



Design and ecology: mismatch or challenge?



In the official International Year of Ecotourism - a programme jointly managed by the United Nations Environment Programme (UNEP), the United Nations Education, Science and Cultural Organisation (UNESCO) and the RARE Centre of Tropical Conservation - the footpaths, trails and track ways of Planet Earth are wearing away. They are not disappearing - quite the opposite because they are getting broader and deeper as the top surfaces are being ground into powder and then eroded by the actions of wind and rain. Many are becoming more difficult to traverse, as muddy areas eventually become deep water-filled holes or miniature swamps. To avoid those, self-propelled travellers are detouring around the obstacles and broadening the paths even further; a metre-wide track becomes several metres wide in a couple of years and we have an ecological problem.

In the heyday of stiletto heels we were given a surface loading pressure at the point of impact of five tons per square inch for an average woman. Imagine the potential for footpath damage in a platoon of those. The prime footwear design requirement for the outsoles in trekking boots and shoes is the provision of a broad platform extending from heel to toe and providing both longitudinal and transverse support. By comparison with the stiletto heel, the point of impact loading is measured in decimal points - but an army of walkers can still do a lot of damage.

It was suggested to a number of expert commentators that possibly the designed arrangements of lugs and cleats on activity footwear outsoles made a major contribution to the damage sustained by footpaths. "Not so," said the authorities responsible for the upkeep of long-distance trails. We checked worldwide with those caring for national parks in Europe and the USA, and with the guardians of the trekking trails in the Himalayas in the hope that someone would agree with the original premise, but it was a lost cause before we had even finished the question.

We thought that military researchers might offer some support and certainly there was a hint, in some quarters, that minimally patterned or smooth outsoles would have a sympathetic reception, but that was only because the team in question were concerned with escape and evasion and therefore looking for means of hiding traces, rather than considering the effect of marching feet on sensitive terrain.

The problem as far as conservators are concerned is quite simply one of volume; hundreds of thousands of pairs of footwear making the most of the modern improvements in travel and the availability of leisure time. The first two or three walkers bruise the vegetation cover, the next batch breaks the stems at soil level leaving the top surface open to successive pairs of boots. That surface is broken into component fragments. Climatic conditions and more walkers do the rest. (It is interesting to contrast the attitude prevailing in much of the

Vibram's Snowshoe outsole - 360° performance



golf world. The move away from metal spikes to soft cleats or ribbed soles has developed, ostensibly to protect greens and close-cut playing surfaces from damage. Yet spikes were once seen as environmentally friendly, helping to aerate the soil surfaces. Could it be that golf clubs could not afford to replace those clubhouse wooden floors damaged by the spikes and, rather than upset members by limiting where they could walk in the clubhouse, conveniently put the reason down to grass damage?)

So, if attempting to conserve the trails by developing eco-friendly outsoles is not seen as a priority, what is it that all the variations on the design theme are attempting to achieve? Four words suffice: Durability, Comfort, Grip, Traction.

Four way performance match

As so often happens with products designed to achieve specific performance, the four targets are both interdependent and work against each other. Most modern sole assemblies are a combination of rubber and low-density polyurethane. The former provides durability, torsional strength and the hardness to resist abrasive wear. The latter material provides an appropriate measure of comfort, but must impart its own degree of firmness to ensure security inside the footwear and the capability to match the longevity of the outer sole.

Grip is achieved in general by the action of moulded cleats where the sharp edges provide a secure interface with the walking surface. The base moulding material (rubber) needs to be of sufficient durability and hardness to resist wear and keep the edges clear and open. Traction, on the other hand, requires a softer medium to maintain the optimum level of adhesion during the forward motion phase of the walking action.

The final rubber mix is therefore a compromise even though biomechanical studies have confirmed that clearly defined and separate areas of the foot are brought into play during the walking action as the foot strikes the ground, grips, and then moves through a rolling action to thrust off for the next stride. The possibilities in matching gripping, stabilising and thrusting forces to areas of the outsole containing differing physical characteristics are under active consideration, but the overall stress sustained by trekking and mountaineering footwear renders the likelihood somewhat remote at present.

Perhaps the most promising technology is contained in the layering of compounds to produce active sole patterns. One Italian company, Vibram SpA, has already developed a similar technique using a thermoplastic frame that allows rubber to be placed only on selected areas of the outsole. The move to placing different compositions of rubber to where they will be most effective has to be the next obvious development.



Generic performance

The world's most popular brand of outsole for outdoor footwear has become almost generic. Whilst the phrase 'wearing my vibrams' is not often heard, certainly Vibram outsoles have become synonymous with certain types of outdoor activity footwear and it is not unusual to hear them being credited with levels of performance even though the company's products may not have actually been fitted to the uppers in question.

Founded in 1937 by Vitale Bramani, the company was the first to apply the vulcanising process to the production of rubber soles for mountaineering and climbing boots. The Vibram base design, with its traditional pseudo-nailing pattern of lugs and serrated edges moulded in rubber, is possibly the most popular - and most copied - product in the range. In the 21st century the company's yellow octagon logo can be found decorating dress and casual footwear in both rural and highly urbanised situations as well as maintaining the traditional involvement with mountaineering worldwide.

The growing adoption of a crossover between athletic and outdoor footwear has brought the science of bio-mechanics to the fore and generated a number of radical designs, including the frame-'n'-rubber development mentioned earlier and the incorporation of an 'S' performance curve into the sole patterns for an increasing number of products.

The letter 'S' actually indicates the prime performance areas of an outsole design, and a Vibram spokesman assures that the outline of the letter on a pair of outsoles indicated that they were performance products geared to a significant improvement in the way that outsoles work in partnership with the natural movement of the foot to enhance the chosen activity, whilst ensuring that the overall comfort was not compromised. It calls them active soles and says that they are designed individually to match the requirements of the end-user in improving personal performance. (It has been interesting to see other companies copy the 'S' construction of Vibram by simply reversing the letter. What the copyists have not apparently appreciated was that the Vibram pattern was the result of indepth research into the way the bones of the foot work when walking. The copy may have

Brasher's lamb's hoof cleat pattern on the Traklite sandal

the same result if one was walking backwards.)

For the future, all performance development will be activity-specific, and as examples Vibram quotes the most recent Vertige and Snowshoe designs. Vertige is an ice-climbing and winter mountaineering assembly that has a rigid insert extending over 75% of the length of the outsole to make it crampon compatible. Pyramid-shaped lugs are said to improve grip on snow and ice, and a markedly convex arch reduces ice build-up under the foot.

Snowshoe has multi-traction lugs said to offer 360° performance on a variety of surfaces, but which have an open design to facilitate self-cleaning in snow, grit or mud. Intended for use in winter expeditions where snowshoeing is a likely method of locomotion, the rubber compound used is markedly resistant to temperature change.

It is not too long ago since Vibram outsoles carried just one standard pattern. Nowadays its output is characterised by the diversity of designs, each developed as a result of close cooperation with specialist footwear manufacturers and their perceptions of the needs of a particular sector of the outdoor market.

Lightweight trade-off

It is over twenty years since British outdoorsman and former Olympic athlete, Chris Brasher, first launched the radical design of the Brasher Boot. Based on a running shoe lasting that was half-sprung for added comfort, the boots were an instant success mainly because they met the claim that they needed no breaking in and they were incredibly light.

The original sole designs were the work of another radical thinker, Ken Ledward of the eponymous Ken Ledward Equipment Testing

Services (KLETS) and whose work will be detailed later. To get an idea of the current thinking on outsole design in the Brasher Boot Company (BBC) of the 21st century we spoke to product director Wayne Edy.

Essentially the company has been trading off the customer benefits of durability, grip and comfort against the ecological considerations. It has developed a rubber outsole that almost refuses to hold dirt and grit between lamb's hoof cleats, which in themselves develop a comprehensive measure of grip on uneven or steep terrain. These cleats are aptly named. Resembling an elongated 'H' in plan view and forming a continuous central pattern from toe to heel, they are composed of three elements that interact to provide grip or traction depending on the angle of the terrain underfoot. Those on the heel section are reversed to those on the sole and thus provide added security on the downhill stretches particularly where wet vegetation is the main component of the slope. Because they are relatively small to their performance potential, Edy suggests that the lamb's hoof cleats are unlikely to cause damage in any measurable degree to their immediate ecological interface.

BBC's main development target for the past 36 months has been loss of weight without loss of performance as it rebuilds an earlier reputation for producing the lightest designs in the high-tec mountain footwear sector. In the succeeding years to its original work with the Hillmaster model, the company added market-led 'bells and whistles' in the shape of breathable membranes, thicker sole protection and heavier leathers. Revisions to the rubber mixes, in particular, has enabled the original outsole weight to be regained but with no loss of shock absorption. 🦋

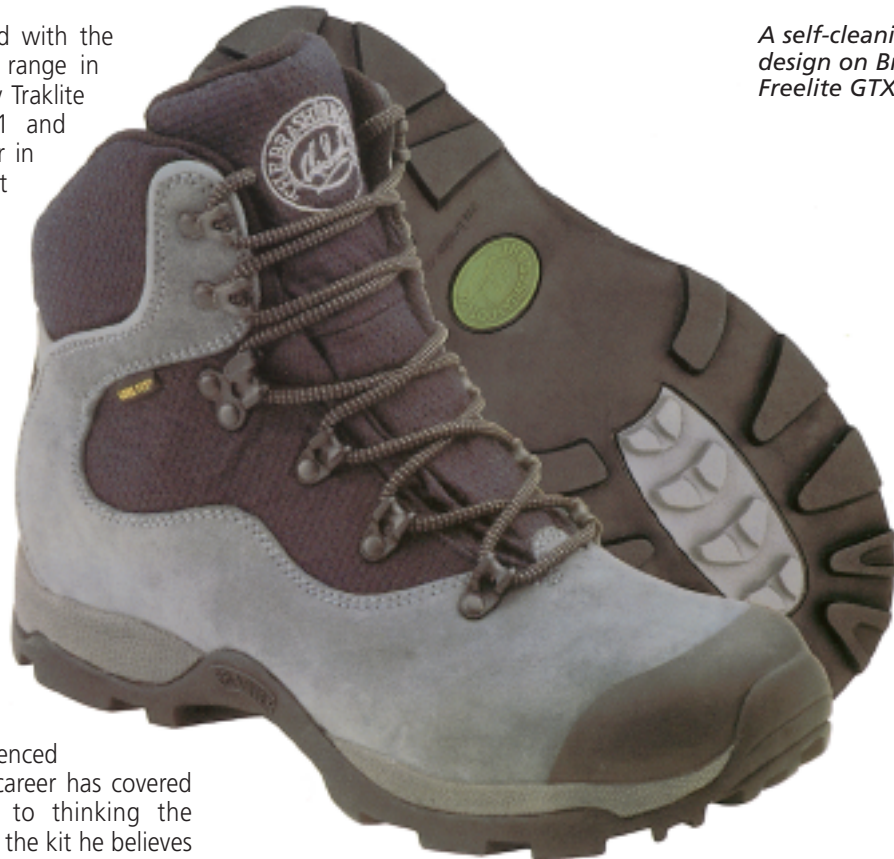


KLETS-designed soles allied to a caver's boot



The benefit was celebrated with the launch of Brasher's Supalite range in year 2000, to be followed by Traklite shoes and sandals in 2001 and Freelite and Tourlite footwear in 2002. Wayne Edy noted that the Freelite and Tourlite soles, although not intended to be so, are probably the most eco-friendly products in the range because the extremely open tread designs leave the walking surface almost untouched, relying on the stickiness of the rubber compound to provide grip and traction.

A self-cleaning sole design on Brasher Freelite GTX footwear



Original thinking

No investigative writing in the area of outdoor equipment development should ignore the input from one of Britain's most experienced field testers. Ken Ledward's career has covered everything from education to thinking the unthinkable on the subject of the kit he believes is necessary to make the mountain experience enjoyable. His response to a request for information on the subject of outsole design versus ecology makes informative reading.

"The original idea to make a super lightweight boot was based on my mid-50s experiences in fell running. There was no consideration of ecological problems, just the need for a lightweight boot for fast travel in the not-too-difficult technical areas of upland. I have always believed that the very deeply grooved profile of most outsoles is just a catchment area for debris and that there is an optimum depth for grip in average terrain. In very deep mud and in mid to firm snow it is the outer profile of the total boot which gives some hold; the sole is already filled in moments in those surfaces and you skate on the infill.

I call a sole profile that relies upon the studs/cleats to penetrate the ground, a Positive. I believe that in most footpath terrain a Negative profile with smooth soles and concave areas, similar to those used in gyms and on compressed hockey pitches, are preferable. That type will do less damage to the terrain than the positive profile and from my experiences it is only on wet firm grass that I have had any serious imbalance. On softer terrain that is preferred to the imbalance from positive profiles on rocky slabs, etc., when the landing can be very uncomfortable.

I decided to aim for something that looked like a klettershuhe but with the outsole performance of a Rucanor hockey boot.

In 1962 I went as Chief Instructor for OB (Outward Bound) at Loitokitok, Kenya. We had very little good kit and many of the African youngsters were already skilled at the making of

sandals from old car tyres. I fashioned my first outsole in this manner and tried to get the conical stud configuration in the centre areas for traction and stability in loose and flat ground (even on snow in the upper areas of Kilimanjaro), and the flatter 'cleat-like' edges for any steep traverses on rock. (Some American tourists on Kibo reported motorcycle tracks. These were the sandals made mainly by locals and also by those at OB who had regular access above the forest line.)

On return to UK I adapted some new Itside outsoles (there is still some discussion as to whether Itside or Vibram was the originator of the Commando sole). Winit, the cricket boot manufacturer, carried out the first production version of a Klets sole design. It was taken-up by cavers at first and then Karrimor wanted a version for its new KSB footwear range, which was produced by Asolo under the guidance of Giancarlo Tanzi. The Scout boot with the Klets sole was eventually one of the best selling Asolo products in the USA.

EuropaSport (of Kendal in north-west England) also wanted a product with the new sole and arranged for Vibram to buy a version from Klets. This was used on several boots but the Zamberlan Ultralite was most prominent. When Chris Brasher developed the first Hillmaster boot, he also wanted a modified Klets sole; a fact which undoubtedly contributed to the success of the range.

It is personally gratifying to remember that my first efforts to try to sell to someone were laughed off, as they didn't want a football boot image. Now most boots have an outsole design closer to the Klets original than to the Itside

Look – no hands

In the 1960s if you didn't climb a rock face in your stiff, cleated, rubber-soled boots – then you wore plimsolls. For those unfamiliar with the term they were also variously called daps, sandshoes, pumps or tackies. Their greatest attribute was their smooth soft rubber soles, which gripped dry rock with the tenacity of Spiderman. In the wet they were lethal.

From these developed the forerunner of the modern rock shoe but there was very little competition, and the manufacturers had yet to work out how to mould a shoe to a foot. Sadism took over and the myth emerged that rock shoes had to be painful to be effective.

The product available today is one of the most technical in the outdoor market – and definitely not designed to be painful in wear. An anatomically shaped and moderately pointed upper, usually laced almost to the first joint on the big toe, may be in suede leather or a synthetic equivalent. Every model is available in half-sizes through a range of fittings – so there's no excuse for tears in the eyes.

But the real open secret lies in the sole assembly. A stiff shank, usually steel, that provides a platform for the foot under stress, supports a moulded insole. A deep rubber rand adds protection from abrasion and, much more importantly, an additional gripping surface when the sole of the foot doesn't quite fit in a tricky hold. The outsole itself is going to be the 'stickiest' rubber compound for the price; more often than not it will be given the title 'stealth', an indication of its grip, tenacity and operational ability – even on wet rock.

A major sales point for all rock shoes is that the outsoles should be capable of being repaired back to the original standard by a specialist repair shop.



Five Ten slipper with hook 'n loop fastening



Traditional format from Rock Pillars

Commando or Vibram standard soles.

There is no solution to the action of feet contributing to erosion unless we follow the Swiss, and some enlightened UK areas, by building a surface which will be more durable than the outsoles. Here I am not referring to those token footpath stone staircases which are appearing, which most people avoid on descent and in doing so create another bed for a small stream. The old Scottish tracks which wind gracefully will long outlast these staircase routes."

Challenge

This article opened with the United Nations. It closes with yet another initiative from the same organisation. In December of last year, the United Nations declared 2002 to be the International Year of the Mountains as the means of 'increasing awareness of mountain

ecosystems, defending the cultural heritage of mountain communities and promoting the conservation and sustainable development of mountain regions'.

Much of the organisation's reasoning lay in the Agenda 21 outcome of the 1992 Earth Summit in Rio de Janeiro. Chapter 13 of the Agenda reads: 'Managing fragile ecosystems: sustainable mountain development' placing mountainous areas on an equal footing with climate change and deforestation.

Is this perhaps the other half of the challenge for walking footwear sole designers? To not only match the users' requirements of durability, grip, traction and comfort, but also to give them the opportunity to make a positive contribution to the ecology without loss of pleasure in the mountain environment? 🏔️

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