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Comparative study of the Aesthetic Properties of (Knitted and weaving) Jacquard Fabrics used in Mattress Fabrics

دراسة مقارنة للخواص الجمالية لأقمشة الجاكارد (التريكو والنسيج) المستخدمة في أقمشة المراتب

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Abstract:

The global technological development in the jacquard circular weft knit fabric industry, which has enabled the production of multi-layered fabrics with a variety of designs and functional performance.

Nowadays bedsets are covered with up to six different fabrics: A better quality circular knit on the top panel the bed's sleeping surface; a matching or contrasting (usually woven) fabric on the border of the mattress; a matching or contrasting (usually woven) fabric on the foundation side panels; a 'non-skid' woven or non-woven fabric on the surface of the foundation and reverse side of the mattress; and a non-woven dust cover on the under side of the foundation.

Modern mattresses are now widely used, even in the popular markets, whether they have a spring (connected chassis or a pocket chassis), sponge or medical (Rebound or Latex). Made on jacquard machines or double-knit fabrics (circular weft knitting), the two types compete with each other.

Double knit fabrics have a comparative advantage due to their soft and porous feel that is characterized by knitted fabrics, which gives them a cotton appearance in many cases, although cotton threads are not used in their production. Therefore, double knit fabrics are used in high-quality, high-priced mattresses. Studying and developing this type of fabric because it takes up a large amount of the fabrics produced.

So, research is aimed to study the Comparative aesthetic properties for the multi-layered jacquard between (weft knit fabric and woven fabric), (4) samples were produced on double jacquard weft knitting machines in different designs and (4) samples were woven in jacquard Weaving machine with different designs , The study will show the aesthetic appearance by a questionnaire .

The research was based on the design of mattress fabrics with four different experiments:

First experiment (knitting):

We used polyester yarn of count (600 denier + 900 denier)for laying in yarn, polyester yarn of count 150 denier colored for face and back of Jacquard fabric design to produce mattress

fabric with two different weight 370 g/m2 and 440 g/m2 with the same width.
Second experiment (weaving)
We used polyester yarn count 1200 denier for lying in yarn, polyester yarn count 150 denier colored for face and back of Jacquard fabric design to produce mattress fabric has two different weight 330 g/m2 and 390 g/m2 with the same width.
Third experiment (knitting):
We used polyester yarn of count 1200 denier for laying in yarn, spun cotton of count 30/1 Ne colored for face and back of Jacquard fabric design to produce mattress fabric with with two different weight 310 g/m2 and 330 g/m2 with the same width .
Fourth experiment (weaving)
We used polyester yarn count (600 denier + 900 denier) for laying in yarn, spun cotton of count 30/1 Ne colored for face and back of Jacquard fabric design to produce mattress fabric has two different weight 360 g/m2 and 405 g/m2 with the same width .

Statement Problem

Woven jacquard fabrics or double knited compete in the production of mattress fabrics, competing to dominate the local and global market

The scarcity of studies and research that work on specialized design programs for the production of jacquard (knitting and weaving) fabrics.

The lack of appropriate standards and prices for the finished modern mattresses, and the absence of values, aesthetic properties.

The difficulty of performing some stages on the knitting design programs and the possibility of merging with the jacquard weaving design programs and knitting designs.

The research problem deals with working on the production of fabrics that show the effect of kaptonism immediately after weaving and processing, that is, without carrying out the captaining process, by increasing the weight of the cloth and using threads for stuffing with combinations that give the cloth a height in some areas

Research Objectives:

1- Producing mattress fabrics that give a Kaptonian feel using the filling method.
2- Choosing the best sample of appearance to determine the most suitable for aesthetic characteristics
3- Comparing the reasons for the spread of jacquard knitted weft fabrics on modern mattresses.

Research Significance:-

1- The spread of modern mattresses manufactured by the jacquard weft knitting method, Reducing costs, time and effort by eliminating the Kaptonian stage.
2- Reducing costs will give a competitive advantage to the mattress product by reducing its price to the consumer.

Research Methods :-

Research methodology The experimental analytical method by making eight samples with different composition and specification for the same design and comparison
Among them in terms of Air Permeability ,Thickness,Weight, Bursting Strength and Abrasion Resistance .

Research hypotheses: -

1- Appearance jacquard knit fabric is excellent and matches the aesthetic properties of the final product.
2- Using the filling method on the jacquard knit double machine with a Kaptonian appearance, saves the Kaptonian process, which saves time.
3- Knitting Cotton will give the best material and best Technique for jacquard mattress fabrics, and it will be the most appropriate in appearance.

Key words

Jacquard Knit Double Circular - Fabrics Mattresses -Filling in -weft knitted fabrics -yarns laid in - weft knitting -Weft cylinder needles.

1- Introduction:

Sleep is a basic and vital activity, it is a physiological need of the human body, and the quality of sleep directly affected by the comfort conditions in the sleep environment Mattresses are an essential component of a sleeping environment. [1]

1-1- Mattresses: -

Modern mattresses are classified into three basic types according to the type of chassis springs Figure:-

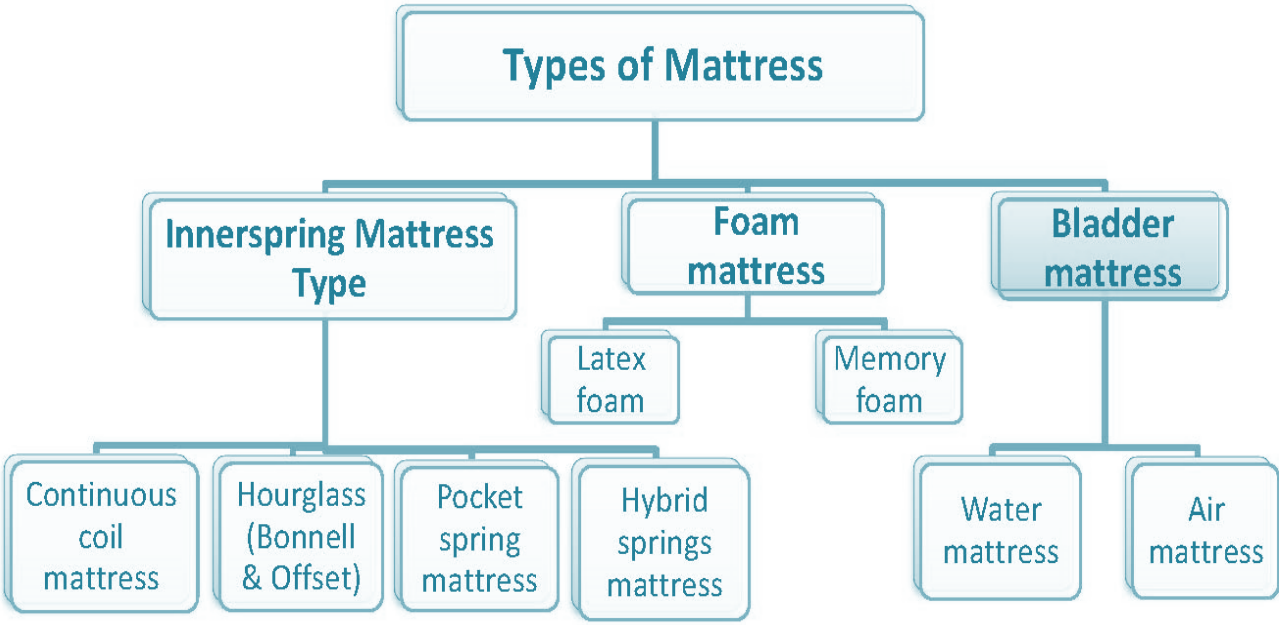

Fig (1) Mattress support system Types

Mattresses often have the basic structure. The mattress core (springs, foam, air, Water, etc.) is sandwiched between layers of foam.

The mattress is topped with a quilted panel that imparts the desired aesthetic appearance and comfort properties to the mattress. Mattress support system Types are shown in Fig (1). [2]

1- Inner Spring Mattress:

The spring mattresses connected as shown in Figure (2) mainly consist of a steel chassis. The springs are fixed to the chassis and completely linked to each other by means of a steel spring, which achieves cohesion and flexibility. [2]

Fig (2): Inner Spring Mattress

2- Pocket Coil Mattress:

Pocket coil or pocket spring mattresses (Figure 3) are characterized by non-vibration, as each zipper moves completely independently, so the zipper does not move on the other side of the mattress. (5)

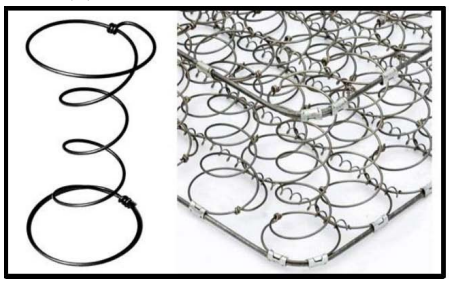

Fig (3) Pocket Coil Mattress

3- Mattresses without springs: Mattresses without spring

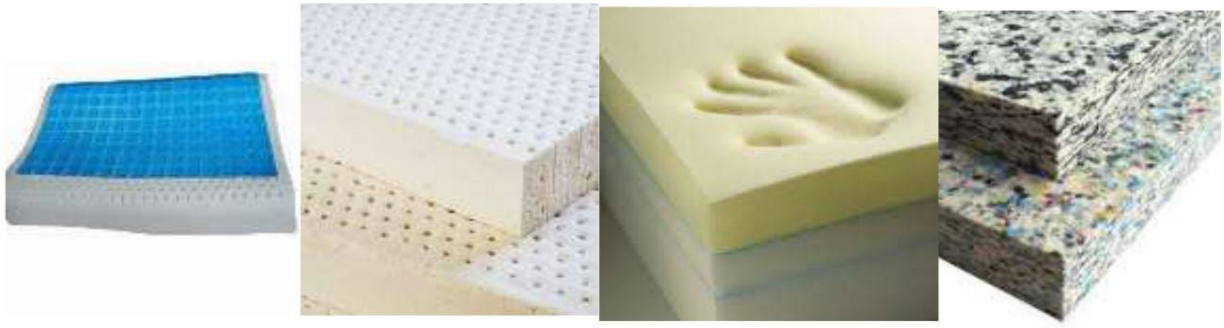

Fig (4) Latex Gel (Latex Foam) Memory Foam Rebound Foam. [2]

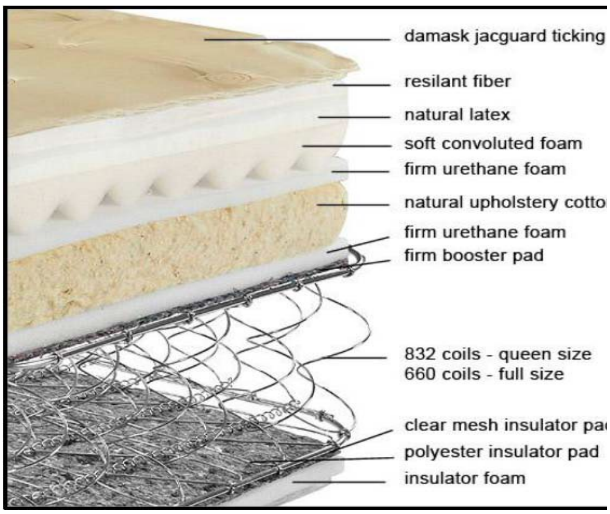

Fig (5): consists of innerspring mattress

A common **innerspring mattress** consists of three components: the spring core, the foundation, and the upholstery layers are shown in fig (5).

Mattress fabrics on double circular knitting jacquard machines:-

They are Rib Jacquard fabrics. These fabrics are produced on double jacquard knitting machines, which contain two types of vertical needles (cylinder needles) as well as horizontal needles (dail needles), where we can choose one of them to make Knit stitch or Miss , and the required designs are produced according to the selection Cylinder needles that make a Knit or Miss stitch for each colored thread used interchangeably, when the thread is not made with cylinder needles, this thread has made a stitch using dail needles the back of the fabric, and the number of feeds required for each complete row of stitches is chosen from the colored thread according to the colored designs. [6]

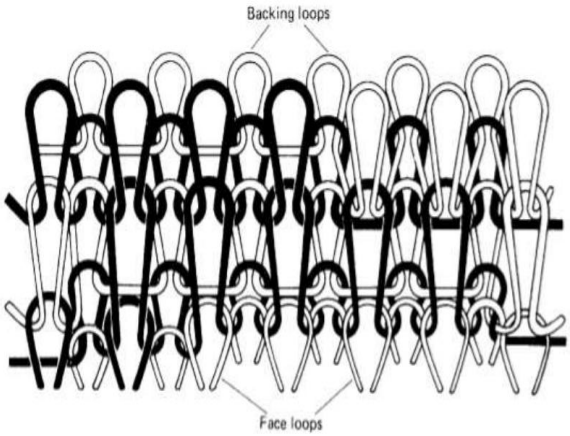

Fig (6) : double circular knitting jacquard loops

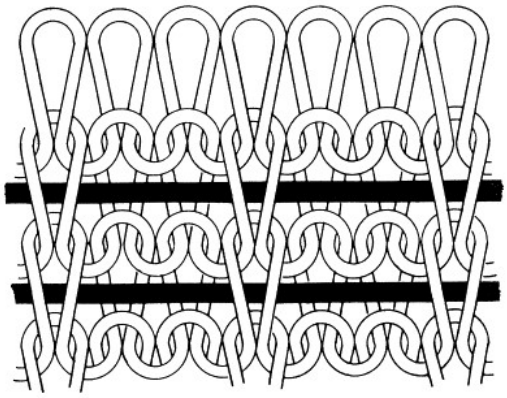

Fig (7) filling shuttle in knitting machines

Double-sided knitting fabrics, double-jersey inlay

Filling can be achieved on double-sided knit tetunnel inlay machines (the same where the stuffing thread is fed Feeding Filling horizontally straight behind the needles of the cylinder each which puts the filling thread in the middle between cylinder feeders and the dail stitches. The three which usually rarity. Figure (7) filling shuttle in knitting machines. (2)

They are also run resistant and do not ravel. Double jersey mattress ticking fabrics are double faced knitted fabrics with inlay yarn. At the beginning they were developed to be used as preforms for textile reinforced composites. Later on these fabrics were begun to be used as pique bed covers and mattress ticking. During fabric production in double bed circular knitting machines, thick Bulk Continuous Filament synthetic yarns are fed as filling yarns in middle layer. (5)

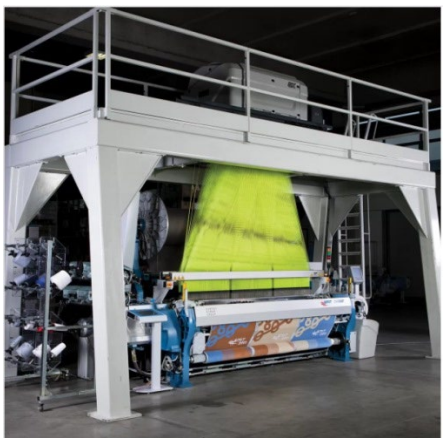

Fig (8) Weaving machine. (7)

Fig (9) knitting machine. (7)

(2)- Practical research experiments:-

The research was based on the production of four designs of mattress fabrics in the jacquard knitting style, once and again with weaving jacquard fabric.

(2-1) Specifications of the machines used in practical research experiments:

Weaving machine

Machine Name : SMIT
Machine Model : GS 900 Italy 2008
Loom Width (Reed Width) : 190 cm
Loom speed : 350 p/min
Weft Selector : 8 fingers Rapier
Weft insertion : Rapier

Jacquard Specification

Jacquard Model : Staubli CX 880
Electronic Switzerland 2008
Jacquard Hooks 3072 hooks
Design Hooks 2560 hooks
Repeats number 4 Repeats
Width of Harness tie repeat 35.5 cm
Fabric width without selvedge 142.2 cm
Fabric width with selvedge 144.2 cm

Knitting Machine

Model : Terrot UCC572M
Terrot Electronic-Jacquard Mattress-Technology
Diameter in inch 34
No. of feeders 84
Gauges E in inch 22
Needle selection :
PIEZO mechanism in
- 1 type of cylinder needles
- 2 types of dial needles
Cam parts : Drop cam system in dial
Fabric take-down:Motorized fabric take-down with 3-roller

Fig (10) UCC572M- fabric sample

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Fig (11) Weaving Head - Filling insertion. (7)

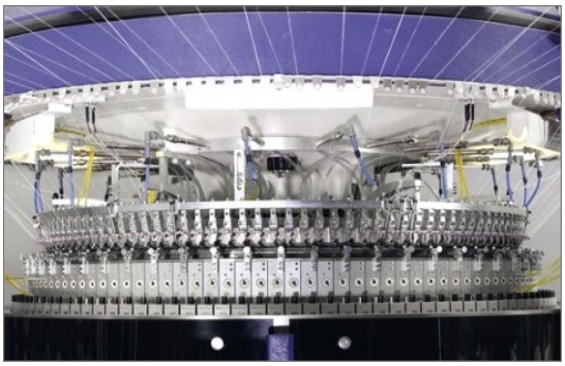

Fig (12) knitting Head. (7)

2.2 Yarns used:

Weaving

Warp : Polyester flat yarn 150 den

Weft :1- Polyester flat yarn 150 den

2- laying in yarns 1200 den

3- cotton blended yarn polyester 35:65 - Ne 30

Number of warp threads /CM : 68 Yarn per CM

Number of weft threads /CM: 30-40 pick per CM

Knitting

1- Polyester flat yarn 150 den

2- cotton blended yarn polyester 35:65 -Ne 30

3- laying in yarns 600 denier + 900 den

Cloth Tension GM\CM2: 2

Number of rows: 18

Stitch length (mm): 2.8

2-3 Implemented designs:-

Fig (13) Executed Designs

2-4 Designing Research Experiments:

The research relied on the production of four designs of mattress fabrics in the jacquard knitting style, once and again with weaving jacquard fabric, and the experiments were as follows in Table (1) :-

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Table (1) experiments Design

Sample	structural style		Design	Yarn material	Count of face and back yarns	Count of laying in yarns (denier)	Weight of M^2
1	Weaving	Double weave	Design1	polyester	150 denier	1200 denier	330 gm
2		Double weave	Design2	polyester	150 denier	1200 denier	389 gm
3		Double weave	Design1	cotton	30/1 Cotton	900 denier +600 denier	360 gm
4		Double weave	Design2	cotton	30/1 Cotton	900 denier +600 denier	406 gm
5	Knitting	Rib Double knitting	Design1	cotton	30/1 Cotton	1200 denier	377 gm
6		Rib Double knitting	Design2	cotton	30/1 Cotton	1200 denier	439 gm
7		Rib Double knitting	Design1	polyester	150 denier	900 denier +600 denier	311 gm
8		Rib Double knitting	Design2	polyester	150 denier	900 denier +600 denier	330 gm

2-5 questionnaire and survey:

A questionnaire and survey of opinions on the aesthetic properties of the produced fabric was conducted by more than thirty professors and textile specialists, and the questionnaire was as follows:

Table (2) the form of questionnaire and survey

Notes	Textile Jacquard			knitting Jacquard			Questionnaire Metrics
	appropriate	**fairly** appropriate	**Non** appropriate	appropriate	**fairly** appropriate	**Non** appropriate	
The first axis: the aesthetic standard							
							1- To what extent are the textile structural achieved to show the aesthetic dimension in the design?
							2- To what extent do the textile materials achieve the aesthetic appearance required in the design?
							3- To what extent does the difference in the number of weft colors achieve the aesthetic values in the design?
							4- To what extent do the executive methods achieve the technical and aesthetic details of the design?
							5- How do you expect the Egyptian market to accept the product?
The second axis: the functional standard							
							1- The validity of the design for use of mattress fabrics?
							2- How good is the selection of textile materials for use in design?
							3- How appropriate is the texture and softness of the fabric for use in mattress fabrics?
							4- How appropriate is the color group for the job? Designs suitable for mattress fabrics?
							5- How appropriate are the executive methods used in mattress fabrics?

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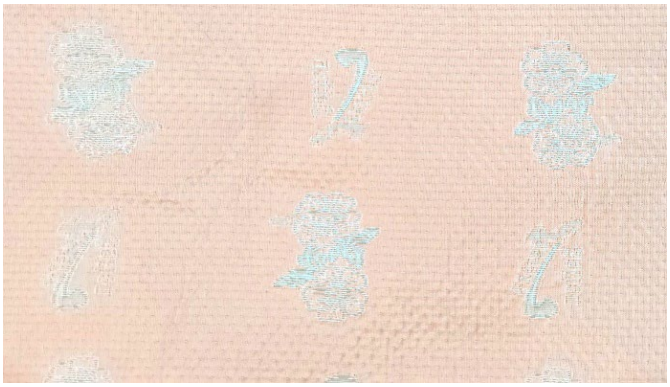
Weaving Jacquard



knitting Jacquard

FIG (14): First Design

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Weaving Jacquard

knitting Jacquard

FIG (15): Second Design

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2-6 Laboratory tests applied to the samples under study:

Several tests were conducted on the samples under study at the National Institute for Measurement and Calibration in the standard atmosphere of the laboratory.

1- Square Meter Weight Test:-This test was carried out according to the American Standard:

ASTM D 3776-M-09 - Standard Test Methods for Mass Per Unit Area Weight of Fabric.

2- Fabric thickness test:- This test was carried out according to the American Standard:

ASTM D 1777 - Standard Test Method for Thickness of Textile Material. This test was carried out by using Mitutoyo Thickness Dial Gage, Japan.

Table (3) shows the average measurements of physical properties of the research samples with warp count 30 / 1 cotton E ,150 denier for mattress fabric.

Table (3): Results of physical and mechanical properties tests of research samples

Sample	Material	Tissue synthesis	Thickness	Weight
1	Polyester	Textile	1.76	330.88
2	Polyester	Textile	1.105	389
3	Cotton	Textile	1.057	357.87
4	Cotton	Textile	1.118	406.2
5	Cotton	Knitting	1.2	377.48
6	Cotton	Knitting	1.55	439.2
7	Polyester	Knitting	1.024	311.72
8	Polyester	Knitting	1.154	330.88

3- Results and Discussion

3.1 Results of physical properties tests of research samples

3-2 Statistical hypothesis tests

The hypothesis states that "the effect of the type of material on the properties of jacquard fabrics and machines (textile, knitting) to achieve aesthetic values for mattress fabrics using specialized design programs".

To test the validity of this hypothesis, the researcher used the Independent samples T-test, and the results were as shown in Table (4).

Table (4): Results of "T-test" tests for the effect of material type on the properties of jacquard fabrics and machines (fabric, knitting).

Properties	Polyester		Cotton		T-test		
	Mean	SD	Mean	SD	(T) value	DF	P-value
Thickness	1.26	0.30	1.23	0.19	0.47	62	0.639
Weight	340.62	29.47	395.19	31.18	7.20	62	**0.001**

Table (4) shows that there is an effect of the type of material on the following properties:

-Weight property, where the value of T is (7.20) and the level of significance is(.0001).

While it was found that there was no effect on the type of material on the Thickness properties .The following graphs illustrate this :-

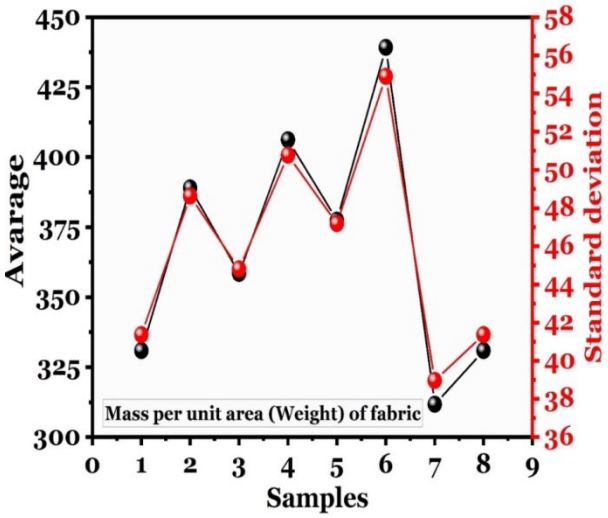


Figure (16): the average values of the Weight property.

Due to the presence of decorative effects on the face of the cloth There was a difference in the densities of the two layers Great difficulty in sampling identical sections

So we calculate the weight of the linear meter for the cloth and then calculate the weight of the square meter through it.

Fig (15) Shows the average values of the Weight property Where samples (6,5,4) with maximum weight are shown to increase the filling in the knitting and weaving fabrics lead to improvement in the aesthetic properties.

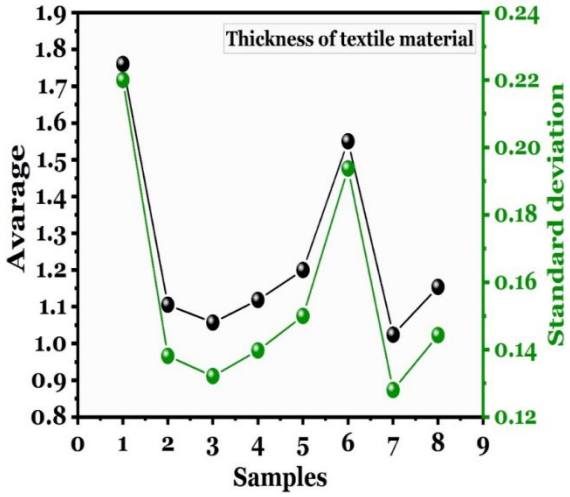


Figure (17): the average values of the Thickness property.

Due to the presence of decorative effects on the face of the cloth

The difference in the cohesion densities of the two layers, which led to

There are about 8 levels of fabric thickness measured in all three research samples (Figure 16). It shows 8 levels of thickness in the research samples show this:

- Increasing the thickness of the fabric with increasing the thickness of the wicking of the filler
- Increasing the thickness of the cloth is required to compensate for the Kapitone.

3-3 Questionnaire results for a resolution about "Evaluation of Proposed Designs"

Corrected on a triple scale.Appropriate, Fairly appropriate, Non appropriate" with weights (3, 2, 1) respectively, and the range was calculated, by subtracting the smallest weight from the highest weight in the scale (3 - 1 = 2), then dividing the range (2) by (3) In order to determine the actual length of each level, it was (2÷3 = approximately 0.67), and this means that the "Non appropriate" level is between a value (1) and less than (1 + 0.67), and that the "Fairly appropriate" level is between a value (1.67) and less than (1.67 + 0.67), and the level is located "Appropriate" between the value (2.33) to (3.0).

Thus, the weighted weight of the answers to each statement is as follows:

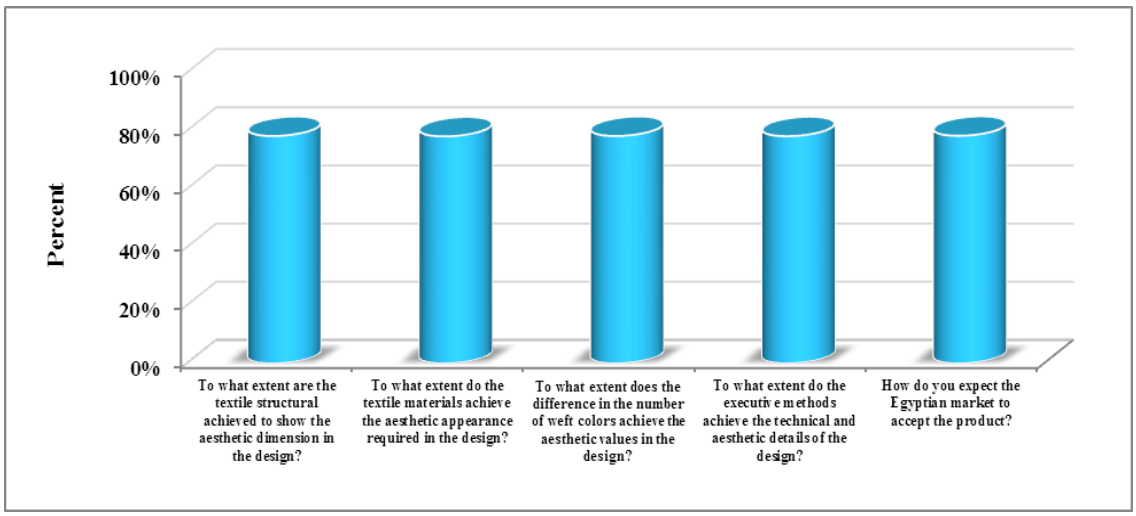
1 – 1.66	(Non appropriate)
1.67 – 2.33	(Fairly appropriate)
2.34 – 3.0	(Appropriate)

3-4 Verification of the achievement of the aesthetic standard in the proposed designs.

Table (5): Arithmetic averages, standard deviations, and the relative weight of specialists' opinions towards the items of the aesthetic criterion in the proposed designs combined.

Items	Arithmetic mean	SD	Percent (%)	Item level
To what extent is the textile structural achieved to show the aesthetic dimension in the design?	2.346	0.74	78.19%	Appropriate
To what extent do the textile materials achieve the aesthetic appearance required in the design?	2.342	0.75	78.06%	Appropriate
To what extent does the difference in the number of weft colors achieve the aesthetic values in the design?	2.346	0.75	78.19%	Appropriate
To what extent do the executive methods achieve the technical and aesthetic details of the design?	2.344	0.79	78.13%	Appropriate
How do you expect the Egyptian market to accept the product?	2.348	0.76	78.26%	Appropriate
The aesthetic standard	**2.345**	**0.56**	**78.17%**	**Appropriate**

In order to verify the achievement of the aesthetic criterion in the proposed designs combined, the researcher calculated the general arithmetic mean, standard deviation and relative weight towards each item of the first axis (the aesthetic criterion), according to the three-tiered scale, and the results came as shown in the table (5):



appearance (18): It clarifies the terms of the aesthetic standard in the proposed designs combined according to the opinions of specialists

from the table (5) Chart (18) shows the agreement of specialists towards achieving the items of the aesthetic criterion in the proposed designs combined, where the opinions were high and fell at the "Appropriate" level for all items based on

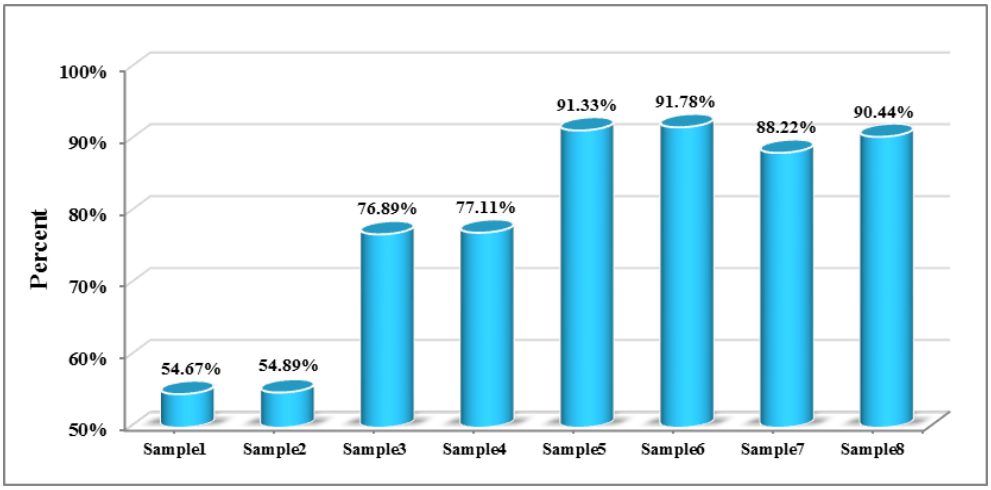
the triple gradation of weight, and the arithmetic mean values for these items ranged between (2.342 - 2.348)), and their relative weights ranged between (78.06% - 78.26%), and for To achieve the aesthetic standard in the proposed designs, the arithmetic mean value (2.345) with a relative weight (78.17%), which shows the achievement of the aesthetic standard and its clauses in the proposed designs.

✓**Evaluation of the proposed designs according to the aesthetic criteria**

Table (6): Arithmetic averages, standard deviations and relative weights of specialists' opinions towards the proposed designs according to the aesthetic criterion.

Samples	Arithmetic mean	SD	Percent (%)	Design level	Rank	Chi-square Test		
						χ^2	DF	P-value
Sample1	1.64	0.35	54.67%	Non appropriate	7	**513.66**	**14**	**0.001**
Sample2	1.65	0.30	54.89%	Non appropriate	6			
Sample3	2.307	0.44	76.89%	Fairly appropriate	5			
Sample4	2.313	0.42	77.11%	Fairly appropriate	7			
Sample5	2.74	0.34	91.33%	Appropriate	2			
Sample6	2.75	0.29	91.78%	Appropriate	1			
Sample7	2.65	0.33	88.22%	Appropriate	4			
Sample8	2.71	0.33	90.44%	Appropriate	3			

From table (6), It turns out that the proposed designs numbers (5, 6, 7, 8) fell at the level of "Appropriate" according to the opinions of specialists based on the triple gradation of weight, where the arithmetic mean values of these designs were (2.74, 2.75, 2.65, 2.71) and the relative weights (91.33%, 91.78%, 88.22%, 90.44%) respectively, and the opinions were at the "Fairly Appropriate" level for the two digital designs (3, 4) with an arithmetic average of (2.307, 3.313) and a relative weight of (76.89%, 77.11%), respectively. While the opinions occurred at the “Non Appropriate” level for the two digital designs (1, 2) with an arithmetic mean (1.64, 1.65) and a relative weight (54.67%, 54.89%), respectively, and it was found that there were statistically significant differences between the proposed designs according to the aesthetic criterion, where reached the value of "^{2}(513.66) and the level of significance (0.001), and App. (19) Explain it.



Appearance (19): It shows the proposed designs according to the Aesthetic standard and according to their relative weights.

3-5 Research results: -

1- Knitting was the best textile method for producing jacquard mattress fabrics, which is the most appropriate in appearance, as in the questionnaire and tests.

2- Cotton was the best material for weaving jacquard mattress fabrics, and it was the most appropriate in appearance, as in the questionnaire and tests.

3- Increasing the thickness of the filler wicking as well as its density will give a more tensile strength to the fabric produced, which can be measured by a explosion test.

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