



Completion Report

Tusayan Museum, Grand Canyon N P

Start Date: 2-8-10

Completion Date: 2-24-10

Project Leader: Al Williams, Preservation Specialist

Supervisor: Craig Struble, WCHP Director



Background:

The Tusayan Museum was constructed in 1931 to house interpretive exhibits for the site's Archeological ruins. It was constructed in the Southwest style, and is approximately 80 years old. The existing structure was constructed in two phases, the main museum part of the building being built first, and the south vestibule enclosed later to provide additional space. The two construction periods are distinguished by the different finishing techniques used on the viga ends: The original ends were rounded using an ax, and the later viga ends were cut with a "beaver cut" also using an ax.

Problem Statement:

Typical of derivatives of the Spanish Colonial style in the American Southwest, the viga roof supports on the structure protrude beyond the exterior wall, exposing the viga ends to the elements. Replacing the viga ends has been necessary several times throughout the buildings life. A majority of the viga ends were replaced in 1987, however three original viga ends, number N1, N4 and N7, still remain. All viga ends required treatment, whether replacement, Dutchman repairs or consolidation.

Description of Project:

The project consisted of replacing or repairing all of the viga ends on the Tusayan Museum.

Extensive preparation work was undertaken prior to beginning work at the Tusayan Museum. First, the viga ends were inspected and a report was provided by the Western Center for Historic Preservation that determined the size and condition of all of the existing viga ends. Second, logs of the appropriate size were gathered and peeled (to prevent the spread of the pine bark beetle) and stored in a dry place. Although the original wood used was Ponderosa Pine, Lodge Pole Pine harvested in Idaho and shipped to Grand Teton National Park was selected instead. The switch was initiated in hopes of extending the lifetime of the viga ends from approximately twenty years, the age of the current deteriorating Ponderosa Pine viga ends.

In order to identify the viga ends, the viga ends were numbered from left to right facing the building and labeled with an N for north (the front) and S for south (the back) (See key below).



South Elevation Vigas

On the south side of the building, vigas S1 and S4 were rotting more than half way through the log, despite having been replaced in 1987. Dutchman half log repairs done in 1987 on vigas S2 and S3 were failing, rotten and split, exposing the rest of the log to further deterioration. Vigas S5 through S10, which were also replaced in 1987, had been removed some time later in an attempt to mitigate a leaking roof. The holes had been plugged with sandbags, hardware, cloth and plastic, and the roof was repaired and a vinyl membrane installed. When the roof was repaired, the canales were extended with clay half pipe, which directed water over S11 and near S5. Viga end S11, not replaced in 1987, was rotten three inches inside the wall. At some point S11 was cut flush with the outside wall, and the canale was directing dripping water directly on it, expediting deterioration.

On the north side of the building, all of the viga ends were still attached, however they were in poor condition. Vigas N1, N4 and N7 were the remaining original vigas. N1 had had a Dutchman repair done at some point, but the repair was sloppy and visible. N4 and N6 were replaced in 1987, and were rotting on top. Vigas N3 and N5 were in fair condition, and the remaining vigas, all replacements from 1987, demanded repair.

In order to address the rotting viga ends, a number of approaches were utilized. On the south side of the building, extension flashing was installed to redirect water past viga S5 and S11. The flashing was constructed of heavy gauge copper and glued in under the vinyl using PL400 construction adhesive.

Vigas S3, S4 and S11 were approached in the same manner. For vigas S3 and S4, the remaining log was cut off flush with the outside of the building. The wood for all three vigas was then removed to a depth of around 6 inches inside the wall using large drill bits and an angle grinder with a special grinding wheel. Once the wood was removed, the end inside the wall was stabilized with an epoxe consolidant to protect the rest of the viga. Holes were drilled and Borate impel rods were installed at 11 and 2 o'clock one inch in from the outside surface of the log end. A hole was drilled and the impel rod inserted into the hole, which was then plugged. Finally, two pieces of fibertglass rebar were situated vertically two inches in from the top and bottom of the logs, drilled twelve inches into the remaining log and twelve inches into the viga end. The new viga ends were then epoxied in place. This technique of inserting Borate impel rods and fiberglass was used on all viga end replacements as a precautony measure to protect the log

ends from moisture and as a means of attaching the new viga ends to the existing logs. All replacement ends were sized to the original for length and diameter.



Vigas S1 and S4 had their rotten 1987 replacement ends removed, and the old fiberglass rebar was cut off and new ends were glued on using the above mentioned technique. The hole for vigas S5 through S10, which had been removed earlier, were cleaned out and the old fiberglass rebar was cut off. New viga ends were attached using the fiberglass rebar and epoxe method. Viga S1 through S4 were finished with the "Beaver Cut" finish using an ax, and vigas S5 through S11 were sized to the holes left and cut at random lengths to match the front. They were finished with a round profile also using an ax.



North Elevation Vigas

On the north side of the building, all the viga ends were replaced or repaired to replicate the existing viga ends, in both diameter, length and finish. Dutchman repairs were made to vigas N1 and N4 (original vigas) and N6 (a 1987 replacement viga). The Dutchman repairs consisted of wood replacement with a new piece of log matching the diameter and character of the existing spliced with a half lap joint. Epoxy cement and fiber glass rod were then used to mechanically join new and old fabric. Vigas N4 and N6 were both rotting on top, and it was determined that a Dutchman half log

replacement was appropriate. The Dutchman repair consisted of cutting away the top half of the log and removing the wood to 4 inches inside the wall. A new top half to the log was fitted, and the log half was fitted to a hair line glue joint on the horizontal plane. The Dutchman half log repairs allowed the vertical seam to be hidden inside of the wall. The log replacement top was then glued in place using epoxe and fiberglass rebar located in the ends of the wood and one in the flat plane.

Vigas N2, N8, N9 and N10 were replacement vigas, and were repaired using the same method as S1 and S4 with the removal of the rotted ends and old fiberglass rebar. N7 was an original viga end and was repaired the same way as S2, S3 and S11 were repaired with the Borate impel rods, fiberglass rebar and epoxy. Vigas N3 and N5 were in good condition, and were treated with epoxy consolidant to penetrate into the wood, and capped with epoxy filler to withstand weather and moisture penetration until the next treatment cycle.

The ends of the vigas on the north side were finished to replicate the existing viga ends. Vigas N1 through N6 were rounded using an ax, and vigas N7 through N10 were cut using the "Beaver Cut" style, also done with an ax.

All of the repaired viga ends were then remortered into the wall using a mixture of portland cement, sand and lime. After the ends were mortared in, a surface coat of "log jam" chinking was applied around the vigas to seal them from water infiltration. The color difference was off

set by applying native sand to the chinking while it was wet to blend in with the existing mortar.

All of the new vigas were left untreated in order to allow the viga ends to weather for a season or two before any preservative is added, allowing the wood to darken to match the originals that were left. The staff at GRCA will determine what preservative and finish will be applied in the future, but the Western Center for Historic Preservation recommends X100 wood preservative.

The dutchman repairs that were done to painted viga ends will be left as they are, as the contrast is a good educational tool for the visiting public to see the various preservation techniques utilized, and to show that preservation is actually taking place.

The work was completed by Western Center for Historic Preservation employees, with the assistance of two PAST workers from Grand Canyon National Park.

Crew:

Al Williams WCHP PAST Mentor
Craig Crafton WCHP Preservation Worker
Ben Isaacson WCHP Preservation Worker
Chris Brothers GRCA PAST Trainee
Tim Beale GRCA PAST Trainee

Materials:

Multiple types of epoxies were used for training purposes.

West system 102 epoxe resin

West System 105 hardner

Conserve 100 epoxe consolidant

Conserve 600 epoxe filler

Simpson Strong Tie epoxe

½ inch fiberglass rebar

Borate impel rods

GRCA supplied the heating pads that were used each night to heat the viga ends, allowing them to set up.

Summary of Work:

Monday 2-8-10:

Traveled from Moose to Cedar City Utah.

Tuesday 2-9-10:

Arrived Grand Canyon, AZ. Trailer setup and accommodations.

Wednesday 2-10-10:

Met Amanda Zeman and the crew at the Maintenance shop in Grand Canyon.

Gathered supplies and scaffolding and transported to work site.

Held safety meeting with work crew: Subject- scaffolding and hard hats. Chris Brothers, Tim Beale, Craig Crafton, Ben Isaacson, Al Williams in attendance.

Set up scaffolding on the south side of the museum.

Started on the first four vigas, S5, S6, S7, S8.

Site safety netted for the night.

Thursday 2-11-10:

Safety meeting: Subject- Epoxy and MSDS.

Preconstruction meeting with Amanda Zeman, Craig Struble, Lisa Collins, Erin Huggins, Chris Brothers, Tim Beale, Ben Isaacson, Craig Crafton, Alan Williams.

Completed vigas S5, S6, S7, S8. Epoxied vigas in place. Placed heating pads on vigas.

Arranged for interpretive staff to unplug the pads on Friday morning.

Site safety netted for the night.

Tuesday 2-16-10:

Safety meeting: Subject-Chainsaw use SOPS and PPE. Chris Brothers, Tim Beale, Craig Crafton, Ben Isaacson, Al Williams in attendance.

Set up scaffolding and started vigas S1, S2, S9 and S10.

Finished and epoxied in vigas S1, S2, S9 and S10 at end of day.

Site safety netted for the night.

Wednesday 2-17-10:

Safety meeting: Subject -Fiberglass rods, fibers and respiratory protection. Chris Brothers, Tim Beale, Craig Crafton, Ben Isaacson, Al Williams in attendance.

Moved scaffolding and started vigas S3, S4 and S11.

Tim Started filling in around the vigas with a combination of mortar and Log Jam latex chinking.

Finished gluing up last of the vigas on the south side.

Site safety netted for the night.

Thursday 2-18-10:

Safety meeting: Subject- Ax and cutting tool safety. Chris Brothers, Tim Beale, Craig Crafton, Ben Isaacson, Al Williams in attendance.

Moved scaffolding around to the North side and started viga replacement on N10 and N9.

Blocked off the main entrance to the Museum and used the east side door for visitor access.

Set up scaffolding at viga N6 and N5. Started Dutchman repair on viga N6.

Vigas N10 and N9 were epoxied in at the end of the day.

Site safety netted for the night.

Friday 2-19-10:

Safety meeting: Subject- Ladder safety and footing awareness. Chris Brothers, Tim Beale, Craig Crafton, Ben Isaacson, Al Williams in attendance.

Moved scaffolding to work on vigas N8 and N7.

Completed work of vigas N8 and N7.

Scaffolding removed to open up main entrance for the weekend.

Completed Dutchman repair on viga N6.

Applied consolidation and epoxy to the top of viga N5, even though it was listed in good condition.

Cleaned up and safety netted site for weekend.

Monday 2-22-10:

Safety meeting: Subject- Snow safety, working in snowy conditions. Tim Beale, Craig Crafton, Ben Isaacson, Al Williams in attendance.

Set up scaffolding for vigas N4.
Dutchman repairs on vigas N2 and N1.
Began Dutchman repairs on vigas N4 and N1. Began replacement of viga N2.
Completed the sealing around vigas N10, 9, 8, and 7.
Opened up the main entrance of the museum to the public.
Site safety netted for the night.

Tuesday 2-23-10:

Safety meeting: Subject- Not relaxing on safety and becoming complacent near the end of the project. Tim Beale, Craig Crafton, Ben Isaacson, Al Williams in attendance.
Vigas N4 and N1 (Dutchman repairs) were glued up and heated for the night.
Viga N2 (replacement) was epoxied in and heated for the night.
Viga N3 was consolidated and had epoxy painted to the top, even though the viga was listed in good condition.

Wednesday 2-24-10:

Safety meeting: Subject- Teardown safety. Tim Beale, Craig Crafton, Ben Isaacson, Al Williams in attendance.
The Dutchman repairs to vigas N1 and N4 were trimmed and sealed.
Viga N2 was sealed.
Scaffolding was taken down.
The site was cleaned up and all of the equipment and supplies were returned to the warehouse or work trailer.

Financial Summary: See attached spread sheet for approximated project costs.

Conclusion for Future Preservation:

While regular replacements and repairs to the viga ends will be needed, the slight changes applied to the project, such as the use of Lodge Pole Pine instead of Ponderosa Pine, will hopefully extend the lifespan of the viga ends beyond the current twenty years. Should the viga ends be painted in the future, they should be painted on a cyclic basis approximately every two years. If they are left unpainted, they should be treated with a wood preservative every three years.

In order to extend the lifespan of the viga ends, the tops of the viga ends should be inspected each year and any rot should be consolidated as soon as it is found. The seal around the vigas should be inspected annually and repaired if needed. When the vigas are replaced, the log ends should be inspected and care should be taken to ensure that the logs remain in good condition. Consolidant should be applied to the log ends at each viga replacement interval.

It has been stated that the species of the logs have been changed to see if they will last longer than twenty years. If this is not the case, Ponderosa Pine should be used as the next replacement wood.

Photographs:



Viga ends prior to preservation



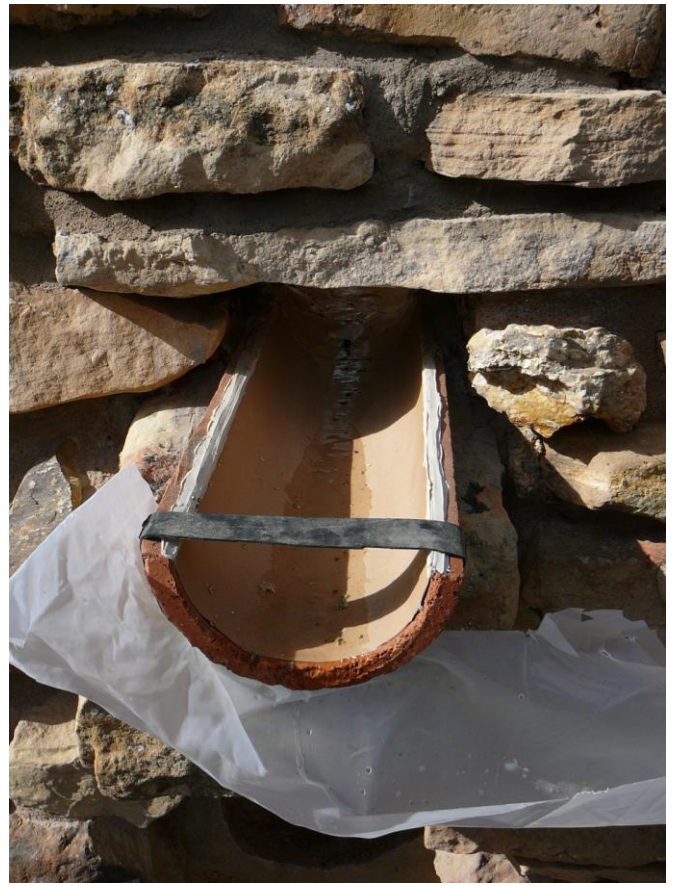
Borate impregnated rods



Removing rotted viga end



Raising viga end replacements



Canaly at east SE



Shaping viga ends



Shaping viga ends



Dutchman half log repair, rounded end



Dutchman half log repair in progress



Complete replacement, "beaver cut" end



Complete replacement, rounded end



Heating pads over the viga ends



Completed preservation