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HABILITATION THESIS
- ABSTRACT -

DYNAMIC BEHAVIOR UNDER SEISMIC ACTIONS OF CONSTRUCTION STRUCTURES WITH CONCEPTUAL AND CONSTRUCTIVE PARTICULARITIES

Assoc. Prof. Dr. Eng. Claudiu-Sorin DRAGOMIR

Faculty of Land Reclamation and Environmental Engineering

University of Agronomic Sciences and Veterinary Medicine of Bucharest

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str. Memorandumului nr. 28, 400114 Cluj-Napoca, România
tel. +40-264-401200, fax +40-264-592055, secretariat tel. +40-264-202209, fax +40-264-202280
www.utcluj.ro

The present work, titled "*Dynamic behavior under seismic actions of construction structures with conceptual and constructive particularities*", emphasizes the professional evolution and the career path of candidate Claudiu-Sorin DRAGOMIR so far, in order to justify obtaining the right to coordinate the activity of PhD level research for the field of civil engineering and installations. The focus is on the activity carried out starting from 2008, the year in which the author defended his doctoral thesis, titled "*The influence of the dynamic amplification phenomenon on the seismic response of masonry constructions*", at the Technical University of Civil Engineering of Bucharest, under the coordination of Prof. Emeritus Dr. Eng. Ramiro SOFRONIE, DHC.

In general, the efforts in didactic and research activity were carried out within the Faculty of Land Reclamation and Environmental Engineering, University of Agronomic Sciences and Veterinary Medicine Bucharest and within the National Institute for Research and Development in Construction, Urbanism and Territorial Development `URBAN-INCERC`.

Through the qualifications obtained by his bachelor's degree, completed by two master's programs, "*Engineering and Environmental Protection in Rural Space*", University of Agronomic Sciences and Veterinary Medicine - 2005, respectively "*Control of noises and vibrations*", „Politehnica" University of Bucharest - 2019, and the doctoral program at Technical University of Civil Engineering of Bucharest, completed in 2008, the author of the thesis attempted to permanently show, through his professional concerns and interests, openness to interdisciplinarity and to the diversity of approaches. Thus, the scientific, professional and academic achievements are materialized in several specific directions, having as a common denominator the information technology and its use in the processing of seismic data, and, respectively, data analysis, in order to emphasize specific characteristics of the studied phenomena.

The habilitation thesis is composed of a first part (I), which presents the author's achievements in each of the directions of the university academic career and the results obtained in the approached scientific field, a second part (II), which presents the plans for the evolution and further development of his career, and a last part containing the bibliography.

The habilitation thesis is conceived as an interdisciplinary scientific essay with value and original contributions finalized with the damage monitoring and detection system that collects data from seismically

monitored buildings, processing and interpreting them in near real time, in order to identify potential changes in dynamic parameters of the buildings, likely to signal the occurrence of damages.

I. The scientific and professional achievements treated in detail in the dedicated chapters within the habilitation thesis

The major amount of the research activity, which contributed to the personal development of the author, is represented by the activity within NIRD „URBAN-INCERC" in the field of earthquake engineering, as a scientific researcher/head of laboratory/head of department/branch manager/CEO. In the field of seismic engineering, the research activity, as well as the development of appropriate technical solutions for construction works, were carried out by the author both within the laboratories of NIRD URBAN-INCERC and those of the Faculty of Land Reclamation and Environmental Engineering within the University of Agronomic Sciences and Veterinary Medicine of Bucharest, where the author of the habilitation thesis is currently an associate professor. The research results were fruitful in the development of his teaching and research professional path.

Chapter 1 EVALUATION OF THE DYNAMIC BEHAVIOR TO SEISMIC LOADS OF MASONRY STRUCTURES begins by informing the requirements of the recent codes that are aligned with the standards of the European Union. The results of the experimental research, carried out by the author based on data provided by major earthquake engineering laboratories in Europe, are then presented.

Chapter 2 IDENTIFICATION AND EFFECT OF GEOMETRIC IRREGULARITIES OF BUILDING STRUCTURES deals first with examples of structural and geometric irregularities from practical cases of building conformation and outlines the conditions for evaluating irregularities according to the seismic design code, P100-1, and the conditions for evaluating irregularities according to Eurocode 8. The simplified analysis technique of the two centers of mass and stiffness, both manually and with the Robot Structural Analysis program is presented. The calculation techniques are exemplified by numerical applications performed by the author on the concrete case of an experimental building model and, finally, the interpretation of the calculation results is commented.

Chapter 3 ASSESSMENT OF THE SEISMIC RESPONSE OF CIVIL BUILDINGS WITH IRREGULAR GEOMETRY refers to L-shaped constructions, such as the former Agronomy students' dormitory, built in 1929 and demolished by implosion in 1997, or the Carlton Hotel, built in 1936 and destroyed by collapse in the earthquake of November 10, 1940. The original idea of this study consists in the reconfiguration of the spatial structure by separating the two aisles of the L after practicing a seismic joint in accordance with the provisions of the seismic design code, P100-1. Different structural systems were taken into account, according to the existing Romanian patents. The results are spectacular and are commented based both on the obtained diagrams and on the analytical results.

Chapter 4 IN SITU INSTRUMENTAL ASSESSMENT WITH SPECIALIZED EQUIPMENT deals with the vibration measurement techniques, the processing of the acquired data with the GeoDAS software and the cross-validation of results, the difficulties dealt with in order to achieve the judicious interpretation of the results being commented on as well. The case study discusses a building with the function of a student dormitory, classified, following its seismic evaluation, in seismic risk class I. Seven retrofitting alternatives were taken into account, all preserving the original design feature, namely the L-shape in plan. In addition, it was highlighted that the application of any retrofitting method from the 7 analyzed involves the evacuation of the building, which is accessed daily by students and teaching staff. For this reason, it was proposed to reconfigure the building by practicing four additional seismic joints and by the execution of some local retrofitting that do not require the evacuation of the building.

Chapter 5 THE CONCEPT, PROCEDURE AND SYSTEM OF MONITORING AND DETECTION OF DAMAGE CAUSED BY THE DYNAMIC SEISMIC REGIME presents the damage monitoring and detection system that acquires data from seismically monitored buildings, processing and interpreting them in near-real time, in order to identify potential changes in the dynamic parameters of the buildings, likely to signal the occurrence of damage. When the critical thresholds of these parameters are exceeded, the system can be configured to issue local warnings (beeps, on-screen notification messages) or remote warnings (e-mail, web service warnings).
To obtain the data that feeds the system, the monitored buildings are instrumented with acceleration sensors (Kinemetrics or GeoSIG devices). The recorded data is transmitted in real time, through dedicated

connections, to the server of the data center of the National Seismic Network for Constructions. The ARTeMIS Modal program (developed by Structural Vibration Solutions, Denmark), intended for operational modal analysis applications, runs continuously on the server. The program is able to automatically detect the appearance of new data on the server, which is provided to the data center following the triggering of the sensors mounted on the buildings. The data are received in real time upon the occurrence of an earthquake or of other vibrations with amplitudes above the trigger threshold of the sensors. These are processed automatically, the dynamic parameters (eigen vibration periods), the eigen vibration forms, the maximum relative displacements between the instrumented levels (drifts), as well as certain specific damage parameters, are calculated. When the critical thresholds are exceeded, the warnings mentioned above are issued. The program can run in several instances, each dedicated to a monitored building. Applications are presented for a pilot seismically instrumented building, located in Bucharest.

II. The career development plan is part of the habilitation thesis and includes all stages of evolution and the necessary requirements for developing and deepening the achievements obtained by the candidate to date. There are mentioned the aimed directions of action, the research intended for the continuation of the already initiated approaches, but also the new areas that the candidate plans to explore, including the doctoral theses that he would supervise.
Finally, the habilitation thesis includes a rich bibliography, consistent with the addressed topic.