Bags

Bags are designed to carry everything from school books to mountaineering gear, or they may simply be a stylish fashion accessory carrying little more than the weight of a lipstick. They are nearly all made from fabric of some form or another, but what governs our choice of material?

Fashion Handbags

Historically, most designs have been made of **leather** or other natural materials. Current technologies allow synthetic polymers such as **polypropylene** to replace natural materials - these can easily be moulded or woven, and made in exotic colours or even translucent. Interesting, semi-rigid shapes can be moulded from the class of polymers known as elastomers (rubbers); **poly-chloroprene** (also known as **neoprene**) is one of these materials used in recent designs.

School Book Bags

A school book bag must support more weight than a hand bag and provide adequate wear resistance to survive the school environment for at least a couple of years. The most common materials chosen for this design are natural or polymer fabrics: **canvas** (usually **cotton**-based), **nylon** and **polyvinylchloride** (**PVC**) are examples.

Mountaineering Backpack

For mountaineering gear, the material and product must perform to high standards with special consideration for the weight of the product, its ability to withstand damage (such as scraping on rocks) and its performance in poor weather. Mountaineering backpacks have evolved from **canvas** to **nylon** to **PTFE**. "**Goretex**" is a PTFE-based laminated fabric used for wet-weather gear because the 'holes' between the fibres are too small to allow water in, but coarse enough to allow water vapour out.

Each type of bag involves a different set of design requirements. All bags must be strong enough to carry the required load. However, the bag must provide this strength subject to other, less easily quantified, design requirements – see the table. Fabrics give a product good strength at low weight, while being very flexible and having good aesthetic qualities for designers to exploit.

Design Requirement	*fashion accessories*	*school book bags*	*mountaineering gear*
required stiffness/strength	low	medium	high
weight of bag	medium	medium	low
water resistance	none	partial	complete
tear resistance	low	medium	high
estimated lifetime	6 months	2 years	5 years
allowable cost	high	low	high

Joining of fabrics

The most common joining method used for fabrics is stitching. Stitching is a very versatile and fast process, though selecting the thread, fabric layup and stitching the pattern are skilled design processes. Stitching works with almost every fabric and can also join fabrics round difficult curved seams (such as for putting the arms onto a jacket). Many joining processes are limited to flat, nearly straight joints, and some will only work with specific fabrics (depending on the polymers used in the fabric).

Try it yourself 1

Try to find out about some alternative processes to stitching for joining fabrics (it may help to examine lots of different fabric products e.g. sails, tents, wetsuits). Describe how each process works and give some advantages/disadvantages compared to stitching.

Try it yourself

Try it yourself 2

For bags, as well as looking at the seams, examine the different ways the handles are joined to the bag. Why do so many bags fail at the handle/bag joints?

Try it yourself

Question 1

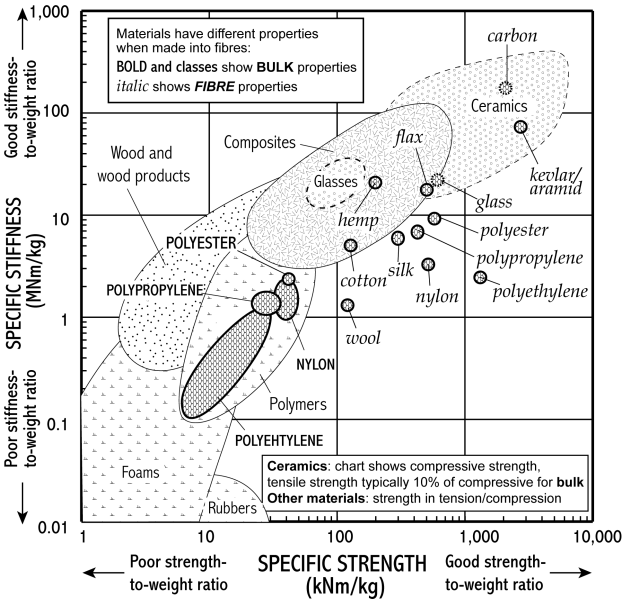
What other factors may need to be considered in selecting a fabric joining process?

Question

Fabric technology

A fabric is a "structured material", usually made as a flat, flexible sheet, by weaving or knitting fibres in bundles – some processes simply tangle the fibres up and the fabric holds together by friction between the fibres. Many fabrics are made as multi-layer composites, with polymer films covering the weave on both sides (this could be to give protection to the fibres, to provide waterproofing, or to change the appearance of the fabric). The fibres can be aligned or random, and are made of natural materials like silk, cotton or wool, or of synthetic materials like nylon, polyethylene (PE), carbon, glass or aramid (known under the trade name Kevlar).

For high performance fabrics, we require strength and reasonable stiffness at low weight. The strength and stiffness of a fabric depends on the type of fibre used, but is also strongly affected by the type of weaving used (which changes the waviness and amount of friction between the fibres). Many fabrics are also composites of a strong fibre weave laminated with weaker polymer coatings. The fibres are critical however, so it is useful to plot their specific strength and specific stiffness on a selection chart – this allows comparison of natural and synthetic fibres, and also comparison of synthetic fibres with the same polymers in bulk form. The chart shows that many fibres have excellent properties – but of course these can only be exploited by building the fibres into a structured material like a rope or a fabric.



Question 3

Polymer fibres are much stiffer and stronger than bulk polymers. What is the difference in their microstructure, and how is this achieved when the fibres are manufactured?

Question

Question 2

There are many properties that are important to fabrics besides strength and weight – for example, flexural stiffness, waterproofing, ventilation, thermal insulation, windproofing, wear resistance, water absorbancy, shrinkage, colour retention and tear resistance. For which of these properties might you be able to gather numerical data? See if you can make your own selection chart for 2 properties and use it to consider the different types of bags and other textiles applications, for example, a fleece jacket, a car seat belt, a dish cloth, or wetsuits.

Question

Try it yourself 3

Devise a test for comparing the tear resistance of different fabrics. It is only necessary to rank the fabrics in order of tear resistance, rather than to get a numerical value for each.

Try it yourself

What is anisotropy?

Many fabric properties - particularly strength, stiffness and tear resistance - are *directional*, i.e. they depend upon the direction of loading compared to the orientation of the fabric. Most woven fabrics have two stiff/strong directions at right angles to each other, parallel to the fibres, with much lower properties in between ("on the bias"). This "anisotropic" structure gives these materials their unique properties.

Try it yourself 4

Try to rip a newspaper parallel to the text and perpendicular to the text...which direction is stronger - why?

Try it yourself