

THE YUNNAN, CHINA EARTHQUAKE OF NOVEMBER 6, 1988

Hu Qingchang, Beijing Institute of Architectural Design and Chung Yicun, Earthquake Engineering Research Institute, Academy of Building Science Research

Introduction

Strong earthquakes of magnitude 7.6 and 7.2 struck the Lancang and Gengma areas of southwestern Yunnan Province at 9:03 and 9:15 p.m., respectively, on November 6, 1988. (The USGS PDE reports Nov 6, 13:03, 17.1 s, Gmt; 22.808 N, 99.765 E, MB 6.1, Ms 7.0 (BRK) and Nov 6, 13:15, 43.4 s, 23.213 N, 99.533 E, MB 6.4, no Ms.) The depths of foci were found to be 13 km and 8 km respectively. Earthquake intensity near the epicenter was estimated to be 9 and up to 10 at a few localities. The scale is China's earthquake intensity scale, with maximum value 12, and, in the 8 to 10 range, very close to MMI. On November 30, Lancang county was hit again by a strong aftershock of M=6.7.

Earthquake disaster effects covered 20 counties in the southwestern part of Yunnan Province, among them 3 counties seriously damaged. The most serious effects were scattered among villages of Gengma county: Yansoi, Tuanji, Mengseng, Sze paishan, Muga, Zutang, and Zanmapo, amongst others. People affected by the disaster numbered 5.16 million, deaths totalled 748, 3759 seriously injured and 3992 lightly injured. The number of rooms in collapsed houses was 1,308,000; 934,800 rooms were damaged. Over 4000 schools and medical

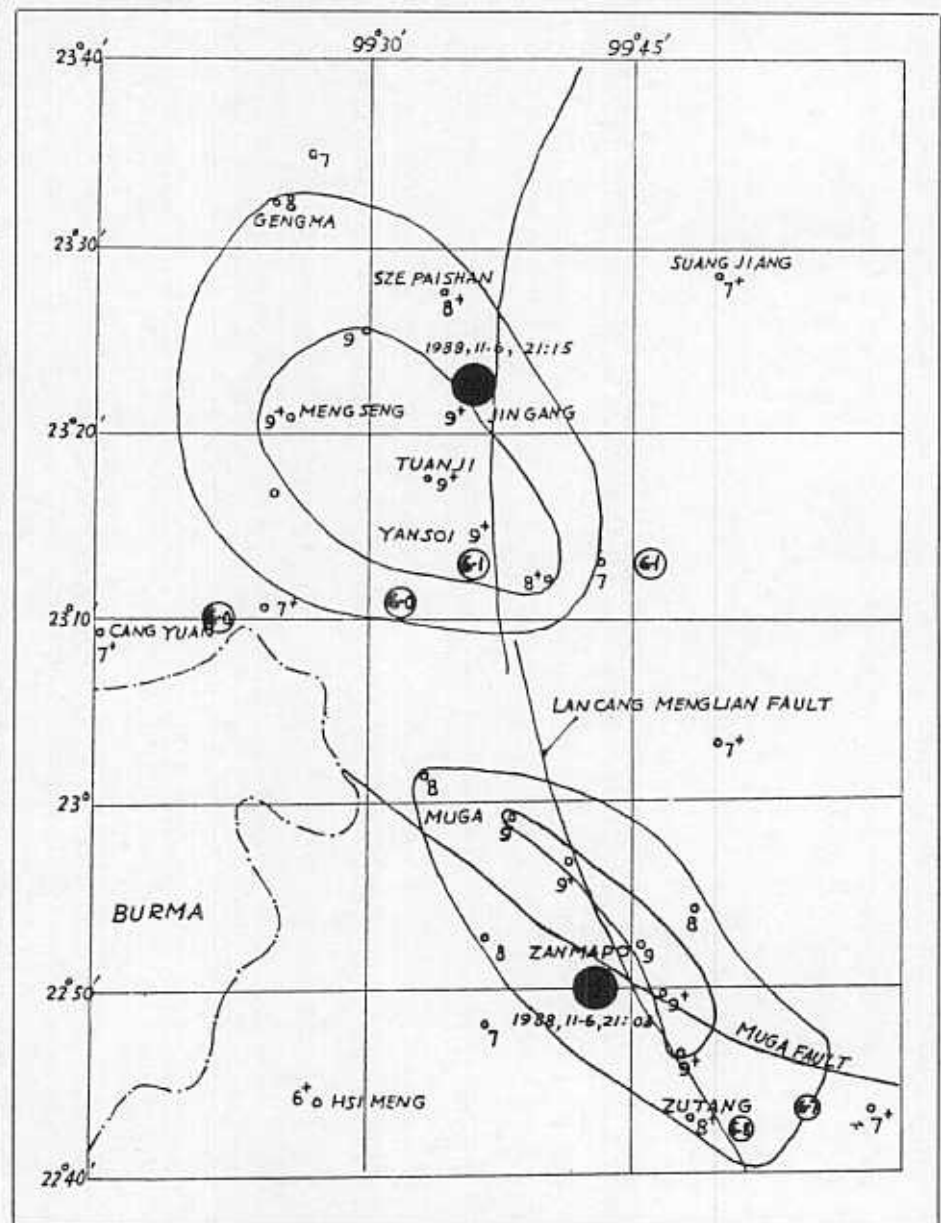


Figure 1. Lancang Gengma Earthquake.
Contour-line of earthquake intensity.

service buildings were damaged. More than one million cubic meters of rock slide caused damage of highways and blocked river transportation.

In comparing earthquakes in China within past 25 years, the direct economical loss estimated is second to that of the Tangshan earthquake of 1976.



Photo 1. Yansoi Village houses, after earthquake shaking of intensity 9.



Photo 2. Administrative building of Gengma County. Adobe walls with brick piers. Intensity 8.



Photo 3. Mengerseng tea factory, after earthquake shaking of intensity 9. Masonry structure with hollow block walls and cast-in-situ reinforced concrete floors.



Photo 4. Office building, Gengma County, intensity 8. Three-storied brick masonry structure with monolithic reinforced concrete floors.

Building Performance

Most village houses were constructed with adobe-filled wooden framing and bundled straw roofing (photo 1). Many office buildings and warehouses were constructed with brick

piers, adobe walls and reinforced concrete floors (photo 2). Brick walls laid with lime-mud or lime-sand mortar were badly damaged (photos 3, 4). Collapse and serious damage of 3- to 5-storied reinforced concrete frame buildings

which were poorly designed and constructed with low strength concrete and incorrect detailing of reinforcement were observed (photos 5-8).

Most buildings in this area were constructed without



Photo 5. Administrative building, Yansoi Village, intensity 9. Two-storied reinforced concrete structure.



Photo 6. Yansoi Village middle school, after earthquake shaking intensity 9. Three-storied reinforced concrete frame structure.

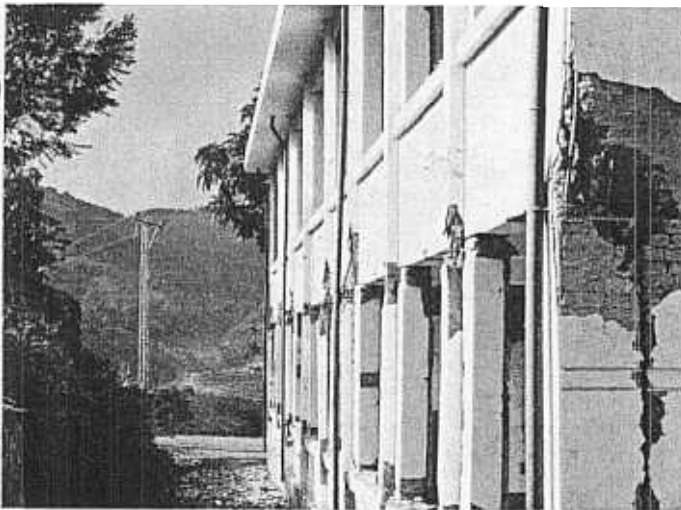


Photo 7. Yansoi Village primary school, intensity 9. Two-storied reinforced concrete frame structure.



Photo 8. Mingseng tea factory, after earthquake intensity 8. Two-storied reinforced concrete frame structure; top story collapsed.

consideration of earthquake resistance. However, several buildings exhibiting adequate seismic behavior were designed or strengthened for earthquake resistance, for example the Gengma cinema building, designed for seismic intensity 8,

suffered no evident damage from the earthquake's intensity 8. The ward building of Lancang county hospital was strengthened for earthquake resistance just before the earthquake; no significant damage can be observed after the

earthquake. In contrast, the clinic building, a similar masonry structure but not strengthened, suffered heavy damage after the earthquake. It has had to be demolished and rebuilt. In Yansoi, Gengma county, a masonry residential

building strengthened by reinforced concrete tied columns and tied beams was completed just before earthquake. It sustained shaking of intensity 9 without any damage (photo 9).



Photo 9. Residential building, Yansoi Village, after earthquake intensity 8. Two-storied brick masonry structure, cast-in-situ reinforced concrete floor with tied columns and tied beams.

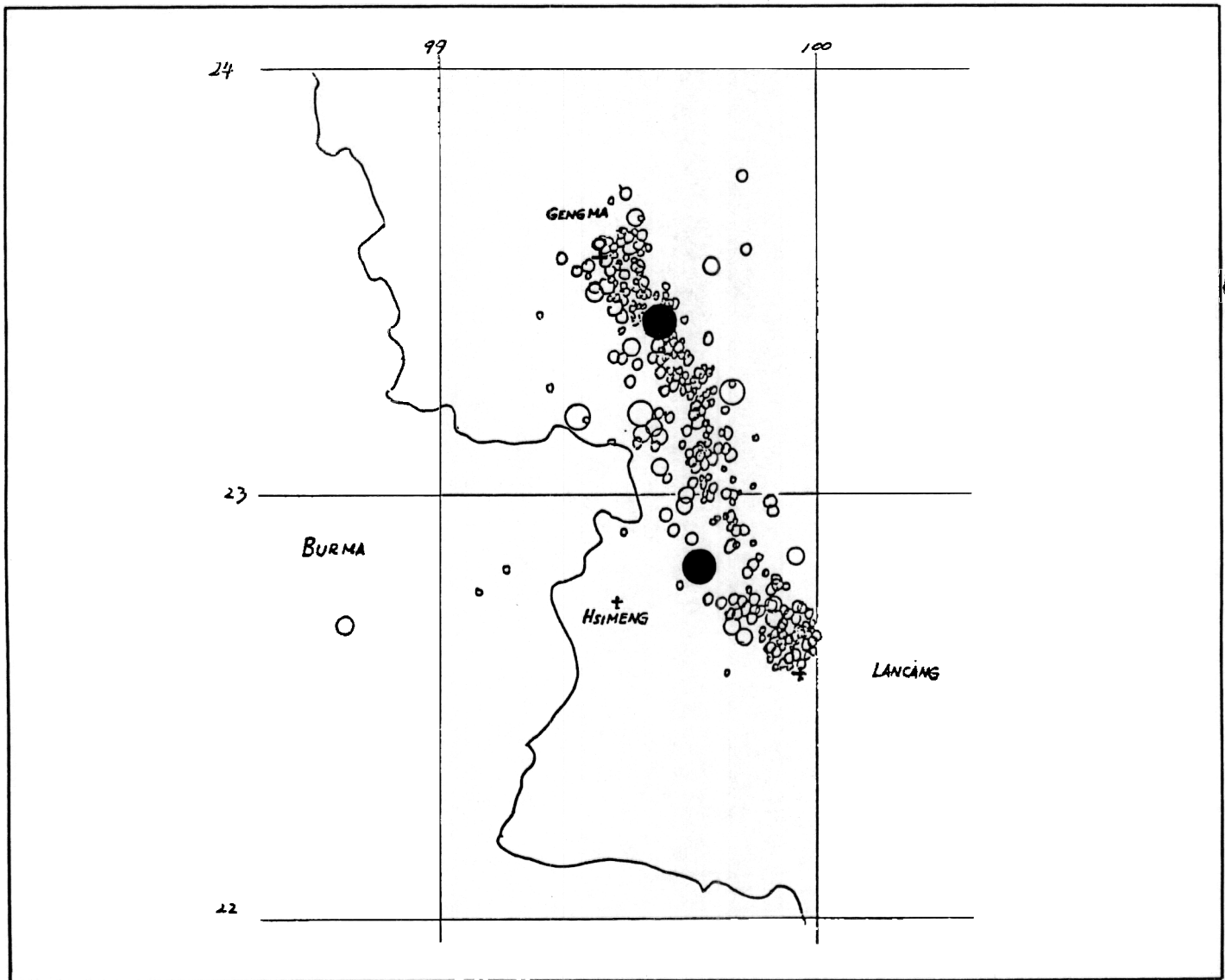


Figure 2. Distribution of epicenters, Lancang Gengma Earthquake.