TALLINN UNIVERSITY OF TECHNOLOGY
SCHOOL OF ENGINEERING
Department's title

LEATHER AND DIFFERENT TEXTILE MATERIALS IN PRODUCT DEVELOPMENT OF BAGS

LOODUSLIKU NAHA JA ERINEVATE TEKSTIILMATERJALIDE KASUTAMINE KOTTIDE TOOTEARENDUSES

MASTER THESIS

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THESIS TASK

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Thesis topic:

Leather and different textile materials in product development of bags

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Loodusliku naha ja erinevate tekstiilmaterjalide kasutamine kottide tootearenduses

Thesis main objectives:

1.	Exploring the possibilities of wastage leather and to upcycle it as new product.
2.	Product development of different bags articles by using leather and fabric materials
3.	Physical Testing of the materials so that the quality and performance of the materials can be sort out as well as which materias are suitable for product manufacturing can be known.

Thesis tasks and time schedule:

No	Task description	Deadline
1.	Overview of Materials for development of bags	15.03.2019
3.	Pattern design and development for bags	06.06.2019
4.	Selection of materials	20.02.2020
5.	Development of prototypes	04.04.2020
5.	Final bag sewing process	15.05.2020
6.	Testing of bag leathers and fabrics	07.06.2020
7.	Submission of the completed master's thesis to the supervisor	03.08.2020

Language: English **Deadline for submission of thesis:** "03" August ,2020a

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INTRODUCTION

The leather and textile industry have a significant impact on the environment, and this has been the case in recent decades has grown significantly - currently, the world consumes 400% more textile made products per year than 20 years back. Today's bag industry also is characterized by constantly changing trends and cheap labour, which in turn leads to lower bag prices and over-consumption. [1] It is also relevant to low-quality clothing and cheap material due to consumers looking for opportunities, how to buy bags as cheaply as possible. However, due to the constant flow of information, people appreciate the quality and durability of the leather products. Quality is also an important part of materials and it is related to human health so that the materials are treated as natural and as little as possible. More and more people are turning attention to the well-being of their body and mind, for example, people buy bags that are used more and more natural materials. In this work, bags are made, the choice of materials of which is consistent with people and their needs. [2] The fashion industry produces an incredible amount of textile and leather products that are used by millions of people around the globe for everyday life. Leather is one of the most popular materials for function and fashion. The leather industry has a long history dating back hundreds of years. [3] It is a $100 billion manufacturing sector that produces leather products all around the world. The most popular leathers come from cows, sheep, goats, and pigs. Shoes, clothing, bags, and upholstery are the most popular products.

This work aims to develop a functional bag collection that combines different materials such as leather, canvas, polyester, etc. Interestingly, leather has been chosen from leftover materials. Furthermore, some tests are carried out on selected materials and a description of the properties of the selected materials and production methods. When designing the collection, leather and textile materials have been selected, which are high quality and sustainable. Which makes the collection special is the choice of materials and their integration into a whole bag collection consisting of simple but elegant styles.

The bags are made of different materials, but from two combinations at once- Leather and polyester or canvas and polyester. The leather selected is chrome tanned cowhide, which is thin and very soft. The selected canvas is natural and thicker. The combination of leather and polyester is suitable for using at more official purposes and day to day life. An important aspect is that the leather is made of Chrome tanned material, but body-friendly, but at the same time elegant and beautiful. This thesis work consists of six chapters.

The theoretical part is the first part of the master's thesis which illustrates the overview of the history of bags and It consists of different tanning process of leather. Moreover, it also provides a brief overview of polyester and canvas fabric which yields the durability and strength of the fabric. Polyester was used as a lining material.

The practical part is the second part of the thesis which illustrates an overview of leather and fabric tests done to choose suitable and durable fabrics and leather for the bag. Analysis of the process of bag manufacturing and development of design, correction, and revision of patterns making of prototypes and sewing technology of the final products are included in the practical parts. The last section is the discussion of the finished product.

1 BAG FASHION

The wearer's ambitions have often been expressed in clothing and accessories which play a key role in fashion. The life cycle of a fashion product includes production, distribution, use, collection, upcycling, and recycling stages. [4] Nowadays bags represent the changing lifestyle, needs, and patterns of women in the contemporary world. Today's style bags can be divided into useful bags, evening bags, luxury bags, and utility bags. A tote type of bag that is great for working moms and women who works a lot of every day. An evening bag is a sign of femininity concerning its small size and hand-made jewellery. [5] The luxury bag represents the desire of people to achieve high quality and to become a part of the brand 's image irrespective of its costs. The utilitarian bag is made of military or sports equipment and is popular with mobs armed younger generations.

1.1 The history of bags

Bags were first mentioned in the mythology of Ancient Greece, e.g. Perseus and Gorgon, and in 14th-century medieval literature. [6] Yet of course the first bags emerged a long time ago when people had their first possessions and valuable items they wouldn't leave away from home. Boxes, antiquated wall carvings, and frescoes can be seen on old Egyptian papyrus. Men also have been using the bags for long since: bags of this kind existed in Europe and Scandinavia. There are remains of fantastic bags from the Viking age in the Nordic territories. Viking made bags can be seen in (Figure 1.1)

Figure 1.1 Bags from Vikings era

1.1.2 Hanging bags 1500 – 1800 A.D

In this period bags were crafted in several different styles, such as loop bags, leather bags, and long string bags. They were all attached to the belt or girdle, except certain unusual shoulder bags. The pockets were introduced in the late 16th century. However, some men's bags disappeared gradually throughout the 17th century. Since chatelains were mostly made of precious metals, they have often been considered symbols of jewellery and rank. The chatelaine 's designs and accessories evolved over the centuries, but the handbag was only finally replaced at the beginning of the 20th century. [6] Hanging bags can be seen in (Figure 1.2)

Figure 1.2 Bag fashion of Germany and Belgium [6]

1.1.3 A replacement era, new bags 1800 – 1900 A.D

Once Pompeii, ancient Greek, and Roman, were discovered in the 18th century, bags became very famous. Classicism, this trend, also had a profound influence on female style: clothes got straightened and the decorative lines got up. There was no space for hanging bags under these delicate garments. The material, the first true handbag, was transferred to the reticule and replaced with a chain cord. Until the start of the 19th century, such bags were in fashion. Replacement era bags can be seen in (Figure 1.3)

Figure 1.3 Bag fashion of France, England 1820 and 1935 [6]

1.1.4 1900 A.D. – present

The art and fashion movements occurred and followed quickly in the 20th century. But the most critical element in forming the bag was women's emancipation. [7] More and more women worked and their handbags had to meet an increasing variety of practical needs as they were becoming independent to work. Moreover, this comes from different kinds of sacks uses, such as leather cases, comfortable everyday walking and visiting leather and plastic bags, elegant sparkling bags, and metal clutch bags for night use. At the end of the 20th century, branding became ever more important, and major manual designers came into limelight. Designers are worldwide known for luxurious leatherware and handbags. The bag has become a fashion accessory that can alter every season. In comparison with the last centuries, where style has been unchanged for many decades. Modern bags can be seen in (Figure 1.4)

Figure 1.4 Louis Vuitton and Michael Kors [8] [9]

2 SELECTION OF BAG MATERIALS

The selection of materials is a crucial task while making of the bags. The actual quality depends on different kinds of materials. There are some different materials required for the bag manufacturing which are given below

2.1 Leather

For designer labels and to produce luxurious bags, leather is widely used. It is because simple to cut, shape, and built. Besides, leather was evaluated for its durability by time. In many social occasions, the elegance it offers is evident. There is no denying that it is one of many fashion lovers favourite materials is leather. [10] The price is the only problem with this stuff. It is certainly quite costly, especially derived from exotic animals. The leather is not even ordinary at all cheap because it is a laborious operation. Example of chrome tanned leather can be seen in (Figure 2.1)

Figure 2.1 Chrome tanned leather [11]

2.1.1 Overview of various leather products

Leather plays a crucial role while the manufacturing of products. However, there are different kinds of leather article for example; Nappa leather, top grain leather is used to manufacture different types of leather products. Leather shoes and small leather products are mostly use for everyday purposes. On the other hand, Upholstery leathers have also increased demand in market for its durability. An overview of various leather products can be seen in (Table 2.1)

Table 2.1 Types of leather products

No	Types of products	Pictures
1.	Leather shoes	 Figure 2.2 Leather shoes [12]
2.	Small leather goods (bags, folders, belts, straps, etc)	 Figure 2.3 Small leather goods (wallet) [13]

3.	Gloves and safety products (aprons)	 Figure 2.4 Leather gloves [14]
4.	Upholstery furniture	 Figure 2.5 Upholstery furniture [15]
5.	Leathers for fashionable accessories (boxes, cases, bracelets, notebooks, etc)	 Figure 2.6 Leather bracelets [16]
6.	Clothing (jackets, hats)	 Figure 2.7 Leather jacket [17]

7.	Furs	 Figure 2.8 Fur fashionable bags [18]

2.1.2 Treatment and properties of natural leather

Leather's characteristics depend on how raw material originates. Pelt is prepared for chemical alteration as conferred by the change in how the leather is lubricated and how the surfaces are pre-lubricated. Leather can be made as stiff and hard. A cloth can be used with it as reinforced materials. It is the usual technology for controlling processing parameters and variables of leathers with properties that are specified, needed, or necessary. It is the artistic dimension of the Leather engineers who continuously produces a variety of leather articles. [19]

By its nature, leather is suitable for the production of different products, as it has good processability. The leather has been used since ancient times and with proper care, it must be made of leather products adopted for many years. Natural chrome-tanned cowhides have been chosen as one of the materials for the manufacturing of the bag models.

2.1.3 Step by step Leather processing

Leather processing evolves a lot of processing steps both in chrome tanning and vegetable tanning process such as; liming, drying, pickling, neutralizing and so on. The description of leather processing steps is given as follows:

Skinning. Skin handling and processing begin with skinning. Skinning is carried out mainly with a knife, cutting through the fibres that connect the skin and the meat. The work must be done very carefully to maintain skin quality. The price of the skin is 20-40% of the price of the animal. Careless skinning cause damages to the leather which can be costly. [20]

Leather pre-treatment processing is divided into three types, which are preliminary work, tanning, and finishing work. During the pre-treatment, the dried hides are soaked with the water and the salt is used too. Followed by unhairing and cleansing of the flesh and surfaces. The following steps to be taken during the pre-treatment of the hides. Drying of the skin - the aim is to preserve the skin by reducing excess fluid so that it prevents the growth of harmful bacteria. It also helps the skinning process. The skin is dried in a shady place outdoors and dry with the flow of air. The flesh of the skin is rubbed with salt before being placed to dry. In wet salts, the skin is placed immediately after skinning and after cooling.

Soaking. The hides are soaked in smooth water to get rid of any filth and usually to eliminate the salt utilized in the previous stage. Curing (salt conservation treatment) additionally eliminates water from the hides and soaking them makes the hides swell and return to their unique softness. The hides can be handled for quite a few days, depending on the amount of salt and the dryness of the skins. Salted bovine hides need various hours and dried hides need quite a few days. [20] Soaking of leather can be seen in (Figure 2.9)

Tasks for soaking are the following:

- restoration of the clean water content earlier than the preservation;
- the restoration of the swelling as earlier than the preservation;
- cleaning the pores and skin of dirt, manure, and blood;
- removal of excess chemicals, preservatives as well as disinfectants.

Figure 2.9 Soaking process [21]

Liming. The most vital step in beam house operations is "liming". The hides are soaked in liming drums which comprise a solution made of lime and sulphur compounds. The principal motive of this method is to separate the hair from the hides. The result is hairless hides which are very greasy, usually because they nevertheless have excessive fat content.

Tasks for liming are the following:

- loosening the upper skin and hair, so that it can be eliminated easily;
- loosening of meat and fats residues for removal;
- removal of proteins that would affect the leather-based quality;
- draining out of fat in the skin;
- swelling of the fibres of the skin;
- open the pores and skin structure, so that the fibres loosen and the tannins can be nicely connected.

Figure 2.10 Liming process [22]

Fleshing. In this stage, the hides are nonetheless in a soaked but softened condition. Traditionally, using a sharp and curved blade, any excess flesh is eliminated through putting them on a beam. Nowadays, this procedure is executed by using a machine. Leftover debris is referred to as "glue stock". [20]

Figure 2.11 Fleshing process [23]

Splitting. Often thick skins are cut horizontally into pieces to form the flesh side, middle layer, and hair side. Generally, two thick layers are used, but if necessary, the middle layer is also retained. Thinner skins can also be split to make the articles. The splitting of the hides takes place with machines.

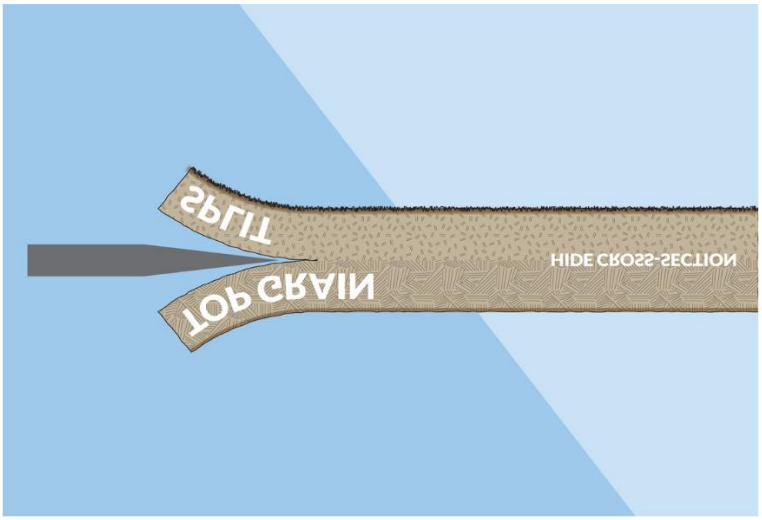

Figure 2.12 Splitting process [24]

Bating. Bating is the most crucial step in leather processing. Hides are processed to break down proteins by using enzymes similar to those present in the digestive system. The leather is made smoother by bating process. The batting cycle is based largely on the desired leather softness. The bating cycle should be longer than as usual If the softness of the leather is required more. [25]. Before industrial production was developed, numerous other batting forms, including horse, pigeon, or hen poop, were used. Due to the unpleasant smell, inaccuracy, and long duration, these methods were not successful. The application of enzymes has indeed enhanced the bating operation. Bating process of leather can be seen in (Figure 2.16)

Figure 2.13 Bating process of leather [26]

Pickling. Pickling is just after the process of bating therefore this process enhances the receptiveness of the hides to tanning. Pickling enables chrome tannins to reach the hide with a maximum pH level of 3. Salt is added to avoid swelling of the fibres. Bactericides and fungicides are used for conservation purposes.

Figure 2.14 Pickled leather [27]

Neutralizing. Acids that have penetrated the leather fibres in the process of tanning are eliminated at some point in the neutralizing stage. Alkaline sodium carbonate is used at the attention of 1.2%. Neutralizing is necessary, to enable fat-liquoring. There are no tries to carry the pH level of leather-based to 7 at some point of this stage since this would dissolve the binding of the tannins to the skin-fibres and as a result drastically minimize the sturdiness of the leather. In the production stage, a pH level of 4-6 is controlled.

Dying. Depending on the kind of leather, the leathers are coloured using aniline dyes (drum dyeing). Leather absorbs colour without creating a layer of the coating when it is coloured with the aniline dye. For example, water-absorbing leather articles (suede, aniline leather and nubuck) are coloured with the aniline dye. The porous aniline is called the top-grained absorbent leather as well. However, the bulk production of the leather is dyed with the pigmented colour process. The darker shade is possible due to its transparent characteristics. Aniline colour is often called "aniline paint." Azo dyes also used significantly nowadays. Dying of leathers provides an exotic look of leathers [28]. Dying of leather can be seen in (Figure 2.15)

Figure 2.15 Dying of leather

Tanning methods. There are mainly four types of tanning method which are discussed as follows:

Chrome tanning. Tanning with Chrome is fairly new, but undoubtedly the most dominant and mostly used tanning process. The hides should be soaked in acidic salt-containing baths until chrome tanning is ready for the next stage. The bath consists of chromium tanning agents ($\mathbf{Cr^{6+}}$) and the bath's acidity is reduced until the chromium agents penetrate the surface of the hides. The wet hides generated by this method are a blue colour and referred to as "wet blue leather". Chrome tanned leather can be seen in (Figure 2.16)

Figure 2.16 Chrome tanned leather [29]

Vegetable tanning. Vegetable tanning has been in use since ancient times, involving bark tannins and leaves of arborescent trees and plants. After the preparation stage, the hides will be put into the tanning chamber, where tanning solutions of different strengths are provided. The tanners have been moving hides from drum to drum over 2 to 3 months and the solution is becoming increasingly stronger. The tanning agents penetrate the skin and the process of deposition and fermentation makes the hides distinctive appearance and colour. Example of vegetable tanned leather can be seen in (Figure 2.17)

Figure 2.17 Vegetable-tanned leather [30]

Synthetic tanning. Synthetic tanning means a tanning method in which the tanning substances used are of synthetic origin.

Dry tanning. A method of tanning in which no tanning agents are used. Dry tanning skin gradually and mechanically treated in smooths and rolls. The fluid content of the skin is transferred to 16%.

2.1.4 Pros and cons of vegetable tanning

The tanning process evolves various stages with different chemicals. Generally, chemicals play a vital role in the processing of leathers. However, the pros and cons of vegetable tanned leather are described as follows:

Pros:

- vegetable-tanned leather, the usage of only herbal tannins, has no hazardous environmental impact;
- the tanning approach is historical and requires expert craftsmen, making vegetable tanned leather-based products extra prestigious;
- owing to the careful tanning process and the natural tannins, vegetable-tanned leather-based develops a rich and stunning patina, and truly gets higher with time and use;
- it doesn't crack or dry out and consequently, has a very long lifespan;
- it has a herbal tone and Pleasant smell. [31]

Cons:

- vegetable-tanned leather is firstly a bit hard and has to be broken in to end up wholly flexible and functional;
- colours from vegetable tanning are not as glossy as in chrome tanning and darken over time;
- vegetable-tanned leather takes 30-60 days, even more, to produce which is a very long time, making the products usually greater expensive.

2.1.5 Pros and cons of chrome tanning

Nowadays chrome tanning is the most significant tanning method among all tanning methods because of its faster and cheap processing characteristics. Pros and cons of chrome tanning are as follows:

Pros:

- Chrome tanning is speedy and less expensive and can be without problems automated and accomplished in one single day;
- Chrome tanned products are consequently cheaper and more considerable compared to vegetable tanned leather products;
- The colours of the leather stay unchanged during the product's whole life;
- Chrome tanned leather is thinner and softer compared to vegetable-tanned leather.

Cons:

- The system of chrome tanning creates poisonous wastewater that has a dangerous environmental impact;
- Chrome tanned goods neither wear nicely nor last very long and it is not suitable for long term use because chromium is a hazardous chemical;
- Chrome tanned goods don't show up very naturally and frequently contain a chemical smell. [32]

2.1.6 Classification of leather according to layers

Leather is typically divided into two or more layers for use commercially. The top layer of natural grain is referred to as the upper grain. The other layers are equally divided. Top grain leathers are used to make novelty products because it has good fibre structure. top grain leathers are costly compared to other layer articles [33] The classification of leather according to its layer can be seen in (Figure 2.18)

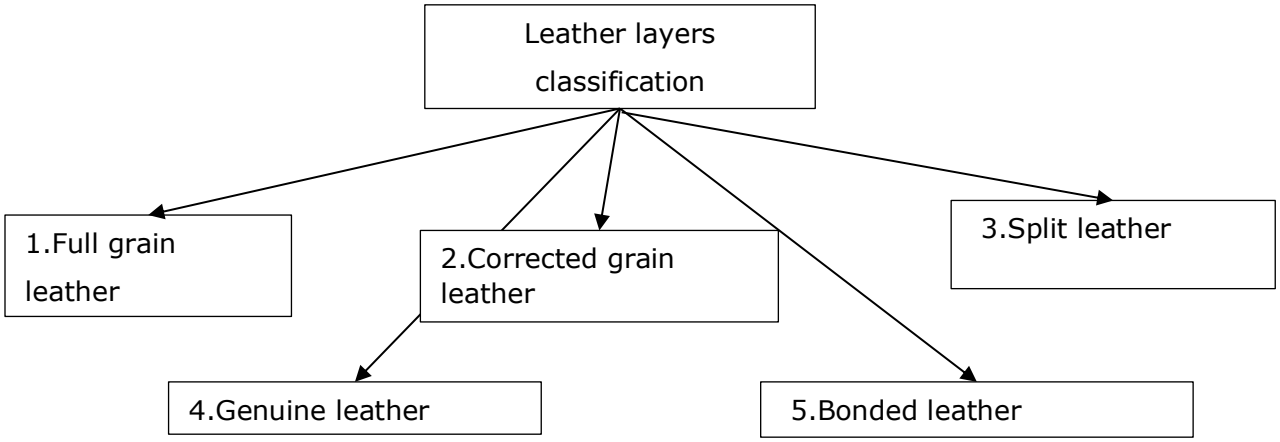

Figure 2.18 Leather layer classification

2.3.7 Classification of leather-based on treatments

There are several treatment methods for leather that are done differently in several chemical conditions. The treatment of leather depends on customer choice. For instance, nappa leather is softer compared to other leathers. Aniline dyed leathers are used to make shades in different colours. On the other hand, pigment-dyed leathers are little bit tenacious. [33]The classification of leather-based on its treatment can be seen in (Figure 2.19)

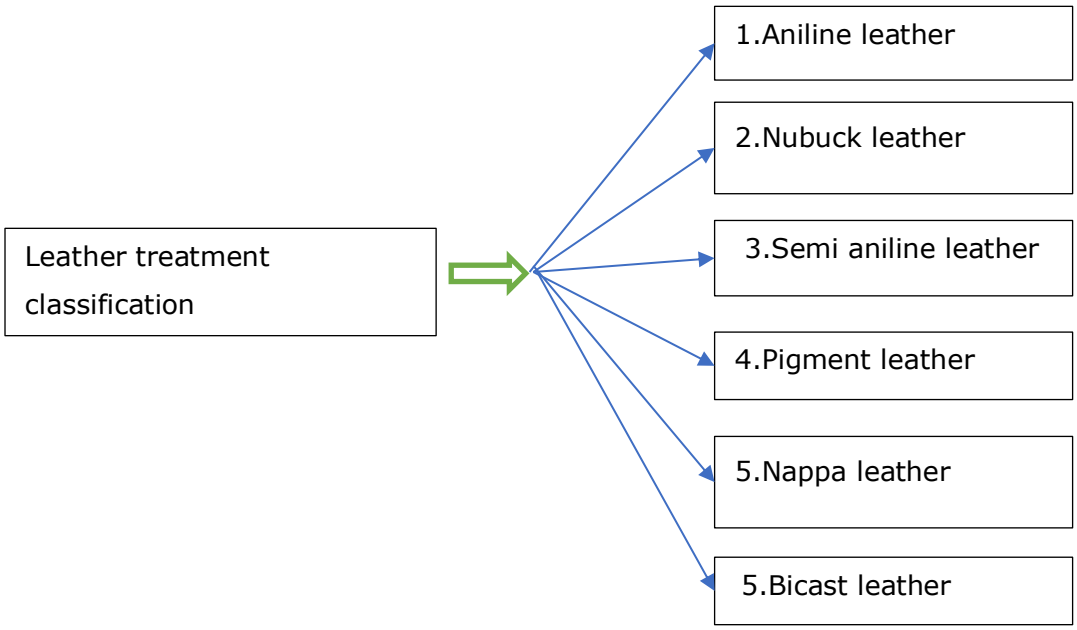

Figure 2.19 Classification according to treatment

2.1.8 Classification of leather based on tanning

The foremost and crucial part is leather can be classified based on the tanning process. Chrome tanned leather is common nowadays because of its faster characteristics. Vegetable tanning requires more time. On the other hand, brain and synthetic tanning used for making certain finishes. According to the method of tanning, leather can be classified as showed in (Figure 2.20)

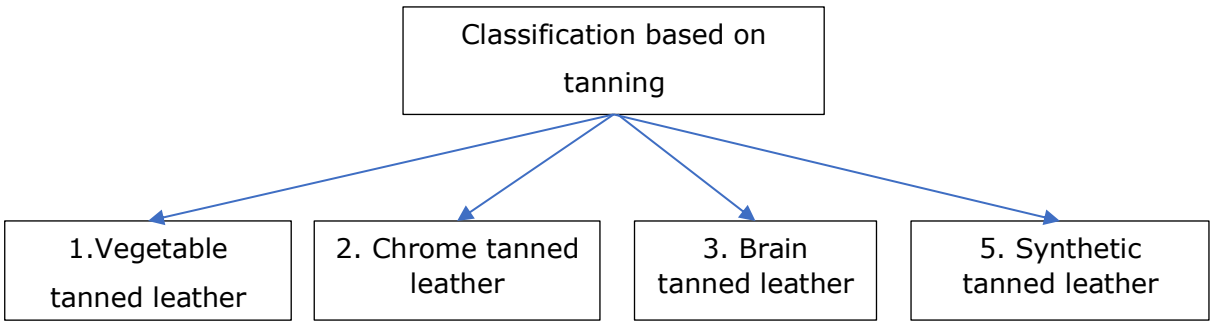

Figure 2.21 Classification based on tanning

2.3.9 Classification according to skin types

Leathers are processed according to the customer needs and durability. Mainly, calfskin shows better fibrous structure among all skin types. However, different products made from different types of leather. Leathers also can be classified according to the skin types as shown in (Table 2.2)

Table 2.2 Classification according to skin types [34]

No	Skin type	Features	Thickness(mm)	Field of application
01	Calfskin	Strong surface and dense fibrous structure. The surface of the skin may be an embossed pattern.	0.5-1.5	Quilted bags and belts, purses and handbags, linings and pockets, footwear
02	Pigskin	Distinctive triple hair markings. Very strong and wearing hard.	0.5-1.5	Leather jackets, bags, belts, money and handbags, suitcases, linings, and pockets.

03	Goatskin	Prominent and not very dense structure; very easy to cut.	1.0-1.5	Leather jackets, bags, handbags, wallets and book covers
04	Glazed leather	The surface is usually glazed, very delicate and lightweight skin.	0.3-0.8	Small bags and belts, very suitable for lining
05	Sheepskin	Spacious and dull fibres; easy to paint.	1.0-1.5	Aprons, pillows, filers, jackets, garments, leather jackets, shoes, gloves

2.1.10 Finishing of leather

It is important to ensure a high-quality appearance and to consolidate the properties achieved by finishing of tanned hides and skins. Each tanned and skin type is finished in various stages, methods and a different sequence of works. Tanning neutralization - tanned hides and skins are treated with neutralizing solutions such as borax or baking soda solution which binds the acid in the skin [29]. Dying of the Leather includes several processes, for instance, the skin is dyed throughout the cross-section and is done with aniline dyes. Aniline is the starting material for the synthesis of many dyes. Later, the top and bottom of the skin are painted and dried. Drying takes place slowly in 1-2 days in the dryer. After drying is important for the skins to moisturize the surface so that the skin does not tear during further processing. Furthermore, ironing gives the leather a nice commercial appearance. The leather finishing process can be seen in (Figure 2.21).

Figure 2.21 Leather finishing process [35]

2.1.11 Properties of untanned skin

After skinning, the hides and skins are very tough and supple, but the skin is unpleasant to be too wet and cold. After skinning, the skin begins to stagnate and becomes hard and brittle when frozen or dry. To maintain the good properties of the skin, it needs to be reprocessed or tanned.

Properties of tanned leather. Leather tanned properties are crucial for tanned skin. Leather is a highly versatile material, extremely resistant to mechanical strain, and, like very few other fabrics, strong and flexible at the same time. The leather has a good perspiration capacity and a high tolerance to outside temperatures and chemicals of different origin, due to its original biological function as animal skin. The process of tanning consists of different chemical and mechanical steps that transform organic matter into a stable material that will not decompose with time. The leather obtained is particularly well suited for leather bags and shoes and can be used both for indoor and technical applications [36]. Therefore, these properties are required for tanned leather are as follows:

- high tensile strength,
- resistance to tear,
- high resistance to flexing,
- high resistance to puncture,

- good heat insulation,
- permeability to water vapour,
- thermostatic properties,
- mouldability,
- resistance to wet and dry abrasion,
- resistance to fire,
- resistance to fungi,
- resistance to chemical attack.

Leather processing flow chart. Tanning is a process that transforms raw hide or skin protein into a stable material that results convenient for a wide variety of applications as well as different end uses. The sequence of processing leather is as follows. [37]

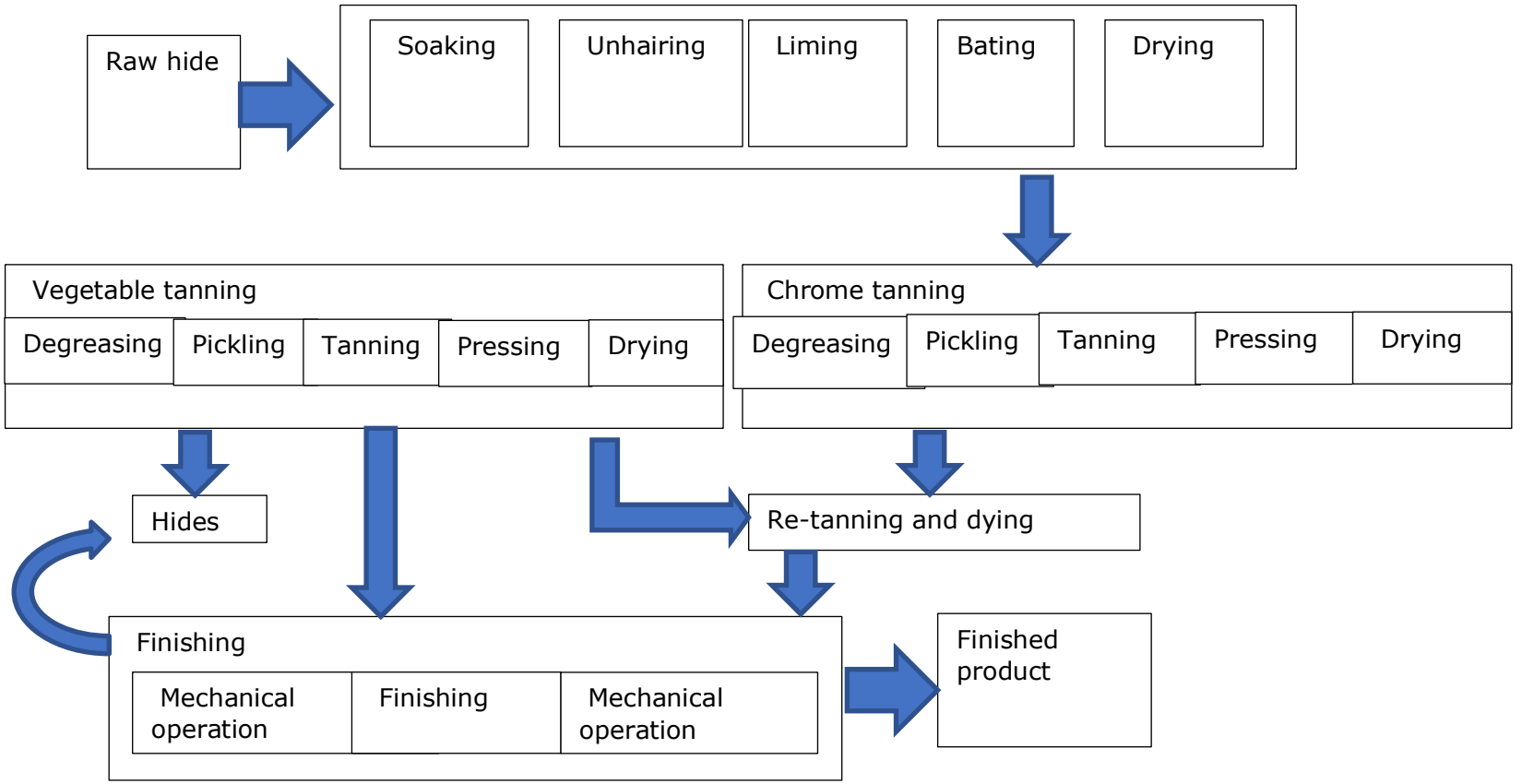

Figure 2.22 Leather processing flow chart

Upcycling of leather. This is how the industry currently works; only 40 percent of the leather is used from each piece of whole leather that goes into production. The remaining 60 percent of the leather patch is waste. To profit, this means that leather goods manufacturers miss over half their revenues. It then generates half of the waste and reuses the waste to make new items. [38] The way industries get rid of the waste is something else that is going horribly wrong. It pollutes the environment directly. Through burning leather bits, the way people get rid of the waste causing air pollution. As these parts were chemically prepared, they are not in the position to putrefy.

Upcycling to the new product. Upcycling means the processing of products into new products, but the quality is always different. If the commodity, which is already made from leather but never the same consistency, must be held in mind. Things like decorative bags or small pocket bags are a suggested option. During the practical work, Leather leftovers were chosen for making the wallet and laptop bag. Good leather pieces were chosen for making the bags. For example, Upcycling of leather products can be seen in (Figure 2.23)

Figure 2.23 Upcycled leather bags [39]

Cost-efficient upcycling diagram. Upcycling means reuse of the same products or materials by its new phase without decreasing its quality. For instance, leather and textile leftovers can be used by making different products. Upcycling reduces wastages and enables the lifecycle of the product much longer. In the practical work of the thesis, leather leftovers were taken for making of the two articles. Selected leather quality was good for making those bags. Diagram of upcycling can be seen in (Figure 2.24)

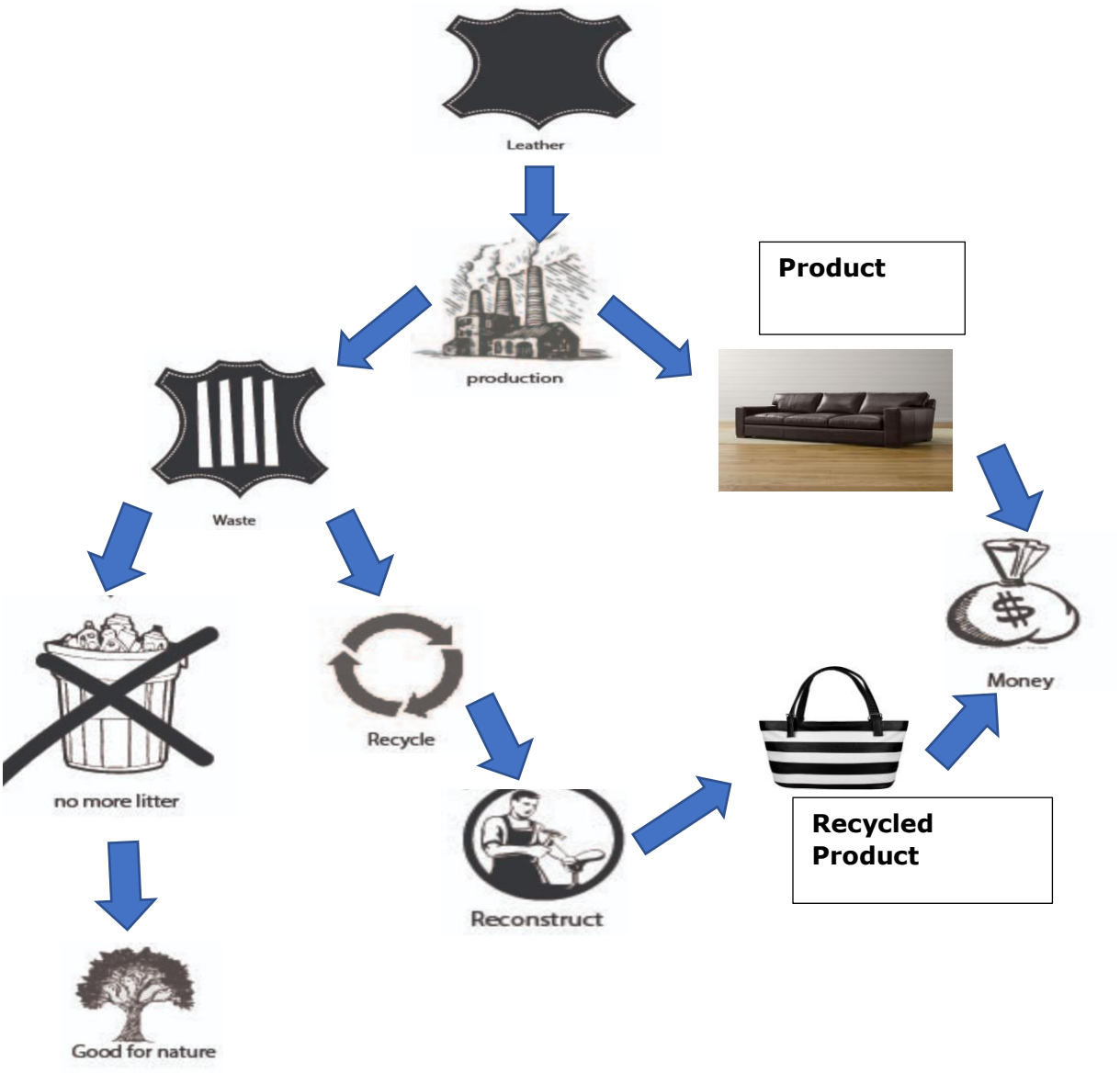

Figure 2.24 Upcycling of leather product [38]

2.2 Other materials used in bag production

Fabrics. The fabric is one of the most commonly used textiles in the world and is used for thousands of different uses and in industries. For bag manufacturing, durable items such as cotton, denim, twills, drapery, canvas fabrics are the finest materials. As many bags rarely need cleaning, drapery, and tapering fabric bags can be enjoyable. Vinyl and synthetic leather are a few longer-lasting options. Cotton fabrics offer the best alternative for the bag lining. Choosing of sturdy, the purpose of reinforcement fabrics is a good option. [40] Often, it is a good idea to use an interface or stabilizer to create a more bag-like structure. A lightweight textile requires a better reinforcement which provides more stiff interfacing. The strong fusible reinforcement fabric provides robust shapes in certain models. Example of fabrics can be seen in (Figure 2.25)

Figure 2.25 Fabrics [41]

Sewing threads. Thread is the crucial part of sewing therefore if the thread is loose or weak heavy-duty fabric is not able to do a better job in the sewing process. Therefore, it is good to pick out the heavy thread and to know about the properties of the thread as well. It is pretty much convenient to stitching with cotton and polyester threads because these types of threads can retain shapes of the products perfectly. [42] Example of sewing threads can be seen in (Figure 2.26)

Figure 2.26 Sewing threads

Strong hardware. Cheap, thinner steel will bend below pressure, so it is well worth spending the greater money on exceptional hardware for the bag. Besides, the outstanding appearance can be seen after making fashionable bags. It will grab customer satisfaction too. Especially D-rings and dog hooks are used to fix the straps with the bag [42]. Example of accessories can be seen in (Figure 2.27).

Figure 2.27 Metal accessories for bags [43]

2.2.1 Polyester fabric

In the polymerization process, the polymer material is extruded while it is too hot and extended into long fibres until approximately five times according to its original length. The resulting fibres are a very strong molecular arrangement. This material is made from fibres via a spinning cycle. Two kinds of spinning processes exist. One is the type of filament in which long fibres are twisted together and the other is spun type, which combines short pieces of fibres to form something known as "staple" which allows the material to be mixed with cotton and wools spun into the polyester. [12] Polyester has diverse use in the textile industries. However, for different products, different types of polyester fabrics are made. The fibre content also varies while making different products. The polyester fabric was chosen for making the bags and the purpose was to sew it as lining materials. While making the laptop bag and wallet polyester fabric was chosen as lining.

Properties of polyester. Polyester is a synthetic substance that is commonly petroleum-derived. [44] Properties of polyester are the following:

- polyester fabric is very strong and durable;
- polyester can absorb moisture worst of synthetic fibres;
- polyester has high tensile strength and abrasion resistance, however, the heat resistance of non-textured fibres is low;
- textured polyester is suitable as a thermal insulation material;
- polyester keeps its shape well, is rigid and durable. Fibre dries quickly and is slightly wrinkled;
- polyester does not affect by the microorganisms.

Use of polyester. Polyester has a wide range of uses. Made in this material, fabrics and films are commonly used in clothes, home furnishings, and industrial applications. For instance, bedsheets, and computer mousepads are some of the examples. Industrial polyester fibres are made into ropes, holding ties, tire enhancements, and transportation ties. It is also used for the creation of bottles, plastic films, and holograms. It has a fluid shape and is used on pianos, guitars, and yachts as a wood finish. [45]In the practical work of the thesis, polyester has been chosen as lining because it is more durable and provides good stitching quality when it is sewn.

Polyester care. Polyester products are particularly easy to maintain. It is recommended to wash them at 40 °C in a machine or by hand. It is recommended to wash the products with a spotting or delicate washing procedure. In the case of polyester products, light centrifugation and tumble drying are allowed. Polyester products dry quickly, and they can be ironed over medium heat (140-175 °C). To prevent the polyester product from turning grey, it has to be washed often, full polyester products attract a lot of dirt. [46]

2.2.2 Canvas fabric

The canvas fabrics fibres usually made from the hemp plant. It comes from the Latin term "cannabis." The production of cotton fabric in the 8th century spread all over Europe and the cotton plants and fabric were traded all over the world. [47] Canvas has a variety of diverse weaving styles that bind and improve textile durability. The pattern of a single tissue fibre is used in a lot of cotton duck fabrics. In a single tissue, there is a yarn in the direction of warp (vertical), and another yarn is in the direction of horizontal fill (the twist). [48] Canvas fabrics are mostly used for durable items like bags and other products. Canvas fabric is kind of thick fabric and usually, bags are made of it. It is cheap, long-lasting fabric and also has a good appearance. In the practical part of the thesis, the handbag was made of canvas fabric. The reason to choose canvas fabric due to its thickness and durability. Example of canvas fabric can be seen in (Figure 2.28)

Figure 2.28 Canvas fabric [49]

Use of canvas fabric. Canvas is created in a plain, very basic textile tissue by strong weaving of yarns together. The threads of a string (vertical) are held on the loom steadily, while the threads cross over and under the string. Thick, medium to heavyweight threads are often used in the canvas. The weight of the thread and basic weaving technique separates canvas from other cotton textiles. Mostly cotton canvas is manufactured with two-ply yarns, or two single yarns twisted together, which adds weight, texture, and creates an even thickness throughout the fabric. Canvas for art is one-ply linen that uses a single-ply yarn. [47] Canvas has an unbelievably flexible texture and has numerous uses, for example; home decoration. Some of its most common functions are as follows:

- Sails: Sails Originally made in canvas, the sails on boats are today made from synthetic sailcloth.
- Tents: Heavy-duty tourist homes are excellent for building shelters and are popular for tents and other supplies for campsites.
- Bags: Canvas is a popular material for use in bags ranging from different articles to articles. The linen is durable, waterproof, making linen bags great for daily use.
- Shoes: Canvas is flexible and long-lasting, making it great for footwear. Two examples of canvas shoes are converse sneakers and espadrilles.
- Painting: Painting. A fantastic art surface is a canvas spread over a wood frame. In the 15th and 16th centuries, canvas became popular in painting.
- Outputs. Lightweight pictures are popular with photographers because they are light and easy to transport.
- Coverings: Many industries use waterproof canvas material as a cover for everything, including military and construction industries. For example; curtains.
- Apparel: Outdoor wear and jackets are usually made of linen and canvas. It is also excellent for camping and sailing gear for its durable, waterproof quality.
- Furniture: Canvas is used for upholstered furniture because of its strength and durability.

Properties of canvas fabric. When the material gets wet it is so tightly woven, it swells, fills any gaps, and creates an aquatic canvas fabric. [50] There are other remarkable features of the canvas are:

- it is a strong fabric,
- durability is so good,
- robust,
- it is a thick fabric,
- quite rigid,
- made of simple fabric,
- close weaved,
- can be made of different fibres,
- wind resistance,
- resistant to elasticity,
- is waterproof and flame resistant when treated differently,
- it can be mixed with natural and synthetic fibres.

3 THE DEVELOPMENT PROCESS OF BAGS

The development process of bags consists of the following steps:

- product design,
- selection of materials,
- making the technical drawing of the prototype,
- making prototypes construction,
- adjustment of patterns,
- sewing.

The first step in the product development process is product design. The finished product has to fulfil the customer's requirements as to its intent, needs, and suitability, it is a very important part of the manufacturing process. Adobe software was used to construct the bags. Adobe is a program for textiles/fashion developed by Adobe Inc., a leading CAD / CAM company. Gerber Accumark is also the other program which enables to produce patterns by designers and engineers. [51] This enables effective collaboration between design teams and speeds up the process of product creation. The textile platform helps designers to develop data collections faster. It also facilitates real-time data sharing. The software automatically saves the pieces of patterns and variations of styles and reflects them.

3.1 Software used for technical drawing of bags

Adobe Illustrator is a vector graphics editor developed and marketed by Adobe Corporation. It is mainly a CAD/CAM software used for graphics design and also for pattern making process. This software includes printing and collection of designs. Illustrator moreover promotes real-time data exchange, allowing collaboration between design teams more effective and quicker product development process. [52] The designer can develop collections more rapidly with this kind of software. Patterns can be plotted out by the Gerber Accumark software. Materials, parts of the patterns, and model variations are saved and expressed throughout the entire design process. Furthermore, for making the patterns adobe illustrator has been used parallelly. Adobe illustrator interface can be seen in (Figure 3.1)

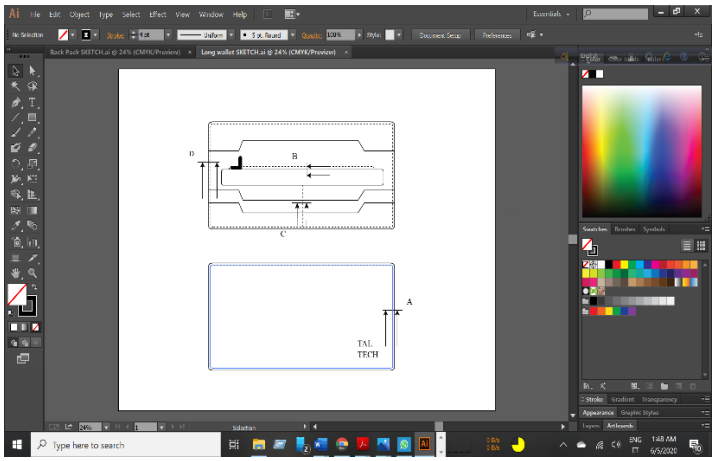

Figure 3.1 Technical drawing in adobe illustrator CC

3.1.1 Software used for pattern making

For the construction of the patterns, Gerber Accumack is a 2D software that has been used. Topics around pattern manipulation, pattern placement, and marking are done by this software. This software is mainly used to construct the patterns and later to plot them out by the plotter. This type of CAD/CAM software has outstanding demands in industries nowadays. For making patterns of the products, this software has been used. [25] Firstly, the actual measurements of the patterns were taken, afterwards all patterns were made through Gerber Accumark. The exact measurement of the patterns is shown in Appendix 14,15,16 and 17. Gerber software interface can be seen in (Figure 3.2)

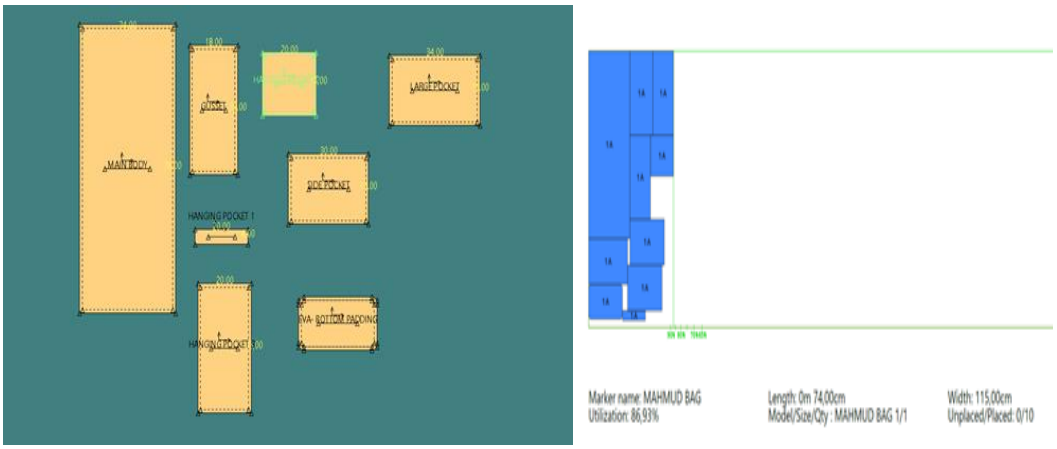

Figure 3.2 Pattern construction using gerber accumark software

3.1.2 Technical drawing of laptop bag

Adobe Illustrator is used to making the technical drawing of the laptop bag. Laptop bags are typical commonly used bags for both men and women. There is an outer card slot pocket that is attached to the front panel. It has mainly one compartment which is used to hold the laptop. There is also a back pocket stitched with the back panel and the main purpose of this pocket is to keep the documents inside. The felt is used to give a softer appearance inside and to keep the laptop well. On the bottom side of the back, the metal buckle has been attached and sewn with the leather to give stronger support for the closure. Technical drawing of laptop bag can be seen in (Figure 3.3)

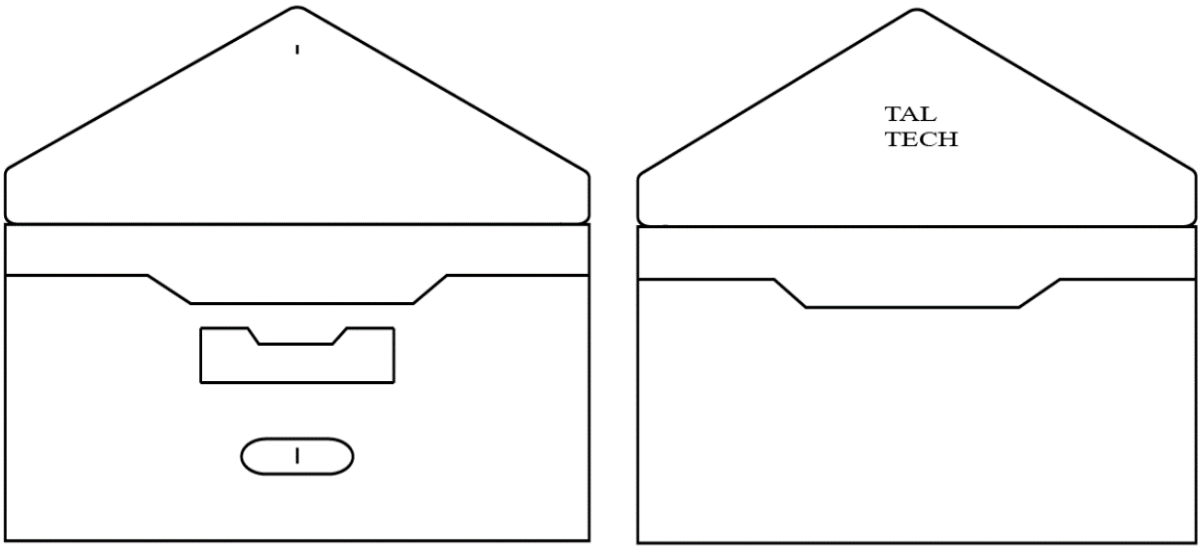

Figure 3.3 Technical drawing of laptop bag

Product description

- Intended consumer: men/women
- Age group: 20-50
- Product Type: laptop bag
- Product styling: mat finish chrome tanned leather
- Product attributes: side-seamed with card slots
- Materials: chrome-tanned Leather

- Lining: polyester
- Fibre Content: 100% polyester lining
- Closure: Metal buckle
- Size: 35 cm × 25 cm

3.1.3 Technical drawing of wallet

Wallets are especially used by men because they are tiny and handy. The main feature of this bag is to have a zipper pocket which will be used to keep coins and some other valuable things. There is a total of six card slots pocket in this wallet. There is a bigger pocket used for keeping documents. Metal zipper provides a strong appearance of the pocket. To provide softer appearance nonwoven felt has been used. There is another pocket which is in the middle. The purpose of this pocket is to keep the smaller documents. Technical drawing of wallet can be seen in (Figure 3.4)

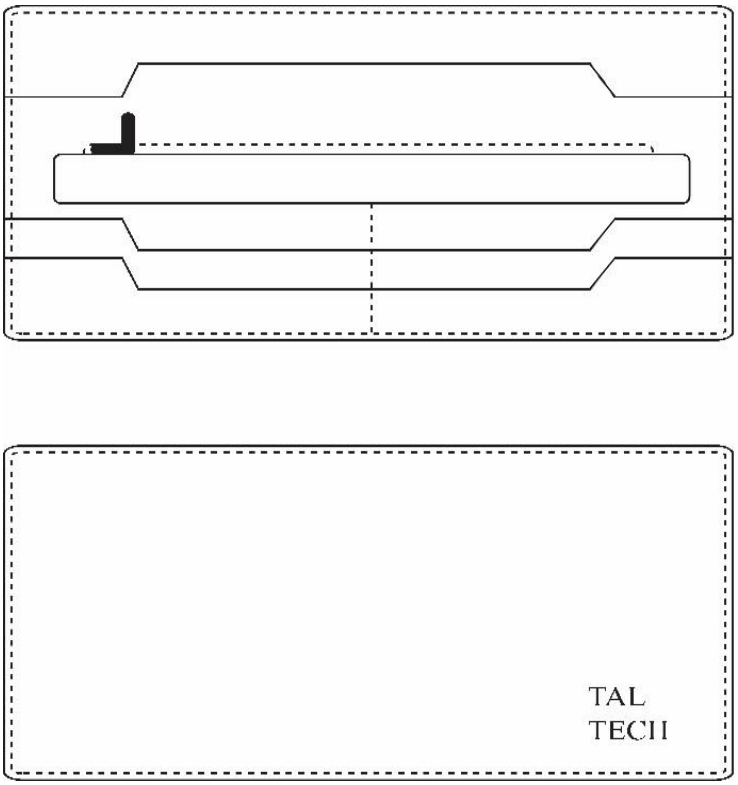

Figure 3.4 Technical drawing of wallet

Product description

- Intended consumer: men
- Age group: 18-50
- Product Type: fashionable wallet
- Product styling: bifold long wallet.
- Product attributes side-seamed with step pockets
- Materials: leather
- Lining: polyester
- Fibre content: 100% polyester
- Closure: bifold
- Size: 22 cm × 21 cm

3.1.4 Technical drawing of the handbag

The market for handbags is high in the world. An integral part of the outfit is comparable to a woman's handbag. This is a fashion statement, which is used to convey imagination and style. It is used to carry necessary items that are important for everyday life. Handbags in various sizes, colours and shapes are available. Moreover, this bag has an inside zipper pocket which is inside of the bag. Besides, there is a large pocket and mobile pocket inside. The reinforcement will provide the robust shape of the bag. Technical drawing of handbag bag can be seen in (Figure 3.5)

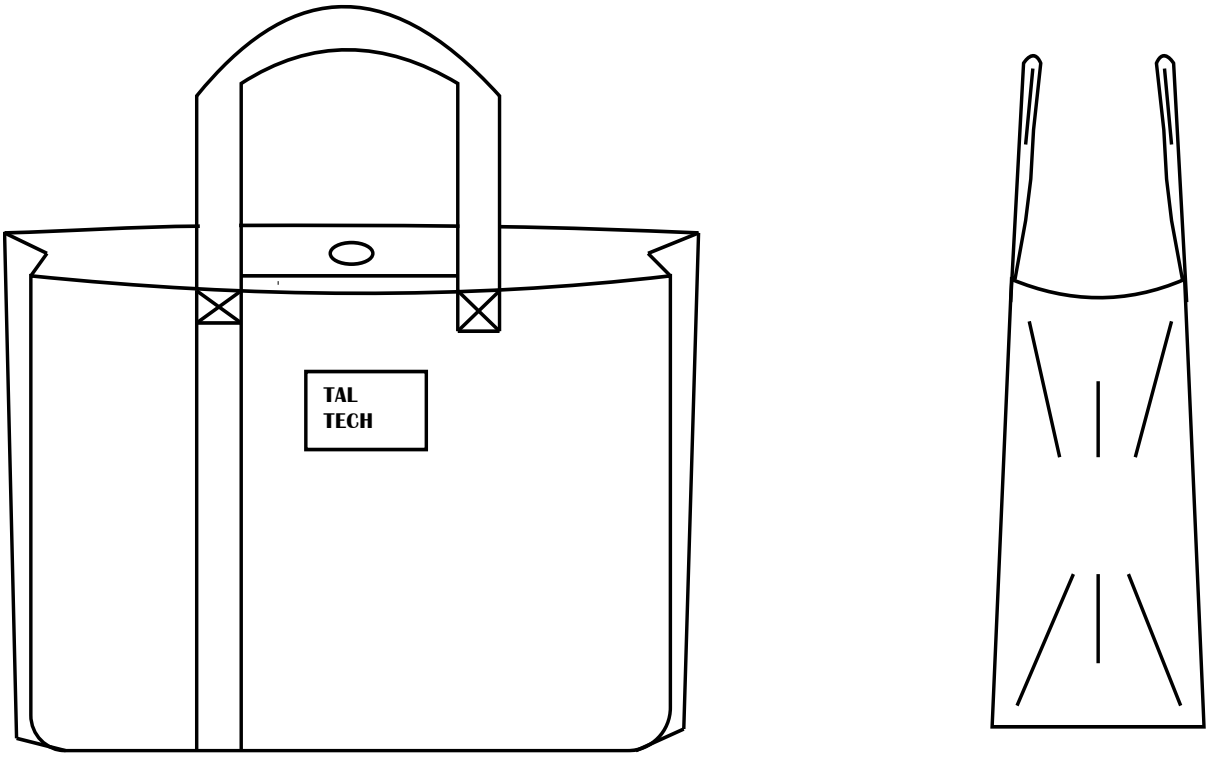

Figure 3.5 Technical Drawing of Handbag

Product Description

- Intended consumer: women
- Age group: 20-50
- Product type: fashionable handbag
- Product styling: tote type ladies handbag
- Product attributes side-seamed and attached pockets
- Fabric type: canvas fabric
- Fibre content: 80% cotton, 20% nylon
- Closure: zipper and magnetic button
- Size: 31.5 cm × 24 cm

3.1.5 Technical drawing of the backpack

A backpack also called packsack is a typical cloth sack put on the backside of both men and women. The two straps that go over the shoulders. There is a total of three compartments such as inside pockets and mobile compartments. The materials for this backpack have been chosen as sturdy materials. This kind of backpack can be used for travelling and as well as everyday use. All of the materials and patterns were prepared. The threads and accessories of the backpack were purchased. However, making this backpack was halted due the pandemic situation started and the laboratories were shut down. Therefore, it was not possible to make the backpack finally. Technical drawing of backpack bag can be seen in (Figure 3.6)

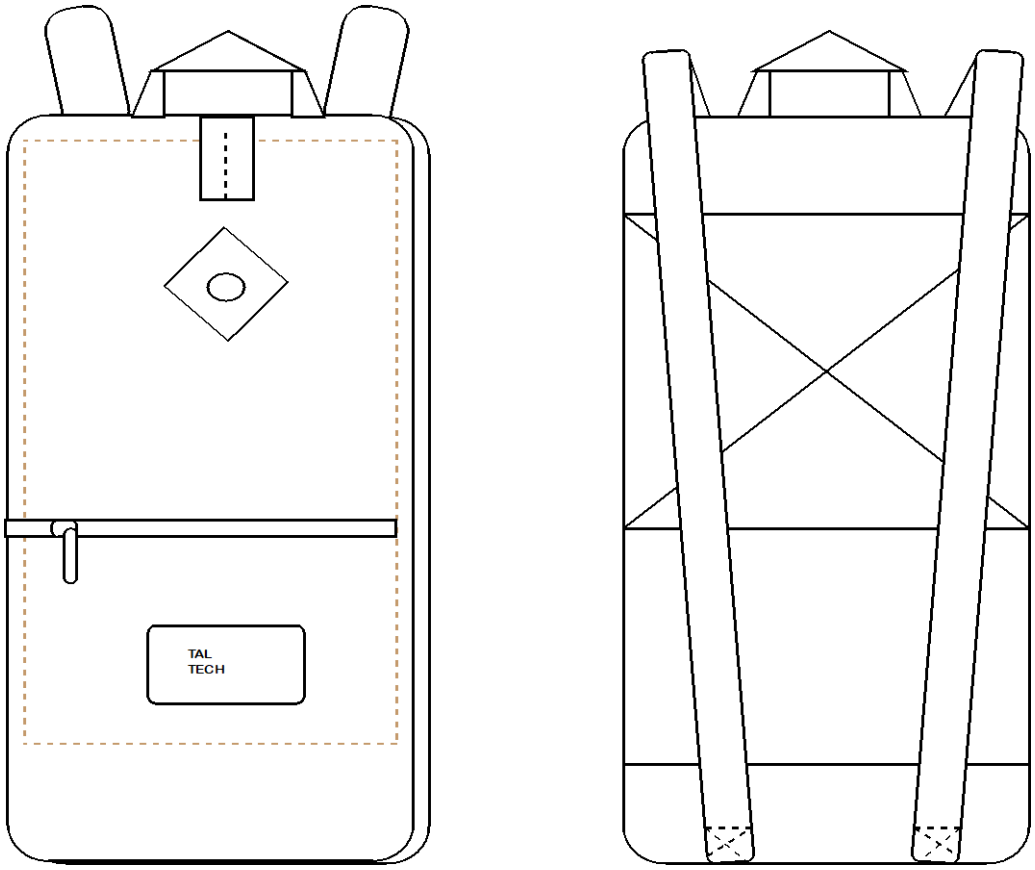

Figure 3.6 Technical drawing of a backpack

Product description

- Intended consumer: men/women
- Age group: 20-50
- Product Type: backpack
- Product styling: hiking backpack
- Product attributes side-seamed with straps
- Materials: canvas nylon
- Reinforcement: felt
- Fibre content: 80% nylon, 20% cotton
- Closure: zipper and buckle
- Size: 40 cm × 20 cm

4 TEXTILE TESTING

Testing is the way of control to check or verify the nature, kind, and character of yarn, fibre, fabric, or any textile material, therefore the control of the degree of excellence. [53] Testing will help the researcher to decide which route should be followed. It helps to select the proper raw materials. The raw material is a relative term. For instance; fibre is the raw material of spinner, yarn is the raw material of weaver, etc. Textile Testing helps to control the different processes, for instance: weaving, spinning, finishing, dyeing, etc. End breakage is determined by controlling weight per lap length, and roving length. The weaving process is controlled by controlling the excessive breakage of warp and weft yarn. The dyeing process is controlled by pressure and temperature. [54]During the practical work of the thesis, three tests were performed. Tests were carried out to evaluate the performance of the fabric and leather. Abrasion resistance and colourfastness to water droplets were carried out on the leather. The purpose of the water droplets test was to analyse leather ability to absorb moisture. Moreover, mass per unity area was tested on the canvas fabric to know the weight of the fabric and is it is suitable for manufacturing the bag or not. Three different tests were carried out on the selective materials can be seen in (Table 4.1)

Table 4.1 Tests carried out on fabric and leather

Material type	Determination of fabrics mass per unit area (EVS-EN 12127:2000)	Determination of the abrasion resistance of leather surfaces using a Martindale abrasion Tester and ball plate (EVS-EN ISO 17076-2:2011)	Determination of colourfastness to water droplets (EVS-EN ISO 15700: 2000)
Canvas (80% cotton, 20% nylon)	+	-	-
Dark brown leather	-	+	+
Dark grey leather	-	+	+

4.1 Determination of fabrics mass per unit area

The EVS-EN 12127:2000 standard was used to determine the mass of textiles – fabrics – per unit area using small specimens. The method applies to woven and knitted textiles as well as to other textiles. [55]

The balance meter AE200 (Figure 4.1), pin, and ruler were used for testing. The fabric has to separate 5 specimens of at least 100 cm^2 (10 cm x 10 cm). The specimen shall measure its width and length three times and be rounded up to the nearest 1 mm. Specimens are calculated by using the average medium width and length. The next step is to measure the weight for every sample and record every detail. The mass should be calculated using the formula for each specimen per unit area

$$\boldsymbol{M = \frac{(m \times 10000)}{A}}$$

Where,

m = conditioned test samples in grams

A = Area of the test samples in cm^2

M = is the mass per unit area in g/m^2

Figure 4.1 Balance Mettler AE200

4.2 Determination of colourfastness to water droplets

The consumer's choice when buying a product is largely based on the colour of the product. For this reason, the colour of the garment must remain unchanged throughout wear. The colour must remain the same as well by rubbing, drying, washing, etc. of the material. [56]Testing shall be performed under EVS-EN ISO 15700: 2000 - Leather - Tests for colour fastness. colour fastness to water spotting tested on eight specimens. The purpose of the test is to determine how the test material reacts when in contact with water. The test method indicates the test subject to physical changes and discolouration of the fabric.

Test equipment

- Test piece measuring 100 mm x 50 mm,
- Pipette,
- Distilled water,
- colour marking scale.

Water droplets should be from the edge of 50 mm. The volume of the water drop should be approximately 0.15 ml. The test piece is left for 30 minutes stand. After this, remove any remaining water drop from the test piece with filter paper and assessing how the test has affected the Leather - severe, moderate, slight change. After evaluation, the test piece is left to stand for 16 hours and after that, it is reassessed using the grey reference scale. To assess the stability of the colour fastness change, the test piece must be lightly handled for the examination. Examine the test specimen under the colour assessment cabinets.

Evaluation of the specimen was carried out under the UV colour assessment cabinet with the greyscale. The scale ranges from 1-5. Evaluation cabinet can be seen in (Figure 4.2)

Figure 4.2 Evaluation done by the colour assessment cabinet and evaluation scale [57]

Samples can be seen in (Figure 4.3) which were taken for the test

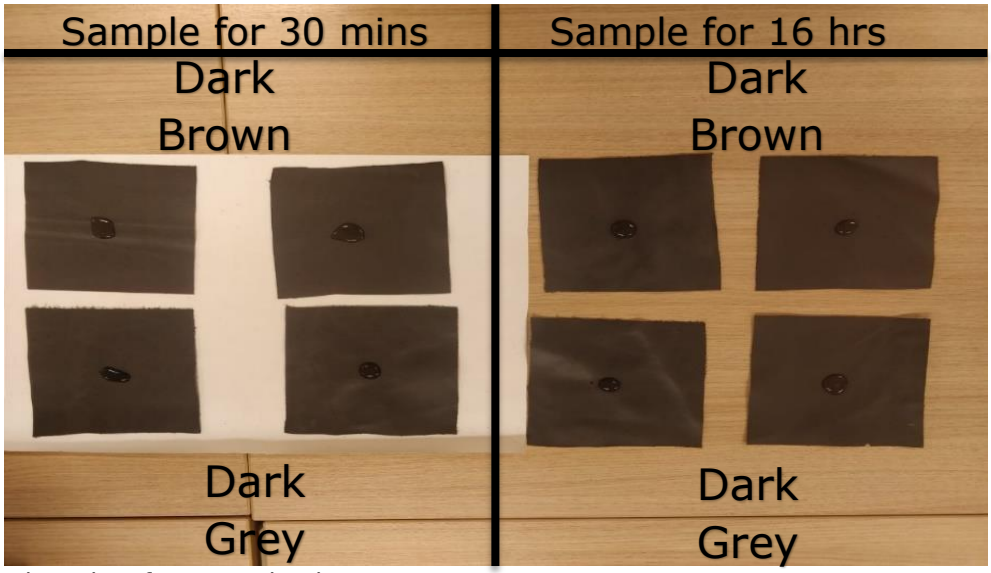

Figure 4.3 Samples taken for water droplet test

4.3 Determination of the abrasion resistance of leather surfaces using a Martindale abrasion tester and ball plate

The standard EVS-EN ISO 17076-2:2011 Textiles – Determination of the Abrasion Resistance of Leather Surfaces using a Martindale Abrasion Tester and Ball Plate part 2. The Test is used to determine the abrasion resistance of leather which is used for car seats and fashionable bags. The Martindale Abrasion Tester (specified in EN ISO12947-1) is used. To better simulate real-life conditions, a Ball Plate is introduced for the testings. For this test, several instruments were used, for instance; ball plate, Sample Holder (38 mm diameter specimen), Pressing Weight,12 kPa Loading Weight, Abrasive Cloth specified in Table 1 of EN ISO 12947-1 (diameter 38mm), Woven Felt specified of EN ISO 12947-1. James Heal mini Martindale machine can be seen in (Figure 4.4)

Figure 4.4 James Heal mini Martindale machine for abrasion test [58]

4.4 Test results

The test was carried out to measure the performance and the quality of the fabric and leather. Three tests were carried out in total. Furthermore, three tests were carried out and the result is as follows:

4.4.1 Mass per unit area test result

The determination of mass per unit area test result was calculated by using EVS-EN 12127: 2000. The specimens were firstly cut out (10×10) cm^2 in size (see Figure 1.43). A mass per unit area was calculated for five different samples. The sample dimensions and average area calculations of the mass of the fabric were calculated according to per unit area and can be seen accordingly in Appendix 26(Tables 1.22). The test results can be seen in (Table 1.4) and the raw data of the test specimens can be seen in appendix 28 (Table A28.1)

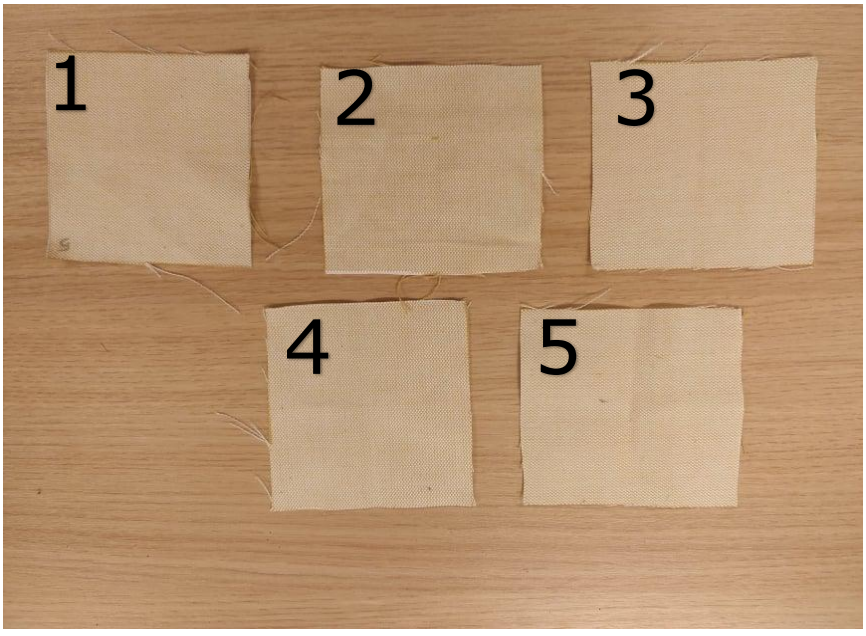

Figure 4.5 Test specimens for mass per unit testing.

Table 4.2 Mass per unit area test result

No	Mass per Unit Area, g/m^2
	Fabric Samples
1	328
2	338
3	328
4	324
5	312
Average	**326**
Standard deviation	**9**

The average mass per unit area is (326±9) g/m^2. After calculation from the equation and standard deviation, the test shows that the fabrics are thick and have the perfect weight for making bag products. They provide good textile drape due to their weight. Besides, the thickness of the material makes the folding and sewing of the bag with the reinforced materials most convenient.

4.4.2 The determination of colour fastness to water droplets test result

The determination of colour fastness to water droplets test was mainly carried out on the two different specimens of leather to show the performance of the leather and the resistant to moisture as well. The test result of colour fastness to water droplets test result can be seen in (Table 4.3)

Table 4.3 Colour fastness test result

Test specimen	Evaluation after 30 Minutes	Evaluation after 30 Minutes	Evaluation after 16 hours	Evaluation after 16 hours
Dark grey leather	Slight	Moderate	3	5
Dark brown leather	Slight	Moderate	3/4	4/5

Two specimens were taken from each leather. From the evaluation, after 30 minutes there was a very slight change of dark brown leather, but dark grey leather had moderate change. However, after 16 hrs the change of dark grey leather was severe, and it was ¾ but dark brown leather had 4/5 on greyscale which is a very slight change. Therefore, dark grey leather is not suitable for bag manufacturing. On the other hand, dark brown leather is suitable for bag manufacturing.

4.4.3 The determination of the abrasion resistance of leather surfaces using a Martindale abrasion tester and ball plate result

The test was conducted with the Martindale system for the determination of the abrasion resistance of leather. In this test, the pilling table has been fastened with samples as well as auxiliary material. The test specimen is taken as a 120mm diameter. The test samples conducted 20 evaluation stages from 100 to 2100 rubs. The loading weight of 12 kPa was used for the test. The test result was evaluated through a microscope (x50) used to aid visual assessment. The test specimens must be conditioned for a minimum of 24 hours in a standard atmosphere (23 °C, 50% R_H). The result of the test shown in Appendix 28, 29 (Table A28.1, A29,1). The fibres break at the 2100 cycle for dark brown leather and dark grey leather fibres break at the 1900 cycle. Assessed per 100 cycles. From this test, it is proved that both types of leather have the good abrasion resistance and both are suitable for making a laptop bag and wallet [59] The raw data of the evaluation test can be seen in appendix 29 and 30 (Table A29.1 and A30.1) Leather specimen under an electronic microscope can be seen in (Figure 4.6).

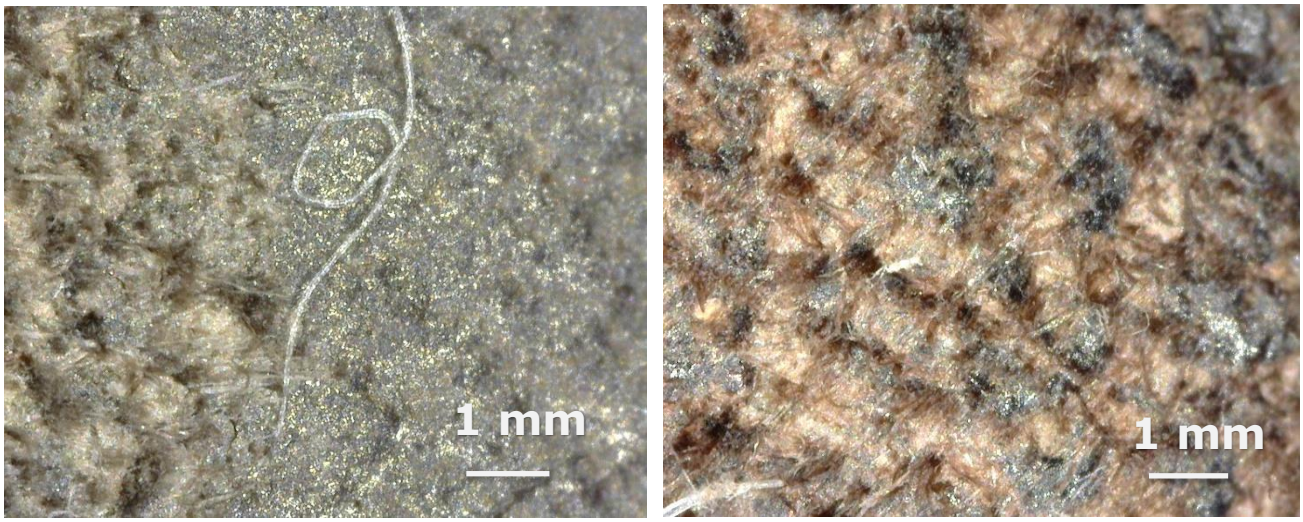

Figure 4.6 Leather specimen under an electronic microscope (50x magnification)

The test specimens of dark brown and dark grey leather which were tested under the Martindale ball plate tester machine can be seen in (Figure 4.7)

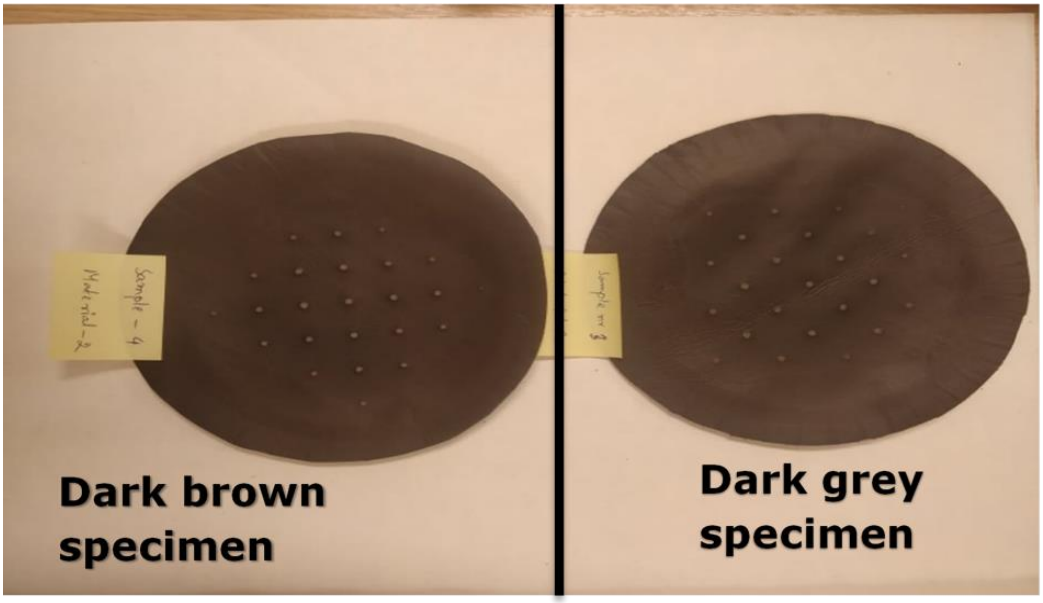

Figure 4.7 Dark brown and dark grey leather specimen

5 PATTERNMAKING OF BAGS

Measurements play a key role in the development of the bags. For the designer or consumer, it is important to know the product anatomy and the proper product measurement method. [60]. In compliance with the guidelines to prevent potential mistakes, all measurements of the pattern components have been taken strictly. Appendix 18,19,20,21 (Table A18.1, A19.1,A20.1, A21.1) shows the measurements. The measurement table describes the correct proportions and patterns were controlled by making the prototypes. Patterns can be seen in Appendix 14,15,16,17 (Table A14.1, A15.1, A16.1, A17.1).

5.1 Correction of patterns and prototypes

Pattern making is a highly skilled process that requires technical ability, flexibility for the interpretation of the pattern, and a realistic understanding of the construction of product manufacturing. The design of patterns is a bridge between design and production. Firstly, the patterns were made according to the measurement which was designed and the prototypes were made to check all of the measurements. While making the prototype of the collections, very few minor adjustments of patterns were required to fix. Afterwards, all the patterns were adjusted and made the prototypes for the final products. Patterns of all of the models have been shown in the appendix 18,19,20 and 21 (Table A18.1, A19.1, A20.1 and A21.1).
Prototype making can be seen in (Figure 5.1)

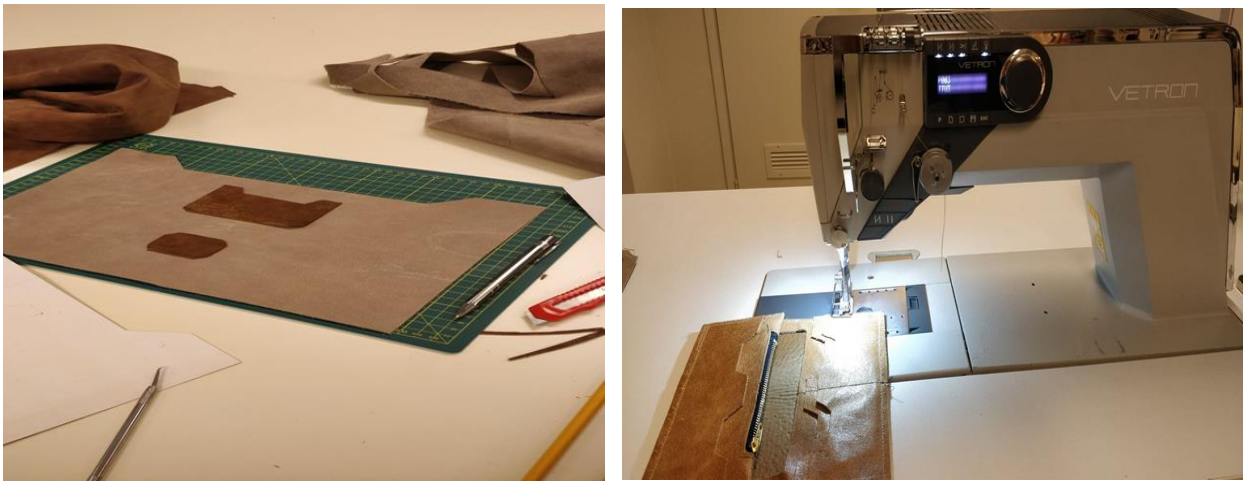

Figure 5.1 Pattern correction and prototype making

5.1.1 The orders of processing steps and the sewing technology description

Technology for sewing depends on the design and construction of the product. The description of sewing technology and the order of processing stages of the bags appear in Appendix 6,8,10,12 (Table no A6.1, A8.1, A10.1, A12.1) This sectional drawing contains the details of the procedure, the use of exact needles, the threads, and the stitch density. Appendix 5,7,9,11 shows explanations for sectional drawings.

5.1.2 Specification sheet for the bag

The specification sheet includes technical drawings for the visual appearance of the detail of the front and back parts of the product. It includes a sample of the, a list of materials used, and the main stitching parameters for the sewing of the product. In the manufacturing sector, the product specification sheet offers an overview of the garment definition and is a basic document that represents the key parameters of the production [61] In Appendix 1,2,3,4 (Table A1.1, A2. 1, A3.1, A4.1) are listed with specification sheets for the bags.

5.1.3 Types of machinery and equipment used for sewing of the bag articles

Several sewing machinery, steam iron, fusing machines were used during the sewing of the bag articles. Sewing machinery and bag articles depend on the choice of sewing equipment. The features of the fusing press and iron machine can be seen in the (Table 5.2). Sewing machine technical parameters can be seen in (Table 5.1). All the machines are listed which were used during the product development process in appendix 31 (Table A31.1)

5.1.4 Technical parameters of sewing

Table 5.1 technical parameters of sewing machines

No	Types of Machine	Name of machines	Technical parameters of sewing machines				
			Type of stitch	Stitch code	Length of stitch	Thread number	Needle number
	1	2	4	5	6	7	8
1	Lockstitch machine	JUKI DDL-9000B-SS	Lock stitch	301	6	120	R90
2	Overlock machine	JUKI GN6-M54-73-4	Overedge stitch	504	6	120	R90
3	Lockstitch machine	JUKI MO- 6716S	Lockstitch	301	6	120	R90
3	Heavy interfacing lockstitch machine	Vetron 5000	Lockstitch	301	5	50	R100

5.1.5 Technical parameters of pressing and engraving machine

Table 5.2 Technical parameters of machines

Types of machine	Name of machines	Technical parameters of machines			
		Temperature C°	Pressure (N/cm2)	Velocity (m/min)	Power
1	2	3	4	5	6
Fusing machine	Meyer RPS-L400	172	45	8	230 Volt
Laser Engraving cutting machine	BCL-1309XU	680	-	40m/min	220 Volt, 50Hz
Steam iron	HD 202 Iron	140	Manual	-	220 Volt

6 DISCUSSION OF THE PRODUCT DEVELOPMENT OF THE BAGS

The bags have been developed in greater time and effort than expected. It had to be decided at the outset which product would be completed during the master's thesis. The product should be acceptable and suitable for the individual to use. Finally, all of those bags designed according to the measurement. It was also necessary to consider how to engrave the leather patch logo while manufacturing. There are several metal accessories used to provide strength and a good finishing outlook.

To start designing bags, the right leather and right fabrics for the bags were important to find. The fabric must be well-thicked and therefore rubbing stain-resistant and pilling resistant. Threads with appropriate properties for the sewing of the bag articles were also significant. The threads should be very good quality.

The construction of a pattern for all bags was crucial when fabrics and threads were chosen. All bags were based on the basic pattern and all mistakes were corrected by preparing the prototypes of all designs. Pattern construction for the bags was easy and accurate.

Some problems occurred while making these bags. Firstly, the selection of piping tape was not perfect at all. The width was too small. For that reason, while doing the final sewing slipped because of bulky thickness. Secondly, the edges were not trimmed properly. For that reason, the edges become too thick and look uneven. While leather patch logo sewing there was a problem with the selection of machine too. However, other things were fine.

To get the good edge 1.8 cm tape has been used for uniform sewing for the handbag. Three thread Overlock machine has been used instead of a single needle lockstitch machine for perfect edging. Leather Patch logo has been sewn with a single needle sewing machine to avoid the needle holes.

The bag making took much time and effort to stop the thread breaks to get a uniform product and to good sewing. Moreover, it took plenty of time to get rid of the thread tension. The prototypes were made with all the selected threads to ensure sewing quality and to prevent loosening of the main material. The sewing was done easily but on the other hand, one of the styles required significant attention, because the impression of the product becomes dull when the leather and the fabric have bad stitches.

6.1 Discussion of the laptop bag

The final product "laptop bag" (see figure 6.1). This bag is and fully made of the leather leftovers and with polyester lining and the closure is a metal buckle. The buckle has mainly two parts. The closure is attached with flaps and beneath the card slot pockets. Black leather paint is used on the raw edge of the product for good finishing. The laptop bags colour is dark brown, and the pocket is a dark grey which is a different colour combination. The large pocket is for keeping the laptop and the card pocket is for keeping the cards. The material mapping and technology of this product can be seen in appendix 23 (Table A23.1) and the process sequence can be seen in appendix 26.

Figure 6.1 Laptop bag

6.2 Discussion of the wallet

The final product "Wallet" can be seen in (Figure 6.2). This bag is soft and fully made of the leather leftovers and with polyester lining and the closure is a metal buckle. Also, there is no closure for this bag because it is a bi-fold wallet The laptop bags colour is dark brown and the pocket is dark grey. Black leather paint is used on the raw edge of the product for good finishing. There are three-step pockets and one zipper pocket which can be used as coin pockets and the step pockets are useable for cards and a large pocket is for keeping banknotes. The material mapping of this product can be seen in appendix 23 (Table no A23.1) and the process sequence can be seen in appendix 26. The technological assembly can be seen on appendix 6 (Table A6.1)

Figure 6.2 Wallet

6.3 Discussion of the handbag

The final product "Handbag" (see Figure 6.3). This bag is the size in rectangular and fully made of the canvas fabric and no lining is used for it. Besides, there is closure for this bag which is a two-part magnetic metal button. There is a logo that is engraved on vegetable-tanned leather and sewed on the front part of the bag. Black leather paint is used on the raw

edge of the leather patch for good finishing. One zipper pocket inside the bag can be used to keep the necessary things. The large pocket can be used for keeping the documents. There has also a mobile compartment pocket which was sewn with a zipper pocket. The material mapping of this product can be seen in appendix 22 (Table A22.1) and the process sequence can be seen in appendix 27.

Figure 6.3 Handbag

SUMMARY

Today's fashion is changing rapidly, and it is difficult to find something that is durable and beautiful for all seasons. Leather and canvas fabric have already been used extensively for clothing and consumer goods for a long time and will continue to be used. Master's thesis study was carried out on how the leather is treated, finished, and how it is tanned as well as also studied on leather properties. It was studied how polyester is obtained and what are the properties of polyester. The application and properties of canvas and polyester are also presented in the work.

This master's thesis aimed to develop bag designs with fabrics and leathers. The collection combines different materials such as leather, polyester, and canvas. The handbag model's special feature is that it is durable, the combination of colour, and it has several inner pockets. The logo patch is made of vegetable tanned natural leather and the wallet and laptop bag are made of chrome tanned leftover materials.

Within the framework of the master's thesis, textile tests were performed on selected materials. Since it is a fashionable product, the colour fastness due to water droplets and leather abrasion was tested. Moreover, the mass per unit area was tested for the convenient use of the product and to determine the weight. The tests showed that the basic properties of the selected materials are very good and properly maintained in which case they are well preserved. Textile materials were chosen for making the handbag, which was high quality, sustainable. Base patterns were designed for the models of the collection, based on which fashionable sections were constructed. Technological maps of the models and technological sequences of processing were compiled. Also, technological drawings for the models were developed. When the bag products were completed, it turned out that one bag still needs further development. Due to the pandemic situation, the backpack model was not completed. The fittings of the bags were perfect. Bags are made according to the client's standard measurements and finalized. Within the framework of the thesis, models of the collection were studied on the design of the fashion market. In a nutshell, it became clear that, in the market, small productions with some specific requirements have higher demands.

The master thesis allowed the development of the product to become familiar as well as some physical testing’s too. It provided awareness of machine uses and experience in product

creation with accompanying documentation from start to finish. The work with the modern sewing machine also provided varied experience, it highlighted the need to get acquainted with designs. This has taught the importance of selecting the ideal needles, threads and fabrics and leathers, as well as how to operate the different types of machinery. A lot of practice was required for the bag production process to succeed. To ensure product quality, it was necessary to understand the materials, equipment, software, and technologies in the product development phase.

The master thesis, which consists of 119 pages and six chapters, 50 figures, and 24 tables, and was written in English. To conclude, it can be said that the goals of the master's thesis were met and were successful.

KOKKUVÕTE

Tänapäeva mood on kiires muutumises ning seetõttu on raske välja töötada tooteid, mis ühest küljest oleksid vastupidavad aga samas ka ilusad. Nahka ja tugevat nn purjeriiet on kasutatud nii rõivaste kui ka muude toodete valmistamiseks juba pikka aega. Magistritöö teoreetilises osas uuriti, kuidas toimub täpsemalt naha töötlemine ning viimistlemine, kuidas nahka pargitakse ning samuti anti ülevaade naha omadustest. Käsitleti polüestri saamist, omadusi ja kasutusvaldkondi ning anti ülevaade purjeriide omadustest ja kasutamisest.

Magistritöö eesmärgiks oli välja töötata kotid, mille valmistamisel on kasutatud nii erinevaid kangasmaterjale kui ka nahka. Kasutati kroompargitud nahka, polüestrit ning purjeriiet. Käekoti mudeli puhul on kasutatud purjeriide ja naha kombinatsiooni, samuti on sellel kotil mitmeid erinevaid taskulahendusi koti sisemises osas. Koti logo on valmistatud taimpargitud nahast. Rahakoti ja arvutikoti valmistamisel on kasutatud kroompargitud naha tööstuslikke ülejääke.

Magistritöös keskenduti ka erinevate tekstiilikatsetuste läbiviimisele. Kuna tegemist on moetootega, siis naha puhul katsetati värvikindlust veetilkade toimele ning samuti katsetati naha hõõrdekindlust. Purjeriide puhul leiti materjali pindtihedus. Katsetulemused näitasid, et antud materjalide omadused olid väga head ning antud materjalid on kottide valmistamiseks sobilikud. Esmalt valmisid toodete tehnilised joonised. Seejärel konstrueeriti lõiked. Valmistati tootekaardid ning koostati toote töötlemise tehnoloogiline järjestus. Seejärel õmmeldi valmis tooted. Tänu riigis kestnud eriolukorrale jäi valmis õmblemata seljakott. Kotid on valminud vastavalt hetkel moes olevate stiilile. Tootearendusprotsessi käigus sai selgeks, et väikeettevõttel võib olla sageli raske täita tootele seatud kõrgeid kvaliteedinõudeid.

Antud magistritöö teostamise käigus sai autor läbida klassikalise tootearendusprotsessi erinevad etapid ning samuti läbi viia erinevaid tekstiilikatsetusi. Samuti omandas autor kogemused töötamaks erinevate seadmetega. Iseäranis oluline on valida toote töötlemiseks õiged nõelad, niidid ning põhimaterjal.

Magistritöö koosneb 119 leheküljest ja kuuest peatükist, see sisaldab 50 joonist, 24 tabelit. Magistritöö on kirjutatud inglise keeles. Kokkuvõttes võib öelda, et magistritöö eesmärgid saavutati.

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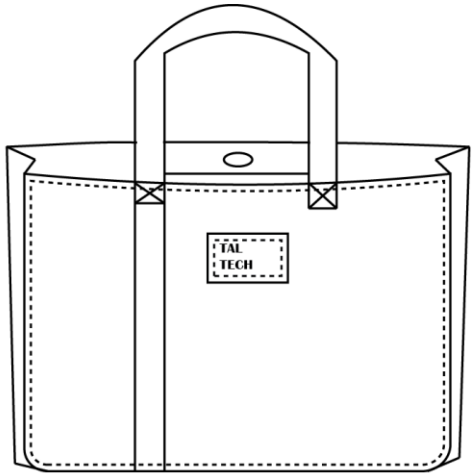
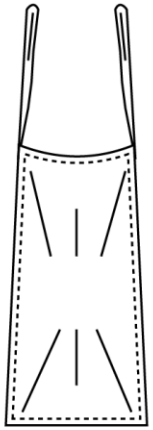
APPENDICES

Appendix 1 Specification of handbag

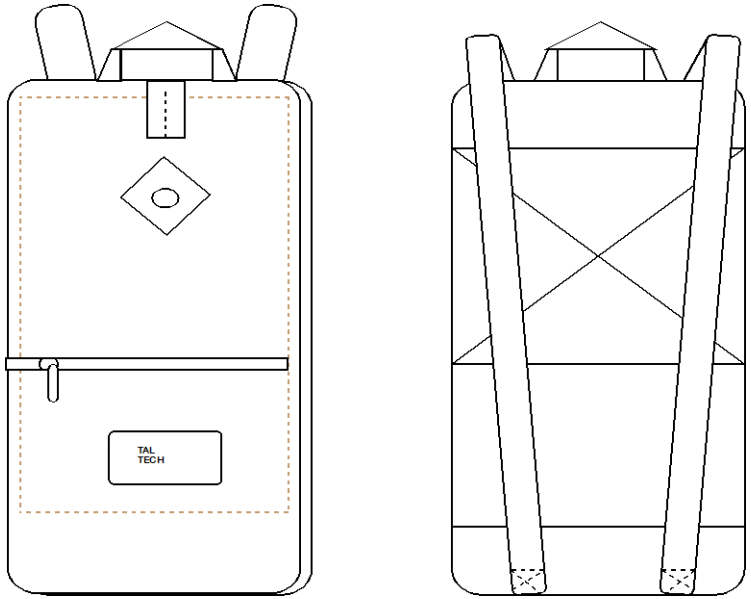
Table A1.1 Specification sheet of handbag

<table>
<tr><td>Product no. 02</td><td rowspan="2">Season: 2020</td><td>Product type:
Handbag</td><td>Model:
Envelop Bag</td><td colspan="2">Technical designer/
Patternmaker Tailor: Shahnewaz</td></tr>
<tr><td>Started: February 2020</td><td>Finished: May 2020</td><td>Season: Summer</td><td>Brand name:
TAL TECH</td><td>Fabric: Nylon Canvas</td></tr>
<tr><td colspan="4">   </td><td colspan="2">Sewing technology:
1. Leather logo sewing: Single needle lock stitch with 0.5 cm allowance.
2.Zipper pocket sewing: Single needle lockstitch with 0.5 cm allowance
3.Mobile pocket sewing: Single needle lockstitch with 1.0 cm allowance.
4. Large pocket: Single needle lockstitch stitch with 1.0 cm allowance
5.Strap sewing: Single needle lockstitch with 1.0cm allowance.6. Side seam: Three thread overlock with 0.5 cm allowance.</td></tr>
</table>

Remark	Material Details	Care instructions:
Magnetic snap button and D-rings have been used on the side panel and front and back parts. The metallic adjuster has been used for straps.	Fabric: Canvas Width: 148 cm Fibre composition: 80% cotton 20% Nylon Fabrics type: Plain woven Reinforcement: No Colour: Grey thread: 90 Leather sticker: Vegetable-tanned leather	Machine wash medium, wash with a similar colour. No bleach. Warm iron. Tumble dry low. 

Appendix 2 Specification of backpack

Table A2.1 Specification sheet of backpack

<table>
<tr><td>Product -04</td><td rowspan="2">Season: 2020</td><td>Product type:
Backpack</td><td rowspan="2">Model:
Backpack</td><td colspan="2">Technical designer/
Patternmaker tailor: Shahnewaz</td></tr>
<tr><td>Started:
February 2020</td><td>Finished: May 2020</td><td>Brand name:
TAL TECH</td><td>Fabric: Nylon Canvas</td></tr>
<tr><td colspan="4">  </td><td colspan="2">1.Attaching button: single needle lockstitch with 0.5cm allowance

2.Leather logo sewing: Single needle lockstitch with 0.5cm allowance

3.Zipper pocket: single needle lockstitch with 0.5 cm allowance.

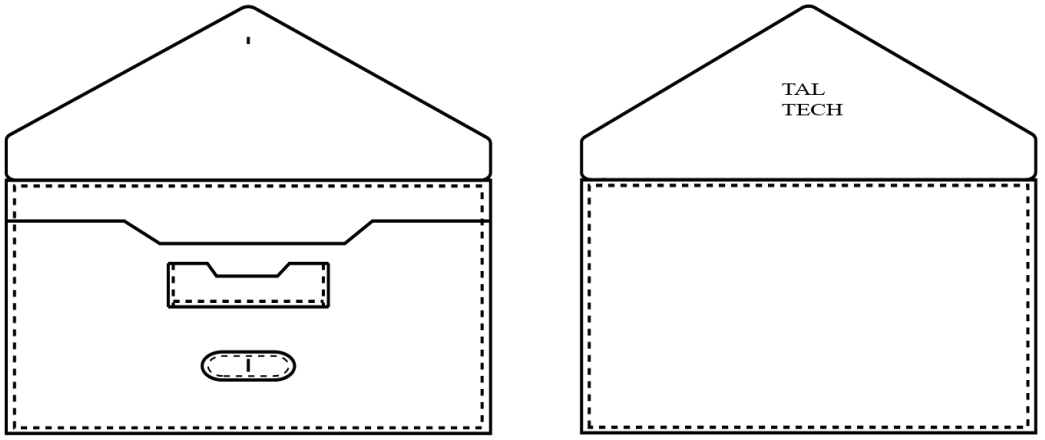
4. Strap sewing: Single needle lockstitch with 0.5 cm allowance

5. Side seam: three thread overlock with 1cm allowance.</td></tr>
</table>

Remarks	Material details	Care instructions
Magnetic snap button has been used on the front Panel. Felt has been used to provide a softer appearance.	Fabric: Canvas Nylon Width: 148 cm Fibre composition: 80% cotton 20% Nylon Fabrics type: Plain woven Reinforcement: No Colour: Brown Thread no: 60 Leather sticker: Vegetable-tanned leather	Machine wash, medium wash with a similar colour. No bleach. Warm iron. Tumble dry low. 

Appendix 3 Specification of laptop bag

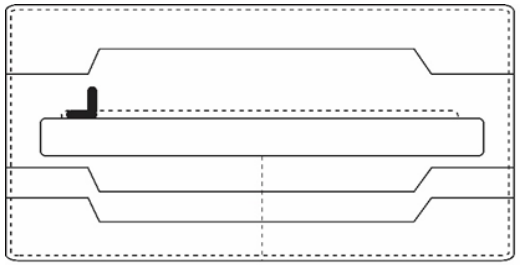
Table A3.1 Specification sheet of laptop bag

Product -04	**Season: 2020**	**Product type: Laptop bag**	**Model: Envelop bag**	**Technical designer/ Patternmaker Tailor: Shahnewaz Fabric code: Canvas**
Started: February 2020		**Finished: May 2020**	**Brand name: TAL TECH**	
				Sewing technology: 1. Outer top: Single needle lock stitch with a 0.5 cm allowance. 2. Lining with reinforcement: Single needle lock stitch with a 0.5 cm allowance. 3.Card pocket: Single needle lock stitch with 0.5cm allowance. 4.Buckle stitch: Single needle lockstitch stitch with 0.5 cm allowance 5. Side seam: Single needle lockstitch stitch with 0.7 cm allowance.

Remarks	Material Details	Care instructions
Felt has been used to provide a softer appearance.	Material: Chrome tanned leather Supplier article: T-003 Width: 50 cm Fibre composition: 100% cellulose Lining type: Plain woven 100% polyester Reinforcement: Yes Colour: Dark Brown Thread no: 60 Logo: Engraved	Machine wash, medium, wash with a similar colour. No bleach. Warm iron. Tumble dry low. 

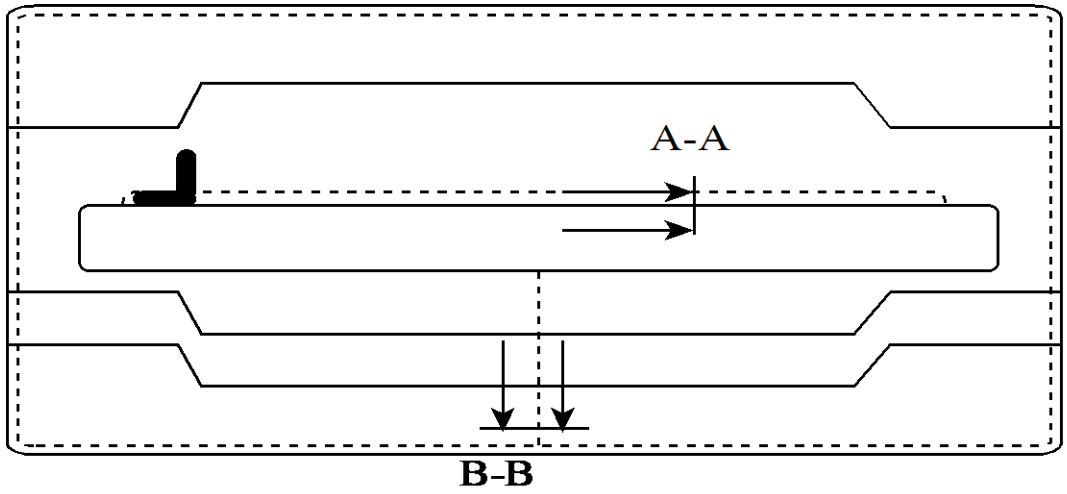
Appendix 4 Specification of wallet

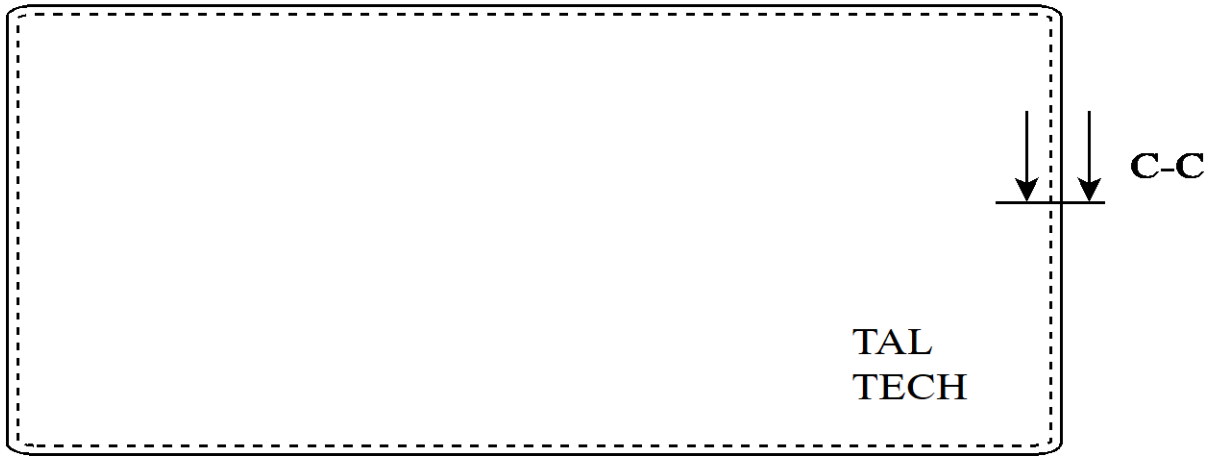
Table A4.1 Specification sheet of wallet

Product -04	**Season: 2020**	**Product type:**	**Model:** **Envelop bag**	**Technical designer/** **Patternmaker Tailor: Shahnewaz**
Start: February 2020	**Materials:** **Leather**	**Finish: May 2020**	**Brand name:** **TAL TECH**	
 				**Sewing technology** 1. Outer top: Single needle lock stitch with a 0.5 cm allowance. 2. Lining sewing: Single needle lock stitch with a 0.5 cm allowance. 3.Step pocket: Single needle lock stitch with 0.5cm allowance. 4. Zipper pocket: Single needle lockstitch stitch with 0.5 cm allowance 5. Side seam: Single needle lockstitch stitch with 0.5 cm allowance.

Remarks	Material Details	Care instructions
Felt has been used to provide a softer appearance.	Chrome tanned leather Supplier article: T-003 Width: 50 cm Fibre composition: 100% cellulose Lining type: Plain woven 100% polyester Reinforcement: Yes Colour: Dark Grey Thread no: 100 Logo: Engraved	Machine wash, medium wash with a similar colour. No bleach. Warm iron. Tumble dry low. 

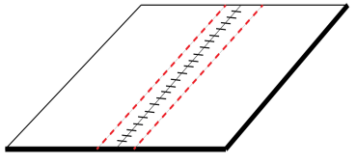
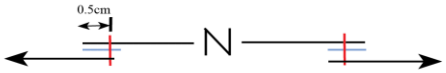
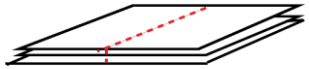
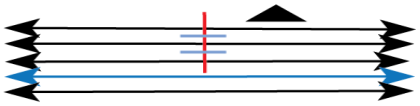
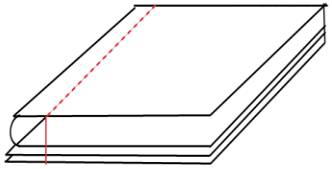
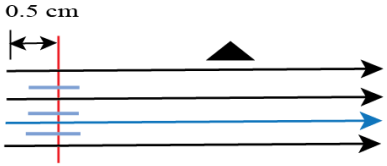
Appendix 5 Technical Drawing of Wallet



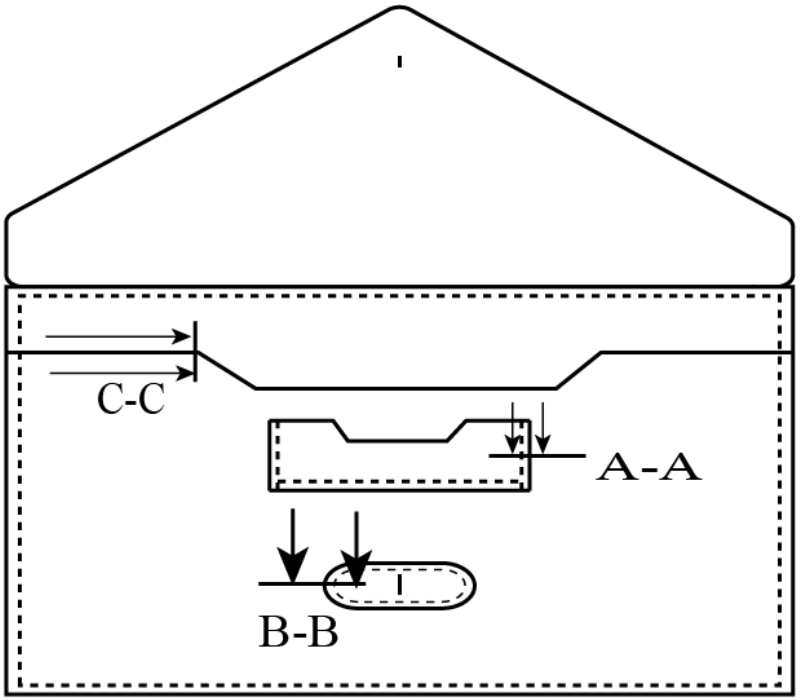


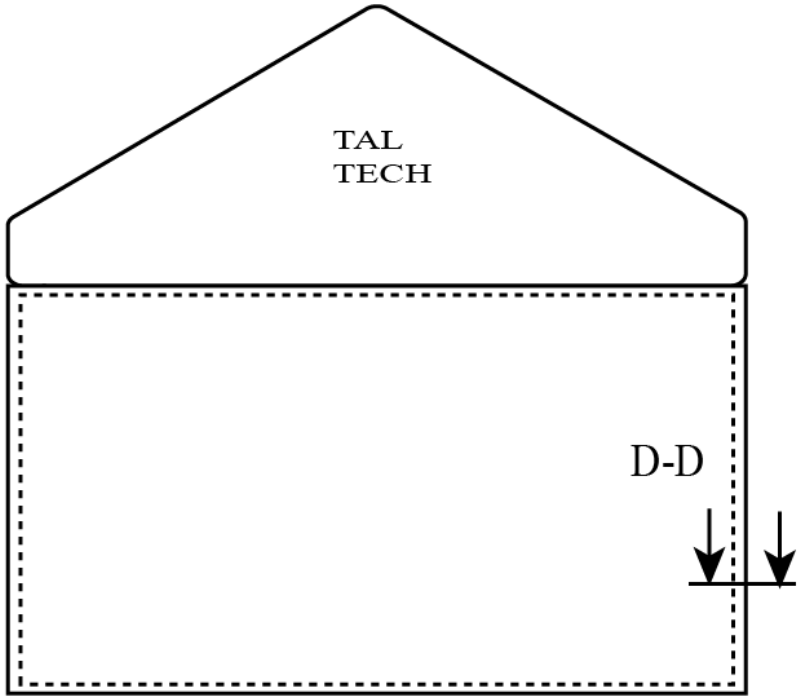
Appendix 6 Sewing technology of wallet

Table no A6.1 Sewing technology description of the wallet

Nr	Mark	Operations	Needle, Thread and seam allowance	Stitch type	Machinery used	Blueprint	Schemes
1.	A-A	Sewing of the zipper pocket	R110,50, 0.5cm	301	Single needle lockstitch		
2.	B-B	Sewing of the card slot pocket	R110,50, 0.5cm	301	Single needle lockstitch		
3.	C-C	Sewing of card, zipper pockets and Outer to with side seam.	R110,50, 0.5cm	301	Single needle lockstitch		

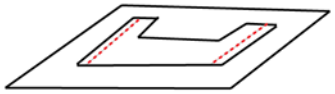
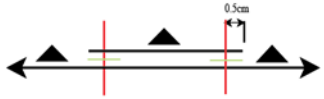
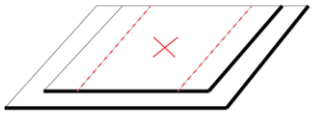
Appendix 7 Technical drawing of laptop bag

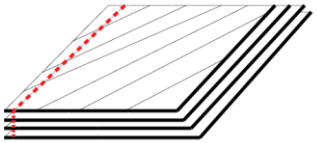
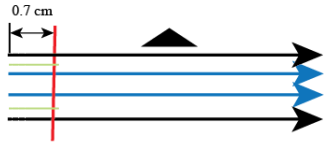




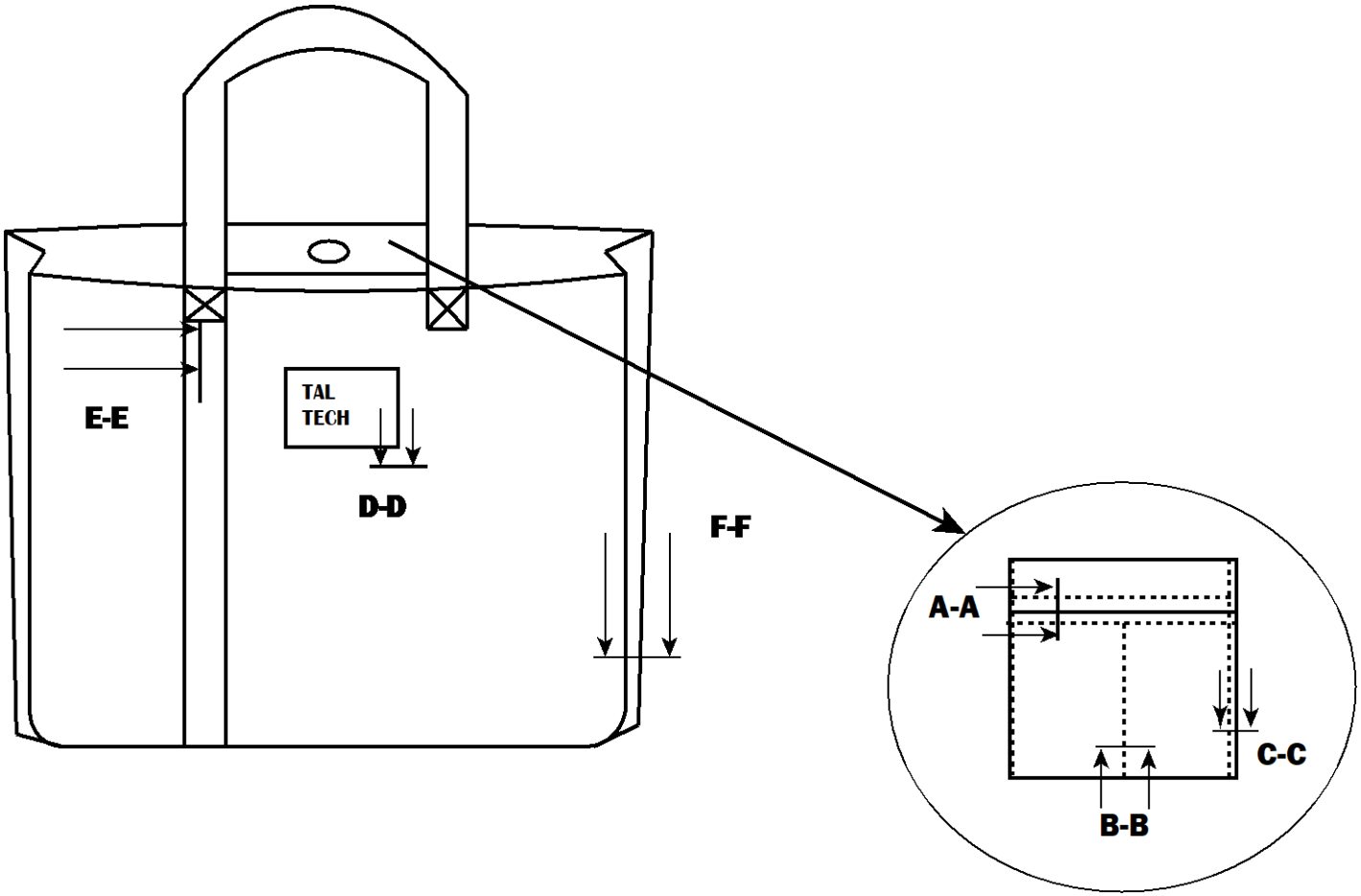
Appendix 8 Sewing technology of laptop bag

Table A8.1 Sewing technology description of laptop bag

Nr	Mark	Operations	Needle Thread and seam allowance(cm)	Stitch type	Machinery used	Blueprint	Schemes
1.	A-A	Cardholder panel sewing on Front panel	R110, 60 and 0.5 cm	301	Single needle lockstitch		
2.	B-B	Attaching and sewing of a metal buckle	R110, 60 and 0.5 cm	301	Single needle lockstitch		
3.	C-C	Lining attaching with front panel	R110, 60 and 0.5 cm	301	Single needle lockstitch		

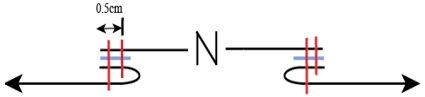
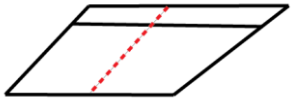
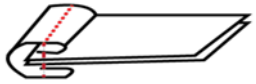
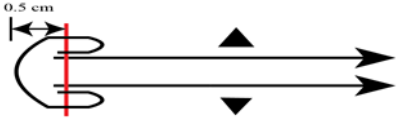
4.	D-D	Sewing of the side seam	R110, 60 and 0.7 cm	301	Single needle lockstitch		

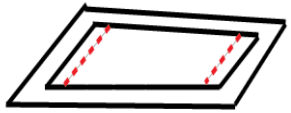
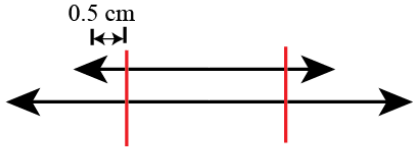
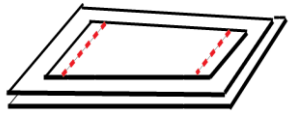
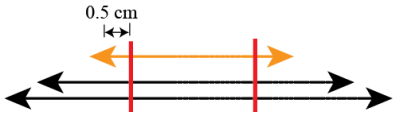
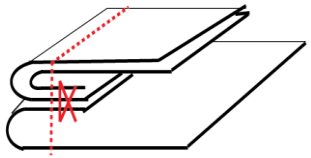
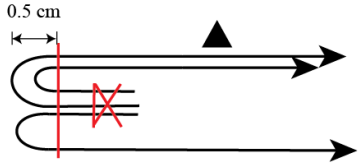
Appendix 9 Technical drawing of handbag



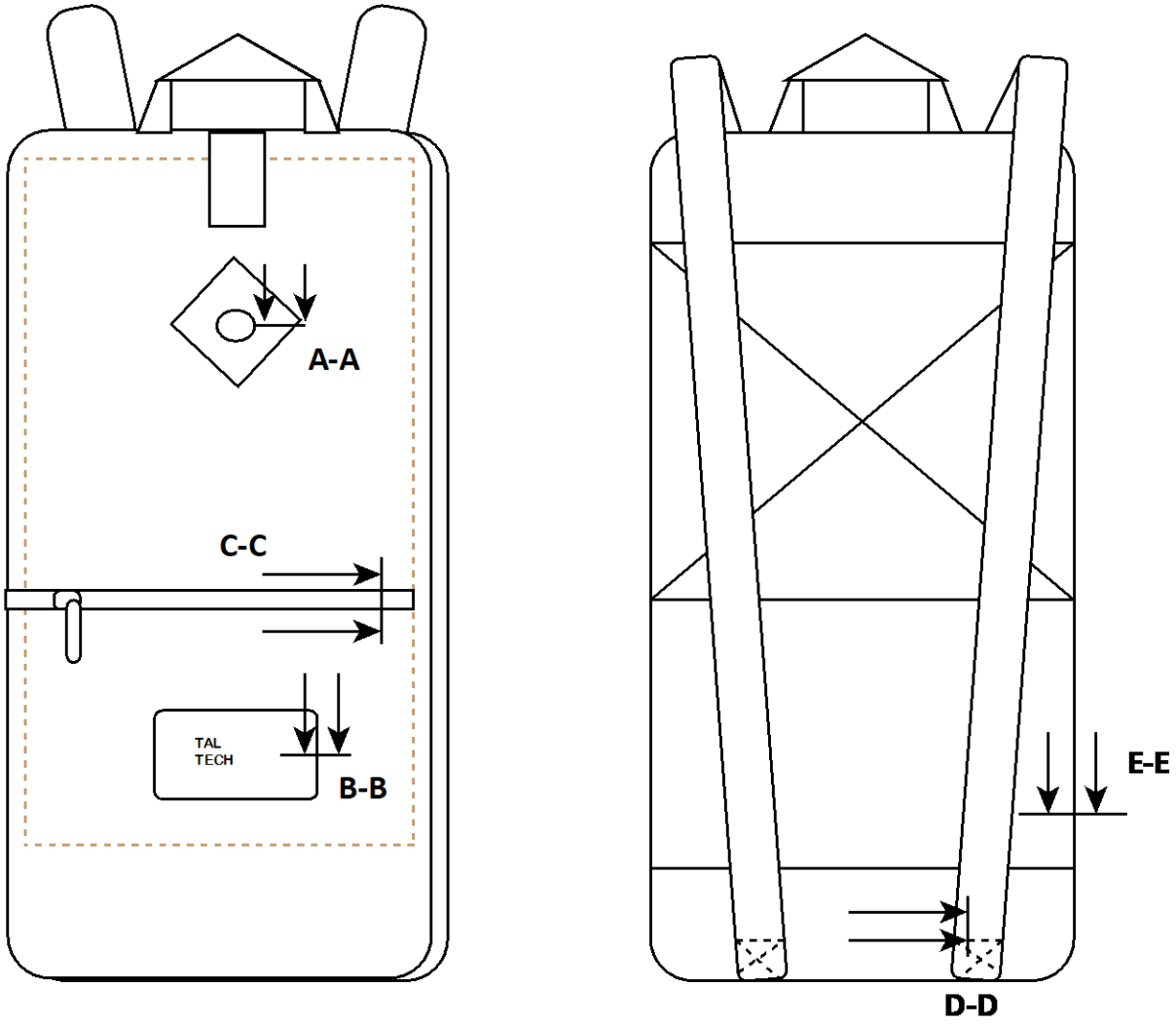
Appendix 10 Sewing technology of handbag

Table A10.1 Sewing technology description of handbag

Nr	Mark	Operations	Needle Thread and seam allowance(cm)	Stitch type	Machinery used	Blueprint	Scheme
1.	A-A	Sewing of the zipper pocket	R90, 40 and 0.5 cm	301	Single needle lock stitch		
2.	B-B	Sewing of mobile pocket	R90, 60 and 1.0 cm	504	Single needle lockstitch		
3.	C-C	Sewing of the piping	R90, 60 and 0.5 cm	301	Single needle lock stitch.		

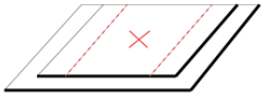
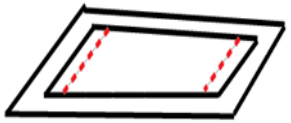
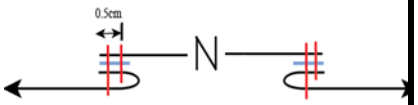
4.	D-D	Sewing of leather logo on fabric	R90 & 60 and 0.5 cm	301	Single needle lock stitch		
5.	E-E	Strap sewing	R90, 60 and 0.5 cm	301	Single needle lock stitch		
6.	F-F	Side sewing	R90, 60 and 0.5 cm	301 and 504	Single needle lock stitch and three thread overlock		

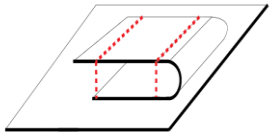
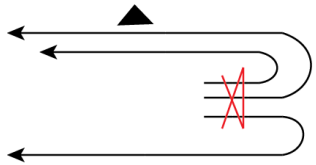
Appendix 11 Technical drawing of a backpack



Appendix 12 Sewing technology of backpack

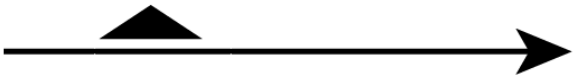
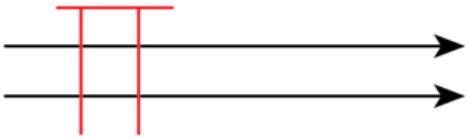
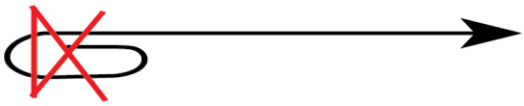
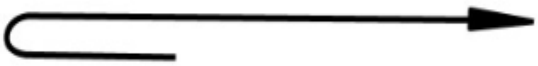
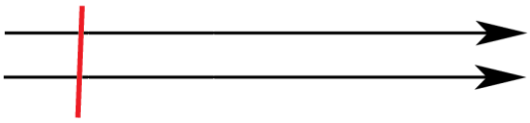
Table A12.1 Sewing technology description of the backpack

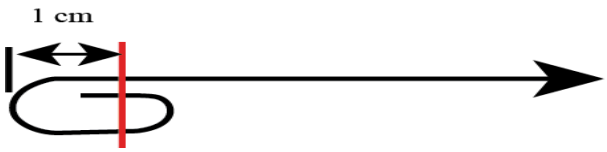
Nr	Mark	Operations	Needle Thread and seam allowance(cm)	Machinery used	Stitch type	Blueprint	Schemes
1.	A-A	Attaching button with leather and sewing with fabric	R90, 120 and 0.5cm	Single needle lock stitch	301		
2.	B-B	Sewing leather logo on the main fabric	R90, 120 and 0.5cm	Single needle lock stitch	301		
3.	C-C	Zipper pocket sewing	R90, 120 and 0.5 cm	Single needle lock stitch	301		

4.	D-D	Strap sewing	R90, 120 and 0.5 cm	Single needle lock stitch	301		
5.	E-E	Side seam (sewing of front and back panel)	R90, 120 and 1.0cm	Three thread overlock	504		

Appendix 13 Sectional drawing explanation

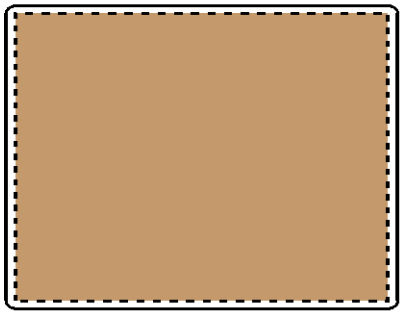
Table A13.1 Sectional drawing explanation

No	Sectional drawing name	Sectional drawing
1	Main fabric/Leather	
2	Lining	
3	The face side of the fabric	
4	Button	
5	Overlock stitch	
6	Folded fabric	
7	Plain seam/Lockstitch	

8	Strap	
08	Seam allowance	
09	Zippers	
10	Adhesive	

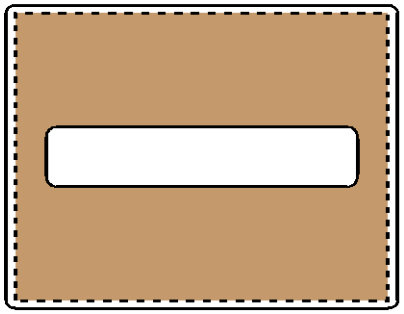
Appendix 14 Patterns of wallet

Outer top'
20*20

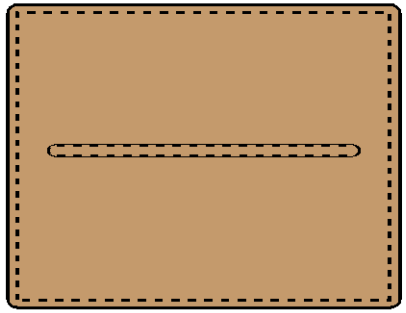


Step pocket*1
20*5

Step pocket *2
20*5

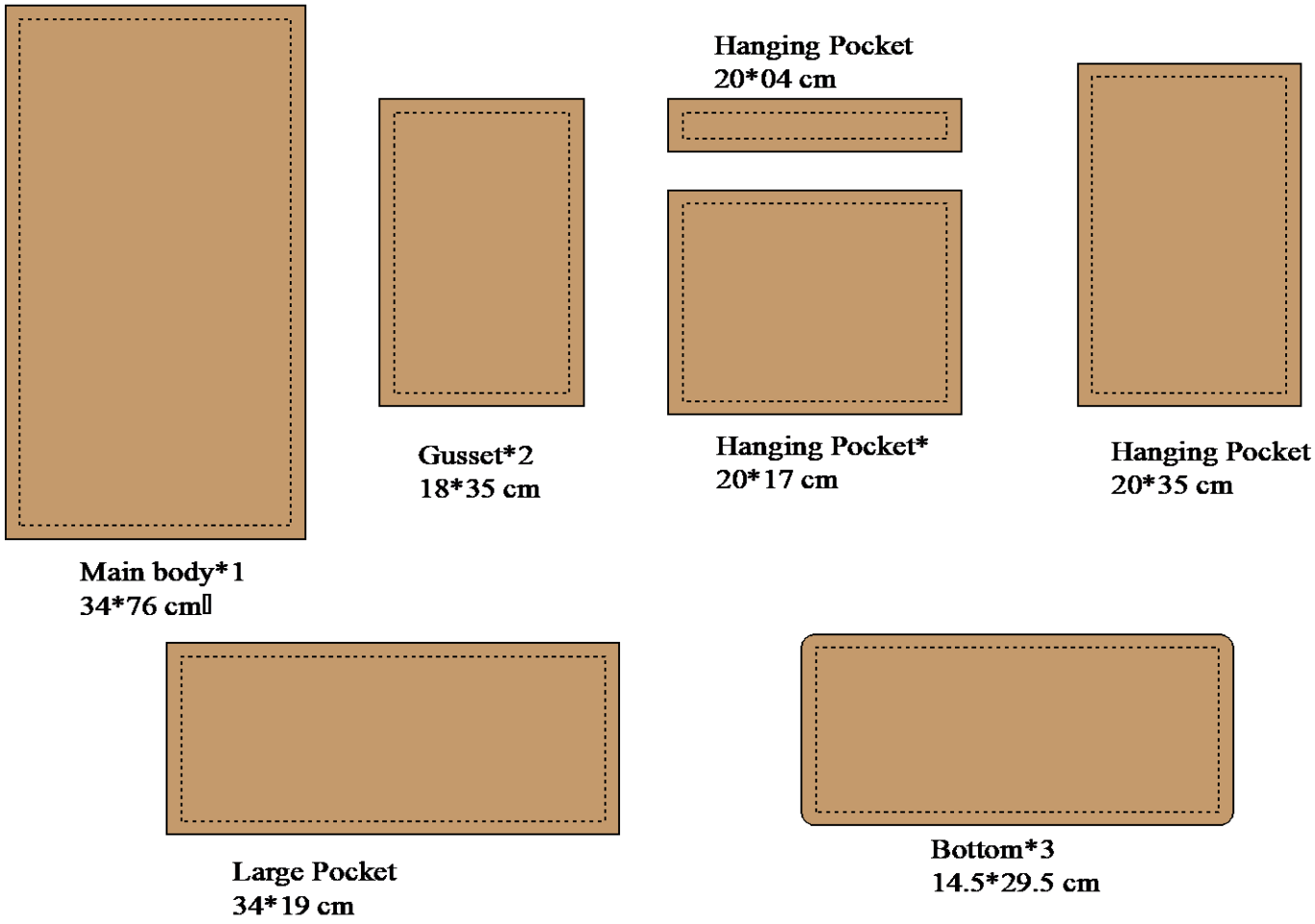


middle part
20*20

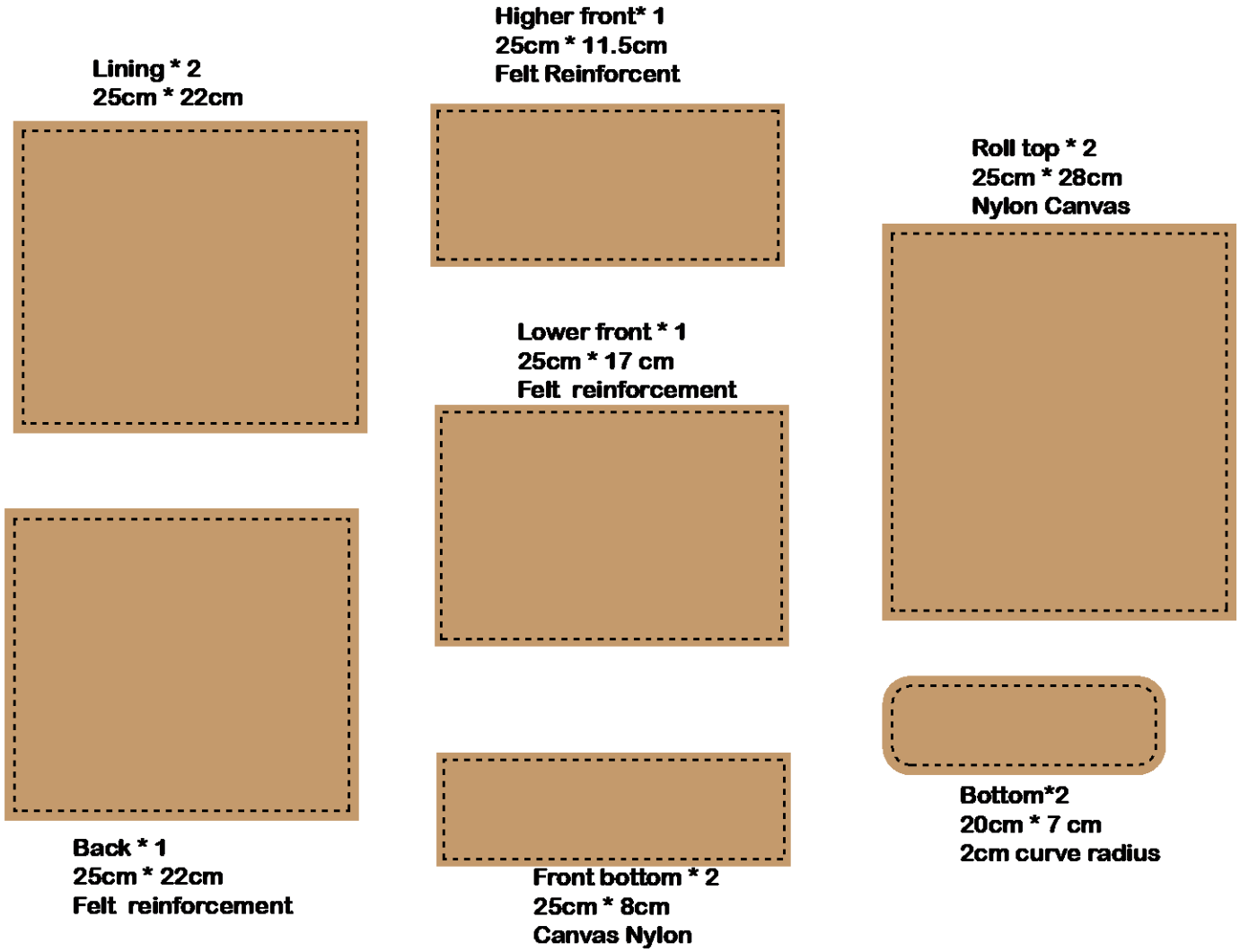


Zipper pocket*1
20*20

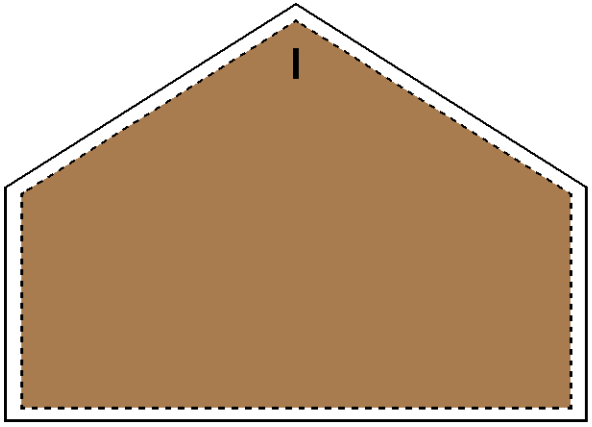
Appendix 15 Patterns of handbag



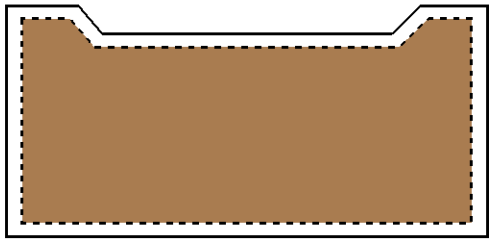
Appendix 16 Pattern of a backpack



Appendix 17 Patterns of laptop bag

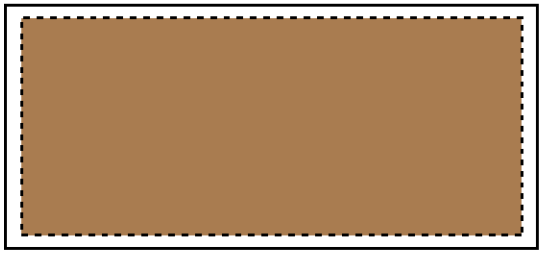


Outer Panel
24cm * 44cm



Front panel
24cm * 37cm

Card Holder Pocket
8.0 cm * 5.5cm



Back Panel Lining
22cm * 35cm

Buckle Holder
5.0cm * 3cm

Appendix 18 Pattern piece details of laptop bag

Table A18.1 Pattern piece details of laptop bag

Name Of the component	Qty	Dimensions (cm)	Fabric/Accessories	Fusing
Outer top	1	24cm*44cm	Leather	No
Front panel	1	20*7*2cm curve radius	Leather	Yes
Lining	2	24cm*37cm	Polyester lining	No
Outside panel	1	24cm*37cm	Polyester lining	No
Card holder pocket	1	8.0 cm* 5.5cm	Leather	No
Button holder part	1	5cm*3cm	Leather	No
Metal buckle lock	1	2 cm	Metal button	

Appendix 19 Pattern piece details of handbag

Table no A19.1 Pattern piece details of handbag

Name of the components	Qty	Dimensions (cm)	Fabric/ Leather	Fusing
Main body	1	34*76	Canvas fabric	No
Large pocket	1	34*19	Canvas fabric	No
Hanging pocket	3	A. 20*4 B.20*17 C.20*35	Canvas fabric	Yes
Gusset	2	18*35	Canvas fabric	No
Bottom	1	14.5*29.5	Canvas fabric	No
Leather logo	1	8*5	Leather	No

Appendix 20 Pattern piece details backpack

Table A20.1 Pattern piece details of laptop bag

Name of the components	Qty	Dimensions	Materials	Fusing
Roll top	2	25cm*28cm	Nylon Canvas	No
Bottom	2	20cm*7cm*2cm curve radius	Nylon Canvas	Felt
Lining	2	25cm*22cm	Polyester lining	No
Back panel	1	25cm*22cm	No	Felt
Higher front panel	1	25cm*11.5cm	No	Felt
Lower front	1	25cm*17cm	No	Felt
Front bottom	2	25cm*8cm	Canvas Nylon	No
Zippers	1	15 cm	Plastic Zipper	No
Leather sticker	1	8cm*5cm	Leather	No

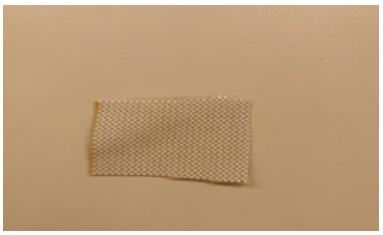
Appendix 21 Pattern piece details of wallet

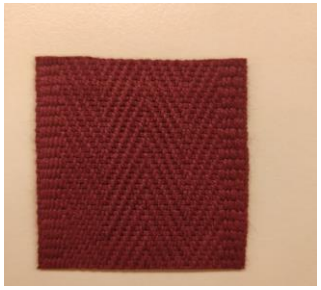
Table A21.1 Pattern piece details of wallet

Name of the components	Qty	Dimensions (cm)	Materials	Fusing
Outer top	1	20*20	Leather	yes
Step pocket	2	20*5	Leather	No
Lining	1	20*20	Polyester lining	No
Zipper part	1	20*20	Leather	No

Appendix 22 Material details of handbag

Table A22.1 Material details of handbag

Materials / Accessories name	Description	Picture
Canvas fabric	80% cotton 20% nylon Colour- Beige	
Piping tape fabric	100 % cotton Width – 1.8 cm Colour- Dark Brown	
Zipper	Width- 0.5 cm Attributes: Metallic Colour: Golden	
D - ring	Width – 2.0 cm Attributes: Metallic Colour: Golden	

Adjuster	Width- 4.0 cm Attributes: Metallic Colour: Golden	
Dog hook	Width – 4.0 cm Attributes: Metallic Colour: Golden	
Adhesive	Water based adhesive	
Straps	100% cotton	
Leather patch	Vegetable Tanned leather	

Appendix 23 Material details for laptop bag and wallet

Table A23.1 Material details of handbag

Materials / Accessories name	Description	Picture
Chrome tanned leather, dark brown	100% cellulose Colour - dark brown	
Chrome tanned leather, dark grey	100 % cellulose Width – 1.8 cm Colour- Dark grey	
Zipper	Width- 0.5 cm Attributes: Metallic Colour: Golden	

Buckle	Width – 2.0 cm Attributes: Metallic Colour: silver	
Adjuster	Width- 2.0 cm Attributes: Metallic Colour: silver	
Polyester lining	100% polyester Polyester fabric Colour: light brown	
Nonwoven adhesive	Water-based adhesive	

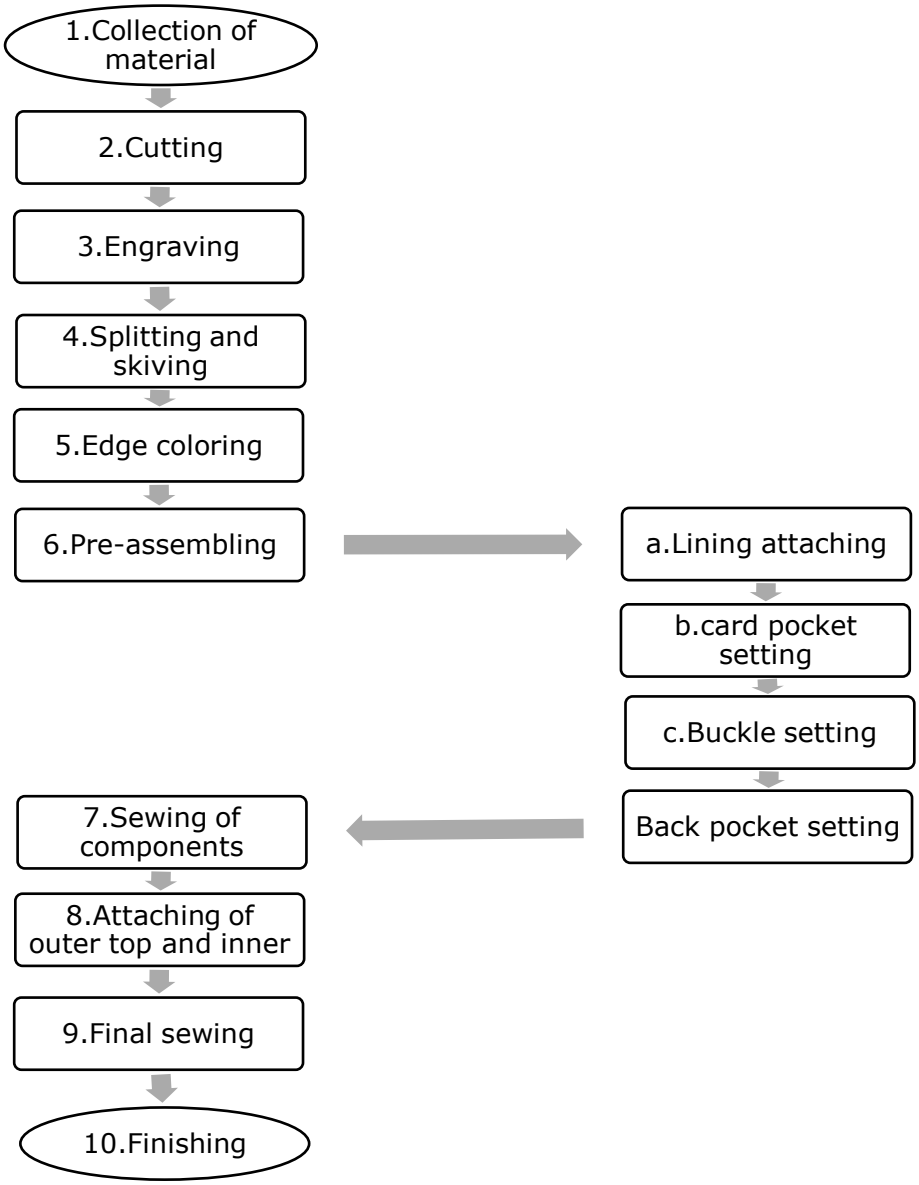
Nonwoven felt	Reinforcement Colour: white	

Appendix 24 Material details for a backpack

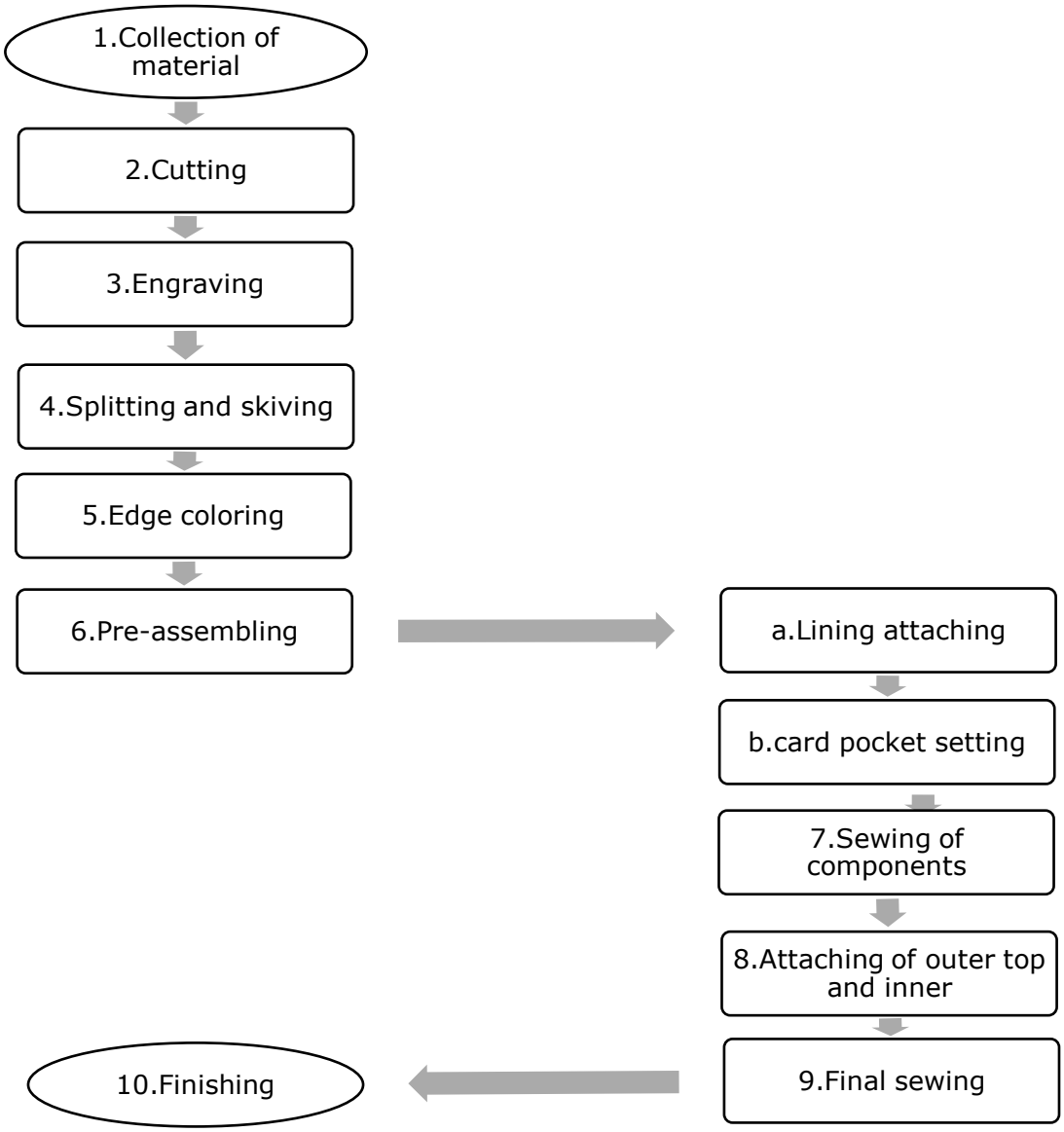
Table A24.1 Material details of backpack

Materials / Accessories name	Description
Canvas fabric	80% cotton 20% nylon Colour- Beige
Piping tape fabric	100 % cotton Width – 1.8 cm Colour- Dark brown
Zipper	Width- 0.5 cm Attributes: Metallic Colour: Golden
Lining	100% polyester Colour: Light brown
Adjuster	Width- 4.0 cm Attributes: Plastic Colour: Black
Nonwoven felt	Reinforcement Colour: white
Adhesive	Water-based adhesive

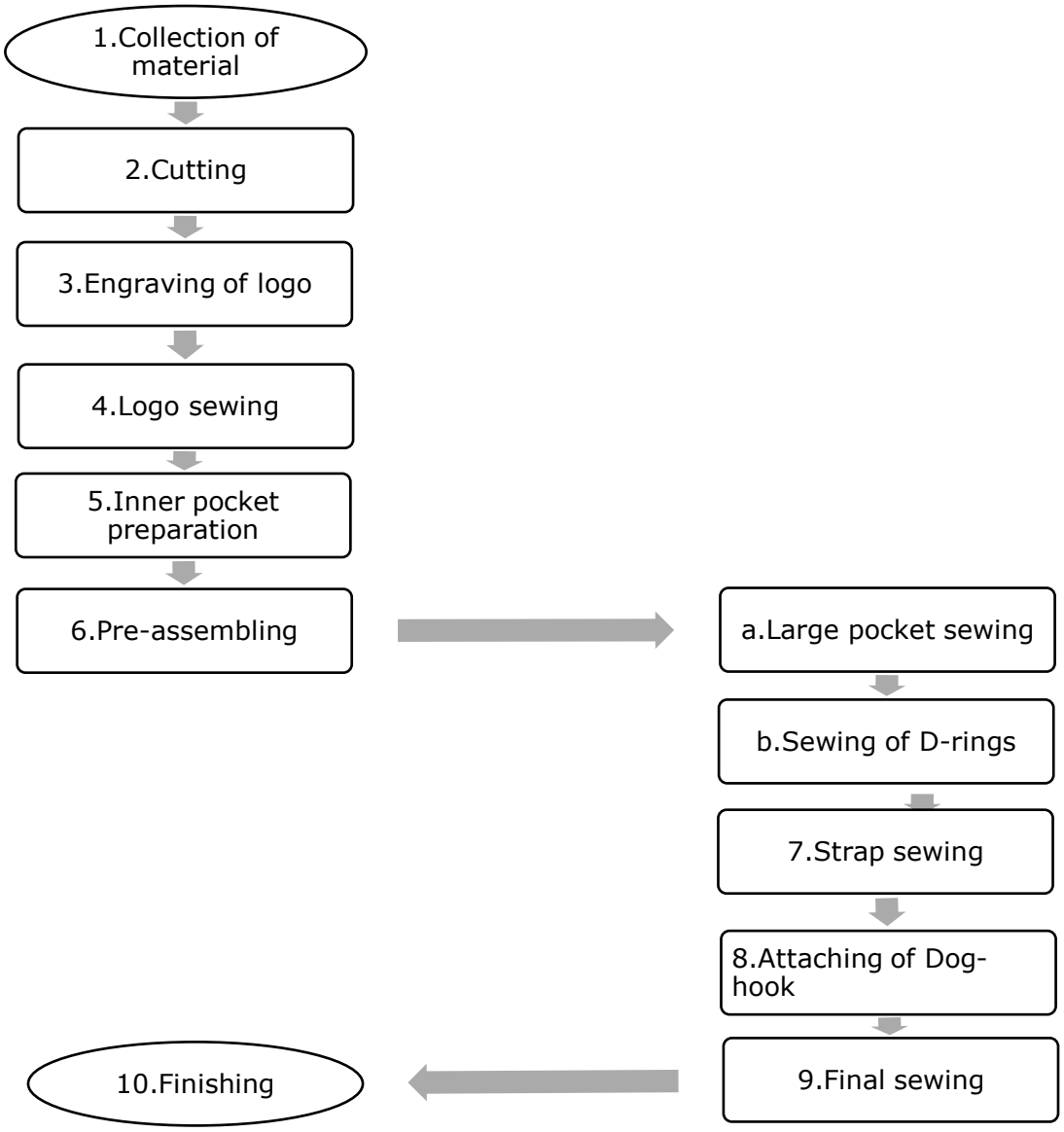
Appendix 25 Flowchart of the manufacturing process of wallet



Appendix 26 Flowchart of the manufacturing process of laptop bag



Appendix 27 Flowchart of the manufacturing process of handbag



Appendix 28 Average area calculations of the specimen

Table A27.1 calculation of mass per unit area

Fabric	**m=3.30 g**			**m = 3.33 g**			**m = 3.27 g**			**m = 3.22 g**			**m = 3.17 g**		
	Sample 1			**Sample 2**			**Sample 3**			**Sample 4**			**Sample 5**		
No	Length (cm)	Width (cm)	Area (cm^2)	Length (cm)	Width (cm)	Area (cm^2)	Length (cm)	Width (cm)	Area (cm^2)	Length (cm)	Width (cm)	Area (cm^2)	Length (cm)	Width (cm)	Area (cm^2)
1	10	10.2		10	9.9		10	10		10	10		10	10.2	
2	10	10		10.1	9.8		10.2	9.8		10.1	9.8		10.1	10	
3	9.9	10.1		9,9	9.9		10	10		10	10		10.1	10.2	
Mean value	10.0	10.1	**100.6**	10	9.86	**98.6**	10,06	9,93	**99.9**	10,03	9.93	**99.6**	10.03	10.13	**101.6**

Appendix 29 Evaluation of abrasion test (dark brown leather specimen)

Table A29.1 Abrasion test result of dark brown leather

Nr	No of cycles	Effect	Result
1	100	No change	
2	200	No change	
3	300	No change	
4	400	No change	
5	500	No change	
6	600	No change	
7	700	No change	
8	800	No change	
9	900	No change	
10	1000	No change	
11	1100	No change	
12	1200	No change	
13	1300	No change	

14	1400	Split of Coating	
15	1500	Split of Coating	
16	1600	Split of Coating	
17	1700	Split of Coating	
18	1800	Split of Coating	
19	1900	Split of Coating	
20	2000	Split of Coating	
21	2100	Fibres break	Fibres breakdown of the dark brown specimen. Assessed through an electronic microscope with 50x magnification.

Appendix 30 Evaluation of abrasion test (dark grey leather specimen)

Table A30.1 Abrasion test result of dark brown leather

Nr	No of cycles	Effect	Result
1	100	No change	
2	200	No change	
3	300	No change	
4	400	No change	
5	500	No change	
6	600	No change	
7	700	No change	
8	800	No change	
9	900	No change	
10	1000	No change	
11	1100	No change	
12	1200	No change	
13	1300	No change	
14	1400	Split of Coating	
15	1500	Split of Coating	

16	1600	Split of Coating	
17	1700	Split of Coating	
18	1800	Split of Coating	
19	1900	Fibres break	Fibres breakdown of the dark grey specimen. Assessed through an electronic microscope with 50x magnification.

Appendix 31 Types of machinery used during product development

Table no A31.1 Machineries used during production Figure [62] , [63], [64] , [65] , [66] , [67]

Machineries	Picture
Fusing machine	
Laser engraving machine	

Universal sewing machine	
Heavy interfacing sewing machine	

Overlock sewing machine	
Pressing machine