SmartStone

INSTALLATION GUIDELINES

COBBLE PAVERS (smaller than 225mm x 225mm in size)

Sealing & Protecting | Maintenance & Cleaning

Disclaimer

While every effort is made by SmartStone to ensure the accuracy of information in the Installation Guide, Smartstone makes no representations or warranties, or in any way guarantees the accuracy or completeness of any information including, but not limited to: quantities, dimensions, or any specifications (including the installation of the products) provided in the Installation Guide. The customer accordingly indemnifies SmartStone and holds it harmless against all and any loss (direct, indirect or consequential), liability, actions, suits, proceedings, costs, demands ,and damages of all and every kind or nature, directly or indirectly arising from any failure, damage, or incorrect information portrayed in this Installation Guide.

SMARTSTONE INSTALLATION GUIDE INDEX

INTRODUCTION

Please read this section carefully before commencing with the installation of paving.

1.1. PURPOSE OF THIS INSTALLATION GUIDE

This guide is focussed on the installation of SmartStone products in standard residential applications. The aim is to equip the homeowner with a basic understanding of the installation of paving, so that:

- Skilled DIY'ers are equipped with the basic skills necessary to carry out simple projects themselves;
- Homeowners have an appreciation of what the installers of their paving should be doing;
- SmartStone customers understand that the installation of paving is not simple, they appoint experienced installers to install their paving, and they are prepared to pay for these skilled installers.

While the principles are similar, paving on commercial sites carry significant volumes of traffic, and need to be designed to handle this 'heavier' traffic, by an engineer experienced in concrete block paving.

Elsewhere in the world, the installation of paving is a trade and is carried out by formally qualified tradesmen, to ensure that the installation is done according to the specification, and lasts a lifetime. SmartStone is a member of the ICPI (the American Interlocking Concrete Paving Institute). SmartStone Accredited Installers have successfully completed the ICPI installation training. Details around the accreditation of installers can be found on our website, as well as within our document titled "Selecting the Right Contractor".

While we cannot guarantee their workmanship, SmartStone strongly recommends the use of SmartStone Accredited Installers to install SmartStone products.

Reference is frequently made in this guide to Cretesol. Cretesol (**www.cretesol.co.za**) is a related company, who supplies specialist products for the concrete paving industry – such as grouting solutions, cleaning agents and sealants for paving, as well as specialist tools used during the installation of paving. Cretesol products can be sourced from your local SmartStone outlet.

Refer to the SmartStone website by visiting **www.smartstone.co.za**, for detailed Technical Specifications on the Installation of Paving. In particular, browse the ICPI Technical Specifications by visiting the following link on the SmartStone website: **www.smartstone.co.za/paving-advice/icpi-technical-specifications/**

A wealth of practical paving information can also be obtained from the website of Tony McCormack, at **www.pavingexpert.com**

1.2. SMARTSTONE PRODUCTS ARE MADE FROM CONCRETE

SmartStone manufactures its range of products using the following three "types" of concrete:

1. **Standard Concrete:**

   Standard Concrete is manufactured to meet the SANS specification for the strength of concrete pavers.

   SmartStone Contractor's Cobble and Contractor's Paver are produced in Standard Concrete. These products meet or exceed the standard of similar products on the market.

2. **S-Tech® Concrete:**

   There have been significant technological enhancements in concrete over the past few years. SmartStone has grown with these advancements and developed S-Tech® Concrete, which is superior in terms of performance and durability.

   S-Tech® Concrete is high-performance concrete with:
   - High strength – 40-50 MPa vs 30-35 MPa of Standard Concrete;
   - Increased density and less porosity;
   - Improved durability and abrasive resistance;
   - Virtual immunity to efflorescence; and
   - Resistance to carbonic acid "attack" (the acid in rain).

3. **Stonework:**

   SmartStone's Stonework range derives its beauty from the specially selected natural aggregates used in its production.

   The Stonework range offers:
   - Natural colouring provided by specially selected natural stone;
   - Finishes obtained from exposing this stone, by either:
   - Removing the concrete paste between the stones, or
   - Grinding and polishing the product.
   - All the measures taken in the production of Standard concrete, and the features of S-Tech® Concrete, are also used to produce the Stonework range, ensuring a technically superior product.
   - The Stonework range offers a finish so durable that it will last a lifetime.

   Not all concrete is the same, so it is important to select the type of concrete best suited to the application.

   It is important to note that concrete has specific properties that make it ideally suited to use in paving. However, because concrete is porous, concrete paving can suffer from:

   - Efflorescence,
   - Picture framing,
   - Staining from minerals in the soil, or from liquids spilled on pavers, and
   - Colour variations between batches.

Furthermore, strong concrete is also brittle, and small chips (<5mm) on pavers are inevitable. Use chipped pavers for cutting, or install them where the chips are not conspicuous. Once grouted, chips are much less noticeable.

1.3. RULES OF NATURE

Segmented paving is **installed outdoors, on** the **earth's surface.** In order to understand the principles of paving, one needs to consider certain **rules of nature:**

- Layers under the earth's surface move.
- Natural material in topsoil decomposes.
- The elements are harsh.
- There are minerals in soil, sand and stone.
- There is moisture in the soil.

1.4. RULES OF PAVING

You expect **paving** to provide a **solid surface to walk or drive on,** be **functional for a lifetime** and **add value** to your **property.** In order to achieve this:

- Paving should not sag when trafficked.
- Paving should not creep sideways.
- Water must drain from the paving.
- A paved area should be smooth and even, with no high or low pavers.
- Paving blocks alone should not carry the load. Weight should be distributed to layers beneath the paving blocks.
- Pavers should be "interlocked" with grouting.

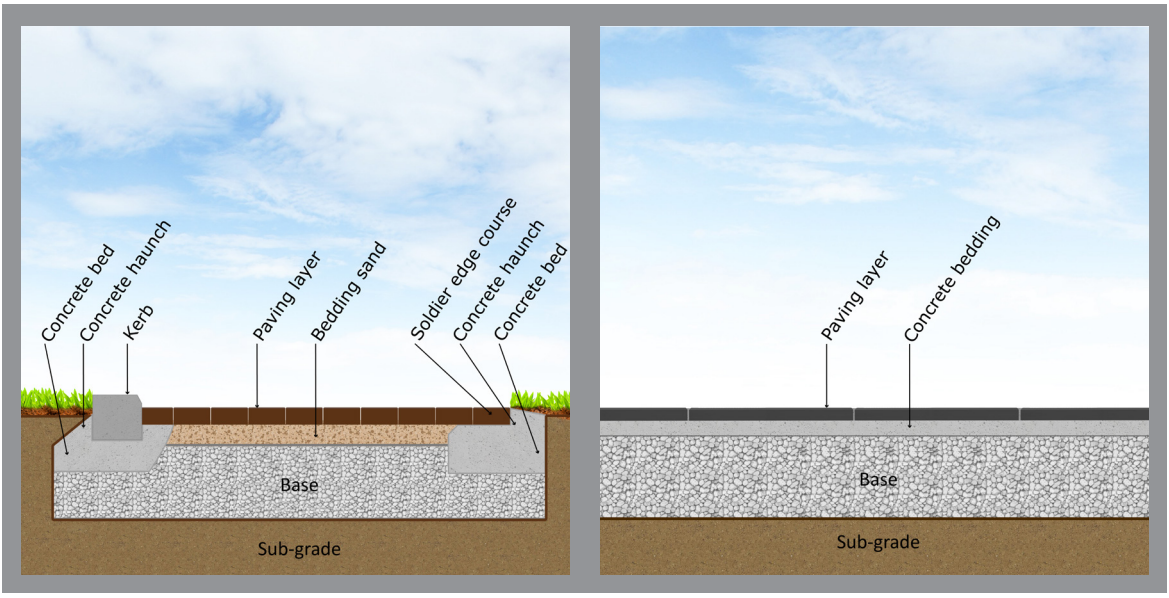
Most importantly, paving needs maintenance – see page 28

When you see this icon in the guideline, it refers to the Rules of Nature & the Rules of Paving outlined in this section.

SmartStone

1.5. THE TWO CONCRETE BLOCK PAVING INSTALLATION METHODS

There are two distinctly different paving installation methods, namely flexible and rigid.



1.5.1 Flexible paving installation

is the globally accepted norm and, when done correctly and maintained regularly, will last a lifetime.

This method is specified by SANS 1200MJ, the official standard for the installation of segmented paving in South Africa.

We recommend this method for SmartStone Cobbles and Pavers smaller than 225mm x 225mm with jointing gaps smaller than 6mm, intended to carry vehicular traffic.

1.5.2 In a rigid paving installation

pavers are bedded in a mortar screed, which creates a single solid surface with no room for movement.

Pavers must adhere to the mortar screed.

All SmartStone Flagstones (pavers larger than 225mm x 225mm) should be installed according to this method.

In certain technical scenarios, Cobbles can also be installed according to this method.

Most importantly: NEVER mix the two methods. In a flexible installation, use sand for bedding and jointing. In a rigid installation, use a mortar bed and cement, or jointing solution (e.g., Romex). Cement in the former, and sand in the latter, simply does not work.

2.1. HEALTH & SAFETY ON SITE

2.1.1 Typical hazards to be aware of on a paving site:

- Back injuries from lifting heavier concrete products.
- Back injuries from repetitive motion of paver installation.
- Muscle pulls from digging and lifting.
- Finger abrasion from handling concrete products.
- Skin rashes or burns from job site chemical spills and splashes.
- Eye injuries from saw cutting.
- Lung and respiratory injuries from long term exposure to saw cutting dust and cement dust.
- Heat exhaustion.
- Impact injuries from moving equipment.
- Vibration related injuries from compaction equipment.
- Hearing loss injuries from working with high decibel equipment such as saws and compactors.
- Knee injuries from repetitive kneeling.
- Foot injuries from heavy paving materials falling on feet not protected by steel toe-cap safety boots.

It is important to adopt safe working practices on site to avoid these hazards.

2.1.2 PPE:

There are a few safety risks that may be encountered when undertaking a paving project. Most of these risks can be mitigated by wearing protective clothing.
The essential PPE to be worn when installing SmartStone paving, include: hard hat, dust mask, goggles, ear protection, gloves, & safety boots.

Staff using equipment on site, particularly power-driven tools, must be properly trained in the use thereof, and take the necessary safety precautions at all times.

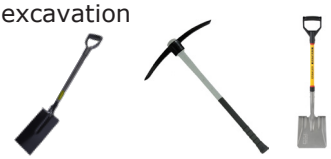
Contractors need to be registered with the Department of Labour in terms of the Compensation for Occupational Injuries and Diseases Act (COIDA).

2.2. INSTALLATION TOOLS

2.2.1 Basic Tools:

Before starting with the installation of your SmartStone paving, there are a few basic tools you'll need to complete your project successfully.

These basic tools include:

Spade, Pick and Shovel for excavation 	Wheel Barrow for moving material 	Wooden Trowel for bedding 
Long Spirit Level to check transverse accuracy 	Timber or Aluminium Straight Edge for screeding 	Rubber or Polyurethane Mallet for bedding individual pavers 
32mm or 40mm PVC or Metal Conduit of different lengths as screeding guides 	Metal Pegs and Builders' Line for setting out 	Hammer to hit pegs into the ground 
Chalk Line for snapping straight lines 	Road Rake to level base and bedding materials 	A short (5m) tape measure and a long (10m+) tape measure 

2.2.2 Specialised Tools:

There are a few specialised tools you'll need to conduct the 'technical' aspects of your SmartStone paving installation.

These specialised tools include:

Roller / Plate Compactor for compaction 	Jumping Jack Tamper and Hand Tamper for compaction in areas difficult to reach 	Masonry Saw / Angle Grinder (both with diamond tipped blades) for cutting pavers 	Hiring a Skid Steer like a Bobcat may be worthwhile for large areas to be excavated 	Dumpy Level to assist in setting site levels 

The following specialist tools are recommended to make the installation of paving safer, easier and more accurate. They are imported from *Probst*, in Germany, and available in South Africa from *Cretesol*.

Paver Transport Cart to move pavers effortlessly 	Alignment Bar for aligning pavers before they are permanently set and compacted 	Measuring & Marking Tool to make precise measurements and marking of angles and lengths on pavers (when cutting is required) 
Vacuum Handy for lifting and installing pavers 	Electrically operated Vacuum Lifting unit for lifting and installing large pavers 	Paving Slab Handle for lifting and placing heavy pavers, with no risk of injury 

2.3. MATERIAL USED IN PAVING PROJECTS

2.3.1 Foundation Material:

The foundation of paving should be constructed with easily compactable material. In South Africa, these materials are referred to as G1, G2, G3, G4 or G5. Soil found on site will simply not compact as well as these materials will. G5 is generally the most widely available and the most cost effective of these options. G5 is a gravel with a nominal particle size smaller than 53mm (crushed stone) or smaller than 63mm (uncrushed stone), and contains 20%-70% (by mass) particles smaller than 2mm. This is readily available from builder's merchants. Alternatively, consult your local SmartStone branch for a list of suppliers in your area.

2.3.2 Bedding Sand

Well-draining river sand containing no clay, and very little fines, should be used for bedding.

Please see the grading analysis for bedding sand, as specified by SANS 1200MJ:

Nominal sieve size (mm)	**% passing**
9,52	100
4,75	95-100
2,36	80-100
1,18	50-85
0,600	25-60
0,300	10-30
0,150	5-15
0,075	0-10

Bear in mind that SANS 1200MJ was last updated in 1984. In countries like the USA and Britain, the specification for bedding sand has been changed and only 1% of particles smaller than 0.075 are permitted. It is crucial that there are very little fines in bedding material in order for it to drain sufficiently.

2.3.3 Jointing / Grouting Material

SmartStone recommends using **specially graded jointing sand**, because it offers the best interlocking capabilities. Cretesol offers specially graded paving jointing sand, which can also be sourced from your local SmartStone outlet.

Plaster sand is generally used for paving grouting in South Africa. We suggest you use light-coloured plaster sand, rather than dark or red sand (should you decide to go with this option); as dark or red plaster sand might stain your paving.

To stabilise the sand between pavers, a specialist paving jointing sand stabiliser can be used. This will harden the sand in the joints, while ensuring flexibility. We recommend Resiblock to stabilise grouting sand. Ask your SmartStone sales consultant about this product.

2.3.4 Cement

When installing pavers according to the flexible method, the only cement needed would be for mixing concrete, or mortar used for edge restraints. When installing paving according to the rigid method, you would also use cement in the bedding and grouting. SANS approved 32.5N cement available from your local builder's merchant is suitable.

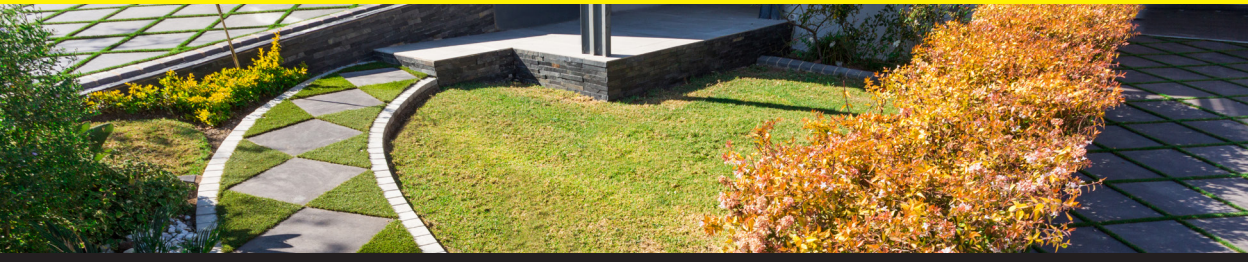
2.3.5 Stone

When mixing concrete used in edge restraints, you will need concrete stone to mix with the sand and cement.

2.4. SELECTING THE CORRECT SMARTSTONE PRODUCT FOR YOUR PROJECT

2.4.1 SmartStone products come in a variety of thicknesses:

- 10-20mm Tiles must be installed on a mortar slab 100-150mm thick;
- 40-60mm Flagstones are designed for pedestrian traffic only, and must be installed using the Rigid Installation Method;
- 50mm Cobbles are suitable for pedestrian and light vehicular traffic, and installed using the Flexible Installation Method; **see page 19** and
- 65mm and thicker Cobbles are suitable for commercial applications, and must be installed using the Flexible Installation Method.



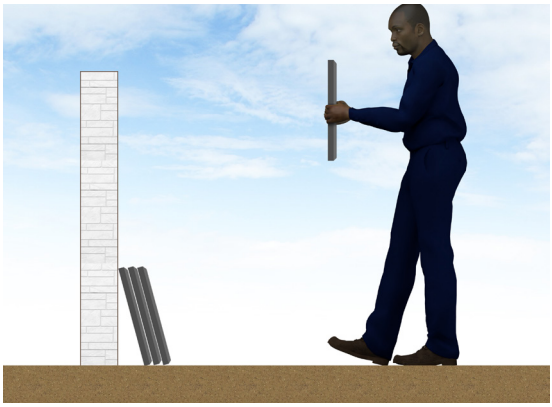
2.4.2 Colour, texture and laying patterns selected are also important:

- SmartStone offers products to suit the most popular design styles – select the product and laying pattern that complements the design of your home – if in doubt, speak to your SmartStone sales consultant;
- Products installed on a driveway should preferably be in a charcoal colour to limit the visibility of tyre marks. Our Sandstone and Bundu blended colours also mask tyre marks quite well;
- Lighter coloured pavers installed in sunny areas result in a high level of glare;
- Products used around a swimming pool should be textured for increased slip resistance;
- Use a contrasting colour on steps' or as a pool coping – this draws one's attention to the change in level; and
- Consider the use of a contrasting colour for the border of a paved area, or for a floating border.

2.5. HANDLING SMARTSTONE PRODUCTS

Pavers are fragile. They could chip and break, if not handled with care.

- **Never throw pavers in wheelbarrows or front-end loaders and tip them at the destination.**
- **Pack and unpack pavers individually, by hand, when using a wheelbarrow to move them.**

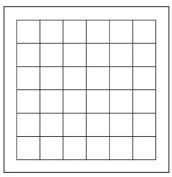


- **Flagstones must be carried individually by hand to avoid chipping and scuffing.**
- **Flagstones should never be 'stacked'. They should be carefully placed against a wall or other sturdy structure, one against the other at a vertically-diagonal stance.**

2.6. INSTALLATION LAYING PATTERNS

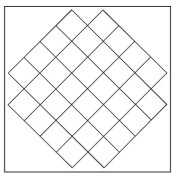
There are various options when it comes to laying your SmartStone paving. View the various patterns possible below.

1 size:



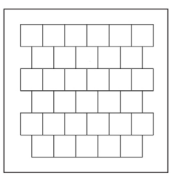
Square Bond

1 size:



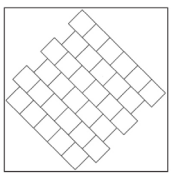
45° Square Bond

1 size:



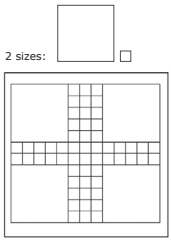
Stretcher Bond

1 size:



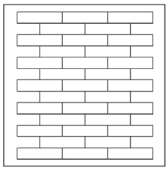
45° Stretcher Bond

2 sizes:



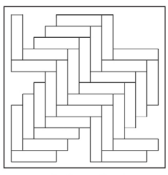
Flagstones and Cobbles

1 size:



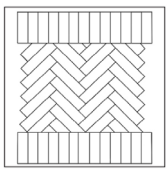
Stretcher Bond showing Paduan Paving

1 size:



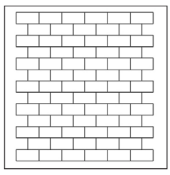
Herringbone showing Paduan Paving

1 size:



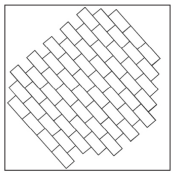
45° Herringbone showing Paduan Paving with 'Soldier' course border

1 size:



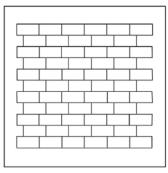
Stretcher Bond

1 size:



45° Stretcher Bond

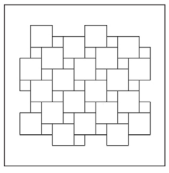
1 size:



Off Centre Stretcher Bond

Ratio: 1 full, 1 quarter
Area: 80% full, 20% quarter

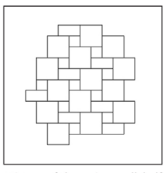
2 sizes:



Mixture of two sizes. Full, and quarter cobble or flagstone

Ratio: 2 full, 1 half, 2 quarter
Area: 66% full, 17% half, 17% quarter

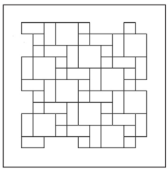
3 sizes:



Mixture of three sizes. Full, half and quarter cobble or flagstone

Ratio: 1 full, 2 half, 2 quarter
Area: 40% full, 40% half, 20% quarter

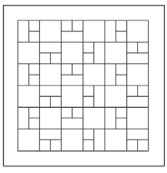
3 sizes:



Mixture of three sizes. Full, half and quarter cobble or flagstone

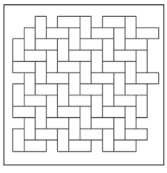
Ratio: 1 full, 1 half, 2 quarter
Area: 50% full, 25% half, 25% quarter

3 sizes:



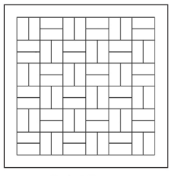
Mixture of three sizes. Full, half and quarter cobble or flagstone

1 size:



Herringbone

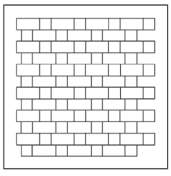
1 size:



Basket Weave

Ratio:1 half, 1 quarter
Area: 67% half, 33% quarter

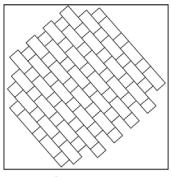
2 sizes:



Stretcher Bond: half and quarter

Ratio:1 half, 1 quarter
Area: 67% half, 33% quarter

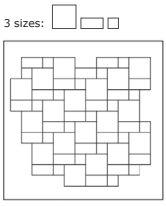
2 sizes:



45° Square Bond: half and quarter

Ratio: 1 full, 1 half, 1 quarter
Area: 58% full, 28% half, 14% quarter

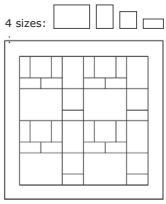
3 sizes:



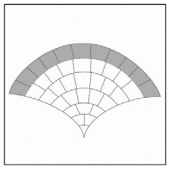
Mixture of three sizes. Full, half and quarter cobble or flagstone

Ratio: 1 maxi, 1 large, 2 medium, 5 small
Area: 33% maxi, 17% large, 22% medium, 28% small

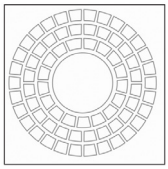
4 sizes:



Mixture of four sizes. showing Aztec Paving



Fan Pattern



Circular Pattern

2.7. INITIAL PLANNING & SETTING OUT OF A PAVING SITE

This is the process of establishing lines, levels and curves, as well as establishing the angle of the paved surface in relation to a given point, typically a house, or another building. Just how lines and levels are established can be complicated, and differ depending on the layout of the area you want to pave.

In simple language, it means the following:

- Basic planning.
- Are there any underground utilities?
- Where am I going to start laying?
- Ensuring effective and sufficient runoff for rain water.
- Ensuring paving is not installed too high or low in relation to the house. (You can't have a step up or down to the garage from the driveway, for instance.)
- What fixed points am I going to use to align the paving to?
- On smaller projects like patios and around pools it might mean laying out flagstones, copings etc. before commencing installation to see how grouting gaps align, where you need cutting, and more.
- Sites can be carefully laid out to minimise cutting, or so that the cut pavers are not conspicuous.

It is important to pay special attention to the following:

- Paving is usually best laid square to the building.
- The finished level of paving adjoining a building should be below the buildings floor level. This is to avoid the flooding of water into buildings, and garages, etc.
- Rain water should not flow into surrounding properties.
- Properties situated on, or at the bottom of a slope, are often subject to water runoff from other areas. Bear in mind that water infiltrating the base layers might also drain downwards on a slope. This can adversely affect the base layers below the paving, or stain the pavers over time.
- Bear in mind that water behind a retaining or garden wall without special drainage, will make its way to the lower area, which will result in much underground water in the low-lying area.
- When laying paving on a slope, start laying paving from the bottom of the slope, working upwards.
- In a paving installation, there should always be a border of one "solid" unit, with the cut part of pavers facing the inside of this border.
- **There may be a slight variation in sizing when it comes to pavers and copings from the same range.** The reason for that is technical in nature. We use moulds manufactured from different materials to cast pavers and copings. These materials may react differently to temperature changes, etc. Full, Half and Quarter size pavers from the same range also need to be laid out carefully to ensure that the grouting gaps align. It is important to consider these possible variations when laying out your paving to be installed.

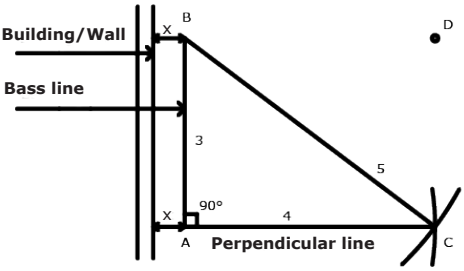
2.7.1 Establishing lines, curves and levels:

Setting out a straight line:

- Position the steel marker pins in the required positions.
- Knock the pins into the ground so that they are secure.
- Tie builder's line tightly between the pins to provide your straight line.
- If the line is longer than 5 metres, intermediate steel pins can be used to ensure the line remains tight and straight. It is crucial that the builder's line remains straight once the intermediate pin is placed.
- The steel marker pins must be vertical, to ensure an accurate site layout.

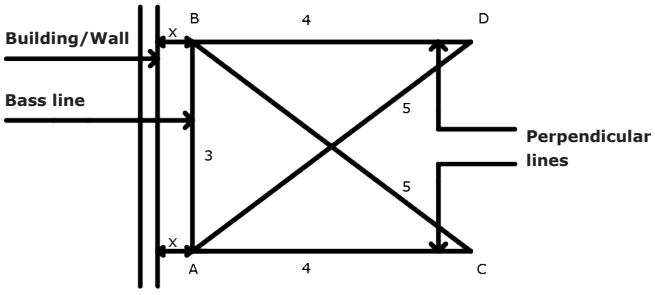
Setting out a perpendicular line:

- Paving is usually installed perpendicular to a building – a perpendicular line is a line that is 90° to a given base line (e.g., the front of a building).
- A simple way to set out a perpendicular line is to make use of a "3-4-5" triangle. In terms of Pythagoras' theorem, the "3-4-5" triangle is a right-angled triangle, with the right angle where the two shorter sides meet.



On a small residential project, use a triangle with sides of 3m, 4m and 5m. On larger projects, use 6m, 8m and 10m

- To set out the perpendicular line:
- Set out the base line A-B with 2 steel pins and builder's line as explained in a) above – the two steel pins (A and B) must be exactly the same distance from the wall of the building ("x" in the diagram).
- Establish point C by simultaneously measuring a line 4 metres from A, and 5 metres from B – where these two lines intersect, place steel pin C.
- Use builder's line to create line A-C.
- Line A-C is perpendicular to A-B, and the building.

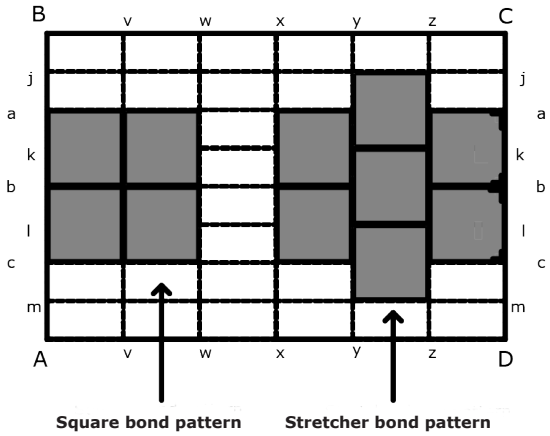


- Simultaneously, point D can be established, providing a second perpendicular line, B-D.
- To check that the lines A-C and B-D are perpendicular to the wall, ensure that lines A-D and B-C are equal in length (5 metres in our example).

Using lines A-B, A-C and B-D to set out the area to be paved will ensure your paving is perfectly square to the building.

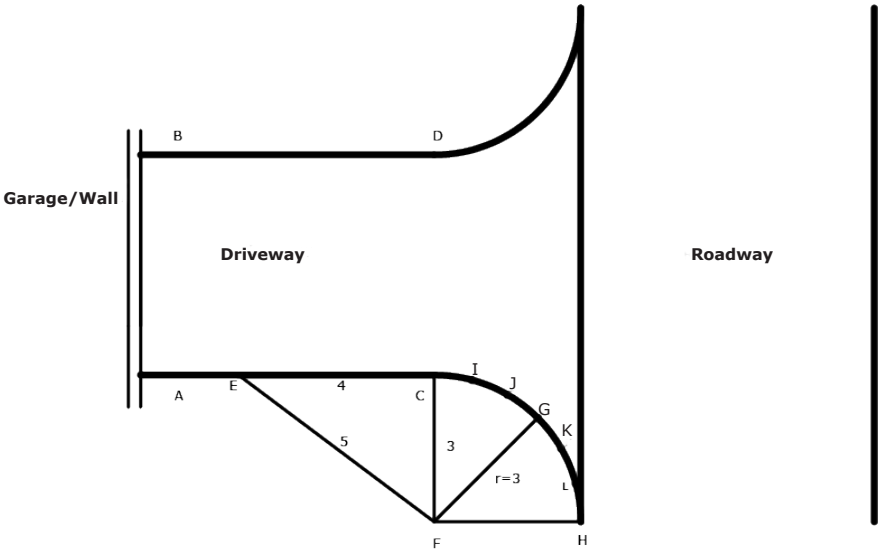
Setting out gridlines:

- Gridlines are essential to ensure that your pavers are laid in straight lines for an aesthetically pleasing finish.
- The spacing between the gridlines should be the same as the coverage of the pavers being installed (paver size plus grouting gap on one side).
- When installing small cobbles (e.g., 111x111mm), a gridline every 5th row should suffice.
- The gridlines are installed as explained in a) above.
- The gridlines should run in both directions as shown in the diagram (a-a, b-b, c-c and v-v, w-w, x-x, y-y, z-z in the diagram).
- When installing pavers in a stretcher bond pattern, additional gridlines will be required (j-j, k-k, l-l, m-m in diagram)



Setting out arcs and curves:

- Setting out arcs is relatively simple, with the radius of the arc determining how tight the corner is – the smaller the radius, the tighter the corner, and vice versa.



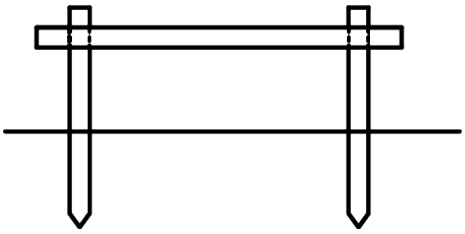
In the above example, a radius of 3 metres has been selected.

- To work out point F, the origin of arc C-G-H, use the "3-4-5" triangle concept again (C-E-F in the diagram).
- Insert a steel marker pin at point F.
- Insert a steel marker pin at point G, 3 metres from E, and insert additional steel pins I, J, K, and L, all 3 metres from E.
- Tie builders line tightly along the arc C-I-J-G-K-L-H.
- You now have your arc.
- In the same way, the arc can be created on the opposite side of the driveway.

Setting out levels:

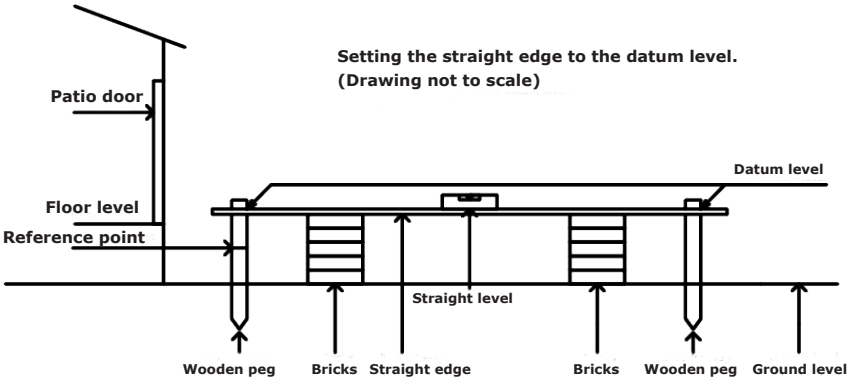
Ideally a dumpy or laser level should be used to set out the levels on site. However, if either of these is not available, a timber straight edge and spirit level can be used.

While there are simple methods to set out levels on site, the correct use of site rails will ensure that the falls on your completed paving project will always be perfect.

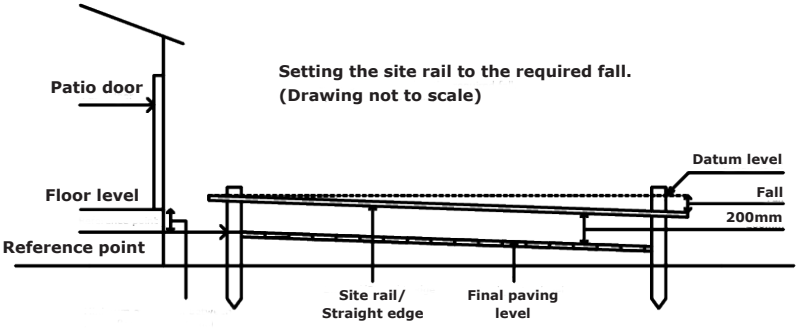


A site rail consists of 2 (or more) wooden pegs driven into the ground, joined by a horizontal timber straight edge.

- The site rails should be installed ±300mm outside of the steel marker pins used to set out the area to be paved (in a) – d) above).
- The finished paving level required must be marked on the wooden peg installed where the finished paving level is known (the reference point), e.g., against a building.
- Mark the peg 200mm above the required finished paving level, creating your datum level.
- Using the straight edge, spirit level and a few bricks to support the straight edge, mark the datum level on the 2nd wooden peg.



- Then mark the required fall on the 2nd peg (measure down from the datum level).
- Refer to the Drainage section below for the required falls for paving.
- Fix the timber straight edge to the pegs so that the top of the straight edge is:
- at the datum level on the 1st peg.
- at the point on the 2nd peg where the required fall is marked.

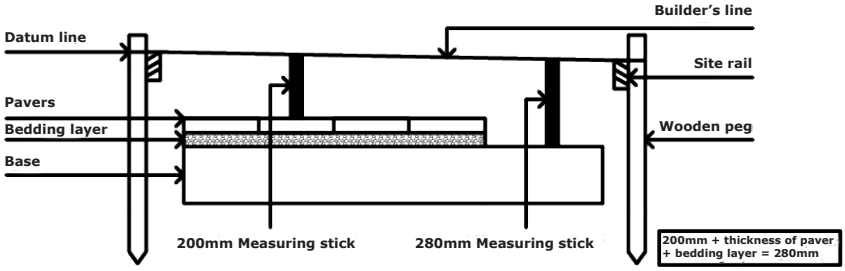


- Once the first site rail is installed, install a second site rail on the opposite side of the area to be paved, in the same way as explained above.

Installing the site rails at exactly 200mm above the required finished paving level will allow the installer to install the pavers without interfering with the lines used for the levels. The installer checks that the level of the pavers is correct by using a 200mm piece of timber, as indicated in the diagram. The site rails and lines are also used to ensure the base has the correct falls.

- The lines used for the levels must be aligned with the top of the rails, and may be installed as each row of pavers is laid.

Ensuring correct falls of base and pavers using site rails, lines and measuring stick.



2.8. DRAINAGE

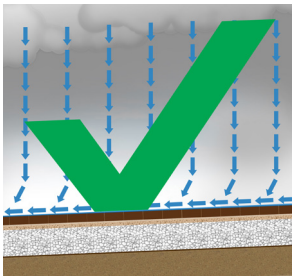
It is important to consider drainage carefully, when installing paving. Many paving installation failures occur due to the ingress of water into the earthworks beneath the paving.

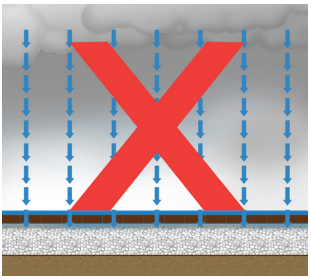
A gradient of 1:50 is recommended in one direction (transverse) and 1:80 in another (longitudinal). 1:50 means that there will be one unit of fall for every 50 units of driveway width.

Example:
Say the driveway is to be 4,5m wide. If that distance is divided by 50, the result is the one unit of fall.
From the above: Required fall = 4 500mm ÷ 50 = 90mm
Hence, there needs to be 90mm of fall across the driveway.

It is important to ensure that the paving is laid sightly proud of (5-10mm higher than) drains or channels to ensure the water runs into the channel.

Drains and underground channels should be installed in areas such as low points in steep driveways, around downpipes and against boundary walls, to avoid flooding and ponding. Carefully consider the natural land, walls and buildings when designing a drainage plan.





Construct the necessary gradients in your foundation layer. Do not use bedding sand to achieve gradients.

Underground water can often adversely affect the appearance of your paving, as concrete pavers are porous. Water is "sucked" to the surface of the paving, bringing minerals and whatever else is in the water and soil below to the face of the paver, resulting in staining.

Install subsoil drainage when there is evidence of high levels of underground water.

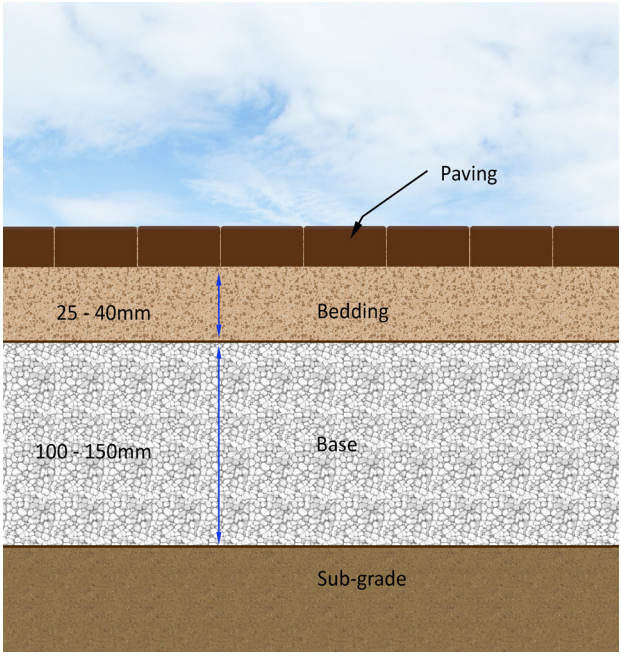
In certain instances, the application of a sealant or waterproofing agent to both sides of the pavers may eliminate water absorption issues.

2.9. BASE

Very Important

A well-compacted foundation layer is one of the most important aspects of any paving installation. Consult any civil engineer or block paving installation guidelines, anywhere in the world, and you will see that a properly constructed foundation layer under the bedding layer is crucial and non-negotiable.

- *Is installing a foundation with special materials expensive and difficult? Yes*
- *What are the chances of paving failing without a foundation of special material? 95%.*
- *Why take the chance?*



The steps to construct the foundation of your paving, discussed in more detail below, are as follows:

- Excavate to remove grass, organic material, and excess soil;
- Compact the base – if required, scarify and stabilise the sub-base with cement (4%);
- Create the 150mm G5 base;
- Compact the base.

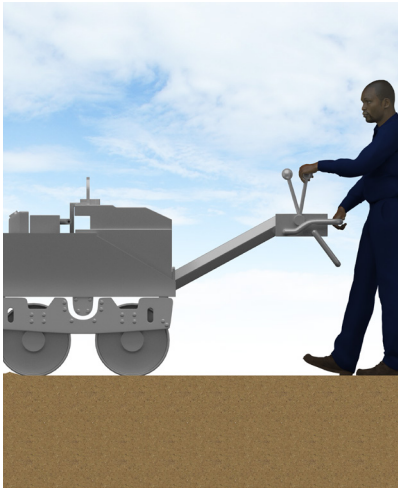
Always consider underground utilities before commencing with earthworks.

2.9.1 Excavate

- Set out the area to be paved and excavate to 300mm beyond the area to be paved.
- Excavate to a depth of ±250mm below the final required paved level. (This should allow for a foundation of 150mm, together with the thickness of pavers and bedding material used.)
- All tree roots and other plant matter should be removed.
- In-situ material must be excavated to the correct falls (slope).

2.9.2 Optional – Cement Stabilised Base

- This additional layer is highly recommended for heavily trafficked residential driveways, including driveways in townhouse complexes.
- Scarify a 150mm layer below the level excavated in 2.9.1 above.
- Mix in cement at 4% of the material scarified.
- Compact to 95% Mod AASHTO MDD".

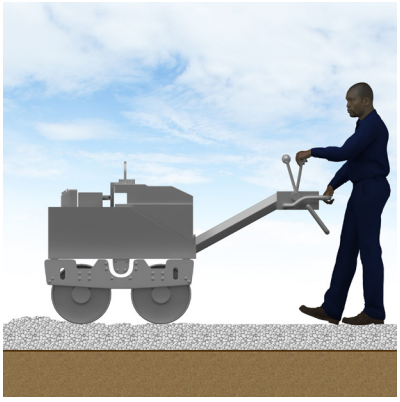


2.9.3 Compact

- Use a roller or plate compactor to compact the earth after excavation. If a plate compactor is used, ensure its weight is at least 75kg.
- A jumping jack tamper could also be used in difficult to reach areas.
- Compact the perimeter of the foundation, working towards the centre (perimeter compaction). Then work from the bottom of the grade to the top and lateral passes (lateral compaction). Then compact the excavation at a 45° angle (diagonal compaction). And then compact in the opposite direction (reverse diagonal compaction).
- Compact the earth to the point of refusal.

2.9.4 Create the Base

- Create an even 150mm foundation of G5 material or similar. Use a rake to even it out.
- The base should extend 300mm beyond the area to be paved, including the edge restraint.
- The desired gradients must be created in the base layers.



2.9.5 Compact

- Compact the foundation with a roller or plate compactor, weighing at least 75kg and a jumping jack tamper or hand tamper in difficult to reach areas.
- Ensure the material is sufficiently moist when compacting. If you can make a ball in your hand with the G5, it is sufficiently moist.
- Compact this material to the point of refusal. Depending on the size and weight of the roller and compactor, you need 3 to 8 passes in order to compact the material sufficiently.
- Compact to 98% Mod AASHTO MDD for heavily trafficked sites.
- Never attempt to compact layers thicker than 150mm. They will not compact sufficiently. It is preferable to compact in 2 layers of 75-100mm.
- Once compacted, the foundation should be to the required falls of 1:50 transverse and 1:80 longitudinally.
- Visualise it. After installing the foundation layer, you should be able to see what the installation should look like; just without the pavers.

Why is a well compacted foundation with G5 or similar so important?

- Layers under the earth's surface move.
- Natural material in topsoil decomposes.
- Paving should not sag when trafficked.
- Paving blocks alone shouldn't carry the load. Weight must be distributed to layers beneath paving blocks.

FLEXIBLE PAVING INSTALLATION

Flexible paving installation, specified by SANS 1200MJ, is the official standard for the installation of segmented paving in South Africa.
We recommend this method for SmartStone Cobbles and Pavers smaller than 225 x 225 mm, 50mm and thicker, intended to carry vehicular traffic.

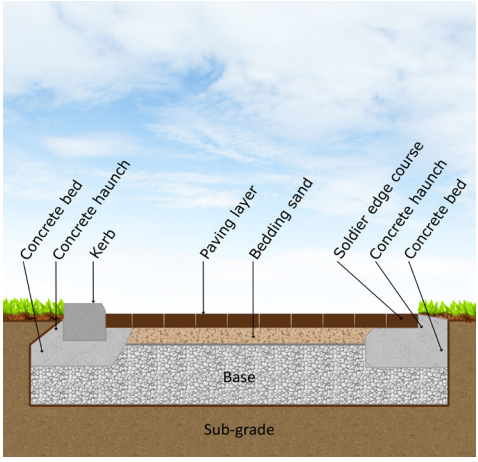
3.1. EDGE RESTRAINTS

Why are solid edge restraints important?

Paving must not creep sideways. When pavers move horizontally, the grouting material between pavers is lost. As a result, pavers will chip (known as spalling), water will ingress and the paved area will fail completely in time.

Edge restraints hold cobbles and pavers in place, keep them together and make the paved area strong enough to carry the weight exerted onto it. It is essential that they are constructed properly. Use a long spirit level or a straight edge to check that the edge restraints are even over the top, with no high/low spots, or hollows. SmartStone recommends that edge restraints be installed before installing the pavers. The foundation should extend beyond the outer side of edge restraints. Edge restraints could be kerbs or pavers / copings bedded in concrete. Where pavers / copings are used, these must be installed as a soldier course, and the edge restraint should be a minimum of 150mm wide.

Once edge restraints have been laid, with the correct alignment and level, they need to be haunched with concrete. This involves laying concrete on the outside edge of the edge restraint to hold them in place and prevent them from moving sideways when the rest of the paving is laid.



Securing Edge Restraints

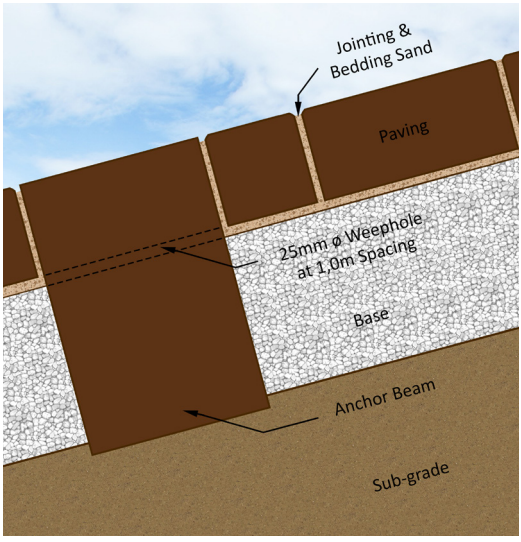
- Bed edge restraints in concrete and haunch with concrete.
- To ensure that the concrete bed also retains the layers underneath the paving, bed edge course pavers on minimum 75mm thick concrete layer and haunch at least to half their height at the back of the paver with concrete at least 75mm wide. This will create a solid concrete block that does not move.
- Use a moist concrete mix of four parts sand and stone, and one-part cement to construct the bedding and haunching of edge courses.

Experience has shown that the best edge restraints are kerbs. For residential and pedestrian applications, garden kerbs are suitable (75mm and thicker).

Kerbs should be bedded and haunched in the same way as edge course pavers, described above. On large paved areas, highly trafficked sites, areas where traffic changes direction, and paving on steep slopes; additional restraints in the form of beams are recommended. Please refer to the CMA / ICPI guidelines for paving on steep slopes or consult an engineer.

Edge Restraints that are sure to fail

- Creating edge restraints by digging a little trench on an edge after paving has been installed, then filling it with in-situ concrete and trowelling it down, will definitely fail within a few months.



Anchor Beams on Steep Slopes

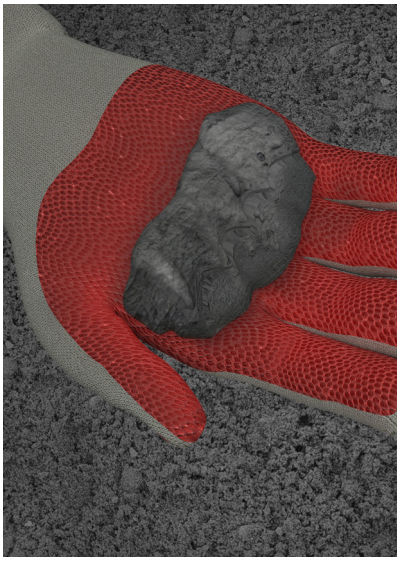
- Anchor beams should be used on roadways where the slope is greater than 12%. Between 8% and 12% anchor beams should be used at the discretion of the engineer.
- The interval of the beams will depend on the gradient of the slope.
- Normal, vertical traffic-loading will have a force exerted on the paving in a downward direction. This is due to accelerating vehicles up the hill and the braking of vehicles down the hill.
- If sloped paving is uncontained, these forces will cause the paving to creep. An anchor beam at the lower end of the paving is necessary to prevent this creep.

3.2. BEDDING

We do not recommend mixing cement with bedding sand, unless specified by an engineer. Bedding sand should be moist when bedding pavers (not saturated with water, just moist). The sand should contain 4-8% moisture, to help it compact and prevent it from blowing away.

The sand bed must be laid slightly in advance of the placement of the units, but only to the extent that the particular area of paving can be completed on the same day. With the sun baking down, it should be limited to a few hours at a time and its moisture content should be continuously assessed on site. When bedding sand becomes dry, it should be raked back into a heap, moistened and spread out again.

Refer section 2.3.2 above for the bedding sand specification.



Moist Bedding Sand

- To check whether the bedding sand is sufficiently moist, squeeze a handful of sand. It should compact into a ball, but no water should escape between your fingers.
- The principle is to ensure you lay pavers on a bed of moist sand. Moist bedding sand will allow pavers to "bed in". This is crucial to create a smooth, even-paved surface.

Thickness of Bedding Sand

- Bedding sand should be 25-35 mm in its compacted state.
- To achieve this, it should be screeded to a thickness of 30-40mm, which will then compact to the correct thickness once pavers are installed.

Screeding Bedding Sand

- Bedding sand should be screeded (levelled) with a straight edge (like a straight plank or similar), using rails, in order to achieve the correct thickness. It is vital to ensure an even level, onto which the blocks can be laid – to prevent high or low pavers.

SmartStone does not support the practice of screeding free-hand in a circular motion, without rails.

Why is it crucial to install pavers on a bed of moist bedding sand of the correct grading and thickness?

- A paved area should be smooth and even, with no high or low pavers. Dry bedding sand will not bed pavers evenly.
- Paving should not sag when trafficked. Incorrect bedding sand will cause sagging.
- Incorrect or insufficient bedding sand will cause pavers to break when trafficked.

3.3. SETTING OUT BEFORE LAYING PAVING

Please refer to section 2.7. (page 11-15) for detailed guidelines to planning and setting out a paving site.

Each job has its own peculiarities and the best way to establish the optimal line and level will vary from job to job. For a more detailed approach to setting out your particular paving application, visit **www.pavingexpert.com** and **www.icpi.org.**

3.4. LAYING PAVERS

When laying cobbles and pavers smaller than 225 x 225 mm onto the bedding sand, it's best to choose a baseline or reference line, an edge, or an imaginary line that is parallel or square to the house (or other site structure), that will act as an alignment guide. Be careful not to stand on the screeded bed, whilst laying pavers. Think about where to place cobbles while they're waiting to be laid. Lay the first course down, with each block being laid hand-tight against the other. Handle pavers with care. It is important to check the alignment and levels, every few courses. Furthermore, keep an eye on your desired laying pattern, to ensure you avoid unwanted vertical joints, so the blocks cross over one another.

3.5. LINE CORRECTING

While laying pavers, it is important to regularly check and correct paver bond lines, to ensure the desired laying pattern is adhered to. If you do not check this in sections, the pavers will be locked in, and it will be harder to correct the alignment afterwards.

You can check and correct lines by choosing two opposite edges of the paved site, and draw a builder's line from the one end to the other end.

When adjusting pavers, stand on the pavers you do not want to move, so that everything in front of you can move. Always use your outer reference lines as a reference point, to ensure pavers lie against this line at all times, while correcting pattern lines.

Using a tool like an Alignment Bar (supplied by Cretesol: **www.cretesol.co.za**) enables you to produce the perfect paving alignment. The alignment bar is notably more efficient compared to conventional screwdrivers, spades and trowels – resulting in less time wasted and a more accurate finish.

3.6. CUTTING-IN

Cutting-in calls for accuracy and patience. When cutting-in, measure the dimension to be cut, then mark the dimension onto the paver. To ensure accuracy, measure the dimension to be cut once again and check that this is what has been marked.

Whole units must be laid first. Precisely cut pieces should then be fitted into gaps which are too small to take complete pavers, such as those which are close to edges and around manholes. Mark and cut one paver at a time.

The best tool to cut pavers is a masonry saw but angle grinders are also commonly used in South Africa. Either way, good quality diamond blades are non-negotiable.

Always order an extra 5-10% of product for cutting.

Do not install cut pavers on the edge of the paved area – there should always be a full paver inside the edging or border, thereafter cut units can be used.

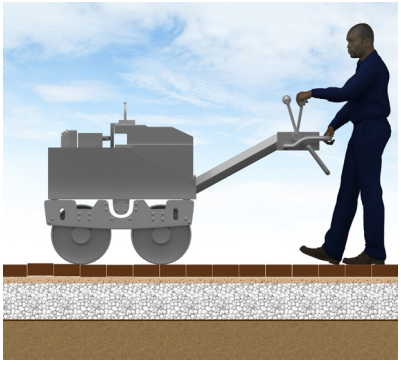
Do not use tiny cut pieces. No cut unit should be smaller than 1/3 of the original product. For instance, use a 2/3 and 1/2 paver in combination, instead of a full paver and a small segment. Do not cut on paving already installed, as fine concrete dust will stain other pavers. Importantly, always wear a dusk mask, gloves and goggles when cutting; and do not cut pavers near other people.

Why is precision cutting essential?

- Precision cutting prevents the creeping of pavers.
- Pavers should be interlocked with grouting. Large gaps will cause grouting to be lost.
- Bad cutting simply looks terrible.

Below we detail two ways to compacting pavers. For both methods, the points below are important to note:

- Sweep the area and remove all debris prior to compaction.
- Compact pavers once they are laid, in sections.
- Check and straighten lines and remove damaged pavers after the first compaction.
- Use a special alignment bar in order to align and "tighten" pavers.
- Do not compact closer than 1m of any free edge.



Compacting Pavers with a Roller

- A roller should preferably be used to achieve levelling.
- Ensure the roller's vibration is switched off.

Compacting Pavers with a Plate Compactor

- It is essential that an attachment with polyurethane rollers or a piece of rubber conveyor belting is attached to the base to avoid the texture of the pavers from being damaged. Plate compactors are only to be used on cobbles.
- Do not lay conveyor belting on the pavers and compact on it, as this will absorb the vibration and the pavers will not be compacted properly.
- Do not compact with a bare metal plate, as this will certainly damage your SmartStone pavers.

Special, large rubber or polyurethane mallets can be used to bed and compact individual pavers in difficult areas.

Temporary edge restraints should be used across the front laying edge when installation is to be continued the following day.

When this is done, remove the first two or three rows of pavers when you start the next morning and repack. These pavers will have moved during the night, opening up larger gaps than required.

Why is regular levelling of pavers by means of compaction important?

- Bedding sand should not be dried out by the time it is compacted.
- Dry bedding sand will not achieve a smooth, even-paved surface, free of high or low pavers.

3.8. GROUTING & FINAL COMPACTION (LEVELLING)

Remove and replace damaged pavers before grouting and the final compaction.

Paving Jointing Sand (Recommended steps)

- Sand must be bone-dry and swept into joints.
- Sweep diagonally across pavers and not along the "lines".
- Go back and forth until all the joints are completely filled.
- Do not use water to wash in sand between the pavers.
- Do not use a mixture of dry sand and cement and then sprinkle water on it to hydrate. The cement left on pavers will stain the pavers.
- SmartStone does not recommend the use of a cement slurry to be swept into joints between pavers. It might stain your pavers and cause picture framing, where pavers absorb moisture from the slurry. This phenomenon creates permanent white stains on the border of the pavers.
- When cement grouting is used on a sand bed, individual pavers cannot distribute loads to the underlying layers.
- The use of Polymeric sand, available from Cretesol, is highly recommended.

Why is jointing with the correct sand important?

- Jointing sand creates interlock between pavers, which prevents sagging and creeping.
- Pavers interlocked with grouting distributes loads to the layers underneath.
- Use light coloured plaster sand, not dark or red sand, as the latter may stain the pavers.
- Refer to section 2.3.3 for the grouting sand specification.

Grouting on slopes:

In areas with a risk of sand washing out, we recommend the use of a joint stabiliser, such as Resiecco. If your budget permits, we recommend the use of this joint stabiliser for the entire paved surface.

Resiecco's dual formula means it acts as a premium-quality paving sealant and joint stabiliser. It will not only ensure sand stays in the paving joints, but will also protect your paving for up to 10 years.

Final Compaction and Joint Filling

Compact Pavers with a Plate Compactor

- Use a plate compactor with an attachment with polyurethane rollers or a protective rubber mat, fixed to the base of the plate, to vibrate the sand into the joints to give a firm and stable paved area.
- Alternatively, you could use a roller with the vibration switched off.

Sweep Additional Sand into Joints

- Sweep more grouting sand into the joints as sand settles in the joints.
- ***Maintenance:*** Sweep additional sand into the paving joints after two weeks, two months and thereafter at least twice a year – before and after the rainy season. Use of Resiecco will significantly reduce this maintenance.
- If grouting sand is washed out after the rainy season, re-grout.

Why is it vital to vibrate sand into the joints?

- Sand creates interlock between pavers, which will improve load bearing, and prevent sagging and lateral movement.
- Sweeping alone will cause bridges and voids in the jointing. Vibration will ensure much better grouting sand penetration between the pavers and proper filling of the joints.

Ensure that the edge restraints are 'set' before 'trafficking' the paved area.

SEALING & PROTECTING INSTALLED PAVING

In the long term, natural elements like water and the sun damage and degrade outdoor building materials. Smartstone offers sealants which have been specially developed for SmartStone paving, to protect them from these elements. They penetrate the concrete and prolong the life of the treated paving installation.

4.1. SMARTGUARD

SmartGuard is a SmartStone paving protector which offers protection against water, wine, soft drinks, and the acid in rain or pool water. It is invisible, and does not change the appearance of the paving when sealed.

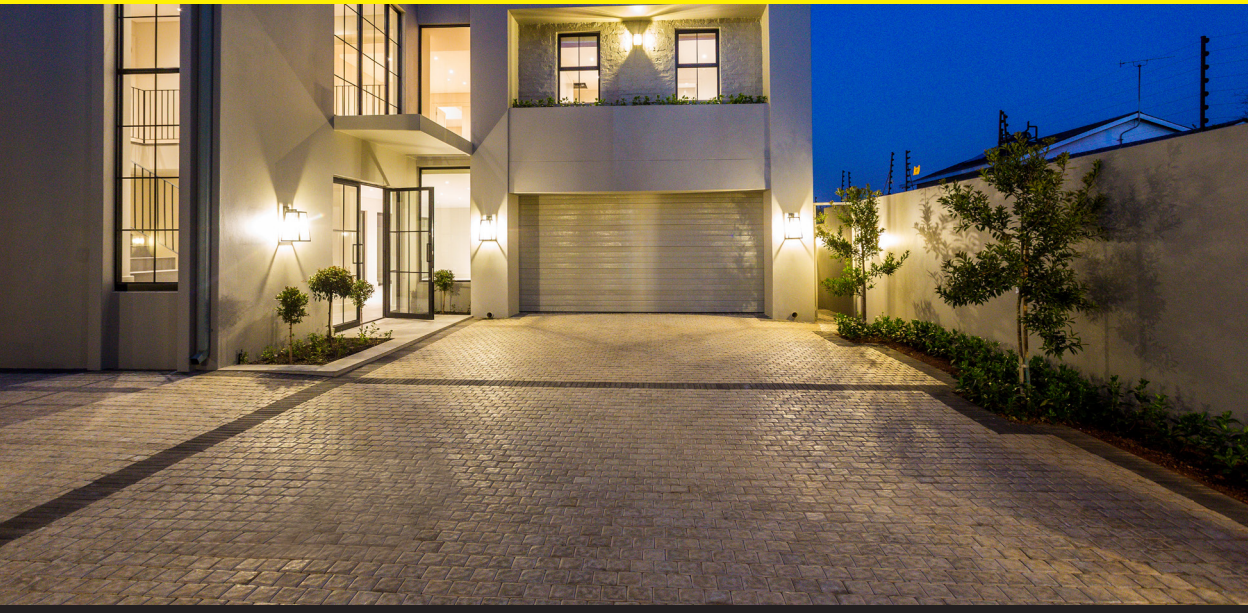
4.2. SMARTGUARD +

SmartGuard + is also a SmartStone paving protector, which offers the same protection as SmartGuard, however, further protects paving from oil, grease and fatty substances. It also enhances the colour of the paving when sealed.

Sealing and protecting your SmartStone Paving installation with SmartGuard or SmartGuard +, will:

- Prevent staining and discolouration.
- Repel water and other fluids from damaging your pavers.
- Strengthen and prolong the lifespan of your paving installation.
- Protect against other common problems associated with concrete pavers.

SmartGuard is extremely cost effective and easy to apply and maintain.



PAVING MAINTENANCE AND CLEANING

Regular maintenance and good cleaning practice will enhance the overall appearance of your SmartStone paving.

Inspect paving a month after installation and then on a bi-annually basis:
This is done to check for any loose, damaged or stained paving, and to ensure that the jointing material is intact.

1. Loose paving
It is important to rectify the cause of the movement. Subsidence of the substrate layers are the most common reasons for pavement failure. No matter what the reason is, it needs to be investigated and rectified before replacing or re-bedding the paving units.

2. Damaged paving
Individual blocks can be replaced, if required.

3. Insufficient jointing material in a flexible installation
Sweep additional jointing sand over the paved surface to top up joints where the sand might have settled or washed out. In areas where grouting continuously washes out of the joints, stabilised jointing material should be used. Speak to SmartStone about approved jointing solutions. Do not use cement grouting to try and fix the problem.

4. Repair grouting on rigid installations
Inspect if any grouting is lose or corroded in a rigid installation, and repair the grouting with Romex, supplied by SmartStone. Do not repair with cement grouting. It never works.

Always retain a few extra pavers for repairs when the pavement is dug up for new water pipes, fibre, etc., as there will be colour variances when buying additional pavers in the future.

5.1. GENERAL CLEANING

Regular hosing and sweeping will not only keep your paving looking clean, but it will also prevent weeds from taking root as they usually grow when seeds are left undisturbed to germinate in the debris that collects in between the pavers.

To remove general dirt and detritus, regularly hose down your paving and sweep with a hard-bristled outdoor broom or use a mechanical sweeper. Pavers should never be cleaned with acid.

Be careful of using power hoses to clean paving, this may wash out jointing sand and damage the grouting between pavers. Always use the widest setting of the spray nozzle and spray at an angle, not directly into joints.

Weeds:
It is a common misconception that weeds grow though the paving. This may occur in rare instances; however, weeds almost always grow from seeds and bird droppings that land in the jointing sand. Regular hosing and sweeping of the paved area will prevent weeds from growing, as it disturbs newly emerging weeds and gets rid of them before they can fully establish themselves.

SmartStone

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