

R E V I E W

of a PhD thesis for obtaining an educational and scientific degree "Doctor"

PhD student: eng. Milena Biserova Haralampieva

Title of the PhD thesis: Intelligent management of thermal energy saving systems

Domain of high education: 5. Technical sciences, **Professional field of study:** 5.2. Electrical engineering, electronics and automation

Doctoral program: Automated information processing and management systems

Member of the jury: Prof. DSc Ivo Malakov, TU – Sofia, IICT director order № 26/31.01.2022

The presented thesis contains 125 pages and is structured in 4 chapters, conclusion, contributions, list of publications related to the thesis, bibliography and declaration of originality. The bibliography contains 61 literature sources. Six publications in connection with the dissertation were presented, and one of them is in collection of reports indexed in SCOPUS reference database. The other publications are presented at scientific conferences in our country. One of the publications is independent, and in the other two the PhD student is in first place. It has not been given proves for citations. A declaration was presented by MARTMAX Ltd. that the thesis results are of interest to the company.

The work was developed at IICT - BAS under the scientific guidance of Prof. Dr. Dimitar Nedelchev Karastoyanov.

1. Relevance of the problems developed in the PhD thesis in scientific and scientific-applied terms

The PhD thesis is in a promising and current field of development of systems for intelligent management of heat storage sources in modern construction, which has been the subject of intensive research in recent years. These systems are a key element of the complex "smart building" system and largely determine its efficiency.

The approaches, used for heat storage, based on phase change of materials, and the innovative combined system for heat storage and heat supply in a building developed on its basis, enrich and further develop the knowledge and methods for solving problems in the field, lead to improvement. the comfort of the users of these buildings and at the same time minimize the operating costs and the impact on the environment.

All this determines the relevance and importance of research in scientific and applied terms.

2. Degree of knowledge of the state of the problem and the literary material and creative interpretation of the literary material

An overview and systematization of the main types of energy sources has been made. Existing methods for energy storage are analyzed and their characteristic features are determined. A special place is given to the analysis of known technological solutions for the use of solar energy as a source of heat to be used for domestic purposes: heating, domestic hot water.

I believe that the candidate is well acquainted with the current situation in the field.

3. Correspondence of the chosen research methodology and the set goal and tasks with the achieved contributions

A combined system for thermal energy storage and heat supply in a building has been developed and researched in the PhD thesis. From the presented works it can be concluded that the chosen research methodology is adequate to the set goal and objectives of the PhD thesis, which fully correspond to the achieved results and contributions.

4. PhD thesis characteristics and evaluation

The PhD thesis demonstrates good knowledge of the problems and technological features of the components of building heating installations using solar energy, as well as methods for their development and research. On this basis, the PhD student has designed a combined building heating system using solar energy storage with built-in intelligent control and monitoring system based on temperature and sunshine, and calculated the performance of the system and its individual components. The proposed innovative system, including a storage tank with phase-changing material, is able to provide partial independence from the central electricity distribution system. An analysis has been made and the economic efficiency of the developed system has been proven on the basis of a comparison of costs in the presence and absence of a storage tank with phase-changing material.

I appreciate the results of the development and their research.

5. Scientific and scientific-applied contributions of the PhD thesis

The candidate has submitted a report with contributions that are scientifically applied and applied. I consider these contributions to be sufficient, but they need to be systematized, edited and refined. They prove that the applicant can independently perform research in the field of the use of renewable energy for practical purposes.

The received scientific-applied and applied contributions can be referred to the groups: proving with new means of essential new aspects of already existing scientific fields, problems, theories, hypotheses; creation of new methods, constructions, technologies and obtaining of confirmatory facts, as well as enrichment of the existing knowledge with practical application.

6. Assessment of personal participation degree in the PhD thesis contributions

The PhD thesis and its contributions are the personal work of the PhD student under the competent guidance of his supervisor.

7. Evaluation of PhD thesis publications

Six publications were made in connection with the PhD thesis and one of them is independent. I have no information about citations or use of PhD thesis results in practice.

The presented publications in accordance with the PhD thesis sufficiently fully and accurately reflect significant aspects of its content and promote the research.

8. Significance of the PhD thesis results in science and practice

The results of the PhD thesis can be used in the modern buildings design with built-in intelligent control systems for heat storage sources. They are a good prerequisite for expanding research in the field after the successful defense of the PhD thesis. A good attestation for the PhD thesis is the declaration presented by MARTMAX Ltd. that the achieved results are of interest to the company and will be used in its activities.

9. Opinions, recommendations and remarks

The research area is current and promising. I have no significant remarks to challenge the main scientific and applied contributions of the candidate.

Notes and recommendations:

- There are unresolved editorial, terminological and technical mistakes. The text in tables, graphs, figures, etc. is desirable to be only in Bulgarian.
- Not all literature sources are cited in the text; the bibliographic reference is not prepared according to the current standards, etc.
- I recommend the PhD student to look for opportunities to implement the results in practice and increase the number of independent publications.

CONCLUSION

Based on my acquaintance with the PhD thesis and the related materials, the fulfilled educational goal of the doctoral studies, the topicality and significance of the achieved scientific and applied contributions, I give a **POSITIVE** assessment of the PhD thesis. All the requirements of the LDASRB, the regulations for its application, as well as the specific requirements for obtaining scientific degrees in IICT-BAS in terms of scope, volume and quality of the PhD thesis are fulfilled.

Based on this, I recommend eng. Milena Biserova Haralampieva to be awarded the educational and scientific degree "Doctor" in the scientific domain 5. Technical sciences, professional field of study: 5.2. Electrical engineering, electronics and automation, doctoral program: Automated information processing and management systems.

Sofia, 22.03.2022

НА ОСНОВАНИЕ

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