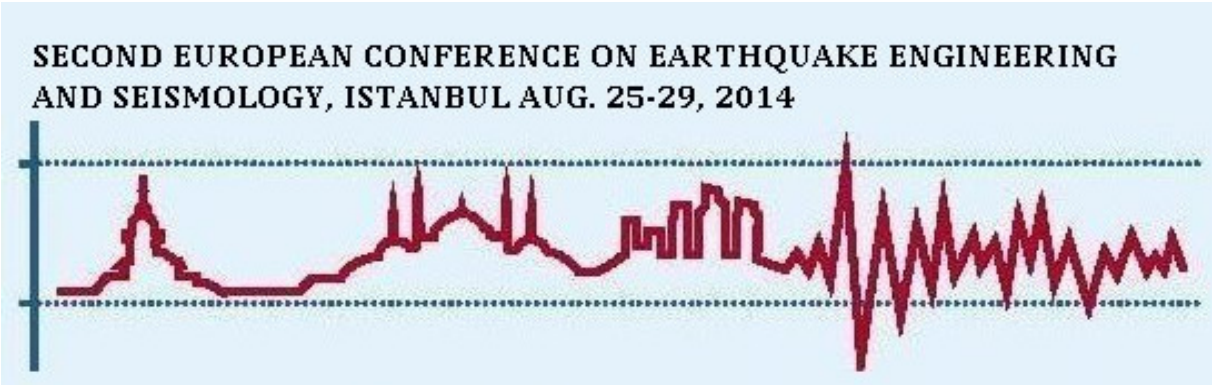

THE NATIONAL STRONG-MOTION NETWORK OF URBAN-INCERC: RECENT DEVELOPMENTS

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As an earthquake-prone country, Romania was affected, during its history, by several catastrophic seismic events, which caused important loss of human lives and destructions. The need for a systematic study of earthquakes was recognized ever since the 19th century, so that, in 1889, the first seismic station was established in Bucharest. During the following decades, seismographs were installed in several cities across the country. In an effort to provide modern instrumentation for strong ground motion recording, in 1967 was established the seismic network of the National Institute for Building Research, INCERC. The first instruments, installed in the premises of INCERC, in Bucharest, were a SMAC-B accelerograph and a Wilmot seismoscope. The network gradually expanded by the installation, until the destructive earthquake of March 4, 1977, of nine accelerographs and two seismographs. The unique and well-known record of this earthquake, obtained at INCERC Bucharest station, triggered an essential change of the design spectrum in the Romanian seismic code.

After the earthquake, following a substantial donation of the US government, the development of the network gained a new momentum, and several SMA-1 accelerographs were installed. Another expansion occurred in 1996-1998 when 26 ADS digital instruments (of Romanian production) and 4 SSS8 stations for continuous real-time monitoring were installed. Between 2002 and 2005, 31 Kinemetrics ETNA instruments were provided to INCERC by the State Inspectorate for Construction, following a donation from JICA, the Japanese International Cooperation Agency. More details on the history and evolution of seismic networks in Romania, including the status, at that time, of the INCERC seismic network, can be found in Craifaleanu et al. (2009).

Starting from 2009, INCERC was integrated in a larger organization, becoming the INCERC Bucharest Branch of the National Institute for Research and Development in Constructions, Urbanism and Sustainable Spatial Development, URBAN-INCERC.

The URBAN-INCERC network underwent, progressively, important changes. Due to the gradual failure of old SMA-1 accelerographs or to the difficulties in procuring photographic films and batteries required for their operation, these were replaced by digital instruments, located, if possible, in the same premises. It should be mentioned that most of the pre-1990 instruments were located in low- or medium-rise buildings, matching rather well the description of the SMRS-SB and SMBRS-DU categories in the COSMOS classification (COSMOS, 2001). An analysis of the usability of records obtained from stations from the SMBRS-DU category, located in densely urbanized areas in Romania, is made by Craifaleanu and Borcia (2014). It should be mentioned, however, that, after 1990, due to the modification of the ownership status of some stations, part of the instruments had to be relocated. In these cases, the new location was chosen such as to be as close as possible to the old location, while, at the same time, ensuring that the owner of the location agrees with all issues implied by the

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hosting of the instrument, as access, preservation etc. Regional civil defence headquarters, county prefectures, premises of the State Inspectorate for Constructions and state-owned schools were among the buildings chosen for the new locations. Small buildings were preferred for this type of stations.

Figs. 1 and 2 show maps of the distribution of seismic stations in the URBAN-INCERC network.

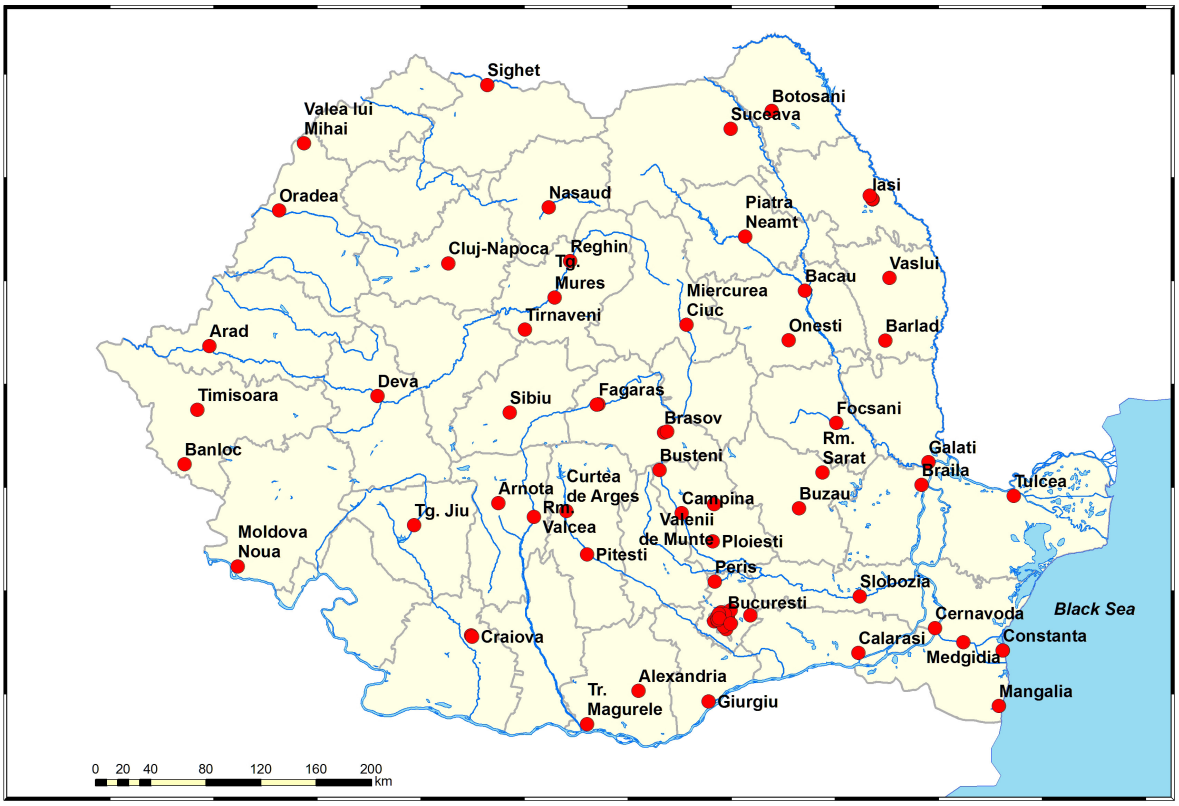

Figure 1. Stations in the URBAN-INCERC strong-motion network: Romania

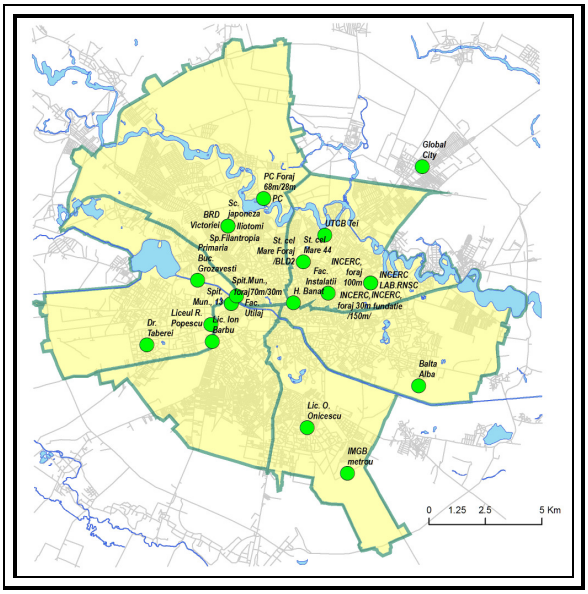

Figure 2. Stations in the URBAN-INCERC strong-motion network: Bucharest

Some of the instruments are placed in boreholes, three of those being located in the premises of URBAN-INCERC, in Bucharest. There are also a number of instruments located in high-rise buildings, installed following the recommendation concerning the instrumentation of this type of

buildings, introduced by the 2013 edition of the Romanian seismic code, P100-1/2013 (MDRAP, 2013).

The URBAN-INCERC network uses instruments of various types, acquired at different periods of time. These types include Kinemetrics ETNA, K2 and Granite, GeoSIG IA-1 and GSM-18, as well as three SSS-8 continuous monitoring stations of Romanian production (Praun et al., 2013).

As a traditional provider of seismic data used in the substantiation of seismic design codes (zonation maps and spectra), the network is considered as a reference source for the civil engineering community in Romania. Under the name of "The National Seismic Network for Constructions", the strong-motion network of URBAN-INCERC is officially included among the infrastructures related to seismic risk reduction. Its functions extend also to support in emergency situations and to the monitoring of the territory of Romania for seismic and vibratory actions, hazardous for constructions and infrastructure. The network delivers reports with recorded and processed data to the competent authorities, in case of events with impact on constructions and infrastructure, according to the attributions established by the Romanian Ministerial Committee and the Operative Centre for Emergency Situations.

ACKNOWLEDGEMENTS

Funding for the research presented in the paper was partially provided by the Romanian Ministry of National Education, UEFISCDI Agency, under Contract No. 72/2012, Project BIGSEES. This support is gratefully acknowledged.

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