



## European Technical Approval ETA-08/0134

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung  
*Trade name*

VELOX

Zulassungsinhaber  
*Holder of approval*

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Zulassungsgegenstand  
und Verwendungszweck

Nichttragendes verlorenes Schalungssystem "VELOX" bestehend aus Schalungselementen aus Holzspanbeton-Schalungswandungen und Stahl-Abstandhaltern ("Platten-Bügel-Bauweise")

*Generic type and use  
of construction product*

*Non-load bearing permanent shuttering system "VELOX" based on shuttering elements of wood-chip concrete shuttering leaves and steel spacers*

Geltungsdauer:  
*Validity:* vom  
*from*  
bis  
*to*

13 May 2013

13 May 2018

Herstellwerke  
*Manufacturing plants*

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Diese Zulassung umfasst  
*This Approval contains*

26 Seiten einschließlich 5 Anhänge  
*26 pages including 5 annexes*

Diese Zulassung ersetzt  
*This Approval replaces*

ETA-08/0134 mit Geltungsdauer vom 08.07.2008 bis 08.07.2013  
*ETA-08/0134 with validity from 08.07.2008 to 08.07.2013*

## I LEGAL BASES AND GENERAL CONDITIONS

- 1 This European technical approval is issued by Deutsches Institut für Bautechnik in accordance with:
  - Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products<sup>1</sup>, modified by Council Directive 93/68/EEC<sup>2</sup> and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council<sup>3</sup>;
  - *Gesetz über das In-Verkehr-Bringen von und den freien Warenverkehr mit Bauprodukten zur Umsetzung der Richtlinie 89/106/EWG des Rates vom 21. Dezember 1988 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedstaaten über Bauprodukte und anderer Rechtsakte der Europäischen Gemeinschaften (Bauproduktengesetz - BauPG) vom 28. April 1998<sup>4</sup>, as amended by Article 2 of the law of 8 November 2011<sup>5</sup>;*
  - Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC<sup>6</sup>;
  - Guideline for European technical approval of "Nonload-bearing permanent shuttering systems based on hollow blocks or panels of insulating materials and sometimes concrete", ETAG 009.
- 2 Deutsches Institut für Bautechnik is authorized to check whether the provisions of this European technical approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European technical approval and for their fitness for the intended use remains with the holder of the European technical approval.
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<sup>1</sup> Official Journal of the European Communities L 40, 11 February 1989, p. 12  
<sup>2</sup> Official Journal of the European Communities L 220, 30 August 1993, p. 1  
<sup>3</sup> Official Journal of the European Union L 284, 31 October 2003, p. 25  
<sup>4</sup> *Bundesgesetzblatt Teil I 1998*, p. 812  
<sup>5</sup> *Bundesgesetzblatt Teil I 2011*, p. 2178  
<sup>6</sup> Official Journal of the European Communities L 17, 20 January 1994, p. 34

## II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

### 1 Definition of the product and intended use

#### 1.1 Definition of the construction product

##### 1.1.1 General

The shuttering system "VELOX" is a non load-bearing permanent shuttering kit based on shuttering elements of shuttering leaves (see Annexes 1 and 2) and accessory parts (see Annex 2) applicable as formwork for plain and reinforced concrete walls cast in-situ.

The shuttering elements (see Annexes 1 and 2) consist of inner and outer shuttering leaves of wood-chip concrete and the shuttering leaves are connected by spacers of steel (steel spacers).

The shuttering elements are generally used for external load-bearing walls as well as for internal load-bearing walls.

Finishes are not part of the shuttering system "VELOX".

##### 1.1.2 Shuttering elements

The shuttering elements consist of factory-made inner and outer shuttering leaves (see Annexes 1 and 2) of long shavings of wood respectively loose wood wool, bonded with a mineral binder and compressed to its final thickness (shuttering leaves of wood-chip concrete) according to ETA-12/0320 and ETA-12/0321 respectively EN 13168 and spacers of steel (steel spacers) combined with accessory parts (see clause 1.1.3). These components are assembled on site. The inner and outer shuttering leaves of wood-chip concrete can be factory-coated with thermal insulation on one face according to EN 13163 ("two layer" leaves: composite shuttering leaves) to improve the thermal resistance (see clause 2.1.2, Table 3).

The following types of shuttering leaves of wood-chip concrete are available:

- WS: shuttering leaves without thermal insulation
  - WS-rot: WS-shuttering leaves red
  - WSD: WS-shuttering leaves containing a higher ratio of cement
  - WSL: WS-shuttering leaves containing a batten in its middle
- WS-EPS: shuttering leaves with thermal insulation

The inner and outer shuttering leaves of wood-chip concrete are one-layered and the steel spacers (see clause 1.1.3) provide thicknesses of the concrete core in the range of 130 mm to 280 mm and thicknesses of the wall in the range of 200 mm to 350 mm, as indicated in Table 1. The thickness of the inner shuttering leaves of wood-chip concrete as well as the thickness of the outer shuttering leaves of wood-chip concrete is 35 mm, 50 mm and 75 mm. The thickness of the thermal insulation is in the range of 50 mm to 150 mm (see Annex 1). The length of all standard shuttering elements is 2000 mm and the height is 500 mm (see Annex 1).

The following types of shuttering elements are used mainly:

Table 1: Wall thicknesses of the shuttering elements according to Annex 1

types of shuttering elements	Thickness of the wall	Thickness of the concrete core	Thickness of the shuttering leaves of wood-chip concrete	
			inner	outer
	[mm]	[mm]	[mm]	[mm]
TT20	200	130	35	35
TT22	220	150	35	35
TT25	250	180	35	35
TT27	270	200	35	35
TT30	300	230	35	35
TT35	350	280	35	35
GT25	250	165	35	50
GT30	300	215	35	50
XT30	300	190	35	75
XT35	350	240	35	75
XU35	350	225	50	75
XX35	350	200	75	75
ET27	270	150	35	35
ET30	300	150	35	35
ET32	320	150	35	35
ET35	350	200	35	35
ET35	350	130	35	35
EE30	300	130	35	35
EE35	350	180	35	35
GG25	250	150	50	50
GG30	300	200	50	50
GG35	350	250	50	50

The vertical ends of the shuttering leaves of wood-chip concrete are smooth and form a tight joint.

The shuttering leaves of wood-chip concrete are dry laid in staggered vertical joints (masonry bond).

The system can be used to construct straight walls.

The inner and outer shuttering leaves of wood-chip concrete are interlocked and built up horizontally and vertically into a tight and rigid formwork. The wall is formed by filling of the standard shuttering elements with concrete.

The formwork is used in conjunction with concrete strength class C16/20 (according to EN 206-1) to build plain concrete walls or in conjunction with concrete of strength classes in the range from C20/25 to C50/60 (according to EN 206-1) to build reinforced concrete walls.

### 1.1.3 Accessory parts

Accessory parts (see Annex 2) are also part of the shuttering system.

#### 1.1.3.1 Steel spacers (Annexes 2, 3.1 and 3.2)

The inner and outer shuttering leaves of wood-chip concrete are connected by spacers of steel (steel spacers). The following steel spacers are available:

1. Steel spacers for the base point of the first shuttering layer:
  - ES (one-sided): is applied directly on the floor,
  - AB ("Aufsatzbügel"): for the prolongation of existing walls in vertical direction (also for the prolongation of existing masonry walls),
  - HB ("Deckenrost-Stecksystem"): below the floor level for the fixation of the shuttering of the floor edges by concreting the floor on existing walls (also for the concreting of the floor on existing masonry walls),
2. Steel spacer between the shuttering layers:
  - DS (double-sided): These steel spacers shall be installed in every layer within the height between the floors.
3. Steel spacer at the top of the topmost shuttering layer of a floor wall:
  - RB ("Rostbügel"): below the floor level for the fixation of the shuttering of the floor edges.

#### 1.1.3.2 Nails (Annex 2)

Nails are used to interconnect the shuttering leaves of wood-chip concrete (three nails distributed over the height of the shuttering leaves and one nail over the length of the shuttering leaves, see Annex 3.1) to form a tight joint between the shuttering leaves of wood-chip concrete in horizontal and vertical direction as well as on wall junctions or corners.

#### 1.1.3.3 Wall end leaves (Annex 2)

Wall end leaves are used to lock walls at vertical (e. g. window openings or door openings) and horizontal (e. g. parapets or lintels) shuttering wall ends between the inner and outer shuttering leaves of wood-chip concrete.

The wall end leaves require support during concrete placing of lintels. The supports may only be removed when the concrete core has sufficiently hardened

## 1.2 Intended use

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

When using this type of construction below ground a waterproofing according to applicable national rules shall be provided depending on whether non pressing water or pressing water is to be dealt with. The waterproofing shall be protected from mechanical damage by an impact resistant protective layer.

According to EOTA TR 034 the following use categories apply:

- Category IA 2: Product with no direct contact to (e. g. covered products) but possible impact on indoor air.
- Category S/W 3: Product with no contact to and no impact on soil water, ground- and surface water.

The provisions made in this European technical approval are based on an assumed working life of the shuttering kit of at least 50 years, provided that the conditions laid down in clauses 4.2, 5.1 and 5.2 for the packaging, transport, storage, installation, use, maintenance and repair are met. The indications given on the working life cannot be interpreted as a guarantee given by the manufacturer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

For the intended use it is essential to protect this type of construction against effects of weather.

## 2 Characteristics of product and methods of verification

### 2.1 Characteristics of product

#### 2.1.1 General

The shuttering kit "VELOX" consists of the following elements:

- inner and outer shuttering leaves of wood-chip concrete and
- accessory parts.

see clauses 2.1.2 and 2.1.3.

#### 2.1.2 Shuttering leaves of wood-chip concrete

The inner and outer shuttering leaves of wood-chip concrete correspond to the information and drawings given in Annexes 1 and 2.

The geometric characteristics of the shuttering leaves of wood-chip concrete are given in Annex 1. The requirements of the shuttering leaves of wood-chip concrete regarding to geometric characteristics are given in ETA-12/0320 and ETA-12/0321, clauses 2.7.1 respectively EN 13168, clause 4.3.

The shuttering leaves are made of wood-chip concrete according to ETA-12/0320 and ETA-12/0321 respectively EN 13168. The parameters and characteristics of the shuttering leaves of wood-chip concrete are indicated in Table 2.

**Table 2:** Parameters and characteristics of the shuttering leaves of wood-chip concrete according to ETA-12/0320 and ETA-12/0321 respectively EN 13168

Type of shuttering leaves	Designation code of wood-chip concrete according to ETA-12/0320 and ETA-12/0321 respectively EN 13168	Declared value of the apparent density $\rho_D$	Declared value of the mass per unit area
		[kg/m <sup>3</sup> ]	[kg/m <sup>2</sup> ]
WS	WW-EN 13168-L-W2-T1-S3-CS(10/Y)1000-BS1500-CI1-DS(70,90)	670	21
WSD	WW-EN 13168-L-W2-T1-S3-CS(10/Y)2000-BS2000-CI1-DS(70,90)	790	28

The declared value of the apparent density as well as the declared value of the mass per unit area shall deviate by not more than  $\pm 10\%$  according to ETA-12/0320 and ETA-12/0321, clauses 2.7.1 respectively EN 13168, clause 4.3.5.

The declared (maximal) value of the thermal conductivity of the shuttering leaves of wood-chip concrete is  $\lambda_D = 0,150 \text{ W}/(\text{m}\times\text{K})$  according to ETA-12/0320 and ETA-12/0321.

The declared value of the tensile strength perpendicular to faces of the multi-layered shuttering leaves according to ETA-12/0320 and ETA-12/0321 shall be at least 0,08 MPa.

The characteristic value of the shear strength  $\tau_k$  of the multi-layered shuttering leaves according to ETA-12/0320 and ETA-12/0321 shall be at least 0,04 MPa. The mean value of the shear modulus  $G_m$  of the multi-layered shuttering leaves according to ETA-12/0320 and ETA-12/0321 shall be at least 1,0 MPa.

The factory-coated thermal insulation (composite shuttering leaves) of expanded polystyrene (EPS) has to conform to EN 13163. The parameters and characteristics of the thermal insulation are indicated in Table 3.

Table 3: Parameters and characteristics of the thermal insulation

Thermal insulation	Standard	Designation code of the thermal insulation according to EN 13163 (see Annex 1)	Declared value of thermal conductivity		Reaction to fire: Class according to EN 13501-1 see clause 2.2.3.1	
			$\lambda_D$	Thermal insulation	Wall with concrete core and thermal insulation	
			[W/(m×K)]			
Expanded polystyrene (EPS)	EN 13163	EPS-EN 13163-T2-L1-W2-S2-P4-DS(70,-)1-BS100-DS(N)2-TR150	0,031	E	E	
		EPS-EN 13163-T1-L1-W1-S1-P4-DS(70,-)3-BS75-CS(10)60-DS(N)5	0,041	E	E	

The material characteristics, dimensions and tolerances of the shuttering leaves of wood-chip concrete not indicated in Annexes 1 and 2 are given in the technical documentation<sup>7</sup> of the ETA.

### 2.1.3 Accessory parts

The accessory parts correspond to the information and drawings given in Annex 2. The accessory parts are:

- steel spacers ES, DS, RB, AB and HB (see 1.1.3.1),
- nails (see Annex 2) and
- wall end leaves.

The spacers consist of steel with anticorrosive coating (stove-enamel finish) and the nails are made of galvanized steel.

The wall end leaves consist of wood-chip concrete, it is the same material used for shuttering leaves specified in clause 2.1.2.

<sup>7</sup> The technical documentation of the ETA is deposited with *Deutsches Institut für Bautechnik* and, as far as relevant for the tasks of the approved bodies involved in the attestation of conformity procedure, is handed over to the approved bodies.

## 2.2 Methods of verification

### 2.2.1 General

The assessment of the fitness of the shuttering system for the intended use has been made in compliance with ETAG 009, 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", edition June 2002.

The ETA is issued for the shuttering kit "VELOX" on the basis of agreed information, deposited with Deutsches Institut für Bautechnik, which identifies the shuttering kit that has been assessed and evaluated. Changes to the production process, the kit or the components which could result in this deposited information being incorrect, shall be notified to Deutsches Institut für Bautechnik before the changes are introduced. Deutsches Institut für Bautechnik will decide whether or not such changes affect the ETA and consequently the validity of the CE marking on the basis of the ETA, and, if so, whether further assessment and/or alterations to the ETA shall be necessary.

### 2.2.2 Essential Requirement 1: Mechanical resistance and stability

#### 2.2.2.1 Resulting structural pattern

In end use conditions walls made with shuttering elements "VELOX" are walls of a continuous type according to ETAG 009, clause 2.2.

#### 2.2.2.2 Efficiency of filling

Considering the instructions of clause 4.2 and the installation guide of the manufacturer an efficient filling without bursting of the shuttering and without voids or any uncovered reinforcement in the concrete core is possible.

The requirements according to ETAG 009, clause 6.1.2 are met.

#### 2.2.2.3 Possibility of steel reinforcement

The instructions in the installation guide of the manufacturer are appropriate to install steel reinforcement for walls according to EN 1992-1-1 or corresponding national rules.

The requirements according to ETAG 009, clause 6.1.3 are met.

### 2.2.3 Essential Requirement 2: Safety in case of fire

#### 2.2.3.1 Reaction to fire<sup>8</sup>

Shuttering elements "VELOX" without thermal insulation (shuttering leaves of wood-chip concrete) fulfil the requirement of Class B-s1, d0 according to EN 13501-1.

Shuttering elements "VELOX" with thermal insulation (multi-layered shuttering leaves) fulfil the requirements of classification criteria of Table 3 according to EN 13501-1.

#### 2.2.3.2 Resistance to fire

The walls will be exposed to fire on one site only.

According to ETAG 009, Annex C, Table 1, for a continuous type of load-bearing walls ("REI") or non load-bearing walls ("EI") and a minimum concrete strength class of C16/20, the system meets the criteria "REI" and "EI" according to Table 4.

<sup>8</sup> A European reference fire scenario for facades has not been laid down. In some Member States the classification of permanent shuttering systems according to EN 13501-1 might not be sufficient for the use in facades. An additional assessment of permanent shuttering systems according to national provisions (e.g. on the basis of a large scale test) might necessary to comply with Member States regulations, until the existing European classification system has been completed.



Table 4: Determination of "REI" of load-bearing walls and "EI" of non load-bearing walls

Minimum thickness of concrete core [mm]	"REI"	"EI"
130	90	120
≥ 150	120	120

The preconditions for this classification are:

- The design of the building has to take into consideration the secondary effects of fire. Especially constraints, introduced by thermal strain, should be sufficiently low and appropriate building joints should be foreseen. The rules, valid in place of use, govern. Structural requirements on work in normal conditions, valid in the place of use, may require larger dimensions. Concrete cover for the reinforcement has to be observed according to the rules valid in the place of use.
- A normal weight concrete as defined in EN 206-1 or EN 1992-1-1 shall be used. As far as European standards EN 206-1 or EN 1992-1-1 are not in force, an equivalent concrete according to national rules, valid in the place of use, is acceptable.
- The strength class of concrete shall be between C16/20 and C50/60 according to EN 206-1. In lack of availability of European standard EN 206-1, alternatively a concrete according to national rules, valid in the place of use, with a compressive strength which fits in the interval given above, is also considered as appropriate.

Note: The classification of walls constructed with the shuttering system "VELOX" regarding to fire resistance are valid only for walls without openings (for windows or doors for examples).

## 2.2.4 Essential Requirement 3: Hygiene, health and environment

### 2.2.4.1 Content and/or release of dangerous substances

The chemical composition of the shuttering system/kit must comply with the data deposited with DIBt.<sup>9</sup>

Due to the chemical composition of the shuttering system "VELOX", the product does not contain dangerous substances according to Council Directive 67/548/EEC, Regulation (EC) No 1272/2008 and/or the "Indicative list on dangerous substances" of the EGDS (expert group on dangerous substances of the European Commission) with the exception of hexabromocyclododecane (HBCDD).

The content of HBCDD is < 1 % by weight.

Note: For dangerous substances falling under the scope of the CPD for which:

- no assessment and verification methods are given in this ETA,
- or
- the "No performance determined" option is declared,
- or
- the chosen verification and assessment method does not comply with the regulatory requirement of a particular Member State,

there might be the necessity for an additional assessment at national level.

<sup>9</sup> In addition to the specific clauses relating to dangerous substances contained in this European technical approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

#### 2.2.4.2 Water vapour permeability

The values of the water vapour resistance factor of wood-chip concrete depending on type and thickness of the shuttering leaves are tabulated in Table 5 (wet conditions as well as dry conditions).

Table 5: Water vapour resistance factor of the shuttering leaves of wood-chip concrete

Type of shuttering leaves	WS35	WS50	WS75	WSD35	WSD50
Thickness of the shuttering leaves [mm]	35	50	75	35	50
Water vapour resistance factor $\mu$	11	9	9	14	

The declared (maximal) value of the water vapour resistance factor of the shuttering leaves of wood-chip concrete according to ETA-12/0320 and ETA-12/0321 is  $\mu = 30$ .

The values of the water vapour resistance factor of concrete depending on type and density and of the thermal insulation (see clause 2.1.2, Table 3) are tabulated in EN ISO 10456.

Using these values the verification of the annual moisture balance or the maximum amount of interstitial condensation according to EN ISO 13788 will be on the safe side.

#### 2.2.4.3 Water absorption

The declared (maximal) value of short-term water absorption by partial immersion of the shuttering leaves of wood-chip concrete according to ETA-12/0320 and ETA-12/0321 is  $W_p = 8 \text{ kg/m}^2$ .

The requirements according to ETAG 009, clause 6.3.3 are met.

#### 2.2.4.4 Watertightness

Because finishes are not part of the shuttering system "VELOX" the "No performance determined" option in ETAG 009, Table 3 is used.

### 2.2.5 Essential Requirement 4: Safety in use

#### 2.2.5.1 Bond strength between shuttering leaves of wood-chip concrete and concrete core and resistance to impact load

The bond strength is at least equal to the resistance of the shuttering leaves of wood-chip concrete against the pressure of fresh concrete, see clause 2.2.5.2.

Concrete walls (without consideration of the finishes), constructed with shuttering system "VELOX" and designed according EN 1992-1-1 respectively in lack of availability of EN 1992-1-1 according national design rules, lead to the assumption that concrete core insures an adequate resistance of the complete wall under normal used impact loads.

The requirements according to ETAG 009, clause 6.4.1 are met.

#### 2.2.5.2 Resistance to pressure of fresh concrete

To resist the pressure of fresh concrete the bending tensile strength of the shuttering leaves of wood-chip concrete shall be at least 1500 kPa (type of shuttering leaves WS) respectively 2000 kPa (type of shuttering leaves WSD), see designation code "BS1500" respectively "BS2000" of the shuttering leaves of wood-chip concrete in clause 2.1.2, Table 2.

The declared value of the tensile strength perpendicular to faces of the multi-layered shuttering leaves according to ETA-12/0320 and ETA-12/0321 shall be at least 80 kPa.

The requirements according to ETAG 009, clause 6.4.2 are met.

2.2.5.3 Safety against personal injury by contact

Delivered on site the shuttering leaves of wood-chip concrete do not have sharp or cutting edges.

Because of a certain risk of abrasion or of cutting people on rough surfaces of the shuttering leaves of wood-chip concrete handling on site shall be done with gloves.

The requirements according to ETAG 009, clause 6.4.3 are met.

**2.2.6 Essential Requirement 5: Protection against noise**

2.2.6.1 Airborne sound insulation

The values of weighted sound reduction index  $R_W$  of walls made of types of shuttering elements "VELOX" in Table 6 are tabulated in Table 6 depending on the mass per wall area (including plaster) according to EN ISO 717-1.

Table 6: Weighted sound reduction index  $R_W$  depending on the mass per wall area (including plaster) of type of shuttering element

Type of shuttering elements	Mass per wall area (including plaster)	Weighted sound reduction index $R_W$ according to EN ISO 717-1
	[kg/m <sup>2</sup> ]	[dB]
TT25	≥ 493	60
TT27	≥ 537	60
TT30	≥ 603	63
TT35	≥ 713	63

The value is defined for the following structure of the wall construction:

1,5 cm gypsum plaster,

18,0 cm shuttering element filled with concrete and

1,5 cm gypsum plaster.

The "No performance determined" option in ETAG 009, Table 3 is used for walls made of types of other shuttering elements "VELOX".

2.2.6.2 Sound absorption

The "No performance determined" option in ETAG 009, Table 3 is used.

**2.2.7 Essential Requirement 6: Energy economy and heat retention**

2.2.7.1 Thermal resistance

The declared value of thermal resistance  $R_{D,element}$  of the shuttering elements in end use conditions (with concrete core without rendering) is the sum of the declared value of thermal resistance of the shuttering leaves of wood-chip concrete  $R_{D,wood}$ , of the concrete core  $R_{D,concrete}$  and maybe the thermal insulation  $R_{D,insulation}$ . The declared value of thermal resistance of the shuttering leaves of wood-chip concrete  $R_{D,wood}$  shall be calculated in accordance with EN ISO 6946 with a declared value of thermal conductivity of the shuttering leaves of wood-chip concrete  $\lambda_D$  tabulated in Table 7. The declared value of thermal resistance of the concrete core  $R_{D,concrete}$  shall be calculated in accordance with EN ISO 6946 with a value of thermal conductivity of the concrete core  $\lambda$  depending on the density  $\rho$  tabulated in EN ISO 10456. The declared value of thermal resistance of thermal insulation  $R_{D,insulation}$  shall be calculated in accordance with EN ISO 6946 with a declared value of thermal conductivity  $\lambda_D$  of the materials of thermal insulation tabulated in Table 3.

**Table 7:** Declared value of thermal resistance  $R_{D,wood}$  of the shuttering leaves of wood-chip concrete depending on the thickness, without thermal insulation

Type of shuttering leaves	Declared value of thermal conductivity of the shuttering leaves of wood-chip concrete $\lambda_D$	Thickness of the shuttering leaves of wood-chip concrete	Declared value of thermal resistance $R_{D,wood}$
	[W/(m×K)]	[mm]	[(m <sup>2</sup> ×K)/W]
<b>WS35</b>	0,110	35	0,32
<b>WS50</b>	0,110	50	0,45
<b>WS75</b>	0,095	75	0,79
<b>WSD35</b>	0,150	35	0,23
<b>WSD50</b>	0,150	50	0,33

**Table 8:** Declared value of thermal resistance  $R_{D,insulation}$  of the thermal insulation depending on the thickness

Type of shuttering leaves	Declared value of thermal conductivity of the thermal insulation $\lambda_D$	Thickness of the thermal insulation	Declared value of thermal resistance $R_{D,insulation}$
	[W/(m×K)]	[mm]	[(m <sup>2</sup> ×K)/W]
<b>WS-EPS85</b>	0,041	50	1,22
<b>WS-EPS115</b>	0,041	80	1,95
<b>WS-EPS135</b>	0,041	100	2,44
<b>WS-EPS185</b>	0,041	150	3,66

To consider the influence of the steel spacers the thermal transmittance U shall be increased depending on the types of the shuttering elements:

- type of shuttering element ET30:  $\Delta U = 0,03 \text{ W}/(\text{m}^2 \times \text{K})$
- other types of shuttering elements:  $\Delta U = 0,07 \text{ W}/(\text{m}^2 \times \text{K})$

#### 2.2.7.2 Influence of moisture transfer on insulating capacity of the wall

Using the values of clause 2.2.4.2 the verification of the annual moisture balance or the maximum amount of interstitial condensation according to EN ISO 13788 will be on the safe side.

#### 2.2.7.3 Heat capacity

The value of the heat capacity c of the shuttering leaves of wood-chip concrete is  $c = 1,50 \text{ kJ}/(\text{kg} \times \text{K})$  according to EN 15498, clause 5.2.8.2.

The values of the heat capacity c of the concrete core and of the materials of thermal insulation (see clause 2.1.2, Table 3) are tabulated in EN ISO 10456.

## 2.2.8 Aspects of durability and serviceability

### 2.2.8.1 Resistance to deterioration

#### Physical agent

The relative changes in thickness  $\Delta\varepsilon_d$  of the shuttering leaves of wood-chip concrete shall not exceed 3 % according to ETA-12/0320 and ETA-12/0321 and the relative changes in length  $\Delta\varepsilon_l$  and width  $\Delta\varepsilon_b$  of the shuttering leaves of wood-chip concrete shall not exceed 0,5 % according to ETA-12/0320 and ETA-12/0321.

As given in the designation code "DS(70,-)1" respectively "DS(70,-)3" of the EPS (see clause 2.1.2) the relative changes of the EPS thermal insulation in length, width and thickness under specified temperature and humidity conditions shall not exceed 1 % respectively 3 % after exposing them for 48 h at 70 °C according to EN 13163.

The requirements according to ETAG 009, clause 6.7.1.1 are met.

#### Chemical agent

The steel parts of the shuttering kit "VELOX" which are subjected to a risk of corrosion are steel-spacers and nails. The steel spacers are protected against corrosion by an anticorrosive coating (stove-enamel finish) and the nails are made of galvanized steel (see clause 2.1.3). There is no corrosion of the steel parts of the shuttering kit in concrete.

The finishes of the wall are not part of the ETA. Determination of the cleaning agent of the surface is not possible.

The requirements according to ETAG 009, clause 6.7.1.2 are met.

#### Biological agent

The application of wood-chip concrete as thermal insulation material for decades has shown that it is sufficiently protected against fungi, bacteria, algae and insects.

Wood-chip concrete and the thermal insulation do not provide a food value and in general it does not contain voids suitable for habitation by vermin.

The shuttering system "VELOX" does not contain any biocides.

The requirements according to ETAG 009, clause 6.7.1.3 are met.

### 2.2.8.2 Resistance to normal use damage

#### Normal use impacts

Concrete walls (without consideration of the finishes), constructed with shuttering system "VELOX" and designed according EN 1992-1-1 respectively in lack of availability of EN 1992-1-1 according national design rules, lead to the assumption that concrete core insures an adequate resistance of the complete wall under normal used impact loads.

The requirements according to ETAG 009, clause 6.7.2.1 are met.

#### Incorporation of ducts

The instructions in the installation guide of the manufacturer are appropriate to produce horizontal perforations through the walls, which are necessary for passing through ducts, see clause 4.2.4.

The requirements according to ETAG 009, clause 6.7.2.2 are met.

#### Fixing of objects

Fixing of objects in the shuttering leaves of wood-chip concrete is not possible. The part of fixings which is significant for the mechanical resistance shall be inside the concrete core.

The requirements according to ETAG 009, clause 6.7.2.3 are met.

### 3 Evaluation and attestation of conformity and CE marking

#### 3.1 System of attestation of conformity

According to the Decision 98/279/EC of 5 December 1997<sup>10</sup> amended by the Decision 2001/596/EC<sup>11</sup> of the European Commission system 2+ of the attestation of conformity applies.

This system of attestation of conformity is defined as follows:

System 2+: Declaration of conformity of the product by the manufacturer on the basis of:

- (a) Tasks for the manufacturer:
  - (1) initial type-testing of the product;
  - (2) factory production control;
  - (3) testing of samples taken at the factory in accordance with a prescribed control plan.
- (b) Tasks for the approved body:
  - (4) certification of factory production control on the basis of:
    - initial inspection of factory and of factory production control;
    - continuous surveillance, assessment and approval of factory production control.

In addition, according to the Decision 2001/596/EC<sup>12</sup> of the European Commission system 1 of the attestation of conformity applies with regard to reaction to fire.

This system of attestation of conformity is defined as follows:

System 1: Certification of the conformity of the product by an approved certification body on the basis of:

- (a) Tasks for the manufacturer:
  - (1) factory production control;
  - (2) further testing of samples taken at the factory by the manufacturer in accordance with a prescribed control plan;
- (b) Tasks for the approved body:
  - (3) initial type-testing of the product;
  - (4) initial inspection of factory and of factory production control;
  - (5) continuous surveillance, assessment and approval of factory production control.

Note: Approved bodies are also referred to as "notified bodies".

#### 3.2 Responsibilities

##### 3.2.1 Tasks for the manufacturer

###### 3.2.1.1 Initial type-testing of the product

For initial type-testing the results of the tests performed as part of the assessment for the European technical approval may be used unless there are changes to the product, in the production line or plant. In such cases the necessary initial type-testing shall be agreed between DIBt and the manufacturer involved.

<sup>10</sup> Official Journal of the European Communities L 127 of 24 April 1998  
<sup>11</sup> Official Journal of the European Communities L 209 of 8 January 2001  
<sup>12</sup> Official Journal of the European Communities L 209/33 of 2 August 2001

### 3.2.1.2 Factory production control

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall insure that the product is in conformity with this European technical approval.

The manufacturer may only use raw materials stated in the technical documentation of this European technical approval.

The factory production control shall be in accordance with the control plan of 10 May 2013 which is part of the technical documentation of this European technical approval. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited with Deutsches Institut für Bautechnik.<sup>13</sup>

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

### 3.2.1.3 Other tasks of the manufacturer

The manufacturer shall, on the basis of a contract, involve a body which is approved for the tasks referred to in clause 3.1 in the field of non load-bearing shuttering systems in order to undertake the actions laid down in clause 3.2.2. For this purpose, the control plan referred to in clauses 3.2.1.2 and 3.2.2 shall be handed over by the manufacturer to the approved body involved.

The manufacturer shall make a declaration of conformity, stating that the construction product is in conformity with the provisions of this European technical approval.

## 3.2.2 Tasks for the approved body

The approved body shall perform the

- initial type-testing of the product (only for reaction to fire),
- initial inspection of factory and of factory production control and
- continuous surveillance, assessment and approval of factory production control,

in accordance with the provisions laid down in the control plan.

The frequency of the inspections by the approved bodies shall be performed in accordance with section II of control plan.

The approved body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

The approved certification body involved by the manufacturer shall issue an EC certificate of conformity of the product stating the conformity with the provisions of this European technical approval (only for reaction to fire).

The approved certification body involved by the manufacturer shall issue an EC certificate of conformity of the factory production control stating the conformity with the provisions of this European technical approval.

In cases where the provisions of the European technical approval and its control plan are no longer fulfilled the certification body shall withdraw the certificate of conformity and inform Deutsches Institut für Bautechnik without delay.

<sup>13</sup> The control plan is a confidential part of the European technical approval and only handed over to the approved body involved in the procedure of attestation of conformity. See clause 3.2.2.

### 3.3 CE marking

The CE marking shall always be affixed on packaging and on the accompanying commercial documents. The letters "CE" shall be followed by the identification number of the approved certification body and be accompanied by the following additional information:

- the name and the address of the manufacturer (legal entity responsible for the manufacturer)
- the last two digits of the year in which the CE marking was affixed
- the number of the EC certificate of conformity for the product (only for reaction to fire)
- the number of the EC certificate for the factory production control
- the number of the European technical approval ETA-08/0134
- the number of the guideline ETAG 009 of the European technical approval
- description of the product: generic name, material, dimensions, ... and intended use
- information on those relevant essential characteristics which are to be declared presented as declared values and, where relevant, level or class according to Essential Requirements or "No performance determined" for characteristics where this is relevant according to Essential Requirements
  - Geometric characteristics of the shuttering leaves of wood-chip concrete (see clause 2.1.2 and Annex 1)
  - Designation code of the wood-chip concrete (see clause 2.1.2, Table 2)
  - Designation code of the thermal insulation (see clause 2.1.2, Table 3)
  - Reaction to fire: Class according to EN 13501-1 (see clause 2.2.3.1)
  - Resistance to fire: Class according to EN 13501-2 in dependence of minimum thickness of concrete core (see clause 2.2.3.2)
  - Water vapour permeability (see clause 2.2.4.2)
  - Minimum value of tensile strength of the shuttering leaves of wood-chip concrete perpendicular to faces (see clause 2.2.5.2)
  - Protection against noise (see clause 2.2.6)
  - Declared value of thermal conductivity  $\lambda_D$  of the shuttering leaves of wood-chip concrete (see clause 2.2.7.1, Table 7) and maybe the declared value of thermal conductivity  $\lambda_D$  of the materials of thermal insulation (see clause 2.1.2, Table 3)

## 4 Assumptions under which the fitness of the product for the intended use was favourably assessed

### 4.1 Manufacturing

The shuttering elements are manufactured in accordance with the provisions of the European technical approval using the automated manufacturing process as identified during the inspection of the plant by Deutsches Institut für Bautechnik and the approved body and laid down in the technical documentation.

The European technical approval is issued for the product on the basis of agreed data/information, deposited with Deutsches Institut für Bautechnik, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to Deutsches Institut für Bautechnik before the changes are introduced. Deutsches Institut für Bautechnik will decide whether or not such changes affect the approval and consequently the validity of the CE marking on the basis of the approval and if so whether further assessment or alterations to the approval shall be necessary.



## 4.2 Installation

### 4.2.1 General

The manufacturer shall ensure that the requirements in accordance with clauses 1, 2, and 4 are made known to those involved in planning and execution. The installation guide is deposited with Deutsches Institut für Bautechnik and shall be present at every construction site. If the manufacturer's instructions contain provisions which differ from those stated here, the specifications of the ETA shall apply.

After installation of the shuttering elements (see clause 4.2.2) site mixed or ready mixed concrete is placed and compacted (see clause 4.2.3).

In end use conditions concrete walls of a continuous type<sup>14</sup> (see clause 2.2.2.1) of plain or reinforced concrete will be formed according to EN 1992-1-1 or according to corresponding national rules.

For structural design purposes the thickness of the concrete core and the weight per unit area without rendering are shown in Annex 4.

In end use conditions the shuttering leaves of wood-chip concrete and the factory-coated thermal insulation are the main parts of the thermal insulation of the walls.

The design values of thermal resistance respectively the design values of thermal conductivity shall be laid down according to the relevant national provisions.

### 4.2.2 Installation of the shuttering elements

The shuttering elements are mounted on site in layers without mortar or adhesive according to the installation guide of the manufacturer. To receive stable floor high formworks the vertical joints between two shuttering leaves of wood-chip concrete of one layer have to be shifted of at least 25 cm of the length of the shuttering leaf to the vertical joints of the previous and next layer (see installation guide of the manufacturer). The length of a single shuttering leaf of wood-chip concrete shall not less than 40 cm.

The installation has to be start at a corner of the building. During concreting nails are used to interconnect the shuttering leaves of wood-chip concrete (three nails distributed over the height of the shuttering leaves and one nail over the length of the shuttering leaves, see Annex 3.1) to form a tight joint between the shuttering leaves of wood-chip concrete in horizontal and vertical direction as well as on wall junctions or corners.

First of all two layers of the entire floor plan are to be interlocked according to the installation guide of the manufacturer.

Afterwards levelling to the subsoil is performed (foundation, bottom, ground floor and ceiling). Voids between the shuttering leaves of wood-chip concrete and the uneven subsoil are to be sealed with PU foam before concreting.

Subsequently, according to the installation guide of the manufacturer, the shuttering leaves of wood-chip concrete are to be laid in a bond formation to floor height and levelled.

The necessary reinforcement according to static calculation shall also be installed according to the instructions in the installation guide provided by the manufacturer.

<sup>14</sup> see ETAG 009, clause 2.2

Rectangular corners and T-walls are to be formed according to Annex 3.

The wall end leaves require support during concrete placing of lintels (see clause 1.1.3.3). The supports may only be removed when the concrete core has sufficiently hardened

Further information is given in the installation guide.

#### 4.2.3 Concreting

For the production of normal concrete EN 206-1 shall apply. The consistency of concrete shall be at least within the lower consistency range F3 when compacted by vibration and at least within the upper consistency range F3 when compacted by poking.

The maximum aggregate size shall be at least 8 mm and shall not exceed 16 mm.

Furthermore the concrete shall have rapid or medium strength development according to EN 206-1, Table 12.

Placing the concrete shall be performed only by persons who were instructed in the works and in the proper handling of the shuttering system.

Placing the concrete shall be performed in layers of maximum 1 m at a maximum concreting rate of 1 m/h.

The maximum level of pressure of fresh concrete of the types of shuttering elements TT, GT, XT, ET and EE (see Table 1) is 1 m so that concreting has to take place not later than after assembling the second layer of the shuttering leaves. The concreting of the shuttering elements XU, XX and GG (see Table 1) has to take place after assembling the shuttering leaves of wood-chip concrete to floor height.

If equivalent national rules are not available the following instructions shall be considered:

Horizontal cold joints are to be arranged preferably at the height of the floor. If cold joints cannot be avoided within the height between the floors, vertical starter bars shall be installed. The starter bars shall meet the following requirements:

- Two adjacent starter bars shall not be situated in the same plane parallel to the surface of the wall.
- The distance between two starter bars in wall direction shall be at least 10 cm and not larger than 50 cm.
- The total section area of the starter bars shall not be less than 1/2000 of the section area of the concrete.
- Anchorage length of the starter bars on both sides of the cold joint shall be at least 20 cm.

Before the further placing of concrete, cement laitance and detached / loose concrete shall be removed and the cold joints shall be sufficiently pre-wetted. At the time of concreting the surface of the older concrete shall be slightly moist, so that the newly placed concrete can combine well with the older concrete.

If no cold joint is planned, placing of concrete in layers may only be interrupted until the concrete layer placed last has not yet set so that a good and even bond is still possible between the two concrete layers. When using internal vibrators the vibrating cylinder shall still penetrate into the already compacted lower concrete layer.

The concrete may fall freely only up to a height of 2 m, beyond that the concrete shall be cohered by discharge pipes or concreting tubes with a diameter of 100 mm at the most and shall be led shortly before the place of installation.

Cones from placing concrete are to be avoided by short distances of the places of fill in.

Planning shall allow for sufficient spaces in the reinforcement for discharge pipes or concreting tubes.

After concreting the walls may not deviate from the plumb line more than 5 mm per running meter wall height.

The ceiling shall only be placed on walls made of shuttering elements when the concrete core has sufficiently hardened.

#### 4.2.4 Ducts crossing and situated inside the wall

Horizontally passing ducts are to be installed according to the installation guide of the manufacturer and are to be taken into account when designing the wall.

Horizontal ducts situated inside the concrete cores and running parallel to the wall surfaces shall be avoided. If absolutely necessary, these are to be taken into account when designing the wall.

Also vertical ducts in the concrete core shall be considered, if their diameter exceeds 1/6 of the thickness of the concrete core and the distance of the ducts is less than 2 m.

#### 4.2.5 Reworking and finishes

Walls of the type "VELOX" are to be protected by finishes (e. g. rendering, plasters, cladding, panelling, coatings). Finishes are not part of the kit and therefore not considered in this ETA. Preferably for external surfaces the rendering systems used should meet the requirements of ETAG 004. The cladding respectively panelling or their substructures shall be anchored in the concrete core. The execution of the rendering shall be performed according to applicable national rules.

The protection by finishes should be implemented preferably within one month after erecting the load-bearing structure, because of the detrimental influence of weather and UV radiation on the surface of the shuttering leaves of wood-chip concrete.

#### 4.2.6 Fixing of objects

Fixing of objects in the shuttering leaves of wood-chip concrete is not possible. The part of fixings which is relevant for the mechanical resistance shall be inside the concrete core. The influence of the fixing to the reduction of the declared value of thermal resistance  $R_{D,element}$  shall be considered according to EN ISO 6946.

### 5 Indications to the manufacturer

#### 5.1 Packaging, transport and storage

The shuttering leaves of wood-chip concrete have to be protected against damage, soiling and intensive action of water during transport and storage. If necessary the shuttering leaves of wood-chip concrete shall be covered.

#### 5.2 Use, maintenance, repair

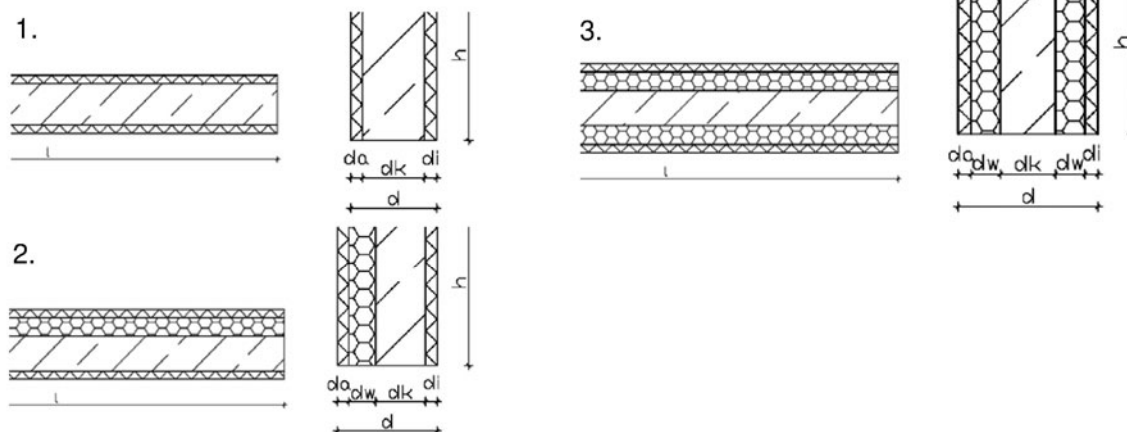
Regular checks should be carried out on renderings and finishes to ensure that any damage is detected and repaired as soon as possible.

The recommendations on use, maintenance and repair in ETAG 009, clause 7.5 shall be considered.

The shuttering leaves of wood-chip concrete have to be protected against high temperature, overheating and intensive exposure to weather and UV radiation. If necessary, the shuttering leaves of wood-chip concrete have to be covered.

Uwe Bender  
Head of Department

*beglaubigt:*  
Alex



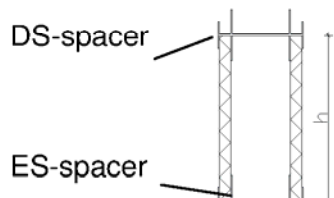
Type	Fig.	$l$	$d$	$dk$	$da$	$di$	$dw$	$h$
		[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
TT20	1	2000	200	130	35	35	-	500
TT22	1	2000	220	150	35	35	-	500
TT25	1	2000	250	180	35	35	-	500
TT27	1	2000	270	200	35	35	-	500
TT30	1	2000	300	230	35	35	-	500
TT35	1	2000	350	280	35	35	-	500
GT25	1	2000	250	165	50	35	-	500
GT30	1	2000	300	215	50	35	-	500
XT30	1	2000	300	190	75	35	-	500
XT35	1	2000	350	240	75	35	-	500
XU35	1	2000	350	225	75	50	-	500
XX35	1	2000	350	200	75	75	-	500
ET27	2	2000	270	150	35	35	50	500
ET30	2	2000	300	150	35	35	80	500
ET32	2	2000	320	150	35	35	100	500
ET35	2	2000	350	200	35	35	80	500
ET35	2	2000	350	130	35	35	150	500
EE30	3	2000	300	130	35	35	100	500
EE35	3	2000	350	180	35	35	100	500
GG25	1	2000	250	150	50	50	-	500
GG30	1	2000	300	200	50	50	-	500
GG35	1	2000	350	250	50	50	-	500

VELOX

Types of shuttering elements which are used mainly

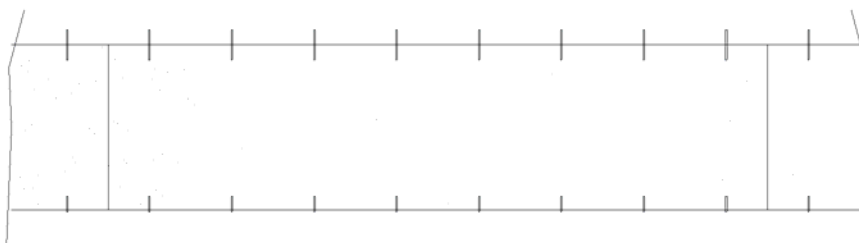
Annex 1

# Shuttering system VELOX

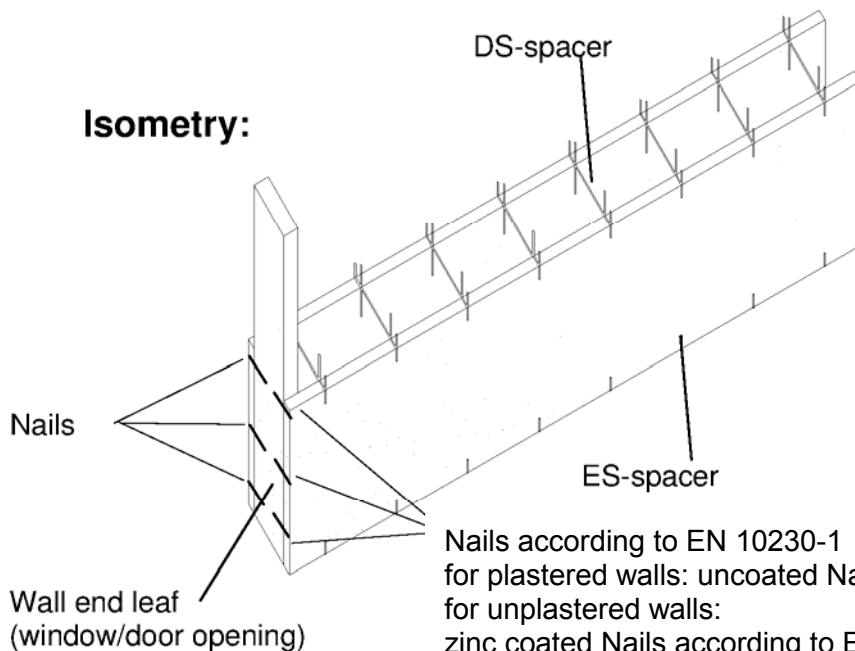


**Cross section:**  
1. layer

**View:**



**Isometry:**



Nails according to EN 10230-1  
for plastered walls: uncoated Nails  
for unplastered walls:  
zinc coated Nails according to EN 10230-1, 6.2b  
Ø 3 till 4 mm, length 80 bis 100 mm

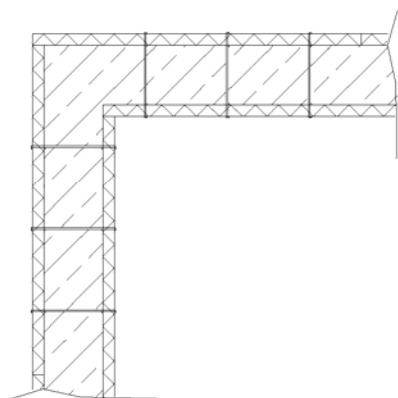
VELOX

Shuttering system "VELOX"

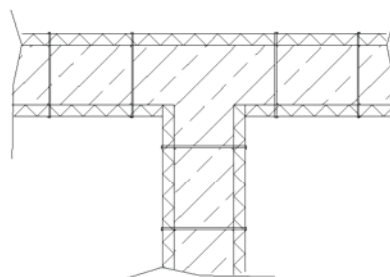
Annex 2

## Internal and external walls see Annex 1, Fig. 1

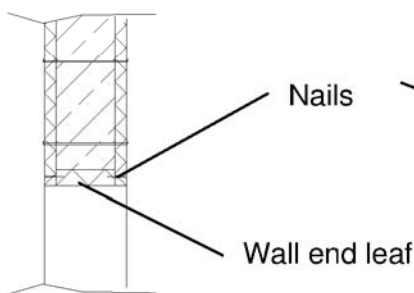
**Layout:**  
Rectangular corner



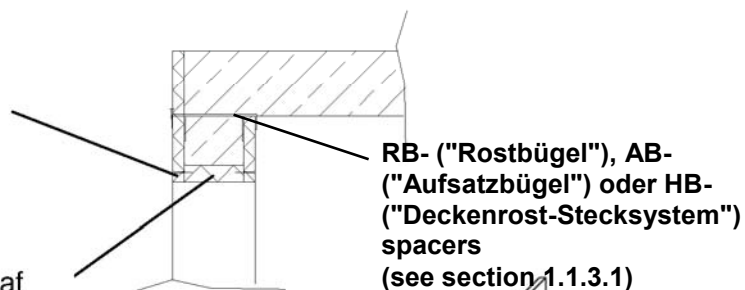
**Layout:**  
T-wall



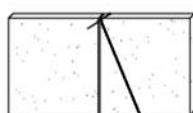
**Layout:**  
window/door opening



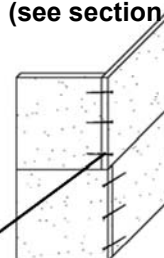
**Cross section:**  
lintel/ceiling construction



**Nails:**  
drive in slightly angled  
(~15°)



Nails



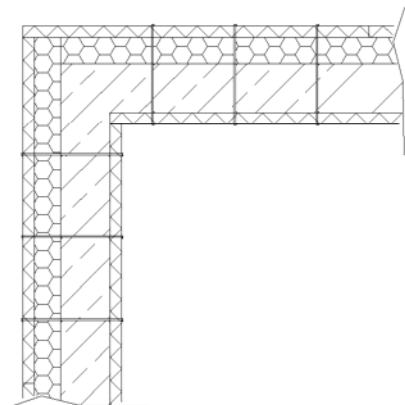
VELOX

Internal and external walls

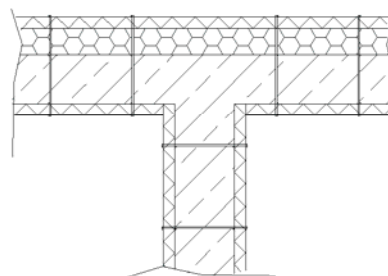
Annex 3.1

## External walls see Annex 1, Fig. 2

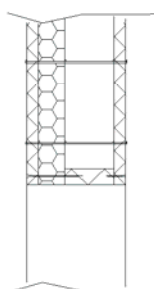
**Layout:**  
Rectangular corner



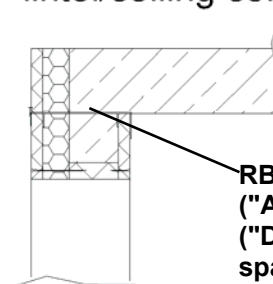
**Layout:**  
T-wall



**Layout:**  
window/door opening



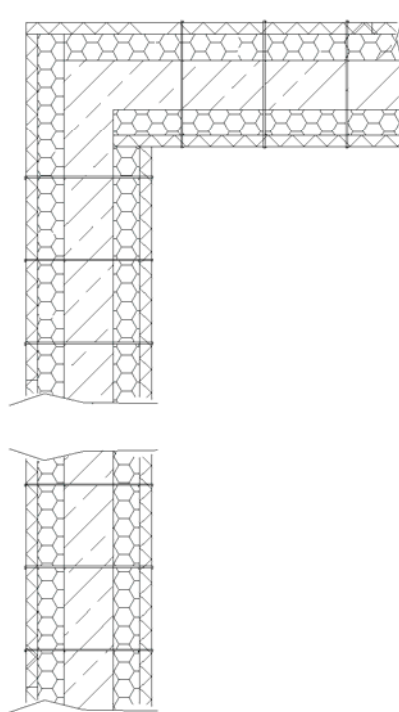
**Cross section:**  
lintel/ceiling construction



RB- ("Rostbügel"), AB-  
("Aufsatzbügel") oder HB-  
("Deckenrost-Stecksystem")  
spacers  
(see section 1.1.3.1)

## Attic and parapet see Annex 1, Fig. 3

### Layout:





Type	Thickness of the concrete core	Type of shuttering leaves		Assumed weight of the wall the wall (without rendering)	Unit weight of the wood-chip concrete	
		outer	inner		outer leaves	inner leaves
	[mm]			[kg/m <sup>2</sup> ]	[kg/m <sup>3</sup> ]	[kg/m <sup>3</sup> ]
TT20	130	WSD35	WSD35	335,0	750	750
TT22	150	WSD35	WSD35	382,5	750	750
TT25	180	WSD35	WSD35	448,6	750	750
TT27	200	WSD35	WSD35	492,6	750	750
TT30	230	WSD35	WSD35	558,6	750	750
TT35	280	WSD35	WSD35	668,6	750	750
GT25	165	WS50	WSD35	415,6	560	750
GT30	215	WS50	WSD35	527,3	560	750
XT30	190	WS75	WSD35	484,8	540	750
XT35	240	WS75	WSD35	595,6	540	750
XU35	225	WS75	WSD50	573,0	540	750
XX35	200	WS75	WS75	521,0	540	540
ET27	150	WS-EPS85	WSD35	353,0	580	750
ET30	150	WS-EPS115	WSD35	270,0	580	750
ET32	150	WS-EPS135	WSD35	387,3	580	750
ET35	200	WS-EPS115	WSD35	497,3	580	750
ET35	130	WS-EPS185	WSD35	342,3	580	750
EE30	130	WS-EPS85	WS-EPS85	327,2	580	580
EE35	180	WS-EPS85	WS-EPS85	437,2	580	580
GG25	150	WS50	WS50	386,0	560	560
GG30	200	WS50	WS50	496,0	560	560
GG35	250	WS50	WS50	606,0	560	560

VELOX

Kernbetondicke und Berechnungsgewicht der Wand pro m<sup>2</sup> ohne Putz

Annex 4

standards and guidelines	issue	title
EN	206-1	2000 Concrete – Part 1: Specification, performance, production and conformity
EN	1992-1-1	2004 + AC:2010 Eurocode 2: Design of concrete structures. – Part 1-1: General rules and rules for buildings
EN	13163	2012 Thermal insulation products for buildings – Factory made products of expanded polystyrene (EPS) – Specification
EN	13168	2012 Thermal insulation products for buildings – Factory made wood wool (WW) products – Specification
EN	13501-1	2007 + A1:2009 Fire classification of construction products and building elements – Part 1: Classification using test data from reaction to fire tests
EN	13501-2	2007 + A1:2009 Fire classification of construction products and building elements – Part 2: Classification using data from fire resistance tests, excluding ventilation services
EN	15498	2008 Precast concrete products – Wood-chip concrete shuttering blocks – Product properties and performance
EN ISO	717-1	1996 + A1:2006 Acoustics – Rating of sound insulation in buildings and of building elements – Part 1: Airborne sound insulation
EN ISO	6946	2007 Building components and building elements – Thermal resistance and thermal transmittance – Calculation method
EN ISO	10456	2007 + AC:2009 Building materials and products – Hygrothermal properties – Tabulated design values and procedures for determining declared and design thermal values
EN ISO	13788	2001 Hygrothermal performance of building components and building elements – Internal surface temperature to avoid critical surface humidity and interstitial condensation – Calculation methods
ETAG	004	2011 Guideline for European technical approval of "External thermal insulation composite systems with rendering"
ETAG	009	2002-06 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"
VELOX		Annex 5
List of standards and guidelines		