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VIBRATION TESTS ON A SPECIALLY CONSTRUCTED PILLAR IN THE STANDARD LABORATORY OF THE MUNITIONS FACTORY, FOOTSCRAY

by

L.V. HAWKINS and A. STOCKLIN

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ABSTRACT

Vibration tests were carried out on a specially designed pillar in the Standards Laboratory of the Ammunition Factory, Footscray. The results are compared with those obtained on the foundations of the pillar prior to its construction.

The tests showed that the construction has been successful in reducing vibration in the pillar caused by nearby trams but that vibration due to other causes has increased considerably. The main cause of the increased vibration is the machinery in an adjacent room or building. It is noted that the vibrations from the machinery are orientated either north-south or east-west and vertical.

1. INTRODUCTION

In response to a request by the Department of Defence Production, measurements were carried out by the Geophysical Section of the Bureau of Mineral Resources, of vibrations on top of a specially designed pillar in the Standards Laboratory of the Ammunition Factory, Footscray, on the 4th and 5th of April, 1957. The pillar, which is raised approximately three feet above the floor, has a flat, level top three feet square.

Measurements were made previously on the foundations of the pillar on 17th November, 1955, prior to its construction. It was desired to determine if the construction of the pillar had been successful in reducing the amplitude of the vibrations. The measurements were made by L.V. Hawkins and A. Stocklin, geophysicists of the Bureau.

2. EQUIPMENT

A "Willmore" three component seismograph, with the components orientated in the directions of north-south, east-west and vertical, was used for all tests.

The "Willmore" seismograph is a velocity-recording instrument, but the ground displacement may be determined from the recorded amplitude. Plate 1 shows a calibration curve for the instrument in terms of the magnification of the ground displacement at different frequencies. The calibration tests were carried out in 1955 by means of a shaking-table designed and built by the University of Delft, Holland. The shaking table can be made to oscillate at any desired amplitude and frequency within a frequency range of 1 to 500 c.p.s.

The results of the calibration tests show that the magnification of the instrument changes rapidly with changes in the frequency of the vibrations. However, the recording-paper speed is too slow to determine the frequency of vibrations above 5 cycles per second (c.p.s.) As frequencies of 5 c.p.s. and higher were recorded in the present test, a constant magnification of 27,000, corresponding to a frequency of 8.5 c.p.s., was taken for all frequencies; this may introduce errors up to ± 30 per cent in displacement amplitude.

3. RESULTS

A. Test on 4th April, 1957.

Machines near the laboratories were switehed off for this test.

The "Willmore" seismometers were placed on top of the pillar and orientated in the directions of north-south, east-west and vertical.

The moving coils of the vertical and east-west orientated seismometers appear to have been "sticking" during the test and the recordings in these directions are not considered reliable. The north-south component showed that the background vibrations (with the machines switched off) had an amplitude of 0.0093µ to 0.028µ with individual peaks of 0.0925µ and occasionally 0.129µ. Vibrations caused by nearby trams were indistinguishable from the general background but a vibration with an amplitude of 0.037µ was identified as being due to a nearby "rock drill".

In an earlier test carried out on 17th November, 1955, on the rock foundations of the pillar prior to its construction no reliable north-south component was measured and only the vertical and east-west components were given in the results of that test. However, the record showed the ratio of the vibration due to trams to the background vibration in the north-south component, to be approximately the same as on the east-west component, namely 6.25 : 1, the ground amplitude being 0.118μ for the vibrations due to the tram and 0.0188μ for the background vibration.

No machinery was running during the test on the 17th November, 1955.

As the vibration caused by trams was indistinguishable from the background vibrations in the test on the 4th April, 1957, it appears that the design of the pillar has been successful in reducing the vibration on the pillar to less than ¼ of the amplitude on the rock foundations of the pillar. However, there has been a considerable increase in the amplitude of the background vibrations notwithstanding the damping effect of the pillar.

B. Test on 5th April, 1957.

The conditions for this test differed from those of the test on the previous day, as the machinery in adjacent rooms and buildings was not switched off. The effect of this machinery was to increase considerably the amplitude of the background vibrations and produce periodic and sporadic vibrations of relatively high amplitude. Table 1 shows the results of this test.

TABLE 1.

	DISPLACEMENT (microns)		
	Vertical Component	N - S Component	E - W Component
General background (frequency up to 10 c.p.s. approx.)	0.167 to 0.39	0.093 to 1.11	0.37 to 0.925
Periodic noise from machines. Period = 2.7 seconds (frequency about 8 c.p.s.)	-	-	0.925 to 1.82
Unidentified sporadic noise from machines.	0.685	1.89	-
Mean value of four stamps on floor adjacent to pillar.	0.537 (greater than background)	0.8 (within general background)	0.925 (within general background)

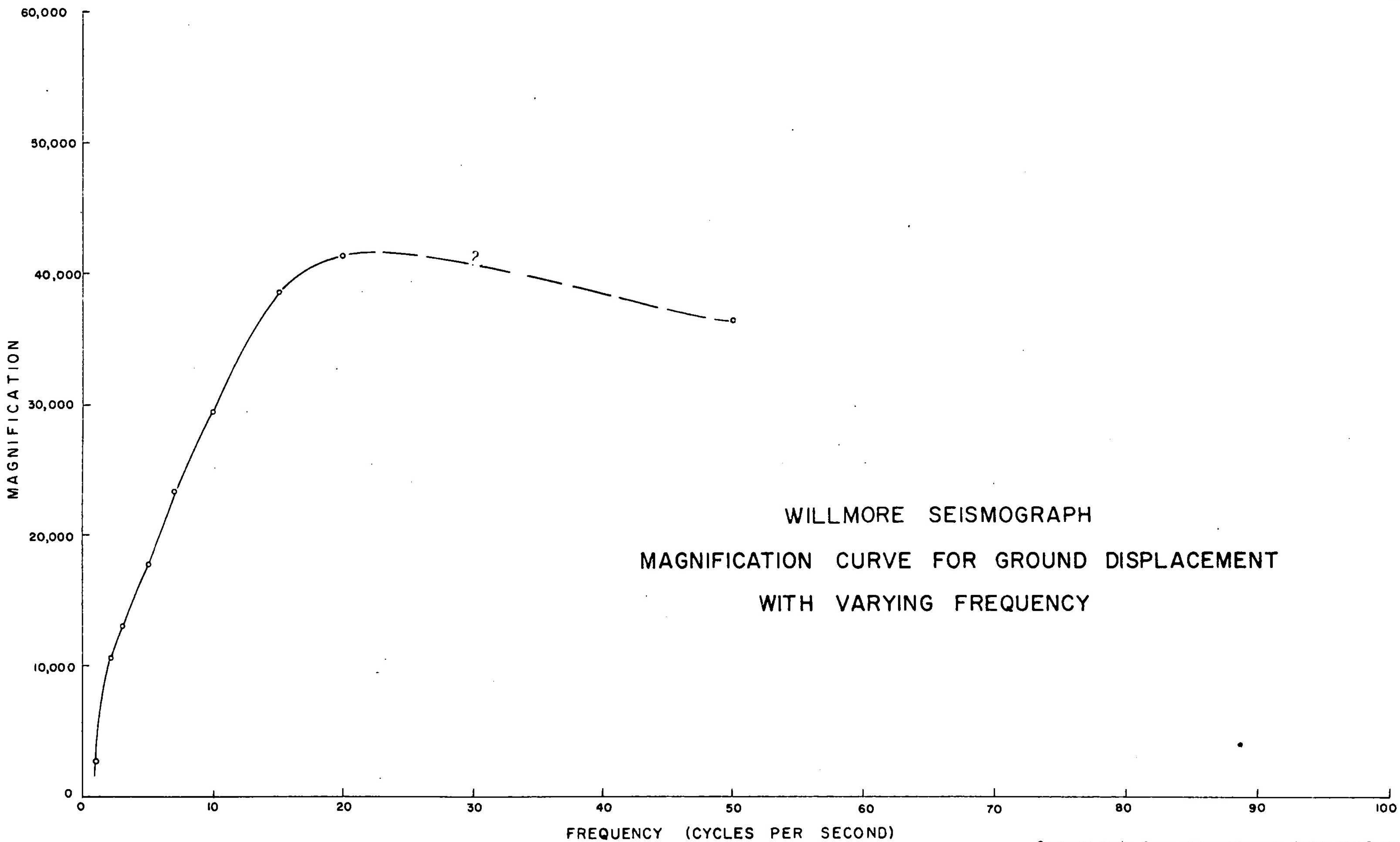
4. CONCLUSIONS.

From the results of the tests it appears that the design of the pillar has been successful in reducing the amplitude of vibrations from specific events such as passing trams, but that the amplitude of the general background vibrations has increased.

The predominant cause of increased background vibrations is nearby machinery, although even with the machinery switched off, the background noise has apparently increased.

It is noted that machinery vibration tends to be directed either north-south or east-west and vertical and appears to be caused by machines with moving parts orientated in these directions.

PLATE I



WILLMORE SEISMOGRAPH
MAGNIFICATION CURVE FOR GROUND DISPLACEMENT
WITH VARYING FREQUENCY

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics.