Deutsches Institut für Bautechnik

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Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

European Technical Assessment

ETA-07/0235 of 6 September 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	DuoTherm
Product family to which the construction product belongs	Non-load bearing permanent shuttering kit "DuoTherm" based on shuttering elements of EPS
Manufacturer	DuoTherm Entwicklungs-Vertriebs mbH Am Himmelfeld 2 56410 Montabaur DEUTSCHLAND
Manufacturing plant	Schaumaplast Sachsen GmbH Gewerbestraße 12 01681 Nossen DEUTSCHLAND Beck & Heun GmbH Steinstraße 4 35794 Mengerskirchen-Waldernbach
This European Technical Assessment contains	40 pages including 31 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-07/0235 issued on 12 December 2017

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Specific Part

1 Definition of the product and intended use

1.1 Definition of the construction product

The shuttering system "DuoTherm" is a non load-bearing permanent shuttering kit based on standard shuttering elements (see Annex A2), special shuttering elements and accessory parts applicable as formwork for plain and reinforced concrete walls cast in-situ.

The shuttering elements consist of:

- shuttering leafs of expanded polystyrene (EPS),
- spacers of steel (steel spacers),
- reinforcing wire mesh and
- anchor tubes of polypropylene (PP tubes).

An overview of all components of the kit is given in Annex A14.

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

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

1.2 Shuttering elements

1.2.1 Standard shuttering elements

The standard shuttering elements (see Annex A2) consist of inner and outer standard shuttering leafs (see 1.3.1 and Annex A1, 3.1) of expanded polystyrene (EPS) and spacers (see 1.4.5 and Annex A1, 4.5) fixed by anchor tubes (see 1.4.4 and Annex A1, 4.4). These components are assembled on site.

The shuttering leafs are one-layered. The spacers provide thicknesses of the concrete core of 142 mm and 192 mm, as indicated in Table 1 of Annex A1. The thickness of the inner shuttering leaf is 54 mm and the range for the thickness of the outer shuttering leaf is 54 mm, 104 mm, 204 mm, 254 mm or 304 mm. The length of the standard shuttering elements is 1000 mm and the height is 250 mm (see Annex A2).

The system can be used to construct straight and angled walls (90°- and 135°-angles).

Steel reinforcement can be fixed directly to the steel spacer web. The maximum centre distance of steel spacers in longitudinal direction of the standard shuttering elements shall be 125 mm, see Annexes A2 to A5.

The shuttering elements are interlocked and build up horizontally and vertically into a tight and rigid formwork. The wall is formed by filling of the shuttering elements with concrete. The shuttering is used in conjunction with concrete class C16/20 (according to EN 206) to built plain concrete walls or in conjunction with concrete of classes in the range from C20/25 to C50/60 (according to EN 206) to build reinforced concrete walls.

1.2.2 Special shuttering elements

The special shuttering elements consist of inner and outer special shuttering leafs (see 1.3.2 and Annex A1, 3.2) of expanded polystyrene (EPS). With regard to all other aspects, they are constructed analogously to the standard shuttering elements described above (see 1.2.1 and Annex A1, 3.1).

1.3 Shuttering leafs

1.3.1 Standard shuttering leafs

The standard shuttering leafs of expanded polystyrene (EPS) include:

BS01 in Annex A3, BS40 in Annex A4, BS47, BS48 and BS49 in Annex A5.

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

The surfaces of the shuttering leafs are generally smooth. There are also vertical grooves on the inside face of each shuttering leaf. These element-high grooves on the inside face provide a mechanical interlock between shuttering leafs and concrete core (see 3.4.1).

The vertical ends of the shuttering leafs are smooth and form a tight but unsealed joint. Sealing foam is used to seal these vertical joints, where required, and to fill in gaps caused by inaccuracy of foundation level.

1.3.2 Special shuttering leafs

The special shuttering leafs of expanded polystyrene (EPS) include:

- outer corner leafs (BS03, BS04 in Annex A6, BS11 And BS12 in Annex A7, BS41 and BS42 in Annex A9, BS44 and BS45 in Annex A10),
- internal corner leafs (BS05, BS06 in Annex A6, BS25, BS26 in Annex A8, BS46 in Annex A9),
- levelling leafs (BS07, BS08, BS15, BS16 in Annex A3, BS17 in Annex A4).

The special shuttering leafs are of the same material and external appearance as the standard shuttering leafs (see Annex A1, 5.1).

1.4 Accesory parts

1.4.1 Lintel leafs (BS10 in Annex A13)

The lintel leafs (BS10 in Annex A13) are used for the shuttering bottoms of the lintels. They are of the same material and external appearance as the standard shuttering leafs (see 1.3.1 and Annex A1, 5.1).

1.4.2 Front leafs (BS02 in Annex A13)

The front leafs are used for sealing the front part of shuttering elements. They are of the same material and external appearance as the standard shuttering leafs (see 1.3.1 and Annex A1, 5.1).

1.4.3 End leafs (BS09, BS22 in Annex A13)

The end leafs are used as shuttering for the opened narrow sides at corners, door openings and blunt-ended inside walls. They are installed vertically in the opened ends of the shuttering elements. They are of the same material and external appearance as the standard shuttering leafs (see 1.3.1 and Annex A1, 5.1).

1.4.4 Anchor tubes (BS50 in Annex A11)

Anchor tubes (see BS50 in Annex A11) are parts of all shuttering elements. The task of the PP tubes is to connect the steel spacers without metal tubes with the inner and outer shuttering leafs.

1.4.5 Spacers

Spacers are parts of all shuttering elements. There are two different types of spacers:

- steel anchors (see BS51, BS58, BS59 in Annex A11 and BS60, BS64, BS65 in Annex A12) with or without metal tubes and
- reinforcing wire mesh (see BS57, BS57K in Annex A11 and BS66, BS66K in Annex A12).

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

3.1 Mechanical resistance and stability (BWR 1)

3.1.1 Resulting structural pattern

In end use conditions walls made with shuttering elements "DuoTherm" 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 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, 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 "DuoTherm" made of expanded polystyrene (EPS) fulfil the requirements of Class E according to EN 13501-1.

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 coefficient of expanded polystyrene (EPS), according to EN ISO 10456, is $\mu = 60$.

Using this value to verify the annual moisture balance or the maximum amount of interstitial condensation according to EN ISO 13788 will be on the safe side.

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

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 "DuoTherm" the "No performance assessed" 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

Under end use conditions the shuttering leafs are durable fixed by the steel spacers. The bond strength is at least equal to the resisting pressure of fresh concrete of the shuttering leafs, see clause 3.4.2, furthermore the vertical element-high grooves on the inside face of each shuttering leaf with a horizontal distance of minimum 35 mm and maximum 55 mm provide a mechanical interlock between shuttering leafs and concrete core.

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

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

3.4.2 Resistance to pressure of fresh concrete

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

The tensile strength shall be at least

- 680 MPa for the steel spacers (see Annexes A11 and A12) respectively
- 520 MPa for the PP tubes (Annex A11, element BS 50).

The pull-out strength between steel spacers and the shuttering leafs shall be at least

- 570 N for the steel spacer without metal tubes in the space of the wall area (see Annexes A11 and A12, e. g. elements BS 51, BS 57, BS 59, BS 60, BS 64 and BS 66) in conjunction with PP tubes (see Annex A11, element BS 50) respectively
- 290 N for the steel spacer with metal tubes at wall base (see Annexes A11 and A12, e. g. elements BS 58 and BS 65).

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 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 Thermal conductivity

The shuttering elements according to Annex A2 are produced in two materials:

- Material white: BASF Styropor F 395-N
- Material gray: BASF Neopor F2400.

The thermal conductivity of the shuttering panels made with these materials is:

- Material white: λ = 0.035 W / (m × K) with a maximum density of 29 kg / m³
- Material gray: λ = 0.032 W / (m × K) with a maximum density of 32 kg / m³.

3.6.2 Heat capacity

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 "DS(70,-)3" of the EPS (see Annex A1, 5.1) the relative changes of the 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

The steel spacers are only necessary for the resistance to pressure of fresh concrete. When the concrete core has sufficiently hardened the bond between concrete core and shuttering leafs is given by the vertical grooves on the inside face of each shuttering leaf (see 3.4.1).

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 does not contain wood.

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

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 "DuoTherm" and designed according EN 1992-1-1 respectively according national design rules, lead to the assumption that concrete core insures an adequate resistance of the complete wall under normal use 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, 4.

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

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 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 6 September 2018 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

beglaubigt:
Dr.-Ing. R. Alex

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Characteristics of shuttering kit

The shuttering system "DuoTherm" is a non load-bearing permanent shuttering kit based on standard shuttering elements (see Annex A2), special shuttering elements and accessory parts applicable as formwork for plain and reinforced concrete walls cast in-situ.

The shuttering elements consist of:

- shuttering leafs of expanded polystyrene (EPS shuttering leafs),
- spacers of steel (steel spacers),
- reinforcing wire mesh and
- anchor tubes of polypropylene (PP tubes).

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

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

1 Standard shuttering elements

The standard shuttering elements (see Annex A2) consist of inner and outer standard shuttering leafs (see Annex A1, 3.1) of expanded polystyrene (EPS) and spacers (see Annex A1, 4.5) fixed by anchor tubes (see Annex A1, 4.4). These components are assembled on site.

The shuttering leafs are one-layered. The spacers provide thicknesses of the concrete core of 142 mm and 192 mm, as indicated in Table 1. The thickness of the inner EPS shuttering leaf is 54 mm and the range for the thickness of the outer shuttering leaf is 54 mm, 104 mm, 204 mm, 254 mm or 304 mm. The length of the standard shuttering elements is 1000 mm and the height is 250 mm (see Annex A2).

Table 1: Wall thicknesses of the standard shuttering elements

Type	according Annex	Thickness of the wall	Thickness of concrete core	Shuttering leafs			Longitudinal centre distance of steel spacers
				Thickness		Height	
				inner	outer		
		[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
25-es	A2	250	142	54	54	250	125
30-es		300	142	54	104	250	125
40-es		400	142	54	204	250	125
45-es		450	142	54	254	250	125
52-es		500	142	54	304	250	125
30/1-st		300	192	54	54	250	125
35/1-st		350	192	54	104	250	125
45/1-st		450	192	54	204	250	125
50/1-st		500	192	54	254	250	125
55/1-st		550	192	54	304	250	125

2 Special shuttering elements

The special shuttering elements consist of inner and outer special shuttering leafs (see Annex A1, 3.2) of expanded polystyrene (EPS). With regard to all other aspects, they are constructed analogously to the standard shuttering elements described above.

3 Shuttering leafs

3.1 Standard shuttering leafs

The standard shuttering leafs of expanded polystyrene (EPS) include:

BS01 in Annex A3, BS40 in Annex A4, BS47, BS48 and BS49 in Annex A5.

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

The surfaces of the shuttering leafs are generally smooth. There are also vertical grooves on the inside face of each EPS shuttering leaf. These element-high grooves on the inside face provide a mechanical interlock between EPS shuttering leafs and concrete core (see Annex A1, 3.4.1).

In addition, marks are provided on the surface of the standard shuttering leafs at a distance of 12.5 cm, so that, if necessary, the shortening of the lengths of the formwork wall at any multiple of 12.5 cm is possible.

The vertical ends of the EPS shuttering leafs are smooth and form a tight but unsealed joint. Sealing foam is used to seal these vertical joints, where required, and to fill in gaps caused by inaccuracy of foundation level.

3.2 Special shuttering leafs

Special shuttering leafs of expanded polystyrene (EPS) include:

- outer corner leafs (BS03, BS04 in Annex A6, BS11 and BS12 in Annex A7, BS41 and BS42 in Annex A9, BS44 and BS45 in Annex A10),
- internal corner leafs (BS05, BS06 in Annex A6, BS25, BS26 in Annex A8, BS46 in Annex A10),
- levelling leafs (BS07, BS08, BS15, BS16 in Annex A3, BS17 in Annex A4).

The special shuttering leafs are of the same material and external appearance as the standard shuttering leafs (see Annex A1, 5.1).

4 Accessory parts

4.1 Lintel leafs (BS10 in Annex A13)

The lintel leafs (BS10 in Annex A13) are used for the shuttering bottoms of the lintels. They are of the same material and external appearance as the standard shuttering leafs (see Annex A1, 5.1).

4.2 Front leafs (BS02 in Annex A13)

The front leafs are used for sealing the front part of shuttering elements. They are of the same material and external appearance as the standard shuttering leafs (see Annex A1, 5.1).

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4.3 End leafs (BS09, BS22 in Annex A13)

The end leafs are used as shuttering for the opened narrow sides at corners, door openings and blunt-ended inside walls. They are installed vertically in the opened ends of the shuttering elements. They are of the same material and external appearance as the standard shuttering leafs (see Annex A1, 5.1).

4.4 Anchor tubes (BS50 in Annex A11)

Anchor tubes (see BS50 in Annex A11) are parts of all shuttering elements. The task of the PP tubes is to connect the steel spacers without metal tubes with the inner and outer shuttering leafs.

4.5 Spacers

Spacers are parts of all shuttering elements. There are two different types of spacers:

- steel anchors (see BS51, BS58, BS59 in Annex A11 and BS60, BS64, BS65 in Annex A12) with (connection wall floor plate) or without (connection wall-ceiling plate) metal tubes and
- reinforcing wire meshes (see BS57, BS57K in Annex A11 and BS66, BS66K in Annex A12).

5 Material

5.1 Standard shuttering leafs, special shuttering leafs, lintel leafs, face and end leafs

The shuttering leaves are made of
EPS-EN 13163-T(1)-L(2)-W(2)-S(2)-P(5)-DS(N)5-DS(70,-)3-BS250-TR150
composed of polystyrene particle foam made with the granule BASF Styropor F 395-N (material white) or BASF Neopor F2400 (material gray).

The density ρ of the expanded polystyreneis , depending on the material:

material white:	27 - 29 kg / m^3
material gray:	30 - 32 kg / m^3

The nominal value of the thermal conductivity is also material dependent:

material white:	0,035 W / (m K).
material gray:	0,032 W / (m K).

5.2 Accessory parts

5.2.1 Anchor tubes

Anchor tubes are made of polypropylene (PP tubes, trade name: "NOVOLEN"). The minimum wall thickness of the anchor tubes is 1 mm.

5.2.2 Spacers

The spacers are made of galvanized steel. The minimum thickness of the wires of the steel anchors and the reinforcing wire meshes is 4,15 mm (Annexes A11 and A12).

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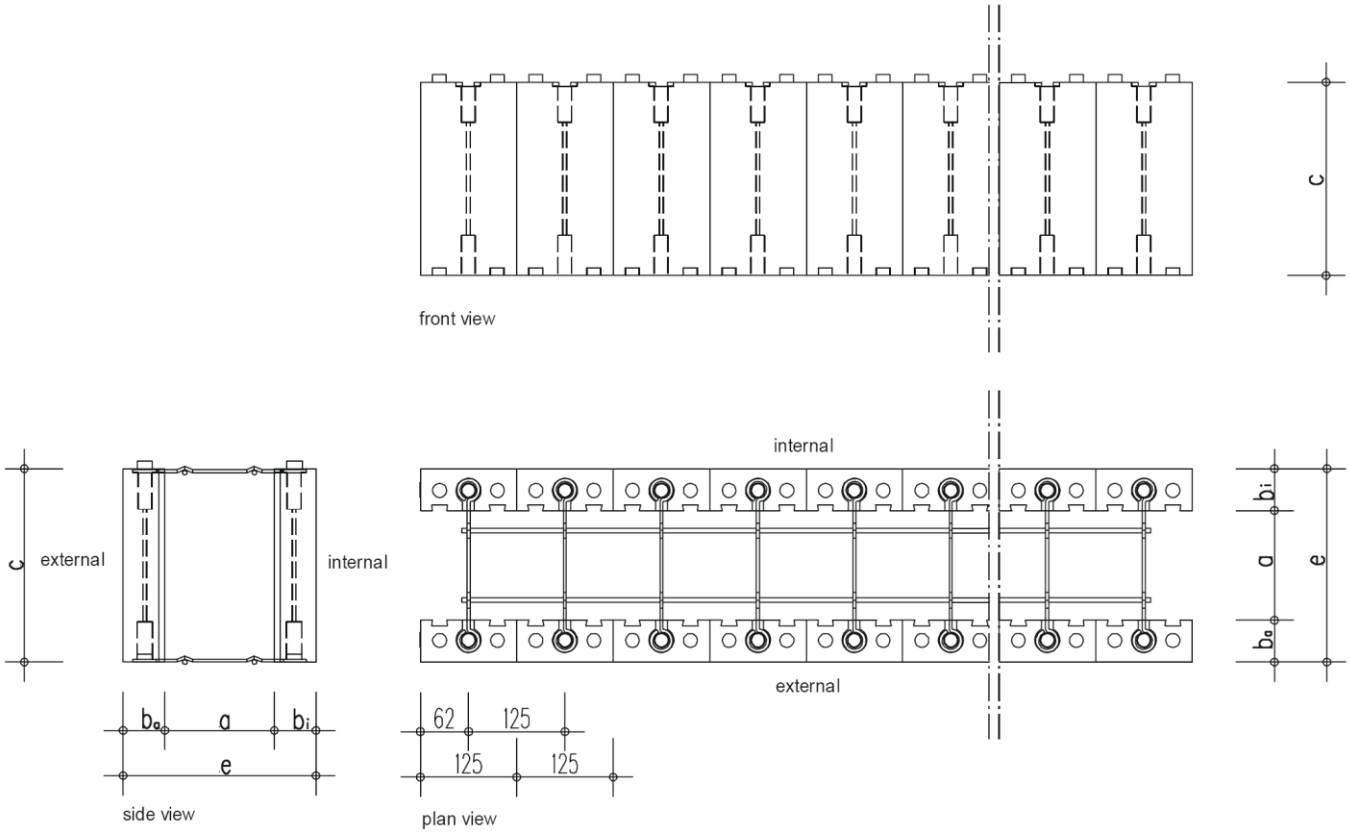

[mm]

type	core thickness	EPS thickness external	EPS thickness internal	height of the element	wall thickness	BS-element external	BS-element anchor tube	BS-element reinforcing wire mesh	BS-element standard anchor	BS-element internal
	a	**b_a**	**b_i**	**c**	**e**					
	[mm]	[mm]	[mm]	[mm]	[mm]					
25-es wall	142	54	54	250	250	BS 01	BS 50	BS 57	BS 51	BS 01
30-es wall	142	104	54	250	300	BS 40	BS 50	BS 57	BS 51	BS 01
40-es wall	142	204	54	250	400	BS 47	BS 50	BS 57	BS 51	BS 01
45-es wall	142	254	54	250	450	BS 48	BS 50	BS 57	BS 51	BS 01
50-es wall	142	304	54	250	500	BS 49	BS 50	BS 57	BS 51	BS 01
30/1-st wall	192	54	54	250	300	BS 01	BS 50	BS 66	BS 60	BS 01
35/1-st wall	192	104	54	250	350	BS 40	BS 50	BS 66	BS 60	BS 01
45/1-st wall	192	204	54	250	450	BS 47	BS 50	BS 66	BS 60	BS 01
50/1-st wall	192	254	54	250	500	BS 48	BS 50	BS 66	BS 60	BS 01
55/1-st wall	192	304	54	250	550	BS 49	BS 50	BS 66	BS 60	BS 01

Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"

Standard shuttering elements

Annex A2

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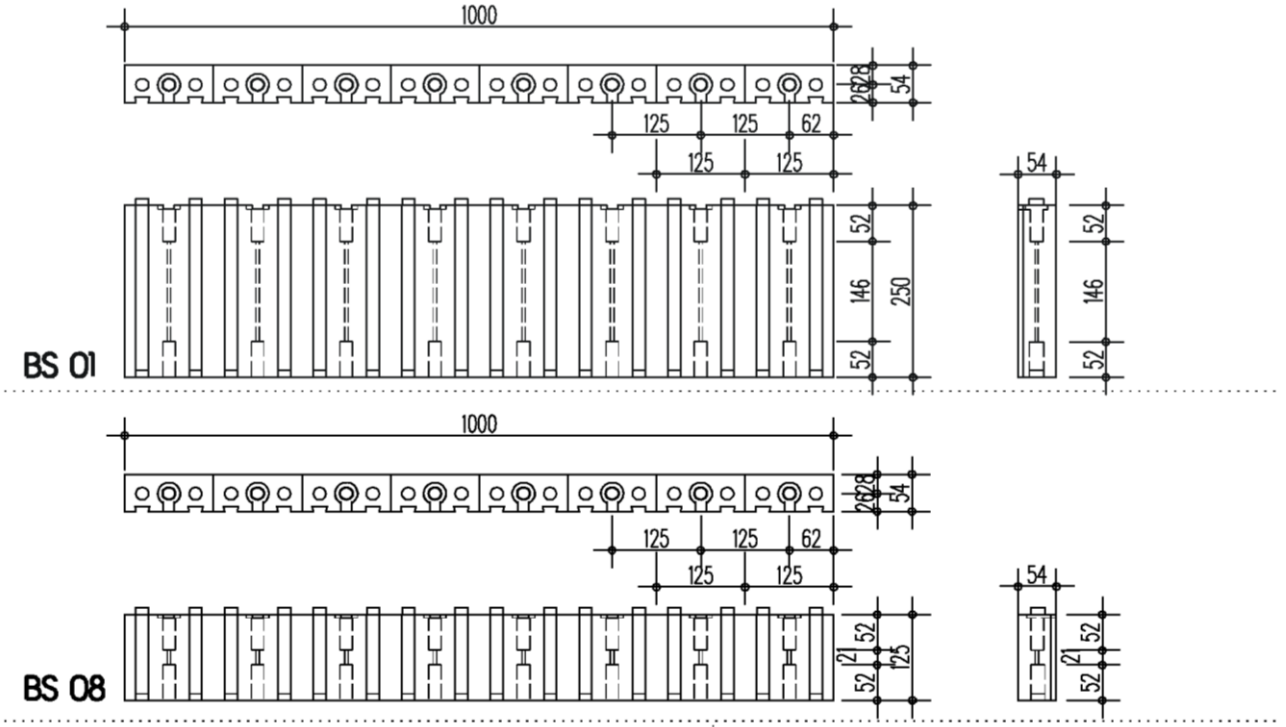

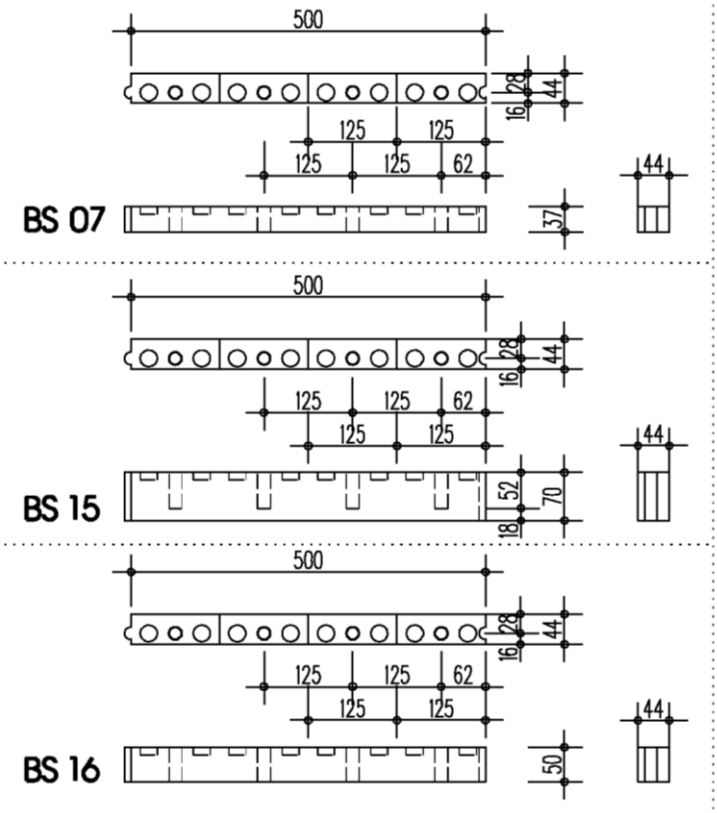

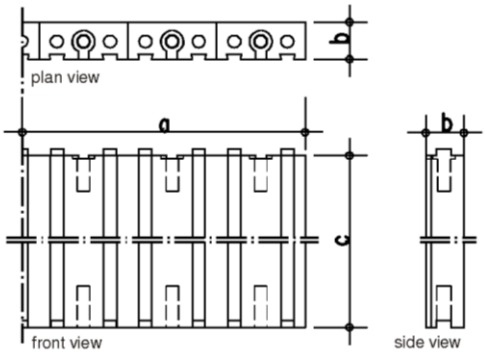

	a	b	c
BS 01	1000	54	250
BS 08	1000	54	125
BS 07	500	44	37
BS 15	500	44	70
BS 16	500	44	50

Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"	Annex A3
BS-elements: BS 91 / BS 08 / BS 07 / BS 15 / BS 16	

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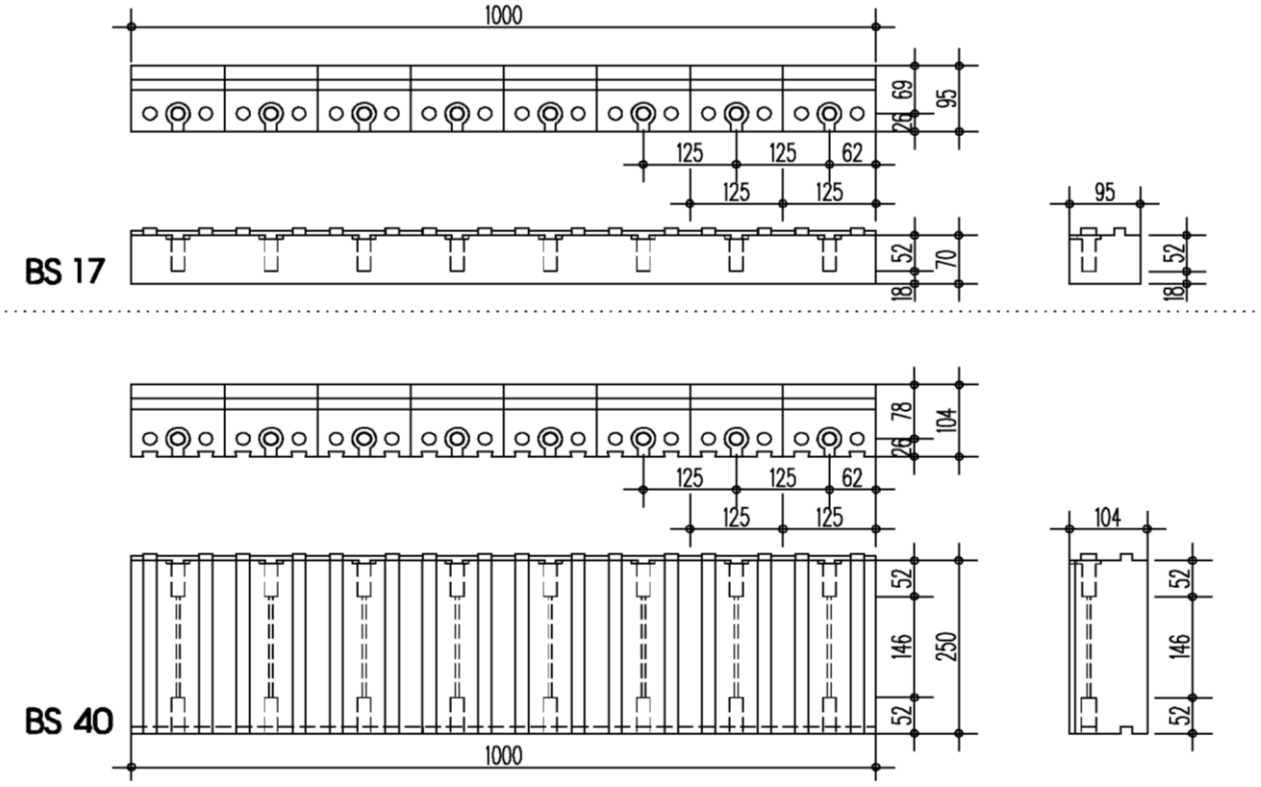

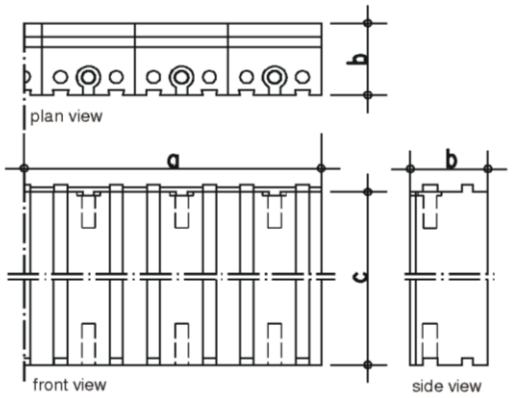

	a	b	c
BS 17	1000	95	70
BS 40	1000	104	250
BS 43	1000	104	125
BS 47	1000	204	250
BS 48	1000	254	250
BS 49	1000	304	250

Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"	Annex A4
BS-elements: BS 17 / BS 40 / BS 43	

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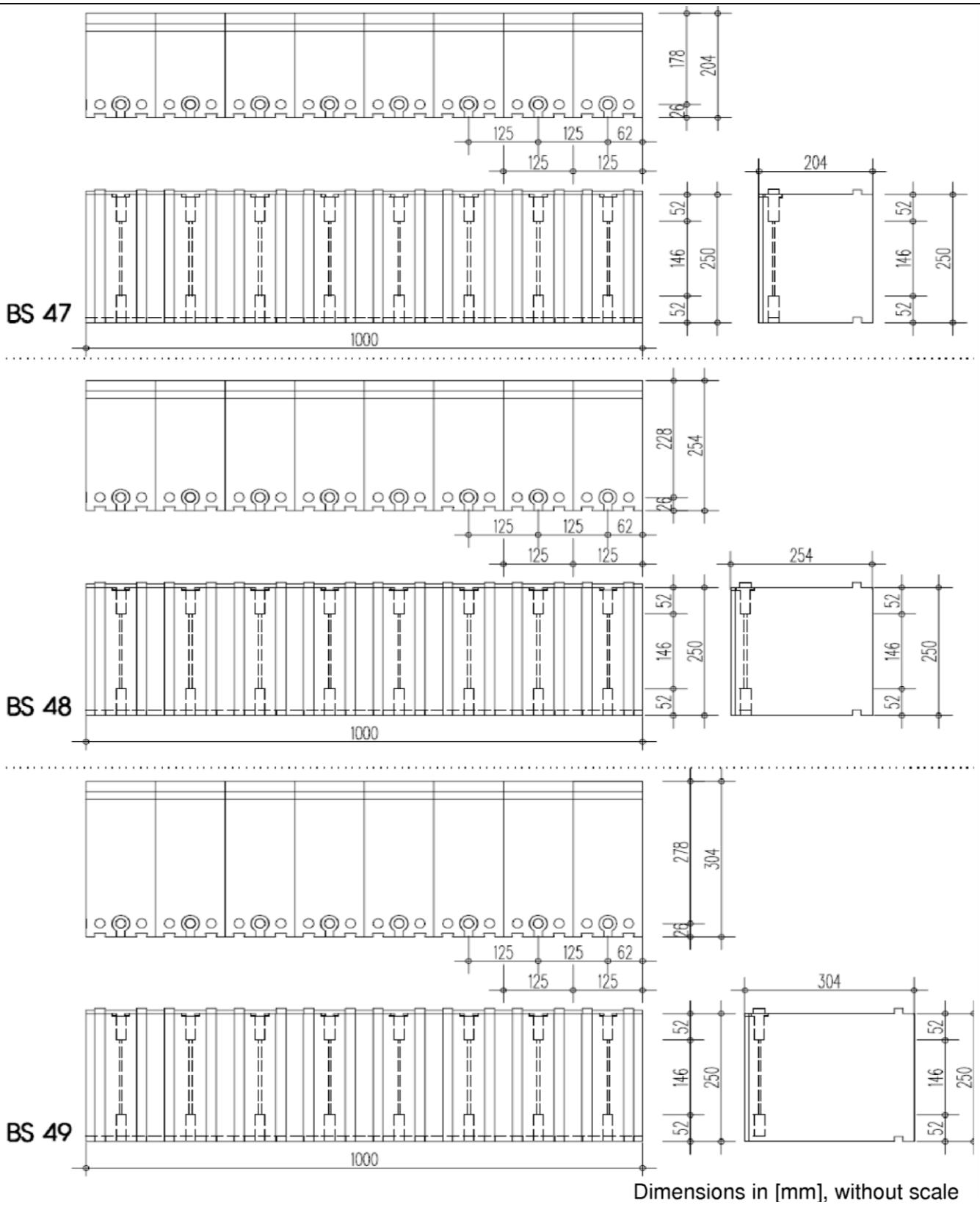

Permanent shuttering kit "DuoTherm"	Annex A5
BS-elements: BS 47 / BS 48 / BS 49	

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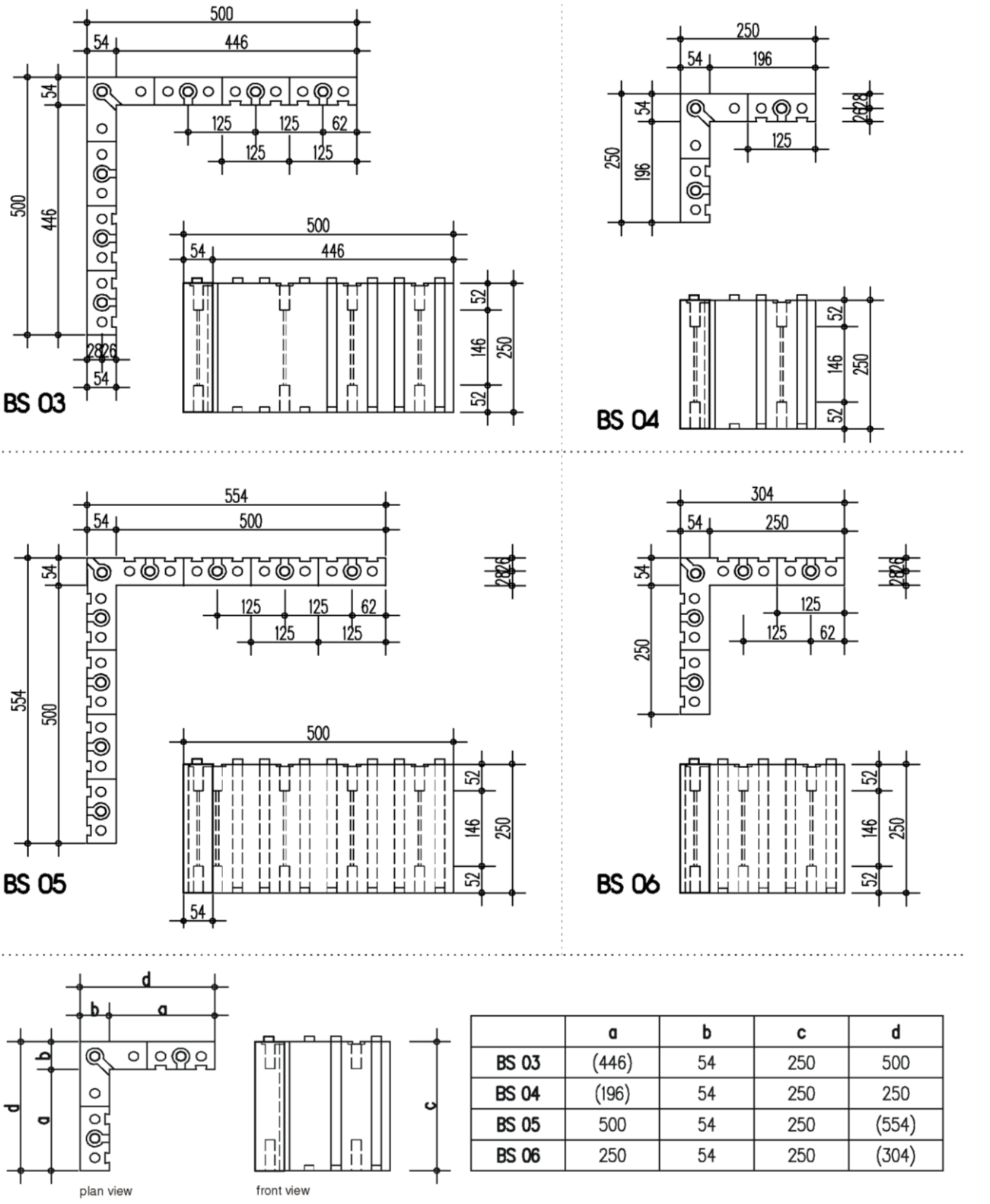

	a	b	c	d
BS 03	(446)	54	250	500
BS 04	(196)	54	250	250
BS 05	500	54	250	(554)
BS 06	250	54	250	(304)

Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"

BS-elements: BS 03 / BS 04 / BS 05 / BS 06

Annex A6

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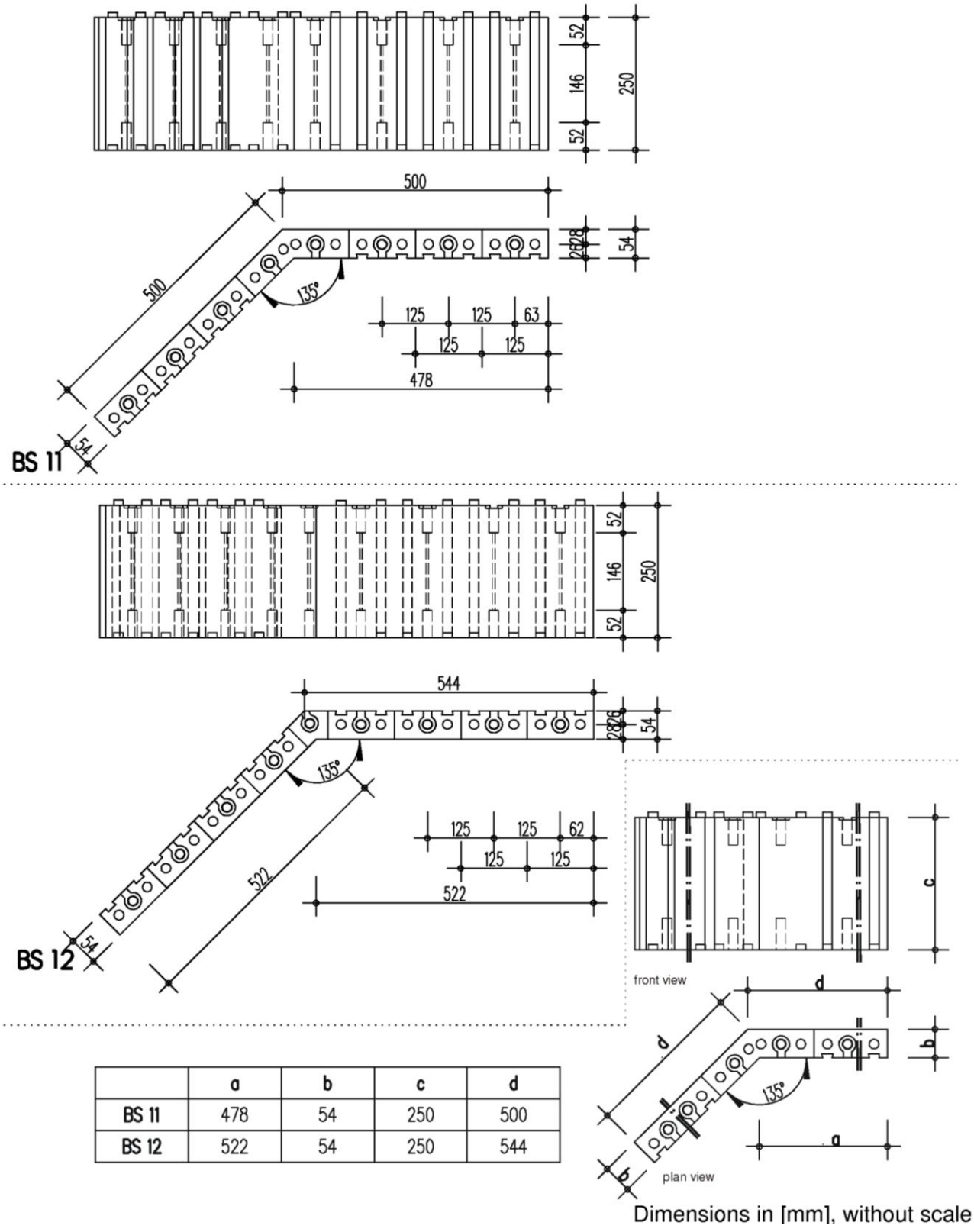

	a	b	c	d
BS 11	478	54	250	500
BS 12	522	54	250	544

Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"

BS-elements: BS 11 / BS 12

Annex A7

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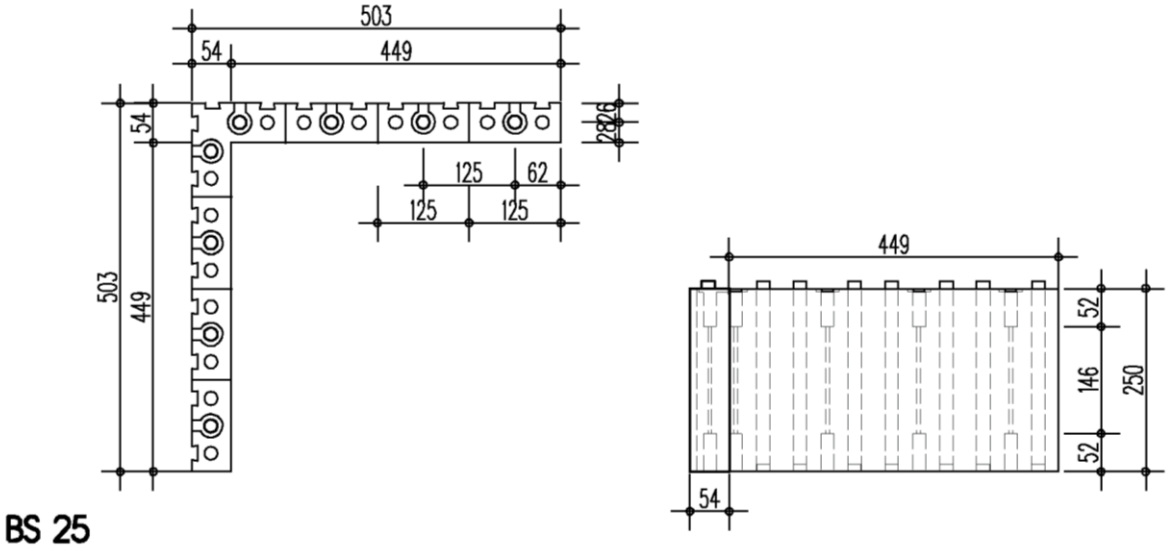
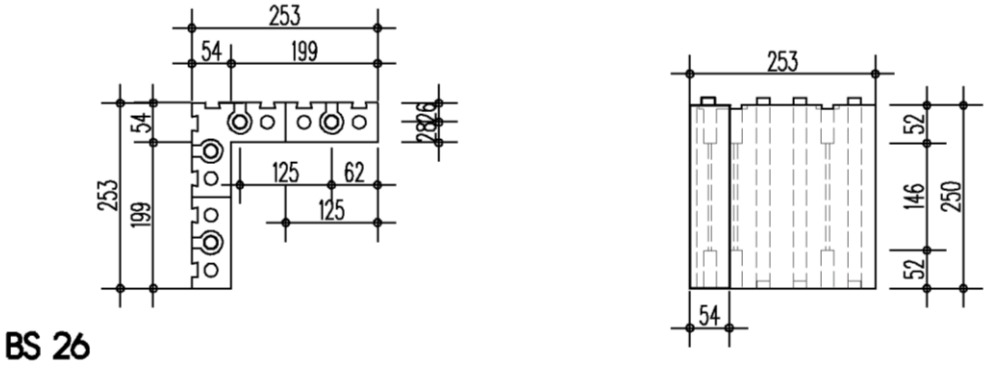
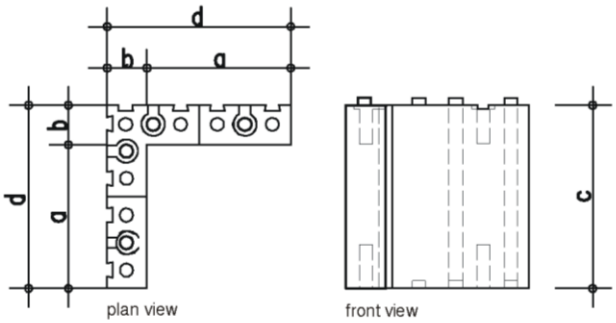


BS 25



BS 26



	a	b	c	d
BS 25	449	54	250	503
BS 26	199	54	250	253

Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"	Annex A8
BS-elements: BS 25 / BS 26	

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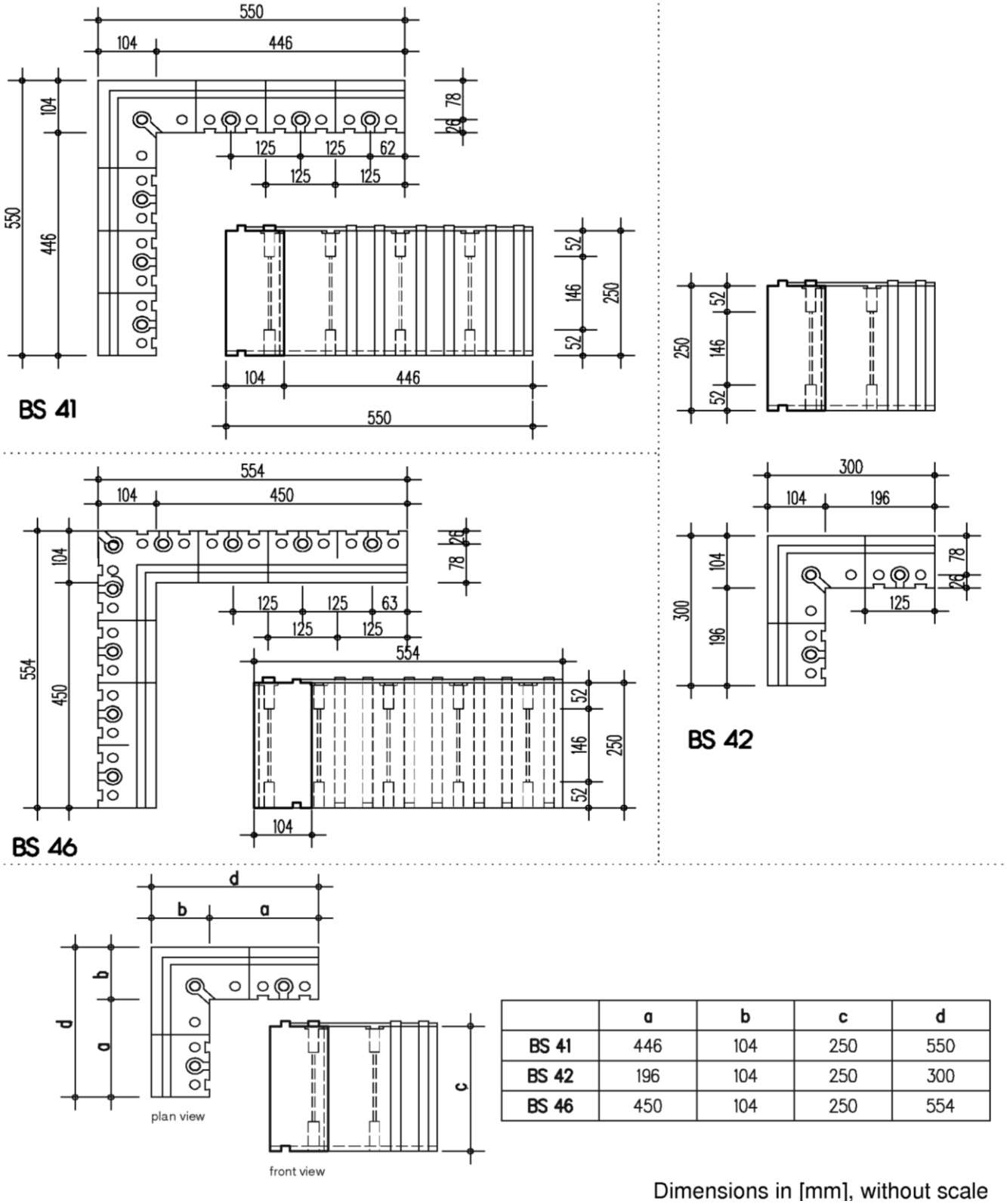

	a	b	c	d
BS 41	446	104	250	550
BS 42	196	104	250	300
BS 46	450	104	250	554

Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"	Annex A9
BS-elements: BS 41 / BS 42 / BS 46	

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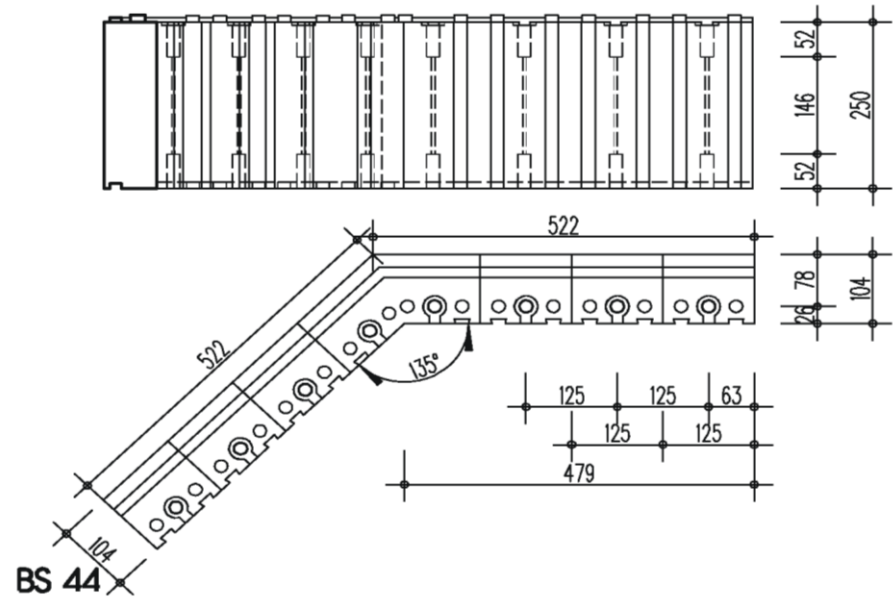
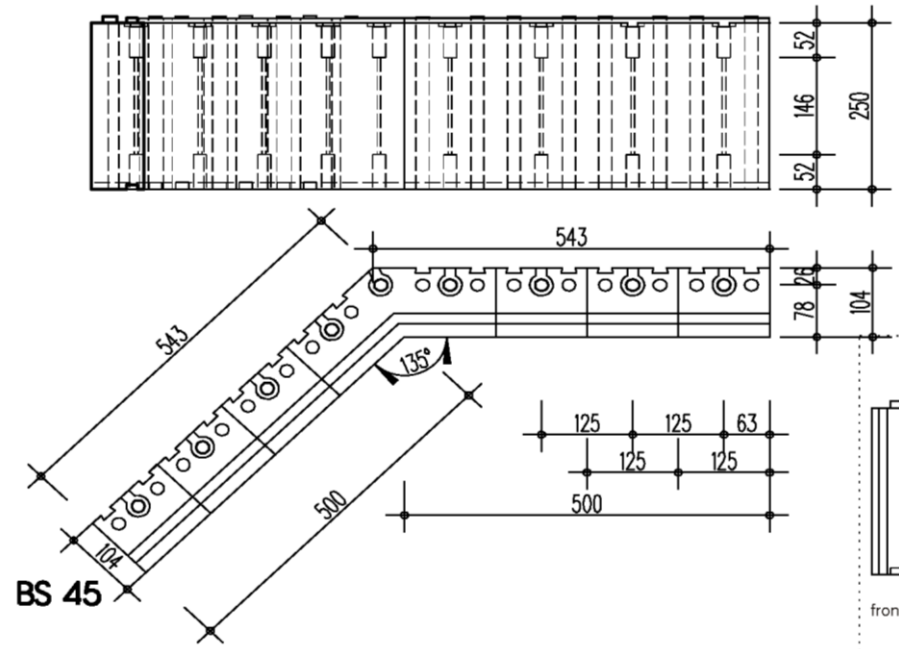
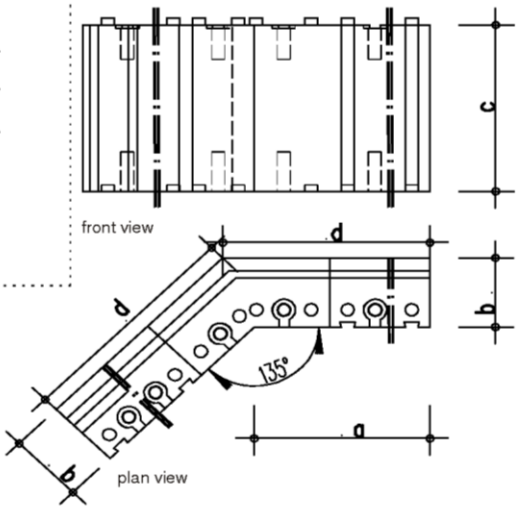




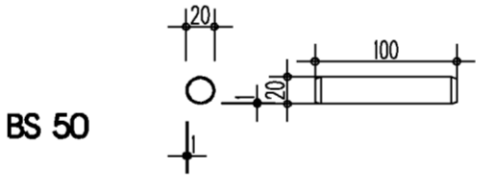


	a	b	c	d
BS 44	479	104	250	522
BS 45	500	104	250	543

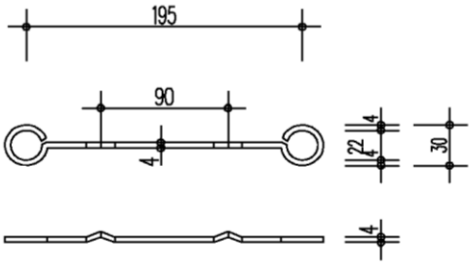
Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"	Annex A10
BS-elements: BS 44 / BS 45	

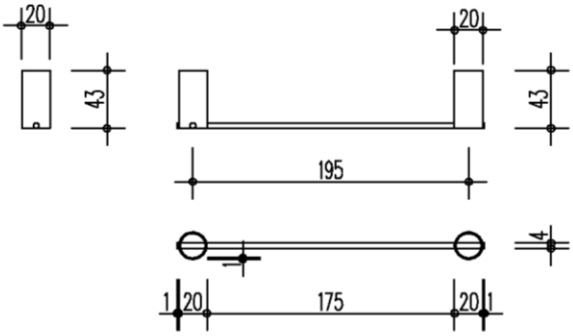
Deutsches Institut für Bautechnik DIBt



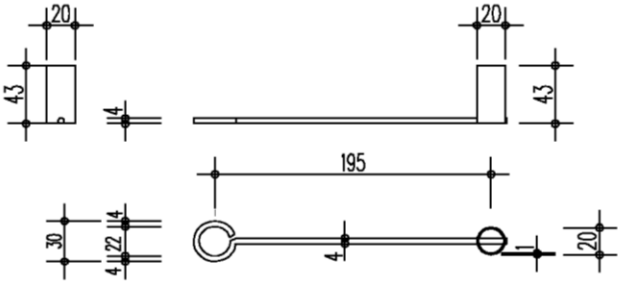
BS 50



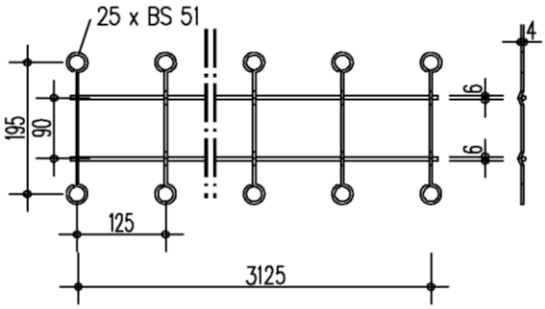
BS 51



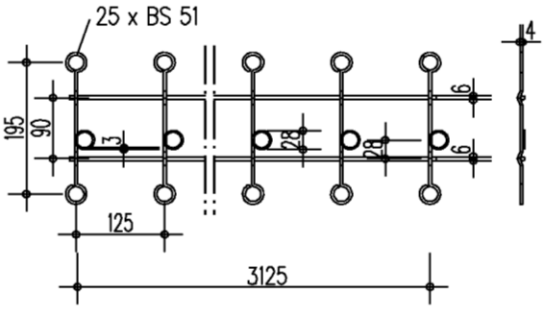
BS 58



BS 59



BS 57



BS 57K

Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"	Annex A11
BS-elements: BS 50 / BS 51 / BS 58 / BS 59 / BS 57 / BS 57K	

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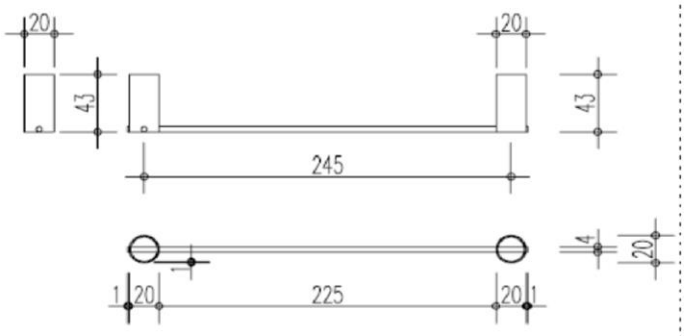
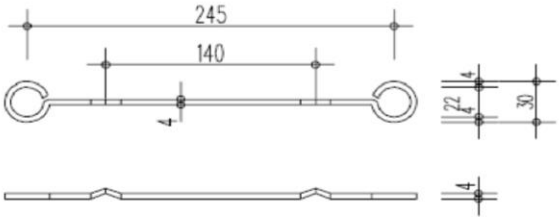
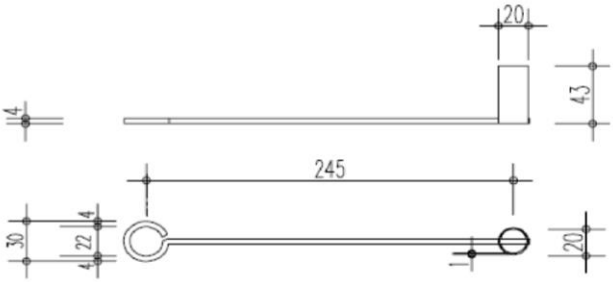


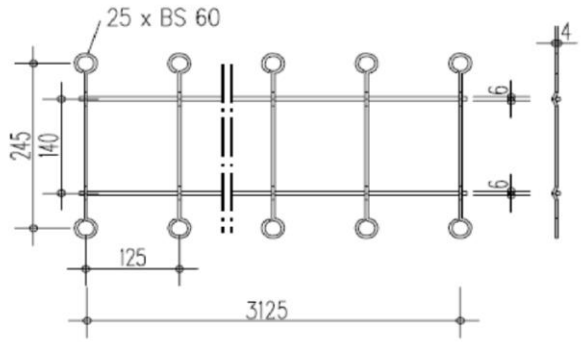
BS 65



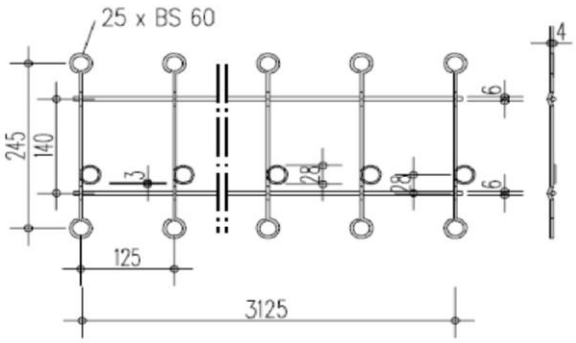
BS 60



BS 64



BS 66

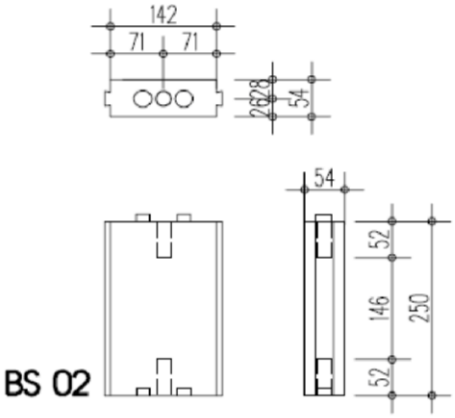


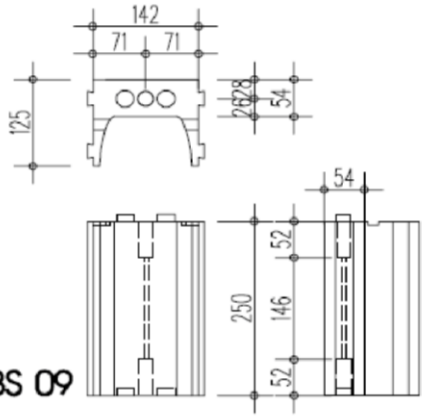
BS 66K

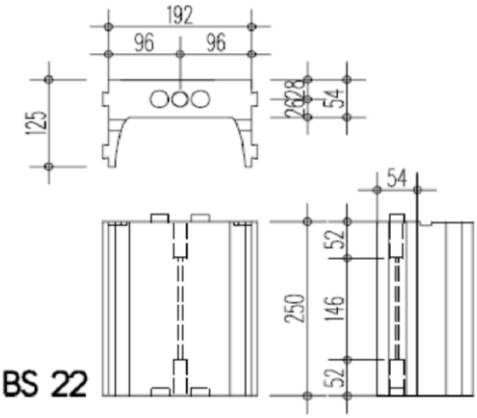
Dimensions in [mm], without scale

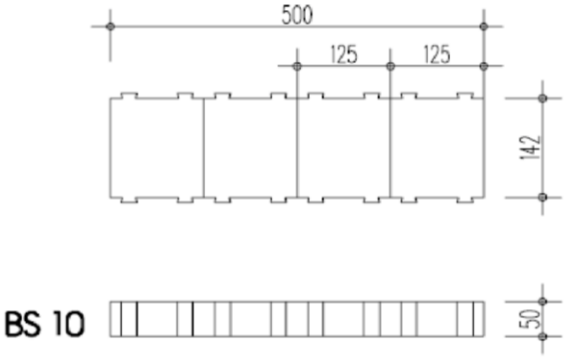
Permanent shuttering kit "DuoTherm"	Annex A12
BS-elements: BS 65 / BS 60 / BS 64 / BS 66 / BS 66K	

Deutsches Institut für Bautechnik DIBt









Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"	Annex A13
BS-elements: BS 02 / BS 09 / BS 10 / BS 22	

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DuoTherm-elements

		142mm core of concrete					192mm core of concrete					annex
	total thickness of wall	**25**	**30**	**40**	**45**	**50**	**30**	**35**	**45**	**50**	**55**	
BS01	standard element	x	x	x	x	x	x	x	x	x	x	A3
BS02	face element	x	x	x	x	x						A13
BS03	outer corner 50/50	x	x	x	x	x	x	x	x	x	x	A6
BS04	outer corner 25/25	x	x	x	x	x	x	x	x	x	x	A6
BS05	internal corner 50/50	x	x	x	x	x	x	x	x	x	x	A6
BS06	internal corner 25/25	x	x	x	x	x	x	x	x	x	x	A6
BS07	levelling element 3,7cm	x	x	x	x	x	x	x	x	x	x	A3
BS08	levelling element 12,5cm	x	x	x	x	x	x	x	x	x	x	A3
BS09	end element	x	x	x	x	x						A13
BS10	lintel element	x	x	x	x	x						A13
BS11	outer corner 135°	x					x					A7
BS12	outer corner 45°	x					x					A7
BS15	levelling element 7cm	x	x	x	x	x	x	x	x	x	x	A3
BS16	levelling element 5cm	x	x	x	x	x	x	x	x	x	x	A3
BS17	levelling element 7cm		x					x				A4
BS22	end element						x	x	x	x	x	A13
BS25	internal corner 45/45	x	x	x	x	x	x	x	x	x	x	A8
BS26	internal corner 20/20	x	x	x	x	x	x	x	x	x	x	A8
BS40	standard element		x					x				A4
BS41	outer corner 50/50		x					x				A9
BS42	outer corner 25/25		x					x				A9
BS43	levelling element 12,5cm		x					x				A4
BS44	outer corner 45°		x					x				A10
BS45	outer corner 135°		x					x				A10
BS46	internal corner 90°/external		x					x				A9
BS47	standard element			x					x			A5
BS48	standard element				x					x		A5
BS49	standard element					x					x	A5
BS50	anchor tube	x	x	x	x	x	x	x	x	x	x	A11
BS51	standard element	x	x	x	x	x						A11
BS57	reinforcing wire mesh 3,125m	x	x	x	x	x						A11
BS57K	reinforcing wire mesh 3,125m f. basement	x	x	x	x	x						A11
BS58	bottom anchor	x	x	x	x	x						A11
BS59	ceiling anchor	x	x	x	x	x						A11
BS60	standard element						x	x	x	x	x	A12
BS64	ceiling anchor						x	x	x	x	x	A12
BS65	bottom anchor						x	x	x	x	x	A12
BS66	reinforcing wire mesh 3,125m						x	x	x	x	x	A12
BS66K	reinforcing wire mesh 3,125m f. basement						x	x	x	x	x	A12

Permanent shuttering kit "DuoTherm"

Overview:
BS-elements

Annex A14

Deutsches Institut für Bautechnik DIBt

Installation

1 General

The manufacturer shall ensure that the requirements in accordance with clauses 1 and 3 of the "Special Part" of this ETA 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. If the manufacturer's instructions contain provisions which differ from those stated here, the specifications of the ETA shall apply.

After installation of the shuttering elements (see 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] 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 is shown in Annex B13.

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

The design values of thermal resistance respectively the design values of thermal conductivity (see 3.6.1) shall be laid down according to the relevant national provisions.

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 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 manufacturer.

Afterwards levelling to the subsoil is performed (foundation, bottom, ground floor and ceiling). Voids between the 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 B12).

The push pull props shall be arranged with a maximum distance of 1,50 m to be connected over the entire wall height with the shuttering elements and to be fastened to the floor.

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 shall be formed according to Annex B4. Wall connections (T-walls) shall be formed according to Annex B5. Typical junctions and constructions between walls and ceilings are to be formed according to Annexes B6 to B11.

Further information is given in the installation guide.

3 Concreting

For the production of normal concrete EN 206 shall apply. The consistency of concrete shall be within the lower consistency range F3 when compacted by vibration and 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.

The maximum filling height amounts to 0,75 m at a concreting velocity of 1 m/h.

[1] see ETAG 009 clause 2.2

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 connection reinforcement bars shall be installed. The connection reinforcement bars shall meet the following requirements:

- Two adjacent connection reinforcement bars shall not be situated in the same plane parallel to the surface of the wall.
- The distance between two connection reinforcement bars in wall direction shall be at least 10 cm and not larger than 50 cm.
- The total section area of the connection reinforcement bars shall not be less than 1/2000 of the section area of the concrete.
- Anchorage length of the connection reinforcement 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 joints are provided, concreting in layers may only be interrupted as long as the last layer has not yet been solidified and thus a good and uniform bond between the two concrete layers is possible. If internal vibrators are used, care must be taken that the vibratory bottle can still penetrate into the lower, already compacted concrete layer.

The concrete shall fall freely only up to a height of 2 m. From this height, it must be held together by means of conductor pipes or concreting hoses with a maximum diameter of 100 mm and brought up just before the filling point.

The formation of concrete hills is to be avoided by selecting small distances between the filling points.

During the planning, sufficient spaces must be provided in the reinforcement for conductor pipes or concreting hoses.

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

Prefabricated ceilings shall only be placed on walls made with shuttering elements when the concrete core has sufficiently hardened.

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

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

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"

Instructions for determining the declared values of the thermal resistance under end use conditions

The declared value of the thermal resistance of the shuttering leafs off EPS $R_{D,EPS}$ is determined in accordance with EN ISO 6946. For the declared value of the thermal conductivity of the EPS λ_{EPS}, the values according to section 3.6.1 should be used, depending on the material used (white or gray). The thermal conductivity of the concrete $\lambda_{concrete}$ shall be taken from EN ISO 10456, Tabel 3. The density of the used concrete shall be taken into account.

Taking into account the inhomogeneity possible for the system "DuoTherm" (higher thermal conductivity of the wire spacers (see Annexes A11 and A12) than the concrete) the thermal resistance is reduced.

In following Tables, these declared values of the thermal resistance of the concrete walls are given for a concrete core without reinforcement with a density of ρ = 2200 kg/m³. The corresponding thermal conductivity according to EN ISO 10456, Table 3 for this concrete is $\lambda_{concrete,\ table}$ = 1,65 W/(m K). The plaster was disregarded in these calculations. Table 1 contains the values for EPS material white and Table 2 for EPS material gray.

Table 1: Declared value of the thermal resistance $R_{D,element}$ for shuttering elements off **EPS material white** (see 3.6.1) under end use conditions (concrete core without reinforcement with a density of ρ = 2200 kg/m³ and a corresponding thermal conductivity according to EN ISO 10456, Table 3 of $\lambda_{concrete,\ table}$ = 1,65 W/(m K)), without plaster) in dependence of the thickness of the outer shuttering leaf.

Type	**Thickness of wall**	**Thickness of concrete core**	**Thickness of EPS shuttering leafs**		**Declared value of thermal resistance R_D according to EN ISO 6946 considering the spacers of steel**
			inner	**outer**	
	[mm]	[mm]	[mm]	[mm]	[(m²×K)/W]
25-es wall	250	142	54	54	2,70
30-es wall	300	142	54	104	4,13
40-es wall	400	142	54	204	6,99
50-es wall	500	142	54	304	9,85
30/1-st wall	300	192	54	54	2,73
35/1-st wall	350	192	54	104	4,16
45/1-st wall	450	192	54	204	7,02
55/1-st wall	550	192	54	304	9,88

Table 2: Declared value of the thermal resistance $R_{D,element}$ for shuttering elements off **EPS material gray** (see 3.6.1) under end use conditions (concrete core without reinforcement with a density of ρ = 2200 kg/m³ and a corresponding thermal conductivity according to EN ISO 10456, Table 3 of $\lambda_{concrete,\ table}$ = 1,65 W/(m K)), without plaster) in dependence of the thickness of the outer shuttering leaf.

Type	**Thickness of wall**	**Thickness of concrete core**	**Thickness of EPS shuttering leafs**		**Declared value of thermal resistance R_D according to EN ISO 6946 considering the spacers of steel**
			inner	**outer**	
	[mm]	[mm]	[mm]	[mm]	[(m²×K)/W]
25-es wall	250	142	54	54	3,22
30-es wall	300	142	54	104	4,79
40-es wall	400	142	54	204	7,92
50-es wall	500	142	54	304	11,05
30/1-st wall	300	192	54	54	3,25
35/1-st wall	350	192	54	104	4,81
45/1-st wall	450	192	54	204	7,93
55/1-st wall	550	192	54	304	11,06

For other densities of the concrete core than $\rho_{concrete,\ tabel}$ = 2200 kg/m³, the modified nominal value of the thermal resistance can be determined as follows:

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

If the thermal conductivity of the inner plaster $\lambda_{plaster,\ inside}$ and of the outer plaster $\lambda_{plaster,\ outside}$ are known, the thermal resistance of the finished wall, taking into account the plasters, can be determined as follows:

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

Wherever relevant, the designer shall consider the thermal bridges (e.g. metal accessories that pierce the insulation) to determine the thermal resistance of the wall.

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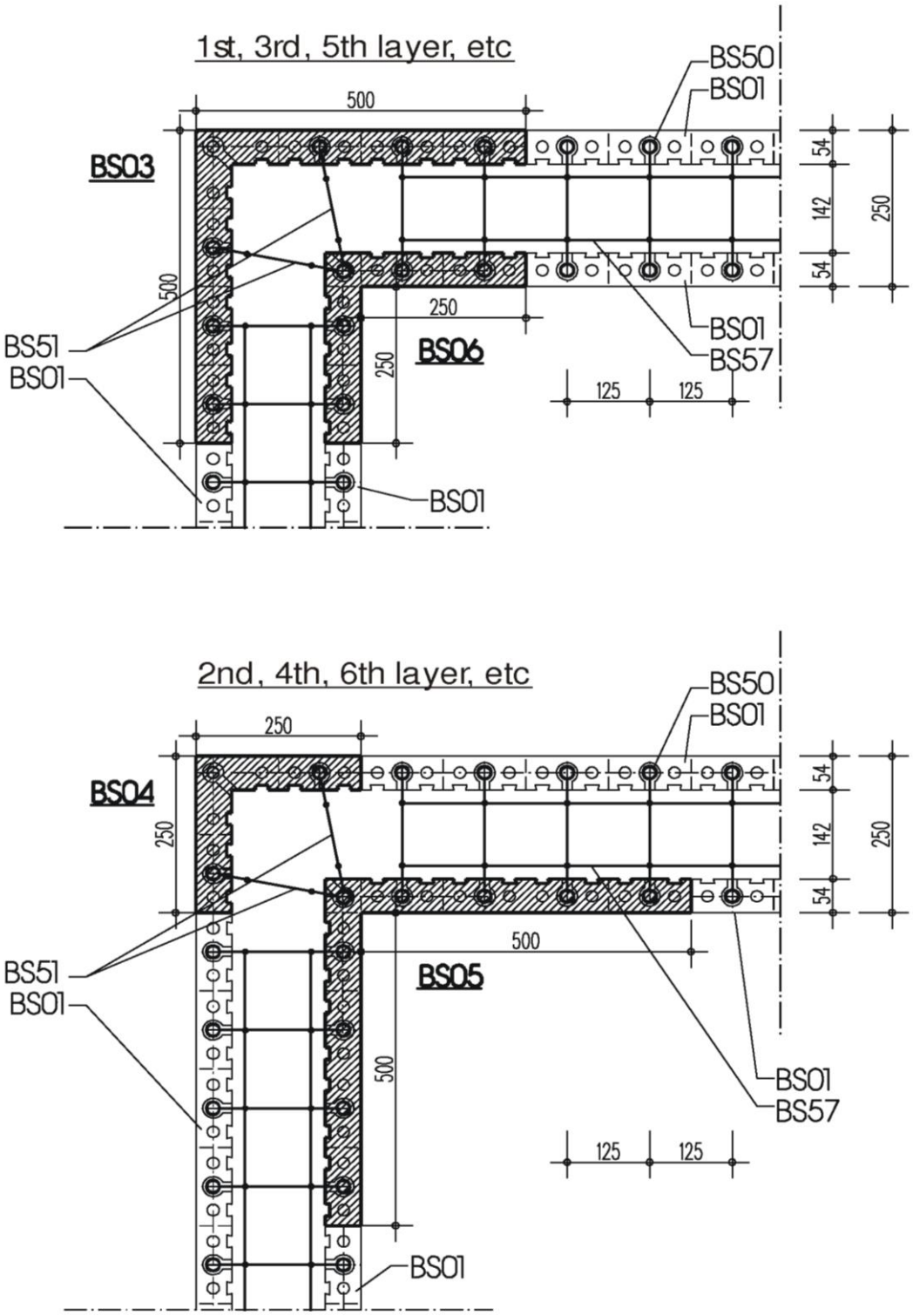

Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"	Annex B4
Outer corner of walls: T-wall with grid sectioning	

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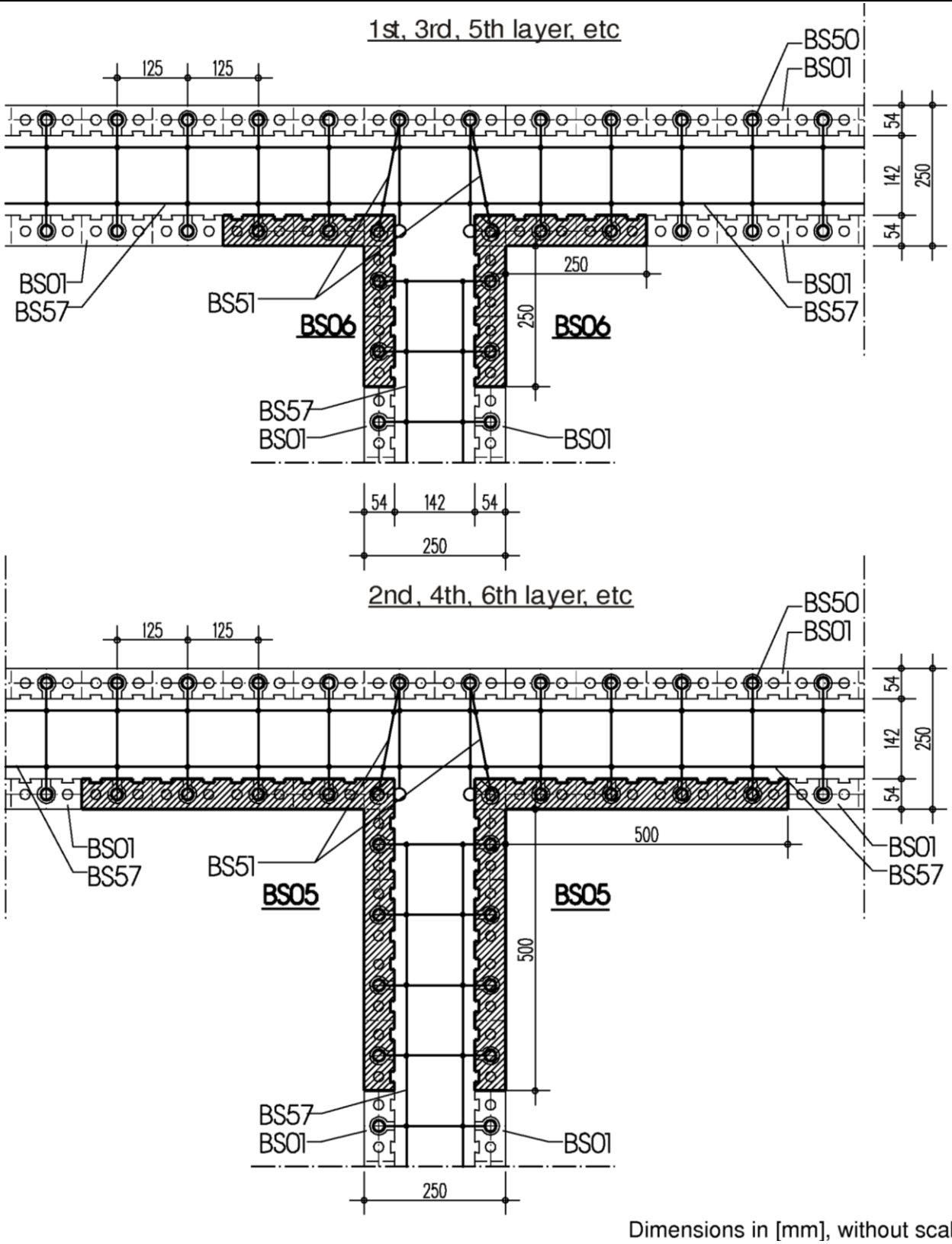
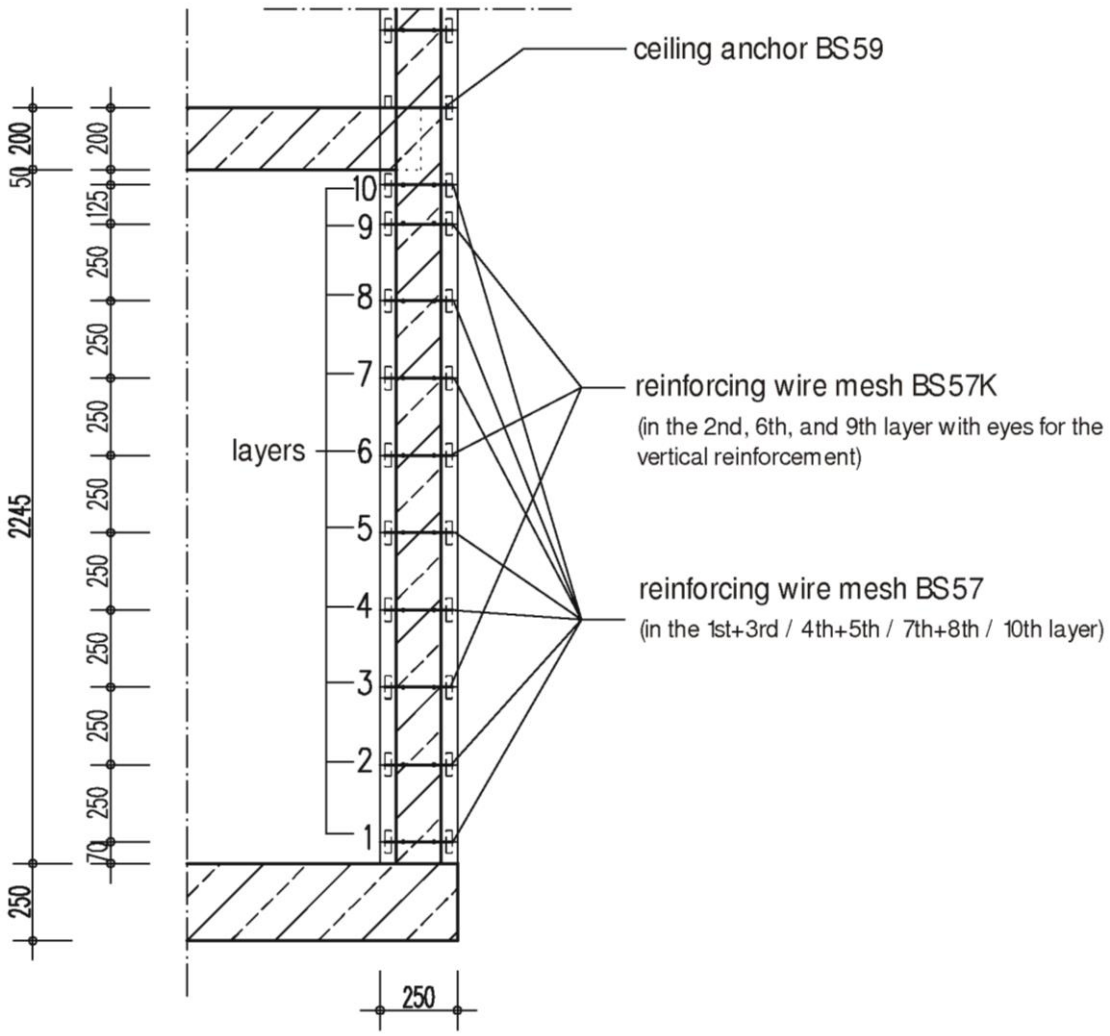


Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"	Annex B5
T-walls: T-wall with grid sectioning	



Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"	Annex B6
Typical junction: Cellar (basement) wall construction with arrangement of reinforcement	

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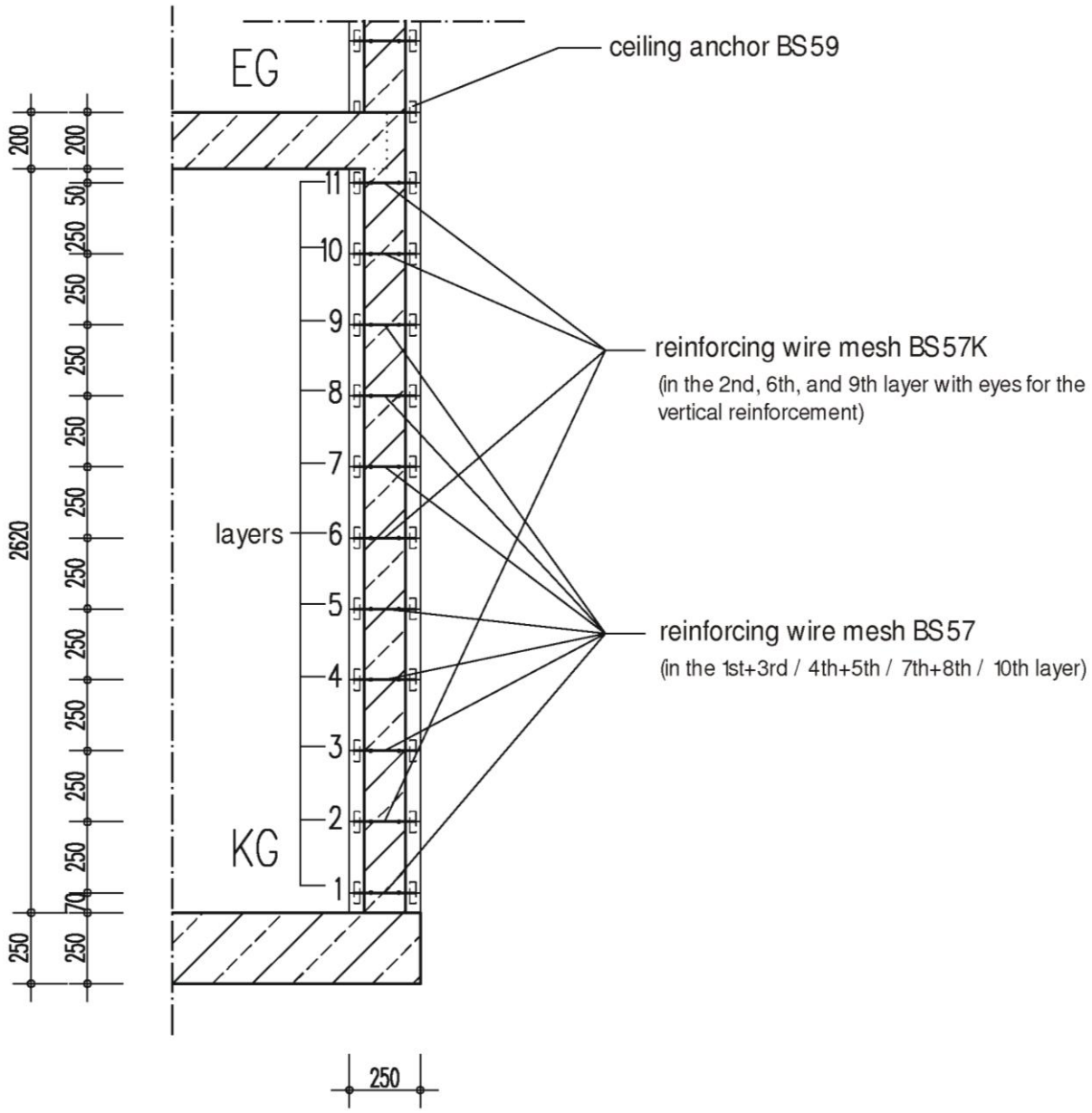

Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"	Annex B7
Typical junction: Cellar (basement) wall construction with arrangement of reinforcement	

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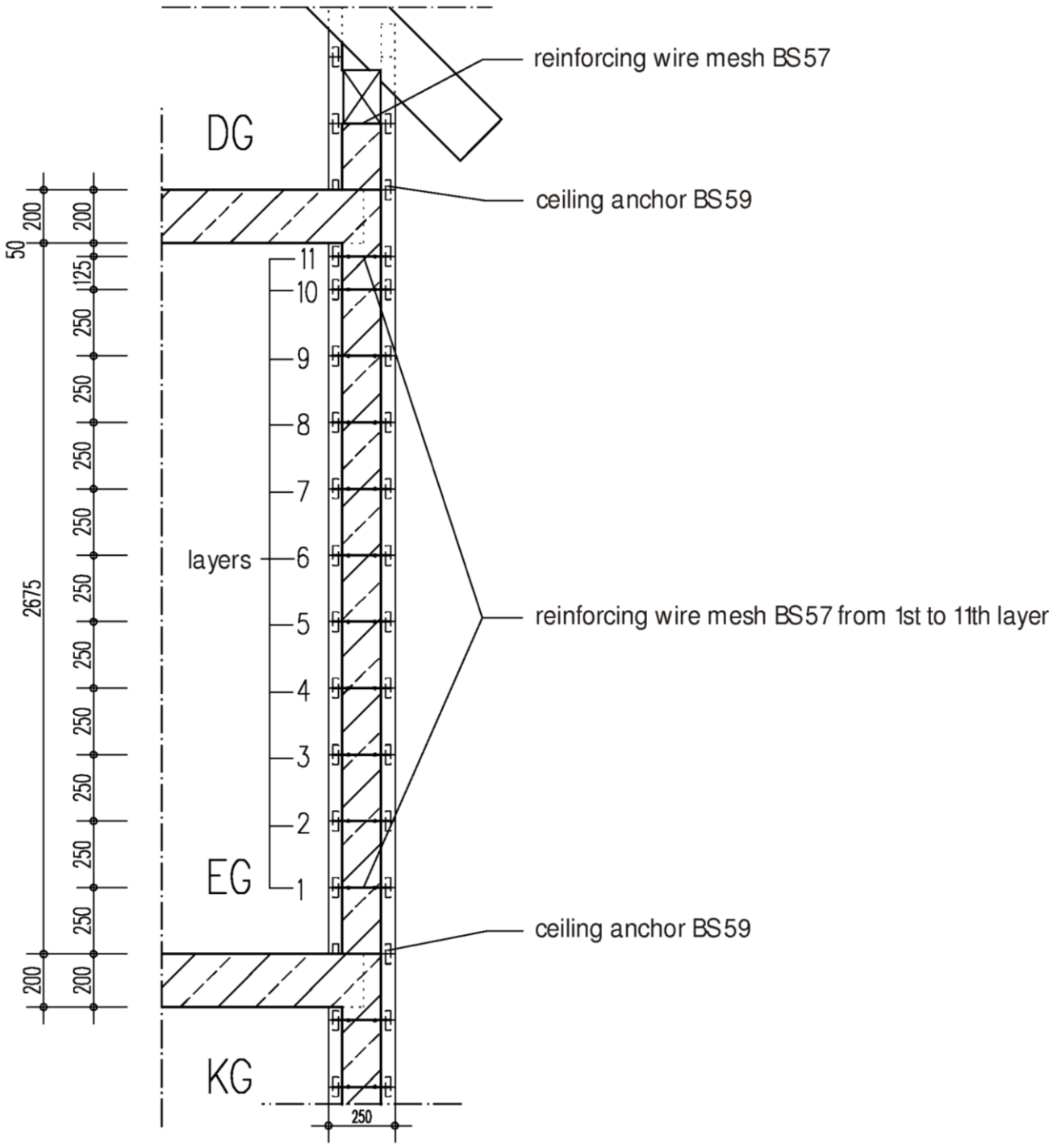

Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"	Annex B8
Typical construction: Cellar (basement) / ground floor) / top floor with grid sectioning	

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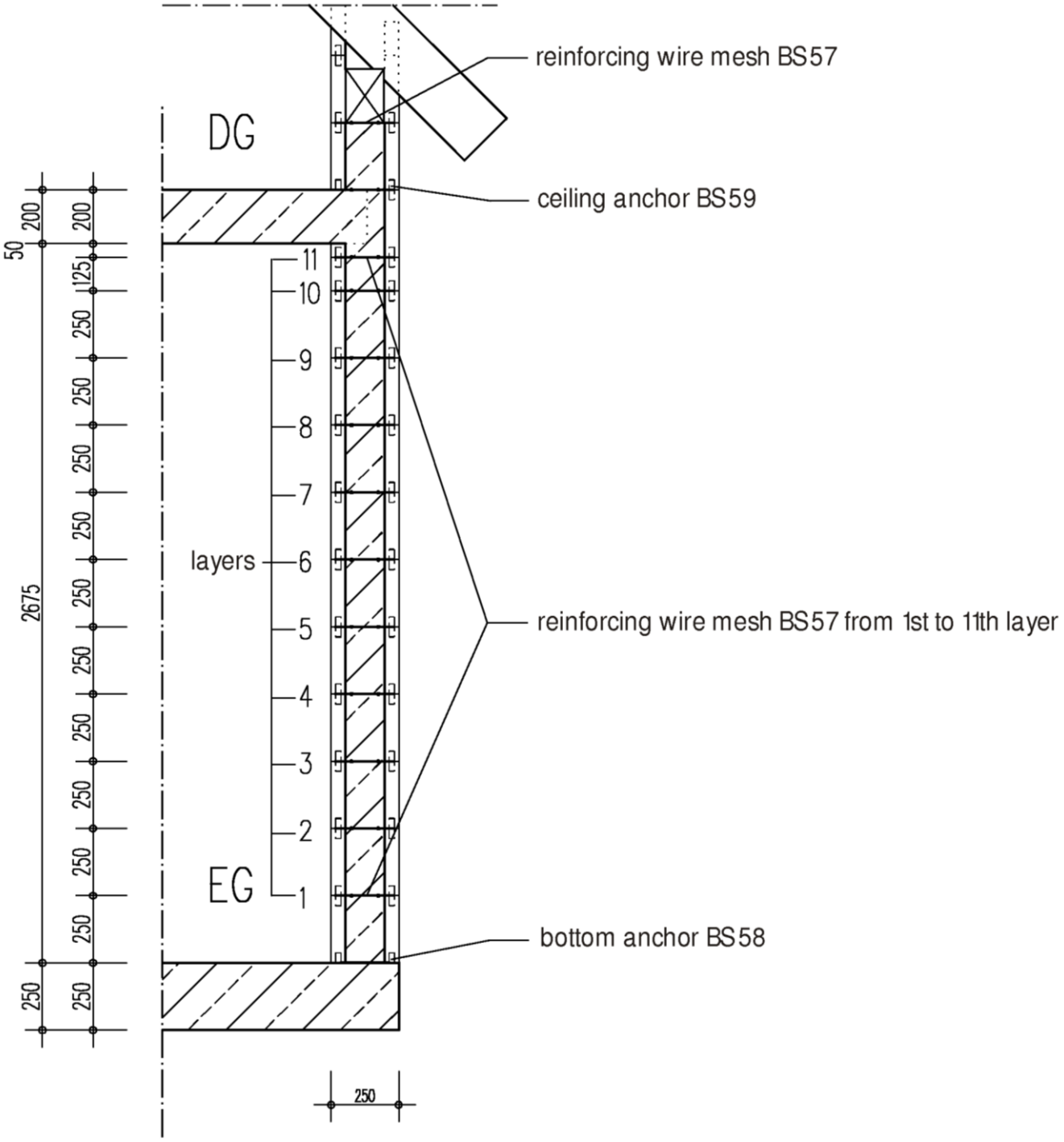

Permanent shuttering kit "DuoTherm"	Annex B9
Typical construction: Ground floor / top floor with grid sectioning	

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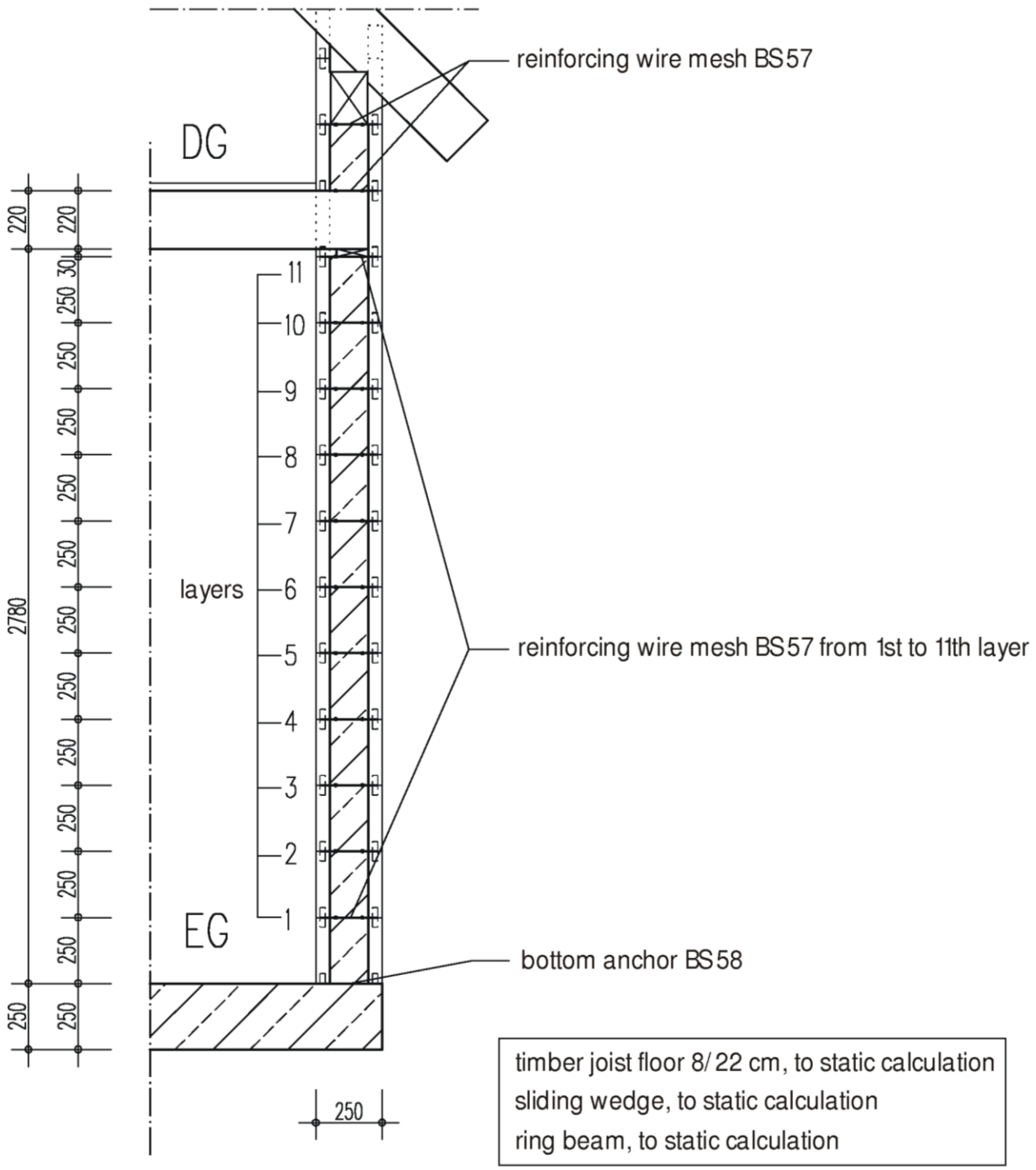

Permanent shuttering kit "DuoTherm"	Annex B10
Typical construction: Timber joist floor between ground floor and top floor with grid sectioning	

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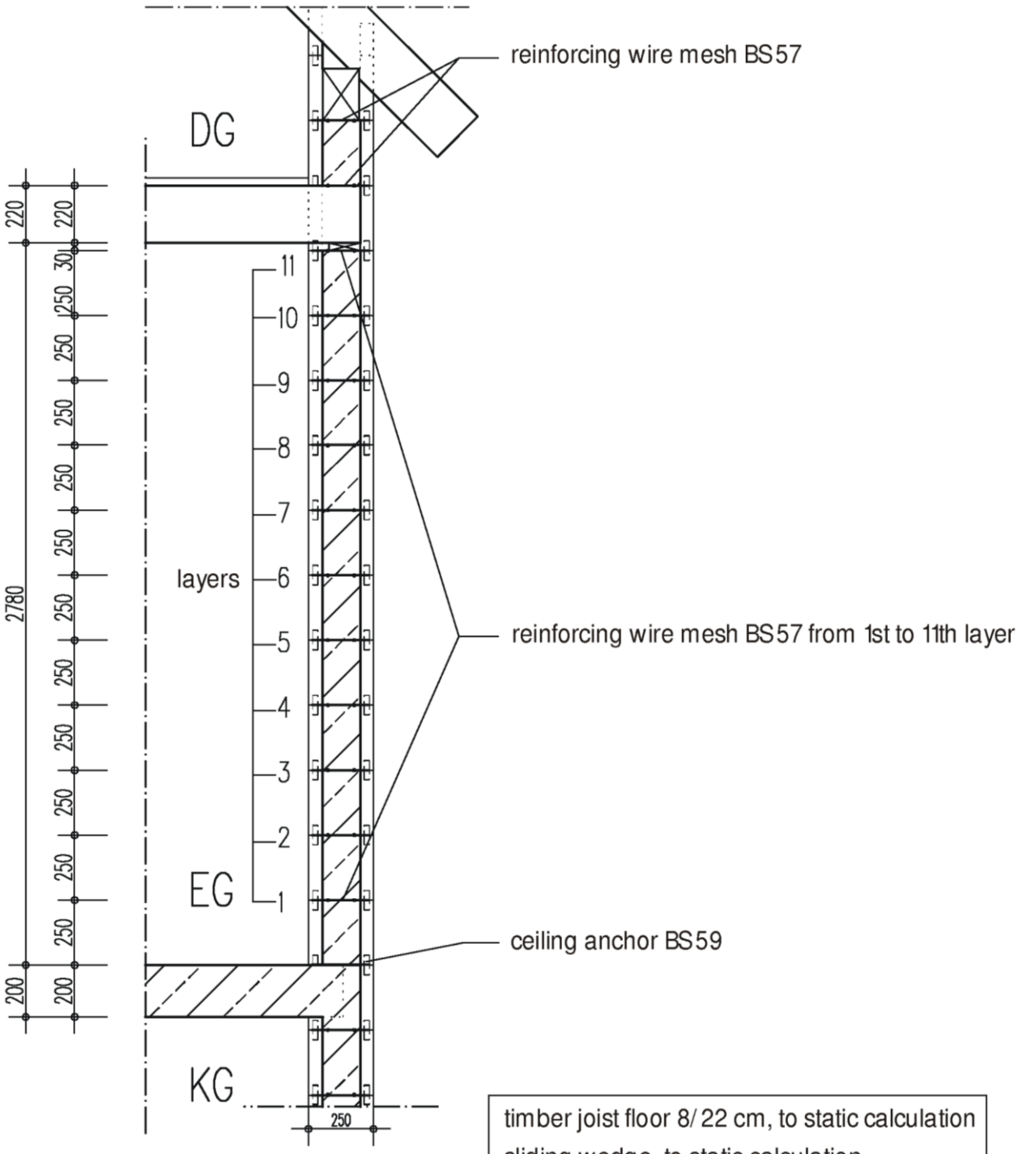

timber joist floor 8/22 cm, to static calculation
sliding wedge, to static calculation
ring beam, to static calculation

Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"	Annex B11
Typical construction: Cellar and timber joist floor between ground floor and top floor with grid sectioning	

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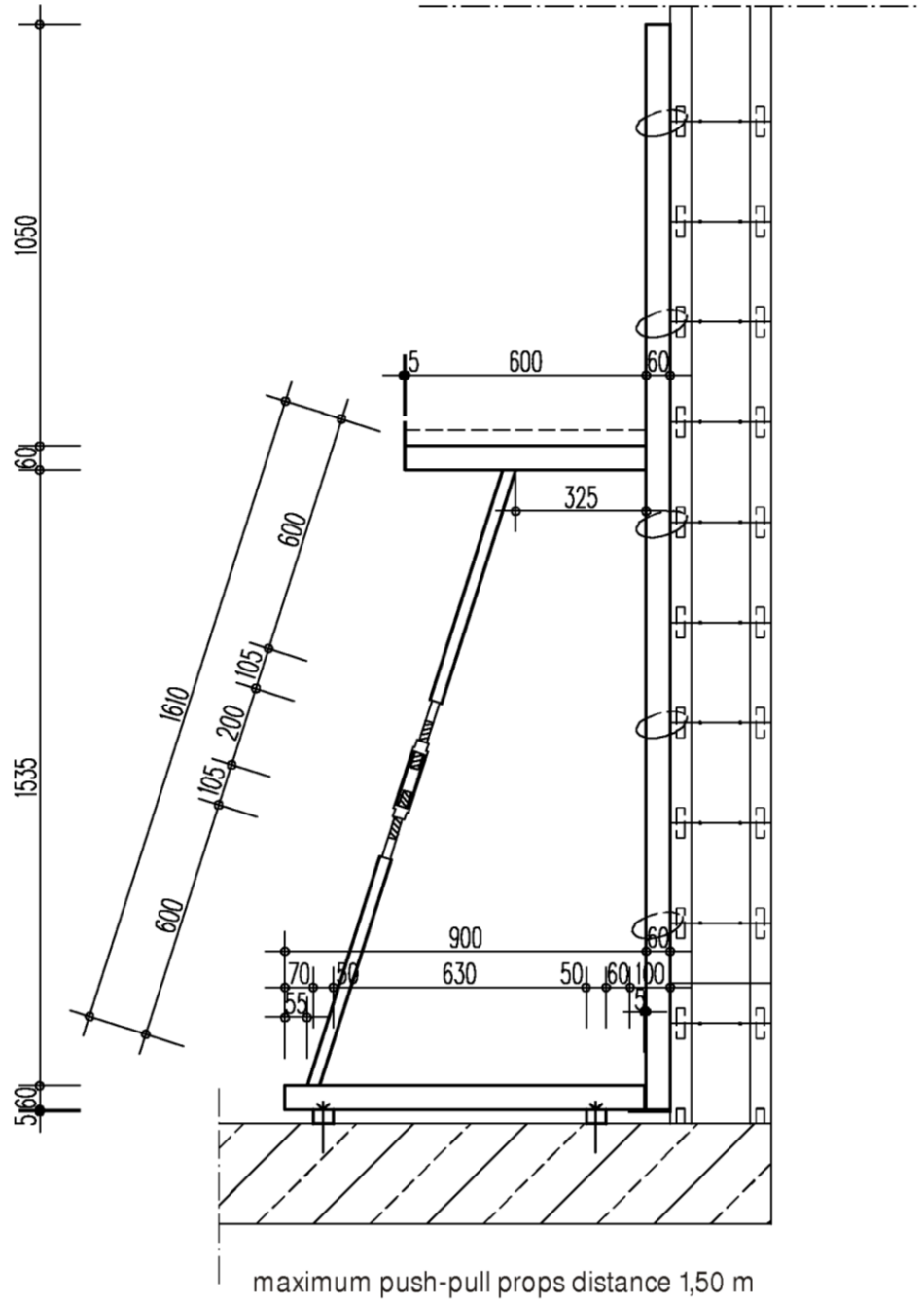

Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"	Annex B12
Mounted push-pull props	

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Type	according Annex	Thickness of the wall	Thickness of concrete core	Area of concrete core in plan view/ per meter wall length	Assumed weight of shuttering elements without rendering γ_{EPS} = 0,3 KN/m²	Assumed weight of the wall with concrete core without rendering $\gamma_{concrete}$ = 25 KN/m²	Area of horizontal frame A_R
		[mm]	[mm]	[m²/m]	[kg/m²]	[kg/m²]	[mm²]
25-es	1	250	142	0,1445	3,24	358	./.
30-es		300	142	0,1445	4,74	360	./.
40-es		400	142	0,1445	7,74	363	./.
45-es		450	142	0,1445	9,24	364	./.
52-es		500	142	0,1445	10,74	366	./.
30/1-st		300	192	0,1945	3,24	483	./.
35/1-st		350	192	0,1945	4,74	485	./.
45/1-st		450	192	0,1945	7,74	488	./.
50/1-st		500	192	0,1945	9,24	489	./.
55/1-st		550	192	0,1945	10,74	491	./.

Permanent shuttering kit "DuoTherm"	Annex B13
Standard shuttering elements Dimensions and weights	