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SUMMARY OF THE HABILITATION THESIS

Contributions to the analysis and optimization of modern engineering structures in the context of sustainability and new manufacturing technologies

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SUMMARY OF THE HABILITATION THESIS

The habilitation thesis entitled "Contributions to the analysis and optimization of modern engineering structures in the context of sustainability and new manufacturing technologies" presents part of the author's contributions in the field of scientific research disseminated through publications, after presenting the doctoral thesis entitled "Studies and research on the buckling of thin walled cylindrical shells with application to metallic silos" (Supervisor: Prof. dr. eng. Pupăzescu Alexandru) and obtaining the phD title.

The habilitation thesis, written by Associate professor dr. eng. Tănase Maria, has 156 pages, containing 138 bibliographical references (37 of which are written by the author), 87 figures, 23 tables, 27 mathematical formulas. It is structured in two parts: Scientific and professional achievements (chapters 1, 2, 3 and 4) and Career evolution and development plans (chapter 5).

The first section, regarding "Scientific and professional achievements" is divided into four chapters, namely: first chapter which presents the introductive part of the thesis, optimization of thin-walled cylindrical shells structures (chapter 2); evaluation of functional properties of polymeric materials (chapter 3); optimization strategies in additive manufacturing to improve the mechanical and tribological characteristics (chapter 4).

The first research direction, presented in chapter 2, focuses on studying the structural buckling behavior of thin-walled cylindrical shells, frequently encountered in engineering constructions (silos, pipes, tanks). In this chapter, is detailed my own research on the optimization of these structures to increase the buckling resistance (the critical aspect of these types of structures due to their small wall thickness and sensitivity to the presence of geometric imperfections) by various stiffening methods: with metallic ribs, with composite layers (FRP – fiber reinforced polymers) and with corrugated sheets. The influence of these

solutions on the buckling behavior was analyzed, using advanced simulation methods (finite element method), validated with analytical models.

Chapter 3 is dedicated to the assessment of sustainability of modern materials and technologies, in the context of sustainable development. The research mainly focuses on the use of polymer and composite materials in applications where they are exposed to aggressive environmental factors. The behavior of polymer materials such as glass fiber reinforced composites (GFRP) in different exposure environments (humidity, saline and alkaline solutions, variable temperatures) was analyzed, using complex characterization methods, such as XRD, FTIR, TGA analyses, combined with mechanical testing. In this way, structural changes could be correlated with the mechanical properties of composite materials immersed in different aggressive working environments. Also, an important component in this chapter was the assessment of sustainable performance of additive technologies (3D printing), in the context of using recycled materials and energy optimization. Studies have shown that by optimally setting the printing parameters, energy savings can be achieved in 3D printing, and at the same time, proper mechanical properties. Also, the use of recycled materials in 3D printing is an effective solution, obtaining mechanical characteristics close to those of virgin materials, especially if a post-processing heat treatment is also applied.

Chapter 4 focuses on the optimization of additive manufacturing processes in order to improve the mechanical and tribological performance of parts. Common polymer materials such as PLA, ABS, as well as carbon fiber reinforced ABS CF and PET CF were analyzed. The mechanical behavior of 3D printed parts obtained from a combination of materials with different properties (PACF and PETG), in different proportions, was also studied. Research has shown that process parameters such as printing temperature, layer thickness, deposition pattern and filling degree significantly influence the tribological behavior (friction coefficient, wear) and mechanical strength of parts obtained through additive technology. In each study, an optimization of the input parameters (printing or post-

processing parameters) was performed in order to maximize the mechanical or tribological performance of parts made from different materials, based on a statistical analysis.

The second section of the habilitation thesis - "Career evolution and development plans" - highlights the education and training part, teaching and research activity, as well as evolution and development plans of the author.

In 2009, I graduated from the Faculty of Mechanical and Electrical Engineering, specializing in Economical Engineering in the Mechanical Field, at Petroleum-Gas University of Ploiești. In 2011, I graduated from the master's program "Modern Methods for Designing and Manufacturing Petrochemical and Refining Equipment", also at the Faculty of Mechanical and Electrical Engineering, and in December 2015, I defended my doctoral thesis at Petroleum - Gas University of Ploiești (field of Mechanical Engineering), obtaining the title of Doctor according to the Order of the Minister of Education and Research no. 3209/23.02.2016.

Since 2016, when I occupied, through competition, the position of university assistant in Department of Mechanical Engineering, I have completed all teaching degrees: Assistant Professor (between 2017-2025), Associate professor (since February 2025).

The teaching activity focused mainly on disciplines in the field of Mechanical Engineering: Mechanics and Strength of Materials.

After the development and publication of the doctoral thesis entitled “Studies and research on the buckling of thin walled cylindrical shells with application to metallic silos”; my research activity materialized through the publication of 55 ISI/SCOPUS indexed scientific articles (in most of them I was the first author or corresponding author and most of them are WOS Q1 and Q2 ranks), participation in 10 national and international conferences, publication of 5 books by prestigious international publishers (2 as first author, 3 as co-author), publication of 5 chapters in books by prestigious international publishers (1 as first author, 4 as co-author), publication by the publishing house of Petroleum- Gas University of Ploiești of a laboratory manual (co-author), two books of problem sets (first

author) as well as a course support for the discipline of Mechanics (unique author). The published works cover various fields within mechanical engineering such as process optimization and structural analysis.

I participated in interdisciplinary projects such as INNOPIPES - Innovative nondestructive testing and advanced composite repair of pipelines with volumetric surface defects″, Hybrid system for energetic efficiency using geothermal energy applied in UPG Ploiesti campus, Corrosion engineering and pipeline corrosion protection.

I have been involved in academic and research networks with universities in Europe, by collaborating in research projects, as well as by writing scientific articles such as: Lvov, G.; **Tănase, M**. Numerical Modeling of Plasticity in Metal Matrix Fiber Composites. Applied Sciences 2024, /Lvov, G.; Pupazescu, A.; Beschetnikov, D.; **Zaharia, M.** Buckling Analysis of a Thin-Walled Cylindrical Shell Strengthened by Fiber - Reinforced Polymers. MATERIALE PLASTICE 2015., /**Tănase, M.;** Diniță, A.; Lvov, G.; Portoacă, A.I. Experimental Determination of Circumferential Mechanical Properties of GFRP Pipes Using the Split-Disk Method: Evaluating the Impact of Aggressive Environments, Applied Sciences 2024.

I am reviewer for various international prestigious journals such as Processes, Applied Sciences, Machines, Sustainability, Buildings, Agriculture, etc. I am also the academic editor for three special issues in journals Polymers, Machines, Journal of Manufacturing and Materials Processing.

In 2023, at the Research Gala organized by Petroleum- Gas University of Ploiești, I was nominated in the "Young Researcher" category, and in 2024 I was awarded the distinction of "Young Researcher", "Cumulative Impact Factor", and "Most Cited Article" (together with the research team), categories and I was also nominated for "Woman Researcher" and "Cumulative AIS" categories.

I participated annually with students in student scientific sessions, as well as in the national phase of the National Mechanics Competition ''Andrei G. Ioachimescu'', where I also participated as a student and where I obtained the first mention (in 2007).

I was part of the supervision committee of several PhD students, actively contributing both to the orientation and coordination of their research activity, and to the writing and publication of scientific articles resulting from these collaborations. My involvement aimed at defining research directions, optimizing experimental methodologies and rigorous interpretation of results, thus ensuring a solid scientific framework for the professional development of researchers. The close collaboration with PhD students resulted in the publication of specialized works in prestigious journals.

The strategic directions of professional development aim, first of all, to consolidate the teaching activity and support the training of students. As regards the coordination of the bachelor's/master/doctoral theses, I propose to continue choosing applied themes, with relevance for the industry, in order to stimulate collaboration with companies producing petroleum equipment and to facilitate the professional integration of graduates. The relationship with students is based on active involvement, support in the learning process and orientation according to skills towards academic, research or industrial careers. I also intend to contribute to the internationalization of the educational process by developing books and laboratory guides in foreign languages, but also by integrating teaching and research activities, in order to increase the quality of the educational act.

Scientifically, I will focus on developing a solid and continuous research activity, focused on projects funded through grants or contracts in partnership with public institutions and industrial partners. I will pursue the involvement of students, master's and doctoral students in these projects, as a form of advanced professional training. Priority will also be given to increasing the scientific impact by publishing results in ISI indexed journals and constant participation in international conferences. I will continue research in the field of numerical analysis and advanced technologies, including in the field of additive

technologies and their applications in industry. Attracting funding through interdisciplinary projects at national and international levels remains a constant objective, as well as expanding research capacity by developing the laboratory infrastructure and the material base within the Department of Mechanical Engineering.

In order to increase academic visibility, I propose to consolidate existing relationships and initiate new collaborations with universities and research institutes in the country and abroad. I will continue to participate in experience exchanges and initiate scientific events, such as conferences and thematic workshops organized within the university, with the aim of strengthening the reputation of the institution and encouraging interdisciplinary scientific dialogue.

The activity carried out over the years in the academic and research environment at Petroleum- Gas University of Ploiești has provided me with solid training and an in-depth perspective, which allow me to provide adequate scientific and methodological support to doctoral students throughout the entire process of developing their doctoral theses.

The habilitation thesis reflects a complex and coherent activity, with high practical applicability and relevant contributions in the field of mechanical engineering, by integrating structural, environmental and manufacturing aspects, in a sustainable and multidisciplinary vision.