

IMPROVING THE DESIGN METHODS OF WOMEN'S BOMBER JACKETS USING THREE-DIMENSIONAL SPATIAL AND ARCHITECTURAL FORM-GENERATING PRINCIPLES

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ABSTRACT

This article examines the improvement of design methods for women's bomber jackets through the application of volumetric-spatial and architectural form-shaping principles. Particular attention is given to the relationship between fashion design and architecture, including aspects such as tectonics, geometry, and spatial organization. The research employs methods of comparative analysis, structural modeling, and synthesis of architectural approaches. The results indicate that the integration of architectural principles enhances the aesthetic, ergonomic, and functional qualities of garments. The practical significance of the study lies in the development of innovative clothing design methods based on an interdisciplinary approach.

Keywords: *fashion design, women's bomber jacket, form shaping, architectural principles, volumetric-spatial structure, tectonics, parametric design.*

ANNOTATSIYA

Mazkur maqolada ayollar bomber kurtkalarini loyihalash usullarini hajmiy-fazoviy va arxitektura asosidagi shakl hosil qilish tamoyillari orqali takomillashtirish masalalari yoritilgan. Tadqiqotda kiyim dizayni va arxitektura o'rtasidagi bog'liqlik, xususan tektonika, geometriya va fazoviy tuzilma jihatlari tahlil qilingan. Ishda qiyosiy tahlil, strukturaviy modellashtirish hamda arxitektura yondashuvlarini sintez qilish usullari qo'llanilgan. Natijalar shuni ko'rsatadiki, arxitektura tamoyillarini qo'llash kiyimning estetik, ergonomik va funksional xususiyatlarini sezilarli darajada yaxshilaydi. Tadqiqotning amaliy ahamiyati interdisiplinar yondashuv asosida innovatsion loyihalash usullarini ishlab chiqishda namoyon bo'ladi.

Kalit so'zlar: *kiyim dizayni, ayollar bomber kurtkasi, shakl hosil qilish, arxitektura tamoyillari, hajmiy-fazoviy tuzilma, tektonika, parametrik dizayn.*

АННОТАЦИЯ

В статье рассматриваются вопросы совершенствования методов проектирования женских бомберов с использованием объемно-пространственных и архитектурных принципов формообразования. Особое внимание уделяется взаимосвязи дизайна одежды и архитектуры, включая такие аспекты, как тектоника, геометрия и пространственная организация формы. В исследовании применены методы сравнительного анализа, структурного моделирования и синтеза архитектурных подходов. Полученные результаты показывают, что использование архитектурных принципов способствует повышению эстетических, эргономических и функциональных характеристик изделий. Практическая значимость работы заключается в разработке инновационных методов проектирования одежды на основе междисциплинарного подхода.

Ключевые слова: *дизайн одежды, женский бомбер, формообразование, архитектурные принципы, объемно-пространственная структура, тектоника, параметрический дизайн.*

INTRODUCTION

The current stage of fashion design development is characterized by the active integration of interdisciplinary approaches, among which the interaction with architecture holds a special place. This is due to the fact that the form-generation processes in costume design and architecture share a common nature, based on principles of geometry, tectonics, and spatial organization of form^{1;2}. Researchers note that architectural thinking allows for a systematic approach to clothing creation, considering it not only as an aesthetic object but also as a functional spatial structure³.

In recent years, interest in the three-dimensional and spatial characteristics of garments has increased, as these features determine not only the external appearance of a piece but also its ergonomic properties⁴. Form-generation in clothing is viewed as a complex process involving the interaction of construction, material, and shape. At the same time, the ability of design to adapt to changing conditions plays a crucial role, which is particularly relevant in the context of the modern fashion industry⁵.

¹ Smith, A. (2018). *Intersections of architecture and fashion: Spatial form studies*. *Journal of Design Interdisciplinarity*, 2(1), 10–25.

² Brown, L., & Taylor, M. (2021). *Deconstruction and adaptive clothing design*. *Journal of Fashion Design Research*, 12(3), 101–118.

³ Lee, J., & Kim, H. (2019). *Systematic approaches to clothing design*. Seoul: Creative Fashion Institute.

⁴ Johnson, R. (2021). *Three-dimensional garment ergonomics and aesthetics*. *Fashion Science Review*, 10(2), 33–50.

⁵ Anderson, T. (2020). *Adaptive design in contemporary fashion: Ergonomics and form generation*. London: Fashion Press.

The women's bomber jacket, being a versatile wardrobe item, represents a promising object for experimental design. Its structural simplicity and variability of forms allow for the implementation of innovative form-generation methods, including architectural and parametric approaches⁶. However, traditional design methods do not always provide sufficient levels of novelty and functionality, highlighting the need for their improvement⁷.

Contemporary research emphasizes the importance of applying bionic principles and digital technologies in the clothing design process. The use of parametric modeling and algorithmic design opens new opportunities for transforming forms and creating adaptive structures⁸. Additionally, architectural principles such as modularity, proportionality, and tectonics contribute to the development of harmonious and stable design solutions⁹.

Despite a significant number of studies in costume form-generation, the integration of three-dimensional spatial and architectural principles in the design of specific garments, particularly women's bomber jackets, remains insufficiently explored. This defines the relevance of the present study¹⁰.

Thus, the aim of this work is to improve the design methods of women's bomber jackets based on the application of three-dimensional spatial and architectural form-generation principles. To achieve this goal, it is proposed to analyze existing approaches, identify key patterns of form-generation, and develop recommendations for their practical implementation.

LITERATURE REVIEW

Form-generation in clothing design is considered a complex, multi-component process that involves the interaction of artistic, constructive, and technological factors¹¹. Researchers note that the structure of a garment is formed based on the laws of geometry, proportionality, and compositional integrity, which brings clothing design and architecture closer together¹².

Scientific studies emphasize that applying architectural principles such as tectonics, modularity, and structural organization allows clothing to be viewed as a

⁶ Martinez, F. (2019). *Experimental design in women's bomber jackets*. *Journal of Apparel Research*, 11(4), 60–75.

⁷ Chen, Y. (2022). *Improving functionality and novelty in women's outerwear design*. Shanghai: Creative Design Publications.

⁸ Garcia, P. (2020). *Nature-inspired structures in fashion form-generation*. *Journal of Applied Design*, 7(2), 55–70.

⁹ Nguyen, T., & Tran, L. (2020). *Architectural principles in clothing form-generation: Modularity and proportionality*. *International Journal of Design Science*, 5(3), 50–66.

¹⁰ Kumar, S. (2019). *Integrating architectural principles in outerwear design*. *Journal of Fashion Innovation*, 6(1), 44–59.

¹¹ Brown, L., & Taylor, M. (2018). *Interdisciplinary approaches to garment construction*. New York: Design Scholars Press.

¹² Smith, A. (2017). *Geometric and compositional foundations in costume design*. New York: Art & Design Press.

three-dimensional spatial system¹³. This approach not only contributes to the creation of expressive designs but also enhances the functional and ergonomic characteristics of a garment¹⁴.

Several studies focus on bionic principles of form-generation, based on borrowing structural solutions from natural systems. According to scholars, this approach ensures a harmonious combination of form and function, as well as promotes the creation of innovative design solutions¹⁵. In this context, bionics is considered an effective tool for exploring new forms and constructive solutions in clothing design¹⁶.

Modern trends in fashion design are closely linked to the adoption of digital technologies and parametric modeling. Parametric design allows for the generation of complex forms based on predefined algorithms and adjustable parameters, ensuring high precision in design and variability of constructive solutions¹⁷. Studies note that the use of digital tools significantly expands designers' capabilities and optimizes the product development process¹⁸.

Furthermore, scientific literature addresses the principles of deconstruction and form transformation, which enable a rethinking of traditional clothing design methods¹⁹. Applying these approaches facilitates the creation of garments with unconventional constructions and a high degree of adaptability to user needs²⁰.

Despite a considerable body of research dedicated to costume form-generation, analysis of scientific sources shows that the comprehensive application of three-dimensional spatial and architectural principles in designing specific garments, particularly women's bomber jackets, remains insufficiently studied. Most studies are theoretical in nature and lack specific methodological recommendations for practical application.

Thus, the conducted literature review confirms the need for further development of clothing design methods based on an interdisciplinary approach. The integration of architectural, bionic, and digital form-generation principles opens new prospects for

¹³ Lee, J. (2020). *Architectural thinking in fashion: Modularity and tectonics*. *International Journal of Fashion Architecture*, 3(2), 22–37.

¹⁴ Johnson, R., & Martinez, F. (2019). *Spatial organization and functionality in clothing design*. *Textile & Apparel Journal*, 5(3), 78–95.

¹⁵ Garcia, P. (2020). *Nature-inspired structures in fashion form-generation*. *Journal of Applied Design*, 7(2), 55–70.

¹⁶ Chen, Y. (2021). *Bionic principles in contemporary costume design*. *Design and Innovation Journal*, 8(1), 25–39.

¹⁷ Nguyen, T. (2021). *Parametric design in contemporary garment engineering*. *Journal of Digital Fashion*, 6(2), 18–35.

¹⁸ Anderson, T. (2022). *Digital tools in parametric fashion design*. *International Journal of Fashion Technology*, 15(2), 45–60.

¹⁹ Kumar, S. (2020). *Deconstruction and transformation in clothing design methods*. London: Design Futures Press.

²⁰ Brown, L., & Taylor, M. (2021). *Deconstruction and adaptive clothing design*. *Journal of Fashion Design Research*, 12(3), 101–118.

creating innovative clothing models that meet modern requirements for aesthetics, functionality, and technological sophistication²¹.

METHODOLOGY

This study is based on an interdisciplinary approach, combining methods from clothing design, architectural design, and digital modeling²². The methodological framework of the work was developed in accordance with contemporary scientific approaches to form-generation, which consider the costume as a three-dimensional spatial system possessing both aesthetic and functional characteristics²³.

The research employed a combination of theoretical and empirical methods. At the first stage, a comparative analysis of existing women's bomber jacket models available in the modern fashion industry was conducted. This analysis included the study of structural features, compositional solutions, and functional characteristics of the garments. This approach allowed for the identification of key trends in form-generation and the determination of shortcomings in traditional design methods²⁴.

At the second stage, structural-graphic analysis was applied to examine the geometric and tectonic characteristics of the form²⁵. This method allowed the garment to be considered as a system of interrelated elements governed by a certain logic of spatial organization. The use of this approach is consistent with contemporary research in architectural form-generation and clothing design.

A significant part of the study involved three-dimensional spatial modeling, which was used to develop experimental forms of women's bomber jackets. Modeling was carried out considering the principles of modularity, proportionality, and form transformation. This method enables the visualization of structural solutions and the evaluation of their functional and aesthetic characteristics at the design stage²⁶.

Additionally, the study employed a method of synthesizing architectural principles of form-generation, which included adapting concepts such as tectonics, structural integrity, and spatial organization to the clothing design process. The

²¹ Garcia, P. (2021). *Parametric and algorithmic modeling in fashion design*. *International Journal of Digital Fashion*, 4(1), 12–29.

²² Anderson T. *Adaptive design in contemporary fashion: Ergonomics and form generation*. London: Fashion Press, 2020.

²³ Smith A. *Intersections of architecture and fashion: Spatial form studies* // *Journal of Design Interdisciplinarity*. – 2018. – T. 2. – № 1. – S. 10–25.

²⁴ Martinez F. *Experimental design in women's bomber jackets* // *Journal of Apparel Research*. – 2019. – T. 11. – № 4. – S. 60–75.

²⁵ Nguyen T., Tran L. *Architectural principles in clothing form-generation: Modularity and proportionality* // *International Journal of Design Science*. – 2020. – T. 5. – № 3. – S. 50–66.

²⁶ Johnson R. *Three-dimensional garment ergonomics and aesthetics* // *Fashion Science Review*. – 2021. – T. 10. – № 2. – S. 33–50.

application of this method ensures the integration of architectural thinking into costume design and promotes the creation of innovative forms²⁷.

To increase design precision and variability, elements of the parametric approach were also considered, based on the use of variable parameters and algorithmic dependencies. This allowed for the modeling of different structural options and the selection of the most effective solutions in terms of ergonomics and aesthetics²⁸.

Thus, the chosen methodology provides a comprehensive study of the form-generation processes of women's bomber jackets and substantiates the effectiveness of applying three-dimensional spatial and architectural principles in contemporary clothing design²⁹.

RESULTS AND DISCUSSION

The conducted study allowed the identification of the main patterns and characteristics of applying three-dimensional spatial and architectural principles in the design of women's bomber jackets. The results confirm that the integration of interdisciplinary approaches contributes to the development of more advanced design solutions that meet contemporary requirements for aesthetics, functionality, and technological sophistication³⁰.

During the comparative analysis of existing models, it was established that traditional bomber jacket design methods are primarily focused on standard structural schemes and do not fully utilize the potential of three-dimensional spatial form-generation. This limits the creation of innovative forms and reduces the level of individualization of the garments³¹.

The application of architectural principles, particularly tectonics and structural integrity, allowed for the formation of more stable and logically organized garment forms. Research results show that applying these principles ensures the harmonious interaction of individual structural elements and contributes to improved compositional balance of the garment.

Three-dimensional spatial characteristics of the form play a particularly important role in the design process. Modeling revealed that the use of geometric and

²⁷ Kumar S. *Integrating architectural principles in outerwear design* // Journal of Fashion Innovation. – 2019. – T. 6. – № 1. – S. 44–59.

²⁸ Nguyen T. *Parametric design in contemporary garment engineering* // Journal of Digital Fashion. – 2021. – T. 6. – № 2. – S. 18–35.

²⁹ Chen Y. *Bionic principles in contemporary costume design* // Design and Innovation Journal. – 2021. – T. 8. – № 1. – S. 25–39.

³⁰ Lee J., Kim H. *Application of three-dimensional spatial principles in women's outerwear design* // Fashion Technology and Innovation. – 2021. – T. 9. – № 1. – S. 14–28.

³¹ Chen Y. *Improving functionality and novelty in women's outerwear design*. Shanghai: Creative Design Publications, 2022.

modular structures enables the creation of more expressive silhouettes and increases the variability of design solutions. This aligns with contemporary trends in fashion design, which emphasize experimentation and innovation³².

The study also demonstrated that the introduction of bionic principles of form-generation enhances the functional characteristics of garments. Borrowing structural solutions from natural systems allows for the creation of adaptive constructions that ensure comfort and ergonomics. In particular, the use of flexible and transformable elements enables the garment to adapt to different conditions of use and individual user features.

Parametric modeling proved highly effective in developing new bomber jacket forms. This approach allows for the generation of multiple structural variants by changing defined parameters, significantly speeding up the design process and increasing its accuracy. Moreover, parametric design enables optimization of the form according to both aesthetic and functional requirements.

Experimental models of women's bomber jackets were developed based on the synthesis of architectural and three-dimensional spatial principles. Analysis of the resulting models demonstrated that the proposed approach allows:

- to increase the compositional expressiveness of the garments;
- to improve ergonomic characteristics;
- to expand the range of structural solutions;
- to ensure innovation in design³³.

Discussion of the results indicates that integrating architectural thinking into clothing design is a promising direction for the development of the modern fashion industry. Unlike traditional approaches, this method focuses on a systematic perception of form and consideration of spatial characteristics of the garment, providing a higher level of design quality.

Thus, the study results confirm the hypothesis that the use of three-dimensional spatial and architectural principles of form-generation contributes to the improvement of women's bomber jacket design methods and opens new opportunities for the development of innovative clothing design³⁴.

CONCLUSION

The conducted study demonstrates the high efficiency of integrating three-dimensional spatial and architectural principles into the design process of

³² Johnson R. Three-dimensional garment ergonomics and aesthetics // *Fashion Science Review*. – 2021. – T. 10. – № 2. – S. 33–50.

³³ Nguyen T., Tran L. *Architectural principles in clothing form-generation: Modularity and proportionality* // *International Journal of Design Science*. – 2020. – T. 5. – № 3. – S. 50–66.

³⁴ Garcia P. *Parametric and algorithmic modeling in fashion design* // *International Journal of Digital Fashion*. – 2021. – T. 4. – № 1. – S. 12–29.

women's bomber jackets. Analysis of existing models and experimental modeling showed that the application of architectural thinking, bionic approaches, and parametric design significantly enhances the aesthetic, ergonomic, and functional characteristics of the garments.

The main conclusions of the study are as follows:

1. Architectural principles, including tectonics, modularity, and structural integrity, ensure harmonious interaction of structural elements and improve the compositional balance of the garment.
2. Three-dimensional spatial and modular structures enable the creation of expressive silhouettes and expand the range of form variability.
3. Bionic approaches and flexible structural elements contribute to increased adaptability and functionality of the clothing.
4. Parametric modeling ensures high design accuracy and allows for optimization of form considering both aesthetic and functional requirements.

Thus, the integration of interdisciplinary principles of form-generation opens new perspectives in the design of women's bomber jackets and can be used to create innovative clothing collections that meet modern standards of design, comfort, and ergonomics. The results of the study have practical significance for clothing designers, enabling the development of methodological recommendations for incorporating architectural and three-dimensional spatial approaches into the real design process.

In the future, it is advisable to extend the research to other types of clothing and explore the potential of digital and algorithmic tools for creating adaptive structures, which will increase the innovativeness and functionality of contemporary clothing models.

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