

June 03, 2016

Spruce Tree House Alcove Assessment

STATUS OF PROJECT. A BRIEF SUMMARY FOR MEVE INTERPRETIVE STAFF.

James A. Mason, Ph.D., P.E.

Structural, geotechnical, and preservation engineer

NPS Vanishing Treasures Program

Mesa Verde, CO

Santa Fe, NM

Status of the project

The *Spruce Tree House Alcove Assessment* project is currently in the contractual phase of the overall stabilization process. It is anticipated that the award of contract will be in the fall of 2016. The analysis phase could take up to 12 months. Once the analyses are completed, an engineering design package will be developed for bidding and ultimately for field construction. The design package development and bidding process could take about 6 months. The construction process could take up to 18 months, depending on weather. This puts late construction completion date around October 2019.

The following paragraphs provide a summary overview of the anticipated project sequencing.

Detailed numeric engineering analyses are required to assess stability and probable stabilization intervention of the Spruce Tree House Alcove sandstone arch. Scope of work includes an overall stabilization plan of action that is a four phased sequential approach. Components of the project would be: 1) LiDAR scan of complete site including existing structures and on-site geotechnical investigation, 2) Conduct detailed three-dimensional computer based analyses of original condition (pre-1900), 1962 strengthening, and probable 2016 strengthening, (a chronological modeling sequence), 3) Develop plans, specifications, and cost estimates to execute probable

strengthening, develop bid package, and execute bidding and award of contract, and 4) Execute probable strengthening. Obviously, if the analyses show that additional strengthening is NOT needed then phases 3 and 4 would not be conducted.

1) **Phase 1.** Lidar scan of complete site including existing structures and on-site geotechnical investigation. Geotechnical investigation includes rock core drilling on the topside of the alcove for 4 to 6 core samples. These will be spaced at about 100 feet. Borings will be to a depth of 30 feet to 40 feet and 4 inches in diameter. Drill rigs with rubber tires and about the size of a large pickup truck will be used to conduct the coring. These drill rigs are powered by gasoline engines with associated damped noise output. Once the drilling is completed, the holes will be backfilled flush with the ground surface with a non-shrink grout that prevents water intrusion. Core drilling necessarily requires drilling fluids to lubricate and cool the core barrel. These cutting fluids are water based which will be contained and recycled while drilling. It will take approximately 2 weeks to complete the investigative drilling. The rock samples will be tested for strength and permeability at a commercial laboratory. The results of the rock testing are used in the numeric analyses.

2) **Phase 2.** Conduct detailed three-dimensional computer based analyses of original condition (pre-1900), 1962 strengthening, and probable 2016 strengthening, (a chronological modeling sequence). The LiDAR scans will be utilized in the development of the 3-dimensional numeric models. The geo-materials in the computer model will be based on the lab test results from the core samples.

The anticipated strengthening is based on a method developed by Dr. Fernando Lizzi (Naples, Italy, deceased) known as reticulated micropiles / tiebacks. The geometric pattern was originally developed to replicate the action of tree root ball systems where the root encased soil mass provides overturning resistance of the above ground portion of the tree due to wind and earthquakes. Examples of reticulation are from the microscale (diatoms) to macroscale (palm fronds wrapping around the tree core).

3) **Phase 3.** Develop plans, specifications, and cost estimate to execute probable strengthening, develop bid package, and execute bidding and award of construction contract.

After completion of analyses and if shown that intervention is necessary, the development of plans, specifications, and cost estimates to execute probable strengthening are the next sequence of activities. Stringent prequalifications will be demanded of any bidding contractor with exhibited extensive experience for this type of project. Also, very clear guidelines about protection of the natural and cultural resources will be a core component of the specifications. The execution of bidding and award of contract will also be managed by NPS VT and MEVE staff. Compliance and construction process monitoring will be performed by NPS VT and MEVE staff. Lastly, all work will be performed within NPS historic preservation guidelines.

4) **Phase 4.** Execute probable strengthening.

The execution of this type of sandstone rock stabilization requires very skilled and competent technicians. All potentially impacted natural and cultural resources will be protected during all phases of construction. Drilling and tieback construction can be performed from either a boom lift or scaffolding.

Measureable Results.

The execution of stabilization measures of the STH alcove arch is measurable in three major ways, two with regards to cultural heritage, and one about the physical preservation of this World Heritage Site: 1) The general public will have the opportunity to continue to behold this wonderful site, 2) The descendants of the Ancestral Puebloans will continue to have access to their physical cultural heritage, and 3) The technology of stabilization of this arch will be conducted fully within NPS preservation guidelines and will likely be utilized at other alcoves within other MEVE sites that are in need of strengthening.