Earthquake Education, Learning and Training for Risk Reduction in Romania. Case Study of a Special Platform and Facility

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SUMMARY:
Romania has the unique Vrancea intermediate seismic source that causes intense shaking and losses at several decades interval (i.e. 1940, 1977), thus many generations are lacking their own experience of facing strong motions. The paper presents the rationale, the structure and means of a new research project of URBAN-INCERC, financed by MDRT, to create and operate a center for education, training and public communication concerning safer earthquake behaviour, associated with a special facility – demonstrative platform, as important factors to mitigate impacts.The center includes logistics and adequate spaces for performing tests, demonstrations and simulations. The dynamic simulators must take into account the specificity of local earthquakes, and shall use furnished precincts to allow a visual contact with shaking items. The equipment and didactic devices donated by JICA Project in Romania for NCSRR as well as the knowledge from Japan will be used.

Keywords: earthquake preparedness, training platform, protection to Vrancea motions

1. INTRODUCTION

The seismic zones exposed to Vrancea earthquakes, a deep source at the Curvature of Carpathian Mountains in Romania, account for more than 50 % of the area and the zones exposed to shallow earthquakes in West (Banat) and North are at risk too. The seismic zones of the country indicate that about 35% of the population, i.e. more than 66% of the urban population, is exposed to Vrancea earthquakes in urban settlements. Vrancea earthquakes of November 10, 1940 (M_w 7.6-7.7) and March 4, 1977 (M_w 7.5), caused a large number of casualties (Georgescu and Pomonis, 2008, 2010, 2011, 2012). Presently, more than 50% of the exposed population was born before the occurrence of last significant events and has no recent experience in seismic protection and behaviour (Georgescu et al, 2004, 2006, 2008). The advances in earthquake engineering are not fully reflected in earthquake preparedness.

Thus, the lack of coping experience of recent generations justifies a new approach to the earthquake education, preparedness, protection of the population and communication in case of earthquake disasters. Such activities, however, need time to be developed and may take different forms of presentation in order to capture the attention, to increase interest, to develop skills and attitudes. Earthquake awareness must be based on motivation and associated to the will and means to prevent death, injury and damages, be based on the accumulation of concerns and knowledge, assessed and updated following actual earthquakes (Masuda, Midorikawa, Miki and Ohmachi, 1988).

Besides its roots in evolution of building techniques, earthquake vulnerability is in fact constructed in the course of the development of the social and built environment, while public and individual perceptions on seismic risk depend of many factors (Solberg et al, 2010). These authors agreed and cited a study of Paton et al., 2010, stating that „when communal knowledge and resources concerning earthquake preparedness are seen as insufficient, people seek help from powerful and expert sources

such as scientists and emergency management organisations", and hence, „collective efficacy in itself has a positive effect on empowerment and empowerment has a positive influence on adjustment intentions, if the experts are trusted". The Romanian authors of the present paper agree this idea, as much as the National Program of Earthquake Education was built independently but on similar premises (Vataman and Georgescu, 1992).

2. **ACHIEVEMENTS TO DATE IN EARTHQUAKE EDUCATION**

Past publications give references about the progress of such activities in Romania (Georgescu et al, 2004, 2006, 2008). MDRT and URBAN-INCERC (INCERC Bucharest Branch) developed since 1990 a National Program of Earthquake Education using posters and illustrated folders, booklets for population at risk (e.g.: citizens in residential buildings), earthquake preparedness manuals (practical guides) for children and school staff, staff of kindergartens and nursery, as well as short documentary films. The dissemination of these materials was for poster in some 40,000 copies, for booklets in 5,000 copies etc. Romanian materials on earthquake education are a part of the National System for Management of Emergency Situations, and MDRT is the institution in charge for earthquake issues.

In 2007, a new programme started in schools, with four types of booklets on earthquake education, in partnership with the Ministry of Regional Development and Tourism-URBAN-INCERC, with the Ministry of Education and Research, the Ministry of Administration and Internal Affairs, and some contribution of JICA Experts. Such booklets are available on INTERNET (www.incerc2004.ro; Georgescu et al, 2004, 2006, 2008; Stamatiade et al 2005; Georgescu, 2007). A World Bank Project (2007) allowed the elaboration of new series of booklets and video about earthquake protection at home.

The European, Japan, New Zealand and USA experience has shown recent developments (see paper references), as:

- Advanced earthquake training and information centers, provided with equipped rooms, and using automated devices, educational tools, virtual systems and earthquake shaking tables: The "Seismopolis" Center for improvement of behaviour in case of an earthquake (Greece); Center with shaking table (Ankara, Turkey); Civil Earthquake Training Center, Shizuoka Prefecture (Japan); Earthquake Disaster Education, Training and Communication Center, Shinshiro/Aichi Prefecture (Japan); Training/ Education Center for a Safer Life – Honjo (Tokyo, Japan); Southern California Earthquake Center (USA), etc.
- National programmes and projects for earthquake education and preparedness for disasters: EDURISK Project – EDUcational Itineraries for RISK reduction (Italy); Websismo (Spain); "CD-Rom Nee-Naw and friends: Tinoni & Co" (Portugal); 'Be safe net'/EUR-OPA Major Hazards; EduSeis- European Educational Seismological Project; "What's the Plan, Stan?" (New Zeeland); National Center for Research on Earthquake Engineering (Taiwan), etc.
- Projects as: "Earthquake Simulator" (Civil Protection, Italy); Earthquake Awareness Days (Turkey); University Consortium of Instructional Shake Tables (USA); Development of devices for structural and soil dynamics experiments, University of Nagoya (Japan);
- The access of school children / students to earthquake engineering laboratories for educational purposes: Multi-disciplinary Earthquake Engineering Research Center, USA, MCEER, Buffalo; Disaster Prevention and Mitigation Research Center – Harbin Institute of Technology – Laboratory of Structures and Earthquake Effects Prevention and Mitigation, People's Republic of China; Faculty of Engineering, New Zeeland.
- Earthquake education exhibitions in museums or at seminars: Human Renovation Museum, Kobe; ShakeZone (California, Kid Zone); Natural History Museum of London; "All Fall Down"- Tutti giù per Terra (Italy) etc.

From a financial point of view, the establishment of such a center needs about EUR 1 million (Greece and Turkey) and about EUR 100,000 / year for activity financing (Aytun, 2004; Dandoulaki, 2009; Seismopolis, 2006-2009).

3. A CRITICAL EVALUATION OF PRESENT APPROACHES AND NEEDS IN ROMANIA

At more than 20 years from the first release in the National Program, in this process of direct action or empowerment in earthquake information-education, some gaps are easily identifiable:

- seismic risk reduction has a physical / engineering component, as well as a social / human one, but they are not in a full relationship of a mutual support;
- some owners that are living in weak and vulnerable buildings are passive in reducing seismic risk; the issue of convincing more owners of Bucharest apartments at risk to sign a contract for strengthening is rather difficult and some Romanian institutions are not fully prepared for the social communication of that kind;
- although many earthquake educational materials for the population have been financed and developed, the implementation of these materials is a difficult process, and mass-media plays in many cases a negative role, providing mostly catastrophic views;
- the legal basis for recommending information sources for earthquake education of the population, is a duty only for some public institutions (Civil Protection);
- reactions of the authorities and professionals are usually only a response to critical events or mass-media warnings;
- there are no specific institutional structures to provide earthquake education as a long term, scientific and diversified activity, with financial, material and professional human resources; when available, resources are not sufficient to disseminate the required amount of educational materials /documentation;
- there is a relatively low participation of teachers and permanent staff in schools in this process, to explain the scientific and technical issues; a limited knowledge of school students about basic data and some details of the hazards to which they may be exposed;
- some lawyers and court judges are confused in their decisions concerning the balance between private property apartments inviolability and risk reduction needs in condominiums;
- staff of public institutions is not educated for specific tasks, as to protect their assets and to have a role in communication with citizens if an earthquake strikes during office hours.

There is a need of new brochures, posters, video cassettes and spots including recommendations for earthquake preparedness and behaviour in case of tremor. For earthquake protection of institutions, a number of aspects related to the disaster prevention measures, the earthquake response/reaction and recovery measures shall be conceived and solved. Every citizen must show that he/she, as an employee or client of a public institution, is aware of the risk he/she is exposed to in case of a major earthquake, being able to answer to a number of questions related to the environment he/she might be at a particular time/ job place (thematic questionnaires). The availability of reliable publications on earthquake protection of the population in the public institutions shall be a part of the communication with the citizens and the mass-media.

There is also a need of a specific facility, a long-run specialized center, endowed with earthquake simulation equipments for quasi-real shaking, experts, dissemination and communication materials, a specific website, booklets and e-questionnaires.

4. CASE STUDY: THE STRUCTURE OF THE CENTER AND DEMONSTRATIVE PLATFORM

4.1. The new conceptual approach

The new concept of this research project is that, in order to compensate these gaps, public policies should generate results at the level of:

- citizens: getting knowledge and skills for a preventive behaviour, active participation in the prevention and management of the emergency situations at home and within the local communities;
- ministries and central bodies, local and county councils, and city councils, mayors: empowerment in the legal framework for emergency management;
- institutions and business operators: duties for prevention and management of emergency situations in their businesses and for their staff;
- National Committee for Emergencies: through inter-sectorial or interdisciplinary actions.

The new conceptual approach for a public center with demonstrative / training platform as a specialized facility in URBAN-INCERC, INCERC Bucharest Branch, is conceived as a local organizational structure, with suitable spaces and technical equipment and specific operational status in order to fulfill its tasks, a part of the prestigious national research institute, capable to provide reliable knowledge on the seismic risk mitigation measures with its own researchers.

Figure 1 shows the main equipment, information logistics (hardware and software) and possible educational materials, as well as the activities of a center for public information, education and training.

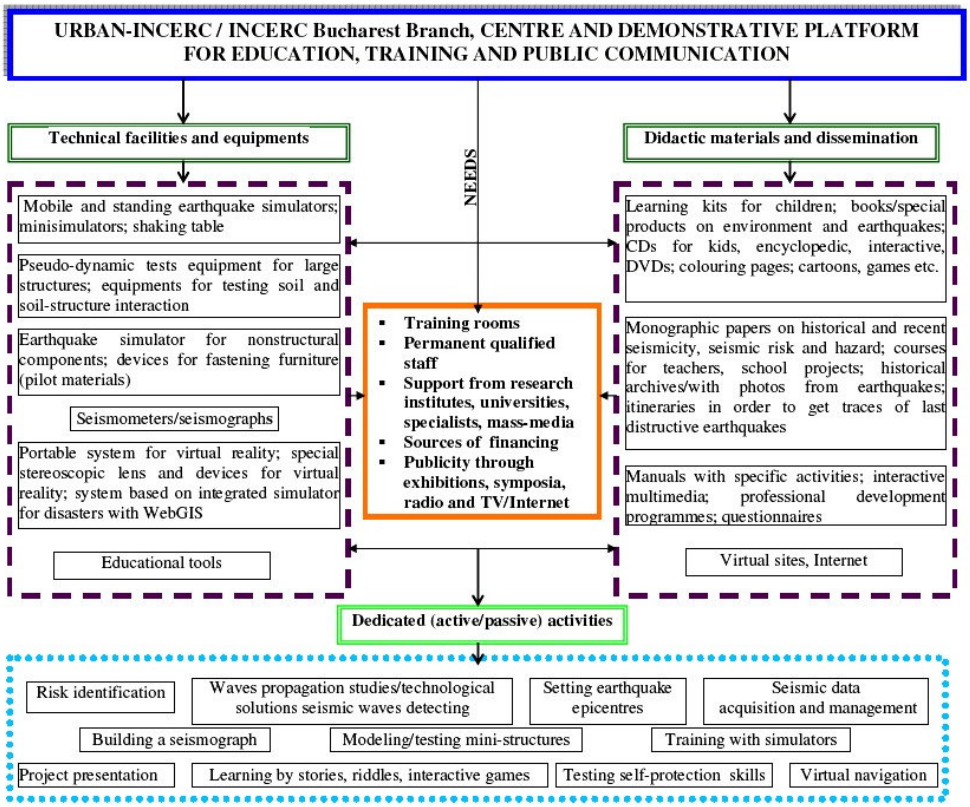

Figure 1. The public earthquake education, training and information center of URBAN-INCERC, INCERC Bucharest Branch (Contract MDRT – INCERC no. 402/2009)

The demonstrative platform for education, training and public communication on public reaction to earthquake includes logistics and adequate spaces for performing tests, demonstrations and simulations. The dynamic simulators must take into account the specificity of local earthquakes, and shall use furnished precincts to allow a visual contact with shaking items. In order to ensure better understanding, model buildings with different scales will be analyzed in terms of structural design methods and seismic response.

The long-period Vrancea motions may cause large amplitude oscillations in recently built high-rise structures. As a consequence, the office and home furniture will be swayed and eventually overturned. Reaction of individuals and grouos under low-frequency shaking is cumbersome and may lead to shocks and panic.

The equipment and didactic devices donated by JICA for NCSRR (Georgescu et al, 2002, 2004, 2006) will be used in this framework. The space will be organized in such way as to enable people to attend the tests performed on existing structural models. Several existing laboratories could cooperate within the platform. The knowledge from Japan will be also useful (Ichimura et al, 2007; Fukuwa et al, 2008). The URBAN-INCERC Branches of Iasi and Timisoara, with their existing laboratories, will be partners. The INCERC website INFORISX may be extended and associated to this approach (Craifaleanu et al, 2011).

The application will use also the framework of ECBR – European Center for Buildings Rehabilitation, as a specialised center of European and Mediterranean Major Hazards Agreement EUR-OPA, included in INCERC Branch of the National Institute for Research and Development URBAN-INCERC.

4.2. Specific findings for the operational aspects of the new center

The Center will develop and use specific tools and advanced technology for knowledge transfer:

- presentations and/or on-line training courses or e-learning, with a virtual dialogue, in correlation with the educational level and the psychological profile of various social and professional categories of population – by age, attributions and previous experience;
- e-learning methods – computer technologies including particularly digital technologies, learning techniques where the student uses the computer, and the Internet for a proper development of distance education;
- earthquake simulating software and protective measures against earthquakes - flowcharts and preparing data for the actual development of the software;
- “earthquake preparedness certificates” for people who, after training courses and e-learning courses, pass the simulation tests;
- mid-level courses for individuals and/or technical staff – good practice rules concerning self-financed buildings, as well as new construction techniques will be considered as alternatives;
- communication sessions for public institutions, citizens and the media, will include recommendations and anti-seismic protective measures for public institutions and their staff.

Trainers will be formed to teach volunteers in schools how to explain the protective measures to students; or volunteers, e.g. students, to transfer knowledge to communities.

The topical themes shall be based on earthquake education materials, training and education sessions in order to provide:

- a clear understanding of the basic concepts: magnitude, intensity, seismic hazard, vulnerability, risk exposed elements, seismic risk;
- what is reality and what is fiction in earthquake forecasting versus the importance and ways to mitigate the seismic risk of buildings;
- categories of earthquake-endangered buildings – according to available statistical data versus visualization and understanding of seismic response and damage of the buildings, with or without strengthening, using data and images of the 1940 and 1977 earthquakes;
- recommendations for individual and group seismic protection;
- enforcement of the legal provisions, liabilities and opportunities resulting from the Ordinance of the Government 20/1994 on the mitigation of the seismic risk of the existing buildings;
- legal assignments related to the necessity to communicate with the citizens, the deontological principles and the freedom of expression;
- understanding the ISDR principle according to which in case of a major seismic event “the citizen is the first rescuer”.

The content of the information materials and/or e-learning questionnaires shall comply with that of the materials already approved by the Ministry of Regional Development and Tourism, and with that of the EU requirements (European Parliament Resolution, 2007). It shall be updated in order to cover the experience gained from the recent seismic disasters in Chile, China, New Zeeland and Japan. The Center will combine the training in seminar rooms with e-learning and specialized web sites for children, students, office staff and population.

The partnership between the Ministry of Regional Development and Tourism, with its National Research and Development Institute INCD URBAN-INCERC and the mass-media on mitigation of the seismic risk, may result in a Practical Guide to the earthquake education and training of the citizens, using also the mass-media, called "S" Files (Seismic knowledge for the mass-media).

5. CONCLUSIONS

Given the recent disasters of China – Wenchuan, 2008, Italy-L'Aquila, 2009, Haiti 2010, Chile-Maule, 2010, New Zealand 2010 and 2011, Japan-Tohoku 2011, and the negative impact of some media release, a reasonable public response to strong earthquakes is a must in Romania. This belief is sustained by some recent small Vrancea events, as well as by some rather insignifiant crustal earthquakes which caused a disproportionate emotional impact and media coverage.

The knowledge related to earthquake preparedness, individual and group earthquake safety measures may contribute to continuous, clear and accurate information of the population in the aftermath of major seismic events.

Apart from the mitigation or prevention of deaths and injuries of the personnel, journalists must be trained to convey information from reliable sources in order to avoid propagation of panic, rumours and disorganization.

The suggested Center may provide a proper preparedness. Seismic simulators and other IT devices will provide attraction. The proposed Center will enhance the responsibility of public authorities, research institutes and professionals in relevant fields of activity, because:

- release of catastrophic data causes serious social anxiety disorder; rumors and false predictions are constantly harming the mind of people;
- professionals acting in the field of earth sciences should cooperate with those involved in earthquake engineering and disaster management to correctly and clearly present the various scenarios to the population;
- for earthquake drills and protective measures, the authorities should only use information consensually validated by professionals acting in the relevant field / interrelated fields.

The researchers of URBAN-INCERC consider that correct, continuous and timely information of the population about the situation in affected areas and the interventions, rescue and recovery is a major responsibility of both public institutions and the media. This is in the agreement with the EU Directives on Civil protection and EU Parliament Resolutions about the right to information, education and protection of the population.

Since the area exposed to strong earthquakes in Romania is large, we believe that the programs and new ways of earthquake awareness and education of people should be a national priority and needs to be supported by a coherent and comprehensive legal framework strongly correlated with, but different from existing laws on civil protection.

Because generations are changing, there is need of a further and more efficient knowledge transfer about risk mitigation from specialists and authorities to the citizens, public servants and school students, as well as from EU and countries like Japan, USA, New Zealand to Romania.

The partnership with International Association of Earthquake Engineering-IAEE and European Association of Earthquake Engineering-EAEE will provide scientific information and framework for exchange of experience and outreach activities.

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REFERENCES

Aytun, A. (2004). A new 3-d earthquake simulator for training and research purposes. *Proceedings of the 13-th World Conference on Earthquake Engineering,* Vancouver, B.C., Canada, August 1-6, 2004, Paper No. 3429.

Camassi Romano Daniele and Peruzza Laura (2002) *Edu-Risk 2002 Earthquake Education: a Journey for Seismic Risk Reduction. Gruppo Nazionale per la Difesa dai Terremoti. 1st year of activity: Annual Report*. Framework Program 2000-2002. Italy. See also: EDURISK Project, Italy. www.edurisk.it

Civil Defence New Zealand (2006). What's the Plan, Stan ?

Contract MDRT / MDRL-INCERC no. 402/2009. Center and demonstrative platform for earthquake education, training, information and public communication. Research Reports 1...5 (Centru şi platformă demonstrativă pentru educaţie, instruire şi comunicare publică privind comportarea la cutremur – cercetare (prenormativă), Rapoarte de cercetare Fazele 1...5.) INCERC.

Council of Europe – EUR-OPA Major Hazards Agreement. "Be safe net"- European center for disaster awareness with the use of the internet – Cyprus.

Craifaleanu, I.G., Georgescu, E. S., Borcia, I. S., Aldea, A., Vacareanu, R., Arion, C. (2011): INFORISX: Information Website on the Seismic Risk in Romania. *Proceedings of TIEMS 2011 - The International Emergency Management Society, The 18-th Annual Conference*, Bucharest, Romania, 2011.

Dandoulaki, M., Kourou, A. and Panoutsopoulou, M.: Does knowledge signify protection? The SEISMOPOLIS center for improvement of behavior in case of an earthquake. *Geophysical Research Abstracts, Vol. 11, EGU2009-1244-1, 2009*. EGU General Assembly 2009. See also: *** Seismopolis-Pilot integrated System for Public Familiarization with Earthquakes and Information on Earthquake Protection, Greece. www.seismopolis.org accessed 2006…2009.

Georgescu, E. S.: Earthquake Education Of School Students, Teaching And Administrative Staff In Romania. *EUR-OPA Major Hazards Agreement Euro-Mediterranean Workshop on Disaster Reduction at School, "Building safer school communities",* Paphos, Cyprus, 2007.

Georgescu E. S., Kaminosono T., Miyara K., Ghica R., Stamatiade C. P., Ionescu G. (2006): Earthquake preparedness in Romania and knowledge dissemination in a JICA project on seismic risk reduction. *Proceedings of the 13-th European Conference on Earthquake Engineering*, Geneva, Switzerland, 2006.

Georgescu E. S., Kato H., Miyara K., Stamatiade C. P., Ionescu G. (2008): Seismic risk perception vs. seismic risk reduction. Results of a JICA Project in Romania. *Proceedings The 14-th World Conference on Earthquake Engineering*, October 12-17, 2008, Beijing, China.

Georgescu, E. S. and Pomonis, A. (2008). The Romanian Earthquake of March 4, 1977 Revisited: New Insights into its Territorial, Economic and Social Impacts and their Bearing on the Preparedness for the Future. *Proceedings of the 14-th World Conference on Earthquake Engineering,* October 12-17, 2008, Beijing, China.

Georgescu, E. S., Pomonis, A. (2010). Human casualties due to the Vrancea, Romania earthquakes of 1940 and 1977: learning from past to prepare for future events. *Proceedings of the Mizunami International Symposium on Earthquake Casualties and Health Consequences,* 15-16 November 2010, Mizunami, Gifu, Japan.

Georgescu, E. S., Pomonis, A. (2011). Emergency management in Vrancea (Romania) earthquakes of 1940 and 1977: casualty patterns vs. search and rescue needs. *Proceedings of TIEMS – The International Emergency Management Society, 18th Annual Conference*, June 2011, Bucharest, Romania.

Georgescu, E. S., Pomonis, A. (2012). Building Damage vs. Territorial Casualty Patterns During the Vrancea (Romania) Earthquakes of 1940 and 1977. *Proceedings of the 15th World Conference on Earthquake Engineering*, Lisbon, 2012. Paper 2123.

Georgescu E. S., Tojo, I., Stamatiade C. P., Iftimescu R., Vladescu C., Negulescu C., Radoi R. (2004): Japan - Romania knowledge transfer for earthquake disaster prevention preparedness of citizens in Bucharest, *Proceedings of the 13-th World Conference on Earthquake Engineering*, August 1st-6-th, 2004, Vancouver, British Columbia, Canada.

Lee, G. C., Dargush, A. S.: Earthquake Engineering Educational Activities Using the Center Approach. Multidisciplinary Center for Earthquake Engineering Research, State University of New York at Buffalo, USA.

Masuda, H., Midorikawa, S., Miki, C., Ohmachi, T. (1988): "Formative process of consciousness of earthquake preparedness and evaluation of effects of earthquake education." *Proceedings of ISCE*, No. 398/I-10, 359-365, Tokyo, Japan, 1988.

European Parliament resolution of 14 November 2007 on the regional impact of earthquakes. Procedure 2007/2151(INI). Text tabled A6-0388/2007.

Fukuwa, N., Tobita, J., Mori, M., Koide, E., Hanai, T: Development of vibration experiment education materials for structural and soil dynamics, *Proceedings of the 14-th World Conference on Earthquake Engineering,* October 12-17, 2008, Beijing, China.

Ichimura, T., Samo, T., Hori, M., Itami, H. (2007): Integrated Earthquake Simulator to Generate Advanced Earthquake Disaster Information, Department of Civil Engineering, Tokyo Institute of Technology, Department of Civil Engineering, Tohoku University, Earthquake Research Institute, University of Tokyo, Kajima Corporation. NENPO 2007.

Meita, V., Dobre, D., Georgescu, E.S., Stamatiade, C.P., Vilceanu, L: Citizens earthquake preparedness in Romania: towards a new conceptual approach for a training platform and facility in URBAN-INCERC. *Proceedings of TIEMS 2011 - The International Emergency Management Society, The 18-th Annual Conference*, Bucharest, Romania, 2011.

New Zealand Earthquake Commission. Public Education Toolbox. http://www.eqc.govt.nz/abouteqc.aspx.

Ordinance of the Romanian Government No. 20/1994 on the mitigation of the seismic risk of the existing buildings. Official Gazette, 1994 (modified, republished)Î

Solberg, C., Rossetto, T. and Joffe, H. (2010): The social psychology of seismic hazard adjustment: re-evaluating the international literature. *Nat. Hazards Earth Syst. Sci., 10, 1663–1677, 2010*; www.nat-hazards-earth-syst-sci.net/10/1663/2010/doi: 10.5194/ nhess-10-1663-2010.

Stamatiade C. P., Georgescu E. S., Ionescu G., Dobre D. (2005): Educaţia şi protecţia elevilor în caz de cutremur, *A 3-a Conferinţă naţională de inginerie seismică,* Bucureşti, 2005.

Team SAFE-T: A California Partenership for safety and preparedness, USA.

Vataman, O., Georgescu, E. S. (1992): "The Romanian Program for public earthquake preparedness". *Proceedings of the 10-th World Conference on Earthquake Engineering*, Madrid, A.A.Balkema, Rotterdam, Netherlands; Brookfield. VT, USA. ISBN 9054100605.

Websismo sitio web, Instituto de Ciencias de la Tierra "Jaume Almera" (ICTJA) y GEOMEDIA, Spain. www.websismo.csic.es/websismo.html.

www.mdrt.ro. Comunicare / Publicatii. Educatia pentru protectie in caz de cutremur. Cutremurele si efectele lor - prevenire si masuri – Brosura (decembrie 2007)

www.incerc2004.ro. Educatia si protectia elevilor in caz de cutremur". Serie de indrumare elaborate de INCERC (format "pdf"), 2007.