SEALING UNDER CERAMIC TILES AND SLABS

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Constructional components and buildings suffer considerable damage as a result of inadequate or non-existent protection against water. Interior parts of buildings that are exposed to moisture are usually covered with tiles or slabs. Ceramic tiles and slabs are moisture resistant and water repellent, however, owing to the joints such surface coverings are not impermeable to water.

The requirement and type of sealing in interior parts of buildings is currently a subject of controversy between specialists. This contribution *Sealing under ceramic tiles and slabs* describes various possibilities of sealing under tiles and slabs considering the different requirements in rooms exposed to moisture.

In addition to sealing with plastic sheeting or bitumen rolls, which are used for industrial and commercial applications but not domestically for constructional and economic reasons (owing to the construction height, for example), systems of sealing with mortar sealants are presented. In this latter case the thin bed adhesive for fixing the tiles is applied directly onto a thin layer of sealant. This sealant is generally made of synthetic/cement mortar, reaction resin or synthetic resin emulsion. When applying these sealants certain requirements must be observed especially with respect to the prevailing conditions. For example deformations and fractures as well as changes in temperature must to a certain extent be compensated for by the sealant. Despite the high demands put on these sealants not all surfaces are suitable for this type of sealing.

1. Principles of sealing

The purpose of sealing is to protect buildings or parts of buildings that are in themselves not watertight or moisture resistant against

- moisture
- non-pressurized water and
- pressurized water.

There is no doubt that the sealing of buildings is of great importance for maintaining the long-term functioning of a building or building complex. This is particularly evident from the widespread damage to constructional components and buildings which has resulted from inadequate or non-existent sealing.

When the seal of a building fails, regardless of whether it is due to planning deficiencies, incorrectly used materials or poor workmanship, the result is always constructional as well as economic damage. Such consequences can generally be avoided when all the involved parties agree on a technical concept in the early planning stages. Technical and economic optimization can only be achieved when the situation is considered as a whole.

Even ceramic tiles and slabs, which themselves are moisture resistant and water repellent, do not present an adequate protection against water owing to the joints between them.

This paper provides information to help avoid water damage occurring to constructional components and buildings that are covered with ceramic tiles and slabs.

2. The purpose of sealing and the stress put on seals

The areas of application of ceramic tiles and slabs are just as diverse as the ways to seal. Areas of application are to name just a few:

- wash and shower rooms in training establishments, industrial companies and sports centres
- swimming pools
- commercial kitchens, food and drinks businesses
- laundries
- wash rooms in hospitals and hotels as well as domestic bathrooms
- external walls, roof terraces and balconies.

The position of constructional components as well as use-related factors, such as the amount of water and how often it is used, are important for deciding what conditions the seal has to withstand. For example in domestic bathrooms the amount of water and frequency of use will generally be considerably less than in public shower rooms or in commercial kitchens. Owing to the different types of use it is not easy to make an unequivocal classification of stress related groups.

The German standard DIN 18195 «Sealing in buildings» differentiates for instance between moderate and high stress according to the amount of stress applied to the seal

resulting from traffic, temperature and water. Seals are moderately stressed when

- the traffic situation is quiet according to DIN 1055 Part 3 and the seal is not underneath a surface which is driven on
- the temperature variation at the seal is no more than 40 K and
- the amount of water is low and not continuous.

When one or more of these limitations are exceeded seals are regarded as being highly stressed.

When selecting the type of seal under ceramic tiles and slabs it is important to consider not only the water on the surface but also how moisture resistant the underlying material is. With wood and wooden materials in particular there is the danger that water, even indirectly, may cause an irregular moisture content in the wood which results in warping that cannot be compensated for by the rigid tile covering. Anhydrite screed, gypsum plaster and gypsum building boards are also moisture sensitive and require special sealing measures to be taken under ceramic tiles and slabs.

3. Demands on the sealing

The stresses to which the sealant is subjected can be found by considering where it is used. Consequently suitable sealants or systems can be chosen. When high stresses exist, for example in the shower rooms of public swimming pools and sports centres as well as in industrial installations such as cleaning plants and where the underlying material is moisture sensitive, sealing should generally be carried out with plastic or bitumen sheeting. These sealing systems provide protective layers on which the ceramic tiles and slabs are laid. Many years of experience has shown that if laid properly this type of sealing is very secure owing to the low fracture risk.

The second category of sealants used today, particularly with ceramic tiles and slabs, are the mortar sealants. These seals, after considering the underlying material, completely satisfy the requirements in domestic areas, i.e. in bathrooms, washrooms and on balconies. Nowadays they are being used successfully in numerous industrial applications. This system enables a composite layer to be built up with an integrated seal using the thin bed method

In practice when sealing under ceramic tiles and slabs there are two main problems:

- achieving sufficient water protection for underlying material that is moisture sensitive; this protection is necessary not only over the whole surface but also at the joins in areas liable to splash water,
- achieving a sufficiently watertight seal between the bathroom units (e.g. bath and shower base), taps and wall surfaces.

4. Sealing with plastic or bitumen sheeting

Generally this type of sealing consists either of two layers of bitumen sheeting with fabric inserts or of one single layer of soft PVC sheeting at least 1.5 mm thick. PVC sheeting must be laid between two protective layers, for example of soft PVC sheeting at least 1 mm thick or synthetic matting at least 2 mm thick and weighing 300 g/m^2. This method should be used for non-pressurized water, e.g. in areas liable to splash water in cleaning plants.

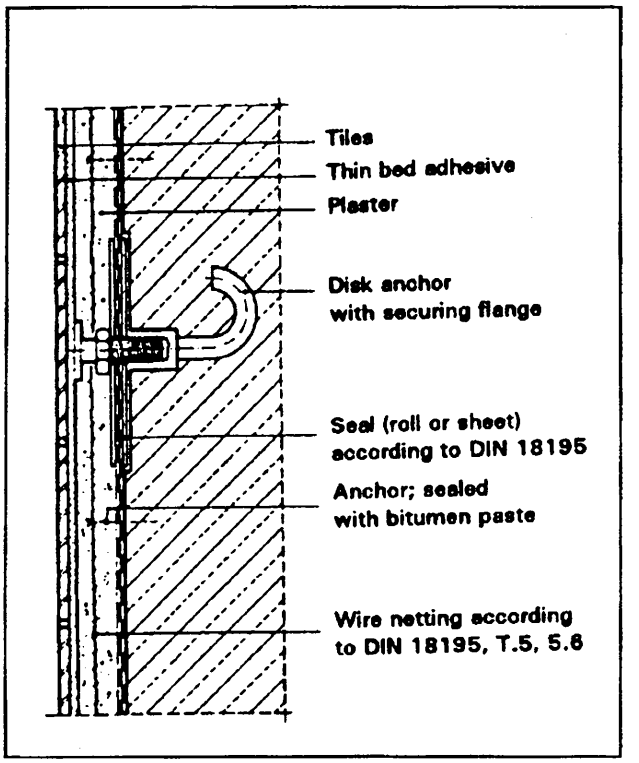

Fig. 1: Plaster and disk anchoring over seal according to DIN 18195

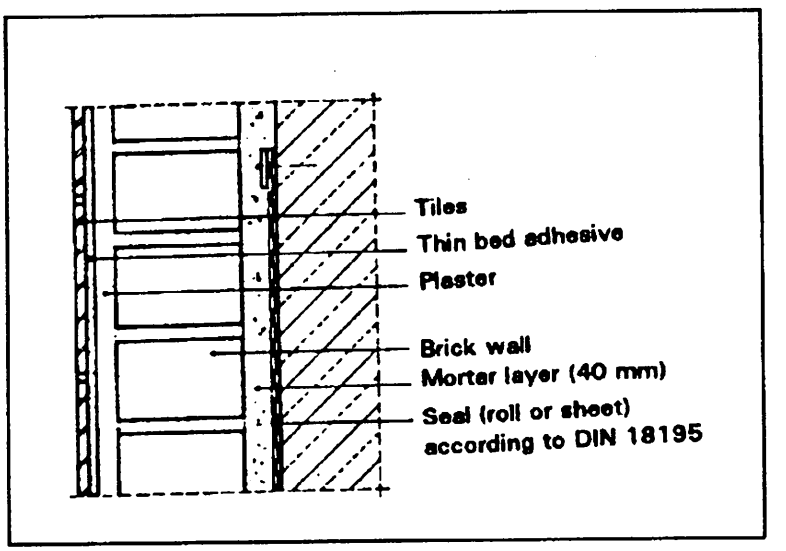

Fig. 2: Masonry wall in front of sealing according to DIN 18195

When the seal is to be made with sheeting the underlying material must be appropriately prepared. Masonry surfaces must be rendered with levelling mortar of group III (cement based). The surfaces of pebbly concrete walls must be levelled with mortar. On walls vertical seals must be fixed by clamp rails or other mechanical means so as to avoid the seal slipping. Ceramic tiles must not subject the seal to a load by their own weight parallel to the seal direction; lath work or self supporting walls with 11.5 cm thick bricks should be used in this case. A 40 mm thick joint between the seal and wall should be completely filled in with mortar The total thickness of the wall for this type of work is about 20 cm. These few details about sealing in wall areas indicate the quite complicated nature of this type of sealing.

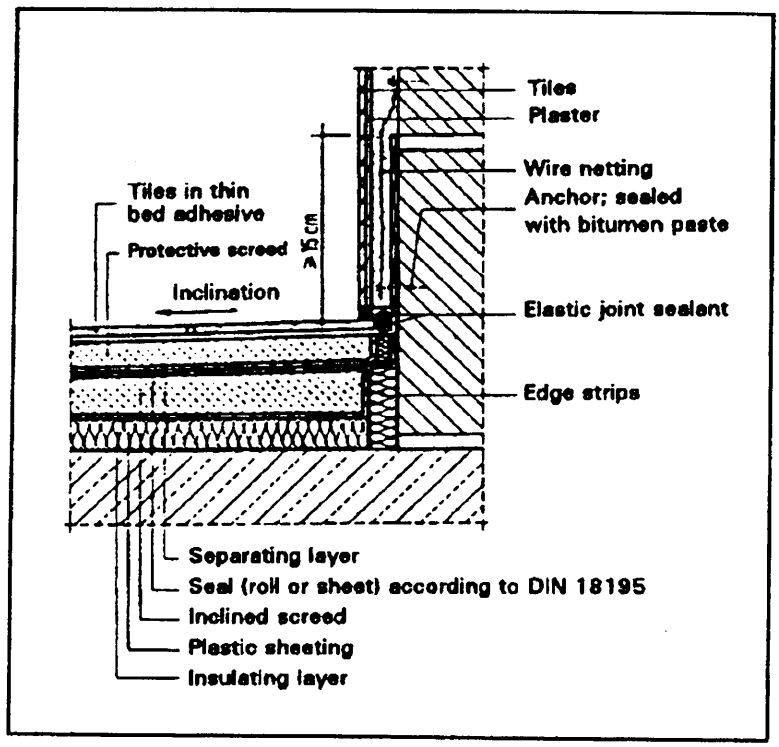

Fig. 3: Sealing according to DIN 18195 at the floor/wall transition

The examples show that sealing under ceramic tiles and slabs requires a multiple-layer system. Consequently if this type of sealing is to be successful it is absolutely necessary that the work is well planned and that all those involved from the planner to builder fully cooperate. This system is not described in greater detail as it is only of secondary importance in connection with ceramic tiles and slabs.

5. Sealing under ceramic tiles and slabs using mortar sealant

There is now an increasing tendency to fix ceramic tiles and slabs using the thin bed method. This trend is boosted by the fact that sealing with plastic or bitumen sheeting is complicated and often not justifiable for economic reasons. Consequently alternative sealing systems have been developed which can be applied to various types of base material. Such systems have been on the market since the beginning of the 1980s. The demands made on these products and how they should be used are given in two leaflets issued by the Association of the German Tile Industry in collaboration with the sealant manufacturers. One leaflet gives *Notes on how to seal indoors under tiles and slabs using mortar sealant*, whereas the second leaflet deals with *Testing sealants and sealing systems*. When sealing is performed according to these leaflets a surface of tiles or slabs laid in thin bed adhesive acts as a protective layer for the seal. For floor constructions with insulating layers the seal is laid directly on the screed. The required floor covering can then be laid on this in thin bed adhesive making thick layers unnecessary.

This type of sealing can generally withstand fractures in the underlying material of up to 0.2 mm as long as there is no vertical displacement.

The layering of this type of composite formation is basically as follows:

- underlying material, e.g. screed on screed on insulating layer
- approx. 2 mm sealant, e.g. synthetic/cement mortar mixture
- approx. 5 mm thin bed mortar
- approx. 8 mm ceramic tile.

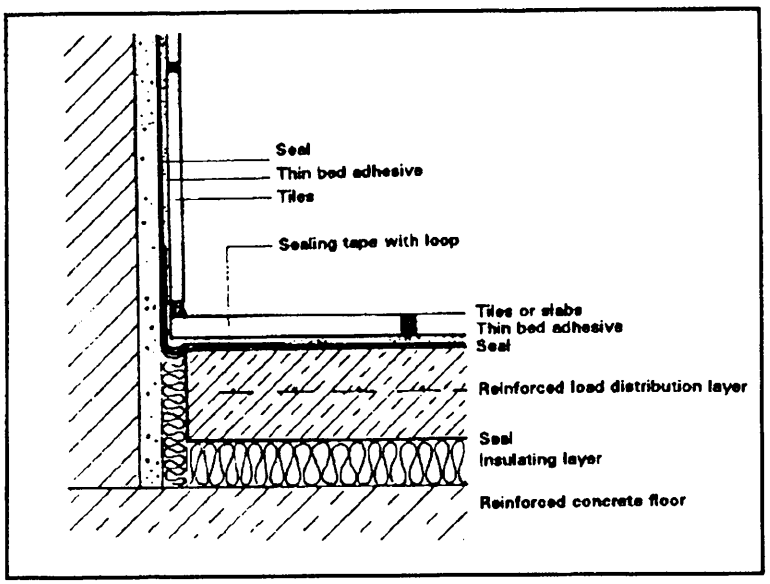

Fig. 4: Join at wall

Sealants are divided into the following groups:

1. synthetic/cement mortar mixture
2. reaction resins
3. synthetic resin emulsions;

and must have the following properties:

1. Adhesive strength 0.5 N/mm²
2. Temperature limit 60 K (+10 to 70°C)
3. Good durability
4. Resistance to lime water _ pH 12
5. Impermeable to water up to 1 bar
6. Ability to bridge fractures up to 0.2 mm with no vertical displacement.

The sealant manufacturer must provide proof according to the leaflet *Testing sealants and sealing systems* that these requirements are fulfilled. Only those sealants which fulfil all requirements may be correspondingly marked. A valid test certificate must be presented on demand.

Plaster of mortar groups PI, PIV and PV (lime, gypsum and gypsum plaster) are not suitable as base materials for sealants. Wood and wood materials are also unsuitable as bases for the reasons mentioned above.

Section 4 of the leaflet describes how to apply the sealant; it can be smeared, painted, rolled or sprayed on. Movement joints should be reinforced by laying matting or sheeting across them. The thickness of the sealant depends on its properties and must be given by the manufacturer. Sealing around holes and wall or floor installations is described in section 4.3 with reference to drawings.

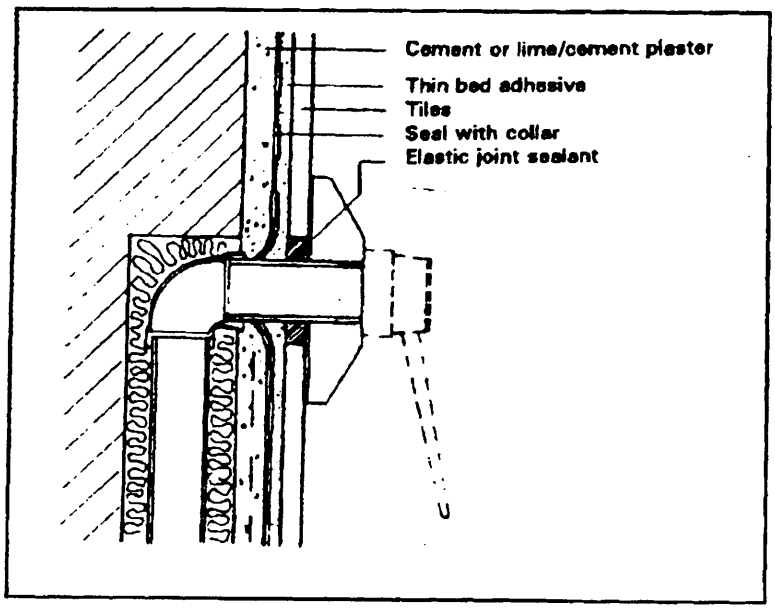

Fig. 5: Sealing around wall installations

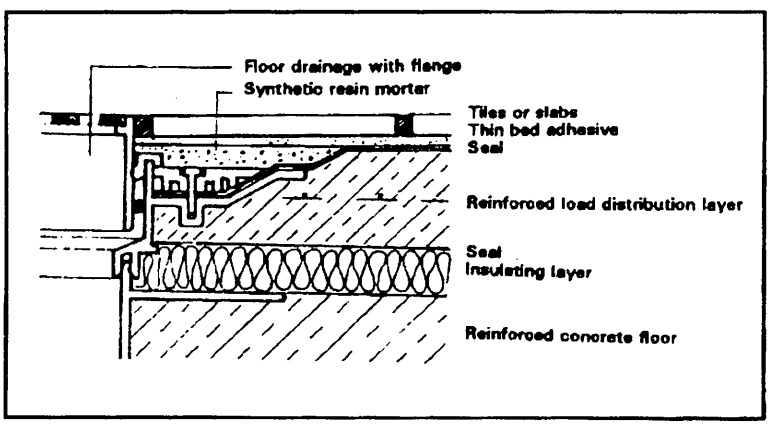

Fig. 6: Join at floor drainage

Flanges, collars or matting should be fitted around holes or installations to ensure a proper seal. Around floor drains the screed must first be chipped away to allow the seal to be joined up to the flange. The recess chipped out of the screed should be filled in later. If wall plugs are necessary they must be sealed with reaction resin or some other suitable substance.

Underneath and around shower units and baths it is recommended to seal the entire surface. Tiling should then be done later as a separate procedure. Further details as well as practical examples are given in the leaflets.

Product quality must be guaranteed at every manufacturing site through product control by the manufacturer and by third party quality controllers. Third party testing is to be made as part of a quality control contract with the third party being neutral and suitable for testing such products.

The third party tests once a year

- resistance to frost
- resistance to temperature changes
- resistance to chlorinated water
- water impermeability

and once every two years

- ability to bridge over fractures.

The results of third party testing are to be written down in a quality control report and kept for a minimum of five years. In this way it is possible to guarantee a consistently high quality sealant.

Summary

It has been shown that there are two fundamentally different ways for sealing under ceramic tiles and slabs. The type of sealing method to use depends essentially on the stress and the sensitivity to water of the underlying material. When the stress is high and the underlying material is sensitive to water, then it is recommended to seal with plastic or bitumen sheeting. This type of sealing requires multiple layers with protective sheeting and complicated sealing work, for instance around floor and wall installations and holes. Often, however, owing to constructional limitations, there is insufficient height or thickness to install protective layers. Moreover in a number of areas, for example in domestic houses, it is not practicable to seal with sheeting and economically not viable.

Sealing with mortar sealant under ceramic tiles and slabs is for numerous applications as good as sealing with sheeting from a technical point of view and superior from an economic standpoint. These sealants have been used not only for interior building work, but also successfully employed for exterior work on balconies and patios for instance. The continuous further development of the products especially over the past five years has contributed to improved safety for both user and builder.