

Recovery

Sefid Rud Buttress Dam Rehabilitated After Iran Earthquake

In the early hours of June 21, 1990, an earthquake measuring 7.3 on the Richter scale devastated the two Iranian provinces of Gilan and Zanjan, north and north-west of Tehran. About 40,000 people were killed and 60,000 injured. Half a million people were left homeless. The epicenter of the quake was about 200 km northwest of Tehran in the region of the Sefid Rud Dam, which is located between the two completely destroyed towns of Manjil and Rudbar in Gilan province. This quake was the most devastating one in recent history in Iran. Several hours after the main shock, two strong aftershocks occurred, having magnitudes of 6.2 and 6.5. In the subsequent weeks more than 400 aftershocks with magnitudes of up to 5.9 were reported by the Geophysics Center of Tehran University.

Sefid Rud Dam was subjected to intensive ground shaking and suffered several types of damage, including severe cracking in the upper parts of the central buttresses. Close observation showed that most of the damage in the dam was concentrated in the central part and in the upper quarter of the buttresses. The main features of the damage included:

- o cracking along the horizontal joints in the upper quarter of the downstream face in all 23 buttresses; significant displacement did not occur in the cracked joints;
- o minor damage and displacement on all the gates; the one exception was a radial gate on

the intermediate spillway, which sustained heavy damage and distortions on the arms;

- o some displacement of a few blocks both up and downstream; the accumulated displacement from blocks 10 to 20 was 10 mm;
- o some damage in the switchyard and transformers;
- o different types of damage on the dam crest; and
- o extensive rockfall on both banks.

Action was undertaken by the government to repair the dam immediately after the extensive inspections and evaluation of repair options. Different alternatives for repair were considered. Finally the method of grouting with resins and stressing the buttresses with post-tensioning cables was adopted.

In all, 234 boreholes, with a cumulative length of 9,450 m, were drilled for anchor installation. The total working load of 1,965,600 kN was installed during the period of January-July 1991. The grouting of the anchors took place from March 10 to June 19, 1991. A total of 738 tons of cement and 36,000 kg of additives were injected. All of the repair work was completed within eight and a half months.

The preceding article was based on a report submitted to the U.S. Committee on Large Dams by the Iranian Committee on Large Dams.

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Policy Issues in Post-EQ Housing

Findings and Recommendations, Symposium on Policy Issues in the Provision of Post-Earthquake Shelter and Housing, is the result of a two-and-a-half day workshop held in January, 1992. The Bay Area Regional Earthquake Preparedness Project, the California Office of Emergency Services, and the National Center for Earthquake Engineering Research sponsored the symposium. About 40 participants represented a range of federal, state, and local officials, research universities, international organizations, and organizations in the private sector.

The goals of the symposium were:

1. to identify major issues that have emerged after previous earthquakes in the provision of post-earthquake shelter and housing,
2. to examine those issues and determine whether policies and procedures need to be changed or formulated to address better any of those issues for the next urban U.S. earthquake, and
3. to make recommendations for necessary changes to improve the delivery of emergency housing.

For the three sub-topics of Emergency Shelter, Temporary Housing, and Permanent Housing, the report identifies critical issues, policy and research recommendations, and "next steps" needed.

The EERI office has a limited number of these reports available for members, made available by the California Office of Emergency Services. Call EERI if you would like to receive a copy.