TILTING PLATFORM FOR MEASURING EARTHQUAKE RESISTANCE OF SMALL BUILDINGS

by

Kenneth D. Munski[I] and W. O. Keightley[II]

SYNOPSIS

A tilting platform, 8 1/2 ft x 8 1/2 ft, was slowly tilted to test the lateral resistance of 9 pairs of brick structures 4 ft x 6 ft x 31 in. high, one brick thick, laid in 1:5 lime-sand mortar, sand, mud, and no mortar at all. A 1350-lb roof slab rested on foam rubber on the walls. The table was then mounted on wheels and pulsed horizontally to attempt to relate building strength under repetitive pulses to strength under static tilt. Building performance under static tilt was quite consistent; performance under pulse loading showed wide scatter. The two kinds of tests produced similar patterns of failure in mortared buildings. Pulsed unmortared buildings unraveled more than those statically tilted.

TESTING PROGRAM

A building which is tilted through angle Θ is subjected to forces corresponding to a constant lateral ground acceleration of $g \times \sin\Theta$ and vertical acceleration of $g(1-\cos\Theta)$. A static tilt does not load buildings in just the same way as the triaxial sequence of pulses of an earthquake, but a tilting platform is simple in construction and operation and may possibly be used to compare earthquake resistance of different constructions and indicate structural weaknesses. The bed and hoist of a dump truck is suggested as a ready-made facility.

Observations from these tilt tests: 1) Collapse of end walls often triggered final failure. All walls should be tied to roof and floor. 2) These structures were weaker in the direction of the short walls by 15-30%. In the diagonal direction strengths were about the same as in the longitudinal direction. 3) Unmortared brick structures withstood about 0.4g, sand mortar about 0.2g, lime mortar about 0.5g, and mud mortar about 0.6g. Buildings tested in pairs showed surprisingly consistent strengths.

In the dynamic tests the intermittently applied acceleration pulses were triangular, of 1/8 sec. duration, maximum acceleration the same as required for static tilt failure. Four buildings were tested. After as few as 4 pulses an unmortared building pulsed longitudinally showed diagonal cracking and loosening of bricks in end walls, but end wall collapse did not occur until after 60 pulses. A second unmortared building, pulsed diagonally, failed after 37 pulses. Buildings of lime mortar pulsed longitudinally first cracked after 1 or 2 pulses, but one withstood 80 pulses and one 26 pulses before failure.

Additional work is recommended with larger buildings more representative of low class houses.

I Graduate Student in Civil Engineering, Montana State University, Bozeman, Montana, USA.

II Professor of Civil Engineering and Engineering Mechanics, Montana State University.