



IRANIAN STRONG MOTION DATABASE AND ITS VISION FOR THE FUTURE

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This article is focused on the Iranian strong motion database and the vision for a future of such database, having a special focus on the Saravan, SE Iran Earthquake of 16 April 2013, Mw7.8.

Iran Strong Motion Network (ISMN) started in 1973 at the former Planning and Budget Organization. This first station was installed in Hamedan (West Iran). The first important record was that recorded in Bandarabbad during the Sakhun, Bandarabbas earthquake of March 7, 1975 (Mw6.1, HPGA=128cm/sec²). In 1981, the ISMN was transferred to BHRC (Building and Housing Research Center), and until 1992, had 274 analog accelerographs. By August 2013 this network has 1149 digital accelerographs, more than 9770 three component accelerograms have been recorded by these instruments.

Table-1 represent a classification of site classifications in Iran and comparing to NEHRP 2000. In Figures 1 the plot of fundamental frequency (FF) versus Vs-30, shows the general increasing of FF with velocity, from soft soil to hard rock. This figure indicates the shear wave velocity and FF at boundaries of about 250, 500 and 750 m/sec and 2.0, 5.0, and 8.0 Hz for Vs-30 and FF that could be considered as new boundaries for four different site classes. Theodulidis and Bard (1995) find the boundary of 5.0 Hz to take apart rock and alluvium sites using Taiwan strong motion data with 1 Hz (4.0 to 5.0 Hz) overlap. The selected shear wave velocity ranges of different references are presented in table 2.

Table 1. The Vs-30 criterion proposed in different considered references

Soil Type \ Ref.	NEHRP 2000	Zare 1999	Standard 2800 Iran Seismic Building Code
IV	<180	<300	<175
III	180 ≤ < 360	300 ≤ < 500	175 ≤ < 375
II	360 ≤ < 760	500 ≤ < 700	375 ≤ < 750
I	760 ≤	700 ≤	750 ≤

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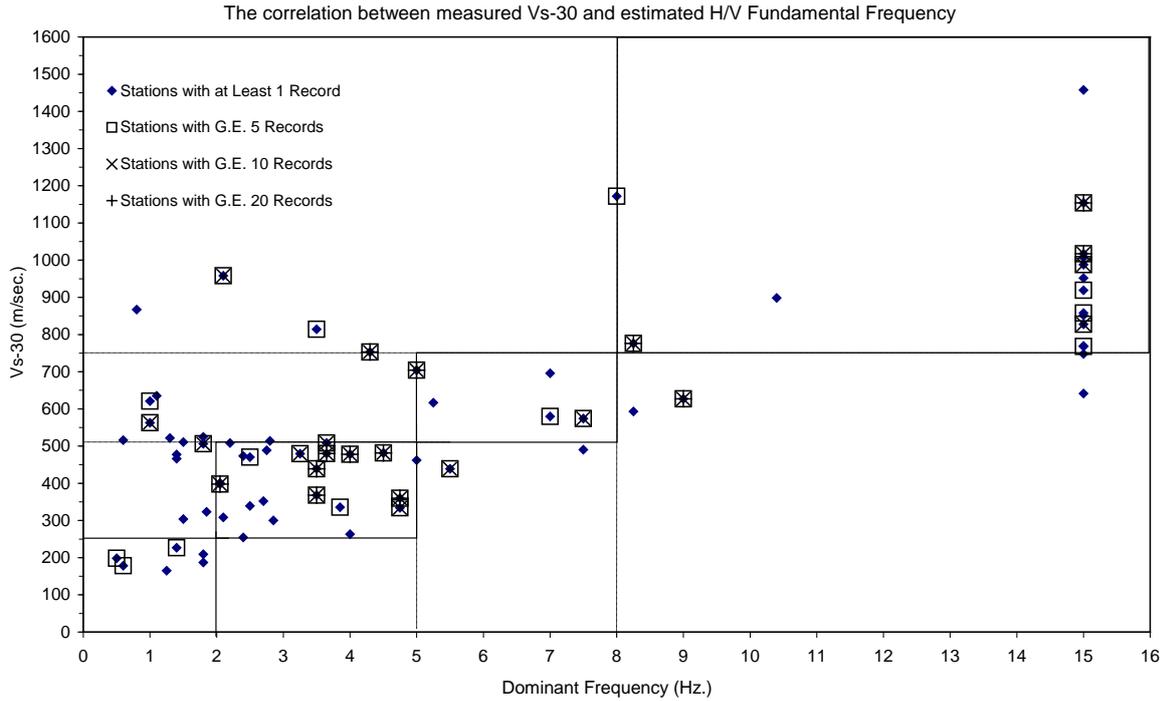


Figure 1. Defining the new limits for Vs-30 and FF boundaries

We tried to find a correlation between the site class estimated by Vs-30 and FF resulted in H/V spectral ratio. The occurred results from different classifications proposed in NEHRP (2000) and Zare (1999) and standard 2800 (2003), show different results in few stations and off course using another scale will result different. Even though, this correlation help us to find the boundaries of < 2.0 Hz, 2.0 to 5.0 Hz, 5.0 to 8.0 Hz and ≥ 8.0 Hz., the reality of high overlaps of the defined boundaries imposed us for finding a direct correlation between the measured Vs-30 and the estimated NF (Natural frequency). This idea enabled us to define new criteria for site classification that presented in table 2.

Figure 1 show that these defined criteria cover more than 75% studied stations, even if there where a single good quality record with the possibility of estimating of H/V spectral ratio.

Table 2. New criteria defined for site classifications

Site Class	Vs-30 (m/sec)	FF(Hz)
I	$750 \leq V_{s-30}$	$8.0 \leq NF$
II	$500 \leq V_{s-30} < 750$	$5.0 \leq FF < 8.0$
III	$250 \leq V_{s-30} < 500$	$2.0 \leq FF < 5.0$
IV	$V_{s-30} < 250$	$NF < 2.0$

The Saravan earthquake of 16 April 2013, which had magnitude of Mw 7.8 occurred in the Gosht region, a sparsely populated, in southeast Iran (Figure-1). This earthquake is the greatest earthquake ever recorded in ISMN since 1973 (in view point of the earthquake magnitude). The event destroyed 300 houses, left a further 1000 homeless and damaged 500 more houses in nearby villages, focusing in Pakistan region. The epicenter of the earthquake lies in the mountainous topography region; however, the surrounded area of the epicenter are moderately populated (about 10000 people lives in the distance of about 100km from the epicenter). The shock was felt strongly in Gosht (assessed VI, 30 km southwest of epicenter), Saravan (V+, 60 km S) and Zahedan (IV, 190 km NW) and less strongly in Masqat (III, 650 km S) and Persian gulf (III, >700 km W).

According to BHRC report, this event was recorded by 33 sets of digital accelerograph of Iran Strong Ground Motion Network. The peak acceleration was recorded in Sabz Gazz station (about 196 cm/s²). The intensity and PGA ShakeMaps are shown in figure-2 based on magnitude, Finite fault and strong motion data.

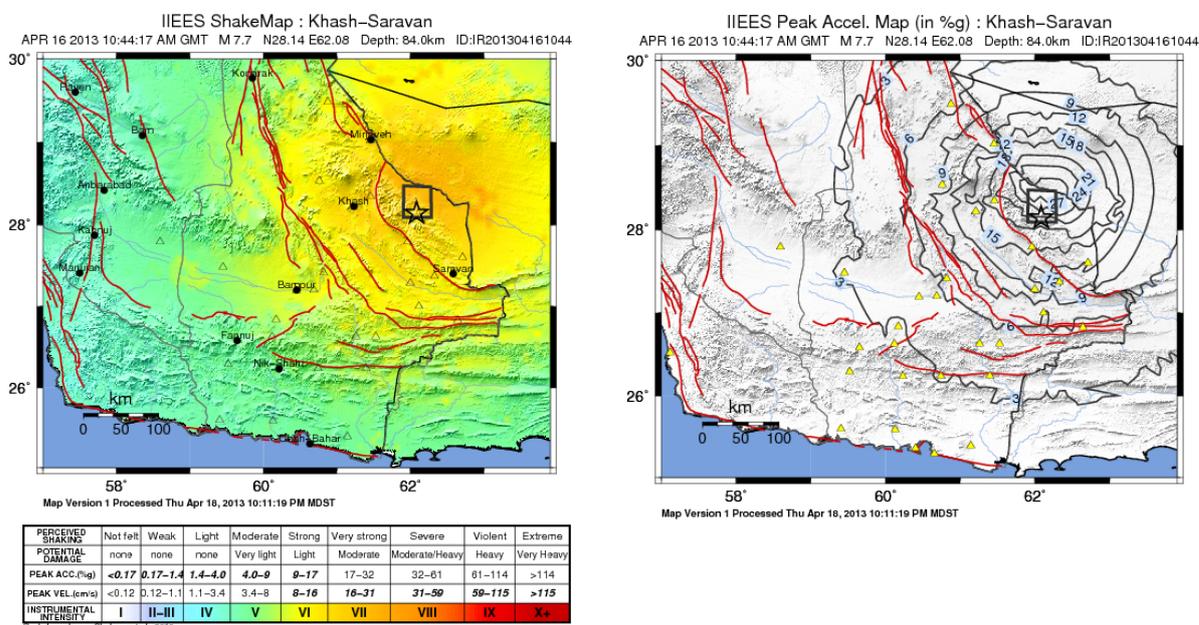


Figure-2 ShakeMaps of the Saravan 16 April 2013 earthquake.

The assessment of site conditions in the strong motion stations, online and synchronized recording of the strong motion records, establishment of the underground (downhole) accelerometry, building accelerometric instrumentation for the tall buildings and online development of shakemaps immediately after the earthquakes are suggested to be the future agenda in order to complete the establishment and usage of Iranian Strong motion database. The site conditions could strongly affected the earthquake ground motions and highly change the pattern of damages. Even though different methods are proposed for the study of site effect, but most involve time consuming and costly. There are 1423 accelerographic stations in Iran in the Iranian Strong Motion Network (ISMN) and it will take years with high charges to be studied for site classification. It is suggested to compare the results of Vs-30 resulted from seismic refraction measurements and H/V spectral ratio using the recorded accelerograms to modify the previous criteria for a fast and reliable classification.

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