

Guidelines

for manufacturing ceramic floor
coverings using the vibration process

Status: July 2005 (replacing the workmanship guidelines issued 4/99)

Published by:

Arbeitskreis Qualitätssicherung Ruettelbeläge (AK-QR)
(Research Group for Quality Assurance of Vibrated Coverings)

In collaboration with:

Untersuchungs- und Beratungsinstitut für Wand- und Bodenbeläge -
Saeurefliesner-Vereinigung e.V., Großburgwedel
(Testing and Advisory Institute for Wall and Floor Coverings -
Association of Floor Tilers, Großburgwedel)
- European Research Society -

RESEARCH GROUP "QUALITY ASSURANCE - VIBRATED COVERINGS"

Contents

- 0 Foreword
- 1 Definition & Scope
- 2 Brief Process Description
- 3 Composition of Mortar
- 4 Floor Covering Materials
- 5 Building Site Requirements
- 6 Supporting Substrate
- 7 Instructions for Workmanship & Laying
- 8 Movement Joints
- 9 Commissioning after Completion
- 10 Cleaning & Maintenance
- 11 Special Considerations
- 12 Quality Assurance
- 13 Quoted Standards & Publications

0 Foreword

These guidelines serve as instructions and requirements especially defined for laying ceramic floor tiles and slabs using the vibration process.

These guidelines are based on test runs regarding the material's technological specifications and technical workmanship and findings derived from these tests as well as systematically analyzed practical experiences in manufacturing coverings using the vibration process.

In this respect the guidelines represent the current state of technology in this area.

Continual tests and developments in this field help to further optimize the process and assure the high quality standard of ceramic coverings according to these guidelines.

1 Definition & Scope

These guidelines define the application of the vibration process to manufacture mechanically resistant and strong ceramic floor coverings especially for commercial and industrial areas. For example floor coverings in shopping centers, DIY stores, bakeries, car workshops and exhibition halls.

The vibration process is a modified thick bedding laying technique. The ceramic tiles and slabs are laid in a fresh cement-mortar bed and mechanically driven in. This results in a set of layers as a compact unit of ceramic covering materials and the bedding mortar.

Due to their comparably high bendable and pressure resistant features the ceramic tiles and slabs provide a load compensating function for the composite construction. Pressure and forces impacting the covering surface are reduced by being transferred to the bedding mortar carrying the ceramic covering.

The benefits resulting from an indirect and reduced strain on the bedding mortar layers below the ceramic coverings justify an adjustment of the requirements regarding the resistance features.

Thus, the defined resistance classifications for floor pavements according to DIN 18560 and the required resistance values for ceramic coverings on bedding mortar manufactured in a vibration process are suitable to only a limited extent.

The instructions following these guidelines serve as a basis for planning and laying.

2 Brief Process Description

After the ceramic floor tiles and slabs have been laid the previously laid bedding layers of mortar are mechanically and intensely compacted evenly with the help of surface vibrators (vibrating boards or vibrating rollers). The achievable resistance features of the bonding system and the even surface of covering surfaces generated as such are favourably influenced by this method.

In contrast to the traditional manufacturing process of manually tamping down tile finishes the vibration process provides efficient and optimized laying performance while generously bedding the ceramic floor covering materials.

3 Composition of Mortar

Mortar mixtures especially prepared according to defined formulas are used for the vibration process. They are manufactured by using additives in form of retarders and plastifiers to prolong the workability period and to achieve better manufacturing performance.

As a binding agent cement is used with a minimum strength of class CEM 32,5 complying with DIN EN 196 (Z 35 complying with DIN 1164). Only additives complying with DIN EN 12620 and DIN EN 13139 resp. DIN 1045 are to be used.

4 Floor Covering Materials

In general the following floor covering materials should be used:

- dry-pressed ceramic tiles and slabs complying with DIN EN 14411 - appendix G or H and / or
- floor clinker slabs complying with DIN 18158.

The lengths of floor tiles and slabs should not exceed 25 cm and the surface area should not be less than 650 cm². The thickness is to be selected depending on the required resistance and should not be less than 14 mm.

The thickness of ceramic tiles and slabs is significant for the mechanical resistance due to static and dynamic states of strain.

Apart from the resistance features varying by material a bigger thickness is favourable to the strength of ceramic tiles and slabs when being impacted by rolling or pushing strains. It also increases the loading capacity limit which evaluates the carrying capacity in terms of breaking load.

The breaking load of ceramic tiles and slabs should be adjusted to the conditions of strain in the respective areas of use, however should meet a minimum of 3000 N.

5 Building Site Requirements

Work must only be done if the temperature of the substrate, the material to be used and the working surroundings is not less than +5° Celsius.

Damaging affects caused e.g. by rain, draughts or sunlight are to be avoided.

6 Supporting Substrate

The substrate construction must be stable, able to support load, sufficiently dry, free of through-going cracks, dirt and loose constituents.

Its evenness must comply with DIN 18202.

Rooms which are subjected to moisture stresses are required to be sealed against ground humidity resp. water that is not under pressure. Reference is made to DIN 18195, DIBt-inspection law¹⁵, and ZDB instructions^{2*}. Thermal and sound insulation measures complying with DIN 4108 resp. 4109 must be provided under certain circumstances.

Should ceramic coverings be laid to gradients for liquid drainage it must be planned and provided by the substrate. In general even surfaces of floor tiles and slabs must be constructed to have a gradient of approx. 1 to 2 %. Greater gradients must be provided for surfaces which are profiled, structured or roughly textured.

The planning of gradients is to be co-ordinated with the company in charge.

7 Instructions for Workmanship & Laying

Ceramic clad surface coverings can be laid by bonding them directly onto the supporting substrate construction, separating or insulating layers.

The minimum thickness of the bedding screed should not be less than 40mm for directly laid coverings, for coverings laid on separating layers 60mm and for insulating layers 75 mm. In case of higher loads a structural calculation to define the thickness of the bedding mortar layer might be required for coverings with insulating layers.

In order to produce insulating layers the insulating materials must be laid by being tightly joined. The insulating boards must be arrayed by bracing and firmly laid fully covering the substrate.

For multi-layered insulation layers the joints must be laid against each other.

The insulation layer must be suitable for the expected load, the compressibility must not be less than 3 mm even in case of multi layers.

When laying for direct bonding sufficient strength of the substrate's surface must be given. Prior to applying the bedding mortar the accumulation of

binder must be removed without leaving any dust. Then the substrate must be pre-wetted and coated with a bonding compound. Any distortions and warping in the supporting substrate construction must have been extensively eliminated for this phase. As a rule such defects occur in concrete after approx. 6 months.

When laying onto separating or insulating layers the screed should incorporate reinforcement consisting of expanded steel lathing or concrete steel mats. The reinforcing mats must be laid on spacers and sufficiently overlapping. The reinforcement must not cover the movement joints.

As a rule the reinforcement is set in the middle of the cross-section and does not have any structural function, thus does not prevent cracks. However, it can reduce their width and a shift in height.

By using reinforcing fibers early contraction cracking can be reduced.

The strength of the hardened bedding mortar should comply with the following according to DIN EN 13813:

- when bonding at least pressure resistance class C16
- on separating layers at least pressure and bendable resistance class C 16/F3
- on insulating layers at least pressure and bendable resistance class C 25/F4.

In order to achieve resistance class C16/F3 the addition of cement, minimum 240kg/m³ of fresh mortar is required. Bedding mortar of higher resistance classes usually requires larger additions of cement.

Bedding mortar for the vibrating process can be mixed at the plant or on the building site by using a mechanical mixer.

Bedding mortar that has been mixed in such a way and contains the appropriate additives should be laid in a consistency of moist, loamy soil.

The bedding mortar will be pre-compacted and laid horizontally or according to pre-defined gradients.

On its surface the mortar is covered by a cement-enriched slurry layer or a cement-mortar mash (mixed on site or at the plant). In case of using cement the screed must be subsequently moistened.

In general, laying the ceramic surface covering is done by providing a closely spaced and bonded network of joints.

After the laying of the ceramic materials in the cement-enriched surface of the bedding mortar, it is compacted. The floor tiles and slabs are tamped down in the vibrating process by passing the surface vibrator (vibrating board or vibrating roller) crosswise over the surface several times.

The workability period of bedding mortar - including mixing, spreading and vibrating times - has an impact on significant features with regard to material technology and technical workmanship such as density, mortar strength, contact area and adhesiveness. A time period of 5 hours should not be exceeded.

After vibrating the surface covering its joints are grouted with pure cement or a jointing material composed of quartz sand and cement.

In order to remove excess grout from the surface covering a dry jointing material is applied, subsequent cleaning of the surface covering is required.

8 Movement Joints

Movement joints are applied in order to enable formations of the surface coverings e.g. caused by shrinkage, temperature affects or load-bearing.

There are different joints such as

- expansion joints for buildings
- edge and adjacent joints
- border joints

Movement joints above expansion joints must be provided in the same place and at the same width as those in the load-bearing construction. They must be trimmed with suitable profiled sections.

Furthermore movement junctions must be provided at junctions with walls, pillars, stilts as well as rigidly integrated components, likewise other components penetrating the floor, around doorway openings and steep changes of level on plan.

After taking into account the structural and geometrical aspects border joints within individual surface coverings must be set out in such a way that panel sizes are formed as compact as possible (square like shape). According to the standard value the side ratio of 1:1,5 should not be exceeded.

Apart from the individual structural prerequisites and utilization requirements the bedding mortar for the ceramic covering determines the array of movement joints considering the size of the surface covering.

Bedding mortar of ceramic floor coverings can be built in by bonding the substrate construction resp. as separating or insulating layers.

Bonding coverings don't require any limitation in panel size when setting the movement joints as they have immediate contact with the substrate construction which results in a strong and push resistant compound. However, separating and insulating layers do require partial panel sizes due to anticipated changes in formation.

A standard value for the movement within joints distances of 8 to 12 m is recommended for coverings on separating and insulting layers.

independent of conditions and impacts from covering construction, substrate,

utilization and formation panel sizes should be limited to approx. 200 m².

Movement joints in trafficked areas must be minimized and protected on the upper edges by incorporating flush level profiled sections of metal or plastic.

Joints filled with resilient joint-sealing compounds require maintenance depending on anticipated strain.

When using box-shaped profiled sections formation of cracks between the profiled sections and the adjacent ceramic floor coverings depend on the type of construction.

Complete - not cut - tiles and slabs should be used for the junctions to the ceramic floor coverings along the border joints.

9 Commissioning after Completion

Surface coverings should not be used before the bedding and jointing mortars have sufficiently hardened. The speed of hardening also depends on the temperature. According to the standard value for commissioning: after 7 days to be walked upon and after 28 days to be used for fully mechanical loading.

10 Cleaning & Maintenance

Taking into account local conditions affecting laying and loading layers of cement residual from the grouting process, mineral deposits and subsequent efflorescence on the ceramic floor coverings' surfaces can not be excluded. It is recommended to use acidic cleaning agents to eliminate such effects during thorough cleaning.

Depending on the amount of staining either acidic or alkaline cleaning agents are to be used for regular cleaning and care of the ceramic tiled floor coverings.

The use of acidic cleaning agents can lead to a chemical strain of the cement materials. In order to minimize the strain the floor coverings have to be wetted prior to the use of acidic cleaning agents. Manufacturer's recommendations and instructions have to be followed when selecting the concentrations. Alternatively, applicable concentrations recommended by the RK list³⁾ have to be taken into account.

11 Special Considerations

Freshly laid tiles must be sufficiently protected against effects of the weather such as rain, frost or severe thermal stresses by taking appropriate measures.

Rubble, rubbish and rejected materials from building sites must be properly disposed in accordance with the waste disposal law's regulations.

12 Quality Assurance

Having floor tiles and slabs laid by specialist fixers, who are members of the AK-QR, guarantees that the above-mentioned characteristics are appropriately met and follow the guidelines for the vibration process.

The member companies of the AK-QR (laying companies and manufacturers) are subjected to regular quality checks. These are carried out by following the corresponding national resp. international DIN / DIN EN standards as well as the technical requirements for building materials, workmanship and application specifications for manufacturing ceramic coverings by using the vibration process.

The acceptance of surface coverings by the client is done shortly after completion under reasonable vertical illumination without side lighting.

The dimensional tolerances of DIN 18202 apply to evaluate the evenness of laid ceramic surface coverings whereby the defined evenness is influenced by the used ceramic material's dimensional accuracy. Unevenness in the ceramic coverings' surfaces as well as differences in height between the adjoining tiles and slabs (ridges) can be identified when being viewed under ideal conditions. The type of compaction produced by the vibration process helps to achieve evenness in surfaces which tolerates a height difference between the adjacent tiles and slabs of maximum 1,5 mm.

It is possible that the vibration process will result in the joints of the ceramic surface coverings not always running continuously linear.

These guidelines can be obtained via:

Saeurefliesner-Vereinigung e.V.- P.O.Box 1254- D-30928 Burgwede

Tel.+49-51 39-9982-0 • Fax +49-51 39-9982-40

Reproduction - even of extracts - can only be done with the permission of the Research Group "Quality Assurance - Vibrated Coverings"

RESEARCH GROUP "QUALITY ASSURANCE - VIBRATED COVER