Earthquake Engineering, Tenth World Conference © 1992 Balkema, Rotterdam. ISBN 90 5410 060 5

Development of stationary and mobile automatic stations for engineering seismometric stations

A. M. Kakhnovskiy, L. Sh. Kilimnik, E. B. Egorov & V. A. Nesterov
TsNIISK, Moscow, Russia

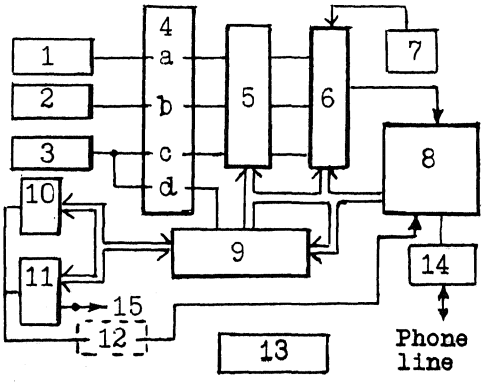
ABSTRACT: The concept of engineering seismometric stations proposed has been determined by the requirements of the earthquake engineering research procedure, the type of seismic vibration mechanisms as well as methodical and technical devices for collecting and transmitting instrumental data. Two types of the stations are under discussion - stationary and mobile with their own functional use.

I INTRODUCTION

At the present stage of scientific researches the value of the initial information could be overestimated. All design and constructive methods of earthquake-resistance of buildings are based on seismometric data that include a vibration process of the ground and structural elements. In addition to the seismological service every country tries to develop a sort of some engineering seismometric survey which would include stations of instumental monitoring or engineering seismometric survey(ESS). All of them could be devided into two large classes: stationary (ASS) and mobile (AMS) and should be connected with the center of accomodation, collection and utilization of the registered information.

2 ASS OF THE ENGINEERING-SEISMOMETRIC SURVEY

The block diagram of the ASS is shown on Fig. I. It contains systems of measurement and registrytion, connection channels and blocks of express analysis. It includes seismometers, eformometers and slopemeters. Every device should be supplied with an analogue transducer of mechanical vibrations into an analogue electric signal which would operate without inner noises. By means of a converter the analogue signal is transformed into digital data (solid memory about 384 kB capacity each).



I - slopemeters, 2 - deformometers, 3 - seismometers, 4 - anti-alids filters (a - 0÷0.5 Hz, b - 0÷5 Hz, c - 0.2÷20,50Hz, d - 0.I÷I0 Hz), 5 - analogue-digital converter I6 bit (96 db), 6 - digital registrator, 7 - satellite clock, 8 - IBM-PC/AT, 9 - automatic control software, I0 - deformograph, II - seismograph, I2 - mobile digital recorder, I3 - guaranteed power source, I4 - modem fulduplex, I5 - earthquake secondary aftermaths warming siglans

Figure I. ASS block diagram

Precise timemarker provides the registration of every seismic event (satellite block on Fig. I).

The principal peculiarity of the ASS is the registration of deformations (displacements, storey drifts, etc.) with the help of deformometers. All of them should prevent the loss

of instrumental data. When necessary the above devices should be installed in seismocontrol and warming stations. These stations should generate special signals for authoritive police and fire proof services, etc. to prevent secondary consequences of earthquakes and to "switch on" the emergency activities.

Collection of data and control are provided with the help of a computer (IBM PC/AT type) directly from a digital register through a mobile digital recorder (using floppy disks).

The software needed for the automatic control includes a processor (IBM PC/AT) with a prescribed switching on of the real signal process as well as the time-consumed control of the device's sencibility.

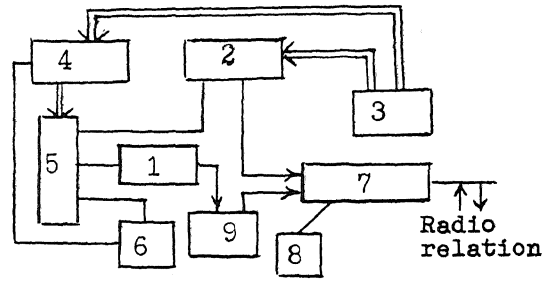
3 AMS OF THE ENGINEERING-SEISMOMETRIC SURVEY

The AMS differs from the ASS by its functional features:

- necessity of experimental conditions control,
- time-consumed period of its fulfilment,
- inability of experiments to be repeated in the same time-period (natural environmentsl vibrations or man-excited vibration tests as an example).

The block diagram of the AMS is presented on Fig. 2. Alike the ASS the mobile stations are based on IBM PC/AT which is supplied additionally with a block of telesatellite transforming of experimental dara (radiorelation).

The scheme includes the set of seismometers and deformometers with link blocks (up to 256 channels); automatic booster of analogue signals; transformer systems for automatic reply with prescribed time-switching in a certain order; registration and analogue converted blocks into digital form. The scheme is developed keeping in mind the variety of the registered signals, their spectral and time characteristics. It is done by modulus of analogue--digital transformers with data channel multiplexer (total frequency range of the control should be from 100 to 200 KHz). All stations are based on native accelerograph ЦАЗ - 3ТС (digital earthquake accelerograph of three-component flexible structure).

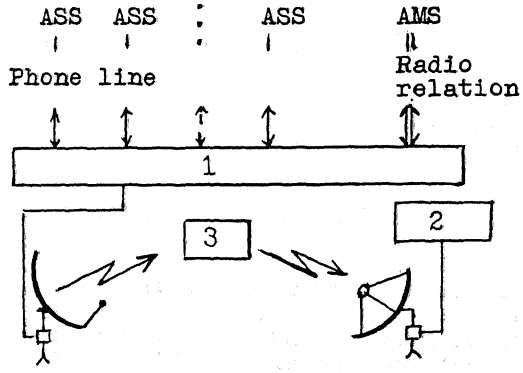


I - analogue measurement system, 2 - digital non-interacting measurement--registration system, 3 - control system, 4 - seismic excitation system, 5 - object under test, 6 - videocontrol system, 7 - IBM PC/AT, 8 - peripheral devices, 9 - system for data digital converting

Figure 2. Informatic-diagnostic AMS block diagram

4 THE ASS & AMS INFORMATION TRANSMISSION

The same ASS and AMS functional principles in the system of seismocontrol provide the necessity of centers for data collection and analysis (Fig. 3). Regional center deals with engineering-seismometric information Subsequently the data is transformed by satellite-operated lines to the main Center of the country or countries of community.



I - engineering-seismometric data collecting & processing regional centre, 2 - center of accomodation, collection, storage and utilization of data, 3 - satellite

Figure 3. Data transmission diagram

5 CONCLUSIONS

The ESS development (with ASS & AMS complexes of reliable instrumental searching for structures in seismic regions) provides for more accurate and detail analysis of earthquake--resistance problems. The use of satellite connections gives the possibility to motivate international activities in research and design projects in earthquake engineering of severe earthquakes all over the world.

REFERENCES

Kilimnik, L.Sh. & Kakhnovskia, A.M. I990. Recent developments in the USSR engineering seismometric service. Proceedings of PRC-USSR Bilateral seminar on earthquake engineering. China, Harbin: p.c. IO-I - IO-8.

Engineering-seismometric service in the USSR. Moscow: Nauka. I987.

Bruce A. Bolt, John E. Friday & Robert A. Uhrhammoc I988. A PC-based broad-band digital seismograph network. Geophysical Journal, University of California, USA. 93: p. 565-573.