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**Site Survey Report
Vibration, AC EMI, and
Acoustics Measurements**

BASKIN ENGINEERING
- BASEMENT
- FLOOR 1

Leo 1550 SEM

Prepared for

UCSC

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1.0 Introduction

The purpose of this measurement survey was to determine the floor vibration, AC EMI and acoustical levels in the Jack Baskin Engineering Building.

2.0 Instrumentation

The instrumentation utilized to conduct the testing is itemized below:

Spectrum Analyzer:	Data Physics ACE DP-104
Accelerometer:	Wilcoxon 731 seismic accelerometer, Serial Number 1791, 100 Volt per G.
EMI coil:	MSI Magcheck 95, 1.0 millivolt per milligauss
Microphone:	RS 33-2050

All instrumentation and the spectrum analyzer are currently calibrated with documentation in place traceable to the National Institute of Standards and Technology.

The analyzer has a low range sensitivity to -130 dB referenced to 1 volt.

3.0 Test Procedures

Data was gathered in the basement and on the 1st floor of the building.

Vibration measurements were made on the floor in three directions at the locations shown in the map below. The EMI and sound pressure measurements were made approximately four feet above the floor.

The RMS velocity measurements were first made at a bandwidth of 250 hertz. Power spectra functions of velocity are produced from the acceleration measurements by integration.

The RMS EMI measurements were performed at a bandwidth of 625 hertz. Power spectra functions of EMI in three directions were recorded on disk for later processing and plotting.

The RMS acoustic levels were measured with a calibrated microphone and the dBA and dBC levels were recorded and reported for each site.

All measurements were recorded on the internal disk of the analyzer for later processing. Measurements were taken under normal operating conditions.

In addition data was taken on the roof of building, close to the building fan units. Measurements were made in all 3 directions for the 6 fans. Figures 1 through 18 – pages 47 through 55 show the

velocity spectra. The fan #fs66 has bad isolators and show velocity levels about 10 times higher than the other 5 fans, as can be seen on figures 13, 14 and 15.

4.0 Specifications

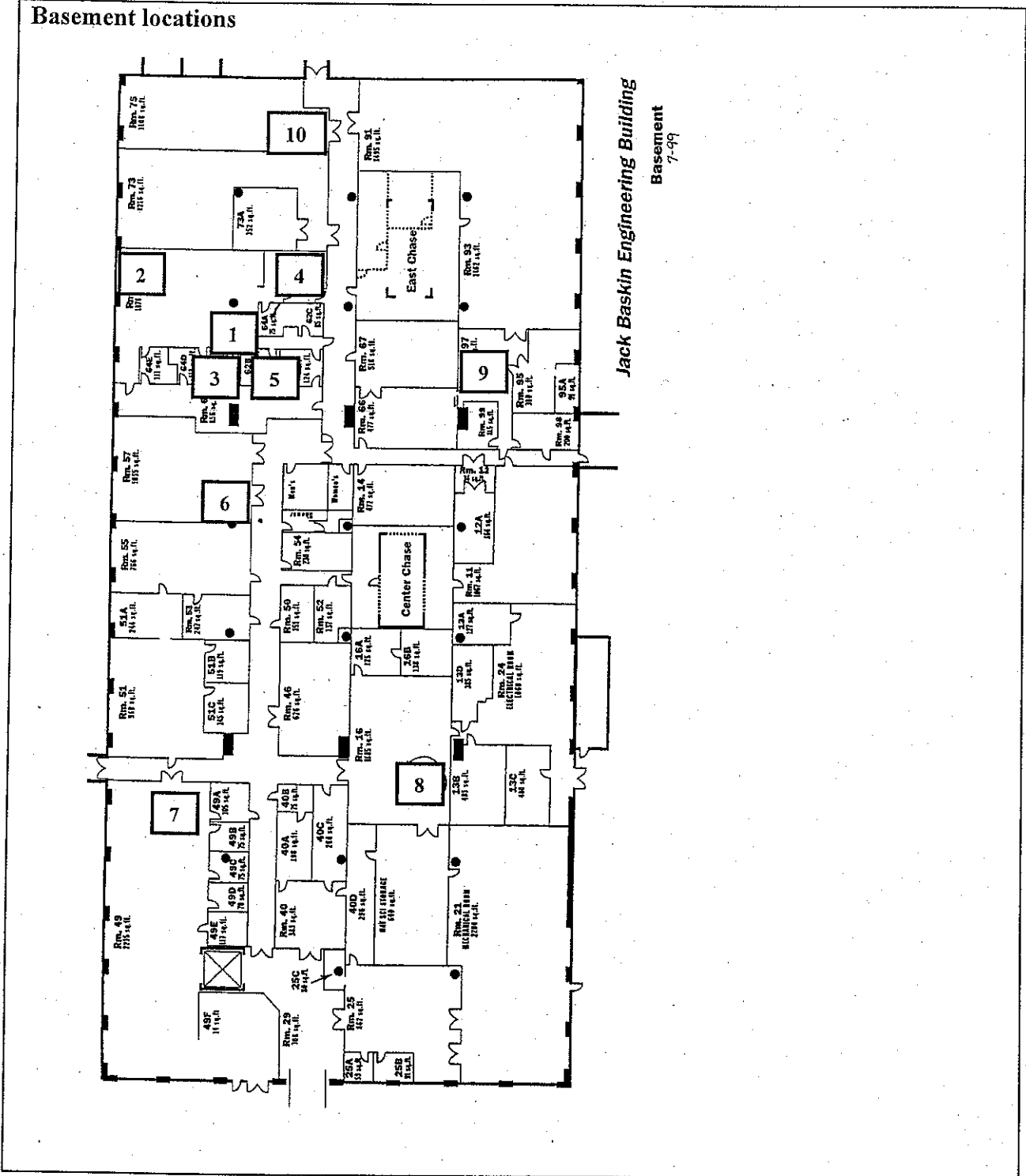
- Vibration: 2 $\mu\text{m}/\text{sec}$ RMS < 20 Hz
 6 $\mu\text{m}/\text{sec}$ RMS > 20 Hz

- EMI: 3 mGauss Peak-to-Peak at 50 and 60 Hz

- Acoustic 50 dBA > 200 Hz
 35 dBA < 200 Hz

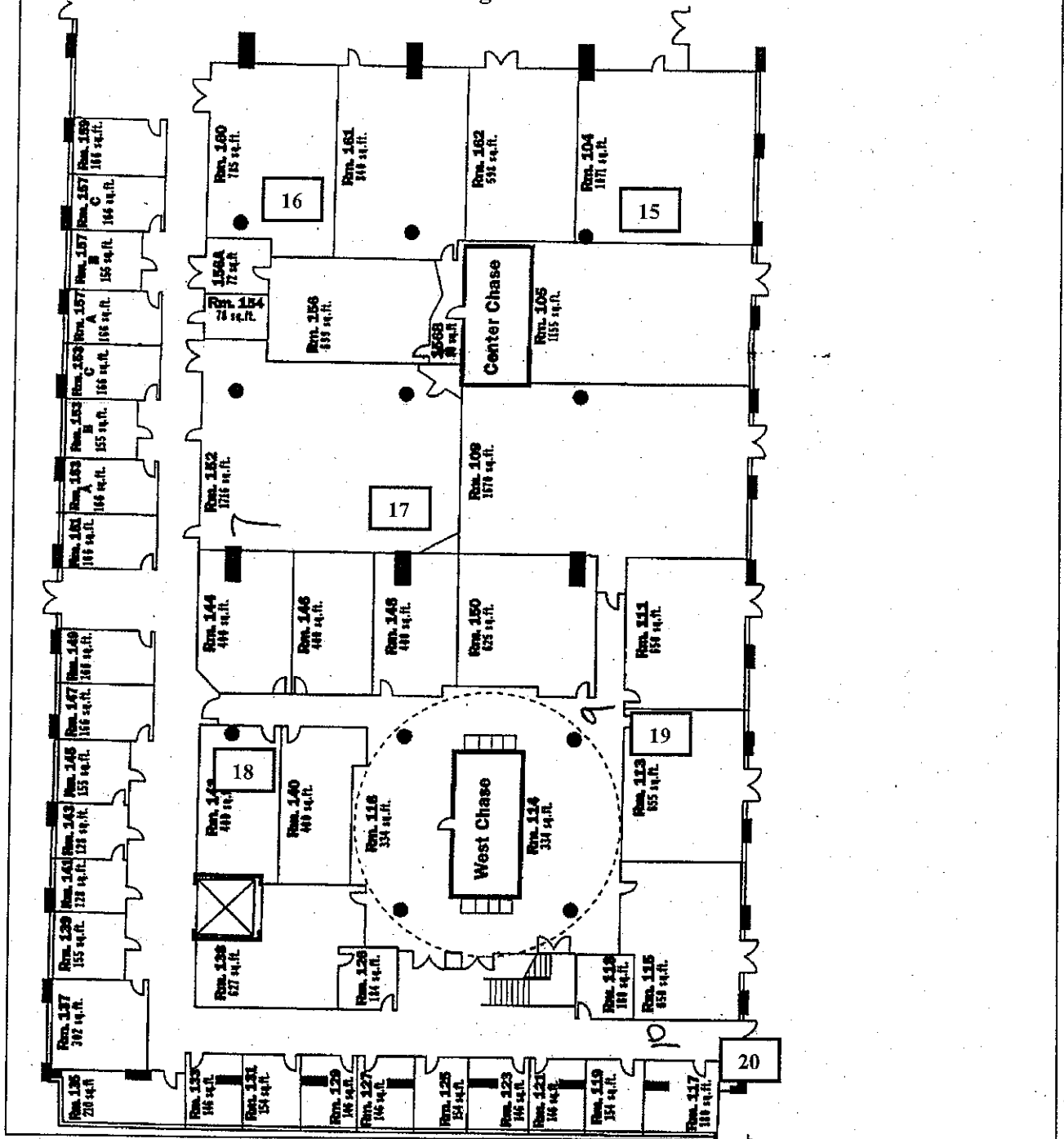
5.0 Measurement locations

Basement locations



Jack Baskin Engineering Building
Basement
7-99

1st Floor locations – West side of building



6.0 Conclusions

- **Vibration:**
The basement meets the LEO specification **except in sites 7, 8 and 9 vertically and 10 in the North-South direction.**
The 1st floor does not meet the specification anywhere.
- **EMI:**
All locations meet the specifications **except for sites 7, 9, 10 and 19. Fields of 9 mGauss RMS were measured on the floor of room 104 (Site 15) and 7 mGauss RMS on the floor of room 113 (Site 19)**
- **Acoustic:**
Sites 3, 4, 5, 6, 7 and 18 meet the LEO acoustical specifications. **All other rooms do not meet them.**
- **Roof fans:**
The fan #FS66 should be fixed so that it is floating freely in all 3 directions on its isolators.

7.0 Recommendations

- A cinderblock room should be built to accommodate the SEM.
- The SEM pumps and transformer should be placed in a chase outside this room.

Vibration Levels				
Site 1 - Room 64				
Direction	Largest Velocity		Total Spectra μm/sec RMS	Save
	microns/sec RMS	Hz		
X North-South	1.7	23.75	2.1	1 ch2
Y East-West	1.5	23.75	2.1	1 ch1
Z Vertical	1.9	23.75	3.1	2
Site 2 - NE corner of Room 64				
Direction	Largest Velocity		Total Spectra μm/sec RMS	Save
	Microns/sec RMS	Hz		
X North-South	0.5	11.25	1.4	5 ch2
Y East-West	0.4	8.12	1	5 ch1
Z Vertical	0.5	20.6	1.2	4
Site 3 - Room 64C				
Direction	Largest Velocity		Total Spectra μm/sec RMS	Save
	Microns/sec RMS	Hz		
X North-South	1	27.19	2.1	7 ch2
Y East-West	0.9	27.19	2.1	7 ch1
Z Vertical	0.8	21.25	1.9	6
Site 4 - Room 64B				
Direction	Largest Velocity, microns/sec RMS		Total Spectra μm/sec RMS	Save
	microns/sec RMS	Hz		
X North-South	0.6	11.25	1.4	9 ch2
Y East-West	0.3	10	1.1	9 ch1
Z Vertical	1.1	29.4	2.3	8
Site 5 - Room 62B				
Direction	Largest Velocity		Total Spectra μm/sec RMS	Save
	microns/sec RMS	Hz		
X North-South	0.9	10.9	3	11 ch2
Y East-West	0.6	10.3	2.2	11 ch1
Z Vertical	0.7	29.4	1.8	10
Site 6 - Room 57				
Direction	Largest Velocity		Total Spectra μm/sec RMS	Save
	microns/sec RMS	Hz		
X North-South	0.5	5.3	1.4	13 ch2
Y East-West	0.3	15	1	13 ch1
Z Vertical	1.2	29.4	3.1	12

Site 7 - Room 49				
Direction	Largest Velocity		Total Spectra µm/sec RMS	Save
	microns/sec RMS	Hz		
X North-South	0.5	21.25	1.4	15 ch2
Y East-West	1.1	29.4	1.9	15 ch1
Z Vertical	9.8	29.1	12.3	14
Site 8 - Room 16				
Direction	Largest Velocity		Total Spectra µm/sec RMS	Save
	microns/sec RMS	Hz		
X North-South	1.4	235.6	2.5	18 ch2
Y East-West	1.4	24.1	2.5	18 ch1
Z Vertical	9.6	29.1	14.4	17
Site 9 - Room 97				
Direction	Largest Velocity		Total Spectra µm/sec RMS	Save
	microns/sec RMS	Hz		
X North-South	4.6	24.1	5.7	20 ch2
Y East-West	1.3	24.4	2.5	20 ch1
Z Vertical	6.8	24.4	10.4	19
Site 10 - Room 75				
Direction	Largest Velocity		Total Spectra µm/sec RMS	Save
	microns/sec RMS	Hz		
X North-South	2.8	1.25	3	22 ch2
Y East-West	0.5	11.25	1.1	22 ch1
Z Vertical	1.6	24.7	2.3	21
Site 11 - NW Corner of Room 164				
Direction	Largest Velocity		Total Spectra µm/sec RMS	Save
	microns/sec RMS	Hz		
X North-South	1.6	5.3	3.1	6 ch1
Y East-West	1	24.4	2.6	6 ch2
Z Vertical	3.2	24.4	6.7	5
Site 12 - Room 178				
Direction	Largest Velocity		Total Spectra µm/sec RMS	Save
	microns/sec RMS	Hz		
X North-South	1.7	5.3	3.3	8 ch1
Y East-West	0.7	21.25	2.6	8 ch2
Z Vertical	5.8	29.4	16.2	7

Site 13 - Room 168H				
Direction	Largest Velocity		Total Spectra μm/sec RMS	Save
	microns/sec RMS	Hz		
X North-South	1.7	12.2	4.3	10 ch1
Y East-West	1.4	12.2	3.1	10 ch2
Z Vertical	20.5	12.2	27.3	9
Site 14 - Room 193				
Direction	Largest Velocity		Total Spectra μm/sec RMS	Save
	microns/sec RMS	Hz		
X North-South	2.6	24.7	4.1	12 ch1
Y East-West	1.5	24.7	3.1	12 ch2
Z Vertical	6.7	29.7	16.1	11
Site 15 - Room 104				
Direction	Largest Velocity		Total Spectra μm/sec RMS	Save
	microns/sec RMS	Hz		
X North-South	2.6	5.3	4.6	14 ch1
Y East-West	1.2	21.25	3	14 ch2
Z Vertical	4.6	19.1	9.4	13
Site 16 - Room 160				
Direction	Largest Velocity		Total Spectra μm/sec RMS	Save
	microns/sec RMS	Hz		
X North-South	2.3	5.3	4	16 ch1
Y East-West	2	55	3.5	16 ch2
Z Vertical	5.3	24.4	11.2	15
Site 17 - Room 152				
Direction	Largest Velocity		Total Spectra μm/sec RMS	Save
	microns/sec RMS	Hz		
X North-South	3	5.3	5.6	18 ch1
Y East-West	1.6	29.1	3.5	18 ch2
Z Vertical	5.5	21.25	11.6	17
Site 18 - Room 142				
Direction	Largest Velocity		Total Spectra μm/sec RMS	Save
	microns/sec RMS	Hz		
X North-South	1.7	15.9	4.1	20 ch1
Y East-West	1.4	29.1	2.7	20 ch2
Z Vertical	37.3	29.1	45	19

Site 19 - Room 113				
Direction	Largest Velocity		Total Spectra μm/sec RMS	Save
	microns/sec RMS	Hz		
X North-South	2.2	34.4	5.9	22 ch1
Y East-West	2.4	34.4	5.1	22 ch2
Z Vertical	23.3	29.4	43.6	21
Site 20 - Room 117				
Direction	Largest Velocity		Total Spectra μm/sec RMS	Save
	microns/sec RMS	Hz		
X North-South	4.8	29.1	6.4	24 ch1
Y East-West	1.1	5.3	3.4	24 ch2
Z Vertical	6.8	21.25	9.3	23

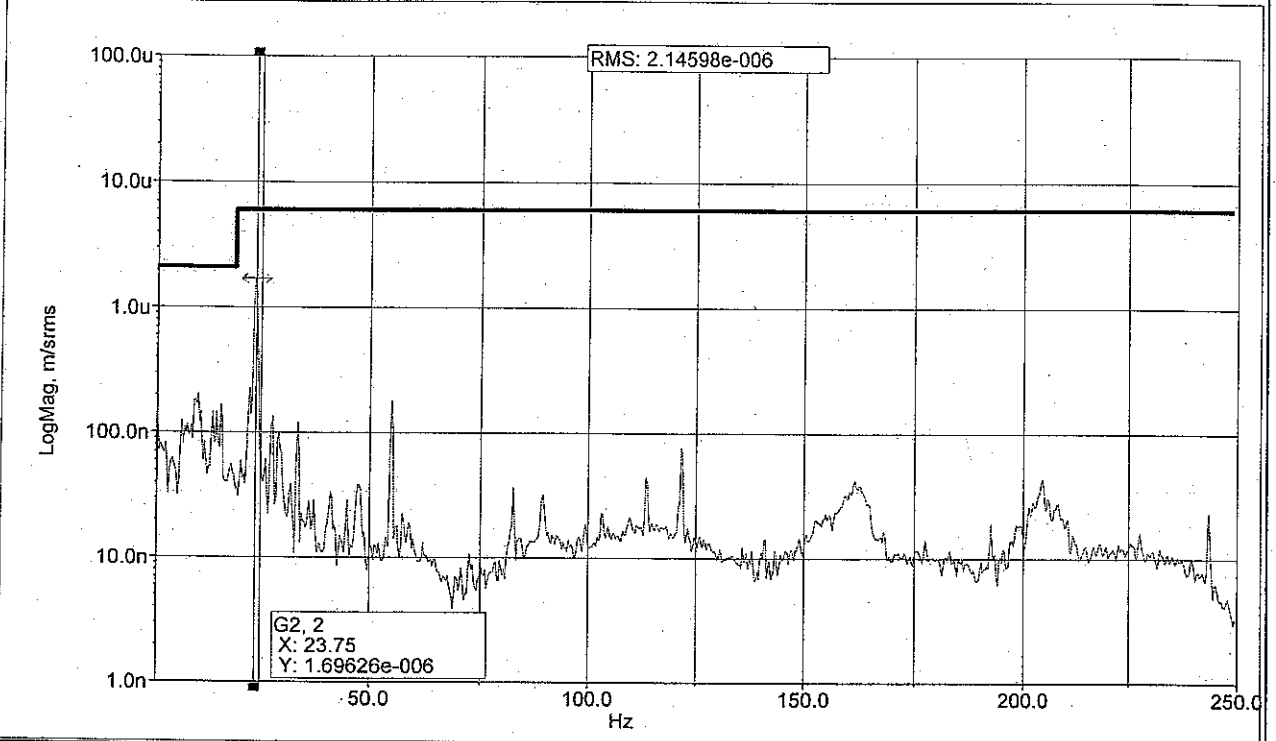
EMI Levels			
Site 1 – Room 64			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	0.42	0.16	2
Y	0.77	0.17	1
Z	1.92	0.87	3
Site 2 – NE corner of Room 64			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	2.28	0.19	5
Y	0.53	0.09	4
Z	0.28	0.02	6
Site 3 – Room 64C			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	1.64	0.13	8
Y	0.66	0.02	7
Z	2.69	0.14	9
Site 4 – Room 64B			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	0.49	0.10	11
Y	0.61	0.16	10
Z	0.42	0.05	12
Site 5 – Room 62B			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	0.75	0.05	14
Y	0.32	0.09	13
Z	1.56	0.04	15
Site 6 – Room 57			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	0.33	0.06	17
Y	0.17	0.03	16
Z	0.26	0.07	18
Site 7 – Room 49			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	2.35	1.04	20
Y	3.25	1.40	19
Z	1.57	0.61	21
Site 8 – Room 16			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	1.19	0.40	23
Y	0.63	0.83	22
Z	0.17	0.24	24

Site 9 - Room 97			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	4.16	2.65	26
Y	0.90	0.42	25
Z	3.78	0.66	27
Site 10 - Room 75			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	3.56	1.04	29
Y	3.42	1.29	28
Z	0.45	0.35	30
Site 11 - NW Corner of Room 164			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	0.72	0.86	4
Y	0.84	0.28	5
Z	0.72	0.19	6
Site 12 - Room 178			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	0.60	0.26	7
Y	0.79	0.11	8
Z	1.48	0.33	9
Site 13 - Room 168H			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	0.28	0.10	10
Y	0.52	0.23	11
Z	0.53	0.06	12
Site 14 - Room 193			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	1.24	0.45	13
Y	0.73	0.19	14
Z	0.78	0.41	15
Site 15 - Room 104			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	2.64	0.47	16
Y	1.05	0.15	17
Z	2.79	0.52	18
Site 16 - Room 160			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	0.38	0.16	19
Y	0.91	0.13	20
Z	1.32	0.83	21

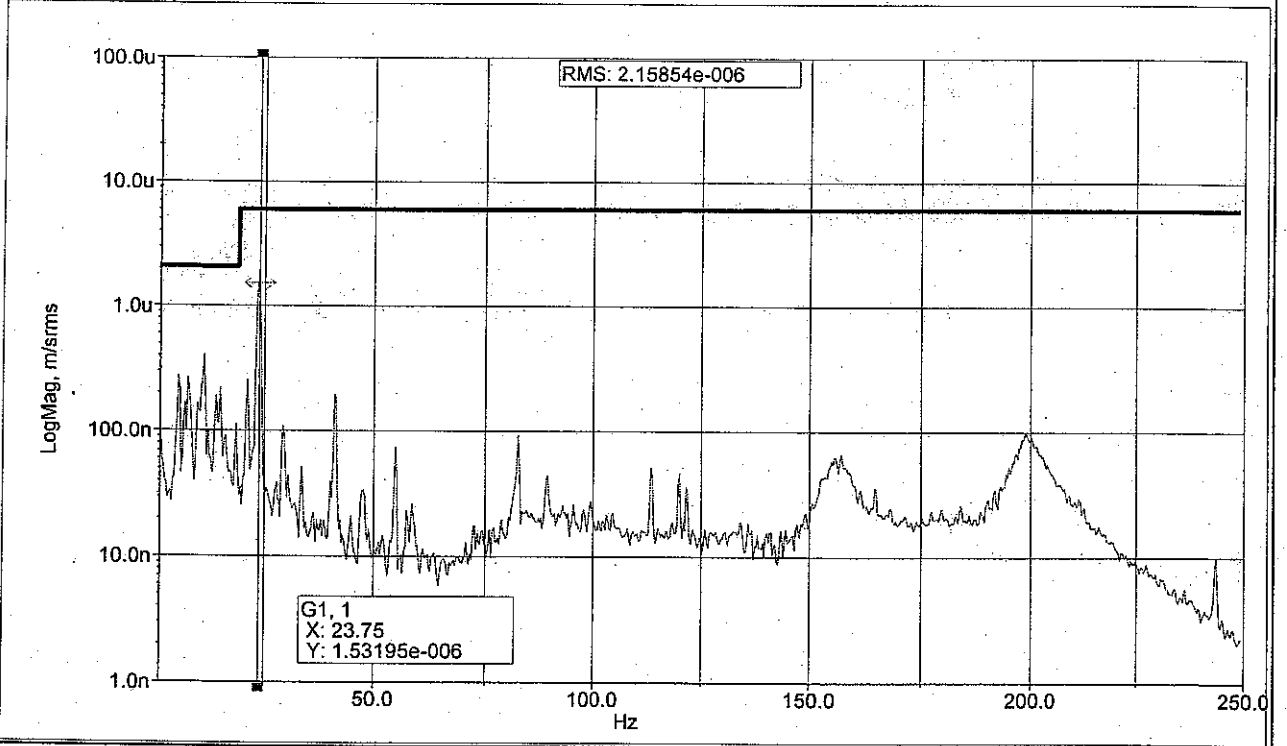
Site 17 - Room 152			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	0.11	0.12	22
Y	1.01	0.16	23
Z	0.23	0.15	24
Site 18 - Room 142			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	0.20	0.03	25
Y	0.21	0.02	26
Z	0.45	0.14	27
Site 19 - Room 113			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	3.26	0.46	28
Y	0.69	0.23	29
Z	0.65	0.18	30
Site 20 - Room 117			
	60 Hz mGauss PtoP	180 Hz mGauss PtoP	Save
X	0.16	0.10	31
Y	0.22	0.11	32
Z	0.32	0.09	33

Acoustics			
	< 200 Hz	> 200 Hz	Save
Site 1	35.9 dBA	39.8 dBA	2
Site 2	36.6 dBA	40.1 dBA	3
Site 3	31.6 dBA	31.4 dBA	4
Site 4	31.4 dBA	30.8 dBA	5
Site 5	33.5 dBA	39.4 dBA	6
Site 6	33.2 dBA	31.9 dBA	7
Site 7	27.2 dBA	23.9 dBA	8
Site 8	39.4 dBA	39.4 dBA	9
Site 9	49.9 dBA	54.2 dBA	10
Site 10	46.6 dBA	48 dBA	11
Site 11	38.7 dBA	44 dBA	3
Site 12	37.1 dBA	40.2 dBA	4
Site 13	42.6 dBA	51.4 dBA	5
Site 14	40.9 dBA	40.9 dBA	6
Site 15	35.3 dBA	34.1 dBA	7
Site 16	38.4 dBA	41.1 dBA	8
Site 17	35.4 dBA	38.6 dBA	9
Site 18	33.3 dBA	32.3 dBA	10
Site 19	35.1 dBA	33.3 dBA	11
Site 20	36.4 dBA	34.3 dBA	12

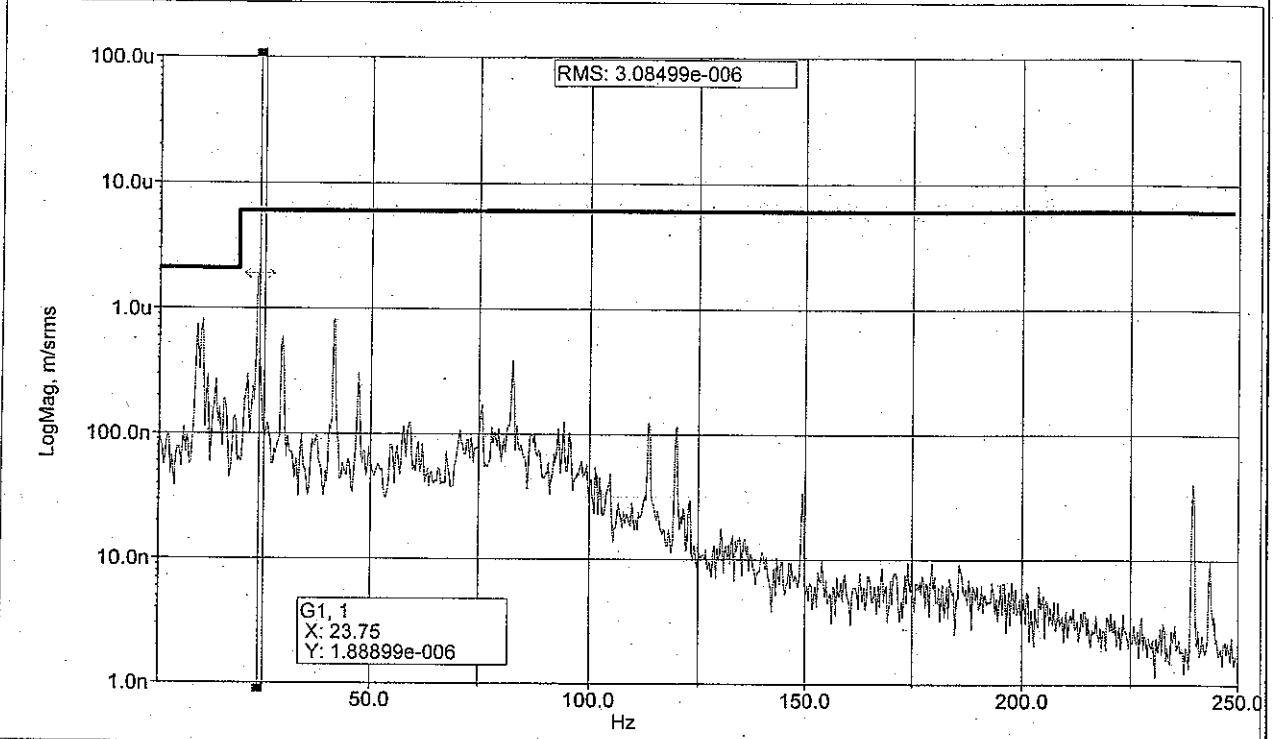
Site I - Velocity RMS - X



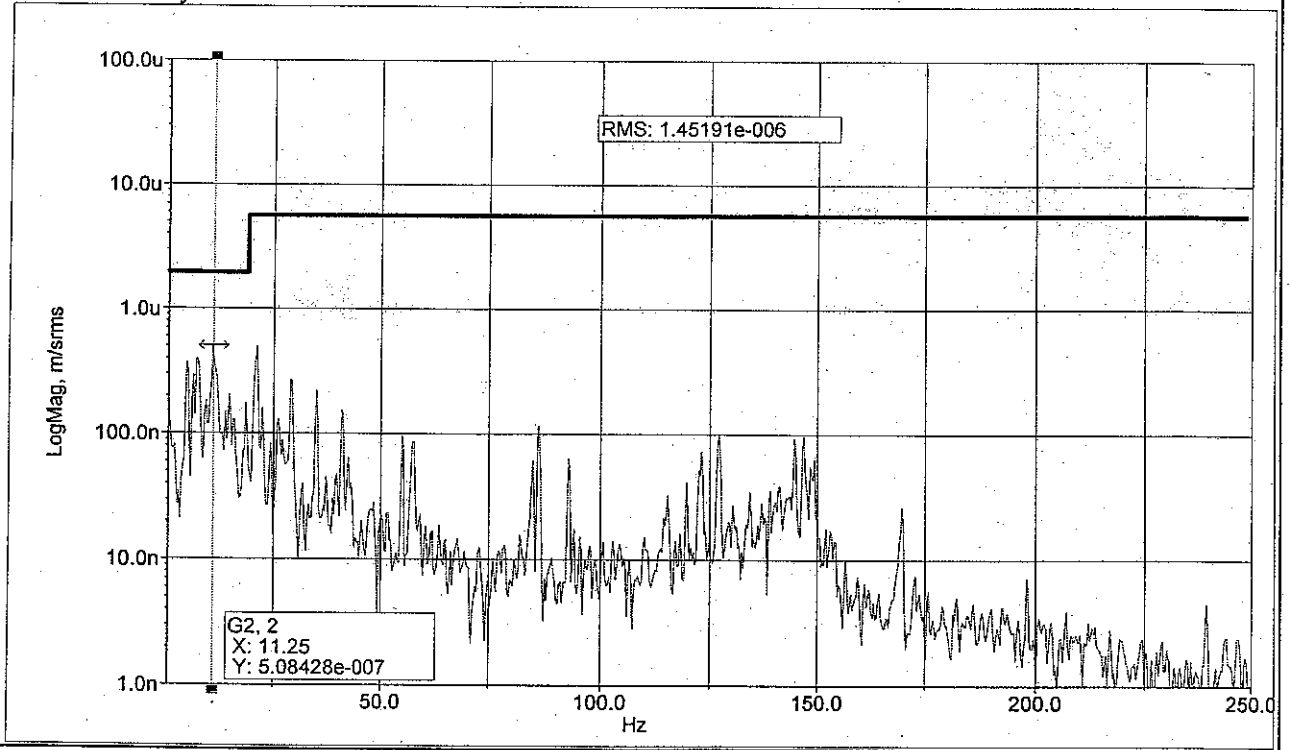
Site I - Velocity RMS - Y



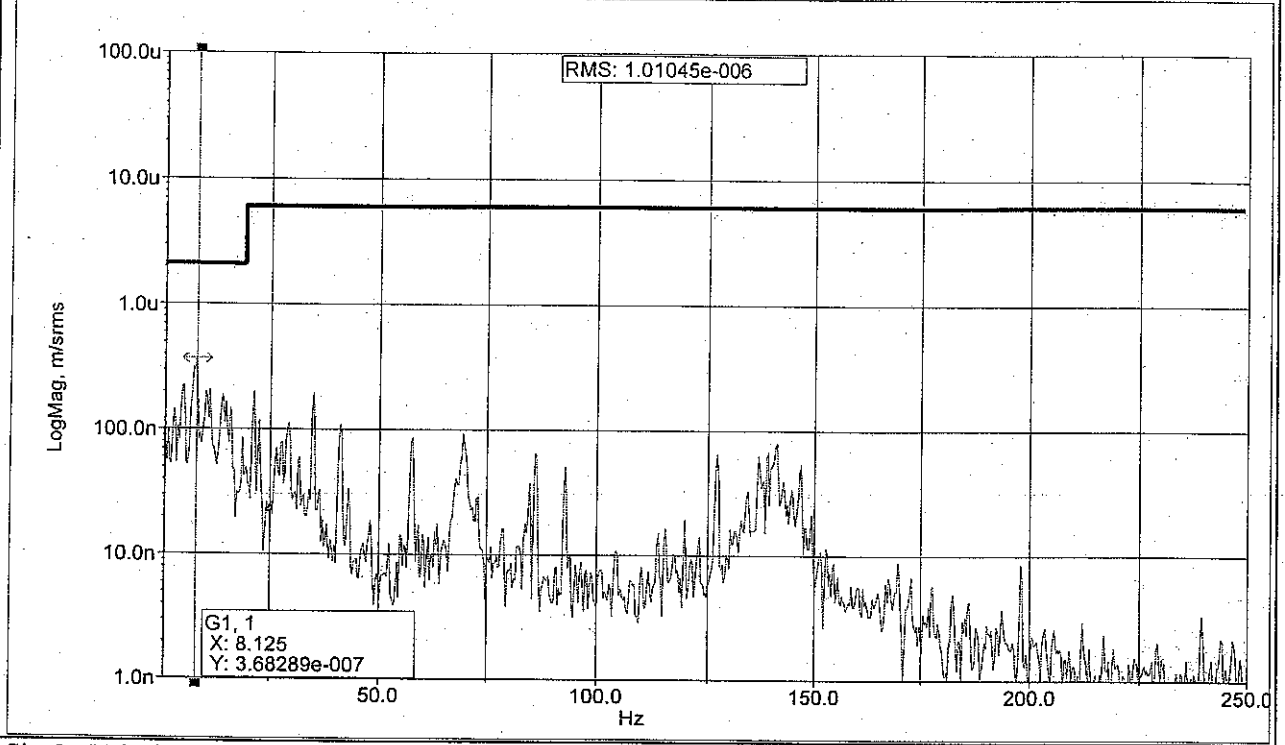
Site 1 - Velocity RMS - Z



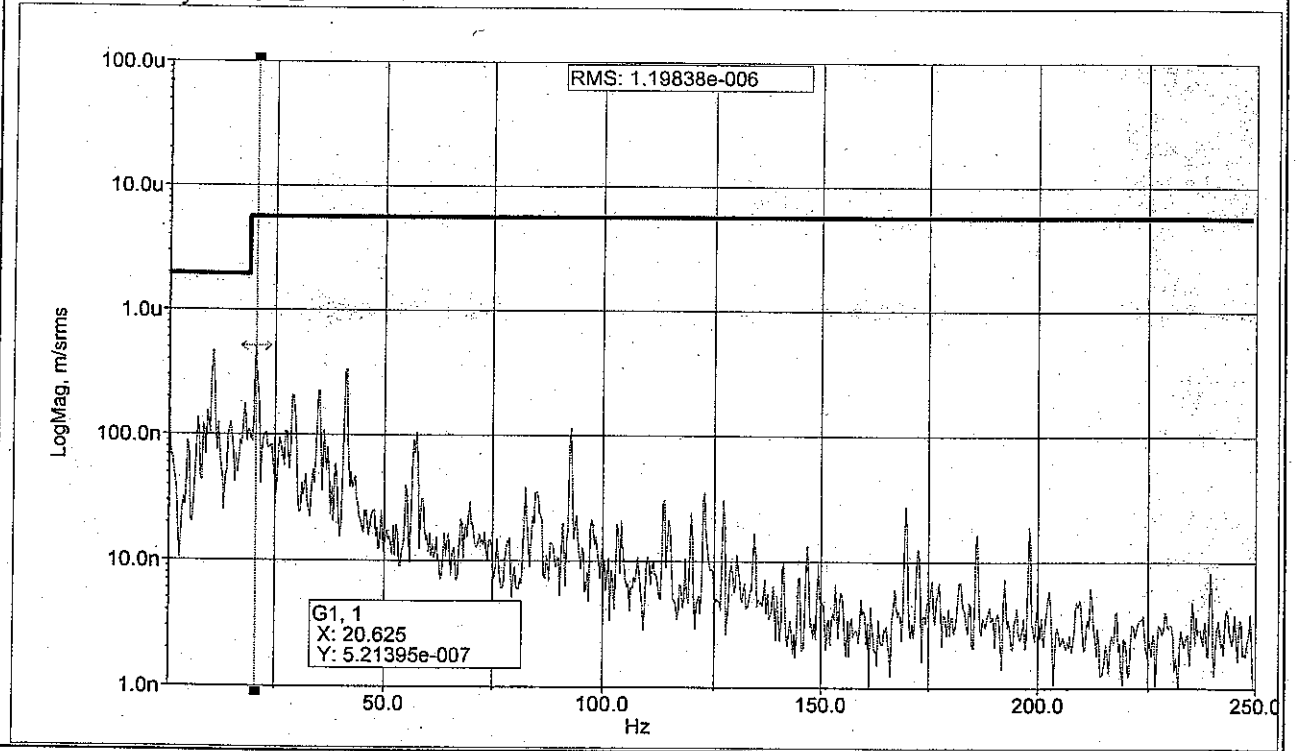
Site 2 - Velocity RMS - X



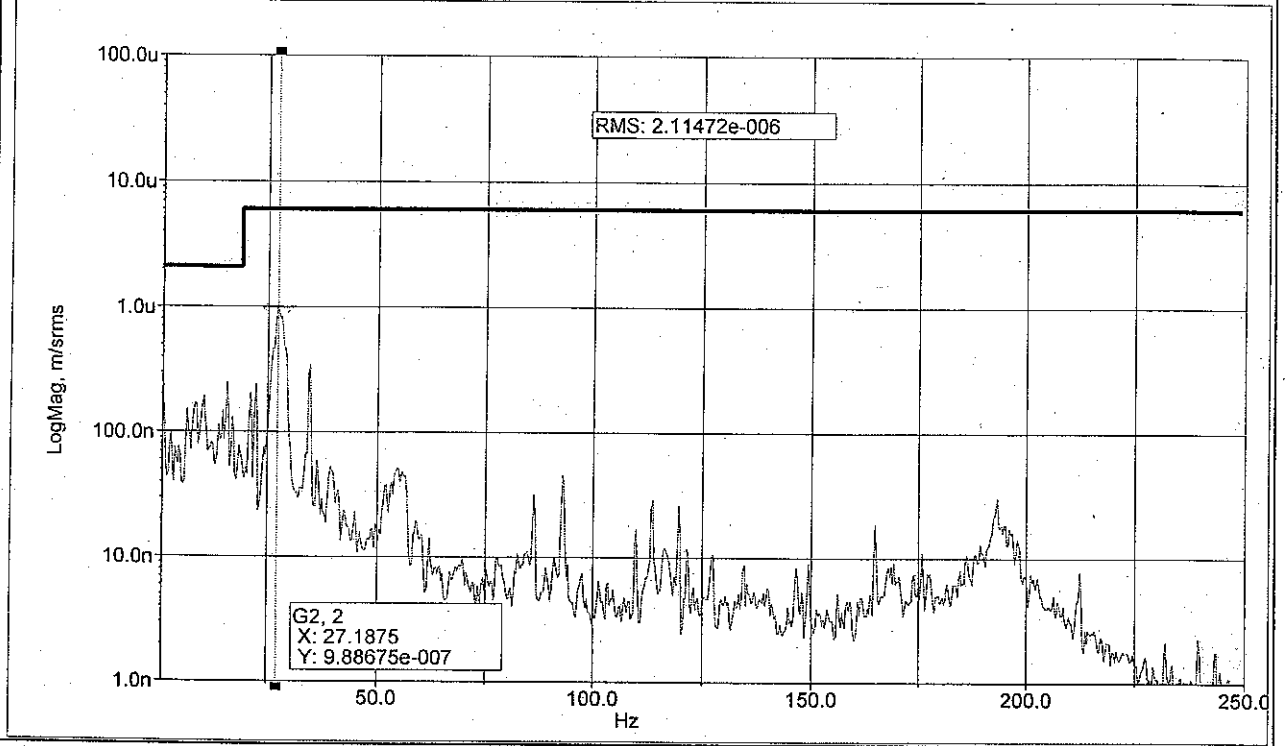
Site 2 - Velocity RMS - Y



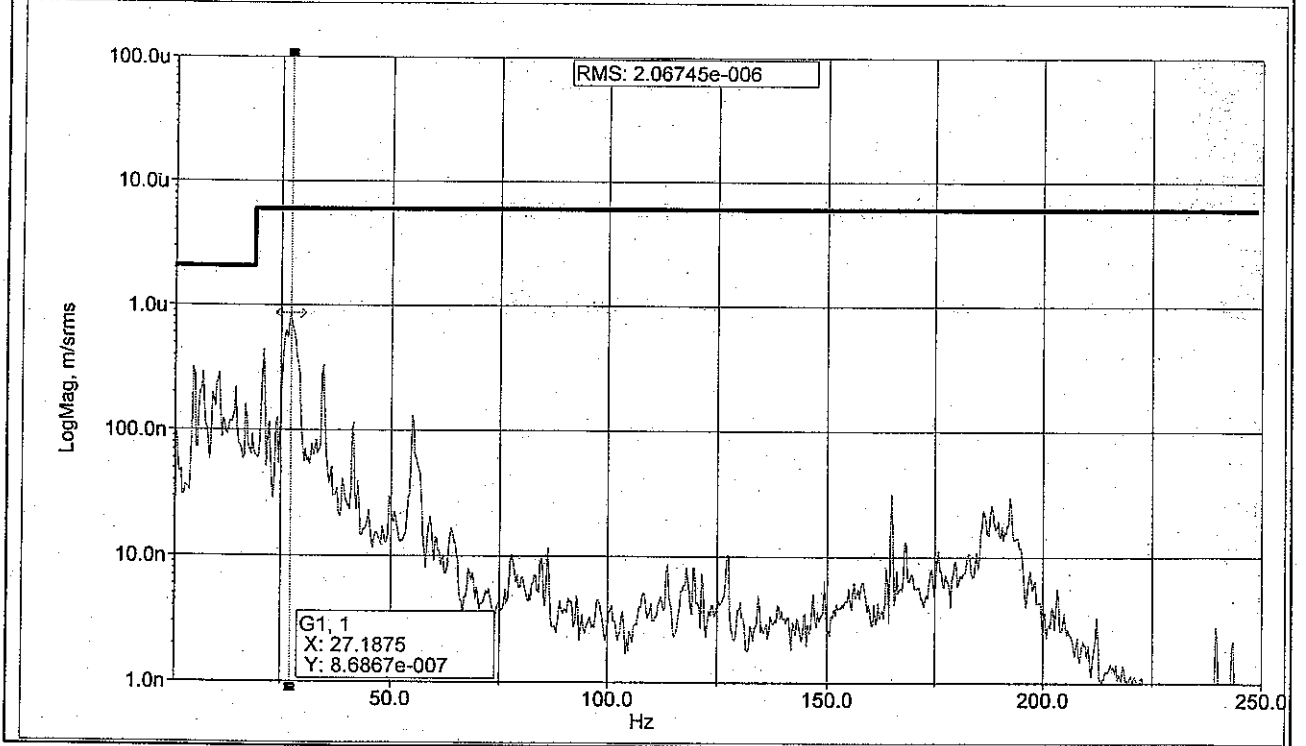
Site 2 - Velocity RMS - Z



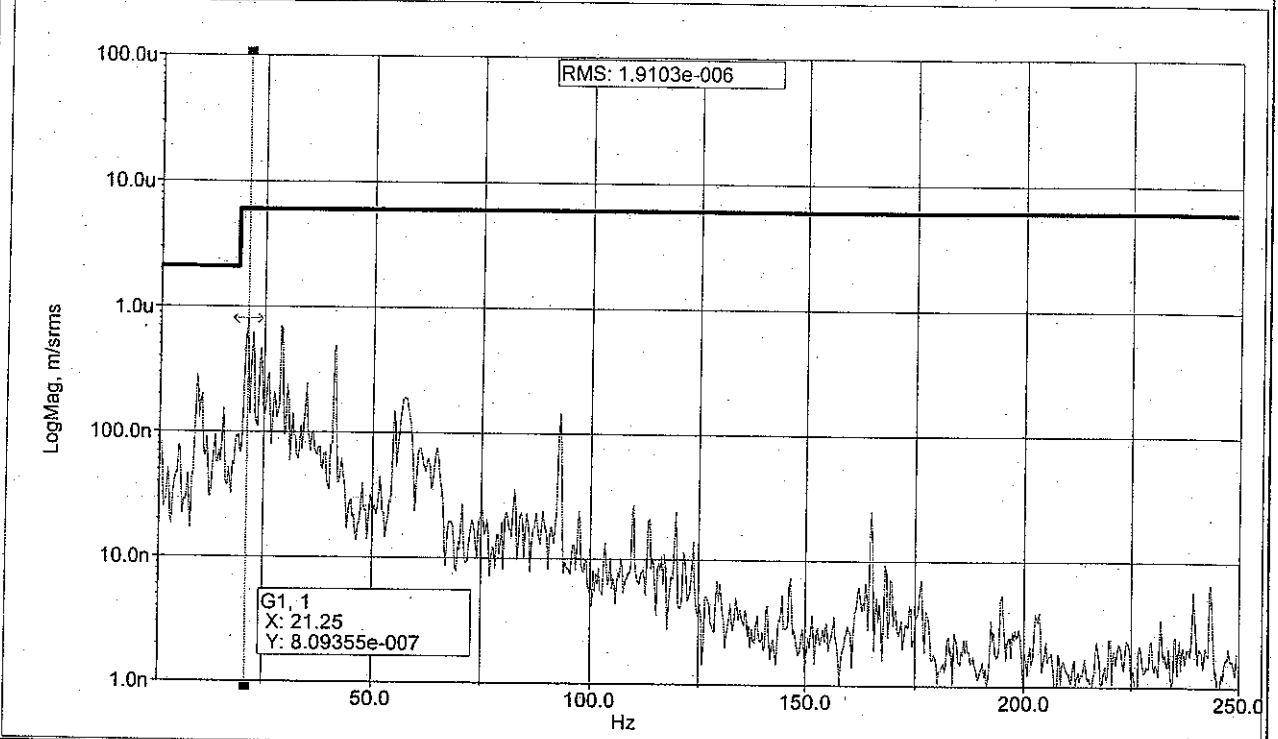
Site 3 - Velocity RMS - X



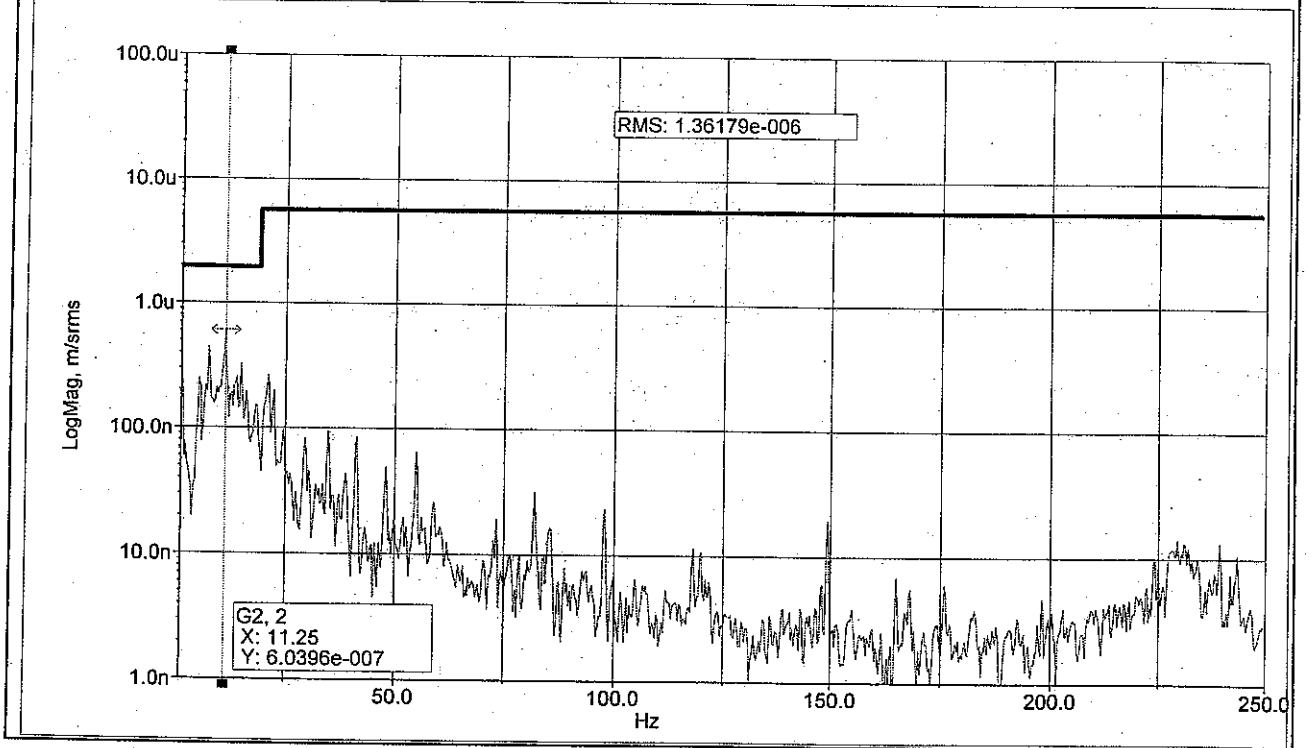
Site 3 - Velocity RMS - Y



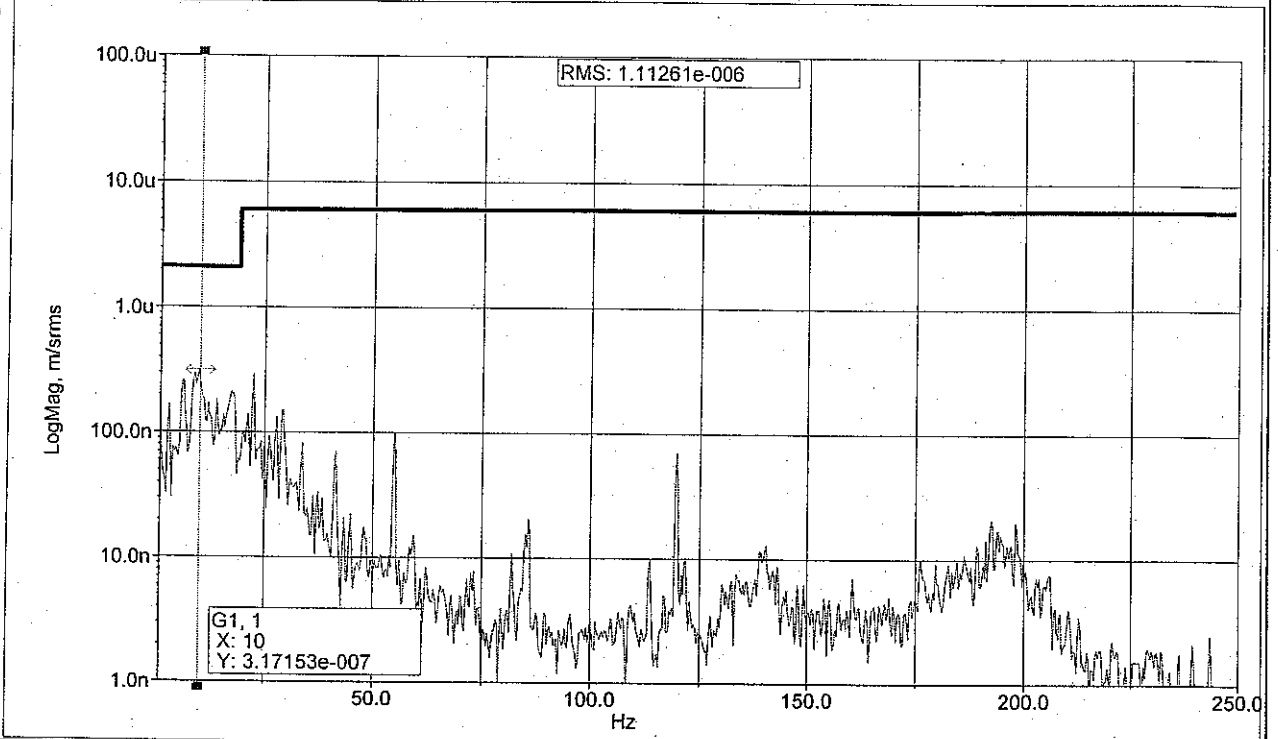
Site 3 - Velocity RMS - Z



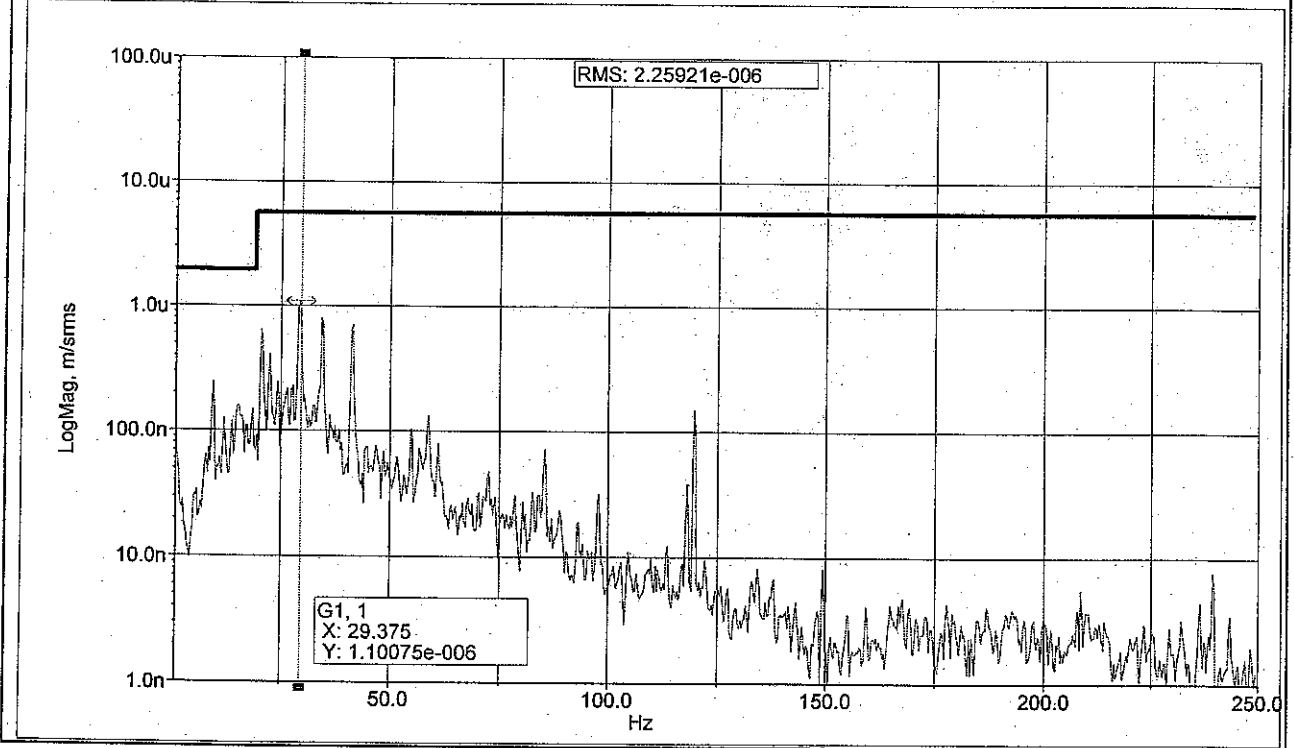
Site 4 - Velocity RMS - X



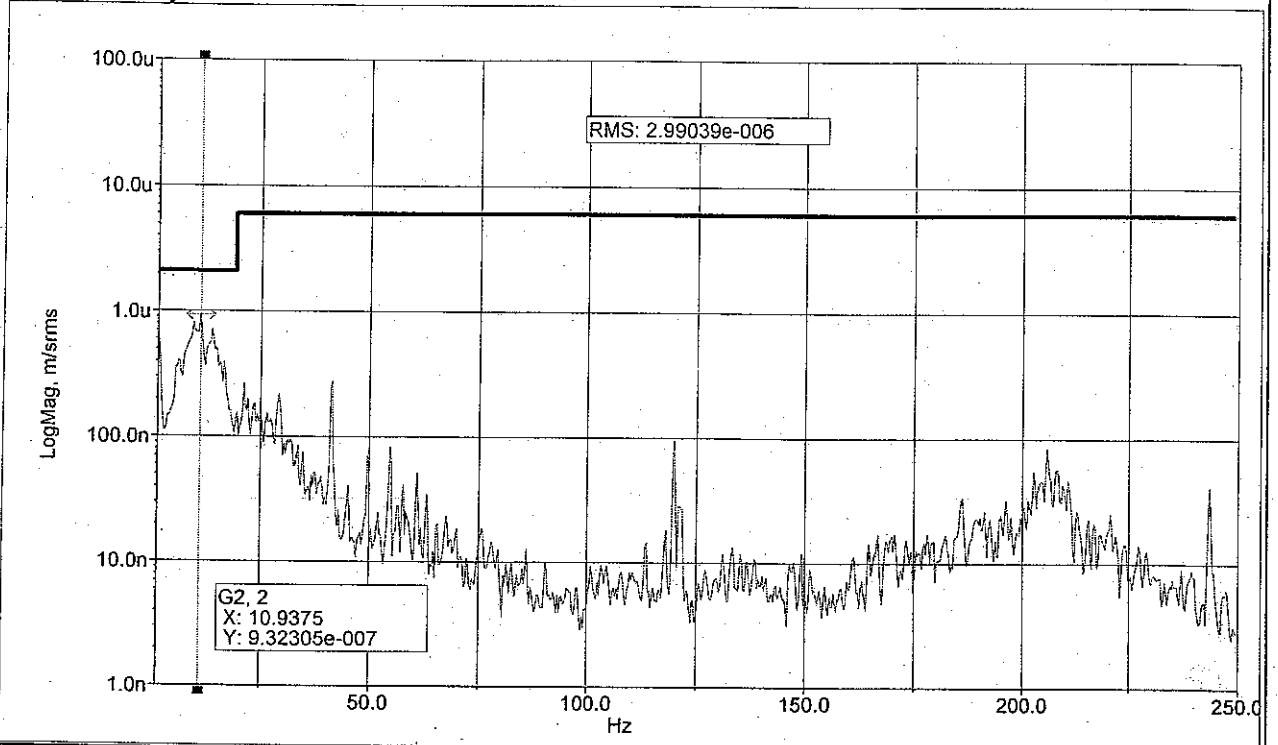
Site 4 - Velocity RMS - Y



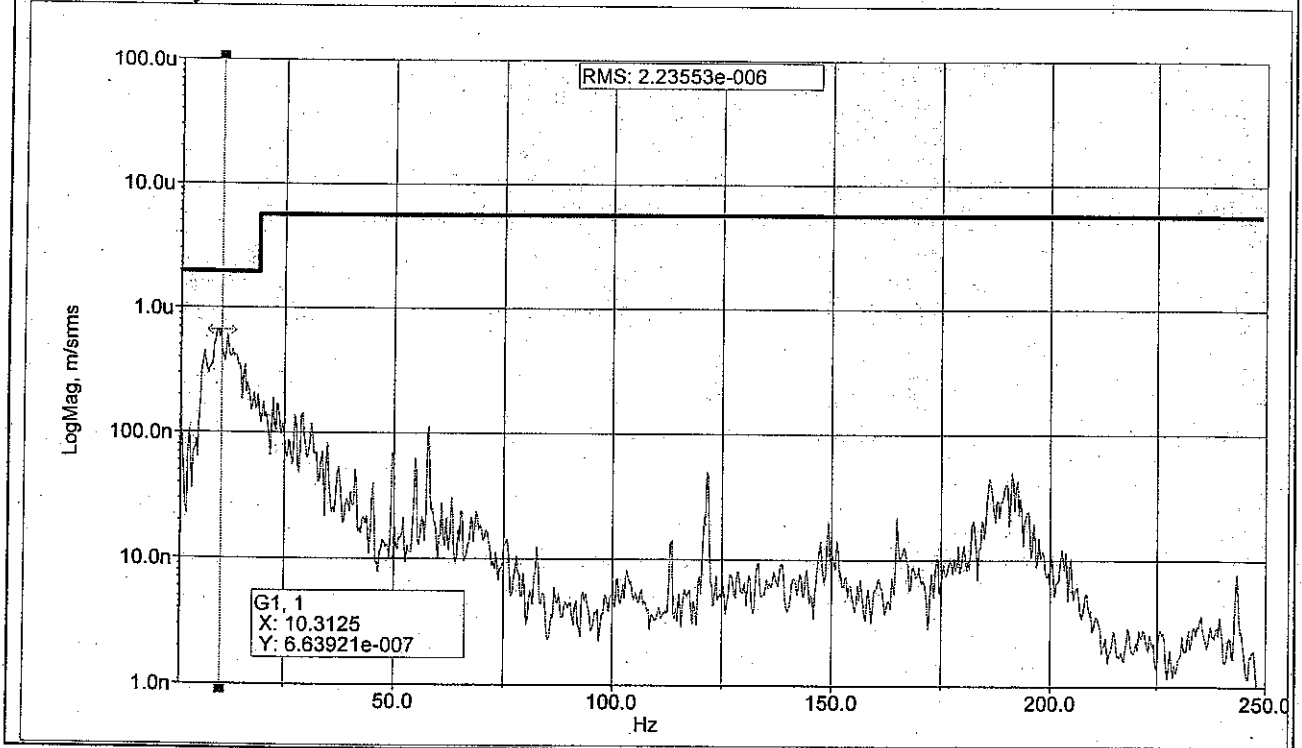
Site 4 - Velocity RMS - Z



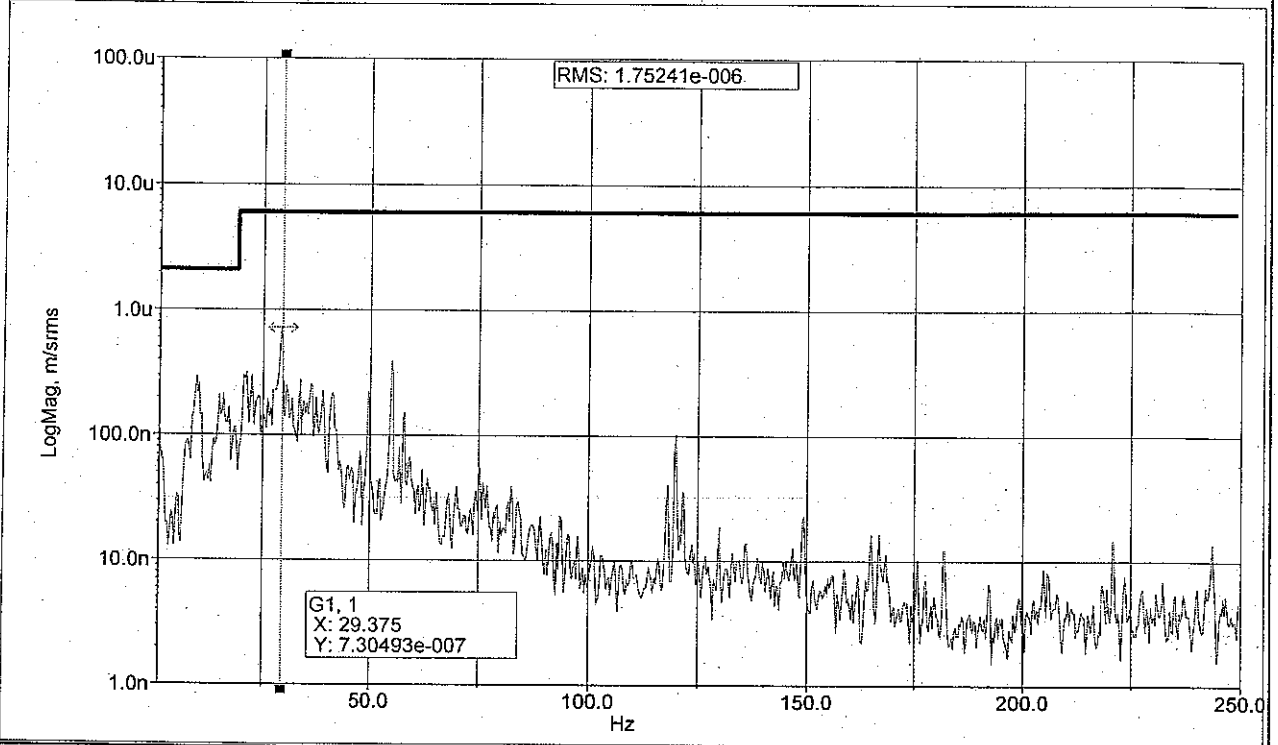
Site 5 - Velocity RMS - X



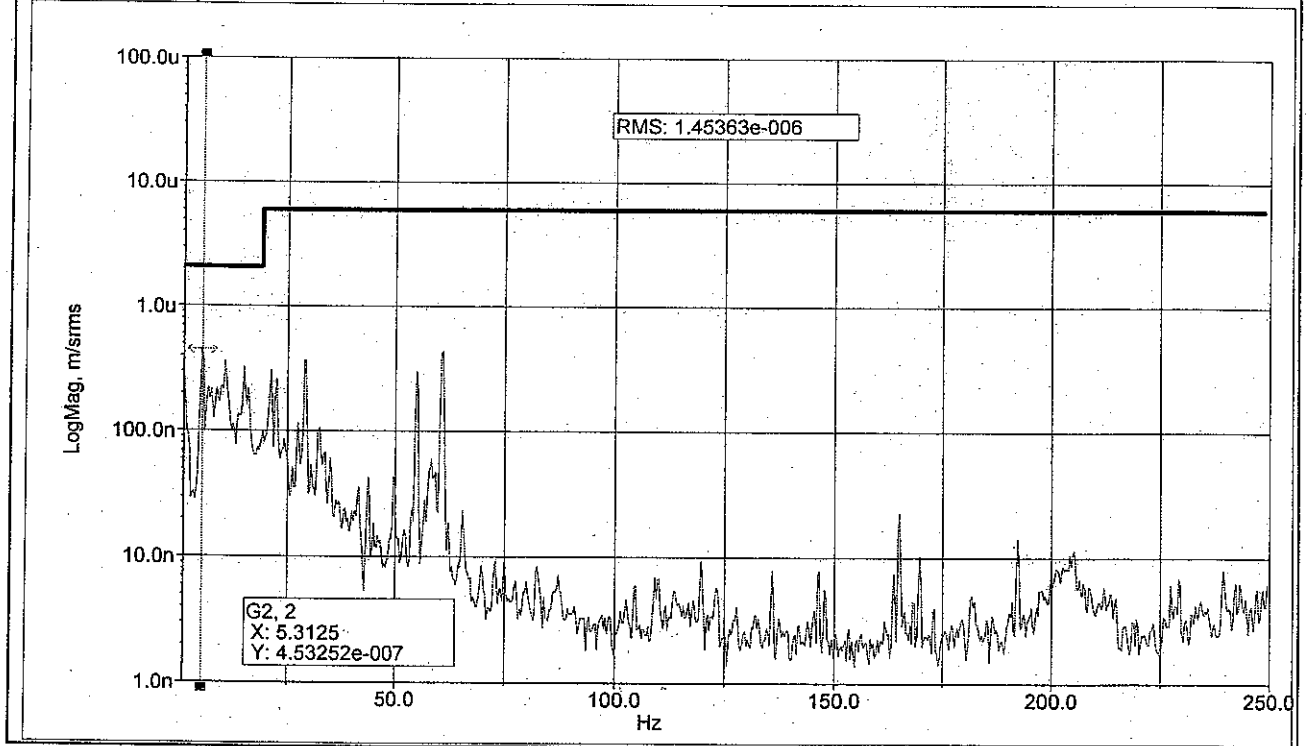
Site 5 - Velocity RMS - Y



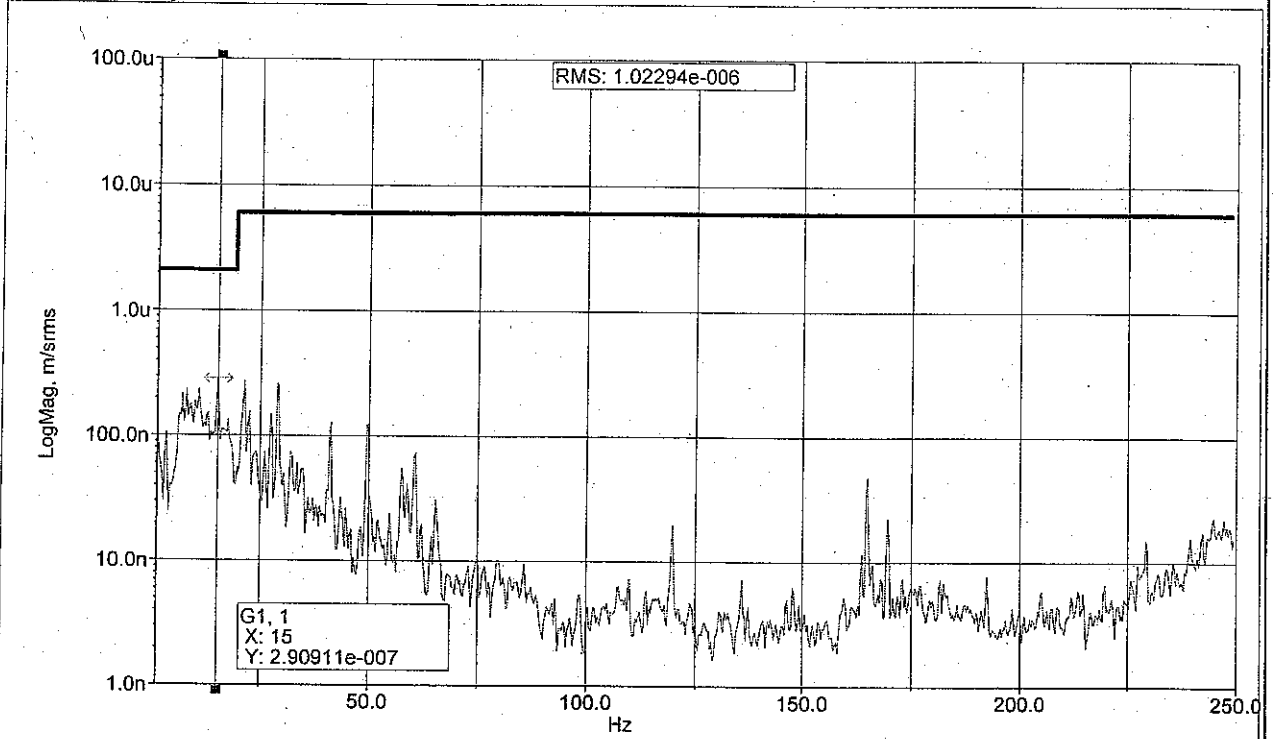
Site 5 - Velocity RMS - Z



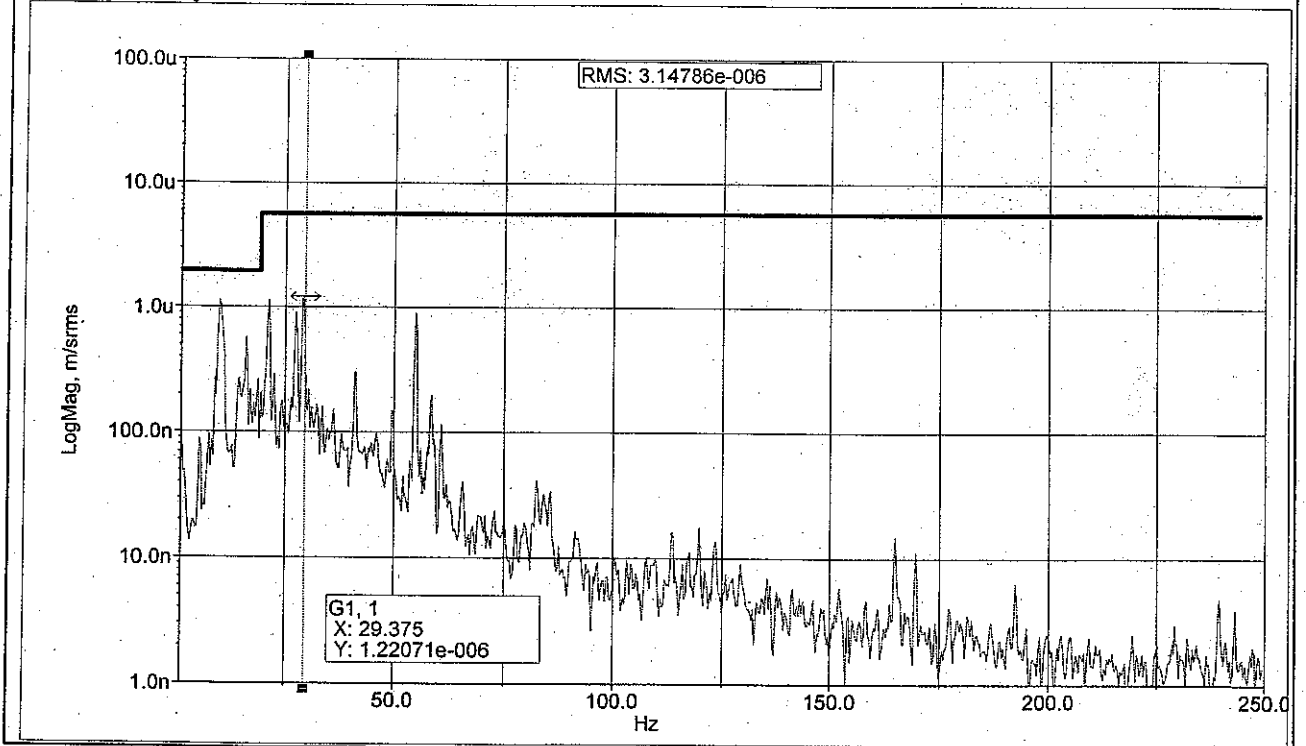
Site 6 - Velocity RMS - X



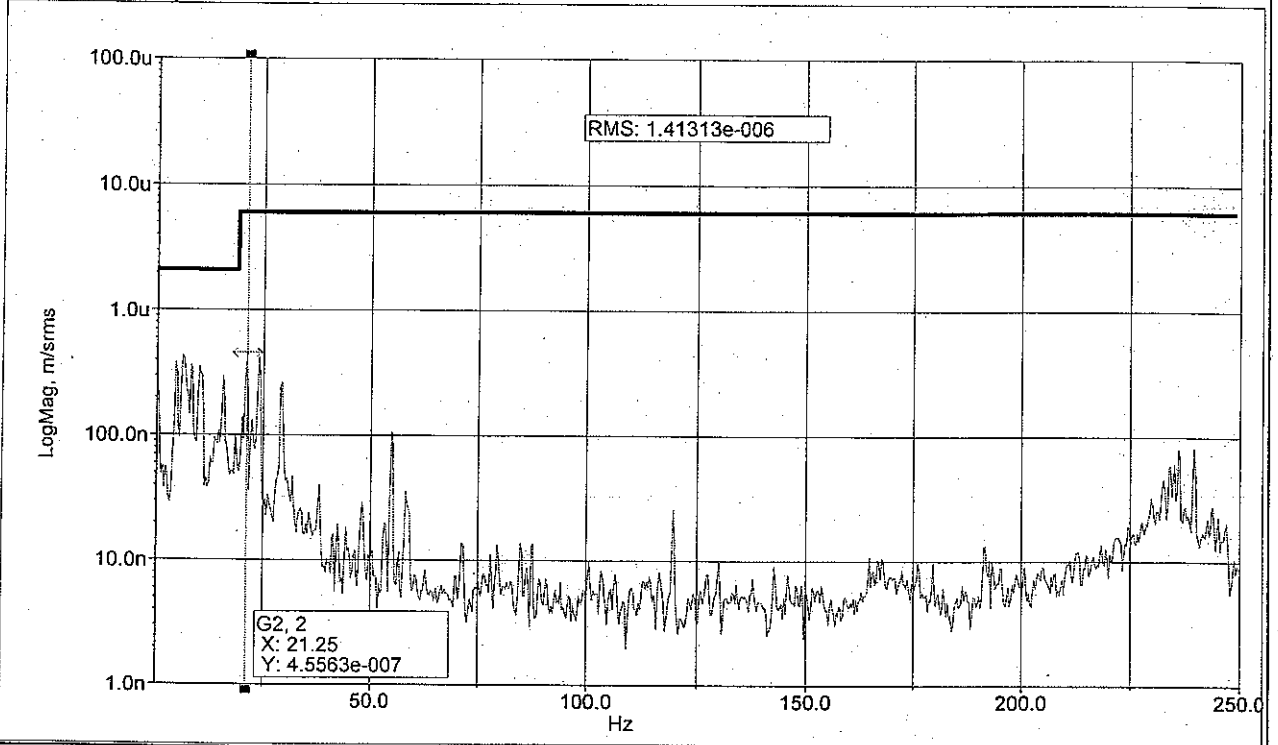
Site 6 - Velocity RMS - Y



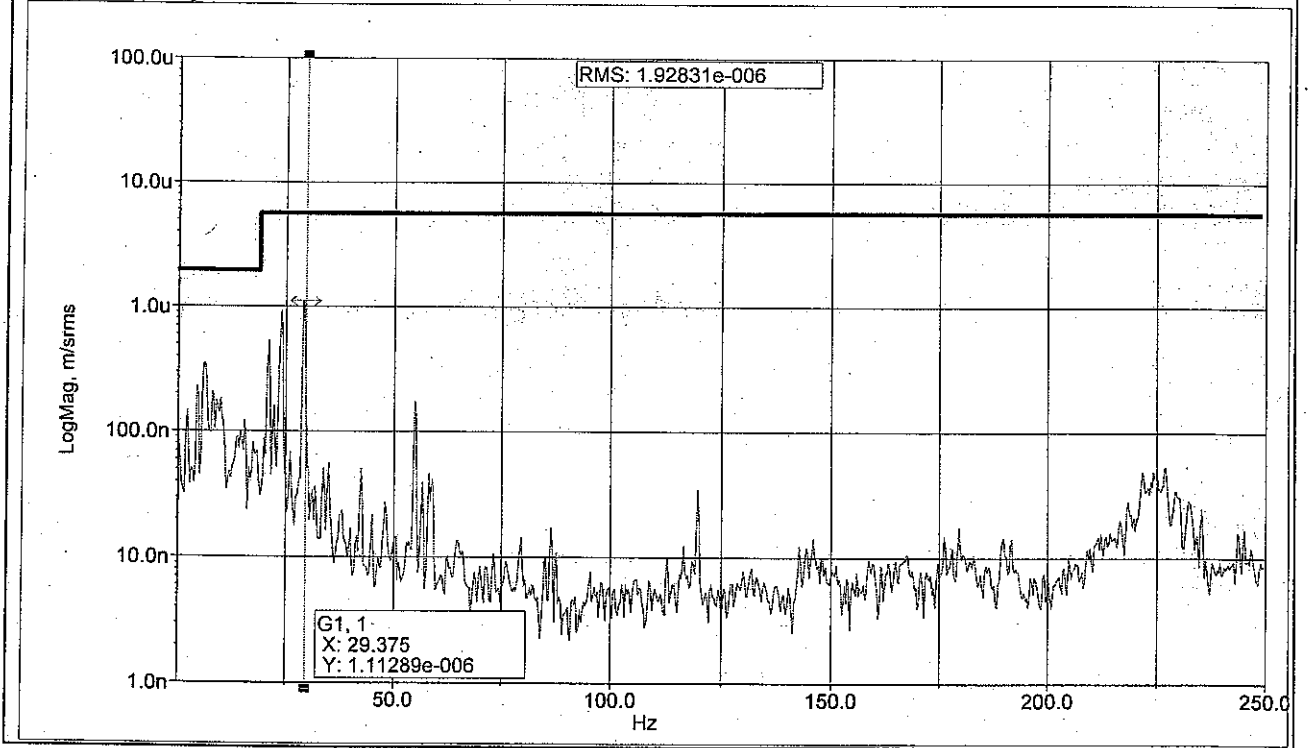
Site 6 - Velocity RMS - Z



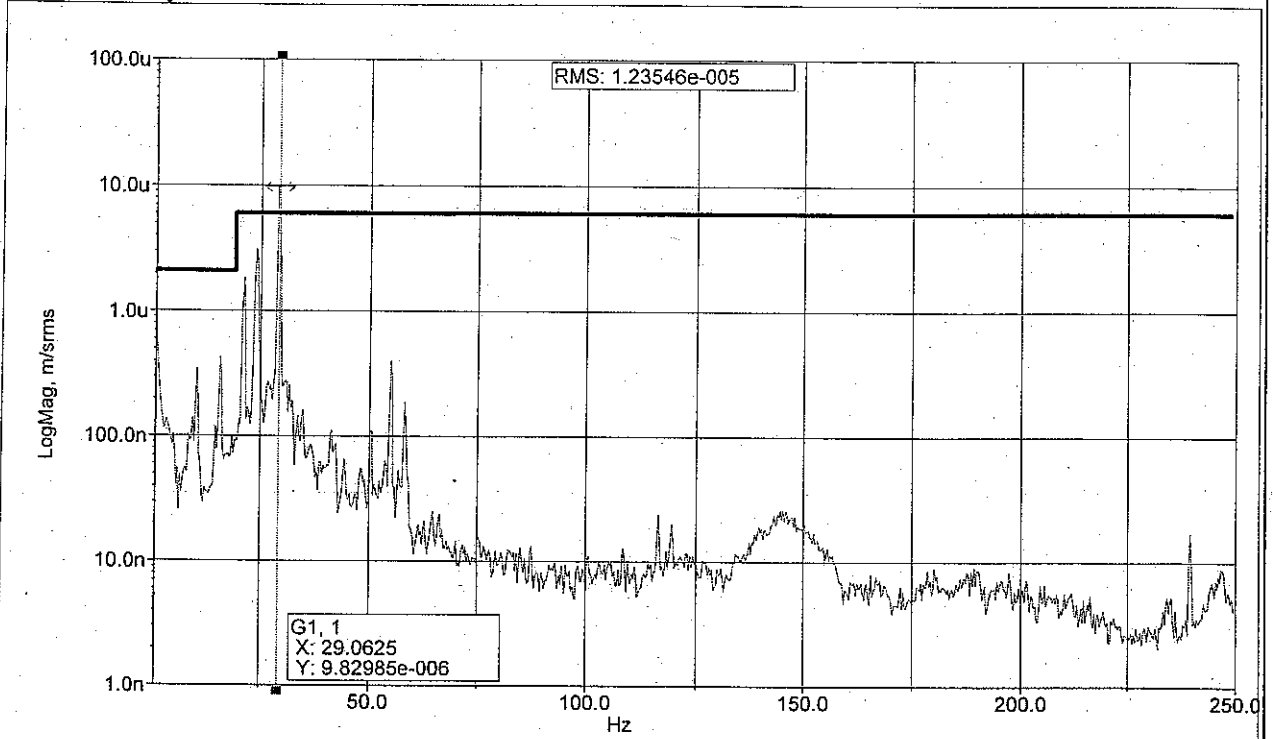
Site 7 - Velocity RMS - X



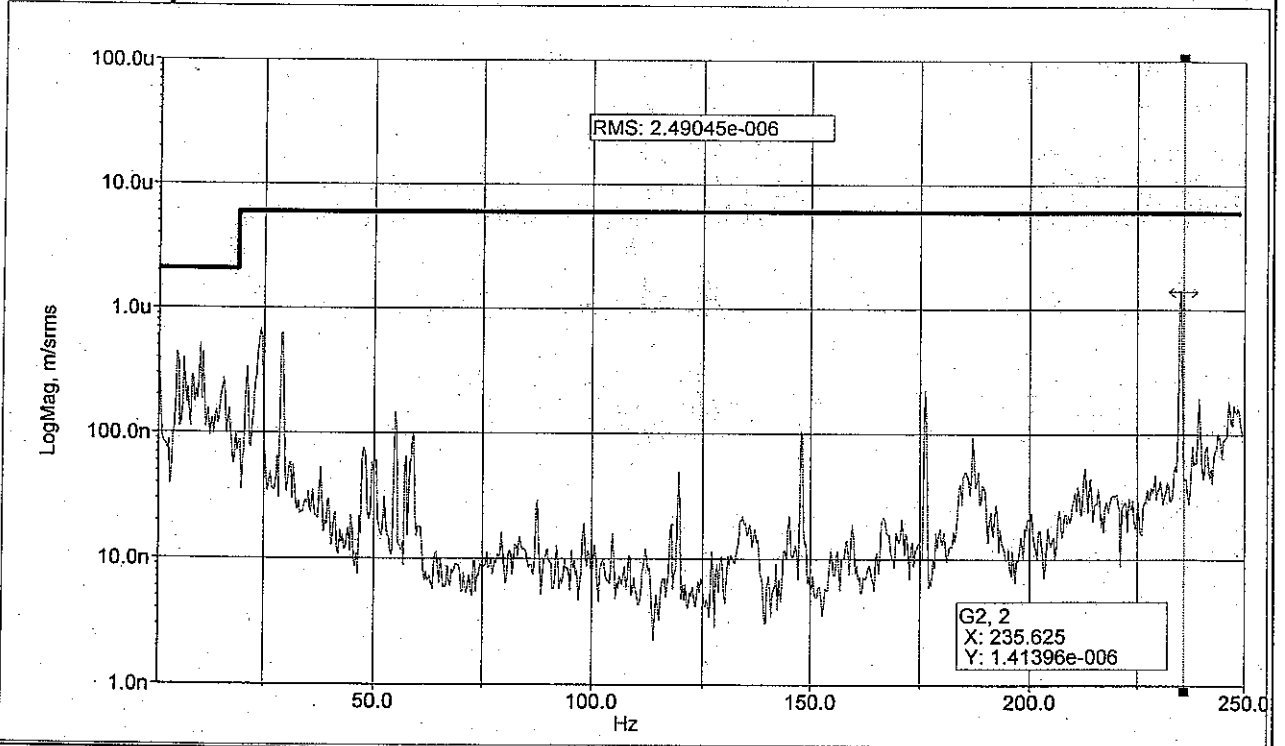
Site 7 - Velocity RMS - Y



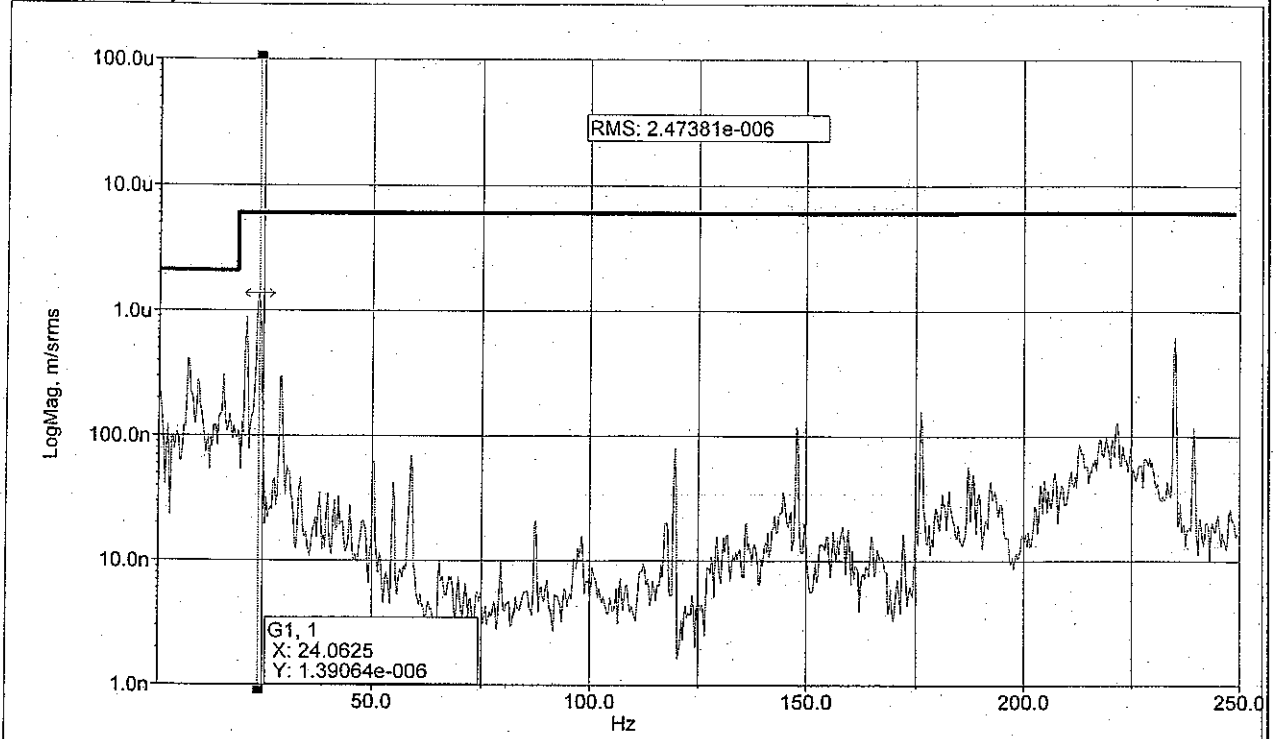
Site 7 - Velocity RMS - Z



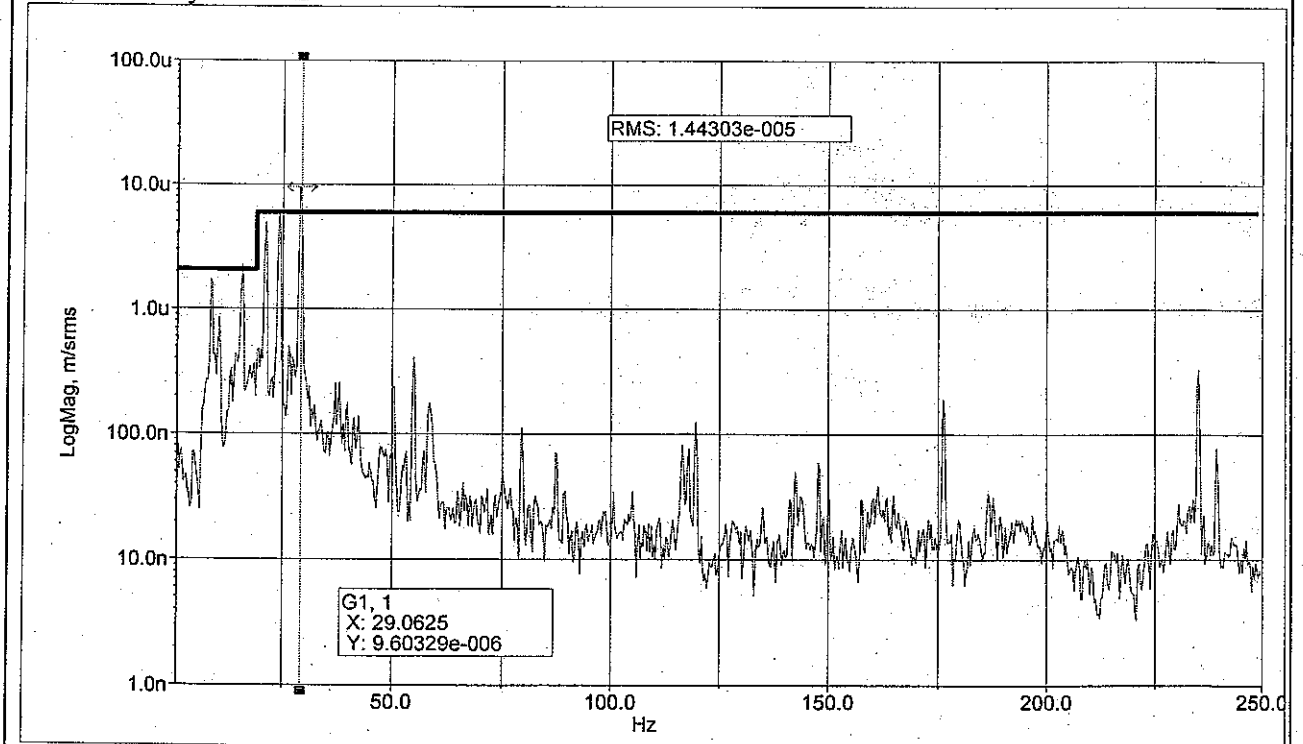
Site 8 - Velocity RMS - X



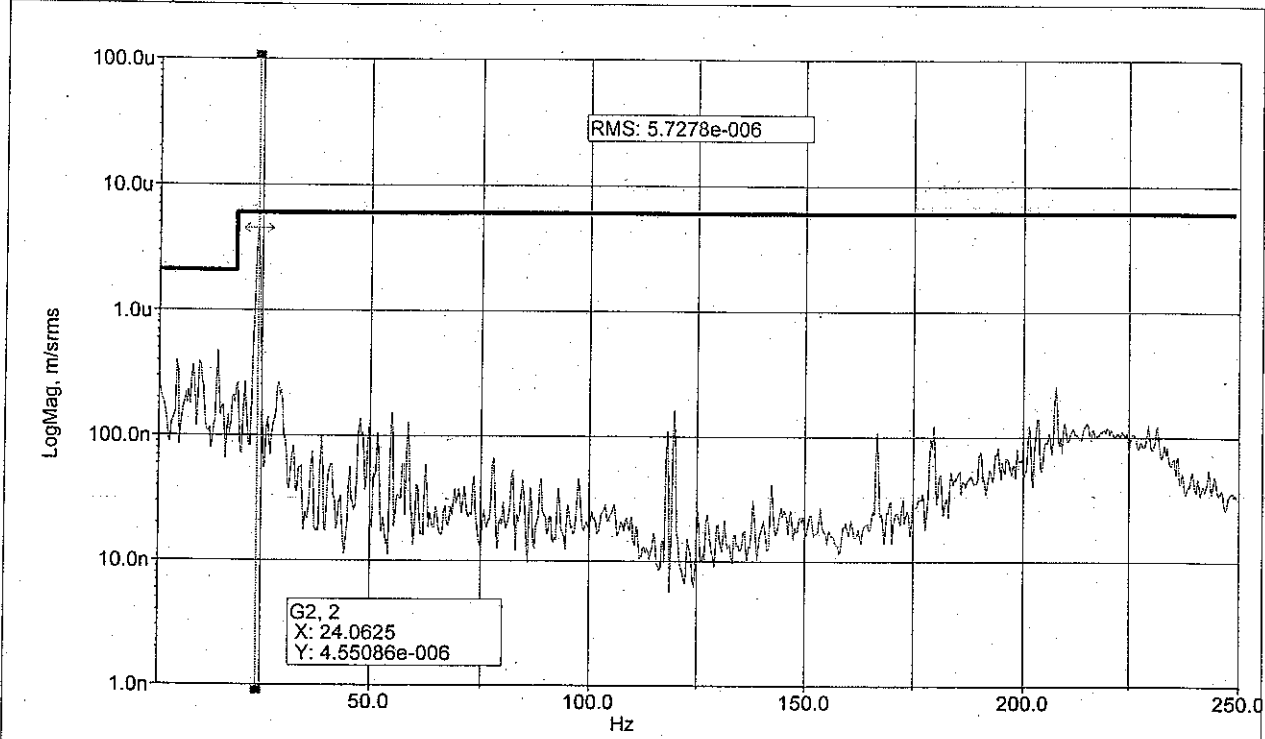
Site 8 - Velocity RMS - Y



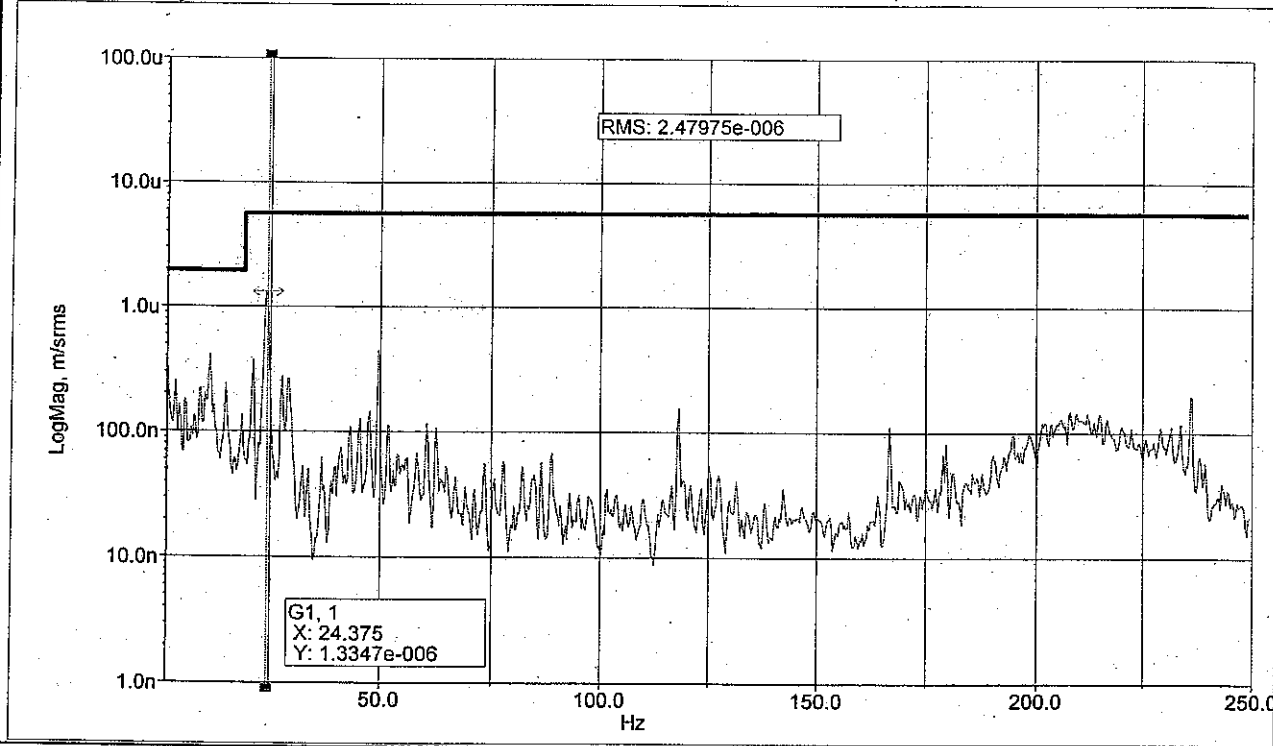
Site 8 - Velocity RMS - Z



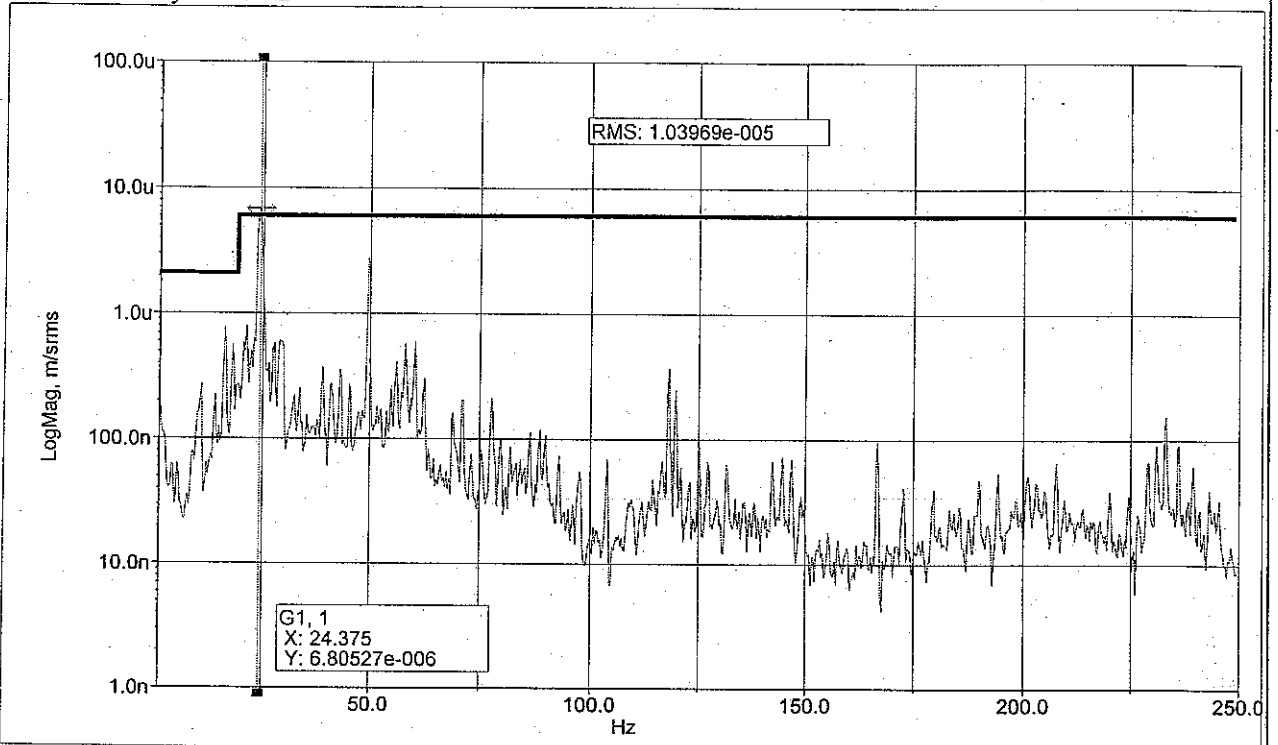
Site 9 - Velocity RMS - X



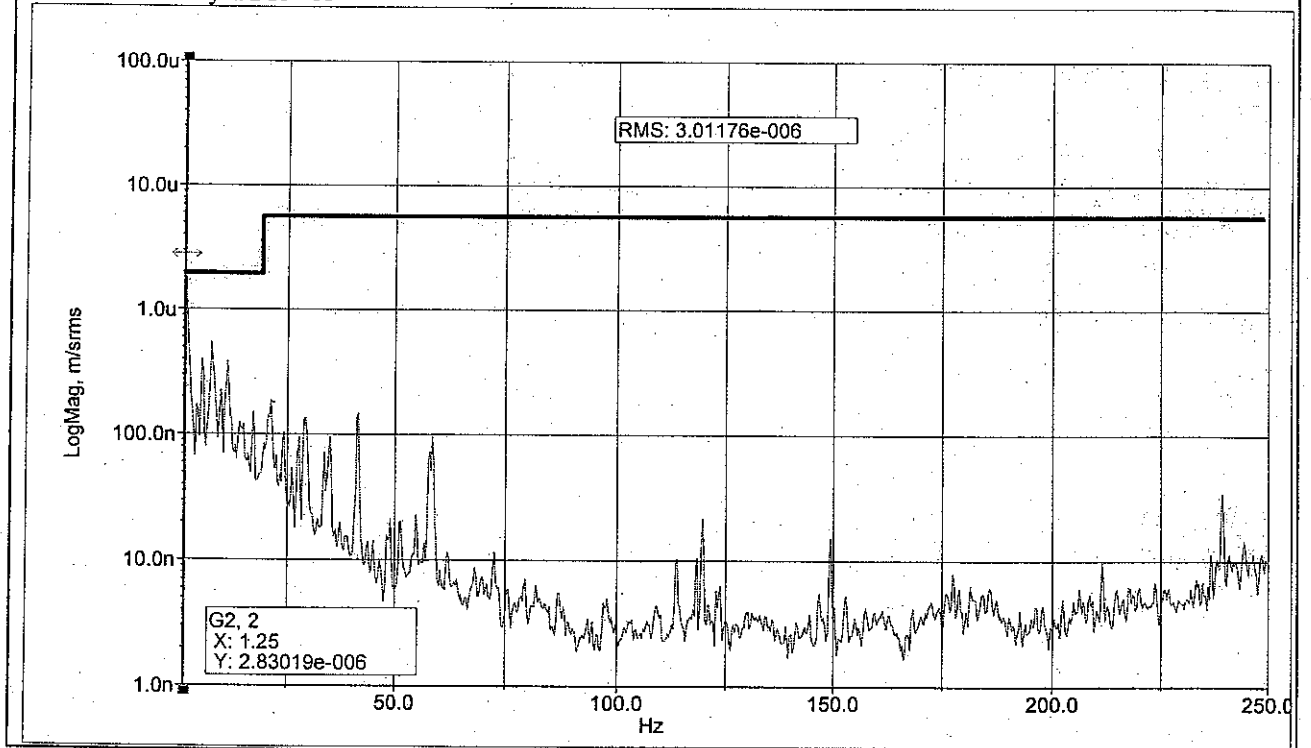
Site 9 - Velocity RMS - Y



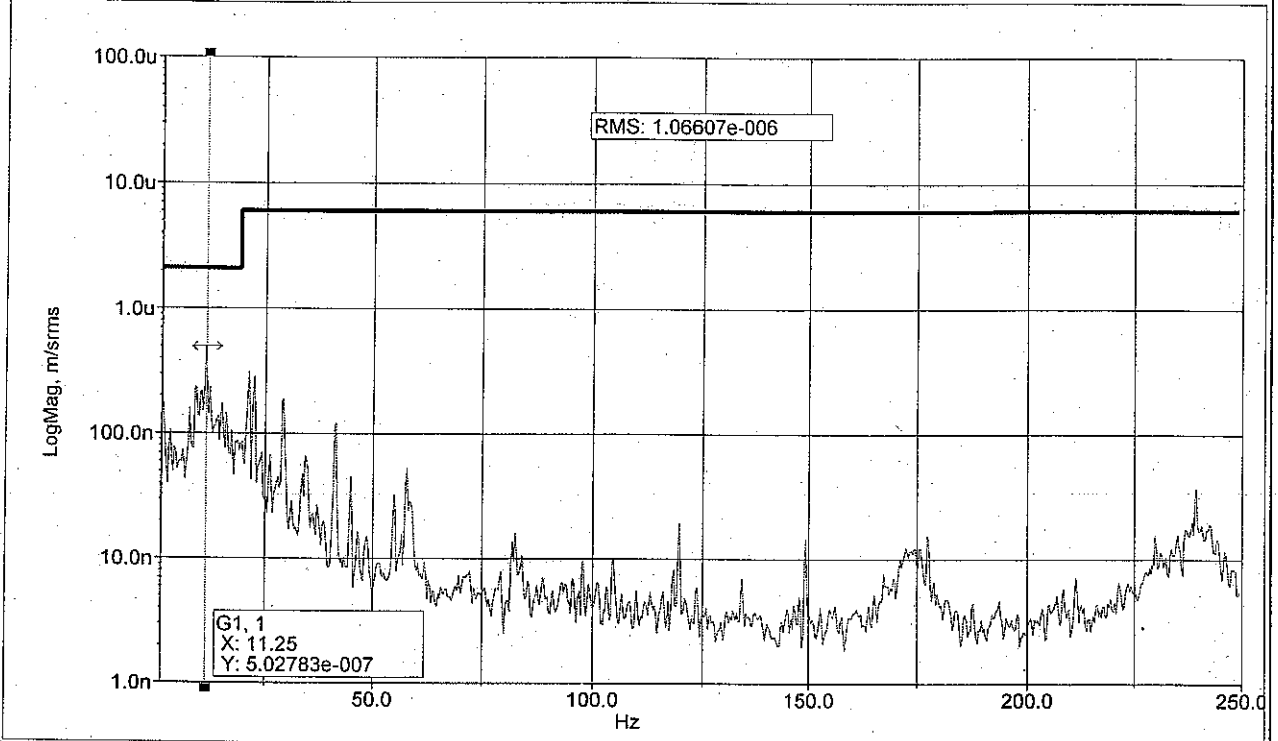
Site 9 - Velocity RMS - Z



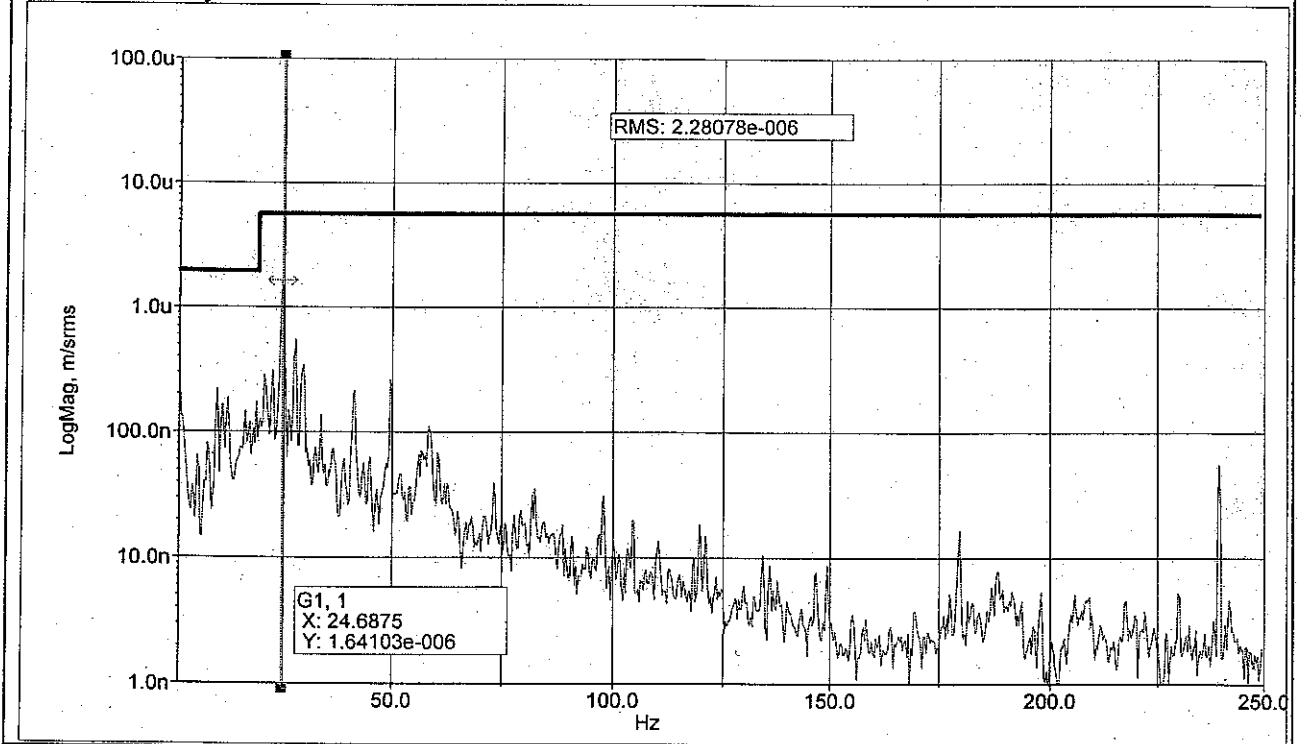
Site 10 - Velocity RMS - X



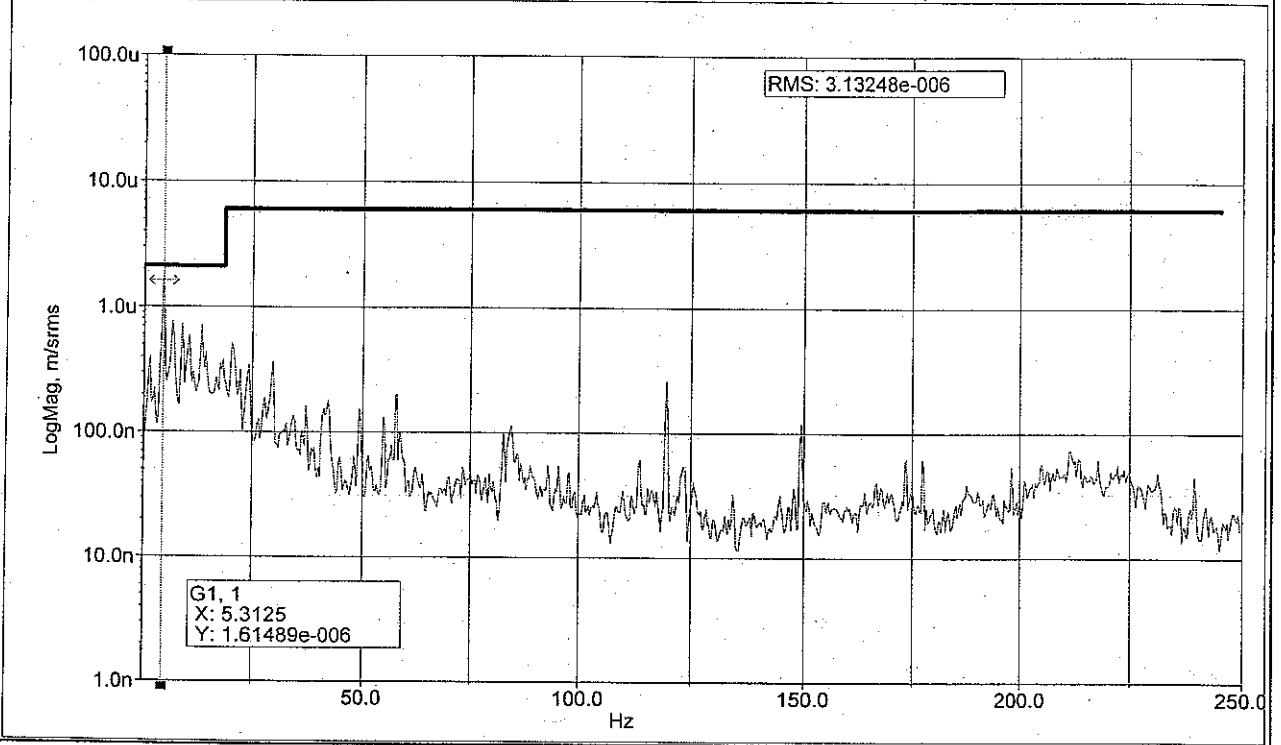
Site 10 - Velocity RMS - Y



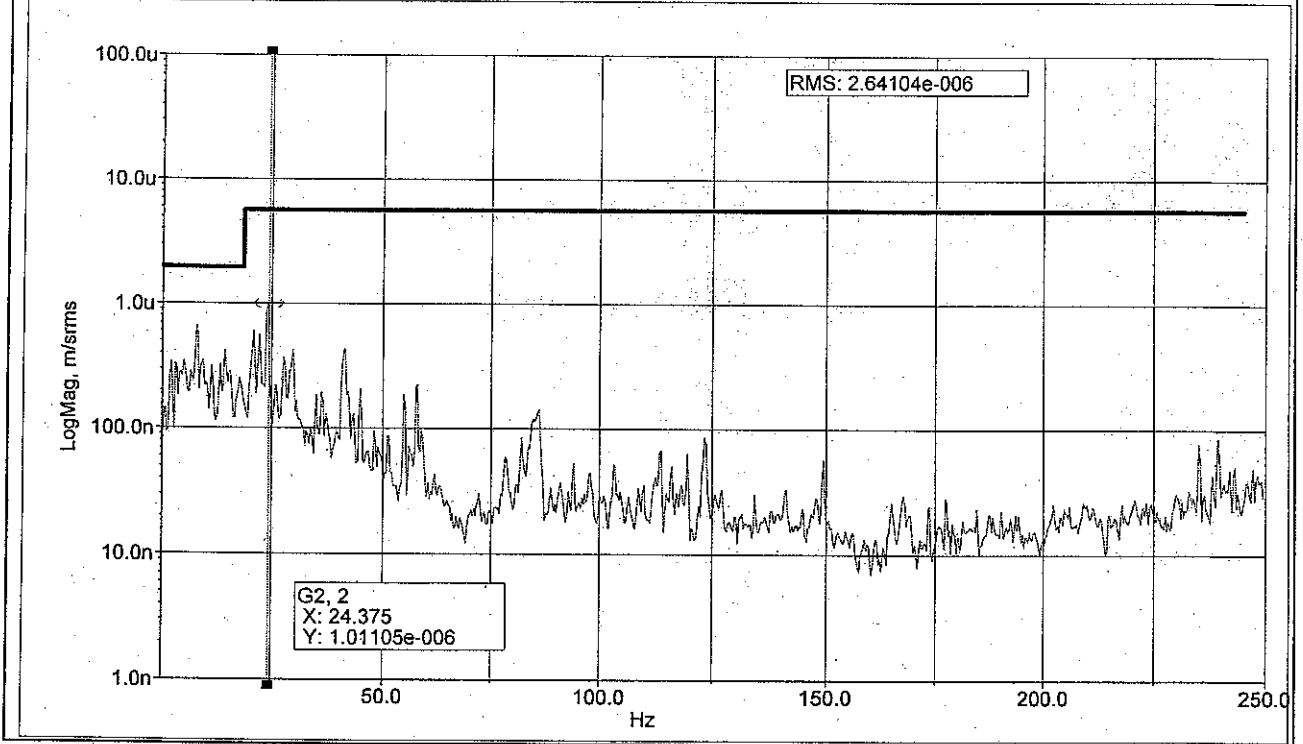
Site 10 - Velocity RMS - Z



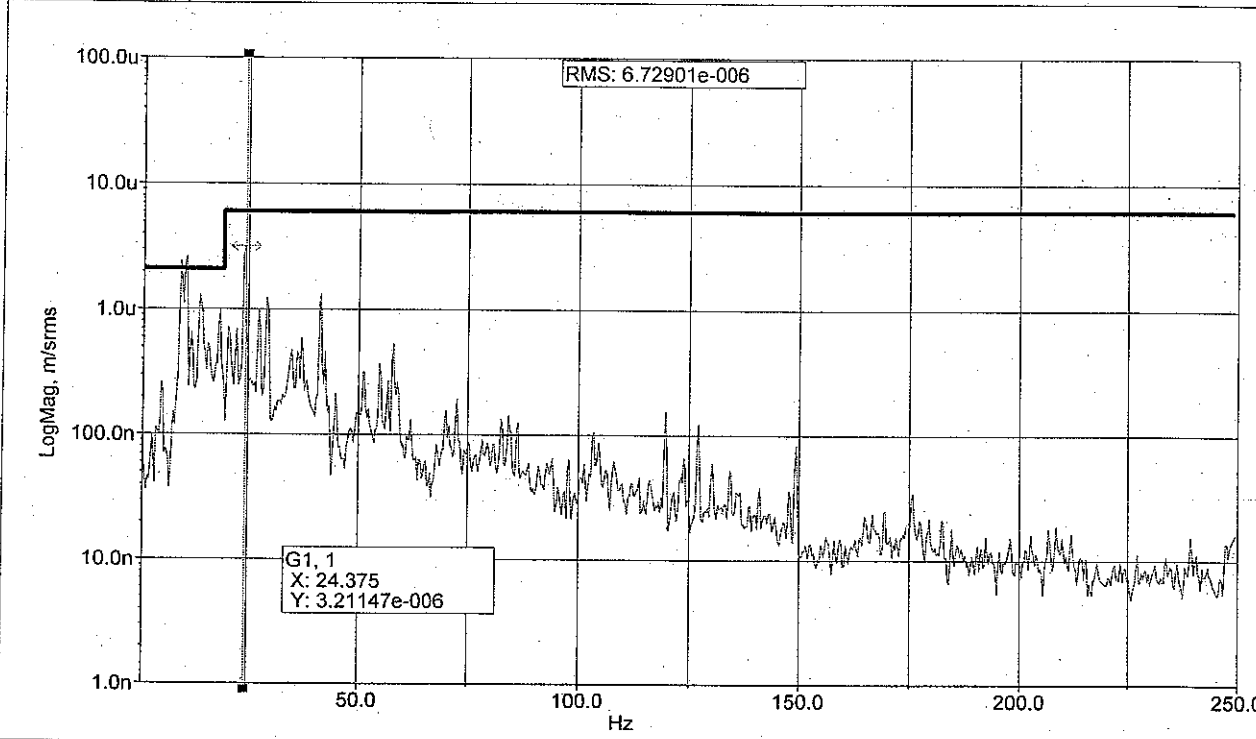
Site 11 - Velocity RMS - X



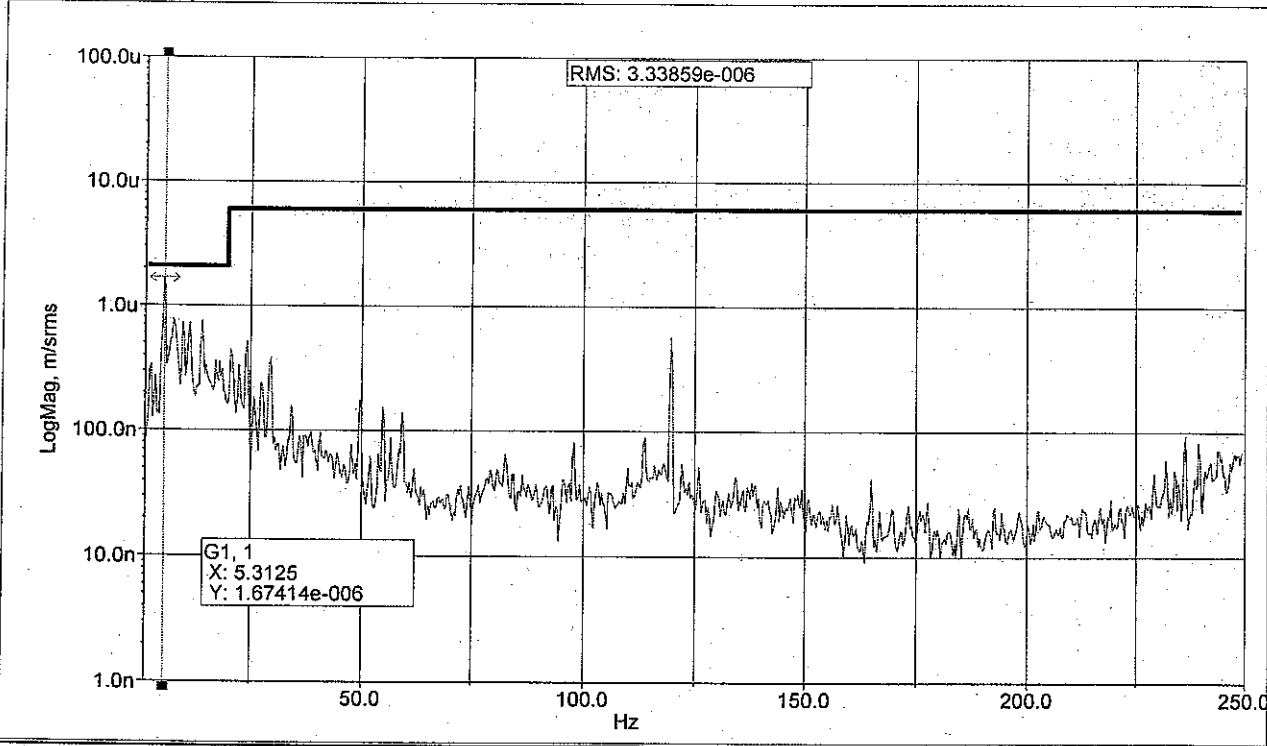
Site 11 - Velocity RMS - Y



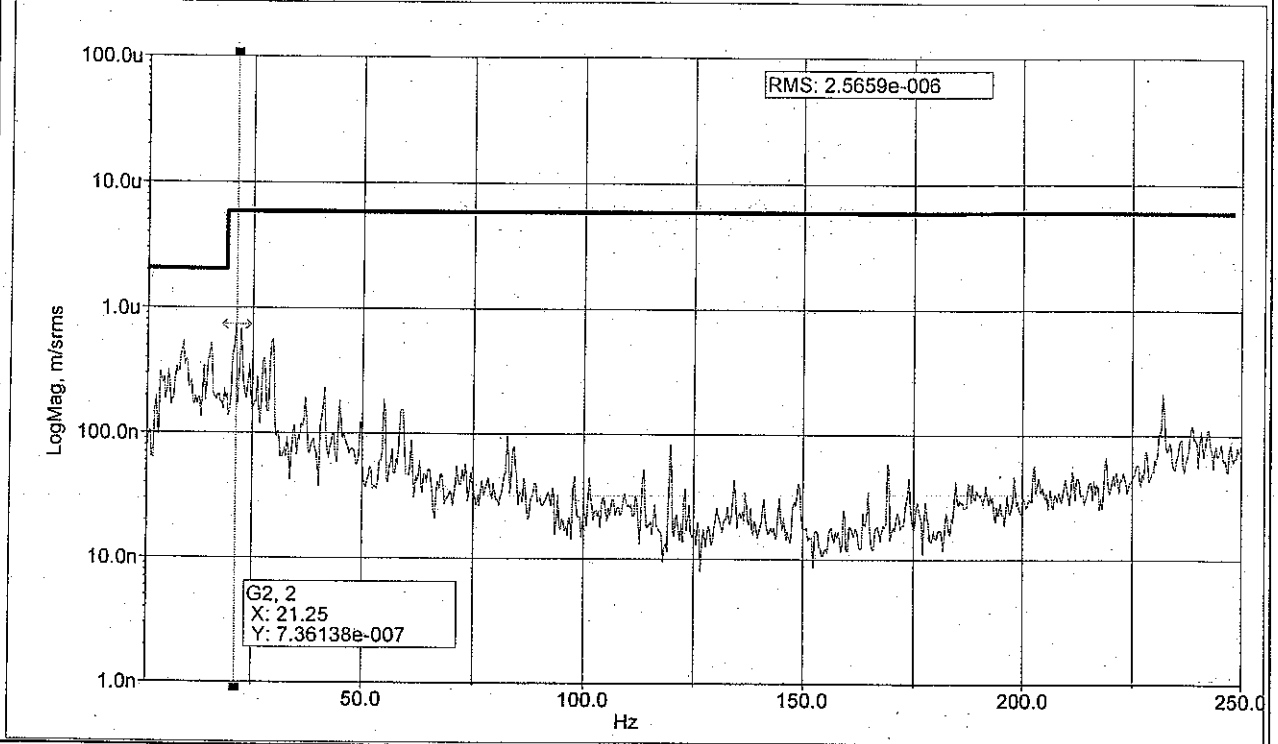
Site 11 - Velocity RMS - Z



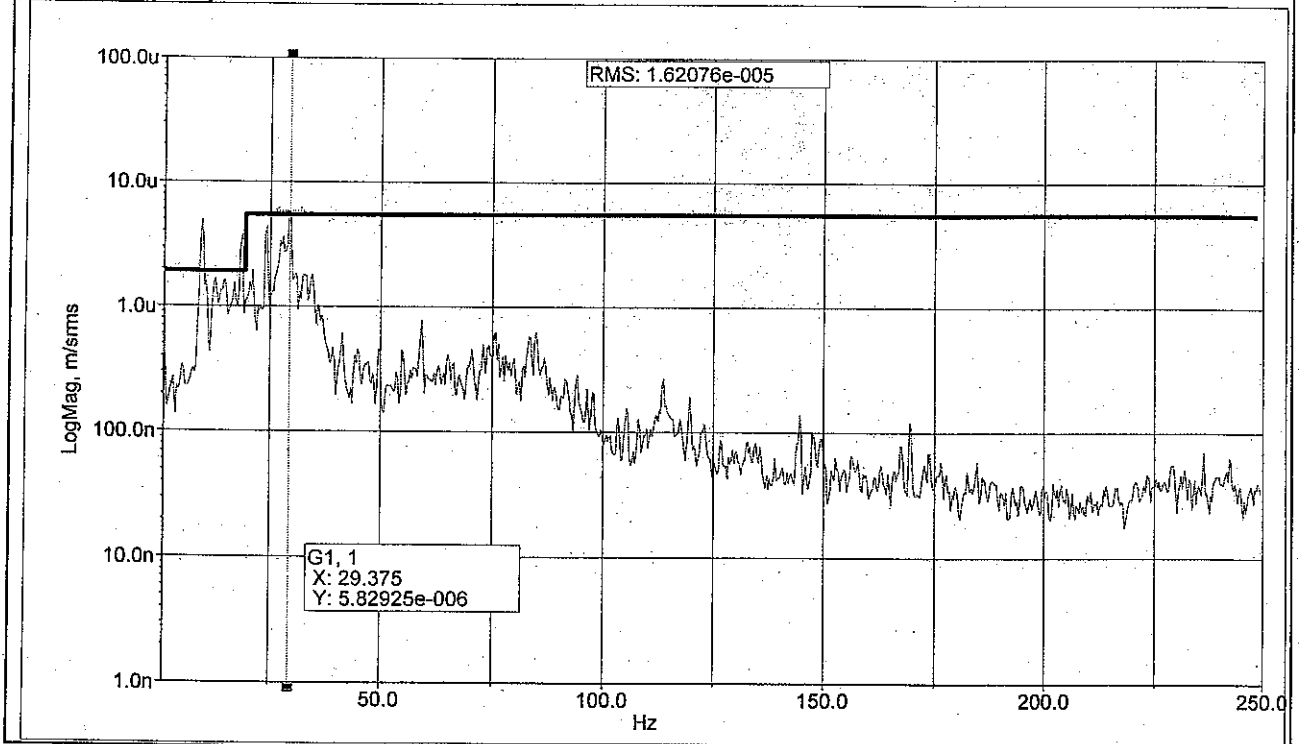
Site 12 - Velocity RMS - X



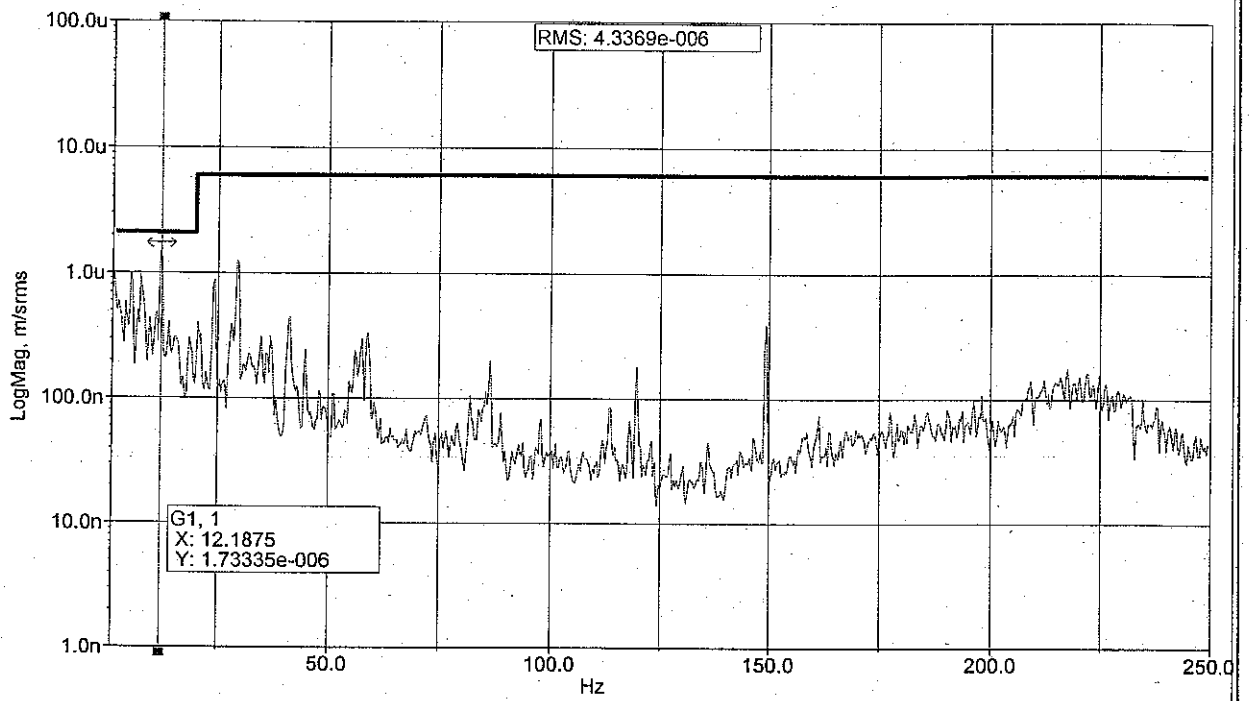
Site 12 - Velocity RMS - Y



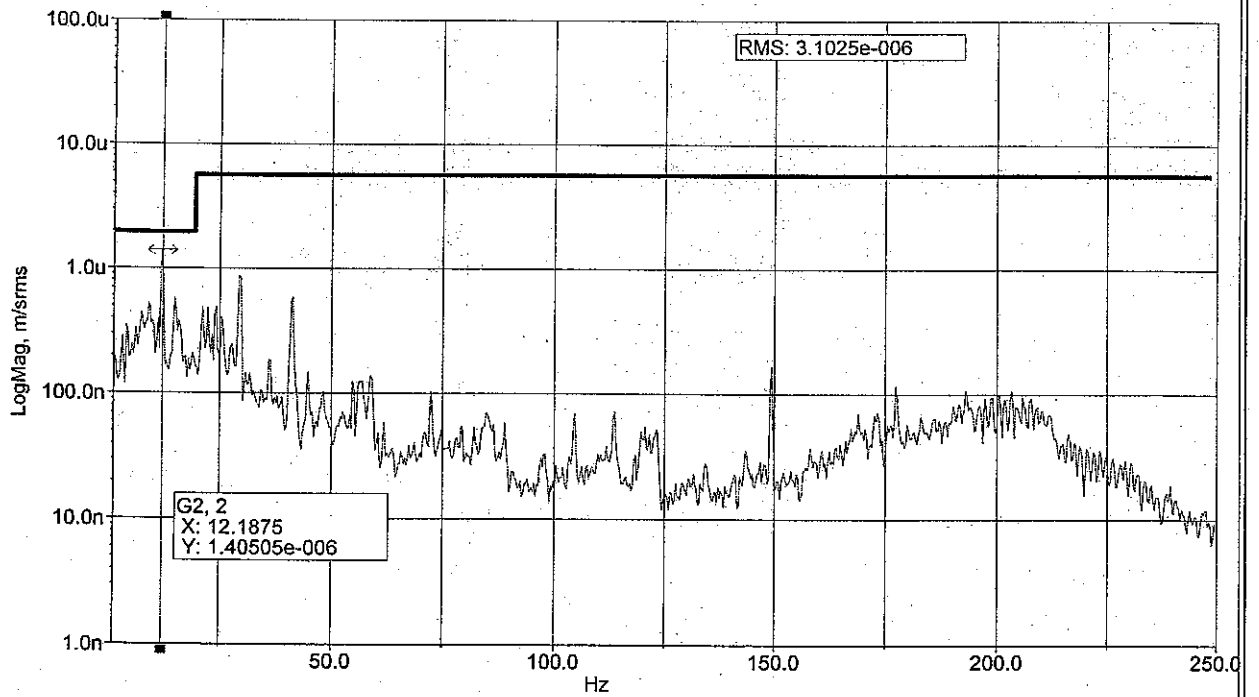
Site 12 - Velocity RMS - Z



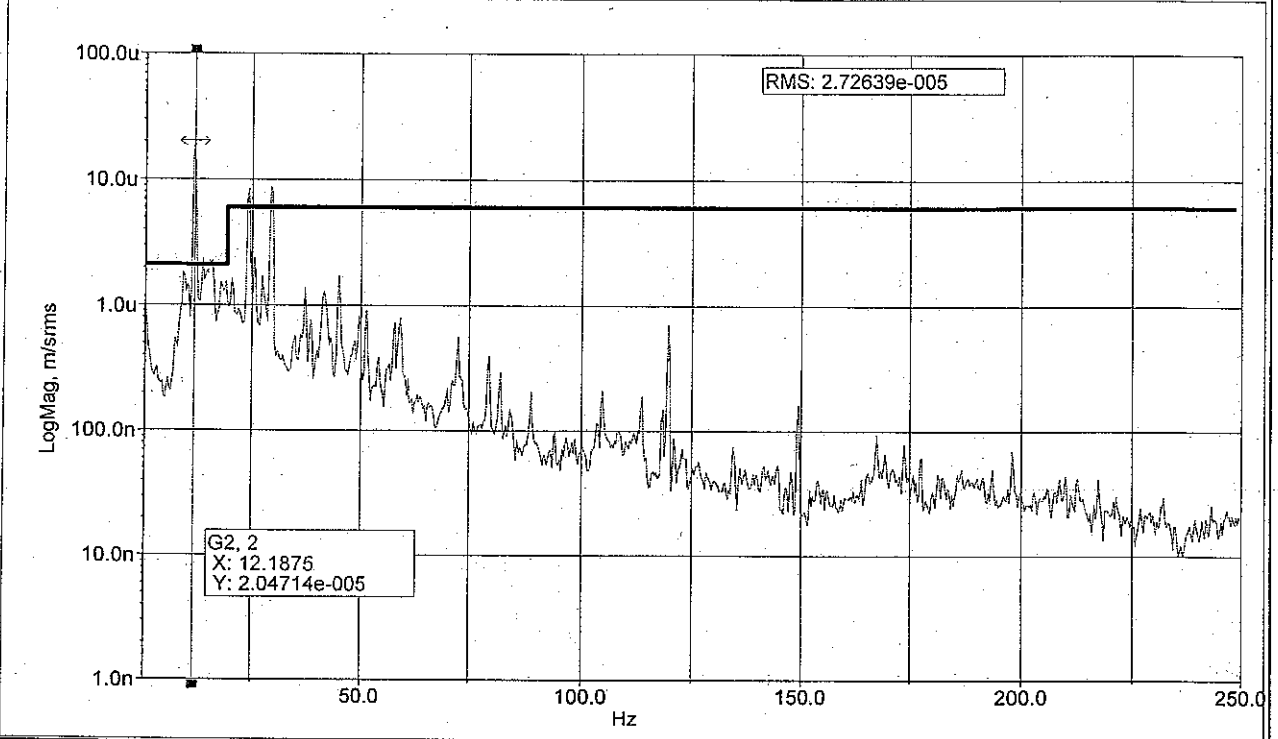
Site 13 - Velocity RMS - X



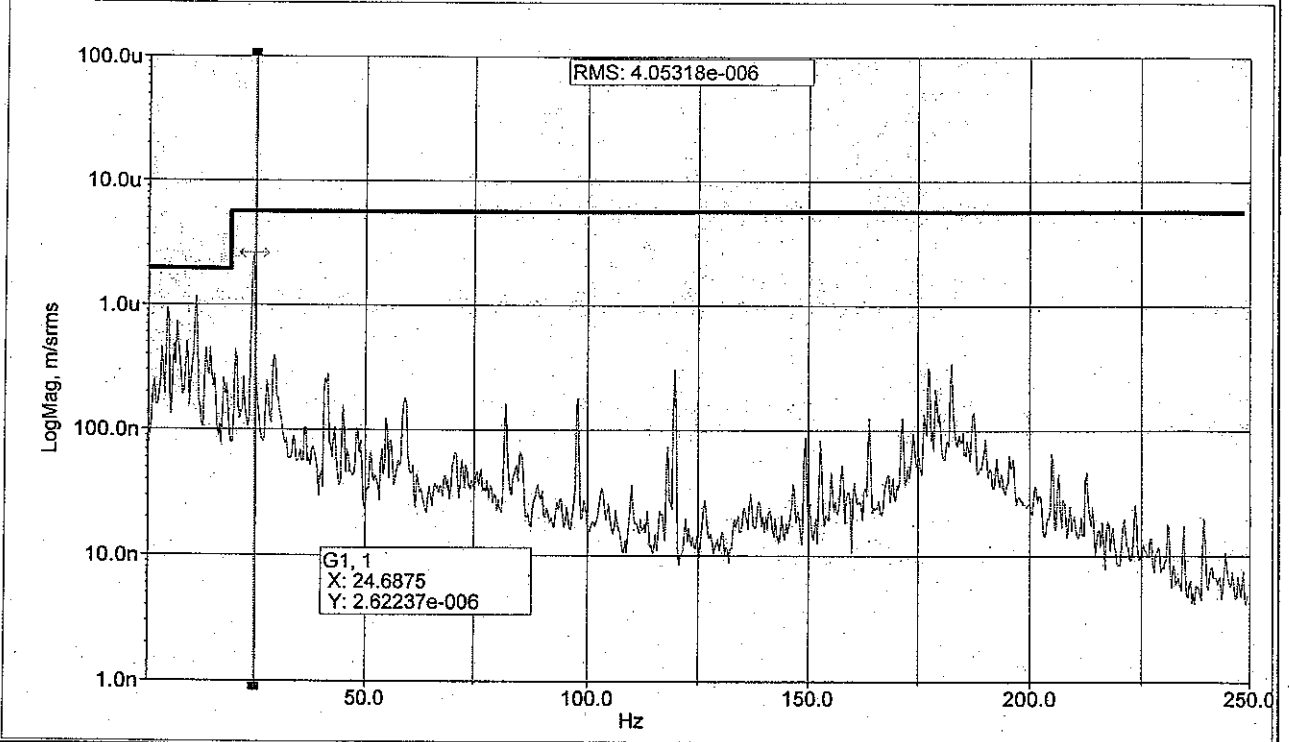
Site 13 - Velocity RMS - Y



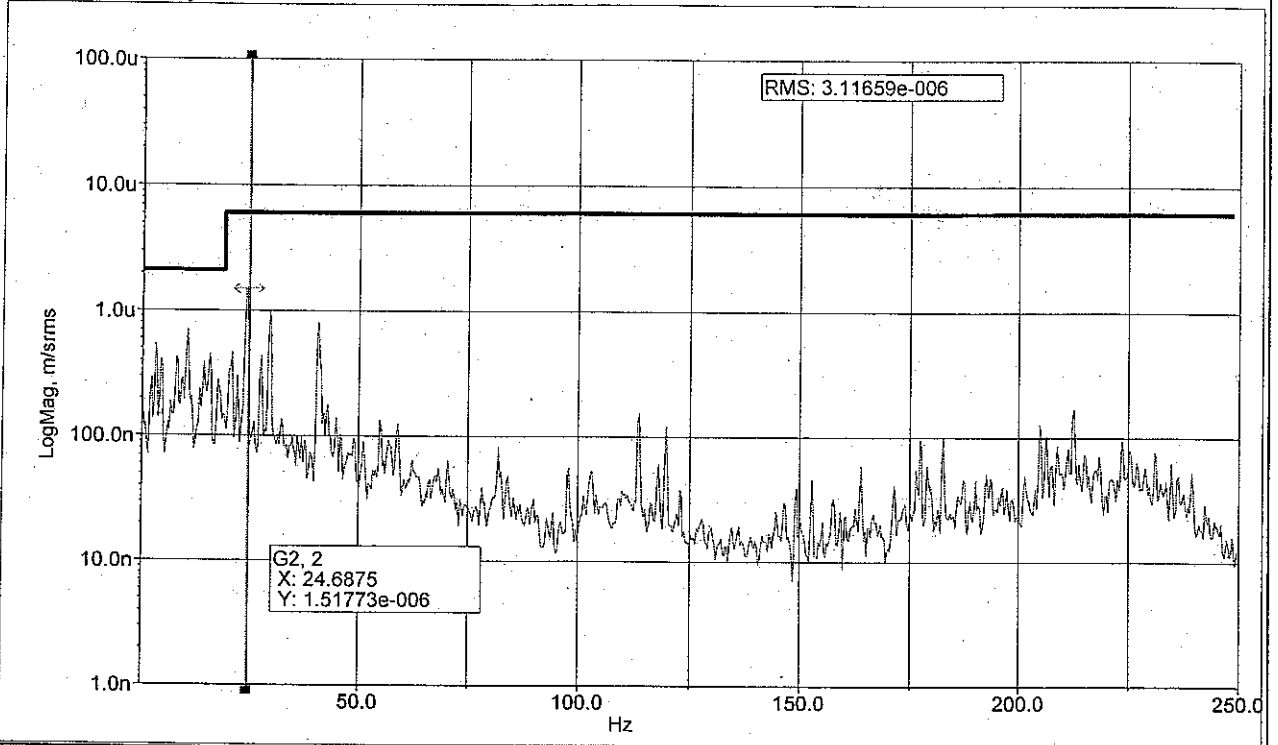
Site 13 - Velocity RMS - Z



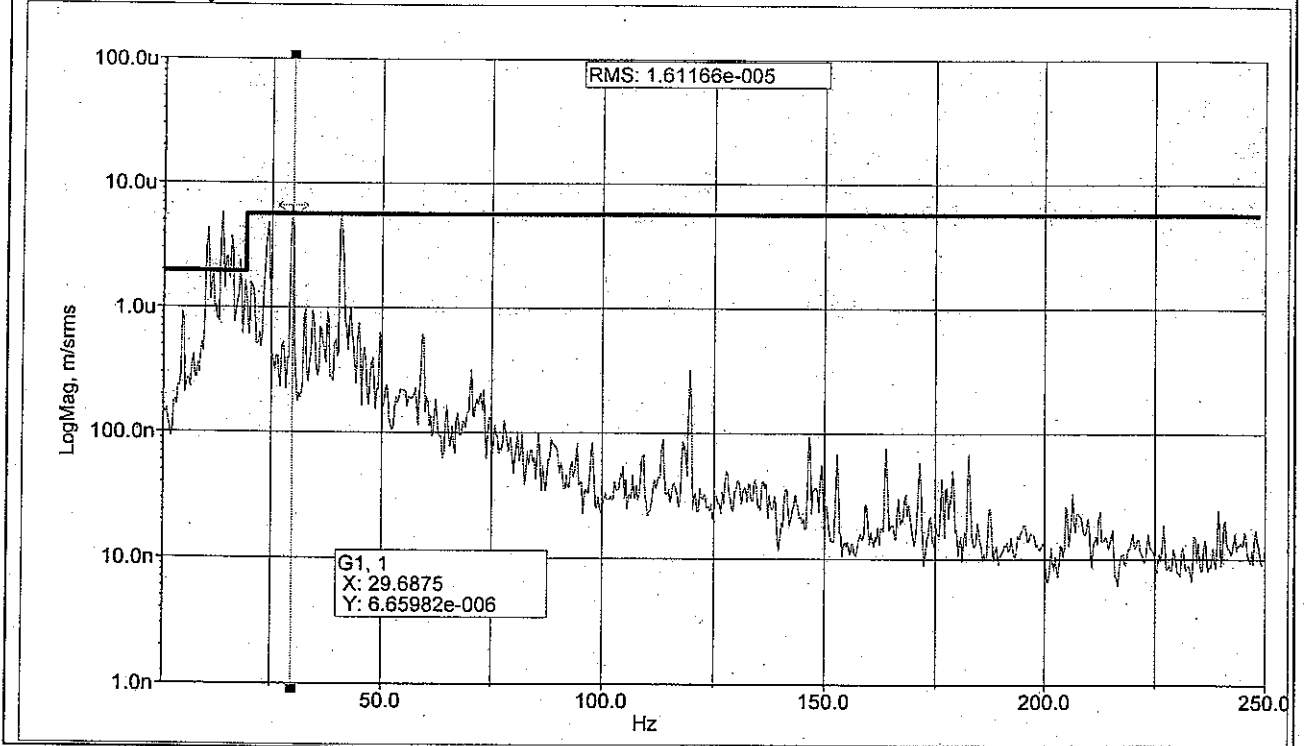
Site 14 - Velocity RMS - X



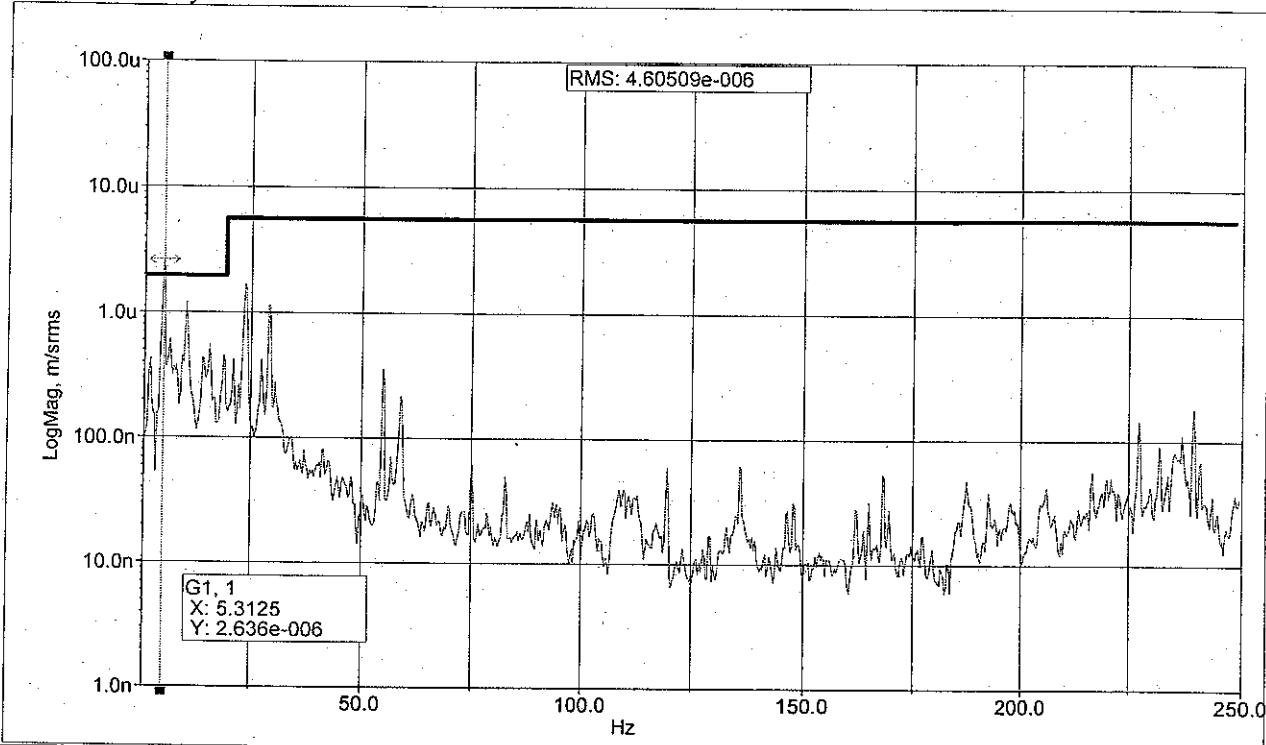
Site 14 - Velocity RMS - Y



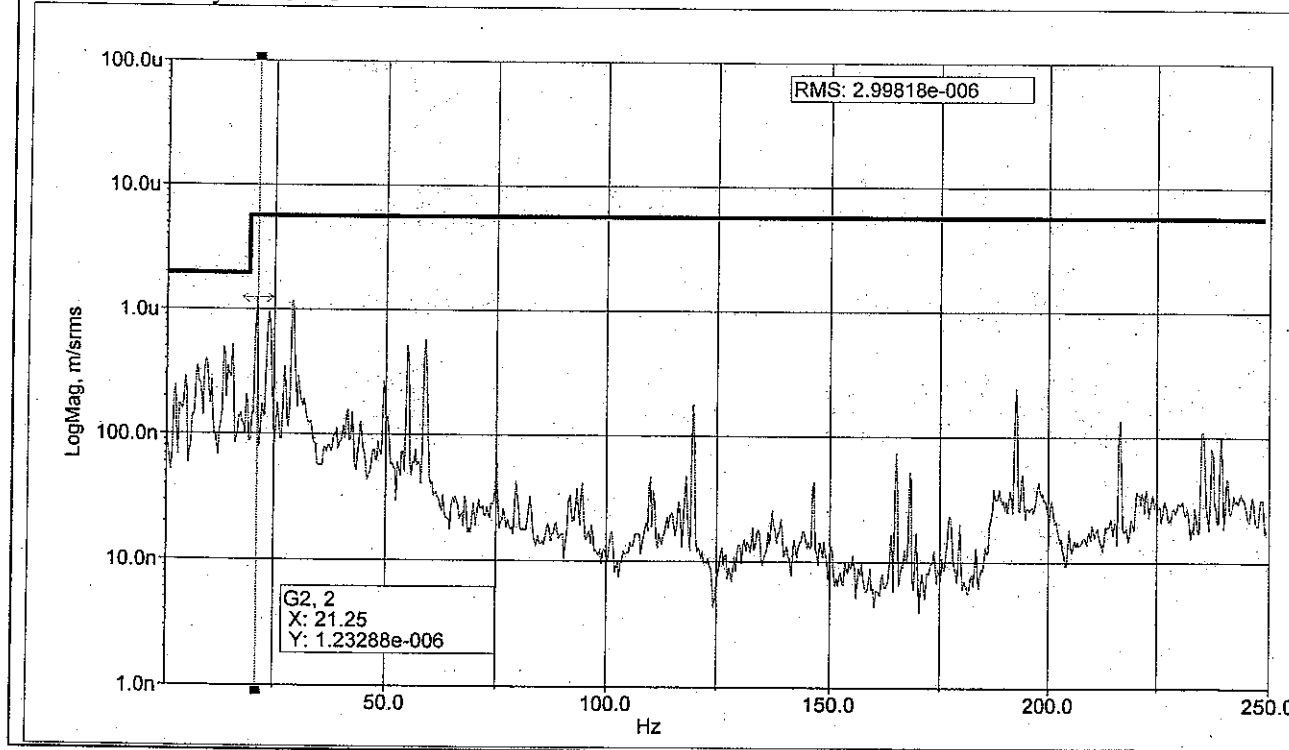
Site 14 - Velocity RMS - Z



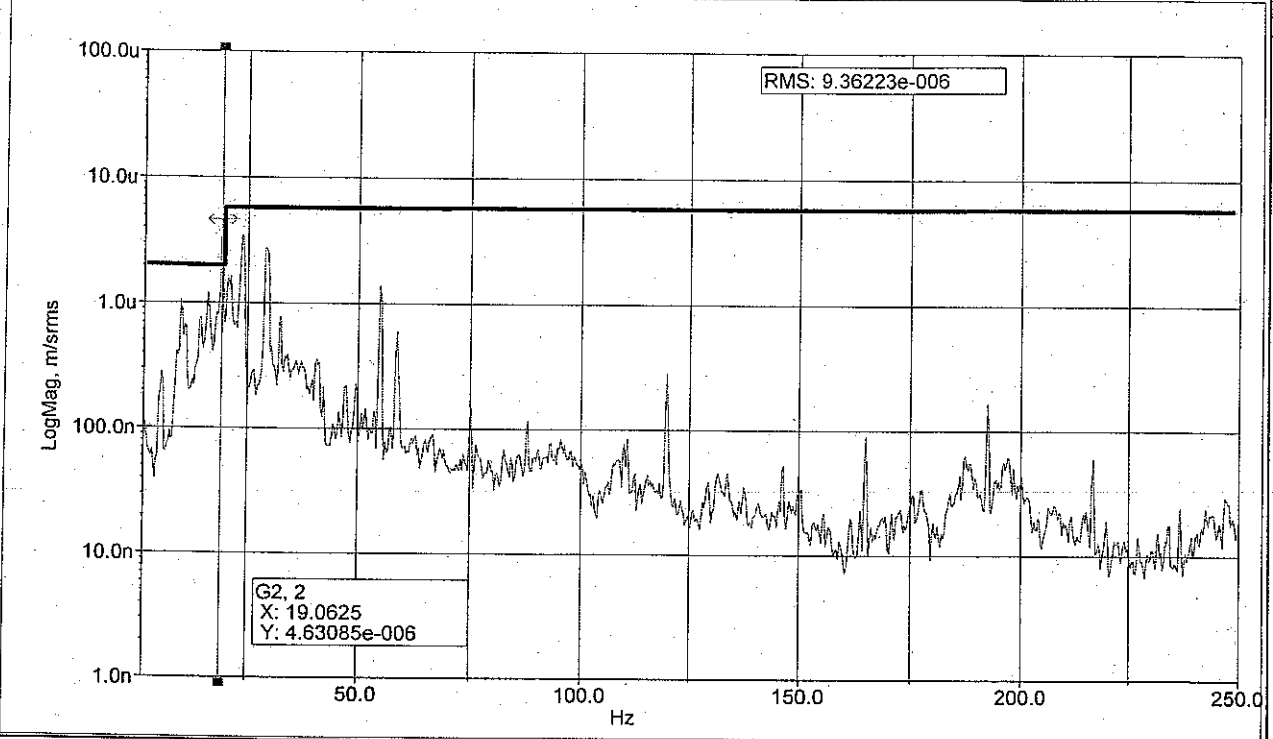
Site 15 - Velocity RMS - X



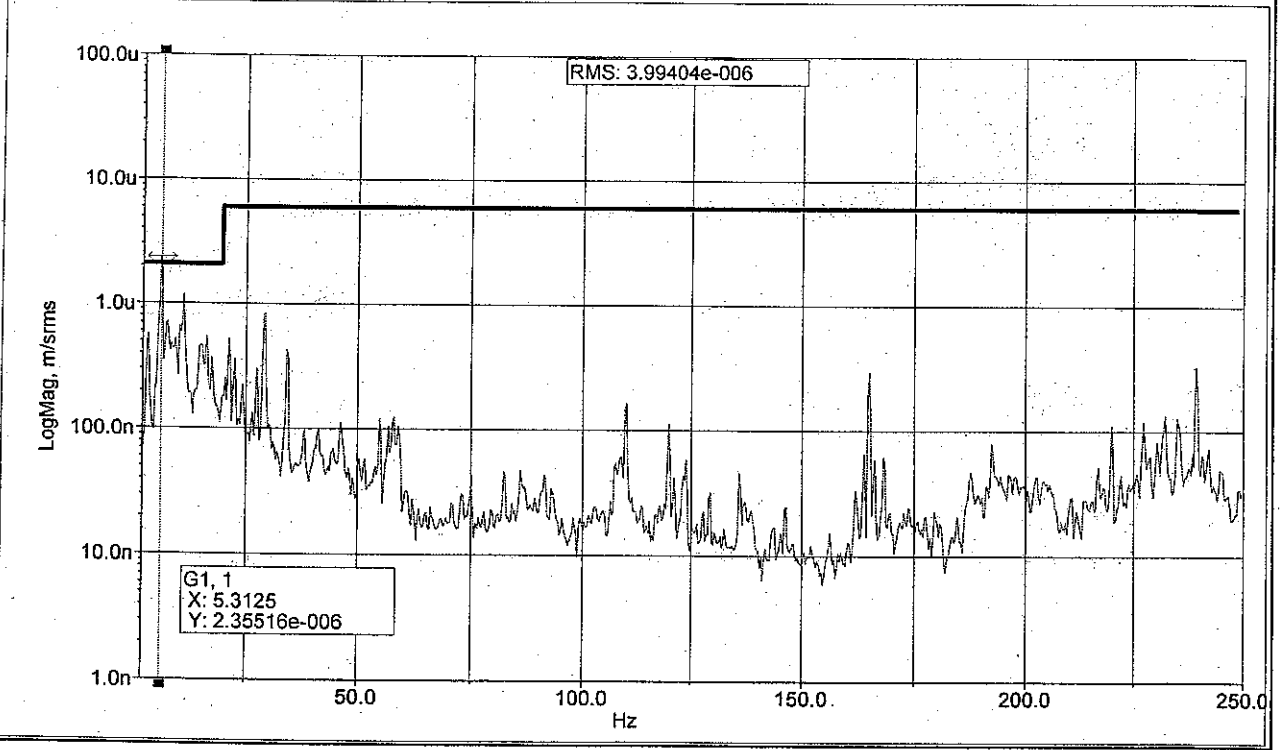
Site 15 - Velocity RMS - Y



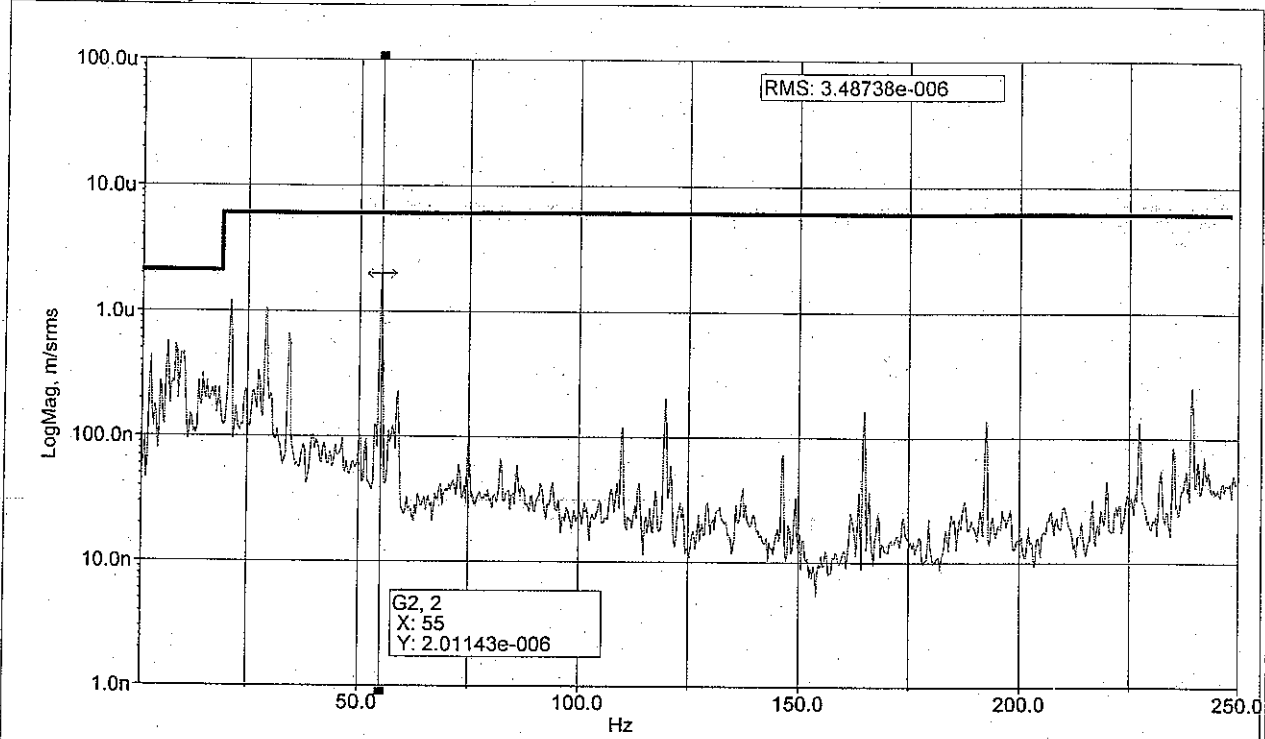
Site 15 - Velocity RMS - Z



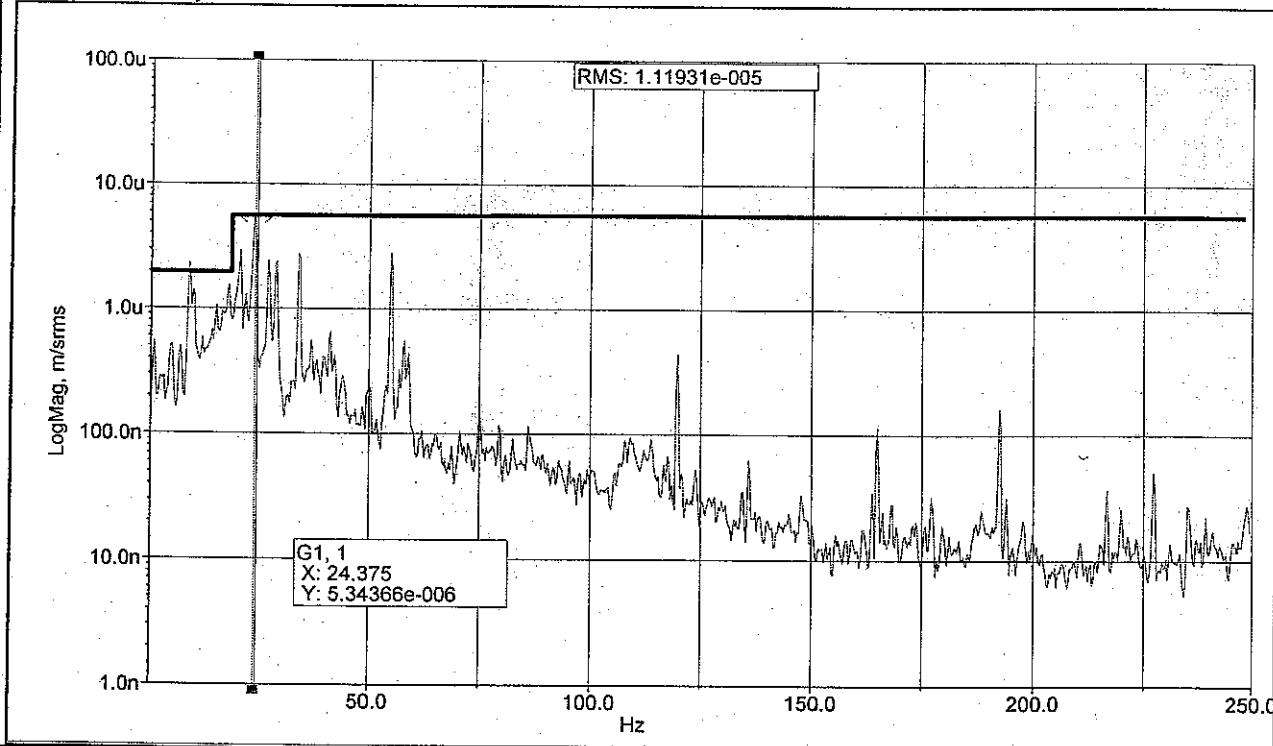
Site 16 - Velocity RMS - X



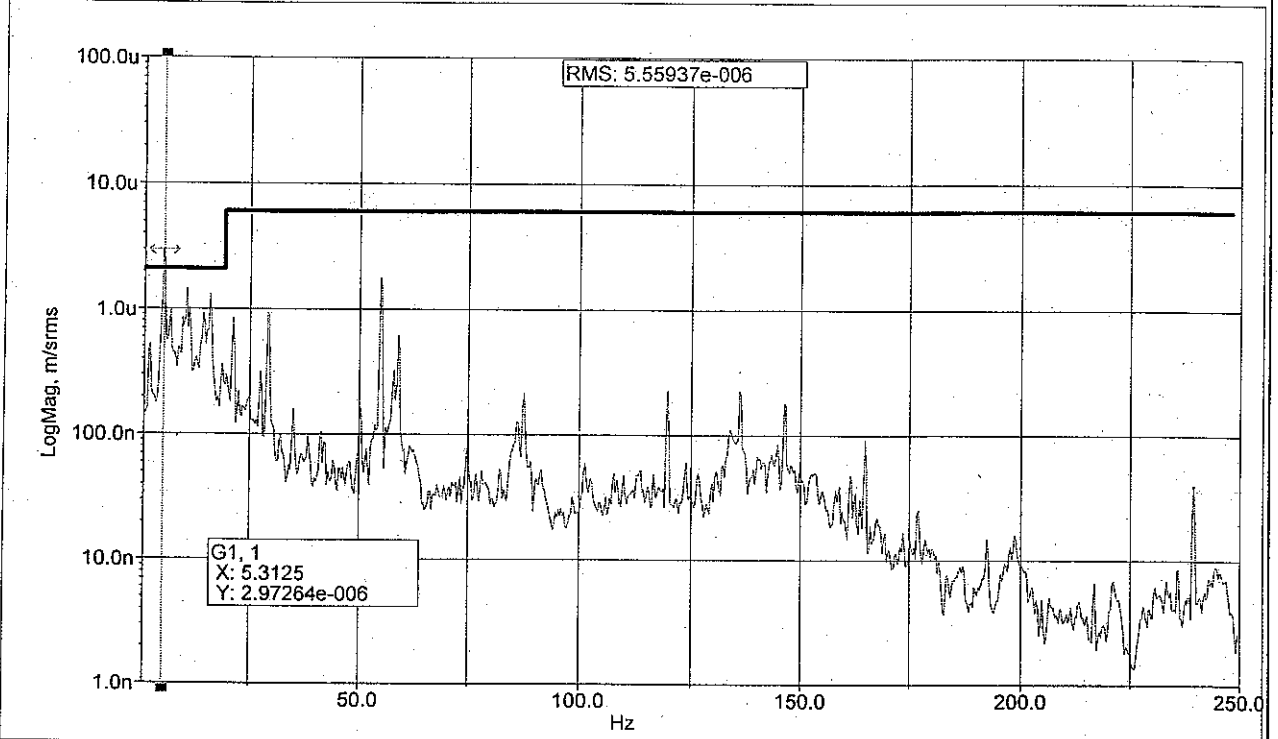
Site 16 - Velocity RMS - Y



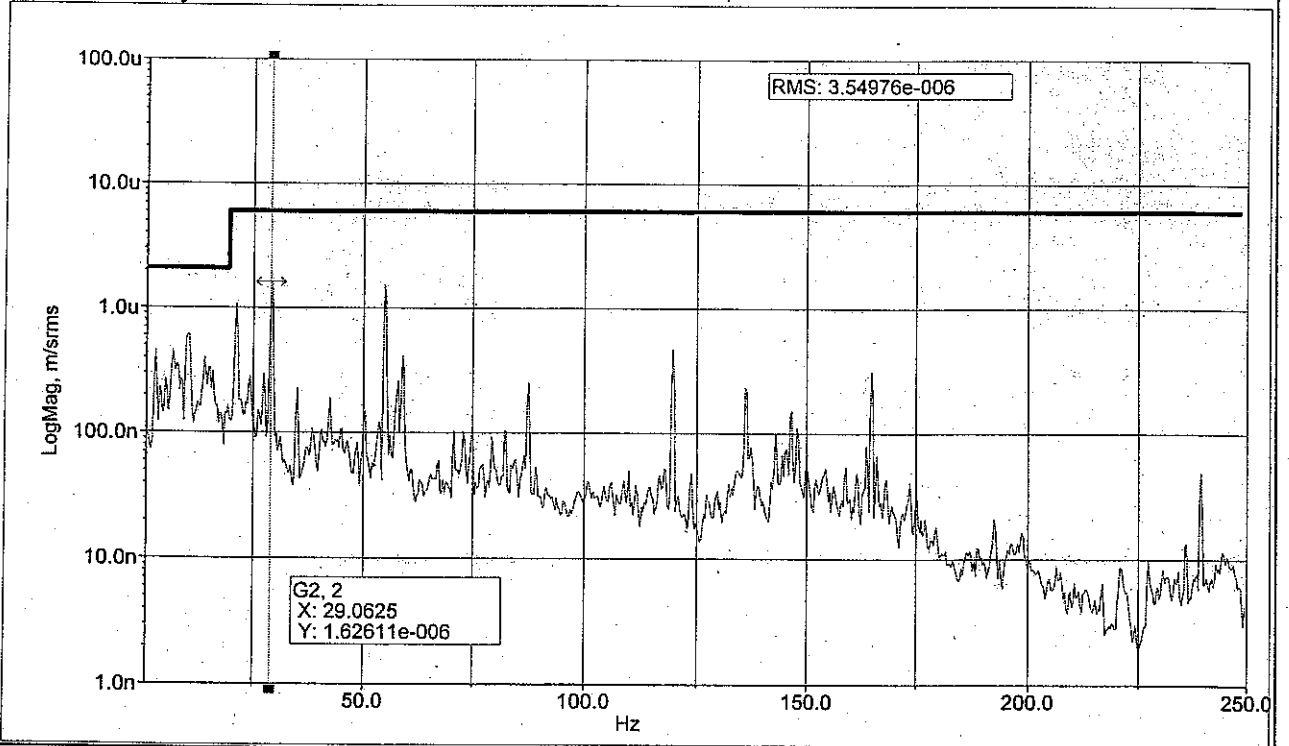
Site 16 - Velocity RMS - Z



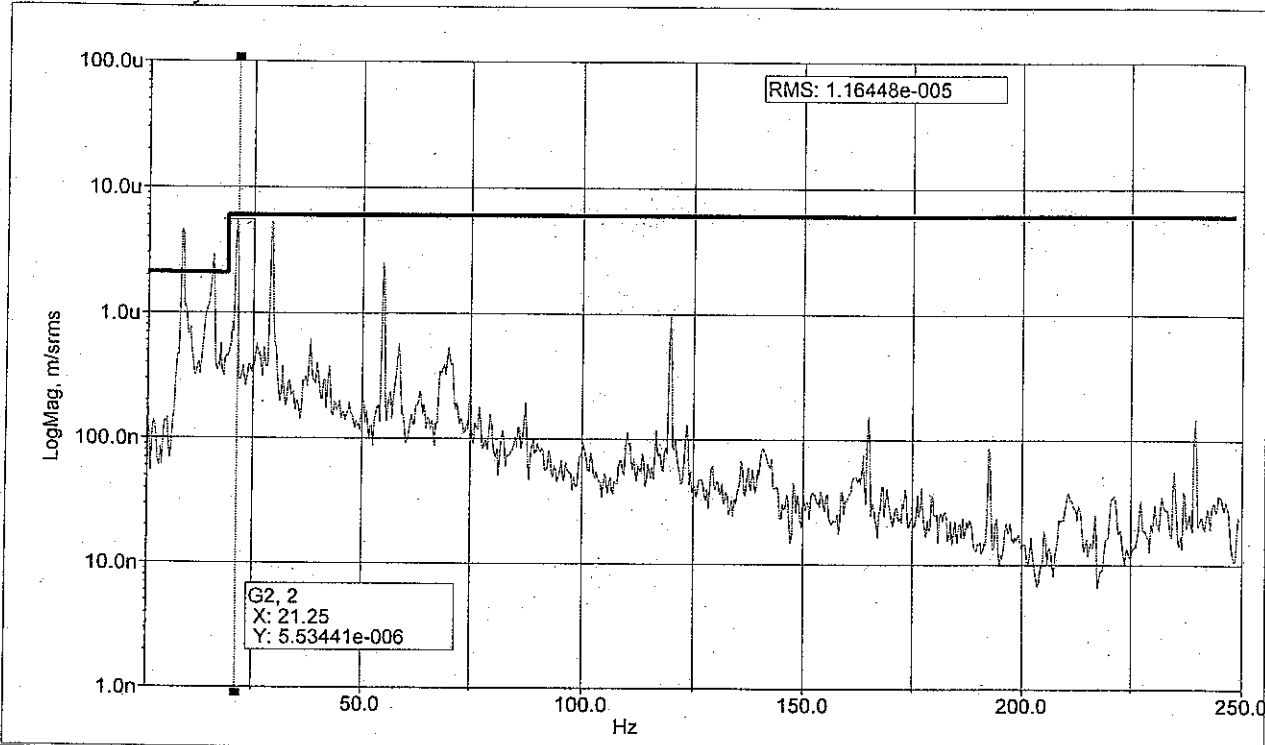
Site 17 - Velocity RMS - X



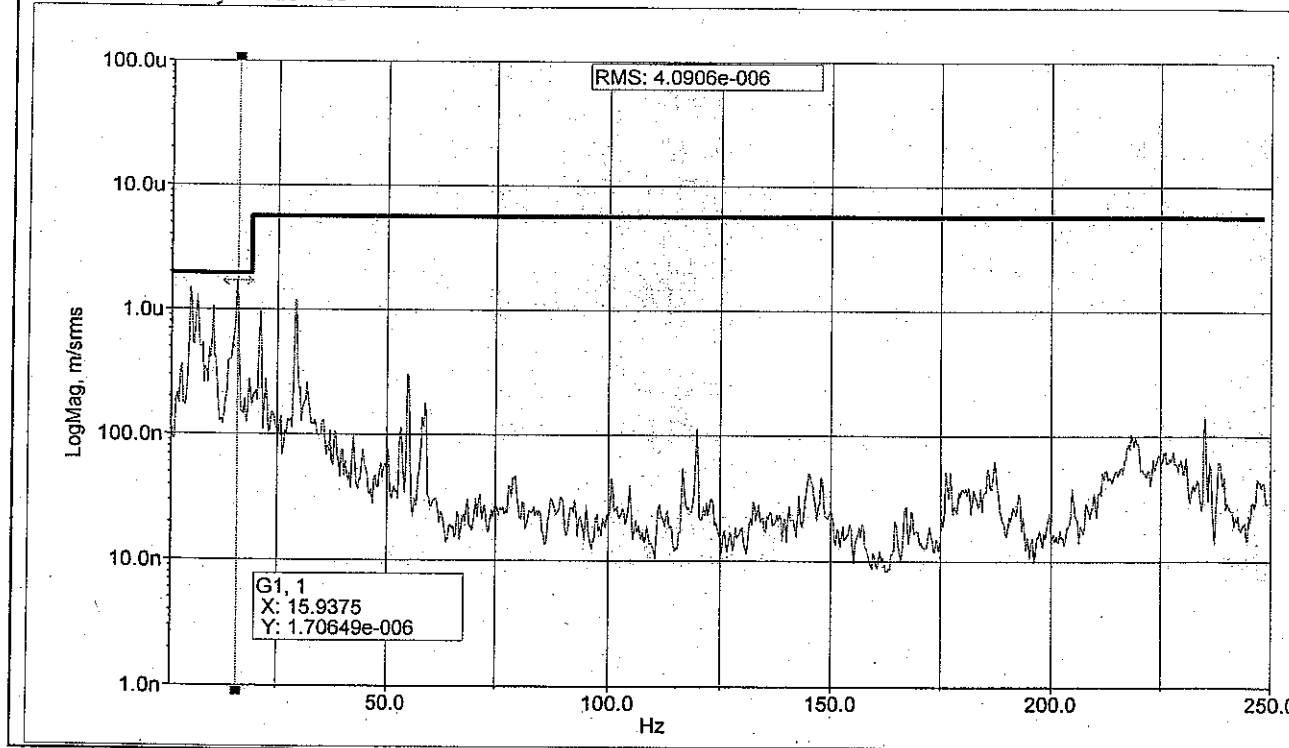
Site 17- Velocity RMS - Y



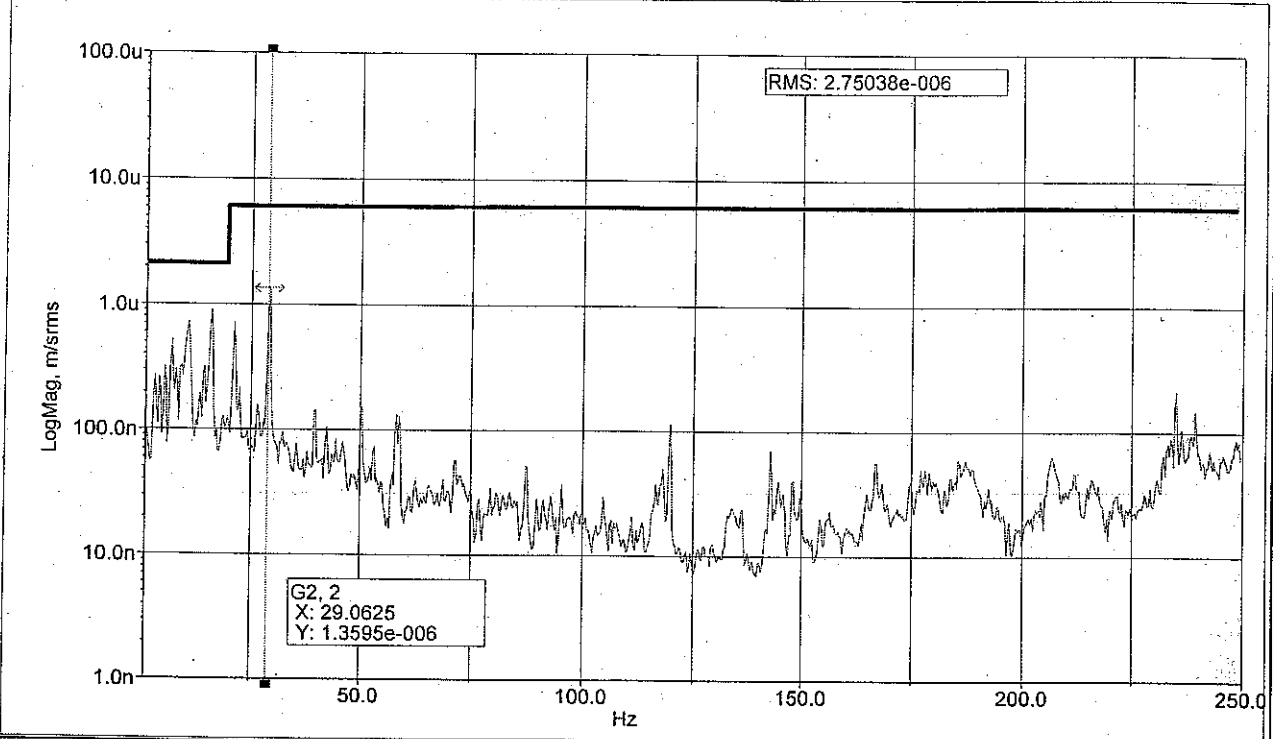
Site 17 - Velocity RMS - Z



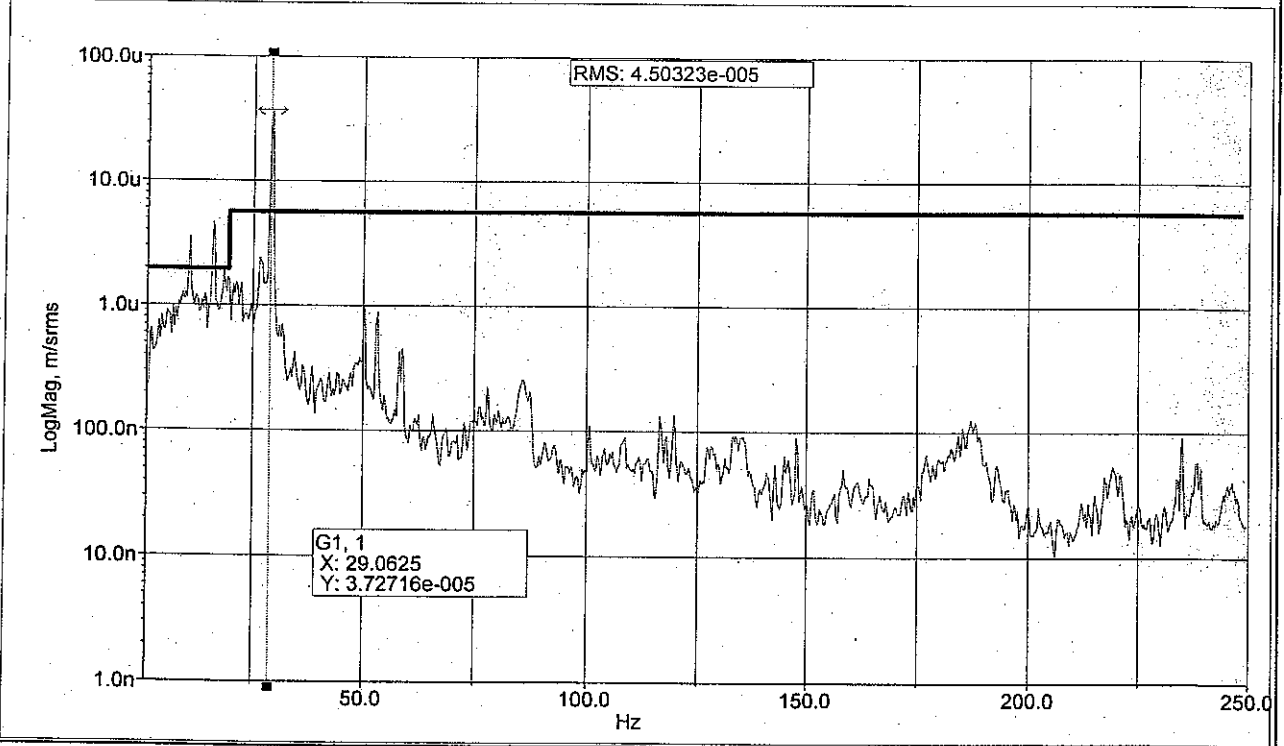
Site 18 - Velocity RMS - X



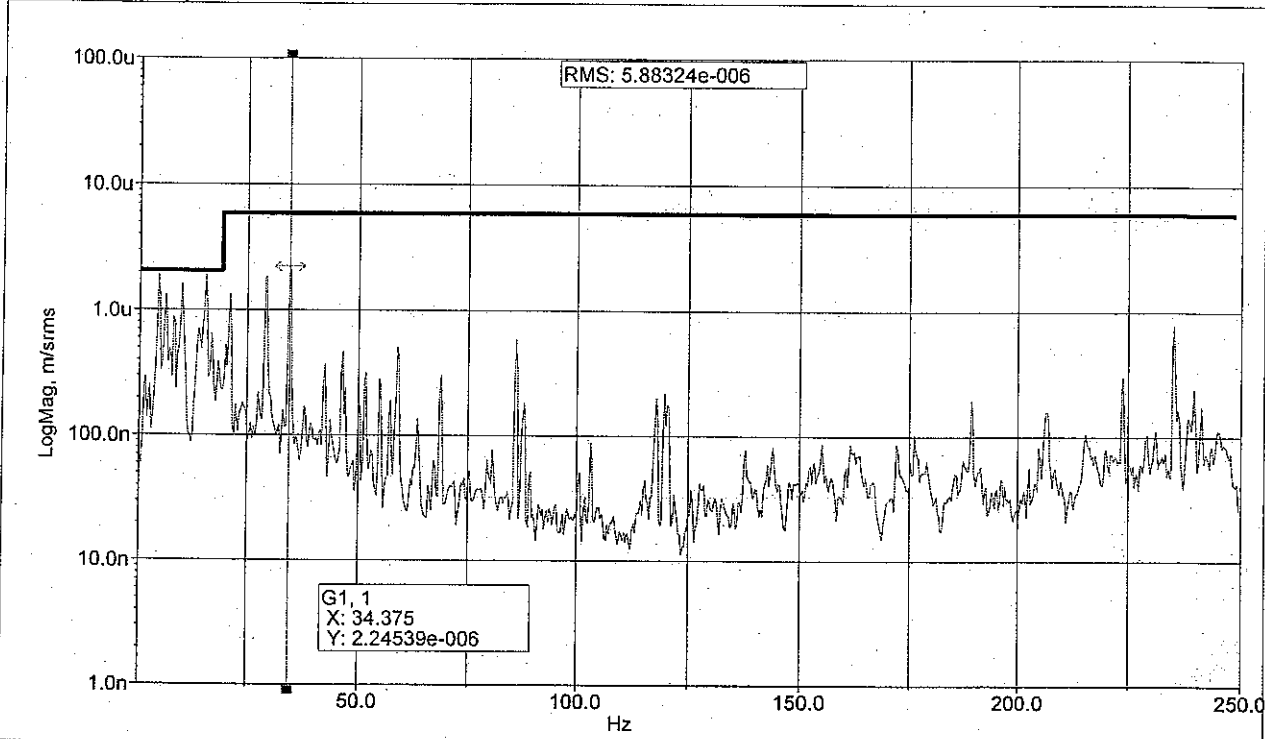
Site 18 - Velocity RMS - Y



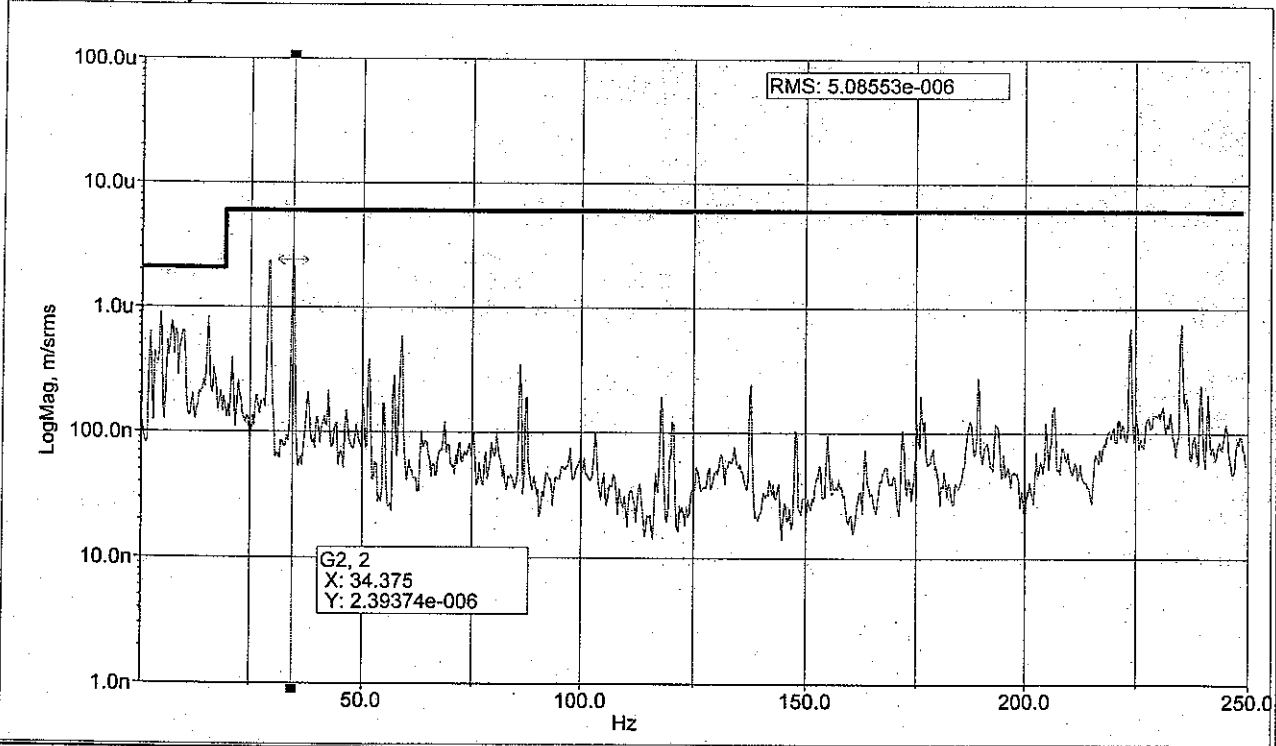
Site 18 - Velocity RMS - Z



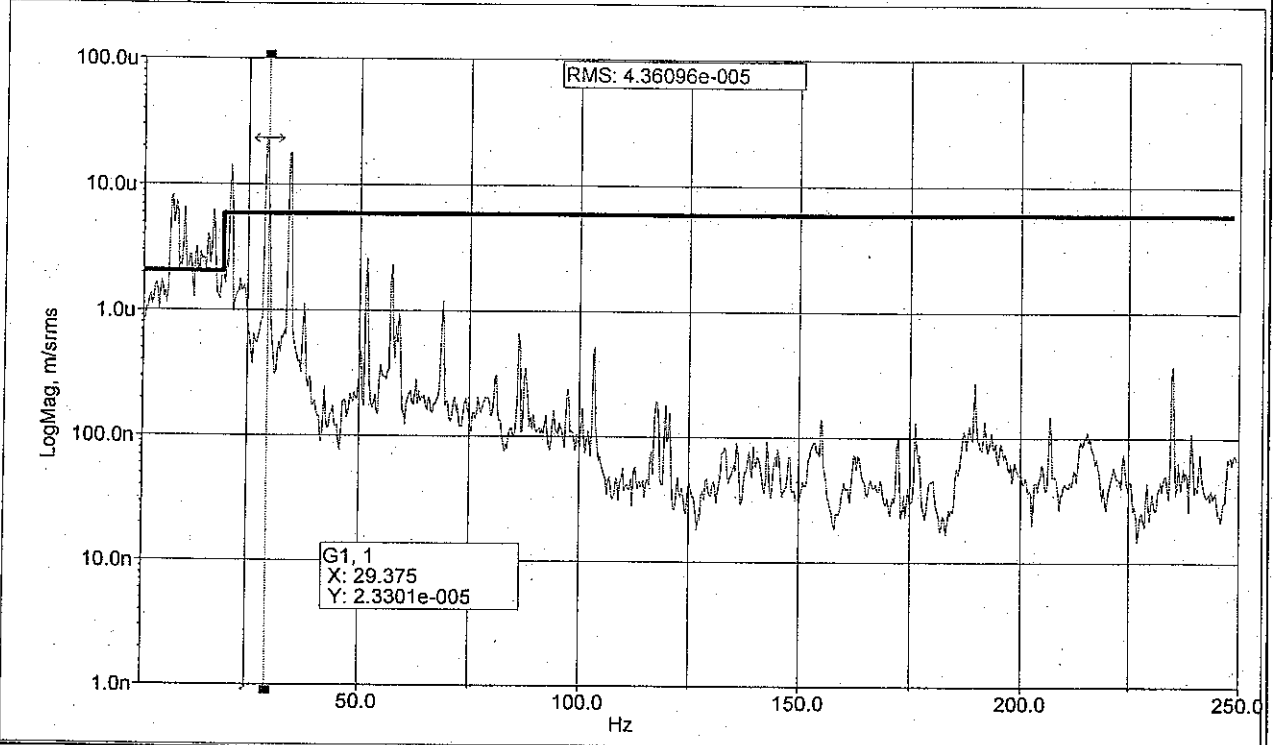
Site 19 - Velocity RMS - X



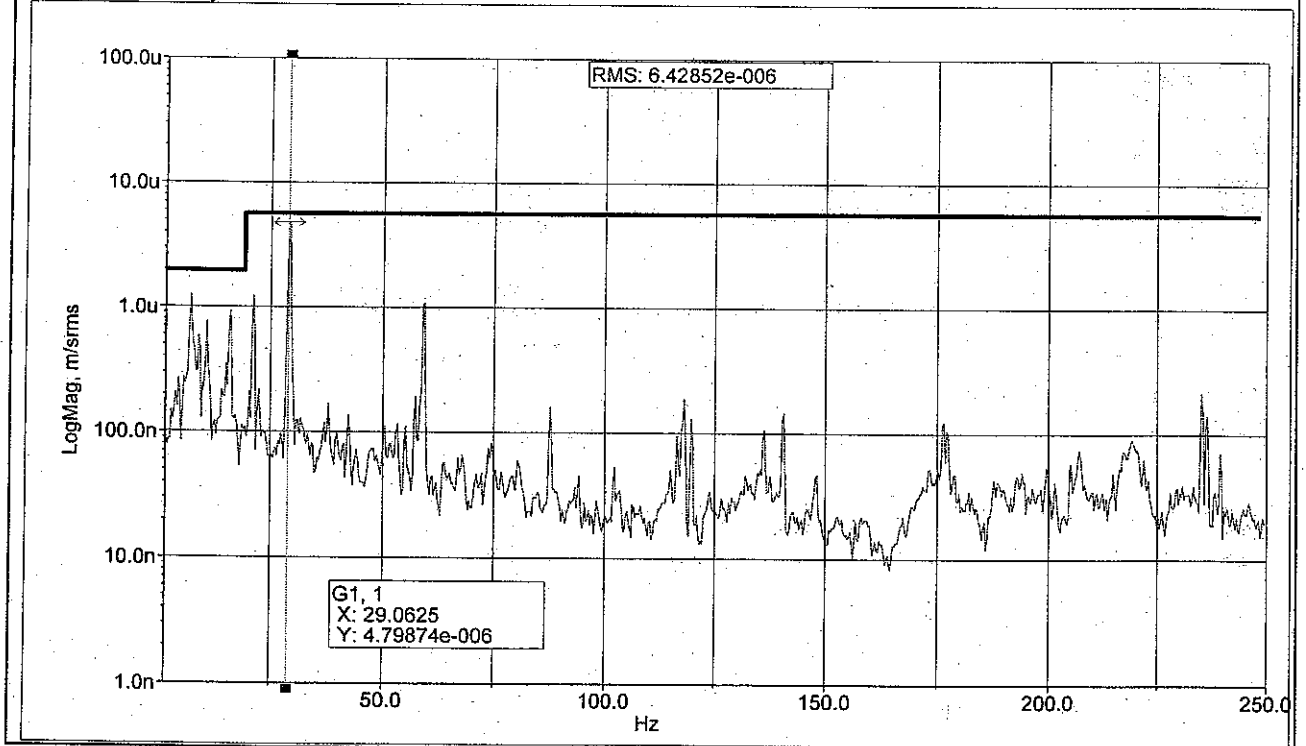
Site 19 - Velocity RMS - Y



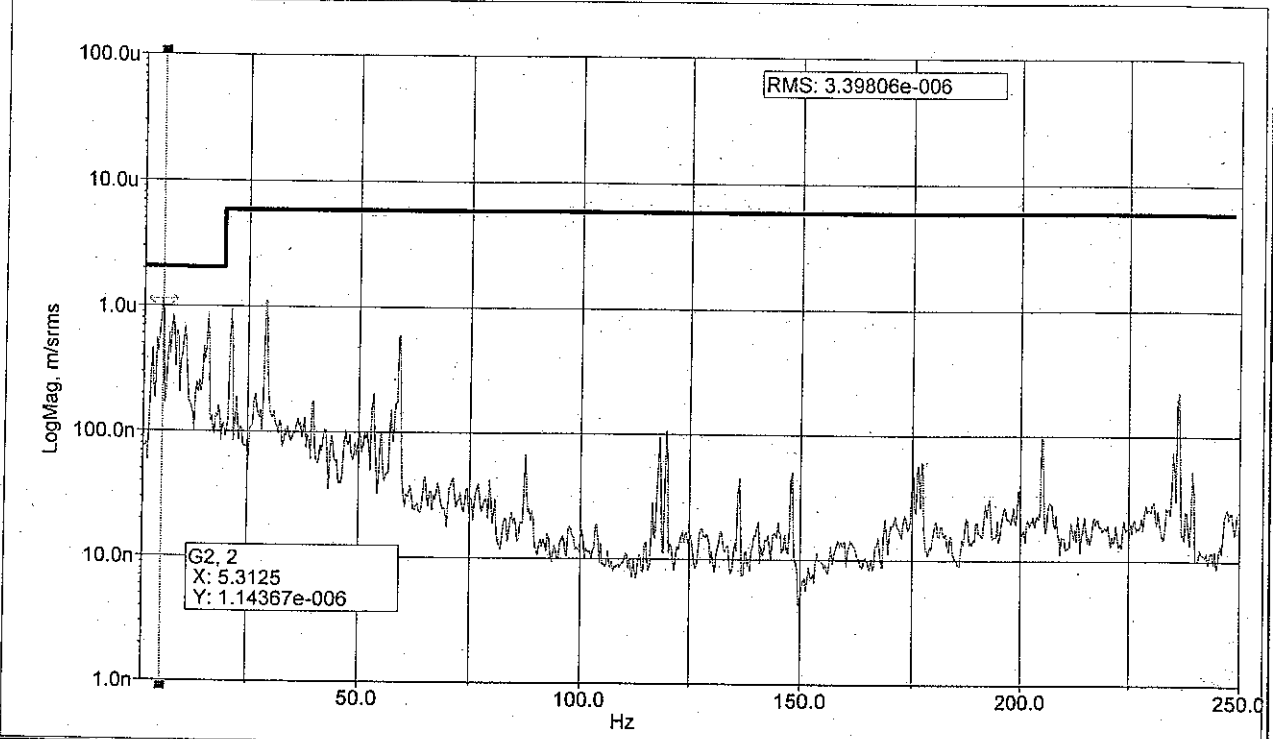
Site 19 - Velocity RMS - Z



Site 20 - Velocity RMS - X



Site 20 - Velocity RMS - Y



Site 20 - Velocity RMS - Z

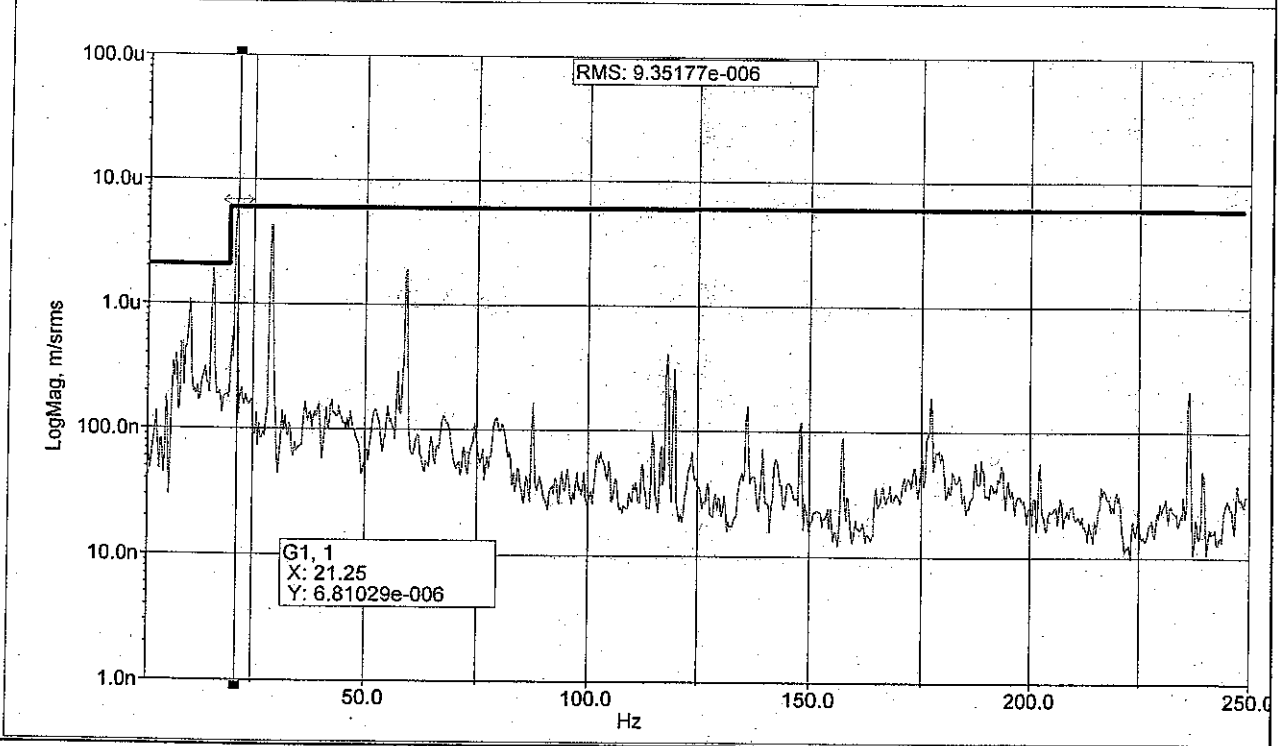


Figure 1 - Eastern Fan vibration - X

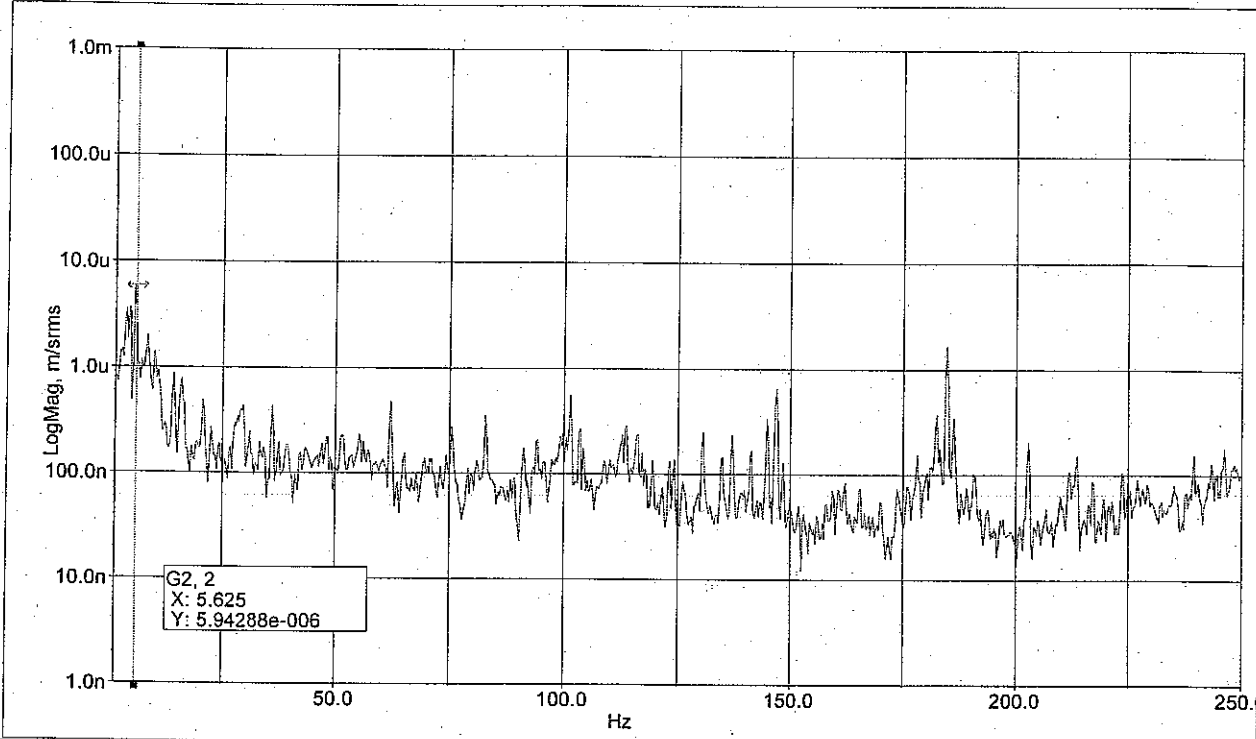


Figure 2 - Eastern Fan vibration - Y

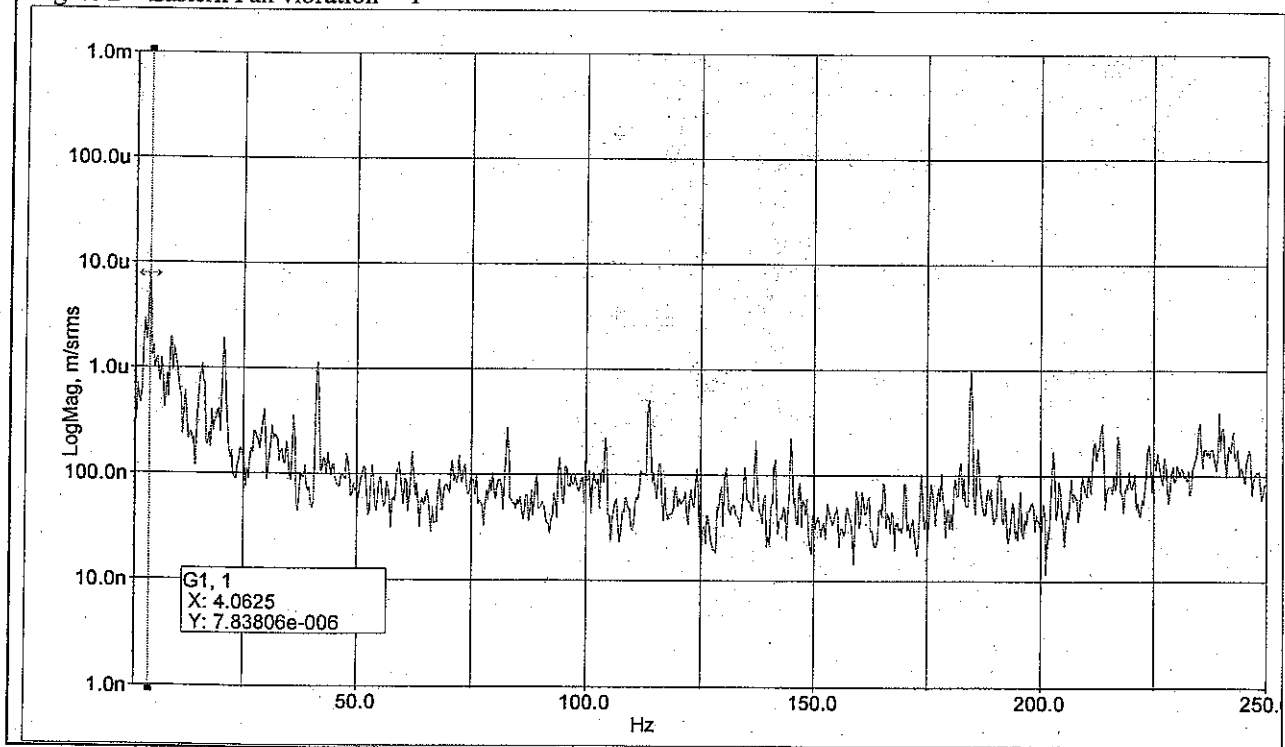


Figure 3 – Eastern Fan vibration – Z

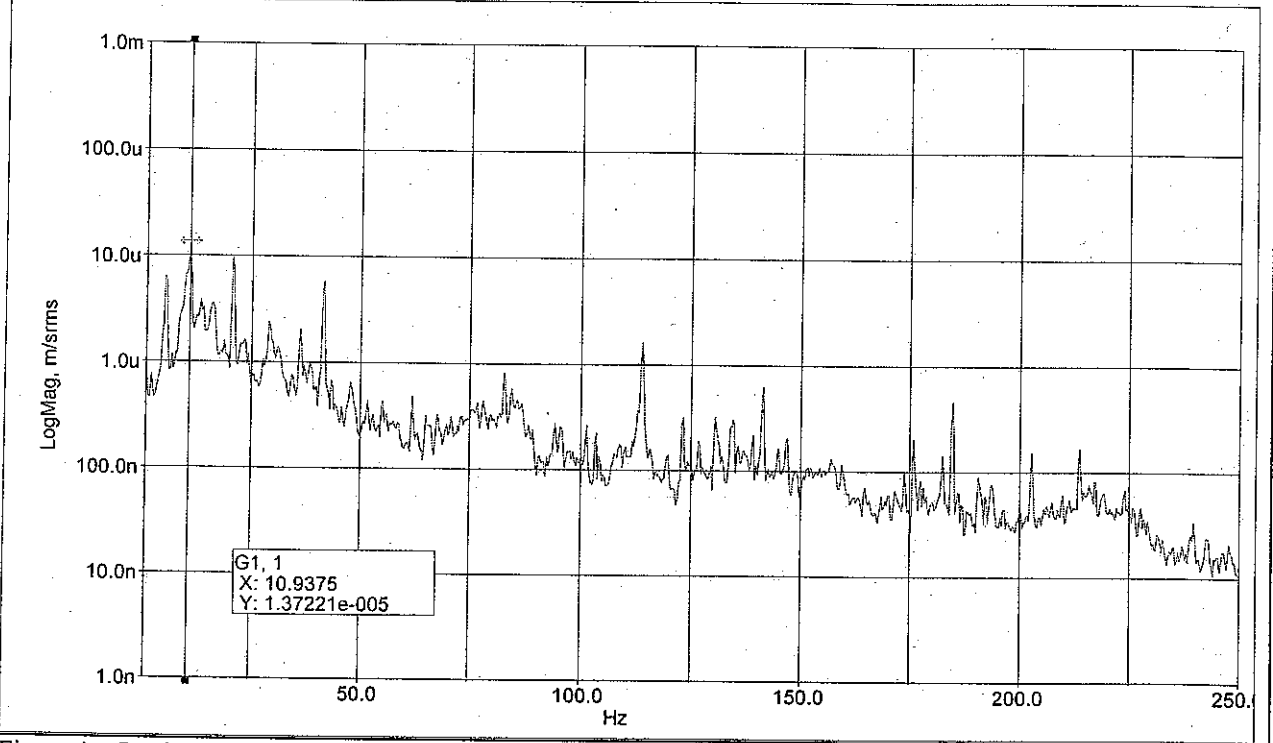


Figure 4 – Southeastern Fan vibration – X

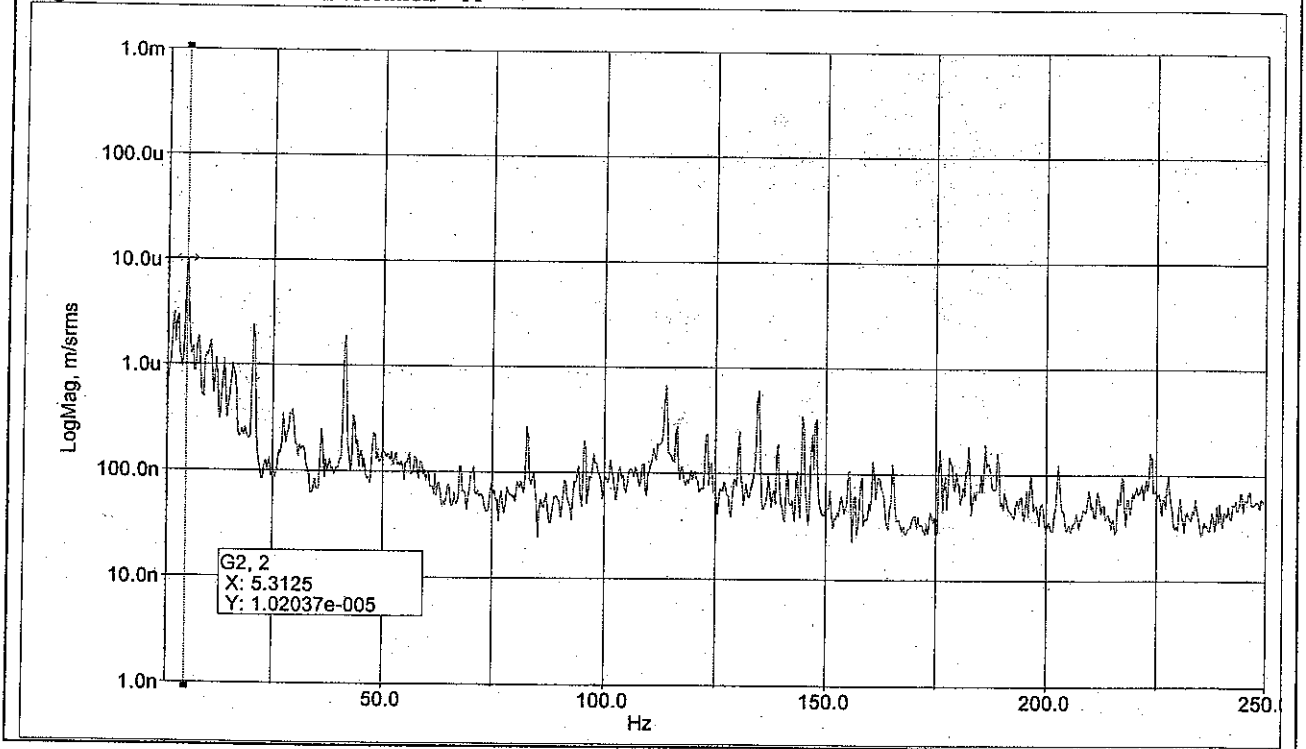


Figure 5 – Southeastern Fan vibration – Y

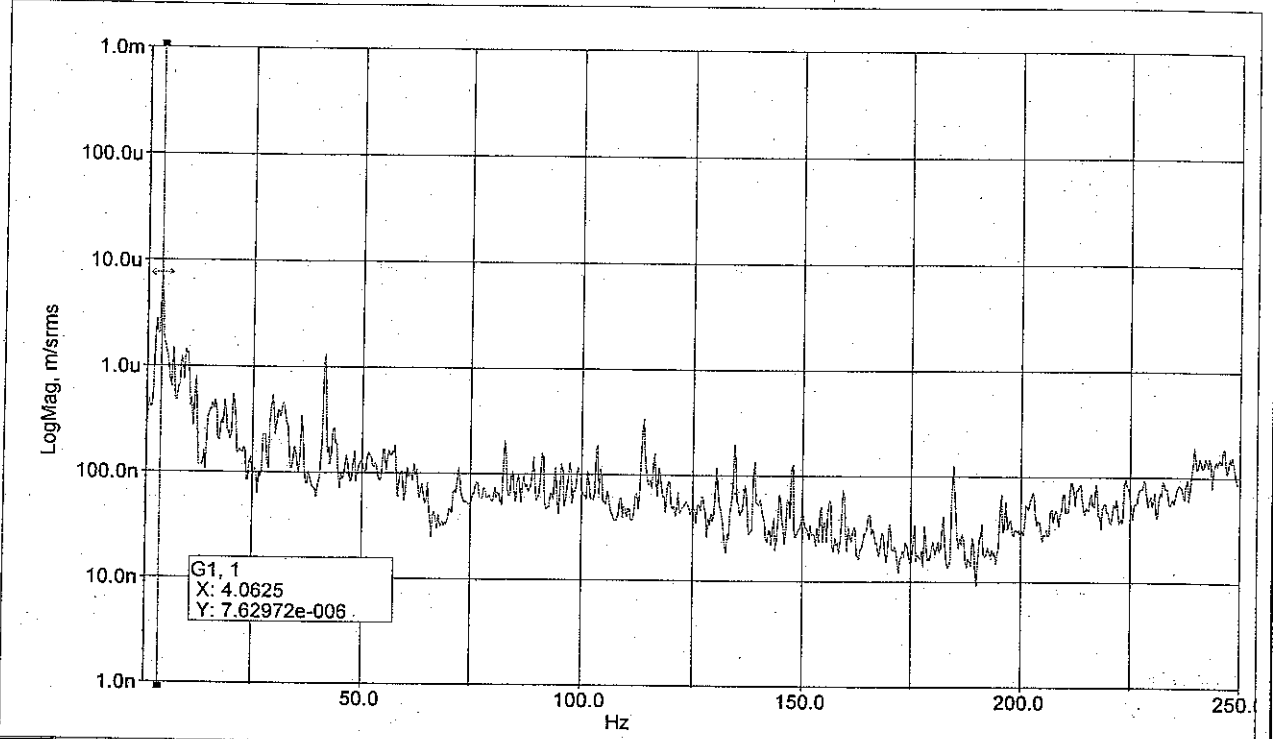


Figure 6 – E Southeastern vibration – Z

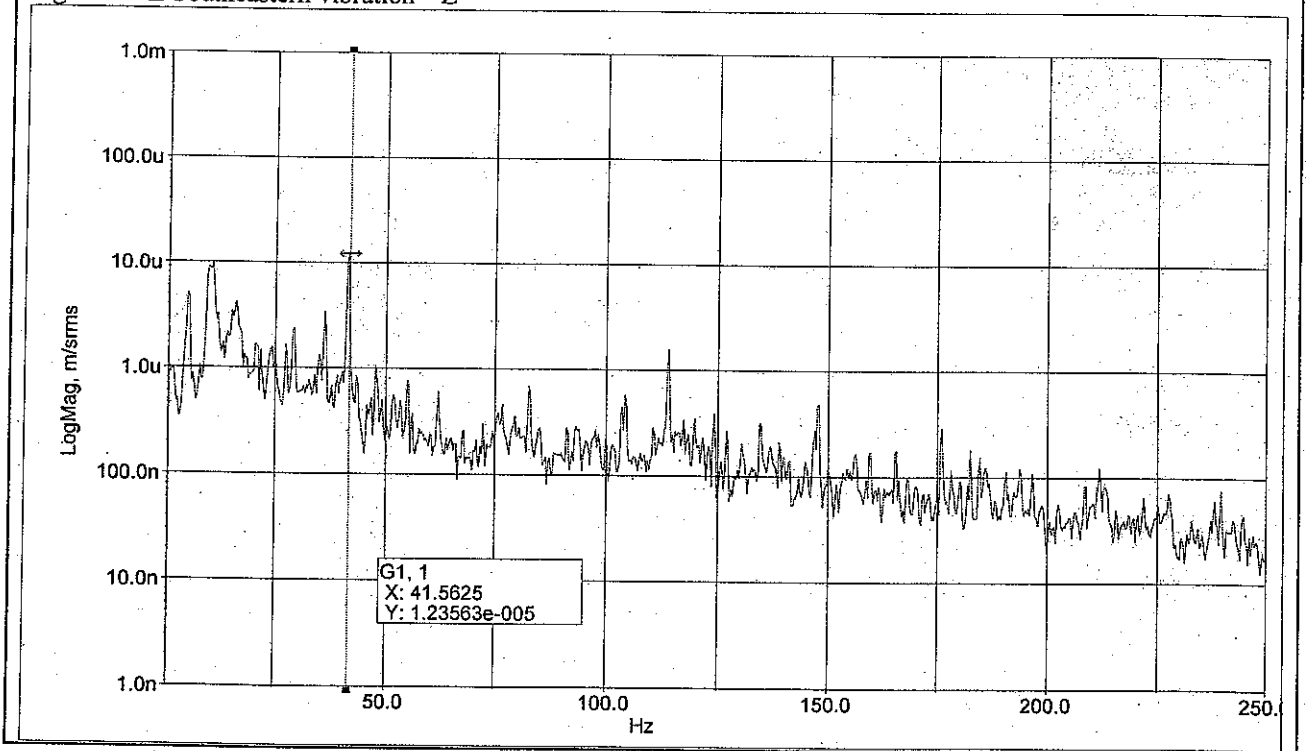


Figure 7 - Third Fan vibration - X

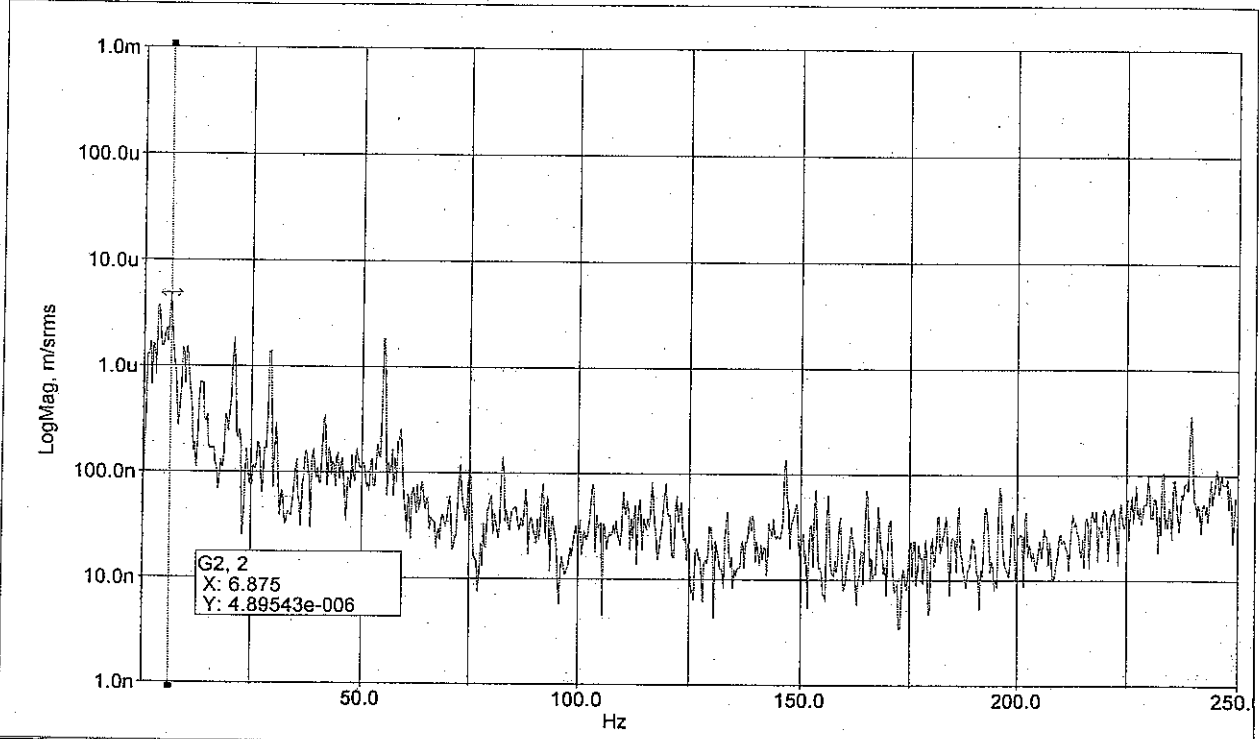


Figure 8 - Third Fan vibration - Y

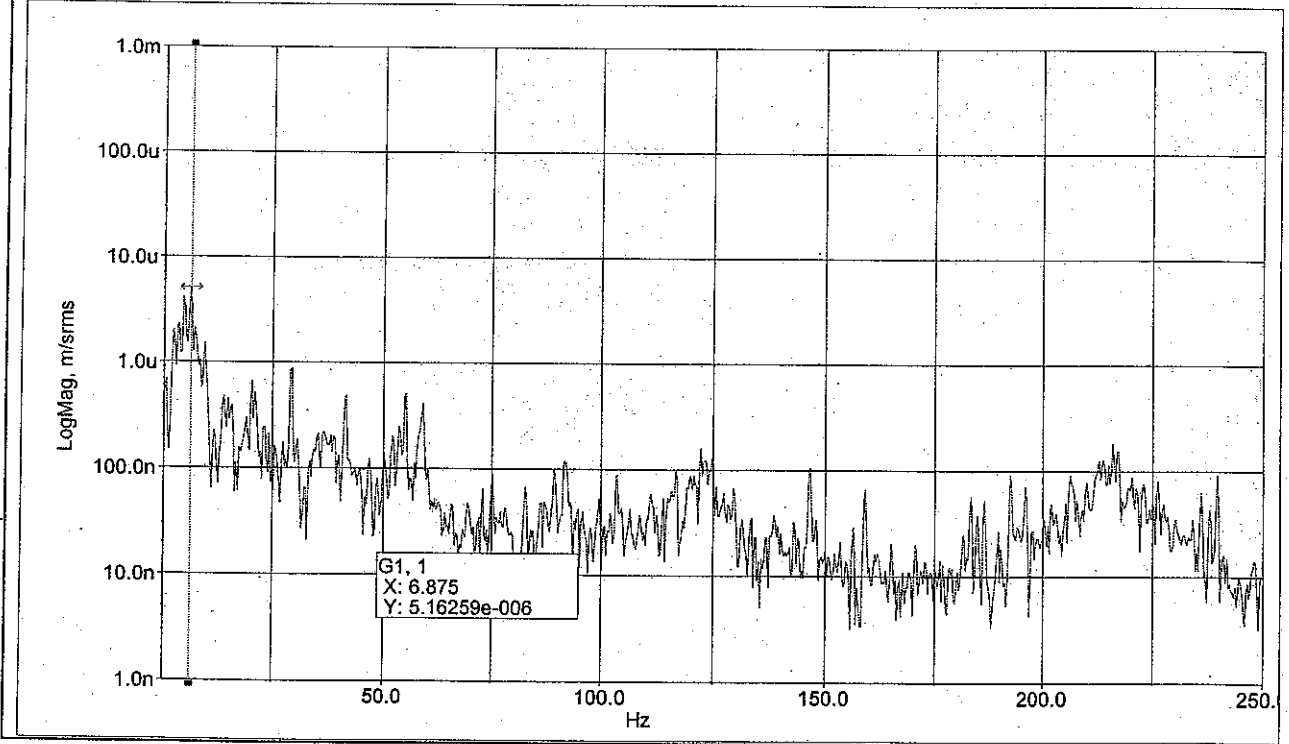


Figure 9 – Third Fan vibration – Z

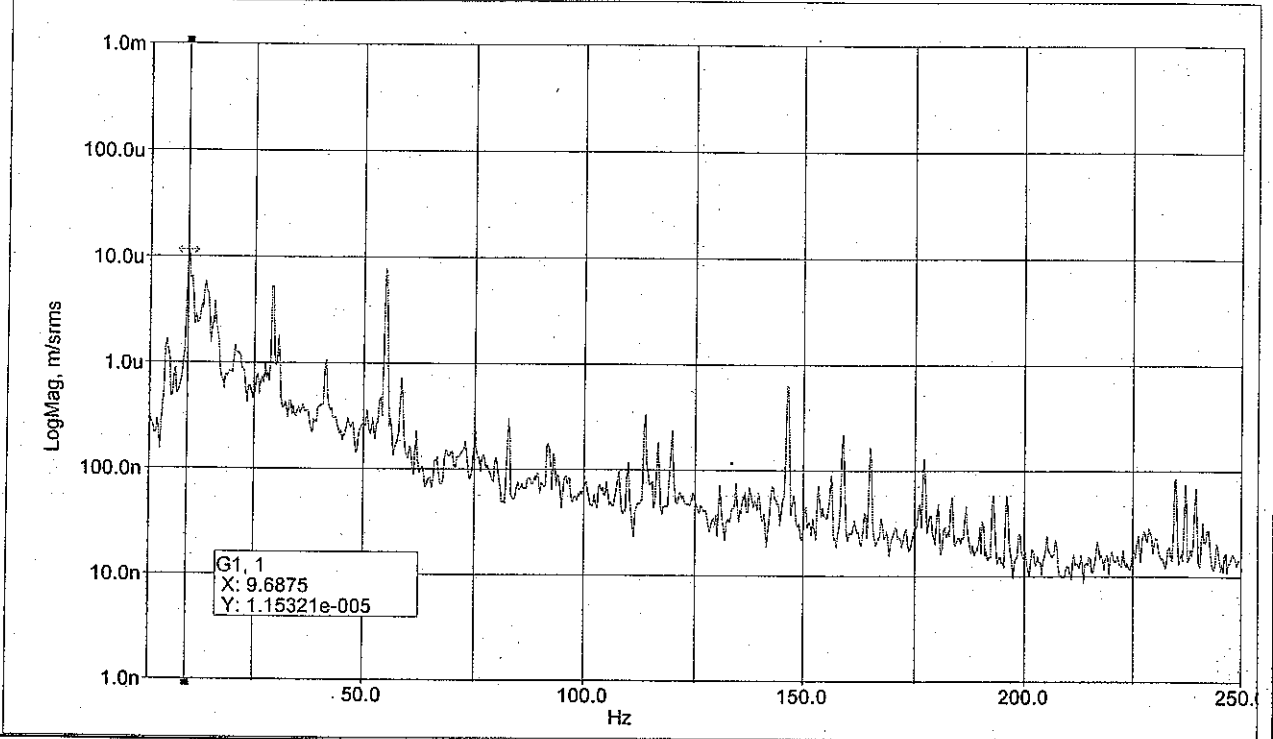


Figure 10 – Fourth Fan vibration – X

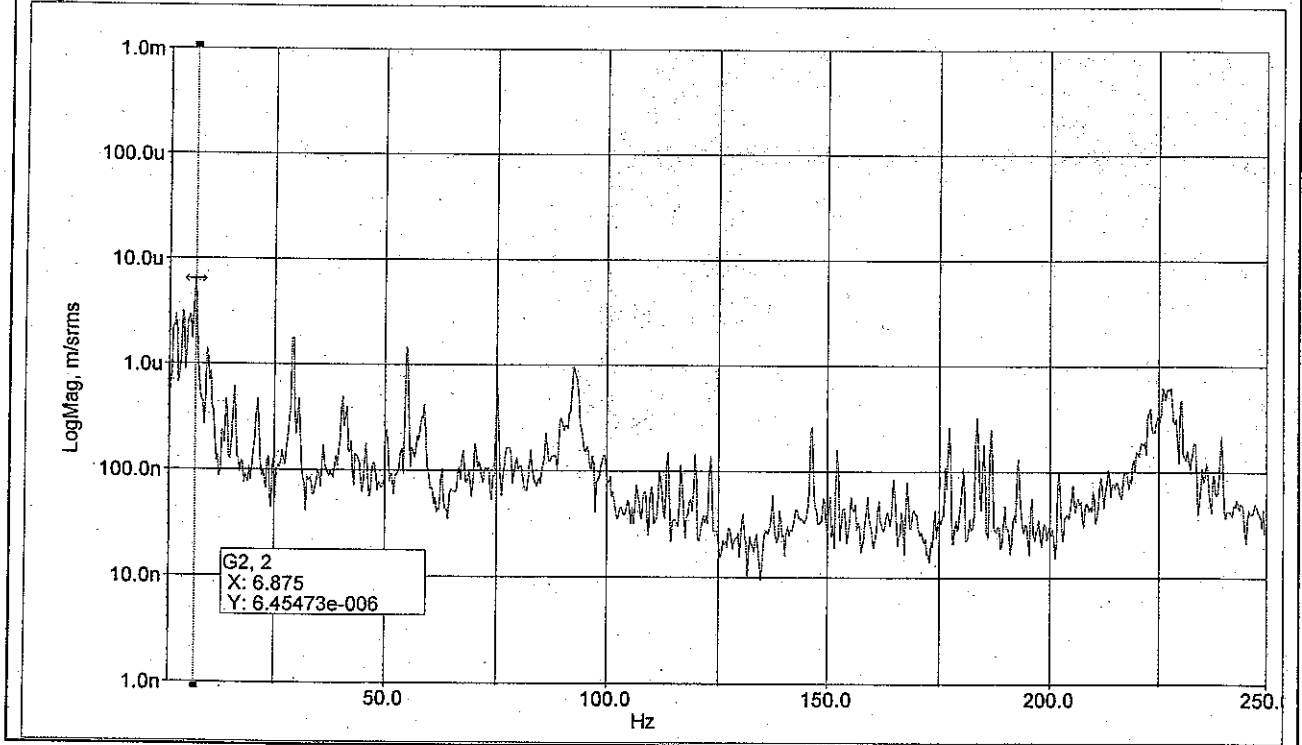


Figure 11 – Fourth Fan vibration – Y

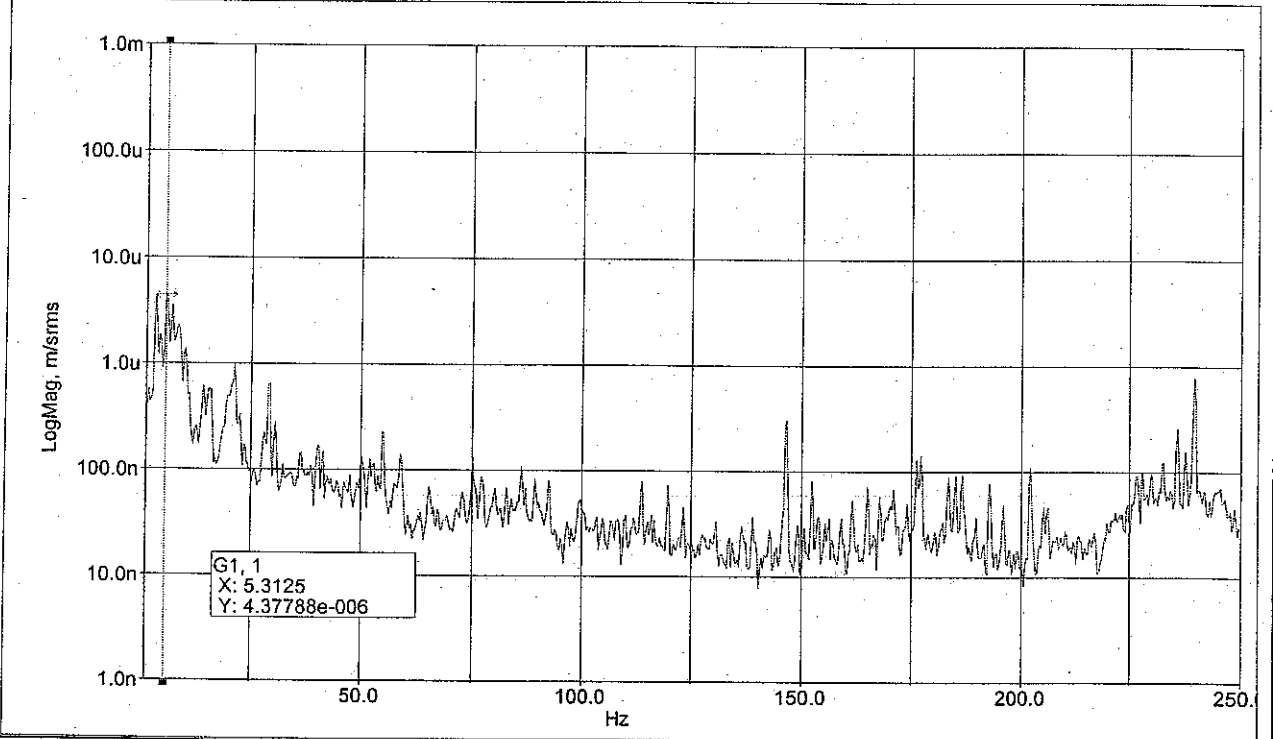


Figure 12 – Fourth Fan vibration – Z

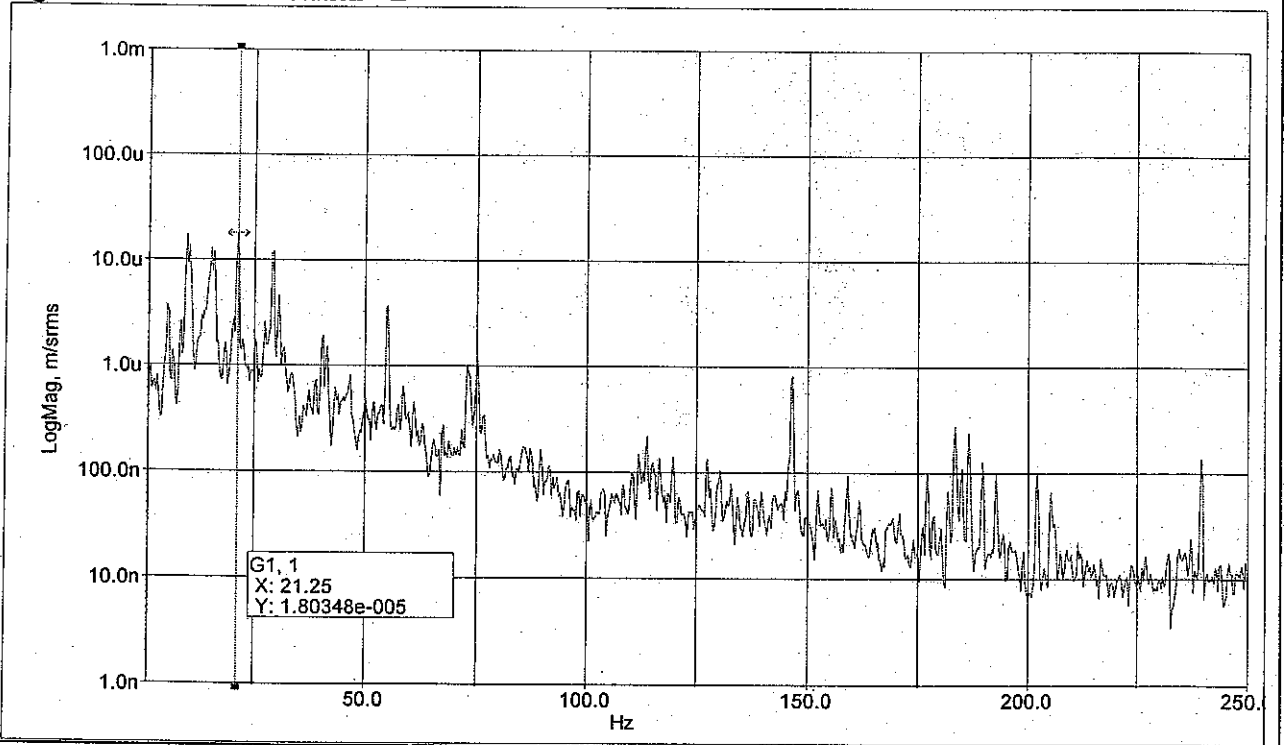


Figure 13 – FS66 Fan vibration – X

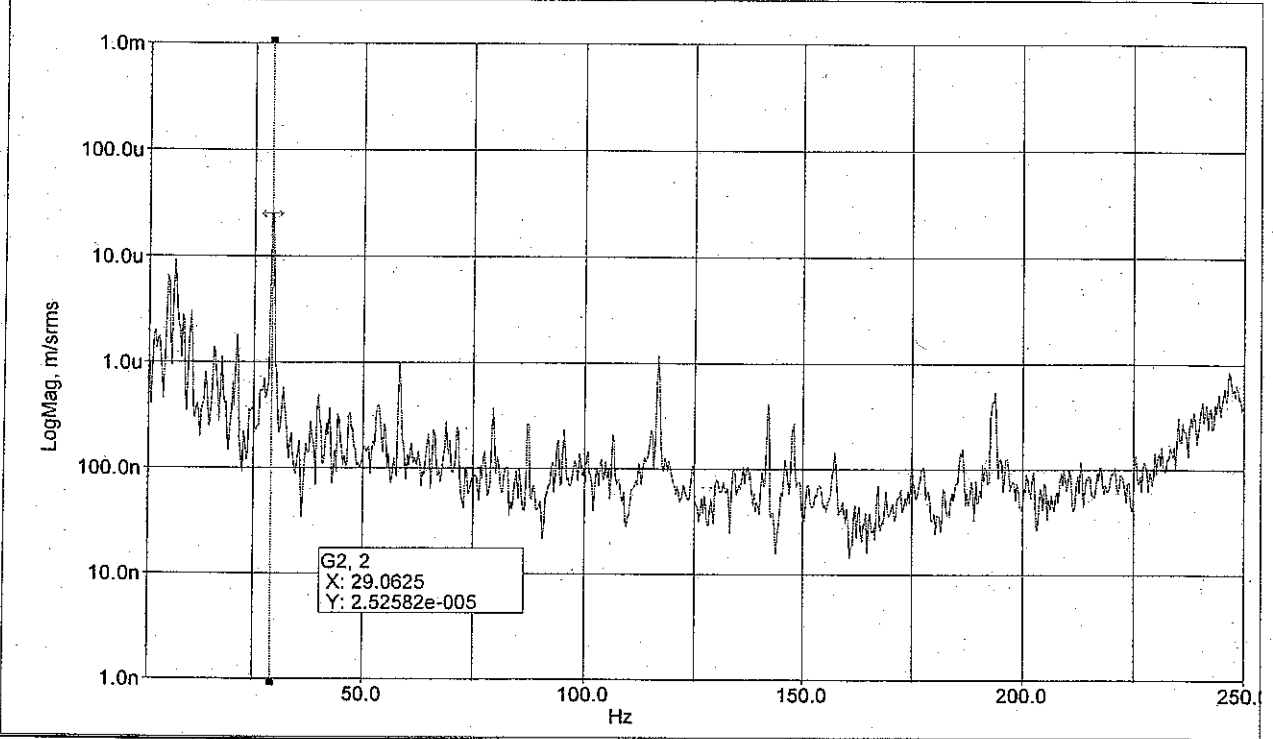


Figure 14 – FS66 Fan vibration – Y

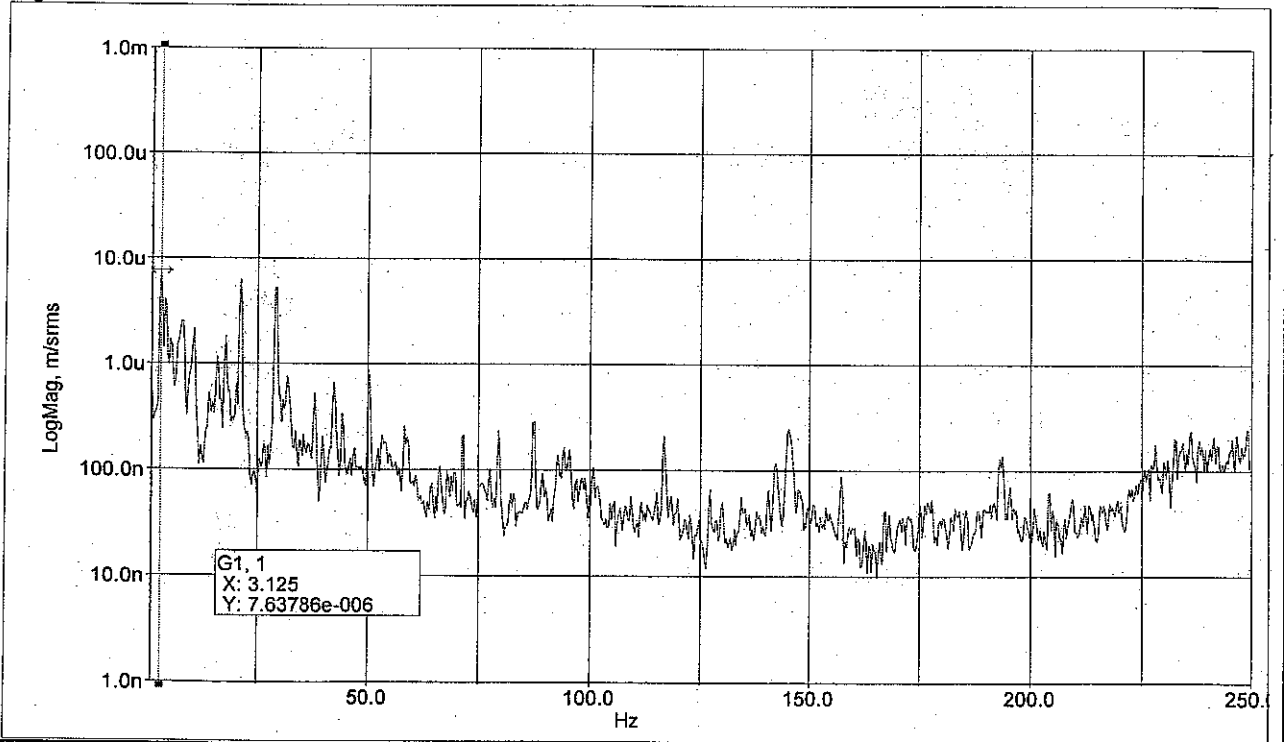


Figure 15 -- FS66 Fan vibration -- Z

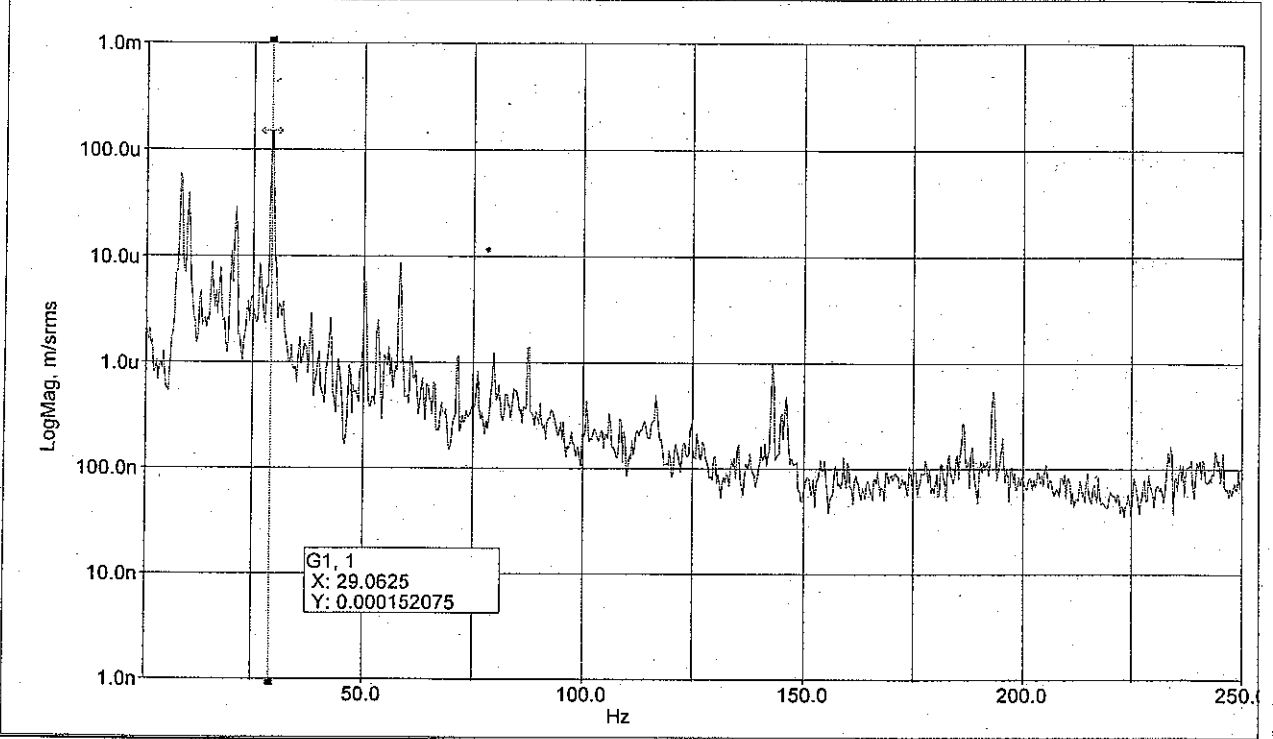


Figure 16 -- Western Fan vibration -- X

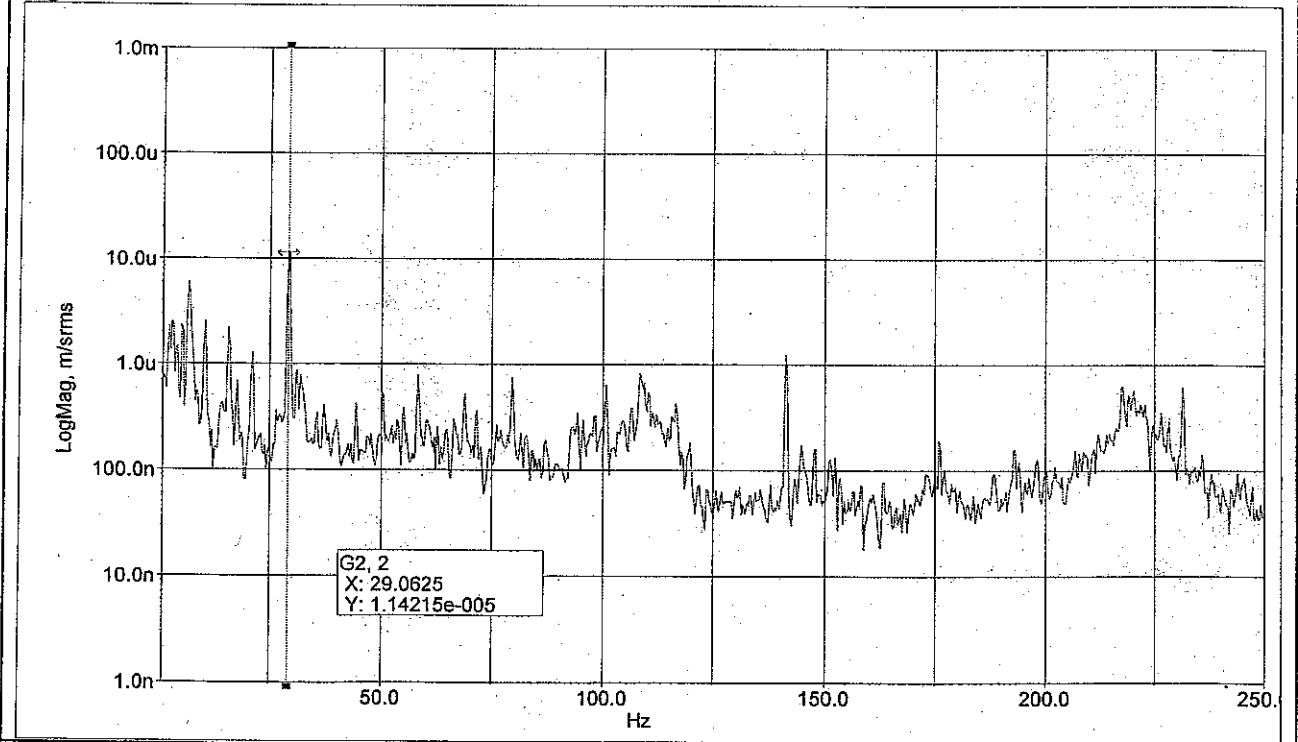


Figure 17 – Western Fan vibration – Y

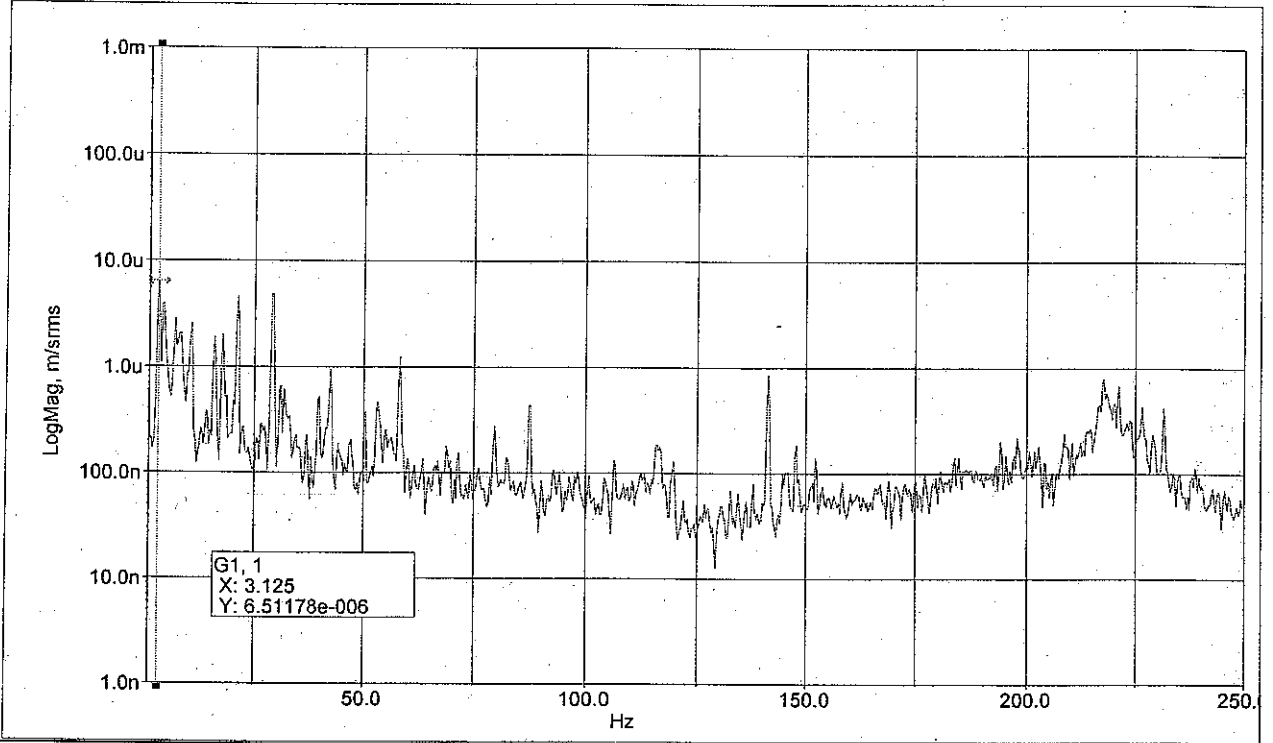


Figure 18 – Western Fan vibration – Z

