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Short Communication

An investigation into the effect of fabric thickness on button pullout strength

Md. Mehedi Hasan Tusher[1]*, Nur-Us-Shafa Mazumder[1] and Md. Nuruzzaman Rana[2]
[1]Department of Textile Engineering, Port City International University, Chittagong, Bangladesh
[2]Dept of Apparel Engineering, Shyamoli Textile Engineering College, Dhaka-1205, Bangladesh
meheditusher@gmail.com

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Abstract

It is significant for trimmings of a garment to have at least same lifetime of the garment; otherwise, the garment would be rejected or lose its appeal. Buttons of a garment are one of the trims that have an essential role in easiness of wearing and aesthetic outlook. However, they encounter heavy force and abrasion during daily uses which make them susceptible to degradation. Therefore, it is noteworthy to explore the appropriate button pulling strength to incorporate in a particular fabric. Concerning this matter, the present study explores the effect of fabric thickness on the pulling strength of button. In this study button pulling tests were carried out on 100% polyester pique fabric of five different GSM (180, 190, 200, 210, and 220). The results show higher button pullout strength with the increase in fabric GSM. The study also engages to employ a relation between fabric GSM and pulling strength for the particular fabric type. The result of the study is expected to eventually help the designers, product developers, and quality managers to predict how materials or products will behave in their intended use or what changes in materials are required to control its behavior during application.

Keywords: Button Pulling Strength, Button, Pull Resistance of Button, Fabric Thickness and Button, Button and Children Safety.

Introduction

Cost, quality, care, and comfort are the consideration of a consumer before purchasing clothing[1]. Quality is considered as one of the dominant criterion in this competitive 21st century for a clothing brand in the global context. According to a study, 91% of unhappy customers will not willingly purchase product again from that brand. Another study shows that Americans tell an average of 9 people about good experiences and tell 16 (nearly two times more) people about poor experiences[2]. Therefore, this increased consumer awareness is making garment quality more essential than ever. At present, quality of apparel's materials and workmanship is ensured by using a number of quality control checks and tests[3]. Achieving quality in a product does not mean only incorporating high quality materials in it but also maintain the same throughout its designed lifetime[4]. Even a small drop in trivial trims in clothing can be a reason of dissatisfaction to a consumer which might pull back a manufacturer or brand from competitiveness. As a consequence, buyers are now much more cautious even about a minor contributor to quality. Buttons are amongst those trims that are often found vulnerable during daily uses, since they face heavy force and abrasion. Button pullout from cloth does not make it unusable yet leads to customer dissatisfaction regarding easy care of the product. But as a matter of fact, there has been little research about button and its resistance to pullout. Many factors can affect the button attaching strength of a cloth, such as sewing thread types, ticket number of sewing threads, construction of fabrics, fabric GSM, and so on. Amongst these factors, this paper investigated the influence of fabric thickness on button attaching strength.

In apparel manufacturing industry, button pulling test is considered significant for making an appropriate product for the ultimate consumer which also helps avoiding accumulated monetary loss due to problem finding at the final stages. The test provides an idea about the pullout resistance of a button. The test is a kind of tensile test which determines how something reacts while pulling apart when force is applied to it in tension. It is one of the widely used and simplest mechanical tests carried out in apparel industry to know the strength of attached button. By this test, material properties can be determined by measuring the force required to elongate a specimen to breaking point. Product development is the crucial recipe for success in today's competitive market[5]. Hence, the result of the test will ultimately help the product developers and quality managers to predict how materials or products will behave in their intended use or what changes in materials will be required to control its behavior during application.

Attaching security must meet the required strength; otherwise, it may be an issue for children safety or hamper human prestige[6]. As a consequence, buyers of garments now usually set a standard of button pullout. According to BS 4162, minimum force is 90 Newtons (9.17 kg)[7]. These tests give data about the safety of materials or components helping manufacturers ensure

that their finished products are safe, fit-for-purpose, and manufactured to the highest quality.

Materials and methods

The study was carried out on 100% polyester pique fabric of five different GSM (180, 190, 200, 210, and 220). Thickness difference of 10 successive grams per square meter is maintained in the samples. Polyester pique is one of the commonly used fabrics in textile industry and the fabrics of above mention GSM were cordially provided by KDS IDR Ltd Bangladesh.

A total of 25 fabric samples of five GSM were taken for button attaching. As the purpose of this study is to know the influence of fabric thickness on button pullout resistance, the others factors that could manipulate the purpose were maintained invariable.

Four-hole round shaped plastic buttons of 16 ligne were first attached on those samples using button attaching machine (Model: LK-1903B). Same sewing thread of polyester 50/2 tex was used for attaching the buttons. Five pulling tests were done on fabric of each GSM following ASTM PS79-96 button pulling standard. The results were then analyzed to come up with a decision about the effect of GSM to resist button pullout.

Finally, regression analysis was carried out on the data to figure out a linear relationship between fabric GSM and pullout force and eventually, to predict force required to pullout a button for a particular GSM.

Results and discussion

The results of button pullout strength on 25 samples of 5 different GSM and their average values are conferred in Table-1.

The test results clearly show the significant impact of fabric thickness to resist button pullout. With the increase of fabric GSM, resistance to button pullout also increases. For instance, 8.9 kg force is required to pullout a button from the fabric of 180 GSM where it is 9.9 for the fabric of 220 GSM. It is noteworthy that higher GSM facilitates the strength between the fabric and button. With the increase of fabric GSM, the number of wales and courses in it also increases. It is because the stitch length of loops of fabric reduces. As a result, the fabric becomes more tight and compacted[8].

In fabrics of higher thickness they have more loops to be interlocked by the sewing thread during attaching button on them. Accordingly, when force is applied on them to pullout buttons, more loops of fabric create more resistance. The bond between the sewing thread and the fabric becomes stronger because of the higher number of loops. Stronger union takes high force to be broken consequently shows higher resistance.

Table-1: Results of Button Pullout Test.

Sample Number	Fabric Thickness (GSM)	Applied Force (kg)	Average Applied Force (kg)
1	180	9	8.9
2		8.8	
3		8.9	
4		8.8	
5		8.9	
6	190	9	9.2
7		9.3	
8		9.2	
9		9.1	
10		9.3	
11	200	9.5	9.5
12		9.2	
13		9.5	
14		9.4	
15		9.7	
16	210	9.6	9.7
17		9.8	
18		9.7	
19		9.8	
20		9.7	
21	220	10.2	9.9
22		10.3	
23		9.6	
24		9.8	
25		9.7	

To figure out how the pullout force typically acts when GSM of the fabric changes, statistical regression analysis was done on the test results of 25 samples of 5 GSM. Thus, a linear

regression equation was formulated to predict the required pullout force for a particular fabric GSM[9]. Following is the linear regression equation for button pullout resistance and GSM -

Y=4.192+0.0262X
Where: Y= Button pullout force and X= GSM of fabric.

For example, 10.48 kg force is required to pullout a button from a fabric of 240 GSM.

Hence, Button pullout force increased by 0.0262 kg as fabric thickness increased by 1 GSM.

The formulated linear regression equation was applied on the GSM of tested samples as well to check its conformity with the tested results. Figure-2 shows a comparison between the tested results and respective values from the linear regression equation. For sample 2 (GSM 190), where tested pullout force was 9.2 and predicted value by regression equation 9.17, the percentage difference found 0.327 % which evidently indicates the conformity.

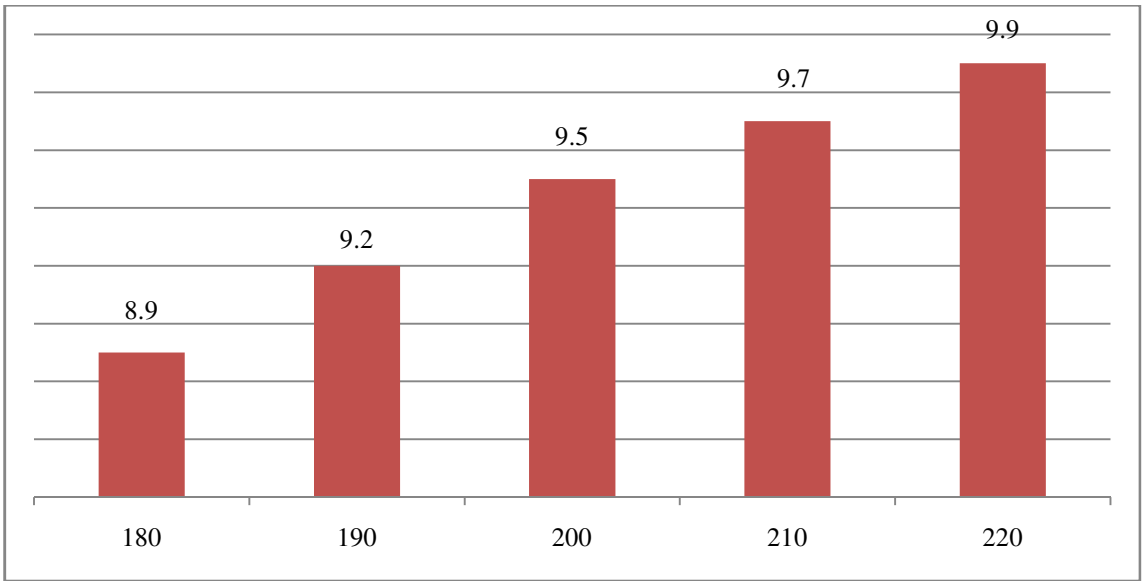
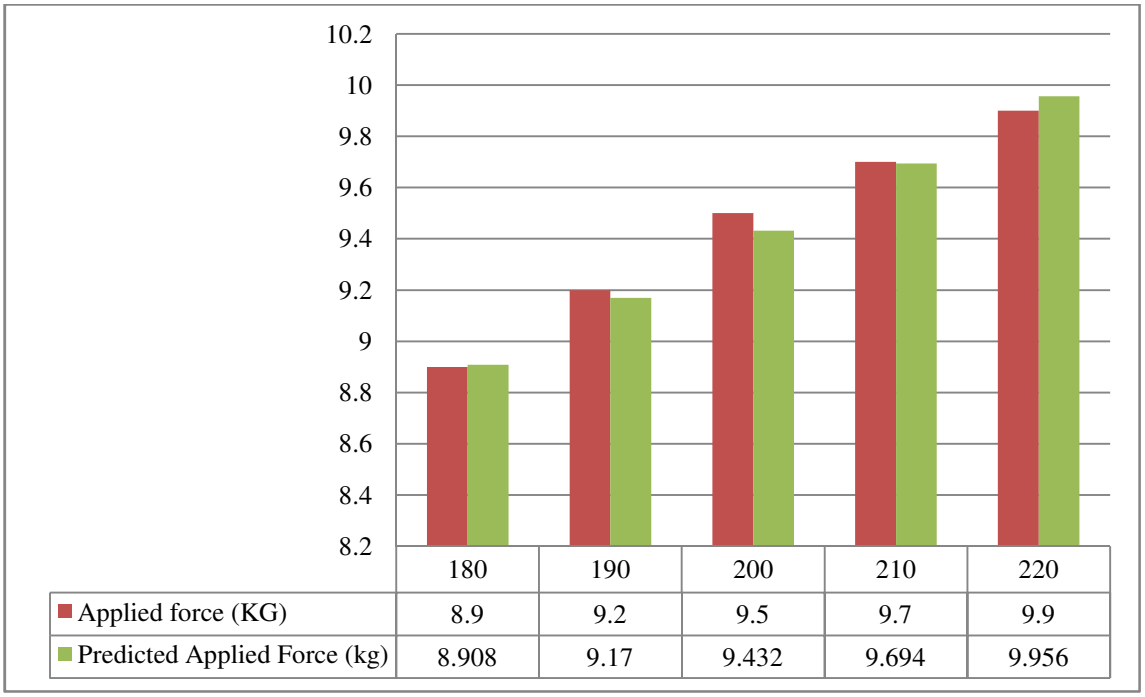


Figure-1: Average Resistance to Button Pullout Force.



	180	190	200	210	220
Applied force (KG)	8.9	9.2	9.5	9.7	9.9
Predicted Applied Force (kg)	8.908	9.17	9.432	9.694	9.956

Figure-2: Comparison between Tested and Predicted Results

Conclusion

The sewing strength between button and fabric mainly depends on the nature and ticket number of sewing thread and the thickness of fabric. This study shows strength increases with GSM. The inclusion of sewing thread types and ticket number along with GSM in the study could give the product developers a complete scheme of knowledge for the right selection of materials for a product based on its intended application and lifetime. They would have choices from affecting factors to incorporate the certain characteristics in the product. Since, the button pullout tests and regression analysis were performed based on only 25 fabric samples, predicted pullout force for fabrics of others GSM closed to the tested ones are expected to comply with actuality. There might have slight fluctuation in prediction for fabrics of faraway GSMs than tested. Even with the best choice of materials, button loss is still a practical consumer trouble. An extra replacement buttons may be attached to the garment in veiled place, attached to a hand tag, or contained in a small plastic bag to make up for this probable loss[10].

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