



CODE OF PRACTICE FOR SLURRY SURFACING INCORPORATING MICROSURFACING



Machine applied Microsurfacing



Hand applied Slurry surfacing

Foreword

This first edition of the Code of Practice has been produced by the RSTA Slurry surfacing Committee. It has been reviewed in the context of the European Standard for Slurry surfacing BSEN 12273 published in 2008 along with the national guidance document PD6689:2009.

Throughout the document the term 'Slurry surfacing' also includes Microsurfacing and Microasphalt.

This document has been peer reviewed by ADEPT Soils, Materials, Design and Specifications Committee.

The information contained herein is intended to represent industry best practice. No liability is accepted by RSTA or ADEPT for any damages caused to property or personal injury resulting from using the guidance contained within this document.

RSTA is the Road Surface Treatments Association www.rsta-uk.org

ADEPT is the Association of Directors of Environment, Economy, Planning and Transport
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1 PREAMBLE

1.1 General

To the highway engineer, Slurry surfacing offers a quick, efficient and cost effective way of maintaining skid resistance and protecting roads against the damaging effects of water and air. To obtain the best results it is necessary to give careful consideration to a wide range of detail and to plan and design the work carefully. The speed of the Slurry surfacing operation and the short duration of time during which motorists are inconvenienced is also an important issue.

The purpose of Slurry surfacing is to re-profile the road surface, to provide texture, skid resistance and prevent the ingress of water and air and therefore helping to maximise the service life of the asset.

A useful way of comparing the effectiveness of a Slurry surfacing, or other maintenance work, is to express it in terms of a 'cost life index'. This is the cost per square metre of the work divided by the satisfactory life in years. It provides a measure of the "value for money" which the highway authority is achieving. A low 'cost life index' and "high value for money" is the result of high-quality work.

The purpose of this Code is to identify the important aspects of the process, and to refer to other documents relating to good Slurry surfacing practice and so give practical guidance on achieving high quality.

Slurry surfacing products are regulated by BSEN 12273:2008 which came into effect in UK in January 2011. In accordance with the Construction Products Regulations:2011 (CPR), CE marking will become a mandatory requirement in 2013.

1.2 Health, Safety and Environment

All those involved in preparing and executing Slurry surfacing operations have a legal duty of care for the health and safety both of the operatives carrying out the works, and those who come into contact with the operation whilst in progress and during aftercare.

The planning and organising for health, safety and environmental issues must commence as soon as a Slurry surfacing programme is envisaged. The Construction Design and Management Regulations 2007 will apply to most Slurry surfacing operations and therefore clients are urged to follow closely the advice in the relevant Approved Code of Practice as they have the responsibility under the new version of the Regulations for initiating the framework for safe working practices. This will enable the CDM Co-ordinator and Principal Contractor to plan and prepare the information and documentation necessary to ensure the specific hazards are identified on the various sites and the level of risk that is envisaged. This must take into account the nature of the site, the materials to be used, the traffic management requirements and any special health, safety and environment issues that have become evident during the pre-tender stage, (ensure the right information is provided to the right people at the right time). The client should employ a competent contractor. It is recommended that the simplest way for a client to achieve this is to select at tender stage contractors registered to National Highways Sector Scheme 13. This is the procedure of selection recommended in the Manual of Contract

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Documents for Highway Works (MCHW), Volume 1 Specification for Highway Works (SHW). Once the contractors have been selected, the pre-construction information contained in the tender document should be detailed enough for the prospective contractors to take account of the health, safety and environment issues in their tender submission.

On the appointment of the Principal Contractor to carry out the Slurry surfacing operations, it will be his duty to prepare a detailed Health and Safety Plan for that particular contract or works from the Pre-construction information supplied by the Client, Designers and CDM-Coordinator. This must itemise the methods to be employed to overcome the specifically identified hazards and risk reduction measures that will be in force on this contract. They must also ensure adequate welfare is provided from the start of the contract.

Once the works commence the Principal Contractor has the control of health, safety and environment matters but liaison with the client, police and the general public on issues of congestion, diversions or closures must be ongoing throughout the contract.

The Principal Contractor has additional duties under other legislation to look after the health and safety not only of his own employees but of other persons who work alongside them and also of the passing public. Written specific risk assessments must be prepared which can be used to identify control measures for both physical and chemical hazards. The measures must form the Contractor's safe systems of work which enhance the safe behaviour of the workforce as well as protect the general public during the various stages of the works. These measures must be communicated to all involved in the project.

Account must also be taken of environmental factors with pollution from fumes, noise and dust being the main concern during the work phase. Disposal of waste and protection from spillage and contamination are other considerations when looking at the overall Slurry surfacing activity.

1.3 Training

The design of Slurry surfacing and its execution is dependent on a wide range of factors and close attention to detail.

The National Highway Sector Scheme 13 now defines the minimum qualifications required for all personnel involved in the design, supervision and installation of Slurry surfacing. It is the Association's view that a competent qualified workforce makes a fundamental contribution to achieving high quality durable Slurry surfacing. The RSTA runs regular training courses, details of which can be obtained from the RSTA website www.rsta-uk.org/calendar.

Operatives should hold NVQ level 2 and Supervisors NVQ level 3 qualifications plus CSCS cards. Supervisors shall attend the RSTA Training course on Slurry surfacing every 5 years and obtain a silver certificate as evidence of maintained competency.

1.4 Quality Assurance.

The Road Surface Treatment Association continues its commitment to quality assurance and has been instrumental in producing the Sector Scheme for Slurry surfacing, which is number 13 in the series of Sector Scheme Documents.

The Sector Scheme Document, which was first published in 2003, is available on the UKAS website. www.ukas.com .

The RSTA, from whom further details are available, currently chairs the National Highway Sector Scheme 13 Technical Advisory Committee.

The quality requirements and performance categories for Slurry surfacings are contained within PD6689:2009.

1.5 Planning and Co-ordination

Careful and detailed planning before work commences is an essential element of successful Slurry surfacing. There should be close co-ordination between contractors and their clients at every stage, commencing with a pre-works meeting, the purpose of which is to ensure total understanding of the way that the programme will proceed.

It is in the interests of both contractors and clients that the programme of works flows smoothly from site to site without the need to travel many miles for the purpose of treating small areas of road.

2 DEFINING THE SITE AND ITS CHARACTERISTICS

Before any design, planning or Slurry surfacing is undertaken, it is important to identify the lengths of road to be treated and to draw up a schedule. A clearly understandable system such as a line, arrow and job number on the road surface is recommended.

3 DETERMINING THE SPECIFICATION

3.1 The selection of the right type of Slurry surfacing, nominal layer thickness and rate of spread of material is as important as the design of other engineering works. Each site must be considered in the light of its unique characteristics, including the nature of surface, geography, volume and speed of commercial and other traffic using the section of road. The contractor will select the rate of spread and thickness based on his Type Approval Installation Trial (TAIT) and experience in accordance with the requirements of PD6689:2009.

3.2 The design considerations of Slurry surfacing are particularly important in order that the treatment applied to the pavement surface is right for the circumstances in which it has to operate and the job it has to do.

3.3 In recent years, there has been a move towards "End Performance Specifications". End Performance Specifications transfer the responsibility for the design of the Slurry surfacing to the selected contractor who is also responsible for the execution of the treatment and generally guarantees the treatment for a specified period of time. With CE Marking becoming mandatory in 2013 it is envisaged that end performance specifications will become more widely used. Local Authorities will however continue to be able to use recipe specifications as per clause 918 particularly if they want to use locally sourced materials.

3.4 Guidance on Slurry surfacing can be found within Clause NG918 in MCHW Vol.2, available on line at <http://www.dft.gov.uk/ha/standards/mchw/vol2/>.

4 SITE INFORMATION

It is important that the person in charge of Slurry surfacing operations on site fully understands the type and extent of the work required. One way of achieving this is the preparation of a schedule and map indicating the sections of road to be treated, the length and average width of each section, the area to be treated, the type of binder, rate of spread of material, nominal layer thickness and location of material storage area – The Information Sheet is usually provided following an assessment by either the client or the contractor.

It is recommended that the client and contractor undertake a joint walk over of the site to agree what is to be done in detail. This ensures all parties know exactly what should happen and when. This is the contractors opportunity to agree or not to carry out the work as specified. Issues that may arise are illustrated below;

- The contractor cannot do the works as planned
 - The planned TM is not safe/inappropriate
 - The timescale is too short
 - Access is impossible
- The contractor cannot achieve the specification
 - The weather forecast is too poor
 - The substrate is too soft
 - The substrate is too poor a profile without planing
 - The layer thickness is wrong for the laid thickness
- The contractor cannot offer the guarantee required
 - The design is obviously not adequate for the site condition
 - » e.g. a single layer of surfacing on a cracked base

The rate of spread in kg/m² and applied thickness is determined by the contractor.

5 PLANNING THE EXECUTION OF THE WORK

In addition to compiling the site information, the person supervising the treatment may need to decide which size of Slurry surfacing machine to use and where joints are to be located.

Unless they are made with proper care, joints can become weak points on any treatment. For that reason, the number of joints made should be kept to a minimum.

5.1 At the design stage due to plant size and equipment, consideration must be taken to achieve minimum safety zones according to Traffic Signs Manual Chapter 8 and a risk assessment approach must be adopted.

5.2 Temporary diversions should not be introduced casually and will involve consultations

between contractors and the highway authority. Refer to RSTA/CSS Code of Practice for Signing at Slurry surfacing Sites (under development). Legal processes often need to be followed to arrange closures or diversions, these can take up to 13 weeks.

5.3 Poor planning can result in low daily output, increased costs and public criticism. Supervisory staff will give proper consideration to the order in which various sections are treated, the number of vehicle movements transporting materials to the site. Leafleting the public and street notification/signing in advance will help to inform the public of intended works and hopefully minimise criticisms.

6 CONTROLLING MATERIAL INSTALLATION

The client usually stipulates a nominal layer thickness and the contractor uses his experience of mix design and machine application to achieve the desired thickness by identifying the nominal aggregate size required in the mix design.

Slurry surfacing machines are calibrated for aggregate and binder flow rates and admixture addition to ensure material blend consistency as stipulated in Factory Production Control (FPC). The control of layer thickness and surface finish is achieved by using an adjustable screed box.

The areas to which Slurry surfacing is to be applied shall be clearly defined by the Customer's Engineer (the Purchaser) prior to commencement of the installation work on-site.

The surface to be treated should be properly swept and in a clean condition prior to Slurry surfacing installation work commencing. The contractor will use his experience to use whatever means deemed necessary to ensure adequate surface preparation prior to installation to ensure good adhesion. The contractor may also consider the need for a bond coat if deemed necessary.

In advance of Slurry surfacing on carriageways all temporary materials, e.g. deferred set macadam containing soft binders, must be removed and replaced with appropriate permanent asphalt materials as specified by the Customer's Engineer (the Purchaser). These can include hotmix asphalt or BBA HAPAS approved permanent cold lay surfacing materials (PCSMs). On footways it is not usually necessary to remove temporary materials prior to overlaying with Slurry surfacing.

Existing extruded/screed thermoplastic road marking thickness should be checked. Significant extruded/screed thermoplastic thickness >3mm will be reflected in the finished surface profile and could be a hazard to road users. Mechanical removal is recommended to ensure even thickness and ride quality of the Slurry surfacing. In addition Slurry surfacings do not adhere well to thermoplastic road marking materials and as time goes by the thermoplastic will reappear. Removal of road markings/lines is recommended if possible.

Ironwork in the carriageway should be masked and the location noted. Ironwork should be raised after the new Slurry surfacing has been installed on carriageways but in advance of

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Slurry surfacing on footways. A joint inspection may be required to identify the items that require adjustment.

Slurry surfacing can be used to regulate where necessary. Transverse regulating and carriageway shaping can be carried out over the length of the site as directed or agreed by the Customer's Engineer (the Purchaser). Depths in excess of 10-15mm should be removed by regulating/shaping with a layer of micro-asphalt before placing the final Slurry surfacing surface course. This final Slurry surfacing surface course work shall not be overlaid until the contractor is satisfied that a full emulsion break of the regulating/shaping layer has occurred.

The finished surface texture and appearance of Slurry surfacing can depend upon the existing surface beneath and the type of equipment installing it. It is unlikely to have the same appearance as hot mix asphalt or surface dressing but this is not necessarily a defect. The appearance may also change over time with trafficking. Guidance on what constitutes a defect is given in PD 6689. However this has occasionally led to a difference of opinion between client and installer. If the customer is inexperienced with Slurry surfacing a site visit to a previous installation may prove beneficial.

Weather Conditions

Installation of the Slurry surfacing in adverse weather should only be carried out as stated in the contractors FPC method statement. This is in accordance with requirements in SHW clause 918.

Installation shall only be carried out at an average road surface temperature and air temperature of 4°C and rising. There is no upper air or surface temperature limit when installing Slurry surfacing. Elevated temperatures during summer months actually help the Slurry surfacing material to dry out quickly and develop rapid cohesive strength.

The Slurry surfacing should not be installed when the relative humidity is >80% as effective break of the emulsion will not occur.

Time critical or traffic management dependent installations of the Slurry surfacing below such ambient weather conditions will only be considered with the adoption of artificial controlled heating of substrate and/or certain constituents of the Slurry surfacing. Specialist requirements should be agreed with the Installer and the Customer (the purchaser) in advance on a project specific basis.

Ambient road and surface temperatures together with relative humidity are recorded daily and per individual Slurry surfacing site and if the weather is variable during the installation process. The ambient and road surface temperatures together with relative humidity are used to ensure the appropriate chemical retarding agent and water doses are applied for the prevailing conditions to ensure effective break of the bitumen emulsion. The ambient weather conditions are recorded on the Laying Record.

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Installation of the Slurry surfacing is not carried out during rain affected conditions. The Slurry surfacing can be installed on a damp substrate subject to the appropriate ambient and road surface temperatures together with relative humidity criteria being met.

If a section of the Slurry surfacing is affected by inclement weather conditions during installation then the Customer's Engineer (the Purchaser) is notified of the estimated time period required for the affected section to harden sufficiently before trafficking in the prevailing weather conditions. A joint inspection may be required to assess the affected area.

Installation on Carriageways

Slurry surfacing is manufactured on site using a dedicated and patented purpose built applicator, which mixes and lays the material in a continuous controlled operation.

All the materials required to produce the Slurry surfacing system are delivered and stored in appropriate transport at a convenient location close to the site. Material requisitions are raised and records are retained on the project file in accordance with the Installers Quality Control System.

System Installation Procedure:-

- a) The mixing of the materials is carried out in the pug mill on the dedicated and patented Slurry surfacing applicator.
- b) The mix constituents are added in a controlled manner to the pug mill mixer via a conveyor belt in the following sequence:
 1. Slurry surfacing conforming coarse and fine aggregates
 2. Ordinary Portland Cement filler
 3. Polymer Modified Bitumen Emulsion
 4. Potable Water
 5. Other additives

The dedicated and patented Slurry surfacing applicator has a control system that permits the following:-

- a) Aggregate to be calibrated at the start of each season at a rate of 1 tonne per minute in accordance with the applicator manufacturers recommendations.
- b) Water is added dependent upon the prevailing weather and temperature conditions, i.e. the colder the temperature, the less water is added.
- c) Cement/Lime and fibres are calibrated at the start of each Slurry surfacing installation season to check that the correct amounts are being discharged in accordance with the applicator Manufacturers recommendations.
- d) Mixing time is approximately 30 seconds to 1 minute.

Note: BSEN12273 provides information on equipment calibration frequency.

The Slurry surfacing mix is then discharged into the Spreader Box. The Slurry surfacing mix is applied to the road as the applicator moves forward. The flow rate stays constant, however the laying speed at which the machine lays the material will depend upon the condition of the existing substrate pavement. If the existing substrate is in poor condition and open textured, then the speed at which the Slurry surfacing applicator lays the

material will be reduced to ensure the Slurry surfacing material fills the texture voids in the substrate. A single layer application is usually 10 to 15 kg/m², dependent upon substrate. Two layers of Slurry surfacing may also be used if necessary.

In normal daytime weather conditions in the UK, the Slurry surfacing tends to be laid late March through to October. The prevailing weather conditions should permit the Slurry surfacing site to be opened to normal trafficking in approximately 30mins.

System Installation Checks by the Installer

A visual check shall be carried out if the client deems the site to be unsatisfactory for uniform surface texture and any discernible faults compared to the quality plan. Document PD6689 (categories for defects determined by visual assessment), table 7, provides guidance with respect to acceptable surface finish.

A program of random tests such as the Pendulum Skid Test (BSEN 13036-4) and/or Volumetric Patch test BSEN 13036-1 may form part of the main contract between the Installer and the Customer (Purchaser) or may be agreed in advance with the Customers engineer.

PD6689 Table 9, "Frequency of testing all road types", lists routine checks which the installer may include as part of his FPC.

Maintenance and Repair

In the event that damage occurs during the installation or during service, the system shall be assessed for defects in accordance with BSEN 12274-8.

Occasionally there can be premature 6mm aggregate loss due to inclement weather conditions occurring during the installation process or occasionally if heavy trafficking has occurred too early. An overlay of machine applied Slurry surfacing patch is recommended of not less than 10m longitudinal length and machine screed width.

Occasionally there can be fretting at a longitudinal or transverse joint with existing substrate. A hand applied Slurry surfacing screed mixture can be used for areas up to 150mm wide in a similar fashion to ironwork reinstatements following main carriageway Slurry surfacing installation.

7 JOINTS

Joints, both longitudinal and transverse, are potential points of weakness. Longitudinal joints should not therefore be located where they will coincide with the wheel tracks of vehicles. Consequently, the best position for a joint is on the centre line of a road or on the line separating adjacent traffic lanes. Refer to requirements in Clause 918.18 and 918.19 and BS EN 12274-8 which shows joint faults.

8 TRAFFIC MANAGEMENT

In undertaking Slurry surfacing the needs of road users must be considered at all stages. The safety of operatives and the public, whether on foot or in motor vehicles, is paramount.

It must always be remembered that the needs of any site should be considered as unique and each Slurry surfacing crew should contain properly trained personnel. For specific sites, a proper risk assessment should be undertaken by an appropriately trained person and acted upon before Slurry surfacing equipment and operatives are dispatched to the site. At some sites, this will require discussion between the contractor and representatives of the highway authority at the pre-contract stage. Where this is the case, the agreement reached between the parties should be passed on to the person controlling site operations. The National Highway Sector Scheme 13 document details these requirements.

The correct selection of traffic management system to be adopted is important. The public should not be unduly inconvenienced by detours or long delays, or the reputation of Slurry surfacing as an efficient and economic process is put at risk. When considering traffic management arrangements, the following factors need to be taken into account:

(a) Traffic flow data

This will include such factors as high peak-hour flows, high percentage of HGV's etc.

(b) Road layout and junctions

This will identify the type of road under consideration e.g. whether it is a 7.3 metre wide single carriageway principal road with no major junctions, or a narrow country lane.

(c) Type of control

The information from (a) and (b) above will give the input necessary to decide the general type of traffic control required, e.g. restricted hours of working, maximum working lengths, availability of alternative routes, level of advance publicity needed, etc. Narrow country lanes, for instance, may need to be temporarily closed or a warning of delays may need to be given.

(d) Specification

Both the specification for the work and the job sheet for the site should state any exceptional requirements for dealing with traffic.

(e) Traffic regulation orders

Legal processes, such as allowing the closure of a road or imposing mandatory speed limits, need to be arranged by the highway authority well in advance of the works, at least 13 week's notice is required.

(f) Publicity

Road users do not like being delayed and will take alternative routes if they are given adequate information. As Slurry surfacing works are normally of a short duration and dependent upon favourable weather forecasts, it is difficult to predict accurately when traffic flow at any particular site is likely to be affected. Nevertheless, principal roads carry many thousands of vehicles per day. It is essential therefore that every possible method should be utilised to inform the road user that a site is to be affected. Press releases to local papers, district and parish councils, local radio etc can all help. The most effective methods are

- 1) The display of information boards at each site saying, for example, that Slurry surfacing is to be carried out and when.
- 2) The distribution of letters to all dwellings and premises and also attached to all vehicles (loosely under windscreen wipers) detailing what works are to take place and when.

In addition, emergency services, bus operators and any other organisation likely to be affected by work at a particular site should be notified in advance.

(g) Traffic control and signing

For the safety of drivers, pedestrians and operatives, traffic passing over newly treated roads, or alongside Slurry surfacing that is in progress, must be properly controlled. Such control includes adequate advance warning of the works, regular reminders throughout the site of the risk of loose chippings and the proper management of vehicles by the use of traffic lanes. Some instructions such as "stop" and "give way", are indicated both by carriageway markings and by mounted signs. When these carriageway markings are covered by Slurry surfacing, it is important to replace them as soon as possible or to provide some temporary signs during the period between the covering of the markings and their permanent replacement. This is particularly important at junctions with high-speed roads.

The careful control of traffic and the maintenance of speeds of 20 mph or less over newly completed treatments is necessary in order to give the material time to 'set' or break'.

Where one-way traffic is operated using stop and go signs, the operators of these signs should be appropriately trained, be in radio communication with one another and one of the operators should be nominated as being in overall control of the traffic flow arrangements. On roads where it is not possible to provide the desirable safety zone between Slurry surfacing plant/operatives and moving traffic, the speed of traffic past the works should be restricted to a maximum of 20 m.p.h.

Where road junctions are treated, which result in the obliteration of "stop" and "give way" markings on the carriageway, the appropriate warning signs should be provided (sign 7012 - the Traffic Signs Regulations and General Directions 2002).

Some highway authorities use mandatory speed limits to control traffic speeds when Slurry surfacing main roads. If the road in question is a trunk road the consent of the Regional Director's Office of the Highways Agency is required. In other cases, local highway

authorities have powers under Section 14 of the Road Traffic Regulation Act 1984. Where local authorities wish to use these powers they should first be discussed with the Chief Constable who will have the task of enforcing any orders that are made. Highway authorities may then "give notice" of a temporary speed limit on a list of roads, usually main roads or roads where traffic speeds are unusually high. The usual procedure is for the council to give their engineer authority, at the appropriate time, to apply the orders that have been approved. Once the order has been applied it may remain in force for a maximum of fourteen days, which is normally far longer than is necessary for Slurry surfacing operations. The speed limit selected is usually 20 mph.

Although the use of mandatory speed limits may be helpful in exceptional circumstances experience suggests that controlling traffic speeds by reducing lane widths and the creation of convoys is likely to prove more effective.

Not only is it important that signs are placed in accordance with the principles outlined in Chapter 8 of the Traffic Signs Manual, it is also important that a safe system of work is operated, to ensure the safety of the operators when placing signs.

(h) Signs

Unless the Highways Agency have given approval in writing to the use of a sign not included in the Traffic Sign Regulations and General Directions and subsequent amendments, only signs approved by Statutory Instrument should be used. Where such signs are used, they should be provided in addition to rather than instead of approved signs. Should a member of the travelling public make a claim against the contractor and/or the highway authority, the use of the correct signs located in the correct positions is likely to be taken into account by the courts.

9 ROAD PREPARATION

The Quality Plan describes the acceptable substrate conditions for application of Slurry surfacing in accordance with EN 12273. Any necessary remedial works to the road surface and structure shall be carried out and completed either prior to the commencement of works, or as part of the Contract, as agreed by the Overseeing Organisation, to enable the surface to conform with these requirements.

10 BINDERS

Binders used for Slurry surfacing are predominantly cationic bituminous emulsions in nature and comply with the requirements of BS EN 13808:2005. Polymer modified binders can be used if the contractor feels he needs extra toughness to cope with traffic stresses.

11 AGGREGATES

The designer of the Slurry surfacing shall select suitable aggregate sources and sizes to ensure installed product meets the requirements of the contract for the site with respect to defects as demonstrated by the TAIT and of the required polished stone value.

12 ROLLERS AND ROLLING

Rolling is not normally necessary. The Contractors Quality Plan should state whether rolling is required for that product laid on that particular class of road to ensure a durable product.

If rollers are required then pneumatic tyred rollers (PTR's) or tandem vibrating rollers with rubber-clad drums are usually used. However, the best type of compaction for a newly laid Slurry surfacing is the passage of slow moving vehicle tyres across the full width of the treated surface.

Heavy steel-wheeled rollers can cause crushing of aggregate, thereby reducing the size and accelerating the loss of texture. For this reason, they are not normally recommended. However, the use of steel-wheeled rollers weighing about 5 tonnes, can result in a minimal amount of crushing and much successful work has been carried out using this type of roller. A disadvantage is the slow speed at which they travel between sites. The steel drums of the rollers may also bridge high spots on the road and thus fail to compact all of the material. Pneumatic tyred rollers (PTRs), being multi-wheeled, avoid this problem.

13 SURFACE PREPARATION SWEEPERS AND SWEEPING

Road preparation can be a problem leading to some de-bonding failures. Mechanical sweepers are used to clean the road before slurry surfacing is carried out. In extreme conditions such as heavy soiling additional measures may be required such as machine pressure washing.

14 ALL PLANT

The noise levels of all plant should be ascertained from manufacturers or suppliers. If they are not available, the user must take measurements themselves and ensure that all operators are provided with the correct hearing protection, where necessary. All plant and vehicles should be adequately maintained with regular inspection reports available.

15 METHOD OF WORKING

On single carriageway trunk and principal roads, Slurry surfacing falls into the category of "mobile works". Under this type of working, traffic will be controlled by the use of stop and go signs as described in Section 8. The length subjected to this operation should be kept as short as possible consistent with safety requirements. Experience suggests that the safest method of operation is to treat one half of the road for the total length of the section. Traffic should be controlled to allow all plant and equipment to turn safely and position itself to treat the second half of the road.

Most contractors prefer to operate in the same direction as normal traffic movement. The decision on the direction of travel to be adopted will depend upon such factors as the speed of traffic and the visibility available. The direction of operation selected should form part of the risk assessment for each particular section of road.

On minor roads, a decision will be required at the initial planning stage as to whether or not the road is to be treated in one pass. The direction of working under these circumstances is probably not important.

Where the whole width is not to be treated in one pass and one way traffic operation past the Slurry surfacing is contemplated, it is essential to ensure that the width of road available to passing traffic is not less than the desirable minimum of 3.25 metres or the absolute minimum of 3 metres set out in paragraph 2.5.1.6 of chapter 8 of the Traffic Signs Manual. Where these widths are not available, the interests of safety suggest that it is preferable to divert traffic away from the road, subject to a risk assessment and length of the diversion that would be necessary. Where for this purpose a road is to be temporarily closed to allow Slurry surfacing operations to be carried out safely, proper contingency arrangements must be made to allow for the passage of emergency vehicles.

Additional advice is given in the RSTA/CSS Code of Practice – Traffic Management of Slurry surfacing (under development).

This covers single carriageway roads:

- a) Over 7.3 m wide
- b) 6.0m – 7.3m wide
- c) Under 6.0m
- d) After completion of treatment prior to final sweeping and relining

16 AFTERCARE

A good Slurry surfacing, using all the right materials, equipment and procedure, is easily spoilt or totally ruined by lack of aftercare. Once a Slurry surfacing has settled down and stabilised it can cope with traffic stresses.

Before dealing specifically with the protection of Slurry surfacing and with aftercare and sweeping, it is worth noting a few elements of good housekeeping, which contribute to the creation of a successful treatment.

- 1 All masking material should be removed as soon as possible after completion and before the road is opened to uncontrolled traffic. Once lifted, the masking material should be removed from the site for disposal.
- 2 Any accidental spillage of material onto parts of the carriageway which are not being treated or onto the kerb face, should be dealt with immediately. The longer they are left the more difficult it is to remove them.

Any loose aggregate larger than 6 mm can cause vehicle damage and should be removed as soon as possible. Care should be taken not to disturb new treatments, although the risk of disturbance is, in practice, limited to a period of a few hours after the work has been completed.

Traffic control is also a vital element of aftercare. On main road sites and points of particular stress, it is essential that traffic control should remain in place to keep vehicle speeds low until such time as the treatment has developed adequate cohesive strength.

17 HAND APPLICATION OF SLURRY SURFACING

In many instances, the machine application of Slurry surfacings is not practical, although small machines for use on footways and the like are available.

However, footways, cycle ways, small residential estate roads, car parking areas and other areas not readily accessible by machine can be successfully treated by the hand application of these materials.

In many instances, the criteria and principles for machine application, set out within this document are applicable.

Typically, small, self propelled mixer units, capable of batch mixing up to 250 kg are utilised to facilitate these works. As these mixer units do not have metered feed capabilities for the various material constituents, it is imperative that trained operatives are utilised to ensure that the material ingredients are correctly proportioned, thereby ensuring consistency of the Slurry surfacing material leaving the mixer unit.

In many instances, particularly on rural footpaths, the degree of preparatory work necessary prior to the application of the Slurry surfacing, is greater than for machine applied applications. Weed spraying, cutting back of overgrown verges, pressure washing to remove ingrained detritus and the masking of kerbs, back edgings, private driveways and all ironwork located within the footpath are all operations typically carried out.

Generally, the bitumen emulsion, aggregates, fillers and chemical additives used are the same as those utilised for machine applications. However, the Polished Stone Value (PSV) of the aggregate is not as critical for footway works and therefore there is an opportunity to use less expensive aggregates. Coloured aggregates and pigmented bitumen emulsions can be used for delineation or aesthetic purposes.

Because of the greater interface with pedestrians when working on footways and cycle ways, pedestrian management takes on greater significance and it is essential that all affected residents be given sufficient advance notification of the works and that provision be made to ensure that access problems can be overcome until such time as the material has sufficiently hardened. Safe pedestrian movement throughout the work area is of paramount importance.

It is worth noting that the drying time (i.e. the time before pedestrians or vehicular traffic can be allowed to use the new surface without causing damage to it), can be longer than for machine applications. This is due to the need to slow down the chemical reaction to ensure that operatives have sufficient time to spread and lay the material, neatly, by hand. The surface finish is agreed between the engineer and installer.

The specification is usually detailed by the engineer.

18 TRAINING AND QUALITY ASSURANCE

It is strongly recommended that Slurry surfacing should only be installed by operatives who have an appropriate CSCS skill card underpinned by NVQ in accordance with requirements in National Highways sector Scheme 13. In addition supervisors should demonstrate they are maintaining competency by attending an appropriate industry accredited training course every 5 years. The RSTA run training courses throughout the year on Slurry surfacing, details of all courses at www.rsta-uk.org/calendar.htm.

Well Maintained Highways, Code of Practice for Highway Maintenance Management published by ADEPT, recommends that Authorities require Sector Scheme registration in their specifications.

Membership of the Road Surface Treatment Association is available to contractors who have third party quality assurance (BSEN ISO 9001) for the type of Slurry surfacing work they undertake. The unanimous decision of the Association is to adopt this principle as an indication of its commitment to quality in all its undertakings. The setting up and maintenance of a quality assurance system represents a substantial financial commitment to member companies. Those costs will inevitably have been reflected in the unit prices tendered for Slurry surfacing. Contractors who are not members of the RSTA and have not invested in quality assurance may therefore be in a position to offer lower contract rates, but it follows that their work may well be of a lower quality than that carried out by RSTA member contractors.

Quality controlled RSTA member companies need much reduced supervision by highway authority representatives and should decrease the call for tests and checks on machinery and workmanship which form part of a quality assurance system.

The Association does not see the requirement for quality control as a restriction to competition but rather a method of ensuring fair competition between contractors giving maximum value for money, that should be implicit in all work undertaken for public bodies.

The National Highway Sector Scheme 13 which contains Slurry surfacing within its scope, has been revised and published in May 2011. This revised document replaces document NHSS 13B in the series of Sector Schemes for Quality Management in Highway Construction and maintenance.

The NHSS13 document, which is available on the United Kingdom Accreditation Service (UKAS) website www.ukas.com, is actively supported by RSTA Members most of whom have or are gaining accreditation against the scheme as their Quality Assurance registration is reviewed and updated.

19 END-PRODUCT SPECIFICATION CONTRACTS

In this type of contract, using the Specification for Highway Works Clause 918 (End Performance Specification), the design of the Slurry surfacing is the responsibility of the contractor. In making his choice of materials and rates of spread, he will take into account the end performance requirements within BSEN 12273 and PD6689. Where these contracts are entered into, the contractor is required to demonstrate performance through the use of a TAIT (Type Approval Installation Trial), see Section 20.

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The Slurry surfacing industry welcomes the introduction of end-product specification contracts as this allows contractors to assume total responsibility for the quality of the work undertaken and to apply their experience to the greatest benefit. Since contractors are to be responsible for the design as well as the execution of Slurry surfacings, it will be necessary for the highway authority to provide them with site location details in good time so the contractor can assess the site and apply the appropriate design or TAIT before commencement of the contract.

For Trunk Roads carrying more than 250 cv/lane/day or with traffic speeds in excess of 60mph, clause 942 should be used. The guarantee period under Clause 942 is 5 years. Local Highway maintenance policies may adopt different site criteria for the use of Slurry surfacings.

The guarantee period under Clause 918 for Microsurfacing is normally 2 years for trunk roads including motorways, heavily trafficked or high stress roads and one year for other roads. Local highway Authorities normally adopt similar requirements.

20 TYPE APPROVAL INSTALLATION TRIAL (TAIT)

The Contractor will have carried out end performance Type Approval Installation Trials (TAIT) in accordance with BS EN 12273 as required by Clause 918 of the Specification for Highway Works (MCHW1) on the type of Slurry surfacing that is proposed to be used at approximately the traffic levels and site difficulty of the site in question. Normally, the trial will have been carried out on a site as described below:

- Within one traffic category (above or below) of the actual site; and
- Within one investigatory level (IL) of the actual site, as described in HD 36/06 (DMRB 7.5.1).

The TAIT demonstrates the product performance and durability (macrotexture and visual assessment demonstrated after one year) and the capability of the Contractor. The TAIT Certificate will be the basis for the contractor to achieve CE marking and provide the Client with a guarantee of compliance against the parameters stated on the certificate and additional assurance that the product will be of the appropriate quality.

CE Marking whilst not yet mandatory in UK does become a mandatory requirement in the UK from 30th June 2013.

APPENDIX A

CHECK LISTS

Pre-Contract Checklist

- 1 Has the contractor all relevant site information i.e. location of schools, bus route, market days, events etc?
- 2 Have all the required notifications for Traffic Management been put in place?
- 3 What type of traffic control is to be operated and is there enough labour to carry out the works in a safe and proper manner?
- 4 Have all labour received the appropriate training?
- 5 Has the correct and adequate plant been allocated as required under the contract?
- 6 Are the materials specified under the contract available when required?

Site Checklist

- 1 Has the road been swept?
- 2 Is the pre-patching complete and satisfactory?
- 3 Is the road clear of parked vehicles or any other obstructions?
- 4 Are the correct signs in place?
- 5 Has all necessary masking of cat eyes and street furniture been carried out?
- 6 Are the operatives all present and correct and wearing the relevant Personal Protection Equipment?
- 7 Is all the plant present and in safe working order?
- 8 Are there enough materials available, in good condition, at the correct storage area?
- 9 Is the required rate of spread of Slurry surfacing known?
- 10 Are the weather conditions appropriate to commence work i.e. check forecast daily for high humidity levels, air temperatures and rain?
- 11 Is the planned method of operation safe, both to the operatives and the public?
- 12 What type of traffic control is to be implemented and does everybody understand the method of operation?
- 13 Have you planned the work with the minimum number of longitudinal joints in the correct place relative to the wheel tracks?

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- 14 Has any appropriate aftercare been arranged i.e. trafficking under restricted conditions and sweeping?

Post Contract Checklist.

- 1 Have arrangements been made for post-contract inspections and any required further sweeping?
- 2 Are signs being maintained in a satisfactory condition and placement and removed when required?
- 3 Is the required contract information being collected and documented?
- 4 Have arrangements been made for line replacement?
- 5 Are re-inspection arrangements clear and agreed?

APPENDIX B

GLOSSARY OF TERMS

ADEPT

Association of Directors of Environment, Economy, Planning and Transport, previously known as the County Surveyors Society (CSS).

ADHESION

The property by means of which a binder sticks to the surface of a solid body, e.g. the road or chippings.

AGGREGATES

Aggregate from mineral sources which has been subjected to nothing more than mechanical processing and which has a particular grading.

AGGREGATES STORAGE AREA

A suitable hard standing for storing graded aggregate.

APPLICATOR

A purpose built Slurry or Microsurfacing machine.

BINDER

Material serving to coat the particles of an aggregate and to assure its cohesion. The binder component of Slurry surfacing is a bituminous emulsion which may be modified with polymer or other additives.

BINDER CONTENT

Difference between 100% and the percentage water content determined in accordance with BS EN 1428. (BS434-2).

BITUMEN

Virtually in-volatile, adhesive and waterproofing material derived from crude petroleum, or present in natural asphalt, which is completely or nearly completely soluble in toluene, and very viscous or nearly solid at ambient temperatures.

BITUMEN - MODIFIED

Bituminous binder whose rheological properties have been modified during manufacture by the use of one or more chemical agents. In this context, "chemical agent" includes natural rubber and synthetic polymers but not sulphur and certain organo-metallic compounds, oxygen or oxidation "catalysts" such as ferric chloride, phosphoric acid and phosphorus pentoxide. Fibres and inorganic powders ("fillers") are not considered to be

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bitumen modifiers. In Slurry surfacings modified bitumens are employed in the form of emulsions.

BITUMEN – PAVING GRADE

Bitumen used to coat mineral aggregate mainly used in the construction and maintenance of paved surfaces and hydraulic works.

BITUMEN– POLYMER MODIFIED

Modified bitumen in which the modifier used is one or more organic polymers.

BITUMEN – EMULSION

Liquid product in which a substantial amount of bitumen is suspended in a finely divided condition in an aqueous medium by means of one or more suitable emulsifying agents.

BOND

The adhesion between the Slurry surfacing material and the underlying substrate.

BREAK (EMULSION)

The coagulation of the dispersed bituminous phase of an emulsion when in contact with mineral aggregate.

BSI

British Standards Institution.

BSEN 13808:2005

A Framework product standard for specifying cationic road emulsions.

BSEN 13043:2002

European Product Standard for Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas.

BSEN 12273

The European Product Standard for Slurry surfacing Requirements.

CATIONIC BITUMEN EMULSION

Emulsion in which the cation of the emulsifier is at the interface with the bitumen particle that is positively charged and in which the aqueous phase is normally acid.

CDM

The Construction (Design and Management) Regulations 2007 which place duties on clients, designers and contractors in relation to management arrangements and practical

measures for construction projects.

CE MARKING

The CE marking (also known as CE mark) is a mandatory conformance mark on many products placed on the single market in the European Economic Area (EEA). The CE marking certifies that a product has met EU consumer safety, health or environmental requirements.

C E N

The European Committee for Standardization or Comité Européen de Normalisation (CEN), is a non-profit organisation whose mission is to foster the European economy in global trading, the welfare of European citizens and the environment by providing an efficient infrastructure to interested parties for the development, maintenance and distribution of coherent sets of standards and specifications.

CLAUSE 918

A clause within the MANUAL OF CONTRACT DOCUMENTS FOR HIGHWAY WORKS VOLUME 1 SPECIFICATION FOR HIGHWAY WORKS SERIES 900, Road pavements – bituminous bound materials, that specifies the use of Slurry surfacing incorporating Microsurfacing.

CLAUSE 942

A clause within the MANUAL OF CONTRACT DOCUMENTS FOR HIGHWAY WORKS VOLUME 1 SPECIFICATION FOR HIGHWAY WORKS SERIES 900, Road pavements – bituminous bound materials, that specifies the use of Thin Surface Course Systems.

COST LIFE INDEX

The cost (in this case of a Slurry surfacing) expressed as the cost per square metre divided by the service life.

CPR

Construction Products Regulations.

DEFERRED MATERIAL

A Slurry mixture which has been treated with Dope to delay the rate of set.

DOPE

A liquid chemical additive, usually an emulsifier or surfactant, which is added to the Slurry material during mixing on site to retard the rate at which the mixture sets to aid workability and ease of material placement.

DURABILITY

Ability of a product to maintain its required performance, under the influence of foreseeable actions, for a reasonable economic working life.

END PERFORMANCE SPECIFICATION

A level of in service performance specified by the contract document based on the performance categories contained within BSEN 12273 and PD6689.

FACTORY PRODUCTION CONTROL (FPC)

Permanent internal control of production exercised by the producer when all the elements, requirements and provisions adopted by the producer are documented in a systematic manner in the form of written policies and procedures.

FIBRES

Fibres usually manufactured from polypropylene which are added into the Slurry surfacing or Micro asphalt mixture during mixing on site to reinforce the product when fully cured for enhanced flexural strength.

HARDENED

A term used to describe a Slurry surfacing where the surface has stabilised to a hard condition ready for overlay or trafficking.

JOINTS

Longitudinal or horizontal lengths along or across the pavement surface where individual layers of Slurry surfacing or Microsurfacing meet or overlap.

LAYING RECORD

A documented record providing details of the Slurry surfacing material laid.

MASK

An adhesive barrier tape or other similar material used to cover cat's eyes, road ironwork, etc to prevent contact with the Slurry surfacing during installation such that after removal these objects remain free from Slurry surfacing or binder and in full working order.

MICRO-ASPHALT

Alternative term often used to describe Microsurfacing.

MIX DESIGN

A laboratory process for determining the optimum combination of Slurry surfacing and Microsurfacing mixture components necessary to achieve the desired level of in service performance.

NVQ

National Vocational Qualifications (NVQ's) are work based awards in England, Wales and N.Ireland that are achieved through assessment and training. In Scotland they are known as Scottish Vocational Qualification (SVQ).

To achieve an NVQ, candidates must prove that they have the ability (competence) to carry out their job to the required standard. NVQs are based on National Occupational Standards that describe the 'competencies' expected in any given job role. Typically, candidates will work towards an NVQ that reflects their role in a paid or voluntary position. For example someone working in an admin office role may take an NVQ in Business and Administration. There are five levels of NVQ ranging from Level 1, which focuses on basic work activities, to Level 5 for senior management.

PAVING MACHINE

Purpose built vehicle used for laying Microsurfacing with in-built mixer and able to carry all mixture components.

PD6689:2009

Public Document 6689 provides guidance on how to use BS EN 12273 to specify Slurry surfacings and Microsurfacing in the UK.

POLISHED STONE VALUE (PSV)

A relative measure of the extent to which different types of aggregate in the surface course will polish under traffic.

PTR

An abbreviation for pneumatic-tyred roller sometimes required to compact Microsurfacing to achieve a denser more durable finish.

PUG MILL

Purpose built mixing equipment for preparing a mixture of Slurry surfacing and Micro Surfacing.

QA

An abbreviation for Quality Assurance.

QUALITY ASSURANCE

Quality assurance, or QA for short, is the systematic monitoring and evaluation of the various aspects of a Slurry surfacing operation to maximize the probability that minimum standards of quality are being attained by the production process.

Registration to BSEN ISO 9001 given to a contractor by a certification body indicates minimum standards are being attained

REGULATING

Re-profiling the existing road surface prior to treating with Slurry surfacing to remove any unacceptable defects such as ruts or potholes.

ROLLER

Mobile plant/equipment used to compact layers of Micro-asphalt.

RSTA

The Road Surface Treatments Association is the trade body representing the road surface treatments industry. www.rsta-uk.org.

SAND PATCH

A standard test, BS EN 13036 Part 1, for measuring the texture depth of road surfaces.

SCREED MIXTURE

A Slurry mixture of aggregates, bituminous emulsion, water and additives, which is mixed and laid in-place by flowing through a levelling screed.

SECTOR SCHEME

National Highway Sector Schemes are bespoke management schemes within an ISO9001:2000 framework. Each scheme is managed by a separate technical advisory committee made up of representatives from across the sector, regulated by UKAS.

SLURRY SURFACING

A mixed material comprising graded aggregates, water, emulsion binder, dope and cement.

SRV

Skid Resistance Value.

TAIT

Type Approval Installation Trial (TAIT) - synonymous with Initial Type Test (ITT) which demonstrates that the characteristics of the Slurry surfaces complies with the declared characteristics according to the European Standard BS EN12273. The TAIT consists of a defined section where Slurry surfacing has been installed using Factory Production Control (FPC) and which has been submitted to performance tests after a period of one year. Detailed information is recorded to clearly identify the product, its performance and the intended uses. Also a requirement within BS.

THERMOPLASTIC

A term used to describe road markings.

TRAFFIC SIGNS MANUAL

Regulatory guidance on the use of traffic signs at mobile works. Traffic Signs Manual Chapter 8: Traffic Safety Measures and Signs for Road Works and Temporary Situations.

UKAS

National Measurement Accreditation Services.

APPENDIX C

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