Seismic retrofit coming for Folsom's biggest earthen dam

Matt Weiser, Sacramento Bee, 12-18-09

A plan to prevent an earthquake from wiping out Folsom Lake's largest earthen dam has taken a significant turn. Federal officials now plan to replace a major section of the dam's foundation.

The project involves Mormon Island Auxiliary Dam, the largest of nine earthen saddle dams that enclose Folsom Lake. It is second in size only to the concrete Folsom Dam itself.

The U.S. Bureau of Reclamation proposes to excavate an area five stories deep and nearly the size of three football fields along Green Valley Road, just below the dam. The goal is to replace unstable soils that could shift in a quake, potentially causing the dam to collapse and devastating Folsom and other areas downstream.

Though the project sounds alarming – it's not every day that the foundation of a functioning dam is dug out and replaced – engineers say such projects are relatively common. In an era informed by major advances in soil and seismic engineering, they say the project makes sense to ensure the region's long-term safety.

"Excavating and replacing loose or weak soils is one of the most effective remediation strategies," said Ross Boulanger, a professor of geotechnical engineering at the University of California, Davis, who specializes in the seismic performance of earthen dams and levees.

The Bureau of Reclamation originally proposed injecting a concrete-like mixture deep below the ground surface to stabilize the loose soils. But tests showed that method wasn't effective enough.

In a new draft environmental impact study released this month, the Bureau of Reclamation now plans to replace all the unstable soils with better material. The work is expected to take two years and cost as much as $100 million.

"It's not an everyday occurrence, obviously," said Reclamation project manager Larry Hobbs. "But on a five-year cycle, you might see two or three of these going on across the country."

The project is part of a larger $1.5 billion effort to shore up Folsom Dam against floods and earthquakes. The star attraction is a new concrete spillway under construction adjacent to the main concrete dam. The earthquake protections have gotten far less attention.

Mormon Island Dam was built across Blue Ravine, once the bed of the American River in a prior geologic age before the river shifted to its present course. The ravine is filled with deep, loose gravel and was a hotbed for gold mining well into the 1900s.

When Folsom Reservoir was built in the 1950s, engineers removed only the loose material directly beneath Mormon Island Dam. At the time, they believed this was adequate to keep the dam stable in an earthquake.

But five decades later, engineers have learned a lot more about earthquake risk and the stability of soils beneath the dam.

They now believe a quake rated 6.5 or greater could liquefy loose gravels left behind just downstream of the dam, causing the dam to slump and fail.

The Bureau of Reclamation proposes to remove those unstable soils by excavating a series of box-like cells, one at a time, across the work area. This way, only a small section is disturbed at any given time, reducing risks to the giant dam.

The cells would be at least 55 feet square and 60 feet deep on average, said Hobbs. Each would be excavated down to bedrock, then refilled with engineered soils that won't shift in an quake.

Hobbs said the construction methods involved are nothing special. And though the project involves drilling, trenching and many truck trips, he doesn't expect a major impact on neighborhoods near the dam.

Steve Heard, a real estate agent and resident of the nearby Willow Creek Estates neighborhood, said he isn't concerned about such inconveniences.

"If that's something that we have to deal with in order to be safe, I'll sacrifice a little commute time," said Heard.

The Bureau of Reclamation expects to award a contract for the work in summer 2010, Hobbs said.

Given the cost and complexity of the work, it's worth asking if the dam will have to be upgraded again as scientists' understanding of earthquake risks and soil behavior continues to evolve.

Geotechnical engineer Robert Youngs, who works for AMEC Geomatrix in Oakland, says that's unlikely.

"I wouldn't think we would be learning anything in, say, 20 years that would say we have to upgrade it even further," said Youngs.