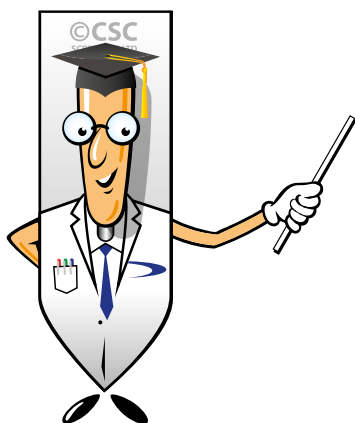


**Why screed testing
can save your project
time and money...**





NOBODY wants delays on their projects; especially delays that can be easily prevented or avoided. Floor screeds are some of the most important yet overlooked components of construction projects. Ensuring that screeds comply with project specifications relating to moisture, surface regularity (SR), departure from datum, and compressive and flexural strength is critical to project success. The easiest way to avoid screed problems and their consequences is to inspect and test screeds in a timely, professional manner.

Faulty screed is easy to lay and hard to spot. But the impact is far reaching, leading to the postponement of different project phases, extra costs and, ultimately, a dissatisfied client.

The most common screed problems and underlying causes

Delivering a flawless screed is the objective of any screeding project. But as many variables affect the quality of the screed installation, ignoring them will negatively impact expected project deliverables. Since a poor-quality sub-floor is unacceptable, identifying and correcting problems in screeds, *before* laying the final floor finish is key in any screeding project.

Typical screed problems include cracking, curling, debonding, softening, and crumbling. In most cases, screed failure can be traced to one or more causes, ranging from *excessive moisture* and *inadequate specifications* to *wrong material selection*, *insufficient or lack of protection*, and *incorrect screed applications*.

Excessive residual moisture can lead to some serious problems with the floor finishes, including swelling, cupping, bubbling, delamination in floors, adhesive degradation further causing the floor to debond from the screed, mould growth, and structural damage. It is therefore very important to ensure that the screed is dry enough before installing the final floor finish. To get a perfect screed, *optimum* temperature, relative humidity, and ventilation must be provided.

Inadequate or inaccurate project specifications may refer to incorrect proportions, mixing techniques, and drying times along with acceptable limits relating to moisture content, surface regularity, departure from datum, and compressive and flexural strength of screeds. Additionally, contractors may misunderstand project documentation, making wrong assumptions and applying incorrect specifications that will lead to screed failure. To ensure that all specifications are correct, the architect or engineer should work closely with the building and screeding contractors in drawing up accurate project specifications. Here are a few more points to bear in mind:

- Finished screeds must comply with the surface regularity specifications provided by the floor manufacturer for each type of flooring;
- Screeders must double check project documentation regularly to ensure that the latest specifications are followed;
- Builders and screeders must take into account the type of screed along with curing and drying times prior to setting project timelines.





Wrong material selection will be down to specifications, which should be reviewed and jointly agreed as fit for the purpose. If screeders use low-grade cements and inappropriate aggregates or admixtures, screeds will be of inferior quality, cracking, curling, or debonding from the concrete slab; they can also crumble due to excessive compression resulting from heavy loads and traffic. In addition to material selection, standard mix ratios and mixing techniques should be carefully considered. Complying with standard ratios and opting for the most appropriate screed mixing technique, such as forced-action mixing, is critical to obtain a workable, high-quality mixture, which will turn into a flat, solid, durable sub-floor once fully dried.



Insufficient or lack of protection can cause damage to traditional sand-cement screeds. If traffic is allowed before the screed has attained adequate strength, it may affect the performance of the screed, and require extensive repairs causing significant down time, and void warranty agreements, which means higher repair costs. It is also imperative to know that there is a difference between *screed drying time* (the period of time required until screeds can take on final floor coverings) and *walk on time* (the time until light foot traffic can proceed). Screeds do not gain strength by drying, but by setting. For example, special screed formulations can set to accept light foot traffic as early as 12 hours, even though they take 3 days to dry completely. Setting times depend on screed mixture, thickness, and site conditions, including temperature, relative humidity, and ventilation. Though it should be noted that screed reaches its final strength in 28 days.



Incorrect screed applications mainly refer to using the wrong type of screed for a certain project. For instance, anhydrite screeds, which are incompatible with the cementitious adhesives used for permanent fixing of tiles, must be sanded and primed appropriately prior to laying ceramic flooring. If adhesive is applied directly onto the screed, it will eventually separate from the base, causing the tiles to come off. Additionally, traditional sand-cement screeds are inappropriate for use in industrial settings, especially if they must withstand heavy loads. In this case, the best screed mixtures are the ones that contain special aggregates and admixtures, which enhance the compressive and flexural strength of the screed.

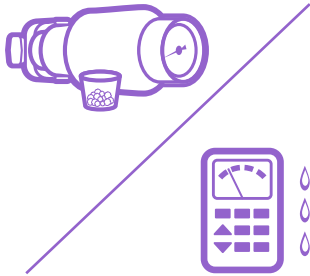
Floor screeds: testing methods

Whilst some screed problems, such as cracking and curling, are visible, others are not (e.g. screed debonding from the concrete slab). Even a perfect-looking screed can debond from the substrate and crumble under heavy loading. To avoid costly screed failures at a later stage, testing screed quality below the surface is of the utmost importance.

After 14 days of screed installation, contractors can test the screed layer to ensure that it has developed appropriate compressive (C) and flexural (F) strength, and is level enough to take on the final floor finish. To save clients a considerable amount of time and money in labour costs, effective screed testing should focus on specific screed properties, such as *moisture content*, usually affecting bond strength, *surface regularity*, and *in-situ crushing resistance* (ISCR).

To verify whether or not screeds comply with project specifications, screeders can use a series of tests, such as the calcium carbide method, *Tramex meter*, *laser level surveying*, *surface regularity tool*, and *BRE drop hammer test*.





Calcium carbide test versus Tramex meter

Residual moisture can cause many problems in all types of sub-floors and floor coverings. According to experts, moisture content in non-heated cement-based screeds should be less than 2%, whilst in heated cement-based screeds should be kept below 1.8%. Additionally, residual moisture levels should not exceed 0.8% in non-heated anhydrite screeds and 0.5% in heated anhydrite screeds. If the screed does not dry properly before the final floor is laid, the residual moisture trapped underneath will eventually rise to the surface, damaging the final floor.

Turning that around, high moisture content in screeds may require extensive remedial work later on, which translates into additional costs and more time needed to complete the project.

According to industry standards, the drying time for traditional screeds is 1mm per day up to 40mm and 0.5 mm per day thereafter. But predicting drying times accurately is impossible because specific factors, such as air temperature, relative humidity, air circulation, special aggregates and additives, and screed depth, can affect the drying rate of the screed significantly. Considering this aspect, testing screeds is critical to obtain a quality construction.

The *calcium carbide test* delivers an accurate gas-pressure test method, in which a small sample of screed – typically removed at 100% of screed thickness – is crushed into powder, mixed with calcium carbide, and then placed in a special test vessel. The vessel must be sealed and shaken for calcium carbide reagent to react to the moisture in the screed; as a result of this reaction, calcium carbide releases acetylene gas. A pressure gauge must be used to measure the pressure exerted by the gas; the readings from the gauge are expressed as a percentage.

The benefits of using calcium carbide test:

- This test provides *accurate, reliable results*, helping screeders determine the exact moisture content in screeds;
- Since no special preparations are needed (except for the screed, which must be crushed before being placed in the special vessel), the test is relatively *easy and quick* to carry out;
- The calcium carbide test implies using a small sample of screed; this means that only minor remedial work is necessary to replace the screed used as a sample.

Tramex meters are special electronic devices that use contact electrodes to assess the *surface moisture* content of screeds.

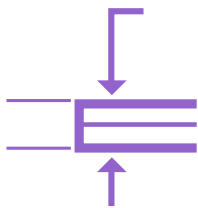
The benefits of using Tramex meters:

- Tramex meters allow screeders to perform *non-destructive, instant measurements* of the surface moisture of screeds;
- They have *different settings*, which can be used to measure moisture content of screeds along with temperature, relative humidity, and dew point of the environment in which screeds are installed;
- Tramex meters also make available a *variety of scales* to suit the characteristics of different types of screed and can store up to *900 readings*, which can be downloaded to computers and included in different reports.



There also are a few considerable downsides to using Tramex meters:

- They cannot measure moisture content within screeds;
- Surface moisture measurement can be misleading because the surface may be dry, whilst the substrate is still wet;
- The readings from Tramex meters are less accurate than the readings obtained using the calcium carbide method; therefore, Tramex meters can only give an indication of moisture content in screeds, the calcium carbide method being typically used to confirm results.

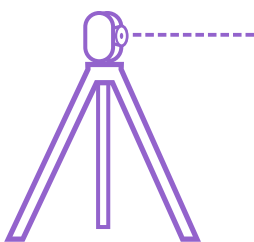


Laser level surveying

Departure from datum is another serious problem that may negatively affect construction projects. Although a departure of up to $\pm 15\text{mm}$ from the datum level (reference point) is considered acceptable in large areas, a deviation of $\pm 5\text{mm}$, and even $\pm 3\text{mm}$, can seriously impact the serviceability of a floor, especially in the close proximity to door openings or in areas where specialised, sensitive equipment is to be placed directly on floors (e.g. medical equipment).

If departure from datum exceeds maximum permissible limits, a few corrective measures (e.g. installing self-levelling compounds on top of the initial screed layer or replacing the screed with a new layer to ensure optimum thickness) can be applied. This type of remedial work requires extra money and time – two luxuries a builder may not have. To avoid costly repairs, it is important to assess departure from datum as soon as possible after installing the screed. This will allow contractors enough time to do remedial work prior to installing the final flooring.

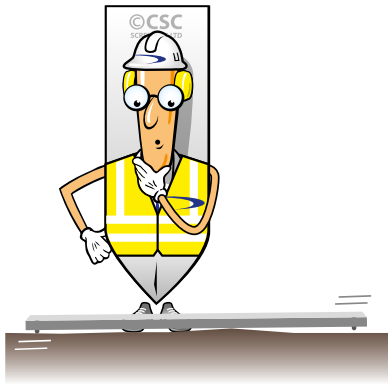
Combining an advanced laser beam projector with a tripod, the *laser level* emits a beam of laser light that can be rotated 360 degrees. A sensor installed on a surveying rod detects the laser beam, beeping continuously until the screeder adjusts the laser level so that the sensor makes full contact with the light. As soon as the sensor emits a solid tone, the screeder can use the readings from the surveying rod to determine deviations from the datum level.



Advantages of using laser levels:

- Since laser levels make possible *hands-free operations*, surveyors can perform any level surveying tasks easily and quickly, with fewer errors;
- Laser levels project a line over long distances and around the corners, allowing for more *complex, accurate measurements* of departure from datum;
- Laser levels can be operated by a *single surveyor*, who can walk around the screeded area and record multiple rod readings;
- A single laser level can be *combined with multiple detectors* so that data can be recorded by numerous surveyors simultaneously.



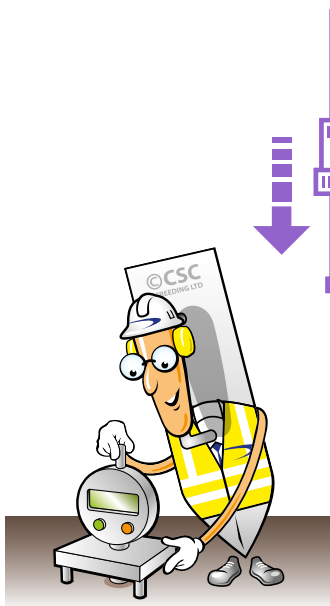


Surface regularity tool

Surface regularity (SR) impacts the way floors perform their desired functions, affecting not only productivity and maintenance costs, but also safety in certain areas. Variations in floor flatness can lead to impacts at high spots and excessive wear and tear of the final floor finish.

In the UK, surface regularity (SR) is controlled by British Standards BS8204-1:2003 and A1:2009. According to these standards, flatness tolerances from the underside of a 2m long straight edge laid directly on the screeded floor should not deviate more than 3mm in high standard floors (SR1), 5mm in normal standard floors (SR2), and 10mm in utility standard floors (SR3). Variations in floor flatness are measured with special devices (e.g. slip gauge) at points of maximum deviation from the straight edge.

Assessing surface regularity is very important in establishing whether or not screeds comply with project specifications. After measuring variations in floor flatness, contractors can determine if specific remedial work is needed for achieving finer tolerances.



BRE drop hammer test

The BRE drop hammer test is carried out to determine the soundness of screeds along with their likely performance in service. The test consists in dropping an annular weight of 4kg or 2kg that falls 1 metre on to a case-hardened steel anvil, which transmits 4 consecutive impact blows on the same spot. For an accurate assessment, a minimum of 3 tests should be performed within areas of 20-25sq.m.

The depth of indentation into the screed is usually measured with a digital depth gauge and compared to maximum permissible limits. In areas where heavy traffic and loading is expected, the maximum permissible depth of indentation is 3mm. (We recommend that the test results are compared to the project specifications and the final flooring requirement to ensure a quality floor. .)

On visual inspection, floor screeds may appear to be able to withstand any traffic and loads. However, using the BRE drop hammer test is imperative to ensure that screeds will actually perform according to specifications.

As many screed failures have been traced to excessive moisture content, poor compaction, low cement content, or levelness and flatness issues, testing screeds for each project is imperative to avoid costly flooring problems that may go undetected until the floor is in use.

Screed testing: a proactive strategy to prevent flooring problems

In most construction projects, flooring is designed from the concrete substrate upwards. Unfortunately, the biggest mistake most builders make is to select final floor finishes after the installation of screeds. Often, this leads to project failure, not necessarily due to screed issues, but due to the fact that each floor finish is different, imposing a certain type of screed and drying rate.

To prevent flooring problems, many screeders are now following a top-down approach to project planning, starting with the final floor finish and ending with the concrete slab. By knowing the type of floor finish that will be used in projects along with the final purpose of buildings or areas, screeders can contribute to project specifications, choose the right screed for each job, install screeds to the required depth, according to point loads, traffic, and heat output in underfloor heating, opt for the right testing methods, and take the necessary preventive measures to avoid expensive flooring disasters.



Screed Scientist is a free information centre available to the general public. Anyone, including builders and home owners, is welcome to read, distribute, download, and print our materials about underfloor heating and screed selection, installation, testing, and care. Our team not only documents and disseminates a variety of interesting and useful topics on floor screeding, but also has a flexible attitude and genuine commitment to helping people make informed decisions. To find out more information about floor screeding, we invite you to contact our friendly advisors, who are ready to answer any questions you may have.

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