

Arapahoe Ridge Park Rock Structure - Structural Survey of Existing Conditions

Arapahoe Ridge Park
Boulder, CO 80303
Anthem Job # 16-030



June 21, 2016

City of Boulder Parks and Recreation
Attn: Tina Briggs
3198 Broadway
Boulder, CO 80304

Reference: Arapahoe Ridge Rock Structure
Structural Survey of Existing Conditions
Anthem Job No. 16-062

Dear Tina:

As requested, Anthem, LLC (Anthem) was present at the above referenced address on June 14, 2016 and June 20, 2016 to observe the condition of the existing structure. The purpose of this investigation was to assess the existing rock structure for structural safety. This report is based on visual observations, and scans with ground penetrating radar at representative locations. This report is not intended to provide detailed analysis results or recommendations, but to provide a general basis for further study.

General Rock Structure Information:

The subject structure consists of a cast-in-place concrete slab/wall system supporting various sized stones generally ranging in size from 18" average diameter to 24" average diameter, constructed in 1972. The concrete slab appears to have been cast over flat stones with dowels projecting into the thickness of the concrete slab. The slab to be supported by a concrete retaining wall along the outer edge of the structure, as well as larger stones toward the inside of the structure. The slab backspans across the inner-most rocks to the back edge of the concrete retaining wall. The geometry of the concrete retaining wall was only partially visible. Larger rocks are stacked above the concrete slab, and are grouted in place.

Basis of Cursory Analysis:

There are no known drawings of the rock structure, so a visual field observation was initially performed to identify the possible supporting structural system. Based on areas of visible concrete, and some exposed steel reinforcing, we had assumed there was an underlying concrete structure supporting the grouted stone. A follow-up observation was conducted on June 20th, 2016, and the ceiling of the 'cave', as well as other areas above the structure were scanned with ground penetrating radar. The scan was limited to accessible areas, and did not include all structural elements. The scan revealed that there is a mat of #4 (1/2" diameter) steel reinforcing spaced approximately 12" oc, each direction, located approximately mid-depth of the concrete slab. The slab thickness was determined to be approximately 7" to 8" thick.

Cursory Analysis & Recommendations:

Our cursory analysis indicates that the presumed concrete structural slab is not compliant with current building codes for the loading above the 'cave'. One possible solution is to reduce the span of the slab in the longitudinal direction by introducing an intermediate support.

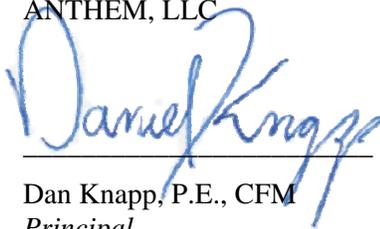
Other areas of the rock structure, including stones bridging over vertical stone walls to form small tunnels, generally appear to be in good condition. There are areas of deteriorating grout, which should be repaired and maintained. The observed tunnels and overhead stones appear to be structurally sound.

It is our professional opinion that elements of the rock structure are not compliant with modern codes; however, this may be addressed with somewhat minor remediation methods, such as introducing an intermediate support in the cave. Further and more thorough investigation should be performed to provide more data for a more thorough analysis if this feature is to be retained. Investigation methods, such as exposing more of the base structure by temporarily removing overlying stone, core drilling to more accurately determine the slab thickness, and more extensive scanning with ground penetrating radar when more of the substructure is exposed, to determine variations in reinforcing patterns.

The opinions and recommendations contained in this report are based on limited visual observations only. There is no claim, either stated or implied, that all conditions were observed. This report does not express or imply any warranty of the structure; it only addresses the condition of the portion which was readily accessible and observable at the time of my investigation.

Please contact me if you have any further concerns or questions related to the Arapahoe Ridge rock structure.

Sincerely,
ANTHEM, LLC



Dan Knapp, P.E., CFM
Principal

