

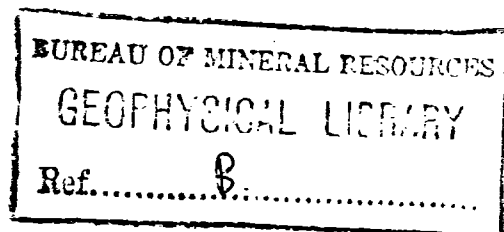
1960/79<sub>6</sub>

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES,  
GEOLOGY AND GEOPHYSICS.

RECORDS



RECORDS 1960 No. 79



"DIAMOND CUT LINGERIE"

VIBRATION TEST, MELBOURNE 1960.

by

F. Jewell.

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 It may not be published in any form or used in a company prospectus or statement without the permission in writing of the Director, Bureau of Mineral Resources, Geology and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.

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## ABSTRACT

This report describes measurements of the vibration caused by eleven warp knitting machines on the ground floor of the factory of Diamond Cut Lingerie Pty. Ltd. in Collingwood, a suburb of Melbourne.

It was found that the ground vibrations in the Knitting Shop were large enough to be slightly damaging to the building, according to the classification proposed by the U.S. Bureau of Mines.

Vibration measured in Emerald Street immediately behind the building were weaker, but they still were close to a level likely to cause annoyance to human beings.

### 1. INTRODUCTION

In response to a request from the Diamond Cut Lingerie Pty. Ltd., the Bureau of Mineral Resources, Geology and Geophysics, undertook vibration tests at the company's factory in Wellington Street, Collingwood.

Eleven knitting machines are installed there on the ground floor of the building; the floor is of concrete and the walls are of brick. The company was concerned that ground vibration from the machines might cause

structural damage to the building.

On 8th July 1960 the author made recordings of the vibration at various locations in the Knitting Shop and on the pavement behind the building in Emerald Street. The locations are shown on plate 1 and some of the recordings are reproduced in plate 2.

The vibrations were recorded by means of a Sprengnether Portable Blast and Vibration Seismograph. This instrument records on a photographic strip the vibration in three mutually perpendicular directions. The records show the ground displacement magnified 100 times, with timing lines at intervals of 0.02 seconds.

## 2. RESULTS

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 resultant displacement is computed by taking the square root of the sum of the squares of the three components.

Several frequencies are present. The one of largest amplitude ~~has~~ has a frequency of 25 c/s and appears mainly on the vertical component. It "beats" at a frequency of 3.7 c/s; i.e. the maxima occur at intervals of 0.27 seconds. At position J, near machine No. 1, a vibration of lower frequency (12.5 c/s) "beats" at a frequency of 3.3 c/s.

Superimposed on these low-frequency vibrations are some of higher frequency. The most important of these is approximately 100 c/s; its amplitude varies irregularly with the location of the seismograph.

The ground accelerations shown in Table 1 were calculated, on the assumption that the vibrations are roughly sinusoidal, from the equation

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

where             $a$  = maximum acceleration  
                    $f$  = frequency  
                    $A$  = ground displacement.

They are given in terms of  $g$ , the acceleration due to gravity ( $= 386 \text{ in/sec}^2$ ).

Various authorities have cited differing criteria for assessing the damaging effect of ground vibration on built-up structures. Thoenen and

Windes (1942) of the U.S. Bureau of Mines concluded that the magnitude of the ground acceleration is the most useful index of damage; they proposed the following classification, applicable to buildings : -

Acceleration greater than 1.0g	: Damaging
Acceleration between 0.1g and 1.0g	: Slightly damaging (caution zone)
Acceleration less than 0.1g	: No damage (safe zone).

Most of the computed values of ground acceleration for locations within the Knitting Shop lie within the "Caution" Zone. That they are so high is entirely due to the presence of the high-frequency vibration; the 25 c/s (and 12.5 c/s) vibrations, although of large amplitude, do not give rise to damaging accelerations.

Although machine No. 1 may be the main source of the high-frequency vibration, it is not the only one, because when it is turned off, a small residual is still recorded at position J.

A very small 100 c/s vibration is transmitted outside the building into Emerald Street. At such small amplitudes the measurements are not very accurate, but they are good enough to show that the resultant ground acceleration lies within the range 0.01 g to 0.1 g. Although they are not damaging structures, ground accelerations of this magnitude are detectable by human beings.

Reiher and Meister (Steffens, 1952), after investigating the annoyance caused to human beings by vibration, reached the opinion that for mild vibrations the best criterion appeared to be the magnitude of ground velocity ( $2\pi Af$ ). The velocity had to rise to a value somewhere in the range 0.1 to 0.3 in./sec. before it caused annoyance to the people they investigated.

The ground velocities recorded at locations F and G were 0.07 and 0.02 in./sec respectively and are therefore lower than those considered to be annoying by Reiher and Meister.

Mallock (Steffens, 1952), after working on the same problem, put forward the criterion that ground accelerations greater than 0.05g would cause annoyance. According to Mallock, therefore, the vibration at position F might be severe enough to cause annoyance to human beings. It is clear, from the recording at position G, that the vibrations die away rapidly with

distance from the building. Clearly also the level of vibration within the ~~Knitting~~ Shop is such as would be considered annoying.

### 3. CONCLUSIONS

The vibrations recorded in the Knitting Shop, particularly near Machine No. 1, are of a magnitude reckoned to be "slightly damaging" by the U.S. Bureau of Mines. Elimination of the high-frequency (100 c/s) vibration would reduce them to the safe level.

The low acceleration level of vibration recorded at position C, between machines which have been shock-mounted, suggests that further attention to the mounting of the remaining machines, particularly No. 1, would be beneficial.

The magnitude of vibration recorded immediately outside the building, in Emerald Street, borders on a level considered to be annoying to human beings. Outside No. 21 Emerald Street however the vibrations are not large enough to cause annoyance.

### 4. REFERENCES.

- |                   |      |   |
|-------------------|------|---|
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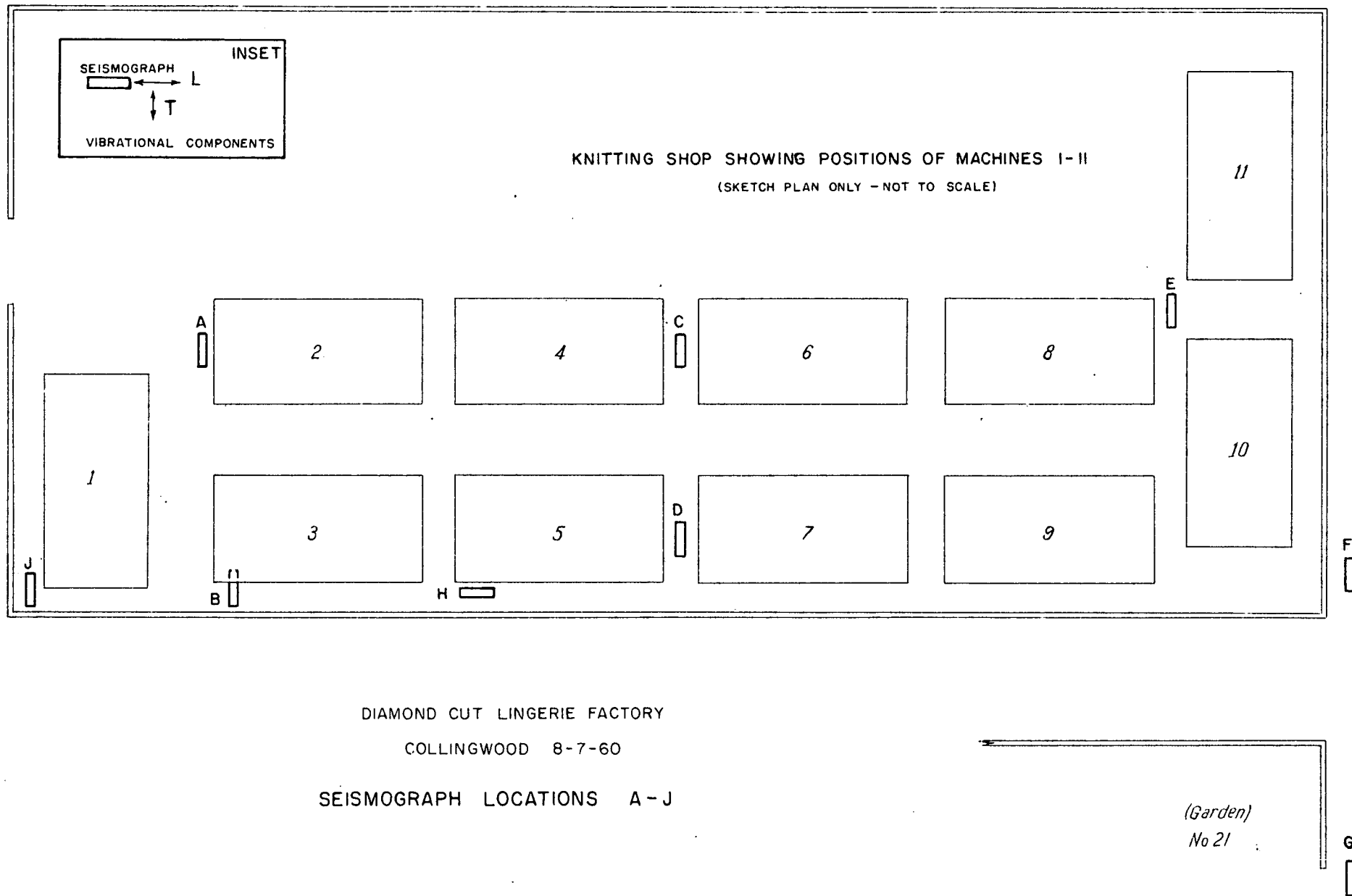
TABLE 1

Location	Displacement A (in.)			Resultant A (in.)	Frequency (c/s)			Resultant Acceleration in terms of g.
	L	V	T		L	V	T	
A	-	0.0005	-	0.00063	-	25	-	0.22g
	0.0001	0.0001	0.00015		100	100	100	
B	0.0003	0.00125	0.0003	0.00137	25	25	25	0.12g
	-	-	0.00005		-	-	100	
C	-	0.00025	0.00005	0.00031	-	25	25	0.03g
	0.00005	0.00005	-		50	50	-	
D	0.00005	0.00025	0.0001	0.00030	25	25	100	0.10g
E	0.0001	0.00025	0.0001	0.00038	50	25	100	0.11g
	-	0.0001	-		-	50	-	
F	0.00005	0.00007	0.00005	0.00010	50	50	100	0.06g
G	-	-	0.00003	0.00003	-	-	100	0.03g
H	-	0.00025	-	0.00034	-	25	-	0.14g
	0.00005	0.00007	0.0001		100	100	100	
J (No. 1 ON)	0.00015	0.0012	0.0003	0.0014	12.5	12.5	12.5	0.21g
	0.0001	0.00012	0.0001		100	100	100	
J (No. 1 OFF)	0.00005	0.0003	0.00005	0.00036	25	25	25	0.07g
	-	0.00005	-		-	100	-	

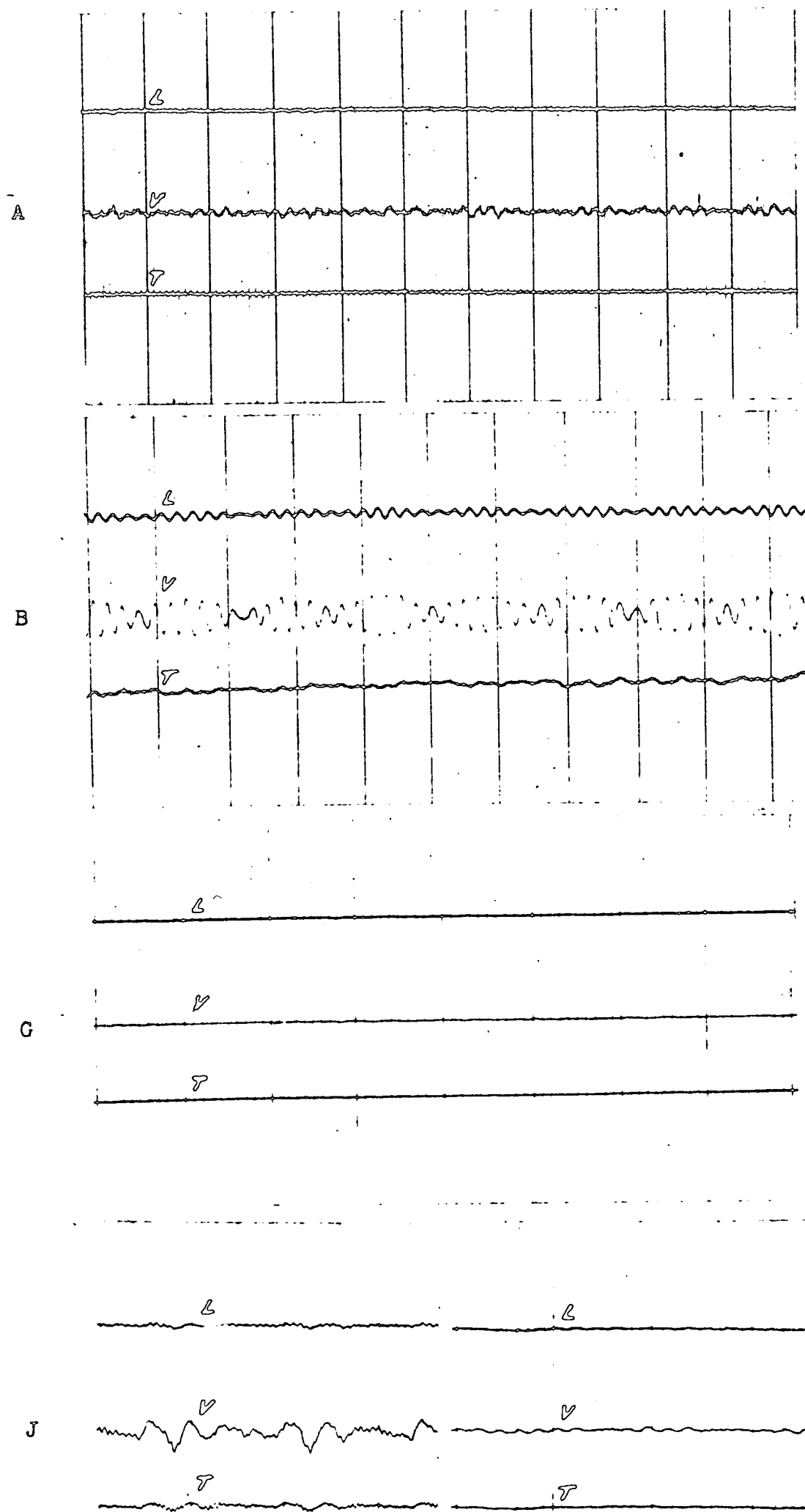
V = VERTICAL

T = TRANSVERSE

L = LONGITUDINAL







Machine No 1 ON

Machine No 1 OFF

Diamond Cut Lingerie Factory,  
Collingwood, 8th July 1960

# VIBRATION RECORDS