



# The Foot Book

ADVICE AND FACTS ON FOOT PROTECTION AND SAFETY SHOES

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# The Foot Book

ADVICE AND FACTS ON FOOT PROTECTION AND SAFETY SHOES

'We tend to ignore our feet. They should be cared for just like we care for other parts of our body, such as our hands, for example.'

/Lars Eghamn, orthopaedic engineer



## An amazing design

The foot is really an amazing design. This relatively small body part must support, balance and simultaneously absorb any impacts. And it has to perform this task throughout our lives. A really tough job!

'Feet have to put up with everything that's thrown at them and also last a lifetime.'

/Lars Eghamn

The best thing for our feet would be if we went without shoes all our lives. It would also give the foot muscles daily physical exercise. But this theory doesn't work in practice because we have a climate and tasks that require footwear to protect, stabilise and warm our feet.



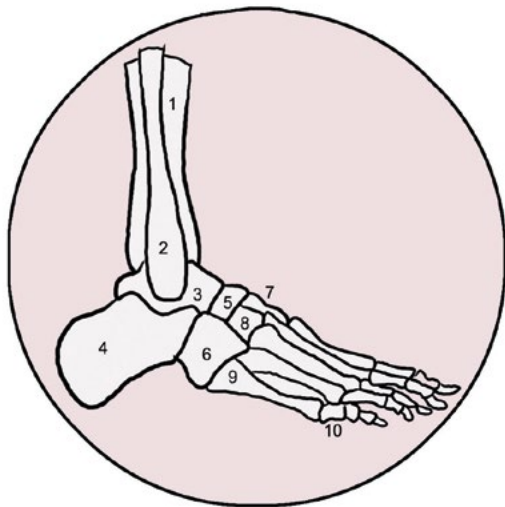
## A complex interplay

For the foot to work correctly, many bones, tendons and ligaments are required to interact. The foot comprises 26 bones, and in addition there are two bones in the tendon of the big toe (sesamoid bone). In the foot there are 57 named joints and 108 ligaments that hold these joints together. A series of tendons, partly connected to muscles in the foot and lower leg, are involved in producing the various movements of the foot. 1,700 nerves are in constant dialogue with the brain. The foot has 90,000 sweat glands, which help maintain body temperature and clean out waste products.

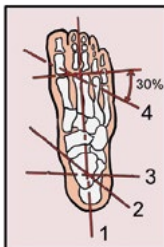
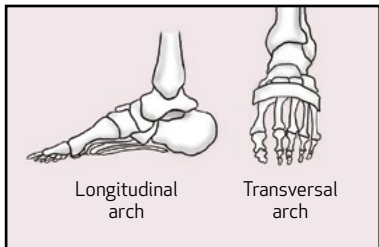
### THREE ARCHES

The bones of the foot create three arches

1. The inner arch extends from the heel bone and the scaphoid to the first three toe bones.
2. The outer arch extends from the heel bone to the outer toes.
3. A transverse arch created by the sphenoid, scaphoid and the metatarsal.



1. Shin bone (Tibia)
2. Calf bone (Fibula)
3. Talus bone
4. Heel bone (Calcaneus)
5. Scaphoid bone (Naviculare)
6. Cuboid bone (Cuboideum)
7. Sphenoid bone (Cuneiform)
8. Sphenoid bone II (Cuneiform)
9. Metatarsal bone
10. Toe bone (Phalanges)



1. Longitudinal axis
2. Oblique axis
3. Transverse axis
4. Toe axis

# Biomechanics – the motion of the foot

By biomechanics we mean the physical and mechanical laws describing body part movements and the forces that influence these movements. Extension and flexion (up and down movement of the foot) occur between the talus and the fork formed by the shin bone (tibia) and the calf bone (fibula). The joint is called the upper talus joint.

Pronation and supination occur between the talus, the scaphoid bone and the heel bone. This movement occurs simultaneously in several joint surfaces and is called the lower talus joint.

Pronation and supination occur through the longitudinal axis from the talus to the toe bone. When you put your heel down an outward folding (eversion) of the heel and an inward folding (inversion) of the heel occur.

The body has its own cushions; tendons, ligaments, the pads of fat on the foot, muscles and bone help to absorb impacts, but when large forces and impacts are felt on the feet and legs, it is easy to suffer injury. When we walk we have one foot alternately in contact with the ground and the other swinging in preparation for the next step, but when one foot is in the air it can still affect the other foot, which is in contact with the ground. The heel bone and talus are the bones that absorb the greatest weight on the foot. The skeletal part that bears the largest part of the body's weight is the talus.

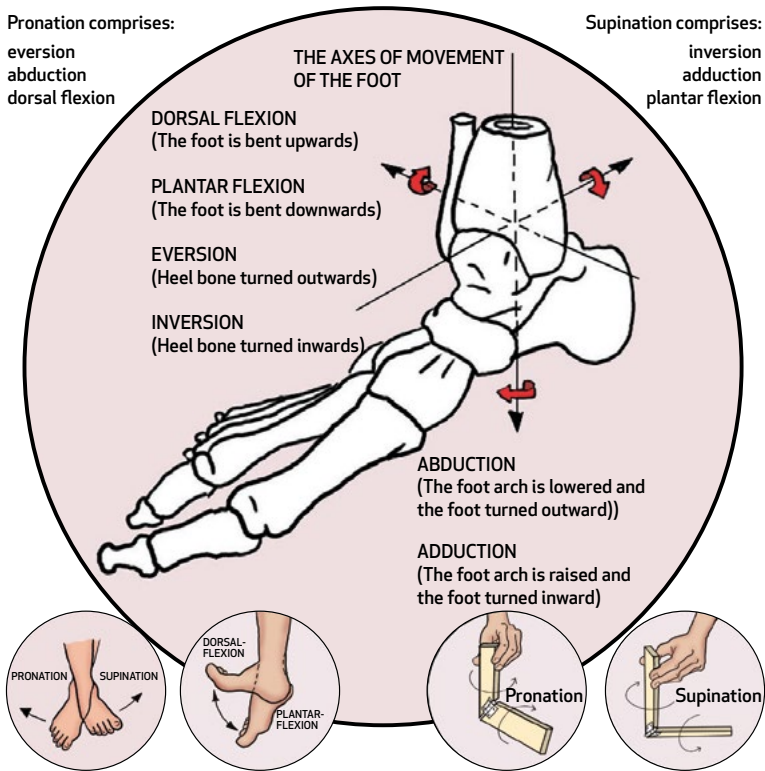


Pronation comprises:

eversion  
abduction  
dorsal flexion

Supination comprises:

inversion  
adduction  
plantar flexion



# The step

The foot moves in three planes. When we walk, the foot continuously adapts to different surfaces and together with the foot muscles acts as a shock absorber to reduce the forces that arise from the ground.

When we take a step, the load follows the support arch, and the foot is placed down starting with the outside of the heel. The suspension of the foot occurs in the inner arch and transversal arch, which is built up of the wedge-shaped form of the bones and their muscles.

The step occurs diagonally from the outside of the heel, moving through to the second toe (through the longitudinal axis). This is the ideal step, but many of us do not have the ideal step; instead we start by turning the heel bone outward (eversion). On loading the foot there is a movement in several joint surfaces and when the muscles and ligaments are unable to fulfil their function, the inner arch drops and pronation occurs (sole of the foot is turned outwards). Two muscles, the long and short fibula muscles, are crucial for the pronation movement, and you can feel the tendons from the muscles under the outer ankle joint. A little pronation is normal and may be viewed as shock absorption during the step.

In addition to this movement there are a few movements that load the foot's outer arch for most of the step and turn the sole of the foot inward. This is called supination, and three muscles come into play here; the long big toe extensor muscle, the long toe extensor muscle and the posterior tibia muscle ensure that you do not supinate. Their tendons pass behind and below the inner ankle.

NEUTRAL  
Left foot



PRONATION  
Left foot



SUPINATION  
Left foot



## THE GAIT CYCLE



STANCE PHASE



LOADING PHASE



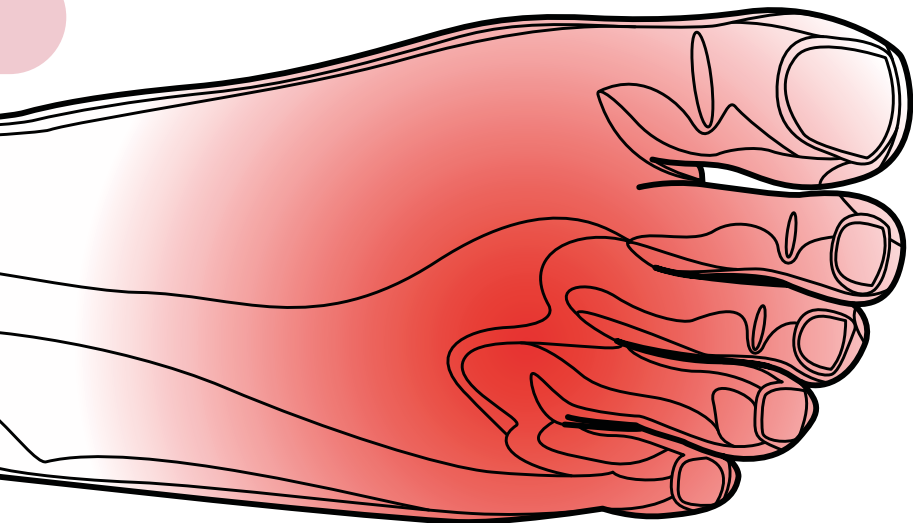
PUSH OFF PHASE



## Ouch, it hurts!

The foot has a tough job to do and there is a lot that can go wrong. Foot problems can be crippling and often very painful.

2



## HEEL SPURS – A COMMON PROBLEM

Under the heel there is a fat pad that acts as a cushion. Inside the heel there is a small fat pad enclosed by tissue to hold together the heel and give maximum cushioning during walking or running.

If the fat pad is compressed due to heavy loads the fatty tissue will slide laterally and the cushioning effect is reduced. This is what we refer to as heel spurs.

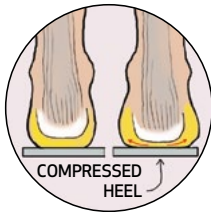
A heel spur can be detected on an x-ray and it looks like a bone projection. The projection often develops in conjunction with an inflammation of the plantar fascia. A clear sign of a compressed fat cushion on the heel is cracks on the back of the heel.

## TREAT HEEL SPURS

Check your shoe and make sure it offers stability to your heel. Relieve pressure on the heel with a cushioning insole. Examine the appearance of the foot; what does the arch look like? Is there excessive pronation? Rub the heel and the tender area. If the pain persists, consult an expert.



Examination of the painful area of the heel



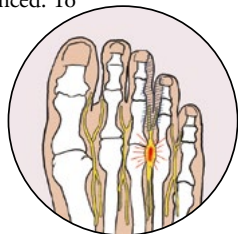
## NERVE ENTRAPMENT

The toes of the foot are not only involved in pushing off a step, but together with the ligaments also maintain the shape of the transversal arch at the start of the toe joints. When the muscles and ligaments are not holding up the arch, there is a lowering of the forefoot arch, resulting in the nerve between the third and fourth toe being squeezed between the toe bones.

This means that at each step persistent pain may be experienced. To raise the forefoot arch, the insole must be supplemented with a forefoot cushion (pad) which helps to raise the arch. There is often nerve entrapment in combination with excessive pronation.

Treatment:

Replace the insole with a cushioning insole with pad.  
Check the foot arch and movement (pronation). Consult an expert if the pain does not subside after three weeks.



Nerve entrapment between the third and fourth toe

## ANKLE SPRAIN

Ankle sprain is by far the most common injury suffered by athletes, but it is also very common to sprain your foot in the workplace. It is very easy to sprain one's ankle when working on uneven or slippery surfaces.

## TEARING OF LIGAMENTS

70 per cent of ligament damage in the foot is due to tearing the ligament that runs between the fibula and the talus.



Examination of the painful area

Symptoms: Pain and swelling in and around the ankle, usually on the outside with discolouration.

Treatment:

Acute: Apply pressure and cool together with elevation. Further treatment with gradual increase in motion, strength, balance and coordination training. A balance board is a good tool for rehabilitation. Taping and ankle support can be used on return to activity and work. Check the stability of the shoe.

### **ACHILLES TENDON**

Soreness and swelling indicate an inflamed Achilles tendon. Inflammation of the Achilles tendon can occur when working out in chilly weather, training on hard surfaces, wearing a different trainer or running uphill.

If thickening of the Achilles tendon occurs there is a risk of chronic Achilles tendonitis, which may require surgery later. If the Achilles tendon is already showing signs of thickening, you should contact a doctor or physiotherapist.

Athletes who have high arches have a greater risk of Achilles tendonitis, and also those who do not stretch the Achilles tendon before and after training.

Treatment:

Refrain from activity if the pain becomes more intense. Inflammation should be managed by massaging or other rehabilitation measures. Try to choose another activity for a while, such as swimming or cycling. Stretching the calf muscle and Achilles tendon is always recommended.







# Strain injuries

By strain injury one means that the foot has been used improperly for a long time, i.e., you have a so-called incorrect biomechanical posture. Hard surfaces and repetitive working movements are often the cause of the injuries although there has been a considerable improvement in recent years. This is due to improved footwear and the fact that businesses and occupational health policies are better at preventing injury by ensuring that employees have the right footwear.

'Foot, knee and back injuries account for the majority of sick days. In other words, the right safety shoes make a great difference.' /Lars Egham

Treatment:

For strain injuries one resorts to orthopaedic techniques using individually customized cushions that relieve sore areas and correct faulty foot posture.

## FOOT ARCH

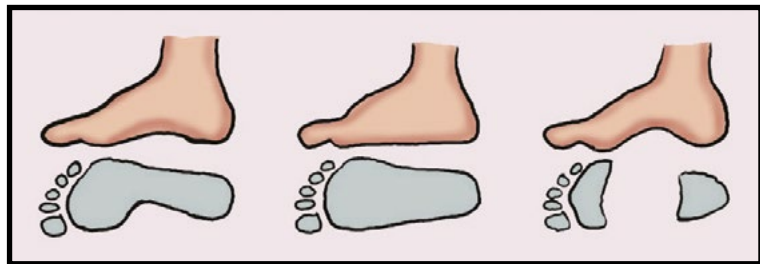
The shape of the foot is usually inherited from one parent or the other. In particular, the foot width is very important when choosing a shoe.

Therefore, one cannot say that one shoe is better than the other; what is crucial is the fitting that suits your foot. A simple test is to wet your foot and then step onto a piece of paper towel. You will then get an idea of what the foot arch looks like. Usually you can feel that a shoe fits your foot comfortably, and you know that you have found the right fit.

Studies carried out on foot width show that most feet are normal to broad and not so many extra narrow or extra wide fit shoes are therefore produced.

Foot shape and width can be checked in a foot scanner, and the information obtained tells us which shoe width is appropriate. In addition, you can see if it needs a different insole to the standard insole that comes with the shoe.

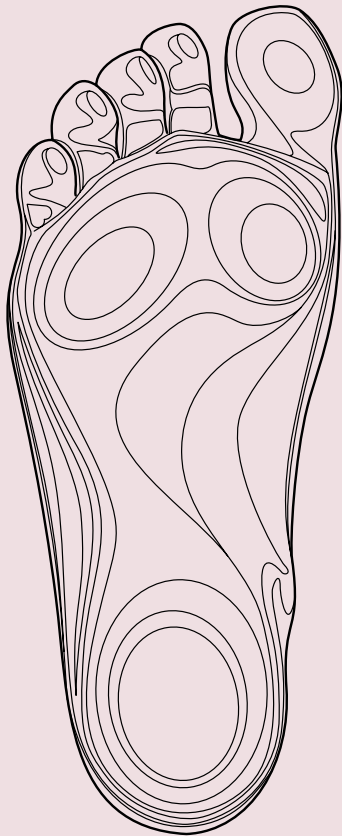
## FOOT ARCH



NORMAL

LOW

HIGH



# Look at your feet

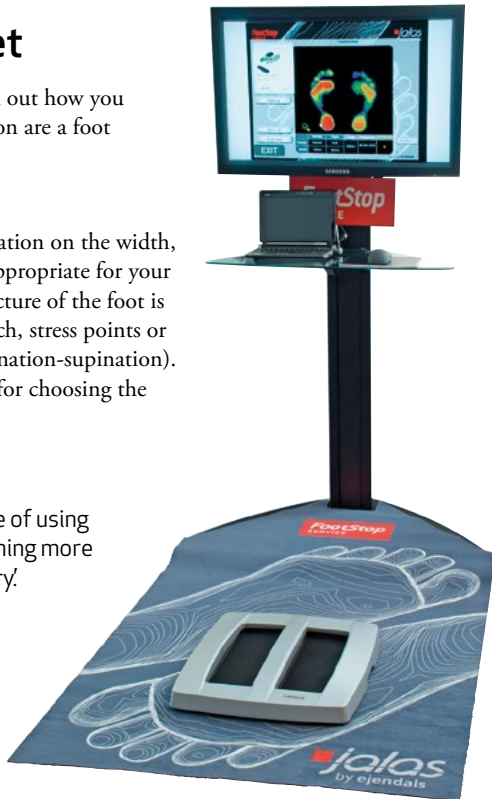
There are different ways to find out how you use your feet. The most common are a foot scanner or a mirror box.

## FOOT SCANNER

Foot scanning provides information on the width, size and model that are most appropriate for your foot. Using foot scanning, a picture of the foot is obtained with respect to the arch, stress points or excessive angle of the foot (pronation-supination). This information is important for choosing the right insole.

'Awareness of the importance of using protective footwear is becoming more and more prevalent in industry.'

/Lars Eghamn





### **MIRROR BOX**

A mirror box is a simple tool which enables the foot to be seen from underneath. It often consists of a glass plate with a mirror and lighting. A professional can assess what type of sole you need.

# Insoles – absorb shocks and correct

In order to correct the arch of the foot there are different insoles that help the foot, including ergonomic insoles and corrective cushions.

## **ERGONOMIC INSOLE**

The foot arch varies from individual to individual. An insole takes pressure off the foot and corrects any deformities quickly and flexibly.

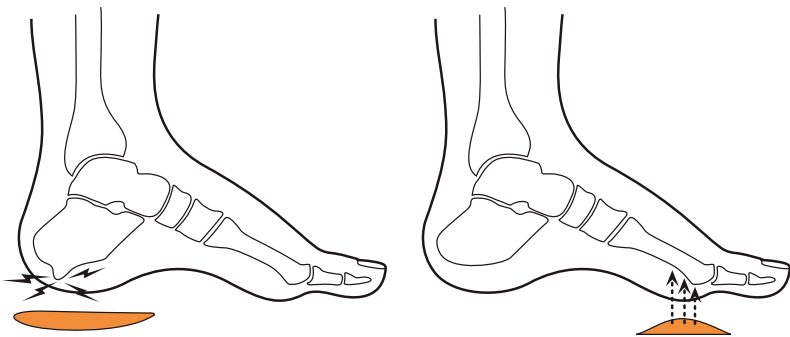


## CORRECTIVE INSOLES

Corrective insoles act as cushions that absorb shock and provide extra support for the foot.

**Heel spur sole:** Anatomical foot cushion with shock-absorbing material for pain under the heel (heel spurs). The foot cushion features an arch support and thick material on the inside of the heel and forefoot section to prevent pronation, which is often the cause of strain injury.

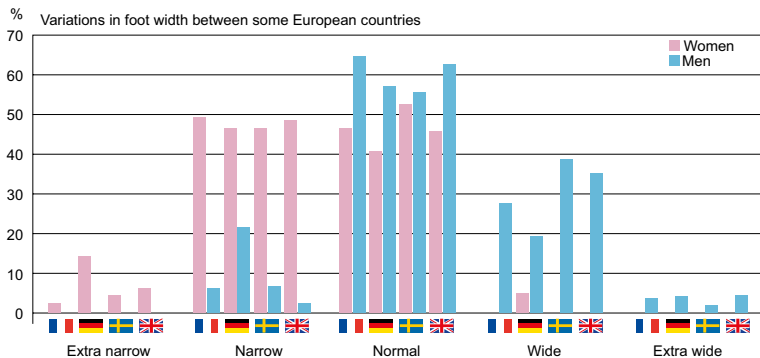
**Forefoot sole:** When the forefoot arch drops, the nerves in the foot become trapped. The sole is fitted with a front cushion (pad), which raises the arch.



# Designing protective footwear

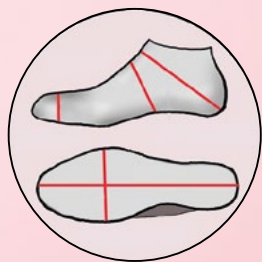
When manufacturing protective footwear there is a lot to consider. Two aspects are more important than others; how wide a fitting should be and the uses a shoe is put to, as well as the safety standards they must conform to.

When manufacturing protective footwear you use materials that offer for instance nail puncture protection or extreme heat resistance. This often means the shoes are slightly heavier.





Measurements in the  
manufacture of shoes



## Choosing a shoe

It is not always easy to choose the right shoe. Many companies would have much to gain if they spent time and effort to ensure that employees had the right footwear. Problems with feet, knees and backs cost a lot of money every year. It also causes unnecessary suffering for those affected.



## YOUR KEY TO CHOOSING THE RIGHT SHOE

### CORRECT FITTING TESTED ON FOOT SCANNER

Yes                       No                       Other method \_\_\_\_\_

Normal fitting       Wide fitting       Narrow fitting

Pronated               Supinated               Don't know

Shoe model: \_\_\_\_\_ Size: \_\_\_\_\_

Shoe model: \_\_\_\_\_ ESD: \_\_\_\_\_

Sandal                       Laced                       Velcro

Mid-high boot       High boot

Uses insole:               Green                       Orange                       Blue

Standard               Shock-absorbing       Correcting

Corrected with forefoot cushion       Orthopaedic

Number of steps taken per minute: \_\_\_\_\_

Work on slippery surfaces       No                       Hot surface

Date when I changed shoes: \_\_\_\_\_ Insole: \_\_\_\_\_

When you have made your own assessment, save the information to show to stores personnel, safety inspection officers or occupational health services.

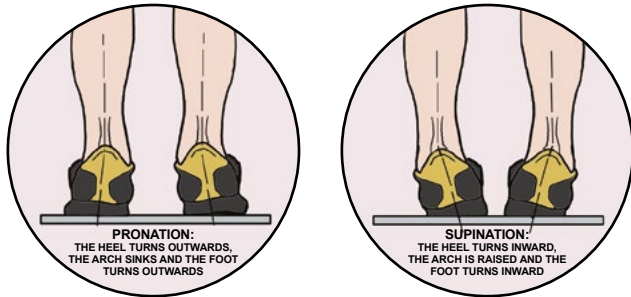
# Stability of a shoe

A shoe must be stable. It is especially important with regard to pronation. If the heel cap is stable and the shoe bends where your foot bends, this makes it much harder to pronate. If you pronate or if the arch is high, you can compensate this using an insole.

You can easily check the shoe's stability for yourself, see illustration.

## SAFETY FOOTWEAR

A protective shoe should not only be well suited to its task but also provide good protection against injuries. High levels of comfort, low weight, good anatomical features and ventilation are factors of at least equal importance.





Bending takes place at the right place, where the toes bend.

The design provides a stiff shoe to prevent excessive lateral movement.



The bending of the shoe is in the wrong place. The shoe has no lateral stability.



When you push your fingers against the heel cap it should be firm. This will stabilise the heel.



No stability in the heel cap.

# Take care of your shoes

Protective shoes are subjected to great stress and require careful maintenance in order to last longer. Below follows some basic advice for caring for and extending the lifetime of your protective shoes.

## **CLEANING**

Clean your shoes with a damp cloth or alternatively brush away clay, sand, dust and other dirt with a soft shoe brush after every time you wear them.

## **DRYING**

If your shoes get wet, always dry them at room temperature – never in an airing cupboard, on a radiator, or in excessive heat.

## **WATER PROOFING**

Waterproof shoes (including seams and tongue). Shoes and boots made of full-grain and oiled leather can easily be moisturized with mink oil.

## **IF THE SHOES BECOME LOOSE**

After using the shoe for a while the shoe may become loose at the heel. It may be that you have a narrow heel, but usually it's because you do not tighten the laces or Velcro closures securely.

By tying the top strap through the loop you can easily ensure the foot is secure at the back of the shoe. It may be that the arch is high or low and you may need to supplement it with an insole.

'Developments in this field are very fast. Just one year ago a safety shoe was 100 grams heavier. New materials and better production now characterise the shoes from leading manufacturers.'  
/Lars Eghamn


SINCE 1916



Tips for holding back  
the heel in the shoe





A close-up photograph of a black safety shoe. The shoe features a textured, grid-like upper and white stitching along the seams. A prominent red patch with the 'asics' logo in white is visible in the upper right corner. The background is dark and out of focus.

'It is important for most people that the safety shoes look good. They should be comfortable and protect against injury, but it is more important than you might think that the design is correct.' /Lars Eghamn



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