Deutsches Institut für Bautechnik

DIBt

Allgemeine bauaufsichtliche Zulassung

Zulassungsstelle für Bauprodukte und Bauarten

Bautechnisches Prüfamt

Eine vom Bund und den Ländern
gemeinsam getragene Anstalt des öffentlichen Rechts

Mitglied der EOTA, der UEAtc und der WFTAO

Date: 22 May 2017

Reference: I 16-1.71.3-10/13

Approval number:
Z-71.3-39

Validity
from: **22 May 2017**
to: **22 May 2019**

Applicant:
solidian GmbH
Sigmaringer Straße 150
72458 Albstadt
GERMANY

Subject of approval:
solidian sandwich panel

The subject of approval named above is herewith granted a national technical approval (allgemeine bauaufsichtliche Zulassung).
This national technical approval (allgemeine bauaufsichtliche Zulassung) consists of 13 pages and five annexes.

Translation authorised by DIBt

I GENERAL PROVISIONS

1 With the national technical approval (*allgemeine bauaufsichtliche Zulassung*) the fitness for use and the applicability of the subject of approval in accordance with the Building Codes of the federal states (*Landesbauordnungen*) have been verified.

2 The national technical approval (*allgemeine bauaufsichtliche Zulassung*) does not replace the permits, approvals and certificates prescribed by law for carrying out building projects.

3 The national technical approval (*allgemeine bauaufsichtliche Zulassung*) will be granted without prejudice to the rights of third parties, in particular private property rights.

4 Notwithstanding further provisions in the 'Special Provisions', manufacturers and distributors of the subject of approval shall make copies of the national technical approval (*allgemeine bauaufsichtliche Zulassung*) available to the user and point out that the national technical approval (*allgemeine bauaufsichtliche Zulassung*) shall be available at the place of use. Upon request, copies of the national technical approval (*allgemeine bauaufsichtliche Zulassung*) shall be placed at the disposal of the authorities involved.

5 The national technical approval (*allgemeine bauaufsichtliche Zulassung*) may be reproduced in full only. Partial publication requires the consent of Deutsches Institut für Bautechnik. Texts and drawings of advertising brochures may not be in contradiction to the national technical approval (*allgemeine bauaufsichtliche Zulassung*). In the event of a discrepancy between the German original of the national technical approval (*allgemeine bauaufsichtliche Zulassung*) and this authorised translation, the German version shall prevail.

6 The national technical approval (*allgemeine bauaufsichtliche Zulassung*) is granted until revoked. The provisions of the national technical approval (*allgemeine bauaufsichtliche Zulassung*) can subsequently be supplemented and amended, in particular if this is required by new technical findings.

II SPECIAL PROVISIONS

1 Subject of approval and field of application

1.1 Subject of approval

The subject of approval is a factory-made, three-layered solidian sandwich panel with a load-bearing inner layer made of reinforced concrete, an insulation layer, a textile-reinforced exterior layer made of standard concrete and a textile connection system.

The 30-mm-thick exterior layer of the sandwich panel is reinforced in its interior by means of a non-metallic solidian GRID Q121/121-AAE-38 reinforcement mesh. The inner layer of reinforced concrete is subject to DIN EN 1992-1-1 in connection with DIN EN 1992-1-1/NA. The inner and exterior layers are connected in a friction-lock manner with a shear mesh as a moulded part, which is also made of solidian GRID Q121/121-AAE-38.

The clearance between the inner and exterior layer h_{WD} is between 140 mm and 250 mm. It shall be filled with an insulation layer that shall not be used for transferring the load.

1.2 Field of application

The solidian sandwich panel may be used as a load-bearing, bracing and non-bearing exterior wall component for buildings of exposure classes X0, XC1 to XC4 as well as XF1 in accordance with DIN EN 1992-1-1/NA, NCI for 4.2, Table 4.1.

The solidian sandwich panel shall be used only in non-rear-ventilated façade constructions.

The solidian sandwich panel shall be used only for static and quasi-static loads.

Resistance to horizontal loads resulting from earthquakes at the levels of the exterior layer and the shear meshes have not been verified within the framework of the approval.

2 Provisions for the construction products

2.1 Properties and composition

2.1.1 solidian GRID Q121/121-AAE-38

The solidian GRID Q121/121-AAE-38 reinforcement consists of alkali-resistant glass filaments, which are drawn together into rovings and processed to form glass fabrics with a mesh-shaped structure. The fabric is manufactured in the form of mat products.

The longitudinal and transverse spacing of the rovings is 38 mm ±3 mm (see Annex 1), with a fibre cross-section of 4.62 mm^2 per roving. The cross-section of the fibre reinforcement in each direction is 121 mm^2/m. Additional technical characteristics of solidian GRID Q121/121-AAE-38 are provided in Annex 1.

Manufacturing plants, composition, characteristics of the fibre material and impregnation material as well as the process-engineering parameters of the manufacturing process shall be identical to the manufacturer's specifications as deposited with Deutsches Institut für Bautechnik.

2.1.2 Reinforcement meshes for the exterior layer

The reinforcement meshes for the exterior layer are made of solidian GRID Q121/121-AAE-38 in accordance with Section 2.1.1. The maximum dimensions of the meshes are 2,500 mm x 6,000 mm. Partial widths and partial lengths may also be produced and used.

2.1.3 Shear meshes

The solidian GRID Q121/121-AAE-38 shear meshes in accordance with Section 2.1.1 are converted into moulded reinforcement in an additional manufacturing step (see Annex 2). In the process, the rovings are arranged at ±45° ±3 relative to the longitudinal axis of the shear mesh. The shear meshes are manufactured as piece goods with a maximum length of 6,000 mm. Partial lengths may also be manufactured and used.

2.1.4 Reinforcement for the inner layer

B500A or B500B reinforcing steel in accordance with DIN 488-1 or a national technical approval (*allgemeine bauaufsichtliche Zulassung*) shall be used.

2.1.5 Concrete

The exterior and inner layers of the sandwich panel are made of concrete of strength class C50/60 in accordance with DIN EN 206-1 in conjunction with DIN 1045-2. The maximum grain diameter of the concrete is d_g = 8 mm. The composition of the concrete (inner and exterior layer) shall be identical to the composition deposited with Deutsches Institut für Bautechnik and the inspection body. In the event of deviations, the provisions of the deposited test and control plan shall be taken into account.

2.1.6 Three-layered solidian sandwich panel

The solidian sandwich panel has a maximum height of 4 m and a maximum length of 6 m.

The textile reinforcement shall not be exposed at the edges. The concrete cover shall be 15 mm on all sides. The reinforcement mesh of the 30-cm-thick exterior layer shall be placed at a distance of 15±1 mm. An overlap length of $l_ü \geq 150±5$ mm shall be observed at mesh joints. A maximum of two reinforcement layers may be placed in the area of the overlap.

The shear meshes shall not be jointed and are embedded 15±1 mm into the exterior layer and at least 25±1 mm into the inner layer. It is not necessary to anchor the shear meshes behind the reinforcing-steel reinforcement of the inner layer. The horizontal and vertical orientation of the shear meshes shall be verified in accordance with Section 3 of this national technical approval (*allgemeine bauaufsichtliche Zulassung*).

2.1.7 Thermal insulation

Thermal insulation boards with compressive strength of at least σ_{10} = 60 kPa in accordance with DIN EN 826 shall be used.

2.1.8 Fire protection

The design specifications in accordance with DIN EN 1992-1-1 in conjunction with DIN EN 1992-1-1/NA shall apply.

Where combustible insulation materials are used, all open edges of the sandwich panel (including around the cutouts) shall be sealed with a continuous and circumferential 200-mm-wide strip of flat and butt-jointed mineral wool in accordance with Section 2.1.7 covering the entire height of the clearance between the inner and exterior layers h_{WD}; the fibres of the mineral wool shall be arranged in parallel to the panel. These fire-protection strips shall be compressed to the wet concrete of the exterior layer and, in addition, secured by means of circumferential mechanical fastening involving stainless-steel connector pins (ϕ 4 mm, 1.4401), spaced at 50-60 cm and with an anchoring depth of 40 mm in the inner layer and h_{WD} - 40 mm in the mineral-wool strips. A two-layered arrangement of the mineral wool shall be excluded; see Annex 4.

For the aforementioned fire-protection measures, mineral-wool insulation boards in accordance with DIN EN 13162 with the following properties shall be used:

- Reaction to fire: non-combustible (*nichtbrennbar*)
- Melting point > 1000°C as per DIN 4102-17
- Apparent density ≥ 60 kg/m³ as per DIN EN 1602

In this installation, the solidian GRID Q121/121-AAE-38 reinforcement is deemed to meet the requirements of flammable (*normalentflammbar*) building materials.

2.2 Manufacture, packaging, transport, storage, marking

2.2.1 Manufacture

2.2.1.1 solidian GRID Q121/121-AAE-38, reinforcement mesh and shear meshes

solidian GRID Q121/121-AAE-38 in accordance with Section 2.1.1, the reinforcement mesh in accordance with Section 2.1.2 and the shear meshes in accordance with Section 2.1.3 shall be manufactured only in selected manufacturing plants. A list of the plants has been deposited with Deutsches Institut für Bautechnik and the external surveillance body.

The fabric shall be manufactured in such a manner that the rovings can be aligned, longitudinally and transversely, without undulations, impregnated fully with the impregnation material, tempered and cured.

The shear meshes are converted into moulded reinforcement in an additional production step. They are moulded when they are not impregnated yet. Then, they are impregnated and tempered. In the process, the rovings shall be arranged at ±45º ±3 relative to the longitudinal axis of the shear mesh.

The meshes and shear meshes shall be marked in a distinctive and durable manner with the type name "solidian GRID Q121/121-AAE-38" in accordance with Section 2.2.3.

The fibre and impregnation materials shall be manufactured only from the components specified in Section 2.1.1 in manufacturing plants whose names have been deposited with Deutsches Institut für Bautechnik.

2.2.1.2 Three-layered solidian sandwich panel

The sandwich panel in accordance with Section 2.1.6 shall be manufactured only in such manufacturing plants as are listed with the company solidian and the certification of which has been deposited with Deutsches Institut für Bautechnik.

Only the materials specified in Section 2.1 shall be used. The manufacturer of the sandwich panel shall ensure that the properties of the solidian GRID Q121/121-AAE-38 textile material comply with the requirements of this approval as per an inspection certificate "type 3.1" in accordance with DIN EN 10204.

The solidian sandwich panel shall be manufactured in a horizontal position as follows:

No conveyor containers shall ride over, and no one shall step on, the component during the entire manufacturing process. The shear-mesh carriers shall not be bent and exposed to loads during the entire manufacturing process.

Damaged reinforcement meshes or shear meshes shall not be used. They shall be removed and marked as damaged.

The reinforcement mesh of the exterior layer is positioned 15±1 mm from the prepared formwork. Appropriate spacers shall be used to this end. An overlap length of $l_ü \geq 150 \pm 5$ mm shall be observed at mesh joints. A maximum of two reinforcement layers shall be placed in the area of the overlap. The shear meshes shall not be jointed and shall be mounted to the reinforcement as per Annex 3. They shall be fixed in place during the concreting process to keep them positioned. The shear-mesh carriers shall always be parallel to the component axes; any deviations therefrom shall be excluded.

Following the concreting of the exterior layer, the thermal insulation is placed on the fresh concrete of the exterior layer. The mineral-wool fire barriers shall be realised using stainless-steel connector pins in accordance with Section 2.1.8.

The inner layer is reinforced and concreted in the last production step. The shear-mesh carriers shall be embedded at least 25±1 mm into the inner layer and shall have a concrete cover of 25 mm on both sides. Installations in the area of the shear meshes shall be excluded on the basis of this boundary condition.

Sandwich boards that, after the formwork has been stripped, are damaged, cracked or show unusual deformations on the outer surface shall not be used.

2.2.2 Transport and storage

2.2.1.1 solidian GRID Q121/121-AAE-38, reinforcement mesh and shear meshes

The reinforcement meshes and shear meshes shall be protected from weather conditions (rain water/condensation moisture) as well as from dirt and UV radiation during transport and storage.

2.2.2.2 Three-layered solidian sandwich panel

The exterior layer and thermal insulation shall not be exposed to loads or impact during transport and storage.

Several boards shall not be stacked on top of each other during transport, as their weight multiplies the load exerted on the shear meshes.

2.2.3 Marking

The solidian sandwich panel shall be marked by the manufacturer with the national conformity mark (*Ü-Zeichen*) in accordance with the Conformity Marking Ordinances (*Übereinstimmungszeichen-Verordnungen*) of the federal states. The mark shall only be applied if the requirements given in Section 2.3 are met. In the event of risk of confusion during assembly, the finished component shall be marked to indicate the installation position.

The delivery note of the solidian sandwich panel shall indicate the exposure classes in accordance with 2.1.5 of this national technical approval (*allgemeine bauaufsichtliche Zulassung*), the manufacturing plant and the date of manufacture.

2.3 Attestation of conformity

2.3.1 General

The attestation of conformity of the solidian sandwich panel with the provisions of this national technical approval (*allgemeine bauaufsichtliche Zulassung*) shall be issued for every manufacturing plant in the form of a certificate of conformity based on factory production control and regular external surveillance, including initial type-testing of the solidian sandwich panel, in accordance with the following provisions.

To issue the certificate of conformity and for external surveillance, including the associated product testing to be carried out in the process, the manufacturer of the solidian sandwich panel shall use an appropriately recognised certification body and an appropriately recognised inspection body.

The declaration that a certificate of conformity has been granted shall be given by the manufacturer by marking the construction products with the national conformity mark (*Ü-Zeichen*) stating the intended use.

The certification body shall send a copy of the certificate of conformity issued by it as well as a copy of the initial type-testing evaluation report to Deutsches Institut für Bautechnik.

2.3.2 Factory production control

A factory production control system shall be set up and implemented in each manufacturing plant. Factory production control is understood to be continuous surveillance of production by the manufacturer to ensure that the manufactured construction products comply with the provisions of this national technical approval (*allgemeine bauaufsichtliche Zulassung*).

The factory production control shall at least include the measures listed in the test and control plan. The test and control plan is deposited with Deutsches Institut für Bautechnik and the body carrying out external surveillance. In addition, the relevant tests in accordance with DIN 1045-4 shall be carried out for the manufacture of the inner layer of the solidian sandwich panel.

The results of factory production control shall be recorded and evaluated. The records shall at least include the following information:

- designation of the construction product or the starting material and the components
- type of check or test
- date of manufacture and testing of the construction product or the starting material or the components
- results of the checks and tests as well as (if applicable) comparison with requirements
- signature of the person responsible for factory production control.

The records shall be kept for at least five years and, to the extent required, be submitted to the inspection body used for external surveillance. They shall be submitted to Deutsches Institut für Bautechnik and the competent supreme building authority upon request.

If the test result is unsatisfactory, the manufacturer shall immediately take the necessary measures to resolve the defect. Construction products which do not meet the requirements shall be handled in such a manner that they cannot be confused with compliant construction products. After the defect has been remedied the relevant test shall be repeated immediately, where technically practicable and necessary to demonstrate that the defect has been eliminated.

2.3.3 External surveillance

The factory production control system at each manufacturing plant of the solidian GRID Q121/121-AAE-38 reinforcement and the shear-mesh carriers and at each manufacturing plant of the solidian sandwich panel shall be inspected regularly, i.e. at least twice a year, by means of external surveillance.

Initial type-testing of the respective construction product shall be carried out within the framework of external surveillance. Samples for random testing may also be taken. Sampling and testing for the respective construction product are always the responsibility of a recognised inspection body as per the list of recognised testing laboratories, inspection bodies and certification bodies (*PÜZ-Stellen*).

At least the tests specified in the test and control plan deposited shall be carried out within the framework of the inspection of factory production control.

The results of certification and external surveillance shall be kept for at least five years. They shall be presented by the certification body or inspection body to Deutsches Institut für Bautechnik and the competent building authority upon request.

3 Provisions for design and dimensioning

3.1 General

Structural verification of the load-bearing capacity of the solidian sandwich panel shall be performed for each individual case.

The dimensioning of the inner layer (reinforced concrete) is not subject to this approval and shall be in accordance with DIN EN 1992-1-1 in conjunction with DIN EN 1992-1-1/NA and DIN 1045-4.

The reinforcement meshes for the exterior layer and the shear mesh (horizontal/vertical) shall be arranged in such manner that the exterior layer is braced against the actions impacting on it. The construction rules as per Annexes 3 and 4 shall be observed. In the dimensioning of the shear-mesh carriers, unplanned obliqueness of 5 degrees along the Z- and X-axes of the shear meshes shall be taken into consideration in accordance with the defined direction as per Annex 5. The maximum distance of the vertical shear meshes e_{SG} in accordance with Annex 4 is 1.2 m. The length of the horizontal shear meshes shall be at least 1 m. Horizontal shear meshes shall be arranged in the area of the deformation resting position.

The thermal insulation shall be deemed not to contribute to the load-bearing behaviour in the serviceability limit state (SLS) and the ultimate limit state (ULS). The dead weight of the thermal insulation shall be taken into account.

The exterior layer transfers actions resulting from dead weight, wind pressure and suction as well as the temperature and shrinking/swelling to the inner layer via the shear meshes.

The load-bearing capacities of the exterior layer shall in combination with the shear meshes or the thermal insulation (sandwich load-bearing effect) shall not be factored into the overall load-bearing behaviour of the building.

3.2 Determination of internal forces

Internal forces shall be determined in accordance with DIN EN 1992-1-1 in conjunction with DIN EN 1992-1-1/NA, Section 5.4, following the linear elastic analysis. The material's technical characteristics as per Section 2.1 of this approval shall be applied. In the dimensioning of the horizontal shear meshes, the internal forces from stresses due to rotation and translation shall be taken into account with respect to the deformation resting position.

Temperature-dependent load cases in accordance with Table 1 and exterior-layer dead weight γ = 24 kN/m³ shall be used in the determination of internal forces. The dead weight of the thermal insulation shall be considered in the dimensioning.

Table 1: Load conditions for the determination of internal forces

Load case	Summer	Winter
Temperature of exterior layer T_a [°C]	+65	-20
Temperature of inner layer T_i [°C]	+25	+20
Temperature gradient T_g [K]	+3.4	-3.4
Shrinking ΔT [K]*) and swelling**)	+10	-10

*) Shrinkage deformations are taken into account in the load case "Winter" by way of a reduction in the exterior temperature by ΔT

**) Swelling may occur as a result of alternating moisture exposure of the exterior layer and is taken into account in the load case "Summer".

For the determination of internal forces, stiffness of the shear meshes shall be taken into consideration in order to reflect constraint stresses realistically. The stiffness values to be used are specified in Table 2 for ULS and Table 3 for SLS.

Table 2: Stiffness and strength of the shear meshes as per Annex 5 for the permanent and temporary dimensioning situation in the ultimate limit state

	Property	**Formula symbol**	**Clearance h_{WD}*)**	
			140 mm	**250 mm**
1	Stiffness in the direction of x (shear)	C_x [MN/(m·m)]	13.0	3.3
2	Stiffness in the direction of y (shear)	C_y [MN/(m·m)]	0	0
3	Stiffness in the direction of z (pressure)	$C_{c,z}$ [MN/(m·m)]	22.6±6.8**)	9.6±2.9**)
4	Stiffness in the direction of z (tension)	$C_{t,z}$ [MN/(m·m)]	19.9	9.2
5	Strength in the direction of x (shear strength)	$a_{Rd,x}$ [kN/m]	9.2	3.9
6	Strength in the direction of y (shear strength)	$a_{Rd,y}$ [kN/m]	0	0
7	Strength in the direction of z (compressive strength)	$a_{Rd,c,z}$ [kN/m]	7.1***)	2.0***)
8	Strength in the direction of z (tensile strength)	$a_{Rd,t,z}$ [kN/m]	8.1	8.1

*) h_{WD}: clearance between inner and exterior layers (see Annex 3). Linear interpolation shall be allowed to calculate values in between for rows 1-5.

**) The effect of reduced and increased stiffness shall be checked to determine the most critical position of a vertical shear mesh.

***) Measured values in between shall be interpolated as follows:

$a_{Rd,c,z} = 313 \cdot 10^3 \cdot (h_{WD}^{[mm]})^{-2.164}$

3.3 Verifications at ULS (ultimate limit state)

3.3.1 Load-bearing capacity of the exterior layer

The bending load-bearing capacity shall be verified as follows. The following verification shall apply to pure bending:

$$M_{Ed} \leq M_{Rd} \quad (1)$$

where:

M_{Ed} design value of the bending moment of the exterior layer

M_{Rd} design value of the bending load-bearing capacity of the exterior layer, M_{Rd} = 0.65 kNm/m

M_{Ed} The design value of the bending moment M_{Ed} may only be reduced by $t \leq 25$ mm in accordance with DIN EN 1992-1-1 Gl. (5.9). The calculated support width for the determination of internal forces shall not exceed this value.

Verification of tensile strength (pure tension):

$$N_{Ed} \leq N_{Rd} \quad (2)$$

where:

N_{Ed} normal tensile force resulting from the permanent and temporary dimensioning situations in the exterior layer, $N_{Ed} > 0$ kN/m

N_{Rd} tensile strength of the exterior shell, $N_{Rd} = 50.5$ kN/m

The losses of strength of the AR-glass reinforcement due to an alkaline attack of the concrete pore solution may amount to up to 25% over 50 years. The relation $f_{tk}(65\ °C)/f_{tk}(20\ °C)$ has been determined as 0.87. These risks are factored into the stated design values of the bending load-bearing capacity and tensile strength in a multiplicative manner.

In the event of combined stresses on the exterior layer due to bending and a normal tensile force, the following interaction verification shall be carried out:

$$M_{Ed}/M_{Rd} + N_{Ed}/N_{Rd} \leq 1 \quad (3)$$

3.3.2 Load-bearing capacity of the shear meshes

For the verification, the installed shear-mesh length L_{SG} shall be reduced relative to the clearance h_{WD} between the exterior and inner layers and the embedding dimensions v_{SG} and a. This produces the reduced shear-mesh length $L_{SG,red}$:

$$L_{SG,red} = L_{SG} - 2 \cdot h_{WD} - 42\ mm \quad (4)$$

The support reactions of the shear meshes shall be verified as follows:

Verification of shear strength: $a_{Ed,x} \leq a_{Rd,x}$ (5)

Verification of compressive strength: $a_{Ed,c,z} \leq a_{Rd,c,z}$ (6)

Verification of tensile strength: $a_{Ed,t,z} \leq a_{Rd,t,z}$ (7)

where:

$a_{Ed,x}$ action on the shear mesh (shear) in the direction of x [kN/m]

$a_{Ed,c,z}$ action on the shear mesh (pressure) in the direction of z [kN/m]

$a_{Ed,t,z}$ action on the shear mesh (tension) in the direction of z [kN/m]

The design values $a_{Rd,x}$, $a_{Rd,c,z}$ and $a_{Rd,t,z}$ shall be taken from Table 2. In the event of combined stresses due to tension-shear and/or pressure-shear, the following interaction verifications shall be carried out:

$$a_{Ed,x}/a_{Rd,x} + a_{Ed,c,z}/a_{Rd,c,z} \leq 1 \quad (8)$$

$$a_{Ed,x}/a_{Rd,x} + a_{Ed,t,z}/a_{Rd,t,z} \leq 1 \quad (9)$$

3.4 Verifications at SLS (serviceability limit state)

3.4.1 Verification of concrete tensile stresses

It shall be verified that the concrete tensile stresses in the exterior layer at SLS do not exceed the concrete tensile strength.

$$\sigma_{ctd} \leq f_{ctd} \quad (10)$$

where:

σ_{ctd} characteristic concrete tensile stress in the exterior layer in [N/mm²] at state I

$f_{ctd} = \alpha_{ct} \cdot f_{ctk;0.05} / \gamma_c$ where $\alpha_{ct} = 0.85$

f_{ctd} as per DIN EN 1992-1-1 in conjunction with DIN EN 1992-1-1/NA, Section 3.1.6

$f_{ctk;0.05}$ 5% fractile of the concrete tensile strength as per DIN EN 1992-1-1, $f_{ctk;0.05}$ = 2.9 N/mm² for concrete strength class C50/60

γ_c partial safety factor for concrete (γ_c = 1.0 for verification at SLS)

The stiffness values to be used are specified in Table 3.

Table 3: Stiffness of shear meshes as per Annex 5 for the determination of internal forces and for verifications of serviceability

	Property	Formula symbol	Clearance h_{WD} *)	
			140 mm	250 mm
1	Stiffness in the direction of x (shear)	C_x [MN/(m·m)]	13.0	3.3
2	Stiffness in the direction of y (shear)	C_y [MN/(m·m)]	0	0
3	Stiffness in the direction of z (pressure)	$C_{c,z}$ [MN/(m·m)]	22.6	9.6
4	Stiffness in the direction of z (tension)	$C_{t,z}$ [MN/(m·m)]	19.9	9.2
*)	h_{WD} : clearance between inner and exterior layers (see Annex 3). Linear interpolation shall be allowed for calculated values in between			

3.4.2 Verification of deformations

The deformation verification, where necessary, shall be carried out in accordance with DIN EN 1992-1-1 in conjunction with DIN EN 1992-1-1/NA for the uncracked exterior layer.

3.4.3 Permanent-state verification of shear meshes

It shall be verified that the vertical loads resulting from the exterior layer's dead weight can be absorbed permanently by the shear meshes.

The verification shall be carried out via the tension limit:

$$\sigma_{tk,perm} = \frac{G_{k,II}}{L_{SG,Vertikal} \quad a_{t,Steg}} \leq f_{tk,perm} \qquad (11)$$

where:

$f_{tk,perm}$ = 110 N/mm²

G_k dead weight of the exterior layer and thermal insulation [kN]

$G_{k,II} = G_k \cdot \sin \alpha$ G_k divided into roving direction with $\alpha = 45° \pm 3°$

$L_{SG,Vertikal}$ calculated shear-mesh length in the vertical direction: $L_{SG} - 2 \cdot h_{WD} - 42$ mm

$a_{t,Steg}$ = 242 mm²/m fibre cross-section of the shear mesh in the web

4 Provisions for the execution

4.1 General

The manufacturer of the factory-made panels shall provide assembly instructions in consideration of the general requirements in accordance with DIN EN 1992-1-1 and DIN EN 1992-1-1/NA, Section 10.2 (NA 6).

The solidian sandwich panels shall not be assembled any sooner than 28 days after the manufacture and not before reaching 90% of the required compressive strength of concrete strength class C50/60. Immediately prior to assembly, the absence of cracks on the exterior side of the exterior layer shall be determined and documented. Sandwich damaged or cracked sandwich panels or panels showing unusual deformations on the outer surface shall not be used.

Precast components with damages that affect the load-bearing capacity shall not be used. In particular, care shall be taken to ensure that the thermal insulation layer and the exterior layer are not exposed to stresses.

A joint width of at least 12 mm at room temperature shall be ensured.

Fasteners used for transport shall be arranged only in the area of the inner layer.

4.2 Fire protection

The vertical joints between the prefabricated solidian sandwich panels shall be filled with mineral wool. The prefabricated panels shall be jointed in such a manner as to create continuous fire barriers for each level.

Unless otherwise specified, the following standards are referred to in the national technical approval (*allgemeine bauaufsichtliche Zulassung*):

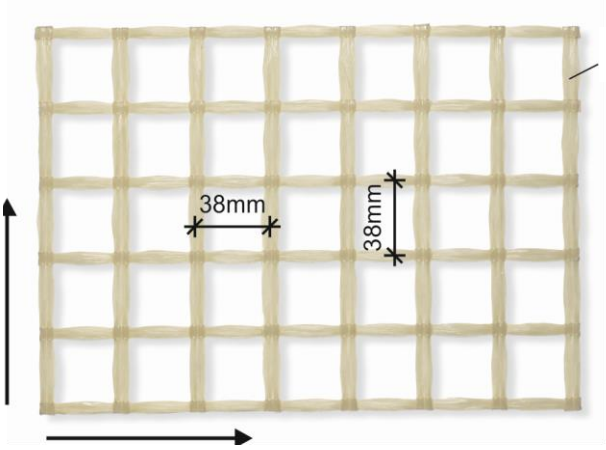
DIN EN 1992-1-1:2011-01	Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings; German version EN 1992-1-1:2004+AC:2010
DIN EN 1992-1-1/NA:2013-04	National Annex - Nationally determined parameters - Eurocode 2: Design of concrete structures – Part 1-1: General design rules and rules for buildings
DIN 1045-2:2008-08	Concrete, reinforced and prestressed concrete structures – Part 2: Concrete; specification, properties, production and conformity – Application rules for DIN EN 206-1
DIN EN 206-1:2001-07	Concrete – Part 1: Specification, performance, production and conformity; German version EN 206-1:2000 in conjunction with: DIN EN 206-1/A1:2004-10 Concrete – Part 1: Specification, performance, production and conformity; German version EN 206-1:2000/A1:2004 DIN EN 206-1/A2:2005-09 Concrete – Part 1: Specification, performance, production and conformity; German version EN 206-1:2000/A2:2005
DIN EN 10204:2005-01	Metallic products – Types of inspection documents
DIN 488-1:2009-08	Reinforcing steels – Part 1: Grades, properties, marking
DIN EN 826:2013-05	Thermal insulating products for building applications - Determination of compression behaviour; German version EN 826:2013

DIN EN 13162:2015-04	Thermal insulation products for buildings - Factory made mineral wool (MW) products – Specification; German version EN 13162:2012+A1:2015
DIN 4102-17:1990-12	Fire behaviour of building materials and elements - Part 17: determination of melting point of mineral fibre insulating materials; concepts, requirements and testing
DIN 1045-4:2012-02	Concrete, reinforced and prestressed concrete structures - Part 4: Additional rules for the production and the conformity of prefabricated elements
DIN EN 1602:2013-05	Thermal insulating products for building applications - Determination of the apparent density; German version EN 1602:2013

Gerhard Breitschaft
President

Drawn up by

solidian GRID Q121/121-AAE-38



Longitudinal direction (max. length: 6000 mm)

Transverse direction (max. width: 2500 mm)

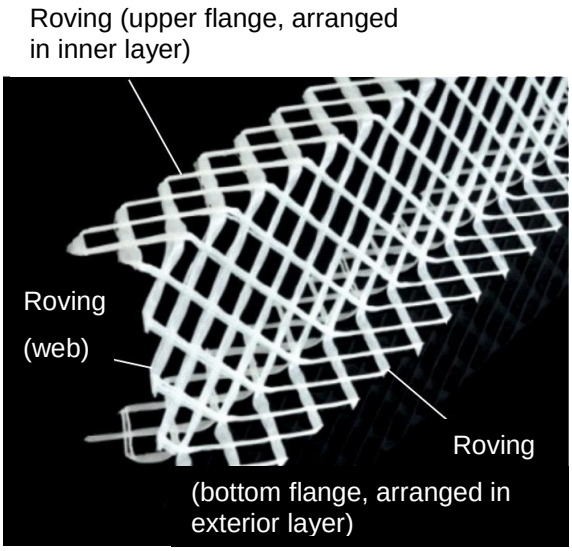
Technical data

	Characteristics	Unit	Longitudinal direction	Transverse direction
1	Fibre material	[-]	AR-glass filaments	AR-glass filaments
2	Impregnation material	[-]	Epoxy resin	Epoxy resin
3	Roving fineness (average)	[tex]	2,400 ±100	2,400 ±100
4	Roving axis distance	[mm]	38 ±3	38 ±3
5	Tensile strength roving*) Average value f_m characteristic value f_k	[N/mm²]	 ≥ 1,300 ≥ 1,100	 ≥ 1,300 ≥ 1,100
6	Modulus of elasticity roving*) Average value E_m characteristic value E_k	[N/mm²]	 ≥ 73,000 ≥ 60,500	 ≥ 73,000 ≥ 60,500
7	Elongation at fracture roving*) Average value ε_m characteristic value ε_k	[‰]	 ≥ 21 ≥ 17	 ≥ 21 ≥ 17
8	Weight per unit area reinforcement	[g/m²]	1,050 ±100	
9	Mass percentage impregnation material	[%]	38 ±5	

*) The rovings shall be taken from the impregnated, cured and level reinforcement. The stated values represent static short-term values. The losses of strength of the AR glass reinforcement due to an alkaline attack of the concrete pore solution may amount to up to 25% over 50 years. The description of the test has been deposited with DIBt.

solidian sandwich panel	Annex 1
Technical data of the solidian GRID Q121/121-AAE-38 textile	

Shear mesh

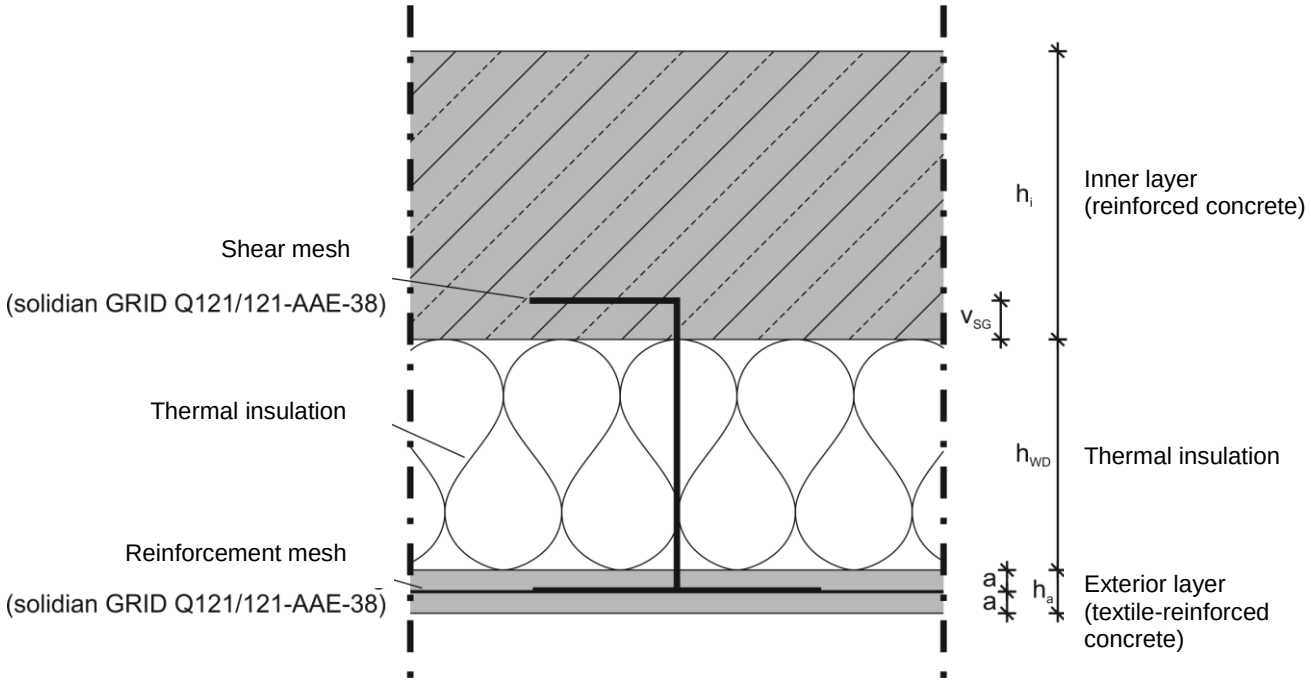


Technical data

	Characteristic	**Unit**	**Longitudinal direction**	**Transverse direction**
1	Height H_{SG} shear mesh	[mm]	H ±2%	H ±2%
2	Angle α of rovings in the web		±45 ±3	±45 ±3
3	Bending roller radius	[°]	in accordance with documents deposited with DIBt	

solidian sandwich panel	Annex 2
Technical data of the shear mesh	

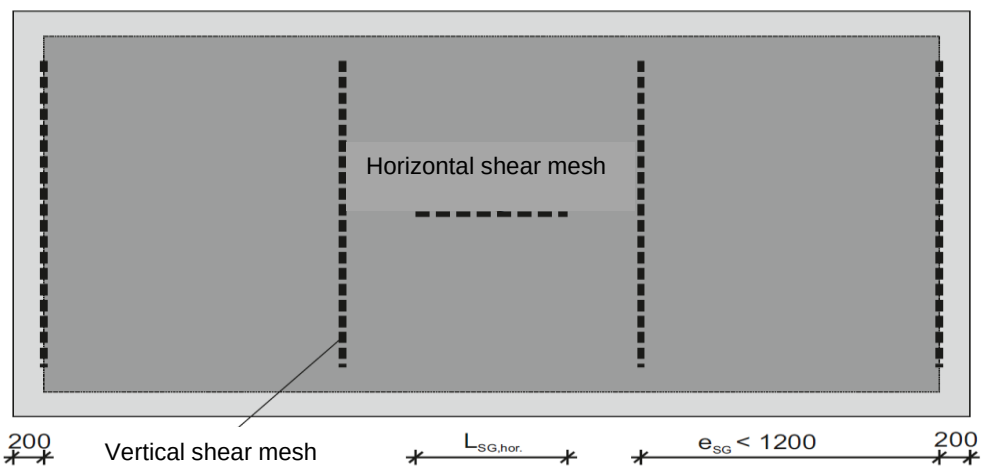
Cross-section

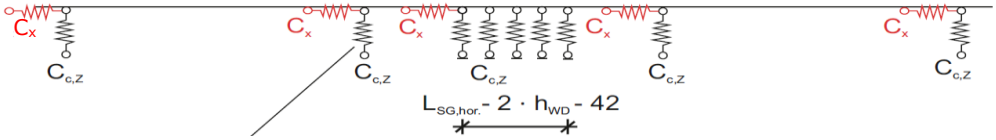


h_i	Thickness inner layer (reinforced concrete; as per DIN EN 1992-1-1)
h_{WD}	Thickness thermal insulation (140 mm ≤ h_{WD} ≤ 250 mm)
h_a	Thickness exterior layer (textile-reinforced concrete; h_a = 30 mm)
a	Position of reinforcement mesh in exterior layer (axial dimension; a= h_a/2 = 15±1 mm)
v_{SG}	Anchorage of shear mesh in inner layer (v_{SG} ≥ 25±1 mm)

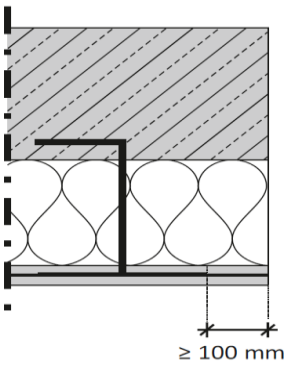
solidian sandwich panel	Annex 3
Cross-section	

View of sandwich panel with sample shear-mesh arrangement



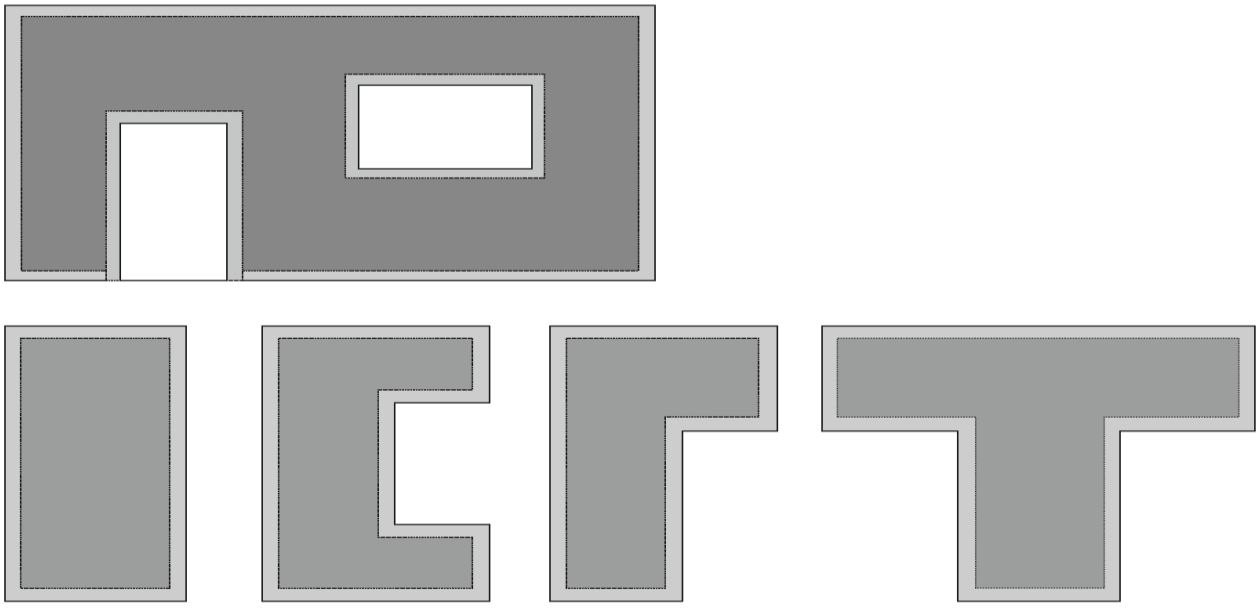


Support length = L_{SG} – 2 · h_{WD} - 42



Combustible thermal insulation e.g. EPS with a minimum compressive strength of 60 kPA at 10% compression

Non-combustible thermal insulation (mineral wool)
Width = 200 mm

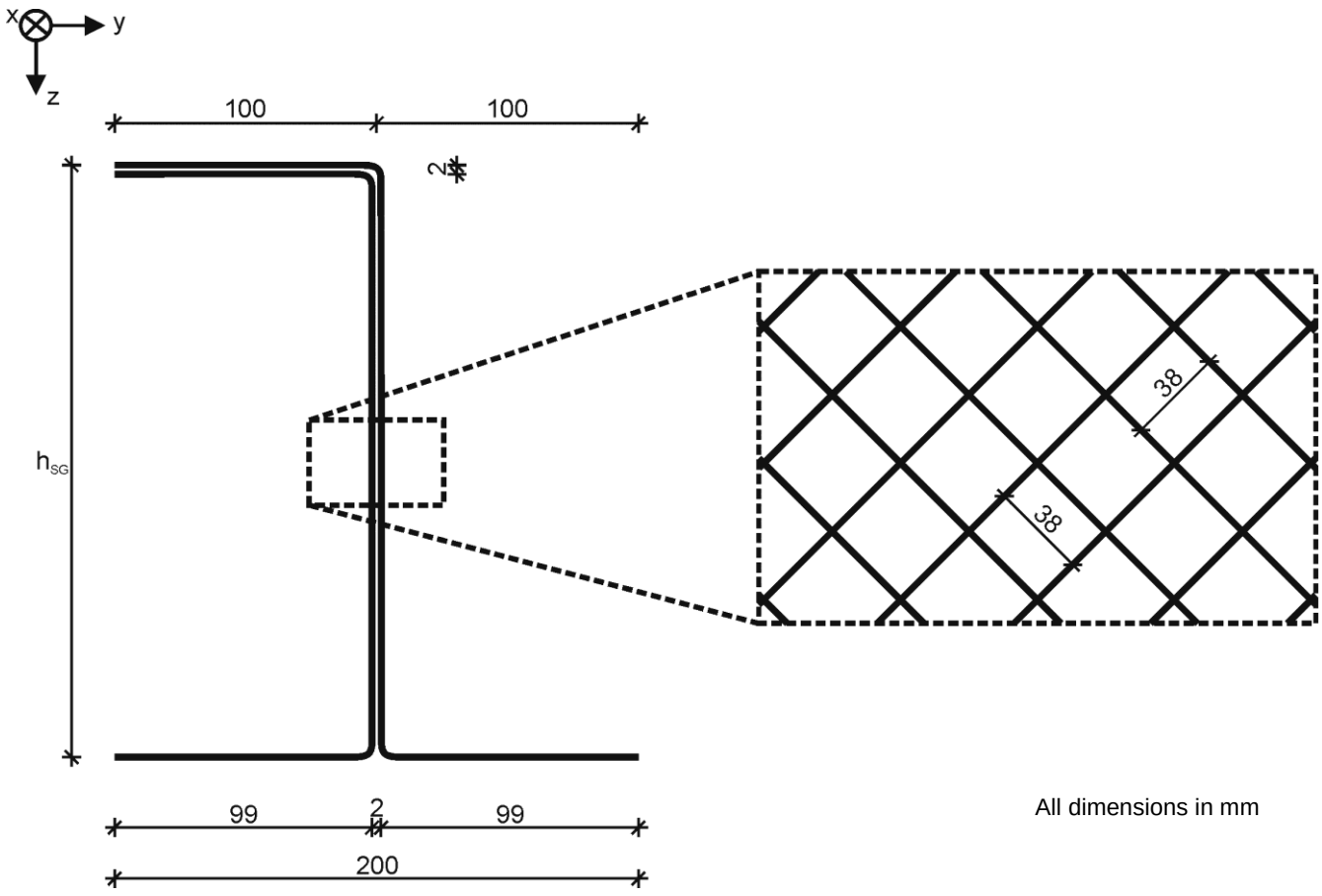


All dimensions in mm

solidian sandwich panel	Annex 4
View of sandwich panel with sample shear-mesh arrangement	

Deutsches Institut für Bautechnik DIBt

Shear mesh



All dimensions in mm

solidian sandwich panel	Annex 5
Shear mesh	