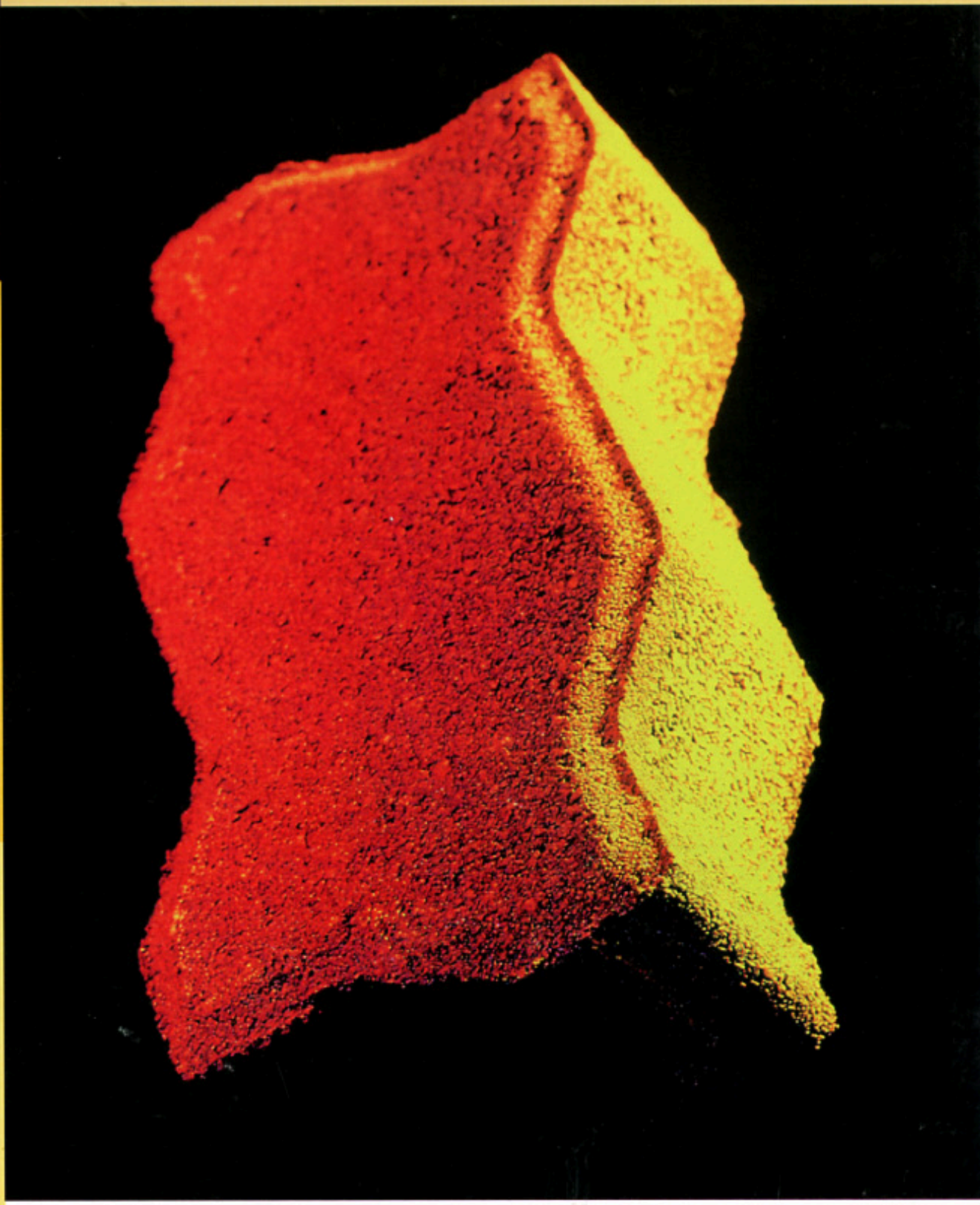
CONCRETE BLOCK PAVING

Book 4 – Site management and laying



A walk-over in cost, looks and durability for Concrete Block Paving

CONCRETE MANUFACTURERS ASSOCIATION
Quality cast in concrete

Concrete Block Paving
Book 4: Site Management and Laying
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1 INTRODUCTION

The purpose of this book is to detail the correct procedures and techniques required to achieve a high quality concrete block paving installation, viz site management and laying.

Whilst this book covers the installation of paving blocks and the construction of edge restraints, the reader is reminded that these are only part of the total pavement. To achieve a durable and economic pavement, the following aspects must be considered.

a) **Design Loads**

Estimation of traffic type and frequency of use of vehicles.

Refer: References 2,3 and 6; professional engineer/competent person

b) **Earthworks**

Assessment of insitu material strength and design layer works to support design traffic

Refer: References 2,3 and 6; professional engineer/competent person

c) **Drainage**

Determination of the correct drainage design for both underground water and surface water flows to avoid premature failures of the earthworks.

Refer: Professional engineer/competent person

d) **Edge Restraints**

Provision of resistance to lateral movement

Refer: Reference 4 and section 4 in this book

e) **Block Paving**

Determine the thickness of block and laying pattern

Refer: References 3,4 and sections 5 to 18 in this book

INSTALLATION DETAILS COVERED IN THIS BOOK

Notes on domestic/pedestrian and light duty pavements

Experience has shown that for domestic driveways and block paving subject only to pedestrian traffic, natural ground will provide sufficient strength for the pavement subject to the following:

a) if the ground is formed from fill material, compaction may be necessary to avoid settlement.

b) the ground must not be subject to saturation from sub-surface water or surface water ponding.

c) the ground surface must be free from weeds or tree roots etc and finished smooth to the required tolerance. Reference 4

If any doubt exists regarding the suitability of insitu material for light duty paving, a competent person should be consulted.

2 SITE INSPECTION

Before block paving work commences, an inspection of the site should be carried out by the paviour.

Items to be checked should include:

- *earthworks surface tolerances*
- *sufficient slopes for drainage (minimum of 2%).*
- *correct levels to allow the finished block paving to tie into buildings, manholes, drainage outlets etc.*
- *edge restraints — if done by others*

Whilst the above items are not the responsibility of the paviour, the block paving should not be laid if other works are not prepared adequately.

It is recommended that the paviour request a certificate or written instruction from his client stating that the other works are complete and ready to receive the block paving.

Any problems should be reported to the client who must arrange for the defective works to be rectified.

The standard specification for the construction of pavements is contained in the SABS 1200 series with SABS 1200MJ covering concrete block paving.

The paviour must also examine and allow for the following:

- *contract drawings and specifications.*
- *setting out requirements for kerbs and edge restraints*
- *details and locations of manholes/catchpits.*
- *truck access for delivery of materials.*
- *material storage areas*
- *any restrictions to working areas*

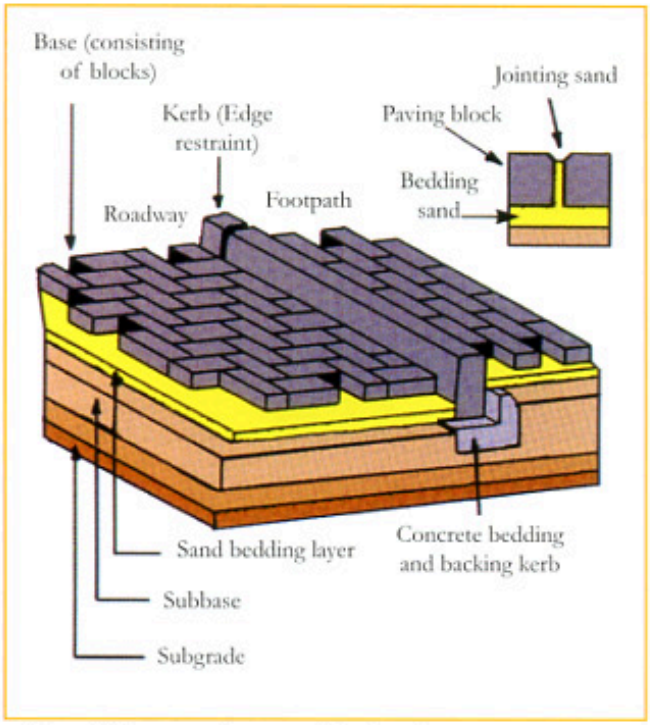


Figure 1: Elements of concrete block paving

3 CONSTRUCTION PLANNING

Economical construction of segmented paving requires co-ordination of the main activities of materials handling, installation of edge restraints and laying, compacting and sanding of blocks to ensure all operations are carried out in an orderly and efficient manner. Refer to figure 2

Cost effectiveness by means of job planning involves an overall assessment of the extent and type of work involved, the requirements for labour, materials and equipment, and time or other constraints. Attention should be given to:

- *examining the drawings, for position of kerbs, manholes, catch pits and other penetrations or obstructions in order to minimise cutting of blocks.*
- *the installation of edge restraints and kerbing.*
- *planning starting point for paving, subsequent development of the laying face and the use of string lines to control regularity of laying.*
- *deciding on the location and phasing of placing, compacting and sanding teams to facilitate orderly progress of the paving; positioning of bedding and joint-filling sand stockpiles; co-ordination of paving block deliveries to minimise travel distances and double handling; selection of equipment to be used, particularly suitable trolleys or buggies etc. to facilitate transport of paving blocks from delivery points to the laying face.*
- *processing of one days production must include total process to complete an area, from laying to compacting and sanding*

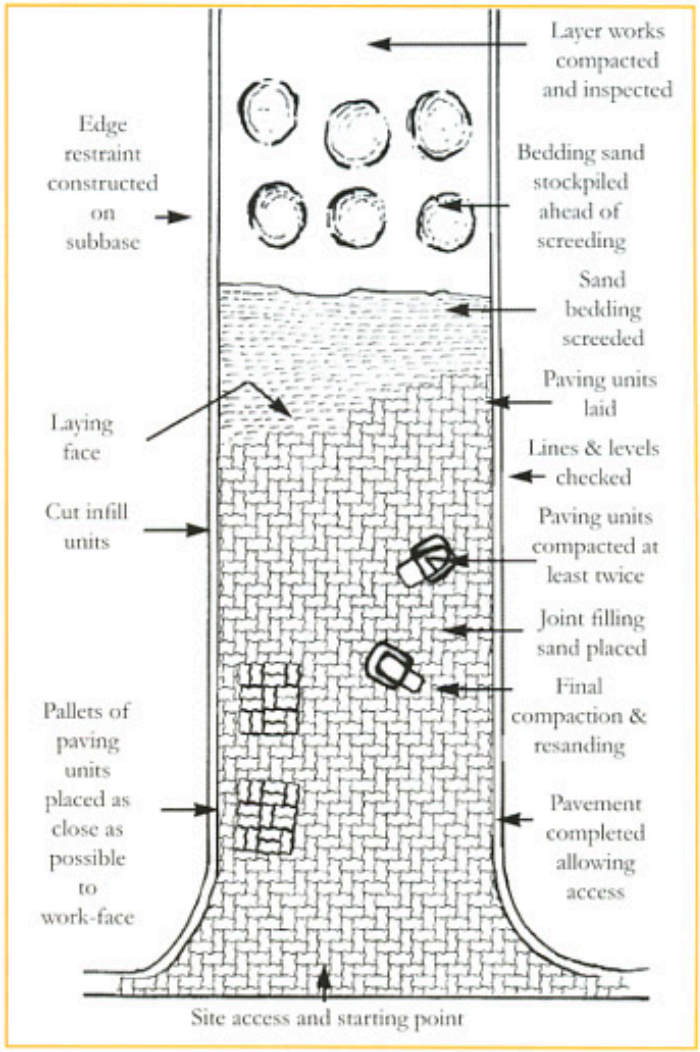


Figure 2: Typical site layout/construction sequence

4 CONSTRUCTION OF EDGE RESTRAINTS

The selection of different types of edge restraints depends on the type of service, the intended traffic load, the required performance life, aesthetic appeal, drainage requirements and cost. Refer to reference 3 for details on edge restraints. Edge restraints must be positioned before block laying begins so that they can be used for reference levels and prevent the migration of blocks. Refer to figure 3

Edge restraints are useful as a screeding guide as the screed board can be cut to the required depth below the top of the edge restraint.

Edge restraints should be positioned on the subbase level and it is important that these are securely supported with an adequate concrete backing before block laying commences.

Figure 3: Checking of edge restraints

5 LAYING THE BEDDING SAND

Ensure that the sand has been protected from either excessive drying out or wetting to ensure a uniform moisture content. Refer to figure 4

Varying moisture content leads to irregular compaction of the blocks into the sand. Sand which is too wet will not screed properly and be difficult to compact and sand which is too dry will not compact satisfactorily.

For the correct grading of the bedding sand, refer to Table 1 below:

Table 1: Grading of bedding sand

Sieve size, mm	% passing
9.25	100
4,75	95 - 100
2,36	80 - 100
1,18	50 - 85
0,500	25 - 60
0,300	10 - 30
0,150	5 - 15
0,075	0 -10

Note: Bedding sand should not be used to even out irregularities in the subbase

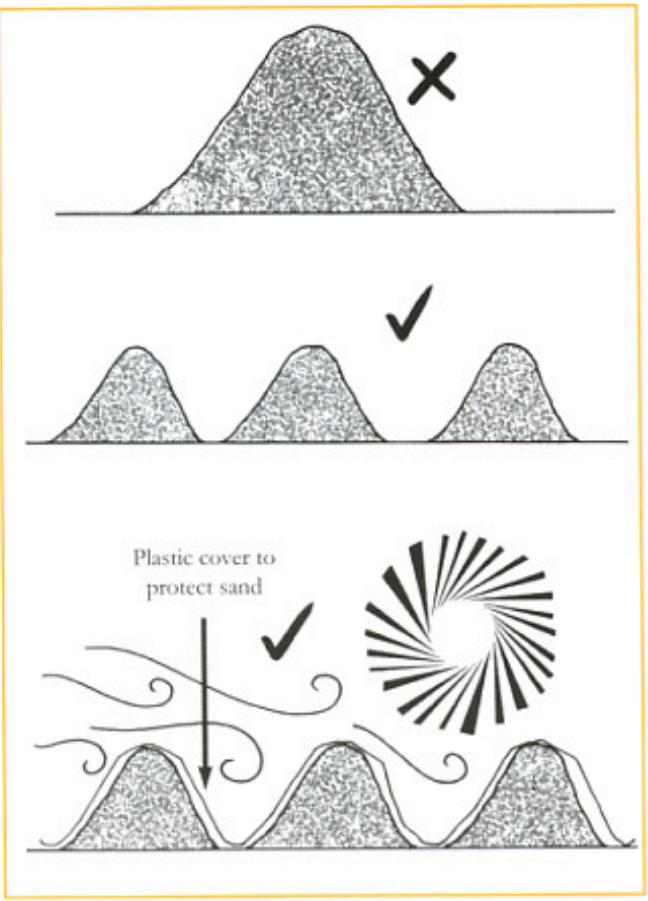


Figure 4: Storage or stockpiling of bedding sand

Adequate compaction of the bedding sand under the blocks can be achieved at moisture contents typically lying within the range from 4 to 8%, with 6% representing a satisfactory target value.

For sands complying with the grading limits, the effects of water content appear to have little influence on the behaviour of the pavement under traffic. However, where the bedding sand contains a significant proportion of clay, greater than about 10%, the infiltration of water into the bedding sand has been found to produce substantial increases in deformation accompanied by pumping. For this reason the use of sands containing active plastic fines should be avoided in the bedding layer. Such sands are nevertheless suitable for use as jointing sands both in respect of their mechanical properties and also as a means of inhibiting the ingress of water into the joints.

The use of plastic sheeting below the bedding sand is NOT recommended since it breaks the bond between the bedding sand layer and the subgrade or subbase layer and may induce horizontal creep of the block surface. It may also result in a reservoir of water collecting in the bedding sand layer. This water, if it evaporates through the blocks, can cause efflorescence.

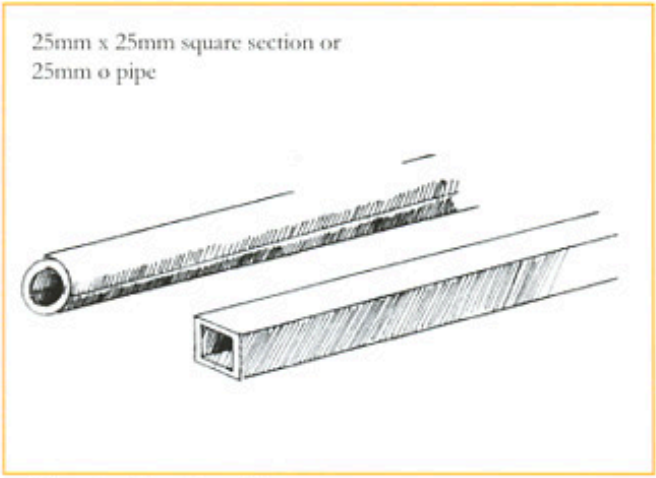


Figure 5a: Screeding rails

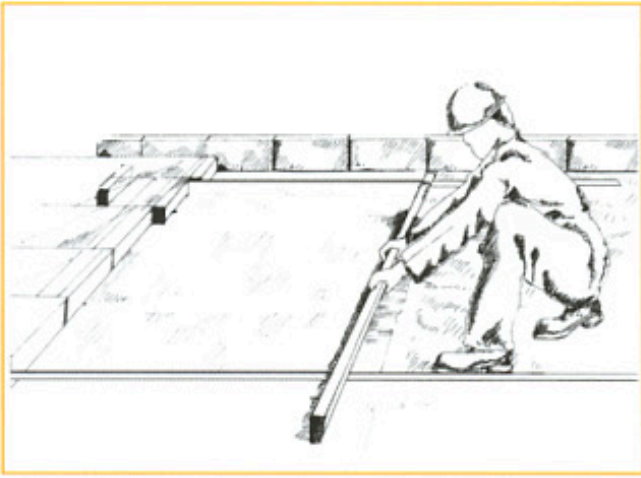


Figure 5b: Prepare the site, place screeding rails and screed the bedding sand.

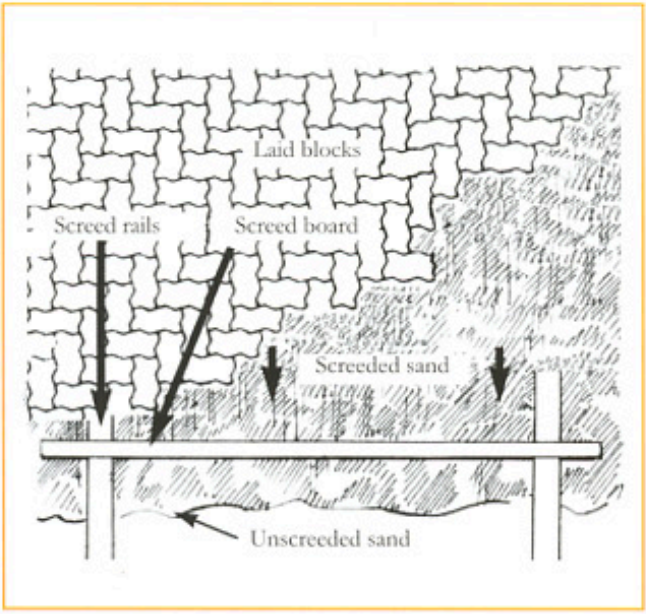


Figure 5c: Lay screeding rails approximately 2m apart

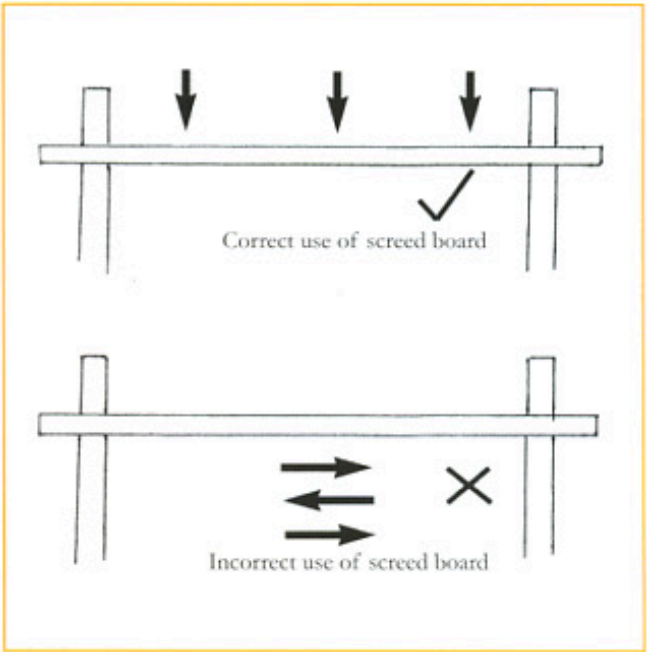


Figure 5d: Use of screed board

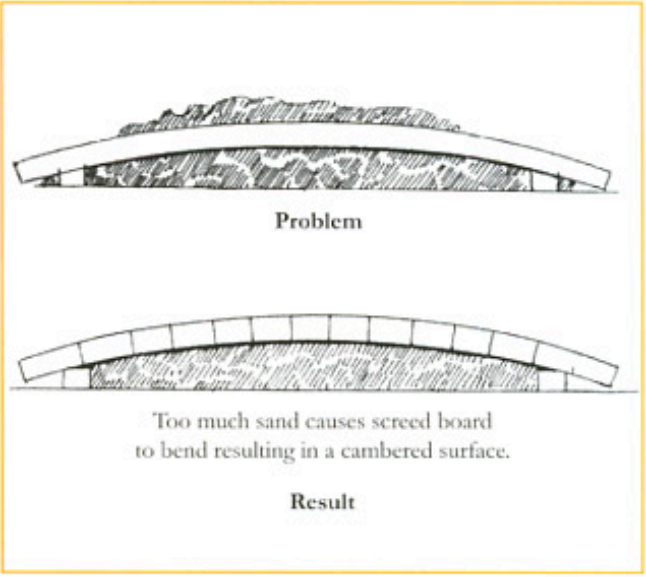


Figure 5e: Do not try to screed too much sand.

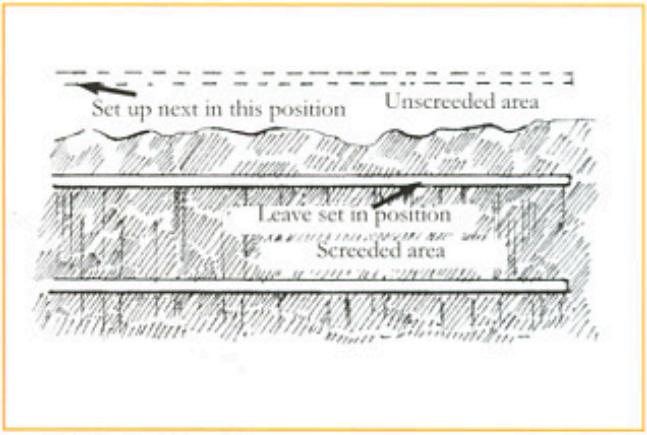


Figure 5f: Preparing and setting a screed rail for a parallel area.

Figure 5: Screeding of bedding sand layer (continued)

Figure 5: Screeding of bedding sand layer (continued over)

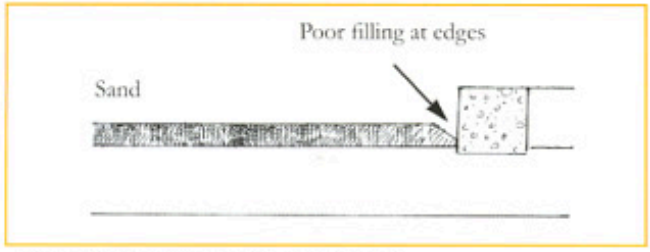


Figure 5g: Watch for poor filling at edges

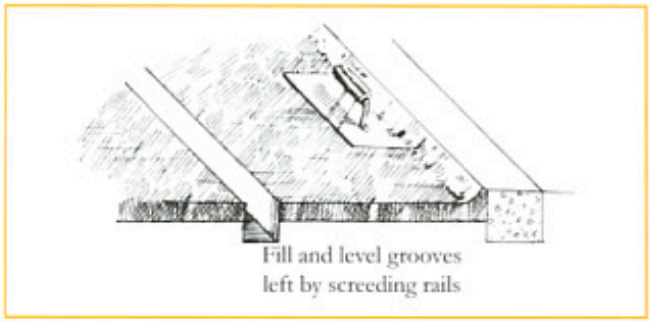


Figure 5h: Making good after removing screeding rails.

6 SCREEDING THE BEDDING SAND

Distribute the bedding sand in sections, a few metres at a time, using the length of the screeding rails as a guide.
Refer to figure 5

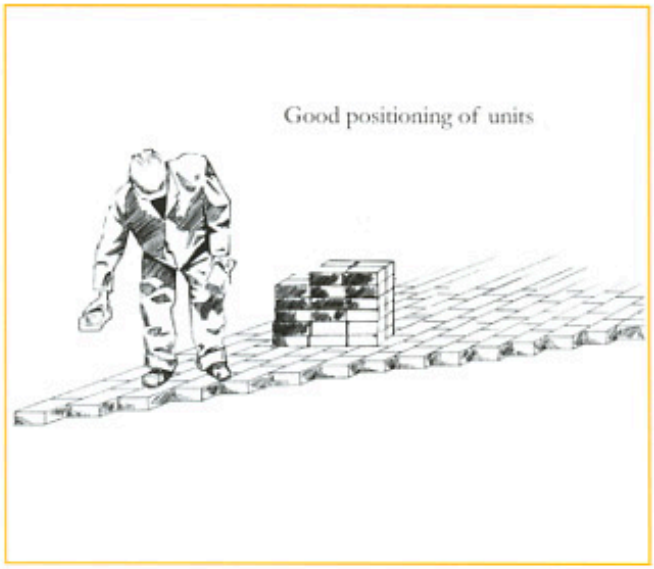
Lay screed rails roughly two metres apart on the prepared surface. Their height should match the uncompacted thickness of the screeded bedding sand to produce the desired surcharge.
Refer to figure 17

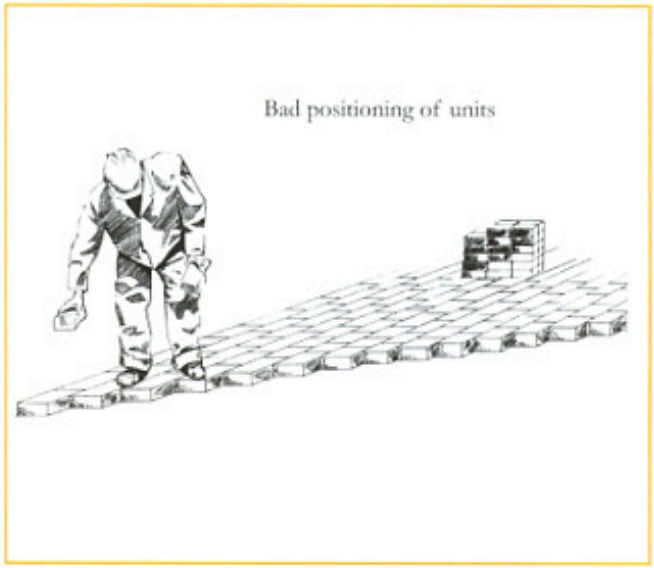
Establish this by tapping a block into the loose bedding sand and measure the amount of surcharge. The thickness of the bedding sand layer should be 15-35 mm after compaction.

Do not permit workmen to walk on the sreeded sand since this results in uneven compaction and an uneven block surface. If pockets or depressions appear behind the screed rail, fill them with loose sand and rescreed the area.

To ensure an even uncompacted surface, make two or three passes with the screeding board. Avoid a sawing action when screeding as this results in an uneven surface area.
Refer to figure 5d

When screeding, adjust the bedding sand level up to edge restraints, kerbs, drainage structures or existing paved surfaces so that the paving, after compaction, will stand proud of the edging by 5-10 mm to allow for subsequent settlement.





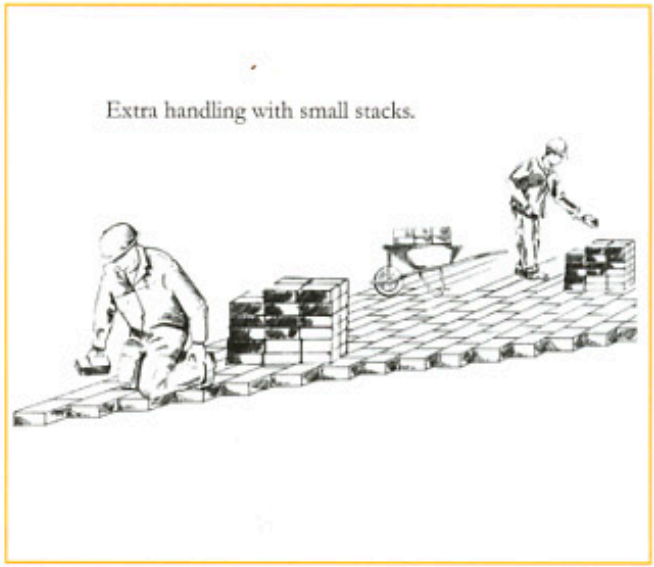
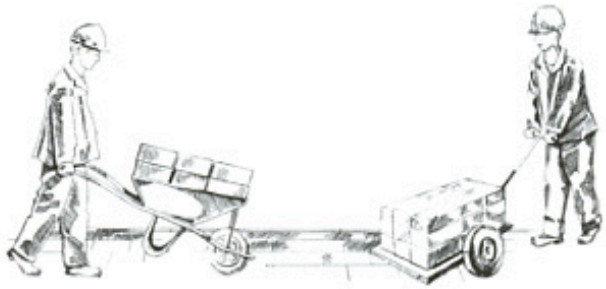
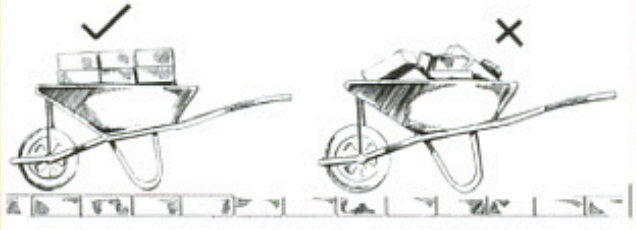


Figure 6: Handling and stacking of pavers

Clamp trolley Manual



Wheelbarrow Trolley and stools



Orderly stacking of blocks in wheelbarrows makes for easy unloading.

7 SQUARING UP THE AREA TO BE PAVED

It is important to commence work from one point only to ensure a uniform pattern of laying.

Determine the line of paving to suit conditions. Align the pattern with the direction of the roadway or parallel to a wall or edge restraint.

Since the kerb-line itself may not be perfectly true use two string-lines at right angles and check the accuracy of the alignment regularly.

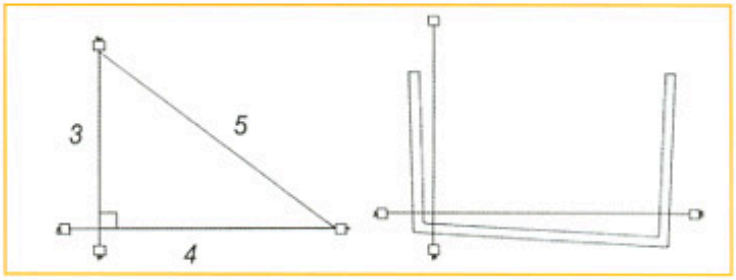


Figure 7: Correct setting out of site

8 LAYING THE CONCRETE BLOCKS

Start laying the blocks in a right angle corner and work outwards in both directions. Establish a diagonal laying face to achieve optimum productivity. Refer to figure 8

If applicable, work uphill to prevent the effect of gravity and movement of the block laying crew opening up joints between the blocks already laid. Refer to figure 10

An optimum space of 3mm should be allowed between each block to ensure the correct filling of jointing sand. If the space is too small, it leads to spalling, damage to the blocks and reduced load transfer between adjacent blocks. If it is too wide, it prevents load transfer between blocks.

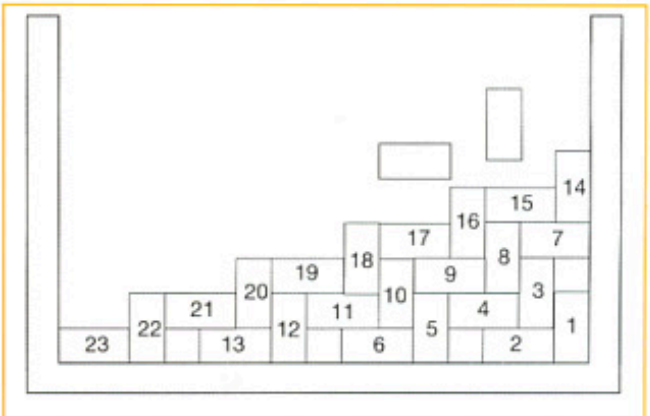


Figure 8: Laying of block paving

Typical site layout/
construction sequence

Edge restraints installed
before laying commences

Screeding the bedding sand

Commencement of laying
establishing a diagonal face

Cutting blocks at edge restraints

Sweeping in the jointing sand

Vibrating the jointing sand into the joints

Temporary restraint at end of a days production

In order to assist with this process, some blocks are manufactured with spacer nibs to avoid a total closing of the joints. Spacers, however, are only a guide and the paviour must adjust the blocks to achieve the optimum 3mm joint width.

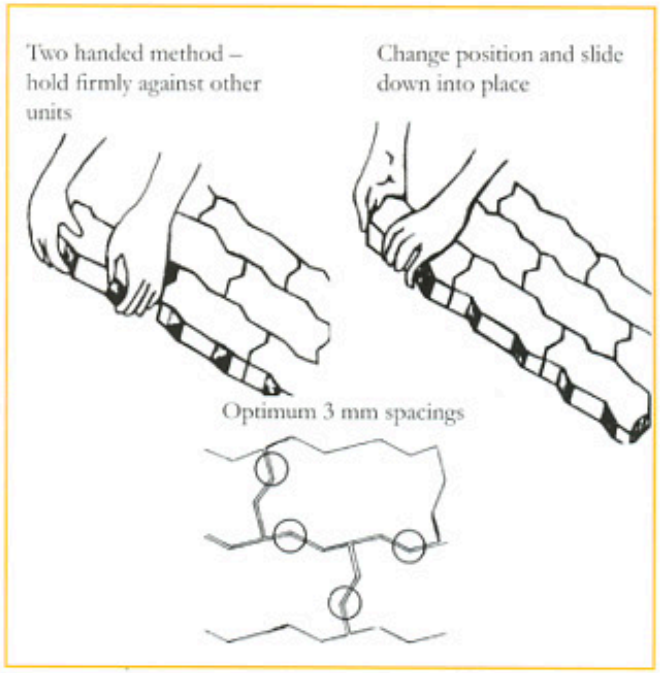


Figure 9: Laying of concrete blocks

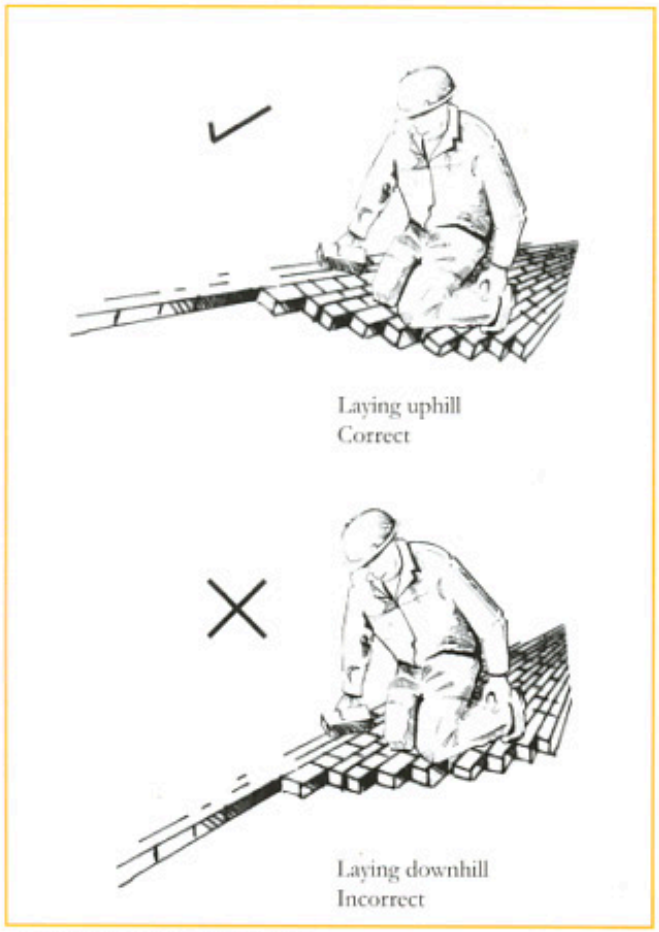


Figure 10: Laying on an incline

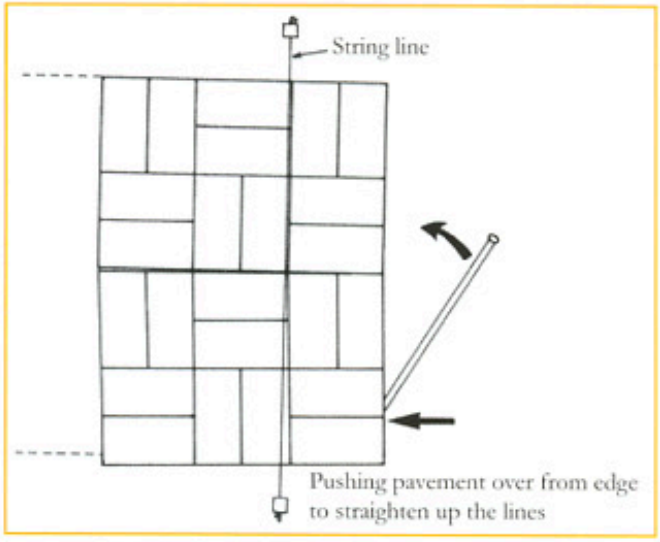


Figure 11: Method of alignment

9 ADJUSTING THE PATTERN AND LINING UP THE BLOCKS

Use a string-line to check the alignment for squareness once a specific area has been completed. Make any adjustments by using a lever to move sections of blocks.

This should be carried out regularly to avoid the difficulty of adjusting large paved areas.

The process must be undertaken prior to compaction and the spreading of jointing sand, as it will be difficult to move blocks after joint filling.

10 BLOCK CUTTING

Block cutting for precise infilling of spaces next to kerbs and edge restraints involves measuring the space on the block to be cut, marking the block with a chalk line, cutting the block with an industrial guillotine and tapping the cut block into the space.

Edge spaces of more than 25% of a full block, should be filled with a neatly-cut block to ensure that the adjacent blocks do not move against the kerb or edge restraint once vibration of the surface has commenced. Generally, the blocks along the edge restraint can be realigned to soldier course so that all cutting results in large rather than small block pieces.

The use of infill concrete should be avoided wherever possible.

However should infill concrete be necessary, it should be of a greater strength than the paving blocks, extend down to the subbase and be properly cured.
Refer to section 14

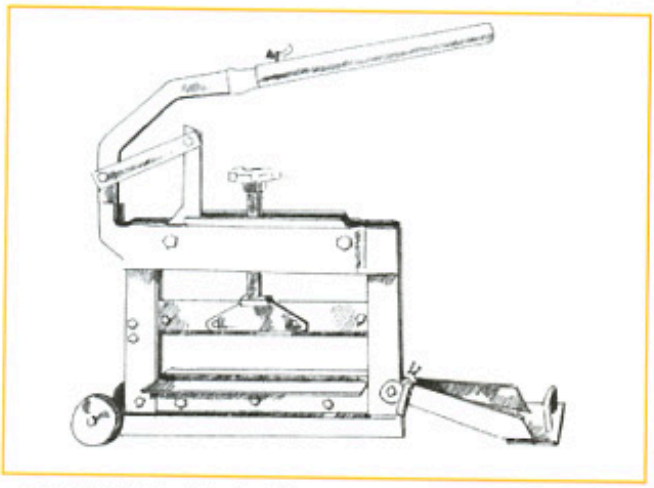


Figure 12: Typical block splitter

Figure 13: Fitting cut blocks into gaps

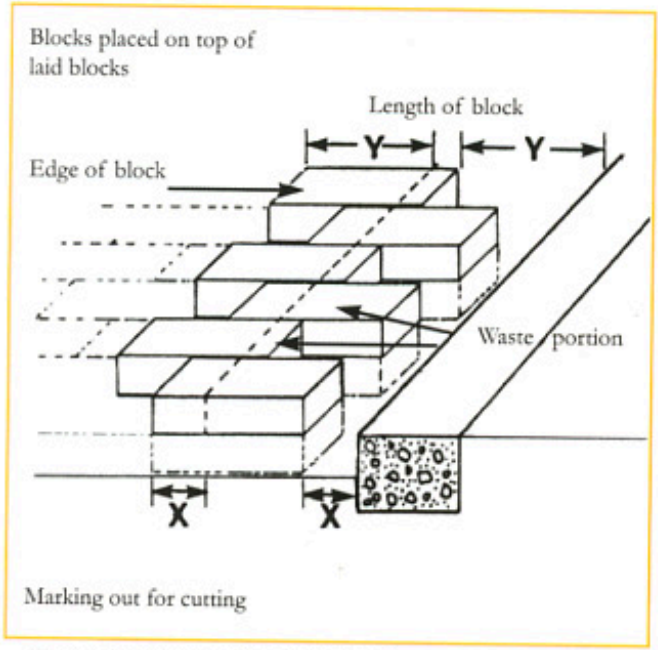


Figure 14a: Marking of blocks for cutting

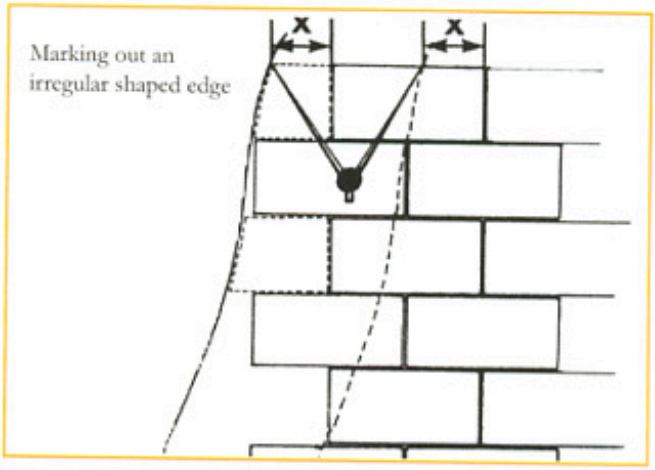


Figure 14b: Marking of blocks for cutting

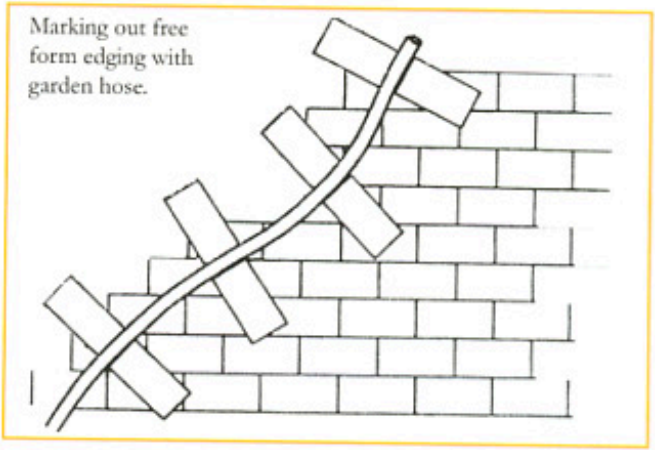


Figure 15: Marking of blocks for cutting

11 VIBRATING THE BLOCKS INTO PLACE

Once the blocks have been placed and edge cutting completed and prior to spreading the jointing sand, the blocks must be compacted into position by at least two passes of the plate compactor. This action will bed the blocks into the bedding sand.

Check and remove blocks that have settled incorrectly i.e. either too high or too low and adjust level by removing or filling with bedding sand.

Individual blocks, which are damaged, must be removed and replaced.

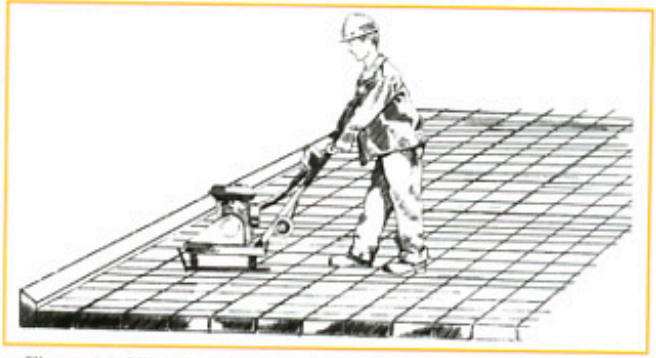
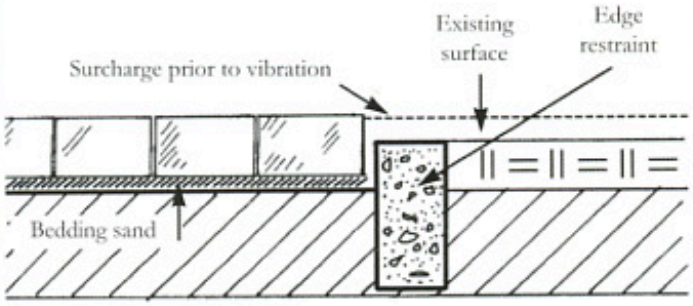
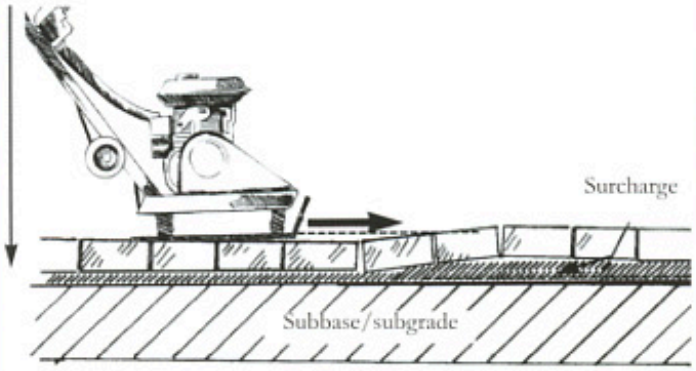


Figure 16: Vibrating the blocks into the bedding sand layer

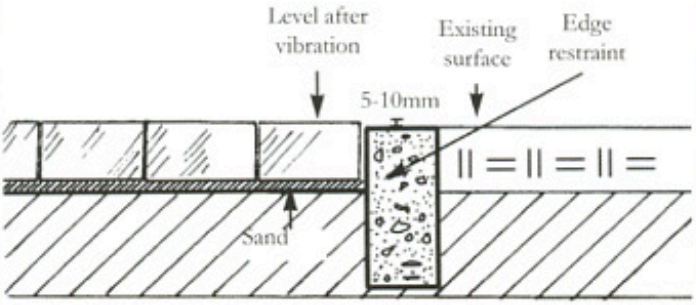


Allowing surcharge for compaction

Thickness of bedding sand layer should be 15-35mm after compaction.



Using a vibrator to compact the pavement



Correct levels after compaction

Figure 17: Allowing for surcharge

12 SWEEPING IN THE JOINTING SAND

Once a specified area has been paved, checked for line and level and the compaction completed, check and replace any damaged blocks. When complete, dry jointing sand should be swept into the joints between the blocks.
Refer to figure 18.

Do not use bedding sand as a substitute for jointing sand as this is often too coarse. The jointing sand should pass a 1,18mm sieve and contain 10-50% material passing the 0,075mm sieve.

Do NOT hose the jointing sand into the joints with water as wet sand will bridge between the units and resist compaction and filling. This results in an unsightly and uneven paved surface. The sand bridges collapse once they dry out, leaving open gaps between the blocks leading to ingress of water and movement under traffic.

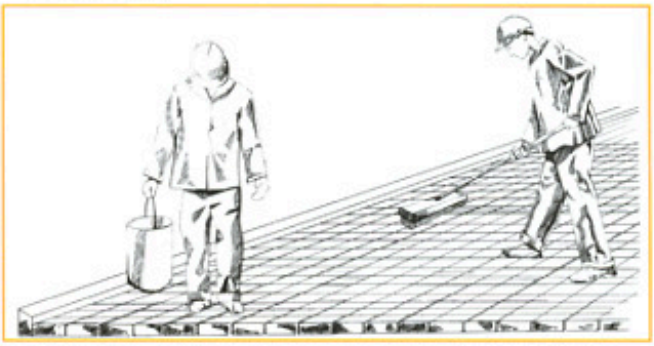


Figure 18: Sweeping in jointing sand

13 VIBRATING THE JOINTING SAND INTO THE JOINTS

Vibrating the jointing sand into the joints is carried out by two or three passes of the plate compactor. This creates the semi-rigid, interlocked surface.

This process, which also achieves additional compaction of the individual blocks, should alternate with sweeping the jointing sand until the joints are completely filled.

Jointing sand must not include cementitious materials, which would turn this flexible form of pavement into a rigid surface.

If construction work is still in progress, excess jointing sand can be left in place after completion and swept off at a later stage. This helps to ensure complete filling of the joints during the period when the blocks are first trafficked. Thereafter excess sand should be removed from the paved area.

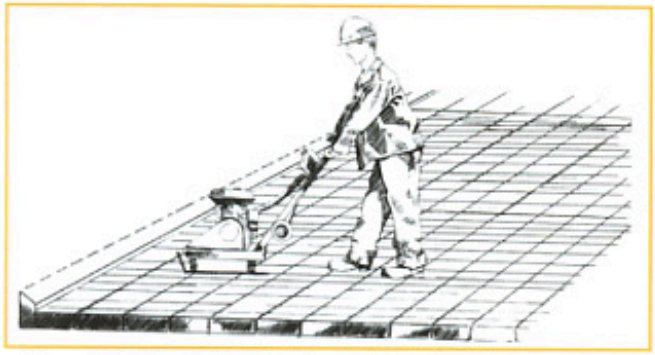


Figure 19: Vibrating the jointing sand into the joints

14 INFILLING

The use of insitu infill concrete should be avoided wherever possible. Small edge spaces can often be eliminated by either orientating the blocks close to the edge or by using the double cut method. Refer to reference 4 for details.

Both of these methods will result in larger cut blocks, which perform better than small pieces. Where the small edge spaces cannot be eliminated by the above methods, then they should be filled with an insitu infill concrete.

It is important that this latter process is only undertaken once all compaction is completed. Vibration and movement of the blocks under the plate vibrator may crack the concrete if infilling is undertaken prior to final compaction.

15 TEMPORARY EDGE RESTRAINTS

If paving cannot be completed in one day, laying should stop about half a metre short of the screeded sand edge to prevent the displacement of unsupported bedding sand and adequate temporary restraints placed to contain the block laying surface.

Note: Complete all compaction, joint sanding and vibration up to the temporary restraints, and ensure that all block cutting and infilling work has been carried out.

Use a plastic sheet to cover the temporary restraint and exposed bedding sand in case of overnight rain. A downpour could be disastrous to a well prepared layer of bedding sand. Rainwater will wash away this layer and result in the lifting of large sections of blocks already laid and thus cause costly delays.

Finish paving at an angle to the kerb line so that when work is restarted, a noticeable transition line is not visible.

16 CHECK LIST

- *Select blocks of appropriate shape, thickness, quality and colour for the surface pattern required.*
- *Engineer to accept earthworks as ready for paving — levels and compaction*
- *Select appropriate edge restraints and install to correct line and level.*
- *Place bedding sand on site. Ensure sand has correct moisture content.*
- *Lay screeding rails on subbase layer.*
- *Tap a block into the loose bedding sand and measure the amount of surcharge. The thickness of the bedding sand after compaction should be 15mm to 35mm.*
- *Spread bedding sand between screeding rails.*
- *Level sand with two or three passes with screeding board.*
- *Fill pockets or depressions in surface with loose sand and rescreed the area.*
- *Adjust the bedding sand level up to edge restraints when screeding.*
- *Remove screed rail and fill recesses with loose sand.*
- *Ensure paving stands proud of fixtures to allow for bedding sand settlement.*
- *Commence laying from one starting point only - the lowest point.*
- *Use string lines to constantly check alignment.*
- *Square up the immediate area to be paved.*
- *Start laying the blocks in a right angle corner and work outwards.*
- *Establish a diagonal laying face.*
- *Allow a space of about 3mm between adjacent blocks.*
- *Make any adjustments to line and joint width by using a lever to move sections of blocks.*
- *Measure and cut blocks for edge spaces. Orientate blocks at the edge or use the double cut method to eliminate the small edge space.*
- *Compact paving blocks with at least two passes of a plate compactor or roller.*
- *Check and adjust for highs and lows.*
- *Sweep jointing sand into the joints between the blocks.*

- Remove excess sand from the surface before vibrating.
- Use a compactor to vibrate jointing sand into the joints.
- Top up joints with sand and recompact.
- Fill edge spaces of less than 25% of a full block, with a high-strength concrete. Only fill these spaces once vibrating has been completed.
- Fit temporary restraints at the end of paving if it cannot be completed in one day. Finish paving at an angle.
- Use plastic sheeting to cover the temporary restraint and exposed bedding sand in the event of overnight rain.
- Restart work on the previously established angle to the kerb-line.

17 MAINTENANCE

a) Resanding

Frequently, jointing sand is lost in the early stages of the pavement life due to wind, rain or traffic. It is advisable that pavements are inspected after three to four months and where unnecessary, resanded and at regular intervals thereafter. Lack of jointing sand causes blocks to tilt under traffic and spall.

b) Weed growth

Occasionally, grass and weeds grow in the joints between blocks. This generally is a result of wind-blown seeds and is not prevented by the use of a plastic sheet under the paving. Herbicides can be mixed into the bedding sand and jointing sand or sprayed onto the finished paving. This, however, will leach out in time and will require respraying on a frequent basis. Weeds and grass will not grow in highly trafficked areas.

c) Settlement/subsidence

Settlement of the paved surface is generally a result of inadequate earthworks, or overloading. Concrete block paving is particularly advantageous in this regard, since a section of the paving can be lifted, the earthworks repaired and the pavers relaid, resulting in an unscarred surface.

d) Reinstatement of trenches after opening

One of the major advantages of using concrete block paving as a surfacing material is that access to underground services for maintenance purposes can easily be obtained, and reinstatement carried out in such a manner that the repair is invisible and does not result in an unsightly scar, as would be the case with other paving materials.

Details of the procedure of trench reinstatement are given in the training manual. Refer to reference 5

In short, the construction is as follows:

- Remove the jointing sand from around one or more pavers. Using two screwdrivers lift up the block. Once the first block is removed others can be uplifted more easily.

  Uplift blocks along the length of the trench to a minimum width of 1m or as required.
- After excavating the trench, backfill and compact the soil to at least the same density as the surrounding soil. Level the top of subbase/subgrade.
- Uplift the blocks on either side of the trench by a further 300mm, loosen up the bedding sand now exposed and spread and rescreed the bedding sand layer.
- Ensure that the blocks are clean. Relay the blocks, compact the paving and replace the jointing sand as normal.

e) Efflorescence

Efflorescence is a white deposit, which is apparent either as white particles or as an overall lightening in colour.

The latter effect is sometimes mistakenly interpreted as the colour fading or being washed out.

Efflorescence is usually a transient phenomenon and can be expected to disappear with time. The major factor influencing its duration is the environment to which the concrete is exposed. Where the concrete is fully exposed to the weather, rainwater (which is slightly acidic) dissolves the deposit and the efflorescence typically disappears in about a year. In more sheltered locations, removal by natural means may take considerably longer.

It is strongly recommended that efflorescence is allowed to disappear naturally to avoid damage by an acid wash.

If immediate removal is required this can be achieved by washing with diluted acid. Generally a 5% solution of hydrochloric acid or a proprietary acid-based concrete cleaner is used.

Before the acid solution is applied, the surface should be dampened with water to prevent the initial suction. This prevents the acid solution from being sucked into the concrete before it has a chance to react with the surface deposit.

The acid solution is applied by brush or spray and a typical application rate is one litre of acid solution to ±10 square metres. Following application of acid solution, the surface of the concrete is washed and allowed to dry out and is then inspected. Often one wash with acid solution is sufficient, but in more stubborn cases the treatment is repeated as necessary until the efflorescence disappears. Finally, it is advisable to give the concrete a final wash with water. When carrying out acid washing, always test the effect on an inconspicuous area before doing the main area. Efflorescence is unlikely to recur following its removal with an acid solution.

f) Oil Stains

Paving is often stained by oil, diesel or other liquids. The best method of removing these stains is to scrub with a hard bristle brush and a strong detergent and to wash off with water.

Where oil stains are to be expected, such as on a garage forecourt, it is recommended that, during construction, a number of coloured pavers are used in a random fashion to create a mottled effect. This will help reduce the visibility of oil stains if they occur. Alternatively a darker paver should be specified.

g) Sealers

There are a number of proprietary brand sealers on the market (silicone, silanes and siloxanes). These sealers have the advantage that they bring out the colour of the pavers and reduce the chances of oil stains. They also reduce the permeability of the sand joints. If required, sealers should be applied when the paving is new or has been thoroughly cleaned. However in most cases, the cost of sealers will not warrant the application. Also the surface is subjected to abrasive action, which will remove the surface sealers, and this will become a regular maintenance item.

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6) *LOCKPAVE® design program.*

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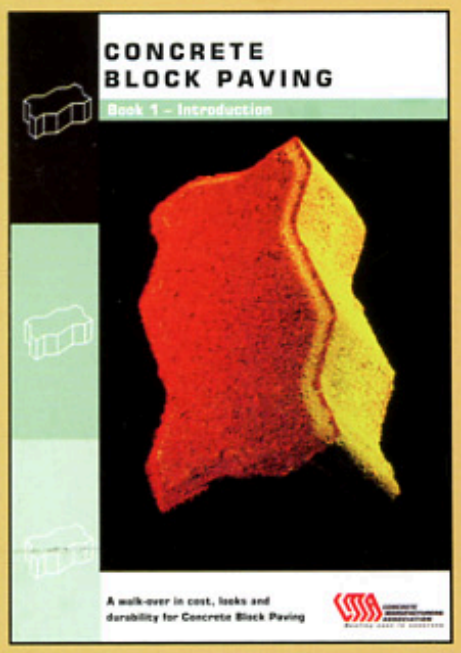

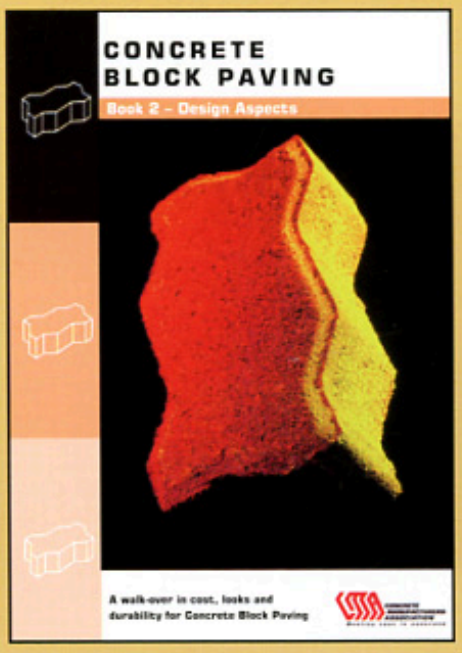

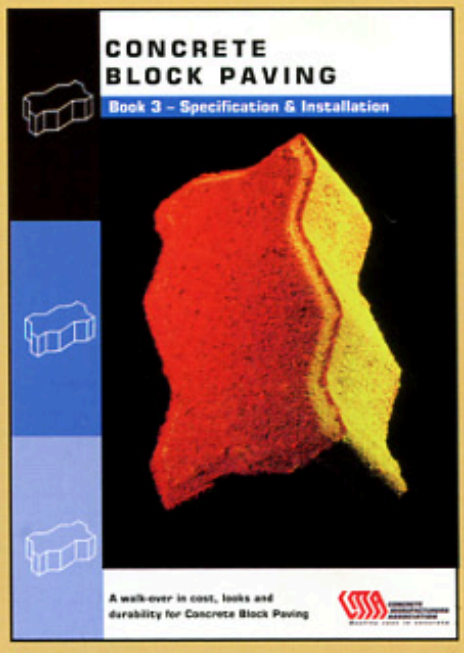

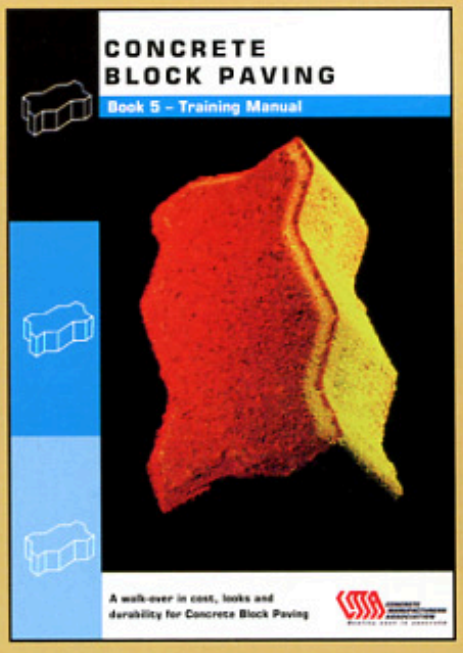

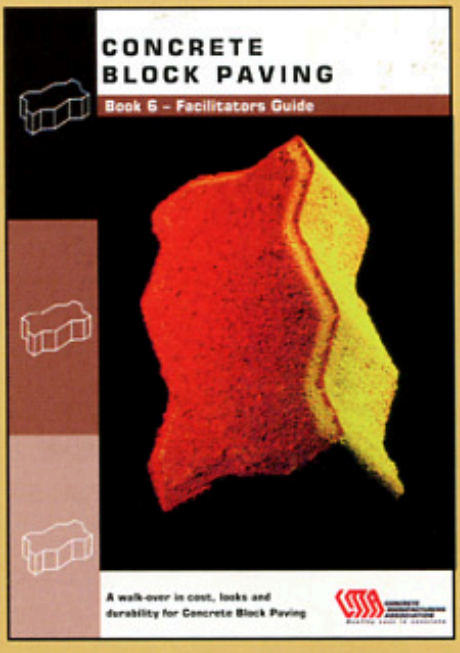

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