Use of Remote Sensing Data and Past Earthquake Events for Deterministic Seismic Hazard Analysis of Bangalore.

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ABSTRACT

Remote sensing is widely used technology for synoptic studies of hazard, mapping of structural features such as lineaments/fractures, folds, faults, etc. Indian peninsular shield, which was once considered to be seismically stable, is experiencing many earthquakes recently; Indian peninsular shield is seismically becoming active region, which is proved by many researches by beyond doubts. To find the seismic vulnerability of Bangalore urban area a detailed study has been carried out by us, considering the remote sensing and seismological parameters in this area. The sources such as faults, lineaments and shear zone features have been identified using satellite remote sensing images (Satellite data from IRS1D WiFS sensor and IRSP6 AWiF Sensor and others) and seismotectonic atlas map of India (also confirmed with Google earth images and wikimapia images) and relevant field studies. Maximum Credible Earthquake (MCE) has been determined by considering the regional seismotectonic activity in about 350 km radius around Bangalore. The seismotectonic map has been prepared by considering the faults, lineaments, shear zones in the area and past moderate events of more than 125 events having the moment magnitude of 3.5 and above. In addition, 1500 number of earthquake tremors having moment magnitude of less then 3.5 has been collected and considered for the study. Shortest distance from the Bangalore to the different sources is measured and then Peak Horizontal Acceleration (PHA) calculated for the different sources and moment magnitude using regional attenuation relation for peninsular India. Based on Wells and Coppersmith (1994) relationship, subsurface fault rupture length of about 3.8% of total length of the fault shown to be matching with historic earthquake events in the area. To simulate synthetic ground motions, Boore (1983, 2003) SMSIM programs have been used and the PHA for the different locations is evaluated. From the above approaches, the PHA of 0.15g was established highlighting the need for up gradation of zone seismic II to seismic Zone III for Bangalore. This value was obtained for a maximum credible earthquake having a moment magnitude of 5.1 for a source Mandya-Channapatna-Bangalore lineament. This lineament in fact passes through Indian Institute of Science campus. This particular source has been identified as a vulnerable source for Bangalore. Acceleration time history (ground motion) has been generated using synthetic earthquake model using regional seismotectonic parameters for many parts of Bangalore.

Key words: *Seismic hazard, remote sensing, Lineament, Ground motion and earthquakes.*

1. INTRODUCTION

Southern India once considered as a stable continent has reported mild to moderate earthquakes in past and recent, it is indicating that it is becoming moderately seismically active region. In particular Bangalore has experienced several minor earthquakes in the 20th century. The damage caused by these earthquakes was not large. The recent earthquake (of magnitude 3.4 on Richter scale) located near the borders of Tamil Nadu, Andhra Pradesh and Karnataka states on August 4th 2006 was felt in Bangalore and recorded in borehole sensor accelerographs installed on a rock at 15m depth in civil engineering department geotechnical laboratory. Remote sensing is the widely used technique for the hazard studies. In this paper an attempt has been made to identify the seismic sources using remote sensing images (IRS-1D WiFS Sensor and IRSP6 AWiF Sensor and others)and a deterministic seismic hazard analysis of Bangalore is presented. The sources have been identified using satellite remote sensing images and seismotectonic atlas of India (also seen on Google earth images same images are there in both Google and Wikimapia) and relevant field studies. A data base has been developed using possible seismic sources around 350km radius of Bangalore and past earthquakes which collated from Indian metrological department (IMD), Gauribidanur seismic recording station and National Geophysical Research Institute (NGRI). A detailed deterministic seismic hazard analysis has been carried out using these data and vulnerable source; and maximum credible earthquake has been determined. Further a synthetic ground motion model has been developed for Bangalore to simulate a synthetic ground motion for the site response studies. About 465 synthetic ground motions corresponding to available borelog locations are generated for different parts of Bangalore metropolitan area (which is 220 sq km). This has been done considering a vulnerable source of Mandya-Channapatna-Bangalore lineament and MCE of 5.1.

2. SEISMIC SOURCES

To evaluate seismic hazards for a particular site or region, all possible sources of seismic activity must be identified and their potential for generating future strong ground motion should be evaluated. Analysis of lineaments and faults helps in understanding the regional seismotectonic activity of the area. Lineaments are linear features seen on the surface of earth which represents faults, fractures, shear zones, joints, litho contacts, dykes, etc; and are of great relevance to geoscientists. Scientists believe that a lineament is a deep crustal, ancient, episodically reactivated linear feature that exerts control on the make up of the crust and associated distribution of ore and hydrocarbons (O' Leary et. al 1976, Ganesha Raj and Nijagunappa, 2004). The study has been carried out for an area of about 350 km radius around Bangalore as per the guideline available in Regulatory Guide of U.S. Nuclear Regulatory Commission (1997). Geological survey of India is mapped the possible earthquake sources such as different types of faults, lineaments, shear zones, geological features and earthquake events for whole India, publishes as a Seismotectonic Atlas in 2000. The sources which are mapped in the Seismotectonic Atlas (2000) are studied before 2000. But this period there is considerable changes in basement geological in southern India. In this project an attempt has been made to identify the seismic sources in the study area using the remote sensing images.

2.1 Mapping of Lineaments

Mapping and analysis of lineaments which indicates faults, fractures, etc. is crucial before taking up any engineering geological projects like dam/reservoir site selection, road/tunnel alignment, harbour, major industries, major bridge site selection etc. It would always be advisable to avoid weaker zones. Generally, it is observed that seismicity is also associated with major lineaments; hence analysis of lineaments is useful for understanding the seismic status of the terrain. Remote sensing data due to its synoptic nature is found to be very useful in mapping lineaments. Images taken in the Near Infra Red (NIR) region (0.7 –1.1 μm) depicts clearly more lineaments than other bands. Radar data also provides information on lineaments due to its oblique look angles. Thermal Infra Red (TIR) data is found to be useful in delineating wet lineaments with moisture/water. Lineaments present in the forest areas, soil covered areas are also clearly visible on images thus enabling us to delineate better structural features.

In fact one of the major applications of remote sensing is in the area of lineament mapping. Lineaments are useful in groundwater, mineral, oil explorations, seismic studies and in engineering geological applications. Lineaments, which represent faults, fractures etc. have been mapped under the National Drinking Water Mission on 1:250,000 scale for India during 1986-90 (Department of Space, 1990). In this project an atlas of hydrogeomorphological map of India has been prepared. These maps helped in locating bore well sites for providing potable water to villages (Department of Space, 1990). Large numbers of studies have been carried out wherein lineaments were mapped using satellite images and Arial photos (Srinivasan and Sreenivas, 1977; National Remote Sensing Agency, 1981; Drury, 1983; Department of Space, 1990; Ganesha Raj, 2001; Naganna and Lingaraju, 1990; Project Vasundhara, 1991; Nijagunappa et al., 1999).

Lineaments could be classified based on their length as: (i) micro: <2km, (ii) minor: 2 - 10 km, (iii) medium: 10 – 100 km, (iv) major: 100 - 500 km, and (v) mega > 500 km.(Ganesha Raj and Nijagunappa 2001).Large scale data is useful for mapping minor and micro lineaments whereas small scale data is needed to map major lineaments and to map mega lineaments normally mosaics of images are needed. Aerial photographs using remotely sensed data are extensively used for mapping of lineaments earlier to the launch of Remote Sensing Satellites. Aerial photographs with the very high spatial resolution and stereo-view are found useful in delineating lineaments. With the advent of satellite era, aerial photos are being used only whenever very detailed information is required. Mapping of minor/micro-lineaments are better done using aerial photographs/high resolution satellite/large scale data, whereas satellite data (on smaller scale) are more useful for mapping medium/major/mega lineaments. Normally, it is difficult to decide whether the mapped lineament is a fault or not from the image itself, but if there is a clear displacement/offset of associated features then the lineament can be identified as a fault. Integration of the lineament map with the available structural and geological information of the terrain, drainage pattern of the terrain and relevant fieldwork helps to decide the nature of the lineament. In the present study an attempt has been made to map the major lineaments and assess their significance with respect to seismicity. The satellite images and other data used in the study are as follows:

- Indian Remote Sensing Satellite (IRS) –1D Wide Field Sensor (WiFS) data(False Colour Composite - FCC) on 1:1 million scale.
- Indian Remote Sensing Satellite data (IRSP6) -AWiF
- Landsat 2/3 & 4/5 Multi Spectral Sensor (MSS)/Thematic Mapper (TM) data (band products/False Colour Composites) on 1:1 million scale.
- Physical map on 1:1 million scale.
- Geological and Mineral Map on 1:500,000 scale.

- Earthquake data (epicenter with latitude and longitude, year of occurrence and magnitude).
- TOPO sheets of the area, Contour map on 1:50,000 scale.

Lineaments with length more than 100 km, i.e., major lineaments were mapped first from individual scenes of Landsat data (MSS/TM) on 1:1 million scale, these were transferred to a base map on 1:1 million scale to make a single mosaic map. This map was superimposed on physical/road network map to eliminate any cultural lineament (road/railway etc). IRS –1D WiFS FCC on 1:1million scale was used further to map/refine the lineaments. Lineaments were numbered and their length and direction were measured. This lineament map was compared with the maps prepared earlier by Srinivasan and Sreenivas (1977), National Drinking Water Mission (NDWM) (Department of Space, 1990), Project Vasundhara (1991), and Ganesha Raj (2001). Figure 1 show the remote sensing image of southern India used for lineaments study. It is observed that there is a good match between the lineaments mapped in the seismotectonic atlas Ganesha Raj, 2001 and the present study. And also major lineaments have been cross checked with field studies (Ganesha Raj, 2001) it shows that the position in the satellite images matches with ground. Very close view of the Google image in Mandya – Bangalore region shows major lineaments of Mandya-Channapatna-Bangalore lineament, which is shown in Figure 2. Figure 2 also shows that this lineament passes through the Indian Institute of Science campus where the earthquake recoding (Two Acclerographs, one at surface outcrop near to summing pool and another at 15m rock in soil laboratories) instruments are installed.

3. STUDY AREA AND SEISMOTECTONIC MAP

Bangalore city covers an area of over 650 square kilometres and is at an average altitude of around 910m above mean sea level. It is situated on a latitude of 12^0 58" North and longitude of 77^0 37" East. The population of Bangalore city is over 6 million and Bangalore city is the one of fastest growing city and fifth biggest city in India. It is the political capital of the state of Karnataka. Besides political activities, Bangalore possesses many national laboratories, defence establishments, small and large-scale industries and Information Technology Companies. That is also called as Silicon Valley of India/Science city of India. These establishments have made Bangalore a very important and strategic city.

The sources identified from Seismotectonic Atlas (2000) and remote sensing studies are compiled and a map has been prepared using Adobe Illustrator version 9.0. The seismotectonic map contains 65 numbers of faults with length varying from 9.73 km to 323.5km, 34 lineaments and 14 shear zones. The map shows different rock groups with different colours. Faults, lineaments and shear zones are given different colours. Earthquake data collected from different agencies [United State Geological Survey (USGS), Indian Metrological Department (IMD), Geological Survey of India (GSI) and Amateur Seismic Centre (ASC)] contains different type scales measurement such as intensity, local magnitude or Richter magnitude and body wave magnitudes. These magnitudes are converted to moment magnitudes (Mw) by using magnitude relations given by Idriss (1985). The earthquake events collated and converted has been super imposed on base map with available latitudes and longitudes. The earthquake events collated are about 1315 with minimum moment magnitude of 1.0 and a maximum of 6.2 and earthquake magnitudes are shown as circles with different diameters and colours. Sitharam and Anbazhagan (2006) have studied these aspects based on seismotectonic atlas of India. Further to this study of the authors, new seismotectonic map has been developed. Closer view of new seismotectonic map developed for Bangalore is shown in Figure 3. Figure 3 shows the active lineament and fault close to the Bangalore with past earthquakes. The maximum occurred events near by the each source are assigned as the maximum source magnitude.

4. VULNERABLE SOURCE

The vulnerable source to Bangalore was identified using the seismotectonic map of Bangalore and south Indian attenuation developed by Iyengar and Raghukanth (2004). The peak ground acceleration at rock level has been calculated by considering the shortest hypocentral distance form the source to the Bangalore center and maximum occurred earthquake magnitude close to the corresponding source. The hypocentral has been calculated by considering the earthquake depth of 15km from the ground level. The Table 1 shows the sources having the moment magnitude of 4and above, shortest distance form Bangalore, hypocentral distance and calculated PHA at rock level. The calculation shows that the least PHA value is 0.001g and maximum PHA value is 0.146g (caused from Mandya-Channapatna-Bangalore lineament). Totally 10 sources have generated the higher PHA values close to Bangalore. Among the 10 sources, the active lineament of Mandya-Channapatna-Bangalore lineament (L15 in Figure 3) having a length of about 105km (which is 5.2km away from the Bangalore) causing a PHA value of 0.146g due to an earthquake event (Mw of 5.1 occurred on 16th May 1972 ; corresponds to a latitude of 12.4^o N and longitude of 77.0^o E). This is a measured earthquake event having a surface wave magnitude (Ms) of 4.6 (Sitharam and Anbazhagan, 2006). The source causing largest PHA is considered has vulnerable source for Bangalore.

5. MAXIMUM CREDIBLE EARTHQUAKE

The MCE has been calculated by assuming the subsurface rupture length of the sources and also it is matched with past earthquakes. Mark (1977) recommends that the surface rupture length may be assumed as 1/3 to 1/2 of the Total Fault Length (TFL) based on the world wide data. However, assuming such large subsurface rupture length yields very large moment magnitude and also it does not match with the historic earthquake data. Wells and

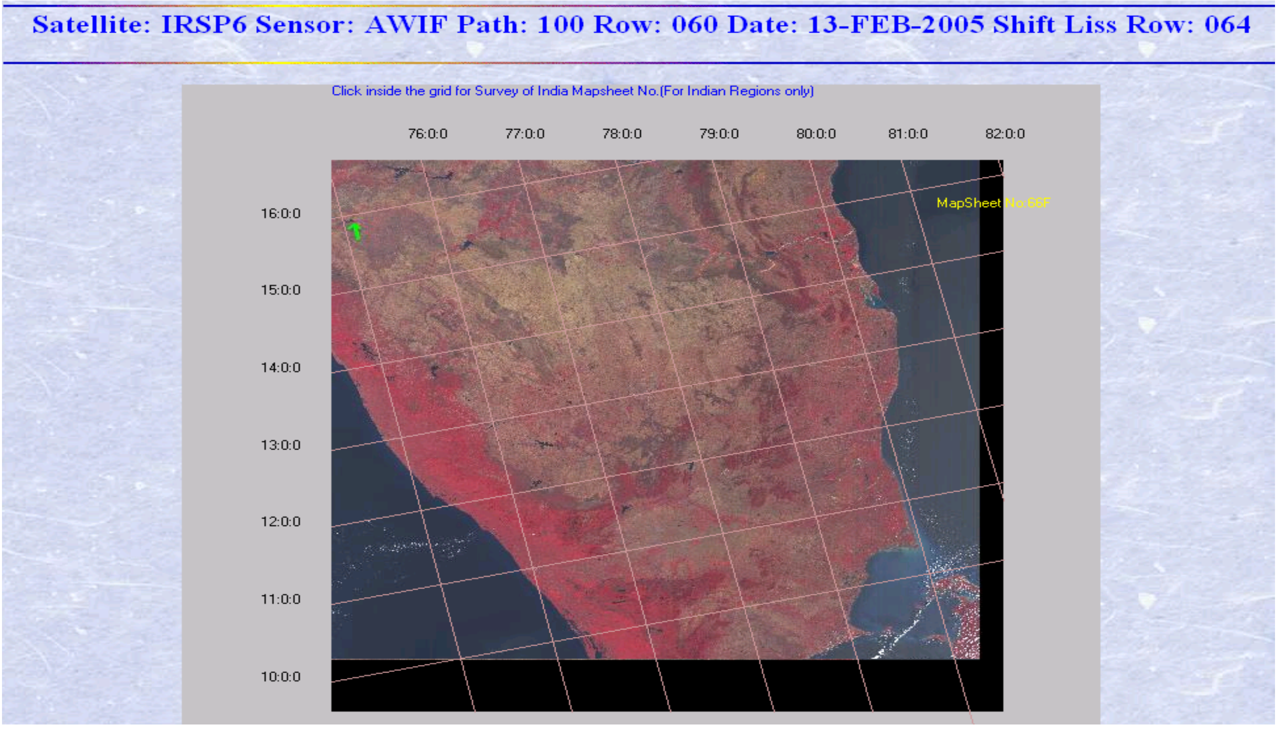


Figure 1: Satellite IRSP6 AWiF Path Image

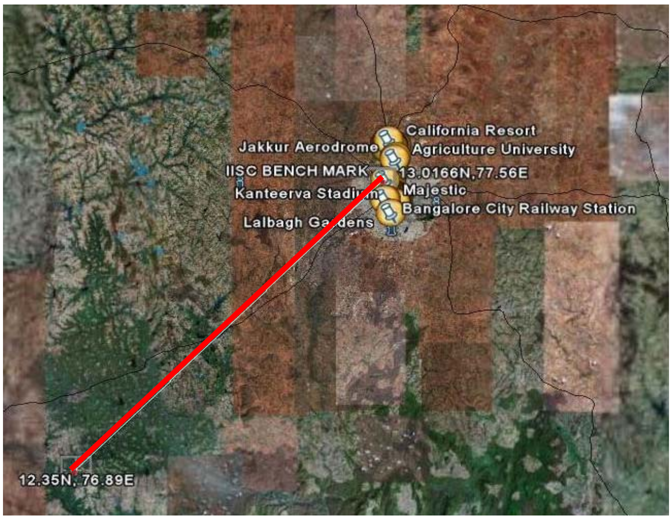


Figure 2: Mandya-Channapatna-Bangalore lineament in Google Images

Coppersmith (1994) developed empirical relation between moment magnitude and subsurface fault length using historical world wide earthquakes. Using Wells and Coppersmith (1994) equation along with a parametric study, it is found that subsurface fault rupture length of about 3.8% of total fault length gives moment magnitudes closely matching with the past earthquakes. Table 2 shows the RLD calculations, expected magnitude, and corresponding PHA from all the sources. The revised PHA lies in between minimum value of 0.001g and maximum value of 0.146g. In total, 9 sources have generated PHA value of more then 0.045g at rock level close to Bangalore region. Among the nine sources, the Mandya-Channapatna-Bangalore lineament (L15 in Figure 5) has a higher PHA value of 0.146g due to an earthquake moment magnitude of Mw of 5.1. The Mw of 5.1 is considered as a MCE for Bangalore.

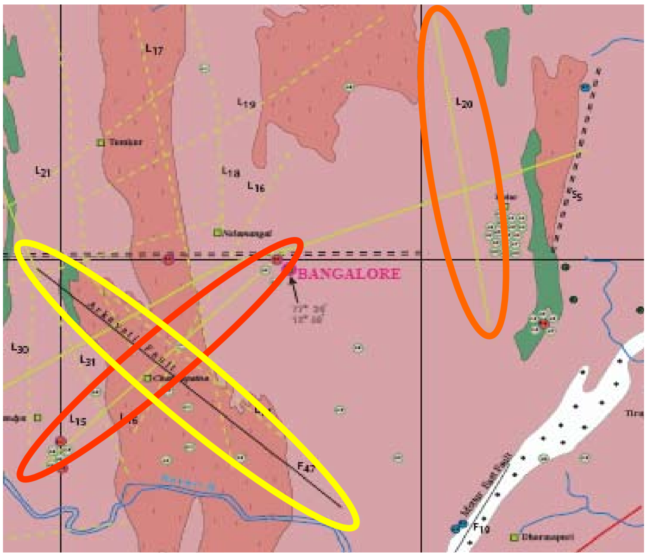


Figure 3: Part of Seismotectonic Map close to Bangalore (after Sitharam and Anbazhagan 2006)

6. SYNTHETIC GROUND MOTION MODEL

In regions lacking strong motion data, it is necessary to generate the synthetic earthquake data (strong motion). Seismological model by Boore (1983) is used for generation of synthetic acceleration-time response (Atkinson and Boore

1995, Hwang and Huo 1997). Seismological model by Boore (1983, 2003) [SMSIM- program for simulating ground

Table 1: Rock Level PHA obtained using Past Earthquake Events (after Sitharam and Anbazhagan, 2006)

Number and Name of Source		Distance (km)	Hypocentral Distance (km)	Occurred Earthquake (Mw)	PHA (g)
F1	Periyar Fault	336	337	4.8	0.002
F2	Vaigai River - Fault	326	326	4.6	0.001
F3	Ottipalam - Kuttampuzah Fault	282	283	4.2	0.001
F6	Valparai-Anaimudi Fault	290	290	4.5	0.002
F9	Pattikkad - kollengol Fault	281	281	6.2	0.009
F10	Cauveri Fault	224	225	5.4	0.007
F13	Crystalline-Sedimentary Contact Fault	243	244	5.3	0.005
F14	Attur Fault	198	199	4.5	0.003
F16	Amirdi Fault	172	172	4.6	0.005
F17	Main Fault	137	138	4.9	0.009
F19	Mettur East Fault	97	98	4.6	0.010
F20	Tirukkavilur Pondicherry Fault	219	220	5.7	0.009
F21	Javadi Hills Fault	162	163	5	0.008
F22	Pambar River Fault	124	125	4.6	0.007
F23	Main Fault	143	144	4.9	0.008
F24		264	264	4.2	0.001
F25	Palar River Fault	175	176	5	0.007
F30	Karkambadi -Swarnamukhi Fault	211	211	5	0.005
F31	Tirumala Fault	216	216	5	0.005
F32	Gulcheru Fault	181	182	4.4	0.003
F35	Papaghani Fault	204	205	4	0.002
F36	Badvel Fault	276	276	4.1	0.001
F41	Wajrakarur Fault	246	247	5.7	0.008
F43	Gani - Kalva Fault	284	284	4.4	0.001
F45	Kumadavati - Narihalli Fault	271	271	6	0.008
F47	Arkavati Fault	51	53	4.7	0.025
F48	Chitradurga Fault	182	183	4.6	0.004
F50	Sakleshpur - Bettadpur Fault	181	182	4	0.002
F52	Bhavani Fault	217	217	6.2	0.015
F65	Cudapah Eastern Magin Shear	269	269	4	0.001
L2	Kabini Lineament	100	101	4.6	0.010
L6	Netravathi Hemavathy Lineament	145	146	4.6	0.006
L9	Yagachi Lineament	173	173	4.6	0.005
L10	Mangalore-Shimoga-Tunga Lineament	251	251	5	0.004
L11	Subramanya- Byadagi Gadag Lineament	235	235	6	0.011
L14	Kunigal- Arkavathi Lineament	44	46	4.1	0.015
L15	Mandya-Channapatna- Bangalore Lineament	5	16	5.1	0.146
L16	Arakavathi- Doddaballapur Lineament	18	24	4.7	0.063
L17	Arkavathi - Madhugiri Lineament	30	33	4.2	0.024
L18	Doddabelvangala- Pavagada Lineament	24	28	4.1	0.026
L20	Chelur-Kolar-Battipalle Lineament	58	60	5.2	0.037
L22	Nelamangala- Shravanabelagula Lineament	26	30	5.3	0.089
L23	Shimoga Lineament	265	265	4.5	0.002
L24	Sorab-Narihalla Lineament	265	266	6	0.009
L25	Vedavathi-Vanivilas Sagar Lineament	158	159	4.6	0.005
L26	Holalkere- Herur Lineament	158	159	6	0.021
L31	Molakalmur-Hospet-Kushtagi- Krishna Lineament	59	61	4	0.010
L34	Sindhnur- Krishna Lineament	55	57	4.2	0.013

Table 2: PHA obtained from RLD Approach (after Sitharam and Anbazhagan, 2006)

Number and Name of Source		Length (km)	RLD (km)	3.8 (%) TFL	Expected (3.8%) Magnitude (Mw)	Occurred Magnitude (Mw)	PHA (g)
F1	Periyar Fault	69	3	3	4.8	4.8	0.002
F2	Vaigai River - Fault	32	2	1	4.2	4.6	0.001
F3	Ottipalam - Kuttampuzah Fault	103	1	4	5.1	4.2	0.003
F6	Valparai-Anaimudi Fault	46	2	2	4.5	4.5	0.002
F9	Pattikkad - kollengol Fault	42	16	2	4.4	6.2	0.002
F10	Cauveri Fault	323	6	12	6.0	5.4	0.012
F13	Crystalline-Sedimentary Contact Fault	222	5	8	5.7	5.3	0.008
F14	Attur Fault	167	2	6	5.5	4.5	0.009
F16	Amirdi Fault	100	2	4	5.1	4.6	0.008
F17	Main Fault	129	3	5	5.3	4.9	0.013
F19	Mettur East Fault	38	2	1	4.4	4.6	0.008
F20	Tirukkavilur Pondicherry Fault	67	8	3	4.8	5.7	0.004
F21	Javadi Hills Fault	90	3	3	5.0	5	0.008
F22	Pambar River Fault	99	2	4	5.1	4.6	0.013
F23	Main Fault	82	3	3	5.0	4.9	0.009
F24		52	1	2	4.6	4.2	0.002
F25	Palar River Fault	136	3	5	5.3	5	0.009
F30	Karkambadi -Swarnamukhi Fault	106	3	4	5.1	5	0.006
F31	Tirumala Fault	48	3	2	4.6	5	0.003
F32	Gulcheru Fault	22	2	1	4.0	4.4	0.002
F35	Papaghani Fault	55	1	2	4.6	4	0.003
F36	Badvel Fault	55	1	2	4.6	4.1	0.002
F41	Wajrakarur Fault	39	8	1	4.4	5.7	0.002
F43	Gani - Kalva Fault	144	2	5	5.4	4.4	0.004
F45	Kumadavati - Narihalli Fault	148	12	6	5.4	6	0.005
F47	Arkavati Fault	125	2	5	5.3	4.7	0.047
F48	Chitradurga Fault	79	2	3	4.9	4.6	0.006
F50	Sakleshpur - Bettadpur Fault	86	1	3	5.0	4	0.006
F52	Bhavani Fault	90	16	3	5.0	6.2	0.005
F65	Cudapah Eastern Magin Shear	94	1	4	5.1	4	0.004
L2	Kabini	130	2	5	5.3	4.6	0.021
L6	Netravathi Hemavathy	169	2	6	5.5	4.6	0.015
L9	Yagachi	102	2	4	5.1	4.6	0.008
L10	Mangalore-Shimoga-Tunga	134	3	5	5.3	5	0.005
L11	Subramanya- Byadagi Gadag	318	12	12	6.0	6	0.011
L14	Kunigal- Arkavathi	101	1	4	5.1	4.1	0.045
L15	Mandya-Channapatna- Bangalore	105	4	4	5.1	5.1	0.146
L16	Arakavathi- Doddaballapur	109	2	4	5.2	4.7	0.107
L17	Arkavathi - Madhugiri	156	1	6	5.4	4.2	0.089
L18	Doddabelvangala- Pavagada	125	1	5	5.3	4.1	0.096
L20	Chelur-Kolar-Battipalle	111	4	4	5.2	5.2	0.037
L22	Nelamangala- Shravanabelagula	130	5	5	5.3	5.3	0.089
L23	Shimoga	130	2	5	5.3	4.5	0.004
L24	Sorab-Narihalla	249	12	9	5.8	6	0.007
L25	Vedavathi-Vanivilas Sagar	163	2	6	5.5	4.6	0.013
L26	Holalkere- Herur	172	12	7	5.5	6	0.013
L31	Molakalmur-Hospet-Kushtagi-Krishna	190	1	7	5.6	4	0.054
L34	Sindhnur- Krishna	223	1	8	5.7	4.2	0.064

motions] is used for generation of synthetic acceleration-time response (Atkinson and Boore 1995, Hwang and Huo 1997). Boore (1983, 2003) gives the details of estimating ground motion based on the Fourier amplitude spectrum of acceleration at bedrock and this is expressed as:

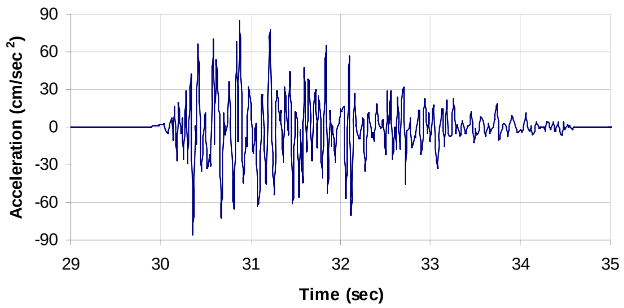
$$A(f) = C[S(f)]D(f)P(f) \quad (1)$$

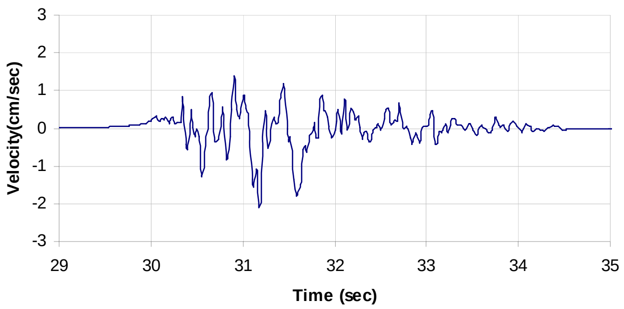
Where, A is the source spectral function, is the diminution function characterizing the attenuation, and is a filter to shape acceleration amplitudes beyond a high cut-off frequency fm, and C is a scaling factor. In the present study, the single corner frequency model has been used (Brune, 1970) and the following regional seismotectonic parameters are considered to generate the synthetic ground motion:

- Source region Shear wave velocity = 2.7km/sec (Parvez et.al, 2003)
- $Q(f)= 488\ f^{0.88}$
- The diminution function D (f) is defined as

$$D(f) = G\exp[-\Pi fR / V_S Q(f)] \quad (2)$$

In which, G refers to the geometric attenuation and the other term to an elastic attenuation. In this equation, Q(f) is the quality factor of the region. For Bangalore, the natural frequency is in the range of 3 to 6 Hz and the corresponding Q value is $488f^{\ 0.88}$ (Tripathi and Ugalde, 2004). The synthetic ground motion generated for 465 borehole points due to the vulnerable source and MCE. The Model gives the highest PHA value of 0.2g for the hypocentral distance of 15.88km close to the lineaments passing in Bangalore. The response spectrums for the simulated ground motions are plotted; it shows that the predominant period of synthetic ground motion is 0.06 seconds irrespective of the magnitude and sources. The typical synthetic ground motion is shown in Figure 4 and corresponding spectral acceleration at rock level show in Figure 5.





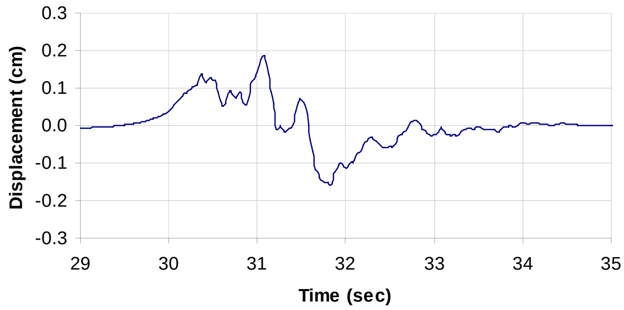


Figure 4: Typical Input Ground Motion used for Analysis

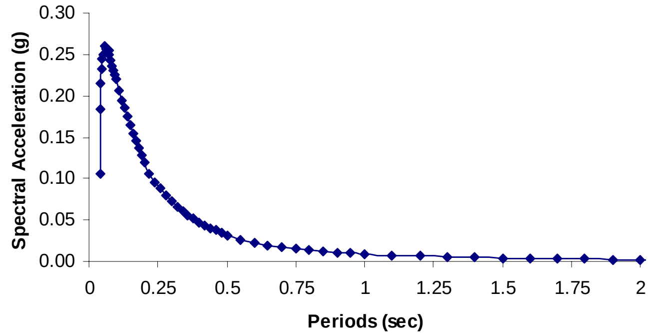


Figure 5: Typical Spectral Acceleration at Rock level.

7. CONCLUSION

The remote sensing images has been can be used effectively to identify and map the lineaments in the area. These lineaments were integrated with the seimotectonic details available in the seismotectonic atlas and historic earthquake events. The vulnerable source has been identified using the regional attenuation law. Mandya-Channapatna-Bangalore lineament (L15) is identified as a vulnerable source after carrying out deterministic seismic hazard analysis and the same is identified using remote sensing images. The maximum credible earthquake has been calculated using the subsurface fault rupture length, Mw of 5.1, resulting in PHA value of 0.146g. The earthquake event of M_W of 5.1 is considered as MCE for Bangalore (which occurred on 16th May 1972; corresponds to a latitude of 12.4^{o} N and longitude of $77.0\ ^{o}$ E) and this event was a measured/recorded earthquake event with surface wave magnitude (M_S) of 4.6. The synthetic ground motion model has been generated for the Bangalore region for the purpose of site response studies and microzonation. The synthetic ground motion and spectral acceleration has been generated and the shape of the spectral acceleration matches with the shape of uniform hazard spectrum.

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