

OFFICE MEMORANDUM



MICHIGAN

STATE HIGHWAY DEPARTMENT

JOHN C. MACKIE, COMMISSIONER

October 8, 1964

To: L. T. Oehler, Supervisor
Physical Research Section

From: C. J. Arnold

Subject: Alleged Damage to Dwelling of A. T. Schmidt, Vassar, Michigan.
Research Project 64 F-79. Research Report No. R-478.

This memorandum is prepared in reply to a request by R. L. Greenman dated July 7, 1964. The Schmidt dwelling is a brick structure originally constructed in 1879 (Fig. 1). Sometime later (probably more than 30 years ago) an addition was made extending the rear of the building. The alleged damage is the separation of the addition from the front part of the house, evidently caused by settlement of the foundation under the addition (Fig. 2). More recently, a garage was added at the rear of the building, in such a way as to require excavation of the soil down to a level with the basement of the addition to the house. Soil pressure from the bank caved in the rear wall of the garage, even before its construction was completed. It also seems possible that the excavation for the garage may have increased the settlement of the house foundation, since Mr. Schmidt's lawyer states in his letter of May 7, 1963, that the condition has become increasingly worse in the past three years.

On September 2, 1964, tests were made at the Schmidt dwelling, consisting of recording accelerations at various points on the structure. In determining the type of instrumentation to be used in this study, reference was made to Vol. 3 of "The Shock and Vibration Handbook," by Harris and Crede. Chapter 50 deals with "Man-Made Ground Motions" and says in part that the most useful type of measurement of the transient ground motion is an acceleration-time record obtained from an accelerometer recording system having flat frequency response from 0 to 100 cps. Our test apparatus included two accelerometers, mounted perpendicular to each other to pick up vertical and horizontal accelerations and firmly attached to the brick window sills or brick porch columns. Signals from the accelerometers were fed into a Honeywell Amplifier system and recorded on a Honeywell Visicorder oscillograph having flat frequency response to over 1000 cps (Fig. 3). Test runs were made up and down the hill with the Department's weight truck (unit No. 04-171), which has a gross vehicle weight of about 30,000 lb. Vibrations due to a few commercial vehicles were also recorded.

The maximum acceleration caused by vehicles was 0.03 g, while acceleration values of two to five times greater were caused by a man's jumping on the ground near the building, and by hitting the ground beside the building with a sledge hammer.

A large brick church, located across the street from Mr. Schmidt's house, was evidently constructed about the same time as the original part of the house. No serious structural damage was noted at the church, although it was equally close to the street and undergoing as much or more vibration since the pavement is faulted more on that side of the street. A stake was driven into the ground in front of the church, 17 ft from the curb, and the accelerometers were attached to the stake. Accelerations as high as 0.1 g were noted at this location when a heavy truck passed by. No measurements were made on the church itself, which lacked locations for attachment of the accelerometers.

To determine the effect of vibrations on buildings, we refer again to Chapter 50 of "The Shock and Vibration Handbook":

"Early tests indicated that for typical small dwelling units, a peak acceleration of 0.1 g corresponded to a caution limit which might mark the beginning of minor plaster cracking, etc., and that 1 g was a limit above which significant structural damage could be expected."

The unstable soil condition at the site can be seen from Fig. 4, which shows the condition of the sidewalk in front of the Schmidt house. A letter from P. R. Baumgartner, District Soil Engineer for the Department, states:

"An investigation of the soils at the subject house site revealed the presence of a considerable amount of clayey silt. Since the house is situated on the slope of the Port Huron moraine, a considerable amount of side-hill seepage results in producing a very unstable soils condition."

We believe, therefore, that the damage to the Schmidt house is the inevitable consequence of the unstable soil condition at the site, coupled perhaps with an inadequate foundation for the addition to the building. While it was possible to

L. T. Oehler

- 3 -

October 8, 1964

detect vehicle-caused vibrations on the Schmidt house with the sensitive instrumentation used, the magnitude of this vibration was very small and not sufficient, on the basis of limiting values stated by Harris and Crede, to account for the serious structural damage that has occurred.

OFFICE OF TESTING AND RESEARCH

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CJA:jlk

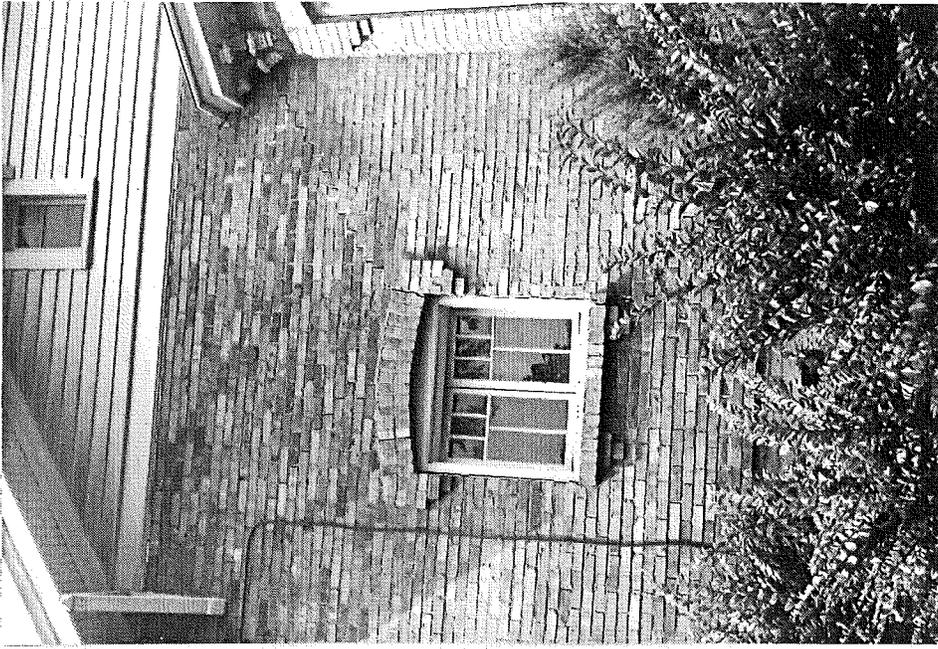


Figure 1. Subject house, owned by A. T. Schmidt, Vassar, Michigan.

Figure 2. SE side of house, showing 10 ft addition, and crack from large window to small kitchen window.

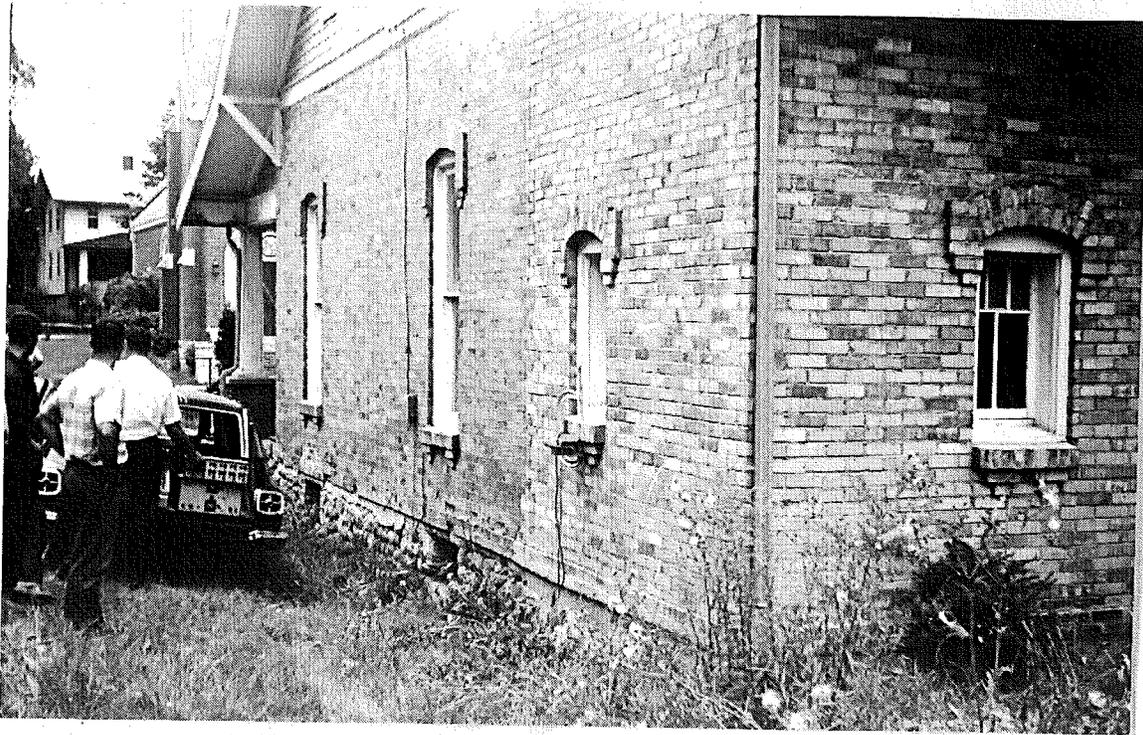


Figure 3. Accelerometers attached to brick window ledge. Instruments in station wagon.



Figure 4. Faulted sidewalk and retaining wall adjacent to subject house.