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# INTRODUCTORY GUIDE TO FLOORS AND FLOORING

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ook verkrygbaar in Afrikaans

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## **INTRODUCTION**

When man first began to build shelters for himself about 8 000 years ago he concentrated on providing effective walls and roofs. The floor got scant attention because it was already provided by the earth. However, without his knowing it, the natural floor within his shelter contributed to man's comfort. The inside of the dwelling was cool in summer. This was not only, as he believed, because the roof and walls provided shade. The earth floor of the dwelling absorbed some of the heat from the air inside the hut thus helping to keep the interior cool.

Conversely, in winter the ground gave up some of the heat it had stored thus adding to the warmth provided by a fire.

The floor's contribution to the comfort of the home was unnoticed by early man and is often not appreciated by his modern descendants. Nearly 5 000 years passed until the first stone floors of water-worn pebbles were laid some 3 500 years ago. As houses became more sophisticated over the centuries, being built first of stone and later of brick, so floors improved in quality. Ceramic tiles replaced flat pebbles and the Romans perfected the art of laying mosaics.

The first soft floor coverings were probably reeds, rush mats and skins. Such coverings did not last long and were gradually replaced by wooden mats. But these, too, rotted and were in turn replaced by board floors, raised above the ground to keep them dry and in good condition.

So, for many years, the contribution that the ground could make to comfort in the home was ignored until scientists came to understand the effects of different kinds of floor structure and floor finish on the internal environment.

Suspended wooden floors are still to be found in many older houses. Their main drawback is that they do not make use of the warming and cooling effects of direct contact with the ground. Indeed the precautions that are necessary to protect such floors against damp and decay may actually reduce the comfort levels within a house. This is because there is a space between the underside of a suspended floor and the ground beneath it. Unless this space is well

ventilated it becomes a warm, moist breeding ground for wood boring insects and fungi which in time will rot the timber and weaken the floor, even to the point of collapse.

The normal way of ventilating the space is to install air bricks in the outside walls below floor level and leave openings in any intermediate support walls, thus creating a flow of air under the floor. Whilst this effectively prevents decay it introduces cold air into the space. In winter particularly this cold air can escape upwards between the floor boards into the house. The effect, of course, is to create draughts and lower the temperature in the house with resultant discomfort and extra heating costs.

Today, in South Africa, most modern homes are of single storey construction with a concrete floor slab in direct contact with the ground which once again makes its full contribution to the comfort and structural stability of the house, provided that the floor itself is properly laid and effectively protected against damp. This is the kind of floor discussed in this guide. Concrete has been used in building since 200 BC. Then its ingredients included lava in the form of volcanic ash called pozzolana from the place of its origin, Pozzuoli near Naples. Pozzolana is still used for some concretes. Modern concrete, as used in the floor slabs we are discussing, is a mixture of Portland cement, sand, coarse stone aggregate and water. When properly mixed, laid and dampproofed it makes a better floor than a suspended floor. However, whilst direct contact between the slab and the earth can bring advantages it can also recreate the problems, such as rising damp, that caused early man to spread skins and rush mats on his floors.

## **WHAT GOES TO MAKE A GOOD FLOOR**

To understand what makes a good floor it is essential to know precisely which features are valuable and which are undesirable. First and foremost a floor must be firm and capable of supporting the heaviest loads that may be put on it.

Second, it must be smooth and level so that furniture stands four-square wherever it is put.

Third, it must withstand attack by the kind of elements with which it is likely to come into contact.

Fourth, and not quite so obvious, it must protect the kind of finishes likely to be applied to it or with which it is likely to be adorned.

Lastly, it must help to improve the environment within the house.

In the following pages we will examine each of these five requirements in greater detail.

### **Structural strength**

People are seldom conscious of the fact that the loads they place on floors produce a variety of reactions in the floor finish and in the structural floor beneath it.

Floors in houses are, or should be, designed with a factor of safety that will cater for all normal loads. But unusual loads can damage both finish and structure, in extreme cases to the point of collapse. A heavy safe or a snooker table, for example, can cause considerable damage if the floor has not been designed for such loads.

A floor slab in direct contact with the ground is probably soundest from the point of view of structural strength. But, because such slabs are virtually part of the ground they cover, care must be taken to avoid the effects of expansive soils, heaving clays and loosely compacted or made up ground. (See page 5 and the NBRI Guide to Foundations in this series).

Therefore, when building a new house or moving into a completed house, owners should satisfy themselves about these structural aspects.

### **Surface quality**

The requirement for a floor to be level and smooth is easily met in the case of concrete floor slabs since this material is plastic when applied. The normal procedure is first to make it level and then to apply a screed to smooth the surface. This in turn provides a suitable base for any final finish that may be required.

The regularity of the floor often depends on the material chosen; thus quarry tiles or stone slabs can have inbuilt irregularities that are part of the overall 'look'.

## **Durability**

In any household water almost always finds its way onto the floor. The effects of water on earth floors was one reason for replacing beaten earth with other materials. Until the middle of the 19th century floors in Britain were often finished with plaster of Paris (gypsum) on a rough board base. But gypsum is also softened by water. So those who could afford to do so began to use good quality boards and omit the plaster of Paris.

Board floors, at or near ground level, have been in use for centuries up to the present day. Their durability, if properly constructed, was good. But, for the reasons given in the introduction they are now being superseded by solid floors.

## **Protection of the finish**

Finishes for floors form the subject of the second half of this booklet and we will look at them in detail from page 20 onwards. The principal enemy of floor finishes is moisture. Damp rises into the floor slab, softening the glue that holds the finish, causing woodwork to swell and some carpets to rot. It can carry with it dissolved salts from the soil and the garden and deposit these on the floor, spoiling the finish and even flaking stonework. Water vapour can sometimes push the finish off the floor.

A base that is insufficiently durable, such as a poor quality levelling screed, can crumble away beneath the finish, breaking it loose and spoiling it completely.

It is vital that floors are planned to take the desired finishes and are protected from rising moisture.

## **Enhancement of the environment**

This is the most subtle role played by a floor because its influence goes quite unnoticed. When the house is cold on a winter night its occupants blame the weather. If a neighbour's house is warm it is because of the fire or the curtains or the fact that the windows were shut early or for any one of many reasons by which we tend to rationalize good or bad environment.

In fact the difference between one house and another is more often than not the difference between good and bad design.

These factors are explained in a booklet called the *Introductory Guide to Temperature Control*\*. It shows how the mass of a house stores energy and how this fact can be used to good advantage. The roles of windows and roofs in home-comfort are also explained and one quickly realizes why some people have comfortable homes and some do not.

Most of our available energy comes from the sun and good house design on the highveld consists mainly in encouraging solar energy absorption on winter days and discouraging its re-radiation at night. In summer and in the warm coastal areas we must reverse this process, discouraging its absorption by day and encouraging night-time re-radiation.

The best way to encourage energy absorption by day is to provide large masses of material that can serve as a heat reservoir, such as the floor slab and thick outer walls. Only where the house fabric is very substantial can one really afford to insulate the floor with raised timbers, woodblocks or wall-to-wall carpeting. However, we must emphasize that we are speaking of a well-sealed house. No amount of energy storage will do much for a draughty building, and you should read the fuller explanation on page 22.

## **THE CAUSES OF FLOOR FAILURE AND HOW TO PREVENT IT**

Of all the things that damage floors the one that causes the most early failures is water.

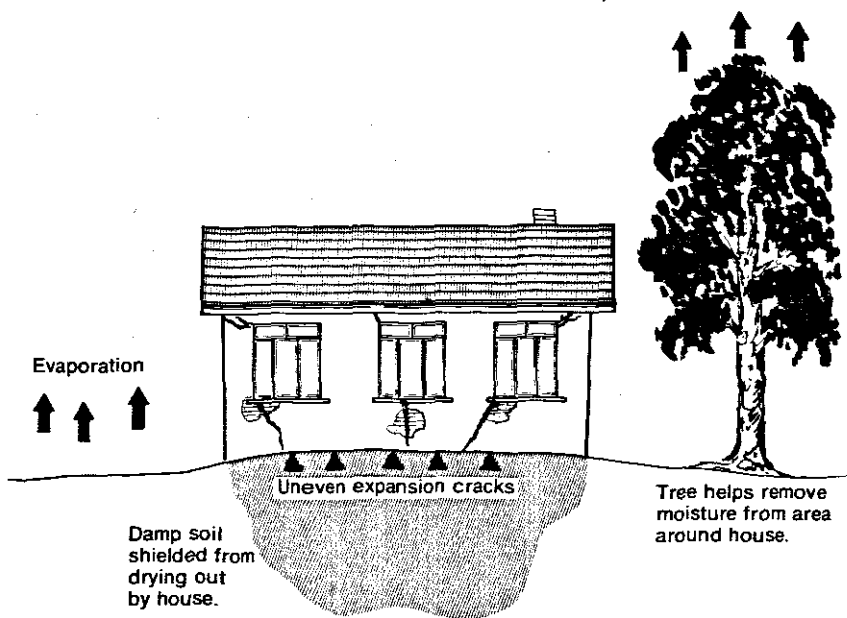
The effects of moisture can begin deep in the earth when the swelling and drying out of certain clays can cause entire buildings to heave and crack. More about this aspect can be found in the *Introductory Guide to Foundations*\*.

In the way it damages finishes moisture plays an equally subtle role. It rises from the water-table by capillary action just as a tree draws up sap and in the absence of proper damp-proofing reaches the

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surface of both walls and floor where it evaporates. Many problems begin when this water carries dissolved salts because these get left behind where the evaporation takes place and they can cause unsightly white furry stains called efflorescence. In extreme cases this can crystallize in tiny pores or cracks and cause stones and tiles to flake away, and mortar to crumble.

Different problems develop where impervious finishes such as vinyl are applied to cementwork because then the moisture cannot escape and the concrete and screed become permanently damp. This does not matter if the impervious layer is truly waterproof.

Some types of floor finish, such as composition flooring or Swiss parquet flooring tiles, are glued to the screed. The glue itself is not impervious to moisture and, if the screed gets damp, the glue will soften and the finish will peel off.

Woodblock floors which consist of separate, quite thick blocks that can be laid in a variety of patterns are also stuck down to the floor screed. If these blocks become damp or wet, either as a result of



damp rising from the screed or, as sometimes happens, by surface washing or flooding, the wooden blocks expand. Because the blocks are thick the forces generated by the expansion are considerable and can force the blocks to press against each other until they bow up into a dome which either tears the floor finish from the screed or may tear both floor and screed together from the concrete slab. This expansion is a slow, irresistible force which takes place within the blocks and, because of the criss cross pattern in which the blocks are usually laid, is ultimately approximately uniform over the floor. There is a recorded case in which the movement of the floor finish was so extensive and inexorable that the walls of the room were pushed off their foundations.

There are many other kinds of floor failure mostly originating from poor laying technique, or bad building practice. For example, the builder usually lays the concrete floor early in the construction process after which mud from wheelbarrows and workmen's feet gets pounded into the surface.

Later on cement droppings get trodden in by the plasterers until by the time the floor is ready for finishing it is caked with solidified plaster. This is often not cleaned off before the final screed is applied with the result that there is no bond to speak of between the screed and the base. There may even be cakes of mud and voids below the screed.

Once the surface below the finish is damaged the floor-covering cannot survive for long.

Most people will have been into a house in which linoleum or the like has been laid on an uneven board floor. After a few months the outline of every board can be seen and shortly thereafter each edge is marked by a line of wear. It is not even necessary for the floor to be bad in the first place. The impervious floor-covering can change the way in which the wood gives off its moisture; a change of moisture content in the wood can cause a quite smooth, level floor to warp enough to spoil the finish. A floor-covering cannot be used to cover up a poor surface and the real work of finishing a floor takes place long before the carpet or tiles or woodblocks are delivered on site.

## **BASIC BUILDING STEPS TO ENSURE A SOUND FLOOR**

### **Step one**

Check the soil on the site to ensure that it is not expansive. Expansive clays are very common in South Africa and a map showing the danger areas is contained in the booklet on foundations mentioned above. A test is described in the booklet that will help you to identify such soils, and advice is given on treating the site.

### **Step two**

If a house is to be built in an area that is heavily infested with termites then it will be advisable to poison the soil below the house to prevent them damaging the woodwork. Soil poisoning is a dangerous operation because the chemicals used are usually extremely toxic and it is best left to a trained pest-control contractor. He should first remove all vegetable matter from the site and then spray the bottom of the foundation trenches before the footings are cast. After the brickwork has reached floor slab height he will spray the ground and walls on the inside and will repeat the operation after the fill has been spread. (If more than 600 mm of fill is used, intermediate sprayings should be carried out at 300 mm intervals.) Any trenches carrying service pipes should be treated for at least 3 m from the house.

Ground-water can also interfere with the soil-poisoning operation. If the soil is very wet the poison will not be absorbed properly and will be carried away with the surface run-off. Always spray when the ground is dry enough to absorb the chemical and ensure that the site is kept well drained. Do not disturb the surface once it has been treated.

Full details on the poisoning of soil are contained in the SABS Code of Practice 0124 on the application of insecticides for the protection of buildings.

### **Step three**

It is important that the fill used should be sprayed with water and then rammed down hard, preferably with a mechanical compactor.

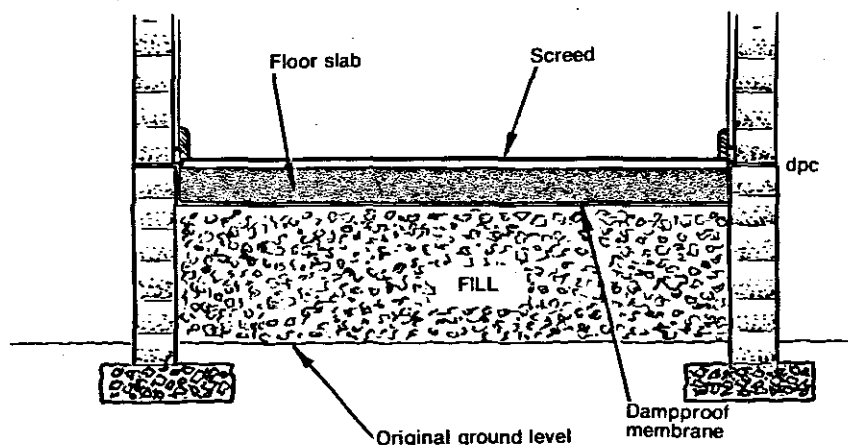
Besides protecting the fill by spraying it with poison it is essential to make sure that suitable fill is used. Power-station ash and mine-dump sand are examples of two risky fillers. Both contain traces of chemicals which can be leached out by rising ground-water and which may well appear as efflorescence on the outside of the foundation walls below the damp-proof course. Serious though this is, however, it is not nearly so disturbing as the fact that some materials used as fill may be highly expansive. Calcareous slags from foundries are particularly dangerous for this reason.

Even ordinary-looking soil from some other excavation can prove to be expansive. This is not an academic problem; there are records of builders using expansive fill excavated from a site miles away and having floor and foundations burst apart a few months later.

The best fill is what is known in the trade as hardcore. This consists of hard, reasonably clean broken brick, stone or clinker, or other hard granular material, free of vegetable or chemical matter. The size of the pieces should not be larger than 75 mm nominal and all material of less than 9 mm should be removed. The hardcore must be thoroughly rammed down in layers.

#### Step four

We have said that water causes most problems with floor finishes. Probably the most essential part of any floor construction schedule is to exclude water. This is done at the foundation stage by laying an

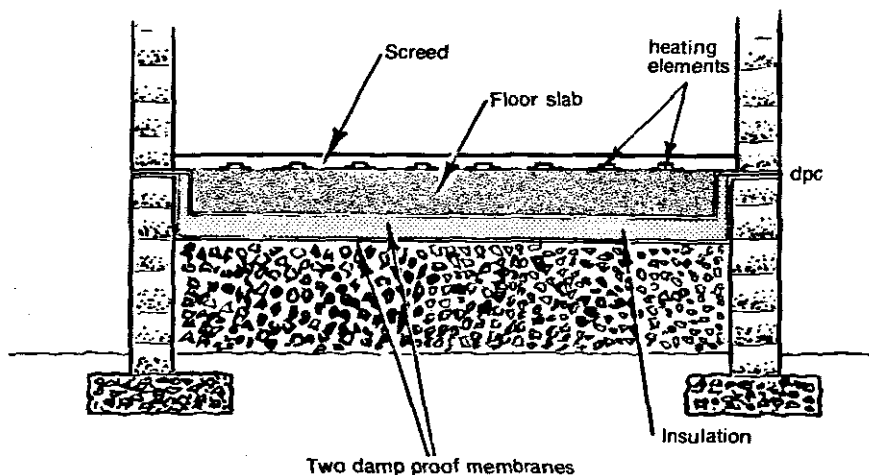


impervious membrane, such as a sheet of polyethelene over the entire house area. This cheap and simple procedure completely eliminates rising damp and only if one is certain that the house is to be built on free-draining soil can it be omitted. From a practical point of view it is best to fill the foundation to the level of the base of the floor slab before laying the plastic sheet. The advantage of this is that the minimum area of plastic sheeting is required. Where separate sheets of plastic must be joined below the house a polyisobutylene (P.I.B.) adhesive provides the simplest acceptable solution. (SABS specification 952 and 110.)

**Step five** (For those who are planning to instal sub-floor heating)

The concrete floor will act as a heat reservoir storing the heat energy produced by the electric elements. Obviously the floor will not be able to give off heat as rapidly as it is being produced until it has warmed up considerably. The greater the mass of the floor the longer this will take. If the floor slab is lying directly on soil or rock below the house then its heat will be passing uneconomically into the soil.

For this reason it is important to insulate the floor slab from the ground below. This is usually done by spreading a layer of 25 mm expanded polystyrene sheet on top of the damp-proof membrane and laying a second damp-proof membrane over the insulation



before casting the floor slab on top of it. The sides of the slab area should be lined with 15 mm polystyrene.

There are several practical problems to be overcome when carrying out this process. First, the polystyrene becomes a poor thermal insulator once it gets wet so a second membrane should be laid above the polystyrene. Secondly, the insulation material is very soft and easily damaged so that, when pouring the concrete, the workmen should take care to stand on stout planks that will spread their loads. It is point loads that cause the damage. Such a floor slab must be of good quality and thickness if it is not to crack.

It is also as well to remember that though polystyrene insulation will improve the performance of the floor in winter when the heaters are switched on, it will make it less effective in summer. On the other hand this deterioration will only be significant in a very lightweight house.

### **Step six**

The success of a floor will depend very largely on the casting of the floor slab and there are three 'golden rules' for a good slab.

First, you must use the right mix. We suggest that you use one part cement to four parts coarse sand to five parts aggregate. This is given as a guide though factors such as sand-grain size and quality can affect the mix. To get the perfect mix it would be necessary to analyse the ingredients you intend using, but the proportions given above will prove satisfactory in most cases.

Second, you must compact the concrete properly, and it is in this operation that the importance of having the right mix becomes evident. All too often there are too few 'fines' and the concrete becomes full of voids.

Third, you must 'cure' the concrete. This merely means preventing it from drying out by covering it with a sheet of plastic or a layer of damp sand. The sand must be kept moist for a week or so if the concrete is to harden properly.

### **Step seven**

In order to get a well-bonded screed one must clean the floor slab thoroughly. As was mentioned earlier it may be caked with mud and

plaster and this should all be chipped off with a spade and the surface hosed and scrubbed clean with a stiff brush.

### **Step eight**

When it comes to laying the screed itself a number of pitfalls must be avoided.

*In the first place it is vital to use top quality sand. The difficulty is often to recognize the right sand for a particular job. In the case of a screed the sand should be clean – that is, it should have been washed to remove fine silt particles. However, it should contain a range of sand particles from coarse down to very fine. Such well-graded sands are often 'created' by mixing pit sand and crusher sand in the right proportion and these will be likely to give good results. Some coarse river sands are also suitable when washed.*

The quantity of water used in the mixing of concrete and of sand and cement mortar screeds has a direct and important influence on the quality and strength of the concrete or screed after it has hardened. Too little water will produce a concrete or mortar that is difficult to mix and compact thoroughly, with the result that the screed will be porous, difficult to finish smoothly and very prone to damage.

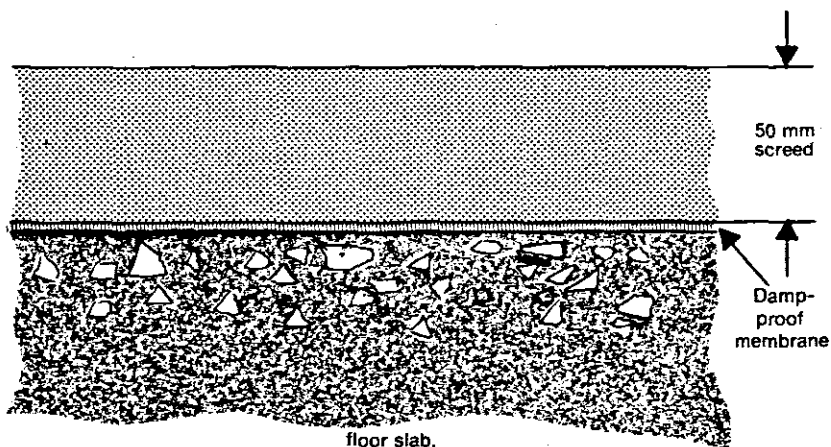
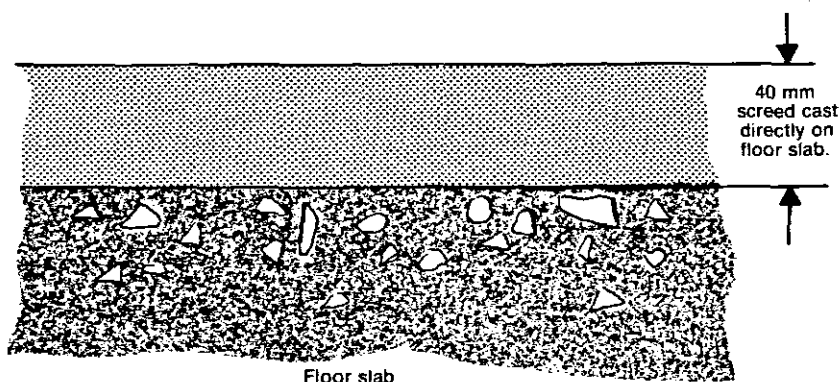
*Too much water, on the other hand, will result in the cement in the mix being floated to the surface when the screed is trowelled. This cement skin will crack easily and, where cracks meet, the cement between them will curl up or flake away. Later, when the floor finish has been laid, any weight on such loose patches will start a chain reaction of cracking and crumbling that will eventually ruin the floor finish.*

There is a tendency to make mixes too wet. Some builders will trowel in a cement and water slurry to make their job easier and produce, what appears at first sight to be a good finish. Others have been known to use too dry a mix to dry out the screed more quickly so that it can be walked on soon after laying. Both practices are to be discouraged as repair work is likely to be extensive and expensive.

If the floor is to carry heavier traffic than is usually found in a home it will be worth considering a concrete screed instead of the layer of

mortar which is usually provided. An even better scheme would be to make a sound job of the concrete floor slab which we cast in Step six and float it smooth. Further details are given in the section on concrete floors on page 23.

Another common cause of floor failure is making the screed too thin. A simple screed laid on top of well-cleaned concrete should be at least 40 mm thick. If it is laid on top of a membrane – such as happens when floors are re-screeded to eliminate rising damp – then 50 mm is the minimum.





A 15 mm screed is acceptable provided it is laid at the same time as the concrete base. The concrete is first levelled and then, while it is still wet, a layer of sand-cement mortar is applied to the surface and smoothed. Alternatively the concrete itself can be trowelled smooth. This makes what is known as a monolithic floor slab and it is extremely effective.

Always make the mortar for the screed with as little water as possible, but it should be sufficiently moist for you to trowel it smooth with its own water. If you find you need to moisten the surface in order to smooth it then the mix is too dry. Adding water makes for a weak surface mix that crumbles or dusts.

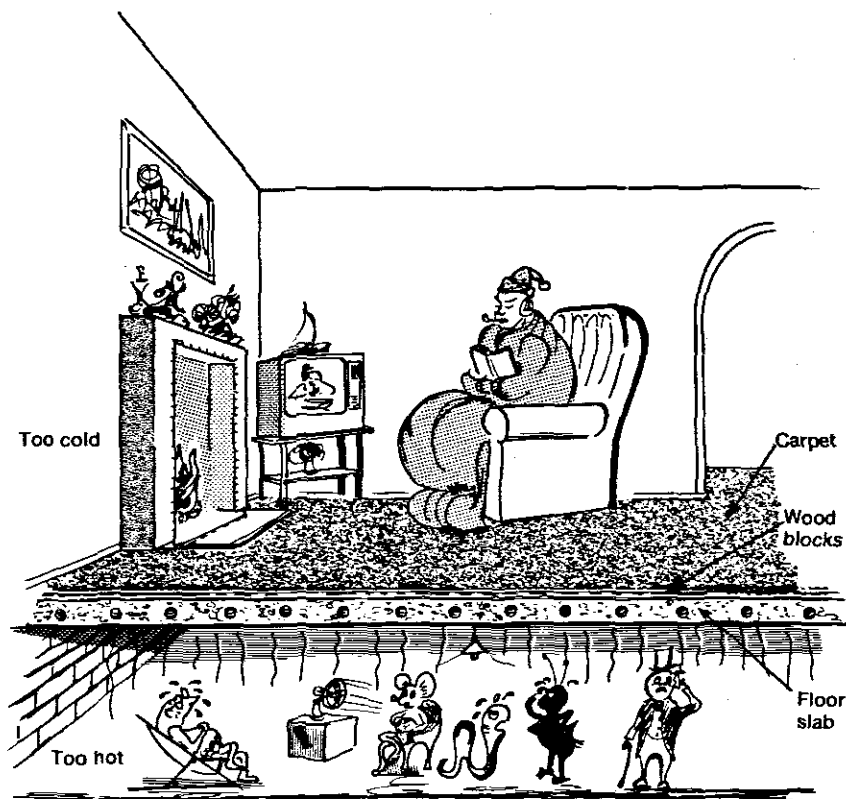
A screed should not be allowed to dry out too quickly and after it has set it should be cured by covering with a plastic sheet and hosing occasionally. Simply hosing down once or twice a day is only satisfactory in a closed room where glass and doors are already installed. Curing under damp sand can also be satisfactory.

### **Step nine**

Those who plan to install under-floor heating should note that the element wires should be laid directly on to the floor slab and covered with the screed. It is important to keep to a minimum the number of different materials involved at the junction of slab and screed otherwise differential expansion may cause cracks. Another warning at this point must be against laying thermal insulators such as woodblocks and carpets over heated floors. The temperature of the



floor slab can become extremely high if the heat is not given free access to the room above. The elements are designed to operate under conditions in which their heat is conducted rapidly away. If they are too close to insulators – either above or below – the heating coils can get too hot in places and burn out.



There was one instance in South Africa where heating elements were installed in an upper floor of a block of flats. The floor was then overlaid with both woodblocks and a carpet with the result that the slab became extremely hot. The people in the flat below were sweltering in the heat while the owners of the heating system kept turning up the thermostat. In the end the resulting thermal expansion caused serious cracks to form in the structure.

### **Step ten**

If flagstones or quarry tiles are to be laid then this should be done directly on to the clean concrete base. Laying should begin by bedding one tile or stone on to 25 mm of mortar at the highest point on the base. All other tiles or stones should now be levelled with reference to this one point by means of a long straight-edge. There is a tendency by some workers to stand each stone or tile on its own pillar of cement. This makes for easy laying but leaves a very weak floor because the unsupported areas can break away. More about laying these floors is to be found in the section on floor-finishing materials.

### **Step eleven**

Before laying plastic tiles or carpet or woodblocks it is essential that the slab be allowed to dry out. Even though we have placed a damp-proof sheet under the entire house, the danger of water damage is not past until the hundreds of litres of water which are contained in the fabric of the floor have evaporated away.

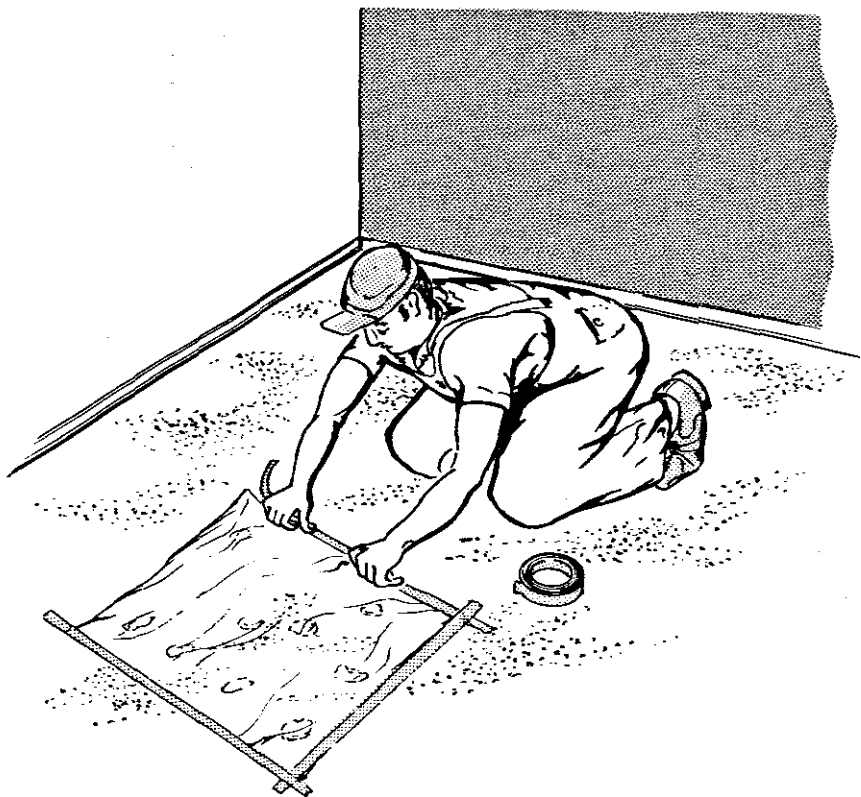
To test a floor for dryness take a small sheet of plastic – half a metre square is quite big enough – and tape it to the floor with masking tape right around the edge.

This should be left on the floor overnight and in the morning if there is any condensation underneath the plastic then the floor is too wet.

The condensation will be easier to see if clear plastic is used and if a few small pebbles are trapped under the plastic to hold it clear of the slab.

This test will at least ensure that the floor is not laid when conditions are very bad, though the absence of condensation does not necessarily mean that the floor is dry enough.

A floor slab with electric heating elements embedded in it can exaggerate damp-problems by creating excessively high vapour pressures when the heaters are switched on. To solve this problem turn the heaters on at least a week before the floor finish is to be applied and leave all windows and doors open so that the moisture coming out from the floor can be dissipated.

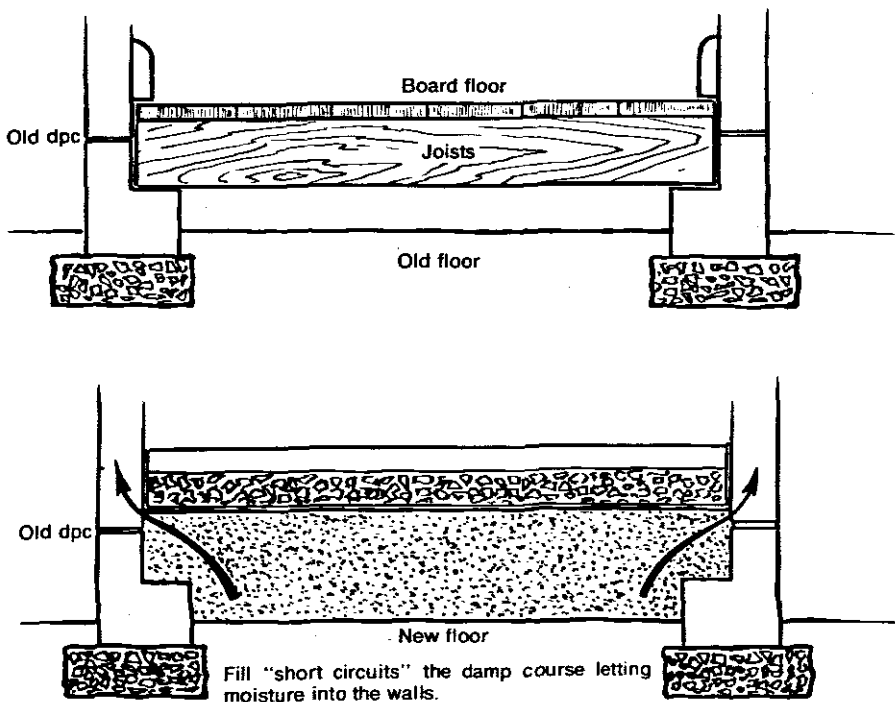


Testing a floor for dryness with a sheet of plastic.

Woodblocks are particularly sensitive to moisture and this is often aggravated by the practice of keeping them locked in the builder's hut for security reasons. In there they remain dry and therefore tend to expand after laying even if the floor slab is comparatively dry. The place to store woodblocks is in the room where they are to be laid so that the humidity of both blocks and floor can approach equilibrium.

### **Converting a suspended wooden floor**

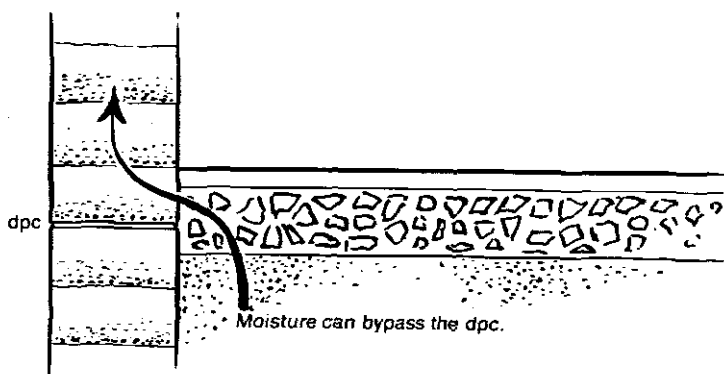
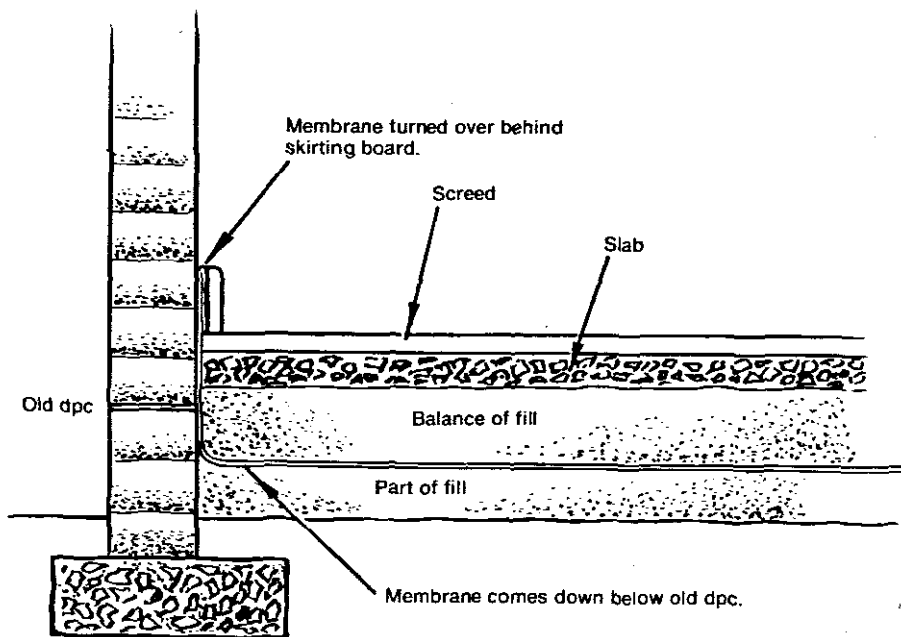
One of the more popular modifications to old houses is to take up the floorboards and replace them with a concrete floor. This is frequently made necessary by the presence of fungus and/or woodworms in the existing timber.



It often happens that the old timber is pulled out, the sub-floor cavity is filled up with hardcore, a sheet of plastic is laid and a concrete slab is cast in place. What the renovator neglects to note is that the existing damp-proof course is between the soil and floor levels. Now with the new soil level damp has easy access to the walls. Often the only solution is to saw through the walls at floor level and insert a new damp-proof course or dig up the concrete and do the job again.

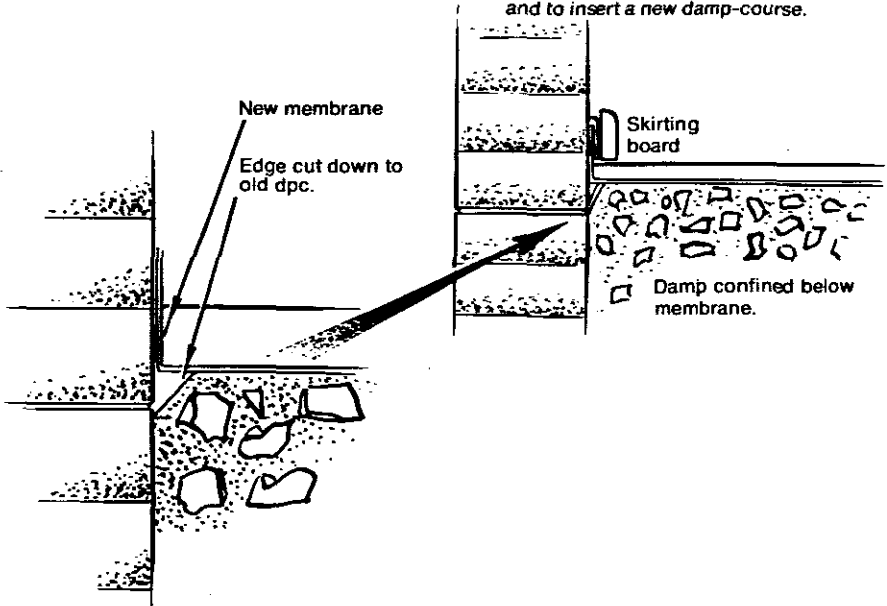
A complete sub-floor membrane is required but it must be laid into the sub-floor cavity below the old damp-proof course in the walls. The plastic sheet should be turned right up at the edges to a point above the new floor level. The best plan is to leave it sticking out until after the new floor is laid and then to turn it over and hide the edges behind the skirting board.

Sometimes a solid floor is plagued with damp problems and the best solution may be to chip off the screed and lay a new screed on top of



a damp-proof membrane. Before doing so, however, make sure that the concrete slab is not bridging the damp-course in the walls. If it is, then the edge should be cut all around the slab down as far as the damp-proof course. The screed should also be of sufficient thickness. (See page 13 for details.)

If the distance between the top of the floor and the damp-course exceeds 50 mm it may even be better to cut a horizontal slot in the floor slab and to insert a new damp-course.



## FLOOR-FINISHING MATERIALS

In earlier sections of this booklet we have explained in general terms what is expected of a floor and how it should be constructed so as to perform these functions properly.

However, it is hardly possible to produce a 'general purpose' floor suitable for all finishes because each requires different conditions if it is to be installed correctly. If the lounge of a house, for example, is to be paved with bricks in a decorative pattern there will be a step down as you leave it unless the floor level in the lounge was made lower from the start.

It will be seen therefore that the householder must choose his floor-covering at an early stage in building design or redecoration, and make certain that allowance is made for its special requirements.

Choosing a floor finish is not easy. There is no way to say that one is better than another because there will be some circumstances in which almost every conceivable floor will be 'best'. On the other

hand different people will look for different features; a husband for instance might look for durability and economy, while his wife might look for colour, texture and ease of maintenance.

With the wide choice available today there is something for almost everyone and it is the aim of this section to help you to select wisely, and install well.

### **Environmental factors**

As far as the environmental contribution of a floor is concerned, finishes can be divided into two groups: those that conduct heat well and those that do not.

The first group (hard floor coverings) comprises such finishes as concrete, terrazzo, natural stone, ceramic tiles, cement tiles and paving bricks.

The second group (soft floor coverings) includes carpets, wooden floors and cork tiles.

There is a third group (thin floor coverings) made from material which conducts heat poorly but which is usually applied too thinly (3 mm or less) for the insulating effect to have a great influence on the environment. Examples are: linoleum, thermoplastic tiles and liquid finishes.

This is not to say that those readers who prefer fitted carpets need reject their choice but they should understand the theory behind the thermal contribution of the floor before making their final decision.

Temperatures on the highveld have a very wide daily variation and a range of 20 °C is not uncommon. In a corrugated-steel sheeted building this range of temperatures will be exaggerated and may easily reach 30 °C. In a very massive building, such as an old stone fort, on the other hand, the thermal extremes are damped to such an extent that the daily temperature change can be less than 5 °C. In this case the summer mean will be very close to man's ideal temperature. So we can make the first rule that a house on the highveld should be as massive as possible with a solid floor and thick brick walls.

Such a house will not guarantee warmth in winter, however, because obviously if the windows are left open and the doors are ill-

fitting, cold air will rapidly replace any warm air that may collect inside. Our second rule, therefore, is that to benefit from massive construction the house must be well built and capable of being sealed against draughts in winter.

If you are at present living in such a building then we can safely say that you can install wall-to-wall carpeting and will hardly be able to detect the difference.

The problems may begin if you live in a normal type of house. For example, many highveld houses, though built of brick, have their north walls almost completely made of glass. These store very little of the winter sun, except for that which falls on the floor slab, and therefore an insulating finish is likely to make the house considerably colder.

The same thing applies to timber buildings and lightweight structures such as are being put up by some system builders. Fit carpets if you like but be prepared to heat your house more frequently.

A different situation exists in the warm coastal areas where a heavy-weight building is undesirable because the 'average' temperature that it settles at may be too high in summer. Lightweight buildings with a heavy floor perform best at the coast because the floor cushions the occupants against extremes of temperature. A carpet will deprive the house of this protection.

To sum up, therefore, most people will be prepared to foot the extra heating bill that goes with wall-to-wall carpeting or parquet. However, those who have 'acres' of north-facing glass should think twice about insulating their floors.

The way we have divided up the different floor finishes in dealing with environmental effects provides a perfectly satisfactory way of grouping them for closer inspection. We will, therefore, look at

- (a) hard floor coverings
- (b) thin floor coverings
- (c) soft floor coverings



## **HARD FLOOR COVERINGS**

This group is 'tops' for durability as well as for environmental advantage and not only boasts some of the most beautiful floors but also provides us with some of the cheapest.

### **In situ concrete**

A plain concrete floor is extremely practical. It is widely used in garages, sculleries, outhouses and factories and provides the basic foundation for almost all other floor finishes. For this reason it is the cheapest functional floor available.

On page 11 we described how a floor slab and screed should be cast and the same procedure is called for even when no finish is to be applied.

It is important to know, however, that the cement component of concrete and mortar is usually the least durable part of the finish. The hardness of concrete comes mainly from the aggregate used. For this reason floors that are smoothed by the use of cement slurries tend to wear rapidly and flake. Concrete is inherently a better material for a floor screed than mortar since it has a larger proportion of aggregate.

When laying a concrete topping there is a procedure to be followed if good results are to be obtained.

First use a very uniform 10 mm aggregate and add sand (see page 12) in the proportion of one part for every two of aggregate. The cement mix should be not stronger than 1:3 and only enough water should be used that it just floats to the surface.

It is important that trowelling be delayed until the bleed water has all evaporated and the concrete has started to set. Early trowelling traps water below the smoothed surface and later this may lead to a weak surface layer that is prone to dusting.

The correct technique is to spread the concrete, compact it thoroughly – many floor failures can be traced to poor compaction – level it off and wood-float it smooth. It must now be left until it begins to stiffen and there is no surface water remaining. Only then should

the steel float be used. A lot of pressure will be required to get a smooth finish and a power trowel will give the best results. Waiting time can be reduced by mopping up the surface water.

Should you wish to try making a pigmented floor it can be done at this stage by sprinkling a dry paste of pigment and cement over the surface and trowelling it in. You must, however, realize that this surface may tend to flake and is only suitable for the lightest traffic areas. Where strength and colour are required – such as in a terrazzo finish – the pigment must be blended with the cement before the topping is mixed so that the colour is not confined to the surface layer. In this case the volume of pigment should not exceed 10 per cent of the volume of the cement.

(Floor paints are discussed on page 39.)

Sand cement screeds are suitable only for light traffic areas.

All cement products deteriorate in contact with acids such as vinegar, fruit juices and some household bleaching agents which can cause them to crumble away. So when it is also realized that stains such as oils and dyes can soak into cement work and leave a permanent mark, it is easy to see why plain concrete floors are best sealed. There is a wide range of sealers on the market such as epoxies, polyurethanes, paints and waxes. A less common process is to treat floors with a chemical called magnesium silicon fluoride which causes silica to be deposited in the pores making the floor denser and more resistant to staining. This chemical, however, is extremely toxic and its application is not a suitable project for the handyman since special protective clothing is required.

Do not seal a concrete floor that does not have a sub-floor membrane, as efflorescence could destroy the surface.

A smooth cement floor sealed with wax or floor paint gives a dust-free surface that resists staining and is easy to keep clean.

Unless very heavily waxed, it gives a relatively non-slip finish. Scrubbing with soap and water is all the maintenance that is usually required and it is only necessary to remember not to use acid cleaners.

### **In situ terrazzo**

This is a modified form of concrete floor that has been ground down to expose more of the coarse aggregate and less of the fine. For this reason it is extremely durable, though subject to the same warnings about staining and acid attack as cement. It is usual for the concrete topping to be made with specially attractive aggregates such as marble and for white or coloured cement to be used.

Terrazzo is an attractive easy-clean surface. Polishing brings out the beauty of the stone but does tend to make the floor slippery. Chemical densification as described above is a useful way of protecting such a floor.

### **Natural stone**

This can be one of the most effective floor finishes – hard, durable and almost completely maintenance-free. Unfortunately a good stone floor is usually rather expensive.

Rocks in general fall into three main categories:

1. *Igneous rocks* such as granite, diorite or basalt which have solidified from the molten state. These must be sawn up into blocks for use and it is this cutting process which makes them expensive.
2. *Sedimentary rocks*. Water-deposited sediments consolidate with time into rocks such as sandstone, shale and limestone. Only sandstones have been used for flooring in South Africa and then only rarely.
3. *Metamorphic rocks*. Sometimes sedimentary rocks are baked and compressed by major forces deep in the earth's crust to the extent that they become fused together. Limestone, for example, becomes marble while sandstone turns into quartzite and shale into slate. Several of these rock types still retain their original layering which enables them to be split comparatively easily. These make less expensive floors (e.g. Slasto).

The success of a stone floor will depend largely on the skill with which it is laid. It is a misplaced economy to bed stones in sand, or to skimp on the mortar.

It is important in laying a stone floor to get good adhesion between the stones and the mortar. With this in mind you should select a good quality washed sand with few fines and mix the mortar with as little water as you need to get a smooth surface. It is also important to see that each stone is completely bedded-in with mortar both around and below it. Liquid grout should not be used to fill the space between stones. In the case of stones that have muddy or dusty surfaces the underside should be scrubbed clean before laying.

Beware of laying stone too soon after a concrete floor slab has been cast. The slab will shrink as it dries and this can cause the stone to flake off.

Where good-quality stone has been selected for its resistance to corrosive liquids, a bedding material that is also resistant should be used when laying it.

Igneous rocks such as granite are immensely durable. They are almost impervious to moisture and spilt liquids and make a really first-class floor. Unfortunately, the price is usually so high that they can only be considered in prestige buildings where beauty and durability are more important than cost. The same applies to some metamorphic rocks but where the bedding planes permit a rock such as a quartzite to be split into tiles then these become a practical proposition for factories or kitchens where extremely heavy wear is expected and for aesthetic effect on prestigious buildings.

The softer metamorphic rocks, such as slate, are both attractive and inexpensive and are widely used in modern homes. However, these rocks are not impervious and it is a wise move to seal them before some household fluid such as ink or dye is spilt on them. As we saw earlier, sealing a porous floor invites the migration of salts into the surface layer unless a sub-floor membrane has been used. Those who own a porous stone floor that has not been damp-proofed must choose the lesser of the two risks, which will probably be sealing with a wax polish. The ultimate solution of relaying the stone floor above a membrane is only feasible when the deterioration has become so severe that the floor needs replacing.

Once a non-natural finish such as wax has been selected then this surface will have to be maintained. Since it will not be as hard as the stone itself it stands to reason that maintenance will be more frequent.

Because the joints along which stone slabs are split are never perfectly flat, natural stone floors, unless they are cut and polished, cannot be absolutely perfect, and furniture placed on them usually tends to wobble.

### **Ceramic tiles**

Clay tiles are once again becoming fashionable but both builders and home-owners are rediscovering some old problems, almost all of which spring from faulty laying technique.

Ceramic tiles come in a variety of shapes and sizes from brick pavers to decorative mosaics. In addition, there is a wide range of types from fully vitrified tiles to glazed bisque and it is as well to know something of the characteristics of each.

Clay can only be shaped effectively when it is moist and plastic but it cannot then be fired until it has had a chance to dry out. In this drying process the tile will shrink a little and if it is not lying perfectly flat it can become slightly warped. Firing such a tile will 'set' it in the warped state.

Also, should it not have dried out properly beforehand it can come out of the kiln marred with cracks or blisters.

The care with which tiles are made governs their quality. So-called 'quarry tiles' are made to much less stringent specifications than 'floor tiles' and may contain slight irregularities.

The main thing to remember about tiles is that, whether matt or glazed, they are an easily cleaned, durable material when used in the form they are made. They are not meant to be painted or waxed as these processes merely substitute non-durable surfaces which require maintenance. Housewives usually prefer glazed tiles, so for domestic purposes these should be chosen wherever possible. Matt finishes – for which there is a smaller range of colours – are generally intended for heavy-traffic areas where slipping is a danger.

Tiles that are fired at very high temperatures become fused into a glass-like mass when they are described as 'fully vitrified'. Such tiles are completely stable, impervious to fluids and almost as effective a floor as igneous rock.

Trouble can arise in the case of tiles that are not fully vitrified because some of them show a marked tendency to absorb water and swell. Unfortunately this particular swelling does not disappear when the tile dries out with the result that over the life of the floor the tiles may easily expand by a millimetre in every metre.

This does not sound much but, if there is no space for the tiles to expand into, even this small size increase can wreck the floor.

Thus when selecting ceramic tiles, one's first choice must be a tile that is completely stable. If financial or other considerations dictate a tile that is potentially expansive then care must be taken to see that it is not laid 'hot from the kiln'. The best process would be to stack these tiles in the open for six months and hose them down regularly so that they can get most of their expansion over and done with before being laid. (See points 4 and 5 below.)

Another cause of trouble is that many architects like to see tiles laid extremely close together. In such a case, because the tiles have no mortar around their edges, they are less secure and will loosen under load.

However, expansion of the tiles is not the only cause of trouble; exactly the same effect can result from contraction of the floor slab. This happens as concrete dries out and it is very important to ensure that the slab is dry before laying tiles. (See page 17.)

Points to remember are:

1. Leave wide joints between tiles.
2. Make sure that these joints are filled with the bedding mortar.
3. Do not mount tiles on 'pats' of mortar and then pour grout in *around the edges*. This is extremely important in heavy-traffic areas since, if the tile is not supported over its entire under-surface, it will break under load.

4. Where more than 6 m of continuous tiling is to be laid then every 2–3 m (in both directions) leave one joint completely free of mortar and fill it with a flexible sealer such as polysulphide. It will be almost indistinguishable from the cement but will take up expansion safely.
5. Leave a space between the tiles and the surrounding walls – it can be hidden below the skirting.
6. Immediately after laying, cement can be rubbed from the tiles with a dry cloth. Once it has hardened you will need to use an acid solution. Ordinary swimming-pool acid diluted with nine times its volume of water is ideal, but remember that it attacks mortar, therefore saturate the floor thoroughly with water first so that the acid is not absorbed.

There are, of course, numerous other techniques for laying tiles and each has its adherents. One scheme you may come across advocates the use of thick beds of weak mortar so that expansion can be absorbed.

Another technique involves laying tiles and mortar over a sheet of plastic or builder's paper so that there is no bond between tiles and floor slab.

Tiles can also be laid using an adhesive which imparts enough flexibility to cope with expansion and they can even be laid directly on to a bed of sand in some circumstances.

### **Brick floors**

Once almost confined to driveways and courtyards, brick pavers are being increasingly used inside buildings. They give considerable scope for the artistic craftsman to create decorative effects at a comparatively modest cost. For internal use it is advisable to bed the bricks in a layer of mortar and to fill the joints between bricks properly. Expansion of the bricks should be allowed for by leaving space between the brickwork and the walls. It can be concealed beneath the skirting.

Comments on environmental qualities, durability, appearance and convenience are substantially those made for quarry tiles.

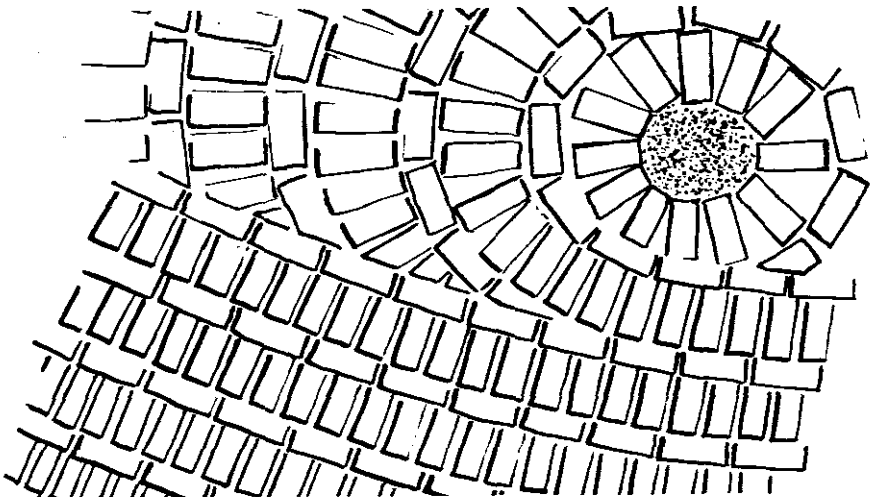
## **Cement tiles**

These are in many ways similar to ceramic tiles except that they are not fired. They, too, can be highly decorative with their surface carrying either an embossed design or with attractive materials such as glass, marble or natural stone embedded in the body of the tile.

Terrazzo tiles are also available, some of them with interesting stones used in the surface aggregate.

Cement tiles have the same drawbacks as the materials of which they are composed, the only advantages being ease of laying and, relatively speaking, ease of replacement. Their big selling point is that they are comparatively inexpensive.

When laying cement tiles it is as well to remember that even though they do not expand permanently as clay tiles and bricks do, they are subject to expansion and contraction as they become wet and then dry out again. The easiest way to combat this is to ensure that cement tiles are moistened before use so that they are laid in an expanded condition. The most precise way of doing this would be to lay them at the same relative humidity as the floor slab could be expected to maintain through most of its life. This is hardly possible in practice so a good hosing-down a few hours before they are laid will give the floor a fair measure of protection.





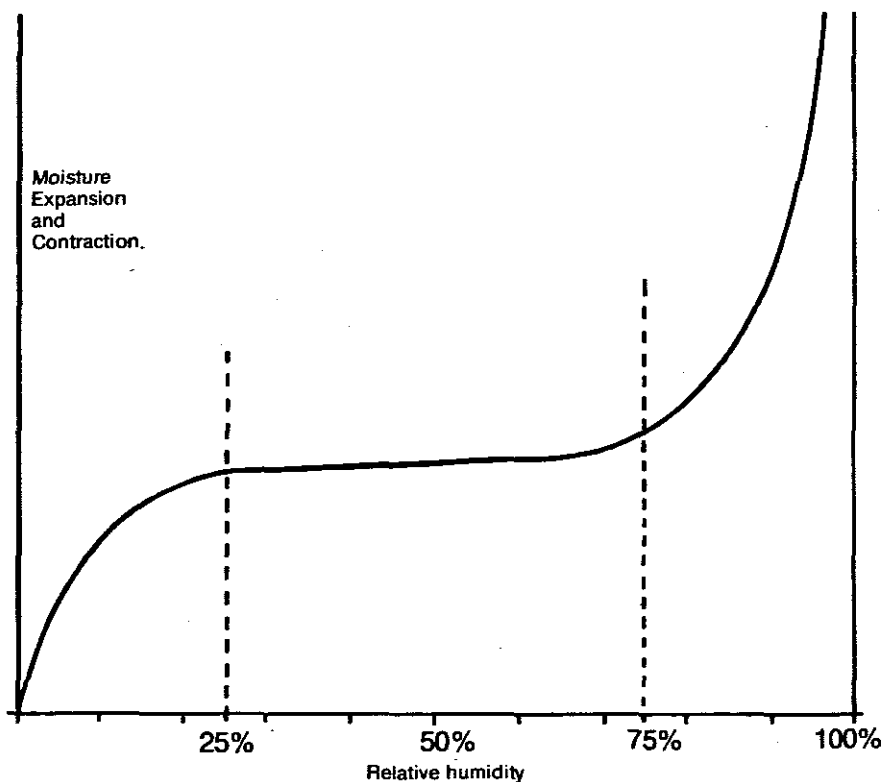
## Moisture expansion in the structure

Just as cement tiles expand and contract as their moisture content changes so too does the concrete floor slab on which they are laid.

The slab has a very high relative humidity immediately after setting and shrinks quite considerably as it dries out. Even vitrified tiles or granite blocks can flake loose if they are applied too early in the life of the building.

The graph below shows that concrete does not change its size in a uniform manner and that, once the relative humidity has come down to below 75 per cent, the main danger from dimensional changes is past.

A simple way to find out if the floor slab is too wet was described on page 17.



## **THIN FLOOR COVERINGS**

Amongst this group are to be found some of the most popular and practical finishes.

The fact that they are basically insulators makes them warmer underfoot than the hard floor coverings. On the other hand their thinness means that they do not interfere unduly with the thermal performance of the structure.

The most frequently made mistake in laying thin floor coverings is to make the assumption that they will hide imperfections in the surface.

Because these coverings are more or less flexible they will, over a comparatively short period of time, settle down to conform to the exact shape of the screed on which they are laid. Thereafter the finish achieved will be not much more regular than was the original surface.

Another factor that is often overlooked is that it is not the finish but the underlying screed that carries the load. Should it crumble under the weight of a heavy piece of furniture the floor covering will come adrift.

What often happens is that the flooring contractor is asked to work on a floor that is rough or damaged and in self defence has to place a skin of smoothing compound on the floor before he can begin. Such compounds are useful when laid as the maker intended but are often required to exceed their limitations, particularly when applied 3 mm or more thick when their natural tendency to shrink is exaggerated.

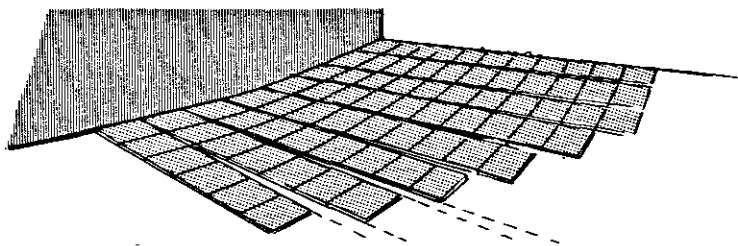
The proper technique is to level the screed and smooth it with a wooden float. (Steel trowelling is unnecessary.) Later the flooring contractor only needs to make sure that the surface is clean, free of loose dirt and sand, and dry.

The simple test described on page 17 will tell you if the floor is too wet but the absence of condensation does not mean that it is dry enough for this type of finish so it is safest to leave the floor for a few weeks after condensation has ceased.

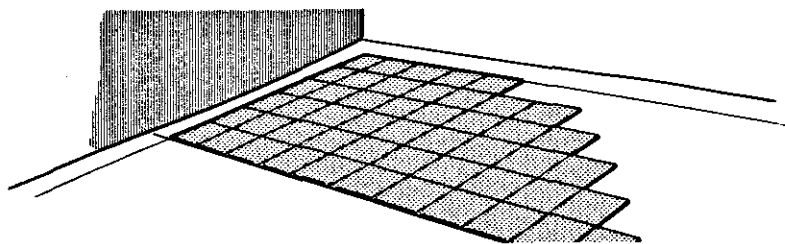
Firms handling large jobs will need something more precise to go on

and taping a hygrometer to the floor and leaving it for a day is the only reliable method. Before laying commences the relative humidity should be 75 per cent or less. The instruments used for measuring electrical conductivity in timber are *not satisfactory* for concrete because of wide variations in salinity, and composition of the concrete. (SABS 0709.)

When it comes to laying tiles care must be taken in setting out the floor. Walls, though apparently straight and square, are rarely quite true and working across a room from one wall to the other can lead to serious errors. The best way is to divide the room down the middle with a straight chalk-line and lay the tiles to this. The same technique can be used when laying sheet material. Incidentally, it may be possible to achieve considerable savings by careful selection of the direction and placing of the flooring.



The first row or two may not be too bad but sooner or later the job will be beyond salvaging.



The correct way is to begin in the middle and work outwards when you will be able to fit any shape.

Most thin floor coverings are fastened to the floor slab with adhesive. There are four kinds in common use: bituminous, solvent-based rubber, rubber emulsion and chemical setting.

- (a) *Bituminous*. This is the cheapest adhesive and when used by an expert can be economical. Unfortunately if the adhesive is laid too thickly it can soften and ooze out at the edges of the tiles and it is extremely difficult to clean off.
- (b) *Solvent-based rubber*. This is an effective adhesive where slightly damp conditions are likely to be encountered. Its disadvantages are that the solvents used can be injurious to health, and present a fire hazard during application.
- (c) *Rubber emulsion*. This is the adhesive recommended for home application since it is safe to use and will give reasonable results without the need for special precautions.
- (d) *Chemical setting*. Most useful of these 'two-pack' adhesives are the epoxies which have exceptionally high strength, but they tend to be rigid and can cause dermatitis.

However, because they are expensive they are not recommended for home use except where serious damp problems have been encountered.

When spread over a screed epoxy tar will retard the passage of water vapour but can cause adhesion problems.

It should be noted that adhesive may not stick to surfaces treated with epoxy.

Polyurethane, though it can resist damp once it has set, performs badly on moist or smooth surfaces.

A word of warning – do not use epoxy for its strength alone. If tiles or woodblocks are being forced off the screed something is causing it and a stronger glue will simply move the failure zone from the adhesive to the screed. Taking advantage of its ability to act as a kind of vapour barrier is a satisfactory reason for its use.

It is important that the adhesive is not too stiff and that the spreading tool is not too coarse else the ribs left by it will show through the tile surface after a while. A combed scraper gives uniform depth to the glue.

Occasionally thin coatings are required to be laid over boarded floors. It must be accepted that this process will change the amount of moisture in the underlying woodwork and that this in turn will affect the shape and accuracy of the floor. It is always worth laying hardboard, chipboard or plywood onto such a floor before putting down a flexible covering. There is a risk in this procedure that the moisture changes will encourage dry rot and the ventilation of suspended wooden floors should be checked first.

### **Linoleum**

'Lino' is one of the oldest thin floor coverings and there is no doubt that it is still very satisfactory. Its use received a severe setback a few years ago when stiletto heels were in fashion because it was unable to stand up to the pressures they created.

Lino is made from finely ground cork bonded with drying oils similar to those used in the manufacture of paint. Because these take time to set and cure, making lino is rather a long-drawn-out procedure and only a few overseas firms produce it.

Lino wears well under normal foot traffic and in addition has a nice feel. It is slightly resilient and is warm underfoot. Unlike plastic coverings, it tends to spread when laid which means that joints disappear with time.

A weakness of lino is that it softens when attacked by solvents such as paraffin or cooking oil and it is sensitive to moisture.

### **Asphalt tiles**

These were the first thin synthetic floor tiles to come on the market and a tribute to their practicality is that they are still being made.

Their main selling point is that they are relatively inexpensive. They are satisfactory for normal household use and stand up to fair wear and tear reasonably well. However, they are sensitive to household solvents such as paraffin, petrol and cleaning benzine and will break up under impact. They are usually stuck down with bituminous adhesives which tend to lose their grip when water is spilt on the floor.

They are in fact so brittle that they must be warmed before being laid.

This material is only available in tile form and then, because of the nature of the binder, mainly in dark colours such as reds, browns and blacks. Tiles with a cumerone-indene resin binder are produced in lighter colours.

### **Bitumastic flooring**

This is another inexpensive material made from a bituminized cellulose-felt backing that has been given a wear coat of iron oxide and drying oils. It is a quiet, comfortable, flooring material but is sensitive to impact and solvent damage and should only be laid in rooms that are not in frequent use.

### **Thermoplastic (PVC) tiles and sheeting**

Polyvinyl chloride (PVC) is a thermoplastic that forms the base for vinyl materials which usually contain plasticizers, fillers and other additives, even other polymers, to modify the properties of the vinyl.

Vinyl flooring is produced as tiles or as sheets. A characteristic of the material is that it changes its shape by shrinking in one horizontal dimension and expanding slightly in the other. The rate of change is more rapid when vinyl flooring is laid on a heated floor. The effect of this shrinkage is more noticeable with sheet than with tiles because, when the vinyl sheet shrinks it pulls away from two opposite walls and may leave an appreciable gap along those walls whilst tending to creep up against the other two walls of a room. With tiles, however, the expansion is distributed over many joints and the effect of movement in the material is almost unnoticeable, particularly when the tiles are laid, as they usually are, with the grain running in alternate directions.

Vinyl flooring has very low permeability. Therefore, after it has been laid for a while, the moisture content of the floor slab will certainly increase unless a subfloor membrane has been installed. Such an increase in moisture frequently causes deterioration of the adhesive and the flooring becomes loose.

On a new floor, laid above a membrane, the only problems likely to be encountered will be associated with the drying out of the concrete or mortar. Tiles, because of the gaps between them, allow the floor slab to dry out more readily, albeit slowly.

An advantage of vinyl sheeting is that it can be heat-welded along the joints. This does not give a strong bond but it is dampproof.

### **Vinyl asbestos**

Vinyl (PVC) is mixed with plasticizers and inert fillers such as asbestos. Pigments are stirred into the mix which is then rolled out into sheet form and cut into tiles.

The relative lack of flexibility means that it cannot be sold in sheet form. Vinyl asbestos is a hard, noisy and cold floor but on the positive side it is very long-lived, comparatively unaffected by normal household liquids and easy to lay.

It is slightly more porous than fully flexible vinyl which may explain why fewer problems are experienced with this kind of tile as a result of moisture movement.

### **Fully flexible vinyl tiles and sheets**

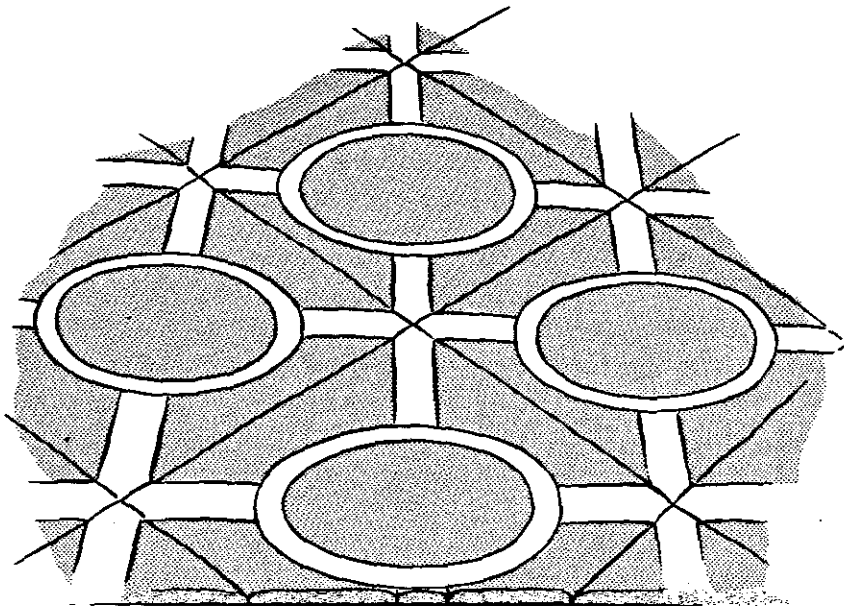
These are made in the same way but with the addition of smaller amounts of filler so that they remain more flexible. They are available in a variety of colours and make a very hard-wearing floor finish.

Flexible vinyl bonds well but the bond may be destroyed by the accumulation of water. No mortar screed is impermeable but screeds should be dampproof in the sense that they will not seriously deteriorate if they are damp. Frequent washing of vinyl tile floors is to be avoided for the same reason, since the washing water will eventually penetrate the joints and loosen the adhesive and the tiles will begin to peel off. However repair of tiled floors by replacement of damaged tiles is not nearly so noticeable as repair of sheeted floors.

Flexible vinyl is softer underfoot than vinyl asbestos but is usually not as comfortable as linoleum.

### **Cushion vinyls**

These are the most attractive of this family of floor finishes since they can be made with regular patterns to simulate floor tiles or mosaics rather than the marbled patterns characteristic of vinyl asbestos and flexible vinyl.



The material is made in three layers each of which performs a specific function.

The 'cushion', a foamed and flexible base layer imparts springiness which is easy on the feet. On top of the foam comes the decorative layer which has a pattern printed on to it. Since such a pattern would be extremely vulnerable to wear it is, in turn, covered by a transparent wear coat of clear vinyl. This gives adequate durability under conditions of normal wear, but a sharp edge such as a tubular steel chair leg that has lost its protective cap will easily cut cushion vinyl and thereafter the wear coat may come away altogether.

### **Liquid floor finishes**

The simplest floor finish of all is a coat of paint. It is true that this makes the floor bright and clean but on the other hand it is an extremely thin layer and it wears through comparatively quickly.

A painted floor is not a normal choice in a home and in any other kind of building the owner will usually be looking for something more than just colour.



Paint is most often used on cement or concrete floor finishes. Acrylic or polyurethane based paints are most suitable. Paints that are affected by alkaline conditions must not be used. The most important part of any painting job is preparation of the surface. This must be done extremely thoroughly. Surface preparation of a floor entails mechanical grinding of the surface or careful etching with acid which must be cleaned off after it has taken effect and before the priming coat is applied. For good results it is advisable to have a liquid floor coating applied by a firm specializing in such treatments. For those who wish to do it themselves the first step after preparation of the surface is to paint the floor with a priming coat of epoxy. This is recommended because of its moisture resistance. Step two is to apply a base colour coat of acrylic or polyurethane based paint within 24 hours of applying the epoxy primer. Step three is to sprinkle different coloured polyvinyl chloride flakes onto the base colour coat while it is still tacky. After the base coat has dried the surplus flakes are swept away and from three to five sealing coats of clear acrylic or polyurethane are painted on.

### **SOFT FLOOR COVERINGS**

The real subject of this chapter is 'insulative floor coverings' which run the gamut from cork tiles through woodblocks to carpets.

They all present the problem that they prevent the floor from playing its full role in stabilizing daily temperature changes.

On the other hand because they conduct heat so poorly a bare foot placed on them raises their surface temperature to equal that of the body almost instantly and thus these finishes are said to 'feel warm'.

Since such a subjective feeling of warmth is far more likely to be appreciated by the householder than even a 3°C difference in the effective air temperature, science tends to get short shrift when this subject comes up.

Soft floor coverings are perhaps the most practical of all the finishes in use today.

Carpets are attractive. They feel soft and luxurious and, if installed when a building is completed, need not be too expensive.

## Carpets

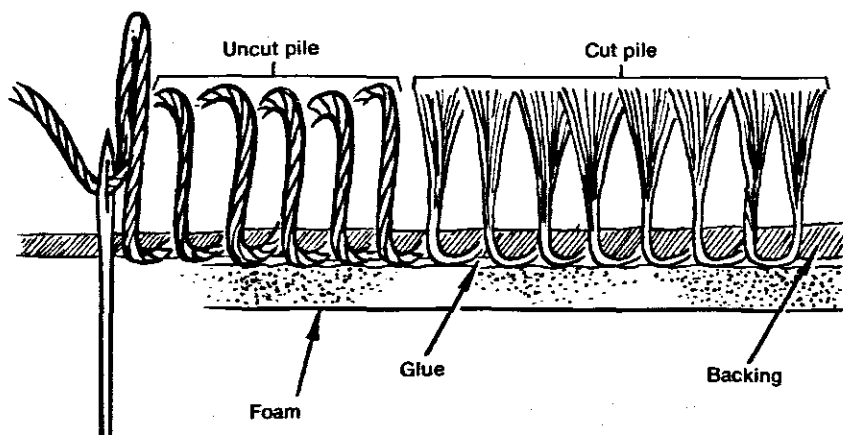
All carpets are combustible, some burning and spreading fire more readily than others. Some carpets when burning give off dense smoke. When purchasing a carpet, it is as well to ask the seller for information on the fire behaviour of the particular carpet. Some of the largest manufacturers of carpets have had many of the different carpets they make tested to determine their fire properties.

There are some carpets where stitch density just cannot be measured because there are no stitches. So it is as well to know a little about how the different kinds of carpet are made.

The traditional woven carpets such as those made in Persia are made on a loom and the tufts are woven into the fabric of the carpet along with the warp and weft. The first mechanical looms to take over this task performed in approximately the same way and industries were established at Axminster and Wilton, two towns in England. These have given their names to the mechanical weaving systems that were pioneered there.

Both methods are capable of producing superb carpets but the name is no guarantee that good materials have been used. The weaving process is inherently slow and this tends to add to the cost.

Some modern carpets are 'tufted' i.e., made on a giant multi-headed sewing machine which sews rows of looped stitches on to a backing material. The stitches are held in place by an adhesive



applied to the back of the carpet. This is usually reinforced with a secondary backing that may be a layer of foam rubber on the underside. This also eliminates the need for a separate underfelt.

The length of the pile may be varied to create raised patterns in the finished carpet. A close resemblance to a woven carpet can be achieved by cutting the loops.

Where adhesive is applied to the backing this may sometimes be drawn up into the tufts which act like a wick, and, as a result, the carpet can have a fine sticky film on the fibres. This soon collects dirt and is extremely difficult to remove. Solvent-type cleaners may help to remove the dirt and the sticky film but they may also penetrate and dissolve the glue adhesion.

Needle-punch carpeting is made by laying a mat of fibres on to a backing (usually made of synthetic fibre) and then stamping it with a frame loaded with barbed needles. These catch the fibres and force them through the backing. The process is continued until the fibres form a felt-like mass. By adjusting the needle density this kind of carpet can be given a ribbed look and made to look more like tufted carpeting.

Both needle-punch and tufted carpets can be made in one colour, or given a 'pepper and salt' look by mixing coloured fibres or have a pattern printed on to them after they have been made. Needle-punch carpets are hard-wearing, quite good-looking and comparatively cheap.

There is another type of carpet on the market called a 'flocked' carpet. To make this, adhesive is spread on a backing and then small nylon fibres are made to stand on end in it by electrostatic force. Once the glue has set one is left with an extremely even carpet that can be (but is not necessarily) hard-wearing.

The capacity for synthetic fibres to develop and store static electricity is responsible for electric shocks that cause discomfort and may cause accidents.

Where carpets are being laid with solvent-based glue the electrical discharges may be quite enough to ignite flammable solvents. For this reason emulsion-type adhesives should always be used.

Trying to stop the carpet shocks is another matter altogether. Most carpet materials gather static electricity whenever the air is dry and charges of as high as 4 000 volts are easily generated when the humidity drops below about 20 per cent. One way to counter this is to use a humidifier to raise the humidity above 50 per cent whereupon the static problem disappears.

There are fluids on the market that neutralize static but these usually leave a cleaning problem in their wake.

The most elegant solution is a type of carpet that has electrical conductors mixed with its fibres and these carry the static away via a conductive backing, generally containing stainless steel wiring but some synthetics have been made to conduct electricity by means of a film of carbon around each fibre.

What should one look for when buying a carpet?

Obviously a carpet must be made to last, but keeping its good looks is just as important as not wearing out. A carpet can also become unsatisfactory as a result of fading, matting or packing down flat, especially since these blemishes do not occur evenly all over.

Checking for such possibilities in the shop is not easy but there are some guidelines that can be followed.

First, take a soft white cloth, moisten it and rub it on the carpet. If any of the colour comes away on the cloth then it is not fast and you are going to experience great difficulties when you come to clean the carpet.

The sun shines into most rooms at some time or another and if the carpet fades in sunlight it will soon become patchy. Take a small sample, cover half of it and leave it standing in full sun for one or two weeks. If at the end of this time you can detect a difference between the two halves then the carpet will soon fade in your home.

When a carpet packs down flat so that it has no springiness and looks like a piece of felt much of its original beauty will be lost. For this reason it is important to be able to tell if this is likely to happen.

If the tufts that make up the pile are packed very close together they tend to hold each other up and resilient fibres such as wool or acrylic

quickly spring back to their original position. This system breaks down when the tufts are too far apart, and it is made worse when the fibre chosen is not as resilient as wool.

There are several means of measuring the pile quality of a carpet, the most accurate being the pile mass. This is the mass of fibre shorn from a square metre of carpet. It is expressed in grams and the figure will be found on the label attached to most imported carpets, though local manufacturers seem reluctant to reveal it.

A good quality woollen carpet might have a pile mass of about 800 grams while the figure for a similar quality synthetic should be around 400 grams. It would be a poor quality carpet that only reached half these values.

Another way of evaluating carpet quality is to count the number of tufts per unit area. To get this figure fold the carpet hard over, back to back, whereupon the tufts will be visible in the fold. Count the number over 50 mm, then refold the carpet at right angles and count again. Multiplying these two figures should give a resultant number greater than 275 (or 11 tufts per square centimetre) if you are dealing with a good carpet.

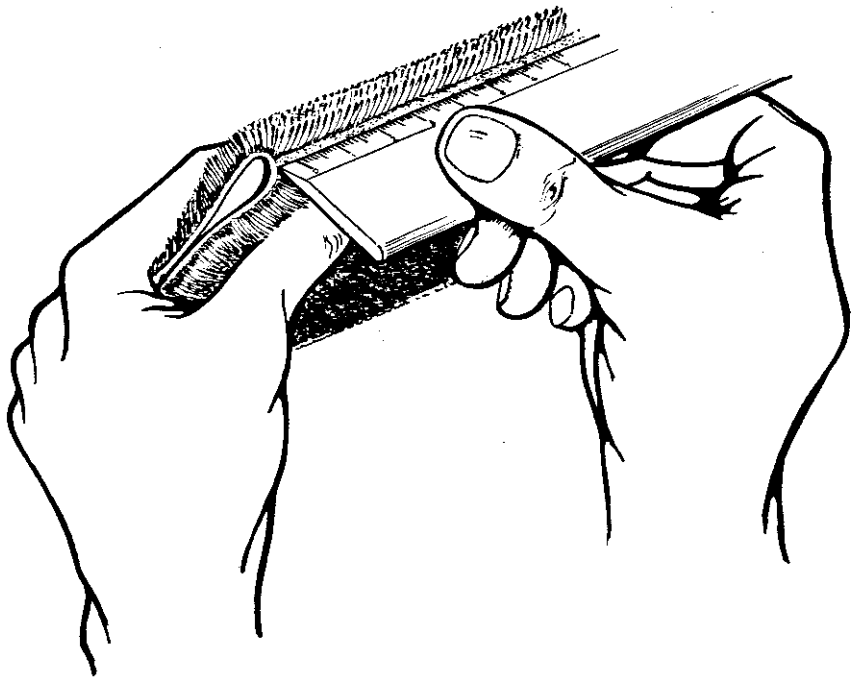
Modern tufted carpets usually average between 5 and 15 tufts per square centimetre. Below 5 the carpet is bordering on the unacceptable.

Obviously a long shaggy carpet may have very few tufts while an extremely tight-packed carpet may have a low pile weight. Both, however, may be good carpets.

Wool is still one of the best materials for carpeting.

It is resilient and, when blended with polyamides, hardwearing. South African wool tends to be too fine for carpetmaking so the wool used by the local carpeting industry has to be imported. This makes it less competitive with synthetic fibres than it might otherwise be.

A useful group of fibres are the polyamides which include Nylon, Bri-nylon, Perlon, Enkalon and Caprolan. These are extremely hardwearing and are very satisfactory when used in sufficient density. However, they are not as resilient as wool and, if the tufts are too far



apart, the carpet tends to pack down into a flat matted layer. Polyamides are resistant to most chemicals.

Closest to wool in feel are the acrylics such as Acrilan, Orlon, Dralon and Courtelle which keep their appearance well. Modified acrylics such as Teklan, Verel and Kanekalon have been created to eliminate some of the disadvantages of simple acrylics.

Other materials found in carpets include polyesters (e.g. Terylene, Dacron); viscose (e.g. Evlan, Cuprama, Arnel); and polypropylene (e.g. Herculon, Meraklon).

### **Laying carpets**

This is a comparatively straightforward procedure requiring merely that the floor be smooth, level, free of irregularities and dry.

Irregularities in the concrete base will provide points for rapid wear while damp can cause the jute backing found on many carpets to rot. If there is only a small quantity of moisture, this will pass up through the carpet and be evaporated, presenting few problems.

However, a really damp floor will raise the humidity of the carpet to the point where rot can set in. (This condition is marked by a distinctive smell.) It may also soften the glue that has been used to fasten the carpet down.

Where an expensive carpet is to be used under damp conditions it will be a wise move to lay a sheet of polyethylene below the underfelt. This in turn can create a slipping problem in which the carpet creeps unless the underfelt is securely anchored.

Do not lay a rubber-backed carpet in a damp place because the rubber may deteriorate and create an unpleasant smell.

### **Wooden floors**

Different timbers have different characteristics but generally the most dense have the greatest resistance to wear. Rhodesian teak is the densest local wood commonly used for flooring, followed by maculata gum, canary pine and patula pine.

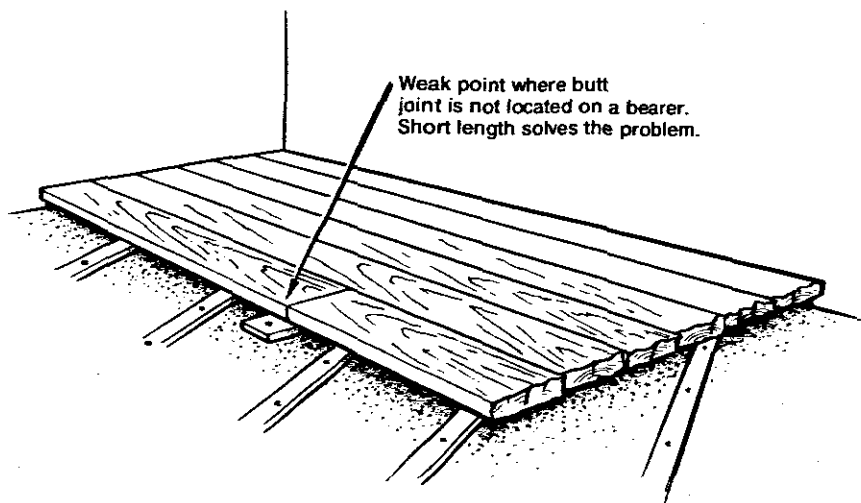
Wood has one overriding drawback, namely that it is more sensitive to moisture than many other finishes. Whereas many floors in the 'hard group' suffer minimal damage where a damp-proof membrane is not installed; for a wooden floor it should be regarded as essential and preferably be set below the concrete slab as described earlier. Where a membrane has been omitted it is wiser to choose a finish that is less affected by moisture.

A wooden floor finish is also unsuitable where underfloor heating has been installed in the concrete slabs. As the heat is switched on and off the floor contracts and expands with the moisture changes. During the dry phase dust and floor sweepings collect in the joints between blocks and then as the blocks take up moisture again this dirt is squeezed between the blocks. Eventually the expansion space becomes completely filled up and the floor breaks down. In addition the insulative properties of wood tend to make sub-floor heating less effective.

Wood, being a natural product, is also subject to attack by natural enemies which include species of termites, wood-boring beetles and a large variety of fungi. Some synthetic materials are also vulnerable.

The processes already described for preventing moisture affecting timber will also do much to prevent attack by fungi because fungi cannot flourish unless there is moisture in the timber. But where there is risk of insect attack in addition to the risk of fungoid growth moisture prevention alone is not enough to prevent it. For, although timber softened by damp is particularly vulnerable to wood boring beetles, these pests will also attack hard dry timber unless it has been pressure impregnated as described in SABS Code of Practice 05-1972. In several areas in South Africa it is a legal obligation to use treated timber in buildings. Even in areas where this is not compulsory treated timber should be used if there is the slightest risk of damp or insect attack. Timber should not be used in spaces that cannot be dampproofed or properly ventilated.

*Board (or strip) floors.* These are normally only found in dance halls or gymnasia today. The modern practice for installing them is to dispense with joists altogether and to shot-nail wooden bearers to the concrete sub-floor. Intermediate bearers can then easily be inserted below end joints of the boards which are the points most liable to failure. Spacing between bearers should be 10 times the board thickness. This practice tends to reduce buckling.



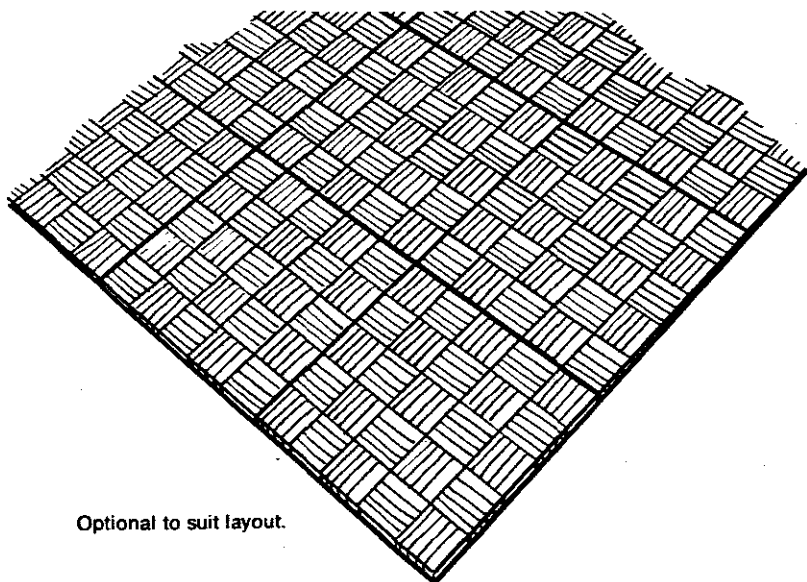
*Parquet blocks.* These are nominally 75 × 225 mm and can be anything up to 30 mm thick. They are found less frequently these days



because they use larger quantities of wood and are consequently more expensive. Problems are less frequent with this kind of floor because the blocks are usually set in hot bitumen, which makes a good vapour barrier. There are normally larger clearances between blocks which help to absorb any expansion that does take place and because of their thickness the floor is inherently more stable against lifting.

*Swiss parquet fillets.* Mostly used today because they can be made from very small pieces of wood and are consequently much cheaper.

They come in preformed tiles as large as 500 mm square and only need to be glued down. Because this can be done all in one piece, it saves laying costs compared with those of traditional parquet.



Optional to suit layout.

Two factors militate against their success.

First, because the fillets have a greater surface area in relation to volume, they respond to humidity change more quickly than blocks and, since each preformed square is machine-assembled there is less room for expansion over the floor as a whole.

The second factor is that Swiss parquet fillets are usually laid on PVA adhesive which, because it is water-based, actually contributes to the moisture load which is at its highest early in the life of the floor slab. Furthermore, PVA is weakened in the presence of moisture which means that floors that are most at risk have the lowest adhesion.

These factors should be kept in mind when laying parquet tiles and special efforts made to see that the floor slab is dry enough (see page 17) before starting work and that the tiles have been left for several days in the room where they are to be laid so that the moisture level in the tiles can stabilize.

*Cork tiles.* Cork is very sensitive to moisture and prone to damage by point loads or indentation by sharp objects. It should be sealed against spillage of liquids. Its advantage is that it is quiet and comfortable to walk on.

### **Finishing wooden floors**

A new wooden floor is usually machine-sanded and then treated with polish, a sealer or varnish to enhance its appearance and protect its surface.

Oleoresinous finishes, such as boiled linseed oil, can be improved by adding modern resins. These mixtures, known as urethane-oil finishes, can be very good. But it is difficult to identify the good ones.

Clear polyurethane undiluted by admixtures of oil gives an extremely hard surface binding the separate blocks or even strips rigidly together. But if the wood floor expands or contracts this floor will develop a few large cracks, rather than many small ones. When this type of finish wears it will tend to flake away in patches and renewal will involve resanding. Clear polyurethane and acrylic will not adhere to a floor that has been waxed. Oleoresins, however, may be applied to a waxed floor with less risk of failure.

All floor finishes are improved by occasional waxing after they have been applied. But overwaxing, without subsequent polishing off, will tend to attract dirt and, possibly, cause accidents as a result of people slipping.