



No Sweat: Teaching the next generation of technic designers about cotton performance technologies

FINAL REPORT PREPARED FOR COTTON INCORPORATED BY

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Summary of the Project

The goal of this project was to develop a semester-long experiential learning product development project to increase students' awareness of advancements by Cotton, Inc. to enhance the functional properties of cotton. The project was implemented in a junior-level Technical Design course and funded through a 2018 Cotton in the Curriculum grant titled, *"No Sweat: Teaching the next generation of technical designers about cotton performance technologies."* Specifically, this project leveraged TransDry®, PurThread®, and StormCotton®, cotton performance technologies to enhance student learning. The project followed a problem-based learning pedagogical approach and the student technical design projects had a user-centric focus. The students developed performance apparel products for underserved target markets.

Under this project, we completed the following six main activities:

1. Eight undergraduate and two graduate students in TAM 3480 Technical Design participated in a semester-long technical design project in which they addressed real-life performance apparel problems of apparel users.
2. The students worked in teams of two to identify an underserved target market that would benefit from cotton performance technologies. They interviewed 22 people and surveyed 73 end-users to identify unmet needs, developed 12 cotton-rich garments (5 ensembles) that creatively addressed the unmet need, developed technical garment specifications for each garment, and submitted comprehensive final reports about the entire user-centered product development process.
3. The students were interviewed twice throughout the semester. The interviews occurred in week 2 and week 14 of a 16-week semester. The interviews were used to assess students' change in knowledge about cotton performance technologies for application in performance apparel and the problem-based learning format.
4. Through these interviews, the students showed increase in knowledge about cotton, increase in knowledge about cotton performance technologies, and increases in excitement about using cotton for performance apparel.
5. The PI developed a complete set of course materials such as course description, learning objectives, sample schedule, description of problem-based learning project, assignment overview, grading schema, discussion topics, and lecture outline that are available to implement in future semesters.
6. The research team **disseminated** the project in the following ways:
 - a. We developed a comprehensive project video posted on YouTube.
 - b. In May 2018, the students presented their final projects in an open house in The Department with faculty and community members in attendance.
 - c. In August 2018, the garments were publicly exhibited for three weeks in the College of Human Environmental Sciences on the University of Missouri campus.
 - d. In November 2018, the PI presented a research presentation about the project at the International Textile and Apparel Association annual meeting held in Cleveland Ohio. This research presentation was **awarded the Intellect Book Research Award** at the conference. In addition, one graduate student project was exhibited as design scholarship at this international conference.
 - e. In January 2019, one undergraduate student project will be exhibited at the Undergraduate Visual Art and Design Showcase held on the University of Missouri campus.

Outcomes of the Project

Students increased awareness about unmet needs of underserved populations that could be addressed through cotton performance technologies.

Five teams of two students followed a user-centered design process in this project. They identified a traditionally underserved target market that could benefit from thoughtfully designed cotton-rich apparel products. The students identified breastfeeding moms, nurses, people with sensory processing disorders, burn survivors and lower limb amputees to work with throughout the semester.

- Nicole Eckerson and Hali Ipaye developed an athleisure tank top, jacket, and pant with features that allow women who have had a lower limb amputated to quickly put on, take off or adjust their prosthetic leg. Their garments have innovations that integrate with prosthetic limbs, maintaining users' independence and personal style.
- Andrea Radicic and Darien Lee created a sports bra and running vest that allows mothers to be physically active and easily breastfeed their newborns without being overexposed and uncomfortable. They also developed a coordinating leggings all of which featured laser-cut ventilation for thermal comfort.
- Lauren Tihen and Brianna Moore created Armor Aid, a scrub top, and pant that protects the wearer from fluids using microbe-fighting cotton fabrics. They also addressed mobility, utility, and thermal comfort in their designs.
- Rylie Bryant and Andrea Bilgrein created a compression top and cover-up jacket for female burn survivors to be used during recovery. Their goal was to create garments that did not look like medical garments and yet served a functional purpose. Their designs have sporty-aesthetic appeal and use fabrics to help regulate body temperature.
- Courtney Rock and Mandy Lupardus created a bomber jacket and jeans for people who are affected by sensory processing disorders. The coat has weights hidden in the shoulders that provide a pressure sensation. Both the jacket and the pants have alternative closures and low-profile seams to allow the wearers to participate in everyday activities without added distractions.

The teams surveyed and conducted interviews to holistically understand the product attributes needed to address their market's needs. Each team compiled a comprehensive report and presented their findings and final garments in an open house at the end of the semester. The garments were also displayed at the University. The teams developed technical packages for each garment and documented their entire technical design process on Instagram @mizzoutechdesign.

In total, the teams interviewed 22 people and gathered 73 survey responses from individuals representing five underserved markets. The teams developed design concepts based on their understandings of their end-users and through an iterative process, they produced two samples and a final prototype of each garment. They also used 3D body scanning and virtual prototyping to check the fit and design of the garments on model's representative of their target market. By the end of the semester, the teams developed 5 ensembles, or 12 garments, featuring innovations to address their market's needs.

Increased student learning about cotton performance technologies for performance apparel.

In the interviews, the students showed increase in knowledge about cotton, increase in knowledge about cotton performance technologies, and increases in excitement about using cotton for performance apparel. The students shared an enhanced and broadened knowledge of cotton innovations. One student shared that prior to the project, “I really didn't know that much about cotton. I'm reading every single week and I didn't realize there were all these technologies of course. I think this project really has made us smarter about our cotton knowledge.” The students showed a sophisticated understanding of the value of cotton and cotton performance technologies, particularly as it related to applying cotton fabrics to address problems with apparel experienced by real consumers.

Increased engagement with technical design content through problem-based learning format.

The course was framed using a problem-based learning (PBL) approach. PBL is an active learning strategy in which students learn about a subject through the experience of solving an open-ended problem (Hung, Jonassen, & Liu, 2008). The open-ended question that guided the project was: How can cotton technologies add value and increase performance apparel of end-users? The delivery of technical design concepts (e.g., development of technical packages, fittings, sample development) were addressed through this question as they related directly to the student's projects. The PI observed improved engagement with the technical design course content because the course learning objectives were addressed holistically through a significant design challenge that gave focus to a design problem that was supported by a globally-recognized brand. Because of this, students felt engaged with the project, as a student explained, “I liked the semester long format a lot better because I think we get to put a lot more effort into it.” Another student mentioned, “It felt like a real product we're working towards. It will actually have an impact on people or hopefully so.”

Conclusions

Implications for apparel product development curriculum

The positive feedback from students is confirmation of the importance of building a semester-long experience where students can focus on learning and applying course learning objectives while simultaneously creating relevant apparel projects for real-life consumers. This project added value to the existing design curriculum by providing students with experiences researching innovative cotton materials, applying functional clothing principles, and gaining user insights to create innovative cotton activewear garments – skills that students would not have encountered elsewhere in the curriculum. As Ellington (2016) aptly wrote, “preparing students for the best chances at securing a career in the fashion industry depends on technical designer experiences educators can provide during the student's educational career.” Through this model project, pedagogical experiences using a problem-based learning format may be explored to provide technical design experiences for students.

Appendix

Course Materials

Course Description:

The primary aim of this course is to prepare you for technical design positions in the global sewn products industry.

Throughout this course, you will apply and hone your apparel, design, construction, and professional illustration skills to translate design concepts into garments through an iterative design process. You will learn to generate technical specifications, evaluate samples, conduct fit sessions, and communicate changes in the tech packs.

Students who take this course will be able to autonomously create garment specifications with confidence because they have experienced the daily activities of a Technical Designer.

Specific Learning Objectives:

At the end of this course, you will be able to:

Develop professional technical packages

- Develop a complete specification package, including technical sketches, construction detail call-outs, points of measure, measurements, tolerances, grade rules, bill of materials and any predefined performance standards for multiple styles of garments.
- Understand responsibilities of Technical Designers and terminology used in Technical Design

Evaluate garment samples and communicate changes in a visual language

- Evaluate garments to determine compliance with spec, construction, fit, product design, styling/aesthetic, and performance standards.
- Identify potential production, quality, costing, and design issues and make appropriate recommendations.
- Use strong communication skills to work through specification, construction, or fabrication issues with potential vendors.
- Analyze garment quality, construction methods and finishing relative to fabric, quality, cost, and performance.

Use CAD Software

- Optitex PDS 12
 - Create garment patterns, markers, and 3D visualizations of garments using Optitex.
- Microsoft Excel
 - Compile Tech Packs/Specifications
- Adobe Creative Suite (Illustrator, Photoshop, Acrobat)
 - Sketches/renderings

Learn about functional clothing design principles

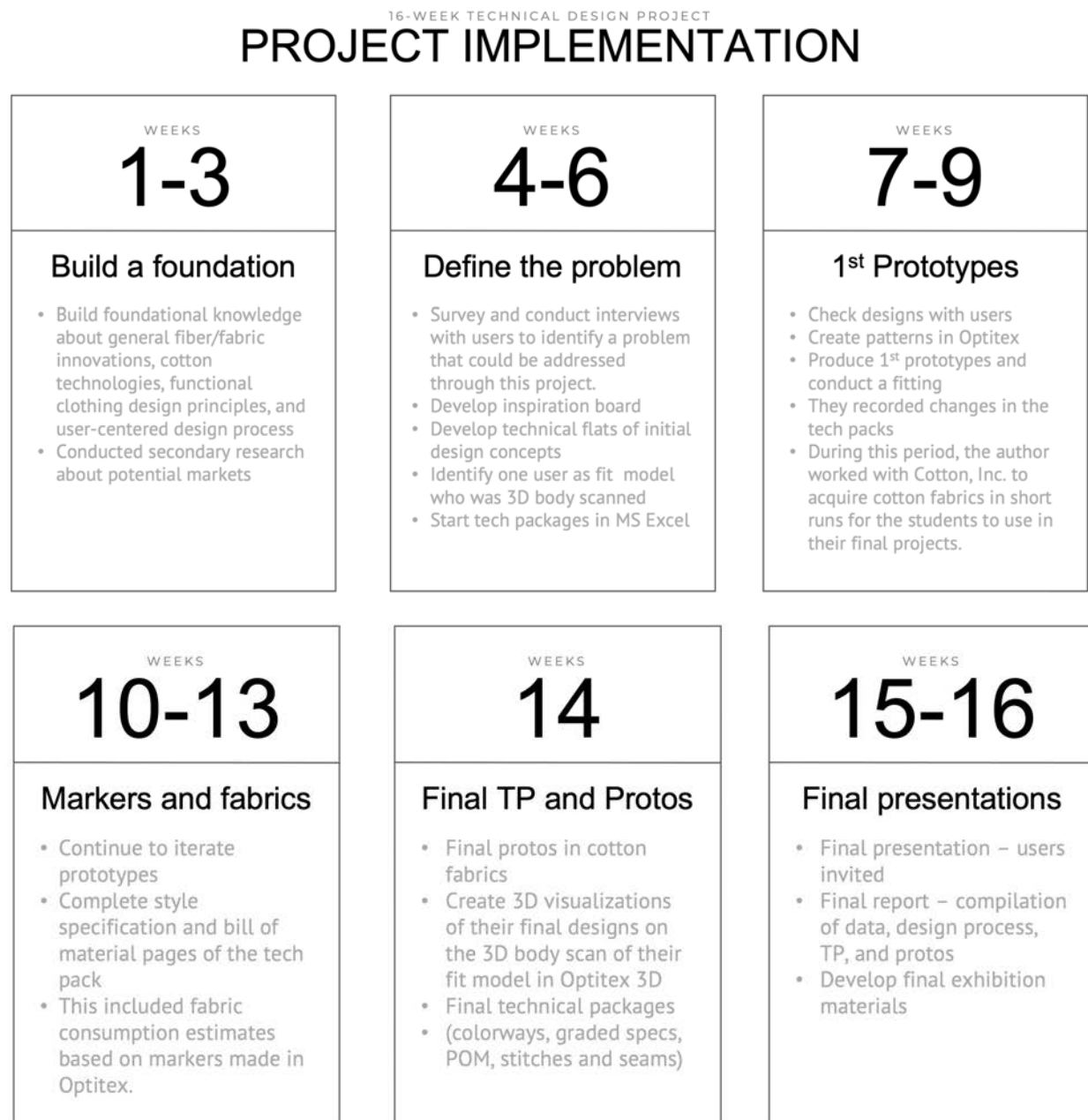
- Enhanced understanding of fiber and fabric characteristics
- Approaches to sewing with knit fabrics

- Integrated study of textiles and materials, design, fit, technology, biomechanics and ergonomics, and apparel production
- Functional clothing principles: mobility, materials, smart clothing and textiles, thermal protection, impact protection, and environmental considerations.

Apply user-centered design strategies to enhance the technical design of garments

- Creatively apply user needs that improve the design and use of your proposed garment.

Sample Schedule



Description of Semester Activities – Problem-based learning project

1. This semester we will work on a project aimed to increase your awareness of cotton fiber as an exciting option for activewear among future technical designers. This is a semester-long experiential learning product development project that is timely and academically engaging. The project is titled *“No Sweat: Teaching the next generation of technical designers about cotton performance technologies.”*
2. We will research and apply innovative cotton materials such as TransDRY® and Wicking Windows, apply functional clothing principles, and gather user insights to create innovative cotton activewear garments – skills that you would not have encountered elsewhere in the curriculum. Notably, this proposed project excels your learning in the areas of cotton material innovation, understanding the raw material supplier's role in fabric innovation development, and fabric finishing.
3. You will create and produce a professionally-constructed innovative cotton activewear garment system that meets the project objectives!
4. This class is divided into two class periods per week of 2 hours each. Week by week we will make progress on the project described above. I will use video/visual materials, power points, in-class activities, additional reading materials, discussions, and outside of class activities to give you information that you will DIRECTLY APPLY TO YOUR COTTON PROJECT. I try to incorporate a variety of approaches and types of assignments provided to reach a diverse range of learning styles.
5. We will use a Problem-Based Learning (PBL) Format. PBL is an active learning strategy in which students learn about a subject holistically through a significant design challenge that may enhance student engagement by giving focus to a design problem that is supported by a globally-recognized brand, Cotton, Inc. the experience of solving an open-ended question.
6. You will work in teams of 2-3 to achieve the project goals.

Coursework Overview

I will provide a detailed write-up of each project/assignment and a grading rubric on Canvas. You will complete the projects independently and with your partner both in class and outside of class. Due dates for all projects are on the course schedule but are subject to change.

- **PROJECT**

- **No Sweat: Teaching the next generation of technical designers about cotton performance technologies:** In a team, develop an innovative garment system (ensemble) based on the given design scenario. Work with actual users of the target demographic to create a collection of garments which address their needs. Follow each garment from initial concept through the sampling process. Develop tech packs and all supplementary information in enough detail that overseas factories could produce your garment.
 - **Instagram Posts:** Posts document your project process
 - **Interviews:** The interviews are done by the instructor/RA about your project. You are being interviewed :)
 - **Peer Evaluations:** Peer evaluations of your partner to document workload distribution and participation
 - **Discussions:** Posts and responses about innovative news relevant to the project. These have to come from the Sourcing Journal, Business of Fashion, or APPROVED news source (not WGSN). You will post discussions and respond to your peer's posts. These discussions are guided by a prompt given by the instructor.

- **ASSIGNMENTS**

- **Reading Comprehension Quizzes:** The quizzes cover the assigned readings, and they are due BEFORE the designated date. The quizzes are multiple choice and short answer. Students who do not complete the quiz before the designated time receive a zero for that quiz. There will be no make-up quizzes.
- **Excel Tech Pack Development:** Use industry samples provided to create tech packs. Using what you learn about developing a TP for the industry sample, develop TPs for your project.
- **Optitex CAD Assignments:** You will create patterns, virtually fit the garments, sew samples, and test the patterns. Using what you learn about developing a TP for the industry sample, develop TPs for your project
- **Other In-Class Assignments:** In addition to the assignments listed above, there may be other In-class activities where your participation is recorded via submission of the assignments.

GRADED ASSIGNMENTS	Points	Grade (%)	Scoring
PROJECT: No Sweat Cotton Inc. <ul style="list-style-type: none"> • Develop a product through Human-Centered Design with Users • Supplemental Research/Concept Testing • Tech Packs for product • Samples/Prototypes • Final Garments • Final PowerPoint Report/Presentation 	325	32.5%	Group
Instagram Posts: 20 posts @ 5 points each	100	10%	Individual
Interviews: 3 interviews @ 25 points each	75	7.5%	Individual
Peer Evaluations: 4 @ 25 points each	100	10%	Individual
Reading Comprehension Quizzes: 10 @ 15 points each on Canvas	150	15%	Individual
ASSIGNMENTS <ul style="list-style-type: none"> • Excel Tech Pack • CAD Assignments • Discussion Posts • Other in-class assignments 	150	15%	Individual
Attendance & Participation <ul style="list-style-type: none"> • Class Attendance (including working the full class period) • In class participation in activities • Participation in b-roll footage 	100	10%	Individual
TOTAL	1000	100%	

List of Lectures

Week	Lecture Topic	Sub-topic addressed in lectures
1	User-Centered Design	Ergonomics, Universal Design and Fashion Introduction to Apparel Tech Packs, PDM, and PLM Cooper Hewitt Access + Ability
2	Extreme Textiles Functional Clothing Design	Cottonworks TransDry Brochure Cottonworks Wicking-Windows-Technology Cottonworks Storm-Cotton-Technology Cottonworks Art of Finishing Parts 1-3
3	Data to Designs	Functional Clothing Design Cottonworks Webcast Control Odor Naturally with Cotton Activewear Sales A Natural Solution Cotton Lifestyle Monitor Winning in The U.S. Activewear Market Cotton Lifestyle Monitor
4	Cotton Fiber	The Use of Natural Fibers Cotton Lifestyle Monitor Consumers Willing to Pay Over Price Increases for Cotton Cotton Lifestyle Monitor Cooper Hewitt Where Do Our Unwanted Clothes Go?
5	Sportswear and Innovation	Sportswear, Fashion Innovation and Sustainability Leave Comfort to Clothes Cotton Lifestyle Monitor Infographic: Cooper Hewitt Global Apparel and Textile Insight
6	Pattern making and Sewing Stretch Knit Fabric	Apparel construction innovations Pattern Making and Sewing Stretch Knit Fabrics
7	Introduction to Optitex	3-D Virtual Prototyping
8	Optitex Continued	Apparel Industry Fit Sessions
9	Optitex Continued	ASTM D3181-15 Conducting Wear Tests on Textiles ISO 13407 Human-Centered Design Process
10	Intro, Fittings, and Communicating Changes in the Tech Pack	Cottonworks Garment Manufacturing Color Consistency from Concept to Production
11	Spring Break	
12	Markers and Bill of Materials Style Specifications	Apparel Production and Cost
13	Lab Dips and POM	
14	Graded Specifications	
15	Stitches, Seams, Cost, COO Optitex 3D Prototypes	
16	Finals Week	

Discussion Topics

1. Technical Design Career

Explore LinkedIn and find 3 postings which are titled Technical Design/er.

Create a discussion thread that summarizes the following:

- The companies you explored
- The main qualifications of technical designers
- Main skills required
- Skills that you are lacking
- Were you surprised by any of the posts? In what way?

2. CottonWorks Website

Create an account with CottonWorks. Copy and paste the URLs of 3 resources you discovered on the CottonWorks or Cotton Inc. websites:

How might the resources you found be valuable for your project this semester?

3. Access + Ability

Explore the website for the current installation at Cooper Hewitt museum in NYC.

ACCESS + ABILITY website

View All Exhibition Objects and summarize your top TWO objects. How are these "things" making life easier for users or how designers are expanding product solutions in new and innovative ways.

DeZeen Innovations in Activewear: <https://www.dezeen.com/2016/08/21/olympics-rio-2016-sportswear-design-athletics-kit-pinterest-board/>

4. Cotton Lifestyle Monitor

Dive deep into the different cotton fabrics available/suitable for activewear.

Start at these websites and articles:

- <http://lifestylemonitor.cottoninc.com/>
- site <http://TrendForecast.Cottoninc.com>
- Read the following articles.

- <http://lifestylemonitor.cottoninc.com/pumping-up-activewear/>
- <http://lifestylemonitor.cottoninc.com/activewear-sales/>
- <http://lifestylemonitor.cottoninc.com/winning-in-the-u-s-activewear-market/>
- <http://lifestylemonitor.cottoninc.com/the-buzz-behind-activewear/>

Craft a post that reports about your findings regarding cotton textiles for activewear and the cotton-rich activewear market. How may these facts help you explain/justify the use of cotton in your garments? This may be thought of as a start to "background research" that will be used to justify your selection of cotton fabrics for your project.

5. Identify and Justify Target Consumer


With your partner, create a thoughtful post that identifies and justifies your target consumer. Address ALL of the following:

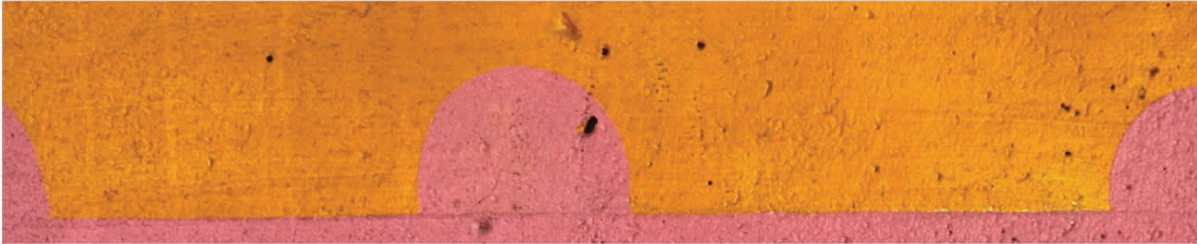
- For whom will you spend this semester designing functional garments?
- What is the main problem your target consumer experiences with their apparel and what are your very preliminary ideas to solve this problem? What is the problem? What is your apparel-based solution?
- What Cotton technologies would you like to use? Why?


6. Innovative Finds - Free for all post!

This discussion is space for you all to share innovative websites/products/news as it pertains to our project and class! Feel free to share!

Links to Project Videos

 Search





Mizzou TAM Technical Design

HOME

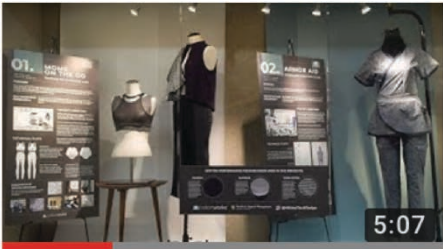
VIDEOS

PLAYLISTS

CHANNELS

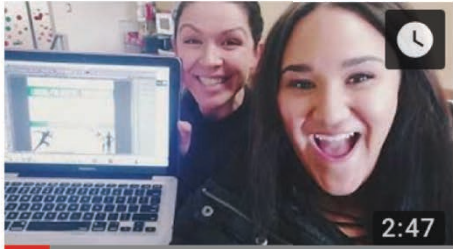
Uploads

PLAY ALL



**Cotton in the Curriculum:
Cotton-rich performance...**

12 views • 2 weeks ago



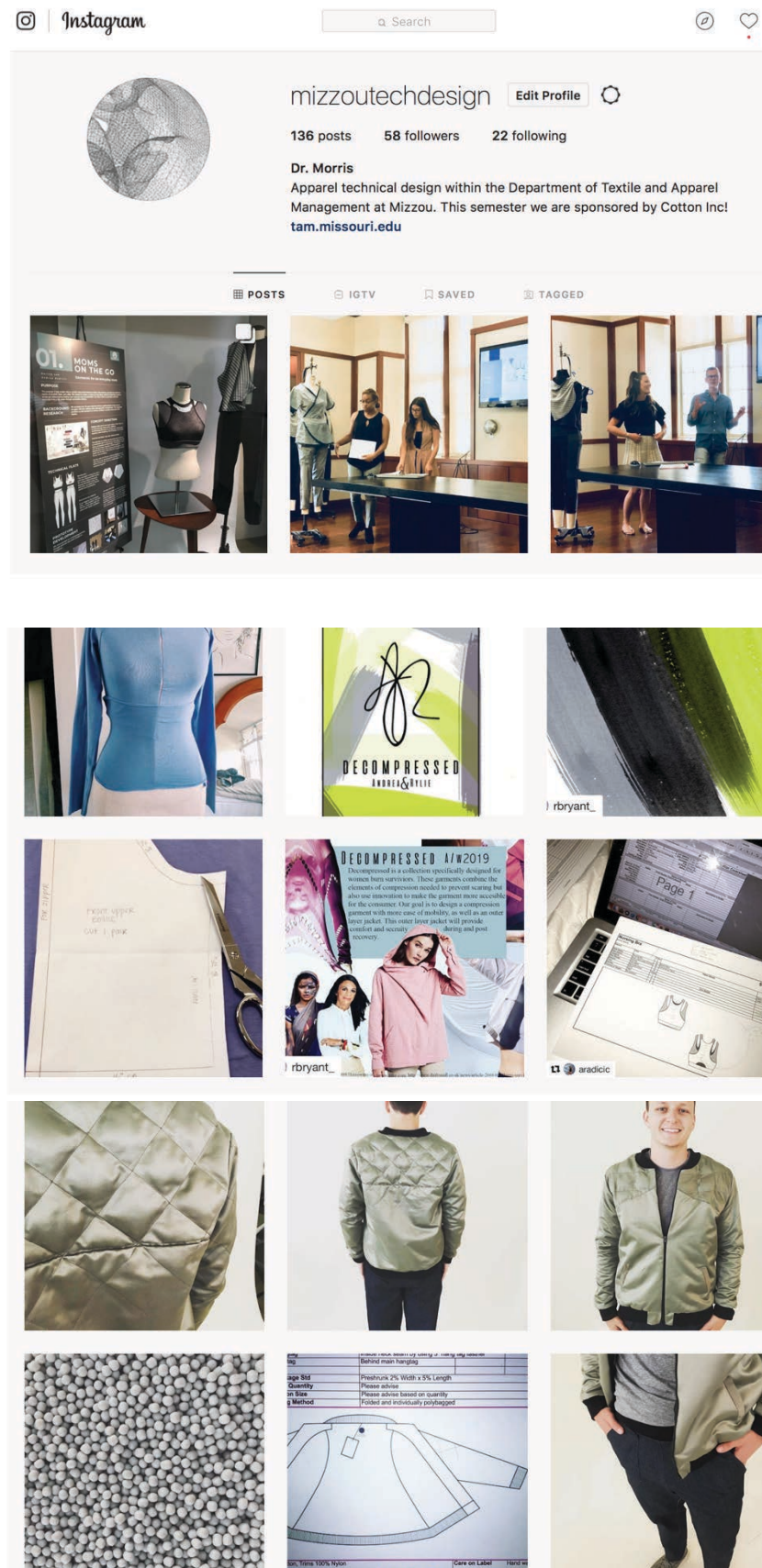
**Cotton in the Curriculum:
Cotton-rich performance...**

4 views • 2 weeks ago

<https://youtu.be/X-86owQ7j9Q>

<https://youtu.be/3gA3HQH6dtU>

The entire technical design process was documented on Instagram
@mizzoutechdesign



Student Final Projects

MOMS ON THE GO

Nursing sports bra and running vest that allows mothers to be physically active and easily breastfeed their newborns without being overexposed and uncomfortable. They used cottons with dirt and water repellent and moisture wicking finishes.

Featured laser-cut ventilation for thermal comfort.



Andrea Radicic and Darien Lee

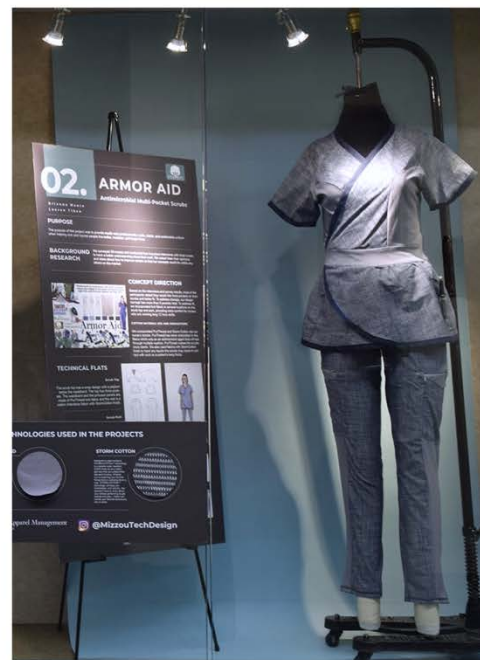


ARMOR AID

A scrub top, and pant that protects the wearer from fluids using microbe-fighting cotton fabrics. They also addressed mobility, utility, and thermal comfort in their designs.



Lauren Tihen and Brianna Moore



FEMALE BURN SURVIVORS

created a compression top and cover-up jacket for female burn survivors to be used during recovery. Their goal was to create garments that did not look like medical garments and yet served a functional purpose. Their designs have sporty-aesthetic appeal and use fabrics to help regulate body temperature.



Rylie Bryant and Andrea Bilgrein



MEN WITH A SENSORY PROCESSING DISORDER

created a bomber jacket and jeans for people who are affected by sensory processing disorders. The coat has weights hidden in the shoulders that provide a pressure sensation. Both the jacket and the pants have alternative closures and low-profile seams to allow the wearers to participate in everyday activities without added distractions.



Courtney Rock and Mandy Lupardus



PHYSICALLY ACTIVE WOMEN WHO HAVE HAD A LOWER LIMB AMPUTATED

developed an athleisure tank top, jacket, and pant with features that allow women who have had a lower limb amputated to quickly put on, take off or adjust their prosthetic leg. Their garments have innovations that integrate with prosthetic limbs, maintaining users' independence and personal style.



Nicole Eckerson and Hali Ipaye



Images of Exhibition of Student Projects





01.

MOMS ON THE GO



Darien Lee
Andrea Radicic

Garments for an everyday mom

PURPOSE

The purpose of this project was to provide busy breast-feeding mothers with athleisure garments that fulfill their needs of comfort, style, and utility. We wanted to create a nursing bra that allows mothers to feed their newborns on-the-go without being feeling over-exposed and uncomfortable. Our hope is that our garments make their everyday lives a bit easier through accessible clothing.

BACKGROUND RESEARCH

We surveyed over 70 post-maternity mothers, gaining insight on the common struggles with their clothing while managing their everyday lives. The responses provided us with examples of common problems everyday moms face within fashion.



CONCEPT DIRECTION

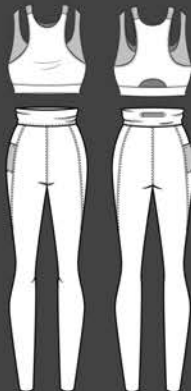
Mothers often don't have much variety in their style, so we had to fix that. Some of the problems communicated through our surveys were: feeling over exposed, ease of staining, lack of storage, and comfort.

COTTON MATERIAL USE AND INNOVATIONS

The daily life of a mother can be hectic and we wanted to incorporate fabrics that would provide utility, while still being comfortable and fashionable. The StormDry fabric with Dirt and Water Repellent (DWR) is great for keeping liquid stains from soaking into the fabrics. The liquids can be easily wiped away and is a great addition for any mom on the go.

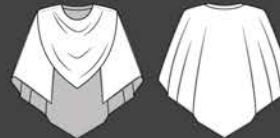
We also used PurThread, a microbe fighting fabric to help reduce any bacteria growth and fight odors. This allows moms to stay fresh for multiple wears, while remaining hygienic.

TECHNICAL FLATS



Nursing Bra

The two-layer nursing bra with a pull down front provides access for nursing without having to expose the entire breast. We also laser cut vents for thermal comfort and breathability.



Nursing Cowl Vest

We wanted to create an easy to wear vest that provided a cover while nursing without restricting the mother or the baby. Many nursing mothers wear scarves to conceal themselves so we included a removable cowl, reminiscent of a scarf into an easy to wear vest hybrid.

Post-Maternity Legging

In our leggings, we prioritized utility - more pockets, more fun. We also made them high rise with a wide elastic waistband.

PROTOTYPE DEVELOPMENT

We documented our prototyping process through pictures that were posted on Instagram.



cottonworks™

02.

ARMOR AID

Antimicrobial Multi-Pocket Scrubs

Brianna Moore
Lauren Tihen



PURPOSE

The purpose of this project was to provide health care professionals a safe, sterile, and comfortable uniform when helping sick and injured people live better, healthier, and longer lives.

BACKGROUND RESEARCH

We surveyed 20 nurses and conducted four in-person interviews with local nurses to have a better understanding about their work. We asked them their opinions and ideas about how to improve scrubs so that our concepts would be unlike any others on the market.

CONCEPT DIRECTION

Based on the interviews and survey results, most of the participants stated they would like more pockets on their scrubs and better fit. To address storage, our design concept has more than 9 pockets total. To address fit, we incorporated knit fabric in several locations on the scrub top and pant, providing extra comfort for nurses who are working long 12 hour shifts.

COTTON MATERIAL USE AND INNOVATIONS

We incorporated PurThread and Storm Cotton into our nurse's scrubs. PurThread has silver embedded in the fibers which acts as an antimicrobial agent that will last through multiple washes. PurThread makes the scrubs more sterile. We also used fabrics with StormCotton finish to repel any liquids the scrubs may come in contact with such as a patient's body fluids.

TECHNICAL FLATS

Scrub Top

The scrub top has a wrap design with a peplum below the waistband. The top has three pockets. The waistband and the princess panels are made of PurThread knit fabric and the rest is a cotton chambray fabric with StormCotton finish.

Scrub Pant

The scrub pant has six pockets, two just below the waistband and two located on each side of the pant leg. PurThread knit fabric was added at the side panels for better comfort and the rest of the pant used a cotton chambray fabric with StormCotton finish.



PROTOTYPE DEVELOPMENT

We developed two prototypes of the scrubs and conducted virtual and physical fit tests to develop our final product.



03.

DECOMPRESSED

Apparel For Female Burn Survivors



Rylie Bryant
Andrea Bilgrien

PURPOSE

The purpose of our project was to provide a means by which burn survivors can effectively recover and treat superficial wounds while also providing a means for mobility and tactile comfort.

BACKGROUND RESEARCH

Our participants were a variety of ages and genders, however we decided to focus in on women burn survivors 16 years and older. There is not a correlation between burn survivors and economic status, family status, gender, ethnicity, or geographic location. In this project, we conducted one in-person interview and five interviews over the phone.



CONCEPT DIRECTION

We found that our consumers wanted garments that were easy to take on and off, easier to care for, and more breathable. After the recovery process survivors are often still attached to the compression garment as a form of security, this lead us to design the jacket.

COTTON MATERIAL USE AND INNOVATIONS

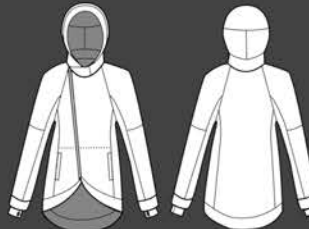
PurThread Cotton was perfect for our target market because it has silver fibers that fight against bacteria which in turn could help prevent infections among burn survivors. PurThread Cotton also fights against odor and requires less laundering, this benefits our consumer as they spend a large portion of the recovery process in and out of the hospital.

TECHNICAL FLATS



COMPRESSION UNDERSHIRT

The purpose of the compression garment is to help prevent scarring throughout the recovery process. There are three rows of hook and eye tape along the bottom portion of the compression garment so that the wearer can adjust compression based on their needs.



COVER-UP JACKET

The jacket helps regulate body temperature and provides mental and physical comfort during recovery process. Our jacket has a removable hood and magnetic zipper opening that helps wearers with dexterity issues get dressed by themselves.

PROTOTYPE DEVELOPMENT

We created three samples for each of our garments and a 3D virtual sample in Optitex to check the garment fit and style lines.



cottonworks

Hidden function for men with sensory processing disorder

PURPOSE

BACKGROUND RESEARCH

CONCEPT DIRECTION

Sense of Ease

Team Sensation was inspired by simple style and proven detail to create a new silhouette in easy, yet stretch knit. Ease accessibility to key components like pockets and zippers. And, stretch and easy to regulate temperature. The use of stretch knit is used exclusively where a subtle change in color will bring out your inner New York. Innerwear is beautiful and the best technology will create a sense of comfort, invisibility and personalized experience.

CELESTY

Team Sensation

We used TransDRY Cotton on each of our garments. Fabrics with TransDRY keep the wearer dry and comfortable. The weighted bomber is made out of cotton sateen with a cotton lining and cotton batting. The jeans were made out of cotton denim.

TECHNICAL FLATS

WEIGHTED BOMBER JACKET

SEW-FREE JEANS

Four pairs of trousers are displayed side-by-side. The first two pairs are dark blue, and the last two pairs are light beige. Each pair consists of a front view and a back view. The trousers have a simple, straight-leg design with a visible waistband and pockets.



PROTOTYPE DEVELOPMENT



05.

EXPLORING ACTIVE DESIGN FOR AMPUTEES WITH PROSTHETIC LIMBS



Halimat Ipaye
Nicole Eckerson

User-centered design for amputees living an active life

PURPOSE

The purpose of this project was to provide female lower limb amputees who utilize prosthetic limbs aesthetically pleasing, adaptive, and durable active apparel. The versatile designs are easy to don and doff, integrating with prosthetics for optimal performance and independence.

BACKGROUND RESEARCH

We interviewed seven people who have had a lower limb amputated and two occupational therapists to learn about problems with clothing. The key needs of our market were centered around functionality. They are active and always on the go. They need comfortable clothing that they can wear to a variety of places including the gym and physical therapy.

CONCEPT DIRECTION



Our interviewees expressed the need for easy access to their prosthetic limb. Dressing and undressing can be difficult if clothing is too tight and there is lack of access. Pants need reinforcement where the prosthetic limb meets the residual limb because fabric tends to wear out in this area. Our users also need large zippered pockets to keep valuables safe. If participants store an item on the side of their prosthetic limb, they cannot feel when an item has slipped from their pocket.

COTTON MATERIAL USE AND INNOVATIONS

Our designs utilize fabrics with TransDRY and Storm Cotton finishes for moisture management and dirt or water repellent. Using fabrics with these features make the garments more versatile.

TECHNICAL FLATS



JACKET

Our jacket can easily transition from the gym to running errands to work. The details and construction provides the support of activewear with sophisticated fabrics and silhouettes.



LEGGINGS

The leggings zip up the side for easy access to prosthetic limbs. There is support and reinforcement in all the right places to reduce wear and tear from the prosthetic.

PROTOTYPE DEVELOPMENT

This is the creative process of creating this activewear for female amputees who utilize prosthetic limbs.



Sample Student Final Project Report



TAM 3480- Tech Design

Burn Survivor Apparel

Rylie Bryant & Andrea Bilgrien

TAM 3480 Technical Design + Dr. Morris
Textile and Apparel Management
University of Missouri

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Executive Summary



Main points of the project:

- Work with potential target market to develop designs
- Employ technical design concepts and technical cotton fabrics in designs

The goal of this project was to create an ensemble for a specific target market with specialized needs that are not currently being met by the apparel industry. Cotton Incorporated made technical fabrics available for us to consider for use in our designs, helping with the process of textile research. Using target market research and concepts of technical apparel design, we have created garments for an underserved market that are both fashionable and functional.

Purpose Statement



The purpose of our project was to provide a means by which Burn Survivors can effectively recover and treat superficial wounds, while also providing a means for mobility and tactile comfort.

After considering different types of medical patients and their needs for apparel in regards to treatment and healing, we decided to focus on burn survivors. While the final product may be applicable to many groups of people, the target market being burn survivors bring the main focus of the project to tactile comfort and range of motion.

Background Research

Our research started out with our own individual research, focused mainly on blogs and specific communication platforms for burn survivors to share their experiences. We reached out to a local burn survivor support group and were invited to attend a meeting. From there we were connected with survivors in all different stages of recovery.

User Research

Our target market, women burn survivors, have the same goals and ambitions of any women you would expect of their age. There is not a correlation between economic status, social status, family status, health, geographic location etc. They are normal people who have suffered a trauma and each situation is unique.

Materials and Fabric Research



Key points while considering fabrics:

- Comfort
- Anti-bacterial properties
- Easily cleaned
- Breathability
- Moisture control

For both our compression garment and our jacket we would like to use PurThread Cotton. Our target market spends a lot of time in and out of the hospital and the antimicrobial and antibacterial properties that the PurThread provides would benefit the consumer. This would help fight infection and would require them to wash the garments less frequently.

Competition



Compression Garments

- Custom Fit
- "Sterile" Hospital Garments

There is very limited competition within the Compression Garment industry. The garments are custom fit and tend to be measured by physical therapists in the hospital during the recovery stages. One can easily buy compression sleeves, gloves, and masks online, but tops and pants are harder to mass produce.

The Interviews



Overview of market research:

- WHO: Women Burn Survivors; Teens (16) +
- WHAT: Women who have survived burns on their arms, torso, chest, and hands
- WHEN: The interviews took place before we started designing the garments that way we could have a better idea of what specifically the consumer wanted
- WHERE: The interviews took place locally in Columbia and St. Louis Missouri
- HOW: One interview was conducted at the University of Missouri Hospital and the other 5 interviews were conducted over the phone.
- WHY: Burn Survivors are typically over looked in regards to apparel and we wanted to provide a more functional and aesthetically pleasing garment compared to competitors on the market.

Recruitment and Data Collection

In order to recruit people for our project, we first started by e-mailing a Burn Survivor support group, located locally in Columbia, MO. We met with a man by the name of Steve Solomon and interviewed him at the University of Missouri Hospital. Mr. Solomon then directed us to the Burn's Recovered Survivor support group located in St. Louis. We proceeded to contact a man who works for the non-profit by the name of Mark Esker. He directed us to multiple members of the St. Louis support group. We conducted 1 in person interview and 5 interviews over the phone. Each interview lasted about 15-20 minutes. We took notes for each interview and compared the similarities and differences between each burn survivor case.



Interview Questions

- Tell us a bit about yourself, what is your story?
- Where are your burns located?
- How has that impacted your everyday mobility/body function/range of motion?
- How long was your recovery process?
- How much time did you spend in and out of the hospital?
- What did the recovery process involve?
- Did you have any issues physically dressing yourself/ and if so what are they?
- Do you currently wear/have worn a compression garment?
- What do you like/dislike about the compression garment?
- How has this affected your ability to wear specific types of clothing?
- Has this restricted/confined you to particular types (Styles/fabrics) of clothing?
- Have clothes that you wore previously become physically or mentally uncomfortable?
- Have you noticed any particular clothing that is irritating and that you try to stay away from buying?
- Is there anything as far as technical clothing (compression, pH levels, treatment, scaring) you wish you would have had to help with the recovery process?
- What type of fabric do you like best and why?
- What type of fibers do you prefer (cotton, polyester, nylon, wool?)
- If you could design your ideal garment what would it be like?
- What features would it have?
- What colors would you prefer? Skin colors or vibrant colors?

Data Analysis

In order to analyze the data, we had different documents for each person that we interviewed. We then proceeded to pull out the similarities from each interview of what the target market/consumer wanted. This helped us to narrow down specifically what we wanted to design, and how our garments could better the lives of our consumers.

Key Findings about Users' Needs



- Compression garments are uncomfortable and difficult to put on
- Garments must be easy to wash
- Must allow full range of motion
- Users have a strong demand for garments that don't look exclusively like medical garments
- Users have a difficult time regulating body temperature

Our Target user is women from the ages of 16 and beyond who have been burned on the arms, torso, chest, back, hands, and neck. Age, income, background, family status, and geographic location were not relevant in this study as burns are not limited to a particular demographic. When talking to the women we interviewed one of their main concerns was the appearance of the garment. They wanted to be able to wear the garment without having to put additional clothing overtop. This lead us to design the compression garment to appear more like active wear, as athleisure is a current trend in the apparel industry. We also designed it to be thin enough (while still compressing) so that the wearer could layer it under our Asymmetrical jacket. Our primary material was PurThread Cotton, as it was light weight, breathable, stretchy, and met the unmet needs of our consumer. Our main design function was focused on dexterity issues and the ease of taking the garment on and off. In addition to our 6 interviews we conducted we read different articles and blog post in relation to technology in the apparel industry as well as burn survivors.

Interviewee Demographics and Psychographics

Provide data about your participant's demographics in the table below (modify as needed). And in this space, write a short paragraph that summarizes the demographics/psychographics of your participants.

	Age	Occupation	Key Wants/Needs
Jessica Thurman (Her Son)	19	Student	Want to be able to get the garment on without help. Less friction between the skin and the garment. Retaining moisture in the skin. More zippers.
Mark Esker	Unknown	Unknown	Provide Physical and mental comfort, difficulty getting dressed, allergic to wool, breathability, less friction between garment and skin.
Crystal Lee	Unknown	Unknown	Ascetically pleasing, retain moisture, soft to the skin, not irritating when working out.
TJ	Unknown	Unknown	<i>Get things on and off easier. Skin gets dry really easily, maintain moisture. Better Zipper placement.</i>
Sharon	Unknown	Unknown	Wants something cute that can be worn out in public, more mobility and easier access, wants to be able to put the garment on without help.
STEVE SOLOMON	UNKNOWN	UNKNOWN	HIS WIFE NEEDED HELP GETTING DRESSED, SHE ALWAYS WORE THE COMPRESSION GARMENTS UNDER HER CLOTHES, REALLY HOT IN THE SUMMER, MORE BREATHABILITY.

Description of Project

Problem Statement



Problems Faced by the Consumer

- Aesthetic Appeal
- Regulating Body Temperature
- Dexterity Issues
- Mobility Issues
- Skin Irritation

The specific goals for this project were:

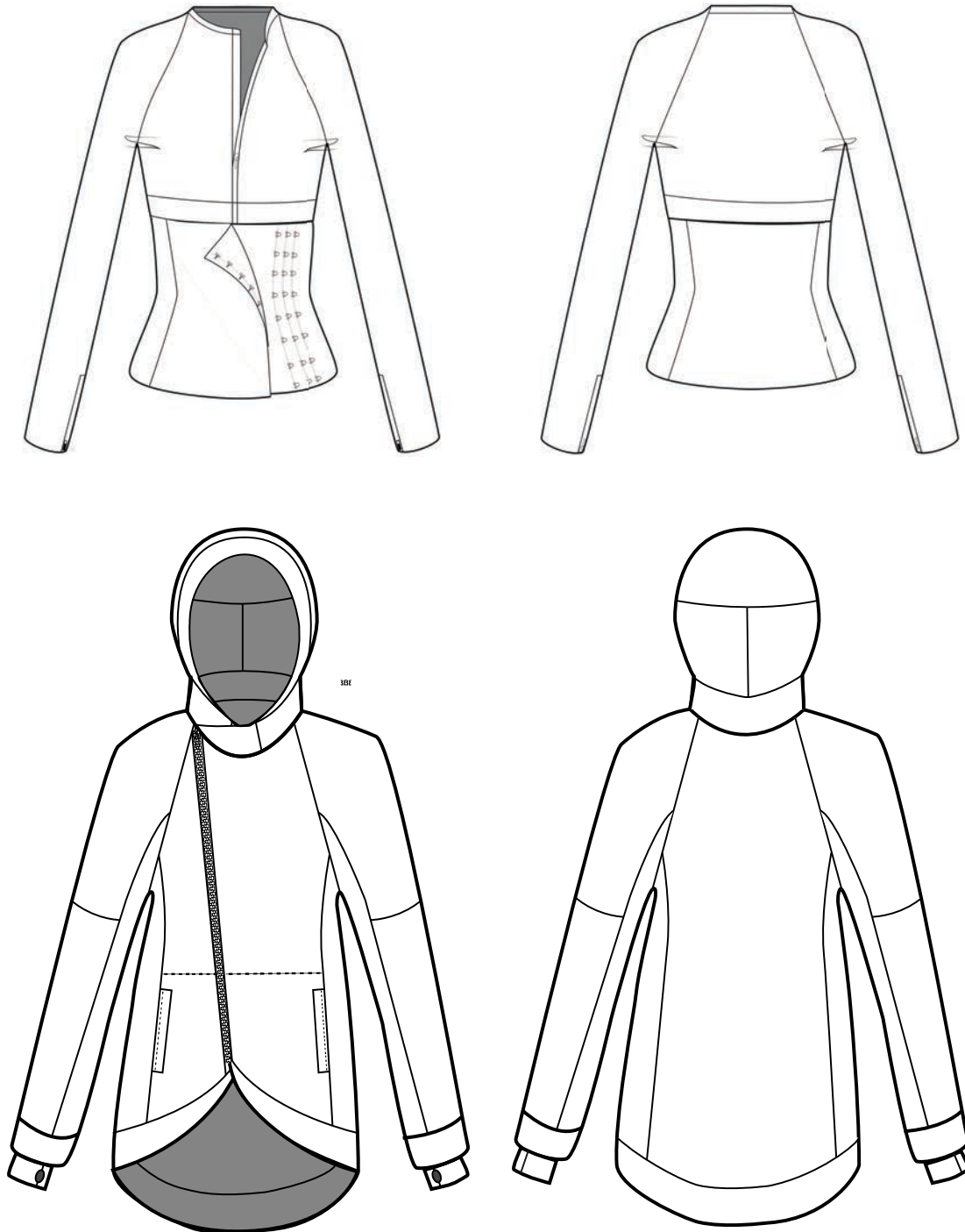
- GOAL 1: Create a functional and aesthetic compression garment
- GOAL 2: Create a garment to accompany the compression top, following the target market needs
- GOAL 3: Employ technical cotton fabrics that are appropriate for the design

Inspiration



We were inspired by seamless garments and accessibility. We wanted the garment to be comfortable against the skin, especially throughout the healing process. We also were inspired by unique ways to make the garment easier to take on and off.

Design Concepts



This garment is more focused around aesthetic than the compression garment, but still has functional qualities. Comfort was of critical importance in this design, which led to a loose fitting shape, raglan sleeves for mobility, and the double-knit cotton fabric that was used for the final. The hand warmers were a component that was thought of after most of our interviews. We learned that it is common for burn survivors to become emotionally attached to their compression garments and they are hesitant to take them off once they reach that point in the recovery process. The hand warmers are a little piece of their compression garment that they can continue to wear after the skin heals for comfort and peace of mind. We chose to also incorporate a removable hood to add value to the wearer.

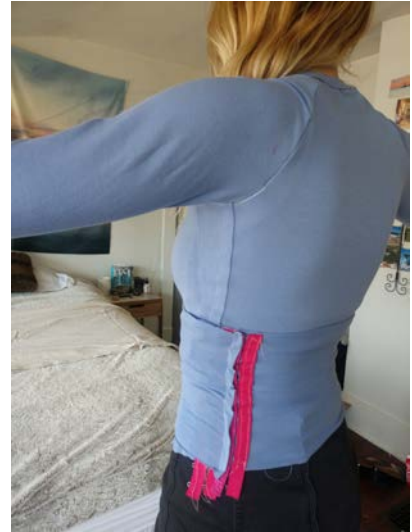
Final Materials and Fabrics Used in Concept

- PurThread Plated Single Jersey: Used in Compression Garment
 - Features: Anti-microbial/bacterial properties
 - We used this fabric because of the breathability, the stretch, and the anti-microbial properties
- Jacquard Double Knit: Jacket
 - Features: We would have this fabric treated with the PurThread as well

Prototype Development

We began drafting patterns for our garments using base patterns, for the compression garment they were from a rashguard and a tight fitting bodysuit, for the jacket they were from a different basic jacket. From there we made the modifications necessary to make the design our own and to meet the needs of our target market. We created the drafts of our patterns and modified them between each prototype (three total).

Prototype 1 Fitting



Fitting Procedure

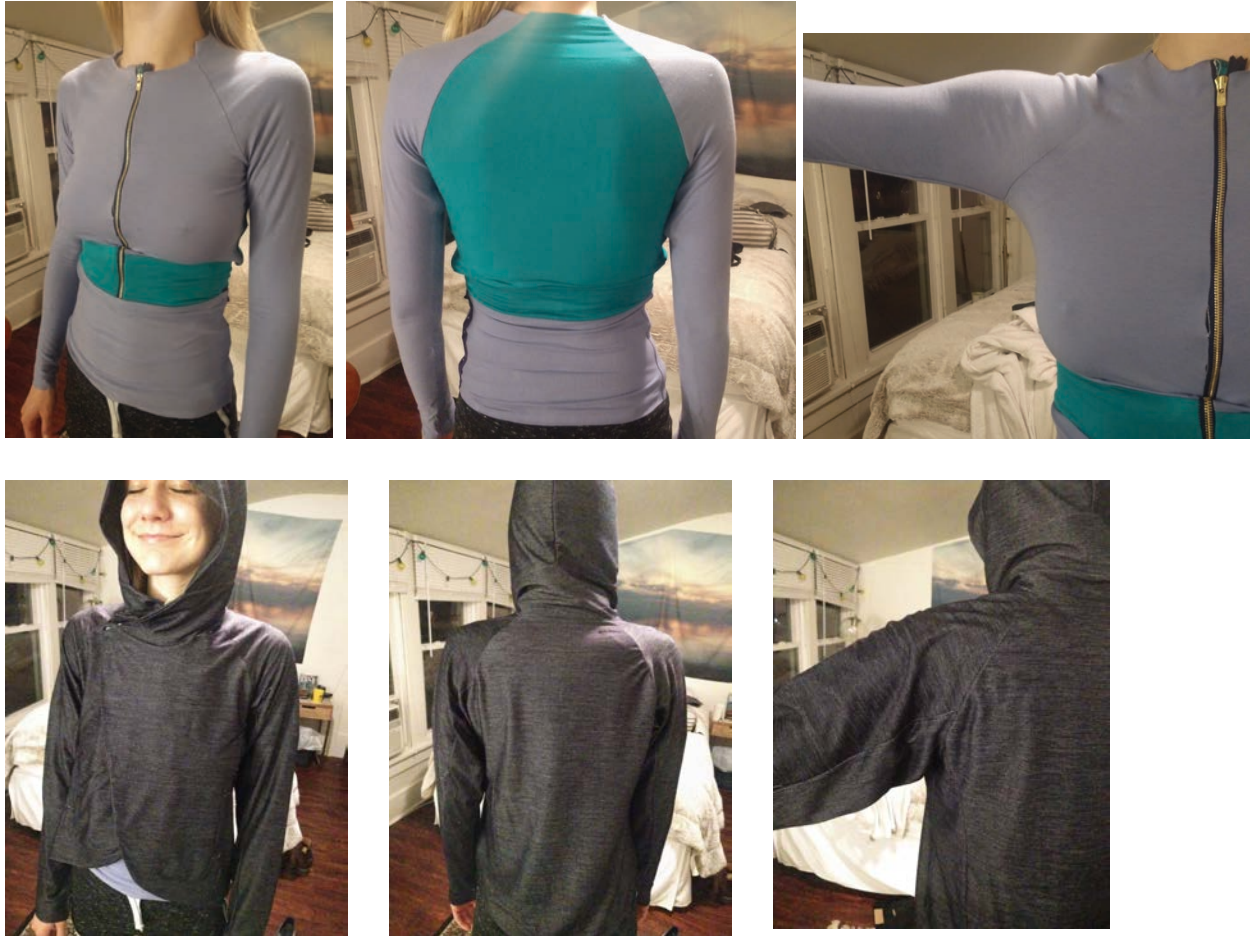
The main goal of the fit test was to make sure the compression garment applied pressure in the right places while still being comfortable for the wearer. Our fit model tested both garments in a casual environment, not too active, but wearing the garment for several minutes while she performs her regular daily activities. Images were taken of the fit model in the garments to capture any errors or room for improvement and then marks were made directly on the prototype where changes were needed.

Fitting Results

One can see in the photos of the compression garment where there is extra fabric around the armholes and length of the sleeves. We made notes to remove that extra fabric and create the next prototype with more accurate zippers. This garment took some trial and error to figure out the best way to use heat-pressed seams, so that was noted for the next prototype as well.

The jacket was easier to fit and the changes made to it from prototype to prototype were less substantial. We added two additional inches to each piece that creates the front of the garment for more overlap and drafted patterns for the waistband missing from this prototype.

Prototype 2 Fitting



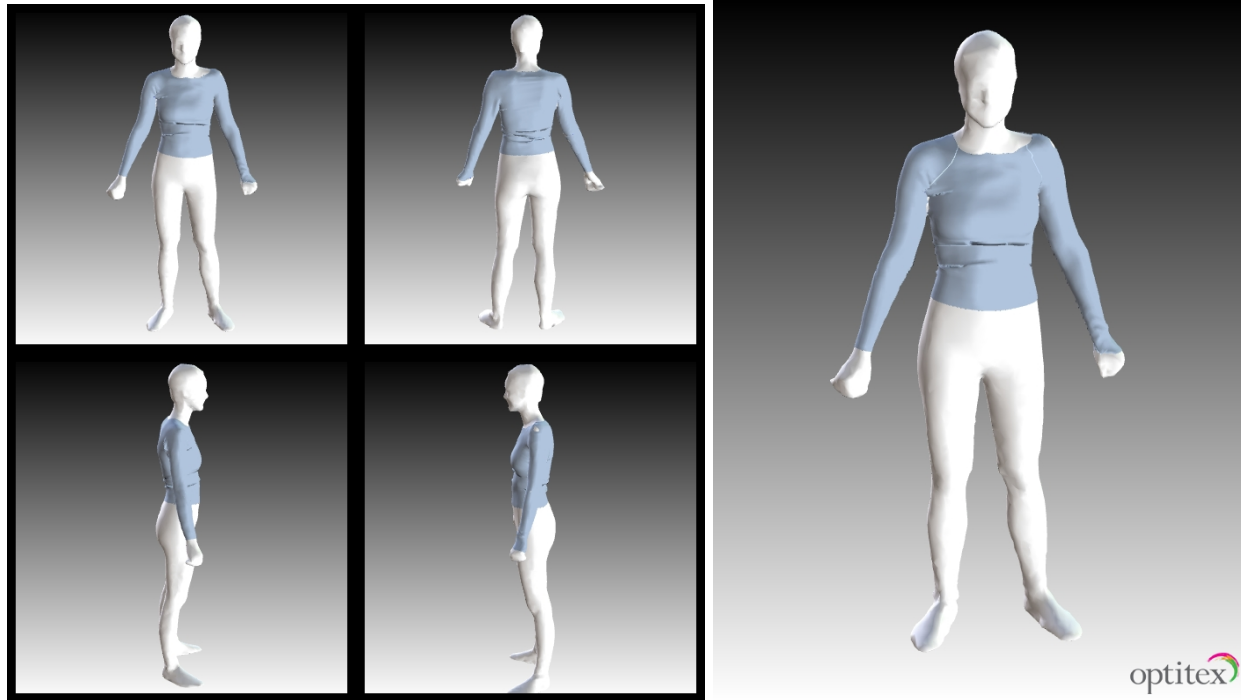
Fitting Procedure

This procedure was essentially the same as the first fit test. The fit model put on the garments and performed some regular activities. She kept the garment on for 20-30 minutes taking note of comfort and range of motion. After that time, we took photos of how the garments were fitting and made any necessary marks where changes were needed.

Fitting Results

With this prototype there was just a little more excess fabric around the shoulder and underarm to take out. We made some changes with the way the band laid under the bust so it was more flat and comfortable, sewing the lower part of the compression garment underneath this band. The jacket patterns were fitting quite well, we just decided to add two extra inches of length to the body of the jacket for aesthetic reasons.

Optitex Virtual 3D Fitting



Fitting the garment in Optitex was more difficult than fitting the garment in real life. Optitex is not the most user friendly approach as it was difficult for us to make quick adjustments and add things such as a zipper, neckband, and waistband. However, Optitex allowed us to very easily see where an excess of fabric might be. However, the bunching in the image could also be due to the type of “fabric” in the Optitex system. Overall, if Optitex was more user friendly, I think it would serve as a great benefit for our compression garment and jacket. Because our compression garment would need to be adjusted to the individual person, this would allow us to scan in the burn survivors body measurements to custom fit them to the garment. It would reduce the probability of irritation because we would be able to see which areas would be too tight.

Fitting Conclusions

For our final compression garment, we would still need to change the bottom wrap portion. The fabric that we used was a black cotton sateen. It would have been better for us to use the same PurThread Plated Single Jersey Knit that we used for the top portion of the compression garment. The cotton sateen did not have as much stretch and it was difficult to adjust the patterns to make up for the amount of stretch that we lost and still maintain the compression.

Overall for the jacket it fit well, if we were to make any changes to the jacket, it would be to make it a little bit longer to cover the compression garment underneath. The fabric that we used for the first two samples was similar to the cotton double cloth that we used for the final jacket.

The Final Project



Special Features

- Magnetic Zipper
- Detachable Hood
- Unique Closures



Summarize your overall project/garments here including any special features. Below you will have an opportunity to dive deep into the technical aspects (like fabrics, trims, fit, construction) – so up here keep it more conceptual.

Technical Specifications



- Magnetic zippers
- PurThread fabric
- Heat-pressed seams
- Technical modifications to seam placements

Limitations of Project and Future Work

We achieved a lot of our goals in regards to aesthetics, mobility, and functionality. What was harder to complete was making the garment with as little seam bulk as possible. If we had the technology, we would have liked to make the majority of the garment without seams. By using the Bemis seam tape we were able to explore this possibility.

If we had the resources and technology we would have like to explore how we could localize the pressure to certain parts of the body, and focus more on regulating the body temperature with the compression garment and the jacket.

Reflection on User-Centered Design

Working with the users of our target market was extremely beneficial in our design process. Neither one of us are burn survivors ourselves so being able to understand what the consumer struggles with and how their needs are different than our own was a huge aspect of our project.

The users influenced our design work by presenting us with new ideas that we had not considered, and sharing their struggles with garments that they currently own. This allowed us to explore new concepts focused around what was most important to the consumer. We were also able to compare what multiple consumers said and make a decision based on what was the common similarities.

The majority of our final concept was driven by user input. As designers we took what the users said they wanted and we focused on the functionality and aesthetics of making the garment they needed. For instance, they mentioned that as they gain weight they would have to go and get refitted for a compression garment. As designers we decided to make the bottom half of the garment adjustable in order to reduce the amount of adjustments needing to be made to the garment. Ultimately we wanted to design what the consumers wanted, and it was our job to execute their wants realistically.

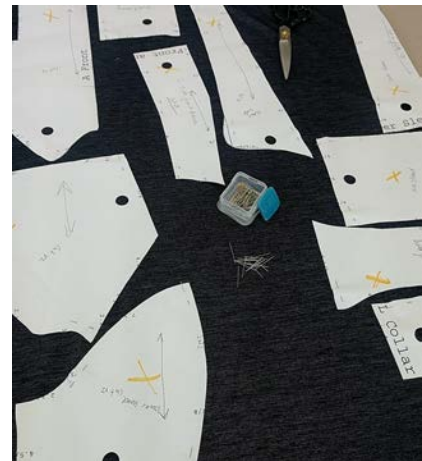
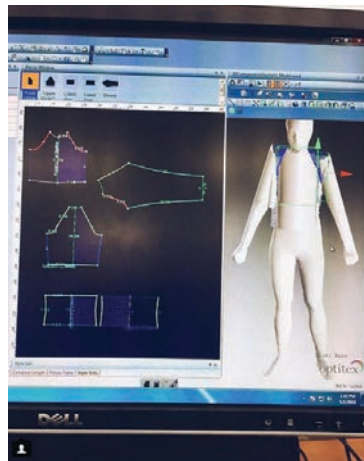
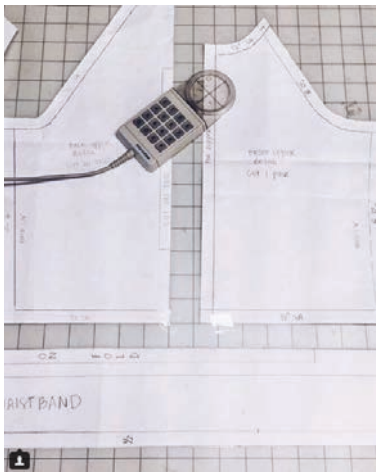
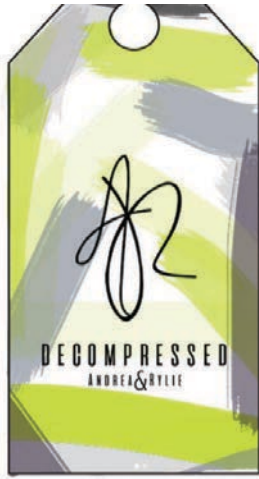
Appendix

Contents of Appendix

- Process documentation on Instagram
- Technical Package for Compression Garment
- Technical Package for Jacket

Process Documented on Instagram

Choose 9 of your best pics (between the two of you) that document your process. Place in a grid format on one page here (pic only – no caption).



Sample Student Final Technical Specifications

Decompressed Compression Top				Product Spec Coversheet	
Style #:	2110	Last Updated:	3-May-18		
Style Name:	Compressed	Date Created:	3-Apr-18		
Description:	Women's Fitted Compression Top	Developer:	Rylie Bryant		
Category:	Women's	PLM:	Dr. Morris		
Size Range:	XS-XL	Fit Block:	Women's Compression Top		
Season:	Autumn/Winter	Status:	New		
Year:	2018				
Vendor:	TBD				
Country of Origin:	Bangladesh				
Status of Garment					
	Author	Proto Number	Date Evaluated	Status	Instructions to Vendor
Approval 1st Proto					
Approval 2nd Proto					
Approval 3 (if needed)					
Salesman Sample					
Jump Sizes					
Size Run					
Pre-Production					
TOP Samples					
Status of Trims					
	Author	Trim Number	Date Evaluated	Status	Instructions to Vendor
How to Proceed					
1					
2					
3					

Decompressed Compression Top

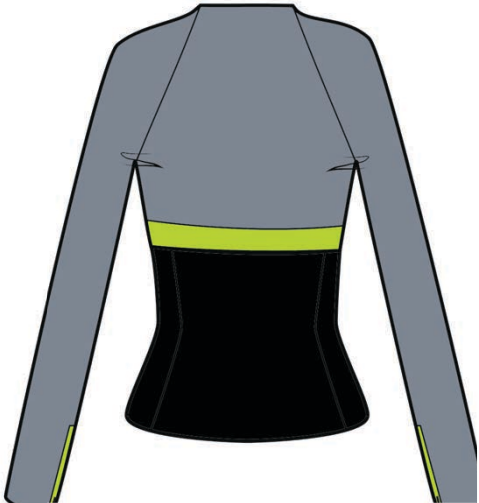
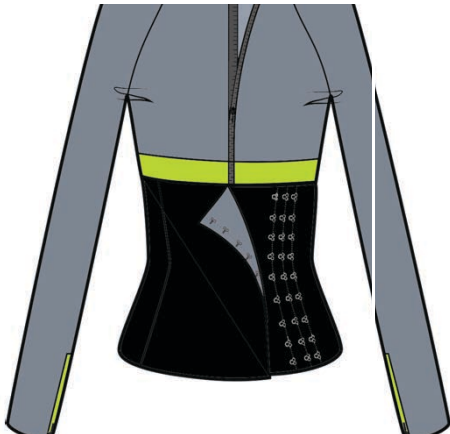
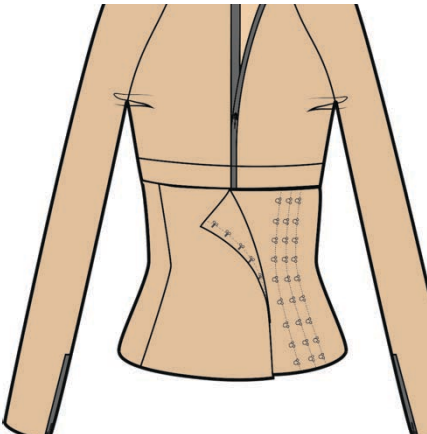
Kristen Morris

Colorway

Date Cre

3-A

	Colorway Name	pper Bodice Fror pper Bodice Bac Sleeves	Waistban	Lower Bodice Front Lower Bodice Back	er Bodice Lining	Topstitching	Sleeve Zipper 1
Category:	Women's						
Country of Origin:		Bangladesh					



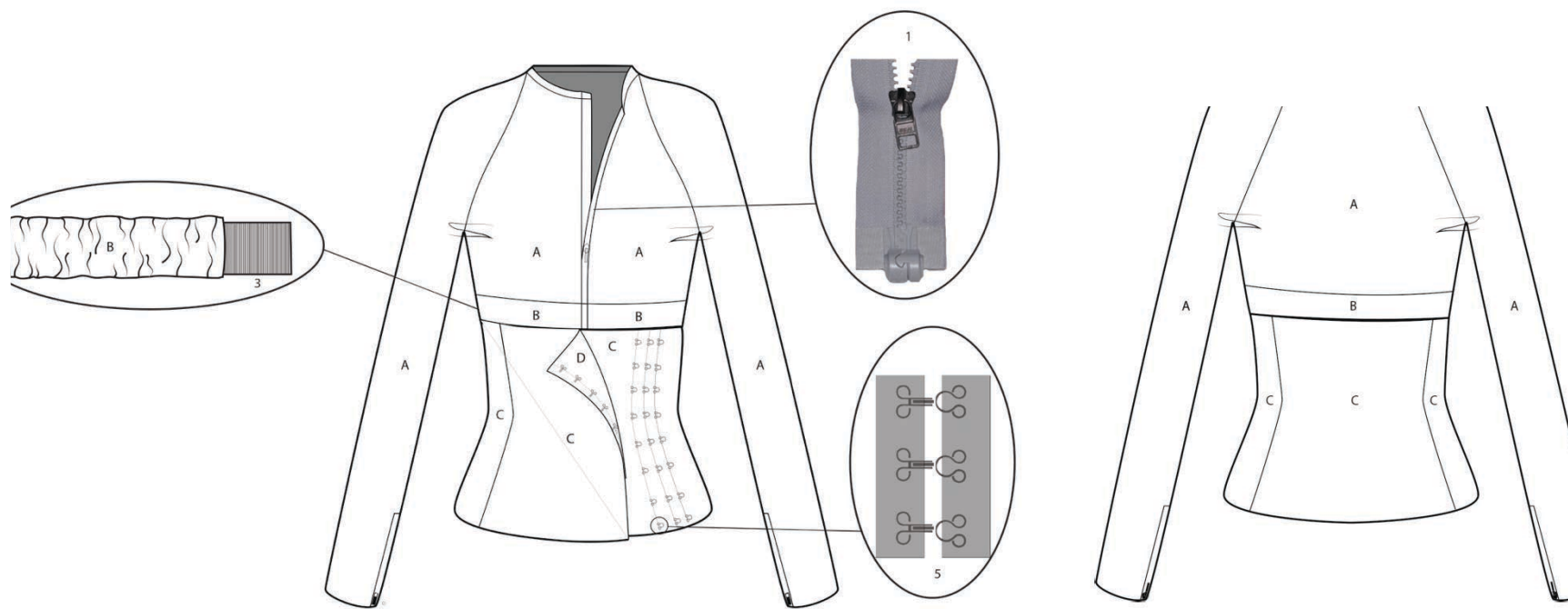
Decompressed Compression

Kristen Morris

Style Spec

Date Cre

Style #:	2110	Fabric Details	Use/location
Season:	Autumn/Winter	Trim Details	Location



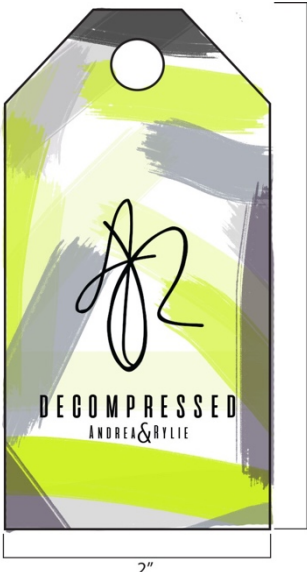
Decompressed Compression Top

Style Specs - Hangtags/Label

Kristen Morris

Date Created3-Apr-2020

Category:	Women's	3	Brand Label (inside) CB neck on quilted lining 1.5" down from CB collar seam (as measured from center of tag)
Country of Origin:	Bangladesh	Carton Size	Please advise based on quantity



Content on Label

Upper: 76% Cotton 14% Spandex 10% PurThread Lower: 92% Cotton 8% Lycra

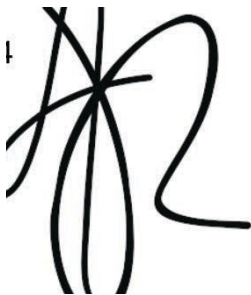
3

DECOMPRESSED
ANDREA & RYLIE

Size M

2 Made In Bangladesh
76% Cotton, 14% Spandex, 10% PurThread,
Cotton/Lycra Blend

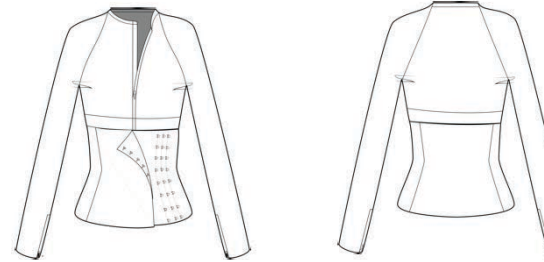
1 Cold Wash, Tumble Dry Low Heat,
Do Not Bleach



Content on Label

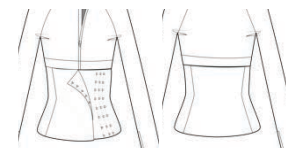
Cold Wash, Tumble Dry on Low Heat, Do Not Bleach

Style Nan	Compressed
Year:	2018

[illegible]

Decompressed Compression Top

Graded Spe

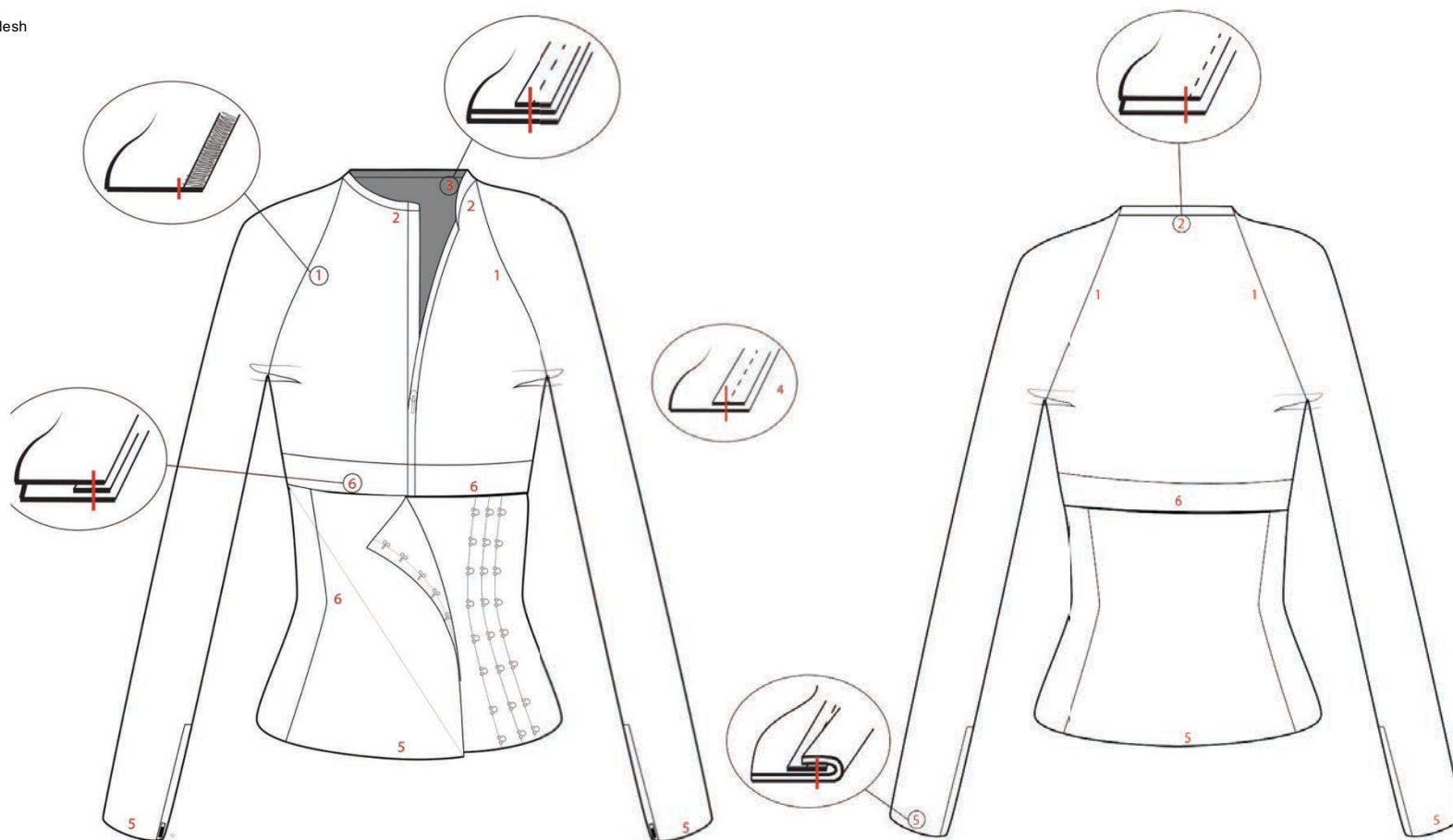



Size Range:


[illegible]

	2110	Seam Number (ISO 491 number)	Seam Allowance in Inches	Thread Type	Heat Setting (Seam Type)	Tape Width	Tape Thickness	ion location
	XS-XL	SSaa	.5"	N/A	120 C to 130 C	.5"	N/A	ow the tape should be attached to the edges of the fabric for the seam

Bangladesh



Decompressed Compression Top		1st Proto Comments	
Style #:	2110	Last Updated:	3-May-18
Style Name:	Compressed	Date Created:	3-Apr-18
Description:	Women's Fitted Compression Top		
Category:	Women's		
Size Range:	XS-XL		
Season:	Autumn/Winter		
Year:	2018		
Vendor:	TBD		
Country of Origin:	Bangladesh		
Garment Details			
1	Bottom needs to be hemmed		
2	Sleeve opening needs to be hemmed		
3	Elastic Band Needs to be Added under the bust		
4	Should have a visible magnetic zipper that opens at both ends		
5	Zippers need to be added at wrist opening		
6			
Fit			
1	Too much ease in the sleeves and armhole/armpits, and shoulders		
2	needs to be more compressed under the bust		
3	needs more compression throughout the entire garment		
4			
5			
6			
How to Proceed			
1	remove ease from armhole, sleeves and shoulders		
2	add elastic waistband under the bust		
3	Hem bottom of garment		
4	replace invisible zipper with a visible magnetic zipper		
5	add zipper to sleeve openings		
6			
			

Decompressed Compression Top		2nd Proto Comments	
Style #:	2110	Last Updated:	3-May-18
Style Name:	Compressed	Date Created:	3-Apr-18
Description:	Women's Fitted Compression Top		
Category:	Women's		
Size Range:	XS-XL		
Season:	Autumn/Winter		
Year:	2018		
Vendor:	TBD		
Country of Origin:	Bangladesh		
Garment Details			
1	Should be a separating magnetic Zipper		
2	Add neckband		
3	add elastic in the waistband casing		
4	excess of fabric, and bunching at the side seam		
5			
6			
Fit			
1	Remove more ease in the arm hole		
2	remove ease at the shoulder		
3	the waistband needs to move up under the bust- reduce bunching		
4			
5			
6			
How to Proceed			
1	Confirm your understanding on the above changes		
2	Send another sample with the changes		
3	Change the order of operations for connecting the bottom panel to the waistband		
4			
5			
6			
			

Decompressed Compression Top		Final Proto Comments	
Style #:	2110	Last Updated:	3-May-18
Style Name:	Compressed	Date Created:	3-Apr-18
Description:	Women's Fitted Compression Top		
Category:	Women's		
Size Range:	XS-XL		
Season:	Autumn/Winter		
Year:	2018		
Vendor:	TBD		
Country of Origin:	Bangladesh		
Garment Details			
1	Different Fabric from 2nd Sample		
2			
3			
4			
5			
6			
Fit			
1	Bottom portion of the compression garment needs adjusting - not enough stretch with the fabric, thus the garment is too large with the new pattern pieces		
2	remove bunching in the back		
3			
4			
5			
6			
How to Proceed			
1	Confirm understanding of above changes		
2	Change fabric of lower portion of compression garment		
3			
4			
5			
6			
			