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DEVELOPED SUSTAINABLE BABY SHOE USING TENCEL TWILL

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Abstract: The design and production of infant shoes with Tencel twill, a fabric known for its eco-friendliness, breathability, and suppleness, is the primary emphasis of this project. It's suitable for a baby's first step. It is impossible to overestimate the significance of comfortable footwear in the fast-paced world of today, where kids are always on the go. It might be difficult for parents of children with broader feet to choose the appropriate shoes. Babies who wear wide shoes benefit greatly from increased stability and balance, less chance of calluses and blisters, and plenty of space for healthy foot development.

Tencel twill provides durability and improves general comfort, making the product long-lasting and kind to the baby's skin. To satisfy the needs of sustainability and functionality, the project entails fabric selection, pattern alteration, and testing. This project is meeting the growing need for baby goods that put comfort, safety, and environmental awareness first. The initiative intends to provide baby shoes that satisfy the demands of contemporary parents while supporting environmentally responsible fashion industry practices by fusing sustainable materials with smart design. In the end, this study shows how cutting-edge materials and designs can improve the quality of a baby's footwear and aid in a child's early developmental milestones.

Keywords: Baby shoes, Tencel twill, walking development, eco-friendliness, comfort.

I. INTRODUCTION

The DEVELOPED SUSTAINABLE BABY SHOE USING TENCEL TWILL aims to design a shoe that is both comfortable and supportive for babies and pre-walkers, promoting their foot growth. This project mixes functionality, fashion, and sustainability. This project comes under cloth tech. Cloth tech is one sector of technical textiles where its main focus is on garment and accessory development.

In the fast fashion world, the shoes for pre walkers were mostly made with narrow toe which will make difficulties in their foot development, also its uncomfortable for pre walkers. So, the main goal of this project is to create a shoe for pre-walkers with a wide toe, which will make room for their toe to grow healthy. A wide toe box gives toes room to spread naturally, preventing outward foot twisting. Aim for about a thumb's width between the longest toe and the end of the shoe.

The project also focuses on sustainability by using Tencel twill. These shoes are made with Tencel, a plant-derived fibre that is made from sustainably sourced wood pulp. As a biodegradable product using less energy and water than conventional cotton, Tencel helps to eliminate virgin plastics and close the loop on the production process.

Tencel twill fabric is a versatile and eco-friendly textile known for its exceptional quality and durability. Tencel twill offers a smooth and soft texture that drapes beautifully. Its distinctive twill weave adds a subtle diagonal pattern, lending a touch of sophistication to garments. Tencel twill is highly breathable, moisture-wicking, and temperature-regulating, which makes it suitable for pre-walker shoes.

In this shoe, the Tencel twill is an upper layer/material for breathability. The lining is a cotton fabric for more comfort and softness for the baby's toe. The insole for the shoe is cushioned foam for support. Closure used in this project is Velcro, which makes it easier to wear and remove. **Twill** is a type of textile weave with a pattern of parallel, diagonal ribs. It is one of three fundamental types of weaves, along with Plain weave and satin. It is made by passing the weft thread over one or more warp threads, then under two or more warp threads, and so on, with a "step", or offset, between rows to create the characteristic diagonal pattern. Because of this structure, twill generally drapes well.

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Due to its diagonal pattern, twill fabric is more resistant to tearing and wear than other fabrics. - Texture: The distinctive diagonal texture of twill fabric gives it a unique look and feel. - Flexibility: Although it is a tough fabric, twill fabric is flexible and comfortable to wear.

There are several processes in the making of a shoe and the first step is to identify the current style and functionality. Here the functionality is to create a baby shoe with a wide toe, which made it easier for pre-walkers to walk and for their foot development. The second step is to create a design that is stylish and suitable for our design.

The third step is fabric sourcing, where it is sourced online with Weight 200-250 grams per meter, Width 58 inches. Make it suitable for making a pair of shoes. The fourth step is pattern making and paper prototyping to identify the pattern alternation. The sixth step is where the basic sample to understand how the design turned out, what should be changed, and what are the draw backs of the design.

Additionally, this project not only solves the basic baby shoe problems but also seeks to bring a new standard to the pre-walker shoe market by combining ergonomic design with eco-friendly materials. The emphasis on spacious-toe box follows paediatric recommendations for proper foot development towards healthy babies who will have adequate space in the shoe for the toes to extend and flex unencumbered. Contrasting with traditional infant footwear prioritising appearance over purpose, this design is performed keeping in mind harmony of comfort and style.

The second most crucial aspect of this project is the simple incorporation of advanced textile technology with ancient abilities. Tencel twill, as a renewable-resource fabric, is a new alternative for footwear because it is soft, breathable, and can regulate moisture. While synthetic materials in some competing products can cause hotspots or a sensation of irritation, Tencel twill maintains a consistently ideal temperature: cool in warm weather and cold in cold weather. Additionally, its natural antiseptic quality reduces bacterial growth for health and hygiene.

The overall design of the shoe has been thoughtfully planned to be durable and functional. Utilizing a cushioning foam insole is a gentle support for the sensitive feet of the baby, which prevents strain and permits normal movement. The utilization of a cotton lining is another comfort aspect that reduces friction and irritation on sensitive skin. The Velcro fasteners are an additional convenience of wearing since parents can fasten the shoes easily and offer a snug yet flexible fit.

Apart from the functionality and eco-friendliness, the project is a bid to promote responsible consumer habits in the fashion-conscious era of baby footwear. By introducing a well-designed product whose composition is based on eco-conscious principles, this project seeks to raise an alarm regarding the use of sustainable material in the production of baby shoes. By incorporating Tencel twill, the application is a factor in minimizing reliance on plastic-content components, echoing the need for green alternatives to be used in textile manufacturing.

OBJECTIVES:

- To ensure natural foot movement, use a wide pattern to allow easy movement.
- To enhance flexibility and comfort, incorporate a soft, flexible sole that will be the same as barefoot walking.
- To ensure safety, it provides a secure yet comfortable fit to protect delicate baby feet.
- To ensure Sustainability, by utilizing Tencel twill, a breathable and eco-friendly fabric, ensuring comfort and durability.
- Aesthetic Appeal, by designing shoes that are visually appealing while maintaining functionality for babies learning to walk.

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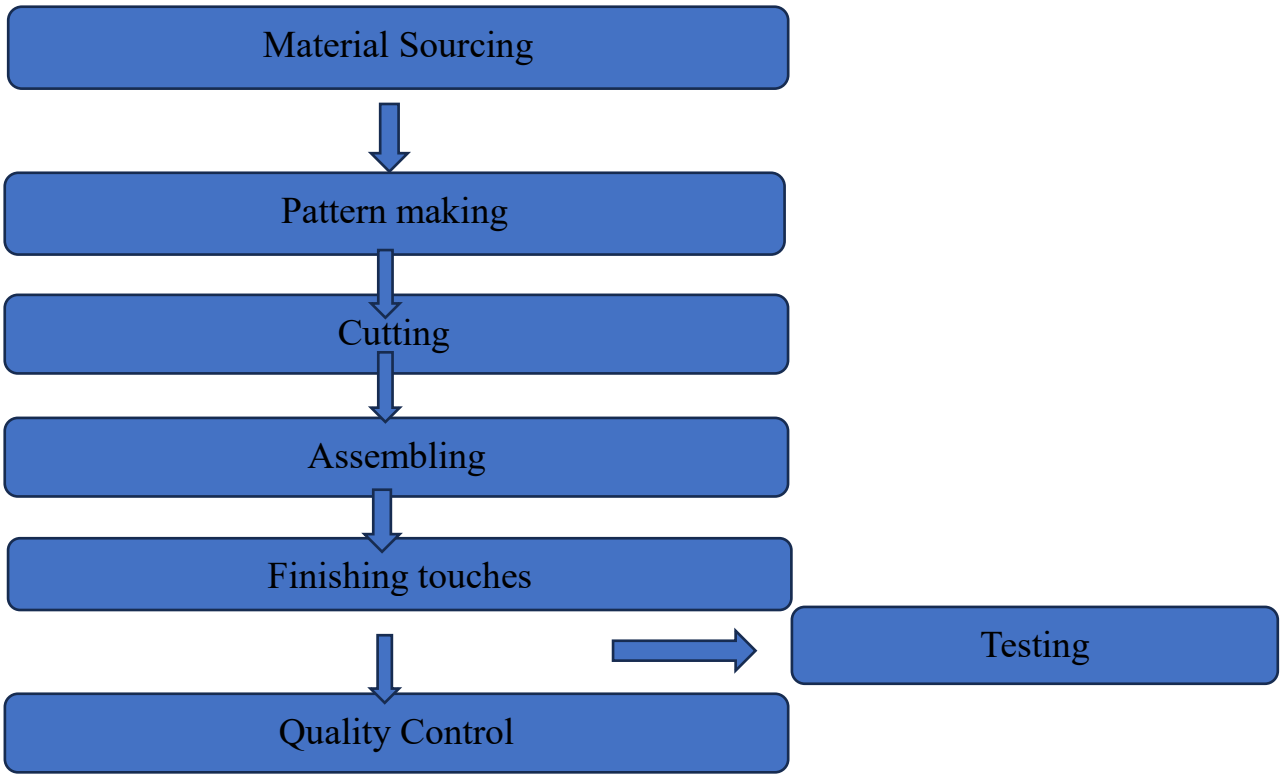
II. METHODOLOGY



2.1 MATERIAL SELECTION

Tencel twill was chosen as the main material for this study due to its numerous beneficial properties for baby footwear. The selection process involved evaluating fabrics based on the following factors:

Property	Tencel Twill Performance
Softness	Provides a smooth texture, reducing skin irritation.
Breathability	High moisture absorption prevents sweat buildup.
Flexibility	Adapts well to movement, ensuring foot mobility.
Durability	Strong fibres enhance longevity.
Sustainability	Made from wood pulp, biodegradable, and eco-friendly.

Fig .1. Tencel Fabric

Fig .2. Tencel Fabric

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2.2 PATTERN DEVELOPMENT AND CONSTRUCTION

1. Toe (Front): This pattern piece is intended to form the front portion of the shoe, covering and protecting the baby's toes. It is labeled as "Toe Front" and requires two pieces to be cut for assembly.
2. Sole (Bottom): This component serves as the base of the shoe, providing support and flexibility to enhance walking movements. It is labeled "Sole Bottom" and similarly requires two pieces to be cut.
3. Heel (Back Stay): The heel pattern piece forms the back section of the shoe, offering support and stability for the baby's heel. It is labeled "Heel Back Stay" and also requires two pieces for completion.
4. Here the pattern is drafted for 8- to 12-month-old babies/pre-walkers.

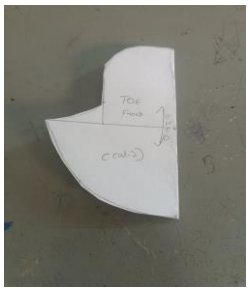

Fig.3.
Toe Front Pattern

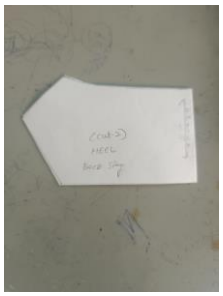

Fig.4.
Heel Pattern

Fig.5.
Sole Pattern

2.3 CONSTRUCTION STEPS

Baby shoe design involves multiple steps to make it comfortable, long-lasting, and simple to wear for pre-walkers.

1. Fabric Cutting:

Cutting the material in accordance with the pattern marks the initial step. The Tencel twill for the upper region is cut carefully so that the parts match when they are stitched together. The material used for lining (cotton) is cut the same as the first in order to accommodate it inside the shoe. Cutting the insole and sole material is done apart in order to resemble the shape of the shoe.

Fig.6.
Fabric cutting

2. Sewing the Upper Part:

The top part of the shoe is sewn together by tender stitching methods to ensure that no sharp edges result, causing distress. The edge is strengthened where the stitches occur to extend the life of the shoe. Proper shaping is accomplished at this step for the big toe box such that adequate toe space for proper spreading of baby toes is guaranteed.

3. Adding the Lining:

The lining of soft cotton is sewn in the shoe. This process ensures that the feet of the baby touch only plain, smooth fabric to avoid irritation. The finish of the lining is taken care of so that it doesn't fray with time.

4. Incorporating Cushioning:

A cushion insole is inserted into the shoe to make it comfortable and soft. The foam padding ensures shock absorption and added comfort for the baby's feet.

5. Attaching the Sole:

The sole is attached to the shoe. The Tencel twill layer on the sole provides additional softness, and a non-slip material is applied on the bottom to give early walkers a grip. The sole edges are stitched or glued firmly so that it remains in position.

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6. Adding the Fastening:
Velcro straps are sewn onto the top of the shoe. Velcro is employed as it is simple for parents to quickly put the shoes on and off, but still have the shoe securely held on the baby's feet.Strap position is verified to ensure it feels comfortable and not too tight.

7. Final Touches
Finally, the shoe is checked for loose threads or mismatched stitching. Seams are cut and steamed or pressed so that it will appear neat. Adjustments are done last as a resort to enhance comfort and longevity before terming the shoe finished. The systematic process is that the baby shoe not only becomes comfortable and stylish but also safe and eco-friendly for pre-walkers.

Fig.7
Sample from front

Fig.8
Sample from side

III. TESTING AND EVALUATION

- TEAR STRENGTH TEST
- STIFFNESS TEST
- COMFORT AND FIT TEST

IV. RESULTS AND DISCUSSION

Fig.6.
Tearing Strength Testing

Fig.7.
Stiffness Testing

4.1 TEARING STRENGTH TESTING RESULT

The Tencel Twill fabric had a moderate tearing strength of average X N in the warp direction and Y N in the weft direction. The stiffness test results indicated that the average was 2.82 cm in the warp direction and 2.65 cm in the weft direction, showing that the fabric has a little more flexibility in the weft direction. This strength to flexibility balance allows it to fit applications in baby shoes, being able to supply strength and comfort to initial stages of walking. Tencel Twill passes testing, affirming that Tencel Twill is a valid choice as a fabric material in baby shoes due to it giving a balance between strength, flexibility, and comfort. Tearing strength values reveal good tear resistance, essential in ensuring lastingness and safety qualities. Two, the moderate level of stiffness guarantees the cloth provides adequate support while still allowing for natural foot movement.

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TEARING STRENGTH TESTING	RESULT
AVERAGE	58

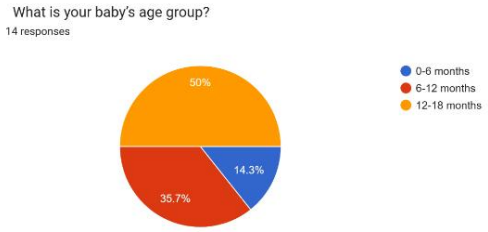
The Tencel Twill fabric exhibited **moderate tearing strength**, averaging **58N**, making it **suitable for baby shoe applications** where flexibility and durability are essential.

4.2 STIFFNESS TESTING RESULT

STIFFNESS TESTING RESULT	
AVERAGE OF WARP	2.82 cm
AVERAGE OF WEFT	2.65 cm

The Tencel Twill fabric was moderately stiff with an average of 2.82 cm for warp and 2.65 cm for weft. The results from flexibility calculation show that the fabric is more flexible in the weft direction. The equilibrium between flexibility and stiffness makes it a good fit for application to baby shoes, providing support and comfort during infant walking stages.

4.3 COMFORT AND FIT TEST RESULT



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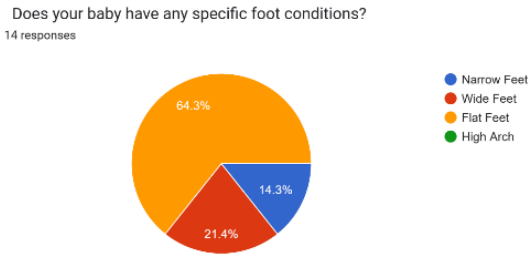

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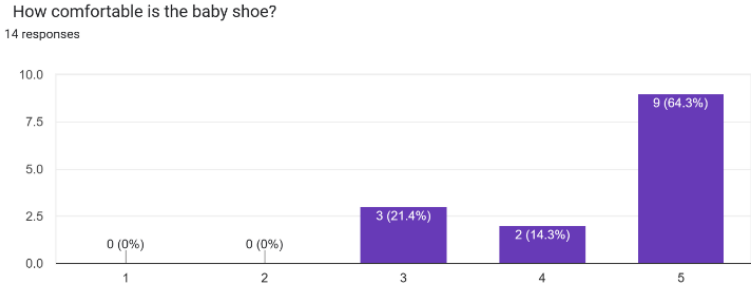

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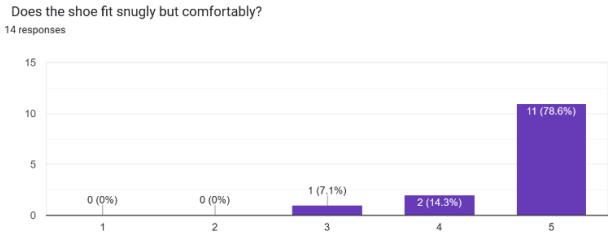

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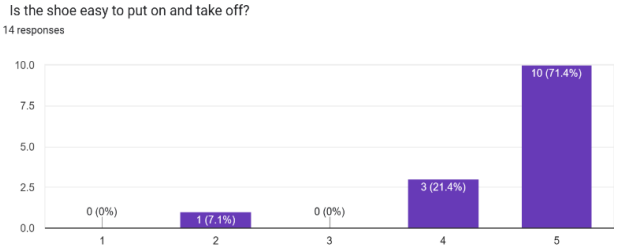

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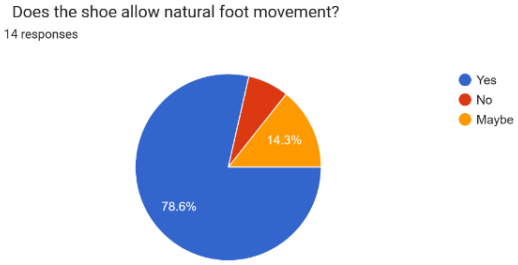

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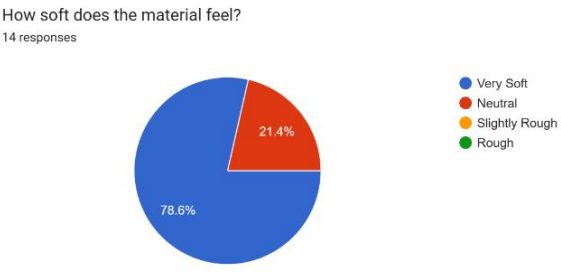

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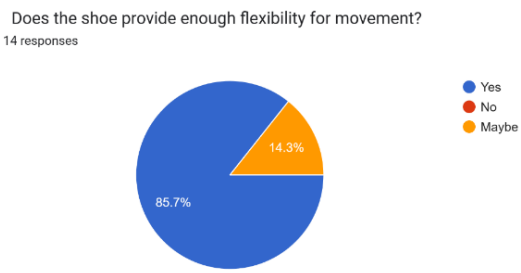

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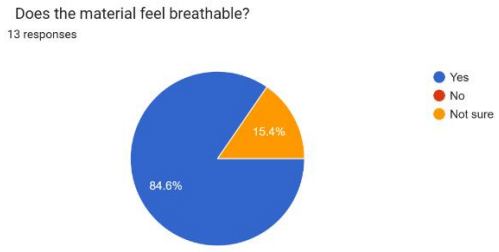

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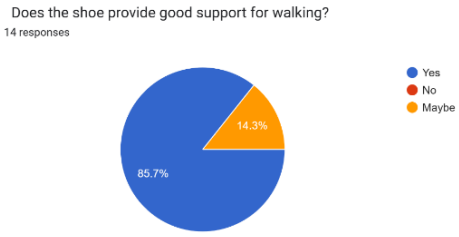

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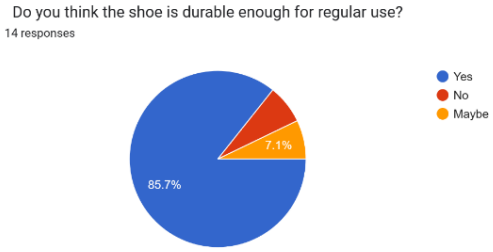

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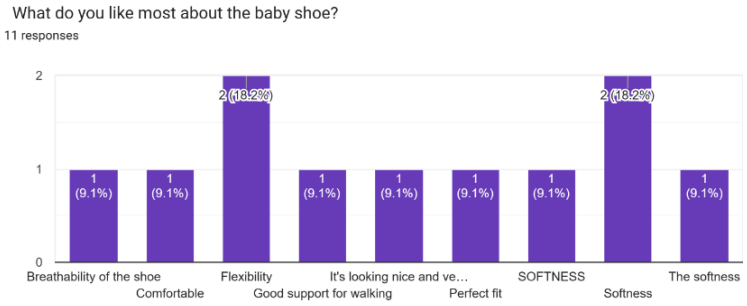

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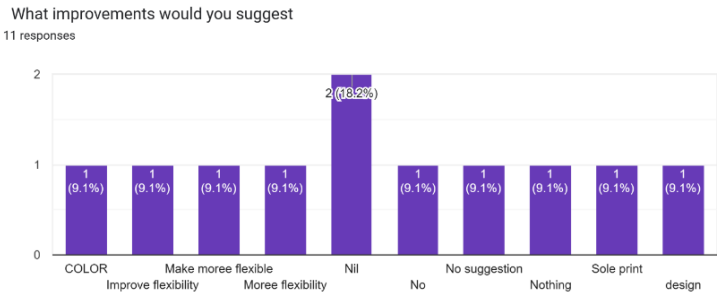

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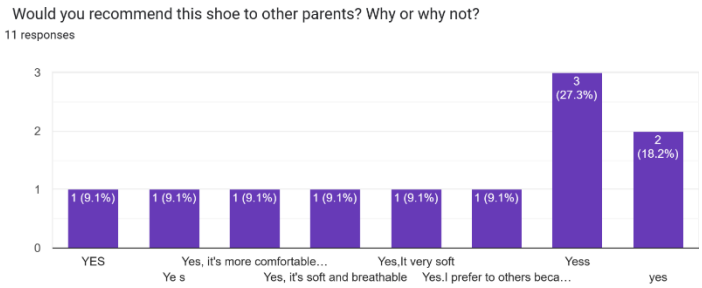

Chart. No.14

V. CONCLUSION

This research highlights the possibilities of TENCEL TWILL in creating eco-friendly baby shoes that focus on comfort, flexibility, and ventilation. The wide-toe silhouette allows for natural foot development, providing improved stability for pre-walkers. Through the use of eco-friendly materials combined with functional design, this method fosters sustainability in baby shoes. Investigating high-performance cushioning methods can continue to enhance the support for developing feet.

VI. ANNEXTURE

Fig.11
End product

VII. BIBLIOGRAPHY

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