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PROACTIVE VS. REACTIVE LEARNING ON BUILDINGS RESPONSE AND EARTHQUAKE RISKS, IN SCHOOLS OF ROMANIA

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ABSTRACT

During the last 20 years, many specific activities of earthquake education and preparedness were initiated and supported in Romania by drafting materials for citizens, students, professors etc. (Georgescu et al, 2004, 2006). The education, training and information on earthquake disaster potential are important factors to mitigate the earthquake effects. 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 in order to induce a proper behaviour towards safety preparedness.

Earthquake awareness must be based on motivation, meaning the understanding of cause-effect relationships, associated to the will and means to prevent death, injury and damages. It shall also be based on the accumulation of concerns and knowledge, which are, in principle, a consequence of the motivation, but which depend on the methods applied and actions taken for efficient earthquake preparedness, assessed and updated following actual earthquakes (Masuda, Midorikawa, Miki and Ohmachi, 1988).

We are now at a crossroad and the proactive attitude and behaviour (anticipative and participative) needs to be extended in learning, within institutional framework, but correlated with the usual targets of schools and teenagers proactive issue (ROEDUSEIS-NET; Page and Page, 2003), by encouraging students in activities closer to earthquake engineering.

INTRODUCTION

In the general context of a sustainable society development process, the disaster perspective has shifted from reactive to more proactive framework (from reactive emergency management to disaster risk reduction). To be proactive means acting in advance to deal with an expected severe earthquake disaster, to think ahead and as results to be able to have a correct behavior, take charge of situation, face it and to create means to deal with it, and do not blame the society for your losses at disasters. To

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be reactive, on the other hand, means being always affected by the environment and the natural disasters, these sources of losses and negative effects acting as stimuli to which respond after.

Preparedness involves measures taken in anticipation and highlights the permanent need for organized disaster activities and the significant role of basic seismic education in schools.

GENERAL PERCEPTION, KNOWLEDGE, COGNITIONS, EMOTIONS IN SCHOOLS CONCERNING THE NATURAL DISASTERS

As in other cases and situations specific to adult people, perceptions of risk at the level of children appear to result in a lack of action or motivation to prepare for a severe seismic event. When children understand the nature of the seismic hazard, have knowledge of protective behavior, and know they have strategies for coping with the event, it is likely that negative emotions such as fear and distress can be tempered (King and Tarrant, 2013). Children that learn ways to keep themselves safe had helped them to feel more positive about their ability to cope during and after a disaster, and this had also helped to reduce their fear about possible events.

There are many seismic protection policies that promote awareness and develop a culture of risk prevention in case of severe earthquakes. The main objective of a strategy to inform and educate the population about emergency situations in case of an earthquake is to create an appropriate behaviour in emergency situations and communication mechanisms, participation in decisions within a community etc. to reduce the loss of lives. This behaviour can be achieved, however, starting from primary education by encouraging students to participate in organized activities dedicated to earthquake issues (causes, measuring changes to the environmental, simulation earthquake effects on buildings, prevention and safety measures etc.).

It is widely recognized that the impact of earthquakes in schools is expressed by multiple effects, at the physical level (fall of lighting fixtures and components of suspended ceilings, overthrow of cabinets, bookshelves, windows breaking, cracking of walls etc.), educational level (damage of school leads to interruption of activities), economic level (repairs investments after quake), having also a psychosocial impact (students may be confused by the situation and can overcome with difficulty).

For pragmatic reasons, most practical plans of prevention are based on some technical-administrative measures while for students “to do” or “not to do” rules of behavior, i.e. reactive, are given, mainly concerning post-earthquake impact. However, the IT, wide social and multimedia access changed the overall framework. With more data, including early warning, but also under attack of wrong advices on social media, the students want to know more things in advance and to check some issues by themselves. The ability of children and youth to be proactive in reducing their own risks has been rather ignored in last years in almost entirely world.

Recently, fortunately, the philosophy has changed and promotes disaster risk education in national school curricula to natural hazards. It is noted that “education for creating a culture of disaster resilience” is an interactive process of mutual learning among population and institutions. It encompasses far more than formal education at schools and universities and affects all aspects of life through the concerted effort to overcome universal barriers of ignorance, apathy, disciplinary boundaries and lack of political will present in communities (King and Tarrant, 2013).

Taking into account all positive and practical results of Educational Seismological Project (EDUSEIS) launched in 1995 as an EU-supported partnership (through Erasmus), with specific support in France, Italy, Germany and Portugal (European Commission, 2013), and of another good example EDURISK of Italy (Camassi et al, 2005), we have evaluated these achievements for a new integrated and interactive approach, "Educational Seismic Network in Romania" (ROEDUSEIS-NET), to fit very specific local conditions.

EARTHQUAKE RISK AND EDUCATION IN ROMANIA

The seismic hazard of Romania is dominated by the Vrancea intermediate depth earthquakes in south-east of the country, that affect with high intensities ca. 50% of the territory at each strong event. The Vrancea motions are different of other seismic sources in Europe and the World because of long predominant periods of soil vibration and low attenuation (Georgescu et al, 2004, 2006). Other crustal (shallow) earthquakes can generate locally high intensities in west and north. The exposure at risk is large, since the seismic areas cover 65% of the territory, including almost 75% of population (over 60% in strong seismic zones). Urban localities expose ca. 35% of the total population or 66% of the whole urban population to the seismic hazard of the Vrancea zone (Georgescu et al, 2008).

Since 1990, a national program of earthquake risk mitigation was gradually developed in Romania, with emphasis on public earthquake information and education, the following activities and materials were developed:

- posters and illustrated folders, booklets for different categories of professions and population at risk (e.g.: citizens in residential buildings);
- earthquake preparedness manuals (practical guides) for children and school staff, staff of kindergartens and nursery;
- short documentary films, available as video products, presenting the main earthquake safety and preparedness rules for citizens and school staff and students.

The dissemination of these materials was at pilot scale, covering 4 pilot counties.

Later on, within the Technical Cooperation Project with Japan on the Reduction of Seismic Risk for Buildings and Structures (2002-2008), a new series of color booklets and associated color posters for schools, on 3 categories of age, with knowledge of gradual complexity, was developed in 2007 (INCERC Earthquake booklets, 2007), materials distributed as printed matter and CDRoms or posted on Web Site (http://inforisx.incerc2004.ro; www.incerc2004.ro). JICA Project provided also knowledge and didactic seismic simulators to NCSRR, presently used by URBAN-INCERC (Georgescu et al, 2006; Fukuwa et al, 2008) for education of the population and knowledge dissemination for preventing risks and for development of technical knowledge by training, studies and documentation, seminars.

Since 2009, URBAN-INCERC prepared a study for *The center for education, training and public communication concerning safer earthquake behaviour, associated with a special facility – a demonstrative platform* (Meita et al, 2011), to develop and use specific hardware and software, didactic equipment, earthquake simulators and mass-media tools for knowledge transfer.

From all above, it can be seen that all programs and projects have intended to change the situation described in the following scheme, Fig. 1. Knowledge and resources have been invested to explain the origin and nature of seismic events, but specific situations that require taking effective measures to prevent and mitigate the effects of earthquakes or disseminated knowledge or involvement of the population (pupils, students, adults) are not enough supported, encouraged, motivated.

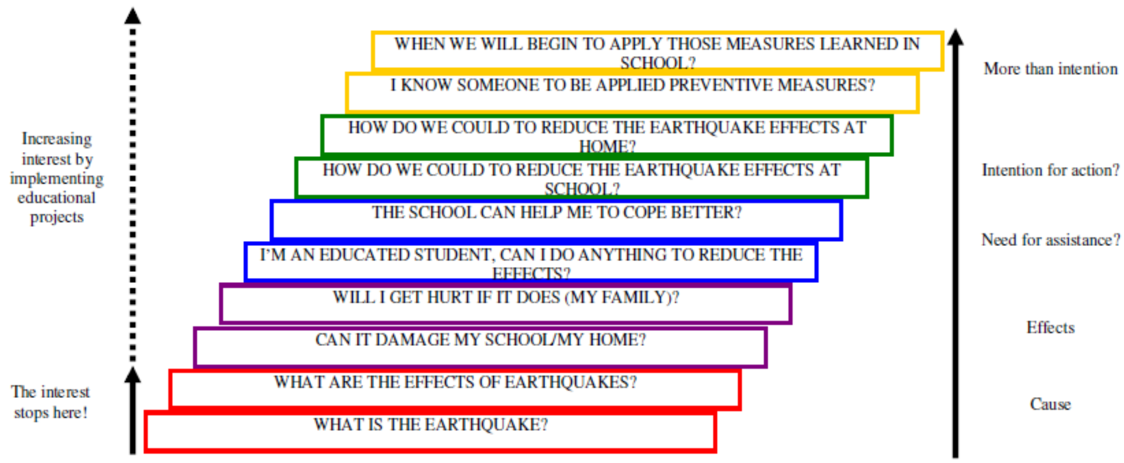


Figure 1. Queries on proactive-reactive situation in the seismically protection

THE ROEDUSEIS-NET PROJECT

In this project (Roeduseis-Net, 2011), NIRD-URBAN INCERC is partner with National Research Institute for Earth Physics (NIRDEP), as project coordinator, and with Babes-Bolyai University of Cluj-Napoca and Beta Sofware Management Company SA. Proactive educational objectives refer to: training of students and teachers in the record, analysis and interpretation of data recorded using dedicated seismometers installed in schools, the development of practical skills to work with seismic waves and other earthquake parameters (Tataru et al, 2013; Zaharia et al, 2013).

Scientific objectives relate mainly to introduce knowledge on Earth and earthquakes, understanding the natural environment patterns and attract students to geosciences, but also aim to create a database of seismic records from equipments installed in schools. The schools from 9 cities throughout the country (Bucharest, Brasov, Focsani, Iasi, Constanta, Sibiu, Timisoara, Zalau, Cluj-Napoca) are involved (Roeduseis-Net, 2011), Fig. 2.

In this context, the project was not just a replica of European EDUSEIS, but was addressed to local issues, both for hazard and buildings. Two types of manuals were developed, structured as Teacher's Book and Student notebook, for primary, secondary and high schools, in a proactive approach, to cover all parties of educational process with topics as "On earthquakes and their effects. Learn • We experience • We protect". The structure of the educational material present the earthquake impact on buildings and prevention and safety measures to be applied. The proactive behaviour is secured enabling school students to learn why and how to act in advance, where to get shelter and why, how to be safer from a future earthquake impact, rather than just reacting according to the rules.

The new approach within ROEDUSEIS-NET emphasizes the required needs and proactive activities and seismological educational programs, such as:

- the use of scientific equipment like seismometer and practical activities from the educational materials will simulate the interest of students for earth science topics and knowledge in general.
- the program provides opportunities to introduce earthquake, seismology, plate tectonics topics, earthquake effects on surrounding environment and buildings into school curriculum.
- the program can be used for a variety of educational levels from kindergarten to high school.
- the program and associated educational materials represent a wide range of information related to seismology.

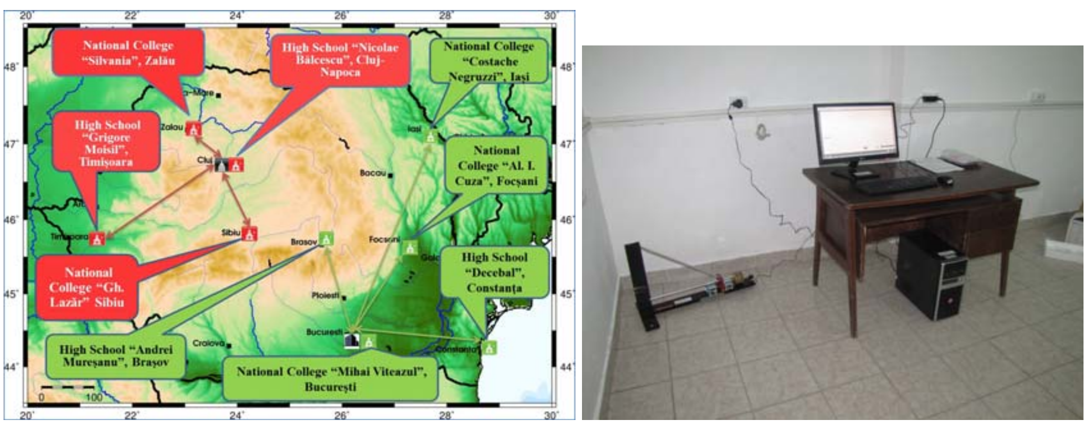


Figure 2. Schools from 9 cities throughout the country are involved in Roeduseis-Net and they are equipped with performance seismographs.

Proposed Teacher's Book and Student notebook include, besides information related to the record, analysis and interpretation of data recorded using dedicated seismometers installed in schools, the development of practical skills to work with seismic waves and other earthquake parameters, also information about:

- maximum seismic intensity possible in their locality, according to official seismic zoning code (students in the upper grades can be informed also about the characteristic effects of each degree, according to the modified intensity scale or MSK scale);

- peculiarities of local geology that may raise some issues (steep slopes and tumble of rocks, landslides, dams upstream or neighboring village, sandy soils or loess, where liquefaction or collapse may occur etc.).
- places from buildings and nearby where there is danger of falling parapets, cornices, chimneys, closets, shelves of books, teaching materials and to be avoided if organized evacuation and subsequent passage along them; specially organized places held for disposal organized in special cases;
- places where they can burst fire or laboratories to be avoided during the critical period; also have participated in the smaller fire and evacuation of material after the earthquake, in an organized manner, under the leadership of teachers;
- that one feels earthquake vibrations of building leading to act and move less freely, creating a state of anxiety, fear sometimes; for these reasons, and from the hazard of accidents from some falling bodies, is recommended staying in the building and avoid being hit by falling structural elements (ornaments, slender cabinets, lamps, teaching material) by sheltering under tables solid benches, beams etc.
- that a collective evacuation on stairs from a storied building, during the earthquake, can put difficult issues agglomeration and falls, worse than the direct effects of the earthquake itself; in practice, although children and adolescents have higher speeds even under the effect of vibrations (0.3-0.5 m/s or 2 steps per second for stairs) the descent coincides with the strongest oscillations, given that the stairs are the component the most dangerous of buildings of any kind; collective evacuation should be considered only after the oscillations, as organized action, if the building shows the damages that would require analysis by specialists;
- type of building school (frames, masonry, new/old type, its height), that normally occur some large oscillations if the structure is flexible, that some walls may crack without showing immediate danger etc.

Knowledge and skills associated with the earthquakes and their effects can be coupled with the teaching of other specialized knowledge as follows:

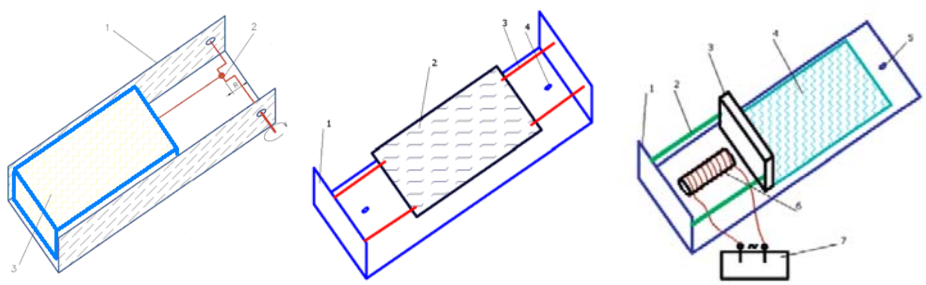
- Problems of seismology, in geography and natural sciences;
- Buildings and oscillation problems, in physics and other technical materials;
- Fire protection problems, in physics, chemistry;
- Issues related to seismic effects on the human body and behavior to earthquake, aid in case of injury, in biology, anatomy, psychology;
- Problems of collective behavior, in psychology, social sciences etc.

EDUCATIONAL DEVICES, DEVELOPED TO FACILITATE AND IMPROVE KNOWLEDGE ON BUILDING OSCILLATIONS WITHIN "EDUCATIONAL SEISMIC NETWORK IN ROMANIA" (ROEDUSEIS-NET)

Some of the teaching materials developed in this project by NIRD URBAN-INCERC team are exemplified further, beeing shown/demonstrated on the fundamental aspects of the building oscillations, their response and type of damage. We choose to make models of simple buildings structures, Fig.3, and seismic simulators, Fig.4, a, b, c and in Fig 5, a and b, in school laboratories or in one of the "Pilot Centers - SeismoLabs" at project partners.

The new proactive approach is that students are the makers of models and simulators, using them to understand the concept and make real observations. Frame models are made of cardboard and infilling walls of polystyrene and may show the fundamental aspects of the buildings oscillations, when shaken. Their response aims especially to understand the behaviour of the slender tall buildings vs. stiff and low structure, deformation of soft-story structures, and to understand the role of bracings and the structural walls.

Figure 3. Simple models of buildings that can be achieved by students



a. b. c.

Figure 4. Models of seismic mini-simulators that can be achieved by students.

Legend:

a. Hand powered cranks mechanism: 1-channel profile of tin; 2-hand powered cranks mechanism; 3-mobile platform of polystyrene, for fixing models, acted by hand crank and rod.

b. Platform and elastic bands/springs: 1- metal profile support; 2- cardboard platform; 3- elastic bands /springs; 4- hole screw fixing device.

c. Mobile platform acted by a ferromagnetic plate: 1- support from material with dielectric properties (plastic, fiberglass etc.); 2- a compression spring; 3- the plate of ferromagnetic material fixed on the movable platform; 4- mobile platform; 5- fixing screw hole device; 6- electromagnet; 7- AC generator.

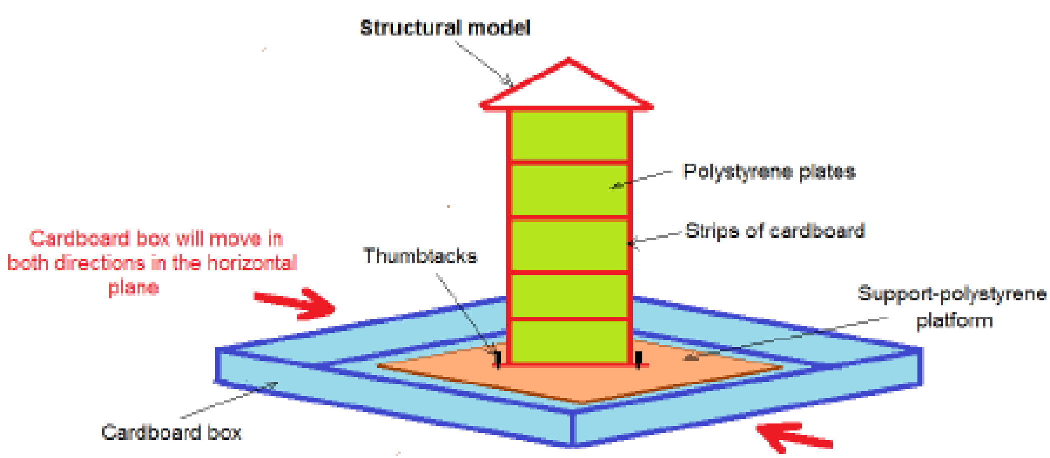


Figure 5. a. Simulator and seismic-resistant structural model, frame with infilling walls

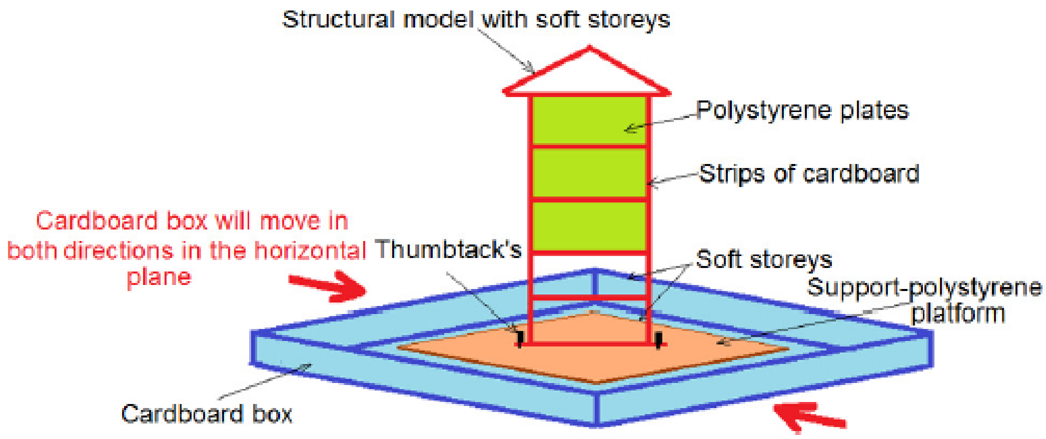


Figure 5. b. Seismic simulator to be made by students and a structural model with soft / weak or flexible story. The frame infilling is removed in the second phase of experiment; Simulator and structural model with flexible floor

CONCLUSIONS

Given the area exposed to strong earthquakes in Romania, the programs and new ways of earthquake awareness and education of students 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. A realistic awareness of potential hazards is critical to motivate preparedness. Perceptions of the incidence of a major seismic event and beliefs about one’s ability to survive and cope with a disaster are linked to an understanding of the nature of a disaster and to levels of preparedness.

The reaction and response to disasters have been more reactive than proactive in almost all disaster prone countries. The trend of increasing worldwide vulnerability to natural hazards can be reversed by providing access to knowledge and technology, increasing the population awareness, and considering the safety measures as the main and key factors. In this context, in most advanced countries, seismic protection is introduced in schools from the earliest ages. However, it must be specified that this action is integrated into a broader context, that safety in schools. The disaster education can play a significant role in developing a culture of disaster reduction in the long term.

In case of Romania, we are now at a crossroad and the proactive attitude and behaviour (anticipative and participative) needs to be extended in learning, within institutional framework, but correlated with the usual targets of schools and teenagers proactive issue (ROEDUSEIS-NET; Page and Page, 2003; Nathe et al, 1999), by encouraging students in activities closer to earthquake engineering.

A critical evaluation of activities in Romania proves that the period 1990-2012 allowed the development of printed materials and seminars in schools, covering a combined preventive and reactive learning, being a close-to-proactive approach, using Japanese mini-simulators.

The ongoing proactive approaches in Romania within the Project Roeduseis-Net and the use of locally made models, for earth and structures, are in line with other European, USA and Japan projects and represent a new paradigm in earthquake education, extending approaches of proactive preparedness by learning, creating building models and making experiments, under Romanian seismic conditions.

After each stage of the project, students realize that almost all territory is strongly seismic and they must cope with this, but they became self-confident because of participation and self-involvement.

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