

Approval body for construction products
and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and
Laender Governments



European Technical Assessment

ETA-11/0001
of 6 January 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

TSH-WM WF2 system stair in load-bearing bolt style or
folded plate style

Product family
to which the construction product belongs

Prefabricated stair with steps made of solid wood and
load-bearing bolts for use as an indoor stair in buildings

Manufacturer

TSH System GmbH
Gesellschaft für Systemlösungen des Tischler-
und Schreinerhandwerks mbH
Fürstenrieder Straße 250
81377 München
DEUTSCHLAND

Manufacturing plant

Werk 1 bis 85

This European Technical Assessment
contains

15 pages including 3 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

European Assessment Document (EAD)
340006-00-0506

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Specific Part

1 Technical description of the product

The "TSH-WM WF2 system stair in load-bearing bolt style or folded plate style" is a prefabricated stair system, which consists of steps, load-bearing bolts and wall ties. The stair can also be formed as a folded plate stair by additional risers.

The steps are connected with each other by a load-bearing bolt on the wall-free side and on the wall side. On the wall side each step is equipped with at least one wall tie, which is anchored in the staircase wall. Alternatively, the staircase wall may also be replaced by a stringer (solid wood or steel).

The steps and risers are made of solid wood, the load-bearing bolts are made of steel and solid wood, the fasteners and wall ties are made of steel.

The product description is given in Annex A. The material values, dimensions and tolerances of the components of the stair not indicated in the annexes shall correspond to the values laid down in the technical documentation¹.

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

The performances given in Section 3 are only valid if the stair is used in compliance with the specifications and conditions given in Annex B.

The verification and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the stair of at least 50 years. 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.

¹ The technical documentation comprises all information of the holder of this ETA necessary for the production, installation and maintenance of the stair; these are in particular the structural analysis, design drawings and the manufacturer's installation instructions. The part to be treated confidentially is deposited with Deutsches Institut für Bautechnik and, as far as this is relevant to the tasks of the approved bodies involved in the procedure of attestation of conformity, shall be handed over to the approved body.

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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Load-bearing capacity of stair	See Annex C2
Load-bearing capacity of fixings	See technical documentation of this European Technical Assessment
Load/displacement behaviour	See Annex C2
Vibration behaviour	First natural frequency: $f_1 \geq 5$ Hz (inclusive a single mass of 100 kg) Deflection under a single load $F = 1$ kN: $w \leq 5$ mm
Prevention of progressive collapse	Failure of individual components of the stair does not lead to a progressive collapse of the complete stair
Residual load-bearing capacity	Local material failure does not lead to an abrupt total loss of load-bearing capacity of the steps.
Long-term behaviour	Load-bearing capacity are ensured under an appropriate use and maintenance over the indicated working life
Resistance to earthquakes	No performance assessed
Durability against physical, chemical and biological agents	Adequate durability for the intended use under an appropriate use and maintenance

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	See Annex A5
Fire resistance	No performance assessed

3.3 Hygiene, health and the environment (BWR 3)

Essential characteristic	Performance
Release of formaldehyde	Wood adhesive does not contain formaldehyde
Release of pentachlorophenol	No pentachlorophenol treated materials are used
Radioactive emission	Not relevant

English translation prepared by DIBt

3.4 Safety in use (BWR 4)

Essential characteristic	Performance
Geometry	See Annex C1
Slipperiness	No performance assessed
Equipment of the stair for a safe use	No performance assessed
Safe breakage of components	No brittle failure of individual components
Impact resistance	No performance assessed

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

In accordance with the European Assessment Document EAD No. 340006-00-0506 the applicable European legal act is: 1999/89/EC

The System to be applied is: 2+

In addition, with regard to reaction to fire for products covered by the European Assessment Document EAD No. 340006-00-0506 the applicable European legal act is: 2001/596/EC

The System to be applied is: 4

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document

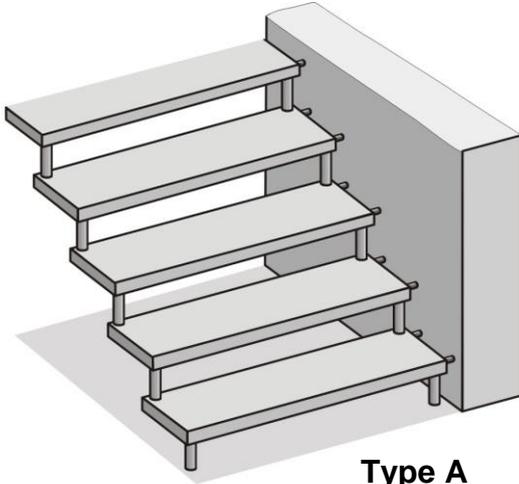
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Deutsches Institut für Bautechnik.

Issued in Berlin on 6 January 2017 by Deutsches Institut für Bautechnik

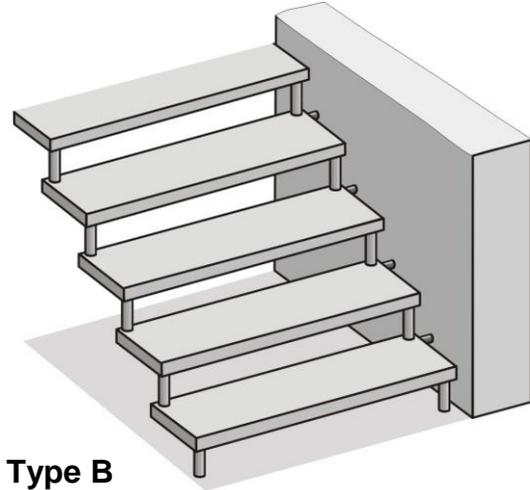
Andreas Kummerow
p. p. Head of Department

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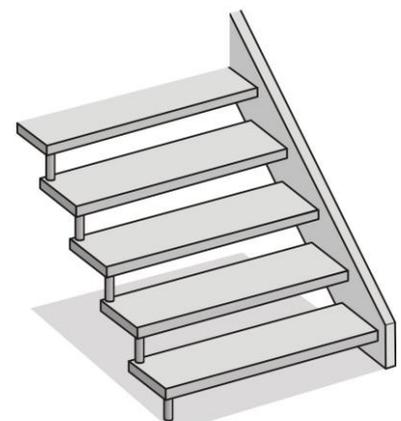
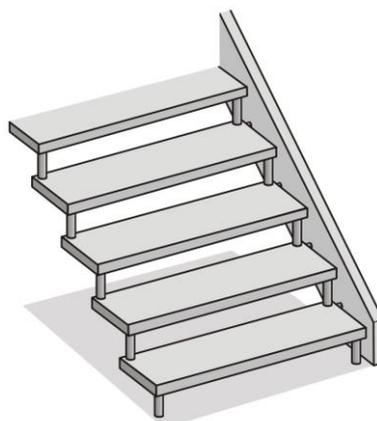
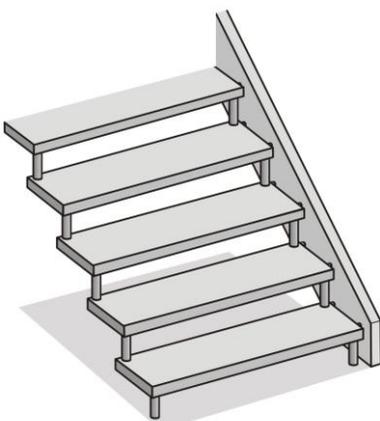
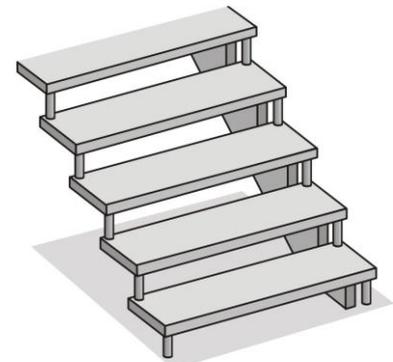
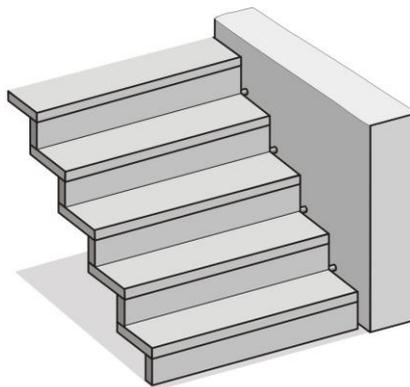
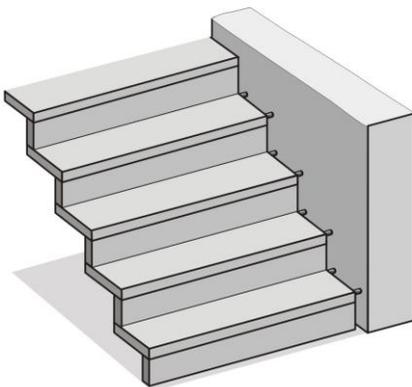
Types of construction



Type A



Type B



Fastening of stringers to the wall according to technical documentation

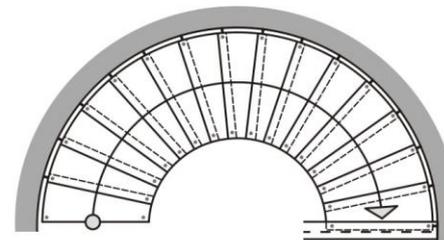
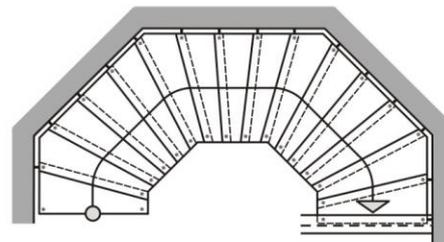
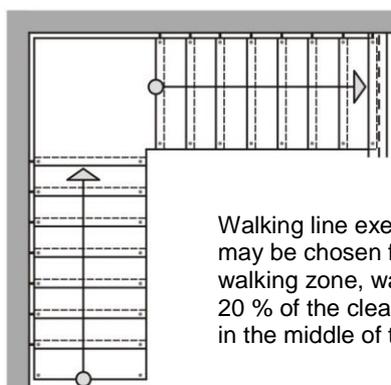
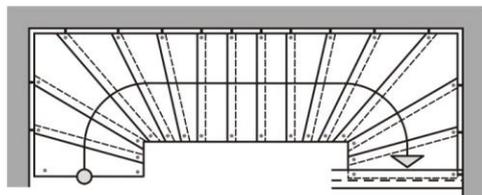
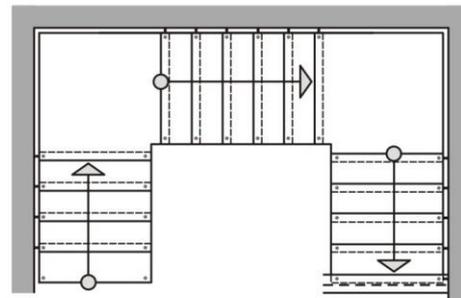
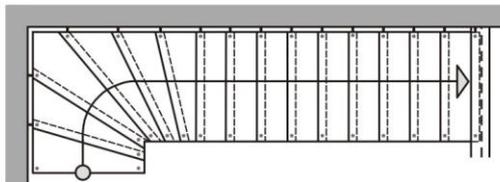
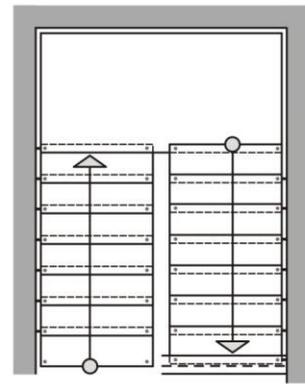
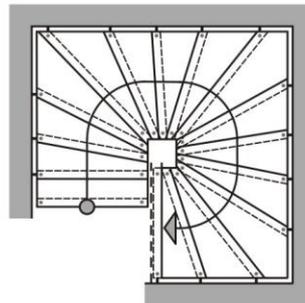
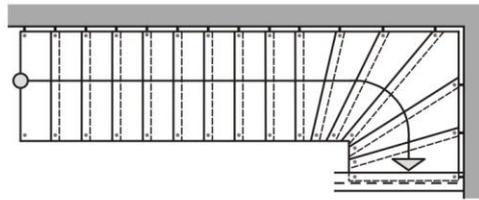
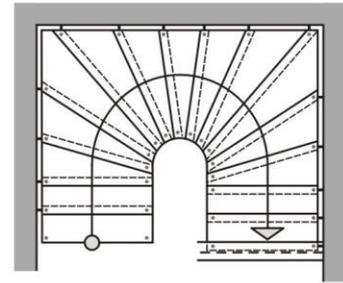
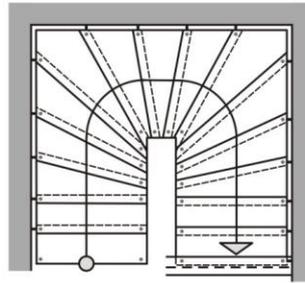
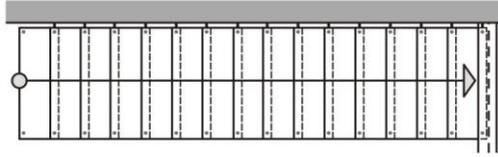
TSH-WM WF2 system stair in load-bearing bolt or folded plate style

Product (Types of construction)

Annex A1

Types of plan

Landings are not part of the ETA



Walking line exemplified, position may be chosen freely within the walking zone, walking zone is 20 % of the clear width of the stair in the middle of the stair

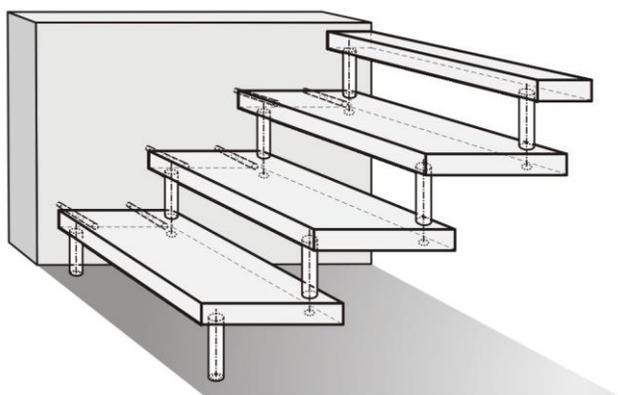
TSH-WM WF2 system stair in load-bearing bolt or folded plate style

Product (Types of plan)

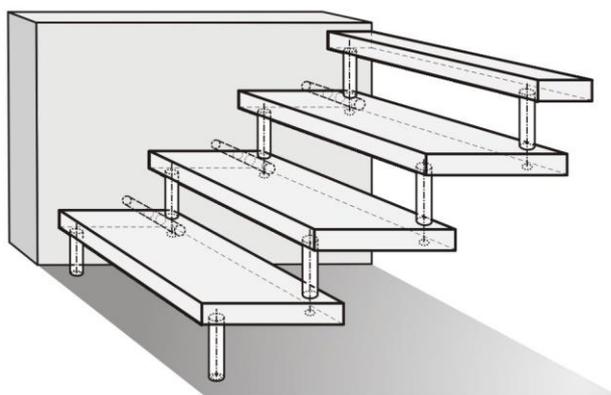
Annex A2

Wall ties

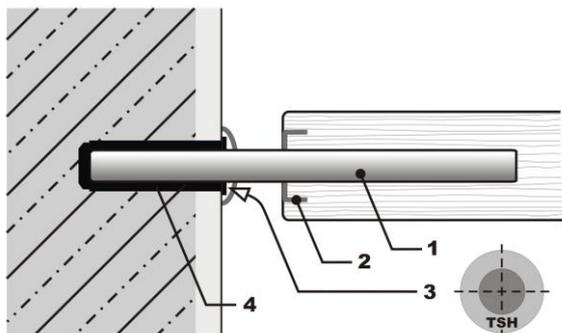
Type A



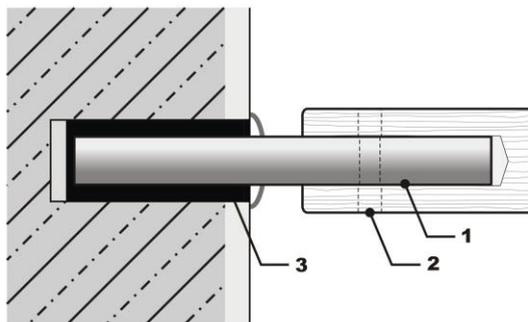
Type B



Minimum wall thickness and minimum strength of the wall material as well as distances to the wall according to the technical documentation



- 1 Wall tie
- 2 Ferrule (steps made of merbau and sapeli needs an edge strengthening according to technical documentation)
- 3 TSH-marking
- 4 Bearing sleeve



- 1 Wall tie
- 2 Bore hole for system screw
- 3 WM bearing sleeve

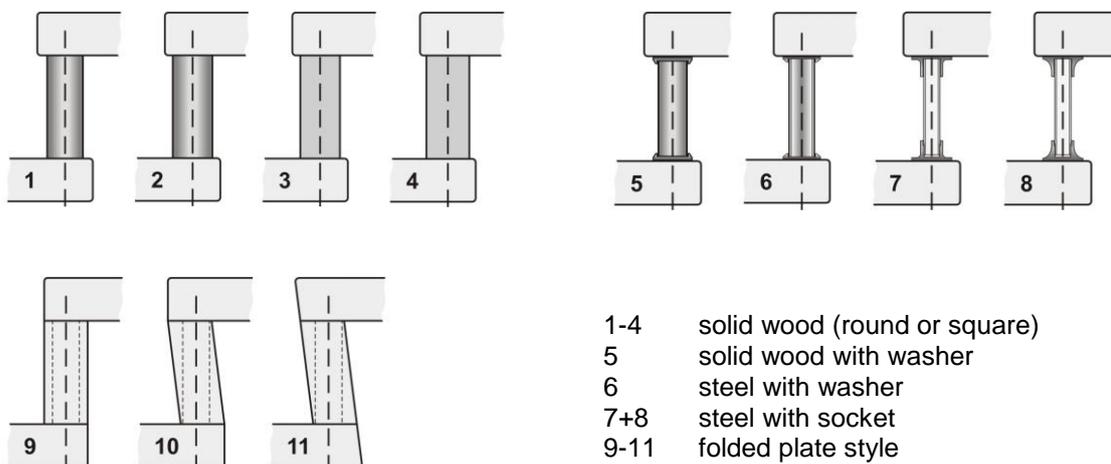
more details as well as supporting of stringers according to the technical documentation

TSH-WM WF2 system stair in load-bearing bolt or folded plate style

Wall ties

Annex A3

Load-bearing bolts



Support at bottom



Support at the top



more details according to the technical documentation

TSH-WM WF2 system stair in load-bearing bolt or folded plate style

Load-bearing bolts, Support at bottom and at the top

Annex A4

Table 1: Minimum dimensions of relevant stair components and reaction to fire

Component	Material ¹⁾	Dimension		Value	Reaction to fire	
Steps, risers	Solid wood ^{2) 3)}	Thickness	[mm]	54 ⁴⁾	D-s2, d0	
Load-bearing bolt - fastener	Steel	Diameter	[mm]	10	A1	
Load-bearing bolt-distance sleeve	Solid wood ²⁾	Diameter	[mm]	45 ⁴⁾ / 35 ⁵⁾	D-s2, d0	
	Solid wood ²⁾	Cross section a x b	[mm]	50 x 50 ⁴⁾		
	Steel	Diameter	[mm]	20 ⁶⁾ / 30 ⁵⁾	A1	
Wall tie Type A	Round steel	Diameter	[mm]	16	A1	
		Embedment depth wall	Masonry	[mm]		70
			Concrete	[mm]		40
			Wood stringer ⁷⁾	[mm]		30
			OSB ⁷⁾	[mm]		30
			Particle board ⁷⁾	[mm]		32
Embedment depth step	[mm]	110				
Wall tie Type B	Round steel	Diameter	[mm]	25	A1	
		Embedment depth wall	Masonry	[mm]		100
			Concrete	[mm]		40
			Wood stringer ⁷⁾	[mm]		10
			OSB ⁷⁾	[mm]		30
			Particle board ⁷⁾	[mm]		32
Embedment depth step	[mm]	95				
Bearing sleeve Type A	Plastics / rubber	Diameter	[mm]	25	not relevant	
Bearing sleeve Type B	Plastics / rubber	Diameter	[mm]	42		

- 1) Characteristic values of material according to technical documentation
- 2) Only hardwood of the following species: beech, oak and
Group 1: cherry tree, sapeli, birch
Group 2: ash, maple, nut tree, merbau,
- 3) 5-layer solid wood plate with characteristic values of material of group 2,
Composition of layers according to technical documentation
- 4) Thickness of steps and distance sleeves for the steps in straight flights an flights with one quarter turn according to Table 2a, 2b und 2c
- 5) Distance sleeves with washer $\varnothing \geq 45$ mm
- 6) Distance sleeves with socket $\varnothing \geq 50$ mm
- 7) Construction according to technical documentation

TSH-WM WF2 system stair in load-bearing bolt or folded plate style

Minimum dimensions of relevant stair components
and reaction to fire

Annex A5

Table 2a: Minimum dimensions of thickness of steps depending on distance sleeves and additional support for straight flights with 9 rises at maximum

Steps without additional support	Length of the walking line between supports	Thickness of Steps with distance sleeve (in mm) ²⁾				Folded plate ^{1) 2)}
		D = 45 ³⁾	D = 50 ³⁾	d/b = 50/50	d/b = 54/54	
8	≤ 2160 mm	62	61	59	58	54
7	≤ 1890 mm	56	54	54	54	54

Table 2b: Minimum dimensions of thickness of steps depending on distance sleeves and additional support for straight flights with 10 to 16 rises

Steps without additional support	Length of the walking line between supports	Thickness of Steps with distance sleeve (in mm) ²⁾				Folded plate ^{1) 2)}
		D = 45 ³⁾	D = 50 ³⁾	d/b = 50/50	d/b = 54/54	
15	≤ 4050 mm	80	79	78	77	67
14	≤ 3780 mm	77	76	74	73	64
13	≤ 3510 mm	75	74	72	70	62
12	≤ 3240 mm	72	71	69	67	60
11	≤ 2970 mm	69	68	66	64	58
10	≤ 2700 mm	66	64	62	61	56
9	≤ 2430 mm	63	61	59	57	54
8	≤ 2160 mm	59	57	55	54	54
7	≤ 1890 mm	56	54	54	54	54

Table 2c: Minimum dimensions of thickness of steps depending on distance sleeves and additional support for flights with one quarter turn

Steps without additional support	Length of the walking line between supports	Thickness of Steps with distance sleeve (in mm) ²⁾				Folded plate ^{1) 2)}
		D = 45 ³⁾	D = 50 ³⁾	d/b = 50/50	d/b = 54/54	
15	≤ 4050 mm	68	66	62	60	55
14	≤ 3780 mm	62	59	56	54	54
13	≤ 3510 mm	58	54	54	54	54

¹⁾ Thickness of riser = thickness of step

²⁾ for steps made of solid wood of group 1: values from Tables are valid
for steps made of solid wood of group 2: values from Tables minus 5%, but ≥ 54 mm
for steps made of beech: values from Tables minus 3%, but ≥ 54 mm
for steps made of oak: values from Tables plus 3%

³⁾ for distance sleeves with washer or socket; D = diameter of washer or socket

TSH-WM WF2 system stair in load-bearing bolt or folded plate style

Minimum dimensions of thickness of steps depending on type of plan, distance sleeves and additional support

Annex A6

Specification of intended use (Part 1)

Intended use:

- European Technical Assessment applies for a construction system.
- For the specific case of use the corresponding type of stair is manufactured within the context of the values defined in this European Technical Assessment.
- Values of this ETA apply to all types of stairs, the real dimensions follow in accordance with the relevant case of use.

Stair subject to:

- Static and quasi static loads

Use conditions:

- Indoor stair
- Air temperatures between +5 °C and +30 °C
- Relative air humidity between 30% and 70%
- To the individual requirements handrail and barrier can be attached to the stair optionally. Conditions for possible handrail/barrier:
 - Dead load ≤ 0.15 kN/m
 - Height ≤ 0.90 m
 - Distance of baluster ≤ 1.00 m

Design:

- Design of the stair according to the annexes and the technical documentation of this European Technical Assessment.
- Fastening of the stair to the construction works according to the annexes and the technical documentation of this Technical European Assessment.
- Verification of the transmission of loads to the construction works by the civil engineer responsible for the construction works.
- Load bearing capacity at ultimate limit state:

$$q_k \cdot \gamma_Q \leq q_{Rk} / \gamma_M$$

$$Q_k \cdot \gamma_Q \leq Q_{Rk} / \gamma_M$$

$$h_k \cdot \gamma_Q \cdot \psi_0 \leq h_{Rk} / \gamma_M$$

with

q_{Rk}, Q_{Rk}, h_{Rk} : characteristic values of resistance; see Table 4

γ_M : recommended material partial safety factor; see Table 4

q_k, Q_k, h_k : characteristic values of imposed loads according to EN 1991-1-1:2010-12

$\gamma_Q = 1.5$: recommended partial safety factor, in absence of other national regulations

$\psi_0 = 0.7$: recommended combination factor, in absence of other national regulations

- Maximum characteristic values of imposed loads under consideration of the partial factors mentioned above; see Table 6

TSH-WM WF2 system stair in load-bearing bolt or folded plate style

Specification of intended use (Part 1)

Annex B1

Specification of intended use (Part 2)

Installation:

- Installation by personal appropriately trained and authorized by the manufacturer by means of the technical documentation of this European Technical Assessment
- Installation only in the way as specified in the technical documentation of this European Technical Assessment
- Installation of timber components when moisture content of timber components is $8 \pm 2 \%$
- Sufficient support of the stair when assembling
- Installation of stair components without imposed deformations
- Installation of stair components without significant defects and cracks
- Replacing of stair components, which begin tearing when assembling
- Bolted connection are protected such that they will not be loosened by vibrations

Indication of the manufacturer:

- Ensure that all persons involved will be appropriately informed about the specific conditions according to sections 1 and 2 (including the annexes to which reference is being made as well as the not confidential parts of the technical documentation deposited to this European Technical Assessment)
- Packaging of timber components such that the wood moisture is $8 \pm 2 \%$ during transport and storage
- Instructions for use should provide information as to use, maintenance and repair of the stair. Including the information of avoidance of moisture penetration of the timber components and retightens the bolting of the load-bearing bolts and connections according to Annex A3 and A4 after the first heating season and the information on the relationship between moisture content of timber components, air temperature and relative air humidity

TSH-WM WF2 system stair in load-bearing bolt or folded plate style

Specification of intended use (Part 2)

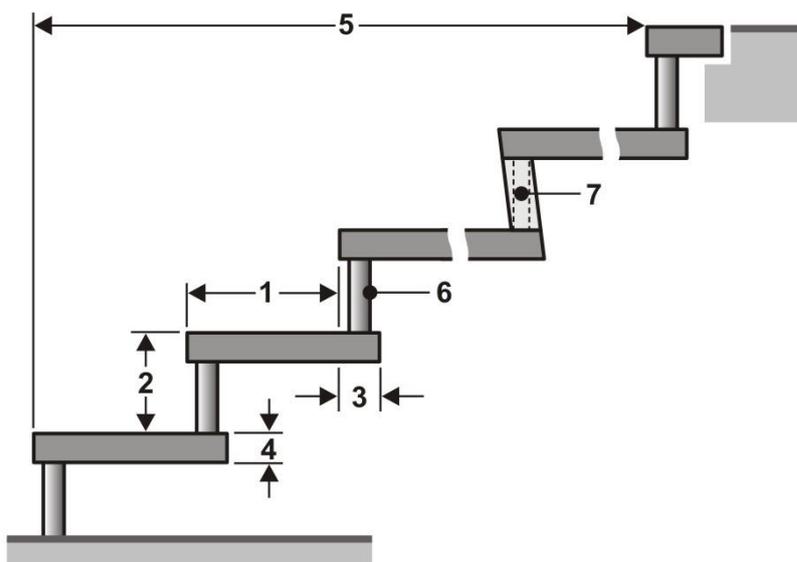
Annex B2

Table 3: Geometry

Designation			Dimension	
			minimum	maximum
Going	step on walking line ¹⁾	[mm]	210	370 ²⁾
	tapered step	[mm]	70 ^{2) 3)}	600 ^{2) 4)}
Rise of the stairs ¹⁾		[mm]	140 ²⁾	210
Pitch of the walking line ¹⁾		[°]	21	45
Overlap of the steps		[mm]	70 ⁶⁾	- ⁵⁾
Number of rises		[-]	3	16
Openings	between stairs and wall	[mm]	- ⁵⁾	50
	between consecutive steps	[mm]	- ⁵⁾	156
Clear width of stairs		[mm]	500	1000
Minimum headroom		[mm]	- ⁵⁾	
Length of the flight		[mm]	- ⁵⁾	4050
Thickness of steps		[mm]	54	- ⁵⁾

- 1) values are constant within one flight
- 2) tolerance between nominal value and actual value = ± 5 mm
- 3) inside of tapered step
- 4) outside of tapered step
- 5) not relevant
- 6) with riser overlap 0 mm

- 1 going
- 2 rise
- 3 overlap
- 4 thickness of steps
- 5 length of the flight
- 6 distance sleeve
- 7 Alternative: riser with load-bearing bolt inside



TSH-WM WF2 system stair in load-bearing bolt or folded plate style

Geometry of the stair

Annex C1

Table 4: Load-bearing capacity - Characteristic values of resistance

Type of loading	Characteristic values of resistance			γ_M ¹⁾
vertical variable uniformly distributed load	$q_{R,k}$	[kN/m ²]	6,8	1,5
vertical variable single load	$Q_{R,k}$	[kN]	4,5	
horizontal variable uniformly distributed load on barrier	$h_{R,k}$	[kN/m]	0,8	

¹⁾ Recommended partial safety factor, in absence of other national regulations

Table 5: Deflections under loading

Deflection of the flight under uniformly distributed load			
uniformly distributed load	q_k	[kN/m ²]	3.0
length of the median line of the flight	L	[mm]	4050 ¹⁾
deflection under load F_S related to the median line of the flight	w	[-]	≤ L/200
Deflection of the step under single point load			
single load	Q_k	[kN]	2.0
clear width of the stair	L	[mm]	1000
deflection under load F_S related to the clear width of the stair	w	[-]	≤ L/200

¹⁾ L = reference length = distance between supports,
with additional support according to Table 2a, 2b and 2c

Table 6: Imposed loads

Type of loading	Imposed loads		
vertical variable uniformly distributed load	q	[kN/m ²]	3.0
vertical variable single load	Q	[kN]	2.0
horizontal variable uniformly distributed load on barrier	h	[kN/m]	0.5

TSH-WM WF2 system stair in load-bearing bolt or folded plate style

Load-bearing capacity – Characteristic values of resistance,
Deflections under loading,
Imposed loads

Annex C2