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### Traffic vibrations at the University of Ottawa and recommendations regarding an anti-vibration mount Crawford, R.

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TECHNICAL NOTE

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PREPARED BY R. Crawford CHECKED BY T. D. Northwood APPROVED BY NBH

DATE August 1963

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SUBJECT TRAFFIC VIBRATIONS AT THE UNIVERSITY OF  
OTTAWA AND RECOMMENDATIONS REGARDING AN  
ANTI-VIBRATION MOUNT

General

In the Physics Department at Ottawa University several low temperature experiments are affected by traffic vibrations. The object of this investigation was to compare traffic vibrations in the old Physics Research Laboratory in Temporary Hut No. 7 with those in the Chemistry Building, which is similar in construction to the proposed new Physics Department. The old Physics Laboratory, of floating slab construction, is affected by traffic on King Edward Avenue and to a lesser degree by the traffic on Somerset Street. The new Chemistry Building is of modern reinforced concrete construction on piles, and is located parallel and adjacent to Nicholas Street.

Measurements

Vibration measurements in the horizontal and vertical directions were taken on the floor and on a vibration-isolated mount in the Physics Laboratory. A comparable set of measurements of background vibrations were taken on the floor of the new Chemistry Building at the south end in the basement and in the sub-basement. Table I shows the vibration measurements in the two buildings. In the Physics Laboratory, the maximum level from traffic noise was incurred by a heavy tractor-trailer passing on King Edward Avenue (Figure 1). This level ( $5.33 \times 10^{-3}$  in./sec) is of the same order as that caused by heavy

walking on the laboratory floor, but is higher by a factor of 5 than the quiet ambient vibration level. The ambient level in the Chemistry Building is caused by continuous traffic on Nicholas Street and in both the basement and sub-basement is approximately the same as that in the Physics Laboratory with no traffic on King Edward Avenue.

#### Comments

Since the new building will be further from Nicholas Street it follows that its vibration levels will be less than in the Chemistry Building. Within the new building the quietest location would then be at the east end, remote from the street. In this location it is likely that the dominant vibrations will be locally induced. Heavy mechanical equipment such as compressors and ventilating fans should be kept away from the instrument site and should be mounted on suitable vibration-isolating devices.

#### Instrument Mounting

The instrument set-up in the Physics Laboratory was more affected by low frequencies of the order of 1 to 5 cps, than by higher frequencies. The sensitive element is a quartz fibre pendulum about 3 ft long (hence a period of about 1.9 sec). This is mounted on a massive concrete base supported on a rubber suspension intended to act as a vibration isolator. The natural periods of this block system are about 1 and 0.2 sec in the horizontal and vertical directions respectively, and appear to have a very high Q factor. The system is sensitive to impact-type blows, such as stamping of the feet on the floor, which set up prolonged vibrations at a relatively high level at its natural frequency: this is of course in the same range as the natural frequency of the pendulum.

A useful improvement would be to introduce damping into the system, perhaps by a simple dashpot arrangement (e.g. baffles in an oil bath). This damping plus the reduced vibration level anticipated in the new Physics Laboratory should take care of most of the problems. An alternative or additional approach would be to modify the block supports so that the period of the base is longer than that of the quartz fibre suspension. In designing the new installation it would be desirable to shape the base block so that the fibre suspension is not too high relative to the block suspension points, and also so that the lateral positions of the block suspension are spread further apart to reduce the possibility of rocking motion.

With the vibration levels anticipated in the new building, and with an improved instrument mount as indicated above, it is not believed that any very complex separate foundation for the instrument is warranted. A simple slab supported on surface soil is not recommended as it would be no more effective than the existing installation in respect to traffic vibrations. A pier separately supported on piles would be little better than the main building foundation for traffic vibration, although it would be an improvement with respect to locally induced vibrations. This procedure is recommended if it can be managed without undue complications in the construction of the building. A slightly less satisfactory method would be simply to locate the instrument site on a substantial concrete floor, employing approximately the same arrangement as is now used.

TABLE I

## VIBRATION OBSERVATIONS

Location	Transducer Position	Component	Peak Amplitude in./sec x 10 <sup>-3</sup>	Approx. Freq. cps	Remarks
Temporary Hut No. 7 Physics Lab.	On concrete block	H	-	-	} Ambient vibration - no heavy traffic
	On concrete block	V	0.25 - 0.70	15	
	On floor beside block	H	0.25 - 0.70	15	
	On floor beside block	V	0.50 - 1.07	15	
	On concrete block	H	0.36	5	} Walking on floor near concrete block
	On concrete block	V	0.35	5	
	On floor beside block	H	0.42	30	
	On floor beside block	V	2.20	30	} Single foot stamp on floor
	On concrete block	H	0.71	15	
	On concrete block	V	2.84	5	
	On floor beside block	H	9.23	-	} on floor
	On floor beside block	V	12.10	30	
	On concrete block	H	1.49	17	} Passing tractor trailer on King Edward Avenue
	On concrete block	V	0.78	17	
	On floor beside block	H	2.84	12	
On floor beside block	V	5.33	17		
Chemistry Building on Nicholas Street	Basement south end	H	2.13	-	} Ambient vibration - constant stream of traffic on Nicholas Street
	Basement south end	V	1.13	10	
	Sub-basement south end	H	1.15	7	
	Sub-basement south end	V	1.85	10	} Walking near transducer
	Basement south end	H	1.78	-	
	Basement south end	V	5.33	10	

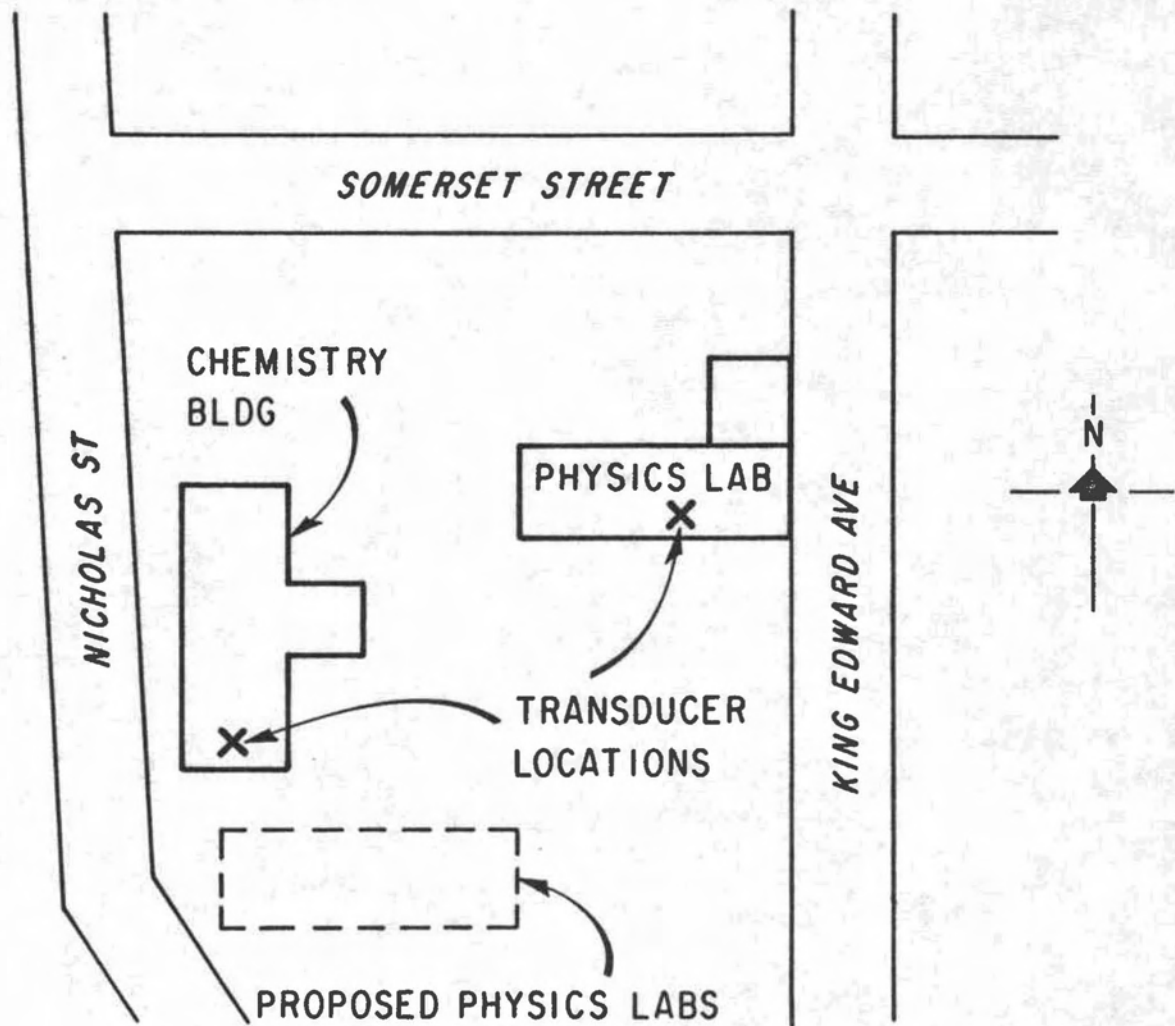


FIGURE 1  
 SCHEMATIC LAYOUT OF UNIVERSITY OF OTTAWA PHYSICS  
 AND CHEMISTRY BUILDINGS