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# SEISMOCODE: A LIFELONG E-LEARNING PLATFORM TO HELP CIVIL ENGINEERS KEEP PACE WITH BUILDING CODES EVOLUTION

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**Abstract.** The harmonization of the Romanian legal framework with its European counterpart, carried out within the preparation of the 2007 accession of the country to the European Union, included, among others, the entire set of national building codes and regulations. This radical change, performed in a rather short interval, had a strong impact on the capacity of civil engineering professionals to assimilate the new norms. The national code for the seismic design of buildings, P100, was completely rewritten and restructured. Its present edition follows closely the structure and content of Eurocode 8, Part I, implementing at the same time, via the Nationally Determined Parameters, results from recent earthquake engineering research performed in Romania. Even though various initiatives were taken for the assimilation of this new code, many of its provisions were still regarded by structural engineers as difficult to understand. This represented a critical situation for a seismic country like Romania. The development of SEISMOCODE, an online lifelong learning platform facilitating the assimilation of the new provisions, came out as an efficient solution. The platform, focused on the seismic design of concrete structures, is built around a body of knowledge that provides basic information on the most relevant parts of the code, as well as on related codes and standards. The platform also includes a Wiki system, several interactive e-learning modules for (self-)evaluation, a multimedia collection and a user's forum. The platform is created in support to lifelong learning programs in civil engineering, as well as an auxiliary tool for graduate and postgraduate university courses.

## 1 INTRODUCTION

In preparation to the 2007 accession of Romania to the EU, a thorough and extensive process of harmonization of the national legal framework with its European counterpart was carried out. The process included, among others, the entire set of Romanian building codes and regulations, which were revised, prior to the accession, over the span of more than one decade. In addition, a large number of European standards, among which the Eurocodes, were adopted as national standards. This radical change, performed in a relatively short interval, had a strong impact on the capacity of the civil engineering community to assimilate the new norms and to implement them in everyday practice. The case of the national code for the seismic design of buildings, P100, is illustrative. Issued in 2006 [1] and revised in 2013 [2], the code underwent substantial changes, being completely rewritten and restructured and following closely, in its new form, the structure and content of Eurocode 8, Part I [3]. The code also implemented results from earthquake engineering research performed in Romania in recent years. Even though various initiatives were taken for the assimilation of this new code, many of its provisions were still regarded by structural engineers as difficult to understand. This represented a critical situation for a seismic country like Romania. The development of SEISMOCODE [4], an online lifelong learning system facilitating the assimilation of the new provisions, came out as an efficient solution.

## 2 PLATFORM STRUCTURE AND IMPLEMENTATION

The SEISMOCODE platform, created in Romania within a recent nationally-funded R&D project, is built around a body of knowledge providing basic information on the seismic design of concrete structures according to the new norms. The platform also includes a Wiki system, several interactive e-learning modules for (self-)evaluation, a multimedia collection and a user forum (Fig. 1).

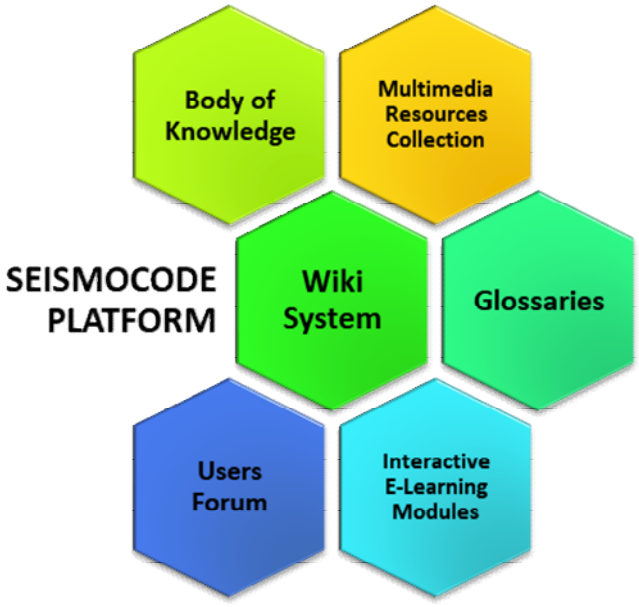


**Figure 1**: Platform components

SEISMOCODE is implemented on the Moodle platform [5], a rich-featured open-source learning management system, largely used worldwide to create online educational environments. Detailed presentations of Moodle features and of their use in higher education can be found in [6] and [7].

## 2.1 The Body of Knowledge

The central part of SEISMOCODE – the *Body of Knowledge* (BK) – is structured according to the logical steps of building design. This type of organization was considered more practical for platform users than the one that would strictly follow the code structure. Implemented by using the *Courses* feature of Moodle, the BK contains 14 sections (courses), as follows (Fig. 2):

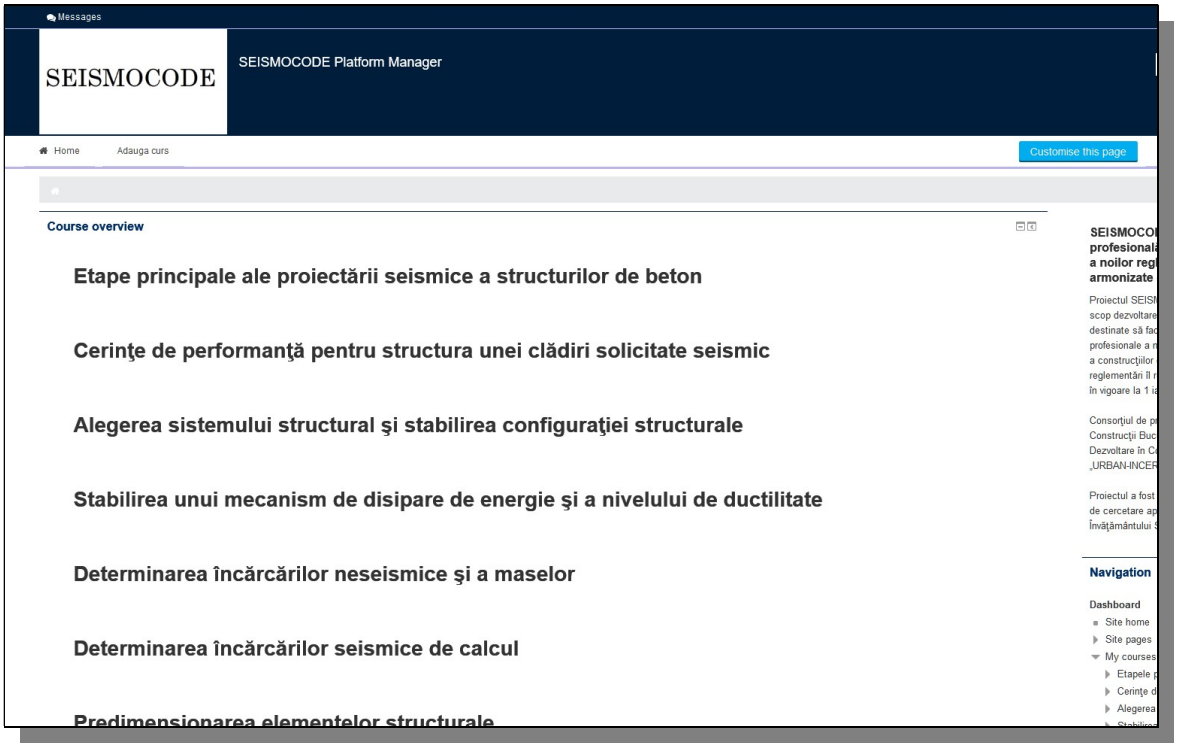


**Figure 2**: Screenshot showing Body of Knowledge sections

1. Main steps of the seismic design of reinforced concrete structures
2. Establishment of performance demands for building structures subjected to seismic loads
3. Selection of the structural system and establishment of the structural configuration
4. Selection of the energy dissipation mechanism and of the ductility level
5. Assessment of non-seismic loads and of masses
6. Assessment of seismic design loads
7. Pre-dimensioning of structural members
8. Structural modelling and analysis
9. Dimensioning and verification of structural members and of the entire structure
10. Design of frame structures

11. Design of shear wall structures
12. Analysis and detailing of floor slabs as horizontal diaphragms
13. Dimensioning of the infrastructure
14. Nonlinear static analysis and nonlinear dynamic analysis

Besides P100 code provisions, the BK also includes references to related norms ([8], [9] etc.) and to commentaries concerning the background of these provisions and their practical use.

## 2.2 The Wiki System

The *Wiki System* (WS) is aimed to bring additional explanations to the topics dealt with in the Body of Knowledge (Fig. 3). The WS, implemented using the *Wiki* feature of the Moodle platform, provides a convenient way to clarify specific aspects without interrupting the basic presentation. In addition, glossaries are provided to specific sections of BK, in order to give short definitions of various notions mentioned in the course. The *Label* feature in Moodle is used as well, in order to create short highlighted notes in the text.

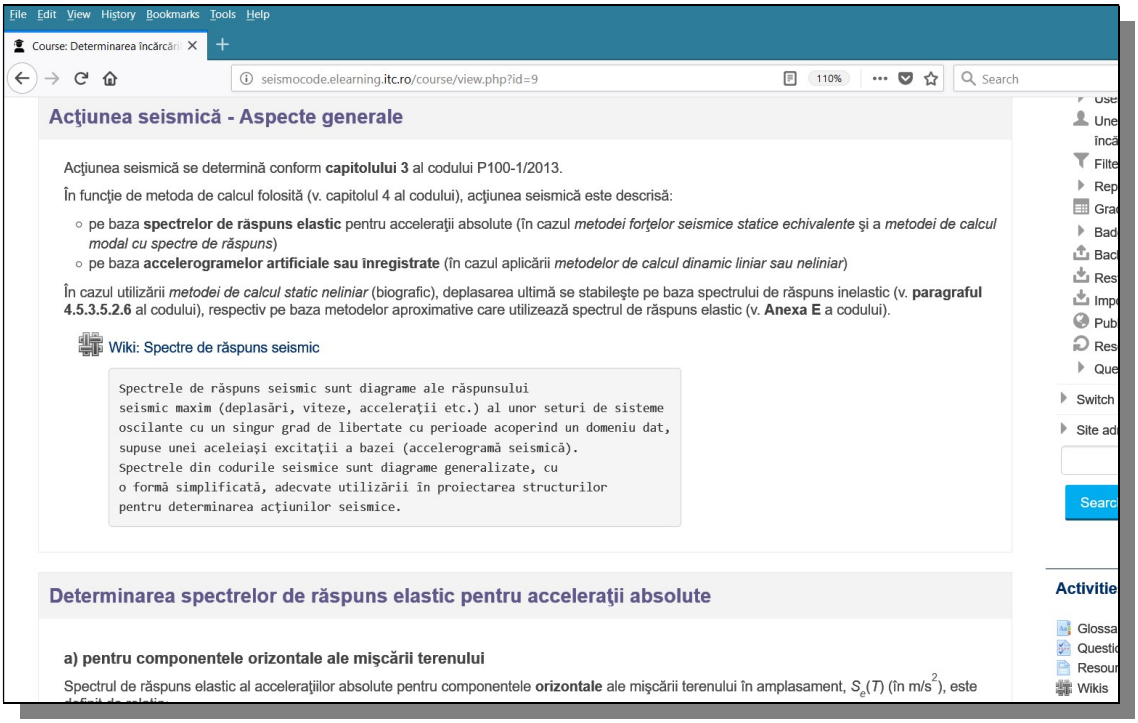


**Figure 3**: A section of the Body of Knowledge, with a Wiki page and a glossary

## 2.2 The Interactive E-Learning Modules

The *Interactive E-Learning Modules* (IELM) include various tools for learning assessment and self-assessment. These are implemented by using the *Questionnaire* and *Quiz* features of the Moodle platform, which allow configuring various types of questions and ways of answering them (Fig. 4). In addition, a COLLES survey [10] was implemented (Fig. 5).

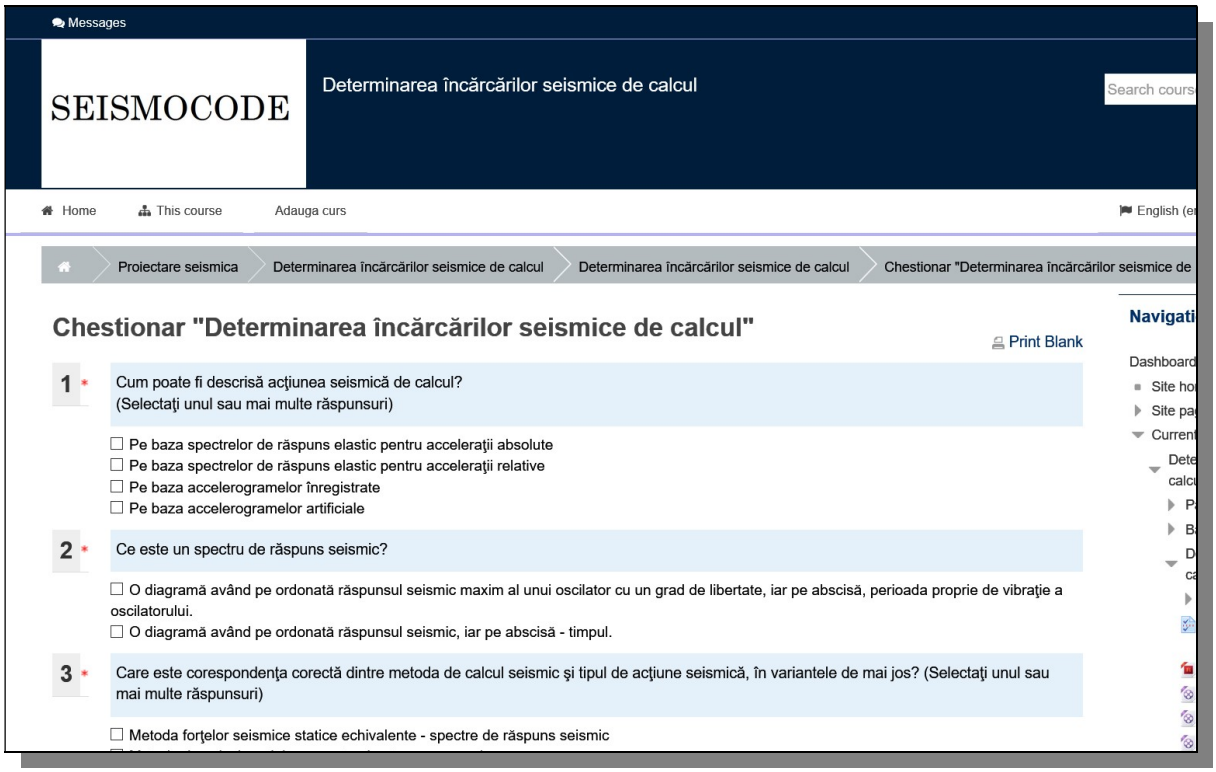


**Figure 4**: Questionnaire on seismic loads assessment

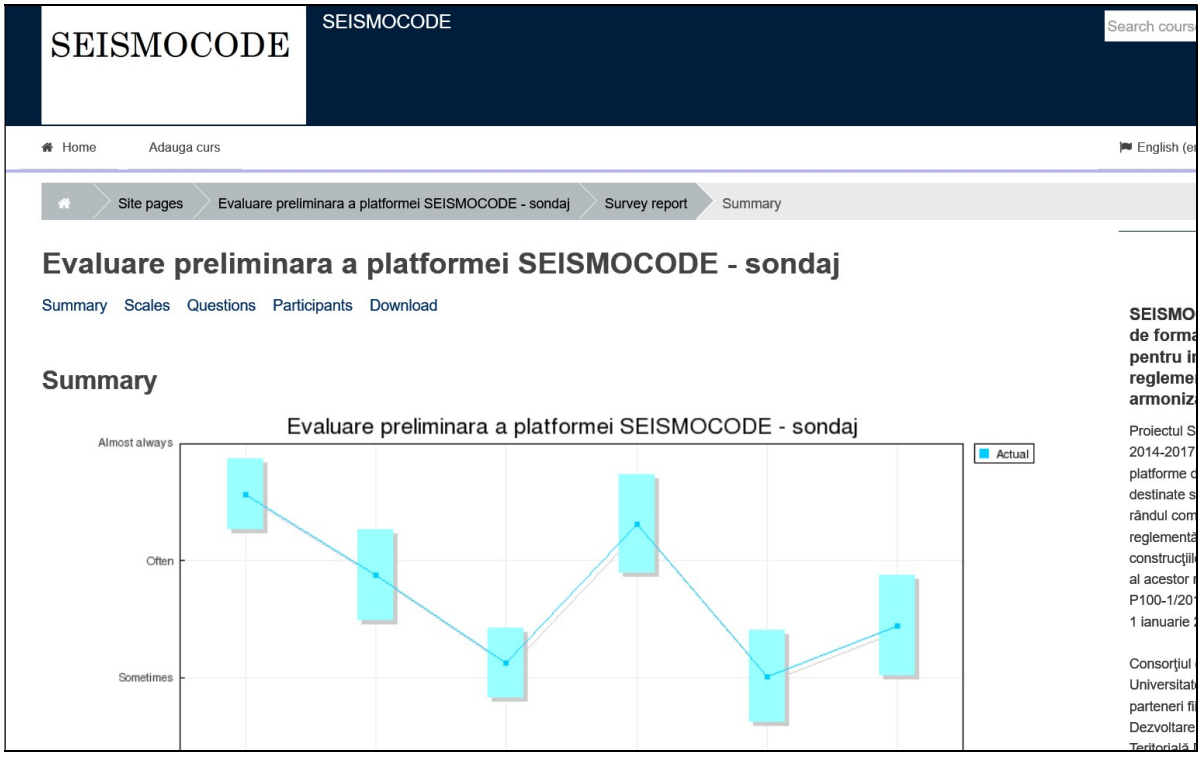


**Figure 5**: COLLES preliminary survey to assess users' opinions

The COLLES survey, part of the users' feedback collection system, focuses on aspects as: relevance, reflection, interactivity, tutor support, peer support and reciprocal interpretation of communications [10]. This type of survey is applicable especially when the platform is used in blended learning environments.

## 2.3 The Multimedia Collection

The SEISMOCODE platform includes a collection of multimedia resources, consisting of a series of presentations focused on relevant topics of seismic design. These are recorded by the members of the project teams, being available either as embedded videos (Fig. 6) or as YouTube videos (Fig. 7). The videos are available in the corresponding sections of the Body of Knowledge and on the platform start page as well.

## 2.4 Other features

A professional discussion forum was also implemented, to allow interaction with users and to provide a more direct way to collect their opinions and potential suggestions concerning the future improvement of platform content and functionality.

The platform can be easily accessed from mobile devices, such as smartphones or tablets, by using the Moodle Mobile application.

More detailed descriptions of particular features and components of the SEISMOCODE platform can be found in [11]…[14].


**Figure 6**: Multimedia resources available in the section "Assessment of seismic design loads"

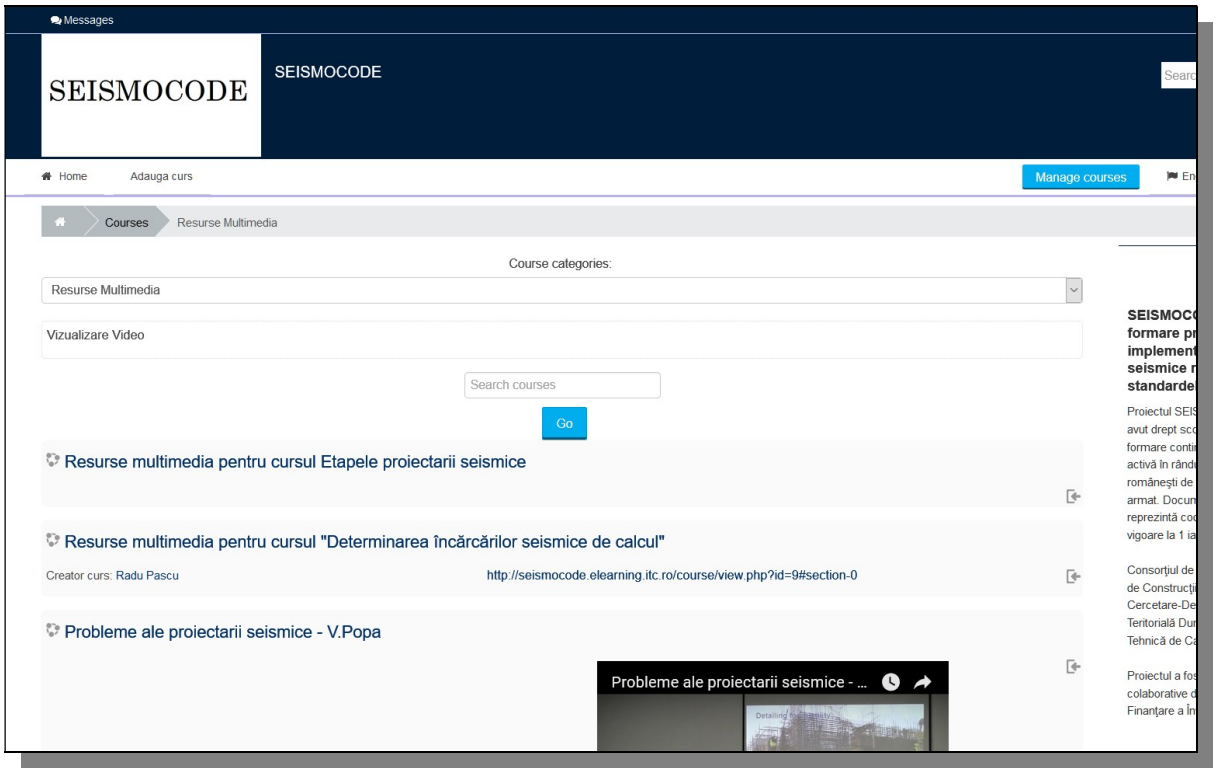


**Figure 7**: Multimedia resources available on platform start page

## 3 CONCLUSIONS

The SEISMOCODE platform was developed in response to the need of facilitating the assimilation of the new European harmonized Romanian seismic code by practicing engineers. In the context of the country's seismicity, the existence of a competent civil engineering community, capable to apply modern seismic design methods, is essential.

The platform was conceived mainly for use in lifelong learning programs, but can represent as well an auxiliary tool for graduate and postgraduate university courses.

## ACKNOWLEDGEMENTS

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