Walking Aids: From Trekking Poles To Zimmer Frames

Walking aids for the elderly range from the traditional wooden walking stick to the tubular metal "Zimmer". Recently the telescopic walking pole, originally designed for mountain trekking, has become popular for general leisure walking.

Walking aids for all

Walking sticks: The varnished wooden stick is an attractive, traditional design. A tight grip is required to gain support from the stick, so these are only suitable for people who are still reasonably mobile and strong.

Zimmers: There are two main varieties of Zimmer – a "box-style" frame, and a "tripod style" stick with three feet to give a more rigid base than a walking stick. The classic box-style Zimmer is very stable and easily gripped, but it requires two hands and is cumbersome to transport. The tripod-style is lighter and one-handed, but offers less support and stability so is only acceptable for more mobile people. These products have been so dominant as aids for the elderly, that the "Zimmer", just like the "Hoover", has become a household name.

Trekking poles: There has been something of a boom in walking for leisure in recent years – with a corresponding boom in gear and accessories to go with it. Originally used by mountaineers to improve balance while trekking over difficult terrain, there is now a large market for high-tech, walking sticks for the casual walker – but with exactly the same goal: to reduce strain on the legs, and reduce the chance of injury.

Product specification

Thinking about what a walking aid must do allows us to define the product specification. For instance, all walking aids must meet certain mechanical performance criteria such as:

- must be stiff enough to support the walker without bending too much;
- must be light enough to carry easily;
- needs to be sufficiently strong and tough i.e. it shouldn't snap or bend permanently if someone drops it or falls on it.

Question 1

There are many other criteria that are important when defining the product specification for a walking aid. For example: it shouldn't slip on a range of surfaces. Consider what types of surfaces a walker might want to cross with each of the three types of walking aid introduced in the left-hand box – how has the design been developed in each case to provide the required grip on the surface?

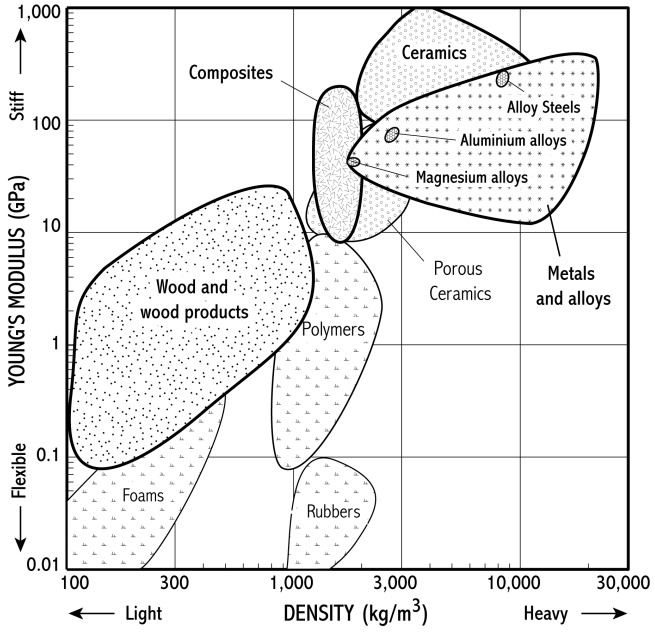
Question

Selecting the best materials

From the product specification above (top right), we can see that two of the most desirable properties in materials for walking aids are stiffness and low weight. A Young's modulus-density chart helps us to identify materials which are light and stiff – they lie towards the top left of the chart.

Composites and many ceramics have high stiffness and reasonably low density. As weight is important the best metals are magnesium and aluminium alloys - steels are stiffer, but have much higher density. Although the woods are not as stiff, they are much less dense, and are suitable provided we use woods *loaded with the grain* to get reasonable stiffness.

We know that some materials in the list above are not used in practice – this is simply because one chart doesn't tell us everything we need to know. For example, we can reject ceramics because they are not tough enough. This leaves composites, aluminium and magnesium alloys, and wood.



Design against buckling

Walking aids are mainly loaded in compression along their length. Because they are long and slender, they tend to fail by *buckling* – which depends on the material stiffness, not its strength. You can see what buckling is by pushing a ruler from both ends – it will bend in the middle, but spring back again (so it is still elastic). The load needed to buckle it is much less than the load needed to break or yield the material in compression **.**

There are 3 things which affect the load required to cause buckling – the material stiffness (Young's modulus), the cross-sectional shape, and the length. This is why we need materials with high Young's modulus, but also why it is best to use a stiff shape (like a tube), instead of a solid cross-section. However, some materials are easier to make into hollow tubes than others, and this will make them stiffer at the same weight.

Working with metals

Magnesium alloys are stiff and very light, but do have some problems. They corrode easily, and can only be shaped easily by casting – not very suitable for making a tube. Aluminium is a bit cheaper and much easier to shape, so it is used in preference to magnesium.

There are many processing routes and joining options for aluminium alloys, which allows great flexibility in design. Hollow extruded tubes are standard sections which may be bought from a material supplier – this is cheaper than having custom shapes made. Using hollow tubes gives improved stiffness without increasing the weight - this gives aluminium an advantage over solid wooden sections when weight is very important. Aluminium tubes are therefore used for Zimmer frames, and for the more high-tech trekking poles.

Working with composites

The total cost of making a product depends on the manufacturing processes used as well as the materials. Composite materials are expensive, and manufacturing in composites tends to be slow and labour-intensive. Composite walking aids are too expensive for everyday use or for aids for the elderly – but, in the more affluent (and fashion-conscious) world of mountaineering and hill-walking gear, they can certainly compete.

Working with woods

Walking sticks have been made from a wide range of woods – for example, beech, chestnut, ash and hazel. It is not economic to use standard processes such as turning – so another approach is needed. As walking sticks are conveniently 'stick' shaped, coppice-grown saplings are used to automatically provide wood in the right size and shape. Wood can be bent after steaming (by hand or machine), but can only withstand modest shaping and it is a slow process. This means that simple designs of walking stick are ideal for making in wood, as they only need one bend to form a simple handle. However, wood is not suitable for more complex walking aids such as Zimmer frames (which would also require many joints).

Try it yourself 1

Design an experiment to find out what load is needed to cause buckling of a small diameter solid circular rod, made of wood or metal (such as aluminium). How does this force change with the length of the rod (keeping the radius the same)?

Try it yourself

Question 2

Most health service walking sticks are made from wood, largely out of tradition and for aesthetic reasons. Modern leisure walking aids are made out of aluminium - how have they been given an attractive appearance?

Question

Question 3

Designs of some leisure walking sticks are becoming very sophisticated. What are the benefits of using a telescopic tubular design? What methods are used to provide the telescopic behaviour? Some trekking poles include anti-shock features to protect the pole from damage – see if you can find examples of these features. Are there secondary benefits to the user?

Question

Try it yourself 2

Zimmer frames are much more stable than traditional walking sticks, but they are bulky to pack in the car. Produce outline schemes for new 'Zimmer' frames which pack up more efficiently when not in use. Are there any lessons to be learnt from the design of leisure walking aids?

Try it yourself

Question 4

In the early 1990's 120 people were employed in one family firm supplying over 2000 wooden walking sticks per day to hospitals, using traditional manufacturing methods. The factory has now closed and the sticks are imported instead. Why has this happened, and could it have been avoided?

Question