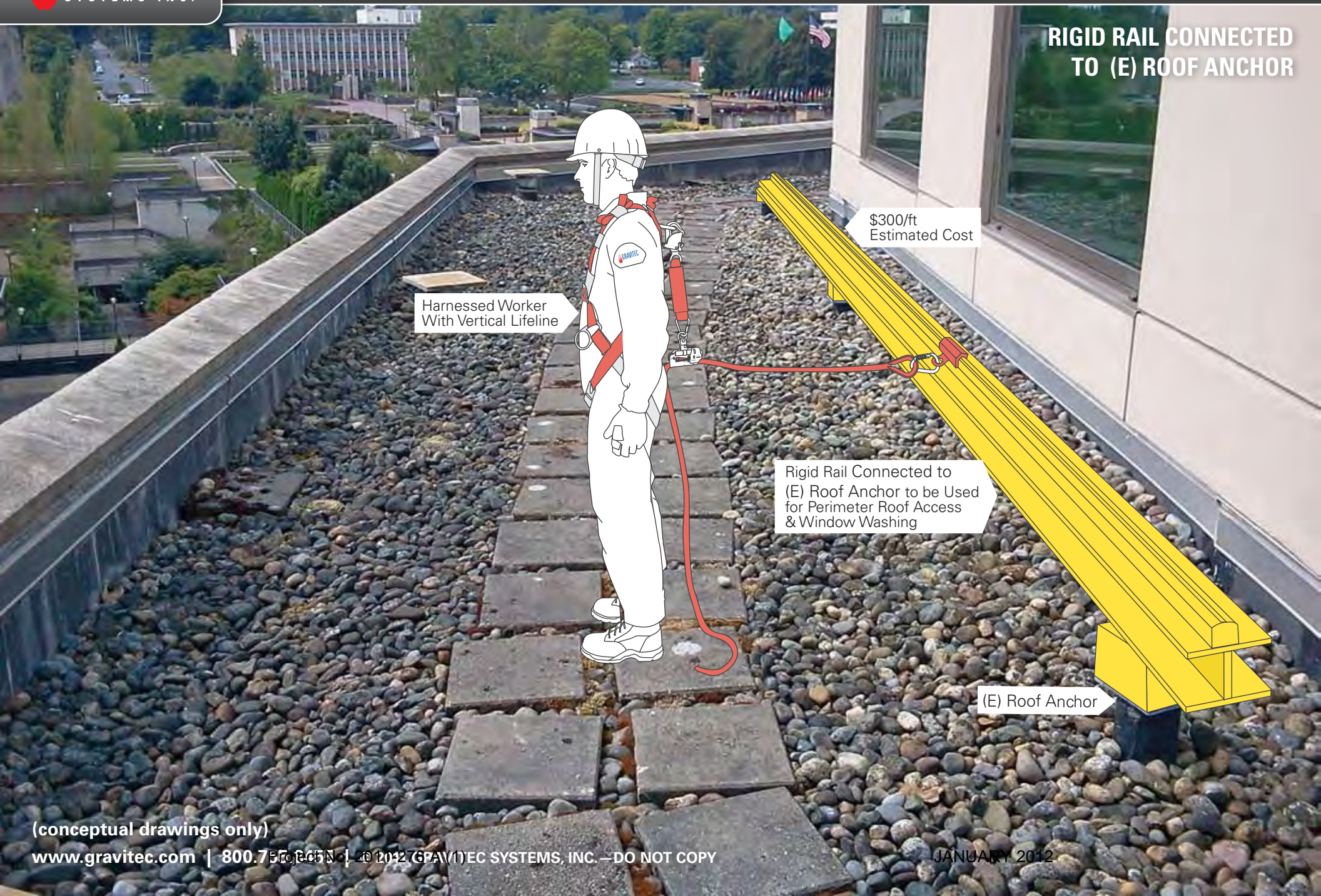
EQUIPMENT OPTION 8

RIGID RAIL CONNECTED TO (E) ROOF ANCHOR



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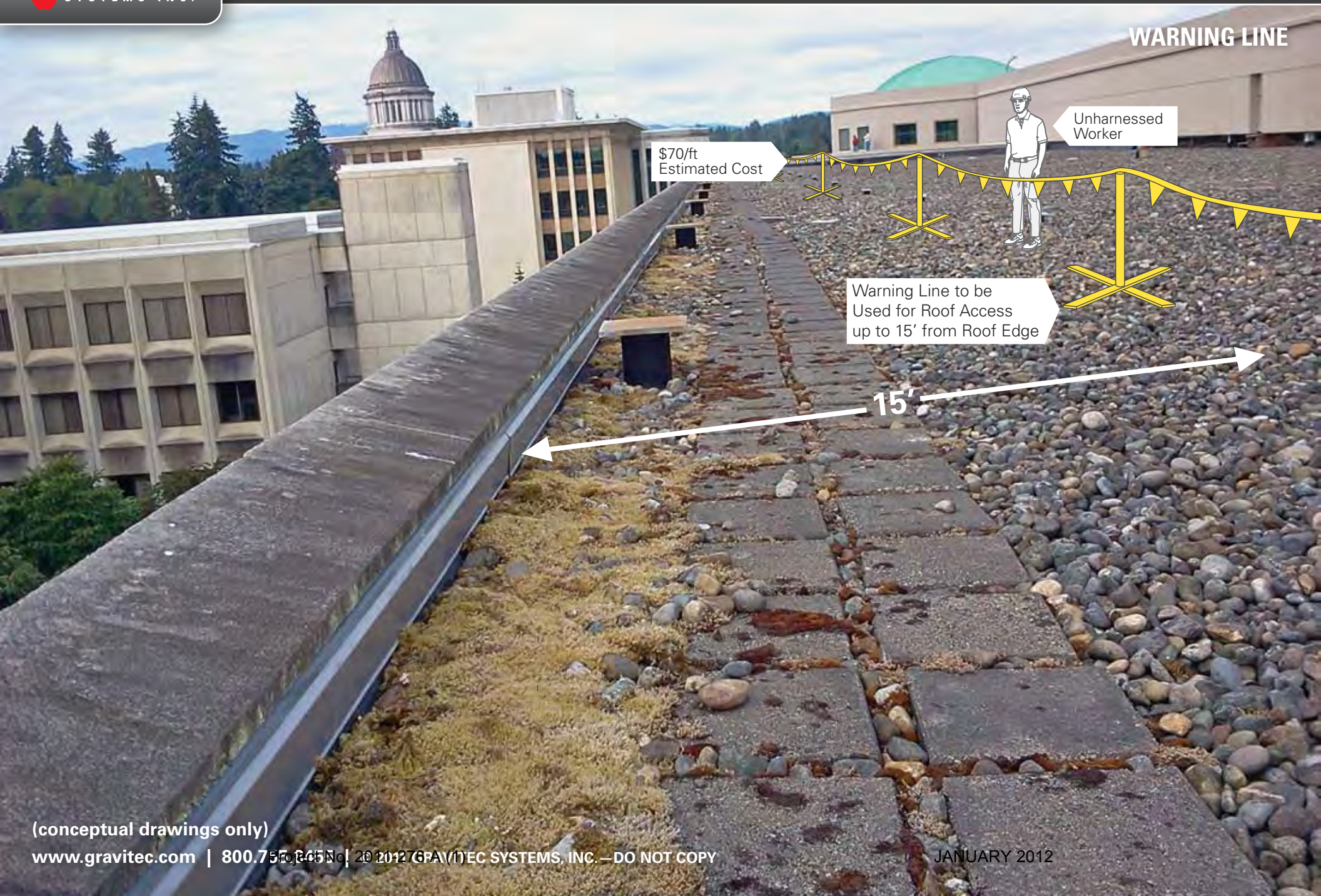
EQUIPMENT OPTION 9



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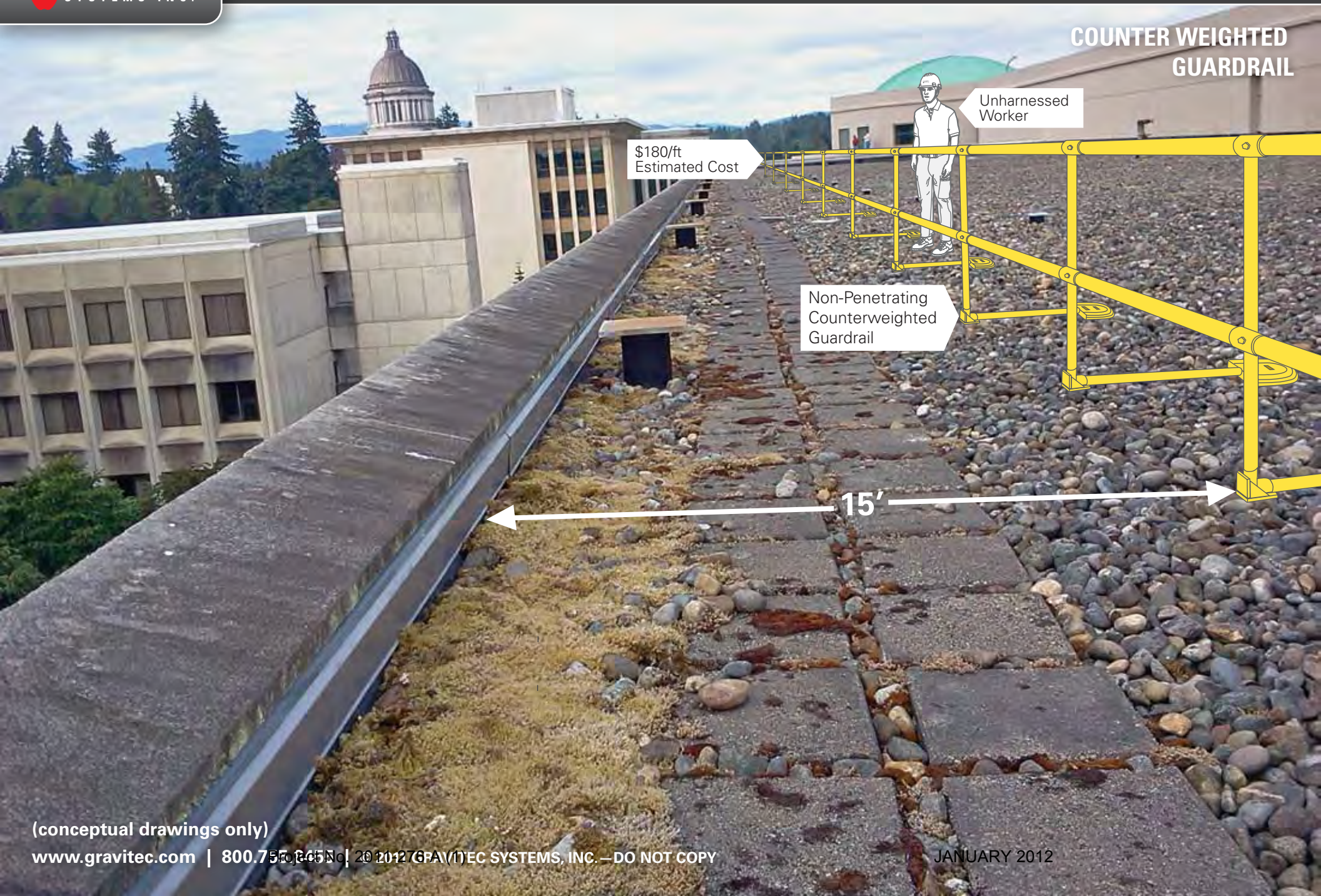
EQUIPMENT OPTION 10



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EQUIPMENT OPTION 11

ANCHOR POINT ON (E) DAVIT BASE

(conceptual drawings only)

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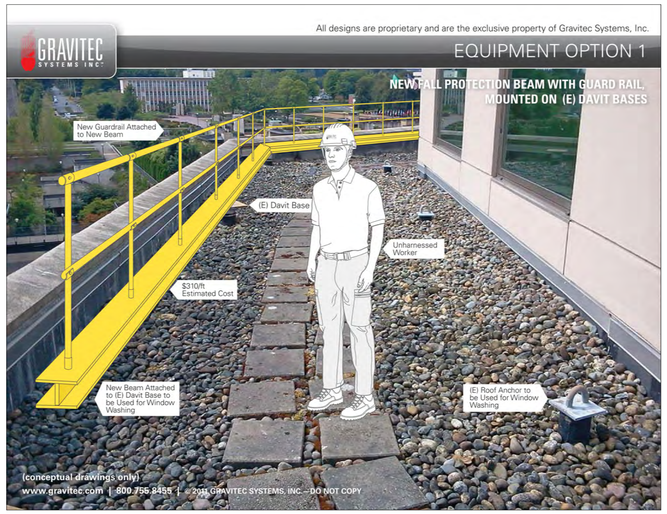
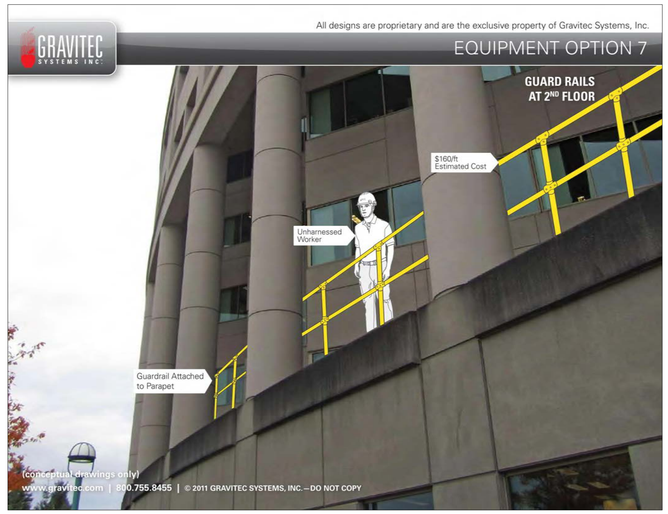
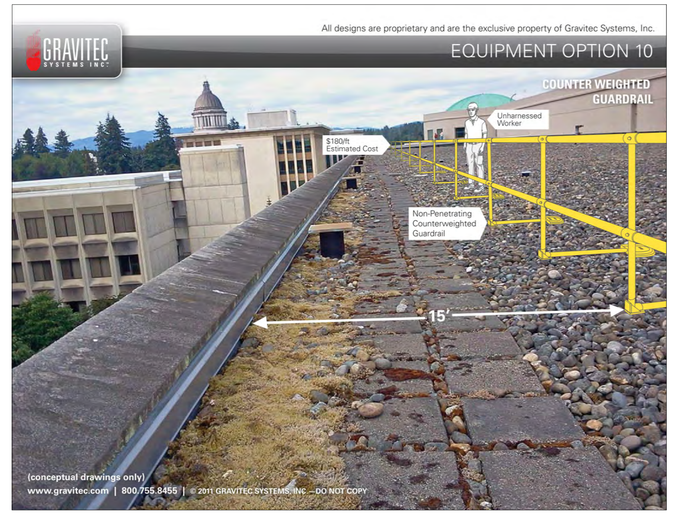
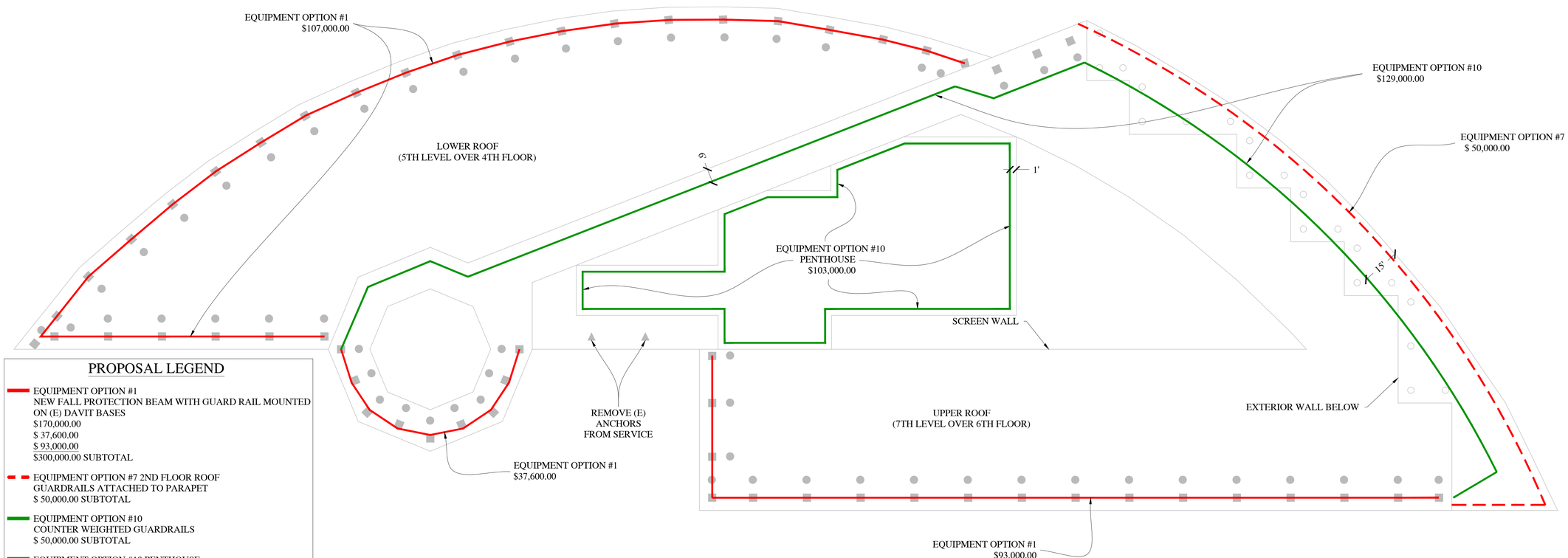
APPENDIX E - SOLUTION PROPOSALS AND COST ESTIMATES









PROPOSAL LEGEND

- EQUIPMENT OPTION #1
  NEW FALL PROTECTION BEAM WITH GUARD RAIL MOUNTED ON (E) DAVIT BASES
  $170,000.00
  $ 37,600.00
  $ 93,000.00
  $300,000.00 SUBTOTAL
- EQUIPMENT OPTION #7 2ND FLOOR ROOF GUARDRAILS ATTACHED TO PARAPET
  $ 50,000.00 SUBTOTAL
- EQUIPMENT OPTION #10
  COUNTER WEIGHTED GUARDRAILS
  $ 50,000.00 SUBTOTAL
- EQUIPMENT OPTION #10 PENTHOUSE
  COUNTER WEIGHTED GUARDRAILS
  $103,000.00 SUBTOTAL

PROPOSAL A: PASSIVE ACCESS (UNHARNESSED)
$503,000.00 TOTAL

EXISTING ANCHOR TYPE LEGEND

- FALL ARREST ANCHOR
- DAVIT PEDESTAL
- THROUGH ROOF ANCHOR
- DAVIT PEDISTAL ON SCREEN WALL

PROPOSAL A: PASSIVE ACCESS (UNHARNESSED)
NO HARNESS REQUIRED FOR MOST ROOF ACCESS

GRAVITEC SYSTEMS INC.™

COMPANY INFO:
Gravitec Systems, Inc.
9453 Coppertop Loop NE
Bainbridge Island, Washington
Phone: (206) 780-2898
Fax: (206) 780-2893

DESIGNING ENG(S): LWC	DATE DESIGNED: 10/25/2011
DRAFTED BY: JDM	DATE DRAFTED: 10/25/2011
CHECKED BY: LWC	DATE CHECKED: 10/25/2011
APPROVED BY: SST	DATE APPROVED: 10/25/2011
REVISION:	DATE REVISED:
REVISION:	DATE REVISED:
REVISION:	DATE REVISED:
REVISION:	DATE REVISED:
REVISION:	DATE REVISED:

CLIENT:
STATE OF WASHINGTON
DEPARTMENT OF NATURAL RESOURCES
OLYMPIA, WA

PROJECT:
NATURAL RESOURCES BUILDING
WINDOW WASHING AND
FALL PROTECTION ANCHOR ASSESSMENT

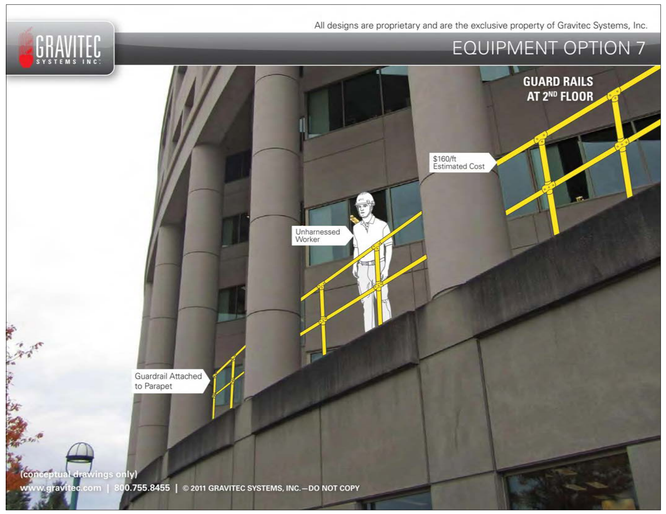
SHEET TITLE:
PROPOSAL A:
PASSIVE ACCESS
(UNHARNESSED)

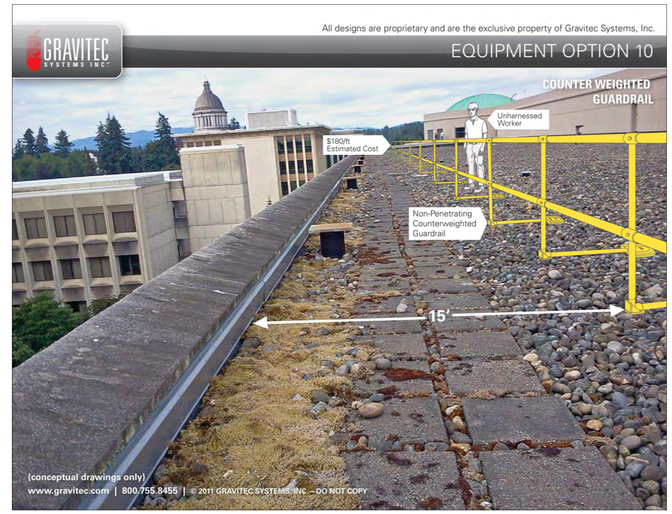
SCALE:

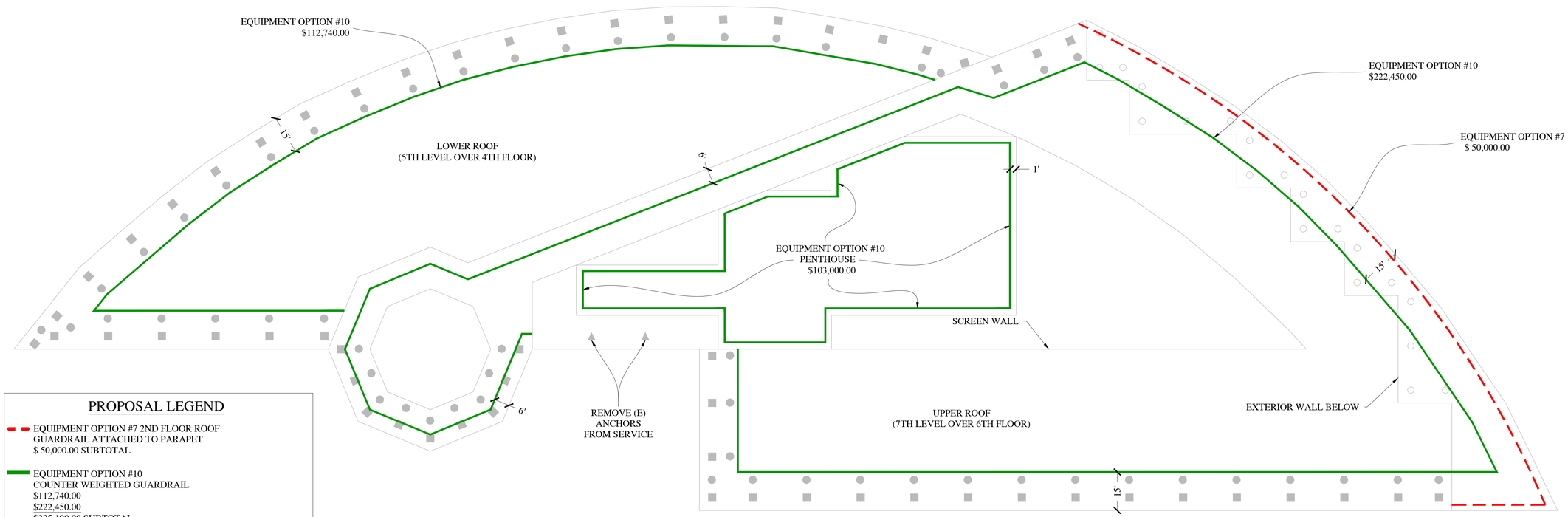
PROJECT NUMBER:
110053

SHEET NUMBER:
1

SHEET 1 OF 4







PROPOSAL LEGEND

- EQUIPMENT OPTION #7 2ND FLOOR ROOF GUARDRAIL ATTACHED TO PARAPET
  $ 50,000.00 SUBTOTAL
- EQUIPMENT OPTION #10
  COUNTER WEIGHTED GUARDRAIL
  $112,740.00
  $222,450.00
  $335,190.00 SUBTOTAL
- EQUIPMENT OPTION #10 PENTHOUSE
  COUNTER WEIGHTED GUARDRAIL
  $103,000.00 SUBTOTAL

PROPOSAL B: COUNTER WEIGHTED GUARDRAIL
PASSIVE ACCESS (UNHARNESSED)
$488,190.00 TOTAL

EXISTING ANCHOR TYPE LEGEND

- FALL ARREST ANCHOR
- DAVIT PEDESTAL
- THROUGH ROOF ANCHOR
- DAVIT PEDISTAL ON SCREEN WALL

PROPOSAL B: COUNTER WEIGHTED GUARDRAIL PASSIVE ACCESS (UNHARNESSED)
(NO HARNESS REQUIRED FOR MOST ROOF ACCESS

GRAVITEC SYSTEMS INC.™

COMPANY INFO:
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Bainbridge Island, Washington
Phone: (206) 780-2898
Fax: (206) 780-2893

DESIGNING ENG(S): LWC	DATE DESIGNED: 10/25/2011
DRAFTED BY: JDM	DATE DRAFTED: 10/25/2011
CHECKED BY: LWC	DATE CHECKED: 10/25/2011
APPROVED BY: SST	DATE APPROVED: 10/25/2011
REVISION:	DATE REVISED:
REVISION:	DATE REVISED:
REVISION:	DATE REVISED:
REVISION:	DATE REVISED:

CLIENT:
STATE OF WASHINGTON
DEPARTMENT OF NATURAL RESOURCES
OLYMPIA, WA

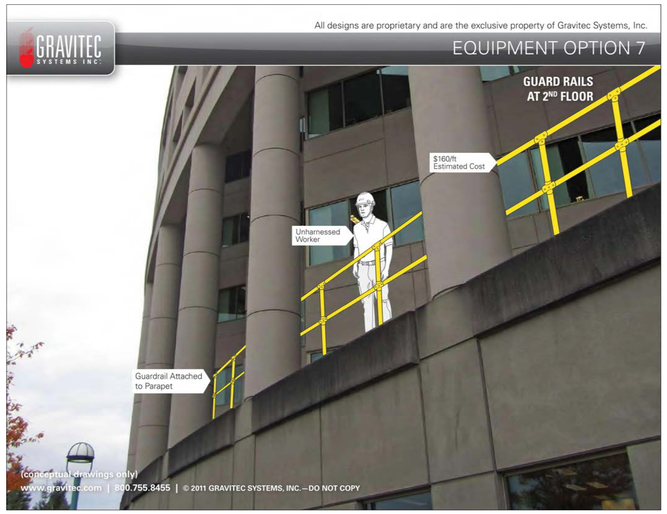
PROJECT:
NATURAL RESOURCES BUILDING
WINDOW WASHING AND
FALL PROTECTION ANCHOR ASSESSMENT

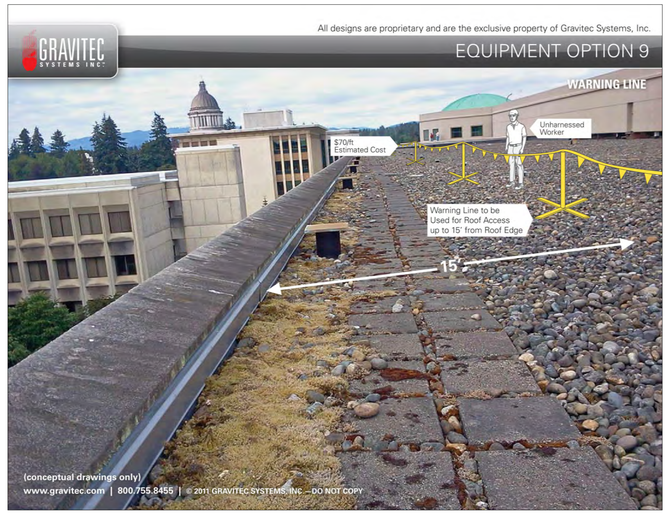
SHEET TITLE:
PROPOSAL B:
COUNTER WEIGHTED GUARDRAIL
PASSIVE ACCESS (UNHARNESSED)

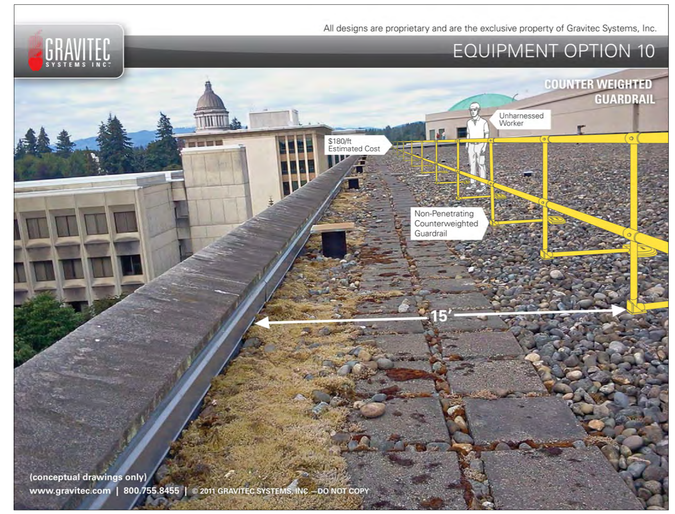
SCALE:

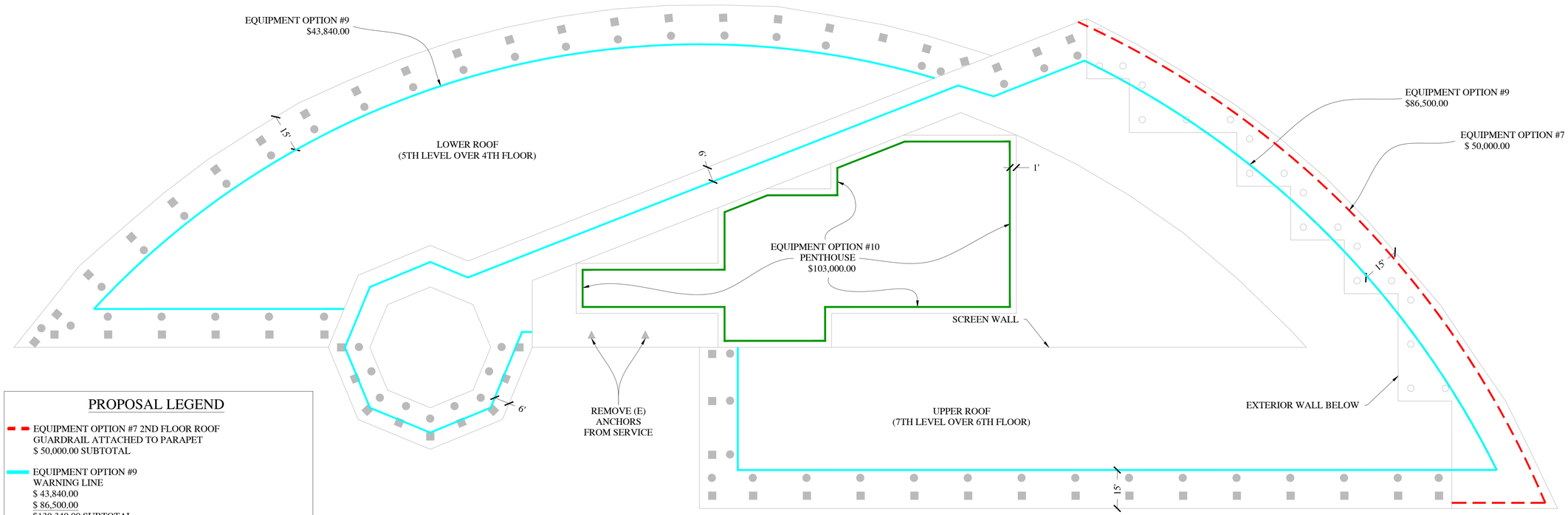
PROJECT NUMBER:
110053

SHEET NUMBER:
2









PROPOSAL LEGEND

- EQUIPMENT OPTION #7 2ND FLOOR ROOF GUARDRAIL ATTACHED TO PARAPET
  $ 50,000.00 SUBTOTAL
- EQUIPMENT OPTION #9
  WARNING LINE
  $ 43,840.00
  $ 86,500.00
  $130,340.00 SUBTOTAL
- EQUIPMENT OPTION #10 PENTHOUSE
  COUNTER WEIGHTED GUARDRAIL
  $103,000.00 SUBTOTAL

PROPOSAL C: LEAST EXPENSIVE
PASSIVE ACCESS (UNHARNESSED)
$283,340.00 TOTAL

EXISTING ANCHOR TYPE LEGEND

- FALL ARREST ANCHOR
- DAVIT PEDESTAL
- THROUGH ROOF ANCHOR
- DAVIT PEDISTAL ON SCREEN WALL

PROPOSAL C: LEAST EXPENSIVE PASSIVE ACCESS (UNHARNESSED)
(NO HARNESS REQUIRED FOR MOST ROOF ACCESS
SOME AREAS REQUIRE SAFETY MONITOR)

GRAVITEC SYSTEMS INC.™

COMPANY INFO:
Gravitec Systems, Inc.
9453 Coppertop Loop NE
Bainbridge Island, Washington
Phone: (206) 780-2898
Fax: (206) 780-2893

DESIGNING ENG(S): LWC	DATE DESIGNED: 10/25/2011
DRAFTED BY: JDM	DATE DRAFTED: 10/25/2011
CHECKED BY: LWC	DATE CHECKED: 10/25/2011
APPROVED BY: SST	DATE APPROVED: 10/25/2011
REVISION:	DATE REVISED:
REVISION:	DATE REVISED:
REVISION:	DATE REVISED:
REVISION:	DATE REVISED:
REVISION:	DATE REVISED:
REVISION:	DATE REVISED:

CLIENT:
STATE OF WASHINGTON
DEPARTMENT OF NATURAL RESOURCES
OLYMPIA, WA

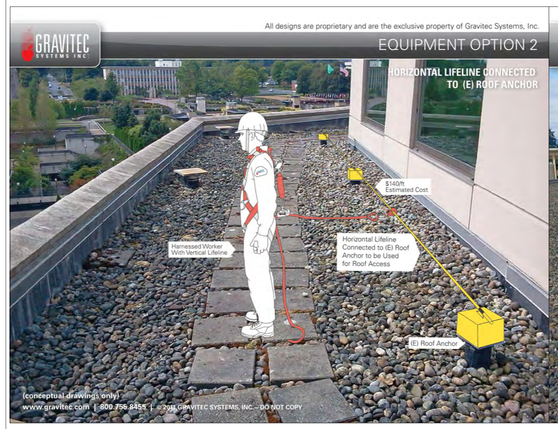
PROJECT:
NATURAL RESOURCES BUILDING
WINDOW WASHING AND
FALL PROTECTION ANCHOR ASSESSMENT

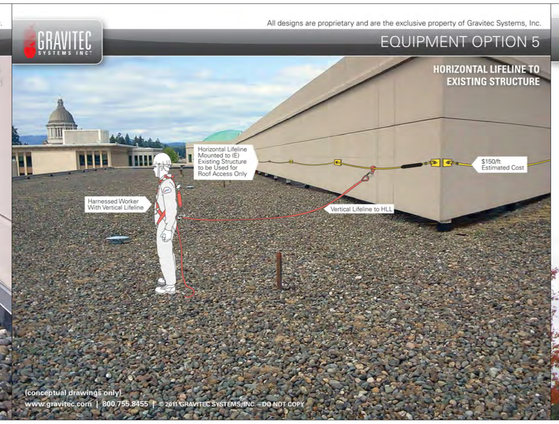
SHEET TITLE:
PROPOSAL C:
LEAST EXPENSIVE
PASSIVE ACCESS (UNHARNESSED)

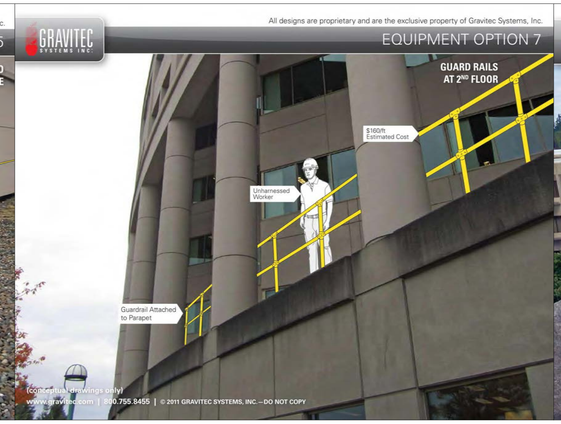
SCALE:

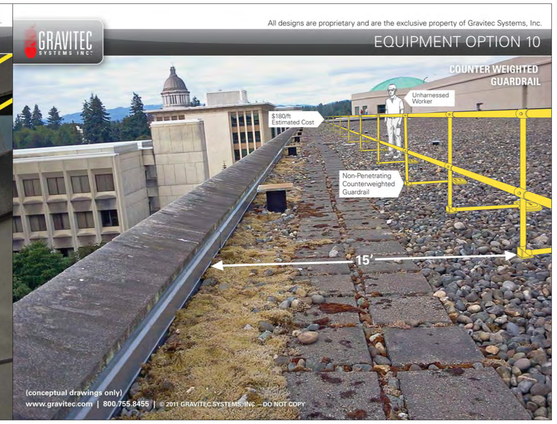
PROJECT NUMBER:
110053

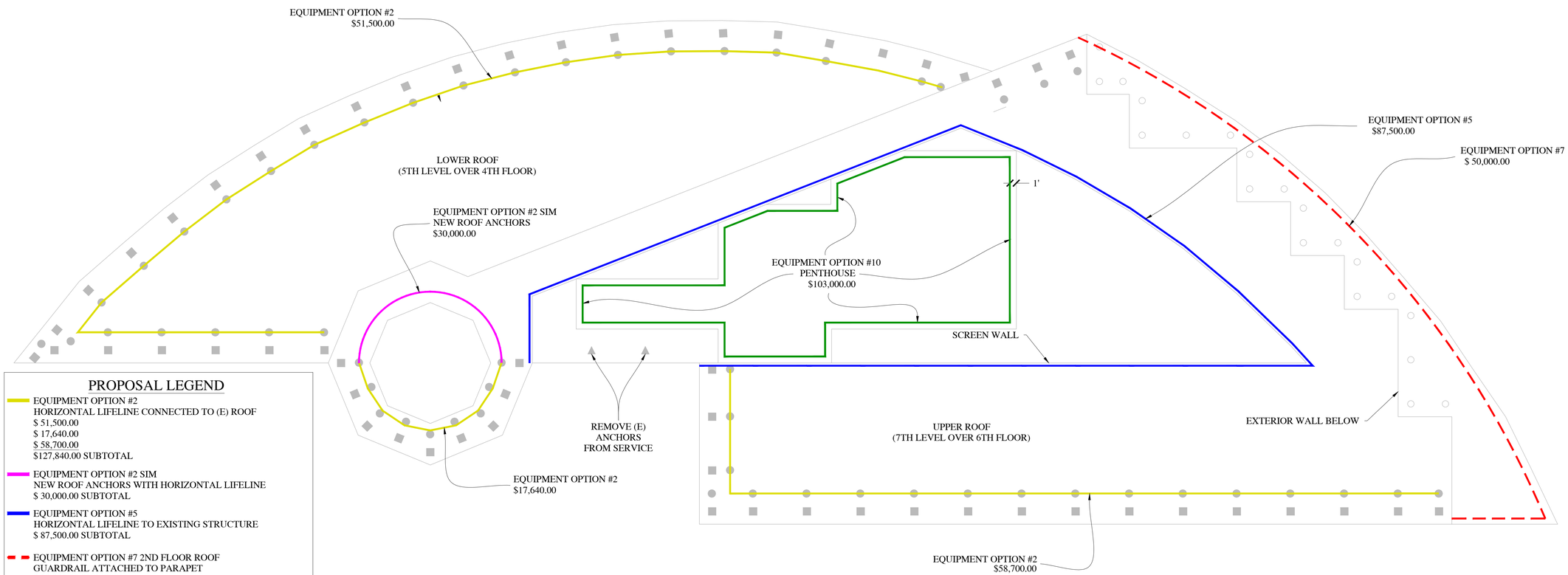
SHEET NUMBER:
3











PROPOSAL LEGEND

- EQUIPMENT OPTION #2
  HORIZONTAL LIFELINE CONNECTED TO (E) ROOF
  $ 51,500.00
  $ 17,640.00
  $ 58,700.00
  $127,840.00 SUBTOTAL
- EQUIPMENT OPTION #2 SIM
  NEW ROOF ANCHORS WITH HORIZONTAL LIFELINE
  $ 30,000.00 SUBTOTAL
- EQUIPMENT OPTION #5
  HORIZONTAL LIFELINE TO EXISTING STRUCTURE
  $ 87,500.00 SUBTOTAL
- EQUIPMENT OPTION #7 2ND FLOOR ROOF
  GUARDRAIL ATTACHED TO PARAPET
  $ 50,000.00 SUBTOTAL
- EQUIPMENT OPTION #10 PENTHOUSE
  COUNTER WEIGHTED GUARDRAIL
  $103,000.00 SUBTOTAL

PROPOSAL D: HORIZONTAL LIFELINE (HARNESSED)
$398,340.00 TOTAL

EXISTING ANCHOR TYPE LEGEND

- FALL ARREST ANCHOR
- DAVIT PEDESTAL
- THROUGH ROOF ANCHOR
- DAVIT PEDISTAL ON SCREEN WALL

PROPOSAL D: HORIZONTAL LIFELINE (HARNESSED)
HARNESS REQUIRED FOR ALL ROOF ACCESS

GRAVITEC SYSTEMS INC.™

COMPANY INFO:
Gravitec Systems, Inc.
9453 Coppertop Loop NE
Bainbridge Island, Washington
Phone: (206) 780-2898
Fax: (206) 780-2893

DESIGNING ENG(S): LWC	DATE DESIGNED: 10/25/2011
DRAFTED BY: JDM	DATE DRAFTED: 10/25/2011
CHECKED BY: LWC	DATE CHECKED: 10/25/2011
APPROVED BY: SST	DATE APPROVED: 10/25/2011
REVISION:	DATE REVISED:
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(HARNESSED)

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SHEET NUMBER:
4

SHEET 4 OF 4

PROTECTING WORKERS AT HEIGHT

engineering ▪ training ▪ testing ▪ equipment

GRAVITEC SYSTEMS, INC.
9453 Coppertop Loop NE
Bainbridge Island, WA 98110

800 755 8455 www.gravitec.com

GRAVITEC SYSTEMS INC.™

ENVIRONMENTAL REPORT

PENDING FINAL ISSUANCE JANUARY 2012

ENVIRONMENTAL REPORT *PENDING*

PBS Engineering + Environmental is the SMSA Team's hazardous materials subconsultant, contracted directly by the State of Washington DES.

PBS has extensive public sector experience including a twenty-year history of projects for the State of Washington.

PBS' Health & Safety consulting practice provides Industrial Hygiene Assessments and Hazardous Building Materials inspections. These typically include inspections for the presence of asbestos, lead, PCBs, and mercury. In addition, the group provides abatement design, training, and indoor air quality investigations including fungal evaluations.

For the NRB Roof Replacement & EIFS Repairs project, PBS is currently conducting a field investigation to test air quality conditions and collect data for analysis and recommendations. PBS' Environmental Report and cost estimates are pending.

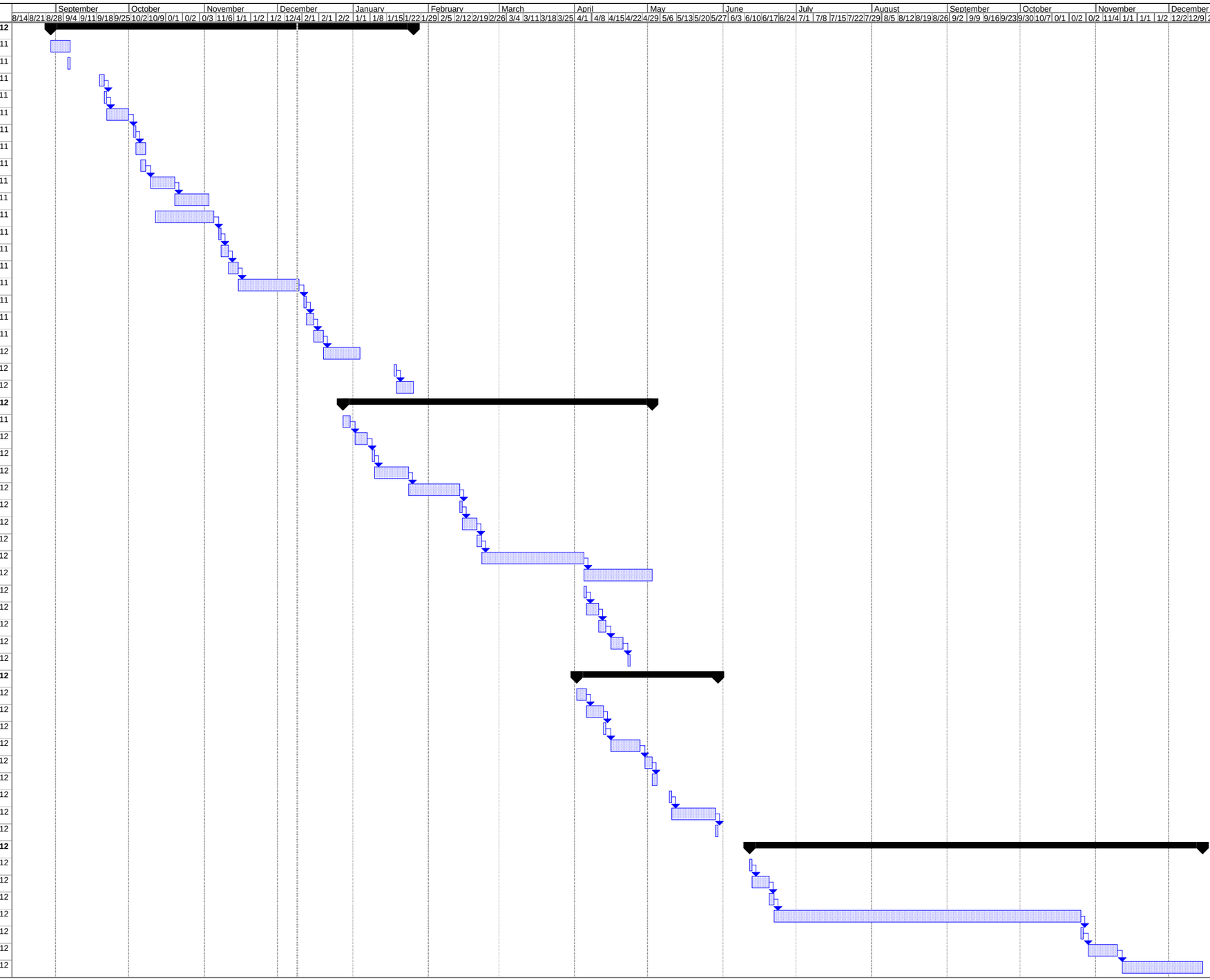
In order to produce preliminary cost estimates, SMSA has made some assumptions regarding the impacts of the forthcoming PBS Environmental Report. For assumptions, *refer to the Report Summary & Overview.*

APPENDIX

- SCHEDULE
- WALL PANEL PRODUCT INFORMATION SHEETS

11-276 NRB - Roof Replacement and Exterior Repairs
Preliminary Schedule

ID	Task Name	Duration	Start	Finish
1	**Investigation & Schematic Design Report**	**107 days**	**Tue 8/30/11**	**Wed 1/25/12**
2	Review plans and produce proposal	6 days	Tue 8/30/11	Tue 9/6/11
3	Submitted Fee proposal	1 day	Tue 9/6/11	Tue 9/6/11
4	Generate investigation plan	2 days	Mon 9/19/11	Tue 9/20/11
5	Fee review telcon	1 day	Wed 9/21/11	Wed 9/21/11
6	GA Provide contract	7 days	Thu 9/22/11	Fri 9/30/11
7	Sign contract	1 day	Mon 10/3/11	Mon 10/3/11
8	In-house preparation for Site investigation-field work	4 days	Tue 10/4/11	Fri 10/7/11
9	Meeting at NRB to coordinate with Client & GA	2 days	Thu 10/6/11	Fri 10/7/11
10	Site investigation/ field work	8 days	Mon 10/10/11	Wed 10/19/11
11	Allowance for weather delays	10 days	Thu 10/20/11	Wed 11/2/11
12	Record process data	18 days	Wed 10/12/11	Fri 11/4/11
13	Meet w/ Owners rep's. - review field findings	1 day	Mon 11/7/11	Mon 11/7/11
14	Develop repair options/recommendations	3 days	Tue 11/8/11	Thu 11/10/11
15	Cost estimate	2 days	Fri 11/11/11	Mon 11/14/11
16	Produce schematic report	19 days	Tue 11/15/11	Fri 12/9/11
17	Report submittal	1 day	Mon 12/12/11	Mon 12/12/11
18	Owner comments	3 days	Tue 12/13/11	Thu 12/15/11
19	Meeting to review comments/responses	2 days	Fri 12/16/11	Mon 12/19/11
20	Final report submittal	11 days	Tue 12/20/11	Tue 1/3/12
21	Receive PBS report	1 day	Wed 1/18/12	Wed 1/18/12
22	Review PBS impacts to SMSA Final Report	5 days	Thu 1/19/12	Wed 1/25/12
23	**DD and CD Phases**	**91 days**	**Wed 12/28/11**	**Wed 5/2/12**
24	Prepare DD/CD fee proposal	3 days	Wed 12/28/11	Fri 12/30/11
25	DES prepare contract extension	5 days	Mon 1/2/12	Fri 1/6/12
26	SMSA sign contract extension	1 day	Mon 1/9/12	Mon 1/9/12
27	DES sign contract extension	10 days	Tue 1/10/12	Mon 1/23/12
28	Develop DD documents for review	15 days	Tue 1/24/12	Mon 2/13/12
29	DD submittal to DES	1 day	Tue 2/14/12	Tue 2/14/12
30	DES review & comments of DD submittal	4 days	Wed 2/15/12	Mon 2/20/12
31	Submittal review meeting @ DES	2 days	Tue 2/21/12	Wed 2/22/12
32	Construction Document production	30 days	Thu 2/23/12	Wed 4/4/12
33	Building permit acquisition	20 days	Thu 4/5/12	Wed 5/2/12
34	CD 95% submittal	1 day	Thu 4/5/12	Thu 4/5/12
35	DES review & comments of CD 95% submittal	3 days	Fri 4/6/12	Tue 4/10/12
36	Submittal review meeting @ DES	3 days	Wed 4/11/12	Fri 4/13/12
37	CD 100% document production	5 days	Mon 4/16/12	Fri 4/20/12
38	CD 100% submittal	1 day	Mon 4/23/12	Mon 4/23/12
39	**Bidding Phase**	**42 days**	**Mon 4/2/12**	**Tue 5/29/12**
40	Bidding & CA Phases Fee Proposal	4 days	Mon 4/2/12	Thu 4/5/12
41	DES prepare contract extension	5 days	Fri 4/6/12	Thu 4/12/12
42	SMSA sign contract extension	1 day	Fri 4/13/12	Fri 4/13/12
43	DES sign SMSA contract extension	10 days	Mon 4/16/12	Fri 4/27/12
44	Bid Document sign off by DES	3 days	Mon 4/30/12	Wed 5/2/12
45	Bid Documents to Printer / advertisement	2 days	Thu 5/3/12	Fri 5/4/12
46	Pre Bid Walk Thru	1 day	Thu 5/10/12	Thu 5/10/12
47	Bid Period	12 days	Fri 5/11/12	Mon 5/28/12
48	Bid Opening	1 day	Tue 5/29/12	Tue 5/29/12
49	**Construction Administration**	**134 days?**	**Tue 6/12/12**	**Fri 12/14/12**
50	Sign Construction Contract	1 day?	Tue 6/12/12	Tue 6/12/12
51	Pre-construction Meeting	5 days	Wed 6/13/12	Tue 6/19/12
52	Notice to Proceed	2 days	Wed 6/20/12	Thu 6/21/12
53	Construction	90 days	Fri 6/22/12	Thu 10/25/12
54	Substantial Completion	1 day	Fri 10/26/12	Fri 10/26/12
55	Final Completion	10 days	Mon 10/29/12	Fri 11/9/12
56	Project Close Out	25 days	Mon 11/12/12	Fri 12/14/12



12-9-11 | Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

NorthClad® rainscreen solutions

NorthClad® AL

Aluminum Panel Series

Sales & Support

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AL Product Literature

Product Home
Product Brochure (pdf)
Guide Specification
Testing Data (pdf)
Installation Instructions
Color Charts
LEED® Credit
Order Literature

AL Details

Without Insulation
With Insulation

AL Projects and Images

Photo Gallery

Other Products

ACM Aluminum Composite Panels
EF Exposed Fastener Panels
DS Designer Series
NorthClad® Home

How can we help?

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Introducing the NorthClad® AL Aluminum Panel System

The NorthClad® AL standard panel systems are ideal for a functional, yet versatile vented rainscreen design. With excellent resistance to extreme weather conditions, the AL standard panel system will perform for many years and provide a significant return on investment.

- Standard and custom options
- Precision fabricated modular design
- Ventilated rainscreen design for a high performance building envelope
- PVDF (Kynar®/Hylar®) paint for long term color retention
- Fully tested for air, water and structural performance
- Tested for ASTM 283, ASTM 330, ASTM 331, AAMA 508-7
- Very Flat surface without visible sealant in the reveals
- Proven sheet metal details
- Installation is quick and easy
- 20 year paint finish warranty
- Complete flashing systems available

Green Building Assistance & LEED® Credit Potential.
Base material contains 50%+ recycled content. LEED® MR Credit 4.
Several paint options with SRI value greater than 29. LEED® SS Credit 7.
All products are 100% recyclable to assist in waste stream diversion. LEED® MR Credit 2.
Manufactured in the Pacific Northwest by a local workforce.

Eklutna Estates
Anchorage, Alaska
Cook Inlet Housing Authority

Material: AL Series
Color: Stone White

More Projects

View and download details.

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NorthClad® rainscreen solutions

NorthClad® ACM

Aluminum Composite Panels

Sales & Support

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ACM Product Literature

Product Home
Product Brochure (pdf)
Guide Specification
Testing Data (pdf)
Installation Instructions
Color Charts
LEED® Credit
Order Literature
Wet Joint Option (pdf)

ACM Details

Without Insulation
With Insulation

ACM Projects and Images

Photo Gallery

Other Products

AL Aluminum Panel System
EF Exposed Fastener Panels
CL Series Column Cover Systems
DS Designer Series

How can we help?

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Introducing the NorthClad® ACM Aluminum Composite Panel Rainscreen System

ACM provides a flat surface comparable to much thicker aluminum, at a more reasonable price. When you desire larger panel modules or panels with greater impact resistance, aluminum composite material is the way to go.

- Tested for AAMA 508-7, Pressure Equalized Rain Screen System
- Engineered to provide superior wind uplift resistance
- Tested for air, water, and structural per ASTM 283, 330, and 331
- Made in the USA by union craftsmen
- 2 layers of aluminum sandwiching a resin core
- Fire rated cores are also available
- Panels feature coil-coated Kynar paint
- 20 year finish warranty
- Drained, back-ventilated design
- Combine with our flashing systems for a high quality facade

Green Building Assistance & LEED® Credit Potential.
Base material contains 50%+ recycled content. LEED® MR Credit 4.
Several paint options with SRI value greater than 29. LEED® SS Credit 7.
All products are 100% recyclable to assist in waste stream diversion. LEED® MR Credit 2.
Manufactured in the Pacific Northwest by a local workforce.

Seattle Mini

Auto Dealership
Seattle, Washington
Helix Design Group

More Projects

View and download details.

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Why StoneLite?
Technical Info
Specification
Testing
Stones Available
Finishes

What is StoneLite®?

StoneLite® panels are composite wall panels made up of a thin natural stone veneer reinforced with an aluminum honeycomb backing. The stone veneer can be almost any stone including granite, marble, limestone, slate and sandstone.

Combining the aerospace technology of aluminum honeycomb with the timeless beauty of natural granite, marble and limestone, StoneLite® can be used for a wide variety of applications including those typically considered weight or cost-prohibitive. They have been used extensively in exterior, interior, renovation, elevator, and specialty applications.

StoneLite® weighs only 3.3 lbs./sq. ft. (16 kg/sq. m) about the same as 1/4-inch (6 mm) thick glass, which is approximately 80% less weight than solid stone. This weight savings alone provides huge savings in installation labor, structural requirements, and installing time.

For over a century, Indiana Limestone Company has been providing the world's finest Indiana Limestone to legendary architects and builders as they construct buildings that inspire and endure. Let us work with you to bring your vision to reality. Discover the possibilities of custom cut stone at IndianaLimestoneCompany.com

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