

Approval body for construction products  
and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and  
Laender Governments



## European Technical Assessment

**ETA-05/0170**  
**of 13 September 2019**

English translation prepared by DIBt - Original version in German language

### General Part

Technical Assessment Body issuing the  
European Technical Assessment:

Deutsches Institut für Bautechnik

Trade name of the construction product

ARGISOL

Product family  
to which the construction product belongs

Non load bearing shuttering kit "ARGISOL"  
based on shuttering elements of EPS

Manufacturer

BEWA GmbH  
ARGISOL-Bausysteme  
Grünstadter Straße 2  
67271 Obersülzen

Manufacturing plant

BEWA GmbH  
ARGISOL-Bausysteme  
Grünstadter Straße 2a  
67271 Obersülzen  
DEUTSCHLAND

This European Technical Assessment  
contains

38 pages including 30 annexes which form an integral  
part of this assessment

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

ETAG 009,  
used as EAD according to Article 66 Paragraph 3 of  
Regulation (EU) No 305/2011.

This version replaces

ETA-05/0170 issued on 30 October 2015

**European Technical Assessment**  
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## Specific Part

### 1 Technical description of the product

#### 1.1 Definition of construction product

The shuttering system "ARGISOL" is a non-load-bearing permanent shuttering kit based on shuttering elements and accessory parts (applicable as shuttering for plain and reinforced concrete walls cast in-situ. The accessory parts are wedges for horizontal curved walls, floor end plates, single plates, pieces for the equalization of differences in height and end stops.

#### 1.2 Shuttering elements

##### 1.2.1 Standard shuttering elements with sheet steel webs

The shuttering elements consist of one-layered expanded polystyrene (EPS) leaves which are prefabricated in connection with webs of sheet steel. The webs of sheet steel are 0.5 mm thick and connect the shuttering leaves. The distance between the webs in longitudinal direction of the elements is 125 mm (see e. g. Annexes A2). The two ends of the webs are embedded in the EPS (expanded polystyrene) of the shuttering leaves.

The horizontal surface at the top of the shuttering leaves is provided with nubs. The horizontal surface on the underside of the shuttering leaves is provided with corresponding recesses to accommodate the nubs (see eg Annex A2). The vertical mating surfaces are tongue and groove to form a tight fit when joined together.

The inner surfaces have vertically extending, conical (dovetailed) shaped, maximum 7 mm deep grooves. These grooves serve as mechanical fixing of the shuttering leaves to the concrete. They also form locks for end stops.

Also the outside of the shuttering leaves have grooves in the vertical direction. These serve to tailor the shuttering leaves and improve the adhesion with the plaster.

The length of the elements is 1000 mm respectively 1250 mm and the height is 250 mm, see Annexes A2 and A3.

The thickness of the inner shuttering leaf<sup>1</sup> for all elements is 52 mm. Depending on the shuttering element the thickness of the outer shuttering<sup>1</sup> leaf is either 55 mm, 65 mm, 155 mm or 255 mm. The continuous thickness of the concrete core<sup>2</sup> also depends on the shuttering element and is 133 mm or 143 mm.

##### 1.2.2 Special shuttering elements with sheet steel webs

Special elements are also part of the kit as corner elements, angular elements, T-elements, elements with wedges for horizontal curved walls and lintel elements which are produced in the same manner as described above.

##### 1.2.3 Standard shuttering elements with EPS webs

The shuttering elements consist of one-layered expanded polystyrene (EPS) leaves which are prefabricated together with the webs, which are also made of EPS. The webs of EPS are about 45 mm thick and 11 cm high. The cross-sectional area of the concrete bars above and below the EPS webs depends on the minimum thickness of the concrete core. For a minimum thickness of the concrete core of 133 mm it is 186 cm<sup>2</sup> and for a minimum thickness of the concrete core of 143 mm it is 200 cm<sup>2</sup>.

<sup>1</sup> The depth of the grooves is included in these thicknesses of shuttering walls. In the drawings in Annex A, these are the higher values of the thicknesses of the shuttering leaves.

<sup>2</sup> The depth of the grooves is not included in these thicknesses for the concrete cores. In the drawings in Annex A, these are the lower values for the thicknesses of the concrete cores. Since they are continuous they should also be used in proof of mechanical resistance and stability.

The center distance between the EPS webs in the longitudinal direction of the elements is 125 mm (see, for example, Appendix A18).

The horizontal surface at the top of the shuttering leaves is provided with nubs. The horizontal surface on the underside of the shuttering leaves is provided with corresponding recesses to accommodate the nubs (see eg Annex A2). The vertical mating surfaces are tongue and groove to form a tight fit when joined together.

The inner surfaces of the shuttering leaves have vertically extending, conical (dovetailed) shaped, maximum 7 mm deep grooves. These grooves serve as mechanical fixing of the shuttering leaves to the concrete. They also form locks for end stops.

Also the outside of the shuttering leaves have grooves in the vertical direction. These serve to tailor the shuttering leaves and improve the adhesion with the plaster.

The length of the elements is 1000 mm respectively 1250 mm and the height is 250 mm, see Annexes A18 and A19.

The thickness of the inner shuttering leaf<sup>1</sup> for all elements is 52 mm. Depending on the shuttering element the thickness of the outer shuttering leaf<sup>1</sup> is either 65 mm or 155 mm. The thickness of the concrete<sup>2</sup> core also depends on the shuttering element and is 133 mm or 143 mm.

#### **1.2.4 Special shuttering elements with EPS webs**

There are no special elements with EPS webs. The special elements such as corner elements, angle elements, T elements, elements with wedges for horizontally curved walls and lintel elements according to 1.2.2 can also be combined with the standard shuttering elements with EPS webs of appropriate dimensions.

### **1.3 Accessory parts**

#### **1.3.1 General**

The accessories listed below are suitable both for the combination with the shuttering elements with sheet steel webs (see 1.2.1 and 1.2.2) and the shuttering elements with EPS webs (see 1.2.3 and 1.2.4) of corresponding dimensions.

#### **1.3.2 Wedges for horizontal curved walls**

Are as high as the shuttering leaves (250 mm) and are used to fill the gaps between the vertical joints on the inner side of the horizontal curved walls.

#### **1.3.3 Floor end plates**

They are used for the vertical shuttering of the floor plates and to avoid heat bridges in the floor levels at the intended use. The horizontal surface is provided with nubs in the same way as for the shuttering leaves of the elements. The horizontal surface on the underside of the shuttering leaves is provided with corresponding recesses to accommodate the nubs in the same way as for the shuttering leaves of the elements.

Their vertical mating surfaces are tongue and groove and form a tight fit when they are put together. They are 100 mm thick and 200 mm high. At the inside of the plates there are pockets which, together with the walls, are filled with concrete and reinforcement (see Annex A8 above). After hardening of the concrete of the wall the floor end plates are sufficiently fixed to resist the concrete pressure when concreting the floors.

#### **1.3.4 Single plates, pieces for the equalization of differences in height and end stops**

The upper and lower surface of all these parts is designed in the same way as for the shuttering leaves of the elements. The structure of the inner and outer surface is the same as for the shuttering leaves. Their vertical mating surfaces are tongue and groove and form a tight fit when put together.

Single plates and pieces for equalization are used to fill gaps, which are not possible to fill with shuttering elements (e.g. joints to the roof). Single plates have the same dimensions as the shuttering leaves. Pieces for the equalization of differences in height are 50 mm thick and high and 500 mm long.

End stops are 50 mm thick and 133 mm respectively 143 mm long. They are inserted in the gaps between the shuttering leaves at the openings of the wall.

## **2 Specification of the intended use in accordance with the applicable European Assessment Document**

The kit is intended to be used for construction of internal walls as well as external walls above or below ground which are load-bearing (structural) or non-load-bearing (nonstructural), 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 water not exerting pressure or water exerting pressure is to be dealt with. The waterproofing shall be protected from mechanical damage by a smash-resistant protective layer.

The performances given in Section 3 are only valid if the shuttering elements are used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the shuttering kit of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, 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.

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

### **3.1 Mechanical resistance and stability (BWR 1)**

#### **3.1.1 Resulting structural pattern**

Shuttering elements "ARGISOL" with sheet steel webs (see 1.2.1 and 1.2.2) are intended to be used for the erection of walls of the continuous type according to ETAG 009, paragraph 2.2.

Shuttering elements "ARGISOL" with EPS webs (see 1.2.3 and 1.2.4) are intended to be used for the erection of walls of the grid type according to ETAG 009, paragraph 2.2.

#### **3.1.2 Efficiency of filling**

Considering the instructions of Annexes B1 and B2 and the installation guide of the ETA holder the 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, chapter 6.1.2 are met.

#### **3.1.3 Possibility of steel reinforcement**

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

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

### 3.2 Safety in case of fire (BWR 2)

#### 3.2.1 Reaction to fire

Class E according to EN 13501-1.

#### 3.2.2 Resistance to fire

Advices for determining the resistance to fire for the intended use are given in Annex B3.

### 3.3 Hygiene, health and the environment (BWR 3)

#### 3.3.1 Release of dangerous substances

Essential characteristic	Performance
Contents of dangerous substances	The product does not contain CMR-substances actively used (in accordance with Regulation (EC) No 1272/2008) and no HBCDD.
Release scenario regarding BWR 3: IA2	

#### 3.3.2 Water vapour permeability

The tabulated design value of the water vapour diffusion resistance coefficient of expanded polystyrene (EPS) according to EN ISO 10456 is  $\mu = 60$ .

The values for the water vapour diffusion resistance of concrete depending on density and type are tabulated in EN ISO 10456.

### 3.4 Safety and accessibility in use (BWR 4)

#### 3.4.1 Bond strength between the shuttering leaves and the concrete core

The expanded polystyrene is bonded to the concrete by mechanical interlocking of the dovetail sections running vertically in the inner surfaces of the shuttering leaves over the whole height of the element with a horizontal distance of 2.4 cm (i.e. 41 sections per meter length). Since the minimum width of the dovetail sections is 10 mm the effective area for the transmission of tensile forces is  $0.01 \times 1 \times 41 \text{ m}^2 = 0.41 \text{ m}^2$ . This is more than 20 % of the whole area of the shuttering leaves and leads to the effective bond strength of  $0.041 \text{ N/mm}^2$  which is sufficient to meet the requirements of ETAG 004, chapter 6.1.4.1.3.

The requirements according to ETAG 009, chapter 6.4.1.3 are met.

#### 3.4.2 Resistance to filling pressure

To resist the filling pressure the bending tensile strength of the shuttering leaves shall be more than 200 kPa (see also designation code of EPS in Annex A1) and the resistance against pulling out of the webs of sheet steel more than 850 N.

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

#### 3.4.3 Safety against personal injury by contact

Delivered on site the shuttering elements do not have sharp or cutting edges.

Because of the soft surface of the shuttering leaves there is no risk of abrasion or of cutting people.

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

### 3.5 Protection against noise (BWR 5)

#### 3.5.1 Airborne sound insulation

The "No performance assessed" option in ETAG 009, table 3 is used.

#### 3.5.2 Sound absorption

The "No performance assessed" option in ETAG 009, table 3 is used.

### **3.6 Energy economy and heat retention (BWR 6)**

#### **3.6.1 Declared value of thermal conductivity and of thermal resistance**

The nominal value of the thermal conductivity of the extruded polystyrene used in accordance with EN 13163, clause 4.2.1 is  $\lambda_D = 0.031 \text{ W/(m}\cdot\text{K)}$  with a gross density  $\rho_a$  according to EN 1602 of not more than  $28 \text{ kg/m}^3$ .

Advices to determine the declared value of the thermal resistance for the intended use are given in Annex B4.

#### **3.6.2 Thermal inertia**

The values for the heat capacity of concrete and expanded polystyrene are tabulated in EN ISO 10456.

### **3.7 General Aspects**

#### **3.7.1 Resistance to deterioration**

##### Physical agent

As given in the designation code of the EPS material used (see Annex A1) the dimensions of the shuttering leaves do not differ more than 3 % after exposing them for 48 h at  $70^\circ\text{C}$  (DS(70,-)3).

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

##### Chemical agent

The spacers made of sheet steel are only necessary for the resistance to concrete pressure. After hardening of the concrete the bond between concrete and shuttering leaves is given by the dovetail sections running vertically on the inner surfaces of shuttering leaves (see 3.4.1).

Therefore the requirement "corrosion protection" according to ETAG 009, chapter 6.7.1.2 is met.

##### Biological agent

The application of EPS as thermal insulating material for decades has shown that it sufficiently protects against fungi, bacteria, algae and insects.

EPS does not provide a food value and in general it does not contain voids suitable for habitation by vermin.

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

#### **3.7.2 Resistance to normal use damage**

##### Incorporation of ducts

The instructions in the installation guide of the ETA holder are appropriate to install horizontally passing ducts on site.

##### Fixing of objects

Fixing of objects in the shuttering leaves is not possible; the part of fixings which is significant for the mechanical resistance shall be in the concrete core.

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

In accordance with guideline for European technical approval ETAG 009, June 2002, used as European Assessment Document (EAD) according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011, the applicable European legal act is: [98/279/EC], as amended by European legal act [2001/596/EC]

The system to be applied is: 2+

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

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 13 September 2019 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow  
Head of Department

*beglaubigt:*  
Alex



## Characteristics of shuttering elements

The standard and special shuttering elements as well as the accessory parts correspond to the information and drawings given in Annexes A2 to A19. The kit consists of the following shuttering elements, plates and pieces:

- Standard shuttering elements with webs of sheet steel (Annexes A2 to A6)
- Corner shuttering elements with webs of sheet steel (Annexes A7, A9 to A13, A14 and A16)
- Angular shuttering elements with webs of sheet steel (Annexes A8, A13 and A14)
- T-elements with webs of sheet steel (Annexes A10 and A11)
- Lintel elements (Annexes A8, A15 and A17)
- Elements with joints and with webs of sheet steel and wedges for horizontal curved walls (Annex A12)
- Floor end plates (Annex A8)
- Single plates, pieces for the equalization of differences in height and end stops (Annexes A4, A5, A6, A12 and A15)
- Standard shuttering elements with webs of EPS (Annexes A18 and A19)

### Dimensions:

#### **Standard shuttering elements with webs of sheet steel**

The webs of sheet steel (see e.g. Annexes A2 to A5) have a minimum overall thickness of 0.50 mm and a minimum height of 50 mm in the middle of the web.

The shuttering elements allow for plain and reinforced situ concrete walls with minimum thickness of concrete core of 133 mm or 143 mm. Table 1 shows the possible wall thicknesses.

**Table 1:** Wall thicknesses for the standard shuttering elements with webs of sheet steel

No	Thickness of the inner shuttering leaf of EPS [mm]	Thickness of the external shuttering leaf of EPS [mm]	Thickness of concrete core [mm]	Overall wall thickness (without plastering) [mm]	according ETA-Annex for standard elements
1	52	65	133	250	A2, A3
2	52	55	143	250	A4
3	52	155	143	350	A5
4	52	255	143	450	A6

Shuttering system "ARGISOL"

Product characteristics of shuttering elements

Annex A1  
Page 1 of 2

### **Standard shuttering elements with webs of EPS**

The webs made of EPS (see Annexes A18 and A19) have a minimum thickness of 19 mm and a minimum height in the middle of the web of 110 mm

The shuttering elements allow the creation of walls of the grid type for unreinforced and reinforced situ concrete walls with a thickness of concrete core of 133 mm or 143 mm. Table 2 shows the possible wall thicknesses.

**Table 2:** Wall thicknesses for the standard shuttering elements with webs of sheet steel

No	Thickness of inner shuttering leaf of EPS [mm]	Thickness of external shuttering leaf of EPS [mm]	Thickness of concrete core [mm]	Overall wall width (without plastering) [mm]	according ETA-Annex for standard elements
1	52	65	133	250	A18
3	52	155	143	350	A19

### **Materials:**

For the shuttering leaves expanded polystyrene

EPS EN 13163-T(2)-S(2)-P(5)-DS(70,-)3-BS200-CS(10)150

made of polystyrene particle foam with a apparent density  $\rho_a$  of 29 to 31 kg/m<sup>3</sup> respectively a thermal conductivity  $\lambda_D = 0,031$  W/(m\*K) according to EN 13163 is used.

The webs of sheet steel are galvanized and have a minimum tensile strength of 360 MPa.

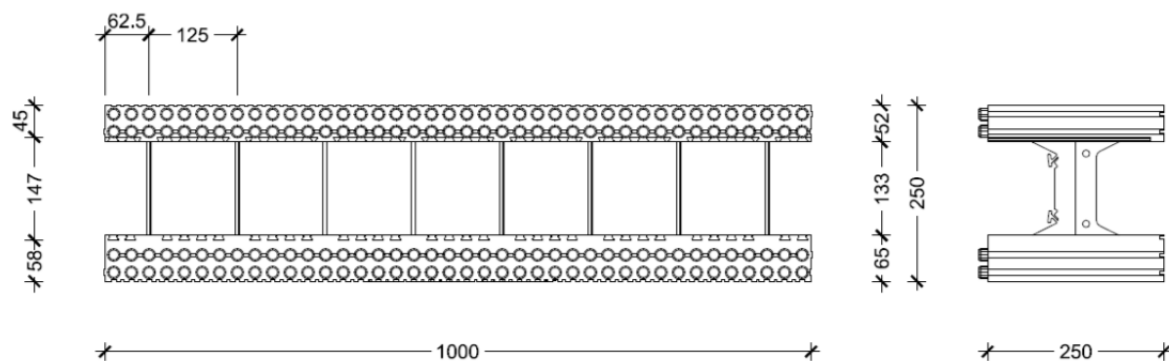
Wedges for horizontal curved walls (Annex A12), floor end plates (Annex A8), single plates, end stops and pieces for the equalization of differences in height (Annexes A4, A5, A6, A12 and A15) are made of the same EPS material as the shuttering leaves.

Shuttering system "ARGISOL"

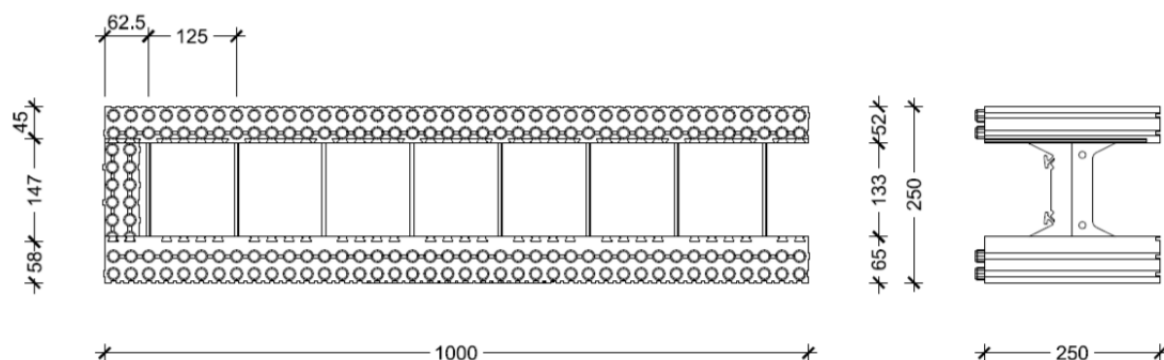
Product characteristics of shuttering elements

Annex A1  
Page 2 of 2

## Standard elements 1000 x 250 x 250 concrete core 133



## Standard elements with end stops 1000 x 250 x 250 concrete core 133



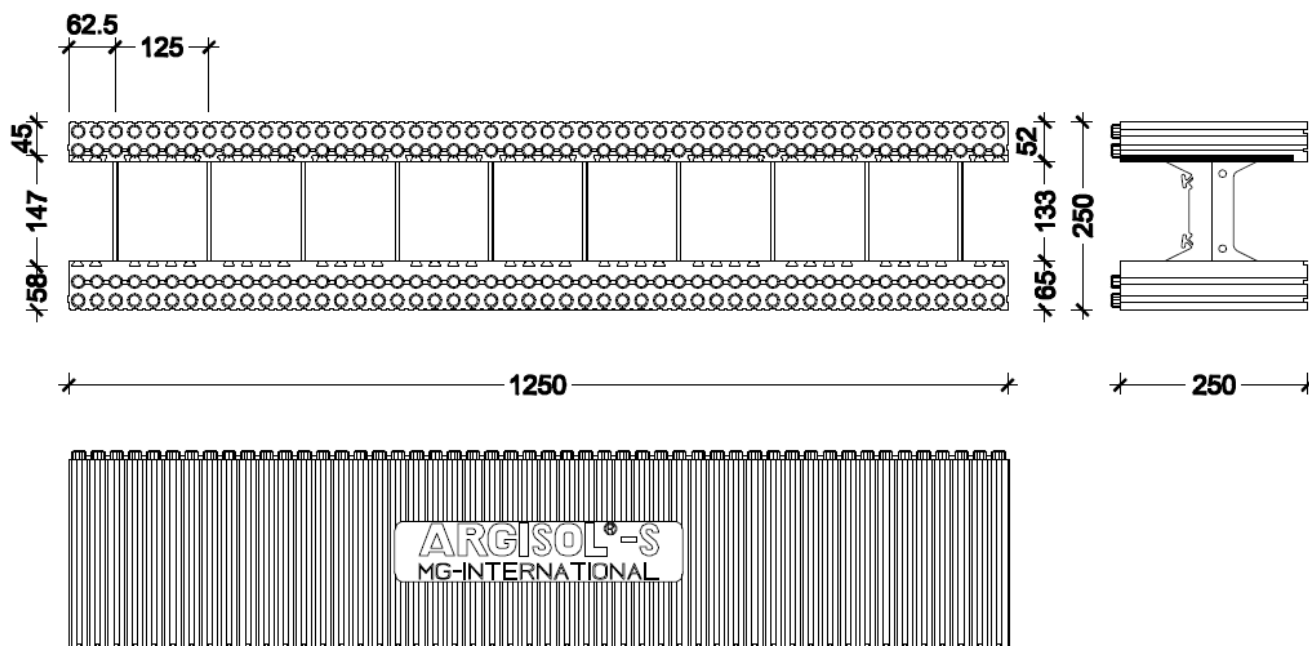
all dimensions in mm

Shuttering system "ARGISOL"

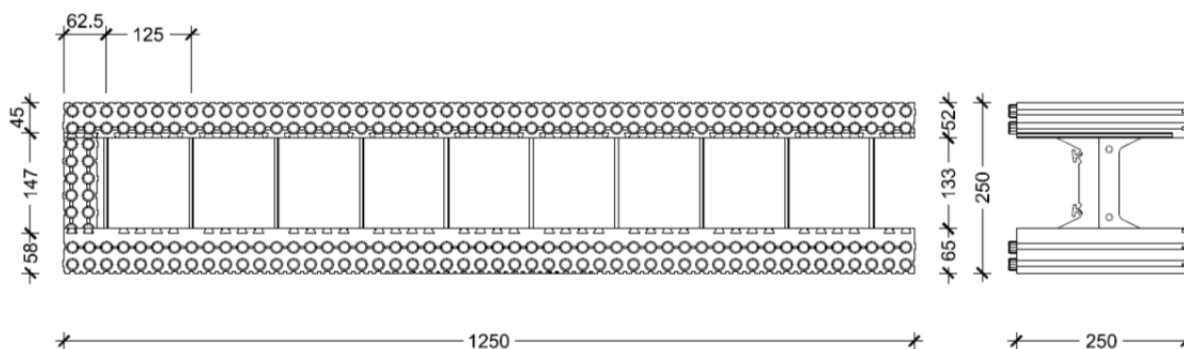
Standard shuttering elements with webs of sheet steel  
Length of element: 1000 mm with a continuous thickness of concrete core of 133 mm and overall wall thickness of 250 mm

Annex A2

## Standard elements 1250 x 250 x 250 concrete core 133



## Standard elements with end stops 1250 x 250 x 250 concrete core 133



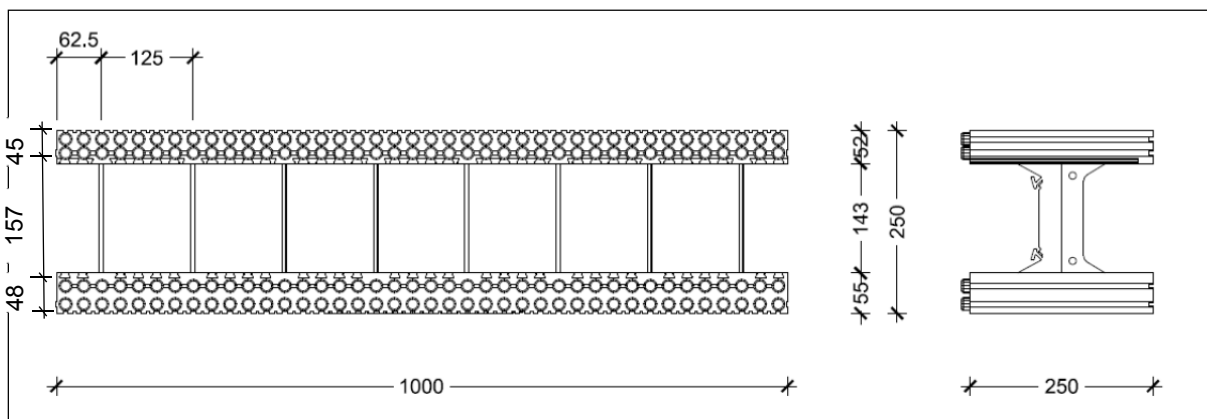
all dimensions in mm

Shuttering system "ARGISOL"

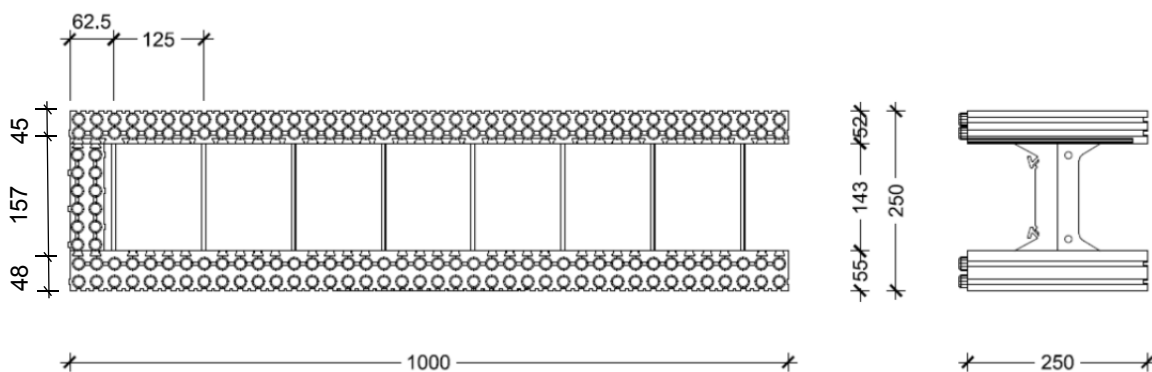
Standard shuttering element S with webs of sheet steel  
Length of element: 1250 mm with a continuous thickness of concrete core of 133 mm and overall wall thickness of 250 mm

Annex A3

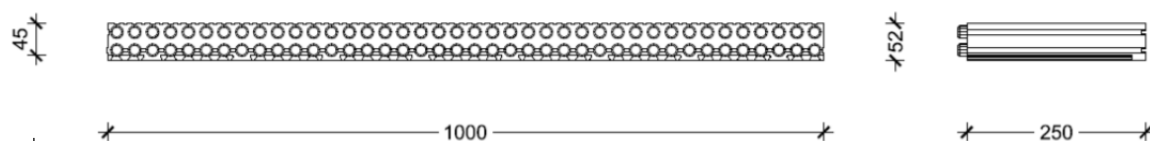
### Standard elements 1000 x 250 x 250 concrete core 143



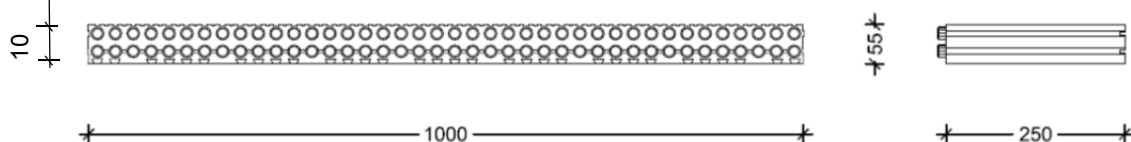
### Standard elements with end stops 1000 x 250 x 250 concrete core 143



### Single plates 1000 x 52 x 250



### Single plates 1000 x 55 x 250



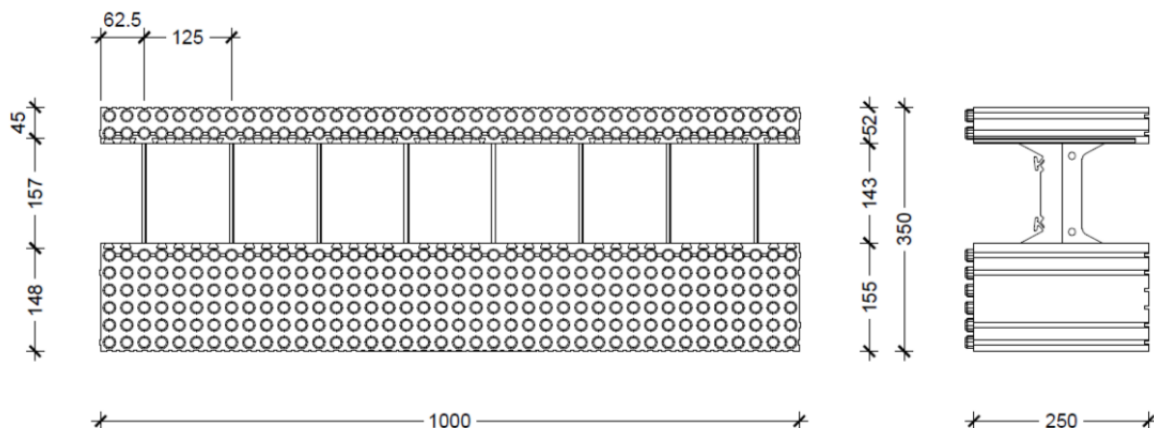
all dimensions in mm

Shuttering system "ARGISOL"

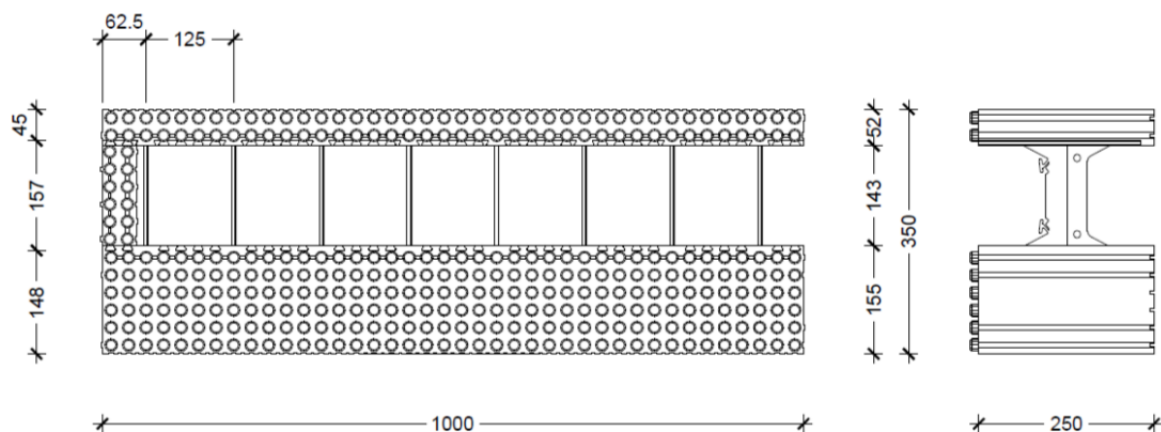
Standard shuttering element, Single plates; with webs of sheet steel  
Length of element: 1000 mm with a continuous thickness of concrete core of 143 mm and overall wall thickness of 250 mm

Annex A4

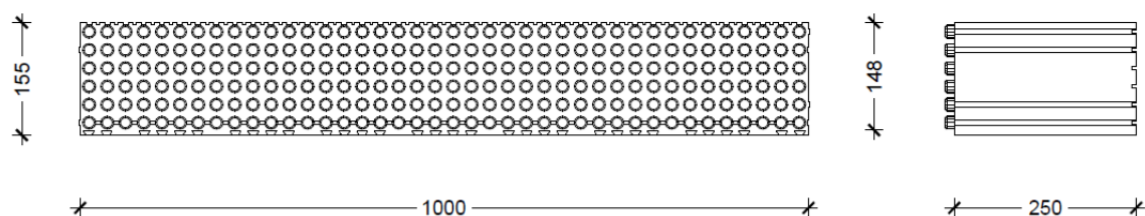
## Standard elements 1000 x 350 x 250 concrete core 143



## Standard elements with end stops 1000 x 350 x 250 concrete core 143



## Single plates exterior 1000 x 155 x 250



all dimensions in mm

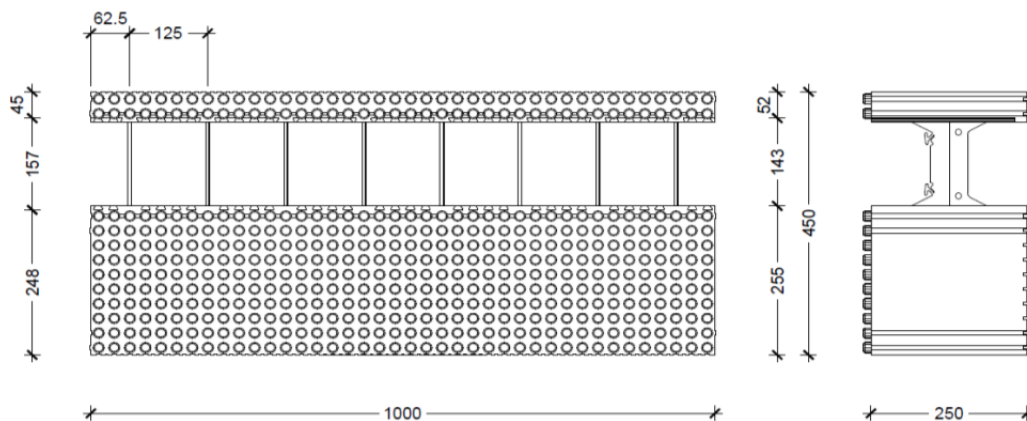
Shuttering system "ARGISOL"

Standard shuttering element, Single plates; with webs of sheet steel  
Length of element: 1000 mm with minimum thickness of concrete core of 143 mm and overall wall thickness of 350 mm

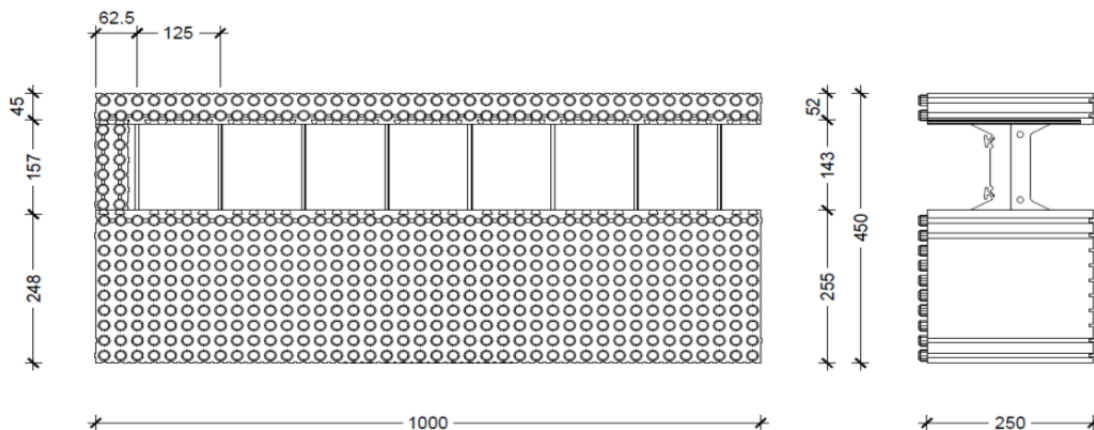
Annex A5



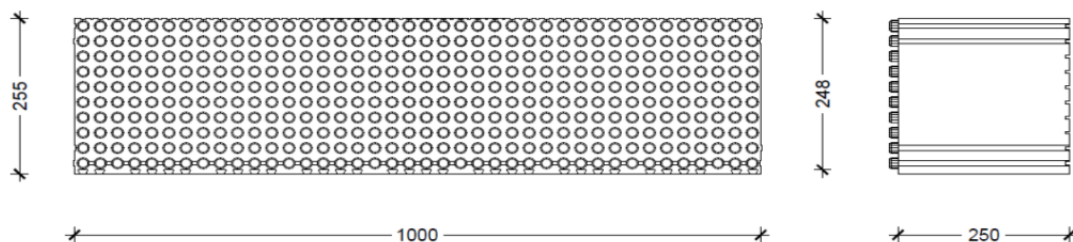
## Standard elements 1000 x 450 x 250 concrete core 143



## Standard elements with end stops 1000 x 450 x 250 concrete core 143



## Single plates exterior 1000 x 255 x 250



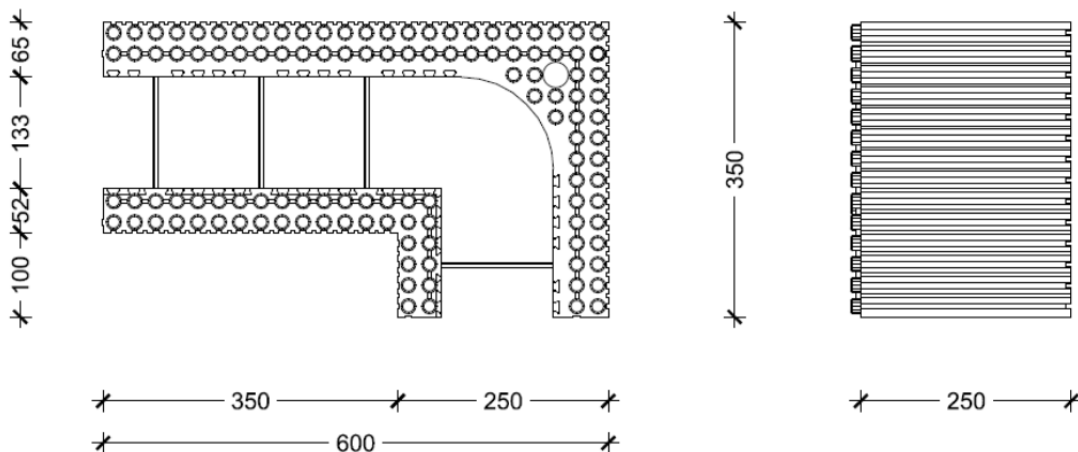
all dimensions in mm

Shuttering system "ARGISOL"

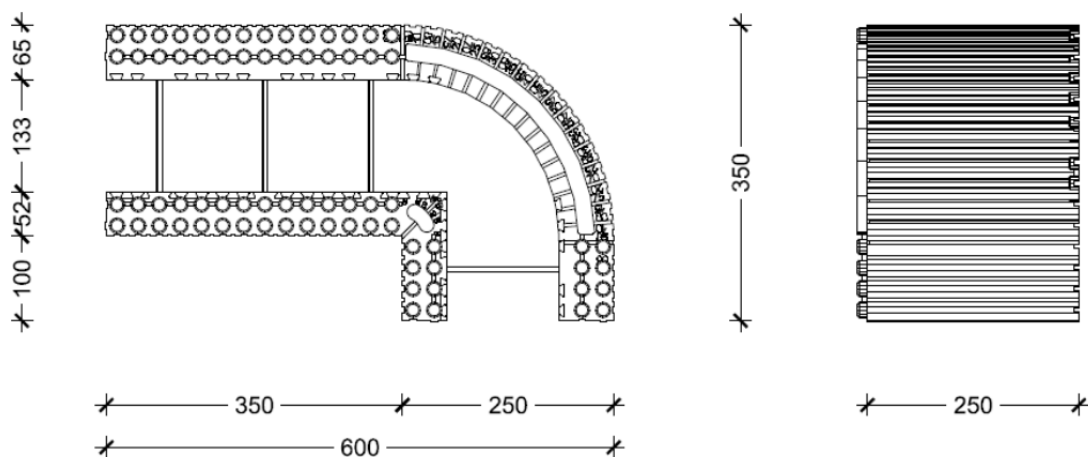
Standard shuttering element, Single plates; with webs of sheet steel  
Length of element: 1000 mm with a continuous thickness of concrete core of 143 mm and overall wall thickness of 450 mm

Annex A6

### Corner element right/left 600 x 350 x 250 concrete core 133



### Curved corner element right/left 600 x 350 x 250 concrete core 133



all dimensions in mm

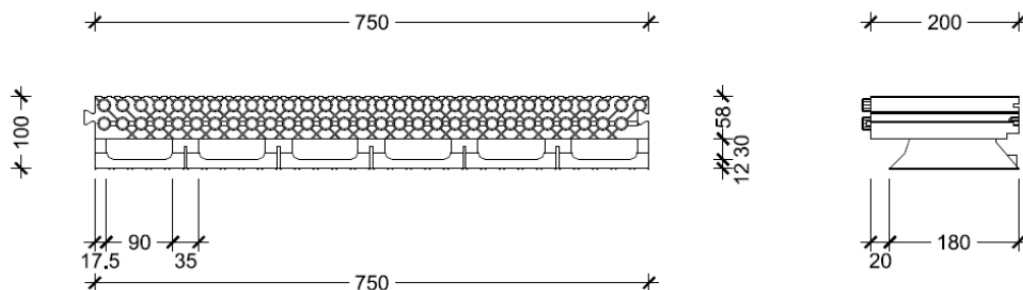
Shuttering system "ARGISOL"

Corner elements with webs of sheet steel  
Length of element: 600 mm with a continuous thickness of concrete core of 133 mm and overall wall thickness of 250 mm

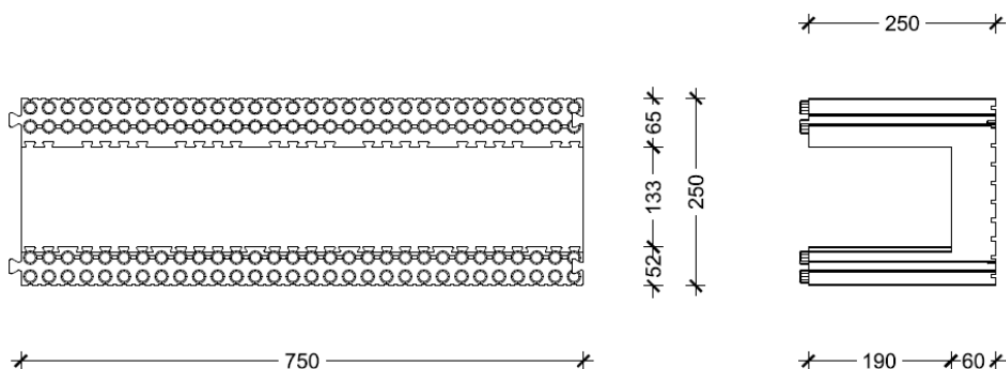
Annex A7



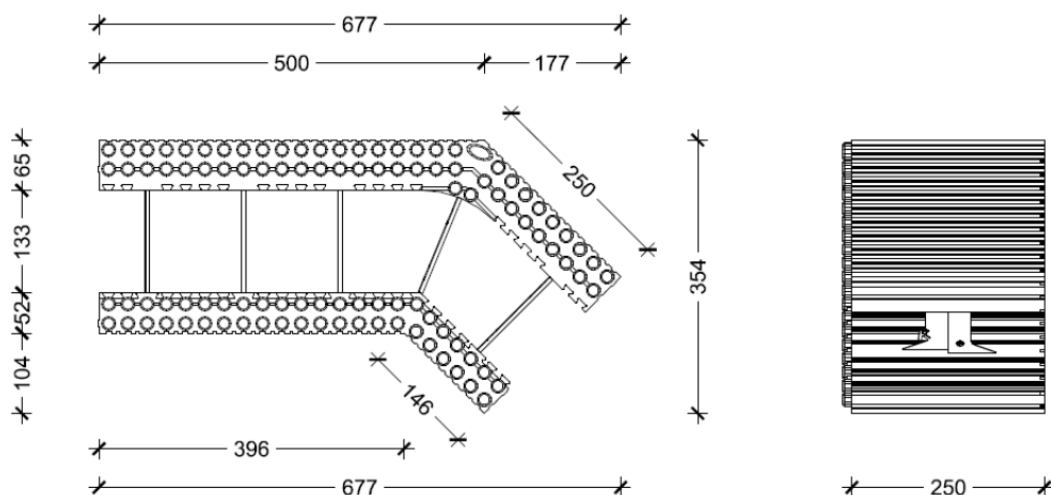
## Floor end plates 750 x 100 x 200



## Lintel element 750 x 250 x 250 concrete core 133



## Angular elements 45° right/left 677 x 354 x 250 concrete core 133



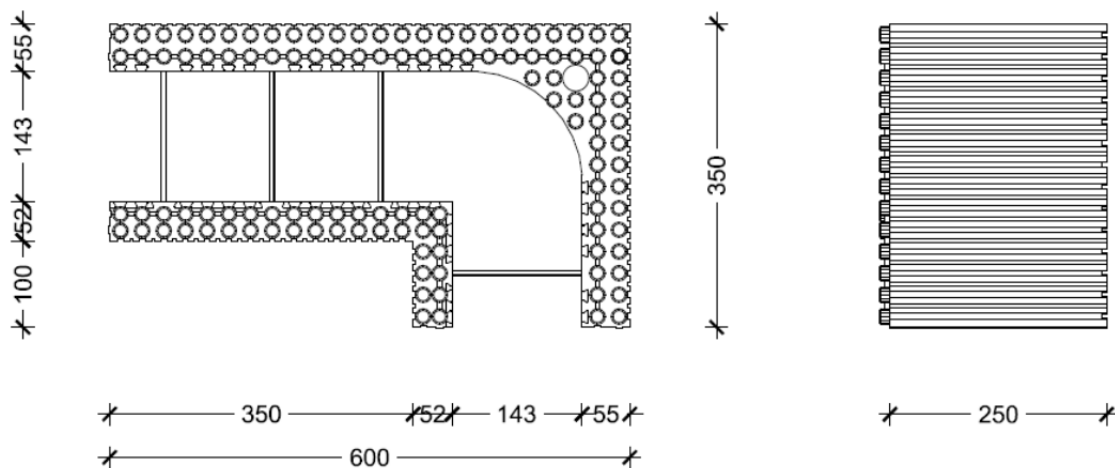
all dimensions in mm

Shuttering system "ARGISOL"

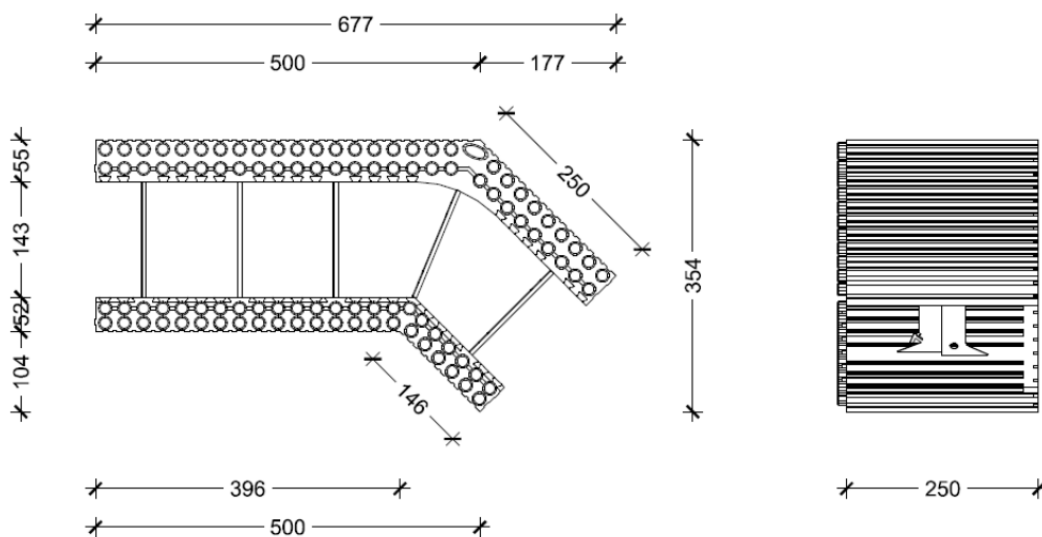
Floor end element, lintel element, angular element; with webs of sheet steel with a continuous thickness of concrete core of 133 mm and overall wall thickness of 250 mm

Annex A8

## Corner element right/left 600 x 350 x 250 concrete core 143



## Angular elements 45° right/left 600 x 354 x 250 concrete core 143



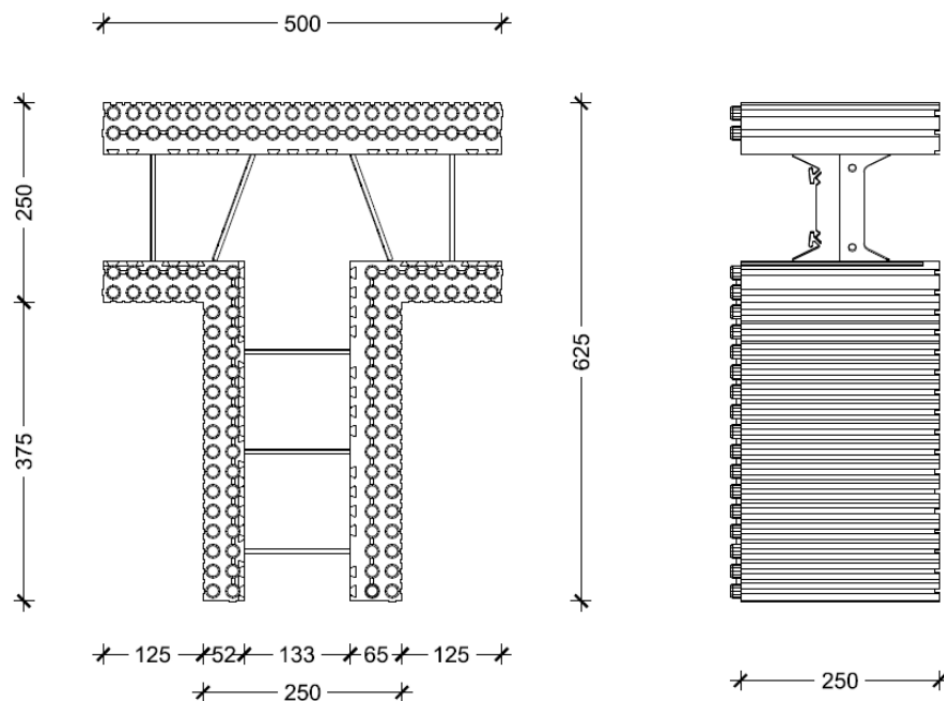
all dimensions in mm

Shuttering system "ARGISOL"

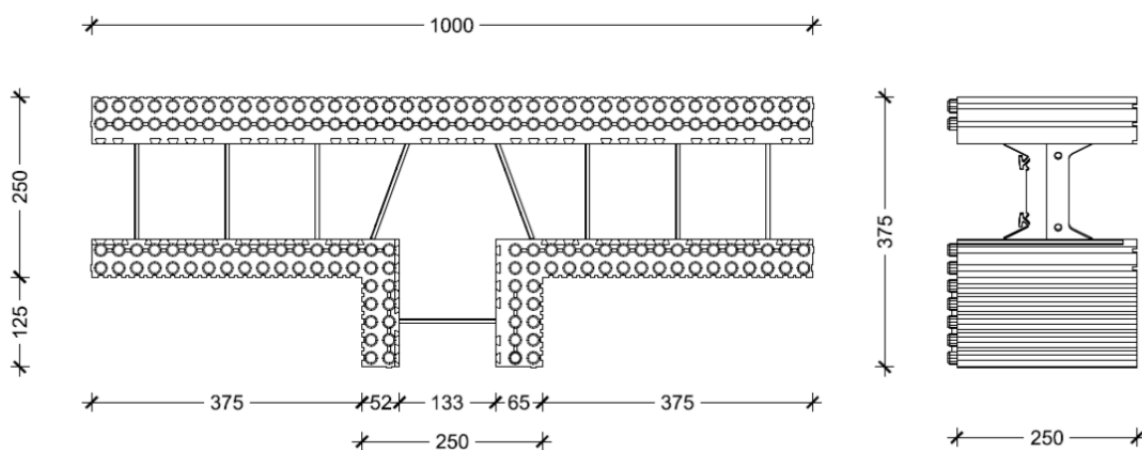
Corner and angular elements; with webs of sheet steel with a continuous thickness of concrete core of 143 mm and overall wall thickness of 250 mm

Annex A9

### T-element 500 x 625 x 250 concrete core 133



### T-element 1000 x 375 x 250 concrete core 133



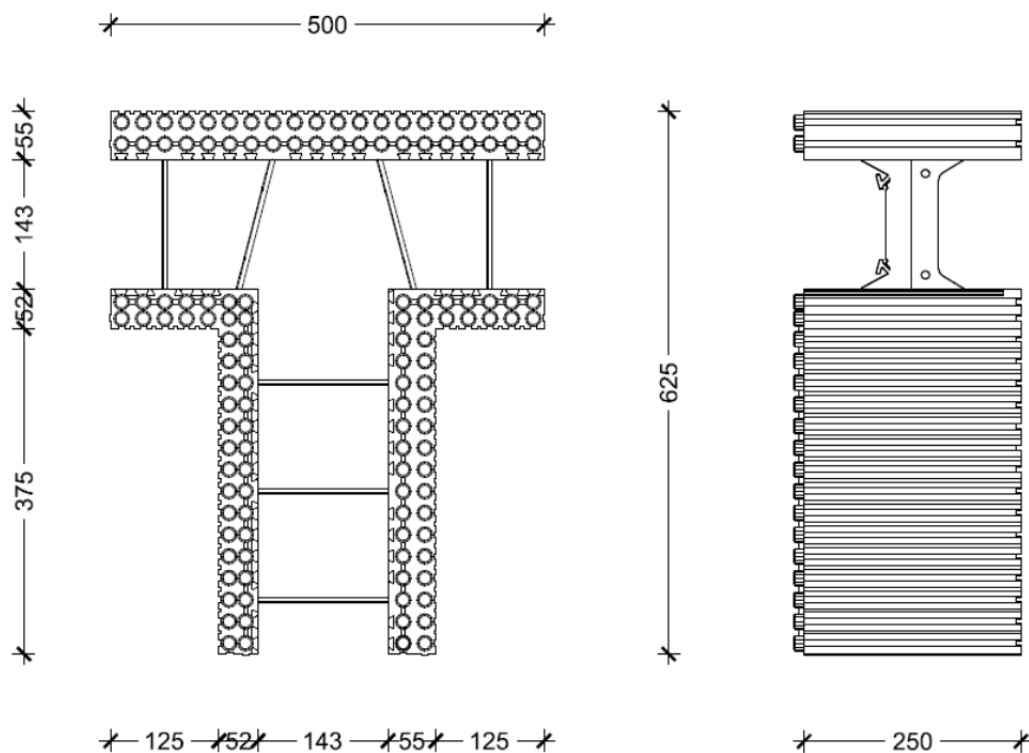
all dimensions in mm

Shuttering system "ARGISOL"

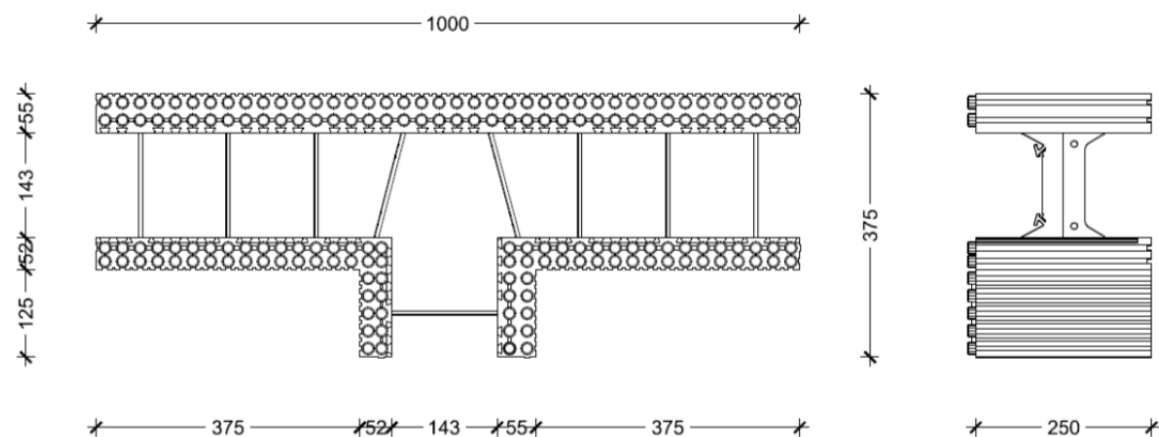
T-elements with webs of sheet steel with a continuous thickness of concrete core of 133 mm and overall wall thickness of 250 mm

Annex A10

### T-element 500 x 625 x 250 concrete core 143



### T-element 1000 x 375 x 250 concrete core 143



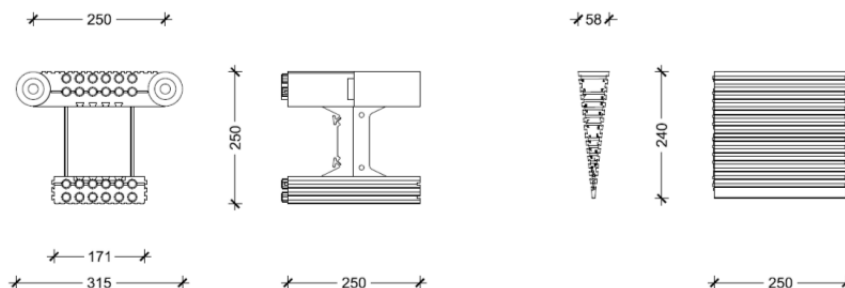
all dimensions in mm

Shuttering system "ARGISOL"

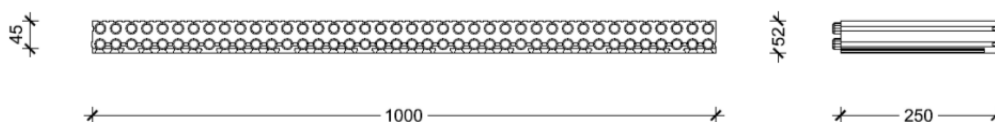
T-elements with webs of sheet steel with a continuous thickness of concrete core of 143 mm and overall wall thickness of 250 mm

Annex A11

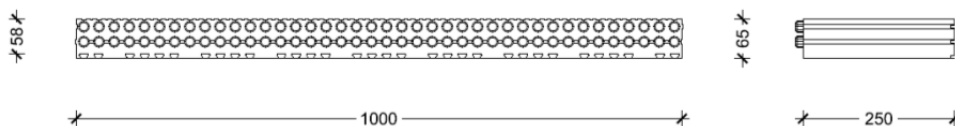
## Element with joint and wedge



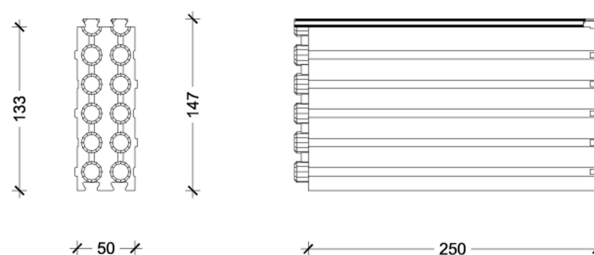
## Single plate interior 1000 x 52 x 250



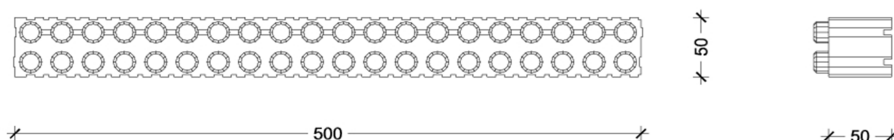
## Single plate exterior 1000 x 65 x 250



## End stop 140 x 50 x 250 concrete core 133



## Height compensation element 500 x 50 x 50



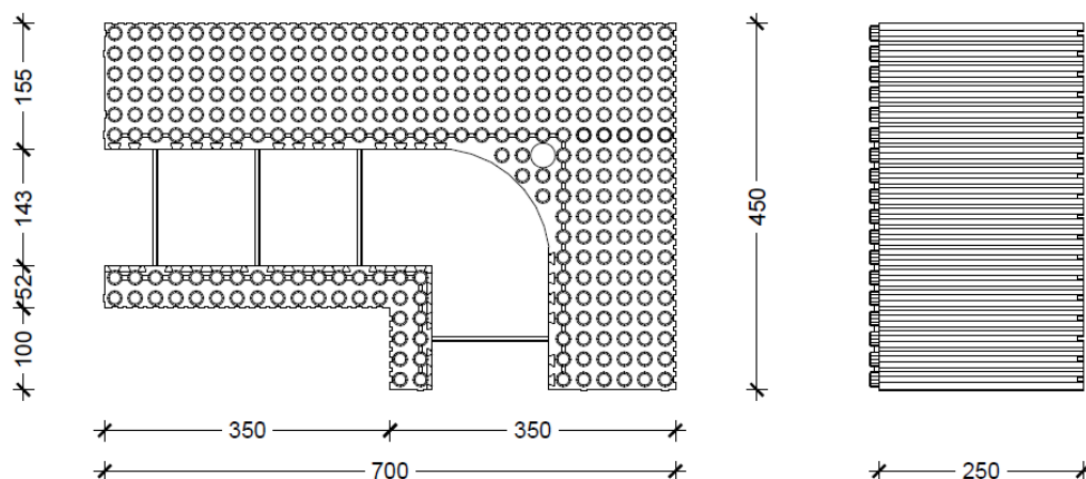
all dimensions in mm

Shuttering system "ARGISOL"

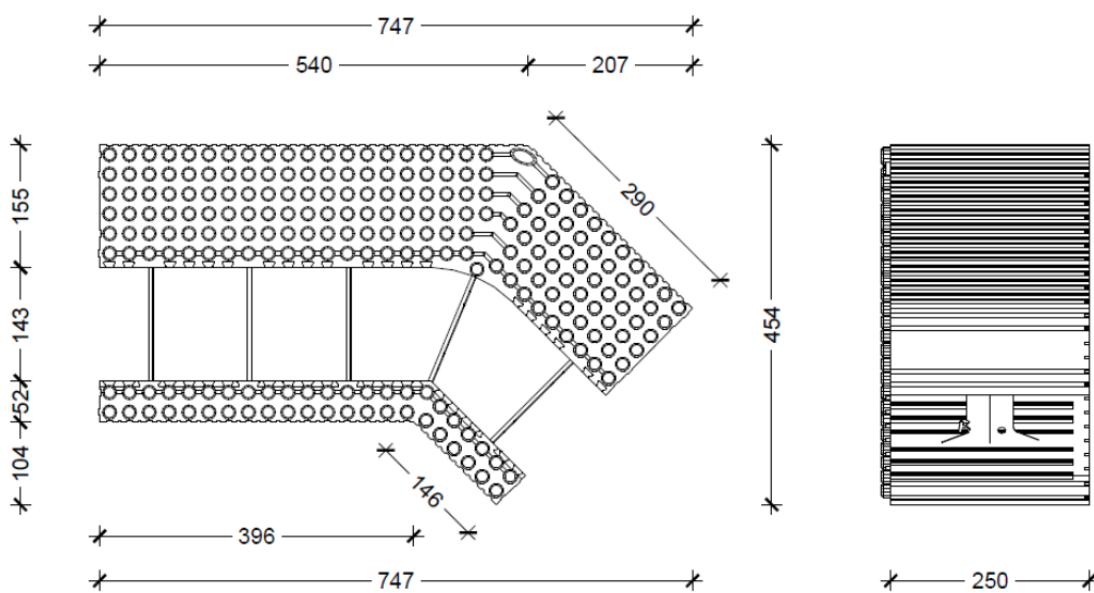
Elements with joints and wedges for horizontal curved walls accessory parts; with webs of sheet steel (Single plates, end stops, height compensation element) with a continuous thickness of concrete core of 133 mm and overall wall thickness of 250 mm

Annex A12

## Corner elements right/left 700 x 450 x 250 concrete core 143



## Angular elements 45° right/left 747 x 454 x 250 concrete core 143



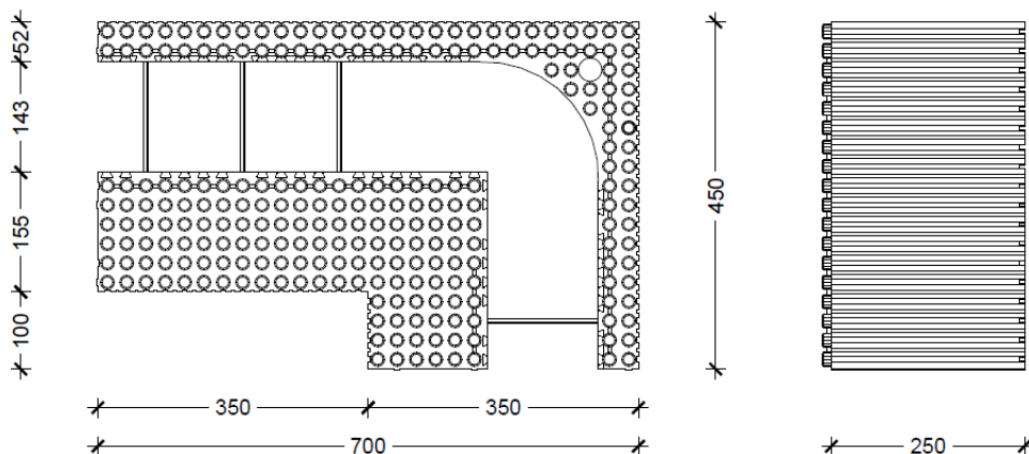
all dimensions in mm

Shuttering system "ARGISOL"

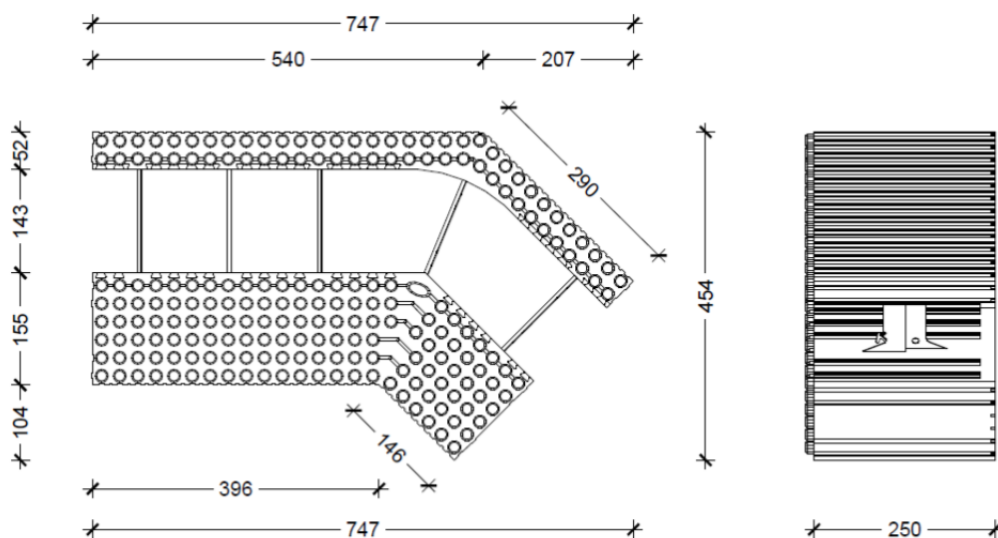
Corner and angular elements; with webs of sheet steel with a continuous thickness of concrete core of 143 mm and overall wall thickness of 350 mm

Annex A13

## Interior corner elements right/left 700 x 450 x 250 concrete core 143



## Interior angular elements 45° right/left 747 x 454 x 250 concrete core 143



all dimensions in mm

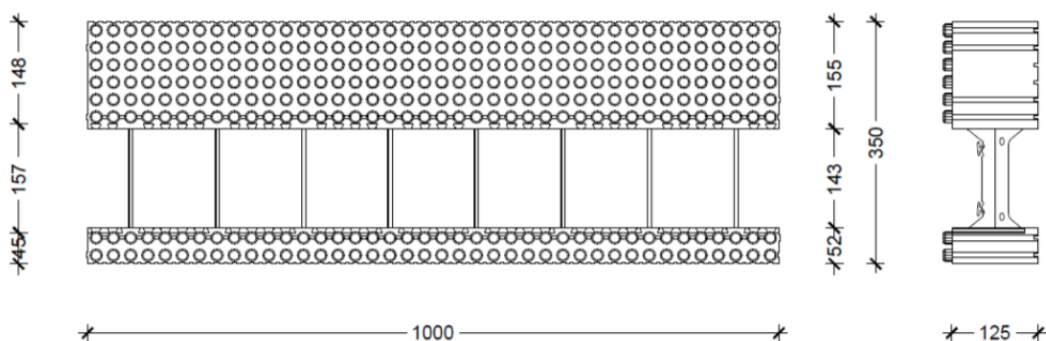
Shuttering system "ARGISOL"

Interior corner and angular elements; with webs of sheet steel with a continuous thickness of concrete core of 143 mm and overall wall thickness of 350 mm

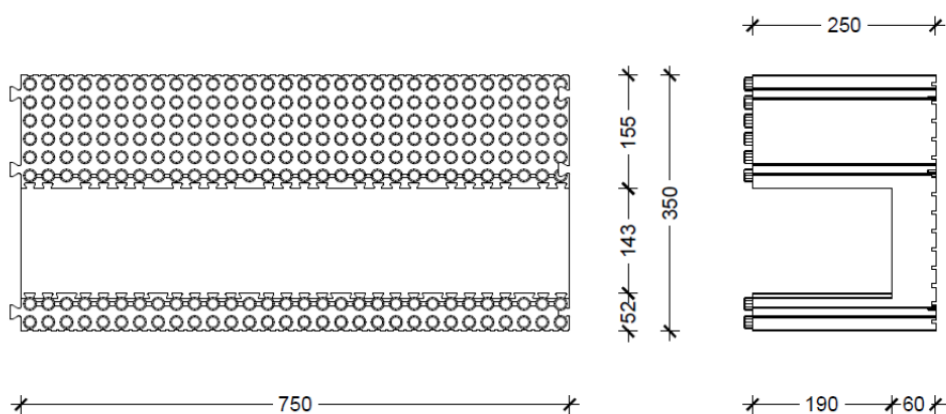
Annex A14



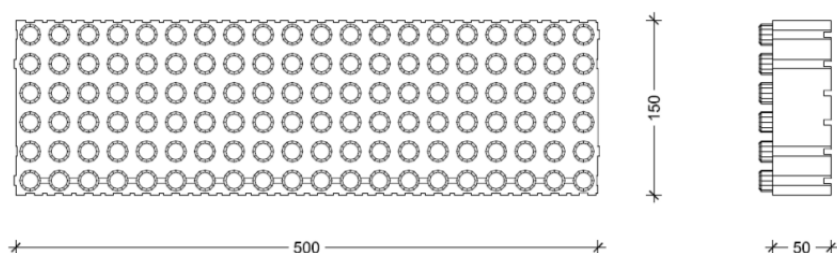
## Standard element ½ height 1000 x 350 x 125 concrete core 143



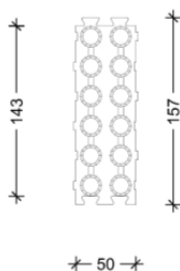
## Lintel element 750 x 350 x 250 concrete core 143



## Height compensation element 500 x 150 x 50



## End stop 150 x 50 x 250



all dimensions in mm

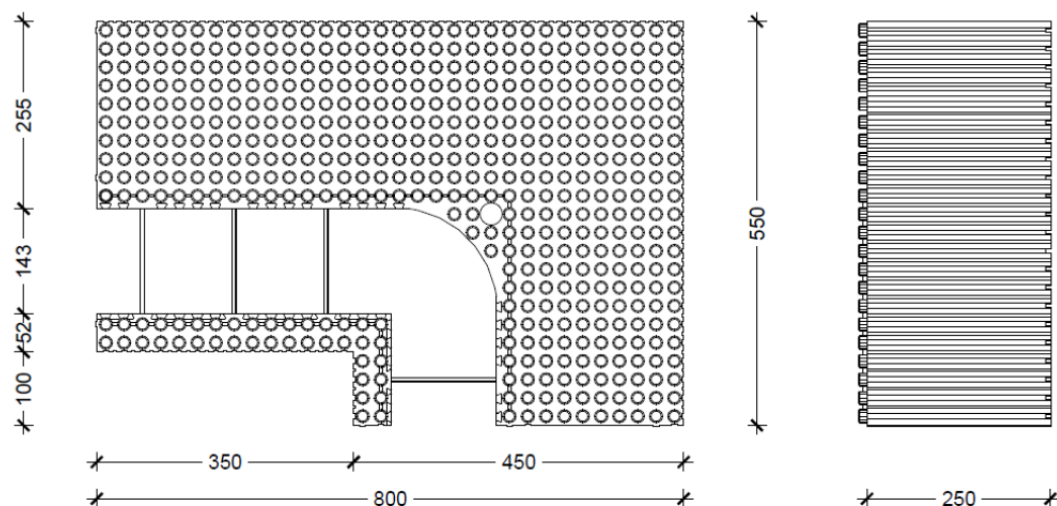
Shuttering system "ARGISOL"

Standard element ½ height, lintel element, height compensation element, end stop; with webs of sheet steel with a continuous thickness of concrete core of 143 mm and overall wall thickness of 350 mm

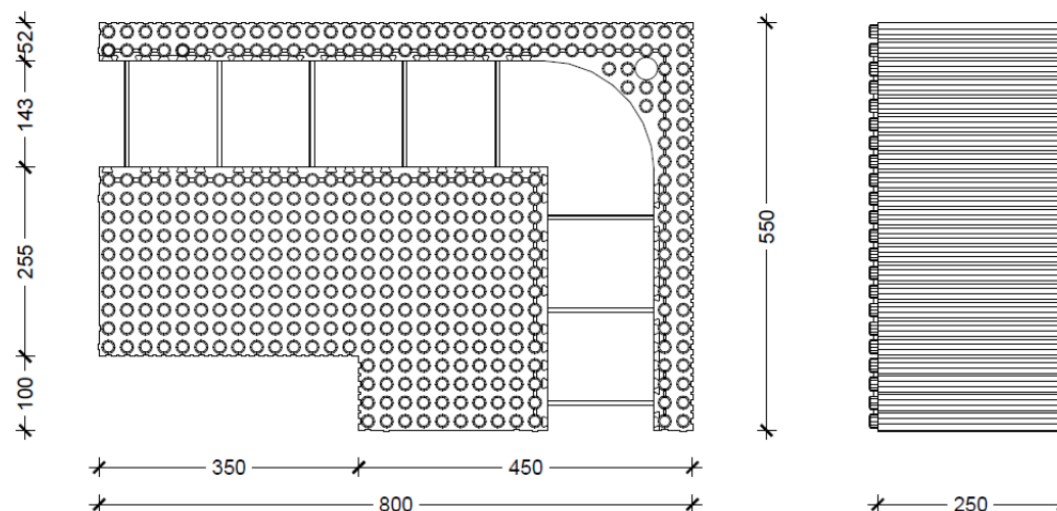
Annex A15



## Corner elements right/left 800 x 550 x 250 concrete core 143



## Interior corner elements right/left 800 x 550 x 250 concrete core 143



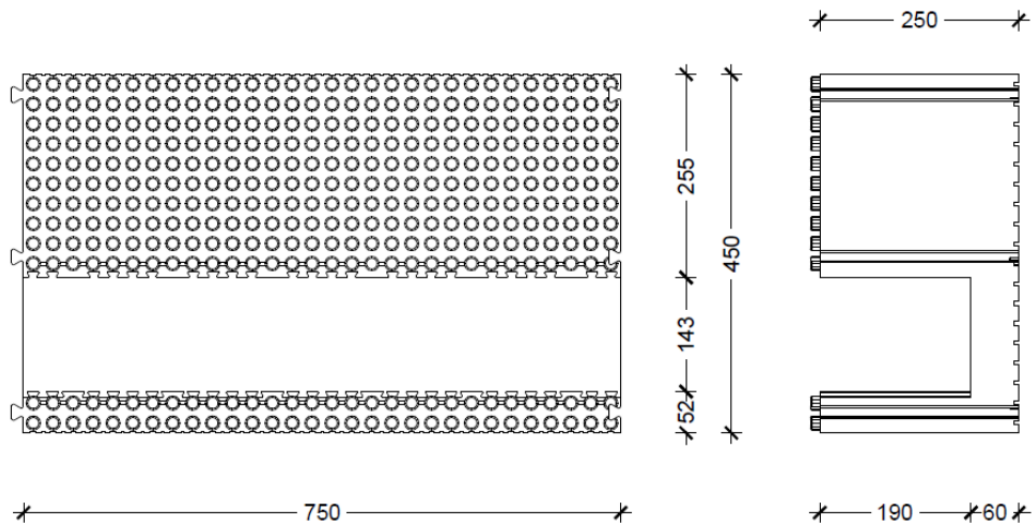
all dimensions in mm

Shuttering system "ARGISOL"

Interior corner elements and corner elements; with webs of sheet steel with a continuous thickness of concrete core of 143 mm and overall wall thickness of 450 mm

Annex A16

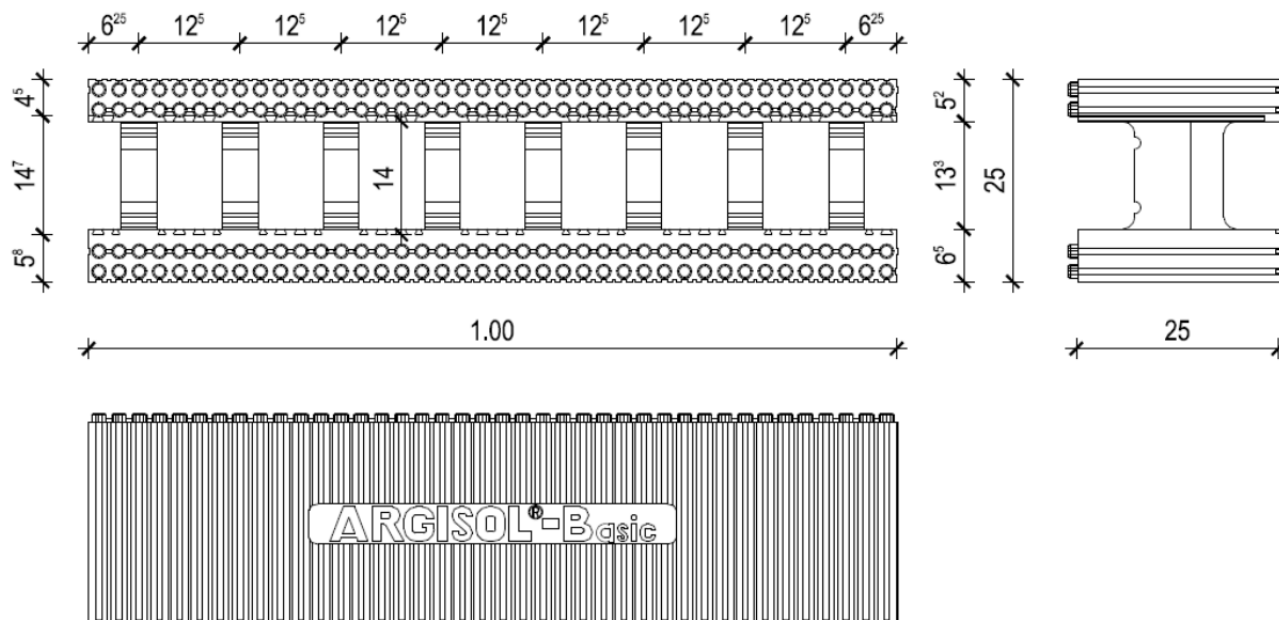
Lintel element 750 x 450 x 250 concrete core 143



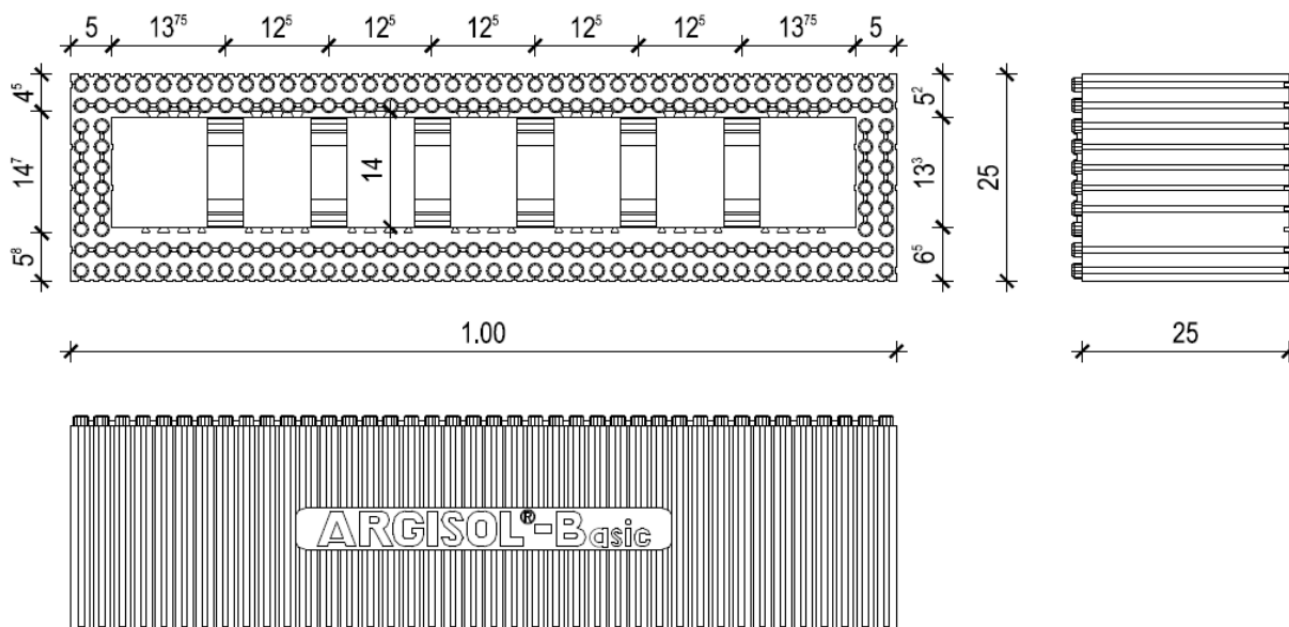
all dimensions in mm

Shuttering system "ARGISOL"	Annex A17
Lintel element with webs of sheet steel with a continuous thickness of concrete core of 143 mm and overall wall thickness of 450 mm	

## Standard element with webs of EPS concrete core 13,3



## End stop with webs of EPS concrete core 13,3



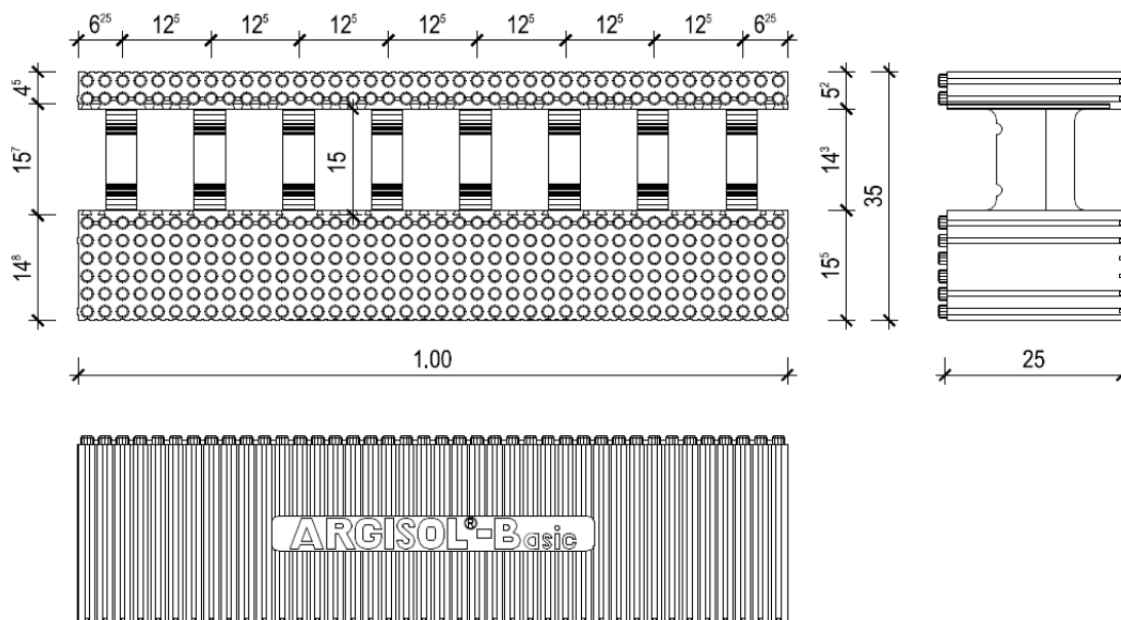
all dimensions in cm

Shuttering system "ARGISOL"

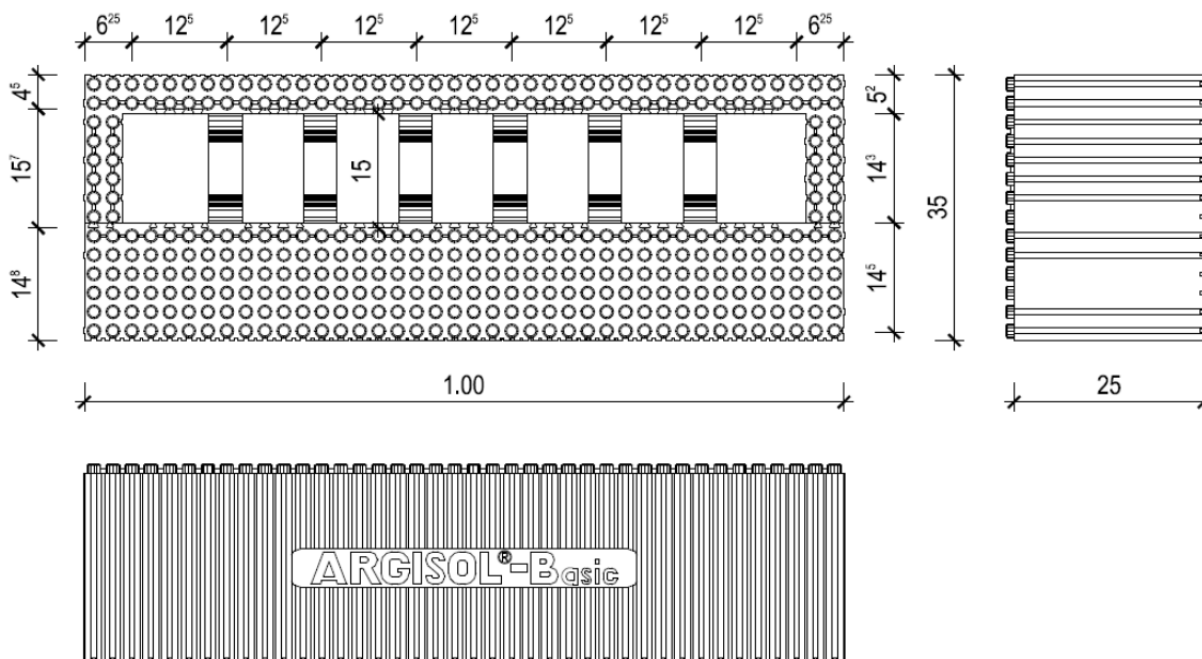
Standard element and end stop; with webs of EPS with a thickness of concrete core of 133 mm and overall wall thickness of 250 mm

Annex A18

## Standard element with webs of EPS concrete core 14,3



## End stop with webs of EPS concrete core 14,3



all dimensions in mm

Shuttering system "ARGISOL"

Standard element and end stop; with webs of EPS with a continuous thickness of concrete core of 143 mm and overall wall thickness of 350 mm

Annex A19

## Installation

### 1 General

The manufacturer shall ensure that the requirements in sections 1 and 3 as well as the Annexes A1, B1 and B2 are made known to those involved in planning and execution. The installation guide is deposited with DIBt 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 the site-mixed or ready mixed concrete is brought in and compacted.

With the shuttering elements with webs of sheet steel concrete walls of the continuous type<sup>1</sup> and with the shuttering elements with webs made of EPS concrete walls of the grid type<sup>1</sup> of unreinforced or reinforced concrete according to EN 1992-1-1 or corresponding national regulations are created.

In structural design the thickness of the concrete core is 133 mm respectively 143 mm and the weight per unit area without rendering 3.40 kN/m<sup>2</sup> respectively 3.83 kN/m<sup>2</sup> (assumed specific weight of concrete of 25 kN/m<sup>3</sup> and for EPS-leaves of 0.3 kN/m<sup>3</sup>).

For the intended use the EPS shuttering leaves are the main part of the thermal insulation of the walls.

### 2 Installation of the shuttering elements

The shuttering elements are put together on site in layers without adhesive. To receive stable floor high formworks the vertical joints between two elements of one layer have to be shifted of at least a quarter of the element length to the vertical joints of the previous and next layer (see Annexes B4 and B5).

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

Afterwards leveling to the subsoil is performed (foundation, bottom plate, ceiling). Voids between the shuttering leaves and the uneven subsoil are to be sealed with PU foam before concreting.

Subsequently, according to the installation guide of the ETA holder, the walls are to be interlocked to floor height, leveled and fastened to the push pull props (see Annex B7).

The push pull props are to be arranged at a maximum distance of 1.20 m to 1.50 m, to be connected over the entire wall height with the shuttering elements and to be fastened to the floor (see Annex B7).

The necessary reinforcement according to structural analysis calculation shall also be installed according to the instructions of the ETA holder in the installation guide. Rectangular wall corners are to be formed according to Annex B5 and wall junctions according to Annex B6.

### 3 Concreting

For the production of normal concrete EN 206 shall apply. Concrete in the lower range of consistency class F3 or smaller shall be compacted by shaking, while concrete in the upper area of the consistency class F3 and above may also be compacted by poking. The maximum aggregate size shall be at least 8 mm and shall not exceed 16 mm. The concrete shall have rapid or middle strength development according to EN 206, table 16.

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

<sup>1</sup> see ETAG 009 chapter 2.2

Shuttering system "ARGISOL"

Installation

Annex B1  
Page 1 of 3

Placing the concrete shall be performed in layers of 1 m at a maximum vertical concreting rate of 3 m/h. For shuttering elements with webs of EPS and horizontal curved walls made with shuttering elements according to Annex A12 the vertical concreting rate shall not exceed 1 m/h.

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

Horizontal day joints are to be arranged preferably at the height of the floor. If day joints cannot be avoided within the height between the floors vertical composite reinforcement bars shall be installed. This composite reinforcement shall comply with the following requirements:

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

Before the further placing of concrete, cement laitance and detached / loose concrete shall be removed and the day 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 brought in concrete can combine well with the older concrete.

If no day joint is planned, placing of concrete in layers may only be interrupted until the concrete layer brought in last is not solidified yet 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 brought in by means of bulk tubes or concreting hoses with a diameter of 100 mm at the most and shall be led shortly before the place of installation.

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

Planning shall allow for sufficient spaces in the reinforcement for bulk tubes or concreting hoses.

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

The ceiling may only be placed or concreted on walls made of shuttering elements if the concrete core has reached a sufficient strength.

#### **4 Ducts crossing and situated inside the wall**

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

Horizontal ducts situated inside the wall cores are to 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 pipes is less than 2 m.

#### **5 Reworking and finishes**

Walls of the type "ARGISOL" are to be protected by finishes. 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 requirement of ETAG 004. The execution of the rendering shall be performed according to applicable national rules.

Shuttering system "ARGISOL"

Installation

Annex B1  
Page 2 of 3

## 6 Fixing of objects

Fixing of objects in the shuttering leaves is not possible. The part of fixings which is significant for the mechanical resistance shall be in the concrete core. The influence of the fixing to the reduction of the thermal resistance shall be considered according to EN ISO 6946.

Shuttering system "ARGISOL"

Installation

Annex B1  
Page 3 of 3



Standards and Guidelines			Issue	Title
EN	206	2013+A1:2016		Concrete – 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	1992-1-2	2004+AC:2008		Eurocode 2: Design of concrete structures. – Part 1-2: Structural fire design
EN	13163	2012+A2:2016		Thermal insulation products for buildings – Factory made products of expanded polystyrene (EPS) – 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	14474	2004		Precast concrete products - Concrete with wood-chips as aggregate - Requirements and test methods
EN ISO	6946	2017		Building components and building elements – Thermal resistance and thermal transmittance – Calculation method
EN ISO	10211	2007		Thermal bridges in building construction – Heat flows and surface temperatures – Detailed calculations
ETAG	004	2013-06		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"



### Advices for determining the resistance to fire for the intended use

The fire resistance of shuttering elements "ARGISOL" using sheet steel webs (see sections 1.2.1 and 1.2.2 in the "Special Part" and Annexes A2 to A16) may be determined under the following conditions according to EN 1992-1-2, Table 5.4, columns "Fire rated on one side" in conjunction with national Annexes applicable at the place of use:

- The wall was dimensioned in accordance with EN 1992-1-1 only taking into account the load-bearing effect of the concrete or reinforced concrete.
- The concrete of the concrete core complies at least with the concrete strength class C16 / 20.
- The wall thickness according to EN 1992-1-2, Table 5.4 uses the thickness of the concrete core.
- All prerequisites according to EN 1992-1-2, sections 5.1 and 5.2 in conjunction with the national Annex applicable at the place of use are met.

For walls erected with the shuttering elements "ARGISOL" using EPS webs (see sections 1.2.3 and 1.2.4 in the "Special Part" and Annexes A18 and A19), the fire resistance with regard to stability (load-bearing criterion R ) for the load-bearing concrete structure can be determined according to EN 1992-1-2, in conjunction with the national Annex applicable at the place of use, if the verification of stability at normal temperatures is possible on basis of EN 1992-1-1, in conjunction with the national Annex applicable at the place of use. The wall thickness is the thickness of the concrete core. The fulfilment of the thermal insulation criterion I and integrity criterion E of such walls is not detectable in this case without additional investigations.

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 shall be used. As far as European standards EN 206 is 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.
- The shuttering elements shall on both sides either be plastered/rendered or at least the joints on both sides shall be sealed with plastering/rendering mortar. The mortar for plastering/rendering or for sealing shall be based on inorganic aggregates, gypsum, cement or lime or on suitable combinations of these three binders.

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

Shuttering system "ARGISOL"	Annex B3
Advices for determining the resistance to fire for the intended use	

### Advices for determining of the declared value of the thermal resistance of concrete walls made of shuttering elements "ARGISOL" with sheet steel webs (see Annexes A2 to A15)

Table 1 shows the declared values of the thermal resistance of the concreted walls with unreinforced concrete in the core of a bulk density of  $\rho = 2200 \text{ kg/m}^3$ . The corresponding thermal conductivity according to EN ISO 10456, Table 3 for this concrete is  $\lambda_{\text{concrete, table1}} = 1.65 \text{ W/(m K)}$ . The plaster was disregarded in these calculations. The reduction of the thermal resistance through the webs of sheet steel was considered.

**Table 1:** Declared values of the thermal resistance  $R_{D, \text{element}}$  of the concrete walls (with unreinforced concrete in the core of the density  $\rho_{\text{concrete, table1}} = 2200 \text{ kg/m}^3$  and a thermal conductivity according to EN ISO 10456, table 3 of  $\lambda_{\text{concrete, table1}} = 1.65 \text{ W/(m K)}$ , without plaster and without considering of the surface resistances inn- and outside), made of shuttering elements "ARGISOL" with webs of sheet steel, determined with a precise calculation method according to EN ISO 10211:2007, section A.2, considering the webs of sheet steel.

Shuttering elements according to ETA-Annex for standard elements	Thickness of inner shuttering leaf [mm]	continuous thickness of concrete core $d_k$ [mm]	Thickness of outer shuttering leaf [mm]	entire thickness of wall (without plastering) [mm]	Thermal resistance $R_{D, \text{element, table1}}$ without plaster and surface resistances inside and outside (declared value) [(m <sup>2</sup> ·K)/W]
A2, A3	52	133	65	250	3,15
A4	52	143	55	250	2,82
A5	52	143	155	350	6,15
A6	52	143	255	450	9,00

Shuttering system "ARGISOL"

Advices for determining of the declared value of the thermal resistance

Annex B4  
Page 1 of 2

## Advices for determining of the declared value of the thermal resistance of concrete walls made of shuttering elements "ARGISOL" with webs of EPS (see Annexes A18 and A19)

Table 2 shows the declared values of the thermal resistance of the concreted walls with unreinforced concrete in the core of a bulk density of  $\rho = 2200 \text{ kg/m}^3$ . The corresponding thermal conductivity according to EN ISO 10456, Table 3 for this concrete is  $\lambda_{\text{concrete,table2}} = 1.65 \text{ W/(m K)}$ . The plaster was disregarded in these calculations. The increase of the thermal resistance through the webs of EPS was not considered<sup>2</sup> in Table 2.

**Table 2:** Declared values of the thermal resistance  $R_{D,\text{element}}$  of the concrete walls (with unreinforced concrete in the core of the density  $\rho_{\text{concrete,table2}} = 2200 \text{ kg/m}^3$  and a thermal conductivity according to EN ISO 10456, table 3 of  $\lambda_{\text{concrete,table2}} = 1.65 \text{ W / (m K)}$ , without plaster and without considering of the surface resistances inn- and outside), made of shuttering elements "ARGISOL" with webs of EPS, without considering the webs of EPS.

Shuttering elements according to ETA-Annex for standard elements	Average thickness of inner shuttering leaf [mm]	Average thickness of concrete core $d_k$ [mm]	Average thickness of outer shuttering leaf [mm]	entire thickness of wall [mm]	Thermal resistance $R_{D,\text{element,table1}}$ without plaster and surface resistances inside and outside (declared value) [(m <sup>2</sup> ·K)/W]
A18	48,5	140	61,5	250	3,63
A19	48,5	150	151,5	350	6,54

For densities of the concrete core other than  $\rho_{\text{concrete,table}} = 2200 \text{ kg/m}^3$  according to Table 1 or 2, the modified nominal value of the thermal resistance can be determined as follows, using the thermal conductivity  $\lambda_{\text{concrete}}$  according to EN ISO 10456, Table 3 which depends on the density  $\rho_{\text{concrete}}$  of the concrete:

$$R_{D,\text{element}} = R_{D,\text{element,table}} - d_k / \lambda_{\text{concrete,table}} + d_k / \lambda_{\text{concrete}}$$

If the nominal values of the thermal conductivity of the plaster layer on the inside of the wall,  $\lambda_{\text{render,inside}}$  and of the plaster layer on the outside of the wall,  $\lambda_{\text{render,outside}}$  are known, the thermal resistance of the finished wall, taking into account the plasters, can be determined as follows:

$$R_{D,\text{element}} = R_{D,\text{element}} + d_{\text{render, inside}} / \lambda_{\text{render, inside}} + d_{\text{render, outside}} / \lambda_{\text{render, outside}} + R_{\text{si}} + R_{\text{se}}$$

Wherever relevant, the designer shall consider the metal accessories as thermal bridges to determine the thermal resistance of the wall.

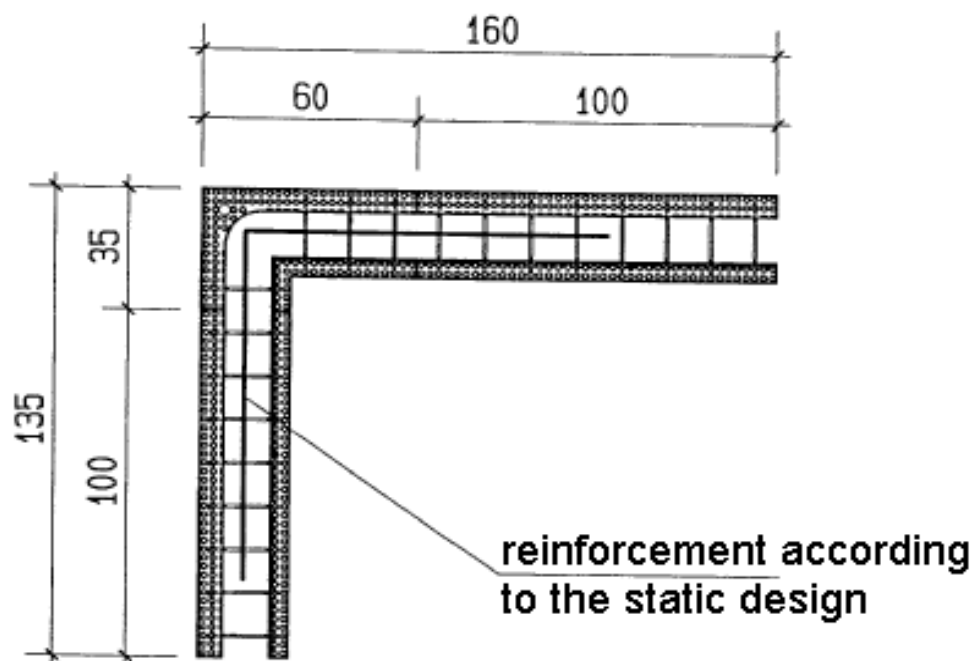
<sup>2</sup> Since these values has not been determined by numerical calculations (finite differences) according to EN ISO 10211 as it is the case in Table 1, but with homogenous layers according to EN ISO 6946, the average thickness of the shuttering leaves and concrete core has been used.

Shuttering system "ARGISOL"

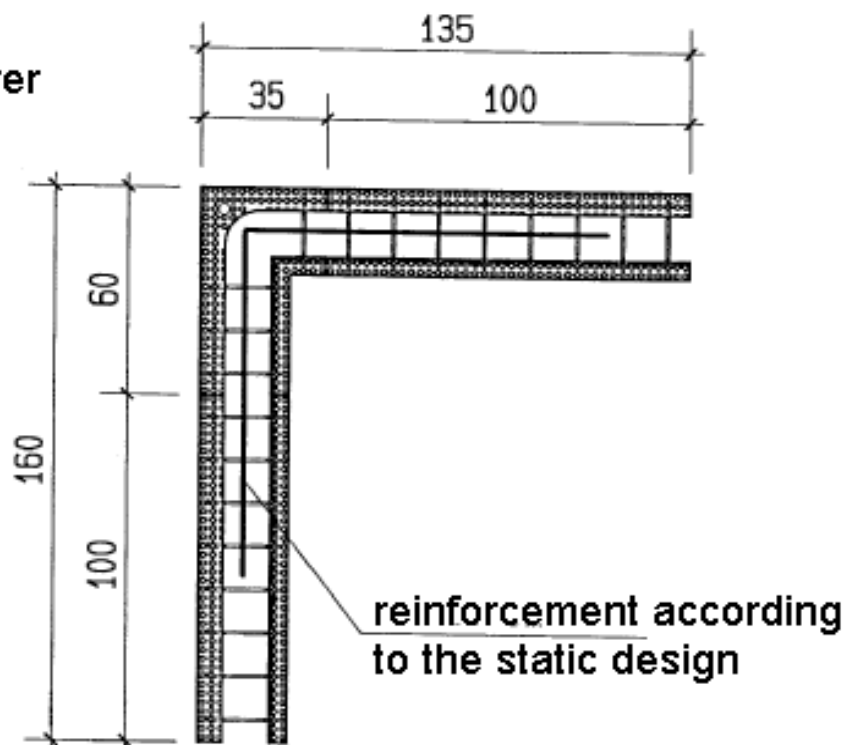
Advices for determining of the declared value of the thermal resistance

Anhang B4  
Page 2 of 2

**first layer**



**second layer**



all dimensions in cm

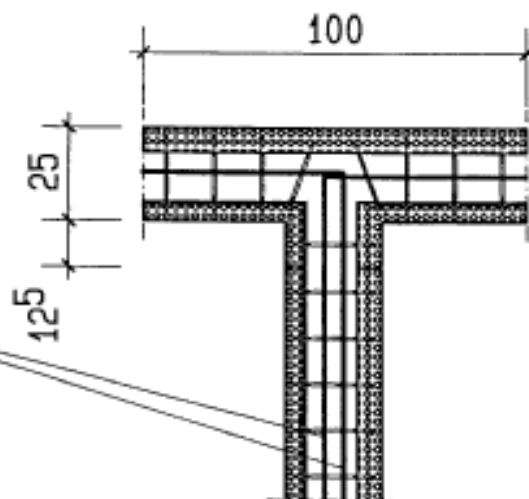
Shuttering system "ARGISOL"

Bond of different layers on a corner  
With concrete core of 13.3 cm and an overall wall thickness of 25.0 cm

Annex B5

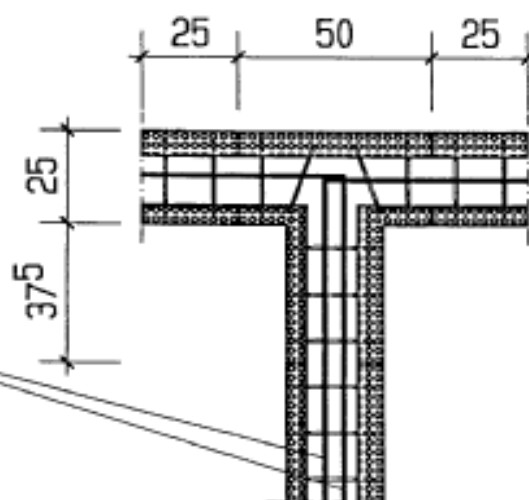
first layer

reinforcement according  
to the static design



second layer

reinforcement according  
to the static design



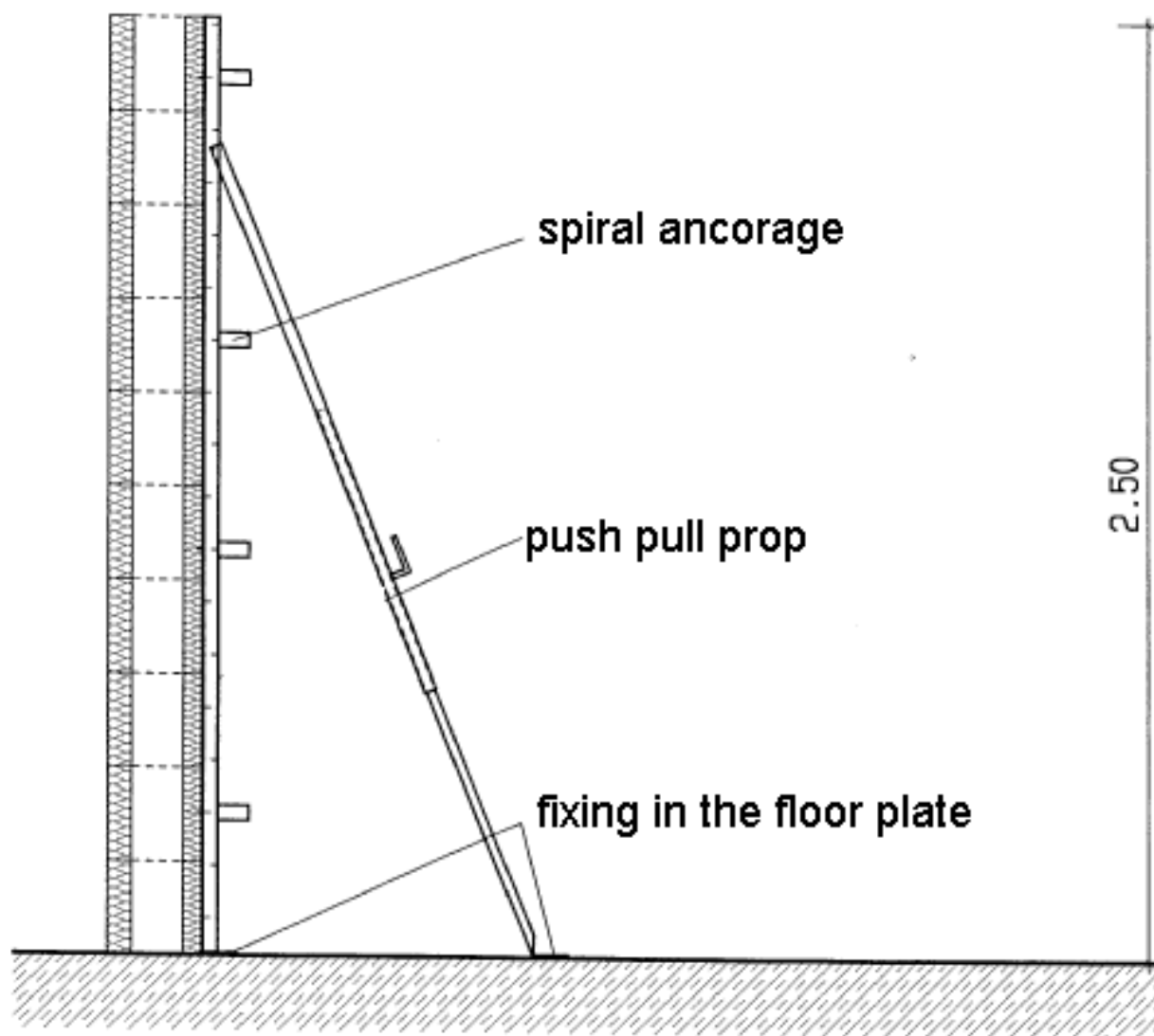
all dimensions in cm

Shuttering system "ARGISOL"

Bond of different layers at a wall junction  
With concrete core of 13.3 cm and an overall wall thickness of 25.0 cm

Annex B6

## push pull prop



all dimensions in m

Shuttering system "ARGISOL"

Scaffolding when placing concrete

Annex B7