

INVESTIGATION OF
ALLEGED RESIDENTIAL VIBRATION DAMAGE



MICHIGAN DEPARTMENT OF STATE HIGHWAYS

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Mr. Storrer, who resides at 1007 N. Shiawassee St., Owosso, made a complaint to the Department's District Office, concerning vibration and alleged damage to his house; caused by trucks riding over a raised joint of the northbound passing lane near the front of his house. The subject investigation has been made at the request of R. L. Greenman, Engineer of Testing and Research.

Mr. Storrer's property is located on M 47, approximately five blocks inside the north city limits of Owosso. The house is approximately 40 years old, and generally in good condition (Fig. 1). The pavement in the area is four lanes wide. The original two-lane concrete pavement was built in 1924, and was widened and resurfaced in 1965. Bumps in the inside lanes result from bituminous overlay on deteriorated joints in the old two lane concrete pavement. The raised joint near Mr. Storrer's house is shown in Figure 2. This causes northbound truck traffic to produce vibration and noise, when operating in the passing lane. The height of the bump has varied during this year from approximately 1/2 to 3/4 in. Variations in the road profile are caused by thermal expansion of the slabs, frost heave at the joints, and traffic action.

The owner's main complaint of damage to the house is based on cracks that have appeared in the wallpaper near the fireplace. The fireplace is brick, framed above and on the sides, and finished with plaster and wallpaper (Fig. 3). The fireplace and foundation seem to be sound, and the cracks appear to be only in the surface of the plastered wall. Other smaller cracks, at various locations in the house, seem to be only in the wallpaper. In talking with the owner, our representative became convinced that he was more concerned about the irritating noise and vibration, than the alleged damage to the building.

The human body is extremely sensitive to vibration. Previous research has shown that vibration is perceptible at less than 0.003 g. Vibration magnitudes above 0.05 g were classified as "unpleasant," and "intolerable" classification was assigned to vibrations above 0.25 g. Earth vibrations

may also set up resonant responses in floors of buildings, thereby increasing the magnitude of the oscillations. These factors result in expressions of concern from persons unwillingly subjected to such vibration.

Harris and Creede have indicated in Vibrations Handbook that earth vibrations above 0.1 g may cause minor plaster cracking in residential structures. Langefors in Sweden, Edwards in Canada, and Bumines in the United States have made experiments correlating peak particle velocity in the earth with damage to structures. Their results agree very closely, and indicate that minor damage to residential structures may occur when the peak particle velocity exceeds four inches per second.

Measurements were made at the Storrer residence to determine the severity of vibration caused by traffic. The accelerometer was secured to a stake driven in the ground at the southeast corner of the house, which is nearest to the raised pavement joint. Output was recorded while several trucks passed over the bump. The largest peak acceleration and particle velocity for these runs were approximately 0.03 g and 0.06 in/sec respectively. Average values for 12 runs were 0.01 g and 0.04 in/sec.

The bump was slightly less than 1/2 in. high on the day of testing, and the measured accelerations were quite low. Since the bump had been somewhat higher during the past winter, it was decided to simulate a larger bump by the use of impact boards placed on the roadway. The only boards readily available were two inches in height. These boards were used, and traversed by the Laboratory's weight truck at approximately 25 mph. The largest peak acceleration and particle velocity for these tests were approximately 0.03 g and 0.08 in/sec respectively. Average values for eight tests were approximately 0.02 g and 0.06 in/sec. Based on these limited test results and the published critical values for damage listed above, we conclude that traffic should not have caused damage to Mr. Storrer's house. It is evident, however, that the magnitudes may be approaching values that could be objectionable to some people. Therefore, the following suggestions are offered.

Since the bumps are located in the passing lanes, much of the problem would be eliminated if trucks proceeded at reasonable speeds and remained in the outside lanes. Although no speed measurements were made, it appears that many of the trucks may be exceeding the posted limit. Perhaps our District personnel could work with City officials to have the area posted to require trucks to keep right and not pass within the city limits. This is done in many towns, and is not uncommon. Some local enforcement of such rules may be required.

It is suggested also that the joint near Mr. Storrer's house be cut out full-depth, and repaired, if maintenance funds can be made available. There are a few more joints in the area that should also be repaired. Two or three are in the southbound passing lanes and in the immediate vicinity of the Storrer residence. These joints are in worse condition than the one in question, and may bring complaints from other residents if not repaired.

It seems reasonable to assume that complaints of this type will be more prevalent in the future than in the past, since people are becoming more conscious of "noise pollution" of their environment. Therefore, it would seem advisable for the Department to inspect more closely pavements that are to be capped, and repair deteriorated joints before the cap is applied. Once the joints are deteriorated, they will be an unending source of trouble, even under a newly applied road surface. Increased use of aggregate cushion may aid in the solution of the problem.

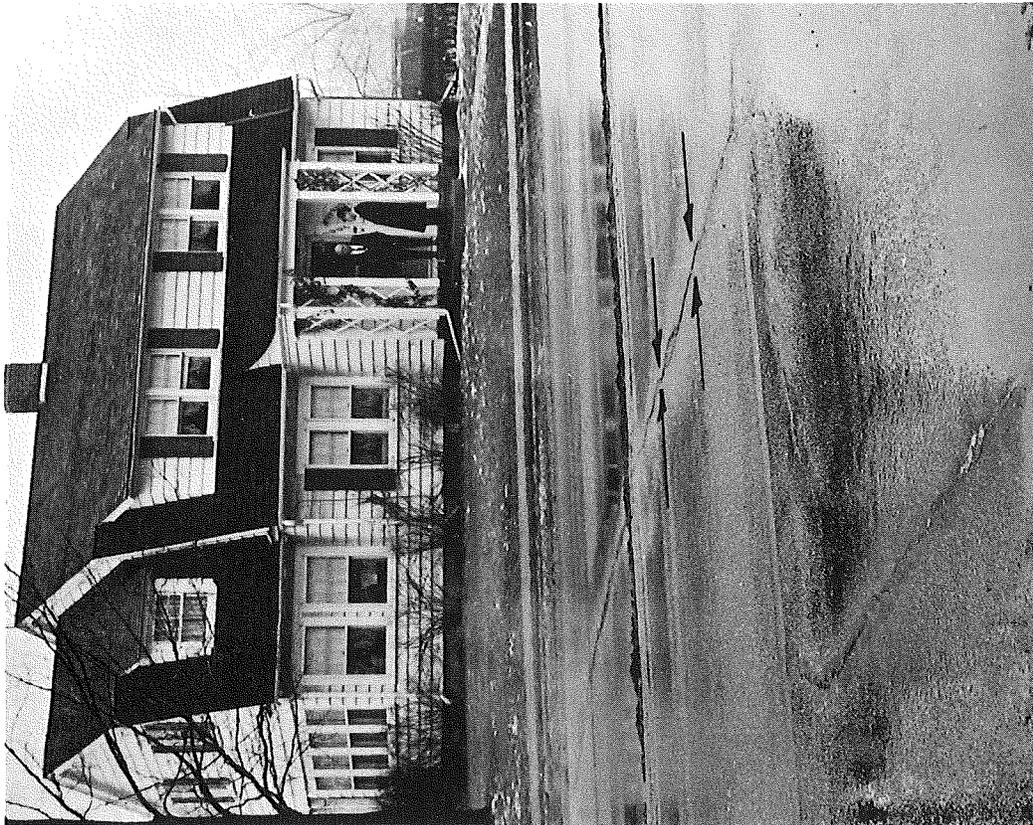


Figure 1. R. Storrer residence, Owosso. Raised joint shown in foreground.



Figure 2. Raised joint, northbound passing lane.

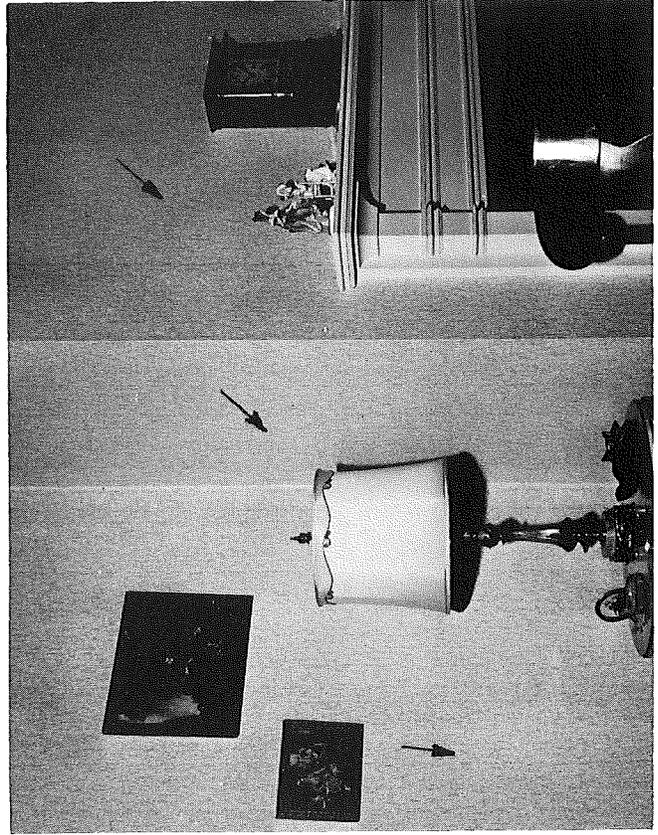


Figure 3. Interior of Storrer house, location of cracks indicated.