

## European Technical Approval ETA-10/0300

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung <i>Trade name</i>	Meckel & Weyel GF - Steintreppe <i>Meckel &amp; Weyel GF - stone stair</i>
Zulassungsinhaber <i>Holder of approval</i>	MECKEL & WEYEL Treppenvertrieb + Betonsteinwerk GmbH & Co. KG Gernsbach 35756 Mittenaar-Bicken DEUTSCHLAND
Zulassungsgegenstand und Verwendungszweck  <i>Generic type and use of construction product</i>	Tragbolzentreppe mit Trittstufen aus Naturwerkstein oder Betonwerkstein zur Verwendung als innenliegende Treppe in Gebäuden  <i>Load-bearing bolt stair with steps made of natural stone or artificial stone for use as an indoor stair in buildings</i>
Geltungsdauer: <i>Validity:</i>	vom <i>from</i> bis <i>to</i>
Herstellwerk <i>Manufacturing plant</i>	Werk 1 bis 3

Diese Zulassung umfasst  
*This Approval contains*

15 Seiten einschließlich 7 Anhänge  
*15 pages including 7 annexes*

## 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 law of 31 October 2006<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>;
  - Guideline for European technical approval of "Prefabricated stair kits - Part 1: Prefabricated stair kits in general (excluding severe climatic conditions)", ETAG 008-01.
- 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 2006, p. 2407, 2416  
<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 product**

The load-bearing bolt stair Meckel & Weyel GF stone stair is a prefabricated stair system (hereinafter referred to as stair) which consists of steps made of natural stone or artificial stone (cement bonded or reaction resin bonded), load-bearing bolts and wall ties. Barrier and handrail are not part of the stair system, but may be attached to the stair optionally according to the individual requirements.

The steps have a minimum thickness of 62 mm. They consist of two plates with a minimum thickness of 30 mm that are glued together by an intermediate GFK-layer with a thickness of 2 mm.

On the wall side and on the wall-free side the steps of the WF2-stair are connected with each other by one load-bearing bolt per side. On the wall side each step is equipped with one wall tie, which is anchored in the staircase wall. In the area of openings in the wall alternatively a construction with fixed load-bearing bolts and strengthened wall ties at the beginning and at the end or a steel beam (wall-replacement-beam according to Annex 3) can be used.

The steps of the WE1-stair are connected with each other by a load-bearing bolt on the wall-free side. On the wall side the steps are embedded in the wall 7 cm at least.

Annex 1 shows the stair with its types of construction and its types of plan. According to the types of plan it is to be distinguished between stairs with straight flights, stairs with one quarter turn, with twice a quarter turn and stairs with half a turn.

#### **1.2 Intended use**

The stair may be used as an indoor stair in buildings with air temperatures between +5 °C and +30 °C and relative air humidity between 30 % and 70 %.

The European technical approval covers 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 approval. The values apply to all types of stairs, the real dimensions follow in accordance with the relevant case of use.

The provisions made in this European technical approval are based on an assumed working life of the stair of 50 years; provided that the conditions laid down in sections 4 and 5 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.

### **2 Characteristics of the product and methods of verification**

#### **2.1 General**

The stair corresponds to the drawings and data of the annexes. 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<sup>7</sup> of this ETA.

<sup>7</sup> 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.

## **2.2 Mechanical resistance and stability**

### **2.2.1 General**

The stair has a sufficient mechanical resistance and stability in order to resist static or quasi-static loads.

The characteristic values of resistance of the stair given in Annex 7, Table 5 were determined by loading tests and by structural analysis. The structural analysis is an integral part of the technical documentation of this European technical approval.

### **2.2.2 Prevention of progressive collapse**

Failure of individual components of the stair does not lead to a progressive collapse of the complete stair.

### **2.2.3 Residual load-bearing capacity**

The stair loaded by service loads stated in Annex 7, Table 7 has a sufficient residual load-bearing capacity. A local material failure does not lead to an abrupt total loss of load-bearing capacity of the stair.

### **2.2.4 Long-term behaviour**

The characteristic values of resistance stated in Annex 7, Table 5 are ensured under an appropriate use and maintenance over the indicated working life.

### **2.2.5 Resistance to earthquakes**

No performance determined (NPD).

### **2.2.6 Load/displacement behaviour and vibration behaviour**

The characteristic values concerning the load/displacement behaviour were determined by test and calculation. The values determined are given in Annex 7, Table 6.

The vibration behaviour was determined by calculation. The stair shows under a single load of  $F = 1,0 \text{ kN}$  acting on the most unfavourable point at the wall-free side a deflection of  $w \leq 5 \text{ mm}$ . The first natural frequency of the stair (inclusive a single mass of 100 kg) is greater than 5 Hz.

### **2.2.7 Resistance of the fixings**

The characteristic loads which are passed on by the fasteners (wall ties and fixings for the bottom step and step on the top) to the construction works are given in the technical documentation to this European technical approval.

## **2.3 Safety in case of fire**

### **2.3.1 Reaction to fire**

The classification of the reaction to fire of the components of the stair is given in Annex 5, Table 2.

### **2.3.2 Fire resistance**

No performance determined (NPD).

## **2.4 Hygiene, health and the environment**

According to the manufacturer's declaration, taking account of the EU database<sup>8</sup>, the stair does not contain any dangerous substances.

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, when and where they apply.

<sup>8</sup>

Notes are stated in Guidance Paper H: "A harmonized approach relating to dangerous substances under the Construction Products Directive", Brussels, September 2002.

## **2.5 Safety in use**

### **2.5.1 Geometry of the stair**

The geometry of the stair is stated in Annex 5. The position of the constant pitch line / walking line is exemplified in Annex 1. The position of the walking line may be chosen freely within the walking zone. The walking zone is 20 % of the clear width of the stair and is located in the middle of the stair flight.

### **2.5.2 Slipperiness**

No performance determined (NPD).

### **2.5.3 Equipment of the stair for a safe use**

Barrier and handrail:

Barrier and handrail are not part of the stair system.

Note: If barrier and handrail shall be attached to the stair, the conditions of Annex 7, Table 5 of this European technical approval apply concerning the static requirements. The construction of the connection between barrier and steps is given in the technical documentation to this European technical approval.

Tactility and visibility:

No performance determined (NPD).

### **2.5.4 Safe breakage of components**

A brittle failure of individual components is excluded.

### **2.5.5 Impact resistance**

The impact resistance of steps made of natural stone or artificial stone was determined by drop tests with a hard body impact load. The steps have a sufficient resistance after the impact of a dropped steel weight of 50 kg from a height of 200 mm directed to the middle of the step.

## **2.6 Durability and serviceability**

### **2.6.1 Resistance to deterioration caused by physical, chemical and biological agents**

Under an appropriate use and maintenance and at an indoor climate with air temperatures between +5 °C and +30 °C and relative air humidity between 30 % and 70 % the stair will have for the intended use an adequate resistance to

- physical agents like effects of temperature, radiation of sun and variations of relative humidity,
- chemical agents like effects of cleaning agents, water, carbon dioxide, oxygen and naturally occurring corrosives and pollution agents and
- biological agents like effects of fungi, bacteria, algae and insects.

### **2.6.2 Finishes and surface layers**

The surfaces of components from natural stone and artificial stone (steps) are non-treated or polished.

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

### **3.1 System of attestation of conformity**

According to the Decision 99/89/EC of the European Commission<sup>9</sup> the System 2+ of attestation of conformity applies.

In addition, according to the Decision 2001/596/EC of the European Commission<sup>10</sup> the System 4 of attestation of conformity applies with regard to reaction to fire.

<sup>9</sup> Official Journal of the European Communities L .29 of 03.02.1999

<sup>10</sup> Official Journal of the European Communities L 209/33 of 02.08.2001

These systems of attestation of conformity are defined as follows:

System 2+: Declaration of conformity of the product by the manufacturer on the basis of:

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

System 4: Declaration of conformity of the product by the manufacturer on the basis of:

Tasks for the manufacturer:

- (1) initial type-testing of the product;
- (2) factory production control.

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

## 3.2 Responsibilities

### 3.2.1 Tasks of the manufacturer

#### 3.2.1.1 Factory production control

The manufacturer shall exercise permanent internal control of production. All the elements, 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. This production control system shall insure that the product is in conformity with this European technical approval.

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

The factory production control shall be in accordance with the control plan<sup>11</sup> 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 at Deutsches Institut für Bautechnik.

For each laminate process but at least each 100 m<sup>2</sup> the torsion resistance of at least one step have to be tested. On the basis of the ultimate torsion resistance reached the material is to be classified to the resistance classes according to Annex 4, Table 1. The ultimate torsion resistance shall not be less than values  $f_{v,k}$  of the appropriate resistance class.

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

#### 3.2.1.2 Other tasks of 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 the field of stairs 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 this European technical approval.

<sup>11</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.



### **3.2.2 Tasks of approved bodies**

The approved body shall perform the following tasks in accordance with the provisions laid down in the control plan:

- initial inspection of factory and of factory production control,
- continuous surveillance, assessment and approval of factory production control.

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 factory production control stating the conformity with the provisions of this European technical approval.

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 a label attached to the stair or on the accompanying commercial documents (e.g. the EC declaration of conformity). The letters "CE" shall be followed by the identification number of the approved certification body, where relevant, and be accompanied by the following additional information:

- name or identifying mark and address of the producer of the stair (legal entity responsible for the manufacturer),
- identification of the stair (trade name),
- the last two digits of the year in which the CE marking was affixed,
- number of the EC certificate of conformity for the factory production control,
- number of the European technical approval,
- ETAG 008, Part 1,
- resistance class I to VI (torsion resistance).

If the CE marking is affixed on the accompanying commercial documents, the following minimum information shall be given on a label attached to the stair:

- initials "CE" followed by the identification number of the certification body,
- name or identifying mark of the manufacturer of the stair,
- identification of the stair (trade name),
- the last two digits of the year in which the CE marking was affixed.

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

### **4.1 Manufacture**

The European technical approval is issued for the product on the basis of agreed data/information, deposited with 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 Deutsches Institut für Bautechnik before the changes are introduced.

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 Design**

The fitness for use of the stair is given under the following assumptions:

The stair is designed according to the drawings and data of the annexes and the technical documentation to this European technical approval.

Depending on the relevant type of plan the declared resistance class of the steps shall not be less than the required resistance class according to Annex 6, Table 4.

The stair is fixed to the construction works according to the drawings and data of the annexes and the technical documentation to this European technical approval. The proof of the transmission of loads in the construction works are made by the civil engineer responsible for the construction works.

The load-bearing capacity of the stair at ultimate limit state is verified according to Annex 7, Table 5. The load-bearing capacity of the stair at serviceability limit state is verified according to Annex 7, Table 6.

#### **4.3 Installation**

The fitness for use of the stair can be assumed only, if the following installation conditions are adhered to:

- installation by personnel appropriately trained and authorized by the holder of the approval by means of the technical documentation of this European technical approval,
- installation only in the way as specified in the technical documentation of this European technical approval,
- sufficient support of the stair when assembling,
- installation of steps without imposed deformations,
- installation of steps without significant defects and cracks,
- bolted connections are protected such that they will not be loosened by vibrations.

### **5 Indications to the manufacturer**

#### **5.1 Manufacturer's responsibilities**

It is the manufacturer's responsibility to make sure that all persons involved will be appropriately informed about the specific conditions according to sections 1, 2, 4.2 and 4.3 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 approval.

#### **5.2 Packaging, transport and storage**

The glued parts of plates or the steps should be packed such that they can not be damaged during transport and storage.

#### **5.3 Use, maintenance and repair**

In his instructions for use the manufacturer provide information as to use, maintenance and repair of the stair.

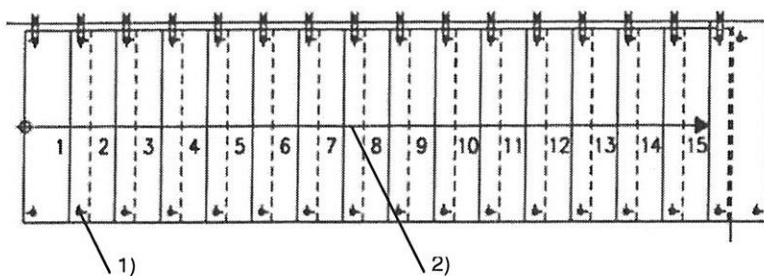
Georg Feistel  
Head of Department

*beglaubigt:*  
Wittstock



## Types of plan

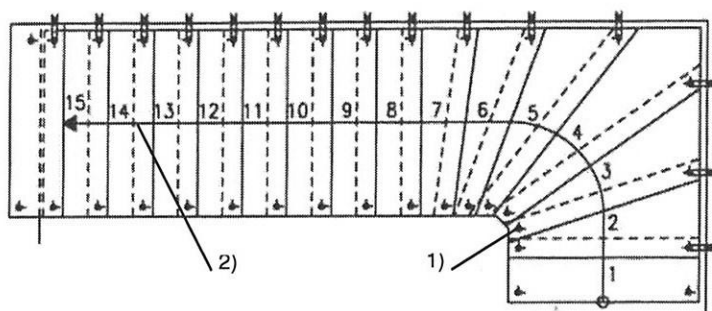
**Type 16G**



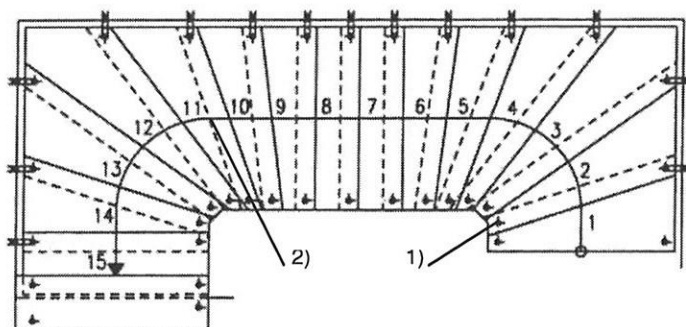
In the area of openings  
wall-replacement-beams  
are possible (see Annex 3).

- 1) additional support  
(according to Annex 6)
- 2) walking line is 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

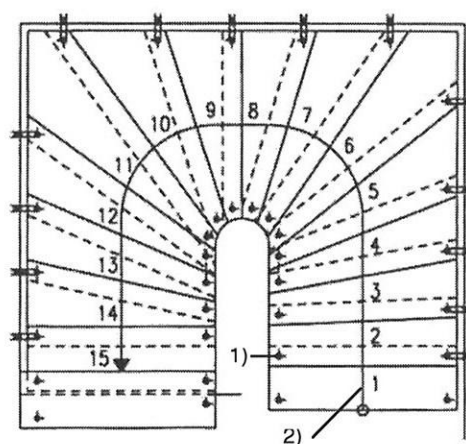
**Type 16V**



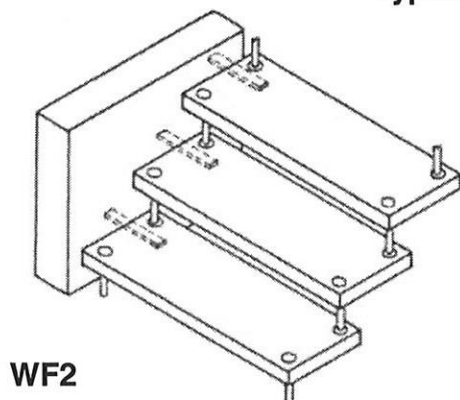
**Type 16VV**



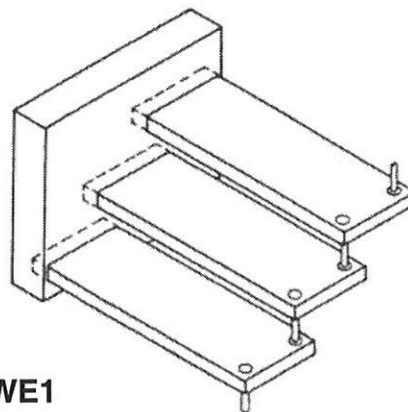
**Type 16H**



## Types of construction



**WF2**



**WE1**

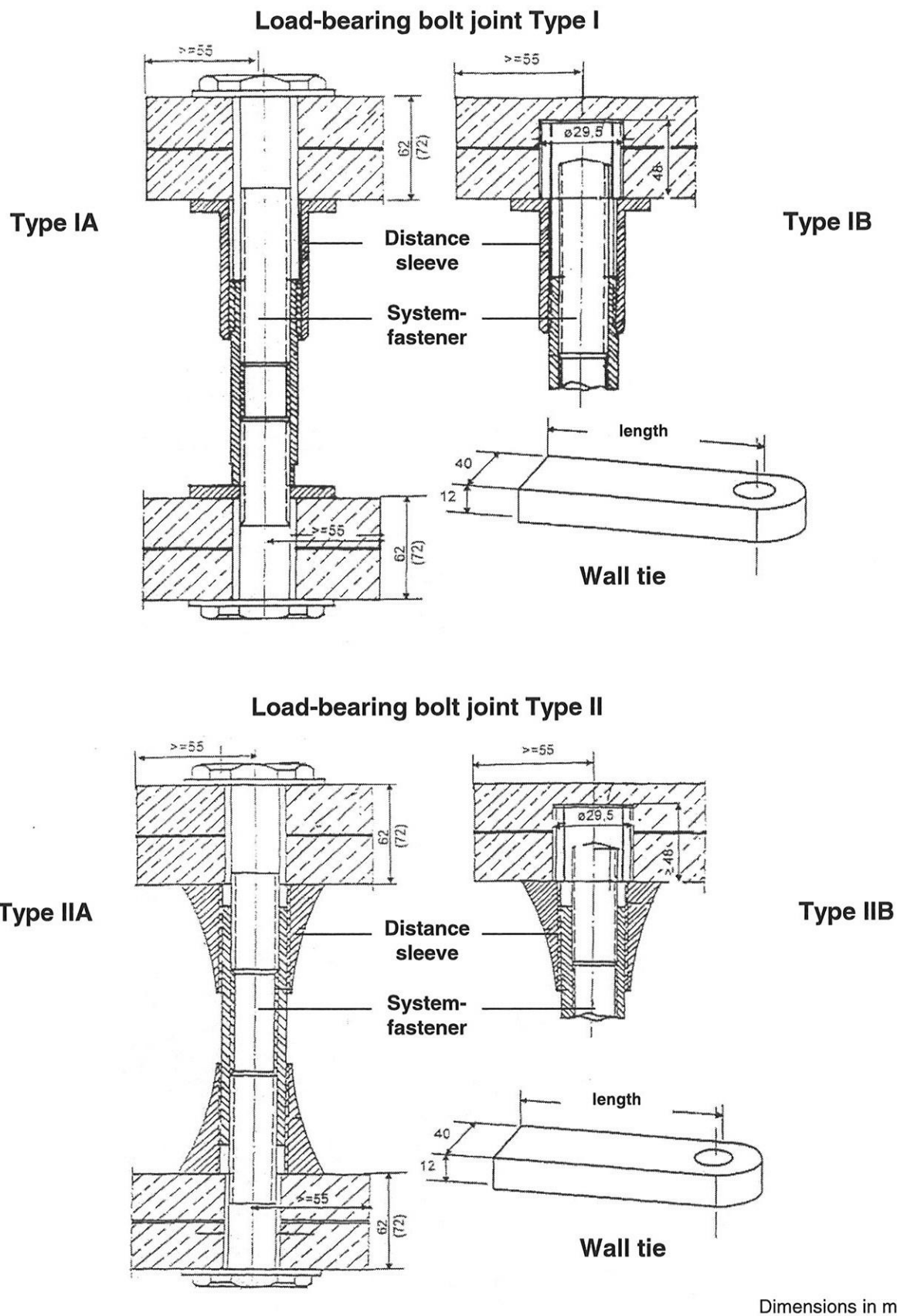
**Meckel & Weyel GF – stone stair**

Product and intended use

**Annex 1**

**of European technical  
approval**

**ETA-10/0300**



Meckel & Weyel GF – stone stair

Load-bearing bolt joint and wall tie (standard joint)

Annex 2

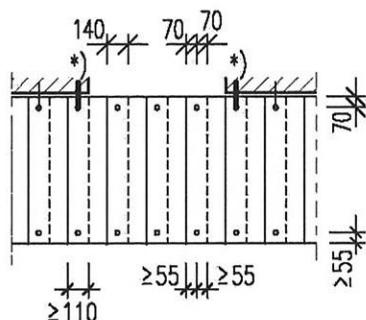
of European technical  
approval

ETA-10/0300

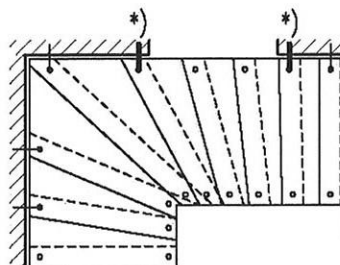
## Wall-replacement-beam

### a) Load-bearing bolt Type III or IV with strengthened wall ties

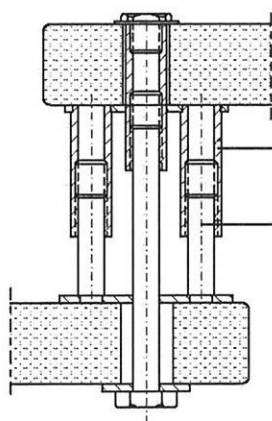
4 goings in the area  
of straight steps



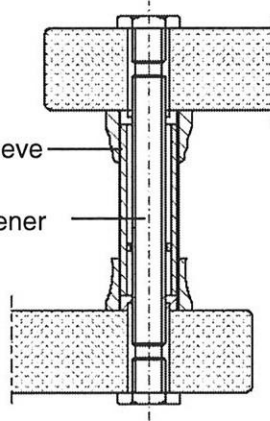
3 goings in the area  
of tapered steps



Load-bearing bolt joint Type III

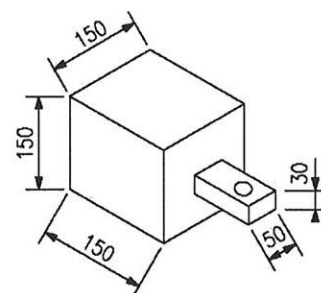


Load-bearing bolt joint Type IV

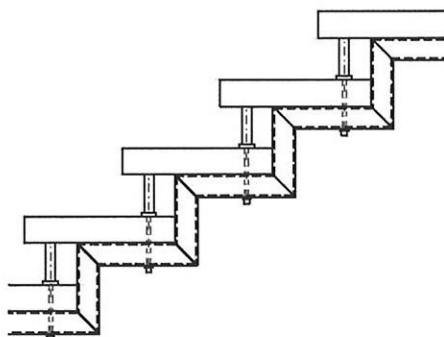


Distance sleeve  
System-fastener

\*) Wall tie (alternatively  
in-situ concrete  
≥ C16/20)



### b) Cascaded steel beam (hollow section 60/60/5)



Dimensions in mm

Further details according to technical documentation

Meckel & Weyel GF – stone stair

Wall-replacement-beam

Annex 3

of European technical  
approval

ETA-10/0300

**Table 1: Characteristic values of materials of relevant stair components**

component of stair	material	characteristic values (minimum values)				
components made of natural stone		$E_{0,mean}$	$G_{mean}$	$f_{m,k}$	$f_{v,k}$	$\gamma_M^{1)}$
		[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	[-]
steps	resistance class I	30000	10000	6.25	6.25	1.8
	resistance class II			7.50	7.50	
	resistance class III			8.75	8.75	
	resistance class IV			10.00	10.00	
	resistance class V			11.25	11.25	
	resistance class VI			12.50	12.50	
components made of artificial stones		$E_{0,mean}$	$G_{mean}$	$f_{m,k}$	$f_{v,k}$	$\gamma_M^{1)}$
		[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	[-]
steps	resistance class I	30000	10000	6.25	6.25	1.6
	resistance class II			7.50	7.50	
	resistance class III			8.75	8.75	
	resistance class IV			10.00	10.00	
	resistance class V			11.25	11.25	
	resistance class VI			12.50	12.50	
components made of steel		$E_{0,mean}$	$G_{mean}$	$f_{y,k}$	$f_{u,k}$	$\gamma_M^{1)}$
		[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	[-]
system-fastener	steel	210000	81000	240	400	1.1
distance sleeve	GD-Al Si 8 Cu 3	70000	27000	160	240	1.1
wall tie	steel	210000	81000	360	600	1.1
cascaded beam	steel	210000	81000	240	360	1.1

<sup>1)</sup> recommended partial safety factor, in absence of other national regulations

**Meckel & Weyel GF – stone stair**

Characteristic values of materials of relevant stair components

**Annex 4**

**of European technical approval**

**ETA-10/0300**

**Table 2: Minimum dimensions of relevant stair components and reaction to fire**

component	material	dimension	value	reaction to fire <sup>1)</sup>
steps	natural stone	thickness [mm]	62 <sup>2)</sup>	F (no performance determined – NPD)
	artificial stone cement bonded	thickness [mm]	62 <sup>2)</sup>	
	artificial stone reaction resin bonded	thickness [mm]	62 <sup>2)</sup>	
system-fastener	steel	diameter Ø [mm]	14	A1 (96/603/EC)
distance sleeve	GD-Al Si 8 Cu 3	inner diameter Ø [mm]	14	A1 (96/603/EC)
wall tie	flat steel	height / width / length [mm]	12 / 40 / 210	A1 (96/603/EC)
		embedment depth - wall [mm]	100	

<sup>1)</sup> according to the provisions of EC decisions

<sup>2)</sup> two plates (minimum thickness 30 mm) and intermediate GFK-layer (thickness 2 mm)

**Table 3: Geometry**

designation			dimension	
			minimum	maximum
going	step on walking line <sup>1)</sup>	[mm]	210	290 <sup>2)</sup>
	tapered step	[mm]	100 <sup>2) 3)</sup>	550 <sup>2) 4)</sup>
rise of the stairs <sup>1)</sup>		[mm]	140 <sup>2)</sup>	210
pitch of the walking line <sup>1)</sup>		[°]	21	45
overlap of the steps		[mm]	110	- <sup>5)</sup>
number of rises		[-]	3	16
openings	between stairs and wall	[mm]	- <sup>5)</sup>	55
	between consecutive steps	[mm]	- <sup>5)</sup>	148
clear width of stairs		[mm]	500	1050
minimum headroom		[mm]	- <sup>5)</sup>	
length of the flight		[mm]	- <sup>5)</sup>	3900
thickness of steps		[mm]	62	- <sup>5)</sup>

<sup>1)</sup> values are constant within one flight

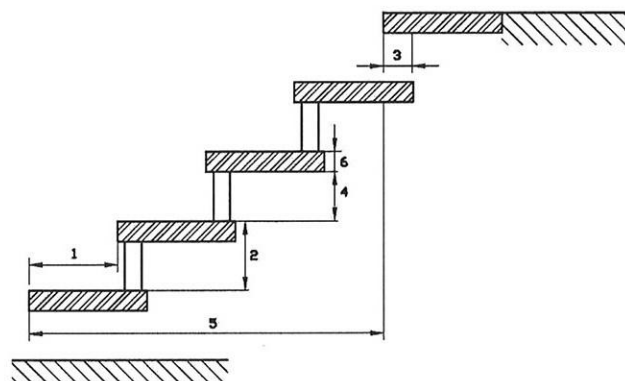
<sup>2)</sup> tolerance between nominal value and actual value = ± 5 mm

<sup>3)</sup> inside of tapered step

<sup>4)</sup> outside of tapered step

<sup>5)</sup> not relevant

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



**Meckel & Weyel GF – stone stair**

Minimum dimensions of relevant stair components  
and reaction to fire, Geometry of the stair

**Annex 5**

**of European technical  
approval**

**ETA-10/0300**

**Table 4: Required resistance classes according to Annex 4, Table 1 for types of plan according to Annex 1**

type of plan	support at step	number of steps <sup>2)</sup>	thickness of steps 62 mm		thickness of steps 72 mm	
			artificial stone	natural stone	artificial stone	natural stone
16G	-	15	IV	V	III	IV
	2	14	IV	V	II	III
	3	13	III	IV	II	III
	4	12	III	III	I	II
	5	11	II	III	I	I
	6	10	I	II	I	I
	7	9	I	I	I	I
16V	-	15	IV	V	III	III
	2	14	III	IV	II	III
	3	13	II	III	I	II
	4	12	II	II	I	I
	5	11	I	II <sup>3)</sup>	I	I
16VV	-	15	IV	IV	II	III
	2	14	II	II (III) <sup>1)</sup>	I (II) <sup>1)</sup>	I (II) <sup>1)</sup>
	3	13	II	II (III) <sup>1)</sup>	I	II
	4	12	I	II	I	I
	5	11	I	II <sup>3)</sup>	I	I
16H	-	15	IV	V	III	III
	2	14	IV	V	III	III
	3	13	IV	V	III	III
	4	12	III	IV	II	III
	5	11	III	III	I	II
	6	10	III	III	I	II
	7	9	II	III	I	II
Wall-replacement-beam			III		II	

<sup>1)</sup> values in brackets valid for plans with straight bottom step or straight top step

<sup>2)</sup> number of steps without additional support

<sup>3)</sup> resistance class I sufficiently if the length of the steps ≤ 940 mm

**Meckel & Weyel GF – stone stair**

Required resistance classes

**Annex 6**

**of European technical approval**

**ETA-10/0300**



**Table 5: Load-bearing capacity at ultimate limit state <sup>1)</sup> - Characteristic values of resistance  $R_k$**

material	type of loading		resistance $F_{Rk}$			$\gamma_M$ <sup>2)</sup>
natural stone	flight	vertical variable uniformly distributed load	$q_{R,k}$	[kN/m <sup>2</sup> ]	8.10	1.8
	step	vertical variable single load	$Q_{R,k}$	[kN]	5.40	
	barrier <sup>3)</sup>	horizontal variable uniformly distributed load <sup>4)</sup>	$h_{R,k}$	[kN/m]	0.95	
artificial stone	flight	vertical variable uniformly distributed load	$q_{R,k}$	[kN/m <sup>2</sup> ]	7.20	1.6
	step	vertical variable single load	$Q_{R,k}$	[kN]	4.80	
	barrier <sup>3)</sup>	horizontal variable uniformly distributed load <sup>4)</sup>	$h_{R,k}$	[kN/m]	0.84	

<sup>1)</sup> Proof of ultimate limit state is only given if the design value of the actions does not exceed the design value of the resistance:  $F_d \leq R_d$  with  $F_d = F_k \cdot \gamma_F$  and  $R_d = R_k / \gamma_M$

$R_k$  and  $\gamma_M$  according to Table 5

$F_k$  = characteristic values of actions (imposed loads according to EN 1991-1-1)

$\gamma_F = 1.5$  (recommended partial safety factor, in absence of other national regulations)

<sup>2)</sup> Recommended partial safety factor, in absence of other national regulations

<sup>3)</sup> Barrier and handrail are not part of the stair system. Conditions for possible barrier/handrail: dead load  $\leq 0.15$  kN/m, height  $\leq 1.00$  m, distance of baluster  $\leq 0.85$  m

<sup>4)</sup> Accompanying action ( $\psi_0 = 0.7$ , recommended combination factor, in absence of other national regulations); load acting on barrier

**Table 6: Load-bearing capacity at serviceability limit state <sup>1)</sup> - Deflections under loading**

deflection of the flight under uniformly distributed load			
load $F_S$	$q_S =$	[kN/m <sup>2</sup> ]	3.0
length of the median line of the flight	$l =$	[mm]	3900
deflection under load $F_S$ related to the median line of the flight	$w \leq$	[-]	$l/200$
deflection of the step under single point load			
load $F_S$	$Q_S =$	[kN]	2.0
clear width of the stair	$l =$	[mm]	1050
deflection under load $F_S$ related to the clear width of the stair	$w \leq$	[-]	$l/200$

<sup>1)</sup> Proof of serviceability limit state is only given if the characteristic value of the actions (imposed loads according to EN 1991-1-1) does not exceed the value  $F_S$  according to Table 6:  $F_k \leq F_S$

**Table 7: Load-bearing capacity - Service loads <sup>1)</sup>**

minimum value from proof of ultimate limit state and serviceability limit state			
vertical variable uniformly distributed load	$q$	[kN/m <sup>2</sup> ]	3.0
vertical variable single load	$Q$	[kN]	2.0
horizontal variable uniformly distributed load <sup>2)</sup>	$h$	[kN/m]	0.5

<sup>1)</sup> Service load =  $\min (R_k / (\gamma_M \cdot \gamma_F); F_S)$  with  $R_k$ ,  $\gamma_M$ ,  $\gamma_F$  according to Table 5 and  $F_S$  according to Table 6

<sup>2)</sup> Load acting on barrier (see Table 5)

**Meckel & Weyel GF – stone stair**

Load-bearing capacity at ultimate limit state,  
Load-bearing capacity at serviceability limit state,  
Load-bearing capacity – service loads

**Annex 7**

**of European technical approval**

**ETA-10/0300**