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European Assessment Document for

Ceramic multilayer slabs for wall claddings and floorings



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This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

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1 SCOPE OF THE EAD

1.1 Description of the construction product

The EAD covers special ceramic slabs provided with a reinforcing backing layer glued to the ceramic slab, in the following referred to as “ceramic multilayer slabs”. In the EAD, two types of ceramic multilayer slabs are defined, namely type A and type B, which, respectively, consist of (see Figure 1.1.1):

- A. One layer of dry-pressed ceramic slab (according to EN 14411¹) reinforced with one layer of glass fibre mat/mesh on the back; the glass fibre is applied by means of an adhesive with controlled industrial process.
- B. One layer of dry-pressed ceramic slab (according to EN 14411), one layer of glass fibre mat/mesh plus another thin ceramic slab (according to EN 14411), applied by means of an adhesive with controlled industrial process.

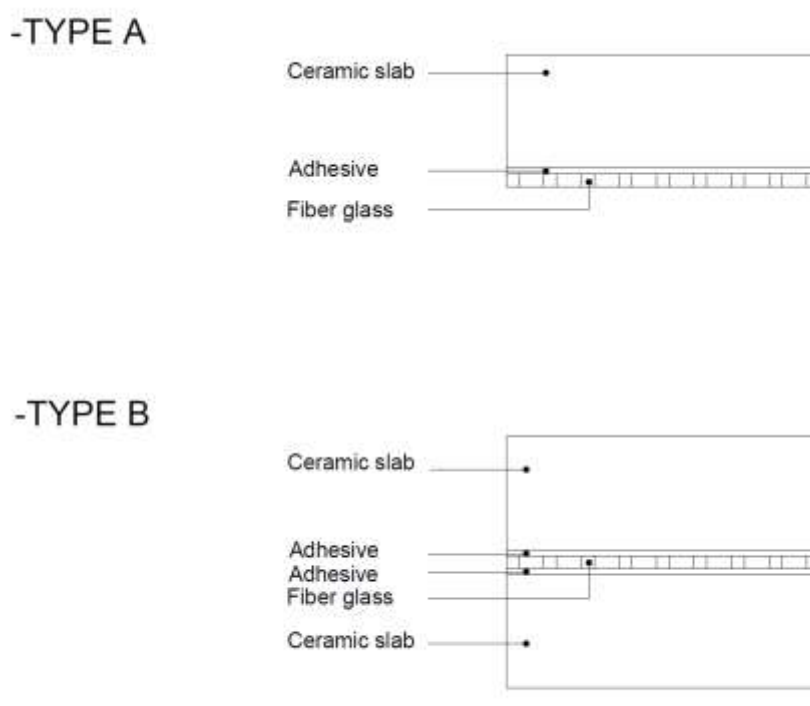


Figure 1.1.1: Stratigraphy of type A and type B ceramic multilayer slab

The ceramic multilayer slab is manufactured in large dimensions (length and width), e.g., 1620 mm x 3240 mm, however, the manufactured slab may be provided either in its original dimensions or cut in smaller size.

The ceramic multilayer slab is unglazed, and the surface can be in different colours, texture and roughness. The slab surface may be also processed with a mechanical process after firing (e.g., polishing).

The application of the product can be done using adhesives and/or mechanical fixings commonly available in the market.

The adhesives and the mechanical fixings are not part of the EAD.

The product is not fully covered by the following harmonised technical specification:

- EN 14411 because it does not consider slabs reinforced on the back with a glass fibre mat/mesh, also referred to in EN 14411:2016 as meshed backed products (slabs type A), nor multilayer products (slabs types A and B). Furthermore, regarding the scope of EN 14411, the intended uses have been expanded

¹ All undated references to standards in this document are to be understood as references to the dated versions listed in chapter 4.

in the EAD to include the use as a cladding element fixed on a subframe for external wall cladding systems (see Use 2 in clause 1.2.1).

With respect to EN 14411, the following characteristics have been added: “Bond strength between layers – strength perpendicular to the faces”, “Bond strength between layers - shear strength”, “Bond strength between layers after freeze and thaw conditioning” and “Bond strength between layers after alkaline ageing”, since these characteristics are deemed to be essential for the assessment of the product due to its specificities (which cause it to deviate from the scope of EN 14411), that is, reinforced on the back with a glass fibre mat/mesh and multilayer.

In deviation from Annex ZA, Tables ZA.1.1 and ZA.1.2, of EN 14411, in this EAD the essential characteristics “Release of dangerous substances: Cadmium” and “Release of dangerous substances: Lead” have not been considered, in accordance with note “t” of Table 2 of EN 14411, because the ceramic multilayer slabs are unglazed. Furthermore, with respect to Annex ZA of EN 14411, other essential characteristics have been included in the EAD for their relevance on the ceramic multilayer slabs, characteristics which are, however, listed in Table 2 in clause 5.2 of EN 14411: water absorption, moisture expansion, flexural tensile strength or modulus of rupture, deep abrasion resistance, coefficient of linear thermal expansion, thermal shock resistance for Use 3 (see clause 1.2.1) and resistance to chemicals.

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer’s instructions or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer’s stipulations, e.g., with regard to the intended end use conditions, having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA as long as the details of the assessment methods as laid down in this EAD are respected.

1.2 Information on the intended use(s) of the construction product

1.2.1 Intended use(s)

Three uses are distinguished for the product:

- Use 1: as a cladding element for internal and external walls in which the product can be applied with common adhesives for ceramic tiles.
- Use 2: as a cladding element for external wall cladding systems in ventilated and non-ventilated facades in which the product is fixed on a subframe (mechanically or glued by means of an adhesive system).
- Use 3: as a paving element for internal and external floorings, including stairs and tactile paving surfaces, i.e., for blind or vision impaired people.

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer’s request to take into account a working life of the ceramic multilayer slab for the intended use of 25 years when installed in the works. These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product, the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works².

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

1.3 Specific terms used in this EAD

1.3.1 Dry-pressed ceramic slab

The dry-pressed ceramic slab is obtained with dry-pressing process from clays and/or other inorganic raw materials. Dry-pressed ceramic slabs are formed from a finely milled body mixture and shaped by pressing at room temperature followed by drying and firing at temperatures sufficient to develop the required properties.

1.3.2 Product loading factor

Ratio of exposed dimension of the test specimen to the empty test chamber volume.

1.3.3 Profile feature

Single component of a tactile paving surface indicator.

1.3.4 Layout

Layout of the profile features on the surface of the ceramic multilayer slab when used for tactile paving surfaces.

1.3.5 Symbols

E_v	[%]	Water absorption of the ceramic multilayer slab.
$\Delta L/L$	[%]	Ratio of the change in length to the initial length of the test specimen due to moisture.
S	[N]	Breaking strength of the ceramic multilayer slab.
R	[MPa]	Modulus of rupture of the ceramic multilayer slab.
V	[mm ³]	Volume of abraded material.
α_{shod}	[°]	Ramp test value representing the angle of slip in the Shod Ramp Test.
e	[-]	Coefficient of restitution (COR).
σ^T_m	[MPa]	Tensile stress perpendicular to faces at the temperature T, mean value.
σ^T_{max}	[MPa]	Tensile stress perpendicular to faces at the temperature T, maximum value of the single specimen.
σ^T_c	[MPa]	Tensile stress perpendicular to faces at the temperature T, characteristic value.

² The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

τ_m^T	[MPa]	Shear stress at the temperature T, mean value.
τ_{max}^T	[MPa]	Shear stress at the temperature T, maximum value of the single specimen.
τ_c^T	[MPa]	Shear stress at the temperature T, characteristic value.
R_{σ}^{ft}	[%]	Residual bond strength (perpendicular to the faces) after freeze and thaw conditioning treatment as a percentage of the as-delivered state.
R_{τ}^{ft}	[%]	Residual bond strength (shear) after freeze and thaw conditioning treatment as a percentage of the as-delivered state.
R_{σ}^a	[%]	Residual bond strength (perpendicular to the faces) after alkaline ageing as a percentage of the as-delivered state.
R_{τ}^a	[%]	Residual bond strength (shear) after alkaline ageing as a percentage of the as-delivered state.
A_s	[N/mm ²]	Tensile adhesion strength of the adhesive in the test of bond strength/adhesion between the ceramic multilayer slab and the specific adhesive.
α_l	[10 ⁻⁶ /°C]	Linear thermal expansion coefficient.
n_{FT}	[-]	Number of damaged tiles after 100 freeze-thaw cycles.
E_1	[%]	Initial water absorption as a percentage by mass.
E_2	[%]	Final water absorption as a percentage by mass after 100 freeze-thaw cycles.
n_{sh}	[-]	Number of tiles with visible defects after the thermal shock treatment.
n_{tot}	[-]	Total number of tested specimens in the thermal shock resistance test.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 2.1.1 to

Table 2.1.3 show how the performance of the ceramic multilayer slab is assessed in relation to the essential characteristics relevant for Use 1, Use 2 and Use 3, respectively, according to Clause 1.2.1.

Table 2.1.1 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics (Use 1)

No	Essential characteristic	Assessment method	Type of expression of product performance
Basic Works Requirement 2: Safety in case of fire			
1	Reaction to fire	2.2.1	Class
Basic Works Requirement 3: Hygiene, health and the environment			
2	Water absorption	2.2.2	Level E_v [%]
3	Moisture expansion	2.2.3	Level $\Delta L/L$ [%]
4	Content, emission and/or release of dangerous substances - SVOC and VOC	2.2.4.1	Description and level Specific emission rates [$\mu\text{g}/(\text{m}^2\cdot\text{h})$] and air concentrations in the reference room [$\mu\text{g}/\text{m}^3$](*)
Basic Works Requirement 4: Safety and accessibility in use			
5	Breaking strength	2.2.5	Level S [N]
6	Flexural tensile strength or modulus of rupture	2.2.6	Level R [MPa]
7	Bond strength between layers – strength perpendicular to the faces	2.2.10	Level σ_m^T [MPa] σ_c^T [MPa]
8	Bond strength between layers – shear strength	2.2.11	Level τ_m^T [MPa] τ_c^T [MPa]
9	Bond strength between layers after freeze and thaw conditioning <i>(only for external uses)</i>	2.2.12	Level R_{σ}^{ft} [%] R_{τ}^{ft} [%]

No	Essential characteristic	Assessment method	Type of expression of product performance
10	Bond strength between layers after alkaline ageing (only for type A)	2.2.13	Level R_{σ}^a [%] R_{τ}^a [%]
11	Bond strength/adhesion: - cementitious adhesives - dispersion adhesives - reaction resin adhesives	2.2.14	Level A_s [N/mm ²]
12	Coefficient of linear thermal expansion	2.2.15	Level α_1 [10 ⁻⁶ /°C]
13	Freeze and thaw resistance	2.2.16	Description
14	Thermal shock resistance	2.2.17	Level n_{sh} n_{tot}
15	Durability for internal uses	EN 14411 Table ZA.1.2 note G	Description
16	Resistance to chemicals	2.2.18	Description

(*) accompanied by the information about the product loading factor used [m²/m³] (see Clause 1.3.2)

Table 2.1.2 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics (Use 2)

No	Essential characteristic	Assessment method	Type of expression of product performance
Basic Works Requirement 2: Safety in case of fire			
1	Reaction to fire	2.2.1	Class
Basic Works Requirement 3: Hygiene, health and the environment			
2	Water absorption	2.2.2	Level E_v [%]
3	Moisture expansion	2.2.3	Level $\Delta L/L$ [%]
4	Content, emission and/or release of dangerous substances - Leachable substances	2.2.4.2	Description and level - EC20-values for each dilution ratio - [% within ... hours/days]

No	Essential characteristic	Assessment method	Type of expression of product performance
Basic Works Requirement 4: Safety and accessibility in use			
5	Breaking strength	2.2.5	Level S [N]
6	Flexural tensile strength or modulus of rupture	2.2.6	Level R [MPa]
7	Bond strength between layers – strength perpendicular to the faces	2.2.10	Level σ_m^T [MPa] σ_c^T [MPa]
8	Bond strength between layers – shear strength	2.2.11	Level τ_m^T [MPa] τ_c^T [MPa]
9	Bond strength between layers after freeze and thaw conditioning	2.2.12	Level R_{σ}^{ft} [%] R_{τ}^{ft} [%]
10	Coefficient of linear thermal expansion	2.2.15	Level α_1 [$10^{-6}/^{\circ}\text{C}$]
11	Freeze and thaw resistance	2.2.16	Description
12	Thermal shock resistance	2.2.17	Level n_{sh} n_{tot}
13	Resistance to chemicals	2.2.18	Description

Table 2.1.3 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics (Use 3)

No	Essential characteristic	Assessment method	Type of expression of product performance
Basic Works Requirement 2: Safety in case of fire			
1	Reaction to fire	2.2.1	Class
Basic Works Requirement 3: Hygiene, health and the environment			
2	Water absorption	2.2.2	Level E_v [%]
3	Moisture expansion	2.2.3	Level $\Delta L/L$ [%]

No	Essential characteristic	Assessment method	Type of expression of product performance
4	Content, emission and/or release of dangerous substances - SVOC and VOC	2.2.4.1	Description and level Specific emission rates [$\mu\text{g}/(\text{m}^2\cdot\text{h})$] and air concentrations in the reference room [$\mu\text{g}/\text{m}^3$](*)
Basic Works Requirement 4: Safety and accessibility in use			
5	Breaking strength	2.2.5	Description and level S [N]
6	Flexural tensile strength or modulus of rupture	2.2.6	Level R [MPa]
7	Deep abrasion resistance	2.2.7	Level V [mm^3]
8	Slipperiness	2.2.8	Level α_{shod} [°]
9	Impact resistance	2.2.9	Level Coefficient of restitution, e
10	Bond strength between layers – strength perpendicular to the faces	2.2.10	Level σ_m^T [MPa] σ_c^T [MPa]
11	Bond strength between layers – shear strength	2.2.11	Level τ_m^T [MPa] τ_c^T [MPa]
12	Bond strength between layers after freeze and thaw conditioning <i>(only for external uses)</i>	2.2.12	Level R_{σ}^{ft} [%] R_{τ}^{ft} [%]
13	Bond strength between layers after alkaline ageing <i>(only for type A)</i>	2.2.13	Level R_{σ}^{a} [%] R_{τ}^{a} [%],
14	Coefficient of linear thermal expansion	2.2.15	Level α_1 [$10^{-6}/^{\circ}\text{C}$]
15	Freeze and thaw resistance	2.2.16	Description
16	Thermal shock resistance	2.2.17	Level n_{sh} n_{tot}
17	Durability for internal uses	EN 14411 Table ZA.1.1 note G	Description
18	Resistance to chemicals	2.2.18	Description
19	Tactility	2.2.19	Description

(*) accompanied by the information about the product loading factor used [m^2/m^3] (see Clause 1.3.2)

2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

This chapter is intended to provide instructions for TABs. Therefore, the use of wordings such as “shall be stated in the ETA” or “it has to be given in the ETA” shall be understood only as such instructions for TABs on how results of assessments shall be presented in the ETA. Such wordings do not impose any obligations for the manufacturer and the TAB shall not carry out the assessment of the performance in relation to a given essential characteristic when the manufacturer does not wish to declare this performance in the Declaration of Performance.

2.2.1 Reaction to fire

Purpose of the assessment

The purpose of the assessment is the determination of the reaction to fire of the ceramic multilayer slabs.

Assessment method

The ceramic multilayer slab shall be tested, using the method(s) referred to in EN 13501-1 and relevant for the corresponding reaction to fire class. The product shall be classified according to the Commission Delegated Regulation (EU) No 2016/364 in connection with EN 13501-1.

1. Preparation of specimens

In addition to EN 13501-1, the following product parameters of the ceramic multilayer slabs shall be considered when preparing the test specimens:

- product-type, in particular: type A or type B of the ceramic multilayer slab;
- type of adhesive (chemical composition/ formulation);
- weight per unit area of adhesive applied per square meter of the ceramic multilayer slab: the highest weight per unit area shall be tested;
- the smallest size of the ceramic multilayer slab in the available range for each relevant intended use shall be tested.

2. Indications for mounting and fixing

- EN ISO 1182 (Non-combustibility test)

The test shall be performed for the substantial components (for the products covered by this EAD: substantial layers) of the ceramic multilayer slab as given in EN 13501-1, Clause 3.1.5, only.

- EN ISO 1716 (Gross heat of combustion test)

The test shall be performed for all the components (for the products covered by this EAD: all the layers) of the ceramic multilayer slab as given in EN 13501-1.

- EN ISO 11925-2 (Single-flame source test)

For the relevant classes, single-flame source test shall be performed by considering the following indications for the preparation of the test specimen.

The specimen shall be cut, from a ceramic multilayer slab, to the required length (250 ± 2 mm) and width (90 ± 2 mm). Products with identical surface finishes on both sides shall be tested on one side only. Asymmetrically composed ceramic multilayer slabs (slabs type A) shall be tested on both sides or on the side representative for the worst reaction to fire performance. The worst reaction to fire performance is normally obtained with the side having the finish with the highest organic content per square meter of surface. The side with the highest organic content shall be derived from the composition of the different layers of the product (i.e., the back side with the glued glass fibre) or by determining their gross calorific value in accordance with EN ISO 1716.

The product shall be tested free standing and with surface exposure and edge exposure. An additional set of tests shall be carried out with the specimens rotated by 90 degrees around their vertical axis and the

flame applied to the mid-point of the bottom edge (for products having a thickness up to 3 mm) or to the centre of the width of the bottom edge (for products having a thickness greater than 3 mm).

- EN 13823 (SBI test)

This test is relevant for Use 1 and Use 2 (as a cladding element).

For the relevant classes, SBI test shall be performed by considering the following indications for the preparation of the test specimens.

Products that in their end use application are directly fixed to a substrate shall be tested fixed as used in the end use application (mechanically, glued) to a substrate. Standard substrates shall meet the requirements of EN 13238. Products that in their end use application are fixed to a substrate with a ventilated air chamber (use of the product in ventilated facades) shall be tested, in accordance with EN 13823, with an air gap depth between the rear side of the product and the substrate of at least 40 mm as well as with the smallest possible air gap in the end use application. Both distances have to be tested and the worst indicative test shall be considered for classification.

For products of large dimensions, the following indications shall be considered: product shall be tested with a horizontal joint in the long wing at a height of 500 mm from the bottom edge of the specimen and with a vertical joint in the long wing at a distance of 200 mm from the corner line, measured when the wings are mounted ready for testing. The maximum joint opening width shall be tested.

- EN ISO 9239-1 (Determination of the burning behaviour using a radiant heat source)

This test is relevant for Use 3 (as a paving element).

For the relevant classes, the burning behaviour using a radiant heat source test shall be performed by considering the following indications for the preparation of the test specimens. The product shall be tested directly fixed to a substrate (glued) as used in its end use. Standard substrates shall meet the requirements of EN 13238.

3. Extended application of test results

The results of the tests considering the aforementioned parameters in fully are also valid for products:

- of the same defined product-type;
- with the same type of adhesive (chemical composition/ formulation);
- with a lower weight per unit area of adhesive applied per square meter of the ceramic multilayer slab with respect to the weight per unit area tested;
- with different dimensions of length and width from those used for the test;
- with a joint opening width equal to or smaller than those used for the test;
- with any orientation;
- fixed with all other types of metal mechanical devices such as metal nails or rivets.

Expression of results

The performance class obtained from the tests shall be stated in the ETA, together with the substrate/s for which the classification is applicable.

2.2.2 Water absorption

Purpose of the assessment

The purpose of the assessment is the determination of the water absorption of the ceramic multilayer slabs by the principle of impregnation (soaking) of the dry slab with water.

Assessment method

The water absorption of the ceramic multilayer slab shall be determined according to EN ISO 10545-3. With regard to clause 8 of EN ISO 10545-3 "Expression of results", only the sub-clause 8.1 "Water absorption" shall be considered.

Expression of results

The average value (arithmetic mean) of the water absorption E_v [%] shall be stated in the ETA.

2.2.3 Moisture expansion

Purpose of the assessment

The purpose of the assessment is the determination of the accelerated moisture expansion of the ceramic multilayer slabs obtained by subjecting the slab to a prolonged immersion in boiling water.

Assessment method

The moisture expansion of the ceramic multilayer slab shall be determined according to EN ISO 10545-10. In clause 7.1 of EN ISO 10545-10 the following modifications are brought to the temperature and duration of the step in the procedure of refiring, to take into account the presence of the glue in the ceramic multilayer slab:

- refire the test specimens in a kiln with a rate of temperature rise of 150 °C/h
- carry out a 4 h step at (150 ± 10) °C.

Expression of results

The average value of the moisture expansion $\Delta L/L \times 100$ [%] shall be stated in the ETA.

2.2.4 Content, emission and/or release of dangerous substances

Purpose of the assessment

The performance of the ceramic multilayer slabs regarding the emissions and/or release and, where appropriate, the content of dangerous substances will be assessed on the basis of the information provided by the manufacturer³ after identifying the release scenarios taking into account the intended use(s) of the product and the Member States where the manufacturer intends his product to be made available on the market.

The identified release scenarios for this product and relevant intended uses with respect to dangerous substances are:

³ The manufacturer may be asked to provide to the TAB the REACH related information which shall accompany the DoP (cf. Article 6(5) of Regulation (EU) No 305/2011).

The manufacturer is not obliged to:

- provide the chemical constitution and composition of the product (or of constituents of the product) to the TAB, or
- provide a written declaration to the TAB stating whether the product (or constituents of the product) contain(s) substances which are classified as dangerous according to Directive 67/548/EEC and Regulation (EC) No 1272/2008 and listed in the "Indicative list on dangerous substances" of the SGDS, taking into account the installation conditions of the construction product and the release scenarios resulting from there.

Any information provided by the manufacturer regarding the chemical composition of the products is not to be distributed to EOTA, to other TABs or beyond.

IA1: Product with direct contact to indoor air

S/W2: Product with indirect contact to soil, ground- and surface water

2.2.4.1 SVOC and VOC

This characteristic is only relevant for Use 1 and Use 3 in internal areas (see clause 1.2.1).

For the intended uses (Use 1 and Use 3) covered by the release scenario IA1, the performance of the ceramic multilayer slabs regarding SVOC and VOC shall be assessed.

Assessment method

Volatile organic compounds and semi-volatile organic compounds (respectively: VOC and SVOC) shall be determined in accordance with EN 16516. In particular, clause 8.2 of EN 16516 which describes the determination of VOCs and SVOCs in test chamber air, is of concern. The loading factors for emission testing for the intended uses of the ceramic multilayer slabs for “walls” and “floor” according to EN 16516 shall be:

- 1.0 m²/m³ for walls;
- 0.4 m²/m³ for the floor.

The installation of the test specimen in the test chamber shall be done in accordance with the manufacturer's product installation instructions, whenever possible, in absence of such instructions, with the usual practice of the building professionals.

Expression of results

A description of specific emission rates [$\mu\text{g}/(\text{m}^2\cdot\text{h})$] and respective air concentrations in the reference room [$\mu\text{g}/\text{m}^3$] of the compounds, together with the information regarding the product loading factor used [m^2/m^3], in accordance with clause 10.6 of EN 16516, shall be stated in the ETA.

2.2.4.2 Leachable substances

This characteristic is only relevant for Use 2 (see clause 1.2.1).

For the intended use covered by the release scenario S/W2, the performance of the ceramic multilayer slabs regarding leachable substances shall be assessed.

Assessment method

A leaching test with subsequent eluate analysis shall take place, each in duplicate. Leaching tests of the ceramic multilayer slabs shall be conducted according to EN 16637-2. The leachant shall be pH-neutral demineralised water and the ratio of liquid volume to surface area shall be $(80 \pm 10) \text{ l}/\text{m}^2$.

Specimens shall be prepared according to clause 8.2 of EN 16637-2.

In eluates of „6 hours“ and „64 days“, the following biological tests shall be conducted:

- acute toxicity test with *Daphnia magna* Straus according to EN ISO 6341;
- toxicity test with algae according to EN ISO 15799;
- luminescent bacteria test according to EN ISO 11348-1, EN ISO 11348-2 or EN ISO 11348-3.

For each biological test, EC20-values shall be determined for dilution ratios 1:2, 1:4, 1:6, 1:8 and 1:16.

Expression of results

Determined toxicity in the leaching test (biological tests) of the ceramic multilayer slabs shall be expressed as EC20-values for each dilution ratio. Maximum determined biological degradability shall be expressed as "...% within ... hours/days". The respective test methods for analysis shall be specified.

2.2.5 Breaking strength

Purpose of the assessment

The purpose of the assessment is the determination of the breaking strength of the ceramic multilayer slabs by the application of a force to the centre of the slab.

Assessment method

The breaking strength of the ceramic multilayer slab shall be determined according to EN ISO 10545-4. The part of the product subjected to test is the sole ceramic slab which is deemed to be decisive for the performance of the ceramic multilayer slab with regard to this characteristic. Concerning clause 8 of EN ISO 10545-4 “Calculation”, only the formula (1) in this clause, and related definitions, shall be considered.

Expression of results

The average value (arithmetic mean) of the breaking strength S [N] shall be stated in the ETA.

For Use 3 only (internal and external floorings), the breaking strength shall be stated in the ETA as given in EN 14411, Table ZA.1.1 column “Notes” for characteristic number B.2. The relevant product group of the ceramic multilayer slab is “dry-pressed” further defined by its water absorption value E_v [%]. Corresponding requirements for each relevant group are set in the Tables of Annexes from Annex G to Annex K of EN 14411. The water absorption value E_v [%] is to be determined in accordance with clause 2.2.2 of this EAD.

2.2.6 Flexural tensile strength or modulus of rupture

Purpose of the assessment

The purpose of the assessment is the determination of the modulus of rupture of the ceramic multilayer slabs by the application a force to the centre of the slab.

Assessment method

The flexural tensile strength or modulus of rupture of the ceramic multilayer slab shall be determined according to EN ISO 10545-4. With regard to clause 8 of EN ISO 10545-4 “Calculation”, only the formula (2) in this clause, and related definitions, shall be considered.

Expression of results

The average value (arithmetic mean) and characteristic value of the modulus of rupture R [MPa] shall be stated in the ETA. The characteristic value shall be determined by using the appropriate value of k_n for unknown V_x according to EN 1990, Annex D, Table D1.

2.2.7 Deep abrasion resistance

Purpose of the assessment

The purpose of the assessment is the determination of the deep abrasion resistance of the ceramic multilayer slabs.

This characteristic is only relevant for Use 3 (see clause 1.2.1).

Assessment method

The deep abrasion resistance of the ceramic multilayer slab shall be determined according to EN ISO 10545-6.

Expression of results

The average value (arithmetic mean) of the resistance to deep abrasion V [mm³] shall be stated in the ETA.

2.2.8 Slipperiness

Purpose of the assessment

The purpose of the assessment is the determination of the slip resistance of the pedestrian surface of the ceramic multilayer slabs.

This characteristic is only relevant for Use 3 (see clause 1.2.1).

Assessment method

The slipperiness of the ceramic multilayer slab shall be determined according to EN 16165 – Method of Annex B “Shod Ramp Test”.

Expression of results

The critical angle α_{shod} , referred to as ramp test value in Annex B of EN 16165, shall be stated in the ETA.

2.2.9 Impact resistance

Purpose of the assessment

The purpose of the assessment is the determination of the impact resistance of the ceramic multilayer slabs.

This characteristic is only relevant for Use 3 (see clause 1.2.1).

Assessment method

The impact resistance of the ceramic multilayer slab shall be determined according to EN ISO 10545-5.

Expression of results

The average value (arithmetic mean) of the coefficient of restitution (COR), e , shall be stated in the ETA.

2.2.10 Bond strength between layers – strength perpendicular to the faces

Purpose of the assessment

The purpose of the assessment is the determination of the adhesion between the different layers of the ceramic multilayer slab by applying a force in the direction perpendicular to the faces, in order to determine the bond strength of the weakest layer.

Assessment method

Bond strength perpendicular to the faces shall be assessed according to Annex A where provisions for the preparation of test specimens, the test procedure as well as the processing of the test results, are given.

Expression of results

The average (arithmetic mean), σ_m^T ⁴, and the characteristic value (5%-fractile), σ_c^T , of the tensile stress perpendicular to faces for each test temperature (23 °C; -20 °C; 80 °C), shall be stated in the ETA.

2.2.11 Bond strength between layers – shear strength

Purpose of the assessment

⁴ σ_m^T is the arithmetic mean of either the breaking tensile stress values of the specimens or the maximum tensile stress values measured during the test on the specimens in case it is not possible to achieve the breaking in the test specimens.

The purpose of the assessment is the determination of the adhesion between the different layers of the ceramic multilayer slab by applying a force in the direction parallel to the faces, in order to determine the bond strength of the weakest layer.

Assessment method

Shear strength shall be assessed according to Annex B where provisions for the preparation of test specimens, the test procedure as well as the processing of the test results, are given.

Expression of results

The average (arithmetic mean), τ_m^T ⁵, and the characteristic value (5%-fractile), τ_c^T , of the shear stress for each test temperature (23 °C; -20 °C; 80 °C), shall be stated in the ETA.

2.2.12 Bond strength between layers after freeze and thaw conditioning

Purpose of the assessment

The purpose of the assessment is the determination of the bond strength between layers of the ceramic multilayer slabs after freeze and thaw conditioning.

Assessment method

Complete freeze and thaw conditioning treatment according to EN ISO 10545-12 (100 cycles) shall be carried out on the following specimens: 5 specimens of dimensions = 50 mm x 50 mm and 5 specimens of dimensions = 50 mm x 200 mm. In particular, only the clauses 4.2, 5 and, partially, 6 of EN ISO 10545-12 (the latter clause only up to the paragraph in which the 100 cycles of freeze and thaw conditioning are described) are of concern. After the ageing, the 5 specimens 50 mm x 50 mm shall be subjected to test of bond strength between layers (series σ^{ft} = strength perpendicular to the faces) as described in clause 2.2.10 and the 5 specimens 50 mm x 200 mm to the test of bond strength between layers (series τ^{ft} = shear strength) as described in clause 2.2.11 of this EAD, both tests only for ambient conditions ($T = (23 \pm 2) \text{ °C}$; R.H. = $(50 \pm 5) \%$).

Expression of results

The residual strength, $R_{\sigma^{ft}}$ [%] and $R_{\tau^{ft}}$ [%], of the mean values as percentage of the as-delivered state (according to 2.2.10 and definition given in note 4 in 2.2.10 and 2.2.11 and definition given in note 5 in 2.2.11) shall be calculated and stated in the ETA. Calculation procedure in the following:

$$- R_{\sigma^{ft}} = \frac{\sigma_m^{ft 23 \text{ °C}}}{\sigma_m^{23 \text{ °C}}} \cdot 100 \quad (2.2.12.1)$$

$$- R_{\tau^{ft}} = \frac{\tau_m^{ft 23 \text{ °C}}}{\tau_m^{23 \text{ °C}}} \cdot 100 \quad (2.2.12.2)$$

where

$$- \sigma_m^{ft 23 \text{ °C}} = \text{mean value of the series } \sigma^{ft} \text{ of 5 specimens calculated on } \sigma_{max}^{ft 23 \text{ °C}} \quad (2.2.12.3)$$

$$- \sigma_{max}^{ft 23 \text{ °C}} = F_{max}^{ft 23 \text{ °C}} / A \text{ of each specimen} \quad (2.2.12.4)$$

$$- \tau_m^{ft 23 \text{ °C}} = \text{mean value of the series } \tau^{ft} \text{ of 5 specimens calculated on } \tau_{max}^{ft 23 \text{ °C}} \quad (2.2.12.5)$$

$$- \tau_{max}^{ft 23 \text{ °C}} = F_{max}^{ft 23 \text{ °C}} / A \text{ of each specimen} \quad (2.2.12.6)$$

$$- A = \text{cross-section area of the test specimen, in mm}^2 \quad (2.2.12.7)$$

⁵ τ_m^T is the arithmetic mean of: either the breaking shear stress values of the specimens or the maximum shear stress values measured during the test on the specimens in case it is not possible to achieve the breaking in the test specimen.

2.2.13 Bond strength between layers after alkaline ageing

Purpose of the assessment

The purpose of this test is to assess the durability of the fibre glass mat/mesh on the back of the ceramic multilayer slab when applied in the works using an adhesive for ceramic tile which creates an alkaline condition on the back of the slab (e.g., cementitious adhesives).

This test shall be applied only for Type A product (see clause 1.1) and when the product is used with adhesives for ceramic tiles (Use 1 and Use 3 according to clause 1.2.1).

Assessment method

The test shall be carried out on the following specimens: 5 specimens of dimensions = 50 mm x 50 mm and 5 specimens of dimensions = 50 mm x 200 mm.

The specimens shall be immersed for 28 days in alkaline solution at $(23 \pm 2) ^\circ\text{C}$. The composition of the solution shall be as follows: 1 g NaOH, 4 g KOH, 0,5 g Ca (OH)₂ to one litre of distilled water.

At the end of the ageing the specimens shall be rinsed by immersion for 5 minutes in acid solution (5 ml HCl (35 % diluted) to 4 litres water) and then placed successively in 3 baths of water for 2 minutes for each bath (4 litres each). They shall be subsequently dried at $(23 \pm 2) ^\circ\text{C}$ and $(50 \pm 5) \%$ R.H. for 48 hours.

After the ageing, the 5 specimens 50 mm x 50 mm shall be subjected to test of bond strength between layers as described in clause 2.2.10 (series σ^a = strength perpendicular to the faces) and the 5 specimens 50 mm x 200 mm to the test of bond strength between layers as described in 2.2.11 (series τ^a = shear strength) and only for ambient conditions ($T = (23 \pm 2) ^\circ\text{C}$; R.H. = $(50 \pm 5) \%$).

Expression of results

The residual strength, R_{σ^a} [%] and R_{τ^a} [%], of the mean values as percentage of the as-delivered state (according to 2.2.10 and definition given in note 4 in 2.2.10 and 2.2.11 and definition given in note 5 in 2.2.11) shall be calculated and stated in the ETA. Calculation procedure in the following:

$$- R_{\sigma^a} = \frac{\sigma_m^{a 23^\circ\text{C}}}{\sigma_m^{23^\circ\text{C}}} \cdot 100 \quad (2.2.13.1)$$

$$- R_{\tau^a} = \frac{\tau_m^{a 23^\circ\text{C}}}{\tau_m^{23^\circ\text{C}}} \cdot 100 \quad (2.2.13.2)$$

where

$$- \sigma_m^{a 23^\circ\text{C}} = \text{mean value of the series } \sigma^a \text{ of 5 specimens calculated on } \sigma_{max}^{a 23^\circ\text{C}} \quad (2.2.12.3)$$

$$- \sigma_{max}^{a 23^\circ\text{C}} = \frac{F_{max}^{a 23^\circ\text{C}}}{A} \text{ of each specimen} \quad (2.2.13.4)$$

$$- \tau_m^{a 23^\circ\text{C}} = \text{mean value of the series } \tau^a \text{ of 5 specimens calculated on } \tau_{max}^{a 23^\circ\text{C}} \quad (2.2.12.5)$$

$$- \tau_{max}^{a 23^\circ\text{C}} = \frac{F_{max}^{a 23^\circ\text{C}}}{A} \text{ of each specimen} \quad (2.2.13.6)$$

$$- A = \text{cross-section area of the test specimen, in mm}^2 \quad (2.2.13.7)$$

2.2.14 Bond strength/adhesion: cementitious adhesives, dispersion adhesives and reaction resin adhesives

Purpose of the assessment

The purpose of these tests is to determine the bond strength/adhesion between the ceramic multilayer slab and the specific adhesive according to EN 12004 clause 3.2: cementitious adhesives (C), dispersion adhesives (D) or reaction resin adhesives (R).

This assessment is relevant only when the product is applied with adhesives for ceramic tiles as a cladding for internal and external walls (Use 1).

Assessment method

For the bullet point “cementitious adhesives” (C) in Table 2.1.1, the bond strength/adhesion shall be the initial tensile adhesion strength and shall be determined according to EN 12004-2 clause 8.3 sub-clauses 8.3.1, 8.3.2, 8.3.3.1 and 8.3.3.2.

For the bullet point “dispersion adhesives” (D) in Table 2.1.1, the bond strength/adhesion shall be the initial shear adhesion strength and shall be determined according to EN 12004-2 clause 8.4 sub-clauses 8.4.1, 8.4.2, 8.4.3.1 and 8.4.3.2.

For the bullet point “reaction resin adhesives” (R) in Table 2.1.1, the bond strength /adhesion shall be the initial shear adhesion strength and shall be determined according to EN 12004-2 clause 8.5 sub-clauses 8.5.1, 8.5.2, 8.5.3.1 and 8.5.3.2.

In clauses 8.3.1.1, 8.4.1.1 and 8.5.1.1 of EN 12004-2 (in “Test materials”) substitute the terms “ceramic tiles” with “ceramic multilayer slabs”. The ceramic multilayer slabs shall be cut so as to obtain the dimensions of the specimens envisaged in EN 12004-2 clauses 8.3.1.1, 8.4.1.1 and 8.5.1.1, and shall be tested on suitable adhesives only (that is, the types of adhesives defined in EN 12004 clause 3.2). Conditioning of the test specimens shall be according to EN 12004-2 clause 4 (referred to as “standard conditions”).

Testing shall be carried out for each adhesive type and class, according to EN 12004 clause 6, which will be employed in end use application with the ceramic multilayer slabs subjected to test.

Expression of results

The bond strength/adhesion A_s [N/mm²] calculated according to EN 12004-2 clause 8.3.4 for cementitious adhesives (C), clause 8.4.4 for dispersion adhesives (D), and clause 8.5.4 for reaction resin adhesives (R), shall be stated in the ETA.

2.2.15 Coefficient of linear thermal expansion

Purpose of the assessment

The purpose of the assessment is the determination of the coefficient of linear thermal expansion of the ceramic multilayer slabs, for the temperature range from ambient temperature to 100 °C.

Assessment method

The coefficient of linear thermal expansion, α_l [10⁻⁶/°C], of the ceramic multilayer slab shall be determined according to EN ISO 10545-8 on two specimens.

Expression of results

The linear thermal expansion coefficient α_l [10⁻⁶/°C] for both test specimens shall be stated in the ETA.

2.2.16 Freeze and thaw resistance

Purpose of the assessment

The purpose of the assessment is the determination of the freeze and thaw resistance of the ceramic multilayer slabs.

Assessment method

The freeze and thaw resistance of the ceramic multilayer slab shall be determined according to EN ISO 10545-12. The number of freeze/thaw cycles shall be 100.

Expression of results

The number n_{FT} of damaged tiles after 100 freeze-thaw cycles accompanied by the description of defects on the tile surface, the initial water absorption in % by mass (E_1) and the water absorption in % by mass after freeze-thaw cycles (E_2) shall be stated. The freeze and thaw resistance of the ceramic multilayer slab shall be stated in the ETA as given in EN 14411, Table ZA.1.1 (for Use 3) or Table ZA.1.2 (for Uses 1 and 2) column “Notes” for characteristic number B.8.

2.2.17 Thermal shock resistance

Purpose of the assessment

The purpose of the assessment is the determination of the thermal shock resistance of the ceramic multilayer slabs.

Assessment method

The thermal shock resistance of the ceramic multilayer slab shall be determined according to EN ISO 10545-9, except for clause 5 “Test specimens”. The test method shall be with immersion of specimens in water as described in clause 6.2 of EN ISO 10545-9. With respect to the test specimens, EN 10545-3 shall be the reference: the number of specimens shall be in accordance with clause 6.1 of EN 10545-3 (their number shall be set on account of the maximum area of the ceramic multilayer slab, as specified therein) and the specimen preparation (cutting) shall be in accordance with clause 6.2 of EN 10545-3. The process of temperature cycling (clause 6.4 of EN ISO 10545-9) shall be repeated 10 times.

Expression of results

The number n_{sh} of ceramic multilayer slabs with visible defects after the completion of the test and the total number of tested specimens n_{tot} , shall be stated in the ETA.

For Uses 1 (for external walls only) and 2 (for external wall cladding systems) only, the thermal shock resistance shall be stated in the ETA as given in EN 14411, Table ZA.1.2 column “Notes” for characteristic number B.6.

2.2.18 Resistance to chemicals

Purpose of the assessment

The purpose of the assessment is the determination of the resistance to chemical agents of ceramic multilayer slabs.

The resistance to chemicals shall be divided into the following types depending on the chemical solution:

- household chemicals
- swimming pool salts
- low concentration acids
- low concentration alkalis
- high concentration acids
- high concentration alkalis

Assessment method

The resistance to chemical agents of the ceramic multilayer slab, for each type of chemical solution, shall be determined according to EN ISO 10545-13. The specimen shall be immersed horizontally so that only the external (wearing) surface shall be immersed into the solution to a depth between 2 and 5 mm and in any way leaving the other surface (the back) exposed to the air.

Expression of results

The resistance to chemicals, assessed through a visual inspection of the specimen, shall be stated in the ETA with a description chosen among the following possibilities for each type of chemical solution:

- no visible effect
- discernible change in appearance
- partial or complete loss of the original surface appearance.

2.2.19 Tactility

Purpose of the assessment

The purpose of the assessment is to evaluate the surface profile features and patterns of the ceramic multilayer slabs used to convey information for visually impaired people. This performance is only relevant when the end use application of the ceramic multilayer slabs is for tactile paving surfaces, i.e., when required for blind or vision impaired people in internal and external floorings (Use 3).

Assessment method

The tactility of the ceramic multilayer slabs shall be assessed according to CEN/TS 15209. The dimensions of the layouts and profiles of the individual ceramic multilayer slabs shall be measured in accordance with Annex B of CEN/TS 15209. In Annex B of CEN/TS 15209, the reference to clause 4.3 of the same standard for the conformity check of the determined measures shall not be understood as a reference to threshold levels, since the applicable dimensions are those valid in the place of use in dependence on the requirements set therein.

Expression of results

The surface description, which will include the surface profile feature/s and the dimensions of the layouts and profiles of the ceramic multilayer slabs, shall be stated in the ETA as given in CEN/TS 15209. The surface description shall be based on the tactile layouts and profiles detailed in Figures from 1 to 19 of CEN/TS 15209 (as stated in clause 4.1 of CEN/TS 15209).

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is:

- Use 1 and Use 2 (see clause 1.2.1): Commission Decision 98/437/EC as amended by Commission Decision 2001/596/EC for internal and external walls and ceiling finishes.

The applicable AVCP system is 4 for any use except for uses subject to regulations on reaction to fire and on dangerous substances.

For uses subject to regulations on reaction to fire the applicable AVCP systems regarding reaction to fire are 1, or 3, or 4 depending on the conditions defined in the said Decision.

For uses subject to regulations on dangerous substances the applicable AVCP systems is 3.

- Use 3 (see clause 1.2.1): Commission Decision 97/808/EC, as amended by Commission Decision 1999/453/EC and Decision 2001/596/EC and Decision 2006/190/EC for floorings.

The applicable AVCP system is 4 for any use except for uses subject to regulations on reaction to fire.

For uses subject to regulations on reaction to fire the applicable AVCP systems regarding reaction to fire are 1, or 3, or 4 depending on the conditions defined in the said Decision.

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 3.2.1.

Table 3.2.1 Control plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]					
1	Incoming component (glass fibre mat / mesh)	Checking of delivery ticket or label on the package	Conformity with the order	---	Each delivery
2	Incoming component (glass fibre mat / mesh) / Mass per unit area	According to control plan	Conformity with the order	---	Each delivery
3	Incoming component (glass fibre mat / mesh) / Ash content at 625 °C	According to control plan	Conformity with the order	---	Each delivery
4	Incoming component (glass fibre mat / mesh) / Mesh size and number of filaments	According to control plan	Conformity with the order	---	Each delivery
5	Incoming component (glass fibre mat / mesh) / Tensile strength and elongation	According to control plan	Conformity with the order	---	Each delivery
6	Incoming component (adhesive)	Checking of delivery ticket or label on the package	Conformity with the order	---	Each delivery
7	Incoming component (adhesive) / Specific mass or density	According to control plan	Conformity with the order	---	Each delivery
8	Incoming component (adhesive) / Viscosity	According to control plan	Conformity with the order	---	Each delivery
9	Incoming component (adhesive) / Pot life	According to control plan	Conformity with the order	---	Each delivery
10	Finished product (ceramic multilayer slab) / Bond strength between layers – strength perpendicular to the faces (only at 23 °C)	Internal test based on 2.2.10	According to control plan	At least 3 specimens	According to control plan (*)
11	Finished product (ceramic multilayer slab) / Freeze-thaw resistance: - Bond strength between layers – strength perpendicular to the faces (only at 23 °C) after freeze-thaw conditioning - Aspect after freeze-thaw conditioning	Internal test based on 2.2.12 and 2.2.16	According to control plan	At least 3 specimens	According to control plan (*)
12	Finished product (ceramic multilayer slab) / Water absorption	Internal test based on 2.2.2	According to control plan	At least 3 specimens	According to control plan (*)

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]					
13	Finished product (ceramic multilayer slab) / Breaking strength, flexural tensile strength or modulus of rupture	Internal test based on 2.2.5 or 2.2.6	According to control plan	At least 3 specimens	According to control plan (*)
14	Finished product (ceramic multilayer slab) / Resistance to chemicals	Internal test based on 2.2.18	According to control plan	According to the control plan	According to control plan (*)
15	Finished product (ceramic multilayer slab) / Reaction to fire	2.2.1	According to control plan	2.2.1	At least each 5 years (**)
(*) Deviations from the given cornerstones (higher or lower frequencies) shall be agreed between manufacturer and TAB and laid down in the Control Plan case by case depending on the type of production process, the variation in the volume produced and the production process control (**). If no changes are presented at the ceramic multilayer slab, then these controls may not be necessary.					

3.3 Tasks of the notified body

The intervention of the notified body under AVCP system 1 is only necessary for reaction to fire for products/materials for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g., an addition of fire retardants or a limiting of organic material).

In this case the cornerstones of the actions to be undertaken by the notified body under AVCP system 1 are laid down in Table 3.3.1.

Table 3.3.1 Control plan for the notified body; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control carried out by the manufacturer regarding the constancy of performance related to reaction to fire <i>(for system 1 only)</i>					
1	Where the intervention of the Notified Body is necessary only because the conditions for the applicability of system 1 are fulfilled for reaction to fire, the notified body will consider especially the clearly identifiable stage in the production process which results in an improvement of the reaction to fire classification (e.g., an addition of fire retardants or a limiting of organic material).	Verification of the complete FPC as described in the control plan agreed between the TAB and the manufacturer	As defined in the control plan agreed between the TAB and the manufacturer	As defined in the control plan agreed between the TAB and the manufacturer	When starting the production or a new line
Continuous surveillance, assessment and evaluation of factory production control carried out by the manufacturer regarding the constancy of performance related to reaction to fire <i>(for system 1 only)</i>					
2	Where the intervention of the Notified Body is necessary only because the conditions for the applicability of system 1 in the Decisions regarding reaction to fire are fulfilled, the notified body will consider especially the clearly identifiable stage in the production process which results in an improvement of the reaction to fire classification (e.g., an addition of fire retardants or a limiting of organic material).	Verification of the controls carried out by the manufacturer as described in the control plan agreed between the TAB and the manufacturer with reference to the raw materials, to the process and to the product as indicated in Table 3.2.1.	As defined in the control plan agreed between the TAB and the manufacturer	As defined in the control plan agreed between the TAB and the manufacturer	2 times per year

4 REFERENCE DOCUMENTS

CEN/TS 15209:2021	Tactile paving surface indicators produced from concrete, clay and stone.
EN 1990:2023	Eurocode - Basis of structural and geotechnical design.
EN 12004:2007+A1:2012	Adhesives for tiles - Requirements, evaluation of conformity, classification and designation.
EN 12004-2:2017	Adhesives for ceramic tiles – Part 2: Test methods.
EN 13238:2010	Reaction to fire tests for building products - Conditioning procedures and general rules for selection of substrates.
EN 13501-1:2018	Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests.
EN 13823:2020+A1:2022	Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item.
EN 14411:2012	Ceramic tiles - Definitions, classification, characteristics, evaluation of conformity and marking.
EN 14411:2016	Ceramic tiles - Definitions, classification, characteristics, assessment and verification of constancy of performance and marking.
EN 16165:2021	Determination of slip resistance of pedestrian surfaces - Methods of evaluation.
EN 16516:2017+A1:2020	Construction products: Assessment of release of dangerous substances – Determination of emissions into indoor air.
EN 16637-2:2023	Construction products: Assessment of release of dangerous substances – Part 2: Horizontal dynamic surface leaching test.
EN ISO 1182:2020	Reaction to fire tests for products – Non-combustibility test.
EN ISO 9239-1:2010	Reaction to fire tests for floorings – Part 1: Determination of the burning behaviour using a radiant heat source.
EN ISO 6341:2012	Water quality. Determination of the inhibition of the mobility of <i>Daphnia magna</i> Straus (Cladocera, Crustacea). Acute toxicity test.
EN ISO 10545-3:2018	Ceramic tiles — Part 3: Determination of water absorption, apparent porosity, apparent relative density and bulk density.
EN ISO 10545-4:2019	Ceramic tiles — Part 4: Determination of modulus of rupture and breaking strength.
EN ISO 10545-5:1997	Ceramic tiles — Part 5: Determination of impact resistance by measurement of coefficient of restitution.
EN ISO 10545-6:2012	Ceramic tiles — Part 6: Determination of resistance to deep abrasion for unglazed tiles.

EN ISO 10545-8:2014	Ceramic tiles — Part 8: Determination of linear thermal expansion.
EN ISO 10545-9:2013	Ceramic tiles — Part 9: Determination of resistance to thermal shock.
EN ISO 10545-10:2021	Ceramic tiles — Part 10: Determination of moisture expansion.
EN ISO 10545-12:1997	Ceramic tiles — Part 12: Determination of frost resistance.
EN ISO 10545-13:2016	Ceramic tiles — Part 13: Determination of chemical resistance.
EN ISO 11348-1:2008+A1:2018	Water quality. Determination of the inhibitory effect of water samples on the light emission of <i>Vibrio fischeri</i> (Luminescent bacteria test). Part 1: Method using freshly prepared bacteria.
EN ISO 11348-2:2008+A1:2018	Water quality. Determination of the inhibitory effect of water samples on the light emission of <i>Vibrio fischeri</i> (Luminescent bacteria test). Part 2: Method using liquid-dried bacteria.
EN ISO 11348-3:2008+A1:2018	Water quality. Determination of the inhibitory effect of water samples on the light emission of <i>Vibrio fischeri</i> (Luminescent bacteria test). Part 3: Method using freeze-dried bacteria.
EN ISO 11925-2:2020	Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test.
EN ISO 15799:2022	Soil quality – Guidance on the ecotoxicological characterization of soils and soil materials.
EAD 090062-01-0404	Kits for external wall claddings mechanically fixed.

ANNEX A: PROVISIONS FOR THE PREPARATION OF SPECIMENS, TEST PROCEDURE AND CALCULATION OF TEST RESULTS: BOND STRESS BETWEEN THE LAYERS - STRENGTH PERPENDICULAR TO THE FACES

This Annex describes the apparatus and procedure for assessing the adhesion between the different layers of the ceramic multilayer slab when subjected to a force perpendicular to the surface of the specimen.

A1. Summary of Test Method

A force shall be applied perpendicular to the faces of a square specimen of multilayer slab using a dynamometer with a constant crosshead speed until failure.

A2. Test equipment

Tests shall be conducted using a dynamometer with a constant crosshead speed of (10 ± 1) mm/min. Two metal plates shall be glued with a two-component adhesive on the faces of the specimen, of which one shall be fixed to the stationary part of the dynamometer while the second shall be fixed to the mobile crosshead (Figure A2.1 and A2.2). The two metal plates are fixed to the dynamometer through a fixing system which shall guarantee that the tension force is exactly perpendicular to the faces of the specimen, with no flexural components.

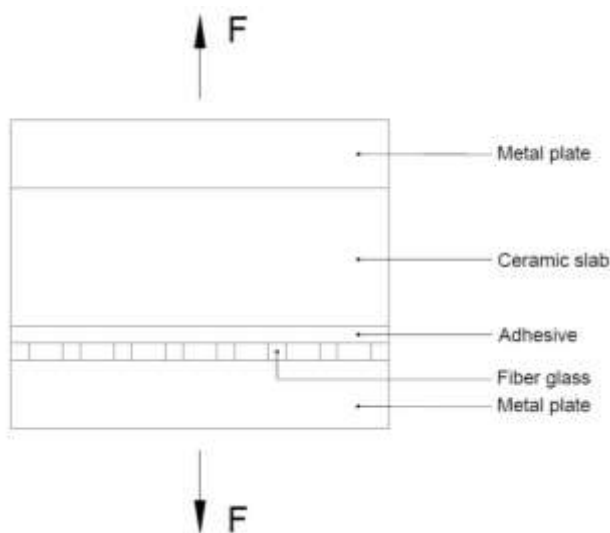


Figure A2.1: Type A specimen

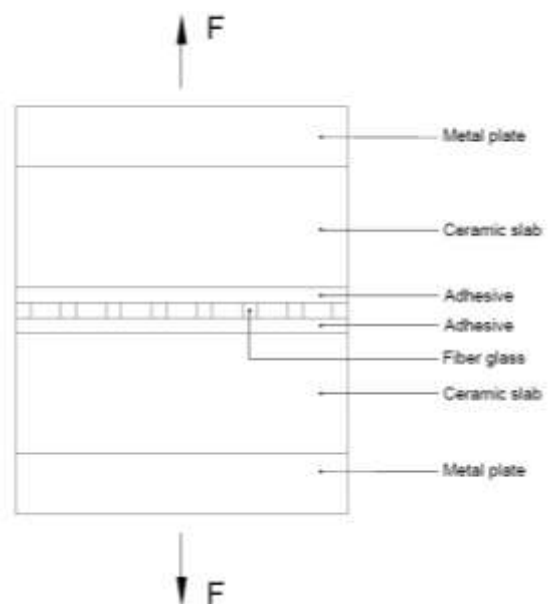


Figure A2.2: Type B specimen

A3. Test Specimens

The test specimens shall be prisms of square cross-section 50 mm x 50 mm and the thickness shall be equal to the original product thickness. The test shall be carried out on 5 specimens for each different temperature condition.

The test specimens shall be cut from the product preferably not closer than 15 mm from the edges of the product to avoid the influence of any edge unevenness.

A4. Conditioning

The bond strength test shall be carried out at three different temperature conditions, which are:

- $T = (23 \pm 2) \text{ } ^\circ\text{C}$; R.H. = $(50 \pm 5) \%$
- $T = (-20 \pm 2) \text{ } ^\circ\text{C}$
- $T = (80 \pm 2) \text{ } ^\circ\text{C}$

Before the test, the specimens shall be conditioned at the test temperature for 24 hours.

A5. Test procedure

Before the 24-hour conditioning, the test specimens shall be glued to the two metallic plates using a two-component adhesive. At the end of the conditioning period, the test specimens shall be attached in the tensile machine by means of the metallic plate fixing and the tensile force shall be increased with a constant speed of the mobile crosshead of (10 ± 1) mm/min until either failure occurs (i.e., the test specimen breaks), or a maximum measured tensile force is reached, when it is not possible to achieve the breaking in the test specimen (i.e., the breaking occurs in the two-component adhesive used to glue the metallic plates to the specimen).

The test is performed at the same temperature of the preceding 24-hour conditioning by means of a climatic cell or a suitable apparatus⁶.

A6. Processing of test results

For each temperature T, the tensile stress perpendicular to faces, σ_{max}^T shall be then calculated with the formula:

$$\sigma_{max}^T = F_{max}^T / A$$

where:

F_{max}^T : is the tensile breaking or maximum force recorded of the specimen tested at temperature T, in N.

A: is the cross-section area of the test specimen, in mm².

The average value σ_m^T at each test temperature shall be calculated as the arithmetic mean of the 5 test results. The 5%-fractile value, σ_c^T , shall be determined by using the appropriate value of k_n for unknown V_x reported in EN 1990, Annex D, Table D1.

A7. Test report

The test report shall report at least the following information:

- Date of test, test temperature.
- Maximum tensile stress perpendicular to the faces, σ_{max}^T , of each specimen tested for each temperature in MPa.
- The average (arithmetic mean), σ_m^T , and 5%-fractile value, σ_c^T , of the tensile stress perpendicular to faces for each test temperature.
- When occurs, the failure mode for each specimen.
- Any other deviations from the procedure.

⁶ E.g., the dynamometer is provided with a portable climatic chamber, also called environmental chamber, which is a chamber for testing at non-ambient temperatures.

ANNEX B: PROVISIONS FOR THE PREPARATION OF SPECIMENS, TEST PROCEDURE AND CALCULATION OF TEST RESULTS: BOND STRESS BETWEEN THE LAYERS – SHEAR STRENGTH

This Annex describes the apparatus and procedure for assessing the adhesion between the different layers of the ceramic multilayer slab when subjected to a shear force.

B1. Summary of Test Method

A test specimen shall be subjected to a shear stress transmitted to the test specimen using metal plates, which shall be bonded to the specimen. The force shall be applied using a dynamometer with a constant crosshead speed until failure.

B2. Test equipment

Tests shall be conducted using a dynamometer with a constant crosshead speed of (10 ± 1) mm/min. Two metal plates shall be glued with a two-component adhesive on the faces of the specimen, of which one shall be fixed to the stationary part of the dynamometer while the second shall be fixed to the mobile crosshead (Figure B2.1 and B2.2). The fixing of two metal plates to the dynamometer shall guarantee that the applied force is exactly parallel to the faces of the specimen, with no flexural components.

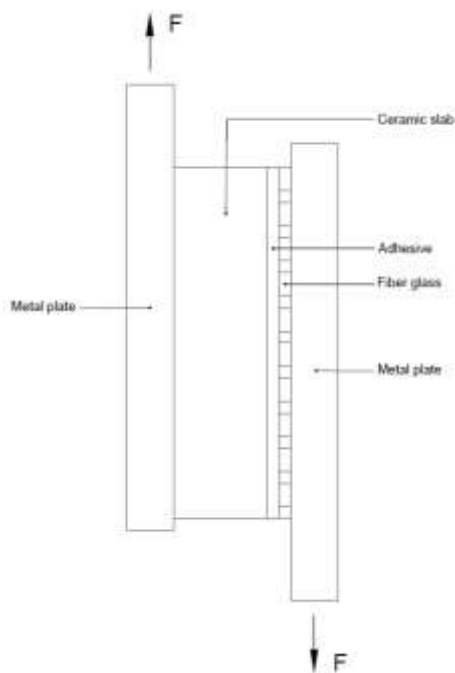


Figure B2.1: Type A specimen

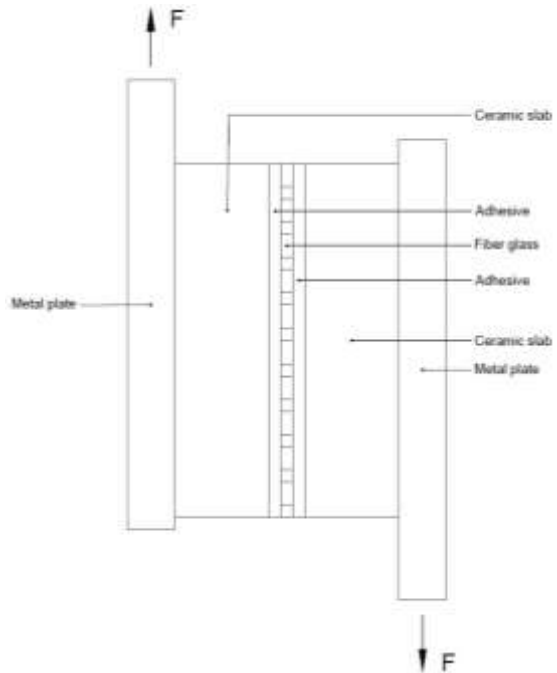


Figure B2.2: Type B specimen

B3. Test Specimens

The test specimens shall be prisms of section 50 mm x 200 mm and the thickness shall be equal to the original product thickness. The test shall be carried out on 5 specimens for each different temperature condition.

The test specimens shall be cut from the product preferably not closer than 15 mm from the edges of the product to avoid the influence of any edge unevenness.

The dimensions of the specimen may be reduced when the failure occurs not in the specimen but in the fixing device of the specimen to the loading machine (dynamometer).

B4. Conditioning

The bond strength test shall be carried out at three different temperature conditions, which are:

- $T = (23 \pm 2) \text{ } ^\circ\text{C}$; R.H. = $(50 \pm 5) \%$

- $T = (-20 \pm 2) \text{ } ^\circ\text{C}$
- $T = (80 \pm 2) \text{ } ^\circ\text{C}$

Before the test, the specimens shall be conditioned at the test temperature for 24 hours.

B5. Test procedure

Before the 24-hour conditioning, the test specimens shall be glued to the two metallic plates using a two-component adhesive. At the end of the conditioning period, the test specimens shall be attached in the tensile machine by means of the metallic plate fixing. The specimen is mounted to have the long dimension on the same direction of the movement of the crosshead. A tensile force parallel to the surface of the specimen shall be increased with a constant speed of the mobile crosshead of $(10 \pm 1) \text{ mm/min}$ until either failure occurs (i.e., the test specimen breaks), or a maximum measured tensile force is reached, when it is not possible to achieve the breaking in the test specimen (i.e., the breaking occurs in the two-component adhesive used to glue the metallic plates to the specimen).

The test is performed at the same temperature of the preceding 24-hour conditioning by means of a climatic cell or a suitable apparatus.

B6. Processing of test results

For each temperature T , the maximum shear stress, τ_{max}^T shall be then calculated with the formula:

$$\tau_{max}^T = F_{max}^T / A$$

where:

F_{max}^T : is the shear breaking or maximum force recorded of the specimen tested at temperature T , in N.

A : is the cross-section area of the test specimen, in mm^2 .

The average value τ_m^T at each test temperature shall be calculated as the arithmetic mean of the 5 test results. The 5%-fractile value, τ_c^T , shall be determined by using the appropriate value of k_n for unknown V_x reported in EN 1990, Annex D, Table D1.

B7. Test report

The test report shall report at least the following information:

- Date of test, test temperature.
- Maximum shear stress, τ_{max}^T , of each specimen tested for each temperature in MPa.
- The average (arithmetic mean), τ_m^T , and 5%-fractile value, τ_c^T , of the shear stress for each test temperature.
- When occurs, the failure mode for each specimen.
- Any other deviations from the procedure.