Survey of Earthquake Damage Areas

On July 29-31 towns and cities which suffered what appears to be the (relative)
most damage from the earthquake were visited. Some interesting features about
the overall damage area and felt effects of this earthquake include:

1. Severe damage (I use this in a relative sense; in actuality there was
no severe damage to speak of — also, it seems there was no structural damage)
seems to be limited to a long, narrow elliptical area between about Mt. Sterling
in the south to Maysville in the north. Most damaged buildings were brick,
and many are over 100 years old.

2. Cemeteries visited show very uniform movement of tombstones. Every
cemetery between Flemingsburg and Mt. Sterling along Rt. 11 had approximately
5 to 10 percent of the tombstones displaced off center and rotated counterclock-
wise. In one instance, a fairly large granite tombstone actually fell off its
base and shattered. One cemetery visited off this N-S line (Rt. 11) was in
Owingsville. Here the blocks were rotated clockwise.

3. The overall felt area of this earthquake seems to be larger than that
of the M = 5.3, MM intensity VII-VIII Anna, Ohio earthquake of 1937. The 1980
earthquake was felt over large distances directionally along the basement arches.
These arches include the Cincinnati, Findlay, and Kankakee, with felt reports
occurring in Wisconsin, Michigan, and as far as Toronto (Canada) to the north
and South Carolina to the south.

4. The University of Kentucky was coordinating monitoring activities to
locate aftershocks. Microseismic instruments were set up around the epicenter
by the USGS, the Tennessee Earthquake Information Center, the University of Ken-
tucky, the University of Michigan, and Virginia Polytechnic Institute and State
University. Preliminary results indicate that the earthquake was fairly shallow
(about 10 to 14 km) and about 15 to 20 aftershocks were recorded between July 28
and August 2. Only two of these aftershocks were felt.

5. Intensity surveys were being undertaken by the USGS, the University of
Kentucky, and the University of Michigan. The preliminary survey of damage indi-
cates small areas of intensity VII surrounded by an elliptical area of intensity VI.

6. No building seems to have suffered any major structural damage. General
features of building damage were: mortar between bricks and cinderblocks cracked
and broken, a few bricks and cinderblocks split, and cracks in plaster walls
both through the walls and along joints. Hundreds of chimneys suffered partial
collapse or damage. Only three chimneys were observed to have broken off below
the house level.

Maysville, KY: Maysville is the town that has received the most attention about
damaging effects of the earthquake although after the damage survey one can find
other areas that were affected as severely (relatively speaking). The majority
of the damage in the city is confined to a rectangular area about two blocks by
three blocks in dimension. The majority of the damage is on the south or south-
east sides of buildings. Damage includes many chimneys partially collapsed and
front pillars on the city hospital split. Exterior walls of many buildings were
cracked, mainly in the mortar between bricks. Interior cracks were chiefly in
plaster walls, with only a few penetrating the exterior brick. A church 1 mile
south of the main area of damage had its front extensively cracked. Some of the
cracks were large enough to let light in. The soil cover may be quite variable
due to the closeness of the Ohio River because parts of the town are on a hill
with bedrock very close to the surface. Buildings damaged in Maysville are old
(some over 100 years), with the principal damage due to poor mortar. Buildings
are on alluvium.
Ewing, KY: Buildings in Ewing suffered general chimney damage, with none totally collapsed. The general store had cracks both through the mortar and cinderblocks in the foundation; two homes reported similar conditions.

Flemingsburg, KY: Three buildings were examined. Both a water processing plant and the county services building had cracks in the cinderblocks through the blocks and mortar. The final building looked at was the county hospital, which may have suffered the most damage. About 50 percent of the rooms with plaster walls were cracked. The hospital chapel had a large crack in one corner, with the brick on the outside also cracked. One stairwell had cracks in the wall, and outside bricks cracked. Although this building had many cracks, there did not appear to be any major structural damage. The town cemetery was examined, and some tombstones were displaced and rotated counterclockwise.

Sherburne, KY: Damage in this small town was to chimneys, with two being broken off below roof level. In both cases the mortar looked extremely weak.

Wedonia, Tilton, Carlisle, and Moorefield, KY: General chimney damage occurred in this area. Few buildings were examined closely because of the sparse population in the area.

Bethel, KY: There was general chimney damage, and many tombstones moved and rotated counterclockwise in the cemetery.

Sharpsburg, KY: Although the town itself suffered only general chimney damage, one old house south of town was severely damaged. This included major cracks throughout the structure penetrating both interior and exterior walls, with some parts of the house close to collapse. This house sits directly on the ground and has no foundation. The cemetery also had moved and rotated (counterclockwise) tombstones.

Mt. Sterling, KY: The only building examined was a cinderblock caddy shack at a golf club. There were many cracks in this building, both through the mortar and the cinderblocks. This building sits on a concrete slab. A cemetery near the club had one rotated tombstone.

Owingsville, KY: There was general chimney damage, with tombstones rotated clockwise in this cemetery.

In driving throughout this area, chimneys with some damage were observed as far away as Ripley, Ohio and Lexington, Kentucky.

As noted in the above discussion, it was found that tombstones exhibited uniform displacement and rotational characteristics. The reference point for each observation is the fixed stone in the ground, with the upper stages (tombstones are usually composed of two-three stages of rock held together by mortar) moving in a relative rotational direction. To record this direction, one needs to look down on the stone and observe whether clockwise or counterclockwise rotation has taken place. This movement is usually caused by shear waves (back and forth motion) and can be useful in defining the mechanisms of faulting. Also, movement of fairly heavy tombstones helps define the intensity of the shaking.
Summary

The July 27, 1980 Kentucky earthquake is the largest event to occur in the eastern portion of the Central Stable Region (Michigan, Ohio, Kentucky) since 1937. Although many buildings suffered cracked interior and exterior walls, no building seems to have sustained major structural damage. A preliminary damage survey indicated that highest MM intensity VII areas are irregular and occur between Maysville and Sharpsburg, Kentucky. It will take months before much information becomes available, such as intensity survey studies and lists of earthquake locations and magnitudes.

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GEOLOGIC MAP AND MERCALLI

INTENSITIES OF MAYSVILLE

KENTUCKY 27 JULY 1980
Counterclockwise rotation of cemetery monuments in Shannon, KY (Photo: University of Michigan)

Cemetery monument movement in Augusta, KY. South is to the right of photo. (Photo: University of Michigan)
This isoseismal map was compiled from felt reports published in local newspapers 28-29 July 1980. Analysis of the data and ground truth information were done by Fred Mauk, Steve Henry, Doug Christensen, and Nat Usher of the University of Michigan. Additional ground truth data were provided by Jeff Kimball of US Nuclear Regulatory Commission Engineering Division. All felt report data are archived at the University of Michigan Seismological Observatory and are available for future investigations.