

Approval body for construction products
and types of construction

Bautechnisches Prüfamt

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European Technical Assessment

ETA-07/0235
of 12 December 2017

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

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

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

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

This version replaces

ETA-07/0235 issued on 7 December 2012

European Technical Assessment

ETA-07/0235

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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 external load-bearing walls as well as for internal load-bearing 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 and 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 formwork 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, BS51 in Annex A11 as well as BS 60 in Annex A12.

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 9),
- 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 BS58, BS59 in Annex A11 and 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 no direct contact to (e. g. covered products) but possible impact on indoor air.
- Category S/W 3: Product with no contact to and no impact on soil water, ground- and surface water.

The 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 references 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 satisfactorily.

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 satisfactorily.

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 satisfactorily.

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 assessability 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 in lack of availability of EN 1992-1-1 according national design rules, lead to the assumption that concrete core insures an adequate resistance of the complete wall under normal used impact loads.

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

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 satisfactorily.

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 satisfactorily.

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 resistance

The nominal value of thermal resistance R_D of the shuttering elements in end use conditions (see Table 1, with concrete core without rendering) is the sum of the nominal value of thermal resistance of the shuttering leafs $R_{D,EPS}$ and the concrete core $R_{D,concrete}$. The nominal value of thermal resistance of the shuttering leafs $R_{D,EPS}$ shall be calculated in accordance with EN ISO 6946 with a nominal value of thermal conductivity of the shuttering leafs of $\lambda = 0,035 \text{ W/(m}\times\text{K)}$ according to EN 13163, clause 4.2.1 and the nominal value of thermal resistance of the concrete core $R_{D,concrete}$ shall be calculated in accordance with EN ISO 6946 with a nominal value of thermal conductivity of the concrete core of $\lambda = 1,65 \text{ W/(m}\times\text{K)}$ and considering the influence of the steel spacers by a reduction factor, see Table 3, according to the influence of the thickness of the shuttering elements.

Table 1: Nominal values of thermal resistance R_D (calculated with concrete core without rendering but with influence of steel spacers) depending on the thickness of the outer shuttering leafs, the thickness of concrete core and the reduction factor

| Type | Thickness of the wall [mm] | Thickness of concrete core [mm] | Thickness of shuttering leafs | | Nominal value of thermal resistance R_D without spacers according to EN ISO 6946 [(m ² ·K)/W] | Reduction factor |
|--------------|-------------------------------|------------------------------------|-------------------------------|---------------|---|------------------|
| | | | inner [mm] | outer [mm] | | |
| 25-es Wall | 250 | 142 | 54 | 54 | 2,70 | 0,930 |
| 30-es Wall | 300 | 142 | 54 | 104 | 4,13 | 0,955 |
| 40-es Wall | 400 | 142 | 54 | 204 | 6,99 | 0,970 |
| 50-es Wall | 500 | 142 | 54 | 304 | 9,85 | 0,970 |
| 30/1-st Wall | 300 | 192 | 54 | 54 | 2,73 | 0,930 |
| 35/1-st Wall | 350 | 192 | 54 | 104 | 4,16 | 0,955 |
| 45/1-st Wall | 450 | 192 | 54 | 204 | 7,02 | 0,970 |
| 55/1-st Wall | 550 | 192 | 54 | 304 | 9,88 | 0,970 |

The planner shall consider the metal parts of the system (see Annexes A11 und A12) as thermal bridges, where relevant, for determination of the nominal value of thermal resistance R_D .

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 satisfactorily.

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 satisfactorily.

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 satisfactorily.

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 in lack of availability of EN 1992-1-1 according national design rules, lead to the assumption that concrete core insures an adequate resistance of the complete wall under normal use impact loads.

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

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 satisfactorily.

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 satisfactorily.

4 Assessment and verification of 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 12 December 2017 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

beglaubigt:
Dr.-Ing. Alex

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 leaves of expanded polystyrene (EPS shuttering leaves),
- 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 leaves (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 leaves are one-layered and 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 leaves | | | 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 |

Permanent shuttering kit "DuoTherm"

Characteristics of shuttering kit

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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, BS51 in Annex A11 as well as BS 60 in Annex A12.

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 clause 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 9),
- 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).

Permanent shuttering kit "DuoTherm"

Characteristics of shuttering kit

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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 BS58, BS59 in Annex A11 and BS64, BS65 in Annex A12) with or without metal tubes and
- reinforcing wire meshes (see BS57, BS57K in Annex A11 and BS66, BS66K in Annex A12). In addition, marks are provided on the surface of the standard Formierungswandungen 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.

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.

The density ρ of the expanded polystyrene is 29 kg/m³.

The nominal value of thermal conductivity of the expanded polystyrene is 0,035 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.

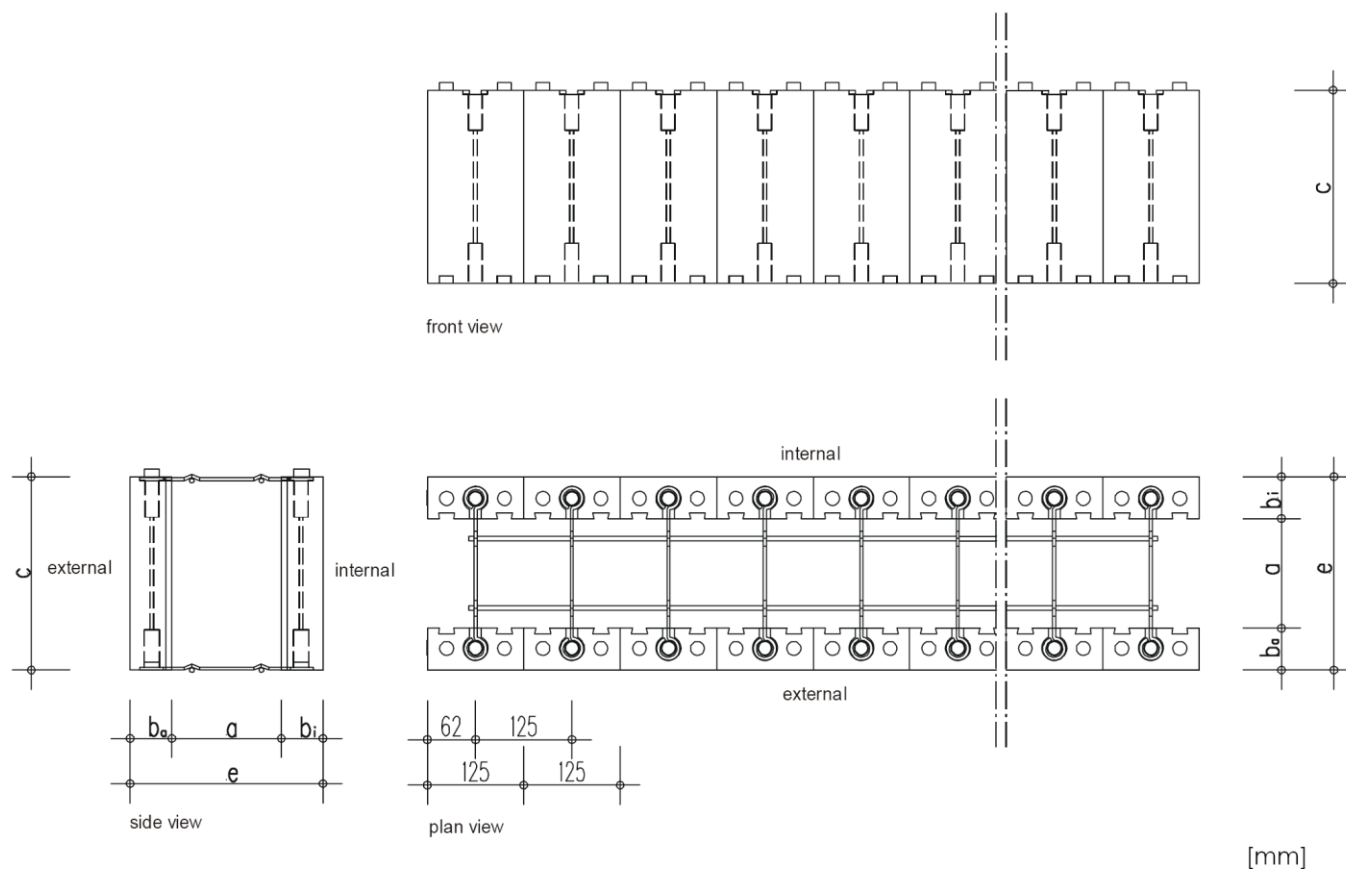
5.2.2 Spacers

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).

Permanent shuttering kit "DuoTherm"

Characteristics of shuttering kit

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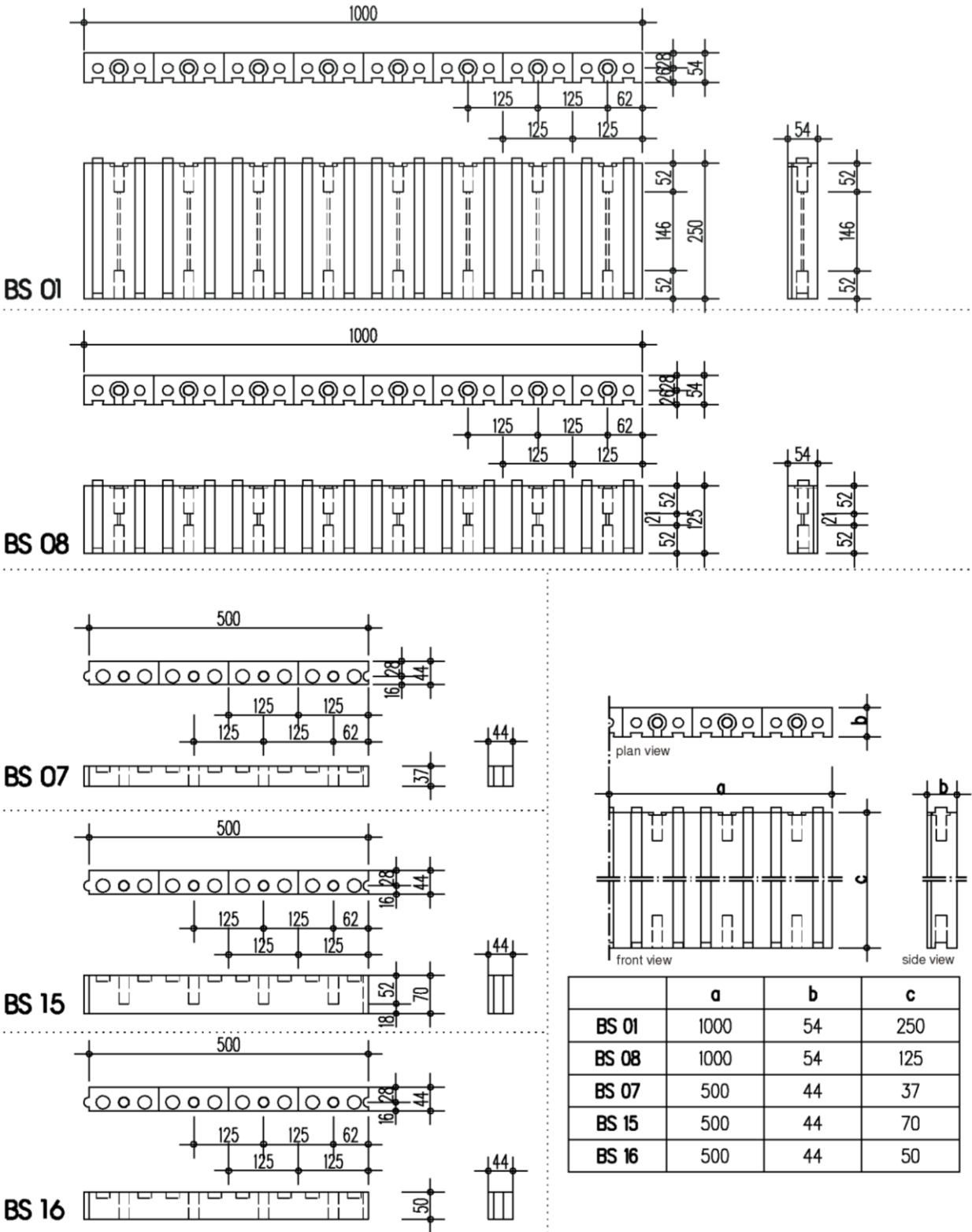
| type | core thickness | EPS thickness external | EPS thickness internal | height of the element | wall thickness | BS-element external | BS-element anchor tube | BS-element reinforcing wire mesh | BS-element standard anchor | BS-element internal |
|--------------|----------------|---------------------------|---------------------------|--------------------------|----------------|------------------------|---------------------------|--|----------------------------------|------------------------|
| | 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"

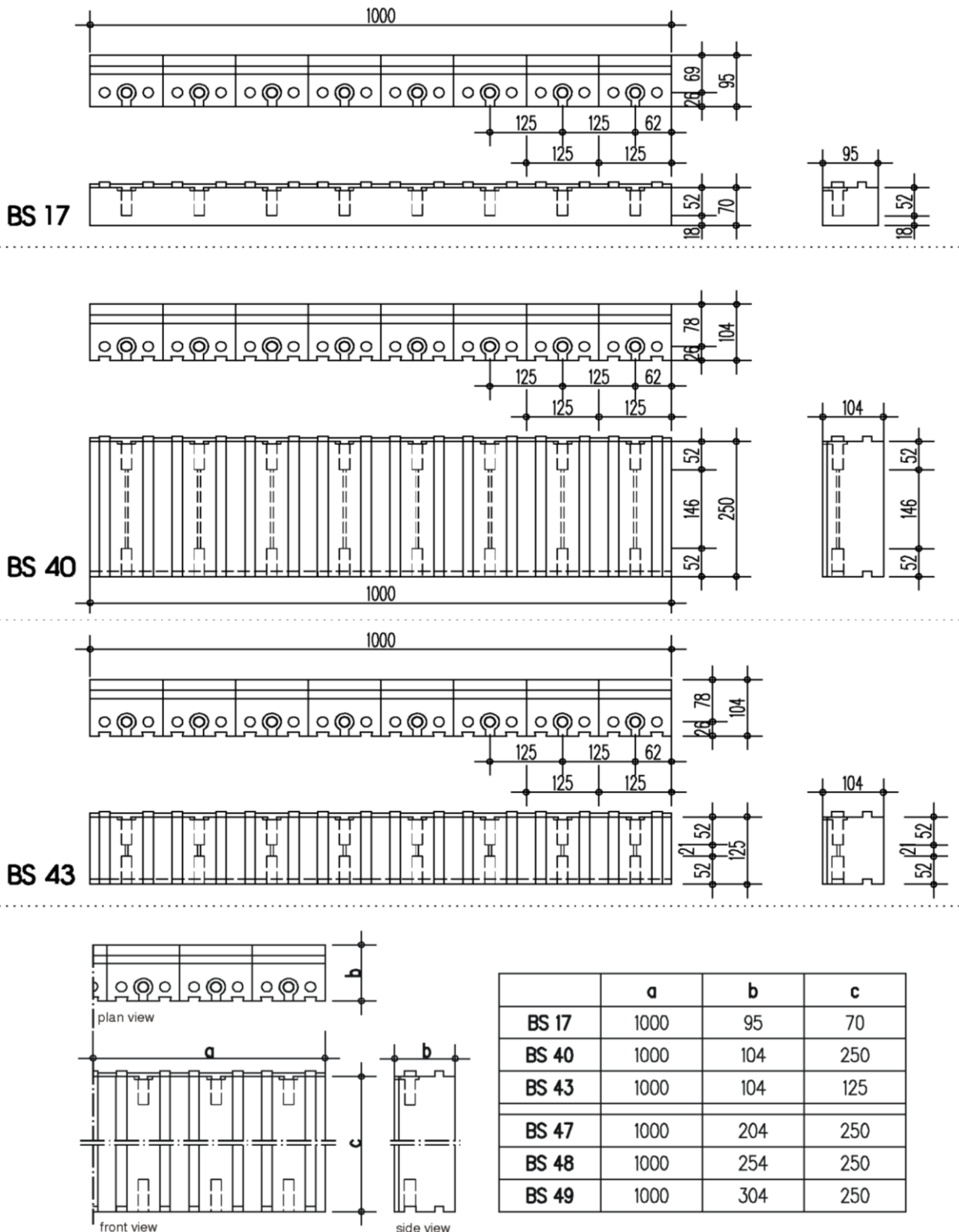
Standard shuttering elements

Annex A2



Dimensions in [mm], without scale

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

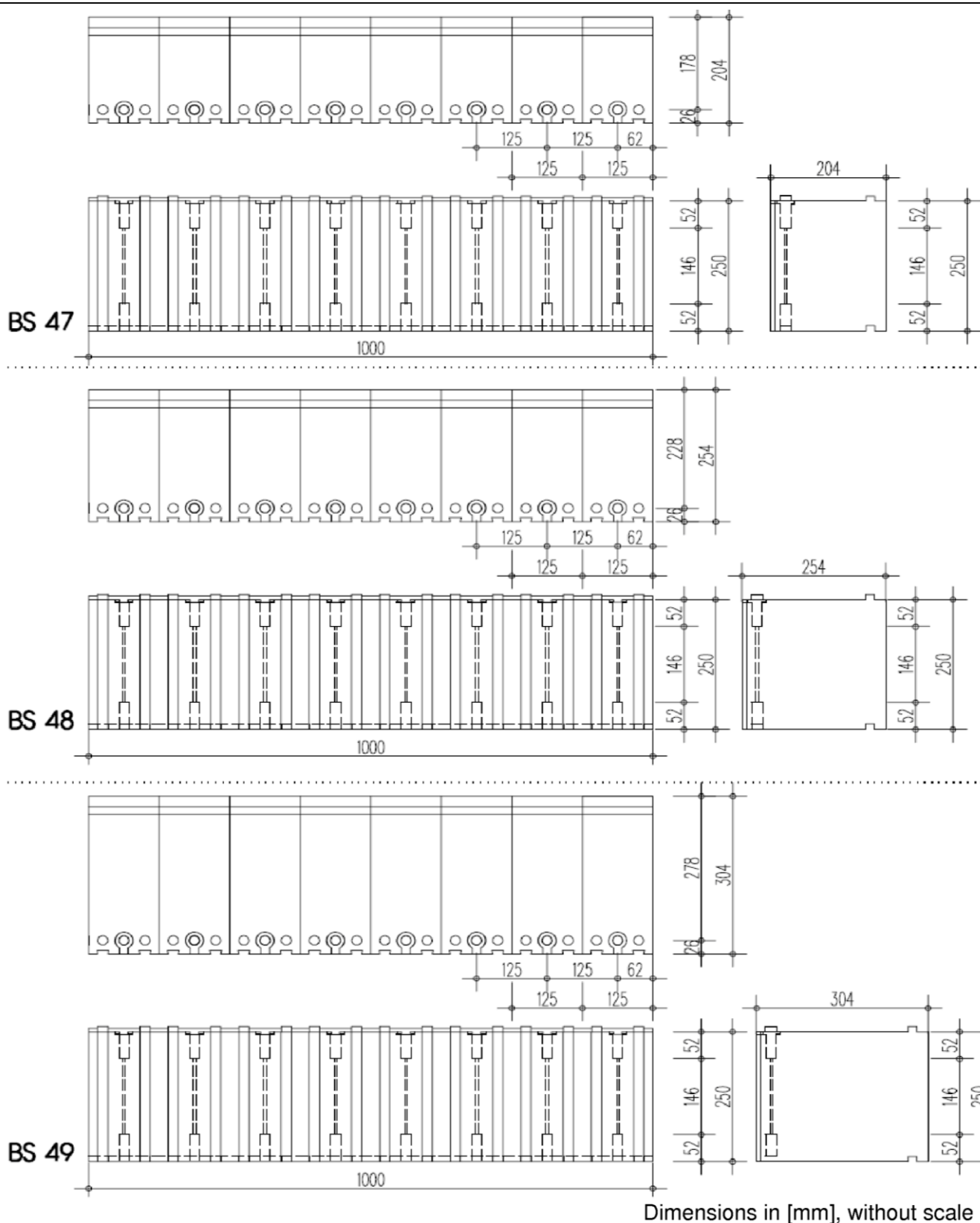


Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"

BS-elements: BS 17 / BS 40 / BS 43

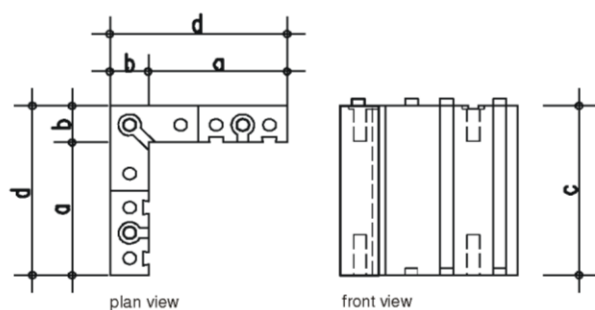
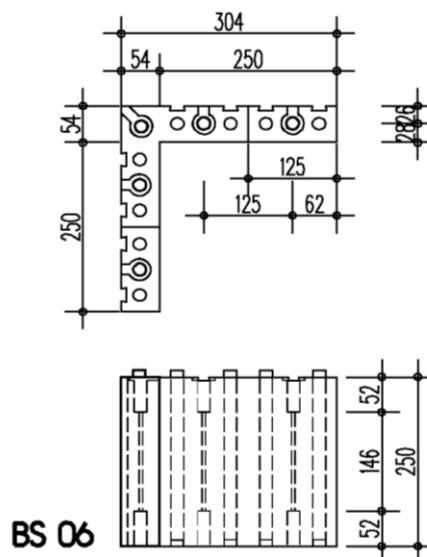
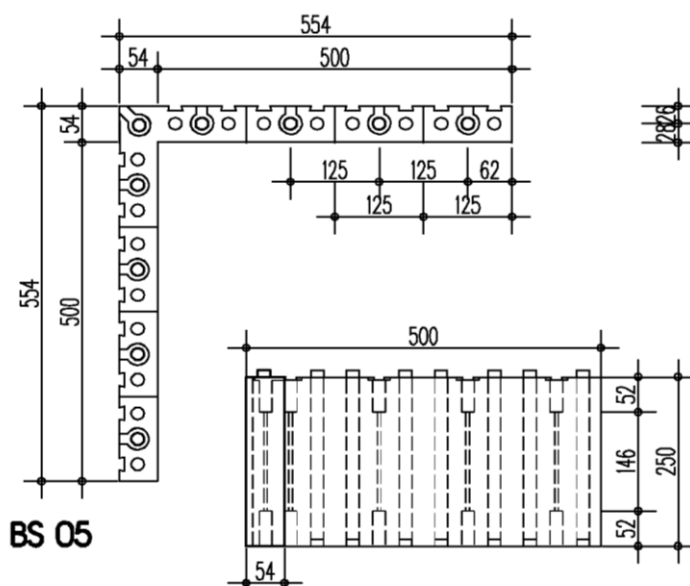
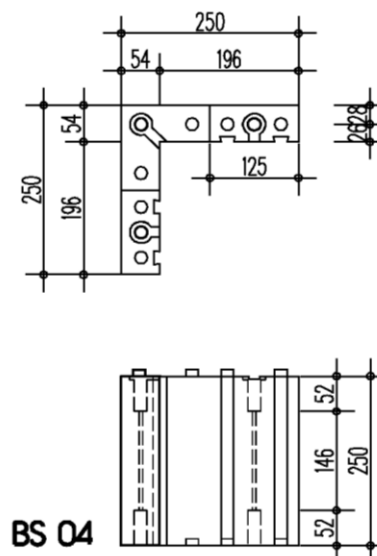
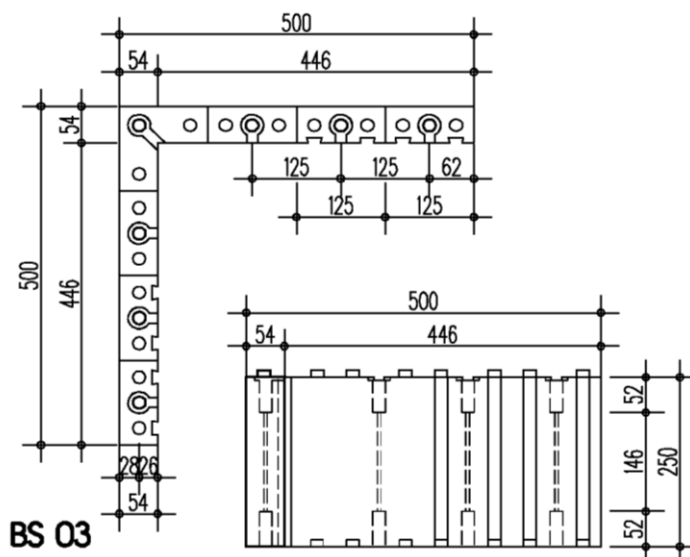
Annex A4



Permanent shuttering kit "DuoTherm"

BS-elements: BS 47 / BS 48 / BS 49

Annex A5



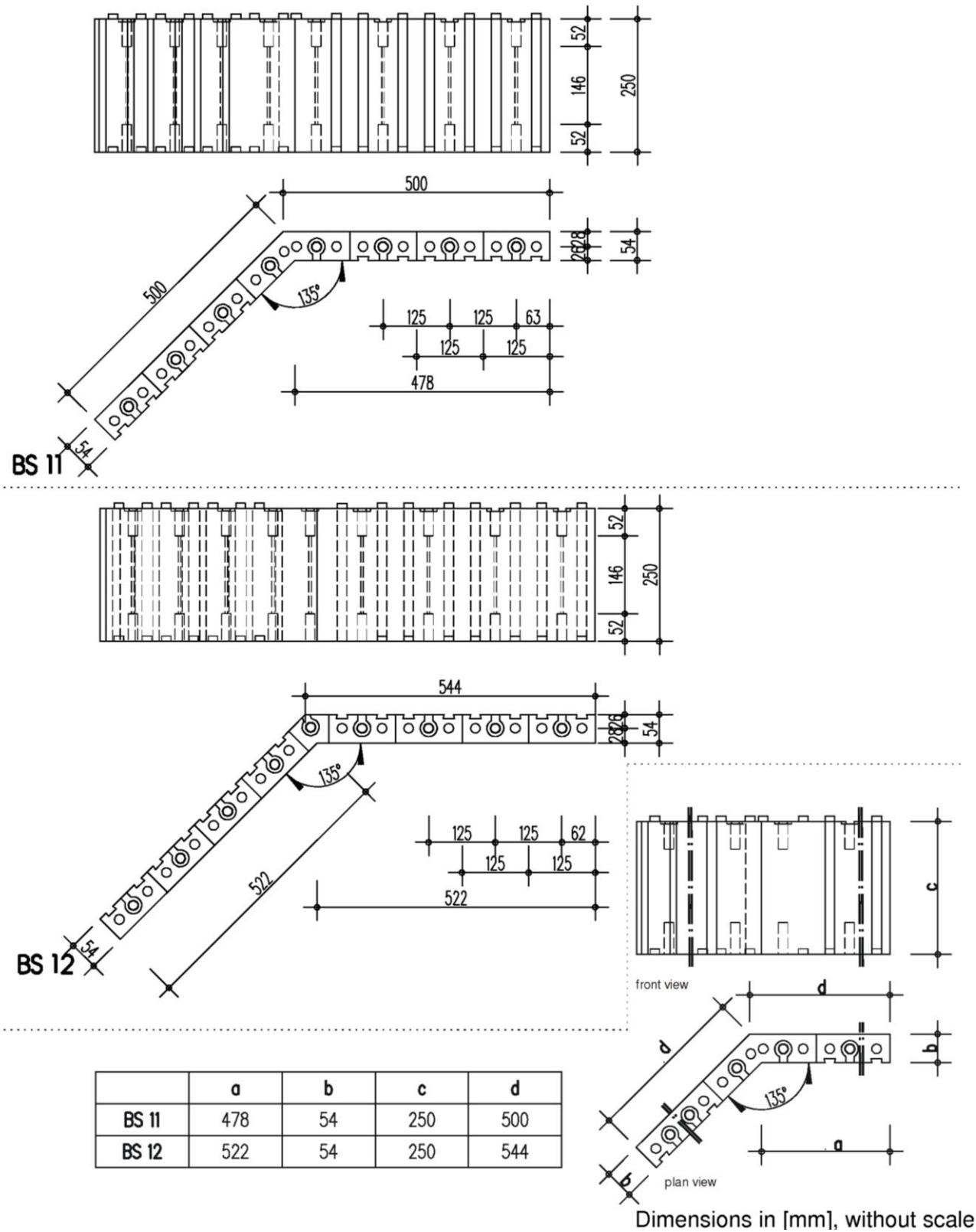
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|-------|-------|----|-----|-------|
| BS 03 | (446) | 54 | 250 | 500 |
| BS 04 | (196) | 54 | 250 | 250 |
| BS 05 | 500 | 54 | 250 | (554) |
| BS 06 | 250 | 54 | 250 | (304) |

Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"

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

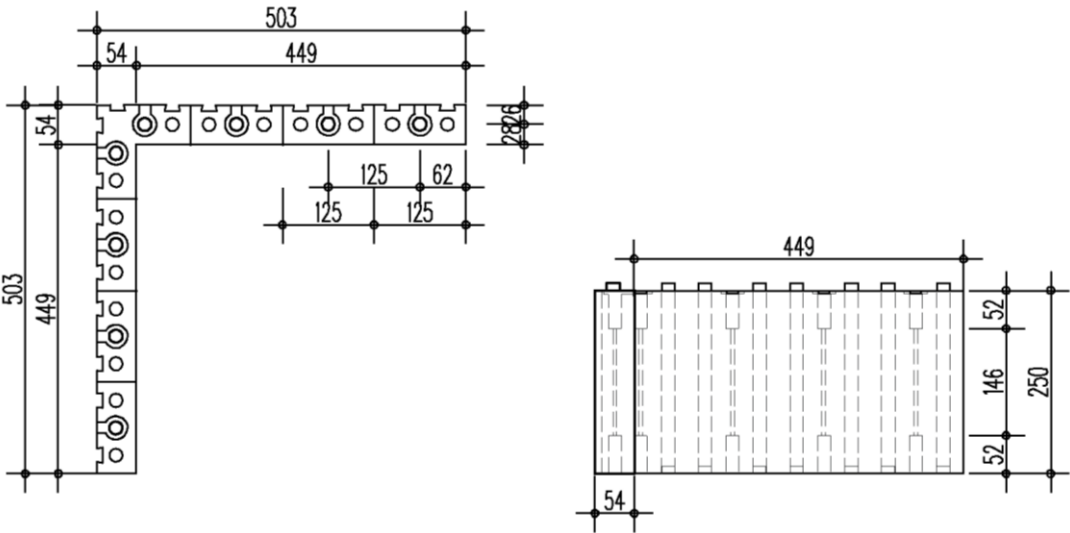
Annex A6



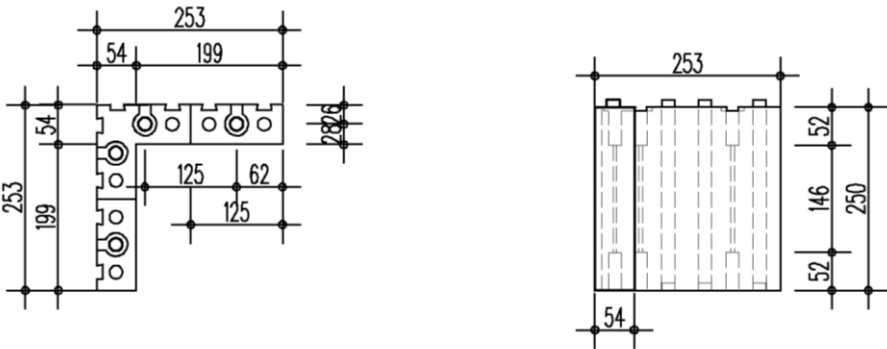
Permanent shuttering kit "DuoTherm"

BS-elements: BS 11 / BS 12

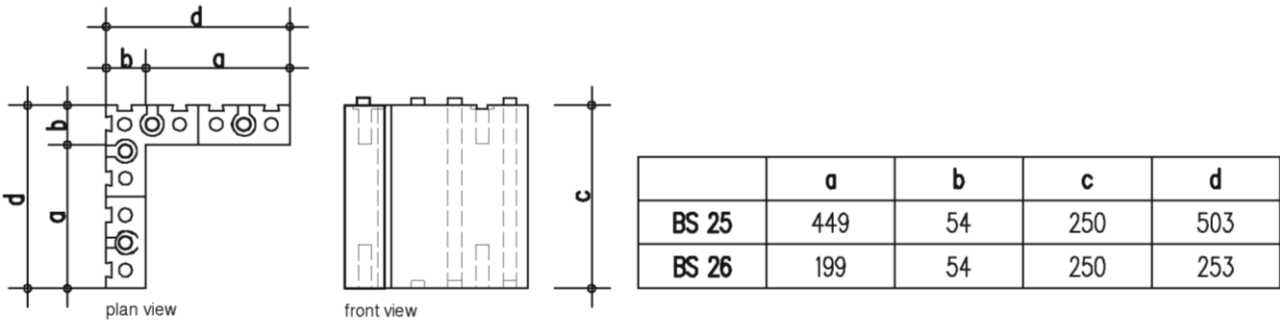
Annex A7



BS 25

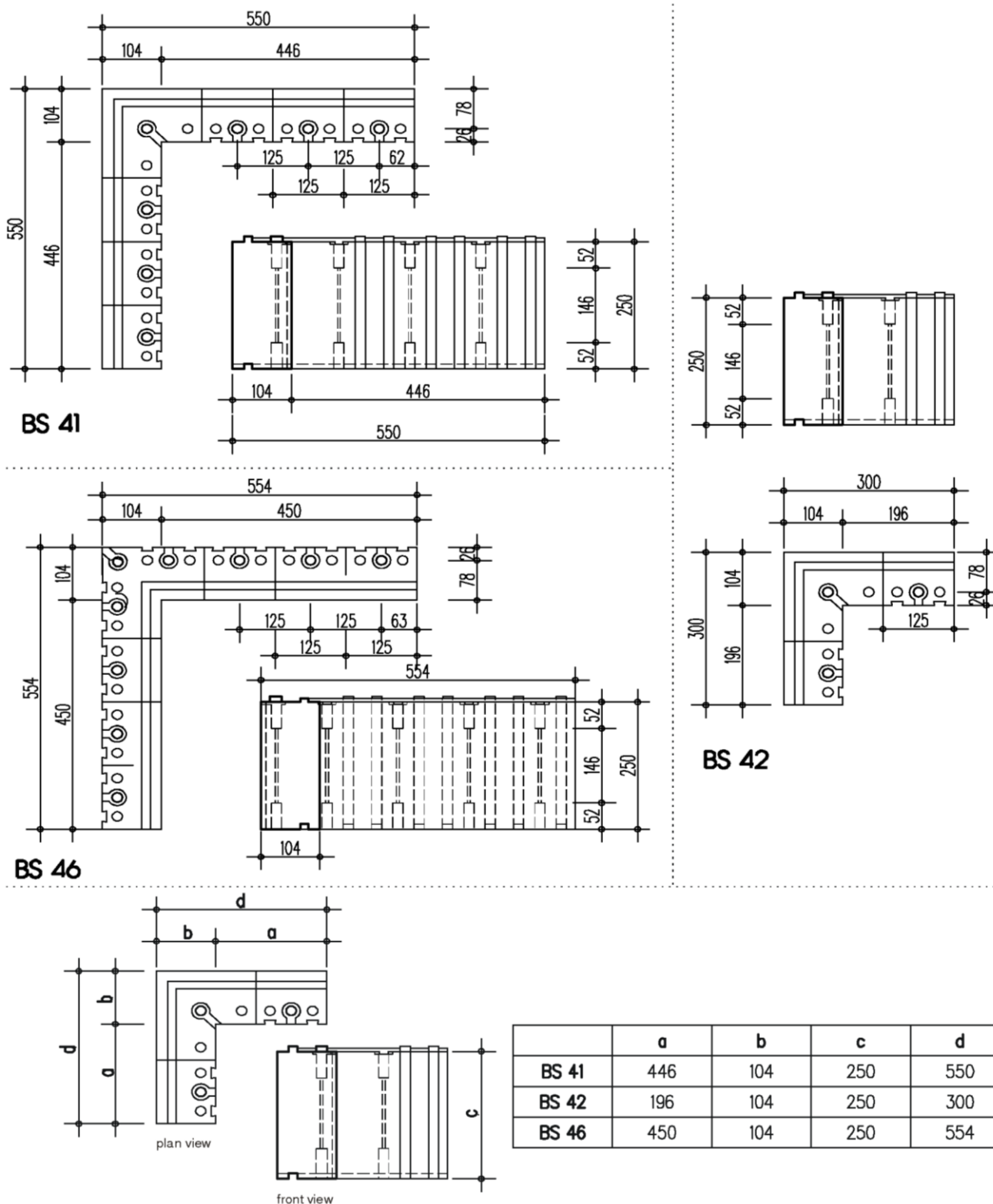


BS 26



Dimensions in [mm], without scale

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

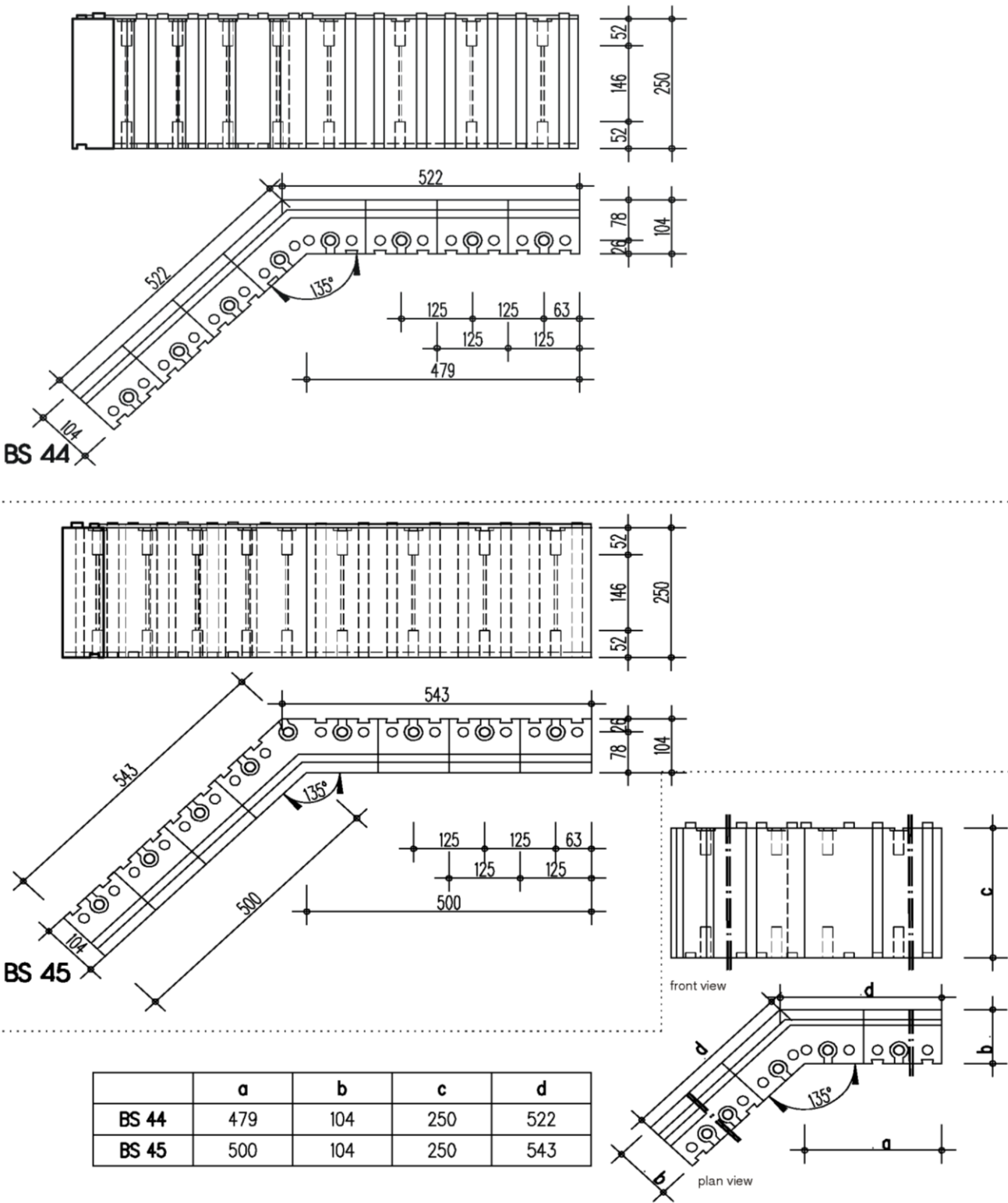


Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"

BS-elements: BS 41 / BS 42 / BS 46

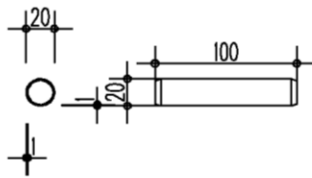
Annex A9



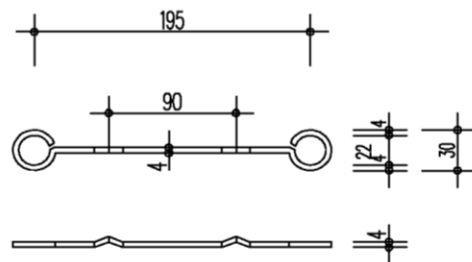
Dimensions in [mm], without scale

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

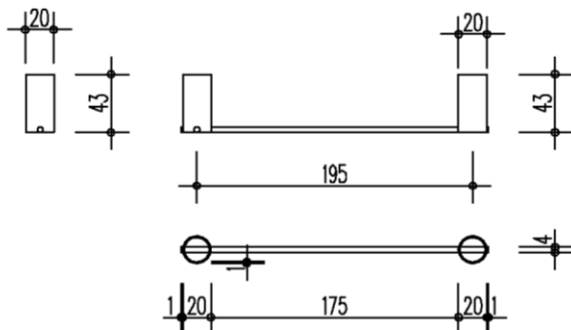
BS 50



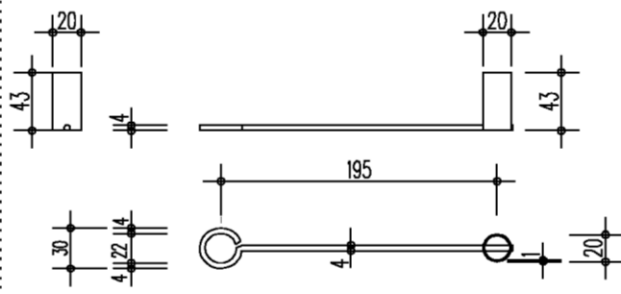
BS 51



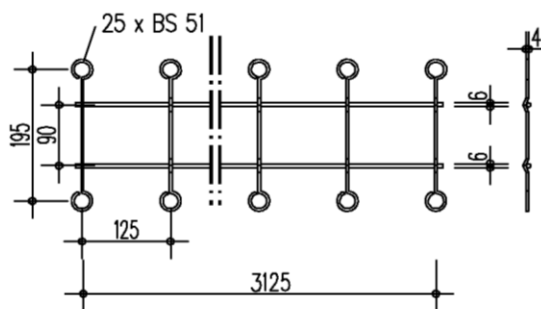
BS 58



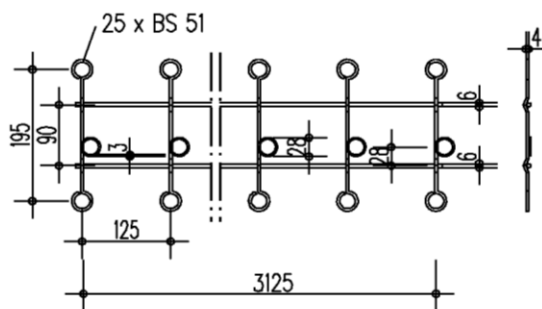
BS 59



BS 57



BS 57K

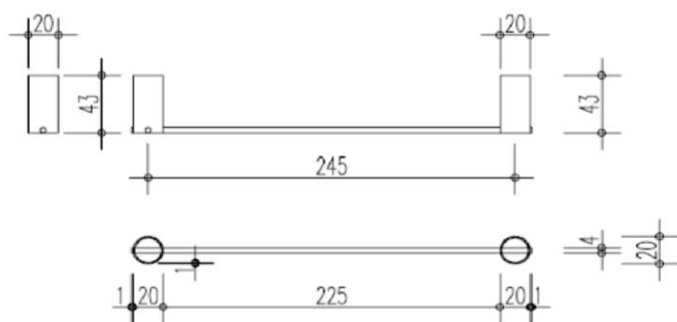


Dimensions in [mm], without scale

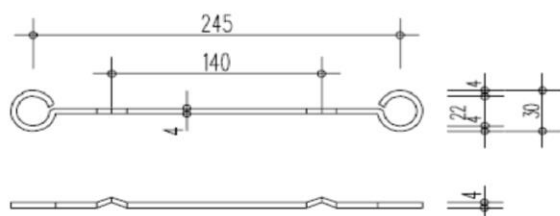
Permanent shuttering kit "DuoTherm"

BS-elements: BS 50 / BS 51 / BS 58 / BS 59 / BS 57 / BS 57K

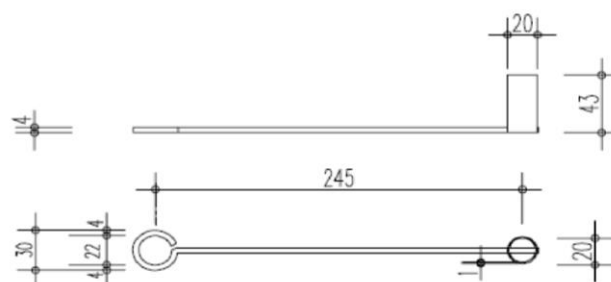
Annex A11



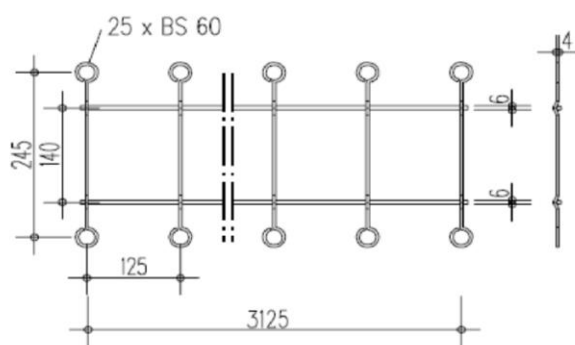
BS 65



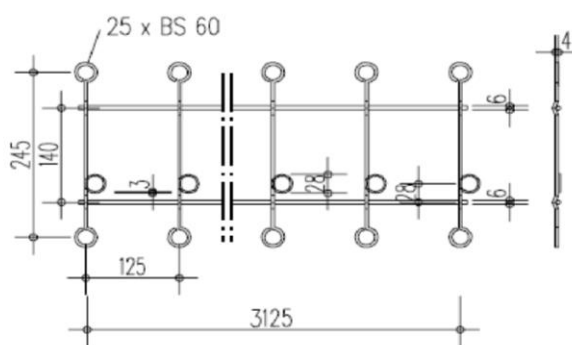
BS 60



BS 64



BS 66



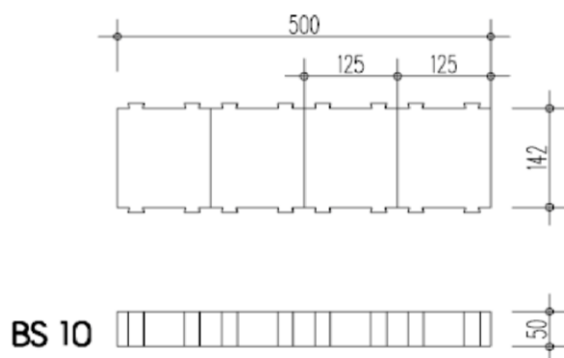
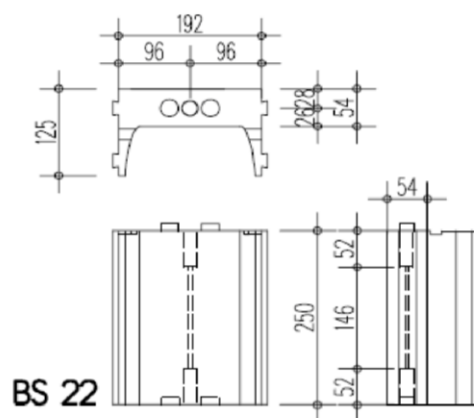
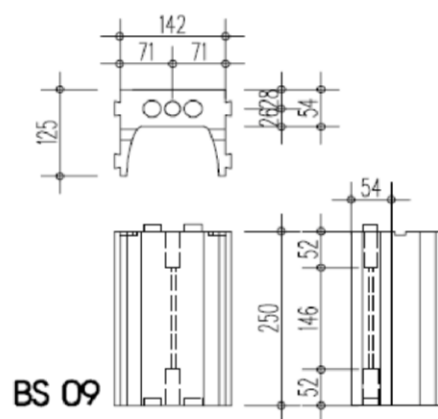
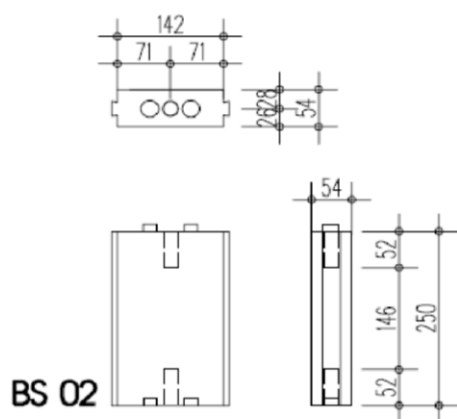
BS 66K

Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"

BS-elements: BS 65 / BS 60 / BS 64 / BS 66 / BS 66K

Annex A12



Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"

BS-elements: BS 02 / BS 09 / BS 10 / BS 22

Annex A13

| DuoTherm-elements | | | | | | | | | | | | |
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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 type¹ 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 B12.

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 B3 and B4).

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 B11).

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 B3. T walls shall be formed according to Annex B4. Typical junctions and constructions between walls and ceilings are to be formed according to Annexes B5 to B10.

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.

¹ see ETAG 009 clause 2.2

Permanent shuttering kit "DuoTherm"

Installation

Annex B1
Page 1 of 2

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.

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.

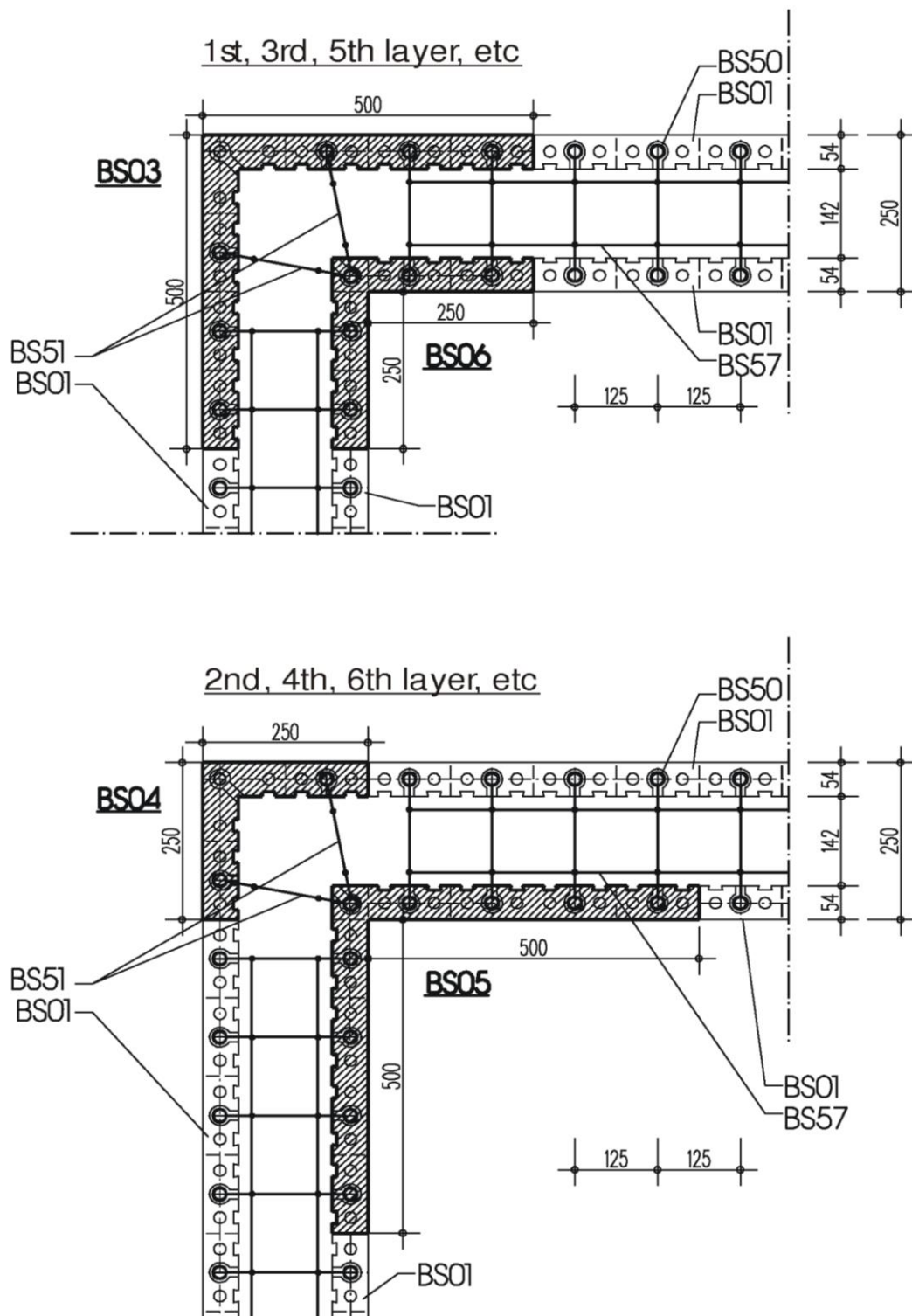
The protection by finishes should be implemented preferably within four month after erecting the load-bearing structure, because of the detrimental influence of weather and UV radiation on the surface of the shuttering leaves.

Permanent shuttering kit "DuoTherm"

Installation

Annex B1
Page 2 of 2

| 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" |
| Permanent shuttering kit "DuoTherm" | | | Annex B2 |
| List of standards and guidelines | | | |

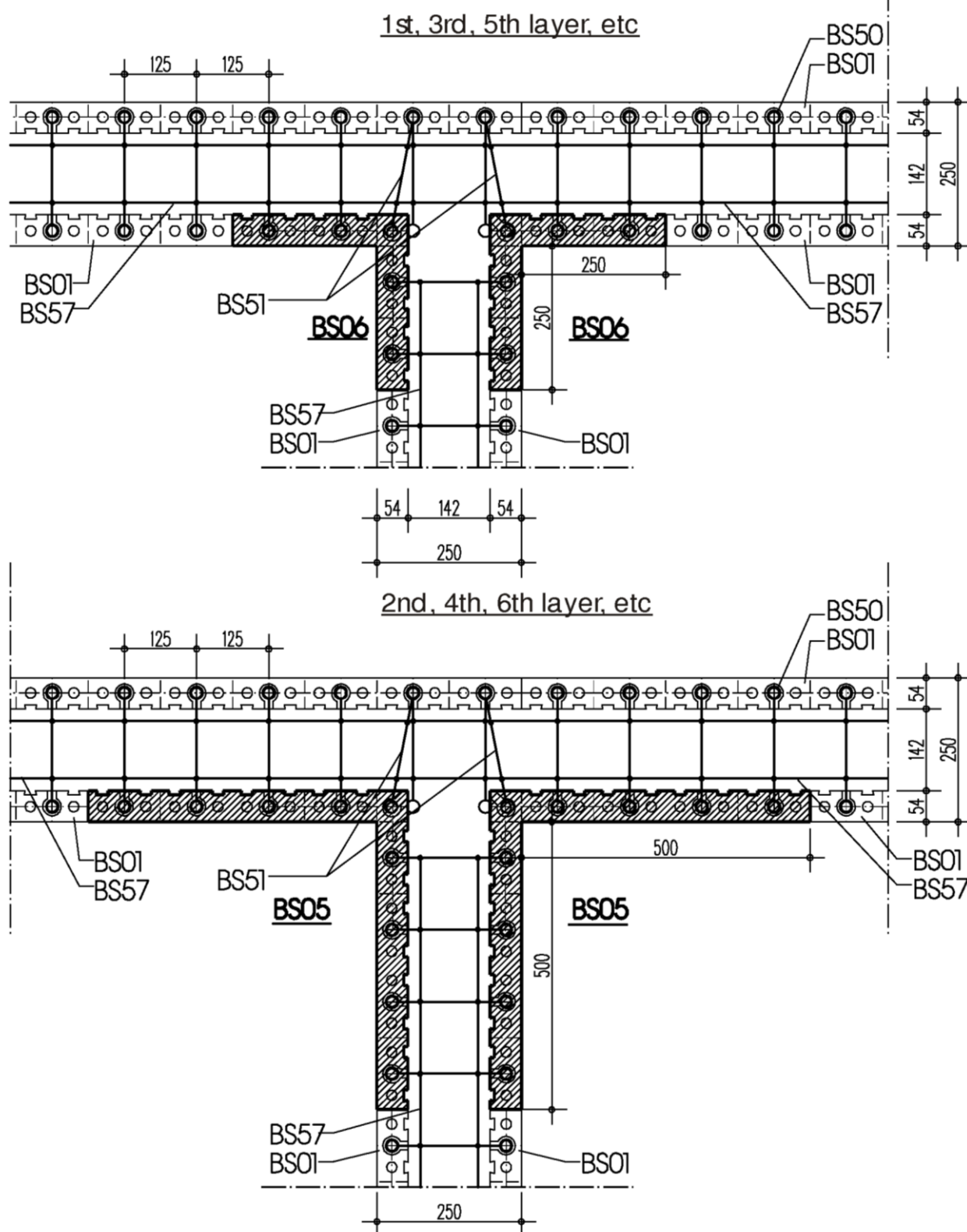


Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"

Outer corner of walls:
T-wall with grid sectioning

Annex B3



Dimensions in [mm], without scale

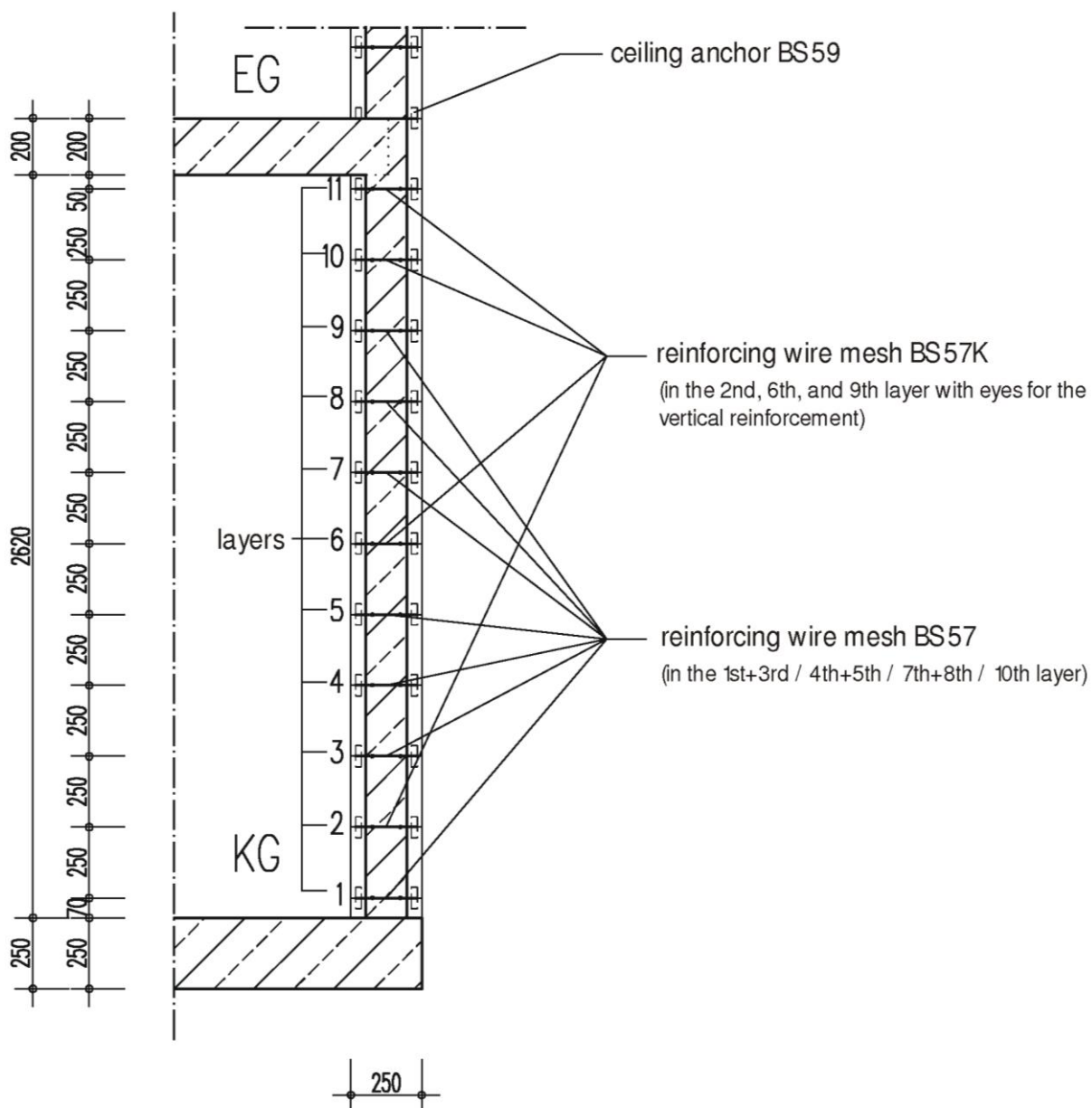
Permanent shuttering kit "DuoTherm"

T-walls:
T-wall with grid sectioning

Annex B4



Typical junction:
Cellar (basement) wall construction with arrangement of reinforcement



Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"

Typical junction:
Cellar (basement) wall construction with arrangement of reinforcement

Annex B6

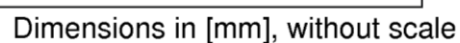


Typical construction:
Cellar (basement) / ground floor) / top floor with grid sectioning



Typical construction:
Ground floor / top floor with grid sectioning

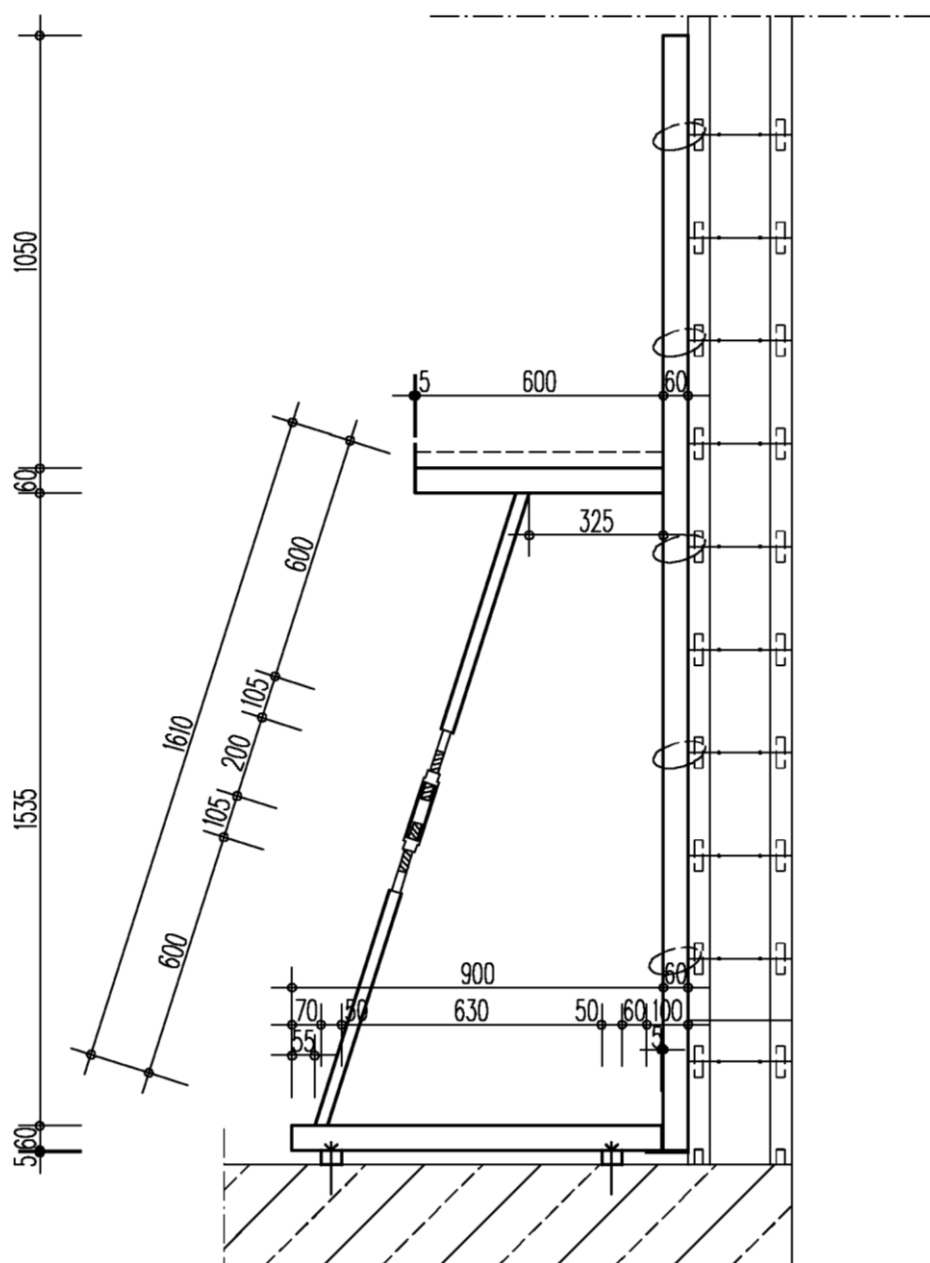
Annex B8



Annex B9



| | |
|---|-----------|
| Permanent shuttering kit "DuoTherm" | Annex B10 |
| <p>Typical construction:</p> <p>Cellar and timber joist floor between ground floor and top floor with grid sectioning</p> | |



maximum push-pull props distance 1,50 m

Dimensions in [mm], without scale

Permanent shuttering kit "DuoTherm"

Mounted push-pull props

Annex B11

| 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 $\gamma_{\text{EPS}} = 0,3 \text{ KN/m}^2$ | Assumed weight of the wall with concrete core without rendering $\gamma_{\text{concrete}} = 25 \text{ KN/m}^2$ | Area of horizontal frame A_R |
|----------------|--------------------|--------------------------|-------------------------------|---|--|--|-----------------------------------|
| | | [mm] | [mm] | [m ² /m] | [kg/m ²] | [kg/m ²] | [mm ²] |
| 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"

Standard shuttering elements
Dimensions and weights

Annex B12