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Comparative Study of the Functional Properties of (knitted and weaving) Jacquard Fabrics used in Mattress Fabrics

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

نور عفيفي حسن عبدالوهاب عصر
مدرس بقسم هندسة النسيج
المعهد العالي للهندسة والتكنولوجيا بالمحلة

جمال عبدالحميد رضوان
أستاذ النسيج بقسم الغزل والنسيج والتريكو
كلية الفنون التطبيقية- جامعة حلوان

عادل عبد المنعم ابو خزيم
استاذ مساعد قسم الغزل والنسيج والتريكو
كلية الفنون التطبيقية جامعة بنها

محمد الشيخ
مدرس مساعد بقسم هندسة النسيج –
المعهد العالي للهندسة والتكنولوجيا بالمحلة

Abstract:

Recently, the computer appeared as an assistant in the design process, Computer Aided Industrial Design, through a system in which both the designer and the computer interact as a team to solve the design problem. A variety of ideas.

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.

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 between functional properties and functional properties for the multi-layered jacquard (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 functional properties by laboratory tests, and 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.

(ISSN 2537-1061) (Print)

(ISSN 2537-107X) (Online)

Second experiment (weaving)
We used polyester yarn count 1200 denier for laying 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 (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 with with two different weight 310 g/m2 and 330 g/m2 with the same width .
Fourth experiment (weaving)
We used polyester yarn 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 has two different weight 360 g/m2 and 405 g/m2 with the same width .

Statement Problem:
Woven jacquard fabrics or double knitted 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, function 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- Select the best construction weave or knitted to give the best functionality
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 a 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

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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:

mattresses are a prerequisite for comfort and development, on which the quality of sleep depends greatly, and this is why we can note the continuous efforts to develop both the mattress core and the mattress cover. With an average lifespan of 10 to 15 years, mattresses are durable consumer goods. Therefore, to preserve the functional and aesthetic characteristics of the whole mattress, which generally consists of the core and the cover, and therefore we will conduct an analytical and executive study of the modern mattress cover fabrics produced in the jacquard knitted and weaving style. . [(1)]

Modern mattress covering fabrics can be produced in two ways:

First, the jacquard weaving method:

Woven fabrics are the most widely used and circulated types of fabrics, and the weaving process is by converting spun threads into fabrics that vary in composition according to the textile design and also according to use, and accordingly it can be said that weaving is nothing but the interweaving of length and width threads with each other at right angles according to the textile composition. . [(5)]

The main performance characteristics of the fabric are:

Durability: The ability of a textile material to retain its physical strength under mechanical stress for an acceptable period of time.

Comfort: The ability of the material to provide a painless, comfortable feeling to the body. Or in other words, the ability of a substance to maintain a neutral state of the body. . [(6)]

Aesthetic appeal: The degree of palatability of the eye, hand, ear and nose of textile materials (human sensations).

Maintenance: The ability of a textile material to maintain the same degree of cleanliness, dimensional stability, and physical strength, and maintain its same color since its purchase, during its use, wear and care procedures.

Health/safety/protection: The properties of the fabric that may render it a hazardous substance, or those that protect the human body and the environment from various harmful substances (including properties that make the fabric suitable for use in the diagnosis, prevention, and treatment of medical matters). . [(2)]

These properties are not measured directly, but are inferred by certain performance tests. For example, durable fabric does not tear, fray, pore, or disintegrate quickly. Therefore, toughness includes the strength of the fabric (its ability not to tear under tensile forces), abrasion resistance (the ability of the material to withstand abrasive forces), flexural or elasticity (the ability of the material to bend repeatedly without breaking), elongation and elasticity, which affect the How fabric absorbs mechanical stress. . [(13)]

Second, jacquard knitting style:

The most important properties that must be taken into consideration, which in turn affect the aesthetics of the fabric, as well as

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its durability, is the high elasticity enjoyed by knitted fabrics, which means comfort and ease of wearing, as well as the high recovery that these textiles enjoy. What is any obstruction for the wearer? As for the semi-permanent deformation of these textiles, it gives comfort when used. Therefore, the physical and mechanical properties related to physiological comfort requirements: Performance properties of out Wear Clothing Fabric

- Feeling of comfort: (including air permeability - water permeability - moisture absorption - thermal insulation)

- Maintain appearance. - Ease of care. . [13]

Among the mechanical properties related to performance efficiency are: dimensional stability, fabric stiffness, elasticity, shedding and anti-freezing

With this difference and great diversity in the two production methods for these fabrics, and with the existence of an interactive relationship between the layers of fabric used in mattresses and the human body, it was necessary to conduct an analytical and executive study of these fabrics and know how to take advantage of specialized design programs for weaving and jacquard knitting to achieve the highest efficiency of use in the presence of aesthetic appearance and access For the convenience of users. . [2]

Mattresses:-

A common **innerspring mattress** . [2]consists ofthree components:the spring core, the foundation,and the upholstery layers are shown in fig (1).

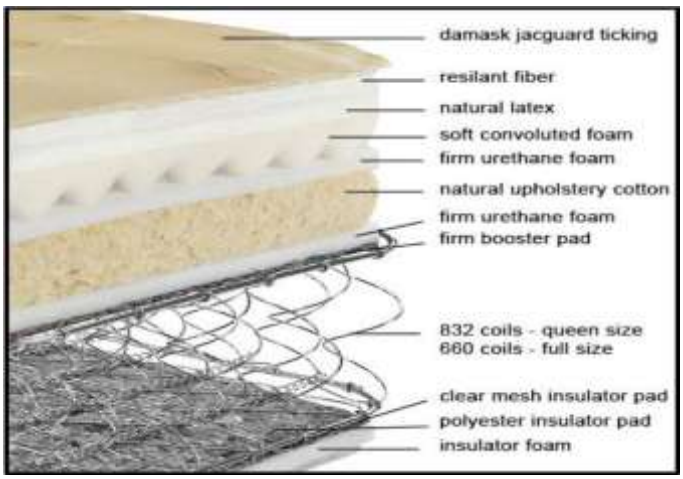

Fig (1) : A common innerspring mattress

Double-sided knitting fabrics, double-jersey inlay

Filling can be achieved on double-sided knit tetunnelinlay 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 (2) filling shuttle in knitting machines. [2]

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(ISSN 2537-107X) (Online)

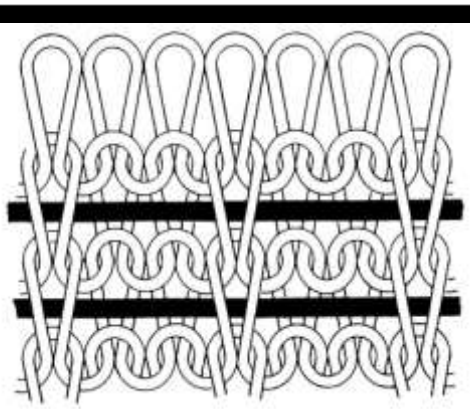

Fig (2) filling shuttle in fabric structure

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. [6]

Fig (3) filling shuttle in knitting machines

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

(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:

(ISSN 2537-1061) (Print)

(ISSN 2537-107X) (Online)

[7] **Fig (4) Weaving machine.**

[7] **Fig (5) knitting machine.**

Fig (6) UCC572M- fabric sample

Weaving machine	**Knitting 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	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
 [7] Fig (7) Weaving Head- Filling insertion.	 [7] Fig (8) knitting Head.
2.2 Yarns used: Warp : Polyester flat yarn 150 den Weft :1- Polyester flat yarn 150 den 2- laying in yarns 1200 den	1- Polyester flat yarn 150 den 2- cotton blended yarn polyester 35:65 -Ne 30 3- laying in yarns 600 denier + 900 den

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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	Cloth Tension GM\CM2: 2 Number of rows: 18 Stitch length (mm): 2.8

(ISSN 2537-1061) (Print)

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(2-3) Implemented designs :-

Fig (9) Implemented 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) :-

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	↑ ↑	Rib Double	Design1	cotton	30/1	1200	377 gm

(ISSN 2537-1061) (Print)

(ISSN 2537-107X) (Online)

Sample	structural style		Design	Yarn material	Count of face and back yarns	Count of laying in yarns (denier)	Weight of M^2
		knitting			Cotton	denier	
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 functional properties of the produced fabric was conducted by more than thirty professors and textile specialists, and the questionnaire was as follows In the latest of research:

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 .

١- Explosion resistance test : This test was carried out according to the American Standard

ASTM D 3787; 2001 - Standard Test Method for Bursting Strength of Fabrics .

Constant Rate of Extension (CRE) Ball Burst Test. This test was carried out by using QMat5.37 /Q3214—NIS

2-Air Permeability Test : This test was carried out according to the American Standard:

ASTM D 737 - Standard Test Method for Air Permeability of Textile Fabrics

3- 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.

٤-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

3- Results and Discussion

3.1 Results of physical properties tests of research samples

Sample	Material	Tissue synthesis	Thickness	Weight	Bursting Strength	Abrasion Resistance
1	Polyester	Textile	1.76	330.88	1951	637

(ISSN 2537-1061) (Print)

(ISSN 2537-107X) (Online)

2	Polyester	Textile	1.105	389	1843	774
3	Cotton	Textile	1.057	357.875	1829	682
4	Cotton	Textile	1.118	406.2	1219	824
5	Cotton	Knitting	1.2	377.48	1331	722
6	Cotton	Knitting	1.55	439.2	1257	949
7	Polyester	Knitting	1.024	311.72	1452	575
8	Polyester	Knitting	1.154	330.88	1547	624

Table (2): Results of physical and mechanical properties tests of research samples

Table (2) shows the average measurements of physical and mechanical properties of the research samples with warp count 30 / 1 cotton E ,150 denier for mattress fabric.

3-2 Statistical hypothesis tests

The first statistical hypothesis of the research:

The hypothesis states that "the effect of the type of material on the properties of jacquard fabrics and machines (textile, knitting) to achieve functional 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 (3).

Table (3): Results of "T-test" tests for the effect of material type on the properties of jacquard fabrics and machines (fabric, knitting).

Table (3) shows that there is an effect of the type of material on the following properties:

Properties	Polyester		Cotton		T-test		
	Mean	SD	Mean	SD	(T) value	DF	P-value
Air Permeability	34.23	9.56	37.90	12.34	1.33	62	0.188
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**
Bursting Strength	1698.25	208.44	1409.00	249.74	5.03	62	**0.001**

-Weight property, where the value of T is (7.20) and the level of significance is(0.001).

-Bursting Strength property, where the value of T "" (5.03) and the level of significance (0.001)

While it was found that there was no effect on the type of material on the two properties

(Air Permeability, Thickness).

The following graphs illustrate this :

Figure (10) shows the explosion resistance (Bursting Strength) of samples,,The search reveals the following:-

- Increased explosion resistance with knitting fabrics not with weaving fabrics.

The use of filling threads led to an increase in Relative as well in Bursting resistance.

This increasing of thickness knitting filling improves the mechanical properties for fabrics produced.

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

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(ISSN 2537-107X) (Online)

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

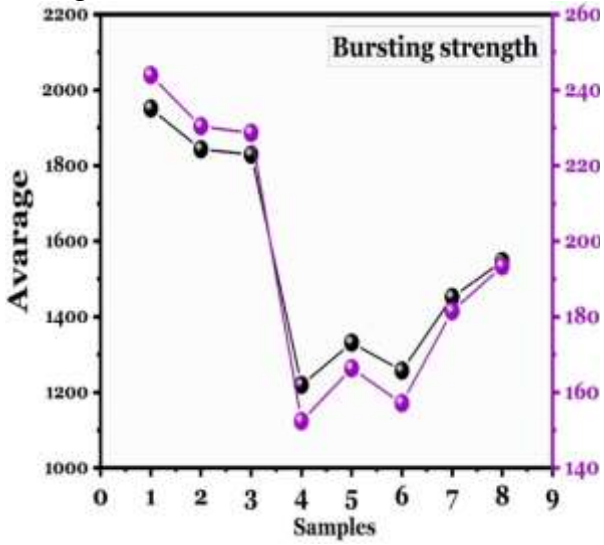

Figure (10): Shows the average values of the Bursting Strength property.

Fig (11) 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 functional

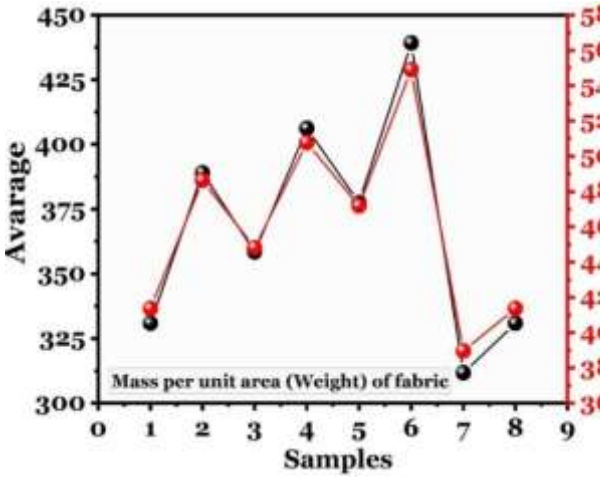

Figure (11): Shows the average values of the Weight property

Figure (12): Shows the average values of the Air Permeability property,, As shown in the figure (12), the knitting samples have a great precedence over weaving fabric samples in the air permeability test, because the knitting stitch allows for a greater and faster passage of air .

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.

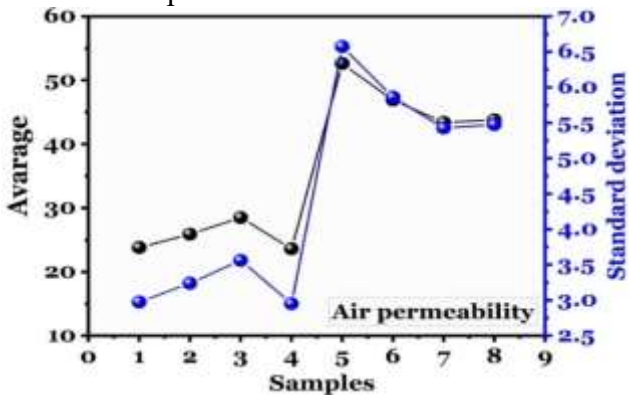

Figure (12): Shows the average values of the Air Permeability property

(Figure 13).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

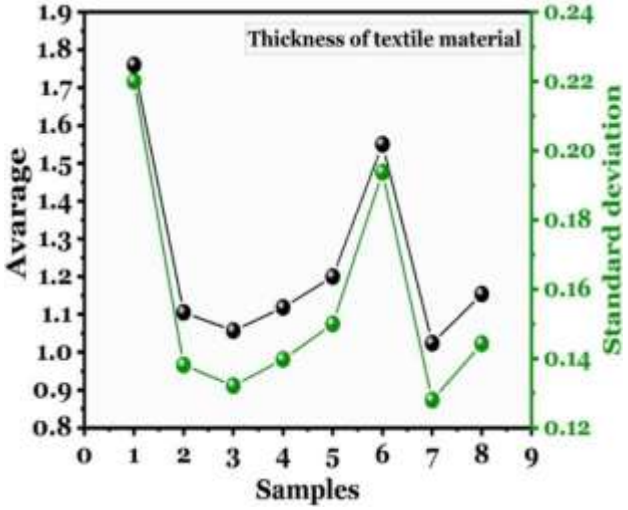

Figure (13): Shows the average values of the Thickness property.

(ISSN 2537-1061) (Print)

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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)

Verification of the fulfillment of the functional standard in the proposed designs.

In order to verify the achievement of the functional criterion in the proposed designs combined, the researcher calculated the general arithmetic mean, standard deviation, and the relative weight towards each item of the first axis (the functional criterion), according to the three-tiered scale, and the results came as shown in the table (4)

Table (4): Arithmetic averages, standard deviations, and the relative weight of specialists' opinions towards the items of the functional standard in the proposed designs combined.

Items	Arithmetic mean	SD	Percent (%)	Item level
The validity of the design for use of mattress fabrics?	2.40	0.70	80.14%	Appropriate
How good is the selection of textile materials for use in design?	2.41	0.69	80.42%	Appropriate
How appropriate is the texture and softness of the fabric for use in mattress fabrics?	2.47	0.65	82.22%	Appropriate
How appropriate is the color group for the job? Designs suitable for mattress fabrics?	2.50	0.64	83.33%	Appropriate
How appropriate are the executive methods used in mattress fabrics?	2.47	0.65	82.22%	Appropriate
The functional standard	**2.45**	**0.43**	**81.67%**	**Appropriate**

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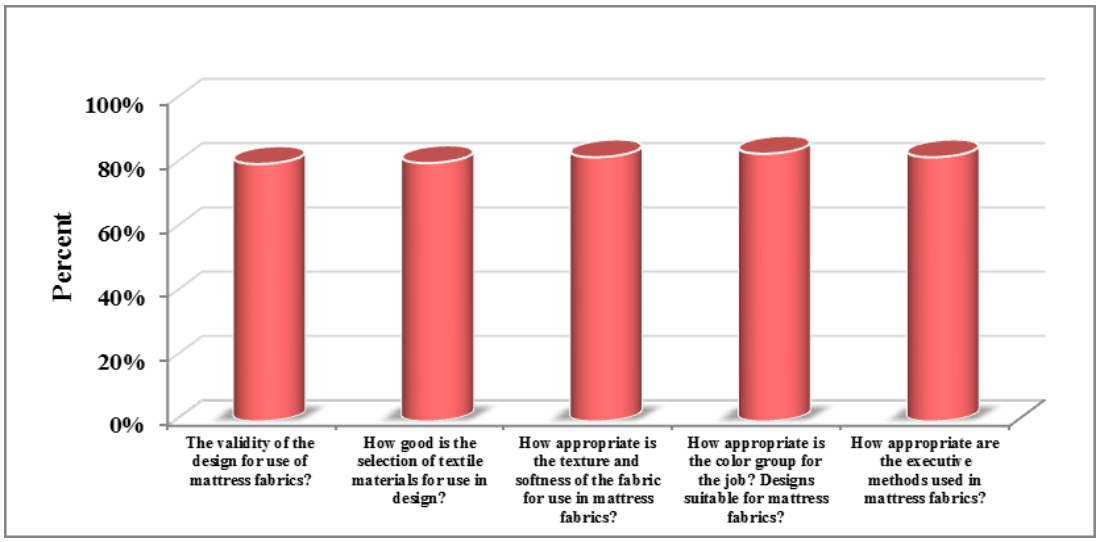

appearance (14): It shows the items of the functional standard in the proposed designs combined according to the opinions of specialists

from the table (5) Chart (14) shows the agreement of specialists towards achieving the items of the functional criterion in the proposed designs combined, where 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 (2.40 - 2.50)), and their relative weights ranged between (80.14% - 83.33%), and for To achieve the functional criterion in the proposed designs, the arithmetic mean value (2.45) with a relative weight (81.67%), which shows the achievement of the functional standard and its clauses in the proposed designs.

✓ **Evaluation of the proposed designs according to the functional standard**

Table (5): Arithmetic averages, standard deviations and relative weights of specialists' opinions towards the proposed designs according to the functional standard.

Samples	Arithmetic mean	SD	Percent (%)	Design level	Rank	Chi-square Test		
						χ^2	DF	P-value
Sample1	2.26	0.43	75.33%	Fairly appropriate	8	132.57	14	0.001
Sample2	2.32	0.40	77.33%	Fairly appropriate	5			
Sample3	2.29	0.37	76.22%	Fairly appropriate	7			
Sample4	2.32	0.33	77.33%	Fairly appropriate	5 rep.			
Sample5	2.56	0.44	85.33%	Appropriate	3			
Sample6	2.71	0.29	90.22%	Appropriate	1			
Sample7	2.53	0.46	84.44%	Appropriate	4			
Sample8	2.61	0.45	87.11%	Appropriate	2			

from the table (5) 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 gradient of weight, where the arithmetic mean values of these designs were (2.56,

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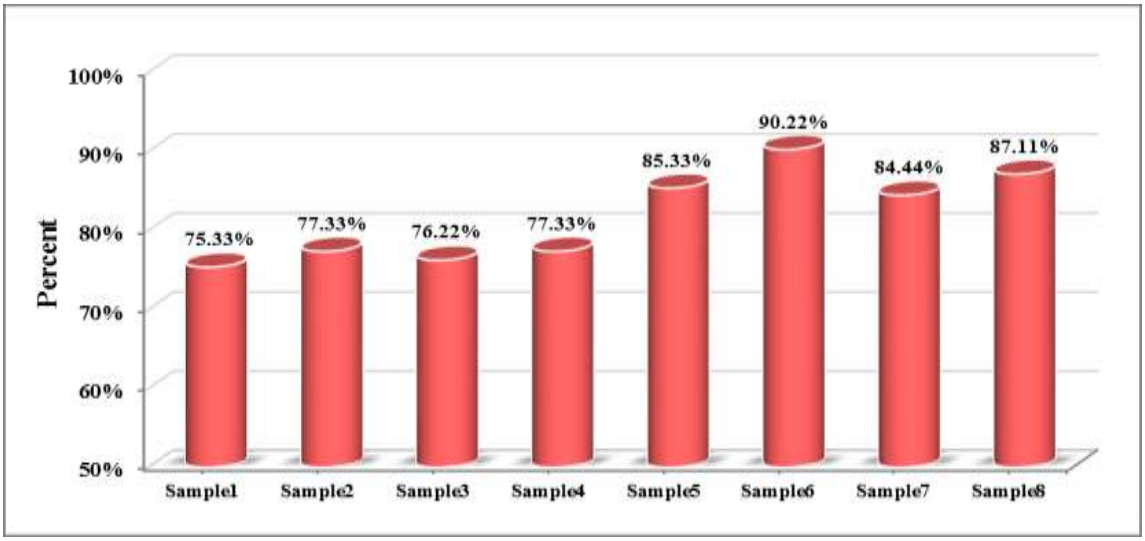
(ISSN 2537-107X) (Online)

2.71, 2.53, 2.61) and the relative weights (85.33%, 90.22%, 84.44%, 87.11%), respectively, while opinions occurred at the "Fairly Appropriate" level for designs numbers (1, 2, 3, 4), where the arithmetic mean values were (2.26, 3.32, 2.29, 2.32) and the relative weights (75.33%, 77.33%, 76.22%, 77.33%), respectively, and it was found that there were statistically significant differences between the proposed designs according to the functional standard, where the value of "^{2}(132.57) and the level of significance (0.001).and graph (15) Explains it.



appearance (15): It shows the proposed designs according to the functional standard and according to their relative weights.

✓ **Evaluate the proposed designs according to the overall evaluation**

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

Samples	Arithmetic mean	SD	Percent (%)	Design level	Rank	Chi-square Test		
						χ^2	DF	P-value
Sample1	1.95	0.35	65.00%	Fairly appropriate	8	535.80	14	0.001
Sample2	1.98	0.29	66.11%	Fairly appropriate	7			
Sample3	2.30	0.37	76.56%	Fairly appropriate	6			
Sample4	2.32	0.33	77.22%	Fairly appropriate	5			
Sample5	2.65	0.34	88.33%	Appropriate	3			
Sample6	2.73	0.28	91.00%	Appropriate	1			
Sample7	2.59	0.38	86.33%	Appropriate	4			
Sample8	2.66	0.36	88.78%	Appropriate	2			

from the table (6) It turns out that the proposed designs numbers (5, 6, 7, 8) fell at the “Appropriate” level according to the opinions of specialists based on the triple gradation of weight, where the arithmetic mean values of these designs were (2.65, 2.73, 2.59, 2.66) and the relative weights (88.33%, 91.0%, 86.33%, 88.78%), respectively, while the opinions occurred at the "Fairly Appropriate" level for designs numbers (1, 2, 3, 4), where the arithmetic mean

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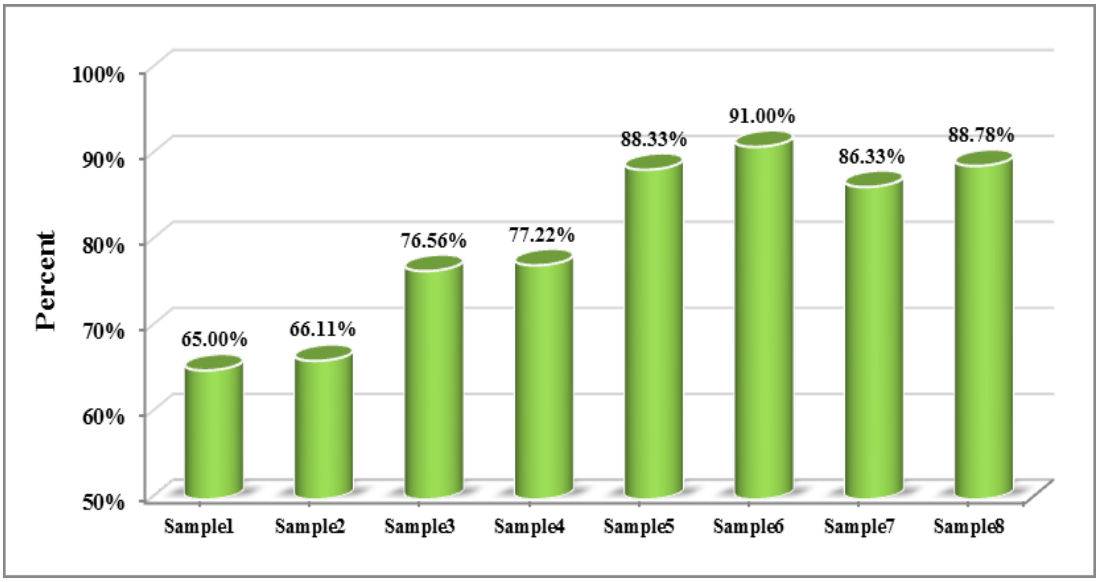
values were (1.95, 1.98, 2.30, 2.32) and the relative weights (65.33%, 66.11%, 76.56%, 77.22%) respectively, and it was found that there were statistically significant differences between the proposed designs according to the overall evaluation, where the value of "(535.80) and the level of morality (0.001). Design No. (6) came in the first rank, followed by Design No. (8) in the second rank, and Design No. (5) came in the third rank, followed by the rest of the designs according to their relative weights. and graph (16) Explains it.



appearance (16): It shows the proposed designs according to the overall evaluation according to their relative weights

Research results: -

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

2- Cotton was the best material for weaving jacquard mattress fabrics, and it was the most appropriate in function, 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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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?

Questionnaire and survey Designs

(ISSN 2537-1061) (Print)

(ISSN 2537-107X) (Online)

weaving Jacquard	knitting Jacquard
	

FIG (17) : First Design

weaving Jacquard	knitting Jacquard
	
	

FIG (18) : Second Design

(ISSN 2537-1061) (Print)

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