



SmartStone



INSTALLATION GUIDELINES

FLAGSTONE PAVERS (larger 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.

THE GROUNDING PRINCIPLES

(Important concepts to understand in order to install your SmartStone product to last a lifetime)

There is good reason for SmartStone advocating the methods described in these installation guidelines. Feel free to "Google" and cross check them against what international experts prescribe. (There is a wealth of good "how to" videos on the internet.) They all say what we say in these installation guidelines.

In section 1.3 and 1.4 of these guidelines, we describe a few universal rules related to paving. Please read these. Every single method described in these guidelines is related to one or more of these rules.

- A residential driveway is a road. Whether you have one car driving on it or a thousand cars, your road should be able to carry the weight of a single car at a time. We have all seen roads being constructed. Contractors spend weeks preparing the base or foundation. They use rollers, graders and other heavy equipment to prepare various layers before quickly coating it with a thin layer of asphalt.
- As described above, paving derives its strength from the layers beneath the paving blocks. These layers need to be constructed with the right aggregate. A well-compacted foundation is critical for your paving to last a lifetime.
- Do not install plastic sheeting beneath paving. Plastic sheets negatively affect the structural integrity and drainage of paving. Furthermore, they do not prevent weed growth, as weeds grow from the top as a result of bird droppings, the wind etc. – not through the paving.
- Consult an engineer experienced in the design of segmented block paving for paving intended to carry commercial traffic, or residential applications where the soil is clay, sand or contains excessive moisture.
- If you are replacing a paved area that has previously failed, establish why your paving failed initially, and ensure that the causes are addressed when repaving.
- Paving on top of existing structures and slabs require special design considerations. Consult an engineer experienced in the design of segmented block paving on slabs.
- Consult SmartStone's product brochure or website for suggested laying patterns that are aesthetically and structurally suited to the paving application. It is important to avoid continuous joints in the direction of vehicular traffic.
- Water ingress is detrimental to any paved area. The paved area must be higher than the surrounding ground level, and sloped so that water drains from it. Paving must always slope away from buildings. Water from downpipes should flow into a gully, or into an underground drain, and not over the paving, to prevent the grouting from being washed out.
- Pavers must be sealed around a salt chlorinated pool; and on a paved patio where there is a braai.
- Almost all cement grouting of pavers and flagstones exposed to the elements (i.e., sun, rain, heat, cold) fails over time – either from expansion and contraction due to temperature variations, or movement of the pavers. We recommend using a proprietary grout, such as Romex, available from Cretesol.
- Paved areas need to be maintained, and should grouting or edge restraints start to fail, this should be repaired promptly.
- Pavers are brittle. 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.
- It is important to note that there will be slight variances in colour between different batches of pavers. It is always advisable to draw and install pavers from different packs during installation, to avoid a patchy finish.

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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 31

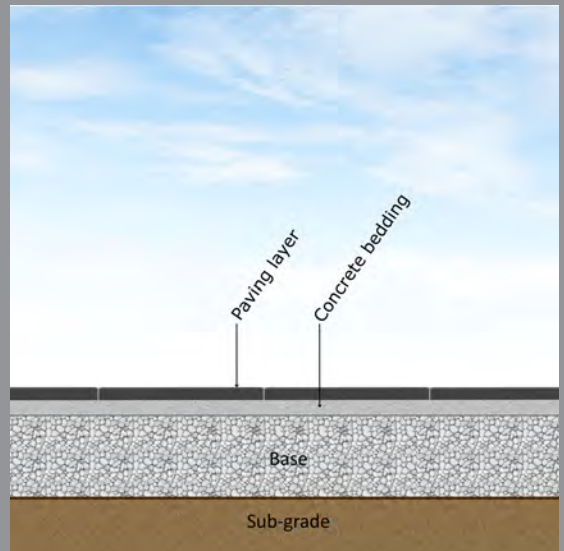
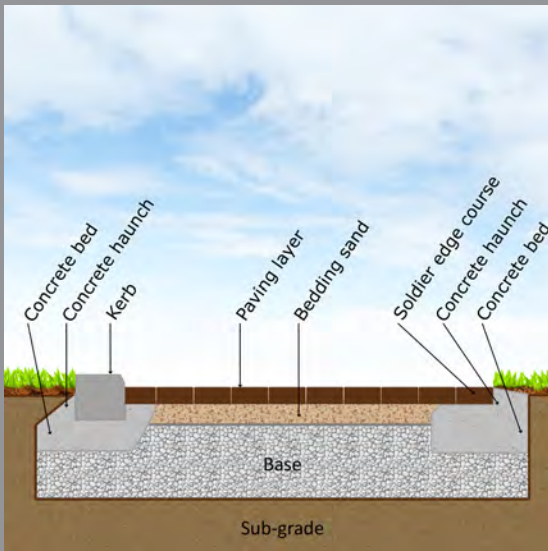


When you see this icon in the guideline, it refers to the Rules of Nature & the Rules of Paving outlined in this section.



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.

PLANNING AND PREPARATION

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:

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







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:

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

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

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.

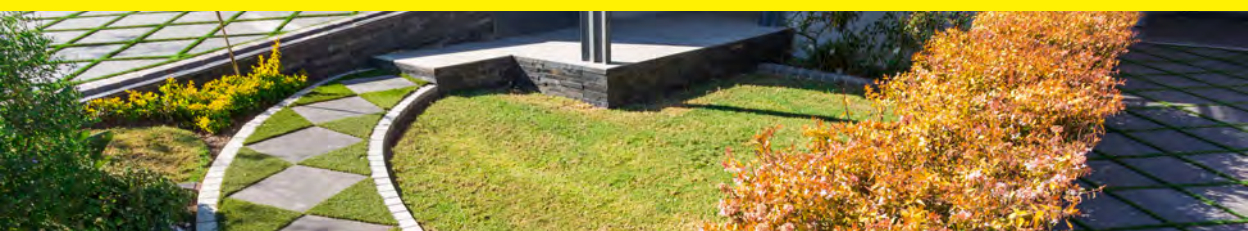
2.3.5 Stone

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. Follow the guidelines on page 38;
- 40-60mm Flagstones are designed for pedestrian traffic only, and must be installed using the Rigid Installation Method; **see page 27**
- 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.

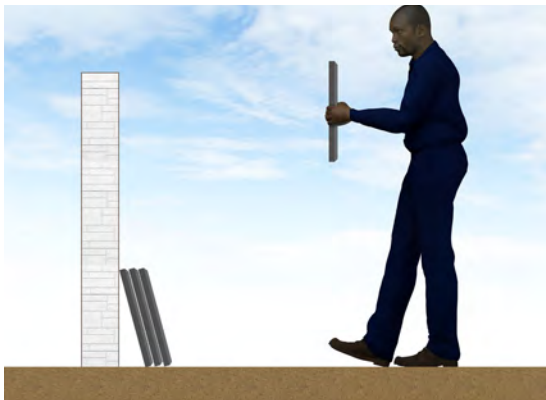
2.5. HANDLING SMARTSTONE PRODUCTS



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.**

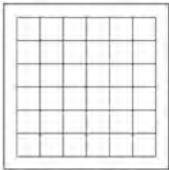


- **Flagstones must be carried individually by hand to avoid chipping and scuffing.**
- **Flagstones should never be 'stacked'. They should be carefully placed against a wall or other sturdy structure, one against the other at a vertically-diagonal stance.**


2.6. INSTALLATION LAYING PATTERNS

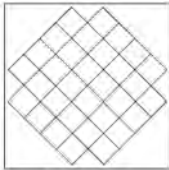
There are various options when it comes to laying your SmartStone paving. View the various patterns possible below.

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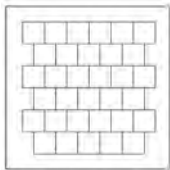
Square Bond

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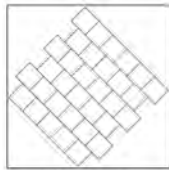
45° Square Bond

1 size: 





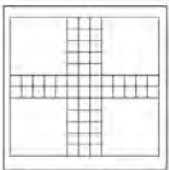
Stretcher Bond

1 size: 





45° Stretcher Bond

2 sizes: 




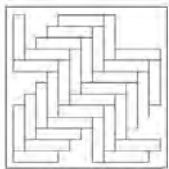
Flagstones and Cobbles

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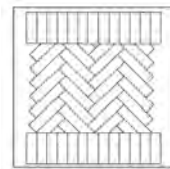
Stretcher Bond showing Paduan Paving

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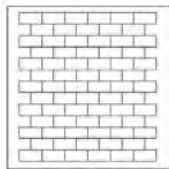
Herringbone showing Paduan Paving

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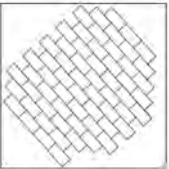
45° Herringbone showing Paduan Paving with 'Soldier' course border

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Stretcher Bond

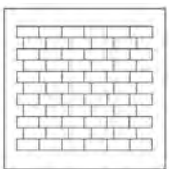
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45° Stretcher Bond



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

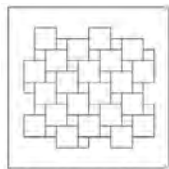
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Off Centre Stretcher Bond




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

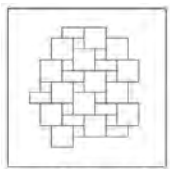
2 sizes: 



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




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

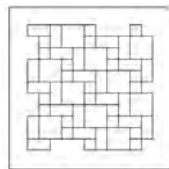
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Mixture of three sizes. Full, half and quarter cobble or flagstone




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

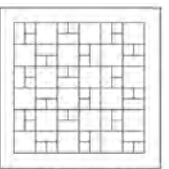
3 sizes: 



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

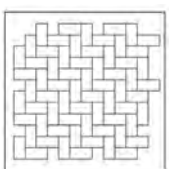
3 sizes: 



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


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

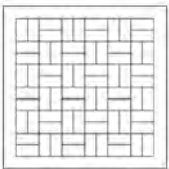
1 size: 



Herringbone



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

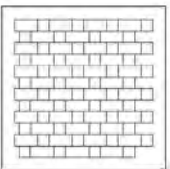
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Basket Weave



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

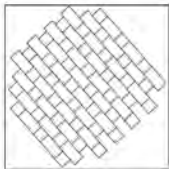
2 sizes: 



Stretcher Bond: half and quarter




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

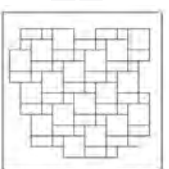
2 sizes: 



45° Square Bond: half and quarter





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

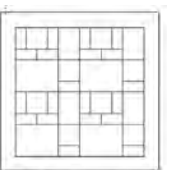
3 sizes: 



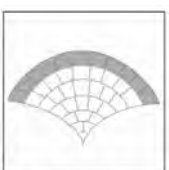
Mixture of three sizes. Full, half and quarter cobble or flagstone

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

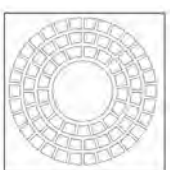
4 sizes: 



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.

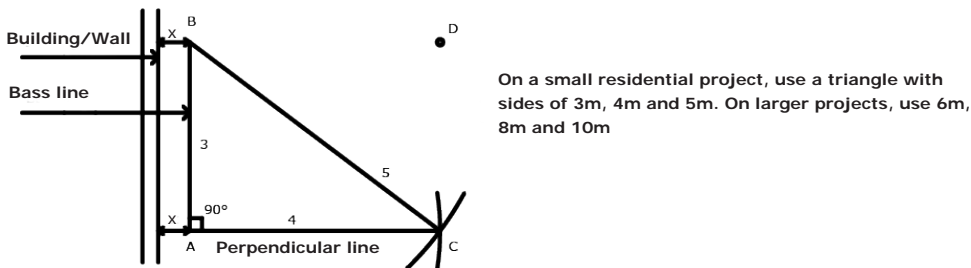
2.7.1 Establishing lines, curves and levels:

Setting out a straight line:

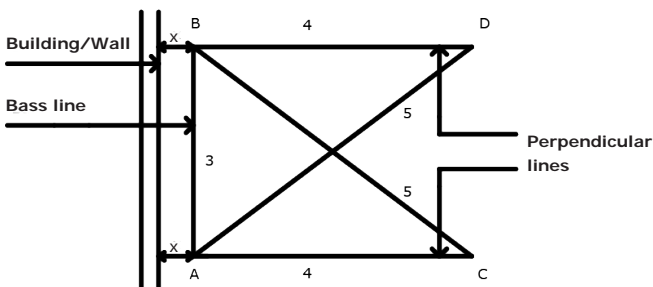
- Position the steel marker pins in the required positions.
- Knock the pins into the ground so that they are secure.
- Tie builder's line tightly between the pins to provide your straight line.
- If the line is longer than 5 metres, intermediate steel pins can be used to ensure the line remains tight 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.



- 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.

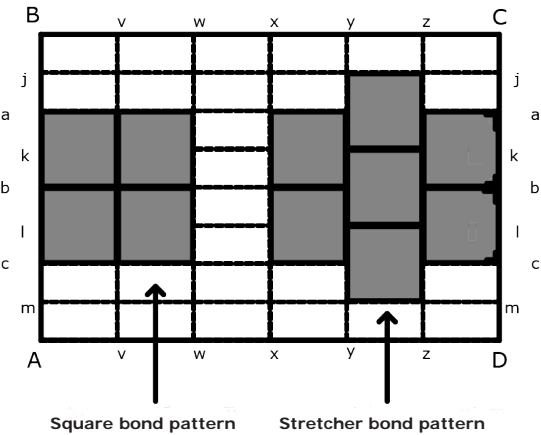


- Simultaneously, point D can be established, providing a second perpendicular line, B-D.
- To check that the lines A-C and B-D are perpendicular to the wall, ensure that lines A-D and B-C are equal in length (5 metres in our example).

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.

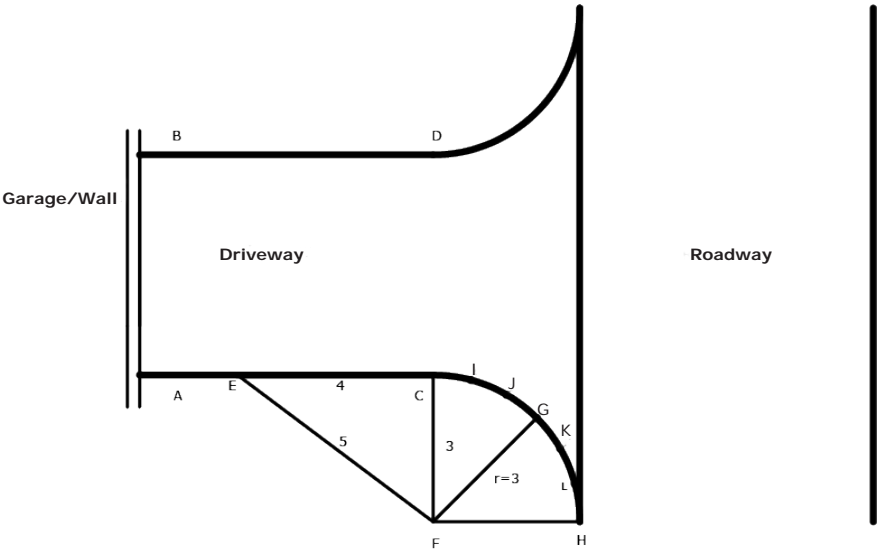
Setting out gridlines:

- 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.



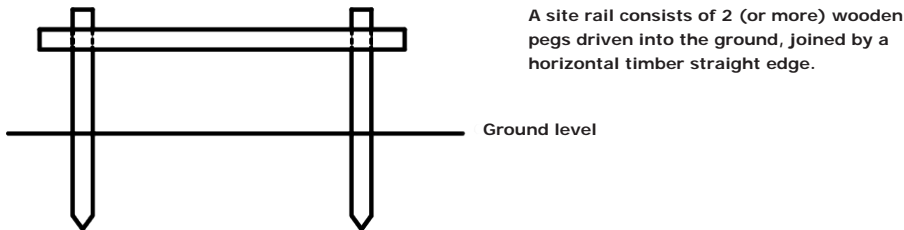
In the above example, a radius of 3 metres has been selected.

- 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.

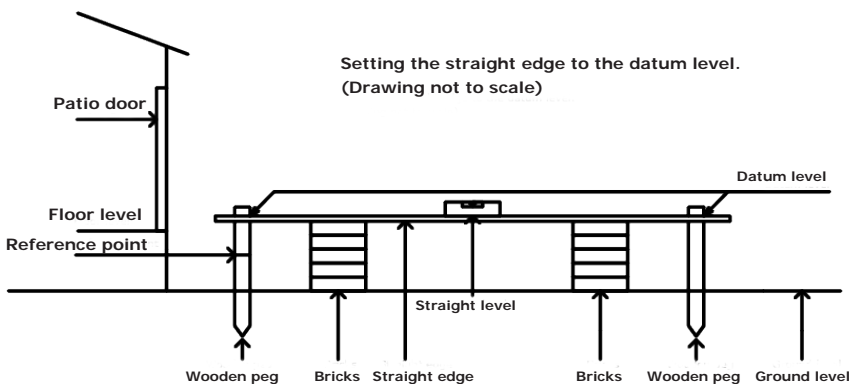
Setting out levels:

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.

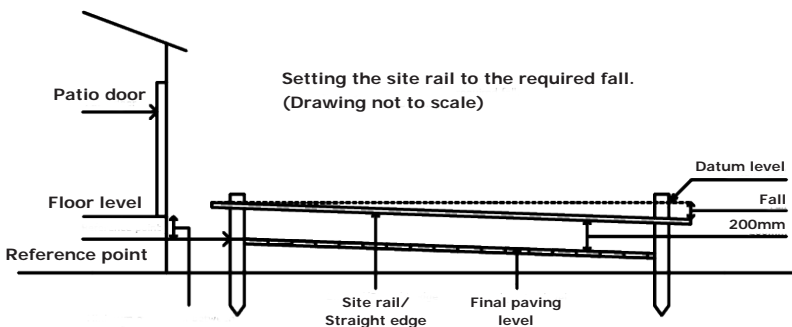
While there are simple methods to set out levels on site, the correct use of site rails will ensure that the falls on your completed paving project will always be perfect.



- The site rails should be installed $\pm 300\text{mm}$ 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.

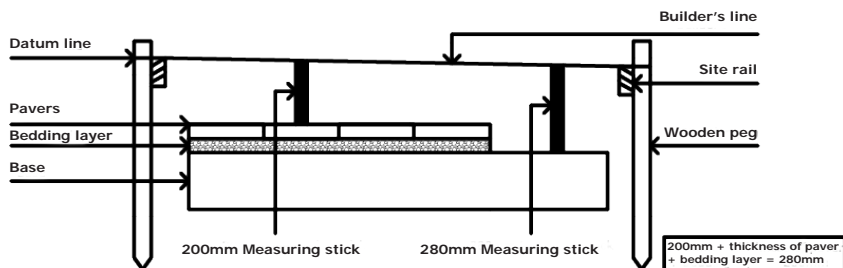


- Once the first site rail is installed, install a second site rail on the opposite side of the area to be paved, in the same way as explained above.

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:

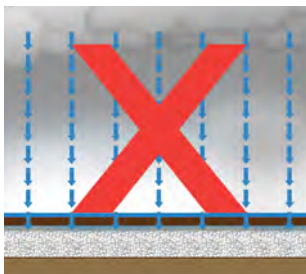
Say the driveway is to be 4,5m wide. If that distance is divided by 50, the result is the one unit of fall.

From the above: Required fall = $4\,500\text{mm} \div 50 = 90\text{mm}$

Hence, there needs to be 90mm of fall across the driveway.

It is important to ensure that the paving is laid slightly 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.

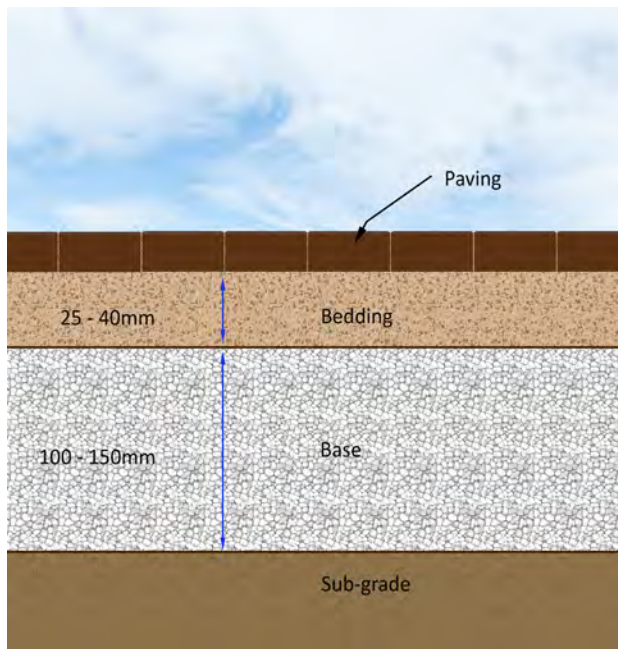
In certain instances, the application of a sealant or waterproofing agent to both sides of the pavers may eliminate water absorption issues.

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 $\pm 250\text{mm}$ 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.

RIGID PAVING INSTALLATION

Rigid paving installation is recommended for Pavers and Flagstones, larger than 225mm x 225mm, usually installed with jointing gaps larger than 6mm, that will be subject to pedestrian traffic. This installation method utilises a solid concrete screed onto which the pavers can be bedded. **The adhesion (bonding) of the pavers to the bedding course is critical**, as the movement of pavers will result in the failure of the paved surface.

Pavers must be wet prior to laying them, to prevent moisture from being drawn out of the mortar bedding layer, as well as prior to grouting.

SmartStone cobbles may also be installed in this manner.

Expansion joints may be required on larger areas. An engineer should be consulted in this



Before proceeding, ensure the foundation and drainage are done as described on pages 7-8 & 15-16 of this document. Paving will fail if these aspects are not dealt with correctly.

3.1. SETTING OUT BEFORE LAYING FLAGSTONES

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

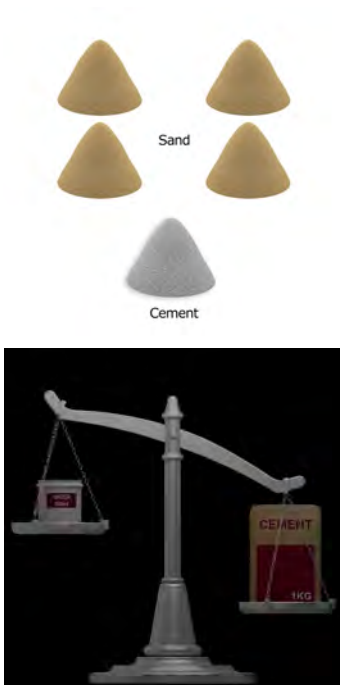
Each job has its own complexities and the best way to establish the optimal line and level will vary from job to job. For a more detailed approach to setting out your particular paving application, visit www.pavingexpert.com and www.icpi.org.



3.2. BEDDING



We recommend a moist mortar mix for bedding. This mix generally contains sufficient water to make a ball if you squeeze the mix in your hand. The bedding should not be too wet either. If you squeeze water out when you make a ball in your hand, you know the mix is too wet.



Mortar Bedding Material Mix

- A 1:4 mix of cement and river sand is recommended.
- **The ratio of water to cement in the mix is 1:2 – i.e., 500ml of water is used for 1kg cement.**
- To achieve a drier mix, use less water (and adjust the cement in relation to this). For a wet mix, use more water (and adjust the cement to maintain the 1:2 ratio).
- This mixture has a long working life and there will be no floating or displacement of material.
- Be aware that mortar might stain pavers. Be careful to ensure the mortar mix does not come into contact with the face of pavers.



Ensure that the sand used is well draining, as bedding that becomes waterlogged will cause discolouration of pavers in time to come. Use river sand for bedding mortar mix. Building sand or plaster sand contains too many fines and does not drain sufficiently.

3.2.1 Mortar Bedding Options

3.2.1.1. Individual Bedding (Recommended by SmartStone)



Bedding Pavers Individually

- Prepare a bed for each individual paver to be installed as you go along. This should avoid premature hydration of the mortar.
- Ensure the bed covers the whole surface area of the flagstone without any hollows or voids.
- Use the taut builder's line as a guide. Make the prepared bed spread $\pm 100\text{mm}$ further than the flagstone will cover - it is better to have the bed too big than too small, rather than leaving an edge of the flagstone unsupported.

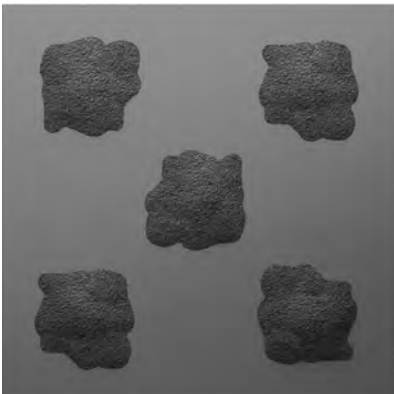
3.2.1.2. Screeded Bedding



Screeding a Large Area to Bed Pavers

- Some contractors screed a larger area at a time. This is more difficult to work with than individual bedding.
- This method is also risky, as mortar will hydrate quickly once screeded.

3.2.1.3. Spot Bedding (NOT Recommended by SmartStone)

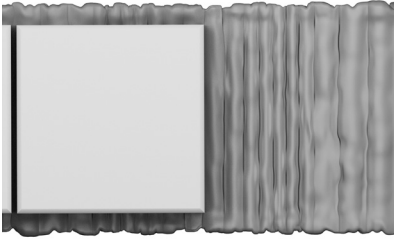


- This method creates voids beneath the flagstones, making them more likely to fracture when loaded, or come loose over time.
- This installation method should be avoided.

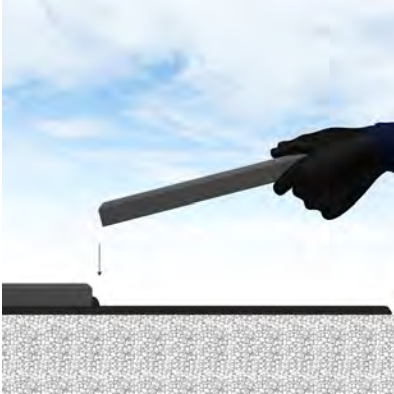


Understand that mortar bedding will always settle and compact. This might affect your levels.

Rippling



- Ripple the surface of each individual flagstone bed.
- Rippling allows for more precise compaction, by providing grooves for excess material to “spread”, without leaving voids or compromising support.



Buttering Edges

- To achieve sound mortar joints, the receiving edges of the flagstones already laid need to be “buttered”.
- Use a trowel to plaster a bit of fresh mortar against the edges of previously laid flagstones.
- Adjoining flagstones should then be lowered into this mortar. This will create better-filled joints and bonding between the flagstones.

Cement & River-Sand Mix for Buttering

- Use a 1:4 moist mix of cement and river-sand for buttering. (This is the same mix used for jointing the flagstones, if a cement grout is used.)
- As for the bedding layer, the water to cement ratio in the mix must be 1:2.



3.3. LAYING PAVERS

Working from pavers already laid might cause problems. Flagstones might settle more and bedding material might be displaced. We recommend working from an unpaved area, wherever practically possible.

One edge of the flagstone should be placed on the bed or on the edge of the preceding flagstone and gently lowered into place, making sure it is kept tight with the butter mortar and that it is not allowed to drop, which will disturb the mortar bed.

SmartStone flagstones are tapered. The underside of flagstones should be separated by 5-10mm, resulting in a larger jointing gap (6-12mm) on the “face” of the paved area.

Some SmartStone flagstones are designed with a spacer nib, which will simplify its laying.



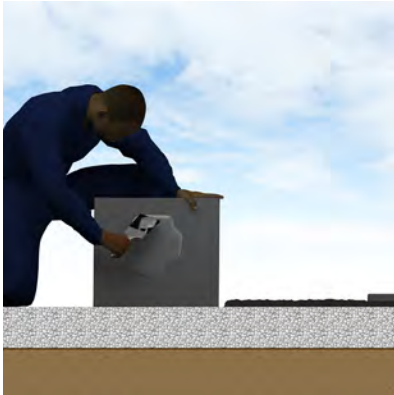
Unless they are flagstones designed with spacer nibs, never lay flagstones "butt-jointed", as they will chip and break.

Some contractors prefer using spacing tools made using round bar, while others use large tile spacers in order to maintain even grouting lines.

Lifting handles are great tools to prevent fingers from getting stuck beneath flagstones and could also aid spacing.

3.4. BOND PAVERS TO BEDDING COURSE & PREVENTING MOVEMENT

The underside of pavers must be free from loose material and rough enough to create adhesion (use a wire brush, if necessary).

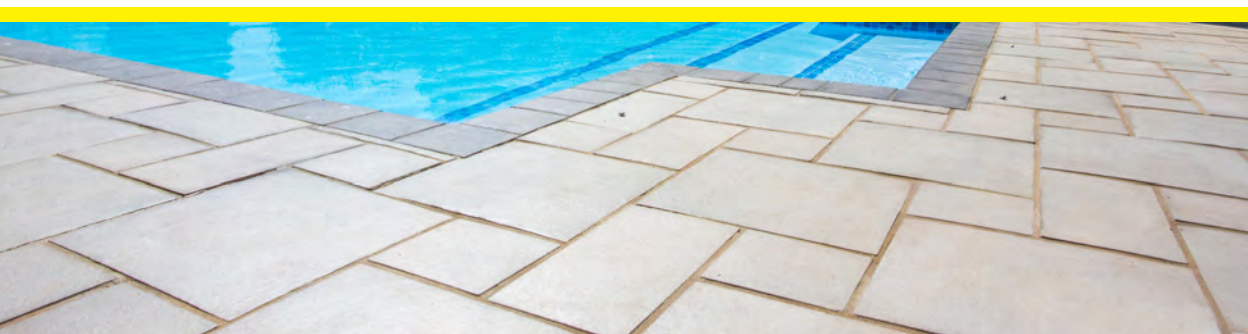


Bond Flagstones to Bedding & Prevent Movement

- Bond Bridges involve glues/adhesives which are applied ("buttered") to the underside of paving units to improve adhesion to the bedding.
- The goal is to prevent any movement in the flagstones, as shifting will eventually cause grouting problems.
- There are a few alternatives in terms of creating this adhesion, including slurry primers/coats, and a practical option being tile adhesives. When using tile adhesives, ensure the mortar bed is hydrated (hard).
- Immediately clean bonding material from the surface of flagstones with a damp sponge, but try not to get any on the flagstones in the first instance.
- Wet the underside of the flagstones before applying a bond bridge or placing them onto the mortar bed.



The most important aspect of rigid paving installation is that the pavers must adhere to the mortar bed.



3.5. LEVELLING & CONSOLIDATION



Compact Flagstones with a Rubber or Polyurethane Mallet

- Tap down the flagstone with a heavy non-marking rubber or polyurethane mallet.
- Tap the flagstones halfway between the centre and edge.
- Use light taps on the areas indicated on the diagram. If you tap too near a corner or too hard over a hollow in the bed, the flagstone may break. Light taps and plenty of them, are important. Concentrate on 'tapping' on the four main areas indicated in the diagram.
- Hitting flagstones too close to the edge will make edges sink in excessively and may break the flagstones.



Ensure that flagstones do not rock, that there are no hollow spots underneath them, and that they are not too high/low. If the bedding is not perfect, rather uplift and adjust the bedding, and then relay.

What do you do when a flagstone(s) is too high?

The flagstone will need to be lifted and re-bedded. Make a mental note of where the flagstone is high, by how much, and then lift the flagstone and stack it carefully somewhere safe, while you adjust the bed. You can use a trowel to reduce the bed in the necessary areas.

What do you do when a flagstone(s) is too low?

Make a mental note of where it is low and by how much, lift it out, add bedding material, re-level with a trowel/spade and re-lay the flagstone.

3.6. CUTTING



Flagstones should be cut using a masonry saw with a diamond tipped blade. An angle grinder is a cheaper option but does not work as well as a saw. Accuracy in measuring is essential when cutting flagstones. Measure the dimension to be cut; mark the dimension onto the flagstone; measure the dimension to be cut once again; and check that this is what has been marked.

Mark and cut one paver at a time. Do not use tiny cut pieces. Neat cutting calls for accuracy and patience.

Do not cut on paving already installed, as fine concrete dust will stain other pavers. Prior to cutting, the flagstones need to be laid out in a position where it can be cut safely. The flagstone itself needs to be firm and secure, with no wobbling or rocking.

It is essential to ensure that there are no bystanders around when cutting; no glass doors or windows near where you'll be cutting; and try to stay at least two metres away from any wall, as the detritus ejected will cling to it and stain any brickwork for a considerable period of time. **It is important that the cutting operative is wearing the necessary PPE, i.e., a dust mask, goggles, and ear protection.**

3.7. FINISHING ON EDGES

It is crucial that copings in particular adhere to the concrete bed extremely well. There are adhesives that do this job particularly well.

Create a border using a single size paver in a contrasting colour to finish the paved area off neatly.

There may be slight size variations in size between pavers and copings. Ensure this is negated by using slightly larger grouting gaps on one or the other. Lay out the pavers and copings prior to installation to ensure the appropriate spacing is used.

3.8. JOINTING / GROUTING

When laying different-sized flagstones in combination, jointing gaps might affect the overall spacing. SmartStone flagstones have, however, been engineered with this in mind and you should maintain 12mm gaps on the face of pavers.

3.8.1. Specialist Paving Grout



Romex Paving Grout

- SmartStone has access to specialised grouting materials, imported from Germany.
- Romex uses a resin binder which is much more durable than traditional cement grouting.
- These are strong, proven solutions for jointing gaps larger than 5mm and are extremely easy to install.
- Ask us about Romex or visit: www.cretesol.co.za
- **The steps to follow are:**
 - Wet the paving.
 - Mix the resin with the special grouting sand.
 - Squeegee the grout into the joints.
 - Sweep excess material from the pavers.

3.8.2. Cement Grouting



SmartStone does not recommend slurry grouting.

Some contractors prefer a cement slurry, because it is quicker to apply than the method described below.

The slurry can easily stain pavers and cause “picture framing”.

In our experience, slurry grouting between flagstones simply doesn’t last either, as the mix used is often weak.



Do not wash dry sand and cement into the joints with a hosepipe. This method will also stain paving.

A moist grouting mix is recommended:



- Use a 1:4 moist mix of cement and fine sand (e.g., plaster or silica sand) for jointing.



- The water to cement ratio should always be 1:2, to ensure a strong grout.



- There should be just enough moisture to loosely bind the sand and cement particles. Grouting should be moist not runny or wet.

The correct method of doing cement-based grouting is a time consuming and precise job. See below:



- **The paved area to be grouted must be thoroughly wet before applying cement grouting.**
- A trowel should be used to carefully work the cement mixture into the joints.
- Hot Tip: Add a 1:5 ratio of good quality tile adhesive to the cement for added strength.



- A pointing tool should be used to tool the joints down.



- Excess grouting material needs to be removed immediately from pavers, using a sponge. The sponge must be rinsed and squeezed dry after each wipe, to avoid staining the flagstone.



The paved area should be kept moist, using a fine mist of water, for 3-5 days after grouting to allow for proper hydration of the cement grout.

Do not traffic the paved area for 7 days.

Regrettably, cement grouting almost always fails over time, unless done properly.

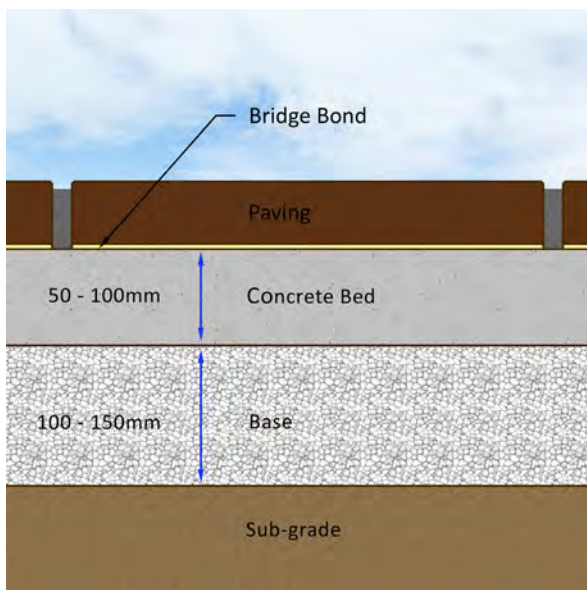
Specialist grout for paving (such as Romex) is recommended.



RIGID INSTALLATION OF LARGE PAVERS ON DRIVEWAYS

Installing large pavers on a driveway is a specialist application, only to be tackled by a contractor experienced in this type of paving installation. For example, if SmartStone Cosmopolitan Pavers are to be trafficked by passenger vehicles, the pavers must be laid on a 50-100mm mortar screed. The traffic is to be restricted to light passenger vehicles only.

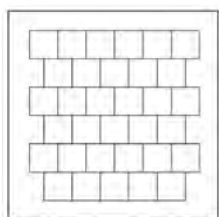
SmartStone is a member of the Interlocking Concrete Paving Institute (ICPI), focussed on training and certifying installers in South Africa. These installers are recommended to install SmartStone paving in general, but specifically, the rigid installation of large pavers on driveways.



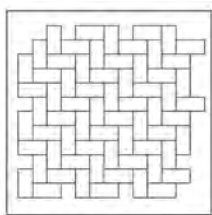
The key to success with a large paver driveway lies in the bedding, base and sub-base. The G5 base and the sub-base should be stabilised with cement (4%). It is important to bond the pavers to the bedding layer to avoid movement, as the movement of pavers will result in the failure of a paved site.

A bond bridge uses a slurry coat to create adhesion between, flagstones and the mortar screed. The benefits of using a bond bridge are invaluable and are essential in preventing flagstones from loosening when trafficked. It significantly improves early adhesion and bond strength in the completed flagstone paved driveway.

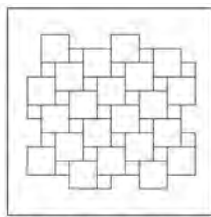
The appropriate installation pattern needs to be selected. The following laying patterns provide better interlocking properties than a square bond; making them better suited to driveway applications.



Stretcher Bond



Herringbone



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

Please note that:

- Driveway must not be trafficked for a minimum for 7 days after the completion of installation and grouting.
- Install concrete beams on sloping driveways to retain the pavers.
- Expansion joints will also be required, preferably every 3 metres.
- Always pave from the lowest point upwards to minimise the risk of movement of pavers once trafficked.
- To reduce the risk of chipping of the pavers or slabs when trafficked, grout right up to the top of the gap between the pavers.
- For more information, please go to:

https://www.pavingexpert.com/flags_driveways01

You are advised to consult an engineer to advise on the sustainability of using slabs for vehicular traffic, as well as for the specification of the base and installation.

Disclaimer: SmartStone has no control over the vehicles that will traffic a paved area, hence does not warrant that any paver larger than 225x225mm is suitable for vehicular traffic.



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.

5.1. 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.

5.2. 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 loose 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.

6.1. 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 through 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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