GeoWatch

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GeoSIG

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Keynote

Scope: Strong Motion Instrumentation in Dams

In this issue of the GeoWatch, we mainly focus on Strong Motion Instrumentation in Large Dams. We have highlighted this topic in some of our previous GeoWatch issues, however we would like to gather the information and update our news on the GeoSIG Ltd. instrumented Dams, so as to address this important topic in depth.

One of the previous newsletter we published was GeoWatch 15, where we have given a special article by Dr. Martin Wieland, with the topic; "Why Do We Need Strong Motion Instruments in Large Dams?". Here one can see the various aspects of the need in strong motion instrumentation of Dams.

In addition to this you will be able to see two regional moderate earthquakes that were recently recorded by the instruments that were mounted for monitoring the seismic behaviour of the Dams. One of them was recorded on 6th October 2005 in Georgia by the strong motion network of Enguri Arc Dam. The other one was recorded on 4th November 2005 in Khoozestan Province, Iran by the strong motion network of Karkheh Dam, which is located in Khusestan Province of Iran.

Figure 1. Karkheh Dam, Iran.

Karkheh Dam aerial view is courtesy of Iranian National Committee on Large Dams (IRCOLD).

Structural Monitoring and Measurement System for Enguri Dam, Georgia

Enguri Dam is one of the highest arch dams in the world and it is located in the Enguri River at an altitude of 240m above sea level with the hight 271.5m. It was built by Georgian Company; Hydromsheni. The construction started in 1978 and finished it in 1987. The crest at 510m altitude has a developed length of 728 m and is 10 m thick. It is 271,5 m tall and 750 m wide, and has 14,5 km of high pressure tunnel 9,5 m in diameter, 5 generators units Francis type in underground power plant, 275 Mw each. (Figure 2).

In year 2000 a Strong Motion Network was installed, composed of 10 stations on Enguri Dam. GeoSIG had supplied the strong motion instrumentation. 5 stations were installed on the crest of the dam (two of them remote from the dam's construction), others at the different levels as shown in Figure 3 and Figure 4. Network was equipped by GPS receiver connected to station No1, which acts as a master in local network.

Figure 2. Enguri Dam, Georgia.

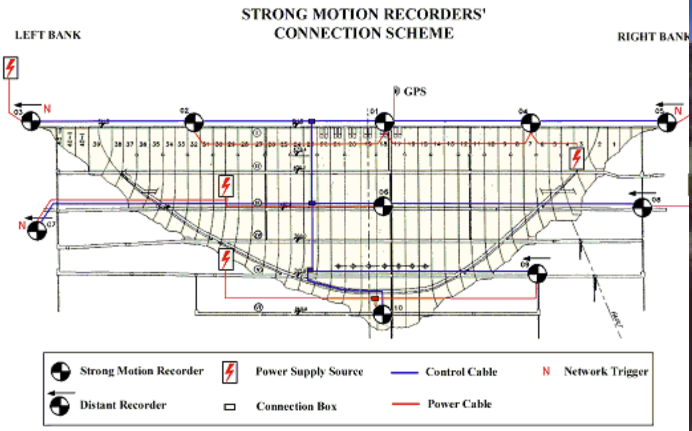

Figure 3. Connection Scheme of Strong Motion Recorders.

Figure 4. Location of the accelerometers on the crest of the dam

Figure 5. One of the Strong Motion Instruments.

Enguri Dam technical information and pictures are courtesy of Georgian Geophysical Society.

Structural Monitoring and Measurement System for Karkheh Dam, Iran

The Karkheh Dam is owned by the Iran Water and Power Resources Development Company (IWPC). It is located in the province of Khusestan at the South West of Iran, in the northwest of Andimeshk city. The Karhkeh dam is situated on the Karkheh River, which is the third largest river in Iran as far as the water yield is concerned.

With a gross reservoir capacity of 7'795 Mio m^3, the dam serves for storage and regulation of water for irrigation of more than 320'000 Hectares of downstream plains, and flood control in the upstream, as well as production of hydroelectricity with an installed capacity of 400 MW.

The Karkheh dam is an earthfill dam with impervious clay core. The height above the foundation is 127 m with an impressive 3'030 m crest length. The regulated water of the Karkheh River is 3'300 Mio m^3 per year. Engineered by Mahab Ghodss consulting engineering company, the dam was contracted to Sepasad Engineering Co.

GeoSIG was selected as the supplier of the strong motion instrumentation for Karkheh Dam. A total of six GSR-18 stations are installed. Access to the network is through the central station module directly to the station A1. Alternatively access can be achieved also through a modem connection. An AC supplies cable leads to all stations. In parallel an interconnection cable provides common timing, common trigger and communication to all stations.

Due to the immense distance between the A2 and A1 stations (over 3 km) two repeaters were installed as illustrated in Figure 1. All the stations are installed on a strong concrete foundation. Since the recorders are exposed to the environmental effects, the specialists of Sepasad designed a steel cover, providing full protection while maintaining easy access. Special care was taken for a proper grounding of all the stations.

Generally in almost all engineering structures specifications with respect to seismic safety either depend on general assumptions or theoretical studies. Such strong motion instrumentation allows monitoring the behaviour of the structure during an earthquake. Such earthquakes would facilitate to review and verify the design specifications of the dam under real seismic conditions.

The vulnerability and respective security measures of this and similar important structures may then be based on a more realistic assumptions established on the extensive knowledge that is gathered from the state of the art seismic instrumentation that GeoSIG provides.

Karkheh Dam technical information, drawings and aerial view are courtesy of Iranian National Committee on Large Dams (IRCOLD).

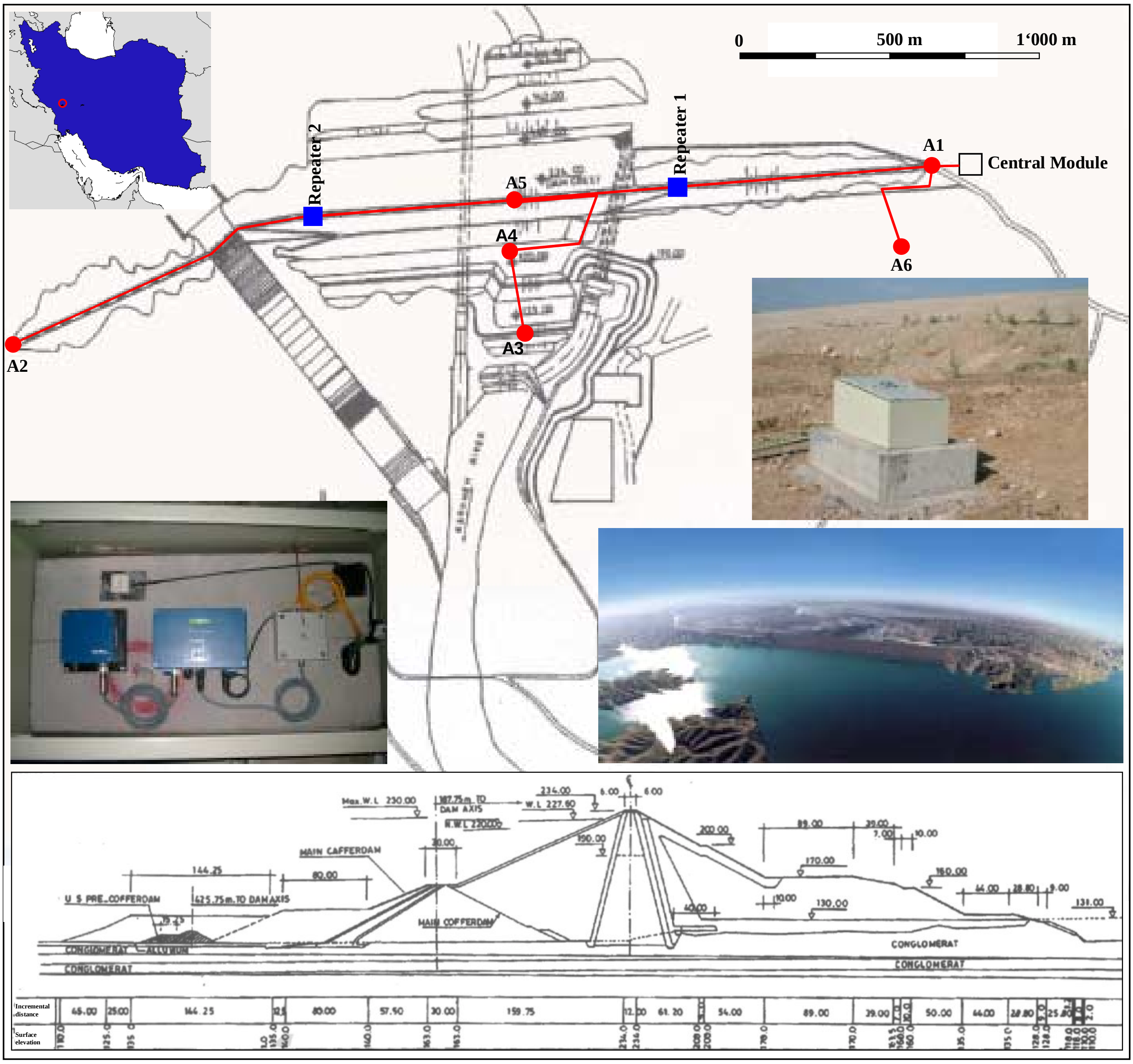

Figure 6. Karkheh Dam Seismic Instrumentation Network.

Structural Monitoring and Measurement System for Karun III Dam, Iran

The Karun III hydroelectric project, owned by the Ministry of Energy and being constructed under direction of the Iran Water and Power Development Company, is located on the Karun River in the Khuzestan Province of southwestern Iran. It is about 120 km upstream from the Shadid Abbaspour (Karun I) dam and approximately 140 km by air northeast of Ahwaz, the capital of Khuzestan. The site is in a seismically active area of the Zagros Mountains, on terrain comprised mainly of limestone and marly limestone rock.

Karun III double-curvature concrete arch dam is the second highest dam in Iran after Karun IV (construction still ongoing) by the present time. Its height above the foundation is 205m, and the discharge capacity of spillways is 17,800 m^3/sec. It is 338 m long at crest level, 29 m wide at its base and 5.5 m wide at the crest. The power plant is underground and is with capacity of 2,000 MW extendable to 3,000 MW.

Figure 7. Karun III Dam and Plunge Pool.

Seismic Telemetry System in Karun III Dam was provided by GeoSIG Ltd. and installed by the customer. Seismic outside stations consist of CMG-40T-1, Güralp 1 Hz Triaxial Seismometer and a cabinet with 19" Rack System including GSD-24, 3-channel Digitizer, 24 bits, GPS Time Receiver.

Karun III Dam technical information and picture are courtesy of Acres International.

Structural Monitoring and Measurement System for Beli Iskar Dam, Bulgaria

The Beli Iskar Dam is situated 60 km from Sofia in the Rila National Park, at the foot of the Moussala Summit and at elevation of approximately 1,800 m. It was constructed in the period 1935-1945 and put into service in 1948. The main function of the Dam is to balance the natural run-off of the Beli Iskar River and to provide water to the communities in the Rila Mountain region and parts of Sofia.

The dam is of concrete gravity type, with a maximum height of 51 m and a crest length of 533 m.

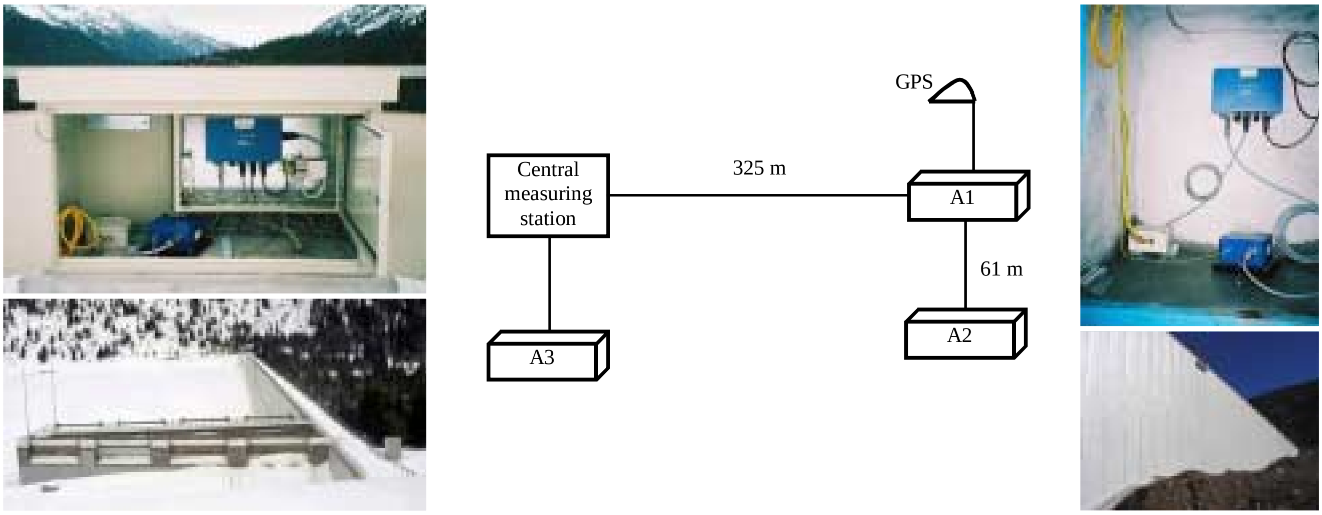

Figure 8. Beli Iskar Dam, structural monitoring and measurement system.

Structural monitoring and measurement system, which was implemented by Start Engineering JSC, Sofia, in the Beli Iskar Dam consists of 3 GSR-16 strong motion recorders and 3 AC-23 triaxial accelerometers. The system has an alarm interface for seismic alarm as well as equipment failure. The state-of-the-art GeoDAS software is utilized to conduct the operations of the system, in terms of data acquisition, processing and alarm generation.

Photographs are courtesy of Start Engineering JSC and Sofiyska Voda AD, Sofia, Bulgaria.

The complementary training for IWPC, Sepasad and Abzar-E-Khak / Karkheh Dam

GeoSIG Ltd. has organized a complementary training program for the officials from Iran Water and Power Resources Development Company (IWPC), Sepasad and GeoSIG Iran Representative Abzar-E-Khak between 20th and 28th of November 2005. Among the officials were Asghari Saeid and Salehifar Eferidoon from IWPC, Salemi Ebrahim from Sepasad, and Khodaei Reza Moheb from Abzar-E-Khak.

During the comprehensive training sessions on GeoSIG systems, the Iranian delegation had also the opportunity to visit Kultur and Kongress Center Luzern and Niederenbach Penstock power generation facility, both of which are instrumented with GeoSIG monitoring Systems, as well as a number of reputable Swiss organizations/companies related with water and power works; Swiss Federal Office for Water and Geology, STUCKY Ltd. and Rittmeyer Ltd.

Dr. Oleg Razinkov

Dr. Oleg Razinkov – Father of GeoDAS

Dr. Oleg Razinkov is the head of our software department and is literally the father of GeoDAS; the state of the art instrument administration, data acquisition, management and analysis software. Oleg has implemented the roots of GeoDAS in 1999 when he first joined in the GeoSIG Family and is continuously improving and enhancing the software as new requirements arise or as the technology advances.

Oleg has a Ph.D. degree in Geophysics from the Moscow State University, specializing in:

- data acquisition and processing systems
- software development
- remote sounding of geophysical media
- real-time systems
- problems of radiotomography

In co-ordination with the engineering department he has contributed in the development of several new instruments as well as customization of existing products according to specific project requirements. His intuitive and pragmatic approach to any challenge has provided GeoSIG with many robust solutions especially in data acquisition and management.

We appreciate Oleg's determination and enthusiasm within the GeoSIG family in creation and enhancement of our leading measuring solutions.

The M_b=4.5 Earthquake of 6th October 2005 in Georgia

Introduction

A recent earthquake in Georgia was recorded on 6th October, 2005, 17:57:28.3 UTC according to EMSC (European Mediterranean Seismological Centre) with an M_b=4.5. The same earthquake was reported as Mb=4.6 by Geophysical Survey. Russian Academy of Sciences Obninsk, Russia and as M=4.8 by United National Survey for Seismic Protection of Georgia (UNSSPG) along with an intensity map and a waveform figure of the earthquake. (Figure 11 & Figure 10).

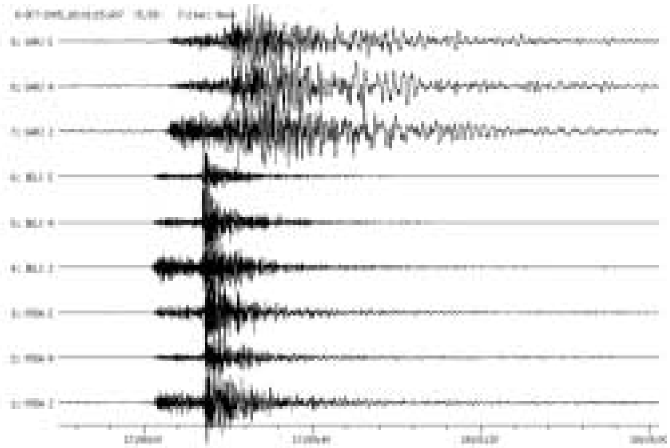

Figure 9. Waveforms of the earthquake according to UNSSPG.

Figure 10. Intensity Map for Enguri Earthquake by UNSSPG.

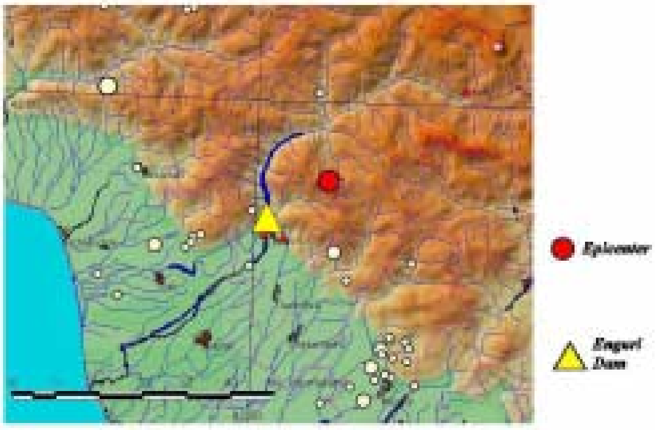

Figure 11. Epicenter of the earthquake and the location of Enguri Dam. (Here the epicentre of the earthquake is marked as red circle, and Enguri Dam is shown as yellow triangle.)

Enguri Dam Strong Motion Instruments

The Strong Motion Instruments that were supplied by GeoSIG Ltd. for the Structural Monitoring and Measurement System of Enguri Dam have recorded this recent earthquake in Georgia.

Here we give the records of this earthquake from 3 of those GSR-18 instruments deployed in Enguri Dam. The transverse recordings from S2, S6 and S8 stations are given in Figure 12.

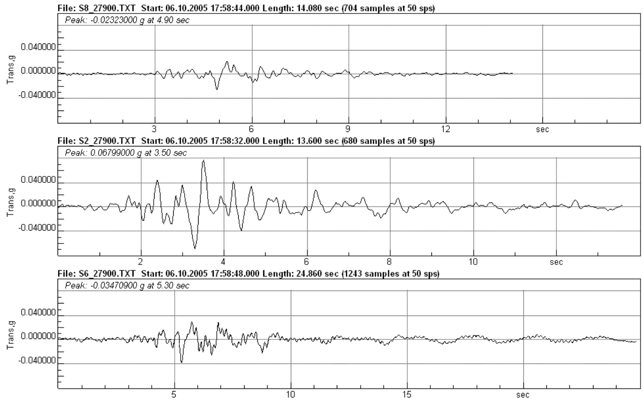

Figure 12. The Enguri Earthquake records from 3 GeoSIG GSR-18 strong motion instruments.

The M_L=4.0 Earthquake of 4th November 2005 in Khoozestan Province, Iran

Introduction

Also on 4th November 2005, an earthquake has been recorded in Khoozestan Province, Iran at 07:43:33.8 (UTC) with M_L=4.0 by International Institute of Earthquake Engineering and Seismology of Iran (Figure 13). The same earthquake was reported by EMSC (European-Mediterranean Seismological Center) with the same magnitude. Iranian Seismological Center has reported the event with Mn=4.1 (Figure 14).

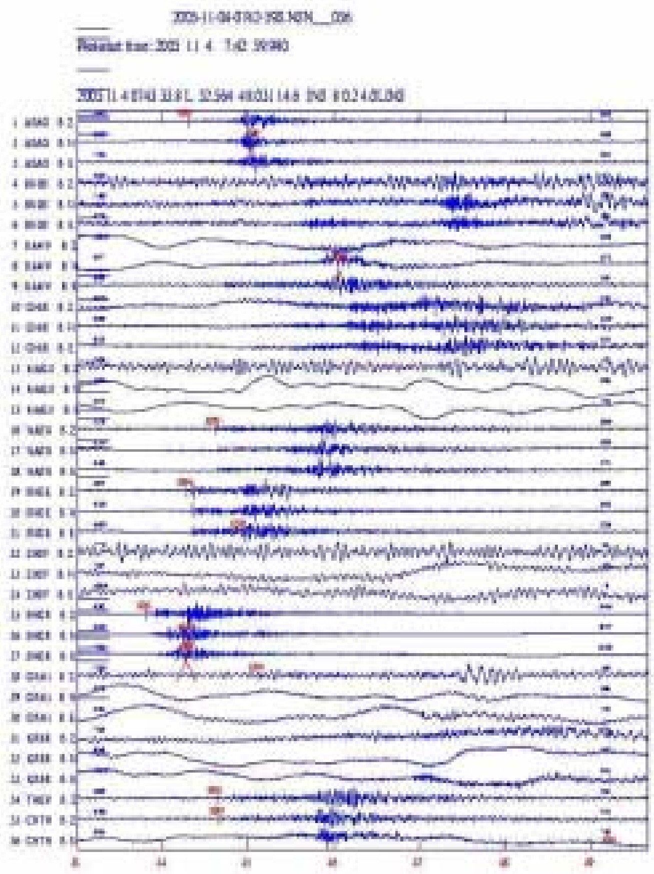

Figure 13. The M_L=4.0 Khoozestan-Iran Earthquake of 4th November 2005 reported by International Institute of Earthquake Engineering and Seismology of Iran.

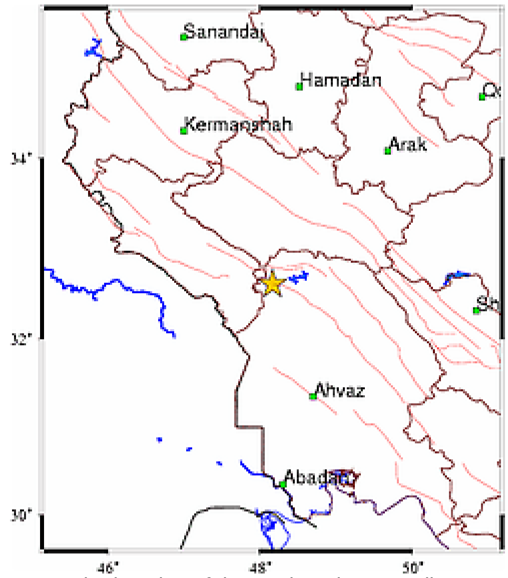

Figure 14. The location of the earthquake according to Iranian Seismological Center.

Karkheh Dam Strong Motion Instruments

This earthquake was also recorded by the GeoSIG GSR-18 strong motion instruments that are deployed in Karkheh Dam. Here we give only the recordings of three stations (Figure 15).

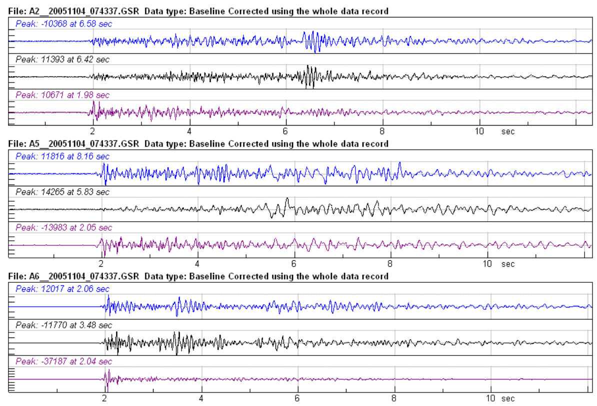

Figure 15. The recent Iran Earthquake records from 3 GeoSIG strong motion instruments.

First European Conference on Earthquake Engineering and Seismology, Geneva, Switzerland, September 2006

The First European Conference on Earthquake Engineering and Seismology will take place in Geneva, Switzerland in September 3-8, 2006.

The European Association of Earthquake Engineering (EAEE) and the European Seismological Commission (ESC) have long traditions of periodic conferences: The European Conference on Earthquake Engineering (ECEE) takes place every four years, and the General Assembly of the ESC every second year, respectively. In 2006, the EAEE and the ESC will join the 13th ECEE and the 30th ESC General Assembly to hold for the first time in common the First European Conference on Earthquake Engineering and Seismology (1st ECEES). *(For more information, please refer to http://www.ecees.org/)*

This professional bulletin has been prepared by GeoSIG Ltd.

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We would like to take this opportunity to announce that our annual winter holiday will be from the 23rd of December 2005 until the 8th of January 2006,
And Wish You a Happy and Prosperous New Year