Transilvania University of Brasov

HABILITATION THESIS
SUMMARY

Title: MULTIDISCIPLINARY RESEARCH IN MECHANICAL ENGINEERING

Domain: MECHANICAL ENGINEERING

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University: TRANSILVANIA OF BRAȘOV

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Acknowledgements

Braşov,   Lecturer. eng. Gabriel NĂSTASE PhD

List of notations

R_{cw} thermal resistance of double skin façade curtain wall;

$U_{cw,1}$ overall heat transfer coefficient of inner envelope;

$U_{cw,2}$ overall heat transfer coefficient of outer envelope;

R_{si}, R_{se} superficial heat transfer resistance from inside and outside;

R_s heat transfer resistance of ventilated or unventilated air layer between inner and outer envelope;

Q_i heat transfer rate to inner surface on inner envelope;

Q_{gi} heat transfer rate through inner glass pane of inner envelope;

Q_b heat transfer rate of argon layer between inner envelope glass panes;

Q_{ge} heat transfer rate through outer glass pane of inner envelope;

Q_{cav} heat transfer rate of air layer inside cavity between inner and outer envelope;

Q_{ss} heat transfer rate through secure glass pane of outer envelope;

Q_e heat transfer rate to outer surface on inner envelope;

A frontal area of box double skin façade;

h_{ri} radiation heat-transfer coefficient for inner surface of inner envelope;

h_{re} radiation heat-transfer coefficient for outer surface of outer envelope;

h_{rb} radiation heat-transfer coefficient for flow between interior window panes;

h_{cav} radiation heat-transfer coefficient for flow between interior and exterior envelope;

h_{ci} convection heat-transfer coefficient for inner surface of inner envelope;

h_{ce} convective heat-transfer coefficient for outer surface of outer envelope;

h_{cb} convective heat-transfer coefficient for flow between interior window panes;

h_{ccav} convective heat-transfer coefficient for flow between interior and exterior envelope;

T_i air temperature inside experimental room;

T_e air temperature outside box double skin façade;

T_1 temperature of inner surface of inner window pane;

T_2 temperature of outer surface of inner window pane;

T_3 temperature of inner surface of outer window pane;

T_4 temperature of outer surface of outer window pane;

T_5 temperature of inner surface of secure glass pane;

T_6 temperature of outer surface of secure glass pane;

R_a Rayleigh number for argon layer inside double pane interior window;

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R_{acav} Rayleigh number for air layer inside box double skin façade cavity;

σ Stefan-Boltzmann constant;

ε glass emissivity;

β bulk expansion coefficient;

g   gravitational acceleration;

H   height of box double skin façade;

L   distance between the two panes of interior window, in mm;

L'   distance between the two envelopes, in mm;

$\nu_{argon/air}$ kinematic viscosity of between-panes gas (argon/air);

$a_{argon/air}$ thermal diffusivity of between-panes gas (argon/air);

$k_{b/cav}$ thermal conductivity of between-panes gas (argon/air);

AR   aspect ratio, H/L;

Nu_b Nusselt number value for argon layer inside double pane window;

Nu_{cav} Nusselt number value for air layer inside box double skin façade cavity;

Pr   Prandtl number;

U   overall heat transfer coefficient for box double skin façade;

R_i interior heat transfer resistance;

R_b heat transfer resistance for argon layer;

R_{cav} heat transfer resistance for air layer;

R_e exterior heat transfer resistance;

$\delta_{gi/ge/ss}$ interior/exterior/secure glass thickness;

List of abbreviations

ISI	International Scientific Indexing;
UNITBV	Universitatea Transilvania din Braşov (Transilvania University of Brasov);
HVAC	Heating, Ventialtion and Air Conditioning;
EU	European Union;
RES	Renewable Energy Sources;
DMSO	Dimethyl Sulfoxide;
MRI	Magnetic Resonance Imaging;
MAGLEV	Magnetic Levitation;
ANRE	Romanian Regulatory Authority for Energy;
INCERC	National Institute of Research and Development in Construction and Economics of Constructions (Institutul Naţional de Cercetare - Dezvoltare în Construcţii şi Economia Construcţiilor)
BMS	Building Management System
EN	European Norm
ISO	International Standard Organisation
EN ISO	European Norm adopted after a ISO Standard
GMT	Greenwich Mean Time
B-DSF	Box Double-Skin Façade
EC	European Comission
HP	Horse Power
RPM	Rotations Per Minute
RES-E	Renewable Electricity Standard for Europe
UK	United Kingdom
LHC	Large Hidron Colider
TBO	Toluine Blue
3D	Three dimensional
IAQ	Indoor Air Quality
PVC	PolyVinyl Chloride
TBL	Team Based Learning
ICT	Information and Communication Teaching
CAE	Computer Aided Engineering

Summary (4000-6000 characters)

Habilitation Thesis "Multidisciplinary research in Mechanical Engineering" presents the main scientific, professional and research activities that I have carried out since the completion of the PhD thesis in the field of Mechanical Engineering, in 2014 (series J, Ministry No 0000837, based on the Order of the Minister of Education and Research No. 3181 of 06.02.2015), and to this day, highlighting also the work carried out since the obtaining of the title of Lecturer (2015) until now.

From the beginning of my university career to the present I have carried out the mentioned activities on Transilvania University of Brasov, at the Faculty of Civil Engineering, the Department of Building Services, initially occupying the position of Assistant.

This paper is structured in 5 chapters and a bibliography in which the scientific achievements are presented.

The first chapter is dedicated to the summary in Romanian, the second chapter being the summary in English. In the third chapter are presented briefly the scientific and professional achievements and the career development plans. The next two chapters represent a continuation of the previous chapter, in chapter four are detailed scientific and professional achievements, and in chapter five are presented the plans for evolution and development of the career. The last part of this paper is dedicated to bibliographic references.

My teaching and research activity has centered over time in the field of my doctoral dissertation, especially in the field of promoting renewable energies and energy efficiency in the built environment. More recently, after obtaining the title of Lecturer, didactic and research activity was extended. The didactic activity was enriched with a Master's course, *Modern Materials and Technologies Used in the Built Environment*. Research has also been extended to renewable energy, where I have already published two ISI articles in the *Renewable and Sustainable Energy Reviews* journal, with an impact factor of 8,050, one showing the wind energy situation in Romania, and one about the Hydroelectric power in our country, from its beginnings to the present. The research activity has also been directed towards the application of refrigeration facilities in comfort air conditioning for buildings, cooling installations using radiation energy transmission systems, analysis of energy performance of building elements and promotion and application of new teaching methods. Of course, I also prepared many ISI articles that are in review and others have already been published in ISI indexed conferences. The most recent research activity that I do is related to the application of knowledge of cold and cryogenics in Bioengineering. In

respect to this matter, I had a postdoctoral appoinment at California University, Berkeley, USA, where I was involved in researching and developing a system for the conservation of biological matter at temperatures below zero degrees at constant volume, and researching and developing a 3D printer for printing tissues in liquid nitrogen and in cold liquid at +4°C. Some of my research on the constant volume cryoconservation system has already been published in some ISI articles, in various renowned journals (*International Communications in Heat and Mass Transfer, Biochemical Biophysical Research Communication, Peer J, PLoS One*), and some are also presented in this habilitation thesis.

Over the years I have published as the first author, co-author and co-author, more than 50 articles and 6 books, of which 3 as first author and 3 as co-author.

The relevance of scientific work and the recognition of national and international activity in the field of Mechanical Engineering are underlined by my publications, many of them in collaboration with recognized researchers from the country, Europe or the United States. The real value of studies and research projects is highlighted by the fact that all problems have been investigated both through a theoretical approach with numerical simulations and experimental, that confirms the theoretical results.

Motivated by an interest in developing more efficient and economical building services, innovative 3D printing methods and long-term organ and tissue preservation systems I want explore deeper all these research fileds from my PhD Supervisor.

I am a member in various organizations, prestigious professional associations, national and international, belonging to organizations in the field of education and research.

Raising standards of academic excellence will be constantly pursued and promoted in the great family of our university: students, teachers, researchers and support staff, actively involved me all initiatives to increase the importance and visibility of the University staff.

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