ST GEORGE SEAL PLANT RESTORATION PROJECT

January 12, 2000

Executive Summary

The United States acquired St. George Island when Alaska was purchased from Russia in 1867. From 1867 to 1910, private companies, under contract to the United States government, ran the fur seal harvest and pelt processing operation on St. George. Then, in 1910, the federal government became the sole administrator and operator of the St. George fur seal operation. This continued until 1983 when the federal government withdrew its operations from St. George Island.

A sealing plant located on St. George was used to process sealskins and render remains. This sealing plant, the last one of its kind, was designated to the National Register of Historic Places in 1986. This building, the largest one on the island, was disintegrating from the combined attack of salt, water, and frosts and was in danger of collapse and being lost forever.

Figure 1. Original Condition of the Seal Plant

To restore the structural integrity of the plant, the National Oceanographic and Atmospheric Administration, NOAA, in accordance with Public Law 104-91, engaged consultants to produce studies

and designs. St. George Tanaq Corporation, an island entity, made an unsolicited proposal to do the construction work required by the designs and specifications provided by NOAA. Notice to proceed on this cooperative agreement was given on June 1, 1998, under award #NA87AE0322. Fieldwork commenced in the fall of 1998. The project was completed November 30, 1999, with project superintendents and most of the workers residents of St. George.

The proposal budget was $2,444,712 and the actual project cost was $2,047,294. The $397,418 in savings were the result of experienced project management by the St. George Tanaq Corporation, the use of St. George's local work force, value engineering by Polarconsult, St. George Tanaq Corporation's engineering subcontractor, and professional oversight by NOAA.

Introduction

Project Objective

The primary objective of this project was to provide the structural improvements needed to bring the Seal Plant into compliance with the plans and specifications provided by NOAA and current building codes. The secondary objective was to slow future deterioration of the structure by improving the building's protective systems. This work included coatings, patching, replacing parts of the roof and windows, and similar activities. All of the work was done in a manner that did not compromise the historic significance of the structure. These objectives were to be achieved in a cost effective manner.

Legislation

Congress passed Public Law 104-91 that funded work on the Pribilof Islands which included restoration of the Seal Plant Building. PL 104-91 also mandated the use of local entities to conduct this work.

Costs

The project cost was negotiated under a Cooperative Agreement with NOAA and was not to exceed $2,444,712. The total cost of the project was $2,047,294, despite the fact that the project started at a time of the year that made logistics more difficult. NOAA may use the resultant savings of $397,418 for other projects. The cost savings were brought about because of the management and supervision of St. George Tanaq Corporation, the talents of the local work force, value engineering, and NOAA's willingness to work cooperatively with the project management team.

Makeup of Work Crew

The St. George Tanaq Corporation hired eighteen residents of St. George to work on the project.

- Andronik Kashevarof, Jr., Project Superintendent.
- Lorene Bristol
- Michael Chercasen
- Joe Kashevarof
- Anthony Lekanof
- Peter Lekanof
- Phillip Lekanof
- Rodney Lekanof
- Paul Lestenkof
- Afanasia Merculief
- Antony Peter Merculief

- Chris Merculief
- Grace Merculief
- Andrew Philemonof, Sr.
- Randy Philemonof
- Alexis Prokopiof
- Crystal Welch
- Peter Zacharof

Federal, State, and Local Government Participation

The participants in this project were: the U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA); the State of Alaska, Department of Natural Resources, Division of Parks and Outdoor Recreation, State Historic Preservation Office (SHPO); the National Parks Service (NPS), Cultural Resources Division; and the City of St. George, Alaska. In particular, NOAA and its project manager, Mr. Minh Trinh, participated via cooperative agreement with the St. George Tanaq Corporation. The State Historic Preservation Office held oversight responsibilities related to archeological standards. The City of St. George participated in this project through the rental of equipment and by making its personnel available to work on the project.

The State Historic Preservation Office, the Advisory Council, and NOAA entered into a Letter of Agreement, which bound NOAA and its restoration contractor to its required provisions.

Design

Original

NYGAARD subcontractor, Alpha Engineering, developed the design documents that describing the repairs and modifications to the structure. These documents were provided to St. George Tanaq Corporation for use in completion of the work.

Alpha Engineering's design required very extensive concrete work for the support system of the Blubber House, which is located in the northwest quadrant of the structure. For all of the columns, the plans required cutting and excavation of the basement floor, replacement of old footings, placement of new footings and columns, new backfill, and recasting of the floor. For the perimeter main beam above the columns, extensive cutting, doweling, and pouring was required. In addition, in the basement two large shear walls connected to massive foundations were to be constructed out of concrete. Further, patching was required of each blemish of the outside surfaces. It was apparent that this design would create a scheduling problem, unnecessary expense, and possible safety hazards to St. George Tanaq's work crew.

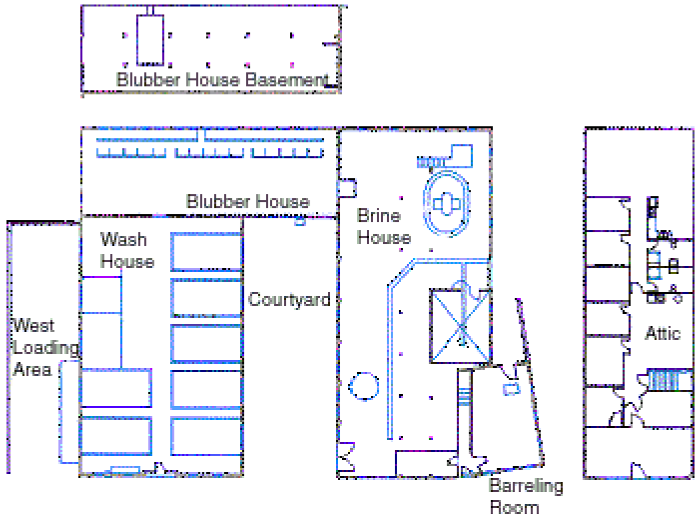

Figure 2. Room Layout

Changes

The St. George Tanaq Corporation and Polarconsult looked for a way to meet the project objectives while meeting the schedule, reducing project costs, and equaling or bettering the structural improvements.

Plans were made and provided to NOAA that eliminated much of the interior column work by casting the large footings on the floor slab and building larger columns around the old columns in the Blubber House basement; however, this changed the appearance of the basement of the blubber house. Working with the State Historic Preservation Office's representative, Russ Sackett, enabled the determination to be made that this area was not of historical significance and would not be an area used for interpretive viewing. There were significant cost savings derived from this decision.

It was then determined that the perimeter support beam could be supported by the timber infill panel which was necessary anyway to meet the archeological requirements. This meant that the extensive structural improvements required in the plans were not needed for this beam. Instead, the damaged concrete and reinforcing bars were removed and replaced with new concrete. The infill panels were designed to transfer load to the underlying concrete floor. As an alternative to excavating and constructing pad foundations under each column and constructing a new column, an 18 inch by 24 inch deep grade beam was constructed around the north and west sides of the basement. With the grade beam, the shear walls could be moved to the northwest corner of the building, and significant additional expense was avoided.

Figure 3. Construction of the Perimeter Grade Beam

During the State Historic Preservation Office representative's visit to the project, it was determined that the areas where there were surface spalls could be left alone, provided that they did not create structural problems. This was preferable from an archeological appearance viewpoint. As a result, patching was done only on the areas where rebar or support might be compromised. The unpatched areas were coated with primer and a thick layer of elastomenc paint that prevents damage from freezing water and salt spray.

Alpha Engineering's plans also specified the replacement of corroded rebar in the Blubber House floor. These plans were impossible to implement because of reinforcement overlapping requirements required by code. Instead, the severely corroded bar was exposed, cleaned, and new bar was welded to it. The steel was treated with a coating to prevent corrosion and new concrete was placed.

Figure 4. New Rebar for the Blubber House Slab and Support Beams

The concrete for making repairs specified by Alpha Engineering required to have a strength of 3,500 psi. A superior product, S88 patching mortar from Master Builders, was substituted to satisfy the mortar requirements. The advantages of the S88 product is that it does not have unfavorable shrinkage characteristics, the bond strength exceeds that of conventional concrete, and it has a high compressive strength (8,400 psi), which exceeds that of the floor concrete. Use of this product allowed a shallower cut into the base concrete around the edges and consequently saved labor costs.

During construction it became apparent that the Blubber House floor was not attached to the east wall and as a result there was no shear strength on the east side of the building, as such, ties and a beam were constructed that connected the floor to the wall. The unsupported edge of the floor slab was also reinforced along with the replacement of decaying concrete in the area.

Results

The changes described in the preceding section were made as proposals to NOAA, who reviewed them and gave permission to modify the Alpha Engineering design. The Cooperative Agreement Contract provided the framework under which NOAA and St. George Tanaq Corporation could work together to save time and money and improve the long-term integrity of the building.

Floor Strength

Through testing and field investigation, the following slab properties were obtained:

- Slab thickness is 5 inches.
- Rebar size is #5 (0.31 ins) spaced 10" O.C.
- Bar yield strength is 48 ksi.
- Concrete strength is 8.4 ksi.
- There is 1.5" concrete cover below the rebar in the middle of the slab and 2.5" at the beams.

Figure 5. Concrete Cores from the Blubber House Slab

Concrete strength of the slab is based on a single compressive test performed by R&M on a core. The result was a compressive stress of 8844 psi. It is impossible to calculate the expected 95% confidence level strength based on this one measurement. However, R&M suggested that the strength may well have been higher if a better core sample had been obtained (implying that the sample was in some way physically damaged during the coring process). Also, using strengths 50% as strong resulted in less than a 5% change is overall slab strength. This is due to the fact that the slab is underreinforced (slab does not meet 99 ACI minimum reinforcement ratio requirements) and the net effect of reducing the concrete strength is a minor reduction in the moment arm within the slab.

As stated above, the strength of the slab is limited by the amount of steel present. Only one sample of steel was taken and submitted for testing. However, because steel is manufactured in large batches and under controlled factory conditions there is good reason to expect that that one sample is representative of all of the reinforcing in the slab. However, the actual effective area of steel is questionable. Observations of exposed steel in the slab showed anywhere from almost no corrosion to complete disintegration of the cross section. Therefore, an average area of 50% is used in analysis.

Redistribution of negative moment (99 ACI 318.8.4) allows for an 18% reduction to the calculated negative moment. Results indicate that for 50% reduced area in reinforcement, the slab can carry 70% of the required total load. The calculated allowable live load is then 60 psf.

Instead of the continuous span scenario, it is likely that the slab section at the interior beams is fully cracked thus making the slab structure a series of simple spans. Complete cracking of the slab over the beams is not a structural concern. The simple span analysis is also more appropriate given that the maximum moment occurs in the middle of the slab (midspan between the beams). This is where most of the repairs were done to the slab (installing new reinforcing). However, to be conservative, it is still assumed that only 50% of the rebar area is effective since the repairs weren't made everywhere under the slab (only where there was spalling and rust stains). Analysis shows that the slab can carry 70% of the required load. Therefore, calculated safe live loads are also 60 psf under this structural condition.

Because it is not known with certainty how much reinforcing has corroded and where, the best indicator of the slab strength would be a live load test. In a sense, this occurred already during construction when a forklift was operated in the room (prior to any slab repairs being done). The exact weight of the forklift is unknown but based on the weight of a similar model the induced stresses are expected to be about equal to the fully loaded condition. The forklift did induce some significant vibrations but did not cause any failures. However, because this was not an actual load test performed under controlled conditions it can not be used to determine a safe load for the slab.

Based on the above analysis, the recommended safe, long term live load for the slab is 50 psf. This is equivalent to the live loads prescribed for office space.

Archeology

Interim Report

An "Interim Report: Archaeological Monitoring of the Seal Plant Stabilization, St. George Island, Alaska" was made by Charles Mobley of Charles Mobley & Associates. Mr. Mobley was present at the site at the start of the project and identified a number of artifacts and potential artifacts that required documentation and protection for the construction to proceed.

The removal of soil around the perimeter of the building to allow for repair of the foundation and site grading required the identification of artifacts. Soil was also removed from the blubber house basement along with numerous items stored there. Following the site work, those artifacts identified were documented in the October 1998 Interim Report.

Final Report

The final report entitled "Archaeological Monitoring of the Seal Skin Plant Stabilization, St. George Island, Alaska" includes minutes of meetings with the SHPO officer and the relevant findings.

Figure 6. Archaeological Artifacts

Lead Paint Removal

Large portions of the exterior and interior surfaces of the Seal Plant were coated with lead based paint. A specialist was retained by St. George Tanaq Corporation to determine the extent and locations of the lead base paint. With the exception of the NOAA housing area (which was not part of the survey) and around the wooden gable ends, the investigation showed the entire building was painted with lead based paint. The survey also indicated that lead paint had contaminated the soil around the perimeter of the building due to paint flaking off over time.

In accordance with the requirements of the Cooperative Agreement, the St. George Tanaq Corporation trained and certified local workers in the removal of lead based paint. Blood tests of the workers were done to test for pre-construction lead levels. Follow-up tests have been offered to workers to check the post-construction lead levels.

In accordance with the plan in the proposal, air monitoring was done initially to determine if using the "Back to Nature VIII" stripper resulted in deterioration of the air quality enough to require respirators. Monitoring showed respirators were not required to meet OSHA requirements, however, many of the workers opted to utilize them anyway. Tyvec suits were provided as over garments and the workers wore gloves and hats during the abatement process.

Figure 7. Lead Paint Removal

The lead paint incorporated with the stripper was contained in plastic bags and placed in marked drums for shipment to a certified disposal facility in the state of Washington. A washer/dryer equipped with a wastewater filter was provided to clean workers' clothes.

Asbestos Shingle Removal

The Brine House, Blubber House, and half of the Wash House were covered with cement asbestos shingles. These shingles were held to the roof with copper nails and were determined to be non-regulated, non-friable asbestos roof shingles. The balance of the Wash House had wooden shingles.

The analysis of the cement asbestos shingles revealed a 45 to 50 percent asbestos content. Certification by OSHA was required to remove the asbestos shingles. Specialized training for local workers was provided so that the St. George Tanaq Corporation could conduct the shingle removal using labor from residents in the St. George community.

A test was conducted to determine if respirators were required by OSHA during the removal of the shingles. This test involved the removal and bagging of the shingles with air monitors in place. The workers wore respirators during the test. Analysis of the monitor filters indicated the level of fibers to be well below the permissible limits, allowing work to proceed without the use of respirators.

The shingles were pried off of the roof, placed in polyethylene bags and lowered into a bin lined with a heavy-duty bag. The double-bagged shingles were then stored in a controlled area and later shipped to Rabanco Recycling’s landfill in Seattle, WA.

Solid Waste Disposal

After commencement of the Project the proposed solid waste disposal plan was found to be too complicated and not possible to implement. These problems stemmed from the lack of an approved landfill in which to dispose of the asbestos shingles and other construction debris in the St. George community.

The St. George Tanaq Corporation originally intended to obtain a permit from the State of Alaska to dispose of construction debris in a mono fill. This fill was intended to be on NOAA property. However, NOAA rejected this solution and the St. George Tanaq Corporation was directed to dispose of the debris off island. This was a change to the original scope of work for the project.

In addition to asbestos and lead disposal, sealskins, wood from the seal pens, metal fences, and other miscellaneous debris required disposal. Some combustible non-hazardous trash (rotten seal skins and wood debris) was burned under permit and the ashes recovered, bagged, and barreled for shipment off-island to Rabamco Recycling in Seattle. Prior to shipment, analyses of the ash were taken for heavy metals. These tests indicate that the ashes were not hazardous. Much additional debris was bagged and shipped to Rabanco Recycling in Seattle.

The requirement to dispose of construction debris off island increased the administrative workload on St. George. The direct cost of this work was approximately 535.000. This cost was an increase over that anticipated in the original budget.

Construction

Methods

In general, standard construction methods were used on this project, however, as a result of logistical difficulties and lack of suitable equipment, some of the work was more labor intensive than it might have been under more favorable circumstances. For example, the excavation of the grade beam for the Blubber House foundations was done with shovels, picks and electric impact hammer-drills. Because of the hardness of the soil-rock matrix, the work proceeded slowly. Removal of the concrete columns around the perimeter was done with the electric impact tools until the air hammer drill arrived. The air-operated hammer that would have improved efficiency was ordered but did not arrive until late in the job due to shipping delays. Once received, the air hammer significantly improved the rate of production.

As directed by the State Historic Preservation Office, the surface of the concrete was either to match the existing finish or be completely different and differentiated. Where exterior concrete was poured and patched, every attempt was made to match the existing finish. Cedar boards were purchased and cut to make forms that had the same board width to match to original shiplap form marks on the concrete. The exterior buttresses on the Brine House and the interior pilasters in the Blubber House are examples of this special effort where the new work matches the appearance of the old.

Lead paint removal difficulties due to weather impacted the project schedule and the completion of other unrelated project tasks. Lead paint removal was required prior to conducting concrete patching or other work on the walls with the exception of drilling out and patching the form ties. There was difficulty in getting the paint stripper to function properly, which prompted St. George Tanaq Corporation to retain a specialist to experiment with the best method of paint removal.

Logistics

The logistical difficulties moving equipment and people to and from the island had a great deal of affect on the timing and the overall cost of the project. Despite the challenging logistics, the knowledge and flexibility of the crew and supervisors resulted in a project completed on time and under budget.

During the 18-month project duration the major freight cargo airline, Northern Air Cargo, ceased flying to St. George. This resulted in substantial freight delays and required that marine transport be used to move all items of significant size and weight. The shipping company, Western Pioneer, restricted the number of visits and often bypassed St. George during adverse weather. This further complicated the project scheduling.

Weather impediments contributed significantly to the logistical challenges associated with air transport of project material, personnel, and equipment. The presence of fog during the late spring and early summer was a chief cause of flight cancellations. As a result of fog, there was a period of over 3 weeks when aircraft would not land on the island. A fatal airline crash which occurred during the period resulted in more cautious airline operations and additional transportation difficulties.

The government delay in startup of the project also contributed to the logistical difficulties. Originally, work activities were scheduled to commence in January 1998 when the local workers were available for training and certification and fog would not have hampered transportation to the same degree.

Many of the processes, such as lead paint removal and painting, are weather dependent and as a result must be completed during the summer. Since the summer is also the fishing season, this resulted in a reduction in the local labor force.

As a result of the logistical difficulties indicated above, significant project savings realized by utilizing the local labor force as opposed to using off-island workers. Equipment or material delays often caused the local workers to be sent home or placed on a part time work schedule. An off-island work force would have required a significantly larger project budget to cover the costs for standby time, travel, and per diem.

Concrete Foundations

As described in the Design Changes section of this report, there were extensive changes in the support system of the Blubber House. During the initial investigation of the building foundation system, it was discovered that all of the columns were on 18-inch square concrete pads. Thickness' were about 12 inches. These pads were mostly on very dense, compacted soil and small rock matrix. Sighting along the original floor line it was noticed that the floor undulates. This is a strong indication that the original foundations settled. Additionally, there were large cracks that had formed at the junction of the Blubber House north wall and the Brine House. These cracks might have been indicative of possible settlement due to the added load of the post fire construction.

A grade beam was designed to support the outside walls of the Blubber house. The beam was designed for a soil load of 2,500 pounds per square foot (proposed by Alpha Engineering). The concrete for this grade beam was designed using 3,500 psi concrete. The reinforcing used was 60 ksi epoxy coated bar. The beam was designed as a beam on an elastic foundation with the assumption that all of the loads were applied through the concrete columns. This was conservative, as the actual loading is applied continuously through the concrete columns and the timber infill panels.

Figure 8. Large Rock in Path of Perimeter Grade Beam Construction

In several instances, during construction of the grade beam, excavation could not be done because solid rock was encountered. In this case reinforcing bar was epoxied 8 inches into the solid rock and the forms were cut to conform the concrete to the rock. At the ends of the grade beam where existing concrete was encountered, the reinforcing was epoxied into that as well. The dimensions of the perimeter foundation were a minimum of 18 inches wide by 24 inches deep, with the exception of rock areas.

The interior concrete foundations were placed on top of the existing floor slab or, in a few cases, on compacted soil. Their dimensions are in accordance with the drawings.

The concrete used on the project was made from 3/8 inch maximum aggregate size premixed sand and gravel from a Washington batch plant. This material was placed in one cubic yard sacks and shipped to St. George with separately packaged Portland cement. Scales were devised for the loading bin on the 1/3"d cubic yard skip-loading mixer that was used for mixing most of the concrete. Air entrainment compounds were added along with a super plasticizer that was used when the situation warranted. Sample cylinders of the concrete were set aside and sent to R&M Consultant's laboratories for testing. Three 4 inch samples were tested and found to have an average compressive strength at 40 days was 4.6 ksi.

Concrete was mixed inside the fish plant and then transported to the site using a buggy on the forks of a large loader. The concrete was placed in forms using chutes and holes in the forms to achieve distribution. For the interior concrete work, the buggy was dropped off and wheeled to the appropriate form.

Columns

The interior columns were, in most cases, less deteriorated than those on the outside wall. Concrete was lost where reinforcing corroded and the expansion forces of the iron oxide caused the concrete to spall off. With the footings on the concrete floor and the original columns encapsulated as part of the footing, it was logical to add a minimum 4-inch outer column over the existing column.

Figure 9. Oversized Interior Columns in the Blubber House Basement

The beams supported by the existing column were supported by temporary screw jacks during the work. The existing column had all loose material removed and badly corroded reinforcing was exposed. If the reinforcing was not too corroded, it was cleaned off and coated with a corrosion inhibitor. A new rebar cage was applied then the forms were constructed and the column was poured with +3,500 psi concrete. Because the new column is larger than the old it decreases the span of the floor support beams by 8 inches. This has the net effect of significantly increasing their carrying capacity.

The Alpha Engineering plan called for replacing the exterior columns with new 10 x 14 inch columns along with a rebuilt overhead beam. The crew replaced all of the exterior columns with new bar and cages as per the plans. The exterior columns were tied to the structure with existing rebar (if clean) or with new bar in drilled holes held by epoxy. Generally, a small gap would occur between the poured top of the column and the beam. This gap was filled with S88 mortar and trowled into the surface. The resultant appearance is almost identical to the original work.

Because the infill panels support the perimeter beam above the exterior columns of the blubber house basement along its entire length, there is no longer a reason for this beam to carry significant bending loads. There was corroded rebar and spalled edges in the lower, outer part of the beam. The broken concrete was removed. Good reinforcing was cleaned of rust and coated with P-22 corrosion inhibitor coating and S88 mortar applied as described under the walls section of this report. The mortar was held in place with forms that provided the alignment and look of the original beam.

Patching

The specifications called for removing the form ties on the exterior walls. As shown on the original plans, there were a large number of these ties. The cores were made with dry bits and water diamond bit drilling. Water was difficult to get when it was cold and restricted the use of the diamond core drill. Once the drilling work was completed the tie wire was broken off and the holes patched with S88 mortar. It should be noted that the form ties had corroded and rust would show through the paint. However, some of the aggregate has high iron content and exhibits similar properties. The specifications did not call for removing the tie wires in the interior of the building.

Figure 10. Wire Tie Removal

As described earlier, the State Historic Preservation Office asked that areas where the original surface concrete was gone and beach rock aggregate exposed not be patched unless it was structurally necessary. As a result, patching took place only where there were areas where there was significant concrete loss, on lintels, and where there might be reinforcing next to the surface. The specifications called for making deep cuts around the patch, chipping out, building a form, and core drilling holes from the inside and pumping concrete into the void. By using high strength S88 mortar, the cut could be 3/8ths of an inch deep and the depth of the patch could just equal or exceed this value. Because of the high bond strength and firmness of the S88 it was possible to do most of the patching without the use of forms and core drilling pour access holes in the walls was unnecessary. Forms were used as was appropriate to the condition. If reinforcing was encountered, the rust was removed and P-22 corrosion protection applied prior to the application of mortar.

During operation, the Blubber House was awash in seawater. Also, it is extensively exposed to salt spray from the nearby beach. As a result, the under side of the Blubber House floor had extensive spalling and evidence of reinforcing corrosion. To correct this the underside of the floor was chipped using hammers and impact tools to find and remove any concrete that was no longer bonded to the main concrete or where there was rust stains indicating reinforcing corrosion. As mentioned earlier, there was some iron-rich aggregate that showed rust but was sound. All of the unbonded concrete was removed to sound reinforcing or to one of the support beams. Corroded reinforcing, of which there were some bars that were completely severed, were paralleled with new number 4 epoxy coated bar that was welded (when the lap lengths could not be practically met) to the existing bar. The existing bar was cleaned of rust with sand blasting and coated with P-22 corrosion inhibitor. Small patches were made with S88 patching mortar and trowels. It was too difficult to apply this mortar with trowels on the larger patches so core holes were drilled through the floor at various locations for pouring. Before pouring all of the high spots in each area were vented by drilling from below. Forms were erected and S88 mortar was poured from above. Afterward the forms were removed and any unfilled spaces were patched. The exposed mortar was coated with Confilm that prevents evaporative loss of moisture.

Crack Repair

The repair of all cracks in the concrete smaller than I/a inch was to be done with epoxy injection using a technique pioneered by Master Builders. The specifications called for an expert with years of experience to do the crack repair. This would not have met the requirement of training local people to do the work.

Initially, during the fall of 1998, Gary Searles from Master Builders showed the crew how to use the injection equipment that was obtained through Master Builders as required by the specifications. However, it was late in the year and the temperatures were too low to do the work after Mr. Searles left.

Figure 11. Repaired Crack with Capping Paste Still Covering the Left Side

In 1999, an expert, Leo Manes, was brought in from Vector, a firm that does extensive crack repair work on bridges and nuclear power plants. He trained and worked with a team of local workers and they repaired all of the injectable and repairable cracks. Even during the summer time it was still too cold for the epoxy to flow effectively. The crew built an enclosure for the pump that was heated. The hot epoxy flowed easily into the smallest of cracks.

For quality control, three diamond cores in accordance with the specifications were taken of injected cracks and they showed complete penetration. As requested, Vector provided a report of the work and findings.

It appeared that there might also have been a requirement to inject the cracks in the Blubber House floor. However, the designers of the specifications did not take into account that the floor is actually comprised of two layers and a crack in one layer is seldom expressed in the second. Injection of epoxy into the top layer would have resulted in an electrical isolation barrier between the two layers and would have precluded the treatment to cause migration of the chlorides to the surface away from the reinforcing bar. Also, because of the extensive patching of the floor from the underside, most of the cracks were intercepted with S88 mortar.

Roof Repair

The original specifications called for leaving the asbestos shingles, rebuilding the flat roof over the barreling room, removing the moss, and treating the old wooden shingles over the cast roof of the Brine House. During the proposal phase, the St. George Tanaq Corporation offered to reduce its administrative charge to allow for the additional expense of roof replacement. It was decided to completely strip and re-roof all areas except over the barreling room using plywood overlayment, ice and water shield, and cedar shingles. The St. George Tanaq Corporation brought in a subcontractor, Broken Arrow, to provide technical support to the workers during the roofing process. The subcontractor had previous experience at St. George on several other projects. Because of driving rain, the existing shiplap was covered with L/z inch of plywood. This was also done to get good anchorage for the nails. Cedar shingles with a 5-inch drop were then applied over the ice and water shield. New cedar fascia boards were put on the truss ends. The appearance of the Seal Plant is consistent with the other buildings in the area.

Windows and Doors

New glass windows were purchased and installed. These windows are consistent in appearance with the original divided light windows. The windows are fastened with special Tap-con concrete screws to an original concrete window stop constructed some years ago. Skylights located in the west roof of the Brine House that were inoperative and were not part of the original building were removed.

The door into the southwest corner of the Brine House was rebuilt. The original hardware was reused to preserve the authentic appearance. The personnel door on the south end the Brine House was rebuilt, as was the door on the south end of the Wash House. A new steel door was installed for access to the basement under the Blubber House. The plywood doors into the Wash House were replaced with new wood doors.

Painting

Prior to painting, the lead paint on most concrete surfaces had to be removed. This paint was removed, to the greatest extent possible, with Back to Nature Strippers, which are non-caustic. Because of the pores and roughness of the concrete, lead paint in low spots remained. as it could not practically be removed without removing the surface of the concrete.

Because uneven surfaces left small incised pockets of lead paint behind, all of the inside surfaces were coated with encapsulate whether the plans called for paint or not. In addition to this encapsulant, the north and west interior walls were painted in the Blubber House. A gray painted wainscot was applied to match the original paint scheme.

The exterior concrete was stripped of lead paint then coated with a primer. Then, many coats of elastomeric paint meeting the specifications were applied with rollers. The local crew found rollers more effective than the airless spray gun. One of the problems with the application of these water based paints was that the recommended relative humidity was not to exceed 55%. During late summer and beyond, there were few days when the relative humidity dropped below 90%. Thin layers of paint dried in spite of the high humidity. Two coats of 20 mil paint would have never dried and might have sagged and blistered. Wind, rain, and fog were constantly disrupting schedules and resulted in tenting and heating the outside walls. The wood gable ends were brushed clean of scale and primed with the same primer used on the concrete. They also received an elastomeric coating.

Electrical

All of the electrical wiring, junction boxes, switches, and conduits were badly corroded by the salt air and needed replacement. Many of the globes for the industrial lamp bases were broken. These lamp bases were made of brass and had corroded to a copper green. During negotiations a task was added to replace the wiring in the Wash House, Blubber House, and parts of the Brine House. The living quarters used by National Marine Fisheries personnel were not part of the project. These quarters were powered from a separate panel and the wiring was Romex, which was stapled to the beams, joists, and walls.

A new wiring scheme was planned that would provide industrial light fixtures similar to those previously used in the locations where activity had taken place. Most of the lighting was placed close to the existing fixtures. The old electrical panels and equipment was to be removed because to operate it was hazardous. New, code compliant wiring panels and fixtures replaced the existing ones. The new equipment, with the exception of the distribution and meter panels and the globe lights, is plastic, as is the conduit, so it will not corrode in the future. New globes could not be obtained for the existing bases therefore new fixtures were obtained that have a similar look. The bases and guards are aluminum. The conduit was slightly oversized so additional circuits can be added if required. The feed for the Wash and Blubber Houses and the basement is from a single meter as this will likely become the main interpretive center. Also, if pelting is resumed, the primary use will be in this area. The Wash House is now fed from the existing meter panel on the south side of the Wash House to a new distribution panel located on the inside south wall. The panel feeding the Brine House is located in the stairwell to the sleeping quarters and is now connected to an existing meter panel on the south side of the Brine House. The Brine House, including the upstairs quarters, is primarily used for Federal Government activities on the island.

Chloride Treatment of the Blubber House Floor

New technology has yielded a means to reduce corrosion of chloride rich concrete by using an electrical current to cause the chloride to migrate away from the steel reinforcing to an anode on the surface. This technology was extensively used in Norway and other northern european countries. The U.S. Department of Transportation has adopted it to retard corrosion of bridges. The process works by connecting a DC negative current to the interconnected reinforcing bar and providing an anode of steel or, if appearance is important on the surface, titanium (which is what was used for this project). Electrical connection between the anode and the reinforcing is done by operating the anode on the surface of the concrete in water. The DC current is controlled to not exceed 40 volts and not to have too high an ampere output per square foot. Lime is used to counteract the chloride that is attracted to the positive anode. The power supply has to have controllable DC voltage and amperage. Vector Engineering provided many of the materials and expert assistance in setting up a chloride removal process for the Blubber House floor. Prior to instituting the chloride treatment, concrete cores with rebar were sent to Vector in Canada for tests to establish if it was possible to cause migration of the chloride in this concrete at this depth. The tests were positive.

Because cores being sent to Vector for testing were lost by the Post Office, and because of very bad transportation, the chloride work schedule slipped until there was only the allocated two months of operation prior to the end of the project. There was no longer time to take a core and determine whether the ions have moved significantly away from the steel to the titanium anodes on the surface of the concrete. Daily records have been kept of the current and voltage put out by the two DC power supplies to the rebar and the anode, and these exhibit typical characteristics of a functioning system.

In addition to the chloride system, Vector recommended putting in sacrificial anodes around the perimeter of the patches. This prevents corrosion at the margins because of the difference in the character of the concrete as compared to the mortar patches. These anodes were put in and were connected to the bolts welded to the rebar that were installed for electrical connections during the chloride treatment.

APPENDIX A

Picture of the Seal Plant before any work began in 1998.

Finished Project. Frost on the roof is covering the cedar shingles which are the same as the ones on the exterior of the blubber house basement infill panels.

Interior of finished Blubber House room.

View of seal plant from the south.

New roof installation. Note the use of ice and water shield over the entire roof area.

Close up of new cedar shingles.

Installing grade beam rebar under the existing slab and exterior columns of the blubber house basement.

Putting forms together for grade beam.