

Laying Flags & Slabs

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Laying Flags & Slabs



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Introduction

There are two acceptable methods of laying flags - individual bedded and screed bedded. There is a third method, spot-bedding, but this is not considered suitable for a professional paving project. The choice of laying methods depends on the personal preference of the contractor/specifier, the **type of bedding** that is chosen, and the types of flags being used.

When stone flags are laid to town centre footpaths and other areas that are open to the general public, the **rigid laying method** is used increasingly. While this method is not radically different to that outlined below, it is important enough to warrant its own page where the methodology is illustrated in more detail.

Individual bedding

This method relies on each flag having a bed prepared for it individually. A bed is prepared, the flag is laid and then the next bed prepared and so on. **See How** (further down page).

This method is more common used with larger flags, where handling and manoeuvrability is a major concern, with natural stone flags, where there can be significant difference in flag thickness between adjacent units, and for many of the **mould cast** riven or decorative flags, which tend to have a variable thickness ranging $\pm 15\text{mm}$ on individual units - this being a result of the mould not being perfectly level when the wet-cast concrete is allowed to set.



Random thickness of natural stone flags makes screed bedding impractical

Screed Bedding

This method requires a screed bed to be prepared before placing the flags. A relatively large area can be screeded in advance and the flags placed one after the other directly onto the bed. [See How](#) (further down page).

Whilst obviously more efficient than the individual bedding method, this method is only suitable for the smaller flags, generally those less than $600 \times 600\text{mm}$, which are small and light enough to be manhandled onto a screeded bed. It is essential that the flags be of a constant thickness, hence only the small element paving and wet-press manufactured patio flags are suitable candidates.



Regular thickness of wet-press flags makes screed bedding possible

Spot Bedding



Note: The '5 dollops of mortar' method, known as "spot bedding" or "dab bedding" is *not* recommended. On public and commercial works, it is rarely, if ever, allowed. If your contractor is using this method, ask would they like a bucket of oats for their horses. 😊

Regardless of what you may have seen on TV DIY and Gardening programs, spot bedding is not an acceptable bedding method because...



Spot bedding - not recommended

- ☹️ it leaves voids beneath the flags, making them more likely to fracture when loaded
- ☹️ the voids can allow surface water to accumulate, leading to subsidence or instability
- ☹️ the voids provide a ready-made home for invertebrates, particularly ants, which love to mine an unbound bedding and/or sub-grade

- ☹️ the solidified mortar spots settle differently causing the flag to 'rock' when trafficked
- ☹️ correcting any rocking flags requires the old mortar to be broken out and disposed
- ☹️ it is more expensive than solid bedding
- ☹️ it does not comply with the relevant Code of Practice (BS7533:Part4) which requires bedding to provide "uniform support".

When asked to inspect a flagged pavement which is troubled by a large percentage of rocking and/or broken/spalled flags, in over 70% of cases, we have found that spot-bedding is the prime cause of the problems.

The two most common faults we encounter are lost bedding, because the voids left between the mortar spots provide a channel into which surface/ground water can wash-out the bedding or sub-grade material, and excessive breakages because the flags are not evenly supported across their entire base.



I wonder what caused this breakage??



You don't need a degree in engineering to see that this type of construction offers buggerrall in the way of support for flagstones

Whilst we can accept that these problems are less likely to occur on a small residential patio, we cannot and will not endorse spot-bedding as a suitable method for laying flags, regardless of the location. Some publications may depict spot-bedding as an acceptable methodology for diy projects, because it makes flag-laying appear simple, but, for a professional contractor, it should never, ever, ever be considered. Ever!

Don't expect any sympathy from this website if you use spot-bedding and it turns out wrong!



Construction

There are only two essential layers to light-use flagged paths and patios: the flags themselves and the bedding. For pavements experiencing heavier usage, or where the ground (sub-grade) is unreliable, a sub-base may be used. Drives, forecourts and public footpaths should use the thicker type of flags (50/63/70/80mm) or may use a concrete sub-base onto which the flagstones are laid directly before it sets.

Preparation

Decide where the paving is to run, and mark out as required. It is assumed that the paving is to be flush i.e. level, with the existing ground. It is a good idea to excavate wider than the planned pavement width, allowing an extra 50-100mm at the edges makes handling much easier.

See [Setting Out](#) page for more information on marking out a paving project.

Falls:

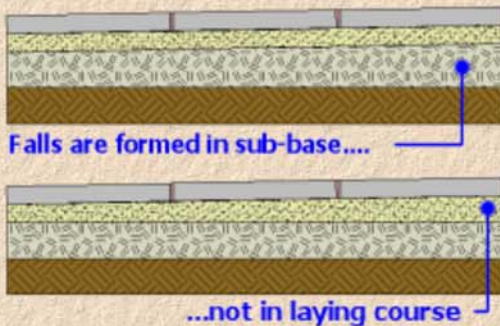
For commercial or specification paving projects, the minimum recommended falls for flag paving as stated in [BS 7533:4](#) are 1:80 longitudinal and 1:40 transverse. There are exceptions, such as when proprietary drainage systems are incorporated into the pavement.

On private patio and driveway projects, a fall of approximately 1:60 is usually adequate. Bear in mind that heavily [riven paving](#) may require additional fall to prevent water accumulating on the surface, which can lead to discolouration, while smooth ground paving can often cope with a shallower fall (say 1:80)

See the [Drainage for Pavements](#) page for a fuller explanation of these terms



Riven flagstones



Falls are formed at sub-base (or sub-grade) level; that is, the sub-base is laid, levelled and compacted to the requisite falls, so that subsequent construction layers (laying course and the paving itself) are all of a fairly uniform thickness.



Sub-grade

The surface needs to be dug off to a depth of approx. 90mm, assuming no sub-base is required. The depth of dig can be calculated as...

(average depth of flagstones + 35-50mm bed + any sub-base required)

Remove all weeds and other unwanted organic matter. Excavate any soft spots and fill with compacted sub-base material or a 10:1 grit sand/cement mix. Where the area of the paving is troubled with weeds, treat the excavated sub-grade with a general weedkiller such as Sodium Chlorate.

Weed or **root barriers** are not essential unless there is known problem with roots or invasive, deep-rooted weeds, but it is unlikely that any weed will be able to penetrate the upper layers.

Where the excavated ground is suspect or unreliable, use of a **construction geo-fabric** may be beneficial.



FAQ

"Do I really need a membrane or a layer of polythene underneath my paving?"

[\[Click Here\]](#)

If an edging is required, it can be constructed at this stage or left until the rest of the paving is in place. Brick edgings, plain or decorative **edging kerbs**, kerbs or cobbles laid lengthways are all suitable.



Sub-base

This will not normally be required for a path or patio unless there is concern regarding the suitability of the sub-grade. However, any low spots can be filled with crushed hardcore, crushed stone or compacted bedding material - see [below](#).

If the area to be paved is such that it requires raising or elevating to a higher level, then the uplift should be constructed by including or adding to the sub-base layer, *not* by increasing the thickness of the bedding layer.

For driveway or other heavy use, the sub-base layer is the load bearing layer, and should be at least 100mm thick, minimum. For public footpaths, this may sometimes be reduced to 75mm, or increased to 150mm or more to give added protection to underground services. Alternatively, the flags can be laid directly onto a **mass concrete sub-base**, but be prepared to work fast to cover the ground before the concrete sets!

The finished surface level of any sub-base, should be (flag+bed depth) ± 10 mm below finished paving level.



See [sub-base](#) page for details of acceptable materials and compaction methods.



Bedding layer

Flagstones can be bedded directly onto either:

- ◆ a coarse, grit sand bed, approximately 40mm thick
- ◆ a cement bound bed approximately 20-40mm thick

In general, most flagstones are laid onto a cement-bound material (a mortar or concrete). However, an unbound sand or grit bed can also be used when the situation warrants it. Just what that "situation" may be is examined in more detail on a [separate page](#) 📄

When working with an unbound bed, **DO NOT USE BUILDING SAND** - it is too soft and can become 'fluid' when waterlogged, consequently moving beneath the flags, causing settlement.

For light patios and pathways, the bedding material can be stiffened by the addition of a small quantity of cement, around a 10:1 mix is adequate. This is useful when working in wet areas, or where the movement of ground water could lead to bed migration, and we find it useful beneath the thinner patio flags as it gives the finished pavement a bit more solidity. Refer to [Bedding Materials](#) 📄 page for details on various cementitious bedding mixes.



Coverage rate for bedding material is approx. 10-12 m² per tonne at 50mm thick, but this varies with moisture content. See [Screeding](#) 📄 page or the [Aggregates](#) 📄 page for more details on grit sands.

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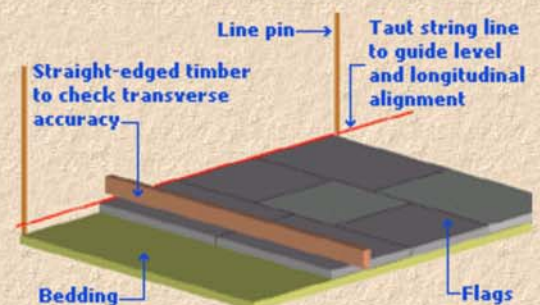


Use this calculator to work out how much sand or bedding mix is needed to lay a typical patio or pavement. Click [here](#) 📄 to open the calculator.

The bedding material should be spread to the area and compacted either by trampling or with a couple of passes with a plate compactor prior to bed preparation, which will be one of the [two methods](#) 📄 previously mentioned.

The flags should be laid to a taut string line, to aid coursing and levelling accuracy. Basically, a length of string is stretched from one known point of the paving to a projected point, and used to guide longitudinal line/level. A straight-edged timber or [long spirit level](#) 📄 (1000mm or more) is used to check transverse accuracy.

The distance between consecutive line pins should not exceed 10 metres. See the [Setting Out](#) 📄 page for more detail on establishing lines and levels for paving projects.



Individual bedding

Use a [spade](#) or large [trowel](#) to level out the bedding material, which should have the top 15-25mm loosened to allow the flag to be bedded down - this is usually achieved by 'rippling' the bedding surface, creating small troughs and peaks with the blade of a trowel. The bed should be 5-8mm high to allow for consolidation. Use the taut string line as a guide - use a piece of broken flag or a piece of timber cut to the correct thickness to judge the level of the bed adjacent to the line.

Make the prepared bed spread 100mm or so further than the flag will cover - it is better to have the bed to big than too small, leaving an edge of the flag unsupported.



Preparing an individual bed

The true art of flag laying is to get the bed right on the first attempt, so that the flag can be laid and consolidated without having to be repeatedly lifted while bed adjustments are made. If you have 100 flags to lay, and it's taking 3 attempts to get each bed right, you've laid 300 flags in actuality, but have only 100 to show for your efforts.

Screed bedding

The bedding material is spread out over the area to be paved, compacted lightly with a plate compactor (around 2 or 3 passes) and then screeded to level 5-8mm high as explained in more detail on the [Screeding](#) page.



Flags at a free edge



Flags laid to a free edge in a garden setting

Where flags are laid to a free edge, that is, an edge where there is nothing firm or solid against that edge, as is the case with a garden path and some patios, the edge flags are often best bedded onto a wettish mortar in order that they are held firmly in place. As the mortar (or a suitable concrete) cures and hardens, it holds the flag fast and prevents lateral movement.

Some suitable techniques for use with edge flags are considered on a [separate page](#).

Buttering or not?

When using a traditional mortar joint, the 'receiving edges' of the previous flags can be 'battered' with a generous amount of a **jointing mortar**, taking care not to get any of the mortar on the surface of the flag. The next flag to be laid is then offered to the receiving edges, squeezing against the mortar that has been battered thereon.

The joints can be topped-up with additional mortar or cementitious material once the flags are aligned and consolidated.



Mortar is battered onto receiving edges

Open Jointing

With the Open Joint method, the flags are laid without any buttering mortar prior to their being filled with a **mortar**, **slurry** or **wet resin** jointing material on completion of the actual laying. When using this method, it is advisable to use small pieces of plywood or other temporary spacing material between the flags to maintain regular 8-10mm wide joints.



Butt Jointing and Close Jointing

With dry jointing, the flag is positioned and pushed hand-tight against the preceding units, but not so tight that the joint is completely closed. For dry-sand joints, the flags should be separated by no more than 3mm. There has to be some gap to allow the jointing sand to enter, but it needs to be kept to a reasonable minimum otherwise there is a real risk that the jointing will be removed by **scour action**.

This technique is often incorrectly referred to as 'butt jointing' but it is actually "close jointing". Butt jointing normally means that adjacent flags (or other paving units) are in direct contact with each other. This is NEVER a good idea as any movement of the flags can result in spalling of the surface.



Butt Joint - flags in direct contact



Close Joint - flags have narrow 1-3mm joint



Laying the flags

The smaller paving units, such as those shown opposite, are often light enough to be lifted directly into place, but the larger units, 450x450mm and above, need to be lowered carefully into position.

Most flags larger than 450x450mm are relatively heavy and often weigh more than the maximum recommended in manual handling guidance (usually taken to be 25kg). Whenever possible, specialist paving tools and lifting aids should be used when working with these larger units.



Lifting a small flag into place



Manual lifting aid - 2 person

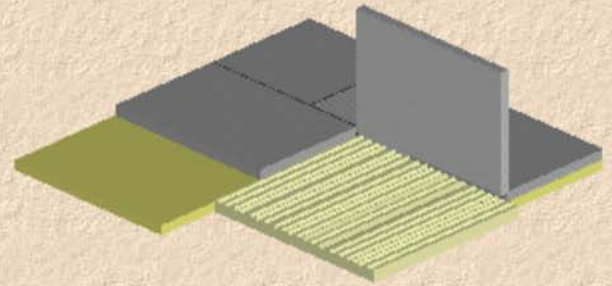


Vacuum lifting aid - 2 person

Returning to unaided manual laying, there are two ways of laying the bigger, heavier flags - from the paved surface and from the leading edge. Note that when using the screed bedded method, work must be done from the paved surface to avoid disturbing the prepared screed bed.

Laying from the paved surface.

Make sure you have the flag in the correct orientation, so that it will not be upside down when laid. Holding the top edge of the flag with both hands, squat down behind the flag and lower it carefully into position, allowing it to pull you up out of the squatting position. This technique places less strain on the back muscles than lowering the flag from an upright or stooped stance.

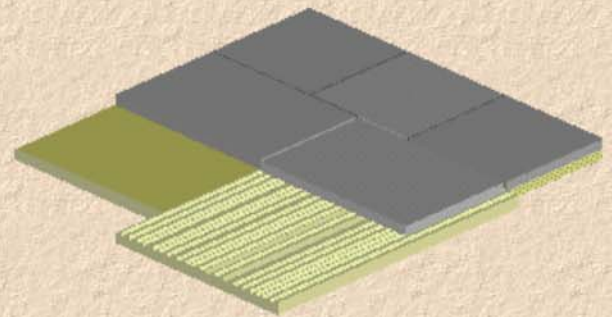


Always lay flags the 'narrow' way - ie, if laying a 600x300mm flag, make sure the 600mm long edge is on the ground and that you are only stretching 300mm to lay the flag.

One technique we use to avoid excessive strain on the back, is to use the [pavior's maul](#) to take the bending motion out of lowering the flag. The head of the maul is used to hold the 'top' edge of the flag, which is then lowered by the tradesman who controls the flag's descent via the maul.

Laying from leading edge

Walk the flag to be laid into position so that the bottom edge of the flag is aligned to deliver the flag into the correct position. Keeping one foot against this bottom edge to prevent the flag from slipping backwards, grip the flag on the open side and carefully lower it into position on the bed. Make sure you do not get your fingers trapped between the flag you are laying and the preceding unit.

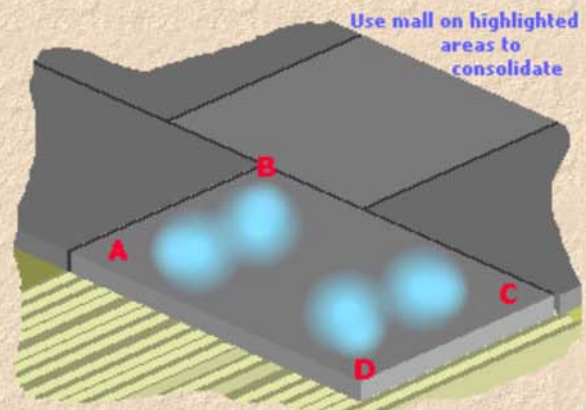


It is not possible to use the maul assisted lowering technique mentioned above when laying from the leading edge, as there is no space for the head of the maul between the top of the flag being laid and the leading edge of the existing paving. This means extra strain on your back, so extra care must be taken.

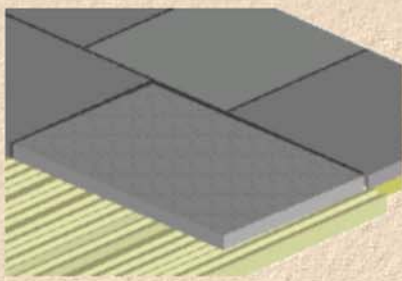


Consolidation

Once on the flat, the flag is nudged into alignment with the [maul](#), and is then tapped down to the correct level with the maul until it is 'flush' with the surface of the preceding flags and/or the string line guide. Use light taps on the areas indicated on the diagram. If you tap too near a corner, the flag might break, if you tap too hard over a hollow in the bed, the flag might break, so remember, light taps and plenty of them. Concentrate your 'taps' on the four main areas indicated.



Some of the small element paving is suitable for consolidation by running the plate compactor over the surface, rather than individually consolidating each flag. Do not attempt this method with patio flags - they are not strong enough and were never intended to be plate compacted - they are almost guaranteed to break and, on some of the decoratives, the surface detail will be spoiled.



Straddle the flag diagonally and shift your body weight about to check that the flag isn't rocking. If the flag is rocking when you straddle corners A and C, then areas B and/or D must be high - tap them down until the rocking stops. Conversely, if the rocking is along the B-D axis, areas A and/or C must be high. Use a [spirit level](#) to check that the flag is falling in the required direction for drainage.

Oh Flip! It's too high!

The flag can only be tapped down a limited amount. Beyond a certain point, no further compaction is possible and if you persist in hammering it with the maul, the flag will break. There is only one remedy, the flag will have to be lifted and re-bedded, but before you do lift the flag, make a mental note of where the flag is high and by approximately how much, then, when you've lifted the flag and stacked it safely while you adjust the bed, you can use a spade or a trowel to reduce the bed in the necessary areas. Once again, loosen the top 15-20mm of the bed and try the flag again. Hopefully, it's right this time. 😊

Oh Sugar! It's too low!

If the flag is too low once you've consolidated it with the maul, it will have to be lifted and the bed added to before relaying. Simply lifting one edge of the flag and packing bedding material in as far as your fingers will reach is not a good idea - it can leave a void in the centre of the flag, meaning the flag is only supported on the packed edge and the opposite edge. Again, make a mental note of where it is low and by how much, lift and stack the flag safely out of the way, and then add bedding material to the entire bed, re-levelling with a trowel or spade before re-laying the flag.



Jointing and/or Sealing

A number of jointing options were briefly introduced [above](#) and such is the range of alternatives that a whole separate series of pages has been created to consider each in turn.

In summary, there are four main options:



- ◆ No jointing - butt-jointed or close-jointed and allowed to fill with detritus
- ◆ Loose jointed - usually a dried sand
- ◆ Cement Mortar - sand/cement mortars and slurries
- ◆ Resin Mortar - polymeric sands and resin slurries

Many factors contribute to determining which will be the most suitable jointing method for any particular project. There is no single 'always right' solution.

See [Pointing and Jointing Pavements](#) and [Jointing for Stone Paving](#) pages for further detail



[Other Flags and Slabs pages on this site](#)

- ★ [Natural Stone Paving](#) 
- ★ [Imported/Indian Sandstone](#) 
- ★ [Celtic Knot Circle](#) 
- ★ [Slate Paving](#) 
- ★ [Pre Cast Concrete Flags](#) 
- ★ [Patio Paving](#) 
- ★ [Crazy Paving](#) 
- ★ [Laying Flags](#) 
- ★ [Techniques for flags at a free edge](#) 
- ★ [Laying Riven Flags](#) 
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- ★ [Custom Random Layouts](#) 
- ★ [Creating Regular Joints Widths in Random Layouts](#) 
- ★ [Pointing and Jointing](#) 
- ★ [Jointing Stone Paving](#) 
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