San Pablo Reservoir

The East Bay Muncipal Utility District
California

Introduction

San Pablo Reservoir's outlet works consists of an approximately 200 foot tall outlet tower (Sobrante Outlet Tower). At its base, the tower is connected to an approximately 600 foot long, 14.5 feet diameter diversion tunnel, which terminates at the drain intake pipe. The drain intake is a 78-inch inside diameter and 30 foot high vertical steel pipe riser, which is connected to the tunnel at its base and houses a 94.5 inch outside diameter and 6 foot high trash rack at its top. The existing reservoir drain valve is located inside the diversion tunnel approximately 75 feet upstream of the Sobrante Tower and because inoperable, and for maintenance and operational considerations, the EBMUD decided to install a new drain valve at the drain intake pipe entrance, just below the trash rack.

The EBMUD was interested in installing a new 78-inch diameter, 30 foot high outlet drain pipe, which weighed 55 kips below the trash rack MMI was asked to perform a detailed nonlinear finite element analysis, to study the dynamic response of the pipe and assess whether it would be able to withstand the additional load under a major earthquake on the Hayward fault, located a few kilometres from the site.

Our Approach

Due to the close proximity of the Hayward fault and the critical nature of the drain to function in an emergency, a seismic evaluation of the drain pipe was performed to assess the impact of the added mass of the valve. MMI assessed the seismic response of the intake pipe through a nonlinear dynamic analysis of the pipe using ANSYS. The dynamic analysis was conducted by using a three dimensional non-linear earthquake time history analysis.

The analysis incorporated the hydrodynamic effect of water and consideration of soil structure interaction. Two different valve sizes were studied, in addition to multiple parametric studies and simplified calculations.

Outcome

Given the special valve's cost of approximately $700,000, the District required approval from the Board of Directors in time for procurement and design of the valve, so as not to miss the limited construction season, when the reservoir level was low; any delay in the process would have resulted in major cost to the District. In addition, the valve design required California Division of Safety of Dam approval. MMI successfully completed the work in less than three weeks, which included interaction with the District's geotechnical engineers, as well as obtaining the necessary data from them.

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