ETA-Danmark A/S
Göteborg Plads 1
DK-2150 Nordhavn
Tel. +45 72 24 59 00
Fax +45 72 24 59 04
Internet www.etadanmark.dk

Authorised and notified according to Article 29 of the Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011

MEMBER OF EOTA

European Technical Assessment ETA-23/0761 of 2025/12/11

I General Part

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011: ETA-Danmark A/S

Trade name of the construction product:	Derix T-Elements, Box-Elements and Web Plates
Product family to which the above construction product belongs:	Prefabricated wood-based loadbearing stressed skin panels
Manufacturer:	Poppensieker & Derix GmbH & Co. KG Industriestraße 24 DE-49492 Westerkappeln www.derix.de
Manufacturing plant:	Poppensieker & Derix GmbH & Co. KG Industriestraße 24 DE-49492 Westerkappeln W. u. J. Derix GmbH & Co. Dam 63 D-41372 Niederkrüchten
This European Technical Assessment contains:	23 pages including 3 annexes which form an integral part of the document
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:	EAD 140022-00-0304 for Pre-fabricated wood-based loadbearing stressed Skin Panels
This version replaces:	The ETA with the same number issued on 2023-11-22

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product

Derix T-Elements and Box-Elements (hereinafter referred to as "T-Elements and Box-Elements") are glued stressed skin panels made of glulam ribs and three-layer CLT panels. The adhesive is of type I polyurethane adhesive as defined in EN 15425 or a gap-filling adhesive of type I according to EN 301. T-Elements and Box-Elements may contain thermal or acoustic insulation inside the cavities, additional fire protective gypsum plasterboards and roofing. T-Elements and Box-Elements may have a top or bottom CLT panel or both, a top and bottom CLT panel. The materials, dimensions and tolerances are given in Annex 1.

Derix Web Plates (hereinafter referred to as "Web Plates") are glued stressed skin panels made of glulam ribs and two-layer timber panels. The adhesive is of type I as defined in EN 301. Web Plates may contain thermal or acoustic insulation inside the cavities, additional fire protective gypsum plasterboards and roofing. Web Plates have both, a top and bottom timber panel. The materials, dimensions and tolerances are given in Annex 1.

T-Elements, Box-Elements and Web Plates are intended to be used as structural or non-structural elements in buildings and bridges. T-Elements, Box-Elements and Web Plates may function as directly load bearing as well as bracing members e.g. as wall, floor and roof elements.

The products are shaped according to the customer's specification. The maximum length of the elements is 18,5 m and the height varies from 180 to 1000 mm. Typical widths are from 600 mm to 3500 mm.

For gluing the ribs and panels to form a T-Element, Box-Element and Web Plate an adhesive type I according to EN 301 or EN 15425 is to be used. Specifications are deposited with ETA-Danmark A/S.

Chemically treated elements are not covered by this ETA.

Manufacturing
The T-Elements, Box-Elements and Web Plates are manufactured in accordance with the provisions of this European technical assessment using the automated manufacturing process in accordance with the technical documentation. Gluing of ribs to panels shall be performed according to the ETA holder's instructions assessed by ETA-Danmark A/S. Gluing pressure is achieved by pneumatic or hydraulic presses as specified in detail in the instructions of the ETA holder or by screw press gluing if gap-filling adhesives are used.

2 Specification of the intended use in accordance with the applicable European Assessment Document (hereinafter EAD)

T-Elements, Box-Elements and Web Plates are intended to be used as directly load bearing parts of building constructions. They may also be used as diaphragms for bracing. T-Elements, Box-Elements and Web Plates are supported below the lower CLT panel or below the ribs for elements without lower CLT panel. Reinforced notched beam supports are also permitted. The T-Elements, Box-Elements and Web Plates shall be subjected to static and quasi static actions only. This includes seismic actions according to EN 1998-1.

Regarding moisture behaviour of the product, the use is limited to service classes 1 and 2 as defined in EN 1995-1-1. The product shall not be used in service class 3 / use class 3 (3.1 exterior, above ground, protected; occasionally wet). If T-Elements, Box-Elements and Web Plates are intended to be a part of the external envelope of the building, they shall be protected adequately, e.g. by a roof or by cladding.

If the elements are intended to be covered by flooring, it is recommended that the moisture content of the top panel is checked by a moisture meter; moisture content of the top panel should not exceed the value recommended by the manufacturer of the flooring material.

T-Elements and Box-Elements with reinforced holes in ribs to provide openings for ducts, pipes etc. are covered by this ETA. T-Elements and Box-Elements with unreinforced holes, modification or repair of the construction are not covered by this ETA.

The provisions made in this European Technical Assessment are based on an assumed intended working life of T-Elements and Box-Elements of 50 years.

The real working life may be, in normal conditions, considerably longer without major degradation affecting the essential requirements of the works.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

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

Characteristic	Assessment of characteristic
3.1 Mechanical resistance and stability (BWR1)	
Mechanical resistance and stiffness	Clause 3.1.1
Dimensional stability	Clause 3.1.2
Durability	Clause 3.1.3
3.2 Safety in case of fire (BWR2)	
Reaction to fire	Clause 3.2.1
Resistance to fire	Clause 3.2.2
External fire performance	No performance assessed
3.3 Hygiene, health and the environment (BWR 3)	
Water vapor permeability and moisture resistance	No performance assessed
Watertightness	No performance assessed
Content, emission and/or release of dangerous substances	Clause 3.3.1
3.4 Safety and accessibility in use (BWR 4)	
Impact resistance	No performance assessed
3.5 Protection against noise (BWR 5)	
Airborne sound insulation	No performance assessed
Impact sound insulation	No performance assessed
Sound absorption	No performance assessed
3.6 Energy economy and heat retention (BWR 6)	
Thermal resistance	Clause 3.4.1
Air permeability	Clause 3.4.2

3.1 Mechanical resistance and stability

3.1.1 Mechanical resistance and stiffness as well as serviceability

Mechanical resistance and deformations of T-Elements, Box-Elements and Web Plates are determined by one of the following methods:

Method 3a: Reference to design documents of the purchaser
Method 3b: Reference to design documents produced and held by the manufacturer according to the order for the works

The structural performance of T-Elements, Box-Elements and Web Plates is considered in accordance with the limit state design principles specified in Eurocodes and is described in detail in the manufacturer's instructions for design. Both ultimate limit state and serviceability limit state (comprising vibrations when relevant) are considered. Calculation methods comply with EN 1995-1-1.

T-Elements, Box-Elements and Web Plates may be used in seismic areas if designed adequately. The use is limited to non-dissipative or low-dissipative structures ($q \leq 1.5$), defined according to Eurocode 8 (EN 1998-1:2004) clauses 1.5.2 and 8.1.3 b), and applicable national rules on works.

Structural design shall be documented. Strength values of timber, glulam and CLT to be used in design together with information of the dimensions of the components are given in Annex 1.

3.1.2 Dimensional stability
In normal conditions, harmful deformations due to moisture changes of the T-Elements, Box-Elements and Web Plates are not expected. When necessary, the dimensional change ΔL of a rib or panel due to change of moisture content may be calculated as for the constitutive materials timber, glulam and CLT.

3.1.3 Durability
T-Elements, Box-Elements and Web Plates may only be used in service classes 1 and 2 according to EN 1995-1-1, and hazard classes 1 and 2 as specified in EN 335. The designer shall pay attention to the construction details and prevent any water accumulation by structural detailing. During the erection of the building, T-Elements, Box-Elements and Web Plates have good resistance to temporary exposure to water without decay, if they are allowed to dry afterwards. Integrity of the bond is maintained in the assigned service classes throughout the expected life of the structure.

3.2 Safety in case of fire

3.2.1 Reaction to fire

Untreated products are classified to have reaction to fire class D-s2, d0 in accordance with EN 13501-1 and Commission Delegated Regulation 2016/364.

T-Elements, Box-Elements and Web Plates treated against fire are not covered by this ETA.

3.2.2 Resistance to fire

Fire design of T-Elements, Box-Elements and Web Plates shall be performed according to standards EN 1995-1-2:2004/AC:2009 and EN 1995-1-1:2004. Nationally determined parameters valid in the relevant Member State shall be used.

Charring rate for timber panels and CLT shall be applied as per ETA-11/0189.

Charring rate for the glued laminated ribs shall be taken from EN1995-1-2, table 3.1.

Passage of fire to the end of the element must be prevented. In addition, the lower CLT panel may not have such holes that can act as passages for fire to the cavity inside the T-Elements, Box-Elements and Web Plates.

3.3 Content, emission and/or release of dangerous substances

3.3.1 Dangerous substances

Based on the assessment of the Assessment Body, the T-Elements, Box-Elements and Web Plates do not contain harmful or dangerous substances > 0.1 mass %. The use of wood preservatives and flame retardants is excluded. The product does not contain pentachloro-phenol, or recycled wood.

The chemical composition of the adhesives for gluing the boards and the finger joints of the individual boards must be in compliance with the chemical composition deposited at the Technical Assessment Body.

T-Elements, Box-Elements and Web Plates treated against biological attack are not covered by this ETA.

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

3.4 Energy economy and heat retention

3.4.1 Thermal resistance

The thermal conductivity λ for the rib material is 0.13 W/(m K) and 0.12 W/(m K) for the timber and CLT panel material according to EN ISO 10456.

The natural density variation of the materials is taken into account in this value.

3.4.2 Air permeability

A construction with T-Elements Box-Elements and Web Plates, including the joints between the elements, will provide adequate airtightness in relation to the intended use, taking into account both energy economy and heat retention, risk of cold draughts and risk of condensation within the construction. The joints of the panels shall be tightened with a gasket.

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

4.1 AVCP system

According to the Decision 2000/447/EC of the European Commission, the system of assessment and verification of constancy of performance (see Annex V to the regulation (EU) No 305/2011) is System 1.

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

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at ETA-Danmark prior to CE marking.

Issued in Copenhagen on 2025-12-11 by

Thomas Bruun
Managing Director, ETA-Danmark

Annex 1	General and tolerances of dimensions
	Derix T-Elements, Box-Elements, and Web Plates

The different cross-section types of T-Elements, Box-Elements, and Web Plates and typical cross sections and symbols used are shown in Annex 1. The products are individually designed based on the specification of the customer. The maximum length of the T-Elements and Box-Elements is 12 m and the height varies from 180 to 600 mm. Top or bottom CLT panels are one-piece CLT panels.

The maximum length of the Web Plates is 18,5 m and the height varies from 150 to 280 mm. Top or bottom flanges are made of two orthogonal layers of timber boards.

Typical dimensions of the members to be glued together are:

b_{rib} = 60 to 280 mm
h_1 = 100 to 940 mm
t_1 = 60 to 280 mm
t_2 = 60 to 280 mm

1. Tolerances of dimensions

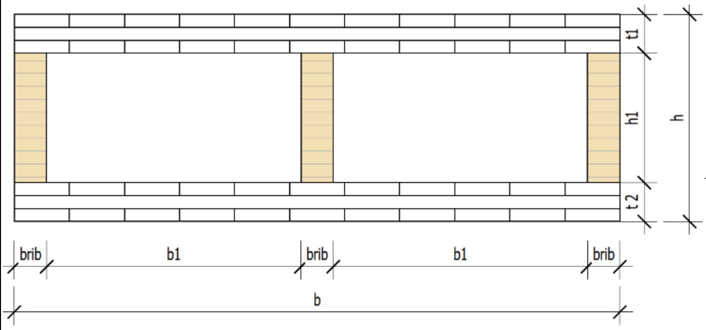
Tolerances of dimensions at the reference moisture content of 12 % are presented in Table 1- 1.

Table 1-1. Tolerances of T-Elements and Box-Elements

Dimension	Tolerance, mm or %
Height of the T-Elements and Box-Elements	± 3,0 mm or 1,5 %**
Width of the T-Elements and Box-Elements	± 0,5 %
Length of the T-Elements and Box-Elements	± 5,0 mm

** whichever is the smaller

Annex 1	Product description
	Derix Box-Element



Total height	h	≤ 1000 mm
Rib height	h1	100 – 940 mm
Element width	b	≤ 3000 mm
Rib spacing	b1	≤ 2000 mm
Rib width	brib	60 – 280 mm
Upper panel thickness	t1	≤ 280 mm
Lower panel thickness	t2	≤ 280 mm
Element length	l	≤ 12 m

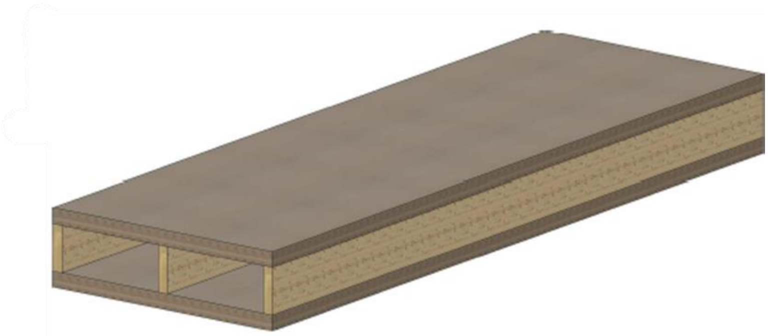
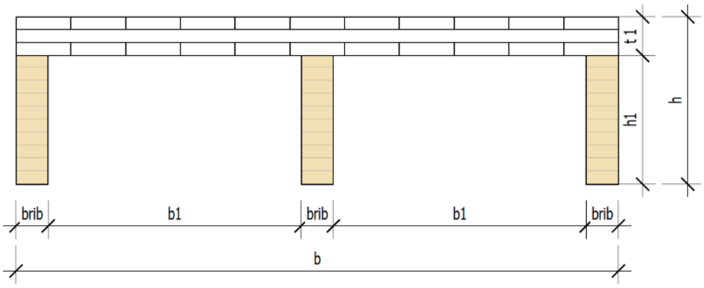


Figure 1-1: Closed type

Annex 1	Product description **Derix T-Element**



Total height	h	≤ 1000 mm
Rib height	h1	100 – 940 mm
Element width	b	≤ 3000 mm
Rib spacing	b1	≤ 2000 mm
Rib width	brib	60 – 280 mm
Panel thickness	t	≤ 280 mm
Element length	l	≤ 12 m

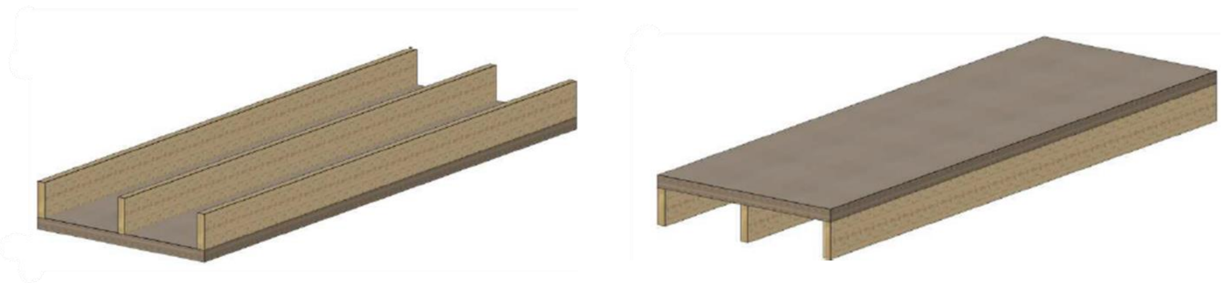


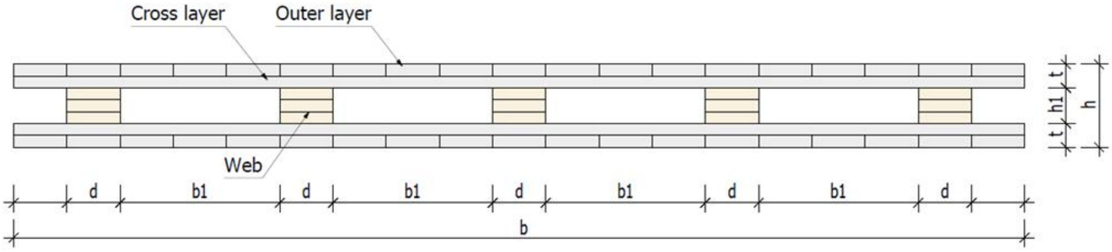
Figure 1-2: Open box with outer webs flush with flange

Total height	h	≤ 1000 mm
Rib height	h1	100 – 940 mm
Element width	b	≤ 3000 mm
Rib spacing	b1	≤ 2000 mm
Rib width	brib	60 – 280 mm
Lower panel thickness	t	≤ 280 mm
Element length	l	≤ 12 m

Figure 1-3: Open box with three webs and protruding flange

Annex 1	Product description
	Derix Web Plates

Total height	h	≤ 360 mm
Web height	h1	60 – 120 mm
Element width	b	≤ 3500 mm
Web spacing	b1	≤ 372 mm
Web width	d	120 – 186 mm
Panel thickness	t	≤ 80 mm
Element length	l	≤ 18,5 m



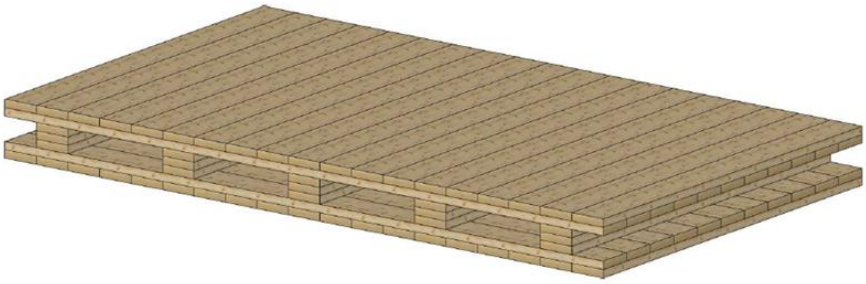
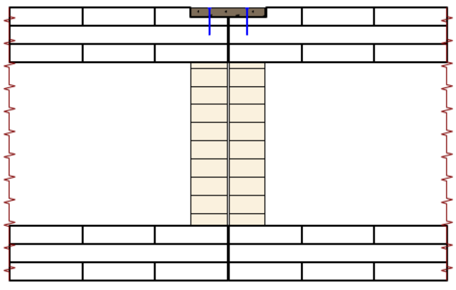


Figure 1-4: Example of Web Plate

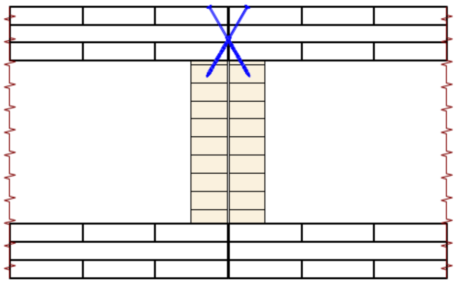
Annex 1	Exemplary butt joint **Derix Box-Elements**

The selection, number, and arrangement of the mechanical fasteners as well as the thickness of the connecting board must be based on static requirements.

butt joint with insert board



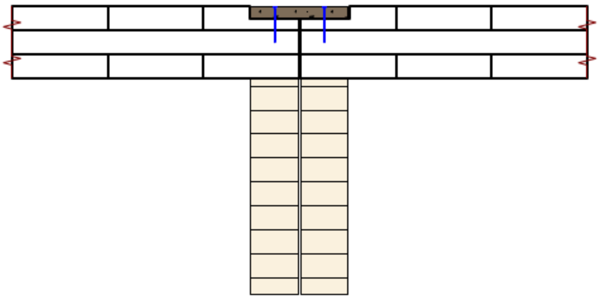
butt joint with crossed screws



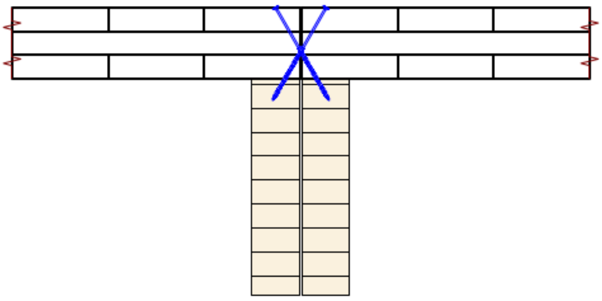
Annex 1	Exemplary butt joint
	Derix T-Elements

The selection, number, and arrangement of the mechanical fasteners as well as the thickness of the connecting board must be based on static requirements.

butt joint with insert board



butt joint with screw cross



Annex 2	Specifications of components **Derix T-Elements and Box-Elements**

2. Specifications of components

The components are made of timber boards according to EN 14081, glulam according to EN 14080 and CLT according to ETA-11/0189 produced by Poppensieker & Derix GmbH & Co. KG. Orientation of the CLT panel material may be parallel or perpendicular to span. The characteristic strength and stiffness values comply with EN 338, EN 14080 and ETA-11/0189, respectively.

The polyurethane adhesive used in manufacturing T-Elements and Box-Elements is of type I as defined in EN 15425. The phenolic or aminoplastic adhesives used in manufacturing T-Elements and Box-Elements with screw press gluing are of type I as defined in EN 301.
The modification factors k_{mod} and k_{def} for glulam and CLT, as defined in Eurocode 5, shall be used in the design of T-Elements and Box-Elements. Partial safety factors γ_m are defined in the National annex of 1995-1-1.

Annex 2	Specifications of components **Derix T-Elements and Box-Elements**

The tensile stresses perpendicular to grain caused by both tensile forces and bending moments in the ribs due to the mass of the acoustic insulation material in the cavities may be considered as follows:

$$\frac{\tau_d}{f_{v,d}} + \frac{\sigma_{t,90,d}}{k_{dis} \cdot k_{vol} \cdot f_{t,90,d}} \le 1$$

Where:

$$\sigma_{t,90,d} = \frac{6 \cdot M_{90,d}}{d^2} + \frac{N_{90,d}}{d}$$

$$M_{90,d} = k_1 \cdot q_d \cdot \frac{(b_1 + d)^3}{12 \cdot b_1} \cdot \left(1 - \frac{u}{2u + w} - \frac{u}{2u + 3w}\right)$$

$q_d \quad = g_{s,d} + g_{f,d}$

$g_{s,d}$ permanent design gravel load per m² floor area

$g_{f,d}$ permanent design load of the lower flange

k_1 factor taking into account unequal load distribution

$$k_1 = \begin{cases} 1,3 & \text{for elements with 3 or more webs} \\ 1,5 & \text{for elements with 2 webs} \end{cases}$$

$$u = \frac{E_0 I_f}{b_1 + d} \qquad w = \frac{E_{90} I_w}{h_1}$$

E_0I_f Bending stiffness of lower CLT panel perp. to longitudinal element axis
E_0 MOE of cross layer parallel to grain

$$I_f = \frac{t_{90}^3}{12}; \text{ where } t_{90} = \text{cross layer thickness}$$

$E_{90}I_w$ Bending stiffness of rib
E_{90} MOE of rib perp. to grain

$$I_w = \frac{d^3}{12}; \text{ where } d = \text{web width}$$

b_1 Interspace between ribs
h_1 Rib heigth
d Rib width

$$N_{90,d} = k_2 \cdot q_d \cdot \frac{(b_1 + d)^2}{b_1}$$

$$k_2 = \begin{cases} 0,5 & \text{for elements without protruding flanges} \\ 1 & \text{for elements with protruding flanges} \end{cases}$$

$$k_{vol} = \left(\frac{V_0}{V}\right)^{0,2}$$

$V_0 \quad = 0,01$ m³
$V \quad = 0,65 \cdot d \cdot h_1 \cdot \ell_{element}$
h_1 Web depth in m
d Web width in m
$\ell_{element}$ maximum element span in m
$k_{dis} \quad = 2$

Annex 2	Notched supports, holes and connections loaded perpendicular to the grain
	Derix T-Elements and Box-Elements

3. Typical connections between T-Elements and Box-Elements

T-Elements and Box-Elements are normally connected to each other with mechanical fasteners (see Annex 1). Diagonal screwing is recommended. T-Elements and Box-Elements shall be designed in such a way that width and thickness changes due to moisture content variation do not cause harmful stresses in the structures. Special attention shall be paid to the design of joints.

4. Derix T-Elements and Box-Elements with notched supports, holes and connections loaded perpendicular to the grain

The tensile stresses perpendicular to grain caused by connection forces acting at an angle to the grain in the ribs may be considered as follows:

To take account of the possibility of splitting caused by the tension force component, $F_{Ed} \sin \alpha$, perpendicular to the grain, the following shall be satisfied:

$$F_{90,Ed} \leq F_{90,Rd}$$

where:

$F_{90,Ed}$ is the design tension force component;

$F_{90,Rd}$ is the design splitting capacity, calculated from the characteristic splitting capacity $F_{90,Rk}$;

$$F_{90,Rk} = \frac{k_s \cdot k_{end} \cdot I}{I_1 + S \cdot z_{1s}} \cdot \left(4 + 23 \cdot \frac{a}{h} - 18 \cdot \frac{a^2}{h^2}\right)(b_w \cdot h)^{0,8} \cdot f_{t,90,k}$$

$$k_s = \max\left\{1; 0,7 + \frac{1,4 \cdot a_r}{h}\right\}$$

k_{end} Modification factor for load introduction at member ends within a length h from the member end
- $k_{end} = 0,5$ if $F_{90,Ed}$ is introduced at the member end of a cantilever or if the force component perpendicular to grain constitutes the member end support,
- $k_{end} = 1,0$ in all other cases.

a Threaded screw length within stressed skin panel, see Figure 1-5, $a \geq 0,4$ h.

h Total heigth of stressed skin panel.

I_1 Effective second moment of area of the upper cross-section above the possible crack line at the screw tips.

I Effective second moment of area of the full cross-section.

S Effective first moment of area of the upper cross-section above the possible crack line at the screw tips.

z_{1s} Distance between the screw tips and the centre of gravity of the upper cross-section above the screw tips.

b_w Sum of rib widths.

a_r Distance parallel to grain between the two outermost screws in Figure 1-5.

Annex 2	Notched supports, holes and connections loaded perpendicular to the grain
	Derix T-Elements, Box-Elements, and Web Plates

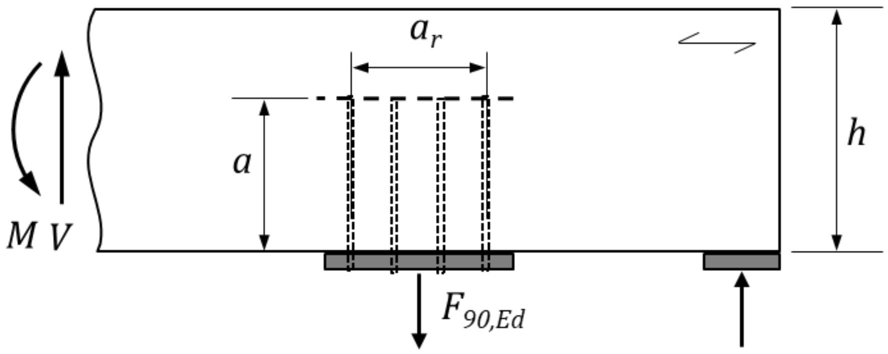


Figure 1-5: Load $F_{90,Ed}$ perpendicular to grain with possible crack line at the screw tips in the ribs of a Derix T-Element or Box-Element

For Derix T-Elements, Box-Elements and Web Plates with a rectangular notch on the same side as the support, see Figure 1-6, the reinforcement may be designed for the design tensile force $F_{t,90,Ed}$:

$$F_{t,90,Ed} = k_\alpha \cdot k_\beta \cdot \left(1 - \frac{I_1 + S \cdot z_{1s}}{I}\right) \cdot V_d$$

Where:

$k_\alpha \quad = 0,9 + 0,5 \cdot (2\alpha - 1)^2$

$k_\beta \quad = 1 + 2\beta$

α is the ratio h_{ef}/h see Figure 1-6.

β is the ratio a/h see Figure 1-6.

a is the distance parallel to the grain from the line of action of the support reaction V_d to the corner of the notch.

I_1 Effective second moment of area of the upper cross-section part above the possible crack line at the notch.

I Effective second moment of area of the full cross-section.

S Effective first moment of area of the upper cross-section part above the possible crack line at the notch.

z_{1s} Distance perp. to member axis between the notch and the centre of gravity of the upper cross-section part above the notch. For top slab support, $z_{1s} = 0,5 \cdot h_{ef}$.

V_d Support reaction.

For $\alpha \leq 0,6$ and $\beta \leq 0,2$, the product $k_\alpha \cdot k_\beta$ may be taken as $k_\alpha \cdot k_\beta = 1,3$.

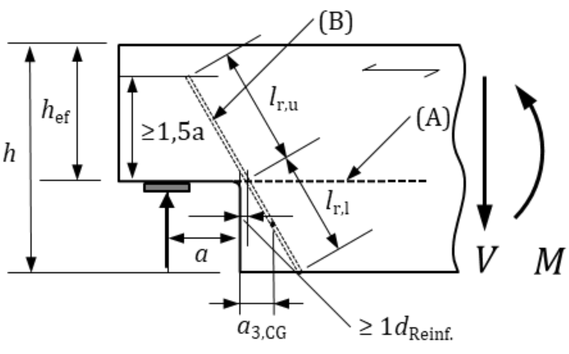


Figure 1-6: Reinforced notched beam support in the ribs of a Derix T-Element or Box-Element
(A) Possible crack line
(B) Internal reinforcement by self-tapping fully threaded screws arranged under 60° to the grain

Annex 2	Notched supports, holes and connections loaded perpendicular to the grain **Derix T-Elements and Box-Elements**

For Derix T-Elements and Box-Elements members with a reinforced individual circular or rectangular hole in areas with dominating shear stresses, see Figure 1-7 and Figure 1-8, the reinforcement may be designed for the design tensile force $F_{t,90,Ed}$:

$$F_{t,90,Ed} = F_{t,90,V,Ed} + F_{t,90,M,Ed}$$

The reinforced hole may be considered individual, if the clearance ℓ_z between adjacent holes, see Figure 1-9, fulfils the following condition:

$$\ell_z \geq \max\{1,5 \cdot h; 300\ \text{mm}\}$$

Where:

$$F_{t,90,V,Ed} = \frac{I_{1,centre} + S_{centre} \cdot z_{1s,centre} - I_{1,split} - S_{split} \cdot z_{1s,split}}{I} \cdot k_{hole} \cdot V_d \quad \text{for quadrant I}$$

$$F_{t,90,V,Ed} = \frac{I_{1,split} + S_{split} \cdot z_{1s,split} - I_{1,centre} - S_{centre} \cdot z_{1s,centre}}{I} \cdot k_{hole} \cdot V_d \quad \text{for quadrant III}$$

I Effective second moment of area of the full cross-section.
$I_{1,split}$ Effective second moment of area of the upper cross-section part above the possible crack line at the hole.
S_{split} Effective first moment of area of the upper cross-section part above the possible crack line at the hole.
$z_{1s,split}$ Distance perp. to member axis between the possible crack line and the centre of gravity of the upper cross-section part above the possible crack line.
$I_{1,centre}$ Effective second moment of area of the upper cross-section part above hole centre.
S_{centre} Effective first moment of area of the upper cross-section part above the hole centre.
$z_{1s,centre}$ Distance perp. to member axis between the hole centre and the centre of gravity of the upper cross-section part above hole centre.
V_d Shear force at hole edge.

$$k_{hole} = 1,1 + 1,3 \cdot \left[\frac{d_{hole}}{h} - \left(\frac{d_{hole}}{h}\right)^2\right] \quad \text{for holes with the hole centre on the neutral axis.}$$

$$k_{hole} = 0,1 + \frac{d}{h} + \frac{4,5 \cdot h_r}{h} - \frac{5,0 \cdot h_r^2}{h^2} \quad \text{for holes with the hole centre not on the neutral axis.}$$

d_{hole} = hole diameter d for circular holes, $d \leq 0,3\ h$ and $d \leq 0,5\ h_w$.

$$d_{hole} = 1,25 \cdot h_d + 0,3 \cdot a \cdot \left[\frac{4 \cdot V_d \cdot h}{M_d} - \left(\frac{3 \cdot V_d \cdot h}{M_d}\right)^2\right] \quad \text{for rectangular holes.}$$

a Length of rectangular hole, see Figure 1-6, $a \leq 2,5\ h_d$ and $a \leq h_w$.
h_d Heigth of rectangular hole, see Figure 1-6, $h_d \leq 0,3\ h$ and $h_d \leq 0,5\ h_w$.
h_w Heigth of stressed skin panel rib.
M_d Bending moment at hole edge.
h Total heigth of Derix T-Element or Box-Element.
h_r Distance h_{rl} respectively h_{ru} from the edge of the hole to the edge of the member, see Figure 1-9.

$$F_{t,90,M,Ed} = 0,09 \cdot \frac{M_d}{h} \cdot \left(\frac{d_{hole}}{h}\right)^2 \quad \text{for holes with the hole centre on the neutral axis}$$

$$F_{t,90,M,I,Ed} = \frac{M_d \cdot d}{h^3} \cdot \max\begin{Bmatrix} 0,62\,(0,13d - e) \\ 0,2\,(0,45d - e) \\ 0,3\,(e - 0,08d) \end{Bmatrix} \quad \text{for quadrant I}$$

Annex 2	Notched supports, holes and connections loaded perpendicular to the grain
	Derix T-Elements and Box-Elements

$$F_{t,90,M,III,Ed} = \frac{M_d \cdot d}{h^3} \cdot 0,22\,(e + 0,19d) \qquad \text{for quadrant III}$$

e Eccentricity of the centre of the hole to the neutral axis of the member,
e is negative in the direction of the member edge subjected to (bending) compression,
e is positive in the direction of the member edge subjected to (bending) tension

For members with holes, having their centre located eccentrically to the neutral axis of the member, the following relevant sets of forces, see Figure 1-10, should be used for quadrants I and III:

For positive bending moment: $F_{t,90,V,I} + F_{t,90,M,I}$ $F_{t,90,V,III} + F_{t,90,M,III}$

For negative bending moment: $F_{t,90,V,I} + F_{t,90,M,III} F_{t,90,V,III} + F_{t,90,M,I}$

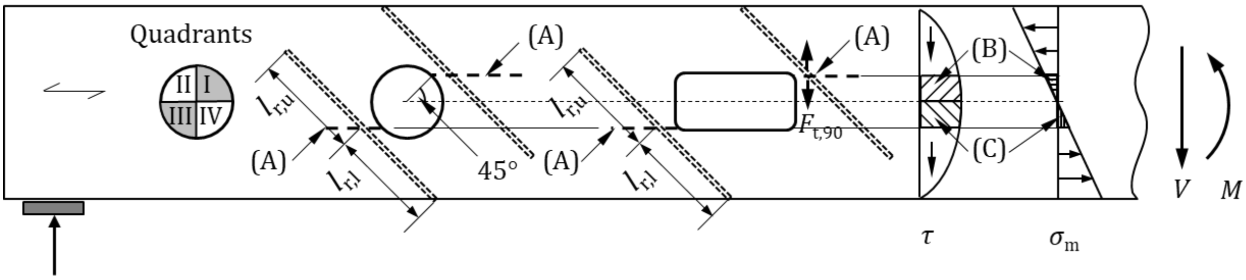


Figure 1-7: Holes in the ribs of a Derix T-Element or Box-Element
(A) Possible crack line in locations with high shear stresses ($F_{t,90,V,Ed} \geq F_{t,90,M,Ed}$)
(B) Portion of shear and bending stresses to be transferred around the upper edge of the hole
(C) Portion of shear and bending stresses to be transferred around the lower edge of the hole

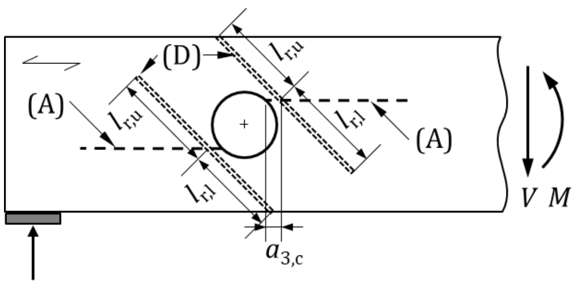


Figure 1-8: Reinforced hole in the ribs of a Derix T-Element or Box-Element
(A) Possible crack line
(D) Internal reinforcement by self-tapping fully threaded screws arranged under 45° to the grain

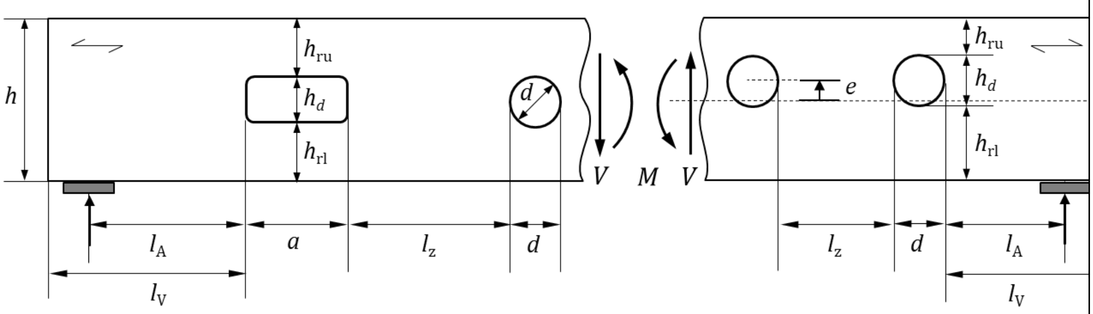


Figure 1-9: Dimensions of holes in the ribs of a Derix T-Element or Box-Element

Annex 2	Notched supports, holes and connections loaded perpendicular to the grain
	Derix T-Elements and Box-Elements

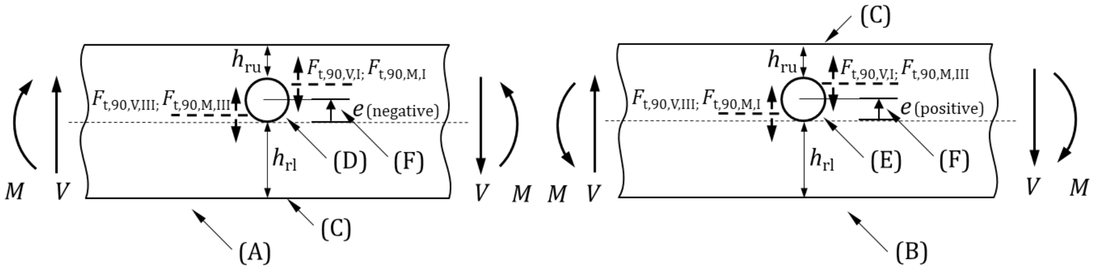


Figure 1-10: Circular hole in a member with positive (left) or negative (right) bending moment

(A) member under positive bending moment (e.g single span beam under vertical load)

(B) member under negative bending moment (e.g. cantilevered beam or continuous beam at supports)

(C) member edge subjected to (bending) tension

(D) hole with eccentricity in direction of the member edge subjected to compression (preferred)

(E) hole with eccentricity in direction of the member edge subjected to tension

(F) eccentricity of the centre of the hole to the centre line of the member,
e is negative in the direction of the member edge subjected to (bending) compression,
e is positive in the direction of the member edge subjected to (bending) tension

Annex 3	**Essential Requirements of the Web Plates**
	Derix Web Plates

Table 1-2. Characteristic strength and stiffness values

ER	Requirement	Verification method	Class / Use category / value
1	**Mechanical resistance and stability**		
	For the calculation the characteristic strength and stiffness values of softwood according to EN 338 shall be used. In addition, the following values apply:		
	Board strength class	EN 338	C16* C24* C27* C30*
	Bending strength parallel to grain of the boards $f_{m,k}$	ETA-11/0189	C16 $k_{sys} \cdot 16$ MPa C24 $k_{sys} \cdot 24$ MPa C27 $k_{sys} \cdot 27$ MPa C30 $k_{sys} \cdot 30$ MPa
	Density ρ_k	EN 338/EN 14080	C16 $1{,}1 \cdot 310$ kg/m³ C24 $1{,}1 \cdot 350$ kg/m³ C27 $1{,}1 \cdot 360$ kg/m³ C30 $1{,}1 \cdot 380$ kg/m³
	1.1 Mechanical actions in plane of the Web Plates		
	Shear strength for the calculation with the gross cross section $f_{v,gross,k}$	ETA-11/0189	3,5 MPa
	Shear strength for the calculation in the joints between non-edge glued boards within a layer $f_{v,net,k}$	ETA-11/0189	8,0 MPa
	Shear strength for the calculation in the crossing areas of orthogonally bonded non-edge glued boards $f_{v,tor,k}$	ETA-11/0189	2,5 MPa
	Shear modulus G_{mean}	EN 16351	240 MPa
	1.2 Mechanical actions perpendicular to the plane of the Web Plates		
	Rolling shear strength $f_{R,k}$	ETA-11/0189	1,1 MPa
	Rolling shear modulus $G_{r,mean}$	ETA-11/0189	50 MPa
	Effective flange width $b_{c,ef}$ or $b_{t,ef}$	EN 1995-1-1, 9.1.2	Min{0,15 ℓ; 25 h_f}
	For references regarding the calculation see below. National regulations might have to be followed.		
	Use of fasteners	ETA-11/0189	
	Creep and duration of load	According to EN 1995-1-1	
	Dimensional stability	Moisture content during use shall not change to such extent that adverse deformations can occur.	
* In each layer, up to 10% of the boards of the next lower strength class may be used.			

5.1 Mechanical actions in plane of the Web Plates

Stress distribution within the element must be calculated by taking into account only the boards which are oriented in the direction of the actions. It is assumed that only the flanges are loaded in plane.

Shear stresses may be calculated with the total thickness of the flanges and must not exceed $f_{v,d}$, where $f_{v,k}$ is defined as:

$$f_{v,k} = \min\left\{ f_{v,gross,k}\,;\; f_{v,net,k} \cdot \frac{t_{net}}{t_{tot}};\; \frac{f_{v,tor,k}}{n_{web} \cdot 6 \cdot t_{tot}} \cdot \frac{(n-1)\left(a^2+b^2\right)}{b} \right\}$$

Annex 3	**Essential Requirements of the Web Plates**
	Derix Web Plates

with t_{net} = lower accumulated thickness of longitudinal or cross flange layers, respectively.
t_{tot} = accumulated flange thicknesses of longitudinal and cross layers.
n = number of board layers within Web Plate. Adjacent parallel web layers are considered as one layer.
n_{web} = ratio of centre-to-centre web spacing over board width.
a = longitudinal or cross board width
b = longitudinal or cross board
$a \leq b$

For the design of Web Plates made of layers of softwood the characteristic strength and stiffness values of the layers of softwood shall be taken from Table 1-2.

For the verification of the bending strength the design bending strength value of a layer of boards may be multiplied by a system strength factor k_{sys}

$$k_{sys} = \min\begin{cases} 0,975 + 0,025 \cdot n_\ell \\ 1,2 \end{cases}$$

with n_ℓ = number of longitudinal boards within a layer.

5.2 Mechanical actions perpendicular to the plane of the cross laminated timber

Stress distribution within the cross laminated timber must be calculated considering the shear deformation of the cross layers.

For simply supported Web Plates with up to 5 layers the stress distribution may be calculated according to EN 1995-1-1 as mechanically jointed beam where the value s_i/K_i is substituted by $d_i/(G\ b)$ with d_i = thickness of the cross layer, G = rolling shear modulus of the cross layer $G_{9090,mean}$ and b = width of the cross layer.

For the design of Web Plates, the characteristic strength and stiffness values shall be taken from Table 1-2.

For the bending design only the stresses at the edges of the boards are decisive, axial stresses in the centre of the boards are not considered in the design.

In bending design, the characteristic bending strength properties may be multiplied by a system strength factor k_{sys}

$$k_{sys} = \min\begin{cases} 0,975 + 0,025 \cdot n_\ell \\ 1,2 \end{cases}$$

with n_ℓ = number of boards within the outermost longitudinal layer

Tension loads perpendicular to the element should be avoided.

Annex 4	**Screw press gluing** **T-Elements and Box-Elements**

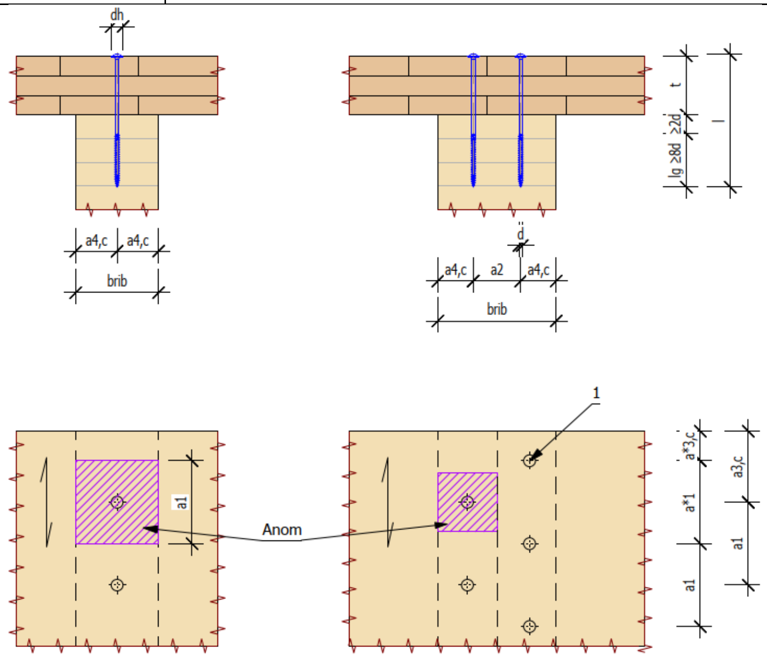


Figure 4-1: Spacing, end and edge distances of screws for screw press gluing

Table 4-1: Requirements for screw press gluing for Derix T-Elements and Box-Elements

t_1 [mm]	d [mm]	a_1 [mm]	a_2 [mm]	p_{req} [MPa]	$k_{p,min}$
28 - 60	6	≤ 150	≤ 12 d	0,20	1
61 - 100	8	≤ 175	≤ 13 d	0,20	See equation (4-3)
100 - 160	8	≤ 200	≤ 14 d	0,25	
161 - 200	10	≤ 225	≤ 15 d	0,25	

Where:
- t CLT plate thickness
- 1 Additional end grain screw
- a_1, a^*_1, a_2, $a_{3,c}$, $a^*_{3,c}$, $a_{4,c}$ [mm]: spacing, end and edge distances
- A_{nom} Nominal screw press area [mm²]
- b_{rib} Rib width [mm]
- d Nominal screw diameter [mm]
- d_h Head diameter [mm]
- ℓ Screw length [mm]
- ℓ_g Thread length [mm]

The pressing force per screw with countersunk or washer head is:

$$F_{pr} = (0{,}314 \cdot d_h - 1{,}32) \cdot 1000 \text{ N} \qquad (4\text{-}1)$$

The required pressure p_{ef} is:

$$p_{ef} = \frac{0{,}8 \cdot F_{pr} \cdot k_{p,min}}{A_{nom}} \geq p_{req} \text{ MPa} \qquad (4\text{-}2)$$

$$k_{p,min} = \min\left(1\,;\left(\frac{100}{a_1}\right)^{\sqrt{\frac{230}{EI_l}}}\right) \qquad (4\text{-}3)$$

Where:
- p_{ef} Calculated effective bond line pressure
- F_{pr} Pressing force per screw
- EI_l Bending stiffness of the CLT plate in the longitudinal direction of the ribs for 1 mm width, in MN·mm²
- p_{req} Required pressure, see Table 4-1