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# European Technical Assessment



General part

Technical Assessment Body issuing the European Technical Assessment

Trade name of the construction product

Product family to which the construction product belongs

Manufacturer

**Manufacturing plant** 

This European Technical Assessment contains

This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of

This European Technical Assessment replaces

Österreichisches Institut für Bautechnik (OIB) Austrian Institute of Construction Engineering

VST permanent formwork system

Non load-bearing permanent shuttering kit based on panels of insulating material

VST Building Technologies AG Schloss Leopoldsdorf Feuerwehrstraße 17 2333 Leopoldsdorf Austria

VST Verbundschalungstechnik s.r.o. Novozámocká 179 949 01 Nitra Slovakia

23 pages including Annexes 1 to 4, which form an integral part of this assessment.

ETAG 009, Guideline for European technical approval for Non load-bearing permanent shuttering kits/systems based on hollow blocks or panels of insulating materials and sometimes concrete, edition June 2002, used according to Article 66 (3) of Regulation (EU) № 305/2011 as European Assessment Document.

European technical approval ETA-07/0039 with validity from 11.07.2012 to 10.07.2017.



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# Remarks

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# Specific parts

# 1 Technical description of the product

## 1.1 General

The European Technical Assessment<sup>1</sup> – ETA – applies to a kit, the

# VST permanent formwork system.

The VST permanent formwork system is a non load-bearing permanent shuttering kit based on panels of thermal insulating material with regularly arranged steel spacers.

An incorporated finish is not part of the shuttering kit.

## 1.2 Shuttering elements

The shuttering elements are made of 24 mm thick cement-bonded particleboards as leaves connected with steel clips as spacers, see Annex 2. The maximum dimensions of the shuttering elements are up to a height of 2.90 m, a length of 6.25 m (in exceptional cases 7.50 m), and a wall thickness of 0.30 m. For higher elements a length of 2.50 m and a wall thickness of 0.30 m apply, see Annex 2.

The shuttering elements conform to the details and drawings in Annex 1 and Annex 2. The main characteristic values of the shuttering kits are listed in Annex 1, Table 2.

The shuttering kit comprises the following shuttering elements.

- Panels with and without openings
- Column elements
- Lintel elements
- Parapet and balustrade elements

The dimensions of the shuttering elements depends on the specific project demand. The maximum dimensions shall be respected, see Annex 2.

Only OPC (Ordinary Portland Cement) cement-bonded particleboards according to EN 633<sup>2</sup> with specifications according to EN 634-2 shall be used.

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ETA-07/0039 was firstly issued in 2007 as European technical approval with validity from 11.07.2007, extended 2012 with validity from 11.07.2012, and converted in 2017 to European Technical Assessment ETA-07/0039 of 28.07.2017.

Standards and other documents referred to in the European Technical Assessment are listed in Annex 4.

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# 2 Specification of the intended use in accordance with the applicable European Assessment Document (hereinafter EAD)

#### 2.1 Intended use

The shuttering kit is intended to be used for construction of internal walls as well as external walls above and below ground that are load-bearing (structural) or non load-bearing (non structural), including those that are subject to fire regulations.

### 2.2 Assumptions

#### 2.2.1 General

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 transport, storage, maintenance, replacement, and repair of the product as he considers necessary.

#### 2.2.2 Recommendations on packaging, transport and storage

The shuttering elements shall be protected against damage during transportation and storage. Depending on weather conditions, the shuttering elements shall be covered if necessary.

The shuttering elements may only be supplied as non-load-bearing, permanent shuttering components.

#### 2.2.3 Design

The shuttering elements are used to contain fresh concrete as a permanent shuttering. Under construction they are loaded by the pressure of the casted fresh concrete. After hardening of the concrete core, the shuttering kit has no load-bearing function anymore. The panels of the shuttering kit then take over a part of the insulation function of the wall and serve as a substrate for additional finishes.

The manufacturer has to ensure that all necessary information concerning planning and installation is made known to those who are responsible for planning and execution of structures with the VST permanent formwork system.

#### 2.2.4 Installation

#### 2.2.4.1 General

It is assumed that the VST permanent formwork system will be installed according to the manufacturer's instructions or – in absence of such instructions – according to the usual practice of the building professionals. An installation procedure to be applied in absence of standards and regulations in force at the place of use is given in Annex 3.

#### 2.2.4.2 Assembly of the shuttering elements

For each structure, an assembly plan is to be drawn up that contains the order in which the individual shuttering elements are installed and the name of the individual shuttering elements. The assembly plan shall be available at the construction site.

Any unevenness and deviations from the horizontal of the subfloor shall be levelled out carefully before setting up the shuttering elements. Lintels are to be supported. After assembly, open joints shall be sealed. The reinforcement shall be installed according to the design, taking into account the required concrete cover. The instructions given by the manufacturer are to be observed.



#### 2.2.4.3 Concreting

The concrete shall be designed, manufactured, conveyed, and placed in accordance with the standards and regulations in force at the place of use. The weather conditions during concreting shall be considered. The concrete should have a consistency of at least F5 according to EN 206 (flow value between 560 to 620 mm) and a maximum grain size of 8 to 16 mm. The shuttering elements are to be completely finished with concrete in a mutual multi-stage workflow. The concreting has to steadily follow the floor plan. During concreting, a concreting rate of approximately 1.0 m/h in the vertical direction shall not be exceeded. The instructions given by the manufacturer are to be observed.

#### 2.2.4.4 Ducts and services

Ducts and services shall be arranged as far as possible in the leaves of the shuttering elements. If ducts and installations are located in the area of the concrete core, their influence on the stability, on the safety in case of fire and on the building physics characteristics of the wall shall be taken into account. The arrangement of horizontal slots in the concrete core shall be avoided as far as possible. The instructions given by the manufacturer are to be observed.

#### 2.2.4.5 Finishes

Surfaces exposed to weather shall be rendered or covered with cladding to effectively protect the panels against adverse moisture. The same applies to surfaces inside, which are exposed to damp climates. The cladding or its substructure shall be anchored in the concrete core. The instructions given by the manufacturer are to be observed.

#### 2.2.4.6 Fixing of objects

All fastened objects that are loaded with tensile forces shall be anchored in the concrete core. This particularly applies to kitchen cabinets, hot water boilers, handrails, etc.. The instructions given by the manufacturer shall be observed.

#### 2.3 Assumed working life

The European Technical Assessment is based on an assumed working life of the shuttering kit of 50 years, provided that the shuttering kit is subject to appropriate installation, use and maintenance, see the Clauses 2.2.

The real working life may in normal use conditions be considerably longer without major degradation affecting the basic requirements for construction works<sup>3</sup>.

The indications given as to the working life of the shuttering kit cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by the Technical Assessment Body, but are regarded only as a means for selecting the appropriate products in relation to the expected economically reasonable working life of the works.

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The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works are subject, as well as on the particular conditions of 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 the working life indicated above.



#### 3 Performance of the product and references to the methods used for its assessment

#### 3.1 Essential characteristics

The performance of the VST permanent formwork system for the essential characteristics is given in Table 1.

Table 1: Essential characteristics an	d performances of the product
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N≌	Essential characteristic	Product performance
	Basic requirement for construction works <sup>4</sup> 1: Mechanical resist	ance and stability
1	Resulting structural pattern	See Clause 3.1.1.
2	Efficiency of filling	See Clause 3.1.1.
3	Possibility of steel reinforcement	See Clause 3.1.1.
	Basic requirement for construction works 2: Safety in ca	ase of fire
4	Reaction to fire	See Annex 1.
5	Resistance to fire	See Annex 1.
	Basic requirement for construction works 3: Hygiene, health, an	d the environment
6	Content, emission, and/or release of dangerous substances	See Clause 3.1.2.
7	Water vapour permeability	See Annex 1.
8	Water absorption	See Annex 1.
9	Water tightness	See Annex 1.
	Basic requirement for construction works 4: Safety and acce	essibility in use
10	Bond strength and resistance to impact loads	See Annex 1.
11	Resistance to filling pressure	See Annex 1.
12	Safety against personal injuries by contact	Characteristic not assessed.
	Basic requirement for construction works 5: Protection ac	ainst noise
13	Airborne sound insulation	See Annex 1.
14	Sound absorption	Characteristic not assessed.
	Basic requirement for construction works 6: Energy economy a	nd heat retention
15	Thermal resistance	See Annex 1.
16	Influence of moisture transfer on insulating capacity of the wall	See Annex 1.
17	Thermal inertia	See Annex 1.
	Basic requirement for construction works 7: Sustainable use of	natural resources
18	No characteristic assessed.	_



Nº	Essential characteristic	Product performance		
Aspects of durability and serviceability				
19	Resistance to deterioration	See Clause 3.1.3.		
20	Resistance to normal use damage	See Clause 3.1.3.		

#### 3.1.1 Mechanical strength and stability

The load-bearing concrete core of the VST permanent formwork system is a continuous type with regard to its geometry, which is only perforated by regularly arranged spacers, see Annex 2. For shuttering elements with openings, the minimum dimensions of the load-bearing concrete core shall be taken into account.

The VST permanent formwork system is suitable to infill the concrete core under the conditions specified in Clause 2.2.4.

Reinforcement, if any, shall usually be installed during assembly of the shuttering elements. Preferably welded fabrics with a pitch of 150 mm should be used to fit them in the grid of the spacers of the shuttering elements. The welded fabrics are fastened with their own spacers. Reinforcement with reinforcing steel bars is also possible.

#### 3.1.2 Hygiene, health and the environment

Content, emission, and/or release of dangerous substances are determined according to ETAG 009, Clause 6.3.1. No dangerous substance is the performance of the shuttering kit in this respect. A manufacturer's declaration to this effect has been submitted.

NOTE In addition to specific clauses relating to dangerous substances in the European Technical Assessment, there may be other requirements applicable to the product falling within their scope, e.g. transposed European legislation and national laws, regulations and administrative provisions. These requirements also need to be complied with, when and where they apply.

#### 3.1.3 Aspects of durability and serviceability

Durability and serviceability of the VST permanent formwork system are given under the conditions given in Clause 2.2.

#### 3.2 Assessment methods

The assessment of the essential characteristics in Clause 3.1 of the permanent shuttering kit for the intended use and in relation to the requirements for mechanical resistance and stability, for safety in case of fire, for hygiene, health and the environment, for safety in use, for protection against noise, for energy economy and heat retention, as well as for durability and serviceability in the sense of the basic requirements for construction works № 1 to 6 of Regulation (EU) № 305/2011 has been made in accordance with ETAG 009, Non load-bearing permanent shuttering kits/systems based on hollow blocks or panels of insulating materials and sometimes concrete, edition June 2002, used according to Article 66 (3) of Regulation (EU) № 305/2011 as European Assessment Document.

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#### 3.3 Identification

The European Technical Assessment for the shuttering kit is issued on the basis of agreed data<sup>5</sup> that identifies the assessed product. Changes to materials, to composition, or to characteristics of the product, or to the production process could result in these deposited data being incorrect. Österreichisches Institut für Bautechnik should be notified before the changes are introduced, as an amendment of the European Technical Assessment is possibly necessary.

# 4 Assessment and verification of constancy of performance (hereinafter AVCP) system applied, with reference to its legal base

#### 4.1 System of assessment and verification of constancy of performance

According to Commission Decision 98/279/EC the system of assessment and verification of constancy of performance to be applied to the VST permanent formwork system is System 2+. System 2+ is detailed in Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014, Annex, point 1.3 and provides for the following items.

- (a) The manufacturer shall carry out
  - (i) an assessment of the performance of the construction product on the basis of testing (including sampling), calculation, tabulated values, or descriptive documentation of that product;
  - (ii) factory production control;
  - (iii) testing of samples taken at the manufacturing plant by the manufacturer in accordance with the prescribed test plan<sup>6</sup>.
- (b) The notified factory production control certification body shall decide on the issuing, restriction, suspension, or withdrawal of the certificate of conformity of the factory production control on the basis of the outcome of the following assessments and verifications carried out by that body
  - (i) initial inspection of the manufacturing plant and of factory production control;
  - (ii) continuing surveillance, assessment, and evaluation of factory production control.

# 4.2 AVCP for construction products for which a European Technical Assessment has been issued

Manufacturers undertaking tasks under System 2+ shall consider the European Technical Assessment issued for the construction product in question as the assessment of the performance of that product. Manufacturers shall therefore not undertake the tasks referred to in Clause 4.1, point (a) (i).

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<sup>&</sup>lt;sup>5</sup> The technical file of the European Technical Assessment is deposited at Österreichisches Institut für Bautechnik.

The prescribed test plan has been deposited with Österreichisches Institut für Bautechnik and is handed over only to the notified factory production control certification body involved in the procedure for the assessment and verification of constancy of performance. The prescribed test plan is also referred to as control plan.



# 5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

#### 5.1 Tasks for the manufacturer

5.1.1 Factory production control

In the manufacturing plant the manufacturer establishes and continuously maintains a factory production control. All procedures and specifications adopted by the manufacturer are documented in a systematic manner. Purpose of factory production control is to ensure the constancy of performances of the VST permanent formwork system with regard to the essential characteristics.

The manufacturer only uses raw materials supplied with the relevant inspection documents as laid down in the control plan. The incoming raw materials are subjected to controls by the manufacturer before acceptance. Check of incoming materials includes control of inspection documents presented by the manufacturer of the raw materials.

Testing within factory production control is in accordance with the prescribed test plan. The results of testing are recorded and evaluated. The records are kept at least for ten years after the product has been placed on the market and are presented to the notified factory production control certification body involved in continuous surveillance. On request the records are presented to Österreichisches Institut für Bautechnik. The records shall include at least.

- Designation of the product, the materials and components
- Type of control and testing
- Date of manufacture of the product and the date of the inspection of the product, materials or components
- Results of control and examination and, if applicable, comparison with requirements
- Name and signature of the person responsible for factory production control

If test results are unsatisfactory, the manufacturer immediately implements measures to eliminate the defects. Products or components that are not in conformity with the requirements are removed. After elimination of the defects, the respective test – if verification is required for technical reasons – is repeated immediately.

#### 5.1.2 Declaration of performance

The manufacturer is responsible for preparing the declaration of performance. When all the criteria of the assessment and verification of constancy of performance are met, including the certificate of conformity of the factory production control issued by the notified factory production control certification body, the manufacturer draws up the declaration of performance. Essential characteristics to be included in the declaration of performance for the corresponding intended use are given in Clause 3.1, Table 1.

#### 5.2 Tasks for the notified factory production control certification body

5.2.1 Initial inspection of the manufacturing plant and of factory production control

The notified factory production control certification body verifies the ability of the manufacturer for a continuous and orderly manufacturing of the VST permanent formwork system according to the European Technical Assessment. In particular the following items are appropriately considered.

- Personnel and equipment
- Suitability of the factory production control established by the manufacturer
- Full implementation of the prescribed test plan



#### 5.2.2 Continuing surveillance, assessment, and evaluation of factory production control

The notified factory production control certification body visits the factory at least once a year for routine inspection. In particular the following items are appropriately considered.

- Manufacturing process including personnel and equipment
- Factory production control
- Implementation of the prescribed test plan

The results of continuous surveillance are made available on demand by the notified factory production control certification body to Österreichisches Institut für Bautechnik. When the provisions of the European Technical Assessment and the prescribed test plan are no longer fulfilled, the certificate of conformity of the factory production control is withdrawn by the notified factory production control certification body.

Issued in Vienna on 28 July 2017 by Österreichisches Institut für Bautechnik

The original document is signed by

Rainer Mikulits Managing Director



Table 2: Characteristic data of the shuttering kit					
Wall thickness	Concrete core thickness	Weight of shuttering element	Weight of concrete core	Weight of wall (plain)	
cm	cm	kN/m <sup>2</sup>	kN/m <sup>2</sup>	kN/m²	
15	10.2	2 × 0.32	2.45	3.09	
17.5	12.7	2  imes 0.32	3.05	3.69	
20	15.2	2  imes 0.32	3.65	4.29	
21.5	16.7	2 × 0.32	4.01	4.65	
23	18.2	2 × 0.32	4.37	5.01	
25	20.2	2 × 0.32	4.85	5.49	
30	25.2	2 × 0.32	6.05	6.69	

#### Table 3: Performance of the shuttering kit

BRCW	Essential characteristic	Assessment method	Level / Class / Description	
1	Resulting structural pattern	ETAG 009, Clause 5.1.1	Continuous type, see Annex 2	
	Efficiency of filling	ETAG 009, Clause 5.1.2	Satisfactory	
	Possibility of steel reinforcement	ETAG 009, Clause 5.1.3	Satisfactory	
2	Reaction to fire			
	Cement-bonded particleboard	EN 13501-1	A2-s1, d0	
	The scope of applications of the classification only applies to leaves with thickness of 24 mm, with a mass of approximately 31 kg/m <sup>2</sup> , with joints that are not bonded or sealed and without an air gap fixed to a Euroclass A1 or A2 substrate.			
	Resistance to fire			
	Wall thickness 15 cm	ETAG 009, Annex C	REI 30	
	Wall thickness 17.5 cm		REI 90	
	Wall thickness 20 cm		REI 120	
	Wall thickness 21.5 cm		REI 120	
	Wall thickness 23 cm		REI 120	
	Wall thickness 25 cm		REI 120	
	Wall thickness 30 cm		REI 120	

VST p	permanent	formwork	system
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## Annex 1

Performance of the shuttering kit

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BRCW	Essential characteristic	Assessment method	Level / Class / Description
3	Content, emission, and/or release of dangerous substances	ETAG 009, Clause 5.3.1	No dangerous substances, see Clause 3.1.2.
	Water vapour permeability		
	Cement bonded particleboard	EN ISO 10456	μ = 60
	Water absorption	EN ISO 15148	Satisfactory
	Water tightness	ETAG 009, Clause 5.3.4	Satisfactory
4	Bond strength and resistance to impact load	ETAG 009, Clauses 5.4.1.3 and 5.4.1.4	Satisfactory
Resistance to filling pressure			
	The shuttering elements resis filling of 1.0 m with a conditions.	st a hydrostatic concrete pre crete density of 2 500 kg/m	ssure with a height of <sup>3</sup> under the following
	Bending strength of cement-bonded particleboard,    und $\perp$	EN 310	≥9 MPa
	Flexural modulus,    and $\perp$	EN 310	≥ 4 500 MPa
	Distance of the spacers, horizontal and vertical, fastened with 8 screws $5 \times 25$ mm per side	Nominal value	≤ 450 mm

# Annex 1

Performance of the shuttering kit

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BRCW	Essential characteristic	Assessment method	Level / Class / Description
5	Airborne sound insulation		
	Wall thickness 15 cm	EN ISO 10140-2	R <sub>w</sub> = 51 dB
	Wall thickness 17.5 cm	EN 12354-1 und EN ISO 717-1	R <sub>w</sub> = 53 dB
Wall thickness 20 cm		$R_w = 55 \text{ dB}$	
	Wall thickness 21.5 cm		$R_w = 56 \text{ dB}$
	Wall thickness 23 cm		$R_w = 57 \text{ dB}$
	Wall thickness 25 cm		R <sub>w</sub> = 58 dB
	Wall thickness 30 cm		$R_w = 61 \text{ dB}$
	Remarks The approximate values $C = -2 dB$ and $C_{tr} = -5 dC$ The walls made of the VS transmission in the build according to EN 12354-1. The sound reduction inder shall be evaluated individ	of the spectrum adapta B. ST permanent formwork sy ding. This shall be consi ex of a wall with thermal i ually, depending on the ac	ation terms C and C <sub>tr</sub> ar extem influence the flanking dered by e.g. calculation nsulation can be lower an iditional layers.
	Sound absorption	Characteristic not assess	sed

Annex 1

Performance of the shuttering kit

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BRCW	Essential characteristic	Assessment me	ethod	Level / Class / Description
6	Thermal resistance			
	Wall thickness 15 cm	Calculation accor	ding to	$R = 0.229 \text{ m}^2 \cdot \text{K/W}$
	Wall thickness 17.5 cm	EN ISO 6946		$R = 0.240 \text{ m}^2 \cdot \text{K/W}$
	Wall thickness 20 cm			$R = 0.251 \text{ m}^2 \cdot \text{K/W}$
	Wall thickness 21.5 cm			$R = 0.257 \; m^2 \cdot K/W$
	Wall thickness 23 cm			$R = 0.264 \text{ m}^2 \cdot \text{K/W}$
	Wall thickness 25 cm			$R = 0.272 \text{ m}^2 \cdot \text{K/W}$
	Wall thickness 30 cm			$R = 0.294 \text{ m}^2 \cdot \text{K/W}$
	Applying the following input val	ues:		
	Cement bonded particleboard	Declaration		$\lambda = 0.26 \text{ W/(m \cdot K)}$
	<u>Concrete</u>	EN ISO 10456		$\lambda$ = 2.30 W/(m · K)
	Thermal inertia	I		
	Wall structure			Annex 2
	Weight per unit area of the wall	Determined by calculation with no dimensions	minal	
	Cement bonded particleboard Concrete			0.32 kN/m² 2.45 kN/m²
	Wall thickness 17.5 cm Cement bonded particleboard Concrete			0.32 kN/m² 3.05 kN/m²
	Wall thickness 20 cm Cement bonded particleboard Concrete			0.32 kN/m² 3.65 kN/m²
	Wall thickness 21.5 cm Cement bonded particleboard Concrete			0.32 kN/m² 4.01 kN/m²
	Wall thickness 23 cm Cement bonded particleboard Concrete			0.32 kN/m² 4.37 kN/m²
	Wall thickness 25 cm Cement bonded particleboard Concrete			0.32 kN/m² 4.85 kN/m²
	Wall thickness 30 cm Cement bonded particleboard Concrete			0.32 kN/m² 6.05 kN/m²
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BRCW	Essential characteristic	Assessment method	Level / Class / Description
6	Densities		
	Cement-bonded particleboard Concrete	EN 323	1 300 kg/m <sup>3</sup>
	Concrete	EN ISO 10456	2 400 kg/m <sup>3</sup>
	Heat capacities		
	Cement-bonded particleboard	EN ISO 10456	1 500 J / (kg · K)
	Concrete	EN ISO 10456	1 000 J / (kg ⋅ K)

Performance of the shuttering kit

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Annex 1





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#### Installation procedure

to be applied in absence of standards and regulations in force at the place of use

- (1) General
  - (a) Only skilled and properly instructed personnel are to be employed for installation of the VST permanent formwork system wall elements and conveying and placing of the concrete.

The safety-at-work and health protection regulations are observed throughout the whole construction process.

- (b) An assembly plan is prepared for each structure, which contains the sequence in which the individual shuttering elements are installed and the designation of the individual shuttering elements. The assembly plan is available at the construction site.
- (2) Preparation of construction site
  - (a) The substructure where the shuttering kit will be installed is swept clean, floor openings are closed, and required scaffoldings are mounted.
  - (b) By chalk lines the position of the walls and openings is marked on the substructure and verified in accordance with the assembly plan by measuring of diagonals.
  - (c) The substructures' altitudes in the walls' zone are measured. Deviations from the horizontal are carefully levelled out by suitable means.
- (3) Positioning of the shuttering elements
  - (a) General

The shuttering elements of the shuttering kit are designed to provide a continuous load bearing concrete core, which is only perforated by regularly arranged spacer.

(b) Shuttering elements

The shuttering elements are to be positioned tightly joined ("crunch") and aligned into a vertical permanent shuttering. By means of e.g. formwork beams and diagonal bracing the installed shuttering elements are secured to result a rigid formwork with plane surfaces which permits the construction of a vertical wall with a concrete core as planned. Lintels are supported. After installation, possible existing open joints between the shuttering elements and gaps to the substructure are sealed, e.g. with polyurethane foam.

The manufacturer's installation instructions are followed.

(c) Reinforcement

The reinforcement according to the design of the structure is installed before interlocking the two leaves of the panel into one element.

The reinforcement of the walls provides ways for the concrete to be placed that are free from reinforcing steel and other installations. They permit filling device to be driven down to the bottom layer of the reinforcement.

(d) Clearance

Before concreting, the shuttering of all walls of the storey is to be checked for alignment before clearance is given.

VST permanent	formwork	system
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#### Annex 3

Installation procedure

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### (4) Concreting

(a) Concrete

Concrete is according to EN 206 and according to the design requirements. Strength class at least C16/20, XC1, consistency class F5, maximum aggregate size 8 to 16 mm.

The use of flow concrete for filling is recommended. Dry and flow concrete: Strength class at least C25/30 XC1; consistency class F5; maximum aggregate size 8 mm.

Ready-mix concrete is with control according to EN 206, Annex C. Wherever possible, concrete is purchased under an approved scheme where there is continuous certification and testing according to the standards and regulations in force at the place of use.

Weather conditions shall be considered in selecting the concrete. Until freeze stability (i.e., compressive strength of 5.0 N/mm<sup>2</sup>) is reached, concrete temperatures below +5 °C are avoided. With ambient air temperatures between -3 °C and +5 °C, the concrete temperature should be at least +5 °C.

(b) Casting concrete

The walls are concreted steadily storey-high in several cycles. The maximum filling height corresponds with the maximum filling rate of approximately 1.0 m per hour. During concreting, formation of concrete cones is to be avoided by small distances between the filling points.

Segregation of the concrete during placing is avoided. In the case of free falling heights in excess of 2 m, filling pipes or concrete hoses (max. diameter of 100 mm) are to be used, driven down just above the point of placing. Ways for placing the concrete are provided for reinforced walls.

If required, the concrete is compacted with caution according to relevant standards and regulations in force at the place of use.

(c) Construction Joints

Walls are concreted in layers without longer interruptions that would allow for hardening of the previously placed layer to a degree preventing adequate bonding of the layers. The construction joints are provided at the bottom floor slab edge level.

Construction joints within the storey-high of plain unreinforced walls are avoided. If this is not possible in exceptional cases, any such joints are secured by means of splice bars with ribbed reinforcing steel.

The splice bars are to be placed with a maximum clearance of 50 cm. The total cross-

section of the splice bars is at least  $\frac{1}{2000}$  of the cross-sectional area of the concrete

core to be connected, and there are at least two reinforcing steel bars, diameter of 8 mm, along a wall length of one metre. The splice bars reach at least 20 cm into each one of the adjacent concrete layers.

Laitance and loose concrete are removed and the surface of the construction joint is pre-wetted adequately before concreting is continued.

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#### (d) Tolerances, floor slabs

The concreted walls are not deviating from vertical by more than 8 mm over a wall height of 3 m. Tolerances are according to relevant standards and regulations in force at the place of use.

Floor slabs may be supported onto the completely concreted walls only after sufficient strength of the concrete core has developed.

#### (5) Finishing

Concrete residues (laitance and fines of the concrete) on surface are to be removed as soon as possible. The propping are removed only after the prescribed stripping times when the concrete of wall and floor slabs has sufficiently hardened.

The wall surfaces can be final coated ready-to-paint (e.g. rendered or plastered). The surfaces subject to the weather or higher moisture is rendered, plastered or cladded. The cladding or its substructure is anchored in the concrete core.

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#### **Reference documents**

ETAG 009 (06.2002): Guideline for European Technical Approval of non load-bearing permanent shuttering kits/systems based on hollow blocks or panels of insulating materials and sometimes concrete

- EN 206+A1 (11.2016): Concrete. Specification, performance, production and conformity
- EN 310 (02.1993): Wood-based panels Determination of modulus of elasticity in bending and of bending strength
- EN 323 (02.1993): Wood-based panels Determination of density
- EN 633 (10.1993): Cement-bonded particleboards Definition and classification
- EN 634-2 (02.2007): Cement-bonded particleboards Specifications Part 2: Requirements for OPC bonded particleboards for use in dry, humid and exterior conditions
- EN 12354-1 (04.2000): Building Acoustics Estimation of acoustic performance of buildings from the performance of elements – Part 1: Airborne sound insulation between rooms
- EN 13501-1+A1 (09.2009): Fire classification of construction products and building elements Part 1: Classification using data from reaction to fire tests
- EN ISO 717-1 (03.2013): Acoustics Rating of sound insulation in buildings and of building elements Part 1: Airborne sound insulation
- EN ISO 6946 (12.2007): Building components and building elements Thermal resistance and thermal transmittance Calculation method
- EN ISO 10140-2 (09.2010): Acoustics Laboratory measurement of sound insulation of building elements Part 2: Measurement of airborne sound insulation
- EN ISO 10456+AC (12.2009): Building materials and products Hygrothermal properties Tabulated design values and procedures for determining declared and design thermal values
- EN ISO 15148+A1 (02.2016): Hygrothermal performance of building materials and products Determination of water absorption coefficient by partial immersion
- 98/279/EG: Commission Decision of 5 December 1997 on the procedure for attesting the conformity of construction products pursuant to Article 20 (2) of Council Directive 89/106/EEC as regards non-load-bearing formwork systems and assemblies consisting of hollow body elements made of heat insulating materials and concrete Of the European Communities № L 127 of 29.4.1998, as amended by Commission Decision 2001/596/EC of 8 January 2001, Official Journal L 209, 2.8.2001, p. 33.

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**Reference documents** 

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- 305/2011: Regulation (EU) № 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonized conditions for the marketing of construction products and repealing Council Directive 89/106/EEC, Official Journal of the European Communities № L 88 As amended by Commission Delegate Regulation (EU) No 568/2014 of 18 February 2014, Official Journal L 157, 27.05.2014, p. 76 and Delegated Regulation (EU) № 574/2014, as amended by 4.4.2011 Commission of 21 February 2014, Official Journal L 159, 28.05.2014, p. 41.
- 568/2014: Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014 amending Annex V to Regulation (EU) № 305/2011 of the European Parliament and of the Council as regards the assessment and verification of the performance of construction products, Official Journal of the European Union European Communities № L 157 of 27.5.2014, p. 76.

Reference documents

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Annex 4