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CPD Article

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Paving the Way: The Benefits of BS 7533

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Introduction

This article intends to offer an overview of the benefits of using BS 7533 for the design and construction of 'rigid' (mortar bed/mortar joint) pavements in public realm works. It discusses the basic principles of the standard and the guidance it provides for designing and constructing your paved area. It will demonstrate high quality paving where BS 7533 has been used successfully and shall also illustrate some of the problems of poor design or construction.

Key Learning outcomes

- An Introduction to what BS 7533 is
- What is 'rigid' construction?
- What problems can arise when not adhering to BS 7533
- Other materials to be considered, e.g. resinous mortars and sand stabilisers

1.0 What is BS 7533?

BS 7533 is a 'code of practice' created by the British Standards Institution (BSI). "Since its foundation in 1901 as the Engineering Standards Committee, BSI Group has grown into a leading global independent business services organisation providing standard based solutions in more than 140 countries (http://www.bsigroup.co.uk/)." A 'code of practice' is a guide to best practice developed and published as a British Standard (BS) by the BSI. BS 7533 in particular refers to the design and construction of both 'rigid' and flexibly constructed paved areas.

For a mortar paving system to 'actually' be proven BS 7533 compliant, rather than just 'manufactured to meet' or 'manufactured in accordance with', it must have undergone independent testing using UKAS methods. The testing assesses the performance capabilities of the materials considering compressive, flexural and adhesive bond strengths, and shrinkage amongst others. It also ensures 'rigid' paving is constructed using the correct procedure. The testing and approval therefore in general ensures the following benefits:

Can be used to design and build schemes in excess of 1000 standard axles per day

- Helps to protect professional indemnity insurance
- Reduces costly failures and resulting personal injury claims
- Trusted throughout the world
- Tried and tested methods of construction
- Removes the uncertainty of site batched mortars

Most significantly, the British Standard promotes professional results that can give a construction life in excess of 40 years, whereas a non-compliant system cannot offer any minimum life expectancy. Using a non-compliant system may in some cases have a lower initial outlay, but the ongoing and life cost of such constructions is generally significantly higher owing to the additional ongoing maintenance. Overall, using a BS 7533 compliant system helps to protect your professional indemnity insurance by reducing the risk of costly failures during the life of the construction.

An often overlooked aspect of the standard is that all of the materials are tested in conjunction with one another, ensuring that they work in harmony. This is extremely important when specifying a full mortar paving system to include bedding, priming and jointing

BS 7533 sets technical and practical guidelines that help to minimise potential workmanship issues. It is evident that using a compliant system is the one and only assurance against costly repercussions and ensures longevity.

The next section will explain the process of correctly constructed 'rigid' paving according to the standard and using the correct mortar paving system.

Always ask for UKAS testing certificates.

2.0 Design and construction of 'rigid' paving in the public realm

Rigid' paving is constructed using a mortar paving system and not simply sand. Its construction is a series of layers beginning with the subgrade. The capping layer is next and is MOT type 1 (DOT type 1/DTP Type 1) road stone installed as a consolidating layer above the subgrade. The third layer, roadbase/sub-base is created using c30/40 concrete or dense bitumen macadam. A BS 7533 approved mortar paving system is then used to lay the setts or flags.

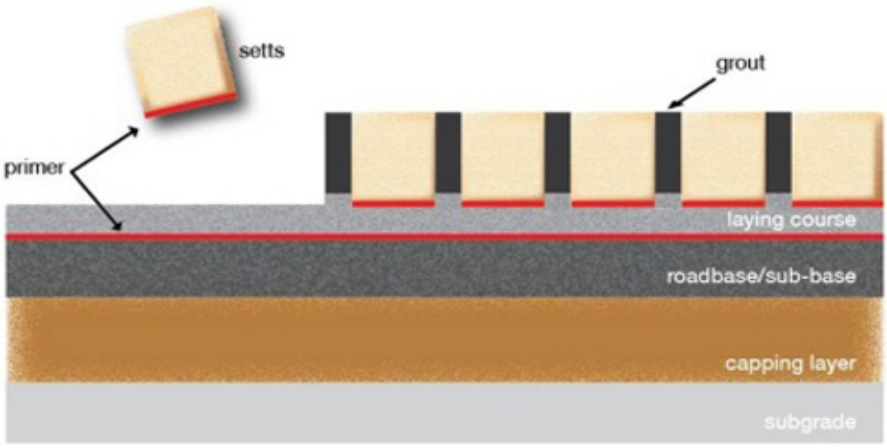
Prior to commencing construction the supportive value of the subgrade, the California Bearing Ratio (CBR), should be established. The CBR value determines the required depths of roadbase and subgrade and ensures it is suitable to bear the load of the construction above. The capping layer is then installed and compacted, providing a suitable surface on which to construct the roadbase.

Best practise is to construct the roadbase layer using a c30/40 concrete that should be allowed to cure for a minimum of 28 days. Where the project programme or cost prohibits the use of a cementitious base material, Dense Bitumen Macadam (DBM) can be considered. Where DBM is being considered, the depth of both the roadbase and paving should be too.

Once the base layers have been adequately constructed the setts or flags can be laid. Although priming of the roadbase is not a specific requirement of the British Standard; it has now become standard practise to prime at this layer. Priming here is more than beneficial because it provides a higher bond between the roadbase and the bedding material. De-bonding between these elements has been identified as a common cause of failure but priming here helps with the life of the construction.

The laying course is a pre-blended bedding mortar, which only requires the addition of water and is mixed in a forced-action mixer or in bulk silo for larger volumes. The material contains numerous additives for controlling shrinkage, adhesion, flexural strength and workability. An approved bedding mortar may cope with depths ranging from 10-75mm, the optimum is 35mm.

One of the most common causes of failure in public realm works is when the paving element comes away from the bedding mortar. Priming the actual paving element will prevent this failure and is essential to meet the British Standard. The bond strength will increase from ca1N/mm^2 to above 2N/mm^2, which is the latest requirement for compliance to the BS 7533.



A diagram showing the typical build-up of a BS 7533 compliant paving construction.

3.0 Grouting: slurry or gun applied?

To finish the 'rigid' paving construction to BS 7533 approval, a choice of 2 methods can be used for grouting the joints. The choice is mortar gun or slurry applied. The handheld gun injected method offers a more traditional 'struck' joint finish, but is considerably more laborious. The slurry (flowable) method is faster, more cost-effective and robust. The nature of this method causes many to worry about staining; however this flowable grout leaves a perfect stain free finish.

There are many benefits of using the slurry method including:

- Slurry grouting, due to its application, is inherently fast and efficient meaning large areas can be grouted quickly

- Slurry grout can be applied in less than perfect weather conditions and its fast setting properties means it can be trafficked more quickly than traditional pointing methods

- Voids in joints, which are a major cause of failure, are avoided because the application method ensures the filling of joints from bottom to top

Although the gun applied method is much more labour intensive than its slurry counterpart, there are occasions, such as vertical applications, where it is the method of choice. It must also be remembered that there is a greater potential for workmanship errors, such as voids in the joints due to poor application, and generally this method requires a 'lighter touch' for better end results.

Its finished look and feel is very traditional.

Image shows the surplus ‘wash off’ stage of the slurry method.

4.0 Success stories

Various public realm works have been completed using BS 7533 for the design and construction of 'rigid' paving. Including the following, to name but a few:

• Manchester city's high profile development, MediaCityUK, the new home of the BBC in the North West, is one of Europe's largest public realm paving schemes. The project covered 40,000m^2 and was completed in 2011

• City Park is a high-quality, six-acre public space in the heart of Bradford which contains the largest manmade water feature in any UK city. The BS 7533 mortar paving system was used to create the feature's foundation. The area is a new mixed use development as the water feature can be drained to provide an outside performance space

• Letchworth Garden City's town centre underwent a dramatic transformation. The project developed a central pedestrian link connecting retailing areas and new developments in nearby areas. Completed in 2010 the project was circa 12,000m^2

• Bovington Army Camp, located in Dorset, is one of the army's primary UK tank training centres and given the extreme conditions all construction materials used at the camp undergo, particularly surfacing materials subject to the wear, tear and impact from vehicle wheel and chain tracks, need to be able to perform to the highest standards. A large area of granite setts was installed on the camp in 2005 and has been subjected to daily tank and other traffic since. BS 7533 constructions are able to cope with extreme traffic conditions, as mentioned previously, schemes in excess of 1000 standard axles per day and so the specification was ideal for the camp.

A BS 7533 compliant system has been used for other projects including the Marriott hotel, Park Lane in Mayfair, Bristol Civil Justice Centre, The Savoy hotel and many other regeneration projects, counting Clapham, Bolton, Gloucester, Great Yarmouth, Kettering and internationally in Belgium, New Zealand and Haugesund.

MediaCityUK, Manchester

5.0 Alternatives for paving constructions

Where exceptionally high flexural, adhesive or compressive strength is required a resinous mortar may be an appropriate alternative for the bedding mortar. A resinous mortar is particularly suited to areas of high impact, shallow bed or high flex, such as raised carriageways or recessed manhole covers. The material copes with extremely high compressive forces and tolerates a greater degree of flexural strain as it achieves a bond strength in excess of 45N/m^2 and flexural strength of over 22N/m^2. A resinous mortar is also entirely waterproof and chemical resistant (once cured) so is ideal for water features.

The alternative paving construction to 'rigid' is 'flexible' (sand bed and sand joint). Flexibly constructed paving can cope with significant loading and is ideal for easy access to services for maintenance and repair work. There are 3 key factors to consider ensuring the durability and longevity of a flexibly paved area: edge restraint, compaction and jointing sand. The trouble with 'flexible' constructions is that when failure occurs it can spread quickly. All 3 factors are causes of failure and so adequate attention should be applied to each. Loss of jointing sand is a significant cause of longer term failure and can be a result of normal use i.e. particularly from aggressive cleaning.

Sand stabilisers are available to prevent the failure associated with sand washout. Jointing sand is often washed out through aggressive cleaning but can also be removed due to dripping from hanging baskets and guttering. An added benefit of using a stabiliser is that it also provides a protective coat to the surface of the paving.

Resin based products are ideal for external areas subject to petrochemicals, oils and 'heavier' use. Waterbased are better suited to internal areas due to the lack of solvent and are ideal where a 'lighter' finish is required.

That concludes the explanation of paving construction - the process and materials used. Although some of the products may appear a little specialist in their application they are generally very simple once training has been given. We offer free of charge site support available before, during and after completion to ensure you get the best from them. We also offer sample panel construction, site specific testing and ongoing support to contractors in the form of 'toolbox' talks.

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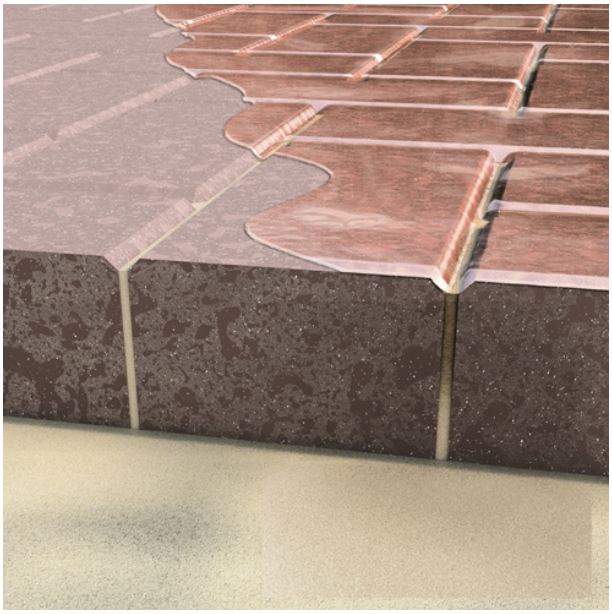

A sand stabiliser binds sand particles within joints together preventing washout.