ZIPINGPU DAM FAILURES (SICHUAN PREFECTURE, CHINA)
CAUSED BY THE 7.9R EARTHQUAKE ON THE 12th MAY 2008

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The 7.9R earthquake that struck Sichuan on the 12th of May 2008, in the district of Chengdu of Southern China resulted in tens of thousands of casualties, the complete destruction of many towns and extended damage to public works. The earthquake was triggered by a reverse fault of NNE-SSW trend, more than 100 km long, that divides morphologically the affected area in two sections, the eastern one with mild low topography and the western one with intense relief representing the boundary of Tibet Mountains.

This mountainous section is characterized by a rich drainage network that drains the greater region of the Tibet plateau. Along the trace of this high-stand for thousands of years numerous hydraulic works have been attempted in order to manage the water supply.

Especially during the past decades, 400 small and large dams have been constructed. The main dam is the Zipingpu dam that has a height of 150m, a capacity of 1.12 billion m³ and includes a hydroelectric plant of 3.4 billion Kwh power. This dam is the last and larger dam before the exit of the Min river to the flat valley through the gorge of the Dujiangyan town.

The Zipingpu dam is located 10km east of the earthquake epicenter and after the earthquake of 7.9R, the following failures were recorded:

- Subsidence of the crown in the central part of the dam, of the order of 50cm in relation to the side survey control points.
- Deformation of the lower face of the dam, an area of approximately 1000 m².
- Deviations and deformations of the construction elements throughout the face of the dam
- Widening of construction joints (approximately 15 cm on the upper face)
- Extended massive landslides throughout the reservoir
- Landslides on both left and right abutments of the dam causing further damages to secondary constructions.

After the evaluation of the dam damages, the discharge of the reservoir was ordered through the emergency spillway in order to minimize the risk of a potential disaster for the nearby towns and especially Dujiangyan. Finally, the causes of the failures are investigated based on the available data.

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View of the right slope of the dam near the primary spillway, the emergency spillway and the hydroelectric power plant. The extended works for the stabilization of the slopes and the landslides triggered by the earthquake can be seen. One of the landslides blocked the emergency spillway.

31° 01' 54,32'' N - 103° 34' 18,52'' E

View of Zipingpu dam and its secondary constructions from the side of the outlet channel. The hydroelectricity plant and the emergency spillway can be seen.

31° 02' 07,45'' N - 103° 34' 19,02'' E
Vertical fractures on the right side of the dam axis due to differential subsidence of the dam body in relation to the rigid section of the emergency spillway.

31° 02' 08,21'' N – 103° 34' 18,42'' E

View of a slope that failed despite the stabilization works that involved a dense network of anchors.

31° 02' 26,17'' N – 103° 34' 36,59'' E
View of the left slope by the abutment axis of the dam that was reinforced with a dense network of anchors. The landslide of boulders can be seen in the upper part of the slope.

31° 02' 10,32'' N – 103° 34' 41,44'' E

View of landslide boulders from the left slope of the abutment on the dam crown.

31° 02' 08,89'' N – 103° 34' 40,81'' E
Differential vertical displacement of the dam body approaching 20cm on the left side.

31° 02' 10,20'' N – 103° 34' 39,60'' E

Landslide view on the slopes of the reservoir 200 metres from the crest of the dam

31° 02' 18,68'' N – 103° 34' 40,82'' E
Failure on the Zipingpu dam crown that resulted by pressure increase caused by the differential subsidence of the dam body.

31° 02’ 09,76’’ N – 103° 34’ 30,80’’ E

View of the face of the dam with clear the deconstruction of the masonry facing. The hydroelectric power plant and the emergency spillway in operation can be seen.

31° 02’ 02,64’’ N – 103° 34’ 26,64’’ E
View of the 40cm subsidence of the dam core and the additional damages that were caused. In the background, large scale landslides that developed on the reservoir slopes can be seen.

31° 02' 08,97'' N – 103° 34' 26,01'' E

View of the Zipingpu dam and a part of the reservoir

31° 02' 09,04'' N – 103° 34' 16,71'' E
Elongated extensional fracture of the order of 40 cm on the dam crown.  
31° 02’ 09,41” N – 103° 34’ 30,03” E