

# Installation Guide



**BOSUN**

B R I C K

*Expect the Best*

## Disclaimer

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**Please read this page carefully before even considering the installation of paving.**

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

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

**One expects 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, your paving installation should comply with the following basic principles:**

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



**Most importantly, paving needs maintenance.**

# Drainage



**Consider drainage carefully. Many paving failures occur due to 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 1 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 1 unit of fall.

From the above:

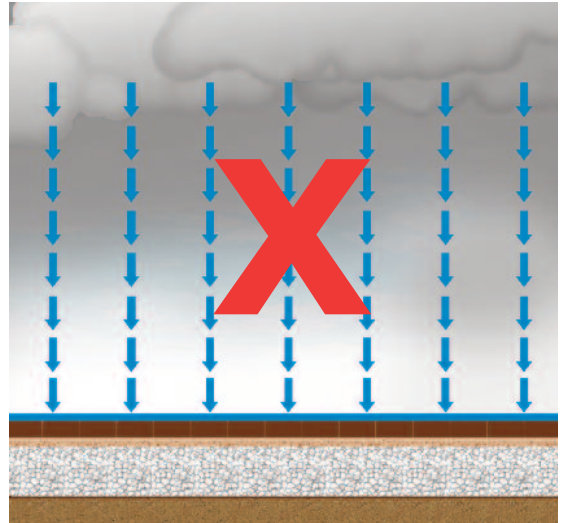
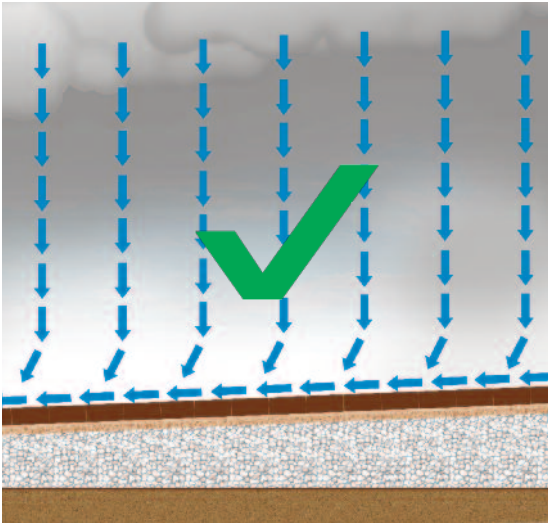
Required fall =  $4,500\text{mm} \div 50 = 90\text{mm}$

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

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

Drains and underground channels should be installed in certain areas like 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.**

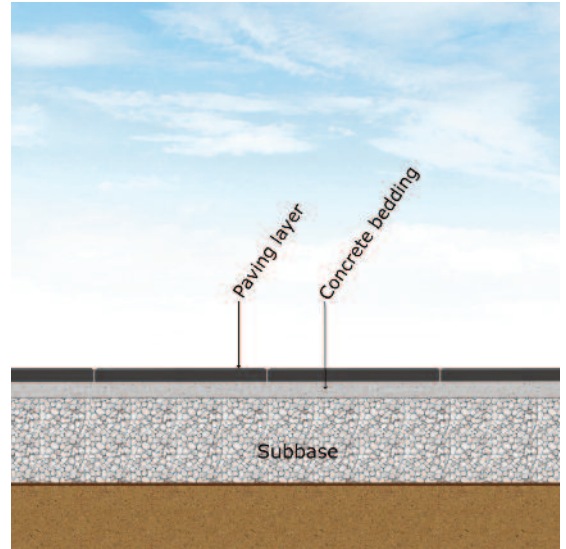
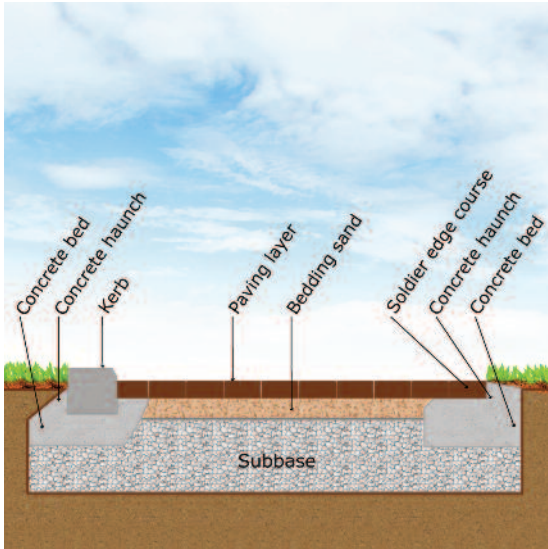
Underground water could adversely affect the appearance of your paving as concrete pavers are porous. Water is “sucked” to the surface of the paving, bringing minerals and whatever else is in the water and soil below to the face of the paver.

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 pavers may eliminate water absorption issues.

# Installation

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



**Flexible paving installation** is the globally accepted norm and when done correctly and maintained, it 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 all Bosun products except Hermetic flagstones. Some installers however prefer a rigid method for the Urban and Linneo ranges of paving. More details will be provided in the guidelines.

**Rigid paving installation** creates a solid concrete screed with the pavers bedded on it. Bosun Hermetic Flagstones should be installed according to this method. It is however possible to install all Bosun pavers according to the rigid method but it might not be the best solution.



**Most importantly though, is to never mix the two philosophies. In a rigid installation, use a concrete bed and cement or similar rigid jointing. In a flexible installation use sand for bedding and jointing. Sand on one and cement on the other simply doesn't work.**

# Foundation (For rigid and flexible installation)

## Option 1: Recommended for paving to last a lifetime

A well compacted subbase or foundation layer is one of the most important aspects of paving installation.

The subbase should be constructed with well compactable material like G5. Soil found on site, will simply not compact as well as G5 or similar and is not recommended as a foundation layer.

G5 is 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 in size.

Consult your local Bosun branch for suppliers in your area.



Always consider underground utilities before commencing with earthworks.



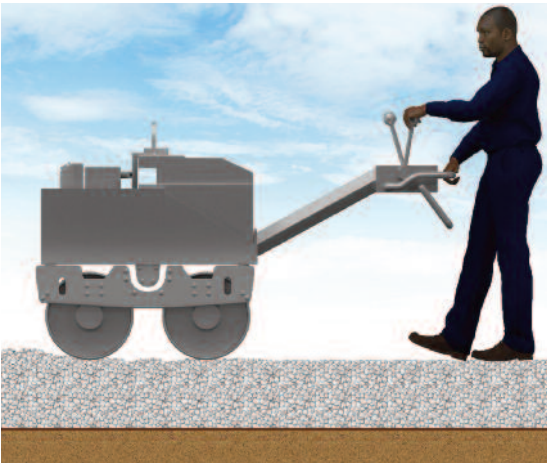
- Set out the area to be paved and excavate to a depth of  $\pm 250\text{mm}$  below the final paved level. (This should allow for a subbase of 150mm together with the thickness of pavers and bedding material used).
- All tree roots and other plant matter should be removed.



- Preferably use a roller 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 for compaction.
- Compact the earth to the point of refusal.



- Create an even 150mm subbase of G5 material.



- Compact the subbase with a roller, jumping jack tamper or plate compactor weighing at least 75kg.
- Again, compact this material to the point of refusal. A rough guideline to the number of passes is provided in Table 1.1.
  - Never attempt to compact layers thicker than 150mm. It will not compact sufficiently.
- Once compacted, the subbase should be to the required falls of 1:50 transverse and 1:80 longitudinal.

| Vibratory Roller | Depth of subbase |           |
|------------------|------------------|-----------|
|                  | 100mm            | 150mm     |
| 1300 – 1800kg    | 6 passes         | 16 passes |
| 1800 – 2300kg    | 4 passes         | 6 passes  |
| 2300 – 2900kg    | 3 passes         | 5 passes  |
| 2900 – 3600kg    | 3 passes         | 5 passes  |
| >3600kg          | 2 passes         | 4 passes  |

| Plate Compactor              | Depth of subbase |          |
|------------------------------|------------------|----------|
|                              | 100mm            | 150mm    |
| (Compaction force)           |                  |          |
| 1400 – 1800kg/m <sup>2</sup> | 8 passes         | X        |
| 1800 – 2100kg/m <sup>2</sup> | 5 passes         | 8 passes |
| >2100kg/m <sup>2</sup>       | 3 passes         | 6 passes |

Table 1.1



### 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 should be distributed to layers beneath paving blocks.

## Option 2: The cheaper option with more pitfalls (For residential pedestrian traffic only)



- Set out the area to be paved and excavate to a depth of  $\pm 80\text{mm}$  below the final paved level. (This should allow for the thickness of pavers used together with the bedding material).
- All plant matter should be removed.



- After excavation, scarify the soil further to an additional depth of 100mm.



- Spread dry cement evenly over the surface of this scarified soil.
- Dig in with the soil until no grey streaks are visible.





- Sprinkle with water (moist not soggy).



- Use a roller, compactor of 75kg or hand tamper to compact the earth after excavation.



The subbase should be smooth, level and the correct falls should be achieved with this material.



## Critical considerations

Paving derives its strength from the layers beneath the paving blocks. 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 of paving. It further does not prevent weed growth as weeds grow from the top and 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.

Paving on steep slopes is more complex than level areas. Use beams to restrain pavers in sections on a slope.

Paving on top of existing structures like underground parking garages requires special design considerations. Consult an engineer experienced in the design of segmented block paving.

Consult Bosun's product brochures for possible laying patterns. It is important however to avoid continuous joints in the direction of vehicular traffic.

Water ingress is detrimental to any paved surface. It is important to either avoid water infiltrating a paved surface as much as possible or create efficient drainage of the paved surface and layers beneath it.

# Handling



**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.



There will be slight variances in colour between different batches. It is therefore recommended to draw and install pavers from different packs during installation to avoid a patchy finish.



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 differences when buying additional pavers later.



**Efflorescence - A white film on the surface of concrete, clay and natural stone products. Because there are minerals and moisture in the soil and the material we use to manufacture paving, your paving might be affected by efflorescence in its lifetime. It is a natural, temporary phenomenon which will disappear in time. Please refer to [www.bosun.co.za](http://www.bosun.co.za) for more information.**

# FLEXIBLE INSTALLATION

For all Bosun pavers except Hermetic flagstones.



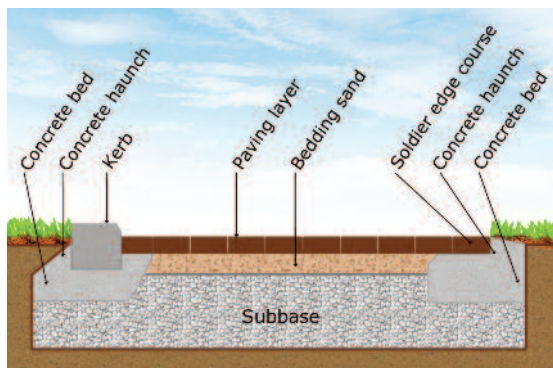
**Before proceeding ensure the foundation and drainage as described on pages 2 - 7 of this document are done according to these guidelines. Paving will fail if these aspects are not dealt with correctly.**

## Edge restraints

Bosun recommends that edge restraints be installed before installing the pavers.

The foundation should extend to the outer side of edge restraints.

Edge restraints could be kerbs or pavers / copings bedded in concrete.



- Bed edge restraints in concrete and haunch with concrete.
- Ensure that the concrete beds also retain the layers underneath the paving. Therefore, bed edge course pavers on 75mm thick concrete and haunch at least to half of their height at the back of the paver with concrete at least 75mm wide. This will create a solid concrete block that won't move.
- Use a moist concrete mix of 4 parts sand and 1 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 and paving on steep slopes, additional restraints in the form of beams might be required. Please refer to the CMA guidelines for paving on steep slopes or consult an engineer.



- 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.

**Tip** Rectangular pavers, laid on a concrete bed in a soldier course is often used for edge courses.



### Why are solid edge restraints important?

- Paving should not creep sideways. When pavers move horizontally, grouting material between pavers is lost. As a result pavers will chip, water will ingress and the paved area will fail completely in time.

# Bedding

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    |

If you install pavers according to the flexible method, do not mix 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.

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.

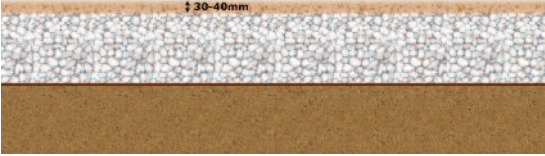


- To check if the bedding sand is sufficiently moist, squeeze a handful of sand. It should compact to a ball but no water should escape between your fingers.

**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.**



- Bedding sand should be 25-35mm 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.



- Bedding sand should be screeded with a straight edge (like a straight plank or similar), using rails in order to achieve the correct thickness.



Bosun does not recommend screeding freehand in a circular motion, without rails.



### **Why is it so 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.

## Laying and setting out

Starting from a corner, use pegs and a taut nylon line, stretched from one known point to another in order to create the correct line and level.

Next, set up another line at a 90° angle.

Adjust the height to the thickness of the bedding material and pavers to be used.

Just how line and level are established can be quite complicated. It all depends on the type of paving being laid, its relationship with the ground and any adjacent buildings, the pattern or layout being used, drainage and falls, and the overall plot or site.

Falls should be away from the property. Paving is usually best laid square to the building.

Each job has its own peculiarities and the best way to establish line and level will probably change from job to job.

### First compaction (Levelling)



**Sweep the area and remove all debris prior to compaction.**



- Compact pavers once they are laid, in sections.
- Bedding sand must be moist when the compaction takes place. This means that compaction should be done once a day and more often when it is very hot.
- A plate compactor should preferably be used to achieve levelling.
- When using a plate compactor on non-bevelled and beneficiated finishes, it is essential that a piece of rubber conveyor belting or a cover is attached to the base.
- Do not lay conveyor belting on the pavers and compact on it as this will absorb the forces and pavers will not be compacted properly.
- Use a special alignment bar in order to align and "tighten" pavers.
- Do not compact closer than 1m of any free edge.



**When installing pavers in combination patterns, be aware that smaller pavers will bed deeper than large pavers when using a very light plate compactor.**

**Larger plate compactors are recommended for levelling large pavers installed in combination patterns.**



- Special, large rubber or polyurethane mallets could be used to bed and compact individual pavers in difficult areas.
- As a rule, it is beneficial to tap down and level large pavers like the Urban and Linneo ranges with a paving mallet as they are laid. (Special paving mallets are available from Bosun)
- 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 would have moved during the night, opening up larger gaps than required.



**Carefully inspect the site at this stage (after levelling but before grouting). Remove and replace all damaged pavers as there will be the odd chipped or broken paver. It will be much more difficult to extract damaged pavers once grouted.**



### **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.

## **Cutting**



- 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 using a block splitter, angle grinder or masonry saw with diamond tipped blades.
- Do not use tiny cut pieces. Rather use a  $\frac{2}{3}$  and  $\frac{1}{2}$  paver in combination, instead of a full paver and a small bit for instance.
- Do not use a saw or grinder on paving already installed. Fine concrete dust will stain other pavers.
- Always wear a dusk mask, gloves and goggles.
- Do not cut near other people.



### **Why is precision cutting essential?**

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



# Grouting

The use of specially graded paving jointing sand is recommended because it offers the best interlocking capabilities.

Plaster sand is however generally used for paving grouting in South Africa.



Use light coloured plaster sand rather than red sand. Red plaster sand might stain your paving.



- Sand must be bone dry and swept into joints.
- Sweep diagonally across pavers and not along the “lines” .
- Go back and forth until all joints are completely filled.
- Do not use water to wash in sand between the pavers.
- Do not use a mix of dry sand and cement and then sprinkle water on it to hydrate. The cement left on pavers will stain the pavers.
- Bosun 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 can't distribute loads to layers underneath.



## 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.



As mentioned earlier, large pavers like the Urban and Linneo ranges, require attention to detail. You might get away with certain shortcuts when installing bevels or interlocking shaped pavers, but it is imperative to follow these guidelines carefully when installing large pavers like the Bosun Urban or Linneo ranges.

## Second compaction (Joint filling)



- Use a plate compactor with a protective rubber mat fixed to the base of the plate.



- Sweep more 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 once a year before the rainy season.
- In areas with a high risk of sand washing out, we recommend the use of a joint stabiliser like Resiblock.
- When your budget allows, we recommend the use of this joint stabiliser for the whole paved surface.
- Resiblock's dual formula means it acts as premium quality, paving sealant and joint stabiliser. It will therefore not only ensure sand stays in the paving joints but it will also protect your paving for ten years.



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



### Why is it vital to vibrate sand into the joints?

- Sand creates interlock between pavers which will prevent sagging and lateral movement.
- Sweeping alone will cause bridges and voids in the jointing. Vibration will ensure much better sand filling.

# RIGID INSTALLATION

Recommended for Bosun Hermetic flagstones with jointing gaps larger than 3mm. This method is also recommended for Bosun XXL pavers, as it is more difficult to level these extremely heavy pavers on a sand bed.



**Before proceeding ensure the foundation and drainage is done as described on pages 2 - 7 of this document. Paving will fail if these aspects are not dealt with correctly.**

## Preparing a concrete bed

Bosun recommends a moist concrete mix. A moist concrete mix generally does not contain any added water. It relies on the natural moisture within the sand and in the atmosphere to initiate hydration of the cement. River sand used should therefore contain 4-8% moisture.



- If you squeeze a handful of sand it should compact to a ball but no water should escape between your fingers.



- A 1:4 mix of cement and river sand is recommended.
- This mixture has a long working life and there will be no floating or displacement of material.
- Be aware that concrete might stain pavers.
- Therefore, be very careful for it not to come in contact with the surface of pavers.



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

# Concrete bedding options

## Individual bedding (Recommended by Bosun)



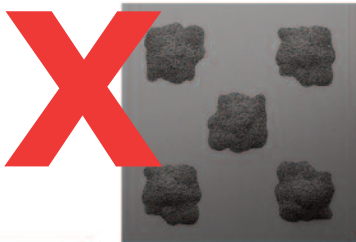
- Prepare a bed for each individual paver to be installed as you go along. This should avoid premature hydration of the concrete.
- Ensure the bed covers the whole surface area of the flagstone without any hollows or voids.

## Screeded bedding



- Some contractors will screed a larger area but it is more difficult to achieve than individual bedding.
- This is tricky as concrete will hydrate quickly once screeded.

## Spot bedding (Definitely not recommended)



- Four or five spots of bedding material under flagstones.
- This method creates voids beneath the flagstones, making them more likely to fracture when loaded.



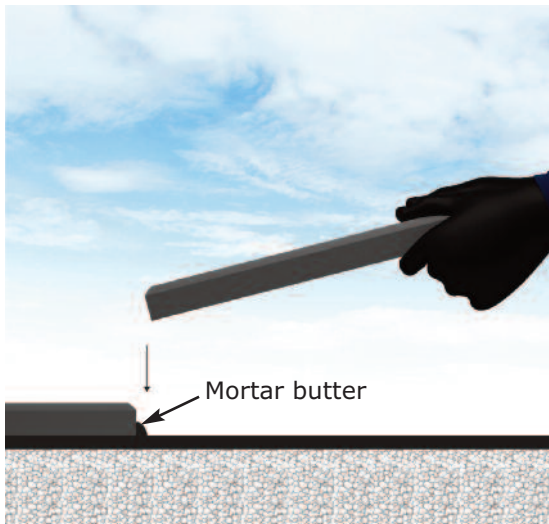
**Understand that concrete bedding will always settle and compact. This might affect your levels.**

## Rippling



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

## Buttering



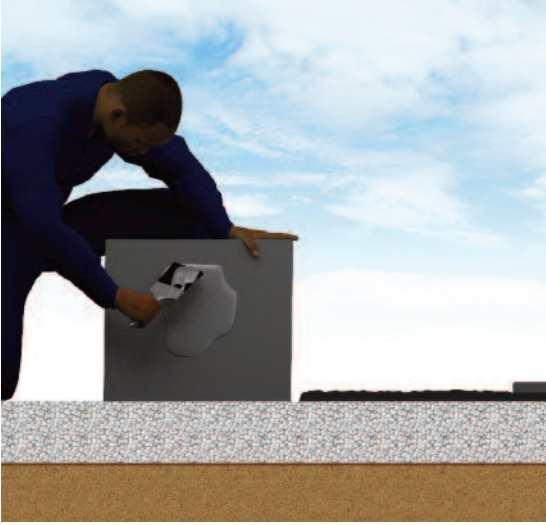
- To achieve sound mortared joints, the receiving edges of the flagstones already laid need to be “battered”.
- Use a trowel to plaster a bit of fresh mortar against the edge of previously laid flagstones.
- Adjoining flagstones should then be lowered into this mortar. This will create better filled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



- Use a 1:4 moist mix of cement and building or plaster sand for buttering. (This is the same mix used for jointing the flagstones, if a cement grout is preferred).

## Bonding flagstones to the bedding course

The bottom of pavers must be free from loose material and rough enough in order to create adhesion. Use a wire brush if necessary.



- Apply a bonding agent to the back of every flagstone in order for it to adhere to the prepared concrete bed. The reason is to prevent any movement in the flagstones, as shifting will eventually cause grouting problems.
- A practical option is tile adhesive. When using tile adhesive, ensure the concrete bed is hydrated (hard).
- Immediately clean bonding material from the surface of flagstones with a damp sponge but preferably be careful not to get any on them in the first instance.
- If no bonding agent is used, wet the bottom of the flagstones before placing them on the concrete bed.

## Laying flagstones

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.

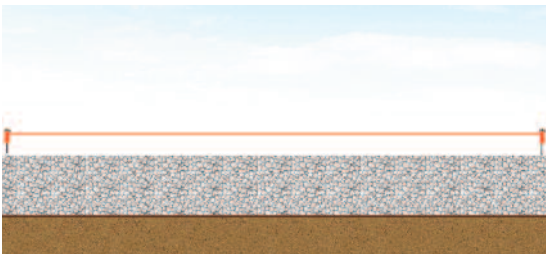
One edge of the flagstone should be placed on the bed, or on the edge of the preceding flagstone and gently lowered into place, making sure it's kept tight with the butter mortar and that it's not allowed to drop, which could disturb the bed or break the flagstone.

**Tip** Use a kerb handler to handle XXL pavers. A very large paving mallet is required to level XXL pavers. Both these tools are available from Bosun.



**Unless it is flagstones designed with spacer nibs, never lay flagstones "butt jointed". They will chip and break.**

Some contractors prefer using spacing tools made with angle iron and some use large tile spacers in order to maintain even grouting lines.



- Taut nylon guides are essential to keep lines straight.
- Ensure the leading edges of pavers are lined up accurately.

**Tip** Lifting handles are great tools to avoid fingers getting stuck beneath flagstones and could also serve as spacing guides.



- Tap down the flagstone with a heavy non-marking rubber or polyurethane mallet.
- Tap the flagstones halfway between the centre and edge.
- Hitting flagstones too close to the edge will make edges sink in excessively and might break the flagstone.



**Ensure that flagstones don't rock and that there are no hollow spots underneath them.  
If the bedding is not perfect, rather uplift, adjust the bedding and then relay.**



Use a straight edge to span several flagstones and spirit level to check falls.

## Cutting



- Preferably cut flagstones using a masonry saw with a diamond tipped blade.
- An angle grinder could also be used although a saw provides better results.
- Mark and cut one paver at a time.
- Do not cut on paving already installed. Fine concrete dust caused by cutting will stain other pavers.
- Always wear a dusk mask, gloves and goggles. Do not cut near other people.
- Precision cutting is crucial for a neat finish.

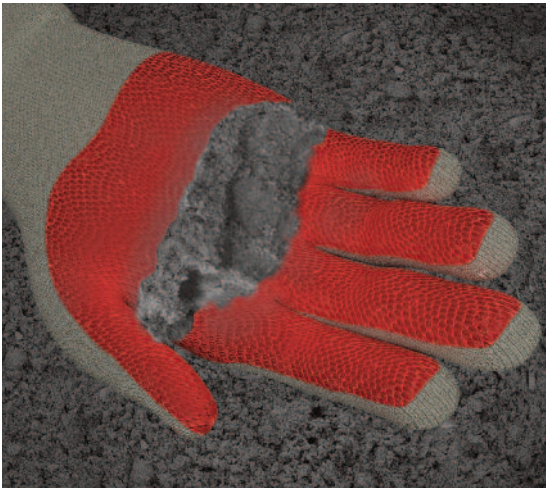
# Cement Grouting

**Tip** When laying different sized flagstones in combination, jointing gaps might affect the overall spacing.

## Moist Grouting (Recommended)



- Use a 1:4 moist mix of cement and plaster or building sand for jointing.



- There should just be enough moisture to loosely bind the sand and cement particles.



**Do not use unbound sand jointing between flagstones. Good jointing is time consuming and requires skill.**





- The area to be grouted must be wet before applying cement grouting.
- Using a trowel, carefully work the mixture into joints.



- Tool joints down with a pointing tool.



- Remove excess grouting material from the pavers immediately with a sponge.
- The sponge must be rinsed and squeezed dry after each wipe to avoid staining of the flagstone.



**Cement grout must be kept moist for ±3 days in order to ensure the best curing. Some contractors prefer to cover a paved area with plastic sheeting for this purpose.**

## Proprietary grouting



- Bosun sells specialised grouting materials imported from Germany.
- These are strong proven solutions for jointing gaps larger than 3mm and are extremely easy to install.
  - Wet the paving.
  - Squeegee the grout into joints.
  - Sweep excess material from the pavers.



**Bosun does not recommend slurry grouting.**

Some contractors prefer a cement slurry. This can easily stain pavers and cause picture framing. When using the slurry, cleaning has to be done quickly and carefully with a sponge. Washing with hose pipes or any excess water will also seriously affect the strength of the joints.



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