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Influence of Sewing Parameters and Fabric Properties on Seam Strength and Quality in Woven Garments: A Comprehensive Review

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Abstract
Seam quality is a crucial determinant of garment durability, functionality, and consumer satisfaction in apparel manufacturing. While fabrics and sewing threads provide the foundational materials, the interplay of sewing parameters—including stitch density, needle size, thread type, and seam type—largely governs seam strength, slippage resistance, and appearance. This review synthesizes existing research on seam performance in woven garments, drawing from fabric mechanical behavior, thread characteristics, and experimental design methodologies. Studies highlight that seam failure often occurs at lower loads than fabric rupture, underscoring the need for optimized parameter selection. Advances such as the Kawabata Evaluation System for Fabrics (KES-F) (Kawabata, 1980) for fabric property assessment and statistical approaches like Box–Behnken experimental design (Box & Behnken, 1960) for process optimization provide scientific frameworks to enhance seam performance. The review concludes with recommendations for harmonizing fabric and process variables, emphasizing predictive modeling to improve quality control and reduce seam-related defects in the apparel industry.

Keywords: Seam strength, seam quality, woven fabrics, sewing parameters, seam slippage, Box-Behnken design, KES-F system.

1. Introduction

In the global apparel industry, consumers increasingly demand garments that combine aesthetic appeal with durability and functional reliability. Seam performance directly affects garment longevity and consumer satisfaction, since seams act as the structural backbone of clothing by joining fabric panels together. Despite their apparent simplicity, seams are influenced by numerous factors, including fabric type, thread characteristics, stitch formation, seam construction, and machine settings. Weakness in this system often results in seam failure, leading to product returns and reduced brand credibility.

2. Seam Quality and Performance

Seam quality encompasses both functional and aesthetic aspects. Functionally, seams must resist rupture, slippage, and wear during usage and laundering. Aesthetically, smoothness, alignment, and absence of defects such as puckering or skipped stitches are critical for consumer acceptance. Seams also contribute to garment design, with seam boldness sometimes used intentionally for visual appeal.

3. Seam Strength

Seam strength refers to the maximum load that a seam can resist prior to failure, making it a vital indicator of garment durability (Laing & Webster, 1998). It is assessed under transverse or longitudinal stress, with elongation capacity serving as a key performance indicator. Seam efficiency (SE) is a widely used metric, comparing seam strength with the tensile strength of the base fabric. Most studies report SE values below 90%, indicating that seams are inherently weaker than unsewn fabrics.

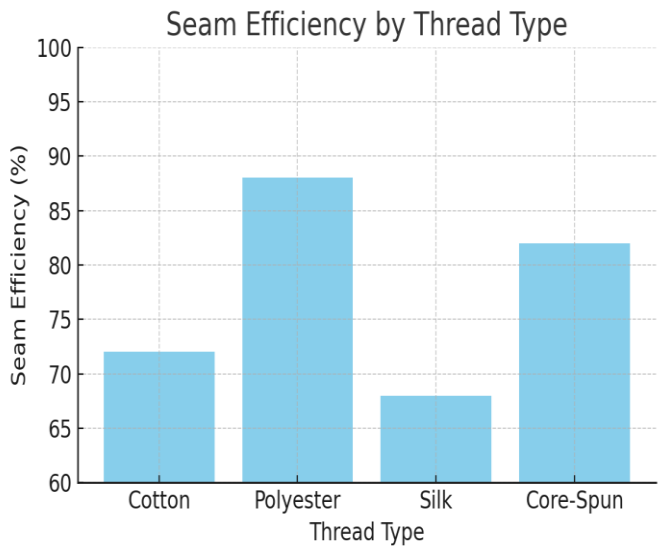

Figure 1: Effect of Stitch Density on Seam Strength

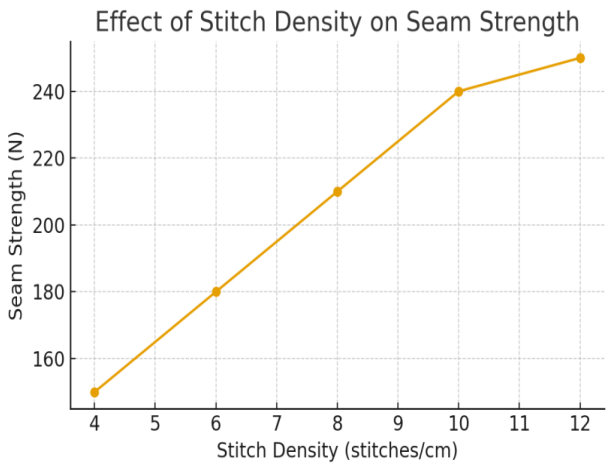

Figure 2: Seam Efficiency by Thread Type

4. Seam Slippage

Seam slippage refers to the displacement of yarns near the seam under stress, common in lightweight or loosely woven fabrics. It reduces garment integrity and is particularly problematic in formal wear, activewear, and performance textiles.

5. Sewing Threads and Fabric Properties

Thread characteristics—including tensile strength, elasticity, finish, size, ply, and twist—play a pivotal role in seam quality. Polyester threads, due to their strength and abrasion resistance, are preferred in most garment applications. Fabric properties such as tensile strength, extensibility, bending rigidity, shear rigidity and compressibility also influence seam behavior.

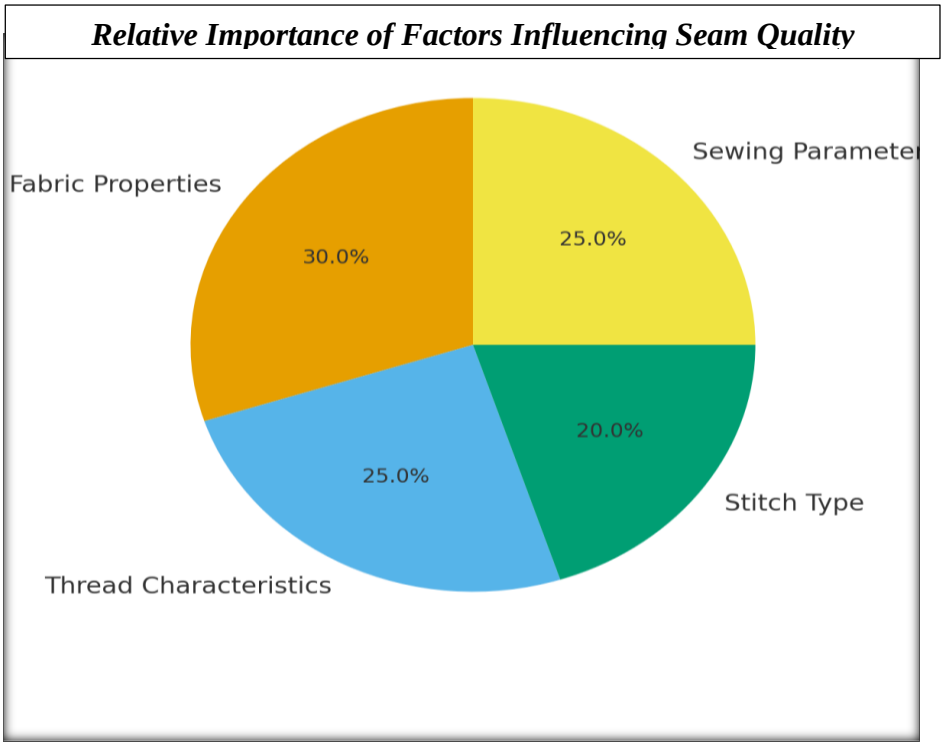

Figure 3: Relative Importance of Factors Influencing Seam Quality

6. Objective Fabric Evaluation and Statistical Design

Advancements in seam research include the Kawabata Evaluation System for Fabrics (KES-F) (Kawabata, 1980), which provides objective measurement of fabric properties, and the Box–Behnken experimental design (Box & Behnken, 1960), which efficiently models interactions among sewing parameters. These methods enable predictive and optimization frameworks for industrial application.

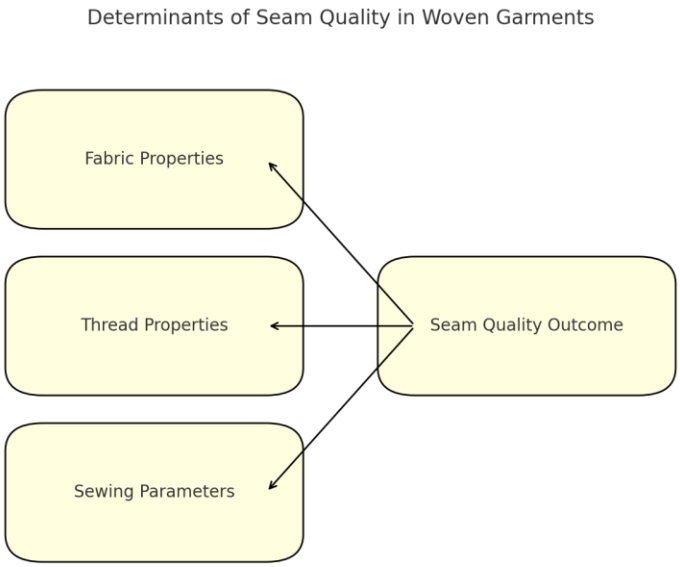

Figure 4: Determinants of Seam Quality in Woven Garments

7. Discussion

The literature consistently shows that seam performance is not governed by a single factor but by the interaction of multiple variables. Strong threads may not guarantee seam durability if combined with incompatible fabrics or stitch types. The integration of objective fabric testing and statistical optimization models provides a pathway to balancing these trade-offs.

8. Conclusion

Seam strength and quality remain central to garment performance and consumer satisfaction. Research confirms the importance of harmonizing sewing parameters with fabric properties to minimize seam failure, slippage, and visual defects. Emerging methods such as KES-F and BBD offer robust, data-driven approaches for optimizing seam performance in woven garments.

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