Deutsches Institut für Bautechnik

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Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

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European Technical Assessment

ETA-10/0143 of 31 May 2018

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	MAGU WS, MAGU ICF, MAGU Isocoffrage
Product family to which the construction product belongs	Non-load bearing permanent shuttering kit "MAGU WS" based on shuttering elements of EPS
Manufacturer	MAGU Bausysteme GmbH Im Dreiangel 2 78183 Hüfingen DEUTSCHLAND
Manufacturing plant	MAGU Bausysteme GmbH Im Dreiangel 2 78183 Hüfingen DEUTSCHLAND
This European Technical Assessment contains	26 pages including 21 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-10/0143 issued on 8 May 2013

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Specific Part

1 Technical description of the product

1.1 Definition of the construction product

The shuttering system "MAGU WS" (for all German-speaking countries, "MAGU ICF" in English speaking countries and "MAGU Isocoffrage" in French-speaking countries, henceforth referred to as "MAGU WS") is a non load-bearing permanent shuttering kit based on standard shuttering elements (see Annex A2), special elements (see Annex A3) and accessory parts (see Annex A4) applicable as formwork for plain and reinforced concrete walls cast in-situ.

The shuttering elements (see Annex A2) consist of shuttering leafs of expanded polystyrene (EPS) and spacers of polypropylene (PP).

The shuttering elements are generally used for non-loadbearing and load-bearing internal and external walls.

Finishes are not part of the shuttering system "MAGU WS".

1.2 Shuttering elements

1.2.1 Standard shuttering elements

The standard shuttering elements (see Annex A2) consist of inner and outer shuttering leafs of expanded polystyrene (EPS) and spacers of polypropylene (PP). These components are assembled on site.

The EPS shuttering leafs are one-layered and in conjunction with the spacers provide thicknesses of the concrete core of 140 mm, 160 mm, 190 mm and 240 mm and thicknesses of the wall in the range of 250 mm to 500 mm, as indicated in Table A1 of Annex A1. The thickness of the inner EPS shuttering leaf is 55 mm and the thickness of the outer EPS shuttering leaf is in the range of 55 mm, 105 mm, 155 mm, 205 mm, 255 mm and 305 mm. Standard shuttering elements with the same thickness (55 mm) of the inner and outer shuttering leaf are also used for internal walls. The length of all standard shuttering elements is 1200 mm and the height is 200 mm or 300 mm.

The system can be used to construct straight walls.

1.2.2 Special elements

The special elements correspond to the information and drawings given in Annex A3. The special shuttering elements are:

- floor edge elements and
- roller shutter box elements.

Special elements are designed in the same manner as the standard shuttering elements described above (see 1.2.1).

The special elements consist of EPS and spacers of PP, it is the same material used for standard shuttering elements specified in Annex A1, 5.

1.3 Shuttering leafs

1.3.1 Standard shuttering leafs

The standard shuttering leafs made of expanded polystyrene (EPS) correspond to the details in Annexes A2.

The top and the bottom of each shuttering leaf incorporate an interlocking arrangement to form a tight joint (see Annexes A2).

Additionally T-slots at a distance of 200 mm are incorporated in the top and bottom of the shuttering leafs to receive the spacers of PP.

The surfaces are generally smooth. There are also tapered vertical grooves on the inside face of each shuttering leaf. These element-high dovetail grooves on the inside face provide a mechanical interlock between shuttering leafs and concrete core (see 3.4.1) and additionally form locks for end stops, lintel bottom leafs and parapet leafs.

1.4 Accesory parts

1.4.1 Accessory-shuttering leafs

The accessory shuttering leafs correspond to the information and drawings given in Annex A4. They contain:

- end stops,
- lintel bottom leafs,
- parapet leafs,
- height adjuster pieces and
- corner leafs.

The accessory parts consist of EPS, it is the same material used for standard shuttering elements specified in Annex A1, 5.1.

1.4.2 Spacers

The spacers are part of all shuttering elements. A sketch of the spacers is given in Annex A2, page 1 above.

2 Specification of the Intended use in accordance with the applicable European Assessment Document

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 indirect contact to indoor air (e. g. covered by permeable products).
- Category S/W 3: Product with no contact to soil water, ground- and surface water.

The performance given in Section 3 are only valid if the shuttering elements are used in compliance with the specifications and conditions given in Annex B1.
The verification 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 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.

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

3.1 Mechanical resistance and stability (BWR 1)

3.1.1 Resulting structural pattern

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

3.1.2 Efficiency of filling

Considering the instructions of Annex B1 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.

3.1.3 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.

3.2 Safety in case of fire (BWR 2)

3.2.1 Reaction to fire

Shuttering elements "MAGU WS" made of expanded polystyrene (EPS) fulfil the requirement of Class E according to EN 13501-12. The density shall be at least 21 kg/m³ and shall not exeed 28 kg/m³.

Reaction to fire of PP-spacers[1]: "No performance assessed"

3.3 Hygiene, health and environment (BWR 3)

3.3.1 Content and/or 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 factor of expanded polystyrene (EPS), according to EN ISO 10456 is $\mu = 60$.

The values of the water vapour diffusion resistance factor of concrete depending on type and density 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.

3.3.3 Water absorption

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

3.3.4 Watertightness

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

3.4 Safety and assesibility in use (BWR 4)

3.4.1 Bond strength between the shuttering leafs and the concrete core and resistance to impact load

Under end use conditions the shuttering leafs of EPS are durable fixed by spacers of PP. The bond strength is at least equal to the resistance of the shuttering leafs of EPS against the pressure of fresh concrete, see clause 3.4.2. Furthermore, the vertical element-high dovetail grooves on the inside face of each EPS shuttering leaf provide a mechanical interlock between EPS shuttering leafs and concrete core.

[1] The parts of the spacers are not embedded in the concrete meet the requirements for small components according to EOTA-TR 21. The fire behaviour of these parts can therefore be considered as negligible.

Concrete walls (without consideration of the finishes), constructed with shuttering system "MAGU WS" and designed according EN 1992-1-1 or 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.

3.4.2 Resistance to pressure of fresh concrete

To resist the pressure of fresh concrete the bending tensile strength of the EPS shuttering leafs shall be at least 250 kPa, see designation code "BS250" of EPS in Annex A1, 5.1.

The resistance of the PP spacers against tensile forces shall be at least 1900 N. The pull-out resistance between the PP spacers and the shuttering leafs shall be at least 470 N.

The requirements according to ETAG 009, clause 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 EPS shuttering leafs there is no risk of abrasion or of cutting people.

The requirements according to ETAG 009, clause 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

The declared value of the thermal conductivity of the expanded polystyrene determined in accordance with EN 13163, section 4.2.1 is λ = 0.032 W / (m × K) with a density ρ_a according to EN 1602 of not more than 28 kg / m³.

3.6.2 Influence of moisture transfer on the thermal resistance of the wall

Using the values of clause 3.3.2 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.

3.6.3 Heat capacity

The values for the heat capacity *c* 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 "DS(70,-)3" of the EPS (see Annex A1, 5.1) the relative changes of the EPS shuttering leafs in length, width and thickness under specified temperature and humidity conditions shall not exceed 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

Spacers are made of plastic (polypropylene PP). There is no corrosion of the PP spacers 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 shuttering leafs do not contain wood.

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

3.7.2 Resistance to normal use damage

Normal use impacts

Concrete walls (without consideration of the finishes), constructed with shuttering system "MAGU WS" and designed according EN 1992-1-1 or 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 Annex B1.

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

Fixing of objects

Fixing of objects in the EPS shuttering leafs 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.

4 Assessment and verification ov constancy of performance (AVCP) system applied, with reference to the 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 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 31 May 2018 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

beglaubigt:
Dr.-Ing. Rolf Alex

Deutsches Institut für Bautechnik DIBt

Characteristics of the shuttering kit

The shuttering kit "MAGU WS" consists of the following elements:

- standard shuttering elements,
- special shuttering elements and
- accessory parts.

see clauses 1, 2 and 4.

1 Standard shuttering elements

The standard shuttering elements (composed of EPS shuttering leafs and PP spacers) correspond to the information and drawings given in Annex A2.

The available standard shuttering elements are listed in Table A1.

Table A1: Wall thicknesses of the standard shuttering elements according to Annex A2

Type	Thickness of the wall	Thickness of concrete core	Thickness of EPS shuttering leaves	
			inner	outer
	[mm]	[mm]	[mm]	[mm]
WS 25/14-30-120	250	140	55	55
WS 30/14-30-120	300	140	55	105
WS 35/14-30-120	350	140	55	155
WS 40/14-30-120	400	140	55	205
WS 45/14-30-120	450	140	55	255
WS 50/14-30-120	500	140	55	305
WS 27/16-30-120	270	160	55	55
WS 32/16-30-120	320	160	55	105
WS 37/16-30-120	370	160	55	155
WS 42/16-30-120	420	160	55	205
WS 30/19-30-120	300	190	55	55
WS 35/19-30-120	350	190	55	105
WS 40/19-30-120	400	190	55	155
WS 45/19-30-120	450	190	55	205
WS 35/24-30-120	350	240	55	55
WS 40/24-30-120	400	240	55	105
WS 45/24-30-120	450	240	55	155
WS 50/24-30-120	500	240	55	205

The material characteristics, dimensions and tolerances of the standard shuttering elements not indicated in Annex A are given in the technical documentation[1] of the ETA.

[1] The technical documentation of the ETA is deposited with Deutsches Institut für Bautechnik and, as far as relevant for the tasks of the notified bodies involved in the assessment and verification of constancy of performance, is handed over to the approved bodies.

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2 Special elements

The special elements correspond to the information and drawings given in Annex A3. The special elements are:

- floor edge elements and
- roller shutter box elements.

Special elements are designed in the same manner as the standard shuttering elements described above, see Annex A1, 1.

The special elements consist of EPS and spacers of PP, it is the same material used for standard shuttering elements specified in Annex A1, 5.

3 Shuttering leafs

3.1 Standard-shuttering leafs

The standard shuttering leafs made of expanded polystyrene (EPS) correspond to the details in Annex A2.

The top and the bottom of each shuttering leaf incorporate an interlocking arrangement to form a tight joint (see Annex A2).

Additionally T-slots at a distance of 200 mm are incorporated in the top and bottom of the shuttering leafs to receive the spacers of PP.

The surfaces are generally smooth. There are also tapered vertical grooves on the inside face of each shuttering leaf. These element-high dovetail grooves on the inside face provide a mechanical interlock between shuttering leafs and concrete core (see 3.4.1) and additionally form locks for end stops, lintel bottom leafs and parapet leafs.

4 Accessory parts

4.1 Accessory-shuttering leafs

The accessory shuttering leafs correspond to the information and drawings given in Annex A4. They contain:

- end stops,
- lintel bottom leafs,
- parapet leafs,
- height adjuster pieces and
- corner leafs.

The accessory parts consist of EPS, it is the same material used for standard shuttering elements specified in Annex A1, 5.1.

4.2 Spacers

The spacers are part of all shuttering elements. A sketch of the spacers is given in Annex A2, page 1.

5 Material

5.1 Standard-shuttering leafs, Special elements, Accessory-shuttering leafs

The EPS shuttering leafs are made of expanded polystyrene (EPS) EPS-EN 13163-T(1)-L(2)-W(2)-S(2)-P(5)-DS(70,-)3-BS250-CS(10)150-DS(N)5-DLT(2)5-TR150 according to EN 13163 composed of polystyrene particle foam with graphite.

The density ρ of the expanded polystyrene is at least 21 kg/m³ and at most 28 kg/m³.

The declared value of thermal conductivity of the expanded polystyrene is 0.032 W/(m×K).

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5.2 Accessory parts

5.2.1 Spacers

The spacers are moulded of plastic (polypropylene PP).

The density ρ of the spacers of polypropylene (PP) is 1.09 g/cm³.

The resistance of the PP spacers against tension shall be at least 1900 N. The pull-out resistance between the PP spacers and the EPS shuttering leafs shall be at least 470 N.

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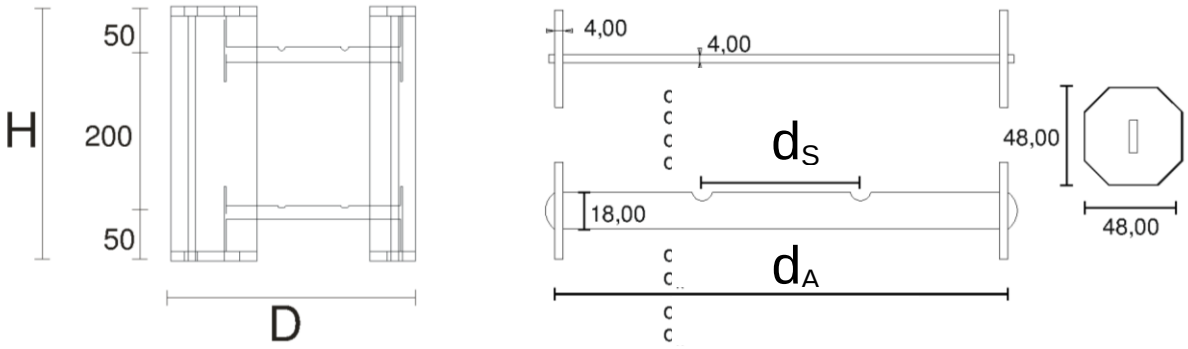
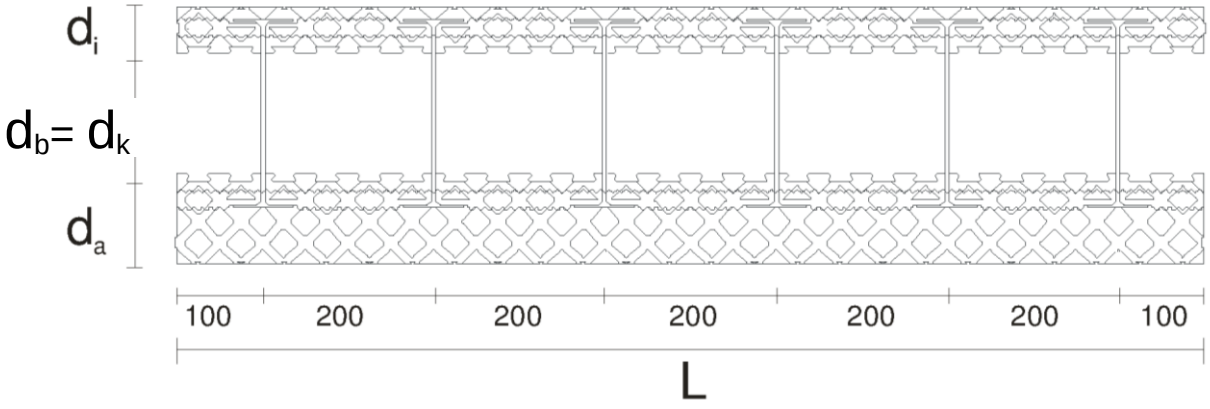
Standard shuttering element Spacer of polypropylene

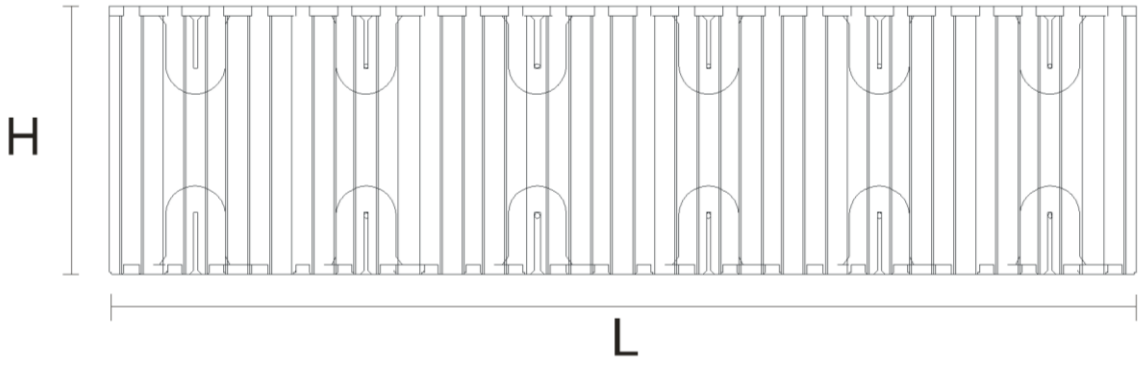
Cross section



Top view



Side view



all dimensions in [mm]

MAGU WS, MAGU ICF, MAGU Isocoffrage	
Standard shuttering elements with spacers of polypropylene (PP)	Annex A2 Page 1 of 2

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Type of standard shuttering elements	Length of spacers [mm]	Thickness oft he wall [mm]	Height oft he element [mm]	Length oft he element [mm]	Thickness of inner EPS layer [mm]	Thickness of the concrete core [mm]	Thickness of outer EPS layer [mm] [mm]	Distance of the reinforcement [mm]	Distance of the anchorage plates of the spacers [mm]
	L_S*	D*	H*	L*	d_i*	$d_b = d_K$*	d_a*	d_S*	d_A*
WS 25/14-30-120	215	250	200 or 300	1200	55	140	55	78	210
WS 30/14-30-120	215	300		1200	55	140	105	78	210
WS 35/14-30-120	215	350		1200	55	140	155	78	210
WS 40/14-30-120	215	400		1200	55	140	205	78	210
WS 45/14-30-120	215	450		1200	55	140	255	78	210
WS 50/14-30-120	215	500		1200	55	140	305	78	210
WS 27/16-30-120	235	270		1200	55	160	55	98	230
WS 32/16-30-120	235	320		1200	55	160	105	98	230
WS 37/16-30-120	235	370		1200	55	160	155	98	230
WS 42/16-30-120	235	420		1200	55	160	205	98	230
WS 30/19-30-120	265	300		1200	55	190	55	128	260
WS 35/19-30-120	265	350		1200	55	190	105	128	260
WS 40/19-30-120	265	400		1200	55	190	155	128	260
WS 45/19-30-120	265	450		1200	55	190	205	128	260
WS 35/24-30-120	315	350		1200	55	240	55	178	310
WS 40/24-30-120	315	400		1200	55	240	105	178	310
WS 45/24-30-120	315	450		1200	55	240	155	178	310
WS 50/24-30-120	315	500		1200	55	240	205	178	310

* The meaning of these dimensions see Annex A2 page 1

MAGU WS, MAGU ICF, MAGU Isocoffrage

Standard shuttering elements with spacers of polypropylene (PP):
Dimensions of the standard shuttering elements

Annex A2
Page 2 of 2

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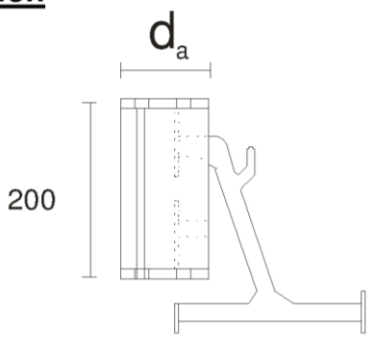
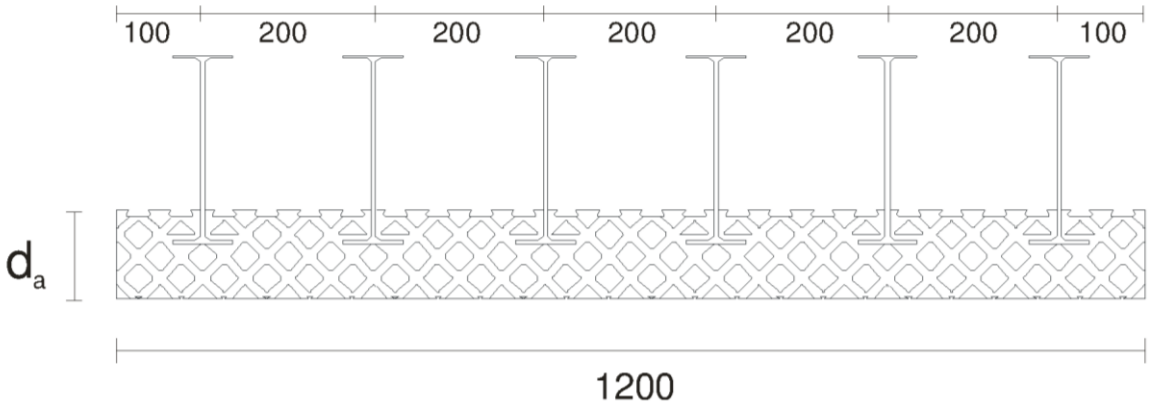
Floor edge element

Cross section

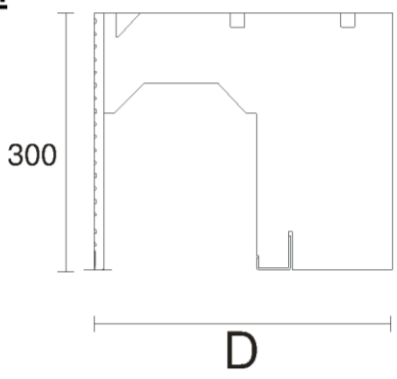


Top view



Roller shutter box element

Cross section



all dimensions in [mm]

MAGU WS, MAGU ICF, MAGU Isocoffrage	Annex A3
Special elements: Floor edge elements and Roller shutter box elements	

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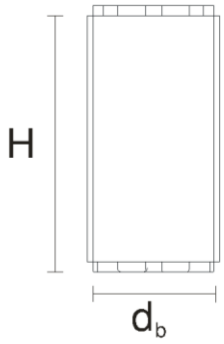
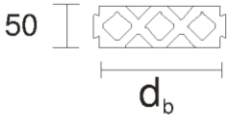
End stop

Cross section

Side view



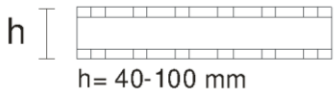
Top view



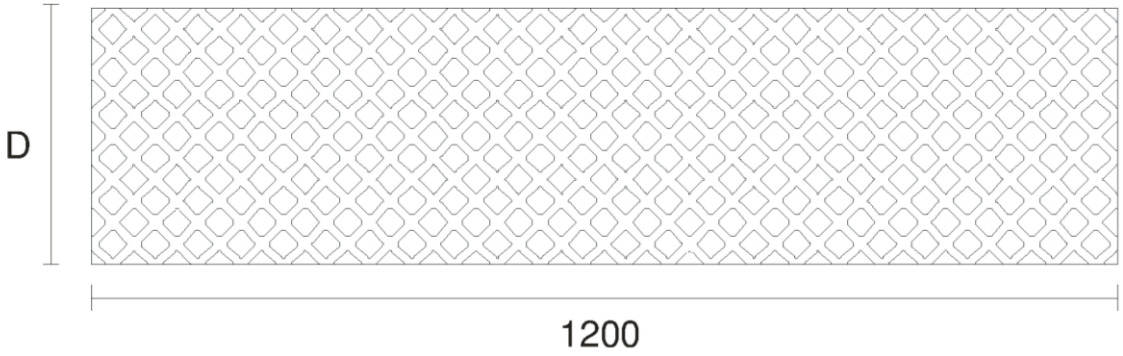
Lintel bottom leaf

Parapet leaf

Cross section



Top view



all dimensions in [mm]

MAGU WS, MAGU ICF, MAGU Isocoffrage	
Accessory parts: End stops, Lintel bottom leafs and Parapet leafs	Annex A4 Page 1 of 2

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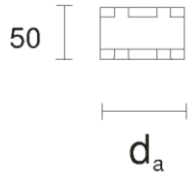
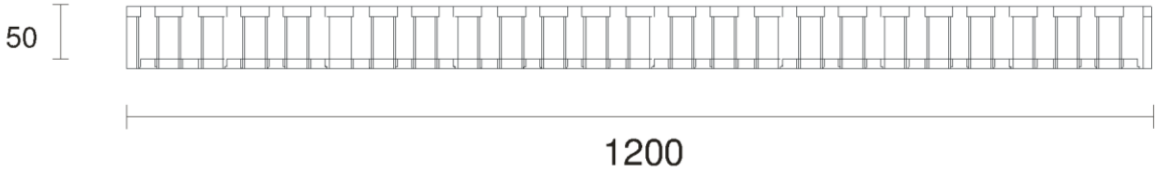
Height adjuster piece

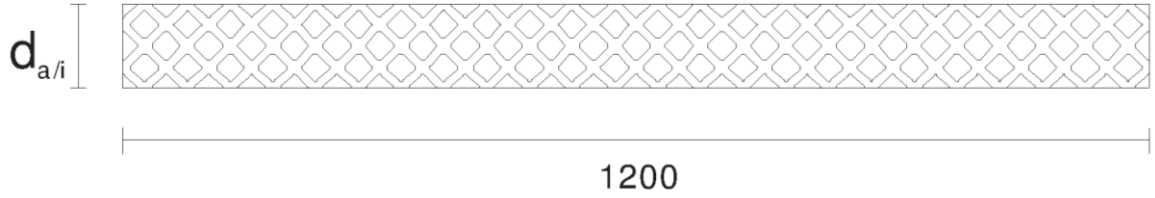
Cross section



Side view



Top view



Corner leaf

Top view

Side view

all dimensions in [mm]

MAGU WS, MAGU ICF, MAGU Isocoffrage	
Accessory parts: Height adjuster pieces and Corner leafs	Annex A4 Page 2 of 2

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Installation

1 General

The manufacturer shall ensure that the requirements in accordance with clauses 1 and 3 as well as the Annexes 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.

After installation of the shuttering elements (see Annex B1, 2) site mixed or ready mixed concrete is placed and compacted (see Annex B1, 3).

In end use conditions concrete walls of a continuous type[1] (see 3.1.1) 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 wall and the weight per unit area without rendering are shown in Annex B5.

In end use conditions the EPS shuttering leafs are the main part of the thermal insulation of the walls.

Information on the determination of the declared values of the thermal resistance under end use conditions (with concrete, without render) from the declared values of the thermal conductivity is given in Annex B3.

The design values of the thermal conductivity or the design values of the thermal resistance shall be determined from the declared values according to 3.6.1 in accordance with the national regulations valid at the place of use.

2 Installation of the shuttering elements

The shuttering elements are put together on site in layers without mortar or 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, better a half of the element length, to the vertical joints of the previous and next layer (see Annex B4, page 1 to 3).

The spacers are assembled on site into the inner and outer EPS shuttering leafs to reach complete shuttering elements. The spacers shall be stacked (one upon the other) to avoid segregation of concrete.

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 EPS shuttering leafs and the uneven subsoil are to be sealed with PU foam before concreting.

Subsequently, according to the installation guide of the manufacturer, the shuttering elements are to be interlocked to floor height, levelled and fastened to the push pull props (see Annex B4, page 5).

The push pull props shall be arranged with a distance of 1,0 m to maximum 1,50 m to be connected over the entire wall height with the shuttering elements and to be fastened to the floor (see Annex B4, page 5).

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

Rectangular corners and T-walls are to be formed according to Annex B4, page 2 and 3. Typical wall junctions are to be formed according to Annex B4, page 4.

Further information is given in the installation guide of the manufacturer.

[1] see ETAG 009, clause 2.2

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3 Concreting

For the production of normal concrete EN 206 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, 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.

Placing the concrete shall be performed in layers of maximum 0,75 m at a maximum concreting rate of 1 m/h.

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

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

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

Before the further placing of concrete, cement laitance and detached / loose concrete shall be removed and the construction 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 construction 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 held together by bulk pipes or concreting hoses with a maximum diameter of 100 mm and should be brought as close as possible to the filling area.

The formation of concrete mounds should be avoided by choosing small distances between the filling areas.

During planning, sufficient clearances must be provided in the reinforcement for bulk pipes and concreting hoses.

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.

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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.

5 Reworking and finishes

Walls of the type "MAGU WS" 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.

For the rendering of external surfaces systems are recommended, which 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.

Because of the detrimental influence of weather and UV radiation on the surface of the EPS shuttering leafs the protection by finishes should be implemented preferably within one month after erecting the load-bearing structure.

6 Fixing of objects

Fixing of objects in the EPS shuttering leafs 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.

7 Indications to the manufacturer

7.1 Packaging, transport and storage

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

7.2 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 elements have to be protected against high temperature, overheating and intensive exposure to weather and UV radiation. If necessary, the shuttering elements have to be covered.

standards and guidelines		issue	title
EN	206	2013+A1:2016	Concrete – Specification, performance, production and conformity
EN	1992-1-1	2004+AC:2010+A1:2014	Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings;
EN	13163	2012 +A1:2015	Thermal insulation products for buildings – Factory made expanded polystyrene (EPS) products – Specification
EN	13501-1	2007 +A1:2009	Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests;
EN	13501-2	2016	Fire classification of construction products and building elements – Part 2: Classification using data from fire resistance tests, excluding ventilation services;
EN ISO	6946	2007	Building components and building elements – Thermal resistance and thermal transmittance – Calculation method (ISO 6946:2007);
EN ISO	10456	2007+AC:2009	Building materials and products – Hygrothermal properties – Tabulated design values and procedures for determining declared and design thermal values (ISO 10456:2007 + Cor. 1:2009);
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 (ISO 13788:2001);
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"

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Information on the determination of the declared value of the thermal resistance under end-use conditions (with concrete, without plaster)

Due to the fact that the thermal conductivity of the concrete $\lambda_{concrete}$ according to table 3 of EN ISO 10456 is generally higher than that of polypropylene spacers, the nominal value of the thermal resistance $R_{D,element}$ of the shuttering elements under end use conditions (with concrete core, without render) in accordance with EN ISO 6946 may be approximated by determining the sum of the nominal value of the thermal resistance of the shuttering walls of EPS $R_{D,EPS} = d_{EPS} / \lambda_{EPS}$ and of the concrete core $R_{D,concrete} = d_{concrete} / \lambda_{concrete}$. Here, $d_{concrete}$ is the thickness of the concrete core and d_{EPS} the sum of the thicknesses of the outer and inner shuttering leaf of EPS. For the thermal conductivity of EPS λ_{EPS} the value according to section 3.6.1 shall be used. For the thermal conductivity of the concrete core $\lambda_{concrete}$, the value from EN ISO 10456, Table 3 can be used. The gross density of the concrete used must be taken into account.

Table 1: Declared value of thermal resistance $R_{D,element}$ of the shuttering elements in end use conditions (with concrete core without rendering) depending on the thickness of the outer shuttering leafs of EPS and of the concrete core

Type	Thickness of the wall	Thickness of concrete core	Thickness of shuttering leafs of EPS		Declared value of thermal resistance $R_{D,element}$
			inner	outer	
	[mm]	[mm]	[mm]	[mm]	[(m²K)/W]
WS 25/14-30-120	250	140	55	55	3,51
WS 30/14-30-120	300	140	55	105	5,07
WS 35/14-30-120	350	140	55	155	6,63
WS 40/14-30-120	400	140	55	205	8,19
WS 45/14-30-120	450	140	55	255	9,75
WS 50/14-30-120	500	140	55	305	11,32
WS 27/16-30-120	270	160	55	55	3,51
WS 32/16-30-120	320	160	55	105	5,08
WS 37/16-30-120	370	160	55	155	6,64
WS 42/16-30-120	420	160	55	205	8,20
WS 30/19-30-120	300	190	55	55	3,53
WS 35/19-30-120	350	190	55	105	5,09
WS 40/19-30-120	400	190	55	155	6,65
WS 45/19-30-120	450	190	55	205	8,22
WS 35/24-30-120	350	240	55	55	3,55
WS 40/24-30-120	400	240	55	105	5,11
WS 45/24-30-120	450	240	55	155	6,68
WS 50/24-30-120	500	240	55	205	8,24

The planner shall consider the metal parts of the system as thermal bridges, where relevant, for determination of the declared value of thermal resistance $R_{D,element}$.

MAGU WS, MAGU ICF, MAGU Isocoffrage	Annex B3
Information on the determination of the thermal resistance	

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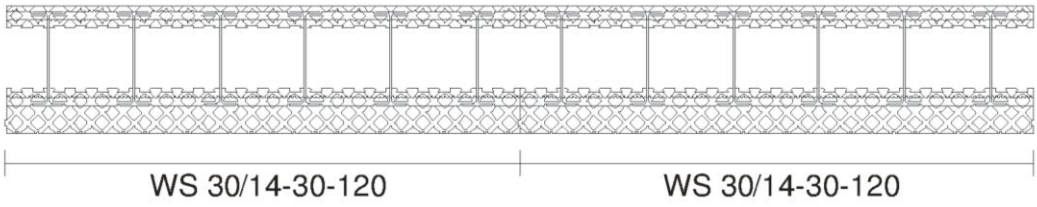
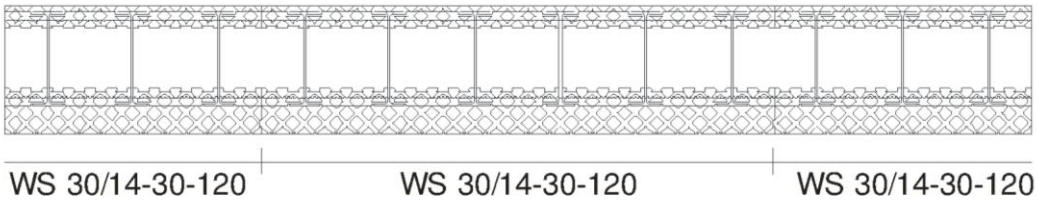
Top view

1st layer



2nd layer

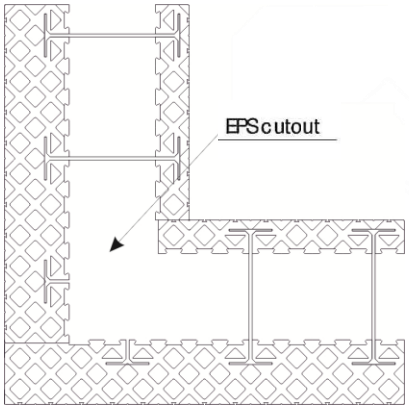


MAGU WS, MAGU ICF, MAGU Isocoffrage	
Structure of layers of straight walls (using the example of the standard shuttering element WS 30/14-30-120)	Annex B4 Page 1 of 5

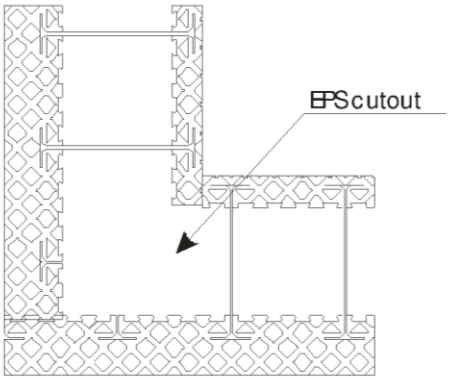
Deutsches Institut für Bautechnik DIBt

Top view

1st layer

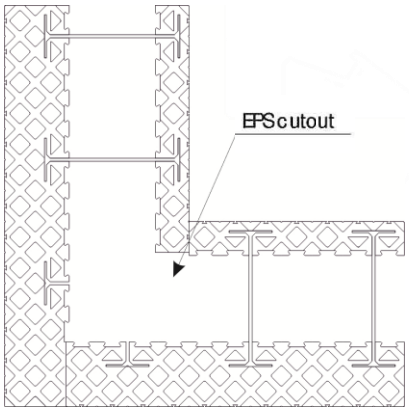


d_b = 140 mm, 160 mm

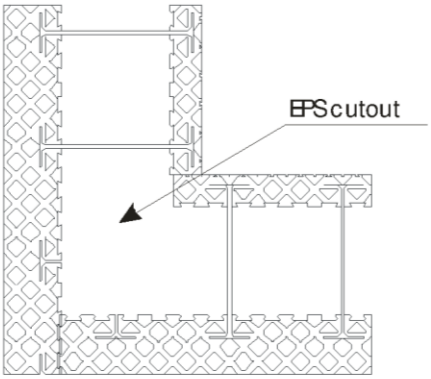


d_b = 190 mm, 240 mm

2nd layer



d_b = 140 mm, 160 mm



d_b = 190 mm, 240 mm

Note: Here only wall corners are shown with the same thickness of the concrete core of the intersecting walls. Even in the case of wall corners with different thicknesses of concrete core ($d_b = d_k$ = 140, 160, 190 or 240 mm) of the intersecting walls it shall be ensured that the spacers of the n^{th} layers and $(n + 1)^{th}$ layers are always stacked on top of each other.

MAGU WS, MAGU ICF, MAGU Isocoffrage	
Structure of layers of rectangular corners	Annex B4 Page 2 of 5

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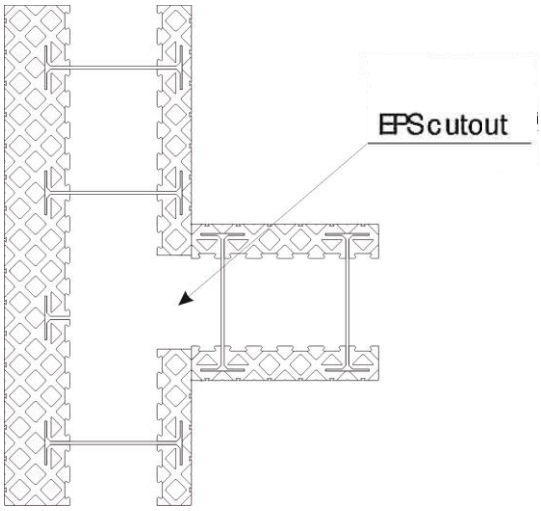
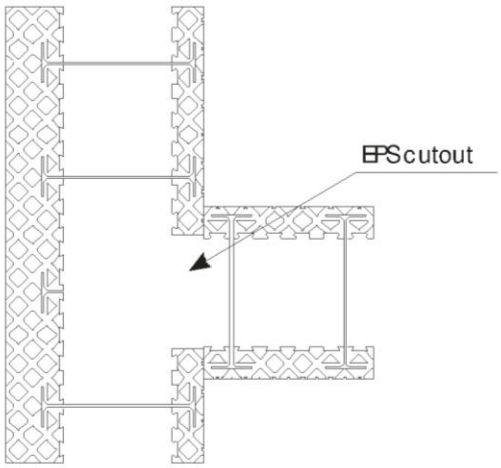
Top view

1st layer

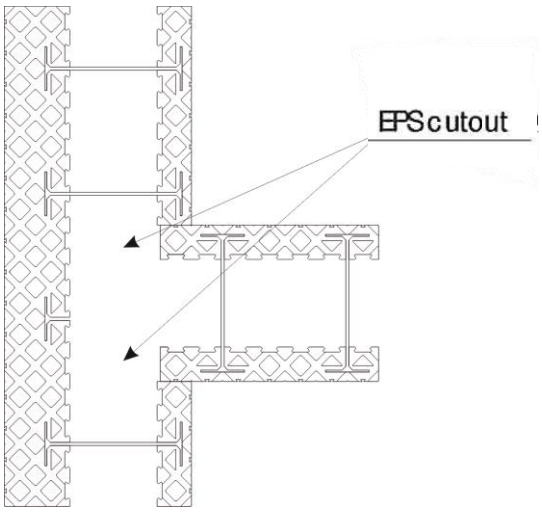


d_b = 140 mm, 160 mm

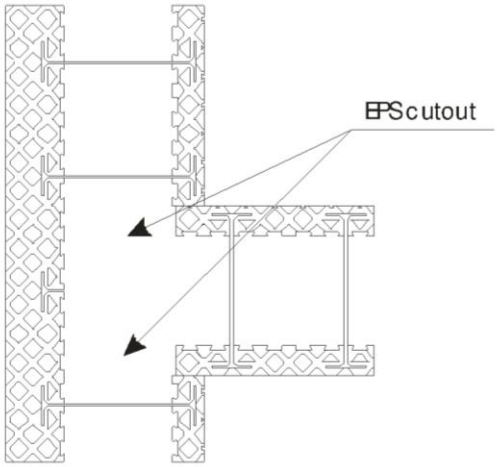


d_b = 190 mm, 240 mm

2nd layer



d_b = 140 mm, 160 mm



d_b = 190 mm, 240 mm

Note: Here only wall connections are shown with the same thickness of the concrete core of the intersecting walls. Even in the case of wall connections with different thicknesses of concrete core ($d_b = d_k$ = 140, 160, 190 or 240 mm) of the intersecting walls it shall be ensured that the spacers of the n^{th} layers and $(n + 1)^{th}$ layers are always stacked on top of each other.

MAGU WS, MAGU ICF, MAGU Isocoffrage	
Structure of layers of T-walls	Annex B4 Page 3 of 5

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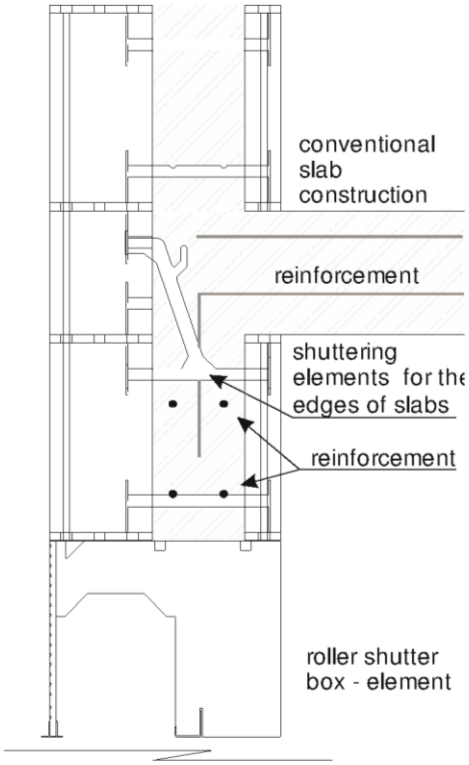
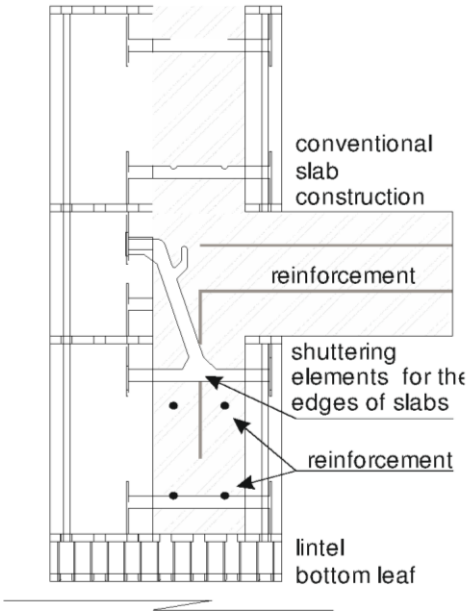
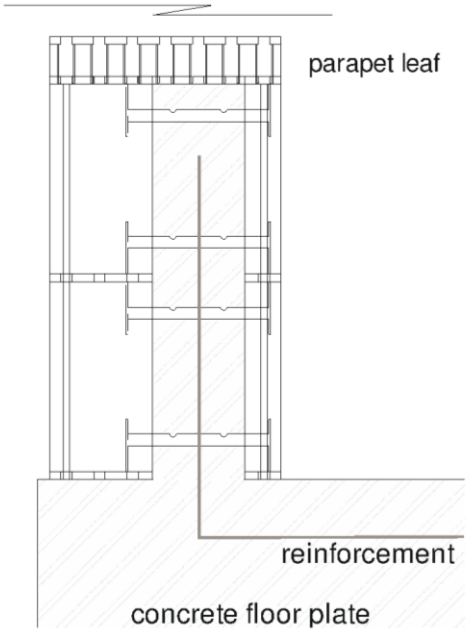
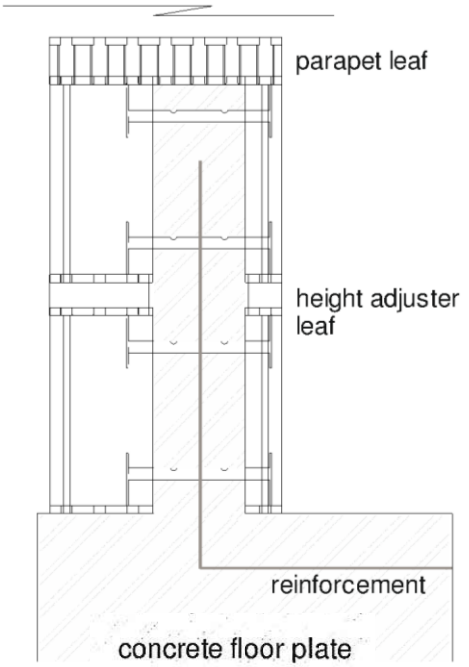
Cross section









MAGU WS, MAGU ICF, MAGU Isocoffrage	
Typical wall-floor junctions	Annex B4 Page 4 of 5

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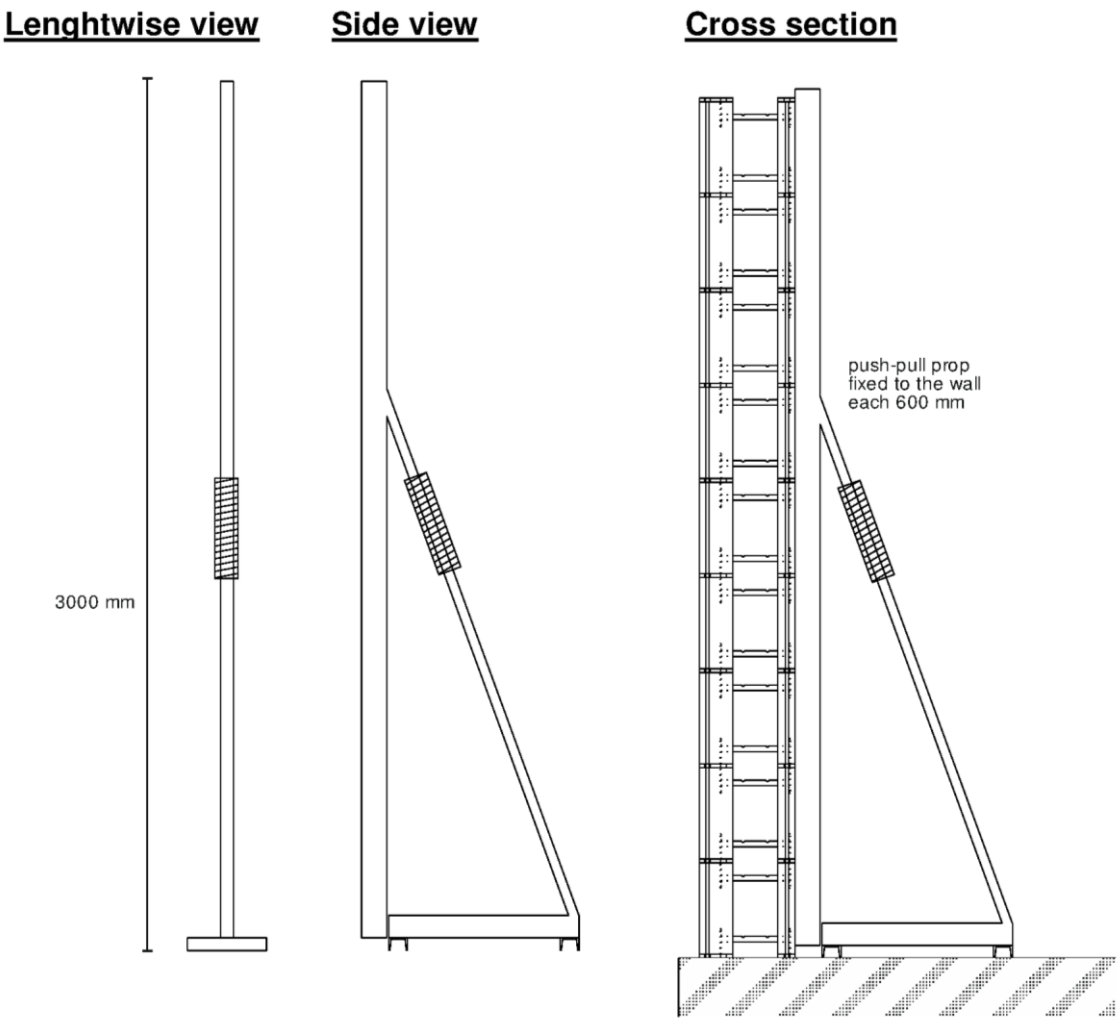

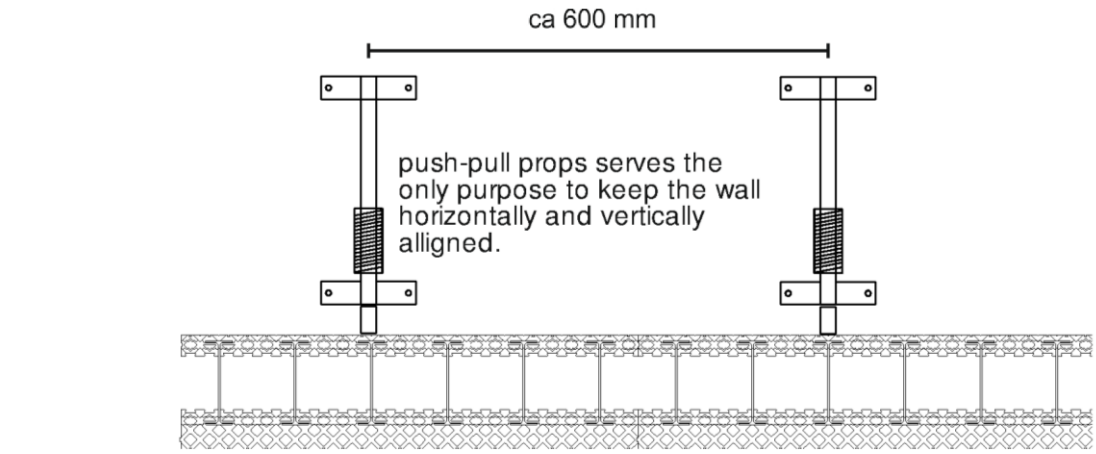

MAGU WS, MAGU ICF, MAGU Isocoffrage

Push pull props

Annex B4
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Type of standard shuttering elements	Thickness of the wall	Thickness of the concrete core	Area of concrete core per meter wall length	Volume of the concrete core per m² wall area	Assumed weight of the shuttering elements without rendering ρ_{EPS} = 30 kg/m³	Assumed weight of the shuttering elements in end use conditions (with concrete core without rendering) $\rho_{Concrete}$ = 2500 kg/m³
	[mm]	[mm]	[m²/m]	[m³/m²]	[kN/m²]	[kN/m²]
WS 25/14-30-120	250	140	140	0,140	0,0437	3,54
WS 30/14-30-120	300	140	140	0,140	0,0587	3,56
WS 35/14-30-120	350	140	140	0,140	0,0737	3,57
WS 40/14-30-120	400	140	140	0,140	0,0947	3,59
WS 45/14-30-120	450	140	140	0,140	0,1037	3,60
WS 50/14-30-120	500	140	140	0,140	0,1187	3,62
WS 30/19-30-120	300	190	190	0,190	0,0450	4,79
WS 27/16-30-120	270	160	160	0,160	0,0450	4,04
WS 32/16-30-120	320	160	160	0,160	0,0600	4,06
WS 37/16-30-120	370	160	160	0,160	0,0750	4,07
WS 42/16-30-120	420	160	160	0,160	0,0900	4,09
WS 35/19-30-120	350	190	190	0,190	0,0580	4,81
WS 40/19-30-120	400	190	190	0,190	0,0750	4,82
WS 45/19-30-120	450	190	190	0,190	0,0900	4,84
WS 35/24-30-120	350	240	240	0,240	0,0470	6,05
WS 40/24-30-120	400	240	240	0,240	0,0620	6,06
WS 45/24-30-120	450	240	240	0,240	0,0770	6,08
WS 50/24-30-120	500	240	240	0,240	0,0917	6,09

MAGU WS, MAGU ICF, MAGU Isocoffrage

Thickness of the wall and weight per m² of standard shuttering elements

Annex B5