

A. ABSTRACT

The research activity of the candidate started in November 1997, when he was recruited as Ph.D. student at the Politehnica University of Timisoara under the coordination of Professor Dan Dubina. In 2001 the candidate was also enrolled at the Institut National des Sciences Appliquées de Rennes, France in a co-tutoring Ph.D. thesis. The candidate passed the Ph.D. defence at the Institut National des Sciences Appliquées de Rennes, France in November 2003.

The present thesis summarizes the most important part of the research activity of the candidate after defending the PhD Thesis. The selected activity was considered to be relevant in terms of originality and importance, in order to anticipate an independent development of the further research and teaching career.

The post-doctoral activity is addressed in two main thematic directions developed by the candidate: (i) *Seismic Behaviour of Steel and Concrete Composite Structures* presented in Chapter 2 below and respectively (ii) *Sustainable Development of Buildings*, presented in Chapter 3.

Continuing the main theme of the Ph.D. thesis – *seismic behaviour of composite structures*, the candidate obtained by competition a research grant (name of the grant: “*Numeric and Experimental Study on the Connecting Devices between Steel and Concrete for Composite Buildings*” Located in Seismic Zones) soon after his Ph.D. defence, offered by the Romanian Ministry of Education and covering the seismic *behaviour of connecting devices* between steel and concrete in composite elements. The grant investigated experimentally and then numerically the cyclic behaviour of connecting devices, by variation of different parameters such as type of connectors, loading type, steel profile flange class and concrete class. Since 2010 the research subject was enriched by the study of the connection between steel Rectangular Tubes and concrete through the use of shot nails, by the integration of the candidate in the team of the European project type RFCS “*High Strength Steel in Seismic Resistant Building Frames - HSS-SERF*”. Although the main purpose of the research was focused on the global use of high strength steel in building frames subjected to seismic loads, a particular attention was devoted to the connection between steel column tubes and in-filled concrete. The research was based on an initial experimental program, aiming to evaluate the load introduction within composite columns realized as CFT of high strength steel

Following another subject touched in his Ph.D. thesis, the candidate explored the *dissipative zones in steel and steel and concrete composite frames*. Based on the previous experimental and analytical work, not entirely developed in the Ph.D. thesis, the candidate published several papers on the *ductility of Column Web Panel Zone*, among which two on ISI indexed journals. Other dissipative zones of steel and composite frames included the *joint zones for Moment Resisting Frames (MRF) and link elements in case of Eccentrically Braced Frames (EBF)*. The research was conducted mainly by integration of the candidate into two Romanian research grants: grant PNCDI II “Partnerships”, contract no. 31.042/2007 “*Structural systems and innovative technological solutions for the protection of buildings subjected to extreme actions in the context of sustainable development PROACTEX*” and respectively the grant type CEEEX-ET, module II, contract 1434/27.04.2006: “*Dual steel structures with dissipative removable links for structures located in seismic zones*”. The study concerned experimental and numerical behaviour of dissipative zones in dual MRF+EBF structures. A special attention was paid to the composite aspect.

Following the investigation of the dissipative zones of frames, the *implications on the structural response* were investigated in a series of studies mainly within the same research grants as mentioned before. The structural response in the case of important seismic motions depends directly on the elasto-plastic behaviour of elements and hinges. The numerical

investigation considered elasto-plastic analyses of low and medium height steel frames, considering the interaction of the steel beam with the concrete slab.

Lately, the candidate was integrated in the team of the national grant 55/2012 (PN-II-PT-PCCA-2011-3.2-1303): „*Structural conception and design based on control of the failure mechanism of multi-storey frames subjected to accidental loads (CODEC)*” for the behaviour of composite elements. The project is devoted to the robustness behaviour of steel and composite frames in the case of a column loss. Progressive collapse resistance is a measure of the structural robustness and relies primarily on resistance of key elements, continuity between elements and ductility of elements and their connections. The different nature and intensity of extreme loading events make difficult the development of explicit design requirements for such design situations. A better strategy is to limit the extent of damage in case of such events, so that the progressive collapse is not initiated.

The second subject of research covered by the candidates is related to the ***Sustainable Development of Buildings***. The topic is detailed in Chapter 3 of the present thesis. The subject was developed by the candidate after his integration in the team of the international grant COST C25 (2006-2010) type TUD COST C25 "*Sustainability of Constructions - Integrated Approach to Life-time Structural Engineering*". There are two main themes addressed by the candidate in the topic of sustainable development of buildings: (i) ***approach for new steel-intensive structures*** and respectively (ii) ***sustainable retrofitting solutions for existing building stock***.

The topic of ***sustainable development of steel-intensive buildings*** was achieved through a series of research grants related to the topic: European grant type RFSR (CT-2010-00027) „*Sustainable Building Project in Steel – SB_STEEL*”, industry grant (founded by ARCELOR MITTAL) “*Affordable House*” and recently RFS2 (CT-2013-00016): "*Large Valorisation on Sustainability of Steel Structures – LVS3*". The main purpose of the research was the quantification of environmental impacts, economic and social aspects for steel based structures. The most important direction in the integrated design of new structures is to find a good relation between cost and comfort. A supplementary parameter could be in some cases the erection time. The environmental impact analyses were made with two main purposes: internal analysis for the identification of the main sources of environmental impact and respectively external analysis for comparison with other structural solutions and/or other locations in Europe (SB Steel Project). The main outcomes of the research lead to the publication of five papers in journals (one ISI indexed) and seventeen papers at conferences among which one ISI indexed.

The ***sustainable retrofitting solutions for existing building stock*** represents one of the issues of large interest in Romania: in this moment more than one third of the Romanian population lives in about 84000 block of flats (apartment house type) built between 1960 and 1990 with important issues to be reviewed. The interior repartitioning of concrete residential buildings can improve the comfort of inhabitants. The apartment coupling on horizontal or on vertical can conduct to new internal configurations and can offer new interior space perspectives with implications at a larger scale on the local community, such as the decrease of densification in the urban areas. Structurally, both types of interventions are possible but care should be given at local interventions: (i) when cuts in the vertical diaphragms are performed, these should be reinforced by additional steel frames or concrete jacketing; (ii) if cuts are made on horizontal diaphragms, additional reinforcement near the cut zone is needed.

Another method of improving the overall performance of large precast concrete panel buildings is by overcladding. This solution offers additional space to inhabitants and also an adequate roofing system. Several possibilities of overcladding were investigated by using steel-intensive solutions. The studies were performed within the ERA-NET research grant (3002/2011): "*INSPIRE - Integrated strategies and policy instruments for retrofitting buildings to reduce primary energy use and GHG emissions*" and led to the publication of four journal papers and eight papers presented in conferences.

Directly connected with the research activity, the candidate was taking part in the implementation of Eurocode system in Romania through translation of documents and realisation of National Annexes, process coordinated at the national level by ASRO (Romanian Association of Standardisation) such as Realisation of the national annexes for EN 1994 1-1 , EN 1993-1-4, EN 1993 1-6, EN 1999 Part 1-3, EN 1999-1- 4 and EN 1999-1-5 and translation into Romanian of EN 1993-1-4, EN 1993-1-5 and EN 1999-1-5.

In the same direction it could be noticed that the candidate was directly involved in the realisation of the design guide “*Design of steel structural connections according to SR EN 1993-1-8. Recommendations, comments and design examples*” in a contract with the Ministry of Regional Development (2010) for use of civil engineers and students as well.

Most of the research mentioned above was done in cooperation with the Ph.D. students within the Department of Steel Structures and Structural Mechanics from The Politehnica University of Timisoara.

The candidate is member of the European Convention of Structural Steelwork (ECCS), with activities in two of the Technical Committees (TC):

- ECCS TC11 – Composite Structures;
- ECCS TC14 - Sustainability & Eco-Efficiency of Steel Construction.

It could be noticed that they have identical directions to the main research topics addressed by candidate.

The research activity of the candidate was embodied in a series of books in the fields of composite steel and concrete structures and sustainability of buildings as author, author on chapters or editor. Also, the didactic activity of the candidate is also related to the main research themes described in chapters 2 (Seismic Behaviour of Steel and Concrete Composite Structures) and respectively 3 (Sustainable Development of Buildings): The candidate sustained several invited presentations in workshops for Ph.D. and master level students as well as summer-courses for bachelor students.

The involvement of the candidate in national and international grants as director or team member provided the relevant skills and competences on management of such projects. One important aspect in the further development of the career of the candidate is to build a research team focused in the directions of composite structures and sustainable development of buildings at home university. It is the intention of the candidate to recruit further potential PhD students among the students involved in Master Thesis on the topics similar to those mentioned above. It has to be mentioned that the candidate already guided three doctoral students for obtaining their Ph.D. degree and in this moment is guiding other four Ph.D. students at the Politehnica University of Timisoara.