STRUCTURAL CONDITION ASSESSMENT HERMIT'S REST GRAND CANYON VILLAGE GRAND CANYON NATIONAL PARK

FINAL REPORT

PREPARED FOR
DEPARTMENT OF PRESERVATION STUDIES
UNIVERSITY OF ARIZONA
COLLEGE OF ARCHITECTURE
AND LANDSCAPE ARCHITECTURE

PREPARED BY TURNER STRUCTURAL ENGINEERING CO.

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SUBMITTED

OCTOBER 12, 2007





October 12, 2007

Mr. Brooks Jeffery University of Arizona College of Architecture And Landscape Architecture PO Box 210075 Tucson, AZ 85721-0075

RE:

HERMIT'S REST

STRUCTURAL CONDITION ASSESSMENT

FINAL REPORT

Dear Brooks:

In accordance with your request Turner Structural Engineering has performed a structural condition assessment of Hermit's Rest located at the west end of the Rim Road in Grand Canyon Village in Grand Canyon National Park.

In the course of preparing this report, we have reviewed available drawing documentation and photographs, that you provided, and performed a site visit to observe the condition of the building.

Our investigation was limited to items that could be readily observed. No removal of building finishes, no testing or structural analysis work was performed.

In general we would characterize the building to be in fair condition. However, there are several structural deficiencies that require attention. Briefly, the areas of most concern are the condition of the roofing, the condition of the exposed heavy timber members, and the condition of the stone masonry retaining wall that supports the front of the porch area and the porch roof.

It is our opinion that the building was well built to support vertical loads and has withstood the test of time for over 90 years. However, given this type of stone masonry construction, the ability of the structure to withstand lateral loads (earthquake) is highly suspect.

In the following pages we list our on site observations, list the structural deficiencies observed, and list our recommendations for repair and upgrade.

If you have any questions, please don't hesitate to contact us.

Sincerely.

TURNER STRUCTURAL ENGINEERING COMPANY

Mark S. Turner, PE

Hermit's Rest Grand Canyon National Park

Document Review:

We reviewed drawings dated 1914 prepared for the Fred Harvey Company for the original construction of Hermit's Rest.

The drawings indicate the building construction over the high main roof and the two side rooms to consist of earth fill over cast concrete pan joists with heavy timber decorative beams and closely spaced wood lattilla rib ceiling exposed to view in the rooms below. The half dome fireplace is shown to be a cast concrete half dome with stone veneer.

The drawings indicate the rear wall of the building to be cast concrete with the side and front walls shown to be stone masonry. The arches over the doorways to the side rooms as well as the arch at the front of the half dome fireplace are shown to be true stone masonry arches.

The two heavy timber posts supporting the high roof, the low porch roof and the front clerestory have steel pipe columns shown buried in the center core of the posts, none of the other heavy timber posts are shown to have buried pipe columns in them.

Concrete footings are shown below the steel pipe columns and also at the concrete retaining wall at the rear. The stone masonry walls indicate the foundations to be stone masonry as well.

There is a note on the floor plan (Sheet 1 of 6) for all concrete beams to have an 8 inch bed of concrete (at supports) and be reinforced as shown on the reinforcing plans. We did not have any sheets showing reinforcing plans.

The roof plan (Sheet 2 of 6) indicates that there is to be rock piled on the roof over the half dome fire place and over the rear half of the two side rooms. The drawings indicate that the porch roof is to be covered with slabs.

Site Observations

A site visit was made on July 27, 2007 and the following observations were made:

The basic building plan and porch layout remains unchanged from the original 1914 construction. The building still functions as a rest house as originally intended.

Exterior and Roof of Building

There were significant changes to the structure from what was indicated on the original drawings. Those changes include the removal of the rock piles on the roof and the addition of a stone masonry retaining wall/parapet wall (approximately 5 feet tall) that aligns with the back of the stone chimney of the half dome fireplace but is approximately five feet beyond the rear wall of the building.

The rock piles on the roof have been replaced with an elastomeric roofing material. In fact the entire roof area including the front porch, high clerestory, the side rooms and the half dome fireplace are all covered with the elastomeric roofing. The elastomeric roofing also extends past the (buried) rear wall and stops at the face of the stone masonry retaining/parapet wall.

Other changes include the addition of a heavy timber patio roof structure at the west end of the existing porch roof. And the extension of the stone masonry retaining wall across the full width of the front edge of the patio and porch area. The retaining wall is approximately 8 foot high.

It is unknown to us, when these changes and/or additions were made.

The elastomeric roofing has failed in several locations. There were various ponding areas, rips, bubbles, soft spots and wrinkles in the roofing.

There is a lot of stone masonry throughout the building. Generally, the condition of the mortar appeared to be good.

Most of the heavy timber outlookers shown on the original drawings had been cut back to the edge of the roof. The exception occurring at the front of the clerestory, the outlookers at this location were deteriorating due to exposure.

The decorative heavy timber members over the clerestory windows and the side room windows have faded, chipped paint, and deterioration due to exposure.

The decorative heavy timbers members above the clerestory windows have shifted and created a gap between the timbers and the lintel above. Some of the mortar has fallen out of the gap.

At the west edge of the original porch as it adjoins the patio addition, there was a gutter loosely set in place. It does not appear as it would drain any area.

The downspout that extends down from the porch roof adjacent to a porch column does not appear to be connected to a roof drain or gutter.

The roofing material on the patio roof addition is in very poor condition, some of the roofing is missing and the decking is exposed.

The retaining wall at the front edge of the patio, at the west end near the location where it adjoins the patio addition, has been undercut at the base by soil erosion. The wall also appears to be settling in some areas. There were gaps in the stone masonry, with void spaces between the stone, and in one location a large stone has fallen out of the wall.

The stone masonry columns supporting the stone roof bear on these stone masonry retaining walls and depend on them for support.

There were two porch columns shown on the original drawings that were not in place. It is unknown how long these posts have been gone, or if they were deleted in the original construction. There was no observable structural deficiency as a result of the posts not being in place. The short beam at the northeast corner of the porch is one location where the post is missing.

Two of the porch beams are supported on the stone masonry columns, that are supported on the stone masonry retaining walls. There were no anchors visible between the heavy timber porch beams and the stone columns.

The porch columns not setting on the stone columns set directly either on elevated bases on the patio stone or were set in in-filled concrete areas. There was no visible connection between the porch columns and the patio stone.

Interior of Building

The stone masonry arches seem to be in good condition.

There was some water staining on the underside of the wood ceiling members located in the hallway between the snack bar and the rear office.

No other structural deficiencies were observed on the interior.

Site Features

Entry Arch with Bell: the stone masonry structure appeared in good condition. The mortar in the stone appeared in good condition.

Lamp Post: the stone masonry structure appeared in good condition. The mortar in the stone appeared in good condition.

Oven: The stone masonry structure appeared in good condition. The mortar in the stone appeared in good condition. The only defect was a crack in the stone lintel over the opening into the oven.

Steel Tank: There was a vertical steel tank (approximately 12' diameter by 20' height) at the rear of the building. The tank was set on a concrete pad. The soil had eroded at the south (rear) edge of the pad and exposed the foundation.

Structural Deficiency Issues:

- 1. Condition of Roofing: The roof appears to pond in several locations; there are soft spots in the roofing; there are some cracks, bubbles, and rips in the roofing (refer to photos 1, 2, and 3
- 2. Roof Leak: Some staining of the ceiling planks was observed in the ceiling in the corridor between the Snack Bar and the Office (refer to photo 4).
- 3. Decorative Beams over Clerestory Windows: Paint has faded, cracked, and peeled off of the heavy timber decorative beams over the clerestory windows (refer to photos 5 and 6).
- 4. Patio Addition Roofing: Roofing in very poor condition; portions of roofing missing and wood decking is exposed (refer to photo 7).
- 5. Gutter on Patio Roof Edge: The gutter has fallen off the edge of the patio roof and is laying on the lower roof of the patio addition. If the gutter were attached it does not appear that it would drain very well (refer to photo 8).
- 6. Heavy timber beam ends: The outlooker beams over the front clerestory windows have deteriorated due to exposure (refer to photos 9, 10, and 11).
- 7. Window at Snack Bar Office: The area outside of the office windows does not appear to drain very well (refer to photo 12).
- 8. Decorative Beams over Snack Bar Windows: The heavy timber decorative beams over the snack bar windows have settled and the mortar has fallen out of the joint between the top of the decorative beams and the underside of the structural lintel (refer to photos 13, and 14).
- 9. Porch Beams bearing on Stacked Rock Columns: No positive means of anchorage of the porch beam to the rocks was observed, and no positive means of connection could be observed between the stacked rocks (refer to photo 15 and 24).
- 10. Porch Columns bearing directly on Porch Slab: The columns have no protective base to protect them from moisture intrusion (refer to photo 16).
- 11. Roof downspout at Porch Column: The roof downspout appears to be no longer in service.
- 12. Stone Retaining Wall at front of Patio Addition: The concrete footing at the base of the wall is exposed.
- 13. Stone Retaining Wall at front of Patio: The portion of the stone masonry retaining wall that has patio columns bearing on the wall has areas that have

eroded at the base (refer to photo 17), has gaps and settlement in the stone work (refer to photos 18, 19, and 20), and a stone has fallen out of the wall (refer to photo 21).

- 14. Stone Retaining Wall at front of Patio: The portion of the stone masonry retaining wall without porch roof columns bearing on it also has settlement gaps in the stone work (refer to photos 22 and 23).
- 15. Water Tank at rear of building: The water tank sits on a concrete pad. The edge of the concrete pad has been undercut and there are gaps in the stonework supporting the pad (refer to photos 25 and 26).





1. Roof Ponding

2. Roof Ponding, Rips, Wrinkles



3. Roof Ponding and Failure



4. Ceiling Water Stain



5. Paint Peeling at Clerestory Window



6. Separation at Lintel and Fascia



7. Patio Addition Poor Roofing

8. Poor Roofing - Detached Gutter



9. Outlooker - Deterioration



10. Outlooker - Deterioration



11. Outlooker - Deterioration



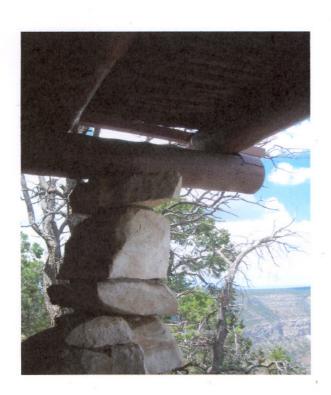
12. East Window - Poor Drainage



13. Lintel / Fascia Separation



14. Close up of Separation



15. Porch Beams on Stacked Rock



16. Porch Column Base





17. Erosion at Base of Wall

18. Settlement Cracks in Wall



19. Voids in Retaining Wall



20. Close up view of Voids





21. Stone fallen from Wall



22. Settlement Gap in Wall



23. Settlement Gap in Wall

24. Stone Column on Ret. Wall





25. Water Tank - Pad undercut

26. Close up of Pad

Recommendations

The building is in fair structural condition, given its age, but for the building to remain in its current fair condition or to last well into the future several maintenance items need to be addressed immediately and should be maintained over time.

We recommend the following deficiencies be addressed:

- 1. Roofing: A new roof should be installed. Modifications as required to insure proper drainage should be included in the new roofing.
- 2. Decorative Beams over Clerestory Windows: Prep and paint as required.
- 3. Patio Addition Roofing: A new roof should be installed. Any deteriorated decking should be replaced.
- 4. Gutter on Patio Roof Edge: Verify that this gutter is not needed and remove.
- 5. Heavy timber beam ends: The outlooker beams over the front clerestory windows should be repaired or replaced and protected from exposure.
- The heavy timber beam at the northeast corner of the porch that cantilevers from the wall and is missing the heavy timber post that was shown on the original drawings should have the connection at the wall verified to insure it is properly anchored.
- 7. Window at Snack Bar Office: Correct the drainage in this area.
- 8. Decorative Beams over Snack Bar Windows: Determine the cause in the movement between the lintel and the heavy timber decorative beams and fix the problem. Re-mortar gap as required.
- 9. Porch Beams bearing on Stacked Rock Columns: A more thorough investigation of the stacked rock columns should be performed to determine if there is any positive connection between the members (heavy timber beams and the stacked stone) besides mortar. Develop a means of anchorage that will allow the porch roof structure and the stacked columns to survive an earthquake and still be historically acceptable.
- 10. Porch Columns bearing directly on Porch Slab: Protect the column bases by elevating them off of the porch slab with an elevated grout base.
- 11. Stone Retaining Wall at front of Patio Addition: Improve the grading at the wall base to protect the base of the wall from erosion.
- 12. Stone Retaining Wall at front of Patio: Perform a more complete evaluation of the stone masonry retaining wall. Improve the grading at the base of the wall to prevent erosion of the base. Develop and engineered solution that carefully

rebuilds portions of the wall that have appeared to settle. Fill in the gaps with new stone work.

- 13. Water Tank at rear of building: Fill in the area around the tank pad foundation that has eroded. Improve the grading around the water tank to prevent any future erosion.
- 14. A complete vertical and lateral load analysis was beyond the scope of this report. However, we recommend that a complete vertical and lateral load analysis of the structure be performed and recommendations prepared for the implementation of upgrades to the building to increase its ability to survive an earthquake. It is unlikely that the structure, or major portions of it, in its current condition would be able to survive an earthquake.