



Flag Paving Design & Specification Guidance

The below information is provided as a guideline for appraisal purposes only on the basics of flag pavement design and considerations. In all cases the user is advised to review this guidance against the detailed requirements of the BS 7533 suite of standards which provide in-depth detail on design, installation, construction and maintenance of concrete flag pavements

BS / EN Standard	Title
BS EN 1339:2003	Concrete paving blocks — Requirements and test methods
BS 7533-1	Code of practice for the construction of pavements of precast concrete flags or natural stone slabs
BS 7533-2	Guide for the structural design of lightly trafficked pavements constructed of clay pavers or precast concrete paving blocks
BS 7533-3	Guide to the structural design of trafficked pavements constructed on a bound base using concrete paving flags and natural stone slabs
BS 7533-11	Code of practice for the opening, maintenance and reinstatement of pavements of concrete, clay and natural stone

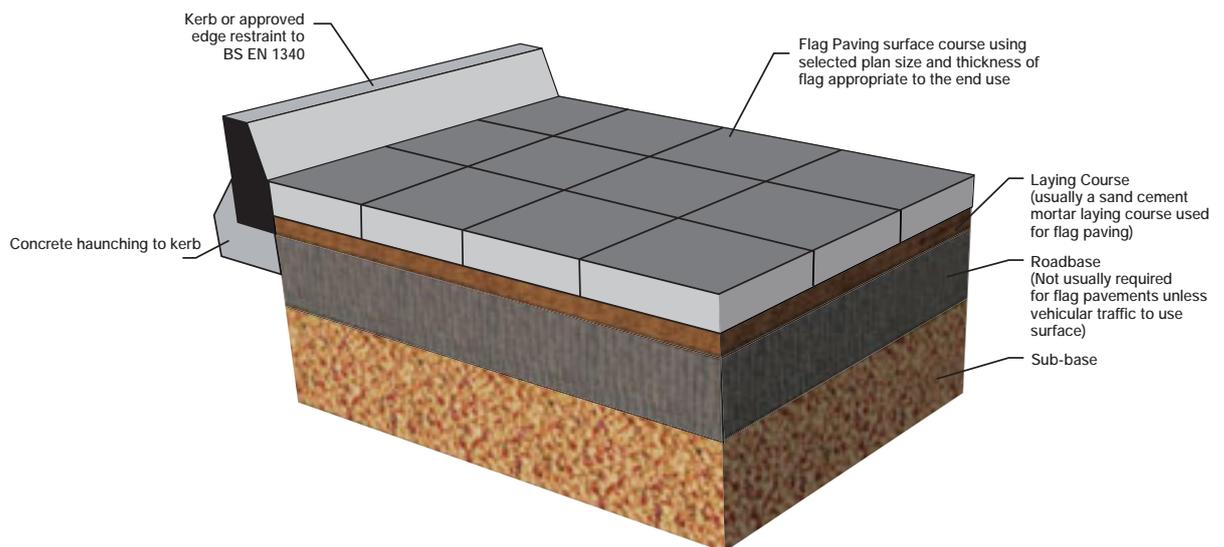
Principles of Concrete Flag Pavements

Flag pavements are generally constructed for pedestrian use or occasionally for emergency or service vehicle access. Since flag paving is not frequently designed and installed to be trafficked, often it will be installed as a rigid bedding construction and so unlike block paving will not be flexible in construction and accommodate vehicle traffic. Experience has shown however that rigidly constructed flag pavements are a long term low maintenance solution and often adapted by local authorities for streetworks and repairs.

Like block paving, it is advised for flag pavements that there is a rigid edge restraint on all sides of the pavement, this can consist of an appropriate kerb haunched in concrete, an existing structure or a rigidly fixed perimeter course. It is also essential that during construction all joints are fully filled with the correct grade of jointing sand and the joints are inspected and topped up as required immediately after construction and for the future life of the pavement. The jointing material in flag pavements prevent water ingress into the pavement layers and potential deterioration of the sub base layers underneath.

Concrete block pavements typically consist of either three or four layers of construction as detailed in the cross section below:

Typical Cross Section of Concrete Flag Pavement



Surface Course

The selected concrete flag paving units for the surface course of the pavement



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Laying Course

The layer of material on which the block paving units are bedded. It is essential that this material complies with the requirements of BS 7533-3 tables D.1, D.2 and D.3 and is appropriate to the end use of the pavement. It is not permitted to add cement or lime to the laying course material to act as a binder. Note that for more heavily trafficked sites the nominal depth of the laying course material is reduced and the allowable fines content is also reduced to minimise the potential for settlement and deterioration in use.

Sand laying course should comply with the requirements of BS 7533-4 section 5.4.6.2 and table 5. Where a sand laying course is adapted it is not permitted to add cement or lime to the laying course material to act as a binder. For bound construction a cement based mortar complying with the requirements of section 5.4.4.2 of BS 7533-4 should be used. Note that normally the finished / compacted depth of laying course material for flag construction should be 25mm for both sand and mortar based laying course materials. Concrete flag paving laid on a bound cement based laying course (mortar bed) should have 4-6mm joints filled with a cement based mortar class M6 to BS EN 998-2.

Roadbase (Not usually required)

The material placed above the sub-base and beneath the laying course layers. A roadbase layer will typically only be required in flag pavements that will be required to accommodate vehicular traffic loadings or where emergency vehicle access must be allowed for, or where the subgrade (ground conditions) are poor and require improvement for the desired traffic loadings. The roadbase layer will act as a 'stiffening layer' in the pavement construction and may be a cement bound granular material (CBM) or a bituminous macadam material

Sub-base

All concrete flag pavements will require a sub-base layer. This is usually a high quality granular all in aggregate material which is installed and compacted in layers. Normally this material will be a 'Type I' material in accordance with clause 803 of the Department for Transport Specification for Highway Works or clause 804 type B in accordance with the National Roads Authority Specification for Road Works. The use of lower quality fill materials and recycled rubble fill should be avoided unless the material has been independently tested to demonstrate it meets or exceeds the requirements of the specified sub-base material above.

Paving Flag Thicknesses

Most of the Kilsaran range of flag paving is available in a variety of thicknesses to suit different end use requirements. Most of the paving flag range is supplied in 50mm depth as standard. While the depth of paving flag selected must be appropriate to the end use, the maximum loading capacity that a constructed pavement can withstand will be substantially more dependent on the pavement build up and construction being appropriate to that end use than the paving flag unit itself.

Flags have been traditionally specified for many years in the common British Standard sizes detailed in BS 7263-1 and the national annex of BS EN 1339:2003

BS Size Flag Designation	Work Size (mm)	Thickness (mm)	Class 3 Flags	
			Characteristic Breaking Load	Minimum Individual Breaking Load
B50	600 x 600	50	9.1	7.3
B63	600 x 600	63	14.4	11.6
E70	400 x 400	70	18.4	14.7
F40	400 x 400	40	9.5	7.6
F5	400 x 400	50	9.5	7.6
F63	400 x 400	63	16.1	12.9
F80	400 x 400	80	16.1	12.9

Information contained in this table is based on BS EN 1339:2003 NA.2 and BS 7263-1:2001 and how these standards best apply to the relevant Kilsaran concrete paving flag products

Pavement Type / End Use	Minimum Thickness and Flag Type
No vehicle traffic at any time, patios, paths and pedestrian only areas	All unit sizes, 40mm in domestic and 50mm in public areas
Very occasional use by cars and cleaning equipment	All unit sizes in 50mm depth or greater with appropriately robust sub base design
Pavements with light vehicular (car only) crossings	All unit sizes in minimum 63mm depth with appropriately robust sub base design
Pavements with light vehicular (car only) traffic or where emergency vehicle access may be required	F80 minimum with appropriately robust sub base design

Information contained in this table is based on guidance within the National Annex of BS EN 1339:2003 and is interpreted as it best applies to the relevant Kilsaran concrete paving flag products



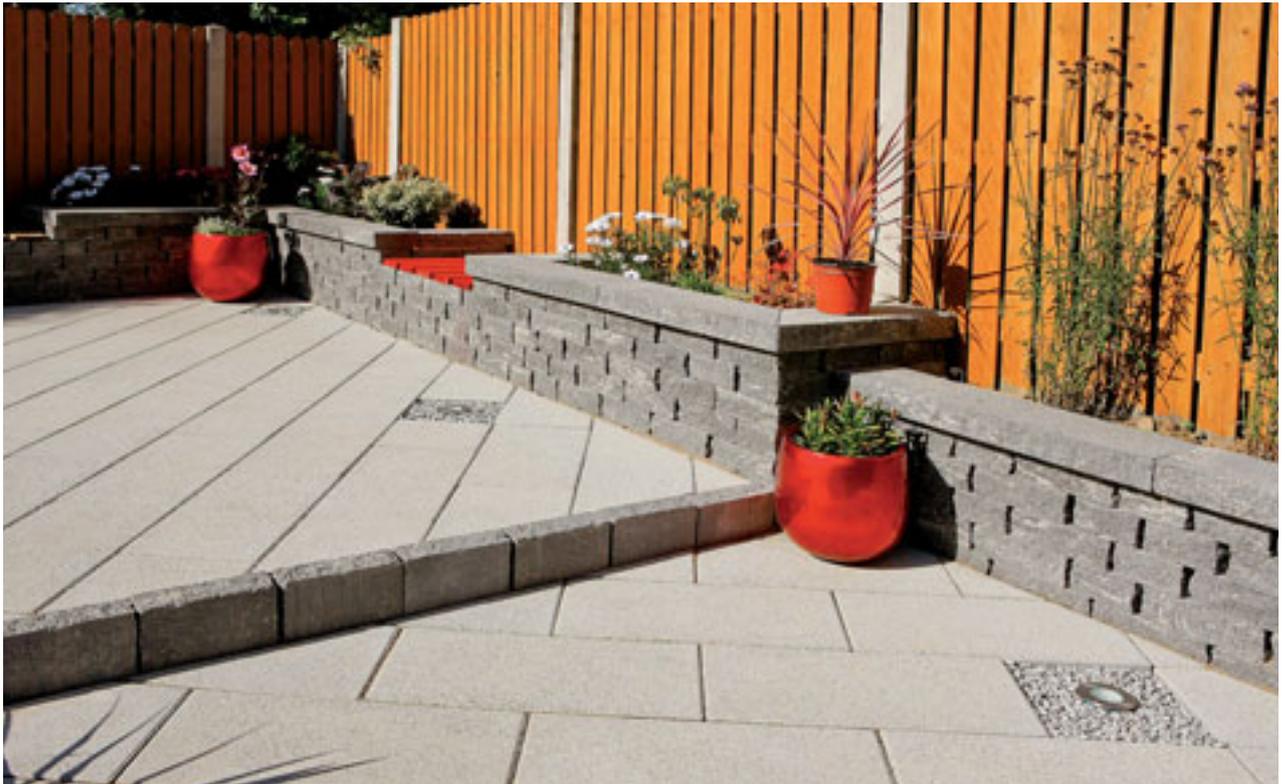
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Site Assessment for Design Purposes

Similar to block paving structural design, for commercial flag paving schemes the ground conditions (drainage and CBR values) and current and predicted traffic volumes (only for trafficked flag pavements) need to be determined to select the most suitable paving flag unit size and depth and also to allow a suitable sub base design to be carried out.

Unlike block paving structural design, the depth of sub base and roadbase (when required) construction is determined using graphs for the paving flag unit stress limit and separately for sub base material stress limit. These graphs are detailed in section 6.4 of BS 7533-8 and the higher value obtained from the two graph interpretations should be used.

For flag paving schemes where no vehicular traffic is to use the surface a simplified approach is often used where the sub base depth will be in the region of 100-150mm and an experienced paving / groundworks contractor will be able to advise at appraisal stage if this should be sufficient.



Construction

All materials used and installation and construction methodology should fully comply with the requirements of BS 7533-4. Maintenance and re-instatement work where required should also meet the requirements of this standard and BS 7533-11.

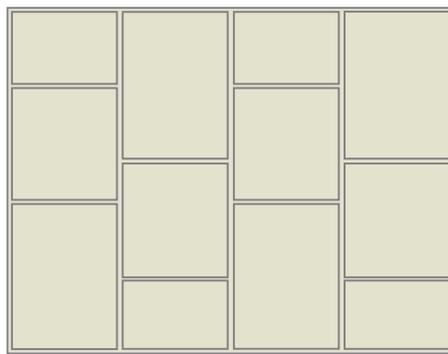


Flag Paving

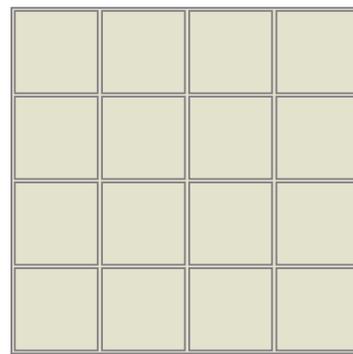
Flag Paving Laying Patterns

Flag paving is generally not laid in the same style of laying pattern as block paving as many traditional unit sizes in flag paving are square in shape and commonly either a stack bond or variations on a stretcher bond is adapted on many schemes

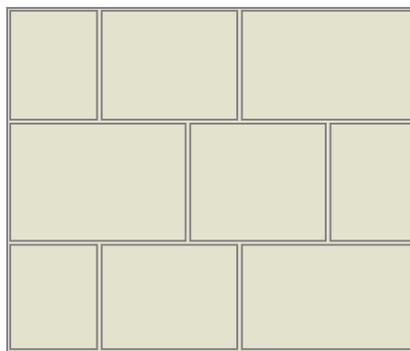
As flag paving is generally not used for vehicular trafficking the laying pattern will not have the same impact on the long term structural stability of the paved surface as it does for block paved surfaces. It should be noted however that often for public schemes and local authority utility schemes that transverse bond laying patterns are often favoured where the longitudinal joint is at 90 degrees to the direction of pedestrian traffic



Transverse Stretcher Bond



Stack Bond



Longitudinal Stretcher bond