

HANDOUTS

Chapter 2

CHAPTER- TWO
INSOLES, SHANK BOARD, LEATHER, LEATHER BOARD, SOLE AND THEIR
PROPERTIES

1.2 CHARACTERISTICS OF INSOLE MATERIALS:

When a shoe is used, the foot rests on the stage of insole and brings to bear all type of mechanical stresses. It therefore, provides protection to the foot along with the outer sole and also takes up moisture in the form of perspiration from the foot. Insoles may be half or full depending upon the construction and design of the shoe.

The properties for an ideal insole material are:

- a) To absorb moisture readily and dry out quickly.
- b) Durable enough to stand up to friction in wear.
- c) Flexibility, and does not harden and crack in wear.
- d) Dimensionally stable (does not alter in shape in manufacture or wear).
- e) Uniformity in thickness and quality.
- f) Lightness in weight
- g) Ability to hold tacks, adhesive, or stitches.



In footwear industry the following boards are used for insole making.

- Insole board/cellulose board
- Shank board/becker board

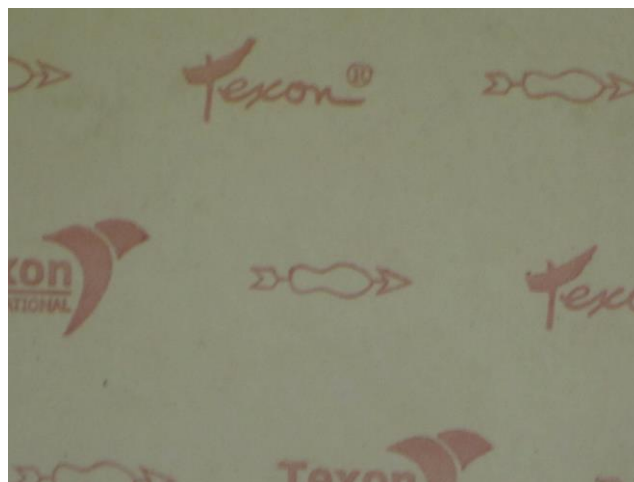
- Leather board
- Leather
- Steel shank

2.1. Insole board/Cellulose board: - Cellulose board for insole is made from wood pulp, resin and bonded with latex. As with leather boards it is supplied in sheet in various thicknesses, and in different grade. This material has better dimensional stability than leather boards.(i.e. does not shrink or grow). It is a flexible board. Common trade names are Texon, Bontex.

Typically women's insole use cellulose board of thickness 1.25 – 1.75 mm and men's insoles boards of thickness 1.5 – 2.25 mm. from a standard sized sheet of dimensions 150 x 100 cm about 33 pairs of men's insole can be obtained which translates to a usages norm of 450 square centimeter per pair of insoles. Similarly for women's insoles about 38 pairs can be produced from a sheet of 150 x 100 centimeter which is equivalent to suage norm of 395 square centimeter per pair of insole.

The characteristics of this material are:

- a) Its ability to absorb moisture
- b) Uniformity of substances
- c) Resistance to shrinkage or growth (in change of humidity and heat)
- d) Resistance to hardening or cracking due to moisture or perspiration.



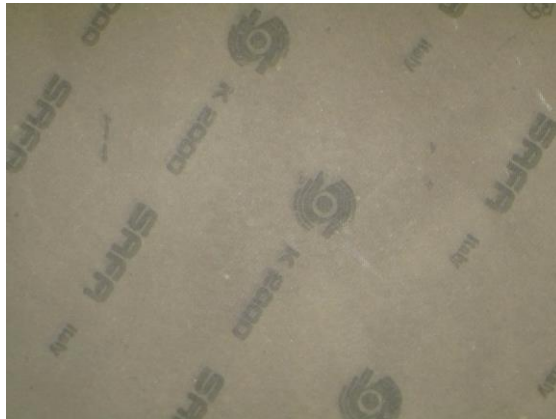
2.2. Shank board/Becker board: - This is a very hard and strong fiber board, able to withstand the tremendous loads which occur in the waist and heel of the shoe. It is again

produced in much the same as way as paper. However the main raw material is mixture of waste and recycled paper which, together with the vegetal bonding resins used in its manufacture, make shank board a very environmental friendly product. The molding quality of this type of board is less than cellulose board.

The standard sheet size of shank boards are 100 x 100 centimeter and the thickness is 2 – 3 mm.

The following raw materials are used for the manufacture of backer board;

- a) Paper pulp
- b) Dye
- c) Hard resin binder
- d) Aluminium sulphate
- e) Preservative



2.3. Leather: - leather is not much used because of high cost and the lack of uniformity in thickness. Leather insole were usually cut from bellies (sometimes shoulders), and are now used only in very high quality footwear e.g. men's welted.



Grain side



Flash side

2.4. Leather board: - A flexible manufactured board made up with at least 75% leather fibers, which gives it the ability to absorb perspiration. It is made in sheets in various thicknesses (mm), and in different grade to suit particular shoe making requirements e.g. tack holding, cement bonding, high pressure/heat for injection molding. Common trade names are Ferrersflex, Articor. Many grades of leather board are available and this material extensively used in the footwear trade as a insole material as well as toe puff and stiffener.

Leather board is manmade material widely used by shoe industry. It is a compound of fibrous substance, vegetable matter and leather scrape bound together with latex rubber. Resin and alum are used in it while mixing. It helps to make the board more waterproof. The alum takes part to thicken with the latex.

General characteristics of a leather board:

- a. Width, length, thickness can be made to order, as opposed to the varying thickness and sizes of leather pieces.
- b. It has most of the quality and properties of leather.
- c. Cheaper than leather.
- d. For superior flexibility and durability as compared with card board or any other types of boards.
- e. It retains the leather look, which other types of boards do not have.
- f. Economic in manufacturing, the ingredients being are waste materials and by-products of trimmings and shavings from chrome tanned leather.

2.5. Shank: - A shank is one of the most vital components in a shoe. In providing essential support for the arch of the shoe, it has to withstand heavy bending and stresses whilst maintaining alignment of forepart and heel throughout all the stresses of shoe's life.

The Shank is a metal strip that from part of the insole. It maintains the longitudinal arch of the foot. Generally shank is made of high grade carbon steel which is properly tempered in order to impart the required material properties. In ladies high heeled shoes, the shank is shaped in such a way that it extends into the heel. Dimensions of typical shank are 10 mm width x 1 mm thickness and length of 85, 95, and 105 mm as per size of footwear.

There are various material used for making shank.

Metal: are manufactured from steel. Two thickness of steel are commonly used 1.2 m.m. and 1.42m.m, the first being the more common. These are available in two widths: 9.5 m.m. and 12.7 m.m. although other widths and thickness are used.

Shank length (m.m.)	Minimum Total Shank Depths (mm) for:	
	9.5 mm wide shanks	12.7 mm wide shank
Less than 50	2.18	1.22
50-74	2.82	2.18
75-99	3.40	2.82
100 and over	Not recommended	3.45



Wood: wooden shanks are not as strong as steel shank. But they are light in weight. Bamboo shanks are also used for a low heel shoes. In welted footwear a special board wooden shank is used which ultimately covers the space between welt ribs, doing an important job both a filler and a shank. Wooden shanks are skived to give a tapered edge at each end and along the side.

Plastic: the plastic shanks are the edition among the shank materials. It is generally used for the PVC unit soles. The shanks are made from polystyrene or polypropylene injection moldings. It is hard plastic but less inflexible than wood or steel shank.

2.6. sole

2.6.1. Characteristics of Sole Materials:

Soling material if we go back at 60 years in the shoe industry we will find that only vegetable tanned leather were used as a soling material. But during last 50-60 years there has been a significant change in soling material used in the footwear trade. The first major changes took place during 1940-50 when rubber was introduced as a soling material to replace leather mainly from cheap grade shoes but its durability attracts industry. The most significant development took place during 1960-62 were the introduction of shoe bottom molded directly using PVC or plastisol and subsequently introduction of PVC injection on process. This D.I.P. (direct injection process) made the shoe production faster and comparatively trouble free. The polyurethane soling material was introduced in the footwear trade in early 1970. Due to its light weight and higher durability it captured the massive market of platform unit sloes used for fashionable ladies

shoes and sandals. Almost at the same time with P.U. soling/Thermo Plastic Rubber (T.P.R.) was also introduced in the market. This material provides a combination effect of both rubber and plastic. The soling material may be broadly classified in to two groups.

- Natural soling material
- Synthetic soling material

Sole the main function of the outsole is to provide grip as well as to reduce wear on the midsole thereby increasing the overall durability of the shoe. Early outsole units were made of leather or rubber and were modified according to the athlete's need. For example, early running shoes used for track events could best be described as leather shoes with nails driven through them. Today, the outsole for track shoes have plastic plates molded into them that allow a runner to change the spikes used depended on the day's event.

Early basketball shoes used a rubber compound that provide some cushioning but tended to wear out pretty easily. Little thought was given to traction relative to specific movements in basketball, like running vs turning, as well as to the type of surface the game was being played on. Today, basketball shoes reflect the need to address the differences between surface types, indoor wooden courts vs. outdoor concrete courts, as well as the understanding that frictional needs differ, depending on movement, in different areas of the outsole.

The ideal qualities for a soling material are:

- a) Durability
- b) Flexibility
- c) Waterproof
- d) Lightness in weight
- e) Non Slip
- f) Uniformity

Natural soling material

- **Vegetable tanned leather:** is accepted in the trade as the most suitable soling material for high quality footwear, because it has all the essential qualities of good soling material except durability. The reason that is has now been superseded is due to the fact that it is too expensive for most types of shoe.

Most soles today are pre finished and because leather is not a uniform material in texture or substance, it does not lend itself to pre finishing.

Leather used soling is buff leather and various thicknesses from 4mm – 7mm. it is available as in Kg. weight unit.

Leather sole has the following advantages-

- It is one of the most 'hygienic' soling materials with ease of perspiration as the upper leather.
- It gives product the unique/antique class & appearance as desired in high class footwear.
- Good sole bonding with upper cement due to fibrous structure present.

The main disadvantages of its usages are-

- It is very expensive sole and the cost further increases due to restriction of various regions.
- It is inflexible and sufficient heavy.
- Its processing is quite time taking, skilled and expensive.
- It is less durable especially in wet conditions.
- Cannot blend with modifiers as in polymeric soles to give a variety of properties.
- **Synthetic soling material**

Resin Rubbers: In recent years, shoe sole of a type has now come to be Resin-rubber have become very popular, especially for ladies and children footwear because of its hard wearing properties. This product was first of all launched in market under the name of 'Neolite'. It is similar to sole leather in general appearance.

It has the following characteristics-

- Hard wearing
- Waterproof
- Easily processed
- Readily stuck, sewn or nail –in

Note: The main defect of resin rubber is tendency to extend in wear, giving a cold feel in wear.



Microcellular Rubber (MCR): It is very widely used as a soling material in the shoe industry because it is very light in weight. It has a very good abrasion resistance and can be made in any colour as per the choice of the customer. The micro rubber has pores which are extremely small.

Advantages are:-

1. Lighter in weight, provides more comfort.
2. Better shock absorption than solid rubber.
3. High flex crack and slip resistance.
4. Abrasion resistance is better than vegetable tanned leather sole but not as good as most solid rubber compound.
5. Good ground insulating qualities.

Disadvantages:

1. Micro cellular rubber has a tendency to shrink about nearly 10% of the original expansion after it removes from the press.
2. Wear resistance is not very good.



Mesonite Heels: Mesonite is a type of hardboard made of steam-cooked and pressure-molded wood fibers. Forming the fibers into boards on a screen, the boards are then pressed and heated to form the finished product with a smooth burnished finish. The long fibers give Mesonite a high bending strength, tensile strength, density and stability.



Plastic Heel:

Although the function of the heel in footwear design is difficult to justify, heels have been an important part in footwear since the 16th century. The last three decades, in particular, have seen major development in design, materials, and method of manufacture. Heel have adorned shoes in variety of shapes and size, from short and thick to tall and slim, from wedge – shaped to square – shaped.

More recently new materials have been introduced, providing fresh design scope and new methods of shoe making, wood, the traditional heel and associated shoemaking problems. We shall examine type of heel, their manufacture, and the evaluation of heels and their attachment.

Many different heel types are used in modern footwear. The most common types for women's shoes in injection – molded plastic, although turned wood heels and built heels are still used. Built heels, however are used mainly on men's shoes.

This is molded heel and any type of plastic material, which is capable of being molded to shape, may be used for this purpose. But considering the various requirements of heels “high Impact Polystyrene” (HIPS) is the most suitable material for this purpose to make a heel.

Injection – molded heels:

The two main styles of heel made by the injection – molded process are the cavity – molded ‘chunky’ heels for both men and women and stiletto heels.

Chunky heels: The most common materials used for this type of heel are polystyrene, ABS (Acrylo nitrile-butadiene-styrene), polypropylene and expanded plastic.

The use of ABS in chunky heels has been limited to heels intended for electroplating. it is harder than most grades of polystyrene and so heel – attaching pin require greater pressure for insertion. Consequently, its pin-holding strength is greater. ABS is available in self-colored form and lacquering is necessary.

Polypropylene has been used only on a limited scale for chunky heels because it is more difficult to mould than polystyrene and is slightly more expensive. It has excellent impact and fatigue resistance and does not become brittle.

Although expanded plastic would appear to be a good choice for covered chunky heels particularly where lightness of weight is required because of its inadequate pin holding strength, it is not recommended unless a solid insert is used in the seat to take the attachment grindery.

Plastic chunky heels are produced by conventional injection molding techniques. All heels are molded in a multi-cavity mould. The mould used is called a hot runner mould. Heels are injected close to centre of the seat surface. After release from the mould, the heels are immersed in water for cooling.



Stiletto heels: For stiletto heels, the most widely used plastic is polystyrene, but other materials used include ABS (Acrylo nitrile-butadiene-styrene), polypropylene, polyacrylate, nylon and expanded polystyrene.

When stiletto heels were fashionable in the 1950's they were usually made from polystyrene, which was relatively cheap and freely available other plastics were tried, but most were eventually dropped in favor of polystyrene, which was stronger, easier to mould and lacquer, and less expensive. With the return of the stiletto heel in the late 1970's the best grades of high-impact, toughened polystyrene were still being recommended.

Most of the strength of a stiletto heels is in its steel reinforcement. Nevertheless, a plastic compound with adequate impact and fatigue resistance must be used to prevent stem breakage. Breakage in wear occurs in two ways- either by a sudden sharp impact or wrench, such as in stepping off a bus or getting caught in a grating, or else by fatigue built up by the repeated small impacts of normal walking. To combat both type of failure, the plastic must have good fatigue resistance and brittle grades must be avoided.

Like chunky heels, plastic stiletto heels are produced by conventional injection-molding techniques. Hot runner molding was adopted during the 1960's when stiletto heels were in fashion. It superseded gate molding, which involved injection the heel from the centre of the breast edge. One reason for changing the position of the injection point was to change the direction of flow of the stream of plastic to eliminate flow lines that formed down the stems near the tip. This was not important when heels were covered, but it was unsightly on lacquered heels.

Steel rod reinforcing inserted are either molded in or inserted after molding. When they are molding in, they have to be located on a spigot at the trip end of the mould cavity.

This delays the moulding cycle, and for this reason some manufacture prefers to reinforce after moulding by inserting the steel inserts into drilled stems.

Many different types of reinforcing insert have been used, but steel is the most satisfactory and allows for extreme heel shape. Medium –hard steel is suitable for the most heels, and if failure occurs in wear, the inserts usually bend rather than break, minimizing injury to the wearer. Some grades of hard steel that have not been correctly heat treated will break readily, usually when the plastic breaks.

Three types of steel insert are suitable for stiletto heels – solid rods (drilled at the tip), tension pins, and solid rod inserts with top-pieces attached.



1.2 Characteristics of toe puff and counter stiffeners

Even with the current demand of less structure footwear, particularly in the search for foot comfort, the toe- puff & stiffener are still one of the most important ingredients in the production of footwear. Whether it is the high fashion, welted, or even sports shoes most of it requires reinforcement at the front and back side of the shoe. We have a wide variety of both the materials and also the several application techniques to suit both the application as well as artistic look of the footwear.

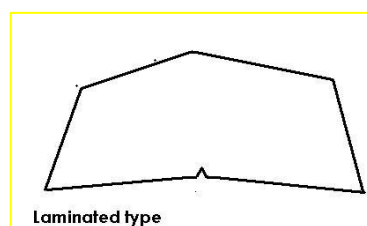
From the wearer's point of view both perform a similar function in maintaining the shape of the footwear and both must have a good wear performance which necessitates the ability to retain their shape & strength when repeatedly collapsed or exposed to moisture.

Additionally, a toe-puff should be able to flex with the foot in wear without causing discomfort or creasing.

The required hardness of the toe-puff and stiffener depends on the type of footwear. In lightweight casual shoes, soft materials are sufficient. Also the properties and shape of toe-puffs & stiffeners are influenced by fashion trends.

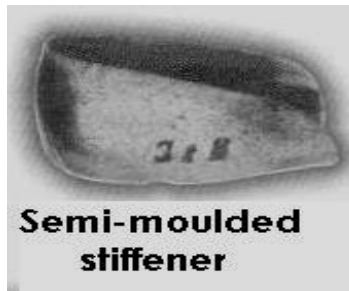
a. Flat Stiffener

This could be both solvent activated and Heat Activated and Cut from the sheets as per pattern to insert at the time of lasting.



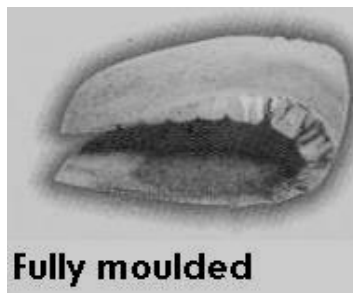
b. Semi Molded Stiffener

Stiffener is added in closing section itself, Stiffener is finger molded before insertion. This type of stiffener is thermoplastic and needs to be softened by heat at some stage of lasting process.



c. Fully Molded Stiffener

High quality shoemakers who wish to use high-grade leather board stiffeners often use this type of stiffener. The stiffener manufacturer molds it to the shape of the back of the last and the flange is molded in.



Solvent Activated

These toe puff are impregnated with either nitrocellulose or polystyrene resin. Polystyrene has recently become popular as the impregnating resin in solvent activated puffs. Production of the polystyrene sheet material is similar to that for the nitrocellulose type. The solvent blend to activate the puff should contain toluene, which dissolves more readily than the resin.

With all solvent activated materials, thorough activation is essential so that the materials easily conforms the shape of the back & fore part of the last. It is also essential that some portion of solvent is still present while lasting. However too much solvent's presence leaves the stain marks in the lining as well as upper.

The toe-puff must immediately be applied to the upper. The bonding takes place only when the toe-puff has sufficient amount of solvent in it.



Thermoplastic Materials:

Adhesive coating on heat – activated puff (for heated press application) are based on P.V.A (poly vinyl acetate), E.V.A.(ethylene vinyl acetate),polyacrylate, polyurethane. Resin and plasticizer are added to impart the required adhesive properties. More recently, hot melt adhesive have been used. The adhesive is heated to 120-140 C and is applied as single coating.



The following recommended uses of various types and thickness of puff are given as guidelines rather than as hard and fast rules.

	Solvent activated fabric-based puffs		Thermoplastic
	Cellulose – Nitrate impregnated	Polystyrene impregnated	Polystyrene impregnated
Women’s shoes	0.7-0.9 mm	0.5-0.8 mm	0.4-0.7 mm
Women’s heavy shoes and boots and children’s and men’s light shoes.	0.9-1.2 mm	0.8-1.0 mm	0.7-1.0 mm
Men’s and Boy’s shoes	1.2-1.6 mm	1.0-1.2 mm	1.0-1.2 mm
Men’s heavy shoes industrial boots and sports shoes	1.6-2.0 mm	1.2-1.6 mm	1.2-1.5 mm

Steel Toe- Cap: These toe caps we use in safety shoe Steel protective toe caps are extremely hard and difficult to damage. They are heavier than aluminum or plastic toe caps, and bend under pressure, anti-rusty.



Plastic Toe- Cap

At the same strength, thermoplastic plastic shoe toe is 50% and 20% lighter than using steel and thermosetting plastic respectively. No rusting, excellent corrosion, chemical and climate resistance



Generic Trade Name of Material

A. Common trade names are Texon, Bontex, Novatex. (insole board)

Common trade names are Ferrersflex, Articor (leather board)

This product was first of all launched in market under the name of 'Neolite'. (Resin rubber sole)

B. Common trade names are Gypsum board (shank board)

End of chapter two

Quiz (10%)

1. List types insole materials?
2. Write the ideal properties of insole materials?
3. What is the size of insole material in centimeter?
4. Write the ideal properties of soling material?
5. List types of soling material?
6. List and explain types of stiffener material (toe-puff and counter stiffener materials)?