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Nina Shults

## THE ART OF REALISM IN THE WORKS OF DMYTRO ZHUDIN

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Шульц Н.А.

## ИСКУССТВО РЕАЛИЗМА В ТВОРЧЕСТВЕ ДМИТРИЯ ЖУДИНА

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*Abstract. The work is considered individual methods of creating images in the work of the artist and teacher Dmytro Zhudin.*

*Key words: art, artist, teacher, creative personality, painting, graphics.*

*Аннотация. В работе рассматриваются индивидуальные методы создания образов в творчестве подольского художника-педагога Дмитрия Жудина.*

*Ключевые слова: искусство, художник, педагог, творческая личность, живопись, графика.*

**Introduction.** One of more important direction of development in modern Ukrainian art is a researching of artist's heritage, whose art on the one hand is the reflection of cultural regions specificity, but on the other hand is an integral part of Ukrainian art.

Great experience of work with painting, the artists of Podolia accumulated in their practice.

Podolia is a region of rich talents and hard-working sons and daughters who are honored and respected in the centuries by their nation. They are still glorifying their homeland. One of the representatives of this artistic pleiad was an artist Dmytro Zhudin who left a large number of paintings. Almost all the titles of the paintings are subjunctive and known only by the lists of collections and museums in which they were kept. It is unknown as the artist called his paintings.

Zhudin realized that the art is a magic touch of the past but not just a reconstruction of the subjects of rural life and to show the rural landscapes he needed a special language. Zhudin knew not only the old masters of European art well, but while he was travelling in Ukraine and Russia he followed of the state of modern art. Good education gave him an opportunity to find his own manner of painting and graphics, his style. The main norm of artist's outlook was realism and a sincere desire to learn the rules of plein painting which helps to saturate with the sunlight, air and brightness of colours in his paintings.

Creating the paintings, Dmytro Zhudin always worked at the plein, step by step illuminating the palette. Gradually he created his own method. He was one of the first who refused of a black colour and we can see it in his work "Kamianets-Podilskyi and its suburb in the beginning of the 20th century". This position frankly points the high intellect and knowledge about history of modern and artistic trends. Refusing of a black colour is characterized the artists of impressionism and his contemporaries.



The artist worked with nature a lot. He drew the realistic images in his real life. Zhudin always saw the traces of human activity and everyday life of the peasants in his paintings. The observation of the nature, the sketches and etudes during his trips and walks were required to his professional preparation of landscape's master. Studying about his homeland at the plein, for artist and teacher, was like an inexhaustible source of demonstrative material during the teaching children at the lessons [1, p. 92]. It helped him to present new material, combining theory with practice. So, at the plein pupils were able to present the interesting places of landscapes in their pictures, recreating specific elements of architecture and constructions of buildings.

Young artist, Zhudin worked a lot, making his own style and handwriting in writing pictures. His direction in painting is academic realism. The artist thought that there is nothing better than imaging a true life of nation, real nature, events and people of this epoch. He gradually implemented his knowledge, skills which were received during studying and tireless work.

Zhudin's works clearly reflect the features which are inherent to historic and academic pictures of those years: using the landscape background at the plein; desire to form optical illusion. The artist's creative method accumulates the traditions of romanticism, academicism and realism.

In 1900s Zhudin created a large of number graphic and picturesque works. The artist's paintings became light and filled with bright consonance of colours which created new and more generalized art images and at the same time – nice and joyful mood [4, p. 12].

His method of pictures' creation "Self-portrait", "The portrait of a young man in a cap", "The portrait of a woman in a red kerchief", "The portrait of a girl" is versatile, imaginative and highly professional. To each picture he found its original composition, colourful decision and expressive drawing, in other words, he made his own handwriting which is recognizable in his pictures.

Dmytro Zhudin was citizen, artist and teacher who actively and emotionally responded on problems of modern and art life in Podolia. Zhudin was a sensitive person in art and he was respected by many Ukrainian artists, progressive intellectuals, scientists and art youth [3].

Zhudin's name was occupied a prominent place in the history of Ukrainian culture. His artistic heritage is large and versatile. But at first the artist was a singer of Podolia and the suburbs of Kamianets-Podilskyi. His pictures are kept at the Central State Archive and Museum of Ukrainian Literature and Art. They are included to the collection fund of the picture's gallery of Kamianets-Podilskyi. In that considerable number of pictures which were left by the master, we can find the image of shy and hard-working person, the image of talented, national artist who is conferred by a big, painting gift. Zhudin's art was organically combined both centuries – the 19<sup>th</sup> and 20<sup>th</sup>. Extremely rich and art Zhudin's heritage shows us about polyhedral talent of the artist who devoted to painting and graphics all his life. Artworks which are painted by Zhudin, can be classified by the direction and genre. Analyzing the totality available pictures from the artist's and authentic pictures, graphics and sketches, which were found during the researches, we can confirm that a large number of pictures allows to



classify the cultural and art artist's heritage. All the artist's compositions which were found in a state and private archives of Ukraine, are divided into such categories: the landscape of nature, villages and towns: still life; portraits and thematic compositions.

Zhudin left the invaluable gallery of portraits, landscapes and sketches. It is hard to find such talented artists with rich and deep images like Zhudin. It seems all Podolia arose in faces and landscapes. It is the endless diversity of characters and types. "The portrait of his daughter – Olga Zhudin", "The portrait of an old woman in oval", "The portrait of a girl gymnast" are extremely reliable, sometimes ruthless for their characteristic and always as alive. Podolian portraits, which have been painted before, had an obstacle between spectator and image. It's like a reminding that there is a work of art in front of us. There isn't any obstacle in Zhudin's portraits and communication between spectator and image is like alive. "The portrait of a woman" and "The portrait of a grandmother" have a moral energy of Ukrainian person. They will stay samples forever which form our spiritual world and characters.

Zhudin's creativity is founded on realistic method which caused the features of stylistic system of his artworks. Zhudin's art was characterized by process "from private to general". The painter equally and masterly had the technique of psychological nuances working with specific image [5, p. 17].

Villages' and region's life was shown in his compositions at the turn of the 19<sup>th</sup> and 20<sup>th</sup> centuries: people, events, monuments of history, architecture and culture of Kamians-Podilskiyi – everything what was he interested in or just reached his eyes. The best artworks are – "Kamianets-Podilsk and its suburbs", "The portrait of an unknown man with a book", "The portrait of his mother", "A weaten field", "The portrait of a girl", "The portrait of a girl in a black dress", "The portrait of his wife", "The portrait of a young woman", "The portrait of an old man with round glasses" and many graphic portraits and landscapes. Zhudin's easel painting is shown by its style. He deeply and convincingly tried to display the life in its different displays.

The artist's portrait genre is based on the individual features of model and objective characteristic of personality. Thanks to the tasks which the artist tried to solve, we should divide the portraits into two groups. The first group has the pictures which include the artist's desire to convey accurately the character and mood of simple peasant people ("The portrait of a young woman", "The portrait of an unknown man with a book"). The second group has the portraits in which the artist was solving the actual problem at that time – to create an image of a citizen. "The portrait of a woman", "A woman with an umbrella", "A woman in a black dress", "A girl in the garden" the artist interprets the models like an intellectual personalities and accents the attention on their social significance in his portraits.

At the time of his artistic maturity he created the pictures of psychological and intimate character: "A woman in the garden", "Tatiana in white", "The portrait of his wife", "The portrait of unknown man", "A weaver", "The portrait of landowner Uniatovski's daughter", "The portrait of a girl", "Teen girl", "The portrait of his daughter – Olga", "The portrait of a woman in a red kerchief", "A girl on a sofa". All the artist's portraits are spoken about Zhudin like a great master. The artist's creative diapason was unlimited: from portraits with dramatism and sometimes with tragic sounding, to delicate images of the child charm like on the portrait of a small girl.



In 1890s Dmytro Zhudin was interested in graphic portrait. Creating it, the artist touched the different parts of Ukrainian life. He paid attention to those things which were worried the society of that time. The images in the graphic pictures, which were painted by the artist, were drawn from real life. Their meaning is opened in the context with social and political events of that time.

The 19<sup>th</sup> - the early 20<sup>th</sup> centuries isn't a big time but it is mentioned by the diversity of high artistic achievements and famous names in the history of Ukrainian art, and it can be supposed as "golden era". The old and artistic traditions formed the national originality of Ukrainian art of that epoch.

**Conclusions.** Dmytro Zhudin is a talented artist and teacher, active and comprehensively gifted personality; he excelled in many spheres of activity and entered to the history of Kamianets-Podilskyi and Podolia. The artist has got high-quality artistic education in the leading art institution of the country; worked creatively, realizing his talent in the sacred paintings of the churches, easel compositions and graphics; took part in the artistic exhibitions and events; was the member of the protective companies; conducted the active, artistic and pedagogical activity in the institutions of the region; introduced new and innovative methods.

Zhudin's creative contribution is an authentic and visual information about cultural life, art and life of the past and his paintings are the important, artistic improvements. The first artist's genre is a psychological portrait, the next is the landscape and another is thematic composition. Zhudin's works brightly represent characteristic features which belong to that epoch: using the plein in the landscape's images; desire to optical illusion of the forms. Stylistic features of the artist's composition accumulate the traditions of romanticism, academism, realism and closely intertwined with Ukrainian motives.

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**AESTHETIC SEMANTICS OF ARCHITECTURAL ENVIRONMENT**

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**СЕМАНТИЧЕСКАЯ ЭСТЕТИКА АРХИТЕКТУРНОЙ СРЕДЫ**

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*Abstract. In this paper we describe the use of philosophical, mythopoetical and phenomenological relationship between architectural and landscape forms. Three-dimensional architectural language expresses the universal characteristics of the landscape, transforming chaos of the world around us in a holistic architectural environment. The variety and complexity of these relationships are the foundation of semantic aesthetics of the architectural environment.*

*Key words: architecture, landscape, semantic, mark, semantics, image, metaphor, structure, aesthetic, language.*

*Аннотация. В работе рассматриваются философские, мифопоэтические и феноменологические взаимоотношения архитектурных и ландшафтных форм. Объемно-пространственный язык архитектуры, выражает универсальные характеристики ландшафта, превращая хаос окружающего нас мира в целостную архитектурную среду. Многообразие и сложность этих взаимоотношений выступают основой семантической эстетики архитектурной среды.*

*Ключевые слова: архитектура, ландшафт, смысл, знак, семантика, образ, метафора, структура, эстетика, язык.*

**Introduction.**

Architecture is a part of the world (second nature) in which we live, it combines the utilitarian and the spiritual. However, architecture is the art, the art of forming and ordering space; the art turning chaos into the system which is convenient and comprehensible for the user. For example, V. N. Toporov states that “the space discovers deep-laid affinity with spirituality of the art...” [1]. Le Corbusier tells about the space as «a miracle» laying emphasis on its ability of psychological effect upon people. Therefore, architectural space soaks a person up making him or her to be a part of the holistic view of the environment.

**The main text.**

Architects and researchers were looking for the solution of the relation between architecture and natural landscape from antiquity to the present day. Antiquity interpreted nature as a strange, dangerous world, granting and taking man's life. Natural was sacralized, endowed with positive and negative characteristics. These characteristics were identified in relation to natural forms (mountain, river, plain, wood, etc.). “Collective Unconscious” of a human retained these representations and brought them to our times. The fundamental characteristic of nature in antiquity was



the unity of the world from the city to the universe (Plato). This attitude was transformed into an understanding of nature as an amorphous object of impact (Plotinus). In the middle Ages, natural environment was seen as a part of the dichotomous structure of “the created” and “uncreated” worlds. The brightest unifying natural characteristic was light. The medieval concept of light harmony was transformed into a Renaissance concept of infinity of the world and nature as such (Nicholas of Cusa, Giordano Bruno). Nature appeared as a model of any order in its natural form (Galileo Galilei). Baroque reduced nature to the subject of refinement and material of decorum. Classicism made actual the aesthetic concept of “imitation of nature”, which gave birth to the concept of “expression” as a sign of presence in any form of art message (content). Romanticism brought back a sense of “natural” – real, scenic and spirituality of nature. Romantics introduced a new characteristic of nature – mystery, unknowability and irrationality. Hegel puts forward the concept of the “second nature” with its “architectonic principle” of formation, which he links to the organization of architectural space (external and internal). Rationality of Modern Times actualizes spatial qualities of nature. Postmodernism proves “the variability, the illusory, the ephemeral, turning over common sense” (Aldo Rossi) [2]. Modern philosophy treats nature as an original concept, stimulating the humanistic traits of a person that can bring back the old world integrity. The end of XX and the beginning of the XXI century are marked with a growing interest in the environment, although the architecture continues to keep a tendency of creating forms, imposing towards natural environment an attitude of domination. This is particularly well-seen in the architecture of the urban environment, as the city forms a special type of landscaping

Modern understanding of the relationship between the city architecture and the natural landscape were influenced by concepts of geographers, environmentalists, writers and architects such as E. Howard, Le Corbusier, L. Mumford, R. Neutra, K. Tange, Alvar Aalto, I. Gruza, F. Dorst, L. Bauer, R. Parson and others.

Art-figurative base of architectural concepts of interaction between nature and architecture follows from man's relationship to nature, which developed and transformed over the centuries. Science presents this relationship as ancient models, as system of mythopoetic images that make up the “mythopoetic model of the world”, which is based on natural-landscape forms and relationships. The most universal form created by landscape image is the mythopoetic one of the “world mountain”.

Imaginative power of nature and its semantic constructions, bearing historical and cultural schemes are becoming increasingly important in architecture. As stated by semiotics semantic or meaningful structures are a part of compositional and aesthetic structure of the object.

Architecture and nature in their “organic community” create an ensemble, a complete picture of the world where connections are stable and universal. Common triad of concepts – sky-mountain-city – creates a semantic model, built on the principle of traits transfer from one text to another. It embodies a sustainable idea of “heavenly” qualities of the landscape, expressed architecturally. Next semantic model is the relation of city-temple-hipped roof. These forms simulate the image of the Heavenly city that combines common signs of heaven and earth. Correlation of stable semantic models fixed in the minds and their recognition in real silhouette forms



gives the spiritual aspect to the seen object and endues it art (spiritual) qualities that a person is experiencing emotionally. Thus, the silhouette becomes a “push for the recognition of the image as a whole”.

Among the variety of landscape forms special mention should go to both main forms such as land (in the manifold of its landscape forms) and the sky, and their various combinations. The system of “Land-Sky” is a dichotomous pair serving invariant for diverse architectural interpretations, forming new meanings by “transmission of feature to the other text” (according U. Eko). Metaphors of landscape are created on the contrasts of these characteristics, such as mountain-valley, forest-field; or comparisons, for example, field-sea, mountain-sky, field-sky, and others. Paired oppositions stimulate the formation of psychological model, connecting the oppositions and eliminating contradictions between them. The sky is traditionally given in two images with vivid silhouette characteristics – mountains and hipped roofs. Mountain serves as the space image, and the tent – as a symbol of the heavenly restrictions of the inner world of people. Earth is traditionally given chthonic (dark and deep) qualities associated with the world of death. The amorphous mass of the mountain in this capacity is associated with the severity of the bottom-hell. However, “touched” with heavenly protection, “heavenalized” land becomes a favorable place of people’s residence. The city with its vertical structure and regularity is more fully simulating the Heavenly City, connecting the idea of earth and sky.

### **Summary and Conclusions.**

Architectural and spatial environment of the city is a complicated and multivariate system established by life activities (not functioning) of a human. Architectural composition is an idea (fictitious, imagined) represented in material form - it is a real city space. Architecture does not tell about the world: it is the world and its facility, a shift into physical measurement of myths and fabrications, caused by the modern conditions, where fabrications become real owing to the architectural performance. However, when creating this reality, architecture becomes habitual and withdraws into the shadows its own mythical nature breaking up visual ties with fabrication.

Emotionally mythological structures reveal archetypical schemes of architectural compositions. When connecting something natural and artificial into single system, the myths have kept the oldest human experience, and mythologems being the main component of a myth reflected the ineffable: possibilities of contact between a human-microcosm and macrocosm-universum, perception by a human of his or her self-image as a part of the world. The modern humanistic approach invests the world around with complicated associations, and according to the science, ordering of any artistic structure is based on their principles. The world can be seen either as chaos or as space, being always active and emotional. Mythological images are formed as binary oppositions which typically represent mythological relationships – “life – death”, whose symbols are concepts of Chaos and Space.

Architecture is a text which can be understood only by knowing the language which consists of a system of symbols arranged in accordance with the semantic. By creating a narrative arc, defining “the play” (of volumes and scales, of light and



shade, etc.) and controlling moves in the space, the architectural structures “talk” to person through signs, symbols and codes. Architectural signs and symbols compositions in the space generate readable semantic. Creation in reality sustainable features of atemporal “space” order through architectural language in the social realm is represented by the antique thesis: “when the particulars demonstrate themselves as a reflection of universals, they become wonderful owing to that” [3].

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**APPLICATION OF POLYMER COMPOSITE MATERIALS IN THE  
CONSTRUCTION OF FOOTBRIDGES***Perm National Research Polytechnic University,**Perm, Komsomolsky prospect 29, 614990*

Законова Е.В., Клевеко В.И.

**ПРИМЕНЕНИЕ ПОЛИМЕРНЫХ КОМПОЗИТНЫХ МАТЕРИАЛОВ В  
КОНСТРУКЦИЯХ ПЕШЕХОДНЫХ МОСТОВ.***Пермский национальный исследовательский политехнический университет,**Пермь, Комсомольский проспект 29, 614990*

*Abstract. The use of polymer composite materials allow to solve many problems for the construction of pedestrian bridges in urban areas. The main characteristics of the innovative material as well as its positive and negative qualities. A brief overview of the application possibilities of composites in the construction of bridges as well as review completed projects integrally composite pedestrian bridges domestic production. At the moment, composites are poorly understood, not established a complete data Bank on mechanical properties and conditions of their application.*

*Key words: polymer composite materials, composite construction, pedestrian bridges, one-piece composite bridges.*

*Аннотация. Применение полимерных композитных материалов позволяют решить многие проблемы по возведению пешеходных мостов в городах. Приведены основные характеристики инновационного материала, отмечены его положительные и отрицательные качества. Представлен краткий обзор вариантов применения композитов в конструкциях мостовых сооружений, а также обзор реализованных проектов пешеходных цельно композитных мостов отечественного производства. На данный момент композиты являются малоизученными, не сформирован еще полный банк данных по механическим свойствам и условиями их применения.*

*Ключевые слова: полимерные композитные материалы, композитные конструкции, пешеходные мосты, цельно композитные мосты.*

In our time, the question of safety of pedestrian traffic in cities is very serious. The number of accidents at pedestrian crossings shows that the usual ground pedestrian crossings do not provide the necessary level of safety [1]. It is necessary to promote alternative types of pedestrian crossings to solve the problem [2-4]. Erection of aboveground and underground pedestrian crossing is the most efficient solution to this problem, but the construction of such structures is limited due to their high cost [3-4]. In many cases, this problem can be solved by applying the pedestrian bridges made of modern synthetic materials and construction techniques.

Today, reinforced concrete bridges, including footbridges make up about 70% of Russian bridges. It claimed the life of these bridges is 80 years with proper care. But in fact they are no more than 40 years old and need major repairs after 25 years of exploitation. The use of polymeric composite materials (PCM) in structure of the



bridge increases the service life, as they are in many ways superior to traditional materials.

PCM represent a reinforcement base of basalt, carbon or glass fibers are combined in one structure with polyester, epoxy or vinyl ester resins. The fibers of the composite attribute to these materials high strength in tension and compression. Tests of composite materials made by a domestic manufacturer [5] showed that the high strength properties combined with low density, which is 4 times less than the density of steel. Cyclic load less effect on reduction of strength composites, as compared with steel. Low temperatures have little effect on the operation of composite materials, which is important for winter conditions in Russia [6]. Additionally, this material does not susceptible to corrosion.

World experience of application of PCM in bridge construction industry already has about 40 years. During this time it was built more than 400 bridges made of PCM, most of them were pedestrian bridges. Most often hybrid constructions are designed in which are combined elements from traditional materials and polymer elements. The constant practice has included the use of certain non-structural composite elements, ramps, handrails, etc.. Construction with load-bearing PCM elements are constructed rarely, mostly only experimentally. The composite bridge decks are promising today. They are produced in the form of a box-like multicellular structures pultrusion methods [5, 7, 8] or winding [8], or manufactured in the form of sandwich panels by RTM or infusion [5, 7, 8]. PCM profiles include mobile bridge construction blocks as main supporting beams and the central rod as a compressed-stretched truss elements [9, 10].

Pedestrian bridges are built primarily from PCM. Their designs are various systems: beam, arch, cable-stayed. Only the Netherlands has more than 40 such bridges.

Russia's first fully composite 3-Flying-pass overpass for pedestrians has been designed and built by a domestic firm "ApAtEk" [5, 6, 7] in 2004 by the railroad tracks. Its characteristics are: weight of 11.8 tons, length 41 m, width of 3 m. For the first time, the same firm in 2005 erected pedestrian bridge with composite spans and stairs [5, 6, 7]. At present, the main merit of the company "ApAtEk" is the construction in Russia for more than 25 composite bridges.

Another domestic company "Ruskompozit" mastered the production of whole composite bridge span of "sandwich" type structure. They can reach a length of 30 m, a width of up to 3 m. Pedestrian crossing on the highway M1 "Belarus" was built in 2013 and is composed of two spans a length of 21 m.

At the moment, actually develop polymeric structure, adjusting to the possibility of a local manufacturer. Farm lot of truss system, all elements of which are made up of strips of rectangular cross-section has been patented by Ltd. "Opora". The bands may be formed from a flat pultrusion fiberglass or wood chipboard or fiberglass [11].

As a result of 40 years of operating experience PCM pedestrian bridges, these advantages have been identified, marked by the authors [6, 7]: high corrosion resistance of the composite material; absence of corrosion of the connecting elements are in contact with the composite; sufficient resistance to wind loads; seismic resistance; the possibility of delivery in the form of individual modules easily



transportable; lightweight modules and the use of hand-built in remote locations for equipment; the total reduction in the cost of installation and operation, reducing the weight and volume of foundations.

### Conclusions:

1. Composite bridges is not widely used in Russia because of the underdeveloped system of normative and technical literature.

2. The high cost of composite bridge (about 10 times higher than its concrete analog) does not allow to introduce such structures into wide practice of building the pedestrian bridges.

3. Reducing the cost of the composite bridge is a very urgent problem, the solution of which is necessary to use composite structures already produced by domestic enterprises.

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**MEASUREMENT OF STRESSES AND STRAINS IN SOILS AT FIELD CONDITIONS**

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**ИЗМЕРЕНИЕ НАПРЯЖЕНИЙ И ДЕФОРМАЦИЙ В ГРУНТАХ В ПОЛЕВЫХ УСЛОВИЯХ**

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*Abstract. The article discusses the stress and strain measurements in the soil in field research. Also analyzed study questions are modern methods and techniques for determining the stresses and strains in the soil.*

*Key words: stress, strain, soil, field testing, pressure capsule, load cell, strain gage*

*Аннотация. В статье рассматривается вопрос измерения напряжений и деформаций в грунтах при полевых изысканиях, анализируется изученность вопроса, приводятся современные методы и способы определения напряжений и деформаций в грунте.*

*Ключевые слова: напряжения, деформации, грунт, полевые испытания, месдоза, тензодатчик, тензорезистор.*

The soils there are the stresses and strains under the influence of external forces or by its own weight. The study and monitoring of stress and strain are required for various calculations, such as calculation of the deformation, the evaluation of strength, stability of soils and soil pressure on the building envelope and the surrounding structure.

Measurement of stresses and strains in the laboratory has been well studied, the range of equipment has a wide variety. Existing devices allow to carry out all the necessary measurements and get an accurate and quick results. Monitoring the stresses and strains of soil in the field conditions is much more complicated due to the inability to use laboratory instruments and measurement methods.

In field conditions measurement of stresses can be done in two ways - directly and indirectly. When indirect measurements of the soil is done by comparing the parameters before and after the experiments, for example, are assessed compression dependency of soil, compared the unit weight of the soil, etc. In the direct method, using special measuring instruments, immersed directly into the ground. This method has worked well in practice [1-6].

Most of the methods for determination of stresses and strains in the calculation of sediment taken from the theory of elasticity of continuum mechanics. Soil is a discrete multi-phase massive, so the the measurement of stresses is possible for displays of stress-strain state. Usually this is done in the deformations that the stress-strain state causes at a graduated pre-measuring device. This experimental approach is always accompanied by measurement errors associated with the lack of



information about the interaction between the measuring device and ground environment.

The study of problem of stress measurement in soils engaged Russian scientist Golly A.V. He refined and perfected the existing strain measurement technique by using a load cell - pressure sensors on the ground. He also set the value of the load cell measurement accuracy in experiments in the sand and clay, depending on the humidity (consistency) of the test soil. According to his experience, the measurement error is inversely proportional to the consistency of clay [7]. In collaboration with other Russian scientists Golly patented several inventions, simplifying the measurement stresses and strains in soils. The main purpose of the invention is to enhance the functionality and improve the accuracy of measurement, as well as reducing labor costs during the tests [8, 9].

Russian scientists Rykov GV and Skobeev AM engaged in stress measurement in the ground by short-term loads. In his monograph, they led a study carried out in two directions: experimental and theoretical. Experimental studies consisted in the creation of the measuring devices and the development of methods of carrying out the experiments. Theoretical studies was to investigate errors of measurements that depend on the instruments of interaction with the environment [10].

The popularity of the use of strain gauges and load cells in the voltage measurement devices has increased dramatically with the development of strain measurement. More and more scientists began to devote scientific works issue. Baranov D.S., Chudnovsky A.F., Stumbur V.K., Ilisavskii S.E. engaged in the study and improvement of semiconductor strain gauges [11-12].

Smyslov I.I. in collaboration with Rajewski N.P. and Pavljva T.T. invented and perfected a new type of strain gages - dendrite silicon strain gauges. The use of this type of strain gauges possible to obtain more accurate results due to the low sensitivity of silicon to the temperature fluctuations in the array [13, 14].

Currently fiber optic strain gauges are increasingly popular, they have high reliability, stability, durability and noise stability. The use of such sensors has greatly speed up measurements, reduced expectation of results, since the measurements are fully automated, no longer need to manually recalculate the results, produce calibration instruments.

One of the innovative methods of strain measurement is the method of photogrammetry or photographic images, the essence of which is to examine the photographic images taken directly to the place of deformation measurements. In the interest of the site set a number of labels, photographic images held the position of each of them and a special processing program assigns them specific coordinates. Another photographic images produced after a certain influence on the analyzed soil, or after a period of time. Processing software compares the position of the reference mark before and after the exposure, and based on this analysis concludes that occurred deformations. Comparison of the results obtained by photogrammetry and any standard method showed that the measurement error of the first method is small. Therefore, this method may be applicable to the determination of deformations in the ground.



**Conclusions:** 1. Currently, the use of semiconductor strain gauges in the load cell and fiber optic strain gauge is the most perspective. 2. Investigations in the area of measuring stresses and deformations in soils is still not well explored and therefore Further studies are needed.

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Kleveko V.I., Moiseeva O.V.

**THE INFLUENCE OF SOIL BACKFILL WIDTH OF REINFORCED SOIL ON THE STRESS-STRAIN STATE OF UNDERGROUND PEDESTRIAN CROSSING MADE OF CORRUGATED METAL STRUCTURES***Perm National Research Polytechnic University,**Perm, Komsomolsky prospect 29, 614990*

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**ВЛИЯНИЕ ШИРИНЫ ГРУНТОВОЙ ОБОЙМЫ ИЗ АРМИРОВАННОГО ГРУНТА НА НАПРЯЖЕННО-ДЕФОРМИРОВАННОЕ СОСТОЯНИЕ ПОДЗЕМНОГО ПЕШЕХОДНОГО ПЕРЕХОДА ИЗ МЕТАЛЛИЧЕСКИХ ГОФРИРОВАННЫХ КОНСТРУКЦИЙ***Пермский национальный исследовательский политехнический университет,**Пермь, Комсомольский проспект 29, 614990*

*Abstract. Underground pedestrian crossings are much safer pedestrian crossings at the same level, but they lose on its cost. The cost of construction can be reduced through the use of flexible corrugated metal structures instead of standard reinforced concrete shells. For the rational design of pedestrian structures shells need to know their stress-strain state (SSS). SSS corrugated flexible metal shells are largely dependent on the strength and deformation characteristics of the surrounding soil. Therefore, improving the characteristics of backfill soil is an urgent task to reduce the cost of construction of pedestrian tunnels. The article presents the results of numerical analysis of SSS flexible metal shell, depending on the width of the reinforced soil backfill.*

*Key words: corrugated metal structures, pedestrian crossing, tunnel, backfill, sand, fiber reinforced sand.*

*Аннотация. Подземные пешеходные переходы намного безопаснее пешеходных переходов в одном уровне, но проигрывают им по своей стоимости. Стоимость строительства можно снизить за счет применения гибких металлических гофрированных конструкций взамен стандартной железобетонной оболочки. Для рационального проектирования оболочек подземных пешеходных конструкций необходимо знать их напряженно-деформированное состояние (НДС). НДС гибких металлических гофрированных оболочек в значительной степени зависит от прочностных и деформационных характеристик окружающего их грунта. Поэтому улучшение характеристик грунта засыпки является актуальной задачей для снижения стоимости возведения пешеходных тоннелей. В статье приведены результаты численного анализа НДС гибкой металлической оболочки в зависимости от ширины армированной грунтовой обоймы.*

*Ключевые слова: гофрированные металлические конструкции, пешеходный переход, тоннель, грунтовая обойма, песок, армированный песок.*

Pedestrian crossings of underground type in times safer pedestrian crossing with light regulation, but they lose on its cost. The cost of the construction of an underground pedestrian crossing often causes to abandon its erection. The cost of



construction can be reduced through the use of corrugated metal structures (CMS) instead of reinforced concrete shell [1-5].

Previous studies have shown that the optimal section for the organization of pedestrian traffic with minimum dimensions  $2,3 \times 3,0$  m (SP 35.13330.2011) is a round tube with a diameter of 3.98 m [6]. The height of the backfill above the tunnel is 0.4 m.

SSS flexible CMS is largely dependent on the strength and deformation characteristics of soil backfill [7-9]. Soil backfill is the area surrounding of CMS, and perceiving the compressive stress at work with the CMS by the payload. Therefore, improving the strength characteristics of a soil backfill is an urgent task to reduce of pedestrian tunnels construction cost.

To improve the strength and deformation characteristics of soils can be achieved by reinforcement. Currently, there are a large number of reinforcement schemes and reinforcing materials. One of perspective methods of soil reinforcement is the use of fiber filaments. Fiber reinforced soils have significantly higher strength characteristics as compared with unreinforced soils [10].

According to ODM 218.2.001-2009 geometric dimensions of the reinforced soil backfill around the CMS appointed by calculation depending on accepted level of reduction of the horizontal stresses. Thus the width to the top of the soil backfill is not recommended to assign more 3D, and in the level of a horizontal diameter 1,0D - 1,5D in each direction (D – diameter of the tube).

To identify the optimal width of the reinforced soil backfill was carried finite element analysis, which was performed in the software package PLAXIS 2D.

The calculation was performed for the reinforced soil filling of fiber reinforced sand, with the following characteristics:  $E = 30$  MPa;  $\varphi = 45^\circ$ ;  $c = 67.0$  kPa. Characteristics of sand, reinforced by polypropylene fibers in an amount of 0.5% taken from the test results presented in [10]. According to current design standards SP 35.13330.2011 "Bridges and pipes" traffic load was a four-axle truck N14 with axle load 252 (kN) and the distance between the axles 1.2 m.

Calculations of the stress-strain state of the CMS were produced with a width of reinforced soil backfill to 1 m, 2 m, 3 m and 4 m, as well as for ordinary sand characteristics:  $E = 30$  MPa,  $\varphi = 40^\circ$ ;  $c = 1$  kPa (width reinforced soil backfill 0 m)

The results are summarized in Table 1.

**Table 1**

**The results of calculation of stress-strain state of CMS**

Maximum values	The width of the reinforced soil backfill, m				
	0	1	2	3	4
Vertical deformation $S_v$ , mm	29,32	21,88	20,71	19,51	19,23
Horizontal deformation $S_x$ , mm	7,85	9,22	8,72	8,13	7,96
Bending moment $M_{max}$ , kNm	6,5	3,85	3,78	3,71	3,7
Shear force $Q_{max}$ , kN	10,48	7,88	7,83	7,37	7,33
Axial force $N_{max}$ , kN	147,87	162,22	164,28	162,91	160,7
Stress, kPa	105412	62442	61307	60172	60010



The analysis of the calculation results showed that the use of fiber reinforced soil instead unreinforced depending on the width of the reinforced soil backfill reduces vertical deformation CMS on the 25.4 - 34.4%, the bending moment on the 40.8 - 43.1% and maximum stress on 40.8 - 43.1%.

### Conclusions:

1. The use of reinforced soil backfill results in a significant reduction of stress and strain in the CMS.
2. The width of the reinforced backfill soil has little effect on the stress-strain state of the CMS with a minimum height of backfill over the tunnel. Optimum width of the reinforced soil backfill is 1-2 m (0.25D – 0.5D).

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**COMBINED INSPECTION TECHNIQUE OF BUILDINGS AND**  
**STRUCTURES ENVELOPE**

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*Abstract. In the article the combined technique for complex thermography and contact heat engineering inspection the technical state and quality of buildings and structures envelope is presented.*

*Key words: thermography monitoring, heat resistance, heat loss, envelope building.*

**Introduction.** Thermographic method is one of modern researches methods, that allows operatively and effectively non-contact estimating the technical state and quality of building objects. Thermograms give visual information after that determine the surfaces temperature mean values, but for the quantitative estimation of heat losses the thermography data is not enough, that is why it is necessary to carry out the touch probing.

**Input data and methods.**

The combined inspection technique of buildings and structures envelope combines the distance controlled external buildings envelope (BE) temperature fields quality analysis with the use of thermography technique and instrumental determination of environmental heat engineering characteristics: temperature, humidity, pressure and rate of air movement near-by the surfaces BE, with the quantitative contact measuring of surface heat flux density and temperature values in the BE representative zones.

The BE heat engineering inspection for determination of heat resistance actual values, heat transfer resistance and heat losses through BE and establishment accordance degree the building (structure) heat covering state to the modern normative requirements consists of such operation:

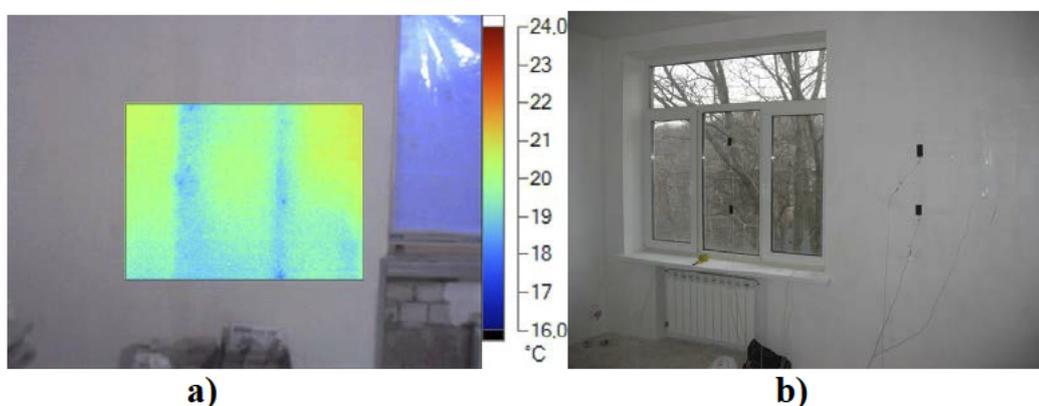
1. preparation to the inspection;
2. visual inspection of object;
3. basic thermography inspection;
4. the contact measuring of heat transfer resistance through BE;
5. measuring data processing and presentation of the results.

At preparation to the BE inspection in verification nature testing it is needed to become familiar with building (structure) technical documentation and choose and adjustment necessary measuring technique devices and ancillaries in consideration of normative documents [1 – 3] recommendations.

By the visual inspection the BE external and technical state by external signs possible defects and damages in building elements at external and internal parties of building, that reduce BE heat cover properties, appears. The external surface



thermography is executed with the simultaneous photographing and measuring of building linear and angular sizes. On results the analysis of thermograms and got temperature fields finally choose a representative zone (zones), that include the maximally possible amount different types of characteristic thermally homogeneous areas, for example, fragment of building facade, that contains the homogeneous area of wall, window, up-a-window beam, area of wall along thermal communications etc. The BE surface selected representative zones partitioning on characteristic thermally homogeneous areas for complete realization the non-touch (Fig. 1, a) and contact (Fig. 1, b) examining and determine among them zero-defects, that have a different construction, that accept for base, and also areas with the rejections of superficial temperature – anomalous, that the external surface temperature differs from the temperature of characteristic base area more than 2 K.



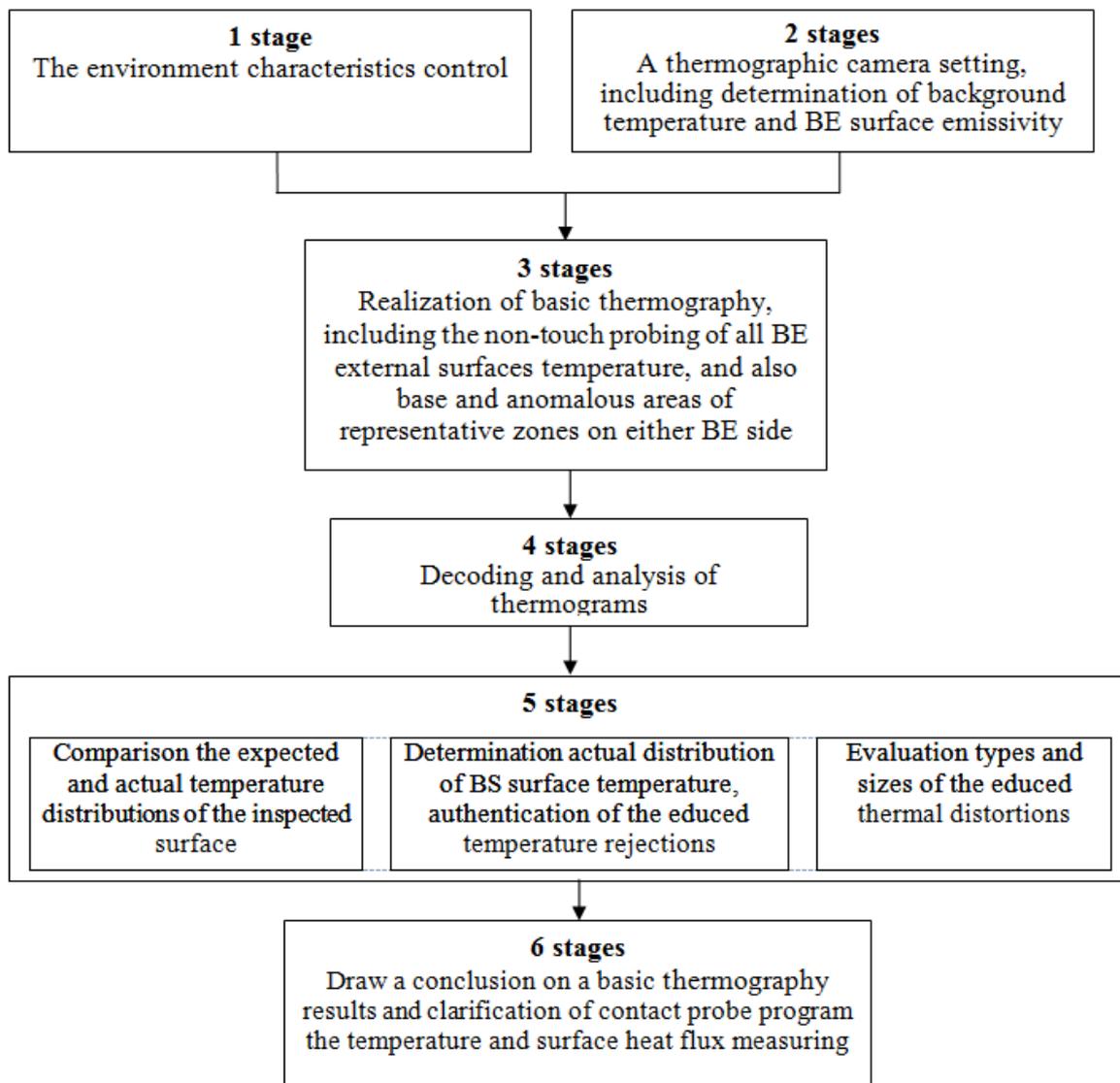
**Fig. 1. Thermograms (a) and location of sensors at contact researches (b) of internal BE surface**

The basic thermography inspection of building (structure) heat-insulation shell is point to the non-contact study of BE surface temperature distributions with simultaneous clarification of measuring works for the calculation the chosen representative zones area values and also separate characteristic areas, base and anomalous. The basic BE thermography inspection structure and maintenance operation are shown at Fig. 2.

The purpose of the touch probing is determination the BE thermophysical characteristics (surface temperature and heat flow density) actual values at external environments. The complete set of primary heat flux and temperature sensors assembled on the BE surface in obedience to requirements [2, 3] is using for the contact measuring. For sensors electric signals registration and measuring information accumulation it is expedient to apply the automated measuring device which record and save data in a form comfortable for further computer treatment.

### **Results and discussion.**

Measuring information that is got during building (structure) heat engineering monitoring contains linear sizes for calculation the separate characteristic areas and representative zones area, general BE area (heat-insulation shell of building) and lengths of the heat-conducting including, and also arrays of primary heat flux and temperature sensors current values signals and other involved devices data.



**Fig. 2. The BE temperature fields non-contact determination action diagram**

Processing of all this data and calculation heat engineering parameters and characteristic (heat exchange coefficients, the modified heat transfer resistance, general transmission heat losses) values is carry out on technique [3]. The building (structure) heat cover inspection results are making up corresponding documents and basic is the building (structure) energy passport appendix that must satisfy requirements [1] and [4].

### Conclusions.

The developed combined inspection technique allows to carry out the building (structure) heat engineering monitoring with the purpose of their thermophysical properties control on the stages of building, acceptance, further exploitation, thermoconversion, reconstruction and major repairs, and also at the energy passport compiling.

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**METHODS AND DEVICES FOR INSULATION MATERIALS  
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**МЕТОДИ ТА ПРИЛАДИ ДЛЯ ВИЗНАЧЕННЯ ТЕПЛОПРОВІДНОСТІ  
ТЕПЛОІЗОЛЯЦІЙНИХ МАТЕРІАЛІВ***Національний університет біоресурсів і природокористування України**Київ, Героїв Оборони 15, 03041*

*Abstract. In this article the review of modern methods and structural charts of devices for the heat-insulation materials and products effective heat-conducting coefficient determination is presented*

*Key words: insulate, heat conductivity, guarded hot plate, heat flow meter.*

*Анотація. В роботі представлено огляд сучасних методів та конструктивних схем приладів для визначення коефіцієнта ефективної теплопровідності теплоізоляційних матеріалів та виробів.*

*Ключові слова: теплоізолятори, коефіцієнт теплопровідності, захищена гаряча плита, тепломір.*

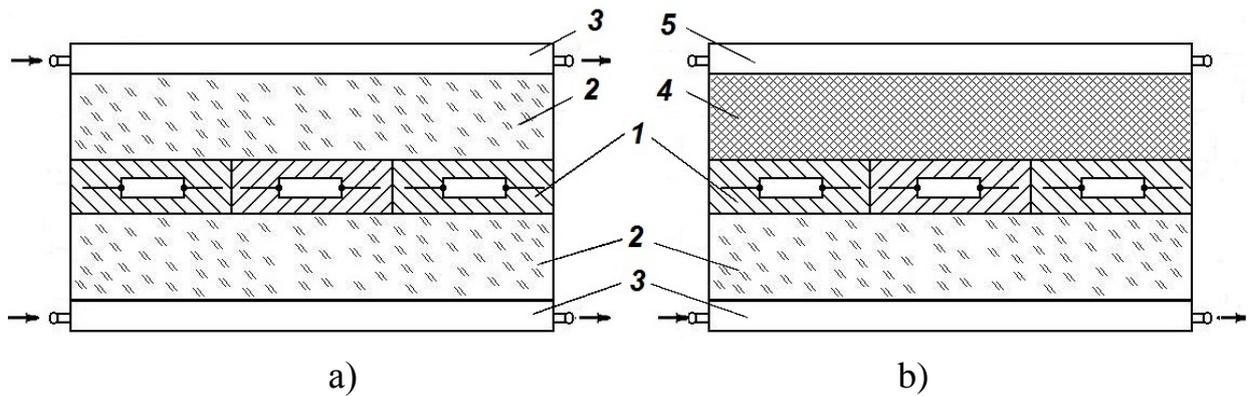
**Entry.**

An effective heat-conducting coefficient is for today one of the main quality indexes hard heat-insulation materials that is used for housing and industrial building, and also for the isolation of equipment and pipelines for an environmental heat losses reduction. For the heat-insulation building materials and products quality estimation and certification by their thermophysical properties the International Organization for Standardizations (ISO) considers it necessary application of heat-conducting measuring methods in the stationary thermal mode. It is predefined by the heat insulators unhomogeneity and, accordingly, nonisotropic of their thermophysical characteristics.

**Basic text.**

The insulation and building materials heat-conducting coefficient measuring in Ukraine is now rationed by the international standards ISO 8302: 1991 [1] and ISO 8301: 1991 [2] and by the national standard ДСТУ БВ.2.7-105-2000 (ГОСТ 7076-99) [3]. These standards are regulate the stationary plate method, that consists in creation of stationary heat flow, that passes through the flat test sample of certain thickness in direction perpendicular to the facial (most) verges of the sample, determination the heat flow density, opposite facial verges temperature difference and thickness of the sample.

This measuring charts (Fig. 1, 2) are recommended in the normative documents to be used at measuring devices creation.



**Fig. 1. Structural charts of guarded hot plate device [1]: a) – device with one sample, b) – device is with two samples**

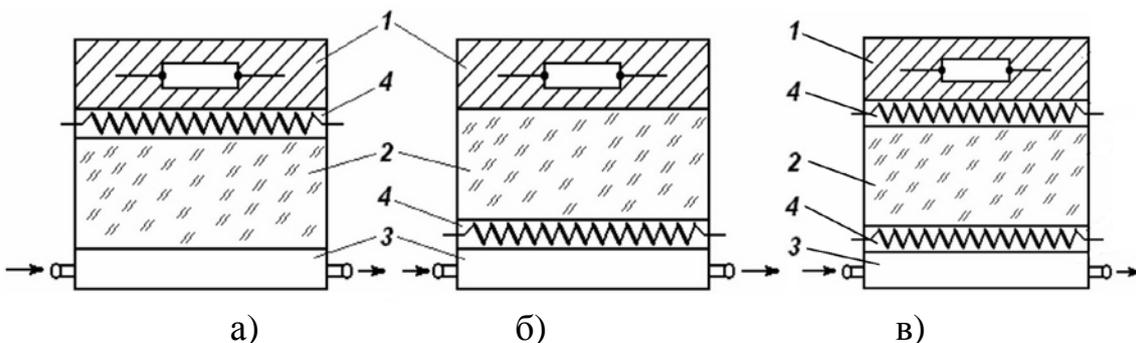
The guarded hot plate method is absolute by the heat conductivity determinate technique, and measuring system configuration can be realized on a symmetric chart (Fig. 1, a) that contains a heat-insulating shell with the system from a few heaters 1, located between two identical test samples 2, and on an asymmetric chart with one test sample 2 (Fig. 1, b), where a heat flow passes through a sample, and the back of heaters works as a protective isolation that provides an experiment adiabatic term. The heat flow density through a test sample is determined by the electric power value  $P = U \cdot I$ , that is given on the devices central heater, its square  $F$  is known, and the heat conductivity  $\lambda$  is calculated by formulas:

– for a symmetric chart 
$$\lambda = P \cdot h / (2F \cdot \Delta T), \tag{1}$$

– for an asymmetric chart 
$$\lambda = P \cdot h / (F \cdot \Delta T), \tag{2}$$

where  $h$  – thickness of sample,  $\Delta T$  – a difference of the sample verges temperature; for a symmetric chart  $h = h_1 = h_2$  and  $\Delta T = \Delta T_1 = \Delta T_2$ .

Basic limitations during work on the guarded hot plate method devices consist in difficulties of continuous support the onedirected heat flow with a permanent density, exact measuring of power, that is given on a central heater, and temperatures, and also in a necessity to provide the maximal identity of structure, thickness and surface quality of both samples at the use of symmetric chart. In addition, large attention it follows to spare to quality of tangent surfaces contact planes for the contact thermal resistance minimization.



**Fig. 2. The heat flow meter apparatus charts [2]: a), б) – asymmetric with one sample; в) – symmetric with one sample**



In the heat flow meter devices (Fig. 2) a heat flow that is created by heater 1 and refrigerator 3 is onedirected and pierces simultaneously the central zone of test sample 2 and the sensitive zone one or two identical heat flow meters 4. On surface heat flow density ( $q$ ) measuring results or at entrance, or at the exit from a sample in an asymmetric device, or simultaneously at entrance, and at exit of sample in a symmetric device, and also difference of its working surfaces temperature values, the sample heat-conducting coefficient is calculated by formulas:

$$- \text{ for a symmetric chart} \quad \lambda = 0,5 \cdot (q_1 + q_2) \cdot h / \Delta T, \quad (3)$$

$$- \text{ for an asymmetric chart} \quad \lambda = q_1 \cdot h / \Delta T. \quad (2)$$

**Conclusions.** Thus, the insulation materials and products effective heat-conducting coefficient determination maximally effectively can be certain on the heat flow meter apparatus, or on guarded hot plate device. If devices are equipped by the thermo-electric transducers of heat flux and temperature (thermocouples), the process of measuring is substantially simplified at simultaneous reduction of amount necessary secondary devices that are advantage at implementation of the mass technical measuring.

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Буро́ва З.А.<sup>1</sup>, Де́куша О.Л.<sup>2</sup>**ТЕПЛОМЕТРИЧНІ ПРИБАДИ ДЛЯ КОНТРОЛЮ ЯКОСТІ ТЕПЛОІЗОЛЯЦІЙНИХ МАТЕРІАЛІВ**<sup>1</sup> Національний університет біоресурсів і природокористування України

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*Abstract.* In this article the complex of the device providing the building insulation materials heat-conducting coefficient and heat resistance measuring in laboratory and field conditions is presented.

*Key words:* insulation, heat conductivity, heat resistance, stationary mode, probe express-method.

*Анотація.* В статті представлено комплекс приладового забезпечення вимірювання коефіцієнта теплопровідності та теплового опору будівельних теплоізоляційних матеріалів в лабораторних і натурних умовах.

*Ключові слова:* теплоізоляція, коефіцієнт теплопровідності, тепловий опір, стаціонарний режим, зондовий експрес-метод.

**Entry.** For realization the enterprises thermomodernisation measures and energykeeping technologies implementation it is necessary first of all to apply quality modern heat-insulation materials. It should be noted that heat-insulation materials are considered, if there heat conductivity is from 0,02 to 0,2 W/(m·K).

**Basic text.** For the insulators quality evaluation by their effective heat conductivity and thermal resistance measuring in laboratory terms the measuring complexes ИТ-7С [1] developed by IET are function in Ukraine. They are intended for researches of wide assortment of building and heat-insulation materials according to the operating standard of ISO 8301:1991 [2]. The heat-conducting of coefficient measuring from 0,02 to 3,0 W/(m·K) with the rationed error  $\pm 3\%$  come true after the heat-metrical plate method in the stationary thermal mode in the working temperature range from minus 40 to 180 °C on samples by a size 300×300×120 mm (max).

In the complement of complex ИТ-7С (Fig. 1, a) enter thermal block 1, intended for an experience material sample placing and providing the necessary temperature and thermal conditions, electronic block 2 with facilities for the thermal modes adjusting, acceptance, treatment and measuring information transfer and block 3 for thermocouples supporting shuts thermostating. For comfort of test sample placing into a measuring cell (Fig. 1, b) a thermal block is set on a lifting-movable platform



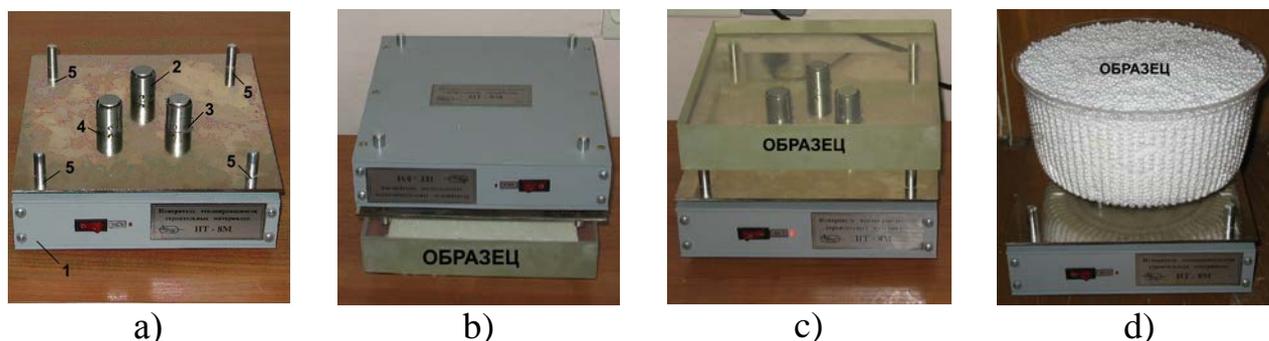
4. During realization of researches in temperature conditions more subzero, a thermal block is concluded into a climatic chamber 5.



**Fig.1. Зовнішній вигляд комплексу ИТ-7С**

Except the building materials samples tests in stationary laboratory terms there is a necessity for realization the heat-conducting coefficient express measuring at manufacture for the fabricated products quality control before ordering to the object, or directly at the assembly place for sorting the unstandard elements. In this connection the compact portable devices ИТ-8М (Fig.2, a) [3] was designed by IET for building and heat-insulation materials express heat conductivity measuring by a probe method.

In the device ИТ-8М the local thermal influence method is realized on a flat surface limit zone of test sample or finish product, that can be free-form, but must have one flat surface or assume her preparation. Sizes of this surface must be not less than 200×200 mm, and a test sample thickness not less than 100 mm.



**Рис. 2. Зовнішній вигляд приладу ИТ-8М (а) та варіанти його розміщення при дослідженні різних зразків (с – d).**

The device ИТ-8М provides the heat-conducting coefficient measuring from 0,02 to 1,5 W/(m·K) with an error  $\pm 6\%$  in the working temperature range 10...40°C, time of measuring folds 5 min, time to operation state – 25 min.



Structurally in a general body 1 (Fig. 2, a) a thermal block and elements of electronic block are combined, and measuring information is from touch-controls built-in in a working probe 2, probe-reviewer 3 and temperature probe 4, passed on the USB interface into a notebook, where its calculated. Horizontal surfaces of body 1 equipped by legs-terminators 5.

Device is 250×250×85 mm size, and 3,5 kg weight. Device can be set on a test sample (Fig. 2, б) or directly on the isolating layer of industrial equipment, creating preliminary necessary terms for the experience correct realization, and to estimate quality of its heat-insulation by a non-destructive method.

**Conclusions.** Devices created by the IEF NAS of Ukraine specialists are metrology attested SE “Ukrmetrteststandard” as the unstandardized facilities for thermophysical characteristics measuring. They are able to provide the European level of heat-insulation materials quality control on their design, production and exploitation times.

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