Abstract #DIS444488

Meeting the Challenges of Characterizing Subsurface Conditions in Bouldery Terrain

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CULTURAL MUSEUM

Cultural History and Geologic Setting

A geotechnical and flood hazard investigation was performed to support construction of the Agua Caliente Cultural Museum. The Museum will showcase the culture and history of the Agua Caliente Band of Cahuilla Indians, who have long inhabited the region. The Museum site is located in the Palm Canyon area, at the base of the San Jacinto Mountains, just south of Palm Springs, California. As currently envisioned, the Museum Building will have two floors and a footprint of about 59,000 square feet. Parking will be provided for approximately 110 vehicles.

The site is located on a debris flow fan at the mouth of Andreas Canyon. The fan (Qf) formed as a result of deposition of large, infrequent, overlapping debris flows disgorged from the canyon in major storm events. The boulders consist of a mixture of granitic and metamorphic rock types. The granitic boulders are predominant and very resistant to breakage.

Exhibit 1 The Agua Caliente Cultural Museum will occupy one acre of a 52-acre site. Most of the architectural development will center around open, naturally landscaped courtyards and terraces. The building is composed of a circular welcome lobby, exhibit galleries, gift shop and food service, education center, offices, and museum support facilities, totaling roughly 110,000 square feet.

Source: Jones & Jones

Aerial photo analysis of the Andreas Canyon fan suggests that at least 11 significant debris flow events are preserved on the fan surface. In the field, individual flows were distinguished using several characteristics, including: 1) degree of desert varnish formation; 2) the amount of in-place weathering of boulders; 3) the degree of preservation of the original depositional morphology; and 4) the degree of desert pavement development. Not including the embedded boulders, the flows are typically about 5 to 8 feet thick near the fan apex, and thin to about 1.5 to 4 feet at the toe. They measure about 300 to 800 feet wide and typically measure 3 to 5 times longer than they are wide. The volume of a mid-sized deposit on the fan is about 3.75 million cubic feet.

Soil age dating performed by others suggests maximum soil ages on the fan surface of about 1,000 to 3,000 years. With 11 debris flow events in a span of 1,000 to 3,000 years, we estimate the average recurrence interval of major debris flows from Andreas Canyon at roughly 100 to 300 years. The most recent debris flow deposits are slightly eroded, and have mature plant communities established on their surfaces. The extensive grove of mature desert palms (Washintonia filifera) that occupy much of the floor of Andreas Canyon probably range up to about 100 years in age and purportedly show no signs of damage due to debris. Moreover, artifacts of human occupation extending back a few hundred years have been recovered at the ground surface in the canyon. Tribal oral history reports that the Indian Canyons were only inhabited after the latest drying of nearby Lake Cahuilla, a fresh-water lake that has occupied the Salton Depression several times in the last thousand years (Waters, 1983). Recent investigations report that the latest lake dried out as late as 1680 A.D. (California Water News, January 24, 2001), so the period of inhabitation probably extends back just over 300 years. This figure provides an approximate minimum age for the latest debris flow from Andreas Canyon.

Source: Traveling Online

GEOLOGY

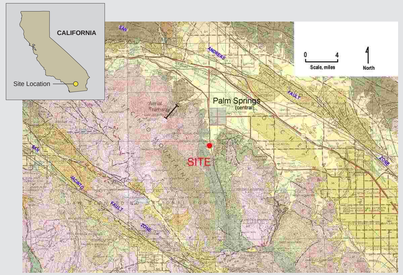


Exhibit 2 Regional geology and site location map

Source: Modified from CDMG (1966)

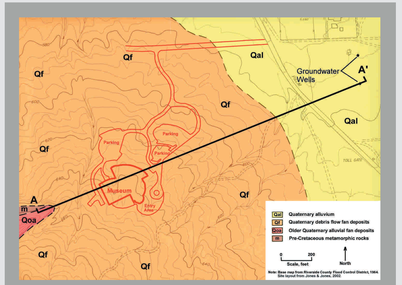


Exhibit 3 (top)
Site geologic map

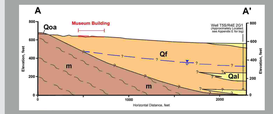


Exhibit 4 (bottom)
Geologic cross section A–A'

FLOOD HAZARD

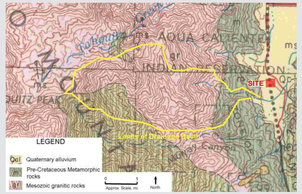


Exhibit 5 Geologic map of the Andreas Canyon drainage basin

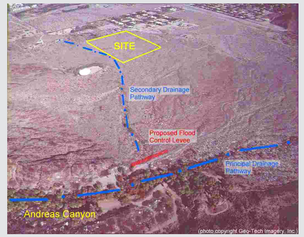


Exhibit 6 Oblique aerial photo of Andreas Canyon fan showing surface drainage features

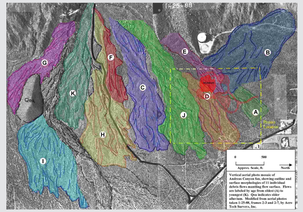
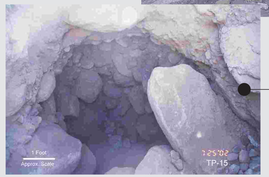
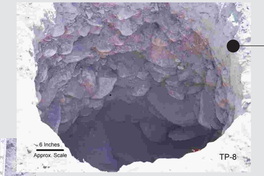
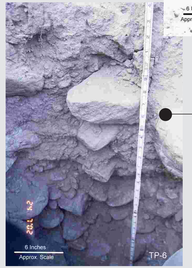


Exhibit 7 Map of debris flow lobes on the Andreas Canyon fan

FIELD INVESTIGATION







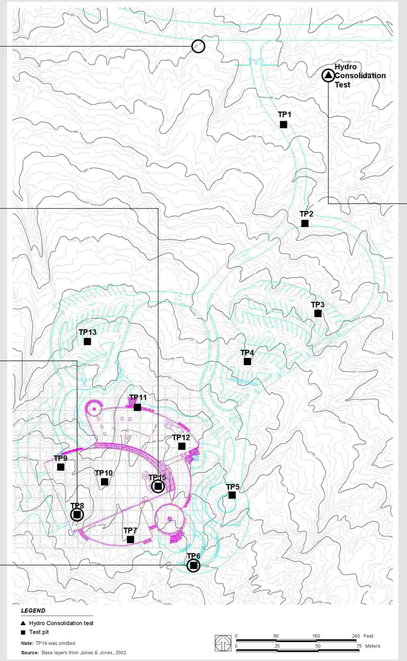


Exhibit 8 Site index map

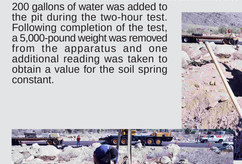
Exponent performed a field investigation consisting of fourteen test pits (TP-1 to TP-15, excluding TP-14) excavated by a four-man crew using shovels and pry bars. Test pits TP-1 to TP-7 and TP-10 to TP-13 were excavated to a depth of 4 feet. Test pits TP-8, TP-9 and TP-15 were excavated to depths ranging from 7.2 to 9 feet.

The test pits indicate that coarse-grained debris flow deposits occur throughout the site beneath a surficial layer of fine-grained alluvium up to 2 feet thick. The alluvium consists of lightly cemented, dry, silty sand and sandy silt, with common pinhole structure. This material typically exhibits over 3% collapse upon inundation. The debris flow deposits consist of cobbles and boulders in a cohesionless matrix of sand to silty sand. Approximately 40 to 70% of the debris flow deposits consist of material greater than 8 inches in maximum size.

Exponent personnel performed a field hydroconsolidation test at the northern edge of the subject site. The pit was excavated over a 10-foot square area to a depth of approximately 1.5 feet, exposing debris flow deposits across the floor of the pit. A crane was used to set a series of weights into the test pit to simulate a footing load. A test weight of 24,980 pounds was applied over a 17.1 square foot area, resulting in a load of 1,461 lb/ft^2.

Water was added to the test pit and the settlement recorded over a two-hour period using three lasers directed at the apparatus from different sides. The water level was maintained at about 1 foot deep in the test pit by intermittent addition of water from a nearby fire hydrant.

The test apparatus recorded a total of _ to _ inch of settlement during the two-hour test. Most of the settlement occurred within the first 45 minutes. A total of approximately 200 gallons of water was added to the pit during the two-hour test. Following completion of the test, a 5,000-pound weight was removed from the apparatus and one additional reading was taken to obtain a value for the soil spring constant.



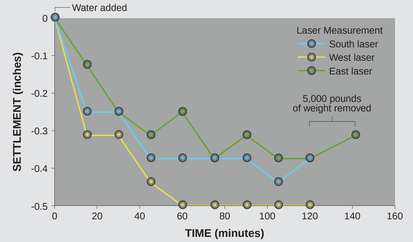


Exhibit 9 Hydroconsolidation test results Agua Caliente Cultural Museum