

REVIEW

by Assoc. Prof. Dr. Dimitar Petkov Dimitrov

Member of the Scientific Jury for the award of the "Doctor of Philosophy" (PhD) degree, approved by Order No. 116/27. 05. 2020 of the Director of the Institute of Oceanology at the Bulgarian Academy of Sciences (IO- BAS), on a Doctoral thesis on

"Floating Caisson Type Pneumo-Structure",

presented by PhD student, engineer Gencho Dinev Georgiev

for the acquisition of the educational and scientific degree "Doctor of Philosophy" (PhD) in Higher education area: 4. Natural sciences, mathematics and informatics, Professional area: 4.4. Earth Sciences, Doctoral Program in Oceanology, with scientific consultant

Prof. Dr. Atanas Vasilev Palazov

Introduction

Eng. Gencho Dinev Georgiev is enrolled in a doctoral program of independent preparation with a term of study until March 31, 2020. The doctoral student has fully completed the program of the individual scientific teaching activity. He was awarded the right to defense by a decision of the Scientific Council of IO-BAS (Protocol № 5 item 6 of 19. 05. 2020) on the basis of a preliminary defense of an extended department seminar of the department "Ocean Technologies" Protocol of 24. 03. 2020).

The PhD student has presented all the necessary documents on the procedure and a list of scientific publications on the topic of the dissertation.

The PhD candidate fully meets the minimum national requirements and the requirements of IO-BAS.

He graduated from the Moscow State University of Civil Engineering with a degree in Hydrotechnical Construction of Waterways and Ports and in 1982 received a master's degree. From May 1983 to April 1996 he worked at the IO-BAS as a research associate in the field - New facilities for waterways, ports and shore protection. Over the years he has worked in various institutions and ministries, which supports his scientific development in the field of maritime construction as an expert. He participated in the design of ports and hydrotechnical facilities on the Bulgarian Black Sea coast (800 completed projects in the field of hydrotechnical facilities and constructions). Since February 2011 he has been working in the

Ministry of Transport, Information Technology and Communications of Republic of Bulgaria as a Chief Expert, in the "Concessions" Department.

General characteristics of the thesis

The dissertation was developed within the framework of an external doctoral dissertation in the department "Ocean Technologies" at the Institute of Oceanology - BAS. The presented dissertation has a volume of 118 pages of text, contains 4 chapters, 60 figures, 3 tables and 1 appendix. The list of cited literature includes 70 titles.

The requirements regarding the structuring of the dissertation are met according to the rules of IO-BAS.

The dissertation presents the results from the development of a new type of floating pneumatic structure, applicable in hydrotechnical engineering of the construction of gravitational facilities subjected to high loads in the aquatic environment, on virtually any type of ground in shallow and deep water areas.

The first chapter (literature review) discusses the advantages and disadvantages as well as the state of modern hydrotechnical constructions based on literature data from scientists from different countries. The indisputable advantages of a new type of caisson with pneumatic support are shown.

The second chapter (goals and objectives of the research) sets out the goals and objectives of the present research and is briefly summarized as:

1. Determining the draft, water displacement and the margin of navigability depending on the size of the air column in the inner chambers of the caisson;
2. Determining the dependence of the water displacement from the height of the air column in the inner chambers;
3. Obtaining the curve of the centers of values of the caisson;
4. Studying of the buoyancy and stability of the caisson in wave conditions;
5. Theoretical studies of the buoyancy and resistance of the caisson to wave conditions;
6. Calculation of the acting forces and the allowable conditions for getting solution;
7. Determination of the initial stability;
8. Dimensioning of the stability at large angles of roll;
9. Model hydrodynamic tests of floating caisson type pneumatic construction;
10. Determination of static stability;
11. Towing tests on still water;
12. Seaworthy tests of a floating caisson model.

The theoretical and experimental study of the characteristics of the floating caisson of a new type of pneumatic construction makes it possible to justify its applicability in hydrotechnical engineering, analyzing its advantages and disadvantages compared to existing and used constructions.

In the third chapter (materials and methods) are made a description of the construction of the new floating caisson, interaction with marine sediments in contour hydrotechnical facilities, as well as a methodology for determining the main elements of the caisson.

In the fourth chapter (results) the results are grouped into three main groups - theoretical studies of the buoyancy and stability of the caisson, studies of the buoyancy and resistance of the caisson to waves and model hydrodynamic tests of a floating caisson type pneumatic structure. The achieved results, supported by calculations and models, show the author's in-depth research on the topic.

Basic scientific and applied scientific contributions

The main achievements in the dissertation of Eng. Gencho Dinev Georgiev are expressed in the design and development of a new type of caisson - floating pneumatic construction, which is a novelty in hydrotechnical engineering and has no analogue in world hydrotechnical theory and practice. The doctoral student has formulated them in five contributions as follows:

1. A new type of caisson is proposed - a floating pneumatic structure, which is a novelty in hydro engineering construction and has no analogue in the world hydro-technical theory and practice. The structure is applicable in hydro-engineering for the construction of gravitational facilities subjected to high loads in aquatic environment, on virtually any type of ground in shallow and deep water areas. It was protected by a patent (Caisson - invention with copyright № 44643 / 08.07.1985, patented in Bulgaria with patent № 1147, the Netherlands with patent № 8 701 423, France with patent № 2 616 464, Finland with patent № 890047, Singapore (China) with patent № 89100199.9 and Russia with patent № 7774529/03).

2. A method had been developed for the installation of a caisson pneumatic structure (invention with copyright certificate № 91624, 1990), in which by means of back pressure / vacuum / in selected or all working closed only from above and in contact with the ground medium chambers of caisson, the main contour of the caisson is incised to the desired or limit value into the ground. With a balance and long-term action of the raised and retained water

volume, the ground base under the main contour of the caisson is consolidated and with vertical loads significantly exceeding the operational ones, the ground base under the main contour of the caisson is prestressed, if subsequent filling with another filler is further intended. The method for pre-driving of a bottomless caisson and tensioning the ground base is a novelty in hydro engineering construction and such a method is not known in the world hydro engineering theory and practice.

3. The working parameters of the project have been validated by a specially planned experiment of a floating caisson type pneumatic construction in order to establish some basic hydrodynamic properties (stability, resistance, seaworthiness, etc.) of a floating caisson with a dynamic principle of support, which are necessary during its transportation from the place of production to the place of installation to a certain hydro facility.

4. As a result of model studies of caisson pneumatic construction at a certain configuration of geometric, kinematic and dynamic parameters, conclusions and recommendations are made regarding: static stability, the required power of the tug hook and the state of the sea when towing the caisson.

5. Recommendations have been made to ensure achievement of desired structural characteristics and requirements have been set for the insulation and airtightness of the reinforced concrete, while the structure should be fully implemented in accordance with the changing external temperature and constant impact of aggressive sea water.

Claims for contributions are supported by patents and copyright certificates, which shows and proves the competence of the author.

Abstract

The abstract (35 pages) fully meets the requirements of rules of IO-BAS and correctly reflects the content of the dissertation. The formulated contributions and publications on the topic correspond to those listed in the dissertation.

Scientific publications on the topic of the thesis

On the topic of the dissertation 4 scientific articles have been published - one is in Scopus, and the other three eng. Gencho Dinev Georgiev is an independent author:

1. **Georgiev G.**, Floating Caisson Type Pneumo-Structure, Proceedings of the Union of Scientists – Varna, Series “Marine sciences”, 2017, ISSN 1314-3379, pp. 53-58 (in Bulgarian)

2. **Georgiev G.**, Method for Preliminary Incision, Leveling of Floating Caisson Type Pneumo-Structure and Pre-stressing of the Ground Base, Proceedings of the Union of Scientists – Varna, Series “Marine sciences (Oceanology)”, 2018, ISSN 1314-3379, pp. 19-25 (in Bulgarian)
3. Palazov A., **Georgiev G.**, Donev V., Pneumo-structures for gravitational hydrotechnical construction, Sustainable Development and Innovations in Marine Technologies – Georgiev & Guedes Soares (eds), © 2020 Taylor & Francis Group, London, ISBN 978-0-367-40951-7, pp. 579-584
4. **Georgiev G.**, Air-Impermeability of Reinforced Concrete Floating Caisson Type Pneumo-Structure, "Science in Service of Society 2017" - Conference of the Union of Scientists – Varna, Varna, October 2019 (in Bulgarian)

In this way the minimum requirements for the candidates for acquiring the educational and scientific degree "PhD" in IO-BAS are fulfilled.

Critical notes

In the dissertation and the author's abstract the units of measurement are not in the "SI" metric system. This fact in no way reduces the value of the dissertation.

Personal impressions

I have known the PhD candidate for more than 10 years and I am partially acquainted with his work and publishing activities. We have one article together.

Plagiarism

Partial examination of the dissertation with specialized software showed the absence of plagiarism.

The doctoral student declared that the research and the results presented in the dissertation were his personal matter, and where the work was done in collaboration with other persons, this was explicitly stated in the text.

Overall conclusion

The presented dissertation is a completed scientific work, parts of which have been published in scientific journals (indexed in Scopus, etc.). The scientific research methods used are adequate and the scientific results obtained are reliable (patents and copyright certificates).

The dissertation contains scientific and applied contributions necessary for obtaining future scientific degrees.

The above facts discussed allow me to give a positive assessment of the dissertation of the PhD candidate and to suggest to the distinguished scientific jury to award to engineer Gencho Dinev Georgiev the educational and scientific degree "Philosophy doctor" (PhD) in the field of higher education: 4. Natural sciences, mathematics and informatics , Professional area: 4.4. Earth Sciences, Doctoral Program in Oceanology.

03. 07. 2020

Varna

Reviewer:

/Assoc. Prof. Dr. D.