1961/13
A
C.3
NOT TO BE REMOVED FROM LIBRARY ROOM

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

BUREAU OF MINERAL RESOURCES
GEOPHYSICAL LIBRARY
Ref. A

RECORDS 1961 No. 13

BUREAU OF MINERAL RESOURCES LIBRARY Copy # 3 CANBERRA, A.C.T.

WANGARATTA RAILWAY VIBRATION TESTS, VICTORIA 1961

by

A. Radeski

The information contained in this report has been obtained by the Department of National Development, as part of the policy of the Commonwealth Government, to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus or statement without the permission in writing of the Director, Bureau of Mineral Resources, Geology and Geophysics.

NOT TO BE REMOVED FROM LIBRARY ROOM

RECORDS 1961 No. 13

WANGARATTA RAILWAY VIBRATION TESTS, VICTORIA 1961

by

A. Radeski

The information contained in this report has been obtained by the Department of National Development, as part of the policy of the Commonwealth Government, to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus or statement without the permission in writing of the Director, Bureau of Mineral Resources, Geology and Geophysics.

CONTENTS

ILLUSTRATIONS

ABSTRACT

This report describes the measurement of ground vibrations produced by trains on the railway track at Wangaratta, Victoria.

The ground vibration measured at 50 ft is classified as non-damaging to structures. It is deduced that ground vibration produced by passing trains will not damage a water tower approximately 50 ft from a new railway track to be constructed.

The ground vibration produced by slow goods trains and road traffic is negligible.

1. INTRODUCTION

This report describes a vibration investigation carried out by the Bureau of Mineral Resources at the request of the Victorian Railways.

The Railways are constructing a new standard gauge (4'-8½") track from Melbourne to Wodonga to complete the standardisation of the track between Melbourne and Sydney.

At Wangaratta, approximately 140 miles from Melbourne, the new track will be laid 50 ft from a concrete water tower which supplies the city of Wangaratta.

The purpose of the investigation was to measure the ground vibration produced by passing trains on the existing track, 150 ft from the tower, in order to gain some knowledge of the ground vibration to which the tower may be subjected when the trains will be running on the standard gauge track.

The survey was conducted by A. Radeski, geophysical assistant, from 16th to 18th January 1961.

2. INSTRUMENTS AND METHODS

The instrument used to record the ground vibrations was a Sprengnether Portable Blast and Vibration Seismograph, Serial No. 1577.

This instrument records three mutually perpendicular components of the ground vibration on a moving strip of photographic paper. A record shows the ground motion magnified 100 times with timing lines at intervals of 0.02 seconds.

The ground vibrations produced by the passage of express passenger trains and goods trains were recorded. In another test the vibrations due to a heavy motor truck were recorded. The individual tests are listed below:-

Record No.	Position	Date 1961	Time	Distance from track ft	Remarks
1	1	16/1	1610	80	Goods train, speed about 15 m.p.h., 33 vehicles, 717 tons.
2	2	16/1	1100	50	Express passenger train.
3	4	16/1	1340	159	Goods train, speed about 25 m.p.h., 40 vehicles, 992 tons.
4	4	17/1	1000	-	Motor truck, about 8 tons, driving within 10 ft of the tower, speed 15-20 m.p.h.
5	1	18/1	1100	80	Express passenger train.
6	3	17/1	1100	34	Express passenger train.

3. RESULTS

Plates 2 and 3 show the records obtained during the tests. In each test the record was run for several seconds, but only that part of a seismogram where the displacement of each of the components is greatest, has been reproduced. The amplitudes and frequencies of the three components of ground displacement were scaled from the seismograms; the scalings were taken at the same instant on each component, and the instant selected is that at which the resultant acceleration is a maximum.

Table 1 shows the magnitude of the three components of ground displacement (taken as half the peak-to-trough amplitude) corresponding to the various positions of the seismograph. The accelerations shown in Table 1 were calculated, on the assumption that the vibrations are sinusoidal, from the equation

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

Where a = maximum acceleration

f = frequency

A = ground displacement.

The resultant acceleration is the vector sum of the accelerations for the three components. The final column shows this resultant acceleration in terms of g, the acceleration due to gravity (=386 in./sec^2).

The ground vibrations shown on Records 1 (goods train) and 4 (motor truck) were too small to permit any calculations.

For Records 2 and 6, in addition to standard calculations, described above, the maximum acceleration was computed using the maximum displacements of each of the three components, irrespective of the instant of time at which they occurred.

Various limiting standards for damaging and non-damaging effects of vibration have been proposed by different authorities (see Appendix). The U.S. Bureau of Mines (Thoenen and Windes, 1942), using acceleration as an index of likelihood of damage, regards vibrations whose accelerations are less than 0.1g as non-damaging. The largest ground acceleration computed from any of the present recordings is only 0.0461g caused by an express train 34 ft from the seismograph. At 50 ft from the seismograph an express train produced a ground acceleration of only 0.0205g.

When the standard gauge track is in use the conditions will be different from those under which the tests were made, because the trains will probably travel at higher speed, and may perhaps be heavier. Also, the track will be in a 12-ft cutting instead of at ground level. None of these factors is expected to cause the ground accelerations at 50 ft to reach 0.1g.

4. CONCLUSIONS

The ground vibration at a distance of 50 ft from the proposed standard gauge railway line is not expected to produce damaging ground accelerations.

The vibrations produced by road traffic passing near the water tower are negligible.

5. REFERENCE

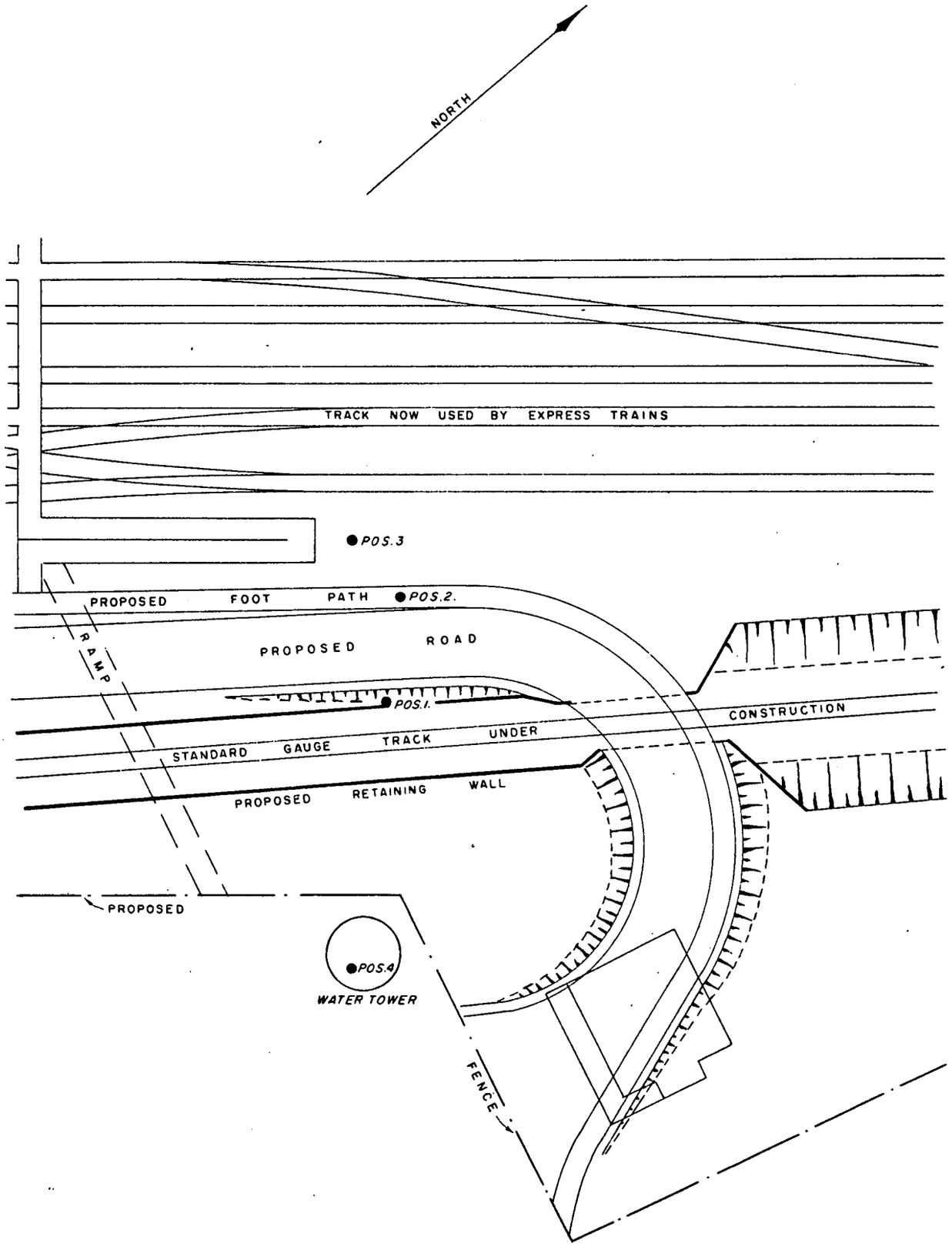
WIDNER, J.H. and WINDES, S.L., 1942 Seismic effects of quarry blasting. Bull. U.S. Bur. Min. 442.

TABLE 1

Record No.	Component	Displacement (in.)	Freq. (c/s)	Acceln. (in./sec^2)	Resultant Acceln.	Resul. Acceln. in terms of g
1		Too small to measure			-	-
2	L	0.00020	26	5.35	6.62	0.017
	V	0.00005	25	1.24		
	T	0.00015	25	3.71		
	L	0.00020	26	5.35	7.80	0.0205
	V	0.00010	33	4.30		
	T	0.00015	25	3.71		
3	L	-	-	-	0.18	0.0005
	V	0.00010	6.5	0.17		
	T	0.00005	6.5	0.08		
4		Too small to measure				
5	L	0.00013	19	1.85	3.62	0.0094
	V	0.00005	31	1.90		
	T	0.00010	25	2.47		
6	L	0.00030	28	9.30	11.76	0.0305
	V	0.00015	25	3.71		
	T	0.00025	25	6.18		
	L	0.00030	28	9.30	17.80	0.0461
	V	0.00010	25	2.47		
	V *	0.00005	76	11.40*		
	T	0.00025	25	6.18		

* Two simultaneous vertical vibrations of different frequencies are present on this record. The resultant acceleration is calculated from the sun of their accelerations (viz. 13.87 in./sec^2) compounded with the other two components.

PLATE I.



VIBRATION TESTS

WANGARATTA RAILWAY STATION

SEISMOGRAPH LOCATIONS.

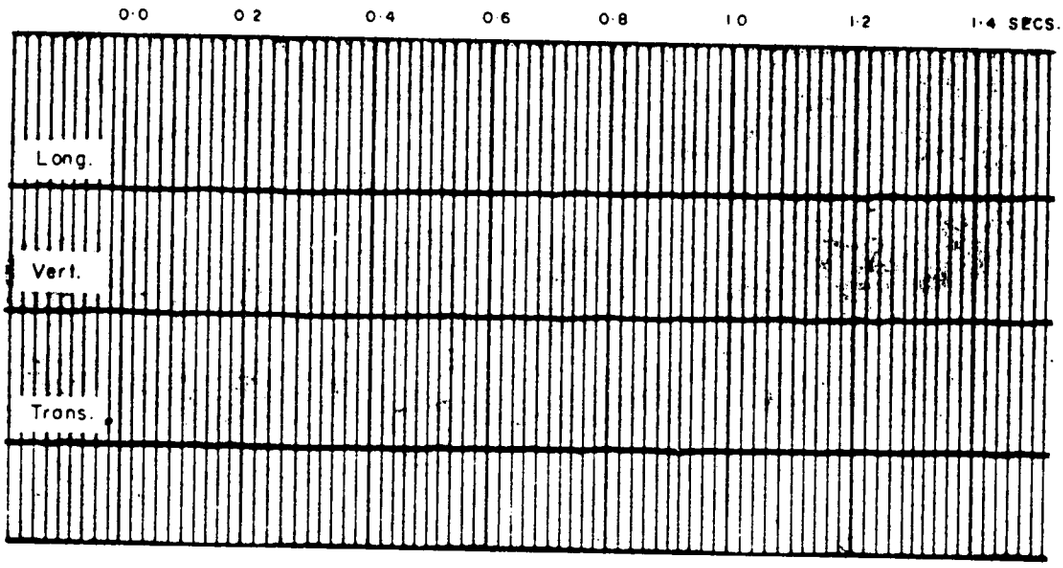
SCALE OF FEET

40 0 40 80 120

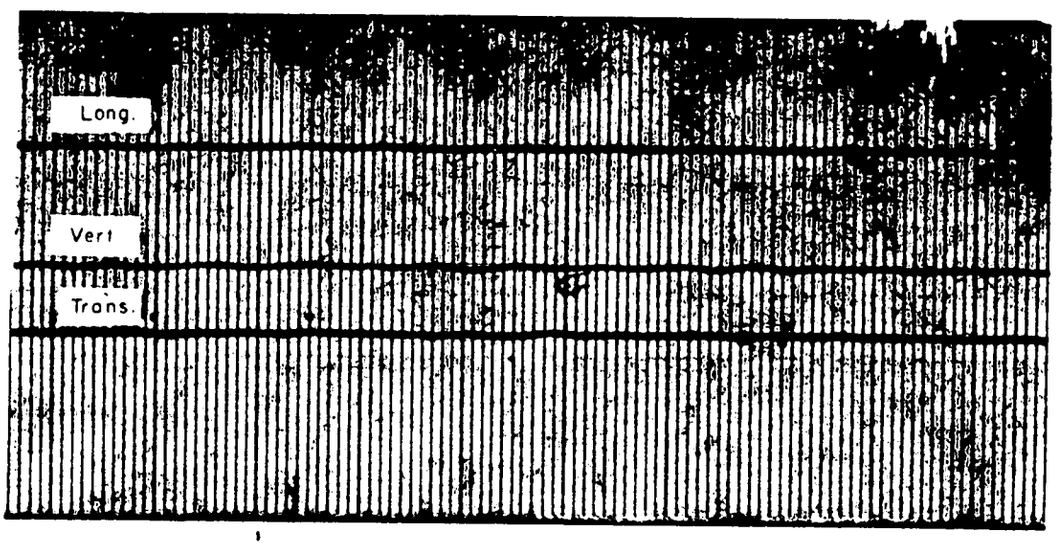
AFTER V.R. PLAN NO. 255/60

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. G.344-70

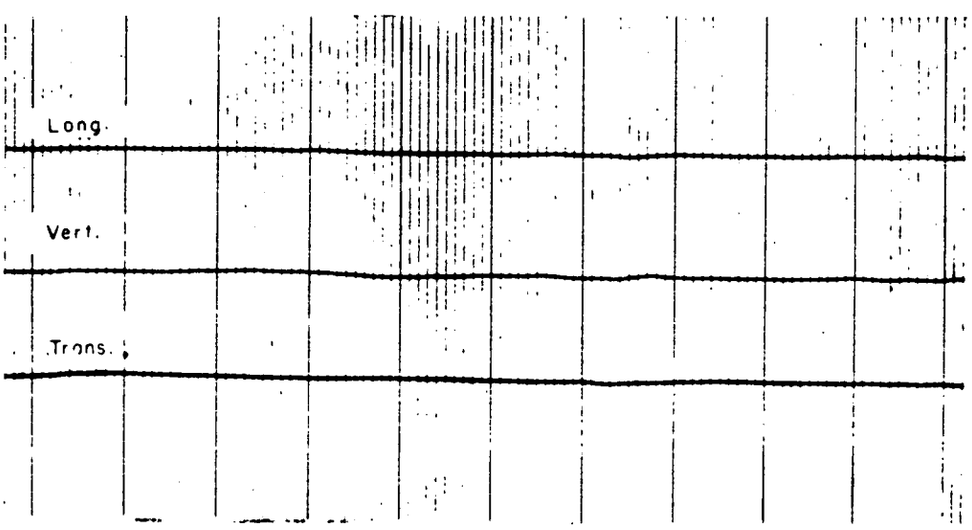
TO ACCOMPANY RECORDS 1961, No. 13



Record No. 1. Goods Train, 80 feet distance

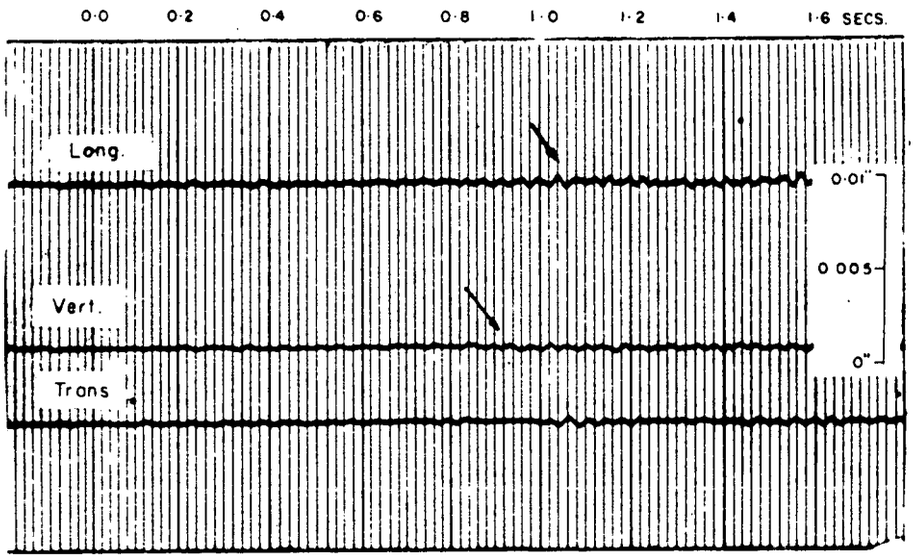


Record No. 3. Goods Train, 159 feet distance.

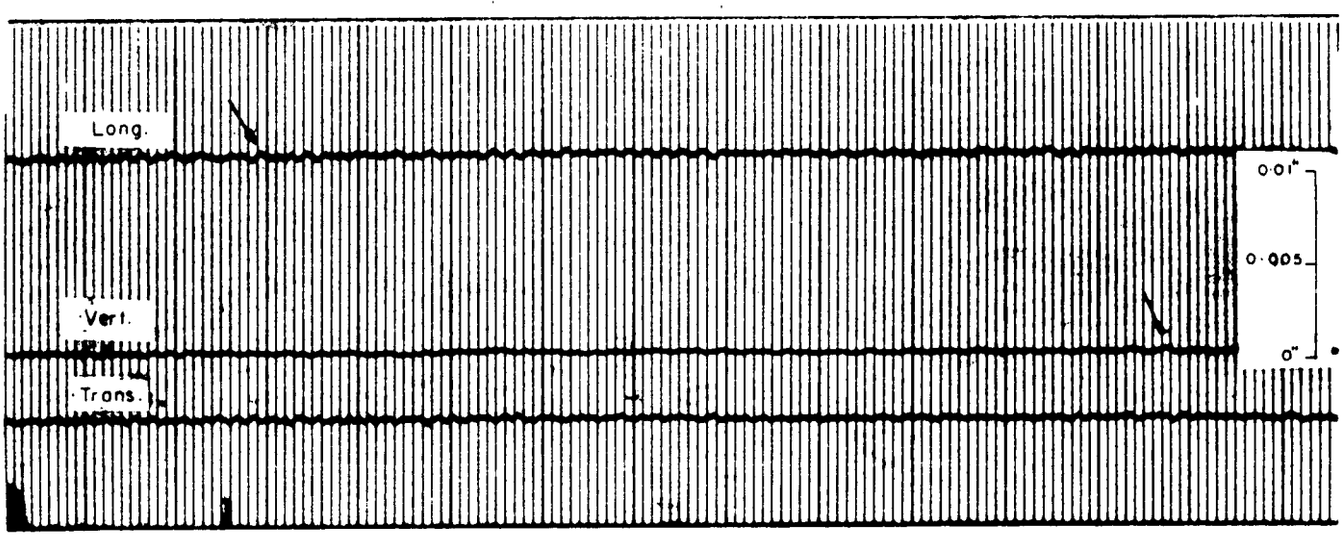


Record No 4. Truck passing approx 10 feet from the tower.
Instrument inside tower.

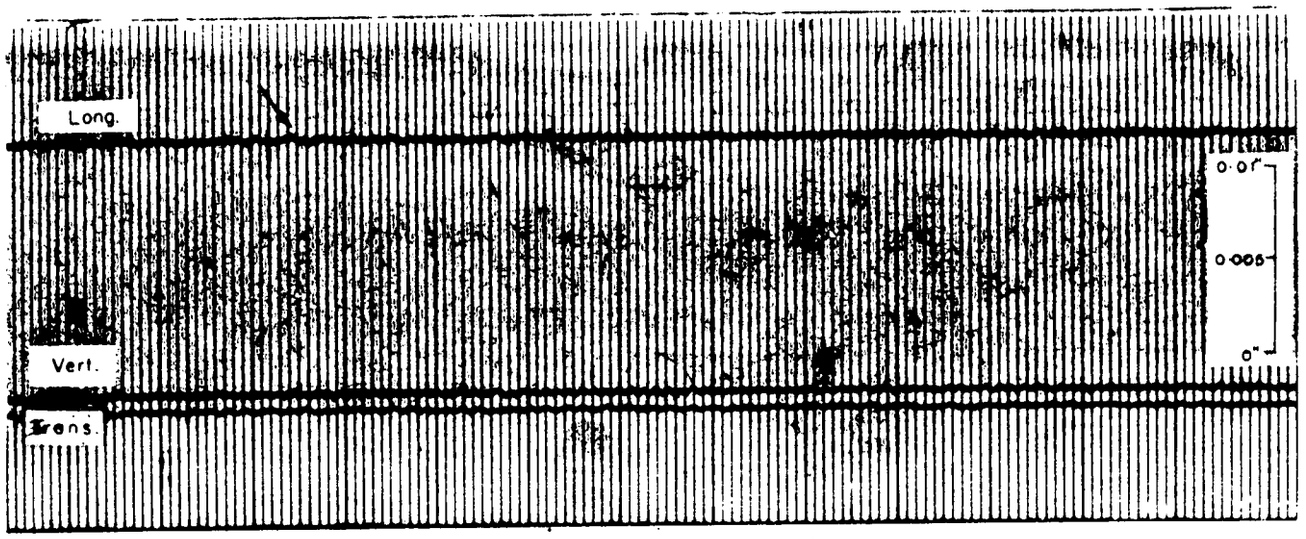
WANGARATTA



Record No. 6. Express passenger train, distance 34 feet.



Record No. 2. Express passenger train, distance 50 feet.



Record No. 5. Express passenger train, distance 80 feet.

WANGARATTA

LEGEND

1 — State of New Jersey as specified by regulation

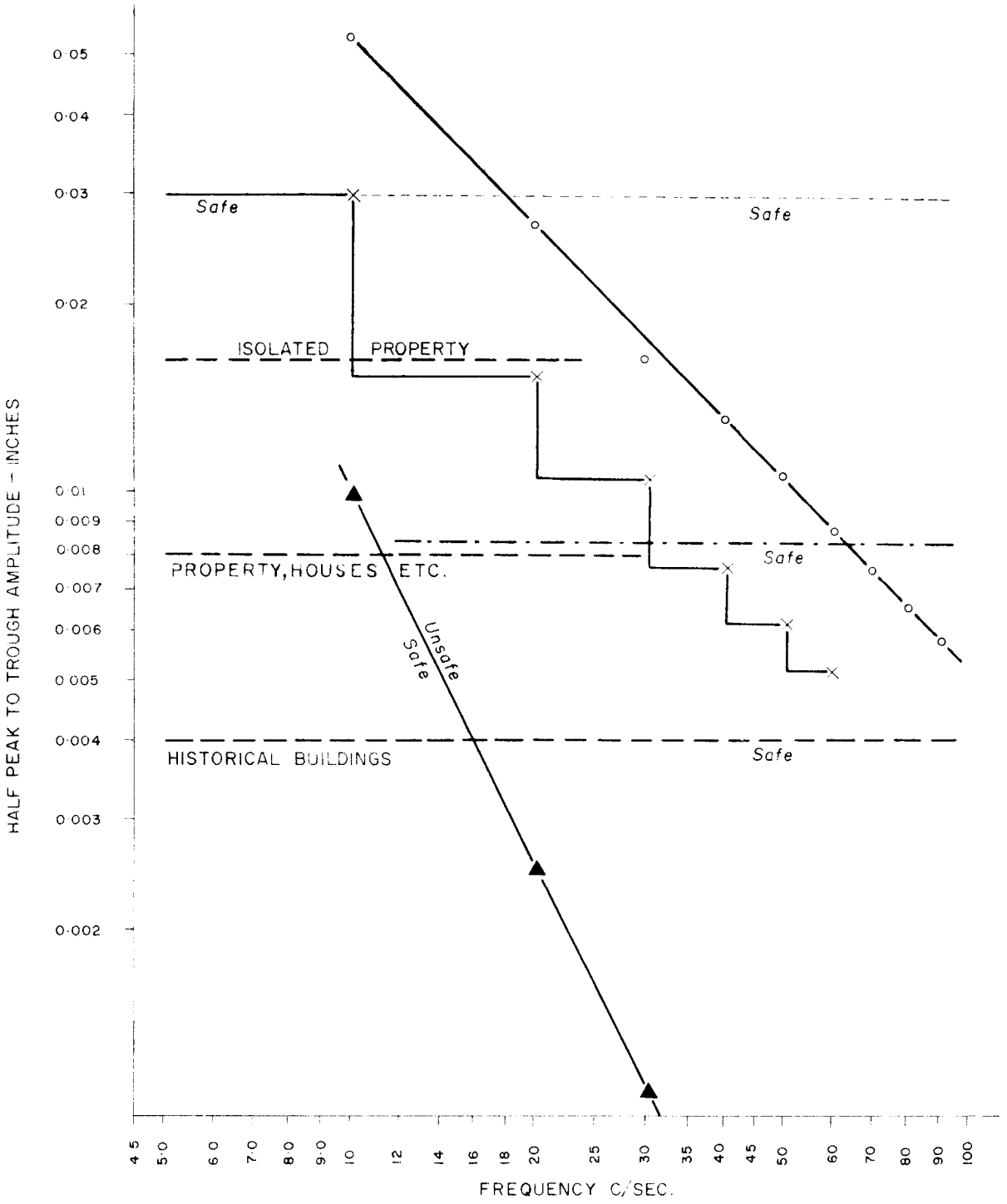
2 — State of Pennsylvania as specified by regulation for any structure

3 — As recommended by Teichman

4 — As recommended by Crandell to a United States Insurance Co.

5 — As recommended by Morris

6 — As recommended by U.S. Bureau of Mines



MAXIMUM SAFE HALF PEAK TO TROUGH AMPLITUDE OF VIBRATION PLOTTED AGAINST FREQUENCY AS SPECIFIED AND RECOMMENDED BY VARIOUS U.S. GOVERMENT AUTHORITIES AND BY INDIVIDUALS