

RESIN BOUND SYSTEMS FOR EXTERNAL APPLICATIONS



FeRFA Guidance Note: No 14

Supported by



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1. INTRODUCTION

This guide is based on the collective knowledge of FeRFA members having extensive experience in the requirements for successful applications of resin bound surfacing. In separate sections, the guide gives recommendations for the selection, design, substrate preparation, application, maintenance and for the inspection and testing of surfacing. Its scope includes **resin bound surfacing** applied to concrete, asphalt concrete conforming to EN 13108 - 1 and hot rolled asphalt conforming to EN 13108 - 4. Resin **bonded** surfacing is often specified for similar applications, more details on these type of systems can be found in FeRFA Guidance Note No 13 (publication awaited).

2. DESIGN

2.1 Who Is The Designer?

The designer is that person or organisation who:

- Takes control and responsibility for the design of the surfacing;
- Ensures that they are provided with all the information as set out in Section 2.2;
- Provides all the information set out in Section 3.1 to the Contractor.

A specified Surfacing Contractor may be deemed the designer if and only if they are provided with the information set out in Section 2.2

The person or organisation which provides a contractor with a standard form of specification and which contains some or all of the information set out in Section 3.3 is ipso facto 'the designer'. The designer is responsible for all aspects of design and should not rely on the contractor to design those aspects which he has failed to include.

2.2 Information Required by the Designer

The following information should be provided to or sought by the designer.

- Description, situation and address of site and means of access;
- Those conditions of contract that might practically affect this particular work;
- Location, intended usage and areas to be covered;
- Age and nature of the base and its strength and finish;
- The type and intensity of traffic to be expected;
- Condition of the sub-grade and possible need for capping layer;
- Composition of the subgrade and possible need for additional drainage (fully permeable resin bound surfacing only).
- Location of manholes, surface drains, etc;
- Drainage requirements;
- Description of junctions with existing edgings/hard landscaping/buildings;
- Location of trees;
- Available depth from finished surfacing level to top of the base;
- Any programming constraints.

2.3 Typical Resin Bound Surfacing Applications

Resin bound surfacing is suitable for foot traffic and light vehicular traffic up to 7.5 tonnes and is not recommended for applications where traffic by heavier vehicles is expected. Typical applications include private and long stay car parks (excluding decked car parks and shopper's car parks), driveways, podium decks and terraces, public squares, courtyards, footpaths and pool surrounds.

Resin bound surfacing should always be chosen for application to permeable pavements and may be preferred to resin bonded surfacing in areas such as playgrounds where children may suffer more serious abrasive injury by falling on coarser textured resin bonded surfacing. Resin bonded surfacing should always be chosen for roads subject to traffic by heavy vehicles.

2.3.1 Resin Bound Surfacing Composition and SuDs Compliance

Resin bound surfacing is composed of kiln-dried aggregates bound with a clear resin, typically laid from a minimum thickness of 15 mm to 20 mm. Resin bound surfacing may typically be laid on a solid base of

concrete, asphalt concrete or hot rolled asphalt. Some products are available for application at a greater thickness to compacted aggregate bases but these products should only be used on footways. Manufacturers' specific instructions and recommendations should be followed. When used with a suitably graded aggregate blend and resin to aggregate ratio, resin bound surfacing is porous. The rate at which water will flow through the surfacing is affected by the choice of aggregate grading as is the ultimate strength of the cured material. It may be applied to existing non-porous bases when an adequate fall is in place and water is free to drain at the interface of surfacing and base. Resin bound surfacing applied to a correctly designed porous base and sub-base will facilitate design of a SuDS compliant permeable pavement construction, reducing flood risk and permitting rainwater to flow into natural water courses.

The composition and properties of resin binders may differ in terms of the performance characteristics they offer. The designer should seek specific advice from the manufacturer about the effects of long term exposure to ultra violet light in relation to the aesthetic appearance and long term physical properties of the system.

Natural aggregates are most commonly used but coloured glass and artificially colour coated aggregates are also available. The designer should be aware that glass crushes more easily than most natural aggregates and has been known to suffer damage under high heeled shoe traffic. Aggregates with UV stable coloured coatings can be sourced but coating loss can occur under regular medium to heavy foot traffic. The designer should consider restricting the use of coloured glass and colour coated aggregates to areas with lighter traffic.

2.3.2 Resin to Aggregate Ratio

The following table is for guidance and reflects the need to consider the resin to aggregate ratio when selecting a UV stable and/or non UV stable resin bound system (see resin selection). The performance of a resin bound surfacing blend can be affected not just by the type and size of aggregate and fine filler selected, but also by the ratio of resin to aggregate. Resin content can seriously affect the performance and service life of the surfacing and although some aggregate blends may require fractionally more or less resin, depending on shape and angularity of aggregates and porosity of fine fillers, the specifier or client should consider whether a significant departure from resin content shown in the table will affect the durability of the surfacing, particularly if the proposed supplier cannot be found on the FeRFA website. Some FeRFA Resin Bound manufacturers may publish alternative ratios and it is always advisable to seek their advice directly.

** These figures reflect the majority of the FeRFA members contributing to this guidance table.

Aggregate size	Resin pack size kg	Aggregate batch size	Sand/filler within the mix	Total aggregate	Total batch size incl resin	**Percentage resin to batch	**Resin to aggregate
< 1-3mm	8	100	0	100	108	7.41%	8.00%
1-3/ 2-5mm	7.5	100	6.25	106.25	113.75	6.59%	7.06%
3-6mm	7.5	100	6.25	106.25	113.75	6.59%	7.06%
2-5mm with 6-10mm	7.5	100	6.25	106.25	113.75	6.59%	7.06%
6-10mm	6	100	7	107	113	5.31%	5.61%

2.4 Thickness

- Foot traffic and driveways with no turning vehicles: 2 – 5 mm & 3 – 6 mm aggregate, minimum 15mm thickness.
- Larger driveways and car parks: 2 – 5 mm & 3 – 6 mm aggregate, minimum 18mm thickness.

2.5 Cracking

Cracking is principally caused by movement or settlement in the base or sub-base and movement of elements such as edgings or stress relief cracking at manholes etc.

2.5.1 Base Movement

Cracks caused by base movement in concrete slabs are rare but economic considerations and the increased construction thickness often required dictate that resin bound surfacing is frequently applied to asphaltic bases. It is good practice only to apply resin bound surfacing to asphaltic bases with a bitumen binder which has a 'pen' or penetration test value $\leq 100/150$ when tested in accordance with BS EN 13108-1 but some flow of asphaltic materials in warm weather will occur irrespective of the hardness of the bitumen. When flow of the bitumen is sufficient to exceed the tensile strength of the surfacing, cracking will occur. In such cases there may or may not be cracking of the base.

2.5.2 Sub-base Settlement

Settlement of the sub-base caused by inadequate compaction or by movement of the sub-grade, typically in clay belts, may result in cracking of the surfacing.

2.5.3 Edgings

Edgings such as concrete or timber kerbs may be inadequately restrained, there may be settlement of the restraints or vehicles such as mowing machines crossing edgings from hard to soft landscaping may cause movement of the edging. Cracking of the surfacing adjacent to the edging will occur if the edging moves and adhesion strength between edging and surfacing exceeds the cohesive strength of the surfacing at that point. Positioning of isolation joints at edgings should be considered as a means of crack prevention. Closed cell polyethylene strips applied to edgings before surfacing is laid is suggested.

2.5.4 Stress Relief Cracks

Stress within the surfacing which would otherwise not be expressed can occur at re-entrant corners, manholes etc. causing cracking to occur. Positioning of isolation joints at all surfacing perimeters should be considered as a means of crack prevention. Closed cell polyethylene strips applied to perimeters before surfacing is laid is suggested.

2.6 Joints

Movement joints in the base must not be bridged. A movement joint trim should be securely fixed to the base before application of the surfacing. Open bay joints should be expressed as bay joints in the surfacing or treated in the same way as movement joints. Consideration should be given to the risk of closed bay joints opening up at a later date.

Formed day-work joints are simple butt joints in the surfacing. Care should be taken by the contractor when planning the works to reduce the length of daywork joints where possible and to position joints where they will have the least possible visual impact. Daywork joints should be finished with a 90 degree angle and should be straight unless agreed otherwise e.g., where curved features with different aggregates have been designed. Positioning of closed cell polyethylene strips to produce isolation joints at all surfacing perimeters including ironwork and re-entrant corners should be considered as a means of crack prevention.

2.7 Waterproofing

When a waterproof membrane is required which must be positioned directly below the resin bound surfacing, the designer should be satisfied that the membrane is seamless, compatible with the surfacing and fully bonded to an in-situ base. Adequate adhesion to bituminous or EPDM membranes is highly unlikely and the best results are more likely to be achieved when bonding the surfacing to a resin based membrane. Most resins are only open to adhesion for a brief period and it is unlikely that adequate adhesion can be achieved without inclusion of a kiln-dried sand scatter into the wet surface of the membrane or mechanical/chemical preparation of the membrane before the surfacing is to be applied. Site trials are strongly recommended. When possible the membrane should be protected by a polymer modified screed which will provide an ideal substrate for the surfacing.

2.8 Weather Protection and Curing

Adequate weather protection must be provided at the work station if works are to be carried out when rain is possible and kiln-dried aggregate must be covered. The contractor must not rely on packaging to prevent moisture ingress. Aggregates should not be stored under tarpaulins for long periods unless adequate ventilation can be provided to prevent moisture ingress from atmospheric humidity. Kiln-dried aggregate which has become damp must not be

used. Substrates which have become wet must be allowed to thoroughly dry before application proceeds. Application of resin bonded surfacing should be avoided if rain is expected before the resin has achieved initial cure.

2.9 Testing

The designer should specify what, if any, tests are to be carried out during or after application of the surfacing. This should include the type of test, the number of test positions, whether these are on a random or grid basis and the acceptance limits. Tests may include:

2.9.1 Surfacing thickness

Periodic checks may be carried out during application to ensure that the specified minimum wet-film-thickness is maintained.

2.9.2 Slip resistance

Slip resistance tests may be carried out using either the Ramp/Trolley test aka SlipAlert, or using a Pendulum Slip Resistance test machine. Tests are normally carried out in both wet and dry conditions. The acceptance limit for wet and dry conditions is generally > 40 PTV (Pendulum Test Value), or as specified by the designer. Please note that slip resistance is influenced by gradient and steep gradients may require aggregate blends which provide greater slip resistance. Slip resistance can be improved by an even application of fine aggregate to the surface of the freshly applied resin.

3. APPLICATION

Application of resin bound surfacing requires specialist skills in substrate preparation, mixing and application. The advice of the manufacturer/system supplier should be sought when choosing a contractor or preparing a tender list.

3.1 Information Required by the Contractor

The following information is required by the Contractor. It is strongly recommended that this information is properly recorded.

- Location of the project.
- Areas concerned.
- Type(s) of surfacing to be laid.
- Programme constraints.
- Relevant details of the base.
- Preparation of the base surface to be carried out.
- Design thickness of the surfacing and minimum thickness to be achieved.
- Joint details and locations.

3.2 Application of Resin Bound Surfacing

- Prepare concrete by mechanical means to provide a sound, clean, dry substrate that is free from laitance and suitable for application of the resin bound surfacing. Asphalt concrete must have cooled and hardened and must be clean, dry and free from loose materials. Resin Bound Surfacing should not be relied upon to make good an already weak surface.
- The bitumen binder of asphalt concrete must have a pen value no greater than 100/150, when tested in accordance with EN 1426 Needle Penetration Test. It is advisable to use a harder grade of bitumen when machine application is possible and 70/100 pen (or harder) is preferred. Bituminous materials with a higher pen value will be too soft and may deform in warm weather. Adequate compaction of the sub-base and base is essential to prevent cracking. A minimum 1 tonne "sit on" roller should be used when possible and the contractor must ensure that the construction is fully restrained at all edges to ensure dimensional stability.
- Ensure that falls are in place to provide adequate drainage when applying to an impermeable base.
- Protect ironwork and termination points as necessary using duct tape to prevent spillage of mixed resin/aggregate sticking to other surfaces.
- Protect all edges abutting soft landscaping with brick, steel, timber or concrete to prevent damage to the surfacing. Edgings should be securely fixed to prevent movement. A flexible joint filler should be used at edgings where there is potential for movement to separate the surfacing from the edging.

- The minimum application temperature is typically 5°C on a rising thermometer and maximum is typically 25°C. Ideal temperature conditions are 15 – 20°C.
- Resin bound surfacing is designed for foot traffic & light vehicular traffic. The surfacing may be affected by the scrubbing action of tyres when vehicles are turning in confined spaces. Regular inspections should be carried out to ensure early detection of damage should this occur.
- The manufacturer's technical data must be followed when mixing. Always ensure that all aggregates are fully coated in resin.
- Discharge the mixed material as soon as mixing is complete and spread to approximate level, minimum 15 mm thick, use battens and a straight edge for final levelling and smooth with a steel float.
- Always ensure that a wet edge is maintained. Joints between mixes will be visible unless the older mix is still workable.
- Tools and equipment may be cleaned with a suitable solvent based cleaner which will remove uncured resin.
- Allow the surfacing to cure in accordance with the recommendations of the manufacturer.

4. CARE AND MAINTENANCE

4.1 Use of Cleaning Products

Cleaning products should be pH neutral where possible and biodegradability should be considered when cleaning permeable pavement as chemicals will drain to natural water courses. When using acidic or alkaline cleaners, pH should be as close to neutral as possible and cleaners should be neutralised before flushing with clean water to reduce the risk of staining and degradation of the resin. A discrete test patch should be chosen for a trial before general use.

4.2 Regular Cleaning

Regular appropriate cleaning of surfacing materials will contribute to the durability of the surfacing. As with any surfacing material, resin bound surfacing should be cleaned regularly and as frequently as necessary to maintain its appearance. Sweep with a broom to remove leaves, paper etc. Use water as necessary to wash the surface and only use cleaning products when water and a sweeping brush are insufficient for cleaning the surface. The use of abrasive pads and wire brushes should be avoided.

4.3 Removing Moss, Algae and Lichen

After brushing off biological growth, remove remaining moss, algae, lichen or other biological growth from the surface with a proprietary fungicide. Flushing with clean water may not be necessary and may affect the long term effectiveness of the treatment. Follow the instructions of the manufacturer and abide by local regulations with regard to the use of chemicals. Periodic use of a fungicide should be considered as a preventative measure in areas where conditions are likely to promote biological growth.

4.4 Chewing Gum Removal

Chewing gum can be removed by scraping or chipping or using proprietary local "spot" removal solutions or by employing a commercial cleaning company. Take care not to dislodge aggregate.

4.5 Power Washing

If power washing the surface, use only sufficient water pressure to remove dirt or contamination. Use cold water only (maximum 40 °C) with a fan jet, maintaining at least 300 mm between the lance and the surface holding the lance at an angle of approximately 45°. Avoid concentration of the jet on one area by using a sweeping action from side to side.

4.6 Removing Oil Stains

Use a proprietary degreasing material and scrub into the surface with a broom. Ingrained stains may require the degreaser to be left in place for some time to allow the product to penetrate the deposit before flushing. Several applications of degreaser may be required for full removal.

4.7 Removing Tyre Marks

Use a proprietary tyre mark remover.

4.8 Removing Cement Stains

Use a proprietary acid based concrete/mortar cleaner and neutralise immediately after removal of the stain using copious amounts of clean water. A discrete test patch should be chosen for a trial before general use. Manufacturer's application instructions and health and safety guidance must be followed.

4.9 Using the Surface

Resin bound surfacing is designed to be used by pedestrians and by light vehicles up to 7.5 tonnes gross weight. Resin bonded surfacing should be considered for heavier vehicle loads and for highways. Protect the surface from damage caused by equipment such as vehicle jacks, skips etc. and from abrasion by dragging of heavy objects. Protect the surface from liquids and other materials which may stain or affect the surface such as hydraulic fluids, petrol, oil, diesel, paints, chewing gum, cement etc.

4.10 Localised Repairs

Resin bound surfacing can be repaired using the same combination of resin and aggregate as used during installation. Repairs should be carried out as soon as possible after they have been identified to avoid further degradation. Please refer to the manufacturer for specific guidance.

5. REFERENCES

This is the fourteenth in a series of useful and informative Technical Guidance Notes produced by FeRFA, all of which can be freely downloaded from the FeRFA website at www.ferfa.org.uk

These include:

- Guide to the Specification and Application of Synthetic Resin Flooring (RIBA CPD Approved)
- Guide to the Selection of Synthetic Resin Flooring

For a full list go to the publications page on the FeRFA website.

FERFA

FeRFA, the Resin Flooring Association, represents the major product manufacturers, specialist contractors and surface preparation companies, raw material suppliers and specialist service providers within the UK Resin Flooring Industry. Established in 1969, FeRFA now represents over 90 UK based companies. The Association has established Codes of Practice for full members. It takes an active role in promoting resin flooring and in developing both national and international standards.

*All FeRFA publications are freely downloadable from the website at www.ferfa.org.uk for further information, contact FeRFA at: 16 Edward Road, Farnham, Surrey, GU9 8NP
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