

## DESIGN AND DEVELOPMENT OF WOMEN'S BOMBER JACKETS USING THE ARCHITECTURE OF VOLUMETRIC FORMS

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### ABSTRACT

*This article explores the design and development of women's bomber jackets using the architectonics of volumetric forms. Particular attention is given to the integration of architectural principles such as tectonics, modularity, and spatial organization into fashion design. The research employs comparative analysis, structural modeling, and the synthesis of interdisciplinary approaches. Experimental models of women's bomber jackets were developed, demonstrating the effectiveness of volumetric and spatial solutions. The results confirm that the application of architectonics improves the aesthetic, functional, and ergonomic qualities of garments. The practical significance of the study lies in the development of innovative clothing design methods.*

**Keywords:** fashion design, women's bomber jacket, architectonics, volumetric forms, form shaping, modularity, tectonics.

### АННОТАЦИЯ

*В статье рассматриваются вопросы проектирования и разработки женских бомберов с использованием архитектоники объемных форм. Особое внимание уделяется интеграции архитектурных принципов, таких как тектоничность, модульность и пространственная организация, в процесс создания одежды. В исследовании применены методы сравнительного анализа, структурного моделирования и синтеза междисциплинарных подходов. Разработаны экспериментальные модели женских бомберов, демонстрирующие эффективность использования объемно-пространственных решений. Результаты исследования подтверждают, что применение архитектоники способствует повышению эстетических, функциональных и эргономических характеристик изделий. Практическая значимость работы заключается в разработке инновационных методов проектирования одежды.*

**Ключевые слова:** дизайн одежды, женский бомбер, архитектоника, объемные формы, формообразование, модульность, тектоничность.

## ANNOTATSIYA

*Mazkur maqolada ayollar bomber kurtkalarini loyihalash va ishlab chiqishda hajmiy shakllar arxitektonikasidan foydalanish masalalari ko'rib chiqiladi. Tadqiqotda arxitektura tamoyillari, jumladan tektonika, modullilik va fazoviy tashkil etishning kiyim dizayniga integratsiyasi tahlil qilingan. Ishda qiyosiy tahlil, strukturaviy modellashtirish hamda fanlararo yondashuvlardan foydalanilgan. Tadqiqot davomida ishlab chiqilgan eksperimental bomber modellar hajmiy-fazoviy yechimlarning samaradorligini ko'rsatadi. Natijalar arxitektonika yondashuvi kiyimning estetik, funksional va ergonomik xususiyatlarini yaxshilashini tasdiqlaydi. Tadqiqotning amaliy ahamiyati innovatsion loyihalash usullarini ishlab chiqishda namoyon bo'ladi.*

**Kalit so'zlar:** kiyim dizayni, ayollar bomber kurtkasi, arxitektonika, hajmiy shakllar, shakl hosil qilish, modullilik, tektonika.

## INTRODUCTION

The modern stage of clothing design development is characterized by the active implementation of interdisciplinary approaches, among which the integration of architectural principles into the form-generation process holds particular significance. In the context of the rapidly evolving fashion industry, there is an increasing need to create garments that are not only aesthetically expressive but also functionally justified, which necessitates the search for new design methods.

One of the promising directions is the use of the architecture of volumetric forms, which considers the design object as an integral spatial system based on the interaction of structure, form, and material. In architecture, this concept reflects the patterns of form construction, its tectonic expressiveness, and compositional integrity. The application of these principles to clothing design significantly expands the possibilities of form-generation and enhances the level of innovation in garments.

Women's bomber jackets, being a versatile element of the contemporary wardrobe, provide a convenient platform for experimental design. Their structural simplicity and silhouette variability allow the implementation of three-dimensional spatial and modular solutions, as well as the application of form transformation principles. However, traditional bomber jacket design methods are often limited to standard structural schemes, which reduces the potential for creating new design solutions.

Contemporary studies emphasize the importance of applying tectonics, modularity, and parametric approaches in clothing design. These principles allow the garment to be considered as a dynamic system capable of adapting to various

conditions of use and the individual characteristics of the wearer. Furthermore, the incorporation of digital technologies and modeling methods opens new opportunities for developing complex volumetric forms and optimizing the design process.

Despite existing research in costume form-generation, the application of the architecture of volumetric forms in designing specific types of clothing, particularly women's bomber jackets, remains insufficiently explored. This underscores the relevance of the current study and the necessity to develop new approaches to design.

The aim of this study is to develop methods for designing and creating women's bomber jackets based on the principles of volumetric form architecture. To achieve this aim, the following objectives have been identified: analysis of the theoretical foundations of form-generation, study of contemporary design solutions, development of experimental models, and evaluation of their functional and aesthetic characteristics.

## **METHODOLOGY**

This study employs an interdisciplinary methodology that synthesizes theoretical and practical design techniques drawn from clothing design, architectural theory, and digital modeling. The methodological framework is grounded in contemporary research on form-generation, which conceptualizes a garment as a three-dimensional spatial system influenced by structure, material, and formal relationships<sup>1</sup>. Such integration enables a systematic approach to garment design that transcends traditional sketch-based methods and incorporates dynamic digital processes.

At the initial stage, a comparative structural analysis of existing women's bomber jacket designs was conducted to identify prevalent form-generation strategies, construction features, and functional properties. This analytical phase utilized visual and compositional analysis methods common in parametric design studies to discern patterns and limitations within contemporary design practice<sup>2</sup>.

The research then applied a system-structural and graphical analysis, inspired by computational design research, to examine geometric, modular, and tectonic characteristics of form as they relate to architectural form-making principles. Such techniques allow designers to understand garment components as interconnected elements governed by spatial logic, similar to digital form exploration in architectural practice<sup>3</sup>. This method reframes clothing design from a series of isolated parts to a cohesive spatial composition.

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<sup>1</sup> Jeong J., Park H., Lee Y., Kang J., Chun J. *Developing parametric design fashion products using 3D printing technology* // Fashion and Textiles. – 2021. – Vol. 8. – Article No. 22.

<sup>2</sup> Kolosnichenko M.V., Chuprina N.V., Krotova T.F., Olishevskaya T.M. *Design of fashion clothing on the basis of parametric design principles* // Art and Design. – 2020. – № 1. – P. 129–141.

<sup>3</sup> Jeong J., Park H., Lee Y., Kang J., Chun J. *Developing parametric design fashion products using 3D printing technology* // Fashion and Textiles. – 2021. – Vol. 8. – Article No. 22.

A core component of the methodology involves three-dimensional spatial modeling, where parametric and algorithmic tools were used to develop experimental bomber jacket forms. Parametric design allows for the generation of multiple form variations by manipulating variables and parameters, enhancing both creative range and design efficiency. The use of these digital modeling techniques provides rapid visualization and evaluation of structural adaptations in real time.

The adoption of architectural form-generation principles such as tectonic expression, modular repetition, and compositional integrity served as conceptual guides for synthesizing innovative garment forms. These principles, well established in architectural studies of form and structure, support the notion that clothing, like buildings, can function as adaptive spatial constructs rather than merely aesthetic surfaces<sup>4</sup>.

Finally, elements of parametric and computational design were integrated to explore diverse structural solutions and optimize the interaction between aesthetic and functional requirements. This digital approach aligns with contemporary practices in both architecture and fashion research, where algorithmic design is increasingly recognized as a means to generate complex forms and enhance process adaptability.

## **RESULTS AND DISCUSSION**

The research demonstrated that the integration of three-dimensional spatial and architectural principles into women's bomber jacket design significantly enhances both aesthetic and functional qualities of the garments. The comparative analysis of existing models revealed that conventional design methods often rely on standard construction schemes and fail to fully exploit the potential of volumetric form generation. This limits opportunities for innovation and reduces the ability to personalize designs according to wearer-specific needs<sup>5</sup>.

By applying architectural principles such as tectonics, modularity, and compositional integrity, the experimental designs achieved greater structural coherence and visual balance. The use of modular grids and repeated geometric motifs allowed for the creation of garments that are both aesthetically expressive and structurally sound<sup>6</sup>. This approach mirrors strategies used in architectural design, where modularity enhances adaptability and systematic organization.

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<sup>4</sup>Lin M. A Brief Introduction to Body Oriented Parametric Design for 3D Printed Fashion and Textiles // *TEXTILE: Vol. 20, No. 1. – 2021. – P. 55–73.*

<sup>5</sup>Jeong J., Park H., Lee Y., Kang J., Chun J. *Developing parametric design fashion products using 3D printing technology* // *Fashion and Textiles. – 2021. – Vol. 8. – Art. No. 22. – P. 1–20.*

<sup>6</sup>Lin M. A Brief Introduction to Body-Oriented Parametric Design for 3D-Printed Fashion and Textiles // *TEXTILE: Vol. 20, No. 1. – 2021. – P. 55–73.*

Three-dimensional spatial modeling enabled the exploration of multiple form variations, allowing designers to visualize complex silhouettes and evaluate their functional properties. The results confirmed that integrating volumetric and parametric principles increases the range of design solutions and provides garments with better ergonomics, movement flexibility, and overall wear ability<sup>7</sup>. For instance, manipulating parametric variables such as seam placement, panel curvature, and sleeve geometry allowed the creation of personalized fits without compromising aesthetic appeal.

Furthermore, the implementation of bionic design principles enhanced the adaptive functionality of the jackets. Structural solutions inspired by natural systems, including flexible and transformable elements, improved comfort and responsiveness to different environmental conditions. For example, modular panels and adjustable fastenings allowed the jacket to adapt to various body types and seasonal needs, demonstrating the potential for highly functional and user-centric outerwear<sup>8</sup>.

Digital and parametric modeling tools also accelerated the design process and increased accuracy. By using algorithmic design strategies, multiple design iterations could be generated, tested, and refined in real time. This computational approach not only optimizes the garment form for ergonomics and aesthetics but also reduces material waste and production time, highlighting the sustainability potential of modern fashion design practices.

The experimental models of women's bomber jackets, developed through the synthesis of architectural, volumetric, and bionic principles, demonstrated several key advantages:

- Enhanced compositional expressiveness and visual harmony.
- Improved ergonomic characteristics and wearer comfort.
- Expanded range of construction and design variations.
- Increased innovation in aesthetic and functional design<sup>9</sup>.

These findings indicate that the integration of architectural thinking into clothing design represents a promising direction for contemporary fashion development. Unlike traditional methods, which often treat garments as isolated aesthetic objects, this approach emphasizes systemic form perception, spatial awareness, and the dynamic interaction between structure and user. It validates the hypothesis that interdisciplinary principles of form-generation significantly advance the design

<sup>7</sup> Kolosnichenko M.V., Chuprina N.V., Krotova T.F., Olishevskaya T.M. *Design of fashion clothing on the basis of parametric design principles* // Art and Design. – 2020. – № 1. – P. 129–141.

<sup>8</sup> Jeong J., Park H., Lee Y., Kang J., Chun J. *Developing parametric design fashion products using 3D printing technology* // Fashion and Textiles. – 2021. – Vol. 8. – Art. No. 22. – P. 1–20.

<sup>9</sup> Lin M. *A Brief Introduction to Body-Oriented Parametric Design for 3D-Printed Fashion and Textiles* // TEXTILE: Vol. 20, No. 1. – 2021. – P. 55–73.

methodology for women's bomber jackets and open new pathways for innovative fashion development.

## CONCLUSION

The conducted study demonstrates the significant effectiveness of integrating three-dimensional spatial and architectural principles into the design process of women's bomber jackets. The comparative analysis of existing models, combined with experimental modeling, confirmed that the application of architectural thinking, bionic principles, and parametric design considerably enhances the aesthetic, ergonomic, and functional qualities of garments<sup>10</sup>.

The key findings of this research can be summarized as follows:

1. **Architectural principles**, including tectonics, modularity, and structural integrity, facilitate harmonious interaction among construction elements and improve the compositional balance of garments. By applying these principles, designers can achieve both visual coherence and structural stability<sup>11</sup>.

2. **Three-dimensional spatial and modular structures** enable the creation of expressive silhouettes and extend the range of design variability.<sup>12</sup> The exploration of volumetric form allows garments to exhibit more innovative shapes, which respond to wearer needs and contemporary fashion trends<sup>13</sup>.

3. **Bionic approaches and flexible structural elements** contribute to the adaptability and functionality of clothing. Inspired by natural systems, these elements allow garments to adjust to different body types and environmental conditions, enhancing comfort and usability<sup>14</sup>.

4. **Parametric and computational modeling** ensures high precision in design, allowing the optimization of garment forms with regard to both aesthetic and functional requirements. Algorithmic design methods enable designers to generate multiple variations efficiently, reducing production time and material waste while improving design quality.

In addition, this study demonstrates that interdisciplinary integration in garment design provides a platform for innovation. By combining architectural, bionic, and parametric principles, designers can create garments that not only meet functional

<sup>10</sup> Jeong J., Park H., Lee Y., Kang J., Chun J. *Developing parametric design fashion products using 3D printing technology* // Fashion and Textiles. – 2021. – Vol. 8. – Art. No. 22. – P. 1–20.

<sup>11</sup> Lin M. *A Brief Introduction to Body-Oriented Parametric Design for 3D-Printed Fashion and Textiles* // TEXTILE: Vol. 20, No. 1. – 2021. – P. 55–73.

<sup>12</sup> Lawson B. *How Designers Think: The Design Process Demystified*. – 5th ed. – Elsevier/Architectural Press. – 2019. – 464 p.

<sup>13</sup> Kolosnichenko M.V., Chuprina N.V., Krotova T.F., Olishevskaya T.M. *Design of fashion clothing on the basis of parametric design principles* // Art and Design. – 2020. – № 1. – P. 129–141.

<sup>14</sup> Vasileva E.A., Reznichenko A.A. *Bionic Methods in Design: From Natural Systems to Technological Innovation* // Design Science Journal. – 2021. – Vol. 12. – № 2. – P. 87–105.

and ergonomic requirements but also push the boundaries of contemporary fashion aesthetics. The developed experimental bomber jacket models validate the hypothesis that spatial and architectural form-generation principles enhance design quality, functionality, and visual expressiveness.

Furthermore, the findings have practical implications for fashion designers and educators. They offer a methodological basis for incorporating volumetric form architecture into design curricula, workshops, and professional practice. This approach encourages systematic thinking, critical analysis of form, and innovative experimentation, which are essential for developing adaptive and sustainable clothing collections<sup>15</sup>.

Future research could expand the application of these principles to other garment types and explore the integration of advanced digital tools, such as generative design algorithms and AI-based fit analysis, to further enhance adaptive capabilities and innovation in fashion design. This would contribute to the creation of clothing that is highly customizable, ergonomically optimized, and aligned with contemporary aesthetic standards<sup>16</sup>.

In conclusion, the study confirms that the integration of three-dimensional spatial, architectural, and interdisciplinary principles in women's bomber jacket design significantly improves design methodology, supports innovation, and opens new opportunities for advanced, adaptive, and aesthetically expressive fashion products<sup>17</sup>.

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