



## **Promover a continuidade do ensino antes da ocorrência de um sismo** ***Enhancing education continuity before an earthquake strikes***

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**Abstract:** Portugal and Spain are countries prone to earthquake hazard. An earthquake that occurs in the sea may trigger a tsunami threat, so in this case they are also prone to tsunamis. After a disaster, the size and severity of the event, undermines the availability of systems and services to function properly, resulting in losses and impacts in human, social, environmental and economic spheres. One of the potential negative effects for children's education is caused by damaged school buildings and lack of road access to schools. The PERSISTAH project aims to study the seismic risk of primary schools located in the regions of Algarve (Portugal) and Huelva (Spain). The present research has specific objectives: 1) to improve school seismic safety; 2) to protect learners and education workers from death, injury and harm in schools; 3) to safeguard education investments; and 4) to strengthen risk reduction and resilience through education.

**Keywords:** Schools, Rehabilitation, Earthquake safety, Education, DRR

### **1. Introduction**

Disasters, both natural or human-induced, have impacted the education sectors and it is one of the basic services suspended and underfunded in times of crisis and disasters (ECHO, 2019). The largest disruption to schooling in history was due to COVID-19 in 2020-21, and one estimate indicated that 200 million children per year will have their lives disrupted by disasters in 2015-2025 period (Ireland, 2016). The 2008 Sichuan earthquake caused approximately 87000 casualties, out of which almost 19000 were school going children; approximately 7000 of the educational institutions in the area faced complete destruction. The disaster forced almost 5 million people to flee their homes (Ferreira, 2012). Schools play a vital role in the community, as well as on the education, development and well-being of children. A safer school can save children's lives, can be used as temporary shelter after a disaster, and can promote the culture of prevention and mitigation through community activities; Thus, the importance of school in every aspect of disaster cycle.

Portugal and Spain are countries prone to earthquake and tsunami hazards. Public and private schools in these countries, both buildings and their occupants, face high risk from earthquakes due to vulnerable buildings (older school structures may not meet current seismic requirements and standards) and lack of awareness and preparedness.

School vulnerabilities during an earthquake include: i) death and injury of students, teachers, staff from structural collapse or non-structural damage (falling objects); ii) damage to school buildings (structural and non-structural); iii) destruction of school equipment and contents; and iv) disruption of school services, including the capability to provide shelter to affected residents. Finally, we cannot forget that earthquakes and tsunamis cause a multitude of inter-connected impacts, leading several disruptions.



The present paper provides a brief insight into the collected data, key findings, disaster education and lessons have been learned which can and should be applicable to different other earthquake prone cities and countries.

## **2. PERSISTAH achievements**

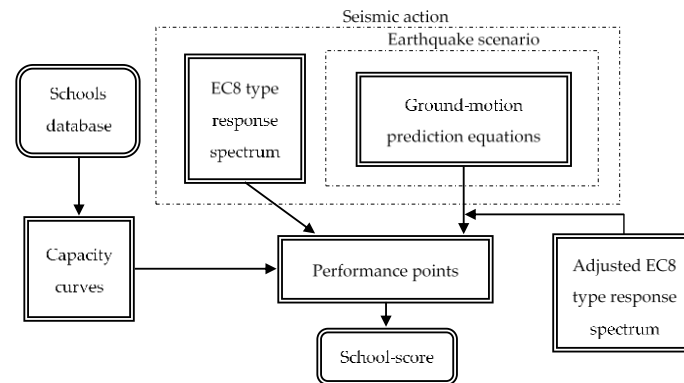
PERSISTAH (Projetos de Escolas Resilientes aos SISMos no Território do Algarve e de Huelva) projects aimed to study the seismic risk of primary schools located in the regions of Algarve (Portugal) and Huelva (Spain), fulfilling the goals of the National Platforms for Disaster Risk Reduction and Civil Protection National Commissions of Portugal and Spain.

### **2.1 To improve school seismic safety**

Seismic vulnerability assessments of 94 primary school buildings existing in Algarve (62) and in Huelva (32) were performed at this stage. A detailed inventory was created, and multiple field visits were conducted, for collecting information about the primary schools, having in mind the specificities of both regions. A software (available in Portuguese, Spanish and English) was developed to manage the seismic safety of schools, composed by three modules: i) management of the school's database; ii) definition of the seismic action to be used; iii) determination of the damage grade and the school-score of each school (a ranking system for the seismic risk of school buildings).

The framework and procedure through which the seismic assessment of school buildings has been conducted is presented in Figure 1. The implemented methodology tried to follow the analysis methods that are presented in Part 3 of Eurocode 8 (EC8) for individual buildings. More than only considering an EC8 type seismic action (a response spectrum), the developed PERSISTAH software also allows to consider an earthquake scenario with different possibilities of geometry sources (point sources, line sources and 3D fault planes) and types of seismic faults (normal, inverse, and strike-slip faults). The use of a code based seismic action (which is the seismic action established in the NP EN 1998-1:2010 for Portugal and the NCSE-02 for Spain) aims to rank the school vulnerability for retrofitting purposes. By the other hand, the hypothesis of selecting a given earthquake scenario is mostly directed for civil protection purposes, but also allows a better understanding about what should be an adequate seismic action for design purposes.

PERSISTAH has so far accomplished seismic retrofitting of two schools (one in Algarve region and another in Huelva region) and developed a manual for rehabilitation, trying to recommend affordable means of strengthening vulnerable schools, taking in consideration the actual differences in the seismic demand of Algarve and Huelva regions, which are quite evident when comparing Portuguese and Spanish national seismic codes.



**Figure 1** – Flowchart of the implemented procedure for the seismic assessment of individual school buildings.

## 2.2 – To protect learners and education workers

There are small steps that an individual can do to reduce his risk in a future earthquake. Identify the non-structural hazards in school and classroom and take protective measures to mitigate the danger of these hazards during an earthquake was one of the PERSISTAH objectives. The “Practical guide for earthquake resilient schools” (Ferreira et al., 2020) was developed to allow teachers and/or school principals to take an active role in the risk management of their schools, stimulating and strengthening the permanent and effective participation of the entire educational community.

## 2.3 – To strengthen risk reduction and resilience through education

By raising awareness in schools, the entire community is aware because the lessons trickle down to parents, relatives, and friends. Training of teachers, parents and students on earthquake preparedness and preparedness planning is of major importance. The project produced an educational guide named “Why does the ground shake?” (Ferreira et al., 2020). It is available in Portuguese, Spanish and English and it aims to help teachers build the knowledge, attitude and practical skills of children regarding earthquake risk reduction. The education material was tested in schools and other learning spaces, such as museums, and feedback received from children and teachers. This material includes engaging activities (ready-to-use, hands-on activities, and lesson plans for teachers, Figure 2) and easy action steps that students will find both fun and effective. During the COVID-19 pandemic lockdown, it was possible to use this educational material, and participate in the Portuguese programme #EstudoEmCasa, aimed at students from the 1st to the 9th grade. The TV program was broadcasted in RTP Memória, RTP Internacional and RTP Play.



**Figure 2** – Courses for primary and secondary school teachers at CEIP Los Llanos (Almonte, Huelva) and Centro de Formação da Ria Formosa (Olhão)



### 3. Conclusions and recommendations

Earthquakes have a major impact on children, youth and education systems, preventing children's access to a quality, basic education. That's why it's so important to create plans for a safer school, for risk reduction and align a disaster risk reduction education (teaching and learning materials). Schools can be built safer and weak schools can be strengthened with concerted effort. When authorities identify hazards and take them into account when planning where and how to build, school grounds become safer. When design teams and construction workers incorporate hazard-resistant techniques in construction, the school building becomes safer. PERSISTAH project did more than just assess school buildings in hazard-prone areas. It also provided guidance and important issues to be considered by different actors:

- Recommend affordable means of strengthening vulnerable schools. The direct beneficiaries of the school retrofitting will be school children, their families, teachers, school authorities, local engineers and construction workers. The indirect beneficiaries are the government and the community as a whole.
- The need to provide training to workers from local construction industries who build schools and residential dwellings.
- The need to raise the level of knowledge among students and school teachers on earthquake as well as other hazards. Prepare disaster education materials for school children, teachers and communities and use them for training and education purposes were an achieved goal.

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