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Impact of Different Parameters on Sewing Performance of Denim Sewed with Organza

Doaa Abdul Qader Ibrahim Al-Qatry, Asmaa Glal Abdelazez Aborady, Rasha Abdelmoty Mahmoud Elshiekh, Hanaa Abdullah Abdulghani Alnawawy, and Kawther Taher Rizk Mohammed.

Clothing and Textile department, Faculty of Home Economics, Al-Azhar University, Gharbia, Egypt

Abstract

Denim fabrics provide a fundamental material upon which the clothing industry relies. It has recently been integrated with other fabrics, such as organza fabric, to create innovative clothing designs. Owing to the different properties of denim fabric and organza fabric, it is necessary to study the standards for sewing denim fabrics with organza fabrics to determine the best parameters that achieve high sewing efficiency. Therefore, the study used 50% cotton and 50% polyester denim fabrics of different weights (light, medium, and heavy weights) as the first fabric and 100% polyester organza fabric as the second fabric. Three directions of fabric cutting (warp, weft, and bias) were used. Three types of seams were used: the SSa seam (superimposed seam), the SSe seam (superimposed seam), and the LSq seam (lapped seam). In addition, three types of stitches were used with those seams as follows: the SSa seam with the 516 stitch, the SSe seam with the 301 stitch, and the LSq seam with the 301 + 514 stitches.

In this study we measured the sewing properties of the samples, including strength, elongation, stiffness, and seam appearance. The results showed that all sewing properties were affected by denim fabric weight, fabric cutting direction, and both seam and stitch types. Therefore, the results demonstrated that when sewing denim fabric of varying weights with organza fabric at the warp, weft, and bias directions, it is advisable to employ the SSa seam with the 516 stitch, as it attained the highest quality coefficient values across all sewing properties.

Keywords: Sewing, Seam, Denim fabric, Jeans, Organza fabri.

Introduction

Quality is the fundamental requirement for being or staying competitive in the market. The apparel industry defines quality as the degree of acceptance of goods or services, while the textile and clothing sector measures product quality by the quality and standard of fibers, yarns, fabric construction, color fastness, designs, and the final finished garment products. Quality also refers to a product or service's capacity to meet or exceed customer expectations in terms of efficiency, performance, durability, comfort, and use (1) (2). Seam quality affects the overall performance of the garments. Poor-quality seams make apparel unusable even though the fabric may be in good condition. If a product bought has a deficiency, it cannot be used, and poor-quality seams are a great deficiency that mostly affects the life of sewn garments. Consequently, the quality and functionality of sewn garments are influenced by both the strength and efficiency of the seams. A seam failure can render the garment unsuitable for everyday use, even if the fabric remains undamaged (3) (4).

Seam is one of the important parameters; it is considered an essential requirement in the construction of garments. The quality of seams holds considerable importance in the manufacturing of apparel products. Consumers typically judge seam quality based on its visual appeal and its resilience after usage and care. A variety of seams and stitches can be applied to finished fabrics (garments) with differing stitch densities, which can affect seam strength, overall quality, and performance attributes. The quality of the seam is assessed based on various factors, including its efficiency, strength, elongation, bending properties, stiffness, abrasion resistance, seam slippage, puckering, tightness, and boldness (5) (6). The function of a seam is to assemble two or more pieces, thereby forming a 3D garment using sewing machines, sewing threads, and various types of stitching methods. The primary objective of any sewing operation is to produce a garment or clothing item that is finished to a high standard. High-quality seams are crucial for the durability, quality, and aesthetic appearance of the garments. Factors that affect seam performance include seam type, suitable sewing thread, sewing process parameters, and sewability ease (7) (2).

Stitches and seams represent fundamental elements of the structure of apparel products. Stitches function to join the apparel components together, whereas seams are responsible for the apparel shape for wear. The determination of the optimal stitch type, seam structure, and thread type that should be used for particular apparel requires a comprehensive understanding of numerous factors. The inappropriate choice of any single element may result in the failure of the sewn, ultimately resulting in the failure of the finished product (3). Certain manufacturers adopt stitch classes, stitch density, and sewing threads without adequately considering their impact on the overall functionality of the garments produced, which can lead to seam failure during wear. Consequently, it is crucial to select suitable seams to enhance the performance of the apparel. The types of seams employed are significant factors that affect the seam's overall performance, particularly regarding durability and comfort (8).

*Corresponding author e-mail: doaaelkatry@azhar.edu.eg.; (Doaa Abdul Qader Ibrahim Al-Qatry).
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The ongoing advancements and innovations in technology have significantly elevated the importance of materials science within the sector of clothing design. Designers and consumers alike are increasingly focusing on products crafted from denim and similar materials. Currently, denim fabrics are utilized across various sectors for the production of trousers, jackets, shirts, blouses, workwear, and bags, with both production and consumption levels consistently on the rise (9) (10) (11). Denim is a durable textile composed entirely of cotton fibers. The traditional variant of denim is characterized by a 2/1 warp-faced twill weave. It incorporates indigo-dyed warp yarns and white weft yarns, leading to a noticeable difference between the fabric's front and back faces. Denim can be crafted from a variety of yarns, including cotton, polyester, and elastane, and is available in multiple weights. Stretch denim fabrics containing elastane are woven in different weaving structures from 100% cotton or polyester-blended warp yarns and elastic weft yarns produced by twisting together cotton or polyester yarn with elastane yarn. It is appropriate for all people and widespread in leisurewear and sports apparel owing to its comfort, long-lasting nature, and attractive, body-conforming silhouette. As the popularity of denim has grown, so have the color combinations used to create it too; blue denim is no longer the only choice (12) (13) (14) (15) (16) (17) (18). The jeans manufacturing sector is presently undergoing a significant phase of transformation and enhancement. In light of the industry's evolution, it is essential to elevate the quality of jeans clothing. Recent developments in the denim apparel sector emphasize the importance of seam performance. Denim fabric, known for its considerable density, thickness, and weight, tends to be more prone to seam and stitch damage during the sewing process. Breaking strength and elongation of the fabric and sewing thread demonstrated a strong correlation with seam efficiency. The studies indicate that the relationship between denim and seam quality plays a vital role in the creation of high-quality apparel (19) (20).

Organza is a crisp, lightweight, soft look, and transparent fabric. Usually silk or polyester, it is durable, comfortable to wear, and easy to press. It wrinkles, has little elasticity, varies in transparency, and may fray badly. Organza is conventionally made out of yarn; where individual strands are tightly twisted and subsequently woven to create a fabric that exhibits both texture and luster. Despite its inherent stiffness, organza is gentle on the skin and does not cause irritation. It is commonly used in evening gowns and cocktail dresses, in addition to shirts, and skirts (21) (22).

Currently, the clothing sector is experiencing heightened international competition and unpredictable variations in consumer demand. Therefore, it is necessary to consistently refresh and modify these products in alignment with customer needs in order to survive and create a competitive advantage. Given the substantial function of clothing in human life, the performance quality of the garment is a crucial aspect in attaining the product's competitive advantage. Understanding the components of the fabric and determining the most appropriate seam for each type of fabric will guarantee the optimal performance for the product and achieve the desired quality (23) (24) (25) (26) (27).

Many studies have addressed the sewing standards and their impact on the quality and appearance of garment products, such as the study of Nasr Eldeen (2013), where three different weights of organza fabric were sewn using some variables such as sewing thread, presser foot material type, and pressing levels. Then the seam properties (stiffness, seam pucker, and seam appearance) were examined to determine the best factors in achieving high durability, efficiency, and appearance. The finding showed that the increasing of organza fabric weight improves the seam stiffness and seam appearance properties. It was also noted that with increasing the level of pressure, the sewing properties improve. Besides, using polyester thread gives better sewing properties (21).

Another study by Ali et al. (2016) examines the impact of seam type, stitch type, and stitch density on the seam strength of denim fabric. The findings indicated that these variables significantly affect the performance of garment seams. The study concluded that an increase in stitch density correlates with enhanced seam strength, and conversely, a decrease in stitch density results in reduced seam strength (5). The study of Malek et al. (2018) evaluated sewing quality to aid the industry in delivering high-quality garments prior to production. Eighteen types of denim fabrics were stitched using two different commercial sewing threads, after which the seam efficiency, seam slippage, and seam puckering were measured to rank them according to the seam quality (28). Similarly, the study of Trivedi et al. (2018) aimed to analyze the effect of different sewing processes on the tensile behaviour of sewing thread in denim garments. In this study, six types of sewing threads were used to stitch denim fabric using lock stitches and chain stitches in a lapped seam. Tensile behavior of all sewing threads was compared in terms of tenacity, initial modulus, and breaking energy for the lock stitch and chain stitch. This study showed that lock stitch is stronger than chain stitch for superior mechanical properties (29). Besides, the study by Tuteja et al. (2019), which found a significant relationship between commercial sewing thread count, stitch densities, and their effects on seam strength, elongation, and efficiency in medium-heavy and heavy-weight cotton denim fabrics (23). The study of Malek et al. (2019), which aimed to investigate the impact of fabric properties and sewing parameters on seam slippage. The findings indicate that an increase in the linear density of the seam thread results in a reduction of the seam slippage, as well as the stitch density. However, the fabric mass has an unpredictable influence on seam slippage. Additionally, it can be inferred that seam slippage is more significant in the warp direction compared to the weft direction (30).

The study of Hossain et al. (2020) also aimed to study the seam strength of denim fabric seams. In this study, denim fabric with a 3/1 weave structure was used, and three different sewing threads were used. The seam class used for this study was superimposed seam SSa and SSb, and the samples were made by stitching with lockstitch in both the warp and the weft directions. Three different stitch densities were used; the results demonstrate that seam type, seam direction, thread types, and stitch density have a direct influence on the lockstitch seam strength of denim fabric to different extents. Notably, the SSb seam type, produced in the warp direction with sewing thread (60 Tex) and 11 stitches per inch, exhibited the greatest seam strength (31). Tiber et al. (2022) performed a study to compare the seam performance characteristics of elastic and standard polyester sewing threads on stretch denim materials. The findings indicated that the elasticity of the sewing thread influences seam strength; however, the strength of the sewing thread has a more significant impact on both seam strength and seam efficiency. The highest seam performance values are recorded in the weft direction when employing chain stitches at 4 stitches per

centimeter (14). Another study conducted by Hossain et al. (2023) aimed to evaluate how various sewing parameters impact the seam strength of chain-stitched denim fabric. The results revealed that the different sewing parameters had varying effects on the seam strength of chain stitches. The SSb seam type, in particular, showed enhanced seam strength when using the 60 Tex thread in the warp direction at a density of 11 stitches per inch (32).

Owing to the rapid advancement of the clothing and textile business, as well as the fashion sector, the clothing industry needs to integrate various fabrics to enhance clothing production. This in turn requires determining the standards for sewing these different fabrics. Since each fabric has its own characteristics that require specific sewing standards, this leads to the need to reach appropriate sewing standards for sewing these different fabrics together. Denim fabrics are one of the most important fabrics on which the clothing industry is based. It has recently been combined with other fabrics to create new, innovative designs. Organza is one of these fabrics that have been combined in clothing with denim fabrics to enrich clothing and fashion. The characteristics of denim fabric are completely different from the properties of organza fabric. Several studies addressed sewing standards of each fabric kind separately. Consequently, researchers have focused on studying the standards for sewing denim and organza fabrics to identify the optimal parameters for achieving maximum sewing efficiency.

Therefore, the research hypotheses were as follows:

1. The study variables (fabric cutting direction, denim fabric weight, and seam & stitch type) affect the seam strength of study samples.
2. The study variables (fabric cutting direction, denim fabric weight, and seam & stitch type) affect the seam elongation of study samples.
3. The study variables (fabric cutting direction, denim fabric weight, and seam & stitch type) affect the seam stiffness of study samples.
4. The study variables (fabric cutting direction, denim fabric weight, and seam & stitch type) affect the seam appearance of study samples.

1. Experimental:

The study was carried out using two fabrics: 50% cotton and 50% polyester denim fabrics as the first fabric and 100% polyester organza fabric as the second fabric. Three weights of denim fabrics (light, medium, and heavy weight) were used. Considering the difference in thickness between denim and organza, the organza has been lined with a layer of bleached calico material to support it when stitched with denim fabric. The study fabric properties are listed in Table (1).

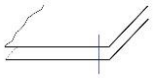
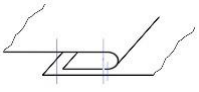
Table (1) shows the study fabrics properties

Fabrics	Material weight difference	Weight per square meter Gm	Material	Weave Structure
The first fabric (Denim)	Light	175 Gm	50% cotton and 50% Polyester	Twill weave 2/1
	Medium	390 Gm		
	Heavy	455 Gm		
The second fabric (Organza)	Fixed	87 Gm	100% Polyester	Plain weave 1/1
Bleached Calico	Fixed	146 Gm	100% Cotton	Plain weave 1/1

27 research samples were conducted with the following variables:

- Fabric cutting direction: The fabrics were cut in three directions (warp, weft, and bias).
- Stitch and seam types: Three types of seams were used as follows: the SSa seam (superimposed seam), the SSe seam (superimposed seam), and the LSq seam (lapped seam). In addition, three types of stitches were used with those seams as follows: the SSa seam with the 516 stitch, the SSe seam with the 301 stitch, and the LSq seam with the 301 + 514 stitches. Seam shapes are listed in Table (2).

Table (2) shows Seam shapes

	Seam Type	Seam shape
1	SSa Superimposed seam	
2	SSe Superimposed seam	
3	LSq Lapped seam	

- Three different types of sewing machines were used according to stitch types. The machine models are shown in Table (3).

Table (3) shows the specifications of sewing machines

	Stitch type	Machine Model
1	301	Typical Gc6925A-MD4
2	516	Sewpower-SP-900D-6-H
3	514	Sewpower-SP-900D-4

The study variables are shown in Table (4).

Table (4) shows the study variables

Sample Number	Fabric Cutting Direction	The first fabric (Denim) Weight per square meter g/ m^2	Seam Type & Stitch Type
1	Warp	Light weight	SSa seam + 516 stitch
2			SSe seam + 301 stitch
3			LSq seam + (301 + 514) stitches
4		Medium weight	SSa seam + 516 stitch
5			SSe seam + 301 stitch
6			LSq seam + (301 + 514) stitches
7		Heavy weight	SSa seam + 516 stitch
8			SSe seam + 301 stitch
9			LSq seam + (301 + 514) stitches
10	Weft	Light weight	SSa seam + 516 stitch
11			SSe seam + 301 stitch
12			LSq seam + (301 + 514) stitches
13		Medium weight	SSa seam + 516 stitch
14			SSe seam + 301 stitch
15			LSq seam + (301 + 514) stitches
16		Heavy weight	SSa seam + 516 stitch
17			SSe seam + 301 stitch
18			LSq seam + (301 + 514) stitches
19	Bias	Light weight	SSa seam + 516 stitch
20			SSe seam + 301 stitch
21			LSq seam + (301 + 514) stitches
22		Medium weight	SSa seam + 516 stitch
23			SSe seam + 301 stitch
24			LSq seam + (301 + 514) stitches
25		Heavy weight	SSa seam + 516 stitch
26			SSe seam + 301 stitch
27			LSq seam + (301 + 514) stitches

Laboratory tests

The following tests were performed:

Tests of the fabrics before sewing:

- Measurement of weight per square meter: This test was conducted according to the American Standard ASTM D3776/D3776M-09a Standard Test Methods for Mass Per Unit Area (Weight) of Fabric (33). This test was conducted in the textile laboratory of the Clothing and Textile Department at the Faculty of Home Economic, Al-Azhar University.

Tests of the study samples after sewing:

- Seam strength and elongation test: This test was performed according to the American Standard ASTM D, 1683-04 (34). This test was conducted in the textile testing laboratory, Faculty of Applied Arts, Damietta University.
- Seam stiffness test: This test was conducted using a Shirley fabric stiffness tester according to the American Standard ASTM 1388-96 (35). This test was conducted in the textile laboratory of the Clothing and Textile Department at the Faculty of Home Economic, Al-Azhar University.
- Seam appearance test: The study samples were judged by a group of specialists in the field of clothing and textile industry (15 judges). The samples were presented to each of them separately, and each sample was given a score out of 10.

2. Results and discussion

Table (5) Results of Seam properties tests for the study samples

Sample number	Cutting direction	Denim Weight per square meter g/m^2	Seam Type & Stitch Type	Seam Strength (kg)	Seam Elongation (%)	Seam Stiffness mg\cm	Seam Appearance
1	Warp	Light weight	SSa seam + 516 stitch	394.53	12.41	183.60	9.00
2			SSe seam + 301 stitch	262.23	11.27	255.00	7.50
3			LSq seam + (301 + 514) stitches	488.06	13.97	234.60	6.50
4		Medium weight	SSa seam + 516 stitch	387.62	17.72	295.93	8.66
5			SSe seam + 301 stitch	328.57	13.93	498.40	6.33
6			LSq seam + (301 + 514) stitches	524.83	16.67	381.59	7.83
7		Heavy weight	SSa seam + 516 stitch	420.38	15.95	361.20	8.33
8			SSe seam + 301 stitch	288.63	11.89	546.96	5.33
9			LSq seam + (301 + 514) stitches	550.78	22.82	510.15	8.16
10	Weft	Light weight	SSa seam + 516 stitch	400.04	33.62	215.83	8.66
11			SSe seam + 301 stitch	318.47	23.89	247.25	6.50
12			LSq seam + (301 + 514) stitches	421.80	32.38	197.06	7.16
13		Medium weight	SSa seam + 516 stitch	313.34	26.26	373.80	8.33
14			SSe seam + 301 stitch	313.67	26.88	397.16	6.00
15			LSq seam + (301 + 514) stitches	368.37	28.47	342.65	7.16
16		Heavy weight	SSa seam + 516 stitch	432.02	23.27	423.12	8.00
17			SSe seam + 301 stitch	324.76	19.05	455.80	6.66
18			LSq seam + (301 + 514) stitches	556.68	23.88	424.15	7.16
19	Bias	Light weight	SSa seam + 516 stitch	338.27	38.83	183.60	8.66
20			SSe seam + 301 stitch	234.86	19.51	234.60	7.50
21			LSq seam + (301 + 514) stitches	427.15	37.98	204.00	6.00
22		Medium weight	SSa seam + 516 stitch	337.55	40.72	311.50	8.00
23			SSe seam + 301 stitch	260.71	41.32	384.08	7.16
24			LSq seam + (301 + 514) stitches	532.93	53.61	363.21	7.83
25		Heavy weight	SSa seam + 516 stitch	353.77	28.67	389.75	9.00
26			SSe seam + 301 stitch	326.63	24.99	478.50	5.83
27			LSq seam + (301 + 514) stitches	470.64	35.81	432.75	8.00

Effect of study variables on the seam strength of study samples:

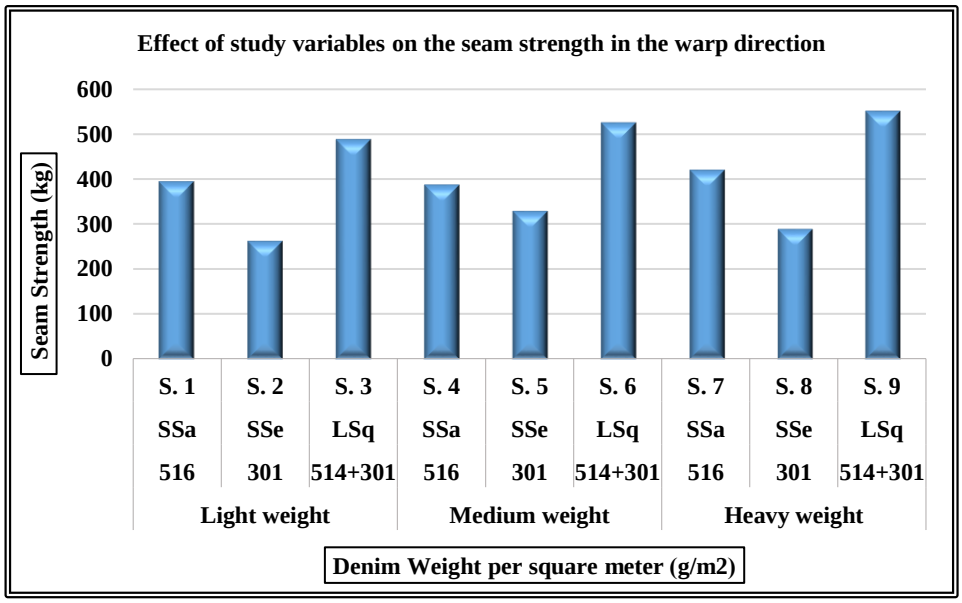


Fig. (1) Effect of study variables on the seam strength in the warp direction

It is clear from Table (5) and Figure (1) that sample No. 9 (heavy weight denim, seam type LSq, stitch type 514+301) achieved the highest value of seam strength in the warp direction, reaching 550.78 kg. While sample No. 2 (light weight denim, seam type SSe, stitch type 301) had the lowest value of seam strength in the warp direction, reaching 262.23 kg. Figure (1) indicates that while sewing denim fabrics of varying weights with organza fabrics, the LSq seam with the (514+301) stitch exhibited the maximum seam strength in the warp direction, followed by the SSa seam with 516 stitch, and subsequently the SSe seam with 301 stitch.

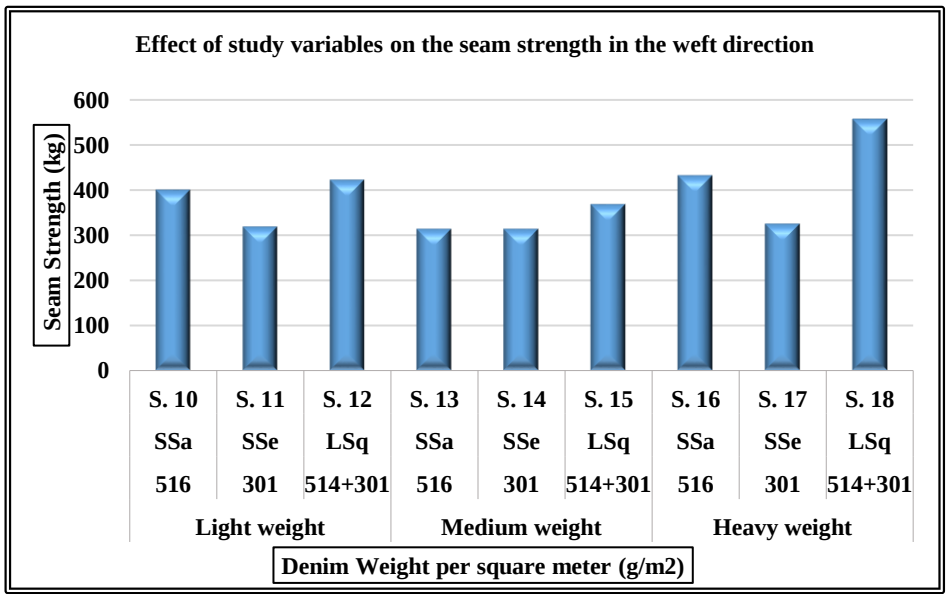


Fig. (2) Effect of study variables on the seam strength in the weft direction

Table (5) and Figure (2) indicate that sample No. 18 (heavy weight denim, seam type LSq, stitch type 514+301) exhibited the maximum seam strength value in the weft direction, reaching 556.68 kg. While sample No. 13 (medium weight denim, seam type SSa, stitch type 516) had the minimum seam strength value in the weft direction, reaching 313.34 kg. Figure (2) demonstrates that while sewing denim fabrics (of light and heavy weights) with organza fabrics, the LSq seam with the (514+301) stitch gave the highest value of seam strength in the weft direction, followed by the SSa seam with the 516 stitch, and subsequently the SSe seam with the 301 stitch.

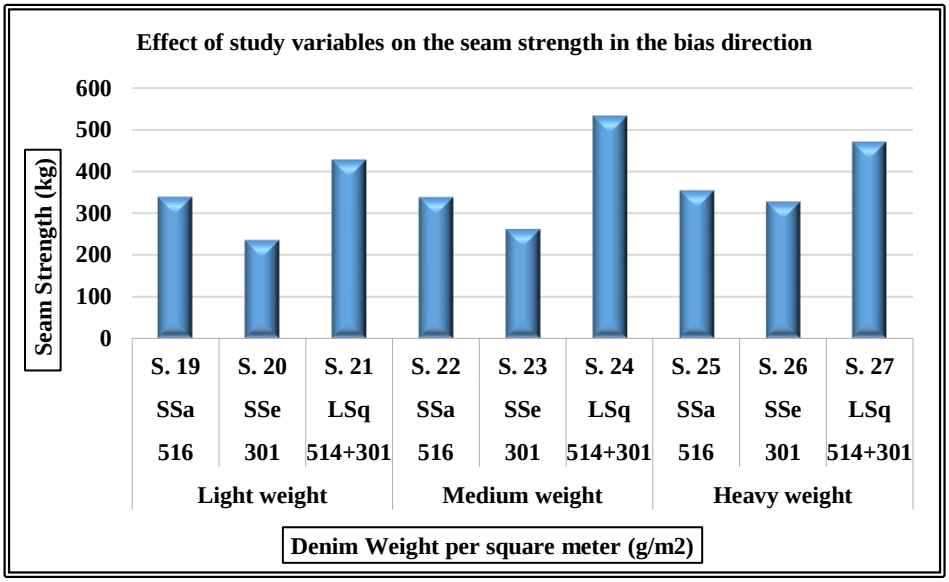


Fig. (3) Effect of study variables on the seam strength in the bias direction

Table (5) and Figure (3) indicate that sample No. 24 (medium weight denim, seam type LSq, stitch type 514+301) exhibited the maximum value of seam strength in the bias direction, reaching 532.93 kg. While sample No. 20 (light weight denim, seam type SSe, stitch type 301) had the minimum value of seam strength in the bias direction, reaching 234.86 kg. Figure (3) demonstrates that while sewing denim fabrics (of varying weights) with organza fabrics, the LSq seam with the (514+301) stitch gave the highest value of seam strength in the bias direction, followed by the SSa seam with the 516 stitch, and subsequently the SSe seam with the 301 stitch.

The strength of the LSq seam in all cutting directions is due to the fact that the LSq seam consists of two types of seams: the first seam is the superimposed seam SSa, with the 514 stitch, and the second seam is the top stitch 301, and the presence of these two seams strengthens the LSq seam. In addition to the presence of the 514 stitch and the 301 stitch, which increases the thread count in the seam formation, thereby enhancing its strength.

Effect of study variables on the seam elongation of study samples:

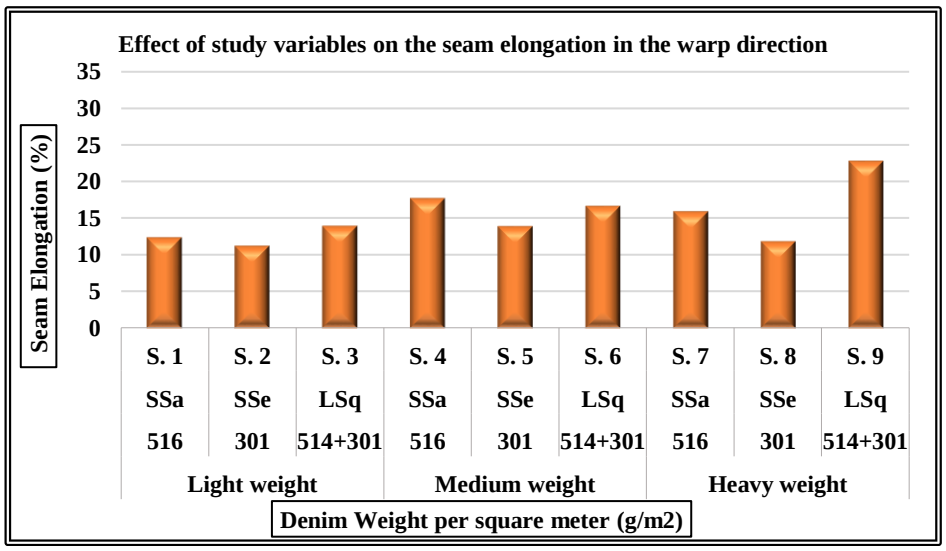


Fig. (4) Effect of study variables on the seam elongation in the warp direction

Table (5) and Figure (4) indicate that sample No. 9 (heavy weight denim, seam type LSq, stitch type 514+301) exhibited the maximum seam elongation in the warp direction, reaching 22.82%. While sample No. 2 (light weight denim, seam type SSe, stitch type 301) had the minimum seam strength in the warp direction, reaching 11.27%. Figure (4) demonstrates that while sewing denim fabrics (of light and heavy weights) with organza fabrics, the LSq seam with the (514+301) stitch gave the highest value of seam elongation in the warp direction. But when sewing denim fabrics (of medium weight) with organza fabrics, it was found that the SSa seam with the 516 stitch gave the highest value of seam elongation in the warp direction.

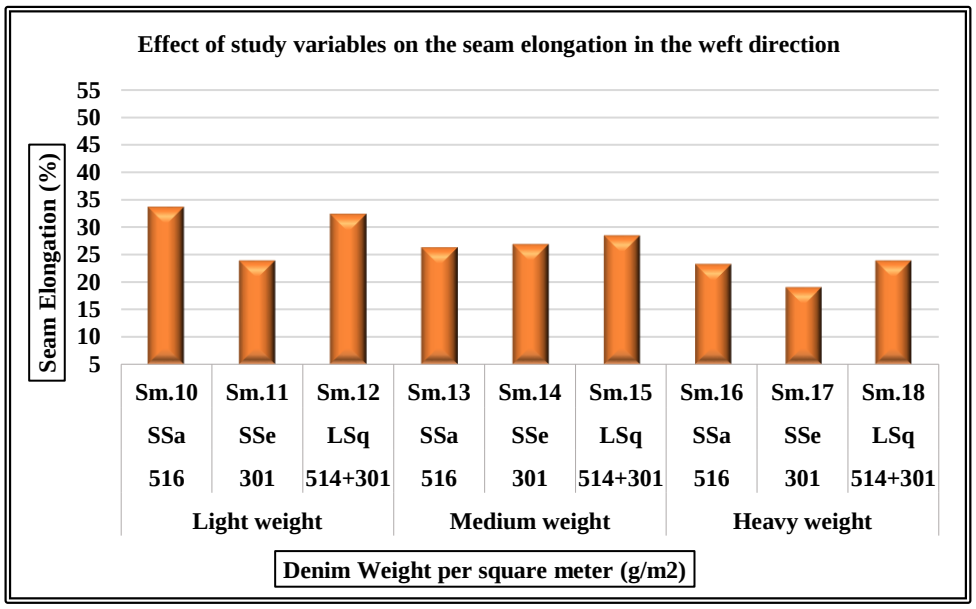


Fig. (5) Effect of study variables on the seam elongation in the weft direction

Table (5) and Figure (5) indicate that sample No. 10 (light weight denim, seam type SSa, stitch type 516) exhibited the maximum seam elongation in the weft direction, reaching 33.62%. While sample No. 17 (heavy weight denim, seam type SSe, stitch type 301) had the minimum seam strength in the weft direction, reaching 19.05%.

Table (5) and Figure (6) indicate that sample No. 24 (medium weight denim, seam type LSq, stitch type 514+301) exhibited the maximum seam elongation in the bias direction, reaching 53.61%. While sample No. 20 (light weight denim, seam type SSe, stitch type 301) had the minimum seam strength in the bias direction, reaching 19.51%.

It is noted from Figures (5) and (6) that the SSa seam with the 516 stitch exhibited the maximum seam elongation (in the weft and bias directions) when sewing light weight denim fabrics with organza fabrics. It also found that the LSq seam with the (514+301) stitch gave the highest value of seam elongation (in the weft and bias directions) when sewing medium-weight and heavy-weight denim fabrics with organza fabrics.

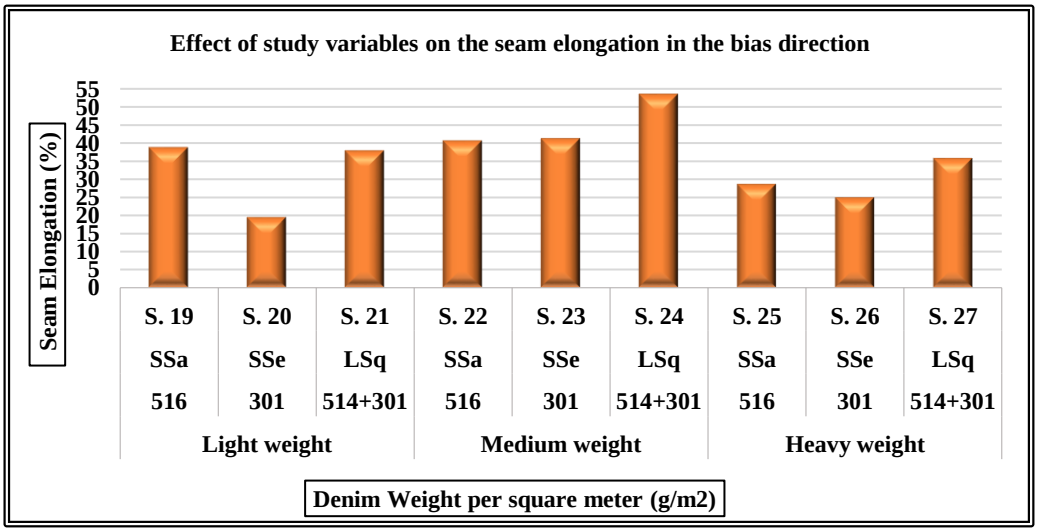


Fig. (6) Effect of study variables on the seam elongation in the bias direction

Effect of study variables on the seam stiffness of study samples:

Table (5) and Figure (7) indicate that sample No. 8 (heavy weight denim, seam type SSe, stitch type 301) exhibited the highest value of seam stiffness in the warp direction, at 546.96 mg/cm. While sample No. 1 (light weight denim, seam type SSa, stitch type 516) had the lowest value of seam stiffness in the warp direction, at 183.60 mg/cm. It is noted from Figure (7) that when sewing denim fabrics of varying weights with organza fabrics, the SSe seam with the 301 stitch gave the highest value of seam stiffness in the warp direction, followed by the LSq seam with stitch (514+301), and subsequently the SSa seam with the 516 stitch.

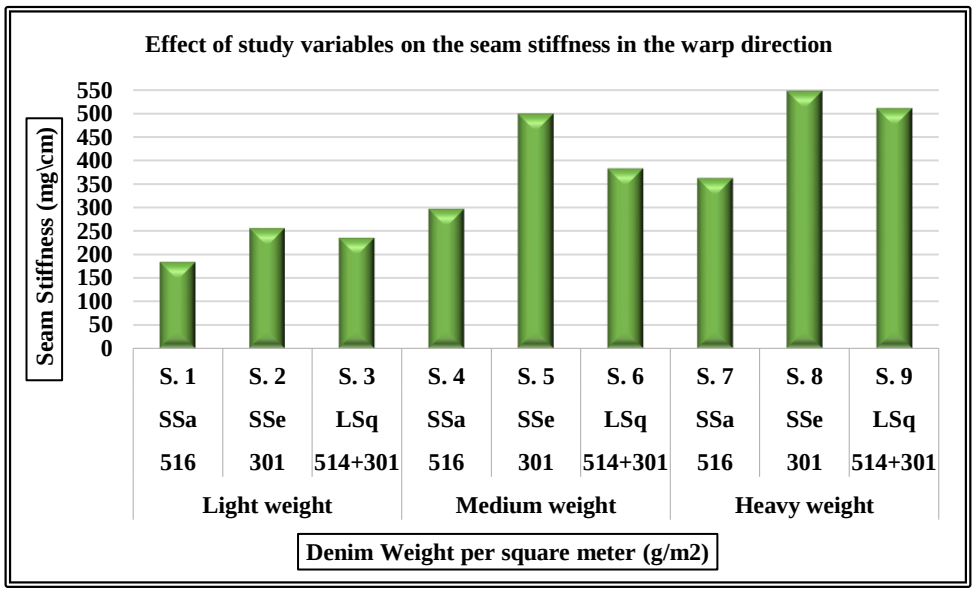


Fig. (7) Effect of study variables on the seam stiffness in the warp direction

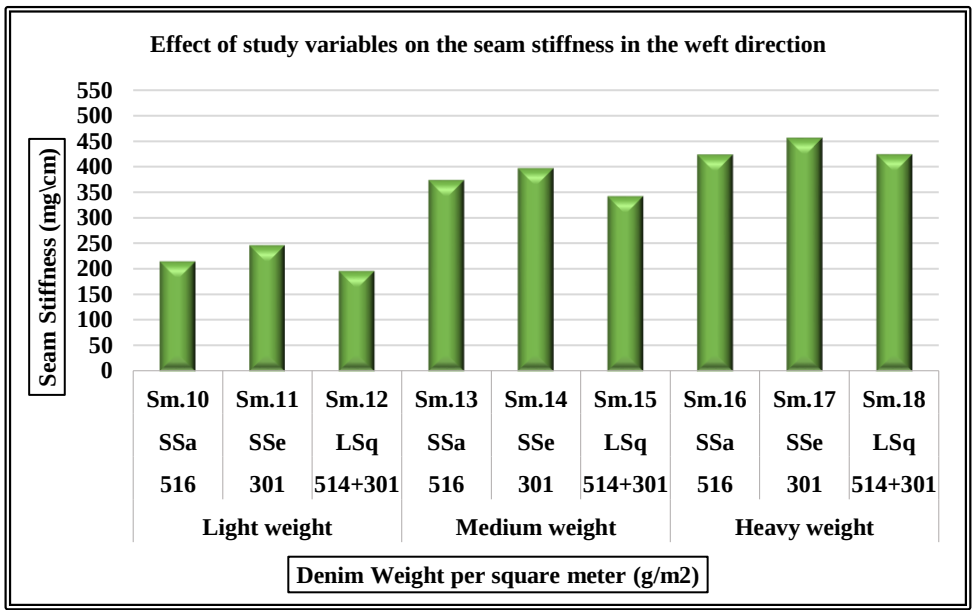


Fig. (8) Effect of study variables on the seam stiffness in the weft direction

Table (5) and Figure (8) indicate that sample No. 17 (heavy weight denim, seam type SSe, stitch type 301) exhibited the maximum value of seam stiffness in the weft direction, at 455.80 mg/cm. While sample No. 12 (light weight denim, seam type LSq, stitch type 514+301) had the minimum value of seam stiffness in the weft direction, at 197.06 mg/cm. It is noted from Figure (8) that when sewing denim fabrics of varying weights with organza fabrics, the SSe seam with the 301 stitch exhibited the highest value of seam stiffness in the weft direction, followed by the SSa seam with the 516 stitch, and then the LSq seam with stitch (514+301).

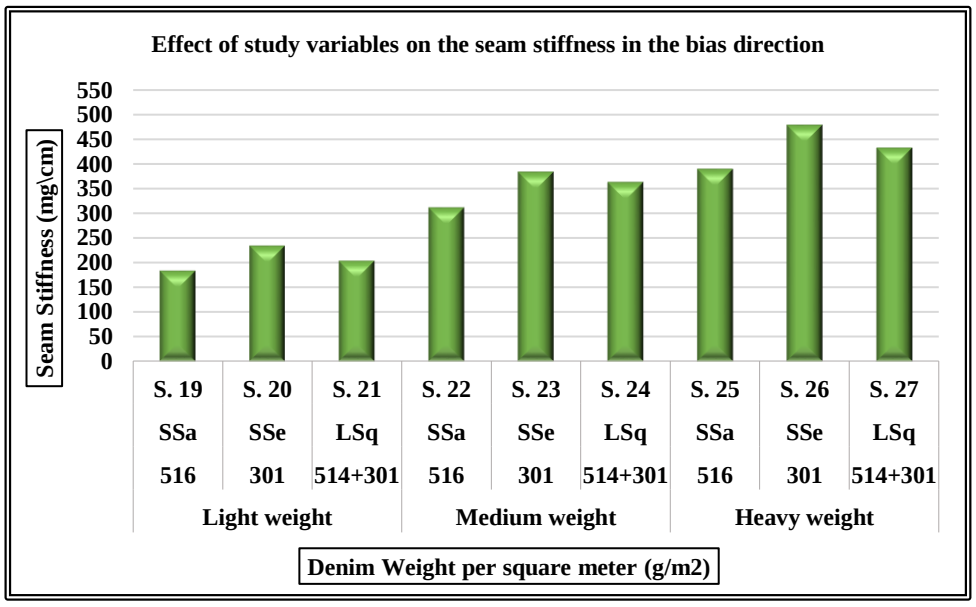


Fig. (9) Effect of study variables on the seam stiffness in the bias direction

Table (5) and Figure (9) indicate that sample No. 26 (heavy weight denim, seam type SSe, stitch type 301) exhibited the maximum value of seam stiffness in the bias direction, at 478.50 mg/cm. While sample No. 19 (light weight denim, seam type SSa, stitch type 516) had the minimum value of seam stiffness in the bias direction, at 183.60 mg/cm. It is noted from Figure (9) that when sewing denim fabrics of varying weights with organza fabrics, the SSe seam with the 301 stitch exhibited the highest value of seam stiffness in the bias direction, followed by the LSq seam with stitch (514+301), and then the SSa seam with the 516 stitch.

It is notable that the SSe seam with the 301 stitch exhibited the highest value of seam stiffness at all cutting directions, attributable to the number of plies constituting the seam (as illustrated in seam shapes at table 2), which enhances the amount of fabric in the seam, thereby increasing the seam stiffness value.

Effect of study variables on the seam appearance of study samples:

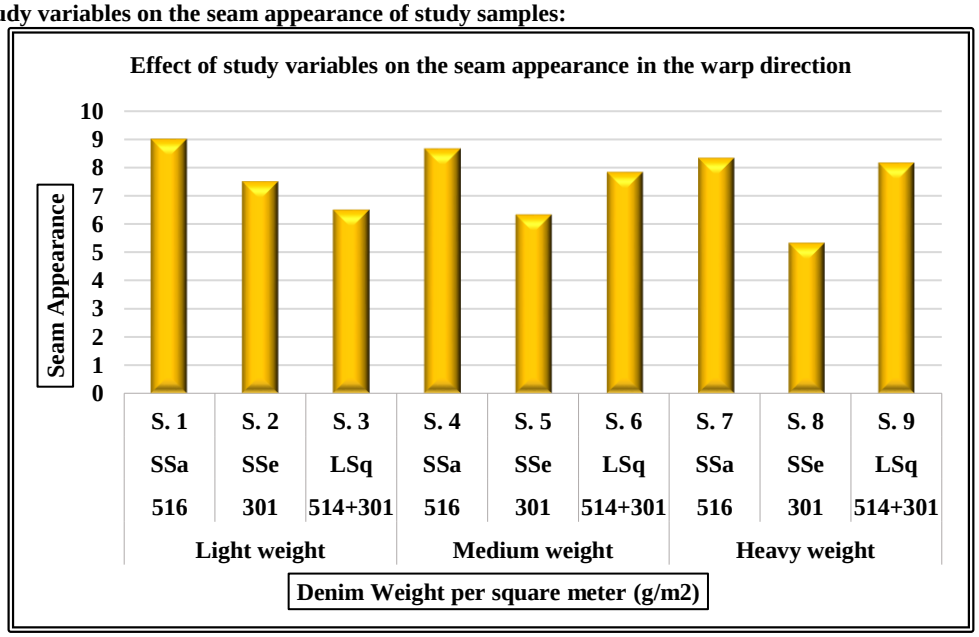


Fig. (10) Effect of study variables on the seam appearance in the warp direction

Table (5) and Figure (10) indicate that sample No. 1 (light weight denim, seam type SSa, stitch type 516) exhibited the maximum value of seam appearance in the warp direction. While sample No. 8 (heavy weight denim, seam type SSe, stitch type 301) had the minimum seam appearance value in the warp direction. Figure (10) demonstrates that when sewing denim fabrics of varying weights with organza fabrics, the SSa seam with the 516 stitch gave the highest value of seam appearance in the warp direction.

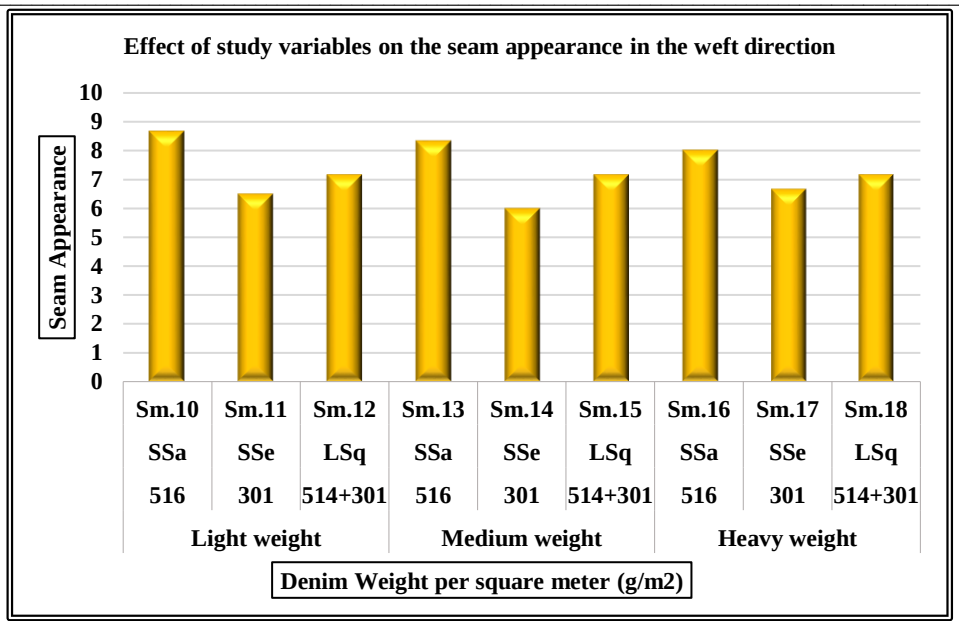


Fig. (11) Effect of study variables on the seam appearance in the weft direction

Table (5) and Figure (11) indicate that sample No. 10 (light weight denim, seam type SSa, stitch type 516) exhibited the maximum value of seam appearance in the weft direction at 8.66. While sample No. 14 (medium weight denim, seam type SSe, stitch type 301) had the minimum seam appearance value in the weft direction. Figure (11) demonstrates that when sewing denim fabrics of varying weights with organza fabrics, the SSa seam with the 516 stitch gave the highest value of seam appearance in the weft direction.

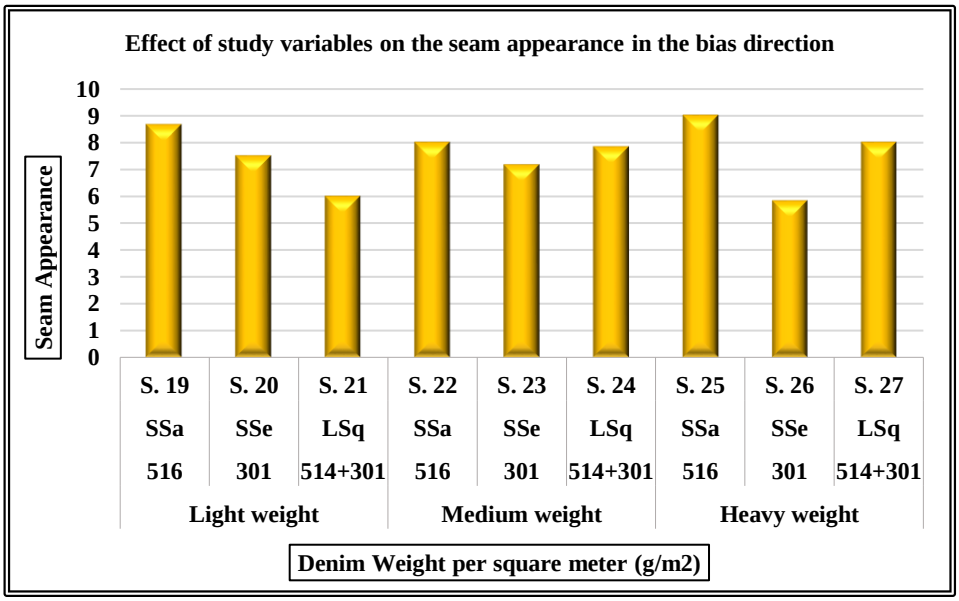


Fig. (12) Effect of study variables on the seam appearance in the bias direction

Table (5) and Figure (12) indicate that sample No. 25 (heavy weight denim, seam type SSa, stitch type 516) exhibited the maximum value of seam appearance in the bias direction. While sample No. 26 (heavy weight denim, seam type SSe, stitch type 301) had the minimum seam appearance value in the bias direction. Figure (12) demonstrates that when sewing denim fabrics of varying weights with organza fabrics, the SSa seam with the 516 stitch gave the highest value of seam appearance in the bias direction.

The SSa seam with the 516 stitch gave the highest value of seam appearance at the three study cutting directions, which may be due to the fact that the SSa seam is characterized by its smoothness and surface softness compared to the other used seams under study.

Relative values and quality coefficients of Seam properties tests for the study samples:

Table (6) Relative values and quality coefficients of Seam properties tests for the study samples

Sample Number	Cutting Direction	Denim weight	Seam Type & Stitch Type	Seam Strength %	Seam Elongation %	Seam Stiffness %	Seam Appearance %	Quality Coefficient %
1	Warp	Light weight	SSa seam + 516 stitch	70.87	23.15	100.00	90.00	71.01
2			SSe seam + 301 stitch	47.11	21.02	72.00	75.00	59.93
3			LSq seam + (301 + 514) stitches	87.67	26.06	78.26	65.00	55.27
4		Medium weight	SSa seam + 516 stitch	69.63	33.05	62.04	86.60	56.68
5			SSe seam + 301 stitch	59.02	25.98	36.84	63.30	46.29
6			LSq seam + (301 + 514) stitches	94.28	31.09	48.11	78.30	46.47
7		Heavy weight	SSa seam + 516 stitch	75.52	29.75	50.83	83.30	68.82
8			SSe seam + 301 stitch	51.85	22.18	33.57	53.30	56.70
9			LSq seam + (301 + 514) stitches	98.94	42.57	35.99	81.60	64.77
10	Weft	Light weight	SSa seam + 516 stitch	71.86	62.71	85.07	86.60	76.56
11			SSe seam + 301 stitch	57.21	44.56	74.26	65.00	54.85
12			LSq seam + (301 + 514) stitches	75.77	60.40	93.17	71.60	59.00
13		Medium weight	SSa seam + 516 stitch	56.29	48.98	49.12	83.30	64.83
14			SSe seam + 301 stitch	56.35	50.14	46.23	60.00	53.18
15			LSq seam + (301 + 514) stitches	66.17	53.11	53.58	71.60	51.44
16		Heavy weight	SSa seam + 516 stitch	77.61	43.41	43.39	80.00	77.33
17			SSe seam + 301 stitch	58.34	35.53	40.28	66.60	59.87
18			LSq seam + (301 + 514) stitches	100.00	44.54	43.29	71.60	64.86
19	Bias	Light weight	SSa seam + 516 stitch	60.77	72.43	100.00	86.60	79.95
20			SSe seam + 301 stitch	42.19	36.39	78.26	75.00	67.63
21			LSq seam + (301 + 514) stitches	76.73	70.84	90.00	60.00	56.03
22		Medium weight	SSa seam + 516 stitch	60.64	75.96	58.94	80.00	59.21
23			SSe seam + 301 stitch	46.83	77.08	47.80	71.60	60.83
24			LSq seam + (301 + 514) stitches	95.73	100.00	50.55	78.30	55.49
25		Heavy weight	SSa seam + 516 stitch	63.55	53.48	47.11	90.00	81.89
26			SSe seam + 301 stitch	58.67	46.61	38.37	58.30	76.15
27			LSq seam + (301 + 514) stitches	84.54	66.80	42.43	80.00	68.44

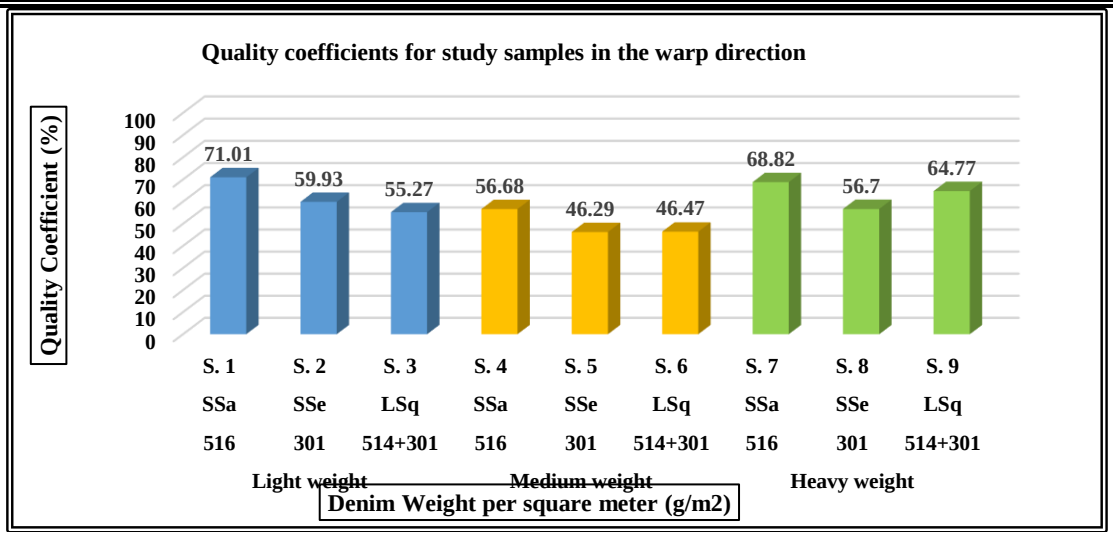


Fig. (13) Quality coefficients for study samples in the warp direction

Table (6) and Figure (13) indicate that when sewing denim fabric of varying weights with organza fabric in the warp direction, it is advisable to employ the SSa seam with the 516 stitch, as it attained the highest quality coefficients values across all seam properties.

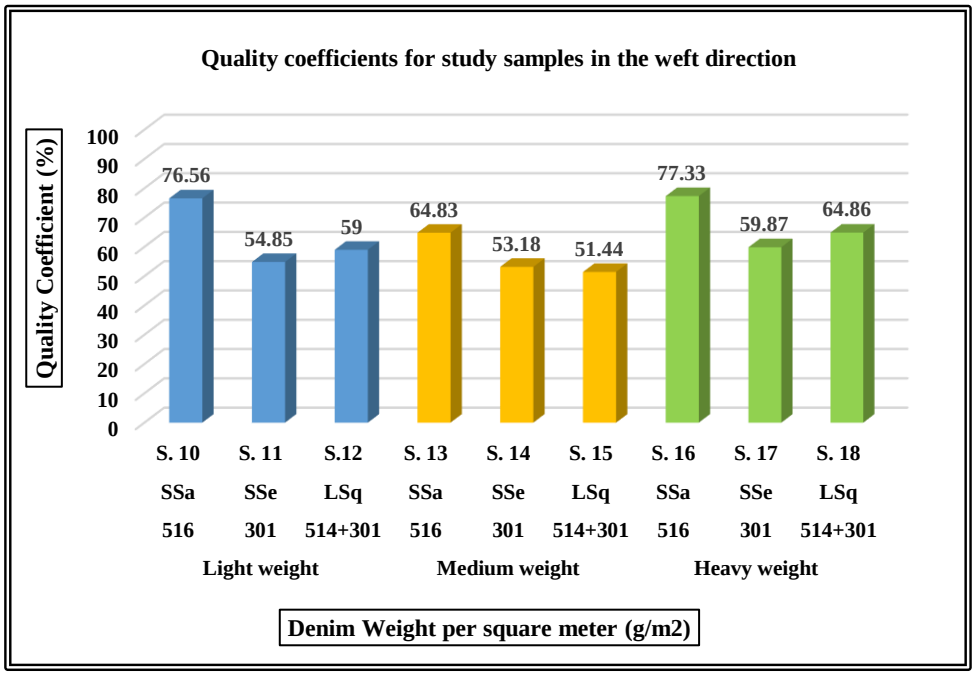


Fig. (14) Quality coefficients for study samples in the weft direction

Table (6) and Figure (14) indicate that when sewing denim fabric of varying weights with organza fabric in the weft direction, it is advisable to employ the SSa seam with the 516 stitch, as it attained the highest quality coefficients values across all seam properties.

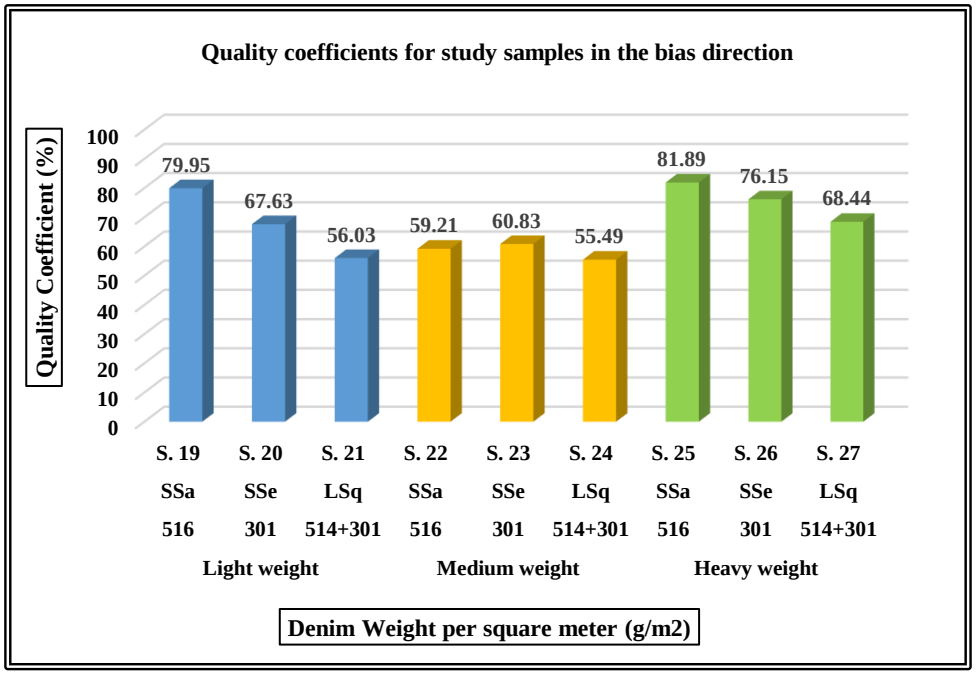


Fig. (15) Quality coefficients for study samples in the bias direction

Table (6) and Figure (15) indicates that when sewing denim fabric (of light and heavy weight) with organza fabric in the bias direction, it is advisable to employ the SSa seam with the 516 stitch, as it attained the highest quality coefficients values across all seam properties, while when sewing medium weight denim fabrics with organza fabrics in the bias direction, it is advisable to use the SSe seam with the 301stitch.

3. Conclusions

In light of the distinct characteristics of denim and organza fabrics, researchers investigated the standards for sewing denim with organza to identify optimal parameters for enhanced sewing efficiency. The study was conducted using 50% cotton and 50% polyester denim fabrics of different weights (light, medium, and heavy weights) and 100% polyester organza fabric; it also used three fabric cutting directions (warp, weft, and bias) and three types of seams and stitches.

The study finding indicates that the LSq seam with the (514+301) stitch exhibited the maximum seam strength while sewing denim fabrics of varying weights with organza fabrics in all cutting directions (warp, weft, and bias).

It was also noted that the SSa seam with the 516 stitch exhibited the maximum seam elongation when sewing denim fabrics (of medium weight) with organza fabrics in the warp direction and when also sewing light weight denim fabrics with organza fabrics (in the weft and bias directions). While the LSq seam with the (514+301) stitch gave the highest value of seam elongation when sewing denim fabrics (of light and heavy weights) with organza fabrics in the warp direction, it also gave the highest value when medium-weight and heavy-weight denim fabrics were sewn with organza fabrics (in the weft and bias directions).

Besides, it was found that the SSe seam with the 301 stitch gave the highest value of seam stiffness when sewing denim fabrics of varying weights with organza fabrics in all cutting directions (warp, weft, and bias).

The results also showed that the SSa seam with the 516 stitch gave the highest value of seam appearance when sewing denim fabrics of varying weights with organza fabrics in all cutting directions (warp, weft, and bias).

Hence, the results demonstrated that when sewing denim fabric of varying weights with organza fabric in the warp, weft, and bias directions, it is advisable to employ the SSa seam with the 516 stitch, as it attained the highest quality coefficients values across all seam properties.

4. Conflicts of interest

"There are no conflicts between authors".

5. Formatting of funding sources

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