STUDY ON GROUND VIBRATION CHARACTERISTICS OF IRANIAN LIGHT SOURCE FACILITY

M.A. Rahimi#, A. Iraji, J. Rahighi, H. Ghasem, B. Kamkari, N. Ranjbar, F. Saeidi,
ILSF, Tehran, Iran

Abstract

In this study the results of ground vibration measurement for the site of Iranian Light Source Facility (ILSF) has been investigated. Light source buildings are very sensitive to ground weak motions. Sources of the ground vibrations could be Cultural noise from human activities like traffic and industrial works. In order to satisfy requirements for level of the ground vibrations, a perfect ground vibration survey has been conducted and compared to other similar projects. Two broad-band seismometers have been utilized for surveying the ground vibration at ILSF site. Raw data have been pre-processed as well as analyzed in terms of seismology and engineering aspects. Spectrum amplitudes along with powers of the vibration amplitudes were calculated at the time domains. Power spectral densities of vibration displacements have been extracted from the measurements and were compared to results of other synchrotron projects. The results show that the dedicated site for ILSF is in the appropriate condition in the point view of ground vibration issues.

INTRODUCTION

ILSF site is located at north side of Qazvin city at the neighbourhood of Imam Khomeini international university, Science and technology park of Qazvin and Azad University of Qazvin, Figure 1. The mentioned site has 50 hectares area. This site is located also at southern foothills of Alborz Mountains.

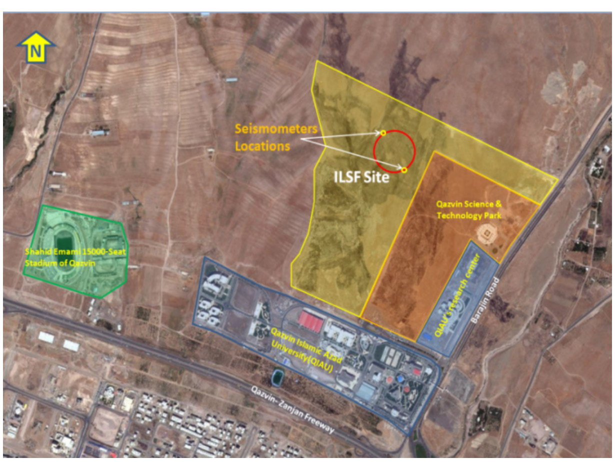

Figure 1: Satellite photo from ILSF and vibration measurement points.

GEOLOGICAL CONDITIONS

Figure 2 presents geological map of the site. Alborz mountain range lies to the north of the region. Alborz Mountains were formed from Jurassic and Tertiary volcanic rocks and sediments seemingly uplifted by volcanoes and given their present shape. The sediments on the southern slopes of Alborz Mountains were mainly formed by seasonal flood waters. The under study region was formed on conglomerate deposits. The mentioned deposits constitute general layer located under Qazvin city. These deposits include mid- layers of clay-stones, silt-stones and sand-stones. Conglomerates are broken to small pieces in shear from. Cements of conglomerates are clay type with high plasticity that causes them to be broken simply. Cobbles of conglomerates originate from different types; however they are from igneous rocks of Karaj formation mostly. Lime-stones are also found among the cobbles of conglomerates.

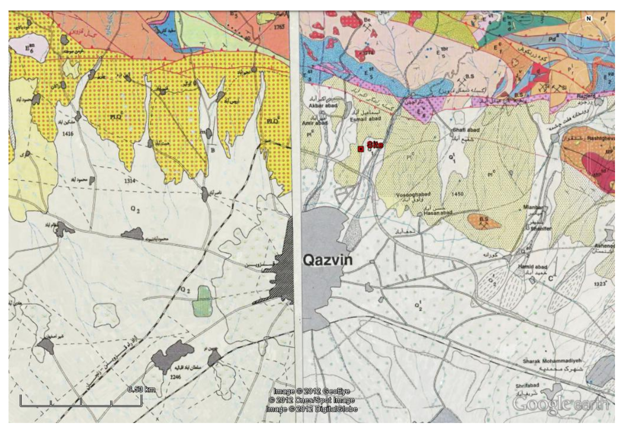

Figure 2: Geological map of the studied region [1].

VIBRATION SOURCES

Main sources of environmental vibrations at the ILSF site can be categorized as follows:

3) Vibration sources at near of the site:

Most important sources of this type are illustrated in Figure 3 presenting their distances from the site (from 550m to 1360m). These types of motions, that are so-called cultural noises, have predominant frequency more than 1 Hz. These sources include Barajin road at the east, Qazvin-Tehran highway at the south, Science and Technology Park at the east, Azad University at the south, and the sport complex at the south-west.

B) Vibration sources at far of the site and sources with lower frequency.

rahimi.acc@ipm.ir

ISBN 978-3-95450-132-8

Vibrations with lower frequency have usually frequency lower than 1Hz. These types of vibrations originate from local climate conditions (frequencies from 0.5 to 1 Hz), as well as regional climate conditions and sea waves (frequencies lower than 0.5 Hz).

Figure 3: Satellite photo of vibration sources distances from main building of ILSF.

Above categorization of frequency has been conducted based on different researches on this context and gathered at a report.

PROCESS OF STUDY

Two points have been selected for measuring ground motions. Distance between two points is 100m. Measuring devices were CMG3T manufactured by Guralp Co. Devices have been installed at depth 50 cm from ground surface, Figure 4. Measurements have been conducted 3 days continuously, with sampling rate of 100 and 200 samples per second. Time history of ground motions, velocity and displacement spectra have been investigated at first step. Figure 5 illustrates time histories of ground motions at three directions of vertical, north-south, and east-west. Table 1 presents averaged values of velocity and displacement at three directions and at two points of measurements.

DATA ANALYSIS

In order to calculate power spectral density, continuous time series of each component of measurement points are fragmented to 1 hour time series. These segments have overlap with each other up to 50%. Overlapping of time series segments are useful for reducing data dispersion in evaluating PSD (Power spectral density) [2]. Pre-analysis of each 1 hour time segment for calculating PSD includes several stages. In order to more reduce data dispersion in calculating PSD, each 1 hour time segment is divided to 13 segments with 75% overlapping. After some analyses, power spectral densities of displacement have been calculated and are presented at three directions in Figure 6.


Figure 4: Installation of seismometer.

CONCLUSION

Figure 7 compares power spectral density of displacement at ILSF and other similar projects. It is comprehensible from this figure that measured power spectral density of displacement at frequencies more than 0.05 Hz are within the same projects data or even lower than them. The measured values are more than that of same projects at frequencies lower than 0.05 Hz. Although these excess values at very low frequencies do not deserve to be cared, however different parameters such as type of used seismometers, season of measuring operations, and distance from oceans need to be investigated and compared at this project and other similar projects. The present measurements have been conducted at winter. Results of such measurements are very sensitive to climate conditions; therefore it may be needed measuring ground motions at summer.

Table 1: Average of Measured Velocity and Displacement at Three Directions

	Measurement point	Z comp	N comp	E comp
Velocity (μm/s)	p1-CMG3T	0.10	0.14	0.12
	p2-CMG3T	0.71	0.86	0.77
Displacement (μm)	p1-CMG3T	0.05	0.09	0.09
	p2-CMG3T	0.73	1.34	0.83

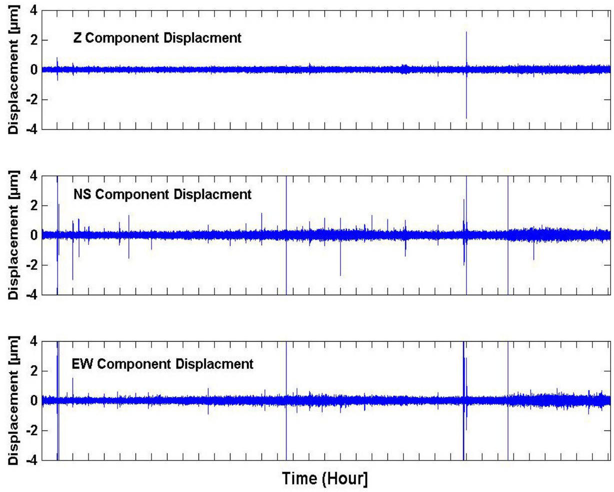

Figure 5: Time histories of displacement at measurement point 1.

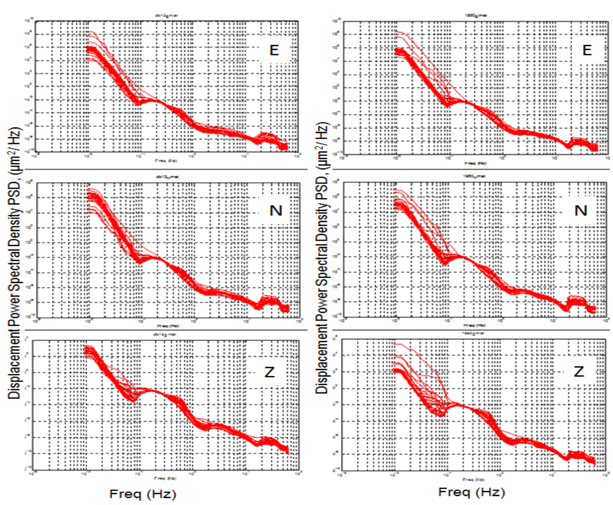

Figure 6: Measured power spectral density of displacement at point 1 (left) and point 2 (right) at three directions.

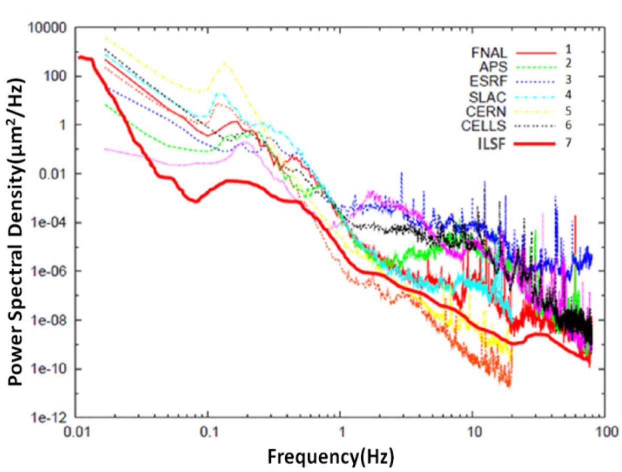

Figure 7: Comparison between PSD of displacement at ILSF and similar synchrotron projects.

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ISBN 978-3-95450-132-8