Report To
City of Evanston
Department of Facility Management
2100 Ridge Avenue
Evanston, Illinois

EVALUATION OF CIVIC CENTER ROOFS

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BTC

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**CITY OF EVANSTON**

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EVALUATION OF CIVIC CENTER ROOFS
CITY OF EVANSTON

As authorized by signed agreement, Building Technology Consultants, PC (BTC) performed an evaluation of the existing roofing systems at Evanston Civic Center. This report indicates our findings, conclusions, and recommendations.

1. BACKGROUND INFORMATION

1.1 Building Construction

The Evanston Civic Center is a masonry structure built in 1909. The building houses many of the City of Evanston Departments, including the City Manager, the Council Chambers, and the Health, Legal, and Human Resources Departments.

The Civic Center encompasses approximately 30,500 square feet of slate roof area divided into two separate areas of construction. The original building includes approximately 10,000 square feet of roof area, and an addition built in 1919 includes approximately 20,500 square feet of roof area. (See Figure 1 of Appendix A for a building roof plan.) The roof over the original portion of the building consists of slate roofing on felt underlayment on gap sheathing wood planks supported by wood framing. The 1919 addition's roof consists of slate roofing on felt underlayment applied over a layer of plywood and cast-in-place gypsum roof deck. This roof deck is supported on a steel framing system.

The building's steep roofs drain to lead-coated copper-lined gutters with external downspouts. The exterior of the gutters is covered with a decorative sheet metal pre-formed cornice that steps back into the masonry walls below.

There are two circular low-slope roofs along the east elevation of the building and two rectangular low-slope roofs on the first and second levels of the building over the west entrance to the building. In addition, there is a small, lead-coated copper low-slope roof on the original building's main roof at the southeast corner of the building. These low-slope roofs are also shown in Figure 1 and are identified as Low-Slope Roofs 1 through 5.

The circular roofs have decorative painted galvanized metal balustrades. These roofs drain to perimeter lead-coated copper gutters that are mitered into the steep roof gutters. The existing roofing system on these roofs consists of a modified-bitumen roof membrane.
There are 8 roof dormers at the eaves, four of which are directly connected to the mechanical vents. All of the dormers are roofed with slate shingles and clad at the sides with painted galvanized metal over felt and plywood. These dormers are also shown in Figure 1 and are identified as Dormers 1 through 8.

There are also four cupolas along the ridge of the 1919 addition’s roof. Two of these cupolas provide ridge ventilation to the attic. Figure 1 shows the locations of these cupolas.

A dome-roofed tower is located at the west side of the original building. This tower is roofed with a fiberglass dome that houses communication antennas. There are four sheet metal steep-sloped roofs at the corners of the tower at a lower level.

There is a small standing seam copper roof over the southeast entrance of the building. This roof was reportedly replaced in recent years.

The original building’s roof also incorporated a skylight on its north slope. This skylight originally provided light to an assembly room on the top level of the building. However, the ceiling of the assembly room has been closed, and the skylight no longer provides light to this room.

1.2 Reason for This Investigation

Over the past several years, a number of issues have developed at the facility, including water leakage, loose slate, falling slate, and falling ice and snow. Several localized repairs have been made to the roofs to address these issues. These localized repairs have yielded mixed results. Therefore, the City of Evanston commissioned this evaluation of the roofing systems to assess their condition and to develop repair/replacement alternatives for the roofs.

2. SCOPE OF SERVICES

BTC’s scope of services for this project will consist of four separate phases. These phases include the following:

- Phase I – Evaluation
- Phase II – Recommendations and Report
- Phase III – Design Development
- Phase IV – Construction Administration
This report outlines the findings of Phases I and II of our services. Phases III and IV of our services will be performed after the City of Evanston has reviewed this report and has selected a repair/replacement option.

Our scope of services for Phase I and II were as follows:

2.1 Phase I – Evaluation

2.1.1 Task 1.1 - Historic Information

1. Obtained copies of all relevant project documents, including design drawings for the 1988 roof rehabilitation and repair records. The documents reviewed by BTC included the following:


   ▪ City of Evanston’s leak location diagram and roof plans dated August 16, 2002.

   ▪ D.A. Bohlen & Sons Architects original addition roof drawings dated October 15, 1924.


   ▪ Civic Center Rehabilitation Drawings dated June 9, 1977.

2. Interviewed facility management personnel to gather information regarding leak history and locations. Prepared a plan view of the building’s top floor and marked all reported active leak locations.

2.1.2 Task 1.2 - Field Investigation

1. Performed a visual review of the roof attic spaces to evaluate visible deterioration of the existing roof sheathing and gypsum decking.

2. Performed an overall visual review of the roofs from a manlift to assess general patterns of deterioration and roof construction details. Noted deterioration and deficiencies in roofing components and related building components such as the balustrades.
3. Based on findings of Task 1.1 and Sub-Task 1.2.1 above, selected several representative locations on the slate roofs for visual evaluation and further investigation. Performed the following:

A. Made an overall visual assessment of the condition of the roofing system, its configuration, and its associated components. Noted configurations and sizes of the gutters and downspouts.

B. Performed a water penetration test at a selected area. Due to the large area selected for the water testing, a fire hose was utilized to perform the water test.

C. At seven locations, removed roof slates in a small area to expose the underlying components. Visually assessed the condition and type of the roof underlayment, condition of the roof deck, type of slate fasteners used, slate dimensions and headlap, and other related roofing components such as flashings, gutters, hip caps, and ridge caps.

D. Evaluated the approximate percentage of cracked, displaced, improperly installed, loose, or otherwise deficient slates at each location.

E. Removed samples of the slate at each location for future laboratory testing (if required).

Upon completion of our observations, each exploratory opening was patched with new slate material in accordance with recommendations contained in “The Slate Book,” by Brian Sterns, et al.

4. Performed a visual review of all remaining roofs. Based on observations, selected two locations for exploratory openings through the roofing systems. Documented the following at each location:

A. Reviewed the roofing system configuration, the type and thickness of underlying insulation, the presence of moisture in the roofing system components, the type and number of roof membranes, the presence of a vapor retarder, and the condition of the roof deck.

B. Removed samples of existing roof membrane and flashing materials for subsequent laboratory testing (if needed).

Upon completion of our observations, each exploratory opening was patched by application of a torch-applied modified-bitumen roofing membrane.
5. Performed a visual review of the slate roof gutters and removed paint samples from selected locations of the gutter cornice for laboratory analysis.

6. Performed a visual review of the metal balustrades on Low-Slope Roofs 1 and 2 and removed paint samples from their surfaces for laboratory testing.

2.1.3 Task 1.3 - Laboratory Testing

1. Two paint samples were subjected to chemical analysis to evaluate the presence of lead in the paint.

2.1.4 Task 1.4 - Meetings

1. Three meetings were held with representatives of the City of Evanston at various stages of our evaluation phase to discuss our work progress and preliminary findings.

2.2 Phase II – Recommendations and Report

2.2.1 Task 2.1 – Analysis

1. Analyzed roof drainage patterns and required gutter and downspout capacities.

2. Evaluated roof wind uplift pressures for low-slope roofs. The analysis was performed in accordance with the requirements of the City of Evanston Building Code.

3. Analyzed field observations to evaluate overall cause(s) of reported leaks and anticipated remaining service life of the roofs.

2.2.2 Task 2.2 - Development of Repair Alternatives and Cost Estimates

1. Based on the findings of our analysis, the anticipated remaining service life of the slate materials, and the extent of deterioration, developed four repair/replacement alternatives for the main steep roofs.

2. Developed a brief scope of work for each alternative repair/replacement scheme.

3. Developed cost estimates for each alternative repair/replacement scheme.

4. Performed a life cycle cost analysis for each repair/replacement scheme.
2.2.3 Task 2.3 – Report

1. Prepared this report outlining the methodology, findings of each task, conclusions, and recommendations. This report also includes alternative repair/replacement schemes along with estimated initial and life-cycle costs for each scheme.

2.2.4 Task 2.4 – Meetings

1. After this report is submitted, we will meet with representatives of the City of Evanston to present our findings, recommendations, and cost estimates.

2. One final meeting will also be held to assist the City of Evanston representatives in selecting an appropriate approach for the project and to obtain direction for future phases of our work.

2.3 Subsequent Phases

Upon review of this report by the City of Evanston, it is anticipated that design documents for the selected repair/replacement approach will be developed by BTC.

3. PARTIES RESPONSIBLE FOR THIS EVALUATION

As Prime Consultant, BTC personnel and affiliated consultants performed a majority of the services for Phases I and II of our work. Mr. Kami Farahmandpour, a Registered Roof Consultant, Licensed Professional Engineer, Certified Construction Specifier and Certified Construction Contract Administrator managed this project. Messrs. Kami Farahmandpour and Jack Robinson performed Field investigation work.

Roula Associates Architects, Chtd., served as architectural consultant for the project. Ms. Roula Alakiotou, a Licensed Architect and Fellow of the American Institute of Architects, performed a review of the aesthetic impact of the proposed roof repairs/replacement.

JMS Environmental Services, a subconsultant to BTC, performed laboratory testing of the paint samples.

Hanson Roofing Company of Evanston, Illinois, provided the project team with assistance during the field investigation and assistance in developing cost estimates for various repair/replacement schemes.
4. HISTORIC INFORMATION

4.1 Roofing Repair History

In the past several years, several attempts have been made to rehabilitate the roofs on the Civic Center. The following information is a summary of the repair history for the roofs:

4.1.1 1988 Roof Replacement

In 1988, the entire roof of the 1919 addition was removed and replaced. One drawing sheet with an unknown date prepared by Frye Gillan Molinaro Architects of Chicago, Illinois, was provided to us for our review. The review of this drawing indicated the following scope of work:

1. The scope of work included the complete tear-off and replacement of all slates on the 1919 addition’s roof. No work was specified to the south of the main roof hips. However, field observations indicated that the gable roof over the connection between the original building and the 1919 addition was also likely replaced.

2. The scope of work included a complete removal and replacement of the perimeter gutter liner. It is not clear if the original building’s perimeter gutter was also included in that work. No work for the exterior of the gutters (gutter cornices) was specified.

3. Low-Slope Roofs 1 and 2 were also scheduled to be re-roofed with a single ply of modified bitumen roof membrane and fiberglass insulation.

4. The work specified for dormers consisted of painting the dormer sides.

5. The work specified for the cupolas included re-flashing their perimeters.

6. Main roof gutters were to receive new 5-inch-diameter corrugated copper downspouts with long horizontal extensions at ground level.

4.1.2 Other Repairs

Subsequent to the 1988 roof replacement, leaks have been reported, and several roof slates have been dislodged. Over the years, various contractors have replaced these dislodged slates.
Also, the building underwent an interior renovation in 1977. As part of those renovations, the observation area at the top of a stair tower was converted to a covered area for communication antennas. As a result, the tower was roofed with a fiberglass dome.

4.2 Other Evaluations

C.E. Crowley and Associated, Inc., of Gurnee, Illinois, performed another evaluation of the roofs in 2001. The findings of that evaluation were reported in C.E. Crowley & Associates’ report dated June 24, 2001, and indicated the following:

1. A significant number (approximately 400 to 600) of dislodged, loose, or missing slates were observed on the steep roofs.

2. Several localized deficiencies, including missing or loose ridge/hip caps, openings through dormer flashings, etc., were observed.

3. The report recommended performing some repairs in the near future, as well as budgeting for a complete roof replacement.

4.3 Leak History

Locations of reported leaks were provided to us by building management personnel. These locations were reviewed by BTC in the field. Figure 2 of Appendix A indicates the reported leak locations on a roof plan.

5. FIELD INVESTIGATION

Our field investigation was performed September 5, 2002, through September 11, 2002. The following sections provide a summary of our field observations. Referenced photographs are included in Appendix B. Locations of our exploratory openings and water test are indicated in Figure 3 of Appendix A.

5.1 Low-Slope Roofs 1 and 2

Low-Slope Roofs 1 and 2 are located along the east elevation of the building and over the turret-shaped round structures. The roofs abut the adjacent steep roof of the 1919 addition building. The following observations were made on Low-Slope Roofs 1 and 2:

1. Both roof surfaces were covered with an APP-modified bitumen roof membrane (Photo 1). The membrane appeared to be in fair condition.
2. The roof surfaces generally had adequate drainage slope towards the roof perimeter gutters.

3. The balustrades around the outer perimeters of both roofs consisted of painted galvanized steel sheet metal components. The tops of the top rails were covered with a fabric embedded in mastic (Photo 2). The balustrades' surfaces were painted using a white-colored paint that had delaminated over the entire balustrade surfaces (Photo 3). A sample of the paint was removed from Low-Slope Roof 1 for laboratory analysis. The balustrades were corroded through in several locations at their bases (Photo 4) and exhibited open seams that could allow water penetration below the roof membrane.

4. The perimeter of the roof membrane along the adjacent steep roofs was adhered onto a lead-coated copper flashing. In some areas, the membrane had debonded from this flashing allowing water to penetrate below the roof membrane (Photo 5). In some areas, pressure applied over the perimeter flashing resulted in water escaping from the flashing perimeter (Photo 6). Also, the lead-coated copper flashing exhibited seam-solder failure in some location (Photo 7). This condition can also allow water penetration below the membrane.

5. Exploratory Opening No. 4 was made through Low-Slope Roof 2. This exploratory opening revealed the following:
   
a. A single layer of modified bitumen roof membrane had been installed over a 1-1/2-inch layer of fiberglass insulation (Photo 8).

b. The fiberglass insulation layer was mechanically fastened through a layer of lead-coated copper liner to the underlying deck. In order to avoid damage, we did not remove the lead-coated copper liner. However, it should be noted that fastening through the lead-coated copper liner likely rendered it useless due to penetrations made by the fasteners.

c. No significant amount of moisture was observed below the roof membrane.

5.2 Low-Slope Roofs 4 and 5 (Roofs Over West Entrances)

Low-Slope Roof 4 is located over the west entrance to the building. Low-Slope Roof 5 is located over the entrance to the Health Department (Photo 9). The following observations were made at Low-Slope Roofs 4 and 5:

1. The roofing system on Low-Slope Roof 4 consisted of a white coating applied directly on the concrete deck. The membrane appeared deteriorated in several areas and exhibited delamination and missing sections (Photo 10).
2. The coating system on Low-Slope Roof 4 had also been applied directly onto the adjacent masonry surfaces. In some locations, the coating exhibited debonding from the masonry surfaces (Photo 11).

3. Surface drainage on Low-Slope Roof 4 was via two through-wall scuppers at the north and south masonry parapet walls. These scuppers discharged water onto an exterior perimeter gutter system that was coated with the same white coating system. The perimeter gutter system discharged water onto the gutter along the south edge of Low-Slope Roof 5 via a downspout (Photo 12). The coating system in the perimeter gutters was in very poor condition and had debonded from the gutter liner and adjacent masonry parapet (Photo 13). In general, surface drainage slope appeared adequate.

4. Masonry surfaces adjacent to and below Low-Slope Roof 4 exhibited extensive efflorescence (Photo 14) and mortar deterioration (Photo 15). Efflorescence and mortar deterioration in those areas appear to be due to prolonged water leakage through the roofing system and subsequent damage to the adjacent masonry. Masonry parapet walls around Low-Slope Roof 4 were in poor condition requiring complete reconstruction.

5. The roofing system on Low-Slope Roof 5 consisted of a built-up roof (BUR) membrane with gravel surfacing. Exploratory Opening No. 9 made through this roof revealed that the roof membrane was applied directly onto the underlying concrete roof deck. The BUR membrane appeared to consist of three plies.

6. The perimeter flashing around Low-Slope Roof 5 was punctured in some locations (Photo 16) and debonded from the masonry substrate (Photo 17).

5.3 Southeast Entrance Roof

The small roof section over the southeast entrance to the building consisted of a standing seam copper roof (Photo 18). The following observations were made at this roof:

1. Based on the patina on the copper surfaces, the roof appears to be approximately 10 years old. In general, the roof was in good condition with no visible signs of deterioration or open standing seams.

2. The roof drains to a perimeter gutter that was formed into the stone trim (Photo 19). The gutter was generally clean, and the downspout appeared clear.

3. The sealant joint between the gutter edge and stone and between the wall counterflashing and the adjacent stone panels appeared to have been replaced.
recently. However, the sealant did not appear to have been tooled properly after application, resulting in some areas where adhesive failure had occurred (Photo 20).

4. The copper counterflashing along the adjacent wall had separated from the adjacent wall surfaces, providing a potential path for water intrusion (Photo 21).

5.4 Original Building Steep Roof (1909)

The following observations were made at the original building steep roof:

1. In general, the slate roofing system on the original building’s steep roof appeared to be in fair condition. The roof surfaces were generally flat with no localized out-of-plane variations (Photos 22 and 23). The only two areas on the original building’s roof that exhibited apparent out-of-place roof deck variations were around the skylight (Photo 24) and at the joint between the original building’s roof and the 1919 addition’s roof (Photo 25).

2. A visual review of the roof deck soffits from the attic indicated the following:
   a. The roof deck consisted of gap sheathing wood plank installed parallel to the eaves. Significant indications of past water leakage through the gap sheathing wood planks were observed, particularly at the eaves (Photo 26) and valleys and near the dormers and various roof penetrations. However, a review of the attic spaces below the roof during a rainstorm did not reveal the presence of any significant active leaks.
   b. The apparent roof deck deflections near the skylight appear to be due to the roof framing configuration at that location. Since the roof rafter below the skylight are not continuous, a wood truss was installed below the skylight to support the upper ends of the rafters (Photo 27). It appeared that this wood truss had deflected, causing the visible deflections in the roof deck above. No other signs of distress were observed in the roof framing. While a structural evaluation of the roof framing at this location was not performed, it appears that the observed deflections are due to cumulative effects of deflections in various members that support the roof rafters below the skylight.

3. Approximately 1 to 2 percent of all slates on the original building’s roof were loose, cracked, dislodged, or missing. In some locations, the adjacent gutters were filled with loose slates (Photo 28). The extent of the observed loose,
cracked, dislodged, or missing on this roof was somewhat higher than expected for similar roofs.

4. Exploratory Opening No. 2 was made at the joint between the original building and the 1919 addition building's roof. (See Figure 3 for locations of exploratory openings.) This opening revealed the following:

a. There were several loose and missing slates in the area of the opening (Photo 29). The joint between the two buildings also exhibited a noticeable out-of-plane variation.

b. On the left side of the opening, the slates were attached directly to the gypsum sheathing. On the right side of the opening, the slates were nailed to the gap sheathing using copper nails. One of the slates removed from the gypsum sheathing was fastened with a nail-in anchor with a plastic grommet (Photo 30). This slate could be removed readily, and the fastener did not provide any significant withdrawal resistance. The remaining slates appeared to have been attached to the substrate using copper nails.

c. There were several layers of 30-pound and 90-pound roof underlayment below the slates (Photo 31). In addition, an 18-inch strip of rubberized asphalt underlayment had been installed at the eaves (Photo 32). The lower edge of the rubberized asphalt underlayment was lapped over the flange of the gutter liner. However, the upper edge of the rubberized asphalt underlayment was back-lapped over a layer of felt.

d. There was a wood starter lath at the eaves (also Photo 32). This starter lath was secured in place using copper wires (apparently to avoid puncturing the gutter liner flange).

e. A section of the gap sheathing was missing adjacent to the joint between the two buildings (also Photo 32). The wood decking material adjacent to this area exhibited significant rotting.

5. Exploratory Opening No. 3 was made adjacent to a dormer on the original building's roof. The following observations were made at Exploratory Opening No. 3:

a. Some of the slates could be removed readily. These slates were apparently attached with copper nails to the tongue-and-groove wood decking. However, the wood decking exhibited extensive rotting in areas adjacent to the dormer (Photo 33). It appeared that those slates that could be readily removed were attached to the rotted decking.
b. A layer of 90-pound felt was installed below the slates.

6. There is a small low-slope roof at the southeast corner of the original building's roof (Low-Slope Roof 3). This roof was covered with a copper flat-seam metal roof (Photo 34). All seams on this roof section were fully-soldered and appeared to be in good condition.

7. All the roof surfaces had a slope of 12 inches per foot with the exception of a small area to the east of the valley between the two building wings that had a slope of 14 inches per foot.

5.5 1919 Addition Steep Roof

The following observations were made at the 1919 addition steep roof:

1. In general, the roof surfaces exhibited out-of-plane variations over the entire roof area, causing an uneven appearance of the roof (Photo 35).

2. In numerous locations, slates had been replaced previously, as evidenced by the installation of retrofit keepers (Photo 36). In most locations, the keepers consisted of light gauge lead-coated copper straps that had flattened, allowing potential dislodgement of the slates (Photos 37 and 38). In a few locations along the east side of the roof, the replaced slates were installed properly using thick wire keepers (Photo 39).

3. It was estimated that approximately 3 to 5 percent of all slates on the 1919 addition's roof were loose, dislodged, cracked, or missing (Photos 40 through 43). In some cases, it appeared that cracked slates were originally not caulked out, or slates were cracked due to overdriving of fasteners. The extent of the observed loose, dislodged, cracked, or missing slates was far greater than normally expected on a slate roof.

4. Exploratory Opening Nos. 1, 5, 6, 7, and 8 were made through the 1919 addition building's roof. The following observations were made at these exploratory openings:

a. In general, the roofing assembly over the area to the north of the south hips consisted of roof slates over felt underlayment (with varying underlayment types). The roof slates were nailed to a plywood overlayment that was mechanically attached to the gypsum deck. In the area south of the south hips, no plywood overlayment was observed.
b. Rubberized asphalt underlayment was observed at the eaves. However, the rubberized asphalt underlayment in Exploratory Opening No. 7 was placed under the flange of the gutter liner (Photo 44).

c. The lead-coated copper valley liner in Exploratory Opening No. 5 was approximately 20 inches wide (10 inches on each side of the valley) and was not secured with cleats. The liner was secured with nails driven directly through the liner metal (Photo 45). In addition, some fasteners used to secure the slates were driven through the valley liner (Photo 46).

d. At Exploratory Opening Nos. 1 and 6 adjacent to dormers, evidence of previous water leaks through the roofing system was observed on the plywood sheathing below.

e. The lower portion of the roof deck in Exploratory Opening No. 5 consisted of wood planks in lieu of gypsum decking (Photo 47).

5. The most significant observation of the 1919 addition’s roof was the observation made in Exploratory Opening No. 8. This opening was made at an area that exhibited out-of-plane variations. Removal of the slates and felt underlayment in the area revealed that the out-of-plane variations coincided with joints in the plywood overlament (Photo 48). One of the plywood sections exhibited vertical displacement and curling along its edge. This plywood section had been attached directly to the gypsum deck with metal fasteners designed for gypsum substrates. However, it appeared that these fasteners did not provide significant withdrawal resistance. As such, the plywood overlament could be moved easily with a pry bar (Photo 49). After cutting the plywood, the gypsum fastener was removed readily.

6. A majority of the hip and ridge caps were attached to the substrate with various types of fasteners. In most locations, exposed fasteners were used to attach the hip and ridge caps. In some cases, these fasteners were missing (Photo 50).

7. In general, the soffits of the gypsum decking appeared to be in good condition. Indications of previous water leaks were observed along the eaves, and at dormers and cupolas (Photo 51). Cracking of the gypsum decking was also observed at regular intervals (Photo 52). In our experience, such cracking is typical of cast-in-place gypsum decks. No indications of any structural deficiencies were observed.

8. A water test was performed in the area over Low-Slope Roof 1. (See Figure 3 of Appendix A for locations.) Water leaks were reported previously in an office below this area. Our water test indicated the presence of a leak through the roof
ridge at the top of the test area. However, our water test failed to replicate the leak reported in the office area below. Due to the massive nature of the masonry walls below the roof, it is likely that the reported leaks develop after prolonged exposure to water. Such conditions are difficult to reproduce during water tests.

9. Overall, the slates used for this roof were thin, measuring from 3/16 inch to 3/8 inch thick. The majority of the slates were 3/16 inch thick. According to ASTM C 406 “Standard Specification for Roofing Slate”, the minimum thickness for roof slates is 3/16 inch.

10. All the slate clad roof surfaces had a slope of 12 inches per foot with the exception of the large dormer over the east entrance, which had a slope of 7 inches per foot.

5.6 Upper Main Roof Gutters and Downspouts

The following observations were made at the upper main roof gutters and downspouts:

1. Two distinct gutter profiles have been used on the upper main roofs. The rear of the building (along portions of the south elevation and the west elevation) has been constructed with a smaller-profile gutter (Photo 53). The front of the building has been constructed using gutters that incorporate two rows of decorative dentils (Photo 54).

2. The gutter construction around the main roof appeared to consist of a lead-coated copper liner, sloped to exterior copper downspouts, and an exterior cornice. The exterior cornice was constructed of galvanized sheet metal and had been painted black. The paint on the gutter cornice was severely delaminated and deteriorated throughout the entire perimeter of the building (Also Photos 53 and 54). Based on observations at an area where the gutter cornice had corroded through, the gutters were attached to a wood subframe that was anchored to the building facade. The downspouts penetrated through the gutter cornice and were mounted on the facade surfaces.

3. The lead-coated copper gutter liner appeared to have been appropriately sloped to the downspouts. Gutter liner expansion joints were observed at a few locations (Photo 55). However, apparent thermal movements of the gutter liner had caused failures of the liner soldered seams in many locations, particularly at the corners and expansion joint covers (Photos 56, 57 and 58). In some cases, failed soldered seams were sealed with sealant. However, the sealant did not appear to have been applied properly and exhibited adhesive failure.
4. At a few locations along the south elevation of the building, the gutter cornice had corroded through, exposing the underlying wood support members (Photo 59).

5. In all other locations, the exterior gutter cornice was in fair to poor condition. In several areas, the exterior cornice exhibited physical damage and tears in the metal (Photo 60).

6. The downspouts appeared to be in good condition. At the location where our water test was performed, the downspout discharged below grade onto an adjacent lower landscaped area. The water used for our water test did not discharge to this outlet, indicating a blockage in the portion of the downspout that was below grade. The building maintenance crew repaired this deficiency the following day.

5.7 Dormers and Cupolas

The following observations were made at the dormers and cupolas:

1. The two dormers on the original building’s roof (Dormers 1 and 2) had hip roofs and slate siding (Photo 61). The other dormers on the 1919 addition’s roof had gable ended roofs with painted galvanized steel siding.

2. On the west elevation of the 1919 addition building’s roof, the dormer windows had been replaced with ventilation louvered. In such cases, the aluminum ventilation louveres were installed in the original wood framing. This framing exhibited severe deterioration and rotting (Photo 62).

3. Most dormer siding and flashing components were deteriorated or corroded. In most dormers, several potential sources of water leakage, including corroded siding and trim panels, were observed (Photo 63).

4. The cupolas were constructed similar to the dormers and also exhibited deterioration of flashing and siding panels.

5.8 Stair Tower Dome Roof

Due to limitation of our access equipment, a close-up review of the stair tower dome roof was not performed. This roof was reviewed using binoculars. A review of the lower components of the stair tower, such as its gutter and metal corner roofs, was also performed. The following observations were made:
1. In general, the fiberglass dome surfaces appeared to be in good condition with no apparent cracks or deterioration (Photo 64). However, the fiberglass seams could not be examined closely and will likely have potential leak sources.

2. All metal components below the dome were in poor condition (Photos 65, 66, and 67). In some locations, the metal trim and small triangular roofs were corroded through.

6. LABORATORY TESTING

Two paint samples were removed for laboratory testing. One sample, identified as “Gutter Paint,” was removed from the gutter cornice paint adjacent to Low-Slope Roof 2. The second sample, identified as “Railing Paint,” was removed from the balustrade on Low-Slope Roof 1. Both paint samples were submitted to JMS Environmental Associated, Ltd., to evaluate the presence of lead in the samples. This evaluation was performed so that paint removal procedures can be specified properly during repairs.

The report of the laboratory tests is attached in Appendix C. The test results indicated that the total lead content in the gutter paint sample was 200 ppm (parts per million). The total lead content of the balustrade paint sample was less than 100 ppm. A total lead content of 5,000 ppm or higher is indicative that the paint is lead-based. Therefore, neither of the paint samples removed form the building contained sufficient lead to be classified as lead-based paint.

7. ANALYSIS

7.1 Downspout Capacities

The adequacy of the existing downspouts to provide sufficient drainage of the water from main roofs was evaluated using the procedures outlined in the Architectural Sheet Metal Manual published by the Sheet Metal and Air Conditioning Contractors’ National Association (SMACNA). The procedures in this manual have been recognized in the roofing industry as the standard in sizing gutters and downspouts.

Our analysis was performed on two selected downspouts with the largest tributary areas (the two downspouts in the middle section of the east elevation). A roof area factor of 1.3 was used to calculate the tributary design area. Using the rainfall design values for 10-year and 100-year storms for the Chicago area, the results indicated that the existing 5-inch-diameter corrugated downspouts have sufficient capacity to drain the water from the roof surfaces.
8. CONCLUSIONS

Based on our review of the historic information and field observations, the following conclusions are provided:

8.1 Low-Slope Roofs 1 and 2

The roofing system on these roofs was in fair to poor condition. Several deficiencies that could contribute to water leakage were observed, including failed and improperly adhered perimeter flashing. The existing roofing systems were installed over a metal roofing system. The integrity of the metal roofing system could not be determined. However, it is likely that any leaks through these roofs are mostly contained by the metal roofing system. On the other hand, it should be noted that the insulation boards below the roof membrane were mechanically attached. Therefore, it could be deduced that the existing underlying metal roof is compromised by fastener penetrations.

Evidence of water entrapment along the interface between these roofs and the adjacent steep roofs was observed.

It is also likely that some leakage below these roof membranes originates at the adjacent steep roofs where deficiencies in the valley liner installation were observed.

The balustrades on both roofs were in very poor condition and can also contribute to water penetration below the membrane. Due to their severe deterioration, these balustrades can no longer be maintained in a serviceable condition through repairs.

The leaks reported in the office spaces below both roofs are partially attributed to the above deficiencies. Considering the condition of these roofs and the balustrades, it is somewhat surprising that more extensive leaks are not experienced. It is hypothesized that due to the massive nature of the building wall construction and its roof deck, leaks do not manifest readily.

8.2 Low-Slope Roofs 4 and 5 (Roofs Over West Entrance)

Our evaluation indicated that Low-Slope Roofs 4 and 5 were in very poor condition, particularly Low-Slope Roof 4. The parapet wall around Low-Slope Roof 4 was also in poor condition and required reconstruction. At the time of this writing, both of these roofs, and the parapet walls around Low-Slope Roof 4 are scheduled to be replaced. Outline specifications for their replacement were prepared by BTC as part of the repair documents for the parapet wall repair on Low-Slope Roof 4.
8.3 Southeast Entrance Roof

The standing seam copper roof over the southeast entrance roof was found to be in good condition. The only observed deficiencies were related to open sealant joints and metal counterflashing that had separated from the adjacent wall. In our opinion, this roof can be maintained in a serviceable condition beyond 25 years.

8.4 Original Building Steep Roof (1909)

In general, the original building’s steep roof was in fair condition. Although this roof was not apparently replaced in 1988, it appeared to be in better condition that the 1919 addition’s roof. In our opinion, the better performance of this roof is primarily attributed to its wood deck. Since the slates were attached directly to the gap sheathing, better attachment was achieved. Furthermore, the gap sheathing provided a smoother substrate with less cyclical movement. Lack of such movement has provided better long-term performance of the slates and a more even appearance of the roof.

Despite its better apparent performance, evidence of water leakage in the form of stains in the attic and rotted decking was observed. Since few active leaks are reported below this roof, it is likely that the majority of the wood deck deterioration occurred prior to the recent repairs. However, the condition of the decking renders this roof more susceptible to slate fastener withdrawal, making the possibility of loose slates more likely.

Several loose, dislodged, cracked, and missing slates were also observed. In some areas, slates were missing where a retrofit sheet metal clip had been used to hold a replacement slate in place. However, the sheet metal clips had flattened and allowed the replacement slate to dislodge. The extent of the slate deterioration was judged as moderate. However, the number of loose and dislodged slates is indicative of performance below anticipated performance of a properly installed slate roof.

In our opinion, this roof has not reached the end of its service life. However, extensive repairs will be required to ensure that it can remain in a serviceable condition for the next 10 to 20 years. Annual ongoing repairs will also be needed to address continued cracking and dislodgement of slates.

8.5 1919 Addition Steep Roof

Considering its age and considering the condition of the original building’s roof, the 1919 addition’s roof was found to be in poor condition. Numerous loose, dislodged, cracked, and missing slates were observed throughout the roof. This condition is attributed to several potential factors, including:
1. The slates were primarily attached to a plywood overlayment. This plywood overlayment was apparently installed directly over the existing gypsum deck to provide a nailing base for the slates. Based on our observations, some of the fasteners used to secure this plywood overlayment have failed, resulting in a vertical displacement of the plywood along the edges. It is not clear whether the failure of these fasteners is due to curling effects of the plywood or the curling of the plywood along its edges is due to fastener failures. Fastener failures may have occurred due to over-tightening of the fasteners during the initial installation. Regardless of the cause of fastener failure, the vertical displacement of the plywood along the edges causes movement in the slates and encourages dislodgement and cracking.

2. The previously replaced slates in most areas were not attached properly with wire cleats. The thin gauge sheet metal cleats had flattened in many areas, allowing the replaced slates to dislodge again.

3. Based on cracks observed in some slates, it appears that the defective and cracked slates were not properly culled out during their installation. Once installed, these cracked and defective slates were more prone to failure and dislodgement.

4. In one area where the slates were attached directly to the gypsum deck, one slate was found to have been attached with a nail-in fastener with a plastic grommet. Such method of attachment may have been used elsewhere and has likely resulted in some of the observed failures.

5. The large number of cracked, dislodged and missing slates along the interface with the original building’s roof is attributed to differential deflection of the two adjacent roof decks and movement between the two decks.

Considering its current condition and its rate of deterioration, it is our opinion that the 1919 addition’s roof cannot be maintained in serviceable condition with a reasonable degree of maintenance. It is likely that the movements of the plywood overlayment will continue to cause cracking and dislodgement of the slates. At some point in the future, more plywood fasteners may fail, resulting in the potential for blow-off of complete sections of the roof. While this phenomenon is unlikely to occur in the near future, the ramifications of continued plywood movement should be considered.

The extent of the slate deterioration was judged as high. The number of loose and dislodged slates is indicative of performance significantly below anticipated performance of a properly installed slate roof.
8.6 Upper Main Roof Gutters and Downspouts

The gutters on the upper roofs were found to be in fair to poor condition. The gutter liners were apparently replaced during the 1988 roof repairs. However, lack of expansion joints has contributed to cracking and failure of some soldered seams, particularly at corners. In some areas, gutter liner sections were caulked with sealant. However, improper application of sealant had resulted in adhesive failure.

The gutter exterior skin (cornice) also exhibited deterioration. In a few areas, the gutter cornice had completely corroded through. Furthermore, the paint on the gutter cornices had delaminated in most areas, exposing the underlying galvanized steel.

It is our opinion that modifications to the gutter liner will be required to control future seam failure. Furthermore, the corroded sections of the gutter should be replaced.

Due to its complex configuration, particularly along the east and north elevations of the building, the reproduction of the gutter will be costly. Therefore, it would be economically advantageous to maintain the gutter cornice and rehabilitate its liner.

Our analysis of the downspouts indicated that they are sufficiently large to adequately drain the roof surfaces during 100-year rainstorms.

8.7 Dormers and Cupolas

The dormers and cupolas were found to be in poor condition. Deterioration of the dormer and cupola siding panels (1919 addition’s roof), wood framing around the louvers, and flashing components were observed throughout.

Evidence of leakage was also observed below the roof decks and on the roof deck surfaces adjacent to dormers. Some of the observed leakage is attributed to the configuration of the louvers, which does not encourage proper drainage. Leaks are also attributed to deteriorated flashing components that readily allow water penetration through the roofing system around the dormers.

In our opinion, the dormers and cupola cladding can no longer be maintained in a watertight and serviceable condition and require complete rehabilitation.

8.8 Stair Tower Dome Roof

The sheet metal components around the perimeter of the dome and the stair tower were found to be in poor condition. In some locations, the sheet metal components were completely corroded through, allowing water penetration into the masonry components below.
A close-up review of the dome surfaces was not performed. However, a review made through binoculars did not reveal any major deficiencies.

9. RECOMMENDATIONS

The following Sections 9.1 through 9.8 describe our general recommendations for each roof section or roof component individually. Section 9.10 combines our recommendations for the roofs and provides a reference to Appendix E, which contains an itemized scope of work.

9.1 Low-Slope Roofs 1 and 2

Regardless of the repair option selected for the original building and the 1919 addition’s roofs, we recommend the following repairs for Low-Slope Roofs 1 and 2:

1. The existing roofing system, including the modified bitumen membrane, insulation, and underlying metal roof, should be removed. We also recommend that the existing balustrades be removed.

2. A new roofing system should be installed. The new roofing system should consist of the following:
   a. A bituminous vapor retarder adhered directly to the structural deck.
   b. A layer of tapered insulation adhered to the vapor retarder.
   c. A layer of insulation coverboard such as siliconized gypsum board adhered to the insulation layer to increase the puncture resistance of the new roof membrane.
   d. A modified bitumen or reinforced thermoplastic roofing system installed over the insulation coverboard. Based on the size and configuration of the roofs, the use of a single-ply reinforced thermoplastic roof membrane may be more practical.

3. If required for aesthetic purposes, new precast concrete or cast aluminum balustrades can also be incorporated into the roofs to replicate the existing balustrades.

It is essential that the new roofing system on Low-Slope Roofs 1 and 2 be properly integrated into the adjacent steep roof’s eaves and flashing and perimeter gutter system. It is also essential that the future replacement or elimination of the balustrades be determined prior to the design of the new roofs so that they can be properly integrated into the new roofing system.
system. Installation of balustrades after installation of the new roofing system will compromise integrity of the new roofs.

9.2 Low-Slope Roofs 4 and 5 (Roofs Over West Entrance)

Based on our evaluation, the roofing systems on Low-Slope Roofs 4 and 5 should be removed and replaced. Outline repair documents for the replacement roofing systems have already been prepared by BTC. The new proposed roofing systems consist of a layer of polyisocyanurate insulation, a siliconized gypsum insulation coverboard, and a reinforced single-ply thermoplastic roofing system.

In addition to replacing the roofing systems, the perimeter gutter and parapet walls of Low-Slope Roof 4 should also be removed and replaced.

9.3 Southeast Entrance Roof

We recommend the following maintenance repairs be performed on the southeast entrance roof within the next 2 years:

1. Re-attach existing wall counterflushing using stainless steel fasteners with neoprene washers.

2. Remove and replace all sealant joints on the roofing system, including metal-to-metal and metal-to-stone joints.

9.4 Original Building Steep Roof (1909)

There are two alternative approaches to address the existing deficiencies in the original building’s roof. Regardless of the approach selected, the roof repairs/replacement for this roof should be closely coordinated with those on the 1919 addition building’s roofs, Low-Slope Roofs 1 and 2, and the upper main roof gutters.

9.4.1 Approach 1 – Localized Repairs

The first approach will include performing localized repairs to address the observed deficiencies. This approach can be selected if the 1919 addition building’s roof is repaired in a similar manner or if that roof is completely removed and replaced with a slate roof. If such an approach is selected, ongoing repairs will also be needed in the future to maintain the roofing system in a serviceable condition. It should also be noted that if the existing slate roofing is left in place (except where repaired), a potential for future hazards will exist. As the existing slates age, and the decking material moves with temperature and moisture
content changes, more slates will dislodge. If dislodged slates are not replaced in a timely fashion, they will pose a potential hazard.

The scope of work for this approach will consist of removing and replacing all loose, dislodged, and cracked slates; removing and replacing all hip caps, ridge caps, and valley liners; removing and replacing the slate at selected areas of the eaves; replacing the deteriorated areas of the wood decking; and removing and replacing the slate adjacent to all dormers, cupolas, and other penetrations. Since the existing skylight is no longer serving its original intended purpose, we also recommend that it be removed and the resultant opening patched with new decking and slate.

9.4.2 Approach 2 – Complete Removal and Replacement

A second approach would be to remove and replace the existing roofing system completely. If this approach is selected, various alternative roofing systems, such as asphalt shingles and standing seam metal roofing, can be considered.

The scope of work associated with this approach would include the complete tear-off of all the roofing components, installation of a layer of plywood over the existing decking as a leveling layer, and installation of a new roofing system. The new roofing system can consist of asphalt shingles or a standing seam metal roof.

It should be noted that the recommended roofing systems for this approach are based on the assumption that the attic space below the roof can be ventilated properly to minimize the potential for ice damming and moisture accumulation in the attic.

9.5 1919 Addition Steep Roof

There are two alternative approaches to address the existing deficiencies in the 1919 addition building’s roof. Regardless of the approach selected, the roof repairs/replacement for this roof should be closely coordinated with those on the original building’s roofs, Low-Slope Roofs 1 and 2, and the upper main roof gutters.

9.5.1 Approach 1 – Localized Repairs

The first approach will include performing localized repairs to address the observed deficiencies. In our opinion, this approach should be considered only as a short-term solution (approximately 5 years or less) to the roof problems at the building. If such an approach is selected, a significant level of ongoing repairs will also be needed in the future to maintain the roofing system in a serviceable condition.
Due to the problems with the attachment of the plywood overlayment below the slates, future deterioration is anticipated to increase over time. Therefore, if the existing slate roofing is left in place (except where repaired), a potential for future hazards will exist. As the existing slates age, and the decking material moves due to moisture content and temperature changes, more slates will become dislodged. If dislodged slates are not replaced in a timely fashion, they will pose a potential hazard.

The scope of work for this approach will consist of removing and replacing all loose, dislodged, and cracked slates; removing and replacing all hip caps, ridge caps, and valley liners; removing and replacing the slate at selected areas of the eaves; replacing the deteriorated areas of the wood decking; and removing and replacing the slate adjacent to all dormers, cupolas, and other penetrations.

**9.5.2 Approach 2 – Complete Removal and Replacement**

A second approach would be to remove and replace the existing roofing system completely. If this approach is selected, various alternative roofing systems, such as asphalt shingles and standing seam metal roofing, can be considered.

The scope of work associated with this approach would include the complete tear-off of all the roofing components, installation of a series of wood sleepers to provide a ventilation gap, installation of a layer of plywood over the sleepers as a new deck surface, and installation of a new roofing system. The new roofing system can consist of asphalt shingles or a standing seam metal roof. If the slates on the original building’s roof are not replaced, the new roofing system on the 1919 addition building’s roof can consist of slates to provide uniformity.

**9.6 Upper Main Roof Gutters and Downspouts**

As previously indicated, the main roof gutter system (on the original building and the 1919 addition building’s roofs) is in poor condition. However, due to its complex geometry and configuration, construction of a new gutter of similar size and configuration will be costly. Therefore, we recommend an attempt be made to repair the existing gutter system.

The repairs should consist of the following:

1. Remove and replace the existing gutter liner in areas where deterioration is evident. Depending on the repair/replacement approach selected for the adjacent roofs, the removal and replacement of the gutter liner can be made on a localized basis or in its entirety.
2. New expansion joints should also be incorporated into the gutter liner to minimize thermal movement and associated deterioration.

3. The gutter cornice should be removed and replaced where it exhibits corrosion. Based on observations made during our field investigation, we estimate that approximately 50 feet of the gutter cornice will require replacement.

4. The existing paint on the gutter cornice surfaces should be removed and the gutter cornice surfaces painted with a paint system suitable for galvanized surfaces.

Alternatively, the entire gutter can be removed and replaced. However, the replacement gutter system will likely have to be smaller in profile and not incorporate decorative dentils to make it more financially viable.

9.7 Dormers and Cupolas

Regardless of the repair options selected for the main upper roofs, all dormers and cupolas should be rehabilitated. We recommend the following repairs be performed on the dormers and cupolas:

1. Remove the existing roofing systems, siding panels, and louvers.

2. Provide new plywood wall sheathing on the dormer and cupola walls.

3. Provide new plywood decking on the dormer and cupola roofs.

4. Provide new louvers with an integrated drainage system and sill flashing.

5. Provide new sheet metal siding panels and trim.

6. Provide new roofs similar to adjacent roofing system.

9.8 Stair Tower Dome Roof

Regardless of the repair options selected for the main upper roofs, we recommend the following repairs be made to the stair tower roof and its associated components:

1. Remove and replace all sheet metal components, including the perimeter gutters, downspouts, and triangular metal roofs around the tower.

2. Coat the fiberglass dome surfaces with an elastomeric coating system. Prior to selecting an appropriate coating system for the dome, the coating system should
be evaluated for any adverse effect on the performance of the communication equipment housed inside the dome.

9.9 Aesthetic Impact of Repair Alternatives

With the assistance of Roula Associates Architects, Chtd., the aesthetic impact of various repair options were evaluated. Roula’s findings and recommendations are indicated in their report, which is attached in Appendix D. The following is a summary of Roula’s findings and recommendations:

1. The Evanston Civic Center is an authoritative and massive structure that requires aesthetic changes to present a less intimidating and more inviting ambience for the public.

2. The renovation of the roofing systems provides an opportunity to implement some simple, yet effective, aesthetic improvements to the building. The recommended changes will introduce more colors to the building, making it more inviting and joyful. The recommended changes include the following:
   a. The existing downspouts are disproportional to the massive gutters. It is recommended that the downspouts be covered with sheet metal enclosures to provide better proportion to the gutters. Photos 4 through 6 of Appendix D represent computer-generated images of such modifications on the downspouts.
   b. The upper roof gutters should be painted. When painting the upper roof gutters, the dentils can be painted in a contrasting color to distinguish them from the surrounding gutter components and to introduce additional colors. Photos 8 through 10 of Appendix D represent computer-generated images of a gutter section with various colors.
   d. Multiple colors should also be introduced into the new dormer siding panels. Photo 12 of Appendix D represents a computer-generated image of such modifications to a dormer. Cupolas should be treated similarly.
   e. Similar color patterns should also be used in construction of gutters and downspouts at Low-Slope Roofs 4 and 5 and at the stair tower sheet metal components.
   f. Future maintenance and repair of the facade can also include introduction of color patterns into the cast iron window mullions. Photos 13 and 14 of Appendix D represent computer-generated images of window mullions that are painted in contrasting colors.
9.10 Summary of Recommended Repair/Replacement Options

While the above recommendations for the Low-Slope Roofs 1 and 2, dormers and cupolas, and stair tower dome are relatively simple, multiple combinations of various repair approaches for the remaining roofs and other components are possible.

We have organized various repairs approaches into four general repair options. The following is a brief description of each repair option. A more detailed scope of work for each repair option is included in Appendix E.

**Option 1 – Localized Repairs**

This option will include the following:

1. Original building and 1919 addition roofs: Perform localized repairs to address deteriorated areas only.

2. Low-Slope Roofs 1 and 2: Completely remove and replace roofing system with a modified bitumen or single-ply thermoplastic roofing system; remove and replace balustrades.

3. Upper roof gutters: Remove and replace deteriorated portions of the gutter liner; remove and replace corroded sections of the gutter cornice; provide sheet metal downspout covers; and re-paint gutter cornice.

4. Dormers and cupolas: Remove and replace siding panels, siding sheathing, roofs, and louvers.

5. Stair tower dome and sheet metal components: Provide new sheet metal gutters and triangular roof; and coat the dome surfaces with an elastomeric coating system.

This option is estimated to provide a service life of 5 to 10 years with regular and extensive maintenance. If this option is selected, a snowguard system cannot be easily incorporated into the existing steep roofs. As such, sliding snow and ice over the mezzanine will continue to be problematic.

**Option 2 – Complete Tear-Off and Replacement with Asphalt Shingles**

This option will include the following:

1. Original building and 1919 addition roofs: Completely remove the existing roofing systems. Provide wood sleepers (1919 addition roof only), plywood
sheathing, and an asphalt shingle roofing system complete with underlayment, eaves membrane, etc.

2. Low-Slope Roofs 1 and 2: Completely remove and replace roofing system with a modified bitumen or single-ply thermoplastic roofing system; remove and replace balustrades.

3. Upper roof gutters: Remove and replace deteriorated portions of the gutter liner; remove and replace corroded sections of the gutter cornice; provide sheet metal downspout covers; and re-paint gutter cornice.

4. Dormers and cupolas: Remove and replace siding panels, siding sheathing, roofs, and louvers.

5. Stair tower dome and sheet metal components: Provide new sheet metal gutters and triangular roof; and coat the dome surfaces with an elastomeric coating system.

This option is estimated to provide a service life of approximately 40 years, assuming premium grade shingles are used. If this option is selected, a snowguard system can be readily incorporated into the new steep roofs.

**Option 3 – Complete Tear-Off and Replacement with Slate**

This option will include the following:

1. Original building: Perform localized repairs to address deteriorated areas only; and patch existing skylight.

2. 1919 addition roofs: Completely remove the existing roofing system. Provide wood sleepers, plywood sheathing, and a slate roofing system complete with underlayment, eaves membrane, etc.

3. Low-Slope Roofs 1 and 2: Completely remove and replace roofing system with a modified bitumen or single-ply thermoplastic roofing system; remove and replace balustrades.

4. Upper roof gutters: Remove and replace deteriorated portions of the gutter liner; remove and replace corroded sections of the gutter cornice; provide sheet metal downspout covers; and re-paint gutter cornice.

5. Dormers and cupolas: Remove and replace siding panels, siding sheathing, roofs, and louvers.
6. **Stair tower dome and sheet metal components**: Provide new sheet metal gutters and triangular roof; and coat the dome surfaces with an elastomeric coating system.

This option is estimated to provide a service life of approximately 50 years for the 1919 addition building’s roof. However, the service life of the original roofs will likely be significantly less. If this option is selected, a snowguard system can be readily incorporated into the new steep roofs on the 1919 addition. Regular maintenance of the un-replaced portions of the original building’s roof will also be required to reduce potential hazards associated with dislodged slates.

**Option 4 – Complete Tear-Off and Replacement with Standing Seam Metal Roofing System**

This option will include the following:

1. **Original building and 1919 addition roofs**: Completely remove the existing roofing systems; provide wood sleepers (1919 addition roof only), plywood sheathing, and a standing seam metal roofing system complete with underlayment, eaves membrane, etc. For estimating purposes, we have assumed that a pre-finished aluminum system will be used.

2. **Low-Slope Roofs 1 and 2**: Completely remove and replace roofing system with a modified bitumen or single-ply thermoplastic roofing system; remove and replace balustrades.

3. **Upper roof gutters**: Remove the existing steep roof gutters and replace with a pre-finished aluminum gutter system with a cornice and new pre-finished aluminum downspouts.

4. **Dormers and cupolas**: Remove and replace siding panels, siding sheathing, roofs, and louvers.

5. **Stair tower dome and sheet metal components**: Provide new sheet metal gutters and triangular roof; and coat the dome surfaces with an elastomeric coating system.

This option is estimated to provide a service life of approximately 40 years for the steep roofs. If this option is selected, a snowguard system can be readily incorporated into the new steep roofs.
10. COST ESTIMATES

10.1 Estimated Construction Costs

We retained the services of Hanson Roofing to assist us in developing order-of-magnitude cost estimates for the four rehabilitation options indicated in Section 9.10 above. The following is a summary of the cost estimates. Itemized cost estimates for each option along with associated quantities of work are included in Appendix E.

<table>
<thead>
<tr>
<th>Repair Option</th>
<th>Estimated Total Construction Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1 – Localized Repairs</td>
<td>$544,000</td>
</tr>
<tr>
<td>Option 2 – Complete Tear-Off and Replacement with Asphalt Shingles</td>
<td>$1,225,000</td>
</tr>
<tr>
<td>Option 3 – Complete Tear-Off and Replacement with Slate</td>
<td>$1,323,000</td>
</tr>
<tr>
<td>Option 4 – Complete Tear-Off and Replacement with Standing Seam Metal Roofing System</td>
<td>$1,359,000</td>
</tr>
</tbody>
</table>

The above cost estimates have been rounded to the nearest $1,000 and are based on the following:

1. Each cost estimate includes an allowance of $40,000 for replacement of the balustrades on Low-Slope Roofs 1 and 2.

2. Cost estimate for Option 1 includes an allowance of $40,000 as contingency to address unanticipated field conditions, etc. Cost estimates for Options 2, 3, and 4 each include an allowance of $60,000 as contingency to address unanticipated field conditions, etc.

3. Cost estimates are based on current labor and material prices and do not include an allowance for annual increases in construction costs.

4. Each cost estimate includes an allowance for access equipment. Cost estimate for Option 1 assumes that access will be via manlifs and includes an allowance of $30,000 for such access (including a small allowance of $5,000 for landscaping repairs). Cost estimates for Options 2, 3 and 4 assume that access will be via
fixed scaffolding and include an allowance of $150,000 each for such access and landscaping repairs.

5. The costs associated with the aesthetic improvements recommended in Section 9.9 are not included in these cost estimates. It should be noted that the additional costs associated with repainting of the existing gutter cornice and roof trim in a two-color scheme is anticipated to be marginal. The additional costs associated with the use of a two-color new gutter cornice in Option 4 may be slightly more significant.

6. Cost estimates do not include permit fees.

7. Allowances for performance and payment bonds and general conditions have been included. Allowance for bonds is based on 2.5% of the base construction cost. Allowance for general conditions is equal to 10% of the base construction cost.

8. The costs associated with replacement of Low-Slope Roofs 4 and 5 are not included in these cost estimates since the work is already bid and nearly complete.

10.2 Life Cycle Considerations

An appropriate evaluation of various rehabilitation options should include a consideration for anticipated life span, maintenance requirements and initial construction cost for each option. Anticipated life spans for various options are indicated in Section 9.10. Estimated initial construction costs are indicated in Section 10.1.

Table E-5 of Appendix E represents a simplified life cycle cost analysis for various roof rehabilitation options indicated in this report. The life cycle cost analysis includes an annual allowance for maintenance for each option.

As shown in Table E-5, it is evident that the most favorable life cycle cost is can be achieved through Option 2 - Complete Tear-Off and Replacement with Asphalt Shingles. Option 1 – Localized Repairs is anticipated to provide the least favorable life cycle cost. The disparity between the life cycle cost associated with Option 1 and all other options is very significant.

Please note that the anticipated life span for each option will greatly depend on factors such as maintenance, quality of materials and quality of workmanship. The provided life spans are for comparison purposes only and should not be construed as a guaranty that the roofing systems will last as long.
11. CLOSING REMARKS

By submitting this report, we have completed Tasks 1.1 through 1.4 and 2.1 through 2.3 of our scope of work. We will meet with representatives of the City of Evanston to discuss this report and to assist in selecting an appropriate repair/replacement approach for the roofs.

We appreciate the opportunity to be of service to the City of Evanston and look forward to serving the City on the next phase of this project.
APPENDIX A

FIGURES
FIGURE 1 - ROOF PLAN
1" = 10'-0" (REF.)
FIGURE 2 – PREVIOUS LEAK LOCATIONS

1" = 30'-0" (RF.)
APPENDIX B
FIELD PHOTOGRAPHS
Photo 1 – Modified bitumen roof membrane, Low-Slope Roof 2.

Photo 2 – Tops of top rails covered with fabric embedded in mastic.
Photo 3 – Delaminated white-colored paint at balustrade surfaces.

Photo 4 – Corroded balustrade base.
Photo 5 – Debonded membrane at flashing adjacent to steep roof.

Photo 6 – Trapped water in the perimeter flashing was ejected when applying pressure on the flashing.
Photo 7 – Seam-solder failure at lead-coated copper flashing.

Photo 8 – Single layer modified bitumen membrane installed over 1-1/2-inch layer of fiberglass insulation. Note the lead-coated copper roofing below the insulation.
Photo 9 – Low-Slope Roofs 4 (red arrow) and 5 (yellow arrow).

Photo 10 – Debonded roof membrane.
Photo 11 – Coating debonded from masonry surface.

Photo 12 – Perimeter gutter system on Low-Slope Roof 4 discharged water onto gutter along south edge of Low-Slope Roof 5.
Photo 13 – Perimeter gutter coating system debonded from gutter liner and adjacent masonry.

Photo 14 – Efflorescence on masonry surfaces adjacent to and below Low-Slope Roof 4.
Photo 15 – Mortar joint deterioration adjacent to and below Low-Slope Roof 4.

Photo 16 – Punctured perimeter flashing.
Photo 17 – Debonded perimeter flashing at masonry substrate.

Photo 18 – Standing seam copper roof at southeast entrance.
Photo 19 – Roof drains to perimeter gutter formed into stone trim.

Photo 20 – Sealant adhesive failure at counterflashing.
Photo 21 – Copper counterflashing separated from adjacent wall surface.

Photo 22 – Overall view of original building steep roof.
Photo 23 - Overall view of original building steep roof.

Photo 24 – Out-of-plane roof deck variation at skylight on original building’s roof.
Photo 25 – Out-of-plane roof deck variation at joint between original building’s roof and the 1919 addition’s roof.

Photo 26 – Evidence of past water leakage through tongue-and-groove wood planks at eaves.
Photo 27 – Wood truss below skylight.

Photo 28 – Gutters filled with loose slates.
Photo 29 – Several loose and missing slates over the joint between the original building and the 1919 addition.

Photo 30 – Slate was fastened with nail-in anchor with plastic grommet.
Photo 31 – Several layers of roof underlayment below the slates at Exploratory Opening 2.

Photo 32 – Rubberized asphalt underlayment installed at eaves. Note the upper edge of the rubberized asphalt underlayment is lapped over the felt.
Photo 33 – Rotted wood deck adjacent to dormer.

Photo 34 – Copper flat-seam metal roof.
Photo 35 – Typical out-of-plane variation over entire roof area.

Photo 36 – Installation of retrofit keepers at previously replaced slates.
Photo 37 – Flattened light gauge lead-coated copper keepers.

Photo 38 – Flattened light gauge lead-coated copper strap keeper.
Photo 39 – Properly installed replacement slate using thick wire slate hook.

Photo 40 – Cracked slate.
Photo 41 – Missing slate.

Photo 42 – Missing slate.
Photo 43 – Dislodged slate.

Photo 44 – Rubberized asphalt underlayment placed under flange of gutter liner.
Photo 45 – Liner secured with nails through liner metal. Note numerous punctures through the liner.

Photo 46 – Fasteners driven through valley liner.
Photo 47 – Wood planks at lower portion of roof deck.

Photo 48 – Plywood overlayment. Note the out-of-plane movement at plywood edges.
Photo 49 – Plywood overlayment easily moved with pry bar.

Photo 50 – Missing fastener at hip cap.
Photo 51 – Previous water leaks at a dormer.

Photo 52 – Gypsum decking cracked at regular intervals.
Photo 53 – Smaller-profile gutter at rear of building. Note severe paint delamination.

Photo 54 – Large profile gutters incorporating two rows of decorative dentils. Note severe paint delamination.
Photo 55 – Gutter liner expansion joint.

Photo 56 – Failure of liner seam at expansion joint.
Photo 57 – Failure of liner soldered seam.

Photo 58 – Failure of liner soldered seam (yellow arrow). Note loose fastener (red arrow).
Photo 59 – Corroded gutter cornice.

Photo 60 – Physical damage to exterior cornice as well as tears in the metal.
Photo 61 – Hip roof and slate siding at dormer on original building’s roof.

Photo 62 – Deteriorated wood framing at ventilation louver.
Photo 63 – Corroded siding and trim panels.

Photo 64 – Fiberglass dome surface appeared to be in good condition.
Photo 65 – Corroded metal trim below dome.

Photo 66 – Corroded triangular roof below dome.
Photo 67 – Corroded metal trim below dome.
APPENDIX C

LABORATORY TEST REPORT, LEAD CONTENT DETERMINATION
September 18, 2002

Building Technology Consultants, PC
215 North Arlington Heights Road
Arlington Heights, IL 60004

Attn: Kami Farahmandpour

JMS Project: 10110
JMS Batch: 12931

Re: Lead Sample Results
Evanston Civic Center 02-204

Dear Kami Farahmandpour,

This report1,2 covers the results3 of the analysis of the lead analysis JMS Environmental Associates, Ltd. (JMS) has performed for Building Technology Consultants, PC. The samples were analyzed for total lead.

Enclosed is a copy of the analytical data sheet for your review. If you have any questions, please do not hesitate to contact us at JMS Environmental Associates, Ltd.

Sample(s) will be discarded after 3 (three) months unless instructed otherwise by the client.

Respectfully submitted,

JMS ENVIRONMENTAL ASSOCIATES, LTD.

[Signature]
Joseph M. Sterner
Environmental Director/President

---

1 This report shall not be reproduced except in full, without the written approval of the laboratory.
2 This report must not be used to claim product endorsement by an accrediting organization or any other agency of the U.S. Government.
3 Results relate only to the items tested.

JMS Environmental is accredited by AIHA (#10264) and NVLAP (#102012)
September 17, 2002

Report No.: 10110JF12931
JMS Project: J-10110
Client: Building Technology Consultants
Client's Project: 02-204
JMS Batch No.: 12931
PM: Kami Farahmandpour
Sample(s): 2-Paint Chip
TAT: 72-hr
Samples Received: 09/16/02
Analyses Requested by: 09/19/02
Analyses Requested: Lead
Method(s): SW-846; 3050B, 7420
Sample Prep: JF
Analyst: JF
iDL: 0.1 mg/l
MDL: 10.0 mg/l
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<tr>
<th>JMS Log N.</th>
<th>Client's Sample</th>
<th>Dilution ml</th>
<th>Weight of Sample grams</th>
<th>Conc. Metal mg/l</th>
<th>Conc. Lead mg/kg</th>
<th>Lead %</th>
<th>Lead %</th>
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<td>Gutter Paint</td>
<td>100</td>
<td>0.1007</td>
<td>Lead 0.2</td>
<td>200</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>219725</td>
<td>Railing Paint</td>
<td>100</td>
<td>0.1083</td>
<td>Lead &lt;0.1</td>
<td>&lt;100</td>
<td>&lt;0.01</td>
<td></td>
</tr>
</tbody>
</table>

**Matrix Spike**

<table>
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<tr>
<th>Metal</th>
<th>True Value mg/l</th>
<th>Reported Value mg/l</th>
<th>Recovery %</th>
<th>Method Blank mg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td>10.0</td>
<td>10.3</td>
<td>103</td>
<td>0.1</td>
</tr>
</tbody>
</table>

I certify that the above data is true and correct.

Jim Figura, Chemist

Reviewed and inspected by:

Joseph M. Sterner, Lab Director
APPENDIX D

ROULA ASSOCIATES ARCHITECTS, CHTD., REPORT,
AESTHETIC IMPACT OF ROOF REPLACEMENT
Evanston Civic Center
Architectural Design Review

Existing Image
The Evanston Civic Center built in 1909 and 1919 is an impressive, authoritative, massive and a sober structure. The texture and red color of the façade’s brick walls are uniform throughout the building. Limestone panels rap-around the ground level of the structure, windowsills and limestone trim are sprinkled throughout the façade. The round bay-turrets with ornamental painted galvanized metal balustrades break up the façade line. The windows are large, in a marching pattern and painted black. The roof is multi-tone color slate whose overall effect is a continuum of the red brick walls. The gutters are incorporated within the building’s ornamental cornice, which is painted black. The downspouts are disproportionate to the massive cornice/gutter. The (8) dormers and (4) cupolas are galvanized metal also painted black.

Photo 1: Existing Façade with main entry

Photo 2: Existing round bay-turret

Recommendation
The Evanston Civic Center is a proud structure and an anchor to its community. Its massive power is dominant, common to early 20th century municipal centers. While preserving the authoritative character, the building also needs to present an ambience of user friendly, joyful, welcoming not intimidation.
1. As the city of Evanston is considering repair/reconstruction of the roof, we propose that this is a great opportunity to ease the building's massiveness by visually separating the roof from the walls by introducing a strong distinction in pattern, texture and color roofing tiles (options #2, #3; Photo 4 and 5) or standing seam metal roofing (option #4; Photo 6). While the existing building presents clearly its base (limestone) and its middle (red brick), its top seems very similar to its middle. It is not presenting a finish, a top or a cap, but a continuation of its massiveness.

2. The rehabilitation of the roof presents an opportunity to create interest and playfulness by highlighting the beauty of the sculptural detail of the existing black ornamental cornice/gutter with a two-color combination. This will tie the roof and walls in a creative way (Photo 7 thru 10).

3. The existing downspouts are not integrated and are disproportionate to the cornice/gutter. A larger cover trim relating to gutter/cornice will provide cohesiveness to the buildings drainage system (Photo 4-6).

4. Two-tone color dormers and cupolas present an opportunity to break up the lengthy roof surface, and like the cornice, can energize the roof allowing the eye to move along the surfaces participating, exploring rather than avoiding (Photo 11 and 12).

5. On the walls we have opportunities to break down the monotony by introducing similar coloring to lower roof's cornice, entrances and balcony trim, and also to the window pipe columns (Photo 13 thru 16).

6. Bay-turret's ornamental balustrade is a strong and positive element on the building's façade. It relaxes the seriousness of the building and we highly recommend that it would be kept or reproduced as shown on Photo 2. The removal of the balustrade as a requested option is shown on Photo 17.

In summary, the roof reconstruction can be the catalyst for a face-lift to the building's image.
Photo 11: Existing dormer and cupola

Photo 12: Accent color at dormer and cupola

Photo 13: Mint accent color at windows

Photo 14: Blue accent color at windows

Photo 15: Mint accent color

Photo 16: Blue accent color
Photo 17: Bay-turret's without balustrade
APPENDIX E

SUMMARY OF WORK SCOPE AND COST ESTIMATE
Table E-1, Work Scope and Cost Estimates for Option 1 – Localized Repairs

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Remove the existing ridge caps, hip caps, dormer roofs slates, dormer siding panels, metal balustrades on Low-Slope Roofs 1 and 2, and membrane roofing system and metal roof from Low-Slope Roofs 1 and 2.</td>
<td>$28,000.00</td>
</tr>
<tr>
<td>2</td>
<td>Remove existing roof slates within 3 feet of the building joint.</td>
<td>$2,000.00</td>
</tr>
<tr>
<td>3</td>
<td>Remove existing roof slates within 2 feet of eaves (approximately 200 linear feet of eaves) and at all valleys, dormers, low-slope roofs, skylight and cupolas.</td>
<td>$12,500.00</td>
</tr>
<tr>
<td>4</td>
<td>Remove loose, broken, cracked or otherwise displaced slates (approximately 3% of all slates).</td>
<td>$10,000.00</td>
</tr>
<tr>
<td>5</td>
<td>Remove siding panels on dormers and cupolas.</td>
<td>$6,000.00</td>
</tr>
<tr>
<td>6</td>
<td>Remove existing dormer louvers and replace with pre-fabricated, pre-finished aluminum louvers.</td>
<td>$40,000.00</td>
</tr>
<tr>
<td>7</td>
<td>In areas where slates are removed, re-secure existing plywood decking to gypsum deck (on 1919 addition only).</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>8</td>
<td>In areas where slates are removed, repair/replace existing gap sheathing on original building only (assume 500 square feet).</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>9</td>
<td>Provide new wood framing and tongue-and-groove wood decking on existing skylight.</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>10</td>
<td>Provide new fully adhered polyisocyanurate tapered insulation, a layer of ½-inch DensDeck, and a fully-adhered 120-mil thermoplastic single-ply roofing system on Low-Slope Roofs 1 and 2.</td>
<td>$6,000.00</td>
</tr>
<tr>
<td>11</td>
<td>Provide new membrane underlayment and lead-coated copper valley liner at all valleys.</td>
<td>$42,500.00</td>
</tr>
<tr>
<td>12</td>
<td>Provide new membrane underlayment within 3 feet of eaves where the existing slates have been removed.</td>
<td>$1,800.00</td>
</tr>
<tr>
<td>13</td>
<td>Provide a new raised wood curb at building joint.</td>
<td>$6,000.00</td>
</tr>
<tr>
<td>14</td>
<td>Provide new plywood sheathing, felt underlayment, and lead-coated copper siding panels on all dormers and cupolas.</td>
<td>$48,000.00</td>
</tr>
<tr>
<td>15</td>
<td>Provide new roof slates where existing roof slates have been removed.</td>
<td>$30,000.00</td>
</tr>
<tr>
<td>16</td>
<td>Provide new membrane cap underlayment lead-coated copper caps at hips and ridges.</td>
<td>$32,500.00</td>
</tr>
<tr>
<td>17</td>
<td>Remove and replace approximately 50 linear feet of the gutter assembly (including liner and wood support members) where existing gutter assembly is corroded.</td>
<td>$10,000.00</td>
</tr>
<tr>
<td>18</td>
<td>Repair approximately 200 linear feet of existing gutter liner by removing existing sealant and soldering seams.</td>
<td>$10,000.00</td>
</tr>
</tbody>
</table>
Table E-1, Work Scope and Cost Estimates for Option 1 – Localized Repairs

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>Provide new gutter liner expansion joints at approximately 30 locations.</td>
<td>$9,000.00</td>
</tr>
<tr>
<td>20</td>
<td>Remove existing paint from gutter exterior surfaces and coat with two coats of epoxy coating system.</td>
<td>$60,000.00</td>
</tr>
<tr>
<td>21</td>
<td>Replace Low-Slope Roofs 4 and 5 gutters and downspouts</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>22</td>
<td>Replace balustrades on Low-Slope Roofs 1 and 2</td>
<td>$40,000.00</td>
</tr>
<tr>
<td>23</td>
<td>Apply elastomeric coating to stair tower roof</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>24</td>
<td>Replace gutters and triangular metal roof's at stair tower</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>25</td>
<td>Repair sealant joints at southeast entrance roof and re-attach counterflashings</td>
<td>$500.00</td>
</tr>
<tr>
<td>26</td>
<td>Provide hoisting equipment and bucket to complete repairs.</td>
<td>$30,000.00</td>
</tr>
</tbody>
</table>

**Subtotal** $448,300.00

Bonds (2.5%) $11,207.50
Contingency allowance $40,000.00
General Conditions (10%) $44,830.00

**Total** $544,337.50
<table>
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<tr>
<th>Item No.</th>
<th>Item</th>
<th>Estimated Cost</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Tear-off the existing roofing systems including membrane roofing, balustrades, roof slates, underlayment, ridge and hip caps, valley liners, existing gutter liner, flashing, etc., down to existing gypsum/wood deck.</td>
<td>$93,750.00</td>
</tr>
<tr>
<td>2</td>
<td>Remove siding panels on dormers and cupolas.</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>3</td>
<td>Remove existing dormer louvers and replace with pre-fabricated, pre-finished aluminum louvers.</td>
<td>$40,000.00</td>
</tr>
<tr>
<td>4</td>
<td>Repair/replace existing tongue-and-groove decking on original building only (approximately 1000 square feet).</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>5</td>
<td>Provide new wood framing and tongue-and-groove wood decking on existing skylight.</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>6</td>
<td>Provide new fully adhered polisocyanurate tapered insulation, a layer of ½-inch DensDeck, and a fully-adhered 120-mil thermoplastic single-ply roofing system on Low-Slope Roofs 1 and 2.</td>
<td>$6,000.00</td>
</tr>
<tr>
<td>7</td>
<td>Repair exposed wood support for gutters where required (approximately 100 linear feet).</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>8</td>
<td>Remove and replace approximately 50 linear feet of the gutter assembly (including liner and wood support members) where existing gutter assembly is corroded.</td>
<td>$10,000.00</td>
</tr>
<tr>
<td>9</td>
<td>Provide new lead-coated copper gutter liner including expansion joints in all gutters. Extend gutter liner up the roof a minimum of 12 inches.</td>
<td>$118,500.00</td>
</tr>
<tr>
<td>10</td>
<td>Prime the gypsum/wood deck and provide a layer of self-adhesive modified bitumen membrane along the eaves. Adhere the membrane over gutter liner flange.</td>
<td>$9,000.00</td>
</tr>
<tr>
<td>11</td>
<td>Remove existing paint from gutter exterior surfaces and coat with two coats of epoxy coating system.</td>
<td>$60,000.00</td>
</tr>
<tr>
<td>12</td>
<td>Provide treated 2x4 wood sleepers (parallel to rafters) at 2-foot centers on 1919 Addition roof. Secure new sleepers to gypsum deck at 12-inch centers with gypsum fasteners (as an alternate, the sleepers may be fastened through the deck to 2x6 nailers below the deck using ½-inch galvanized lag screws at 24 inches on center). Secure sleepers through tongue-and-groove decking to wood rafters in the original building.</td>
<td>$87,500.00</td>
</tr>
<tr>
<td>13</td>
<td>Provide ½-inch plywood decking over the sleepers on the 1919 Addition and over the existing deck on the Original Building. Provide ventilation slots at ridges.</td>
<td>$87,500.00</td>
</tr>
<tr>
<td>14</td>
<td>Prime plywood surfaces and provide a layer of new membrane underlayment within 5 feet of eaves and all roof interfaces with cupolas and dormers.</td>
<td>$12,000.00</td>
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Table E-2, Work Scope and Cost Estimates for Option 2 – Complete Tear-Off and Replacement with Asphalt Shingles

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<td>15</td>
<td>Provide a layer of Type 1 roof underlayment on all deck surfaces.</td>
<td>$3,500.00</td>
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<tr>
<td>16</td>
<td>Provide new membrane underlayment and lead-coated copper valley liner at all valleys.</td>
<td>$21,250.00</td>
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<tr>
<td>17</td>
<td>Provide new plywood sheathing, felt underlayment, and lead-coated siding panels on all dormers and cupolas.</td>
<td>$48,000.00</td>
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<tr>
<td>18</td>
<td>Provide new premium grade laminated asphalt shingle on all roof surfaces.</td>
<td>$175,000.00</td>
</tr>
<tr>
<td>19</td>
<td>Provide new continuous ridge and eaves vents.</td>
<td>$14,000.00</td>
</tr>
<tr>
<td>20</td>
<td>Replace Low-Slope Roofs 4 and 5 gutters and downspouts</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>21</td>
<td>Replace balustrades on Low-Slope Roofs 1 and 2</td>
<td>$40,000.00</td>
</tr>
<tr>
<td>22</td>
<td>Apply elastomeric coating to stair tower roof</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>23</td>
<td>Replace gutters and triangular metal roofs at stair tower</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>24</td>
<td>Repair sealant joints at southeast entrance roof and re-attach counterflashing</td>
<td>$500.00</td>
</tr>
<tr>
<td>25</td>
<td>Provide a snowguard system along the perimeter of the steep roofs</td>
<td>$50,000.00</td>
</tr>
<tr>
<td>26</td>
<td>Provide hoisting equipment and bucket to complete repairs.</td>
<td>$150,000.00</td>
</tr>
</tbody>
</table>

Subtotal                                           | $1,053,000.00   |
Bonds (2.5%)                                         | $26,325.00      |
Contingency allowance                                | $40,000.00      |
General Conditions (10%)                             | $105,300.00     |
Total                                               | $1,224,625.00   |
<table>
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<th>Item No.</th>
<th>Item</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>On the 1919 addition and on roofs adjacent to the building joint, tear-off the existing roofing systems including membrane roofing, balustrades, roof slates, underlayment, ridge and hip caps, valley liners, gutter liner, flashing, etc. down to existing gypsum/wood deck.</td>
<td>$50,000.00</td>
</tr>
<tr>
<td>2</td>
<td>On the original building roof, remove the existing ridge caps, hip caps, dormer roofs slates, and dormer siding panels. Remove existing roof slates within 2 feet of eaves (approximately 100 linear feet of eaves) and at all valleys, dormers, low-slope roofs, skylight and cupolas. Remove loose, broken, cracked or otherwise displaced slates (approximately 2% of all slates).</td>
<td>$14,000.00</td>
</tr>
<tr>
<td>3</td>
<td>Remove siding panels on dormers and cupolas.</td>
<td>$3,500.00</td>
</tr>
<tr>
<td>4</td>
<td>Remove existing dormer louvers and replace with pre-fabricated, pre-finished aluminum louvers.</td>
<td>$40,000.00</td>
</tr>
<tr>
<td>5</td>
<td>Repair/replace existing gap sheathing on original building only (approximately 500 square feet).</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>6</td>
<td>Provide new wood framing and gap sheathing on existing skylight.</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>7</td>
<td>Provide new fully adhered polyisocyanurate tapered insulation, a layer of ½-inch DensDeck, and a fully-adhered 120-mil thermoplastic single-ply roofing system on Low-Slope Roofs 1 and 2.</td>
<td>$6,000.00</td>
</tr>
<tr>
<td>8</td>
<td>Repair exposed wood support for gutters where required (approximately 100 linear feet).</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>9</td>
<td>Remove and replace approximately 50 linear feet of the gutter assembly (including liner and wood support members) where existing gutter assembly is corroded.</td>
<td>$10,000.00</td>
</tr>
<tr>
<td>10</td>
<td>Provide new lead-coated copper gutter liner including expansion joints in all gutters on the 1919 addition. Extend gutter liner up the roof a minimum of 12 inches.</td>
<td>$62,500.00</td>
</tr>
<tr>
<td>11</td>
<td>Repair approximately 100 linear feet of existing gutter liner on original building by removing existing sealant and soldering seams.</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>12</td>
<td>Provide new gutter liner expansion joints at approximately 10 locations on original building.</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>13</td>
<td>Prime the gypsum/wood deck and provide a layer of self-adhesive modified bitumen membrane along the eaves. Adhere the membrane over gutter liner flange.</td>
<td>$7,200.00</td>
</tr>
<tr>
<td>14</td>
<td>Remove existing paint from gutter exterior surfaces and coat with two coats of epoxy coating system.</td>
<td>$60,000.00</td>
</tr>
<tr>
<td>15</td>
<td>On the 1919 addition and roof areas adjacent to the building expansion joint, provide treated 2x4 wood sleepers (parallel to rafters) at 2-foot centers. Secure new sleepers to gypsum deck at 12-inch centers with gypsum fasteners (as an alternate, the sleepers may be fastened through the deck to 2x6 nails below the deck using ¾-inch galvanized lag screws at 24 inches on center). Secure sleepers through gap sheathing to wood rafters in the original building roofs adjacent to the building expansion joint.</td>
<td>$50,000.00</td>
</tr>
<tr>
<td>Item No.</td>
<td>Item</td>
<td>Estimated Cost</td>
</tr>
<tr>
<td>---------</td>
<td>----------------------------------------------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>16</td>
<td>Provide 3/8-inch plywood decking over all wood sleepers. Provide ventilation slots at ridges.</td>
<td>$50,000.00</td>
</tr>
<tr>
<td>17</td>
<td>Prime plywood surfaces and provide a layer of new membrane underlayment within 5 feet of eaves and all roof interfaces with cupolas and dormers.</td>
<td>$12,000.00</td>
</tr>
<tr>
<td>18</td>
<td>Provide a layer of Type 2 roof underlayment on all deck surfaces.</td>
<td>$2,000.00</td>
</tr>
<tr>
<td>19</td>
<td>Provide new membrane underlayment and lead-coated copper valley liner at all valleys.</td>
<td>$21,250.00</td>
</tr>
<tr>
<td>20</td>
<td>Provide new plywood sheathing and lead-coated siding panels on all dormers and cupolas.</td>
<td>$48,000.00</td>
</tr>
<tr>
<td>21</td>
<td>Provide new slate on all 1919 addition building roofs and roof areas adjacent to expansion joints (assume using Vermont weathering slate).</td>
<td>$400,000.00</td>
</tr>
<tr>
<td>22</td>
<td>Provide new continuous ridge and eaves vents on new roofs.</td>
<td>$9,000.00</td>
</tr>
<tr>
<td>23</td>
<td>Provide new roof slates where existing roof slates have been removed from original building.</td>
<td>$10,000.00</td>
</tr>
<tr>
<td>24</td>
<td>Provide new membrane underlayment and lead-coated copper caps at hips and ridges on original building.</td>
<td>$13,000.00</td>
</tr>
<tr>
<td>25</td>
<td>Replace Low-Slope Roofs 4 and 5 gutters and downspouts</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>26</td>
<td>Replace balustrades on Low-Slope Roofs 1 and 2</td>
<td>$40,000.00</td>
</tr>
<tr>
<td>27</td>
<td>Apply elastomeric coating to stair tower roof</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>28</td>
<td>Replace gutters and triangular metal roofs at stair tower</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>29</td>
<td>Repair sealant joints at southeast entrance roof and re-attach counterflashing</td>
<td>$500.00</td>
</tr>
<tr>
<td>30</td>
<td>Provide a snowguard system along the perimeter of the steep roofs</td>
<td>$50,000.00</td>
</tr>
<tr>
<td>31</td>
<td>Provide hoisting equipment and bucket to complete repairs.</td>
<td>$150,000.00</td>
</tr>
</tbody>
</table>

**Subtotal** | **$1,140,450.00**

**Bonds (2.5%)** | **$28,511.25**

**Contingency allowance** | **$40,000.00**

**General Conditions (10%)** | **$114,045.00**

**Total** | **$1,323,006.25**
Table E-4, Work Scope and Cost Estimates for Option 4 – Complete Tear-Off and Replacement with Standing Seam Metal Roofing System

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tear-off the existing roofing systems including membrane roofing, balustrades, roof slates, underlayment, ridge and hip caps, valley liners, existing gutter liner, flashing, etc. down to existing gypsum/wood deck.</td>
<td>$93,750.00</td>
</tr>
<tr>
<td>2</td>
<td>Remove siding panels on dormers and cupolas.</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>3</td>
<td>Remove existing dormer louvers with pre-fabricated, pre-finished aluminum louvers.</td>
<td>$40,000.00</td>
</tr>
<tr>
<td>4</td>
<td>Repair/replace existing gap sheathing on original building only (approximately 1000 square feet).</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>5</td>
<td>Provide new wood framing and gap sheathing on existing skylight.</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>6</td>
<td>Provide new fully adhered polyisocyanurate tapered insulation, a layer of ½-inch DensDeck, and a fully-adhered 120-mil thermoplastic single-ply roofing system on Low-Slope Roofs 1 and 2.</td>
<td>$6,000.00</td>
</tr>
<tr>
<td>7</td>
<td>Remove existing gutter assembly including supporting wood framing.</td>
<td>$45,000.00</td>
</tr>
<tr>
<td>8</td>
<td>Provide a new pre-finished aluminum gutter system (similar in size to existing) including outer and inner layers.</td>
<td>$135,000.00</td>
</tr>
<tr>
<td>9</td>
<td>Prime the gypsum/wood deck and provide a layer of self-adhesive modified bitumen membrane along the eaves. Adhere the membrane over gutter liner flange.</td>
<td>$9,000.00</td>
</tr>
<tr>
<td>10</td>
<td>Provide treated 2x4 wood sleepers (parallel to rafters) at 18-inch centers on the 1919 Addition. Secure new sleepers to gypsum deck at 16-inch centers with gypsum fasteners (as an alternate, the sleepers may be fastened through the deck to 2x6 nailing below the deck using ¼-inch galvanized lag screws at 24 inches on center). Secure sleepers through gap sheathing to wood rafters in the original building.</td>
<td>$87,500.00</td>
</tr>
<tr>
<td>11</td>
<td>Provide 5/8-inch plywood decking over the entire roof surface. On 1919 Addition, provide ventilation slots at ridges.</td>
<td>$78,750.00</td>
</tr>
<tr>
<td>12</td>
<td>Prime plywood surfaces and provide a layer of new membrane underlayment within 5 feet of eaves and all roof interfaces with cupolas and dormers.</td>
<td>$12,000.00</td>
</tr>
<tr>
<td>13</td>
<td>Provide a layer of Type 1 roof underlayment on all deck surfaces.</td>
<td>$3,500.00</td>
</tr>
<tr>
<td>14</td>
<td>Provide new pre-finished aluminum standing seam metal roofing system.</td>
<td>$350,000.00</td>
</tr>
<tr>
<td>15</td>
<td>Provide new plywood sheathing and pre-finished aluminum siding panels on all dormers and cupolas.</td>
<td>$36,000.00</td>
</tr>
</tbody>
</table>
Table E-4, Work Scope and Cost Estimates for Option 4 – Complete Tear-Off and Replacement with Standing Seam Metal Roofing System

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Provide new continuous ridge and eaves vents.</td>
<td>$14,000.00</td>
</tr>
<tr>
<td>17</td>
<td>Replace Low-Slope Roofs 4 and 5 gutters and downspouts</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>18</td>
<td>Replace balustrades on Low-Slope Roofs 1 and 2</td>
<td>$40,000.00</td>
</tr>
<tr>
<td>19</td>
<td>Apply elastomeric coating to stair tower roof</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>20</td>
<td>Replace gutters and triangular metal roofs at stair tower</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>21</td>
<td>Repair sealant joints at southeast entrance roof and re-attach counterflashing</td>
<td>$500.00</td>
</tr>
<tr>
<td>22</td>
<td>Provide a snowguard system along the perimeter of the steep roofs</td>
<td>$50,000.00</td>
</tr>
<tr>
<td>23</td>
<td>Provide hoisting equipment and bucket to complete repairs.</td>
<td>$150,000.00</td>
</tr>
</tbody>
</table>

Subtotal $1,172,500.00

Bonds (2.5%) $29,312.50
Contingency allowance $40,000.00
General Conditions (10%) $117,250.00

Total $1,359,062.50
Table E-5, Life Cycle Cost Analysis

<table>
<thead>
<tr>
<th>Rehabilitation Option</th>
<th>Initial Construction Cost</th>
<th>Annual Maintenance Cost</th>
<th>Annual Maintenance Cost (After Year 5)</th>
<th>Service Life for Original Building (years)</th>
<th>Service Life for 1919 Addition (years)</th>
<th>Ave. Life Cycle Cost (per year)</th>
<th>Life Cycle Cost (First 5 years)</th>
<th>Life Cycle Cost (Years 6-10)</th>
<th>Life Cycle Cost (Years 11+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1 - Localized Repairs</td>
<td>$544,000</td>
<td>$30,000</td>
<td>$20,000</td>
<td>10</td>
<td>5</td>
<td>$120,667</td>
<td>$56,133</td>
<td>$47,000</td>
<td></td>
</tr>
<tr>
<td>Option 2 - Complete Tear-Off and Replacement with Asphalt Shingles</td>
<td>$1,225,000</td>
<td>$5,000</td>
<td></td>
<td>40</td>
<td>40</td>
<td>$35,625</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Option 3 - Complete Tear-Off and Replacement with Slate</td>
<td>$1,323,000</td>
<td>$20,000</td>
<td></td>
<td>10</td>
<td>50</td>
<td>$67,628</td>
<td>$67,628</td>
<td>$50,168</td>
<td></td>
</tr>
<tr>
<td>Option 4 - Complete Tear-Off and Replacement with Standing Seam Metal Roofing</td>
<td>$1,359,000</td>
<td>$7,000</td>
<td></td>
<td>40</td>
<td>40</td>
<td>$40,975</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This table is based on the following assumptions:
Option 1: Replacement cost for 1919 addition building after 5 years: $900,000
Options 1 and 3: Replacement cost for original roof after 10 years: $450,000
Unless otherwise noted, maintenance cost for various options will remain constant even after replacement.
No inflation or increases in costs have been considered
Option 2: Initial Construction Cost is 80% replacement of 1919 Addition, 20% repairs to original building
Option 1 and 3: Replacement after 5 and 10 years is Slate, lasting 50 years