HABILITATION THESIS - ABSTRACT

"Bearing structures in architecture. Past, present and future"

The present habilitation thesis synthesizes the most important results of the didactic, research and professional activity of the author in order to obtain the title of doctor engineer, research series C number 0004961, issued by the Order of the Ministry of Education and Research with the number 3876 from 19.05.2004.

The author began his research activity with the elaboration of the diploma work in 1994, under the scientific coordination of Prof. Valeriu Stoian in the domain of anti-seismic design of structures with reinforced concrete walls. The PhD thesis "Contributions to the calculation and conformation of reinforced concrete structural walls" studied the seismic behaviour of reinforced concrete structural walls; it was finalized in 2003 and was publicly defended in 2004.

In 1998, the author started his collaboration with Prof. Dr. H.C. Victor Gioncu, as an assistant within the Faculty of Architecture and Urbanism from Timisoara. Under the scientific coordination of Prof. V. Gioncu, the author performed research, design and didactic activities in the design and consolidation domain of reinforced concrete, steel, masonry and timber bearing structures subjected to different types of actions. Within his studies, the author showed a great deal of interest for the satisfaction of the aesthetical and functional requirements of these bearing structures, based on the newest design, consolidation and execution philosophies. Together with architects Prof. I. Andreescu and Prof. V. Gaivoronschi, with Dr. Eng. A. Anastasiadis and other international collaborators, as well as with colleagues from H.I. STRUCT design office, the author has performed original research studies which later led to theoretical and practical contributions in the design and consolidation domain of bearing structures used in architecture.

Research domains in which the author brought innovative theoretical contributions after the completion of his PhD thesis:

- *Reinforced concrete structural walls.* Personal contributions: explanation of the brittle failure mechanisms developed by the walls with ordered vertical openings based on recordings of the acceleration component and speed of the seismic waves measured in the field and in buildings;
- *Historic masonry bearing structures*. Personal contributions: development of calculation methodologies specific for the failure modes of mosques, synagogues and orthodox churches, within the PROHITECH research program, based on the theory of failure blocks;
- *Reinforced concrete frame structures with masonry infills*. Personal contributions within the INSYSME research program: identification of the failure modes of these structures and the proposal of new technologies for the increase of the bearing capacity of these infill walls subjected to out-of-plane solicitations;
- *Timber framing systems*. Personal contributions within the COST FP1101 research program: identification of new types of timber framing systems, consolidation solutions, in-situ investigations, failure mechanisms and development of a methodology for their vulnerability assessment;
- *Steel bearing structures*. Personal contributions: investigation of the influence of the cyclic loading type and of the loading speed on the local and global ductility of steel frames as well as on the steel elements and connections;

- *Seismic vulnerability of historic centres*. Personal contributions: studies performed on individual buildings and aggregates of buildings from Timisoara;
- *Research and development of new ways of teaching structural design in architectural schools*.

Published articles by the author: 103; 12 in ISI journals, 14 ISI proceedings, having 18 citations in ISI journals and 12 in ISI conferences; 1 published book, co-author for 3 international books, associate editor for 1 international book; 2 courses and 2 practical guides. The author has participated in 3 international research grants, among which 2 as coordinating director for Romania, and in 4 national research grants.

The author will continue to develop research activities in the following domains:

(i) Design of bearing structures:

- Theoretical and experimental analysis of the failure modes, ductility and rigidity developed by steel, reinforced concrete, timber and masonry structures, subjected to seismic actions;
- Experimental and theoretical research for the study of the influence of infill walls on reinforced concrete frame structures, within the INSYSME European research contract;
- Development of a calculation methodology based on rigid failure blocks, for historic orthodox churches from Banat region;
- Theoretical and experimental study of several types of composite or r. c. shear walls with staggered openings;
- Investigation of the influence of the cyclic loading type and of the loading speed on the local and global ductility of steel moment resisting and braced frames;
- Development of new details or structural systems;
- Development of a methodology to implement the ductility verification in practical design and in the corresponding design codes, thus continuing Prof. Gioncu's studies;
- Investigation of the architectural design impact on the structural design of constructions, particularly on the seismic behaviour;

(ii) Assessment and consolidation of historical bearing structures:

- Identification of new consolidation methods and technologies for modern and historic timber, r.c., steel and masonry elements and buildings, using modern materials and techniques;
- Organization of an experimental monitoring program of the behaviour of historic buildings before, during and after the consolidation of their bearing structures;
- Research with the help modern measurement and control techniques of the degradation level of buildings and historic sites with heritage value;

(iii)Vulnerability of historic buildings and historic urban areas:

- Elaboration of a rapid method for the evaluation of the vulnerability of historic masonry and timber bearing structures;
- Elaboration of vulnerability maps for historic buildings and sites, in function of the structural systems, materials used and specific earthquakes for Romania.

Within the Faculty of Architecture and Urbanism from Timisoara, the candidate will continue his collaboration with architects and engineers from didactic and scientific point of view, in regard to the future development of bearing structures which would satisfy the aesthetical and functional requirements of buildings, proposal of new consolidation methods and technologies for buildings classified as monuments, as well as the training process of future architects and engineers. The development plans and future activities of the candidate are presented in more detail in *Chapter (b-ii): Future scientific, professional and academic development plans.*