

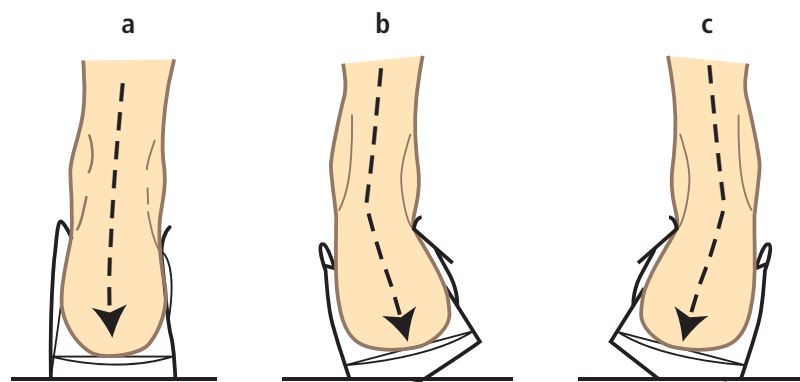
Norms for shoe comfort

Extracts from a paper by the Biomechanics Laboratory of IBTeC, the Brazilian Institute of Leather, Footwear & Leathergoods Technology

Our early ancestors came down from the trees and changed their feeding habits, probably due to the disappearance of large areas of forest. This, in turn, led to a gradual change in posture and the foot's structure becoming more complex and acquiring new functions. One of the most important of these was the plantar arc, which serves as a cushioning system and also returns energy. Although we have been wearing shoes for over 10,000 years, it has only been in the last 100 that they have been subjected to the effects of hard flat surfaces on a daily basis.

Understanding the foot

In order to produce effective and comfortable footwear, it is necessary to understand how we walk, how the foot works and how the construction of the shoe affects both of these. Further research is needed in order to provide reliable data for the development of more comfortable shoes with regard to their final end use and to evaluate climatic and fit factors as the world's population varies



- a if the right foot moves like this, the movement is considered to be normal.
- b here the movement is called eversion and involves rotation of the foot so that the internal lateral face of the foot turns down.
- c here it is called inversion and the foot rotates such that it is the external lateral face of the foot that turns down.

enormously in terms of size, weight and environment.

As the world's population increases and standards of living improve, the demand for footwear grows. At the same time, the technology of footwear manufacture is becoming more and more sophisticated. It therefore makes sense to analyse the requirements and suitability of footwear from a variety of viewpoints:

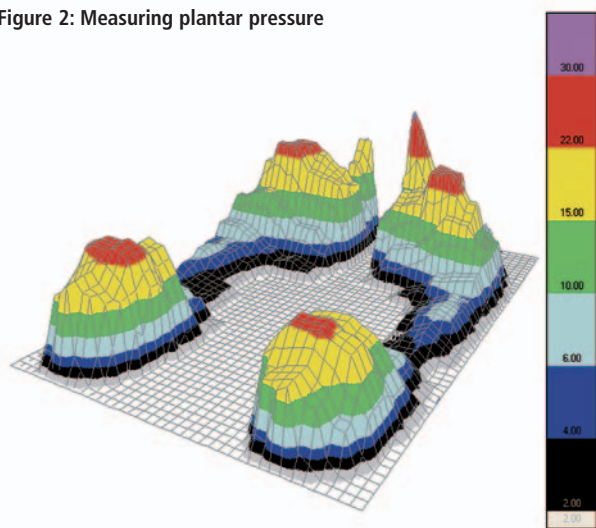
- Consumer** – male, female, child, etc.
- Shoe type** – boot, tennis, sandal, etc.
- End use** – casual, competitive sport, safety, etc.

Human gait analysis is complicated and although it has been studied for 100 years little is really known about it due to the fact that the foot's structure and movements are highly complex, as is its interaction with the remaining parts of the body and the ground itself.

We walk in three main ways

Each gait ideally needs the correct footwear for different types of activity. For example, the principal function of the insole is plantar pressure distribution, whereas most people think its major function is impact absorption. To be comfortable, a shoe must have a number of basic

Figure 2: Measuring plantar pressure



characteristics. The essentials include free toe movement, flexible uppers, good fit, adequate height, no excessive pronation, good contact with the surface of the foot, absorption of humidity, controlled temperature, correct plantar pressure distribution and low weight. This goes some way to explain why footwear is such a complex product to produce. Much important information has been obtained through modern techniques such as force platforms (impact absorption), electronic insoles (plantar pressure distribution), scanners, cinemetry systems and, more recently, thermography using infrared cameras.

Brazilian norms for shoe comfort

Until recently, shoe comfort was evaluated only qualitatively and depended totally on individual perception. This has often led to confusion between fashion and comfort. In 2002, Brazil became the first country to develop norms to quantify shoe comfort (NBRs 14834 to 14840) via the Brazilian Association for Technical Norms (ABNT).

Technical characteristics are essential in showing the difference between various shoes. They are associated factors such as internal temperature, plantar pressure distribution and impact and pronation angle amongst others. Measuring these parameters has enabled Brazilian shoe manufacturers to respond to the growing demands for improved footwear performance by developing better products.

Brazilian norms for shoe comfort are as follows:

- NBR 14834 : General norm
- NBR 14835 : Mass of the shoe
- NBR 14836 : Peak of pressure (plantar pressure distribution measurement)
- NBR 14837 : Internal temperature increase
- NBR 14838 : Weight carrying ability
- NBR 14839 : Pronation angle
- NBR 14840 : Fitting (individual perception)

Examples

As noted above, the most important function of the insole is to distribute plantar pressure in order to minimise the peak values. *Figure 2* shows the plantar pressure distribution of a male test subject walking at a speed of 5 km/h on a treadmill. Different colours represent different values of pressure. The red

areas represent pressures relative to a comfortable shoe as quantified by the Brazilian norm of pressure below 290 kPa.

Pronation is a complex movement that also includes eversion. This is sometimes referred to as being only the movement of eversion. The pronation angle is one of the parameters analysed by Brazilian norm 14839 and is calculated by a system involving a high speed camera and a software program to store and analyse the image data taken. While the current norms are not perfect, they have provided the Brazilian footwear industry with a powerful tool for the analysis of footwear. Research undertaken at IBTeC, in partnership with several universities, is continuing in order to make improvements and, most probably, to define further new norms. 



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