WHITEPAPER

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Choosing and Installing the Right Underfloor Heating System

Central heating is a standard requirement in contemporary construction, and with the industry seeing an ever increasing focus on comfort, many developers are turning to underfloor heating (UFH) systems to meet the needs of both new-build and refurbishment projects. This popularity is borne out by the fact that UFH is the fastest growing sector within the heating industry thanks to its ability to deliver on both comfort and efficiency.

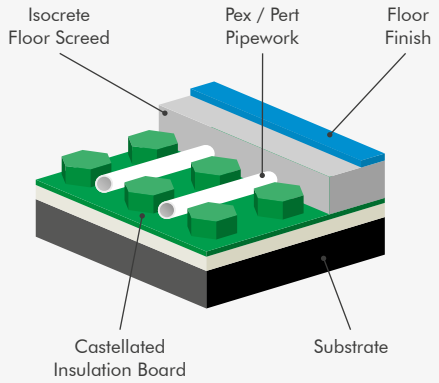
Underfloor heating is a system which achieves indoor climate control by circulating heated water or by placing electric cables through a floor medium such as screed, which in turn transfers radiant energy (heat) to create a pleasant ambient room condition.

The principle of UFH has been in place for centuries — in fact, the Romans circa 500 B.C. used heated floors and walls in many buildings. While the UFH principle is the same today, the advancement in technology, particularly with respect to UFH pipes but also in low temperature renewable sources, means UFH can be efficiently designed within the fabric of the building itself. This method results in an efficient and invisible heating system which self regulates to maintain an extremely high level of comfort for the end user.

Where Can UFH Be Installed?

The short answer is almost anywhere! Older restrictions relating to floor build up and minimum coverage of screed have been virtually eliminated as low profile systems have developed over the years. For example, depending on the insulation and acoustic requirements, it is possible to install the pipes of an UFH system on a castellated board in conjunction with a pump applied, self-smoothing floor screed at a nominal 40–50 mm build up.

Typical UFH System Section



It is however important to first determine if the UFH system currently specified is the most appropriate type for the task at hand. Be sure to consult the manufacturer to ensure that it will meet the project's requirements.

Different Types of UFH Systems

There are many types of UFH system on the market today and this section will focus on the most prevalent types — "in-screed" systems and "dry fit" (without screed) systems. Each of these types have different benefits and merits which makes them suitable for different scenarios.

All wet systems share certain commonalities, such as distribution manifold and UFH pipes. These components form the core of any wet system as the heated water is distributed from the manifold to the UFH circuits which will be balanced and commissioned to specific flow rates, ensuring that the design conditions are met.

"In-Screed" System

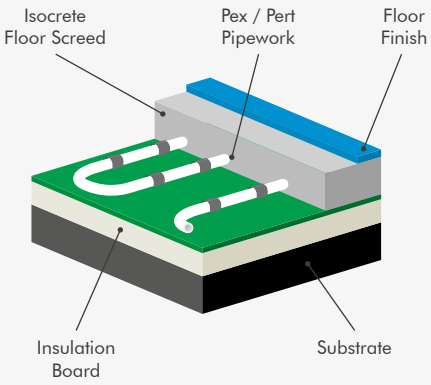
This system type is the most popular choice in today's UFH market. The installation will result in a surface level to SR2 or SR1 tolerance, and depending on the screed type and floor covering used it can also be fast acting and efficient. A typical ground floor section would include 50 mm EPS insulation with separating membrane, 16 mm or 20 mm UFH pipes and 65–75 mm of screed.

One of the main benefits of this type of system is the speed of installation, as the pipes are easily clipped directly onto the insulation. Depending on site conditions, it is possible for one team of installers to lay approximately 100–150 m^2 per day.

It is important that the screed is installed as soon as possible after the UFH system has been installed, tested and signed off. Quick drying screed options that use additives to produce an early drying, high strength screed are available that improve on the traditional sand and cement formula.

The CIBSE guide stipulates that most modern buildings have a typical maximum output requirement circa 60 W/m^2. Depending on the design conditions and floor build up, standard pipe in-screed UFH systems should be able to produce a maximum output circa 80–100 W/m^2.

Tackerboard Section



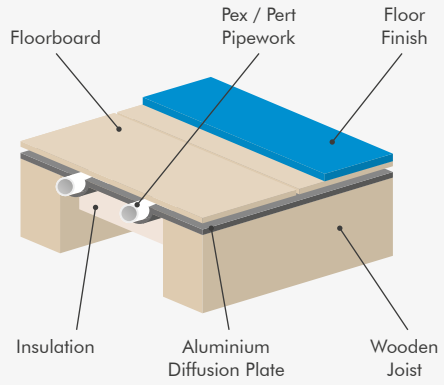
"Dry Fit" (No Screed) System

Where a levelling screed cannot be incorporated, such as an upper floor that does not have a load bearing capacity, then a "dry fit" system can be utilised. This allows UFH to be specified and installed in areas where screed cannot, keeping the continuity of a heating system as well as the end user comfort throughout the building regardless of other restrictions. Another relevant example would be when retro fitting UFH between joists, as the system can be installed between existing joists and will not raise the floor level.

The installation rates of a "dry fit" system are typically 50–80 m^2 per day. Whilst having no screed to cure can be advantageous, the flooring contractor still needs to install the floor

very quickly after the UFH has gone down, as the UFH system should not be left exposed to site conditions and other trades.

"Dry Fit" (No Screed) System

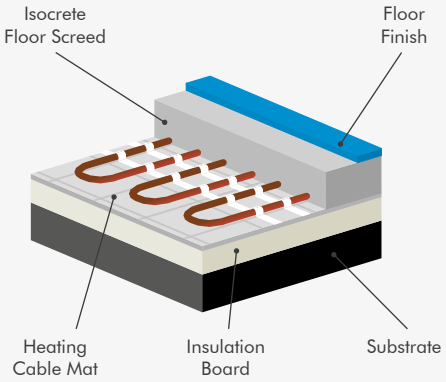


Electric UFH Systems

Previously electric UFH systems were inefficient and expensive but they have evolved over the years into efficient, fast responding systems. An extremely low profile combined with a fast reaction time can make electric UFH a great choice for wet rooms and single zone renovations.

The installation will involve either a cable clipped to insulation (in a manner virtually identical to the in-screed method) or a mat with prefixed cable that is laid to the full heated area. The main difference with electric UFH is that there is no distribution manifold, as the circuits are powered through the 240v thermostat. This makes electric UFH ideal for single room refits where a low temperature hot water (LTHW) source and manifold cannot be accommodated. Rates of install can vary from 50–150 m^2 per day depending on the system type and the site conditions.

Electric UFH System



Suitable Screed Types

Similar to the choice of UFH system type, the screed type must also be carefully selected based on the specific building and programme requirements. Some key considerations specific to UFH within screed are:

Floorzone Depth

One of the most important and primary considerations should be how much depth is there to select a screed and UFH system.

Most new builds will allow a typical 150 mm zone which lends itself nicely to a specification of 50 mm insulation and 70–100 mm of screed. Where this zone is reduced, typically for renovation/refurbishment projects, then a product such as a cementitious, pumped self-levelling screed should be specified.

As a general rule, lower profile systems will have a quicker UFH reaction time, but do not necessarily have higher outputs due to the maximum temperature restrictions that are outlined in BSEN 1264.

Structural Movement Joints

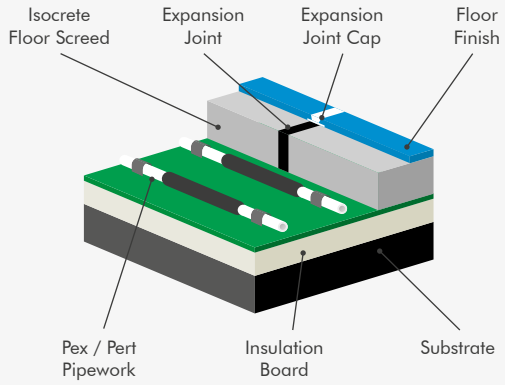
Where structural joints are shown, it is important to mirror this in the UFH and screed design. Where possible the UFH pipes should not cross

building movement joints as this movement can shear the pipes. If it is not possible to avoid crossing these joints, then it is important that the UFH pipes are protected sufficiently to allow for this movement.

Expansion Joints

While it is not necessary to protect the UFH pipes in the same way as with a structural joint, it is nevertheless advisable to be aware of expansion joints within the screed when designing the UFH system, especially if there are unheated areas adjoining heated areas. If a large enough temperature differential occurs this can thermally shock and ultimately crack the screed, therefore a thermal break and expansion will be required in this instance.

Typical Expansion Joint



Temperature

The UFH design and floor surface temperatures need to be carefully managed to ensure surface temperatures do not exceed the specified maximum, which is generally 29°C for most types but is reduced to 27°C for sensitive flooring materials such as timber or vinyl.

The floor finish and screed type have an inherent temperature resistance which needs to be accounted for when designing the system, for example liquid screeds have a typical thermal conductivity of 1.9 W/mK whereas sand and cement types are closer to 1.2 W/mK. This means that it is important that the specified screed type is not changed on site, as this can significantly affect the UFH outputs and performance.

Heat Up Cycle & Commissioning

Screeds with UFH must be commissioned prior to laying floor coverings, as any moisture within the screed cannot be released properly once floor coverings have been laid, which can in turn lead to an expensive failure of the floor covering. The heat-up cycle should follow BSEN 1264 and BSEN 8204 guidelines and take into account any specific requirements of the screed. For example, certain anhydrite screeds can use the UFH system to assist in the cure process but this needs to be managed carefully to avoid curing the screed too quickly.

Potential Floor Failures and How to Mitigate Them

Floor failures can come in many forms, from floor coverings de-bonding to excessive screed cracking and while it is not always clear, there is always a specific reason for why the failure has occurred. Vinyl debonding, for example, could be down to poor application of the vinyl from the flooring contractor, or it could be the result of a poorly designed UFH system that results in floor surface temperatures being consistently higher than 27°C. Perhaps it may be that the screed heat cycle has not been carried out thoroughly and the relative humidity level is above 75%, causing the vinyl to fail as the excess moisture leaves the screed.

As with the vast majority of failures in construction, floor failures are built in at the design stage. Often the fact that one contractor provides the heating system, another the screed and a third the floor coating means that the different components do not fit together properly and will result in a failure arising sooner or later.

Single-source floor build-ups are available, in which each element has been designed to work with all the other surrounding systems in order to negate the potential for ill-fitting components to cause problems. It is always advisable that, regardless of the number of contractors employed, the floor build up design takes into account all the relevant information and is designed appropriately.

When a failure does occur, it is important to identify and affirmatively rectify them. Sourcing each element from a single supplier means that when facing failures, the provider can quickly advise on the correct action to take in order to minimise client disruption. Build ups that rely on multiple suppliers can often face time delays while the various parties communicate and discuss the issue at hand.

Specification

It is absolutely crucial to specify the right UFH system(s) and furthermore to ensure that it will integrate well with other services. This is where there will be an overlap between the UFH specifying authority (mechanical & electrical consultant) and the architect, the dialogue here is crucial to ensure that all items are included and nothing is missed.

Certain aspects, such as floor coverings for example, can have a massive and direct impact on the UFH system performance and outputs. This is due to the fact that as floor covering resistance increases then the UFH system efficiency and outputs will reduce. For all these reasons the system specification must be bespoke and not copy paste.

A couple of key standards to be aware of during the specification process are BSEN 1264 for UFH systems and BS 8204 for screeds and the technical team should ensure that the project complies with the relevant British Standards and guidelines, such as BSRIA and CIBSE, at all times.

This guide has been produced to provide an overview on underfloor heating.

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