Rickley

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VIBRATION LEVEL DATA
BRIGHTON-NEW YORK CITY TRANSIT AUTHORITY

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16. Abstract

A vibration measurement program was conducted on August 14-15, 1980 in the Midwood section of Brooklyn, NY next to the tracks of the Brighton Line of the New York City Transit Authority. A two-story home of a private citizen was instrumented to obtain a measure of the ground-borne and structural vibration levels resulting from the passby of rapid transit trains on the nearby tracks. The purpose of this test was to expand the data base being developed by the Transportation Systems Center for the prediction of ground-borne noise and vibration from near Transit Systems.

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PREFACE

Appreciation is expressed to personnel and officials of the New York City Transit Authority (NYCTA) for their help in finding a suitable location for this study and for information supplied. A special thanks to Gene and Bunny Schneider of 1546 E 16th Street, Brooklyn, NY for providing their home as a test site.

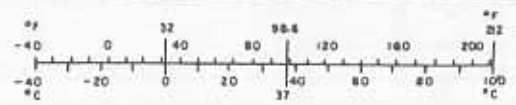
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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SUMMARY

Vibration data were obtained in and outside a two-story private home during the passby of rapid transit cars on the Brighton Line of the New York City Transit Authority (NYCTA). The home, situated within 30 feet of the near tracks, was instrumented with six vibration transducers in several rooms and on the outside patio. An analysis of the data showed the ground-borne vibration spectra peaked in the 40 Hz 1/3 octave band. This frequency is directly related to the natural resonance of the cars' suspension system. The spectral data measured in the home (vertical axis midfloor) exhibited an additional peak near 20 Hz. This is a function of the natural resonance of the floor.

No attempt has been made to assess the vibration level measured vs. annoyance or damage criteria since it is beyond the scope of this limited project. The purpose of this project was to obtain data to expand the data base being developed by the Transportation Systems Center for the prediction of ground-borne noise and vibration near transit systems.

1. INTRODUCTION

This report documents the results of a vibration measurement program conducted on August 14-15, 1980 in the Midwood section of Brooklyn, NY next to the tracks of the Brighton Line of the New York City Transit Authority (NYCTA). The test was conducted by the U.S. Department of Transportation - Transportation Systems Center (DOT/TSC) for the U.S. DOT-Urban Mass Transportation Administration.

A two-story home of a private citizen at 1546 E 16th Street, Brooklyn NY, was instrumented to obtain a measure of the ground and structural vibration levels resulting from the passby of rapid transit trains. The house was built on the old roadbed of the Long Island Railroad in 1943 and stands approximately 30 feet from the near track of the four-track right-of-way of the Brighton Line. R-27, R-30, R-38, R-40, R-42, and R-44 transit cars made up into 8- and 10-car trains travel on these tracks enroute between the Bronx and Brooklyn.

Vibration transducers were deployed in three separate rooms in the home on both the first and second floors. Vibration levels in the vertical and transverse axes, resulting from the passby of the transit trains, were measured and recorded on magnetic tape. In addition, ground vibration levels in three axes were recorded within 3 feet of the foundation of the home on the concrete backyard patio.

Spotters identified passing trains by car type, number of cars in the train, speed, passenger load, and track number for correlating with the measured vibration data. All data tapes were returned to TSC for reduction and analysis.

2. EXPERIMENTAL APPROACH

2.1 BASIC APPROACH

The movement of transit cars on tracks over railbeds is accompanied by the generation of ground-borne vibration. This vibration, transmitted to a structure, depends upon the elastic properties of the medium relative to the structure. To obtain a measure of the ground-borne vibration and the structural vibration levels, vibration transducers (accelerometers) were deployed in three rooms of a two-story residential home at 1546 E. 16th Street, Brooklyn, NY and on the attached backyard concrete patio, 3 feet from the foundation of the home (see floor plan Figure 1). Six individual accelerometers were simultaneously deployed during the two-day period (August 14-15, 1980 as follows:

		Axis
August 14, 1980 1500-1800 Hours	Midfloor, 2nd floor dining room	Vertical
	Load-bearing wall, 2nd floor dining room	Vertical Transverse
	Midfloor, 2nd floor living room	Vertical
	Load-bearing wall, 2nd floor living room	Vertical Transverse
August 15, 1980 0730-0930 Hours	Midfloor, 1st floor den	Vertical
	Load-bearing wall, 1st floor den	Vertical Transverse
	Backyard patio	Vertical Longitudinal Transverse

Measurements were scheduled during the evening rush hour on August 14 (1500-1800 hours) and the morning rush hour of August 15 (0730-0930 hours). All trains that passed during these time periods were measured, and vibration data from the six sensors were recorded on magnetic tape to be processed back at the TSC laboratory.

Spotters identified trains that passed the measurement location by time of day, car type, number of cars, approximate speed, passenger load, and track number for correlating with the recorded noise data. A total of 125 trains passed the measurement site during the periods of observation. Appendix A contains the on-site observer's log data.

2.2 MEASUREMENT SITE

Through the courtesy of a private citizen, a brick two-story "attached" home at 1546 E 16th Street, Brooklyn, NY was made available for instrumenting for the purpose of monitoring vibration levels resulting from the passby of transit trains on the nearby four tracks (2 local, 2 express) of the Brighton line of the NYCTA (see photographs Figure 2).

The home, set back 30 feet from the near transit track, was built without a cellar on the old roadbed of the Long Island Railroad (see Figure 3). The level of the first floor was 12 feet below the level of the rails of the four track right-of-way of the Brighton Line.

Accelerometers were deployed on two successive days (August 14-15, 1980) in three rooms of the two-story residence and on the outside patio. Two rooms on the second floor, the dining room and the living room, were instrumented the first day. On the second day, the first floor den and the backyard patio were instrumented.

In each of the three rooms, vibration transducers, mounted on the floor in the center of the room, monitored vibration levels in the vertical axis. In addition, two vibration transducers, mounted on the floor within six inches of a load-bearing wall, monitored vibration levels in the vertical and transverse (perpendicular to the track) axes (see photograph Figure 4).

On the outside patio, three accelerometers were mounted 3 feet from the foundation of the home on a one-inch brass cube (one on each of three faces) to monitor vertical ground motion, the transverse motion (i.e., perpendicular to the track), and

the longitudinal motion (parallel to the track). The patio location was 8 feet below the level of the near rails (see photographs, Figures 2C and 2D).

2.3 INSTRUMENTATION AND DEPLOYMENT

The vibration measuring systems consisted of Endevco Accelerometers Model 2217E with signal conditioning amplifiers and filters as shown in Figure 5. Vibration data in the frequency range 1 Hz to 2500 Hz was recorded on three tracks of a four-track FM Instrumentation Tape Recorder HP Model 3960A. A time code signal was recorded on the fourth track for exact time synchronization of the recorded data with the observers' log of events and between measuring systems. The GR type 1557A Vibration Calibrator was used to provide a dynamic 1 g acceleration reference signal at 100 Hz. This calibration signal was recorded on tape for each of the six measuring systems. Two identical three-channel systems were used.

In the middle of the first floor den and second floor living room, the accelerometers were attached as follows: a number 9, 1 1/2 inch flathead wood screw was screwed into the hardwood flooring through the wall-to-wall rug, taking care not to damage the rug nap or the backing material.

A one-half inch washer was epoxied to the head of the wood screw to provide a flat mounting surface for an accelerometer. The accelerometer was then attached to the washer/screw combination with beeswax.

In the middle of the second floor dining room, the accelerometer was mounted directly to the asphalt tile flooring with beeswax.

In all three rooms, at the load-bearing wall locations, two accelerometers were mounted on the vertical and transverse faces of one-inch brass cubes. Each cube was attached to the flooring with beeswax (In the dining room, it was attached directly to the asphalt tile; in the living room and den, the rug was peeled back

from the wall and the cube was attached to the hardwood flooring) (see photograph Figure 4).

On the outside patio, accelerometers were mounted on three faces of a one-inch brass cube, and the cube was epoxied directly to the concrete patio (see photograph Figure 2D).

2.4 DATA REDUCTION

The configuration of the data reduction system is shown in Figure 6. The acceleration data plus the calibration signal which were recorded on tape, were reproduced and fed to a GenRad 1921 Real-Time Analyzing System made up of a 1925 Multifilter and 1926 Multichannel RMS Detector. The necessary gain adjustments were made in the multifilter and graphic level recorder using the calibration reference signal.

The GenRad 1925 Multifilter contains a set of 30 parallel 1/3 octave band filter channels ranging from 3 Hz to 2500 Hz plus an unfiltered channel with flat response.

The output of the unfiltered channel was fed to the Graphic Level Recorder to produce a chart of acceleration level vs. time (acceleration time history) of all the recorded data. All 31 outputs of the multifilter were fed into the 1926 multichannel detector. The detector simultaneously computes the rms (root mean square) level for each filter channel, over a designated measurement period, and converts the level to a digital output. The digital data (frequency spectra) was then fed to the Data General NOVA2 computer for storage and further processing. For this program, the multichannel detector was programmed to provide contiguous one-second averages of the acceleration data over the period of each passby event. The period of the event was determined by inspection of the acceleration level time history. The time between the passage of the first wheel truck and the last was taken as the period of the event.

Further processing of the data was accomplished by computer to produce the average acceleration spectra over the period of each event at each measurement location. In addition, the average acceleration level (dB re 1 micro-g) was computed along with the average velocity level (dB re 1 microinch per second) and the average displacement level (dB re 1 microinch).

Similar events on the same track were further averaged together to produce statistically significant results for each car type at each measurement location.

3. MEASUREMENT DATA

3.1 SUMMARY DATA

Summary vibration data from the passby of trains on the Brighton Line of the NYCTA are presented.

Table 1 contains the average acceleration levels measured at the eight locations inside and outside a residential home. Data from trains of the same car type or combination of car types were averaged together to provide a single statistically significant level for that car type as measured at the various locations. The level tabulated represents the average vibration measured in a period of time represented by the passage of the first wheel truck to the last wheel truck (axle to axle) of the multiple car train. Because an average value is measured, it is possible to combine the data from 8- and 10-car trains.

In a similar manner, Tables 2 and 3 contain calculated average velocity and displacement levels.

Note that because of instrumentation problems, some date on August 15, 1980 was not retrieved.

An inspection of the acceleration levels of Table 1 shows, in general, that the levels measured at the various locations in the house are less than the ground vibrations measured on the outside patio. The exceptions are the vertical acceleration levels measured midfloor in the first floor den. As discussed in the spectral data of Section 3.3, a floor resonance at approximately 40 Hz has the effect of amplifying the ground vibrations transmitted to the home structure. The ground vibration peaked at 40 Hz.

3.2 ACCELERATION TIME HISTORIES

Graphic level time history recordings are presented of the acceleration levels measured at several locations during the passby of representative events. Figures 7 and 8 contain coincident time history recordings of the acceleration levels measured in three axes on the backyard concrete patio. Figure 7

contains graphic recordings of the acceleration levels measured on the concrete patio from the 15 mph passby on track 2 of a fully loaded 10-car train made up of R40 and R42 cars. The peaks on the time history are the result of the "point source" vibrations from the wheel trucks as they pass the measurement location. In this case, the uniformity of the peaks suggests all wheel trucks on the cars were of equal quality.

For comparison, Figure 8 contains graphic recordings of the acceleration levels measured on the concrete patio from the 15 mph passby on track 2 of a partially loaded 8-car train made up of R44 cars. Note that the wheel trucks between the first and second and fourth and fifth car contain one or more bad wheels.

Figure 9 contains graphic level time history data measured simultaneously for the same 8-car train of Figure 8 above in the first floor (ground floor) den. The A and B curves respectively are data measured in the transverse and vertical axes 6 inches from a loadbearing wall. Note the histories are not too dissimilar from the transverse and vertical data from the patio. However, Figure 9C, which contains data measured in the vertical axis in the middle of the floor in the den, shows an increase in the levels measured. One may suspect that the floor has begun to resonate (This will be confirmed upon examination of the spectral data of Section 3.3).

To complete the comparison, Figures 10 and 11 contain graphic level time history data measured on the previous day simultaneously in the second floor dining and living rooms during the passby of an 8-car train of R44 cars traveling on track 2 at approximately 10 mph. Note the vertical and transverse level data at the load-bearing wall in the dining room (closest to the track) are greater than the vertical and transverse acceleration data measured at the load-bearing wall in the living room, as would be expected. However, the vertical acceleration of the living room floor is greater than that of the dining room floor.

3.3 FREQUENCY SPECTRA

Data from similar events were averaged together to increase the statistical significance of the information measured for each

type of consist which passed the measurement site. Tabulation of the average acceleration level vs. 1/3 octave frequency band (1/3 octave frequency spectra) are presented in Tables 4-18. In addition, the average acceleration levels, velocity levels, and displacement levels were computed from the acceleration spectral data and are included in the tabulation. The standard deviation shows the spread of the data within each 1/3 octave band.

Spectral data are provided for 8-car consists of R44 cars on track 2 in Tables 4-7; for 10-car consists of R40/42 cars on track 2 in Tables 8-11; for 8-car consists of R27/30 cars on track 1 in Tables 12-15; for 8- and 10-car consists of R32 cars on track 1 in Tables 16-18.

An inspection of the acceleration spectral data in the vertical axis on the outside patio and midfloor in each of the three rooms in the home shows a peaking of the data in the 40 Hz 1/3 octave frequency band. In addition, a second peak in the spectra is noted in the 20 Hz 1/3 octave frequency band in the living room and in the 25 Hz band in the dining room.

The peak in the data in the 40 Hz band is as expected, and is a function of the resonances of the suspension system of these transit cars. The 20 Hz band peak in the second floor living room and the 25 Hz band peak in the second floor dining room suggest a sympathetic floor resonance in the vicinity of 20 and 25 Hz respectively. The floor in the first floor den appears to resonate at or near 40 Hz. This may be explained by the fact that with no cellar in the home, the floor in the den may be supported at various places under the floor thus effectively changing the dimensions of the "vibrating plate." This was not verified since this area could not be seen from the opening in the small crawl space between the floor and ground.

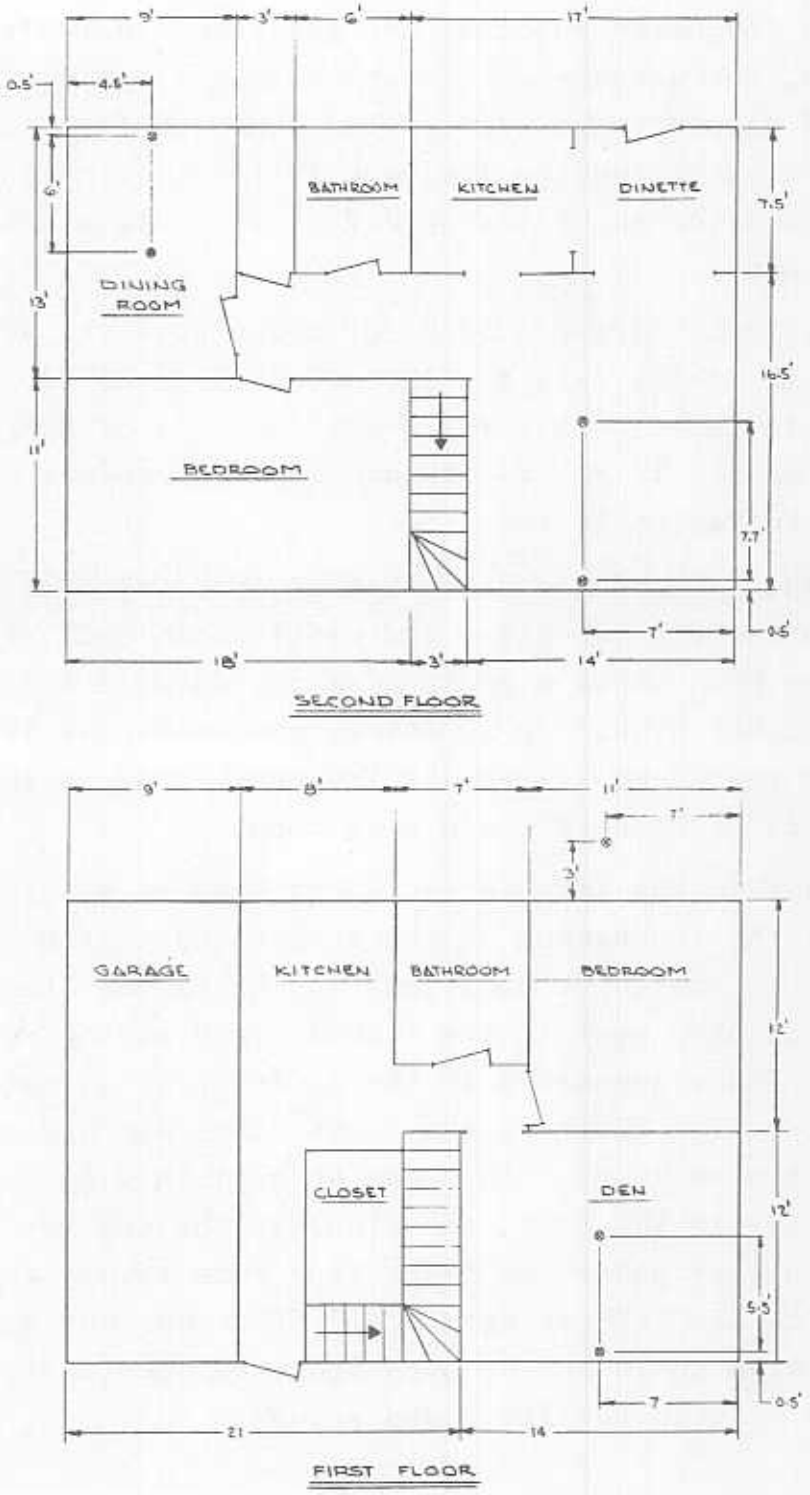

FIGURE 1. FLOOR PLAN, PRIVATE RESIDENCE, 1546 E 16TH STREET, NYCTA BRIGHTON LINE, AUGUST 14-15, 1980

FIGURE 2. PHOTOGRAPHS - NYCTA BRIGHTON LINE, AUGUST 14-15, 1980

A - "ATTACHED" RESIDENCE TEST SITE; B - 4-TRACK BRIGHTON LINE
C - LOCAL ON TRACK 1 D - BACKYARD PATIO, TRIAXIAL ACCELEROMETER MOUNT

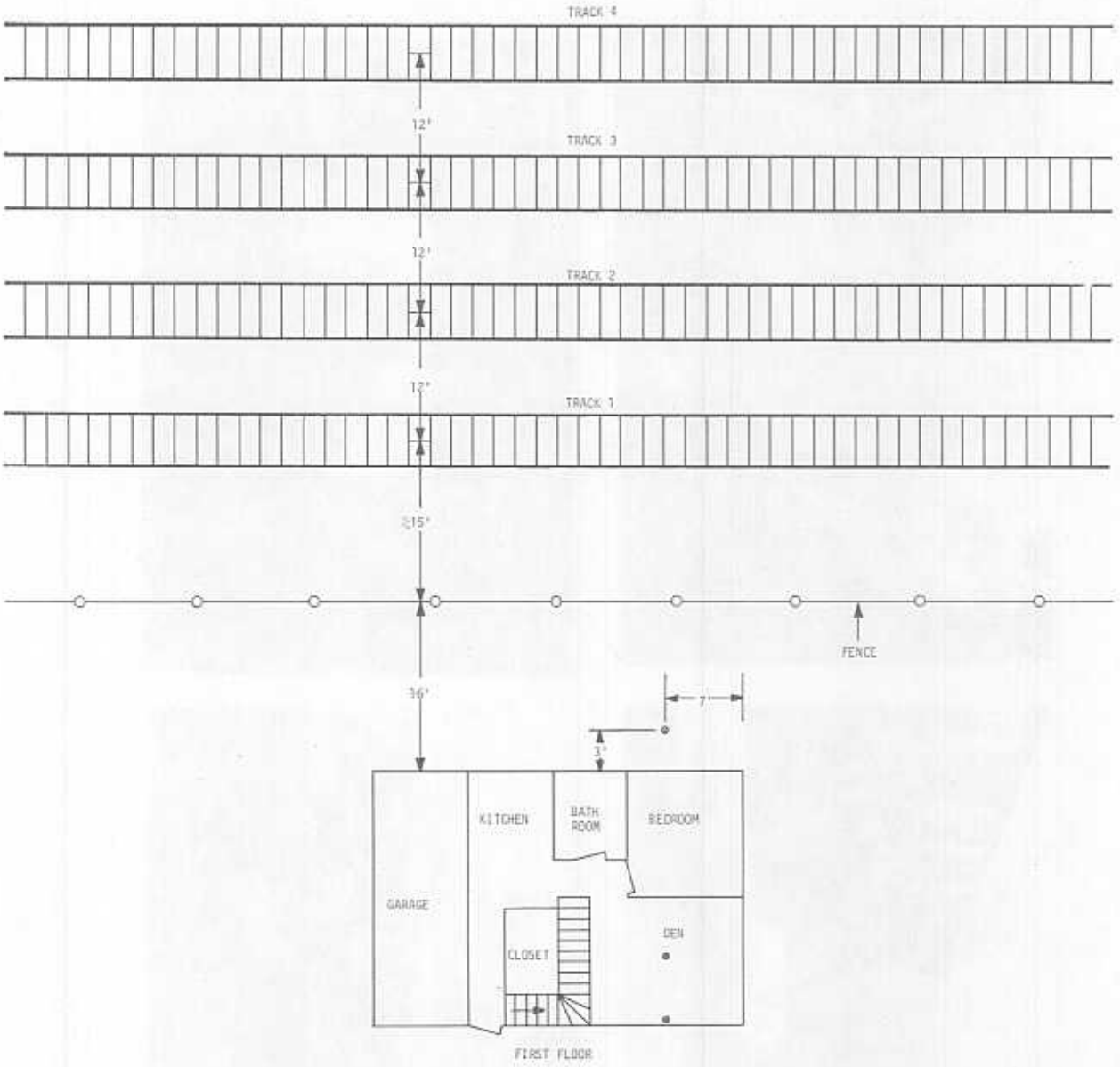

FIGURE 3. MEASUREMENT SITE PLAN VIEW, NYCTA BRIGHTON LINE

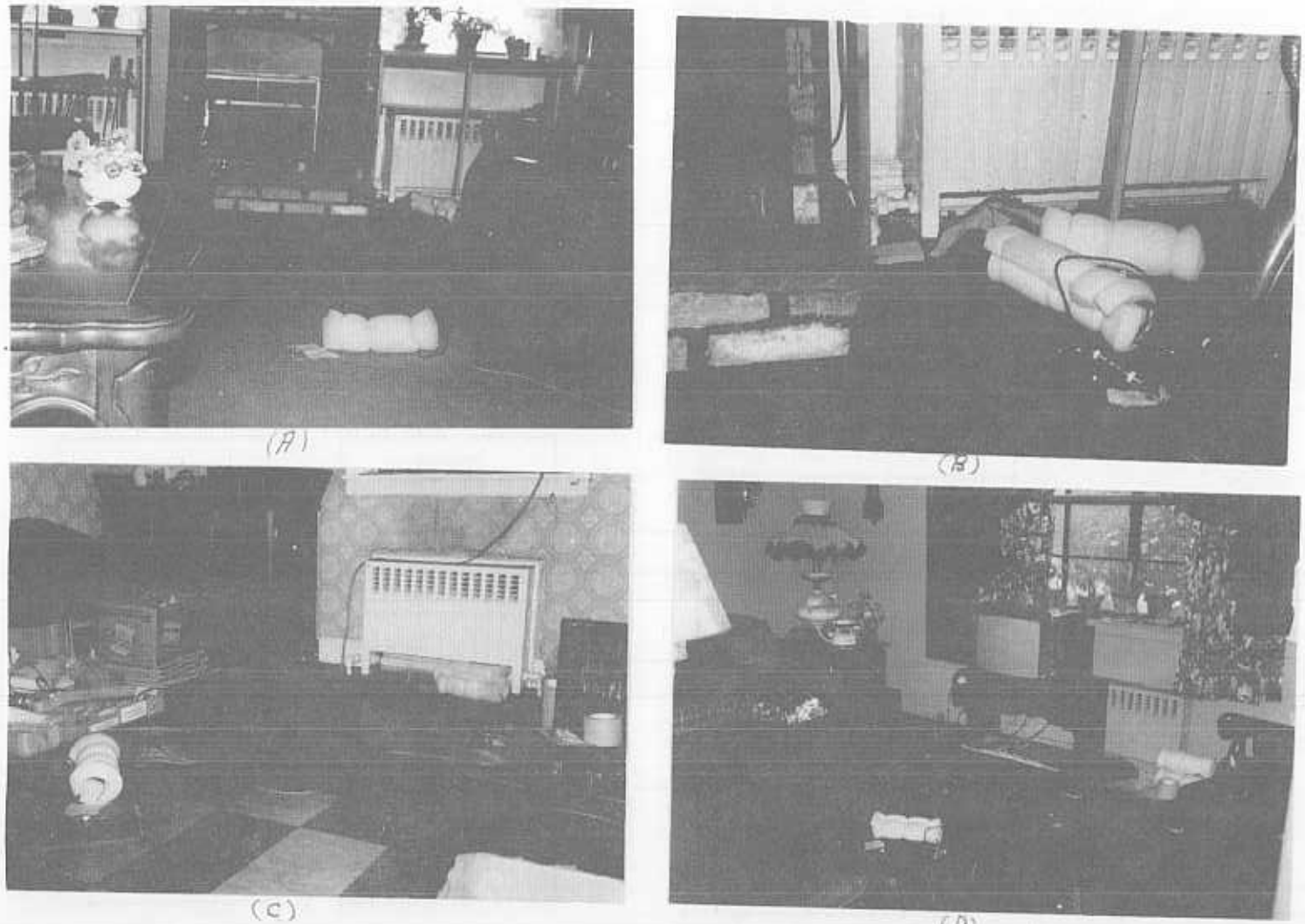

FIGURE 4. PHOTOGRAPHS - PRIVATE RESIDENCE, BROOKLYN NY, NYCTA BRIGHTON LINE

A - LIVING ROOM
B - LIVING ROOM, ACCELEROMETER AT LOAD-BEARING WALL
C - DINING ROOM
D - DEN

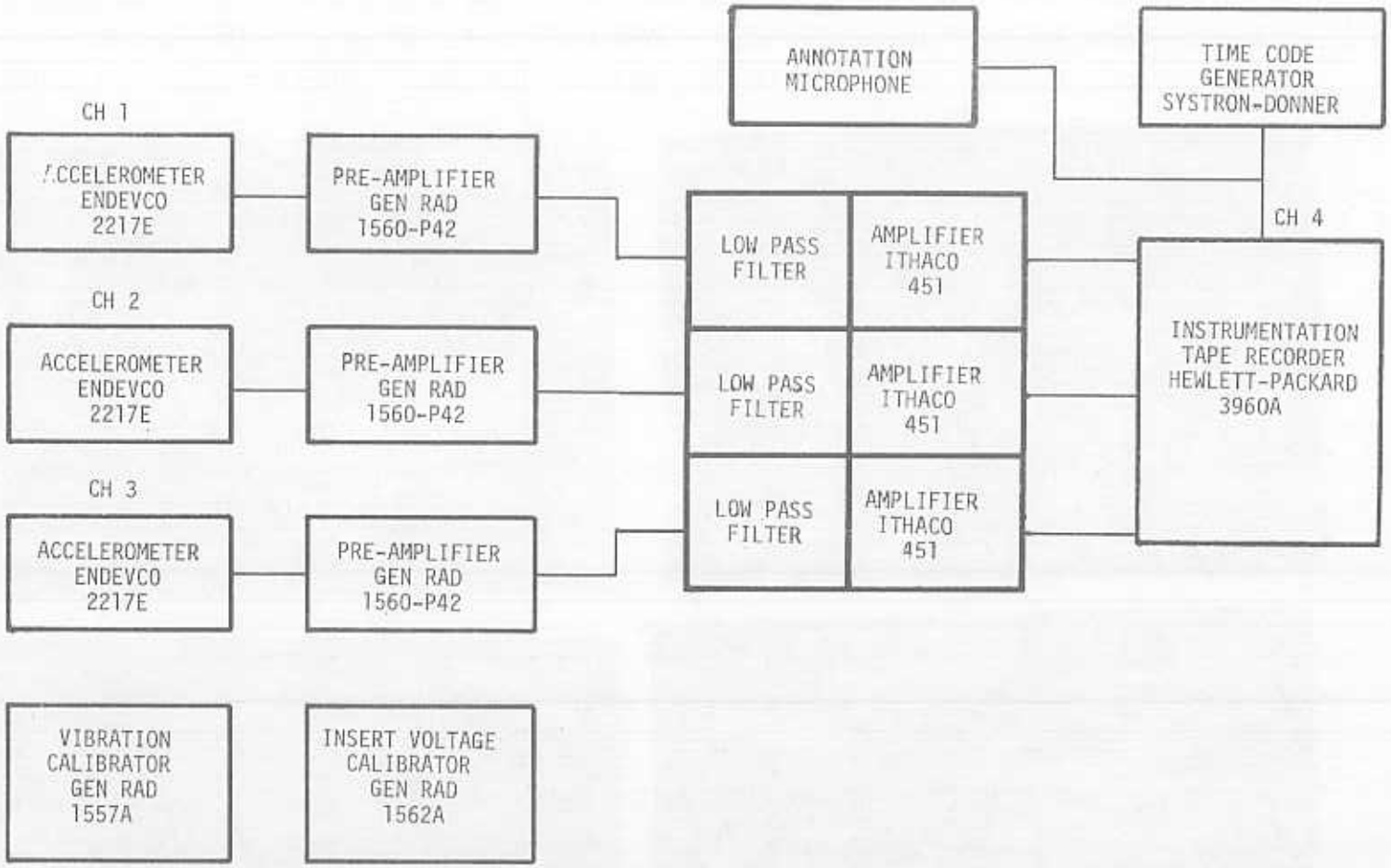

FIGURE 5. 3-CHANNEL VIBRATION MEASUREMENT SYSTEM

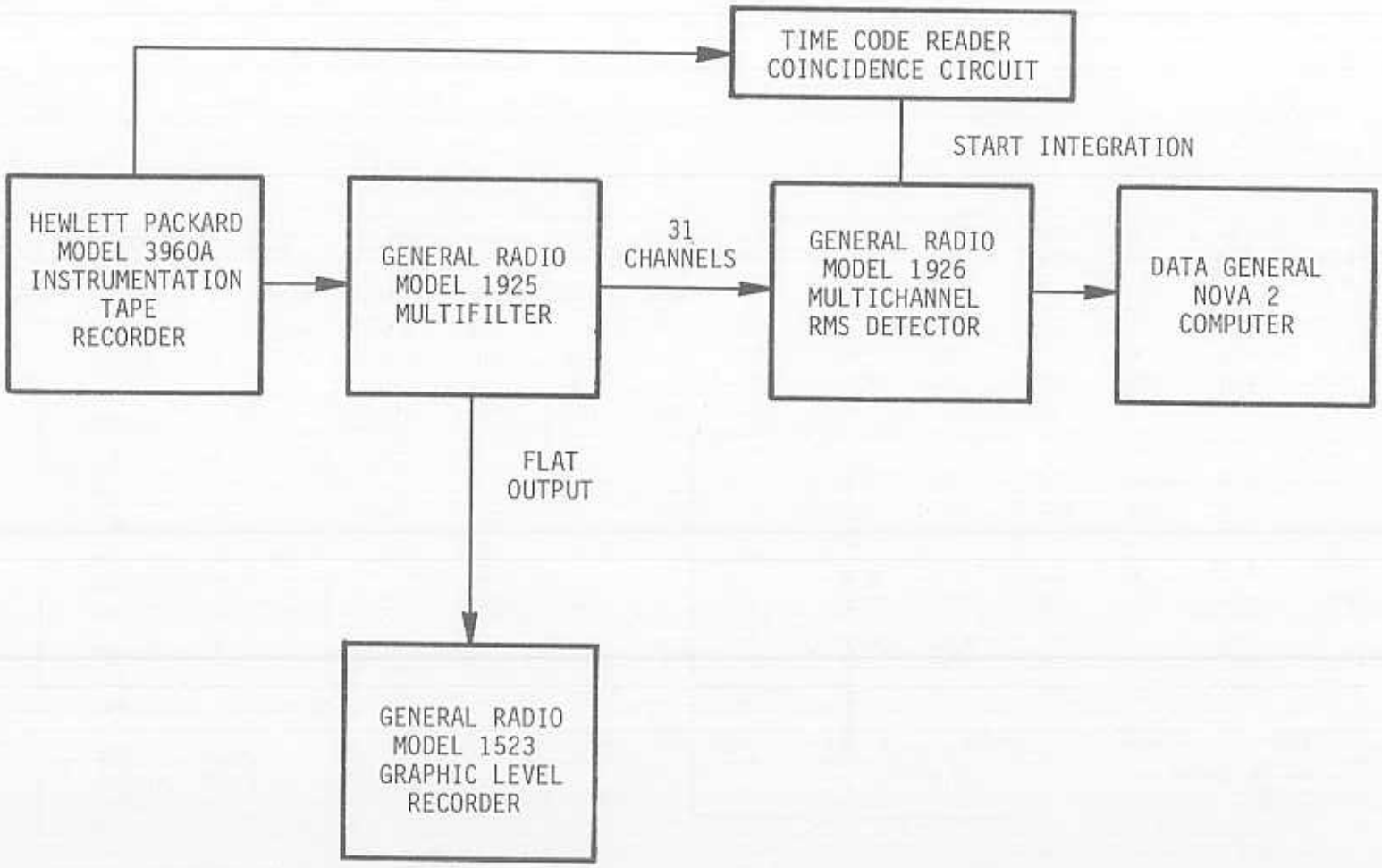

FIGURE 6. NOISE AND VIBRATION DATA REDUCTION SYSTEM

TABLE 1. SUMMARY VIBRATION DATA

Average Acceleration-dB RE 1 Micro-g (RMS)
Pass-By 8- and 10-Car Trains

AUGUST 15, 1980

AUGUST 14, 1980

CAR TYPE	TRACK NO.	OUTSIDE PATIO			1st-FLR DEN			2nd-FLR LVR. RM			2nd-FLR DNG. RM		
					MID-FLR	LOAD-WALL		MID-FLR	LOAD-WALL		MID-FLR	LOAD-WALL	
		VERT.	TRANS.	LONG.	VERT.	VERT.	TRANS.	VERT.	VERT.	TRANS.	VERT.	VERT.	TRANS.
R44	2	75.9	78.8	78.6	81.6	74.4	72.2	71.5	71.2	68.9	66.6	77.8	71.8
R44	3	72.9	75.8	74.3	-	-	-	72.8	69.8	67.8	65.9	73.7	70.5
R44	4	-	-	-	-	-	-	73.2	69.3	66.8	64.7	73.5	70.7
R42	1	-	-	-	-	-	-	76.0	75.2	73.7	72.4	84.4	75.9
R42	2	-	-	-	-	-	-	70.8	70.8	67.9	66.1	77.8	71.0
R42	4	68.6	75.7	75.7	-	-	-	-	-	-	-	-	-
R32	1	79.7	84.3	81.4	-	-	-	76.3	73.8	73.5	71.4	83.1	75.2
R32	4	-	-	-	-	-	-	71.9	69.7	68.7	64.7	75.2	71.7
R38	1	80.7	81.9	81.3	-	-	-	-	-	-	-	-	-
R40/R42	1	77.1	77.6	67.0	82.7	78.5	77.2	-	-	-	-	-	-
R40/R42	2	76.5	70.3	61.5	79.7	73.0	70.5	70.3	70.0	68.0	65.9	72.8	65.8
R40/R42	3	71.8	69.4	60.3	79.0	73.3	69.4	73.8	69.4	67.2	65.0	70.2	66.5
R40/R42	4	71.4	70.8	61.1	-	-	-	-	-	-	-	-	-
R27/R30	1	80.0	77.1	66.1	82.7	77.1	75.3	76.0	74.2	72.8	72.3	78.0	70.6
R27/R30	3	-	-	-	-	-	-	73.4	70.9	68.8	66.1	71.2	67.3
R27/R30	4	70.1	70.7	60.4	76.7	75.6	70.9	72.3	71.4	69.5	65.7	70.9	67.5

TABLE 2. SUMMARY VIBRATION DATA

Average Velocity-dB RE 1 Micro Inch-Per-Second (RMS)
Pass-By 8- and 10-Car Trains

AUGUST 15, 1980

AUGUST 14, 1980

CAR TYPE	TRACK NO.	OUTSIDE PATIO			1st-FLR DEN			2nd-FLR LVR. RM			2nd-FLR DNG. RM		
					MID-FLR	LOAD-WALL		MID-FLR	LOAD-WALL		MID-FLR	LOAD-WALL	
		VERT.	TRANS.	LONG.	VERT.	VERT.	TRANS.	VERT.	VERT.	TRANS.	VERT.	VERT.	TRANS.
R44	2	80.4	84.7	83.8	86.5	79.9	76.1	82.2	78.6	76.9	71.8	82.2	77.5
R44	3	78.9	84.2	81.8	-	-	-	84.1	78.9	80.1	74.1	79.7	79.3
R44	4	-	-	-	-	-	-	85.0	79.0	78.5	76.1	81.1	80.6
R42	1	-	-	-	-	-	-	86.4	82.1	82.5	76.6	89.2	82.2
R42	2	-	-	-	-	-	-	81.7	78.1	76.9	71.8	82.5	77.1
R42	4	76.7	84.5	84.9	-	-	-	-	-	-	-	-	-
R32	1	85.0	91.5	87.3	-	-	-	86.8	81.0	82.3	75.7	87.8	81.8
R32	4	-	-	-	-	-	-	83.3	79.3	80.2	74.6	82.0	80.2
R38	1	86.9	89.1	87.2	-	-	-	-	-	-	-	-	-
R40/R42	1	81.7	84.7	73.5	87.3	84.7	82.2	-	-	-	-	-	-
R40/R42	2	81.2	76.1	67.0	84.7	79.3	75.1	80.8	77.2	76.5	71.7	77.3	71.6
R40/R42	3	79.3	78.8	68.7	84.5	80.4	76.9	85.2	78.8	78.9	73.2	76.1	75.4
R40/R42	4	77.8	79.6	69.5	-	-	-	-	-	-	-	-	-
R27/R30	1	85.0	84.0	72.5	87.6	83.3	80.5	86.5	81.0	81.8	76.2	82.6	76.9
R27/R30	3	-	-	-	-	-	-	84.3	79.8	79.8	75.3	77.6	75.9
R27/R30	4	78.6	79.3	69.7	82.6	82.7	78.0	83.5	79.7	80.3	75.1	77.3	75.5

TABLE 3. SUMMARY VIBRATION DATA

Average Displacement-dB RE 1 Micro-Inch (RMS)
Pass-By 8- and 10-Car Trains

AUGUST 15, 1980

AUGUST 14, 1980

CAR TYPE	TRACK NO.	OUTSIDE PATIO			1st-FLR DEN			2nd-FLR LVR. RM			2nd-FLR DNG. RM.		
					MID-FLR	LOAD-WALL		MID-FLR	LOAD-WALL		MID-FLR	LOAD-WALL	
		VERT.	TRANS.	LONG.	VERT.	VERT.	TRANS.	VERT.	VERT.	TRANS.	VERT.	VERT.	TRANS.
R44	2	38.8	41.9	41.0	38.7	34.7	31.6	41.1	37.7	36.9	31.1	36.2	36.0
R44	3	36.6	42.8	41.7	-	-	-	43.0	39.0	42.7	34.6	37.5	40.4
R44	4	-	-	-	-	-	-	43.9	39.3	41.9	41.3	43.5	44.2
R42	1	-	-	-	-	-	-	44.7	40.6	43.7	36.4	42.2	41.2
R42	2	-	-	-	-	-	-	40.5	37.3	38.5	31.1	36.8	36.4
R42	4	36.4	43.8	45.4	-	-	-	-	-	-	-	-	-
R32	1	43.4	47.7	44.8	-	-	-	44.9	39.0	43.1	35.9	41.2	40.6
R32	4	-	-	-	-	-	-	42.4	39.8	42.4	35.6	38.7	40.0
R38	1	50.5	45.3	44.8	-	-	-	-	-	-	-	-	-
R40/R42	1	35.8	41.3	31.6	41.1	41.7	40.4	-	-	-	-	-	-
R40/R42	2	37.8	33.9	26.1	39.0	34.4	34.1	39.6	35.9	37.8	30.7	31.4	30.6
R40/R42	3	41.5	40.8	29.3	39.8	37.3	36.0	43.9	38.8	41.3	32.6	32.9	36.0
R40/R42	4	36.6	38.6	30.2	-	-	-	-	-	-	-	-	-
R27/R30	1	42.0	40.2	31.6	42.6	38.3	36.9	44.5	38.9	43.9	35.8	35.9	35.7
R27/R30	3	-	-	-	-	-	-	43.1	40.0	42.0	38.1	36.8	39.4
R27/R30	4	39.8	38.1	31.7	38.1	39.2	38.1	42.6	39.6	42.5	36.3	34.0	34.7

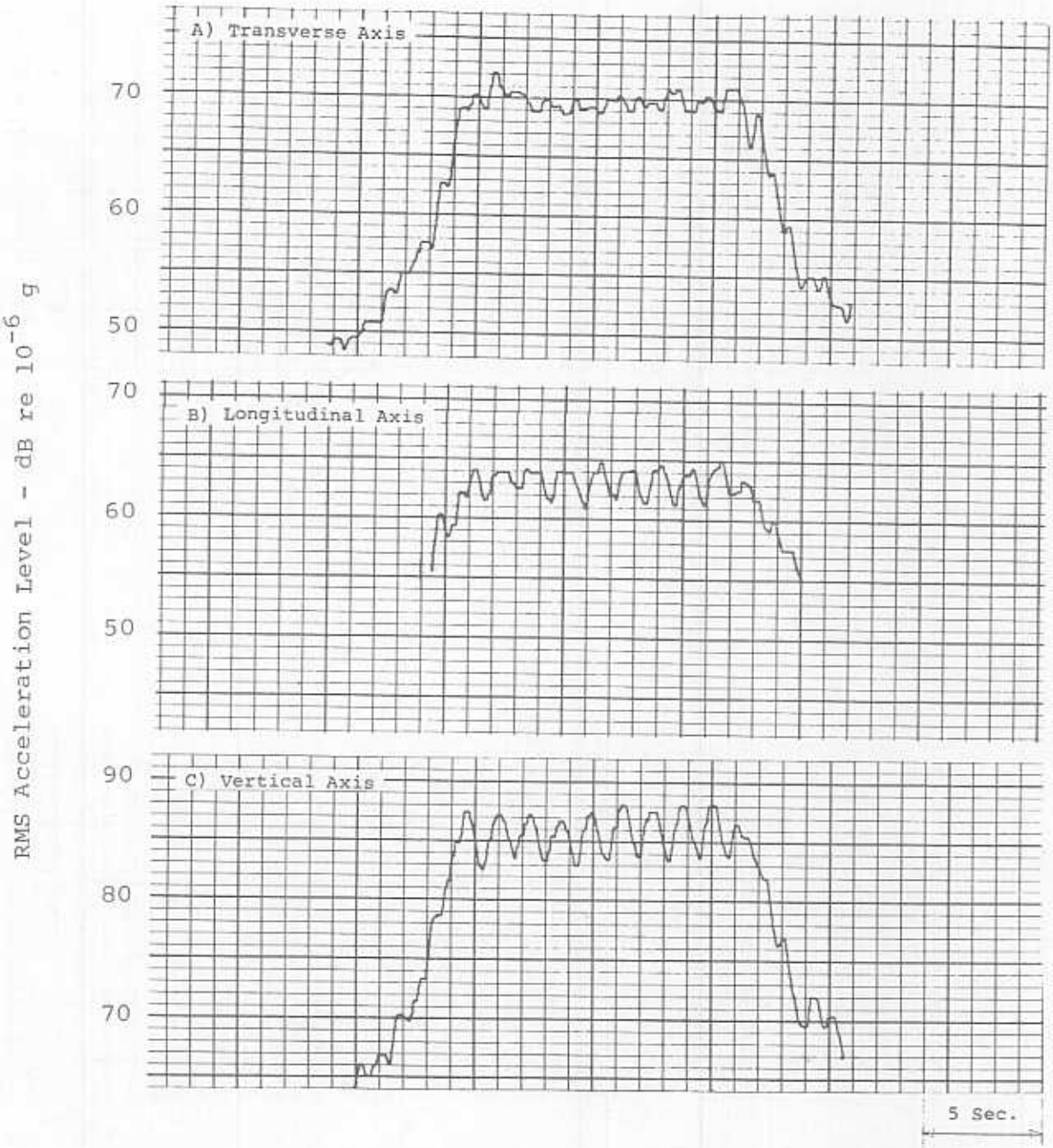

FIGURE 7. COINCIDENT TIME HISTORIES-GROUND VIBRATION LEVELS, CONCRETE BACKYARD PATIO-AUGUST 15, 1980-EVENT NO. 10 1546 E 16TH STREET, BROOKLYN, NY, 10-CAR TRAIN, R40/42 CARS, 15 MPH, TRACK 2, FULLY LOADED

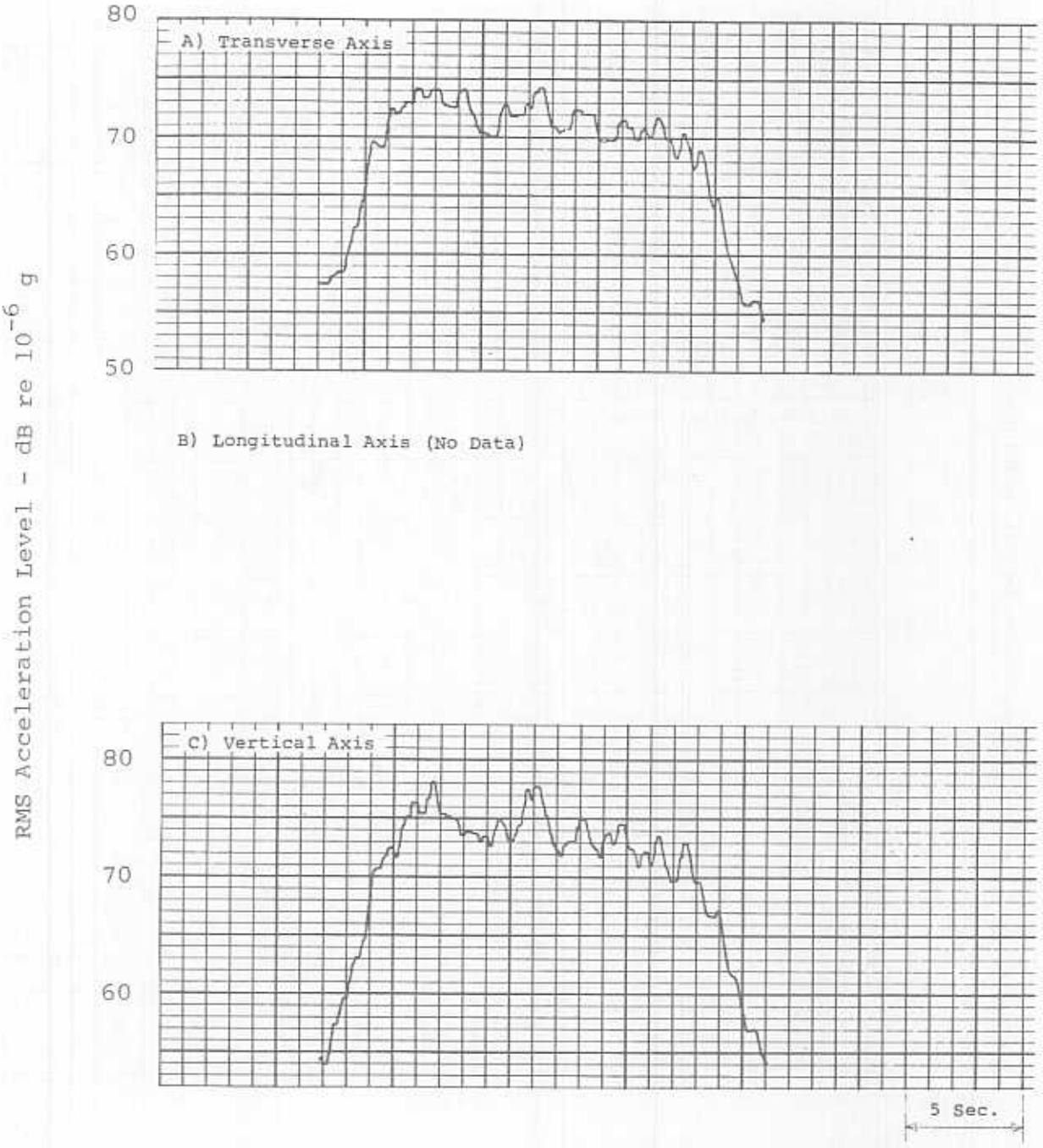

FIGURE 8. COINCIDENT TIME HISTORIES-GROUND VIBRATION LEVELS, CONCRETE BACKYARD PATIOS-AUGUST 15, 1980-EVENT NO. 50
1546 E 16TH STREET, BROOKLYN, NY, 8-CAR TRAIN, R44 CARS, 15 MPH, TRACK 2, PARTIALLY LOADED (SEE FIGURE 9)

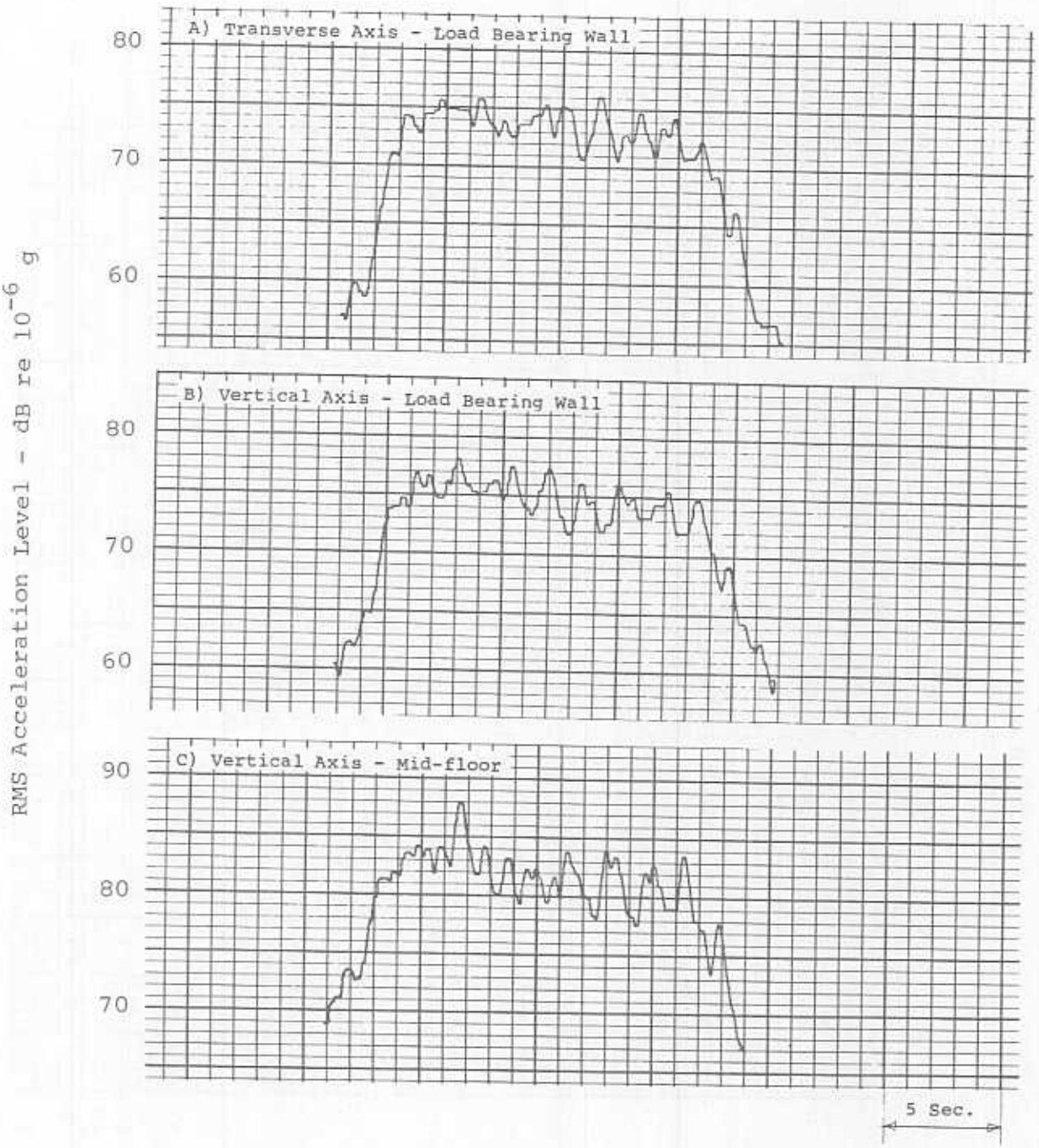

FIGURE 9. TIME HISTORIES - STRUCTURE VIBRATION LEVELS, FIRST FLOOR DEN - AUGUST 15, 1980 - EVENT NO. 50, 1546 E 16TH STREET, BROOKLYN, NY, 8 CAR TRAIN, R44 CARS, 15 MPH, TRACK 2, PARTIALLY LOADED (SEE FIGURE 8)

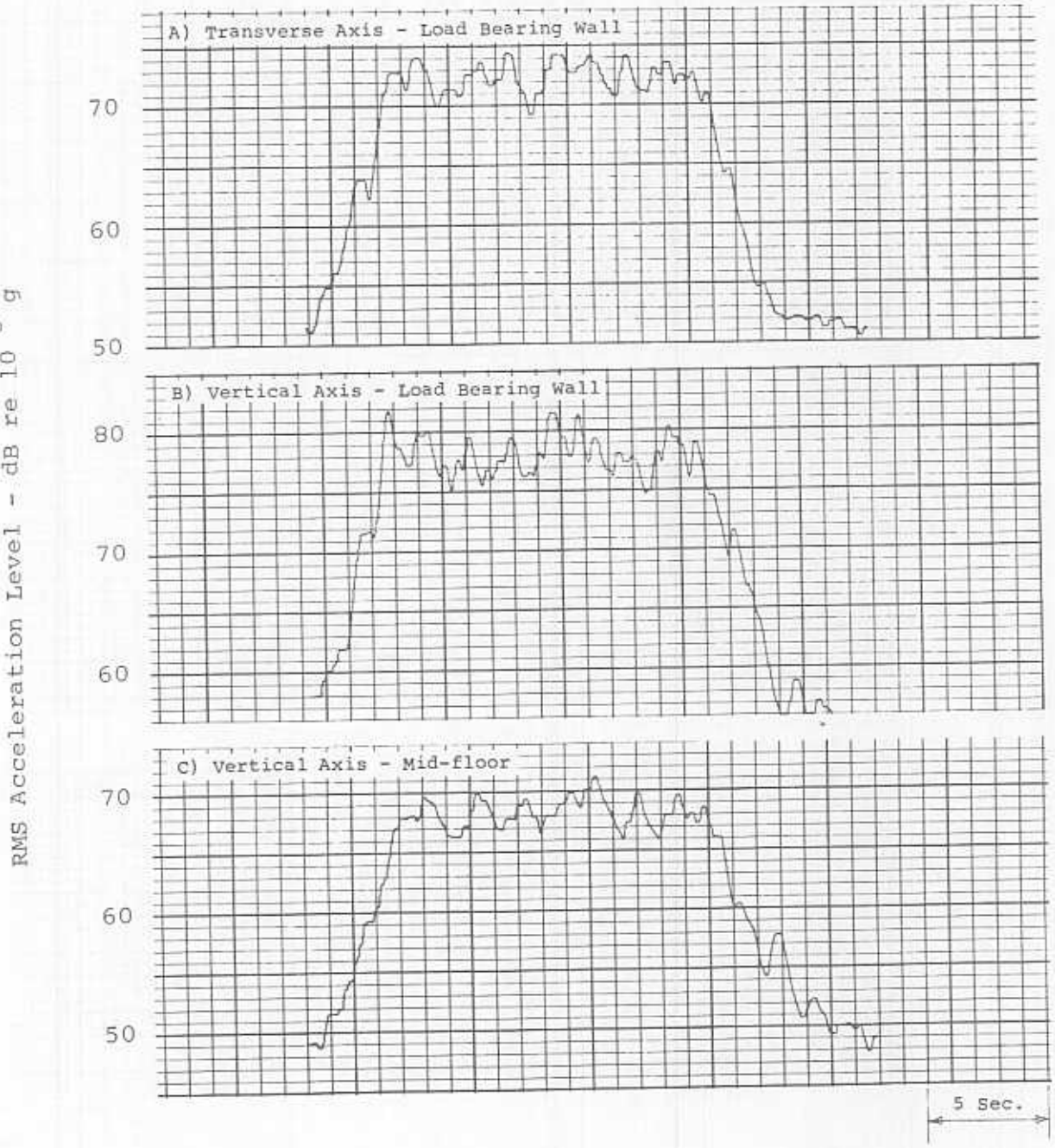

FIGURE 10. TIME HISTORIES - STRUCTURE VIBRATION LEVELS, SECOND FLOOR DINING ROOM - AUGUST 14, 1980 - EVENT NO. 44, 1546 E 16TH STREET, BROOKLYN, NY, 8-CAR TRAIN, R44 CARS, 10 MPH, TRACK 2, PARTIALLY LOADED (SEE FIGURE 11)

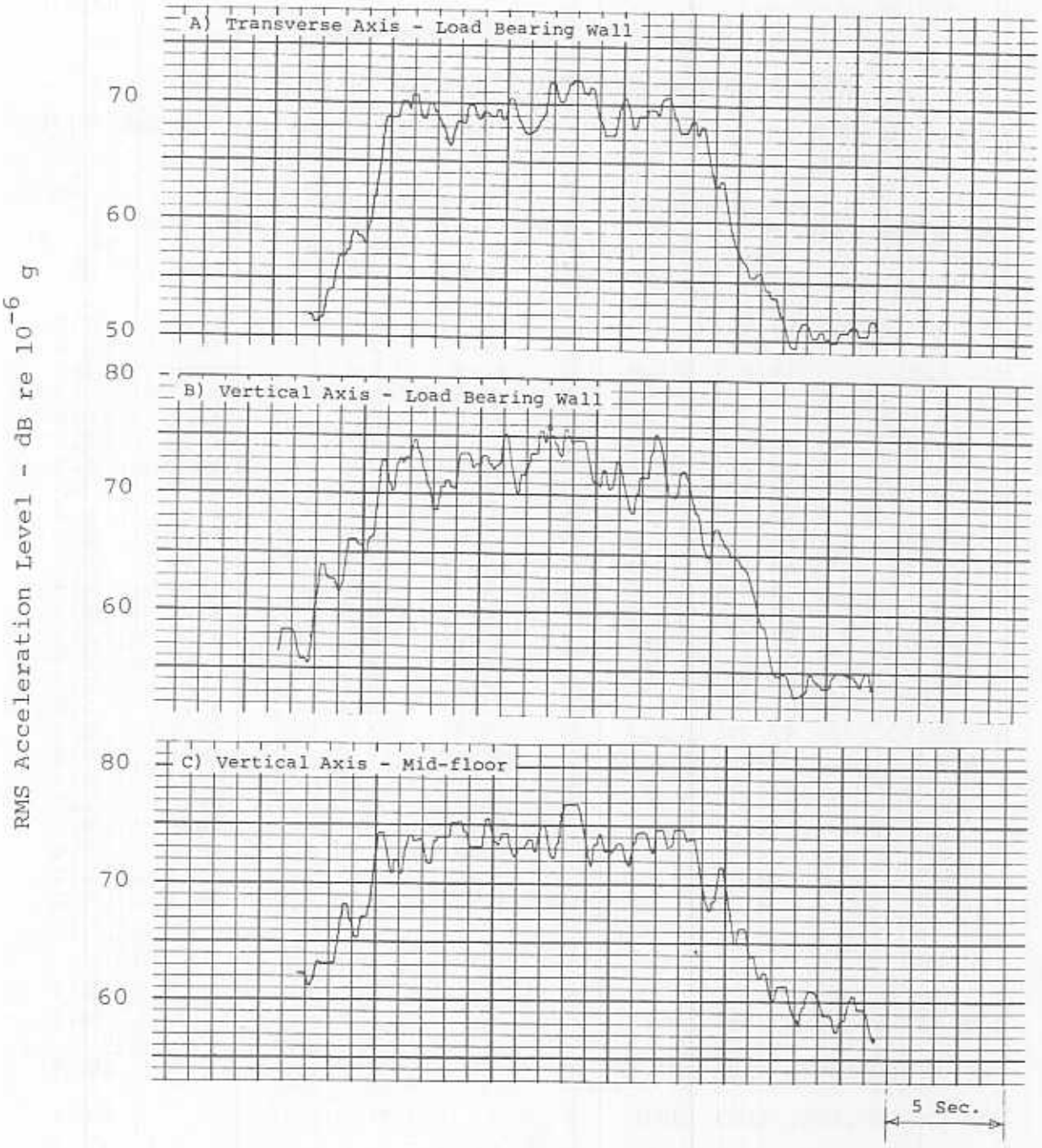

FIGURE 11. TIME HISTORIES - STRUCTURE VIBRATION LEVELS, SECOND FLOOR LIVING ROOM - AUGUST 14, 1980 - EVENT NO. 44, 1546 E 16TH STREET, BROOKLYN, NY, 8-CAR TRAIN, R44 CARS, 10 MPH, TRACK 2, PARTIALLY LOADED (SEE FIGURE 10)

TABLE 4. VIBRATION LEVEL DATA

DOT/TSC
8/15/80

CONCRETE PATIO - 3 FEET FROM FOUNDATION

R44 TRANSIT-CARS PASSBY - EVENTS 15,18,33,42,50

AVERAGING TIME 10 SECONDS TRACK NO. 2 8-CAR TRAINS

1/3-OCTAVE CNTR-FREQ HZ	VERTICAL-AXIS AVE ACCEL LEVEL DB	VERTICAL-AXIS STD DEV DB	TRANSVERSE-AXIS AVE ACCEL LEVEL DB	TRANSVERSE-AXIS STD DEV DB	LONGITUDINAL-AXIS AVE ACCEL LEVEL DB	LONGITUDINAL-AXIS STD DEV DB
4	42.0	5.5	35.6	1.9	38.4	1.9
5	*	-	36.2	2.1	38.1	1.2
6.3	44.4	1.8	45.9	1.9	45.7	1.0
8	*	-	42.4	1.6	43.7	0.7
10	*	-	46.8	1.7	47.5	0.6
12.5	44.7	3.4	56.2	2.5	53.6	0.2
16	50.6	4.4	62.3	2.6	58.7	0.3
20	57.3	3.3	66.7	2.9	64.7	0.5
25	62.0	1.5	68.4	3.0	64.5	0.8
31.5	65.1	2.0	68.0	2.4	67.3	0.8
40	68.1	2.4	68.0	3.0	72.8	0.6
50	71.4	2.3	73.4	2.9	72.6	0.4
63	69.6	2.3	72.0	3.3	71.0	0.6
80	63.8	2.5	67.5	3.1	66.3	0.9
100	58.7	2.3	63.4	3.3	63.7	0.8
125	57.5	2.2	64.2	3.5	61.4	1.1
160	51.7	2.6	60.3	3.3	57.7	1.0
200	49.3	2.8	54.4	3.2	55.2	0.9
250	45.2	1.9	48.1	2.9	49.1	0.6
315	41.1	1.6	45.0	2.2	46.7	0.4
400	41.8	1.3	45.0	2.7	49.6	1.4
500	*	-	40.8	1.9	46.7	0.2
630	*	-	40.2	1.6	48.0	0.1
800	*	-	41.0	1.9	47.1	0.1
1000	*	-	42.2	2.1	48.3	0.2
AVE ACCEL LEVEL (DB)	75.9		78.8		78.6	
AVE VELOC LEVEL (DB)	80.4		84.7		83.8	
AVE DISPL LEVEL (DB)	38.8		41.9		41.0	

ACCELERATION - DB RE 1 MICRO-G (RMS).
VELOCITY - DB RE 1 MICRO-INCH-PER-SECOND (RMS).
DISPLACEMENT - DB RE 1 MICRO-INCH (RMS).

* - DATA AT OR BELOW INSTRUMENTATION NOISE-FLOOR.

TABLE 5. VIBRATION LEVEL DATA

DOT/TSC
8/15/80

1ST-FLOOR DEN

R44 TRANSIT-CARS PASSBY - EVENT 50

AVERAGING TIME 10 SECONDS TRACK NO. 2 8-CAR TRAIN

1/3-OCTAVE CNTR-FREQ HZ	MID-FLOOR VERTICAL-AXIS AVE ACCEL LEVEL DB	STD DEV DB	LOAD-BEARING WALL VERTICAL-AXIS AVE ACCEL LEVEL DB	STD DEV DB	TRANSVERSE-AXIS AVE ACCEL LEVEL DB	STD DEV DB
4	*	-	*	-	*	-
5	*	-	*	-	*	-
6.3	41.9	0.0	40.5	0.0	38.4	0.0
8	*	-	36.1	0.0	35.7	0.0
10	40.1	0.0	38.0	0.0	38.7	0.0
12.5	47.8	0.0	47.2	0.0	44.0	0.0
16	48.6	0.0	51.0	0.0	50.3	0.0
20	54.2	0.0	54.4	0.0	54.0	0.0
25	58.3	0.0	61.2	0.0	56.7	0.0
31.5	70.6	0.0	68.8	0.0	60.8	0.0
40	80.1	0.0	68.9	0.0	62.5	0.0
50	72.6	0.0	66.1	0.0	65.7	0.0
63	68.6	0.0	66.1	0.0	68.2	0.0
80	64.2	0.0	62.3	0.0	63.2	0.0
100	59.3	0.0	54.2	0.0	51.6	0.0
125	55.9	0.0	48.1	0.0	46.4	0.0
160	47.5	0.0	39.0	0.0	39.6	0.0
200	44.2	0.0	35.3	0.0	37.0	0.0
250	45.6	0.0	36.2	0.0	37.4	0.0
315	43.2	0.0	35.6	0.0	40.1	0.0
400	43.7	0.0	35.6	0.0	46.2	0.0
500	48.4	0.0	40.7	0.0	37.5	0.0
630	47.3	0.0	41.5	0.0	35.4	0.0
800	40.6	0.0	*	-	*	-
1000	41.7	0.0	*	-	*	-

AVE ACCEL LEVEL (DB)	81.6	74.4	72.2
AVE VELOC LEVEL (DB)	86.5	79.9	76.1
AVE DISPL LEVEL (DB)	38.7	34.7	31.6

ACCELERATION - DB RE 1 MICRO-G (RMS).
VELOCITY - DB RE 1 MICRO-INCH-PER-SECOND (RMS).
DISPLACEMENT - DB RE 1 MICRO-INCH (RMS).

* - DATA AT OR BELOW INSTRUMENTATION NOISE-FLOOR.

TABLE 6. VIBRATION LEVEL DATA

DOT/TSC
8/14/80

2ND-FLOOR LIVING ROOM

R44 TRANSIT-CAR PASSBY - EVENTS 14,44,49

AVERAGING TIME 10 SECONDS TRACK NO. 2 8-CAR TRAINS

1/3-OCTAVE CNTR-FREQ HZ	MID-FLOOR VERTICAL-AXIS AVE ACCEL LEVEL DB	MID-FLOOR VERTICAL-AXIS AVE ACCEL STD DEV DB	LOAD-BEARING WALL VERTICAL-AXIS AVE ACCEL LEVEL DB	LOAD-BEARING WALL VERTICAL-AXIS AVE ACCEL STD DEV DB	LOAD-BEARING WALL TRANSVERSE-AXIS AVE ACCEL LEVEL DB	LOAD-BEARING WALL TRANSVERSE-AXIS AVE ACCEL STD DEV DB
4	*	-	*	-	30.2	2.4
5	*	-	*	-	*	-
6.3	40.0	0.6	34.2	0.9	36.8	1.4
8	37.8	0.6	36.5	0.6	44.3	0.2
10	50.3	0.1	55.9	1.0	53.2	0.8
12.5	59.2	0.2	49.6	0.7	47.2	0.8
16	64.3	1.2	54.3	1.0	55.8	0.7
20	66.3	0.1	57.9	0.1	59.6	0.2
25	62.0	0.5	57.7	0.2	52.6	0.7
31.5	60.4	0.5	58.0	1.0	57.0	0.8
40	62.6	0.6	68.2	1.0	62.0	1.1
50	61.1	1.0	65.3	1.3	62.2	0.9
63	54.4	0.6	55.1	0.6	60.8	0.4
80	51.7	0.8	48.9	1.0	56.9	0.6
100	46.5	0.8	51.1	0.9	50.3	0.8
125	46.8	1.2	48.9	0.7	50.4	0.4
160	40.2	0.9	42.4	0.2	44.4	0.3
200	37.5	0.2	39.3	0.6	44.5	0.3
250	42.3	0.7	35.9	0.6	41.8	0.4
315	47.0	0.8	38.8	0.4	48.4	0.6
400	43.2	0.6	43.2	0.3	50.4	0.5
500	*	-	39.4	0.3	35.6	0.3
630	*	-	40.8	0.4	30.2	0.3
800	*	-	33.5	0.3	*	-
1000	*	-	*	-	*	-
AVE ACCEL LEVEL (DB)	71.5		71.2		68.9	
AVE VELOC LEVEL (DB)	82.2		78.6		76.9	
AVE DISPL LEVEL (DB)	41.1		37.7		36.9	

ACCELERATION - DB RE 1 MICRO-G (RMS).
VELOCITY - DB RE 1 MICRO-INCH-PER-SECOND (RMS).
DISPLACEMENT - DB RE 1 MICRO-INCH (RMS).

* - DATA AT OR BELOW INSTRUMENTATION NOISE-FLOOR.

TABLE 7. VIBRATION LEVEL DATA

DOT/TSC
8/14/80

2ND-FLOOR DINING ROOM

R44 TRANSIT-CAR PASSBY - EVENTS 14,44,49

AVERAGING TIME 10 SECONDS TRACK NO. 2 8-CAR TRAINS

1/3-OCTAVE CNTR-FREQ HZ	MID-FLOOR VERTICAL-AXIS AVE ACCEL LEVEL DB	MID-FLOOR VERTICAL-AXIS STD DEV DB	LOAD-BEARING WALL VERTICAL-AXIS AVE ACCEL LEVEL DB	LOAD-BEARING WALL VERTICAL-AXIS STD DEV DB	LOAD-BEARING WALL TRANSVERSE-AXIS AVE ACCEL LEVEL DB	LOAD-BEARING WALL TRANSVERSE-AXIS STD DEV DB
4	*	-	*	-	*	-
5	*	-	*	-	*	-
6.3	38.5	0.5	41.5	2.1	43.0	3.4
8	39.1	0.3	39.7	0.2	42.2	0.4
10	40.9	0.8	42.7	0.2	44.5	0.9
12.5	45.7	0.7	49.7	0.6	49.3	0.5
16	48.6	0.9	52.1	1.0	57.4	1.0
20	52.8	0.2	56.2	0.4	57.8	0.2
25	53.8	0.5	59.1	0.7	57.1	0.4
31.5	53.2	0.7	67.3	0.2	61.9	0.5
40	56.4	1.4	74.0	0.9	60.9	0.6
50	56.9	0.7	71.0	0.7	64.9	0.7
63	62.2	0.3	68.9	0.3	67.3	0.4
80	55.4	0.4	64.4	0.6	58.6	0.6
100	53.8	0.6	60.8	1.3	51.6	0.8
125	56.1	0.6	61.3	0.5	51.2	0.4
160	48.8	0.4	61.7	0.2	54.1	0.6
200	48.9	0.3	58.8	0.6	57.8	0.7
250	44.6	0.6	53.3	0.2	48.6	0.5
315	43.8	0.9	51.5	0.1	45.4	0.2
400	37.4	0.8	46.1	0.3	38.9	0.2
500	36.2	0.1	39.4	0.7	*	-
630	33.0	0.1	35.6	0.6	*	-
800	31.6	0.1	*	-	*	-
1000	34.1	0.1	*	-	*	-
AVE ACCEL LEVEL (DB)	66.6		77.8		71.8	
AVE VELOC LEVEL (DB)	71.8		82.2		77.5	
AVE DISPL LEVEL (DB)	31.1		36.2		36.0	

ACCELERATION - DB RE 1 MICRO-G (RMS).
VELOCITY - DB RE 1 MICRO-INCH-PER-SECOND (RMS).
DISPLACEMENT - DB RE 1 MICRO-INCH (RMS).

* - DATA AT OR BELOW INSTRUMENTATION NOISE-FLOOR.

TABLE 8. VIBRATION LEVEL DATA

DOT/TSC
8/15/80

CONCRETE PATIO - 3 FEET FROM FOUNDATION

R40/R42 TRANSIT-CARS PASSBY - EVENTS 2,10,28,37,52

AVERAGING TIME 10 SECONDS TRACK NO. 2 10-CAR TRAINS

1/3-OCTAVE CNTR-FREQ HZ	VERTICAL-AXIS AVE ACCEL LEVEL DB	VERTICAL-AXIS STD DEV DB	TRANSVERSE-AXIS AVE ACCEL LEVEL DB	TRANSVERSE-AXIS STD DEV DB	LONGITUDINAL-AXIS AVE ACCEL LEVEL DB	LONGITUDINAL-AXIS STD DEV DB
4	*	-	*	-	*	-
5	*	-	*	-	*	-
6.3	46.0	2.5	42.0	1.4	*	-
8	*	-	39.1	1.3	*	-
10	*	-	41.3	1.0	*	-
12.5	45.3	2.6	47.2	0.7	40.0	1.8
16	52.5	3.7	54.0	0.7	45.0	1.0
20	57.7	3.4	56.2	0.9	50.8	0.8
25	61.6	2.5	58.6	1.5	49.9	1.1
31.5	66.1	2.4	60.7	1.0	51.2	0.5
40	67.4	2.9	59.7	1.0	54.4	1.7
50	71.1	3.7	64.7	1.1	54.5	1.6
63	68.9	3.3	63.5	0.7	53.4	0.9
80	62.3	2.7	58.2	0.9	51.3	0.5
100	58.3	2.2	54.8	1.2	48.3	0.6
125	57.4	2.8	55.6	2.0	46.2	1.3
160	52.3	3.0	51.6	1.5	43.0	1.8
200	50.2	2.4	46.1	1.2	40.4	1.0
250	46.7	1.9	41.2	0.7	35.4	0.6
315	*	-	39.8	1.1	*	-
400	*	-	39.7	0.7	37.6	1.0
500	*	-	36.6	1.1	35.9	1.5
630	*	-	36.4	1.0	37.5	1.7
800	*	-	36.9	1.2	36.0	1.7
1000	*	-	38.6	1.3	37.8	1.6
AVE ACCEL LEVEL (DB)	75.5		70.1		61.7	
AVE VELOC LEVEL (DB)	80.2		75.9		67.6	
AVE DISPL LEVEL (DB)	36.6		34.2		23.4	

ACCELERATION - DB RE 1 MICRO-G (RMS).
VELOCITY - DB RE 1 MICRO-INCH-PER-SECOND (RMS).
DISPLACEMENT - DB RE 1 MICRO-INCH (RMS).

* - DATA AT OR BELOW INSTRUMENTATION NOISE-FLOOR.

TABLE 9. VIBRATION LEVEL DATA

DOT/TSC
8/15/80

1ST-FLOOR DEN

R40/R42 TRANSIT-CARS PASSBY - EVENT 52

AVERAGING TIME 10 SECONDS TRACK NO. 2 10-CAR TRAIN

1/3-OCTAVE CNTR-FREQ HZ	MID-FLOOR VERTICAL-AXIS AVE ACCEL LEVEL DB	MID-FLOOR VERTICAL-AXIS STD DEV DB	LOAD-BEARING WALL VERTICAL-AXIS AVE ACCEL LEVEL DB	LOAD-BEARING WALL VERTICAL-AXIS STD DEV DB	LOAD-BEARING WALL TRANSVERSE-AXIS AVE ACCEL LEVEL DB	LOAD-BEARING WALL TRANSVERSE-AXIS STD DEV DB
4	*	-	*	-	*	-
5	*	-	*	-	*	-
6.3	47.5	0.0	38.1	0.0	43.8	0.0
8	*	-	35.6	0.0	40.7	0.0
10	*	-	38.0	0.0	40.6	0.0
12.5	47.2	0.0	46.9	0.0	43.0	0.0
16	50.8	0.0	53.5	0.0	50.1	0.0
20	55.4	0.0	57.4	0.0	52.2	0.0
25	58.8	0.0	61.0	0.0	54.6	0.0
31.5	69.9	0.0	68.9	0.0	59.4	0.0
40	77.9	0.0	66.1	0.0	62.1	0.0
50	70.8	0.0	63.2	0.0	64.2	0.0
63	66.8	0.0	64.5	0.0	65.9	0.0
80	62.6	0.0	59.6	0.0	61.7	0.0
100	57.4	0.0	51.5	0.0	49.3	0.0
125	53.6	0.0	46.4	0.0	44.1	0.0
160	45.7	0.0	37.7	0.0	38.8	0.0
200	43.2	0.0	35.6	0.0	36.5	0.0
250	42.7	0.0	*	-	35.7	0.0
315	40.6	0.0	*	-	39.6	0.0
400	41.1	0.0	*	-	45.0	0.0
500	46.3	0.0	38.4	0.0	35.5	0.0
630	43.9	0.0	38.2	0.0	*	-
800	*	-	*	-	*	-
1000	*	-	*	-	*	-
AVE ACCEL LEVEL (DB)	79.7		73.0		70.5	
AVE VELOC LEVEL (DB)	84.7		79.3		75.1	
AVE DISPL LEVEL (DB)	39.0		34.4		34.1	

ACCELERATION - DB RE 1 MICRO-G (RMS).
VELOCITY - DB RE 1 MICRO-INCH-PER-SECOND (RMS).
DISPLACEMENT - DB RE 1 MICRO-INCH (RMS).

* - DATA AT OR BELOW INSTRUMENTATION NOISE-FLOOR.

TABLE 10. VIBRATION LEVEL DATA

DOT/TSC
8/14/80

2ND-FLOOR LIVING ROOM

R40/R42 TRANSIT-CARS PASSBY - EVENTS 39,52

AVERAGING TIME 10 SECONDS TRACK NO. 2 10-CAR TRAINS

	MID-FLOOR		LOAD-BEARING WALL			
	VERTICAL-AXIS		VERTICAL-AXIS		TRANSVERSE-AXIS	
1/3-OCTAVE CNTR-FREQ HZ	AVE ACCEL LEVEL DB	STD DEV DB	AVE ACCEL LEVEL DB	STD DEV DB	AVE ACCEL LEVEL DB	STD DEV DB
4	*	-	*	-	*	-
5	*	-	*	-	*	-
6.3	40.6	0.1	35.1	1.0	37.7	2.7
8	37.9	0.8	35.8	1.3	48.4	1.0
10	49.3	1.3	53.5	0.8	53.8	2.2
12.5	58.0	1.1	48.9	0.7	45.6	0.4
16	63.8	1.3	53.0	0.0	53.0	0.3
20	64.4	0.1	57.0	0.1	58.6	0.3
25	62.0	2.8	56.8	0.8	52.2	0.5
31.5	59.6	1.2	57.3	1.5	58.3	0.1
40	61.4	0.7	66.4	1.0	60.6	0.4
50	60.2	1.4	64.6	1.8	60.9	0.5
63	52.9	1.1	53.7	0.2	59.2	1.1
80	50.5	0.4	47.7	0.4	56.7	0.1
100	45.8	0.4	49.8	0.0	49.1	0.0
125	46.3	1.3	47.9	0.3	49.0	0.9
160	40.2	1.0	41.5	0.2	43.7	0.1
200	38.6	0.6	39.5	0.9	44.4	0.2
250	43.6	1.6	36.1	0.8	41.9	0.7
315	48.0	0.6	39.6	0.3	49.3	0.1
400	45.0	0.8	45.2	0.2	51.3	0.7
500	36.1	0.5	42.6	0.5	39.2	0.2
630	37.5	1.5	44.2	1.3	32.6	1.1
800	*	-	36.2	1.3	*	-
1000	*	-	31.8	1.0	*	-
AVE ACCEL LEVEL (DB)	70.6		69.9		67.9	
AVE VELOC LEVEL (DB)	81.2		77.1		76.5	
AVE DISPL LEVEL (DB)	40.1		35.9		37.5	

ACCELERATION - DB RE 1 MICRO-G (RMS).
VELOCITY - DB RE 1 MICRO-INCH-PER-SECOND (RMS).
DISPLACEMENT - DB RE 1 MICRO-INCH (RMS).

* - DATA AT OR BELOW INSTRUMENTATION NOISE-FLOOR.

TABLE 11. VIBRATION LEVEL DATA

DOT/TSC
8/14/80

2ND-FLOOR DINING ROOM

R40/R42 TRANSIT-CARS PASSBY - EVENTS 20,39,52

AVERAGING TIME 10 SECONDS TRACK NO. 2 10-CAR TRAINS

1/3-OCTAVE CNTR-FREQ HZ	MID-FLOOR VERTICAL-AXIS AVE ACCEL LEVEL DB	MID-FLOOR VERTICAL-AXIS STD DEV DB	LOAD-BEARING WALL VERTICAL-AXIS AVE ACCEL LEVEL DB	LOAD-BEARING WALL VERTICAL-AXIS STD DEV DB	LOAD-BEARING WALL TRANSVERSE-AXIS AVE ACCEL LEVEL DB	LOAD-BEARING WALL TRANSVERSE-AXIS STD DEV DB
4	*	-	*	-	*	-
5	*	-	*	-	*	-
6.3	38.1	1.9	37.5	1.6	37.0	2.9
8	39.1	1.0	*	-	39.5	0.9
10	41.4	0.8	35.5	0.7	40.3	1.6
12.5	42.3	1.0	42.3	1.2	42.7	1.3
16	47.9	0.7	47.9	0.7	50.3	0.7
20	54.1	0.1	51.6	0.2	53.2	0.3
25	55.0	0.6	55.2	0.3	51.6	0.6
31.5	53.5	0.9	61.7	0.3	55.7	0.5
40	54.5	0.9	69.0	0.8	54.3	0.7
50	56.0	0.6	64.2	0.9	58.1	0.9
63	60.3	0.6	62.7	0.1	60.8	0.7
80	53.7	0.4	57.6	0.3	52.1	0.8
100	52.5	0.3	54.3	0.7	45.5	0.4
125	55.1	0.4	55.5	0.4	45.5	0.5
160	48.8	0.4	56.2	0.4	48.6	0.7
200	49.5	0.4	54.3	0.6	52.3	0.9
250	46.5	0.6	49.9	0.7	45.0	0.9
315	45.4	0.4	48.5	0.5	42.7	0.7
400	38.4	0.3	43.1	0.9	35.9	0.8
500	38.9	0.5	36.4	0.7	*	-
630	36.6	0.8	*	-	*	-
800	35.4	1.3	*	-	*	-
1000	37.7	1.2	*	-	*	-

AVE ACCEL LEVEL (DB)	65.6	72.2	65.5
AVE VELOC LEVEL (DB)	71.5	76.8	71.5
AVE DISPL LEVEL (DB)	30.8	31.0	30.5

ACCELERATION - DB RE 1 MICRO-G (RMS).
VELOCITY - DB RE 1 MICRO-INCH-PER-SECOND (RMS).
DISPLACEMENT - DB RE 1 MICRO-INCH (RMS).

* - DATA AT OR BELOW INSTRUMENTATION NOISE-FLOOR.

TABLE 12. VIBRATION LEVEL DATA

DOT/TSC
8/15/80

CONCRETE PATIO - 3 FEET FROM FOUNDATION

R27/R30 TRANSIT-CARS PASSBY - EVENTS 1,14,16,27,31,34,53

AVERAGING TIME 10 SECONDS TRACK NO. 1 8-CAR TRAINS

1/3-OCTAVE CNTR-FREQ HZ	VERTICAL-AXIS AVE ACCEL LEVEL DB	VERTICAL-AXIS AVE ACCEL STD DEV DB	TRANSVERSE-AXIS AVE ACCEL LEVEL DB	TRANSVERSE-AXIS AVE ACCEL STD DEV DB	LONGITUDINAL-AXIS AVE ACCEL LEVEL DB	LONGITUDINAL-AXIS AVE ACCEL STD DEV DB
4	45.9	4.6	*	-	37.1	7.4
5	*	-	*	-	*	-
6.3	46.2	1.6	41.9	1.6	36.1	3.9
8	*	-	44.7	0.8	36.2	0.8
10	*	-	46.6	0.8	39.3	0.6
12.5	50.9	4.2	53.5	0.4	44.9	0.6
16	55.5	3.9	57.8	1.1	49.9	2.1
20	63.9	3.6	66.8	1.5	53.9	0.7
25	63.9	1.8	68.0	1.0	56.1	0.4
31.5	70.1	2.0	70.2	0.3	57.4	0.5
40	74.9	2.6	71.6	1.1	59.1	1.2
50	73.0	2.8	66.0	1.0	57.2	2.0
63	70.5	2.7	65.3	0.8	55.6	1.7
80	66.8	2.6	65.8	0.8	57.8	1.8
100	66.0	2.7	61.7	0.8	57.2	0.5
125	65.6	2.4	61.6	1.0	51.3	1.0
160	61.1	2.8	59.5	1.0	49.4	1.4
200	56.5	3.0	53.5	1.2	46.5	1.5
250	53.1	2.4	51.1	1.1	41.4	1.1
315	49.1	2.5	46.1	1.0	40.2	1.0
400	50.2	1.8	44.9	0.9	42.9	1.0
500	50.0	1.9	43.4	0.9	42.9	0.8
630	50.1	1.9	42.5	0.7	43.8	0.8
800	50.1	2.0	43.0	0.9	42.3	0.8
1000	48.6	1.9	44.2	1.0	43.3	1.0
AVE ACCEL LEVEL (DB)	79.7		77.2		66.6	
AVE VELOC LEVEL (DB)	84.6		84.0		72.9	
AVE DISPL LEVEL (DB)	42.6		40.2		33.7	

ACCELERATION - DB RE 1 MICRO-G (RMS).
VELOCITY - DB RE 1 MICRO-INCH-PER-SECOND (RMS).
DISPLACEMENT - DB RE 1 MICRO-INCH (RMS).

* - DATA AT OR BELOW INSTRUMENTATION NOISE-FLOOR.

TABLE 13. VIBRATION LEVEL DATA

DOT/TSC
8/15/80

1ST-FLOOR DEN

R27/R30 TRANSIT-CARS PASSBY - EVENT 53

AVERAGING TIME 10 SECONDS TRACK NO. 1 8-CAR TRAIN

1/3-OCTAVE CNTR-FREQ HZ	MID-FLOOR VERTICAL-AXIS AVE ACCEL LEVEL DB	MID-FLOOR VERTICAL-AXIS STD DEV DB	LOAD-BEARING WALL VERTICAL-AXIS AVE ACCEL LEVEL DB	LOAD-BEARING WALL VERTICAL-AXIS STD DEV DB	LOAD-BEARING WALL TRANSVERSE-AXIS AVE ACCEL LEVEL DB	LOAD-BEARING WALL TRANSVERSE-AXIS STD DEV DB
4	41.7	0.0	*	-	*	-
5	*	-	*	-	*	-
6.3	49.6	0.0	43.7	0.0	43.9	0.0
8	42.5	0.0	39.8	0.0	43.5	0.0
10	43.9	0.0	42.2	0.0	43.4	0.0
12.5	50.9	0.0	49.8	0.0	48.9	0.0
16	49.8	0.0	52.9	0.0	52.3	0.0
20	56.0	0.0	58.2	0.0	58.7	0.0
25	60.8	0.0	65.5	0.0	64.4	0.0
31.5	72.2	0.0	73.5	0.0	65.7	0.0
40	80.9	0.0	70.9	0.0	68.9	0.0
50	73.9	0.0	64.9	0.0	67.7	0.0
63	70.1	0.0	67.1	0.0	69.3	0.0
80	68.5	0.0	63.6	0.0	65.4	0.0
100	64.3	0.0	60.3	0.0	56.6	0.0
125	61.3	0.0	51.6	0.0	51.0	0.0
160	53.0	0.0	43.8	0.0	45.7	0.0
200	47.6	0.0	39.5	0.0	41.2	0.0
250	49.0	0.0	39.4	0.0	41.4	0.0
315	46.0	0.0	37.9	0.0	43.3	0.0
400	46.4	0.0	37.2	0.0	48.6	0.0
500	50.9	0.0	41.7	0.0	38.8	0.0
630	49.0	0.0	44.5	0.0	38.1	0.0
800	43.0	0.0	*	-	*	-
1000	44.8	0.0	*	-	*	-
AVE ACCEL LEVEL (DB)	82.7		77.1		75.3	
AVE VELOC LEVEL (DB)	87.6		83.3		80.5	
AVE DISPL LEVEL (DB)	42.6		38.3		36.9	

ACCELERATION - DB RE 1 MICRO-G (RMS).
VELOCITY - DB RE 1 MICRO-INCH-PER-SECOND (RMS).
DISPLACEMENT - DB RE 1 MICRO-INCH (RMS).

* - DATA AT OR BELOW INSTRUMENTATION NOISE-FLOOR.

TABLE 14. VIBRATION LEVEL DATA

DOT/TSC
8/14/80

2ND-FLOOR LIVING ROOM

R27/R30 TRANSIT-CARS PASSBY - EVENTS 12,25,47,53

AVERAGING TIME 10 SECONDS TRACK NO. 1 8-CAR TRAINS

	MID-FLOOR		LOAD-BEARING WALL			
	VERTICAL-AXIS		VERTICAL-AXIS		TRANSVERSE-AXIS	
1/3-OCTAVE CNTR-FREQ HZ	AVE ACCEL LEVEL DB	STD DEV DB	AVE ACCEL LEVEL DB	STD DEV DB	AVE ACCEL LEVEL DB	STD DEV DB
4	*	-	*	-	*	-
5	*	-	*	-	*	-
6.3	40.3	2.2	37.9	1.9	42.6	0.6
8	46.4	1.0	44.2	0.9	55.3	0.5
10	52.4	1.6	55.1	1.6	56.6	1.3
12.5	59.2	0.4	49.3	0.6	50.0	0.6
16	64.5	0.6	54.5	0.2	56.3	0.5
20	74.3	1.7	63.1	1.0	63.6	0.3
25	64.1	0.6	60.9	0.5	59.3	0.3
31.5	64.6	0.5	63.0	0.2	66.6	0.5
40	65.2	1.2	70.5	0.9	66.0	1.1
50	61.8	1.0	68.1	0.6	63.2	0.4
63	55.9	0.6	56.0	0.5	62.0	0.7
80	57.1	0.7	53.7	0.4	60.2	0.6
100	53.1	0.6	56.2	0.5	54.0	1.0
125	51.4	0.5	53.0	0.9	55.5	0.4
160	45.4	0.7	47.1	0.2	48.7	0.6
200	44.0	0.5	44.1	0.3	49.2	0.6
250	47.7	0.4	41.6	0.3	47.6	0.3
315	51.7	0.3	44.1	0.5	53.4	0.6
400	48.4	0.9	49.7	1.4	55.1	0.9
500	40.6	0.5	47.5	1.0	44.2	0.7
630	40.4	0.4	48.3	0.2	36.9	0.9
800	38.5	1.1	41.8	2.7	*	-
1000	*	-	36.6	2.8	*	-
AVE ACCEL LEVEL (DB)	76.3		74.0		72.8	
AVE VELOC LEVEL (DB)	86.8		80.9		81.5	
AVE DISPL LEVEL (DB)	44.7		38.7		42.5	

ACCELERATION - DB RE 1 MICRO-G (RMS).
VELOCITY - DB RE 1 MICRO-INCH-PER-SECOND (RMS).
DISPLACEMENT - DB RE 1 MICRO-INCH (RMS).

* - DATA AT OR BELOW INSTRUMENTATION NOISE-FLOOR.

TABLE 15. VIBRATION LEVEL DATA

DOT/TSC
8/14/80

2ND-FLOOR DINING ROOM

R27/R30 TRANSIT-CARS PASSBY - EVENTS 12,25,47,53

AVERAGING TIME 10 SECONDS TRACK NO. 1 8-CAR TRAINS

	MID-FLOOR		LOAD-BEARING WALL			
	VERTICAL-AXIS		VERTICAL-AXIS		TRANSVERSE-AXIS	
1/3-OCTAVE CNTR-FREQ HZ	AVE ACCEL LEVEL DB	STD DEV DB	AVE ACCEL LEVEL DB	STD DEV DB	AVE ACCEL LEVEL DB	STD DEV DB
4	32.4	3.9	*	-	*	-
5	30.1	0.6	*	-	*	-
6.3	40.1	1.7	38.6	2.1	38.8	1.3
8	46.2	0.1	41.2	0.2	46.4	0.3
10	46.6	0.5	41.7	0.4	47.1	0.5
12.5	47.2	0.4	46.1	0.3	46.6	0.2
16	52.4	0.8	50.8	0.8	53.4	0.3
20	56.5	0.2	52.7	0.3	56.8	0.4
25	58.2	0.2	55.8	0.6	59.3	0.2
31.5	58.7	0.2	68.2	0.8	62.5	0.6
40	62.1	0.4	75.1	0.5	63.7	1.0
50	58.1	0.4	63.9	0.5	59.9	0.8
63	60.7	1.1	62.8	0.7	60.4	0.8
80	60.2	0.4	64.0	0.4	57.4	0.3
100	67.1	0.5	66.8	0.5	58.5	0.3
125	65.8	0.8	63.2	0.4	55.6	0.4
160	55.1	0.8	61.0	0.5	54.5	0.5
200	54.6	0.9	58.3	0.5	58.7	1.5
250	49.9	0.4	54.5	1.1	50.5	1.5
315	48.8	0.6	51.5	0.4	46.3	0.2
400	43.8	0.6	47.6	0.4	39.8	0.4
500	45.6	0.9	41.7	0.6	35.4	0.2
630	41.5	0.2	38.3	0.9	*	-
800	40.1	0.8	*	-	*	-
1000	41.5	0.4	*	-	*	-
AVE ACCEL LEVEL (DB)	72.2		77.5		70.3	
AVE VELOC LEVEL (DB)	76.0		82.0		76.7	
AVE DISPL LEVEL (DB)	35.8		35.5		35.4	

ACCELERATION - DB RE 1 MICRO-G (RMS).
VELOCITY - DB RE 1 MICRO-INCH-PER-SECOND (RMS).
DISPLACEMENT - DB RE 1 MICRO-INCH (RMS).

* - DATA AT OR BELOW INSTRUMENTATION NOISE-FLOOR.

TABLE 16. VIBRATION LEVEL DATA

DOT/TSC
8/15/80

CONCRETE PATIO - 3 FEET FROM FOUNDATION

R32 TRANSIT-CARS PASSBY - EVENTS 20,41

AVERAGING TIME 10 SECONDS TRACK NO. 1 8-CAR TRAINS

1/3-OCTAVE CNTR-FREQ HZ	VERTICAL-AXIS AVE ACCEL LEVEL DB	VERTICAL-AXIS AVE ACCEL STD DEV DB	TRANSVERSE-AXIS AVE ACCEL LEVEL DB	TRANSVERSE-AXIS AVE ACCEL STD DEV DB	LONGITUDINAL-AXIS AVE ACCEL LEVEL DB	LONGITUDINAL-AXIS AVE ACCEL STD DEV DB
4	45.8	1.4	38.3	1.2	40.0	2.2
5	42.6	1.2	37.7	1.3	39.8	0.3
6.3	45.7	2.5	47.5	1.9	46.5	0.8
8	42.1	1.8	51.8	2.3	49.8	1.8
10	44.7	2.4	52.6	1.8	54.7	0.4
12.5	50.9	3.9	60.5	2.9	59.5	0.1
16	55.9	4.4	65.0	2.6	63.7	2.3
20	64.3	3.1	74.9	2.0	68.4	0.6
25	63.7	2.1	76.0	3.8	71.2	0.4
31.5	71.1	2.4	77.7	3.0	72.2	0.6
40	75.5	2.1	78.3	2.4	73.9	1.3
50	72.5	2.0	73.2	3.0	71.8	0.2
63	69.4	1.8	72.0	2.9	72.1	0.6
80	65.6	1.9	71.8	2.6	72.1	0.7
100	65.0	1.9	67.9	2.9	71.5	0.4
125	64.0	1.9	67.7	3.4	65.8	0.1
160	60.2	1.9	65.4	3.5	64.2	0.3
200	56.5	2.1	60.3	3.6	61.5	0.3
250	52.8	1.8	57.5	3.5	56.4	0.0
315	49.2	1.8	53.3	3.3	55.0	0.2
400	50.4	1.3	52.5	3.3	58.2	0.2
500	50.5	1.1	51.4	3.6	58.8	0.1
630	50.5	0.6	50.2	2.9	59.6	0.5
800	50.7	0.8	50.8	2.9	58.3	0.8
1000	49.0	0.8	52.0	2.8	59.0	0.5

AVE ACCEL LEVEL (DB)	79.7	84.3	81.4
AVE VELOC LEVEL (DB)	85.0	91.5	87.3
AVE DISPL LEVEL (DB)	43.4	47.7	44.8

ACCELERATION - DB RE 1 MICRO-G (RMS).
VELOCITY - DB RE 1 MICRO-INCH-PER-SECOND (RMS).
DISPLACEMENT - DB RE 1 MICRO-INCH (RMS).

* - DATA AT OR BELOW INSTRUMENTATION NOISE-FLOOR.

TABLE 17. VIBRATION LEVEL DATA

DOT/TSC
8/14/80

2ND-FLOOR LIVING ROOM

R32 TRANSIT-CAR PASSBY - EVENTS 19,59

AVERAGING TIME 10 SECONDS TRACK NO. 1 8-CAR,10-CAR TRAINS

1/3-OCTAVE CNTR-FREQ HZ	MID-FLOOR VERTICAL-AXIS AVE ACCEL LEVEL DB	STD DEV DB	LOAD-BEARING WALL VERTICAL-AXIS AVE ACCEL LEVEL DB	STD DEV DB	TRANSVERSE-AXIS AVE ACCEL LEVEL DB	STD DEV DB
4	*	-	*	-	*	-
5	*	-	*	-	*	-
6.3	41.3	0.0	39.5	0.1	43.1	0.8
8	46.8	0.0	44.1	0.7	56.0	1.0
10	53.1	0.0	55.2	1.6	57.1	0.8
12.5	61.2	0.0	50.0	0.8	50.0	0.7
16	64.9	0.0	54.6	0.3	57.2	1.1
20	73.7	0.0	64.1	0.6	64.6	0.3
25	66.0	0.0	61.6	0.6	61.3	0.0
31.5	66.5	0.0	61.8	0.4	67.5	0.8
40	65.2	0.0	70.2	0.8	66.7	0.9
50	62.4	0.0	67.5	0.2	62.8	0.1
63	55.1	0.0	55.7	0.3	61.7	0.6
80	56.5	0.0	53.0	0.3	59.8	0.2
100	51.8	0.0	55.6	0.4	53.7	0.1
125	50.5	0.0	53.1	0.1	54.5	0.9
160	45.3	0.0	46.9	0.3	48.7	0.1
200	44.0	0.0	44.8	0.1	50.2	0.4
250	48.3	0.0	42.4	0.4	49.3	0.6
315	52.5	0.0	46.0	0.8	56.3	2.1
400	48.8	0.0	51.0	1.4	58.0	2.1
500	40.4	0.0	49.7	2.5	45.9	2.3
630	40.8	0.0	50.3	2.8	38.9	3.4
800	38.5	0.0	42.1	3.0	*	-
1000	*	-	37.1	2.5	*	-
AVE ACCEL LEVEL (DB)	76.3		73.8		73.5	
AVE VELOC LEVEL (DB)	86.8		81.0		82.3	
AVE DISPL LEVEL (DB)	44.9		39.0		43.1	

ACCELERATION - DB RE 1 MICRO-G (RMS).
VELOCITY - DB RE 1 MICRO-INCH-PER-SECOND (RMS).
DISPLACEMENT - DB RE 1 MICRO-INCH (RMS).

* - DATA AT OR BELOW INSTRUMENTATION NOISE-FLOOR.

TABLE 18. VIBRATION LEVEL DATA

DOT/TSC
8/14/80

2ND-FLOOR DINING ROOM

R32 TRANSIT-CAR PASSBY - EVENTS 19,59

AVERAGING TIME 10 SECONDS TRACK NO. 1 8-CAR,10-CAR TRAINS

	MID-FLOOR		LOAD-BEARING WALL			
	VERTICAL-AXIS		VERTICAL-AXIS		TRANSVERSE-AXIS	
1/3-OCTAVE CNTR-FREQ HZ	AVE ACCEL LEVEL DB	STD DEV DB	AVE ACCEL LEVEL DB	STD DEV DB	AVE ACCEL LEVEL DB	STD DEV DB
4	30.0	2.7	*	-	*	-
5	32.1	0.1	*	-	*	-
6.3	41.0	1.2	43.6	3.5	43.1	1.1
8	46.0	1.1	46.6	0.6	51.7	0.4
10	46.9	2.3	48.0	2.2	52.6	1.5
12.5	47.4	0.4	52.0	0.1	52.8	0.4
16	52.9	1.2	56.9	1.2	58.8	1.4
20	55.9	0.6	57.9	0.5	61.3	0.1
25	57.4	0.6	62.0	0.5	64.7	0.4
31.5	58.4	0.8	74.0	1.1	68.1	0.6
40	61.6	0.1	81.0	0.7	68.5	0.4
50	57.4	0.3	68.8	0.3	64.2	0.2
63	60.7	0.1	66.5	0.8	65.3	0.1
80	59.1	0.3	68.5	0.1	61.8	0.5
100	66.0	0.5	71.4	0.6	62.7	0.8
125	64.8	0.6	68.3	0.4	59.8	0.2
160	55.1	0.7	66.7	0.4	59.3	0.4
200	54.3	0.2	63.8	0.7	63.3	1.0
250	49.5	0.3	59.6	0.6	55.1	0.5
315	48.5	0.1	57.4	0.1	51.5	0.1
400	43.6	0.1	53.3	0.1	45.1	0.3
500	45.5	0.1	47.4	1.1	40.8	0.6
630	41.6	0.7	44.1	1.5	38.5	1.0
800	39.8	0.3	37.5	0.9	36.8	0.8
1000	42.2	0.5	*	-	35.6	1.1
AVE ACCEL LEVEL (DB)	71.4		83.1		75.2	
AVE VELOC LEVEL (DB)	75.7		87.8		81.8	
AVE DISPL LEVEL (DB)	35.9		41.2		40.6	

ACCELERATION - DB RE 1 MICRO-G (RMS).
VELOCITY - DB RE 1 MICRO-INCH-PER-SECOND (RMS).
DISPLACEMENT - DB RE 1 MICRO-INCH (RMS).

* - DATA AT OR BELOW INSTRUMENTATION NOISE-FLOOR.

APPENDIX A

ON-SITE OBSERVERS LOG

RAPID TRANSIT VIBRATION OBSERVERS LOG Date Aug. 14, 1980

Location 1546 E 16TH St., Brooklyn, NY Observer Ditomaso

Event	Time	Car Type	Track	No. of Cars	Approx. Speed	Remarks
1	3:10	R42	4	6		NOTE: Track 1: Northbound local; Track 2: Northbound express; Track 3: Southbound express; Track 4: Southbound local
2	3:12:40	R42	2	10		
3		R40/42	3	8		
4		R42	1	8		
5	3:20	R42	1	8		
6		R30/30D	4/2	8/10		2 trains crossed at site
7		R38	4			
8		R44	4	8		
9		R27/30A	1	10		2 trains
		R42	2	10		
10		R27/30A	4	6		
11		R40/42	3	8		
12	3:39	R27/30	1	8		
13	3:42	R27/30	4	8		
14	3:45	R44	2	8	Slow	
15	3:40	R42	1	8		
16	3:52	R42	2	10	Slow	
17		R27/30	1	10		2 trains crossed at site
		R42	4	10		
18	3:55	R27/30	3	10		
19	4:02	R32	1	8		
20		R40/42	2	10		
21		R40/42/44	3	10		
22	4:03	R27/30	4	8		
23		R42	3	10		Flat wheel on first car
24		R27/30	1	8		
25		R27/30	1	8		
26	4:16	R27/30	4	10		
27	4:17	R27/30	1	10		
28		R40/42	3	10		

RAPID TRANSIT VIBRATION OBSERVERS LOG Date Aug. 14, 1980

Location 1546 E16TH St., Brooklyn, NY Observer Ditomaso

Event	Time	Car Type	Track	No. of Cars	Approx. Speed	Remarks
29		R 27/30	1	8		
30		R27/30	4	8		
31		R40/42	1	10		
32		R27/30	1	10		
33		R38	1/2			2 trains
34		R27/30	1	10		
35		R44	3	8		
36		R27/30	4	10		
37		R44	2	8		
38		R44	3	8		
39	4:42	R40/42	2	10		
40		R27/30	4	8		
41		R27/30	3	10		
42		R27/30	1	10	10 mph	
43		R44	3	8	10 mph	
44		R44	2	8	10 mph	Partially loaded
45		R40	3	10		Fully seated and standing
46		R32	4	8		
47		R27/30	1	8		
48		R42	3	8		Fully seated
49	5:00	R44	2	8		
50	5:06	R40/42	3	8		
51	5:08	R27/30	1/2	10/10		2 trains
52	5:22	R40/42	2	10		Partially loaded
53	5:22	R27/30	1	8	25 mph	Partially loaded
54	5:25	R27/30	4	10		Fully loaded
55	5:26	R40/42	3	10		Fully loaded
56		R40/42	4/2			2 trains crossed at site
57		R44	3	8	25 mph	Fully loaded
58		R40/42	3	10	25 mph	Fully loaded

RAPID TRANSIT VIBRATION OBSERVERS LOG Date Aug. 14, 1980

Location 1546 E16TH St., Brooklyn, NY Observer Ditomaso

Event	Time	Car Type	Track	No. of Cars	Approx. Speed	Remarks
59		R32	1	10		Partially loaded
60		R40/42	3	10		Fully loaded
61		R27/30	4	8		Fully loaded
62	5:42	R40/42	2	8		Partially loaded
63	5:42	R40/42	4	10		Fully loaded
64	5:42	R40/42	3	10		Fully loaded
65	5:46	R42/R44	1/2	10/8		2 trains at site Both partially loaded
66		R27/30	3	8		Fully loaded
67		R27/30	4	8		Fully loaded
68		R40/42	2	8	slow	Empty
69		R27/30	1	10		Partially loaded
70		R27/30	4	10		Fully loaded
71		R27/30	3	10		Fully loaded
72	5:59	R32	4	8		Train stopped

RAPID TRANSIT VIBRATION OBSERVERS LOG Date Aug. 15, 1980

Location 1546 E16TH St., Brooklyn, NY Observer Ditomaso

Event	Time	Car Type	Track	No. of Cars	Approx. Speed	Remarks
1		R27/30	1	8		
2		R40/42	2	8		Fully loaded
3		R27/30	4	8	10-15 mph	
4		R44	3	8	10-15 mph	
5		R27/30	4	8	15-20 mph	
6		R32	1	8	10-15 mph	
7		R40/42	2	10	10 mph	Fully loaded
8		R44	3	8	15-20 mph	
9		R38	1	8	10 mph	Fully loaded
10		R40/42	2	10	15 mph	Fully loaded
11		R27/30	4	8	15 mph	Empty
12		R40/42	2	10	15-20 mph	Fully loaded
13		R40/42	3	10	25 mph	Empty
14		R27/30	1	8	15 mph	Empty
15		R44	2	8	10 mph	Fully loaded
16		R27/30	1	8	15 mph	
17		R44	3	8	20-25 mph	
18		R44	2	8	15 mph	Fully loaded
19		R40/42	3	10	20-25 mph	
20		R32	1	8	15 mph	
21		R27/30	4	10	20 mph	
22		R27/30	1	10	15 mph	Partially loaded
23		R27/30	2	10	15-20 mph	Fully loaded
24		R32	4	8	25 mph	Empty
25		R27/30	1	10	15-20 mph	
26		R44	3	8	25 mph	
27		R27/30	1	8	15-20 mph	Empty
28		R40/42	2	10	10 mph	Fully loaded
29		R40/42	2	10	15 mph	Partially loaded
30		R40/42	3	10	15 mph	

RAPID TRANSIT VIBRATION OBSERVERS LOG Date Aug. 15, 1980

Location 1546 E 16TH St., Brooklyn, NY Observer Ditomaso

Event	Time	Car Type	Track	No. of Cars	Approx. Speed	Remarks
31		R27/30	1	8	15 mph	Partially loaded
32		R44	3	8		
33		R44	2	8	15 mph	Fully loaded
34		R27/30	1	8	20 mph	
35		R44	3	8	25 mph	Empty
36		R42	4	8	20 mph	Empty
37		R40/42	2	10	20 mph	Fully loaded
38		R44	3	8	25 mph	Empty
39		R40/42	4	10	25 mph	Empty
40		R27/30	4	10		Empty
41		R32	1	8		Fully loaded
42		R44	2	8		Fully loaded
43		R40/42	3	10		Partially loaded
44		R40/42	1	8	20 mph	Empty
45		R40/42	3	10	25 mph	Empty
46		R27/30	4	8	25 mph	Empty
47		R44	2	8	10 mph	Empty
48		R40/42	1	8	20 mph	Empty
49		R27/30	4	8	20 mph	Empty
50		R44	2	8	15 mph	Partially loaded
51		R40/42	3	10	25 mph	Empty
52		R40/42	2	10	20 mph	Empty
53		R27/30	1	8		Empty

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