Deutsches Institut für Bautechnik DIBt

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Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

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

European Technical Assessment

ETA-15/0565 of 10 August 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	FHS Spiral Stair
Product family to which the construction product belongs	Spiral stair with steps made of solid wood for use as an indoor stair in buildings
Manufacturer	FHS Treppen GmbH Kampenwandstraße 8 83224 Grassau DEUTSCHLAND
Manufacturing plant	Frisch Holz-Systembau
This European Technical Assessment contains	17 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 FHS Spiral Stair is a prefabricated stair system, which consists of steps, landings, a newel and load-bearing bolts.

The steps are stressed together between distance sleeves with tensioning bolt (newel). On the outside the steps are connected with each other by load-bearing bolts.

The steps and distance sleeves are made of solid wood, the newel and load-bearing bolts 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 documentation[1].

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 C3
Load-bearing capacity of fixings	See technical documentation of this European Technical Assessment
Load/displacement behaviour	See Annex C3
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 A6
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

3.4 Safety in use (BWR 4)

Essential characteristic	Performance
Geometry	See Annex C2
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

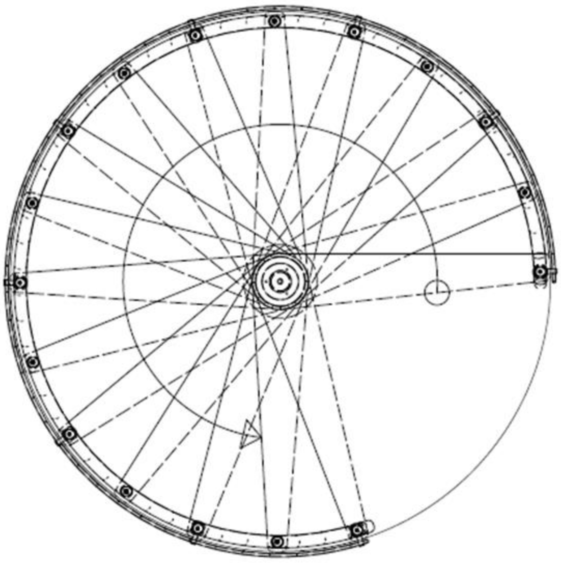
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Deutsches Institut für Bautechnik.

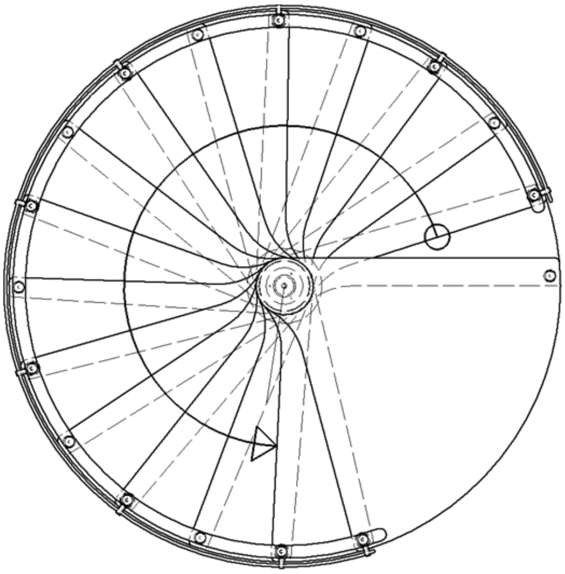
Issued in Berlin on 10 August 2017 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

beglaubigt:
Stiller

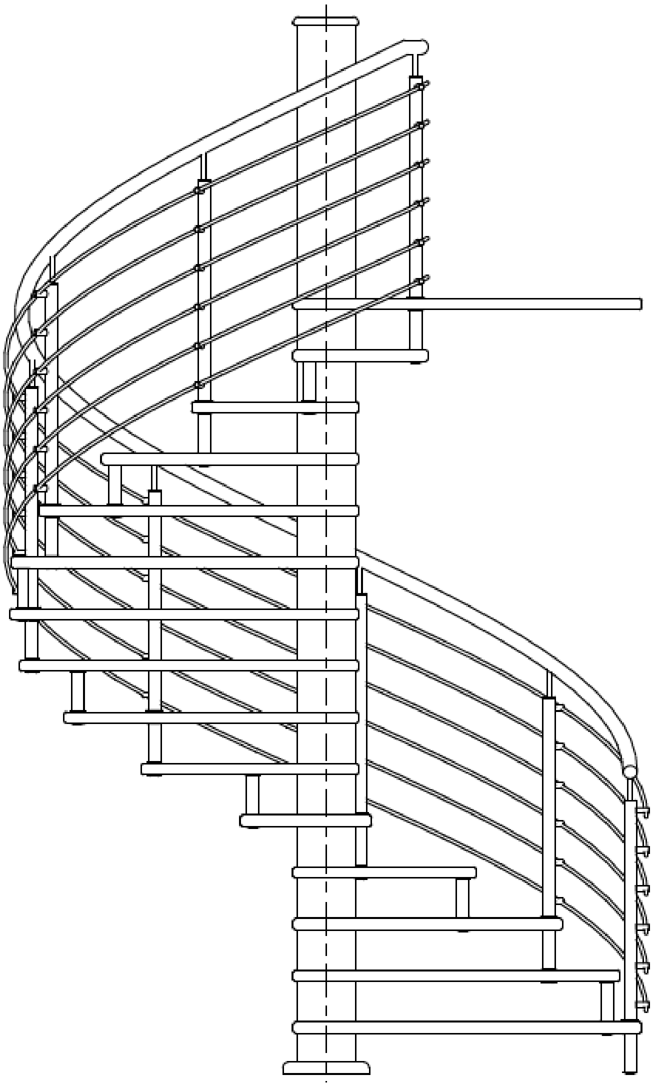
Plan view





Type I, ∅ ≤ 1300 mm
Type II, ∅ ≤ 1600 mm
Type III, ∅ ≤ 2000 mm
Type IV, ∅ ≤ 2200 mm
Type V, ∅ ≤ 2500 mm
Type VI ∅ ≤ 3000 mm

Front view



Notes:
Barrier and handrail are not part of the ETA

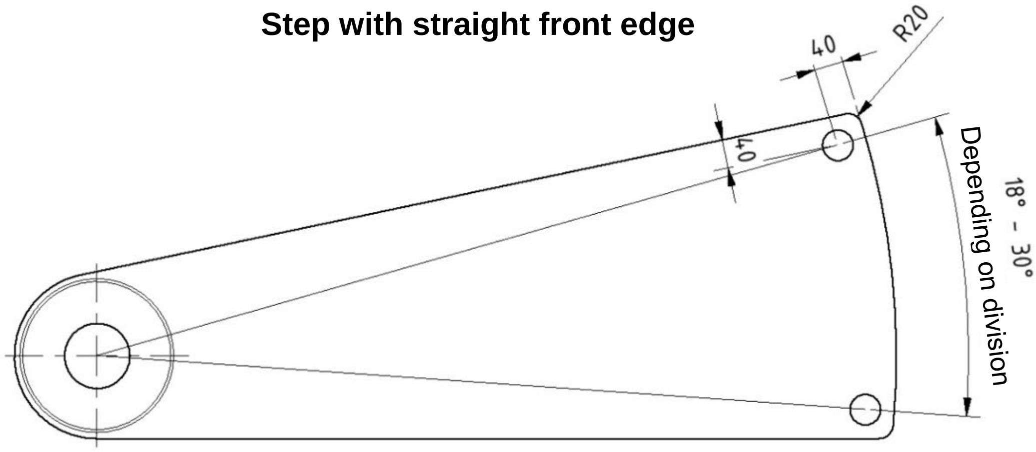
Walking line is exemplified, position may be chosen freely within the walking zone; walking zone is 20 % of the clear width of the stair. The inside limit of the walking zone is in the middle of the clear width of the stair

FHS Spiral Stair

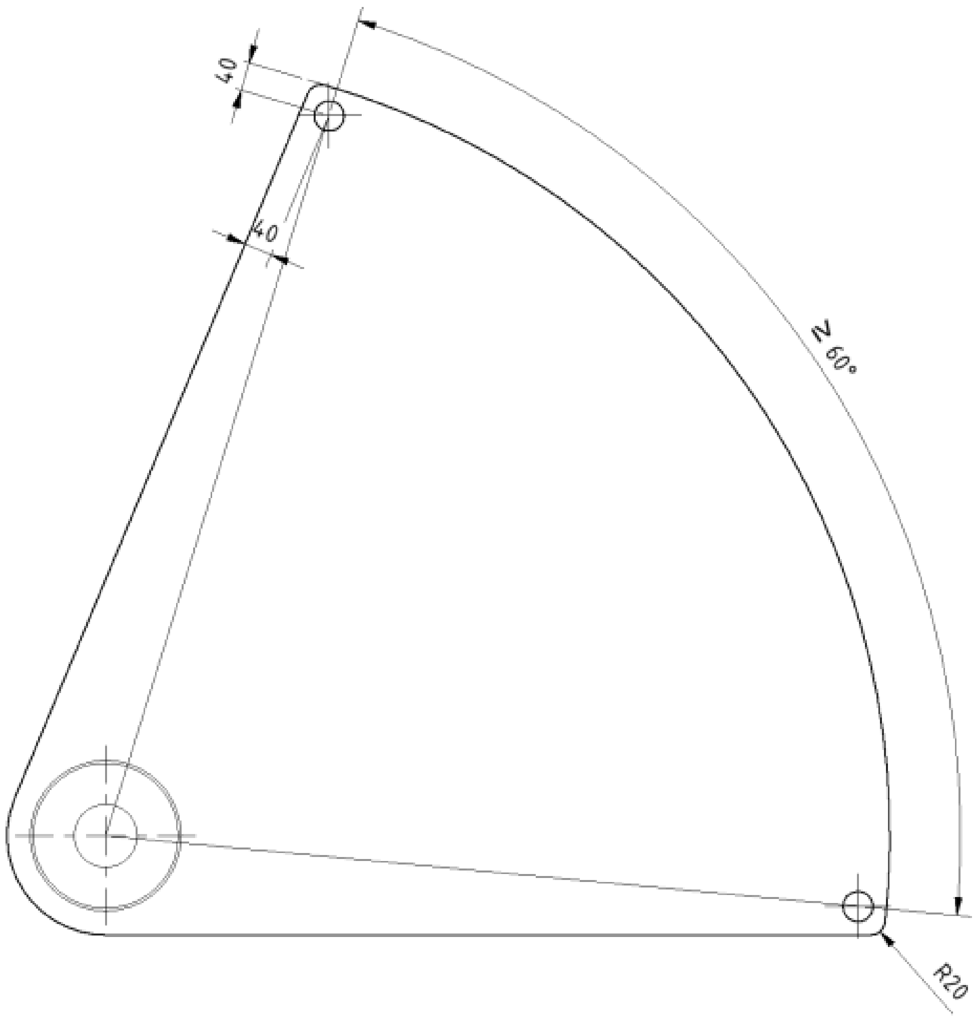
Product

Annex A1

Step with straight front edge



Landing with straight front edge



Dimensions in mm

More details according to the technical documentation

FHS Spiral Stair	Annex A2
Step and landing with straight front edge	

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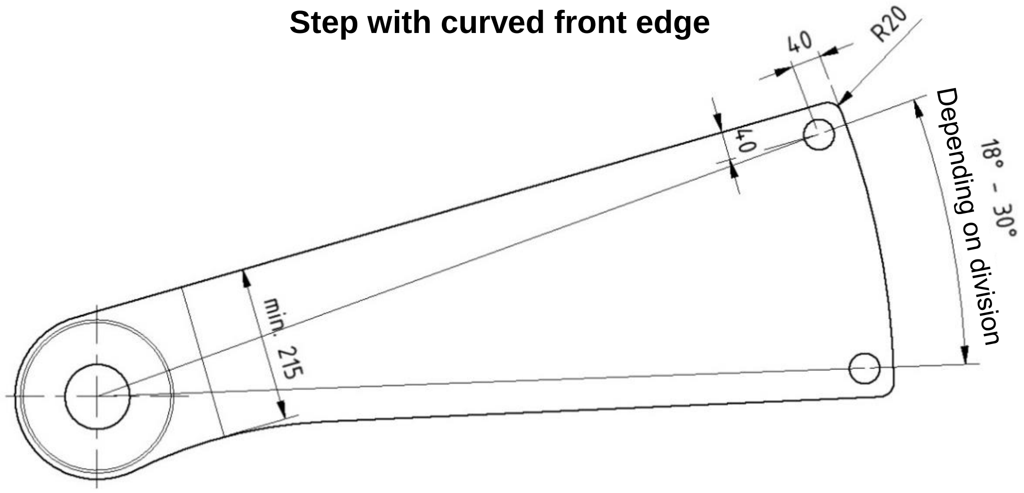
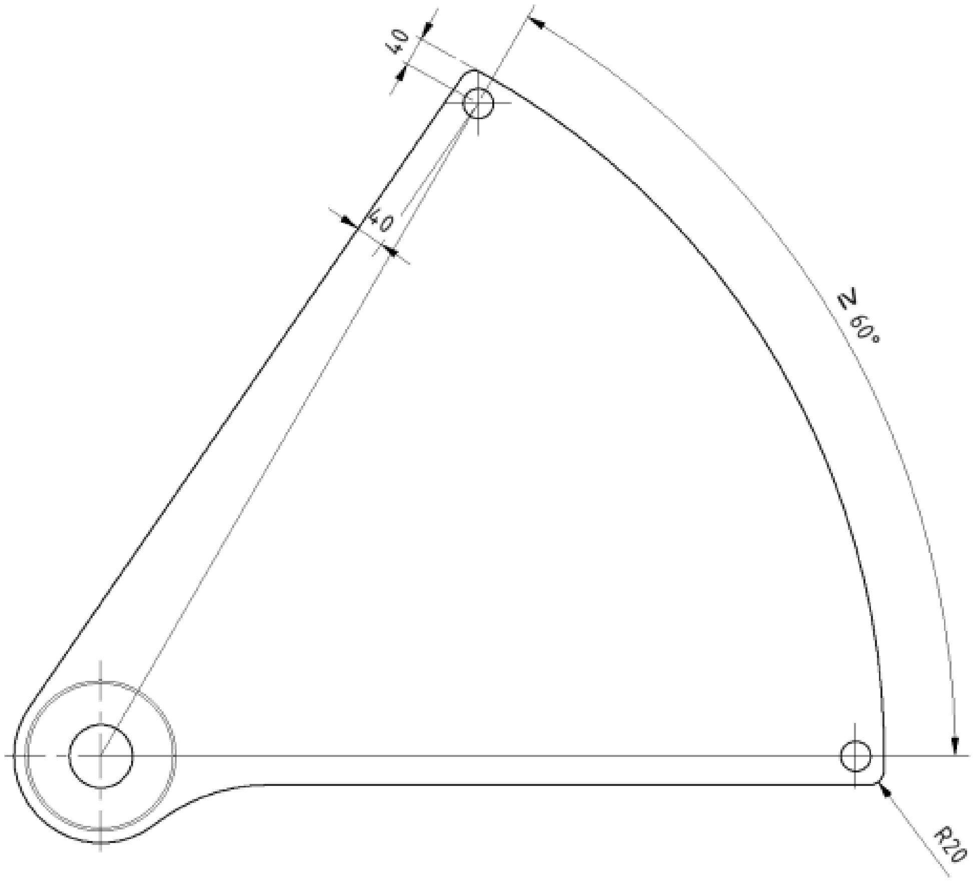
Step with curved front edge



Landing with curved front edge

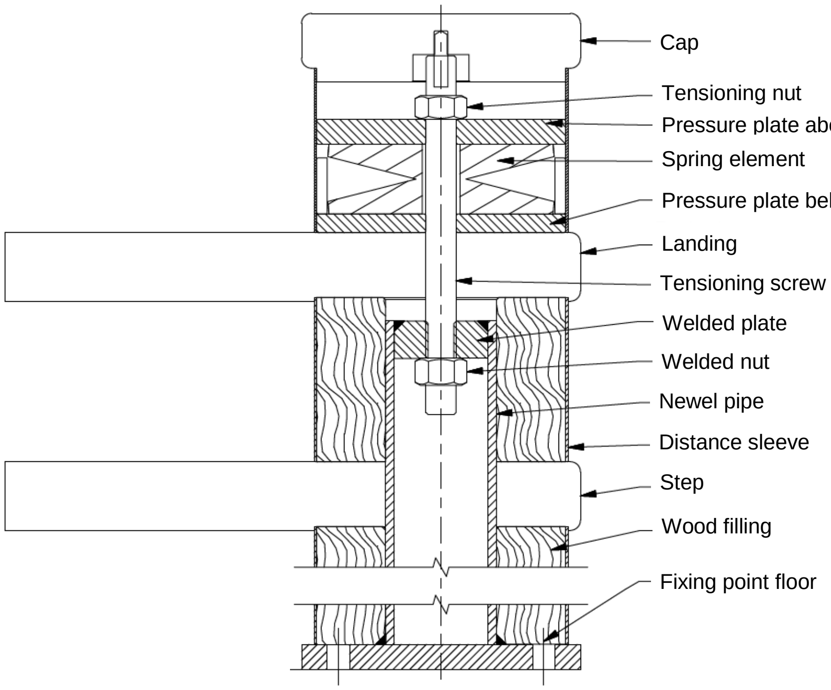


Dimensions in mm

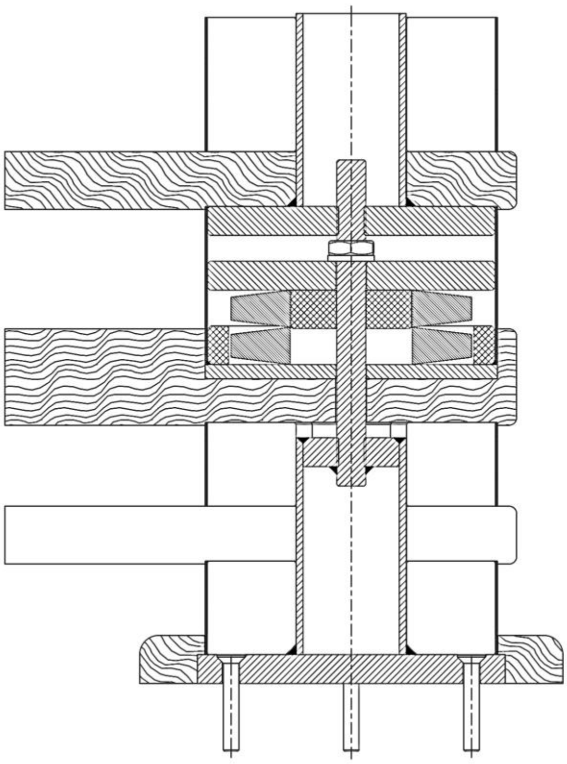
More details according to the technical documentation

FHS Spiral Stair	Annex A3
Step and landing with curved front edge	

Newel



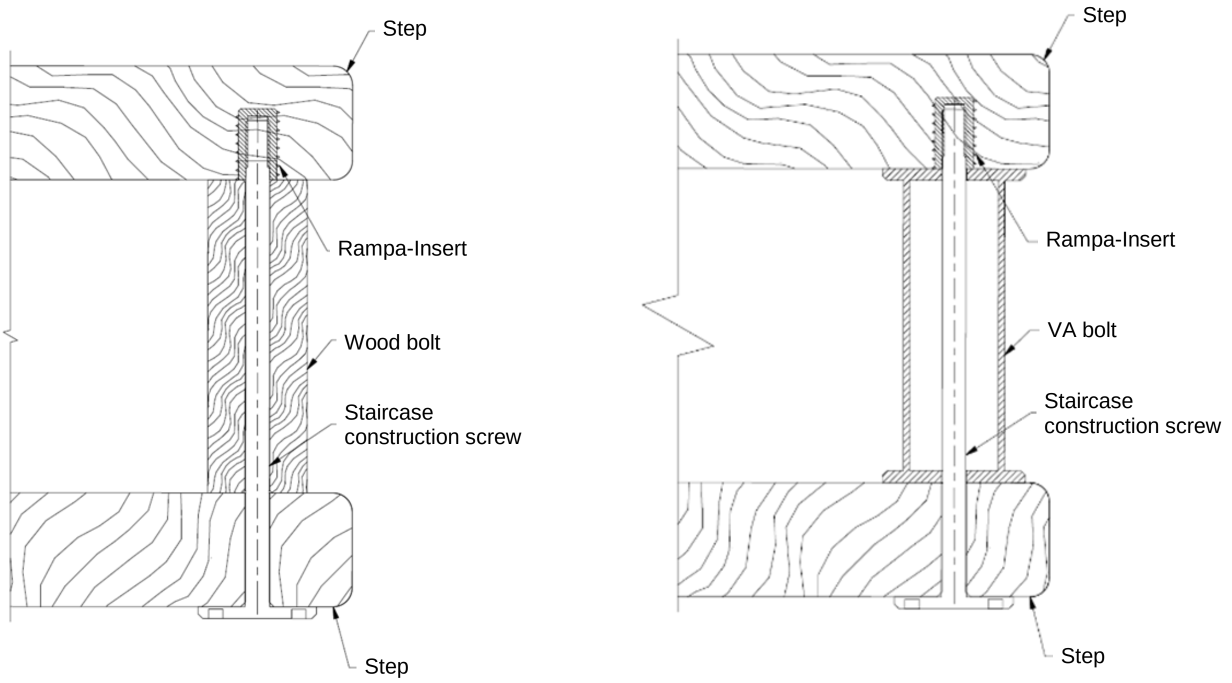
Newel connection from floor to floor



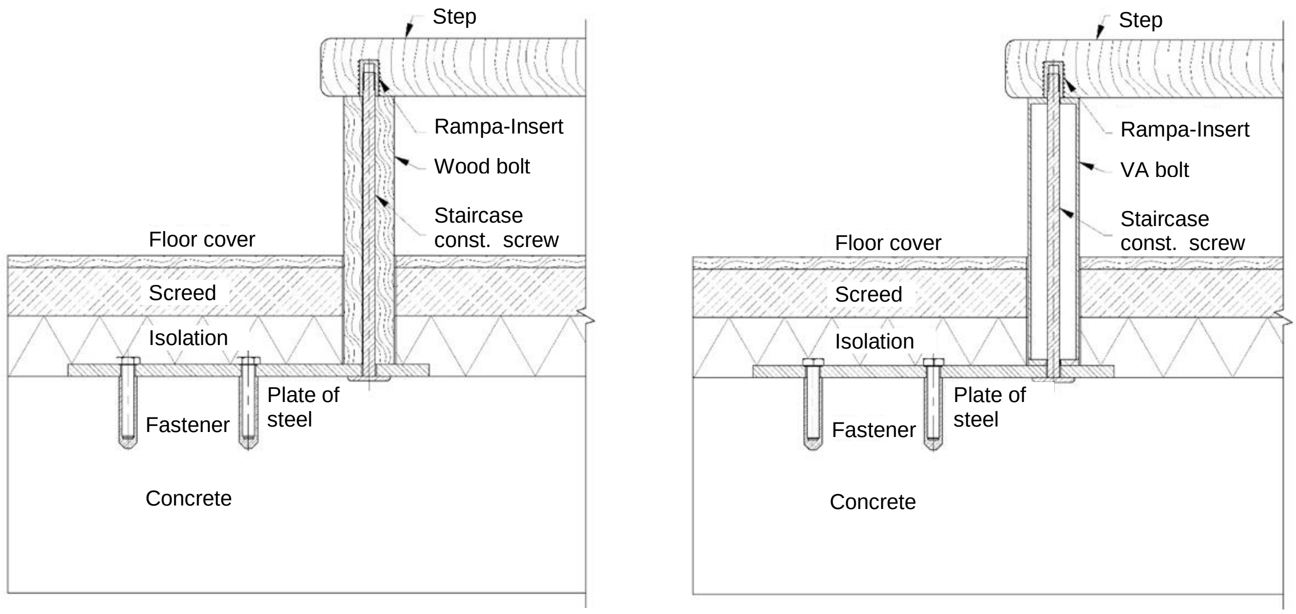
More details according to the technical documentation

FHS Spiral Stair	**Annex A4**
Newel and Newel transfer	

Load-bearing bolts



Load-bearing bolt joint at bottom

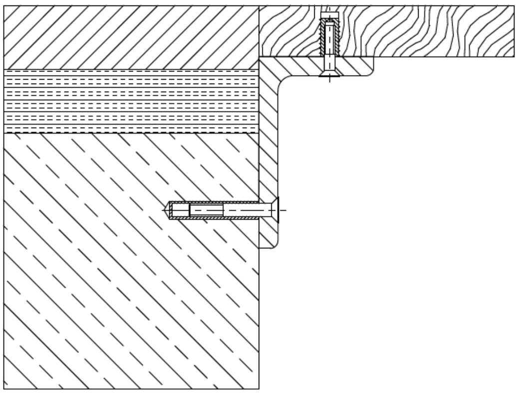


More details according to the technical documentation

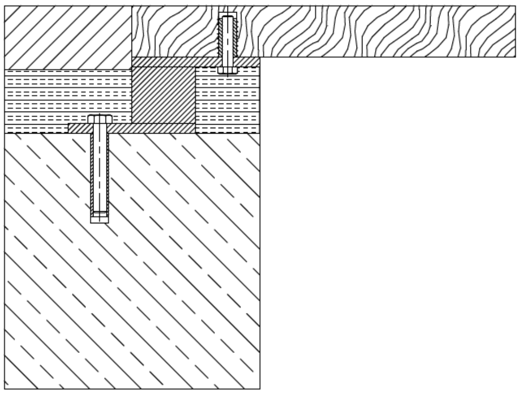
FHS Spiral Stair	**Annex A5**
Load-bearing bolts and Load-bearing bolt joint at bottom	

Support of landing

Fastening to the ceiling edge



Fastening on the ceiling



Anchors and fasteners are to be designed (dimensioned) according to the local situation

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

Component	Material	Dimension		Value [1)]	Reaction to fire
Step, Landing	Solid wood [2)]	Thickness	[mm]	45	D-s2, d0
Spindle pot (Wood filling)	Solid wood [2)]	Outer diameter	[mm]	140	D-s2, d0
Load bearing bolt	Steel screw	Diameter	[mm]	10	A1
Distance sleeve	Steel bolt	Inner diameter	[mm]	37	A1
	Wood bolt	Diameter	[mm]	40	D-s2, d0
Newel	Steel pipe	Outer diameter x Thickness	[mm]	60,3 x 5,0	A1
	Tensioning screw	Diameter	[mm]	16	A1

1) Minimum value, required values depending on the type of stair according to Table 2,

2) Only hardwood of the following species: beech, oak, birch, ash, maple, elm, cherry tree, doussie, nut tree, merbau, acacia

More details according to technical documentation

FHS Spiral Stair

Support of landing
Minimum dimension of relevant stair components and reaction to fire

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 the 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 or quasi-static loads

Use conditions:

- Indoor stair
- Air temperatures between +5 °C and +30 °C
- Relative air humidity between 30 % and 70 %
- According to the individual requirements handrail and barrier may be attached to the stair optionally. Conditions for possible barrier/handrail:

  Dead load ≤ 0.10 kN/m

  Height ≤ 0.90 m

  Distance of baluster ≤ 0.65 m

Design:

- Design of the stair according to the annexes and the technical documentation to this European Technical Assessment
- Fastening of the stair to the construction works according to the annexes and the technical documentation to this European Technical 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 1991-1-1:2002 + AC:2009

  $\gamma_Q = 1.5$: 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 oft the partial factors mentioned above; see Table 6

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 ± 1 %
- 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
- Depending on the type of stair the nuts of the tensioning bolt have to be tighten with the torque moment according to Annex C1, Table 2

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 ± 1 % 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 of retightens the bolting of the load-bearing bolts and connections according to Annexes A5 after the first heating season and the information on the relationship between moisture content of timber components, air temperature and relative air humidity

Table 2: Dimension of relevant stair components depend on the type of stair

Type of stair		I	II	III	IV	V	VI
Diameter of stair	[mm]	1300	1600	2000	2200	2500	3000
Thickness of step	[mm]	45	45	48	55	55	60
Minimum width of steps	[mm]	144	165	188	215	218	245
Diameter of newel	[mm]	60,3	76,1	88,9	88,9	88,9	114,3
Thickness of newel pipe	[mm]	5	5	6,3	6,3	7,1	7,1
Diameter of newel pot	[mm]	140	160	200	220	250	300
Thickness of pressure plate above	[mm]	15	16	20	20	25	30
Thickness of pressure plate below	[mm]	12	12	15	15	15	15
Thickness of base plate	[mm]	12	15	15	20	25	30
Size of tensioning screw	[-]	M 16	M 16	M 20	M 24	M 27	M 30
Thickness of treaded plate	[mm]	20	20	25	30	30	30
Spring deflection	[mm]	9,9	8,15	8,99	13,42	15,92	21,82
Pre-stressing moment	[Nm]	104	148	256	440	743	1028
Pre-stressing-force	[kN]	43	61	94	110	165	210

FHS Spiral Stair

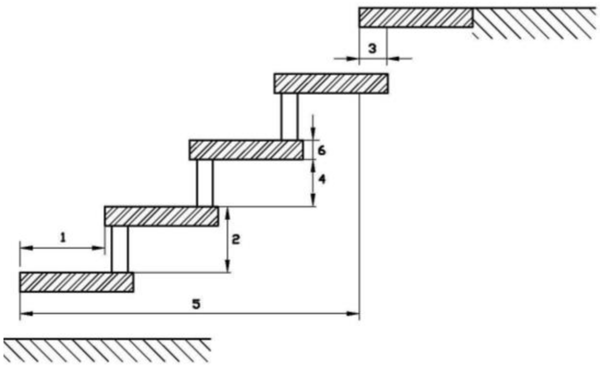
Dimension of relevant stair components depend on the type of stair

Annex C1

Table 3: Geometry

Designation		Dimension	
		Minimum	Maximum
Going step on walking line [1]	[mm]	167	370 [2]
Rise of the stairs [1]	[mm]	140 [2]	220
Pitch of the walking line [1]	[°]	21	45
Overlap of the steps	[mm]	80	- [3]
Number of rises	[-]	3	18
Openings between consecutive steps	[mm]	- [3]	175
Clear width of stairs	[mm]	520	1140
Floor to floor height	[mm]	- [3]	3240
Minimum head room	[mm]	2000	- [3]
Length of the flight	[mm]	- [3]	5560
Thickness of steps	[mm]	45	60

[1] Values are constant within one flight
[2] Tolerance between nominal value and actual value = ± 5 mm
[3] Not relevant



1 going
2 rise
3 overlap
4 opening between consecutive steps
5 length of the flight
6 thickness of steps

FHS Spiral Stair

Geometry of stair

Annex C2

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

Component of stair	Type of loading	Characteristic values of resistance			γ_M
Step	Vertical variable uniformly distributed load	$q_{R,k}$	[kN/m²]	5.9	1.3 [1)]
	Vertical variable single load	$Q_{R,k}$	[kN]	3.9	
	Horizontal variable uniformly distributed load on barrier	$h_{R,k}$	[kN/m]	0.7	
Newel	Vertical variable uniformly distributed load	$q_{R,k}$	[kN/m²]	5.0	1.1 [2)]
	Vertical variable single load	$Q_{R,k}$	[kN]	3.3	
	Horizontal variable uniformly distributed load on barrier	$h_{R,k}$	[kN/m]	0.6	

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

2) Recommended partial safety factor (steel decisive), in absence of other nation regulations

Table 5: Deflections under loading

Deflection of the step under single point load			
Single load	Q_k	[kN]	2.0
Radius of stair (maximum)	L	[mm]	1500
Deflection related to the clear width of the stair	w	[-]	$\leq$ L/150

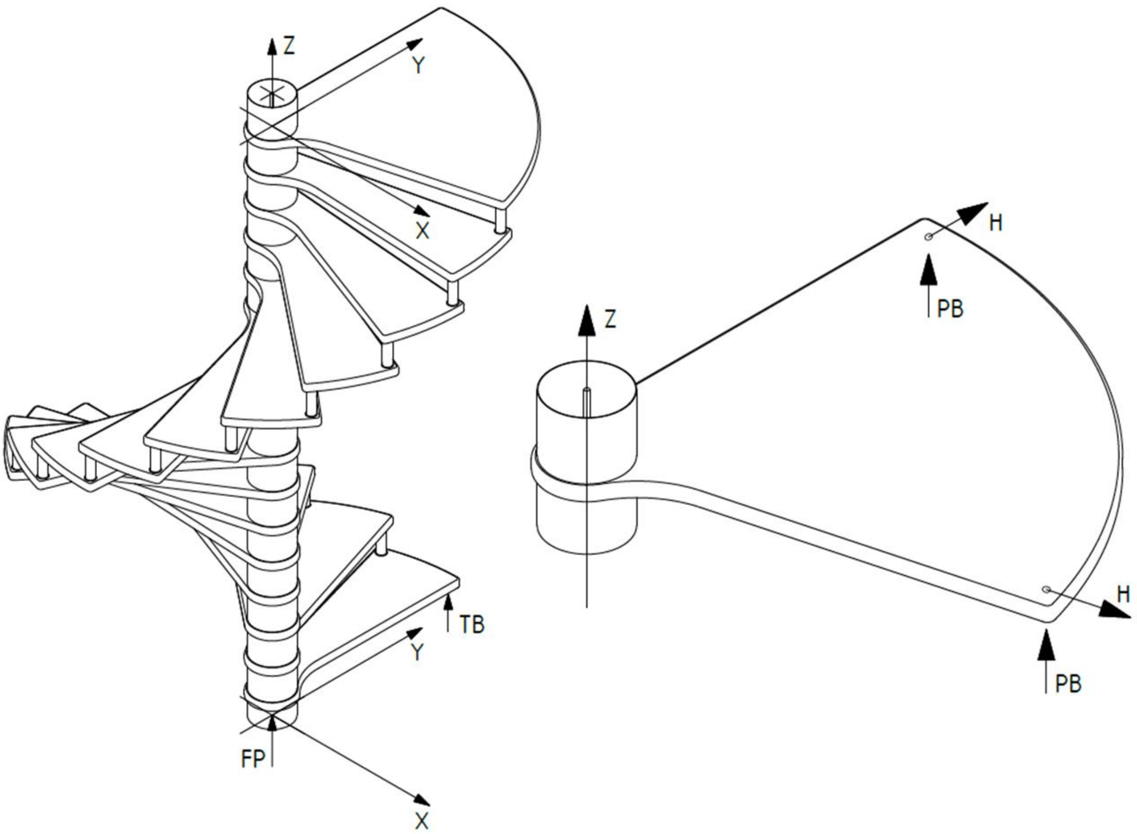
Table 6: Imposed loads

Type of loading	Imposed loads		
Vertical variable uniformly distributed load	q_k	[kN/m²]	3.0
Vertical variable single load	Q_k	[kN]	2.0
Horizontal variable uniformly distributed load on barrier	h_k	[kN/m]	0.5

Table 7: Design loads for transmissions of the loads to the construction works

Type of stair				I	II	III	IV	V	VI
Support of newel FP		x	[kN]	± 0,73	± 0,73	± 0,73	± 2,18	± 2,18	± 3,48
		y	[kN]	± 0,73	± 0,73	± 1,31	± 2,18	± 2,18	± 3,48
Support of newel	one-storeyed	z	[kN]	9,0	12,8	17,3	19,6	22,9	33,6
	two-storeyed	z	[kN]	18,0	25,6	34,5	39,2	45,8	67,5
	three-storeyed	z	[kN]	27,0	38,4	51,8	58,7	68,9	101,1
Support of landing PB		z	[kN]	3,50	3,50	3,50	3,50	3,50	3,60
Support of landing at the top		H	[kN]	0,34	0,46	0,60	1,30	1,67	2,66
Support of intermediate landings		H	[kN]	0,68	0,92	1,20	2,60	3,34	5,32
Support of load-bearing bolt TB		z	[kN]	3,50	3,50	3,50	3,50	3,50	3,50
		x = y	[kN]	0	0	0	0	0	0

Supports



FHS Spiral Stair

Design loads for transmissions of the loads to the construction works

Annex C4