international DESIGN JOURNAL
Print ISSN 2090-9632
Online ISSN 2090-9640

Design and Implementation of a Model to Prevent Hazards and Injuries when using a Straight Knife Fabric Cutting Machine in Ready-Made Garment Factories

Mostafa A. A. Badawy
Lecturer, Ready-Made Garments Technology Program, Faculty of Technology of Industry and Energy, Samannoud Technological University mostafabadawy1990@gmail.com
Ahmed Mahmoud Abdo Elsheikh
Assistant Professor and Head of the Ready-Made Garments and Fashion Department, Faculty of Applied Arts, Tanta University dr.ahmedelsheikh@Appart.tanta.edu.eg

Abstract
This study aims to design and implement a protective cover for the Straight Knife Fabric Cutting Machine to reduce hazards and injuries in ready-made garment factories. The research highlights the challenges faced by cutting workers due to the sharp blades and high speeds of the machine, as well as the limitations of traditional protective gloves. A transparent fiberglass cover was designed and experimentally tested in 15 factories with 75 cutting workers. The survey results demonstrated significant improvement in safety, comfort, and usability. More than 90% of workers reported easier machine handling, enhanced vision, and improved personal safety after using the cover. Additionally, 100% of the participants confirmed the absence of injuries during the trial. The cover also addressed the common drawbacks of protective gloves, including discomfort and performance limitations. The results confirm that protective cover is a viable safety solution that enhances worker protection without compromising productivity or comfort.

Keywords
Hazards, Injuries, Straight Knife Fabric Cutting Machine.

Paper received July 9, 2025, Accepted August 26, 2025, Published online November 1, 2025

Introduction:
Safety represents the state in which risks are managed at acceptable levels. Safety is considered a constant and guaranteed occurrence, especially when organizations face continuous production pressures. Safety focuses on preventing or reducing hazards and injuries in the workplace, which negatively impact organizational performance at a variety of levels.

The safety and security of workers in any industry is at significant risk due to hazards and injuries. These issues also negatively impact on the lives of workers and their families. Many people are injured or killed each year because of work-related accidents. It is essential for both employers and workers to be aware of the hazards and injuries associated with the garment industry and take the necessary measures to prevent work-related hazards and injuries.

The term Occupational Safety and Health is defined as the maintenance of a work environment that is relatively free from actual or potential hazards and injuries that can injure employees. Research indicates that work environments in the apparel industry often involve a variety of workers, machinery, and management teams, so these environments must remain safe and free of safety and health hazards. It aims to prevent potential adverse health effects resulting from working conditions and protect workers from health hazards and injuries they may encounter during the performance of their duties.

The cutting department is a fundamental component of the garment industry. Various types of knives are used to cut different parts of the garment. Cutting machines that use a bar razor or straight blade can present some challenges in this department.

Straight knife fabric cutting machine have sharp blades, posing a significant threat to hands when cutting fabric. Many workers, without realizing it, sustain injuries to their hands or other body parts from using scissors. Observations have shown that most workers sustain these injuries to their hands due to straight knife fabric cutting machine use.

Metallic protective gloves are used to reduce injuries, but most workers experience discomfort when wearing them, which leads them to avoid them. Despite their effectiveness in protection, gloves can restrict movement and cause sweating and allergies, making them unsuitable for continuous use.

CITATION **Mostafa Badawy, Ahmed Elsheikh (2025), Design and Implementation of a Model to Prevent Hazards and Injuries when using a Straight Knife Fabric Cutting Machine in Ready-Made Garment Factories, International Design Journal, Vol. 15 No. 6, (November 2025) pp 225-236**

Research Problem:

- Cutting Workers in ready-made garment factories have been exposed to many hazards and injuries due to the use of a Straight Knife Fabric Cutting Machine.
- Protective gloves used by cutting workers to prevent hazards and injuries are uncomfortable and affect the speed, quality, and accuracy of work.
- Through this, can a model be designed and implemented to prevent hazards and injuries when cutting workers use a straight knife fabric cutting machine?
- Does using this model affect vision, speed, quality and accuracy of work?
- Would cutters accept this model as an alternative to protective gloves?

Research Importance:

- Providing safer straight knife fabric cutting machine to prevent hazards and injuries during use, and as an alternative to wearing protective gloves that affect the speed, quality, and accuracy of work.

Research Aim:

- Design and Implementation of a Model to Prevent Hazards and Injuries when using a Straight Knife Fabric Cutting Machine.

Methodology:

- Analytical methodology: Analysis of Hazards and Injuries to cutting workers when using a Straight Knife Fabric Cutting Machine.
- Experimental methodology: Design and Implementation of a model to prevent Hazards and Injuries when using a Straight Knife Fabric Cutting Machine.

Research Limits:

- Straight Knife Fabric Cutting Machine, Cutting departments in Ready-Made Garment Factories.

Research Tools:

- Design models on 2D programs (Adobe Illustrator) and 3D programs (3D Max).
- Use fiberglass (E-glass) 2mm thick for the cover body, 3mm thick for the cover surface.
- A survey was conducted, collecting data from 75 cutting workers in fifteen different garment factories in Egypt. This was conducted through face-to-face interviews with the workers at their workplaces, about the hazards and injuries they are exposed to when using Straight knife fabric cutting machine, to develop solutions to improve occupational safety and health.

Theoretical Frame Work:

Average age of cutting workers and years of experience:

All workers were male. The average age of the workers varied: 30% of the workers were between 25 and 35 years old, 40% were between 36 and 45 years old, and 30% were over 46 years old.

Number of Years of Worker Experience: 90% of the workers had more than 5 years of experience, while 10% had between 1 and 5 years of experience. Number of Working Hours: 73% of the workers spent 8 hours or more on the job. The following figure shows the percentage distribution of ages, experience, and working hours of the workers under study.

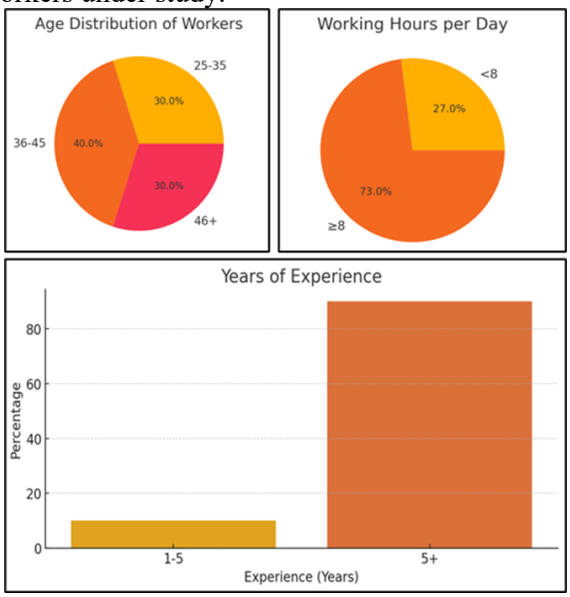

Fig (02) Age Distribution, Experience and Working Hours of Workers under study

Hazards and Injuries to Cutting Workers.

The study revealed that the most common hazard to cutting workers was accidents or injuries caused using band saws, with 82% of the workers surveyed. These accidents involved injuries to fingers and hands from knife blades while operating the Straight knife fabric cutting machine, despite the fact that all workers received safety training when using Straight knife fabric cutting machine in their various factories. Among their suggestions was the provision of safer Straight knife fabric cutting machine to prevent accidents or injuries caused using Straight knife fabric cutting machine.

Use of Protective Gloves:

The study revealed that only 15% of workers used protective gloves while working with Straight knife fabric cutting machine. 26% of the workers surveyed used protective gloves occasionally, while 59% of workers did not use protective gloves. The following figure shows the percentage of workers studied who used protective gloves.

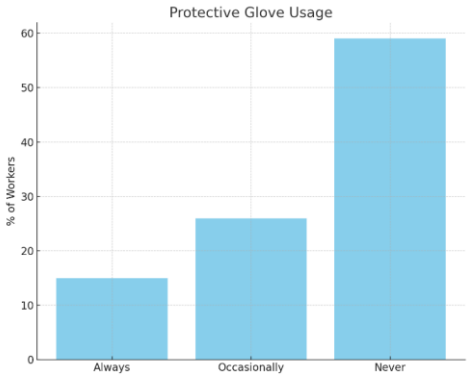

Fig (03) Percentage of workers studied who used protective gloves

This is even though 60% of the companies surveyed provided these protective gloves to their workers while working with Straight knife fabric cutting machine, and these protective gloves were made of cut-resistant metal. The following figure shows the percentage of companies providing protective gloves.

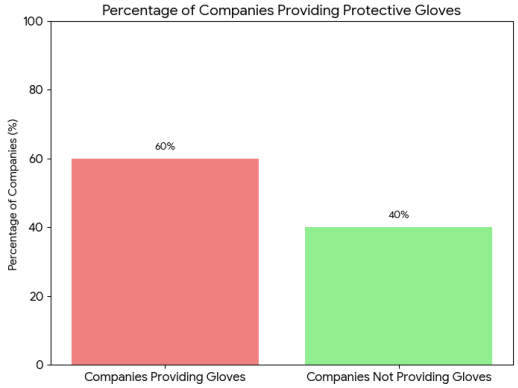

Fig (04) Percentage of Companies Providing Protective Gloves

The study showed that 88% of workers agreed that these Protective Gloves are highly effective in preventing hazards and injuries due to the use of Straight knife fabric cutting machine, and that most of workers do not experience hand injuries when wearing protective gloves. The following figure shows the percentage of workers agreement on protective effectiveness in preventing injuries.

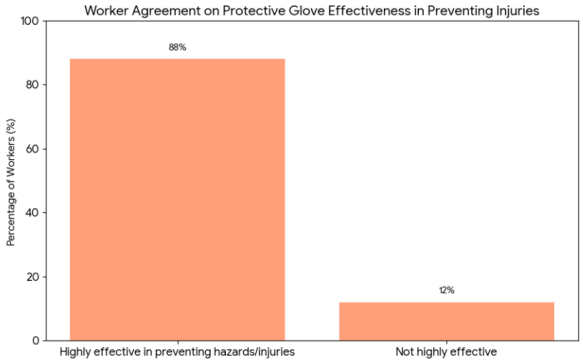

Fig (05) Percentage of workers agree on protective effectiveness in preventing injuries.

In the study 21% of the workers agreed that these protective gloves are acceptable and comfortable and do not affect the speed and quality of work, but they cause some fatigue when wearing them. However, 79% agreed that these gloves affect the speed and quality of work, are uncomfortable, and hinder accuracy in work. They also have many problems, including (sweating and lack of ventilation, their weight and difficulty of free movement, and cause skin sensitivity). The following figure shows the worker's opinion about the comfort of protective gloves when using them.

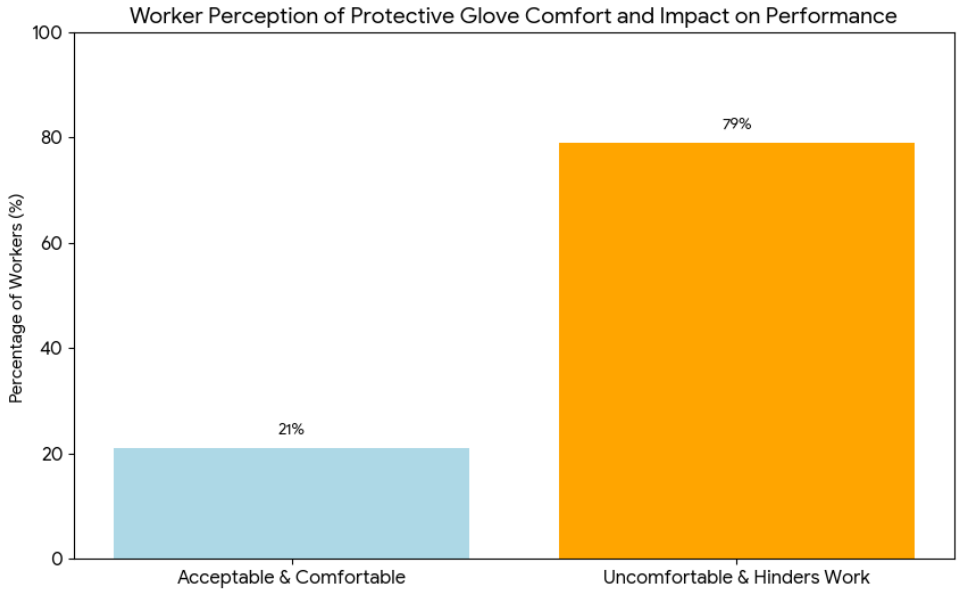

Fig (06) The worker's opinion about the comfort of protective gloves when using them.

Table (01) presents a statistical summary of a survey conducted among cutting workers using Straight knife fabric cutting machines. The majority of respondents were in the 36–45 age group and had over five years of experience, indicating a mature and experienced workforce. Most workers reported

working 8 or more hours daily, highlighting a high workload environment. A significant 82% reported injuries, primarily to fingers and hands, raising serious safety concerns. Despite 88% acknowledging the protective value of gloves, 59% never used them, reflecting a gap between awareness and practice. Moreover, 79% found the gloves uncomfortable, citing their negative impact on performance and comfort.

Table (01) "Survey Results on Hazards, Injuries, and Protective Glove Usage Among Cutting Workers Using Straight Knife Fabric Cutting Machines in Egypt"

Variable	Mean (Est.)	Mode (Most Common)	Remark
Age Group	~36–45	36–45	Majority in mid-age group
Experience (Years)	>5 years	>5 years	Very experienced workforce
Working Hours/Day	≥8 hrs	≥8 hrs	High workload
Injuries (%)	82%	Injured	Serious safety concern
Glove Use	Never	Never (59%)	Indicates lack of usage
Perceived Glove Safety	Yes (88%)	Yes	Workers recognize protection
Perceived Glove Comfort	No (79%)	No	Gloves hinder comfort/performance

Therefore, there was a need to design a model to prevent hazards and injuries when using the Straight knife fabric cutting machine.

Straight knife fabric cutting machine Parts

One of the most widely used and adaptable cutting equipment in the textile and garment manufacturing sector is the straight knife fabric cutting machine. It has a vertical, straight blade that slices through several layers of fabric with accuracy by moving quickly up and down.

The Straight knife fabric cutting machine has many features, which are: Vertical Blade Movement: 10–13 cm broad and 2.5–4 mm thick straight blade oscillates vertically at a fast rate (3000 to 5000 strokes per minute). Driven by an electromotor—generally between 0.5 and 1.5 horsepower—the blade mechanism is powered. Features a base plate cutting over the fabric layers. It has ergonomic handles for operator control. Generally able to cut 10 to 15 cm thick fabric piles.

The Straight knife fabric cutting machine has many advantages, including (Accuracy: Helps to make exact cuts along patterns lines, mobility; movable and portable on the cutting table, Effectiveness: Superior to hand scissors for big cuts, Cost-effective: smaller initial investment than automated cutting machines).

The Straight knife fabric cutting machine consists of a group of parts, including (Power Connector, Gas Station (Lubrication Port), Switch (Main Power Switch), Sharpening Switch, Control Handle, Blade, One-Piece Forging (Body Frame), Presser Foot, Stabilize Bottom Plate, Move the Scroll Wheel (Mobility Wheel)), The following figure shows the main parts of the Straight knife fabric cutting machine.

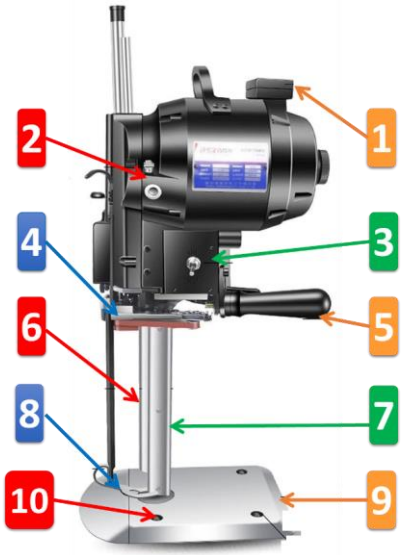

Fig (07) Straight Knife Fabric Cutting Machine parts

Each part of the Straight Knife Fabric Cutting machine has a function, and there are details that explain each part. The following figure shows the function and details of those parts:

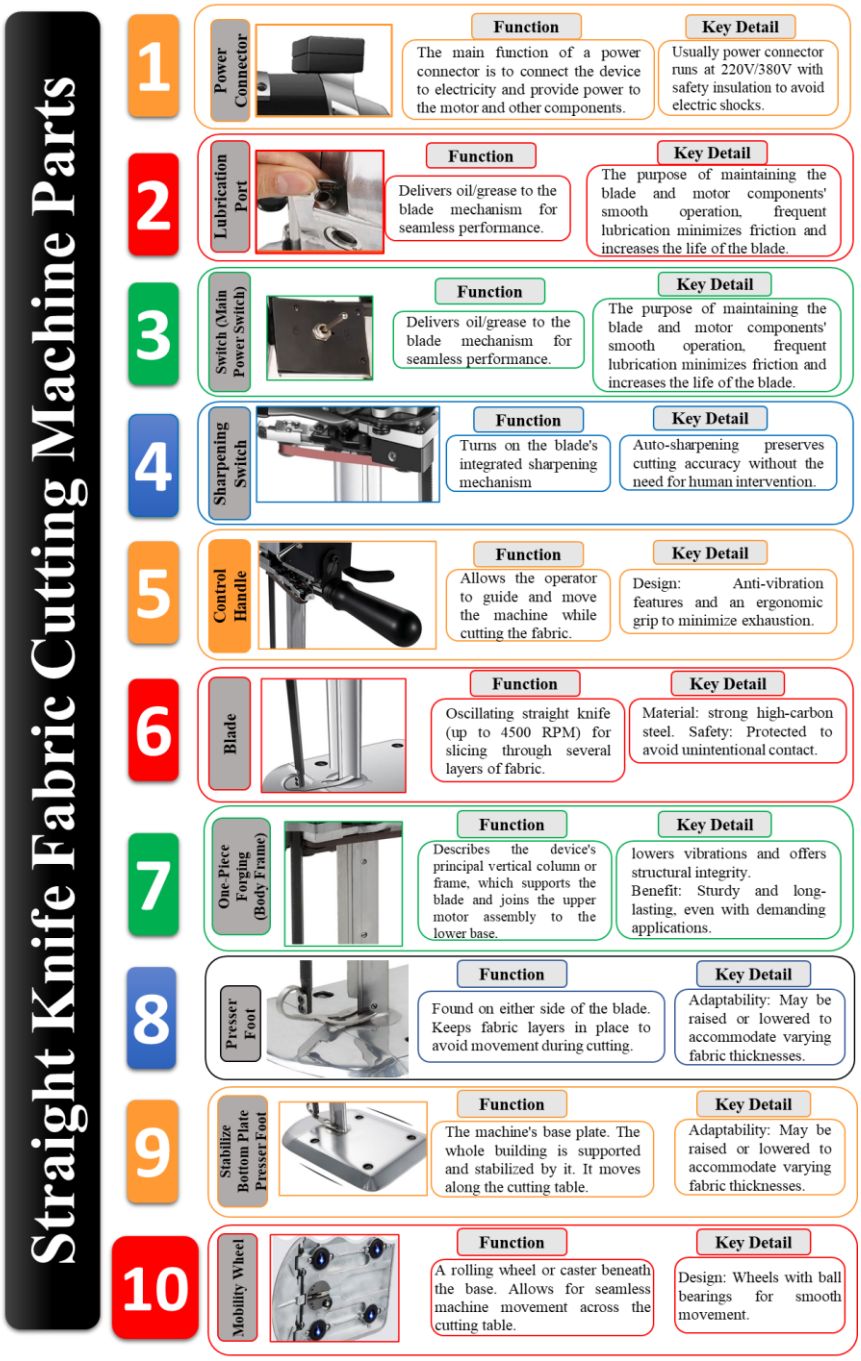

Fig (08) The function and details of the Straight Knife Fabric Cutting Machine parts

The parts that pose hazards and injuries to operators

Before starting to design a model to protect against hazards and injuries resulting from the use of a cutting machine, we must identify the places and parts that expose workers to hazards and injuries.

The following figure shows the position of cutting workers' fingers and hands while using the Straight knife fabric cutting machine, which exposes them to hazards and injuries. The following figure shows the position of operators' fingers and hands while using the Straight knife fabric cutting machine.

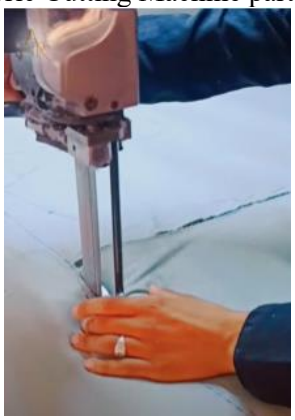

Fig (09) shows the position of operators' fingers and hands while using the Straight knife fabric cutting machine

The Straight knife fabric cutting machine contains several parts that pose a hazards and injuries to operators, especially in the hands and fingers. The following are the main parts that cause injury:

The sharp blade (blade)

Its speed of 3,000 to 5,000 strokes per minute makes it most dangerous.

Should the hand contact the blade during surgery, it might cause major cuts or finger amputation.

The cutting zone below the blade

The area where the blade passes through the fabric.

If the worker accidentally places his hand under the blade, he could be seriously injured.

Reciprocating Mechanism

The reciprocating system is the inside part raising and lowering the blade.

Fingers could get pinched or injured if they lacked protection covering.

Base Plate

The metal plate that moves across the fabric as it is being cut is the base plate.

If the hand slides beneath the blade, it might crush or slice the fabric as it passes, the following figure shows the parts that pose hazards and injuries to operators.

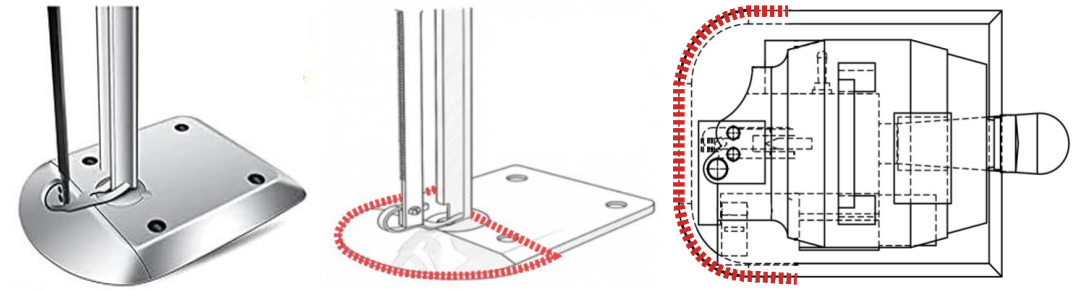

Fig (10) The parts that pose hazards and injuries to operators.

The previous figure shows the part that operators should not approach when using the knife fabric cutting machine. Therefore, this part needs a (Protective Cover) to protect operators from hazards and injuries.

Cover specifications

The cover must be made of materials with the following specifications:

Highest clarity
Superior mechanical strength and abrasion resistance
lowest haze
scratch resistance
Good transparency
lower cost

All these specifications are available in fiberglass. Fiberglass is a composite material made up of small glass fibers that are immersed in a resin, like polyester or epoxy. The chemical makeup of the glass used to create the fibers determines the variety of fiberglass, which in turn affects its physical and chemical characteristics. There are different types of fiberglass, as follows:

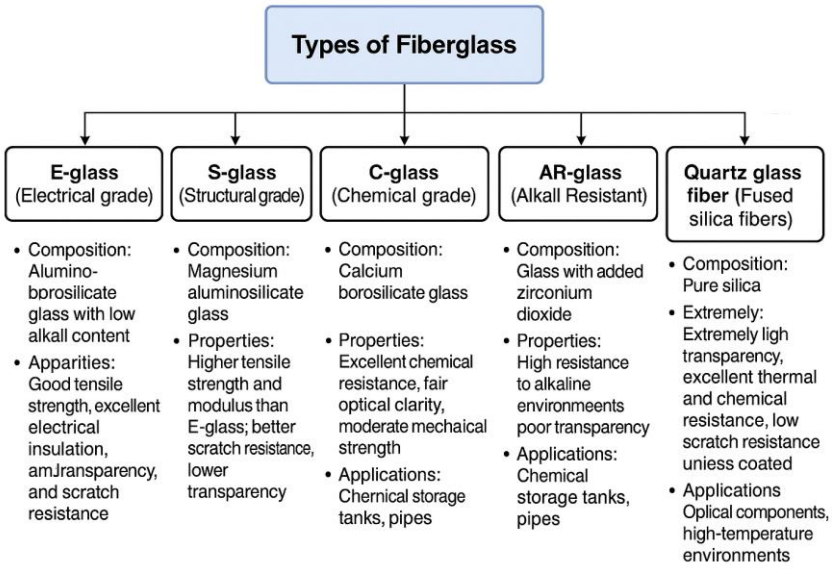

Fig (11) shows the different types of fiberglass

Quartz glass fiber is excellent for optical applications due to its transparency. Its lesser scratch resistance, however, calls for protective coatings to increase its lifespan.

Because of its high tensile strength and modulus, S-glass provides the best scratch resistance, making it ideal for situations where durability is paramount.

Particularly when surface treatments are applied, E-glass offers a good balance between scratch resistance and transparency at a reasonable price.

Protective Cover Design

The protective cover is designed in two parts (Surface, Body). Cover Surface is designed to integrate with the Straight knife fabric cutting machine's presser foot. It is also equipped with four wheels for easy movement with the Straight knife fabric cutting machine without obstructing the operator during use. The protective cover on the cutting machine is easy to install and change by changing the presser foot. The following figure shows the cover surface design.

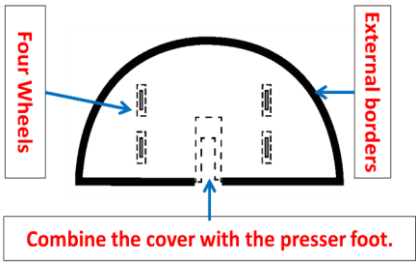

Figure (12) shows the cover surface design.

Cover Body is designed to prevent the operator from approaching the Straight knife fabric cutting machine housing. Care must be taken to ensure it is made of a transparent and highly light-transmitting material that is resistant to dust and is scratch-resistant. Care must be taken to ensure that the cover components are made of a transparent, highly light-transmitting, dust-resistant, and scratch-resistant material.

Therefore, fiberglass material (E-glass) was used because it is transparent, transmits light highly, is dust-resistant and scratch-resistant. E-glass offers a good balance between scratch resistance and transparency at a reasonable price. Use fiberglass (E-glass) 2mm thick for the cover body, 3mm thick for the cover surface, the following figure shows a schematic diagram of the cover assembly with the Straight knife fabric cutting machine.

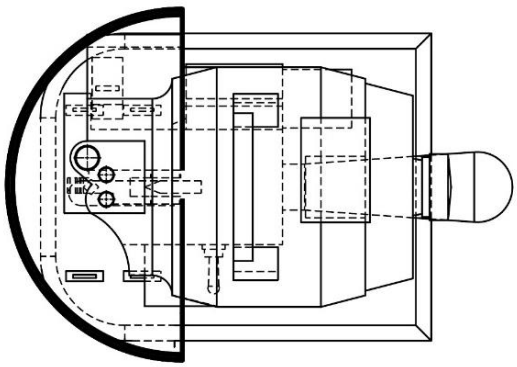

Figure (13) Shows a schematic diagram of the cover assembly with the Straight knife fabric cutting machine.

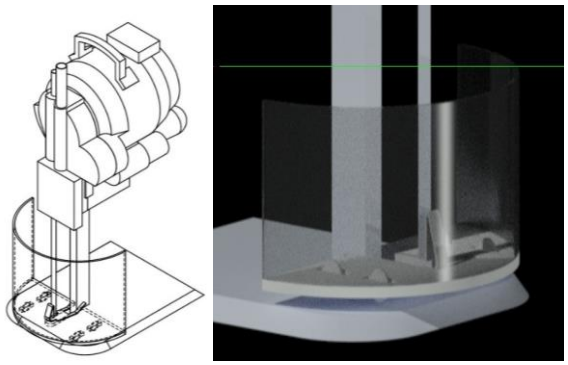

Figure (14) Illustration of the protective cover on the Straight knife fabric cutting machine

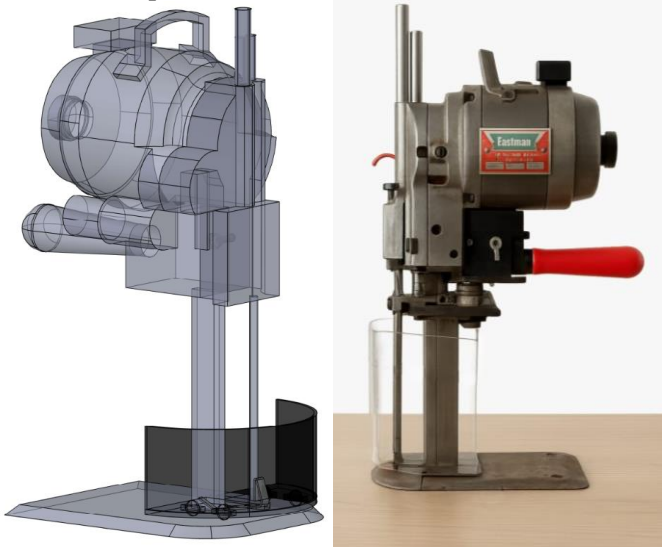

Figure (15) The final shape of the protective cover after its implementation on the Straight knife fabric cutting machine.

Results and Discussions

The protective cover for the straight knife fabric cutting machine was tested in (15) different factories using (75) cutting operators. A survey was conducted for cutting workers in garment factories to evaluate their experience with using the straight knife fabric cutting machine equipped with the protective cover made of transparent fiberglass, through three main axes: evaluating the use after installing the protective cover, evaluating safety and security, and suggestions and impressions. The results of this survey were as follows:

First: Evaluation the use after installing the protective cover on the straight knife fabric cutting machine:

When inquiring about whether there is a difference in the ease of use of the straight knife fabric cutting machine after installing the protective cover: The study showed that 88.25% of workers in the study reported ease of use of the straight knife fabric cutter after installing the protective cover, While 05.5% of workers in the study reported significant difficulty in using the straight knife cloth cutter after installing the protective cover, and 6.25% of workers in the study reported some difficulty using the straight knife fabric cutter after installing the protective cover.

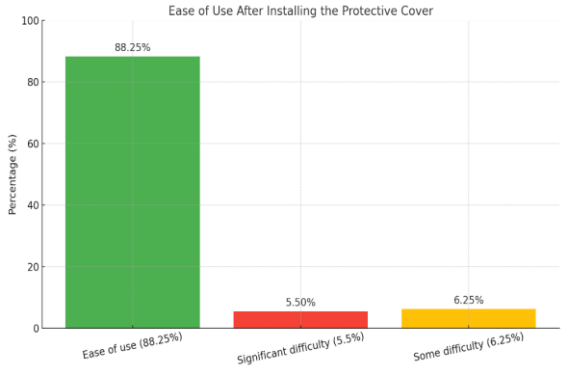

Fig (16) Ease of use after installing the protective cover.

The study revealed that 91.4 % of the workers in the study reported that the protective cover did not affect the clarity of vision during work, while 05.2% of the workers in the study reported that the protective cover slightly affected the clarity of vision during work, while 03.4 % of the workers in the study reported that the protective cover greatly affected the clarity of vision during work.

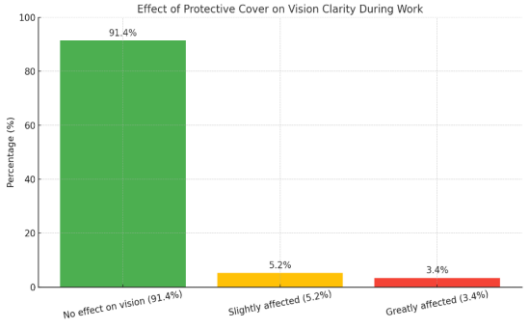

Fig (17) "Effect of Protective Cover on Vision Clarity During Work".

As for how easy it is to control the straight knife fabric cutting machine after installing the protective cover: 90.3 % of the workers in the study reported that controlling the straight knife fabric cutting machine is very easy, while 05.4 % of the workers in the study reported that controlling the scissors is moderately easy, while 04.3% of the workers in the study reported difficulty in controlling the straight knife fabric cutting machine.

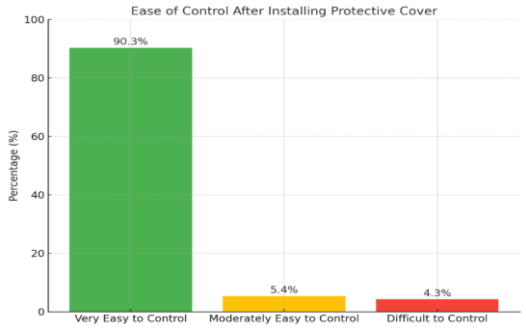

Fig (18) shows how workers evaluated the ease of control after installing the protective cover

When asked about moving the straight knife fabric cutting machine between layers of fabric after installing the protective cover: 91.1% of the workers in the study reported that there was no difficulty, while 03.2 % of the workers in the study reported that there was difficulty, while 05.7% of the workers in the study reported that there was some difficulty.

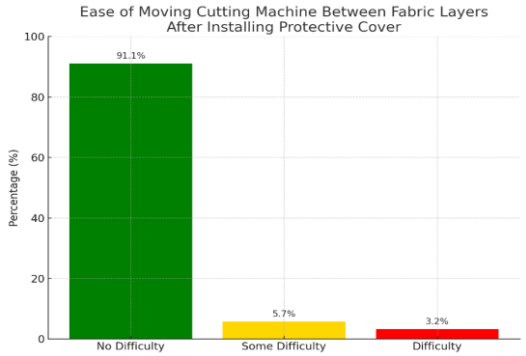

Fig (19) Ease of Moving Cutting Machine Between Fabric Layers After Installing Protective Cover

As for the extent to which the protective cover affects the work speed: 89.2 % of the workers in the study reported that the protective cover does not affect the work speed, while 05.6 % of the workers in the study reported that the protective cover reduces the speed slightly, while 05.2% of the workers in the study reported that the protective cover reduces the speed.

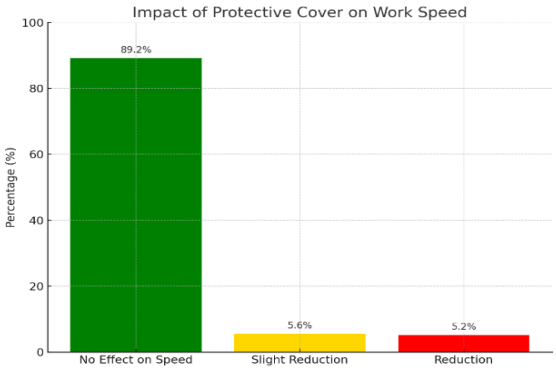

Fig (20) Impact of Protective Cover on Work Speed

Second: Evaluation the Safety and Security

When asked about the improvement in personal safety after installing the protective cover, 92.1 % of the workers in the study reported that they felt an improvement in their personal safety after installing the protective cover, while 03.2 % of the workers in the study reported that they did not feel an improvement, and 04.7% of the workers in the study reported that they felt somewhat better.

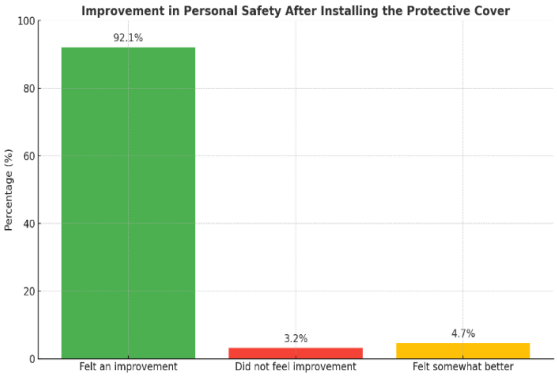

Fig (21) Improvement in Personal Safety After Installing the Protective Cover

When asked whether this cover reduces the chances of hand injury during cutting: 94.6 % of the workers in the study reported that the protective cover reduces the chances of hand injury during cutting to a large extent, while 03.3 % of the workers in the study reported that the protective cover reduces the chances of hand injury during cutting to a small extent, while 02.1% of the workers in the study reported that the protective cover does not reduce the chances of hand injury during cutting.

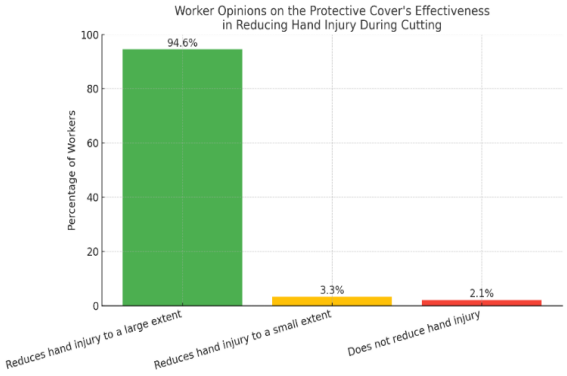

Fig (22) Worker Opinions on the Protective Cover's Effectiveness in Reducing Hand Injury During Cutting

When workers were asked about any hazards or injuries they encountered while using the straight knife fabric cutting machine after installing the protective cover, 100 % of the workers in the study reported that they did not encounter any hazards or injuries.

When workers were asked how confident they felt while working with the protective covering, 93.4 % of the workers in the study reported feeling very comfortable, 04.2 % of the workers in the study reported feeling partly comfortable, and 02.4% of the workers in the study reported feeling uncomfortable.

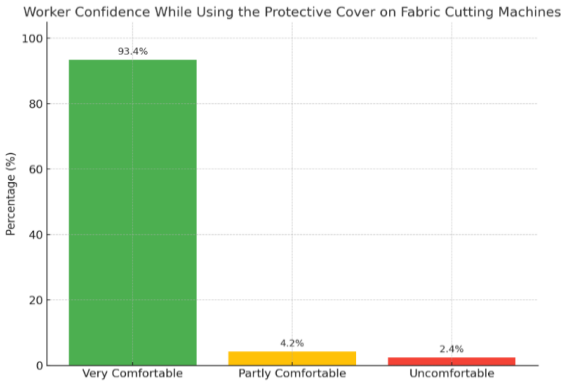

Fig (23) worker confidence while using the protective cover on fabric cutting machines

Third: impressions

When workers were asked about their general opinion of the protective cover after the experiment: 80.2 % of the workers in the study reported that it was excellent, 13.3 % of the workers in the study reported that it was good, 05.1 % of the workers in the study reported that it was acceptable, and 02.4 % of the workers in the study reported that it was weak.

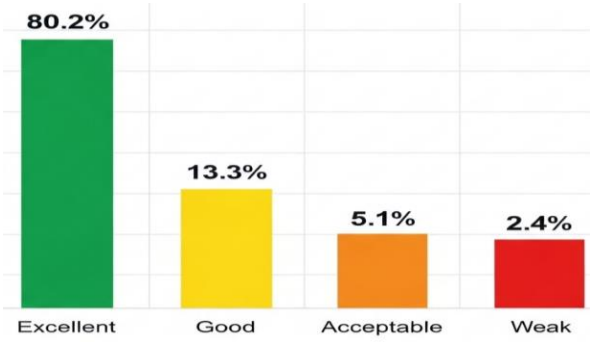

Fig (24) workers' overall perceptions of the protective cover following its experimental use

When workers were asked whether they preferred to continue using the protective cover during work, 93.3 % of the workers in the study reported that they preferred to continue using the protective cover during work, and 06.7% of the workers in the study reported that they did not prefer to continue using the protective cover during work.

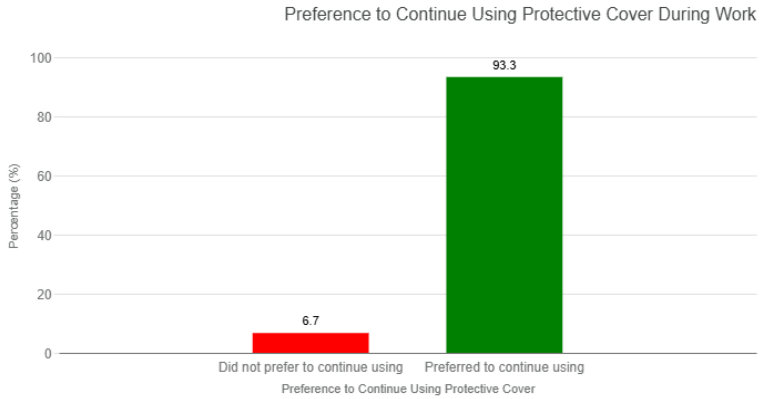

Fig (25) workers' preference to continue using the protective cover during work

Here is the comparison table between the transparent fiberglass protective cover and the metal mesh protective glove used during fabric cutting with the straight knife fabric cutting machine:

Table (02) Comparison: protective cover (Fiberglass)vs. Metal Protective Glove

Criteria	protective cover (Fiberglass)	Metal Protective Glove
Material	Transparent fiberglass	Interlinked metal rings (usually stainless steel)
Protection Location	Mounted around the knife blade to physically isolate the hand	Worn directly on the worker's hand
Transparency & Vision	Transparent – does not affect visibility of the cutting area	Doesn't obstruct view but covers the hand
Weight	Lightweight	Heavier due to metal composition
Freedom of Movement	Does not restrict hand movement as it protects the machine	Slightly limits finger flexibility
Level of Protection	Prevents direct access to the blade, offering a physical barrier	Protects only from direct contact, doesn't prevent access
Ease of Use	Easy to use after installation, no need for repeated application	Needs to be worn and removed regularly
Comfort While working	Doesn't affect comfort as it doesn't touch the body	May cause discomfort due to weight or heat over time
Protection Effectiveness	Highly effective in preventing blade-related injuries	Partially effective, reduces severity but not full protection
Worker Dependency	Independence of the worker's behavior or attention	Rely on the worker's compliance in wearing it

The protective cover offers better continuous protection by physically preventing blade contact and reducing reliance on worker behavior.

The metal protective glove provides personal protective reinforcement but is less effective alone in preventing accidents.

Chi-Squared Goodness-of-Fit test was applied to the provided data. This test is used to determine if the observed distribution of categorical data (the survey results) differs significantly from a hypothesized or expected distribution.

Null Hypothesis (H_0): The opinions of the workers are evenly distributed across all response categories for each question.

Alternative Hypothesis (H_1): The opinions of the workers are not evenly distributed across the response categories.

This was tested for each of the key survey questions. The total number of workers (sample size) is N = 75.

Table (03) Chi-Squared Results

Survey Aspect	Chi-Squared Value (χ^2)	Degrees of Freedom	Statistical Significance
1. Ease of Use	100.88	2	Extremely Significant ($p < .001$)
2. Vision Clarity	114.44	2	Extremely Significant ($p < .001$)
3. Personal Safety	116.24	2	Extremely Significant ($p < .001$)
4. Reduce Injury	126.96	2	Extremely Significant ($p < .001$)

Conclusion:

The Chi-Squared Goodness-of-Fit tests confirm that the results from the survey are overwhelmingly statistically significant.

For every aspect tested—ease of use, vision clarity, safety improvement, and injury reduction—the observed distribution of worker opinions is not due to random chance. The data provides very strong evidence that:

- The vast majority of operators found the protective cover easy to use, non-disruptive to vision or speed, and easy to control.
- The vast majority of operators felt a significant improvement in their personal safety and believed the cover was highly effective at reducing the chance of hand injury.
- The positive overall impression and preference to continue using the cover are clear and statistically justified.

The extremely high χ^2 values (all above 100) indicate that the positive feedback is consistent and robust across the different evaluation axes. The protective cover, based on this operator feedback, has been a resounding success.

Recommendation:

Based on the overwhelmingly positive results of this study, it is strongly recommended that the transparent fiberglass protective cover be implemented on all straight knife fabric cutting machines in garment factories. Future research should investigate the specific challenges faced by the small percentage of workers who reported difficulties in use or control, in order to refine the cover's design and achieve universal user satisfaction. The model could also be enhanced by equipping it with an air suction device to eliminate dust generated during the cutting process, as well as by adding smart sensors to further ensure user safety. Furthermore, it is recommended that similar safety-oriented innovations and studies be carried out for other high-risk machinery within the ready-made garment industry to foster a safer working environment. This research serves as clear proof of concept that safety enhancements can be both effective and well-received by the workers they are intended to protect.

References:

1- Amponsah-Tawiah, K. and J. Mensah (2016). "Occupational health and safety and organizational commitment: Evidence from the Ghanaian mining industry." Safety and health at work 7(3): 225-230.

2- Bhagawati, B. (2015). "Basics of occupational safety and health ".IOSR Journal of Environmental Science, Toxicology and Food Technology 9(8): 91-94.

3- Ertekin, M. and G. Ertekin (2020). "Characterization of cut resistance and comfort properties of protective gloves based on different materials." The journal of the Textile Institute 111(2): 155-163.

4- Islam, M. T., M. N. H. Tarekul Islam and M. N. Islam (2022). "Protective Textiles and Operative Management Systems: Pres-ent Situation and Health Hazards of Workers in

Readymade Garment Industry in Bangladesh".
5- Islam, S., M .A. H. Mia and M. Z. Abedin (2022). "Evaluation of causes and effects of fire and other safety incidents in readymade garment industry of bangladesh." American Journal of Mechanical and Industrial Engineering 7(1): 13-30.
6- Khan, N. R., T. R. Dipti, S. K. Ferdousi, M. Z. Hossain, S. Ferdousi, S. A. Sony, N. Zafrin, N. Paul and M. S. Islam (2015). "Occupational health hazards among workers of garment factories in Dhaka City, Bangladesh." Journal of Dhaka Medical College 24(1): 36-43.
7- Mehrin, S., M. R. Sheikh ,M. Y. Ali, M. M. R. Khan, N. E. Alam and M. M. Rahman (2022). "Scope of Injury Minimization in Garments Industry: An Analysis." Open Journal of Safety Science and Technology 12(3): 72-83.
8- Mehta, R. (2012). "Major health risk factors prevailing in garment manufacturing units of Jaipur." Journal of ergonomics 2(2): 1-3.
9- Mohibullah, A., U. Takebira, K. Moni and M. Rahman (2018). "Social Compliance." Occupational Health and Environmental Safety Management Practice in the Apparel Industry of Bangladesh: An Overview. J Textile Sci Eng 8(342): 2.
10-Parveen, I., M. I. Mahmud, A. K. Mondol, M. N. Akter and S. Shil (2019). "A study on minimization of injury and accidental causes in different operational sections of RMG industries in Bangladesh." International Journal of Industrial and Manufacturing Systems Engineering 4(1): 10-18.
11-Rajih Issa Maadi, Ahoud, Mustafa Kamel Daabas, & Rania. (2022). Proposed models for developing occupational health and safety systems in ready-made garment manufacturing plants. International Journal of Design and Applied Research, 1(2), 7-24.
12-Thatshayini, P. and P. Rajini (2018). "Occupational safety and health hazards of apparel sector: perspective of Northern Province employees of Sri Lanka." Journal of Business Studies 5(١).