

Tigra Dam Failure, Gwalior, India

A Case of Sedimentary Sliding

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Tigra Dam was first constructed between 1913 and 1917 to provide an irrigation and water supply source for the nearby major city of Gwalior, India in the central state of Madhya Prahesh. The dam failed tragically during a flood event on August 4, 1917, shortly after first filling. Few records are available on the failure and subsequent damage, but it is estimated that about 1,000 lives were lost.

The 86-foot high, 4,400-foot long masonry gravity dam impounded a massive storage volume of 106,041 acre-feet (34.6 BG). The structure was composed of a rubble masonry interior placed with lime mortar and faced with stacked masonry with cement mortar joints. The dam had a vertical upstream face and a 2:3 downstream slope. The dam was founded on stratified sandstone with near horizontal bedding planes. Excavation for the dam was limited to about a 2-foot depth although weaker zones in the sandstone were reportedly excavated deeper and filled with concrete. There were apparently no additional seepage control or cutoff measures installed in the dam foundation.

Records indicate that the spillway activated during the monsoon season each year during construction, and cracking of the masonry structure was noted prior to the planned first filling of the reservoir.

On August 4, 1917, the water surface elevation in the reservoir rose to a historic level and overtopped the dam by about one foot from abutment to abutment. Overtopping flows were estimated at 30,000 cfs. During the overtopping event, two of the spillway monoliths were moved several hundred feet downstream resulting in an uncontrolled release of the reservoir. These two monoliths still stand today at the site as a distinct reminder of the dam failure.

Various publications provide differing opinions regarding the different mechanisms that contributed to the dam failure. However, the ultimate cause of failure is generally agreed to be the result of sliding of sections of the gravity dam along the untreated, stratified foundation. The development of excessive uplift pressures creating tension at the heel of the dam and downstream scour due to overtopping likely contributed to the ability of the dam to slide.