

## Learning from Earthquakes

### The January 21, 1997, Jiashi, China Earthquake

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On January 21, 1997, an earthquake with twin mainshocks, measuring 6.2 and 6.5  $M_s$ , occurred in Jiashi County, Xinjiang Autonomous Region, in northwest China. They were followed in the next three months by five aftershocks measuring over 6  $M_s$ . Altogether, more than 5,000 aftershocks had been observed by May 1997.

The building structural types in the affected area include:

- a. RC frame with brick infill wall
- b. multi-story masonry
- c. multi-story masonry with RC inner frame
- d. single-story with twin-hinge large-span arch, RC column and bent structure, net-bracery, or brick-wood large span truss (*Editor's note—the English language equivalent of the "net-bracery" system is not clear.*)
- e. adobe and earth-wood houses
- f. brick masonry water towers 18-24 meters high

Most of the single-story houses that were constructed with bricks, adobe, earth-wood, or brick-wood were seriously damaged or entirely destroyed due to poor connections between walls, or between wall and wood frame. The low strength of materials also contributed to the problem.

Most multi-story apartment buildings, which were built later than 1985 with seismic measures in design and construction (based upon degree 7 of the PRC seismic intensity scale), survived the earthquake disaster. Some school, office, and commercial buildings which have large, open rooms suffered slight to moderate damage to the walls or to the connections between beam and column.

The main structures of the net-bracery of the Jiashi County Theatre and the Stadium didn't appear obviously damaged, but some X-cracking was observed in the walls.

The workshop and warehouse with twin-hinge arches, which were designed and constructed aseismically, suffered slight damage to the roof. The main parts remained in good condition.

RC frame structures, such as the Jiashi Communication Hall, worked safely during the earthquakes. There was some cracking in the brick infill wall.

Twenty percent of the water towers structured with brick masonry collapsed because of the poor quality of construction and unsatisfactory anchor length of the steel bar in the tie-column to the base of the RC tower.

In general, lifelines performed well in the quake. The power supply was interrupted in downtown for 30 minutes because of a short circuit caused by the collision of swaying electrical wires. There were 25 poles broken in the countryside. It took 2 days to fully restore service.

The Jiashi Communication Hall, which was aseismically constructed and equipped, functioned well without damage to the main structure and instruments inside; thus communication with the

outside world remained reliable after the event.

The broadcast and television station worked during the earthquakes in the urban region, but a two-hour break in transmission occurred in rural areas after a 6.6  $M_s$  aftershock because of the collision of swaying wires.

A 20-meter long water pipe over a river was broken by strong ground motions. It caused a several-day interruption of the water supply. In downtown, the underground pipelines were broken to different degrees due to the aging of pipes and poor connectors.

The County Hospital survived and functioned during the earthquakes. This meant that rescue work could be carried out successfully right after the earthquakes.

The highway system was not damaged so that the link to the outside world remained. The relief work went on smoothly thanks to the good condition of the highway system.

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## Voices from the Past

### Shakespeare Explains Earthquakes

*First Part of King Henry the Fourth, Act III, Scene i*

Diseasèd nature oftentimes breaks  
forth  
In strange eruptions; and the  
teeming earth  
Is with a kind of colic pinch'd and  
vex'd  
By the imprisoning of unruly wind  
Within her womb; which, for  
enlargement striving,  
Shakes the old beldame earth, and  
topples down  
Steeles and moss-grown tower.