

## GUIDE TO THE SPECIFICATION & APPLICATION OF SCREEDS



**FeRFA Guidance Note: No 15**



**CONTENTS**

- 1. INTRODUCTION .....3
- 2. DESIGN .....3
  - 2.1 Who is the Designer? .....3
  - 2.2 Information the Designer Needs (areas of use, trafficking, final floor finish).....3
  - 2.3 Choice of Screed type .....3
  - 2.4 Thickness .....5
  - 2.5 Bonded/Unbonded/Floating .....5
  - 2.6 Reinforcement .....6
  - 2.7 Bay Construction .....6
  - 2.7.2 Cracking .....7
  - 2.7.3 Joints .....8
  - 2.8 Damp proofing .....8
  - 2.9 Tolerances and surface regularity.....8
  - 2.10 Protection and curing.....8
  - 2.11 Testing.....9
  - 2.12 Underfloor heating ..... 10
  - 2.13 Thermal/Acoustic insulation ..... 11
- 3. APPLICATION ..... 11
  - 3.1 Information the Contractor needs..... 11
  - 3.2 Advice to be given to the Main Contractor or equivalent body: ..... 11
  - 3.3 Preparation of the base ..... 12
  - 3.4 Preparation for Laying..... 12
  - 3.5 Batching and Mixing ..... 13
  - 3.6 Laying of the screed ..... 13
  - 3.7 Reinforcement placing..... 14
  - 3.8 Joints ..... 14
  - 3.9 Finishing..... 14
  - 3.10 Curing, drying, protection..... 15
  - 3.11 Testing, Inspection and Repair..... 15
  - 3.12 Preparation for subsequent floor finishes..... 16

**FERFA**

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## 1. INTRODUCTION

This Guide is based on the collective experience of FeRFA members who have extensive experience in designing and applying screed systems. In separate sections, the Guide gives recommendations for the selection, the design, substrate preparation, the application and for the inspection and testing of Screed Flooring. Its scope includes cementitious screeds, calcium sulphate screeds, polymer modified screeds and granolithic screeds.

The terminology 'screed' is defined in accordance with BS EN 1318 as "*Layer or layers of screed material laid in situ, directly onto a base, bonded or unbonded, or onto an intermediate layer or insulating layer, to obtain one or more of the following purposes: to obtain a defined level; to carry the final flooring; to provide a wearing surface.*"

## 2. DESIGN

### 2.1 Who is the Designer?

The designer is that person or organisation who

- Takes control and the responsibility of the design of the screed as set out in Part 1 of this document.
- Ensures that all the information as set out in Section 2.2 is provided.
- Provides all the information set out in Section 3.1 to the contractor.

A nominated screeding contractor may be deemed the designer if, and only if the contractor is 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 the Designer Needs (areas of use, trafficking, final floor finish)

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

- a) description, situation and address of site and means of access;
- b) those conditions of contract that might practically affect this particular work;
- c) degree of weather protection afforded by the structure;
- d) location, intended usage and areas of floors to be covered;
- e) age and nature of the base and its likely strength and finish;
- f) whether there is an effective dpm within or under the existing base;
- g) whether the screed is to provide the wearing surface, if so, the type and intensity of traffic to be expected;
- h) if not a wearing surface, the type and thickness of the finished flooring to be applied;
- i) type of underfloor heating (if any) to be used;
- j) requirements (if any) for acoustic/thermal insulation;
- k) requirements (if any) for provision of services within or through the screed;
- l) location of any structural columns, manholes, surface drains, etc;
- m) any requirement for the surface to provide free drainage;
- n) description of any junctions with existing flooring;
- o) available depth from finished floor level to top of the base concrete;
- p) any programming constraints.

### 2.3 Choice of Screed type

#### 2.3.1 Sand/Cement screeds

The most commonly used screed, it can be mixed on site using just cement, aggregate and water or can be supplied in bulk ready to use.

Sand/cement screeds should only be used as a levelling screed, i.e. as a base for tiles, vinyl, timber flooring.

Sand/cement screeds should not be used as a base for resin screed finishes, however some proprietary modified sand/cement screeds may be suitable. Please refer to the manufacturer for specific guidance.

The screed can be pumped as well as hand applied.

They are 'semi-dry' in order to control shrinkage and need a significant amount of work when laying in order to compact them properly. Thick sections need to be laid in more than one layer.

A minimum thickness of 25 mm is required for a fully bonded screed, 50 mm for an unbonded screed and 65 mm for a floating screed (i.e. on top of insulation). 75 mm is the minimum in a commercial environment for a floating screed.

### **2.3.2 Fine concrete screeds**

These contain larger-sized aggregate and are used particularly for the thicker floating screeds.

They can have a higher water content than the standard sand/cement screed, making them easier to lay in thick sections.

### **2.3.3 Granolithic cement screeds**

These are screeds which are used as wearing surfaces, they contain a proportion of hard aggregates such as granite and are bonded to the substrate slab.

They are trowelled during the first 12 hours after laying in order to 'close' the surface and provide an extremely hard and durable finish.

### **2.3.4 Polymer modified cementitious screeds**

These screeds can be used as both levelling and wearing screeds depending upon their specific design qualities and can be flowable or trowel applied.

They can be used under resin screed finishes and are applied in thinner sections than standard cement screeds. (See Ferfa Guidance Note No. 8)

### **2.3.5 Calcium Sulphate screeds**

These are normally pumped and are self-levelling, requiring much less work than a cementitious screed. They are only used as levelling screeds - not wearing surfaces.

Calcium Sulphate screeds require additional preparation before installing the floor finish, and are not compatible with cementitious materials, particularly when wet. Unlike a cementitious screed, if they get wet after having dried out, they lose their strength in those areas affected by moisture. Calcium Sulphate screeds are not suitable for reinforcement with steel and are generally not suitable as a base for resin finishes. Seek manufacturer's specific guidance.

## 2.4 Thickness

	Bonded	Unbonded	Floating	
			Commercial	Light Domestic
Normal Sand/Cement*	25/40	50/70	65/90 (A)	60/85 (A)
			75/100 (B)	70/95 (B)
Granolithic Wearing Screed	15/20 (M)	100-150 Concrete overslab	Concrete Overslab	N/A
	20/40 (S)			
Polymer Modified Sand/Cement	6-15/15-25 (LD)	35/55	35/55(A)	35/55(A)
	10-40/20-50 (MD)			
	20-40/30-50 (HD)			
	20-40/30-50 (VHD)			
Calcium Sulphate	25/35	30/45	40/55 (A)	35/55 (A)
Pumped Self-Levelling Cementitious	6/10 (I)	N/A	N/A	N/A
	3/7 (D)			

\* Proprietary screeds may vary, seek manufacturer's guidance.

The first value given in the above table is the minimum thickness in millimetres.

The second value (in bold type) is the design value assuming a reasonably flat and level substrate surface. This may have to be increased, possibly substantially, if (or where) services are embedded in the screed, or the substrate surface has significant variations in level, in order to ensure that the minimum screed thickness can be achieved at all positions over the installation.

Notes to be read in conjunction with Table 1

Floating Screeds	(A)	On heavy duty thermal insulation boards.
	(B)	On sound insulation quilts.
Granolithic Wearing Screeds	(M)	Laid monolithically with the base slab.
	(S)	Laid separately but bonded to the base slab.
Polymer Modified Screeds	(LD)	Light duty.
	(MD)	Medium duty.
	(HD)	Heavy duty.
	(VHD)	Very heavy duty.

The thickness required for these duties will also depend on the polymer content.

Pumped Cementitious Screeds	(I)	Industrial/Commercial.
	(D)	Domestic.

## 2.5 Bonded/Unbonded/Floating

### 2.5.1 Bonded screeds

A bonded screed acts integrally with the base slab and all the forces acting on the screed are transmitted via the bond to the base slab. A good bond is essential, particularly around the edges of the screed to help resist internal drying forces which can cause cracking.

### 2.5.2 Unbonded screeds

Unbonded screeds are used either to install a damp proof membrane (dpm) between the base slab and the screed or where the base slab surface is unsuitable for a bonded screed due to problems such as chemical contamination. They need to be thicker because they need to be strong enough to resist certain forces which

cannot be transmitted to the base slab and to resist curling at the edges. It is also important that the surface of the base slab is of uniform level and as smooth as possible, and that ample provision is made at screed perimeters to isolate walls, door thresholds, columns, manholes and other fixed building elements from contact with the screed, to allow the screed to contract or expand freely during the drying process and with changing temperature – otherwise it will inevitably crack.

### 2.5.3 Floating screeds

Floating screeds are those which rest directly onto thermal or acoustic insulation. Because the insulation is compressible, these screeds have to act in semi structural mode as they have to distribute any loads and forces applied to their surface over as wide an area as possible. The most serious issue with floating screeds is the difficulty of properly compacting the semi-dry screed mix due to the resilience of the insulating layer, and it is often better to use the slightly wetter fine concrete mix. As with unbonded screeds, it is important that the screed is of uniform thickness, ample provision is made at screed perimeters to isolate walls, door thresholds, columns, manholes and other fixed building elements from contact with the screed.

### 2.5.4 Insulation boards

When selecting an insulation board for use with a floating screed subject to high point loads, consideration should be given to the load transmission to the board through the screed, particularly when screed thickness is reduced. A board with sufficient strength to withstand high point loads without deformation should be chosen, deformation of insulation under point loads is likely to damage a screed. 150kPa (0.15N/mm<sup>2</sup>) boards are popular for floating screed applications and are adequate for residential use but may not be strong enough for floating screeds subjected to high point loads, however irregularly the loads are to be imposed.

The compressive strength of insulation boards is typically expressed in kilopascals; it is important to note that compressive strength of boards composed of materials such as polystyrene and urethane is tested at 10% compression in the board, meaning that at the maximum design load a 100mm board would deform by 10mm. There is no data published by manufacturers for compressive strength at zero compression but it will be considerably reduced. At least one manufacturer shows compressive strength at 10% & 2% compression, the compressive strength of their 250kPa board reduces to 125kPa at 2% compression and the strength of their 700kPa board is reduced to 250kPa at 2% compression. Products such as cellular glass insulation exhibit higher compressive strength without deformation of the board; the cellular glass board with the lowest loadbearing capacity has a compressive strength of 800kPa or 0.8N/mm<sup>2</sup>.

## 2.6 Reinforcement

### 2.6.1 Steel Reinforcement

Reinforcement in the form of steel mesh is used to control the early drying shrinkage of the screed e.g. in floating screeds, or to limit crack widths. It should be noted that it does not prevent cracking. In floating screeds, wire netting is sometimes used immediately on top of the insulation in order to protect it. This should not be considered as enhancing the structural performance of the screed.

The design of mesh needs to be chosen such that the screed can accommodate up to three layers at overlaps and occupying the middle third of the screed thickness.

In order to prevent lipping at joints in floating and unbonded screeds, reinforcement can span the joints and the joint formed using crack inducers. Joints in bonded screeds, particularly those over joints in the concrete base, need to be free to move and should not be reinforced.

### 2.6.2 Fibre Reinforcement

Polypropylene fibres are used to control initial cracking. They are not used for structural purposes.

## 2.7 Bay Construction

### 2.7.1 Bay sizes

Bonded and unbonded levelling screeds are normally laid in strips some 3 m to 4 m in width. This is to facilitate the use of screeding bars down either side which are used to ensure the correct thickness of screed/surface level. Alternate bays are laid, the bars removed and the infill strip thickness/ surface level is then based on the finished strips either side. Stress relief joints are usually formed every 5 m - 6 m down each strip. Such joints are either formed by cutting through with a trowel or saw-cutting the hardened screed. When choosing to saw cut a screed, the contractor should consider how soon after laying the screed should be cut; stress relief cracks may be formed in fast drying or high strength screeds at a very early stage in the curing process.

The setting out of such bays will depend on several factors. In a bonded screed the joints should follow closely the joints in the concrete base since it is inevitable that these will open and cause a crack in the screed. Similarly, sealant filled expansion/movement joints in the structure should never be screeded over.

In a floating screed designed to receive rigid floorings, bay sizes are normally limited to 40 sq m and positioning of joints will depend on the layout of the heating pipework system if underfloor heating is the reason for using a floating screed.

If ceramic tiling is to be laid as the final floor finish, bay joints in the screed may also need to be carefully set out to coincide with the bay joints in the tiling system.

Calcium sulphate levelling screeds do not shrink to the same extent as cementitious screeds and there is a tendency to lay them in much larger bays. However, building/base movements and stress caused by heating and cooling in underfloor heating systems can cause random cracking in large bays, particularly if the screed is restrained in various places by columns, service ducts, etc.

Long thin strips such as corridors are prone to cracking and should be provided with stress relief joints at intervals, particularly as the screed tends to become restrained at doorways and junctions.

Cementitious (e.g. granolithic) and polymer modified wearing surfaces should be considered in the same way as bonded levelling screeds and joints should coincide with those in the underlying concrete slab.

### 2.7.2 Cracking

Cracking is caused by either the external forces applied to the screed exceeding the relatively weak tensile strength of the screed or the internal forces within the screed exceeding its tensile strength.

External forces can be applied by the building itself or its major structural components. Hence general movement of the building, e.g. flexing of suspended floors, foundation settlement, thermal expansion and contraction, can exert significant tensile forces on the screed which it does not have the tensile strength to resist. The most common external force is between adjacent ground-supported concrete slabs which are shrinking away from each other in the long drying out period. A screed which is bonded to both slabs and is continuous over the joint between them will inevitably crack.

Internal forces are caused due to the screed itself trying to shrink due to loss of its moisture content. In theory as a floating or unbonded screed dries and shrinks, the edges of the screed will move evenly inwards towards the centre of the area. Unfortunately in practice this may not happen either because the drying and thus the shrinkage is uneven throughout the area of screed, or because the screed becomes restrained at one or more places.

Restraint of the screed, thus preventing it shrinking evenly can be caused by a number of factors. Internal columns in the building, re-entrant corners, manholes, service ducts typically can cause restraint. However, the most common cause is the weight of the screed itself and the friction that is generated thereby on whatever is supporting it. This is why it is important that the concrete slab surface in an unbonded screed is as smooth as possible. It should be clearly understood that reinforcement in the screed will not prevent cracking. It only limits the crack width. The crack will be initiated long before the reinforcement can have any effect.

One of the most important factors in limiting cracking is curing of the screed. Curing prevents moisture loss from the screed and hence the shrinkage which is associated with moisture loss. Curing therefore delays that shrinking process whilst allowing the tensile strength to build up to resist the forces induced by shrinkage. To prevent cracking, the rate of build-up of tensile strength (and bond strength in the case of bonded screeds) needs to be faster than the build-up of internal shrinkage forces - proper attention to the curing process enables this to be achieved.

It is particularly important in hot or windy conditions as loss of moisture from the surface can be very rapid in the early stages.

Curling of a screed at its edges is likewise associated with shrinkage of the screed. In curling the upper surface of the screed dries out too rapidly in relation to the bottom of the screed. The high tensile forces so induced in the surface of the screed will cause the edge to curl upwards. Theoretically, once the moisture content has become uniform throughout the depth of the screed, the curl should disappear; however this does not always happen in practice or will take longer than the building programmes will allow, so that corrective measures need to be taken.

### 2.7.3 Joints

Formed daywork joints are simple butt joints in the screed.

Bay joints can either be cut out by trowel during the laying process or saw-cut as soon as the screed is hard enough to walk on.

It is important that ample provision is made at screed perimeters to isolate walls, door thresholds, columns, manholes and other fixed building elements from contact with the screed. Isolation joints may be closed cell polyethylene joint strips (typically 10-20mm thickness) or may be formed with cut pieces of insulation board.

## 2.8 Damp proofing

Cementitious screeds, like concrete, do not need protection from damp in order to maintain their integrity. However, calcium sulphate screeds must be protected from damp otherwise when wet or damp they will lose their integrity. The same applies to many floor finishes, adhesives and levelling compounds.

Ideally there should be a fully working dpm under the main concrete slab but where this does not exist or where the time for the slab to dry out sufficiently is longer than the building programme can permit, a dpm can be included either above or below the screed. If under the screed this is normally a polythene dpm so the screed is then an unbonded screed, whereas if the dpm is on top of the screed an epoxy-type dpm is used. In both cases the surface on which the dpm is laid needs to be as smooth as possible. If the surface is rough, a smoothing/levelling compound may be used providing it is specifically designed to retain its integrity indefinitely in wet or damp conditions. NB. some epoxy dpms are in practice only a moisture suppressant rather than damp proof membranes. These should only be used where there is a fully functioning dpm in the construction. Surface dpms should not be used above a calcium sulphate screed.

## 2.9 Tolerances and surface regularity

On large floors such as warehouses, a tolerance of  $\pm 15$  mm on the level of the surface at any point relative to a fixed datum may be acceptable but such a tolerance may be unacceptable on smaller floors. If this is the case then the designer must make this clear in the information passed to the screeding contractor.

Surface regularity is the 'waviness' or 'flatness' of a floor surface. It can be thought of as the size and depth of puddles should the floor ever become flooded. It is measured by placing a 2 m long straight edge on the floor and measuring the maximum gap under the straight edge between the points of contact with the floor. NB. not at the ends beyond the points of contact.

SR1	Should be specified where flatness is critical, eg high bay warehouses or television studios
SR2	Should be specified for normal commercial situations, eg shops, hospitals, schools, offices
SR3	Should be specified for domestic situations or where surface regularity is not critical to the use of the floor.

NB. insistence on higher standards of surface regularity than are necessary will result in higher costs.

## 2.10 Protection and curing

Curing of a screed is an important stage in its construction and the time required for this needs to be incorporated in the building programme. The designer should inform the screeding contractor what type of finishes are to be applied to the screed as this may affect the choice of curing method, i.e. whether to use spray-on curing membranes or polythene sheeting. If spray-on membranes are to be used, the designer should specify when and how they are to be removed to allow normal drying out to proceed and also to ensure that any bonding needed to fix floor finishes is not impaired.

The screed should be protected against abuse from following trades.

Providing the surface of the screed is free to allow passage of the entrapped moisture, and providing the ambient conditions comply with "Ideal Drying Conditions" (i.e. <60%RH 20°C, it will take approximately 1 day per mm thickness up to 50 mm for cementitious screeds and up to 40 mm for calcium sulphate screeds. For thicker screeds and where the base concrete is itself damp when the screed is laid, significant additional time will be required in order for the construction to dry out sufficiently to allow moisture sensitive adhesives to be used. BS8204 Part 1 gives further advice on this matter. Floors should be tested prior to application of adhesives. In the United Kingdom the most commonly approved method of testing the dryness of the base, prior to the installation of floorcoverings, is with the surface hygrometer box. Full details of the instrument and method of operation are given in BS5325,



BS8203, BS8201 and BS8425. Briefly, the hygrometer measures the equilibrium relative humidity of a pocket of air trapped above the slab/screed for the duration of the test using an insulated impermeable box, which can be sealed to the floor surface to create an enclosed pocket of air which is isolated from the humidity and fluctuations in temperature of the outside air. It is essential that this is sealed to the floor using a preformed butyl sealant tape and that readings can be taken while the apparatus is in position on the floor without breaking the seal and releasing the trapped pocket of air. If underfloor heating or other artificial drying aids are present in the base, these should be switched off 96 hours prior to any hygrometer test being carried out.

Some proprietary screeds may require less curing time, seek manufacturer guidance.

## 2.11 Testing

The designer should specify what, if any, tests are to be carried out after laying the screed. 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:

### 2.11.1 Surface regularity - for all screeds

Tests are carried out using a 2 m long straight edge resting on the floor surface. Measurements are taken of the gap under the straight edge between points of contact with the floor. NB. not at the ends of the straight edge, using an appropriate means of measurement. This is often a calibrated wedge which is slid into the gap.

Acceptance requirements for surface regularity are:

SR1 3 mm maximum

SR2 5 mm maximum

SR3 10 mm maximum

### 2.11.2 In-situ crushing strength - cementitious levelling screeds

This test is also known as the BRE drop hammer test, the acceptance category is found in the table under 2.11.5.

### 2.11.3 Floor usage

Heavy heavy foot traffic and/or heavy trolleys or where any breakdown of the screed would be unacceptable, e.g. hospital operating theatres, X-ray rooms.

Medium medium/heavy foot traffic and/or medium weight trolleys, e.g. public areas, restaurants, schools, retail outlets.

Light light foot traffic and light trolleys, e.g. domestic, light office use.

### 2.11.4 Floor covering thickness

Thick 20 mm timber block flooring, 16 mm ceramic tiling, 20 mm natural stone or 28 mm terrazzo tiles.

Medium 9 mm ceramic tiles in adhesive.

Thin thermoplastic sheet/tiles, carpet.

### 2.11.5 Acceptance limits

	Bonded/Unbonded	Floating
<b>A</b>	3 mm	3 mm
<b>B</b>	4 mm	4 mm
<b>C</b>	5 mm	2.5 mm (2.5 kg weight)

NB. All except Category C for floating screeds use the 4 kg weight for testing.

### 2.11.6 Bonding test - bonded screeds (both levelling and wearing)

This is also known as the tapping test. This is carried out using a light hammer, dropping a steel ball (approx 25 in diameter) or a special tapping device. Bonded areas make a distinct sharp sound compared to the dull low frequency sound when bonding has failed.

Bonded screeds should be fully bonded but should be noted that a full bond cannot be guaranteed above 40mm.

#### 2.11.7 Slip resistance - wearing screeds

Slip resistance tests should be carried out using either the Ramp/Trolley test aka SlipAlert, or using a TRL Pendulum Slip Resistance test machine. Tests are normally carried out in both wet and dry states.

Acceptance limits:

Dry	40 PTV (Pendulum Test Value) 0.4 Coefficient of Friction
Wet	If the floor is likely to get wet in normal use or is regularly washed without it being possible to prevent its use during those times, the acceptance limits are as per 'dry'. If the floor is rarely wet or may suffer only an occasional wet spillage, a lower value of PTV is often acceptable, but the end user/client should be informed of that value for use in slip risk assessments.

#### 2.11.8 Moisture Testing

Floors should be tested prior to application of adhesives. In the United Kingdom the most commonly approved method of testing the dryness of the base, prior to the installation of floorcoverings, is with the surface hygrometer box. Full details of the instrument and method of operation are given in BS5325, BS8203, BS8201 and BS8425. Briefly, Providing the surface of the screed is free to allow passage of the entrapped moisture, the hygrometer measures the equilibrium relative humidity of a pocket of air trapped above the slab/screed for the duration of the test using an insulated impermeable box, which can be sealed to the floor surface to create an enclosed pocket of air which is isolated from the humidity and fluctuations in temperature of the outside air. It is essential that this is sealed to the floor using a preformed butyl sealant tape and that readings can be taken while the apparatus is in position on the floor without breaking the seal and releasing the trapped pocket of air. If underfloor heating or other artificial drying aids are present in the base, these should be switched off 96 hours prior to any hygrometer test being carried out.

The surface hygrometer should be installed over an area of the base considered likely to be the wettest. To determine the wettest location a capacitance or RF moisture meter which provide a fast, but only approximate guide as per BS8201.

The Carbide Bomb (CM) Test is commonly referred to in specifications relating to floor screeds in the UK but is not recognized by British Standards as an approved method of testing.

The CM test involves removing a sample of the slab/screed with hammer and chisel and crushing using a mortar and pestle, then weighing the required amount and placing into an airtight chamber together with Calcium Carbide which, when in contact with moisture, produces acetylene gas. The higher the concentration of moisture the more gas is produced which is read as pressure from the devices gauge. Because calcium carbide reacts with free moisture only, the CM test will not measure chemically bound moisture within the sample, the test is ideal for certain, fast drying screeds which act by chemically binding the majority of construction moisture and therefore cannot be tested with relative humidity or electrical impedance devices which will give high results. Typical measurements which are specified/achieved with the CM test are:

Concrete/Sand Cement slabs/screeds  
2.5%CM without underfloor heating installed  
1.5%CM with underfloor heating installed

Anhydrite/Hemi-Hydrate screeds  
0.5%CM without underfloor heating installed  
0.3%CM with underfloor heating installed

#### 2.12 Underfloor heating

Heated levelling screeds are generally laid in conjunction with either electrical cable-type heating systems or hot water heating systems. These systems are normally proprietary systems which are laid on a layer of insulation resting on the concrete base. The insulating layer is 25 mm or more in thickness and is of the dense foam type in order to provide the necessary structural support to the screed above.

The thickness of a sand/cement floating levelling screed should be based on the cover to the pipes or cables and as recommended in Section 2.4. Some proprietary screeds and heating system manufacturers recommend less thickness. The danger with using thinner screeds is that heavy point or rolling loads can cause the screed to fail and a small island of screed to be pushed down into the insulation. Such failures are known as 'elephant's footprints'.

In all heated screeds the heating should not be turned on until the screed is cured and dried. They should then be heated up very slowly before being maintained at working temperatures for several days. The screed should then be allowed to cool down to room temperature before installing the finished flooring. The spacing and positioning of joints in heated screeds needs careful planning, since the screed is continually moving (or trying to move) in response to the alternating heating and cooling of the heating system. Pipes or cables which cross such joints must be designed to tolerate such movement without distress.

### 2.13 Thermal/Acoustic insulation

The insulation used for thermal or acoustic floating floors should be products which are specifically designed for use in concrete/screed floating floors and to support the compacted loads applied both during construction and service life. The thickness of such products will depend on the particular materials used, and reputable manufacturers publish data showing the insulation value which their products will achieve in this form of construction.

All these products should be laid close-butted on a smooth flat concrete surface, preferably one that has been power floated. Where the concrete surface is not smooth, a non-moisture sensitive cementitious levelling compound should be used to produce the required smooth surface.

## 3. APPLICATION

### 3.1 Information the Contractor needs

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

- Location of the project.
- Floor areas concerned.
- Type(s) of screed to be laid, i.e. levelling/wearing, bonded/unbonded/floating, cementitious/calcium sulphate/proprietary.
- Programme constraints.
- Relevant details of the concrete base.
- Preparation of the base surface to be carried out.
- Whether a new dpm is needed and how this is to be provided.
- If the floor is a floating floor, the type and thickness of the insulation.
- Type of underfloor heating if this is to be installed.
- Mix details of the screed + polymer type and content if the screed is a polymer modified screed.
- Design thickness of the screed and minimum thickness to be achieved.
- Details of services to be incorporated within the screed.
- Details of any reinforcement to be included within the screed.
- Joint details and locations.
- Type of surface finish required.
- Class of in-situ crushing resistance required.
- Class of surface regularity required.
- Details of curing to be carried out.
- Whether the contractor is to provide subsequent temporary protection for the screed surface.
- Details of any conformity testing to be carried out by the contractor.

### 3.2 Advice to be given to the Main Contractor or equivalent body:

- Flooring contractors must be informed if the screed is a calcium sulphate type due to incompatibility issues.
- The curing period is essential and no attempt should be made to remove the curing medium before the time stated or attempts made to accelerate drying during this time.
- After curing, normal drying out takes approximately 1 day/mm thickness. Refer to section 2.10.
- Protection on the screed surface will partially inhibit drying.

- Accelerated drying should be commenced slowly and not during the first week after curing.
- Screeds should not be loaded with stacks of materials for following trades. If this is unavoidable only one stack should be placed on any one screed bay and that in the centre of the bay.

### 3.3 Preparation of the base

#### 3.3.1 Bonded Screeds

Adequate adhesion of screeds can only be achieved when correct substrate preparation has been carried out. Finishing of concrete by trowelling, powerfloating or tamping may leave a layer of laitance (a relatively weak layer of hydrated cement) on the surface which must be removed; adhesion to laitance can result early failure of adhesion of floor screeds. The mode of failure is typically a breakdown of cohesion in the substrate at or close to the bond line and inspection of debonded mortars will reveal laitance and often parts of the concrete matrix adhered to the mortar. Some degree of surface texture is also required for adequate adhesion and mechanical preparation of the surface of the substrate will remove laitance and provide the required texture for good adhesion of screeds.

Captive shot blasting is the preferred method of preparation for application of screeds and toppings when the removal of laitance and provision of light to medium texture is required. Scabbling/planing produces a more heavily textured surface than shot blasting; surface texture can be influenced by the choice of attachment fitted to the drum of a planer. All loose materials must be removed by vacuum and the floor should be thoroughly cleaned before the screeding process commences.

#### 3.3.2 Unbonded and floating screeds

The base should smooth and clean, abrupt changes in regularity of the surface may affect the integrity of the screed. Repairs to the base should be carried out as required before proceeding. See also 3.5.2 and 3.5.3.

#### 3.3.3 Contaminated Substrates

Concrete contaminated by substances (such as acids) which weaken the concrete or are a barrier to adhesion should be removed, or in the case of heavy oils, the concrete should be degreased. Mechanical surface preparation alone may not fully remove these contaminants, which will either remain visible or they can be invisible but drawn up to the surface by capillary action when the substrate is coated. When there is clear evidence that mechanical surface preparation has not fully removed the contaminant or concerns exist about invisible deep contamination, it is often prudent to use a good quality industrial degreaser/oil remover to help breakdown the contamination. These products should be applied in line with manufacturer instructions, but the key is to always allow sufficient time for the product to break down the contamination. The treated area should then be washed down and potentially cleaned again using a pH neutral industrial cleaner to remove all residues. Sufficient drying time should be allowed prior to application of moisture tolerant products. Jet air drying systems are available to accelerate the drying process.

### 3.4 Preparation for Laying

#### 3.4.1 Bonded Screeds

Wetting of prepared bases is required to reduce suction, thus preventing loss of liquid from the priming slurry and extending the open time of the slurry primer; when porosity of the substrate has been satisfied, prepared bases should be primed with Portland cement/water slurry, Portland cement/polymer slurry or proprietary primer. When laying screeds on slurry primed surfaces, the screed must be applied to wet or tacky primer. Pre-wetting of the substrate is not required when resin based primers are to be applied. Pre-wetting of the substrate may not be required when flowing cementitious screeds are to be applied and diluted acrylic polymer is used to seal the substrate. When flowing cementitious screeds are to be applied to concrete surfaces which may be very porous, the use of a moisture tolerant epoxy primer should be considered instead of acrylic sealer/primer, to reduce the incidence of blow holes.

#### 3.4.2 Unbonded Screeds

Provision should be made at screed perimeters to isolate walls, door thresholds, columns, manholes and other fixed building elements from contact with the screed. Isolation joints may be closed cell polyethylene joint strips (typically 10-20 mm thickness) or may be formed with cut pieces of insulation board. The base should smooth and clean, abrupt changes in regularity of the surface may prevent free movement of the screed and cause cracks to occur. The screed must be applied to a suitable slip membrane such as polythene.

### 3.4.3 Floating Screeds

Provision should be made at screed perimeters to isolate walls, door thresholds, columns, manholes and other fixed building elements from contact with the screed. Isolation joints may be closed cell polyethylene joint strips (typically 10-20 mm thickness) or may be formed with cut pieces of insulation board. The base should be smooth and clean to provide a level bearing for insulation boards, abrupt changes in regularity of the surface may cause rocking or bridging of insulation boards. The screed must be applied to a suitable slip membrane such as polythene. Additional gauging liquid may be required in floating screed mixes to improve compaction when laying screeds on resilient surfaces.

## 3.5 Batching and Mixing

### 3.5.1 Cementitious Screeds

Cement binder should be Portland cement CEM II 42.5N, CEM II 42.5R or CEM I 52.5R. Aggregate should be 0/4mm washed sharp sand for sand/cement screed; a proportion of sharp sand may be replaced with single size aggregate, typically 5/10mm when fine concrete screeds are required. The quantity of clean water added should be sufficient for compaction of the screed mix and for hydration of the cement; when screeds are to be laid on resilient bases such as insulation boards, the screed mix may need to be wetter. When loose aggregates are used, water content may be variable and allowance for the water content of aggregate must be made when adding gauging water. Proportions of aggregate & cement for screed mixes are typically 1:3 to 1:4.5 by weight and materials should be batched by weight when possible. Batch boxes should be used when batching by volume; accurately proportioned materials are particularly important when polymers or fast drying additives are used.

Screeds must be mixed for approximately 3 minutes in a forced action mixer; pan mixers with static pans and rotating mixing blades such as Baron, or pan mixers with rotating pans and static blades such as CreteAngle are typical forced action mixers. Pumped screeds should be mixed with screed pump/mixers such as Mixokret for trowel screeds or Putzmeister SP11 series pump/mixers for flowing cementitious screeds. Free fall mixers are not appropriate for mixing of screeds, particularly when the screed mix contains additives or fibres. Screed components will not be fully dispersed in free fall mixers and balling of sand is common; workability is also likely to be affected.

The screed's workability can be checked by squeezing a handful of the mix with a gloved hand. If the consistency is correct the screed will form a moist cohesive ball when released; if it disintegrates the mix is too dry and if it drips water the mix is too wet. This is commonly referred to as the "snowball test".

### 3.5.2 Calcium Sulphate Screeds

Calcium sulphate screeds are generally manufactured and supplied by ready mix to BS EN 13892/BS EN 13813 and delivered to site by a truck mixer. Mortar design is used to ensure the screeds remains workable for a specified timeframe to allow for delivery, installation and finishing to be completed within this timeframe. Bagged screed systems are available for mixing on site, it is essential that the correct type of mixer is used to mix and pump the screed such as a Putzmeister, Brinkmann or Turbosol mixing conveying pump. The workability of the screed is checked by using a standard flow ring and plate. The screed flow value should be in accordance with the manufacturer's recommendations, with the test undertaken prior to installation and the results recorded.

## 3.6 Laying of the screed

Trowel applied screeds may be laid in strips by setting battens to the required level and spreading the mortar mix between battens, ensuring that a surcharge of material is placed to ensure that the correct level is maintained after the screed has been compacted and levelled with a screed board. Thicker screeds may be applied in two layers of equal thickness wet on wet to aid compaction. The first layer should be compacted and raked to provide a key for the second layer.

Thorough compaction of the screed either by heavy tamping or preferably by mechanical means is essential. A good test to check whether the screed has been properly compacted is to walk over it with flat soled shoes immediately after compaction. If properly compacted, only the faintest outline of the footprints will be visible.

If the laying process is interrupted, the first layer of screed should be removed and a day work joint formed. If mesh is to be laid it should be positioned in the middle third of the screed. Battens should be removed before laying an adjacent strip and if the edge of a strip is to be a day joint, the edge should be formed to a 90 degree angle. Trowel applied screeds may be finished with a steel or wood/plastic float depending on the required finish and/or further treatment required to the cured screed. Stress relief joints should be positioned across the width of bays to limit the length to width ratio of screed bays. Joints other than expansion joints may be cut with the edge of a trowel or by early age saw cutting, in both cases the cut should be approximately half the depth of the screed. Saw cutting should

be undertaken as soon as the screed has gained sufficient strength, to ensure that cracking is not initiated before joints can be cut.

Levels for flowable cementitious screeds are typically set out by setting pins in the floor. Flowable screeds should be applied by screed pump, although hand pouring may be acceptable for small areas. Several trial mixes may be required to establish the correct flow rate when using continuous feed mixers and the contractor should be satisfied that the mixer produces adequate dispersal of the components. Levelling of flowable cementitious screeds may be required and pin rakes are suitable for this purpose. Entrained air should be expelled by spike rolling or for thicker screed a floating tamping bar may be used, this should be done before the screed has begun to gel, to avoid leaving marks from the spike roller in the surface. Shrinkage of flowable cementitious screeds is often low or very low and bay sizes may be larger but attention should still be given to bay proportions, to reduce the risk of stress relief cracking. Most flowable cementitious screeds are fast curing and application of a curing agent or polythene is not appropriate; screed surfaces should not be exposed to direct sunlight or drying winds for at least 24 hours.

### 3.7 Reinforcement placing

#### 3.7.1 Sand/cement and polymer modified cementitious screeds

Reinforcement for crack control may be short strand polypropylene fibres or steel mesh. Steel mesh should be D49 sheet (not wrapping grade) or A98.

Short strand polypropylene fibres should be added to the screed mix at an equivalent rate of approximately 910g/m<sup>3</sup>; mixing should continue until uniform dispersion of fibres has been achieved. Steel mesh reinforcement may be required at day joints. Steel mesh should be placed in the middle third of the screed thickness. Steel mesh may not be the most appropriate form of reinforcement for thin screeds where overlapping sheets of mesh cannot be contained within the middle third of the screed. Approximately half the thickness of the screed should be laid, compacted and raked before application of mesh reinforcement, sheets should be overlapped at joints by 150mm approximately. The upper layer of screed should be applied wet on wet to the base layer, if the base has been allowed to dry, the raked surface of the base layer should be slurry primed before application of the upper layer. Steel mesh must not span expansion joints. When mesh is required for structural purposes, the reinforcement should be designed by a structural engineer.

#### 3.7.2 Pumpable self smoothing cementitious screeds

When reinforcement of self-smoothing cementitious screeds is required, alkali resistant glass fibre mesh may be applied to the prepared base, or prepared and primed base, before application of the screed. Some pumpable self-smoothing cementitious screeds are supplied already reinforced with polypropylene fibres.

### 3.8 Joints

#### 3.8.1 Sand/cement and polymer modified cementitious screeds

Contraction joints/ stress relief joints may be cut with the edge of a trowel or by early age saw cutting. Saw cutting should be undertaken as soon as the screed has gained sufficient strength, to ensure that cracking does not occur before joints can be cut. Care should be taken when saw cutting screeds with mesh reinforcement, pipes, conduits or heating pipes to ensure that these elements are not damaged in the process. Edges of day joints and expansion joints should be formed to a 90 degree angle. Formed edges must be protected against damage by site traffic. When applying screed against an existing bay edge, the edge should be primed to provide good adhesion.

#### 3.8.2 Pumpable self smoothing cementitious screeds

Formwork used for joints must form a vertical edge to screed bays and be grout proof to avoid plastic settlement cracking. Formed edges must be protected against damage by site traffic. When applying screed against an existing bay edge, the edge should be primed to provide good adhesion. Early age saw cutting may be acceptable but should be undertaken as soon as the screed has gained sufficient strength, to ensure that cracking does not occur before joints can be cut and in the case of rapid hardening screeds, cutting may need to be carried out on the same day as the screed is laid.

### 3.9 Finishing

#### 3.9.1 Sand/cement and polymer modified cementitious screeds

Trowel applied screeds may be finished with a steel or wood/plastic float depending on the required finish and/or further treatment required to the cured screed. A wood float finish will improve slip resistance of the screed.

Regular cleaning of the float is required, particularly when applying polymer modified screeds, to remove the sticky film of paste. Trowel finishing should be limited to producing a level and defect free surface; a patchy appearance may be produced by over-trowelling and a polymer rich mix may become increasingly difficult to finish when overworked.

### 3.9.2 Pumpable self smoothing cementitious screeds

Trowel finishing of self-smoothing cementitious screeds is not required. Levelling of flowable cementitious screeds may be required and pin rakes are suitable for this purpose. Entrained air should be expelled by spiked rolling or for thicker screed a floating tamping bar may be used, this should be done before the screed has begun to gel, to avoid leaving marks from the spiked roller in the surface.

## 3.10 Curing, drying, protection

### 3.10.1 Sand/cement and polymer modified cementitious screeds

The initial curing period is typically 7 days for a sand/cement screed and 1-3 days for polymer modified screeds; the advice of manufacturers should be sought when rapid strength gain or rapid setting/drying screeds are laid. Polythene sheet should be sealed at perimeters, particularly if construction is not complete, to prevent passage of air under the sheet. Curing agents may be applied earlier than sheet membranes but when floor finishes are to be applied to the screed, they should be removed after the initial curing period to allow the screed to dry and ensure that they do not form a barrier to bonded floorings. After initial curing screed should be allowed to dry at ambient temperature, forced drying of screeds is not recommended until cement has adequately hydrated, typically 28-56 days for sand/cement screeds depending on curing temperature. Refer to the manufacturer for advice about drying of polymer modified screeds or screeds containing fast drying additives when dehumidifiers are to be used, or when underfloor heating is to be commissioned. Materials must not be stored on the screed until the screed is sufficiently dry for application of the specified flooring and after this drying period the floor should be protected as required against damage by following trades.

### 3.10.2 Pumpable self smoothing cementitious screeds

Most flowable cementitious screeds are fast curing and application of a curing agent or polythene is not appropriate; screed surfaces should not be exposed to direct sunlight or drying winds for at least 24 hours. Materials must not be stored on the screed until the screed is sufficiently dry for application of the specified flooring and after this drying period the floor should be protected as required against damage by following trades.

## 3.11 Testing, Inspection and Repair

Testing should be conducted on a properly considered basis in respect of the final use of the floor, its size, sampling theory, and agreement as to the percentage of 'failures' allowed and the absolute minimum value those failures should achieve. After completion of the installation, the finished screed is normally inspected for the following properties where relevant.

### 3.11.1 Surface Regularity

This should be appropriate to the intended use of the screed. The classifications of surface regularity and the test method, which uses a 2-metre straightedge, are described in BS 8204-1 *Concrete bases and cementitious levelling screeds to receive floorings*.

### 3.11.2 Adhesion of bonded screeds to the base

This is assessed by tapping the surface of the screed with a rod or a hammer. A hollow sound indicates poor adhesion but does not necessarily mean that the screed is unfit for purpose, unless it also exhibits visible lifting. **Note:** Full adhesion of screeds cannot be guaranteed, especially if they are applied above 40 mm thickness.

### 3.11.3 Curling and lipping of unbonded and floating screeds

These are more likely to occur in unbonded or floating screeds than in bonded screeds, but are only of concern if the screed has lifted at joints and cracks to such an extent that there is a risk of failure when subjected to loads in use.

#### 3.11.4 In situ crushing resistance

This test, also known as soundness, gives an indication of the degree of compaction of the screed and is carried out using a BRE screed tester (also known as a “drop hammer”), by dropping a weight four times onto a steel anvil resting on the surface of the screed. The depth of the indentation caused by the impact is then measured with a bridge micrometer.

The classes of in situ crushing resistance required will depend on the floor covering thickness and the intended end use of the area, and are described in Table 2.11.5 and BS 8204-1.

#### 3.11.5 Cracking

As noted in section 2.7.2, shrinkage cracking may occur as the screed dries and will be more likely to occur in unbonded or floating screeds than in bonded screeds. It is usually only of concern if there is significant associated curling or if the cracks exceed 2 mm in width. Proprietary resin-based repair materials are available to “stitch” static cracks in these circumstances. Such crack repairs may also be considered necessary if the area is heavily trafficked or if the screed contains underfloor heating.

#### 3.11.6 Slip Resistance

Screeds that are intended to be used as a wearing surface require an appropriate degree of slip resistance, which should be measured either by the Ramp/Trolley method aka SlipAlert as described in BS8204 Parts 2-6, or the Pendulum as described in BS7976-2.

### 3.12 Preparation for subsequent floor finishes

Once the screed is dry and strong enough, prepare the surface mechanically and remove all residues to leave a dry and dust free open textured surface. Refer also to the FeRFA Guide to Preparing Substrates to receive Resin Flooring and Finishing of Resin Terrazzo Systems.

## 4. REFERENCES AND FURTHER READING

BS EN 13813: Screed Material and Floor Screeds

BS EN 13892: Methods of Test for Screed Materials

BS 7976: Pendulum Testers

BS 8201: Installation of Flooring of Wood and Wood-Based Panels

BS 8203: Installation of Resilient Floor Coverings

BS 8204: Screeds, Bases and In Situ Floorings

BS 8425: Installation of Laminate Floor Coverings

This is the fifteenth 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](http://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.