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KYIV NATIONAL UNIVERSITY OF TECHNOLOGIES AND DESIGN**

FASHION DESIGN IN A MULTICULTURAL SPACE

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The collective monograph contains the results of the synthesis of theoretical materials, as well as the authors` applied research developments on the design of the clothes of different assortment and purpose, made from different materials considering the modern scientific methods.

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PREAMBLE

Clothing as a result of design activities is created in accordance with the general laws and methods of shaping of any design object. The pressing issue of modern fashion design is not only solving of the functional task of creation of ready-made products but also ensuring of the artistic expressiveness of the clothes in the context of fashion and imaginative and stylistic trends of the specific time, the harmonious perfection of shape, considering the properties of the materials and other components. A wide range of modern textile materials, rapid changes in fashion, constructive and stylistic diversity of modern clothing, as well as the rapid introduction of computer-aided design technologies necessitate the innovative conceptual approaches to the clothing design, that is why the monograph is relevant comprehensive research. The monograph considers the problems of fashion design from the perspective of art and technologies.

The first section presents the results of an artistic search in the clothing design, with attention paid to both historical experience and prospects for the development of modern design trends. Clothing is considered as a “shape – material – structure” system, in the context of which the basic principles of tectonics for clothing design are formulated. The means of composition regarding the organization and harmonization of the shape of clothing in the context of the research are considered, the structural and logical scheme of taking into account the properties of fabrics at different stages of clothing design is developed. The authors determine the artistic and compositional characteristics of the tectonic structure of new promising models in the development of the theory of costume shaping based on the analysis of modern shapes of the classical suit in combination with other styles in the collections of British, French, Italian and Ukrainian designers. Also, the artistic and aesthetic problems of evolution of the uniform as an object of design activity are generalized, the analysis of its historical development as a component of the project culture is given, the cultural phenomenon of the uniform, its traditions, symbolism, and characteristic features of the development are studied. The part of the research is devoted to the identification of the factors that influence the selection of jewelry and accessories to the costume within the systematic approach to the process of artistic design, based on the principles of harmonious shaping of accessories and jewelry in the “costume system” and associative shaping of the costume considering the principles of bionics.

The second section of the monograph is devoted to the problems of the integration of art and technologies into the clothing design. The authors consider the use of principles of transformation in the design-projecting of the clothes, theoretically substantiate and form an information base of the

elements-transformers to create modern special and uniform clothes, and structure their range depending on the types of clothes and operating conditions. Also, the research is devoted to solving the problem of improvement of design-projecting of special and uniform ergonomic clothes with predictable reliability indicators by harmonizing the shape and establishing the unity of ergonomic and aesthetic properties. The issues of design of school uniforms are comprehensively considered: the history, modern trends, the analysis of the basic components, color combinations, and proportionality of sets of school uniforms in Ukraine and other countries of the world. The introduction of modern tools of ergonomic design into the process of industrial design is offered. On the example of the development of sports and children`s clothes, the ways of realization of such stages of designing as “design-research” and “design concept” are considered. Also, the analysis of modern information technologies used in the design of the clothes is carried out, the situation regarding three-dimensional designing of the clothes, including the consideration of the properties of fabrics, is analyzed.

The collective monograph contains the results of the synthesis of theoretical materials on the issues of design of the clothes made from different materials, based on the tectonic approach and modern scientific methods, as well as the results of the authors` applied research developments on the design of the clothes of different assortment and purpose.

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1 CREATIVE SEARCH IN THE DESIGN OF THE CLOTHES: HISTORICAL EXPERIENCE AND PROSPECTS

1.1. TECTONICS AND COMPOSITION OF CLOTHES IN THE SHAPE-FORMING PROCESS

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Abstract. *The work is devoted to the development of theoretical and methodological fundamentals of the design of the clothes as a practical component of technical aesthetics, based on the study and critical analysis of the use of basic principles of tectonics in a holistic shape-forming process. The concept of “tectonics” in the shape-forming compositional process has been analyzed; the tectonic approach as a mean of technical aesthetics for the design-projecting of garments, which considers the properties of the fabrics, has been substantiated. The classification of tectonic systems of clothes has been offered; their characteristics and main features have been described; the regularities of the influence of model and stylistic, functional, structural and technological factors, as well as flexible properties of the fabrics, have been outlined.*

Key words: *properties of the fabrics, design of the clothes, computer design, model of the clothes, involute of the surface of the clothes, “mannequin – clothes” system.*

Introduction. Clothing as a result of design activity is created under the common principles and methods of shaping, applicable to any objects of the design. The actual problem of the modern design-projecting of the clothes is not only the solution of functional tasks for the manufacture of finished products, but also the provision of artistic expressiveness to the clothes in the context of fashion and imaginative & stylistic tendencies of the given period of time, the harmonious perfection of the shape, taking into account the properties of the materials and structural & technological features of the manufacture. The wide range of modern textile materials, the rapid change of fashion, the structural and stylistic variety of the modern clothes, as well as the rapid introduction of computer-aided design technologies, – all of the above necessitate the latest conceptual approaches to the design of the clothes. It is known that the tectonic approach, which is widely used in the process of shaping of the objects of architecture and industrial products, is implemented in the art of design of the clothes; it is one of the effective means of creation of aesthetically

perfect and compositionally organized designs with a high level of consumer quality of the finished products.

The works of T.O. Berdnyk, Yu. H. Bozhok, I.T. Volkotrub, V.G. Vlasov [5], H.B. Minervin, Yu.V. Nazarov [9], T.V. Nikolaieva [10] and Yu.S. Somov are devoted to the problems of tectonic shaping of the objects of architecture and industrial products.

Nikolaieva T.V. in her work [10] analyses the tectonics of shaping of the costume and the compositional principles of designing of harmoniously perfect clothes. H.S. Horina [6], T.V. Kozlova, A.I. Cheremnykh in their works do research on the relation of the shape of the clothes and the properties of the materials; but as to the clothes, the artistic design and shaping are considered in most works mainly at the compositional level within the artistic and graphic search for the original shapes of the clothes, and the structural and technological solution of the clothes, as a rule, does not consider the compositional and tectonic aspect.

The scientifically grounded selection of optimal means of shaping at the designing and manufacturing stages within the modern variety of fashionable shapes of clothes, which contain different complex solutions, as well as the need to take into account the tectonic and flexible properties of the modern textile materials are the important problems of designing of the clothes. The use of tectonic approach in the theory of design of the clothes together with the computer-oriented technologies will provide an opportunity to use different textile materials effectively, to expand the range of garments, to increase the efficiency of the design & production process by reducing the number of stages of working out and fitting of the clothes, and to improve the fit of the clothes significantly.

Statement of the problem. The purpose of the research is to generalize the scientifically grounded approaches to the design of the clothes, using the laws of tectonics; to formulate the basic principles of tectonics for the design of objects; to determine its place in the general model of shaping of the clothes.

Results of the research and their discussion. Tectonics as a mean of shape-forming process is used in the design of the architectural environment, machines, and mechanisms, as well as products of object design, which are used in everyday life.

Tectonics, as a shape-forming aspect, should be used in the design of the clothes to produce imaginative and flexible, three-dimensional shapes, made from various textile materials with the use of traditional and innovative technologies. The tectonic approach to the design of the clothes is one of the scientifically grounded effective ways of improving the qualitative indicators of functional and aesthetic production of the modern range of the light industry products, which has a direct dialectical connection with the development of the cultural level of the society (Fig. 1).

Tectonics of the clothes means the design of the clothes, which takes into account the properties of the materials, the rationality of their use through the visual reflection in the outer form and in the design of details. The consideration of the tectonic aspect ensures the harmony of shape, preprograms the correct impression about the purpose of the clothes, the features of the technology used for its manufacture, and the properties of the materials.

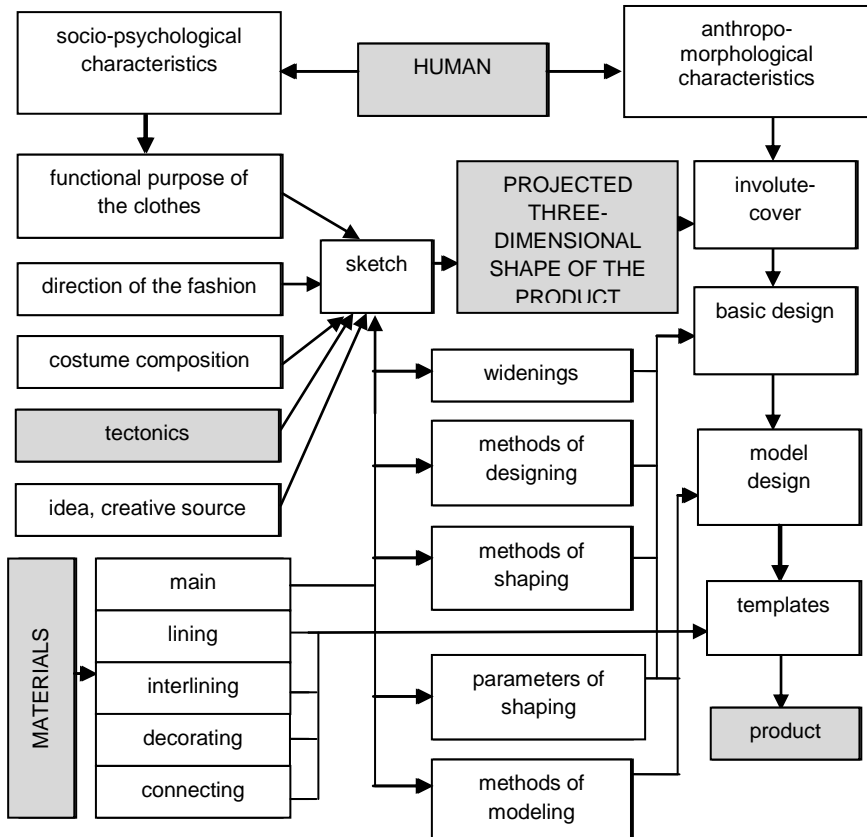


Fig. 1. General model of shaping of the clothes

The tectonic approach is based on the study of the process of creation of a given shape of the design objects, on the identification and study of regularities of their integrity and harmony. The basic principles of tectonics in the design of the object, their place in the modeling of the individual components of the holistic process of design have been

determined. The basic principles of tectonics in the design of the objects can be formulated as follows: consideration of the purpose, consumer and production requirements; consideration and rational use of the properties of materials in order to solve the artistic & design and technological problems of designing; assurance of the constructive expediency of the shape in the design and in the decoration; adherence to the basic principles of harmony, composition, and so on.

The main characteristics of the tectonically balanced product are the perfection of its content and shape, the direct correlation between such characteristics, and its aesthetic value. The relation between the components of the shape is the main property of the aesthetic quality of the products, which is manifested through the morphology of the shape and its parts, proportions, distribution of masses, etc. The model of a balanced triangle of efficiency of the design process, based on the modified Euler-Venn Diagram, is presented in Figure 2. This model provides that the optimal result is achieved when the indicators take the optimal values, which are internally balanced.

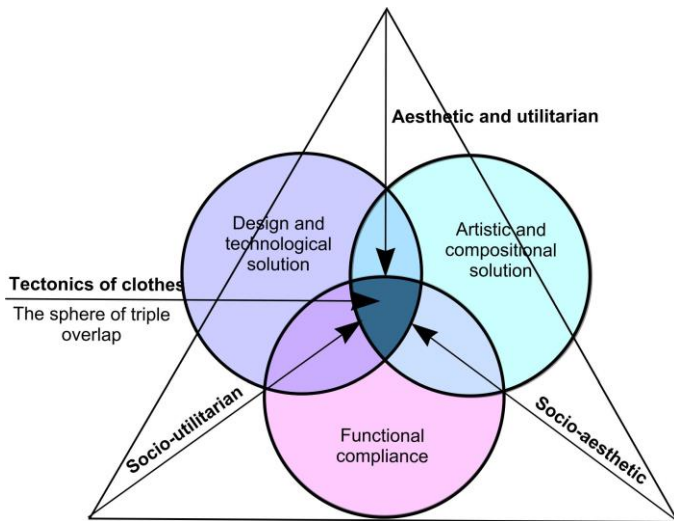


Fig. 2. The place of tectonics in the model of the efficiency of the process of design

The substantive content of the concept of “tectonics of the product”, which is directly related to the problematics of the research, as the unity of shape of the product of design and the material, which influences the qualitative indicator of aesthetics and conformity of the designed image of the finished product to its functional purpose, is substantiated. The

interpretations of the combinations of words “tectonic principles”, “tectonic approach”, “rational tectonics”, “anti-tectonics”, and “a-tectonics” are formulated.

The concept of tectonics is predetermined by the personal visual and tactile perception of the product, as well as by the evaluation of its artistic content. It is concluded that the anti-tectonic approach to the design-projecting of the clothes is based on non-standard combinations of the materials, changes in their properties, the experiments with the shape of the clothes, deliberate violation of the rules of composition, the use of non-traditional methods (for example, avant-garde, deconstruction, etc.), which can be found in the collections of well-known designers. This approach is supported by the designers, who use non-traditional methods (for example, avant-garde, deconstruction, etc.) in their work and intentionally violate the rules of composition. Such designers as V. Westwood, M. Margiela, A. Demeulemeester, D. Bikkembergs, D. Van Noten, and others represent this direction; their designs are mainly focused on the *epatage*, the embodiment of a certain artistic image, rather than on the perfect fitting of the product or the good cut. If the clothes of tectonic shape have a harmonious combination of the properties of materials, design, etc., then the anti-tectonic product is a “bad” combination of the characteristics, listed above. The products designed under the anti-tectonic principles also have their consumers, as today there are no clearly defined criteria for conformity of the product to the fashion or aesthetic ideals; originality and individuality are appreciated. The concept of a-tectonics in the design of the clothes can be described as a mismatch of the shape and the construction of the product, of the materials used and its functional purpose.

The harmony of the product is conditioned by the connection between the composition and the functional, technical and economic requirements [7]. Tectonic product is a complete composition based on the subordination of the general form of the product to the basic idea of its functional purpose, in relation to which a general scheme of its composition is developed. It is based on emphasizing the basic idea that determines the expediency of composition of the elements of product and selection of the materials for its manufacture.

The means of organization and harmonization of the shape of clothes in the context of the study of the qualitative level of its tectonics are considered; the statement that the tectonic approach should take into account not only the compositional laws of design but also the properties of the materials that ensure the required level of functionality, ergonomics, and aesthetics in general, is formulated (Figure 3).

The peculiarities of the scientific approach to the solutions for the problems of design of the clothes consist in the influence of the dual nature of creative processes on the execution of the design-project [12]. The

duality is manifested in the use of expressive and purposefully adapted designer's activity in the creation of design images of the clothes.

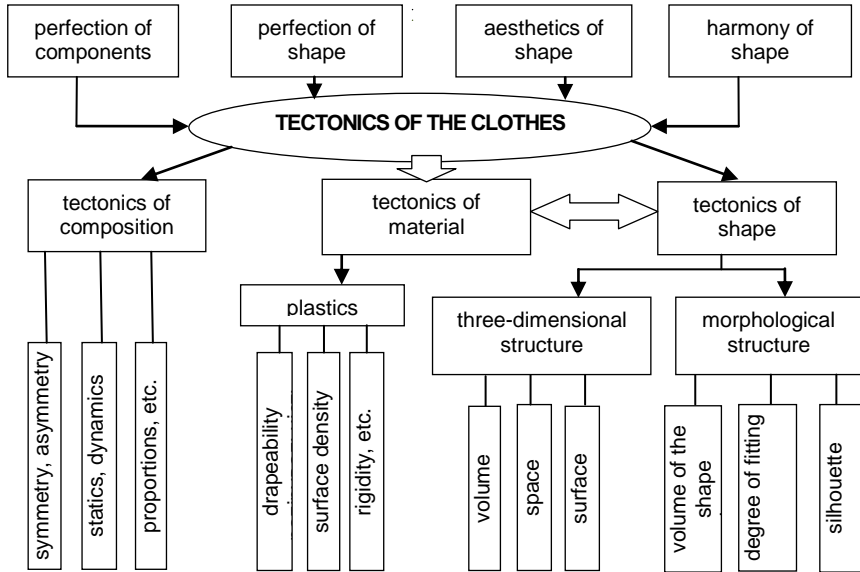


Fig. 3. Factors that create the tectonics of the clothes

The main purpose of compositional matching of tectonically perfect shape of the product is the purposeful modeling of aesthetic perfection of the costume that is achieved by embodying the expressiveness, integrity, perfectly balanced composition with predetermined static or dynamic characteristics. The harmony is achieved by the creation of a complete “human-clothes” compositional system, which ensures the unity of content and artistic form, subordination to the visual perception of human appearance.

When designing a tectonic shape of the clothes, the main purpose of the compositional design of the product is to find such connections and relationships between the elements of the costume form that would reveal and fully contribute to the expression of aesthetic and functional content of the created model of the clothes. The functional purpose of the costume, the proper proportioning of its parts, the confectioning of the materials, and other factors must be properly combined, expressing the basic idea and functional purpose of the clothes [13].

To create different types of balancing of the compositional arrangement of clothes, such common means as rhythm, balance, symmetry, asymmetry, dynamics, and statics of the form are used. For all

types of artistic creativity, the harmonization of three-dimensional structures of different tectonic forms is carried out considering the auxiliary means of harmonization (module, proportions, rhythm, scale, etc.).

The harmony (in design) means the proportionality of the elements, the coordination of the shape of the parts of the product, the consistency of their plastic, color and compositional characteristics, the overall compositional organization, which altogether ensure the achievement of the integrity of the product as an object of aesthetic perception and evaluation. The main means of composition (the means of the first level) are proportions, rhythm, and scale. The means of the second level are symmetry, asymmetry, dynamics, statics, contrast, identity, and nuance [4].

The main task of the design of the costume is to achieve its expressiveness, perfection, integrity, balance, and liveliness. Expressiveness and perfection of the artistic image embody the emotional perception of the shape of the costume and are common indicators that characterize the aesthetic quality of the model. Integrity and balance at the general level characterize the aesthetics of the correspondence of the elements of costume and are the characteristics of the compositional solution for the model.

The integrity of the costume`s composition combines a fair amount of the rational connections between the elements of the costume. The excess amount of the elements of composition negatively affects the visual perception of the model of clothes; therefore, the compactness of the shape and the parts on the whole is the basic condition for the integrity of the composition. The balance of the composition is an important characteristic of the tectonics of the costume. Each element of the composition should be visually perceived in a balanced, stable state. To balance the composition, it is necessary to balance all the elements of the form to each other. The presence of the compositional balance in the costume is the main factor that affects its perception. The compositional balance in clothes, depending on its functional purpose, can be achieved in different ways: if the product is extremely functional, then its shapes repeat the outlines of the shape of the figure. The problem of the compositional balance of the functional clothes is solved geometrically – by duplicating the contours of the shape by the contours of the clothes [6]. In festival clothes, where the shape of the costume is emphasized and accentuated the most, the compositional balance is solved by contrasting the shape of the costume with the shape of the figure.

It is known that the statics of the composition means a stable position of the shape of the costume, which is characterized by the visual absence of movement [10]. The statics of the composition is characterized by a state of calm and stability. The dynamics of the composition is an unstable position of the shape, which is characterized by the presence of movement of its elements. The dynamic composition is characterized by

the change of form, development, and movement. The selection of either static or dynamic organization of the costume's composition is made by the designer on the basis of the functional purpose of the product.

Considering the above, the main task of the compositional harmonization of the tectonically perfect shape of the product is a purposeful visual communication of the aesthetic perfection of the costume and its direct functional purpose, which are achieved by designing a clear, integral, perfect, balanced composition with given static or dynamic characteristics [11].

The shape of the costume is shaped and a harmonious combination of its elements is achieved through the proportioning. The proportioning of the costume includes the development of the system of proportion of the elements and the parts of the shape to achieve their harmonious integrity. The proportioning of the general form of the clothes can be in two directions: during the creative search for the tectonic shape of the product, and when the tectonics of the shape of the clothes is driven by the characteristics and the structure of the package of materials. The material determines the shape of the product; the tectonics of the shape of the product directly affects the structure of the clothes. The balance of the shape and plane fragments, which are separated by the structural lines, is achieving in accordance with the logic of the material's behavior, considering the dynamic movements of the wearer [7].

The shape-forming factors that determine the process of purposeful creation of a holistic, relevant, aesthetically perfect shape of the product, in which its components are figuratively reflected, are the conditions for harmonization of the shape by means and techniques of composition on the basis of its principles and laws. Without the use of means and techniques of composition of shaping, the product of the design-process can only be functionally, operationally, constructively, technologically and economically relevant [8].

The scale of the shape of the costume and its elements is also quite important for the compositional balancing of the clothes. Properly scaled costume ensures the aesthetics of the composition and operational comport of the clothes. In the composition of the costume, the rhythm is expressed in the alternation of shape-forming divisions, planes, lines, details, and is used to bring the different elements of the shape into a whole thing. The use of rhythm makes it possible to achieve the harmonious expressiveness of the costume. The means of subordination of the elements, such as contrast, nuance, and identity are used for the visual comparison or separation of the individual elements of the costume composition.

Therefore, the tectonic shape of the clothes, which has the consistency of the parts of the whole and the artistic unity, is a harmonious one. The harmony reveals the common logic of the combination of the

shape and functional content of the product. The developed classification of means of compositional matching of the tectonic shape of the clothes is provided in Figure 4.

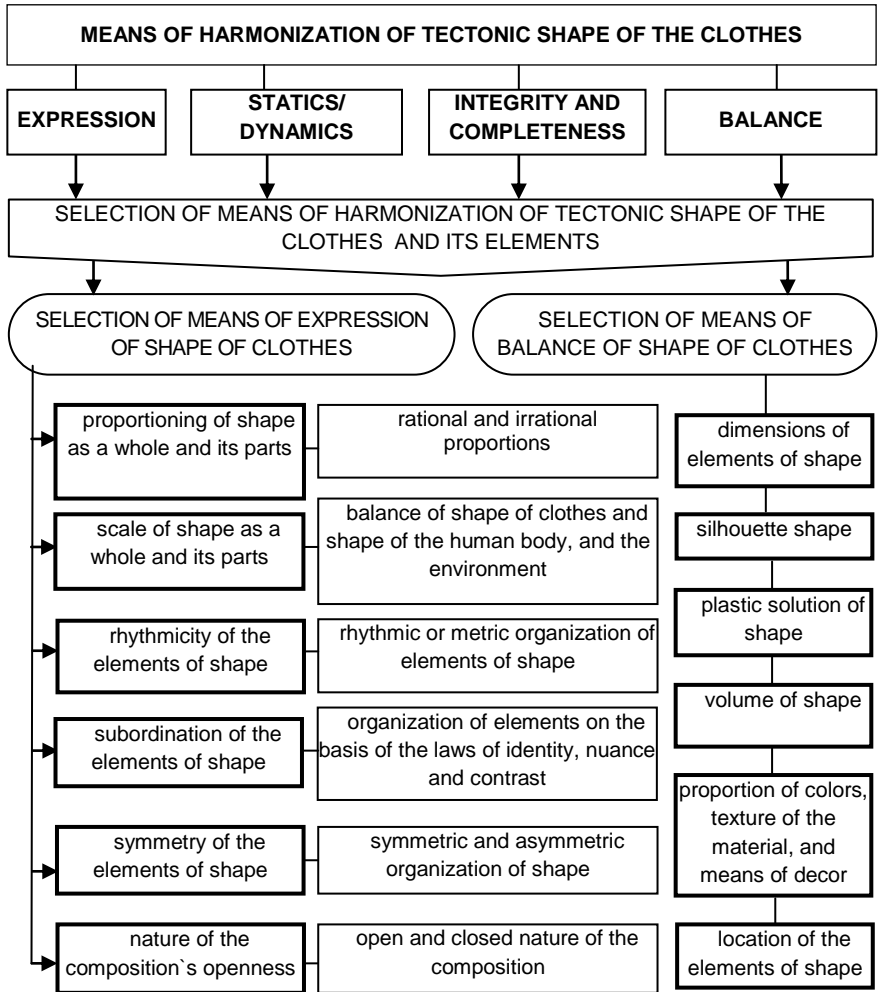


Fig. 4. Classification of means of compositional harmonization of tectonic shape of the clothes

As known, all means of composition in design, architecture, applied and decorative and fine arts are directly related to geometry. The geometric properties mean the proportion of basic parameters, the dimensions of all directions of shape, the angles between the linear and planar elements, the

nature of the contour line, the shape-forming points, etc. Such properties form the main aesthetic characteristics of the appearance. The process of spatial, volumetric or planar shaping cannot be separated from the geometric comprehension of the composition [15].

To have a structural view of the shape-forming components of the costume, its images are divided into separate flat geometric shapes, which are the parts of the general planar contour. Figure 5 illustrates the example of the analysis of the model of women`s clothes at the sketch level, which makes it possible to imagine the silhouette of the future product and to structure it. Such stylized images (projections) are used by the fashion designers not only in the design practice but also during the demonstrations of the designs.

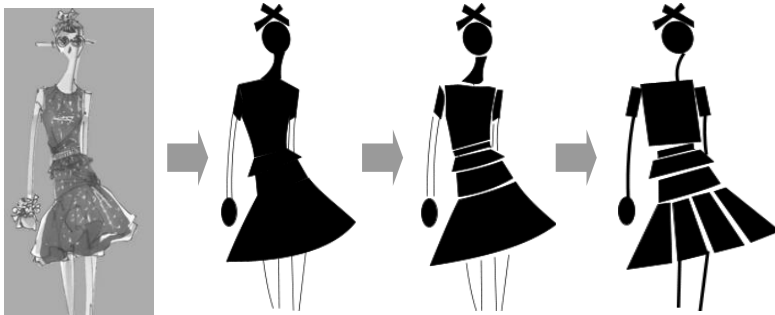


Fig. 5. Structuration of a general outline of the model of women`s clothes at the sketch level

The structuration of the silhouette of the design of clothes provides information on the parameters of the designed shape. The structure of the transformation of graphic information in the “sketch-clothes” system is analyzed, and it is found that for the structural representation of the shape-forming components of the costume`s shape, it is advisable to divide its image into separate flat geometric shapes, which are the parts of the general planar contour. At the sketch level, decomposition operations provide an opportunity to study the structure of the tectonic shape of clothes, to distinguish the basic forms in the general solution, and to determine the algorithms for its transformation. During the analysis of the transformation of graphical information in the “sketch-clothes” system, it is found that among the variety of shapes of clothes, two types of shapes can be distinguished: the basic type and the derived type, which, as a rule, is formed by the use of means of combinatorics with the use of the methods of transformation. Based on the structuration of the silhouette shape of the

design of clothes, the method of development of volumetric geometric models is proposed to obtain information on the parameters of shape.

To specify typical combinatorial variations, the structural analysis and the classification of typical elements of the costume by shape, size, etc., as well as the analysis of their placement, have been performed. When designing at the level of combinatorial systems of shaping, the order of displacement of the initial elements-transforms is the most important. The specifics of the combinatorial shaping of costume consist in the conformity with the geometric regularities, as well as in the use of operations of combinatorial symmetry.

The dependence of the emotional perception of the costume on the expressiveness of its shape is determined, which is non-verbal information medium and is given by the three-dimensional plastic structure of the costume and the means of compositional division. The “golden section” is selected as a size-modular mean of harmonization for various imaginative and silhouette shapes of clothes (Figure 6). To determine the optimal sizes of details of clothes, a compositional coordination of the division lines is applied by using the value-added network.

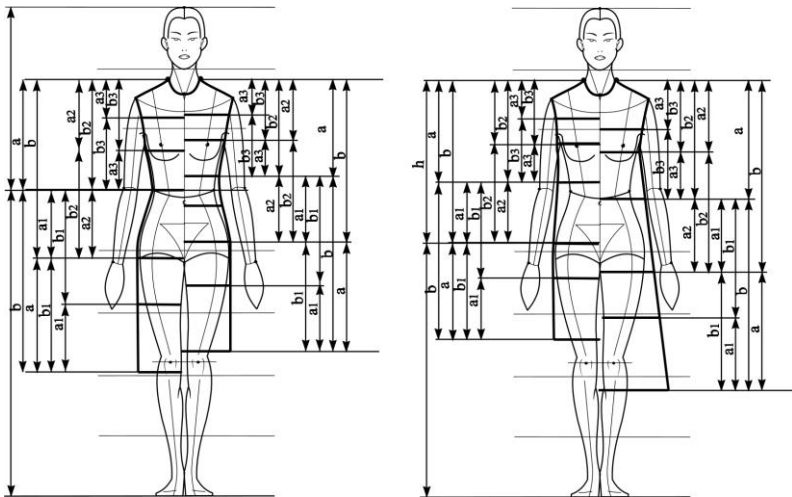


Fig. 6. Harmonious divisions of women`s clothes of different silhouettes according to the traditional rank of the “golden section”

The analysis of dynamics of change of the shape of the modern costume has shown that the widespread use of combinatorial method of shaping with the use of geometric primitives makes it possible to carry out design activities in two directions: the creation of new structural designs and the variation of the initial elements. The synthetic combination of such

procedures is the basis of the conceptual model of the modern design of clothes, which takes into account the tectonic principles of shaping.

As it is known, the initial material (fabric, knitted or non-woven fabric, etc.) determines the way of shaping of the clothes, and the ways of shaping the finished product determine its stability of shape and stability of shape of its elements [1-3]. There are two main approaches to the selection of the materials for clothes: the designer approach and the industrial approach. In a design approach, users first select the material that meets the specified characteristics, and then design a product from such material. In an industrial approach, users first analyze consumer demand for the products, modern trends and characteristics of consumers, develop the sketch of the model, and then select the material for its manufacturing. The industrial approach is more grounded and cost-effective for garment enterprises.

The process of designing the clothes includes many interdependent stages: starting from the formation of the task for the creation of the new model of clothes to the development of documentation for the model and its industrial production [11, 12].

The first stage of the design of clothes is the formation of task for the creation of new model of clothes, which grounds and clarifies the basic requirements for the styling-design development of the product, namely: its functional purpose, compliance with the basic requirements of a particular group of consumers, design and technological solution, as well as substantiates the basic consumer and technical & economic requirements for the product being designed. After the specific requirements for the designed product are formed and the group of consumers is analyzed, the series of sketches of the clothes are developed. The laws of composition, aesthetics and the principles of tectonics are taken into account at this stage.

Depending on the sketch of the clothes, the method of modeling and the fabric with certain properties that allow taking the desired shape are selected. The process of designing a new model of clothes involves the analysis of the assortment of textile materials, suitable for its manufacturing, their physical, mechanical, shaping, aesthetic and other properties. The steps of the selection of fabrics in the industrial production of clothes are presented in Figure 7.

It should be noted that the selection of the materials requires the experimental determination of the properties of fabrics for scientifically grounded selections [1 – 3]. It is important to determine the main characteristic of the fabric that will reproduce the shape of the product (for example, drapeability or thickness). The ranking of requirements for the clothes depends on their purpose, and the selection of the material is determined by the basic requirements.

Next, the methods of product shaping and the design solution are determined, and the constructive divisions, their number, location, as well

as the methods of processing, are selected. In the process of searching for the compositional and constructive solution of the product, the models in the material that reflect the features of the new model and the degree of its compliance with the given requirements can be made [13].

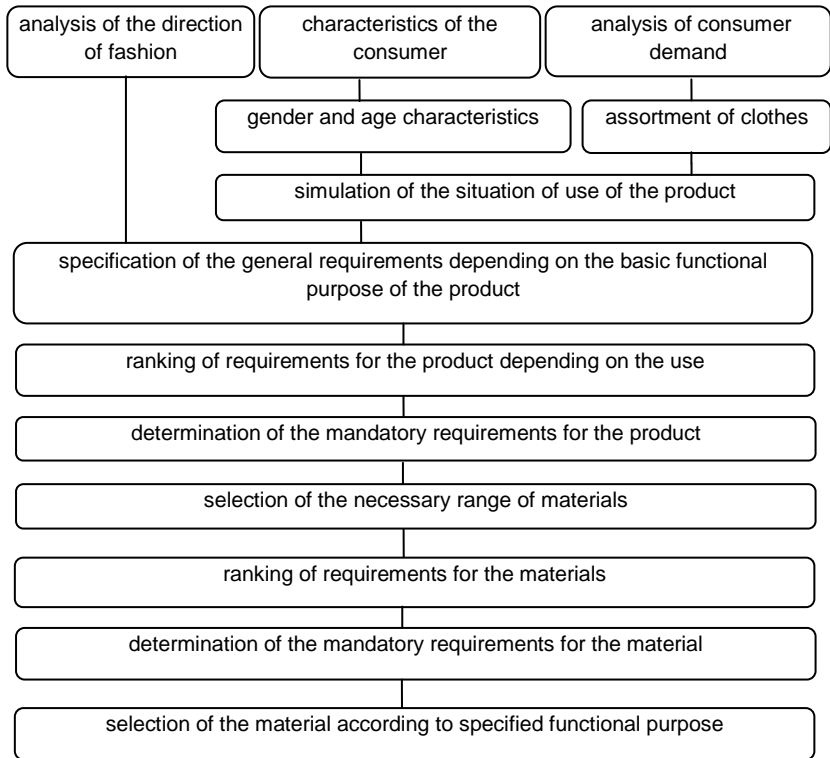


Fig. 7. Formation of the requirements for the selection of fabric in the industrial designing of the clothes

The most important step in the design of the clothes is to find the tectonic shape of the clothes and to work out its elements, which will reflect the basic idea of the product and its functional conformity. After a detailed working out of the sketch or the prototype of the product, the general scheme of the constructive solution for the product is developed, and the appropriate placement of knots and decorative elements in the product are made up. As a result of working out of the sketch, the best option to reflect the content of the product via the details of its shape is found. One of the steps of this process is the development of the shape of clothes on the

basis of the tectonic approach, starting from the idea and to the prototype or to the finished product (Figure 8).

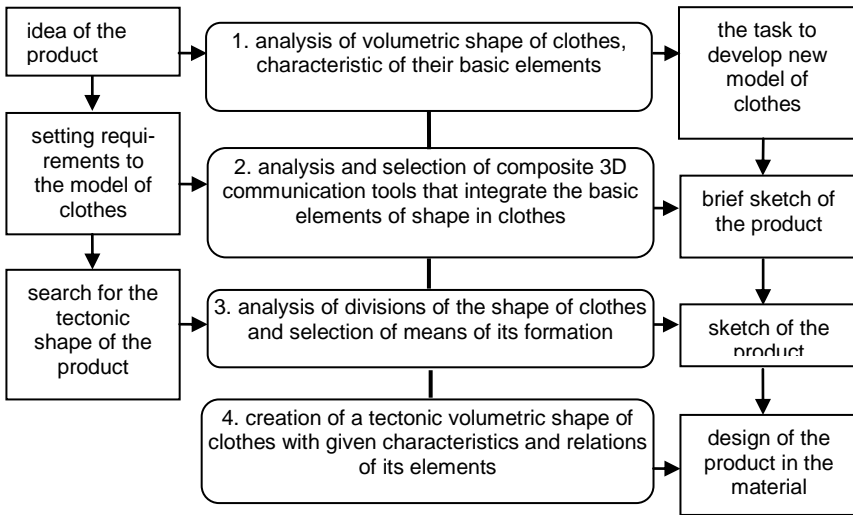


Fig. 8. The creation of tectonic form of clothes with predicted characteristics

After the form and the constructive solution of the product are developed, the variants of its technological processing in the material and the conformity of the selected method of shaping of the product to its main artistic idea are specified. Both the artistic working out of the primary image of the design and the development of the conceptual scheme of its structural and technological solution come down to the selection of the sketch, which most fully conform with the requirements for the product and the approved artistic and design concept, on the basis of which the design and technological project is developed.

Summing up all of the above, the main task in the design of the clothes is to create a tectonic shape, which will reveal its content. Such a tectonic shape should meet the requirements for the design of the product. The general scheme of taking into account the properties of the materials at different stages of design-projection of the clothes is presented in Figure 9.

Thus, from the tectonic point of view, in the design of the clothes, the first step of the tectonic shaping of clothes is to determine their functional purpose, which, in turn, determines the basic principles of organization of its spatial form. The second step is to specify the properties of the materials and to find a constructive solution for the selected tectonic

three-dimensional shape. The analysis of plastic, shape-forming, and operational properties of the materials significantly influences the selection of the construction of the parts. The revealing of the aesthetic significance of the shape, its constructive solution, and the logical selection of the material required by the properties contribute to the harmonious integrity of the costume.

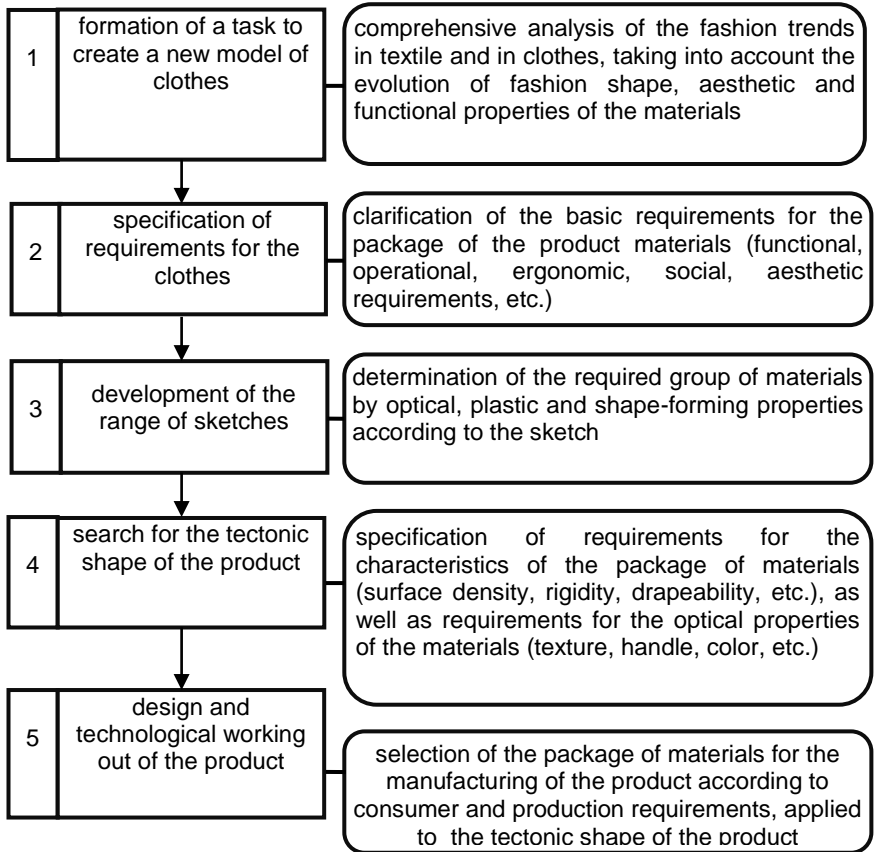


Fig. 9. The sequence of works during the creation of the products of tectonic shapes, which take into account the properties of fabrics

Therefore, the consideration of the properties of materials, as well as the use of principles of tectonic shaping in the design of the clothes make it possible to carry out the design activities rationally and to create harmonious solutions for the clothes.

Conclusions. The preconditions for the use of the tectonic approach as a creative method of technical aesthetics are specified. The

concepts of tectonics, a-tectonics, and anti-tectonics in the design of the clothes are considered; the basic principles of tectonics, which concern the design of the objects, are formulated; the place of tectonics in the general model of shaping of clothes is determined. The means of composition for the organization and harmonization of the shape of clothes in the context of the analysis of the qualitative level of its tectonics are considered. Also, it is stated that the tectonic approach should take into account not only the compositional laws of design but also the properties of the materials, which provide the required level of functionality, ergonomics, and aesthetics in general. The dependence of the emotional perception of the costume on the expressiveness of its shape is determined, which is a non-verbal information medium and is given by three-dimensional plastic structure of the costume and the means of compositional division and combination. The “golden section” is selected as a size-modular mean of harmonization for various imaginative and silhouette shapes of clothes. On the basis of the paradigm of dialectical unity of functional and aesthetic laws of clothes shaping and compositional and technological properties of the fabrics, the sequence of design-projection of clothes and the algorithm for the rational selection of materials depending on the initial design conditions are considered.

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1.2. AESTHETICS AND TECTONICS OF FORMATION IN ARTISTIC MODELING OF A COSTUME

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Abstract. *The article is devoted to the study of the tectonics formation problems of the design objects and determination of aesthetic quality indicators. In many modern design practices, in many cases, the subjective-intuitive approach to defining the aesthetic qualities of design objects prevails, which does not always ensure their proper quality. Insufficient validity and reasonableness of these types of design decisions, lack of aesthetic evaluation, manifestation of subjectivism cause the creation of poor quality of design decisions. The main objectives set in the scientific work are to determine the condition and proven nomenclature of aesthetic indicators, their systematization, analysis and modeling of each aesthetic factor on the main features (aesthetic value, weight, interconnectedness). Identifying the essence and meaning of the concepts of architectonics and tectonics of formation, which combine rationality, efficiency and functionality, contributes to the comprehensive refinement of projected objects of design and the entire subjective environment of human existence.*

Key words: *tectonics, shaping, aesthetic qualities, systematization, perfection of design, costume.*

Introduction. A necessary prerequisite for the creation of new design technologies in design is the renewal of the theoretical and methodological basis of this process, from the design of models by the designer to the manufacture of design products and its advertising. Such an approach requires the active development of modern scientific means of design, which have developed at the junction of basic and applied sciences and art. One of the main directions in design is the development of new tools and methods of shaping design objects, taking into account the artistic and compositional patterns [1].

The theory of formation determines the regularities of the optimal aesthetic embodiment in the appearance of the designed products of their purpose, functional essence, material-constructive and technological basis. The interrelation of the perfect internal content with the optimal appearance allows to achieve a harmonious unity of usefulness, convenience and beauty in the works of design. In the designed product the theory of formation is embodied as one of means of creative process of creation of comprehensively finished objects [2].

The theory of formation allows to achieve in the process of designing the material and information-aesthetic relationship of the internal content and external form of design objects, to provide a visible artistic embodiment

of the purpose, functional essence, spatial organization, and constructive-technological design [3, 9].

Different aesthetic requirements are put forward to different products of industrial production. If beauty should be possessed, if possible, by industrial goods, then separate products: vases, hours, unique furniture, including clothes, should have special aesthetic properties. Such products are classified as works of industrial art [5]. One of the conditions for increasing the aesthetic value of industrial products is to master the means and methods of building a beautiful shape of the projected objects [6]. The science of composition has a complex of such means. This branch of science has not yet reached the stage of development at which one could speak of its laws, as in the exact sciences. So far we can only talk about the general laws of construction of the form of objects based on the laws of nature and harmony [8].

Therefore, it is extremely important to determine the essence of aesthetic requirements for design objects, artistic and compositional characteristics of the construction of the tectonic structure of new promising models in the development of the theory of costume design.

Results of the research and their discussion. The methods of using the laws of composition change with the development of science and technology, as well as with the change of artistic and aesthetic concepts about the beauty of the objects of the human environment.

When deciding on the shape of the costume as a whole and its individual parts, it is necessary, first of all, to strive to ensure that this shape meets social needs and utilitarian-functional purpose as much as possible. Therefore, the design of any thing should begin with the study of its utilitarian purpose and functions and the possibility of their embodiment in aesthetic form.

*In modern design practice, the essence of the first principle of the theory of formation can be expressed briefly by the following formula: **benefit + convenience + beauty.***

The main factors that determine the essence of the first principle of artistic design are the following:

1. Progressiveness – the desire to achieve progressive parameters, technical perfection of the structure, its greatest compliance with the specified requirements and functions.

2. Constructiveness – achievement of the maximum possible simplicity and expediency of a design, the maximum compactness.

3. Technological – ensuring the simplicity and convenience of manufacturing, assembly and adjustment of parts, assemblies and structures.

4. Economy – ensuring high economic efficiency of structures and technologies in production, operation and operation.

5. Reliability – increase of operational qualities of a product and clarity of its work at normal modes, guarantee durability, simplicity and safety of service.

6. Ergonomics – providing convenience of operation, service of products, conformity to parameters and functions of the person.

7. Aesthetics – achieving the integrity, proportionality and expressiveness of the shape of the product, its best compliance with the materials, structure and purpose[9].

It is impossible to create a complete design project without prior and consistent scientific elaboration. The process of artistic design of a costume is divided into stages that in methodological terms have common features with the stages of design and are part of this process (fig. 1).

The design of new design objects begins with the assembly and formation of the task. The task briefly specifies: the functional purpose, the envisaged constructive-technological solution, the special requirements proposed for artistic and design development. The design task can be issued both for modernization of an existing product and for perspective design. When studying and analyzing the task, the main requirements must be specified: functional-operational, social, psychophysiological (dictated by the environment and specific conditions of consumption), technological, constructive, economic and artistic-aesthetic [4].

After studying the literary sources and field samples, the designer, in collaboration with the designer, begins to develop sketches in several versions. Sketches are presented in the form of artistic images and technical drawings that give a clear idea of the projected object.

An extremely important stage in the design of modern forms of costume is to determine the requirements for the aesthetic quality of the designed objects, ensuring high tectonic and significance.

In search of the aesthetics of the compositional solution of the product, it is also necessary to use three-dimensional means – models made in different materials. Development of drawings, drawings, the sketch project of production of models is searches of the basic idea of a product, its arrangement and generalization of the form. This process begins after a detailed study of the task and artistic and constructive analysis of the future object on the basis of analog models.

The work on the sketch variants includes the analysis of the basic sign-symbol of the form, expedient composition of the structure of knots and separate details and ends with the most responsible creative work on the external form and color of the product, logically connected with the content and aesthetic tasks.

Composing the shape of a design object – one of the most important moments of the process of artistic design. The process of composing a design object is performed by both the designer and the design engineer.

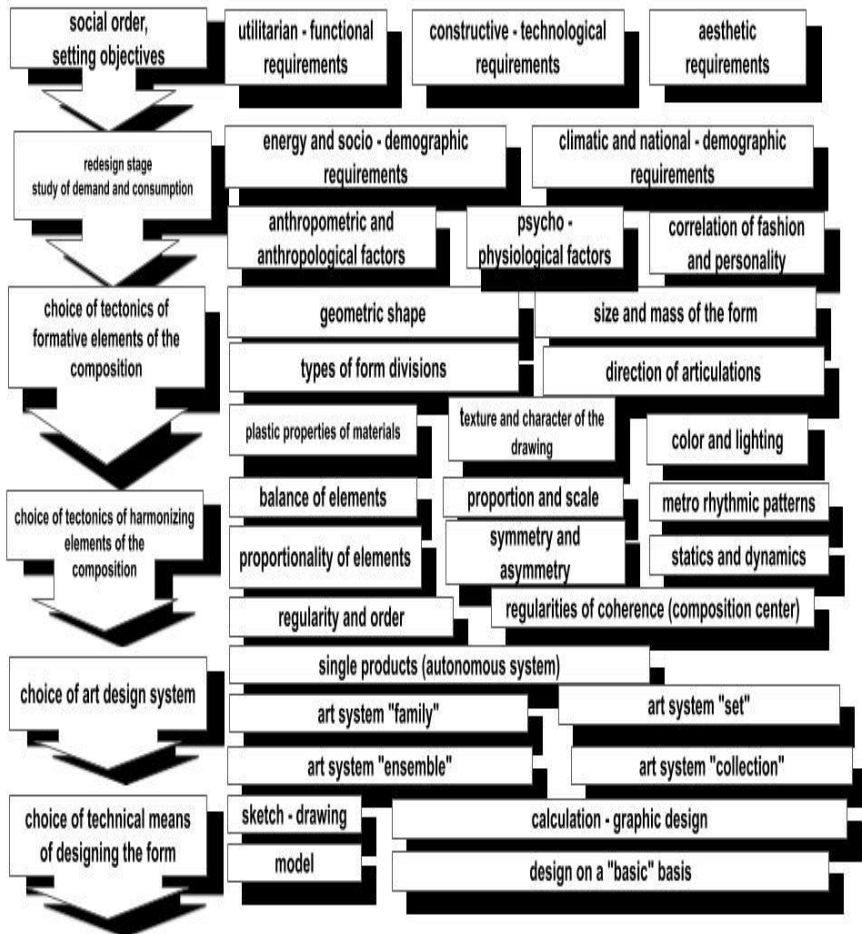


Fig. 1. Algorithm for tectonic shape construction in design of costume

The further creative process is a compositional refinement of the form which has arisen under the scheme of formation. Aesthetic qualities of the product are related to specific conditions and tasks that determine its shape and internal content [6, 7]. Obligatory and very difficult condition of tectonic formation in the process of artistic design is observance of laws of harmonization: expedient subordination of the main ones has well-thought-out proportions, scale, degree of static or dynamic, symmetry or asymmetry, rhythmic or metric system.

Analysis of the artistic and design proposal – represents an intermediate stage, at which the choice of the best of the presented variants of the optimal solution of the shape and structure of the costume takes place. Art and design project – represents the design stage, which involves in-depth development of the art and design proposal, taking into account the comments and optimization tools adopted in the process of project analysis.

The last stage is working design and author's supervision, execution of elements of industrial graphics and advertising, preparation of accompanying documentation, presentation of a new design project.

Nowadays, on the basis of new scientific data, new approaches and technical possibilities, an objective combined method of aesthetic quality assessment of design objects is formed, which combines computational and intuitive assessments with the necessary degree and in full form. This method is based on a reasonable, sufficiently complete and reliable combination of objective and subjective elements of aesthetic evaluation, in the form of a combination of aesthetic characteristics and intervals of their optimal values, mathematical models and subjective initial and final evaluations of the designer. In this method of evaluation, the level of beauty is partially determined numerically, by compiling indicators of individual aesthetic properties, taking into account their specific values in the overall aesthetics of the object. The method uses not only subjective aesthetic ideas, but, to a greater extent, the criteria of harmony, which are determined on the basis of scientific analysis and generalization of a large factual material and practical experience of the designer.

The search for solutions is based on intelligent harmony in design as interaction, organic unity of the properties of the shape of the object with certain evaluative ideas in the human mind, the fusion of subjective artistic tastes with social aesthetic advantages. The starting point is to understand the objective principles of aesthetics of design objects, the design process, as a synthesis of all the individual capabilities of designers, knowledge and skills transformed into creative intuition.

The emotional influence of the design object and its form is the source and specific basis of aesthetic properties and their evaluations. Aesthetic assessment of the designed form is its emotional assessment, taking into account the degree of expediency, socio-functional and constructive-technological content of the form, ie assessment of the content of the design object.

The approach to the definition of the nomenclature of aesthetic properties and their classification and systematization confirm the importance of this factor in the process of designing new forms of costume. Indeed, the main goal of design (creation of a new optimally constructed object or object) is achieved by providing the created project with as many optimal aesthetic properties as possible [9].

The aesthetics of one or another property of an object is called certain characteristics and indicators of aesthetic value, which are a means of aesthetic evaluation of this factor. The name of each aesthetic property includes, as essential, the terms "aesthetics" and "compositionality". Thus, the impression of the whole set of aesthetic properties of the designed object, a holistic assessment of its beauty and attractiveness is called aesthetic quality. This is the first hierarchical level of the system and the main aesthetic goal of artistic design and tectonic formation of the costume.

Aesthetic quality is a complex structure due to the fact that it specifically reflects many objective characteristics of the designed product, representing the visual-emotional aspect of perception of its three-dimensional structure, absolute dimensions of silhouette shape, color, texture, degree of staticity and staticity. subordination of constituent elements.

The complexity of aesthetic quality depends, in particular, on the stage of realization of the artistic product. Aesthetic evaluation of the object made in the material differs from the evaluation of the project due to the degree of perfection of implementation and operation.

The components of the aesthetic quality of the generalizing character are the aesthetics of the form as a whole and the aesthetics of all its main parts. The general aesthetic impression of the composition of any type and type of object must include an assessment of the whole form as a whole and the individual structural components that fill this form. The main components of the main aesthetic properties of aesthetic quality (aesthetics of unity in diversity, order, proportionality, balance) are identified and taken into account in stages: partly in the form as a whole, partly in the basic structures.

For objects of high degree of complexity, the general structure of the model of their aesthetic quality consists of the indicator of the aesthetics of the form as a whole and the indicators of the aesthetics of the main parts. It can be partially modified by the values of the weight of these main components, as well as by their composition and utilitarian-functional, ergonomic tasks.

That is, for each type of projected object characteristic of the level of tectonic complexity, some clarification of the composition of specific indicators of the basic model of aesthetic quality is necessary, which is the subject of further development and modeling of aesthetic properties of composite elements. The aesthetic quality of any complex object of design necessarily includes, in addition to the main aesthetic properties of the form as a whole, also the aesthetics of the main parts of the form. The purpose of design, in relation to this property, is that the main parts of a complex designed form as most appropriate and most fully meet the aesthetic criteria of tectonics (fig. 2, 3).

Analyzing the above, we can make the following generalizations. The structure of the system of aesthetic properties, in the aspect of designing new forms of a costume, is the structure of differentiated goals – from the most general to its intermediate and most elementary stages.

Analyzing the above, we can make the following generalizations. The structure of the system of aesthetic properties, in the aspect of designing new forms of a costume, is the structure of differentiated goals – from the most general to its intermediate and most elementary stages. A general systemic property, especially at the level of means of harmonization, is that the absolute majority of them form dialectically integral, opposite properties-oppositions, which describe the harmonization of the object in their relationship: nuance-contrast, symmetry – asymmetry, static – dynamic and etc. Such oppositions also form some aesthetic properties of the third level of the system, namely: the aesthetics of originality – banality, unity in diversity. The importance of aesthetic properties is a systemic feature, which in its essence reflects the qualitative and quantitative role of the significance of each of the factors in their whole set, complexes, system. The significance of aesthetic properties, as a rule, is different between the elements of different hierarchical levels: the higher the level to which the aesthetic property belongs, the more capacious it is.

The fundamental compositional-aesthetic, architectural regularity of the unity of form and content is decisive in the modeling and evaluation of all aesthetic properties. It is manifested in the form of formalized or intuitive criteria, basic indicators of the characteristics of aesthetic properties, the most appropriate and perfect forms with which to compare specific objects. Based on the above, the aesthetic impression of the object as a whole or its individual properties is more positive in nature and higher in level, the closer the value of this property in the analyzed object to the base (optimal), and the more important this factor to create aesthetic project (for example, the higher value of tectonicity and three-dimensional structure of the object in comparison with its decorative design).

The dependence of the aesthetic properties of new forms of costume on the corresponding characteristics and parameters is the first internal aspect of relationships of various kinds. Since all the aesthetic properties of an object also influence each other, this is where the external aspect of their relationship is revealed. For example, the dependence of the visual dimensions and "materiality" of a form on its color, plastic and tonal divisions. Another aspect of the interaction of aesthetic properties is their relationship with the factors of the functional-ergonomic series. This relationship can be generally considered as an independent factor: the aesthetics of utilitarian-functional perfection, which establishes, firstly, the very correlation between usefulness and beauty, and secondly, the direct nature of their relationship and interaction.



a



b

Fig. 2. Design based on the assessment of aesthetic quality:
a – objective, b – subjective



a

b

**Fig. 3. Costume design based on the assessment of aesthetic quality:
a – objective, b – subjective**

Some researchers consider the connection between aesthetics and ergonomics to be the most important. At the same time, all interactions of aesthetic properties and related visual and emotional effects are still in the nature of additions, without fundamentally changing the main impressions of each of these objective properties, in particular, the aesthetics of three-dimensional structure, absolute dimensions, material, color, etc. So, there are all the principles to consider the described set of aesthetic properties as a multifactorial, multilevel, structured hierarchical system with a dialectical unity of integrity and autonomy. From this follows the conclusion about the possibility of applying an integrated method for determining the assessment of the aesthetics of complex properties and indicators in the systematic design of new design objects.

An important aspect of the aesthetic quality of the objects of artistic design of a costume is also aesthetics, as a derivative of utilitarian-functional and constructive-technological perfection. In other words, it is an aesthetic assessment of the utilitarian quality of the designed form. The aesthetic value of this property lies in the fact that the whole set of utilitarian properties of the design object is perceived simultaneously, both visually-emotionally and aesthetically, assessing the level of this aesthetic derivative so far as the visually and vividly depicted properties are reflected. The purpose of this factor, as one of the elements of the design process, is to create an emotionally expressive, artistically perfect, architectural form based on the formation of a comprehensively utilitarian-perfect object, ie absolutely functional, constructive-technological, ecological [4].

The criterion of aesthetics of utilitarian perfection is the maximum social-utilitarian, functional perfection of the design object, which is clearly and vividly reflected in its form and tectonic structure. This capacious aesthetic property is directly related to the general utilitarian-functional quality of the design object and can be evaluated by its value, but not by the coefficient of not utilitarian, but aesthetic weight in the general system of aesthetic evaluation. Formalization of this complex aesthetic property, its parameters and criteria is practically unrealistic, therefore the expedient means of its consideration is an expert estimation, in particular, on the basis of the general structural and logical model of formation.

The aesthetics of the three-dimensional structure and tectonics of the art form is the visual-emotional perception of the most important primary property of the form, its physical basis and two main components: material volume and open space. In the design of the harmonious three-dimensional structure of the form, one of the main complex compositional and aesthetic problems, the solution of which is designed to provide the design model with optimal values of such properties as aesthetics of expediency, beauty of integrity, certainty, unity, diversity, diversity. is compliance with the laws of tectonic formation. Objects of tectonic design

have not only utilitarian, but also a specifically defined and closely related to the purpose of structural, ie three-dimensional typology. One of the main components of the overall aesthetics of the three-dimensional structure is the tectonic structure of the material and color. The essence of this compositional-aesthetic property is that the objects of design of different utilitarian-functional type, different characteristic purpose have their own, same characteristic, but quite different in specific outlines three-dimensional structures and their geometries. The more obvious and emotionally expressive in a certain form is this correspondence, integrity, tectonics, the higher we evaluate the aesthetics of this form. In turn, the tectonicity of the three-dimensional structure is a complex property. It includes such two components as the aesthetics of the three-dimensional structure of the form as a whole and the aesthetics of the distribution and correlation of the main parts of the structural composition.

The criterion for tectonicity of the three-dimensional structure of the costume is the maximum visual-emotional proportionality of the parameters. The nature of the aesthetic value of this factor – in its high informative richness, visualization of such a basic and universal for everything around us, signs of perfection and harmony, as the unity of form and content of the basis of the object and its structure.

Emotional, aesthetic influence on the person of the absolute sizes of this or that form, or object is one of the strongest in general aggregate properties. Understanding large, small or medium-sized forms is always a conscious or intuitive assessment of its dimensions, compared with similar in purpose and the most characteristic in size objects, especially with the shape and size of the human body.

The basis of aesthetic assessment of the size of an object and its shape is a more universal and objective than metric unit of measurement – man, his physical size and features of visual and emotional perception. The nature of the aesthetic value of this factor lies in the functional-typological expediency of the dimensions of a particular shape, its proportionality to the dimensions of the human body and visually predominant tectonic relations.

Ensemble conformity is another component of the aspect of aesthetic quality of projected objects, among the most significant features of which is the similarity in materials and compositional features with other forms and objects of the ensemble. Aestheticity of ensemble is one of the main properties of the general aesthetic quality in designing of a complex of design objects. Among the specific tasks of design is to ensure in the created object of ensemble consistency of form: unity of style, appearance, general composition, geometry, color, materials, decorative and finishing details with the environment, traditional national features of the subject-cultural environment. Ensemble consistency of forms is a very relevant factor for modern design. The nature of the aesthetic value of this property lies in the clarity, which is perceived visually-emotionally and evaluated

aesthetically, in the reflection of such a universal sign of the universal perfection of phenomena and objects, as indirect relationships of everything with everything in the environment.

For design objects, the following indicators should be considered as the most significant components and characteristics of the ensemble of the three-dimensional structure of the costume and the geometry of the shape:

- 1) aesthetics of ensemble coherence of the basis of three – dimensional structure;
- 2) aesthetics of ensemble coherence of the general compositional and stylistic character of forms;
- 3) measure of similarity of configuration and plasticity of parts of forms;
- 4) the degree of similarity of parts of the form by types of materials and structural and technological features;
- 5) the degree of presence in the form of proportional, ornamental and other compositional features, similar to the characteristic sign-symbolic regional and national artistic-compositional characteristics and properties.

Under the aesthetics of the configuration understand the visual and emotional impact of the most characteristic (boundary) surfaces and lines of form, which create its silhouette, contour, plasticity and are manifested in all outlines of the shape of the costume. The nature of the aesthetic value of the configuration of the form is that it is visually the most impressive, most informative property of the overall spatial organization of the form, which reflects the most important typological features of the internal structure of the object. Configuration is one of the most important compositional and aesthetic properties, which is closely interrelated with the properties of originality, informativeness of the form, as well as its imagery. The criterion of this property and orientation in the process of its design should be the creation of expressive geometric shapes and ensembles. The general configuration of the form consists of three main components-varieties: the outline, silhouette and plasticity of the shape of the costume.

The nature of the aesthetic value of the material of the form clearly reveals the constructive essence and utilitarian-functional features of the projected object. The most appropriate combination of different materials often determines the overall aesthetic impression of the shape or ensemble in the costume. As one of the main aesthetic target functions of artistic design, the aesthetics of the material determines the need to ensure a combination of the most appropriate, expressive and modern materials in the designed form. If the composition of the materials of the form is optimally closer to the aesthetic ideal, the higher the level of aesthetics of the whole form of the costume [10].

One of the most important aesthetic properties of the designed objects and one of the main components of the purpose of design, is the beauty of color – aesthetics of the general color system. The emotional significance of the color gamut lies in a certain direct physiological effect on a person of each of the components of the spectrum – exciting, soothing, etc. The aesthetic value of this factor is in the appropriate tectonic application of the emotional influence of colors, according to the internal content of the object and its shape. The main components, arguments and parameters of color aesthetics in the design of the costume can be defined as indicators and characteristics:

- aesthetics of tectonicity of the general color decision, degree of conformity of color scale of the form to social and utilitarian purpose of object of designing;
- aesthetics of the general level of sign-symbolic expression of the color solution of the form;
- aesthetics of originality of color solution of the form;
- aesthetics of ensemble coherence of color combinations of this projected object;
- aesthetics of ordering of color composition of the form;
- aesthetics of unity in a variety of colors in the general coloristic decision of a form of a costume.

The essence of such a property as aesthetics orderliness is that, in addition to the rational perception and evaluation of the organization of the design object, in the process of its utilitarian use, simultaneously perceives the orderliness of the object and its form, evaluates the aesthetic relationship of the main structural parts, regularity and regularity. main and secondary language. Appropriate, visual regularity of the designed form as a whole, orderliness of parts and elements is one of the most important tasks in the process of system design design of a costume. The nature of the aesthetic value of the orderliness of the shape of the costume is that it vividly, clearly reflects one of the attributes of all truly perfect and beautiful in the world – a certain pattern, organization as a sign of any organic whole, including, human environment habitat.

Aesthetic proportionality of form is the aesthetic property of dimensional correspondence, as well as the compositional significance of the object and its form, which is characterized by the ratio of the absolute dimensions of the object with its characteristic parts, environment and dimensions of the human body. It is in accordance with the dimensions, proportionality of the whole, its components, which are perceived as a single complex system, is the basis of the compositional value of this aesthetic factor.

The aggregate criterion of symmetry and compositional significance of the form should be the optimal correspondence of dimensions, compositional nature of the form to the purpose and functional essence of

the object, the maximum measure of symmetry of the human scale expedient, as a rule, a measure of the proportionality of the magnitude of the object and the environment. The general degree of proportionality of the main parts of a complex shape and their dimensions – one of the main characteristics of aesthetic symmetry. Among its components are the following:

- degree of internal modularity, the proportionality of each of the parts of the form;

- the degree of external modularity, that is the mutual proportionality of the parts, which is determined by the juxtaposition of all combinations of forms [11].

Aesthetics of balance of form, proportionality of masses and space between them, by means of which the structure is created, which is perceived as a single whole, – the main feature of the aesthetics of the balance of three-dimensional relations of the composition. Information sign representation of the balance of these main components of the composition – volumes of shape and space, there are general horizontal and vertical surfaces, the degree of appropriate compactness and overall proportionality of the shape of the costume. It should be noted that this property and its correct detailed description-factors are very important in design processes, where the requirements for it are inextricably linked with the requirements of certainty and unambiguity of the algorithmic description of forms, as well as aesthetic evaluation of three-dimensional structure, configuration and forms of the design object.

Aesthetics of form perfection includes two components: semantic (or logical) and aesthetic (emotional) perfection, which can be manifested in the form of direct utilitarian-functional essence of the object and rational perfection of its form.

The optimality of the measure and the role of perfection of the shape of the costume, in the final case, are determined not so much by the absolute quantitative level, but by the degree of expediency of a certain aesthetic quality. The optimal perfection of the costume shape, in most cases, also determines its tectonicity, as it is closely related to architecture, being a necessary prerequisite and component. The main characteristics of the perfection of the form are the relationship of "content" and "form" of the object, the structural parameters of which are equally diverse and numerous. The overall perfection depends on such essential factors as the integrity of the form, the degree of typological complexity and the consistency of the elements of the form. Due to the high complexity of the tectonic construction and the complex certainty of the perfection of the form, even its logical-structural modeling is quite difficult in the absence of optimization of the relationship of these factors.

Another leading property of the construction of the design object is the aesthetics of integrity, visual-emotional connection of the three-

dimensional structure, and the definiteness of the costume shapes. Under this factor is understood the compositional and aesthetic property of the definiteness of the outlines, the boundaries of the shape of the object, its general spatial contour, which is perceived visually and emotionally. The general aesthetic impression of the integrity of the form depends on the fullness of the whole composition. An important component of this compositional and aesthetic factor is the aesthetics of the integrity of the three-dimensional structure. Dependence of the general aesthetic impression on the definiteness of the form on the indicators that characterize it, mainly – straight: the more evenly filled the form, the more coordinated its elements, the more defined the whole form of the object, and the more predominant and aesthetic it is. The criterion of the given compositional and aesthetic factor is as follows: the shape of the design object and, first of all, its three-dimensional structure, must be sufficiently defined tectonic characteristics for which it is necessary that the shape of the object was filled evenly and integrally [12].

The criteria and range of harmonic values of the spatial connection of the elements of the costume shape are invariant, and are a factor inherent in the complete object of any functional-structural purpose, which is the purpose of designing this property in each specific object. The dependence of this property on the spatial connection determines that the greater the coordination-subordination of the elements of the costume shape, the more emotionally and visually it is more integral.

The aesthetics of unity in diversity is one of the universal aesthetic tasks of artistic design to ensure the harmonious visual and emotional unity of the parts of the form, due to one or another degree of similarity of the geometry of these parts. The goal is precisely unity in the form of similarity, not proportionality, because proportions are the attribute and means of achieving the proportionality of parts of the whole. The dual property of the aesthetics of unity in diversity is determined by a dual characteristic – the degree of similarity-difference. The essence of this aesthetic factor is that the forms, one way or another similar, unique in their geometry, at the same time differ in absolute size and similarity. Such a manifestation of unity in the variety of costume shapes is emotionally perceived and evaluated aesthetically in most cases as a positive property, an element of beauty. An important component of the dual aesthetic factor – the aesthetics of the unity of parts of a complex shape of the design object. The property of compositional similarity and aesthetics of the unity of the geometry of the parts of the form is very closely in contact with the compositional integrity and significantly complements it. Aesthetics of diversity, the second equivalent component of a dual compositional and aesthetic property, determines a clear difference between the parts of the shape of the costume with each other and with respect to a single whole. The nature of the aesthetic value of the unity of parts of form, their

compositional similarity lies in the visual reflection in the form of a specific object of such an important sign of perfection as the organic integrity of objective forms of the world, the similarity or unity of many or all components.

The aesthetic value of the variety of parts of the form lies in the fact that it reflects an important tectonic property of the construction of the costume shape. The value of this property is also in meeting the psychological needs of man in multivariate information. In accordance with this, the design task and the criterion of this property, is a moderate overall similarity and diversity of parts of complex shape and providing each specific project with an appropriate level of similarity. Two equally unacceptable, polarly opposite limit values of this property are: oppressive monotony and maximum, without any similarity diversity, which destroys the tectonic unity of the parts of the shape of the costume. The main characteristic of aesthetics in diversity – the degree of similarity – the differences of parts of the form for each of the tectonic characteristics: geometric structure, configuration, color scheme, materials and rhythm.

High independence of manifestation, the dominant value of the factor of aesthetic imagery and its aesthetic self-worth are obvious in the process of costume design. The utilitarian-functional integrity of the ensemble, the relationship between its elements can exist for a variety of structural and dimensional characteristics. Quite different is the visual-emotional integrity, compositional imagery, the relationship between the components that are evaluated aesthetically. This aesthetic property is so complicatedly mediated in its concrete material manifestation that it is expedient to consider two components as the basic components of its part: completeness of structure of the maintenance and brightness and expressiveness of its embodiment. The aesthetics of the associative imagery of a form is the most complex property, the degree of which is determined by how fully, in comparison with other perfect objects and images, its utilitarian-functional purpose, ideological image, is reflected in a concrete object of design. Imagery also characterizes the informativeness of the form – a visual reflection in the appearance of the object of design, its purpose and internal content. Artistic imagery is characterized mainly by the associative similarity of the structure and configuration of this, a particular form with the form of other objects of similar functional essence, as well as the degree of typology of perception of form by consumers.

The analysis of the system of aesthetic indicators of the tectonic structure of such design objects in the design makes it possible to make the following generalizations:

1. The method of aesthetic evaluation of design objects is based on a reasonable, sufficiently complete and reliable combination of objective and subjective elements in the form of optimal aesthetic and tectonic characteristics.

2. Aesthetic assessment of the designed shape of the costume – is an emotional and compositional assessment, taking into account the degree of expediency, socio-functional and constructive-technological content of the form, its imagery and informativeness.

3. The set of aesthetic properties of the projected object, a holistic assessment of its attractiveness is called architectural (or aggregate, global aesthetic property of the object).

4. The aesthetics of the design object is complex in nature content and features of the system of various tectonic properties. These factors-properties are different both in their aesthetic value and in complexity, certainty, relative importance of the character.

5. The structure of the system of tectonic properties of costume forms in the aspect of design is the structure of differentiated goals – from the most general to the intermediate and most elementary stages. A general systemic property, especially at the level of means of harmonization, is that the absolute majority of them forms completely opposite properties-oppositions, which are determined directly in their interrelation and interaction.

6. One of the best ways to determine the importance of factors of aesthetic quality – statistical, in which the desired values are found through a questionnaire survey of a large number of consumers and specialists, followed by statistical processing of the results. The dependence of aesthetic properties on the corresponding tectonic characteristics and parameters is the first internal aspect of relationships of various kinds. All the aesthetic properties of the object also affect each other, so this is where the external aspect of their relationship.

7. The total set of aesthetic properties is a multifactorial, multilevel, structured system with a dialectical unity of integrity and autonomy of factors. From this follows the conclusion about the possibility of applying an integrated method for determining the assessment of the aesthetics of complex properties and indicators in the systematic design of new forms of costume.

8. The set of aesthetic properties as a single system, ie the definition of the composition (nomenclature of all elements), structure (grouping of elements of different importance by hierarchical levels), the relationship of elements with each other in the functioning of the system – all this creates the necessary prerequisites for and practical consideration of the objective characteristics of this system in design. This is also a necessary prerequisite for considering the question of objective, theoretically sound (and not just subjective-intuitive) management of the system of aesthetic properties of the designed object, based on architectural design solutions.

One of the most important specific tasks in the design of a costume is the most expedient embodiment in appearance of the designed products of their purpose and functional essence, material-constructive and technological bases that make up the principles of the architectural approach.

The term "architectonics" originated in the era of formation of ancient art, from the Greek word "architectonics" – building art, and meant the artistic expression of the laws of construction of an architectural object. This term is now used in design-design not only in the constructive-technological sense, but also in the functional-utilitarian and, first of all, in the aesthetic. It contains symbols of comprehensive perfection and organization, rationality, logical harmony, harmony of external and internal aspects of construction of design objects. The first theoretical formula of architectonics was defined in Vitruvius' well-known "triad" about the necessity of observing harmonious unity in objects of design: usefulness, reliability and beauty.

In the modern definition, the term "architectonics" means: a comprehensive material and information-aesthetic relationship of internal content and form, or a visible, artistic embodiment of purpose, function, spatial organization and constructive-technological design.

Tectonics is a narrower concept and defines the constructive-material aspect of architecture, ie, the visual, artistic expression of the properties of materials and the constructive-technological basis of the product in its external form. In order for a thing to be architectural, it must be perfect in its purpose, functionality, construction, strength, reliability and aesthetics.

At the same time, architectonics depends on how attractive and symbolic the shape of the object is, how its appearance corresponds to the visual and emotional peculiarities of perception and cultural and aesthetic needs of man.

The importance of architectonics in the design of a costume is that it serves as a means to make things that are visually better perceived, easier to recognize, are psychologically close to the person. The great importance of architecture in its emotional, aesthetic impact on the consumer, creating a sense of confidence, reliability, satisfaction. That is, architecture is an effective means of humanization and comprehensive harmonization of man-made industrial products and habitats.

The most important essence of the architectural construction of forms in the design of the costume is the unity of the internal content and external form of design objects..

The internal content of design objects is a set of components that express the main features of this entity:

- signs of utilitarian-functional content, expressing social usefulness, functionality, utilitarian purpose, way of realization of this purpose;

- features of constructive-material-technological content, expressing the construction of the constructive basis, technologies and means of production, basic materials and their properties;

- features of the structural content that express the tectonic morphology of the object, the general three-dimensional construction, the mutual arrangement and interaction of its parts, their association in the basic form.

Form is the second dual essence of any thing, that is form is an external, visually perceptible material-spatial manifestation of the internal content of object objects. It is an active component, combined with the content not only directly, but also feedback, and is able to influence the internal content and structure. The form contains two organically interdependent aspects: the internal form-structure and the external form – the boundary plastic shell. It is determined that in design-designing objects the structure is the general basis of construction of the composition of the object and its form, which materializes the purpose and functional essence. This tectonic property of the form in the design of the costume is defined by the term "three-dimensional structure". In the three-dimensional structure, two main material elements are clearly distinguished: volume (material) and open procedure, on the interaction of which the organization of the three-dimensional structure of any design object, including the costume, depends.

The external form of the object is its visible front surface, with all set of parts and elements of appearance: a relief, the invoice, color, various divisions, decorative elements, chiaroscuro effects and other factors. It is important that it is in the structure and outer shell of the form that the main characteristics of the architecture of the design object are revealed.

The main characteristics of architecture in the design of a costume are:

- the level of perfection of the internal content of the object;

- the level of perfection of the external form of the object;

the level of informativeness of the form, ie the expression of the relationship

internal content and form, compliance with the visual and emotional features of perception;

- the level of artistic expression of the content in the form, the degree of aesthetics and tectonicity of the design object – the costume.

As a result of scientific research it is determined that the condition for the creation of an architectural object in the design of a costume is the obligatory and simultaneous presence of perfection of the internal content and appearance of the form; truthfulness, informativeness and artistic expressiveness of their visual embodiment. This task in the process of costume design is provided through the use of techniques of architectural design.

In general, these techniques take into account the main requirements for the construction of an architectural object and have the following sequence:

1. Creation of sketch design variants of new objects of design – designing of the most economic and perfect on functioning, designs, technologies, convenience of exploitation.

2. Selection of equivalent options for the optimal level of overall quality, the most relevant to the essence of the projected object and the most emotionally and aesthetically expressive in appearance.

3. Detailed compositional and artistic development of the accepted tectonic structural-constructive type of the form of the designed models.

4. The most complete application in each case of the laws of architecture – a comprehensive harmony of form and internal content, the relationship between geometry, structure, plasticity, size and its structural, technological and decorative and artistic properties.

5. Flexible and innovative application of the whole arsenal of compositional and aesthetic means of shaping, the language of architecture, with a focus on optimal criteria and samples of the natural environment and cultural and aesthetic ideals of beauty.

6. Optimal use of information and tectonic capabilities, natural appearance and properties of construction materials and decorative and protective properties of finishing materials (textures, textures, patterns, colors).

7. Correspondence of color-graphic and decorative-pictorial means of art processing of the form, degree of their expressiveness and intensity, to a concrete constructive basis of object of designing.

8. Visual accentuation, by means of harmonization, tectonic perfection of a design and progressiveness of manufacturing technology.

9. System accounting and expedient, harmonious interrelation of concrete tectonic requirements with other factors of art-compositional formation, subordination to the general quality of the projected object.

10. Achieving the artistic integrity of the tectonic construction of the object of design of new costume forms of their significance, figurative expressiveness and aesthetic integrity.

Conclusions. As a result of scientific analysis of the use of the theory of formation in the design of a costume, it is determined that the leading direction in the designer's activity is to achieve information-aesthetic relationship of internal content and external form, maximum imagery, expressiveness and significance of the projected object, effective objective assessment of aesthetic quality. Algorithm of construction of tectonic form in costume design, definition of nomenclature of aesthetic properties of design objects, systematization and structuring of leading aesthetic properties of modern costume forms, determine that the fundamental architectural law is the unity of form and content of designed

objects, based on optimal aesthetic assessment. properties. Criteria for tectonic design of the costume are: the level of perfection of internal content and external form, the level of informativeness and compliance with visual and emotional features of perception, artistic expression of content in external form and the degree of perfection of the overall aesthetic quality.

In the process of design of a modern costume such requirements can be provided on the basis of detailed compositional and artistic development of the accepted tectonic basis, innovative application of a rich arsenal of compositional and aesthetic means of formation, visual accentuation of design perfection, expedient, harmonious interrelation of tectonic requirements with all factors. compositional formation, achieving the artistic integrity of tectonic construction of new forms of costume, their significance, imagery and aesthetic integrity. The study and structuring of indicators of aesthetic quality in the process of shaping provides an opportunity to improve the process of design of a modern costume and its architectural characteristics.

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1.3. SYNTHESIS OF CLASSIC SUIT FORMS WITH TOPICAL STYLE DIRECTIONS

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Abstract. *The study presents an analysis of modern forms of classical costume in combination with other styles in the collections of British, French, Italian and Ukrainian designers. Combination of classic style with sports, ethnic, romantic, etc. enriches it with new elements, allows interpreting the ideas of the classics in various forms, textures and combinations. Among the Ukrainian designers, the Voronin concern; Yulia Aisina, Lilia Pustovit, Serhiy Smolin, and others traditionally represent the classic suit-they refer to the motifs and forms of the classics in their collections. The analysis helps to compare the options for the synthesis of styles and identify the most common and distinctive features in the work of designers from the European countries.*

Key words: *classic suit, polystylism, clothing model, modern tendencies.*

Introduction. The art of costume of the XXI century is focused on the broad stylistic and figurative boundaries, which can be explained by the growth and changes in the nature of human needs, but a lot of today's fashion consumers prefer classic forms of clothing. This tendency encourages studying the features of the artistic structure of the classical costume, options for compositional solutions and ways to use the means of expression associated with the shape, material, design, color, decor. Classic forms of costume, transforming over time, successfully exist today in a «pure» style, maintaining the constancy of basic features. However, the dynamism of life, incomprehensible human desire for changing and diversity cause the synthesis of the whole form or individual elements with other styles and backgrounds, and interaction of different cultures in costume.

Modern fashion trends in the costume classics are transformed into the practice of modeling, causing a new sound of this style with typical and complex forms, enriching it with the new elements that interpret the ideas of the classics in various design, texture, color and other combinations. Thus, the research of artistic and stylistic features of classical costume cannot be limited by the structures in the «pure» style, but encourages a new understanding of the manifestations of polystylism as the image components. The relevance of the study of the interaction of forms of classical costume with other styles is due not only to scientific interest. This is necessary to identify the state of demand of classics in all its manifestations of nowadays as the most stable form in fashion.

Statement of the problem. The European experience of art design is not fully understood. The variety of possibilities for modeling the classical

canons of English costume in the works of prominent British, French, Italian masters is not sufficiently studied and is not fully used in design practice in Ukraine. The active exchange of cultural information between countries contributes to the emergence of many common features, in particular in fashionable clothing designed for democratic consumers. In this connection, the task of the study is to present and analyze the author's versions of artistic and figurative structures of women's costume in the works of British, French, Italian, Ukrainian designers of the early XXI century. As far as the suit is a dynamic system, inextricably linked to human, and it can be considered only in relation to its image, proportions and movement, the source of analysis are photos and videos of models of the leading designers of the above countries on the example of fashion shows during fashion weeks. Such intercultural analysis makes it possible to identify a variety of forms that actively interact today with classical forms in modern fashion.

Results of the research and their discussion. The classic costume has come a long way in history. The idea of this- is reduced primarily to business attire: women's – лдж jacket and skirt or pants, men's – jacket and trousers of straight silhouette with a collar and lapels of moderate size, with shapes and proportions as close as possible to the natural shapes of the human body. Women's classic costume acquired its characteristics during the XIX century due to the imitation of men's fashion by transferring the cut of shoulder clothing (tailcoat, frock coat, coat) to the forms of women's corsages and jackets. Clothing for an active lifestyle – horseback riding, hunting, sports, travel, which was based on the forms and cuts of men's suits – gradually became universal and took a permanent place in a woman's wardrobe [13; 14]. In addition, an element such as trousers was also present in the women's wardrobe as part of the «Amazon» costume. The direction of universalization of women's fashion was determined by the famous English couturier John Redfern (1853-1929). The suit he proposed, a jacket with a skirt, was called a «taylor suit» (in French, *tailleur* means «tailor»). Following the structure of a man's suit, a traditional dress is divided into two elements – a shoulder (corsage with a *basque*) and a waist (skirt). The principle of costume, i.e the division of women's clothing into two elements - a jacket and a skirt – is fully established.

During the manufacture of these clothes, the traditions of the British tailoring school were formed in terms of technology, ways to give the fabric the desired shape, finding a comfortable fit on the figure, skillful processing of details [12]. Tailors from Seville Row in London played the main role in the formation of aesthetic and design features of the classic costume. There were a lot of companies with highly professional masters, such as Henri Pool, where the main purpose of creating a suit was «unsurpassed high standard of tailoring for ladies and gentlemen» [36, p. 5]. Among the

companies that specialize, in addition to the production of men's clothing, also in women's suits in the classical style, we should mention «Huntsman». Thanks to these companies, the English sewing style has invariably maintained its leadership position for more than two centuries, despite changing fashion trends.

In the first half of XX century of women's classic costume forms were fully formed. Developing over time, they concentrated on the features and phenomena of modernity at every stage of their history and as a result became international and the most democratic. Over the next decades, the Taylor suit evolved into a business suit. Going beyond the "pure" style became common in the second half of the XX century. According to the researcher of costume forms of this period O. Kosarev, the combination and flowing of numerous styles into each other was called in the 1970s a mixture of styles, and later – «diffuse style» [10, p. 369]. We support the author's conclusion that «in all the variety of ideas that materialize a man in a suit - from self-expression to the reflection of objective social values, we can trace and identify one common, global orientation – the expression of sense of human life from a certain point of view of society» [10, p. 455].

In the Ukrainian fashion of the XX century the classical style is preserved both in its pure form and combined with national motifs. Various variants of costumes developed by designers of Kyiv and Lviv model houses are presented in the magazines «Beauty and Fashion», which was published in the second half of the twentieth century. It is expedient to distinguish models of women's and men's suits by T. Shevel, E. Kotsyuba, T. Gapon, G. Khokhlov, P. Zagubin, M. Voronin, A. Goldievsky, Z. Teslyak, and others. Among them are casual suits, street suits, and evening suits, made both of plain fabrics and in various combinations.

Among the numerous ways in which different styles interact with the classical, a special place is occupied by the synthesis of the classical with the ethno-direction. The formation of the original folk style in Ukraine was facilitated not only by the work of talented designers, but also by the activities of leading ethnographers, art critics G. Stelmashchuk [29], M. Selivachova [28], T. Kary-Vasylieva [8], O. Nikorak [17], O. Kosmina [11], Z. Vasina [1] and others, whose monographs and albums represent Ukrainian decorative and applied art, as well as traditional attire in all the richness of figurative, textural and color, ornamental, tonal and rhythmic diversity. New approaches to artistic costume design, issues of theory and practice of costume art in Ukraine are covered in the works of such representatives of Lviv and Kyiv schools of modeling as Z. Tkanko, O. Korovytsky [30], O. Tkanko [31], M. Kolosnichenko [9 ; 35; 40], K. Pashkevich [25; 27; 35; 40], T.V. Nikolaev [15; 16]; N. Ostapenko [40], O. Kolosnichenko [27; 40], N. Chuprina, T. Struminska [32], T.I. Nikolaeva, A. Baranova [15], N. Paranko [16], A. Malinska, M. Smirnova [27] and others.

The name of Mykhailo Voronin is of special significance in the practice of classical costume in Ukraine. Information about his invention – the vest-model method – is set out in the work of V. Radkevych [26], as well as in the Voronin's work «Design and manufacture of men's outerwear by the unparalleled method» [7]. The description of the main stages of the designer's creative path is given in the book by A. Stray [33]. Researchers' studies and practical experience of modeling in Ukraine demonstrate a steady trend of preserving the unique qualities of folk costumes alongside or in combination with the stable structure of traditional classical costume.

Ukrainian fashion is mostly developing within the country, although the attempts to represent the collections of Ukrainian designers abroad have recently intensified.

Let's consider the variants of the classic costume, presented by Ukrainian designers, in the context of modern European trends. Modern parallels in the development of fashion forms, as noted above, were carried out by a selective method based on the analysis of trends in the framework of «London Fashion Week», «Paris Fashion Week», «Milan Fashion Week», «Ukrainian fashion week».

The focus is on the surface, material layer, which carries different characteristics of the suit. Determining a specific shape in the movement of models on the catwalk is an extremely difficult task, and at the same time movement is one of the most important factors in determining the shape, because its perfection ensures the conformity of the suit to the natural plasticity of the body. The necessary characteristics can be established by analyzing video and photo material from different angles.

The organizer of London Fashion Week is the British Fashion Council – an organization that promotes British fashion on the world market, and the main venue is Somerset House – a historic building in the style of classicism – a famous art and cultural center London. «London Fashion Week» has been held since 1984, and since 2010, designers have the opportunity to present their collections online. Themes of classics are developed in the collections of such British fashion houses as Paul Smith, Barberry Prorsum, Zoe Jordan, Richard Nicoll, Jasper Conran and others. Let us dwell on each of the main parameters of the form listed within the analysis.

Paul Smith. Paul Smith's autumn-winter women's collection, presented during the London Fashion Weeks [39], vividly expresses today's interpretation of the classics by an outstanding master. We see models of the collection, which are originally based on classical forms, but with the presence of fantasy elements - draperies, ruffles, individual details (Fig. 1, a). Such a synthesis of classics with elements of fantasy in the cut and softness of the fabric are softened the severity of rational rectangular forms.

In general, the basis of the collection are loose jackets, pants, comfortable light coats, cardigans, sweaters, dresses, blouses with light wool, silk, surfaces with gloss effects. Mostly saturated deep shades of blue, red, brown, black, gray, burgundy, turquoise, terracotta diluted with a dosed introduction of white. Monochromatic surfaces are contrasted with surfaces with a geometric pattern. Silhouette decisions of jackets and blouses – free fitting, concerning trousers, they are presented both free, and narrowed forms. Practicality, femininity and a real «English tone» combined with deep saturated colors - this is how you can describe the figurative solution of the collection.

Zoe Jordan. In the presented women's collection Zoe Jordan [43] the attention is attracted by several models with a combination of feminine and masculine elegance in a single image. Based on the cut of the men's tuxedo, it acquired a new sound due to the change of proportions and shape of the collar and lapels – they do not turn as in the traditional version, but they are part of jacket and join where we usually used to see the button (Fig. 1, b). These tuxedos have no buttons; in combination with a blouse with a collar made of the same silk fabric as the collar and lapels or with a knitted golf, the presented variant of the suit, on the one hand, is closer to the conservative classics in general, and on the other – only due to one detail - the collar and lapels, changed in proportions and design, forces us to classify these models as avant-garde solutions. In general, the collection combines several popular themes and movements - the impulses of the city's multicultural capital – London: elements of graffiti, street art of the 90's and urban clothing.

Richard Nicholl. The next original version of the classic reading is observed in certain models of the women's collection of Richard Nicholl [42]. The starting point for its creation was a purely men's suit. The analyzed models of suits-jacket-trousers and jacket-top-skirt (Fig. 1, c) demonstrate the designer's ability to skillfully adapt the silhouettes of men for women. Forms are freely located on a figure, only trousers are narrowed; increased shoulder width, dominated by emphasized geometry in the form of details: lapels, flap pockets, blouse collar, top details, skirt cuts. The restraint of the image is also created due to the cold steel color of the fabric, clear structure of the cut and balancing of the elements, smooth hairstyles, the most restrained makeup, lack of jewelry and accessories, low heels.

If Richard Nicholl transforms a man's silhouette into a woman's, *Jasper Conran's* collection [37] is permeated with the frivolous and retro nature of the 1960s. The inspiration for the designer was the image of the charming Mia Farrow, who with her characteristic thinness, teenage awkwardness and huge shining eyes was a muse and an ideal for fans of contemporary American cinema and fashion. Various sets, costumes, dresses are presented in the systematic development of form and decor

from minimalist presentation to romanticized and fantasy images with complex layers of rounded and other plastic elements (Fig. 1, d). The collection has an indisputable integrity due to the basic rectangular shape, the length of the products above the knee, additions to the original elongated hats, which are combined in color with clothes, tights, bags, shoes. Especially original is the color scheme of the collection: bright lemon, purple, orange, brown; there are two models in black, which we analyzed. They are examples of a complex synthesis of classical, youth and sports styles: free silhouette in jackets, slightly trapezoidal shape of skirts, plastic properties of the fabric, patch pockets, accentuated belt. The classic correctness of the general form, emphasized by elegant details, creates a fresh, carefree image.

Analyzing the models of London designers, it should be noted that the catwalk trends are bold decisions, extravagance in contrast to the costumes of conservative traditional studios Seville Rowe. As if, Seville Rowe is the center of preservation, the inviolability of traditional classics, and the podium is a platform for numerous experiments with its forms. Paris Fashion Week has been organized with the support of the French Federation of Haute Couture, Pret-a-Porte and Fashion Designers (French Federation of Fashion and Ready-to-Wear Couturiers and Fashion Designers) since 1973. Let's analyze the collections of those fashion houses that from the very beginning of their existence preferred the classic suit - these are the houses «Chanel», «Dior», «Yves Saint Laurent», «Louis Vuitton».

Chanel. From 1983 to 2019, the traditions of the legendary house were continued by Karl Lagerfeld. For more than 30 years, the fashion designer did not deviate from the key components of his predecessor, did not change her «handwriting», only skillfully added a modern color. Each of his new collections aroused aesthetic admiration for the endless possibilities of interpretations of G. Chanel's style. Obviously, this became possible thanks to the master's talent to feel, see, imitate the language of another designer's style. It will be recalled that the position of artistic director of Chanel was preceded by experience working with four houses at once – K. Lagerfeld created completely different collections for each of them, maintaining the characteristic stylistic features of each. To implement his own design developments in 1998, he launched the «Karl Lagerfeld» line. In the collection for «Chanel», he follows the style of the brand's founder, but enriches the models with modern elements [5]. Yes, a trouser suit consists of an oversize jacket, and tight-fitting trousers. Oversize jacket is characterized by blurred contours, which gives the figure a loose, informal look, despite the presence of an English collar.

The suit with a skirt has a lowered oval neck, a false enlarged collar and a beveled shoulder, which coincides with the asymmetrical clasp at the bottom. Sleeve length – «three quarters», skirt length – above the knee.

The same length of skirts is maintained on the other two models. Suit in fig. 2, decorated with a characteristic «Chanel» ribbon on the edges of the sides of the jacket, collar, lapels, flaps, and skirts. Although some models quote the design of G. Chanel's early style jacket, the ensembles have an updated «sound» due to the «torn» texture and new shapes. Thus, the elements of the traditional style of «Chanel» are fabric – tweed, jacket shapes, decorative ribbon decoration, a characteristic contrasting dark toe shoes; elements that bring a modern look to the model are extended silhouettes of jackets, asymmetry in the composition, «torn» texture of the fabric, accessories.

Dior. Fashion house «Dior» is represented by women's and men's collections by Raf Simson .In the women's collection, the designer turns to a simple, elegant cut of the 1960s [23; 24] (Fig. 2, b). Suits are intended for outerwear, free-cut jackets without a clasp with a loose fit, or consist of a fitted jacket, and trousers have a free, volume silhouette. Some models are subtly reproduced and modified by «New Bow» by K. Dior, the accuracy and precision of the cut of the jacket provide recognizability of the famous silhouette.

Yves Saint Laurent. The famous women's tuxedo, created in the last century by Yves Saint Laurent, is played in the autumn/winter 2013 collections of Stefano Pilati in different variants. In his women's collection for «Yves Saint Laurent» the author presented a variety of clothes [21; 22], including trouser sets with a high belt. Set of fig. 2, consists of a silver jacket with a black collar and lapels and narrowed cropped pants. Despite the fact that the entire collection bears the image of a militant and confident woman, such details as the image of a calla flower in the form of prints on trouser suits, dresses, embroidery and jewelry, it speaks of the inner fragility of the heroine S. Pilate. In addition to tuxedos, the collection includes overalls and long dresses, as well as knitted coarse knitwear. Due to the unusual structure of the materials used, some dresses and skirts resemble knight's chain mail worn on fragile women's shoulders. Models made of leather and velvet are intended to emphasize the strength of a woman's character.

Louis Vuitton. The creative director of the French house «Louis Vuitton», American fashion designer Mike Jacobs has always involved artists to the collections creating. The spring/summer 2013 collection is also inspired by the works of artist Daniel Buren, with whom the designer has collaborated for many years. The language of the collection is a chess cell and graphics borrowed In the transformation of the fashion designer's fantasies, the graceful and elegant classic of the 1960 acquired a completely new, unexpected sound.



Fig. 1. Models from the London Fashion Week show: a – Paul Smit. Women's autumn/winter collection; b – Zoe Jordan. Autumn/winter collection; c – Richard Nicoll. Autumn/winter collection; d – Jasper Conran. Autumn/winter collection



Fig. 2. Models from the Paris Fashion Week show: a – Chanel. Spring/ summer collection; b – Dior. Autumn/winter collection; c – Yves Saint Laurent. Autumn/winter collection; d – Louis Vuitton. Spring/summer collection

The suit in Fig.2 has a shortened jacket with three-quarter sleeves and a high fastener and a midi-length skirt with a low waist. The game of a checkwork pattern within the same model (a jacket is a larger cell, a skirt is small) applies to a couple of models – this pattern is read diagonally. In the next pair, classical proportions are kept. A jacket with a skirt and a cardigan with a skirt are made of a monophonic base, but a stylized motif appears on it – the outline of the flower. Patch pockets and shirt collars are the only product details. from the artist's sculptures and installations [2].

The third pair of gray sets, in addition to playing with a floral motif on a plain canvas, includes playing with patch pockets of a contrasting color. The unifying elements of the entire collection are accessories for hairstyles, boots with elongated pointed toecaps, and bags with surfaces that reproduce the graphics of various models. The patterns and rhythm of the collection supports the podium cover in a white and yellow-checked net, dynamism to the collection was added by the movement of models to the catwalk by an escalator.

Considered models of French clothing brands allow us to highlight the characteristics that are inherit by the most ancient capital of fashion, frequent use of gray as a base for deploying an elegant game with details, restrained accessories, expressive contrasting accents; ability to form a set of random elements, while maintaining elegance and sophistication.

Italian fashion weeks have been held since 1979. By this time, Florence was considered the center of fashion, significant shows were held in the Pitti Palace. The situation changed in the late 1970s when Milan introduced a new concept of the event: under the leadership of the Italian National Fashion Chamber (Camera Nazionale della Moda Italiana), a multi-day show was organized with special visits to the shows.

Emporio Armani. The main trends of the spring/summer 2014 collections of the Armani House are pastel colors and loose silhouettes. The women's collection consists of “midi” dresses, trouser suits and cocktail dresses [3, 4]. The pastel palette contains matte pink, blue, silver, pistachio, mint shades. Comfortable trouser sets are made of satin silk and light wool. The shape of the trousers – extended on the hips and gathered in the lower leg area provides a subtle association with the east. Double-breasted and single-breasted jackets have English collars and an emphasized rounded hem (Fig. 3, a). Carelessly tied neck clothes and large white lilies in the breast pockets of jackets are the main accessories of the collection.

«*Valentino*». The fall/winter 2013 collection of Maria Grazia Curie and Pierre Paolo Piccioli in the tradition of the Valentino brand is extremely feminine [19; 20]. The ensemble in Fig. 3 b black straight silhouette jacket without underlining the waistline, with loose sleeves, richly decorated with woven braid. It is completed with a blouse of contrasting white color. The collection includes model, made in white. A cardigan with a fly piece is

decorated with elements of a military coat of the XIX century – woven braid. It is completed with narrow shortened trousers, a blouse with a shirt collar.

«Prada». The theme of the fall/winter 2012-2013 women's collection was space and the technogenic future. The main elements are cropped chinos, which Miuccia Prada suggests wearing not only with fitted elongated jackets in the style of the 1970s, but also dresses, sundresses, skirts [18]. Among the models of the Collection is a suit of bright red shade, decorated with an original belt with a large rectangular buckle and numerous brooches (Fig. 3, c). Separately, the virtuoso combination of various prints in one ensemble, such as the one that we see in Fig. 3d in the form of surrealist collages based on futuristic silent cinema should be noted. In general, prints in the Prada collections always deserve special attention, they have become a kind of visiting card of the brand. The futuristic nature of the clothes is complemented by appropriate hairstyles and makeup: dark smoky eye makeup with bright arrows, bleached faces and dyed orange, red and black hair ends.

So, having analyzed the collections of the brands «Armani», «Valentino», «Prada», we can highlight the main features of the Italian approach to classical elegance: ingenuity in color combinations: (mainly bright colors and their combinations), stylistic convergence of various fashion trends (except for traditional costume offer clothes with modern avant-garde silhouettes) expressiveness of accessories and a handmade demonstration using high-tech, comfortable fabrics.

Let's consider the presented collections of Ukrainian designers in the framework of Ukrainian fashion week-2013. The classical suit is traditionally presented by the Voronin concern; an appeal to the motives and forms of classics is observed in the collections of designers Yuliya Aisinoy, Liliya Pustosvit and Sergey Smolin.

The Voronin collection is dedicated to travelers and aesthetics [6]. The inspiration was the talisman of long-distance travel aquamarine, which reflects the soul of the sea and the coolness of pure water. The men's and women's collection is designed in a single classic style. It presents linen two-piece suits in a casual version, original suits without sleeves or with short sleeves in combination with shorts, fitted sets of companion fabrics. The collection's colors are coal gray, blue, black, from rich tones of warm brown to light sand, as well as all shades of blue - from deep to light.

The women's ensemble in the collection is an original combination of traditional classics and romantic style, achieved by adding a light transparent wrap from chiffon with wavy frills, it is connected with a jacket with two buttons (Fig. 4, a). Pants are narrowed and shortened below. Made in white, the image is extremely light and fresh. The model in Fig. 4b also demonstrates a masterful combination of classics with romantic motifs: a jacket with sewn draped wave-like inserts on the sides attracts attention, which emphasizes the fittedness of the silhouette. An interesting solution of

a fasten to a fairly open jacket without a blouse - the sides are connected end to end. The «airy» accessory on the arm of the same white chiffon adds a romantic touch. Men's images are complemented by the breath of the Mediterranean and are represented by elegant silhouette forms of a tuxedo and suit with a business card, made in the colors of the collection of lightweight wool. Elegance is emphasized – n cut and details.

The women's collection of Yulia Aisina's fashion house fall/winter 2013-14 under the name «Loom» [38] is presented in an elegant feminine version of the classic style. Dresses, suits, coats of fitted and straight silhouettes successfully emphasize the lines of the body. The collection is made of tweed, wool, thick silk and velvet; the color palette is designed in dark colors – black, gray with the introduction of milk. The suit in fig. 4, consists of a shortened jacket, free rectangular silhouette with extended inclined lapels and a fur collar; the skirt is straight, knee-deep. The designer introduces an exquisite decorative design of the suit with semiprecious stones – on the shoulders and bottom of the skirt. The next model is made of thick silk. The free-cut dress is also decorated with hand-embroidered stones on the collar, pockets and plank. Pants with a high waist free silhouette decorated in an identical way at the side seams. The image is complemented by voluminous smooth hairstyles with hoops or bandages, as well as accessories - gloves, bags. The main character of the collection has femininity, softness and at the same time internal strength.

The women's collection of Lilia Pustovit fall/winter 2013-2014 is an appeal to the images and silhouette lines of the 1960s – early 1970s [41]. The prototype of the collection was the French singer, actress and iconic figure in the field of fashion Françoise Ardi. The designer was inspired by the young years of the heroine and her qualities – sincerity, confidence, a penchant for romance – that's why all the silhouettes that dominate the collection are characteristic for this time. In these images, it was important for the designer to convey the intelligence and harmony between internal and external beauty. Although the main element of the collection is the dress, the suits in it also have a certain place, we analyze two of them.

On the models of the collection we see feminine versions of jackets, in which clear lines and natural volume are combined with original polka dot prints. Fold-over collar, lapels, three buttons – these are all the details. In its form, this jacket is based on the style of Chanel jackets, very fashionable in the 60s of the last century. Yoke-waist skirt, flared down with an overhead detail of a geometric shape.

The jacket on the second model (Fig. 4, d) has a masculine cut, but the author is steadily supporting the feminine essence in the form of a suit - a tight leather belt that emphasizes the thin waist so clearly. The skirt has a shape identical to the first, but without division. The color scheme is quite restrained: muted shades of blue-gray, brown, black. Fabrics – wool crepes, silk.



Fig. 3. Models from the Milan Fashion Week show: a – Armani. Spring/summer collection; b – Valentino. Fall/winter collection; c – Prada. Fall/winter collection; d – Prada. Fall/winter collection



Fig. 3. Models from the Ukrainian Fashion Week show: a – line «Voronin DeLuxe women»; b – line «Voronin DeLuxe women»; c – Yulia Aisin. Fall/winter collection; d – L. Pustovit. Fall/winter collection

The designer uses the reception of female silhouettes fragility opposite in nature elements – a combination of feminine lines with rough shoes, developed in collaboration with the Braska trend. In general, the images are quite eclectic, in connection with this they are designed for an individual endowed with spontaneity and at the same time self-confidence.

So, as a result of the analysis of the collections of designers from Great Britain, France, Italy and Ukraine, presented as part of the 2013 fashion seasons, we focus on those created in the classical style or with interpretations and development of classic motifs. An analysis of the features of the modern interpretation of the classics and its interaction with other styles and fashion styles provided for the consideration of such constituent elements of the form. Such as a silhouette, proportions, the nature of connection between the parts, constructive features, texturally-material solutions, decoration color, link shape and the appointment shaped characteristics. The analysis allows us to establish the parallels of the existence of classics in several countries and determine the most typical common and distinctive features in trends:

1. Silhouettes of models are based on a rectangular shape of various lengths, volumes, proportions. Interpretation of the traditional silhouette decisions of the suit is achieved thanks to the appeal of Jasper Conran, and Lilia Pustovit to retro styles. Retro style silhouettes allow to widely vary the main features of the suit, to use freely the details, division of the form and texture.
2. Proportions in details retain traditional ratio only in classical forms in a «pure» style (Voronin; Richard Nicoll). At the slightest interference from other styles, we observe variations in proportional ratios. In particular, in order to strengthen the character of femininity in a suit, Y. Aisina significantly increases and gives the shape of a semi-oval to the lapel of the jacket, as well as significantly shortens it,
3. The features of the romantic style integrally resonate with the classics due to the additional layer of transparent lightweight fabric with plastic edges (Voronin) or soft folds of jacket details and accessories;
4. The image acquires a fantasy character by completing the costume with additional elements of a fantasy cut (Paul Smith, Richard Nicholl)
5. The combination of classics and sports style allows you to vary the proportions and lengths, the degree of fit, combine soft and geometric shapes, cut and division;
6. The classic substyle – «Casual» – occupies a prominent place on the catwalks and provides additional freedom in the interpretation of classical forms, that also includes clothes from knitwear;

7. Bold avant-garde transformations of traditional forms are achieved by a variety of methods - from a bright color palette to a change in shape and proportion (Paul Smith; Zoe Jordan).

Conclusions. After analyzing by a selective method, a significant variability of interpretations of the classics and its elements is revealed. As part of a combination of two or three styles, a complex interaction of such elements as silhouette, color, decor, texture emerge. Studying the transformations of classical forms and their interaction with other styles, we come to the conclusion about the variety of those geometric and plastic configurations that determine the whole structural diversity of the costume. Processing and analysis of the work results of leading designers in the UK, France, Italy and Ukraine on modern methods of shaping on the basis of the classics, serves as the basis for determining multicultural fashion trends in order to make innovative design decisions.

The study of the mechanisms of artistic communication of forms and the systematization of the components of the structure of a classic costume is necessary at the present stage of development of a design culture, aimed at enriching the tastes of fashion consumers. A wide range of stylistic diversity, which is based on permanent or transformed forms of classics, allows us to assert the vitality and universality of the classical style.

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1.4. UNIFORM DESIGN: HISTORIOGRAPHY, EVOLUTION OF FORM AND STYLE

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Abstract: *The research is devoted to the generalization of artistic, aesthetic, methodological and technological problems of uniform evolution as an object of design activity. An analysis of the historical development of the uniform as a component of the project culture is given; the cultural phenomenon of uniform, its traditions, symbolism, and characteristic features of development are investigated. It is emphasized that the stylistic trends of historicism differ from the style of clothing as a component of artistic systems of certain epochs. The evolution of stylistic trends and their peculiarities in the design of clothing design are considered. To understand the essence of shaping as a source of stylistic, artistic and compositional ideas, consideration is given to the form of clothing as a set of elements that form its qualitative aesthetic indicators; the interrelation of the technical and artistic components in its content according to functional purpose is analyzed.*

Key words: *uniform design, artistic and compositional formation, style of clothing, cultural phenomenon of uniform, artistic and aesthetic properties of corporate clothing, aesthetic and harmonious design.*

Introduction. The study of the problems of shaping in the design of the clothes gives grounds to unite the analysis of the experience of subject-artistic creativity starting from the end of the 19th century and ending by the designers' works of recent years. The last-mentioned make it possible to identify the universality of the laws of shaping of the 20th century in the design-artistic, visual, and technological aspects. The issues of shaping have always been among the priority artistic and design issues. They became especially relevant in the late 20th century because of the emergence of new forms of social organization, the formation of new ideals of social and artistic consciousness. That necessitated the development of not only a new understanding but also new approaches to the process of formation in design, which reflects a holistic view of the current level of development of visual culture, features of figurative integration of scientific and cultural, and socio-cultural factors. In this regard, it is advisable to conduct interdisciplinary research aimed to solve a lot of theoretical and given tasks in the formation of human life. In design, the shaping impulses are formed and come from several areas:

- from the socio-functional (the type of society, consumer groups, the purpose of the subject, the question of prestige or democracy: the form of the subject is determined by the level of development of society, its tastes, habits, etc.);

- from the artistic culture and art (which ensure the artistic and creative nature of the design; the use of means of formal-compositional language, the technology of modeling by means of figurative and artistic expression);

- from the scientific and technical spheres (technologies, materials, concepts of natural science, and technology, which sometimes become the subject of experimental works of art).

Talking about the art as a factor of formation, such authoritative scientists as N.V. Voronov, O.M. Lavrentyev, V.F. Koleichuk, B.T. Shymko, and S.O. Khan-Mahomedov traditionally assigned a significant role to composition, means, and methods of expression, creative experiments that mainly concerned industrial design, recalling the pioneering ideas of domestic founders of modern design, in particular of the avant-garde period [1-4, 7, 9, 11, 18].

From a historical perspective, uniform as an item clothing was studied by R.P. Andreeva, I.C. Baldano, A. Vasyliiev, L.M. Gorbacheva, A. Hryhorieva [3, 11, 12, 17, 18, 20], etc. Thorough research that has become a mainstay in the study of the development of the uniform is "Military Uniforms of the World" by Preben Kannik [10], which studies the descriptive aspects of cutting and color range of the components of the uniform, along with the indication of completeness. Particular attention is paid to the historical development of women's uniform, which is mostly disclosed in foreign publications of E. Ewing, J. Finkelstein, M. Garber, and A. Hart, M. Young [1, 7-9, 21-24]: the obtained information determines the women's uniform as a feminized men's uniform.

The thorough works of N.V. Voronov, Ya.E. Shestopal on the aesthetics of technique, essays on the history of domestic design, as well as the scientific papers of H.L. Demosfenov, E.M. Lazarev, V.M. Munipov, Yu.V. Nazarov [1, 2, 4-9, 12, 13], etc. have become the basis of research on aesthetics of the form of the clothes of special purpose. R. Arnheim, I. Johannes, T.A. Kravtsova, T.A. Zaitseva, N.P. Mylova, O.M. Lahoda, N.M. Milyutina, N.P. Nikitina, Kh. Chidziyiva [4, 5, 7, 9, 12, 20], etc. devoted their works to the peculiarities of form and color perception.

Statement of the problem. Specific features of artistic and creative activities are formed by a holistic "communication" of its constituent elements. Such elements act separately; later integrating, they create an artwork. It may not always look aesthetically pleasing: the beauty does not always have to contain an artistic concept. Such a situation may occur when designing objects with accentuated functionality, which include the uniform in its historical development. History shows that a man in uniform has always been perceived as a permanent image [1, 3, 4, 7, 15]. Considering the development of forms of historical household clothes, not excluding the uniform, it should be noted that due attention has not always been given to the question of aesthetics of the latter. Nowadays, when the

development of society has reached aesthetic literacy, there is a need to study the genesis and development of the uniform as a separate object of artistic and aesthetic human activity. The form of the clothing of special purpose (uniform) has gradually acquired the features and characteristics of the design object, endowed with aesthetic qualities, satisfying the spiritual needs of both consumers and ordinary citizens of the society.

It is known that in art history, there are definitions, which are more common and have a relative and probabilistic nature, in particular: description definitions (occur because of consideration of some values and features); indicative definitions (refer the described phenomena to certain groups). Thus, in the 1950s, researchers [2, 5, 7, 8] introduced the concept of “interpretation” as a fundamental method of art history to explain the content of works of art by constructing systemic definitions. At the same time, it was noted that the aesthetic and artistic characteristics of works of art consist of many factors that cannot be determined with absolute accuracy. The main quality is the consistency between the content and the form (in a different interpretation – between the spirituality (emotionality) and the utility). It depends on the intention of the author, developer of the design-project, or product (collection of products). However, such intension also cannot be determined accurately. To be sure, let’s consider the most common terms of art criticism: tectonics and atectonics, sculpturesqueness and plasticity, picturesqueness, and graphics, voluminosity and flatness, which are the tools for stylistic analysis and attribution of works of art. According to experts, the nuances of these definitions create definitions that are generic [2, 4, 5], i.e. have a hierarchical structure as a logical motivation from general to partial. Such scenario forecasting makes it possible to assert that a systematic approach to the creation of works of art and design is necessary; it is possible and able to ensure the effectiveness of the research process.

Results of the research and their discussion. In recent years, a person in uniform has become a part of material culture; sometimes even the uniform acquires fashion trends, which means that we can observe the so-called “militarization of the imagination”. For example, the uniform with military signs is popular among certain categories of society, it is worn by the employees of many non-military departments and agencies.

At the same time, the direction of design-projecting of clothing of special purpose is insufficiently studied in the design theory: there are no answers to many important questions that are relevant for the theory, methodology, and practice of use. During the 20th century, scientific schools deeply studied and solved the issues regarding functionality and reliability of production, special, emergency, uniform, departmental, and other types of clothing of special purpose. However, the consideration of the scientific basis and theory of shaping processes that take into account the aesthetic categories of the clothes of special purpose had been being

rejected by artists and designers almost till the beginning of the 21st century. An exception was a semiotic approach to their design, i.e. the formation of the range of their varieties as a system of the use of some individual sign and symbolic elements and forms. The main places in the design of the clothes of special purpose belong to the issues of shaping and aesthetic potential of the future product together with compliance of all the functional requirements, as evidenced by the results of surveys and examinations of consumers and experts [17].

Issues of the shaping of the clothes of special purpose are analyzed by studying and generalizing artistic and aesthetic, methodological, technological, sanitary, and hygienic, as well as safety problems. The methodological basis of the research is classification and technological approaches that reveal the essence and ranges of use of tasks and means of shaping in the design of the clothes, which allows identifying contradictions and problem areas in modern artistic and compositional design of the clothes of special purpose, considering ergonomic requirements.

At first glance, the use of the concept of “design” in the design of the clothes of special purpose is superfluous, because there is a statement that the clothes of special purpose are not the object of design. Such a position was typical of the history of design as the real contacts of designers with the production were established considering the realities of social and economic development. And of course, the existing problems of the creation of the clothes of special purpose are related to the abovementioned circumstances.

The modern clothing is a multifaceted phenomenon of the project culture that requires in-depth research. The semiotics issues in the morphological dictionary of the modern graphic language of design are considered in the works of many researchers [1, 6, 7, 12, 14, 17], who introduced semiotics concepts into the theory of design and formulated some theoretical provisions characterizing the visual language of design objects. The scientific results confirmed the idea of the prospect for further semantization of knowledge about modern clothing as an object of design.

Such issues become especially relevant today when radical, destructive metamorphoses connected with both objective and purely ideological circumstances are taking place in art. Objective circumstances mean the rapid development of scientific and technological progress, improvement of technical and technological tools, socio-economic stability of society. At the same time, IT-support for this a priori anthropocentric, ambivalent (artistic and technical) creativity should be more focused on strengthening of its aesthetic significance. However, in real practice, IT-design is mainly focused on economic indicators of increasing the product mass of industrial products and stimulating its sales.

The processes of creation of new types of clothes of special purpose remained unchanged for decades and had a utilitarian character. However, in recent years, the consumers of the clothes of special purpose make demands on their aesthetic nature along with the performance characteristics and protective properties. Together with the requirements of perfection of artistic and aesthetic properties of special clothing, its quality criteria include ergonomic, structural, and technological, protective ones, etc. In case of non-compliance with the specified requirements, the clothing cannot be considered as such that harmoniously accumulated the criteria of quality assessment in its shape. Also, the cost-effectiveness indicators must be considered as well.

The problem of a creative concept takes a central place in the problematics of modern design. Conceptuality is a common creative attitude that is the essence of project culture. As a rule, the concepts existing in clothing design are in line with the main problems of the design of their time and are associated with general trends in lifestyle changes. The modern specificity of design of the clothes is that at the stages of sketching, working design, and manufacturing, the concepts are embodied primarily in visually perceptible, rather than descriptive forms.

For centuries, clothing has been the subject of handicrafts and has not been considered as an art object: it has gradually become an art category. According to modern researchers, in our period when fashion is spreading rapidly with the help of global brands and large groups of pre-a-porter, clothing is becoming more uniform and monotonous [10-12, 16, 19, 31]. The development of forms of clothes, as well as its component and separate part – uniforms (clothes of special purpose), has its own characteristics. The uniform is clothing that is uniquely tied to the status of a person and requires its deindividualization. The uniform forms a person's feeling of being a representative of a certain profession, creating a similar effect from the environment. It is well known that a person in uniform is perceived by society ambiguous but in general quite positive.

As a rule, the author's creative concepts in the design of the clothes do not exist beyond the general trends in design culture but fit into the concepts that exist in this period in design. If we talk about the dominant global concepts in the design of the clothes in the 20th century, two main concepts should be distinguished, in particular: functionalism in the design of the first half of the 20th century, and postmodernism (new design, anti-functionalism), which emerged in the postmodern era in the last third of the 20th century.

The main principles of functionalism were functionality, expediency, and universality of forms. D. Rams, the classic of German functionalism, defined its basic guidelines as follows: simple instead of complex, ordinary instead of unusual, long-term instead of fashionable, functional instead of emotional, reasonable instead of spectacular [1, 4]. These features

characterized the creative concepts of architects (Le Corbusier, Ginzburg brothers), designers-constructivists (O. Rodchenko, V. Stepanova), and fashion designers (G. Chanel) of the epoch.

The analysis of the source base shows that the peculiarities of mutual influence of technology and morphology of the development of forms of the clothes of special purpose have not been studied enough, just partially, that is why they need a comprehensive development. To this end, the research provides a large list of developments that contribute to the creation of modern lines and determine the trend of future developments. In fact, the technology of peculiarities of the shaping of the clothes of special purpose is considered as a cultural phenomenon, a kind of library of signs and images that carry a certain range of associative meanings.

We can note that the world of engineering, accepted by the culture, is imprinted in the human imagination at the level of the archetypes [2, 4, 5, 9, 12, 17]. They were used by designers and architects to create a special, artistically meaningful language of technique and technology in the 20th century. The value aspects of the technology of shaping of the clothes of special purpose as the element of culture were used by designers to create the image of design-product in the process of a mythologization of technology and futurization of form during the scientific and technological revolution, to form a special consumers` attitude to design technologies and manufacturing processes. At the same time, the features and elements of technique and technologies in the shape of the projected product were identified.

In the modern design objects, including clothes of the special purpose, the shape is created according to the general laws of shaping, of course, with some specific features, considering the latest materials, techniques, and technology. That is why the so-called intangibility, the combination of well-known and new tactile sensations against the new techniques of plastic shaping gives grounds [15-17, 28-30] to point out on new "digital tectonics" of the modern objects, which is some kind of digital formalism in the designing of consumer goods in the 21st century. In general, we can conclude that the world style trends of the industrial forms are equally concerned the process of shaping the elements of clothes, the tectonics of which depends on plasticity and technology of the materials more and more.

Given the above, it should be noted that to identify trends in the design-projecting of clothes of the special purpose, new means of the analysis of external form are required to substantiate the imaginative and aesthetic characteristics: in the variety of shapes and colors, the justification of logic and feasibility of the combination of the elements into a system of the modern suit is required. All this gives grounds to confirm the idea that modern clothes of the special purpose are a multifaceted

phenomenon of the project culture, which requires a systematic in-depth study.

Returning to the origins of constructivism, we can agree with the opinion of its representatives that the national history of constructivism, its theoretical understanding, practical achievements, and utopian projects began, in fact, with O. Rodchenko and V. Stepanova. O. Rodchenko stated that there was no need to depict anything, it was necessary to create. That was confirmed by V. Stepanova in her self-made catalogs for “proclothes” exhibitions (originated from the term “production clothes”), which for the last century is considered as a prototype of the modern special clothes. She wrote that art as a unique creation is sent to the archive, while technology and industry require a constructive approach and active action from the artist. V. Stepanova stated that any avant-garde work of abstract art is duplicated and reproduced using a particular technology of printing, assembly and editing, emphasizing that the algorithms that determine the rules of working with elements, as well as accents and elaboration of such elements are the value for constructivists. V. Stepanova’s compositions with geometrized and extremely schematized human figures can be considered as the examples of a constructive approach to the design of industrial clothing.

It is known that form, uniform, coatee are special (official) clothes that are the same in style, cut, color, and fabric and used to create a single image of the corporate group. The uniform symbolizes the function of its carrier and his or her belonging to the organization. A set phrase “the honor of the regiment” is a sign of military or corporate honor in general. The opposite of the uniform is particular or individual clothing. Thus, the uniform means belonging to the army, police, departments, corporations. Delving into the depths of time, we can see that even in that time soldiers had a certain uniform. Thus, the visualization of the form has gone its own way from brightly colored, multi-decorated samples to the functionally motivated colors and shades of their appearance.

It should be pointed out that certain types of military clothing became fashionable in household clothes from time to time: short sleeveless tunics with the so-called “Roman neck” came into fashion in 1960 – 1970s – sweaters without collars.

With the decline of the traditions of the ancient world, for a long time, for example, in the Middle Ages, there was no uniform; there was the only insignia between the wealthy and the common people. Over time, the form of a single model was adopted in the armies of all countries. There were two main types of uniforms: ceremonial and field uniform. In addition, in many countries, the wearing of special clothing was obligatory for some civilian departments. Such clothes were worn by civil servants, railroad workers, postmen, hotel workers, service personnel of monarchical houses, and nobles.

Military uniform is clothing, which is set by the rules that are mandatory for each type of army. Even in the Roman Empire, soldiers were given the same weapons and armor. In the Middle Ages, it was customary to depict the emblem of a city, kingdom, or feudal lord on shields to identify soldiers. The Royal Guards had something like a uniform as well. In the 16th century, some kind of special clothing appeared, for example, among royal hunters during hunting, when the camouflage colors defined the palette of greens. In many countries, the main color of the military uniform is green. As a rule, the clothes differ in shades of the color of the fabric, the form of headgears, insignia, and accessories. Only in the 17th century, there was an attempt to unify the military uniform due to the formation of the army, especially after the Thirty Years` War (1618 – 1648), when the principles of warfare changed. At that time, the uniform was introduced simultaneously in several countries.

In turn, civilian or individual fashion also influences the development of uniforms, so it should be considered when studying military uniforms of a certain period. Also, it is worth noting that the primary difference between civilian and military clothing was inconspicuous and less significant. Thus, the relevance of research is due to the need to solve the scientific problem of finding new methods of the shaping of the clothes of special purpose, aimed at improving the aesthetic, ergonomic and economic indicators of its assortment range.

This group of studies [3, 8-11, 16, 17, 19] reveals certain aspects of creation aesthetic and ergonomic clothing of special purpose, identifies certain gaps, and creates trends in the way of their solution, helping to draw the analogies in the transfer of basic artistic and compositional principles and techniques from the household clothes to the clothes of special purpose under the production conditions. The presented dissertation research became a logical follow-up of the specified scientific researches, and the abovementioned analysis of the scientific literature revealed an urgent need for scientific understanding of the problem of shaping to create a design concept and develop a range of aesthetic uniforms for civil servants and corporations.

The shaping concept in the design of the clothes is created by the factors of the dominant style, socio-economic circumstances, technology, materials, the influence of fashion, which generally act as a source of stylistic, artistic, and compositional ideas. This factor is universal for different areas of design activity. That is why many studies are devoted to the history of the formation and evolution of design styles, the development of theoretical and practical issues of style, features [2-5, 7-9, 13, 25-27]. It is known that people have always tried to protect the body from the environmental impact and create not only housing but also clothing. At first, these were primitive products that covered the body. With the development

of mankind, clothes acquired certain varieties depending on the material used.

During the tribal conflicts, wars, the first samples of identical functional clothes for fighting were designed. The uniformity of forms in clothing performed not only protective but also signal and distinctiveness function.

Over time, the uniform, its stylistics, color have been changing, evolving, and improving with the development of culture [3, 7, 9-11, 13, 15-17] but the functionality has remained unchanged.

Nowadays, the clothes of special purpose are considered as a system of standard clothing, which consists of many varieties in accordance with the functions of purpose and operation. Thus, according to the Hague Convention (III) on the Opening of Hostilities, 1907, during the hostilities or armed conflicts, the wearing of the uniform is a necessary condition: special privileges and the semantics of clothing become mandatory. The uniform has always been an integral part of human society, especially in situations of group identity. It has been used as a sign of social status.

As noted above, the style of military clothing has always influenced civilian clothing. And the change in the style of mass fashion during World War I evidenced that. The War was a turning point in recent history that changed not only Europe's political map but also the way of life. The uniform influenced not only the civilian costume of that time but also the fashion of the 20th century [7, 10, 11, 15-17]. In general, many elements of military uniforms have become everyday men's clothing. On the territory of present-day Ukraine, a new style of women's clothing originated due to their struggle for equality: while men were at the front, women mastered their professions. They worked in agriculture, at the factories and military plants, on the construction, as the conductors and bus drivers. With the beginning of the War, fashion issues were temporarily relegated to the background, and the uniform became especially important and widespread. And then happened that all the reformers of the women's clothing fought for: jewelry and corsets disappeared, and the color range, the length of women's dresses, the shape of hairstyles, etc. changed. At that moment, an everyday costume was of the highest priority, in which the woman spent most of the day. The functional details, borrowed from uniforms, appeared, in particular a turn-down collar, high-buttoned "aviator" front, patch pockets: all companies fulfilled orders for the needs of the front. Traditionally, before the war, the civilian population lacked the fabrics, so they had to sew on a military uniform in a different way. There were even special brochures with tips on how to sew a fashionable coat or jacket from an overcoat. For example, during World War I, the costume (an extended skirt with a front zipper, a baggy jacket with patch pockets, a turn-down collar or an "aviator stand") and a universal dress made from practical fabrics (of black, gray,

brown or blue color) with white turn-down collar were the most common women's clothing. Such a dress could be worn all day without changing it several times per day, as it was customary before the War. In domestic and industrial circumstances, fasteners in the women's clothing had to be placed only in front. The underwear was also simplified. The corsets finally gave way to bras and stocking belts [11, 15-17, 19, 29].

World War II affected the postwar world order and the way of life. In addition to the general situation, it may be noted that a blue military uniform was developed for the British Women's Royal Naval Service and the Women's Auxiliary Air Force. In Germany, women's uniform for staff was gray, a military uniform was brown. In the Soviet Union, women in the army wore the uniform of protective color, as did men; the main difference was that they had skirts instead of trousers, although pilot women wore trousers as well [7, 15, 17, 19, 26]. Almost all enterprises of the textile and garment industries fulfilled military orders, producing clothes in millions of artificial units and sets. The civilian population often wore old re-worked clothes. Men's suits and shirts, pillowcases, and blankets were sewn on women's blouses and suits, children's dresses, and coats. Even elegant wedding dresses were sewn from curtains. Combined models became fashionable, for example when several old dresses were made into one new one. In the wartime designs, there were a lot of constructive details: yokes, inserted gores, made from different fabrics. Thus, despite all the difficulties, wartime fashion was still subject of style and required the preservation of its unity. It should be pointed out that the culture of the clothes of special purpose is still in the process of formation, thus, it requires systematic research in the creation of modern collections of appropriate functionality and style. At the same time, the unity of the corporate style remains quite important.

Traditions have always played an important role in the development of uniform, which characterize all epochs. Traditions are a mechanism for transmitting the values of epochs. Even modern clothes of special purpose bear the imprint of ancient traditions. Over time, their details, which pointed at belonging to a certain epoch, lost their original meaning but were often preserved in the form of symbolic signs – ornaments, crosses, color combinations.

A study of the history of the emergence and the use of working clothes shows its very difficult way. In the Russian Empire, workers worked hard but wore old and worn clothes. In the middle of the 18th century, the so-called "cloth regulations" were adopted. It obliged the owners of factories and other enterprises give the same special clothes to workers; that was aimed to increase the prestige of enterprises and professions. However, baggy trousers and sizeless jackets made of cheap fabrics did not facilitate people's work at all [7, 16, 17, 27].

The further development of the industrial revolution forced to use different types of industrial clothing; then the time of the "gold rush" came

and jeans appeared – a cult item of clothing in the form of Levi`s work pants.

The industry continued to develop: fabrics for special clothes became to be impregnated with fireproof and waterproof solutions. The end of the 19th century was marked by the appearance of the first threads made of chemical fibers. Later, spinning and weaving machines, as well as man-made fibers and mixing fabrics, were created. In 1930, the first research institute of the garment industry was established within the Soviet Union, the main task of which was an innovative policy for the development of domestic special clothes. All that was aimed to improve the quality of special, uniform, and departmental clothing, and to increase its functionality [15, 17, 26-29].

The introduction of the uniform caused some complications, as at the beginning the military received uniforms, the cost of which was deducted from their wages. Eventually, that situation changed, and the cut and the colors of the uniform, which could provide maximum camouflage, were unified. Today, in many countries, the military has field (ordinary) uniforms, which serve as everyday clothing. And many studies are devoted to the cultural phenomenon of uniforms. So, let`s look at the history of the development of this phenomenon by studying the development of its external forms.

At first there were some attempts to give a special look to the uniform of each regiment but quickly realized that it was better to introduce same-cut uniform for each type of forces (and then for the whole army) and distinguish military units by the shape and color of collars, cuffs, chevrons, strips, and buttons. However, some military units, such as the Hussars, retained their special uniforms [3, 10]. Only at the beginning of the 19th century, it became customary to dress the whole army or the most of it, in particular infantry, in almost the same uniform, and to distinguish the regiments by the monograms on the headgears and symbols, preserving the traditions at the same time. At the beginning of the 20th century, most countries chose almost the same cut for their military uniforms. But the soldiers of the Guard and Cavalry units still wore luxurious and lavish uniforms in many cases. The bright colors of the uniforms did not change while the smooth-bore guns loaded through the barrel had a small hitting range. Later, the increase in the effectiveness of firearms made to look at the uniform from a completely different angle. To make the movement of soldiers in the field invisible to the enemy, the color of the uniform had to match the color of the surrounding landscape. In the middle of the 16th century, the wearing of scarves became a notable feature; the colors of scarves were chosen by the monarch. Usually, these were the colors of the royal emblems. The scarves were worn on hats and clothes. During the Thirty Years` War, Spanish soldiers and soldiers of the German Empire wore red scarves, French soldiers wore white scarves, Dutch soldiers wore

orange scarves, and Saxons soldiers wore green scarves. In such a way the soldiers of the allied armies recognized each other on the battlefield and easily distinguished enemies.

In Europe, the custom of dressing an entire military unit in the same so-called “uniform” first appeared in the Guard units (Fig. 1-3). Such units were common in the 16th and 17th centuries. They consisted of nobles and the best non-commissioned officers, and their task was to protect the royal and other nobles. Private guards were always luxuriously dressed and fully armed. The black beret and white gloves attracted attention (gloves were not always worn). The correct color scheme of costume details’ alternation was very important and the same in all cases. Corporal in the uniform – white ceremonial morion with red plumage of rooster feathers. Large round corrugated collar, worn with white morion. The usual stand-collar was visible from under a round collar. The creation of models of the military uniform for the Guards by such great Renaissance artists as Raphael or Michelangelo is a legend. The main features of the existing uniform and color combination have remained unchanged since the middle of the 16th century.

As history has shown, the companies of King’s Musketeers, where the King himself was captain, appeared in 1634 (Fig. 4); in 1816 they were finally disbanded due to the financial difficulties. The uniform was replaced by the uniform of the revolutionaries [3, 10, 17]. The hat with a fur edge gave English Dragoons a militant look (Fig. 5). The color of the uniform of military artillerymen of any army was dark, as the uniform was often soiled by the black charge of the cannon. Until 1672, in the Netherlands officers wore a bright red bandage, and later – an orange bandage (Fig. 6).

The color range of the heraldic colors of the provinces of Sweden was not enough to be noticeable; that is why brown and green colors were additionally used (Fig. 7). All that remained of heavy armor was a bulletproof breastplate. The similarity of Sweden and Denmark uniforms during the war necessitated the introduction of clear insignia: white armllets, bundles of straw, or straw-woven cap badges on Swedish` hats. Such traditions have remained unchanged to our days and are a sign of respect for bravery.

In the late 17th century, the uniform of the Spanish cavalry was yellow, with the red cuffs on the uniforms (Fig. 8); the breastplates and helmets served as protection. The corps of grenadiers of the Danish army (Fig. 9) had an elegant uniform: redingote (frockcoat) in the Polish style had a rich decoration on the front side and the cuffs on the sleeves. At the same time, the uniforms of Russian dragoon regiments were decorated with light gray, white, or blue with red colors (Fig. 10), which existed for almost half a century. The field of the hat was fixed in three places. This is how the famous headgear “triangle” appeared, which was transformed into a two-angle form over time.

In 1699, Charles XII introduced a new luxurious uniform for his guards: the edges of uniforms and hats were rimmed with gold braid for officers and with silver braid for non-commissioned officers. At the end of the protracted war, the Swedish regiments were dressed in simple gray uniforms (Fig. 11). The British Kirk's Regiment is one of the oldest in the army. The first fur hats were replaced by cloth grenadiers embroidered on the front; the lining was with lapels (Fig. 12), which later became the decoration of the uniforms of many armies around the world.

The French infantry and cavalry wore a gray uniform (Fig. 13). Only a few regiments wore red uniforms, and the royal regiments wore blue uniforms with red cuffs. Multicolored patterns on the saddles and holsters were the insignia of the regiments. The yellow color of the uniforms of Spain dragoons was replaced by green (Fig. 14); the uniforms of various regiments differed in colors of the cuffs, but the aiguillettes remained yellow. The uniform of the Bavarian Grenadier Regiment and Infantry was of Bavarian heraldic colors – sky blue and white (Fig. 15). They were the first who used stocking covers or leg warmers made of unpainted gray cloth for the winter. After the unification of Poland and Saxony, the military uniform kept the traditions of both states: the clothes of the cuirassiers are both Polish and Saxon (Fig. 16). After the introduction of uniforms in the Russian army, starting from 1720 all infantry regiments wore uniforms with red cuffs and camisoles of the same color (Fig. 17).

After the war for Austrian heritage, Prussian dragoons got a blue uniform. In accordance with the fashion of the epoch, the officer's uniform was decorated with wicker ribbons, embroidered with gold or silver (Fig. 18). Austrian dragoons were ordered to wear blue uniforms, but they could not do that because of the war, thus, they continued to wear green (Fig. 19), red or white uniforms.

Hungarian infantrymen wore uniforms of German type, and the officers often wore Hungarian mirlitons instead of hats (Fig. 20). Hungarians' uniforms differed by the presence of boutonnieres on their chests instead of lapels, tight-fitting colored trousers, decorated with Hungarian knots on the hips, and black ties (in German regiments they were red). Since the time of Peter, I, the cannoneer of the Russian artillery wore red caftan with the cuffs of blue, and then black color (Fig. 21). The uniforms of the Reich army's infantrymen were of Austrian (white) or Prussian (dark blue) design (Fig. 22).

Hats were also of two types: mitres or bearskin hats; the head bands of the mitre were metalized. The British Royal Navy was provided with the uniforms late enough, only in 1748. Blue and white colors were officially approved; the combination of these colors is used in modern uniforms as well. The decoration with gold chevrons corresponded to the title and was special on the ceremonial samples; the uniform showed in Fig. 23 was worn by the officers every day.



Fig. 1. The Vatican. The Swiss Guard, common soldiers, 1506.



Fig. 2. England. The Trabant Royal Guard, soldier, 1520.



Fig. 3. Spain. The Royal Noble Guard, common soldiers, 1646.



Fig. 4. France. King's Musketeers, 1640.



Fig. 5. England. Officer and dragoon, 1670.



Fig. 6. The Netherlands. Artillery officer, 1668.



a b

**Fig. 7. Sweden:
a – cavalryman, 1676.
b – The Helsingfors Infantry Regiment, Musketeer, 1675.**



Fig. 8. Spain. Dragoon 1690.



Fig. 9. Denmark. The Grenadier Corps, common soldier, 1709.



Fig. 10. Russia. Dragoon officer, 1701.



Fig. 11. Sweden. The Foot Guards. Musketeer, 1709.



Fig. 12. The UK. The Kirk's Regiment of Foot, grenadier, 1715.



Fig. 13. France. Common soldier, 1701.



Fig. 14. Spain. Common soldier, 1707.



Fig. 15. Bavaria. Musketeer, 1701.



Fig. 16. Saxony-Poland. Officer, 1734.



Fig. 17. Russia. Grenadier, 1740.



Fig. 18. Prussia. Officer, 1757.



Fig. 19. Austria. Common soldier, 1763.



Fig. 20. Hungary. Grenadier, common soldier, hussars, cavalry, 1756.



Fig. 21. Russia. Cannoneer, 1757.



Fig. 22. The Franconian District. Grenadier, 1760.



Fig. 23. The UK. Commodore of the Royal Navy, 1756.

French officers that served on the galleys wore red uniforms; officers on sailboats wore uniforms of the royal colors – blue and red (Fig. 24). From 1780, they obtained permission to wear white casual clothes. The uniform of the Polish Royal Hussars combined the features of Saxon military and national Polish clothing (Fig. 25). A hat with a square top was called a Confederate; later it served as a model for the creation of original headgear for various purposes. The mace was a prototype for the command stick, which became a sign of senior officers in Poland. In the

British North American colonies, militiamen wore their uniforms. Commander Washington had a rag-tag dressed army; he wore a dark blue caftan with cuffs made of light brown buffalo skin (Fig. 26, a). The insignia was determined by the cockades on hats.

Till 1778, the idea of unification of military uniform of the American army was illusory, because the lack of uniforms was catastrophic. Therefore, it was decided to equip the soldiers with jackets for hunting (Fig. 26, b), which also disoriented the enemy; later the leather pants were replaced by cloth or linen leggings. The US Mariners wore green uniform with a white collar (Fig. 26, c); later collars, lapels, cuffs, and linings became red; then the uniform was of dark blue color. The British Ranger Corps kept the green uniform due to its good camouflage characteristics. They differed from the American soldiers by the headgear in the form of a truncated cone (Fig. 27). The British made a lot of changes to their uniform: khaki protective clothing was associated with their army in Africa; shorts were for hot countries; they had many cardigans (the name of English general); military and sailor sweaters originated from there as well. Even the balaclava was named after the city in which the hostilities continued. Trenchcoat, the coat for trenches, became part of women`s fashion as well.

The uniform of officers-hussars differed significantly from the clothes for common soldiers (Fig. 28). Soldiers of the Russian Musketeer regiments (Fig. 29) wore the uniforms of traditional colors: epaulettes on the left shoulder were the insignia. The uniform of the Swedish army at that time was of a traditional cut (Fig. 30), it consisted of long stockings, shoes with laces, and hats with colorful feathers. The color range of the French National Guard (Fig. 31) corresponded to the new national colors.

The cavalry of the Swiss Cantonal Guard was dressed in a French-style uniform in the Hussar style (Fig. 32). In the Russian army, the coatee of a newly designed uniform fastened to a waist and had a high collar, was without lapels and of light to dark green color (Fig. 33); also, there were skinny white pants with high boots. The coatees of the British common soldiers were single-breasted (Fig. 34); the buttonholes were hemmed with chevrons, which served as a sign of distinction. Dragoons of the French Empress Josephine wore green uniforms (Fig. 35, a); the copper helmets with plumes on the ceremonial uniform gave her a graceful appearance. The uniform of French vivandieres (Fig. 35, b), who selling food, served as a prototype of a female nurse during the war. They dressed in costumes of such colors in accordance with the uniforms of the regiments and sometimes took part in parades.

The uniform of the Cossacks was various: bloomers (Cossacks trousers), astrakhan hats (Fig. 36); the regiments differed in colors; the guards wore red half-caftans, blue trousers, and hats with bright red pointed caps.



Fig. 24.
France.
Navy
Officer,
1763.



Fig. 25.
Poland.
Captain of
the Royal
Hussars,
1770.



a **b** **c**
Fig. 26. The USA:
a – Washington's
personal guard. Fusilier,
1775.
b – The First Regiment of
Georgia. Fusilier, 1777.
c – The Marine Corps.
Fusilier, 1780.



Fig. 27. The
UK. Hussar,
1781.



Fig. 28.
France.
Officer-
hussar of
the
Lausanne
Legion,
1780.



Fig. 29.
Russia. The
Musketeer
Regiment.
Common
soldier,
1788.



Fig. 30. Sweden. The
Cronberg Regiment.
Fusilier, 1788.



Fig. 31.
France. The
National
Guard.
Grenadier,
1792.

The uniform of the Russian army points to the changes during the Napoleonic wars (Fig. 37): shako of the European style, the emblem, and the number of the regiment on the plates; the ceremonial uniform provided for wearing of the white trousers. The Polish Rebel Army had the same uniform as the Russian army (Fig. 38) but differed in color: its uniform was dark blue with yellow decoration.

The American military uniform complied with the main fashion trends: the narrow blue uniform was part of the everyday and ceremonial uniforms (Fig. 39). Later, the uniform also included blue pants and a high cylindrical shako. The collars of the uniforms were decorated with embroidery.

The officers wore yellow stripes. In 1842, the uniform of the Danish army was simplified, and the battalions differed in numbers on shoulder straps (Fig. 40).



Fig. 32.
Helvetic
Republic.
Horsed
ranger,
1800.



Fig. 33.
Russia. Non-
commissioned
officer of the
dragoon
regiment,
1803.



Fig. 34.
The UK.
Grenadier,
1801.



a



b

Fig. 35. France:
a – The Imperial Guard.
Dragoon, 1809.
b – vivandiere, 1809.



Fig. 36.
Russia.
Cossack
of the
Ural
army,
1812.



Fig. 37.
Russia.
Common
soldier of the
infantry
regiment,
1830.



Fig. 38.
Poland.
Captain of
the
infantry
regiment,
1831.



**Fig. 39. The
USA.**
Common
soldier of
the dragoon
regiment,
1847.



Fig. 40.
Denmark.
Common
soldier of the
line infantry,
1848.

The old uniform (coatee) became longer, the ceremonial uniform included white trousers; helmets with brass finishing served as headgears. The uniforms of allies and enemies in the Russo-Turkish War in 1854 are presented in Fig. 41 – 44.

The regiments were the parts of a brigade advancing near Balaklava; it was the British who invented the headgear with the appropriate name of the city. Later, the Russian helmet of the sharp form (Fig. 42) was replaced by shako of a cylindrical form. The infantry wore overcoats over their uniforms during the campaigns; the overcoat was too long, so it needed to be tucked in; the boots became higher and wider to tuck in the bloomers.



Fig. 41. The UK. Common soldier of the Ulan Regiment, 1854.



Fig. 42. Russia. Common soldier of the infantry regiment, 1854.



Fig. 43. Turkey. Cannoneer of the artillery, 1854.



Fig. 44. France. Vivandiere of the line infantry, 1854.



Fig. 45. Prussia. Cannoneer of the field army, 1864.



Fig. 46. Denmark. Common soldier of the dragoon regiment, 1864.



Fig. 47. The UK. Common soldier of the Regiment of Scottish Shooters, 1900.



Fig. 48. Japan. Common soldier of the foot guards, 1904.



Fig. 49. Russia. Common soldier of the infantry regiment, 1904.



Fig. 50. Japan. Captain of the first rank of the Navy.



Fig. 51. Russia. Captain of the first rank of the Navy.



Fig. 52. Serbia. Common soldier of the cavalry, 1913.



Fig. 53. Greece. Common soldier of the infantry, 1913.



Fig. 54. Turkey. Brigadier General, 1913.

After 1820, the Turkish army introduced a European-style uniform, mostly of French design. However, a fez remained the main headgear until the end of the Ottomans` existence (Fig. 43). Only French vivandieres, who

were the wives of non-commissioned officers, wore the attractive uniform with a small headgear (Fig. 44).

The uniform of the Prussian artillerymen repeated the uniform of the infantry (Fig. 45): overcoats, coatees with a straight collar, black stripes, and red edging; equipped with a hood. The uniform of Danish dragoons was blue (Fig. 46), wide overcoat covered the horse's croup. At the end of the 19th century, the British army should have names instead of numbers (Fig. 47); the regiments of the Indian army were equipped with khaki uniforms. On the eve of the Russo-Japanese War, the samurai in the old Japanese uniform were replaced by an army dressed in the European-style uniform (Fig. 48), which also had a khaki uniform. On the eve of the War, the introduction of the field uniforms of the protective color also accelerated in the Russian army (Fig. 49).

The form of the officers of the Japanese Navy (Fig. 50) also had the features of English and American uniforms: coatees were popular, the insignia was placed on the sleeves in the form of black stripes. From the time of Peter, I to the end of the 19th century, the dark green uniform of the Russian Navy turns black; the military ranks were determined by epaulettes and shoulder straps (Fig. 51); single-breasted coatees had gilded buttons.

The Serbian army wore a French-style uniform (Fig. 52), later – a Russian-style one. Changes in the form of the Greek army led to an external similarity with the Danish uniform (Fig. 53). The French influence on the Turks' uniform was intensified by German influence: officers wore long coatees (Fig. 54); the insignia was in the form of gold generals' chevrons, as well as the number of chevrons on the cuffs.

During World War I, the uniforms of the same cut and color were introduced in all armies [3, 17]. The insignia was in the form of small letters and numbers, as well as small icons and edging. For the first time, the German army joined forces into a single army; the uniform was standardized according to the Prussian design (Fig. 55); the general emblem in the form of an imperial cockade of black, white, and red colors was introduced; shooters had the aiguillettes on their right shoulder. An old way of distinguishing the regiments by the colors of cuffs and buttons remained a characteristic feature of the uniform of Austro-Hungarian soldiers (Fig. 56): the uniform of the regiments differed in colors. The uniform of the Russian army proved to be almost unsuitable in the conditions of the Russo-Japanese War, so the army returned to the improved uniforms of the previous years (Fig. 57); the shakos were also improved. The coatees of the French infantry remained whites (Fig. 58), the overcoat with a hood was used all the time. The red uniform was always worn by the British army (Fig. 59); soldiers wore the helmets only on duty.



Fig. 55.
Germany.
Common
soldier,
1914.



Fig. 56.
Austro-
Hungary.
Common
soldier of
the Danish
King's
Regiment,
1914.



Fig. 57.
Russia.
Common
soldier of
the
Yeoman of
the Guard
Regiment,
1914.



Fig. 58.
France.
Common
soldier of
the line
infantry
regiment,
1914.



Fig. 59. The
UK. Common
soldier of the
infantry
regiment, 1914.



a
Fig. 60. Germany:
a – captain of the field
artillery, 1914.
b – common soldier of
the machine-gun
division, 1914.



Fig. 61.
Russia.
Yesaul of
Cossack
army,
1914.



Fig. 62.
Serbia.
Common
soldier of
infantry
regiment,
1914.



Fig. 63.
Germany.
Common
soldier of the
infantry, 1917.



Fig. 64.
France.
Common
soldier of
the
infantry,
1917.



Fig. 65.
Austro-
Hungary.
Common
soldier of
the infantry,
1917.



Fig. 66.
Poland.
Ranger of
the Polish
Legion,
1919.



Fig. 67. Soviet Russia. The
Red Army:
a - artilleryman, 1919.
b - infantry soldier, 1919.



The German field uniform for officers and common soldiers was of the same color (Fig. 60, a); they were allowed to keep chevron stripes; the officers` uniform was supplemented by a belt-scarf. Soldiers of the

machine-gun divisions wore the uniforms of the protective color (Fig. 60, b), made of gray-green cloth, as the hunters. The Kuban Cossacks had identical uniforms (Fig. 61), but the system of military ranks was special. The khaki color for the Serbian army was eventually introduced in 1914 (Fig. 62); the national footwear – opanki – was in demand during the War.

The field-type jacket of modern design (Fig. 63) gradually changed the German uniform; gray pants did not have lapels anymore; boots became black – the trench war made its demands; due to the use of gases, gas masks were added to the equipment.

The hard lessons of the French army forced to change the blue and red uniform of the infantry for the field uniform (Fig. 64). The cut remained almost unchanged; they had a gray-blue uniform to differ from the khaki uniform of the German army. Austria started to sew the field uniform in 1915; later the jacket was made with a turn-down collar (Fig. 65); only in 1933 soldiers received the uniform of the traditional Austrian cut again. The Polish Legion had a French gray-blue uniform (Fig. 66); a square cap with the emblem indicated the nationality of the Legion.

The first uniform of the Red Army had its special features: a red bandage with the inscription “The Red Guard” and a red ribbon on the headgear (Fig. 67, a) – a conical cloth helmet, known as “Budyonovka”, designed for the soldiers of the tsarist army. The edges of that helmet could be wrapped into the hood. The Soviet service shirt (Fig. 67, b) had insignia, and on the Budyonovka, there was a large star made of red textiles. The Finnish army had temporary uniforms; the field uniform was taken; a heraldic vase was the defining sign; buttons and buckles were decorated with the images of Finnish lions (Fig. 68). The Estonian army of those years was dressed in different ways (Fig. 69): only a cap was a national detail of the uniform. The uniform of the Latvian army (Fig. 70) was red with a white stripe; a steel helmet of the French model served as the headgear. Probably, the French design of the uniform (but of a protective color) served as a design of the uniform for the Lithuanian army (Fig. 71).

The uniform of the German army at the beginning of World War II (Fig. 72) was developed based on the uniform of World War I. The uniforms of Poland (Fig. 73) and Denmark (Fig. 74) were of traditional design; they differed only in stripes of different colors that were in the form of flags. The British uniform (Fig. 75) became an example for the other world. Its feature was the large universal pockets for the cartridge magazine of the automatic weapons.

On the eve of the Great Patriotic War, the uniform of the Soviet forces was constantly improving (Fig. 76); the insignia was placed on the lapels; the uniform of the commanding officers was changed significantly. The U.S. Marine Corps Women`s Reserve was formed in 1918 and called up for service in 1943. The everyday uniform was of green color; white uniform was worn only in summer (Fig. 77); the insignia and military ranks

repeated other parts of the Marine Corps. The uniform of the Bundeswehr (Fig. 78) differed from the old uniform of the Wehrmacht. Later, the Germans improved their uniform, returning to the Wehrmacht traditions in cutting and colors; the aiguillettes were worn for very special occasions.



Fig. 68.
Finland.
Common soldier of the White Guard, 1922.



Fig. 69. Estonia.
Ulan of the cavalry, 1922.



Fig. 70. Latvia.
Common soldier of the infantry, 1923.



Fig. 71.
Lithuania.
Lieutenant of technical troops, 1926.



a

Fig. 72. Germany:
a - pilot of the Air Force, 1939.
b - common soldier of the infantry, 1940.



b



Fig. 73.
Poland.
Captain of the infantry, 1939.



Fig. 74.
Denmark.
Common soldier of the infantry, 1940.



Fig. 75. The UK.
Common soldier of the infantry corps, 1942.



a

Fig. 76. The USSR:
a – senior lieutenant of field artillery, 1940.
b – Common soldier of the infantry, 1943.



b



Fig. 77. The USA.
Corporal of the Marine Corps, 1944



Fig. 78. The Federal Republic of Germany.
Lieutenant of the artillery, 1966.



Fig. 79. The USA.
Cadet of the military academy, 1965.

The first uniform of the cadets (Fig. 79) was dark blue; then it was gray but almost did not change in cut and color. The shako was decorated with a cockade with the emblem; in our days, the ceremonial uniform is used only during the ceremonies. In addition to the white pants, gray pants with wide black stripes are used. In many countries, soldiers wear common or field uniforms, which are used for everyday wear in peacetime and wartime, as well as the uniforms, designed only for parades and ceremonial events.

Summing all the above, we can conclude that the uniform has a double nature. There is a significant difference between the verbal definition of a uniform (uniform clothing of the army, departments, organizations) and the features associated with it. Also, it is worth paying attention to the synthetic image of the uniform in the art (painting, photography, movies, performance art, music). In other words, it is possible to see a constant game between two aspects of the uniform: a given symbolism (identity, rules, hierarchy status, roles) and stereotypes associated with the informal use of the uniform and its details (diversion, individual interpretation).

Therefore, modern civilian clothing is increasingly approaching the military clothing in its shape, style, colors, features of textile prints, reproducing the "civilian concept". Even though the double nature of the statutory, protective, ceremonial and household wearing of uniforms is not in the scope of our research, we consciously pay attention to this as one of the formative features of the design of the clothes, stating that the rules and regulations of wearing uniforms are a key block. This allows us to explore new approaches to the process of shaping in the design by reflecting a holistic view of the current level of development of visual culture.

Conclusions. The conducted studies have shown that design is a systemic component of the artists' experience, a product of their artistic thinking, aesthetic consciousness, and practical activities. It is found that the artistic concept of uniform development remains underdeveloped. Also, the need to improve the creative component of the analysis and synthesis of form and style of uniform, and its development as one of the components of project culture of a society are identified: the peculiarities of mutual influence of technology and morphology of the development of its forms, as well as the importance of designers' professional activity in the final quality of the projected samples, are considered; the changes in artistic-compositional and constructive-technological means and methods of shaping are described.

The evolution of the style of the uniform and the peculiarities of its visual perception, the influence of the clothes of special purpose on civilian clothing, and mass fashion are studied. The traditions, symbolism, constructive, and figurative-plastic characteristic features of the development of the uniform of different peoples within the respective epoch

are considered. It is stated that it is expedient to consider traditions as a cultural phenomenon of uniforms. The systematized chronology of the uniform's development is given; the geographical features of the development of the uniforms, as well as the heraldic components of the uniform and the tonal-color relations, are singled out. The compositional principles of the formation of complete units of uniforms considering the accessories, headgears, features of the weapon, and its application are presented. The peculiarities of design, production, and use of women's uniforms are considered.

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1.5. ECLECTICISM AS THE BASIS OF DESIGN PRACTICES IN THE MODERN FASHION SYSTEM

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Abstract. *The study describes the principles and means of eclecticism as a design practice in the formation of artistic images in the modern fashion system, as well as defines its fundamental regularities and methods of application in design of clothes as a fashion product. It is substantiated that by applying the principles of eclecticism in costume design, it is possible to design an individual and unique image that creates preferences for the identification of its wearer in society. The work defines eclecticism as a design practice and a means of forming fashion trends in the modern fashion system. Eclecticism is characterized as an assimilation of diverse style elements borrowed from all kinds of cultural (including subcultural) systems, historical styles, areas of art and architecture, which have qualitatively different meaning and purpose, with subsequent harmonization of the compositional and stylistic nature of fashion.*

Key words: *eclecticism, design activity, design practice, fashion system, costume design, fashion trend, kitsch, mass fashion, stylistic trend.*

Introduction. The fashion system existing at the turn of the 20–21st centuries is looking for new driving forces both in design industry and distribution of fashion products, as well as in creation of fashion trends and looks that could attract an experienced mass consumer. Among the main trends used by the fashion system representatives in design activity, the principle of mixing these art trends in order to develop new design practices, create new art images and find new stylistic solutions is increasingly applied. The modern structure of fashion is very divergent, but most of its proposals are based on eclectic principles, which are expressed in several stylistic trends combined in one look. Given the historical preconditions for the spread of eclecticism in culture and the negative attitude towards it that most people have, analysing the reversible development of this trend is quite interesting [2, p. 153–156].

The point is that eclecticism was seen as a bad taste, which in the 19th century was called kitsch, however, nowadays the eclectic style and kitsch are rapidly losing this negative status, which means that they are positively influenced by our society [19, p. 120–122]. Their characteristic features can be found in most models offered by modern fashion that boldly uses them in all kinds of clothing and accessories.

Statement of the problem. The everyday life has made people get used to comfort and practicality, since the eclectic style has become widespread and continues to hold a dominant position in fashion. However, people involved in design industry are getting more interested in how the eclectic style and kitsch begin to diffusely effect those areas of cultural and

social life where clothing is more important (dress code, uniform, etc.). For example, the office dress code, which is generally business-oriented, has been influenced by eclecticism, namely one of its trends – casual style, creating business casual office dress style.

Results of the research and their discussion. Encyclopedic literature notes that 'ideological and aesthetic eclecticism inherent in the modern art in general, and clothing in particular, allows using different combinations of symbols and languages, reserving the right to change the standard symbols to more emotional ones' [16, p. 1530].

The modern fashion also does not ignore formal clothing worn for a special purpose, for instance, a social event or a dinner party, but leaves endless space for creative expression, designer experiments and bold decisions, which are embodied in unusual cuts, unique décor, non-standard and expensive fabric. Thus, the eclecticism and kitsch acquire the status of unique creative 'tools' that help modern designers to create solutions for different looks in order to diversify and make the usual structure of fashionable clothing more interesting.

The relevance of this issue lies in the study of eclecticism as a creative tool for creating new and modern clothing models. The 'lack of taste' in eclecticism has managed to attract the professional attention of people involved in art professions, who saw them as effective art tools and are actively using them in their professional activities. Therefore, we can say for sure that due to the ability to penetrate into any stylistic or art trends in the cultural area, the issue of eclecticism will be relevant for a long time, despite the fact that the tastes and needs of people tend to change [20, p. 51–55].

However, the principles of this assimilation have been insufficiently studied, and therefore they need to be paid special attention. Nowadays, it is difficult to follow every fashion trend or style, since the purity of specific styles is very rare as compared to a combination of different styles. This combination is justified by a new stylistic phenomenon in clothing, namely eclecticism. In this context, it can be defined as the basis of design practices combining several stylistic trends. Accordingly, there is an active tendency for creating an individual fashionable look using affordable, factory-made and stylish (thanks to modern day mass media) items of clothing in a wide circle of mass fashion consumers. The main principle is to combine not only various items of clothing, but also elements of an outfit (both clothing and accessories), representing different stylistic and functional features. Furthermore, the more they do not match in style, patterns or colours, the more vividly they reveal the wearer's personality, reflecting his/her tastes and preferences (Fig. 1, 2).



a b c d e

Fig. 1. Fragments of the collection of designer brands that combine eclecticism in the design image: a – c – Dolce & Gabbana, collection “pret-a-porter” (2017); d – e – Jean-Paul Gaultier, колекція «haute couture» (2016)



a b c d e

Fig. 2. Fragments of the collection “prêt-a-porter” of designer brand Kenzo (2019), presenting the "diffuse style", formed on the basis of eclectic design characteristics of various short-term fashion trends

Researchers studying the history of clothing and fashion development of the 20th century believe that the beginning of eclecticism that allowed creating fashion trends in European fashion took place in the 1970s. Back then, people tended to buy non-traditional clothing and accessories at 'flea markets', the most avant-garde of which was considered to be the Portobello Road Market located in London. The eclecticism of this period was manifested through the techniques of combining items of clothing belonging to different styles and trends in one set. "The multi-layered mixed clothes made of different fabrics of various textures were matched with unusual floppy mink fur hats offered in different colours", this is how S. Odoievskiy, art critic and journalist, describes the eclectic combination of different elements in one look [13].

Last but not least, the eclecticism of the 1970s fashion contributed to the replacement of the dominant design system in the professional area of fashion design – a combination cultivated by the leading Haute Couture houses creating costumes that represented different looks and individual Haute Couture outfits was replaced by a set of clothes reflecting the most practical and rational principle of creating the individual consumer's wardrobe, and consisted of a small number of matching clothes (and often not matching clothes) [27]. It was during this period of the 20th century that the system of fashion saw a new vector of development – design and production of single clothing items with maximum variability of stylistic solutions, as well as compositional and decorative designs used for broadening options for their combination (Fig. 3).

The influence of eclecticism on the design of fashionable clothes grew stronger in the 1980s. During this period, the 'feminine' and the 'masculine' were mixed, creating a 'unisex' style, the militarism of women's clothes was combined with romance, while rock was 'seasoned' with glamour. In addition, a wide choice of items belonging to different styles, the influence of popular musicians, economic prosperity and the desire to express one's own individuality were reflected in the absolute freedom of choosing clothes, as well as in their combination. People were increasingly wearing comfortable clothes to their own taste and at their own discretion.

One of the main vectors of the public life development in the 1990s was also eclecticism aimed at reflecting the reality in the choice of clothes by the majority, creating new aesthetics, finding the most successful combinations of different styles. This concept resulted in fashion designers beginning to actively mix different styles, sometimes running a risk to create absolutely tasteless things [10].

At the same time, they take into account the needs and wishes of their regular and potential consumers. Such bold combinations led to further democratisation of fashion, while generalised fashion trends gave way to individual taste. The evolution of fashion and the development of clothing shapes are often subject to different principles of transformation.



Fig. 3. Design and production of single items of clothing with maximum variability of stylistic solutions and compositional and decorative design to expand the possibilities of their combinatorial use



Fig. 4. The principle of complete organization of everyday clothing of mass demand (the so-called "mix & match" principle)

This trend emerged due to the fact that the creation, manufacture and distribution of clothes as products of fashion for various purposes in the 20th century almost completely 'migrated' to the areas of industrial design, advertising and information promotion among various segments of consumers. In this regard, it is worth mentioning the tendency of so-called accelerated 'moral ageing' of clothing as a product of fashion and its replacement by new fashion models, the stylistic or compositional solutions of which are insignificantly different from the previous ones.

In view of this, another aspect of the eclecticism formation as a design practice of the fashion system is the fact that items of clothes that go out of fashion do not age so quickly physically, and therefore, they continue to exist when mixed with new models, but in a slightly changed functional and aesthetic sense. According to the study, although fashion started offering the consumer lots of options, the main types of clothing, especially the men's one, varied around the same product range. The

increase in mixing various clothing styles was greatly facilitated by the trend offering to create mixed sets using separate items of clothing called 'mix & match' (the principle of making stylistically correct combinations in a set of clothes of different brands, both top-class and democratic ones, as well as elements of vintage, second hand and handmade clothes). This technique, which is actually a manifestation of eclecticism in clothes, shows the priority of an individual approach to the creation of a stylish look over the power of fleeting fashion trends (Fig. 4). It became the basis and determined the development of ethnic patterns in creation of the modern Ukrainian clothing.

On the other hand, fashion innovations and creation of fashionable looks by world-famous Haute Couture houses are not so openly focused on marketing success and financial well-being. The development of aesthetic properties of fashion products, creation and implementation of fashion innovations aimed at shaping trends in modern art and raising the general cultural level of the society, as well as identifying individual traits of consumers that are levelled by mass production of clothes can be considered as one of the main tasks of the fashion system representatives [23].

Accordingly, in the modern society of mass consumption, eclecticism is popular as a way of emphasising the fragmentary and multifaceted nature of mass information as opposed to the integrity, subordination to the main idea, presentation consistency and internal coherence of the elements. However, it should be noted that the internal contradictions are not identified by all the authors using eclectic design techniques in their creative activities. In this regard, the modern fashion system is facing an issue where “existing trends of polystylism, eclecticism, fragmentation in modern art, particularly in clothes, demonstrate the evolution of collage accompanied by deepening the principle of its construction – diversity” [17].

Given the fact that the suit is multicomponent, this trend should allow using at least one connecting element in a different-style set. Given the theory of composition and the laws of harmony, a combination of incompatible, harmonious colour scheme, techniques of contrasts and nuances, proportional balance of each style involved, content-related factor, appropriate combination of different textures, decorations, etc. were identified as the main principles of creating new models of clothes on the basis of eclecticism in the study. We must not forget about the 3-component rule and the composition centre [4, 6, 15, 18].

This trend has undoubtedly affected the functioning of the fashion system, which could no longer, as before, massively control fashion trends and the consumer's choice. The modern pace of life requires a comfortable and practical outfit that could give people the opportunity to keep up with this pace and meet their needs. Thanks to its various tools, the eclecticism has influenced the formation of other fashion trends, one of which is *casual*

[22]. Its development was impossible without the influence of eclecticism, since it combines different styles of things in one set, and therefore expresses the freedom to dress, emphasising the individuality of its owner [26].

To understand it better, we need to analyse more deeply the stages and factors of development of the currently dominant *casual* trend, which will allow us to determine the limits of influence and further changes in this trend in terms of its compliance with eclectic criteria in modern clothing design (Fig. 5). The name of the *casual* style comes from the English word 'casual', which means occasional, daily. The original meaning fully characterises the essence of its manifestation in clothing. It originated in the middle of the 20th century, transforming and adapting the stylistic features, image and design characteristics of the 1940s–1990s youth subcultures [21].

Accordingly, the widespread introduction of *casual* style in mass consumption was caused by: counteracting conservatism, kitsch and eclecticism aestheticisation, the 1980s economic boom, which led to the development of light industry, including mass production of clothing, the influence of various subcultural trends [34], the philosophy of democracy in clothing and natural strive of people for comfort, as well as designers seeking inspiration in everyday life [22, p. 84–92]. As we can see, the *casual* style is a bright embodiment of eclecticism in clothing.

Today, there is a huge number of brands producing clothing in eclectic and casual styles, namely: *Adidas, Armani, Ben Sherman, Burberry, Calvin Klein, Dolce & Gabbana, Fred Perry, GUESS, Hugo Boss, Lacoste, ZARA, Mango* and others [28].

Classification of its properties and categories addresses the issue of determining the factors of influence exerted by this fashion trend on the formation of stylistic solutions for the currently popular clothing in the segment of so-called mass fashion. Nowadays, casual style can be divided into several types, the main of which are: smart-casual, business-casual, street-casual, sport-casual, casual-glamour, all-out-casual, dressy casual. It is appropriate to cover the main specific features of all the branches of the fashion trend discussed (Fig. 6 – 10), namely:

- Smart-casual is a combination of aristocratic origins supplemented with simplicity, where there is no place for unnecessary and uncomfortable details. In addition, 'this style also allows wearing T-shirts, vests, casual jackets, scarves' [3, p. 94];
- Business-casual is similar to the previous sub-trend, but it is more common among office workers willing to combine the business purpose of clothing with convenience and elegance. A strict shape and silhouette are typical for the suit, but its art and technological solution is much more colourful.

- Sport-casual is a set of clothes including sportswear. It is also very common and the most convenient.
- All-out-casual is a sub-trend combining things that suit best for walks, spending time out or travelling.
- Street-casual is mainly a combination of clothes that can be seen on the streets of your city during the day. This is the most common type of casual trend that allows wearing completely different, even casual items of clothing that the owner likes most as they are comfortable or practical. This trend mostly combines sport-casual, casual glamour and mixed items of clothing allowing to create an embodied style to dress.
- Casual-glamour is a sub-trend characterised by a more refined selection of clothing items complemented by different accessories, romantic elements, slender silhouettes.
- Dressy-casual means wearing free garments with a hint to a night out. You can wear such clothes after 5 p.m. [12, p. 9, 10].

In the 1970s, street-casual sub-style inspired by the clothes worn by English football fans started going into fashion. Their wardrobe included famous brand items of clothing, namely a specific brand symbolising their favourite football team. This look was first called casuals because of its bold casualness and informal nature. “Thus, such football casual style became not just the style followed by football troublemakers, but also the style of life” [34].

As a result, the *casual* style started entering the catwalks, where the designers offered bold solutions, combining garments different in style and purpose [11, p. 17, 18]. *Casual* style was finally established as a fashion trend in the 90s of the last century, and now it is the most common and popular style, impressing and modifying other style trends, creating other varieties mentioned above. Hence, *casual* style can be interpreted as an opportunity to combine clothes that can be different in style and purpose, and be appropriate in everyday life. But it is also widely used in the corporate dress code [403, p. 84–92]. This style trend excludes formal and elegant clothes, classic clothing (except for certain eclectic mixes) in combinations including clothes of one or different brands.

It should be emphasised that due to the functioning of the fashion system, eclectic and *casual* styles have formed a symbiosis related to almost every style that was mixed with comfortable items of clothing that do not match. For instance, the emergence of the *casual glamour* sub-trend was facilitated by women's desire to look feminine, elegant and feel comfortable at the same time.



Fig. 5. Fragments of casual clothing collections of leading brands (2019), which to some extent combine the design features of other styles - sports, romantic, ethno:

a – Akris; b – Etro; c – Jil Sander; d – Sacai; e – Hyke; f – Issey Miyake



Fig. 6. Models of women’s clothing *smart-casual* (a – c) and *business-casual* (d – e), designed by leading fashion brands (2019):

a – Fendi; b – Giada; c – Sandy Liang; d – Akris; e – Alberta Ferretti



a b c d e

Fig. 7. Models of women's clothing *sport-casual* (a – c) and *all-out-casual* (c – e), designed by leading fashion brands (2019):
 a – Iceberg; b – Salvatore Ferragamo; c – Fendi; d – Hermes;
 e – Monse



a b c d e

Fig. 8. Models of women's clothing *street-casual*, designed by leading fashion brands, 2019:
 a – Fendi; b, d – Dolce & Gabbana; c – Hermes; e – Tommy Hilfiger



a b c d e

Fig. 9. Models of women's clothing *casual-glamour*, designed by leading fashion brands, 2019: a, d – Dolce & Gabbana; b – Giambattista Valli; c – Dries Van Noten; e – Genny



a b c d e

Fig. 10. Models of women's clothing *dressy-casual*, designed by leading fashion brands, 2019: a – Chloe; b, d – Fendi; c – Mark Jacobs; e – Versace

The following features are typical for casual style: highly practical due to well-chosen materials that can be used for a long time, moderate in décor or having no décor, having simple and accurate lines, restrained but attractive [7].

As the *casual* style combines features of other styles (sports, romantic, ethnic style), it automatically takes over their characteristic features, functions, materials, décor and colour-related solutions. For example, sports and ethnic styles can add dynamism, ease of movement, rationality, simplicity of cuts and brightness to the outfit, while romantic style can make it more feminine, tender and sensual. Thus, the *casual* style adapts to the needs of different consumers, while still maintaining its own features.

Thus, the restless development of new styles and fashion trends, the dominance of individual choice, as well as the influence of subcultural trends, famous people and designers have paved the way for the spread of eclecticism in clothing fashion.

In the 21st century, eclectic style became an integral part of fashion collections launched by many fashion designers. Among the famous couturiers of the late 20th century creating high fashion collections, V. Westwood, J. P. Gaultier, T. Mugler, as well as J. Galliano and A. McQueen are worth mentioning. A notable feature of their creative activity is that every detail is taken into account and all the garments are perfectly matched in complex sets. "Such Haute Couture works cannot be seen as kitsch-oriented, since the basis of their creation is eclecticism", say the art experts M. Aksienova, T. Yevseieva and A. Chernova [2, p. 424]. Eclecticism took deep roots in fashion as an endless source of inspiration, gaining more and more fans. Now it is neither seen as a manifestation of bad taste, nor condemned or mocked.

Based on the results of the research, it should be emphasised that eclecticism is holding an active position in the middle-class clothing environment at the beginning of the 21st century as the basis of design practices. Utilitarian and affordable brands such as *Zara*, *New Yorker*, *Bershka*, *Stradivarius*, *Pull & Bear* offer their consumers a range of clothing that can be suitable for sports, everyday life, business and social gatherings or nights out. Combining clothes for different purposes in each of their collections, they automatically offer their consumers to match such clothes with each other, stressing that eclectic style is actually relevant and worth following.

Thus, the mainstream offered by professional couturiers and fashion designers is increasingly getting infused with eclecticism born out of street fashion and anti-fashion, although already adjusted and fashionably directed by popular designer brands and chain stores representing the fashion system. Consequently, eclecticism is increasingly used by a large number of fashion designers in their professional creative activities at the

present stage of functioning of the fashion system and fashion trends creation. As a design practice in the modern fashion system, eclecticism has become an alternative to the minimalism trend, which is also quite common among mass consumers. In other words, eclecticism cannot be seen as a lack of taste. Although the eclectic style clothing looks harmonious and has particular features, it does not meet any canons or rules of the classic style.

According to the analysis of publications made by various mass media in the field of fashion, it should be noted: some high fashion couturiers and prêt-à-porter designers admit that it is more acceptable for them to create fashionable eclectic style looks based on the features and properties of certain sources of inspiration, including historical and art styles, national traditions and modern art. Art and culture of the 20th century, from the eccentricity of the 1920s European creative Bohemianism to crazy mottled combinations typical for hippie subculture of the 1970s, as well as national and ethno-artistic motifs, inspire many designers and couturiers (*Blumarine, Donna Karan, Marc Jacobs, Todd Oldham, Michael Kors, Anna Sui* and other famous designers of 'concept brands' and brands of the modern fashion system) to create mass-produced fashion models (Fig. 11, 12) [23].

Despite its colourfulness and unsophisticated nature, eclectic fashion is not so simple to be created. The lack of rules, standards, practical recommendations and methods makes it difficult to match the incompatible in a balanced way. In this regard, the paper presents some general recommendations for the systematic design of fashionable clothing as a product of fashion using the principles of eclecticism. Accordingly, among the basic laws of fashion design based on the principles of eclecticism, it is necessary to pay attention to the following ones:

- Combination of product units (single items) in complex multicomponent sets of clothes. This principle suggests that there must be at least one criterion of compatibility of items representing different clothing styles: shape, texture or decorative design, colour, content-related factor, etc. Subordination and coordination of product units must be observed when a design or art look is created.
- Appropriate combination of stylistic and image characteristics inherent in different epochs and national traditions. To implement this principle, it is necessary to break the stylistic canons typical for a particular original art material, adapt or quote various elements of each time or art style. Herewith, the main criterion for the harmonious implementation of this principle in clothing design should be considered the achievement of the aesthetic look of clothes as a fashion object.



Fig. 11. Fragments of collections of leading design brands, in which the stylistic characteristics of "disco" are adapted to modern fashion trends: a – Yves Saint Laurent, 2017; b – Balmain, 2018/19; c – Elie Saab, 2018; d – Marc Jacobs, 2017



Fig. 12. Fragments of collections of leading design brands, in which the stylistic characteristics of "ethno" are adapted to modern fashion trends: a – Roberto Cavalli, 2016; b, c – Etro, 2018; d – Valentino, 2016

- Harmonious combination of heterogeneous surface characteristics and fabric grains used for creating a design or art look. As we know from the theory of composition, the fabrics having different surface characteristics can be combined in a coordinated manner within certain colours or on the basis of nuanced colour relationships. It helps to achieve the aesthetic look of the fabric in the stylistic and compositional solutions based on the compositional characteristics of plasticity and fabric grains.
- Competent use of bright saturated colours creating a certain colour harmony, or in combination with achromatic graphic solutions, since

eclecticism, being a method of matching the incompatible, involves using bright non-standard, sometimes unnatural colours and non-traditional, sometimes inappropriate ornaments. In this case, as a rule, the starting point for choosing a colour solution for making clothing as a product of fashion are the forecast colour proposals for a particular fashion season. Ultimately, observance of this principle provides for achieving colour-to-tone ratios for fashionable clothing solution as a product of fashion.

- Creation of innovative stylistic solutions of clothing complex as a fashion object (or a set of fashionable clothes as a fashion product), usually by combining essential features of two or three styles, or combining the main features of a particular style with specific features of other sources of inspiration or innovative technologies. As a rule, this assimilation is enhanced by a combination of colour, texture, decorative features of each component, making the effect of eclecticism stronger in clothing. However, when used in the right way, they play the roles of both dominant elements and accents, and contribute to the achievement of aesthetics or uniqueness and ideological content.

In addition, it is important to correctly apply the distinctive features of eclecticism in the design of fashion collections, so that the end result could hide its negative aspects, and show the positive ones, proving its growing aesthetic impact on the fashion system.

Conclusions. Thus, nowadays the interests of designers and art experts are focused on the analysis and application of negative and positive features of eclecticism, as well as the use of the latter as a tool of art expression and a source of inspiration. However, to make these studies as reliable and adequate as possible, the eclecticism as an art trend in general should be considered the object of this interest, being the leading trend in matching the incompatible, as well as its impact on fashion trends and the consequences thereof.

A deep constructive and analytical approach to creating a promising collection of fashionable clothes should always be consolidated by the practical implementation of ideas in the model of current fashion, since any theoretical and art analysis clearly explains the key rules of applying kitsch and eclecticism as the tools of art expression.

Our analysis of the eclecticism phenomenon in modern fashion allows us to conclude that this design practice is an inexhaustible source of inspiration for designers who represent different segments of the fashion system. We have pointed out that by applying the principles of eclecticism in clothing design, it is possible to make an individual and unique look that will always bring advantages for the wearer's identification. Furthermore, if the designed clothing is organic and attractive enough, its creator or wearer may be among the idols of the mass consumer or even among the trendsetters.

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1.6. BIONICS AS A PERSPECTIVE DIRECTION IN CLOTHING DESIGN

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Abstract. *Today, the task of designing competitive children's clothes is significantly complicated by the fact that children's of different age groups have their morphological features, in particular, the disproportion, which is explained by the different rate of growth of individual body parts. This determines the design features of children's clothes, in addition, they must be designed to vary the degree of independence of the child in the use of clothing at different ages. The aesthetic preferences of today children's are also volatile and change as they grow older. For the garment industry, a promising direction for the development of modern models of children's clothes is associative costume design based on biotectonic objects. The urgent task is to improve the process of artistic design of clothes for children on the basis of bionic principles of formation with the aim of creating aesthetically and functionally perfect clothes with a fundamentally new tectonic structure.*

Key words: *associative, design, biotectonics, form-structuring, proportions, transformation, children's, clothes.*

Introduction. During formation of a harmoniously developed personality, since childhood, a special place is occupied by the upbringing of culture, both ethical and aesthetic. For aesthetic education there is a rich arsenal of tools, among which the most important is art, as the main component of art culture. The art of creating a human surroundings – is design, awakens and develops an understanding of aesthetic values in human life, love of beauty, history, nature and the environment. The main purpose of the design is to create new kinds and types of products that meet the requirements of public benefit, ease of use and beauty. Today, the main goal of clothing designers is not only to make a designed product fashionable, but also to help people find a creative solution, cultivate good taste and culture of consumption [1,2].

In modern design, bionics and traditions of national culture are one of the main creative sources that have taken their place in the general international fashion. In their creative works, artists and designers constantly turn to folk traditions and the richness of nature, the functionality of its forms and colors. The theme of nature is quite popular in today's world of fashion and design activities. Creating a modern costume, the process of creative rethinking of the natural environment richness is used, taking into account modern conditions. Thus bionic motives in the most interesting models give the chance to reach not only artistic expressiveness of forms, but also prompt interesting and unusual functional and ergonomic properties [3].

Statement of the problem. The purpose of the work is to improve the method of artistic design of children's clothing on the basis of bionic principles of shaping with the providing of aesthetic and ergonomic compliance. To achieve this goal, the following tasks are formulated and solved:

- the current state of art process design and existing methods of shaping children's clothing from the standpoint of bionics for determining their improvement, was analyzed in work;

- the algorithm of art process designing of a models assortment series of children's clothes with the increased aesthetic and ergonomic indicators, on the basis of application of means of transformation, taking into account rational principles of their construction and proportioning is developed;

- recommendations for practical implementation of the developed method of art process design of children's clothes are developed.

Results of the research and their discussion. Design of modern children's clothing – is a complex process of developing a new model that meets all modern requirements, is carried out taking into account social conditions, technical progress, psychophysiological growth of children, the laws of art design and ergonomics, upbringing the individual style of each child.

The development and industrial manufacture of children's clothing, is complicated by the fact that the change in the proportions of individual parts of the child's body during growth is uneven, so children's clothing by the size cannot be neither a reduced copy of adult clothing, nor the same by proportions for different age groups. In addition, children during growth are not only in a special physical condition, but also in psychological and morphological, which must be taken into account when designing clothing for children. Due this, the development and design of clothing should follow a systematic approach, which is based on the solution of multi-criteria complex design tasks [4].

The main tasks at the stages of artistic and engineering design of children's clothing are: search for appropriate external and internal parameters of the product, its individual parts and elements; harmoniously interconnected structural-decorative and functional divisions, proportional relations, metro-rhythmic constructions, coordination and subordination of the components of the form structure. Human physical development is the process of changing: size, body shape and functions of the body during growth. Each age period of a person – from birth to maturity – has specific features of the structure and functioning of the body, which must be taken into account when designing clothing to ensure its comfort and reliability.

The most important signs of a child's physical development, which characterize the external shape of the body, are the largest anthropometric features: body length (height), perimeter (girth) of the chest and body

weight. The combination of anthropometric features gives a certain data of external shape of the child's body, but does not reflect the features of the morphological structure [5].

An important morphological indicator of age-related changes in the child's development is the proportions – the ratio of size of individual parts of the body. Age-related changes of proportions of the child's body occur unevenly, are mainly in decrease of the relative parameters of head and torso and increase of the relative length of the limbs, in abrupt change in relationship between individual parts of the body. Each child age period characterized by some features of physical development that changes the shape of her body.

For infants (up to 1 year) is characterized by a short neck and thoracic torso, abdomen convex and elongated, legs shorter than arms. The girth of the chest, waist and hips are almost the same. The first year of life is characterized by the highest rate of body growth in length and rate of weight gain.

In early childhood (1 to 3 years) the neck is still short, the abdomen is convex, the torso is long, the waist is not marked, the arms and legs are relatively short. From the second year of life, the growth rate decreases significantly, but the proportions of the body change, the body becomes relatively narrower.

The period of childhood (from 3 to 7 years) is characterized by the following changes in the structure of the child's body: the convexity of the abdomen is significantly reduced, but the waist line is not yet marked, the neck is significantly elongated. In the period from 5 to 7 years there is an acceleration of body growth in length, the limbs at this time grow faster than the torso.

In the second period of childhood (boys – from 8 to 12 years, girls – from 8 to 11 years) there are the lowest growth rates and weight gain. The child gradually stretches, the child's figure becomes slimmer, the bulge of the abdomen disappears, the waist begins to emerge, the arms and legs are significantly lengthened.

Development of a typology of children's population for the clothes designing purposes, provides definition of typical figures on six age groups accepted in the garment industry, namely: newborns, nursery, preschool, primary school, senior school and teenage [5, 6].

When developing the dimensional typology of children (except for children of the nursery group), the leading dimensional features are taken to be height, third breast circumference (horizontal torso girth at the level of protruding breast points) and waist girth, which most fully meet these requirements.

The modern assortment of children's clothing is divided into groups according to the following characteristics: gender, age, season, purpose and use in a particular field of activity. Also the character of fastening of

clothes on a figure, character of a cut, a way of manufacturing, style and others are allocated. In the design of children's clothing, the main clothes characteristics include: shape, silhouette and cut. The shape of the clothes can be soft, orbed or geometric, large or small. The volume of the form depends on the degree to which the clothes fit the body. The shape of the clothes either emphasizes the child's figure or changes it. In modern clothing, the shape mainly corresponds to the natural proportions of the human body or modifies them within certain limits [6].

In the practice of children's clothing design there are four main silhouettes: adjacent, semi-adjacent, straight and trapezoidal or extended. In the adjacent silhouette, the fit along the lines of the chest and waist is significant, the waist line is emphasized. The semi-adjacent silhouette has a small volume along the chest line, a slight fit at the waist and hips, a moderate enlargement at the bottom. The straight silhouette is characterized by the same width of the product on the lines of the shoulders, chest, waist, hips and bottom. The trapezoidal (extended) silhouette has a small volume at the top of the garment and an enlargement at the bottom [3].

Children's clothing is also characterized by the use of different cuts, according to the main features of the shape and connection of the components. The analysis of the initial data showed that the main factors in setting tasks for the process of children clothes designing are to determine the dimensional characteristics of body structure, according to gender and age group of clothes, to season, purpose and use in certain operating conditions. Modeling and artistic design of children's clothing is a separate project area, with its main purpose to help educate and develop the aesthetic taste of children. In raising a child, it is important that children's clothing has a high artistic value, teaches culture and love of nature. Children's clothing should be particularly comfortable, hygienic, beautiful and appropriate, fit to the all ages children activity and, in addition, be economical, durable and ergonomic.

The practicality and efficiency of children's clothing should combined with hygiene and other requirements: light weight, heat-protective properties, good breathability, ease of wearing, the ability to be frequently washed, cleaned, ironed [7].

The quality of the product consists of a set of its properties, so the requirements for new models of modern clothing can be divided into two main groups – consumer and industrial (technical and economic). Each of the groups has its own subgroup of indicators, the weight of which is determined by the type, range and purpose of the product. Consumer requirements include social, functional, ergonomic, aesthetic, exploitative. Social requirements determine the competitiveness of children's clothing in domestic and foreign markets. Functional requirements – is the conformity of clothing to a specific purpose, age, body structure, level of psychological

development. Ergonomic requirements include a set of anthropometric, physiological, hygienic and psychological requirements.

Uncomfortable clothing deprives children of activity, restricts movement and negatively affects the growth and development of the body.

Hygienic requirements need creation of an optimal microclimate around the child's body and protection from climatic influences, pollution and damage. This is especially important for children, because their body has not yet strengthened and the temperature mechanisms are less perfect than in adults. Psychophysiological requirements are realized in the properties of clothes that are perceived by the child in the senses, they are provided by the comfort of wearing and removing clothes, as well as the ease of use of its individual elements, compliance with the preferences and character of the child. Aesthetic requirements are determined by the compositional and color solution of models; proportion of parts; construction of its shape. For children's clothes, it is recommended to choose simple shapes and cuts, so sometimes color and structure are the main in the compositional perception of the product as a whole. Color is very important, because research has shown that drawing and color stimulate the child's curiosity and mental development. The age and sex of the child significantly affect on choice of a particular color. An important requirement is the decorativeness of clothing, which is given by decorations, colorful decorative details, accessories, applications.

Performance requirements are important and relate to the resistance of clothing (its shape, material, edges and seams) to various loads: friction, creasing, tearing. Operational requirements are taken into account when choosing materials, determining the design of parts, methods of processing the edges of parts and seams, choosing rational designs of functional elements (pockets, fasteners, etc.), especially the elements that are transformed [7, 8]. Thus, almost the same requirements are set for children's clothes as for adult (Table 1), but the significance are different: some requirements are first-rate, others are of secondary importance.

The analysis of the classification of modern requirements for children's clothes has identified the need to set tasks to clarify the range of indicators of quality. When creating new models of children clothes, it is necessary to develop requirements depending on the type of clothing, its purpose and application. This approach reflects the level of development of the child, its biological nature, social essence, as well as the degree of technical feasibility of design, design methods and technology of clothing, taking into account the cost of its manufacture and operation. In artistic design of clothes is widely used the system approach, in which models are combined with the unity of structural characteristics, materials, basic structures and certain images.

Table 1 – Classification of indicators of quality clothes for children

Complex quality indicators	Group quality indicators	Quality indicators	Offered additional quality indicators for children's clothes
CONSUMER	Social	Correspondence to the size-growth assortment of clothes	Compliance with the size and growth range of clothing, taking into account the acceleration
		Compliance with the forecast of consumer demand for clothing for this purpose	Ability to meet needs over a long period
	Functional	Compliance with the main objective function (specific purpose, operating conditions)	The degree of compliance with the term of moral and physical wear
		Correspondence to the size and age group of consumers	The degree of conformity to the proportions of the child's figure
	Aesthetic	Novelty of model and design (correspondence to modern style and fashion)	Individuality and creative taste
		The degree of perfection of the composition of the model	Harmonization of division lines and proportional relations
	Ergonomic	Anthropometric correspondence	Optimization of design parameters of clothing in the areas of the largest changes in size
		Psychophysiological compliance	Ease of use of clothing
		Hygienic compliance	Use of natural materials
	Exploitative	Resistance of materials and connecting seams to loadings	Improvement of technological methods of product processing
		Shape resistance of details and edges of clothes	The choice of rational composition of the package of materials
		Wear resistance of materials and structural elements (durability)	Using special material treatments
	Economic	Resulted consumer expenses for operation of a product	Time spent on care product

The system of properties of the design object – children's clothes, consists of interconnected systems of properties: value (convenience, functionality, social demand) and formative (structure, types of cut, silhouette shapes, volumes, structural and decorative elements). The first form the axiological system of comfort, and the second – the morphological system of construction of the form, wich are interconnected (Fig. 1).

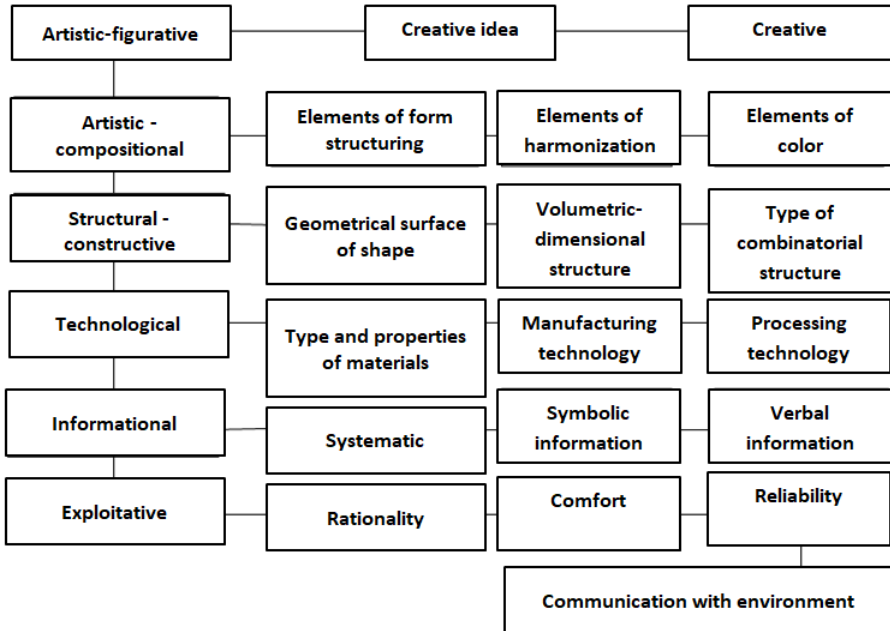


Fig.1. Component factors of the shaping process

The purpose of artistic design should be creation of a holistic tectonic structure and the feasibility of mass production of the designed object. Therefore, the requirements of designers and consumers of children's clothing must be taken into account and optimally combined.

Consideration of all the internal relationships of the structure formation of clothes and its interaction with the child, the conditions of existence in the system of social surroundings and environment, determines the need for a systematic approach to art design.

This approach is systematic, allows you to use the information obtained in the design of children's clothing to optimize the target design. That is why the main goals of research to improve the process of designing children's clothes were identified:

1) the analysis and structuring of the process of designing children's clothing;

2) development of an algorithm for the process of artistic design of perspective forms of children's clothing (younger age groups) based on the study of tectonic characteristics of bioforms, different levels of evolutionary complexity and their functional compliance;

3) search and classification of constructive – decorative elements that provide opportunities for structural transformations of children's clothing using automated design tools [8].

Statement of tasks of associative clothes design and forecasting of forms development defines that the basis of creativity in a costume art design is the image-associative approach to creation of new forms. Various phenomena and objects of the world around us, the beauty of nature and its formations are able to inspire the designer to create new perspective forms of costume.

Since the creative process is the achievement of a form unity and content, the basis of creativity in the artistic design of clothes should be a figurative-associative approach to creating a new, non-traditional forms of clothes for children. Creative sources for costume design can be natural phenomena, works of art, historical and national costumes, architecture, objects of applied art, but a special place in the designer work is occupied by forms of living nature [3].

The principles of analysis and transformation of different creative origins in creating a costume are quite close and differ only in certain nuances that are associated with the individual characteristics of each form. The way to transform the creative source into a new form of costume is a series of successive stages:

- at the first stage there is an analysis of the form of creative source, proportions, plasticity, texture of its surface, color solution. If the creative source is objects of living nature (flowers, plants, fish, animals, birds), then their behavior, means of transportation, characteristic poses are studied;

- at the stage of analytical research, the most characteristic features of the creative source are analyzed and determined, its main characteristic features are distinguished, which can be: unusual shape, proportional division of the form, rhythmic organization of its elements, texture, color;

- based on a series of sketches, the creative cycle is transformed into a conditionally generalized stylized image, which requires from the artist the ability to abstract in the sketch, the ability to abandon secondary, insignificant features, highlight the main features as an artistic image and as a functional object;

- at the stage of the sketch project the main characteristic-sign of a creative source which is accepted as a basis in work on a series of sketches of a costume. The image of the designed costume is created, stylized and generalized.

The main tasks of these stages, the preservation of figurative – associative connection with the source of inspiration and aesthetic proportions of the shape of the costume based on the proportions of the figure [3].

Studies of the bionic model of the fashion functionality in a costume proved the feasibility in predicting the development of various forms of clothing, which allows to study mechanisms of formation at the structural level of its organization. Analysis of the structural and bionic parameters of the costume establishes the cyclical nature of their distribution and the presence of a correlation between them. On the changes of costume silhouette forms influence the changes that occur in the solar system and the total biosphere of human existence.

Research related to the issues of biotectonic formation and the functioning of bionic structures that move and change shape, led to the emergence of a new direction in the project activity – kinetic formation. Kinetic shaping considers the problem of using motion in creating new means of constructing shape. As a means of organizing form, kinetic formation may include transformation – a method of sequential image development and combinatorics, sequential construction of form from individual elements according to the laws of development of different types of symmetry [3, 9, 10].

Theoretical issues of image formation in various directions of fashion are studied, elements of image-informative structure of modern costume are defined, the main principles of transformation of creative sources into elements of image-informative structure of costume are established. A morphological model of XX century styles has been formed, which establishes a correlation between the main elements of style, which is determined by the system of relations of structural elements of the costume and multidimensional sets of internal and external factors of influence.

The development of the theory of the cyclical nature of fashion establishes deep patterns between natural phenomena and the development of fashion. The oscillatory dynamics of social processes is considered in 4 phases, which correspond to 11-year cycles of solar activity. The principle correlation dependence of the dynamics of fashion cycles to the dynamics of solar activity cycles was proved, and the correlation dependences of 5, 8, 13 and 21 – year cycles of fashion development on natural factors were determined. Periods of formation of a new form (5-year periods) are marked by a special sensitivity to external influences, which is manifested in the growth, intensity of the processes of formation, the emergence of new structures and forms. The theory of system design of a costume establishes a connection between evolutionary – cyclic processes in nature and regularities of development of a costume forms.

The variety of plant and animal forms serves as a creative source for creating models of children's clothing. Emotional, figurative associations that arise when the artist observing the world of wildlife, become the basis for the formation of fundamentally new forms. Taking as a basis, in design of children's costume, natural motifs, it is necessary to know the main rules of transformation of natural objects.

The transformation of natural source into a new forms of costume takes place in stages. Working with natural forms, step by step reveal the following characteristics and features: plastic organization of natural form, rhythmic organization of divisions and lines of forms of living nature, elements of form, its details, which give originality, characteristic surface texture and ornamentation, colors, characteristic postures and manner of behavior, functional and psychological features, emotional impact of wildlife on the child.

The use of wildlife motifs in the development of perspective forms of children's clothing gives particularly vivid figurative associations and functional conditionality. This is primarily due to the fact that children, especially the younger age groups, are the closest to the natural environment and the laws by its development. From birth to growth, the child goes through various stages of formation of the organism and the external shape of the body, which are largely similar to the stages of evolution of living organisms in nature. The structure of the child's body, proportions, features of its functioning and movements also have much in common with the functions and forms of living organisms, from plants and protozoa, through fish, insects, to complexly organized higher animals. Younger children are the most emotionally vulnerable and sensitive to the aesthetic characteristics of wildlife. They are very active in responding to interesting shapes, bright colors and the dynamics of the natural environment [3, 12].

The tasks of determining the patterns of visual – compositional detection of analogues of bionic forms in the design are as follows:

- general perception of form in space, analysis of its volumes and contours;
- structural analysis of the most characteristic elements of the construction of the form, its division, proportional and rhythmic construction;
- determination of connections of characteristic structural elements, establishment of regularities of subordination of elements and their coordination;
- formation of a holistic image, selection of compositional – psychological center.

The costume, which is most adapted to the shape and functions of the human body, in comparison with other objects of design, takes over from the analogues of wildlife lines and shapes in their generalized, figurative solution. Studying the bioform, the task is to identify the nature of

functions, movement, the ratio of the main masses and the silhouette, to determine the vitality and functionality of the bioobject. The analysis of biotectonics of natural objects can suggest ideas of associative development of lines of a silhouette form and internal division, receptions of decorative development of internal volume – spatial structure, ornamental and textural registration of a surface of the form, functionally – transforming elements and additions [3, 9].

The lack of objective scientific conclusions about the patterns of implementation of bionic principles in the formation of children's clothing has necessitated the systematization of knowledge about bionics and its importance at the level of costume design, which can be defined as objective prerequisites for bionic research of children's clothing.

To achieve this goal, the following tasks are defined:

- analysis of the main principles of tectonics of the natural forms structural organization;
- study of the current level of use of bioforms as prototypes in architecture and design;
- analysis of ergonomic compliance of children's costume and prototypes of wildlife;
- analysis of figurative, associative costume structure formation on the basis of bionic prototypes;
- study of the influence of natural factors on the process of costume formation;
- formation of a bionic approach to the process of a children's costume design designing;
- search and classification of conformity of a costume constructive-decorative elements to the elements of tectonic structure of prototypes – bioforms.

Conducting research in this direction allows to analyze the shaping principles of natural structures, to identify bioform patterns of using in clothes design, aesthetic and ergonomic compliance with bionic shaping patterns and children's costume, improving the process of designing children's clothes based on bionic models (Fig. 2).

On the basis of analysis, can determine the main principles of using natural forms in costume design:

- imitation of a bioform in separate elements of a costume;
- similarity of silhouette decisions and the general form of a costume to natural bioforms;
- bionic design with the identification of functionality and image-associative expressiveness of the costume.

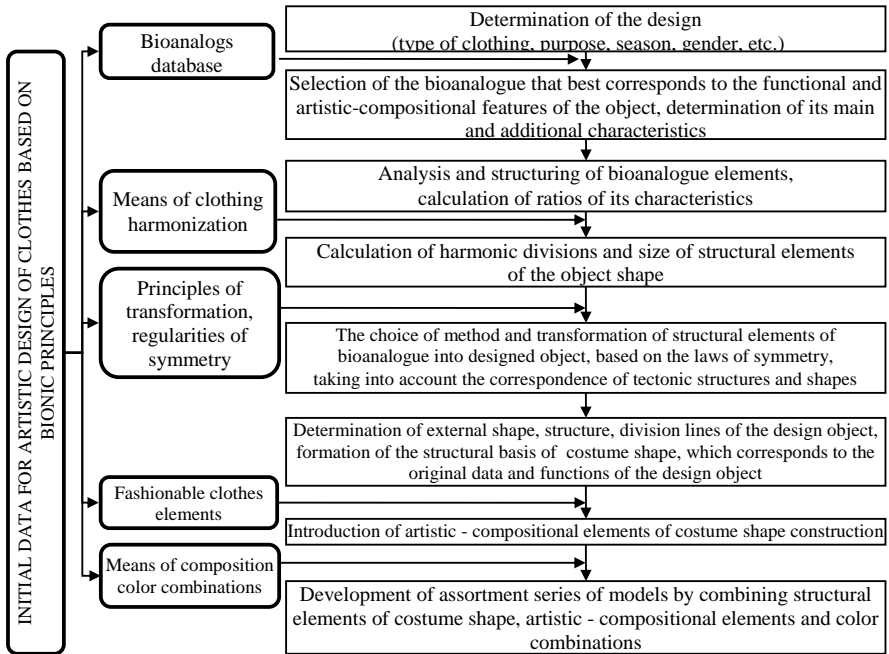


Fig. 2. The sequence of artistic design of clothing based on the principles of bionic shaping

The main stages of transformation of natural forms into a stylized form of a costume can be defined as follows:

- assessment of the external form and functional features of the natural form;
- determination of analogies of natural form with the projected one;
- comparison of the general contour and internal elements of the natural form with known silhouette forms and tectonic structures;
- determination of the general silhouette shape and tectonic construction of the projected object.

Without knowledge of the principles and general laws of shape formation in nature, it is impossible to understand the principles of forms optimization in design, including children's clothing, the requirements for comfort and quality of which are closely related to the development of the child's body and its functioning in the environment. Using bionic principles in design activities, the designer has the opportunity to identify in natural analogues special ergonomic and aesthetic types of dependencies. In

artistic design can be used, first of all, those properties and characteristics that determine the functions of a particular natural formation [10].

The process of artistic design of modern children's clothes is based on the use of the principles of functional analogies adopted in bionics, which are comparing, determine the patterns, degree of correlation of forms and functions of nature and objects of design activities. Complex outlines and surfaces of natural forms are the result of simultaneous reflection in their structure of various forming factors that determine the complexity of the three-dimensional structure and geometry of the surface.

In scientific works a significant place is given to the geometric analysis of forms of living nature, where it is an integral part of a comprehensive approach to the study of bioforms and analytical determination of the laws of their construction. Researchers have drawn attention to certain patterns of construction of wildlife forms, due to the principles of symmetry. The first type of symmetry, called mirror, is inherent in flowers, leaves, butterflies, insects, birds, fish and mammals. The second type of symmetry, called rotary, is inherent in the structure of the tree crown, flower inflorescences, simpler marine animals and organisms. The general law of symmetrical construction of natural formations is formulated: objects that grow or move vertically have a shape mainly rotational symmetry, horizontally – are characterized by mirror symmetry of construction.

Symmetry of natural structures, spirality of growth trajectories, cyclic change of forms and other dependences testify to orderliness of geometry of natural forms that gives the chance of their geometrical modeling. Natural formations are examples of the most appropriate forms and design solutions of the environment that is widely used in design [9 – 11]. In the process of design objects shaping, when determining their geometry, different methods can be used, it is necessary to take into account the specific features of their formation (Fig. 3).

In the structure of the formation process in a children's costume the most relevant is the appeal to natural analogues. The analysis of formations of flora and fauna allows to define some features of their design:

- in the organization of the internal space of most natural formations there are certain geometric patterns – the compactness of the volume, the smoothness of changes in the contours, the gradual flow of lines at the junction of parts;

- the presence of different types of symmetry (mirror, axial), makes it possible to predict that symmetry has a positive effect on the strength and aesthetics of the form.

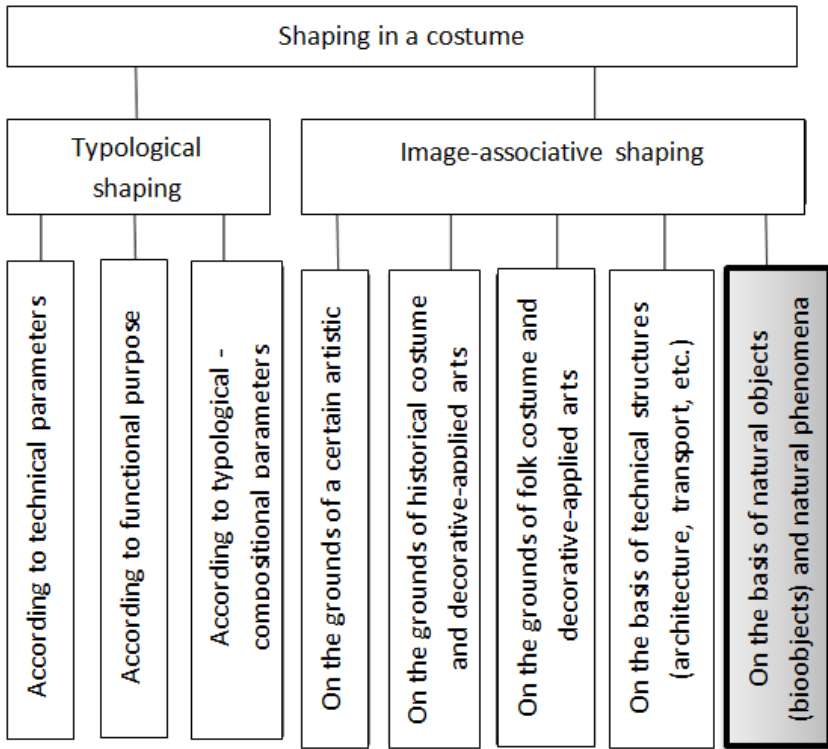


Fig. 3. The structure of process of the costume shape formation

Thus, the geometry of the natural form-structure objectively reflects its functional properties and is the basis for the evaluation characteristics as an object of design.

Bionic analysis of natural analogues involves preliminary selection of natural forms that meet the established functional requirements, selection of characteristic samples among several types of natural forms (prototype selection), analysis of the conditions of their operation. At the next stage, a geometric model of the bioform is created, the geometric principles of shape formation and the principles of construction of geometric models are established (Fig. 4).

The comparison of the structures of the designed and natural form is not formal, the geometric elements of these forms are compared on the basis of their functional similarity, in order to further embody the ergonomic properties of the projected object, based on the analysis of design objects.

After selecting the bioform that has the most pronounced structural elements that meet the target characteristics, perform a geometric analysis of its structural structure and surface shape (Fig. 5).

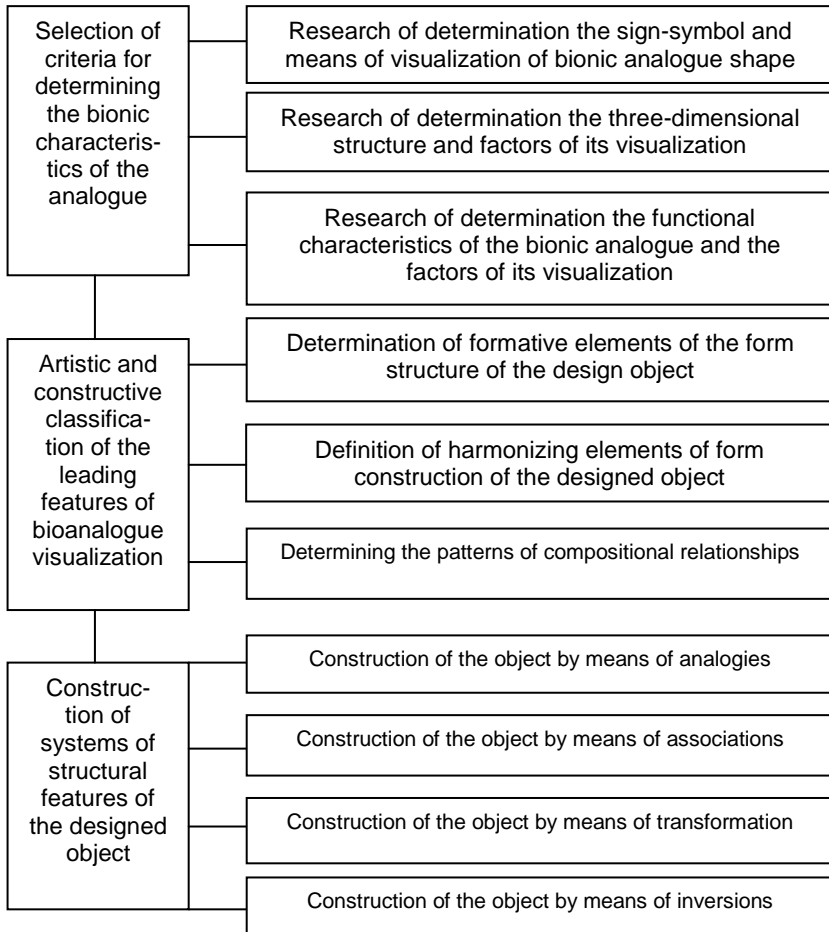


Fig. 4. Complex scheme of problem statement in bionic formation

The edification of constructive forms on the basis of bionic models is based on the use of similarity theory, which establishes certain connections between the characteristics of the natural form and the created project.

Based on the selection, analysis and modeling of bioforms, the most rational functional and aesthetic solutions suggested by wildlife are sought.

Due to the fact that clothing is the surface shell of the body, of great interest is the geometric study of wildlife with a bright thin shell: flowers, birds' eggs, shells of mollusks, insect wings, shells of crustaceans, etc. From a geometric standpoint, natural formations in the form of shells can be characterized by a shape that outlines their surface and dictates interesting, from an artistic point of view, and functionally conditioned design solutions.

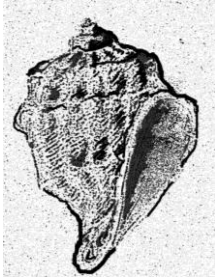



The form of bioanalogue	1st stage of structuring
	
2nd stage of structuring	3rd stage of structuring
	

Fig. 5. The structuring of a bioanalogue in transformation process to a costume shape

Thanks to the creative approach to the hints of wildlife, various principles of transformation were created based on the use of laws of symmetry. That is why most of the various modern designs that are transformed, including the costume, have as their prototypes natural forms and organisms.

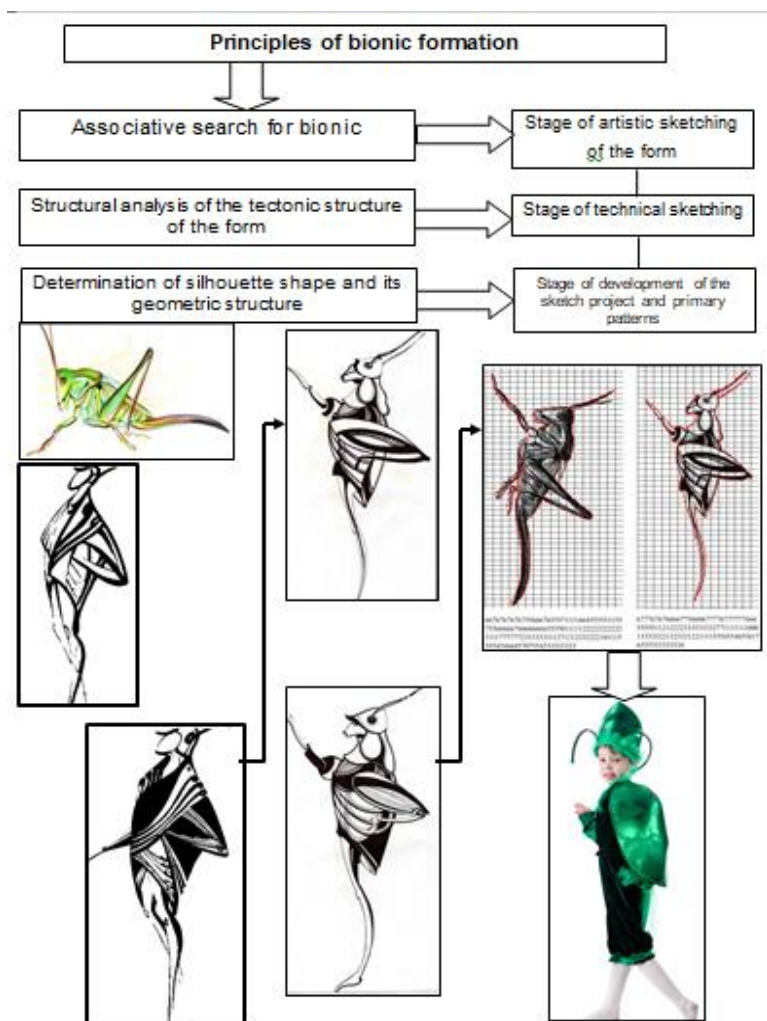


Fig. 6. The sequence of the process of costume formation based on bionic principles

The study of the structural organization of external and internal construction of bionic analogues – elements, connections and integral properties of the structure, together with the process of formation and taking into account the active activity of the child's body, will solve many project problems based on bionics. These tasks are to use the principles of

construction and operation of bionic systems, the means of their development that provide these systems with a particularly high flexibility and reliability in difficult living conditions, to create fundamentally new design systems.

Functional construction from homogeneous combinatorial elements is clearly revealed in each formation of nature. For prefabricated forms and shells, it is very important to optimally divide the surface into constituent elements. In nature, other principles of combinatorial shaping are often implemented.

The constructive perfection of bioforms consisting of a relatively small number of structurally homogeneous elements, is important in the design in terms of harmony of their construction. The formative capabilities of combinatorial structural elements, following the nature example, can be significantly expanded by increasing their variability.

Visual perception in assessing the compositional and artistic properties of the material form is an integral part of the project process, creative cognitive process, during which individual elements of the form are studied, analyzed and combined into a holistic image based on system-structural analysis. A certain structure of the form is able to actively influence the psychology of perception. This quality is most actively possessed by new, unusual forms that nature tells us in its bioanalogues.

In wildlife, the expediency of constructing a form is inseparable from its general harmony. The structure of the natural form, color, texture of its surface – all subject to a single goal: optimal functioning in given conditions.

Structural systems in living nature form a functional three-dimensional structure, so it is possible to note that the composition of natural forms due to their content is semantic. According to its features it is possible to determine the functional essence of the form, its main purpose [3, 9, 10].

Among a number of characteristics of bionic objects, the most important are their geometric structure and patterns of construction. The regularities of structural-compositional detection of the characteristics of the bioform of the analogue are determined:

- general perception of the configuration of the form in space, its volume and contours;
- study of the most characteristic structural elements of the form, its division, proportional and rhythmic construction, laws of symmetrical construction;
- analysis of connections of structural elements, establishment of regularities of subordination of elements and their coordination.

A certain combination of different parts of the form, their symmetrical transformations determine the nature of the three-dimensional composition,

which is shown by the example of bionic formation on the basis of a natural analogue (Fig. 6).

Of great importance is the shape of the characteristic lines belonging to the corresponding surface: the contours of a curved shape, the visible silhouette or other characteristic lines of divisions.

In the study of natural forms from the standpoint of artistic and compositional characteristics of the structure is important to determine their aesthetic qualities. Complex in its characteristics, natural forms are quite interesting compositionally, so the establishment of relationships between geometric and aesthetic characteristics of natural bioforms and the projected object, involves determining the aesthetic quality by finding the ratio of elements that meet the requirements of harmonization such as compositional proportionality, balance, rhythm, coherence and integrity.

In most cases, an objects of wildlife is a complex system, so the study of their form and structure requires a clear structuring of the process of analysis and construction of new design forms using bionic patterns. The use of a formal description of the structure of bioforms is based on the assumption of functional and ergonomic feasibility of natural design in modeling its analogue in practice, as a result of the peculiarities of the functioning of the child's body. A systematic approach in the study and modeling of the structure of natural structures for the construction based on their geometry of new solutions for children's clothing, has a real basis in the form of geometric design of surfaces in automatize design systems.

The process of using principles of structure shaping of living nature in artistic design is characterized by the transition from intuitive imitation of natural forms to scientifically sound means of their analysis, which is presented in the scheme of the design module in bionic shaping (Fig. 7).

Comparison of functions and geometric basis of the designed and natural forms gives the chance of modeling of new design structure on the basis of the geometrical analysis of surfaces and development of mathematical models. Bionic studies of wildlife formations, in the design of new forms of children's costumes, can be of practical use only in their creative interpretation and use in the artistic design of clothing.

The approach, based on the identification of patterns of construction of natural forms, combined with the analysis of their feasibility, completely eliminates the formalistic use of bioforms in artistic design and allows to achieve the optimal ratio of aesthetic and ergonomic performance of projected objects. In-depth study of the features of the projected object is impossible without a logical analysis, in the process of which reveals the patterns of connections of natural objects and tectonic construction of children's clothing. The constructions of living nature that organize the form most effectively counteract static and dynamic loads, so the analogies between the development of forms of living nature and the shape and functions of the child's body are logically determined [9,10].







Bioanalogue	Intermediate transformation	The original form of the costume
1	2	3
		
		
		

Fig. 7. Stages of associative transformation of a bioanalogue into a form of children's clothes

In childhood, a person is in contact with the natural environment most actively, this requires a special approach to clothing design in this period, with due regard for ergonomic comfort and functionality. In this regard, the study of the dynamic conformity of the shape of clothing and its tectonic construction become relevant in the process of designing clothes for children of different ages.

It should be noted that during the whole period of the child's growth there are a number of proportional changes in the body, which are not sufficiently objectively determined by the constant values. In addition, the dimensional features of the body in a static position, which are the basis for designing children clothes, do not fully determine the ergonomic needs and behavior of children of different ages. If the youngest age groups (from infants to preschool age group) master their environment extremely actively, then with further growth, the increase in the number of types of natural movements becomes slower and turns into the development of special sports or work movements.

In the child life, there is a system of morphological, physiological and psychological features that determine its constitution and are associated with a number of natural and social factors. The structure of the child's body is only its external morphological feature, others are determined by the development of resistance to the environment and the ability to adapt to its changes. It is proved that there are certain correlations between body structure and psychological and functional properties of personality, which determine a set of morphological characteristics (body structure, its shape), psychophysiological indicators (nature and intensity of body functioning). This approach to the characteristics of the child's life in the natural environment is the most reasonable. In accordance with the above tasks of the process of artistic children clothes design, the study of ergonomic correspondence of evolution stages of bionic structures and characteristics of child mobility, which repeats the most characteristic stages of evolution of wildlife, was conducted (Table 2).

The dynamic characteristics of the shape design and its tectonic construction, determine the greatest compliance with the ergonomic requirements of the functioning of the child's body. Dynamic matching determines the ability to perform a variety of movements with the least pressure of clothing on the body and its minimum deformation. Studies aimed at determining the dynamic conformity of clothing, allow optimizing its shape, size and nature of the construction of structural and decorative elements in certain parts of the child's body, which are the most mobile (Fig. 8) [12, 13].

Ergonomic parameters of children's clothes have an impact not only on the ease of use, but also on the correct development of the child's motility. At the stage of artistic design of children's clothing it is very important to design models in accordance with the level of development of children's motility, taking into account the specifics of movements inherent in the corresponding age groups (Table 3) [13].

Table 2 – Correspondence of children's movements to the structure and functional characteristics of bioanalogues












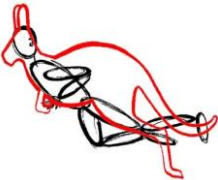


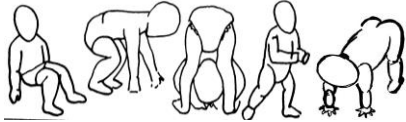
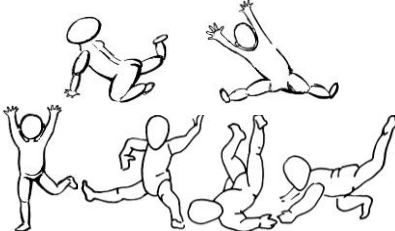
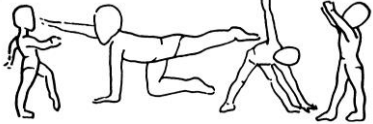

№	Bioobjects	The main movements of children of certain age groups	Correspondence of functional characteristics of bioobjects to the children movements of certain age groups
1			
2			
3			
4			

Table 3 – Correspondence of the child's movements to bioanalogues

Age of the child	The most useful movements	Compliance with biological objects
0-6 months		Stationary bioobjects (flowers, plants)
7-24 months		Moving bio-objects (fish, arthropods, insects and amphibians)
25-36 months		Moving bio-objects (fish, arthropods, insects and amphibians)
37-66 months		Actively moving bioobjects (insects, fish, arthropods, amphibians, birds)
67-114 months		Actively moving bioobjects (fish, arthropods, amphibians, birds and mammals)
115-192 months		Actively moving bioobjects (fish, arthropods, amphibians, birds and mammals)

Conclusions. The paper presents the material for the development of a method of artistic design of children's clothing based on the bionic principles of shaping, which is universal for the development of models of any kind and purpose, taking into account the age characteristics of the child.

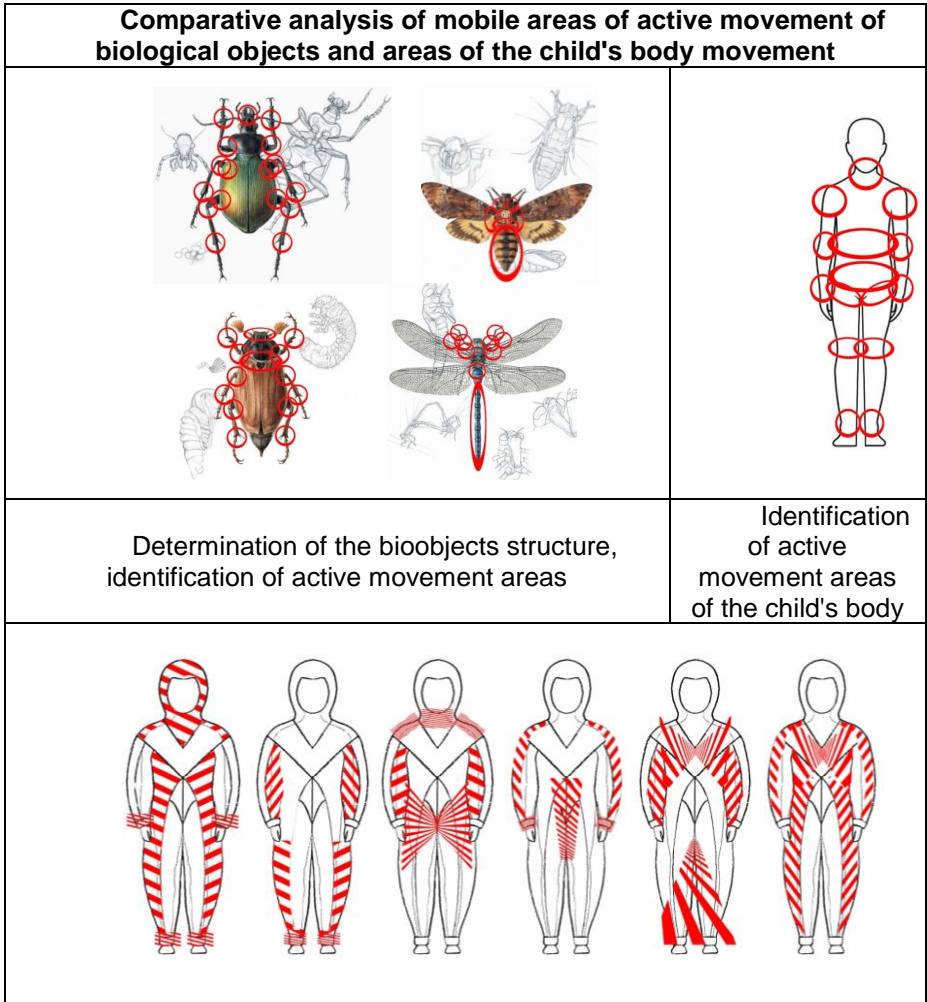


Fig. 8. Determination of the location of children's clothes elements that are transformed

Based on an experimental study of motor activity of children of different ages, a model of children's motility development was developed, which made it possible to identify areas of increased deformation in children's clothing. Based on a scientifically justify method of artistic design of children clothing, on the basis of bionic principles of shaping, an algorithm for the sequence of conversion of bioanalogue into a model design is developed and recommendations are given for developing a

range of models with high ergonomic and aesthetic indicators. Which have substantiated data on the definition of zones of transformation, places of division, means of transformation, taking into account the age of the child. The implementation of the proposed method of artistic design of children's clothing based on bionic principles of shaping, carried out in industrial conditions, confirmed the correctness of theoretical laws, and proved the feasibility and benefits of its introduction in the design of new models of children's clothing with high ergonomic and aesthetic indicators.

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1.7. IMAGE AND STYLE FEATURES OF JEWELRY AND ADDITIONS IN THE SUIT SYSTEM

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Abstract. *The work is devoted to the issue of determining the factors that influence the choice of jewelry and accessories in the suit. Within the framework of a systematic approach to the process of artistic design, based on the principles of harmonious formation of accessories and jewelry in the suit system, the classification of accessories by purpose and their correlation with the elements of the suit system is presented; elements of compositional formation and means of compositional coordination of ornaments and additions in the suit system; the main factors influencing the perception of the harmonious image in general and its parts are highlighted.*

Key words: *jewelry, accessories, artistically-composition signs, stylistic unity, facilities of composition concordance, harmonious image.*

Introduction. Accessories and jewelry are integral parts of the suit system. Their use creates an image, actively affects the image of person. In recent centuries, they alternately represent the main accent in the suit or are leveled by fashion trends depending on the historical period. In the coming decades, these changes are occurring at an accelerated pace – on the one hand increasingly emphasize the feasibility of using jewelry and elegant accessories, on the other – the active use of so-called "network" clothing of mass-market brands, which determines the relevance of systematic research on selected issue.

The harmonious use of jewelry and accessories allows for a universal reflection of the image of the wearer, which is associated with the possibility of stylistic transformation. A few additions can change the purpose of clothing and make it possible to use it in several ways: to turn, for example, a romantic style into an extravagant one, and to make a business suit evening wear. A characteristic feature of modern design is the conceptual diversity of products due to different value systems, traditions, ethnic characteristics, etc. and, as a result, the aesthetic needs of different social groups. The study of the evolution of form, color combinations, artistic and compositional features, the structure of the decor of products, in particular accessories and ornaments, contributes to the expansion and renewal of the range of modern artistic and aesthetic products, the achievement of figurative expressiveness of the suit. Decoration, considering modern technologies and materials, significantly changes the properties of the whole suit, and thus affects the formation of the image, focusing on the needs of the consumer.

Statement of the problem. The separate development of the principles of jewelry development and the separate development of design

of accessories in the suit system does not mean that these two areas are harmoniously combined. Analysis of literary sources on the issue of harmonization of accessories and jewelry with a suit showed the lack of research conducted in terms of the theory of artistic design. Existing materials are limited to historical and ethnographic information. The study of the use of geometric principles in the field of artistic design was carried out by M.I. Yakovlev [1], historiographical analysis of transformative formation and costume modeling was performed in the works of M.V. Kolosnichenko [2], the problems of tectonic formation of clothing, architectural objects and industrial products are studied in the works of Yu.G. Bozhko [3], I.T. Volkotrub [4], G.B. Minervin [5], K.L. Pashkevych [6], but the problem of scientifically substantiated application of technical aesthetics in the design of accessories and jewelry remains unexplored. Therefore, it is necessary to create a scientific basis to identify opportunities for harmonious shaping of jewelry and accessories in the suit system, which involves the use of a systematic approach. There are a number of scientific works [7, 8], the authors of which consider the interaction of suit elements. The subjects of their research are clothes, shoes and hats, but little studied remains the question about the role of accessories and jewelry in the suit system, where one of the important tasks is to determine the factors influencing the choice of jewelry and accessories in the suit, which is the task of this research.

Results of the research and their discussion. The path from the chosen image of the future product to its manufacture must go through a complex system of informational synthesis. The characteristic features of the method of using certain accessories and jewelry are determined, which involves the study of the suit, as well as the features of the consumer's figure, type of appearance. As a result, there is a need for a systematic approach to the process of artistic design, which is based on the principles of harmonious design of accessories and jewelry in the "suit system". Therefore, the attention should be focused on the combination, the correlation of accessories, jewelry and the suit in general.

Researchers are constantly looking for a solution to the problem of harmony. The concepts of beauty and harmony are similar in content, but harmony is an objective and natural phenomenon that expresses the relevance of things, shows in consciousness the meaning of the relationship, is an indicator of "eternity", invariant in things, and beauty is only a subjective color [9]. At determination of conformities to laws of harmony different approaches are used and understood: phenomena in nature and society are considered, the qualitative and quantitative analysis of works of art. Researches are mainly conducted on the examples of classical objects of art, architecture or the human body. But there are works [10-13], where the harmonisation in the suit is analyzed in details with the help of composition.

The suit acquires a socially important role, and its composition is perceived as ideal, characterizing a certain meaning if the designer used all means to create and combine all the components, to achieve their harmonious integrity and the intended idea. We set a task to organize the schemes of comparison and combination of accessories, jewelry and suit. Artistic harmonization of the elements of the suit is an order of methods of subordination, revealing the general logic of their development, by means of which aesthetic perfection in the chosen style is achieved. To solve this problem, first of all, we emphasize that the harmonization of the suit system is passing certain development. Harmonious combination occurs according to the laws of composition and the well-known principles of harmonization of systems. Even with a non-random combination of volumes and elements, the system continues its harmonious functioning. Conversely, the inappropriate combination of jewelry and accessories with the suit in the visual perception makes it impossible to understand the patterns of creation of the intended image, which indicates a violation of harmonious compliance, lack of harmony. Let's examine this.

It is known that the suit involves a certain system, the main elements of which include clothing, shoes, accessories, hair and makeup. Note that in fashion accessories are a very important part of the image, style of clothing. Accessories change along with fashion (accessory (French accessory, Latin accessory – additional) addition to the suit, which gives it a finished look) [2]. So, according to the purpose we will point out functional, functional-decorative and decorative accessories (Fig. 1).

The functional ones include hats, shawls, neckpieces, scarves, etc.; functional-decorative – ties, neckpieces, waistbands, belts, bags, umbrellas, etc.; decorative accessories are ornaments and jewelry that can be both functional and decorative: earrings, necklaces, bracelets, pins, cufflinks, etc. Within the form of a suit there is always a tendency to unity, expressed in the harmony of its elements, their balance on a number of features. The harmonious combination of accessories and jewelry in the suit system gives the impression of a perfect image. The process of spatial organization of the details of the product, the means and methods of which unite a person with a suit is called compositional shaping. The elements of compositional shaping include proportionality, rhythmic series (intervals of rhythm and meter, number of elements), scale (physical size and their perception); balance of elements (symmetry, asymmetry); tectonics (artistic expression through interaction and harmonious combination of material and structure). The compositional elements of the suit are all its components: the shape of clothing, material and its properties, color, design and decorative lines of clothing, accessories and additions: hats, shoes, jewelry, which also determine the basic shape of the costume. First of all, a person perceives the general shape of clothing, then – color, components of the form and, last but not least – the details.

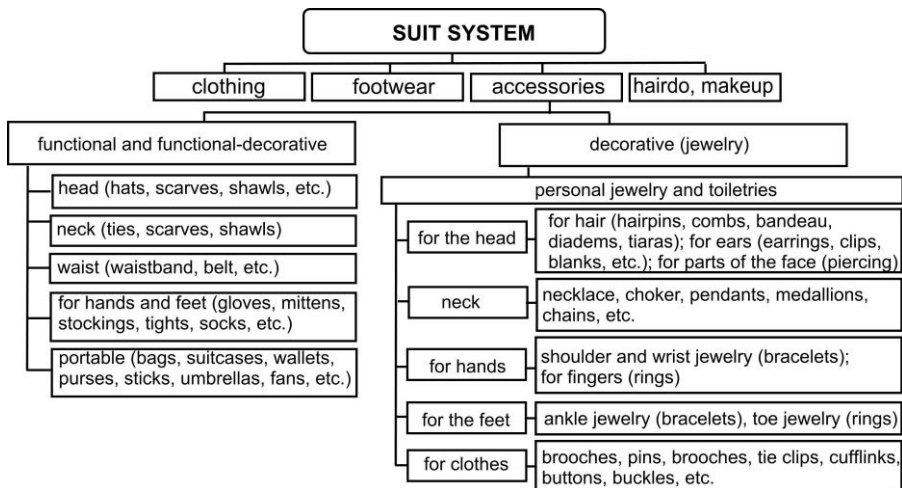


Fig. 1. Elemental composition of the suit system

It is necessary to solve the problem of finding connections and correlation between the elements in the suit system, which would reveal and most fully contribute to the expression of the aesthetic and functional content of the suit in general. To address this issue, we have created a classification of means of compositional coordination of jewelry and additions in the suit system. The functional purpose of the suit, the correct proportion of its parts, harmoniously selected accessories and jewelry, confection of materials and other factors must be perfectly combined, expressing the main idea and functional purpose of the suit. Any composition should have such properties as expressiveness, integrity, stylistic unity, harmony (Fig. 2).

The integrity of the form of the suit reflects the logic and organic connection of constructive solutions with its compositional embodiment, it is connected with another important property of the composition – subordination, based on compliance with the laws of subordination of elements and additions in the suit. Excessive predominance of the elements of the composition impairs the visual perception of the shape of the suit, so the main condition for the integrity of the composition is the organic combination of form and its elements.

The means of artistic expression in the suit are color, texture, texture of materials, lines, geometric shape. Suit and accessories are means that have a certain artistic expression, able to reflect, emphasize or mask the features of the figure, with its help you can achieve maximum

harmonization of the individual image of the consumer in accordance with the aesthetic ideal of a certain period of time.

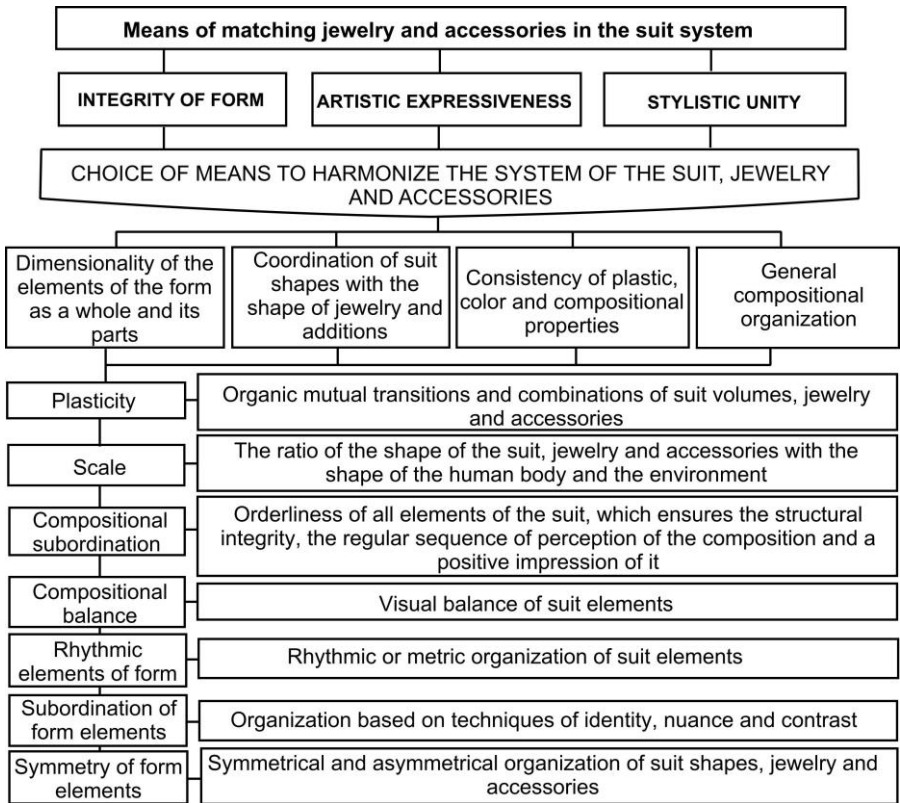


Fig. 2. Classification of means of compositional coordination of jewelry and additions in the suit system

Stylistic unity is achieved through the commonality of the image system, style-forming elements, means of artistic expression, creative techniques characteristic of the style [14]. Considering the structure of the concept of "style", there are distinguished the following elements: great artistic styles, stylistic trends of the second half of the twentieth century, author's styles. The basis for the classification of stylistic trends of the second half of the twentieth century are many different characteristics, such as: time period; correspondence to historical epochs; purpose of the suit; modernity; the influence of the cultures of ancient civilizations; regional influence; sociomental, etc. [15].

Among the means of harmonization of the suit system we have pointed out: plasticity, scale, compositional subordination, compositional balance, rhythmicity, subordination, symmetry of the elements of form (Fig. 2).

Plasticity or plastic conjugation is characterized by organic transitions and connections of the volume of the suit, jewelry and accessories. Note that the constituent elements in the suit (clothes, shoes, hat, accessories, jewelry) have the following types of forms: shapes that define the base (bodice, skirt, sleeve, etc.); forms required for the external complement: collars, pats, pockets, flaps in the suit, jewelry, hats, scarves, gloves, belts, etc. Forms of the first kind are the main ones, forms of the second kind are suit-decorative. The difference between the forms of the second type is that they cannot function independently, without the participation of the main forms and must be subordinated to them. Consider the variants of the suit of the twentieth century and modern costume, which are characterized by plastic consistency of its components with jewelry and accessories (Fig. 3). The plastic solution of the main lines of the suit is reflected in the lines of jewelry and accessories of a certain period, namely, for example, for an Art Deco suit, characterized by a straight silhouette of dresses, elongated earrings and accessories, hats without brims.

Very important in the compositional proportion of the human image is the scale, in the ratio of the shape of the suit, jewelry and accessories with the shape of the human body and the environment. Correctly found scale of a suit and additions in it provides aesthetics of a composition and operational comfort.

The compositional means of harmonization of the suit also include proportional relations – the correspondence of elements, the unity of parts and whole, the proportionality of the elements of the composition with each other and with the human figure [16]. To create a harmonious structure of the composition of the form, it is necessary to identify the nature of all elements of the suit and its additions, that is to achieve their relationship and interaction. On the first stages of artistic design, the question of proportionality is determined, when the structure and the relationships between the components of the costume are established. In modern literature, the concept of proportion is used in two main meanings. The first – the closest to the designation of proportionality – means the ratio of the basic parameters of the form (length, width, height). Proportion in this case characterizes the object as a whole and forms the basis of its image. Proportionality as a method of quantitative coordination of parts and the whole is based on geometric or numerical regularity, which contributes to the achievement of aesthetic integrity, harmony of the shape of the object by combining its dimensions into any system. Proportions are divided into: simple (based on rational numbers) and complex (based on irrational numbers). Simple proportions are expressed as a fractional number, where

the numerator and denominator are integers from 1 to 8. For example, in jewelry, the size of the main central gemstone and auxiliary decoration in the form of stones or metal caste are $2/3$, $2/5$, $1/4$ (Fig. 4), in a suit, for example, sleeve are $7/8$, jacket – $2/3$, skirt – $1/2$, etc. Simple proportions also include the so-called Egyptian triangle with an aspect ratio of 3:4:5 [11, 18].



Fig. 3. Plastic conjugation:

a – in an Art Deco suit; b – in a modern suit (Giambattista Valli haute couture primavera-verano 2013)



Fig. 4. Examples of simple proportions in jewelry

The complex proportions include the three well-known classical canons of proportionality: Indo-Tibetan, Egyptian, European. Their use allows to create design objects of more dynamic shapes, products of certain styles or those that meet fashion trends. The Indo-Tibetan canon established numerous modular relations between individual quantities, comparing them with the phalanges of the fingers. On the basis of

geometrical relations ideal, from the point of view of ancient Hindus, figures of deities were created. Vital centers were located at the intersections of canonical lines. The Egyptian canon (Fibonacci numbers) provided for other ratios of parts of the suit, closer to European proportions (Fig. 5). The modular grid was a complex system of triangles. The European (golden section) canon is based on the harmony of the human body and the nature. Canons can be characterized by the corresponding numbers: Indo-Tibetan – $e = 2,718$; Egyptian – $\phi = 1,618$ and European $\pi = 3,142$ [11, 18].



Fig. 5. Examples of complex proportions in jewelry

Proportionality is quite strong, but not the only means of harmonization the form and therefore one perfection of proportions is not a guarantee of achieving an aesthetically integral and harmonious system.

Let us also explore the means of coordinating the various elements of the unity of form – rhythm. Rhythm is known as a natural alternation of any elements, occurs with a clear sequence, frequency in time and space, it serves to express order, dynamics and beauty, has a high strength of emotional impact. A sign of rhythm is the repetition of elements of form and the intervals between them on the plane or in space. Rhythmic repetitions of the same element of form can be uniform or non-uniform (increase or decrease). There are two types of repetition: simple (static or metric) and complex (dynamic). The alternation of equal-sized elements expresses uniform movements, in this movement some elements are distinguished by visual "emphasis" – accent.

Rhythm of the highest order in the suit is manifested in the desire for organization, stylistic unity and integrity not only between the forms, elements of clothing decor, but also in their interaction with accessories and jewelry [19]. In accessories and suit, the emergence of a rhythmic structure is often determined by the expression of the natural expediency of design features.

In addition, the rhythm may correspond to the nature of the decorative elements of the forms. Elements of rhythm in clothing can be seams, reliefs, folds, placement of buttons, pockets, etc.; in accessories –

articulation, color, matte and glossy surface of the material; in jewelry – fixing of precious stones in castes, color of enamel, color of metal, transparency of stones, articulation, etc. (Fig. 6).

The rhythmic construction of the shape of a suit is determined by its constructive basis, which in turn depends on the structure of the human figure. Metric order as a regularity can develop endlessly, but in an artistic composition, where integrity is an integral attribute, repetition must have certain limits, meaning the row must have a limited length, a beginning and an end. Excessive repetition of elements can negatively affect the perception of the image and cause unpleasant emotions. We determined that the compositional rhythm in accessories and jewelry should begin with the establishment of the rhythmic order of the main forms, which are at least three values – head (hat, collar, hood; earrings, pins, combs, etc.), body (scarf, neckpiece, belt; necklaces, pendants, chains, brooches), hands (sleeves, gloves; bracelets, rings). The general rhythmic system of large forms is complemented by the rhythm of small details.



Fig. 6. Rhythmic and metric consistency of jewelry, accessories in the suit system

A study of the harmonization of elements of the suit system in contrast, nuance and identity, which can be called quantitative and qualitative categories, as they express a complex process of accumulation of quantitative changes in differences in shape characteristics and their transition to a new quality. They are present in any art system, but are noticeable if one of them predominates and acquires the role of the leading attitude (Fig. 7).

Contrasting combinations in the suit are of great importance, as they are aimed at sharpening the perception of form, visible and cause a corresponding reaction [16]. Contrasting elements of the system attract

attention to the extent that they are contrasting in relation to neighboring elements. This pattern allows to ensure the orderliness, harmony (proportionality, balance) of the system. Contrast in the suit system can be expressed in shapes, sizes, plasticity and orientation of shapes, materials, textures, decorative content and color solutions. When contrasting sizes in the “suit system”, for example, hats of large volume with a relatively small volume of clothing (Fig. 8), or on the contrary small-volume jewelry and large-volume clothing can be found, and so on. Color contrast is also often used (for example, a black coat and a red bag and gloves), as contrasting color relationships make it possible to highlight the most accented elements. With skillful use, contrast can play a crucial role in achieving a harmonious interaction of additions in the suit.

The display of nuanced relations in the compositional harmonization of the suit system uses slight differences in characteristics with elements of similarity and is most often manifested in proportions, color and tonal ratios, decor, plasticity.



Fig. 7. Contrast, nuance, identity in the harmonization of jewelry, accessories and suit



Fig. 8. Examples of symmetry (Dolce & Gabbana spring-summer 2013) and asymmetry in the suit

The nuance is expressed by an inconspicuous change in the shape of the elements of the suit, their texture and color, creates more interesting connections between the elements of the suit. The suit, the color scheme of which is based on nuances, combinations of shades, looks more complex, more refined than a solid color [17].

If the suit has a complete similarity of elements in size, shape and design lines, color, etc., then in this case we are talking about identity (similarity). Identical in shape and size details served as the basis for the creation of folk suits, their decoration (eg, embroidery) and jewelry. The use of identity, for example, in jewelry can be found in chains with the same links, or in necklaces of the same size pearls, rings with the same inserts of precious stones, and so on. Also, the principle of identity in the suit can use, for example, a decorative detail – a chain, which can be a handle in a bag, and a bracelet, and decoration on the flaps of the pockets. The construction of metric and some rhythmic series are based on the principle of identity. The principle of identity is the basis of modular systems. Although this principle has some limitations: identical relations can only convey mass, set, so design objects built on the basis of repeating elements, as a rule, contain additions that differ from the basic pattern.

Another means of harmonizing the compositional form that has been studied is symmetry and asymmetry (symmetry (Greek "symmetria" – proportionality) equal location of elements relative to a point, axis or plane) [7, 20]. In the broadest sense, the concept of "symmetry" is closely related to the concept of regularity as such, as it characterizes the preservation, constancy of certain properties of the image in relation to any changes. An example of the use of symmetrical accessories and jewelry in a suit can be a pair of earrings, a pair of gloves and more. Elements of symmetry are auxiliary geometric elements (points, lines, planes), which are used for symmetrical transformations, for example, in a suit – fasteners, articulation, neckline, in jewelry – articulation, placement of precious stones and so on. There is a mirror, axial (symmetry of rotation), helical symmetry. Asymmetry is considered as a counterbalance to symmetry, which can be used in a suit to create original images that emphasize the personality of the consumer. Examples of symmetry and asymmetry in a suit are presented in Fig. 8.

As you know, color is one of the main components of a decorative image. Color harmonious series can be divided into contrasting, in which colors are opposed to each other, and nuanced. Nuanced – harmonious color relationships that have slight differences in color tone, saturation and brightness. The phenomenon of simultaneous color contrast is often used in tectonic constructions of forms [20].

The questions of harmonious combinations in the composition were dealt with by Itten, R. Adams, Brucke, M. Chevrell, A. Mensel, V.M. Shugaaev and many other scientists [20]. Color harmony is a certain

combination of colors taking into account all their basic characteristics, such as color tone, lightness, saturation, shape, size of these colors on the plane, their relative position in space, which leads to color unity and most favorably aesthetically affects a person. Harmonious combinations can be given by achromatic colors which have only light differences and are combined, as a rule, in two, three colors. Color contrast is known to be a change in color that occurs due to its proximity to other colors. There are various theories of harmonious color combinations, which are used in the search for a color solution of the composition. For V.M. Shugaev there are four groups of color harmonies (Fig. 9, 10):

- likeness- and contrast-neutral colors;
- harmony of family colors;
- harmony of family-contrasting colors;
- harmony of contrasting and contrasting complementary colors.

It is also known that color can cause various emotional and physiological reactions. Therefore, the psychophysiological effect of color on a person is very important. As for the role of color as a means of composition in design, its importance in the harmonization of form has not been studied enough. When developing a color solution for a complex suit system, designers often intuitively approach this issue without finding reliable objective criteria for connection with the form. The color, function and shape of any design object must be organically linked. Color cannot be considered outside the usage conditions of the products. Already at the sketch stage of artistic design of the form it is necessary to build a composition of color and tone. Color is associated with the three-dimensional structure of the object – this is one of the main conditions for the use of colors in the artistic design of products, jewelry and additions in the suit system.

Color is closely connected with other means of composition – proportions, scale, with its help it is possible to emphasize the necessary elements of the form or to weaken them compositionally, to subordinate the basic idea of tectonic construction. The major role of color is in achieving the imagery of the shape of the suit. A successful color solution helps to reveal the essence of the item, sharpen, or, conversely, make more neutral, when necessary, the nature of the form, its functional purpose. Thus, the contrast of complex structure and simple volume can be enhanced by the contrast of color and tone, and the nuance of plasticity to make an even more refined introduction of a light color nuance. Thus, the artistic properties of color are one of the most important tectonic characteristics in the formation of the suit as an object of design. One of the characteristic properties of color perception associated with lighting is color change under artificial lighting. Red colors lighten, cold greens, blue, purple – darken, orange colors turn red, light yellow – difficult to distinguish from white, blue colors turn green, and purple turn red [20].

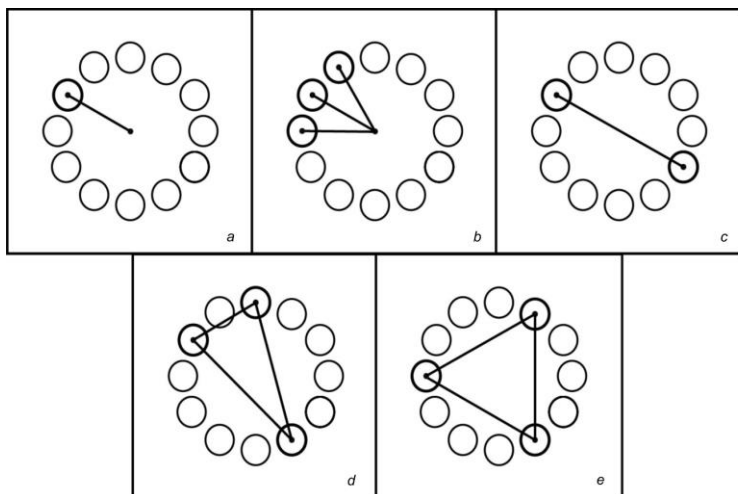


Fig. 9. The scheme of harmonic combinations according to V.M. Shugaev: *a* – monochromatic; *b* – harmony of similar colors or family triad; *c* – harmony of additional colors (complementary); *d* – broken additional; *e* – triad equidistant

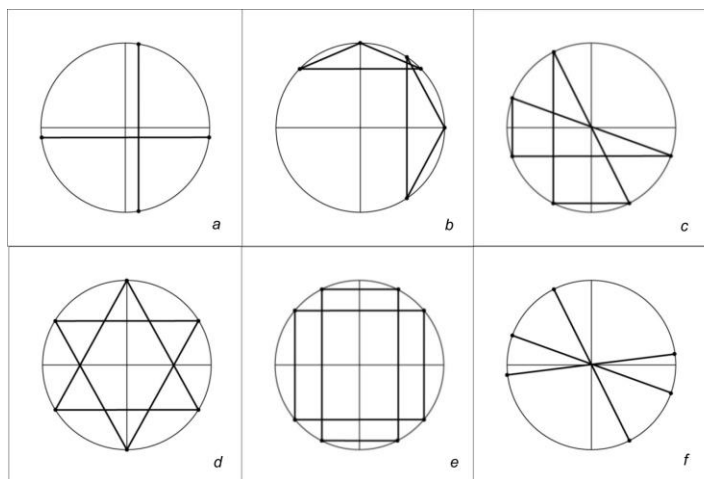


Fig. 10. The scheme of constructions of harmonious combinations of colors according to V.M. Shugaev: *a* – two family-contrasting colors; *b*, *c*, *d* – three family-contrasting colors; *e* – four family-contrasting colors; *f* – contrasting colors

When perceiving color, the human eye experiences its various properties and associations. For example, there is the concept of "heavy and light colors", "warm and cold". The darker the color, the "heavier" it is, and on the contrary, the light color is perceived as "airy". This rule applies to all colors, chromatic and achromatic. Color tone, saturation and reflection coefficient are the main parameters that provide the most correct associative perception of the absolute size and scale of the product, dynamic and rhythmic constructions, a sense of weight and thermal characteristics, proximity and range. Regarding to jewelry, the concept of transparency and luster of jewelry stones and metals is becoming more important. Texture is also important for the aesthetic expressiveness of the product. The treated surfaces of the product can be glossy, matte or rough. The most complete and beautiful color is on a matte texture, gloss scatters color in space, and rough texture, to some extent, masks the color due to shadows. The matte texture hides the nuances of the form in diffused lighting, and glossy – in bright directional light.

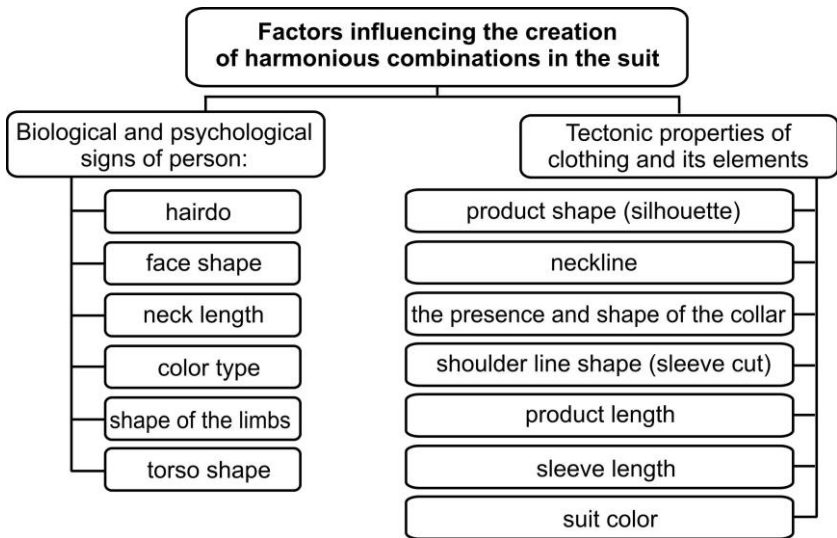


Fig. 11. Factors influencing the creation of a harmonious image

Let's point to another important factor in the harmonious perception of the suit in general – the color type of appearance, with which you can create makeup from the most successful shades, choose jewelry with the appropriate color of inserts and metal that will emphasize skin, hair and eyes. The color type is determined only by a set of external natural data: hair color, eyebrows, eyes, skin tone and lips.

As is known [14], the structure of the artistic image is created by:

- harmonious matching of individual parts of the suit, their artistic unity and functionality;
- harmonious organization of the human figure, posture and nature of movement which meets the requirements of time, fashion, type of activity;
- merging of a suit with a person, its ergonomic and aesthetic correspondence to a figure and an image

To study the plastic conjugation of accessories, jewelry in the suit system we have identified the main factors influencing the perception of a harmonious image in general and its parts (Fig. 11) [21, 22]. They can be divided into two groups: factors directly related to the person, his body, psychological characteristics, and factors related to the suit (silhouette, length, color, etc.). Determined factors will make it possible to create an algorithm for selecting harmonious combinations of accessories and jewelry in the suit system.

Conclusions. The structure of the artistic image is created by the harmonious conformity of individual parts of the suit, their artistic unity and functionality, harmonious organization of the human figure, posture and nature of which meet the requirements of time, fashion, activity, merging the costume with a person, its ergonomic and aesthetic conformity to the figure and image. For research of plastic conjugation of accessories, jewelry in the suit system it is important to identify the factors influencing the choice of jewelry and accessories in the suit. The main focus should be on the combination, correlation of accessories, jewelry and suit in general. Therefore, there is a need to streamline the scheme of matching and combining accessories, jewelry and suit. The results obtained in the study regarding the classification and correlation of accessories to the elements of the “suit system”, elements of compositional shaping and means of compositional coordination of jewelry and additions in the “suit system”; The main factors influencing the perception of the harmonious image in general and its parts can be useful in creating a general algorithm for the selection of harmonious combinations of accessories and jewelry in the suit system.

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2 INTEGRATION OF ART AND TECHNOLOGIES IN CLOTHING DESIGN

2.1. PRINCIPLES OF TRANSFORMATION IN CLOTHING DESIGN

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Abstract: *In the paper the types of protective products and their elements are structured by different characteristics, their design features are described. The classification of functions of protective clothing elements is proposed; depending on the range of protective clothing the constructive and technological features of designing and manufacturing of existing varieties of elements with adjustable parameters are revealed. The data base of the existing elements-transformers for the creation of modern effective protective clothing is formed and theoretically substantiated, the range of protective products is structured depending on the types of hazards and operating conditions. It is noted that the creation of varieties of effective protective clothing is achieved by a different combination of design parameters of products and their elements by the method of transformation.*

Key words: *design, protective clothing, elements-transformers, adjustable parameters, principles of transformation.*

Introduction. Creating safe working conditions and implementing the best European and world practices of industrial safety, health and environment in Ukraine is impossible without the design, manufacture and implementation of qualitatively new types of protective clothing for workers. Without a deep scientific substantiation, defined methods and criteria for assessing the parameters of protective clothing, it is difficult to expand the range of products, the need for which is constantly growing.

Creating protective clothing at the present stage is a difficult task due to the variety of conditions faced by the employee in the production process. With the development of industrial production, the requirements for the quality of protective clothing increase, as it must ensure safety, prevent harmful production factors, maintain a normal functional condition of a worker, his ability to work throughout working hours, be non-toxic, do not irritate the worker, with stand scientifically determined service life. Each profession has its own specific requirements for protective clothing, which must be taken into account when designing it.

In various aspects, the problem of creation of personal protective equipment has been studied by such leading scientists as Romanov V.E., Chubarova Z.S., Afanasieva R.F., Koketkin P.P., Rusynova A.M., Kolesnikov P.A., Tretiakova L.I., Mychko A.A., Kolosnichenko M.V., Tretyakova L.D., Tappuraa K., Holdstock P. and other specialists.

However, the multifactorial and interdisciplinary development of the scientific basis for the design of protective clothing, the steady trend towards the emergence of new textile protective materials on the world market, modern clothing manufacturing technologies preclude the uniqueness of decisions and comprehensiveness of the topic.

Statement of the problem. Domestic protective clothing existing on the consumer market does not withstand the established service life for various reasons, does not provide adequate protection of workers from the declared types of hazards, does not fully meet the specific level of requirements, creates additional risk factors, does not always meet the specific needs of the production environment, and also has unreasonably high cost.

Ergonomic imperfection of products for protection of workers in their professional activity leads to physical overload due to excessive weight of clothing, complication and limitation of movements of the worker, inconsistency of design and technological solutions of products with operating conditions, and as a result - thermal imbalance.

Currently, the relevance of the research of the development of effective protective clothing of different functional orientation seems undeniable and evidence of this is the statistics on the level of occupational injuries and deaths.

Results of the research and their discussion. Transformation is a morphological feature in which the object acquires the ability to change its spatial characteristics and thus form new properties, to change the function of clothing. General theoretical scientific works, developments and separate researches of Petushkova G.I. [1, 2], Akilova Z.T., Patsyavichute A.A. [3], Semkina V.V. [4], Goncharova S.O. [5], Shamukhitdinova L.S. [6] and other experts are devoted to the study of new methods of transformation, the study of the mechanism and patterns of transformation of design objects.

There is a well-known definition of the term "transformation" in the design, which means the property of objects of the object-spatial world to change their original forms and parameters in the process of existence or operation. There are many interpretations of the concept of "clothing transformation", including such an interpretation as "the ability of a garment to significantly change the shape, silhouette, functional purpose and properties by means of a movable structure, i.e. the ability of clothing to change."

The purpose of this study is to systematize the existing types of protective clothing to improve the system of providing employees with protective products [7]. The variety and large number of types of protective clothing determines the feasibility of their division into different classification groups: by term of use; by method of protection; by protective properties;

by season; by gender; by bearing area; by range; by complexity of construction, etc. (Fig. 1).

As a result of the analytical study, protective clothing products were systematized according to different classification groups in order to optimize the design process and the system of providing workers with protective products. It should be noted that for further research in the context of protective clothing design, we have singled out clothing for passive method of protection of the worker of various structural complexity in order to form an assortment series of kits, which include products for protection of hands, feet, head, etc.

To systematize the elements of clothing on the basis of the principles of transformation, the range of existing protective clothing for different purposes has been analyzed.

The lack of systematized information on the types of structural elements using the method of transformation was the reason for their proposed structuring based on literature sources (Fig. 2), which made it possible to classify and generalize clothing elements by functional feature [8] taking into account the requirements of unification, standardization, workability and cost-effectiveness of construction.

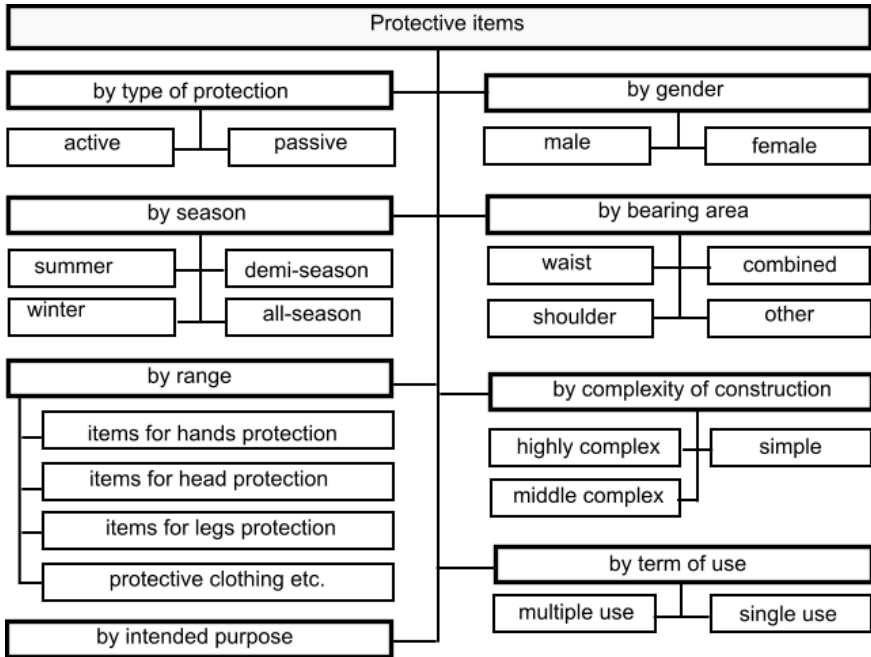


Fig. 1. Generalized classification of protective clothing

Below are given some existing varieties of elements with applied principles of transformation on functional grounds (Fig. 3 - Fig. 27). In addition, a greater variety of types of selected elements can be achieved by varying the combinations of their parts and components.

Information about the profession, position of the worker, the sphere of protective clothing use (Fig. 11) is provided by such elements as shoulder straps, emblems, which can be located on the shoulders, sleeves, forepart, back and fixed with buttons, snaps, textile fasteners, etc. The label of protective clothing contains an icon indicating the hazard and sphere of use, profession, position of the employee, etc.

The ability of materials or items to maintain stable dimensions and shape during a given service life is provided by such elements as shoulder and knee (goffered) pads. The comfortable microclimate of the undergarment space is provided by ventilation openings which can be located in leg seams, in underarm hollows, in seams of sewing of a yoke, on foreparts, a back and can unfasten (fasten) by means of a textile fastener, a zipper, etc.

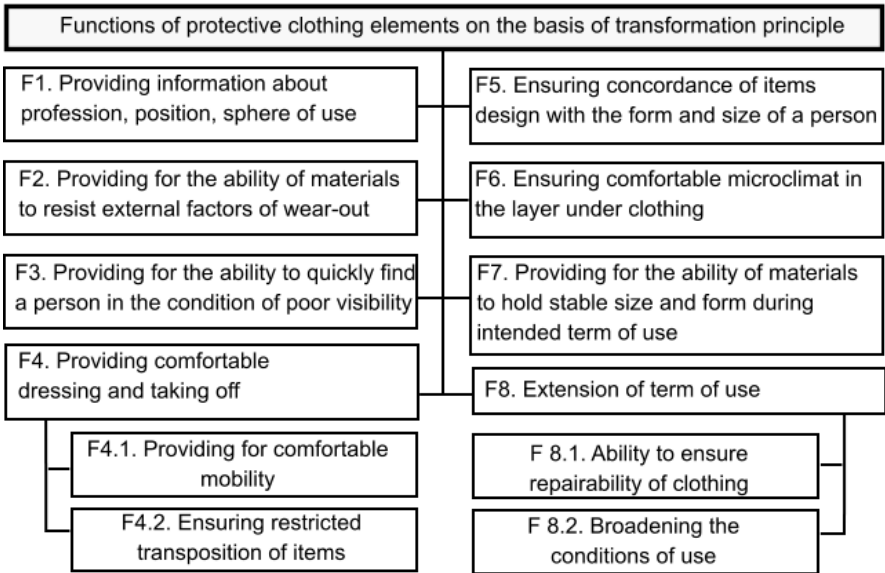


Fig. 2. Classification of the functions of protective clothing elements with coded identification on the basis of transformation principle

Conformity of the product design to the shape and size of the human body and at the same time preventing harmful substances from entering the undergarment space is provided by elements that regulate the width / length along the waist lines (Fig. 5), neck and bottom of sleeves (Fig. 3, a - e, c - o), in side seams, hoods (Fig. 8, a - k), collars, cuffs (Fig. 3, c), at the bottom of the shoulder and waist items, etc. (belts, drawstrings, straps, staples, wristbands, ties (Fig. 5), shoulder straps (Fig. 7, a - d), puffs (Fig. 3, i - y, n, o, Fig. 7, g), cuffs, strips (Fig. 3, e, g) , elastic bands, etc.).

Moreover, the time for mounting these elements and (or) removing them should be minimal, and these elements should be easy to use.

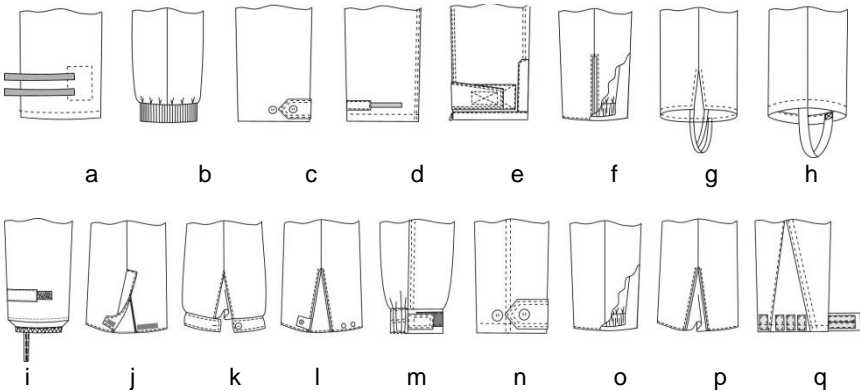


Fig. 3. Examples of varieties of elements (sleeve bottom design) (a-f) and trousers (a-h, j-q)

Thus, the degree of fit of the hood to the head (or to the means of individual protection of the head) in depth, width and front face line is carried out through the use of straps, elastic drawstring in appropriate places and so on. The drawstring also ensures a tight fit of the product on different parts of the body and the connection of clothing items with each other.

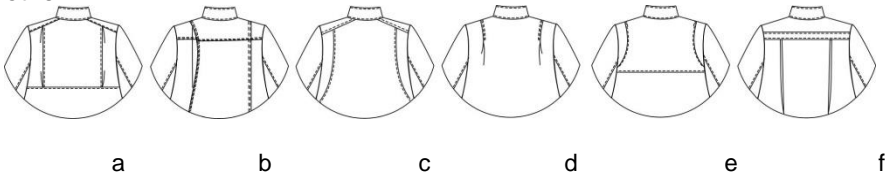


Fig. 4. Examples of varieties of elements (design of the back of sleeve unit)

There is a known set for protection against water, in which the width at the knee level of the full-length jumpsuit with boot covers is regulated by staples with straps and buckles. Depending on the type of danger, the cuffs provide a tight fit around the wrist or ankle and protect from dangerous and harmful substances entering the underwear space. The ability of materials or parts of the product to withstand external wear and tear and at the same time protect the torso, limbs, head and neck is provided by such elements as removable and non-removable knees, elbows, shoulders, chest, side reinforcement pads, trousers` back part pads, capes, yokes, lining, etc.

Clothing designed to protect against mechanical shock, vibration, static compression of any part of the body must have damping properties sufficient to protect parts of the body that have been hit by objects of various kinds (falling, protruding, etc.), in particular, from fractures and penetrating injuries. Therefore, the pads contain removable layers of shock-absorbing, reinforcing materials.

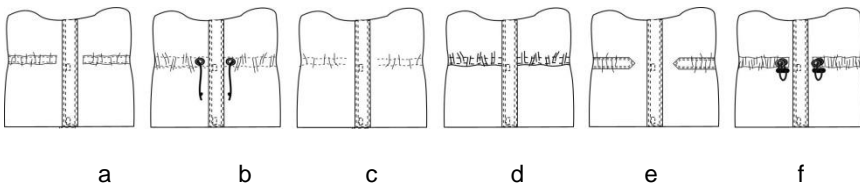


Fig. 5. Examples of varieties of elements (design of waist line in sleeve units)

The design of the garment must ensure that it fits properly on the worker's body and remains in the correct position throughout the operation, regardless of the environmental conditions, movements and position of the worker. Therefore, protective clothing must have the means to adapt to the morphological characteristics of the worker (such as adjustment or fastening systems) or be available in several variants of different sizes. Parts of protective clothing to be adjusted and replaced by the worker must be designed in such a way that they can be adjusted, secured and dismantled independently and without tools.

Extension of service life of protective clothing is provided by a possibility of maintainability of removable collars, knee, elbow, shoulder strengthening overlays, yokes, capes, emblems, pockets, sleeves, lining, shoulder straps (fig. 6, a), hoods (fig. 8, g, h) etc. and at the same time by expanding the conditions of their use and the product as a whole due to removable thermal insulation layers, pockets with shock-absorbing underlining, wind protection valve for the chin area.

Restriction of movement of details of a product and fixing of position of its parts concerning a body of the worker is provided by adjustment of holders of a thumb (fig. 3, i), strips (fig. 3, g, h), shoulder straps (fig. 7, a -

e), puffs, ties, straps on the hood (Fig. 8, d, f), elastic bands, etc., which are fixed with snaps, buttons, carabiners, zippers, etc.

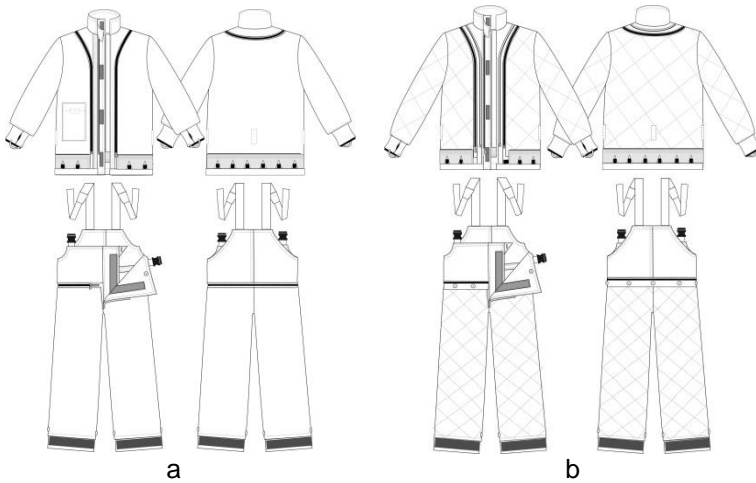


Fig. 6. Examples of varieties of elements (design of removable lining layers)

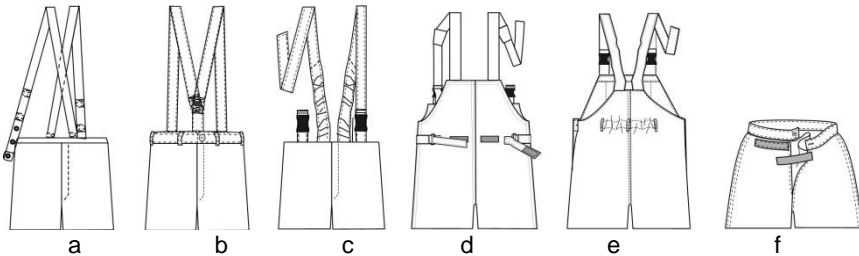


Fig. 7. Examples of varieties of elements (design of straps (a - c), waist line of waist-high garments (d - h))

Restrictions on the movement of the employee, due to the use of special clothing, should be minimal and at the same time not pose a danger to him or other people. Thus, to fix the jacket for protection against moisture a strap, which is adjustable in length and sewn to the bottom of the shoulder product and which is located along the middle front and rear seams of the waist product, is used.

To maintain the production clothes on the shoulders or neck, the common elements are the straps of the apron, trousers, bib of the overalls (Fig. 7, d, e) of various shapes and sizes, with different placement on the body, with different ways and means of connection.

To fix the elements on the basis of the principles of transformation, various means are used for their fastening, among which the most common are snaps, buttons, zippers, textile fasteners, snap hooks, etc.

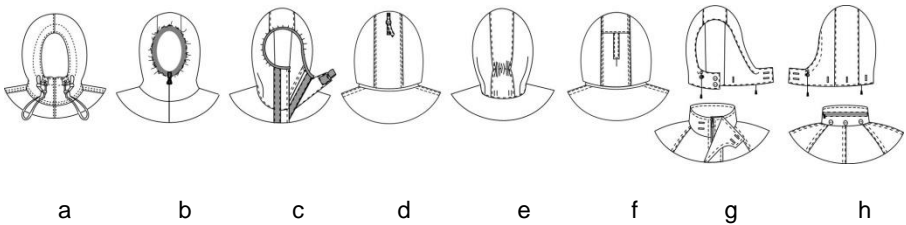


Fig. 8. Examples of varieties of elements (design of hoods)

The design and technological solution of protective clothing should provide the ability to perceive and transmit audio and visual information using special devices, as well as the possibility of its use with equipment of a worker - with means of visual and respiratory protection, technical weapons, special footwear, hand protection and more. The ability to quickly find a worker in conditions of limited visibility (smoke, poor lighting, etc.) and good aesthetic perception is provided by such elements as removable signal tapes that can be located on the hood, at the bottom of the product and the bottom of the sleeve, at the knees, at the sewing line of a yoke on the back and foreparts of special clothing, etc.

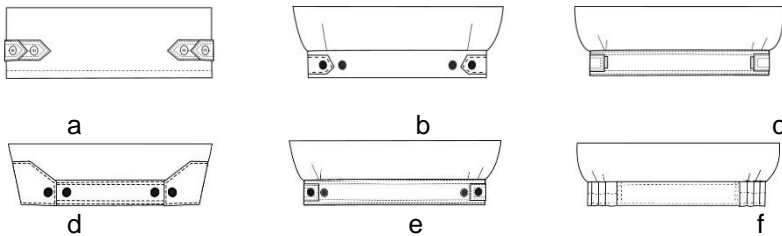


Fig. 9. Examples of varieties of elements (design of bottom of sleeve unit)

Convenience of dressing and removal is provided by such elements as straps, yokes, shoulder straps, etc. taking into account characteristic movements and position of a body of the worker. The time required to attach and / or remove special clothing should be kept to a minimum. Any items of clothing used for proper positioning should be easy to use.

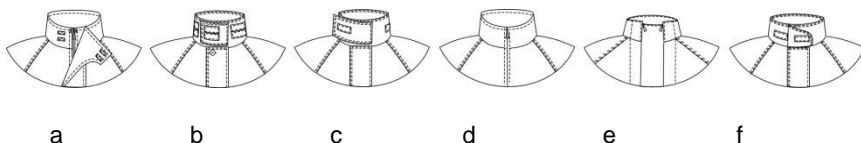


Fig. 10. Examples of varieties of elements (design of a collar and placket)

If there is a risk of the elements of the product engaging with a moving object under the intended operating conditions, the strength of the workwear material and the joint must be calculated in such a way that it tears or breaks when the garment engages with the moving object ensuring the worker's safety.

Clothing parts that fit closely or are potentially capable of fitting closely the worker when wearing protective clothing should not have rough parts, sharp edges, or protrusions that could cause skin irritation or injury.

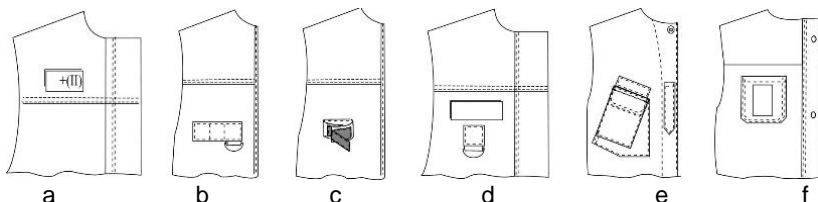


Fig. 11. Examples of varieties of elements (design of fastening elements) in protective clothing

The analysis of modern sources [9 – 30] allowed us to establish that the range of protective clothing is quite large, and among the components of it quite common are overlays. Insufficiency and scattering of materials in this area adequately explains the lack of scientific publications in the sphere and indicates the need to form an information base of overlays in protective clothing and their design and technological characteristics. Therefore, the outlined task, namely the systematization of types of overlays in protective clothing in order to predict their range and optimize the process of designing protective clothing, is relevant.

These analytical studies are aimed solely at studying the types of parts of special clothing and do not apply to overlays products which are quite common means of personal protection of feet, hands, protection against falling from a height. According to [31], the overlay is a part of the product that provides increased wear resistance and (or) protective properties of individual parts of the product, as well as is used for its design. Note that the overlays are one of the unified structural parts of clothing.

The professional activity of workers, the specifics of production and climatic conditions of the area are the determining factors in the design of special clothing, and, as a consequence, its details, including overlays, under conditions of unification, manufacturability and cost-effectiveness of construction. Substantiation of the choice of overlays, namely areas of their location, configuration, size, shape, assembly of materials, etc., is preceded by the study of types, intensity and recurrence of dangerous and harmful factors of the production environment, topography of their impact on different parts and areas of clothing and more.

Based on the analysis of the range of existing protective clothing, the types of overlays [32] in protective clothing are generalized and systematized according to different classification groups (Fig. 12).

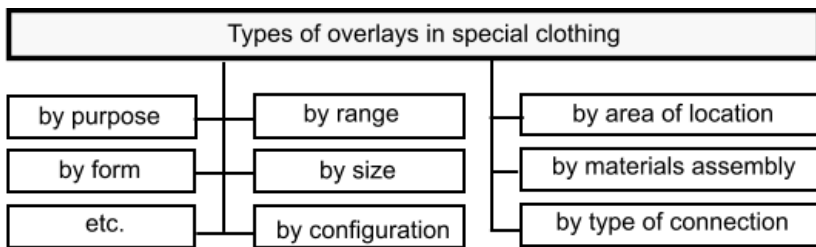


Fig.12. Classification of overlays in special clothing

The use of overlays for functional purposes is explained by the ability of materials or parts of the product to withstand the effects of different types of hazards and their various combinations, extending the service life, the ability to maintain stable dimensions and shape during a given service life and more.

The grouping of types of overlays by their purpose is due to the influence of dangerous and harmful production factors of the production environment on a specific area of the product. Thus, protective clothing provides for overlays to protect against abrasion, infrared radiation, electric current, dust; toxic substances, slip, water, solutions of non-toxic substances; solutions of acids, alkalis, organic solvents, oil, petroleum products, oils, fats; harmful biological factors; sparks and splashes of molten metal, mechanical shocks, vibration, static compression, punctures, cuts and other damage. For example, the overlays on the bottom of the product are most often used to protect against abrasion. In the welder's suit, which is made of heat-protective fabrics, it is mandatory to use overlays on the bottom of the back halves of the trousers to protect against sparks and splashes of molten metal, which are reflected from the floor, as well as on the front parts of foreparts, sleeves and front halves of trousers. At the same time, there are known overlays that are attached to the riser of

the upper collar of the metallurgist's jacket to prevent irritation of the skin of the neck, overlays that strengthen the joints of straps or ties with the apron, and so on.

The range of overlays in products for protection of hands (gloves, mittens, oversleeves, overpalms, etc.), legs (boot covers, leggings, etc.), head (helmets, helmet liners, etc.) is also quite diverse and poorly studied, and requires separate research.

By the area of placement there are such types as shoulder overlays, elbow overlays, knees overlays, overlays in the upper parts of the back halves, and so on. The classification of overlays with the coded designation of places of their location which is presented in figure 13 is offered.

The protection of different parts of the human body determines such designs of the overlays which combine two or more their types. The proposed classification of combined overlays with coded designation of their locations is presented in Figure 14.

The offered classification of overlays by materials assembly provides application of overlays both from the main material of clothes, and from materials with the increased protective properties, including removable or stationary overlays with shock-absorbing linings for giving to these details of specific properties. Overlays can be made of fabrics of different raw material composition, structure, purpose, etc.; genuine and artificial leather, knitted fabrics; nonwovens; materials with coatings, impregnations, etc. It is known to combine different materials in overlays - for example, fabric and knitted fabric, etc.

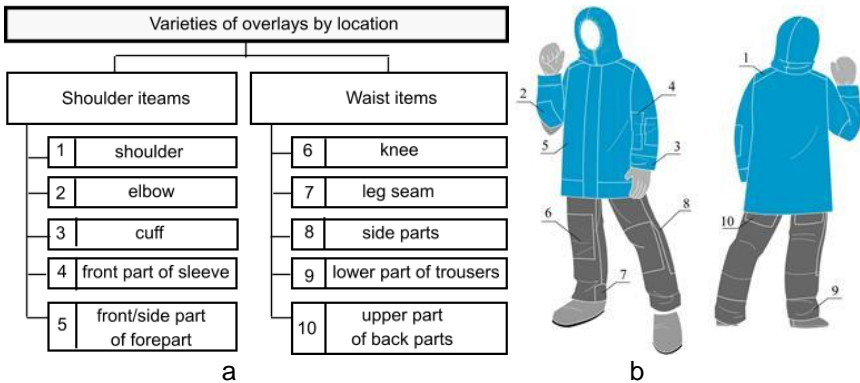


Fig. 13. Classification of overlays by the area of their location with coded designation (a) and examples of overlays placement in protective clothing (b)

The choice of materials for protective clothing of the corresponding purpose causes the ways of connection of items of overlays and a product

which include threaded, welded, glue, combined connection, and places of their connections can be sealed.

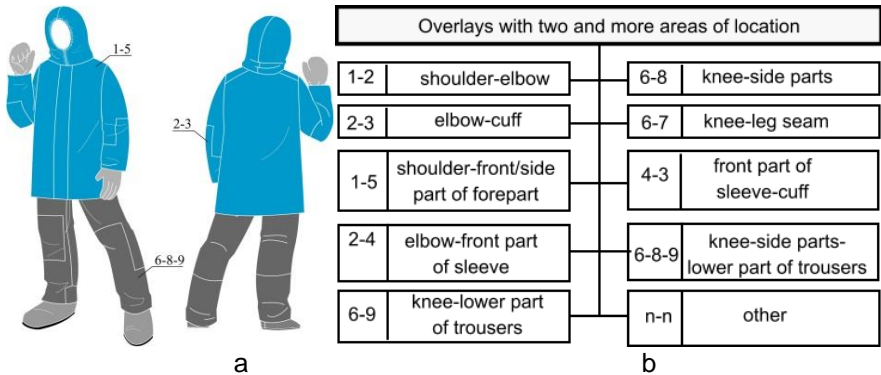


Fig. 14. Classification of combined overlays by the area of their location with coded designation (b) and examples of overlays placement in protective clothing (a)

It should be noted that the overlays can be flat, volume and combined. As a rule, volume overlays are more ergonomic and effective at dynamic loadings because have greater degree of conformity to the movements of the worker, impose less pressure on joints and do not lead to fast fatigue of the worker. All layers of a product which are located under an overlay should be ergonomic. Knee, shoulder, elbow overlays in the form of pockets with stationary or removable overlays, in particular shock-absorbing, are among popular ones.

Knee pads are the most common of all types of overlays. It is known [31] that the knee pad is a reinforcing or protective pad on the outside of the front halves of the trousers, bib overalls, overalls in the area of knee. Knee pads - pockets with removable liner can have an entrance from above, below and from the side. In order to prevent dust, water, etc. from getting into the pocket, flaps are used provided that the liner is inserted from above or the entrance to the pocket is placed from below (Fig. 15, b). Depending on the specific operating conditions, the knee pads can be: with decomposition (Fig. 15, l); gores (Fig. 15, f); quilted (Fig. 15, h); sewn with placement of sections only in side seams (fig. 15, a), only in step seams (fig. 15, g), both in the side and step seams (fig. 15, c, h); sewn with the placement of sections that overlap either the side or step seams, or both, or that are not included neither in the side nor step seams (Fig. 15, i), etc. Varieties of combined overlays are known that combine knee pads with overlays of the front halves (Fig. 15, k) with upper parts (Fig. 15, d), with the bottom of the trousers (Fig. 15, j), with side parts, with step seam, and

so on. There are also known pads, which are placed in the upper parts of the back halves of pants, bib overalls, overalls, shorts to protect against mechanical action [31].

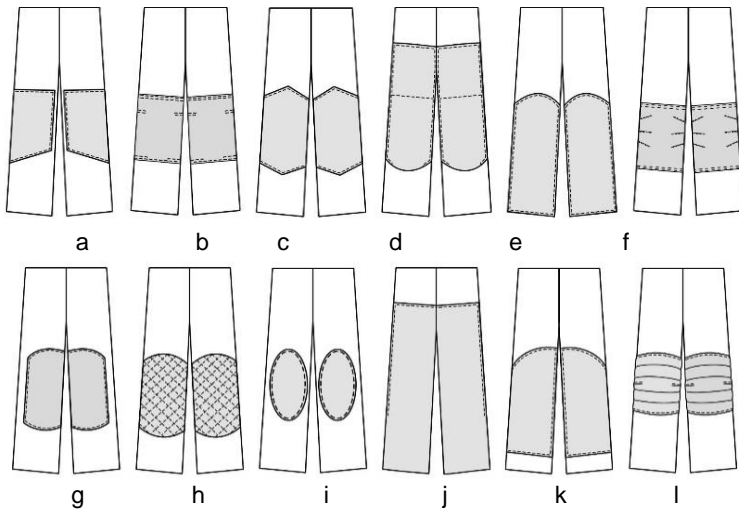


Fig. 15. Examples of varieties of elements (knee pads design) in protective clothing

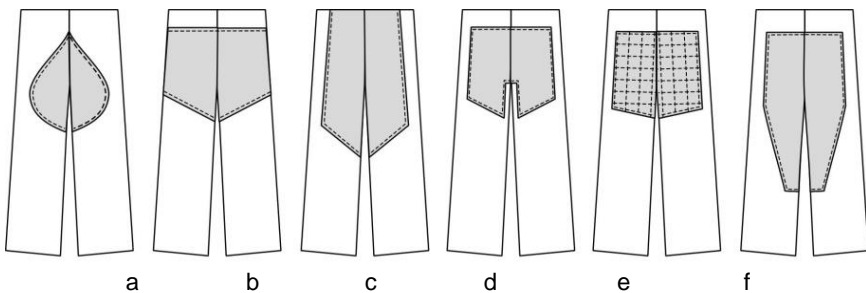


Fig. 16. Examples of varieties of elements (pads design) in protective clothing

The use of such pads is advisable when performing work while sitting. It should be noted that these pads can be with liners (Fig. 16, e), including shock-absorbing.

Depending on specific operating conditions such overlays are made: quilted (fig. 16, d); sewn with the placement of sections in the side seams (Fig. 16, b), in step seams (Fig. 16, a - c, e, f), both in the side and step seams (Fig. 16, b), in the seam of the belt (Fig. 16, c) etc.

The range of side overlays in shoulder and waist products is limited. Improvement of the wear resistance and / or protective properties of the side sections of the product is provided by appropriate overlays that differ in shape, size, area, etc.

These areas require increased protection to reduce the force of shocks and other mechanical actions due to the use of a shock-absorbing liners. Examples of types of side overlays in waist products are shown in Figure 17.

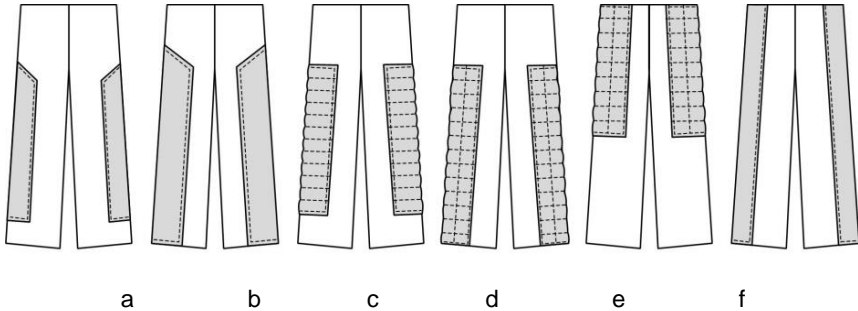


Fig. 17. Examples of varieties of elements (side overlays design) in waist products of special clothing

The design and manufacturing features of design and manufacture of types of overlays in protective clothing are revealed, including in the given examples. Therefore, when designing protective clothing and, in particular, overlays for a particular type of production, it is very important to take into account all the requirements for clothing and materials for its manufacture. The number of overlays should be necessary and sufficient in terms of ergonomics, manufacturability and cost-effectiveness of the design.

When developing design and technological solutions of overlays in each specific design situation one should take into account all the information about the purpose of protective clothing and industry. Analysis of the existing types of overlays in protective clothing allowed to reveal their design and technological features.

The proposed systematization of types of protective clothing overlays by different classification groups is aimed at forming an information base of these parts, as well as their design and technological characteristics with the ability to predict and expand the range of protective clothing. The proposed classification will allow to develop a matrix of unified structural elements of protective clothing based on the principles of transformation and to create an information database of such elements with the definition of their size, location, methods of connection with the product.

Also, an important function of protective clothing is maintaining high human performance in conditions of dangerous and harmful production factors. It is known that protective clothing should provide an artificial adjustable microclimate in the undergarment space, which, by reducing heat loss, creates favorable conditions for maintaining a constant body temperature.

The analysis of modern sources revealed that protective clothing is in demand among workers and a fairly large range of it has ventilation elements. Insufficiency and dispersion of materials in this area accordingly explains the lack of scientific publications and indicates the need to form an information base of ventilation elements in protective clothing and their design and technological characteristics. Therefore, the outlined task, namely the systematization of types of ventilation elements in protective clothing in order to predict their range and optimize the process of designing protective clothing, is relevant.

Ventilation is a process of air exchange that occurs due to the pressure difference between inside and outside air, through specially arranged openings, the degree of opening of which can be adjusted.

The choice of location of a ventilation element is determined by the topography of sweating, as well as by the ventilation effect that can be achieved in specific operating conditions of clothing (for example, when walking, body tilts, etc.). It is established that the intensity of sweating in different areas of the human body is different. Areas of severe and moderate sweating include the armpits, lumbar area, chest area, between the shoulder blades, groin area, knee area, wrists and hands, forehead, and front of the neck [10].

On the basis of the conducted analytical researches the kinds of ventilating elements in protective clothes on various classification groupings are generalized and systematized (fig. 18).

The basis for the formation of the range of protective clothing is a set of consumer properties of the products themselves, which are influenced by their design features and raw material composition of materials. The use of ventilation elements in protective clothing is provided in both shoulder and waist products, namely in overalls, vests, jackets, shirts, T-shirts, raincoats, bib overalls, pants, shorts etc.

Varieties of ventilation elements (openings, systems, cooling elements, etc.) among the existing range of clothing, hats, shoes, gloves and hosiery for protective, sports, military purposes, etc. were analyzed and systematized according to various features, their design features were revealed [33].

The range of ventilation elements in hats, gloves and hosiery, shoes is also quite diverse and poorly studied, and requires separate research.

According to the area of placement on the product, the ventilation elements of the underarm area, the area of the shoulder blades, chest,

thighs, lumbar region, etc. are known. The classification of ventilation elements by areas of their location is offered, which is presented in figure 19.

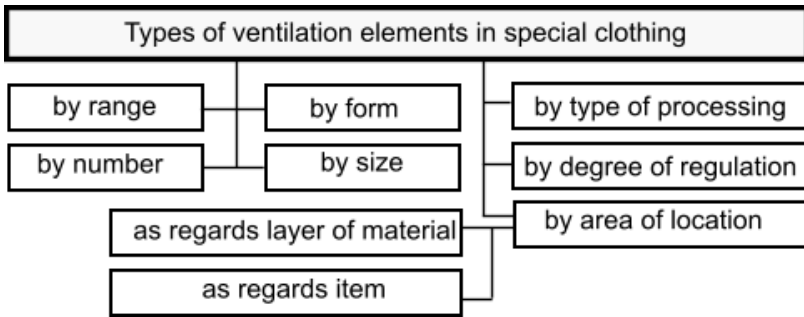


Fig.18. Classification of ventilation elements in special clothing

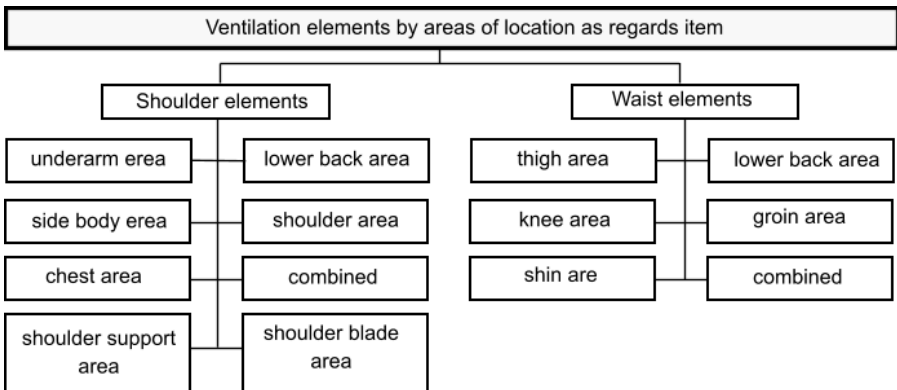


Fig. 19. Classification of ventilation elements in sleeve units of protective clothing

According to [10], human heat transfer conditions are significantly improved due to the introduction of slot-like ventilation elements on the back part and back of the sleeves. The use of ventilation elements reduces the overheating of the body when the level of its energy consumption increases. Examples of types of slit-like ventilation elements in shoulder products are shown in Figure 20.

Ventilation of the undergarment space, carried out by the temperature difference under clothing and in the environment, human movements, changes in wind speed, is necessary both to improve heat

transfer during physical activity and to remove gas exchange products through the skin.



Fig. 20. Examples of varieties of slot-like ventilation elements in protective clothing

Therefore, both in sleeve, and in waist units ventilating elements which promote removal of excess moisture and temperature from undergarment space are used. If there is insufficient drainage of moisture, the body overheats, which can cause discomfort and colds. Examples of types of ventilation elements in waist products are shown in Figure 21.

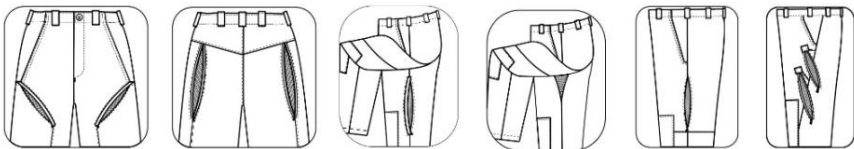


Fig. 21. Examples of varieties of waist ventilation elements in waist units of protective clothing

When using protective clothing, it is necessary to take into account the variable parameters of the environment, the nature of the workers production activities, material properties, and, as a consequence, the possibility of direct regulation of normal heat and gas exchange of the human body with the environment. Structural and technological solutions of such "closed" elements include the use of a placket, flap, gore of various shapes and sizes, methods and means of connection with products, etc.

According to the method of processing of ventilation elements, there are holes in the seams, overlapped, sewn around, with the use of perforated material and various accessories. Examples of methods of processing of ventilation elements are given in Fig. 22.

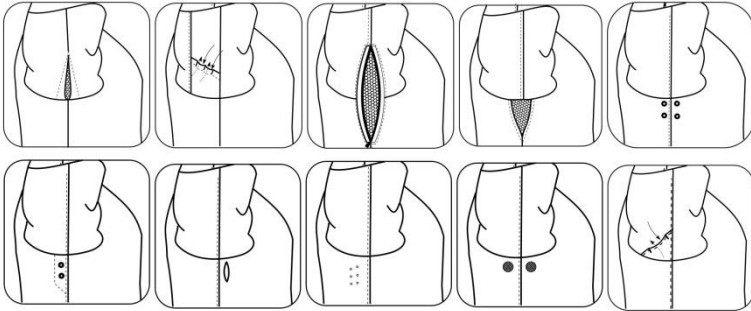


Fig. 22. Examples of underarm ventilation elements and openings

The number and size of ventilation elements depend on the required heat consumption by the worker during the performance of his professional activities, the shape of the ventilation elements and their location, the impact of the environment. So, for example, placement of ventilation elements on a back of a warehouse coat increases physical working capacity of the worker and improves endurance of physical activity.

To ensure improved ventilation, moisture and heat transfer, parts made of perforated material are used, which determine the shapes of ventilation elements: slot-like, round, diamond-shaped, oval, square, rectangular, triangular, combined, etc. (Fig. 23).

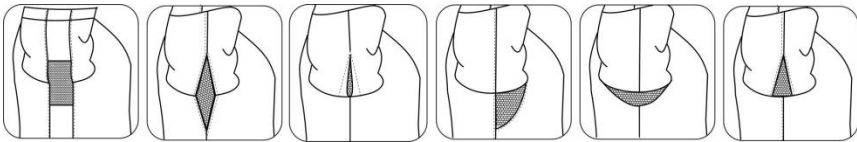


Fig. 23. Examples of varieties of forms of ventilation elements using perforated material

Therefore, the choice of the number and location of ventilation openings is especially important to maintain the normal parameters of the microclimate of the underclothing space, in particular, this concerns grommets. Grommets are shaped rings that have a collar on one side. They are designed to strengthen the edges of the holes of garments, leather goods and footwear [34]. Examples of grommets placement are shown in Figure 24.

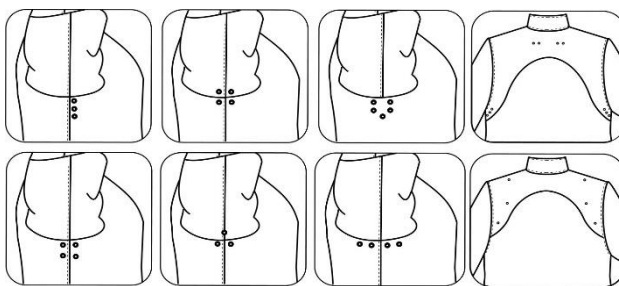


Fig. 24. Examples of grommets placement in sleeve items

The location of the ventilation elements under the yoke helps to improve heat transfer conditions in the torso.

Examples of varieties of storm flaps are shown in Figure 25.

According to the area of placement as regards the layers of the assembly of materials, "external" and "internal" ventilation elements are singled out (Fig. 26). The "external" elements are located on the front of the product, the internal - on the back and between the layers of the assembly of materials. For example, for the lining of the product or pockets perforated material is used, etc. In any case, to ensure efficient ventilation and normal thermal state, these elements of the product must interact with each other.

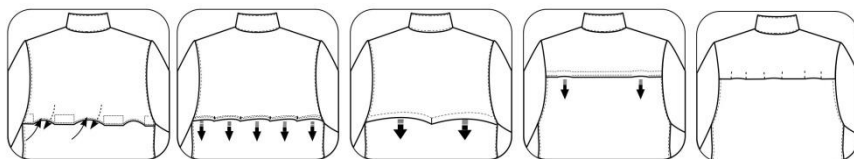


Fig. 25. Examples of varieties of storm flaps in protective clothing

The degree of regulation of ventilation elements can be changed according to the principle of transformation of initial transforms - permutation, replacement, separation - joining, stretching - compression, disappearance - appearance, combination - embedding, folding - deployment, adjustment - fixing [35].

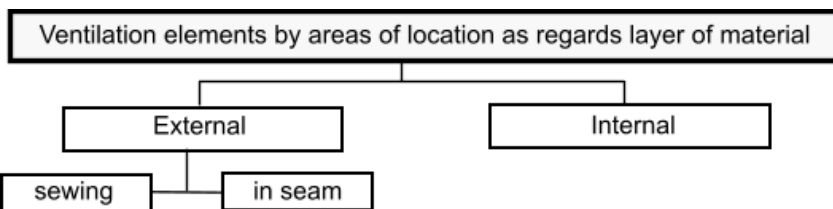


Fig. 26. Classification of varieties of ventilation elements by areas of location as regards layer of material in protective clothing

Their implementation is carried out by unbuttoning / fastening, fixing with a textile clasp, zipper, etc. For example, it is possible to change or maintain the required air exchange regardless of the outside air temperature and wind speed. Examples of types of ventilation elements with the function of the degree of regulation are shown in Fig. 27.

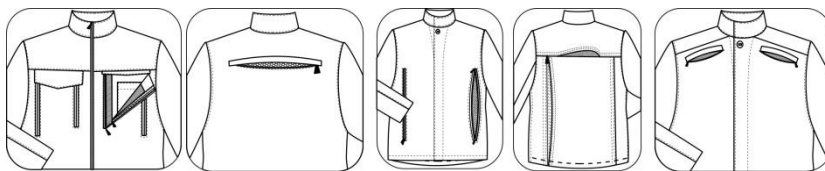


Fig. 27. Examples of varieties of ventilation elements with the function of degree of regulation

The thermal comfort of a person largely depends on the ability of the assembly of materials to ensure the removal of residual vapor and drip-liquid moisture from the undergarment space, so the use of the latest materials made by leading technologies helps to create light comfortable clothing that has "breathing activity" [5], provides the necessary heat-protective properties on various parts of the human body and does not prevent the worker from moving freely during the activity. New, high-tech materials are used for the production of protective clothing both for the main fabrics of the top and for auxiliary non-woven materials. For example, American researchers have developed inserts made of living material, which depending on the moisture content in the environment change its state, i.e. at low temperatures the insert expands, and at high temperature it contracts (Fig. 28, a). Various technologies are used in sportswear to create new designs of ventilation systems, for example, laser cutting. With the help of special equipment, holes of different sizes are punched, which allows to make clothes more breathable without dissipating excess heat (Fig. 28, b). When developing design and technological solutions for ventilation elements in each specific design situation one should take into

account all the information about the purpose of protective clothing and industry. Analysis of the existing types of ventilation elements in clothing revealed their design and technological features.

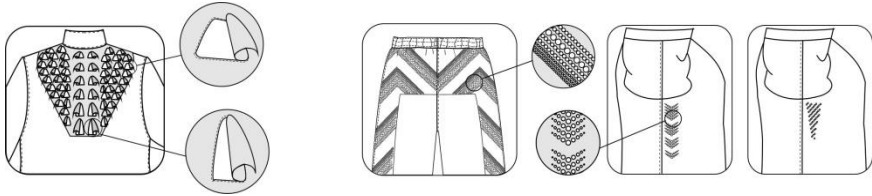


Fig. 28. Examples of varieties of ventilation systems from high-technology materials (a) and production techniques (b) for protective clothing manufacture

The proposed systematization of types of protective clothing by different classification groups is aimed at forming an information base of these elements, as well as their design and technological characteristics with the ability to predict and expand the range. A much greater variety of types of elements using the principles of transformation is achieved by varying the combinations of their parts and components. It was found that the same element of protective clothing contributes to the performance of different functions. Therefore, to find new elements, the range of existing protective clothing was analyzed, on the basis of which Table 1 with the types of existing elements of protective clothing was developed.

Table 1 - Systematization of elements of protective clothing based on the principles of transformation by various indicators

Elements list		Types of protective clothing			
		Jacket	Overall	Bib overall	Trousers
1	2	3	4	5	6
Parts of a unit	Shoulder strap		$\Delta 2/3/5/7$	$\Delta 2/3/5/7$	$\Delta 2/3/5/7$
	Tie	Δ	Δ	Δ	Δ
	Elastic band	Δ	Δ	Δ	Δ
	Hood	$\Delta 1/2/3/4/5/7$	$\Delta 1/2/3/4/5/7$	Δ	
	Pocket	$\Delta 1/2/3/4/5/7$	$\Delta 1/2/3/4/5/7$	$\Delta 1/2/3/4/5/7$	$\Delta 1/2/3/4/5/7$
	Yoke	$\Delta 1/2/3/4/7$	$\Delta 1/2/3/4/7$	Δ	$\Delta 1/2/3/4/7$
	Collar	$\Delta 3/4/5/7$	$\Delta 3/4/5/7$	Δ	
	Drawstring	Δ	Δ	Δ	Δ
	Gore	$\Delta 3/4$	$\Delta 3/4$	Δ	Δ
	Trousers`		$\Delta 3/4$	$\Delta 3/4$	$\Delta 3/4$

	back part pad				
	Overlay	$\Delta 1/2/3/4/5/6/7$	$\Delta 1/2/3/4/5/6/7$	$\Delta 1/2/3/4/5/6/7$	$\Delta 1/2/3/4/5/6/7$
	Kneepad		$\Delta 3/4/5/7$	$\Delta 3/4/5/7$	$\Delta 3/4/5/7$
	Wristband	Δ	Δ	Δ	Δ
	Cape	$\Delta 3/4/5/7$	$\Delta 3/4/5/7$		
	Placket of blind fly	Δ	Δ	Δ	
	Belt	$\Delta 3/4/7$	$\Delta 3/4/7$	$\Delta 3/4/7$	$\Delta 3/4/7$
	Puff	$\Delta 1/2/3/4/5$	$\Delta 1/2/3/4/5$	$\Delta 1/2/3/4/5$	$\Delta 1/2/3/4/5$
	Marker panel	$\Delta 1/2/3/5$	$\Delta 1/2/3/5$	$\Delta 1/2/3/5$	$\Delta 1/2/3/5$
	Footstrap	Δ	Δ	Δ	Δ
Design elements	Side seam	Δ	Δ	Δ	Δ
	Ventilation openings	$\Delta 1/2/3/4/5/7$	$\Delta 1/2/3/4/5/7$	$\Delta 1/2/3/4/5/7$	$\Delta 1/2/3/4/5/7$
	Fasteners	$+1/2/3/7$	$+1/2/3/7$	$+1/2/3/7$	$+1/2/3/7$
	Double parts of sleeves, trousers	Δ	Δ	Δ	Δ
	Removable layers of materials assemblies	$\Delta 1/2/5/7$	$\Delta 1/2/5/7$	$\Delta 1/2/5/7$	$\Delta 1/2/5/7$
	Decomposition	$\Delta 1/2/3/4/6$	$\Delta 1/2/3/4/6$	$\Delta 1/2/3/4/6$	$\Delta 1/2/3/4/6$
Additional devices	Cooling devices	Δ	Δ	Δ	Δ
	Fastening devices	$\Delta 1/2/3/5/7$	$\Delta 1/2/3/5/7$	$\Delta 1/2/3/5/7$	$\Delta 1/2/3/5/7$
	Devices for extension	$\Delta 1/2/3/5/7$	$\Delta 1/2/3/5/7$	$\Delta 1/2/3/5/7$	$\Delta 1/2/3/5/7$
	Signaling devices	$\Delta 1/2/3/5/7$	$\Delta 1/2/3/5/7$	$\Delta 1/2/3/5/7$	$\Delta 1/2/3/5/7$

Key:

«+» - necessary presence; « Δ » - can be present or absent;
«/» - various by: 1 – location; 2 – number; 3 – size;
4 – shape; 5 – means and (or) way of connection;
6 – intended purpose; 7 – type.

Thus, systematization of the varieties of elements of protective clothing by location, configuration, shape, size, means and way of connection etc. gave the possibility to facilitate the process of search for the appropriate element during design of protective clothing on the basis of the principle of transformation.

For further research and development elements with the use of

transformation principles which are components of protective clothing and allow regulation of its parameters by various features have been chosen.

The overview of modern scientific and practical achievements of sewing and textile production in the area of intended formation of rational structure of protective sets from dedicated types of hazards shows the advantages of introduction of elements with regulated parameters which ensures effective protection of the worker.

Conclusions. Varieties of protective units have been generalized and systematized by the type of protection, intended purpose, complexity of the construction, term of use, range, bearing area, season and gender with the aim of selection of protective sets segment of dedicated functional direction. Design and development of clothing with passive way of workers protection has been emphasized with the aim of formation of range lines of sets, elements of which are items for arms, legs, head etc. protection.

Classification of the functions of protective clothing has been developed, and on the basis of it eight groups of varieties of elements with the use of transformation principles have been formed.

Varieties of overlays of protective clothing have been generalized and structured by intended purpose, range, area of location, way of connection, materials assembly, shape, size, configuration on the basis of analysis of the range of existing protective clothing. Their design features have been revealed, the examples of their varieties have been given.

Varieties of ventilation elements in protective clothing have been systematized by different classificational groups, among which are the degree of regulation, area of location etc.

For the first time, the information base of existing elements-transformers for creation of modern effective protective clothing has been theoretically justified; their range as regards the types of hazards and conditions of use has been structured. It has been stated that the creation of varieties of effective protective clothing is achieved by various combination of construction parameters of unots and their elements by the method of transformation.

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2.2. TECHNOLOGY AS A FACTOR IN THE DEVELOPMENT OF SPECIAL CLOTHES

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Abstract. *The paper is devoted to the scientific and technical solutions of an actual problem of developing protective clothes for aviation staff involved in emergency and rescue operations by improving its design-projecting. The professional and qualification activities of rescuers have been analyzed; the nomenclature of dangerous and harmful factors has been developed and the topography of their influence has been identified; the requirements for protective clothes and materials used for their production have been determined. Based on the conducted theoretical and experimental researches, the assortment range of protective clothes has been formed, and design and technology concepts of overalls with different levels of protection for localization and elimination of emergencies and their consequences have been developed.*

Keywords: *protective clothes, design-projecting, rescuer's overalls, emergency and rescue operations.*

Introduction. The work in aviation necessitates special attention both to the safety of personnel and the protection of passengers. One of the main reasons for the injuries among the rescuers is the lack of efficient and modern personal protective equipment, which includes protective clothes. The basis of the study is the general theoretical works of L.I. Tretyakova, M.V. Kolosnichenko, N.V. Ostapenko, A.R. Horrok, J. Alongi, F. Bosco, and other scientists.

In case of an emergency, specially trained and equipped teams promptly arrive at the scene and begin search and emergency and rescue operations aimed at localization, elimination of accidents, disasters, and their consequences. During the accidents at aviation facilities, the most dangerous for workers and passengers are increased gas contamination, fragments of the metal structure, increased thermal radiation, contact with heated surfaces, rapid movement of heat flows, increased electric current, spills of fuel and lubricants, and so on. Localization and elimination of the consequences of accidents require immediate rescuers' response and appropriate decisions.

Thus, emergency and rescue operations are accompanied by a lot of dangerous and harmful factors and necessitate the efficient organization of the rescuer's protection system, including by the design-projecting of new types of modern protective clothes with increased reliability and ergonomic indicators.

Protective clothes for emergency and rescue operations of Ukrainian and foreign production that already exist in the consumer market do not provide adequate protection of workers from all dangers and do not fully meet the specified requirements, especially regarding the ergonomics of the design. Also, it does not always protect against specific environmental conditions during aviation events. It is found that the existing clothes for emergency and rescue operations do not withstand the useful lifetime guaranteed by the manufacturer and regulated by standardized documents, which leads to an increase in the number of injuries and deaths of the rescuers. Therefore, the development of modern and effective protective clothes of Ukrainian production with predicted indicators of reliability, ergonomics, and aesthetics for aviation staff involved in emergency and rescue operations is a relevant scientific and technical task.

Statement of the problem. The purpose of the work is to develop modern and effective protective clothes with predicted indicators of reliability, ergonomics, and aesthetics for aviation staff involved in emergency and rescue operations.

To achieve this objective, the following tasks are formulated: to analyze the protective clothes` operating conditions, the types of existing sets of protective clothing and other personal protective equipment; to determine the nomenclature of dangerous and harmful factors and provide the topography of their impact on workers; to formulate requirements for protective clothes for emergency and rescue operations and requirements for the materials for their manufacture, and on this basis determine the value indicators of quality by conducting an expert assessment; to generalize and systematize the information base of the components of protective clothes depending on the types of hazards and operating conditions; to offer an assortment range of protective clothes with different levels of protection, in particular overalls for localization, elimination of accidents and their consequences, to develop artistic and design, structural and technological solutions of products for aviation staff, to perform design development using the system of computer-aided design (CAD), to make experimental samples.

Results of the research and their discussion. The main purpose of protective clothes is to provide reliable protection of a person from adverse factors and to ensure performance efficiency and normal functional state of the body [1]. In protective clothes, it is also important to combine the maximum level of protection with the ergonomics of the design.

The design of such type of protective clothes considers the specific climatic conditions of the area, seasonality of works, types, intensity, and recurrence of dangerous and harmful factors and topography of their influence, size of the working area, time of workers` continuous stay under the influence of dangerous factors, duration of working hours and breaks, professional and qualification operations, the possibility to use technical

equipment and personal protective equipment, types of characteristic movements and poses, conditions of comfort and maintenance of comfortable conditions during work, etc. [2].

It is known [3] that the rescuer's equipment consists of special protective clothes, boots, helmet with inner liner, leather gloves, mask, breathing apparatus, and respirator for breathing protection [4, 5]. The systematization of the types of personal protective equipment for rescuers is shown in Fig. 1.

The main component of the process of designing new types of protective clothes for emergency and rescue operations is the development of design and technological solutions. The maximum level of protection of the clothes is achieved, among other things, due to the ergonomics of a product. The design of the clothes and their elements, materials, and technology of production must prevent the penetration of such hazardous substances like dust, gas, steam, surface-active agents, etc. into the underclothing space [6].

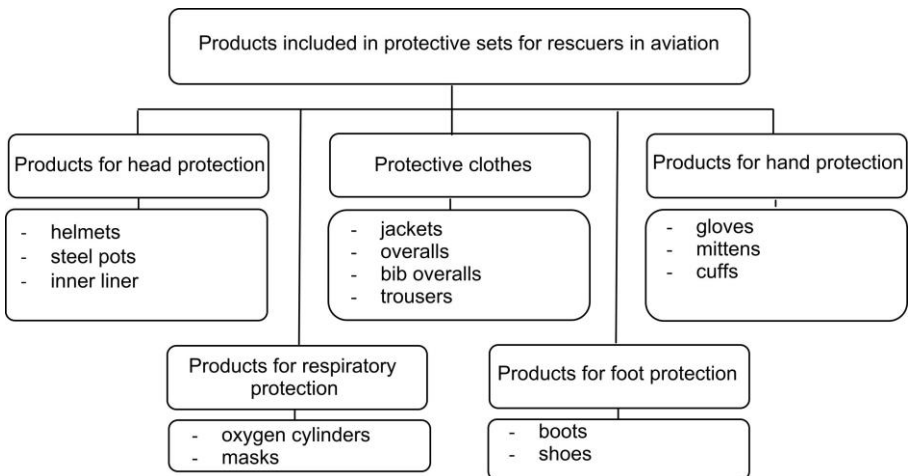


Fig. 1. Types of protective items for workers in aviation

Nowadays, there are a lot of protective clothes for rescuers and most often they consist of jacket and trousers (Fig. 2, a-d) or bib overalls (Fig. 2, e-h), overalls (Fig. 3). The jacket should cover the trousers at least 30 cm below the starting line of the trousers. The products must have knee pads and be able to be dressed in protective footwear. The number, shape, and size of overlays, pockets, and other elements must be justified. To ensure the ease of use, as a rule, the structure should be of a straight silhouette [7-9].

Due to limited visibility, the presence of reflective and fluorescent materials with a width of at least 0.02 m is a mandatory requirement. The total surface area of reflective materials must be not less than 0.2 m², on the sleeves – 0.12 m², on the back and chest – not less than 0.08 m². The signal stripes on trousers and bib overalls should be placed at the lower part of the products; the surface area is not less than 0.05 m² [10, 11].

Protective clothes for rescuers must be designed to allow moisture to drain from the surface of the clothes and not be retained. Therefore, all external pockets must have flaps. For the constant coordination, the clothes should have one or more pockets for a portable radio set. The cut of the sleeve is sewn to ensure the high level of dynamism. The ventilation of the undergarment space must be provided via special holes in the areas of the greatest sweating [12-14]. Protective clothes must have a stand-up collar with a high of at least 100 mm.

Reliability indicators ensure overlays in the areas of abrasion, punctures, cuts (elbow, knee, shoulder overlays, etc.). Shoulder straps, half-belts, self-belts, etc. are used to ensure the fitting of the rescuers` clothes. To prevent hitching with moving mechanisms, the details of the clothes should not extend beyond the garment [14].

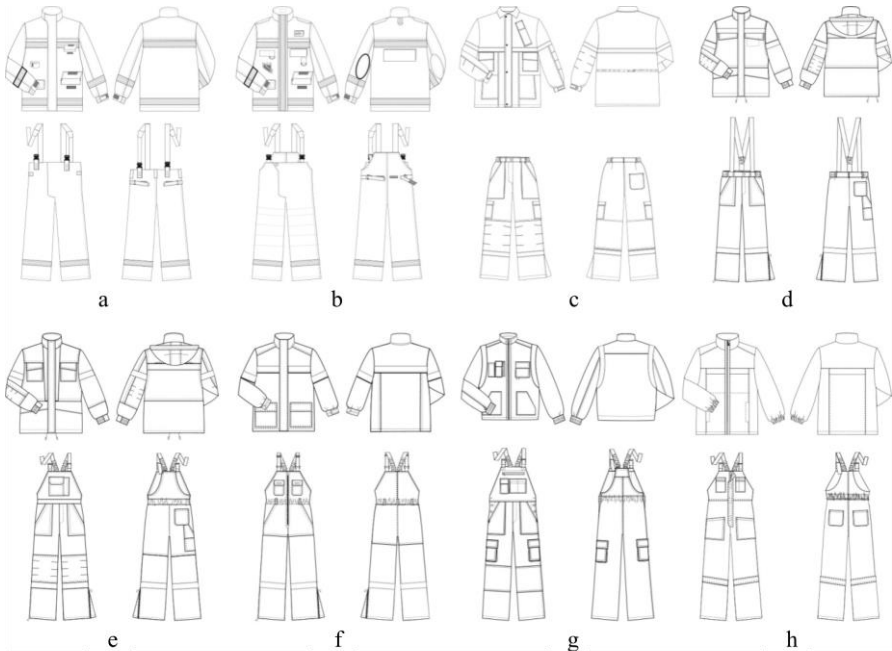


Fig. 2. The appearance of existing types of rescuers` protective suits

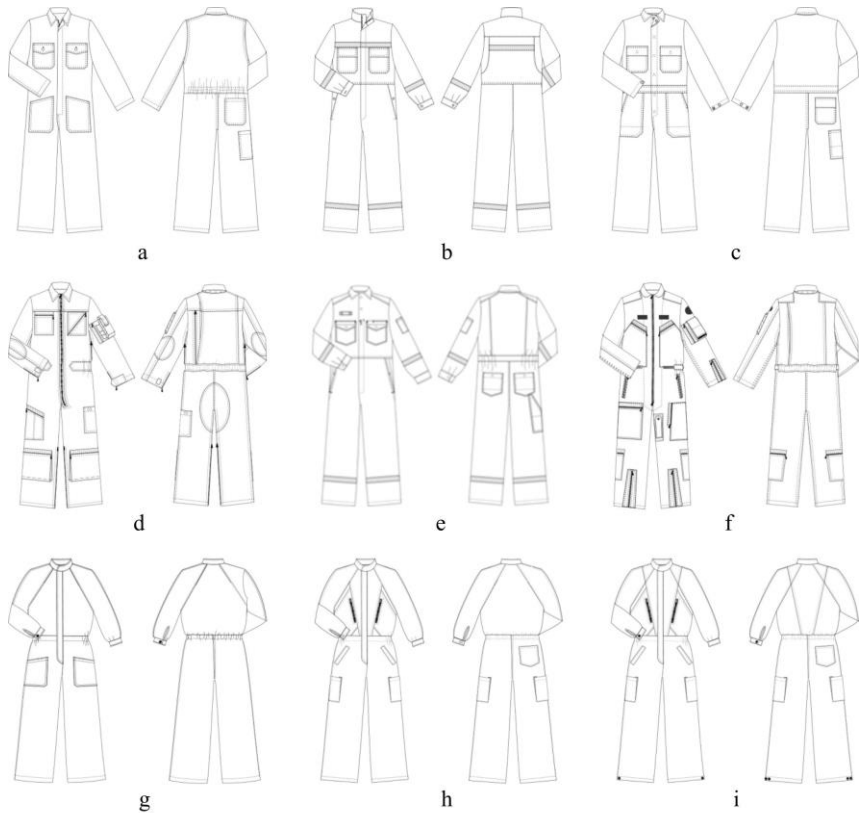


Fig. 3. The appearance of existing types of rescuer's protective overalls

At present, the design of protective clothes is made on a basic-modular basis, i.e. a basic product with specified properties is created. The design is performed on the basic design of this type of clothing of the same group, with the subsequent unification, modification of details and components.

The reliability of the design of protective clothes is ensured, among other things, by the reliability of its elements. That is why the theoretically grounded selection of structural elements, their sizes, and shapes ensures the compliance of the proposed clothes with the requirements.

The clothes should insulate a person from negative external factors as much as possible. For the convenience of use of clothes according to characteristic movements and poses, it is necessary to use an anatomical cut, to compensate dynamic outsizes by designing additional tucks, gores,

and considering the properties of the materials, etc. Depending on the works performed, the clothes must have necessary and enough pockets and other structural and decorative elements. For some types of works, special pockets are designed, such as a pocket for tools, a telephone or a portable radio set, a knife, etc.

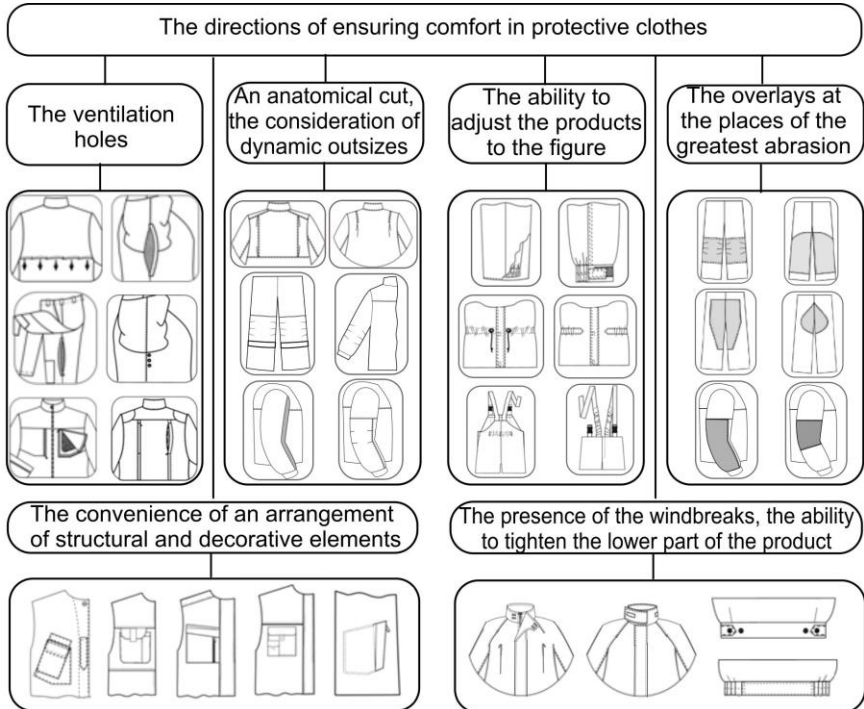


Fig. 4. The main directions of ensuring the comfort of the workers in protective clothes

The design of the clothes must ensure their simplest and most correct dressing and removal. The fitting of protective clothes is ensured by various details with the means of size adjustment. To improve the heat exchange in the back, torso areas, etc., the ventilation holes are designed. To increase the useful lifetime, the overlays in the places of the greatest abrasion are designed. To improve the thermal insulation properties, the windbreaks and ruffles that are adjustable at the cuff and lower parts are used in the design of protective clothes. Fig. 4 presents the systematization of the elements of protective clothes by the areas that ensure a comfortable stay of workers in protective clothes under the influence of various hazards [15].

When designing protective clothes, it is important to choose a rational design and technological solutions to ensure the basic functions of protective clothes.

The designing of protective clothing for emergency and rescue operations that will meet the imposed but often contradictory requirements is a complex and responsible task. The staff involved in fire-fighting operations and eliminating their consequences on an aircraft must be provided with protective clothes and other personal protective equipment [16-21].

The prerequisite for the design-projecting of protective clothes for rescuers is a methodological approach to its information support, based on the study of dangerous and harmful factors and the topography of their influence, the climatic conditions of the working environment, the completeness of products, the features of professional and qualification activities (Fig. 5).

In case of an emergency, the rescuers must use the entire set of clothing and personal protective equipment within a limited timeframe. Some products and their elements are worn during the entire work shift period.

Protective clothes are a complete or partial barrier between a person and an aggressive environment, so their design-projecting is performed only after the careful study of the working conditions, depending on which the type, completeness and seasonality are chosen, as well as a reasonable selection of materials, the properties of which must meet the protective, operational, and hygienic requirements. The clothes must meet a set of developed strict and contradictory requirements due to their functional purpose.

Protective clothes for rescuers must be all-season, consist of sufficient and necessary number of products of the set, each of which must have an ergonomic and aesthetic design and technological solutions: to provide a comfortable microclimate in an underclothing space, the maximum possible level of comfort; not to create difficulties in the performance of official duties; not to restrict movements, working positions or sensorial perception; not to cause movements dangerous for the crew or passengers; to ensure proper fitting and remain in the correct position during the whole period of use, regardless of the environment, movements and positions of the rescuer; to be serviceable with the possibility of replacing separate details; to have a design that ensures its fast and correct dressing.

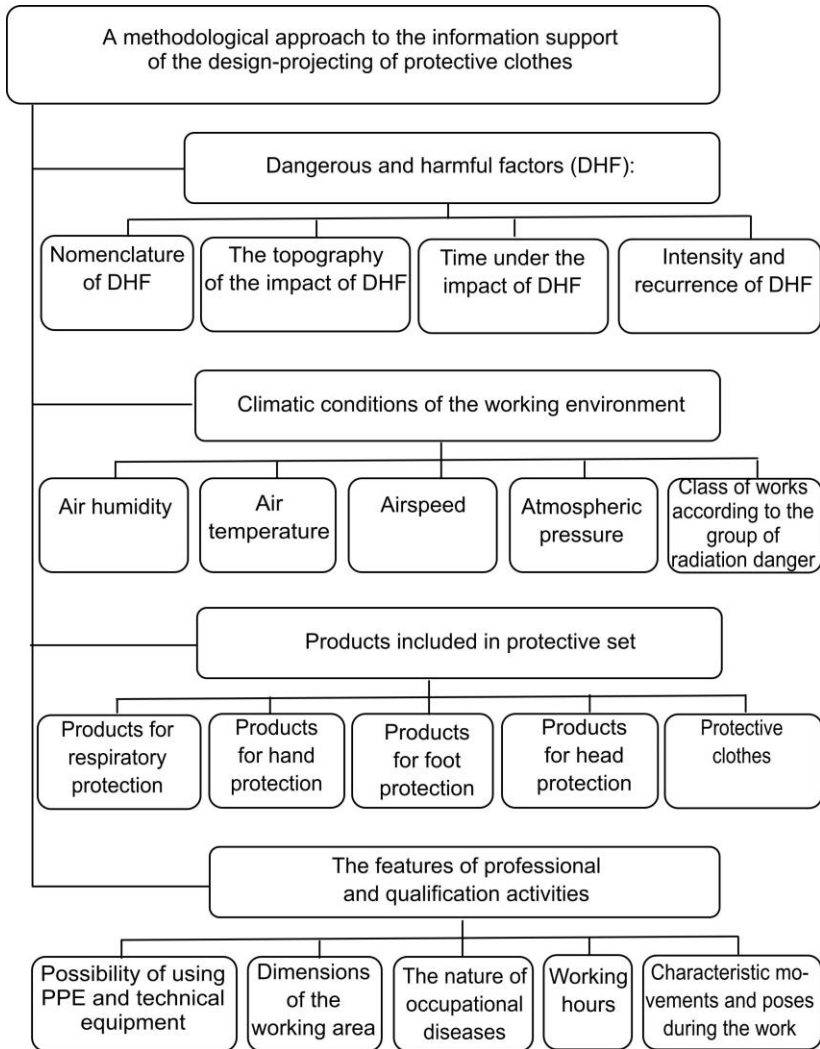


Fig. 5. The components of the methodological approach to the design-projecting of protective clothes for emergency and rescue operations

The quality of protective clothes depends on the properties of the package of materials that can meet the rescuers` specific needs in accordance with their purpose. Protective clothes for rescuers must meet

the indicators of protection, heat exchange, reliability, ergonomics, aesthetics, and be economically feasible.

The main component of design-projecting of new types of protective clothes for emergency and rescue operations is a development of design and technological solutions and a reasonable selection of materials with subsequent manufacture of the products [22-24].

The design and technological solutions of protective clothes, the materials from which they are made, as well as the components and accessories used for their manufacture must meet the requirements of current regulations. Protective clothes, the upper material, the inner liner of the helmet, as well as the rescuer's underwear are subject to mandatory certification and must have a sanitary-epidemiological conclusion on their compliance with applicable regulations. Therefore, the rescuers' clothes must have an ergonomic design to ensure the maximum possible dynamic compliance and be made for two levels of protection – for localization of emergencies and elimination of their consequences.

At high external heat loads, the inner surface of protective clothes and the underclothing space overheat first. During the long-term works with a high load, the human body can overheat, but the temperature in the underclothing space should not exceed a critical value of 45 °C.

During the development of the new type of protective clothes, the range of ambient temperatures is taken from minus 20 °C (during the works in winter) to 400 °C in the immediate accident area. The principle of local protection is offered considering the specificity of the influence of various harmful production factors on the separate area of the rescuer's body. The surface of the human body is divided into zones taking into account the most vulnerable organs and tissues, and spatial orientation during the fire-fighting operations, which makes it possible to justify the requirements for zonal protection of the organism. The results of the analysis have shown that the extreme temperature in the underclothing space (around 50...55 °C) is reached most rapidly in the head, groin, and chest areas. Based on the results of field and laboratory tests, the four areas of the firefighter's body are identified: head, torso (back, chest), feet, and hands, which require a priority level of protection.

Therefore, protective clothes for rescuers must have a regulated period of use and storage, be constantly checked for suitability and repair, or refusal to use if necessary.

In the design process, the most important function of the clothes is a protective one. The development of protective clothes for rescuers should consider the changing parameters of the environment, the nature of the works, the worker's anthropometric parameters, the properties of the materials used, the peculiarities of forming a package of the clothing materials under a given influence of the set of factors, etc.

The main purpose of protective clothes is to ensure the proper degree of protection of the human body from various environmental factors while keeping a normal functional state and performance efficiency.

One of the conditions for the creation of modern protective clothes of high quality that will meet the consumers` demands is to improve the quality of its design. Insufficient consideration of human morphological features (anthropometric and biomechanical characteristics, power capabilities, the sensitivity of analyzers, features of heat and moisture exchange with the environment, etc.) when designing protective clothes can lead to the creation of products with non-ergonomic, irrational design, the use of which will increase the loss of physical, thermal, nervous and emotional energy [25-28].

Therefore, a lot of requirements are based on the methodological approach to the designing of protective clothes for rescuers; such requirements consider the analysis of the working conditions, specifics of climatic conditions of the working area, features of accidents and catastrophes and works on their localization and elimination, recurrence of dangerous harmful factors and topography of their impact on the clothes (Fig. 6).

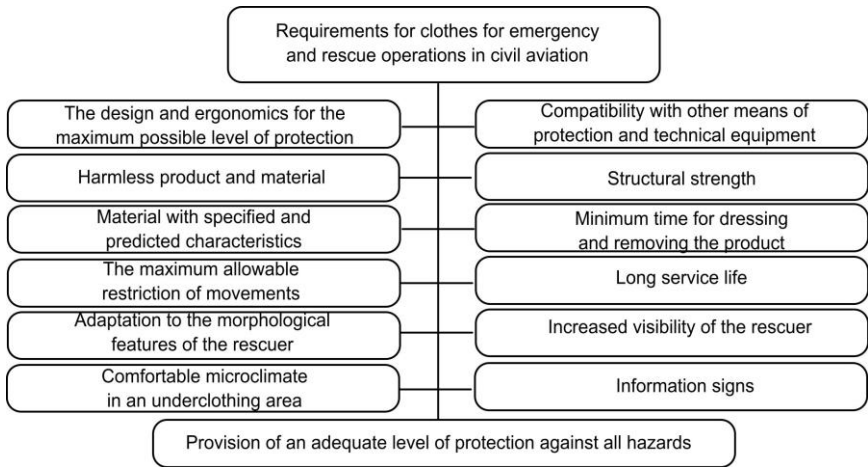


Fig. 6. The classification of the basic requirements for protective clothes for emergency and rescue operations in aviation

The convenience and time necessary to put on protective clothes are important for the design, as the work requires the rescuer to put on a complete set of equipment in 40 seconds or faster.

To ensure the maximum possible level of protection, the clothes for emergency and rescue operations must have an ergonomic design. The

conformity of the design of the clothes for emergency and rescue operations with the shape and size of the rescuer's body is also important, provided that it is manufactured for a conditionally typical figure.

The comfortable microclimate of the underclothing space in the clothes for emergency and rescue operations should be ensured with the ventilation holes, which are in the areas of greatest sweating (in armpits, in step seams, in the seams of the back yoke, etc.). To reduce the sweating while ensuring a normal microclimate in the underclothing space, protective clothes should, if possible, be adequately ventilated.

The extension of the useful lifetime of a product is provided by the additional overlays in the places of the greatest abrasion (for example, elbow, shoulder, knee overlays).

The information about the profession and position of the rescuer in protective clothes is placed on the shoulder straps, emblems, and other elements that are located on the shoulders, sleeves, fronts, and back, etc.

Signal and reflective elements can provide the ability to find the worker quickly in the conditions of limited visibility (smoke, poor lighting, etc.), as well as a good aesthetic perception.

The materials from which protective clothes are made should not ignite spontaneously, flare, support the combustion, or melt; they should not have through holes.

It is also important to consider the aesthetics of protective clothes, namely the color combination and proportionality since the rescuers work with passengers who are in an unstable psychoemotional state due to the emergency.

The fulfillment of all the requirements for the design, technology, and materials will contribute to the creation of modern and effective protective clothes for emergency and rescue operations.

Therefore, the basic requirements for protective clothes and the materials are formulated, which is a prerequisite for the development of nomenclature of mandatory and recommended quality indicators.

The rescuers are provided with protective clothes made from fire-resistant materials for 48 months in accordance with the allowances for clothing and personal protective equipment for aviation workers [16]. However, in accordance with international mandatory norms (ICAO requirements), the use of unusable clothes is not allowed; so, it is repaired when it is appropriate, or replaced by a new set of clothes. The workers inspect the clothes by themselves before every shift, and every 12 months this is done by a special commission. It is allowed to use the clothes, the shelf life of which does not exceed 10 years from the date of manufacture.

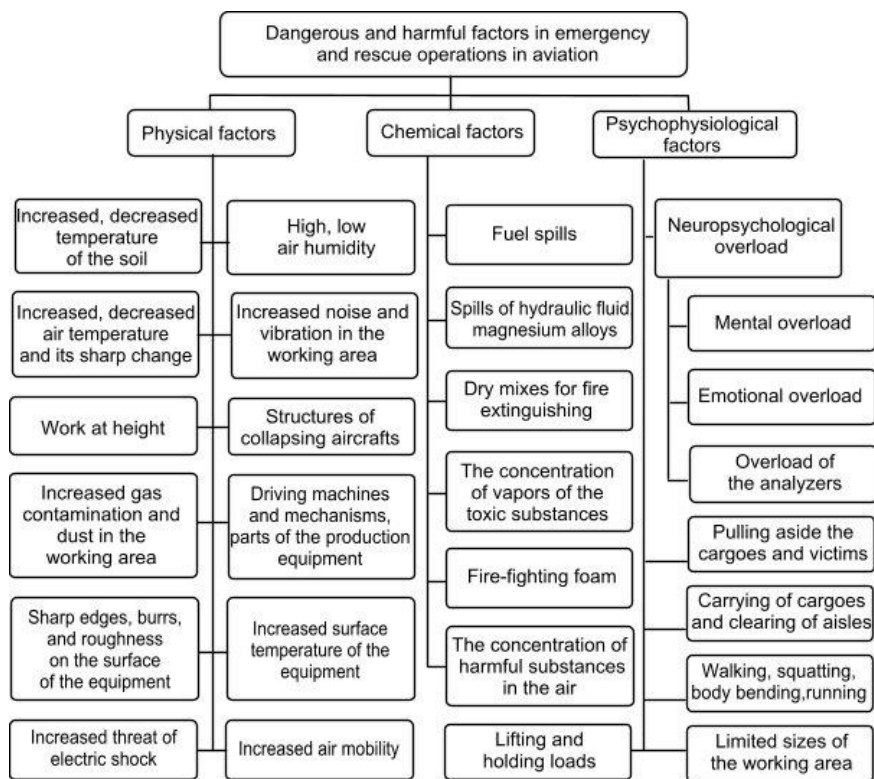


Fig. 7. The nomenclature of dangerous and harmful factors affecting the rescuers in aviation

Protective clothes for rescuers differ significantly from the uniform of the firefighters; such clothes are used throughout the firefighting process, as well as during the training. They are designed to protect rescuers from heat radiation, fire, injuries, etc. There are a lot of strict requirements for the rescuers' protective clothes, both for the materials from which it is made and for the design solution.

The clothes for emergency and rescue operations are a complex multifunctional object that must consider the working conditions and meet the requirements for reliability, ergonomics, and quality of garments. To perform emergency and rescue operations, it is necessary to use personal protective equipment for organs of sight, hearing and breathing, hands, feet, skin in the creation of a protective system. Even under normal production conditions, the appropriate protective clothes and additional personal protective equipment (for hands, feet, organs of hearing, and

breathing) should always be available to rescuers, providing the necessary short-term protection during emergencies [29].

The characteristics of personal protective equipment used by the rescuers in Ukraine are analyzed, and it is identified that the main reason for non-compliance of protective clothes with the working conditions is the low level of physical, mechanical, and hygienic characteristics of materials used, as well as the components for their manufacture. Such non-conformity is especially evident when protective clothes are affected by high temperatures and concentrated chemicals. The current norms of the provision of emergency and rescue teams [16], in contrast to European practice, do not include the special underwear; rescuers wear protective clothes over the daily standard form labeled "rescuer" on the chest. The form is blue and made of mixed fabric: (60...70) % is polyester and (30...40) % is cotton or wool, respectively.

In addition to the effects of high temperatures, the rescuers are affected by a lot of dangerous and harmful factors (DHF) when performing their duties (Fig. 7). The rescuers' working conditions are determined by a set of factors of working environment that affect human health and the ability to work.

The systematization of the groups of factors (physical, chemical, and psychophysiological) is based on the nature of their impact on humans:

- increased, decreased temperature of the working area – after extinguishing the open flame, the rescuers begin to perform their professional duties, while the temperature in the working area is still high;
- increased, decreased temperature of the soil in the working area, accordingly, remains increased as well;
- high thermal action is a heat that comes out of a damaged aircraft or its wreckage after a fire is extinguished;
- high, low air humidity – the extinguishing the fire by surface-active agents or other extinguishing agents leads to an increase in humidity in the working area (the primary task of extinguishing the fire is to reduce the temperature and density of smoke in the cabin by spraying jets with high-crushing drops; at the same time, it is necessary to ensure quick opening of emergence exits, to extricate the fuselage in the predetermined places to ensure the maximum speed of evacuation of passengers and crew members from the cabin);
- increased gas contamination, dust in the working area, as almost all fires are accompanied by combustion of substances with the release of toxic smoke;
- increased surface temperature of the equipment, including the hull of the aircraft, its parts and wreckage after the crash, personal belongings, and objects in the aircraft, etc. (depending on the location, aircraft fires are divided into: chassis fires, engine unit fires, spilled fuel, cabin fires; chassis fires most often occur when landing and are mainly related to the

combustion of the materials such as hydraulic fluids, rubber, and magnesium alloys; the combustion of hydraulic fluid due to the destruction of chassis hydraulic system is one of the most common fires; getting into the brake drum, heated to a high temperature (300 – 600 °C), the hydraulic fluid breaks into flames that leads to the ignition of tires of wheels; the high temperature of the fire leads to the ignition of magnesium alloys of the drums of the chassis wheels and occurs in 6-8 minutes after the start of the fire; a characteristic feature of the burning of magnesium alloys is the presence of splashes of burning metal, white glow of flame and the appearance of white dense smoke, such a fire leads to an explosion of shock absorbers of the landing gear unit and spreads to the wing or fuselage of the aircraft, depending on the type of chassis; the probability of explosion of tires, armor landing gear units and hydraulic accumulators must be taken into account during the firefighting operations, because the explosion may lead to their scattering for 100-150 m);

- structures of collapsing aircraft;
- increased noise in the working area after the burning and destruction of structures of aircraft or buildings damaged in the plane crash, the screams of people, the sirens of fire engines, ambulances, etc.;
- driving machines and mechanisms (fire engines, ladders on fire engines, fire hoses, etc.);
- moving parts of production equipment, ladders on fire engines, fire hoses, etc.;
- sharp edges, burrs, and roughness on the surface of the equipment, parts of the aircraft structure, its wreckage, fragments of passengers` luggage, other things from the aircraft;
- increased air mobility;
- the threat of electric shock.

Chemical factors include surface-active agents that were onboard or may be the part of the construction, or used in flight operations; fuel spills (up to 50 tons can be onboard), dry mixes, and fire-fighting foam; spills of hydraulic fluid, magnesium alloys, etc. A hard landing is often accompanied by a spill of fuel over a large area around the aircraft. Depending on the aircraft position on the ground, the nature of the destruction of its fuel tanks, and spill of the fuel around the aircraft, the fires are divided into double-type and one-type fires. The double-type fires of spilled fuel are the most dangerous and difficult in extinguishing and rescuing people.

The psychophysiological factors are divided into physical, namely, static, and dynamic overloads and neuropsychological overloads. The static overloads include lifting and holding the load. The dynamic overloads include carrying loads and walking, squatting, body bending, running, etc. The peculiarities of the rescuers` work are the performance of their professional duties and tasks in an aggressive environment together with danger to life and health, under the adverse effects of physical and

chemical factors, high “cost” of their activities, decisions taken, increased responsibility for saving people, material valuables, localization and liquidation of an emergency, in the lack of time for the analysis of information obtained, making the decision and performance of necessary actions, difficult dynamics of changes of functional states, high level of nervous and mental pressure, increased physical activities, possibilities of panic and fuss caused by both victims and strangers, dynamic changes in the environment, emergencies, etc. [16].

Therefore, the working conditions stipulate the increased demands not only on the health and physical training but also on the individual psychological make-up of the rescuers.

Analytical studies of the rescuers` working conditions allow developing the nature and recurrence of dangerous and harmful factors and the topography of their impact on protective clothes during the emergency and rescue operations (Fig. 8) [29].

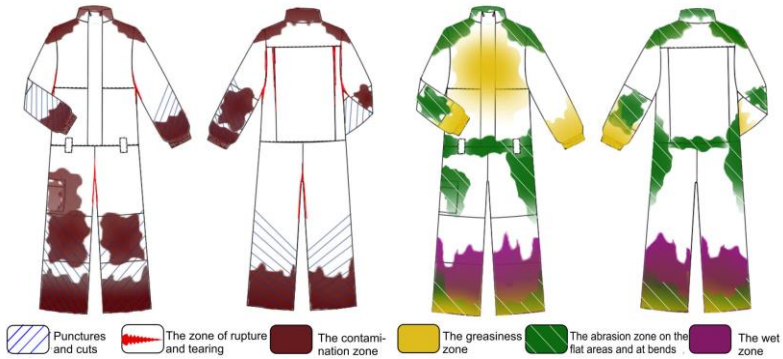


Fig. 8. The topography of the influence of dangerous and harmful factors during the emergency and rescue operations in aviation:

a – front view; b – back view

It should be noted that the rescuer in clothes is completely under the influence of the high temperature and dust, thus, it is not indicated on the topography. The topography of the influence of dangerous and harmful factors shows the following areas:

- the zone of punctures and cuts arising from the wreckage of metal and other aircraft structures or sharp objects that are onboard or around it;
- the zone of rupture and tearing, which is most often in the area of shoulder blades, armpits, leg seam, etc.;
- the contamination zone covers the area of the shoulder slope, neck, elbow and knee joints, the lower part of trousers and sleeves, the area around the pocket;

- the abrasion zone on the flat areas and at bends (due to the frictional force in the armpits, on the waist upon contact with special equipment and belts, in the pocket area, around the neck, in contact with the means of head protection, on the shoulder slope and along the lower part of trousers);

- the greasiness zone characterizes possible oiling by spilled substances that are on board or are a part of its design and mechanisms; the areas along the lower part of the sleeves and in front are the areas of the greatest contamination;

- the wet zone is in the shoulder slopes and along the lower part of trousers.

The consideration of the developed topography makes it possible to create the design of protective clothes that will provide maximum protection, ergonomics, and reliability of the product.

When designing clothes for emergency and rescue operations in aviation, it is necessary to consider a lot of factors, including thermal radiation, contact with heated surfaces, rapid heat flow, static current, etc. Ergonomic design is also important, as clothes should not curtail the movement, have ventilation holes for heat and steam, provide speed, ease of dressing and removing, have identification marks, and be combined with other personal protective equipment. The design of the clothes must be compatible with the protective equipment used by the rescuer during the work.

The selection of the optimal version of reliable, ergonomic, and compositionally perfect design of protective clothes is complicated by the variety of requirements.

The main purpose of protective clothes is to ensure reliable protection of the worker from various environmental factors while keeping normal functional condition and performance efficiency. Also, protective clothes must provide the necessary hygienic conditions during the work, normal thermoregulation of the body, be comfortable, light, not curtail the movement, be wet- and chemical-cleaned from dirt. Protective, operational, and hygienic properties of clothes primarily depend on the materials from which they are made, as well as on the design.

Different types of clothes are used in emergency and rescue operations, namely: jackets, trousers, bib overalls and overalls. Based on the survey conducted among the rescuers, it is found that just overalls meet the requirements to a high extend. This is because it takes less time to put it on, and considering the ergonomic component, it is more comfortable than a suit.

Although this product is not convenient in use, it provides greater protection due to the more closed body of the rescuer.

A prerequisite for the design of protective clothes is to consider all the requirements for clothes. It is known that utilitarian functions are the

basic functions of protective clothes, so the greatest attention is paid to them. Fig. 9 lists the elements, details, components of overalls that ensure its basic functions, and due to the introduction of which the protective, ergonomic, aesthetic, and reliability indicators will increase. It is important to remember that when designing protective clothes, each of the elements should be appropriate [30].

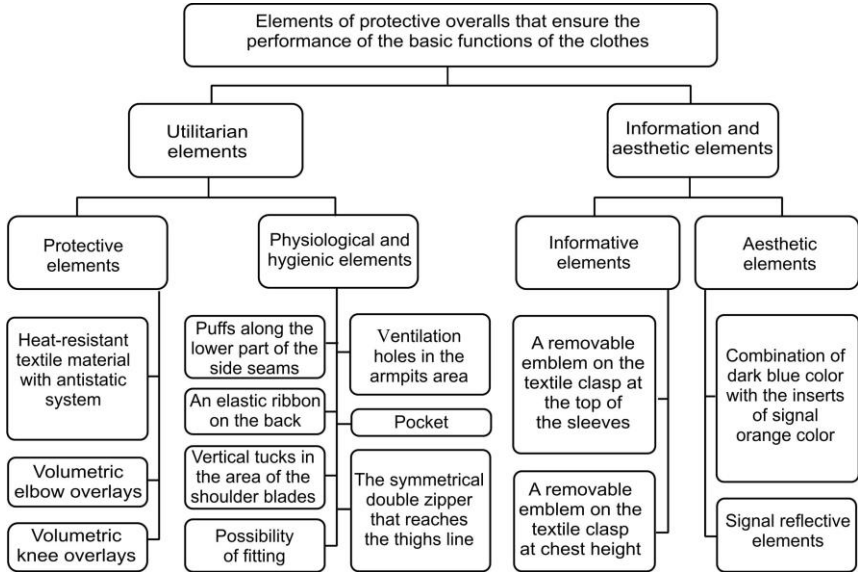


Fig. 9. The list of the elements of protective overalls designed to provide their basic functions

Aesthetic perception is also quite important for the rescuer's clothes. This is because during the performance of his professional activities he, in particular, has to come into contact with people who are in an unstable psycho-emotional state due to a plane crash. That is why the appearance of protective clothes should worsen neither this condition nor psychological trauma. Also, the harmonious color combination is important, which at the same time must include bright elements to recognize the rescuer in poor visibility.

When performing professional and qualification activities, the rescuer has to work in the conditions of limited visibility, for example, in high smoke. That is why protective overalls must have signal and reflective elements.

An important aspect for the design of the rescuer's protective clothes is to ensure a normal microclimate in the underclothing space. It is known that when the body overheats, the mechanisms of thermoregulation

increase heat transfer, which is carried out through the circulatory system through sweating. Therefore, to ensure the removal of excess heat and moisture from the underclothing space, the ventilation holes are made. The greatest moisture occurs in the armpits, therefore, the most effective is to place ventilation holes there. Also, there is a 20 cm long ventilation hole in the sleeve-side seam, which is closed with a zipper and a strapping that is cut as a one-piece. When opening the zipper, the hole is closed with a textile net.

The peculiarity of the rescuer's work is that he must put on a complete set of equipment in 40 seconds or faster, so the question of fast and convenient dressing is quite important. It also should be noted that the dressing of the overalls must be done without removing shoes. It is found that the central placement of the zipper is inconvenient and inefficient, that is why a new type of fastener is proposed, which consists of two symmetrically located zippers that reach the thighs line. Due to this, the overalls are fully open and do not restrict movements during dressing. For the convenience of dressing overalls in shoes, the width of the lower part of the trousers is increased and the presence of puffs in the side seams of the trousers on the zipper is provided. The puffs are made of signal orange fabric for visual control whether the fastener is closed or not.

The ergonomics of the overalls provide additional volume in elbow and knee joints. In these areas, volume overlays are more comfortable as they consider the dynamic increase when performing movements of the arms and legs and put less pressure on the joints. In their manufacture, the volume is achieved through the introduction of gores and tucks. The overalls also have an additional layer of fabric in the elbow and knee areas to extend the service life. When designing overalls, it is very important to ensure ergonomics during the forward inclination of the body. For this purpose, it is necessary to consider the dynamic addition to the length of the back, which is 6 – 9 cm. To compensate for this addition, a new design of the back of the overalls is developed, which has a vertically placed elastic ribbon. The back has a cutting yoke, in the stitching seam of which an elastic ribbon 250 mm wide is sewn, the lower edge of which is sewn to the upper part of the back half, with the possibility of simplified replacement of the elastic ribbon after the reduction of its deformation characteristics. For the convenience of the performance of movements by hands, two vertical tucks are placed in the area of the shoulder blades.

Provided that protective clothes are manufactured industrially for a conditionally typical figure, it is important to be able to adapt clothes to the morphological characteristics of the worker. Therefore, the rescuer's overalls provide several ways to adjust their width or length, and so on. Firstly, along the waistline, there are hooks and self-belt on the back, thus, it is possible to run the belt, including a special fire belt. Secondly, the lower part of the sleeve is decorated with a ruffle with an elastic ribbon and a half-

belt to adjust the width of the ruffle. Thirdly, to lower part of the trousers has half-belts to adjust the width of the lower part of the trousers.

Based on the analysis of operating conditions and assortment range of protective clothes for emergency and rescue operations, and the study of professional and qualification activities, a new design and ergonomic solutions of protective overalls is developed. Various structural elements that will meet the requirements for protective clothes are substantiated. Also, attention is paid to the new solutions of individual parts and components used for greater convenience in the performance of the duties by rescuers [6].

Based on the analysis of all initial data on the design-projecting of protective clothes, an assortment range of the products for emergency and rescue operations is presented, namely single-layer and multilayer overalls with different levels of protection.

1. Single-layer overalls for the elimination of the consequences of emergencies

The selection of the design and technological solutions is based on the requirements for protective clothes and must consider the operating conditions. It is found that the use of overalls is the most effective for rescuers in aviation. Considering the professional and qualification activities of rescuers, it is rational to choose a straight silhouette and a sewn-on cut of the sleeve. The ergonomics of the overalls is achieved using additional overlays on the knee and elbow joints, ventilation holes, elastic ribbon on the back, central double fastener, straps, elastic ribbon along the lower part of sleeves, puffs along the lower part of trousers, and stand-up collar.

The design of the structure considers the analysis of information on accidents and catastrophes, intensity, the topography of dangerous and harmful factors, and the requirements for protective clothes for rescuers. It should also consider the properties of the material; for that reason, the experimental studies have been conducted.

The construction of the basic design of the overalls is made using the CAD system "Julivi" (AWS Design, Designer).

The design of the overalls must consider the requirement for minimum time for dressing. Given that the central fastener in the overalls is not ergonomic, two symmetrically located zippers that reach the thighs line are designed. Also, for the convenience of dressing and preventing the ingress of foreign substances into the underclothing space, an elastic ribbon is placed along the lower part of the sleeves, the width of the lower part of the trousers is increased, and the presence of puffs on the zipper is provided. With a constant forward inclination of the body, it is necessary to consider the dynamic addition to the length of the back. It is found that such addition is approximately 6 – 9 cm, therefore, the new design of the back with the use of the elastic ribbon is presented.

We should note that there are a lot of structural elements that can increase the functionality of the overalls, that is why it is advisable to choose the optimal amount of such elements as it significantly affects both the weight and the cost of the overalls. There is no need to add such additional elements as pockets, straps, etc. to the overalls. It is found that in the performance of their professional duties, the rescuers mainly use one pocket to keep protective gloves.

The design and technological solutions of protective overalls provide for:

- elastic ribbon, which is placed along the length of the back, and tucks in the shoulder blades area to increase ergonomics;
- two symmetrical zippers for easy dressing and removing;
- overlays in the knee and elbow joints to increase abrasion resistance;
- ventilation holes in the axillary area for a comfortable underclothing microclimate;
- seams with double grinding off for the increased durability of the design;
- elastic ribbon and straps along the lower part of sleeves for compatibility with gauntlets;
- widened pants, puffs, and straps along the lower part of trousers for the convenience of dressing overalls in shoes;
- patch pocket to keep the gloves;
- hooks along the waist to fasten the belt for adaptation to the rescuer's morphological features.

The overalls are cut at the waist, the upper part of the front has horizontal divisions, the back has a cutting yoke and vertical divisions; in the central part of the back, there is an elastic ribbon 250 mm wide, and two tucks in the area of the shoulder blades. The lower part of the overalls consists of the front and back halves of the trousers, which have overlays in the knee joints area. Along the lower part of trousers, there are puffs and straps. On the right half, at the level of the thighs, there is a patch pocket with a flap. The overalls are with sewn-on sleeves, the lower part of which is decorated with an elastic ribbon and straps. Overlays are located in the area of elbow joints. The overalls are fastened with two centrally placed zippers that reach the thighs line. The neck is decorated with a stand-up collar. At the waist, the hooks for the belt are located. On the front halves and on the upper part of the sleeve, there are textile clasps for fastening of information elements (chevrons). Also, 50 mm wide reflective strips are placed on the front half below the armhole line, on the back along the shoulder line and at the waistline, on the sleeves above the elbow and along the lower part of the trousers.

The designed and proposed design and ergonomic solutions of protective overalls for emergency and rescue operations in aviation in

compliance with all requirements are presented in Figure 10.

The development of the design of protective overalls is a complex and time-consuming process. The proposed protective clothes for emergency and rescue operations are ergonomic and maximally protect the body of the rescuer; such clothes are compatible with other personal protective equipment. A systematic approach is used to develop protective clothes.

Therefore, the proposed protective heat-resistant overalls differ from existing analogs, because the front half is made as cutting one at the waist and knee line, additionally equipped with a vertical insert that passes through the center of the front half to the knees and connected to it by two zippers, the back half is made as cutting one at the waistline and the line of the shoulder blades with a floating back attached to the back half along the line of the shoulder blades and containing two vertical tucks, made with the possibility of opening at 50 mm, and an elastic ribbon sewn along the cutting lines of the back half. The novelty of the proposed design is confirmed by the patent of Ukraine for a utility model [30].

2. Multi-layer protective overalls for localization and elimination of emergencies in aviation

A new design and ergonomic solutions for protective multi-layered overalls for emergency and rescue operations in aviation are developed and proposed (Fig. 11).

The rescuers' overalls are made of gray and red fabric, a heat-insulating layer, a lining fabric, and a grid, a split leather used for processing of the lower part of sleeves and trousers, and a membrane. Threads that are resistant to burning and high temperatures are used to connect the parts of the overalls. Heat-resistant zippers are used in the manufacture of overalls. The fastening of the information chevrons on the top of the sleeves and along the breast line, to the shoulder straps and along the lower part of trousers and sleeves is carried out using a fire-resistant textile clasp. Also, 50 mm wide reflective strips are provided for emergency and rescue operations in limited visibility. The overalls are thermal protective overalls with an evacuation loop containing sleeves and a stand-up collar, the front half cut along the waist line and the knee line, additionally equipped with a vertical insert passing through the center of the front half to the knees and connected to it by two zippers, the back half cut along the waistline and the line of the shoulder blades, with a floating back attached to the back half along the line of the shoulder blades and containing two vertical tucks, made with the possibility of opening at 50 mm, and an elastic ribbon sewn along the cutting lines of the back half; such overalls have heat-insulating and lining layers, a protective valve along the neckline on the back, the system of evacuation loop consisting of upper and lower loops located between the heat-insulating layer and the top material [31].

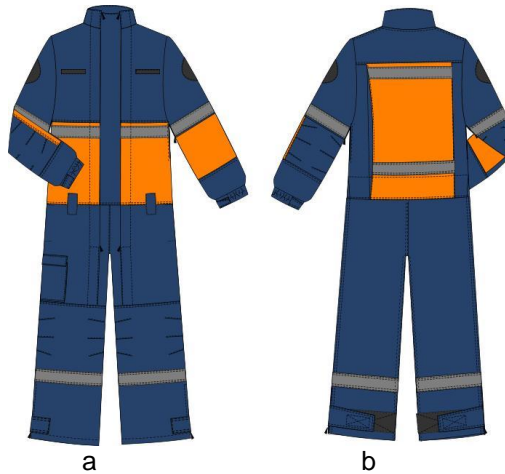


Fig. 10. The general appearance of protective overalls for the elimination of the consequences of accidents in aviation аварійних ситуацій в авіації:
a – front view, b – back view

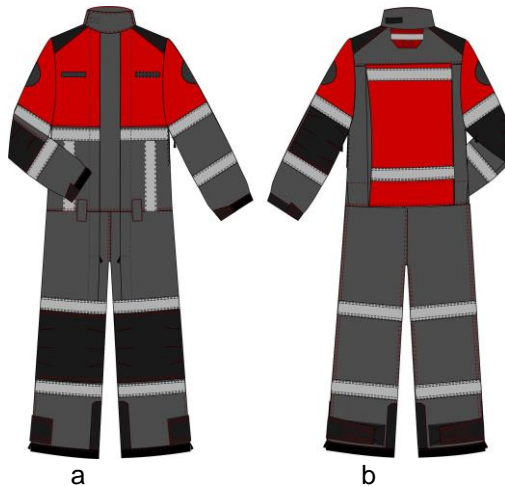


Fig. 11. The general appearance of the rescue overalls for localization of emergencies:
a – front view, b – back view

The proposed overalls have an additional thermal insulation layer and lining, which allow the rescuer to work in high temperatures and near

open flames. The overalls also have reinforcing shoulder overlays. The areas of the knee and elbow joints are reinforced with volumetric knee and elbow overlays; along the lower part of the sleeves and trousers, there are reinforcing overlays made of split leather. The front protective valve is in the chin area. At the back, on the yoke under the neck, there is a protective valve for the outer loop; under the valve, there are internal and external reinforcing overlays made of split leather aimed to increase the strength of the structure in the area where the evacuation loop comes out. In case of moisture entering the underclothing space, a membrane is placed along the lower part of the sleeves and trousers for unhampered removal of moisture from the underclothing space.

The reflective strips are placed on the trousers above and below the knee line, on the sleeves above and below the elbow line, on the back at the waistline and the shoulder line, on the front half along the armhole line and along the central part, along the protective valve that closes the outer evacuation loop. At the top of the sleeves and along the chest line, there is a textile clasp for fastening of chevrons. On the front half along the waistline, there are two hooks, and on the back half, there is a self-belt to run the belt.

The evacuation loop system is located between the heat-insulating layer and the front and back sides and consists of the upper and the lower loops (Fig. 12).

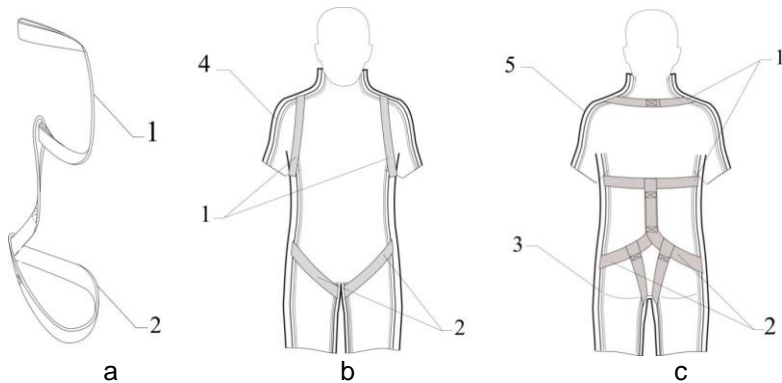


Fig. 12. The appearance of the evacuation loop system:

- a – side view; b – front view; c – back view; 1 – the upper loop; 2 – the lower loop; 3 – inner lining layer; 4 – heat-insulating layer; 5 – outer heat-resistant layer

During the performance of the duties, the rescuer may suffer injuries, including loss of consciousness, so the introduction of the evacuation loop

into the system provides an accelerated rescue of the incapacitated rescuer.

The execution of the evacuation loop in the form of two interconnected straps-loops, one of which covers the shoulders through the armpits, passing at the level of the shoulder blades through the opening of the other, which in turn covers the legs at the thighs area (in the perineum), provides reliable and fast pulling off the rescuer from the danger zone in case of loss of consciousness or injury (Fig. 13). The lower loop consists of a belt folded in half, forming a hole that is fixed by a threaded connection parallel to the line of the spine. The ends of the loop wrap around the loop itself, creating holes that are threaded together, thus forming additional loopholes to be dressed on the human figure. The holes provide an opportunity to adapt the system to the morphological features of the rescuer and be convenient during operation. The upper loop extends through the hole of the lower loop and extends through the holes of the yoke at the back of the overalls to the outside, thus forming an outer loop. The length of the evacuation loops includes overhangs for the operation of the evacuation system itself and comfort in use.

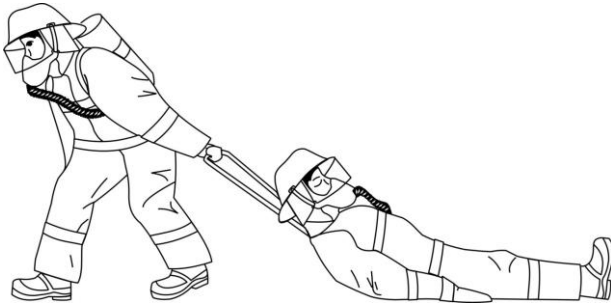


Fig. 13. The evacuation of the rescuer from the danger zone in case of loss of consciousness or injury

Therefore, the design and ergonomic solutions for protective overalls with different levels of protection are developed. The components of protective clothes for rescuers in aviation are systematized. The technological schemes of assembly and cross-sections of threaded connections of protective overalls for rescuers are presented. When developing the design solutions, the compatibility with personal protective equipment and technical equipment used by the rescuer during the performance of his professional and qualification duties is considered (Fig. 14).

The production of modern and effective protective clothes requires fundamentally new approaches to its design. In this connection, the

systems of computer-aided design of clothes (CAD Systems) become more and more widespread. Their use allows to significantly reduce the time for the development and the number of tools used, while increasing the accuracy of design, reducing the material costs and processing time by optimizing the work by using personal computers (Fig. 15).

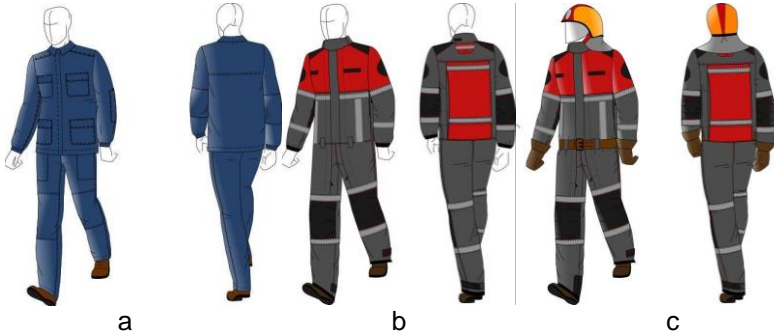


Fig. 14. The sequence of dressing a set of clothes for emergency and rescue operations:

- a – working clothes; b – protective overalls without equipment;
- c – protective overalls with equipment

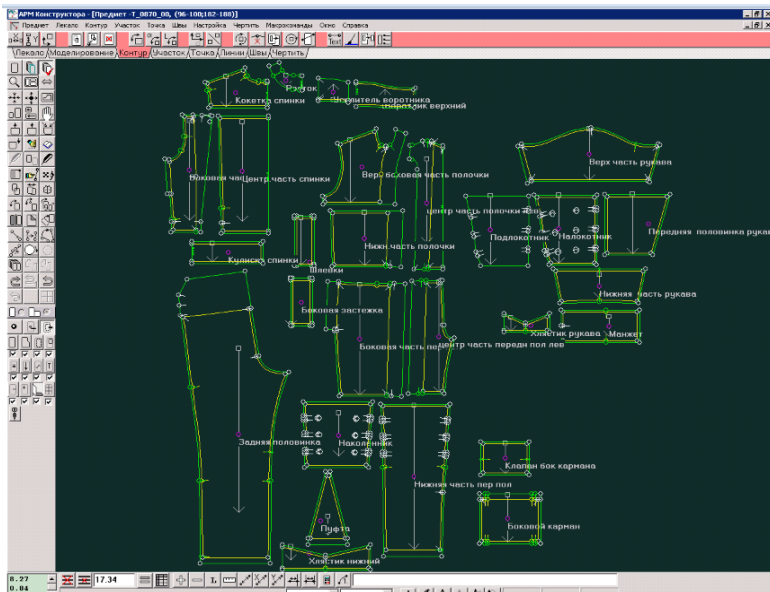


Fig. 15. The processing of patterns of overalls design in the CAD subsystem “Julivi” (AWS Designer)

Conclusions. The actual scientific and technical task on the creation of effective and modern protective clothes with predicted indicators of reliability, ergonomics, and aesthetics for emergency and rescue operations in aviation based on theoretical and experimental research is solved in the work. The analysis of professional and qualification activities of rescuers gave the basis to define the nomenclature of dangerous and harmful factors and the topography of their impact on the clothes, as well as to develop requirements for the rescuers` protective clothes and to the materials used for their manufacture.

The automation of design-projecting of protective overalls for emergency and rescue operations with different levels of protection has ensured the high accuracy and quality of development.

The varieties of design and decorative decisions for the introduction of the rational elements into the design and technological solutions of protective clothes that would provide a proper degree of the worker`s protection against the certain dangers have been systematized. The design and technological solutions of protective overalls with different levels of protection for localization, elimination of emergencies, and their consequences have been developed. The design of the overalls is made in the CAD subsystem “Julivi”, which provides high accuracy of design and ease of manufacture in terms of mass production. Also, the assortment range of clothes for rescuers with different levels of protection has been developed.

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2.3. CLOTHING DESIGN FOR CORPORATIONS: AESTHETIC AND ERGONOMIC ASPECTS

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Abstract: *The work is devoted to solving the scientific and technical issue of improving the design and design planning of ergonomic uniform for car attendants of railway transport with the predictable reliability indicators by harmonizing the shape and establishing the unity of ergonomic and aesthetic properties. Theoretical bases have been developed, and the methods of estimating reliability of uniform have been improved. The methods and techniques of harmonization of the “employee – uniform – production environment” system have been systematized in accordance with the properties of materials and peculiarities of design planning of the range of uniform. A theoretical model for searching new forms and variability of the range of uniform have been developed on the basis of analytical methods to build regular links between its parameters in the anthropomorphic space of geometric similarity.*

Key words: *design planning, uniform for car attendants of railway transport, harmonious proportioning, clothing design methods.*

Introduction. The modern uniform for railway employees is a complex object that performs various functions. In the conditions of constant development of technologies, increase of the scope of rendered services, the special attention is paid to ergonomic and aesthetic aspect of quality and reliability of clothing. One of the main requirements for design planning of the uniform and a decisive factor in choosing its design parameters is to ensure harmony and dynamic compliance. Achievement of maximum comfort and aesthetics of products remains important, and development of such clothing is one of the top priorities.

In the conditions of constant development of technologies, increase of the scope of rendered services the PJSC “Ukrzaliznytsia” takes care of building its image, the component of which is a uniform – a significant element of the corporate style of the employees and company as a whole. In these circumstances, the special attention is paid to the ergonomic and aesthetic aspect of the quality and reliability of clothing. M.V. Kolosnichenko, N. V. Ostapenko, O.M. Troian, L.D. Tretiakova are the scientists in the field of design and ergonomic design planning of special-purpose clothing who made a significant contribution to the study of this issue.

Statement of the problem. The aim of research is to improve the design planning process and create aesthetic and ergonomic uniform for car attendants with high reliability indicators by harmonizing its shape and

design and technological solutions in the “employee – uniform – production environment” system.

Results of the research and their discussion. The general methodology of the system approach to design planning of clothing, project and typological approach to design planning of complex objects is used for solving the set tasks in the work. The theoretical and methodological basis is the theory of reliability, the main provisions of projective ergonomics; methods and means of ergonomic biomechanics, including dynamic anthropometry; method of functional analogies; expert evaluation method and method of mathematical statistics for processing measurement results. The experimental researches to determine quality indicators have been conducted according to the standard methods. The test results have been processed, using such software products as Microsoft Excel and MathCad.

When developing design objects for industrial production, the external form and composition are arranged in such a way that the function of the industrial product is clearly and concisely traced. Simultaneously all elements have to be in close semantic volume and spacial, textural and colour relations. Ease of use, ergonomics and aesthetics are the most important criteria of compositional integrity and forms of industrial products, which include the types of uniform for car attendants. That is why the study of patterns of construction and harmonization of the “employee – uniform – production environment” system from the standpoint of structural and compositional integrity and artistic and informative expressiveness are relevant and prospective.

It is known that the composition in the design is creation of an image of an industrial product by arranging its main elements in a certain system and sequence; it is purposeful distribution and combination of weight, shape, lines, colour and light [1, 2, 6]. Compositionally, the shape of the suit should be organized so that it gives the impression of an indivisible whole. In this case, the concept of harmony is important in the theory of composition. If we consider the harmony of functional and aesthetic integrity of the subject, the composition can be represented as a synthesis of principles and patterns: symmetry and asymmetry, rhythm, scale of the object, proportionality, unity of the composition, etc. [3-7]. Ergonomic requirements in the design of uniform have always been given due attention, but the creation of varieties by dimensional and modular harmonization of form by design methods remains studied insufficiently. Tasks are complicated by the multicriteria of parameters that are simultaneously applied to the uniform. At the same time, uniform should achieve colour and compositional harmonization of graphic elements by selecting harmonious colour ratios, meet style-forming factors (features, characteristics and properties that consistently determine them, characteristic figurative features, etc.) and be effective according to the

conceptual model of the activity in the “employee – uniform – production environment” system [8-10].

It is known that the style of clothing is a set of details, elements or accents that together create an individual image. Uniform, especially departmental, is characterized by a classic style which is appropriate for all situations and age categories. It is characterized by severity and conciseness, conservatism, high quality materials and technological peculiarities of manufacture, absence of superfluous details and bright decor. The set of the uniform for car attendants consists of suit jackets, jackets, trousers, skirts, shirts, blouses of different silhouettes and lengths, usually a solid restrained colour. All this is complemented by inconspicuous makeup, neat hairstyle and harmonious accessories. However, the process of improving the uniform for car attendants needs to be radically changed: it must begin with the development of a proportional structure and external form, what became the subject of our further research.

The constituent elements of uniform should coexist harmoniously as a holistic artistic image. When creating a suit, all the elements that make it up must be justified. Anything superfluous or something that does not express the idea well enough should be discarded. Different elements of the uniform, their combinations due to visual features, associations, imperfect design and manufacture create inconvenience in operation and a negative image of the suit as a whole. It should also be borne in mind that mechanical combinations, connections of elements of the form of clothing are not a priority, as socio-ideological factors often change the view of the whole composition, which seems to be properly organized. Therefore, the use of methods of artistic design is one of the ways to improve the quality in creating varieties of aesthetically attractive departmental clothing. In industrial art, the imagery of the shape of products is understood as its greatest conformity to the function, as well as artistic expressiveness, tectonics and informativeness of newly created forms. Therefore, in industrial art, the beauty and functional perfection of a technical object do not contradict and are harmoniously synthesized. And the composition in creating products is formed by search of new, most perfect forms taking into account the existing forms in this production field what is justified by practice of traditions and progressive tendencies of form creation. Thus, the artistic harmony of the uniform for car attendants, first of all, is determined by compliance with the functional purpose, as well as design and ergonomic requirements for it.

The analysis of the existing types of departmental uniform for car attendants of the PJSC “Ukrzaliznytsia” proved that the possibilities of complex ergonomic design were not taken into account to a sufficient extent: the problem of providing aesthetic and ergonomic indicators (artistic and informative expressiveness, compositional integrity, rationality of form, etc.) is not solved, moreover there is insufficient compliance with utilitarian

function, perfection of industrial performance, stability of marketable state, etc. This discrepancy is due to the lack of equilibrium and balance of this form which leads to a lack of compositional integrity of the corresponding design-object. Therefore, the factors of equilibrium of the composition are the proportions, size, scale, rhythm, statics – dynamics, symmetry – asymmetry, contrast – nuance, colour harmony, direction and location of division lines. Thus, the main means of composition in the formation of design objects are proportions which became the subject of our further research. It is also shown that the existing uniform includes the elements of the classical style (double-breasted clasp, length of the product, silhouette), which need improvement, as the disadvantage is the lack of elements that should ensure its ergonomics. That is why development of the uniform requires consideration of the requirements of ergonomic design, the components of which are justified and harmoniously combined into a coherent artistic and design image. The combination of different elements of the uniform – folds on the back in men's and women's shoulder items of clothing, pates on the sleeves in a blouse and shirt, figured bottom of shoulder items of clothing, finishing stitches, a combination of different materials – creates ease of use and a positive image in general.

To solve this problem, rational structural and compositional solutions have been chosen, which are used in the design of men's and women's uniform [6, 7]. The peculiarities of the constructive solution were the introduction of additional elements that do not fully meet the requirements of the classics, but give such a clothing more ergonomics and novelty. Thus, for the design and ergonomic design planning of the uniform for car attendants, the elements of the “casual” style (subtype “business-casual”) have been chosen, this style is harmoniously combined with the classic and is characterized by a combination of classics and democracy. The main feature of this style is that it gives many different combinations in clothing. This style is so popular also because it suits absolutely all men and women of different ages, body types, any professions. Various fabrics were used in sewing the suits, including the ones made of stretching fabrics and of various fibre composition, the suits have free combinations and colours. Business “casual” allows to unbutton a shirt at the top, no tie, non-classic details (figured pockets, double finishing stitch, various structural and decorative elements, etc.). The conceptual basis of clothing in creating a range of uniform for car attendants was the combination of styles, what allowed to harmoniously combine the details of the design according to the functional purpose, as well as to give an attractive and modern look to the suit as a whole. The purpose of development is a practical, reliable, ergonomic product of high composite quality (integrity of form), which provides comfort in use. Thus, the harmony of form is achieved by the consistency of compositional contradictions between different geometric (line) and physical (colour, weight, texture) characteristics.

The integrity of the form is achieved by selecting the physical and geometric characteristics of the parts of the composition due to which it is perceived as a single natural organism. The mismatch of the elements of the form based on the same features (proportions, texture, colour) leads to a violation of integrity. Integrity also implies the unity of structure and tectonics. Also, we should note that the laws of scale, proportionality, contrast operate in the composition of artistic and design products. Thus, the law of scale implies the availability of the same forms in different sizes according to the functional requirements; the law of proportionality – intuitive or conscious organization of techniques of planar and volume and spacial formation on the basis of multiple and simple proportional quantities; the law of contrast – the availability of a clearly defined opposite of the relevant properties of the object, state, action, etc. And, the main factor is to understand the essence of designing functionally appropriate, technically sound, economically justified and aesthetically expressive products, which together constitute the optimal object environment of human life. We paid special attention to the study of the operational properties of the uniform. All this together acts as the ultimate goal of creating a product and meets the criteria for consumer evaluation of its quality.

The creation of the external form of clothing at the stage of designing an expressive artistic image is now becoming more important, because clothing is the most informative factor in the visual perception of a man. Interpenetration of cultures, the emergence of new production technologies, the need for more complete learning of modern technologies in the field of design and production of clothing, accelerating changes in fashion trends require scientific developments in the field of artistic clothing design. In design planning of the uniform, the modern style trends and fashion have been taken into account; it allows to make the designed clothes modern and ergonomic. Also, in design planning of clothing, much attention is paid to design development methods.

Stages of design and ergonomic design planning run simultaneously with the engineering ones; they begin before preparation of technical design specification and end with bringing research prototype to production. At the same time, the analysis of fashionable stylistic trends involves the use of the latest technologies and materials (textures, colours) to achieve a certain imaging. The main relevant aspects of design planning have been identified for forming the features and specifics of artistic design of the uniform; the possibilities of the methodology of artistic design of the uniform on the basis of complex consideration of various factors of natural and social environment have been investigated; the main functions and factors of formation of the ranges of the uniform have been determined; the general patterns of compositional and coloristic solutions of the sets of the uniform have been established. That is why, the theoretical basis of our

research is the systematization of means of figurative expression of clothing, its classification in order to establish the patterns of influence of clothing on the formation of the aesthetic ideal. Creation of comfortable uniform for car attendants implies taking into account the functional, ergonomic, aesthetic components, what necessitates the research of the principles of creation of structure of emotional and informative artistic image, the relations between them. At the same time, the uniform should correspond to the utilitarian function and the environment of functioning: to combine functionality, beauty, information content. Let's consider the integrative figurative content of the uniform as a structuring of its individual figurative qualities – informational and emotional, culturological, compositional and functional. Thus, when considering colour as one of many structural and compositional factors influencing on formation of the image, we can assume different nuances of development of expressiveness of a particular form of the design object. The colour in the suit is not subject to analysis as an abstract property and means. It actively works on perception, filling the form, and the way of filling with colour of a particular silhouette form is important. The line, which can fill a suit with a specific associative figurative quality, adding a feeling of broken shape, awkwardness or smoothness and straightforwardness, also adds an emotional load. Thus, considering the individual means of composition of the suit, formally distinguish its separate means – an element: its structure, components, the impact on the integrity. Achieving the maximum effect of artistic expression and informativeness is possible only in an integrated approach to all means of artistic expression of the suit.

The proportionality of the parts of the uniform for car attendants leaves a large field of activity to designers-developers of clothing. If one takes as a basis the thesis that the concept of proportion means proportionality, a certain ratio of parts, details, and that its correct establishment in its unity is proportional and harmonious, violation of proportion reduces artistic expression, and when used to departmental clothing for car attendants, it violates the composition of the costume and attractiveness of the person who works in it. The latter thesis affects the social and psychological component of the company's clothing, harming its image. That is why one of the main factors in harmonization of artistic forms of clothing should be its compliance with the content, practical purpose and functionality, as well as materials and design and technological feasibility when developing its range.

The composition analysis of the design feature of the uniform for car attendants proved its disproportion, which creates inconvenience in operation. Thus, below we would like to determine the proportional correlations of the parts and divisions of the compositional and structure patterns of the existing sets of men's and women's uniform for car attendants (Fig. 1, Fig. 2).

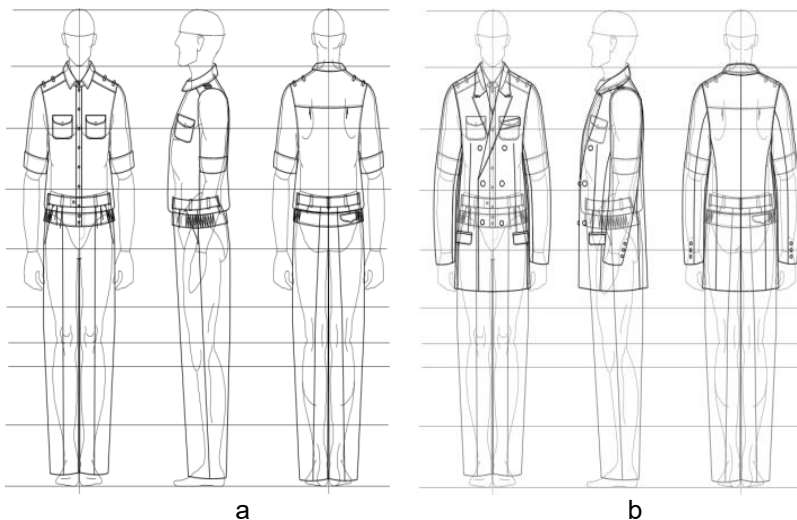


Fig. 1. Proportional patterns of the existing sets of men's uniform (front, side, back view):
 a – shirt, trousers, b – suit jacket, shirt, trousers

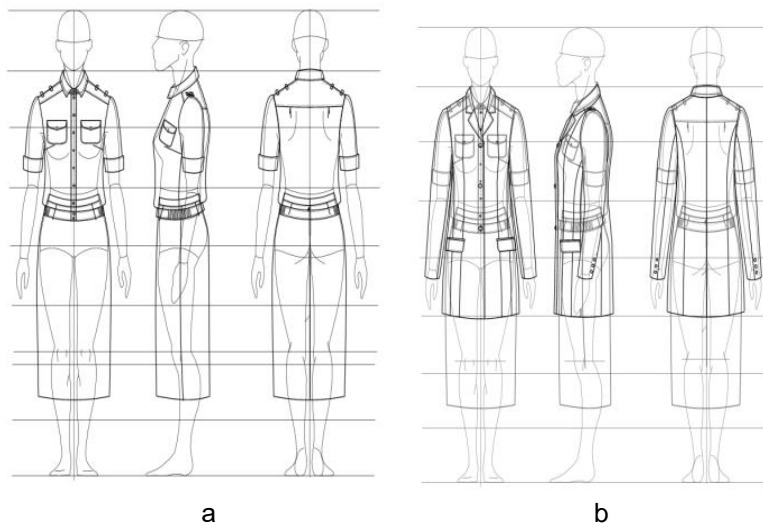


Fig. 2. Three-view image of proportional patters of the existing sets of women's uniform (front, side, back view):
 a – blouse, skirt, b – jacket, blouse, skirt

The conducted analysis of the proportional and structural patterns of the existing types of the uniform for car attendants allowed to determine their consistency; the three-view proportional image of a many-layer set of the men's and women's assortment respectively has been provided. The analysis of the compositional and structural patterns of the existing men's and women's uniform for car attendants (suit jacket, jacket, shirt, blouse, trousers, skirts) in accordance with proportional correlations of the "golden section" proved the necessity of its improvement. The analysis of imperfections of the abovementioned existing uniform became a ground for classification of the disadvantages of its structural and harmonious solution. Having analysed the production activity of car attendants, their main and additional production movements (positions), the disadvantages of their existing constructional design have been determined.

Thus, the cut of the sleeves, cut and length of the skirt, length of the suit jacket do not allow to perform certain movements without obstacles, create difficulties and discomfort, which result in tearing (laceration) of the connecting stitches; working of the lower part of a shirt (blouse) with the help of attached bar with elastic inkle on each side is not comfortable (it rides up) and creates a negative aesthetic impression; collar of the shirt (blouse) becomes dirty very quickly, soils, loses its aesthetic appearance; silhouette form of the fabrics hinders movements; number of pockets is not sufficient, as well as their placement creates obstacles, stretch, lacerate; single-cut and double-cut closing, its functional elements (buttons, loops) stick to equipment, and since the fittings work, it may result in not only damaging of the fabric, but also injure the car attendants.

The main factor of resolution of this issue is improvement of the outer form of the uniform for car attendants of railway transport by creating harmonious rows. One of the ways and ground of resolution of the issue is an application of proportional correlations when dividing its parts on the basis of the "golden section" principle. The ergonomic indicators remain a top priority, which together with the indicators of technical compliance and economic feasibility will enable to diversify the assortment, increase its issue to fully meet the needs of the consumers. That is why a study of consistency of development and harmonisation of the "employee-uniform-production environment" system from the perspective of structural and compositional integrity and artistic and informative expressiveness of proportions of the "golden section" have been defined as necessary. It has been established that the lengths, measurements of the elements of the sets, placement of the divisions, structural and decorative elements of the items, proportional correlations of their parts, being the ground for artistic arrangement of the weight in the body and at the limbs, do not comply with the harmonious proportions. In order to avoid disadvantages of ergonomics and proportions we offered to use the elements of modular design (Fig. 3).

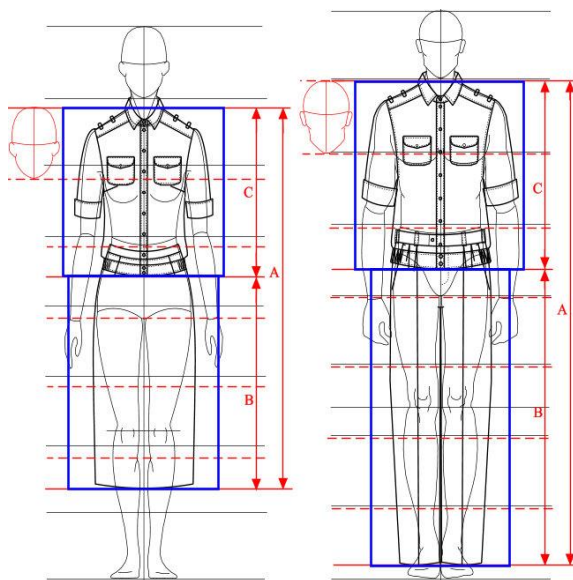


Fig. 3. Image of the proportional correlations of the existing sets of uniform, front view: a – women's (blouse and skirt); b – men's (shirt and trousers) uniform

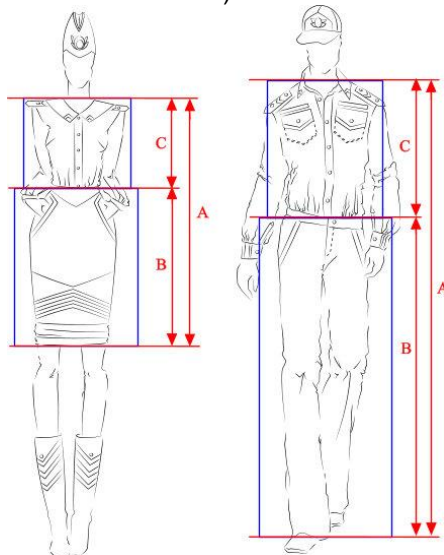


Fig. 4. Image of the offered proportional correlations of the developed models of the uniform for women's and men's sets, front view: a – blouse and skirt, b – shirt and trousers

When developing the classification of the main geometric modules to create the structure of the special-purpose clothing, a famous classification of the types of garments, based on the principle of dividing the human body into construction belts with the relevant elements, has been used. In addition, the particular feature of the inclusive design is that the artistic effect is achieved by means of discovering of new functional and composition solution by a designer-planner, optimization of its form, search of expressive colour solution, use of decor.

As of today, design planning of new forms of clothing is in static condition. Preliminary researches proved the necessity of improvement of development of clothing forms by means of design, taking into account human dynamics and movement, which are natural. Whilst, the tasks of design planning follow from industrial, functional, economic requirements and are performed with the use of the current concepts and achievements of IT technologies. They include forecasting the information about changes of structural parameters in quantified models, ranges of their layout and compositional variation; ensuring the anthropometric compliance with the size and form of human's body, taking into account the movement dynamics and distinctive poses of the employees; ensuring aesthetics, workability and cost-effectiveness of the functional solutions, etc. That is why the clothing form serves as a dynamical model of the multilevel research with its own structure of interconnections between the elements, figure of a person and environment.

The main reason of imperfection of the construction and compositional structure of the existing departmental uniform is insufficient assessment of the artistic and aesthetical component in the process of creating the design objects, which is directly related to the ergonomic indicators of the fabrics quality. The main priority of the managing directors of the departments is ergonomic expediency adapted to industrial production by large batches without taking into account particularities of the figures, nature of movements, size and height measurements of the employees. It does not always comply with such concepts as "quality", "technical compliance", "variety of assortment", "functionality", etc.

Forming of information and sign system that characterizes significance of the symbols by its possible availability in clothing, in particular, a group of colours, is also common for the uniform of car attendants. Thus, in general, branding is throngs of symbols and colours for this brand, for this collection, at this stage. That is why, the style-related tasks in the process of creating the uniforms for the companies are also included into the process of development of information and sign systems. First of all, for this purpose it is necessary to choose the criteria of determination of stylistic image of the clothing form, which envisages making of hypothesis and developing the types of identification geometric structures for its visualization. The next stage is historical classification and

division into periods of the geometric structures, which included identification of the statistic consistencies of functioning and examination of the particularities of development and functions. Then formation of the typical criteria structures, envisaging creation of the stratified schedules of graphic planning systems of car attendants' uniform, takes place.

It should be noted that in the modern planning practice an excessive number of techniques, measures and methods of harmonization are being used, which complicates their systematization within the theory of the artistic design planning, which forms a concept of harmony, module and extent. Precisely that is why the mathematical tool "golden section" is widely used in the process of description of structural harmony of the proportioning system. Herewith, the module may be represented as a system of interconnection of the geometric quantities, being the ground for formation of the structure of the car attendants' uniform and its elements. This forms the basis for development of the assortment collection of the industrial goods of harmonious forms. As follows from the requirements of design and ergonomic planning, development of the composition and harmonious solution for the uniform for car attendants of the railway provides for consistency of the components of the external form and silhouette features, as well as proportionality of the elements with the accented centre of the composition. Assortment ranges of the industrial production depend on the particularities of manufacturing, while taking into account characteristics of the materials and constructive structure of the forms.

For the purpose of the harmonious arrangement of the stylistic solution and given the above, we offered a basic proportional correlation of the modules in men's and women's uniform for car attendants in accordance with the "golden section" principle (Fig. 4). Thus, the basis of the "golden section" is correlation of lengths: the biggest one to the whole and the smallest one to the biggest one, which is approximately 0.618.

The best example of replication of the "golden section" principle is the human body, therefore, the use of such a proportion in clothing is a necessary condition for its harmony. It should be noted that this became the basis of the proposed structure of men's and women's clothing in accordance with aesthetic and functional trends.

The creation of the models of assortment ranges was preceded by a study of the types of figures of employees, posture and nature of movements that meet the needs and type of activity; symmetry of separate parts of the suits, their artistic unity and functionality; "merging" of the suit with a person, its ergonomic and aesthetic compliance with the image in the "uniform-person-work environment" system.

Thus, expansion and variety of employee's function make the design planning of the departmental uniform a prospective direction of creating harmonious models. Herewith, its impact on production and arrangement

of infrastructure with its economic, cultural, material, technical and aesthetics conditions raises.

The artistic form is a means of embodiment of the constructive form in industrial art and expresses the structure of individual components. An important role in development of the artistic forms is played by the composition solution, implementing the unity of all elements, their constituent parts. Development of the range of the uniform for car attendants requires consideration of the elements of corporate identity. Its main carriers are trademarks, colours, fonts, constituting the corporate logo according to the production functions. It is known that the expansion of contacts with partners involves creation of a corporate image, design of the visual image of the company. The corporate identity and signs are designed on the basis of a methodological approach that has developed in the process of many years of international practice and taking into account the concept of activity.

Graphic elements of the corporate identity of the railway employees are used in the symbols placed on the products, documents, signs, direction schemes, trains, buildings, etc. The uniform for car attendants of the PJSC "Ukrzaliznytsia" is one of the elements of the company's corporate identity. Peculiarities of the corporate identity of the car attendants of Ukrzaliznytsia are the presence of shoulder straps, buttonholes and stripes in clothing and hats. They contain the corporate logo distinguishing Ukrzaliznytsia from other means of transportation. There are also internal insignia of railway employees according to the categories of management and position. Corporate insignia of car attendants (low-ranking and other personnel) are shoulder signs on jackets (slip-jackets), shirts (blouses). These signs have the established sizes, corresponding symbols and colour that allows to identify a rank appurtenance of the person wearing the clothing. The appearance, colour and texture of the material, functionally justified decor have a great influence on the perception of this type of clothing. The known nature of the associations that arise in the perception of primary colours allowed to determine the main characteristics of the requirements for colour solutions of the uniform for car attendants. The analysis of the regulated system of requirements to the colour solution of the corresponding clothing and systematization of the theoretical material made it possible to set the task for developing new colour combinations and patterns for the fabric of the outer garments. This is due to the fact that the existing colours according to the results of the survey do not provide good aesthetic perception of consumers, as well as differ from modern world trends. Therefore, in accordance with the ergonomic design concept, we offer neutral shades of dark blue of the main materials using warm red and yellow colours of warm shades in finishing. For shirts, it is recommended to use white, light yellow, light blue and grey-blue colours of warm shades. For the aesthetic

expressiveness of artistic and colour solutions, the use of textured processing of fabrics and prints is offered

Development of new sets of closing of car attendants is carried out at the level of world design achievements; aesthetic and ergonomic characteristics of the items are taken into account as defined indicators for assessing consumer properties and quality. On the one hand, ergonomic approaches focused on the “human factor” should be taken into account, and on the other hand design ideology, a significant place in which is given to the development of integral, aesthetically perfect complexes of the subject environment. New forms of design, which appeared as a result of introduction of artistic design methods into traditional design process, has a number of unique features. This originality is expressed in the fact that technical (engineering) and artistic design, form a single process of development of closing. Whilst technical designing serves in this complex process as a constructive basis of the item and design forms this item as consumer value making it useful, convenient and aesthetically beautiful. Functionally morphological and technological aspects of artistic design are included into the artistic and graphic design of closing, which is targeted at creating an integral aesthetic form. As a result of structural and compositional design, the integrity of material and technical, social and cultural consumer properties of closing that meet the needs of consumers is achieved.

Based on the above structural elements of design planning, a collection of the uniform for car attendants of the PJSC “Ukrzaliznytsi” has been developed and offered (Fig. 5).

The collection of models consists of separate elements that are organized into a single whole to express a conceptual idea. The basis of the collection is the unity of image, style, taking into account modern trends, shapes, materials, colours, decorative and structural and technological solutions of all elements. The basic symbol and form of the collection, three-dimensional form has a certain geometric shape (rectangle, trapezoid), being the structural code of the collection of models; reflects the conceptual idea of the collection and is the source for the artistic design of all elements of the “collection of models” system. It is proposed to expand the range of clothing to include vests, shorts, skirts of different designs, aprons, as well as to solve the problem of combining the models within the range groups: to combine one jacket with two skirts (or skirt + trousers), one jacket with two trousers, etc. Expansion of the complete set of closing makes it possible to combine independent elements with each other, to make changes in the sets depending on the situation. Different combination of individual models of closing allows to change the purpose of sets and diversify the stylistic solution. Expansion of the range of closing will also allow to extend the period of physical wear of the proposed models.

The colour scheme of the uniform is made in accordance with the corporate identity of the PJSC “Ukrzaliznytsia”, which allows to distinguish car attendants among other railway employees and employees of other connections. Insignia also function as decorative elements. The minimum risk of mucking and ease of taking on and taking off closing is achieved by the use of materials of different composition (fabrics and knitted fabrics), colours with a zonal location. The increased number of pockets allows to distribute external forces on them more rationally and prolong their service life.



Fig. 5. Sketch range of developed models of the collection of the uniform for car attendants of Ukrzaliznytsia

Also, in the collection of the uniform there are elements of transformation – the length of the sleeves of the shirt (blouse) changes due to the use of pattes. This makes it possible to use the clothing item in different situations, without damaging or mucking certain areas of the sleeve. Further functional and compositional systematization of rational, from the standpoint of ensuring anthropodynamic compliance, structural and technological solutions and choice of structural and decorative elements of the above

clothing is needed. In the aggregate, these proposed solutions serve the basis for the formation of an information base for development of collections and assortment groups of the uniform for car attendants in ergonomic design.

Conclusions. As a result of the conducted research the scientific and technical task of improvement of modern uniform for car attendants has been solved. The mobility of design planning of the uniform for car attendants has been increased due to the determination of proportional correlations of its spatial forms and application of modular design; the properties of materials have been studied, their indicators have been determined; the dominant value of crease-resistance and breaking strain as the main characteristics of ensuring reliability of the uniform for car attendants has been established; expansion of the complete set of the uniform for car attendants is being offered that enables to change the purpose of use of the sets, diversify the stylistic solution and prolong the term of physical wear of the models; a range of sets of functionally justified uniform has been developed and implemented; the design and design planning through constructive modelling with the use of modern technologies has been improved. The results of the work have been used in the PJSC “Ukrzaliznytsia” to create new uniform for car attendants.

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2.4. SCHOOL CLOTHING DESIGN: HISTORY, TOPICAL TRENDS

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Abstract: *The study comprehensively considers the design of school uniforms. The analysis of the main components, color combinations and proportions of school uniforms in the countries of the world is carried out. Harmonious proportions in sets of school uniforms presented on the market of Ukraine are determined. An analysis of consumer preferences on the range, composition of sets and colors of school uniforms in Ukraine. The conditions of operation of school uniforms are investigated.*

Keywords: *school uniform, design, comfort, harmonious proportions, color.*

Introduction. The design of sets of uniforms is often a matter of developing clothing items that unite members of the community (companies, associations of certain activities). This is crucial in the definition and dissemination of certain lifestyles, programs of social behavior, values and forms socio-psychological attitudes in the mass consciousness of society [2, 11, 16, 17]. The design of school uniforms in the context of an element of the educational environment simultaneously with the educational and disciplinary tasks performs an informative task, forms the child's environment and socializes it. School uniforms as a socio-cultural phenomenon pose a challenge to scientists and designers to solve problems related to the justification and understanding of the mechanisms of the impact of clothing on the lives of students.

Many scientists in Ukraine and around the world have studied the issue of the expediency of using school uniforms in educational institutions. The issues of expediency of school uniforms, advantages and disadvantages of its use in secondary schools of different countries were studied in [20-22]. The authors note that the presence of mandatory uniforms for schoolchildren, above all, increases safety and prevents violence among students. The results of research provided in [20, 21] showed that the presence of mandatory school uniforms leads to a reduction in violence and theft in schools. However, in the work of J. Sanchez, A. Joximer and G. Gill [20] it was noted that among schoolchildren only a small percentage of students like to wear uniforms (12.7%), while respondents confirm that the uniform makes them more disciplined and provides more safety at school [20, 21].

The concept of uniform, its use and impact on the person was studied in [5, 10, 12-14]. Parshutin I.A. in his work on the psychology of the use of uniforms notes: "Clothing in a special context regulates actions, norms and order. The very fact of issuing a uniform means a change in

social status. Uniforms give the right to demand... compliance with the rules and regulations of the organization as a whole. The other side of the matter: form equalizes all...., makes individuality less significant in the face of the team" [13; C.199]. The influence of school uniforms on the educational process and discipline of students in educational institutions was studied in the work of T.V. Vlasova. The author confirms the importance of using uniforms in schools: "uniform disciplines; uniform smooths out social differences; uniform creates the effect of reading, the child in the form is adequately perceived as a school student "[5, p.144].

Lutseva I. studied the influence of uniforms on the development of personal qualities of students. In her work [10], she notes that school uniforms contribute to the formation of such personal qualities as organization, responsibility, neatness, diligence, honesty. Uniform is a necessary element in the educational process, it promotes the formation of moral and volitional qualities of the individual, stimulates learning, develops social skills (communication, collectivism, corporatism, etc.), allows students to identify themselves as a member of class and school team, the bearer of its norms and values . School uniforms contribute to the correction of such negative personality traits as disorganization, arrogance, snobbery, underdeveloped aesthetic taste. "Uniforms are an element of education, discipline and an important tool of social identification of the child, which creates the necessary distance between student and teacher" [14; S.402]. The analysis of scientific research confirms the importance of school uniforms in the education and upbringing of the student as an educational and disciplinary tool of social identification of the child [5, 12, 14, 15]. DA Aikyan in his work noted that the introduction of modern, ergonomic, fashionable and affordable school clothes will allow students to better learn new social roles, to form their personality [1].

Statement of the problem. In recent years, the use and mandatory school uniforms are not regulated by the state and many schools in Ukraine, but according to research [4], this type of clothing remains relevant and in demand. In matters of school uniform design, a special place is occupied by the issue of psychophysiological comfort of the child. Ergonomic features of changes in the parameters of the child's body are associated with the dynamics of its growth at certain ages. The mental development of students also goes through certain stages, during which the qualitative perception of reality changes, clear boundaries are formed between the imagination and the real world, self-esteem and the "I" is determined.

Theoretical and methodological substantiation of the principles of formation in clothing design is the basis of many scientific works and theories. Formation as a process was studied not only in the field of design and engineering, but also in the areas of philosophy, culturology and history in the works of J.-L. Besson [3], N.M. Kaminska [7], L. Kibalova, O.

Gerbenova, M. Lamarova [8]. These works dealt with the organization of the suit as a whole and changes in its shapes and proportions over time, which are associated with many factors: social change in society, economic development, historical events and more. However, the current research results do not sufficiently reveal the features of the design of school uniforms.

The issues of uniform design [9, 18], school uniform [5, 6, 14, 17, 22] and children's clothing [11, 19] have been studied by many scientists. The research of G.V. Omelchenko, M.V. Kolosnichenko, S.V. Donchenko, K.L. Pashkevych [19], in whose work the issues of constructive-technological solutions of children's clothes for beginner roller skaters with elements of transformation were considered. The authors [11] explored the possibility of using transformation methods in the creation of multifunctional children's clothing, which allows to significantly expand the existing range of products. Issues of uniform design for various purposes were studied in [9, 10, 14, 17]. Craik D. [17] investigated the issue of determining the features of finishing elements of uniforms (signs, stripes, etc.). The authors [10, 14] noted that the design of school uniforms, in addition to the aesthetics of the student's appearance, must present the school and its values.

The changes in education that are taking place now in Ukraine are leveling the old concept of "uniforms" for school clothing and require revision and modernization of the design concept of this range of products, namely addressing the dynamic compliance of school uniforms with harmonious artistic and constructive solutions with elements of transformation. Systematization of information on the features of designing school uniforms and research of modern needs of consumers of this range of products determines the specifics of modern design of school uniforms and design areas of search for creative solutions of multifunctional harmonious forms.

The issues of design components of school uniforms, along with the conceptual issues of modern definition of its tasks also need solutions related to the concepts of comfort and aesthetics of this range of products, namely: ergonomics (the problem of rapid growth of school children), aesthetics (proportions and original solutions) and economic factors (the ability to use the clothing set or its individual elements for a longer period of time, pricing policy, etc.).

Results of the research and their discussion. The design of modern sets of school uniforms requires the identification of the main design components that would determine the peculiarities of the formation of this range of products. Analysis of the functions of school uniforms showed that this type of range combines on the one hand utilitarian functions, such as uniforms (protective, work, casual wear) and socio-aesthetic functions, as an element of corporate culture (corporate identity and dress code) (Fig. 1). From the social functions of school uniforms can

be identified the following: informational, educational, communicative and the function of a stimulator of mental activity.

It should be noted that school uniforms can be considered as one of the symbols that unites the "student-school" system, and which is used to regulate the relationship between students and teachers. Analysis of scientific sources showed that in the interpretation of the element of corporate culture, school uniforms can contribute to the formation in the minds of employees (students) a set of "correct" beacon symbols, through which it affects all areas of enterprise management (school).

In the aesthetic education of modern students different sources are used, one of which is the design of school and classroom life (involving children in creating an aesthetic environment) [16], where the appearance of the student is one of the components. Aesthetics of school uniforms – an important component in the education of students. The very concept of the aesthetics of uniforms, in the system of corporate culture, can be based on the principles of corporate style aesthetics. Determining color combinations, shapes, logos (corporate signs), proportions of units of clothing and suit in general, etc., can, in addition to aesthetic, simultaneously perform an information-recognizable function. As an element of corporate style, school uniforms perform a social function: they unite a group of students and identify them with a particular school. The design of school uniforms, as an element of corporate culture, can be considered as a task of product development, which would allow to convey certain information about the individual and the enterprise (school).

Clothing is one of the sources of self-expression of the individual, and branded clothing/dress code is one of the sources of expression and presentation of the existing corporate culture of the institution. Clothing style and its compositional solutions make it possible to identify the direction of the organization. Branded clothing is a way to express yourself as part of an organization. Dress code, as well as branded clothing, is an integral part of corporate culture. The components of the design of the "corporate" style in the uniform are: color scheme, visual symbol (general geometry of the suit and proportions), completeness and logo [15].

Utilitarian functions of school uniforms – defined as a uniform (protective, work, casual clothes) (see Fig. 1). Among the utilitarian functional features in the design of school uniforms the following factors that affect the solution of certain project tasks can be identified: age (features of the child's development in a certain age period), ergonomic (operational).

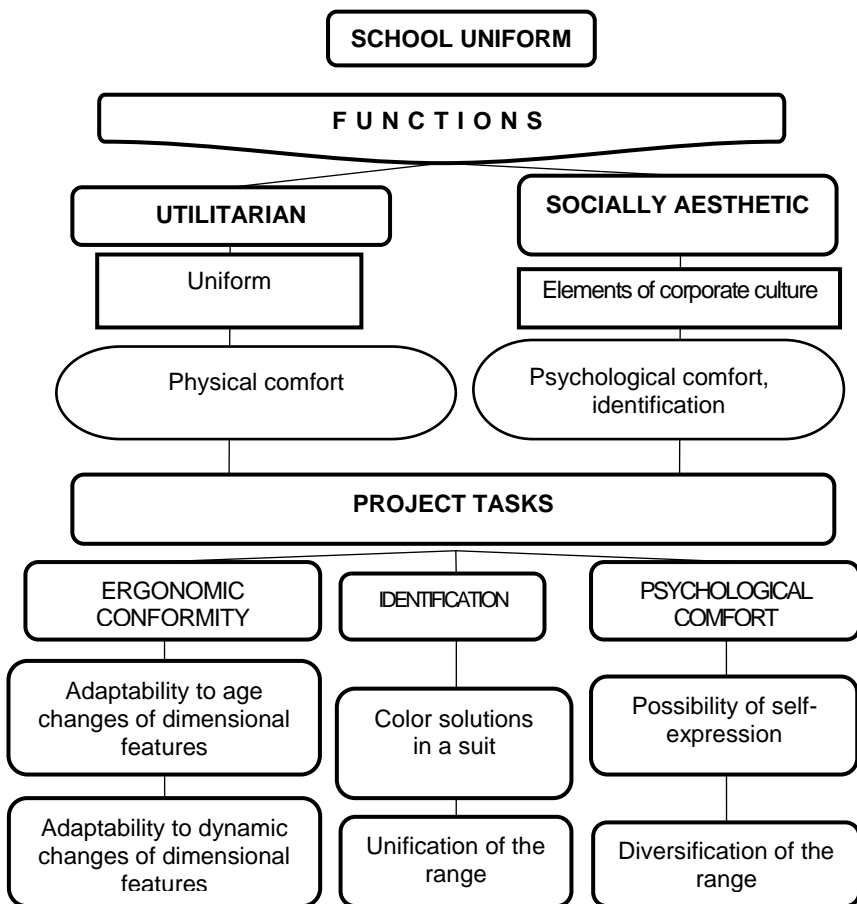


Fig. 1. The concept of school uniform design and its tasks

In order to determine the peculiarities of the formation of sets of school uniforms, their color combinations, an analysis of samples and photo prints of school uniforms of the world was conducted. The results of the analysis showed that this range of products is widespread and used in most countries. The composition of school uniforms and their color solutions are not regulated as a single model in all countries except North Korea, Cuba and public schools in Vietnam. The analysis of the experience of the countries of the world concerning the use of school clothes in educational institutions has shown that today the following directions can be distinguished:

- school uniforms are not regulated by the state – as a practice of a dress code of a certain school (Ukraine, USA);

- school uniforms are obligatory and regulated by the state, but their composition and color are determined by a certain school (Great Britain, Mexico, China, Russia);
- school uniforms are not used and regulated (free choice of clothes by the student) (Germany, Canada);
- school uniforms are mandatory and have a uniform pattern throughout the country (North Korea, Cuba).

This policy only applies to public schools. Studies have shown that in private educational institutions, uniforms are often mandatory, which is prescribed in the charter of the institution (range, combinations, color, accessories). Let's consider in more detail features of design of school uniforms in different countries, its structure, color combinations, etc.

Analysis of samples and photo prints of school uniforms in UK schools showed that uniforms for girls in public schools include: jacket, sweater, skirt and/or pants, tights and socks of a certain color are mandatory in the set. The daily school uniform set for boys consists of a shirt, jacket, sweater, pants and tie. Often a sweater and/or jacket is decorated with embroidery or stripes with the logo of the educational institution (Fig. 1, a). It should be noted that the color of uniforms is determined by the management of the educational institution, which is prescribed in its charter. In addition to the everyday school uniform, a sports school uniform with a certain composition and colors with stripes with school symbol is also regulated. The model and color of shoes in a school uniform must be regulated in the charter of the educational institution.

Studies have shown that a similar set of school uniforms can be traced in many former colonies of the British Empire – Australia, India, Singapore, Uganda and Ghana. In these countries, the principle of forming sets of school clothes, which was introduced during the colonial rule, is preserved to this day. For example, in Australia, school uniforms are a mandatory element of the educational environment, but their composition and color are decided in each educational institution separately. The resulting sets have common features depending on the season: 1) in the uniform for boys under 13 years of age shorts must used, and pants for high school; 2) the headdress is a mandatory element of the school uniform; 3) outerwear is not included in school uniforms (especially the hot climate of Australia), but jackets or cardigans with stripes are required. The color and model of hats, ties, knee socks, socks, and shoes are prescribed in the school charter (see Fig. 2, b, c).

The design of school uniforms in educational institutions in India has several directions. The postcolonial, pro-European design of school uniforms is a set consisting of a shirt and shorts for boys, and a shirt and skirt or sundress for girls. Another direction – the design of school clothes on the basis of traditional can exist in two types: 1) as a sari in certain

colors and proportions, 2) as models developed on the basis of shalwar gameez (kamiz) – traditional clothing consisting of wide pants tapered down and long shirts (see Fig. 2, d). Traditional school uniforms can sometimes be accompanied by suit items such as the hijab or headscarf for girls whose families are Muslims, or turbans for Sikh boys.

The pro-European design of the school uniform can be traced in Japan. In this country, uniforms are considered mandatory in schools. Each school establishes and dictates the set and color scheme. The design of school uniforms for middle and high school is based on the military clothing of the Meiji period, which mimics the European naval uniform. Sets of school uniforms for boys consist of a gakuran (closed jacket and straight black pants) and a shirt; for girls – a white shirt, dark jacket and skirt or "sailor suit". A large bag or briefcase is a must in a uniform.

In the Republic of Sri Lanka, the design of school uniforms is also divided into two areas: 1) postcolonial, pro-European: for girls – a shirt with a tie and a white skirt, for boys – a white shirt and blue shorts, which are replaced by white shorts on festive days; 2) traditional, based on the national dress of white color (see Fig. 2, e). In Muslim schools, pants and veils are added to school sets for girls.

It should be noted that in Muslim countries, the hijab is mandatory for school uniforms for girls, for example, in Iranian schools, school uniforms for girls must include this element. A school set for girls in Iran may consist of elements of traditional clothing of certain colors and lengths regulated by the school. Countries with a similar design of school uniforms for girls include Malaysia, Oman, Iraq, Iran, Yemen (Fig. 3).

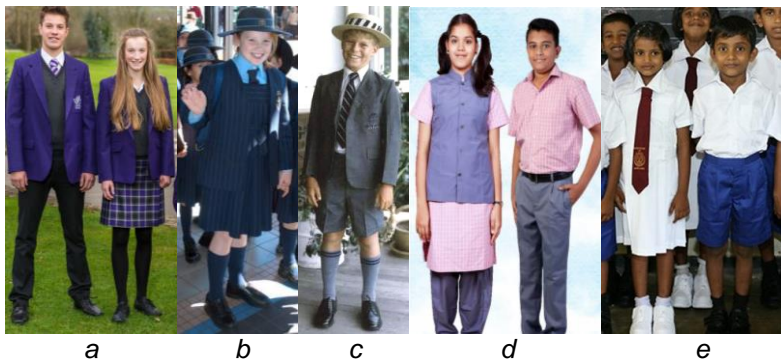


Fig. 2. Sets of school uniforms for secondary school students:
a – Great Britain; b-c – Australia;
d – India; e – Sri Lanka



Fig. 3. Sets of school uniforms for schoolgirls:
 a – Malaysia; b – Oman; c – Iraq; d – Iran; e – Yemen

A separate group includes school uniforms in Vietnam, Cuba and North Korea. These countries, which for some time were under the influence of the USSR, adopted the pro-Soviet principle of the formation of school uniforms. Vietnamese school uniform set for girls consists of a dark blue sundress-transformer (skirt with removable straps) and a white shirt. In high school, a schoolgirl's uniform for a girl consists of a traditional white "ao dai" dress, navy blue or black pants, and a national "non la" hat. School uniforms for boys include a white shirt and navy blue pants or shorts. Red ties are a must-have for high school students. It should be noted that the samples of school shirts may be the same in shape, but differ: the edge trim, the shape of the collar, pockets and stripes on the sleeves (Fig. 4, a).



Fig. 4. Sets of school uniforms for school students:
 a – Vietnam; b – Cuba; d-e – North Korea

In the Republic of Cuba, school uniforms are mandatory for all students in schools and universities. The school uniform set consists: for girls from a shirt and a sundress (a skirt with straps), and for boys from a shirt and shorts for pupils of elementary, secondary school and a shirt and trousers (high school). Color combinations can be different: white or blue shirt and red, yellow or navy blue bottom. Often the color combinations can change according to the age of the student: junior and middle grades – white and red, seniors – white and yellow (see Fig. 4, b), or blue and blue. Mandatory accessory to the uniform set of primary and secondary schools – is a tie. For elementary school students – blue, and high school – red.

The school uniform for girls of North Korea (see Fig. 4 c-d) consists of a white or burgundy shirt, a skirt and a dark blue jacket, a uniform for boys with a white or blue shirt, pants and a dark blue jacket. A red tie and badge are a must-have accessory.

Analysis of samples of school uniforms in China showed that the design of school uniforms of Chinese students can be defined in the following areas: 1) as a classic European suit; 2) in a sporty style; 3) as school sets using traditional national elements. Most often, school uniforms are a sports suit and sneakers, the color and model of which are regulated by the school. Studies have shown that students in Chinese schools have several sets of uniforms: for holidays and ordinary days, for different seasons.

Analysis of the shapes and proportions of school uniforms in the world showed that in general most countries in Asia, Europe, South and North America, Africa and Australia: the same structure and shape, but the composition and proportions of uniforms in countries differ due to climate, national traditions and religion. Exceptions are Islamic states, where the school uniform for girls is either traditional national clothing (abaya, kamiz) in combination with a hijab, shayla or himar. School uniforms for boys in Islamic countries exist in two types: 1) classic shirt and pants, 2) camisole and pants. National hats can be added to the boys' uniform.

Studies have shown that the identification function of school uniforms can be carried out using: the shape and proportions of the uniform, a certain color, color combinations, embroidery, stripes, badges and accessories with logos.

The study of the samples showed that the proportions in the sets of school uniforms of pro-European design have certain features depending on the age of the child. It is determined that in the classic pro-European uniform set for girls, the proportional length of the skirt differs significantly depending on age. For girls of primary school age, the most common lengths of the skirt are copper, which is proportional to height: 2: 5, 2: 3 and 4: 9, and for teenage girls, the most common are mini skirts, the length of which is proportional to height 1: 5 and copper. In girls' suits the following proportions of divisions in pro-European school suit are most often found:

2: 3, 3: 4, 3: 7, 7: 8; traditional-religious: 7: 2, 3: 2, 2: 5; national: 5: 8, 3: 7. For boys, the proportions are in: pro-European design: 1: 2, 4: 9, 5: 8; traditional-religious: 4: 3, 3: 4; national: 4: 3, 3: 4, 5: 8. The choice of these or those proportions is determined by the functional and aesthetic requirements that the product must meet. The use of proportions in the design of uniforms is a means of obtaining a holistic form, as it creates harmony of individual parts of the suit and their combinations.

To determine the features of the design of school uniforms in Ukraine, an analysis of photo prints of samples of school clothes presented on the market of Ukraine was conducted. The results of the study of school uniforms for girls showed that the harmonious proportions are often expressed in lengths of 7: 8 and 3: 4 sleeves, the length of the mini skirt in the set often corresponds to 1: 3 length of all clothes (2: 3 length is a sweater or blouse), copper 2 : 3 (1: 3 set is a jumper or blouse). To determine the harmonious horizontal divisions of sundresses, dresses and sets for girls of primary school age group, proportional ratios were calculated based on typical product lengths: 1) sundresses and dresses – proportional length ratios to height: 2: 3; 5: 9; 2) jacket and skirt – proportions: 4: 1; 3: 1; 9: 4; 3: 2; 7: 8; 8: 7; 5: 9; 3) blouse and skirt – proportions: 3: 1; 2: 3; 7: 8; 3: 4. In sets of school uniforms for boys the most common combinations of sets in the following proportions: 1) jacket and pants 4: 9, 7: 8; 2) jumper and pants 2: 3; 3) coat and pants 4: 5.

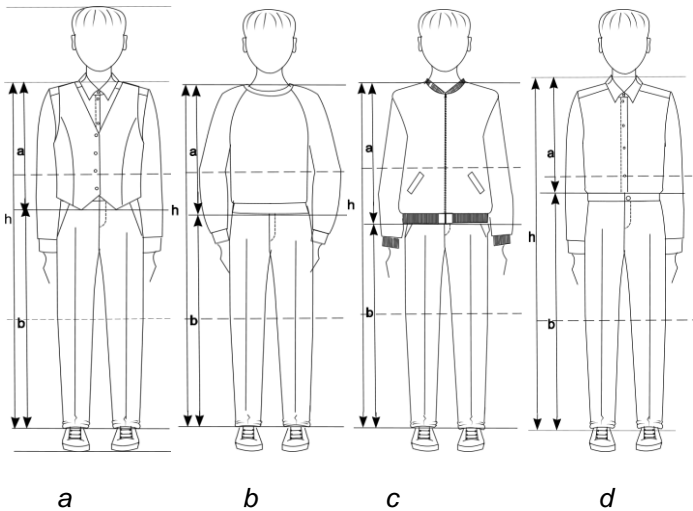


Fig. 5. Proportions and lengths of school uniforms for boys of primary school age:

a – pants and vest: 1 – proportion 5: 9; b – pants and sweater, proportion 3: 4; c – pants and coat, proportion 4: 5; g – pants and shirt, proportion 4: 9

It should be noted that in the composition of school uniforms, as well as in any suit, the proportion can be realized through the ratio of shapes, divisions, areas of different textures, colors, sizes of details, decorative and finishing elements.

In order to determine the features of the design and operation of school uniforms, a study of the activity of children of junior (6.5 years – 12 years) and senior (12 years – 15 years) school age group was conducted. The results of research have shown that a student spends at least 5-7 hours in a secondary school (Fig. 6). Most children under 11-12 years remain in groups for an extended day (about 2-6 hours). Surveys conducted among 200 students of secondary schools in Kyiv and their parents showed that only 5% of students change into another clothes after classes. Time after lessons in groups of an extended day can be divided into study time (homework) and free time (walking, games, etc.).

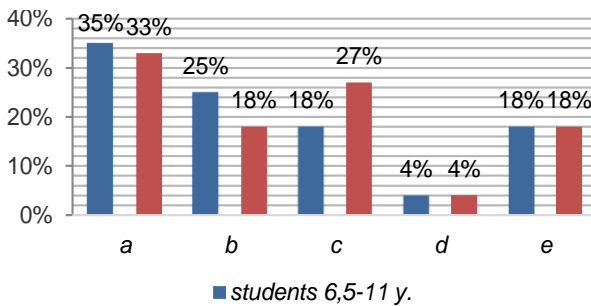


Fig. 6. Distribution of working time of students of junior and senior school age group: a – sleep, rest; b – GPA, sections, communication; c – time of lessons; d – preparations and the way to school;; e – time spent at home (morning, evening, preparations, rest)

During the studies it was determined that students of primary and secondary school age are in school with a constant change of situations and conditions of operation of uniforms. During operation, students perform a large number of different movements. According to the results of the analysis of video materials and photo prints made in the gymnasium №109 of Kyiv in different periods of the 2017-2018 school year, a typology of situations of school clothes use was developed, the most characteristic postures and movements of a child during school were determined (Fig. 7) during the day.

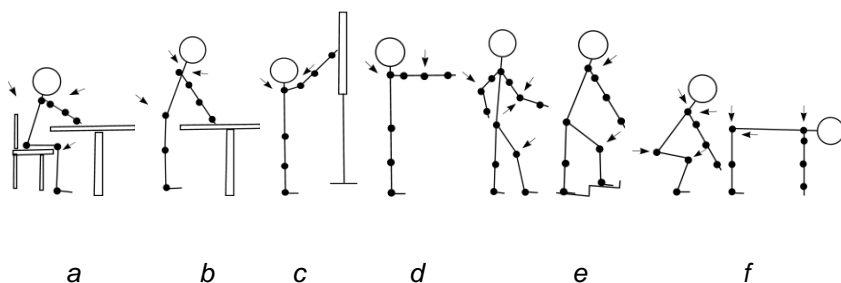


Fig. 7. Typical movements and postures of students of primary and secondary school age during the school day: a-d – study time; e-f – free time

In order to determine the peculiarities of the formation of school uniforms and their use, a survey was conducted among 100 primary and secondary school students of Kyiv schools, their parents and teachers. According to the results of the survey, one of the main recommendations of the school administration regarding school clothes is to adhere to certain colors, or color combinations and variants of uniform sets, which are determined by the school. School uniforms in this case act as a dress code. Regarding the service life of school uniforms, the results of the survey showed that on average these products are used from one to two years. The reasons are changes in the size and proportions of the child due to the growth and wear of the material. Abrasion on the plane (lass) was formed in jackets in the area from the elbow to the bottom of the sleeve and on pants, sundresses from the waist line to the knee line (front and back). Wrinkles most often occur along the chest line in the armpits, at the waist, hips and are formed in jackets, blazers, blouses, shirts and sundresses.

The results of the survey showed that girls and boys of younger and older age groups prefer sets of school uniforms, which must include sweaters, jumpers and blouses/shirts. It is determined that when choosing jumpers and knitted sweaters, both boys and girls prefer the classic models with sewn-on sleeves, cut from canvas or knitted on flat-fang machines. When choosing shirts, boys prefer classic shapes with a small number of structural and decorative elements and decorations, and girls – blouses with long wide sleeves, a variety of collars, ruffles and slings. When choosing pants, 70% of boys and 58% of girls prefer jeans. Sets that include jackets are chosen by 60% of consumers among girls of primary school age, while knitted jackets from this sample are chosen by 80%, and fabric jackets – only 20%. Analysis of the survey results showed that the percentage of boys of younger and older age groups, which prefers sets that include jackets and blazers, both fabric and knitwear is not more than 20%, although today this type of range is up to 90% all sets of school

clothes for boys, produced by the domestic industry. Among the range of uniforms for girls, the largest percentage of choice in the sets are sundresses 47.6% and skirts 45.3%, and the smallest – dresses 7.1%.

The analysis of the survey results on the choice of silhouette shapes and volumes of school clothing products (Fig. 8) showed that about 85% of respondents as boys, girls and their parents prefer the average volume of products. The results of the analysis showed that the preferences of girls and boys regarding the silhouette shapes of a sweater or jumper differ significantly, and when choosing a vest and a half-length jacket and blouses/shirts with straight silhouettes, they are almost the same. According to the results of the survey, it is determined that the main types of range of school uniforms, which are preferred by consumers are: for girls: jacket, sweater, jumper, blouse, pants/jeans, sundress, skirt; for boys: sweater, cardigan, shirt, pants/jeans). The most acceptable silhouettes for girls: close-fitting, straight and trapezoidal; for boys: semi-adjacent and straight.

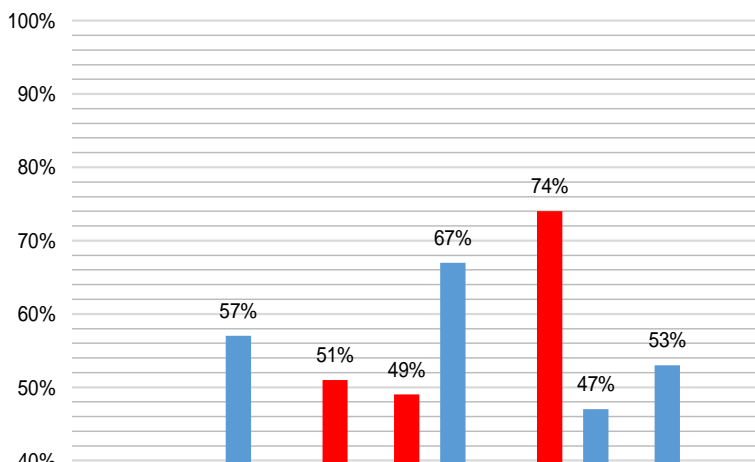


Fig. 8. Analysis of current silhouette forms of the range of school uniforms:

a – sweater/jumper of the adjacent silhouette; b – sweater/jumper with a semi-adjacent silhouette; c – sweater/jumper of a direct silhouette; d – jacket of a semi-adjacent silhouette; e – jacket of a direct silhouette; f – vest of a semi-adjacent silhouette; g – vest straight silhouette; h – blouses/shirts of a semi-adjacent silhouette; i – blouses/shirts of a direct silhouette; g – sundresses/dresses of a semi-adjacent silhouette; k – sundresses/dresses of a direct silhouette; l – sundresses/dresses with a trapezoidal silhouette; m – straight skirt; n – trapeze skirt

In order to determine students' preferences for colors in everyday school uniforms, the survey asked questions about color preferences when choosing school clothes. According to the survey, today most children and their parents prefer blue, black and gray uniforms (Fig. 9). Today, burgundy and green clothes are chosen only in cases when these colors are mandatory for a certain educational institution.

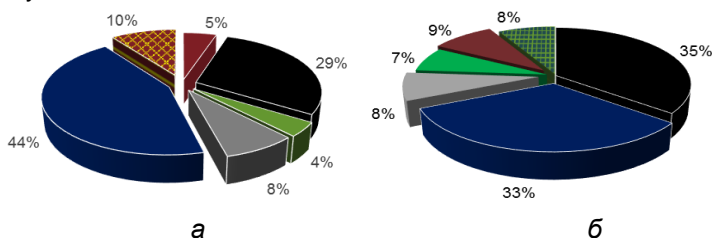


Fig. 9. Analysis of color preferences when choosing school uniforms (children of primary and secondary school age):
a – girls; b – boys

Analysis of the survey results showed that 35% of respondents prefer two-tone sets, in which a jacket, skirt, pants or sundress are of one color, sweater, jumper, shirt, blouse or sweatshirt – of another color, 65% – a three-color set, in which pants, skirt or sundress are of one color, upper shoulder product (jacket, sweater, jumper, coat) – of another color, shirt, blouse or sweater – of the third color. Black pants and skirts are often used in the sets.

Conclusions. The range of school uniforms remains relevant and in demand in the Ukrainian market. School uniforms can be considered in several aspects: school clothes, which perform the functions of socialization, association and identification of the student; way of disciplining students; object of formation of aesthetic taste. Analysis of literature sources and surveys confirmed the relevance of school uniforms. Many factors need to be considered when deciding on the design of modern school uniforms, including the child's psychophysiological comfort and age. In defining the concept of school uniforms today, we can distinguish several of its meanings: 1) uniform (student's work clothes, study clothes); 2) an element of corporate culture (identification of belonging to a particular educational institution).

Studies of samples and photo prints of school clothes from around the world have shown that the design of these products is based on: 1) historical school uniforms, which are "modernized" to meet the needs of students; 2) national traditions; 3) national and religious traditions; 4) modern stylistic decisions of school uniforms. The analysis of proportions in sets of uniforms, presented in Ukraine and in the world, determined the common ratios in school uniforms for boys and girls: 2: 3, 3: 4, 7: 8. The

results of the survey among primary and secondary school students, their parents and teachers allowed to determine the optimal school uniform for girls and boys, its completeness and silhouette forms, consisting of the following products: sweater, jumper, blouse/shirt, pants and/or jeans. The most common color range of school uniforms in Ukraine today – tricolor sets, where the main color is blue, black or gray in combination with other colors.

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2.5. CHILDREN'S SPORT CLOTHES DESIGN: METHODS AND COMPOSITIONAL MEANS

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Abstract. *The work is devoted to improving the process of designing competitive and ergonomic children's clothing for roller skaters. The introduction of modern ergonomic design tools into the process of industrial design has been proposed. On the example of developing children's clothing for roller skaters the mechanisms of realization of such stages of designing as "design research" and "design concept" have been considered, where the requirements for designing have been developed, the main ideas for solving the set tasks have been formulated and the basic principles of product construction have been formulated. They are about creating clothes with advanced functionality with the use of transforming and damping elements.*

The method of experimental determination of the parametric characteristics of the protective elements and their locations on the construction details have been described, as well as the choice of a rational structural device in accordance with the study results of the dynamic conformity of children's clothing design for roller skaters. The rational constructive-technological and color-graphic models of multifunctional children's costume of roller skaters have been presented and the model range has been created on their basis.

Keywords: *multifunctional children's clothing, clothing for roller skaters, safety elements, design research, design concept, model range, transformation methods, transformative clothing elements.*

Introduction. Technological progress, lifestyle changes, environmental changes, development and spreading of new activities – factors that transform the everyday concept of everyday clothes into the classical sounding. Nowadays, everyday clothes are not just a set of products designed to be worn in various household and social conditions, but, above all, a complex design object. It performs not only the main functions: protective, informational, aesthetic, but also satisfies the hidden needs of consumers due to the peculiarities of modern human life.

Statement of the problem. A fairly large group of clothing consumers are children, whose lifestyle has its own characteristics in accordance with the age of psychophysiological development. Since the age of 3-4, children learn to adapt to any circumstances, adapt to any environment and master new types of physical activities, such as cycling, scootering, skateboarding, rollerblading, etc., and therefore risks of injuries of varying degrees increase. In such situations, everyday clothes are not able to fully protect the child's body from damage, especially in summer, when a set of clothes consists of a minimum number of things.

It is known that in order to protect the human body from mechanical and impact loading in various sports we use special clothing and personal protective equipment (PPE). Specialists and scientists have long been engaged in the development of protective clothing of various functional orientations. The main principles and approaches to the design of varieties of protective clothing are set out in the works of Chubarova Z.S., Kolosnichenko M.V., Ostapenko N.V., Tretyakova L.D. and others [1-7] However, these provisions relate to the ergonomic design of special clothing, the use of which is expected in certain harmful conditions of the production environment. But it should be noted that such clothing has a specialized purpose and its use in household conditions is not expected. Therefore, the creation of everyday clothes with additional protective capabilities is an urgent issue for nowadays.

Results of the research and their discussion. Multi-functionality as a direction was chosen to create children's clothing for roller skaters, which allowed to develop a concept based on the ideas of versatility, interdimensional transformation, high ergonomics and resource efficiency of production. For its implementation and adaptation to the production process, an improved method of industrial design has been used, the main differences of which are the presence of stages of design research and design concept (Fig. 1).

The application of design thinking approaches to modern clothing design has revealed the so-called “hidden needs” of the consumer, which he himself is unable to realize and verbalize. For this purpose, design studies are conducted to identify, interpret and visualize information in a form accessible for further communication to all parties involved in the process [8-12].

One of the technologies created on the principles of design thinking is ergonomic design. It is presented as a new type of design activity, different from the traditional ergonomic and artistic design. The purpose of ergonomic design, in the broadest sense, is to ensure the success and well-being of a person in many areas of his activity. This is achieved by ensuring the unity of the three aspects of design —convenience, comfort and aesthetic perfection of the means and conditions of human activity. The mechanism of the phenomenon of “ergodesign” is expressed in integrating design and ergonomics. Thus, in the works of Kolosnichenko M.V., Ostapenko N.V., Pashkevich K.L., Baranova T.M., Tretyakova L.D., Smirnova M.R., Kolosnichenko O.V., Nikolaeva T.I. etc. [8-14] the problem of obtaining competitive garments for various purposes from the standpoint of an integrated approach have been solved as well as the principles of transformation and scientifically sound parameterization.

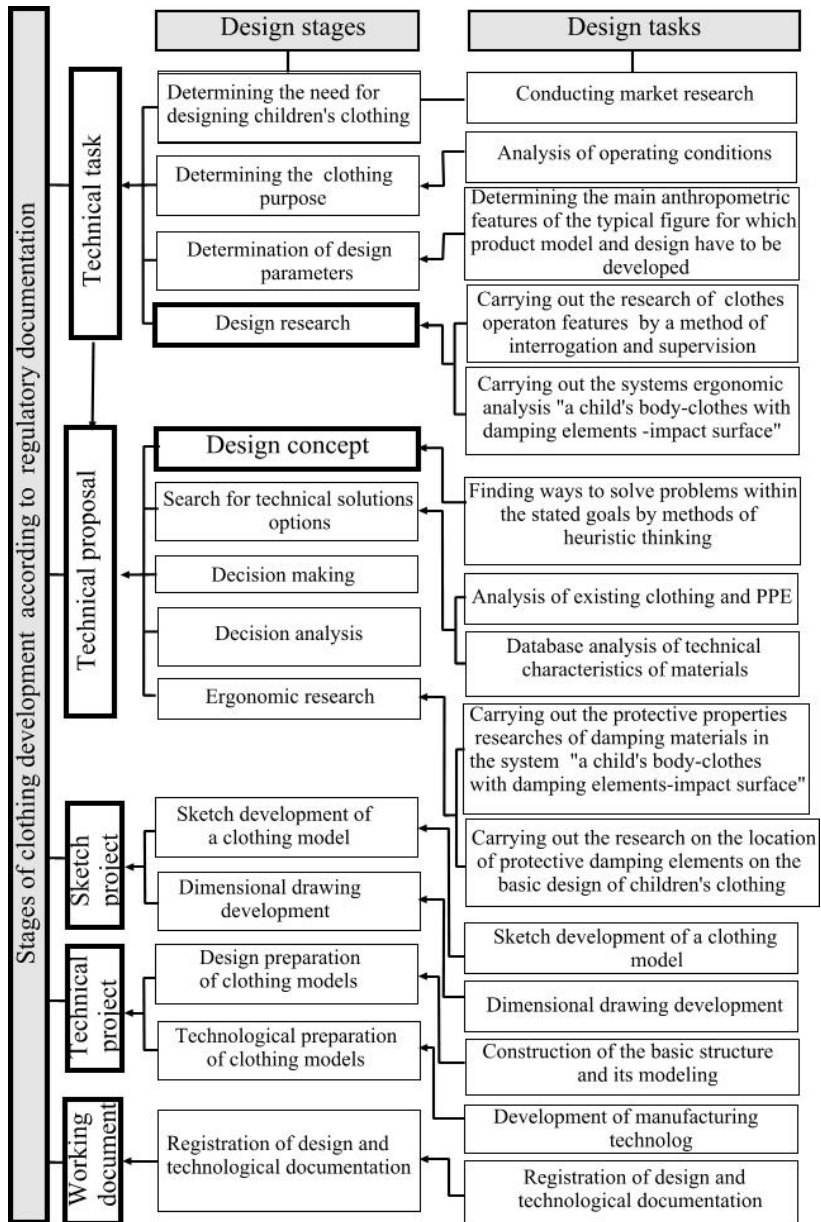


Fig. 1. Improved structural scheme of the designing process of children's clothing for roller skaters

However, in these works, the improvement of functionality is considered from the standpoint of designing special clothing, and the design of children's clothing was addressed in terms of anthropometric and ergonomic parameterization of the construction drawings of products. Experts consider that a modern scientific approach to the design of industrial products and the subject environment is inconceivable without the use of ergonomics. That is why the main thesis of one of the works of recent years, the authors of which are V.M. Munipov and V.P. Zinchenko, says: "Any design work cannot be carried out outside of the connection with ergonomics" [15].

This view is complemented by the fact that the quality of products in the XXI century, which a number of international organizations has declared a century of quality, cannot be achieved without taking into account the requirements of man to the products. In this regard, any design for humans should involve the implementation of a wide range of knowledge about the human factor. The purpose of the "design research" stage was to identify the operation features of children's clothing used for roller skating. Using the observation and survey method, it has been found out that children begin to learn roller skating usually during walks in the fresh air and in specialized roller rinks. However, the time spent on rollers in the initial stages of training is 15-20 minutes, due to the unusual load on a certain muscle group and their rapid fatigue. That is why there are long breaks between workouts during one walk, and that is why household clothes are the ones that are most often used in this situation.

The use features of such clothing in accordance with the described situation leads to the need to analyze the child's movements while learning to skate. It should be noted that roller skating classes include exercises to warm up the muscles without the use of rollers and PPE. Such exercises include warm-ups for different parts of the body: chest, back, arms and legs. The child's movements analysis allowed to develop sportswear with high dynamic compliance for use not only during roller skating training, but also during walks.

The result of the "design research" stage is the requirements development for the design of children's clothing for roller skaters. Given the above information, it has been determined that children's clothing should: be comfortable to put on and take off; provide an adequate degree of protection against all types of danger; have damping properties sufficient to protect the parts of the body affected; protect the thighs and forearms from injuries of varying degrees; have such a design and ergonomics to ensure the highest possible level of consumer protection, and the consumer to be able to perform risk-free activities without complications; have pockets for carrying personal belongings that would be protected in case of a fall; be as light as possible, but at the same time provide the necessary strength and effectiveness of protection; set the maximum

possible levels and classes of protection; the optimal level of protection that must be taken into account when designing – the maximum level of protection at which the effectiveness of clothing is not reduced during exposure to risk factors; to ensure harmlessness, i.e. not to create additional risk factors and other harmful factors, and the absence of risk factors and other “internal” harmful factors when used in the intended conditions; be made of materials that do not adversely affect the consumer’s health, and the decomposition products of the materials should not adversely affect the consumer’s health; have the surfaces nature of clothing components that touch or are potentially capable of touching the consumer, so as not to cause skin irritation or injury, i.e. should be smooth, not have sharp edges, protruding parts, etc.; have the maximum allowable restriction of movements; to provide fast finding of the child in the conditions of limited visibility; to correspond to the trend and to provide good aesthetic perception; have the means to adapt to the morphological characteristics of the consumer, such as adjustment or fastening systems, or be available in several versions of different sizes; ensure the possibility of proper fit on the consumer’s body and remain in the correct position throughout the time of use, regardless of environmental conditions, movements and position of the consumer; have the strength of the clothing material and the joints so that when the clothing engages with a moving object, it is torn or broken, ensuring the consumer’s safety; have appropriate markings on the size of clothing; to have a comfortable microclimate of the clothing space during training and relaxing; be made of material resistant to mechanical deformation; be multifunctional (used as sports and casual wear) [16].

The developed requirements allow to pass to the next stage of designing (Fig. 1) – “design concept” creation. The purpose of the design concept is to find ways to solve problems within the outlined requirements. During this stage, based on the pre-project analysis, key conceptual ideas (possible variants of ideas) are developed, which allow to determine the further course of the project [17,18]. In order to identify and propose the main ideas for the implementation of the tasks, it is necessary to identify key factors influencing the future concept. Such key factors for children’s clothing for roller skaters are its use throughout the walk with the child and during the process of learning to skate; protection of the body areas that are damaged and not protected by PPE; convenience in selection of the clothes size according to individual anthropometric parameters of children aged 4-5 years.

Given the above, at the “design concept” stage the idea of expanding the functionality and consumer qualities of sportswear by applying the principles of transformation and modern damping materials was proposed.

At the stage of searching for technical solutions, an analysis of the range of modern sportswear used to protect against shock loads was

conducted, which revealed that its variety is quite large, and the use of protective elements in clothing is a fairly common design solution.

Protective elements in such types of clothing, as a rule, have a multi-layer structure and are made of the main fabric and tabs of foamed synthetic materials, which are connected to the details of clothing by welding, adhesive and thread connection methods (non-collapsible design) or by means of pockets of various types and forms (collapsible design). Damping materials, which are the basis of damping elements in clothing, are mostly made and developed by the manufacturers of such clothing. It is also known that the German company SEDO specializes in the production of its own know-how, foamed chloroprene rubber, best known under the trade name "neoprene" and is the only manufacturer of this material in Europe [19]. Among the range of materials they make are those recommended for making special clothing.

According to the results of the materials analysis used as protective damping gaskets of protective elements in special and sportswear clothing, it has been established that they are mostly made of elastic cellular polymeric materials. The latter have high elastic, damping and flexible properties. It is known that such materials differ in raw material composition; technology of obtaining a molecular model; cell structure; density, etc. [20, 21]. For their manufacture such substances are used as: polyethylene, polyurethane, synthetic rubber, etc., and to obtain a cellular structure, they use the method of foaming, whence the names "foamed polymers", "foampolymers", "cell plastics", "foamplastics", "polymer foams" and "sponge plastics".

The analysis of the range of modern special equipment with damping elements allowed to develop a classification distribution of such elements according to the constructive device and transformation principles (Fig. 2). To determine the location areas of protective elements on the details of multifunctional children's clothing, an analysis of the protection degree of the child's body areas that are injured by a fall has been performed, and a visual information and sign model has been developed (Fig. 3).

To obtain a rational design of multifunctional children's clothing, which takes into account all ergonomic requirements, the location of anthropometric points on the child's body has been determined, which take the shock loads when falling. To do this, a method which consists of direct contact of the model of clothing on the child's body with the surface, which creates shock loads during roller skating training, has been used. The topography of the distribution of contact areas on the details of the basic design of children's clothing (Fig. 4) allowed to obtain the dimensional characteristics of the protective elements, which are shown in table 1.

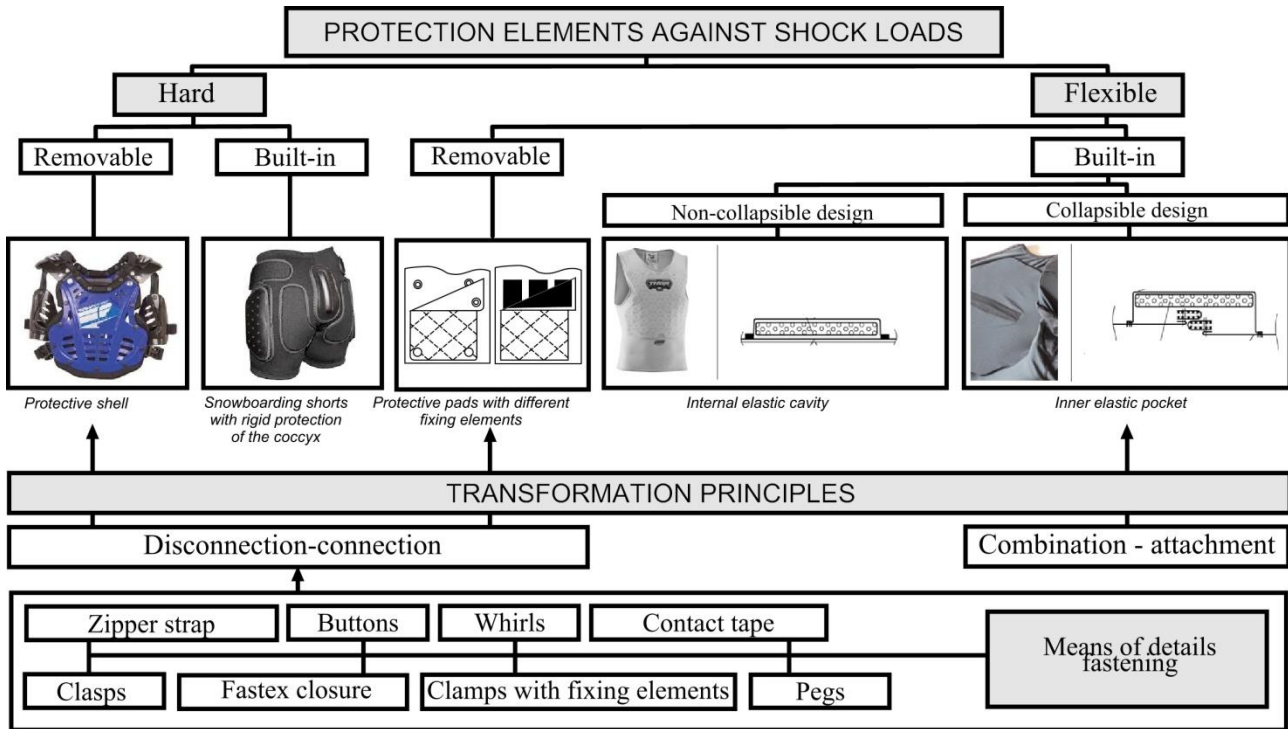


Fig. 2. Classification of protection elements from shock loads in sportswear

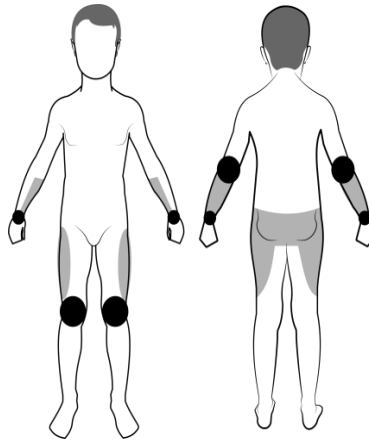


Fig. 3. The protection degree of the body parts that are most often injured (a – front view; b – back view):
 - body parts protected by PPE,
 - body parts having no special protection

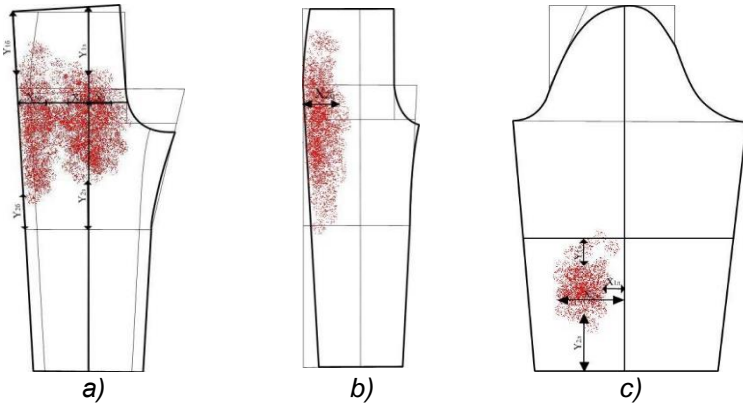
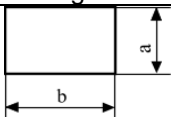
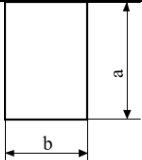
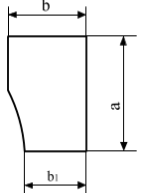


Fig. 4. Topography of the distribution of contact areas on the details of the basic design of children's clothing:
 a – trousers back half; b – trousers front half; c – sleeve

Table 1 – Dimensional characteristics of the protective elements of children's clothing

Details names	Details sizes	Details images
Elbow sleeve protective element	a=6,0 b=6,5	
Trousers side protective element	a=14,0 b=9,0	
Trousers back protective element	a=15,0 b=8,0 b ₁ =6,0	

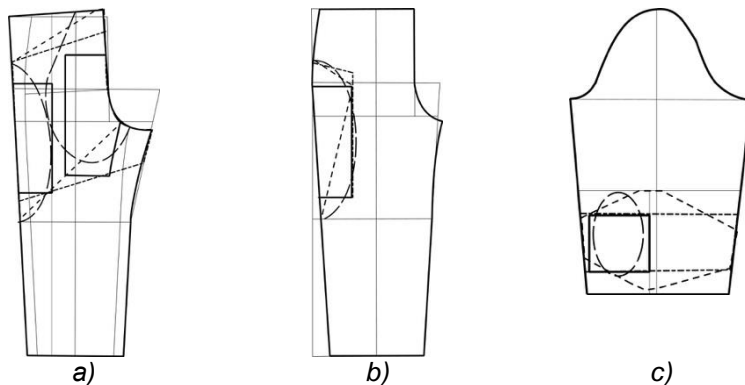


Fig. 5. The main modified design of children's clothing for roller skaters with protective elements and modeling of modification models:

a – trousers back half; b – trousers front half; c – sleeve

According to the study results, the information has been obtained, which made it possible to develop a sequence of modification of the basic design of children's clothing taking into account ergonomic requirements (location and optimal size of protective elements). The developed design is

shown in Figure 5 by a solid line. Using the developed modified design of children's clothes for roller skaters by constructive modeling (Fig. 5) a model range of products with various forms and types of protective elements (Fig. 6) has been received [22].

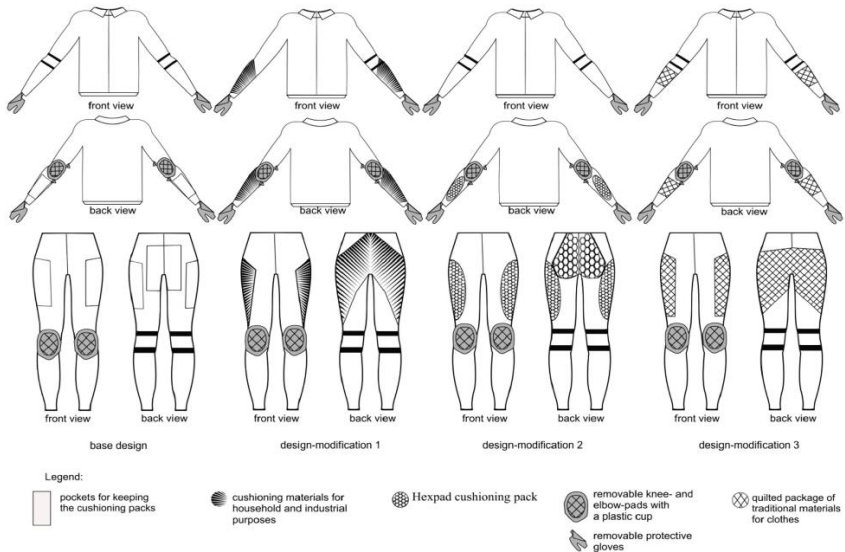


Fig. 6. Model range sketches of children's clothes for roller skaters with various forms and types of protective elements

To ensure the established requirements during the design, the principles of transformation to clothing elements have been applied, which are divided into two groups: those that can provide interdimensional adaptation (Fig. 7) and those that can hold damping materials that should protect the child's body from impact due to falling (Fig. 8).

The choice of rational design of transformative elements of children's clothing for roller skaters has been made by the method of expert evaluation.

Taking into account the results of research, a multifunctional children's suit has been designed, which was researched for dynamic compliance using an ergonomic stand.

The conducted studies have shown that the best dynamic fit is provided by a raglan sleeve with a gusset made of elastic material and a three-dimensional shape of the sleeve in the elbow area, formed by folds on the front seam; trousers with a yoke made of elastic material and three-dimensional shape of the trousers in the knee area due to the folds on the side and step seams.

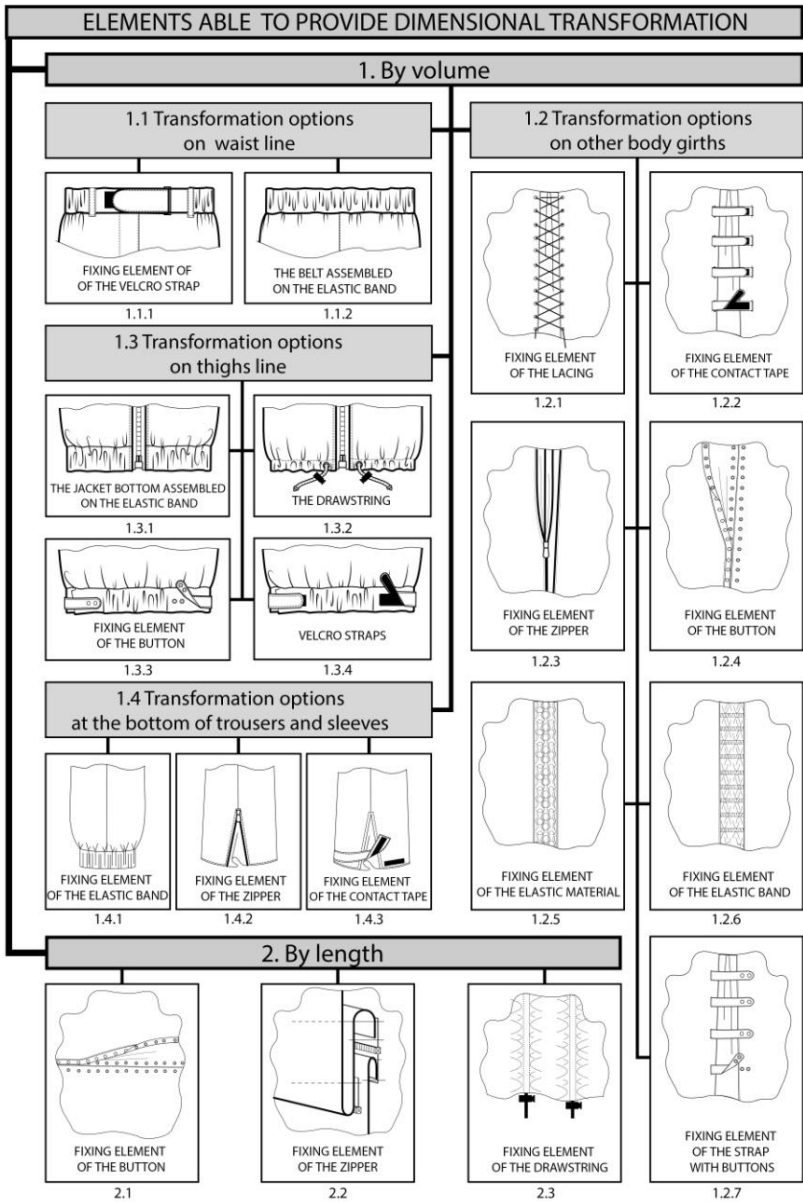


Fig. 7. Matrix of transformative elements that provide interdimensional clothing adaptation

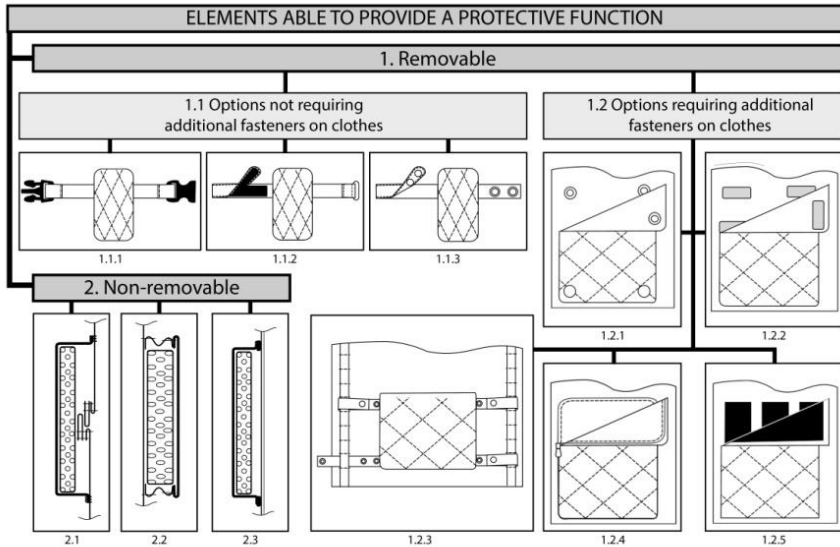


Fig. 8. Matrix of transforming elements that provide a protective function of clothing: 1.1.1 – fixing element of the clamp on the fastex closure; 1.1.2 – fixing element of the clamp on the button closure; 1.1.3 – fixing element of the clamp on the contact tape; 1.2.1 – fixing element of the button; 1.2.2 – fixing element of magnetic buttons; 1.2.3 – fixing element of the clamp with button closure attached to the periodically sewn tape; 1.2.4 – fixing element of the zipper; 1.2.5 – fixing element of the contact tape; 2.1 – fixing element of the inner pocket; 2.2 – fixing element of the patch volume pocket; 2.3 – fixing element of the three-dimensional elastic cavity.

An important factor that affects the consumer demand for garments is also the appearance of the material from which they are made (texture, color scheme, luster, compliance with trends, etc.). The product, as a unit of goods, is evaluated by the consumer when comparing it with the ideal, i.e. a person's idea of beauty, which is formed under the influence of such factors as living standards, climate, national and individual characteristics, etc.

It is known that the colour of clothing for most consumers, as an aesthetic indicator prevails over other groups of quality indicators and affects the emotional and sensory experiences [23].

Peculiarities of psychophysical development of preschool children determine their desire to identify themselves with significant people or film characters, cartoons, etc. And because modern children are constantly under the influence of modern multimedia, they easily create an image in the imagination, which is then imitated in real life, transferring its special

characteristics to their behavior, clothing and games. Obviously, the most successful form of meeting the requirements of age psycho-emotional characteristics of preschool children can be a holistic image-composition solution of children's clothing developed on the basis of associations with cartoon and game images [24]. As a research material, popular multi-series cartoons have been selected, the characters of which, according to the concept developed in the work, have the ability to transform.

The list of cartoons with characters-transformers, which are most often viewed by children of primary school age, has been obtained as a result of parents' survey. The most popular cartoons are listed in Table 2 with the main colour scheme of the main characters' images.

Table 2 – Colour characteristics of the images of the cartoons main characters

Cartoons	Colours											
	black	white	yellow	orange	red	dark blue	green	violet	brown	pink	light blue	turquoise
«Robocar Poly»		+		+	+	+	+					
«Heroes in masks»	+				+	+	+					
«The Fixies»			+	+	+	+	+	+	+	+	+	
«The Transformers»	+	+	+	+	+	+	+					+
Total	2	2	2	3	4	4	4	1		1	1	1

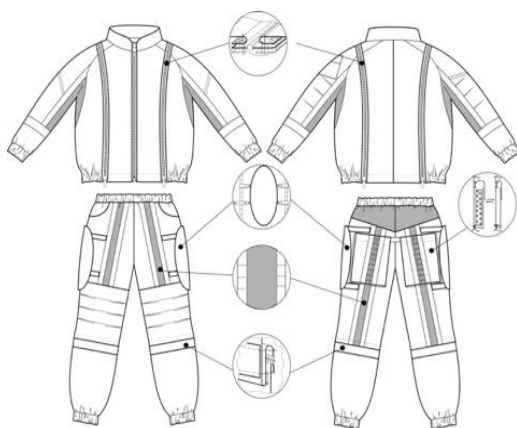


Fig. 8. Design-technological and layout-colour solutions of children's multifunctional suit for roller skaters

As a result of the research the actual colour scale of children's multifunctional suit for roller skaters has been determined, namely the combination of the basic colours of blue and red with finishing inserts of dark blue and bright red colors. Based on the research, an artistic and design solution of the basic model of a children's multifunctional suit for roller skaters has been developed (Fig. 8) [25].

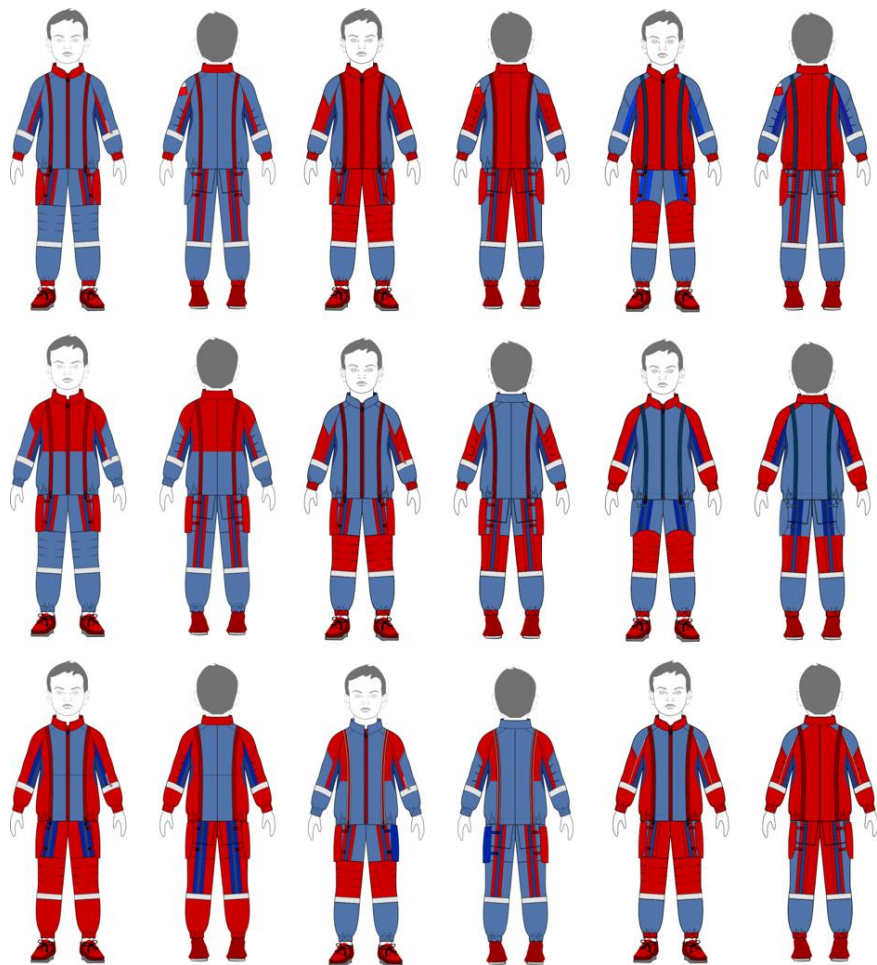


Fig. 9. Models product line of children's multifunctional suit for roller skaters

The suit consists of a jacket, trousers up to the middle of the calf, the removable lower parts of the trousers, protective elements: pads, elbow pads; knee pads and shock absorbers. On the basis of the basic model various stylistic layout and colour solutions of sets of children's clothes for roller skaters have been developed (Fig. 9).

Conclusions. As a result of the conducted research the scientific and technical task of expansion of functional possibilities of modern competitive children's clothes for roller skaters has been solved; regularities of construction of clothes with damping elements and parametric characteristics of protective elements and their location on a typical basic design of children's clothes for typical figures have been researched; the process of designing competitive children's clothing for roller skaters through the use of modern design tools has been improved; a comprehensive approach to the creation of multifunctional clothing has been proposed, according to which the choice of design and technological solutions to ensure interdimensional transformation has been substantiated. An artistic and design solution of a multifunctional children's suit for roller skaters has been developed, the novelty of which has been confirmed by the patent of Ukraine for an industrial design, as well as a range of children's clothing for rollerskating with justification of their layout and colour solutions.

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2.6 MODERN INFORMATION TECHNOLOGIES IN CLOTHING DESIGN

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Abstract. *The analysis of modern programs for clothing design is carried out, the concept of three-dimensional modeling of clothes is considered. For modeling of clothes on a virtual electronic mannequin, the information and methodological support of the process of three-dimensional clothing modeling was improved, the databases of the modifications of clothes parts were developed, the methods of transformation of the basic designs of clothing according to the sketch of the model of the projected form of clothing were improved. Approval of research results in the CAD-system JULIVI.*

Key words: *CAD-system, 3D-design, mannequin, clothes.*

Introduction. Automated design of clothing is one of the most promising directions for the development of modern fashion industry. Today, computer programs automate the whole process of designing clothes from the design of the sketch to the development of product patterns and its simulation on the electronic mannequin. Among the modern programs are two- and three-dimensional design programs. Applications that implement technology design from 2D to 3D design technology allow the visualization of clothing on an electronic mannequin of human shapes. 3D applications in 2D envisage the deployment of a three-dimensional clothing image in ready-made patterns, but this area is not well developed today.

Currently, there are new ways of automated projecting, which allow to increase productivity and quality of developments at different stages of designing new models of clothes: sketch designing of a suit and its transformation into construction of clothes, designing and modeling various assortment of clothes, parametrization the form of clothing, etc. In the direction of three-dimensional visualization and designing clothes of different assortment there was been working software developers for clothing design and foreign researchers such as N. Magnenat-Thalmann, P. Volino, A. Psikuta, J. Wang, V. Yeshchenko, A. Yeshchenko [1], V. Ryabukha, O. Kostukevich, O. Khivrina [2], V. Kuzmichev, G. Surikova [3]. They have actively developed this direction of designing garments and solved the tasks of developing various types of clothing for three-dimensional modeling of clothing.

The work [4] is devoted to the analysis of using 3D scan technologies of the system "human-clothes", the studying of the relationship between the parameters of areas under clothes and fitting

clothes on the human body and the calculation of supplements to different sizes of the body for patterns of clothing.

The results of studying the distribution of the supplements and the thickness of the air gap between the clothes and the body are described in the article [5]. Also, the researchers have determined the effect of the properties of knitwear on the distribution of the air gap and the area of contact clothing with the surface of the human figure.

The influence of the body shape's features and the position of man are considered on the distribution and the size of the air gaps in clothing in [6].

Chinese scientists [7] have been investigated the magnitude and features of the air gaps' distribution in areas under clothes. It is established that the distribution of projective supplements is influenced by such properties of fabrics as stiffness and drapery.

Modeling the shape of horizontal sections of women's jackets was considered in the work of researchers at the Textile Institute in Hong Kong [8]. It has been established that the shape of the horizontal sections of the garment can be modeled by the distribution of supplements in clothes at different heights.

3D digitizer for obtaining three-dimensional body measurement data was proposed by South Korean researchers, which automatically generates a three-dimensional basic design of a product corresponding to an individual figure and automatically generate the patterns of clothes [9].

Experimental studies of the clothing packages' behavior have been carried out in a three-dimensional environment with the use of 3D scanning technology, which contains information on the patterns of changing the surface plastics of clothes under the influence of design parameters of the product.

In the work of I. Petrosova [10] the concept of exterior clothing design has been developed, which provides the ability to select, combine and integrate by the manufacturer of various CAD modules and traditional methods of designing into a single information digital network through the using of 3D technology. Also, this concept provides step-by-step control over the parameters projected product in the form of a sketch, a virtual model, a pattern of clothing.

Statement of the problem. The complexity and ambiguity of the solution of the tasks in relation to the tectonics of clothing require the development of theoretical foundations and conducting additional experimental research aimed at developing a set of measures that provide informational and methodological support for design of clothing with the using of modern technologies. Actual is the establishment of links between the properties of fabrics and the volume and silhouette of clothing in the system of "mannequin-clothes" and the formation of a database sufficient for the formalization of the volume-spatial form of clothing.

Results of the research and their discussion. With the development of modern information technologies, the study of the three-dimensional form of a garment is relevant, taking into account the principles of tectonics. Plane design methods are gradually being replaced by three-dimensional design's technologies of clothing in specialized programs, therefore, the study of the volume-spatial form of clothing, the patterns of operational behavior of materials and their visualization in three-dimensional programs acquire special relevance. In such researches it is possible to distinguish the following main directions:

- studying the surface of a human figure (mannequin) and developing their electronic copies;
- study of the volume-spatial shape of the "mannequin-clothes" system;
- visualization of sewing products in modern programs;
- development of a three-dimensional image of the system "mannequin-clothes" with the subsequent deployment of their surfaces on the plane, etc.

The analysis of literary sources has shown that contact and contactless methods are used to study the surfaces of the mannequin-clothes system. The contact method is used mainly in the study of the forms and sizes of solids surfaces by direct mechanical touch of special tools or by copying the body shape using plastic masses (cut planes, geodesic lines, grids, topography of projections of horizontal sections, calculation and measuring, etc.). In the study of easily deformable surfaces, the most expedient is contactless method with the help of special devices emitting light or electromagnetic waves, a laser beam, etc. Known contactless methods are: photogrammetric, stereophotogrammetrical, simultate stereophotogrammetry, light sections, X-ray, etc. Recently, widespread technology of three-dimensional scanning with the help of white light or laser beam, which allow measuring the spatial coordinates of individual points of the object, for example, digitize the surface of a human figure, represent it in three-dimensional space on the computer screen, remove from the digital image dimensions, etc. Body scanners are characterized by a short measurement time, high accuracy, but high cost. On average, the complete cycle of measuring one body with a body scanner takes 10 seconds and the accuracy of measurements is up to 0.01 cm. Using body scanning systems are carried out contactless measurements of a large number of people, for example, to form national anthropometric standards of figures, as has already been done in the United States, Great Britain, Mexico and other countries.

Of considerable interest is the experience of foreign countries offering devices for contactless measurement of the figure: Cyberwear (USA), Hamamatsu, Hamano (Japan), Textile / Closing Technology

Corporation [TC] 2, Telmat Industrie (France), Vitronic (Germany), TecMath, etc. The data obtained during the scans can be used to obtain an electronic copy of a person's figure or dummy in the form of a sketch, frame with a set of horizontal and vertical sections or a mannequin. Electronic mannequins for clothes and underwear propose CAD Optitex, Israel – module Runway Designer, CAD Gerber Garment Technology, USA – Module V-Stitcher, PAD System, Canada – Module 3D Sample, CAD JULIVI, Ukraine – program JULIVI 3D, CAD Lectra, France – module Modaris 3D Fit, the company Toyobo, Japan – program Lookstailor etc.

The emergence of three-dimensional scanners, the ability to clearly depict on the screen the human figure and design object – clothing (model, suit), influenced the development of automation design subsystems for the designer. One of the most famous and promising garment CAD systems is the program Runway Designer of the Israeli company Optitex. In addition, some firms, for example Reflection Fabrix Inc. and DigiScents, who are not the developers of high-quality garment CADs, offer three-dimensional clothing visualization packages for use when shopping for clothes over the Internet or in place of dressing rooms in clothing stores.

Most of modern garment CAD systems contain a module of simulation of the fabric behavior in the product and take into account some of the materials' properties such as the visual properties (color, texture, ornament) and physical-mechanical properties (stretching in warp and in weft directions, bending, surface density, thickness, etc.) Generation of the physical model of future clothing contains several stages: visualization of its appearance from the material of the top, reproduction of the behavior of the materials' package on the characteristics of its layers, determination of properties, for example, by the method Kawabata Evaluation System.

Realistic simulation tools are increasingly used by designers in cinema, television, advertising and computer games when creating and dressing up virtual characters. Now, when designing stylish textiles and apparel, they are trying to use 3D graphics software to help digitize the dynamics and visual image of the fabric in the product. At the same time, most programs in various industries work at the level of physiological and psychological similarities. This is Autodesk 3ds Max, Alias Wavefront Maya, TrueSpace - Surface Modeling, Tinting and Animation, Amapi 3DTM for building 3D models and more.

In some 3D clothing design systems, there is a certain database of materials that can be replenished by the user. Demonstration modules of individual CAD clothes make it possible to set the behavior of tissue on a moving figure, to analyze the proportions and location of structural and decorative elements, but the reliability of visualization needs further improvement.

At the present stage of the development of the garment industry a new industrial paradigm of clothing design and production has been formed

- the transition from two-dimensional to three-dimensional design of clothing. Virtual design of 3D-based clothing is becoming a major alternative to the traditional approach to designing 2D -grade models and assessing the quality of sewing products at the design stage.

Three-dimensional design of clothing involves creating a three-dimensional image of the clothing model on the monitor screen and getting templates of its parts by deploying the surface of the garment on the plane for the addition of special software. There is a generation of individual or typical dimensional signs of a three-dimensional virtual mannequin of the human figure, the creation of a three-dimensional virtual model of the product on a virtual dummy, taking into account the plastic properties of the fabric, the scanning of the surface of the garment to the plane, with its division into details of the design. The initial data for three-dimensional design in the "figure-clothing" system are: anthropometric database; mathematical models of mannequin surface dressing by garment details, taking into account the properties of fabrics; simulation methods of outer clothing surfaces for different assortment taking into account the package of materials; geometrical methods of transformation of surfaces of a figure or clothes depending on the sketch of the el-style, features of the structure of the consumer's body, the desired volumetric-spatial form of clothing, etc.; methods of deployment surfaces of clothes which based on the study of the shape of a virtual model of clothing, etc.

At present, there are two approaches to three-dimensional design of clothing. The first approach only involves visualizing the appearance of the product on a three-dimensional mannequin of human figures using patterns of a model that pre-designed in other CAD modules or programs. Such programs allow you to reproduce in a three-dimensional not only the design features of the product, but also the visual characteristics of the fabric (color, pattern, etc.). This approach involves the mandatory presence of a three-dimensional mannequin, which today can be built in special programs, taking into account the size of their features of the human figure and the features of its body structure. The construction of the electronic dummy consists of the following steps: determining the magnitude of the dimensional features by scanning the surface of a human body or a physical mannequin using a 3D scanner, photogrammetry, etc.; parametric construction of a surface of a dummy using a database of dimensional features.

The second approach involves the formation of a three-dimensional image of the model of clothing with the subsequent deployment of its surface and the receipt of details. In this case, the three-dimensional image of the clothing model can be created both with the use of a three-dimensional electronic dummy, and without it. The technology of three-dimensional design of clothing in this case can be realized as follows: on a three-dimensional image of a mannequin of the desired size, varying by

projective supplements, the designer creates a model of clothing according to the artistic design (Fig. 1).

Projection supplements between the inner surface of the garment and the surface of the mannequin are the main form-forming parameters for the three-dimensional design of clothing. Using the values of supplements at different parts of the "mannequin-clothes" system, the patterns of their change, depending on the type of clothing, silhouette, form of the model, the properties of tissues is generated the representation of clothing in a three-dimensional space (Fig. 2). On the received three-dimensional image of a clothes put lines of a division and its parts are deployed on a plane. This approach to three-dimensional design makes it possible to adjust the "mannequin-clothes" system depending on the parameters of the mannequin (individual or typical figure), which facilitates the development of the desired shape of the garment's surface. Despite the large number of studies, this approach is only partly implemented in industrial production due to the complexity of the surfaces' deployment of the "mannequin-clothes" system.

The three-dimensional modeling of clothing involves the transformation of pre-designed in any way patterns of the basic design of clothing into a three-dimensional image of the model after the task of rules for their virtual "cross-linking" on the electronic dummy (Fig. 3). Next the dividing lines is putted on the three-dimensional image of the model and then the parts of the surface of the virtual model design is deployed to the plane.

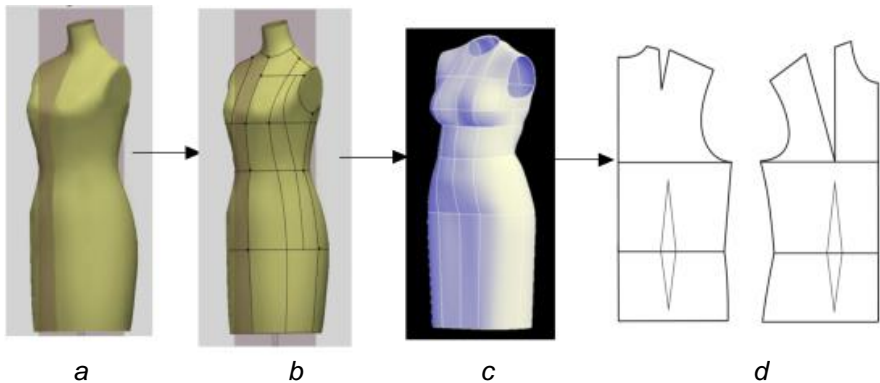


Fig. 1. Stages of three-dimensional design of clothes:
a – mannequin; *b* – the surface of clothes, built from the surface of the mannequin; *c* – the surface of clothing; *d* – ready patterns

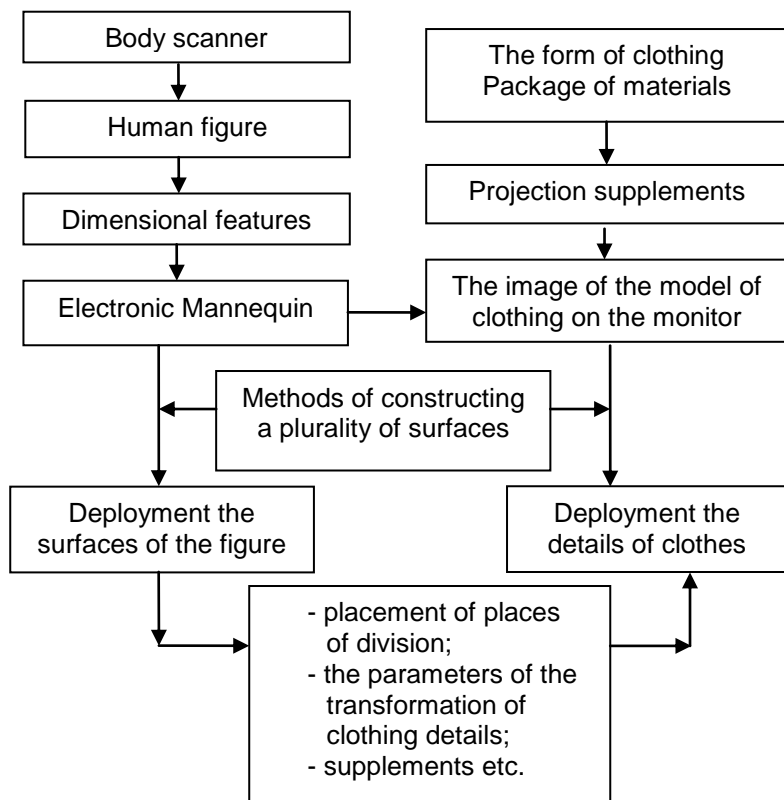


Fig. 2. Sequence of three-dimensional deployment the surfaces of clothes

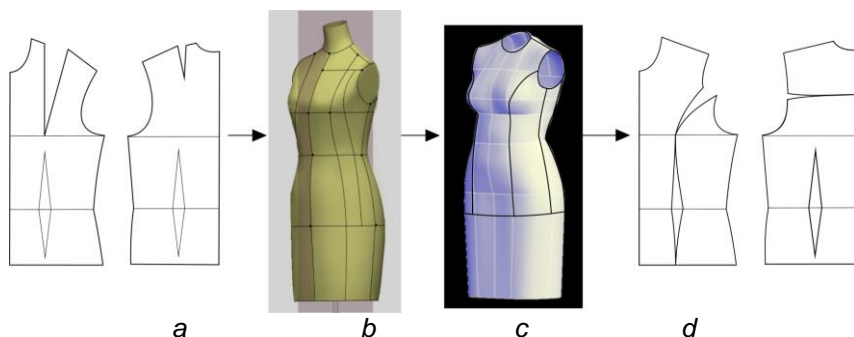


Fig. 3. Stages of three-dimensional clothing design:
a – flat shapes of the basic design; *b* – mannequin; *c* – clothing surface; *d* – patterns of model design

In order to obtain a three-dimensional image of a garment, patterns are used to ensure the quality of planting of the product, that is, they are designed taking into account the properties of the fabrics, manufacturing technology and other output parameters and checked in the material. As a result of three-dimensional modeling, the new model will have the same landing quality as the original base design. In addition, this method allows you to get a variety of clothing patterns for different sizes and growths.

Developers of CAD Lectra in 2005 patented a method for designing garments that comprises the following steps: imaging appearance clothes on electronic human mannequin, modeling clothing details on the electronic dummy, obtaining patterns of clothing details [11]. The approach is promising for the mass production of clothing, because it allows at least partially solve the problem of obtaining details of a three-dimensional virtual product model. For example, Toyobo's program Lokstailor (Japan), offers the ability to modeling garments in three-dimensional space and obtain patterns of clothing, but the resulting patterns do not provide the quality of planting the product on the figure of human [12].

The most effective variant offers JULIVI CAD in its 3D modeling software [2]. The first version of the "Electronic Mannequin" program of the JULIVI complex implemented the functions of three-dimensional modeling, which involves applying model lines to the product and transferring them to the patterns, changing the silhouette of the model by modifying its cross-section at a certain level, three-dimensional graphics of the patterns, etc. The principal difference of this program from the other is the connection of the product forms and its three-dimensional image on the electronic dummy, in which the mechanism of modification of the worked-out quality base design of clothing is implemented.

For modeling of clothes on a virtual electronic mannequin, we have improved the informational and methodological support of the process of three-dimensional clothing modeling, namely the development of databases for the modification of clothing details, improved methods for transforming the basic constructions of clothing, in accordance with the sketch of the model, the projected form of clothing, etc. To create a program of three-dimensional clothing modeling we have solved the following positions:

- the optimal location of the points and the location of the minimum necessary lines for the design of clothing designs on a three-dimensional mannequin (24 points, of which 6 are anthropometric) are determined;
- between the points on the surface of the electronic mannequin and the points of the surface of the basic design of clothing were established interconnections;
- the database of methods of transformation of details of basic constructions of different types with consideration of properties of materials is developed;

- the sequence was investigated and the optimal parameters of the construction of humeral men's and women's clothing are determined experimentally.

Developed elements of the informational support of the three-dimensional clothing modeling process can be implemented into a three-dimensional clothing modeling program.

Today, manufacturers propose mainly programs for dressing virtual clothing models in order to visualize the finished fabric, which also requires knowledge of the laws of tectonic-plastic behavior of fabrics.

We have tested the results of the study in the JULIVI 3D program. The JULIVI 3D [2] program provides an opportunity for a high degree of realism to evaluate the external cost of a model of clothing, taking into account the physical and mechanical properties of tissues and the nature of the interaction of tissue with the surface of the mannequin. The "dressing" of templates pre-designed in other JULIVI CAD modules is being implemented on a three-dimensional virtual mannequin - a copy of the figure of a real person. It is also possible to edit the design of the finished product: the choice of color solution, the pattern of fabric, the application and combination of different in texture and texture materials, the selection of structural and decorative elements, decoration and fittings. The program has the ability to put on the dummy several products to assess the harmony of their combination and quality of landing; take into account the thickness of the package of materials when rendering the product, so with all the alternatives to existing programs, CAD JULIVI has, in its technical parameters, has sufficient advantages for designing clothing and conducting research. The sequence of work with a three-dimensional electronic mannequin is as follows: the transfer of patterns from the program Maestro to JULIVI CLO3D; layout the patterns in 2D window; pairs of seams that need to be sewn; Location of the molds around the electronic dummy; simulation of mannequin dressing; problem of material properties; design of the model (fig. 4, a).

The JULIVI 3D program contains mannequins for women's, men's and children's figures. Mannequins are formed on the main dimensions, the main of which is the growth and waist circumference. When changing these dimensional signs, the rest of the signs change automatically and proportionally. It is possible to use the finished mannequin of the desired size or set the size manually. The database of the program includes mannequins of typical figures of women and men, children's figures of different age groups. The mannequin can be adjusted to an individual figure, but only if the figure of the customer has a slight deviation from the dimensional features of a typical figure.

In the program it is possible to evaluate the quality of landing a virtual clothing on a virtual figure, for example: to assess the balance, the location of the side seams, shoulder seams, constructive and decorative

elements, etc.; the presence and absence of defects and the nature of tissue's folds at different sites; fitting status of garment; the comfort of the product due to the color chart, which shows the force of pressure on the mannequin at the indicated point; measure the distance between the product and the surface of the mannequin for checking and specifying the magnitude of the supplements for free placement; determine the locations of the contact of the mannequin with the garment (bearing surface), etc. This information is similar to what getting as a result of fitting ready clothing, but the advantages are substantial due to the saving of materials on the production of experimental sample and time at its cutting and manufacturing.

In the process of simulation (dressing the patterns on a virtual mannequin) it is possible to build assemblies, folds, to do something like bend the collar of the garment. The fabric properties are taken into account at visualizing: tensile in warp, weft and diagonal directions, stiffness, draperiness, surface density. Units of measurement of these indicators differ from standardized, only the index of surface tissue density coincides. The program has a database of the characteristics of the main materials (jeans, knitted cloth, jersey, wool, leather, satin, etc.), as well as decorating (fittings, shoulder pads, leather strap, etc.). Degree of realism drapery I material in the program is quite high due to the use of a special structural clothing grid, which consists of equilateral triangles. The size of the triangle side of the grid (from 5 to 10 mm) depends on the degree of realism of the product on the figure: the smaller it is, the more accurate and more detailed the image of clothing looks. The results of the simulation some garments in three-dimensional space with the help of the JULIVI 3D program was highly realistic (Fig. 4, b).

Approbation in the production conditions of our proposed recommendations for taking into account the properties of the tissues and the location of the shoulder sewing product, taking into account the distribution of the supplements at the main constructive levels on the electronic mannequin in the JULIVI 3D program for visualizing of models with the subsequent manufacture of products in the conditions of serial production, showed:

- a high degree of conformity the appearance of finished products to the computer model of the clothing and an adequate reflection of its silhouette and compositional design solution;
- shortening the terms of products' design for a typical and individual figure of consumers as a resulting of excluding examples;
- improving the quality of the drawings of details of garment designs due to the possibility of making adjustments to the drawing based on the results of the virtual sample;



Fig. 4. Models of clothing and their three-dimensional virtual copies in JULIVI 3D

– shortening the time for the development of new clothing patterns due to the possibility of executing simulations in three-dimensional space (changing the length of the product, the sleeves, the configuration of the collar, lapels, boards, etc.).

Conclusions. The analysis the programs of 2D in 3D technology showed a sufficient level of their development and the realism of the models received. The comparative analysis of programs that provide the possibility of visualization of clothes on the electronic mannequin of human figures taking into account the features of human body structure, sex, size and growth are considered and performed. The advantages of the programs considered are the ability to put on a model design on a virtual mannequin, which saves time on the production of a prototype. The disadvantages are that the presented modules require improvement because they do not provide ideal visualization. Among the programs of 3D in 2D technology have analyzed the capabilities of the programs for three-dimensional modeling of clothing LookStailor (Japan) and Tukatech (USA). They allow automatic generation of 2D finished patterns from the 3D representation of a sewing items. Such programs are easy to use, they are in demand from ordinary clothing consumers, and not by the specialists of clothing industry, because their main disadvantage is the inadequate quality of the resulting patterns. After analyzing the possibilities of the considered programs, we were concluded that the most successful programs are the hybrid-type one that implement 2D in 3D technology with the further simulation of clothing in three-dimensional space.

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