



roadstone

Technical Construction and Detailing for Concrete Pavements.

Introduction

This section describes how purpose-made concrete blocks are laid to form the surface of areas used by low-speed traffic or pedestrians. Roadstone Concrete paving is widely used because it is attractive and durable, and can be laid in both simple and complex areas with very little construction plant.

Coloured and contrasting blocks can be used for decorative patterns. Another advantage of block paving is that it can easily be broken into, and afterwards replaced, to permit access to underground services.

To ensure the best from blocks and to lay them with the minimum effort requires good planning.

In addition, edge restraint is essential to prevent the blocks moving sideways and becoming loose. Standard pre-cast concrete kerbs or channel blocks normally provide it.

Basic operations of paving

- (a) Place and screed the laying course.
- (b) Place the blocks.
- (c) Complete the edges.
- (d) Vibrate the surface.

There are three layers in a block paving

- (a) the sub-base -laid as for a conventional road, the thickness depending on the nature of the ground and the amount of traffic;
- (b) the laying course - a layer of carefully screeded sand, about 50 mm deep;
- (c) the surface course -the blocks themselves.

Establish levels.

Ensure that all have been adequately briefed regarding finished levels. These are normally determined by kerb lines and cross falls amended as necessary for features of adjacent buildings.

Excavate to required levels.

Excavation, either by hand or machine, should be controlled as closely as possible to give a constant thickness of sub-base and bedding layer. The sub-grade should be protected against rain where necessary with polythene sheeting.

Is bottom of excavation acceptable material?

If the sub-grade is unacceptable or soft spots exist then the unacceptable material will normally be removed and replaced with suitable material properly compacted.

Compact sub-grade.

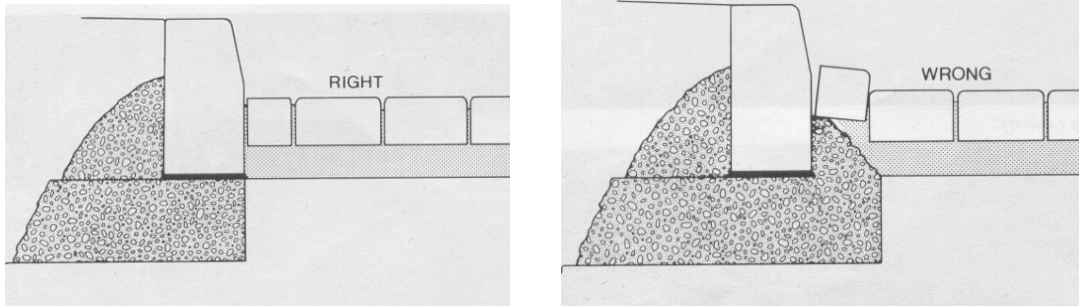
The sub-grade is to be compacted using a roller or vibrating plate. Where no sub-base is required then finished level must have a tolerance of $\pm 20\text{mm}$.



Edge restraint.

This is normally provided by pre-cast kerbs and/or channels, which are laid prior to paving. It is essential that the kerb foundation should not project in front of the kerb or channel face as the surplus concrete will prevent blocks being laid properly. Similar care must be taken with the hunching to gully and manhole surrounds. Edge restraint is still needed even where special edge blocks are used.

Alternatively, use products similar to the Edge Pro restraint available from Roadstone.



Install edge restraint.

Where edgings, channels etc. are required they must be installed in advance and concrete allowed to set before laying sub-base and paving units unless already in existence.

Is sub-base material required?

Where laying on existing sub-base this must be re-profiled and re-compacted. New sub-base as specified to be spread and compacted to the correct profile. It is most important that the sub-base is within the $\pm 20\text{mm}$ tolerance to avoid the finished work being uneven. It is important to ensure that the compacted thickness of the bedding layer will not be less than 25mm at any point.

Spread sub-base material and compact.

Where necessary manhole covers must be adjusted to level in accordance with appropriate specifications. Areas surrounding ironwork must be reinstated to correct profile

Set up screed rails.

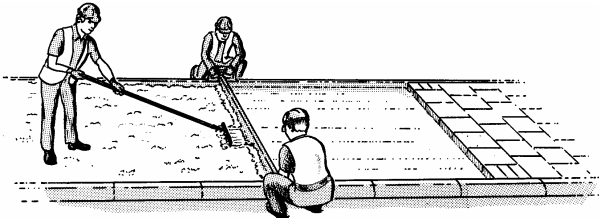
Screed rails must be set up to account for the specified thickness of bedding material together with the surcharge needed to allow for compaction. Preformed steel channels or straight edge timers are ideal. A starting guide is 15-20mm when compacting to 50mm and 9-14mm when compacting to 30mm.

Check levels of sub-base to ensure an even bedding layer will be achieved.

At this stage a final check should be made to ensure that an even bedding layer would be achieved. Failure to achieve this will result in an unsatisfactory surface. Drawing the screed board across the screed rails can do this and ensuring the maximum tolerance does not exceed $\pm 20\text{mm}$.



Screeding to level. Screeding is by traditional methods. On roads up to about 5 m wide Screeding can be done by traditional methods. For wider roads, or over large areas, temporary screed rails set to level on a windrow of sand can be used. It is essential to take care with Screeding, not only because it.



Surcharge.

After final vibration, the blocks will be lower than their initial level because the laying course sand has been compacted and some has moved up into the joints between the blocks. Thus the sand has to be laid to a surcharge, the amount of which depends on the type and moisture content of the sand but is normally in the range 5 to 15 mm.

To ensure that the surcharge is correct, the final road level should be checked after completion of the first few meters and then at frequent intervals. If the final level is incorrect, the blocks may be lifted and stacked and the sand thoroughly raked and re-screeded at a new level.

Is pre-compaction method specified?

BS 7533. Part 3 provides for two methods either pre-compaction or post-compaction. Pre-compaction gives slightly greater control over finish levels but is considerably more labour intensive. Spread first layer of bedding material and screed. The un-compacted depth of the first layer of the sand should be equal to the specified compacted thickness of bedding layer. The layer is to be screeded at this stage. It is important that only sufficient material for a day's laying is prepared or the bedding layer may become unsuitable.

Compact bedding layer.

The bedding layer is compacted using a vibrating plate in one pass. Spread further layer of bedding material. This further layer is the layer on which the paving units are directly laid. A surcharge must be provided to allow for compaction after laying of units. On no account must units be laid directly on pre-compacted sand.

Un-compacted method.

Screed bedding layer, the screed board is moved across the bedding layer to ensure correct levels on which to lay. It may be advantageous for an extra operative to walk in front of the screed board raking away excess sand. Low spots must be filled and re-screeded. No tolerance is allowed in this operation.

Laying patterns.

The most adaptable pattern is herringbone since no special blocks are needed round bends, or in hammer heads and junctions - the pattern is simply maintained.

Rectangular blocks must be laid only in a herringbone pattern; otherwise they will tend to 'creep' under traffic, allowing the joints to open.

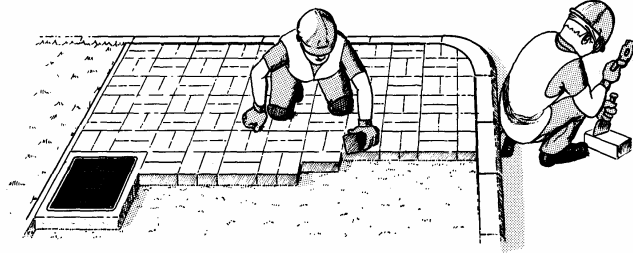
Shaped blocks, on the other hand, can also be laid in stretcher bond, although this pattern may not be suitable for all road layouts. With some designs of block, 'special' shapes are made to allow road curvatures to be followed or to minimize block cutting at the edges. The manufacturer's advice should be followed when specials are used.

The use of paving blocks in a residential road layout. The scale of the blocks is exaggerated to allow the pattern to be seen.



Commence laying paving from a restrained edge laying to required pattern

The blocks are small enough to be picked up and laid with one hand. Blocks are made in a variety of colours. Some types have a chamfer or radius, which should be laid uppermost. Laying must always begin from a restrained edge. In the case of concrete blocks with nibs (spacers) these should be laid "hand tight". Units without nibs (spacers require a joint of 2mm to 5mm to allow sand to rise through the joint to achieve locking. The positioning of the first blocks demands extra care. To give the required laying pattern the blocks must be placed at the correct angle against a firm starting edge such as a row of concrete channel blocks.



Each block has to be placed very carefully so as not to disturb its neighbours, and it is not until three or four rows have been placed that the normal rapid laying rate can be achieved. The order of laying must ensure that the blocks can be placed easily and in such a way that it is never necessary to force a block between those already laid. The herringbone pattern is when they are at an angle of about 45° to the centre-line of the road. Until 8 to 10 rows of blocks have been laid, no attempt should be made to infill at the starting edge or sides - only whole blocks should be laid. However, with a herringbone pattern where the blocks are at 90° to the centre-line, half-blocks should be fitted at the starting line.

Each block must be placed firmly against its neighbours, being held slightly above the laying -course so as not to disturb the sand until the block is in its correct place. Any damaged blocks should be rejected. All blocks must be laid so that they fit closely together. If joints begin to open, the blocks should be knocked together with a hide mallet. Care must be taken not to tilt the blocks on the leading edge of the laying face by standing or kneeling on them.

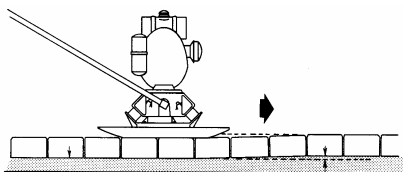
Although cutting need not be undertaken as laying progresses, all cut sections should be placed before compaction and never left until the following day. It is recommended that an extra person undertake cutting. In the case of 200mm x 100mm blocks the trade recommendation is that sections of less than 25% of a whole unit should not be used. For other units it is recommended that cuts be avoided altogether.

Gully entries and manholes.

These also are dealt with by cutting blocks to fit. To ensure efficient drainage of surface water, the blocks should be finished slightly above the gully level. If the ironwork surround is complex, owing to the inclusion of fins, block laying can be simplified if a reinforced concrete surround has been cast in advance.

Vibrate paving to finished levels.

Compaction is to be carried out using a plate vibrator. It should be fitted with a rubber or neoprene skirt where recommended by the paving manufacturer to protect delicate surfaces. This will usually require metres. Men or light equipment can move over the blocks before they have been vibrated. At this stage this may cause an uneven surface, but this will be 'ironed out' by the plate vibrator.



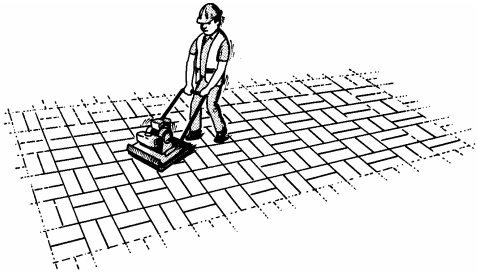
The blocks are vibrated to their final level with a plate vibrator having a frequency of 75-100 Hz. For 60-65 mm thick blocks, the vibrator should have a centrifugal force of 7-16 kN and a plate area of 0.2-0.4 m². For 80 mm blocks, the vibrator should have a centrifugal force of 16-20 kN and a plate area of 0.35-0.5 m². The vibrator should be guided over the whole area, avoiding any unrestrained edge by about a metre. Two or three passes will normally be needed to vibrate the blocks to the finished level.

Spread fine, dry sand to fill all joints.

Fine dry sand as specified should be spread over the surface and swept into joints until filled leaving a surcharge of sand.



Vibrate surface to fill joints.



After the initial vibration, sand is brushed over the surface of the blocks, and is vibrated into the joints by a further two or three passes of the plate vibrator. After all the joints are filled, surplus sand can be swept away. The road is now ready for use.

Detailing

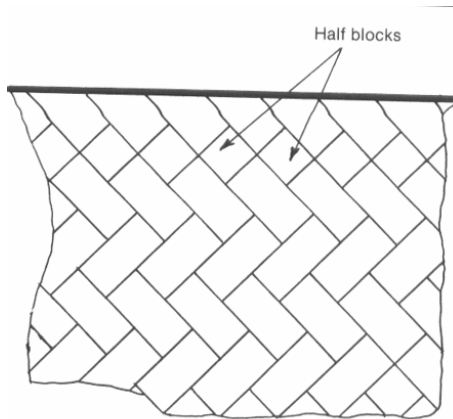
Detailing of edges

Cutting products to fit to a line or around an obstruction costs time and money and it is a great temptation to fill any unavoidable gaps with mortar. If the area of this form of in-filling is small it may show very little and not cause visual offence, but if it is relatively large in area or extensive in quantity this will not be the case. Too much in-filling with mortar can dominate and therefore spoil a desired visual effect.

Flexible paving with blocks and pavers

<p>Small off-cuts</p> <p>Cut two blocks</p>	<p>Even with the smallest units, some cutting will be needed; a good 'rule-of-thumb' is to avoid in-filling with pieces of paver less than a quarter of the area of a whole unit. The wrong and right ways of doing this with units laid in stretcher-bond pattern. When the laying is approaching an edge, instead of finishing with less than a quarter of a block, both the penultimate and final block should be shortened by half the space length. This detail will be apparent under careful inspection, because of the two foreshortened blocks in some rows. Also, the cut edges will not be chamfered, but one of the cut edges can be against the edge restraint and therefore virtually invisible.</p>
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To allow the creation of a similar appearance on both sides of a pavement, most desirable when the pavement is narrow, proceeding outwards in both directions together.



The solution above cannot be used with the majority of shaped units as the shaped sides fix the relative locations of individual blocks. Some makers of shaped blocks have introduced special edge blocks, which can be cut, avoiding the need to cut standard blocks. To avoid cutting along the length of a block in a parquet pattern, all the blocks adjoining the edge restraint should be turned so that their lengths are normal to the edge. If the paving is so narrow that the user will see both pavement edges at once, turning the blocks in this manner on both sides is advisable. If the paving is in herringbone form using rectangular units, there are two ways of avoiding the use of small pieces of block or mortar in-fill. Use half blocks, cut on site, away from the immediate edge. If a full chamfer is considered important, then the half blocks could be cut from stable blocks available from some manufacturers, which have a V-notch halfway across their width. Part blocks can also be used in a similar way where the main laying lines are at 90° to the line of the edge restraints.

None of these techniques can be used with shaped blocks for the reasons given already, therefore when using shaped blocks some mortar in-filling is unavoidable. The mortar should be moist 3: 1 sand: cement mix, tamped firmly into the full depth of the blocks to prevent the ingress of surface water to the underlying parts of the pavement. When deciding whether or not to use a shaped block for a particular project these edge detail aspects must be considered; there is no doubt the rectangular units cause the fewest problems.

Site Organization

The block layer works from the surface he has just laid and is continually supplied with blocks brought to him over those already in place. Sand for the laying course is brought in from the other direction.

It is bad practice

- (a) to bring blocks across the sand;
- (b) to take the laying course sand over the blocks to the area being screeded.

This means that in a cul-de-sac the paving will progress into the site, unlike other road construction methods which progress outwards. Unless alternative access is provided, enough sand must be stockpiled to avoid having to move it over the laying face.

Delivery of blocks

A typical lorry load of blocks from the manufacturer contains about 120 square metres of paving which, for a road 5 m wide, will pave 24 linear metres.

Delivery of blocks should take place in two stages

- (i) bulk delivery by lorry;
- (2) delivery to the laying face by a member of the team.

Stage 1 deliveries are best programmed so that the blocks can be brought along the already completed road and unloaded near the laying face. This will minimize the distance for stage 2 deliveries.

Stage 2. Blocks are loaded and wheeled to the laying face, by a second man. This type of transport is effective for distances up to about 3.0 m.

If available, a fork-lift truck can be used to bring up pallets of blocks, but these still have to be broken down for the block layer. The block layer should always be able to reach the next block to be placed without having to walk or stretch.



Any further tips on laying?

Organise your site well in advance to minimise movement of materials. Avoid delivery of materials before they are needed, as they clog-up the site. Don't spread the base course sand before you are ready to screed, as it dries out in hot weather and reducing its performance. On delivery it is recommended to cover the sand to keep the moisture content consistent. Completed area laid each day including cutting, whacking and sanding.

The laying team

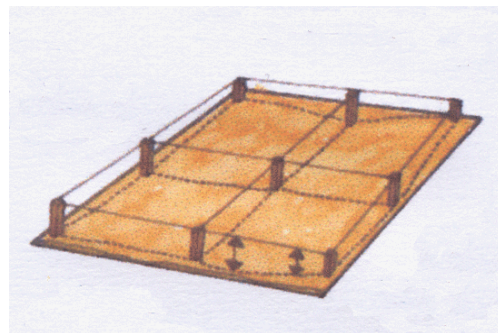
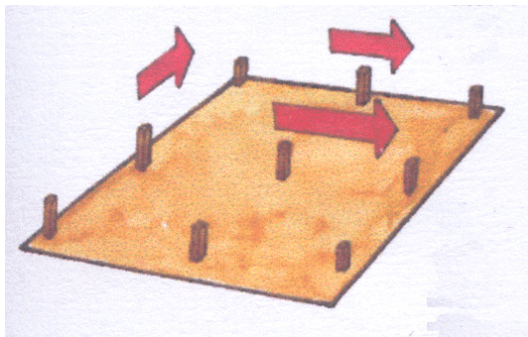
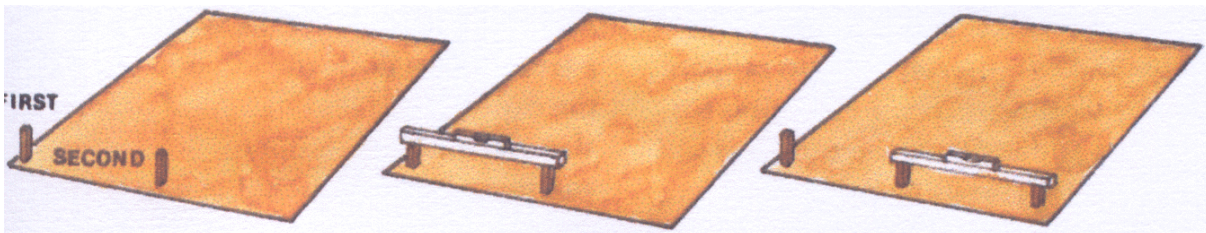
The size of the laying team needed will depend on the complexity of the job. For a typical estate road, a team of three will be needed. The men should change jobs periodically.

When it is necessary to screed more sand, the team breaks from block laying to carry this out. The occasional use of a dumper or loading shovel will be needed for delivering the sand. One-man drops back from time to time to finish the edges and vibrate the paving. On narrow or complex sites the screeding and finishing operations will require a fourth man in the team.

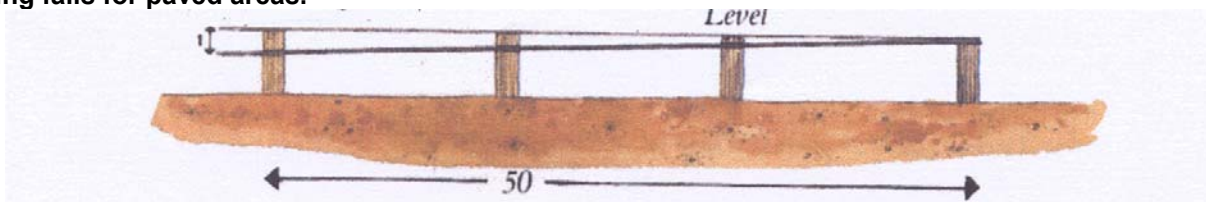
Setting levels

An area may look reasonably level to the eye and where paving is concerned it just is not good enough. Before construction you need to know exactly the surface profile. The first operation is to install accurately levelled pegs to cover the whole area.

A method is to drive a peg firmly into the ground, ensuring that it is firm. About a metre away drive in a second peg into the ground. Span both pegs with a straight piece of timber and place a spirit level on top. Check for level. Remove and gently tap the second peg further into the ground. Replace timber and check for level. Repeating as necessary. Then start again from the first peg and drive in pegs ensuring they are level. Continue the operation across the whole site.



Setting falls for paved areas.





To Calculate Gradients / Falls

A gradient is a slope that relies on gravity to cause the water to flow from the higher point to the lower point. All gradients are defined as the amount of rise (height difference between two points Δh) over a given horizontal distance (run between two points **HD**). Gradients are usually expressed in two different ways – Ratio 1:40, or as a percentage 25%

See Drawing above: $\Delta h = 1$ $HD = 50$

In % Terms: $\frac{\Delta h}{HD} \times 100 = \frac{1}{50} \times 100 = 2\%$

In Ratio Terms: $\frac{HD}{\Delta h} = \frac{50}{1} = 1:50$

