



## CONSIDERATIONS REGARDING THE DESIGN OF FOOTWEAR WHICH ASSURES THE HEALTH OF THE FOOT

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**Abstract:** *The high demands for cheap footwear can only be satisfied by mass fabrication. Costumed footwear would represent a regress, despite the advantages that it brings. This paper regards mainly the demands that mass footwear requires, in order to maintain the health of the foot. The desire to maintain the foot shape and functionality requires certain last forms and fabrication algorithms. We analyze certain aspects referring to: the correct design of the inner sole, insuring the flexibility of the lower part of the footwear by choosing the right type of materials and confection systems, choosing the right height of the heel, setting the adequate shape by increasing the number of different shoe sizes. In order to give a loose space to the adults' toes, where they are not pressed, but have a complete range of motion, the orthopedists and the last specialists have set several requirements for building the contour of the inner sole. The technique of building a bond between the footwear forepart and the inferior ensemble is dependent to the purpose and partially to the fashion demands of the shoe. The sole shape is influenced by the buyers, as seen by the development of the ex-flex footwear. There must be noted that in this case, the work of the model designer coincides with the exigencies of the specialist in footwear health. With the help of certain functional considerations and of several mechanical calculations, it can be proven that a heel with a height of 3 cm does not necessarily have a negative impact on the foot health. This is why even the orthopedics consider this limit as acceptable. Higher heels must be avoided if we want to maintain a normal function and development of the foot.*

**Key words:** *footwear, functionality, foot health, fabrication, orthopedic.*

### 1. INTRODUCTION

The increased demands for cheaper footwear can only be satisfied by mass production. This means that the obvious advantages of custom made footwear are definitely not compatible with low prices, and emphasizing this type of manufacture would be a regress.

Therefore we must first reveal the demands required for mass production footwear, which also takes into account the foot health. The desire to maintain the foot shape and functionality requires certain last forms and fabrication algorithms.

Our paper analyses several aspects regarding the way in which the so-called "healthy footwear" should be made.

We analyze certain aspects referring to: the correct design of the inner sole, insuring the flexibility of the lower part of the footwear by choosing the right type of materials and confection systems, choosing the right height of the heel, setting the adequate shape by increasing the number of different shoe sizes.



## **2. THE CONTOUR OF THE INNER SOLE**

The shape of the footwear, and more importantly its tip is determined by the contour of the inner sole. The last specialist often starts from a correct contour of the sole, which is modified depending on the shape that we want to give to the tip of the shoe. This aspect is conditioned by the supplementary add at the tip. It is sufficient to look at different types of tips that are used today (for example square shape, plateau, national or dutch) in order to recognize the influence that it has on the shape of the inner sole.

The main requirement that we claim when it comes to functionally correct footwear is this: the shoe must give the foot a fitting that does not bring any inconvenience to its radial shape. This happens when the radial shape of the footwear is not pushed towards the center by the margin of the shoe. Although loose footwear does not put so much pressure on the toes, it does not fill all the requirements for a fan setting. By pressuring the fingers at the tip, they are not only taken out of their normal position, but also, as comparative x-rays show, this also happens with the metatarsal bones.[1]

Moreover, as the toe musculature also contributes to the sole arch, weakening them can dangerously lead to a foot insufficiency and with it, to a skeletal deformation. Also, by pressing the toe, the blood circulation is affected, this limiting the blood flow to the toe tissues. As a consequence, the toes are pressed by lateral forces which increase as the foot is being pushed further from the sole. The result of wearing sharp tip shoes is the pressure on the big toe, that increases gradually. The deforming action increases as the individual is used to walk keeping his feet oriented towards the exterior.

The pathological consequences of placing the foot in a sharp tip shoe is already known. As the toes must handle high pressures, incompatible with normal function, in points that are inadequate to receiving such pressures, durions, callosities and wefts are formed. Besides that, the normal relationship in the basal joint is disrupted, by deforming the hallux (hallux valgus) and the metatarsal-phalangeal joint is being pushed outward. This causes osseous formations (exostoses).

In order to avoid this, it has often been tried to give the anterior side of the footwear a shape that is functionally adapted. All these tries have failed so far, mainly because the variable shape of the shoe tip is dictated by the fashion tendencies. Next to the heel height, the shoe tip is an important aspect that must adapt to the fashion demands. Only for children footwear the radial shape of the foot has yet been preserved. Comparing the radial footwear for children with the fashion driven footwear for adults, the negative influence of fashion becomes very obvious.

A normal, radial foot of a child will further develop in a radial shape if the toes will not be pushed in an abnormal position by the footwear. So, there is no justification to force the foot of an adult in a layer that blocks the normal development, only to adapt to accidental fashion prescriptions. Women's feet develop "hallux valgus" deformation, while men's feet will only be affected at the big toe. [2]

In order to give a loose space to the adults' toes, where they are not pressed, but have a complete range of motion, the orthopedists and the last specialists have set several requirements for building the contour of the inner sole.

## **3. THE INFERIOR ENSEMBLE OF FOOTWEAR**

The technique of building a bond between the footwear forepart and the inferior ensemble is dependent to the purpose and partially to the fashion demands of the shoe. The sole shape is influenced by the buyers, as seen by the development of the ex-flex footwear. There must be noted



that in this case, the work of the model designer coincides with the exigencies of the specialist in footwear health.[3]

The flexibility of the inner side of the footwear in the toe region is necessary so that the active and passive movement in the basal joints of the toes can be used completely. In flexible footwear the foot is able to push the sole strongly during walking. This allows the toe musculature to develop and become stronger and its capacity to connect to the skeleton increases.

Contrarily, in the lower side of the rigid footwear, the foot dangles in the toe region and the toes cannot function correctly. As known, an increased shaping of the tip compensates the lack of toe movement inside the footwear.

Although the sole flexibility must be looked at as another exigency for maintaining the range of motion of the foot, this necessity cannot always be met. The special footwear for mountain climbers, the protection footwear must have an especially resistant sole, protecting the foot from mechanical and thermal actions, as well as against damp. The wooden soles for street workers and the mountain climbers' boots have two or three sewed soles, which are not flexible. In order to maintain the toe muscle activity, the footwear that needs to protect the foot from special actions can be made with a rigid lower part. The street footwear must allow the toes to extend and slowly flex.

The frame-sewed shoe corresponds mostly to this demand, when the height of the inner sole is as low as possible. The manually frame sewed shoe is superior to the mass frame sewed shoe. For the footwear that imitates the CR system, a fixed frame is often applied in the lower side of the frame, which is fixed with metallic clams, which make the sole more rigid. An increased flexibility of the sole is characteristic by the CB system, where the faces are sewed without perforating the inner sole. [4]

The footwear with a glue sole is also quite flexible if we use an adhesive which keeps its elastic properties.

#### **4. THE HEEL HEIGHT**

The theoretical research show that the heel is actually a useless part of the shoe, a high heel being in fact quite harmful for the foot health. Pro-heel researches have two more frequent arguments: on one side, the heel would ease rolling the foot, which is necessary especially on rough surfaces as for instance the street pavement, and on the other side, they claim that a large number of women declare themselves uncomfortable walking with a small-heel footwear.[5]

However, from the physiological and functional point of view, the heel is in no way conditioned by the normal foot.

The heel increases the tension in the tendons and ligaments of the dorsal side of the foot, this causing unpleasant sensations, which are often compensated by flexing the knee while walking, causing a slightly elastic walk.

The other objection, claiming that some women simply cannot walk on low heels is justified. When the foot is placed in a shoe with a small heel, the tension in the calf and foot musculature is moved (shortening the Achilles' tendon, contracting the capsule and the ligaments), this causing unpleasant sensations, thus justifying the above mentioned complaint.

The data that we have gathered so far pleads without a doubt against using high heels. By tilting the entire sole, the forces push the foot to the front of the shoe, which overtakes the pressure. The toe area receives a supplementary pressure, which can be reduced by widening the tip of the shoe. Besides this aspect, the footwear specialist knows very well that a high heel shoe with a wide tip does not have a pleasant aspect when placed on the foot, this observation being typical for the escarp shoe last. We believe that the moment when it will be proven without a doubt that even a



pressure of 95 g/cm<sup>2</sup> causes a significant compression on the vascular system of the skin, the serious disadvantage of pressing the toes in a high-heel shoe will be recognized. This disadvantage causes a partial interruption/decrease of the blood flow to the toes. By such a decrease in the blood flow, the capacity of action can be decreased in the tissues, ignoring the inactivity hypertrophy of the long and short muscles of the toes, which is directly conditioned by the pressure that is exercised on the toes.

As a general conclusion, we must affirm that the normal foot does certainly not need a high-heel footwear, this being only conditioned by the fashion tendencies. With the help of certain functional considerations and of several mechanical calculations, it can be proven that a heel with a height of 3 cm does not necessarily have a negative impact on the foot health. This is why even the orthopedists consider this limit as acceptable. Higher heels must be avoided if we want to maintain a normal function and development of the foot.[6]

Given the fact that the usage of the heel is often mentioned when appreciating the position of the foot, we ought to also research these relations. If a normal foot moves correctly from the functional point of view, we can observe an uniform usage of the heel at it's posterior margin, symmetrically to the medial line if the repartition of the wood in the heel area and in the anterior part of the last is correct. This premises means that the heel will be used at its interior part when the foot is placed in a valgus position. However, if the heel area is not stable, then the heel can also be pressed outward, by pushing the heel in the valgus position; this is observed when the heel is mostly used at the exterior side.

Appreciating the foot position by the heel usage is a process that must take into consideration all possible situations in order to avoid incorrect conclusions. The practical results cannot be totally satisfactory, because on one side each person develops a different type of walking, and on the other side, the usage is relatively higher because even when the heel is completely intact, it lacks material that can be found in wide heels.

Finally, the usage of the heel material is directly dependent to the shoe model. An accurate footwear specialist knows that the same foot can determine different types of pressure on different heels with different shapes and therefore, he uses them in different manners.

## 5. CONCLUSIONS

The appearances analyzed in the writing refers, in particular, on footwear series. Within each chapter are presented aspects regarding the design of parts , the way which you need to chose the materials and the role for some patters have to ensure footwear fuctions.

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