UNDERGRADUATE FINAL YEAR PROJECT REPORT

Faculty of Engineering
Department of Textile Engineering

Development of a Basic Shirt with Enhanced Side Seam Tear Resistance

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This Report Presented in Partial Fulfilment of the Requirement for the Degree of Bachelor of Science in Textile Engineering

Advances in Apparel Manufacturing Technology

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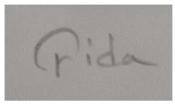
Author's Declaration

We thus proclaim that we are this project's only authors. It is the exact version of the project that our supervisor(s), **Tanvir Ahmed Chowdhury Sir** approved, including any adjustments that were required. Furthermore, we authorize Daffodil International University to duplicate this material in hard copy or electronic format and disseminate it.



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LATTER OF APPROVAL

This project report, prepared by Md. Ataher Fida (ID-213-23-1029) & Md. Mehedi Hasan Murad (ID-213-23-1035) is approved as partial fulfillment of the requirements for the degree of B.Sc in Textile Engineering. I have supervised the student throughout his project work, and during the research period, I found Fida & Murad to be sincere, hardworking, and enthusiastic.

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Statement of Contributions

In this final year Capstone project, we two friends work together to measure the dummy, sketch the garments, do pattern making, and fabric selection & collection, cutting, sewing, and finishing are done by ourselves. Only weaving and dyeing are done by a factory in the supervision of one teammate who is working there right now. We also use the sewing expert's advice and their help for sewing perfection. Both of us worked by discussing between us and our advisor, sir. To finish is project, our project advisor **Tanvir Ahmed Chowdhury** supervises us in each step.

Executive Summary

In our Final Year Design Project, we aimed to develop a basic shirt that addresses a common wear-and-tear issue: side seam tearing. While the fundamental principles of shirt construction are well-understood, we recognized a significant opportunity to enhance product durability by focusing on the often-stressed side seams. Our initial challenge involved precisely measuring and cutting fabric according to standard dummy measurements within our apparel lab, ensuring a foundational fit for the basic shirt design.

The core of this project, however, revolved around incorporating features to improve the tear resistance of the side seams. We encountered several technical difficulties during this development. For instance, achieving consistent and robust stitching along the curved side seams while maintaining the shirt's intended drape and fit proved challenging. There were also considerations for fabric selection, as the material's weave and strength directly impact seam integrity. We experimented with different stitching techniques, seam finishes, and reinforcement methods to identify the most effective solution for preventing premature tearing.

To overcome these hurdles, we conducted multiple iterations of measurement, cutting, and stitching trials. This involved extensive collaboration and discussion with our pattern master and experienced industry professionals, who provided invaluable insights into best practices for durable garment construction. Their guidance helped us refine our techniques and select appropriate materials and reinforcement strategies. Ultimately, our goal was to create a unique and highly durable basic shirt for our final year design project, setting a new standard for essential garment longevity, with the advice and support of our advisor sir.

Acknowledgments

At first, we expressed our heartiest thanks and gratefulness to Almighty Allah for his divine blessing made it possible to complete this project successfully.

Again, we expressed our highest gratitude to **Mr. Tanvir Ahmed Chowdhury**, Associate Professor, Department of Textile Engineering, Daffodil International University, for his guidelines and priceless advice. His scholarly guidance, continual encouragement, constant and energetic supervision, constructive criticism, reading many inferior drafts, and correcting them at all stages have made it possible to complete this final year design project.

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List of Abbreviations

SDGs: Sustainable Development Goals.

GSM: Grams Per Square Meter

CM: Centimeter

CAD: Computer-Aided Design

POM: Point of measurement

List of Equations

Serial	Equation
01	GSM= Sample Weight x 100

United Nations Sustainable Development Goals

The Sustainable Development Goals are a universal call to action to end poverty, protect the planet, and improve the lives and prospects of everyone, everywhere.

All United Nations Member States adopted the Goals in September 2015 as part of the 2030 Agenda for Sustainable Development, which sets out a 15-year plan to achieve the Goals and their related targets. Never before had world leaders pledged common action across such a broad and universal policy agenda.

The 17 Goals are interconnected, apply to all countries, and need to be carried out by all stakeholders – governments, the private sector, civil society, the United Nations system, and others – in a collaborative partnership.

This year marks the midpoint of SDG implementation. However, on its current course, the world may miss many Sustainable Development Goals targets by 2030. For the first time in decades, development progress has stalled and even reversed under the combined weight of climate disasters, conflict, economic downturn and the lingering aftermath of COVID-19. The SDG Summit, held on 18 to 19 September 2023 at the UN Headquarters in New York is a unique opportunity for the world to pivot from crisis to development and deliver the breakthroughs needed to achieve the Goals.

This exhibit illustrates the Sustainable Development Goals through photos from around the world, bringing to life what the 17 Goals mean for people on the planet.

The UN Department of Global Communications produced this exhibit.

Goal 1: No Poverty

Goal 2: Zero hunger

Goal 3: Good health and well-being

Goal 4: Quality education

Goal 5: Gender equality

Goal 6: Clean water and sanitation

Goal 7: Affordable and clean energy

Goal 8: Decent work and economic growth

Goal 9: Industry, Innovation, Technology, and Infrastructure

Goal 10: Reduced inequality

Goal 11: Sustainable cities and communities

Goal 12: Responsible consumption and production

Goal 13: Climate action

Goal 14: Life below water

Goal 15: Life on land

Goal 16: Peace, justice and strong institutions

Goal 17: Partnerships for the goals

"Halfway to the deadline for the 2030 Agenda, we are leaving more than half the world behind. We have stalled or gone into reverse on more than 30 per cent of the SDGs. Unless we act now, the 2030 Agenda will become an epitaph for a world that might have been." – **United Nations Secretary-General Antonio Guterres.**

Chapter 1: Introduction

1.1 Background Information

In the final year design project, we are challenged to create a real garment, which is all done by us. Like, choose a design, adjust it with our dummy, take the measurements of the dummy to make the chosen garments, sewing, finish, and finally present the final product which is fits with our dummy. To complete this project, we need to expand up knowledge of how garments are actually made in the factory, how the factory minimizes process faults, how garment fault is adjusted, and how to make a proper decision in the moment of time pressure. In this project design, we worked with a woven shirt. We develop a different type of shirt which has a different side seam in hem which is more tear strength & more durable than a normal Woven shirt.

1.2. Significance & Motivation

1.2.1 Significance:

As a student of the Textile Engineering department, we should be measuring almost any type of garment or clothing. Should be named the point of nearly all points of measurement. But in our academic book, we only learn about basic garments and their measurement. Again, as Textile Engineering, we should be aware of how to make a garment from sketch and fabric. Not just academic knowledge but also real-world experience. During making garments from a design and fabric, there were many technical issues, we faced. Together we try to solve it. We believe this knowledge will help us in the industry and understand the manufacturing process very easily and can work efficiently.

1.2.2 Importance and benefits: Through this project, we have learned to

1. Make Garments from the measurements of the dummy.
2. Draw the sketch of a piece of clothing according to the measurement.
3. Adjust the measurement of clothing for better fitness.
4. Collecting and attaching decoration items.
5. And overall manufacturing process.

1.3 Aims and Objectives:

1. To make garments beyond basic garments.
2. Gather knowledge of a few unknown points of measurement.
3. Gather knowledge of the garment manufacturing process practically.
4. Know more about woven fabric and woven garment manufacturing
5. Gather practical knowledge and solve the issues that occur during manufacturing.

1.4 Methodology

When we initiated this project, our goal was to create a basic yet durable piece of clothing that could withstand everyday wear and tear, especially in areas prone to stress—like the side seams. We brainstormed ideas that would not only be simple to manufacture but also address a common issue in garment longevity: seam failure. After evaluating various garment types, we decided to develop a basic shirt that incorporates enhanced side seam tear resistance.

To achieve this, we selected a woven 100% cotton fabric. We reinforced the side seams using a double-stitched flat-felled seam technique, which is commonly used in denim garments for its durability. Additionally, we integrated a narrow bias tape along the seam allowance to further distribute stress and reduce the risk of tearing. This approach ensures that the shirt remains comfortable, breathable, and suitable for daily use, while significantly improving its structural integrity.

1.5 Report Outline

This report outlines the development process of our basic shirt with enhanced side seam tear resistance. In the first chapter, we describe our motivation, the problem we aimed to solve, and the methodology we followed. The subsequent chapters delve into the selection of fabric and materials, the detailed construction process of the shirt, and the testing methods used to evaluate seam strength. We also include a comparative analysis of standard seams versus our reinforced seams to highlight the improvements in durability.

Chapter 2: Literature Review

2.1 Introduction

For this project work, we developed a basic shirt using 100% BCI (Better Cotton Initiative) Cotton Woven Fabric. While the shirt itself is a common garment, our focus was on improving its side seam tear resistance, which is a frequent point of failure in daily wear. This is the first time such a modification has been attempted in our lab using sustainable BCI cotton. The use of this eco-friendly fabric not only supports responsible cotton farming but also ensures breathability and comfort. To enhance durability, we applied reinforced stitching techniques such as double-needle lockstitching and bias tape reinforcement along the side seams. This makes our project unique in combining sustainability with structural innovation.

2.2 Limitations

Despite our efforts to improve the shirt's durability, we encountered several limitations:

 The use of reinforced stitching increased production time and required skilled labor.

BCI cotton, while sustainable, is slightly more expensive than conventional cotton, affecting cost-efficiency.

The added seam reinforcement slightly reduced the shirt's stretch ability and may affect comfort for some users.

 We were limited in our ability to test the shirt under extreme stress conditions due to lab constraints.

2.3 Summary

This project focuses on developing a basic shirt that is both sustainable and structurally improved. By using 100% BCI cotton and reinforcing the side seams, we aimed to create a garment that is comfortable, eco-conscious, and long-lasting. Although there were some limitations, the project opens up new possibilities for combining sustainability with functional garment engineering. Future work can explore optimizing comfort and cost while maintaining durability.

Chapter 3: Manufacturing Steps of Basic Men's Shirt

3.1 Introduction:

In this project, we focus on developing a basic men's shirt that incorporates enhanced side seam tear resistance. The shirt is constructed using 100% BCI (Better Cotton Initiative) Cotton Woven Fabric, chosen for its sustainability and durability. To ensure a structured and efficient workflow, the manufacturing process is divided into the following stages:

a. Measurement

b. Sketch Creation

c. Adjustment of Measurements

d. Fabric and Accessories Collection and Details

e. Pattern Making

f. Fabric Cutting

g. Sewing

h. Finishing

3.2 Measurement:

To begin, we recorded the initial measurements using a male lab dummy. All measurements were taken in centimeters (cm), following academic guidelines for garment construction. At this stage, no extra allowances were added, as the goal was to capture the precise body dimensions for accurate sketching and pattern development. Seam allowances were incorporated later during the pattern drafting and CAD file creation phases.

Table 1: Measurement of Lab dummy(Male) without allowance

POM Mark	Points of Measurement (POM)	Measurement (CM)
A	Chest	114.00
B	Waist	106.00
C	Hem width	110.00
D	Center back	74.00
O	Shoulder	17.00
E	Shoulder (complete)	18.00
F1	Sleeve length	68.00
F2	Sleevelength:F1+1/2E	92.00
Z	Sleeve hole height (Z1+Z2)/2	22.50
R	Upper arm width	42.00
T	Elbow width (width at 1/2F)	34.00
L	Cuff width	23.00
M	Cuff height	5.00
K1	Neckhole width	16.80
P	Neckhole circumference	45.00
K2	Front neck drop	8.50
K3	Back neck drop	3.20
J1	Collar stand height front	2.50
J2	Collar stand height back	3.00
J3	Collar height back	4.00
J4	Collar height front	6.00

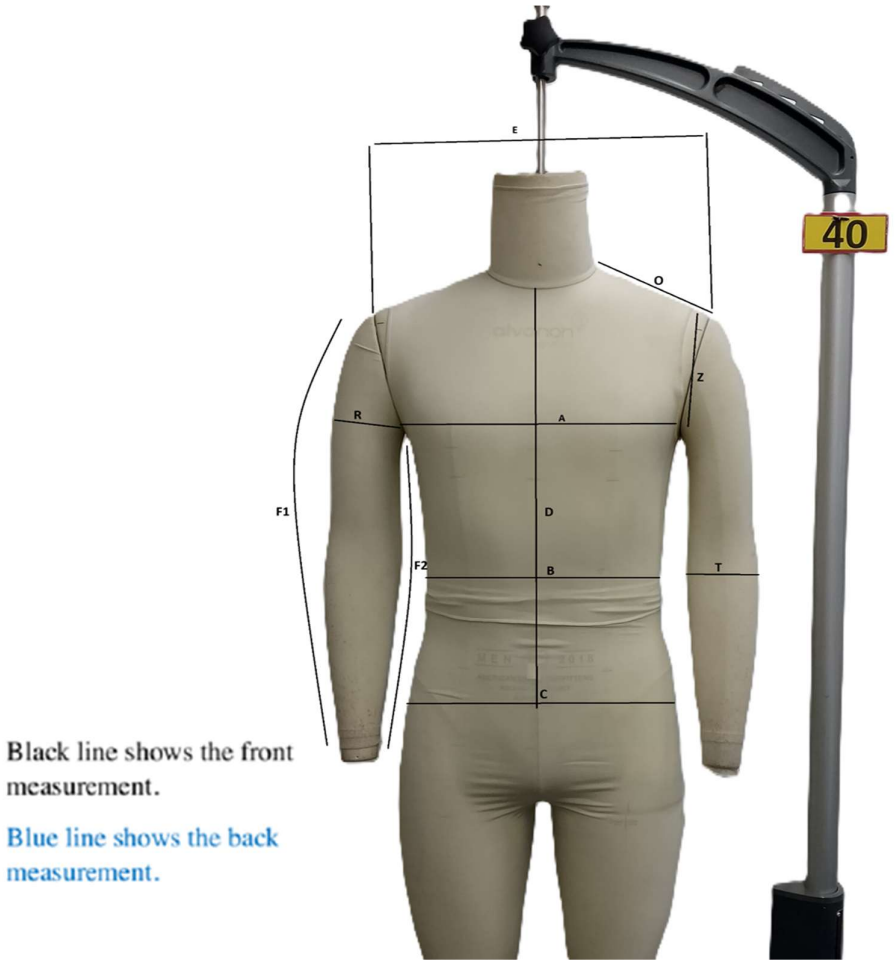

Figure 1: Making of Measurement Points

Before the garments selection, we initially took the measurement of the dummy so that it could help us understand and select the garments.

3.3 Sketch creation

For the development of this shirt, we began by creating a detailed sketch of the garment. The sketch served as a visual blueprint, helping us identify all Points of Measurement (POM) and design features critical to both fit and function.

Figure 2: Front sketch of the shirt

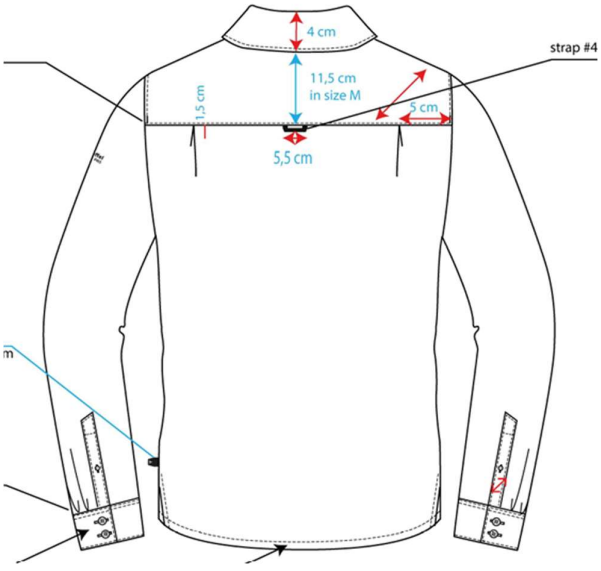

Figure 3: The back sketch of the Shirt

After finalizing the design and a few modifications, we make a digital drawing of the shirt and identified the POM and by making the number.

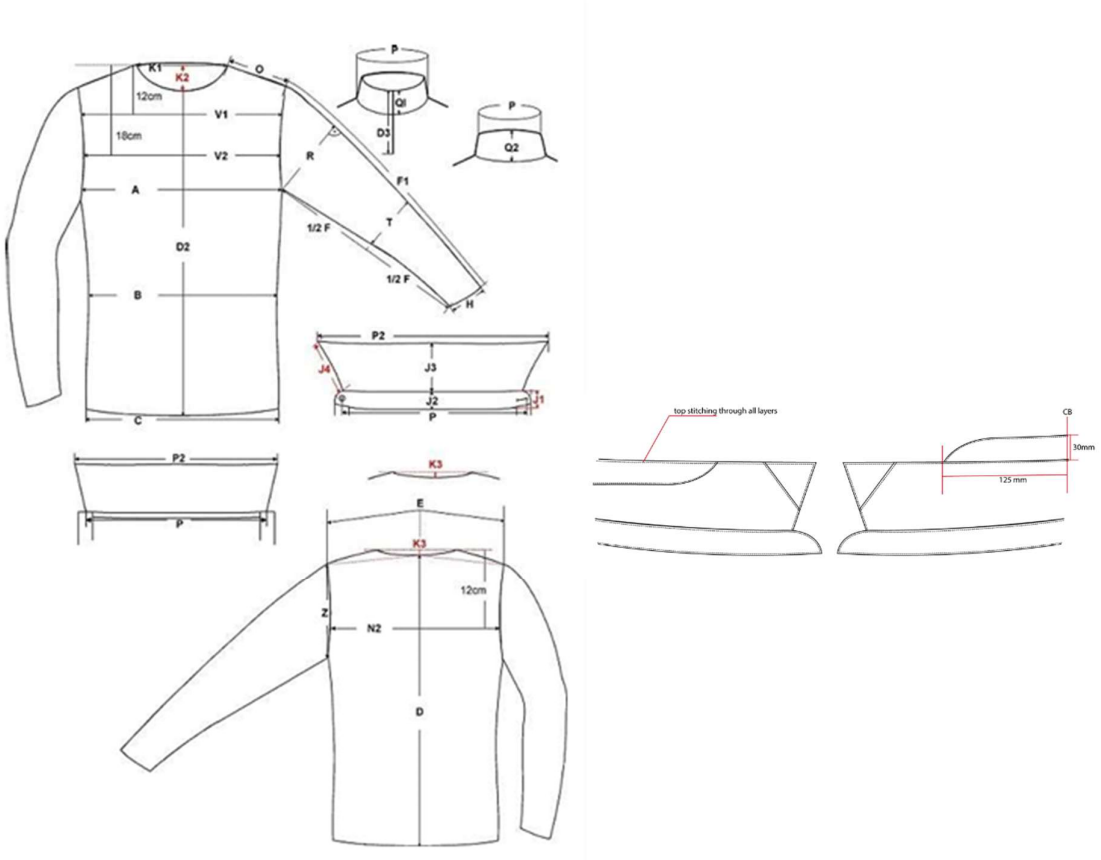

Figure 4: Digital Drawing of the shirt and making of measurement points.

3.4 Adjust the measurement:

According to the design we have chosen, it seems the there need to be of some measurement. So, we need to adjust and reconsider the measurement and modify it as per design and mark the point of measurement so that it can help to create the pattern.

Table 2: Adjusted and modified measurement

POM Mark	Points of Measurement (POM)	Measurement (CM)
A	Chest	114.00
B	Waist	106.00
C	Hem width	110.00
D	Center back	74.00
O	Shoulder	17.00
E	Shoulder (complete)	18.00
F1	Sleeve length	68.00
F2	Sleevelength:F1+1/2E	92.00
Z	Sleeve hole height (Z1+Z2)/2	22.50
R	Upper arm width	42.00
T	Elbow width (width at 1/2F)	34.00
L	Cuff width	23.00
M	Cuff height	5.00
K1	Neckhole width	16.80
P	Neckhole circumference	45.00
K2	Front neck drop	8.50
K3	Back neck drop	3.20
J1	Collar stand height front	2.50
J2	Collar stand height back	3.00
J3	Collar height back	4.00
J4	Collar height front	6.00

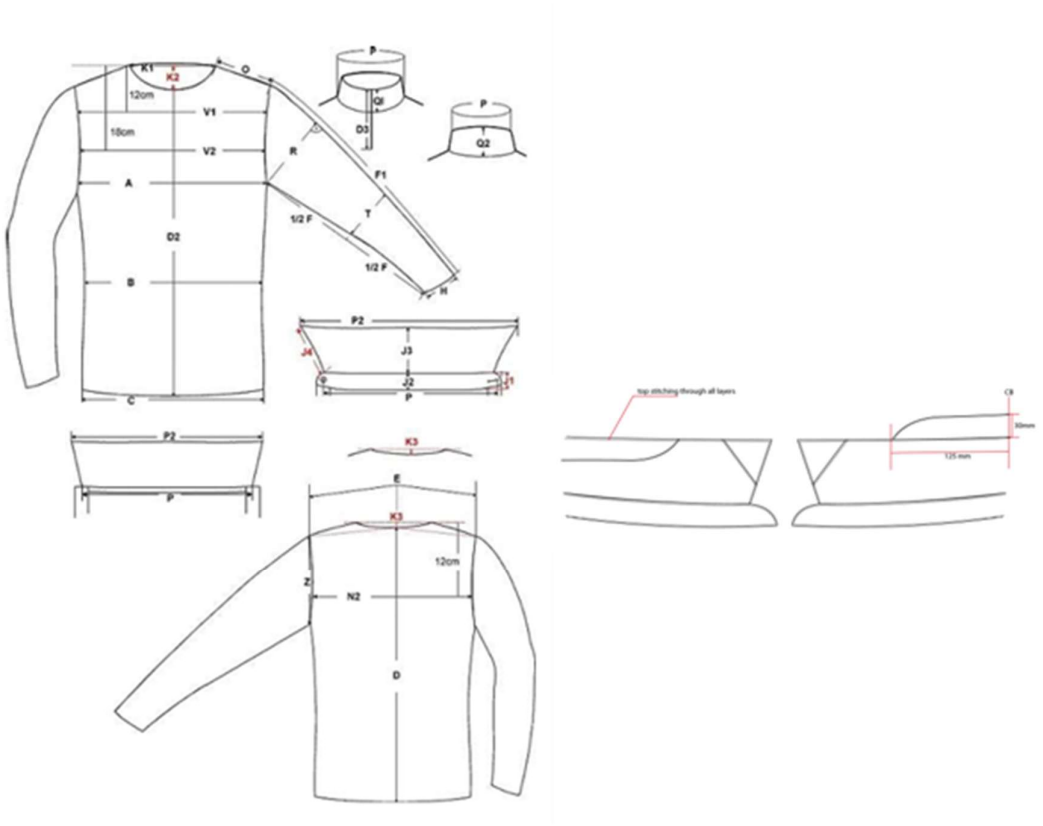

Figure 5: Marking points according to the new modified measurement chart.

Table 3: Final modification of measurement by adding elongation percentages.

POM Mark	Points of Measurement (POM)	Measurement (CM)	Modified (CM)
A	Chest	114.00	112.00
B	Waist	106.00	104.00
C	Hem width	110.00	108.00
D	Center back	74.00	73.00
O	Shoulder	17.00	16.50
E	Shoulder (complete)	18.00	17.00
F1	Sleeve length	68.00	67.00
F2	Sleevelength:F1+1/2E	92.00	91.00
Z	Sleeve hole height (Z1+Z2)/2	22.50	21.50
R	Upper arm width	42.00	41.00
T	Elbow width (width at 1/2F)	34.00	33.00
L	Cuff width	23.00	22.00
M	Cuff height	5.00	4.70
K1	Neckhole width	16.80	15.80
P	Neckhole circumference	45.00	44.00
K2	Front neck drop	8.50	8.50
K3	Back neck drop	3.20	2.70
J1	Collar stand height front	2.50	2.20
J2	Collar stand height back	3.00	2.70
J3	Collar height back	4.00	3.70
J4	Collar height front	6.00	5.70

3.5 Fabric collection and details:

To make these garments, we used woven fabric.

Woven fabric is made by interlacing yarn. Here, we use two sets of yarns for warp and weft. Warp yarns are vertical and weft yarns are horizontal. This is one of the most common and versatile types of fabric construction. It is strong, stable and holds its shape very well.

In here we used:

100% cotton woven fabric. Construction; 146*84/ 50*50. It means,

Figure 6: 146*84/ 50*50 woven fabric (100% cotton).

Here, the warp is 146 and the weft is 84. And both yarn counts are 50.

Figure 7: 1/1 woven fabric construction.

3.6 Pattern Making:

In this stage, we first made the pattern design according to the measurement. To make the pattern, we used **OPTIMAX** software.

3.7 Fabric Cutting:

After making the CAD file, we carefully draw the pattern on a pattern paper. And on a masking paper. After drawing the pattern, we cut all the pieces from the pattern paper. Then we spread the fabric and placed the pattern cut pieces on it according to the grain line. Then draw the pattern on the fabric by outlining the paper pattern pieces. The pattern pieces are,

Figure 8: Back Part pattern

Figure 9: Left side front pattern

Figure 10: Right side front pattern

Figure 11: Sleeve pattern

Figure 12: Patterns of other parts of the Shirt.

3.8 Sewing

To enhance the durability and tear resistance of the side seams in the developed basic shirt, two types of seams are strategically applied: reinforced overlock seams and double-stitched lock seams.

- **Superimposed Seam (Overlock Stitch):** This seam is used extensively throughout the garment, especially along the side seams. The overlock stitch provides:
    - Excellent stitch security, reducing the risk of seam failure under stress.

- Superior abrasion resistance, which is critical for areas subject to frequent movement and friction.

- **Lapped Seam (Single Lock Stitch):** Applied selectively to attach decorative elements and reinforce specific stress points. The lock stitch offers:
  - Neat appearance and structural stability.
  - Additional reinforcement when layered with overlock stitching.

Figure 13: Stitching location

By combining these two seam types, the shirt achieves improved structural integrity, particularly at the side seams, which are prone to tearing during wear and laundering. This approach ensures both functional durability and aesthetic finish.

3.9 Finishing:

To complete this project, we collected the woven fabric and which fabric was made of dyed cotton yarn containing 100% cotton yarn. So, this fabric was already passed through the surface finishing process. But after sewing, we wash the fabric with detergent to clean the sewing dust and then iron the garment and make it ready to wear the dummy.

3.10 Lab Test:

3.10.1 GSM Test:

At first, after collecting the fabric, we test GSM of the fabric so that we can conduct other tests on it. And knowing the GSM is very important to describe the fabric properties and testing. For that we used a lab GSM Cutter to cut the fabric and used the following equation to find out the GSM of the fabric. Here we use a GSM cutter whose area is 1/100 square meter.

So,

GSM = weight of the fabric which is cut by GSM cutter × 100

3.10.2 Tearing Test:

Tearing test on 100% cotton woven fabric measures its resistance to the propagation of a tear. Several methods are used, including the tongue, trapezoid, and wing methods, all of which involve clamping a specimen with a pre-cut tear and applying force to propagate the tear. The results are typically reported as the average force required to tear the fabric over a specified distance.

3.11 Summary:

To complete this final year design project, we chose to make a woven shirt. To manufacture it, we systematically divided our working flow as such:

First, we took the measurement of the dummy to understand which item can be matched with the dummy size. Then we chose the garment and made the sketch. Then we implant the measurement in the garment sketch and make modifications to the measurement according to the design and fabric elongation quality. After that, we make the design on **OPTITEX** software and make a pattern. Then cut the fabric according to the pattern. After sewing, we wash the garment to remove the sewing dust and unwanted dirt. By ironing, we are finally ready for the trial dummy.

Chapter 4: Project Submission

4.1 Introduction:

For any project, lab testing and presenting the final project provides the actual properties, quality, and outlook view. Here we submit the garment and also the test report for our work final evaluation.

4.2 Lab Test Report:

4.2.1 GSM test Report:

We used lab GSM cutter to cut the fabric and used the following equation to find out the GSM of the fabric, here we use a GSM cutter whose area is 1/100 square meter.

Table 4: GSM test report chart

Observation No.	Sample Type	Sample Weight (gms)	GSM = Sample weight × 100	Average GSM
1	Woven Fabric (YD)	1.11	111	111
2		1.12	112	
3		1.1	110	
4		1.11	111	
5		1.1	110	

4.2.2 Tearing Test Report:

Type of Machine Used- CRE

Breakdown before 6 mm opening at

SHELL: 20 ldf

Table 5: Tearing strength test Report

Test Location	Observation No.	Enhanced Side Seam (lbf)	Average Force	Regular Sida Seam (lbf)	Average Force (lbf)	Compersition
Left sida seam	1	45.3	9.06	40.3	8.06	1
	2	45.9		40.9		
	3	45.2		40.6		
	4	46.0		40.1		
	5	45.7		40.5		
Right side seam	1	47.0	9.4	41.7	8.34	1.06
	2	47.9		42.1		
	3	46.8		40.9		
	4	47.2		41.3		
	5	47.5		41.4		

The test report indicates that the Enhanced side seam is stronger than the regular side seam in the shirt.

4.3 Project Demo:

Figure 14: Garment on the dummy.

Figure 14: Garment on the dummy.

Figure 14: Garment on the Dummy.

Figure 14: Garment on the dummy.

Figure 14: Garment on the dummy.

Measurement Sheet

-	MEASUREMENT ([Werte])	XS	S	M	L	XL	XXL	3XL	4XL
A	chest	104,0	108,0	114,0	120,0	128,0	138,0	148,0	158,0
B	waist	96,0	100,0	106,0	112,0	120,0	130,0	140,0	150,0
C	hem width	100,0	104,0	110,0	116,0	124,0	134,0	144,0	154,0
D	center back	72,0	72,0	74,0	78,0	80,0	82,0	84,0	86,0
O	shoulder	16,0	16,5	17,0	17,5	18,0	18,6	19,2	19,8
E	shoulder (complete)								
F1	sleeve length	67,5	67,8	68,0	68,5	68,7	68,9	69,1	69,3
F2	sleevelength:F1+1/2E	90,0	91,0	92,0	93,3	94,3	95,5	96,7	97,9
Z	sleeve hole height (Z1+Z2)/2	21,3	21,8	22,5	23,5	24,5	25,5	26,5	27,5
R	upper arm width	38,5	40,0	42,0	44,0	46,2	49,2	52,2	55,2
T	elbow width (width at 1/2F)	31,1	32,4	34,0	35,6	37,3	39,3	41,3	43,3
L	cuff width	21,0	22,0	23,0	24,0	25,0	26,0	27,0	28,0
M	cuff height	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0
K1	neckhole width	15,8	16,2	16,8	17,4	18,0	18,8	19,6	20,4
P	neckhole circumference	42,0	43,2	45,0	46,8	48,6	50,6	52,6	54,6
K2	front neck drop			8,5					
K3	back neck drop	3,2	3,2	3,2	3,2	3,2	3,2	3,2	3,2
J1	collar stand height front	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5
J2	collar stand height back	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0
J3	collar height back	4,0	4,0	4,0	4,0	4,0	4,0	4,0	4,0
J4	collar height front	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0

4.4 Result and Discussion:

We finally submitted the final year design project and the test report summary.
The fabric GSM is 111.
The fabric is A-grade from inspection.
Lastly, the measurement of the final product is almost the same as the measurement sheet.
So, it should fit in the dummy.

4.5 Summary:

Here, we provide the testing report data and try to strengthen our stand that we maintain the quality level and try our best to make a complete garment in our lab. Once again, all the test is done in our lab.

Chapter 5: Social Ethics

5.1 Introduction

Here, we discuss the responsibilities, health, safety, socio-cultural, and environmental considerations. We aim to ensure that our product aligns with social expectations, preserves ethical principles, and supports environmental sustainability.

5.2 Ethical Principles and Professional Commitment Involvement

In this project, we followed ethical principles by ensuring the shirt design is modest, culturally precise and affordable. We are committed to using safe, high-quality materials and respecting social values, intending to meet customer needs responsibly and professionally.

5.3 Impact of the Project on the Environment and Sustainability

For this project, we're working with 100% cotton woven fabric, which is a natural, biodegradable fiber. We can rely on cotton to reduce reliance on man-made fibers and verify sustainability. We're also obsessed with eco-friendly sourcing, minimal chemical use and potent design that minimizes environmental footprint and promotes responsible consumption.

5.4 Summary

Social ethics include respect for cultural norms, human dignity and community health. In our project we address social norms by creating a polite, high quality 100% cotton shirt that is affordable, comfortable; as well as ethical MAY RESPONSIBLE and inclusivity in fashion.

Chapter 6: Conclusions

6.1 Summary

The invention of an improved basic shirt with increased tear resistance at the side seams solves an important part of the garment's durability problem, in bringing together innovation through function and a day to day wear quality. The chemical engineering defense mechanism the shirt's side-seams are cracked through reinforcement in the form of material and the way in which the seams themselves are sewn, resulting in a shirt that will have its own better life. This development also prolongs the life-cycle of garment, thus has a beneficial impact on sustainable fashion by minimizing the number of disposals. All in all, the project represents a well thought out incorporation of.

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