2004

An online fabric database to link fabric drape and end-use properties

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AN ONLINE FABRIC DATABASE TO LINK FABRIC DRAPE AND END-USE PROPERTIES

A Thesis

**Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the
degree of
Master of Science**

in

The School of Human Ecology

**by
Ayse Gider
B.S., Istanbul Technical University, 1997**
December 2004

Acknowledgements

I would first like to thank my major professor, Dr. Jonathan Yan Chen, for his guidance, support and more importantly for his patience. I also would like to express my sincere appreciation to Dr. Jenna Tedrick Kuttruff for her continued motivation and friendship. Valuable insights and constructive critiques of my committee members, Dr. Jianhua Chen, and Dr. Jacquelene Robeck are appreciated. I also thank to my friend Gillian David Sims for his support during image recording, and to Yvonne Marquette for her assistance with sample preparation process.

Finally, I would like to thank my parents and my brother for their help and encouragement during my study. Also, a very special thank you is extended to my family in Baton Rouge; Sacit Akbas, Virginia and Charles Grenier, and Zelda Long for their support.

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Abstract

The main obstacle for adaptation of fabric selection through the Internet is that there is no objective selection method that is suitable for fashion fabrics. The purpose of this research is to develop an objective evaluation method for selecting fabrics through an online fabric database. The relationship between fabric mechanical properties and fabric drape was investigated. One hundred eighty-five commercial fabrics from different manufacturers were tested using the Kawabata fabric evaluation system (KES-FB) and Cusick drape tester. Applying regression analysis, the parameters that were significantly correlated with drape coefficient (DC) were determined.

The test results, fabric structural parameters, and contact information for fabric manufacturers, were included in the database. A web-site with a user interface allowing users to implement various types of searches was published on the Internet. Fuzzy linear clustering technique was used to predict fabric drape property. The accuracy for predicting fabric drape using this technique was 94%. This means the model using fuzzy linear clustering is an efficient method to predict fabric end-use properties.

Additionally, a new method to measure drape coefficient using Photo Shop was developed by this author. Instead of weighing paper rings, shaded drape area was used to calculate the drape coefficient. With the new Photo Shop method, the cost, testing time and human error was reduced while the accuracy of the test result was increased.

Chapter 1 Introduction

1.1 Research Significance

Fabric drape is among the most important quality features for assessing fabric performance in apparel. Selecting the right fabric with desirable drape is something that has to be done to produce well fitting clothes, allowing the wearer to move comfortably, as well as producing specific design aura and appearance. Since the textile industry is capable of producing a variety of fabrics with specific features, finding the most suitable fabric for a specific clothing end-use is becoming more important.

With today's technology, computer-aided design (CAD) and manufacturing (CAM) are applied to many industries. Although the textile and apparel industry also adapted this technology in some areas of the design and manufacturing processes, CAD/CAM technologies lack the capability of properly predicting fabric performance. To fill this gap, understanding drape behavior of fabrics, in terms of fabric mechanical properties, is helpful in apply updated computer techniques in textile design and manufacture.

The Internet is playing an important role in today's communication and business world. Parallel to other industries, the textile industry also gains benefit from the usage of the Internet. Members of the textile industry eagerly go online for fabric sourcing as well as for following the current fashion and business trends. The Internet technology can be used to improve industries production and marketing strategies.

Worth Global Style Network (WGSN, www.wgsn.com) is one of the most dynamic online services [4]. It was launched in London in 1998. The users of WGSN can benefit from its services such as up-to-date international style intelligence, research, trend analysis and news, as well as resources for yarn, fabric, and garment accessories. The WGSN team is made of over 100 industry professionals, such as journalists, designers and researchers with experience in international fashion, graphics, interiors, manufacturing and media. WGSN covers an average of 160 shows with over 32,000 pictures each season and over 5,000 store window photos every month from major fashion centers. Having an annual subscriber renewal rate of over 90%, WGSN is example of the desirability for industry users to go online for the services that WGSN provides. Similar to WGSN, TextileWeb is another web-site that was established by a community of professionals in the textile industry [4, 39]. TextileWeb provides services such as a fabric database with product information, market research reports, job search and intranet marketing.

To meet customers' demand for using online searching and shopping, textile companies are focusing their investment on launching online services for customers. One of the examples is a retail company, Neiman Marcus Group. According to InternetWeek, an online journal, the company invested $24 million to establish a website in 2000 [20]. The article reported that the company's planned expenditure for Information Technology (IT) for fiscal years 2002-2006 is 181 million dollars. The two major IT initiatives are launching the fully transactional Horchow.com web-site and Customer Relationship Management (CRM) – 'data mining' [26]. An article published by America's Textile Industry, reported that the percentage of women and men who have browsed the Internet for clothes has increased 80 percent and 40 percent respectively over the past year [30].

The current online sites, WGSN and TextileWeb, assist users to save time and money by saving business trips to select fabrics. But these sites are unable to help users to choose the fabric with required end-use properties. This is because their databases do not include numerical data related to fabric aesthetic and end-use information.

1.2 Background of the Research Project

This thesis is based on a part of joint research project with the School of Human Ecology at Louisiana State University (LSU), the Computer Science Department at LSU and Apparel-Computer Integrated Manufacturing Center (ACIM) at University of Lafayette-Lafayette. The project was funded by Louisiana Education Quality Support Fund (LEQSF) within the Research Competitiveness Subprogram (RCS). The principal investigators are Yan Chen, Jianhua Chen, Teresa Summers, Jacquelene Robeck, Al Steward, and Ramesh Kolluru.

The purpose of the project was to establish an online intelligent database server that would help the clothing manufacturers in Louisiana (1) to retrieve fabrics that match the manufacturers preferences in color, drape and style, (2) to select fabrics with high quality of physical properties that would ensure high quality of garment products, (3) to find better-buy fabrics, and (4) to better communicate with fabric manufacturers to determine earliest shipping.

The project's aim was to develop a method for predicting fabric tailorability and fabric drape from fabric mechanical and physical properties. And the focus of this thesis was only to cover the method for prediction of drape property. The instrumental testing of tailorability was done at the Apparel-Computer Integrated Manufacturing Center (ACIM) at UL-Lafayette, and same fuzzy-clustering technique was used to find pattern predicting tailorability. The publications are two articles [7, 9], and a book chapter [8].

1.3 Research Objectives

This research investigated the relationship between drape coefficient and fabric mechanical properties using statistical methods. An online intelligent search engine for fabric is used to select fabrics with desired drape and mechanical properties from the database. Another researcher within the project applies a new model that uses a fuzzy clustering technique to predict drape coefficient from fabric mechanical properties. The validation of the fuzzy-clustering model and search process is also one of the objectives of the author.

The specific objectives of this research:

1. To evaluate mechanical properties of 185 commercial apparel fabrics using the Kawabata KES-FB instruments;
2. To evaluate drapeability of the 185 commercial apparel fabrics using the Cusick Drape Tester;
3. To create still and dynamic drape image data for these 185 fabric samples;
4. To investigate the correlation between the mechanical properties and drape coefficient;
5. To validate the performance of the database search engine and end-user interface Web page.

Chapter 2 Literature Review

2.1 Introduction

This literature review includes the statement of the problem with fabric mechanics, fabric physical and mechanical properties related to drape property, correlation between fabric mechanical and physical properties, and fabric drape property. Techniques to measure mechanical properties and drape property are covered. The previous findings are also included.

Creating a fabric database consisting of fabric properties to indicate fabric performance and dynamic draping images of fabrics is an important step toward solving the problem. To create an online fabric database, one needs a clear understanding of the subjective meaning of drape, the traditional instrumental measurements of fabric drapeability, fabric mechanical properties that correlate with the drape property, and the correlation of fabric mechanical properties with fabric end-use characteristics, including hand, drape, comfort and tailorability.

2.2 An Online Fabric Database for Fabric Mechanics

As we move from the industrial age to the digital age, powerful computer systems are used in various areas from design to manufacturing. To apply newly developed techniques in information technology (IT), we need to understand the mechanical behavior of fabric structures. This requires quantitative prediction of the mechanical performance. While this is accomplished in most engineering materials, mechanics of textile materials are not fully uncovered.

Fabric mechanics as a design tool was highlighted by Hearle [18] and he stated that to develop user friendly computer programs that would store and display fabric properties plays a major role in solving the problem with fabric mechanics. In his paper, Dr. Hearle described the problem and pointed out the traditional route and the way forward in textile mechanics. The traditional method for solving the problems of textile mechanics is illustrated in Figure 2-1 [17]. Fiber properties and material structures are two determinators of textile mechanics. Fiber properties can be represented by parametric equations and test results and, geometry can be defined by algebraic and trigonometric equations. Differential and integral calculus help to analyze textile mechanics.

Although this method had been used by textile engineers since the 1960's, the method has limitations and that it requires a new method to be developed by textile scientists and engineers. One of the limitations of the traditional method is that it assumes that fabric has small strain and linear elastic behavior, which means yarn cross-section shape does not change. The method is not applicable to complex weaves and knits, yarns with various cross-section shapes, and other specific situations. Besides, these analyses are produced for fabrics that have deformation along two main directions, which are warp and filling for woven fabrics [17].

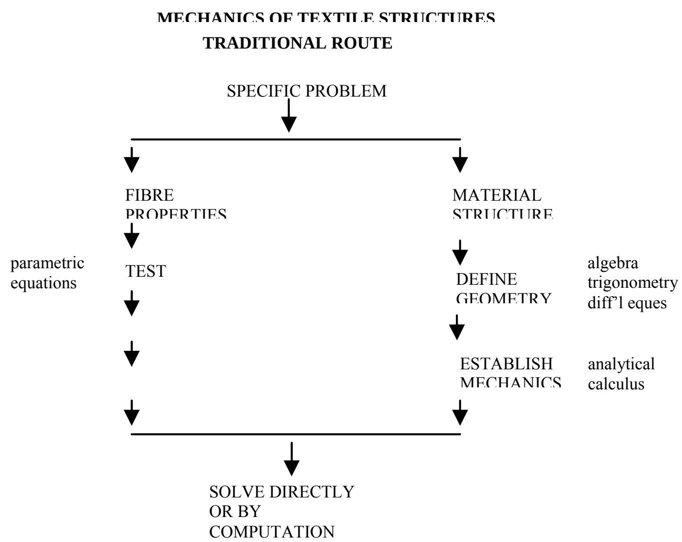


Figure 2-1. Mechanics of Textile Structures – traditional route [18]

Since the traditional method cannot describe textile mechanics fully, Hearle suggested a new approach for solving the problem. The main difference in the new approach is that the calculations are done by using computer programs instead of hand-made. This new approach illustrated in Figure 2-2.

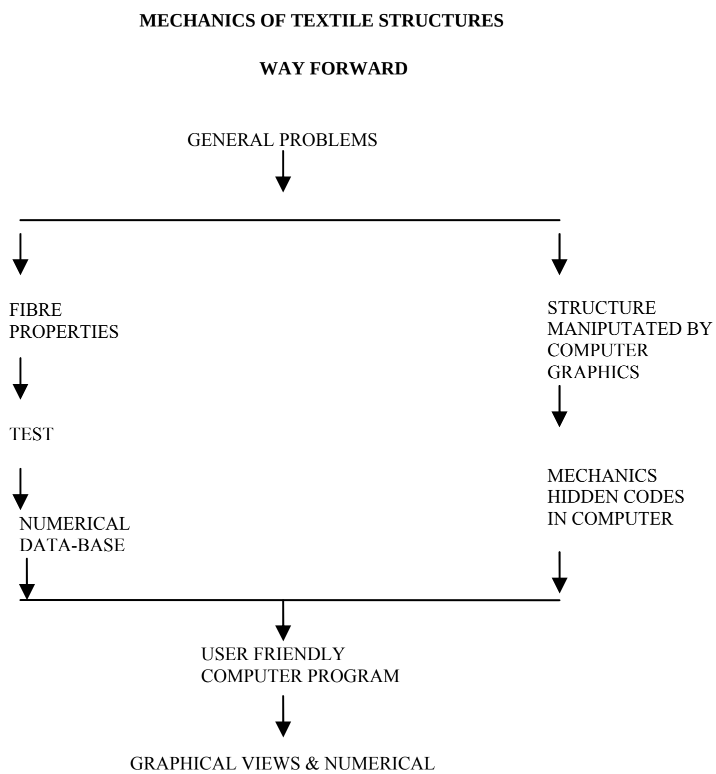


Figure 2-2. Mechanics of Textile Structures – the way forward [18]

Figure 2-3 illustrates the total system's cycle, which Hearle [18] proposed. The system shows the interactions among customers, manufacturers, designers and engineers, and computer systems. It contrasts with the traditional methods, in that input from experts and manufacturers, along with customer input, are stored and processed in a computer system. This computer system consists of 3 parts: (1) knowledge based system, (2) computer programs, and (3) a database consisting of information on fiber and fabric properties [17]. Using this computer system, designers and textile manufacturers will be better able to meet the need of customers.

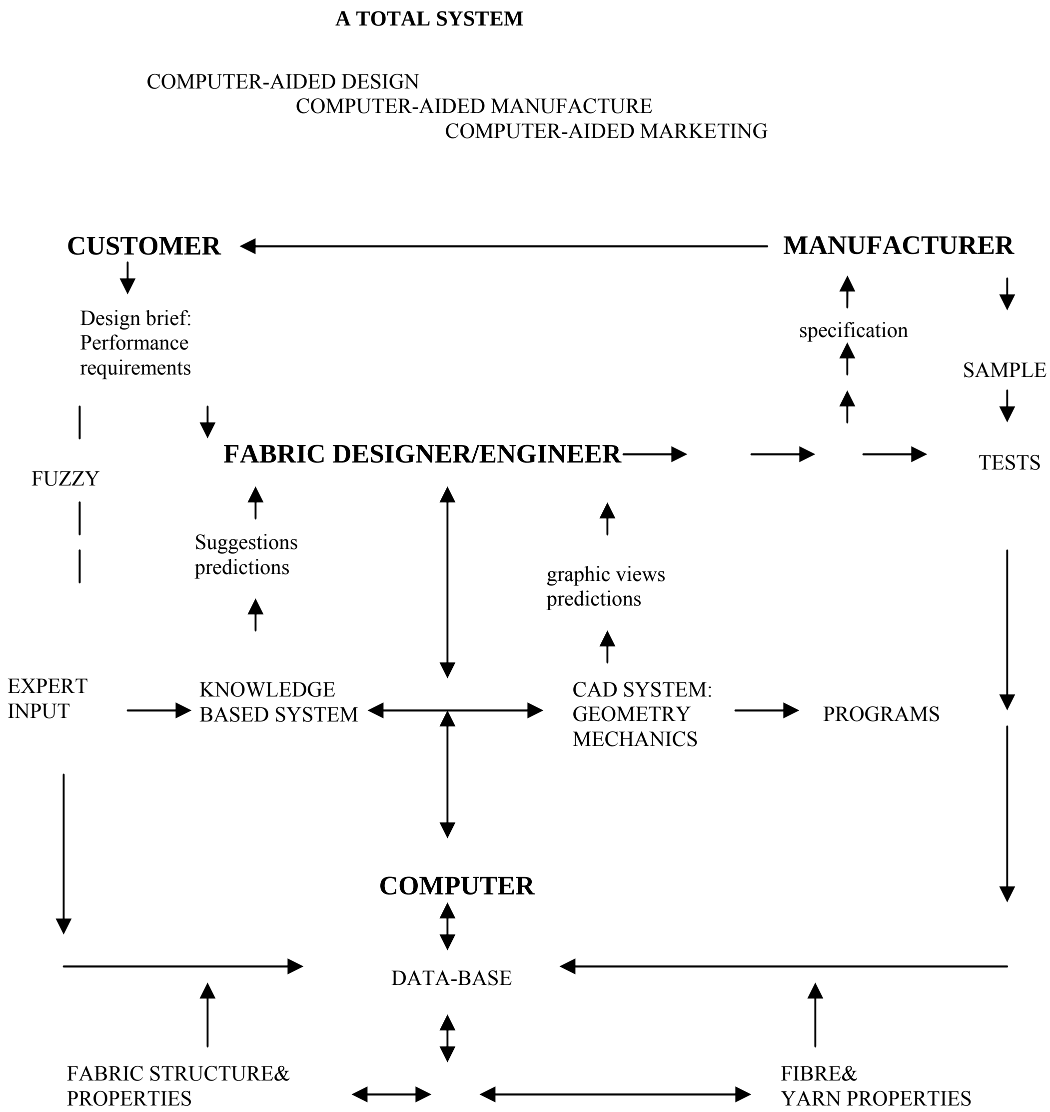


Figure 2-3. A Total System [18]

2.3 History of Understanding Drape Behavior of Fabrics

Drape is described as a fabric's ability to form folds when bent under its own weight [11]. Similar to the assessment of other attributes of fabric, drape has been traditionally assessed subjectively. The relationship between fabric mechanical properties and fabric aesthetics has been investigated by many researchers [19]. In Peirce's classic paper published in 1930 [28new], he described a way of measuring some of fabric mechanical properties related to fabric drape and fabric hand. He introduced the first cantilever drape meter in this study.

In 1950, Chu et al. introduced a drape-meter that measures the amount of drape and assigns a drape value. The validation of drape value produced by the drape meter was studied and found to have a good correlation with subjective evaluation of drape [10]. Since the drape meter measurement produced a quantitative drape value, it became possible to study the correlation between the drape value and measured fabric mechanical properties.

Chu et al. found that the measured drape value correlates with fabric bending and shearing properties and with weight and thickness [10]. In 1965 another researcher, Cusick, found that both bending rigidity and shear stiffness influenced drape [13]. Cusick also improved the drape meter by making the testing process more simple and accurate.

Since Kawabata introduced the Kawabata's system to evaluate fabric hand in the 1970's [19], the Kawabata's system has been widely used in the studies of fabric mechanical properties relating to drape. Using multiple regression equations, Morooka and Niwa claimed that fabric weight and bending modulus were the most important factors related to drape. Although in this research shear resistance was not found to be a significant predictor of fabric draping behavior, in later studies by Collier et al., shearing properties were more significant predictors of fabric drape than bending properties [12]. Collier et al. also found that shear hysteresis is a stronger determinater of drape than shear stiffness. In the same study Collier et al. introduced for the first time a digital drape tester. The previous method, which was introduced by Chu et al. and later improved by Cusick, was a manual process and thus was tedious to measure the drape.

The literature indicates that, in early studies that date back to the 1930's, researchers studied to develop a method to measure drape quantitatively and focused their attention on the correlation among the fabric mechanical properties and qualitative drape value. In the mid 1980's the tremendous development in computer technology started a new era of research on this subject. Since then, researchers have focused on understanding the dynamics of fabric drape, modeling drape behavior with image analysis, and simulating drape using high speed computers.

This new approach and necessity of solving the problem has attracted researchers from the areas of computer science, engineering, material science, mathematics and physics [1, 21, 35]. To solve the problem, a mathematical representation of drape behavior of fabrics was studied. Fabrics were treated as an engineering material, and fabric buckling and folding behavior related to drape was taken into consideration. In an earlier study of Hearle and Amirbayat [16], fabric was considered to be a linear elastic material. In the same study, as a result of analysis of drape by using bending and shear stiffness, the researchers concluded that the drape property might be a non-linear behavior [16]. Fabric drape behavior has been studied as a non-linear dynamic system problem by many researchers [5, 6, 12, 14, 15, 21, 29, 33, 34, and 35]. Also time dependence of the drape coefficient was studied by Vangheluwe and Kiekens [38].

The two most common approaches are finite element analysis (FEA) and particle method. The finite element approach for fabric drape behavior was studied by Collier et al. [12], Bruniaux and Vasseur [3], and Gan et al. [15]. The fabric drape behavior was approached as a non-linear, small-strain/large-displacement problem using finite element analysis. The fabric was assumed to be an orthotropic, shell membrane. Using the FEA analysis, drape behavior of a circular piece of fabric on a circular pedestal was simulated. Tensile and shear moduli and bending rigidity were tested using Kawabata's system. The traditional drape testing method was used to determine the drape coefficient and the experimental drape coefficient is 68.4 %. The drape coefficient was also calculated theoretically from the mathematical model as 71.0 %. The researchers investigated the effect of changing Poisson's ratio on drape behavior and the amount of deformation was significantly different when a different Poisson's ratio was used.

Postle & Postle [29] tackled fabric deformation as a waving problem. Chen and Govindaraj [5] used flexible shell theory with finite element analysis to model fabric drape. The researchers investigated the effect of Young's modulus, Shear modulus, Poisson's ratio, and fabric thickness on drape. Fisher et al. [14] used the shell theory to simulate fabric deformation. These researchers considered fabric as an isotropic material. Only the bending rigidity and the mass per area as fabric parameters were used in the model. Since the shearing stiffness is also important for drape behavior, the model is not very useful to model the fabric with low shear stiffness [14].

2.4 Methods to Evaluate Fabric Drape

2.4.1 Subjective Evaluation

Traditionally, fabric drape was evaluated by sight, holding fabric in the hand, or hanging it from a pedestal, which gave an idea about how readily the fabric falls into folds and how small and regular these folds were [32]. Fabric aesthetic properties were not defined and measured objectively till the 1970's, when Kawabata's KES-FB System was developed for the purpose of quantifying fabric hand. Prior to this, the research conducted by Brand [2] defined drape as one of six concepts of fabric aesthetics, which was evaluated subjectively using common words. He claimed that aesthetic concepts were basically people's preferences and should be evaluated subjectively by people. He classified commonly used polar words related to fabric cover, body, drape, resilience, surface texture and style. These polar words were lively-dead, compliant-stiff, limp-crisp, clinging-flowing, sleazy-fully, and boardy-supple. Liveliness and fit were the sub-concepts of drape [2]. The term 'drape' and the terms used to describe drape such as lively, limp, crisp were qualitative and based on subjective evaluations. However, to create a standard understanding of drape and to apply the meaning of this property to different areas of manufacturing, design and marketing, the textile industry needed to measure it objectively to produce quantitative results [13]. Although objective techniques for the measurement of drape property were introduced first in 1930 by Pierce using cantilever and hanging loop methods, then in 1950's by Chu, et al. using a drape meter, these methods had not been commonly used in the industry.

Even today, many companies in the textile and apparel industry still use subjective evaluation to assess fabric deformation behavior. The reason for this may be the tedious process of measurement or the lack of knowledge for users to interpret the test results.

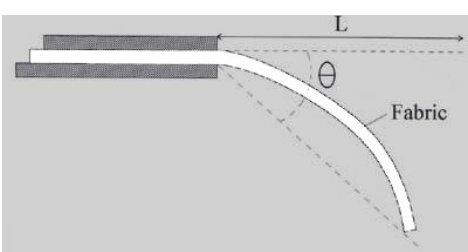
2.4.2 Objective Evaluation

Development of the drape meter and understanding of fabric mechanical properties allowed researchers to study objective techniques to assess fabric 3D deformation. Many scientists achieved significant progress in developing mathematical techniques to describe fabric drape behavior. Despite this, Professor Hearle [18] stated that the mechanical performance of textile materials was still not properly assessed in contrast to many other branches of engineering.

2.4.2.1 Test Methods to Measure Fabric Drape

Cantilever Stiffness Test

Cantilever is an instrument that was introduced by Pierce in 1930. It is the earliest method used to measure fabric stiffness by determining bending length. Figure 2-4 illustrates this testing method. The following equation was developed to calculate the fabric stiffness:



$$G = ML^3\left[\frac{\cos\frac{1}{2}\Theta}{8\tan\Theta}\right] \quad C = L\left[\frac{\cos\frac{1}{2}\Theta}{8\tan\Theta}\right]^{\frac{1}{3}}$$

Figure 2-4. Cantilever Stiffness Test

Where:

G: flexural rigidity M: fabric mass per unit area

Θ : angle fabric bends to C: bending length L: hanging fabric length

Hanging Loop Method

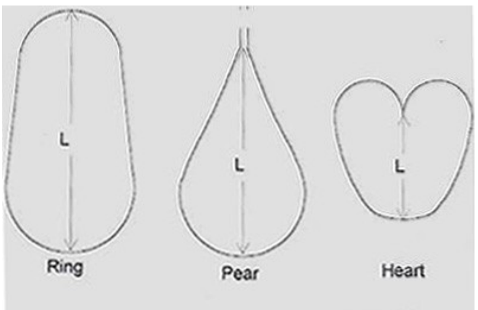


Figure 2-5. Hanging Loop Method

If the fabric is too limp, the cantilever method does not provide a satisfactory result. In this case, the hanging loop method was used to measure stiffness of fabric [28, 31]. The three major hanging methods are illustrated in Figure 2-5. The hanging length of the loop L and undistorted length of the loop was used to determine the stiffness.

Drape Meter

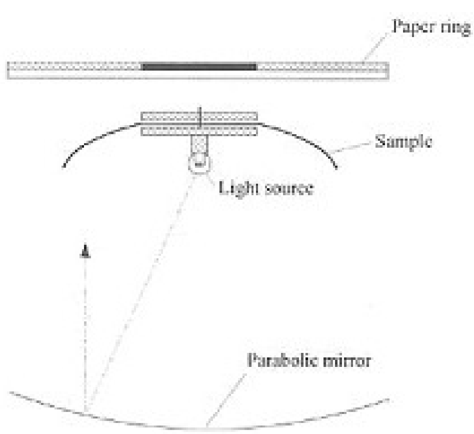


Figure 2-6. Principal of drape meter [13]

The Figure 2-6 shows the principle of the optical drape meter [31]. This instrument was first invented by Chu et al. in 1950. Later it was improved by Cusick in the 1960's [13].
Light underneath the specimen creates a shadow, on a paper ring above which is shown in Figure 2-7. Although the computerized test method is not currently used in the industry, the development of such a system makes the testing process much more practical. The computerized system for measuring drape is shown as Figure 2-8.

$$drape\ coefficient = \frac{mass\ of\ shaded\ area}{total\ mass\ of\ paper\ ring} \times 100\%$$

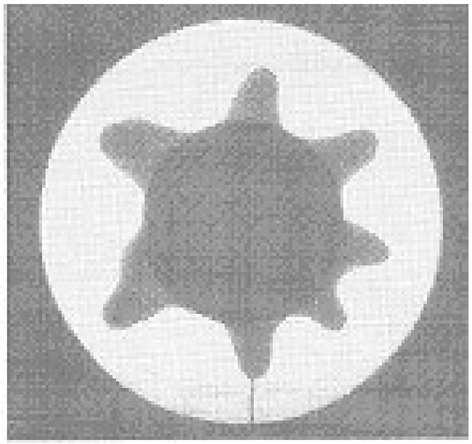


Figure 2-7. Top view of draped fabric [31]   Figure 2-8. Computerized drape test [31]

2.4.3 Fabric Mechanical Properties Related to Drape Property

Although Kawabata introduced his KES-FB system and a method to evaluate fabric hand, this approach was extended to evaluate other fabric performance, such as tailorability and fabric softness. Since fabric drape is also a mechanical behavior of fabric, the Kawabata parameters can also be used to evaluate fabric drape. The parameters used by Kawabata are listed in Table 1.

Table 1 Fabric mechanical and surface parameters related to drape [19]

Property	**Parameter**	**Unit**
Tensile	Linearity (LT)	Dimensionless
	Energy (WT)	gf.cm/cm²
	Resilence (RT)	%
Shear	Rigidity (G)	gf/cm.degree
	Hysteresis at 0.5° (2HG)	gf/cm
	Hysteresis at 5° (2HG5)	gf/cm
Bending	Rigidity (B)	gf.cm²/cm
	Hysteresis (2HB)	gf.cm/cm
Compression	Linearity (LC)	Dimensionless
	Energy (WC)	gf.cm/cm²
	Resilence (RC)	%
Surface	Frictional Coefficient (MIU)	Dimensionless
	Mean Deviation of MIU (MMD)	Dimensionless
	Roughness (SMD)	Micron

2.4.4 Techniques to Measure Mechanical Properties

There are two types of commercially available instruments used for measuring fabric mechanical properties. One is Kawabata's System (KES-FB), and the other is Fabric Assurance by Simple Testing (FAST System).

2.4.4.1 Kawabata's Evaluation System for Fabric (KES-FB)

Professor Kawabata developed the KES-FB system mainly for measurement of fabric hand value in the 1970's [19]. It was also designed to measure basic mechanical properties of non-woven, papers and other film-like materials [23]. The purpose of developing this KES-FB system was to replace the traditional subjective method of evaluating fabric hand. The KES-FB system consists of four instruments to measure the following different properties.

KES-FB 1 for Tensile and Shearing

KES-FB 2 for Bending

KES-FB 3 for Compression

KES-FB 4 for Surface Friction and Roughness.

Both the tensile and shear property of fabrics are very important features in evaluating fabrics. The combination of these two properties may sometimes be even more important than other mechanical properties to fabric evaluation.

In all Kawabata systems an integrator, an automatic data processing system, is used. For most fabrics, tested results can be calculated and recorded by the computer software developed in the LSU School of Human Ecology.

<u>Tensile Test Using KES-FB-1</u>

The principle of the instrument is to apply a constant tensile force to fabric in one direction and to measure the amount of stretch on the fabric. The stretching deformation can be considered as a kind of biaxial tensile deformation. As shown in Figure 2-9, the sample is held by two chunks (A and B), and chunk B is on a movable drum connected to a torque detector. The fabric sample is clamped between chucks A and B and the distance between the chucks is 5cm. A torque meter is used to measure the tensile stress and by sensing the movement of chuck B, a potentiometer is used to measure the tensile strain. Stretching the sample when the tensile force reaches the preset value, it turns back and recovers to the beginning position. There are two tensile rate adjustments as 0.2mm/sec or 0.1mm/sec. This is done by changing the gears at the back of the instrument.

The tensile force (F) and strain (ε) are recorded on the X-Y plotter. From the graph, LT, WT, RT, and EMT can be calculated. As shown in Figure 2-10, the sample size between the chucks is 20 cm x 5 cm. Figure 2-11 shows a typical tensile force –strain curve which is similar for both warp and weft directions.

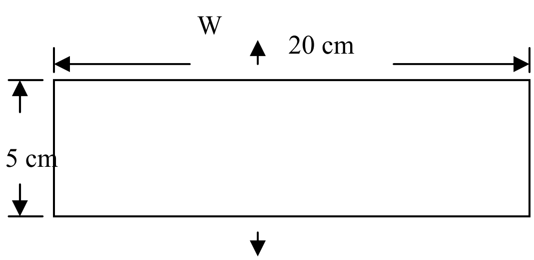


Figure 2-10 Sample Portion Between Chucks A and B

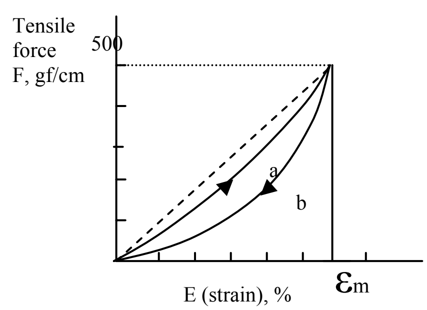


Figure 2-11 A Typical Force-Extension Tensile Curve of Fabric [22]

$$WT = \int_0^{\varepsilon m} F(\varepsilon)d\varepsilon$$, where:

WT: Tensile Energy or the work done while stretching the fabric until maximum force

ε: tensile strain

ε_m: the strain at the upper limit load

F_m: 500gm/cm

F: tensile load as function of strain

$$LT = \frac{WT}{(1/2)F_m \varepsilon_m}$$, where:

LT = Linearity

RT = (WT' / WT) × 100

RT: Tensile Resilience (%);

Where WT' is the recovery work and calculated as

$$WT' = \int_0^{\varepsilon m} F'(\varepsilon) d\varepsilon$$, where:

F'(ε) = tensile force during the recovering.

Referring to Figure 2-12, hand calculation can be done as below.

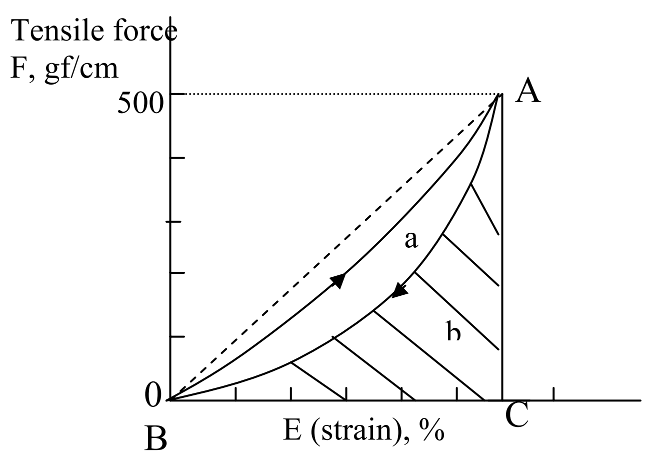


Figure 2-12 Tensile Property Calculation [22]

LT: Linearity of load-extension curve [22]

$$LT = \frac{Area(a) + (b)(WT)}{Area \Delta ABC *}$$

$$\Delta ABC = \frac{500 gf / cm \times EMT}{2 \times 100}$$

WT: Tensile Energy

WT=Area (a)+(b)

$$WT = INT \times 5$$

RT: Tensile resilience

$$RT = \frac{B - INT}{INT} \times 100$$

EMT: Tensile Strain at the point A on the curve

Shear Test Using KES-FB-1

The shear test using the KES-FB-1 is shown in Figure 2-13. A constant force is applied to the fabric by attaching a weight to the fabric end on clutch A side. By turning the clutch off, chuck B is freed and able to move. When the test starts, chuck B constantly slides to the side until there are 8 degrees of shear angle (standard condition), and chuck B returns to the original position. During the test, shear force is detected by a transducer and shear strain is detected by a potentiometer.

The shear angle can be adjusted between ±1 and ±8 degrees by presetting the potentiometer. It is advisable to do shear test before the tensile test because tensile deformation is greater than the shear deformation.

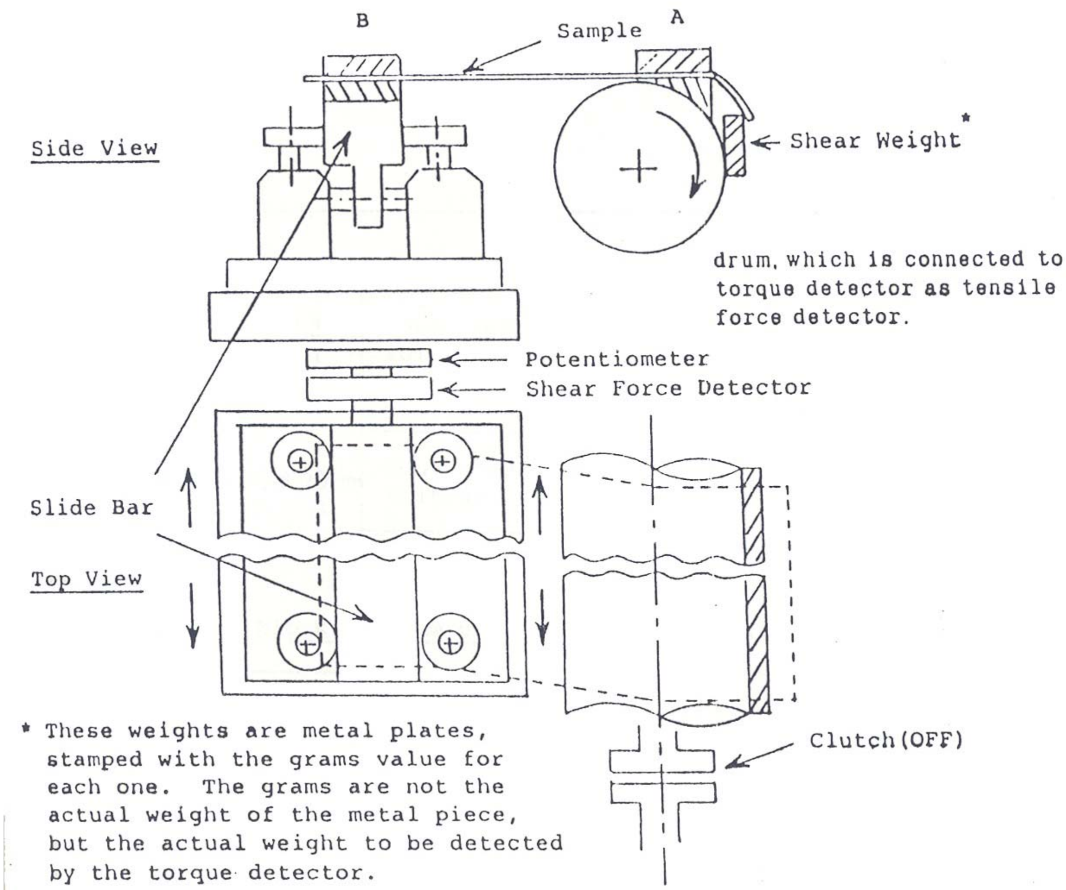


Figure 2-13 Principle of Shear Property Test [22]

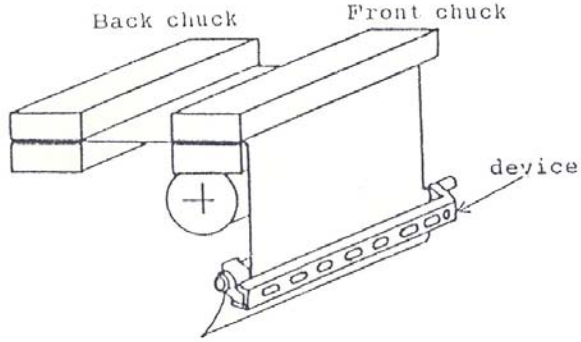


Figure 2-15 Initial Tension to Place Sample on Chucks [22]

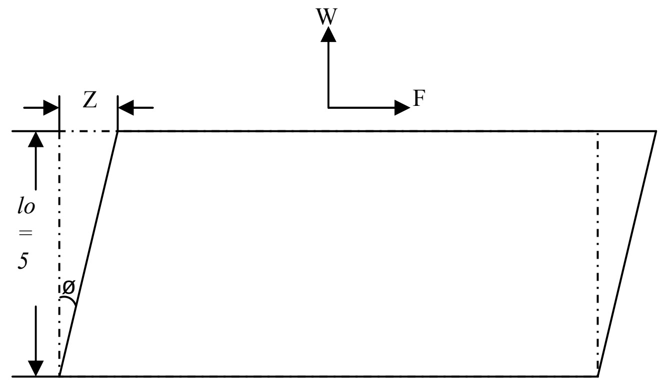


Figure 2-16 Shear Deformation Under a Constant Extension [22]

G: The slope measured between ø = 0.5 and 2.5º (gf/cm.degree)

2HG: Hysteresis of Fs at ø = 0.5º (gf/cm)

2HG5: Hysteresis of Fs at ø = 5º (gf/cm)

MEAN: Average of these values for positive and negative curves on warp and filling

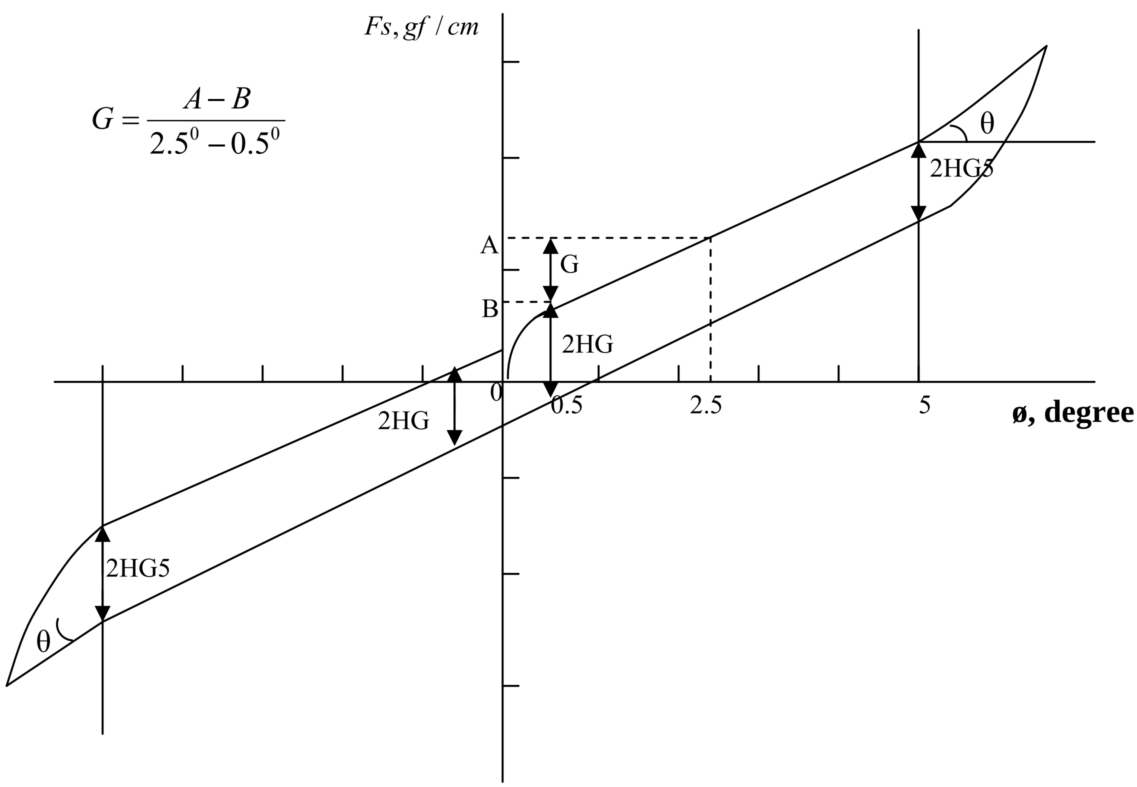


Figure 2-17 A Typical Shear Test Force-Shear Angle Curve [22]

Referring to Figure 2-18, hand calculation can be done as below.

$G = \frac{a+b}{2 \times 2^{o}} \times 2gf/cm$, where:

G= Shear stiffness

$2HG = \frac{c+d}{2} \times 2gf/cm$, where:

2HG= Hysteresis of shear force at 0.5º of shear angle

$G = \frac{e+f}{2} \times 2gf/cm$, where:

2HG5= Hysteresis of shear force at 5º of shear angle

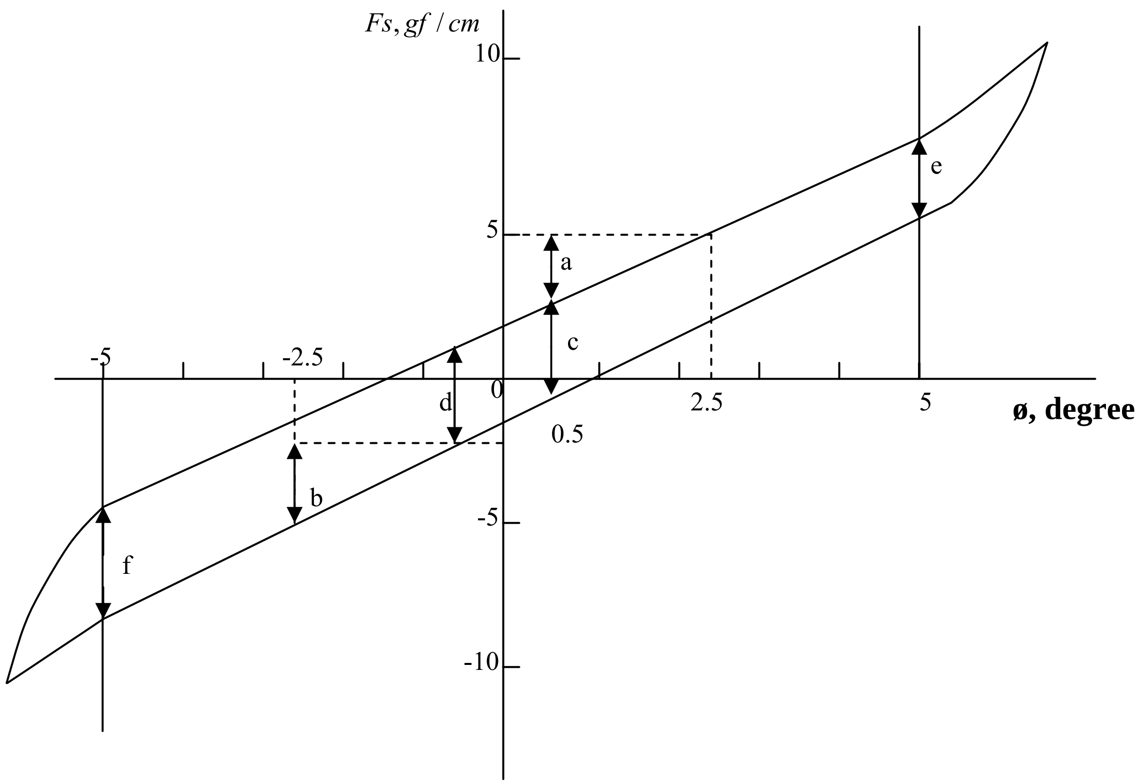


Figure 2-18 Shear Hand Calculation [22]

Pure Bending Test Using KES-FB-2

Bending property is an important feature to evaluate fabrics. It is necessary to assess fabric hand as well as fabric drape. Pure bending test is a component of the KES-FB system. It is used to determine fabric bending rigidity. Before the invention of the KES-FB pure bending test, Pierce's cantilever method was used to measure bending rigidity. The pure bending tester can be used to measure the bending property of thin film materials such as leather, rubber, film and yarn as well as fabrics (manual bending). The KES-FB pure bending method is a different method than the cantilever test because the sample is bent to a uniform curvature. It is also automatic and computerized, consisting of mechanical unit and electronic unit [23].

The fabric sample is mounted on the instrument. One chuck that holds one end of the sample is movable and the other is fixed. The moving of the sample edge by one of the chucks enables the measurement of bending properties. The figure 2-19 shows the top view of the mounted sample on the instrument.

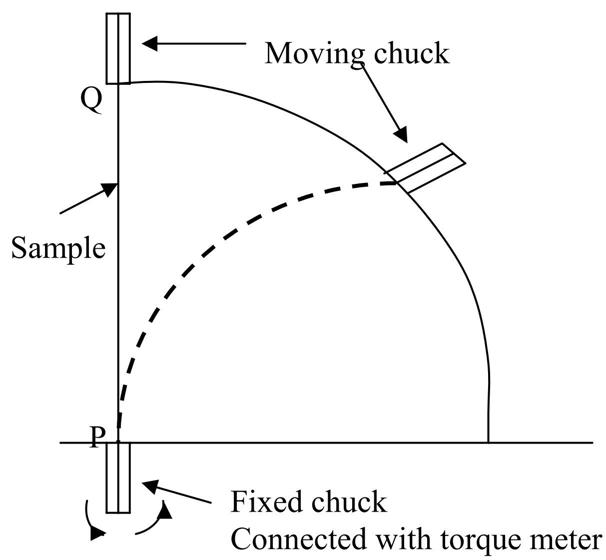


Figure 2-19 Pure Bending Deformation [23]

(1) X = (1-cos K)/K

(2) Y = (sin K)/K, when:

C= 1cm and $C = \frac{ø}{K}$

(3) K (cm^{-1}) = ø

B= slope between at $K = 0.5cm^{-1}$ and $K = 1.5cm^{-1}$

2HB= hysteresis at $K = 0.5\ cm^{-1}$

2HB1.5= hysteresis at $K = 1.5cm^{-1}$

X= digital output of voltmeter received from T terminal

From Figure 2-22,

$M = BK \pm HB$ where

M= Bending momentum per unit width (gf.cm/cm)

K= Curvature (cm^{-1})

B= Bending rigidity per unit width $(gf.cm^2/cm)$

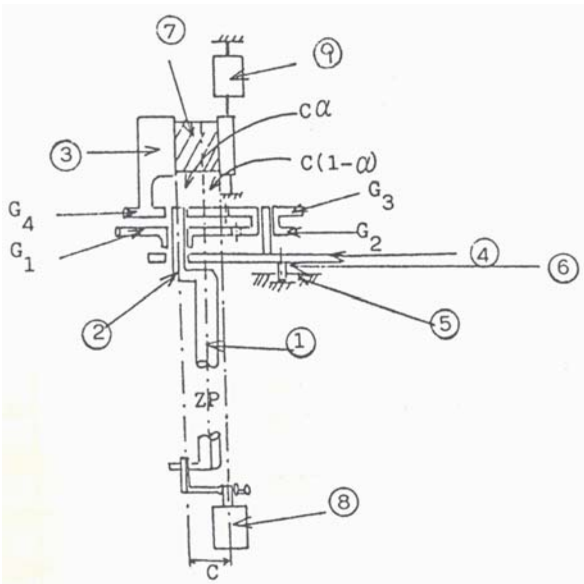


Figure 2-20 Schematic Illustration of the Bending Mechanism [23]

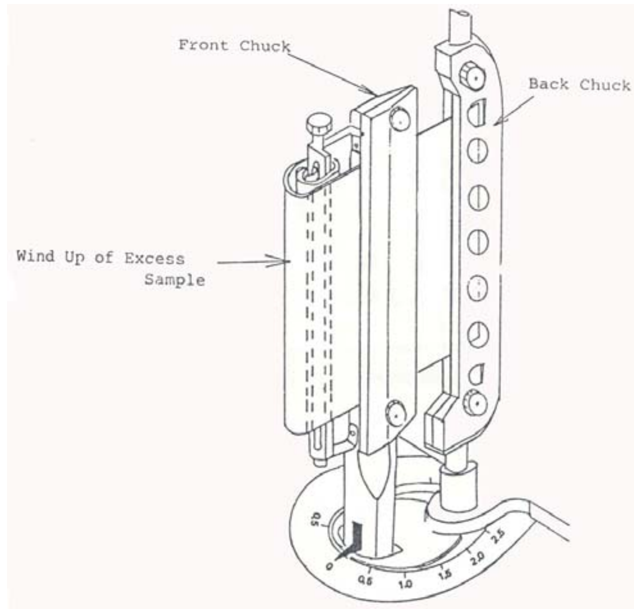


Figure 2-21 Setting of Sample [23]

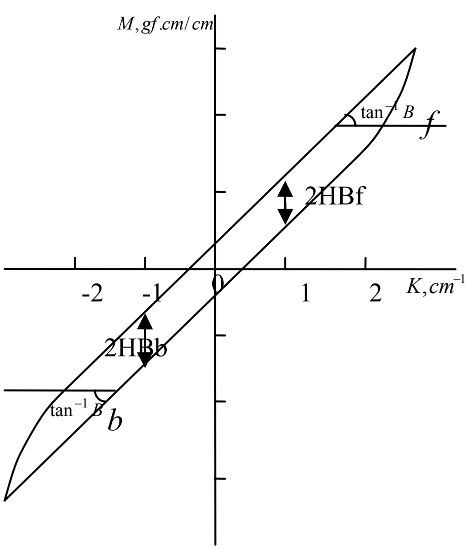


Figure 2-22 Bending Test Diagram [23]

To find B, bending rigidity, the average of the two slopes is taken. One value is when sample is bent with its face surface outside and the other is when sample bent with its face surface inside. This leads to $B = (Bf + Bb)/2$.

Similarly to finding bending rigidity, to find bending hysteresis, 2HB, and the average of the two hysteresis width at curvature ±1 is taken. Thus, $2HB = 2\,(HBf + HBb)/2$.

Compression Test Using KES-FB-3

Compressional property of fabrics is another mechanical property of fabric that is necessary to evaluate fabrics. The KES-FB-3 is a component of the KES-FB series and is used for measuring the compressional property of fabrics as well as other materials such as non-woven, leather, rubber and film. One advantage of the instrument is it can test fabrics with non-linear compressional property. This is made possible by the installation of an integral circuit. It also can be used to measure the bending properties of a loop-shaped fabric and yarn. The sample should be under the upper-limit force and constant rate of compressional deformation.

There are two types of maximum strokes. A standard stroke is 0mm to 5mm and a large stroke is 0mm to 50mm. The maximum applicable compressional force is 2500gf.
First the upper-limit force and the distance of the plunger from the bottom plate should be set. Then the sample should be placed on the bottom plate. When the measurement starts, the plunger comes down at a constant rate and compresses the sample. As soon as the compressional force reaches the upper limit force, the plunger starts to move up and it stops when it completes the recovery process [24].

The KES-FB-3 consists of two units, a mechanic unit and an electronic unit. The electronic unit consists of amplifier and integrator. The mechanical unit and the working mechanism of the KES-FB-3 are illustrated in Figure 2-23. The fabric sample to be measured is placed on the sample plate. The plunger for compression moves down at the rate of 1mm/50sec (standard) to compress the sample. A potentiometer detects the displacement of the plunger.

While the plunger compresses the fabric sample, the output voltage of the compressional force reaches the preset voltage and the synchronous motor reverses causing plunger to ascend. During the testing, pressure versus thickness is measured and recorded on the X-Y recorder. The resilience, compression energies, and linearity can be calculated according to the compression curve on an X-Y chart.

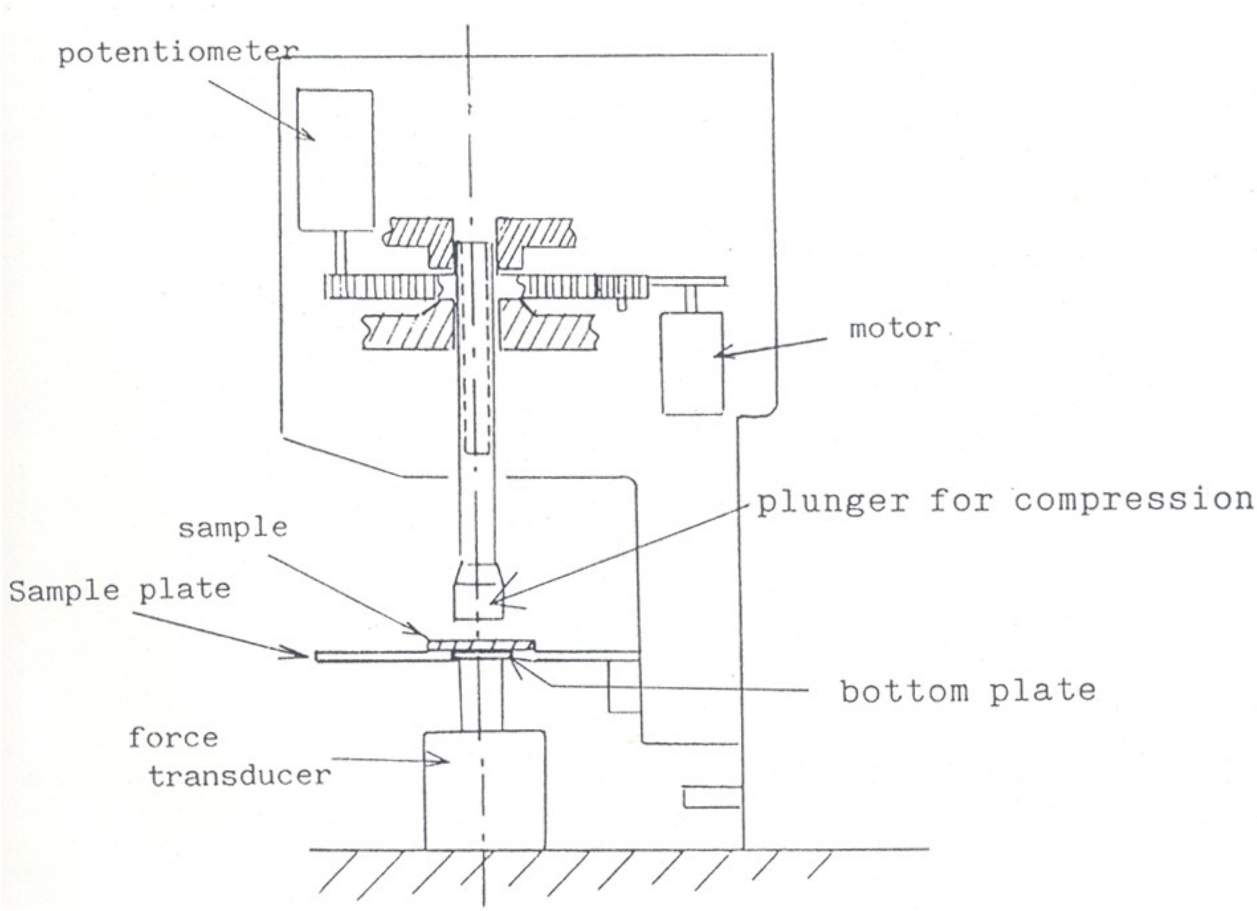


Figure 2-23 Schematic Illustration of the Compression Tester [24]

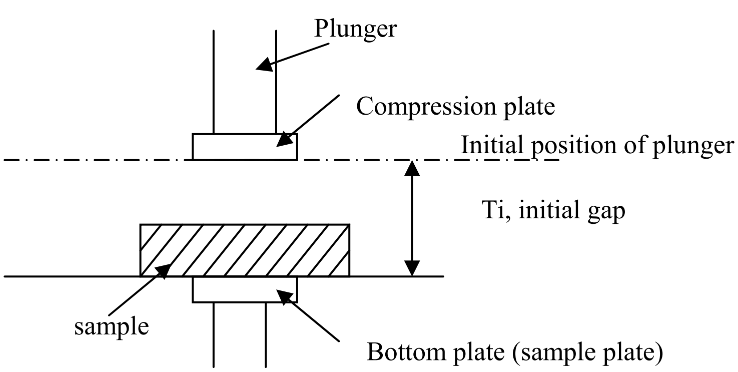


Figure 2-24 Initial Setting of Plunger

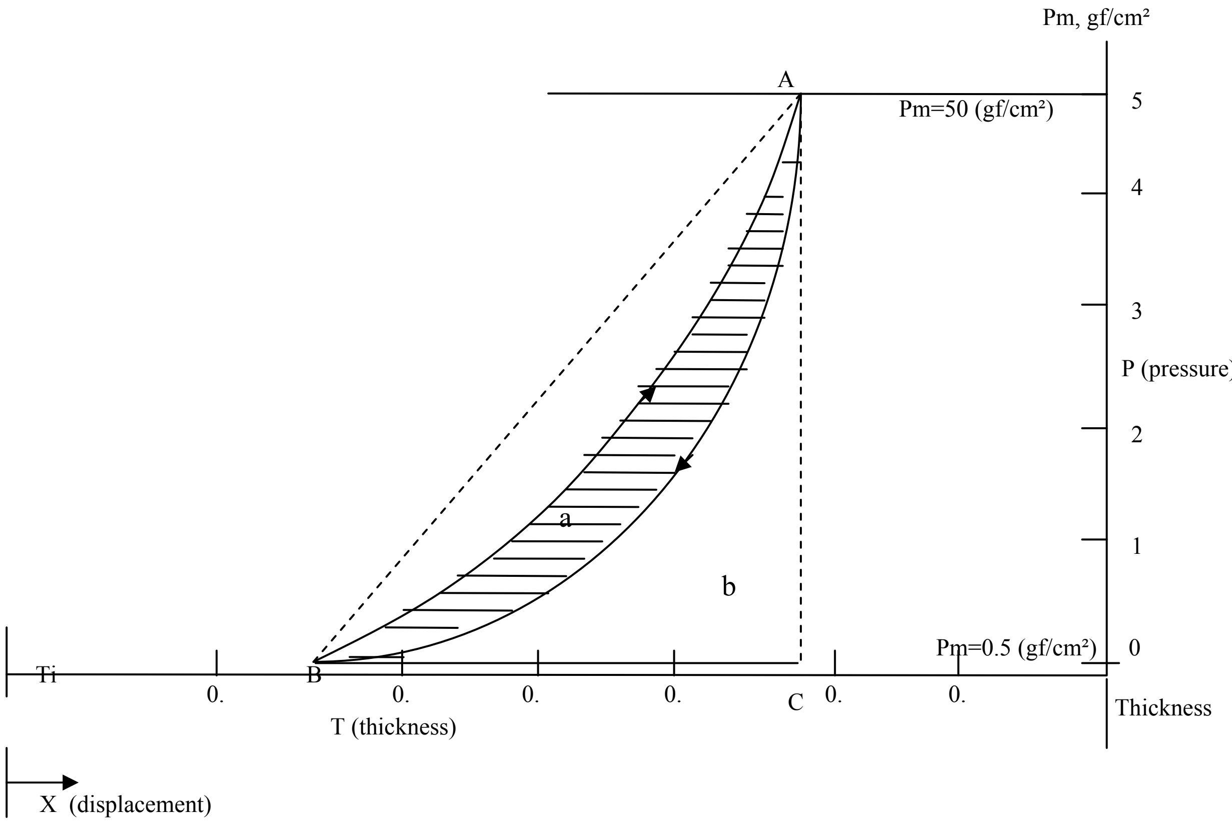


Figure 2-25 An Example of Pressure Thickness Curve [24]

LC: Linearity of compression thickness curve

$$LT = \frac{Area(a)+(b) \quad (WC)}{Area\ \Delta ABC*} \qquad *\Delta ABC = \frac{50gf/cm^2 \times (To - Tm)}{2\times 10}$$

WC: Compressional Energy

WC=Area (a) + (b)

$$WC = INT \times 0.1$$

RC: Compressional resilience

$$RC = \frac{B-INT}{INT} X100$$

To: Thickness value of X-axis at Pm=0.5gf/cm²

Tm: Thickness value of X-axis at Pm=50gf/cm²

EMC: Compression rate $RC = \frac{To - Tm}{To} X100$

Surface Friction and Roughness Test Using KES-FB-4

As well as other properties previously explained the surface test is also necessary to evaluate fabrics. Although the surface properties are closely related to the fabric hand, its effect on fabric drape is not that significant.

The KES-FB-4 measures the frictional coefficient (MIU), the mean deviation of the coefficient of friction (MMD) and geometrical roughness (SMD). The measurement is automated and the data processing is computerized so, data can be read directly after the test.

As shown in Figure 2-26 the sample is fixed at a winding drum, chunk A, and a constant force is applied on the opposite end, chuck B, which gives a tension to the sample by pulling it down. During the testing, a winding drum moves the sample by turning at a constant speed (1mm/sec). To measure the friction, a contactor, which was designed to simulate the human finger surface, is placed on the fabric surface. By the rotation of the drum, the fabric moves, and the contactor senses the fabric surface.

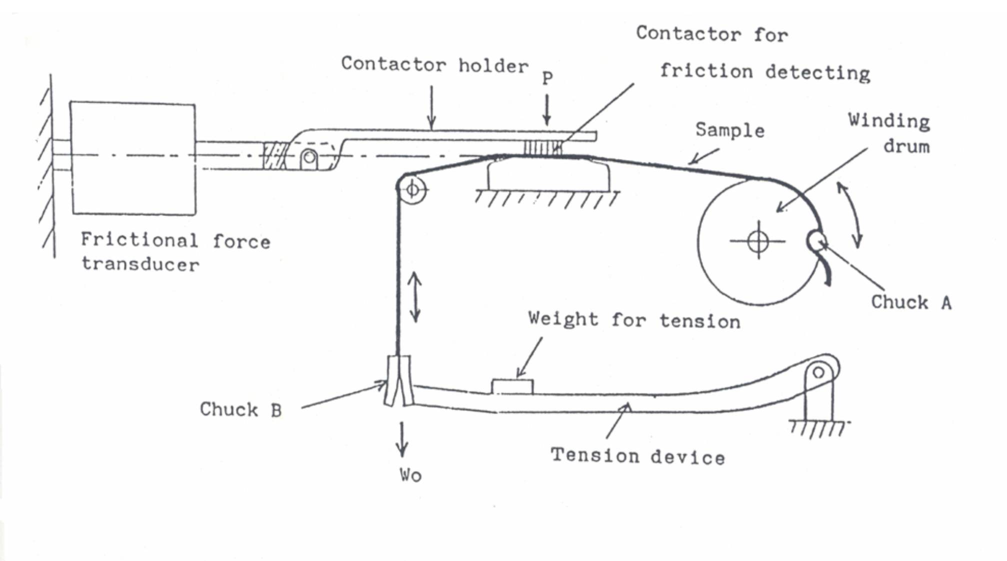


Figure 2-26 Principle of Friction Measurement [25]

To measure the geometrical roughness (SMD), a vertical contactor, which is at the top of the instrument, touches to the fabric with a constant force. While the fabric moves, the displacement of the contractor is detected by a transducer and the SMD value is calculated automatically. After the drum turns 3cm, it turns back to the starting position with the same speed [25].

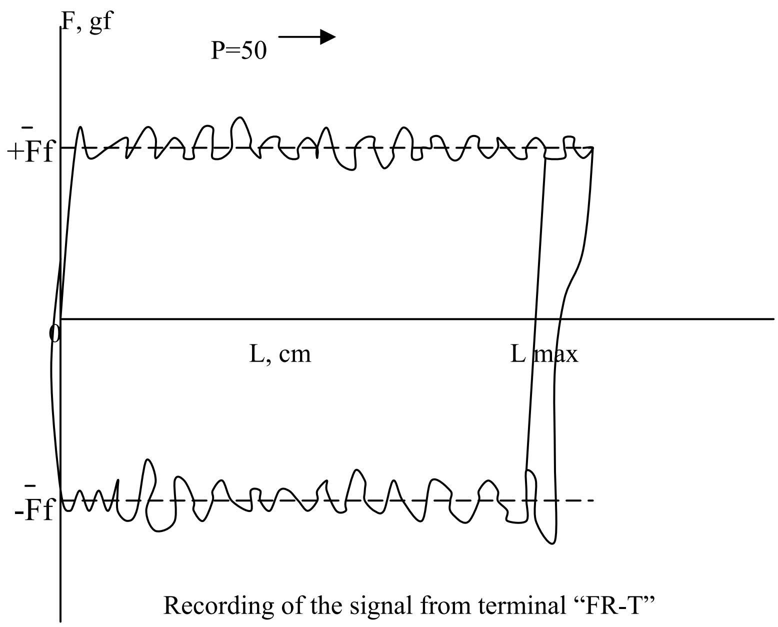


Figure 2-27 Surface Frictional Curve [25]

$\mu = \textit{frictional coefficient}$

$F = \textit{frictional force}$

$P = \textit{normal force}$ (The force applied by the contractor pressing on the fabric sample.)

$$\mu = \frac{F}{P}$$

The μ value differs while roughness detector moving on the sample surface.

$$\bar{\mu} = \frac{1}{L\max} \int_0^{L\max} \mu \, dL$$

Where,

L: distance on fabric surface

L_{max}: the sweep length

MMD: deviation of the frictional coefficient

Thus, $MMD = \frac{1}{L_{max}} \int_0^{L\max} \left| \mu - \overline{\mu} \right| dL$

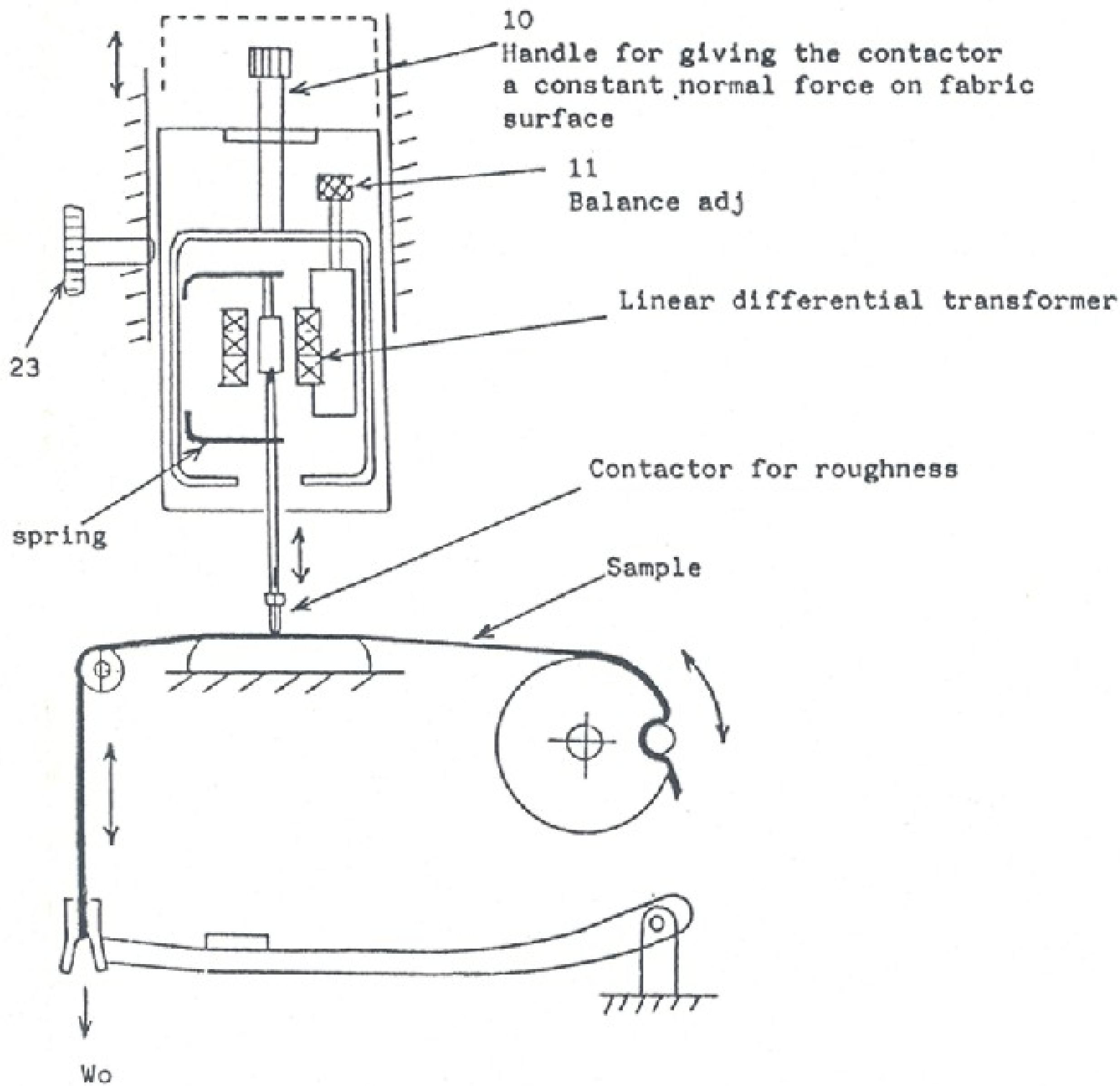
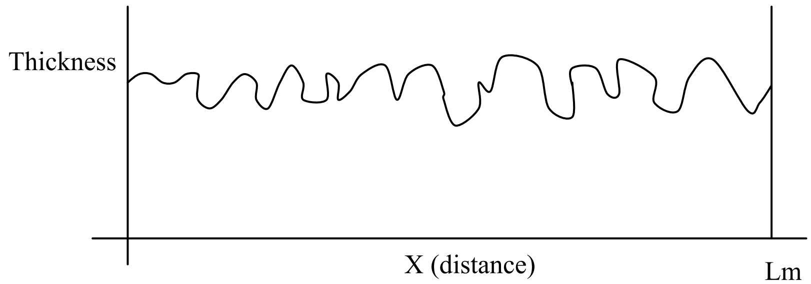
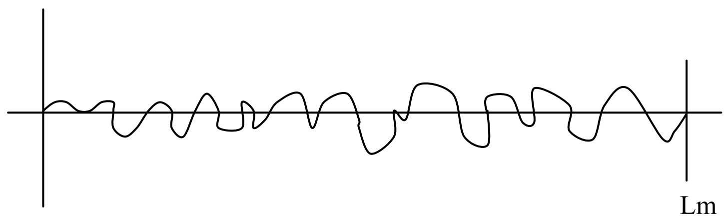


Figure 2-28 Principle of Surface Roughness Measurement [25]



(A) Recording of the signal from terminal “SR-T”



(B) Recording of the signal from terminal “F”

Figure 2-29 Surface Roughness Curves [25]

Where,

L= distance on fabric surface

L_{max}= the sweep length

SMD= Surface roughness

To test surface geometrical roughness, SMD, the contactor moves vertically. If the vertical displacement of the contactor is Z, the surface roughness is the mean deviation of SMD of Z.

$$SMD = \frac{1}{L_{\max}} \int_0^{L\max} \left| Z - \overline{Z} \right| dL$$

2.4.4.2 Fabric Assurance by Simple Testing (Fast)

Fabric Assurance by Simple Testing (Fast) system was developed by the Common Wealth Scientific and Industrial Research Organization (CSIRO) to assess fabric appearance, hand and performance properties by objective measurements. The aim was to provide information for designers, tailors, finishers and fabric manufacturers to predict fabric performance. CSIRO claimed that the tests are simple, and robust, it is even claimed to be much simpler than the KES-FB system [36, 37].

2.5 Summary and Conclusion

Based on the brief literature review presented above, it can be summarized that to create a database to help solve current problems with textile mechanics would be beneficial.
This will allow the exchange of data between customers, designers and manufacturers. To do this, an objective evaluation method to assess performance and appearance of fabrics is necessary. This objective method will increase reliability and efficiency for selecting the fabrics. Two systems have been developed for these purposes. These are: (1) The KES-FB system by Kawabata in Japan and (2) FAST system by CSIRO in Australia. Both systems measure similar parameters using different instrumental methods.

By using Kawabata's system, research can be directed to create a database with mechanical properties of fabrics. Although the instrumental method of determining drape coefficient is possible, fabric mechanical properties measured by either the KES-FB or the FAST can also be used to assess fabric drape property.

Chapter 3 Methodology

3.1 Introduction

This research is conducted to create an online fabric database consisting of fabric properties in the form of numerical data and to investigate the correlation of fabric drape property with fabric properties. Two steps used to analyze fabric drape. The first step is measurement of the mechanical parameters and drape property of the samples. The second step is to apply statistical methods to analyze the data.

The relationship between measured fabric mechanical properties and fabric drape is modeled using fuzzy-clustering technique. Computing program of the fuzzy-clustering technique is developed by the Computer Science Department at LSU. Independent variables used for the fuzzy-clustering computation are fabric mechanical and surface characteristics that are explained later in this -section. The fabric drape is used a dependent variable, in the fuzzy-clustering computation. The results obtained using the instrumental method are compared with those computed by the fuzzy-clustering techniques.

3.2 Fabric Properties Included in the Database

Fabric properties included in the database are mechanical parameters of extension, shear, bending, and compression; surface properties; fabric drape images. The parameters and the instruments, which were used to measure the parameters, are listed in Table 2. The Kawabata System for fabrics (KES-FB) was used to assess mechanical parameters and the thickness of the fabrics. The drape coefficients of the fabrics were tested on a Cusick drape tester. This data is listed in Appendix A. Manufacturers' input for structure information of the fabrics was also included in the database, which is listed in Appendix C. Fabric dynamic images were video taped as fabrics were allowed to drape on a circular pedestal. A Canon digital camcorder (ZR 30) was used for taping. The software Adobe Premier was used to edit the videos. Edited duration was 5 seconds for each dynamic image. The computer codes to establish the database and the fuzzy-clustering method were developed by another graduate assistant at LSU.

Table 2 Mechanical & Physical Parameters and Measuring Instruments

Property	**Parameter**	**Unit**	**Tester**
Tensile	Linearity (LT)	Dimensionless	KES-FB1
	Energy (WT)	gf.cm/cm²	
	Resilience (RT)	%	
Shear	Rigidity (G)	Gf/cm.degree	KES-FB1
	Hysteresis at 0.5° (2HG)	Gf/cm	
	Hysteresis at 5° (2HG5)	Gf/cm	
Bending	Rigidity (B)	gf.cm²/cm	KES-FB2
	Hysteresis (2HB)	gf.cm/cm	
Compression	Linearity (LC)	Dimensionless	KES-FB3
	Energy (WC)	gf.cm/cm²	
	Resilience (RC)	%	
Surface	Frictional Coefficient (MIU)	Dimensionless	KES-FB4
	Mean Deviation of MIU	Dimensionless	
	Roughness (SMD)	Micron	
Structure	Thickness (To)	Mm	KES-FB3
	Weight (W)	g/m²	Manufacturer's Input
	Fiber Content	picks/10cm	
	Filling Density	ends/10cm	
	Warp Density	Blended ratio	
Drape	Drape Coefficient	%	Cusick Drape
	Drape Image		Digital Camera

3.3 Sample Preparation

Test material for this study consists of 185 commercial woven fabrics, which were manufactured in the P.R. of China. Since the relative humidity and the temperature of the testing environment can affect the test results, the fabric sample were conditioned at least 24 hours before testing under the standard relative humidity (RH) and temperature. The standard Condition was:

RH 65±2 %

T 70±2 ºF

For use in the Kawabata System, the fabric specimens were cut into the dimensions illustrated in Figure 8.Two specimens from each fabric were cut straightly along with warp and filling directions. Sample ID and the directions were marked on each sample clearly. For those fabric samples with very high stiffness, a 10 cm x 10 cm specimen size was used. One of the specimens was tested on filling direction and the other was tested on warp direction. Since the compression property did not have directions, both specimens were tested for a repeat test. For use, in the Cusick Drape Tester, fabric specimens were cut in a circle with 30 cm diameter, which is suggested for medium stiff fabrics. A total number of 370 specimens were prepared.

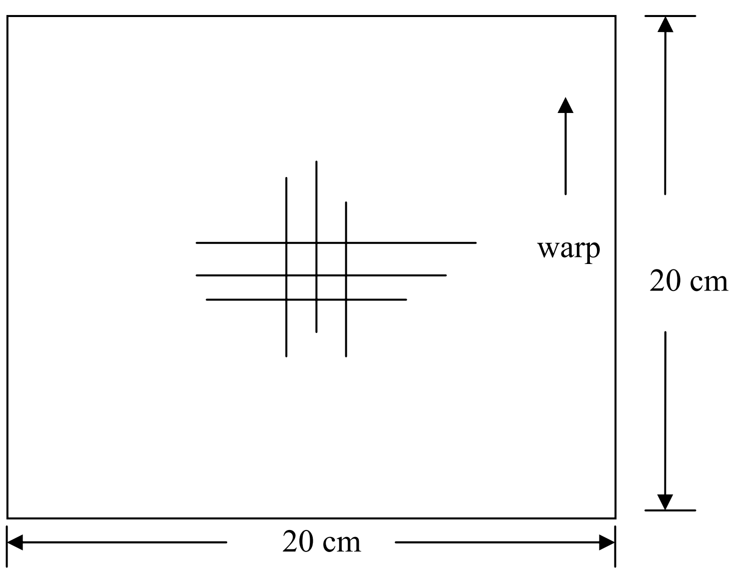


Figure 3-1 Sample Cut Straight and Marked

3.4 Instrumentation

3.4.1 Cusick Drape Tester

The Cusick Drape Tester (Figure 3-2 and 3-3) was used to measure fabric drape coefficient. Two circular fabric specimens, 30cm in diameter, were tested for each fabric face and back side in order to calculate average fabric drape coefficient. Since there were two fabric specimens for each sample, the drape coefficient of the sample was calculated as the average of drape coefficients of the two specimens.

Figure 3-2 Cusick Drape Tester

Figure 3-3 Top view of draped fabric sample

3.4.1.1 Manual Calculation

A white paper ring designed for Cusick Drape measurement is shown in Figure3-4. The ring is placed on the top of the tester as shown in Figure 3-2. The fabric is allowed to drape under its own weight. With the help of a light and a parabolic mirror underneath the fabric specimen, the drape image of the fabric is reflected to the paper ring. Top view of a fabric drape is shown in Figure3-5. After tracing the drape image, the paper ring is cut to separate the shadowed and non-shadowed area. Calculation of the drape coefficient is expressed as:

$$drape\ coefficient = \frac{C}{A} \times 100\%$$

where A is mass of paper ring and C is mass of inner shadow.

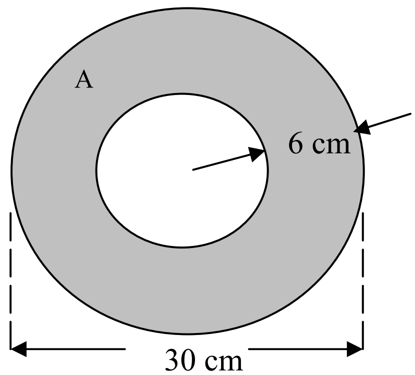


Figure 3-4 Paper ring

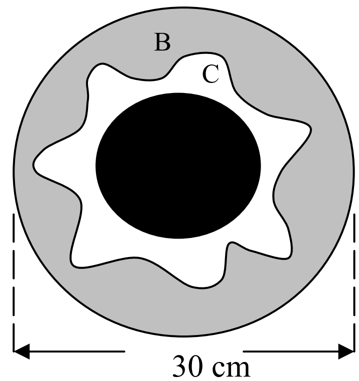


Figure 3-5 Paper ring with draped image

3.4.1.2 New Method to Calculate Drape Coefficient

Since the Cusick drape tester requires the use of special paper rings for drape measurement and purchase of those special paper rings is quite expensive, the drape test for all 370 fabric specimens is costly. A more economical way to calculate drape coefficient was developed in this study. This new method was based on counting the number of pixels of inner and outer area of the draped image. The draped image, which was drawn on a paper, was scanned in to Adobe Photo Shop 6.0 and drape coefficient was calculated using the features of this software and processing the data in Microsoft Excel spread sheet.

First, the drape images of the fabric specimen were drawn to a plain white paper, 13 inches x 18 inches. Draped images of fabric face and back sides are drawn on a paper. The reason for drawing the front and back sides on the same paper is to reduce the scan time, the process time in the computer and paper consumption by half. Additionally, having drape images of a fabric face and back side on the same paper made organization easier and it prevented any error that would be caused by mixing the measurements for two sides.

The new method is based on the principle that the ratios of weights of two paper pieces are the same as the ratio of the areas because the paper ring is plain and homogenate in thickness and density. Therefore, this principle can be applied to calculate the drape coefficient. Procedure of this method is described below.

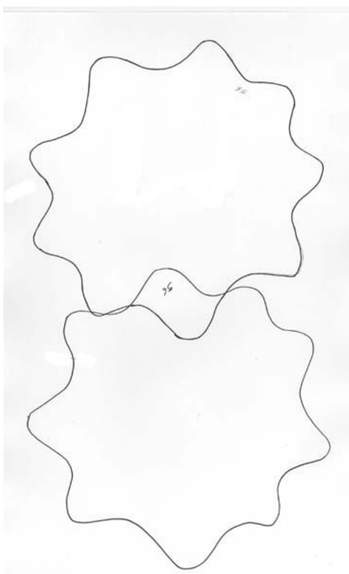


Figure 3-6 Scanned images (in gray scale)

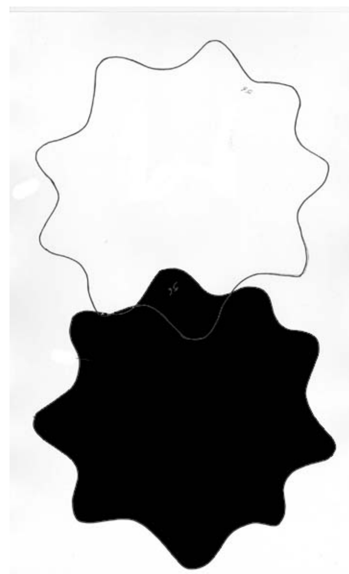


Figure 3-7 Scanned Images, one is filled with black paint in Photo Shop

Drape images are scanned in gray scale and exported to Photo Shop (Figure 3-6). The images are overlapped during the drawing to fit the image in the scanner area. For the same reason the image is reduced by 70% by copying. The overlap area is taken account for both samples while processing in Photo Shop. The images are opened in Photo Shop to determine the draped area. First, any noisy spots or shadows created during the scanning process are cleaned using the eraser tool in Photo Shop. Once at a time, each draped image is filled using the paint bucket tool of Photo Shop. The filled sample is shown in Figures 3-7 and 3-8.

3.4.1.2.1 Reading the percentage of the dark area

Histogram property under Image tool, as shown in Figure3-9, displays the histogram of gray scale image. Highlighting the black line at the end of the histogram by mouse, the percentage of black area and number of black pixel count are read under the graph. The value of percentage is used to calculate the drape coefficient.

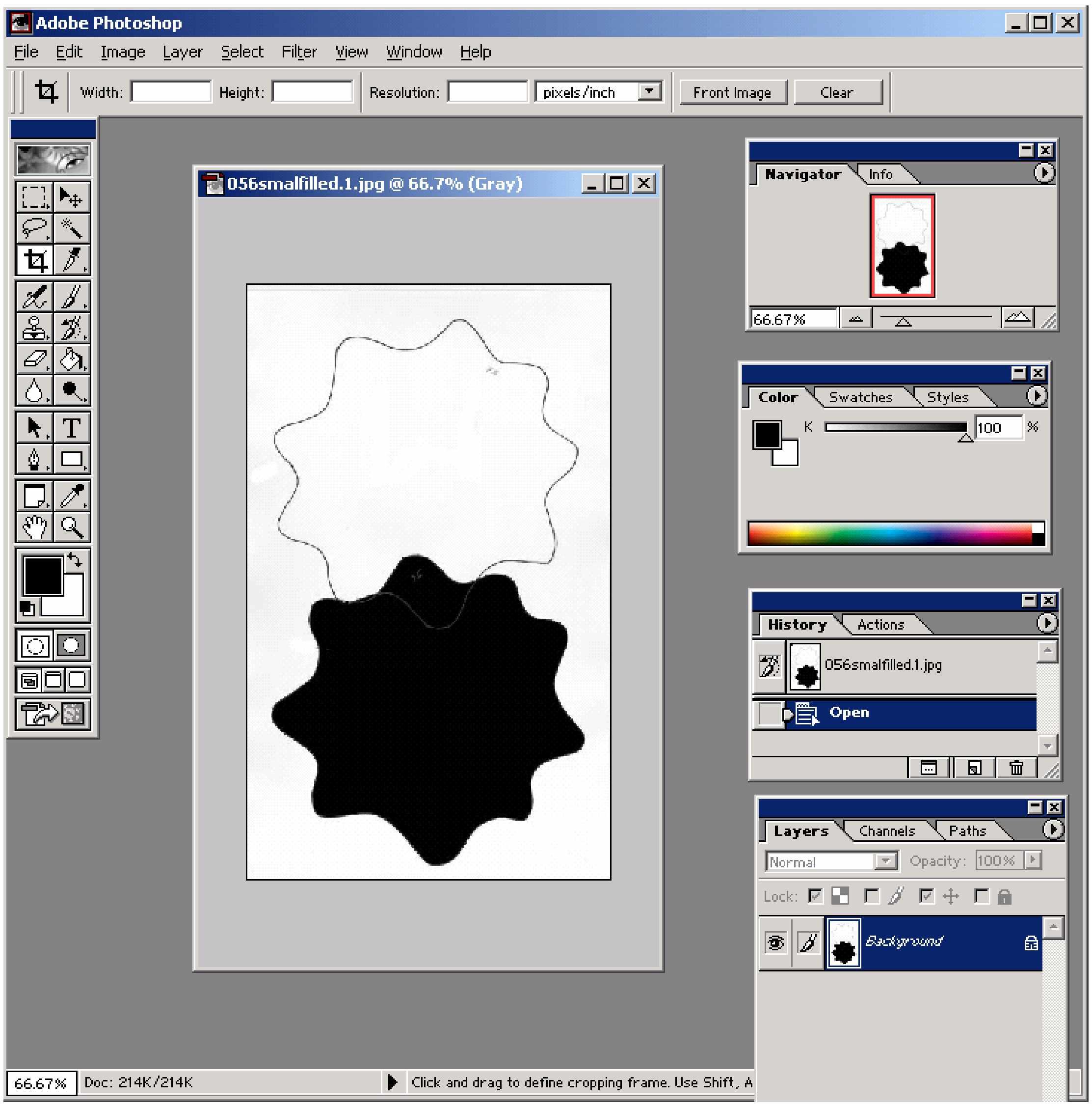


Figure 3-8. Images in Photo Shop

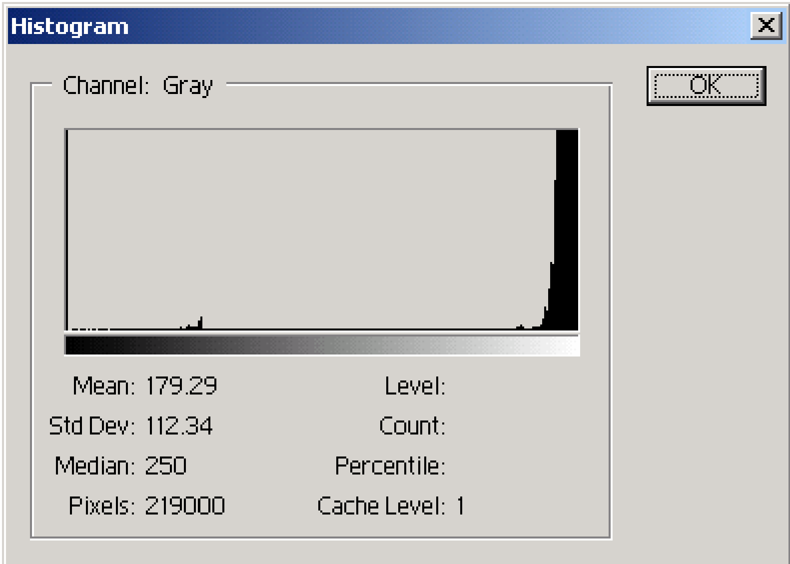


Figure 3-9 Histogram for the whole image

3.4.1.2.2 Calculation of Drape Coefficient Using Area Instead of Weight:

The steps in calculating the drape coefficient using area instead of weight are very similar. Thus the calculation based on the area is the ratio between the area of whole paper ring and the area of inner paper ring, which is drawn by tracing the fabric shadow. If A represents the area of a whole paper ring (area of gray area shown in Figure 3-4), the area of A is

$$A = (15^2 - 9^2)\pi = 452.16 \text{ cm}^2.$$

Thus, according to the calculation equation, the drape coefficient can be expressed as

$$drape\ coefficient = \frac{C}{A} \times 100\%,$$

where C represents the area of inner ring of drawn circle (area of white area shown in Figure 3-4). To determine C, a whole area of the drape image (filled with black color in Figure 3-8) is calculated using the Adobe Photoshop Software.

The scanner used for this research has a scanning area of 21.59 cm x 35.56 cm (8.5 inch x 14 inch). Thus, the scanning area is

S_s= 767.74 cm², and

H: percent of filled area read from the histogram gray scale (Figure 3-9).

Because the scanning area was not big enough to cover draped area, the drawn images were reduced by 70% on a copy machine to adjust scanning area. Since the copy reduction rate (r) is 70% in one dimension, the area reduction rate is

$$r^2 = \frac{70}{100} \times \frac{70}{100} = \frac{49}{100}.$$

This means the drape image area is reduced to 49%. Thus, in further steps of calculation, to increase the scanned area result by 49% is fundamental to get the correct result. If H represents the percentage of black pixels read from histogram in scanned image, the actual area of black shadow, S, can be calculated as

$$S = (\frac{H}{100} \times S_s \times \frac{1}{r^2})$$

Therefore, C can be obtained by

$$C = S - 254.47.$$

Fabric drape coefficient can then be calculated by

$$\text{Drape Coefficient} = \frac{C}{A} \times 100, \text{ or}$$

$$\text{Drape Coefficient} = \frac{(\frac{H}{100} \times 767.74 \times \frac{100}{49}) - 254.47}{452.16} \times 100.$$

Before implementing the new method for each sample, four specimens were tested to validate this new method. The test result for validation is shown in Table 3. The accuracy of new method is 99.39%. This new method can be used to replace the traditional manual method.

Table 3 Comparison of Scanned Drape Coefficient Measurement to Scanned Measurement

Fabric Code	Scanned DC (%)	Manual DC (%)	Accuracy (%)
56-1	76.45	76.15	99.61
56-2	76.37	77.17	98.96
72-1	74.19	74.79	99.20
72-2	77.67	77.85	99.78
Average			**99.39**

3.4.2 Kawabata Evaluation System for Fabric (KES-FB)

In the previous section, Table 2 displays the properties and related parameters to be tested using the Kawabata evaluation system (KES-FB). Figures 3-10 to 3-13 show four testing units of the KES-FB instrument.

Figure 3-10 KES-FB Bending Tester

Figure 3-11 KES-FB Compression Tester

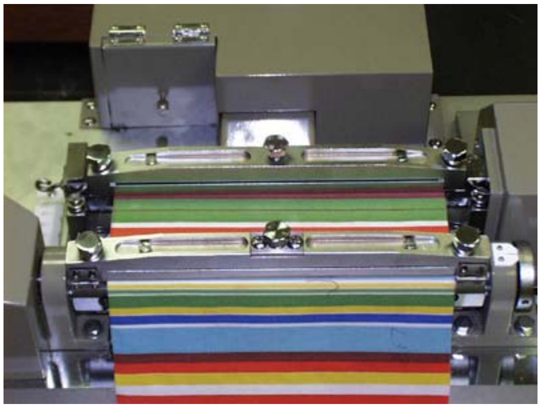


Figure 3-12 KES-FB Bending/Shear Tester

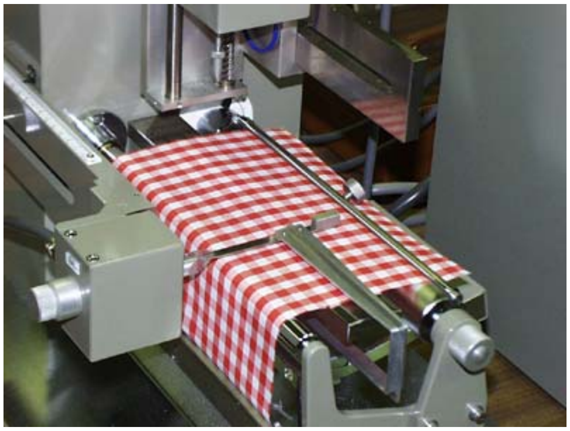


Figure 3-13 KES-FB Surface Tester

3.5 Procedure and Analysis of Data

After the instrumental testing of fabric mechanical properties and drape property for each fabric sample, all the numeric results were recorded in the Microsoft Excel spread sheet. Regression analysis was applied using SAS to determine the interrelationships between mechanical parameters and, more importantly, the relationship between the mechanical properties and drape property.

The database eventually will include fabric tailorability for all tested fabrics. The tailorability of fabrics is being assessed by the Apparel-Computer Integrated Manufacturing Center (ACIM) at the University of Lafayette-Lafayette, Louisiana. Similar to drape property, the purpose is to develop an objective method to assess tailorability of the fabrics according to the physical and mechanical properties. The KES-FB data and subjective tailorability evaluation will be used to create that model.

Since the overall purpose of the project was to create an online fabric database and to implement a Web-based intelligent search engine. This web-site will allow textile manufacturers, retailers and designers to go online to search for materials that will best fit their needs. Distinct from subjective evaluation of fabric drape and tailorability, the intelligent database helps evaluate the fabric drape and tailorability using tested instrumental data.

3.6 Online Database and Intelligent Search Engine

The database consists of fabric mechanical properties, physical and structural properties as well as fabric dynamic images and contact information of fabric manufacturers. The instrumental data is listed in Appendix A. Fabric end-use classification is listed in Appendix B. This classification of fabric end uses was a subjective assessment done by the author. Since the major focus of this research was to predict fabric drape, the end-use classification was added to the database to implement additional search process using end-use property. In addition to Appendices A and B, fabric manufacturers' input data is listed in Appendix C. An intelligent search engine was established to find desired fabrics that match users' preferences using fuzzy clustering and data mining methods.

The web-site can be accessed by URL http://www.textilelab.huec.lsu.edu. It allows users to access the database to use the intelligent search engine. The server hosting the search engine is Windows 2000 Server version server and the database is hosted on a different server [27]. The conceptual model of the system is shown in Figure 3-10.

By connecting to this web site, clothing manufacturers, designers, and clothing retailers can query the database to determine which companies offer fashionable fabrics that best meet their needs and how to contact them. They will also be able to predict if the products they select will undergo garment manufacturing easily, drape properly, need specific care, or cause serious problems during production.

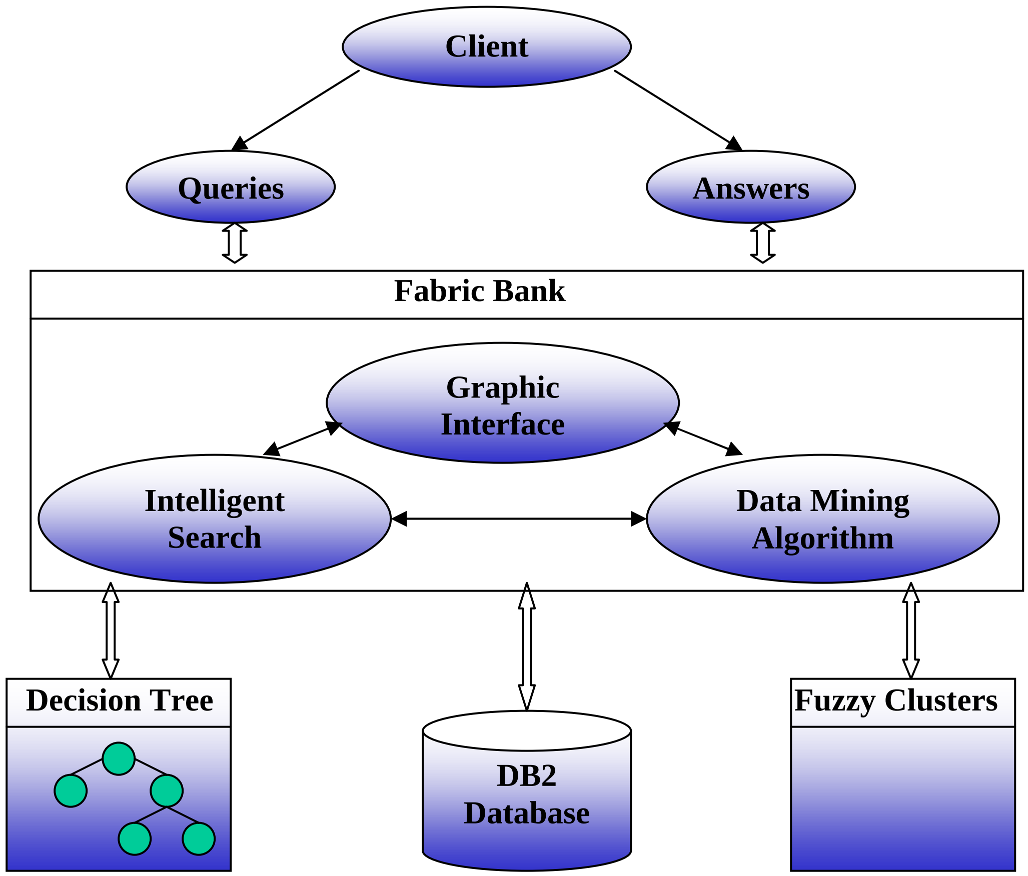


Figure 3-10 Intelligent Database Architecture [8, 9]

3.7 System Components

Clients connect to the internet and access the Online Fabric database site going to URL http://www.textilelab.huec.lsu.edu. The server's operating system is Windows 2000 Server and the interactive Web-server applications were developed using Active Server Pages (ASP). Active Server Pages (ASP) technology is made available by Internet Information Server (IIS). The data is stored in a fully Web-enabled relational database management system, IBM DB2 Universal Database (DB2 UDB) version 7.1, which is used to store fabric data and user transactions [40]. The system components are shown in Figure 3-11.

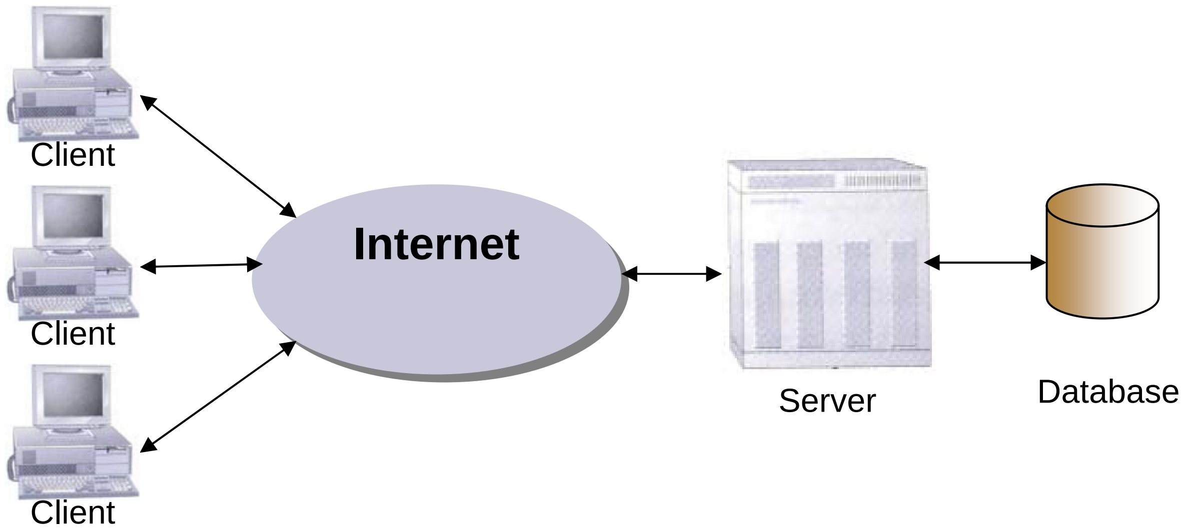


Figure 3-11 Online Database Server [4]

When end-users bring up a web-site, first the browser requests the ASP file from the Web server. Then the server-side script begins to run with ASP and ASP processes the requested file sequentially (top-down), executes any script commands contained in the file, and produces an Hyper Text Markup Language (HTML) Web page. At last, the Web page is sent to the browser.

Because the script runs on the server, the Web server does all the processing, and standard HTML pages can be generated and sent to the browser. This means that the Web pages are limited only by what our Web server supports. Another benefit of having the script reside on the server is that the user cannot "view source" on the original script and code. Instead, the user sees only the generated HTML as well as non-HTML content, such as Extensible Markup Language (XML), on the pages that are being viewed [27].

Chapter 4 Results and Discussion

4.1 Analysis of Kawabata Testing

To determine bending, shear, compression, and surface properties, the fabric samples were tested by the Kawabata System. Both Kawabata and drape test results of 185 fabric samples are given in Appendix A. To find the correlation between Kawabata results and fabric drape, the data is analyzed using a regression technique. The parameters were tested at 95% confidence level, i.e. α=0.05. It was found that the Kawabata parameters significantly influence the fabric drape property.

The meaning of parameters used in the Tables 4 and 5 is listed below:

Bending properties:

HB= Bending rigidity (gf.cm^2/cm)

2HB= Hysteresis of bending moment (gf.cm/cm)

Tensile properties:

LT= Linearity of tensile curve RT= Tensile resilience (%)

WT= Tensile energy (gf.cm/cm^2) EMT= Tensile strain

Surface properties:

SMD= Surface roughness (Micron) MIU= Mean frictional coefficient

MMD= Deviation of frictional coefficient

Shear properties:

G= Shearing rigidity (gf/cm.degree)

2HG= Hysteresis of shear force at 0.5° (gf/cm)

2HG5= Hysteresis of shear force at 5° (gf/cm)

Compression properties:

WC= Compressional energy (gf.cm/cm^2) RC= Compressional resilience (%)

LC= Linearity of Compression thickness curve　　to= fabric thickness (mm)

EMC= Compression rate (%)　　W= fabric weight (gr/m²)

Stepwise method was used for the regression analysis. After last insignificant variable WT was removed from the model, the R-Square value was 0.8056. The regression result is summarized in Tables 4-6. All variables left in the model are significant at the 0.05 level. As a result, placing the parameters found in the table above, the equation to predict drape coefficient (DC), can be estimated as:

$$DC = 69.17 + 25.51\,(2HB) - 35.69MIU + 3.50G + 0.00049RT + 21.13WC - 0.492RC - 13.04t0 + 0.303EMC + 0.51\,W$$

This shows that among 18 parameters, bending hysteresis (2HB), mean frictional coefficient (MIU), shearing stiffness (G), tensile resilience (RT), compressional energy (WC), compressional resilience (RC), fabric thickness (t0), compression rate (EMC), and weight are significantly correlated with drape coefficient (DC).

Table 4 Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr>F
Model	9	32939	3659.93951	80.58	<.0001
Error	175	7948.05992	45.41749		
Corrected Total	184	40888	40888		

Table 5 Result of Regression

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	69.17377	6.37258	5351.49254	117.83	<.0006
2HB	25.50535	3.87347	1969.18166	43.36	<.0006
MIU	-35.69084	11.96789	403.92544	8.89	0.0038
G	3.49488	1832.78833	1832.78833	40.35	<.0006
RT	0.0004869	0.0002439	180.98277	3.98	0.048
WC	21.12759	8.45467	283.61567	6.24	0.0139
RC	-0.49212	0.07665	1872.06424	41.22	<.0006
t0	-13.03745	3.64943	579.63847	12.76	0.001
EMC	0.30312	0.07232	797.83798	17.57	<.0006
W	0.51093	0.22595	232.23376	5.11	0.0255

Table 6 Summary of Backward Elimination

Step	Variable Removed	Label	Number Vars in	Partial R-Square	Model R-Square	C(p)	F Value	Pr>F
1	2HG	HG	17	0.0002	0.8207	17.2063	0.21	0.6502
2	SMD	SMD	16	0.0003	0.8204	15.4451	0.24	0.6249
3	LC	LC	15	0.0011	0.8193	14.4831	1.05	0.3075
4	B	B	14	0.0012	0.8181	13.5715	1.1	0.2961
5	LT	LT	13	0.0021	0.816	13.5536	2	0.1592
6	2HG5	HG6	12	0.0026	0.8134	13.9612	2.41	0.1221
7	MMD	MMD	11	0.0025	0.8109	14.2967	2.32	0.1294
8	EMT	EMT	10	0.0026	0.8083	14.7007	2.37	0.1253
9	WT	WT	9	0.0027	0.8056	15.187	2.43	0.1205

4.2 Web-based Online Database and Intelligent Search

An online intelligent search engine for fabric has been established to select fabrics with desired drape and mechanical properties from the database. The database and intelligent search is accessible through the web-site http://www.textilelab.huec.lsu.edu. While the Kawabata data, fabric draped images and videos are obtained, both the web-site and intelligent search engine is implemented by the Computer Science Department at Louisiana State University.

The Kawabata data that represent fabric mechanical characteristics is stored in the database. In addition, fabric draped images and videos are also included in the database. The system is able to implement both basic search and intelligent search. Basic search can be carried out in two ways, either ordinary exact queries or range queries. In real life, range queries are more beneficial than exact queries, because mostly users may not know what the exact values are they are looking for. Another benefit of it is that if the database does not have a sample with the exact values, it returns the closest values that are available in the database.

Intelligent search predicts fabric drape coefficient from fabric mechanical data. To do that, data mining by using fuzzy clustering techniques is used.

4.2.1 System Design and Site Map

The web-site consists of a front page, with links from the front page to other components of the site. The system components are shown in Figure 4-1. Front page covers introduction information about the school and current news. There are links to the intelligent search engine, information about this research, useful links, and FAQ.

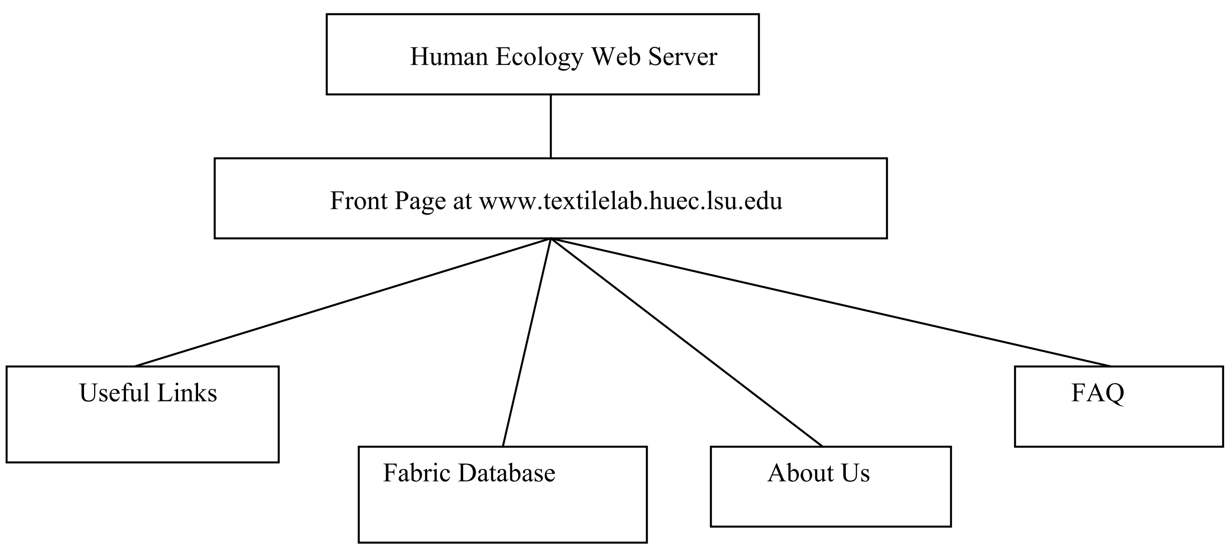


Figure 4-1 System Components of Web-site [40]

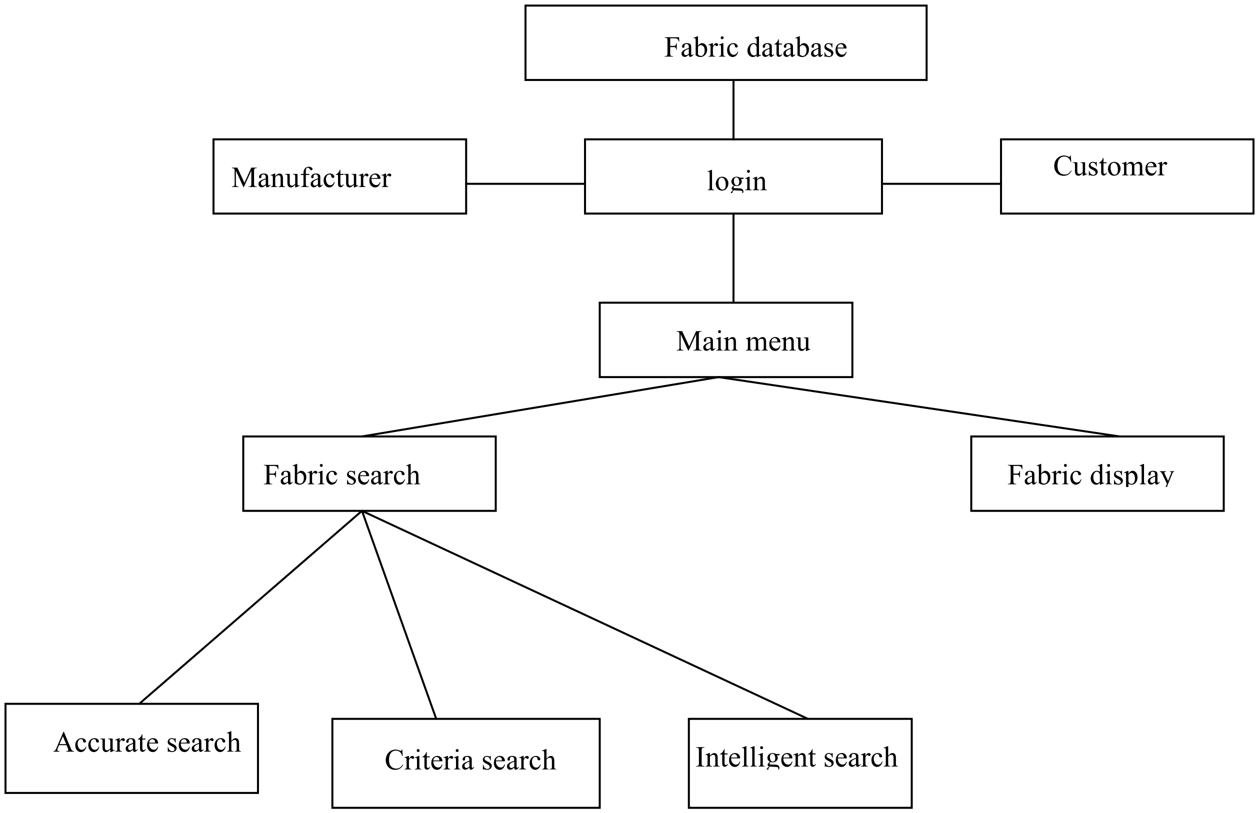


Figure 4-2 System components of fabric database [40]

Figure 4-2 shows components of the fabric database, which consist of fabric search and fabric display options. Fabric search offers three search methods, which are accurate search, criteria search, and intelligent search. The front page is shown in Figure 4-3.

To access fabric database, user needs to click the link, 'Fabric Database' at the left top of the front page. The system brings member login interface, which is shown in Figure 4-4. While signing up, the user should specify either s/he is a customer or a manufacturer. In addition, for new users, the link to the registration is given under the login box, with 'Sign up'. The registration form interface is shown in Figure 4-5.

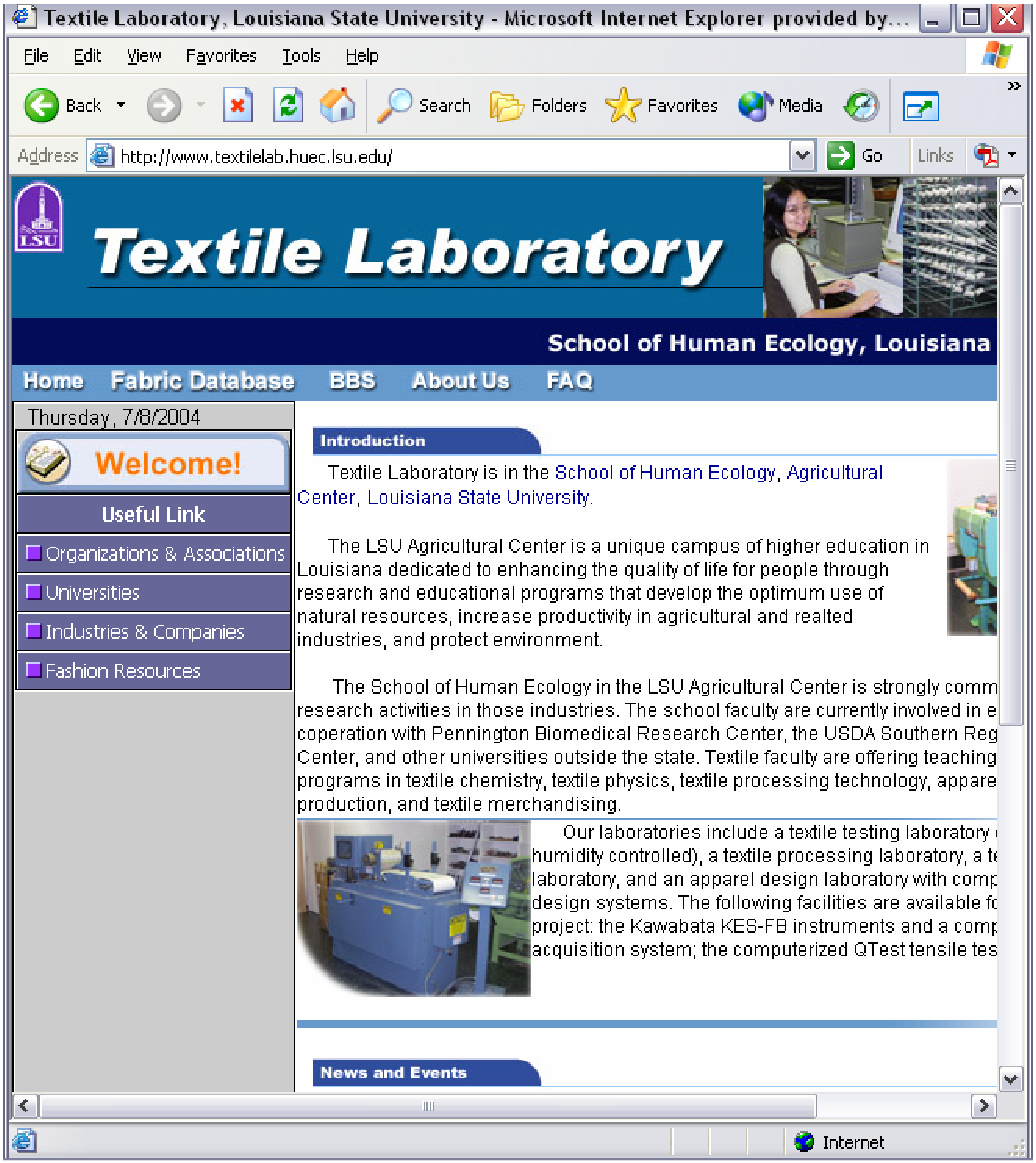


Figure 4-3 On-line fabric database web-site front page

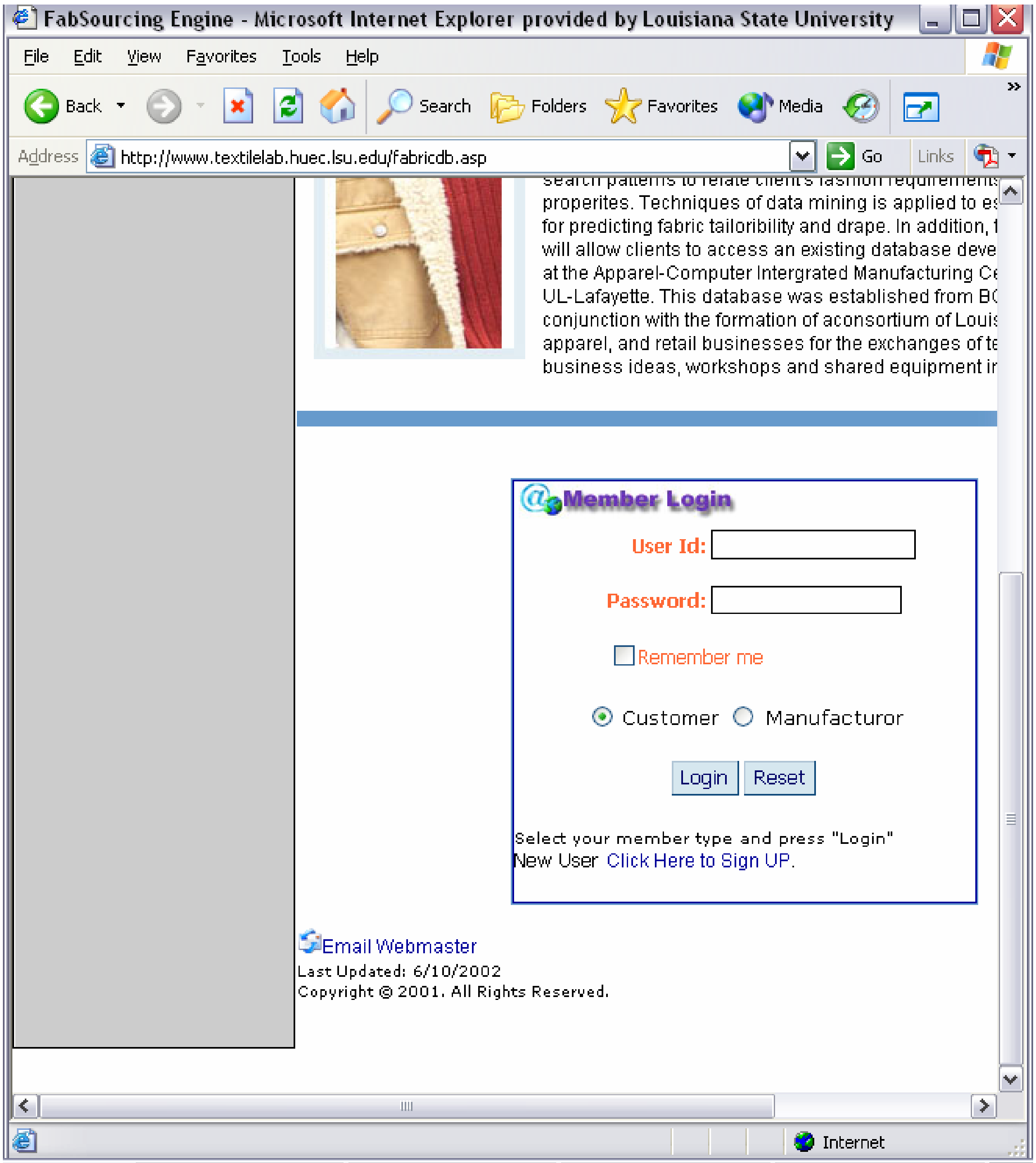


Figure 4-4 Member login interface

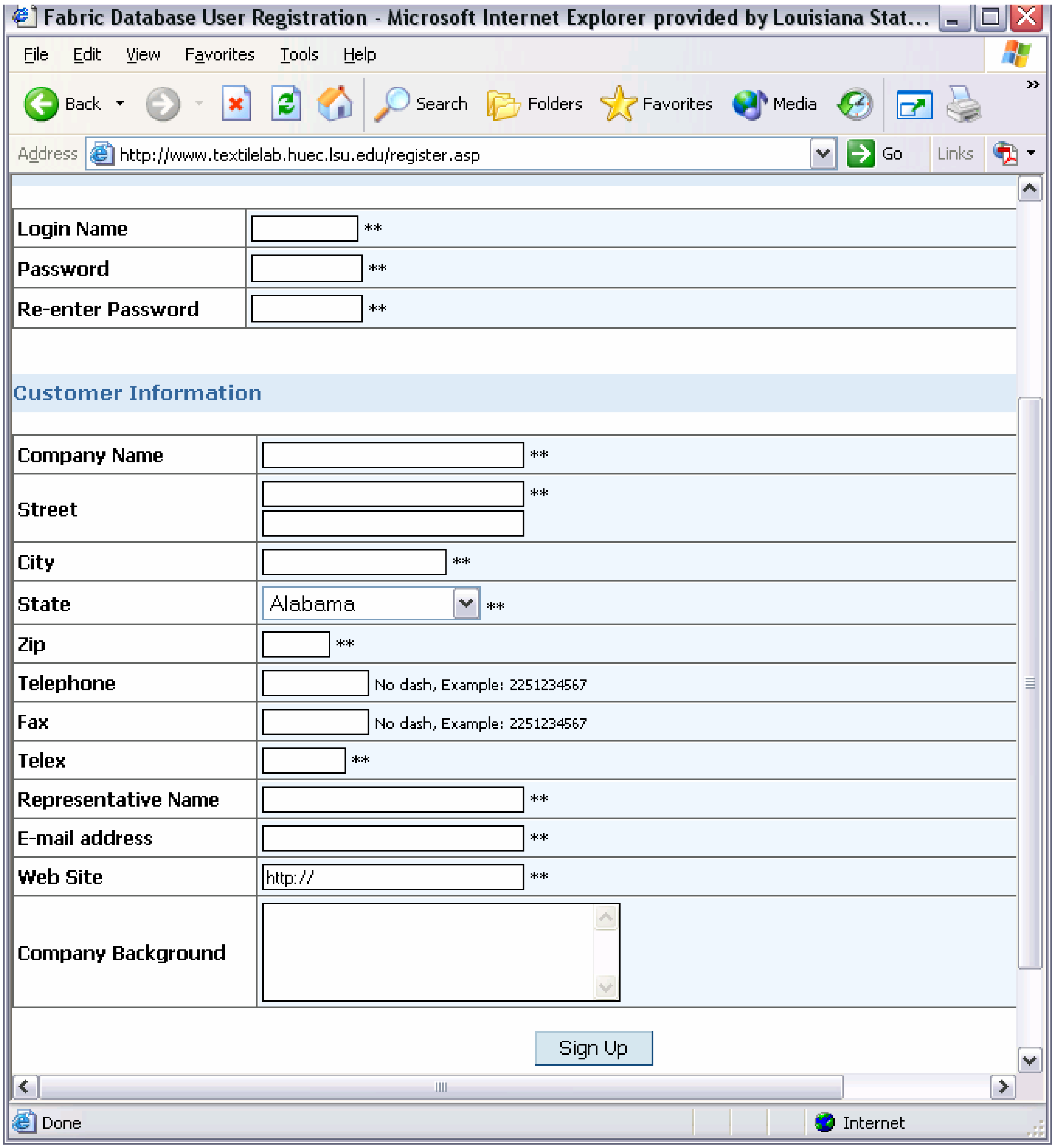


Figure 4-5 User registration online form

Since one of the goals of this research is to provide a communication tool among fabric manufacturers, garment makers and designers, the system gets this information from users during the registration. By completing a simple online registration form, a new user can choose a login ID and password. Additionally, the user needs to enter company name, address, telephone, representative name, email address, company web-site and company background. This information is saved by the system. The [**] indicates that the text box it is next to must be filled. If user leaves blank the information that must be filled, the system will give an error message similar to Figure 4-6, and ask user to try again.

4.2.2 Fabric Database and Search Options

Web interface of the site allows user to implement searches that will fit into users' need. For instance, if the user would like to search for fabrics only by end-use or only by mechanical properties, this made possible by offering variety of options to search. These search options are grouped under 4 different groups. They are accurate search, range search, criteria search, and intelligent search. Beside that, fabric display property allows user to access all the data for specific sample, including fabric still and dynamic images.

4.2.2.1 Accurate Search and Range Search

The figure below shows user interface for accurate search. First user asked to select search range. The options are given from same as input to 30% deviation. If users choose to get result in 10% range, the fabrics within ±10% range will be returned as a query result. The values within [User input ± ((User input × 10)/100)] will be returned as result. For instance, if the data shown in figure 4-6 is entered, the result is shown in figure 4-7.

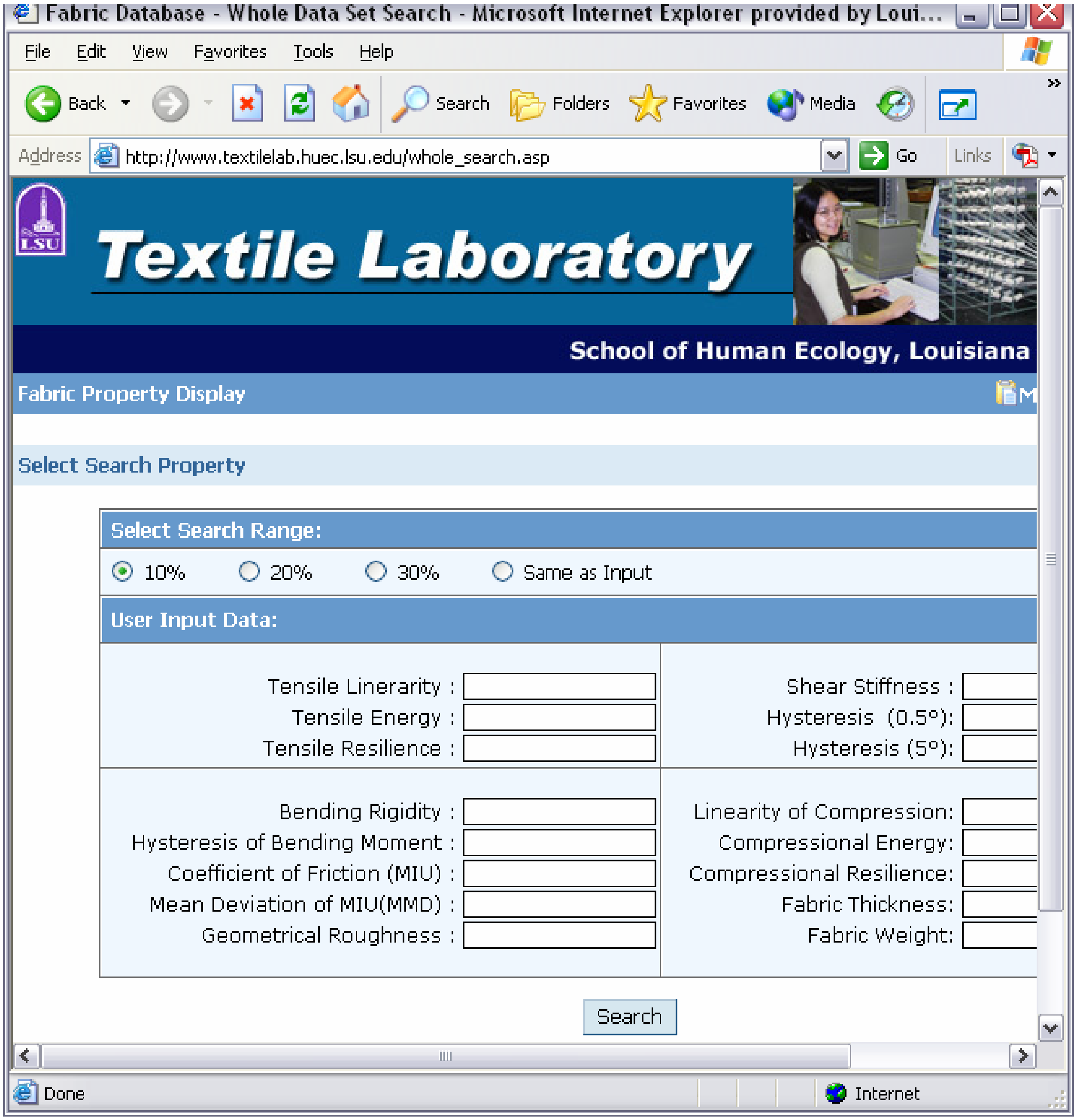


Figure 4-6 Accurate Search User Interface

In the figure 4-6 above, the data for sample number 10 entered to verify search process. The data for fabric number 10 is given in Appendix A. And as it is displayed in Figure 4-7, fabric number 10 is returned as result. For various data values entered in the query to see if other options are working. In range search, the search is working even if the user enters only few of the parameters.

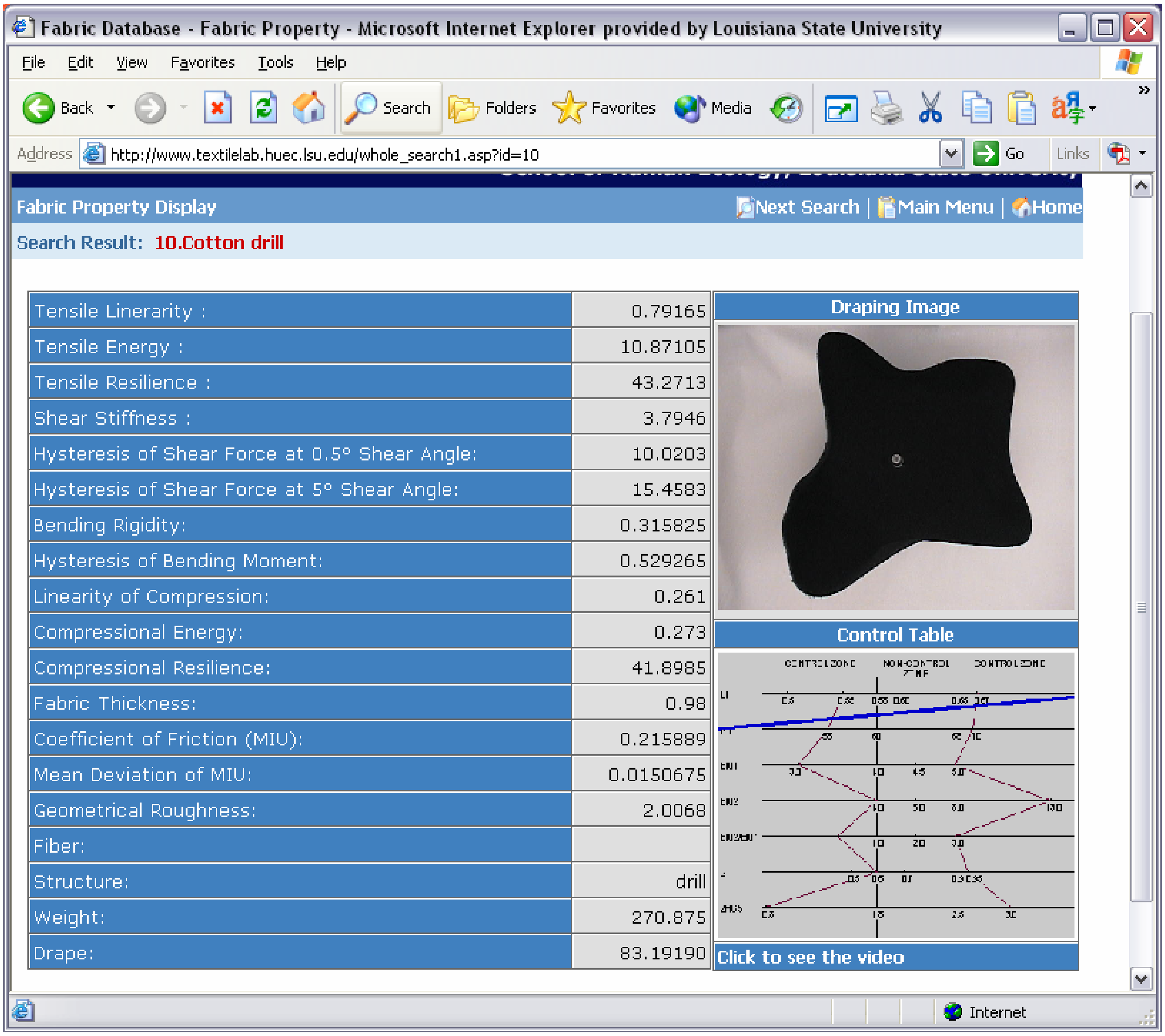


Figure 4-7 Accurate Search Result

4.2.2.2 Criteria Search

The criteria search allows a user to search fabrics by end-use properties. The data stored in the database for this purpose is given in Appendix B. The figure below displays the user interface of the web-site for this search. Children's dress is selected for this example, and 9 samples are returned. Figure 4-9 display the retrieved sample list. The result from web search is the same as the data in Appendix B. The fabric numbers, 13, 14, 20, 87, 129, 150, 156, 162, and 165 are the only ones classified as fabrics for Children's dress.

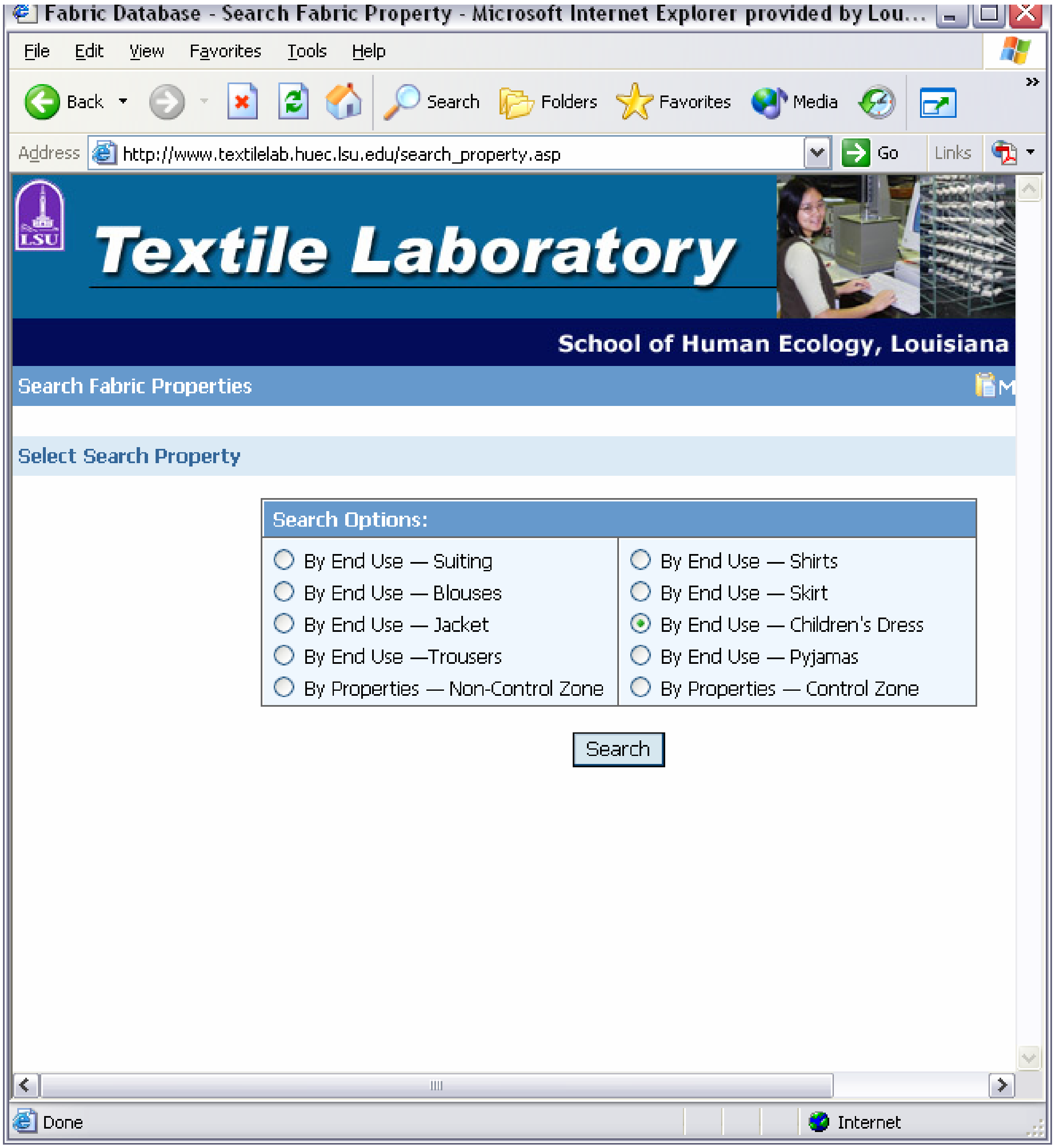


Figure 4-8 Criteria Search User Interface

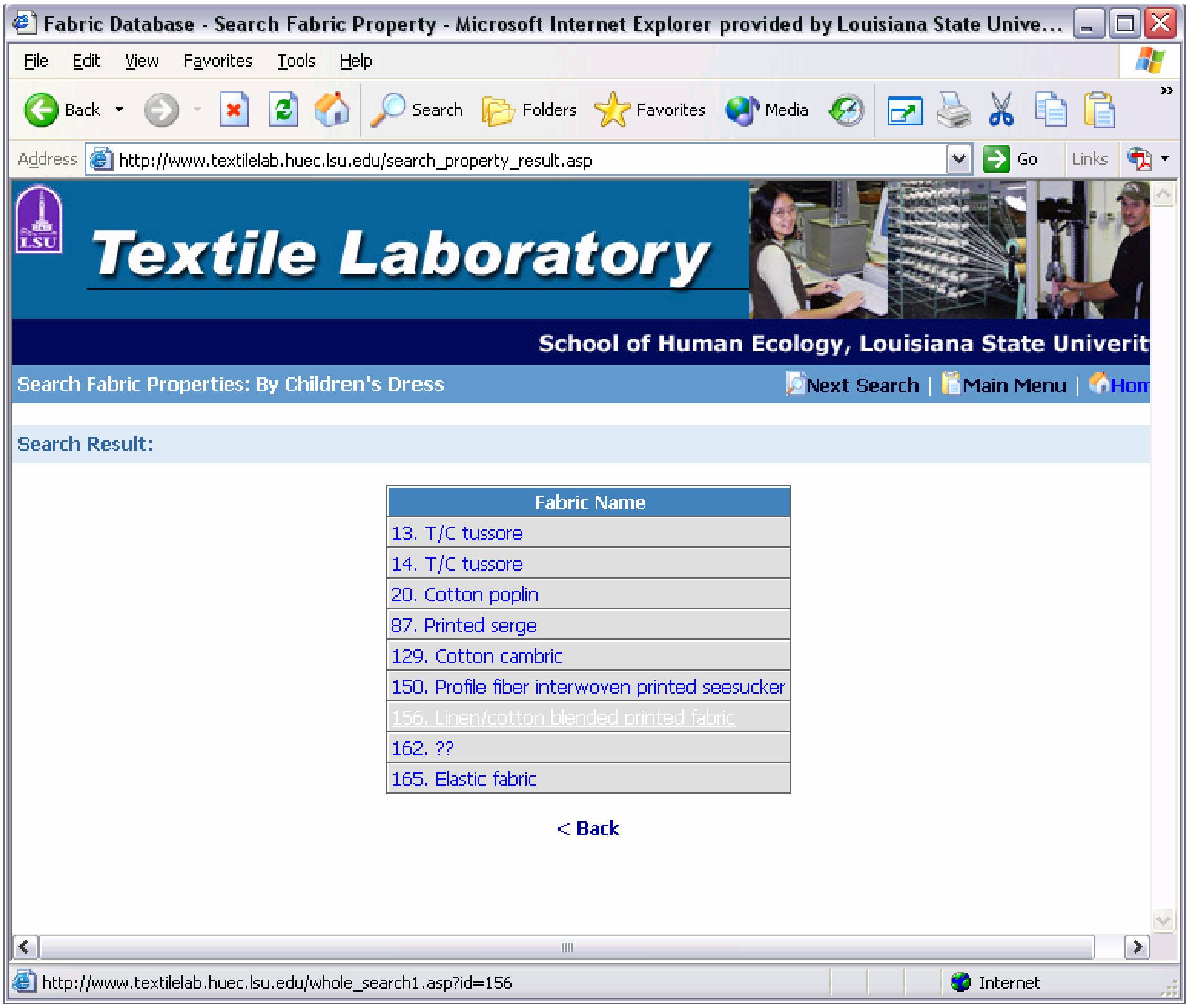


Figure 4-9 Criteria Search Result

4.2.2.3 Intelligent Search

Intelligent search is the most significant search process that was implemented for this project. This is because previous search methods are already commonly used for web-sites for similar purposes. In contrast to that, the intelligent search process is unique because it was created specifically for this project. It involves software programming and statistics as well as database management knowledge.

Using Fuzzy clustering technique, the fabric mechanical data and drape data is classified, and a pattern between drape coefficient and fabric mechanical data is discovered. This pattern can be used to predict fabric end-use property, which is the drape property in this research. Figure 4-10 displays a sample search process. The data for fabric number 1 is entered, and as it is displayed in figure 4-10, drape value is not known yet. Clicking Search box will run the intelligent search, and the result will be shown as in Figure 4-11.

Drape coefficient for this data set is predicted as 61.29 and calculated drape coefficient is 63.96. The accuracy for this sample is (61.29/63.96) × 100, which is 95.82.

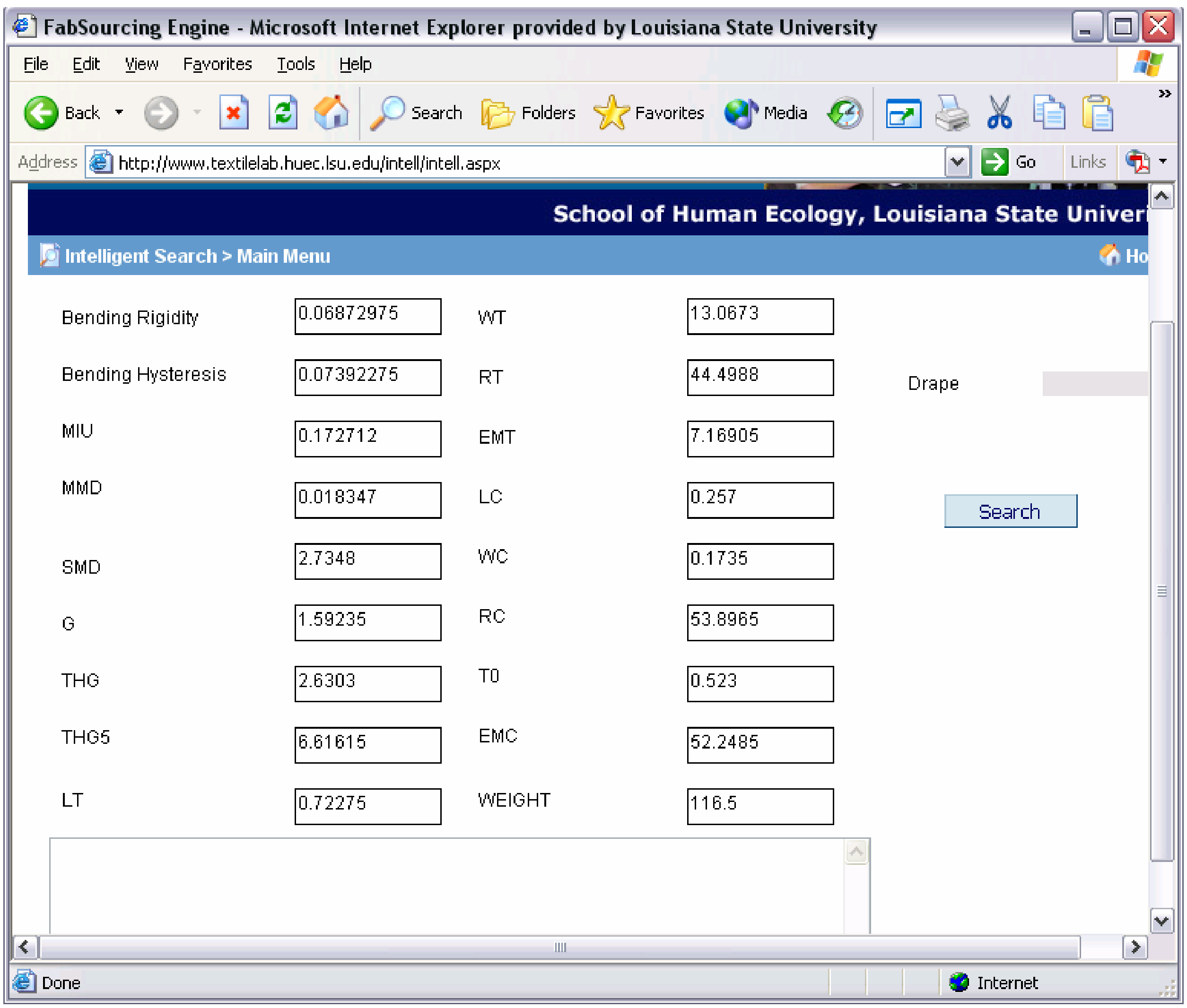


Figure 4-10 User Interface for Intelligent Search

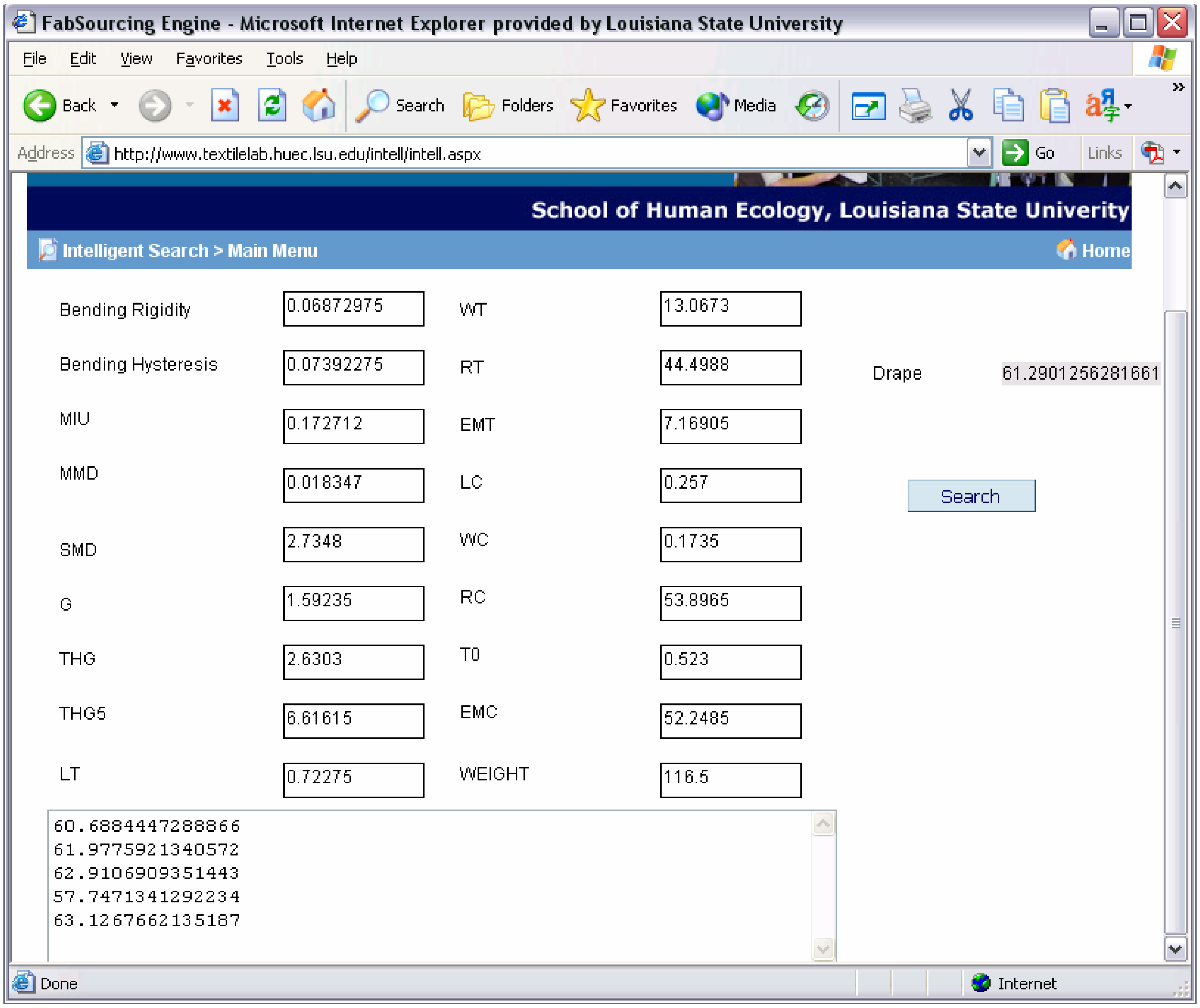


Figure 4-11 Intelligent Search Result

Randomly selected 5 set of data from Appendix A is tested to access accuracy of prediction technique. Each set of data is entered in and calculated result is compared with Cusick drape coefficient. The results are shown in Table 7.

Table 7 Comparison of Predicted Drape Coefficient with Measured Drape Coefficient

Sample #	Instrumental Drape Coefficient (Cusick result)	Predicted (Fully clustering technique)	Accuracy
1	63.96	61.29	95.83
46	44.84	43.13	96.19
94	72.39	65.50	90.49
141	70.84	65.27	92.13
187	89.97	85.78	95.34
Average			**94.00**

4.2.2.4 Fabric Display Property

The fabric display property is provided to allow users to display any property of any selected sample. The user first selects the fabric number and then selects the list of properties from the box next to the drop down fabric list box. Property subgroups are listed in this box at the right, and the user can select more than one property subgroup. This subgroup includes fabric mechanical properties, fabric drape property, draped image of fabric, fiber contents, and fabric structure. Drape image display can retrieve both a top-view still image and a side-view dynamic image of the draped fabric.

For instance, Figure 4-12 displays an example. Fabric number 189 is selected from the drop down list, and on the right hand side tensile, surface, shear and fiber contents are selected as subgroup properties. Clicking display button has brought up the window in Figure 4-13. The data is verified comparing it with the data in Appendix A.

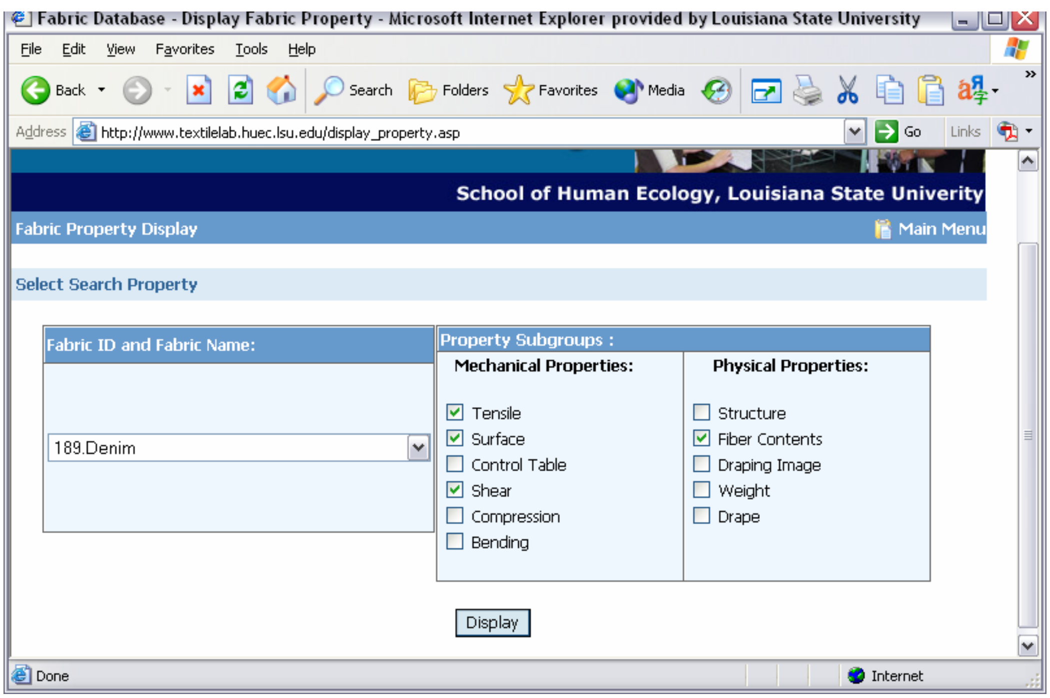


Figure 4-12 Fabric Display User Interface

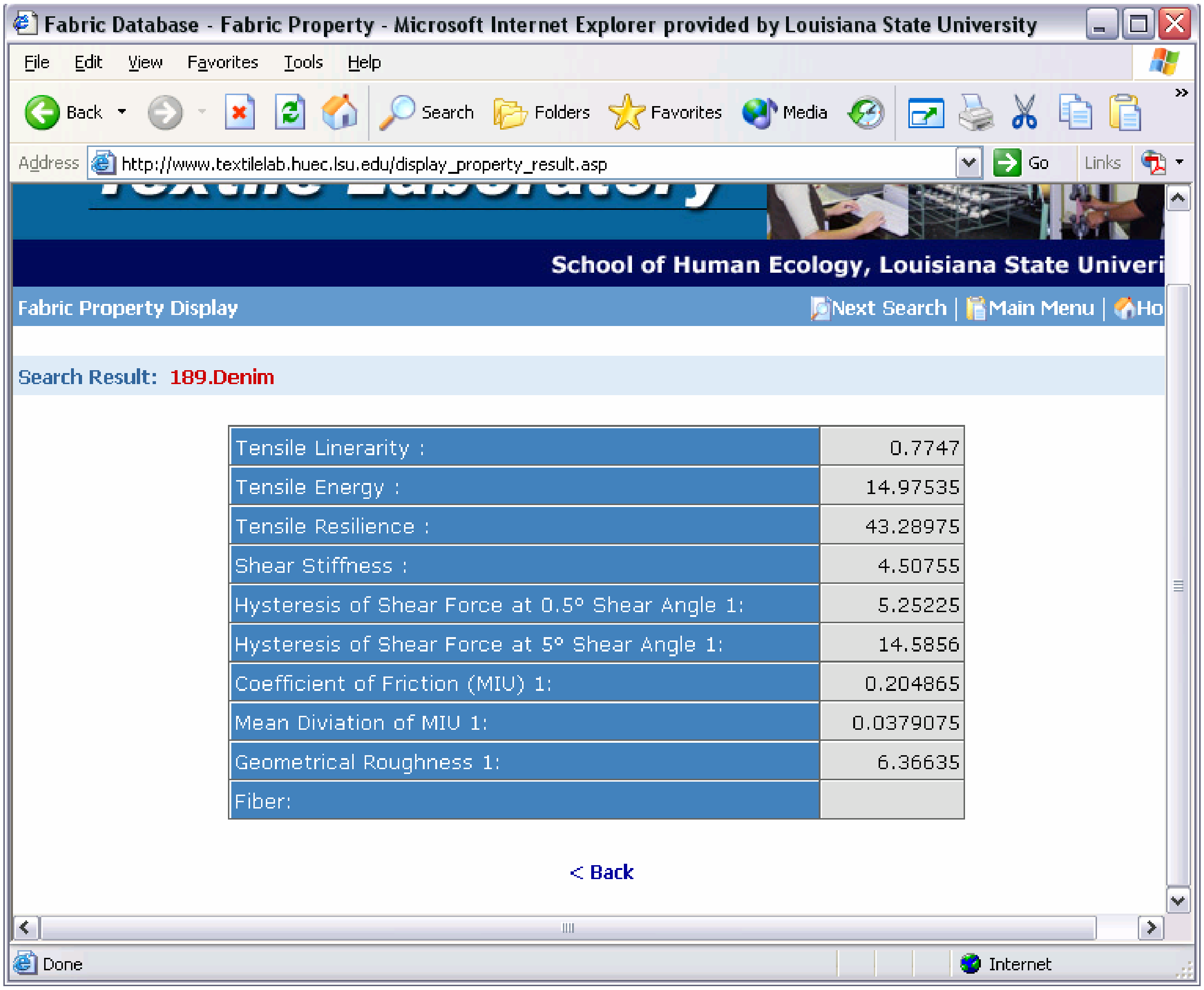


Figure 4-13 Fabric Display Result

A 5 second video for each sample is included in the database. Users can view a dynamic image by playing the 5-second video.

Chapter 5 Conclusions and Suggestions for Further Work

5.1 Conclusions

Mechanical properties of 185 commercial apparel fabrics were evaluated using the Kawabata KES-FB instruments. Drape property for these fabric samples was also evaluated. The correlation between the fabric mechanical properties and drape coefficient was studied using regression analysis. It is found that 9 out of 18 parameters are significantly correlated with fabric drape property. These 9 parameters are bending hysteresis (2HB), mean frictional coefficient (MIU), shearing stiffness (G), tensile resilience (RT), compressional energy (WC), compressional resilience (RC), fabric thickness (To), compression rate (EMC), and weight (W).

While testing the samples, a new method to measure drape coefficient using Photo Shop was developed. Instead of weighing fabric, the area is used to calculate the drape coefficient. The accuracy of the new method is 99.39%. With Photo Shop testing, the need for using a paper ring is no longer needed in measuring the drape coefficient. Time for cutting paper ring was saved, and the chance for human error during the test was reduced.

Along with the fabric mechanical data, still and dynamic drape images of fabrics were used to create an on-line fabric database. A search engine web-site has been published on the Internet. This web-site allows users to search this fabric database. A challenging part of the search process was fuzzy linear clustering, which could predict fabric drape from fabric mechanical properties. The new database search engine and web interface for the database was verified and tested by running various search queries. The accuracy for predicting fabric drape reached 94%. Use of fuzzy linear clustering was an efficient method to predict fabric end-use properties.

5.2 Suggestions for Further Work

1. The number of samples to train the fuzzy cluster model needs to be increased, so that the prediction can be made more accurate.
2. Since this research is focused only on the technical aspect of the issue, user surveys will help to understand better the needs of the market, and help improve the web interface.
3. The parameters used in this research are not commonly used in the market to evaluate fabric end-use properties such as fabric hand and tailorability. Further studies to introduce the Kawabata System to the market will help the clothing and retailing industries in upgrading production technologies and IT applications.
4. The model established in this research for predicting fabric drape from fabric mechanical parameters can be applied to other fabric end-use properties. Fabric hand and tailorability are two of the most interesting end-use properties.
5. The inter-relationship among fabric mechanical properties should also be investigated, in order to find if there are some parameters that show strong linear correlations among them. Linearly related parameters involve redundant parameters that can be removed from the database.

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Appendix

A: Kawabata Test Result for 185 Fabric Samples

Fabric_ID	B	2HB	MIU	MMD	SMD	G	2HG	2HG5	LT
1	0.069	0.074	0.173	0.018	2.735	1.592	2.630	6.616	0.723
2	0.047	0.036	0.178	0.034	3.085	1.236	1.619	5.337	0.765
3	0.064	0.056	0.159	0.034	2.384	3.662	2.984	7.428	0.898
4	0.179	0.308	0.188	0.061	5.359	3.455	10.538	12.731	0.723
5	0.190	0.224	0.166	0.033	3.079	2.713	5.204	10.106	0.796
7	0.154	0.222	0.186	0.016	2.336	1.479	3.083	6.876	0.631
8	0.255	0.416	0.189	0.017	1.914	3.253	8.273	12.894	0.699
10	0.316	0.529	0.216	0.015	2.007	3.795	10.020	15.458	0.792
11	0.266	0.330	0.190	0.024	7.052	1.807	3.283	8.903	0.765
12	0.408	0.902	0.218	0.022	2.632	6.316	14.367	24.496	0.788
13	0.163	0.100	0.172	0.055	4.058	3.520	2.590	6.978	0.844
14	0.094	0.125	0.173	0.046	4.013	3.475	5.312	11.712	0.778
15	0.041	0.054	0.190	0.024	2.774	0.848	2.235	4.132	0.650
16	0.067	0.083	0.169	0.027	5.460	1.236	2.867	4.497	0.798
17	0.083	0.120	0.195	0.018	1.725	1.639	4.741	6.588	0.690
18	0.109	0.148	0.198	0.025	2.892	1.320	3.493	6.363	0.762
19	0.065	0.078	0.181	0.025	3.641	1.669	3.389	6.712	0.658
20	0.054	0.066	0.171	0.029	1.954	1.961	3.603	7.474	0.755
21	0.415	0.584	0.203	0.014	2.085	3.756	9.792	15.786	0.810
22	0.173	0.206	0.194	0.015	1.333	2.115	5.200	5.071	0.773
23	0.079	0.097	0.144	0.023	2.277	3.637	5.225	9.403	0.742
24	0.111	0.105	0.165	0.013	2.969	2.608	2.822	7.018	0.747
25	0.095	0.111	0.203	0.020	2.312	2.518	4.729	10.243	0.765
26	0.155	0.106	0.179	0.073	5.071	0.641	1.048	2.866	0.809
27	0.026	0.027	0.183	0.023	1.394	0.464	0.737	1.313	1.272
28	0.060	0.113	0.155	0.015	2.640	2.126	4.917	4.496	2.492
29	0.218	0.238	0.207	0.020	1.867	2.994	3.952	13.138	0.801
30	0.321	0.425	0.195	0.020	1.427	3.711	8.064	14.709	0.707
31	0.042	0.034	0.156	0.017	3.616	1.261	2.062	5.660	0.737
32	0.058	0.052	0.162	0.014	1.539	0.983	1.965	4.474	0.707
33	0.055	0.039	0.511	0.015	2.084	0.431	0.710	1.508	0.821
34	0.026	0.029	0.188	0.021	2.110	1.292	4.425	6.810	0.738
35	0.111	0.066	0.250	0.022	2.201	1.474	1.462	3.270	0.603
36	0.066	0.056	0.407	0.019	2.444	0.418	0.716	1.454	0.860
37	0.110	0.133	0.259	0.047	2.456	1.236	5.200	7.197	0.645
38	0.031	0.027	0.212	0.009	1.247	0.539	0.938	1.905	0.738
39	0.245	0.038	0.257	0.010	1.161	0.726	1.072	3.201	0.768
40	0.027	0.023	0.240	0.020	2.058	0.679	0.865	2.402	0.706
41	0.147	0.106	0.277	0.014	2.927	0.706	2.014	2.812	0.918
42	0.124	0.113	0.435	0.022	1.883	0.848	2.155	4.053	0.918
43	0.074	0.051	0.293	0.012	2.593	0.758	1.472	3.429	0.761
44	0.108	0.028	0.231	0.063	8.950	0.552	0.494	1.147	0.570
45	0.091	0.016	0.203	0.016	2.194	0.471	0.278	0.721	0.555
46	0.060	0.015	0.159	0.017	2.765	0.497	0.306	0.889	0.597
47	0.073	0.020	0.194	0.018	3.351	0.556	0.589	1.131	0.616
48	0.076	0.014	0.184	0.018	2.178	0.608	0.395	1.292	0.589
49	0.065	0.015	0.165	0.015	1.924	0.569	0.338	0.994	0.677
50	0.036	0.021	0.178	0.019	2.231	0.596	0.405	1.052	0.663
51	0.088	0.022	0.176	0.023	3.642	0.463	0.525	1.005	0.592
52	0.080	0.020	0.174	0.044	5.455	0.638	0.405	0.973	0.547
53	0.090	0.024	0.187	0.027	2.554	0.639	0.474	1.253	0.547
54	0.150	0.044	0.136	0.020	1.812	0.989	0.598	1.978	0.799

Fabric_ID	B	2HB	MIU	MMD	SMD	G	2HG	2HG5	LT
55	0.127	0.059	0.208	0.025	11.242	0.462	0.835	1.373	0.778
56	0.084	0.018	0.237	0.042	7.309	0.306	0.289	0.474	0.515
57	0.126	0.044	0.181	0.020	2.102	0.557	0.897	1.757	0.612
58	0.062	0.018	0.221	0.045	5.936	0.686	0.583	1.255	1.189
59	0.084	0.032	0.220	0.041	6.412	0.418	0.550	1.270	0.601
60	0.067	0.018	0.157	0.013	1.483	0.744	0.484	1.516	0.603
61	0.064	0.019	0.194	0.043	8.803	0.589	0.587	1.459	0.690
62	0.577	0.678	0.235	0.022	2.766	4.131	5.847	16.331	0.718
63	0.888	1.175	0.184	0.017	2.102	3.961	7.782	21.411	0.542
64	0.174	0.202	0.267	0.021	1.563	1.767	3.909	9.960	0.814
65	0.123	0.186	0.198	0.024	5.553	2.112	4.748	8.123	0.607
67	0.140	0.207	0.185	0.031	4.618	2.230	4.830	9.570	0.719
68	0.199	0.199	0.167	0.011	1.851	3.078	5.182	11.245	0.815
69	0.109	0.134	0.203	0.045	9.840	0.850	1.663	3.774	0.685
70	0.181	0.225	0.207	0.073	5.559	1.228	2.748	4.930	0.752
71	0.083	0.112	0.215	0.017	5.674	1.137	2.667	4.937	0.756
72	0.105	0.120	0.218	0.025	7.198	0.606	1.313	2.258	0.769
73	0.074	0.100	0.229	0.035	4.933	1.004	1.984	3.809	0.672
74	0.073	0.092	0.177	0.025	2.494	1.787	3.026	7.565	0.695
75	0.361	0.548	0.222	0.034	7.124	5.391	11.773	17.231	0.806
76	0.211	0.193	0.185	0.049	7.680	1.927	3.199	7.380	0.790
77	0.464	0.452	0.234	0.020	1.673	3.805	6.204	13.917	0.804
78	0.265	0.248	0.198	0.016	1.630	2.179	3.861	10.408	0.831
79	0.495	0.656	0.240	0.059	7.926	3.510	6.806	15.392	0.814
80	0.383	0.551	0.224	0.039	2.449	3.672	6.789	13.646	0.773
81	0.291	0.353	0.228	0.028	5.379	4.429	5.028	12.562	0.855
82	0.344	0.546	0.236	0.037	8.910	3.339	6.429	12.410	0.771
83	0.162	0.169	0.217	0.065	4.670	2.401	3.494	8.920	0.791
84	0.299	0.360	0.204	0.020	2.668	2.911	4.968	8.278	0.827
85	0.113	0.106	0.187	0.016	1.484	1.105	1.795	5.175	0.806
86	0.307	0.273	0.171	0.034	2.227	1.626	1.961	7.296	0.799
87	0.075	0.065	0.206	0.019	3.353	0.526	0.906	1.935	0.708
88	0.253	0.180	0.182	0.055	6.209	0.892	0.859	4.006	0.687
89	0.105	0.074	0.230	0.062	7.457	0.606	0.696	2.180	0.660
90	0.318	0.230	0.168	0.022	3.013	3.395	8.578	7.178	2.807
91	0.056	0.062	0.194	0.038	4.751	0.885	1.788	4.001	0.710
92	0.035	0.033	0.194	0.035	2.919	0.840	1.533	4.059	0.722
93	0.049	0.043	0.208	0.036	3.153	1.206	1.740	5.290	0.735
94	0.083	0.132	0.184	0.019	3.465	2.227	6.118	4.621	2.652
95	0.150	0.086	0.186	0.053	5.890	0.577	0.830	2.600	0.830
96	0.156	0.097	0.158	0.026	5.365	0.643	0.989	2.950	0.741
97	0.205	0.322	0.209	0.037	6.121	1.702	4.406	8.119	0.782
98	1.419	0.919	0.159	0.020	1.869	3.947	3.676	17.207	0.775
100	0.101	0.073	0.205	0.045	3.488	1.977	2.518	4.778	0.707
101	0.392	0.417	0.168	0.054	4.768	3.816	7.183	16.220	0.745
102	0.098	0.068	0.159	0.071	4.973	2.370	2.526	4.545	0.682
103	0.116	0.144	0.208	0.021	2.001	1.446	3.042	7.197	0.754
104	0.201	0.302	0.210	0.020	1.797	2.556	6.624	11.127	0.831
105	0.106	0.127	0.201	0.066	4.745	2.231	3.702	8.345	0.727
106	0.269	0.341	0.182	0.014	2.040	3.450	8.260	15.092	0.702
107	0.218	0.299	0.184	0.034	5.273	3.895	5.109	10.588	0.762
108	0.050	0.072	0.212	0.025	5.545	1.050	1.880	4.452	0.682
109	0.084	0.120	0.201	0.031	4.832	1.488	3.014	6.063	0.752
110	0.144	0.211	0.229	0.018	1.721	1.402	2.513	6.335	0.738
111	0.372	0.436	0.169	0.011	1.790	3.118	5.531	13.136	0.749
112	0.192	0.289	0.212	0.065	4.815	2.666	5.965	9.318	0.735
113	0.269	0.305	0.313	0.083	4.593	5.454	11.133	14.462	0.934

Fabric_ID	B	2HB	MIU	MMD	SMD	G	2HG	2HG5	LT
114	0.296	0.447	0.206	0.019	2.213	3.259	6.054	12.876	0.787
115	0.306	0.453	0.209	0.018	2.464	4.029	8.580	14.494	0.747
116	0.360	0.294	0.226	0.031	2.248	1.064	1.472	4.907	0.839
117	0.395	0.511	0.204	0.016	2.269	2.062	3.752	9.340	0.725
118	0.119	0.149	0.219	0.023	1.806	2.042	4.319	8.842	0.746
119	0.104	0.141	0.190	0.023	1.427	1.761	4.243	7.987	0.744
120	0.163	0.121	0.211	0.016	1.414	0.759	1.165	3.250	0.630
121	0.030	0.012	0.221	0.015	1.478	0.444	0.637	1.562	0.755
122	0.059	0.008	0.215	0.016	2.984	0.362	0.258	0.581	1.877
123	0.059	0.019	0.234	0.018	4.562	0.580	1.102	2.630	0.726
124	0.061	0.057	0.160	0.018	2.421	1.603	2.334	4.505	0.716
125	0.076	0.062	0.178	0.020	3.128	1.939	1.977	2.930	1.276
126	0.056	0.060	0.169	0.017	3.621	1.475	1.992	3.808	1.339
127	0.264	0.262	0.212	0.012	1.399	2.379	6.391	5.874	2.782
128	0.163	0.205	0.227	0.021	2.711	1.803	3.368	6.031	0.678
129	0.018	0.013	0.220	0.027	2.170	0.343	0.493	0.749	1.181
130	0.085	0.053	0.160	0.038	2.239	5.323	3.130	7.321	0.813
131	0.061	0.038	0.139	0.017	3.383	1.137	1.239	2.777	0.734
132	0.059	0.048	0.187	0.017	1.416	0.509	0.790	1.202	0.815
133	0.090	0.063	0.188	0.012	2.012	0.759	1.166	1.771	2.311
134	0.099	0.083	0.166	0.011	1.721	2.577	3.805	7.546	0.816
135	0.097	0.082	0.184	0.017	2.164	2.041	3.145	6.444	0.792
136	0.057	0.077	0.159	0.013	1.354	1.555	2.564	4.002	0.775
137	0.047	0.069	0.129	0.012	1.260	4.097	6.858	9.109	0.867
138	0.081	0.110	0.138	0.010	1.458	3.869	6.079	10.557	0.803
139	0.123	0.134	0.185	0.081	5.786	3.545	4.255	11.580	0.726
140	0.065	0.077	0.151	0.010	1.529	1.340	1.692	3.887	0.822
141	0.079	0.087	0.155	0.026	5.138	2.501	3.995	3.512	2.268
142	0.045	0.062	0.143	0.015	1.397	3.435	5.072	7.077	0.786
143	0.053	0.069	0.170	0.027	3.036	2.314	3.177	6.733	0.741
144	0.090	0.110	0.130	0.023	2.237	4.275	4.984	8.838	0.733
145	0.072	0.114	0.152	0.011	1.547	3.001	4.911	8.407	0.728
146	0.126	0.133	0.196	0.067	7.615	1.519	2.000	6.245	0.805
147	0.046	0.047	0.200	0.015	2.120	0.416	0.768	1.257	0.565
148	0.049	0.038	0.203	0.055	1.438	0.540	0.785	1.408	0.608
149	0.036	0.024	0.187	0.035	4.949	0.577	0.840	1.913	0.624
150	0.044	0.043	0.183	0.028	5.408	0.419	0.726	1.332	0.682
151	0.050	0.039	0.240	0.038	7.583	0.428	0.697	1.208	0.590
152	0.054	0.060	0.201	0.025	3.676	0.997	1.841	2.458	2.190
153	0.027	0.022	0.210	0.033	1.873	0.476	0.826	2.122	1.261
154	0.083	0.104	0.220	0.020	3.015	2.743	4.630	5.715	1.498
155	0.138	0.064	0.185	0.042	5.133	0.287	0.106	0.533	0.639
156	0.121	0.057	0.192	0.050	8.854	1.184	1.461	3.510	0.617
157	0.109	0.112	0.247	0.038	7.502	0.480	1.064	1.408	10.304
158	0.068	0.075	0.256	0.051	6.280	0.416	0.780	1.072	2.407
159	0.081	0.094	0.207	0.053	5.790	1.270	2.733	5.826	0.690
160	0.052	0.065	0.231	0.019	3.476	0.486	1.032	1.589	0.645
161	0.124	0.143	0.193	0.040	4.649	0.447	0.970	1.618	0.615
162	0.039	0.042	0.208	0.044	3.403	0.416	0.692	1.128	0.576
163	0.055	0.032	0.209	0.071	7.804	0.462	0.597	1.210	0.564
164	0.086	0.030	0.202	0.058	7.698	0.306	0.192	0.537	0.670
165	0.041	0.045	0.178	0.016	3.902	1.244	1.816	3.224	2.456
166	0.036	0.033	0.183	0.020	3.332	0.814	1.421	2.566	0.647
167	0.130	0.128	0.184	0.045	4.469	2.767	3.631	9.668	0.785
168	0.266	0.658	0.168	0.014	2.045	2.794	12.322	9.647	2.638
169	0.169	0.213	0.184	0.045	1.960	3.077	5.022	11.273	0.715
170	0.067	0.022	0.243	0.036	7.845	0.457	0.622	1.868	0.762

Fabric_ID	B	2HB	MIU	MMD	SMD	G	2HG	2HG5	LT
171	0.123	0.058	0.286	0.014	1.232	0.354	0.389	0.859	1.238
172	0.277	0.207	0.423	0.015	1.995	0.374	0.493	0.888	0.917
173	0.914	0.630	0.184	0.033	3.542	2.942	2.623	8.874	0.697
174	1.065	0.883	0.156	0.028	4.096	3.614	4.020	11.190	0.793
175	0.579	0.540	0.191	0.026	2.668	3.201	5.175	7.567	2.874
176	0.348	0.239	0.214	0.022	4.623	1.360	1.812	3.834	2.425
177	0.963	0.688	0.153	0.025	3.429	3.081	2.610	9.903	0.726
178	0.728	0.561	0.195	0.025	4.266	8.943	9.989	21.869	0.795
179	1.100	0.772	0.185	0.048	5.239	5.094	5.043	15.902	0.821
180	0.730	0.653	0.185	0.032	5.649	2.473	2.842	8.901	0.775
181	1.041	1.203	0.182	0.025	5.818	5.337	9.136	13.414	2.966
182	0.984	0.773	0.197	0.036	4.994	2.956	3.222	9.531	0.703
183	1.439	1.030	0.209	0.034	4.314	7.513	12.828	18.126	2.988
184	1.031	0.798	0.195	0.028	3.141	5.356	7.051	12.899	2.794
185	1.658	1.098	0.207	0.039	4.112	5.601	7.792	12.664	3.052
186	1.403	0.938	0.185	0.031	4.032	4.026	4.916	10.065	2.727
187	1.344	0.938	0.197	0.034	4.516	8.019	9.055	23.421	0.831
188	0.485	0.339	0.190	0.038	4.566	1.674	1.944	5.777	0.673
189	1.455	1.096	0.205	0.038	6.366	4.508	5.252	14.586	0.775

Appendix A Continues: Variables from WT to Drape

Fabric_ID	WT	RT	EMT	LC	WC	RC	To	EMC	Weight	Drape
1	13.067	44.499	7.169	0.257	0.174	53.897	0.523	52.249	116.500	63.957
2	13.315	38.183	6.979	0.244	0.140	55.946	0.440	52.305	97.125	55.579
3	7.849	64.084	3.497	0.313	0.132	57.584	0.406	41.481	128.000	67.894
4	9.890	55.583	5.620	0.304	0.190	38.553	0.637	39.470	184.875	81.900
5	14.354	38.945	7.219	0.235	0.176	46.792	0.712	42.365	186.625	78.240
7	11.728	45.849	7.490	0.281	0.191	39.160	0.686	39.825	179.813	73.262
8	11.996	44.140	6.965	0.226	0.199	45.836	0.835	43.611	228.125	79.714
10	10.871	43.271	5.493	0.261	0.273	41.899	0.980	42.693	270.875	83.192
11	13.972	42.440	7.361	0.347	0.192	32.005	0.837	26.374	232.250	75.846
12	13.961	37.357	7.123	0.261	0.265	41.031	1.139	36.112	337.750	86.392
13	8.684	63.451	4.116	0.390	0.224	42.642	0.581	39.538	175.125	74.416
14	8.428	57.418	4.326	0.330	0.205	36.457	0.642	39.098	181.750	68.588
15	17.312	46.090	11.048	0.302	0.172	41.703	0.502	45.103	99.375	63.358
16	13.163	53.552	6.826	0.316	0.210	48.648	0.623	42.835	140.375	62.682
17	14.862	46.785	8.565	0.329	0.193	52.991	0.564	41.669	144.000	67.139
18	11.828	47.379	6.609	0.326	0.211	44.264	0.614	42.169	143.750	62.639
19	14.969	42.411	9.028	0.278	0.180	37.532	0.504	51.297	118.000	66.394
20	14.338	44.442	7.600	0.307	0.164	40.169	0.438	49.096	104.375	63.116
21	11.920	42.752	5.960	0.260	0.274	43.975	0.958	44.097	255.375	83.435
22	15.806	40.145	8.100	0.299	0.121	34.791	0.519	31.031	170.875	76.289
23	12.732	45.454	6.810	0.361	0.180	39.722	0.448	44.573	136.750	68.354
24	12.741	49.249	6.557	0.272	0.227	42.674	0.579	57.037	119.875	72.213
25	11.832	49.642	6.158	0.248	0.238	42.461	0.696	56.313	137.125	72.039
26	10.551	49.495	5.436	0.320	0.130	35.288	0.457	35.421	119.500	70.209
27	3.985	56.738	3.284	0.309	0.158	45.857	0.427	47.675	69.625	48.650
28	7.010	60.727	4.330	0.291	0.151	48.038	0.466	45.302	128.000	69.420
29	7.828	53.610	3.915	0.246	0.172	47.046	0.703	39.704	219.500	71.961

Fabric_ID	WT	RT	EMT	LC	WC	RC	To	EMC	Weight	Drape
30	8.945	52.388	5.082	0.239	0.166	49.878	0.798	35.482	276.375	83.235
31	9.273	59.054	5.128	0.322	0.126	53.703	0.379	41.315	99.625	54.374
32	13.410	44.880	7.563	0.283	0.123	45.657	0.377	45.429	100.000	59.187
33	13.598	56.610	7.115	0.504	0.182	44.898	0.618	23.380	151.750	41.964
34	10.086	55.889	5.455	0.274	0.052	37.438	0.208	36.715	85.875	37.862
35	10.860	45.247	5.646	0.395	0.139	51.957	0.539	26.224	176.625	57.479
36	12.104	57.925	5.941	0.504	0.212	45.256	0.709	23.685	145.375	38.347
37	9.832	47.954	6.108	0.279	0.402	47.751	1.479	35.820	218.000	53.689
38	11.017	55.167	6.033	0.386	0.223	50.825	0.594	39.308	142.500	29.163
39	9.018	56.648	4.942	0.533	0.168	43.330	0.534	23.642	152.500	43.291
40	9.492	59.581	5.409	0.324	0.104	44.122	0.340	37.969	95.750	40.559
41	7.091	57.236	3.108	0.459	0.291	44.328	1.049	24.148	264.875	46.378
42	7.091	57.236	3.108	0.345	0.211	47.954	0.666	36.668	169.500	58.892
43	13.370	56.531	7.486	0.497	0.194	46.245	0.733	21.363	190.750	44.756
44	17.359	66.386	12.134	0.367	0.136	49.332	0.642	22.987	211.875	51.321
45	17.638	61.473	12.849	0.290	0.107	52.297	0.607	24.411	203.000	47.341
46	11.345	64.160	7.957	0.332	0.129	60.227	0.452	34.606	148.500	44.843
47	15.449	64.006	10.150	0.312	0.190	61.609	0.802	45.310	200.875	45.493
48	12.096	66.625	8.369	0.265	0.079	50.498	0.512	23.376	184.125	46.291
49	16.108	62.684	9.990	0.269	0.106	72.999	0.524	30.424	186.125	41.851
50	15.813	63.972	9.512	0.297	0.142	65.837	0.678	28.523	237.375	44.167
51	13.693	62.101	9.112	0.343	0.151	59.794	0.609	29.012	188.000	48.737
52	9.708	71.708	7.121	0.315	0.158	61.043	0.520	38.499	136.375	55.970
53	11.757	66.119	8.744	0.243	0.129	64.750	0.626	34.236	212.125	47.280
54	12.426	65.411	6.217	0.288	0.132	59.958	0.649	28.193	257.750	55.484
55	8.879	60.355	4.632	0.271	0.180	52.801	0.813	32.808	191.625	51.547
56	21.379	62.711	16.740	0.340	0.179	55.526	0.860	24.475	210.125	40.819
57	12.239	57.904	7.983	0.288	0.163	56.221	0.756	30.172	245.000	47.549
58	9.168	70.231	7.354	0.213	0.146	64.094	0.906	46.677	158.500	50.202
59	10.565	54.706	7.144	0.358	0.119	63.930	0.518	26.255	163.000	45.554
60	9.864	64.784	6.513	0.302	0.092	68.760	0.474	25.807	196.000	42.111
61	11.637	63.417	6.760	0.228	0.126	64.354	0.732	30.169	181.000	42.736
62	11.509	45.440	6.242	0.287	0.238	37.260	0.950	34.873	296.250	87.537
63	9.514	42.106	7.017	0.178	0.300	45.152	1.264	53.950	356.250	91.960
64	8.100	50.404	4.063	0.272	0.157	46.612	0.626	37.599	203.875	69.611
65	18.132	40.436	10.857	0.303	0.154	38.945	0.530	37.944	143.000	75.161
67	13.210	43.529	7.245	0.363	0.270	39.413	0.728	41.124	167.125	76.271
68	9.217	52.663	4.430	0.283	0.264	44.492	0.856	41.163	190.625	75.482
69	14.243	42.956	8.798	0.331	0.195	36.061	0.677	34.786	147.750	74.823
70	13.040	48.279	7.561	0.256	0.277	45.169	0.862	54.209	166.875	71.744
71	15.377	44.101	8.490	0.380	0.368	45.303	0.995	38.733	148.750	63.749
72	13.308	43.956	8.003	0.283	0.285	47.438	0.854	47.168	112.625	62.717
73	14.840	38.653	9.151	0.264	0.284	47.374	0.942	46.062	146.000	59.456
74	12.137	46.527	7.045	0.244	0.228	45.378	0.773	61.954	114.250	68.544
75	11.976	40.453	5.985	0.211	0.179	41.243	0.858	39.760	241.750	85.343
76	9.900	50.295	4.987	0.121	0.180	47.441	1.004	59.953	178.875	78.916
77	12.109	42.361	6.022	0.152	0.197	41.493	1.066	50.539	261.125	84.432
78	11.150	42.924	5.303	0.240	0.217	48.200	0.724	49.891	169.750	83.467

Fabric_ID	WT	RT	EMT	LC	WC	RC	To	EMC	Weight	Drape
79	9.779	46.749	4.788	0.248	0.212	37.975	1.049	32.782	289.500	86.427
80	11.471	43.786	5.828	0.282	0.200	37.445	0.847	33.820	256.750	85.195
81	12.639	42.637	5.882	0.304	0.224	39.607	0.836	35.631	249.750	83.175
82	11.888	41.668	6.198	0.255	0.304	40.977	1.070	45.171	250.375	88.083
83	11.433	47.335	5.807	0.259	0.260	49.158	0.791	53.352	161.875	74.546
84	24.273	45.772	12.087	0.280	0.216	37.385	0.818	37.646	228.750	84.684
85	10.595	49.158	5.211	0.315	0.219	51.309	0.581	48.023	125.000	74.190
86	11.162	52.491	5.701	0.283	0.189	51.943	0.587	45.661	151.500	82.455
87	12.424	41.668	6.987	0.177	0.237	51.819	0.898	60.671	115.000	60.038
88	13.468	41.443	7.587	0.277	0.248	43.728	0.384	46.867	178.000	74.884
89	19.282	41.046	12.609	0.270	0.207	48.008	0.626	49.128	125.875	60.011
90	5.897	59.143	3.549	0.204	0.235	47.783	0.735	62.723	140.875	80.122
91	11.205	53.579	6.752	0.254	0.141	47.924	0.535	41.411	128.750	58.181
92	9.932	53.764	5.494	0.266	0.152	51.455	0.465	49.155	90.625	52.266
93	8.685	58.051	4.672	0.320	0.121	50.937	0.367	43.955	98.875	56.299
94	8.308	59.165	5.165	0.241	0.166	54.039	0.554	49.812	138.125	72.386
95	10.379	48.418	5.465	0.283	0.211	46.286	0.616	48.811	116.250	74.381
96	13.633	41.287	7.753	0.215	0.232	49.157	0.744	57.732	128.375	71.684
97	12.983	42.774	6.623	0.308	0.260	39.022	0.980	34.419	239.750	77.069
98	9.590	53.822	5.081	0.261	0.235	46.044	0.983	38.676	340.250	90.763
100	10.269	63.587	5.787	0.265	0.089	30.883	0.319	25.858	161.000	61.442
101	7.580	53.792	4.104	0.235	0.156	40.242	0.688	38.714	230.625	82.481
102	9.110	67.447	5.329	0.322	0.163	42.431	0.550	36.701	179.125	64.217
103	8.908	53.694	4.831	0.315	0.206	45.522	0.658	39.736	182.125	63.835
104	10.936	51.105	5.395	0.330	0.194	43.826	0.694	33.829	221.125	72.742
105	8.225	56.655	4.521	0.318	0.178	50.523	0.551	40.372	164.375	66.784
106	8.098	52.839	4.593	0.190	0.202	38.576	0.921	46.395	264.875	75.196
107	13.581	48.883	7.176	0.261	0.219	40.511	0.775	44.346	202.875	83.955
108	17.289	43.819	10.554	0.209	0.231	47.505	0.878	52.300	106.500	62.274
109	17.518	45.477	9.942	0.269	0.142	36.403	0.557	38.051	139.750	68.128
110	12.136	48.633	6.946	0.209	0.231	47.507	0.878	52.300	177.000	73.462
111	12.057	49.151	6.379	0.219	0.249	43.275	1.022	52.389	234.250	82.368
112	12.148	47.364	6.560	0.243	0.277	42.423	0.915	51.832	202.500	77.165
113	12.521	47.793	5.484	0.149	0.280	46.913	1.123	69.939	176.250	83.027
114	11.990	45.311	6.031	0.267	0.223	49.736	0.860	38.259	222.875	80.729
115	12.160	46.340	6.504	0.323	0.180	34.448	0.754	29.595	266.500	85.880
116	9.849	51.249	4.871	0.375	0.202	45.275	0.588	36.511	152.750	80.816
117	12.195	43.580	7.087	0.251	0.248	39.995	0.978	41.064	251.000	80.053
118	13.269	48.375	7.236	0.368	0.207	49.041	0.491	49.688	123.000	72.074
119	13.177	45.647	6.996	0.335	0.196	43.869	0.532	43.735	141.250	73.722
120	6.716	55.007	4.209	0.379	0.183	51.889	0.474	41.193	137.500	54.929
121	9.659	57.704	5.126	0.444	0.108	52.994	0.359	27.333	90.625	35.512
122	1.390	90.647	2.963	0.512	0.133	59.896	0.530	19.666	157.500	39.431
123	6.564	60.059	3.949	0.526	0.191	63.502	0.604	24.013	159.000	40.533
124	12.635	51.109	6.924	0.303	0.247	50.161	0.609	56.816	119.125	62.795
125	4.629	65.583	4.337	0.331	0.142	44.224	0.399	43.184	118.125	64.226
126	6.218	59.163	5.321	0.347	0.152	50.263	0.421	41.104	123.375	62.734
127	6.370	61.603	3.893	0.294	0.168	39.837	0.746	30.776	247.125	72.239

Fabric_ID	WT	RT	EMT	LC	WC	RC	To	EMC	Weight	Drape
128	21.538	41.057	13.288	0.194	0.173	46.802	0.867	45.151	197.500	76.644
129	3.252	58.530	2.581	0.240	0.128	41.927	0.392	54.370	52.625	43.820
130	10.309	62.757	4.962	0.358	0.156	56.517	0.408	42.803	129.375	71.502
131	9.842	59.862	5.257	0.304	0.124	55.673	0.387	42.183	107.375	62.092
132	9.370	50.788	4.911	0.309	0.188	49.159	0.584	41.834	120.500	57.479
133	4.298	70.288	2.849	0.340	0.169	46.905	0.733	27.425	179.875	57.409
134	11.469	56.495	5.593	0.301	0.188	42.249	0.572	45.631	124.875	65.518
135	11.749	56.758	5.903	0.305	0.193	44.065	0.648	39.519	164.750	68.900
136	10.727	47.985	5.509	0.284	0.178	45.150	0.514	48.773	136.500	65.223
137	12.157	48.607	5.629	0.247	0.145	44.760	0.404	59.055	104.875	68.709
138	10.711	49.149	5.325	0.290	0.147	43.760	0.426	47.686	148.125	74.459
139	8.517	58.844	4.632	0.255	0.095	42.493	0.468	31.859	171.125	73.366
140	10.486	49.077	5.144	0.305	0.131	42.777	0.415	41.313	135.250	69.446
141	6.887	64.853	4.365	0.313	0.148	42.714	0.447	42.506	135.375	70.843
142	12.798	49.434	6.504	0.273	0.119	49.803	0.342	50.732	109.500	69.993
143	12.006	45.874	6.458	0.310	0.146	50.324	0.409	46.115	116.500	62.491
144	12.863	51.786	6.881	0.077	0.143	60.566	0.973	78.245	137.875	74.147
145	11.673	48.698	6.491	0.287	0.164	44.848	0.480	47.264	150.000	71.068
146	20.035	37.407	10.529	0.226	0.122	36.063	0.637	34.013	183.375	66.576
147	13.737	45.293	9.724	0.347	0.167	48.456	0.506	38.342	110.625	48.520
148	17.011	41.108	11.399	0.356	0.253	41.485	0.546	52.051	112.625	51.998
149	14.357	43.736	9.169	0.393	0.144	51.624	0.471	32.245	103.500	47.410
150	13.061	45.533	8.037	0.262	0.351	50.683	0.866	61.905	103.625	51.122
151	19.572	34.198	13.271	0.389	0.269	44.496	0.668	41.496	117.375	46.430
152	7.688	55.045	5.294	0.255	0.159	46.672	0.511	49.964	106.250	56.221
153	0.515	49.270	1.488	0.237	0.126	52.252	0.384	55.249	52.625	57.340
154	8.436	55.883	6.289	0.330	0.141	39.585	0.465	36.943	145.500	72.811
155	10.996	46.323	6.933	0.304	0.173	50.140	0.549	41.477	141.375	46.924
156	15.543	46.090	10.116	0.286	0.185	37.807	0.744	34.933	204.750	53.186
157	9.643	48.457	5.259	0.479	0.808	50.143	1.591	42.523	115.000	55.978
158	1.190	124.908	2.888	0.568	0.766	41.470	1.295	41.958	111.875	56.993
159	13.514	41.378	7.859	0.264	0.178	49.273	0.680	40.586	157.750	66.480
160	15.254	38.511	9.743	0.338	0.371	43.424	0.991	44.213	139.375	51.625
161	14.128	43.218	9.458	0.260	0.302	37.360	0.971	47.866	140.750	62.864
162	14.440	43.259	10.015	0.285	0.210	46.702	0.554	53.245	94.000	43.664
163	14.099	38.390	9.932	0.237	0.208	47.003	0.693	50.847	115.250	53.446
164	16.231	41.144	10.086	0.282	0.179	42.492	0.630	40.439	168.000	46.022
165	7.579	56.037	4.951	0.360	0.197	45.233	0.514	42.468	120.875	55.085
166	15.497	37.876	9.574	0.337	0.184	46.956	0.481	45.380	100.000	55.883
167	8.659	55.131	4.393	0.254	0.124	41.429	0.550	35.772	176.625	70.400
168	5.978	55.923	3.948	0.248	0.207	43.617	0.827	40.484	236.875	80.608
169	8.727	56.495	4.784	0.226	0.170	41.997	0.748	40.483	243.125	74.303
170	9.046	56.163	5.158	0.425	0.295	57.418	0.990	28.019	262.625	26.527
171	4.491	72.049	4.784	0.379	0.126	57.695	0.586	22.643	218.250	37.272
172	15.669	53.508	8.431	0.340	0.299	48.703	0.967	39.512	184.875	54.270
173	18.167	51.671	11.246	0.210	0.228	52.997	1.076	44.506	250.500	74.275
174	28.053	39.150	15.157	0.283	0.141	52.289	0.825	24.230	240.500	84.467
175	10.105	62.001	6.805	0.210	0.238	47.618	1.418	46.990	304.250	80.876

Fabric_ID	WT	RT	EMT	LC	WC	RC	To	EMC	Weight	Drape
176	12.691	53.318	7.331	0.164	0.337	44.352	0.924	59.224	268.875	72.221
177	17.711	47.316	10.117	0.196	0.264	55.760	1.386	49.423	248.250	78.743
178	17.968	40.249	9.024	0.068	0.187	61.190	1.926	57.319	357.750	88.976
179	18.573	40.436	8.590	0.095	0.171	60.862	1.591	51.589	308.500	84.753
180	17.197	38.173	8.789	0.223	0.163	49.667	0.939	31.049	244.625	80.200
181	5.143	63.662	2.670	0.149	0.204	61.877	1.467	44.553	335.250	91.301
182	19.889	39.648	11.414	0.185	0.146	49.230	0.979	32.842	250.000	82.498
183	12.393	54.389	5.317	0.053	0.250	54.610	2.448	78.173	335.000	90.806
184	7.402	57.192	3.769	0.097	0.249	57.653	1.792	65.463	272.875	89.037
185	12.099	52.905	5.214	0.091	0.220	42.970	1.673	61.461	279.375	90.893
186	12.509	53.292	5.520	0.140	0.175	51.787	1.406	52.466	240.125	82.455
187	9.861	46.273	4.759	0.063	0.266	57.231	2.382	69.844	390.750	89.974
188	14.708	45.024	8.768	0.233	0.105	42.922	0.750	23.913	207.375	75.625
189	14.975	43.290	7.703	0.113	0.220	56.935	1.695	48.836	310.000	82.975

B: End-use Subjective Classification of 185 Fabric Samples

Fabric_ID	Specification	Structure	Suit	Jacket	Trousers	Blouse	Shirt	Skirt	Child	Pajamas	Outer	Lining	Coat	Swimming Suit	Sportswear	Intimate	Interior, Bed & pillow
1	Cotton high density poplin	poplin					X										
2	T/C poplin (Trueran/Cotton)	poplin					X										
3	Down proof poplin	poplin															X
4	Cotton shirting						X										
5	Cotton half-drill	half-drill		X													
6	No Sample																
7	Cotton drill	drill			X												
8	Cotton drill	drill			X												
9	No Sample																
10	Cotton drill	drill			X												
11	Corduroy	corduroy		X													
12	Cotton drill	drill			X												
13	T/C tussore	tussore		X					X								
14	T/C tussore	tussore		X					X								
15	Cotton cambric	cambric					X										
16	Cotton cambric	cambric					X										
17	Cotton twill	twill			X												
18	Cotton plain cloth	plain			X												
19	Cotton poplin	poplin					X										
20	Cotton poplin	poplin					X		X								
21	Cotton tussore	tussore			X												
22	Cotton tussore	poplin			X												
23	Cotton high density poplin	poplin					X										
24	Sanded printing fabric					X											
25	Cotton/nylon fabric or cotton/rayon						X										
26	Cotton/ramie fabric					X											
27	Cotton poplin	poplin				X											
28	Ammine elastic poplin	poplin					X										
29	T/C drill	drill			X												
30	CVC				X												
31	T/C poplin	poplin					X										
32	Cotton high density poplin	poplin			X												
33	Moss suede			X													
34	Checked sharkskin						X										
35	Plain elastic fabric	plain					X										
36	Moss suede			X				X									
37	Wool-imitation fabric			X													
38	Peach-skin fabric			X	X		X										
39	Moss			X	X												

Fabric_ID	Specification	Structure	Suit	Jacket	Trousers	Blouse	Shirt	Skirt	Child	Pajamas	Outer	Lining	Coat	Swimming Suit	Sportswear	Intimate	Interior, Bed & pillow
40	Elastic fabric or stretched fabric						X										
41	Peach-skin fabric			X	X												
42	Suede			X	X												
43	Moss suede			X	X												
44	Wool valitin	valitin	X	X	X			X									
45	Wool gabardine	gabardine	X	X	X			X									
46	Wool /trueran tropical worsted		X	X	X			X									
47	Wool tweed	tweed	X	X	X			X									
48	W/T gabardine	gabardine	X	X	X			X									
49	Wool serge	serge	X	X	X			X									
50	Wool satin-back serge	satin-serge	X	X	X			X									
51	Wool gabardine	gabardine	X	X	X			X									
52	W/T valitin	valitin	X	X	X			X									
53	W/T satin-back serge	satin-serge	X	X	X			X									
54	Wool mopen	mopen	X	X	X			X									
55	T/W tweed	tweed	X	X	X			X									
56	Wool ladies cloth		X	X	X			X									
57	T/W tweed	tweed	X	X	X			X									
58	Wool lycra valitin	valitin	X	X	X			X									
59	Silk/wool tweed	tweed	X	X	X			X									
60	W/T mopen	mopen	X	X	X			X									
61	W/T tweed	tweed	X	X	X			X									
62	Cotton dyed drill	drill			X												
63	Cotton dyed drill	drill			X												
64	T/C dyeing drill	drill		X	X												
65	Chambray						X										
66	No Sample																
67	Sanded oxford	oxford					X										
68	T/C twill	twill			X												
69	Dyed coarse sheeting					X											
70	Dyed tussore	tussore					X										
71	Dyed one-side flannel	flannel				X				X							
72	Dyed one-side flannel	flannel				X				X							
73	Dyed one-side flannel	flannel				X				X							
74	Dyed cloth						X										
75	Dyed canvas	canvas			X												
76	Dyed checks			X													
77	Dyed drill	drill			X												
78	Dyed drill	drill			X												
79	Dyed corduroy	corduroy		X	X												
80	Dyed sateen	sateen		X	X												

Fabric_ID	Specification	Structure	Suit	Jacket	Trousers	Blouse	Shirt	Skirt	Child	Pajamas	Outer	Lining	Coat	Swimming Suit	Sportswear	Intimate	Interior, Bed & pillow
81	Sanded canvas	canvas			X												
82	Dyed canvas	canvas			X												
83	Dyed canvas	canvas			X		X										
84	Printed elastic drill	drill			X												
85	Filling sateen	sateen				X		X									
86	Twill fabric	twill				X											
87	Printed serge	serge				X			X	X							
88	Printed linen					X											
89	Printed linen					X											
90	Printed elastic poplin	poplin				X											
91	Bleached T/C fabric						X										
92	Dyed T/C fabric						X										
93	Dyed T/C poplin	poplin					X										
94	Dyed elastic poplin	poplin					X										
95	Ramie fabric					X											
96	Ramie-cotton fabric					X											
97	Reverse napping fabric			X	X												
98	Ramie drill	drill			X												
99	No Sample																
100	Dyed waterproof plain fabric T/C	plain					X										
101	T/C dyed drill	drill		X	X												
102	Dyed waterproof T/C tussore	tussore		X	X						X						
103	Dyed T/C sanded drill	drill			X												
104	Dyed sanded drill CVC	drill			X												
105	Dyed T/C tussore	tussore					X										
106	Dyed T/C drill	drill			X												
107	Coarse sheeting						X										
108	Dyed fabric						X										
109	Dyed fabric					X											
110	Dyed drill	drill			X												
111	Dyed drill	drill			X												
112	Dyed sanded canvas	canvas			X												
113	Two-color tussore	tussore		X	X						X						
114	Dyed sanded drill	drill			X												
115	Dyed sanded drill	drill			X												
116	Dyed twill	twill		X	X												
117	Dyed drill	drill			X												
118	Dyed twill	twill			X												
119	Dyed twill	twill					X										
120	Trueran/ Terylene/Dacron						X										
121	Trueran/ Terylene/Dacron						X										

Fabric_ID	Specification	Structure	Suit	Jacket	Trousers	Blouse	Shirt	Skirt	Child	Pajamas	Outer	Lining	Coat	Swimming Suit	Sportswear	Intimate	Interior, Bed & pillow
122	Trueran/ Terylene/Dacron					X											
123	Trueran/ Terylene/Dacron					X											
124	Cotton printed poplin	poplin				X											
125	C/T Ammine elastic poplin	poplin					X										
126	Cotton ammine elastic poplin	poplin					X										
127	Nylon/cotton elastic fabric				X												
128	Cotton ammine drill	drill			X												
129	Cotton cambric	cambric				X			X								
130	T/C sanded waterproof fabric						X										
131	T/C fabric						X										
132	Cotton printed filling sateen	sateen			X												
133	C/T sateen elastic fabric	sateen			X												
134	Cotton/nylon fabric						X										
135	Cotton/nylon fabric						X										
136	Cotton satin down proof fabric	sateen															X
137	Cotton down proof fabric																X
138	Cotton check																X
139	T/C dyed fabric			X	X												
140	Cotton check																X
141	Cotton ammine elastic poplin	poplin					X										
142	Cotton down proof fabric						X										
143	Cotton poplin	poplin					X										
144	Cotton down proof fabric																X
145	Cotton satin	sateen															X
146	Linen			X	X												
147	Cotton combed colored woven chevron					X											
148	Herringbone twill	twill					X										
149	Cotton/tencel jacquard poplin	jacquard poplin					X										
150	Profile fiber interwoven printed seesucker	seesucker							X								
151	Antimycotic ergosterol fiber fabric					X											
152	Ammine filling elastic printed poplin	poplin					X										
153	Cotton combed high density cambric	cambric				X											
154	Ammine filling elastic printed poplin	poplin				X											
155	Linen/viscose blended printed fabric					X											
156	Linen/cotton blended printed fabric								X								
157	Cotton/ammine crepe	crepe				X											

Fabric_ID	Specification	Structure	Suit	Jacket	Trousers	Blouse	Shirt	Skirt	Child	Pajamas	Outer	Lining	Coat	Swimming Suit	Sportswear	Intimate	Interior, Bed & pillow
158	Cotton willow crepe	crepe				X											
159	Cotton oxford	oxford					X										
160	Explanation?									X							
161	Cotton double side fabric																X
162	??					X			X								
163	Linen							X									
164	Ramie/cotton shimmer fabric						X										
165	Elastic fabric								X								
166	Cotton chambray	chambray					X										
167	?	denim					X										
168	?	denim			X												
169	?	denim			X												
170	?	denim		X			X										
171	?	denim								X							
172	?	denim		X				X									
173	Denim	denim		X	X			X									
174	Denim	denim		X	X			X									
175	Denim	denim		X	X			X									
176	Denim	denim		X	X			X									
177	Denim	denim		X	X			X									
178	Denim	denim			X												
179	Denim	denim			X			X									
180	Denim	denim			X			X									
181	Denim	denim			X												
182	Denim	denim			X			X									
183	Denim	denim			X												
184	Denim	denim		X	X			X									
185	Denim	denim		X	X			X									
186	Denim	denim		X	X			X									
187	Denim	denim			X												
188	Denim	denim		X	X			X									
189	Denim	denim		X	X			X									

C: Structural Information of 185 Fabric Samples

Fabric_ID	Fabric Name	Width (inch)	Content	Yarn Count	Cloth Count	Manufacturer
1	Cotton high density poplin	44		80/2 x 80/2	133 x 72	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
2	T/C poplin (Trueran/Cotton)	44		45 x45	110x76	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
3	Down proof poplin	44		45 x 45	139 x 94	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
4	Cotton shirting	42		14x14	60x60	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
5	Cotton half-drill	44		42/2 x 16	94x48	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
7	Cotton drill	44		20 x 20	108 x 58	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
8	Cotton drill	44		20x 16	128 x 60	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
10	Cotton drill	44		16x 12	108 x 56	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
11	Corduroy	47		20x 16	122 x 60	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
12	Cotton drill	58		7x7	70 x 42	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
13	T/C tussore	44		45/2 x 45/2	101 x55	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
14	T/C tussore	44		20x20	100 x 56	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
15	Cotton cambric	44		30 x 30	68 x 68	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
16	Cotton cambric	44		20x 20	60x60	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
17	Cotton twill	44		32 x 32	130 x 70	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
18	Cotton plain cloth	44		24x24	96x64	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
19	Cotton poplin	44		40x40	133 x 72	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd

Fabric_ID	Fabric Name	Width (inch)	Content	Yarn Count	Cloth Count	Manufacturer
20	Cotton poplin	44		50 x 50	140 x 88	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
21	Cotton tussore	44		36/2 x 24/2	114x57	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
22	Cotton tussore	44		60/2 x 60/2	144 x 76	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
23	Cotton high density poplin	44		40x40	133 x 100	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
24	Sanded printing fabric	57		40x40	133 x 72	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
25	Cotton/nylon fabric or cotton/rayon	57		32 x 100D	133 x 86	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
26	Cotton/ramie fabric	45		21 x21	60 x 58	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
27	Cotton poplin	55		60x60	90x88	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
28	Ammine elastic poplin	44		40 x 40 + 40D	133 x 72	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
29	T/C drill	44		42/2 x 21	124 x 69	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
30	CVC	44		16x12	108 x 58	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
31	T/C poplin	44		45 x 45	133 x 72	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
32	Cotton high density poplin	44		120/2 x 120/2	160 x 100	Wuxi Qing Feng Weixien Bleaching & Dying Co., Ltd
33	Moss suede	54		75D x 236D	202 x 98	Yangzhou Worldbest Company Ltd.
34	Checked sharkskin	57		75Dx 100D	132 x 93	Yangzhou Worldbest Company Ltd.
35	Plain elastic fabric	49		200D x 75D + 40D	126 x 79	Yangzhou Worldbest Company Ltd.
36	Moss suede	57		75Dx236D	196 x 96	Yangzhou Worldbest Company Ltd.
37	Wool-imitation fabric	46		150D x 150D	110xl52	Yangzhou Worldbest Company Ltd.

Fabric_ID	Fabric Name	Width (inch)	Content	Yarn Count	Cloth Count	Manufacturer
38	Peach-skin fabric	57		150D x 150D	133 x 85	Yangzhou Worldbest Company Ltd.
39	Moss	57		75D x 236D	200 x 110	Yangzhou Worldbest Company Ltd.
40	Elastic fabric or stretched fabric	57		75D x 236D	110x89	Yangzhou Worldbest Company Ltd.
41	Peach-skin fabric	46		150D x 150D + 40D	200x94	Yangzhou Worldbest Company Ltd.
42	Suede	57		135D x150D	230 x 90	Yangzhou Worldbest Company Ltd.
43	Moss suede	54		75D x 200D	203 x 106	Yangzhou Worldbest Company Ltd.
44	Wool valitin		W100%	40/2 x 40/2		Wuxi Xiexin Worsted Spinning Weaving&Dying Co., Ltd
45	Wool gabardine		W100%	60/2 x 38		Wuxi Xiexin Worsted Spinning Weaving&Dying Co., Ltd
46	Wool /trueran tropical worsted		W50% P50%	80/2 x 48		Wuxi Xiexin Worsted Spinning Weaving&Dying Co., Ltd
47	Wool tweed		W96.3%. 30DL3.7%	56/2x 56/2		Wuxi Xiexin Worsted Spinning Weaving&Dying Co., Ltd
48	W/T gabardine		W70%, P30%	68/2 x 50		Wuxi Xiexin Worsted Spinning Weaving&Dying Co., Ltd
49	Wool serge		W96.5%. P3.5%	20x20		Wuxi Xiexin Worsted Spinning Weaving&Dying Co., Ltd
50	Wool satin-back serge		Weft. 92%W. 8%P	20x 16		Wuxi Xiexin Worsted Spinning Weaving&Dying Co., Ltd
51	Wool gabardine		W100%	16x 12		Wuxi Xiexin Worsted Spinning Weaving&Dying Co., Ltd
52	W/T valitin		W45% P55%	20x 16		Wuxi Xiexin Worsted Spinning Weaving&Dying Co., Ltd
53	W/T satin-back serge		W70% P30%	7x7		Wuxi Xiexin Worsted Spinning Weaving&Dying Co., Ltd
54	Wool mopen		W100%	45/2 x 45/2		Wuxi Xiexin Worsted Spinning Weaving&Dying Co., Ltd
55	T/W tweed		W35% P65%	20x20		Wuxi Xiexin Worsted Spinning Weaving&Dying Co., Ltd

Fabric_ID	Fabric Name	Width (inch)	Content	Yarn Count	Cloth Count	Manufacturer
56	Wool ladies cloth		W100%	30 x 30		Wuxi Xiexin Worsted Spinning Weaving&Dying Co., Ltd
57	T/W tweed		W40% P60%	20x 20		Wuxi Xiexin Worsted Spinning Weaving&Dying Co., Ltd
58	Wool lycra valitin		W97.2%. 40DL2.8%	32 x 32		Wuxi Xiexin Worsted Spinning Weaving&Dying Co., Ltd
59	Silk/wool tweed		W33.3%P33.3%V33.3%	24x24		Wuxi Xiexin Worsted Spinning Weaving&Dying Co., Ltd
60	W/T mopen		W70%, P30%	40x40		Wuxi Xiexin Worsted Spinning Weaving&Dying Co., Ltd
61	W/T tweed		W68%, P32%	50 x 50		Wuxi Xiexin Worsted Spinning Weaving&Dying Co., Ltd
62	Cotton dyed drill			10x 7	70 x 42	Wuxi Defa Printing & Dying Co., Ltd
63	Cotton dyed drill			7x7	70 x42	Wuxi Defa Printing & Dying Co., Ltd
64	T/C dyeing drill			42/2x21	124 x 69	Wuxi Defa Printing & Dying Co., Ltd
65	Chambray			21 x21	69x61	Wuxi Defa Printing & Dying Co., Ltd
67	Sanded oxford			40+40 x 20/2	100 x 50	Wuxi Defa Printing & Dying Co., Ltd
68	T/C twill			28 x 12	112x56	Wuxi Defa Printing & Dying Co., Ltd
69	Dyed coarse sheeting			12x10	40 x 32	Wuxi Defa Printing & Dying Co., Ltd
70	Dyed tussore			40/2 x 21	100 x 53	Wuxi Defa Printing & Dying Co., Ltd
71	Dyed one-side flannel			20 x 10	40 x 42	Wuxi Defa Printing & Dying Co., Ltd
72	Dyed one-side flannel			24 x 13	42 x 44	Wuxi Defa Printing & Dying Co., Ltd
73	Dyed one-side flannel			20 x 20/2	46 x 42	Wuxi Defa Printing & Dying Co., Ltd
74	Dyed cloth			40x40	133 x 72	Wuxi Defa Printing & Dying Co., Ltd

Fabric_ID	Fabric Name	Width (inch)	Content	Yarn Count	Cloth Count	Manufacturer
75	Dyed canvas			21/2 x 10	70 x 42	Wuxi Defa Printing & Dying Co., Ltd
76	Dyed checks			40/2 x 16	98 x 55	Wuxi Defa Printing & Dying Co., Ltd
77	Dyed drill			36/2 x 24/2	114x57	Wuxi Defa Printing & Dying Co., Ltd
78	Dyed drill			60/2 x 60/2	144 x 76	Wuxi Defa Printing & Dying Co., Ltd
79	Dyed corduroy			16x 10	118x52	Wuxi Defa Printing & Dying Co., Ltd
80	Dyed sateen			21 x7	98 x 48	Wuxi Defa Printing & Dying Co., Ltd
81	Sanded canvas			10x 10	70 x 42	Wuxi Defa Printing & Dying Co., Ltd
82	Dyed canvas			12+12 x 28	83 x 34	Wuxi Defa Printing & Dying Co., Ltd
83	Dyed canvas			42/2 x 21	100 x 54	Wuxi Defa Printing & Dying Co., Ltd
84	Printed elastic drill			16x16+70D	120 x 46	Wuxi Defa Printing & Dying Co., Ltd
85	Filling sateen			40 X 40	80 x 130	Wuxi Defa Printing & Dying Co., Ltd
86	Twill fabric			24 x 24	96x64	Wuxi Defa Printing & Dying Co., Ltd
87	Printed serge			32 x 20	64 x66	Wuxi Defa Printing & Dying Co., Ltd
88	Printed linen			11 x 11	51 x 47	Wuxi Defa Printing & Dying Co., Ltd
89	Printed linen			20 x 20	60 X 54	Wuxi Defa Printing & Dying Co., Ltd
90	Printed elastic poplin			40 x 40+40	133 x 72	Wuxi Defa Printing & Dying Co., Ltd
91	Bleached T/C fabric			20 x 20	60x60	Wuxi Defa Printing & Dying Co., Ltd
92	Dyed T/C fabric			45 x 45	110x70	Wuxi Defa Printing & Dying Co., Ltd

Fabric_ID	Fabric Name	Width (inch)	Content	Yarn Count	Cloth Count	Manufacturer
93	Dyed T/C poplin			145 x45	133 x72	Wuxi Defa Printing & Dying Co., Ltd
94	Dyed elastic poplin			40 x 40+400	133 x72	Wuxi Defa Printing & Dying Co., Ltd
95	Ramie fabric			121 x21	151 x58	Wuxi Defa Printing & Dying Co., Ltd
96	Ramie-cotton fabric			21 x 19	151 x58	Wuxi Defa Printing & Dying Co., Ltd
97	Reverse napping fabric			42/2 x 10	100 x 54	Wuxi Defa Printing & Dying Co., Ltd
98	Ramie drill			7x7	70 x 42	Wuxi Defa Printing & Dying Co., Ltd
100	Dyed waterproof plain fabric T/C			42/2x21	84x64	Wuxi Defa Printing & Dying Co., Ltd
101	T/C dyed drill			33/2 x 33/2	111X 55	Wuxi Defa Printing & Dying Co., Ltd
102	Dyed waterproof T/C tussore			20 x 20	100x56	Wuxi Defa Printing & Dying Co., Ltd
103	Dyed T/C sanded drill			20 x 20	108x58	Wuxi Defa Printing & Dying Co., Ltd
104	Dyed sanded drill CVC			20 x 16	120 x 60	Wuxi Defa Printing & Dying Co., Ltd
105	Dyed T/C tussore			45/2 x 45/2	100x53	Wuxi Defa Printing & Dying Co., Ltd
106	Dyed T/C drill			16 x 12	108x56	Wuxi Defa Printing & Dying Co., Ltd
107	Coarse sheeting			14 x 14	60x60	Wuxi Defa Printing & Dying Co., Ltd
108	Dyed fabric			30 x 30	168x68	Wuxi Defa Printing & Dying Co., Ltd
109	Dyed fabric			20 x 20	60x60	Wuxi Defa Printing & Dying Co., Ltd
110	Dyed drill			20 x 20	108x58	Wuxi Defa Printing & Dying Co., Ltd
111	Dyed drill			20 x 16	128 x 60	Wuxi Defa Printing & Dying Co., Ltd

Fabric_ID	Fabric Name	Width (inch)	Content	Yarn Count	Cloth Count	Manufacturer
112	Dyed sanded canvas			32/2x 16	196x48	Wuxi Defa Printing & Dying Co., Ltd
113	Two-color tussore			20 x 20	100x 56	Wuxi Defa Printing & Dying Co., Ltd
114	Dyed sanded drill			16 x 12	96x48	Wuxi Defa Printing & Dying Co., Ltd
115	Dyed sanded drill			16 x 12	108x56	Wuxi Defa Printing & Dying Co., Ltd
116	Dyed twill			16x 12	70x42	Wuxi Defa Printing & Dying Co., Ltd
117	Dyed drill			10x 10	70 x 42	Wuxi Defa Printing & Dying Co., Ltd
118	Dyed twill			40x40	133 x 72	Wuxi Defa Printing & Dying Co., Ltd
119	Dyed twill			32 x 32	130x70	Wuxi Defa Printing & Dying Co., Ltd
120	Trueran/ Terylene/Dacron			75D x 75D	133 x 72	Wujiang Shengze Print & Dying Factory
121	Trueran/ Terylene/Dacron			150D x 150D	110x 76	Wujiang Shengze Print & Dying Factory
122	Trueran/ Terylene/Dacron			(150D+40D) x C1500+40D	139 x 94	Wujiang Shengze Print & Dying Factory
123	Trueran/ Terylene/Dacron			(75D+500) x 150D	60 x 60	Wujiang Shengze Print & Dying Factory
124	Cotton printed poplin	44		42/2 x 16	194x48	Luoche Print & Dying Co. Ltd
125	C/T Ammine elastic poplin	44		20 x 20	108x58	Luoche Print & Dying Co. Ltd
126	Cotton ammine elastic poplin	44		20 x 16	128 x 60	Luoche Print & Dying Co. Ltd
127	Nylon/cotton elastic fabric	44		16 x 12	108 x56	Luoche Print & Dying Co. Ltd
128	Cotton ammine drill	47		20 x 16	122 x 60	Luoche Print & Dying Co. Ltd
129	Cotton cambric	58		7x7	70 x 42	Luoche Print & Dying Co. Ltd

Fabric_ID	Fabric Name	Width (inch)	Content	Yarn Count	Cloth Count	Manufacturer
130	T/C sanded waterproof fabric	44		45/2 x 45/2	101 x55	Luoche Print & Dying Co. Ltd
131	T/C fabric	44		20 x 20	100 x 56	Luoche Print & Dying Co. Ltd
132	Cotton printed filling sateen	44		30 x 30	68 x 68	Luoche Print & Dying Co. Ltd
133	C/T sateen elastic fabric	44		20x 20	60x60	Luoche Print & Dying Co. Ltd
134	Cotton/nylon fabric	44		32 x 32	130 x 70	Luoche Print & Dying Co. Ltd
135	Cotton/nylon fabric	44		24 x 24	96 x 64	Luoche Print & Dying Co. Ltd
136	Cotton satin down proof fabric	44		40 x 40	133 x72	Wuxi Xueyu Group Co. Ltd.
137	Cotton down proof fabric	44		50 x 50	140x88	Wuxi Xueyu Group Co. Ltd.
138	Cotton check	44		36/2 x 24/2	114 x 57	Wuxi Liyi Dyeing & Weaving Co. Ltd.
139	T/C dyed fabric	44		60/2 x 60/2	144 x 76	Wuxi Liyi Dyeing & Weaving Co. Ltd.
140	Cotton check	44		40x40	133 x 100	Wuxi Liyi Dyeing & Weaving Co. Ltd.
141	Cotton ammine elastic poplin	57		40 x 40	133 x72	Wuxi Liyi Dyeing & Weaving Co. Ltd.
142	Cotton down proof fabric	57		32 x 100D	133 x 86	Wuxi Liyi Dyeing & Weaving Co. Ltd.
143	Cotton poplin	45		21 x21	60 x58	Wuxi Liyi Dyeing & Weaving Co. Ltd.
144	Cotton down proof fabric	55		60 x 60	90 x 88	Wuxi Liyi Dyeing & Weaving Co. Ltd.
145	Cotton satin	44		40 x 40 + 400	133 x72	Wuxi Liyi Dyeing & Weaving Co. Ltd.
146	Linen			42/2x21	124x69	Wuxi Liyi Dyeing & Weaving Co. Ltd.
147	Cotton combed colored woven chevron	44		16x 12	108x58	Wuxi Pacific Textile Co. Ltd.

Fabric_ID	Fabric Name	Width (inch)	Content	Yarn Count	Cloth Count	Manufacturer
148	Herringbone twill	44		45 x 45	133 x 72	Wuxi Pacific Textile Co. Ltd.
149	Cotton/tencel jacquard poplin	44		120/2 x \20/2	160 x 100	Wuxi Pacific Textile Co. Ltd.
150	Profile fiber interwoven printed seesucker	54		750 x 236D	202x98	Wuxi Pacific Textile Co. Ltd.
151	Antimycotic ergosterol fiber fabric	57		75D x 100D	132x93	Wuxi Pacific Textile Co. Ltd.
152	Ammine filling elastic printed poplin	49		200D x 75D + 40D	126 x 79	Wuxi Pacific Textile Co. Ltd.
153	Cotton combed high density cambric	57		75D x 236D	196 .X 96	Wuxi Pacific Textile Co. Ltd.
154	Ammine filling elastic printed poplin	46		150D x 1500	110x 152	Wuxi Pacific Textile Co. Ltd.
155	Linen/viscose blended printed fabric	57		150D x 150D	133 x 85	Wuxi Pacific Textile Co. Ltd.
156	Linen/cotton blended printed fabric	57		75D x 236D	200 x 110	Wuxi Pacific Textile Co. Ltd.
157	Cotton/ammine crepe			32 x 32 +70D	90x60	Nantong Bayi Group Co.
158	Cotton willow crepe			40x21	90x51	Nantong Bayi Group Co.
159	Cotton oxford			40 x 21/2	100 x 50	Nantong Bayi Group Co.
160	Explanation?			21 x21	64 x 54	Nantong Bayi Group Co.
161	Cotton double side fabric			32 x 32	110x 100	Nantong Bayi Group Co.
162	??			32 x 32	80 x 58	Nantong Bayi Group Co.
163	Linen			21 x21	64 x 54	Nantong Bayi Group Co.
164	Ramie/cotton shimmer fabric			30/2 rayonx 14 linen	47 x 58	Nantong Bayi Group Co.
165	Elastic fabric			40 x 40+40D	120 x 70	Nantong Bayi Group Co.

Fabric_ID	Fabric Name	Width (inch)	Content	Yarn Count	Cloth Count	Manufacturer
166	Cotton chambray			40x40	11Ox70	Nantong Bayi Group Co.
167	?Denim			45/2 x 45/2	100 x 85	Hongda Textile Co.
168	?			(16 x 16)+70D	120 x 40	Hongda Textile Co.
169	?			20 x 16	120 x 60	Hongda Textile Co.
170	?			350D x 350D	95 x 65	Huayuan Xishan Textile Co.
171	?			150D x 160D	210 x 70	Huayuan Xishan Textile Co.
172	?			750 x 2250	225 x 90	Huayuan Xishan Textile Co.
173	Denim starts here			16x16+700	108 x 46	Wuxi Xichang Textile & Grament Co. Ltd.
174	Denim			16x 16+700	108 x 46	Wuxi Xichang Textile & Grament Co. Ltd.
175	Denim			10x 16+70D	90x46	Wuxi Xichang Textile & Grament Co. Ltd.
176	Denim			16x21+40D	90x46	Wuxi Xichang Textile & Grament Co. Ltd.
177	Denim			16 x 16 +70D	108 x 46	Wuxi Xichang Textile & Grament Co. Ltd.
178	Denim			(10+5)x 7	72x44	Wuxi Xichang Textile & Grament Co. Ltd.
179	Denim			(10+8)x 7	72x44	Wuxi Xichang Textile & Grament Co. Ltd.
180	Denim			(10+10)x 7	72x44	Wuxi Xichang Textile & Grament Co. Ltd.
181	Denim			10 x 10 +70D	90x46	Wuxi Xichang Textile & Grament Co. Ltd.
182	Denim			12x 12	72 x 42	Wuxi Xichang Textile & Grament Co. Ltd.
183	Denim			10x 16+70D	90x 46	Wuxi Xichang Textile & Grament Co. Ltd.

Fabric_ID	Fabric Name	Width (inch)	Content	Yarn Count	Cloth Count	Manufacturer
184	Denim			16 x 16 +70D	108 x 46	Wuxi Xichang Textile & Grament Co. Ltd.
185	Denim			16x21 +70D	108 x 46	Wuxi Xichang Textile & Grament Co. Ltd.
186	Denim			16x21+40D	90x46	Wuxi Xichang Textile & Grament Co. Ltd.
187	Denim			10x7	72x44	Wuxi Xichang Textile & Grament Co. Ltd.
188	Denim			16x 16	80x46	Wuxi Xichang Textile & Grament Co. Ltd.
189	Denim			10x 10	80x 46	Wuxi Xichang Textile & Grament Co. Ltd.

Vita

Ayse Gider was born in Tarsus, Turkey. She graduated from Cengiz Topel High School, Tarsus. In June 1997, Ayse received her bachelor of Engineering in Textile Engineering from Istanbul Technical University, Istanbul, Turkey. During her senior year of college and after graduation, she worked in textile industry both in Turkey and abroad. She is pursuing her M.S. degrees both in Textile Science, School of Human Ecology and Library & Information Science at Louisiana State University (LSU). While pursing her M.S. degrees, Ayse had completed her minor in Systems Science at Computer Science Department, LSU.