Environmental Impact Assessment

October 2020

India: Bengaluru Metro Rail Project

Phase 2A (Outer Road Ring Metro Line)

Volume 6
Annex 5

Prepared by Bangalore Metro Rail Corporation Ltd. (BMRCL), India for the Asian Development Bank.

NOTES

(i) The fiscal year (FY) of the Government of India and its agencies ends on 31 March. “FY” before a calendar year denotes the year in which the fiscal year ends, e.g., FY2019 ends on 31 March 2019.

(ii) In this report, "$" refers to United States dollars.

Base Line Vibration Monitoring for the Proposed Metro Project in Bangalore Phase -2A & 2B

Prepared for Client :

Bangalore Metro Rail Corporation Limited, Bangalore

Report Prepared By

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EXECUTIVE SUMMARY

Geosmart have been requested by AECOM to collect vibration level data from the existing environment at BMRCL phase 2 location . The scope of the survey is to complete day and night time measurements at noted sensitive locations within the immediate vicinity to BMRCL stage 2 area for selected properties as mentioned in the report.

The following report details the findings in regard to collected vibration levels. The aim of the survey is to provide Base Line data which can then be used as a part submission for a further information request from authorities

1.0 Introduction:

Ground borne vibrations from sources such as blasting, piling, machinery or road/rail traffic can be a source of concern for occupants of building and the structure of the building itself with in the vicinity of the source of vibration. This concern leads to a need to assess the effect of the imposed vibration on the building structure to ascertain whether damage could occur to the building due to vibration.

The measuring of vibration includes the following instrumentation:

- Transducers
- Data recording system

In general, the transducer would consist of a tri-axial sensor which would record the vibration in three directions namely vertical, longitudinal, and transversal. The data recording system will consist of processors, which will record the above measurement and record them in the system.

2.0 PROJECT LOCATION & SCOPE OF WORKS

The works under this Contract includes the supply and installation of vibration sensor , monitoring, recording and presentation of the data from these instruments for 10 locations at BMRCL Phase 2A and Phase 2B and vibration data will be recorded for a continues 24 hours in a single schedule. Below table depicts the proposed VM locations

LIST OF VIBRATION MONITORING STATIONS

PHASE – 2A (Central Silk Board to KR Puram)

Sl. No.	Station Code	List of Vibration monitoring locations	Chainages (km)	LHS/ RHS	Distance from Center Line (m)	Remarks
1	VM1	Near HSR Apartment Bus Stop	1+020	LHS	25	Thick Residential Area
2	VM2	Krupanidhi College (RHS) & Thick Residential Area (LHS)	6+800	RHS	50.00	
3	VM3	Saphire Honda Show room Near Salarpuria Hallmark	8+900	LHS	15.00	Alignment is very close
4	VM4	Car Care show room near ISRO	12+370	LHS	15	Row of Buildings are as near as 15 m
5	VM5	Lowry Memorial Educational Institution	16+800	LHS	58	

PHASE – 2B (KR Puram to Kempegowda International Airport via Hebbal Junction)

Sl. No.	Station Code	List of Vibration monitoring locations	Chainages (km)	LHS/ RHS	Distance from Center Line (m)	Remarks
1	VM6	Motherhood Hospital	3+700	LHS	30.00	
2	VM7	Manyata Tech Park	9+200	RHS	25.00	
3	VM8	Columbia Asia Hospital Hebbal	12+100	RHS	44.70	
4	VM9	Cytecare Cancer Hospital,	19+900	LHS	90.00	Cancer Research Lab
5	VM10	Chikkajala Fort	26+900	RHS	33.00	Archaeological Importance

3.0 Installation of Manual Vibration Monitoring System:

- Secure the Transducer to the ground using anchor
- Make sure that the arrow on the sensor is pointing towards the direction of activity.
- Secure a steel Protection Box over the sensor
- Connect the sensor with the readout unit with manufacturer‟s provided

connection cable and extended battery.

- Turn the Unit by “ON” by pressing ∗.

  Press SET UP to or edit the setups. Test to check geo channels or to access events..

- Press Start Monitor to enter monitor mode.

Features

- Instant LCD readout for all blast results
- Sturdy case makes for completely self contained unit
- Case mounted microphone with ground spike alternative
- Standard 175+ event memory, optional 300+ memory
- Completely waterproof for continuous all weather operation
- Standard RS-232 port for downloading with downloading software in Windows included

4.0 Operation:

The following details are to be recorded at the time of testing at the site:

- Source of vibration
- Type of building
- a sketch of the site location and the sensor location
- directions of measurements

5.0 Base Line Monitoring :

It is important that baseline monitoring be conducted prior to the onset of actual construction in order to measure any subsequent changes due to actual construction that may be attributed to the ground vibrations.

Setting a baseline of vibration data involves collecting multiple data sets on all monitored sensors under normal operating conditions.

Once a baseline has been established, vibration analysts use the signature as a point of reference to track deviations due to other construction activity. Monitoring periods ranged from continues 24 hours for every location.

Threshold limit (upper Limit) has been set to 0.5 mm/s which refers the event has been captured above 0.5mm/s.

Guideline values of vibration velocity, for evaluating the effects of short term vibration, DIN4150-3:1999

Line	Type of Structure	Vibration peak particle Velocity (mm/s)			
		Foundation Frequency			Plane of Floor of Uppermost Storey
		Less than 10 Hz	10 to 50 Hz	50 to 100* Hz	Frequency Mixture
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (eg buildings that are under a preservation order)	3	3 to 8	8 to 10	8

6.0 Summary of Reading :

A summary of the maximum baseline vibration recorded at each location is shown in Below Table

VIBRATION MONITORING SUMMARY				
S.NO	INSTRUMENT ID	DATE OF MONITORING	LOCATION	MAXIMUM TRIGGER
PHASE-2A (CENTRAL SLIK BOARD TO KR PURAM)				
1	VM01	11/12/2019	Near HSR Apartment Bus Stop	No events record
2	VM02	12/12/2019	Krupanidhi College (RHS) & Thick Residential Area (LHS)	No events record
3	VM03	11/12/2019	Saphire Honda Show room Near Salarpuria Hallmark	No events record
4	VM04	12/12/2012	Car Care show room near ISRO	1.22m/s
5	VM05	13/12/2019	Lowry Memorial Educational Institution	No events record
PHASE-2B (KR PURAM TO KEMPEGOWDA INTERNATIONAL ARIPORT VIA HEBBAL JUNCTION)				
6	VM06	15/12/2019	Motherhood Hospital	3.32mm/s
7	VM07	15/12/2019	Manyata tech park	No events record
8	VM08	13/12/2019	Columbia Asia Hospital Hebbal	1.82m/s
9	VM09	14/12/2019	Cyte Care Cancer hospital	No events record
10	VM10	14/12/2019	Chikkajala Fort	1.71mm/s

Based on the results of the vibration monitoring, the ground vibrations during this monitoring period were below typical threshold limits and no waveforms were recorded except VM04, VM06, VM08 and VM10.

7.0 Discussion and Conclusion

The general environs during the monitoring period was that of passing commuter traffic including buses, trucks and commercial delivery vehicles

When a bus or a truck strikes an regularity / irregularity in the road surface, it generates an impact load and an oscillating load due to the subsequent “axle hop” of the vehicle.

The impact load generates ground vibrations that are predominant at the natural vibration frequencies of the soil / structures for the following locations mentioned in the below table. The traffic including buses and trucks were the predominant source of vibration

level as the following instruments were located close proximity of highway, road and sub road.

S.NO	INSTRUMENT ID	DATE OF MONITORING	LOCATION	MAXIMUM Value
4	VM04	12/12/2012	Car care Showroon near ISRO	1.22mm/s
6	VM06	15/12/2019	Motherhood Hospital	3.32mm/s
8	VM08	13/12/2019	Columbia Asia Hospital	1.82mm/s
10	VM10	14/12/2019	Chikkajala Fort	1.71mm/s

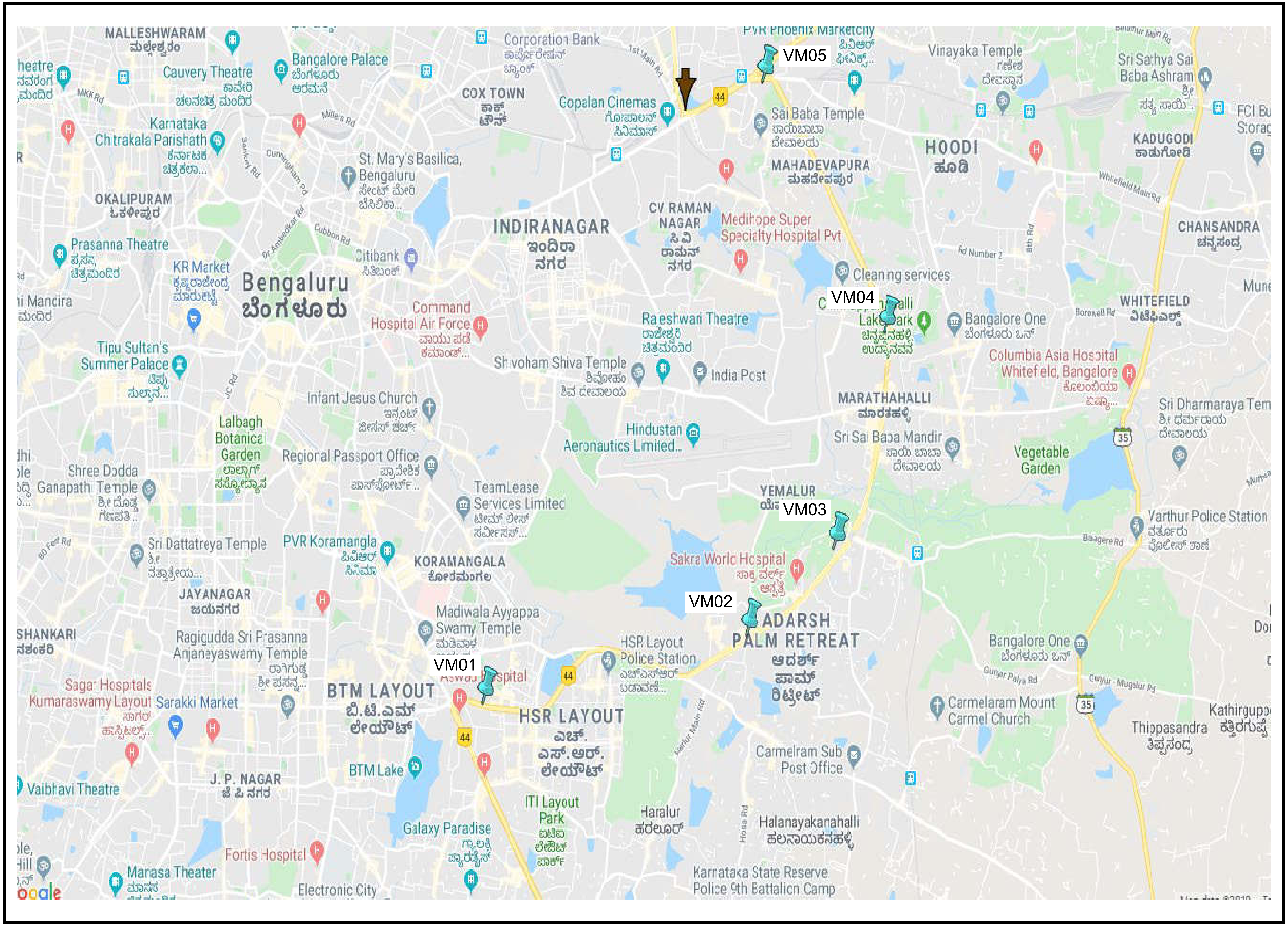
- In general the majority of base line vibration events recorded are in the range of 0.5 to 1.9mm per sec at locations motherhood hospital and fort .
  In addition there are few Maximum events PVS recorded 2.5mm and 3.3mm, that shall be taken as isolated events and shall be ignored .
- At hospital location, the vents are recorded especially at night time that could be due to fast moving traffic at the adjacent roads at night time
- DIN standards on the permissible vibration limits for various buildings are mentioned in above pages (5.0 Base Line Monitoring) as a reference and guidelines

The predominant frequencies and amplitude of the vibration depend on many factors including suspension system; soil type and stratification; traffic time Peak / Non Peak hours; distance from the road / highway; and type of building and the effects of these factors are interdependent. Vibrations readings are depicted in Appendix

Appendix

Location and Readings

PHASE–2A
(Central Silk Board to KR Puram)


VM01
VM02
VM03
VM04
VM05
MALLESHWARAM
Bangalore Palace
Cauvery Theatre
Corporation Bank
PVR Phoenix Marketcity
Vinayaka Temple
Sri Sathya Sai Baba Ashram
COX TOWN
Gopalan Cinemas
1st Main Rd
Sai Baba Temple
Karnataka Chitrakala Parishath
St. Mary's Basilica, Bengaluru
MAHADEVAPURA
HOODI
KADUGODI
Whitefield Main Rd
OKALIPURAM
INDIRANAGAR
CV RAMAN NAGAR
Medihope Super Specialty Hospital Pvt
Rd Number 2
CHANSANDRA
Prasanna Theatre
KR Market
Bengaluru
ಬೆಂಗಳೂರು
Citibank
Cubbon Rd
Cleaning services
Command Hospital Air Force
Rajeshwari Theatre
Bangalore One
Borewell Rd
WHITEFIELD
Tipu Sultan's Summer Palace
Shivoham Shiva Temple
India Post
Columbia Asia Hospital Whitefield, Bangalore
Infant Jesus Church
MARATHAHALLI
Sri Dharmaraya Temple
Lalbagh Botanical Garden
Hindustan Aeronautics Limited...
Sri Sai Baba Mandir
Regional Passport Office
Vegetable Garden
Shree Dodda Ganapathi Temple
TeamLease Services Limited
YEMALUR
Varthur Police Station
Balagere Rd
Sri Dattatreya Temple
PVR Koramangla
KORAMANGALA
Sakra World Hospital
JAYANAGAR
Madiwala Ayyappa Swamy Temple
ADARSH PALM RETREAT
SHANKARI
Ragigudda Sri Prasanna Anjaneyaswamy Temple
HSR Layout Police Station
Bangalore One
Gunjur Palya Rd
Gunjur - Mugalur Rd
Sagar Hospitals Kumaraswamy Layout
Sarakki Market
BTM LAYOUT
HSR LAYOUT
Carmelaram Mount Carmel Church
Kathirguppe
Thippasandra
BTM Lake
Carmelram Sub Post Office
J. P. NAGAR
Vaibhavi Theatre
ITI Layout Park
Haralur
Haralur Main Rd
Hosa Rd
Halanayakanahalli
Galaxy Paradise
Fortis Hospital
Manasa Theater
Electronic City
Karnataka State Reserve Police 9th Battalion Camp
44
35
Google

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VIBRATION REPORT

INSTRUMENT ID : VM01 **DATE : 11-Dec-19**

LOCATION :Near HSR Apartment Bus Stop

INSTALLATION PHOTO

INSTRUMENT ID : VM 01

LOCATION NAME : Near HSR Apartment Bus Stop

PROJECT STRECTCH : PHASE – 2A (Central Silk Board to KR Puram)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
LOG	UM11175	Dec 11 /19 16:11:08	***	***	***	***	***		***	Start Monitoring
LOG	UM11175	Dec 12 /19 15:26:15	***	***	***	***	***		***	Stop Monitoring

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VIBRATION REPORT

INSTRUMENT ID : VM02 **DATE : 12-Dec-19**

LOCATION : Krupanidhi College (RHS) & Thick Residential Area (LHS)

INSTALLATION PHOTO

INSTRUMENT ID : VM 02

LOCATION NAME : Krupanidhi College (RHS) & Thick Residential Area (LHS)

PROJECT STRECTCH : PHASE – 2A (Central Silk Board to KR Puram)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
LOG	UM11175	Dec 12 /19 16:14:08	***	***	***	***	***		***	Start Monitoring
LOG	UM11175	Dec 13 /19 12:51:13	***	***	***	***	***		***	Stop Monitoring

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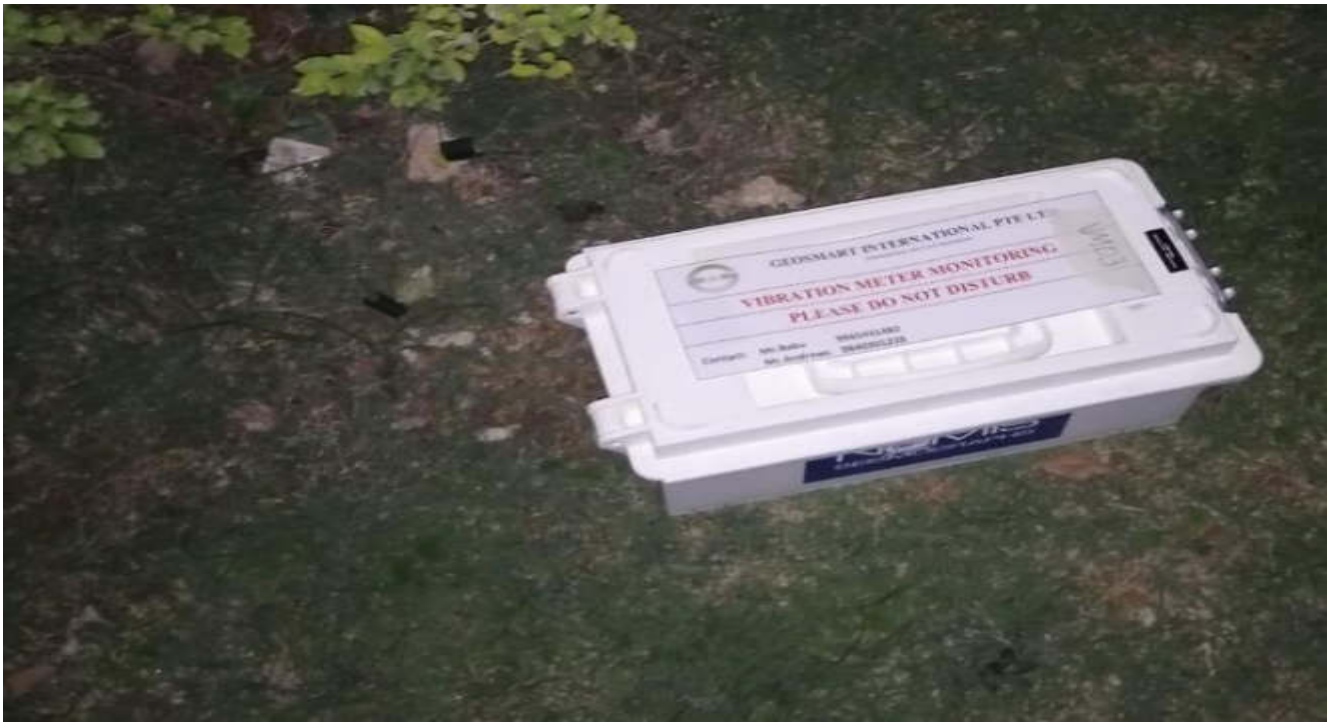
VIBRATION REPORT

INSTRUMENT ID : VM03 **DATE : 11-Dec-19**

LOCATION : Saphire Honda Show room Near Salarpuria Hallmark

INSTALLATION PHOTO



INSTRUMENT ID : VM 03

LOCATION NAME : Saphire Honda Show room Near Salarpuria Hallmark

PROJECT STRECTCH : PHASE – 2A (Central Silk Board to KR Puram)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
LOG	UM10787	Dec 11 /19 18:26:04	***	***	***	***	***		***	Start Monitoring
LOG	UM10787	Dec 12 /19 16:32:52	***	***	***	***	***		***	Stop Monitoring

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VIBRATION REPORT

INSTRUMENT ID : VM04 **DATE : 12-Dec-19**

LOCATION : Car Care show room near ISRO

INSTALLATION PHOTO

INSTRUMENT ID : VM 04

LOCATION NAME : Car Care show room near ISRO

PROJECT STRECTCH : PHASE – 2A (Central Silk Board to KR Puram)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
W	UM10787	Dec 12 /19 17:51:30	3	Long	0.418	0.378	1.088	***	1.129	
W	UM10787	Dec 12 /19 17:52:53	3	Long	0.189	0.812	0.930	***	1.220	
W	UM10787	Dec 12 /19 17:53:03	3	Long	0.473	0.835	0.946	***	1.166	

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VIBRATION REPORT

INSTRUMENT ID : VM05 **DATE : 13-Dec-19**

LOCATION :Lowry Memorial Educational Institution

INSTALLATION PHOTO

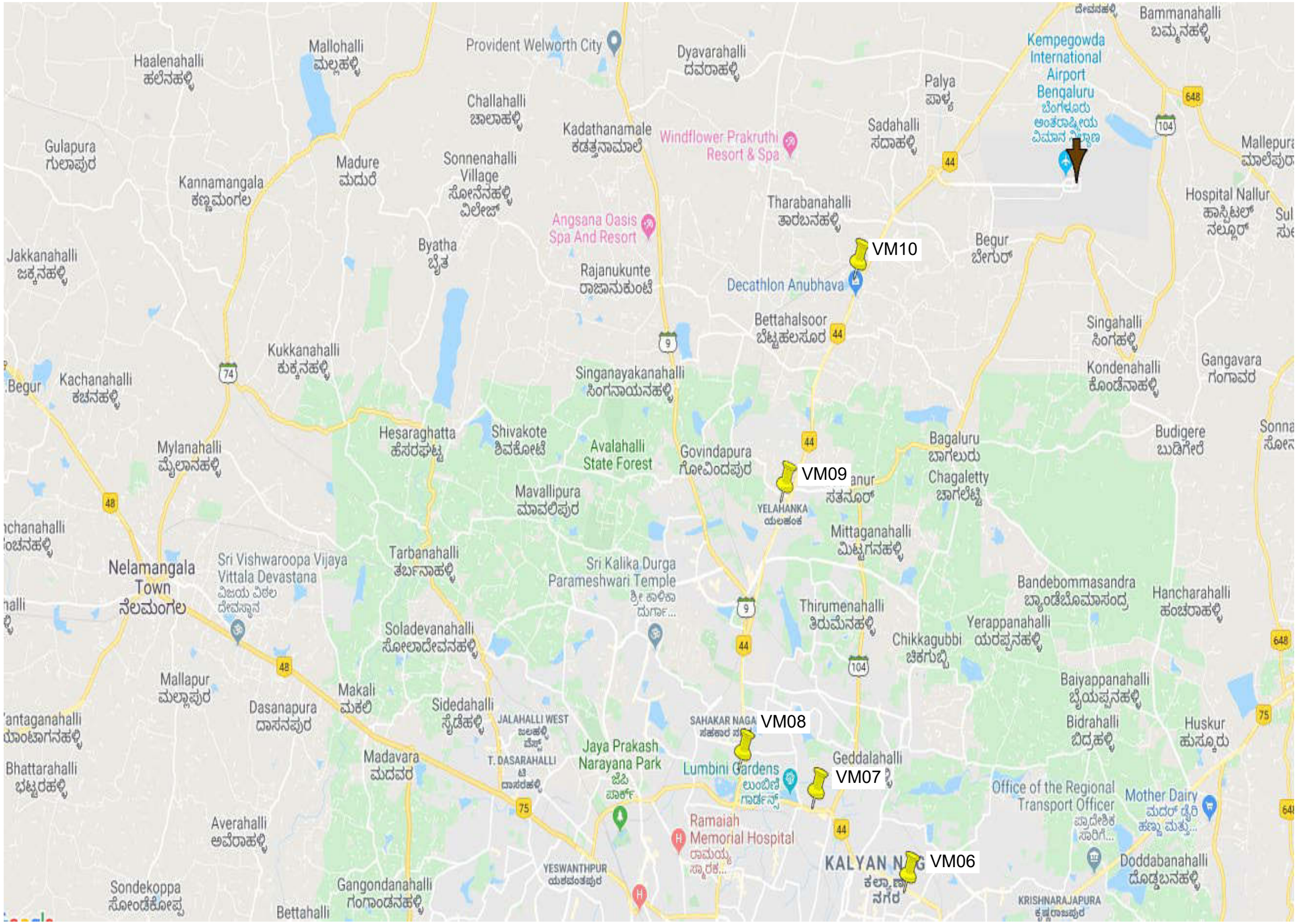
INSTRUMENT ID : VM 05

LOCATION NAME : Lowry Memorial Educational Institution

PROJECT STRECTCH : PHASE – 2A (Central Silk Board to KR Puram)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
LOG	UM11175	Dec 13 /19 14:54:17	***	***	***	***	***		***	Start Monitoring
LOG	UM11175	Dec 14 /19 12:10:34	***	***	***	***	***		***	Stop Monitoring

PHASE – 2B
(KR Puram to Kempegowda International Airport via Hebbal Junction)


Haalenahalli
ಹಲೆನಹಳ್ಳಿ
Mallohalli
ಮಲ್ಲಹಳ್ಳಿ
Provident Welworth City
Dyavarahalli
ದವರಾಹಳ್ಳಿ
Challahalli
ಚಾಲಾಹಳ್ಳಿ
Kempegowda International Airport Bengaluru
ಬೆಂಗಳೂರು ಅಂತರಾಷ್ಟ್ರೀಯ ವಿಮಾನ ನಿಲ್ದಾಣ
Bammanahalli
ಬಮ್ಮನಹಳ್ಳಿ
Palya
ಪಾಳ್ಯ
Gulapura
ಗುಲಾಪುರ
Kadathanamale
ಕಡತ್ತನಾಮಾಲೆ
Windflower Prakruthi Resort & Spa
Sadahalli
ಸದಾಹಳ್ಳಿ
Madure
ಮದುರೆ
Sonnenahalli Village
ಸೋನೆನಹಳ್ಳಿ ವಿಲೇಜ್
Kannamangala
ಕಣ್ಣಮಂಗಲ
Tharabanahalli
ತಾರಬನಹಳ್ಳಿ
Hospital Nallur
ಹಾಸ್ಪಿಟಲ್ ನಲ್ಲೂರ್
Angsana Oasis Spa And Resort
Byatha
ಬೈತ
VM10
Jakkanahalli
ಜಕ್ಕನಹಳ್ಳಿ
Rajanukunte
ರಾಜಾನುಕುಂಟೆ
Begur
ಬೇಗುರ್
Decathlon Anubhava
Bettahalsoor
ಬೆಟ್ಟಹಲಸೂರ
Singahalli
ಸಿಂಗಹಳ್ಳಿ
Kukkanahalli
ಕುಕ್ಕನಹಳ್ಳಿ
Kachanahalli
ಕಚನಹಳ್ಳಿ
Singanayakanahalli
ಸಿಂಗನಾಯನಹಳ್ಳಿ
Kondenahalli
ಕೊಂಡೆನಾಹಳ್ಳಿ
Gangavara
ಗಂಗಾವರ
Hesaraghatta
ಹೆಸರಘಟ್ಟ
Shivakote
ಶಿವಕೋಟೆ
Avalahalli State Forest
Govindapura
ಗೋವಿಂದಪುರ
Budigere
ಬುಡಿಗೇರೆ
Mylanahalli
ಮೈಲಾನಹಳ್ಳಿ
Mavallipura
ಮಾವಲಿಪುರ
VM09
YELAHANKA
ಯಲಹಂಕ
Bagaluru
ಬಾಗಲುರು
Chagaletty
ಬಾಗಲೆಟ್ಟಿ
Mittaganahalli
ಮಿಟ್ಟಗನಹಳ್ಳಿ
Nelamangala Town
ನೆಲಮಂಗಲ
Sri Vishwaroopa Vijaya Vittala Devastana
ವಿಜಯ ವಿಠಲ ದೇವಸ್ಥಾನ
Tarbanahalli
ತರ್ಬನಾಹಳ್ಳಿ
Sri Kalika Durga Parameshwari Temple
Bandebommasandra
ಬ್ಯಾಂಡೆಬೊಮಾಸಂದ್ರ
Hancharahalli
ಹಂಚರಾಹಳ್ಳಿ
Thirumenahalli
ತಿರುಮೆನಹಳ್ಳಿ
Yerappanahalli
ಯರಪ್ಪನಹಳ್ಳಿ
Chikkagubbi
ಚಿಕಗುಬ್ಬಿ
Soladevanahalli
ಸೋಲಾದೇವನಹಳ್ಳಿ
Mallapur
ಮಲ್ಲಾಪುರ
Dasanapura
ದಾಸನಪುರ
Makali
ಮಕಲಿ
Sidedahalli
ಸೈಡೆಹಳ್ಳಿ
Baiyappanahalli
ಬೈಯಪ್ಪನಹಳ್ಳಿ
Bidrahalli
ಬಿದ್ರಹಳ್ಳಿ
Huskur
ಹುಸ್ಕೂರು
JALAHALLI WEST
ಜಲಹಳ್ಳಿ ವೆಸ್ಟ್
SAHAKAR NAGA
ಸಹಕಾರ ನಗರ
VM08
Bhattarahalli
ಭಟ್ಟರಹಳ್ಳಿ
Madavara
ಮದವರ
T. DASARAHALLI
ಟಿ ದಾಸರಹಳ್ಳಿ
Jaya Prakash Narayana Park
ಜೆಪಿ ಪಾರ್ಕ್
Lumbini Gardens
ಲುಂಬಿಣಿ ಗಾರ್ಡನ್ಸ್
Geddalahalli
VM07
Office of the Regional Transport Officer
ಪ್ರಾದೇಶಿಕ ಸಾರಿಗೆ...
Mother Dairy
ಮದರ್ ಡೈರಿ ಹಣ್ಣು ಮತ್ತು...
Averahalli
ಅವೆರಾಹಳ್ಳಿ
Ramaiah Memorial Hospital
ರಾಮಯ್ಯ ಸ್ಮಾರಕ...
YESWANTHPUR
ಯಶವಂತಪುರ
KALYAN NAGA
ಕಲ್ಯಾಣ ನಗರ
VM06
Doddabanahalli
ದೊಡ್ಡಬನಹಳ್ಳಿ
Sondekoppa
ಸೋಂಡೆಕೊಪ್ಪ
Gangondanahalli
ಗಂಗಾಂಡನಹಳ್ಳಿ
Bettahalli
KRISHNARAJAPURA
ಕೃಷ್ಣರಾಜಪುರ

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VIBRATION REPORT

INSTRUMENT ID : VM06 **DATE : 15-Dec-19**

LOCATION : Motherhood Hospital

INSTALLATION PHOTO

INSTRUMENT ID : VM 06

LOCATION NAME : Motherhood Hospital

PROJECT STRECTCH : PHASE – 2B (KR Puram to Kempegowda International Airport via Hebbal Junction)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
W	UM10787	Dec 15 /19 16:24:49	3	Vert	0.520	0.504	1.301	***	1.323	VM06
W	UM10787	Dec 15 /19 16:24:58	3	Long	0.670	0.292	0.804	***	0.830	VM06
W	UM10787	Dec 15 /19 16:25:07	3	Long	0.378	0.158	1.584	***	1.587	VM06
W	UM10787	Dec 15 /19 16:25:16	3	Long	0.213	0.118	0.583	***	0.584	VM06
W	UM10787	Dec 15 /19 16:25:50	3	Vert	0.528	1.836	0.489	***	1.852	VM06
W	UM10787	Dec 15 /19 16:26:56	3	Long	1.584	0.623	1.702	***	1.942	VM06
W	UM10787	Dec 15 /19 16:27:28	3	Long	0.536	0.434	3.161	***	3.183	VM06
W	UM10787	Dec 15 /19 16:27:43	3	Long	0.213	0.134	0.741	***	0.746	VM06
W	UM10787	Dec 15 /19 16:35:36	3	Tran	0.591	0.315	0.418	***	0.638	VM06
W	UM10787	Dec 15 /19 20:02:21	3	Long	0.441	0.244	0.567	***	0.591	VM06
W	UM10787	Dec 16 /19 04:42:13	3	Vert	0.426	0.544	0.402	***	0.696	VM06
W	UM10787	Dec 16 /19 06:46:06	3	Long	0.150	0.638	2.554	***	2.579	VM06
W	UM10787	Dec 16 /19 06:46:16	3	Long	0.087	0.765	3.287	***	3.321	VM06
W	UM10787	Dec 16 /19 08:15:12	3	Long	0.110	0.331	1.316	***	1.320	VM06
W	UM10787	Dec 16 /19 10:17:01	3	Long	0.063	0.725	0.504	***	0.802	VM06
W	UM10787	Dec 16 /19 10:44:18	3	Vert	0.189	0.914	0.544	***	1.033	VM06
W	UM10787	Dec 16 /19 11:52:44	3	Vert	0.150	0.528	0.410	***	0.633	VM06
W	UM10787	Dec 16 /19 13:32:16	3	Long	0.071	0.126	0.835	***	0.839	VM06

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VIBRATION REPORT

INSTRUMENT ID : VM07 **DATE : 15-Dec-19**

LOCATION : Manyata Tech Park

INSTALLATION PHOTO

INSTRUMENT ID : VM 07

LOCATION NAME : Manyata Tech Park

PROJECT STRECTCH : PHASE – 2B (KR Puram to Kempegowda International Airport via Hebbal Junction)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
LOG	UM11175	Dec 15 /19 15:52:03	***	***	***	***	***		***	Start Monitoring
LOG	UM11175	Dec 16 /19 13:12:47	***	***	***	***	***		***	Stop Monitoring

GEOSMART

VIBRATION REPORT

INSTRUMENT ID : VM08 **DATE : 13-Dec-19**

LOCATION : Columbia Asia Hospital Hebbal

INSTALLATION PHOTO

INSTRUMENT ID : VM 08

LOCATION NAME : Columbia Asia Hospital Hebbal

PROJECT STRECTCH : PHASE – 2B (KR Puram to Kempegowda International Airport via Hebbal Junction)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
W	UM10787	Dec 13 /19 16:35:32	3	Long	0.181	0.118	0.607	***	0.609	VM08
W	UM10787	Dec 13 /19 16:37:32	3	Long	0.173	0.134	0.504	***	0.508	VM08
W	UM10787	Dec 13 /19 16:44:48	3	Vert	0.434	0.591	0.213	***	0.601	VM08
W	UM10787	Dec 13 /19 20:17:25	3	Vert	0.370	0.567	0.236	***	0.579	VM08
W	UM10787	Dec 13 /19 20:43:29	3	Tran	0.497	0.402	0.189	***	0.522	VM08
W	UM10787	Dec 13 /19 20:44:02	3	Vert	0.520	0.512	0.221	***	0.580	VM08
W	UM10787	Dec 13 /19 20:52:20	3	Vert	0.410	0.528	0.189	***	0.537	VM08
W	UM10787	Dec 13 /19 21:57:49	3	Tran	0.725	0.662	0.323	***	0.805	VM08
W	UM10787	Dec 13 /19 22:23:01	3	Tran	0.497	0.418	0.315	***	0.508	VM08
W	UM10787	Dec 13 /19 23:03:51	3	Tran	0.544	0.481	0.173	***	0.549	VM08
W	UM10787	Dec 13 /19 23:05:01	3	Vert	0.504	0.536	0.181	***	0.568	VM08
W	UM10787	Dec 13 /19 23:47:54	3	Vert	0.434	0.765	0.300	***	0.766	VM08
W	UM10787	Dec 13 /19 23:48:35	3	Vert	0.300	0.615	0.229	***	0.635	VM08
W	UM10787	Dec 13 /19 23:48:46	3	Vert	0.331	0.512	0.189	***	0.557	VM08
W	UM10787	Dec 13 /19 23:49:14	3	Tran	0.725	0.528	0.244	***	0.736	VM08
W	UM10787	Dec 13 /19 23:55:29	3	Vert	0.276	0.528	0.181	***	0.550	VM08
W	UM10787	Dec 13 /19 23:56:12	3	Vert	0.599	0.670	0.355	***	0.731	VM08
W	UM10787	Dec 14 /19 00:07:29	3	Vert	0.528	0.749	0.323	***	0.771	VM08
W	UM10787	Dec 14 /19 00:16:44	3	Vert	0.370	0.607	0.236	***	0.631	VM08
W	UM10787	Dec 14 /19 00:27:33	3	Vert	0.504	0.765	0.323	***	0.769	VM08
W	UM10787	Dec 14 /19 00:27:41	3	Vert	0.363	0.741	0.276	***	0.762	VM08
W	UM10787	Dec 14 /19 00:30:15	3	Vert	0.489	0.701	0.331	***	0.708	VM08
W	UM10787	Dec 14 /19 00:35:30	3	Vert	0.528	0.835	0.434	***	0.870	VM08
W	UM10787	Dec 14 /19 00:38:08	3	Vert	0.465	0.497	0.292	***	0.527	VM08
W	UM10787	Dec 14 /19 00:41:36	3	Vert	0.623	1.206	0.386	***	1.212	VM08
W	UM10787	Dec 14 /19 00:45:06	3	Vert	0.497	0.757	0.339	***	0.767	VM08
W	UM10787	Dec 14 /19 00:46:15	3	Vert	0.441	0.528	0.229	***	0.560	VM08
W	UM10787	Dec 14 /19 01:00:24	3	Vert	0.536	0.757	0.307	***	0.784	VM08

INSTRUMENT ID : VM 08

LOCATION NAME : Columbia Asia Hospital Hebbal

PROJECT STRECTCH : PHASE – 2B (KR Puram to Kempegowda International Airport via Hebbal Junction)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
W	UM10787	Dec 14 /19 01:04:30	3	Vert	0.552	0.678	0.363	***	0.684	VM08
W	UM10787	Dec 14 /19 01:06:31	3	Vert	0.560	0.670	0.504	***	0.758	VM08
W	UM10787	Dec 14 /19 01:06:42	3	Vert	0.386	0.701	0.244	***	0.702	VM08
W	UM10787	Dec 14 /19 01:13:56	3	Vert	0.481	0.575	0.205	***	0.606	VM08
W	UM10787	Dec 14 /19 01:16:05	3	Vert	0.418	0.560	0.315	***	0.611	VM08
W	UM10787	Dec 14 /19 01:20:23	3	Vert	0.331	0.623	0.221	***	0.643	VM08
W	UM10787	Dec 14 /19 01:20:58	3	Vert	0.307	0.512	0.260	***	0.536	VM08
W	UM10787	Dec 14 /19 01:22:33	3	Tran	0.717	0.694	0.347	***	0.798	VM08
W	UM10787	Dec 14 /19 01:23:03	3	Tran	0.567	0.457	0.252	***	0.590	VM08
W	UM10787	Dec 14 /19 01:32:25	3	Vert	0.520	0.804	0.370	***	0.835	VM08
W	UM10787	Dec 14 /19 01:34:48	3	Vert	0.331	0.567	0.236	***	0.577	VM08
W	UM10787	Dec 14 /19 01:40:44	3	Tran	0.780	0.678	0.378	***	0.808	VM08
W	UM10787	Dec 14 /19 01:43:28	3	Vert	0.481	0.552	0.284	***	0.592	VM08
W	UM10787	Dec 14 /19 01:48:13	3	Vert	0.378	0.591	0.244	***	0.615	VM08
W	UM10787	Dec 14 /19 01:53:49	3	Vert	0.418	0.560	0.276	***	0.563	VM08
W	UM10787	Dec 14 /19 02:38:14	3	Vert	0.615	0.567	0.244	***	0.660	VM08
W	UM10787	Dec 14 /19 02:45:57	3	Vert	0.694	0.701	0.213	***	0.721	VM08
W	UM10787	Dec 14 /19 03:00:11	3	Vert	0.631	0.575	0.378	***	0.726	VM08
W	UM10787	Dec 14 /19 03:02:58	3	Vert	0.489	0.749	0.300	***	0.750	VM08
W	UM10787	Dec 14 /19 03:03:24	3	Vert	0.694	0.694	0.355	***	0.749	VM08
W	UM10787	Dec 14 /19 03:06:09	3	Vert	0.315	0.504	0.284	***	0.547	VM08
W	UM10787	Dec 14 /19 03:21:22	3	Vert	0.418	0.591	0.284	***	0.593	VM08
W	UM10787	Dec 14 /19 03:21:32	3	Vert	0.378	0.512	0.363	***	0.567	VM08
W	UM10787	Dec 14 /19 03:23:06	3	Vert	0.536	0.843	0.323	***	0.884	VM08
W	UM10787	Dec 14 /19 03:35:45	3	Vert	1.040	1.135	0.599	***	1.205	VM08
W	UM10787	Dec 14 /19 03:37:53	3	Vert	0.394	0.646	0.363	***	0.684	VM08
W	UM10787	Dec 14 /19 03:51:17	3	Vert	0.363	0.575	0.236	***	0.606	VM08
W	UM10787	Dec 14 /19 03:54:17	3	Vert	0.575	0.883	0.378	***	0.909	VM08
W	UM10787	Dec 14 /19 03:54:31	3	Vert	0.536	0.623	0.252	***	0.633	VM08
W	UM10787	Dec 14 /19 03:55:30	3	Tran	0.615	0.701	0.221	***	0.732	VM08
W	UM10787	Dec 14 /19 04:08:22	3	Vert	0.599	1.080	0.363	***	1.083	VM08
W	UM10787	Dec 14 /19 04:08:49	3	Vert	0.670	1.056	0.434	***	1.059	VM08
W	UM10787	Dec 14 /19 04:09:51	3	Vert	0.386	0.615	0.244	***	0.617	VM08
W	UM10787	Dec 14 /19 04:12:25	3	Vert	0.418	0.678	0.339	***	0.714	VM08
W	UM10787	Dec 14 /19 04:17:56	3	Vert	0.260	0.504	0.355	***	0.508	VM08
W	UM10787	Dec 14 /19 04:18:55	3	Vert	0.599	0.662	0.276	***	0.673	VM08
W	UM10787	Dec 14 /19 04:23:13	3	Tran	0.615	0.607	0.236	***	0.657	VM08
W	UM10787	Dec 14 /19 04:25:14	3	Vert	0.552	0.867	0.370	***	0.895	VM08
W	UM10787	Dec 14 /19 04:27:29	3	Vert	0.370	0.623	0.347	***	0.644	VM08
W	UM10787	Dec 14 /19 04:29:20	3	Vert	0.449	0.780	0.418	***	0.818	VM08
W	UM10787	Dec 14 /19 04:29:59	3	Vert	0.662	1.001	0.307	***	1.005	VM08
W	UM10787	Dec 14 /19 04:30:25	3	Vert	0.323	0.536	0.378	***	0.582	VM08
W	UM10787	Dec 14 /19 04:33:31	3	Vert	0.686	0.717	0.347	***	0.855	VM08
W	UM10787	Dec 14 /19 04:34:02	3	Vert	0.520	0.528	0.252	***	0.554	VM08
W	UM10787	Dec 14 /19 04:38:00	3	Vert	0.394	0.528	0.276	***	0.557	VM08
W	UM10787	Dec 14 /19 04:38:35	3	Vert	0.560	0.638	0.307	***	0.655	VM08
W	UM10787	Dec 14 /19 04:43:28	3	Vert	0.339	0.638	0.276	***	0.655	VM08
W	UM10787	Dec 14 /19 04:49:15	3	Vert	0.441	0.544	0.252	***	0.568	VM08
W	UM10787	Dec 14 /19 04:51:08	3	Vert	0.512	0.843	0.489	***	0.847	VM08
W	UM10787	Dec 14 /19 04:52:11	3	Vert	0.504	0.725	0.339	***	0.739	VM08

INSTRUMENT ID : VM 08

LOCATION NAME : Columbia Asia Hospital Hebbal

PROJECT STRECTCH : PHASE – 2B (KR Puram to Kempegowda International Airport via Hebbal Junction)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
W	UM10787	Dec 14 /19 04:54:35	3	Vert	0.828	1.230	0.528	***	1.331	VM08
W	UM10787	Dec 14 /19 04:57:39	3	Vert	0.410	0.662	0.236	***	0.675	VM08
W	UM10787	Dec 14 /19 05:02:36	3	Vert	0.528	0.725	0.276	***	0.726	VM08
W	UM10787	Dec 14 /19 05:05:36	3	Vert	0.378	0.623	0.370	***	0.685	VM08
W	UM10787	Dec 14 /19 05:07:45	3	Vert	0.355	0.638	0.347	***	0.640	VM08
W	UM10787	Dec 14 /19 05:09:12	3	Vert	0.363	0.607	0.268	***	0.631	VM08
W	UM10787	Dec 14 /19 05:10:41	3	Vert	0.489	0.851	0.441	***	0.872	VM08
W	UM10787	Dec 14 /19 05:11:23	3	Vert	0.363	0.670	0.394	***	0.685	VM08
W	UM10787	Dec 14 /19 05:14:33	3	Vert	0.426	0.512	0.181	***	0.528	VM08
W	UM10787	Dec 14 /19 05:15:07	3	Vert	0.489	0.638	0.315	***	0.660	VM08
W	UM10787	Dec 14 /19 05:21:38	3	Vert	0.363	0.520	0.213	***	0.531	VM08
W	UM10787	Dec 14 /19 05:30:17	3	Tran	0.552	0.607	0.276	***	0.636	VM08
W	UM10787	Dec 14 /19 05:30:28	3	Tran	0.544	0.504	0.244	***	0.588	VM08
W	UM10787	Dec 14 /19 05:31:41	3	Vert	0.378	0.528	0.260	***	0.540	VM08
W	UM10787	Dec 14 /19 05:34:42	3	Vert	0.323	0.520	0.236	***	0.524	VM08
W	UM10787	Dec 14 /19 05:35:28	3	Tran	0.520	0.418	0.300	***	0.595	VM08
W	UM10787	Dec 14 /19 05:42:35	3	Vert	0.623	0.725	0.197	***	0.743	VM08
W	UM10787	Dec 14 /19 05:43:01	3	Vert	0.504	0.567	0.260	***	0.609	VM08
W	UM10787	Dec 14 /19 05:45:12	3	Vert	0.394	0.575	0.355	***	0.620	VM08
W	UM10787	Dec 14 /19 05:51:13	3	Tran	0.497	0.473	0.150	***	0.552	VM08
W	UM10787	Dec 14 /19 05:51:33	3	Vert	0.370	0.670	0.378	***	0.683	VM08
W	UM10787	Dec 14 /19 05:58:44	3	Vert	0.449	0.544	0.276	***	0.576	VM08
W	UM10787	Dec 14 /19 06:01:15	3	Vert	0.307	0.497	0.260	***	0.527	VM08
W	UM10787	Dec 14 /19 06:02:51	3	Vert	0.300	0.536	0.221	***	0.539	VM08
W	UM10787	Dec 14 /19 06:11:09	3	Vert	0.560	0.638	0.276	***	0.645	VM08
W	UM10787	Dec 14 /19 06:14:33	3	Vert	0.418	0.733	0.244	***	0.771	VM08
W	UM10787	Dec 14 /19 06:15:35	3	Vert	0.441	0.583	0.213	***	0.623	VM08
W	UM10787	Dec 14 /19 06:17:52	3	Vert	0.473	0.544	0.221	***	0.630	VM08
W	UM10787	Dec 14 /19 06:19:15	3	Vert	0.402	0.623	0.221	***	0.665	VM08
W	UM10787	Dec 14 /19 06:21:53	3	Vert	0.418	0.599	0.252	***	0.621	VM08
W	UM10787	Dec 14 /19 06:33:35	3	Vert	0.599	0.599	0.339	***	0.753	VM08
W	UM10787	Dec 14 /19 06:37:27	3	Tran	0.662	0.599	0.331	***	0.814	VM08
W	UM10787	Dec 14 /19 06:41:05	3	Vert	0.504	0.544	0.205	***	0.613	VM08
W	UM10787	Dec 14 /19 06:44:01	3	Vert	0.355	0.536	0.181	***	0.540	VM08
W	UM10787	Dec 14 /19 06:50:43	3	Vert	0.536	0.552	0.292	***	0.619	VM08
W	UM10787	Dec 14 /19 06:51:35	3	Tran	0.536	0.449	0.213	***	0.553	VM08
W	UM10787	Dec 14 /19 06:56:10	3	Vert	0.363	0.662	0.347	***	0.662	VM08
W	UM10787	Dec 14 /19 06:56:30	3	Vert	0.394	0.662	0.260	***	0.666	VM08
W	UM10787	Dec 14 /19 06:57:57	3	Vert	0.457	0.520	0.197	***	0.559	VM08
W	UM10787	Dec 14 /19 06:58:23	3	Vert	0.552	0.670	0.363	***	0.685	VM08
W	UM10787	Dec 14 /19 07:03:36	3	Vert	0.449	0.512	0.284	***	0.527	VM08
W	UM10787	Dec 14 /19 07:05:34	3	Vert	0.434	0.520	0.181	***	0.578	VM08
W	UM10787	Dec 14 /19 07:08:43	3	Tran	0.528	0.465	0.181	***	0.540	VM08
W	UM10787	Dec 14 /19 07:10:52	3	Vert	0.315	0.528	0.252	***	0.547	VM08
W	UM10787	Dec 14 /19 07:19:33	3	Vert	0.441	0.567	0.252	***	0.579	VM08
W	UM10787	Dec 14 /19 07:28:36	3	Vert	0.331	0.575	0.244	***	0.579	VM08
W	UM10787	Dec 14 /19 07:44:36	3	Vert	0.418	0.528	0.181	***	0.557	VM08
W	UM10787	Dec 14 /19 07:55:05	3	Tran	0.654	0.560	0.370	***	0.706	VM08
W	UM10787	Dec 14 /19 08:16:23	3	Tran	0.504	0.465	0.268	***	0.560	VM08
W	UM10787	Dec 14 /19 08:26:34	3	Vert	0.347	0.615	0.189	***	0.623	VM08

INSTRUMENT ID : VM 08

LOCATION NAME : Columbia Asia Hospital Hebbal

PROJECT STRECTCH : PHASE – 2B (KR Puram to Kempegowda International Airport via Hebbal Junction)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
W	UM10787	Dec 14 /19 08:30:35	3	Vert	0.504	0.788	0.378	***	0.790	VM08
W	UM10787	Dec 14 /19 08:35:52	3	Tran	0.512	0.426	0.205	***	0.544	VM08
W	UM10787	Dec 14 /19 08:38:02	3	Tran	0.504	0.520	0.315	***	0.564	VM08
W	UM10787	Dec 14 /19 09:06:08	3	Tran	0.709	0.631	0.221	***	0.810	VM08
W	UM10787	Dec 14 /19 13:52:25	3	Long	1.718	0.355	0.993	***	1.826	VM08

GEOSMART

VIBRATION REPORT

INSTRUMENT ID : VM09 **DATE : 14-Dec-19**

LOCATION : Cytecare Cancer Hospital

INSTALLATION PHOTO

INSTRUMENT ID : VM 09

LOCATION NAME : Cytecare Cancer Hospital

PROJECT STRECTCH : PHASE – 2B (KR Puram to Kempegowda International Airport via Hebbal Junction)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
LOG	UM11175	Dec 14 /19 17:02:03	***	***	***	***	***		***	Start Monitoring
LOG	UM11175	Dec 15 /19 14:51:47	***	***	***	***	***		***	Stop Monitoring

GEOSMART

VIBRATION REPORT

INSTRUMENT ID : VM10 **DATE : 14-Dec-19**

LOCATION : Chikkajala Fort

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INSTALLATION PHOTO

INSTRUMENT ID : VM 10

LOCATION NAME : Chikkajala Fort

PROJECT STRECTCH : PHASE – 2B (KR Puram to Kempegowda International Airport via Hebbal Junction)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
W	UM10787	Dec 14 /19 15:38:20	3	Long	0.977	0.095	0.528	***	1.038	VM10
W	UM10787	Dec 14 /19 15:38:42	3	Long	0.567	0.260	0.796	***	0.919	VM10
W	UM10787	Dec 14 /19 15:38:51	3	Long	0.213	0.087	0.512	***	0.517	VM10
W	UM10787	Dec 15 /19 14:18:56	3	Long	0.386	0.268	1.301	***	1.351	VM10
W	UM10787	Dec 15 /19 14:19:31	3	Long	0.205	0.158	0.741	***	0.771	VM10
W	UM10787	Dec 15 /19 14:19:40	3	Long	0.142	0.071	0.512	***	0.516	VM10
W	UM10787	Dec 15 /19 14:19:53	3	Vert	1.245	0.820	1.442	***	1.714	VM10