COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

RECORDS
1959 NO. 81.

VIBRATION TESTS AT C.S.I.R.O. LABORATORY FISHERMAN'S BEND, MELBOURNE.

BY

E.J. POLAK AND B. BAMBER.

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ILLUSTRATIONS

ABSTRACT

This report gives the results of tests on floor vibrations in the C.S.I.R.O. Chemical Laboratory at Fisherman's Bend, Melbourne. The records show that vibrations due to passing traffic or to work in adjacent workshops have a maximum amplitude of displacement, measured from trough to peak, of 0.0002 inches, with frequencies of between 3 and 18 cps.

1. INTRODUCTION

The Geophysical Section of the Bureau of Mineral Resources carried out vibration tests in the C.S.I.R.O. Chemical Laboratory at Fisherman's Bend, Melbourne, to measure floor vibrations. Electron and diffraction microscopes are used in these laboratories and will ultimately be transferred to a new Laboratory at the site of the Monash University. The vibration measurements were required to estimate permissible vibrations in the planning of new laboratories.

The test was carried out by E.J. Polak and B.Bamber on 28th May, 1959. Measurements were taken during working hours and under normal conditions, in the Electron Microscope Preparation Laboratory, in the Electron Diffraction Laboratory and in an office adjacent to the Instrument Workshop. Traffic passed along the road adjacent to the Electron Microscope Preparation Laboratory, a vacuum pump was operated in the Electron Diffraction Laboratory, and in the Instrument Workshop various machines were switched on and off.

2. INSTRUMENT USED

The instrument used for the measurements was a Leet Vibrograph, which gives a photographic record of the three mutually perpendicular components of the ground displacement, with an optical magnification of 50. The scale of the record is such that a movement of one inch on the record represents 0.02 inches of the ground movement. The timing lines have an interval of 10 milliseconds.

From the record are measured the amplitudes and frequencies of the three components of a vibration. The component amplitudes are measured as the maximum value of the peak-to-trough displacement. The total resultant amplitude equals the square root of the sum of the squares of the component amplitudes. The frequency is defined as the predominant frequency in cycles per second at the maximum amplitude of the ground displacement.

From the values, the acceleration is calculated from the formula:-

$$a = 4\pi f^2 A$$

where:

a = acceleration in inch/sec^2

f = frequency in cps.

A = amplitude in inches

The low amplification of the Leet Vibrograph imposes a limitation on the amplitude which it is possible to record with the instrument. The lowest amplitude which can be read on the record is about 0.01 inches peak to trough. This value corresponds with an actual ground displacement of about 0.0002 inches. Frequencies detected were mostly of the order of 10 cps. For this frequency the minimum acceleration that can be detected is:-

$$a = 4\pi^2 \times 100 \times 0.0002$$

$$a = 0.8 \text{ inch/sec}^2 \quad = 2.0 \text{ cm/sec}^2$$

This is twice the maximum permissible acceleration quoted by the manufacturers of the electron microscope.

3. RESULTS

The results are shown on Plates 1 to 3.

Plate 1. Electron Microscope Preparation Laboratory.

Record A. A small displacement less than 0.01 inches at the end of the record has a frequency of about 16 to 18 cps. Its origin was unknown.

Record B. The main feature is a vibration with frequency of from 12 to 14 cps from peak to trough representing a ground vibration of amplitude approximately 0.0002 inches, superimposed on a vibration with a frequency of about 2 to 3 cps. A bus was passing along the road at the time.

Record C. This record is similar to Record B and shows the vibrations from a truck passing along the road.

Plate 2. Electron Diffraction Laboratory.

Record A. Measurements taken on a concrete base produce a record with continuous vibration of small amplitude, especially visible on the two horizontal components, with a frequency of about 10 cps. The amplitude on the records is less than 0.01 inches.

Record B. As Record A, with the vibration from the vacuum pump superimposed every 0.2 secs.

Record C. Measurements taken on a wooden floor produce a record of vibrations more irregular and of a higher amplitude than those in Record A. The amplitude on the record is approximately 0.01 inches.

Record D. On this record the starting of the vacuum pump showed no effect. Heavy, deliberate stamping in the passage outside the laboratory produced displacement of less than 0.01 inches in the traces.

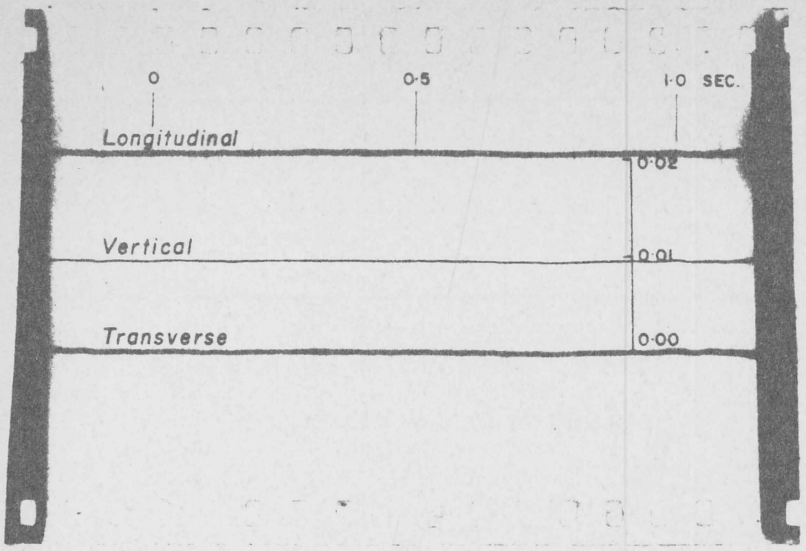
Plate 3. Office adjacent to the Instrument Workshop.

Record A. The general vibration level has a frequency of about 10 cps with very low amplitude.

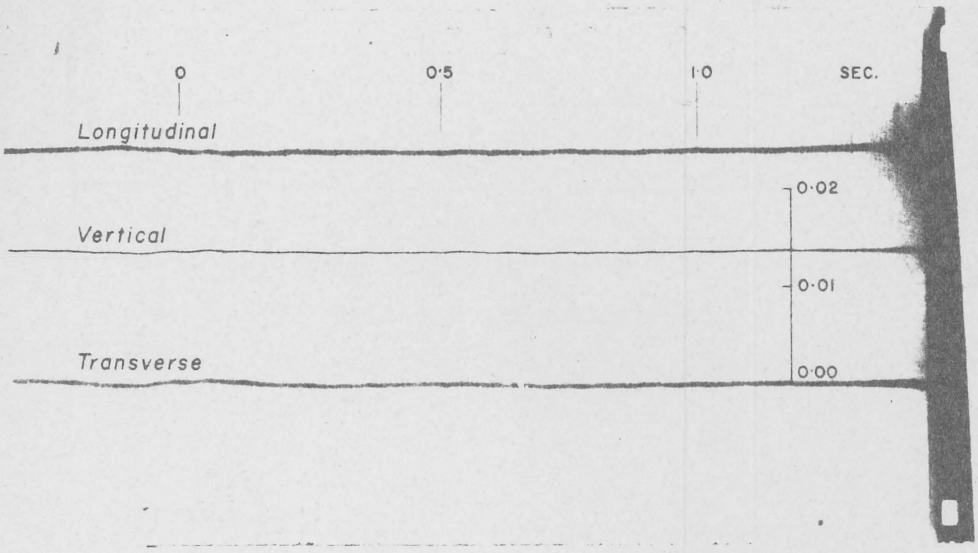
Record B. A vibration of about 12 cps and slightly higher amplitude than that on Record A was produced by the starting of all machinery in the workshop.

4. CONCLUSIONS

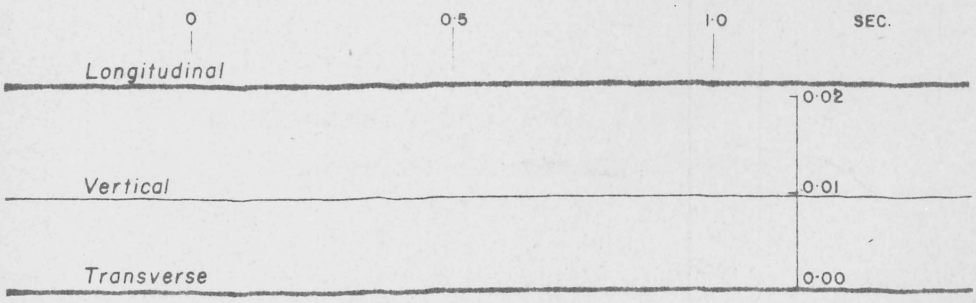
The vibration level in the C.S.I.R.O. Chemical Laboratory, as measured in the three places given above, under normal working conditions, rises at times to twice that considered desirable by the makers of the electron microscope and the diffraction microscope used there. The amplitude of the ground displacement may be as high as about 0.0002 inches and the frequency is between 3 and 18 cps.



A. General vibration level



B. Bus passing along street



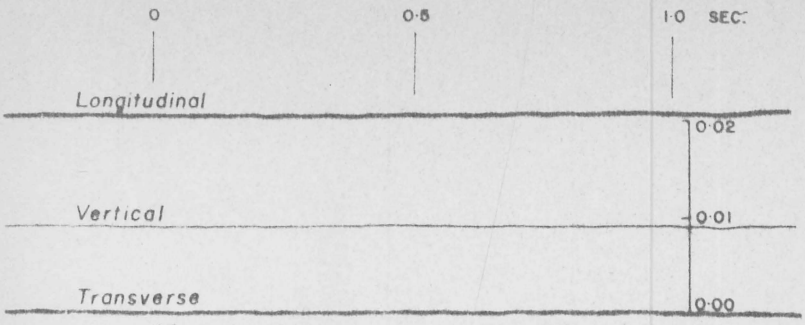
C. Lorry passing along street

Vibration Tests at CSIRO Laboratory,
Fisherman's Bend, Victoria

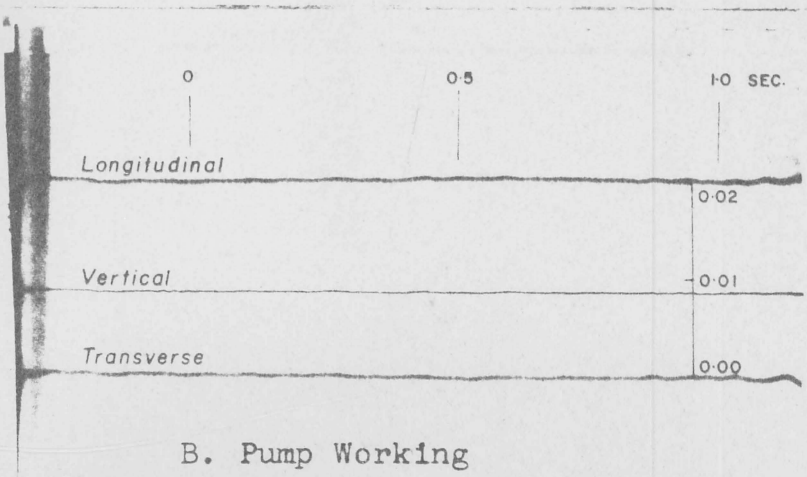
TEST No. I

ELECTRON MICROSCOPE
PREPARATION LABORATORY

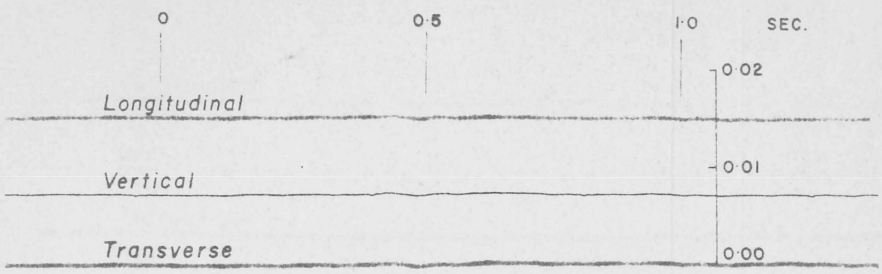
To accompany Records 1959, No 81.



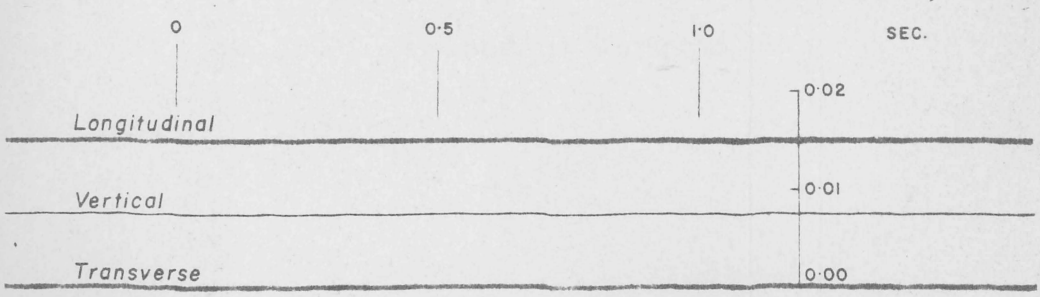
A. General vibration level
(Recorder on concrete)



B. Pump Working
(Recorder on concrete)



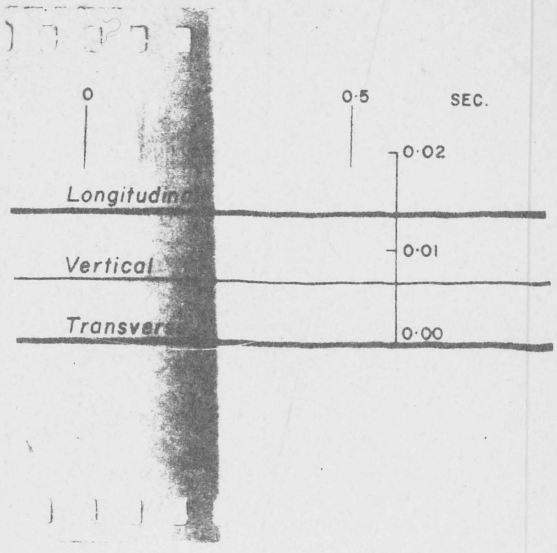
C. General vibration level
(Recorder on wooden floor)



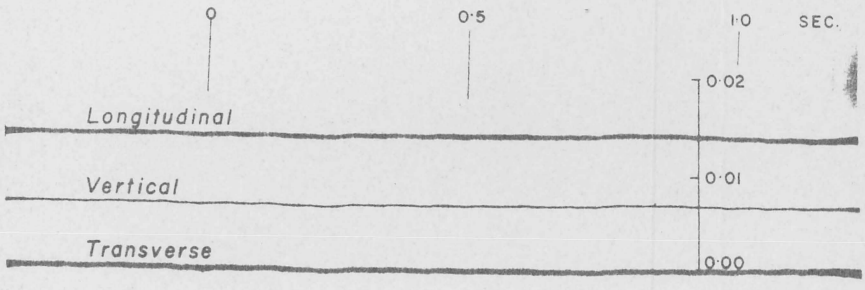
D. Pump Working, Stamping
in Passage
(Recorder on wooden floor)

Vibration Tests at CSIRO Laboratory,
Fisherman's Bend, Victoria

TEST No. 2
ELECTRON DIFFRACTION LABORATORY



A. General vibration level



B. Instrument Workshop
Working

Vibration Tests at CSIRO Laboratory,
Fisherman's Bend, Victoria

TEST No. 3

OFFICE ADJACENT TO
INSTRUMENT WORKSHOP