Condition Assessment and Analysis of the Goddard Mansion
Fort Williams Park, Cape Elizabeth, Maine

Submitted to:

The Town of Cape Elizabeth
Cape Elizabeth, Maine

September, 2004

360.28.01

OEST
343 Gorham Road
South Portland, ME 04106

CONDITION ASSESSMENT AND ANALYSIS OF THE GODDARD MANSION FORT WILLIAMS PARK, CAPE ELIZABETH, MAINE

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TOWN OF CAPE ELIZABETH
GODDARD MANSION STRUCTURAL INVESTIGATION

Executive Summary

The Goddard Mansion, originally constructed in 1853, is located in Fort Williams Park, at the Town of Cape Elizabeth, Maine. The building was constructed for William Goddard in an 'Italianate Villa' style of architecture. The stone masonry walls are 2 feet thick and the interior walls and roof structure were wood. The original stone masonry which was exposed to view was hand cut. The stone which was not exposed to view was constructed using rubble stone. The mansion was used by the US Government and was later gifted to the Town of Cape Elizabeth. Due to deterioration and vandalism of the structure, a controlled burn was conducted by the Town's Fire Department in 1981, and the basement portion was filled to allow visitor access to the ruin. Since that time, the stone masonry has been deteriorating under normal exterior exposures (wind, rain, snow, and freeze/thaw cycles). Portions of the mortar joints have deteriorated allowing the stones to loosen and fall. The falling stone and the presence of visitors has become a safety concern for the Town.

The April 2003 Updated Master Plan of Fort Williams Park, recommended the detailed study of the Goddard Mansion. The Master Plan also recommended an evaluation of the structural integrity of the mansion with respect to its continued use by visitors. Therefore, OEST Associates, Inc. has been commissioned by the Town to perform a structural assessment of the ruin. The purpose of the investigation and assessment is to address the safety concerns, determine the causes and extent of the deterioration, estimate the construction costs of the rehabilitation, and recommend a phased work scope for the rehabilitation. Field investigations were performed in June of 2004.

The majority of the masonry stone was found to be in satisfactory condition. The mortar was found to range in condition from poor to satisfactory. The condition of the mortar joints on each wall were recorded on drawings to allow cost estimating and rehabilitation scope document preparation. The window and door opening headers, jambs, and sills were found to be granite and wood from the existing construction and pressure treated wood which was installed as part of a previous repair work. Other conditions affecting the ruin consisted of trees which need to be cleared away from the ruin, walks which should be treated to reduce surface erosion, bird nesting areas which should be closed off, and a new subsurface drainage system to reduce the risk of frost action on the foundation.

The scope of the required mortar repairs is shown on the attached drawings. The materials and condition of the headers, jambs and sills has been recorded. Construction cost estimates have been prepared based on the required work scope of the rehabilitation. The recommended phased work scope has been provided based on an estimated annual expenditure. Once repairs have been completed, cost of annual checking and maintenance should be approximately $3,000 to $5,000 per year. The masonry repairs, when completed, should last 30 to 50 years with standard maintenance.

This document is intended to provide the Town and its representatives with a technical assessment of the Mansion and recommended improvements to allow for the continued use of the structure as an actively visited ruin. The procedure and methods implemented to achieve the long term safe usage of the ruin will need to be resolved by the Town.

1. Purpose and Goals

The purpose of this investigation and report is to determine the scope of rehabilitation and repair that will be required to create a safe and structurally sound ruin for people to visit. Further, the repairs suggested by this investigation are intended to preserve the mansion in the event that it may someday be renovated for future uses.

The goals for the project as communicated by the Town of Cape Elizabeth and the Fort Williams Advisory Commission are listed below:

a. Provide a structural assessment of the masonry and report on its current condition.

b. Provide recommendations for the repair and renovation of the mansion based on the first priority of providing a safe venue for visitors and the second priority of preserving the structure as a ruin.

c. Fulfill one of the goals of the 2003 Updated Master Plan of Fort Williams Park by completing a study of the structural integrity of the mansion.

A summary of the project scope is listed below:

a. Categorize Condition of Masonry Mortar: The repointing of the masonry mortar will constitute a considerable portion of the scope of work in the renovation process. The Town has expressed an interest in an annual repointing program. The scope of this phase of the project is to provide the prioritized data necessary to begin the rehabilitation of the masonry.

b. Masonry Stone Investigation: The scope of this phase of the project is to determine the general condition of the masonry stone, identify problem areas, and recommend solutions for retarding the deterioration and rehabilitating the areas which are unsatisfactory. Throughout the mansion, there are stones which have cracked. Our investigation researches the reason(s) for the cracking.

c. Study of Headers and Sills: Many of the interior headers have been replaced with pressure treated wooden headers. Several of the existing granite headers and sills on the exterior of the structure are cracked and weathered. The goals of this phase of the project are to identify which headers and sills should be replaced, which should be repaired, and to summarize other work related to the headers and footers. We will also investigate methods of retarding the deterioration of the existing granite headers and sills.

d. Roof/Canopy Investigation: The scope of this phase includes an investigation of possible roofs or canopies over the existing structure to protect the masonry from further deterioration. The purpose of the canopy would be to protect the masonry from rain and snow degradation.

e. Study of Related Issues: There are many issues surrounding the mansion which will need to be addressed. For example, the current ground cover in and around the mansion allows erosion of the topsoil. With respect to this issue, we will make recommendations for the application of ground covers which will allow visitors to access the various rooms of the mansion, and minimize further erosion of the soil.

2. Background of Goddard Mansion

The Goddard Mansion was constructed in 1853 in the Town of Cape Elizabeth, in the area now known as Fort Williams Park. The structure was originally designed as a load bearing stone masonry structure with a wood framed roof and interior partitions. The stone masonry walls are 22" to 24" thick.

The mansion has served as a residence and a veterans gathering space. Due to the deteriorating condition of the structure, the Town of Cape Elizabeth performed a controlled burning of the mansion in 1981. The controlled burn left the masonry walls and brick fire places and chimneys standing. Since that time, the condition of the masonry has deteriorated. At the time of this report, there are several areas in which the masonry and bricks are no longer being held in place by the mortar, and stones and brick have fallen creating an unsafe condition for visitors. Some areas of the mansion have been closed off to the public. The basement and several other portions of the foundation were filled in the 1980's by the Town to create safe access to the mansion for pedestrians.

In 1995, the Town of Cape Elizabeth commissioned Structural Design Consultants to assess the structural condition of the mansion. This report was used as the basis for annual monitoring by the Town. Information used in the report is also referenced herein.

Based on our field work and discussions with members of the Fort Williams Park Advisory Commission and the Town of Cape Elizabeth, we have summarized some of the studies/repairs that have been performed:

a. Several of the holes in the masonry stone walls have been patched with brick. (> 15 years ago).

b. A major portion of the east face (facing the ocean) has been mortared solid such that no stone is showing. The mortar appears to be in good condition. (>15 years ago).

c. A cast in place reinforced concrete cap was trowelled on the top of the masonry walls. The condition of the cap ranges from satisfactory to poor. (>15 years ago).

d. Many of the interior window headers have been replaced with pressure treated wooden headers. Some of these sills are in need of repair. (>15 Years ago).

e. The masonry mortar has been repaired in several locations and at various times during the life of the structure (Time of repairs, unknown).

f. A Structural Condition Assessment was commissioned by the Town in 1995, and the assessment was performed by Structural Design Consultants.

3. Summary of Field Investigation

A field investigation was performed at the Goddard Mansion between Tuesday, June 8th, and Wednesday June 16th, 2004. A set of general measurements of the mansion were taken and the mansion was photographed, see drawing S-1 for the Floor Plan of the structure. The masonry stone walls were surveyed to identify their condition and other unique features such as metal embeds. The following terms will be used to define the condition of the various structural elements:

a. Poor: A poor assessment means that the element is not performing as required and is affecting the performance of other structural elements. For example, masonry mortar which has eroded,

allowing water to enter the joint and is crumbling, and has allowed stones to move within the wall system is considered to be in poor condition.

b. Unsatisfactory: An unsatisfactory assessment means that the element is not performing as required or not performing a portion of its intended service, and is not affecting the performance of other structural elements. For example, a masonry mortar joint which has been eroded, allowing water to enter the joint, is supporting the intended loads and has not allowed the masonry stones to move is considered unsatisfactory.

c. Satisfactory: A satisfactory assessment means that the element is serving its intended purpose, but may be exhibiting normal degradation. For example, masonry mortar which does not allow water to penetrate the joints and is still supporting the intended loads (Dead load, snow load, wind load, etc.) is considered satisfactory.

The structural elements of the mansion were visually inspected, given a condition rating, and inventoried for a phased construction process.

a. Investigation of Masonry Stone: During the field investigation, the large areas of cracked masonry stone were noted. There are numerous individual stones which are cracked, but the integrity of the wall as a structural system did not appear to be compromised. The drawings and specifications will identify which types of cracked stones should be replaced. See attached photograph #4: Interior stone masonry.

b. Investigation of Masonry Mortar: The mortar joints were visually inventoried; the classifications of the mortar are rated on the attached drawings. The condition of the mortar has been rated in three different categories: I, II, and III. Both the interior and exterior walls have been surveyed and categorized using this system.

i. Mortar Rating I: Areas of the walls which have been designated with a "I" are in poor condition. Many of these areas have become severely eroded allowing stones and mortar to fall from the wall, causing a hazardous condition. These areas should be the highest priority in the construction phasing process. See attached photograph #1: Type I Mortar Joint.

ii. Mortar Rating II: Areas of the walls which have been designated with a "II" are in unsatisfactory condition. In most cases the mortar is still supporting the dead and live loads, but is in varying states of weathering. These joints are allowing water to access the joints; subsequent frost action will further degrade the mortar. See attached photograph #2: Type II Mortar Joint.

iii. Mortar Rating III: Areas of the wall which have been designated with a "III" are in satisfactory condition. The mortar in the joints is tightly bonded to the stones or bricks making a watertight joint. See attached photograph #3: Type III Mortar Joint.

c. Investigation of Headers Jambs and Sills: Several of the granite headers and sills are cracked. There are several potential causes for the cracks. Some of the granite headers appear to be spawling. Several of the headers are charred from fire. We believe that charred headers are part of the original construction.

d. Holes: The holes in the walls have been placed into one of three categories, small, medium and large. Small holes are defined as holes which are less than 6 inches in diameter. Medium holes are defined as those which are between 6 and 12 inches in

diameter, and large holes were measured and dimensioned on the drawings. The purpose of defining the holes sizes is to allow contractors to accurately bid the repair work.

4. Summary of Findings

The following summarizes the findings for the various elements of the ruin.

a. Masonry Stone: The masonry stone is generally in satisfactory condition. There are several locations at which individual or groups of stones are cracked, and should be considered unsatisfactory. The orientation of the cracking appears to be mostly vertical in orientation. There are several possible reasons for the cracking of the stone.

- Weathering: Small cracks in the structure of the stone allow water to penetrate. Subsequent frost action can cause cracking of the stones.
- Movement: Frost action, causing the building to heave during the winter months, could cause this type of cracking. The fine soil particles in the fill that was brought to the site could cause it to be frost susceptible, and could be a potential cause of the cracking.
- Burning: Depending on the type of stone and moisture content at the start of the controlled burn, the trapped gases and moisture could have expanded causing the some of the stones to crack.
- Structural Loading: As areas of the mansion are weakened, the areas which are still strong 'attract' more of the load. This situation can cause areas to become overstressed resulting in cracks.

Based on our observations, we believe that the cause of the cracking is a combination of movement induced by frost and fire induced cracks.

b. Masonry Mortar: The masonry mortar joints range in condition from satisfactory to unsatisfactory. The categorized areas have been identified on the attached drawings. The total amount of each area is provided for each face of the structure. The mortar repairs which were conducted most recently are in satisfactory condition. The majority of these repairs are within the lower 6 feet of the structure.

c. Headers and Sills: The majority of the exterior headers, sills, and jambs are granite. We have estimated that approximately 20% of the headers are showing signs of distress. These signs include spawling and cracking. The spawling is believed to have occurred during the controlled burn of the structure. Small pockets of water or entrapped air expand due to the heat of the fire causing areas of the surface to spawl. We believe that this was an isolated incident and that these cracks will not perpetuate. A majority of the interior headers are pressure treated wood. Most of these are in satisfactory condition. Some of the headers are fire damaged, and some have allowed the masonry above the header to settle, crack, and in some cases fall out. These areas are noted on the drawings. The majority of the interior jambs and sills are missing. We believe that these elements were wood framed in the original design of the structure

d. Roof Investigation: OEST has investigated the addition of a weather canopy over the existing structure. The purpose of the canopy would be to shield the masonry from rain and snow, thus slowing the rate of deterioration of the masonry. The possibility of integrating the canopy structure into the restoration of the building into an inhabitable space was also considered.

The original roof structure is believed to have been a wood framed truss structure supported by the masonry walls and some interior columns. Without significant rehabilitation, the existing masonry walls could not be considered capable of supporting a roof structure. Use of the existing walls to support a roof structure would most likely require the addition of several interior columns and footings. While the interior columns and footings would not affect the use of the structure as a tourist attraction, they might affect a rehabilitation of the mansion in the future.

e. Applicable Codes and Standards: The Town of Cape Elizabeth has adopted the 1999 Building Officials Code Administration (BOCA) Building Code. This Code references ASCE 7 as the applicable structural loading requirements for the specific location of the building. The loads which apply to the structure are provided on an attached reference page. The loads listed below were calculated considering the structure to be inhabited.

5. Rehabilitation/Renovation Recommendations

a. Masonry Stone: The quantity of stone that is cracked is estimated to be less than 5% of the surface area of the walls. The corner of walls M and K appears to be the most affected area. During the repointing/rehabilitation program, these stones should be replaced. If they are stones which connect both sides of the walls, the cracks may be caulked or mortared in lieu of removing the stone. Some testing and monitoring of the stone in this area should be performed to determine the most probable cause prior to corrective action.

b. Masonry Mortar: The attached drawings indicate the locations of the three different conditions of the mortar. Prior to starting the mortar repointing program, we recommend that the structure be sprayed with a masonry mortar sealer. The purpose of the sealer is to keep water from entering the mortar joints. This will significantly slow the rate of deterioration for the mortar which has been categorized as Type “II” or Type “III”.

c. Headers and Sills: The headers and sills that are cracked will need to be made structurally sound. Repointing of the mortar joints above the cracked headers could result in rework if the deteriorated headers allow the stones to move and crack the mortar joints again. The interior wooden header beams should be stained to preserve the structural characteristics of the wood. The sills should be rebuilt using pressure treated lumber. The sills should be constructed to keep water from draining into the interior of the wall system.

d. Holes and Missing Structural Elements: We recommend that the holes and the missing structural elements be replaced with stone masonry which matches to the existing masonry structurally and aesthetically. Repair of these missing elements will have a significant impact on the stiffness of the structure, the integrity of the weather envelope, and the future use of the walls as load bearing members.

e. Roof Investigation: We have analyzed the addition of a roof supported on the existing walls to keep the snow and rain off the interior portions of the structure. Our analysis shows that the walls are not capable of supporting a roof structure without significant rehabilitation. Further, the interior columns which helped support the original roof would need to be reconstructed. The addition of these columns could interfere with the future re-use of the mansion. Based on the cost of the roof and the additional requirements that may not have a long term payback if the mansion is renovated (bird screening, security lighting, etc.), we do not recommend that the roof structure be constructed.

f. Roof Canopy Recommendation: Another means of providing a weather shield over the structure is to use a pre-engineered metal building style structure. Tapered steel interior columns and footings would be required. The roof structure could be made to look similar to the original roof (slate shingle roof). Three column bents would be required in each of the three main areas of the structure. Diagonal steel rod bracing would be required to brace the structure against wind and seismic loads. Interior reinforced concrete footings would be required to transmit the loads to the ground.

The addition of a canopy as outlined in options e. & f. would most likely require a liner which would be capable of keeping birds from accessing the structure for shelter or nests. This is an additional cost which would not be needed if the mansion was to be renovated. Providing a canopy would most likely require the addition of security lighting and possibly security patrols. Both of these costs need to be weighed against the benefits of having a weather canopy over the masonry.

We have estimated the cost of option e) and f) above to be between $275,000 and $350,000.

6. Investigation of Related Issues

The issues listed below are a collection of observations, suggestions, and ideas. Based on the amount of funding available for annual rehabilitation and renovation work, the issues listed below could be added to the scope of work to improve the structure and the surrounding grounds.

a. Basement Fill: We understand that the basement and some surrounding areas were filled with material collected during street sweeping operations. Material collected during street sweeping normally has a large percentage of very fine particles. Unlike gravels and sands, the fine particles allow the material to hold water and subsequent frost action can adversely affect the structure. There are several methods to alleviate this problem. The first would be to add an under drain system around the interior and exterior of the structure and backfill next to the foundation with free draining gravel material. A second method would be a ground cover which minimized the infiltration of stormwater. Our recommendation is to monitor the structure for movement due to frost and install the underdrain system if required. This can be achieved by establishing a vertical control benchmark onsite and monitoring specific spots monthly throughout the winter.

b. Soil Erosion: The interior ground covering is a fine sand. The pathways around the building are worn and not stabilized against erosion. We recommend that a suitable ground cover and walkway cover be constructed to minimize the erosion around the mansion. The use of slate walks would serve this purpose and would match the historic period of the structure. The ground covers should be placed in such a manner to promote drainage of stormwater away from the structure.

c. Trees/Foliage: All trees within 15 feet of the structure should be removed. Trees and branches within this area permit higher moisture levels to occur which promote bacterial growth on the masonry. Tree roots can also penetrate the structure below grade and cause heaving and damage.

d. Bird/Animal Nests: At least one birds' nest exists in each window opening and a family of squirrels has made a nest in a hole in one of the chimneys in the north wall. We recommend that the construction be started after August when most of the young birds will have matured and left their nests. The renovation work, when complete, should not allow any holes large enough for animals to enter the walls, windows areas, or basement areas.

e. Guy Wire: There is a guy wire on the east face of the structure (facing the ocean). We believe that this wire once supported a utility such as telephone and possibly power cables to the mansion. We recommend that this wire be removed.

f. Foundation Information: We were unable to find records of the foundation system for the mansion. Based on the number of ledge outcroppings surrounding the house, we have assumed that the structure was supported directly on bedrock. We recommend that this assumption be confirmed and noted for future reference. A series of test pits would allow data to be gathered regarding the size and depth of the footing, the condition of the masonry below the ground surface, and type of soil or bedrock which the structure is founded on. The purpose of determining the foundation type and condition is to allow calculation of wind and seismic loads on the structure and to allow accurate construction cost estimates to be prepared for the foundations if required.

g. Wood Inserts in the Stone Masonry Walls: There is a consistent pattern of wood inserts in the interior walls of the structure. We believe that these inserts were used to support the wood siding on the interior of the mansion. Many of the wooden members are still in the holes. We recommend that if the wood supports are loose, they be removed. If the wood inserts are solidly embedded in the wall, they may be mortared over. Our recommendation would be to have them removed, but this process is likely to be expensive and may cause further damage to the walls. If the wood inserts can be kept dry, they will not swell and will not cause any damage to the wall system.

h. Steel Embeds in Granite: The steel embeds in the granite headers, sills, and jambs should be removed and the holes grouted or caulked. The embedded steel items are rusting and there is a risk of further spawling the granite.

i. Existing Piping: There are several sections of pipe embedded in the walls. Two of the pipes appear to be drainage pipes and one appears to be a stove pipe. These should be removed and the holes filled with stone and mortar.

j. Chimney Repair: The two main chimneys in the main room of the mansion are in unsatisfactory to poor condition. We recommend removal of the bricks to the face of the surrounding wall, leaving the outline of the chimney in brick that the original chimneys be repaired. This would leave the outline of the chimneys for viewing purposes and retain some of the history of the mansion. The bricks and mortar should be sealed with a waterproofing agent.

7. Maintenance Recommendations

Based on our discussions with personnel from the Town of Cape Elizabeth, we understand that there have been few significant maintenance efforts performed at the Goddard Mansion site over the last 15 years. A list of suggested annual maintenance items has been prepared and described below.

a. Grounds Inspection: The grounds should be inspected annually for erosion. The interior and exterior areas surrounding the structure should be inspected and recommendations made to control the erosion. Areas which receive high visitor traffic should be landscaped using suitable materials (pavers, flagstone walkways, and/or crushed stone). Other areas should be planted with suitable plantings.

b. Mortar Maintenance: Standard mortared joints which have been treated with a moisture barrier will last for approximately 5 to 10 years between applications of moisture barrier protection and 20 to 50 years between maintenance of the mortared joints. The wide range of life expectancy for the mortared joints is based on the wide range of applications and exposure to the elements. The Goddard Mansion is located very near the Atlantic Ocean and receives a much higher rate of moisture and salt attack than a standard inland structure. Three sides of the structure are unprotected from direct sunlight which contributes to the deterioration of the moisture barrier. We recommend that the masonry be sealed at least once every 5 to 7 years.

c. Header, Sill and Jamb Maintenance: Under normal service conditions, granite of the type used for the exterior headers, sills, and jambs will last indefinitely without maintenance. We believe that the fire in the mansion allowed the degradation of the surface layers of the granite. Further, differential movement maybe one of the causes of the cracking of the headers and sill beams. The headers and sill beams should be inspected annually to determine if the surface degradation of the granite was only caused by the fire, or if there are defects in the granite which are causing the degradation to continue. The interior wooden headers should be inspected annually and replaced or stained as required to maintain the integrity of the masonry.

8. Conclusion

Based on our field survey and analysis of the stone masonry at the Goddard Mansion, we have made the following conclusions:

- There are safety concerns which need to be addressed at the Goddard Mansion. Our recommendation is to restrict access to the middle and eastern portions of the structure and to rehabilitate the main portion of the mansion.
- The mansion, or portions thereof, could be rehabilitated to ensure a safe venue for visitors and to stop the weathering for possible renovations to the structure at a future date.
- In addition to the stone masonry rehabilitation project, there are other options and improvements that could be made to ensure the longevity of the mansion and to improve the site visually and environmentally. The addition of ground covers, for example, such as slate or other stone work would reduce the erosion at the site and reduce the infiltration of stormwater which can cause frost heaving.
- We do not recommend that a roof be constructed on the existing walls or as a separate structure to protect the stone masonry from snow and rain. The required footings, columns, bracing, and roof structure would be costly and have a negative effect on the aesthetics of this historic structure.
- The cost of the rehabilitation work will need to be weighed against the value of the structure as a draw for visitors to Cape Elizabeth, the value of the structure as part of Cape Elizabeth's history, and other projects.

9. Estimated Construction and Maintenance Costs

2004 Construction Costs

1	Repoint: Type II (unsatisfactory condition) masonry, interior and exterior	10,000 SF @ $14.00 = $140,000
2	Rebuild: Type I (poor condition) masonry, replace stone as required, interior and exterior	2,350 SF @ $42.00 = $98,700
3	Fix Holes: (small, medium, and large) Replace stone as required interior and exterior	Lump Sum = $ 42,000
4	Steel Lintels: C12 (steel channels) with anchors and masonry support plates	325 LF @ $105/FT = $34,125
5	Pressure Wash and Seal: Rebuild Type I & II and existing Type III, 5 year, manlift	18,800 SF @ $1.75 = $32,900
6	Inspection/Submittal Review/Meetings and Progress Reports: 20 week construction period; 2 visits/wk, 2hours/visit, report, 3-2 hour meetings	110 hours @ $80 = $8,800
	SUBTOTAL	$356,525
7	Contingency 10%	$35,650
8	Engineering/Design: Scope to include door and window jamb and sill design, structural design of headers, temporary supports for safety issues (support of cracked beams, etc.), and 3 meetings	$9,300
	TOTAL	**$401,475**

2004 Maintenance Costs

Assumptions

A	Maintenance costs to begin immediately after the repairs are complete; Type III areas will require work by this time.	
B	200 SF/per year of wall surface will require repointing, washing, sealing, inspections, and administration.	
	***ESTIMATE**	**$5,000**

***Costs are estimated for 2004. Add 3%/yr to calculate escalation.**

10. Estimated Construction Costs (6 Year Term)

Item	Deduct	Increase	Balance
Total to start			**$ 401,475**
2004 Construction	$(25,000.00)		**$ 376,475**
Escalation 3%		$ 11,294	**$ 387,769**
2005 Engineering	$ (9,300.00)		**$ 378,469**
2005 Construction	$(60,000.00)		**$ 318,469**
Escalation 3%		$ 9,554	**$ 328,023**
2006 Construction	$(80,000.00)		**$ 248,023**
Escalation 3%		$ 7,440	**$ 255,464**
2007 Construction	$(80,000.00)		**$ 175,464**
Escalation 3%		$ 5,263	**$ 180,728**
2008 Construction	$(80,000.00)		**$ 100,728**
Escalation 3%		$ 3,021	**$ 103,750**
2009 Construction	$(80,000.00)		**$ 23,750**
Escalation 3%		$ 712	**$ 24,462**
2010 Construction	$(24,462.00)		**$ 0**
	Original Contract	$ 401,475	
	Total Escalation	$ 37,284	
	TOTAL	**$ 438,759**	

11. Recommended Construction Phasing Design Criteria

The following table may be used as a guideline for establishing the scope of work for the rehabilitation of the structure. The priorities used to establish the phased work scope are the safety of the visitors, the condition of the various areas of the structure, and the funding which has been estimated. See drawings S-1 for Section designation.

Year	Scope		Budget
2004	a.	Erect nylon coated safety fencing over openings in Sections B & C.	$25,000 Const. $9,300 Eng.
	b.	Rebuild the Type I areas on walls C and D (interior).	
	c.	Stabilize the interior masonry on walls J, K, and L; remove loose stones and patch holes.	
	d.	Perform engineering design of structural elements (headers, masonry reinforcing).	
2005	a.	Section A: Complete 1/3 of Type II joint repairs	$60,000
	b.	Section A: Complete 2/3 of Type I joint repairs	

	c. Section A: Complete 1/2 of hole repairs d. Section A: Complete 1/2 of Header jamb & sill rehabilitation	
2006	a. Section A: Complete Type I & Type II Mortar joint repair b. Section A: Complete hole repairs and header & sill repairs c. Section A: Pressure wash and seal interior and exterior *Note: The masonry in Section A should be complete at this time.	$80,000
2007	a. Section C: Complete 1/2 of Type I & Type II joint repair b. Section C: Complete 1/2 of the hole repair and header, jamb, and sill repairs	$80,000
2008	a. Section C: Complete Type I & Type II joint repair b. Section C: Complete hole repair and header, jamb, and sill interior and exterior c. Section C: Pressure wash and seal interior and exterior d. Remove fencing at Section C *Note: Section C should be complete at this time and opened for public access.	$80,000
2009	a. Section B: Perform 2/3 of Type I & Type II joint repairs b. Section B: Perform 2/3 of hole and header, jamb, and sill repairs	$80,000
2010	a. Section B: Complete Type I & Type II joint repairs b. Section B: Complete hole repairs and header, jamb, and sill repairs c. Section B: Pressure wash and seal interior and exterior d. All Sections: Perform minor repairs and punch list items, final cleanup and demobilization	$24,500

12. Design Criteria

Design Criteria Summary:

Design Code:	BOCA National Building Code, 1996		
Snow Loads:	Ground Snow Load (P_g)	= 60 psf	
	Flat Roof Snow Load (P_f)	= 46 psf	
	Roof Slope	= 45 deg	
	Sloped Roof Factor C_s	= 0.625	
	Sloped Roof Snow Load (P_s)	= 29 psf	
	Unbalanced Snow Load (Pub)	= 36 psf	on Leeward Roof
		= 0 psf	on Windward Roof
Wind Loads:	Wind Speed	= 90 mph	
	Importance	= 1.1	
	Exposure	= D	
	Building Height (z)	= 40 ft	
	Basic Velocity Pressure (P_v)	= 20.7 psf	
	Velocity Pressure Coefficient (K_z)	= 1.46	
	Gust Response Factor (G_z)	= 1.11	
	Internal Pressure Coefficient (GC_{pi})	= +/- 0.25	
	Main Wind Force System	Windward Wall = 38psf	(C_p = 0.8)
		Leeward Wall = -27 psf	(C_p = -0.5)
		Side Walls = -34 psf	(C_p = -0.7)
		Windward Roof = 25 psf	(C_p = 0.45)
		Leeward Roof = -34 psf	(C_p = -0.7)
	Component & Cladding	For Exposure D, use Main Wind Force Loads	
Seismic Loads:	Velocity Coefficient (Av)	= 0.10g	
	Acceleration Coefficient (Aa)	= 0.10g	
	Seismic Hazard Exposure Group	= I	
	Seismic Performance Category	= C	
	Site Coefficient (S)	= 1.0	
	Unreinforced Masonry Shear Walls	R^a = 1.25	
		C_d = 1.25	
		C_T = 0.02	
		T_a = 0.318 sec	
		C_s = 0.21	
		C_s max = 0.2	
		V_s = 0.20 x Weight	
	Bearing Walls	F_p = 0.10 x Weight	

Photograph #1: Type I
Mortar Joint (Poor Condition)

Photograph #2: Type II
Mortar Joint (Unsatisfactory Condition)

Photograph #3: Type III
Mortar Joint (Satisfactory Condition)

Photograph #4: Interior Stone Masonry
Note cracks in stone and mortar.

Photograph #5: Typical Interior Wall (Rubble Stone)

Photograph #6: Interior Wall
Note brick infill repair and typical interior rubble stone work.

Photograph #7: Interior Walls
Note fireplace and chimney at right.

Photograph #8: Exterior Wall
Note rubble stone work at top of wall (formerly unexposed).

Photograph #9: Granite Header
Deterioration

Photograph #10: Interior Wall 1
Note missing wall section.

Photograph #11: East Face
Note grouted face at left.

Photograph #12: Wall Repair using a brick infill.
Note cracks at mortar joints.