INVESTIGATION OF TRAFFIC-INDUCED VIBRATIONS AT THE MARY ROY RESIDENCE, MARINE CITY

MICHIGAN DEPARTMENT OF STATE HIGHWAYS

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This report covers the results of an investigation of purported traffic-induced vibrations at the residence of Mrs. Mary Roy, 6168 North River Rd, Marine City. The study was requested in a January 23, 1974 letter from J. T. Monaghan, Metropolitan District Soils Engineer, to K. A. Allemeier, Testing and Research Engineer.

Background Information

The house is a brick structure with a concrete block basement. The owner has stated that damage to her basement walls is due to vibrations, generated by truck traffic bouncing across a patched section of M 29 in front of the house. The house is approximately 40 ft from the edge of the roadway and at about the same elevation as the road.

Vibrations Measurements

Vibration measurements were made at the site on February 26, 1974. Two accelerometers were used to make simultaneous measurements of ground vibrations at the edge of the roadway and at the front of the house. Accelerometers were mounted on steel stakes driven into the ground. Their outputs were recorded on a low-speed, two-channel oscillograph, for several trucks in the traffic stream, and for the Laboratory's weight truck running over impact boards 2-in. high. Ten vibration events were chosen from the trace for evaluation, and the maximum acceleration peak noted for each event. Results of these tests are shown in Table 1.

Discussion

The response generated by vehicles traversing the small bumps in front of the house was not unusually large when compared with results of previous tests at other sites. The pavement roughness was not extreme at the site and only minor deterioration on the surface of the roadway was evident when tests were made. A localized pavement failure in front of the house probably varies in roughness as weather conditions change. A surfacing project, programmed for May 1974, has been completed and should have improved the situation considerably.

To estimate the probable structural results of the vibrations, reference is made to Chapter 50 of Harris and Crede (1) which deals with accelerations in the ground: "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 plastic cracking, etc., and that 1 g was a limit above which significant structural damage could be expected."

Langefors in Sweden, Edwards in Canada, and Bumines in this country, have conducted experiments correlating peak particle velocity in the earth with damage to structures. Their results agree quite closely with one an-

other, and are in general agreement with the acceleration criteria of Harris and Crede.

Comparing the measured acceleration values with limiting values from Harris and Crede, shows that the vibrations present at the site are well below the levels required to cause structural damage. The human body, however, is extremely sensitive to vibration, and values far below structurally significant levels are known to be objectionable to many people.

Humans can feel vibrations of 0.0001-in. deflection; and vibratory motion of 0.001-in. amplitude at 20 cycles per second is annoying. Vibratory accelerations are "noticeable" well below 0.01 g, are "unpleasant" at 0.04 g and above 0.25 g are classified as "intolerable" at certain frequencies.

Conclusions

Test results have shown vibration values far below the magnitude required to cause structural damage. Vibrations were within ranges known to be objectionable to some people and these values are higher near the roadway. The resurfacing project completed in May, should have caused a marked reduction in vibration levels at the site.

REFERENCES

1. Harris and Crede, The Shock and Vibrations Handbook, Vol. 3, McGraw-Hill, New York, 1971.

TABLE 1
RECORDED ACCELERATIONS

Event	Accelerometer Orientation		Accelerometer Location		Peak Acceleration, g	
	1	2	1	2	1	2
1	Vert.	Vert.	Edge of Road	At House	0.030	0.002
2	Vert.	Vert.	Edge of Road	At House	0.020	0.001
3	Vert.	Vert.	Edge of Road	At House	0.020	0.002
4	Vert.	Vert.	Edge of Road	At House	0.010	0.001
5	Vert.	Vert.	Edge of Road	At House	0.050	0.002
6	Vert.	Vert.	Edge of Road	At House	0.060	0.005
7	Vert.	Vert.	Edge of Road	At House	0.070	0.008
				AVERAGE	0.040	0.003
8	Horiz.	Vert.	On Same Pole At Edge Of Road		0.08	0.06
9	Horiz.	Vert.	On Same Pole At Edge Of Road		0.02	0.04
10	Horiz.	Vert.	On Same Pole At Edge Of Road		0.07	0.04
				AVERAGE	0.05	0.05