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CONTENT

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THE CURRENT STATUS AND PROSPECTS OF MODULAR HOUSEBOATS CONSTRUCTION AND TECHNICAL EXPLOITATION

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Abstract. *Priority plans include designing, constructing and operating houses and those facilities, which are based on water, above water and water. The classification of floating objects at the deposits of the sea is indicated on the surface of the water, the method of positioning is visible on the ground and the construction materials, as well as the shape of the floating equipment. The theoretical basis was science robots in the project hall and the house and house construction, debarked, pontoon; regulatory framework for the Navigation Register of Ukraine, as well as the availability of a modular design and the design and technology of floating and coastal equipment. The meta-duplication of the viability of the project design and technology of the viability of the service, adapted for the Ukrainian water supply. Task, for viral duplication, foregoing supplementary tendency for projecting a wake-up call on a plumbing base; the provision of substantially substantiated project design for watershed infrastructure; providing sound and visual design and visualization and typology of real-world classifications; a description of the functional-planning organ of the house. It has been found that in the 21st century, floating and water houses are a worthy alternative to land-based residential buildings as environmentally viable buildings in major cities.*

Xülasə. *Tədqiqat üzən evlərin və suyun üzərində, suyun üstündə və suyun altında olan digər obyektlərin dizaynı, tikintisi və inşasında mövcud tendensiyaları araşdırır. Üzən obyektlərin təsnifatı, yerləşmə metodundan, su hövzəsinin səthindən və üzən qurğunun tikintisindən istifadə edilən konstruksiya materiallarından asılı olaraq verilir. Nəzəri əsas üzən evlərin dizaynı və tikintisi sahəsində elmi işlər idi; Ukrayna Dəniz Gəmiçiliyi Registrinin tənzimləyici və hüquqi bazası, həmçinin üzən və qurudakı qurğuların modul formalaşdırılması və struktur və texnoloji həlləri ilə bağlı tədqiqatlardır. Tədqiqatın məqsədi Ukraynanın su hövzələrinə uyğunlaşdırılmış üzən ev istehsalının dizayn və texnoloji xüsusiyyətlərini müəyyənləşdirməkdir. Tədqiqatda həll olunan tapşırıqlar, üzən əsasda konstruksiyaların dizaynı və tikintisində mövcud tendensiyaların müəyyənləşdirilməsini əhatə edir; üzən konstruksiyalarda infrastrukturun dizaynı və qurulmasında müasir və xarici təcrübənin təhlili; üzən evlərin dizaynı və qurulması, tipoloji xüsusiyyətlərinin müəyyənləşdirilməsi və təsnifatının yaradılması üzrə ümumiləşdirilmiş təcrübənin nəzərə alınması; ev botlarının funksional-planlaşdırma təşkilatının xüsusiyyətlərinin təsviri. XXI əsrdə üzən və su evlərinin, böyük şəhərlərdə ekoloji cəhətdən faydalı quruluşlar kimi "quruda" yaşayış binalarına layiqli bir alternativ olduğu aşkar edildi.*

Аннотация. *В исследовании рассмотрены современные тенденции проектирования, конструирования и строительства хаусботов (плавучих домов) и других объектов, которые базируются на воде, над водой и под водой. Приведена классификация плавучих объектов в зависимости от расположения, относительно поверхности водоёма, способа позиционирования, относительно грунта и конструктивных материалов, которые используются при формировании плавучего сооружения. Теоретической базой послужили научные работы в области проектирования и конструирования хаусботов, дебаркадеров, понтонов; нормативно-правовая база Регистра судоходства Украины, а также исследования относительно модульного формирования и конструктивно-технологических решений плавучих и береговых сооружений. Цель исследования состоит в выявлении особенностей проектно-конструкторских и*

технологических особенностей изготовления хаусботов, адаптированных под водоёмы Украины. Задачи, которые решаются при исследовании, предусматривают выявление современных тенденций проектирования и строительства сооружений на плавучей основе; проведение анализа современного и заграничного опыта проектирования и строительства инфраструктуры на плавучих сооружениях; учитывая обобщенный опыт проектирования и строительства хаусботов, выявление их типологических особенностей и создания их классификации; описание особенностей функционально-планировочной организации хаусботов. Выяснено, что в XXI столетии плавучие и водные дома являются достойной альтернативой жилых зданий «на суше» как экологически жизнеспособных сооружений в крупных городах.

Key words: *houseboat, floating equipment, hydraulic engineering constructions, vocal analysis*
Açar sözlər: *üzən ev, üzən qurğular, hidrotexniki konstruksiyalar, müqayisəli analiz*
Ключевые слова: *хаусбот, плавучие сооружения, гидротехнические конструкции, сравнительный анализ*

Formulation of the problem. The houseboats are relatively a new direction in both domestic and foreign shipbuilding. At the same time, these floating structures quickly and firmly won high positions in the sales ranking and reliably aroused sympathy among lovers of tourism and water recreation. Houseboats are used in calm enclosed waters. Quite often they are used for hydraulic engineering, scientific research and other marine research and work, giving their sufficient force, stability and ease of use [1]. Houseboats are most widespread in the Netherlands. There are many wide rivers in the country with a slight flow rate; a large percentage of citizens preferred living on the water periodically leaving the parking lot and going on a trip. Because of this, the state was even forced to take measures to limit the construction of such floating structures [2].

In Ukraine, interest in houseboats emerged in the late 2000s. This is largely due to excessive housing prices. The design and construction of the first houseboats in Ukraine were carried out without taking into account special technical standards and requirements of classification societies. The composition and size of the premises were taken on the basis of analogues of stationary single-story buildings, which did not always take into account the specifics of the operation of the houseboat, as well as the seasonality of its use. Nowadays, most domestic houseboats are designed for the class of the Register of Shipping of Ukraine for river vessels [3]. At the same time, there was a need for technological modernization of stationary and floating structures taking into account the requirements of international standards for building codes, which in turn led to the improvement of houseboat formation technologies, including the use of modular technologies. Insufficient study of the problem of typological and modular-spatial organization of the construction of the vessels under consideration, necessitated the development of new trends in the methodology of their design, functional zone and planning.

All this testifies to the **relevance** of this study and defines the **purpose**, which is to identify the features of design and technological features of the manufacture of houseboats adapted to the reservoirs of Ukraine.

In accordance with the set goal it is necessary to solve the following scientific **problems**:

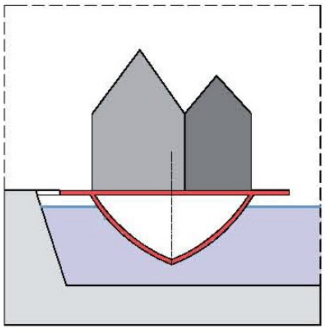
- to identify current trends in the design and construction of buildings on a floating basis;
- to analyze modern and foreign experience in designing and building infrastructure on floating structures;
- to identify the typological furfures and create their classification based on the generalized experience of designing and building houseboats;
- identify the features of the functional-planning organization of houseboats.

Analysis of resent research and publications. The scientific works in the field of design and constructions of houseboats landing stages, pontoons; regulatory framework of the Register of Shipping of Ukraine, as well as research on the modular formation and design and technological solutions of floating and shore structures served as a theoretical basis of research [1, 2, 4-6]. The study takes

into account the development of M.V. Savitsky and S.E. Shekhorkina, which reflects the constructive tasks of positioning houseboats with anchor racks, which also control the landing of a houseboat during high tides, which is typical for the lower reaches of the Dnieper and Danube [4, 5]. The works of M.S. Yelensky, B.V. Ionov, R.Ya. Khiger are dedicated to the architecture and design of floating river stations and pavilions. Scientific research by I.S. Ekonnomov, A.V. Panfilova, V.Ye. Barishev is dedicated to the architecture of low level water-based buddies. They have considered the actual nutritional technologies for the formation of floating ships in their minds [6-8]. Issues of reinforced concrete shipbuilding are covered in the works of M.G. Slutsky, O.S. Rashkovsky, V.M. Konnov, O.M. Postupalsky [9-11]. The research also used the results of the author's developments [12-14].

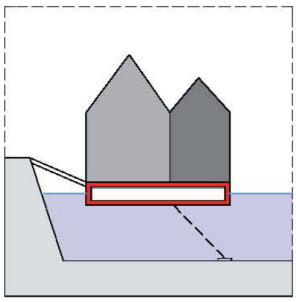
Presentation of the main material. The current state of design and construction of architectural objects on the water is quite diverse. As a result of the analysis of various floating structures and structures on the water, an appropriate typology was developed. The basics of classification include the main distinctive features of the construction of houseboats on water, over water and under water. Criteria for the formation of typical objects on the water, taking into account the design and technological features and seaworthiness are as follows.

Floating bases - the object has buoyancy, but is not self-propelled; has a fixed permanent location, is analogous to a mooring vessel moored to the shore structure (fig. 1).

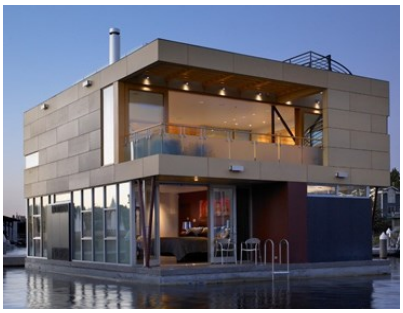


House on the mooring hull

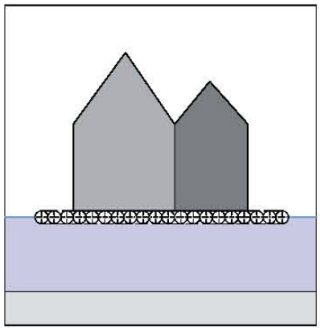
House on the barge, Amsterdam
(http://polostroy.org/)



House on the concrete cushion



Floating office in Prague
(http://radio.cz/)



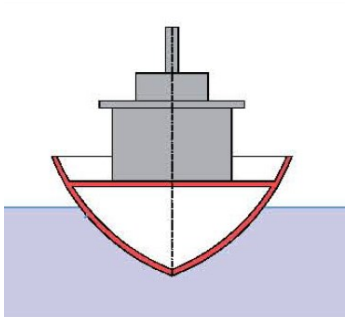
House on rafts

House on the fence in Melburn
(http://kultimatum.ru/)

Fig. 1. *Floating houses with static bases*

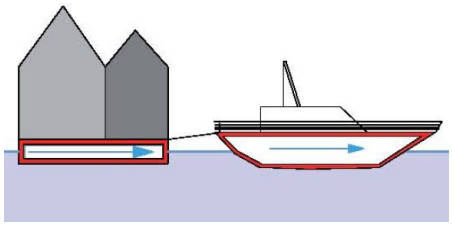
Such structures with static floating bases include:
- moored houses on the basis of the ship's hull;
- houses on various pontoons;
- houses with a geometric pontoon hull;
- houses on fences.

Dynamic floating bases differ in that the object, in addition to buoyancy, has other seaworthiness, namely navigability and controllability, it has the ability to move around the water on its own, or by towing other vessels (fig. 2).



House on the floating hull

Hull on the self-propelled barge in Antwerp (http://fresher.ru/)



Hull on the hollow concrete cushion with yacht tugging

House on the concrete pontoon with the tugging of yacht-catamaran house-boat (http://techcult.ru/)

Fig. 2. *Types of structures on the water with dynamic floating foundations*

Buildings with dynamic floating foundations include:
- boats;
- cruise liners "weekend";
- floating city liners on the water.

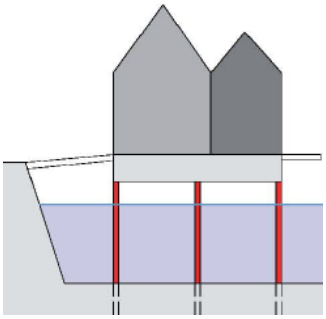
Self-propelled structures with a dynamic basis should include:
- houses on towed landing stages;
- pontoon structures, crossings;
- converted for housing and other functions of the vessel and other floating structures.

It should be meant it is obvious that the head energy installation on the objects which are considered, does not transfer to a great distance. Through the price for economical dignity, electric motors should be used for driving on alternative energy jets, since they do not apply a waste of water to an exuberant water environment, not to do harm to water environment, not to make noise and to be simple in operation.

Bulk foundations: the object is formed on an artificial embankment-base.

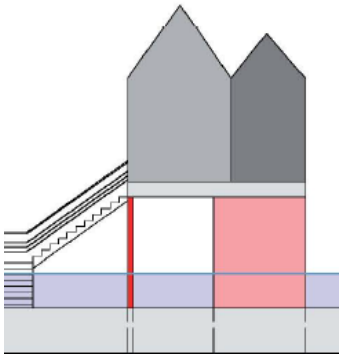
The first step is to tie groups of boulders or other smaller fireplaces to the bottom of the pond to use them as rigid rods. After that, by applying sand or other embankment-base material on them, the required geometric shape is given. This technological solution has proven itself in the creation of famous artificial islands in the United Arab Emirates. Combinations of bulk and pile structures are also possible.

Non-floating foundations – the object is partly buoyant due to its own design features. There are five ways to keep non-floating bases on the surface of the water (fig. 3).



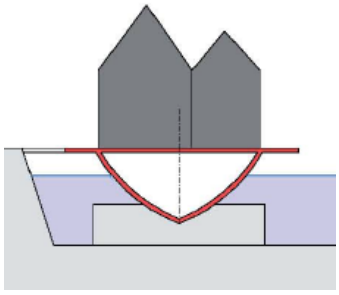
House on stilts

Hotel on stilts, Cook Islands (http://robo-hunter.com/)



House on pylons

Villa «Savoy» near Paris (http://museum-design.ru/)



Hull on a concrete basis

Eco-tech loftboat, Antwerp [4]

Fig. 3. *Non-floating houseboat bases*

Pile foundations: the object has a fawn design for different depths. The use of fawn structures has been well known since the time of the first settlements on the water. And if the use of tree trunks as the main material was previously the only solution, given the increase in the strength characteristics of wood in the process of interaction with water, nowadays structural composite materials have actively replaced traditional ones.

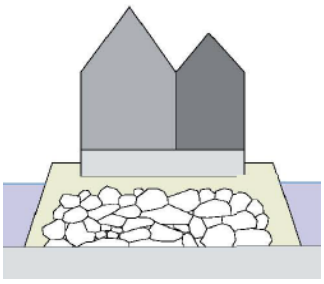
In modern engineering practice of designing stationary and floating structures on the shelf of the seas and oceans, there are a number of design and technological solutions, which cover both pile and alluvial technologies together with creation layers of boulders and base plates. Buildings with pile foundations include a number of high-rise objects on the water:

- lighthouses on stilts;
- fortifications;
- residential platforms of oil rigs;
- residential platforms of sea mines;
- supports many span bridges.

Pylon foundations: the object has a pylon structural solution that works for strength, rigidity and stability similar to pile. The use of a pylon or a system of pylons allows to increase the structural, functional and aesthetic characteristics of residential and special buildings on the water. Redistribution of load of a bearing design gives the chance of functional zoning of rooms of the house. The combination of pylon and pile structures provides an opportunity to expand the range of design solutions.

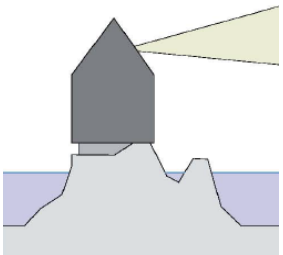
Houses on concrete hulls: the facility is an old (not used for its intended purpose) hull, which for one reason or another does not have sufficient seaworthiness, strength and other qualities. The hull of the vessel is concreted (a concrete cushion is created between the hull and the ground of the reservoir). This is done if the housing has holes, structural defects of the set and cladding, platforms, decks.

Houses on solid natural foundations: the object resists freely and a solid stone, or other type of solid foundation. At the same time rigid bearing property is provided due to a combination of concreting of a plate of the base with firm breed or due to pile designs. A typical example is the various houses near the water on the rocks, different types of lighthouses, which are located on rocky outcrops of water at a distance from the shore with relatively shallow depths for the safe passage of large vessels and other vessels (fig. 4).



House on a washed-out basis

Palms Islands Resort, Dubai (http://20 minutos.es/)



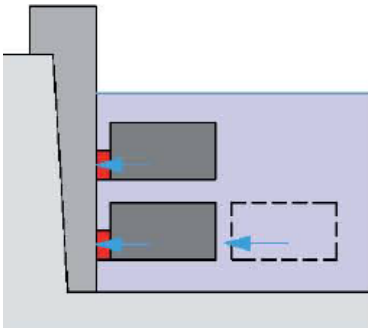
House on a rock and concrete foundations

Lighthouse on the rock of Andros (Greece) (http://teletype.in/)

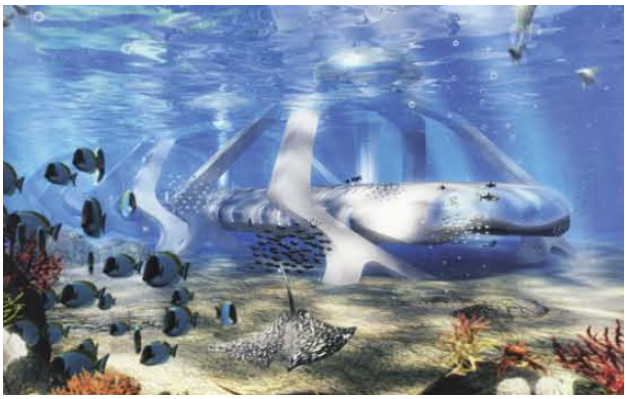
Fig. 4. *Types of houses on artificial and natural sea bases*

Underwater bases – the object is under water at a certain distance from the surface. This distance can be determined by the object itself, such as on private mooring or autonomous submarines, or only by the design of the main underwater element, the part of the structure under water to which the underwater object is attached or docked: airtight backlash capsules, apartments with seabed views, which are manufactured using submarine construction technology. To date, there are two solutions for the possibility of tourists underwater in the apartment.

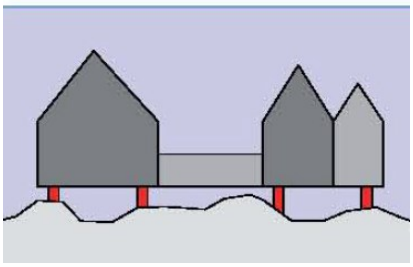
Static underwater structures: the object is at a given distance from the water surface, has a fixed position due to additional design solutions (fig. 5).



Underwater capsules are connected to communications

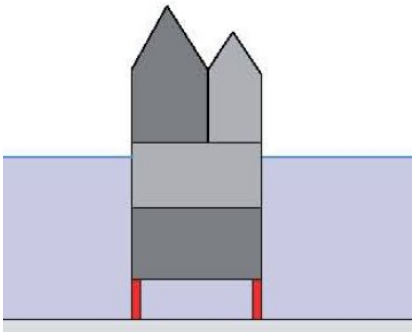


Underwater hotel «Seven ocean» [7]



Underwater capsules-houses on the ground of reservoirs

Underwater hotel «Planet Ocean», Florida, USA (http://RuYachts.com/)



Будинок на палях із підводними поверхами

Hotel «Otter Inn», Sweden (http://OrangeSmile.com/)

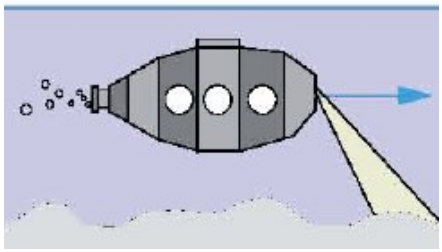
Fig. 5. *Static underwater structures*

The structure can be located directly on the seabed, and access to them can be realized only through other submarines that can be docked to them. Facilities of this type can be used as research laboratories, underwater hotels and recreation centers, but access to them is associated with high risk and requires initial diving training.

The more rational solution is to rigidly fix such an object to the bottom of the reservoir and at the same time form both underwater and surface tiers. In general, static underwater structures include:

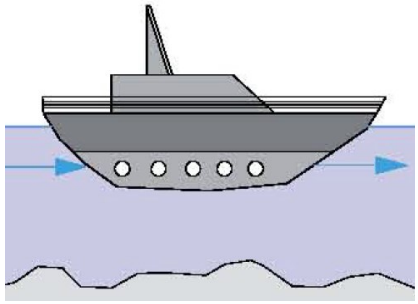
- different types of underwater hotels;
- underwater restaurants;
- underwater aquariums
- underwater museums
- underwater training laboratories.

Dynamic underwater structures: the object is completely or partially under water and has the ability to move spatially (fig. 6).



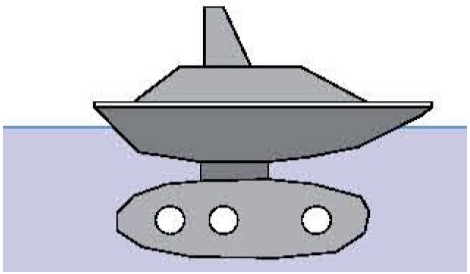
Underwater private submarines

Tourist submarine «Sadko», Russia (http://visacomtour.ru/)

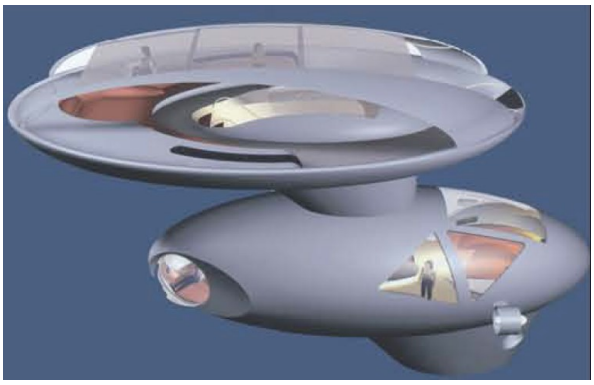


Vessel-hotel with underwater cabins

Hotel project «Sea Venture» [6]



Yacht house with an underwater compartment



Project «Polinarius», Germany [6]

Fig. 6. *Dynamic underwater structures*

The dynamic underwater structures include:

- large underwater floating stations;
- small submarines, bathyscaphes, submarines.

Thus, the general modern typology of underwater objects on water, in water and under water includes:

- artificial islands;
- cities on stilts;
- static houses on the water;
- houseboats;
- high-altitude objects on the water;
- houses under water.

The current state of design, construction and construction of water infrastructure is based on pontoons, piles and artificial embankments. The convenient practice of rebuilding housing using decommissioned vessels is no less successful than building houses on the water.

In Figure 7 is shown Eberhard Seidler's project in Toronto, Canada, which is an artificial peninsula with marinas and five pavilions on stilts and pylons (Was build in 1969).

Resume. In the 21st century, floating and water houses have been found to be a worthy alternative to land-based housing as environmentally viable structures in major cities. Some German cities (including Hamburg and Rostock) are promoting a water-based model based on the experience of the Netherlands, offering a way of life closer to nature.

The world experience of construction of residential buildings on the water is analyzed and the stages of their formation are revealed.

The possibility of building houses on stilts and pontoons in those regions of Ukraine where floods and inundations are systematic (Vinnytsia, Khmelnytsky, Volyn regions), is an alternative solution in the fight against water.

Fig. 7. *Eberhard Seidler's project [7]*

The classification of constructions on water, over water and under water depending on type of superstructures, the principle of their support on water and a way of performance is developed.

References

1. Hellweg, U. (2012) Floating Homes at Rummelsburg Day in Berlin. Wasserstadt. Gmbh. 32-38.
2. Kendall, S. (2015) Residential open building? Jonathan Teicher. London: E&FN SPON. 23-26.
3. Pravila klassifikacii i postrojki malyh sudov (2015) [Rules of classification and building of small vessels]. Kiev: Ukrainian Register of shipping [in Russian].
4. Shehorkina, S. E. (2013) Racionalnoe proektirovanie konstrukcij maloetazhnyh zhilyh zdanij na vode [The rational designing of low-rise residential buildings on the water] The dissertation for the degree of candidate of technical sciences. Dnepropetrovsk. 168 p [in Russian].
5. Savitsky, N.V. & Shekhorkina, S.Ye. (2013) Plavucha platforma [Floating platform]. Invention patent of Ukraine. № u201302998. declared 11.03.2013; published 27.08.2013 [in Ukrainian].
6. Ekonomov, I. S. (2010) Principy formirovaniya maloetazhnyh zhilyh obektov na vode: [The principles of the formation of low-rise objects on the water] The dissertation for the degree of candidate of architecture. Moscow. 2010. 131 p [in Russian].
7. Ekonomov, I.S. (2010) Sovremennye sposoby stroitelstva arhitekturnyh obektov na vode [Modern methods of building objects on the water]. Materials of the scientific and practical conference. 238-244 [in Russian].
8. Koekoek, M. Connecting Modular Floating Structures: A General Survey and Structural Design of a Modular Floating Pavilion URL: http://repository.tudelft.nl/view/ir/uuid:33b59201-1718-4dda-98f8-ee16d5b7c023/pdf. (access date 12.11.2019).
9. Sluckij, N. G. (2006) «Palada». Novye gorizonty prezhnej specializacii ["Pallada". New horizons of previous specialization]. Shipbuilding & Shiprepair. Odessa. №8. 8-9 [In Russian].
10. Sluckij, N. G., Rashkovsky, A.S. & Ermakov, D.V. (2007) Ekonomicheskaya effektivnost stroitelstva i ekspluatacii kompozitnyh plavuchih dokov bolshoj podemnoj sily [Cost-effective construction and operation of floating docks of high lift] Economics: problems of theory and practice. Donetsk. # 232, Volume III. 614–621 [in Russian].
11. Rashkovsjkyj O. S. et al. (2015) Proektuvannja, tekhnologhija i orghanizacija pobudovy kompozytnykh plavuchykh dokiv. [Design, technology and organization for building composite floating docks]. Mykolajiv, RAL-polighrafija. 254 p. [in Russian].
12. Shchedrolosiev, O.V., Terlych, S.V. & Shedrolosiev M.O. (2019) Doslidzhennya hodovih yakostej plavuchogo budinku [Research on the driving performance of a houseboat] X International science-practical conference «Advanced energy installations for transport, technology and ownership for servicing (SEUTTO-2019)» (11-12 sept. 2019). Kherson. 238-240 [in Ukrainian].
13. Shchedrolosiev, O. V. & Terlych, S.V. (2016) Kompleksnoe usovershenstvovanie tehnologij oborudovaniya i otdelki pomeshenij nesamohodnyh sudov i drugih plavuchih sooruzhenij [Comprehensive improvement of equipment technology and decoration of non-self-propelled vessels and other floating structures]. Collection of scientific papers of Azerbaijan State Marine Asademu #2. Baki. [in Russian] 50–56.
14. Shchedrolosiev, O. V. & Terlych, S.V.(2008) Suchasnij stan modulnogo formuvannya primishen na nesamohidnih plavuchih dokah [Current state of modular formation of premises on floating docks]. Collection of scientific papers of National University of Shipbuilding. Mykolajiv. #1. 94–99 [in Ukrainian].

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