MINISTRY OF HIGHER AND SECONDARY SPECIALIZED EDUCATION OF THE REPUBLIC OF UZBEKISTAN

TASHKENT INSTITUTE OF TEXTILE AND LIGHT INDUSTRY

Technology of textile fabrics department

METHODOLOGICAL GUIDELINE

for laboratory classes of the subject

«TECHNOLOGY AND EQUIPMENT OF TEXTILE PRODUCTS»

(Weaving manufacture)

For undergraduate students of the educational direction
5320900 - Technology and construction design of textiles
(silk production, spinning production)

Author: O. Kasimov

Tashkent - 2017

The methodological guideline of the module “Technology and equipment of textile products” is designed for undergraduate students of the educational direction 5320900 - Technology and construction design of textiles. It covers such aspects as: preparation of warp and weft yarns for weaving, weaving technology, weaves and conditions of their formation, technological factors of their production on weaving loom, and their application areas.the methodological guideline consists of purpose of each laboratory exercise, required equipment, implementation order and method, examining questions and examples, and recommended references necessary to run each laboratory exercise.

Authors: assist. teacher O.Kasimov

Reviewers:

Fayzullaev Sh. R. “Technology of silk and spinning”dept. head, PhD

I.Abdurakhmanov “ILXOMBEK STYLE” LLC, director

Discussed and approved at the methodological council of TITLI.
Protocol №___ “ ”_____20__y.

COURSE SCHEDULE

№	Topics of laboratory exercises	Hours
1.	**1st Lab exercise** Fabric and its creation on the weaving loom.	6
2.	**2nd Lab exercise** Bobbin package types delivered to weaving factory. Rewinding process and equipment.	6
3.	**3rdLab exercise** Warping. Purpose of warping. Types of warping. Modern warping machines.	6
4.	**4th Lab exercise** Sizing. Preparation of sizing material and its composition.	6
5.	**5thLab exercise** Warp drawing-in and tying.	8
6.	**6thLab exercise** Weaving looms and classification.	4
7.	**7thLab exercise** Shedding process and devices.	4
8.	**8thLab exercise** Weft feeding methods	4
9.	**9thLab exercise** Weft beating up.	4
10.	**10thLab exercise** Fabric rolling-up.	4
11.	**11thLab exercise** Warp let-off and tension.	8
12.	**12th Lab exercise** Basic weaves. Full design plan of basic weaves.	6
13.	**13th Lab exercise** Huckaback weaves. Full design plan of huckaback weaves.	6
	TOTAL:	**72**

General guidance

1. The main purpose of laboratory exercises of students is to practice the skills obtained in lectures and by self-education. Also, students learn the construction, operation, maintenance and management of technological processes and equipment. It is required that students, during study of technological processes and equipment have to pay attention to following:

- To be informed about technical parameters of modern weaving looms;
- To learn technological processes and equipment, to analyze and draw schematic graphs;
- To learn and compare the purposes, construction, operation and production capability of equipment;
- To have a knowledge on production waste and the ways of its decrease.
- To learn the defects caused by equipment malfunction, reasons and the ways of their prevention;
- To have practical knowledge about each processing equipment;
- To search for the information on the Internet to add to the information from lectures.

2. Before doing laboratory exercises, students have to possess a strong theoretical knowledge about technological processes and equipment from lectures and self-education from textbooks. Figures and schematic graphs have to be drawn with a pencil, a ruller and a pair of compasses.

There has to be a blank field on the right side of the exercise book for teacher's notes and corrections.

A fulfilled exercise book has to be signed by a teacher.

3. Students write a report on each laboratory exercise. In order to prepare a report students can use lectures, textbooks, study materials, tutorials as well as instruction manuals and any information about equipment.

A report is prepared in following order:

a) topic and purpose of exercise, report plan;
b) main information about studied equipment (purpose, types etc.);
c) purpose, construction and operation of technological mechanisms and parts of equipment;
d) analysis of schematic (in certain cases, also kinematic) drawings of equipment and mechanisms;
e) waste and defects of technological processes, analysis of their nature and ways of prevention.

Notice: All calculations, analytics, drawings and graphs in the report have to correspond the State Standard (DS).

Each laboratory task after its full completion has to be prepared in report form and to be signed by a responsible teacher.

LABORATORYEXERCISE 1

Topic: **Fabric formation on the weaving loom.**

Purposeofthisexercise*istostudy the schemes of fabric creation and the preparation of warp and weft yarns.*

Content:

1. To study and make the technological scheme of fabric formation.
2. To study the technological process of warp and weft yarns preparation.

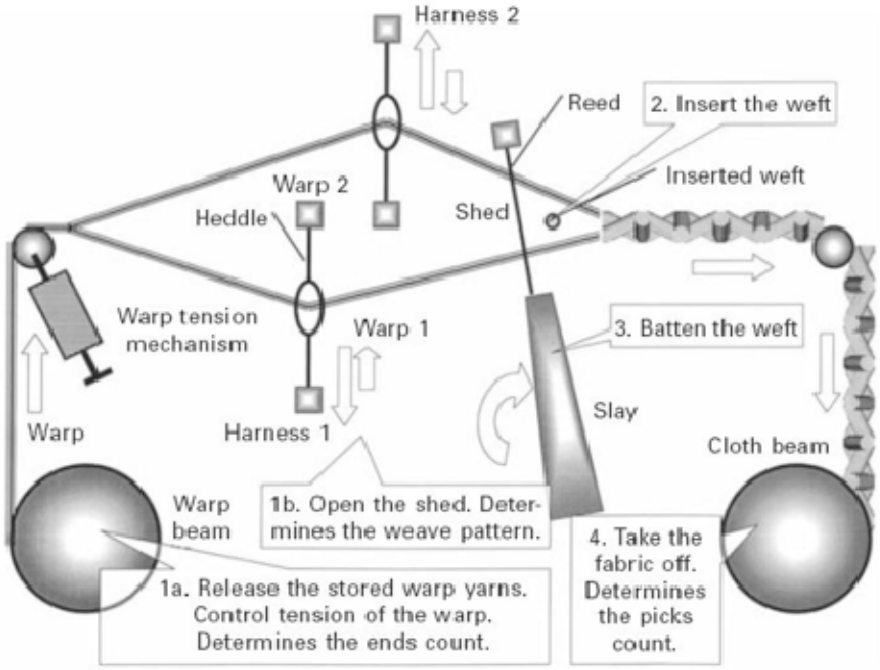


Fig. 1. General schematic graph of a weaving loom.

1. Review fabric samples, explain their fiber structure and application areas according to the table 1.

Table 1.

№	Fabric title	Article	Fiber structure	Application area
1.				
2.				
3.				
4.				
5.				

2. Mainmechanismsinvolvedinfabricformation. Schematicgraphofaweavingloom.

3. Identify the main parameters of warp yarns and fabric on a weaving loom for production and drawing plan. Fill the boxes in the table 2 accordingly.

Table 2.

№	Type and model of weaving loom	Warp drawing width				Fabric width		
		Weaver's beam	Dropper	Harness	Reed	Fabric roll	Front rest	Fabric edge
1.								
2.								

4. Identify the warp density at the different zones of weaving loom.
5. Identify the change of fabric width at all zones of weaving loom and fill the table 3 accordingly.

Table 3.

№	Indicators	Z O N E S		
		Fabric edge	Front rest	Fabric roll
1.	Fabric density 1.1.Warp density 1.2.Weft density			
2.	Weft shrinkage 1.1.By width measurements 1.2.Warp density			

Methodological recommendations on task implementation.

Requirements for task implementation are following:

Different fabric samples (albums) by fiber structure (fiber density, finishing and other indicators);

Ready-to-produce weaving looms;

Rulers (100 and 25-30 cm length), 2 special needles, scissors, magnifying glass and analytic scales.

For the fabric range study, it is necessary to identify the application area by fabric appearance, decoration, weight and other parameters.

Questions:

1. What is woven fabric?
2. What are the main parameters of loom tackling?

3. How to identify the thread density at different zones of weaving loom?
4. Ho to explain the change of fabric width at different zones of weaving loom?
5. What information gives the fabric article?
6. Tell the application areas of the fabric according to its appearance, decoration, weight and other parameters.

LABORATORY EXERCISE 2

Topic: Yarn packages delivered to weaving mill. Winding process.

Purposeofthisexercise *is to study the yarn packages delivered to weaving mill and the technological scheme of winding, its parameters, defects and waste.*

Content:

1. Types and main parameters of packages.
2. Calculation of packages (volume, mass and length)
3. Winding process and equipment. Study of their function and features.
4. To study and make the technological scheme of winding machines M-150-2 and Murata, Autoconer, Autosuk
5. To study the operation of tensioner, monitoring and cleaning devices.
6. Winding machines. Parameters, defects and waste.

Methodological recommendations on task implementation.

Present the interrelation of each process during warp and weft preparation, with their purpose, requirements and product range, present a drawing. During study of package types, focus on yarn package form, spinning methods, fabric range, type of weaving loom, production. During study of winding process, focus on the particular mechanisms of winding, yarn drafting system, package types and form. The winding productivity depends on the correct choice of technological parameters.

Questions:

1. Main indicators of packages.
2. Main features and application.
3. Purpose of the process, technological scheme of winding.
4. Yarn tension during winding. Tensioning devices.
5. Yarn monitor and cleaning.
6. Classification of modern winding machines. Purpose of Uster and Splicer devices on Murata winding machine

LABORATORY EXERCISE 3

Topic: Warping. Purpose of warping. Types of warping. Modern warping machines.

Purposeofthisexercise *is to study the warping process.*

Content:

1. Warping
2. Types of warping
3. Warping creels
4. To study and to draw schamtics of sectional and beam warping machinery.
5. Warping calculations. Parameters, waste and defects.

Methodological recommendations on task implementation.

Comparison of warping types according to such indicators as bobbin package type, labour efficiency, creelling space.

In order to study the technological schemes, to compare the difference between machinery and process.

To analyze the defects and wastes caused my machinery malfunction or lack of experience of the worker.

To learn the adjustment of technological parameters, control their changes and etc.

To study the difference between real and theoretical speed of the sectional warping machine, its efficiency and factors influencing it.

Questions:

1. Warping, its purpose and objectives.
2. Types of warping and their application.
3. Warping creels and their types.
4. Sectional warping, its advantages and disadvantages.
5. Beam warping, its advantages and disadvantages.
6. Waste calculation.

LABORATORY EXERCISE 4

Topic: Sizing. Preparation of sizing material and its composition.

Purposeofthisexercise *is to study sizing, preparation of sizing material and its composition.*

Content:

1. Study the sizign process. Requirements for sizing.

2. Learn the schematic of sizing machine.
3. Main mechanisms and parts of sizing machine.
4. Function and structure of main parts of sizing machine.
5. Defects and waste of sizing process.
6. Composition of sizing material according to given fabric.

Methodological recommendations on task implementation.

To study sizing materials, their parameters, their impact on yarn quality and cost.

To have a knowledge about machines and mechanisms of sizing process.

To calculate required indicators according to the quality of size, size concentration, amount of sizing.

Questions:

1. Purpose of sizing. Yarns for sizing.
2. Technological requirements for sizing.
3. Size composition and its requirements. Preparation of sizing material and supply to sizing machine.
4. Main mechanisms of sizing machine and their functions.
5. Parameters influencing the speed of warp yarns during sizing.
6. Purpose of size box, construction and function.
7. Sizing waste.
8. Calculation of production efficiency of sizing machine.

LABORATORY EXERCISE 5

Topic: Warp drawing-in and tying.

Purposeofthisexercise *is to study warp drawing-in and tying.*

Content:

1. Conditions of drawing-in and tying-in.
2. Draw the technological scheme of drawing-in machine (PSM).
3. Study the drop wire, headle eye and reed, and types of drawing-in.
4. Study the function and construction of tying-in machine (UP) and give the schematic.
5. Get the information on the Internet about modern drawing-in and tying-in equipment.

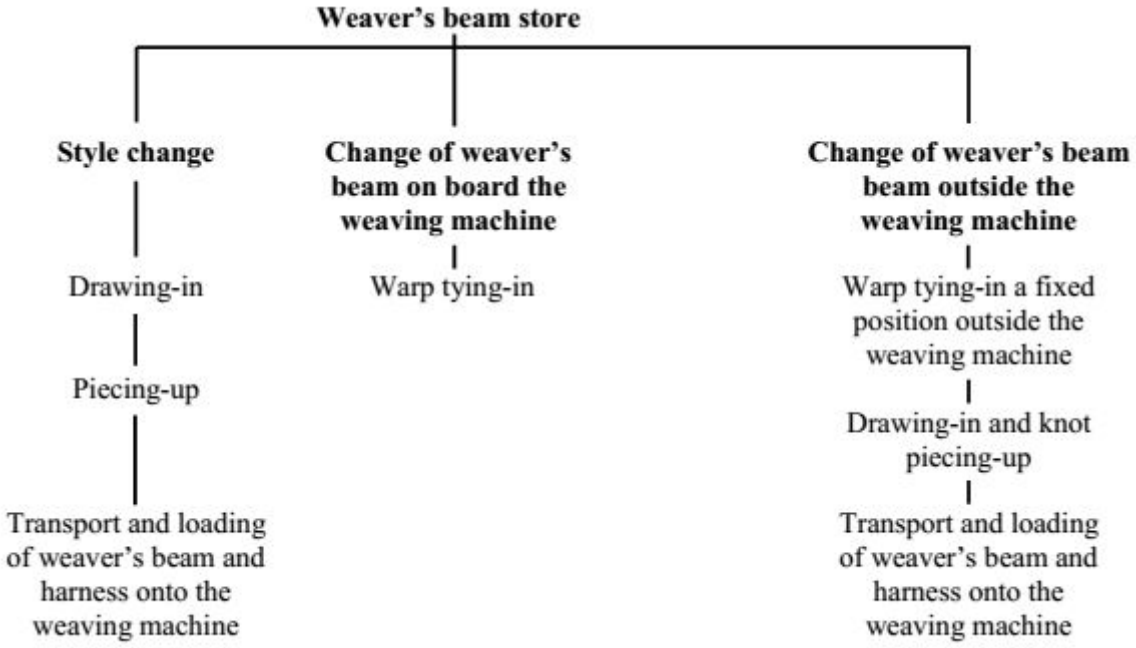
Methodological recommendations on task implementation.

Drawing-in is the entering of yarns from a new warp into the weaving elements of a weaving machine, namely drop wires, heddles and reed, when starting up a new fabric style.

Tying-in-the new warp ends to the depleted warp is done when a pattern is not required.

A drop wire is a narrow metal sheet that that is hung in the air by the tensioned warp yarn. If the warp yarn is broken, then the drop wire drops and touches a metal bar that extend along the width of the machine. This contact between the drop wire and metal bar closes an electrical circuit and shuts down the machine immediately. There is drop wire for each warp yarn.

Depending on the styles of the produced fabrics and on the company's size, this operation can be carried out manually, by drawing-in female workers operating in pairs (a time consuming activity which requires also skill and care), or by using automatic drawing-in machines.



Questions:

1. Function of passet on drawing-in machine.
2. Application of universal tying-in machine.
3. Knotting during drawing-in process.
4. Content of drawing-in machines.
5. What adjustments are required for quick style change?

LABORATORY EXERCISE 6

Topic: Weaving looms and classification.

Purposeofthisexercise *is to study weaving looms and classification.*

Content:

1. Types of weaving machines and their main mechanisms.
2. Shedding mechanisms of weaving machines installed at the laboratory class: cam, dobby, jacuard. Their schematic drawings.
3. Compare the shedding mechanisms of the following weaving machines: R-190, ATPR, STBva Somet, Toyota.

Methodological recommendations on task implementation.

Weaving machines have been developed to enable the industrial production of woven fabrics in large volumes at high weaving speeds. This requires the preparation of warp and weft yarns of suitable quality, and various preparatory operations (winding, warping, sizing, drawing-in the warp yarns through the droppers, the healds of the harness and the reed). These operations are essential to ensure that high-quality fabric can be produced with minimum interruptions to production.

After carrying out the necessary preparation, the warp and weft threads are transferred to the weaving machines in the production unit. They are then interlaced to form a woven fabric having a particular density, width and type of interlacing, so as to be able to achieve particular physical characteristics (such as air permeability, abrasion resistance, tensile strength, crease retention, draping, etc.) as required for the fabric's intended application.

Questions:

1. Types of weaving looms.
2. Jacquard machines and their application areas.
3. Modern jacquard machines.

LABORATORY EXERCISE 7

Topic: Shedding process and devices.

Purposeofthisexercise *is to study shedding process and devices.*

Content:

1. Shedding mechanisms of weaving machines installed at the laboratory class: cam, dobby, jacuard. Their schematic drawings.
2. Parameters and sizes of shed by shedding mechanism type.
3. Present the technical and technological parameters of above given shedding mechanisms in the table-1.

Table-1

№	Loom model	Type of shedding mechanism	Type and shape of the shed	Height of the shed, N, cm	Avg.position, cm	No. Of harness	open-rest-closemoments, grades
1.	AT-100-5M	Cam	Close, full	28	25	4	120-200-300
2.	AT-120						
3.	STB2-175						
4.	ATPR-100-4						
5.	Somet						
6.	TOYOTA						

Methodological recommendations on task implementation.

Cams with weave pattern profiles rotate to deliver lifting and/or lowering instructions to harnesses. A typical cam system can handle weave patterns with up to 14 different harnesses. Cam shedding mechanisms are relatively simple and inexpensive to design and maintain, they are more reliable for producing fault free fabric and they do not restrict the weaving machine speed. A pair of cams is sufficient to weave a plain fabric. The main disadvantage of the cam shedding mechanisms is their restricted patterning possibilities. Another disadvantage is that, when the weave has to be changed, it is usually necessary to change or rearrange the cams, which is time-consuming and not practical for frequent pattern changes.

Questions:

1. Purpose of shedding.
2. Shedding types and phases.
3. Shedding mechanisms and types.
4. Close, open and semi-open shed types and their application.

LABORATORY EXERCISE 8

Topic: Weft feeding methods

Purposeofthisexercise *is to study weft feeding methods*

Content:

1. Process and methods of weft feeding.
2. Study the weft picking methods on weaving looms ATPR, AT, STB, Somet and Toyota.
3. Schematic of weft picking.

Methodological recommendations on task implementation.

In shuttle weaving, the weft is inserted by a shuttle that traverses back and forth across the loom width.

Air-jet weaving is a type of weaving in which the weft yarn is inserted into the warp shed with compressed air. Yarn is drawn from a weft supply package by the weft feeder and each pick is measured for the weft insertion by means of a stopper.

A water-jet weaving machine inserts the weft yarn by highly pressurized water. The tractive force is provided by the relative velocity between the weft yarn and the water jet.

In projectile looms instead of the shuttle the weft is inserted by means of the projectile, that's why these looms are called as a projectile loom. The small projectile is also called as a gripper.

Questions:

1. Weft picking methods.
2. Weft movement of shuttleless looms (STB).
3. Weft picking on water-jet and air-jet looms.
4. Weft picking on projectile looms.

LABORATORYEXERCISE 9
Topic: Weft beating up.

Purposeofthisexercise*istostudy weft beating up process.*

Content:

1. Weft beating-up process. Methods of weft beating up.
2. Beating up meachnisms and their classification.
3. Study and draw technological schemes of beating up mechanisms of weaving looms AT, ATPR, STB, Somet, Toyota.
4. Features, advantages and disadvantages.

Methodological recommendations on task implementation.

When the weft yarn is inserted through the shed, it lies relatively far from its final position. This is because the insertion device (air-jet, projectile, rapier, etc.) cannot physically fit at the acute angle of the shed opening. This final position is called fell which is the imaginary line where the fabric starts. Therefore, the newly inserted filling yarn needs to be brought to its final position by pushing through the warp sheet. Beat-up is the process of pushing the last inserted weft yarn to the cloth

fell by using a device called reed for all practical purposes, the fabric is not formed until beat-up occurs.

Questions:

1. Methods of beating up.
2. Classification of beating up mechanisms.
3. Advantages and disadvantages.

LABORATORYEXERCISE 10
Topic: Fabric rolling-up.

Purposeofthisexercise*istostudy fabric rolling-up.*

Content:

1. Fabric rolling-up process.
2. Methods of fabric rolling-up.
3. Technological schemes of fabric rolling-up on weaving looms AT, ATPR, STB, Toyota, Somet.
4. Productivity calculation.

Methodological recommendations on task implementation.

The objective of take-up is to draw forward the woven cloth as a new pick is inserted in order to maintain the line of fabric formation and pick spacing constant.

Take-up motion is classified as negative and positive take-up. Another way of classifying it is intermittent and continuous take-up. Intermittent take-up actuates itself only after newly inserted pick is beaten-up by the sley. On the other hand, continuous take-up operates continuously to draw the woven fabric. The presence of ratchet and pawl arrangement in the take-up mechanism makes it intermittent type whereas the presence of worm and worm wheel renders it a continuous one.

Attribute ‘negative’ justifies itself in the sense that no positive or direct motion is imparted to the take-up roller to wind up the woven fabric. In this system, the motion of the rocking shaft actuates a system of levers and a ratchet-pawl mechanism, favored by gravity aided movement of dead-weights which in turn, transmits the rotational motion to take-up roller through a worm and worm-wheel.

Questions:

1. Purpose of fabric rolling-up motion and their features.

2. Position of weft in the fabric.
3. Fabric rolling-up device on AT loom. Weft density
4. Fabric rolling-up device on STB loom. Weft density
5.

LABORATORYEXERCISE 11
Topic:Warp let-off and tension.

Purposeofthisexercise*istostudy warp let-off and tension.*

Content:

1. Warp let-off and tension. Regulators and breaks.
2. Methods of warp let-off and tension process.
3. Technological schemes of warp let-off and tension devices on weaving looms AT, ATPR, STB, Somet, Toyota.
4. Features, advantages and disadvantages.

Methodological recommendations on task implementation.

The objective of let-off motion is to maintain the free length of warp within specified limits and to control the warp tension by means of feeding the warp at a correct rate to the weaving zone.

Let-off motion is classified as negative and positive let-off. In case of negative let-off, warp is pulled from the warper's beam against a slipping-friction system. For positive let-off system, warp beam is rotated through driving mechanism at a controlled rate in order to maintain constant warp tension.

The chain makes some wrap over the ruffle. Slack side of the chain is attached with the machine frame whereas the tight side is attached with the weight lever. The lever is fulcrumed at one end with the machine frame. The other end carries dead weights.

Questions:

1. Purpose of warp let-off motion.
2. Position of weft in the fabric.
3. Warp let-off on AT loom. Weft density
4. Warp let-off device on STB loom. Weft density

LABORATORYEXERCISE 12
Topic:Basic weaves. Full design plan of basic weaves.

Purposeofthisexercise*istostudy basic weaves. Full design plan of basic weaves.*

Content:

1. Analysis of basic weave samples
2. Define face and back sides of the fabric
3. Define the direction of warp and weft yarns in the fabric.
4. Calculate the warp and weft density
5. Calculate the warp and weft shrinkage of the fabric.
6. Define the linear density of warp and weft yarns
7. Define the weight of samples and calculate the surface density.
8. Make the full design plan for basi weave samples.

Methodological recommendations on task implementation.

The design indicates the interlacement of warp and weft threads in the repeat of the design. It is made up of a number of squares, which constitute the repeat size of a design. The vertical direction of the squares indicate the picks and the horizontal direction indicates the ends. A blank in a square indicates that a warp goes below the corresponding weft and 'X' mark in the square indicates that the warp floats above the weft.

The draft or drawing plan indicates the manner of drawing the ends through the heald eyes and it also denotes the number of heald shaft required for a given weave repeat. The choice of the type of drafting plan depends upon the type of fabric woven.

The lifting plan provides useful information to the weaver. It denotes the order of lifting of heald shafts. In a lifting plan the vertical spaces indicate the heald shafts and the horizontal spaces indicate the picks. The lifting plan depends upon the drafting plan. In the case of a straight draft, the peg plan will be the same as the design. Hence no peg plan is necessary in the case of a straight draft. The design, draft and peg plan are illustrated with the aid of an example shown

$$a_T = \frac{l_T - l_{Tq}}{l_T} \cdot 100\% \qquad (1).$$

a_T–warp shrinkage, %.

l_T–length of warp yarns, cm.

l_{Tq}–length of woven fabric, cm.

Weft shrinkage(a_A)

$$a_A = \frac{l_A - B_X}{l_A} \cdot 100 \quad (2).$$

l_A–length weft yarns, cm.

B_X–width of grey fabric, cm.

Table-1

№	Weave	Linear density of warp and weft yarns, tex		Weave repeat by warp and weft		Shrinkage	
		T_{wp}	T_{wt}	R_{wp}	R_{wt}	A_{wp}	A_{wt}
1	Plain						
2	Twill						
3	Satin(Sateen)						

Questions:

1. Definition of the fabric
2. What is intersection
3. Fabric parameters
4. What is weave repeat
5. What parameters are defined by fabric analysis
6. Parameters of plain weave
7. Parameters of twill weave
8. Parameters of satin (sateen) weave.

LABORATORYEXERCISE 13

Topic:Huckaback weaves. full design plan of huckaback weaves.

Purposeofthisexercise*istostudy huckaback weaves. full design plan of huckaback weaves.*

Content:

1. Analysis of derivative weave samples.
2. Derivatives of twill weave: warp rib, weft rib, basket
3. Full tackling plan of derivative weaves
4. Show the draw plan of derivative weaves on the canvas
5. Parameters of derivative weaves.

Methodological recommendations on task implementation.

To illustrate how derivative weaves are obtained, a regular 45° twill, Fig. 20, is taken and three other weaves formed from it. Suppose that it is desired to form a derivative weave by rearranging the ends of Fig. 20 in 1, 4, 7, 2, 5, 8, 3, 6 order; that is, the first end of the new weave is to be like the first end in Fig. 20, the second end of the new weave like the fourth end of Fig. 20, the third end of the seventh, the fourth like the second, and so on.

It will be seen that com- mencing with the first end of Fig. 20, every third end is taken until by this method the first end is reached again, when the design commences

to repeat. Fig. 21 shows the twill in Fig. 20 rearranged in this order, Suppose that it is desired to arrange the ends in the twill in Fig. 20 in 1, 2, 5, 6, 3, 4, 7, 8 order. Fig. 22 shows that the first and second ends are like the first and second ends in Fig. 20; that the third end is like the fifth in Fig. 20; the fourth is like the sixth; the fifth like the third, and so on.

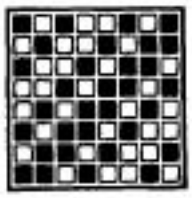


FIG. 20

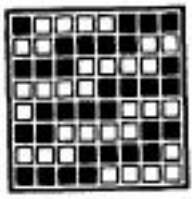


FIG. 21

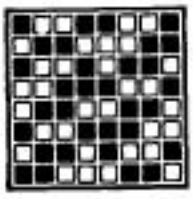


FIG. 22

Questions:

1. What are the features of huckaback weaves?
2. Tell the application areas of huckaback weave fabrics.
3. Conditions of formation of complex fabrics
4. Derivatives of plain weave
5. Derivatives of twill weave
6. Derivatives of satin weaves.

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