Development of 2.5D Multi-Layer Stitched Woven Anti-Ballistic Fabric on a Conventional Handloom

Submitted By

Arooj Shahid

ID: 15026089003

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Statement of submission

The title of my research project "Development of 2.5D multilayer stitched woven anti-ballistic fabric on a conventional handloom" is being submitted for completion of MS Textile degree from School of Textile and Design, University of Management and Technology, Lahore, Pakistan.

Name of Student: Arooj Shahid

Student ID: 15026089003

Supervised by: _____ Date: _____

Dr. Mumtaz Hasan Malik

(Professor/ Dean)

Declaration

I, Ms. Arooj Shahid ID: 15026089003, student of MS Textiles in the area of weaving, hereby declare that the matter printed in the thesis title, "Development of 2.5D multilayer stitched woven anti-ballistic fabric on a conventional handloom" is my own work. It has not been copied from any published material; except the references, literature, tables and few figures. Further, it has not been printed, published, and submitted as research work, thesis or publication in any form in any other university, research institution, etc. in Pakistan or overseas.

Student's Signature: _____

Name of Student: Arooj Shahid_____

Date: June 08, 2017

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(Signed)

_____ (Arooj Shahid Student ID: 15026089003)

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Abstract

Anti-ballistic armours are of vital importance for personal protection equipment. High-tech organic aramid fibres are chiefly used for imparting anti-ballistic properties. In recent times, 3D weave emergence, in the technical textiles sector is on the run of uncurtaining vast novel opportunities and advancements.

The research focuses on developing 2.5D multilayer stitched woven fabric on a conventional handloom, incorporating technical yarns for imparting anti-ballistic properties. Multifilament Kevlar® 49 having a linear density of 1420 denier was used as technical material. Samples of four, six, eight and ten layer stitched multilayer weave structures were successfully drafted and fabricated on a conventional handloom, in addition to a plain weave sample.

The increased number of layers displayed gradual increase in the thickness generating a compact stitched fabric construction. As, more the layers better will be the impact resistance and greater will be the energy dissipation The stitched weave structure design may compensate the varied ends spaced open construction with higher number of picks to form a considerable thickness. In future it may fulfil the anti-ballistic performance and impact resistance properties followed by further ballistic testing and manufacturing such multilayer stitched woven body armour on high speed mechanical looms.

Key words: 2.5D weave, stitched multilayer, conventional handloom, anti-ballistic.

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Chapter 1
Introduction

1.1 Background

Weaving, being the major means of fabric construction, has been and still encountering enormous advancement and improvements over the years and from time to time to fulfil the unremarkable changes, varying demands and requirements of mankind. The principle of fabric formation, generally referred to as the two-dimensional (2D) sheet, is the combining of warp and weft yarns in a plane perpendicular to each other via crisscrossing. Primarily the textiles were used for covering and adornment purposes [1], but as the technical textiles emerged with evolution of high-tech fibers the prior manufacturing purpose became the functionality and performance [2].

The advances and special technical applications gave an insight to construct more sustained dimensional weave structures, in terms of dimensions, providing considerable height or thickness to the fabric. Such variations in the conventional means of weaving mechanism led to the origination of three-dimensional woven fabrics. There are three chief 3D fabrication systems namely 2D weaving, 3D weaving, and Noobing, comprising two sets of yarns, three sets of yarns and non-interlacing technique respectively [3]. The 3D fabric structures constructed through 2D conventional weaving are termed as multi-layering or in some cases referred to as 2.5D weaves [3, 4]. The phenomenon is achieved by constructing several joined layers providing thickness for reinforcement thus improving material's delamination resistance i.e. splitting of layers. The fundamental definition of 2.5D fabric is "the component yarns are placed in two mutually perpendicular planes in relation to one another, (e.g. terry fabrics) [5]".