# Block Paving Design & Specification Guidance

The below information is provided as a guideline for appraisal purposes only on the basics of block 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 block pavements

| BS / EN Standard | Title |
|---|---|
| BS EN 1338:2003 | Concrete paving blocks — Requirements and test methods |
| BS 7533-1 | Guide for the structural design of heavy duty pavements constructed of clay pavers or precast concrete paving blocks |
| BS 7533-2 | Guide for the structural design of lightly trafficked pavements constructed of clay pavers or precast concrete paving blocks |
| BS 7533-3 | Code of practice for laying precast concrete paving blocks and clay pavers for flexible pavements |
| BS 7533-11 | Code of practice for the opening, maintenance and reinstatement of pavements of concrete, clay and natural stone |

## Principles of Concrete Block Pavements

The principle on which concrete block pavements operate is that it is a flexible construction technique. For this is reason no cement based materials are permitted for use as a sub base layer and especially in the laying course material. The pavement must maintain its flexible construction to perform effectively.

This flexible nature of the pavement construction allows concrete block pavements to carry from very light to extremely high loadings from trucks and commercial vehicles to aircraft and handling and stacking machinery. This is not always possible with in situ concrete or bituminous macadam surfaces which may suffer pavement fatigue under the same loading stresses.

The individual concrete paving blocks are ‘locked’ together in their laying pattern and as one block is loaded it spreads its load to its neighbouring block and the load is spread outwards in a radial pattern, effectively dissipating the load over a larger area.

Since there is no bound surface and paving blocks are relying on their neighbouring block to provide frictional interlock to hold them in place, it is an essential part of the block pavement design 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 assists with the interlock of the pavement, and improperly filled joints is likely result in deterioration of the surfacing layer and the sub base layers underneath.

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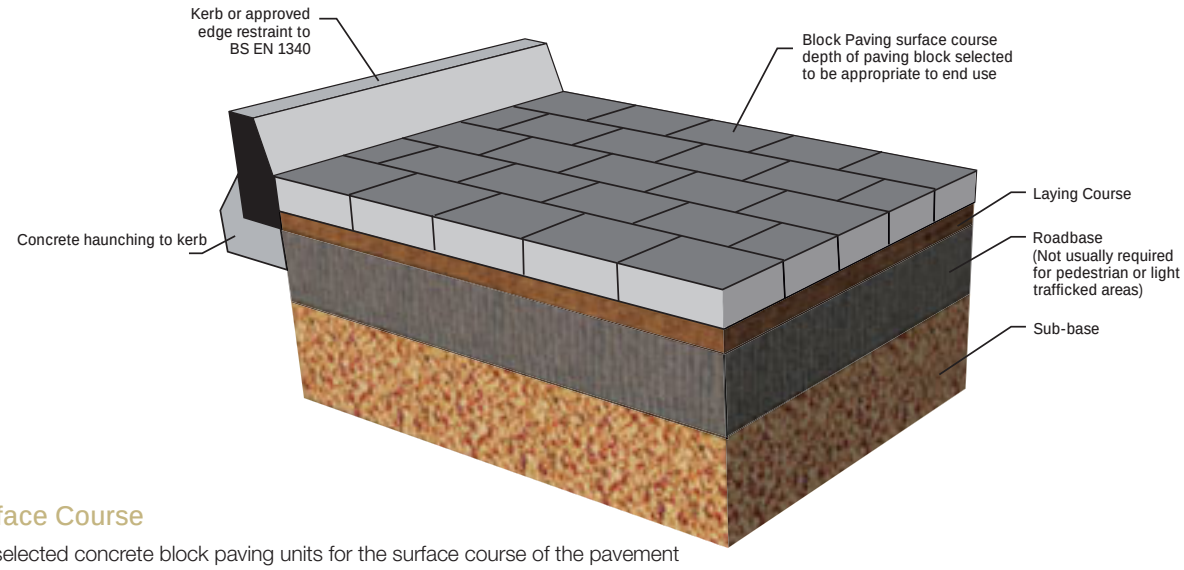
Concrete block pavements typically consist of either three or four layers of construction as detailed in the cross section below:

## Typical Cross Section of Concrete Block Pavement




## Surface Course

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

## 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.

## Roadbase

The material placed above the sub-base and beneath the laying course layers. A roadbase layer will typically only be required in pavements that will be required to accommodate medium to heavier duty commercial traffic loadings, 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. Note that conventional lean mix concrete or mass concrete is not suitable for use in block pavements that are to receive vehicular traffic.

## Sub-base

All concrete block 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 Block Thicknesses

Most of the Kilsaran range of block paving is available in a variety of thicknesses to suit different end use requirements. While the depth of paving block selected must be appropriate to the end use, the maximum loading capacity that a constructed pavement can withstand will also be heavily dependent on the pavement build up and construction being appropriate to that end use.

| **Table 1** - Pavement Type / End Use | Minimum thickness of Block Paving (mm) |
|---|---|
| Domestic & pedestrian footpaths | 40mm |
| Domestic driveways (light traffic) & pedestrian footpaths | 50mm |
| Normal duty trafficked areas, car parking, retail, public areas with lower volume commercial traffic | 60mm |
| Service roads in retail, commercial and civic public areas. Adapted public roadways and commercially and heavier trafficked areas | 80mm |

*Note details in this table are intended as a quick reference guide only. For more detailed description of loading categories and trafficking types please review table 2 below and BS 7533 part 1 or 2.*

# Site Assessment for Design Purposes

## Stage 1 – Establishing bearing capacity of the existing sub-grade

For pavement design purposes it is necessary to know the strength or bearing capacity of the underlying sub grade (soil / clay). A simple site test method known as the CBR test (California Bearing Ratio) is used to determine subgrade bearing capacity. This is a simple test where a plunger of standard size and mass is forced into the sub-grade and the force at which the plunger stops at is recorded.

The CBR value is calculated from this. Typical values are in the range of 3-5% for normal clay sub-grades. Wet, poorly drained and made up ground will have lower values. The lower the value, the more sub base / pavement build-up will be required as per **table 2**.

CBR Testing being carried out on site

On most schemes the pavement designer will already have site CBR values to hand as this testing would have been carried out at site investigation stage prior to designing other buildings or structures on site. The Structural Engineer would have required this for the foundation design of the building and you are likely to find CBR values in this report. Note the lowest average CBR values will be taken for the site.

For smaller schemes and residential schemes where it is not economically feasible to carry out site investigation and CBR testing, BS 7533-2 provides guidance in table 1 on likely CBR values for different physical ground conditions determined on site. An experienced paving and groundwork's contractor is likely to be able to advise on the basis of a site visit.

## Stage 2 - Commercial Traffic Assessment

When the site appropriate CBR value for the site has been determined at stage 1, it will be necessary to decide on the appropriate traffic category for the pavement and select a loading category as detailed in the table below. It is essential at this design stage that all commercial traffic including occasional service vehicles and emergency vehicle access is taken into account within the design process. Pavements which have not been designed to accommodate HGV traffic should never receive service vehicles or emergency vehicles. It is also necessary to factor in increasing traffic volumes over the design life of the pavement. The BS 7533 design standards provide further guidance in this area.

## Stage 3 – Pavement Construction Thickness

When details from stage (1) CBR assessment and stage (2) traffic assessment have been ascertained it is possible to determine the required thicknesses of block paving, laying course and sub base that are likely to be required for the scheme. Table 2 below is based on Table 4 of BS 7533-2 which gives guidance on construction thickness of block pavements. Note very heavily trafficked sites will have to be designed separately to the requirements of BS 7533-1.

**Table 2** - Pavement Construction Thickness

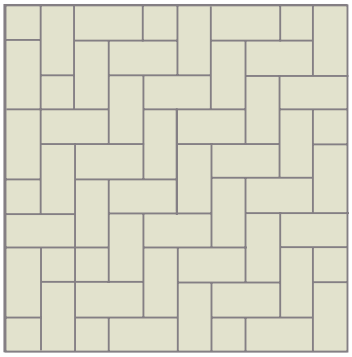
| Loading or end use Description | BS 7533-2 Loading Category | Maximum commercial vehicle movements per day | Minimum compacted sub base thickness (mm) | | | | | Nominal compacted thickness (mm) | | Minimum Paving Block thickness (mm) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Design CBR | | | | | | | |
| | | | ≤2% | 3% | 4% | 5% | ≥6% | Roadbase | Laying Course | |
| Commercially trafficked pavements, roadways, heavily trafficked commercial areas, adopted major roadways and streets, freight depots, container and shipping terminals, rail depots etc | Category I | For commercially heavy trafficked pavements the design guidance in this table and BS 7533-2 is not appropriate and a more detailed site specific design will be required to be carried out in accordance with the requirements of BS 7533-1 with the assistance of an appropriate Consulting Engineer with detailed experience of Pavement Design. | | | | | | | | |
| Adopted minor roadways and access roads, delivery roads within business areas and shopping facilities, cul de sac's, petrol station forecourts, pedestrianised areas subject to heavy vehicle movements, footways regularly overridden by vehicles and car parks receiving heavy traffic regularly | Category II | ≥ 5 For commercial vehicle movements above 10 per day consult BS 7533-1 and seek specialist design guidance | 400 | 350 | 250 | 150 | 150 | 125 | 30 | 80 in more heavily trafficked areas 60 in medium traffic |
| Pedestrianised and car trafficked areas receiving only occasional heavy traffic (1 commercial vehicle per week max) | Category IIIa | Less than 1 | 350 | 300 | 225 | 150 | 150 | 0 | 50 | 50 |
| Car parks receiving no heavy traffic, footways receiving no vehicle traffic | Category IIIb | Zero | 300 | 250 | 175 | 100 | 100 | 0 | 50 | 50 |
| Private drives, patios and hard landscaping areas which never receive commercial traffic | Category IV | Zero | 200 | 150 | 125 | 100 | 75 | 0 | 50 | 40 (no traffic) 50 with light traffic |

## Construction

All materials used and installation and construction methodology should fully comply with the requirements of BS 7533-3. Maintenance and re-instatement work where required should also meet the requirements of this standard and BS 7533-11.

# Block Paving Laying Patterns

The laying pattern has a significant impact on the long term stability of the paved surface and its load bearing abilities. Block paving schemes which have been designed to accommodate heavier traffic loads and commercial and service vehicles are normally completed in herringbone pattern (either 45 or 90 degree) as this has been time proven to be the most effective laying pattern for dissipating heavy loads and resisting spread from continual turning movements. Patterns such as stretcher bond will also be effective for medium traffic loading while patterns such as parquet or stack bond will not be suitable for vehicular trafficking.

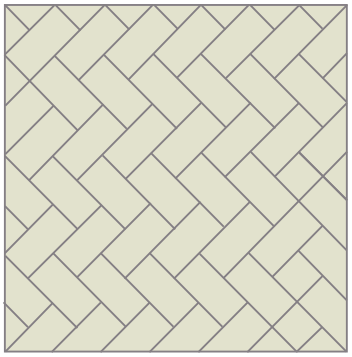


## 90 Degree Herringbone

Suitable for all loading categories up to and including heavier duty commercially trafficked pavements

Products which can be laid in this pattern:

- Slane 200 x 100mm
- Mellifont Large size only (240 x 160mm)
- Lismore Large size only (240 x 160mm)
- Newgrange Large size only (240 x 160mm)

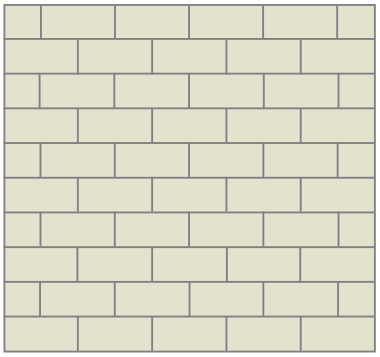


## 45 Degree Herringbone

Suitable for all loading categories up to and including heavier duty commercially trafficked pavements

Products which can be laid in this pattern:

- Slane 200 x 100mm
- Mellifont Large size only (240 x 160mm)
- Lismore Large size only (240 x 160mm)
- Newgrange Large size only (240 x 160mm)

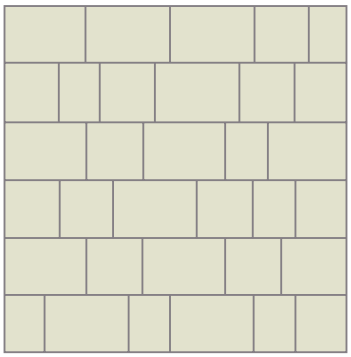


## Stretcher Bond

Suitable for all loading categories up to medium traffic commercial pavements having once to twice weekly goods vehicle traffic. Should be laid with longitudinal joints at 90 degrees to the direction of traffic

Products which can be laid in this pattern:

- Slane 200x100mm
- Mellifont Large size only (240x160mm)
- Lismore Large size only (240x160mm)
- Newgrange Large size only (240x160mm)
- Boyne

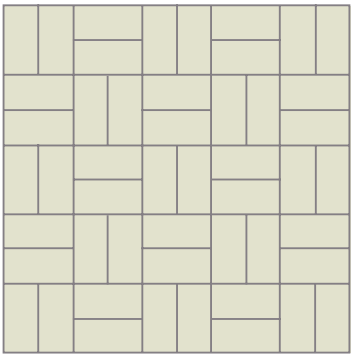


## Random Stretcher Bond

Suitable for all loading categories up to medium traffic commercial pavements having once to twice weekly goods vehicle traffic. Should be laid with longitudinal joints at 90 degrees to the direction of traffic

Products which can be laid in this pattern:

- Mellifont 3 size mix
- Lismore 3 size mix
- Newgrange 3 size mix

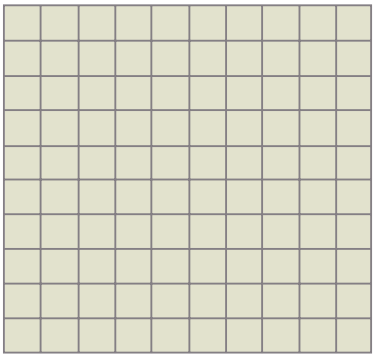


## Parquet or Basket-weave

Generally suitable for pedestrian areas only. Not recommended for areas which are to receive vehicular traffic

Products which can be laid in this pattern:

- Slane 200x100mm



## Stack Bond

Generally suitable for pedestrian areas only. Not recommended for areas which are to receive vehicular traffic

Products which can be laid in this pattern:

- Slane 100x100 size
- Mellifont Medium size only (160x160mm)
- Lismore Medium size only (160x160mm)
- Newgrange Medium size only (160x160mm)