



## European Technical Approval ETA-06/0009

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung  
*Trade name*

Binderholz Brettsperrholz BBS  
*Binder Brettsperrholz BBS*

Zulassungsinhaber  
*Holder of approval*

Binderholz Bausysteme GmbH  
Zillertalstraße 39  
6263 FÜGEN  
ÖSTERREICH

Zulassungsgegenstand  
und Verwendungszweck

*Generic type and use  
of construction product*

Binderholz Brettsperrholz BBS  
Mehrschichtige Holzbauelemente für Wand-, Decken-, Dach- und  
Sonderbauteile  
*Binderholz Brettsperrholz BBS  
Multilayered timber elements for walls, ceilings, roofs and special  
construction components*

Geltungsdauer:  
*Validity:* vom  
*from*  
bis  
*to*

19 June 2013  
20 December 2016

Herstellwerk  
*Manufacturing plant*

Binderholz Bausysteme GmbH  
Stranach 26  
5585 Unternberg  
ÖSTERREICH

Diese Zulassung umfasst  
*This Approval contains*

21 Seiten einschließlich 10 Anhänge  
*21 pages including 10 Annexes*

Diese Zulassung ersetzt  
*This Approval replaces*

ETA-06/0009 mit Geltungsdauer vom 20.11.2011 bis 20.12.2016  
*ETA-06/0009 with validity from 20/11/2011 to 20/12/2016*

## I LEGAL BASES AND GENERAL CONDITIONS

- 1 This European technical approval is issued by Deutsches Institut für Bautechnik in accordance with:
  - Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products<sup>1</sup>, modified by Council Directive 93/68/EEC<sup>2</sup> and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council<sup>3</sup>;
  - Gesetz über das In-Verkehr-Bringen von und den freien Warenverkehr mit Bauprodukten zur Umsetzung der Richtlinie 89/106/EWG des Rates vom 21. Dezember 1988 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedstaaten über Bauprodukte und anderer Rechtsakte der Europäischen Gemeinschaften (Bauproduktengesetz - BauPG) vom 28. April 1998<sup>4</sup>, as amended by Article 2 of the law of 8 November 2011<sup>5</sup>;
  - Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC<sup>6</sup>.
- 2 Deutsches Institut für Bautechnik is authorized to check whether the provisions of this European technical approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European technical approval and for their fitness for the intended use remains with the holder of the European technical approval.
- 3 This European technical approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European technical approval.
- 4 This European technical approval may be withdrawn by Deutsches Institut für Bautechnik, in particular pursuant to information by the Commission according to Article 5(1) of Council Directive 89/106/EEC.
- 5 Reproduction of this European technical approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of Deutsches Institut für Bautechnik. In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European technical approval.
- 6 The European technical approval is issued by the approval body in its official language. This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

<sup>1</sup> Official Journal of the European Communities L 40, 11 February 1989, p. 12  
<sup>2</sup> Official Journal of the European Communities L 220, 30 August 1993, p. 1  
<sup>3</sup> Official Journal of the European Union L 284, 31 October 2003, p. 25  
<sup>4</sup> *Bundesgesetzblatt Teil I* 1998, p. 812  
<sup>5</sup> *Bundesgesetzblatt Teil I* 2011, p. 2178  
<sup>6</sup> Official Journal of the European Communities L 17, 20 January 1994, p. 34

## II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

### 1 Definition of product and intended use

#### 1.1 Definition of the construction product

"*Binderholz Brettsperrholz BBS*" are special plane timber building components which are made by at least three layers of softwood boards. Adjacent layers are glued together with an angle of 90°. Cross section of the elements is symmetrically. The term symmetry only refers to the properties of the product which are relevant for the load-bearing capacity: geometry (grain direction of the longitudinal and cross layers) and strength of the applied timber (grading and classification).

The principle structure is shown in Annexes 1/1 to 1/3. Details of the acceptable structures are contained in section 2.1.2.

Two adjacent layers may be oriented with parallel grain direction if a symmetric and crosswise blocked structure is guaranteed.

Not load-bearing outer layers are permissible.

Building elements are plane.

Timber elements can be produced with a width up to 3.5 m and a length up to 22 m as *Großformat* and with a width up to 1.25 m und a length up to 5 m as *Systemformat*.

By cutting after the production more narrow elements can be fabricated.

The building components in *Systemformat* may be connected in the plant in longitudinal direction by universal finger jointing in accordance with EN 387<sup>7</sup> to a length of up to 24 m.

The application of chemical substances (wood preservatives and flame-protective agents) is not subject of this European technical approval.

#### 1.2 Intended use

1.2.1 The elements are intended to be used as load-bearing and/or stiffening or not load-bearing wall, ceiling/floor, roof and special construction components for timber structures. For the taking up and transmitting of loads they may be stressed both perpendicular to the element plane and in the element plane.

1.2.2 The application may only be made in construction works with mainly static resp. quasi static actions according to the standard EN 1990<sup>8</sup>.

1.2.3 The application is admissible only in the service classes 1 and 2 according to EN 1995-1-1<sup>9</sup>.

When the elements are used as external construction components an additional durable effective weather protection is necessary.

1.2.4 The provisions made in this European technical approval are based on an assumed working life of the "*Binderholz Brettsperrholz BBS*" of 50 years, provided that the conditions laid down in sections 4.2, 5.1 and 5.2 for the transport, storage, installation, use, maintenance and repair are met. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

<sup>7</sup> EN 387:2001 Glued laminated timber - Large finger joints - Performance requirements and minimum production requirements

<sup>8</sup> EN 1990:2002 + A1:2005 + A1:2005/AC:2010 Eurocode: Basis of structural design

<sup>9</sup> EN 1995-1-1:2004 + AC:2006 + A1:2008 Eurocode 5: Design of timber structures - Part 1-1: General - Common rules and rules for buildings

## 2 Characteristics of product and methods of verification

### 2.1 Mechanical resistance and stability

#### 2.1.1 General

The characteristics of the building product and its components are contained in Annexes 2/1 to 3 of the European technical approval. Details of the elements are laid down with *Deutsches Institut für Bautechnik*.

#### 2.1.2 Structure of the timber elements

Specifications of the structure of the elements and the boards were used are given in Annexes 1/1 to 2. Boards are visually or machine strength graded. Only technically dried wood shall be used.

Only boards which are planed on both sides of the outer layer shall be used. The individual boards may be glued together in length direction by finger jointing according to EN 385<sup>10</sup>. Butt joints are not permissible.

Building components of *Systemformat* with a width up to 1.25 m may be connected in longitudinal direction by universal finger jointing in accordance with EN 387.

The boards of the longitudinal layers of the *Großformat* have grooves with a width of 4 mm in grain direction. The distances of the grooves from the edge and among each other must be in a range of 40 mm to 80 mm. The remaining thickness of the board under the groove must be 50 % of the thickness of the board at least.

The single boards of the layers in longitudinal direction may be glued at narrow side. The permissible width of the gap is given in Annex 2/1.

#### 2.1.3 Requirements to adhesive

For gluing the board layers, for the finger joint connection of the individual boards and for the universal finger joint connection shall be used an adhesive according to EN 301<sup>11</sup> which meet the requirements of EN 302-1, -2, -3 and -4<sup>12</sup>. Alternatively a PU-adhesive free of formaldehyde which meets the requirements of EN 14080<sup>13</sup>, annex C, may be used. For the classification EN 15425<sup>14</sup> applies.

Regarding the applicable type of adhesive national regulations apply.<sup>15</sup>

Details on the adhesives are deposited with *Deutsches Institut für Bautechnik*.

The bonding of the surfaces of *Großformat* will be carried out by a vacuum press method. All other bonding will be carried out by a hydraulic pressing service.

- |    |  |   |
|----|--|---|
| 10 | EN 385:2001  | Finger jointed structural timber - Performance requirements and minimum production requirement  |
| 11 | EN 301:2006  | Adhesives, phenolic and aminoplastic, for load-bearing timber structures  |
| 12 | EN 302-1 to -4                                     | Adhesives for load-bearing timber structures – Test methods –<br>Part 1: Determination of bond strength in longitudinal tensile shear strength; Edition 2004<br>Part 2: Determination of resistance to delamination; Edition 2004<br>Part 3: Determination of the effect of acid damage to wood fibres by temperature and humidity cycling on transverse tensile strength; Edition 2004 + A1:2005<br>Part 4: Determination of the effects of wood shrinkage on shear strength; Edition 2004 |
| 13 | EN 14080:2005                                      | Timber structures – Glued laminated timber and glued solid timber - Requirements  |
| 14 | EN 15425:2008                                      | Adhesives – One component polyurethane for load bearing timber structures – Classification and performance requirements   |
| 15 | In Germany adhesives of the type I are to be used. |   |

The pressing operation of the boards for "*Binderholz Brettsperrholz BBS*" must be carried out by vacuum press method at an absolute air pressure in a range of 10 kPa to 20 kPa (vacuum 90 kPa to 80 kPa). The measuring of the vacuum in the pressing jig has to take place with a large distance to the suction point.

The vacuum has to be produced before the total holding time of the adhesive is elapsed.

**2.1.4 Mechanical resistance**

Specifications of strength values of the building components are included in Annex 2/2 to 5.

The design of works can be achieved according to EN 1995-1-1. Design also may be carried out according to corresponding national provisions that apply at the installation site of the certified object.

**2.2 Safety in case of fire**

**Reaction to fire**

In accordance with Commission Decision 2003/43/EC "*Binderholz Brettsperrholz BBS*" for use as wall, roof and special construction components shall be assigned classes D-s2, d0 according to EN 13501-1<sup>16</sup>. For use as floor/ceiling construction component they shall be to in class D<sub>f</sub>-s1. The boundary conditions stated in the Commission Decision shall be respected.

The Decision of the European Commission might not apply if wood-based panels or other coverings are part of the element, depending on the coverings used and the boundary conditions affected.

Note:

A European reference fire scenario for façades has not been laid down. In some Member States, the classification of the cross laminated timber according to might not be sufficient for the use in façades. An additional assessment of the cross laminated timber according to national provisions (e.g. on the basis of a large scale test) might be necessary to comply with Member State regulations, until the existing European classification system has been completed.

**2.3 Hygiene, health and environment**

A manufacturer's declaration has been submitted to *Deutsches Institut für Bautechnik* that no dangerous substances are used in the timber elements.

The class of formaldehyde is E1 according to EN 13986<sup>17</sup>.

Note:

In addition to the specific clauses relating to dangerous substances contained in this European technical approval, 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. In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with.

**2.4 Methods of verification**

The assessment of the fitness of the cross laminated timber for the intended use in relation to the requirements for mechanical resistance and stability, for safety in case of fire, for hygiene, health and the environment, for protection against noise, for energy economy and heat retention, as well as for durability in these fields has been made in compliance with the assessment rules for cross laminated timber agreed upon within EOTA.

16	EN 13501-1:2007	Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests
17	EN 13986:2005	Wood-based panels for use in construction - Characteristics, evaluation of conformity and marking

### 3 Evaluation and attestation of conformity and CE marking

#### 3.1 System of attestation of conformity

According to the decision 97/176/EC<sup>18</sup> of the European Commission the system 1 of attestation of conformity given in Annex III applies.

This system of attestation of conformity is defined as follows:

System 1: Certification of the conformity of the product by an approved certification body on the basis of:

- (a) Tasks for the manufacturer:
  - (1) factory production control;
  - (2) further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan;
- (b) Tasks for the approved body:
  - (3) initial type-testing of the product;
  - (4) initial inspection of factory and of factory production control;
  - (5) continuous surveillance, assessment and approval of factory production control.

Note: Approved bodies are also referred to as "notified bodies".

#### 3.2 Responsibilities

##### 3.2.1 Tasks for the manufacturer

###### 3.2.1.1 Factory production control

The manufacturer shall exercise permanent internal control of production. All the information, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. The factory production control system shall insure that the product is in conformity with this European technical approval.

The manufacturer may only use raw materials and constituent materials stated in the technical documentation of this European technical approval.

The factory production control shall be in accordance with the "Control Plan relating to the European technical approval ETA-06/0009, issued on 18 June 2013" which is part of the technical documentation of this European technical approval.

The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited with *Deutsches Institut für Bautechnik*.<sup>19</sup>

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the "Control Plan". The records include at least:

- designation of the product, basic materials and components,
- type of control or testing,
- date of manufacture of the product and date of testing of the product or basic materials or components,
- results of control and testing and, if appropriate, comparison with requirements,
- name and signature of person responsible for factory production control.

<sup>18</sup> Official Journal of the European Communities L 73/19 of 14/03/1997

<sup>19</sup> The "Control plan" is a confidential part of the European technical approval and only handed over to the approved body involved in the procedure of attestation of conformity. See section 3.2.2.

### 3.2.1.2 Other tasks for the manufacturer

The manufacturer shall, on the basis of a contract, involve a body which is approved for the tasks referred to in section 3.1 in order to undertake the actions laid down in section 3.2.2 For this purpose, the control plan referred to in sections 3.2.1.1 and 3.2.2 shall be handed over by the manufacturer to the approved body involved.

The manufacturer shall make a declaration of conformity, stating that the construction product is in conformity with the provisions of the European technical approval ETA-0/0189 issued on 18 June 2013. The declaration of conformity may only be given if the provisions of this European technical approval are met and the control plan is being followed.

### 3.2.2 Tasks for the approved bodies

The approved body shall perform the

- initial type-testing of the product,
- initial inspection of factory and of factory production control,
- continuous surveillance, assessment and approval of factory production,

in accordance with the provisions laid down in the control plan.

The initial inspection of the factory shall include the inspection of the factory plant, the technical equipment and the qualification of the staff,

The approved body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

The approved certification body involved by the manufacturer shall issue an EC certificate of conformity of the product stating the conformity with the provisions of this European technical approval. The certificate of conformity can only be given if the provisions of this European technical approval are met and the control plan is being followed.

In cases where the provisions of the European technical approval and its control plan are no longer fulfilled the certification body shall withdraw the certificate of conformity and inform *Deutsches Institut für Bautechnik* without delay.

### 3.3 CE marking

The CE marking shall be affixed on the product itself, on a label attached to the product; on the packaging or on accompanying commercial documents.

The letters "CE" shall be followed by the identification number of the approved certification body and be accompanied by the following additional information:

- name and address of the manufacturer (legal entity responsible for the manufacture),
- the last two digits of the year in which the CE marking was affixed,
- number of the EC certificate of conformity for the product,
- number of the European technical approval,
- designation of the element type, of which the use shall be followed from,
- species of the wood used,
- number and arrangement of the layers,
- nominal thickness of the element,
- strength class of the wood of each layer,
- class of release of formaldehyde,
- type and classification of the adhesive used.

#### **4 Assumptions under which the fitness of the product for the intended use was favourably assessed**

##### **4.1 Manufacturing**

The timber elements are manufactured in accordance with the provisions of this European technical approval using the automated manufacturing process in accordance with the technical documentation deposited and checked in the inspection.

The layers shall be glued together to the required thickness of the element.

The European technical approval is issued for the product on the basis of agreed data/information, deposited with the *Deutsches Institut für Bautechnik*, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to the *Deutsches Institut für Bautechnik* before the changes are introduced. The *Deutsches Institut für Bautechnik* will decide whether or not such changes affect the approval and consequently the validity of the CE marking on the basis of the approval and if so whether further assessment or alterations to the approval shall be necessary.

##### **4.2 Installation**

Design, calculation and installation shall be carried out by an expert/specialised company and qualified personnel.

###### **4.2.1 Design of timber elements**

This European technical approval only applies to the manufacture and use of the timber regulated here. Verification of stability of the buildings while using the timber elements is not subject of this European technical approval.

Fitness for the intended use is given under the following conditions:

- Design of the timber elements is carried out under the responsibility of an engineer experienced in these elements.
- Design of the construction provides a sufficient protection of the cross laminated timber elements.
- The cross laminated timber elements are installed correctly.

Design can be performed according to EN 1995-1-1 taking into account the Annexes 2 to 5 of this European technical approval. Standards and regulations valid in the place of use shall be considered.

###### **4.2.2 Installation of timber elements**

The manufacturer shall prepare assembling instructions in which the product-specific characteristics and important measures to be taken into consideration for assembling are described. The assembling instructions shall be available at every construction site.

The assembling of timber elements according to this European technical approval shall be carried out by qualified personnel.

Elements which are directly exposed to the weather shall be provided with an effective protection for the cross laminated timber element during assembling and service.

The safety-at-work and health protection regulations have to be observed.



## 5 Indications to the manufacturer

### 5.1 General

The manufacturer shall ensure that the requirements stated in clauses 1, 2 and 4 and of this European technical approval are made known to those who are concerned during planning and execution of the works.

### 5.2 Recommendations on packaging, transport and storage

The cross laminated timber elements shall be protected during transport and storage against any damage and detrimental moisture effects. The manufacturer's instructions for packaging, transport and storage shall be observed.

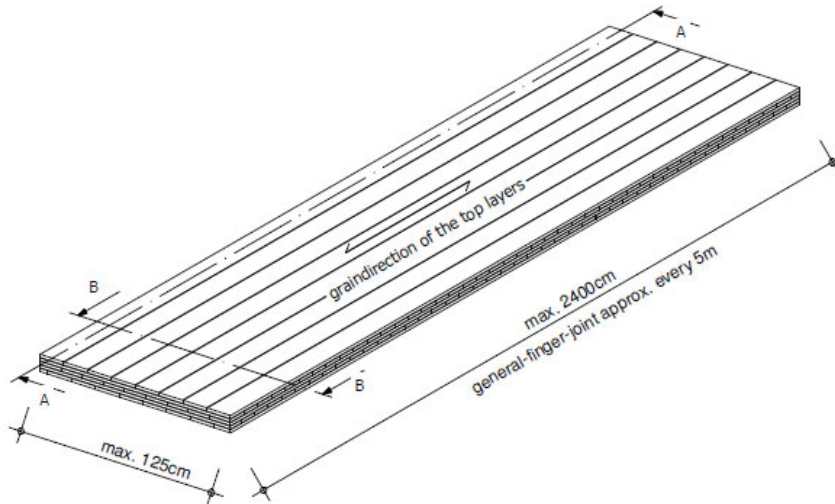
### 5.3 Use, maintenance, repair

The assessment of the fitness for use is based on the assumption that maintenance is not required during the assumed intended working life. In case of a severe damage of the building elements immediate actions regarding the mechanical resistance and stability of the works shall be initiated. Should the situation arise replacement of the elements can be necessary.

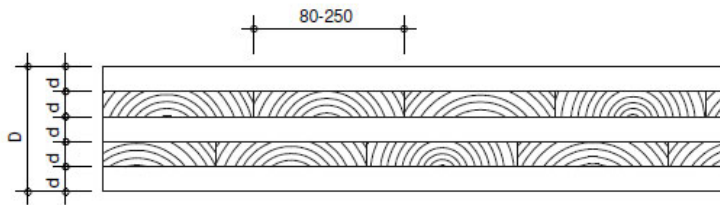
Andreas Kummerow  
p. p. Head of Department

*beglaubigt:*  
Wehlan

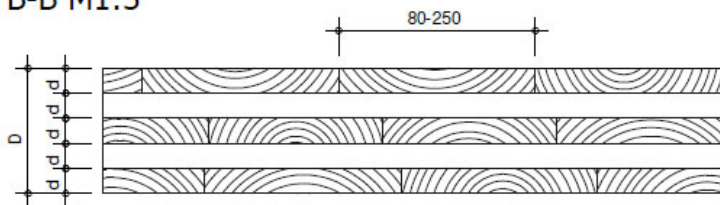
### ANNEX 1/1 Construction of a wood slab element of *Systemformat*



section A-A M1:5

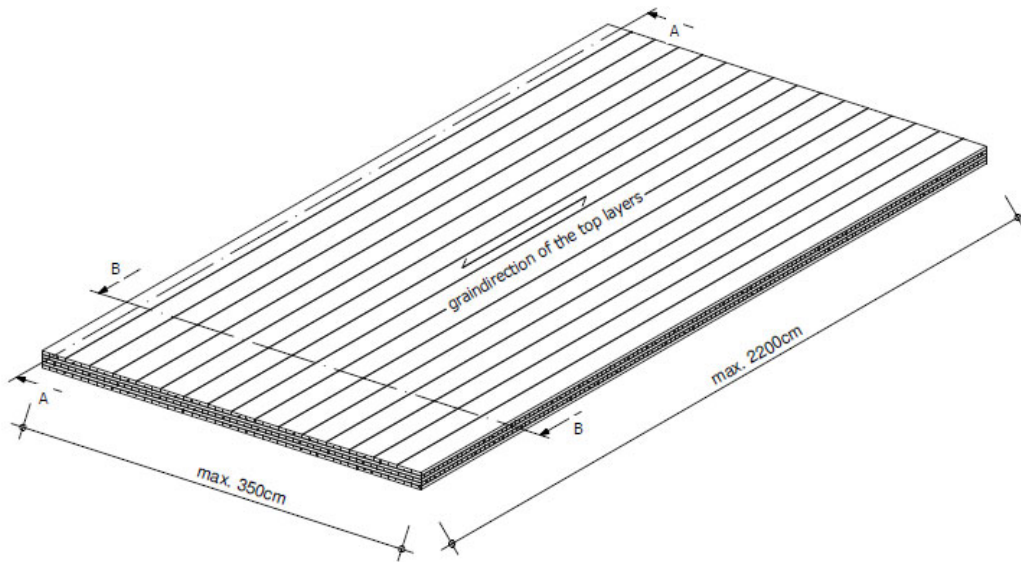


section B-B M1:5

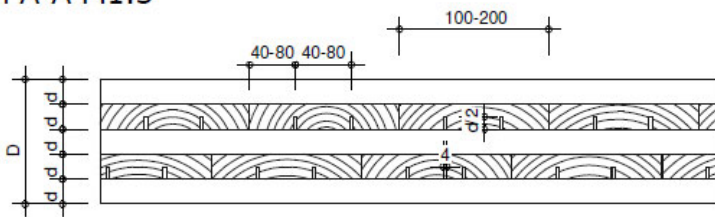


d= board thickness (18mm - 45mm)  
D= element thickness (54mm - 350mm)

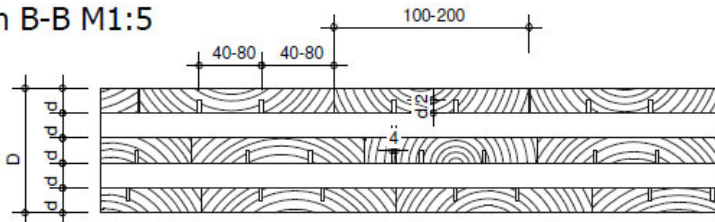
**ANNEX 1/2 Construction of a wood slab element of *Großformat***



section A-A M1:5

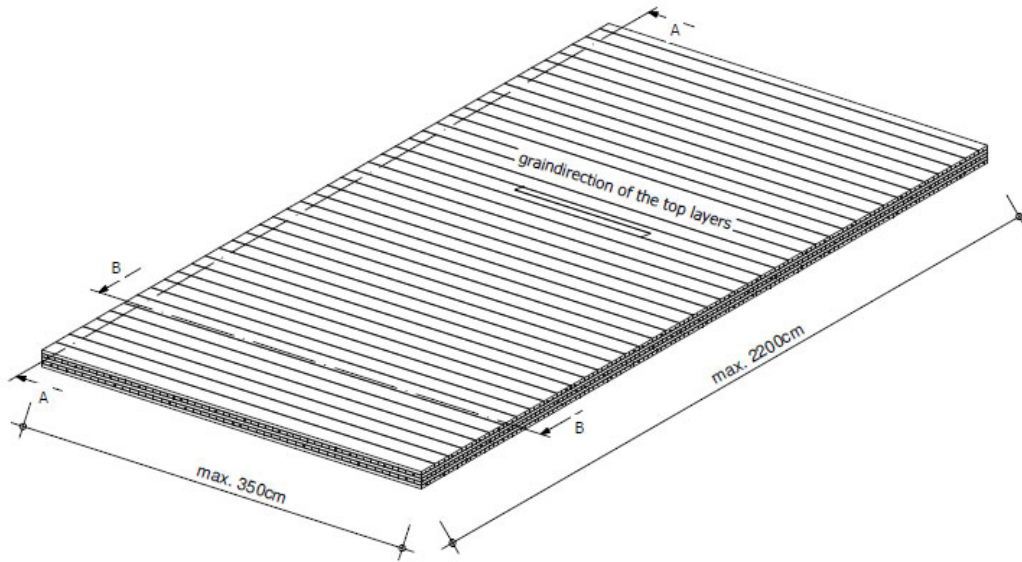


section B-B M1:5

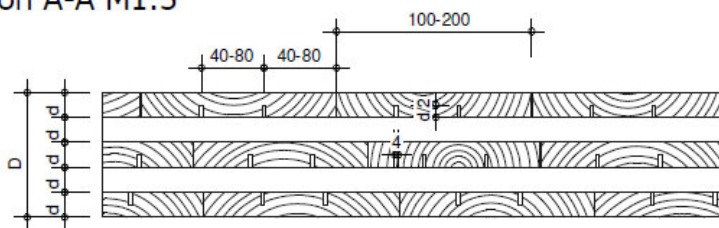


d= board thickness (17mm - 43mm)  
D= element thickness (51mm - 215mm)

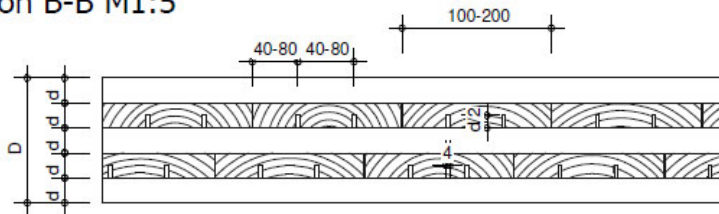
ANNEX 1/3 Construction of a wood slab element of *Großformat DQ*



section A-A M1:5



section B-B M1:5



d= board thickness (17mm - 43mm)  
D= element thickness (51mm - 215mm)

## ANNEX 2/1 Dimensions and specifications of the timber elements

Table 1 Dimensions and specifications of the timber elements

Characteristic	Specification
<b>Binderholz Brettsperrholz BBS "Systemformat"</b>	
Thickness	54 to 350 mm
Tolerance in thickness	± 1 mm
Width	≤ 1.25 m
Tolerance in width	± 2 mm
Length	≤ 5 m
Tolerance in length (relating to a max. length up to 5 m)	± 2 mm
Length of the element with large finger joint	≤ 24 m
Number of layers	3 ≤ n ≤ 9
maximum number of consecutive layers having the same grain direction	≤ 2
maximum width of gap between the boards of a layer	4 mm
<b>Boards</b>	
Material	softwood
Strength class according to EN 338 <sup>1</sup>	
Cover layers / longitudinal layers (having the same grain direction as cover layers)	≥ 90 % C24; < 10 % C16*
Cross layer (having the a grain direction perpendicular to the cover layer)	≥ 30 % C24; < 70 % C16**
Thickness	18 to 45 mm
Width	80 to 250 mm
Ratio width to thickness of the cross-layers	≥ 4:1
Moisture of wood according to EN 13183-2 <sup>2</sup>	12±2
Finger joints	according to EN 385
<b>Binderholz Brettsperrholz BBS "Großformat" and "Großformat DQ"</b>	
Thickness	51 to 215 mm
Tolerance in thickness	± 1 mm
Width	≤ 3.5 m
Tolerance in width	± 2 mm
Length	≤ 22 m
Tolerance in length (relating to a max. length up to 22 m)	± 2 mm
Number of layers	3 ≤ n ≤ 5

<sup>1</sup> EN 338:2009  
<sup>2</sup> EN 13183-2:2002

Structural timber – Strength classes  
Moisture content of a piece of sawn timber - Part 2: Estimation by electrical resistance method

**Table 1 (continued)**

maximum number of consecutive layers having the same grain direction	≤ 2
maximum width of gaps between the boards of a layer	4 mm
<b>Boards</b>	
Material	softwood
Strength class according to EN 338 Cover layers / longitudinal layers (having the same grain direction as cover layers) Cross layers (having the grain direction perpendicular to the cover layers)	≥ 90 % C24; < 10 % C16*
Thickness	17 to 43 mm
Width	100 to 200 mm
Ratio width to thickness of the cross-layers	≥ 4:1
Moisture of wood according to EN 13183-2	12 ± 2 %
Finger joints	according EN 385 mechanical resistance
* The proportion of wood of grade C16 may be disregarded by way of calculation. ** The proportion of wood of grade C24 shall be disregarded by way of calculation.	

**Annex 2/2 Dimensions and specifications of the timber elements**

**Table 2: Characteristic strength values and values of stiffness for  
"Binderholz Brettsperrholz BBS" in MN/m<sup>2</sup>**

Kind of stress		Strength class of boards	
		C16	C24
Characteristic strength values			
Bending	$f_{m,k}$	16	24
Tension	$f_{t,0,k}$	10	14
	$f_{t,90,k}$	0.4	0.4
Compression	$f_{c,0,k}$	17	21
	$f_{c,90,k}$	2.2	2.5
Shearing	$f_{v,k}$	1.8	2.5
Rolling shear "Systemformat"	$f_{R,k}$	1.0	
Rolling shear "Großformat" and "Großformat DQ"	$f_{R,k}$	0.7	
Values of stiffness			
Elasticity modulus of bending	$E_{0,mean}$	8000	11000
	$E_{90,mean}$	270	370
Shear modulus	$G_{mean}$	500	690
Rolling shear modulus	$G_{R,mean}$	50	

**Annex 3 Essential requirements of the timber elements**

**Table 3: Essential requirements of the timber elements**

ER	Requirement	Verification method	Class / Use category / Value	
<b>Mechanical resistance and stability</b>				
1	Panel shear strength  Bending strength	For the calculation of the single layers the characteristic strength and stiffness values of softwood of the corresponding strength classes according to EN 338 resp EN 14081-1 shall be used taking into consideration the definitions in Annex 2/2. In addition the following values apply:		
		Rolling shear strength "Systemformat" (5%-fractile)	$f_{R,k}$	1.0 N/mm <sup>2</sup>
		Rolling shear strength "Großformat" and "Großformat DF" (5%-fractile)	$f_{R,k}$	0.70 N/mm <sup>2</sup>
		Rolling shear modulus (mean value)	$G_{R,mean}$	50 N/mm <sup>2</sup>
		In case of connecting the elements by universal jointing the characteristic bending strength is to reduce by 25 %. In case of racking the characteristic tensile strength is to reduce by 30 %.  For references regarding the calculation see annexes 4/1 to 5. National regulations might have to be followed.		
	Use of fasteners	according to EN 1995-1-1, for further details see Annex 4		
	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.		
<b>Safety in case of fire</b>				
<b>Reaction to fire</b>				
2	Timber elements except for floorings	Commission Decision 2003/43/EC	Euroclass D-s2, d0	
	Floorings		Euroclass D <sub>fl</sub> -s1	
<b>Resistance to fire</b>				
	Charring rate	EN 1995-1-2 <sup>1</sup>	0.7 mm/min	
<b>Hygiene, health and the environment</b>				
3	Vapour permeability $\mu$	EN 10456 <sup>2</sup>	20 to 50	
	Release of formaldehyde	EN 13986 with respect to solid wood slab elements	Class E1	
<b>Safety in use</b>				
4	Slipperiness		no performance determined	
	Impact resistance		no performance determined	

<sup>1</sup> EN 1995-1-2:2004 + AC:2009 Eurocode 5: Design of timber structures – Part 1-2: General – Structural fire design  
<sup>2</sup> EN 10456:2007 \* AC:2009 Building materials and products – Tabulated design values and procedures for determining declared and design thermal values



**Table 3 (continued)**

<b>Protection against noise</b>		
<b>5</b>	Airbourne sound insulation	no performance determined
	<b>Table 3 (continued)</b>	
	Impact sound insulation	no performance determined
	Sound absorption	EN ISO 717-2 no performance determined
<b>Energy economy and heat retention</b>		
<b>6</b>	Thermal conductivity $\lambda$	EN ISO 10456 0,13 W/(m <sup>2</sup> · K)
	Air tightness	no performance determined
	Thermal inertia $c_p$	EN 10456 1.600 J/( kg · K)
<b>Durability</b>		
-	Use only in service classes	EN 1995-1-1 1 and 2

## Annex 4/1 Recommendations for the design of the elements and the fastener

### 1 Recommendations for the design of the elements

#### 1.1 General

Design, calculation and realization can be done according to EN 1995-1-1 taking into account the following provisions. For the calculation according to EN 1995-1-1 national regulations may have to be followed.

The determination of the distribution of stresses and internal forces must consider the influence of shear deformations of the cross layers. In Annex 5 advice is given on how to perform the calculation of the elements.

If using panels as cover, the deformation of the covers might have to be taken into account. These cover layers may not be used for calculation of the bearing capacity of the cross laminated timber elements.

#### 1.2 Characteristic values

The characteristic strength and stiffness values can be taken from Annex 2 and 3. In addition the following applies:

While calculating the part of the deformation due to shear forces, the element's thickness  $D$  regardless of the configuration and a shear modulus of  $G = 60 \text{ N/mm}^2$  may be used.

#### 1.3 Mechanical actions perpendicular to the element's plane

##### 1.3.1 Bending and shear

For the calculation of the characteristic values of the element according to Annex 5, only the boards, which are oriented parallel to the span direction, might be considered.

For the verification of the bending strength of a layer the design value of the bending strength might be multiplied with a system factor  $k_{\ell}$ :

$$k_{\ell} = \min \begin{cases} 1 + 0,025 \cdot n \\ 1,1 \end{cases}$$

with  $n$  = number of boards lying side by side.

##### 1.3.2 Tension and compression

The behaviour in bearing and deformation against compression perpendicular to the element's plane can be calculated according to EN 1995-1-1 using the strength and stiffness values given in chapter 1.2.

Tension loads perpendicular to the element should be avoided.

#### 1.4 Mechanical actions in plane of the element

For loads in plane of the element only layers can be taken into account, where the direction of the grain is parallel to the stresses occurring from external loads.

##### 1.4.1 Shear

If forces between adjacent boards of a layer are transmitted only by means of using the next layer glued crosswise, the shear stresses in the crossing surfaces have to be calculated as follows:

$$\tau_{T,d} = \frac{F_d \cdot h}{\sum I_p} \cdot \frac{a}{2} \leq f_{v,d}$$

with  $F_d$  = external load on a wall element (N)  
 $h$  = height of the wall (mm)  
 $a$  = largest side length of the crossing area (mm)

## Annex 4/2 Recommendations for the design of the elements and the fastener

- $I_p$  = polar moment of inertia of a certain crossing area  $i$  ( $\text{mm}^4$ )  
 $\sum I_p$  = sum of all polar moments of inertia of the crossing areas in the element  
 $f_{v,d}$  = design value of the torsional shear strength; the characteristic value shall be set to  $f_{v,k}$   
= 2.5 N/mm<sup>2</sup> for this calculation  
 $\tau_{T,d}$  = design value of the torsional stresses occurring if boards of one layer are not glued on their narrow sides

In addition it has to be verified that the layers can bear the stresses falling upon them.

### 1.4.2 Tension and compression

The behaviour in bearing and deformation in the element's plane can be calculated according to EN 1995-1-1 using the strength and stiffness values given in chapter 1.2.

## 2 Recommendations for the design of the fasteners

### 2.1 General

The determination of characteristic values of the load-bearing capacity of fasteners in the element shall be carried out according to EN 1995-1-1 or a European technical approval which has been granted for the relevant fastener as for softwood or for glued laminated timber. For the calculation according to European regulations national provisions may apply.

Side surfaces are the surfaces of the element parallel to the plane of the element consisting of the surface of the outer layers.

Narrow surfaces are the surfaces perpendicular to the plane of the element, consisting of the lateral surfaces and the cross grain of the boards.

As fasteners nails, wood screws, bolts, dowels and dowels type fasteners according to EN 1995-1-1 or a European technical approval may be used.

Fasteners in narrow sides may not take into account as load-bearing. Decisive for the minimum spacings of the fasteners and the embedding strength is the grain direction of the cover layers.

Other fasteners resp. their dimensions and application stated in this approval may be used and calculated with special and with *Deutsches Institut für Bautechnik* coordinated verifications.

### 2.2 Connections with dowels and bolts

The characteristic value of connections with dowels and bolts in the side surfaces can be calculated according to EN 1995-1-1.

The minimum distance and spacing for dowels and bolts must be  $5 \cdot d$  from the loaded edge and between each other and  $3 \cdot d$  from the unloaded edge. This applies regardless of the angle between the direction of force and the direction of the grain.

## Annex 4/2 Recommendations for the design of the elements and the fastener

### 2.3 Nails

The characteristic value of the load-bearing capacity of axially loaded nails in the side surfaces can be calculated according to EN 1995-1-1.

The diameter of nails must be at least 4 mm. Only grooved nails with a characteristic value of the point side withdrawal strength  $f_{ax,k} \geq 50 \cdot 10^{-6} \cdot \rho_k^2$  and a characteristic value of the head side pull-through strength  $f_{head,k} \geq 100 \cdot 10^{-6} \cdot \rho_k^2$  might be employed for axial loading ( $\rho_k$  = characteristic density in kg/m<sup>3</sup>; max. 500).

### 2.4 Screws

The characteristic value of the load-bearing capacity of screws in the side surfaces of the board can be calculated according to EN 1995-1-1.

Screws must have a diameter of at least 4 mm.

### 2.5 Split ring connectors and toothed-plate connectors

The characteristic value of the load-bearing capacity of split ring connectors and toothed-plate connectors in the side surfaces of the board can be calculated according to EN 1995-1-1.

Toothed-plate connectors in the narrow surfaces might not be taken into consideration as load-bearing.

## Annex 5 Recommendations for the design of the element under bending stress Design according to the theory of flexible bonded beams

The calculation of elements with up to five layers can be performed using the theory of flexible bonded beams as described in EN 1995-1-1.

To consider deformations due to shear the factor  $s_i/K_i$  according to the standard is substituted by the factor  $\bar{h}_i/(G_R \cdot b)$ .

The effective moment of inertia is calculated by:

$$I_{ef} = \sum_{i=1}^3 (I_i + \gamma_i \cdot A_i \cdot a_i^2) \quad \text{with} \quad A_i = b_i \cdot h_i; \quad I_i = \frac{b_i \cdot h_i^3}{12}$$

$$\gamma_1 = \frac{1}{1 + \frac{\pi^2 \cdot E_0 \cdot A_1 \cdot \bar{h}_1}{G_R \cdot b \cdot l^2}}; \quad \gamma_2 = 1; \quad \gamma_3 = \frac{1}{1 + \frac{\pi^2 \cdot E_0 \cdot A_3 \cdot \bar{h}_2}{G_R \cdot b \cdot l^2}}$$

$$a_1 = \left( \frac{h_1}{2} + \bar{h}_1 + \frac{h_2}{2} \right) - a_2; \quad a_3 = \left( \frac{h_2}{2} + \bar{h}_2 + \frac{h_3}{2} \right) + a_2$$

$$a_2 = \frac{\gamma_1 \cdot A_1 \cdot \left( \frac{h_1}{2} + \bar{h}_1 + \frac{h_2}{2} \right) - \gamma_3 \cdot A_3 \cdot \left( \frac{h_2}{2} + \bar{h}_2 + \frac{h_3}{2} \right)}{\sum_{i=1}^3 (\gamma_i \cdot A_i)}$$

The verification of the bending performance is done by determination of the bending stress at the boundary of the boards. The bending stress in the middle of the boards may remain unconsidered.

$$\sigma_{m,r,i,d} = \pm \frac{M_d}{I_{ef}} \cdot \left( \gamma_i \cdot a_i + \frac{h_i}{2} \right) \leq f_{m,d}$$

The verification of the shear performance is done by determination of the shear stress in the decisive plane:

$$\tau_{v,d} = \frac{V_d \cdot \gamma_i \cdot S_i}{I_{ef} \cdot b} \leq f_{R,d}$$

Legend:

- $h_{tot}$  = thickness of the whole element [mm]
- $h_i$  = thickness of the layer  $i$  parallel to the direction of load transfer [mm]
- $\bar{h}_i$  = thickness of the layer  $i$  perpendicular to the direction of load transfer [mm]
- $b$  = width of the element [mm]
- $n$  = number of layers
- $l$  = span width [mm]
- $I_{ef}$  = effective moment of inertia [Nmm<sup>2</sup>]
- $G_R$  = rolling shear modulus [N/mm<sup>2</sup>]
- $E_0$  = modulus of elasticity parallel to the grain of the boards [N/mm<sup>2</sup>]