

# ENVIRONMENTAL SYSTEM DECLARATION

in accordance with ISO 14025 and EN 15804

Declaration holder	Bundesverband der Gipsindustrie e.V.
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**Non-load-bearing partitions made of gypsum blocks**  
**Bundesverband der Gipsindustrie e.V.**

[www.bau-umwelt.com](http://www.bau-umwelt.com)



Institut Bauen  
und Umwelt e.V.



## 1 General information

### Bundesverband der Gipsindustrie e.V.

#### Programme holder

IBU – Institut Bauen und Umwelt e.V.  
 Rheinufer 108  
 D-53639 Königswinter

#### Declaration number

ESD-BVG-2013121-EN

#### This declaration is based on the Product Category Rules:

PCR, Part B: Requirements on the EPD for room partition systems, 2013-01  
 (PCR tested and approved by the independent Committee of Experts (CoE))

#### Issue date

14.01.2013

#### Valid until

13.01.2018



Prof. Dr.-Ing. Horst J. Bossenmayer  
 (President of Institut Bauen und Umwelt e.V.)



Prof. Dr.-Ing. Hans-Wolf Reinhardt  
 (Chairman of the CoE)

### Non-load-bearing partitions made of gypsum blocks

#### Holder of the Declaration

Bundesverband der Gipsindustrie e.V.  
 Kochstrasse 6-7  
 D-10969 Berlin

#### Declared product/unit

Non-load-bearing partitions made of gypsum blocks  
 2.7 m x 10 m (27 m<sup>2</sup>)

#### Area of validity:

This ESD applies for partitions made of gypsum blocks. The consumer data on which the products are based involves average values for the declared non-load-bearing partitions made of gypsum blocks. The technical data was taken from up-to-date information supplied by the manufacturers of components for partitions made of gypsum blocks.

This document is translated from the German Environmental Product Declaration into English. It is based on the German original version ESD-BVG-2013121-DE. The verifier has no influence on the quality of the translation.

#### Verification

The CEN Norm /EN 15804/ serves as the core PCR.

Verification of the EPD by an independent third party in accordance with ISO 14025

internal  external



Dr.-Ing. Wolfram Trinius  
 (Independent auditor appointed by the CoE)

## 2 Product

### 2.1 Product description

Solid gypsum blocks<sup>1</sup> are construction products manufactured in the plant from calcium sulphate and water with even and smooth visible sides for the manufacture of building components which no longer need to be plastered. They are manufactured in gross density classes of medium (M, gross density approx. 850 kg/m<sup>3</sup>) and high (D, dense, gross density approx. 1,200 and 1,350 kg/m<sup>3</sup>) as well as in water absorption classes H3 (no requirements on water absorption) and H2 (water absorption not exceeding 5% of the dry mass after storage in water for 2 hours). For visual identification of the various board types, gypsum blocks are dyed reddish (gross density class D) or bluish (water absorption class H2). Gypsum block dimensions are determined by thickness, length and height. The preferred sizes for thickness are 60 mm, 80 mm and 100 mm; 400 mm, 500 mm and 666 mm in length and 500 mm in height.

Constructions made of gypsum blocks are joined using gypsum-based adhesive for gypsum blocks. The components retain their structural stability

thanks to a composite sandwich design as well as their connection to adjacent components. The largely elastic or smooth joint is achieved using edge connection strips.

Structures made of gypsum blocks are primarily realised as single- or double-layer non-load-bearing interior partitions or apartment dividing walls with separate shells. They can also be set up as (firmly-bonded) composite constructions in the case of special requirements or more extensive wall heights. In the form of a single-layer partition (100 mm thick, gross density class M) and a double-layer partition (260 mm thick, gross density class M), the declaration comprises two construction variants which essentially depict the area of application referred to above.

#### Single-layer partition

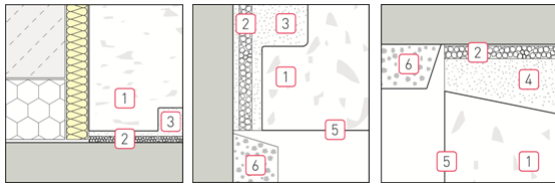
Wall dimensions: W x H = 10.0 m x 2.7 m  
 (A = 27.0 m<sup>2</sup>)

Surfaces: Quality level Q2 (joints filled)

- Gypsum blocks, 100 mm, gross density 850 kg/m<sup>3</sup>
- Gypsum-based components: gypsum-based adhesive, jointing compound

<sup>1</sup> All details refer to MultiGips gypsum blocks manufactured in Germany.

- Edge connection strips made of PE low-expansion foam



**Fig. 1: Construction details of elastic connections to adjacent components**

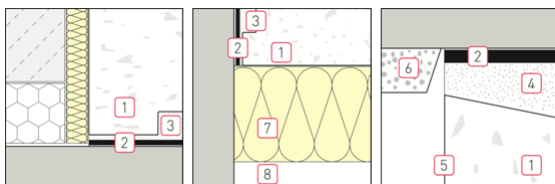
1. Gypsum blocks, 100 mm (MultiGips M100, gross density approx. 850 kg/m<sup>3</sup>)<sup>2</sup>
2. Edge connection strips made of PE low-expansion foam (MultiGips AkustikPro 120-3/120-3 sk)
3. Gypsum-based adhesive for gypsum blocks (MultiGips SuperWhite 200 adhesive)
4. Jointing compound for sealing the ceiling connection joint (MultiGips FG 70 filler gypsum)
5. Skim coating for filling the joints or across the entire surface (MultiGips SG 90 Uni)
6. Interior plaster with separating layer

### Double-layer partition

Wall dimensions: W x H = 10.0 m x 2.7 m (A = 27.0 m<sup>2</sup>)

Surfaces: Quality level Q2 (joints filled)

- Gypsum blocks, 80/80 mm (MultiGips M80, gross density 850 kg/m<sup>3</sup>)<sup>3</sup>
- Gypsum-based components: gypsum-based adhesive, jointing compound
- Mineral wool insulating material, 80 mm
- Edge connection strips based on bitumen



**Fig. 2: Construction details of elastic connections to adjacent components**

1. Gypsum blocks, 80 mm (MultiGips M80)
2. Edge connection strips based on bitumen (MultiGips AkustikBit 1000)
3. Gypsum-based adhesive for gypsum blocks (MultiGips SuperWhite 200 adhesive)
4. Jointing compound for sealing the ceiling connection joint (MultiGips FG 70 filler gypsum)
5. Skim coating for filling the joints or across the entire surface (MultiGips SG 90 Uni)
6. Interior plaster with separating layer
7. Mineral wool insulating material

<sup>2</sup> Alternative: gypsum blocks, hydrophobic (MultiGips MH100)

<sup>3</sup> Alternative: gypsum blocks, hydrophobic (MultiGips MH80)

8. 20 mm air space, corresponds with clearance from 2nd layer

## 2.2 Application

The constructions made of gypsum blocks referred to in 2.1 are primarily used in public, private or commercial buildings for achieving non-load-bearing partition walls, shaft walls, free-standing plaster-board facings and as cladding for supports.

## 2.3 Technical data

Technical data on single-layer partitions			
System wall		MultiGips WM.100	
Gypsum blocks		M100	
Gross density (kg/m <sup>3</sup> )		approx. 850 (M)	
Thickness (mm)		100	
Wall thickness (mm)		100	
Surface density (kg/m <sup>2</sup> ) <sup>1)</sup>		approx. 89	
Max. wall height (m) <sup>2)</sup>	EB 1	(A) 7.0	(B) 7.5
	EB 2	(A) 5.5	(B) 6.0
Max. wall length (m) <sup>2)</sup>	EB 1	(A) –	(B) –
	EB 2	(A) –	(B) 16.5
Edge connection strips in line with DIN 4103-2		MultiGips AkustikPro 120	
Fire resistance		F 180-AB	
Sound reduction index R <sub>WP</sub> (dB) <sup>3)</sup>		40 <sup>4)</sup>	
<sup>1)</sup> Wall shell incl. components, e.g. skim coating			
<sup>2)</sup> Max. permissible wall height and length for single-layer partitions in accordance with DIN 4103-2, Tables 1 and 2, which (A) may display large wall openings and are connected at least at the top and bottom and/or which (B) may not display any large wall openings and are connected on four sides. Max. permissible wall height where fire safety requirements are limited to ≤ 5.53 m as per ABP.			
<sup>3)</sup> R <sub>WR</sub> = R <sub>WP</sub> - 2 dB, without flank transmission to adjacent units			
<sup>4)</sup> Test report no. 4.2-11-189-5-MFPA-Leipzig, 2011.03			

Technical data on double-layer partitions			
System wall		MultiGips WM.80.80L	
Gypsum blocks		M80	
Gross density (kg/m <sup>3</sup> )		approx. 850 (M)	
Thickness (mm)		80	
Wall design Shell/MW/Air/Shell (mm)		80/80/20/80	
Wall thickness (mm)		260	
Surface density (kg/m <sup>2</sup> ) <sup>1)</sup>		approx. 148	
Max. wall height (m) <sup>2)</sup>	EB 1	(A) 5.5	(B) 5.5
	EB 2	(A) 4.0	(B) 4.5
Max. wall length (m) <sup>2)</sup>	EB 1	(A) –	(B) 13.75
	EB 2	(A) –	(B) 8.0
Edge connection strips in line with DIN 4103-2		MultiGips AkustikBit 1000	
Fire resistance		F120-AB	
Sound reduction index R <sub>WP</sub> (dB) <sup>3)</sup>		68 <sup>3)</sup>	
<sup>1)</sup> Wall shells incl. components, e.g. mineral wool			
<sup>2)</sup> Max. permissible wall height and length for double-layer partitions in accordance with DIN 4103-2, Tables 1 and 2, which (A) may display large wall openings and are connected at least at the top and bottom and/or which (B) may not display any large wall openings and are connected on four sides. The permissible wall dimensions are determined by the shell with the lowest wall thickness. Max. permissible wall height where fire safety requirements are as per DIN 4102-4, wall height limited to ≤ 5.0 m as per ABP.			
<sup>3)</sup> R <sub>WR</sub> = R <sub>WP</sub> - 2 dB, without flank transmission to adjacent units			
<sup>4)</sup> Test report no. 4.2-11-189-5-MFPA-Leipzig, 2011.10			

Up-to-date technical information can be obtained from VG-ORTH GmbH & Co. KG:

[www.multigips.de](http://www.multigips.de)

Tel. +49 (0)5532 505-0

E-mail [vertrieb@multigips.de](mailto:vertrieb@multigips.de)

## 2.4 Placing on the market / Application rules

The currently valid versions:

### Standards for gypsum blocks

DIN EN 12859 Gypsum blocks – Definitions, requirements and test methods

DIN 4103-1 Internal non-load-bearing partitions; requirements, testing

DIN 4103-2 Internal non-load-bearing partitions – Part 2: gypsum wallboard partitions<sup>4</sup>

DIN EN 15318 Design and application of gypsum blocks

DIN EN 13501-1 Fire classification of construction products and building elements – Part 1: Classification with the results of tests on reaction to fire of construction products

DIN EN 13501-2 Fire classification of construction products and building elements – Part 2: Classification using data from fire resistance tests, excluding ventilation services

DIN 4102-1 Fire performance of building materials and components – Part 1: Building materials, concepts, requirements and tests

DIN 4102-1 Corrigendum to DIN 4102-1

DIN 4102-2 Fire performance of building materials and components – Part 2: Building materials, concepts, requirements and tests

DIN 4102-3 Fire performance of building materials and components – Part 3: Fire walls and non-load-bearing exterior walls, concepts, requirements and tests

DIN 4102-4 Fire performance of building materials and components – Part 4: Synopsis and application of classified construction materials, components and special components

DIN 4102-4/A1 Fire performance of building materials and components – Part 4: Synopsis and application of classified construction materials, components and special components; Amendment A1

DIN 4109 Sound insulation in buildings – Part 1: Requirements

DIN 4109 Supplement 1: Sound insulation in buildings; construction examples and calculation method

DIN 4109 Supplement 2: Sound insulation in buildings; guidelines for planning and execution; proposals for increased sound insulation; recommendations for sound insulation in personal living and working areas

DIN 4109 Amendment 1: Amendments according to DIN 4109/11.89, DIN 4109 Supplement 1/11.89 and DIN 4109 Supplement 2/11.89

DIN 4109 Supplement 1/A2: Sound insulation in buildings – Supplement 1: Construction examples and calculation methods; Amendment A2

DIN 4109 Supplement 3: Sound insulation in buildings – Calculation of R<sub>w</sub>R for assessing suitability as defined in DIN 4109 on the basis of the sound reduction index R<sub>w</sub> determined in laboratory tests

### Standards for gypsum-based adhesive

DIN EN 12860 Gypsum-based adhesives for gypsum blocks – Definitions, requirements and test methods

### Standards for gypsum plaster

DIN EN 13279-1 Gypsum binders and gypsum plasters – Definitions and requirements

### Standards for mineral wool

DIN 52270 Testing of mineral wool insulating materials – Definitions, forms and kinds of delivery

DIN EN 13162 Thermal insulation for buildings – Factory-made mineral wool (MW) products – Specifications

### Standards for interior walls

DIN 4103-1 Internal non-load-bearing partitions, requirements, testing

DIN EN 1991-1-1 Eurocode 1: Actions on structures – Part 1-1: General actions – Densities, self-weight, imposed loads for buildings<sup>5</sup>

DIN EN 1991-1-1/NA National Annex – Nationally determined parameters – Eurocode 1: Actions on structures – Part 1-1 General actions – Densities, self-weight, imposed loads for buildings<sup>6</sup>

<sup>4</sup> This standard considers the national minimum requirements on non-load-bearing partitions made of gypsum blocks in accordance with DIN 4103-1. Where DIN 4103-2 and DIN EN 15318 Design and application of gypsum blocks apply simultaneously, DIN 4103-2 shall take precedence over DIN EN 15318.

<sup>5</sup> Withdrawn: DIN 1055-3 Actions on structures: Dead loads and effective loads for buildings

<sup>6</sup> Withdrawn: DIN 1055-3 Actions on structures: Dead loads and effective loads for buildings

## 2.5 Delivery status

All components required for wall design are available separately. A compilation of all requisite materials is possible via the building materials trade.

Gypsum blocks are delivered in packs of 12 (M100) or 15 (M80) blocks. Gypsum plaster (gypsum-based adhesive, jointing compound, skim coating) is delivered in 25-kg sacks.

## 2.6 Base materials / Auxiliaries

### Gypsum blocks

Safety data sheet in accordance with Directive (EC) 1907/2006 (REACH)<sup>7</sup>:

Set plaster (CaSO<sub>4</sub> x 2H<sub>2</sub>O); calcium sulphate CaSO<sub>4</sub> x n H<sub>2</sub>O (n = 0, ½, 2); content > 85%; CAS-number<sup>8</sup>: 7778-18-9; EINECS number<sup>9</sup>: 231-900-3; not subject to specific labelling requirements in accordance with Directive (EC) 1272/2008 (CLP Directive); no special measures required if used as designated; P1 or FFP1 respiratory mask recommended in the event of high dust development (BGR 190), gloves, goggles and personal protective equipment not necessary; odourless; pH value in aqueous solution approx. pH 7 (not applicable on delivery as hardened); density approx. 850 kg/m<sup>3</sup> and approx. 1,200 kg/m<sup>3</sup> or 1,350 kg/m<sup>3</sup>; non-flammable; no negative effects known for people (calcium and sulphate are natural components in water and foodstuffs), product does not pose any ecological reservations in air, water or soil; insofar as there is no subsequent contamination, the product can be re-used unreservedly or recycled as non-hazardous waste; disposal on landfills complying with Landfill Classes I and II in line with the Landfill Ordinance (non-hazardous waste according to § 3, paragraph 5 KrWG).

Environmental Product Declaration  
EPD-VGO-MG-10-2010-1:

Emissions of volatile organic compounds and formaldehyde were determined in the test chamber experiment using realistic surface-specific ventilation rates on representative samples after 3 and 7 days. The VOC concentrations of individual substances detected were evaluated after 3 and 7 days using the AgBB LCI concept. The total values were formed according to the AgBB scheme (last revised March 2008). On day 3 and day 7 of the test chamber experiment, no carcinogenic substance as per the AgBB scheme could be detected using the examination methods applied. Emissions of volatile organic compounds on days 3 and 7 were below the limits/requirements specified by the AgBB scheme. The gypsum block tested complies with the requirements of the AgBB scheme for the use of construction products in interior applications. Due to the measured values on days 3 and 7 (TVOC<sub>3</sub> ≤ 0.022 mg/m<sup>3</sup>, TVOC<sub>7</sub> ≤ 0.017 mg/m<sup>3</sup>), the test was aborted after seven days.

### Gypsum-based adhesive and filler

<sup>7</sup> Procurement source: [www.multigips.de](http://www.multigips.de) > Service > Publications > Gypsum blocks > Safety data sheets

<sup>8</sup> The CAS number (Chemical Abstracts Service) is an international designation standard for chemical substances.

<sup>9</sup> The EINECS Inventory (European Inventory of Existing Commercial Chemical Substances) is the waste materials directory applicable in the EU.

Safety data sheet in accordance with Directive (EC) 1907/2006 (REACH)<sup>10</sup>:

Gypsum-based adhesive made from calcium sulphate beta semi-hydrate with organic suspending agents (cellulose ether, protein breakdown products) and mineral aggregate (powdered limestone); content > 88%; CAS number<sup>11</sup>: 7778-18-9; EINECS-number<sup>12</sup>: 231-900-3; not subject to specific labelling requirements in accordance with Directive (EC) 1272/2008 (CLP Directive); respiratory mask is not required for gypsum with free moisture, P1 or FFP1 respiratory mask recommended when handling dry gypsum in the event of high dust development (BGR 190), gloves, goggles and personal protective equipment not necessary; odourless; pH value in aqueous solution approx. pH 7; density approx. 270 kg/m<sup>3</sup>, non-flammable; no negative effects known for people (calcium and sulphate are natural components in water and foodstuffs), product does not pose any ecological reservations in air, water or soil; sacks or other packaging should be emptied in full and can be directed to recycling after cleaning; insofar as there is no subsequent contamination, the product can be re-used unreservedly; recycling in certified plants according to waste code (waste key 10 13 06 for waste from the production of gypsum and gypsum products and 17 08 02 for building and demolition waste); disposal on landfills complying with Landfill Classes I and II in line with the Landfill Ordinance (non-hazardous waste according to § 3, paragraph

Environmental Product Declaration  
EPD-VGO-MG-10-2010-2:

Emissions of volatile organic compounds and formaldehyde were determined in the test chamber experiment using realistic surface-specific ventilation rates on representative samples after 3 and 28 days. The VOC concentrations of individual substances detected were evaluated after 3 and 28 days using the AgBB LCI concept. - The total values were formed according to the AgBB scheme (last revised: March 2008). On days 3 and 28 of the test chamber experiment, no carcinogenic substance as per the AgBB scheme could be detected using the examination methods applied. Emissions of volatile organic compounds on days 3 and 28 were below the limits/requirements specified by the AgBB scheme. The gypsum-based adhesive tested complies with the requirements of the AgBB scheme for re-using construction products in interiors based on the values measured on days 3 and 28 (TVOC<sub>3</sub> ≤ 0.008 mg/m<sup>3</sup>, TVOC<sub>7</sub> ≤ 0.006 mg/m<sup>3</sup>).

#### Note

Reference is made to the Environmental Product Declarations available from the Bundesverband der Gipsindustrie e.V. concerning the base materials / auxiliaries of individual components.

Base materials / Auxiliaries do not lead to an obligation to labelling requirements for hazardous substances on the part of gypsum blocks or gypsum-based components. None of these components

<sup>10</sup> Procurement source: www.multigips.de > Service > Publications > Gypsum blocks > Safety data sheets

<sup>11</sup> The CAS number (Chemical Abstracts Service) is an international designation standard for chemical substances.

<sup>12</sup> The EINECS Inventory (European Inventory of Existing Commercial Chemical Substances) is the waste materials directory applicable in the EU.

display substances of very high concern (SVHC) in contents exceeding 0.1% by weight.

VG-ORTH offers safety data sheets even for products or mixtures for which safety data sheets are not legally required on account of their lack of labelling requirements concerning hazardous substances.

## 2.7 Manufacture

Partitions are completed directly on the building site.

With regard to the manufacturing processes for individual components, reference is made to the Environmental Product Declarations available from the Bundesverband der Gipsindustrie e.V. and IBU, while mineral wool is covered by rock wool panels (Heralan DPF 50 or equivalent).

The construction products supplied are used for realising two constructions measuring (W x H) 10.0 m x 2.7 m (A = 27.0 m<sup>2</sup>) whose joints are filled after mounting (quality level Q2).

Material requirements for the respective variants in accordance with the following table:

Material requirements by the declared partitions made of gypsum blocks				
Product	Single-layer		Double-layer	
Gypsum blocks, 100 mm, gross density 850 kg/m <sup>3</sup>	27 m <sup>2</sup>	2295 kg		
Gypsum blocks, 80 mm, gross density 850 kg/m <sup>3</sup>			54 m <sup>2</sup>	3672 kg
Adhesive for gypsum blocks, gross density 980 kg/m <sup>3</sup>	54 kg	54 kg	81 kg	81 kg
Jointing compound, gross density 870 kg/m <sup>3</sup>	54 kg	54 kg	108 kg	108 kg
Edge connection strips	25.4 m	1.3 kg	50.8 m	12.2 kg
Mineral wool insulating material (rock wool panels), gross density ≥ 50 kg/m <sup>3</sup>			27 m <sup>2</sup>	108 kg

This results in an overall weight of approx. 2,400 kg for the declared single-layer wall or 89 kg/m<sup>2</sup>, and approx. 4,000 kg for the declared double-layer wall or 148 kg/m<sup>2</sup>.

## 2.8 Environment and health during production

Observance of the requisite condition governing health protection and additional measures:

- Reduction of dust emissions by
  - Moist-dedusting of mixing devices
  - Enclosure or encapsulation of individual plant components (e.g. crusher and screening unit, grinders) and connection to dedusting plants
  - Dedusting of loading processes
  - Keeping transit routes clean and damp
  - Storing fine-grain materials in silos and connection to dedusting plants
  - Covering or enclosing stockpiles or storage areas for bulk materials emitting dust
- Reducing noise emissions via sound absorbers on extraction fans
- Reducing energy consumption by optimising the drying processes
- Conserving resources by saving on raw materials and avoiding waste:
  - Gypsum waste from production and after drying (rejected boards) is redirected to the production process.

- Substitution, e.g. by screened material incurred as a by-product during the manufacture of ceramic plaster at other production sites
- Using FGD plaster
- Reducing water / waste water consumption
  - Using water from heat recovery during board drying and dehydrating gypsum quarries

## 2.9 Product processing/Installation

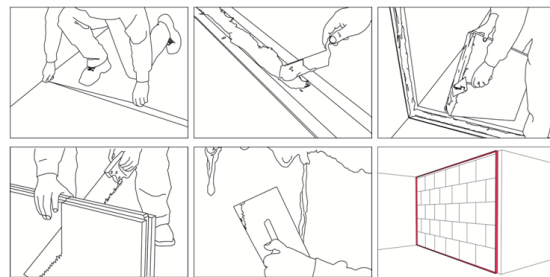
Building elements made from gypsum blocks are realised in a system which only requires a few components: gypsum blocks, gypsum-based adhesive, jointing compound, skim coating and edge connection strips. Important quality criteria for structural stability and fitness for use include a perpendicular and flush composite sandwich design, fully-pointed bonding and professional connections.

The exact position of components comprising gypsum blocks is guaranteed if the line of the bare ceiling is established using a chalk line and the marking made perpendicular to the adjacent components. Unless edge connection strips with position markers are used, the position of the component on the visible side of the strip is marked again using a chalk line after fixing the edge connection strip in place. Self-adhesive edge connection strips, e.g. MultiGips AkustikPro 120-3 sk, require a smooth sub-surface. Edge connection strips secured with gypsum-based adhesive enable compensation of smaller irregularities. The force-fit gypsum blocks can be aligned perpendicularly and flush using a rubber hammer and spirit level during processing.

Components made of gypsum blocks are bonded using gypsum-based adhesive. Gypsum plaster (DIN EN 13279, e.g. adhesive plaster B4/20/2) is not permissible for bonding gypsum blocks. The gypsum-based adhesive must be applied to both the butt and bearing joints in order to guarantee that the gypsum blocks are firmly bonded (fully pointed). Generous application of the gypsum-based adhesive guarantees the static, sound insulation and fire safety characteristics displayed by the component. Adhesive swelling out of the joints is to be wiped off in a slightly hardened condition while working the blocks or removed from the surface when fully hardened, e.g. in mounting areas.

Gypsum block components are connected to adjacent elements, whereby edge connection strips also guarantee acoustics-optimised edge mounting in the case of elastic connections. In order to avoid acoustic bridges, edge connection strips must not be plastered over. Extra-wide strips have proven useful which are trimmed directly after wall construction or after any requisite full-surface filling of joints.

When forming the ceiling connection in particular, care must be taken to ensure that the edge connection strip is fitted compactly and without forming any cavities. The edges of the top row of blocks can be both horizontal and inclined from a normative perspective. Inclined wall edges enlarge the adhesive area for the designated components (MultiGips FG 70 filling/smoothing plaster). Prior to filling the ceiling joint, the cut edges are dedusted and pre-wetted. The ceiling joint must be filled in full in terms of sound insulation, fire safety and statics.



**Figs. 3 – 8:** Mark the position of the partition wall on the floor using a chalk line; fit the edge connections strips without forming cavities and apply gypsum-based adhesive across the entire surface; bond the gypsum blocks securely and with a perpendicular and flush fit; consider a joint offset of 1/4 – 1/2 of the block length; wipe off any adhesive swelling out of the joints or remove it when hard; component mounted with edge mounting on four sides without any large wall opening and with elastic connection

Double-layer gypsum block components are mounted the same way as single-layer elements. The internal mineral wool insulation panels are secured to the first shell using clumps of adhesive or setting plaster.

Gypsum blocks can be cut to the exact size using hand or power saws. Sawn panels are used in the composite. During the cutting, sawing or grinding processes for construction materials or components, the occupational exposure limit value of 6 mg/m<sup>3</sup> alveolar dust (A-dust) must be observed for calcium sulphate as a time-weighted average (in accordance with TRGS 900 "Occupational Exposure Limit Values", issued in January 2006, last amended and supplemented by GMBI 2012, p. 11, no. 1). If necessary, dust-reducing measures or organisational measures should be provided for based on TRGS 559 "Mineral dust" (issued in February 2010) and the exposure categories outlined there.

## 2.10 Packaging

Gypsum blocks are delivered (at ground level on the construction site with protective storage and/or unloading by crane onto the respective storey of a building) on pallets and in foil packaging. Wooden pallets are available as reusable or disposable pallets.

Gypsum plaster (gypsum-based adhesive, jointing compound, skim coating) is delivered in sacks. Building material sacks are directed to paper recycling via a return system.

The edge connection strips are delivered packed in foil. Mineral wool is also delivered as sheet material and packed in foil. Packaging is disposed of via a return system.

A compilation of all of the requisite materials in a shipment is organised by the construction products trade and realised by VG-ORTH GmbH & Co. KG.

## 2.11 Condition of use

Gypsum block components can be tiled, wallpapered or painted after completion. The surface finish is not considered in this analysis but it does protect the underlying component from external influences.

Partitions made of gypsum blocks do not make any demands on the load-bearing construction. They do not require any ceiling reinforcements or wall supports. Openings can be arranged in the homogeneous components without any reservations and as required thanks to grid dimensions – while

building the wall or subsequently, e.g. within the framework of a change in use. The layout plan can be determined close to sale or rental of the property. In the event of a change in function or tenant, openings can be sealed using the same material and positioned elsewhere. The partitions can also be mounted on screed.

Modifications implemented by later users are not considered in this declaration.

## 2.12 Environment and health during use

In accordance with the recommendations of the IRK/AOLG ad-hoc working group<sup>13</sup> on limiting ambient air concentrations for the total content of volatile organic compounds TVOC (Total Volatile Organic Compounds), gypsum blocks with a concentration of less than 0.3 mg/m<sup>3</sup> are assigned to the group of construction products (stage 1, Table 6<sup>14</sup>) for which no further measures need to be taken. Accordingly, TVOC values below 0.3 mg/m<sup>3</sup> do not pose any reservations in terms of hygiene provided no individual substance reference points are exceeded. They are referred to as "target values" (hygienic precautions) and must be striven towards sufficiently in rooms ahead of new construction or renovation measures and not fall short of where possible. Gypsum blocks and their gypsum-based components fall significantly short of this target value, e.g. gypsum blocks display a concentration of 0.017 mg/m<sup>3</sup>.

VG-ORTH GmbH & CO. KG is a product partner in the Sentinel-Haus network. As a quantifiable instrument, the Sentinel Standard developed by the Sentinel-Haus Institut permits judicial assertion of the indoor room quality agreed by contract, e.g. based on the recommendations outlined above.

## 2.13 Reference Service Life

The Reference Service Life of gypsum blocks is intended to cover the entire life cycle of the building. Its service life is indicated as ≥ 50 years (replacement in 50 years = 0) in the table depicting useful lives and replacement cycles for components for life cycle analyses in accordance with the Sustainable Building for State Buildings evaluation system (11.2011, code 342.511).

Components made of solid gypsum blocks are resistant to rotting and ageing when used as designated – even when used in areas of standard humidity, including kitchens and bathrooms in residential buildings. The useful life of gypsum blocks is not technically limited under such conditions. As components used in interior design, constructions featuring gypsum blocks are not exposed to any adverse influences which would reduce their useful lives (weathering, mechanical wear).

## 2.14 Extraordinary effects

### Fire

In chemical terms, set plaster as in gypsum blocks is calcium sulphate dihydrate (CaSO<sub>4</sub> x 2H<sub>2</sub>O) which comprises approx. 20% by weight chemically bound crystal water. Even a gypsum block 60 mm thick features approx. 12 litres of bound crystal water across an area of one square metre; approx. 20 litres per square metre for blocks which are 100 mm thick. In the event of a fire, the crystal structure changes, the plaster is dehydrated and converted to CaSO<sub>4</sub> x ½H<sub>2</sub>O (semi-hydrate), whereby significant volumes of water are expelled. The process withdraws thermal energy from the flames and ensures that the temperature in the respective zone does not exceed 100 °C during the entire process. This is where gypsum blocks have a favourable influence in fire safety applications – both for protecting supporting components from premature and excess heating and for maintaining the permissible temperature increase on the rear of separating components.

Gypsum blocks and their gypsum-based system components are classified as construction product class A1 according to DIN 4102 and in accordance with the table below. The solid components retain their structural and dimensional stability for the fire resistance period indicated and also throughout full dehydration of the plaster.

Construction product classes for gypsum blocks and gypsum-based components (construction products in italics as alternative components to the variants reviewed)				
Product	Thickness (mm)	mass percentage of organic substances	Evidence	Construction material class
Gypsum blocks DIN EN 12859				
M100	100	< 1%	DIN 4102-4, 2.2.1	A1
M80	80	< 1%	DIN 4102-4, 2.2.1	A1
<i>MH80 moisture-resistant panel</i>	80			
<i>MH100 moisture-resistant panel</i>	100			
<i>DH100 Rmax acoustic panel</i>	100			
Gypsum-based adhesive for gypsum blocks DIN EN 12860				
<i>Kleber ClassicWeiss (adhesive)</i>		< 1%	DIN 4102-4, 2.2.1	A1
<i>Kleber SuperWeiss 120 (adhesive)</i>		> 1%	P-3406/021/07-MPA-BS	
<i>Kleber SuperWeiss 200 (adhesive)</i>		> 1%		
<i>Kleber Hydro 90 (adhesive)</i>		< 1%	DIN 4102-4, 2.2.1	
Gypsum plaster DIN EN 13279				
<i>FG 70 Füll- und Zargengips (filling/smoothing plaster)</i>		< 1%	DIN 4102-4, 2.2.1	A1
<i>SG 90 Uni Flächenspachtel (surface smoothing plaster)</i>				
<i>CasoFill Super 90m Maschinenspachtel (super-adhesive smoothing plaster)</i>				
<i>RotWeiss 100 Gips-Haftputz (adhesive plaster)</i>				

Components made of gypsum blocks are constructions classified to DIN 4102-4. Their fire resistance is indicated in Table 38, line 6 without requiring any further evidence or tests<sup>15</sup>. In evidence of fire resis-

<sup>13</sup> Ad-hoc working group of the Federal Environment Ministry's IRK Indoor Air Quality Commission and the AOLG working group of the Indoor Air Quality of the Environmental Hygiene Committee of the working group of the supreme state health authority (formerly AGLMB Arbeitsgemeinschaft der Leitenden Medizinalbeamten und -beamtinnen der Länder)

<sup>14</sup> in: Guidelines for indoor hygiene in school buildings, developed by the Indoor Air Quality Commission of the Federal Environmental Ministry, Berlin, 08.2008

<sup>15</sup> DIN 4102-4 in the 1994 version refers to gypsum blocks according to the obsolete DIN 18163, now DIN EN 12859-2011-05. The statements in DIN 4102-4

tance of components made of gypsum blocks according to DIN 4102-4, the permissible wall height is limited to max. 5 metres.

If fire resistance is planned and verified according to DIN 4102-4 (100 mm thick: to F 180-A; 80 mm thick: to F 120-A), the use of edge connection strips made of mineral wool insulation material in line with DIN EN 13162 is generally required (non-flammable, construction product class A1 as per DIN 4102, melting point  $\geq 1,000$  °C, 13 mm thick, permissible compressibility  $\leq 3$  mm).<sup>16</sup>

Alternatively, the connections can also be achieved using edge connection strips made of PE low-expansion foam (MultiGips AkustikPro 120-3) which verifiably achieve the same fire resistance duration as edge connection strips made of mineral wool insulating material. In this case, walls (100 mm thick) are referred to as up to F 180-AB and (80 mm thick) as up to F 120-AB. This also applies when using bituminised edge connection strips (MultiGips AkustikBit 1000).

European class to DIN EN 13501-1: non-flammable, A1 (no smoke, no burning droplets/drips).

### Water

For calcium sulphate:

No negative effects on people are known (calcium and sulphate are natural components in water and foodstuffs); no long-term toxicity in salt water (Plonor list) or fresh water (natural component); product poses no ecological reservations in air, water or soil.

Components made from gypsum blocks must be protected from extensive penetration by moisture.

A leaflet is available from the Bundesverband der Gipsindustrie e.V. on remedying damage to components made of gypsum following flooding.

### Mechanical destruction

Gypsum blocks are practically "infinitely repairable": Damage to the monolithic composite can be repaired using gypsum-based adhesive or jointing compound without compromising quality in terms of the cross-section or surface.

### 2.15 Re-use phase

Gypsum blocks form stable solid walls displaying a high degree of resistance to mechanical stress. Technically, their useful lives are practically unlimited when used as designated. The components made of solid gypsum can be repaired any number of times using the same material.

Floor plans can be specified at a very late stage using gypsum blocks. Subsequent refurbishments or entire conversions are possible at any time as the partitions can be easily removed or opened. Property featuring partitions made of gypsum blocks can therefore react flexibly to future requirements.

Components made of gypsum blocks avail of the same characteristics throughout their cross-section and across their entire surface as well as the same technical characteristics across their entire useful

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can also be applied to gypsum blocks according to DIN EN 12859.

<sup>16</sup> Classification of a wall construction made of gypsum blocks (excl. installation parts) according to DIN EN 13501-2 with mineral wool insulating material and a max. permissible wall height  $\leq 3.00$  m is EI 120.

lives. Subsequent wall openings can therefore be arranged at any time and flexibly. For this reason, wall openings can be based on the principles of the most favourable floor plan right from the start. Components made of gypsum blocks are "tolerant" in terms of changes to plans. An opening already available which needs to be closed again can be sealed using gypsum blocks and gypsum-based adhesive – fast, custom-fit and without any compromises in quality in terms of fitness for use.

### 2.16 Disposal

#### Avoiding waste

Good construction planning enables waste to be largely avoided using gypsum blocks with prefabricated industrial elements and precisely planned requirements per square metres of partition. Cut sections are treated like uncut blocks and installed in components made of gypsum blocks. Empirical values indicate that when materials are planned accurately, waste volumes of a mere 4% of the overall floor plan requirements are incurred (leaflet on disposing of gypsum waste issued by the Bundesverband der Gipsindustrie e.V., 2005, with reference to new construction measures). If, despite careful assessment of demand, material is left over, gypsum blocks – like all other accessory products – can be stored without reservation in a dry place for future construction measures.

Components made of solid gypsum blocks are robust, resistant to rotting and ageing – even when used in areas of standard humidity, including kitchens and bathrooms in residential buildings. Technically, the useful life of gypsum blocks is not limited under such conditions and when used as designated. As components used in interior design, they are not exposed to any adverse influences which would reduce their useful lives (weathering, mechanical wear). Unlike other internal partitions, gypsum blocks are practically "infinitely repairable". Damage to the monolithic composite can be repaired using gypsum-based adhesive or skim coating without compromising quality in terms of the cross-section or surface (see 2.13).

#### Re-use

Gypsum block waste as well as demolition material made of solid gypsum walls represent pure recyclable material made of calcium sulphate dihydrate which does not require separation or complex sorting processes. However, this is only possible if no other construction products or packaging have been collected in a container intended for gypsum. These recyclable materials are redirected to the recycling sector as – from a chemical perspective – original raw materials for renewed manufacture of gypsum products, for fertilisation and soil conditioning in agriculture or for recultivation or renaturation in mining areas, whereby gypsum blocks can be processed in the same crushing and grinding plants used for processing natural gypsum.

Some companies in the disposal sector or responsible for construction site management exclusively offer recycling options for construction waste while others only offer disposal services. Owing to logistics and technical processing, the economic benefits must always be considered and assessed despite the ecological advantages. One problem involves reliable and sufficiently high tonnages which need to be compiled continuously and at consistent quality



for recycling. Collection systems and specifications will however develop significantly in the course of waste legislation: gypsum blocks installed today will then represent an easily handled reusable material with a high recycling potential when they reach their end-of-life stage.

### Disposal and waste management

Small volumes which can not be practically collected and recycled in terms of collection and transport costs can be disposed of at landfills from landfill

class I in accordance with the Landfill Ordinance. According to the List of Wastes Ordinance (AVV), the waste code for gypsum blocks is 170802 (construction products based on gypsum). Until disposal, waste should be stored in a weather-proof and dry place. Savings in weight reduce costs and ensure better re-usability. In co-ordination with the disposal company, separate collection of gypsum block waste can be practical.

## 3 LCA: Calculation rules

### 3.1 Declared unit

The declaration refers to non-load-bearing partitions made using gypsum blocks and measuring  $W \times H = 10.0 \text{ m} \times 2.7 \text{ m}$  ( $A = 27 \text{ m}^2$ ) filled according to surface quality level Q2 (compound joints without reinforcing strips).

### 3.2 System boundary

Type of ESD: cradle to grave

Modules A1-A3 include the production of raw materials and transport thereof, the provision of energy and manufacturing processes required for the production of all components for the partitions made from gypsum blocks. Transport of the components to the construction site is included in Module A4 while the wall construction, including disposal of packaging are covered by A5. Demolition of the walls and recycling or disposal of the materials is included in Module C. Credits based on disposal and recycling are allocated to Module D.

### 3.3 Estimates and assumptions

Transportation assumptions were made for all materials required and for disposal.

### 3.4 Cut-off criteria

All components for building partitions made of gypsum blocks and the water required were considered.

Accordingly, material and energy flows with a share of less than 1 per cent were also considered.

It can be assumed that the processes ignored would have contributed less than 5% to the impact categories under review.

### 3.5 Background data

“GaBi 5” – the software system for comprehensive analysis developed by PE INTERNATIONAL AG – was used for modelling the life cycle of all components /GaBi 5, 2012/.

The Life Cycle Assessment was drawn up for Germany as a reference area. This means that apart from the production processes under these marginal conditions, the pre-stages also of relevance for Germany, such as provision of electricity or energy carriers, were used. The power mix for Germany 2008 is used.

### 3.6 Data quality

All of the background data records of relevance for manufacturing were taken from the GaBi 5 software data base.

### 3.7 Period under review

The data basis for materials required for the declared partitions is taken from the manufacturer descriptions for 2011/2012 /VG-Orth 2011/.

### 3.8 Allocation

No allocations arise for the unit process concerning installation of the gypsum block partitions in buildings modelled in this ESD. Allocations were used in the background data for modelling the requisite components, e.g. for the provision of electricity. Allocation was avoided for the provision of FGD plaster which is partially used for the production of calcium sulphate beta semi-hydrate.

### 3.9 Comparability

As a general rule, EPD data can only be compared or evaluated when all of the data sets to be compared have been recorded in accordance with DIN EN 15804 and the building context or product-specific performance characteristics are taken into consideration.

## 4 LCA: Scenarios and additional technical information

The following technical information forms the basis for the declared modules or can be used for developing specific scenarios within the context of a building assessment.

### Transport to site (A4)

A distance of 200 km was assumed for transporting all components of the gypsum block partitions by truck.

### Construction installation process (A5)

The gypsum block partitions are installed manually. Water consumption corresponds with approx. 0.63 l/kg adhesive and 0.71 l/kg jointing compound.

A generic distance of 50 km plus an empty run of 50 km were assumed for the packaging material to be disposed of.

Polyethylene foil was considered as packaging material for the gypsum blocks and paper sacks for the jointing compound and adhesive. Incineration in a waste incineration plant was assumed for disposal of the polyethylene foil. It was assumed that paper sacks are directed to waste paper recycling. As

most of the waste paper is required for the manufacture of paper sacks, no credits were considered in Module D. No other packaging was considered.

Incineration in a waste incineration plant was assumed for disposal of sections of edge connection strips made of polyethylene.

#### **Use (B)**

The Reference Service Life in accordance with the "Nutzungsdauern von Bauteilen für Lebenszyklusanalysen nach dem Bewertungssystem Nachhaltiges Bauen (BNB)" (Useful life of components for the LCA according to the Sustainable Building assessment system) table, last revised 03.11.2011,  $\geq 50$  years for all of the partitions listed here in accordance with code number 342.511 "Non-load-bearing interior walls – Gypsum blocks".

Use is not declared in this ESD as no environmental loads are generally incurred through the use of the declared partitions.

#### **End of Life (C1-C4)**

Transport: 50 km (one run at 100% utilisation capacity plus one empty run). It is assumed that the mineral components (gypsum blocks, jointing compound, adhesive and rock wool) are disposed of at a landfill for building rubble.

The edge connection strips are directed to incineration in a waste incineration plant.

#### **Re-use, recovery and recycling potential (D)**

Credits are considered for electricity and thermal energy as a result of thermal utilisation of packaging materials and edge connection strips.

## 5 LCA: Results

The following tables depict the results of the indicators concerning impact estimates, use of resources as well as the waste and other output flows with reference to the declared unit measuring W x H = 10.0 m x 2.7 m (A = 27.0 m<sup>2</sup>).

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)																
Product stage			Construction product stage		Use stage							End-of-life stage				Benefits and loads beyond the system boundary
Raw material supply	Transport	Manufacture	Transport to site	Construction installation process	Use / Application	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction	Transport	Waste processing	Disposal	Re-use, recovery or re-cycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X

### RESULTS OF THE LCA – ENVIRONMENTAL IMPACT: gypsum block partition, single-layer, 27 m<sup>2</sup>

Parameter	Unit	A1-3	A4	A5	C1	C2	C3	C4	D
GWP	[kg CO <sub>2</sub> equiv.]	640.5	22.7	6.7	0.0	8.2	2.9	33.6	-6.5
ODP	[kg CFC11 equiv.]	3.15E-07	1.22E-09	1.59E-10	0.00E+00	4.40E-10	5.93E-11	2.95E-08	-1.57E-08
AP	[kg SO <sub>2</sub> equiv.]	6.14E-01	9.81E-02	4.31E-04	0.00E+00	3.63E-02	1.51E-04	2.04E-01	-7.90E-03
EP	[kg PO <sub>4</sub> <sup>3</sup> equiv.]	8.21E-02	2.36E-02	9.92E-05	0.00E+00	8.77E-03	3.20E-05	2.80E-02	-8.88E-04
POCP	[kg ethene equiv.]	8.81E-02	-3.49E-02	3.51E-05	0.00E+00	-1.30E-02	1.78E-05	2.13E-02	-8.04E-04
ADPE	[kg Sb equiv.]	3.75E-02	1.04E-06	4.29E-08	0.00E+00	3.74E-07	1.47E-08	1.21E-05	-4.25E-07
ADPF	[MJ]	9970.4	312.4	1.1	0.0	112.8	0.3	448.6	-86.1
Legend	GWP = Global warming potential; ODP = Ozone depletion potential; AP = Acidification potential of soil and water; EP = Eutrication potential; POCP = Photochemical ozone creation potential; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil fuels								

### RESULTS OF THE LCA – ENVIRONMENTAL IMPACT: gypsum block partition, single-layer, 27 m<sup>2</sup>

Parameter	Unit	A1-3	A4	A5	C1	C2	C3	C4	D
PERE	[MJ]	146.6	-	-	-	-	-	-	-
PERM	[MJ]	0.0	-	-	-	-	-	-	-
PERT	[MJ]	146.6	12.5	0.1	0.0	4.5	0.0	34.8	-7.6
PENRE	[MJ]	10168.5	-	-	-	-	-	-	-
PENRM	[MJ]	39.3	-	-	-	-	-	-	-
PENRT	[MJ]	10207.8	313.6	1.2	0.0	113.2	0.4	469.3	-99.0
SM	[kg]	1362.1	-	-	-	-	-	-	-
RSF	[MJ]	0	0	0	0	0	0	0	0
NRSF	[MJ]	0	0	0	0	0	0	0	0
FW	[m <sup>3</sup> ]	147.0	1.2	0.2	0.0	0.4	0.0	22.6	-7.7
Legend	PERE = Renewable primary energy as energy carrier; PERM = Renewable primary energy resources as material utilisation; PERT = Total use of renewable primary energy resources; PENRE = Non-renewable primary energy as energy carrier; PENRM = Non-renewable primary energy as material utilisation; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary materials; RSF = Renewable secondary fuels; NRSF = Non-renewable secondary fuels; FW = Use of net fresh water								

### RESULTS OF THE LCA – ENVIRONMENTAL IMPACT: gypsum block partition, single-layer, 27 m<sup>2</sup>

Parameter	Unit	A1-3	A4	A5	C1	C2	C3	C4	D
HWD*	[kg]	-	-	-	-	-	-	-	-
NHWD	[kg]	369.0	1.7	0.2	0.0	0.6	0.1	2480.0	-17.4
RWD	[kg]	9.66E-02	4.43E-04	5.15E-05	0.00E+00	1.60E-04	1.97E-05	8.33E-03	-5.24E-03
CRU	[kg]	-	-	-	-	-	0	-	-
MFR	[kg]	-	-	-	-	-	0	-	-
MER	[kg]	-	-	-	-	-	0.9	-	-
EE [electricity]	[MJ]	-	-	12.7	-	-	5.5	-	-
EE [steam]	[MJ]	-	-	30.6	-	-	13.2	-	-
Legend	HWD = Hazardous waste for disposal; NHWD = Non-hazardous waste for disposal; RWD = Radioactive waste for disposal; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EE = Exported energy by type								

\* In accordance with the transition solution of 4.10.2012 approved by the CoE

### RESULTS OF THE LCA – ENVIRONMENTAL IMPACT: gypsum block partition, double-layer, 27 m<sup>2</sup>

	Production	Installation		Disposal			Credit

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP	[kg CO2 equiv.]	1200.5	37.6	8.8	0.0	13.5	38.2	60.5	-32.1
ODP	[kg CFC11 equiv.]	1.56E-05	2.02E-09	2.18E-10	0.00E+00	7.22E-10	7.94E-10	4.87E-08	-7.74E-08
AP	[kg SO2 equiv.]	1.46E+00	1.63E-01	5.89E-04	0.00E+00	5.96E-02	2.03E-03	3.37E-01	-3.91E-02
EP	[kg PO43 equiv.]	1.88E-01	3.91E-02	1.38E-04	0.00E+00	1.44E-02	4.29E-04	4.64E-02	-4.39E-03
POCP	[kg ethene equiv.]	1.84E-01	-5.77E-02	4.87E-05	0.00E+00	-2.13E-02	2.39E-04	3.67E-02	-3.98E-03
ADPE	[kg Sb equiv.]	6.09E-02	1.72E-06	6.03E-08	0.00E+00	6.15E-07	1.97E-07	1.99E-05	-2.10E-06
ADPF	[MJ]	18367.9	517.2	1.6	0.0	185.2	4.3	740.9	-426.1
Legend	GWP = Global warming potential; ODP = Ozone depletion potential; AP = Acidification potential of soil and water; EP = Eutrication potential; POCP = Photochemical ozone creation potential; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil fuels								

### RESULTS OF THE LCA – ENVIRONMENTAL IMPACT: gypsum block partition, double-layer, 27 m<sup>2</sup>

		Production	Installation		Disposal				Credit
Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PERE	[MJ]	353.2	-	-	-	-	-	-	-
PERM	[MJ]	0.0	-	-	-	-	-	-	-
PERT	[MJ]	353.2	20.6	0.1	0.0	7.4	0.4	57.5	-37.6
PENRE	[MJ]	18897	-	-	-	-	-	-	-
PENRM	[MJ]	472.1	-	-	-	-	-	-	-
PENRT	[MJ]	19369.1	519.2	1.8	0.0	185.9	5.0	775.2	-489.7
SM	[kg]	2139.3	-	-	-	-	-	-	-
RSF	[MJ]	0	0	0	0	0	0	0	0
NRSF	[MJ]	0	0	0	0	0	0	0	0
FW	[m <sup>3</sup> ]	231.0	1.9	0.3	0.0	0.7	0.5	37.3	-38.2
Legend	PERE = Renewable primary energy as energy carrier; PERM = Renewable primary energy resources as material utilisation; PERT = Total use of renewable primary energy resources; PENRE = Non-renewable primary energy as energy carrier; PENRM = Non-renewable primary energy as material utilisation; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary materials; RSF = Renewable secondary fuels; NRSF = Non-renewable secondary fuels; FW = Use of net fresh water								

### RESULTS OF THE LCA – ENVIRONMENTAL IMPACT: gypsum block partition, double-layer, 27 m<sup>2</sup>

		Production	Installation		Disposal				Credit
Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
HWD*	[kg]	-	-	-	-	-	-	-	-
NHWD	[kg]	1100.0	2.7	0.3	3860.0	1.0	0.9	4090.0	-85.9
RWD	[kg]	3.41E-01	7.33E-04	7.04E-05	0.00E+00	2.62E-04	2.65E-04	1.38E-02	-2.59E-02
CRU	[kg]	-	-	-	-	-	0	-	-
MFR	[kg]	-	-	-	-	-	0	-	-
MER	[kg]	-	-	-	-	-	12.2	-	-
EE [type]	[MJ]	-	-	16.8	-	-	73.1	-	-
EE [type]	[MJ]	-	-	40.4	-	-	176.0	-	-
Legend	HWD = Hazardous waste for disposal; NHWD = Non-hazardous waste for disposal; RWD = Radioactive waste for disposal; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EE = Exported energy by type								

\* In accordance with the transition solution of 4.10.2012 approved by the CoE

## 6 LCA: Interpretation

The total use of non-renewable primary energy resources (PENRT) for single- and double-layer partitions made of gypsum blocks is essentially dominated by manufacture of the blocks. Gypsum blocks for single-layer partitions account for approx. 97% of Modules A1-A3 which reflects the mass distribution. Gypsum blocks for double-layer partitions account for 81% of Modules A1-A3 while 14% is incurred by the rock wool insulation and the remainder is accounted for by adhesive (gypsum-based), jointing compound and edge connection strips. For a distance of 200 km, transporting individual components to the construction site accounts for approx. 3% of the entire life cycle for both partition types without considering Module D. The PENRT incurred by installing the partitions (Module A5) is negligible. Disposal of the partitions (Module C) made of gypsum blocks, essentially disposing of gypsum waste in an inert landfill, accounts for

approx. 5% of the PENRT throughout the entire life cycle.

The total use of renewable primary energy resources (PERT) accounts for 2% of the total use of primary energy by the partitions. The PERT arises from the share of renewable energies in the power mix used in the production of gypsum products.

With only a few exceptions (EP and AP), the impact categories considered are essentially determined by the production of gypsum blocks for single-layer partitions. In terms of both the Acidification Potential and the Eutrication Potential, the influence of transport (Module A4) and disposal (Module C) on the entire life cycle is significantly higher than among the other impact categories. Transport accounts for 11% of AP during the entire life cycle and EP for 16%. In terms of disposal, AP and EP ac-

count for 26% and 28% of the entire life cycle, respectively.

With the exception of ADPE and ODP, rock wool production for double-layer partitions accounts for between 11% and 24% of the entire life cycle.

## 7 Requisite evidence

The requirements in accordance with the AgBB test scheme (version 2008) regarding all existing test items are complied with /Scherer 2010/.

<b>TVOC<sub>3</sub></b>	≤ 10 mg/m <sup>3</sup>
<b>Carcinogens<sub>3</sub> EU cat. 1 and 2</b>	≤ 0.01 mg/m <sup>3</sup>
<b>TVOC<sub>28</sub></b>	< 1.0 mg/m <sup>3</sup>

<b>SVOC<sub>28</sub></b>	≤ 0.1 mg/m <sup>3</sup>
<b>Carcinogens<sub>28</sub> EU cat. 1 and 2</b>	≤ 0.001 mg/m <sup>3</sup>
<b>Total VOC<sub>28</sub> excl. LCI</b>	≤ 0.1 mg/m <sup>3</sup>
<b>Total VOC incl. LCI R = <math>\sum C_i/LCI_i</math></b>	< 1

## 8 References

### General principles:

Institut Bauen und Umwelt e.V., Königswinter (pub.): Modelling Environmental Product Declarations (EPP); General principles for the EPD range of Institute Construction and Environment e.V. (IBU), 2011-06, www.bau-umwelt.de

### PCR guidelines for building products and building-related services:

Institut Bauen und Umwelt e.V., Königswinter (pub.): **PCR, Part A:** Calculation rules for the LCA and requirements on the background report 2011-07

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