Poroton

Wall solutions

Technical information

30 JAHRE Qualitätsprodukte von Wienerberger

Wienerberger
Building Material Solutions

Contents

Wienerberger
Building Material Solutions

Online information from the Internet

Here you will get quick and comprehensive information about the company and comprehensive solutions in the areas of walls, chimney, roof, facade and open spaces. A 24-hour service that keeps you up to date at all times.

- Clear look
- Extremely fast image construction
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www.wienerberger.de

Wienerberger planning tool and detailed catalog

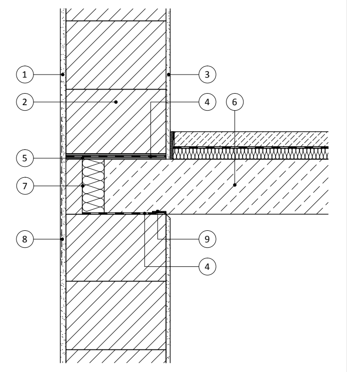
Plan masonry structures quickly and safely

The Wienerberger planning tool and the online catalog of details are clear, comfortable and quick as a time-saving planning aid for architects, specialist planners and contractors. In the planning tool, an objective-related product recommendation with detailed instructions on the design and statics of masonry constructions can be obtained by selecting the desired building type - from the passive house to the commercial building - as well as the component and the respective wall construction. Tables show - depending on the selected building type and the desired wall construction - a selection of the optimal bricks with all technical data including the tendering text. For every wall construction, the tool provides the corresponding heat and sound insulation values as well as information on fire protection. In addition, the extensive detailed catalog offers practical solutions for EnEV-compliant planning with heat-bridge-minimized connections and constructions from the basement to the roof.

http://www.wienerberger-planungstool.de
http://www.wienerberger.de/wandloesungen/download-center/details

Wienerberger planning tool
The optimal planning aid

Poroton Details
Download in pdf and dwg format



Clay block building physics software module Energy 20.20

The "Arbeitsgemeinschaft Mauerziegel" is breaking new ground and, in cooperation with the software developer ESS, is offering an innovative software for the residential building sector based on DIN V 4108-6 and DIN V 4701-10, which offers many possibilities for daily use online-supported. Regardless of whether the laptop or tablet is in use, there is an unbeatable advantage to talking to customers through simplified data capture and direct on-site viewing over an Internet connection.

Building Physics Software Module Energy 20.20 enables complete verification of demand and consumption information in accordance with the requirements of the Energy Saving Ordinance 2016, KfW verification procedures including the KfW interface and the EEWärmeG. Building heat load calculations for boiler design can be carried out and solar thermal and PV systems can be designed.

In addition, great attention is paid to the creation of detailed heat-bridge proofs, which we can determine with an integrated calculation tool for monolithic component situations in more than 2000 constellations in addition to the equivalency criteria of DIN 4108 Supplement 2.

In addition, we offer a supplementary solution in the Energy Desktop module, which enables proof of non-residential buildings according to the specifications of DIN V 18599.

Clay block Building Physics Software Module Sound 4.0

In the run-up to the construction law introduction of the new DIN 4109 - sound insulation in building construction - the German brick and tile industry has developed a software with which the verification can be provided in solid construction.

The **building automation software Modul Schall 4.0** enables the implementation of the revised standard series with the help of an acoustic energy balance, and predicts the sound insulation in buildings with high reliability.

The sound insulation properties of a single component are characterized from now on by the direct sound insulation measure Rw and the flank transmission, which has a significant influence on the resulting weighted Bauschalldämm measure R'w is evaluated in more detail.

In addition to the transmission of airborne sound between rooms also house partition walls, the impact sound transmission of solid components and the airborne sound of external components can be acoustically examined and proven.

Bauphysiksoftware Modul Schall 4.0

New building physics software of the brick industry

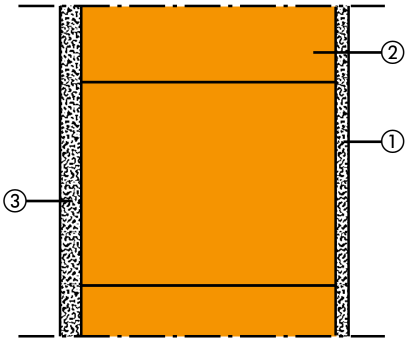
When it comes to the technical planning of buildings, the building physics disciplines pose increasing challenges in the face of increasing demands on the energy efficiency of a building. Especially in the field of building law sound insulation and structural heat insulation are suitable planning tools now indispensable and serve the architects and specialist planners as working basis.

With the building supervisory introduction of the new sound insulation standard DIN 4109 in 2016, which is based on a completely new detection concept compared to the current standard, as well as the changed requirements of the EnEV 2016 in connection with new eligible efficiency house standards, the working group will community Mauerziegel eV offer new software modules for these areas.

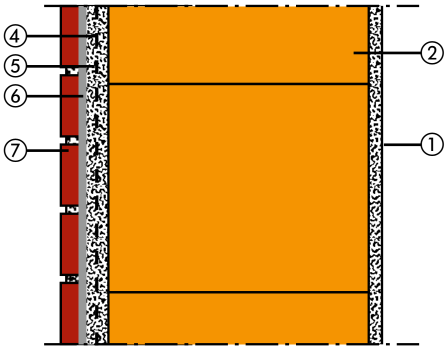
The Arbeitsgemeinschaft Mauerziegel e.V. works as a network of all producers of monolithic brick masonry in Germany and has many years of experience in the development and sale of its own software modules in sound and heat insulation.

Weitere Informationen zur Software erhalten Sie unter www.wienerberger.de

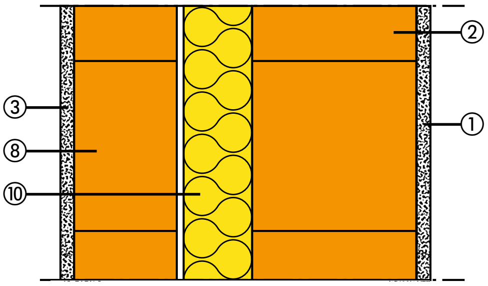
Construction principles for exterior walls



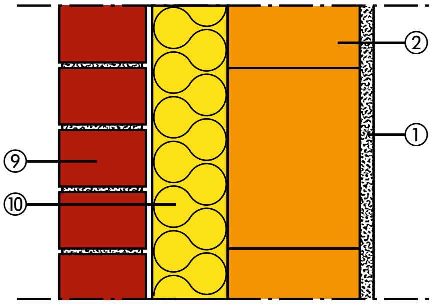
1. Single-shell masonry



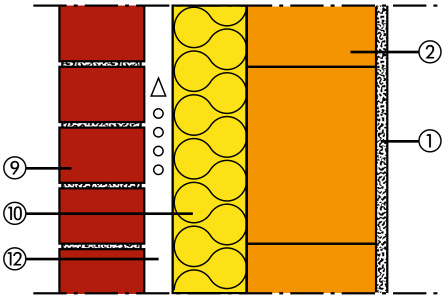
2. Single-shell masonry with strappy clothing



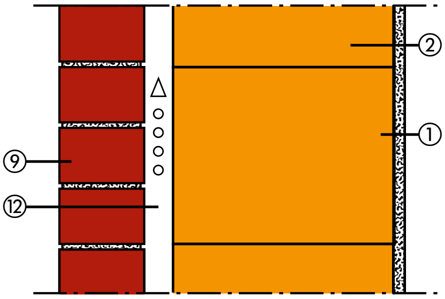
3. Two-shell masonry with core insulation and plastered facing brick



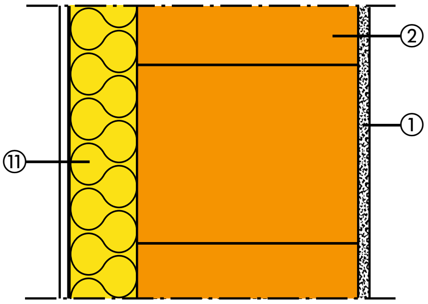
4. Two-shell external masonry with core insulation



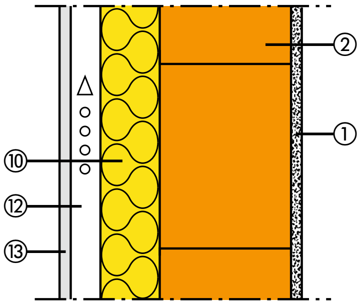
5. Two-shell external masonry with air layer + insulation



6. Two-shell external masonry with air layer



7. Multi-shell masonry with thermal skin / ETICS



8. Multi-layer masonry with insulation and ventilated curtain wall

Legend wall construction:

①Interior plaster
② Poroton Plan clay block
③ Exterior plaster
④ Under plaster
⑤ **Reinforcement mortar with**
Reinforcing fabric
⑥ Bonded adhesive mortar
⑦ Terca Riemchen
⑧ **Poroton plan / block tile**
or small formats
⑨ **Terca brickwork brick /** clinker
⑩ Thermal insulation
⑪ **Thermal insulation composite**
system (ETICS)
⑫ Layer of air
⑬ Curtain wall

The clay block for single-family homes.

For the external wall

z. B. Poroton-T7-P

For the inner wall

z. B. Hlz-Plan-T

For the cellar

z. B. Poroton-Keller-Planziegel-T16
oder Poroton-S10-MW

For the details

U-shells, ceiling edge shells,
Brick falls and much more

With Poroton brick relax the current EnEV W-level security master + secure passive house / KFW level

Areas of application for EFH, DH and RH

Areas of application Poroton-Planziegel	External wall			Internal wall		Partitions
	external basement-wall d ≥ 30,0 cm	partitions external wall EG/OG/DG d ≥ 30,0 cm	multi-shell external wall d ≥ 17,5/24,0 cm	supporting/not supporting Internal wall d ≥ 11,5 cm	light non-loadbearing Internal wall d ≥ 11,5 cm	Housepartitionwall d ≥ 17,5 cm two layers parting line d ≥ 3,0 cm
Poroton-T7/8/9-P	●	●				
Poroton-T7/8-MW	●	●	●			
Plan-T8/9/10	●	●				
Plan-T12	●	●	●			
Plan-T14	●		●			
Plan-T16			●			
Plan-T18			●			
HLz-Plan-T 0,9				●		
ZWP-Plan-T				●	●	
HLz-Plan-T 1,2/1,4				●		●
Planfüllziegel PFZ-T						●
Keller-Plan-T16	●					

EFH = detached house RH = townhouse DH = duplex

Poroton S10-MW

Not just gain height.

Wienerberger
Building Material Solutions

Clay blocks for apartment buildings.

For external wall

z. B. Poroton-S10-MW oder Poroton-S9-P

For Internal wall

z. B. Hlz-Plan-T-1,4

For apartment wall

z. B. Planfüllziegel-PFZ-T-24,0 oder 30,0

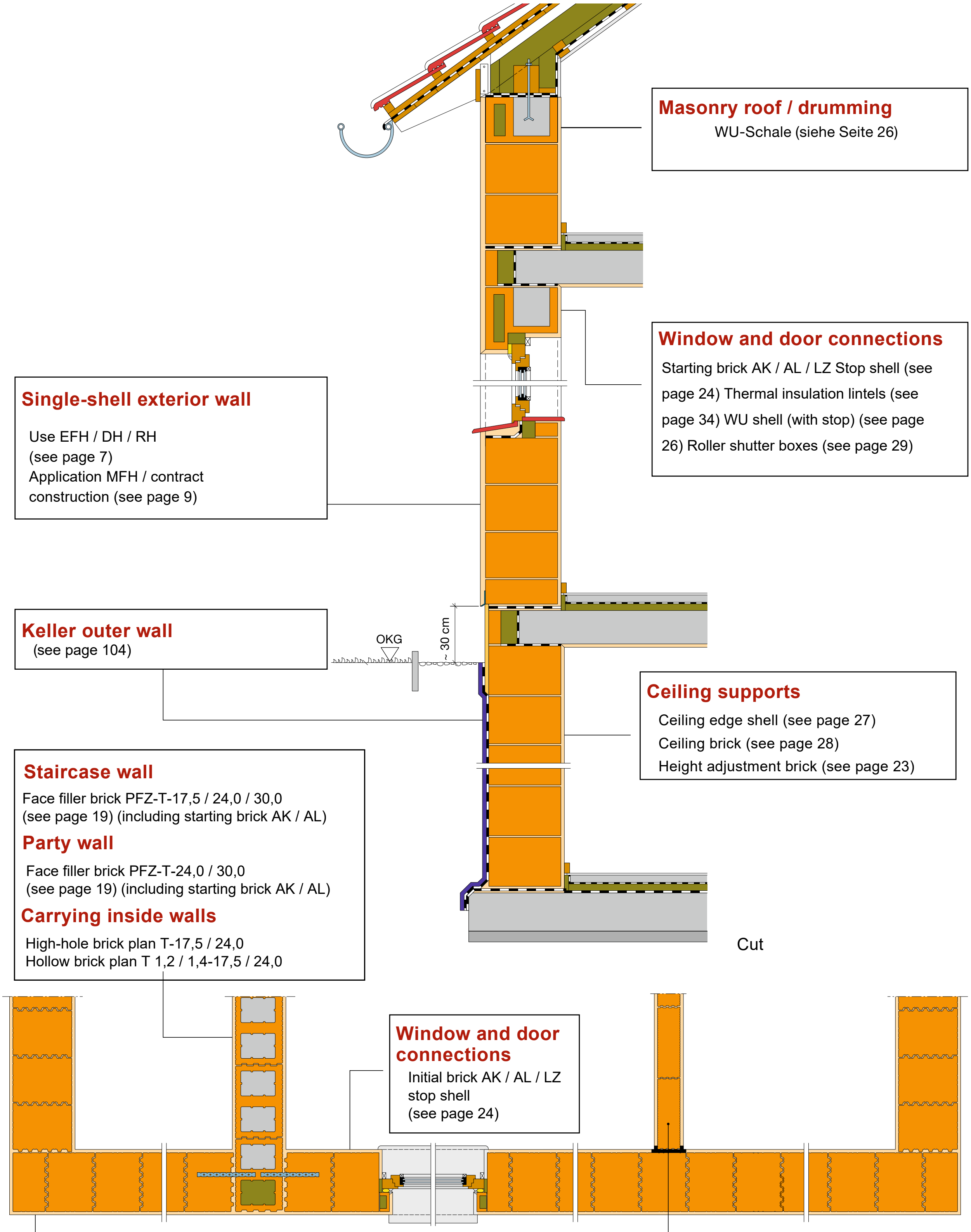
For the details

U-shells, ceiling edge shells, brick lintels and much more.

Areas of application for MFH and contract construction

Areas of application Poroton-clay block	External wall			Internal wall		Partitions
	Cellar outside-wall d ≥ 30,0 cm	Single-shell External wall EG/OG/DG d ≥ 30,0 cm	Multi-shell external wall d ≥ 17,5 cm	supporting/ not supporting Internal wall d ≥ 11,5 cm	light not supporting internal wall d ≥ 11,5 cm	Housing-partition wall single shell d ≥ 24,0 cm
Poroton-S8-P/-MW	●	●				
Poroton-S9-P/-MW	●	●				
Poroton-S10-P/-MW	●	●				
Plan-T14		●				
HLz-Plan-T 0,9			●	●		
ZWP-Plan-T-ZIS					●	
HLz-Plan-T 1,2/1,4			●	●		
Planfüllziegel PFZ-T						●
Schallschutzziegel 2,0				●		●
Schallschutzziegel 1,4/1,8				●		
Keller-Plan-T16	●					

Single-shell masonry



Masonry roof / drumming
WU-Schale (siehe Seite 26)

Window and door connections
Starting brick AK / AL / LZ Stop shell (see page 24) Thermal insulation lintels (see page 34) WU shell (with stop) (see page 26) Roller shutter boxes (see page 29)

Single-shell exterior wall
Use EFH / DH / RH
(see page 7)
Application MFH / contract construction (see page 9)

Keller outer wall
(see page 104)

Ceiling supports
Ceiling edge shell (see page 27)
Ceiling brick (see page 28)
Height adjustment brick (see page 23)

Staircase wall
Face filler brick PFZ-T-17,5 / 24,0 / 30,0
(see page 19) (including starting brick AK / AL)

Party wall
Face filler brick PFZ-T-24,0 / 30,0
(see page 19) (including starting brick AK / AL)

Carrying inside walls
High-hole brick plan T-17,5 / 24,0
Hollow brick plan T 1,2 / 1,4-17,5 / 24,0

Window and door connections
Initial brick AK / AL / LZ stop shell
(see page 24)

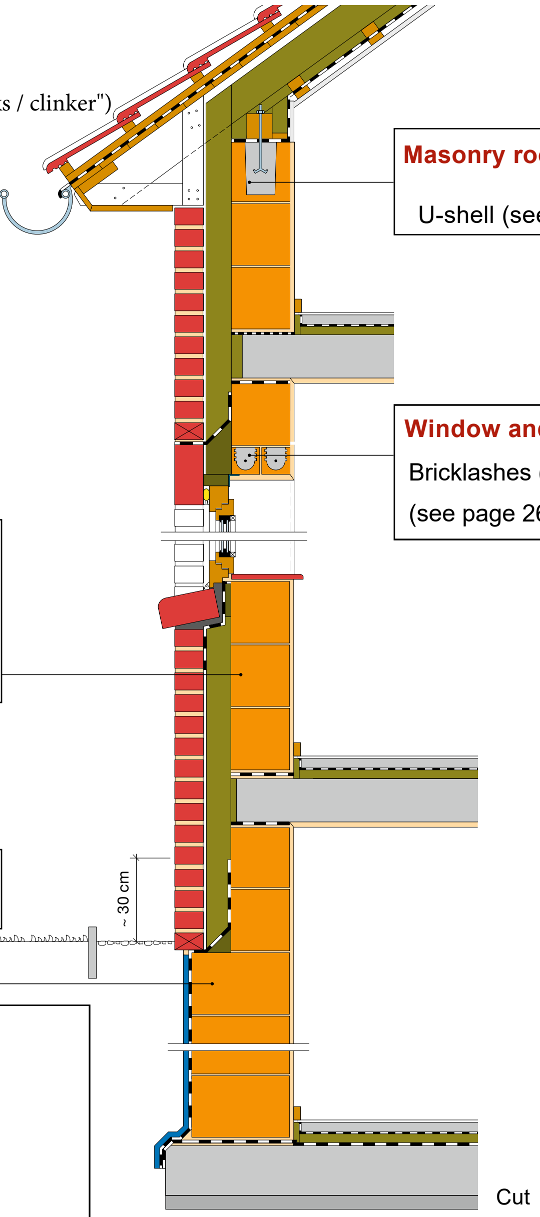
Corner associations
Initial brick AE
(see page 17)

Lightweight non-loadbearing interior walls
ZWP-Plan-T 11,5-ZIS (see page 68)

Multi-shell masonry (facing masonry / ETICS)

Legend:

- 🟥 Brickwork (see price list "facing bricks / clinker")
- 🟧 Poroton hollow bricks
- 🟫 thermal insulation
- ⬛ Mortar with sealant
- ⬜ Concrete, screed
- 🟨 Mortar / plaster
- ▬ DPC



Masonry roof / drumming

U-shell (see page 26)

Window and door connections

Bricklashes (see page 34) U-shell (see page 26)

Behind walls

Use EFH / DH / RH
(see page 7)
Application MFH / contract construction (see page 9)

Keller outer wall

(see page 104)

Staircase wall

Face filler brick PFZ-T-17,5 / 24,0 / 30,0 (see page 19)

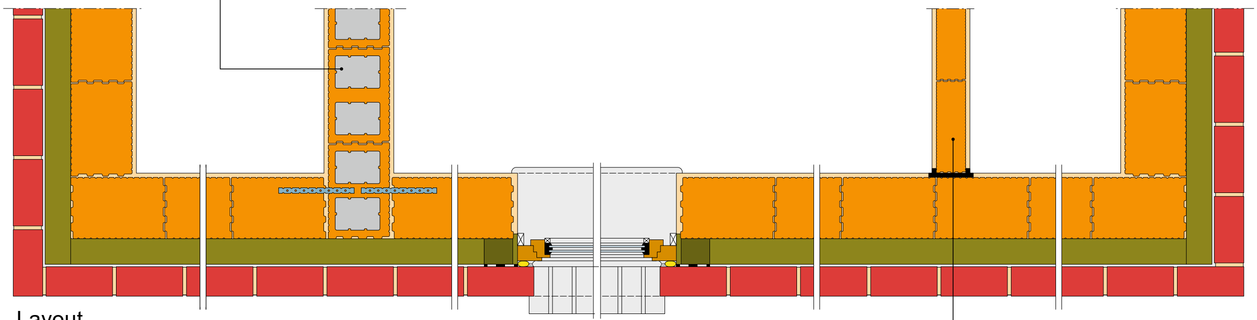
Party wall

Face fill brick PFZ-T-24,0 / 30,0 (see page 19)

Carrying inside walls

High Hole Plan T-17,5 / 24,0
Hole Plan T 1,2 / 1,4-17,5 / 24,0

Cut



Layout

Lightweight non-loadbearing interior walls

ZWP-Plan-T 11,5-ZIS (see page 68)

Poroton Dryfix System

The Dryfix System was specially designed by Wienerberger for the Poroton-clay block-Dryfix developed.

For more productivity, more orders and more sales.
Anyone who has previously worked with thin-bed mortar can now switch to Dryfix.
And for those who have used clay block with thick bed mortar, the system pays off even more: the workmanship is simple and saves up to 50% working time, in winter even down to -5 ° C can be processed.

The advantages

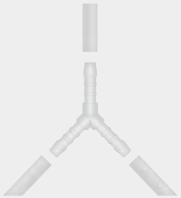
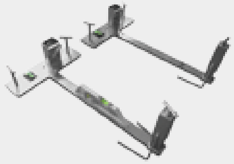
- Can be used all year round, even in winter up to - 5 ° C.
- Be faster and save costs: up to 50% working time Savings compared to block bricks, up to 30% compared to flat bricks with thin-bed mortar.
- Conserve resources: eliminated by simple processing Transport, preparation and storage of mortar and equipment cleaning.
- Safe construction: an approved procedure and contractor Training ensures consistently high quality.
- For the Poroton face tile T9-T10 Dryfix, high hole brick Plan-T Dryfix, T18 Dryfix, PFZ-T Dryfix, T7-MW Dryfix and T8-MW Dryfix.
- Optimalplasterreason:exact,visuallybeautifuland without Mortar joints.
- The adhesive hardens faster than mortar, the wall factory develops faster strength.
- Tested and harmless to health.

Technical specifications	
Product description	Moisture-curing, 1-component PUR adhesive, which may only be used for bonding Poroton Planziegeln for the Dryfix system.
Use	The product may only be processed by Wienerberger certified companies.
Processing temperatures	
Ambient temperature:	-5°C up to +35°C
Can content temperature:	min. +10°C, ideal +20°C up to +25°C
Temperature resistance:	-40°C up to +100°Camax. 3 Minute
Adhesion-free: Curing time:	1,5–5 Hours, depending on temperature and relative humidity
Disposal	Emptied cartridges are collected by an external company free of charge at Verwen-der and disposed of properly.
Approvals (Only these products can with the PU adhesive are processed)	Z-17.1-1110 Poroton Plane Seal T9 Dryfix (applied for) Z-17.1-1088 Poroton Planziegel-T10 Dryfix, Z-17.1-1090 Poroton Hollow-Hole Plan-T Dryfix and Poroton Hollow-Hole Plan-T 1.2 Dryfix (Soundproofing Tile), Z-17.1-1094 Poroton Planed-Headed T18, Z-17.1-1091 Poroton Planfüllziegel PFZ-T, Z-17.1-1093 Poroton T7-MW, Z-17.1-1092 Poroton T8-MW, Z-17.1-1099 non-bearing flat lintels with dryfix masonry walls

Equipment

The Poroton Dryfix system for the optimal processing of Dryfix-Planziegeln requires training by Wienerberger and may only be used by certified processing companies.

Material Group 299

Locations Bad Neustadt 1	Malsch 2	Wefensleben 3	Zwickau 4	Artikel-Nr.		description
Einzelbestellung						
●	●	●	●	30095000		**Poroton Dryfix Plan brick adhesive** (for repeat orders) Moisture-curing, one-component PUR adhesive, which may only be used for bonding Poroton branded floorings for the Dryfix system. A tin of Poroton Dryfix ready-to-use-stick adhesive is sufficient for approx. 5 m² wall (with wall thickness 11.5 cm: 1 tin for 10 m²).
●	●	●	●	30095010		**Poroton Dryfix Plan brick adhesive (6-pack)** (for repeat orders) Moisture-curing, one-component PUR adhesive, which may only be used for bonding Poroton branded floorings for the Dryfix system. A tin of Poroton Dryfix ready-to-use-stick adhesive is sufficient for approx. 5 m² wall (with wall thickness 11.5 cm: 1 tin for 10 m²).
●	●	●	●	30095020		**Poroton Dryfix System Reiniger** For removing adhesions as well as cleaning and flushing the applicator gun in the event of faults.
●	●	●	●	30095050		**Poroton Dryfix System application gun** For approval-compliant application of the Poroton Dryfix Planziegel adhesive.
●	●	●	●	30095060		**Y-Düsen-Set** For the simultaneous application of 2-bricks (only for filled bricks). Set consisting of 3 pieces of Y-nozzles and 9 pieces of tubes for cutting on the construction site. Two sets free of charge per site with backfilled bricks.
●	●	●	●	30092165		**Justierboy** For producing the level mortar bed for the first brick layer. The Justierboy is a precision tool with its own dragonflies for leveling the two peel-off gauges and creates a level, horizontal bearing surface with high accuracy.

- *A tin of Poroton Dryfix ready-to-use adhesive is sufficient for approx. 5 m² of wall (For wall thickness 11.5 cm: 1 box for 10 m²).*
- *Poroton Dryfix surface sealant, cleaner, applicator gun and Justierboy are available for all Poroton Dryfix brick systems: Poroton T9 Dryfix, Poroton T10 Dryfix, Poroton Hollow T-Dryfix, Poroton Hollow Tile -T 1,2 Dryfix (soundproof tile), Poroton-Planfüllziegel PFZ-T Dryfix,*
  Poroton T-18 Dryfix, Poroton-T8-MW Dryfix, Poroton-T7-MW Dryfix.

Training Document Poroton Dryfix System
User Manual Poroton Justierboy Winter
Mortar for Poroton Dryfix System

Download unter www.wienerberger.de
→ Wall solutions → Download-Center
→ Brochures

VD-System
The simple processing: rolling, setting, done.

Safe planning and building in the Plan bricks system!
Architects, structural engineers and processors value the constructional advantage of full-surface thin-bed mortar joints as a safety reserve in wall processing. With the VD system, the tried-and-tested planer-type technology has been further developed, decisively improved, and thus gives the surface-to-ceiling construction system maximum processing security.

Thanks to the specially developed VD mortar roller, the thin-bed mortar is applied to the entire surface of the bricks quite simply and without additional materials in the mortar - like a lid. The processing of the plain brick remains even more simple and efficient.

The advantages:
With additional processing safety, you can even save about 35% of the processing time in comparison to conventional block brick construction. In addition, you save about 80% of mortar and thus of course also reduce the mortar-related building moisture by about 80%. Soundproofing, windproofness and thermal insulation are optimized. The bearing joints of the bricks are closed as in the conventional mortar layer by layer through the Dünnbettmörtelschicht. This guarantees even better masonry.

A perfect thing: Rolling · Setting · Done!

The 1st layer: Align horizontally in the mortar bed

Rolls: Simple and efficient application of the covering thin-bed mortar

Setting: Simply place bricks in the teeth of the neighboring tile
Carrying aids: make placing more comfortable

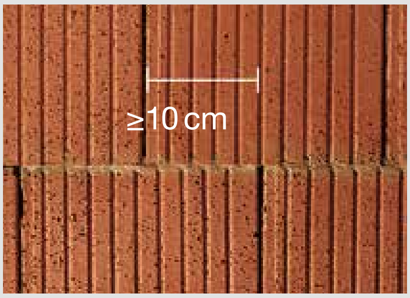
◄ Done
clean, almost seamless masonry

Miscellaneous

It must be masonry, i. The joints of superimposed layers must be offset. The over lapping must gem. 10 cm (overbinding ≥ 0.4 h).
Please check the flatness of the layers continuously. Compensating tiles can be sawed accurately with a suitable special saw.

Help with work

To stir the mortar, a stirrer is used. The bearing surfaces are to be cleaned with a firm hand brush. The vertical and horizontal position of the 1st layer can be easily and accurately performed with a Justierboy.
Through the use of gripping aids, the surface crucible processing is easy and quick from the hand.
The use of the VD mortar roller allows the application of the thin-bed mortar directly on the surface of the last stone layer, so that the dipping of the tile is eliminated.

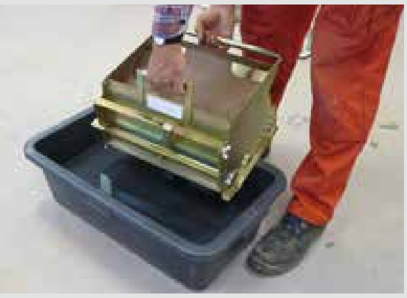


Processing in bandage: comply with standard overbinding dimensions

Justierboy: simplified and precise application of the 1st layer

VD mortar roll, thin-bed mortar, clean mixing bucket or mortar bucket, powerful whisk, gripping aids.

The thin bed mortar is ideally mixed with a powerful stirrer and double stirrer with no lumps.



In longer work breaks, it is recommended to store the roll in a water bath to prevent the mortar from drying out.

The stirred thin bed mortar is filled into the mortar roll. Before starting work, spray the mortar roll with release agent! Facilitates the later cleaning.

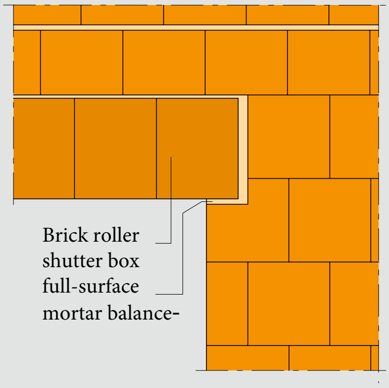
Wall connection: butt joint with flat steel core and fully grouted butt joint or even better: slot connection in the outer wall

After work, the VD mortar roll is thoroughly cleaned with plenty of water.

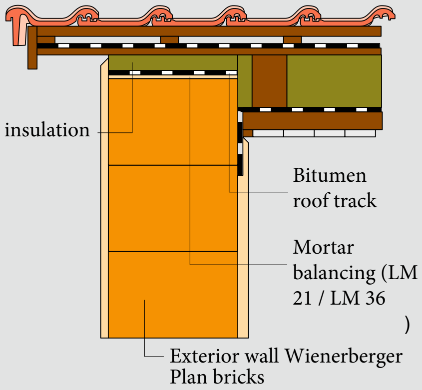
Details - System Solutions

Within the framework of the German Energy Saving Ordinance, the professional execution of connection details and wall terminations to achieve an airtight building envelope in accordance with DIN V 4108-7 is required. For a solid brick house it is therefore considered that wet plastered masonry with at least one plastered surface is basically airtight. The illustrated connection points (suggestions) are to be considered in detail planning.

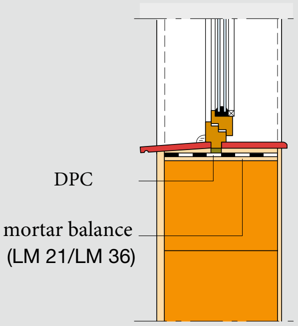
Shutter box (Bearing surface, front side)



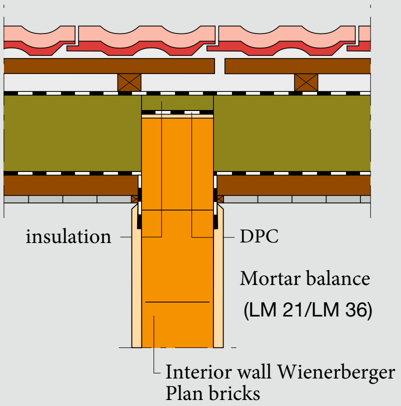
Exterior wall roof connection



Window sill



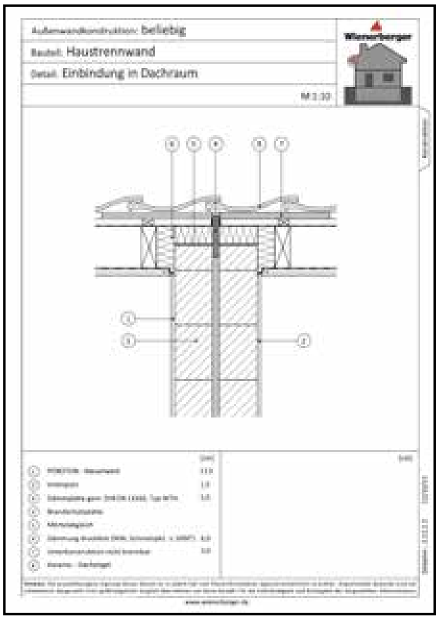
Interior walls roof connection



Wall tops / bearing surfaces

It is necessary that the upper wall finish be "capped off". The mini-malan request can be met with a balance of mortar. Recommended is the additional installation of a windproof separating layer of bitumen cardboard.

Bituminous roofing membrane R500 in thin-bed mortar laid on Poroton-T7-P



Außenwandkonstruktion: beliebig
Bauteil: Haustrennwand
Detail: Einbindung in Dachraum
M 1:10

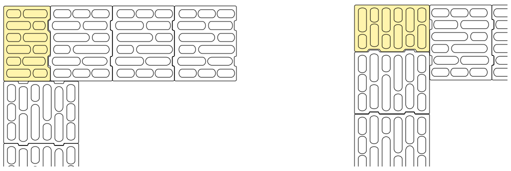
Wienerberger

A large number of detailed suggestions is available for download at www.wienerberger.de

Backfilled bricks - Planziegel

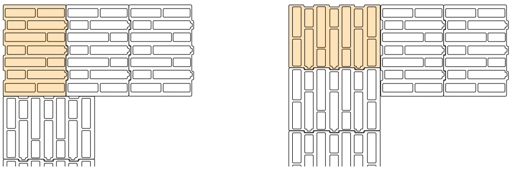
Training of corner associations

Wall thickness 30.0 cm


1. Schicht
2. Schicht

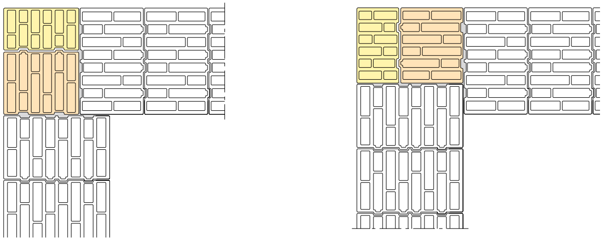
Material requirement per running meter Building corner:
4 pieces corner tiles 30.0 T-30.0-AE or AE / LZ

Wall thickness 36.5 cm


1. Schicht
2. Schicht

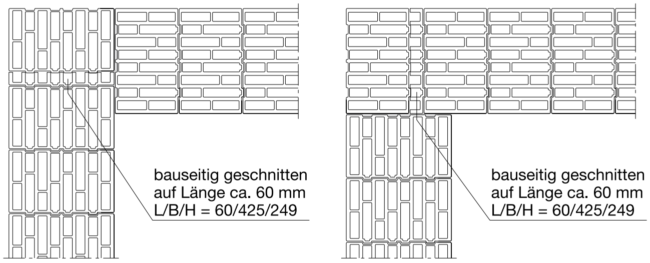
Material requirement per running meter Building corner: No separate corner tile necessary

Wall thickness 42.5 cm

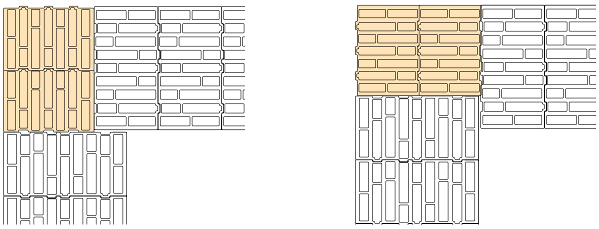

1. Schicht
2. Schicht

Materialbedarf je lfdm. Gebäudeecke:
4 Stück Eckziegel T-30,0-AE bzw. AE/LZ
4 Stück Poroton-T-30,0-P bzw. -MW

Wall thickness 42.5 cm - Variant B

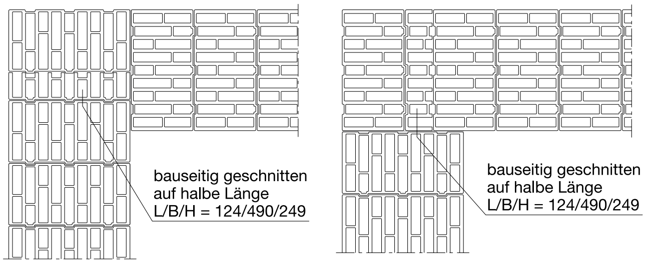

1. Schicht
2. Schicht

Wall thickness 49.0 cm


1. Schicht
2. Schicht

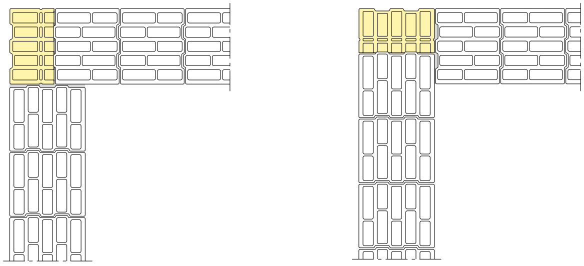
Materialbedarf je lfdm. Gebäudeecke:
8 Stück Standardformat 36,5

Wall thickness 49.0 cm - variant B


1. Schicht
2. Schicht

Poroton-T7/T8-MW

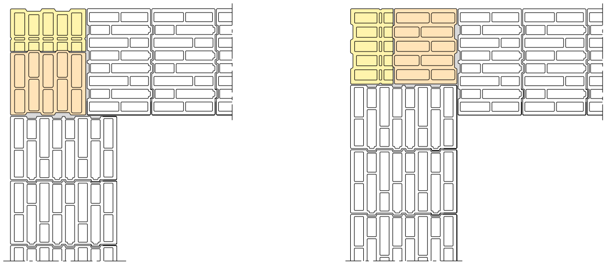
Wall thickness 30.0 cm


1. Schicht
2. Schicht

Material requirement per running meter Building corner:
4 pieces corner tiles T-30,0-AE / LZ-MW

Note: Hole patterns may differ

Wall thickness 42.5 cm


1. Schicht
2. Schicht

Material requirement per running meter Building corner:
4 pieces corner tiles T-30,0-AE / LZ-MW
4 pieces Poroton-T-30.0 MW

Accessories for surface treatment with thin-bed mortar

material Group 299

VD accessories ("full-surface covering" bearing joint)

- Rental Pledge Seal VD Mortar Roll
- VD mortar roll 17.5 cm / 24.0 cm
  (incl. reducer 6.5 cm, measuring bucket for water metering and release agent)
- VD mortar roll 30.0 cm / 36.5 cm
  (incl. reducer 6.5 cm, measuring bucket for water metering and release agent)
- VD mortar roll 42.5 cm / 49.0 cm
  (incl. reducer 6.5 cm, measuring bucket for water metering and release agent)
- VD-Mörtelrolle 36,5 cm/42,5 cm
  (incl. reducer 6.5 cm, measuring bucket for water metering and release agent)
- Only Malsch works: VD mortar roll for 24.0 cm / 30.0 cm
  (incl. reducer 6.5 cm, measuring bucket for water metering and release agent)
- Reducer 6.5 cm for VD mortar roll 24.0 / 36.5 / 42.5 / 49.0 cm
- Poroton thin bed mortar type IV 15 kg bag
- Mortar bucket for bagged mixing, approx. 35 liters
- Measuring bucket for dosing water
- Double stirrer (adapter for industrial or drill chuck)
- Release agent, 1 liter spray bottle
- Ceramicfile
- MortarLadle
- Carrying aid for Poroton bricks (wall thickness ≥ 30.0)

Accessories "Diving"

- Poroton thin bed mortar type IV 15 kg bag
- Mortar bucket for bagged mixing, approx. 35 liters
- Mortar trough approx. 40 liters (dimensions approx. 64 x 34 x 21 cm)
- Double stirrer (adapter for industrial or drill chuck)
- Ceramicfile
- Carrying aid for Poroton bricks (wall thickness ≥ 30.0)

Accessories block tile processing

- Lightweight mortar LM 21; 20.0 kg / bag, approx. 32 l wet mortar, 40 bags / pallet
- Lightweight mortar LM 36; 30 kg / bag, approx. 36 l wet mortar, 35 bags / pallet
- Normal mortar NM MG IIa; 40 kg sack, approx. 25 l wet mortar, 30 sacks / pallet

Mortar requirements see page 20.

Accessories / Tools / connection means

- Grip aids (one piece at a time)
- Justierboy
- Electric hand saw; Cutting length 425 mm
- Carbide tipped saw blade for electr. Hand saw 425 mm (replacement blade)
- Flat steel anchor for butt joint technology
  (300 x 22 x 0.5 mm V4A steel) 250 pieces / bundle
- Only locations Sittensen, Buldern, Wefensleben and Bad Neustadt:
  For double-shell masonry
  Wienerberger air layer anchor (Z-17.1-1062)
  WB LSA8 (shell distance up to 8.0 cm) 250 pieces / package WB
  LSA15 (shell distance up to 15.0 cm) 250 pieces / package
- Only locations Sittensen, Buldern, Wefensleben and Bad Neustadt:
  For double-shell masonry
  Wienerberger insulation clamping disc incl. Drip nose WB
  DKS60 (plate diameter 60 mm) 250 pieces / package
- Mortar roller for surface treatment 24,0 / 30,0 / 36,5 cm
- Decoupling connection profile "EAP wall"; 1 running meter
- Decoupling connection profile "EAP ceiling"; 1 running meter
- Only work Malsch: stone planer

*When ordering Poroton-T8-24.0-MW bricks together with Terca facing bricks
For a construction project, the Wienerberger air layer anchor will be credited to you as a system supplement.
For single order plus shipping costs

Planfüll brick-T (soundproof tile)

The high sound insulation values make the Planfüllziegel system the ideal brick for sound insulation walls. This is especially true for the area of apartment partitions terraced house dividers and partitions to corridors or staircases.
The PFZ-T converts the bricks using the economical thin-bed process. Then the wall is filled high in a concreting process. It makes sense to backfill with concrete ≥ C12 / 15 at the same time as concreting the ceiling.

Admission	Compressive strength class	DIN 1053-1 permissible wall factory pressure - voltage s0 [MN / m²]	DIN EN 1996 characteristic masonry pressure resistance fk [MN / m²]
Z-17.1-537	12	2,2	5,8
	8	1,7	4,4

Demand about filling concrete	l/m²	l/m³
PFZ-T 17,5	85	490
PFZ-T 24,0	125	520
PFZ-T 30,0	144	480

description	DF-Format	Dimensions L x B x H (cm)	Compressive strength class-	gross density *)	Weight kg/piece	Package content pieces	Material required approx. Pieces / m²	Material requires approx. Pieces / m³
PFZ-T 17,5	9 DF	37,3 x **17,5** x 24,9	12	2,0	12,7	75	11	61
PFZ-T 24,0	12 DF	37,3 x **24,0** x 24,9	12	2,0	15,3	60	11	44
PFZ-T 30,0	15 DF	37,3 x **30,0** x 24,9	8	2,0	21,5	45	11	36
PFZ-T 24,0-AL	12 DF	37,3 x **24,0** x 24,9	12	–	15,3	36	–	–
PFZ-T 24,0-AK	6 DF	18,3 x **24,0** x 24,9	12	–	7,7	40	–	–

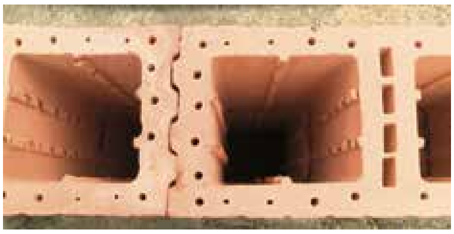
*) Crude density class filled with concrete $ C 12/15, grit 0-16 mm

The thin bed mortar is supplied in sufficient quantity!

- *Suitable for the earthquake zones 0-3.*
- *Processing recommendation: dipping or rolling process.*
- *Concrete at least strength class C12 / 15. For fire protection requirements, concrete at least strength class C20 / 25.*
- *The filled concrete is to be designed as fluid concrete (consistency F5, flowable)*
- *that a complete filling of the chambers is achieved.*
- *The largest grain of the aggregate must be at least 8 mm and*
- *may not exceed 16 mm.*

- *The backfilling can be done after projecting high walls of the wall. Initial brick with*
- *Insulation insert (mineral fiber WLG 035) for full integration in monolithic external masonry guarantees optimal sound and heat protection in partition wall impact.*

Soundproofing dimensions including concrete filling		
	Bewertes Sound reduction index R'w, R [dB] after suitability test	Bewertes Direct sound insulation R'w, R [dB] according to E DIN 4109 / DIN EN 12354
PFZ-T 17,5	52	56,9
PFZ-T 24,0	55	60,8
PFZ-T 30,0	57	63,6



About binding measure:

The joints of superimposed brick layers must be offset in the runners association by half a brick length, so that each of the filling channels are exactly above each other.

The PFZ-T

- Good sound insulation combined with the Advantages of the Plane Seal System.
- Fast and easy!
- The ideal tile for lean, economical and soundproof walls between apartments, in stairwells, in commercial buildings and in densified buildings in inner cities.
- Improved construction quality Minimization of wall construction costs.

Calculated values of the dead load

Calculated values for the dead load in kN / m3 including filled concrete
21

PFZ-T 24,0

AK = Beginners short

AL = Beginners long

Starting tiles with insulation insert WLG 035 guarantee optimum connection of apartment dividing walls to external walls.

Please note:

- Easy filling with Concrete ≥ C12 / 15
- no concrete plasticizer needed
- no shaking, because the concrete by its own weight safely fills the hole channels (concrete pumped or with concrete bomb)

The plan fill brick masonry is processed as previously described either with thin bed mortar or dryfix system. The filling of the hole channels with concrete takes place efficiently high.

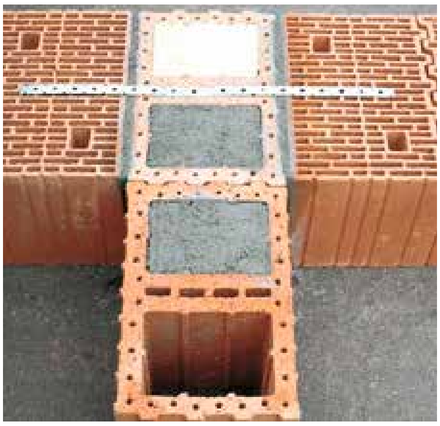
Apply the leveling mortar layer using Justierboy with normal mortar MG III.

Leveling and leveling of the 1st tile layer on the leveling mortar layer (example bivalve house partition wall).

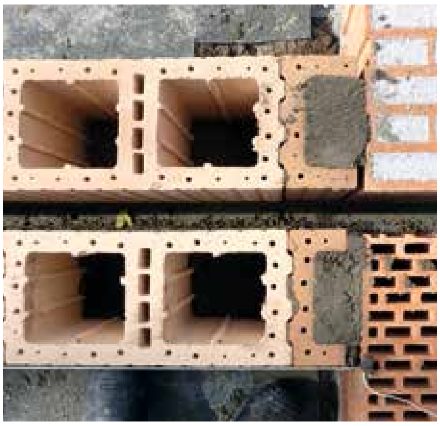
If possible, mix the Poroton thin-board mortar in a sack bucket with a powerful mixer.

Dip the PFZ-T into the thin board mortar with the underside and move. The mortar must adhere fully to the webs. Alternatively, the mortar can be applied with a roller on the bearing surfaces of the brick.

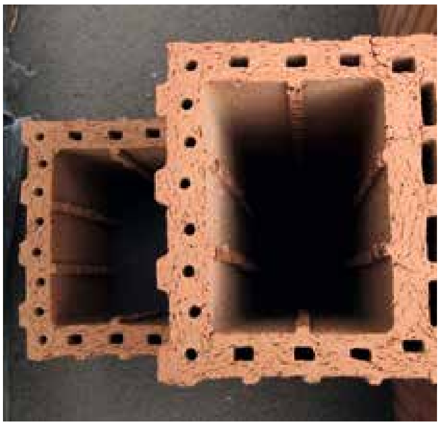
For wall connections by means of butt joint
(Example, two-shell house partition), the connecting joints are full to mortify (joint thickness about 1.5 to 2.0 cm).



The most economically sound connection of single-shell apartment partitions to monolithic exterior walls is the integration with thermally insulated beginners (details see next page).



Chambers of non-full size (eg in the case of passages at the ends of walls or in the masonry verge) are to be crammed in layers with masonry mortar MG III or MG IIa in layers.



Layer by layer, projectile-high through-hole channels are created, which are then filled with concrete.

Finally, fill the created wall with concrete in a single operation. This is done efficiently when concreting the ceiling structures.

The influences of the type of integration are taken into account in the complex calculation procedure of DIN EN 12354 in terms of sound insulation. For wall connections, the following variants are recommended:

Bonding in monolithic outer wall

Recommendation for requirements in the compacted housing construction of multi-family houses. The acoustically optimal connection to the PFZ-T wall z. B. monolithic exterior masonry is done by the through-connection of the partition wall through the outer wall. For this, in the wall thickness required for apartment partitions, 24.0 cm initial bricks PFZ-T-AL or PFZ-T-AK are available.

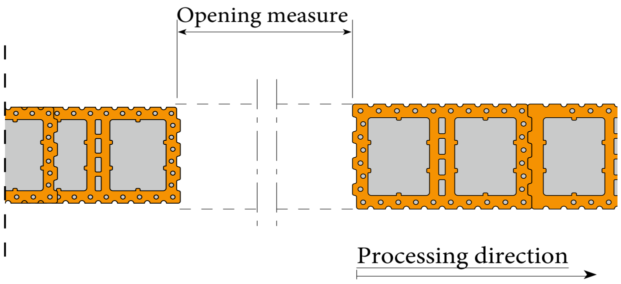
Slot integration

The slot inclusion is also bullet-high, the embedment depth should be half the outer wall thickness. Again, a rich Vermörtelung integration is required.

Openings

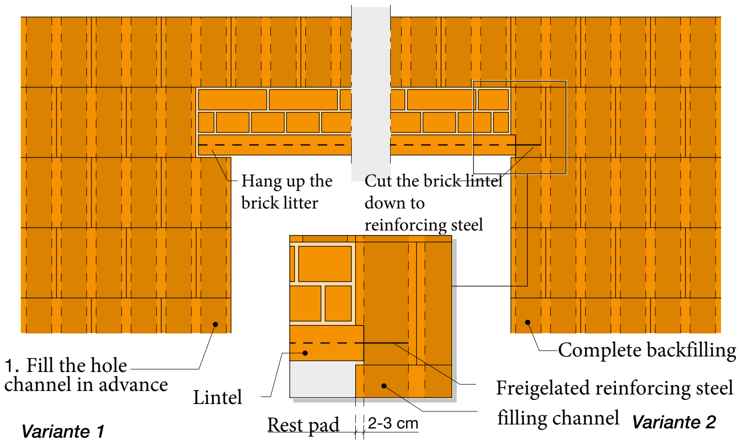
In apartment partitions usually no openings are planned. It is different with staircase walls with outgoing apartment doors. Here, with the processing of the PFZ-T, starting from the opening towards the connecting walls, masonry should be possible in order to be able to start with whole or half bricks, thus avoiding face shutters in the reveal area of the doors.

Example openings



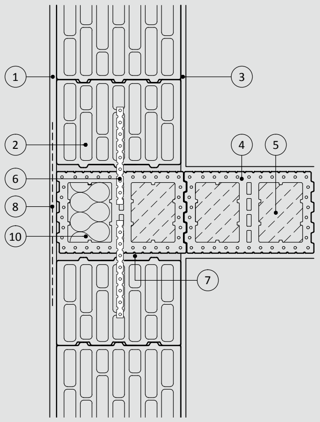
Lintels

When using brick lintels over the door openings, two processing options are conceivable. Fill the first hole channel in the support area of the brick lintel in advance or remove the brick shell and concrete shell of the reinforcing bar in the backfill area on site with a remaining layer of brick tile of 2-3 cm. In both cases, the lintel guidelines must be observed for brickwork and installation support.



Example throughput

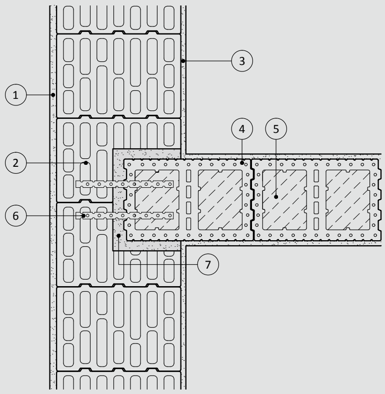
Floor-high through a filler wall with insulated initial brick



$K_{i,j}$ between 9–11 dB

Example slot inclusion

Floor-to-ceiling slot integration of a filler brick wall with embedment depth approx. Half the outer wall thickness



$K_{i,j}$ between 8–11 dB

① External render 2,0 cm
② Monolithic outer masonry
③ Internal plaster 1,5 cm
④ Planfüllziegel PFZ-T 24,0 cm
⑤ Concrete filling on site
⑥ Flat steel anchor according to statics
⑦ Mortify at closing joint
⑧ Fabric reinforcement in exterior plaster
⑨ Thermal insulation 6.0 cm WLG 035
⑩ Starting tile with integrated heat insulation PFZ-T 24.0 cm - AL / AK

Processing

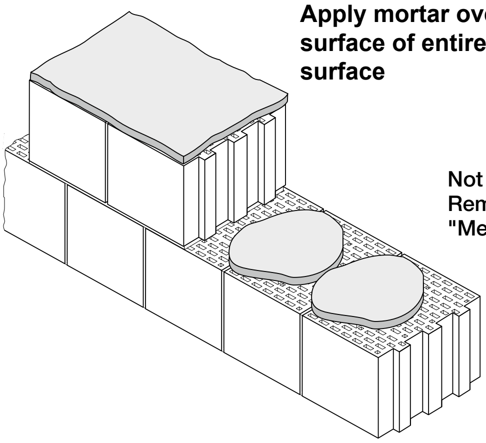
Clay block

When Poroton block brick is a 12 mm thick mortar joint (bearing joint) as usual applied with the trowel or mortar carriage.

The Poroton blocks are inserted into the teeth of the neighboring tile, placed on the vollfugige mortar bed and pressed, then brought lot and flush in the final position. The butt joints of the next brick layer must be offset by about 10 cm (overbinding ≥ 0.4 h) compared to the previous, in order to meet the requirements of DIN 1053 at the brick height of 23.8 cm. Block bricks can also be processed with light mortar (LM 21 or LM 36) using commercially available standard mortar or to improve the thermal insulation properties of the masonry of exterior walls.

Recommended are factory dry mortar.

Full bed




Laying the block


Interlocking

The mortar requirement of approx. 90 l / m3 of masonry results from the wall thickness-related following approach (without butt joint mortar):

Wall thickness in cm	l/m²
11,5	ca. 11
17,5	ca. 15
24,0	ca. 22
30,0	ca. 27
36,5	ca. 33
42,5	ca. 39
49,0	ca. 45

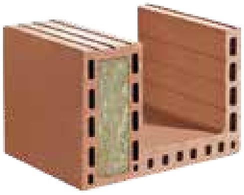
Tipp:

Benefit from the advantages of the Plan bricks system!

- **High processing safety**
- **Less building moisture**
- **Shorter working hours**
- **Better static values with comparable heat protection**
- **Thin bed mortar as system mortar included in the price**

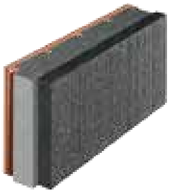
System supplements
Monolithic external wall construction

Ring beam



Poroton-WU-Shell
- Integrated insulation
- Wall thickness in cm: 30,0/42,5/36,5

Ceiling supports



Poroton-DRS-First floor insulation
- Insulation from NEOPOR
- Optimized sound insulation
- For ceiling heights in cm: 18,0/20,0/22,0/24,0

Wall connections

Poroton-Anfangsziegel Planfüllziegel
- Sound-optimized wall connection for apartment and stairwell walls
- Integrated insulation
- For wall thickness 24.0 cm

Window and door reveals

with stop

Poroton stop shell
- Integrated insulation
- For subsequent masonry in the soffit
- Stop depth 6.0 cm
- For wall thicknesses from 30,0 cm

without stop

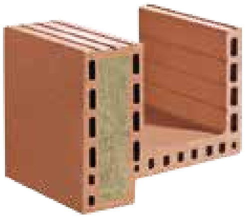
Poroton Reveal brick
- Available as a system supplement for surface brick filled P / MW
- Secures optimal window attachment

Height adjustment

Poroton height compensation
- Available as a system supplement per plane brick product
- Wall thicknesses in cm: 30.0 and 36.5

Window and lintel formations

with stop

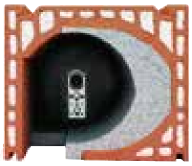


Poroton WU-shell
- insulation integrated
- Depth of attack 6.0 cm
- For wall thickness 36.5 cm

without stop

thermal insulation fall
- Integrated insulation
- For wall thicknesses 30.0 and 36.5 cm

Shutter boxes



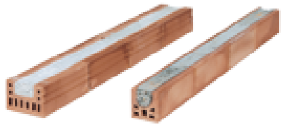
Brick-Shutter boxes
- Integrated insulation
- Closed on the room side optimized Airtightness
- For wall thicknesses 30.0 / 36.5 / 42.5 / 49.0 cm

Multi-shell exterior masonry with additional thermal insulation

Ring beam

Poroton-U-Shell
- Wall thicknesses in cm: 17.5 and 24.0

Window and door lintel



Brick and standard falls
- Widths in cm: 11.5 and 17.5 in Combination for all wall thicknesses

height adjustment

Poroton height compensation
- Available as a system supplement ever Planziegelproduct
- Wall thicknesses in cm: 17.5 and 24.0 cm

Processing

Stop shell / reveal brick

Window and door stop

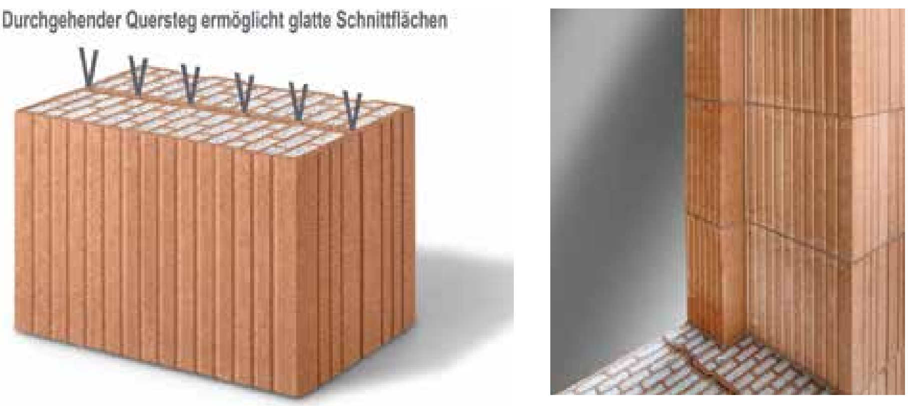
To minimize the risk of condensation and rain, it is recommended to reset the window or the door by about one third of the wall thickness. Slate masonry can also be done without a stop, but with an impact shell, the thermal bridge effect is kept to a minimum.

Window and door openings are made simply and problem-free with the heat-insulated Poroton stop shell in the case of faced brick masonry. The webs of the shell are wetted with thin-bed mortar (application thickness 3-5 mm) and mortared to the vertical reveal masonry from the soffit brick or cut passport pieces. This has the advantage that at first planned blunt Lai-bung even subsequently a stop can be made. For the subsequent plaster application, as in the opening area is common practice, an additional Gewe-bespachtelung recommended.
The stop depth is 6 cm. On request, the bowls are also available for the stop depth 4.5 cm.

Reveals: Rational formation with stopper shell

IIn the formation of soffits (window and door), there are various possibilities to perform the impact.
The aim must be:

- rainproof location of the frame
- dew water free window and door reveals
- firm hold for the frame
- easy from feeding and testable joint seal between window / door and masonry.

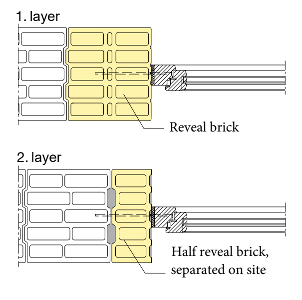


Divisible reveal tiles ensure a secure masonry bond and smooth reveal

Simple + Safe: Stop shell in combination with the soffit brick

Formation of windows and door reveals

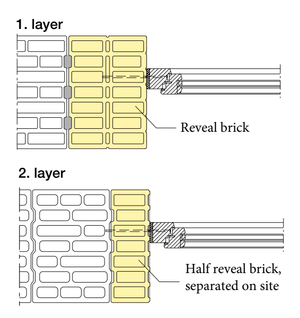
Wall thickness 30.0 cm (Poroton T8 MW)



Material requirement per running meter Window and door reveal:

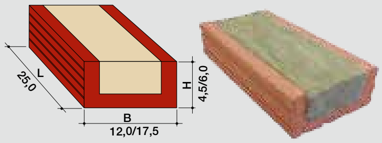
2 pieces standard format T8-30.0 MW
2 pieces corner and reveal tiles 30,0-AE / LZ-MW

Wall thickness 36.5 cm and 42.5 cm



Material required per meter. Window and door reveal:
6 pieces of reveal tiles 36.5 (LZ-P / -MW) and 42.5 (LZ-P / -MW)

Poroton stop shell, thermally insulated

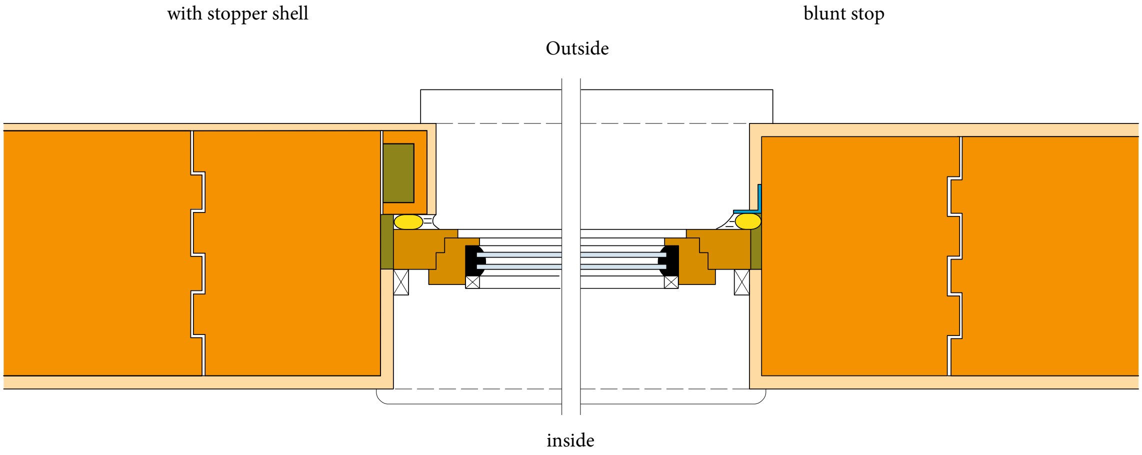


For optimal creation of a heat-insulated window stop in the single-walled flat brick masonry.

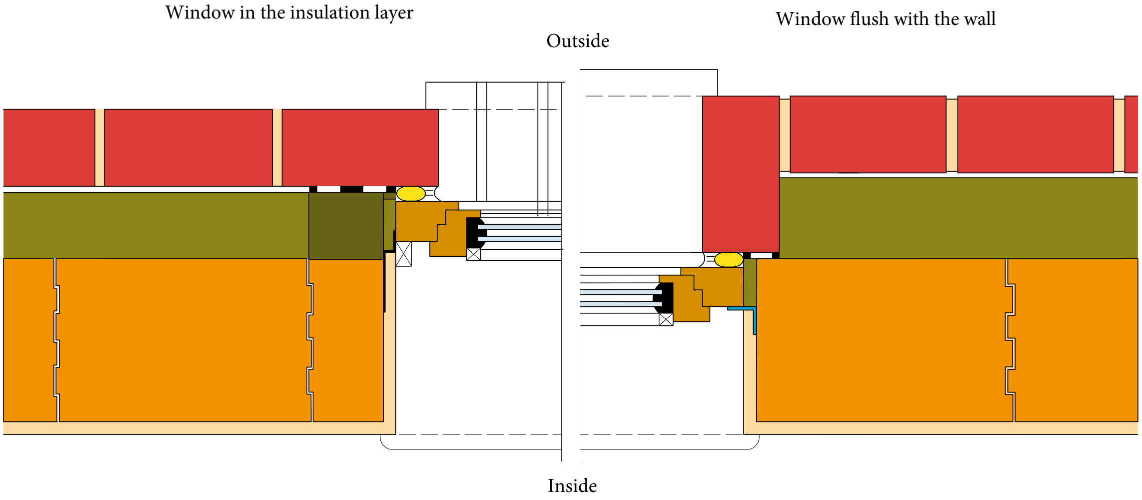
- Solid brick U-shell including hydrophobic mineral wool core for optimal creation of a heat-insulated window stop.
- Optimized for thermal bridges, fulfills the requirements according to DIN 4108 Supplement 2.
- Simple and easy to process.
- Apply a thin layer of mortar to the impact shell on the heat-insulated side (application thickness: 3-5 mm) and subsequently apply mortar to the vertical reveal masonry.
- When applying plaster, we recommend, as usual in the window area, to provide additional fabric filling.

Possibilities of window attachment with one and two shelled walls

single-shell wall construction



double shell wall construction

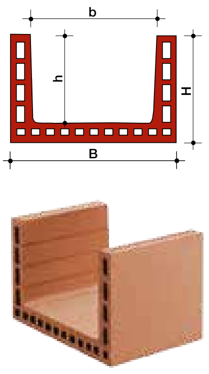


Legend:

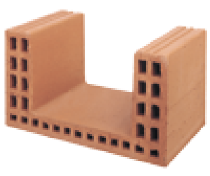
🟥	Brickwork	▭	Mortar / plaster	■	Extruded hard foam cores (Heat bridge minimization)
				▬ ▭ ▬	poetry
🟧	Hollow brick	🟩	thermal insulation	●	backfill
				⌧	Elastically joint sealant

Processing

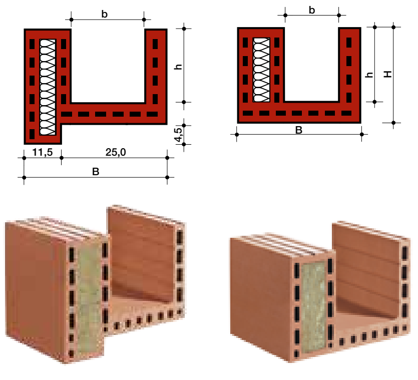
U-shells, WU shells with / without stop



U-Shell 36,5



U-Shell 42,5



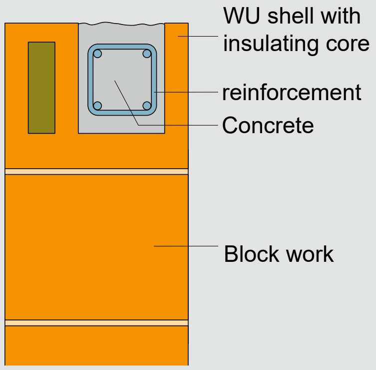
WU-Shell

U-shells are full and fully grooved on the plane brick masonry mortar with group III mortar.
In monolithic exterior walls, additional heat insulation should be set in U-shells or WU shells should be used!

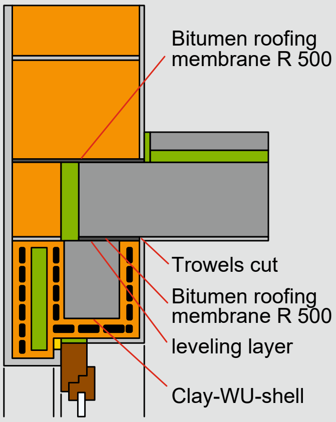
description	Dimensions L x B x H (cm)	Dimensions inside b x h (cm)	Compressive strength class *
U-Schale 17,5	25,0 x **17,5** x 23,8	9,5 x 19,5	12
U-Schale 24,0	25,0 x **24,0** x 23,8	15,0 x 19,5	12
U-Schale 30,0	25,0 x **30,0** x 23,8	21,0 x 19,5	12
U-Schale 36,5	25,0 x **36,5** x 23,8	27,0 x 19,5	12
U-Schale 42,5	25,0 x **42,5** x 23,8	25,0 x 18,5	12
U-Schale 49,0	25,0 x **49,0** x 23,8	32,0 x 18,0	12

* Filled with concrete C 20/25 a strength of 15.0 N / mm² is achieved on average.
Based on DIN 1053-1, this corresponds to compressive strength class 12.

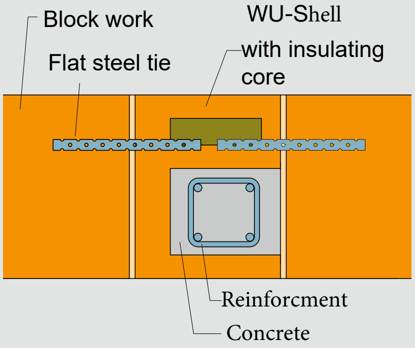
Forming ring anchors / ring beams



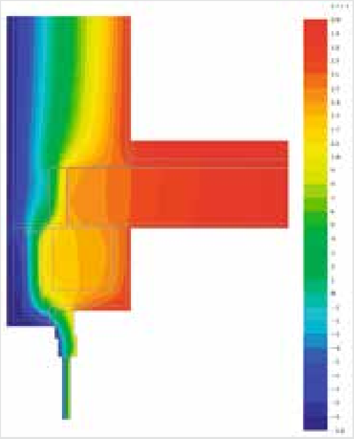
WU shell with stop



Column formwork



Isothermal presentation



WU bowls with / without stop

description	Dimensions outside L x W x H (cm)	Dimensions inside b x h (cm)	Compressivestrengthclass
WU-Schale 30,0	25,0 x **30,0** x 23,8	12,0x18,0	12
WU-Schale 36,5	25,0 x **36,5** x 23,8	18,5x18,0	12
WU-Schale 42,5	25,0 x **42,5** x 23,8	27,0x19,0	12
WU-Schale m.A. 36,5	25,0 x **36,5** x 23,8	20,0x19,0	12

WU shell 30,0 thermal resistance
(Mean value of leg and bottom plate including concrete core):
R ~ 1.33 [(m² K) / W] Reinforced concrete section ~ 247 cm² WU shell 36.5 Thermal resistance
(Mean value of leg and bottom plate including concrete core):
R ~ 1.79 [(m² K) / W] Reinforced concrete section ~ 323 cm²

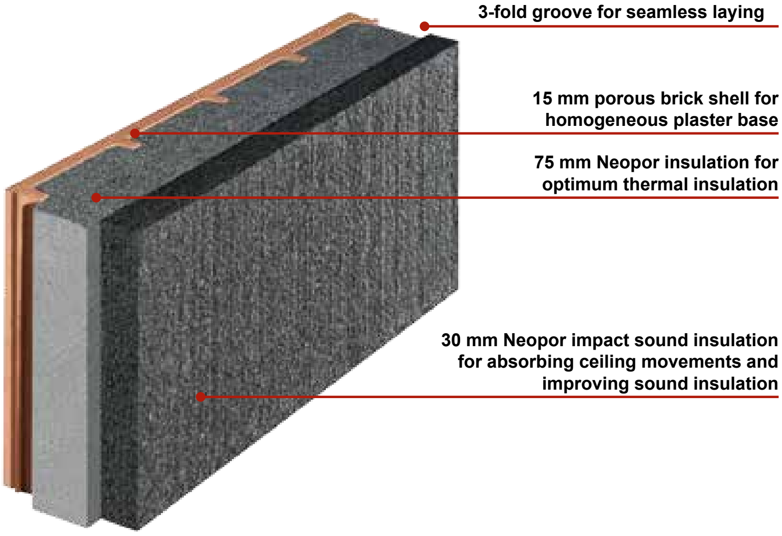
Ceiling brick and ceiling support with the Poroton-DRS ceiling edge shell

New

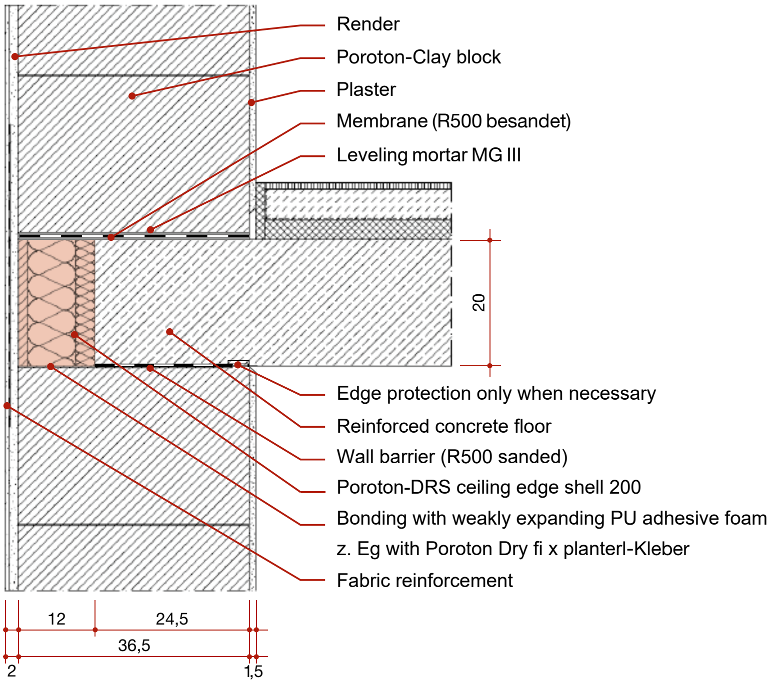
In order to avoid thermal bridges in the support area, the floor slabs are insulated on the front side.

For larger ceiling span widths (≥ 4.20 m), the edge pressure due to deflection of the ceiling must be reduced by design measures, if permitted by the permissible masonry pressure stresses.

· Meets the requirement for EC6 a = 2/3 t
· Meets the requirement of Supplement 2 to DIN 4108 Psi value ≤ 0.06 W / (mK)



Example: Ceiling support with Poroton-DRS 200 ceiling edge shell from Wienerberger



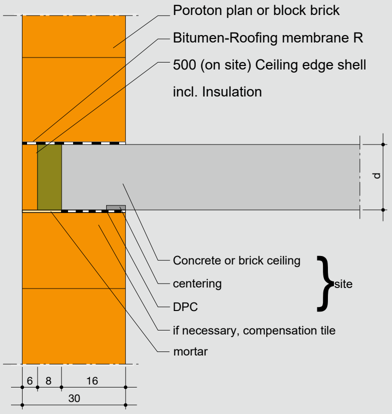
description	Dimensions L x B x H (cm)	For ceiling height (cm)	Material requirement pieces / running meter
Poroton-DRS 180	50,0 x **12,0** x 18,0	18	2
Poroton-DRS 200	50,0 x **12,0** x 20,0	20	2
Poroton-DRS 220	50,0 x **12,0** x 22,0	22	2
Poroton-DRS 240	50,0 x **12,0** x 24,0	24	2
Poroton-DRS 260	50,0 x **12,0** x 26,0	26	2
Poroton-DRS 280	50,0 x **12,0** x 28,0	28	2
Poroton-DRS 300	50,0 x **12,0** x 30,0	30	2

- For plane brick masonry - easy and safe to apply with the supplied Poroton Dryfix ready-made adhesive.
- 1Dose Poroton Dryfix Planziegel-Kleber is sufficient for approx. 25 m Poroton-DRS ceiling edge shell
- Insulation made of NEOPOR Lambda 0.032 W / mK with integrated vibration damper
- Optimized sound insulation through 2/3 support depth of the reinforced concrete ceiling

To stabilize the corner area, glue the cut surface to Poroton Dryfix Glue.

Application example ceiling edge shell

Ceiling support Plan or block tile 30.0 cm with ceiling edge shell



Ceiling rim (classic)

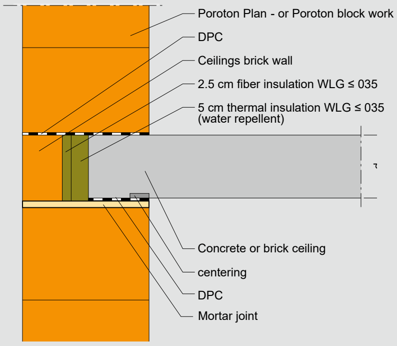
- Massive brick ceiling slab in one piece.
- Long hole brick with factory glued 80 mm thick hydro-phobic mineral wool WLG 035.
- Textured outside for excellent plaster cleavage - homogeneous plaster base.
- Simple and easy to use work by bricking in the thin-bed mortar.
- Suitable for wall thicknesses from 30.0 cm.

Length in cm: 49.8

Width in cm: 14.0 (including insulation) Ceiling thickness in cm: 18 · 20 · 22 · 25

Application example ceiling brick

Ceiling support Plan or block tile 36.5 cm with ceiling bricks



Ceiling support with ceiling bricks

Ceilings bricks - toothed

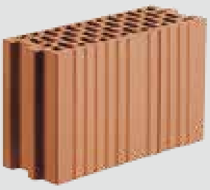
Brick DIN V 105-2, HLzB 12-0.9

Thermal conductivity = 0.42 W / mK

Length in cm: 30.8

Width in cm: 11.5

Ceiling thickness in cm: 18.0-25.0



The brick roller shutter box. The prefabricated component in many variants.

The static self-supporting brick roller shutter box in the versions ROKA-LITH-RG and ROKA-PER-LITH-RG is made of 25 cm long, flat-ground brick shells. The constructions thus form a uniform plaster background with the masonry brick wall. Furthermore, the Wienerberger Rollla-denkasten guarantees the physical properties of the brick: thermal insulation, dimensional stability, durability, vapor permeability, moisture protection, fire resistance, sound and noise protection.

Delivery

Wienerberger ROKA-LITH-RG roller shutter boxes are available in lengths of 88.5 cm to 251 cm in grid spacing 12.5 cm (intermediate sizes and boxes longer than 251 cm on request).
The roller shutter boxes are supplied ex works with plastic side panels including polystyrene inlay, aluminum plaster rails (projection 20 mm outside) as well as a completely pre-assembled telescopic shaft. The heat-insulated belt passage type ESM (ventilation rate at 50 Pa pressure difference ≤ 0.12 m3 / h) is included in the scope of delivery and must be installed by the customer.

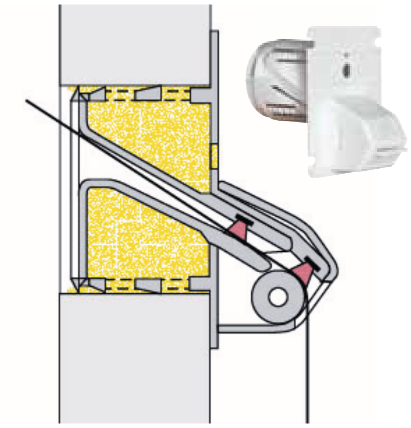
Execution revision

ROKA-LITH RG,
closed room side

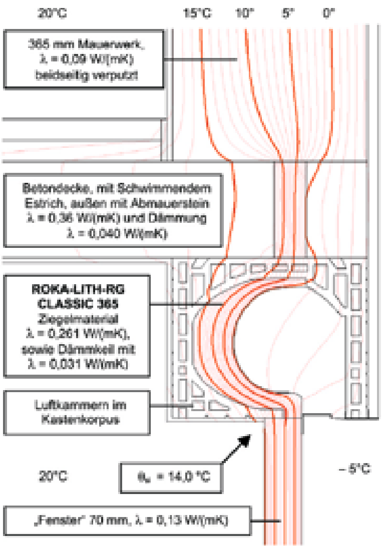
optimal all-round insulation and air tightness as well as higher sound insulation

Belt passage type ESM

- Belt passage with double Brush seal and foamed inner insulation
- Tested ventilation rate at 50 Pa pressure difference: ≤ 0.12 m3 / h



Excerpt from the test certificate of Hermes® building physics



Einbausituation mit ROKA-LITH-RG-CLASSIC 365
Verlauf der Isothermen (Ausschnitt zur besseren Detailsicht)

PSI-Value:
Soll-Value: $\Psi \leq$ 0,30 W/(mK)
Result: $\Psi =$ **0,20 W/(mK)**

Temperature factor:
Soll-Value: $f_{Rsi} \geq 0,7$
Result: f Rsi 0,76

Since the upper limit of DIN 4108 Supplement 2-Vor-amounting to PSI = 0,30 W / (mK),
and the Tempered Construction Terminal Detector with the factor of factor is not less than 0.70, ROKA-LITH 365 is an example of this is undelattr-2 equivalent mounting detail. It can thus be used in the flat-rate heat bridge certificate according to EnEV with ~UWB = 0.05 W / (m2K) as an alternative to Supplement 2 specification.

Heat protection

Roller shutter boxes are thermal bridge-optimized components. This is ensured by the closed brick shell and additional insulation in the box interior. According to the Energy Saving Ordinance, the roller shutter boxes must be calculated or taken into account when determining the heat loss coefficient. (Report available on request)

ROKA-LITH RG

Optimized version with heat-insulating wedge made of NEOPOR WLG 032 equivalent to Supplement 2 of DIN 4108.

ROKA-PER-LITH RG

for further improvement of the thermal insulation by PERLIT-filling. Perlite is an ecological insulation made of volcanic rock.

Electric distribution system type EVS

- Thermally insulated and airtight for foaming
- For thermal bridge surcharge ΔU_{WB} = 0,05 W/(m²K)

Installation of the brick roller shutter box:

The Wienerberger roller shutter box is placed on a support that is fully leveled with mortar. The displacement and alignment of the roller shutter box is then easily by its torsionally rigid construction. Mounting support is required from a clear opening width of 1.38 m and for special constructions.

Planning details

ROKA-LITH-RG Window stop with two-part guide rails and locking system.

AIR SOUND INSULATION

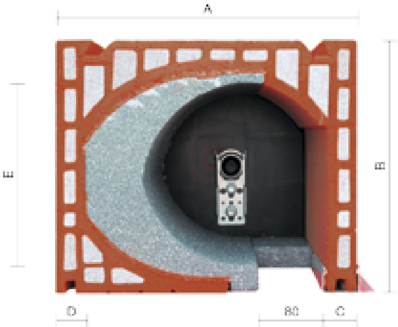
Roller shutter tank above $R_W = 49$ dB
Roller shutter tank below $R_W = 48$ dB

Advantages:

- closed on the room side
- optimal all-round insulation
- Thermal insulation sheet 2-compliant with NEOPOR WLG 032
- no installation effort for inspection cover
- Frame connection fully insulated
- higher sound insulation
- Window installation according to RAL guidelines
- Guide rail system two-piece
- Mounting opening 80 mm, with installation warranty
- Option: insect screen roller blind

Fire protection

According to DIN 4102, the box as building material class A1, the additional insulation classified as B1.

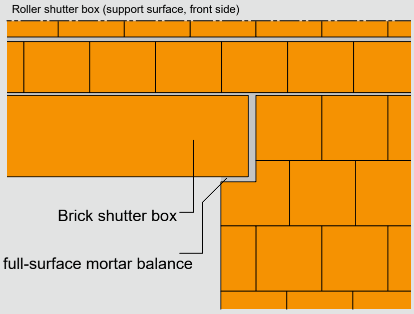


Technical specifications	RG 300	RG 365	RG 425
A Wall width (mm)	300	365	425
B Box height(mm)	300	300	300
C Thigh strength outside (mm)	35	35	35
D Thigh thickness inside (mm)	35	35	104
E Roll space (mm)	190	200	200

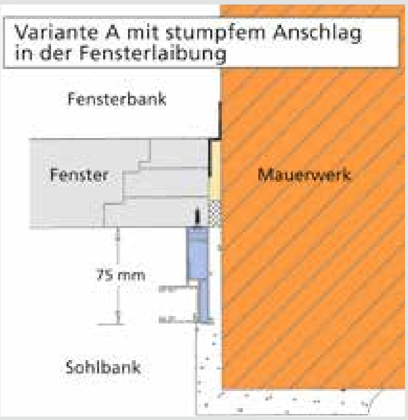
Note: All measures are approximate and subject to the tolerance of natural materials such as bricks due to different drying and burning behavior. The real dimensions (rolling room, etc.) are to be taken on site.

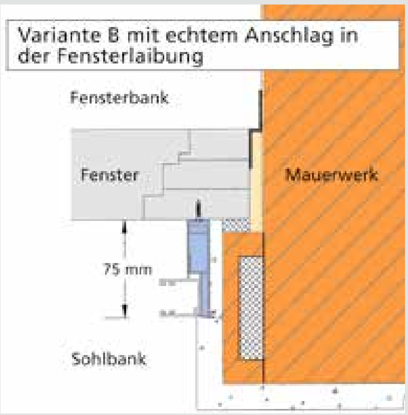
Edition versions education

- Standard support L = 12.5 cm at belt operation
- Minimum support L = 6.0 cm in electrical operation
- Bearing surface and front side to the masonry are to be fully closed with lightweight mortar



Detail: Window stop with RG guide rail system





The roller shutter guide rail must be mounted on the stop for the installation combination stop shell (stop width 12.0 cm) and brick roller shutter box ROKA-LITH-RG (see Detail window stop, page 28). The open area (approx. 40 mm) between window frame and guide rail is provided by the customer, eg. B. to close with an aluminum profile with brush seal or optionally with an insect screen.

Statics

All brick roller shutter boxes are self-supporting. You can also use with following loads (eg by bricking).

Span (m)	1,00	1,50	2,00	2,50
p (perm.) (kN / m)	26,7	12,3	6,1	3,4

Test mark 701662/06

Overview of different roller shutter tank profiles

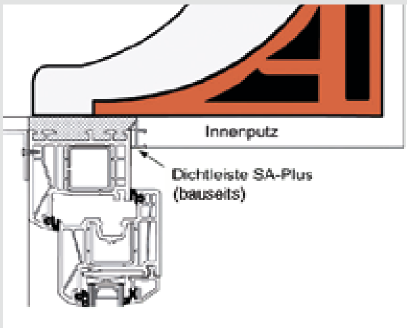
The bale diameter of the rolled-up roller shutter results from the height of the window, the door and the shape and size of the roller shutter profiles. The overview shows the technical data of common profiles and their bale diameters and makes no claim to completeness.

Roller curtain	**Plastic**		
Profiltyp	L 7/37	L 11/46	L 14/53
Nominal thickness in mm	7,7	11,0	14,0
Cover width in mm	37,0	46,0	53,0
Roller shutter height in cm	Bale diameter in mm (shaft 60 mm)		
140	128	132	141
160	137	144	150
180	144	149	157
200	149	160	162
220	154	164	171
240	156	172	181
Max. Width * at height up to 240 cm	140 cm	160 cm	180 cm

Roller curtain	**Aluminium**		
Profiltyp	AL 37-8/37	AL 40-9/40	AL 52-14/52
Nominal thickness in mm	8,0	9,1	14,0
Cover width in mm	31,5	42,0	52,0
Roller shutter height in cm	Bale diameter in mm (shaft 60 mm)		
110	125	140	140
130	140	155	158
150	140	160	158
170	156	170	175
190	156	182	175
210	170	182	185
240	179	182	189
270	179	198	198
300	195	207	213
Max. Width at max. area	280 cm/6 m²	380 cm/8 m²	380 cm/8 m²

* when exceeding the max. Width and height of the plastic armor must be strengthened

Detail: Window seal with PVC sealing strip SA-Plus



Sealing strip SA-Plus

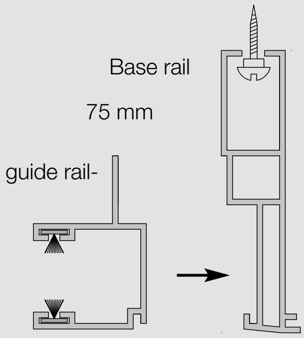
All-round window installation after RAL guidelines

Delivery note Accessories

Roller shutter guide rails, roller shutter armor and PVC sealing strips are not included. These accessories are manufactured by roller shutter system providers, eg. B .: Beck & Heun GmbH
35794 Mengerskirchen

RG guide rail system aluminum

75 mm wide



ROKA-LITH-RG KOMBI (SHADOW)

with and without perlite filling

Technical specifications	KOMBI 490	KOMBI 425
A wall width (mm)	490	425
B box height (mm)	310	310
C Thigh strength outside (mm)	35	35
D Thigh thickness inside(mm)	145	80
E roll space (mm)	200	200
For external blind operation		
shaft width (mm)	130 (for 80 mm slats)	
Packaging height (mm)	260	260

Note: All dimensions are approximate and subject to tolerance, the natural materials such as Brick products due to different drying and burning behavior. The real dimensions (roll room etc.) are to be taken on site.

ROKA-LITH-SHADOW

with and without perlite filling, closed on the room side

Technical specifications	SHADOW 365	SHADOW 425
A wall width (mm)	365	425
B shaft width for 80 mm slats (mm)	130	130
C brick thickness inside (mm)	145	205
D Thermal insulation wedge made of Neopor (l 0,032) (mm)	50	50
E box height outside and support (mm)	330	330
F chest height room side Clear width (mm)	300	300
G Thigh thickness outside (mm)	40	40
Package height (mm)	270	270

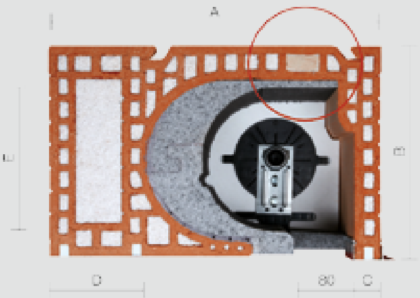
Note: All measures are approximate and subject to the tolerance of natural materials such as bricks due to different drying and burning behavior.
The real dimensions (rolling room, etc.) are to be taken on site.

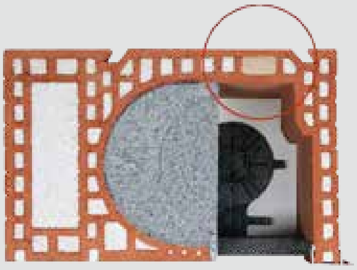
Thermal bridge surcharge

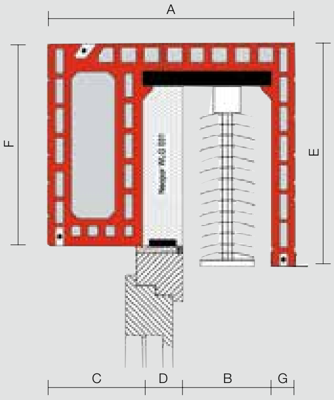
$\Delta U_{WB} = 0{,}05\ W/m^2K$

PSI-Value:
Soll-Value: $\psi < 0{,}30$ W/(mK)
Result: $\psi = 0{,}25$ **W/(mK)**
Temperature factor:
Soll-Value: $f_{Rsi} < 0{,}7$
Result: $f_{Rsi} = 0{,}76$

With Phonotherm stripes for external blinds







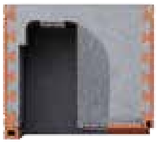
Evaluation: Since the upper limit of DIN 4108 Supplement 2 specification in the amount of PSI = 0.30 W / (mK) is not exceeded, and the temperature factor is not less than 0.70, the building connection examined here is a detail the ROKA-LITH-SHADOW 365 is a supplement 2-equivalent one-baudetail. It can thus be used in the blanket thermal bridge certificate pursuant to EnEV with UWB = 0.05 W / (m2K) as an alternative to Supplement 2 specification.

NEW
psi-Values minimized
$*\psi = 0{,}05\ W/(mK)$
$**\ \psi = 0{,}07\ W/(mK)$

System Neoline - For highest energy demands


ROKA-LITH NEOLINE
30,0/36,5**

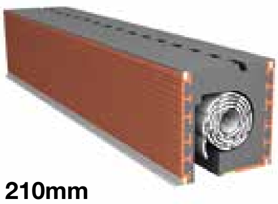

ROKA-LITH-NEOLINE
42,5/49,0

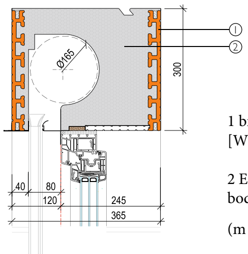

ROKA-LITH-SHADOW
NEOLINE
30,0/36,5*


ROKA-LITH-SHADOW
NEOLINE
42,5/49,0

Brick roller shutter box ROKA-LITH NEOLINE

165mm

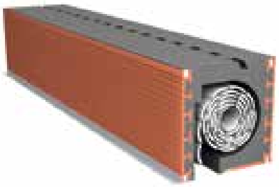


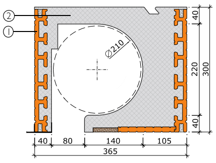


1 brick shell = 1.0û 2 [W / (= 1.02 m * K)] [W / (m * K)

2 EOPOR® DNEOPORämmk ® insulating body λ = 0.0û 32 [W / (m * K = 0.032 [W / (m * K)

210mm



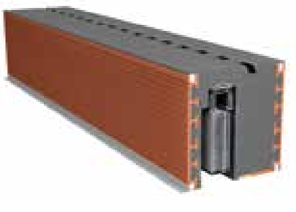


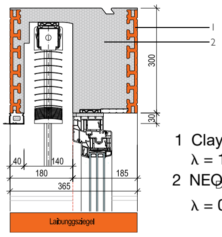
1 brick shell
λ = 1,02 [W/(m*K)

2 NEOPOR® insulating body
λ = 0,032 [W/(m*K)

- Full-body box with thermal break and NEOPOR® insulation
- For the highest demands on thermal insulation, for KFW and passive houses
- Rollraum Ø = 16,5 cm for Window
- Rollraum Ø = 21,0 cm for Door

Tile Venetian blind ROKA-LITH SHADOW NEOLINE





1 Clayshell
λ = 1,02 [W/(m*K)

2 NEOPOR® Insulation body
λ = 0,032 [W/(m*K)

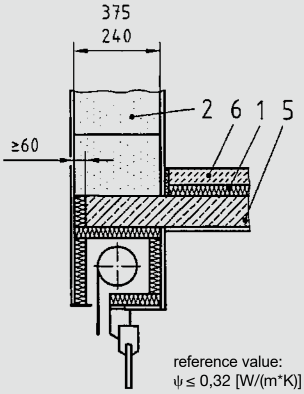
- Full-body box with thermal break and NEOPOR® insulation
- For the highest demands on thermal insulation, for KFW and passive houses
- External leg extended by 3.0 cm downwards to cover the structural connection joint

Further information on the NEOLINE system is provided in the brochure

With brick roller shutter boxes for thermal bridge-free building envelope

Schematic diagram DIN 4108, Supplement 2, 2006-3, Roller shutter box

monolithic masonry - installation situation without ceiling edge stone



reference value:
$\psi \leq 0{,}32$ [W/(m*K)]

Calculated psi values as a function of masonry strength and lambda value of the masonry:

For rolling room 16.5 cm

thermal conductivity λ : [W/(m*K)]	Wall thickness (cm)			
	30,0	36,5	42,5	49,0
λ 0,07	0,127	0,102	0,100	0,132
λ 0,09	0,103	0,083	0,084	0,119
λ 0,11	0,080	0,065	0,068	0,106
λ 0,14	0,046	0,037	0,045	0,087

Note: The values apply to ceiling thickness 18 cm
$\psi_{e,max}$: 0,13 [W/(m*K)] 0,32 [W/(m*K)]
Equivalence is fulfilled.

For rolling room 21.0 cm

thermal conductivit- λ : [W/(m*K)]	Wall thickness (cm)			
	30,0	36,5	42,5	49,0
λ 0,07	0,227	0,162	0,154	0,152
λ 0,09	0,203	0,142	0,138	0,132
λ 0,11	0,179	0,123	0,122	0,126
λ 0,14	0,145	0,093	0,098	0,106

Note: The values apply to ceiling thickness 18 cm
$\psi_{e,max}$: 0,23 [W/(m*K)] 0,32 [W/(m*K)]
Equivalence is fulfilled

For external venetian blinds

thermal conductivit λ : [W/(m*K)]	Wall thickness (cm)			
	30,0	36,5	42,5	49,0
λ 0,07	0,151	0,127	0,121	0,120
λ 0,09	0,127	0,107	0,104	0,106
λ 0,11	0,103	0,088	0,087	0,093
λ 0,14	0,068	0,060	0,063	0,072

Note: The values apply to ceiling thickness 18 cm
$\psi_{e,max}$: 0,15 [W/(m*K)] 0,32 [W/(m*K)]
Equivalence is fulfilled

Processing
Lintels

Clay insulation lintels

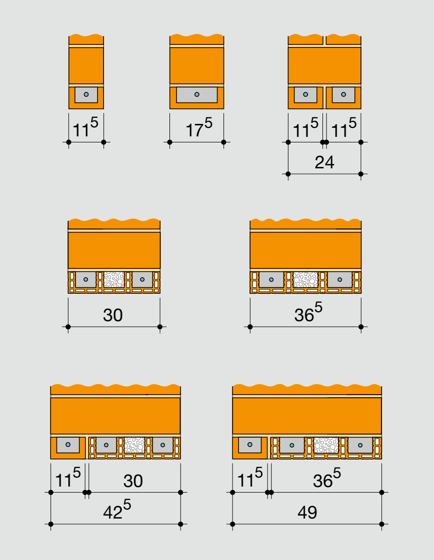
Without additional measures a fall in an outer wall forms a thermal bridge. The result of the increased heat flow are heat losses and, above all, very low temperatures on the room-side wall surface. The moisture from the indoor air can precipitate here and provides an ideal base for mold.

The remedy is our brick thermal insulation lintel. The three-chamber lintel has a central insulating core. The two outer chambers contain the load-bearing reinforced concrete cross-sections [U-value in the load-bearing, heat-insulating cross section 0.4 W / (m²K)]. The reinforcement forms the tension belt into a supporting structure of camber and brickwork.

The tile thermal insulation lintel above door and window openings reduces heat bridges and avoids the danger of condensation on the room side. At the same time it reduces heat losses. Through a uniform plaster background crack damage from different deformation behavior of the building materials is pre-bended.

Non-insulated clay flat lintels

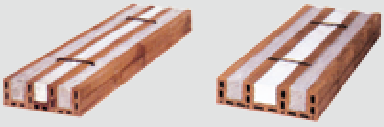
For external walls with additional insulation as well as for interior walls, flat lintels are delivered without additional insulation. The reinforced brick shells are filled with normal concrete. For larger wall thicknesses (42.5 and 49.5 cm), a combination of thermal insulation and uninsulated brickwork makes sense.



The installation regulations of the approvals of the DIBt, Berlin, Z-17.1-900, Z-17.1-1083 und Z-17.1-1099 (Dryfix) is notable.

Dimensioning tables Thermal insulation lintels, brick and standard lintels

Brick falls prevent structural damage and streamline the construction process.

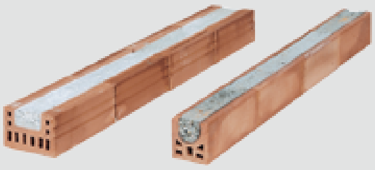


Thermal insulation lintels, height 11.3 cm

Width cm: 30,0 · 36,5
Length cm:100 · 125 · 150 · 175 · 200 · 225 · 250

Clay lintel, height 7.1 cm

Width cm: 11,5 · 17,5
Lenght cm: 100 · 113 · 125 · 150 · 175 · 200 · 225 · 250



Clay lintel, height 11,3 cm

Width cm: 11,5 · 17,5
Lenght cm: 100 · 125 · 150 · 175 · 200 · 225 · 250

Measurement

Carrying flat brick lintels (Z-17.1-900)

The design of load-bearing flat lintels is regulated by the building inspectorate approval Z-17.1-900.

For reasons of simplification, type-tested dimensioning tables (available on request) can be used. The height of the pressure zone must be at least 125 mm.

The compressive strength of the bricks for the brickwork must be at least compressive strength class 6. So that a pressure arch can form over the built-in bricks flat falls, the bearing and butt joints are to be mortared in the area of the brickwork with normal mortar, at least the mortar group IIa.

Self-supporting brick flat lintels (Z-17.1-1083)

The building inspectorate approval Z-17.1-1083 regulates the application of non-load-bearing flat falls from slackly reinforced tension straps in brick shaped bricks in conjunction with a brickwork brickwork without butt jointing, which is only loaded by the dead load of the masonry above it. In the brickwork, all officially approved hollow bricks and flat roof bricks as well as perforated bricks with perforation A and perforation B according to DIN V 105-100 may be used.

■ Demands on the compressive strength of the bricks

Tension belt height 71 mm: compressive strength class ≥ 6
Tension belt height 113 mm: compressive strength class ≥ 4

Due to the low load from the maximum 1.0 m high fall can be dispensed with an explicit bending and shear design.

■ Requirements for single-layer bricking:

- Overmounting height ≥ 125 mm, ≤ 250 mm
- Tile class, ≤ 0.9
- Zuggurthöhe 113 mm

■ Requirements for multilayer bricking:

- Overmounting height ≥ 250 mm, ≤ 1000 mm
- Tile class, ≤ 1.4
- Pull belt height 71 mm or 113 mm

■ maximum permissible clear span Lw = 2.25 m

Processing instructions

■ The support depth must be the same on both sides of the brick lintel.
It depends on the load, but must be at least 11.5 cm
(see dimensioning tables).

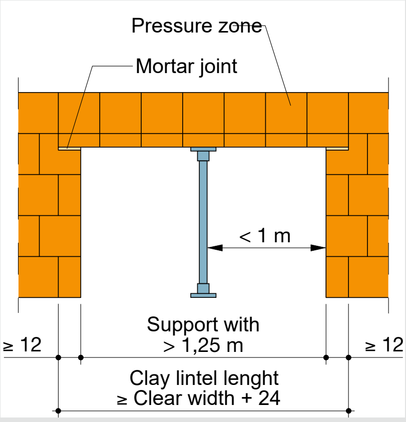
■ Brick lintels must be fully supported in the mortar bed.

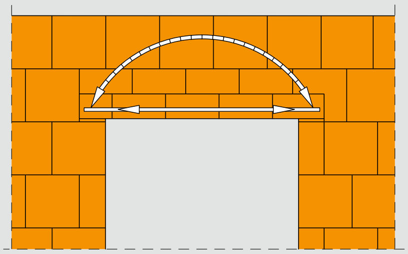
■ Clean brick lintels before wetting the pressure zone and wet them.

■ The first mortar layer above the tension belt is with normal masonry mortar
at least the group of mortars IIa.

■ Up to 1.25 m clear openings no assembly support is required.

■ For larger spans, a mounting support is to be provided at intervals of no more than 1 m. (Removal of assembly support only after the pressure zone has reached sufficient strength - i.d.R. 7 days)





Walling, clay flat lintel

Practical, economical, comfortable

Clay - a building material also for the ceiling

The clay is considered by construction professionals as an ideal building material. Its capillary structure leads to a rapid dehydration of the construction in conjunction with a low equilibrium moisture content. Bricks are also good thermal insulation, non-flammable and statically highly resilient. The ideal combination of thermal insulation, heat storage and humidity regulation creates an optimal, healthy indoor climate. Due to the high brick content, creeping and shrinkage are reduced to a minimum in brick ceilings. According to an examination of the Güteschutz Ziegelmonta-Bau, it is therefore necessary to calculate about three times larger deformations for concrete ceilings. The low ceiling deformations of the brick ceilings thus make an important contribution to the freedom from cracks in the building - houses from one piece.

The right ceiling for every requirement: Clay-suspended ceilings

Wienerberger clay-mounted suspended ceilings, system V-TEC or system FILIGRAN, are provided on site by prefabricated brick lattice girders and special suspension tiles in accordance with DIN 4160 and concrete casting. Block suspended ceilings are therefore particularly flexible and practically adaptable to all floor plans. Due to the low weight of the individual components and their ease of use, they are ideal for renovation of old buildings or for owners with a high level of internal performance.

- Virtually no deformations by shrinkage and creep (freedom from cracks)
- Rapid dehydration of the construction thanks to capillary structure of the brick

- Heat-insulating, non-combustible and statically highly resilient
- Healthy living room climate

Brickyard suspended ceiling:

- System V-TEC

- System FILIGRAN

Pluses for every application

Various advantages

Brick ceilings are a proven and economical alternative for all construction sectors and ensure rapid construction progress, as large areas can be laid quickly and cost-effectively. They are ecologically harmless, have a positive effect on the indoor climate due to the capillary brick structure and thus regulate fluctuations in the humidity of the room much better than non-capillary building materials. The clay tiles, which promote hoogenous construction, have a high initial strength and reach their full buoyancy after a short time. Due to the flexible processing options and the low weight, the brick-suspended ceilings are ideal for renovation of old buildings. Since the ceiling replacement takes place in blocks, the stiffening of the outer walls is retained and expensive scaffolding costs are eliminated.

- Lowest deformation properties due to shrinkage and creep compared to binder-bound building materials
- Brick ceilings make one important contribution to the freedom from cracking of the structure.
- Improvement of the indoor climate and the humidity balance due to the high capillary brick structure. Has a particularly positive effect on floor-to-ceiling tiled walls.
- Low dead weight has a favorable effect on wall loads, large ceiling spans and old building renovation.
- Due to the high brick content Brick ceilings make a high contribution to thermal insulation
- Little building moisture due to the small amount of grouting concrete

Family houses

Apartment buildings

Commercial

Renovation of old buildings

Calculated values for the deformation properties of masonry after DIN 1053-1:1996-11

Wall stone type	Final value of the moisture elongation (shrinkage, chemical swelling) f 1) in mm / m	final creep φ_∞ 2)	Thermal expansion coefficient α_T in 10-6/K
Clay wall	0	1,0	6
Sand lime stones 3)	-0,2	1,5	8
Lightweight concrete blocks	-0,4	2,0	10/8[4]
Concrete stones	-0,2	1,0	10
aerated concrete blocks	-0,2	1,5	8

1) Shortening (shrinkage): sign minus, lengthening (chemical sources): sign plus

2) $\varphi_\infty = \varepsilon_{k\infty}/\varepsilon_{cl}$ $\varepsilon_{k\infty}$ End creep, $\varepsilon_{cl} = \sigma/E$

3) Also applies to hut stones

4) For lightweight concrete with mostly expanded clay as surcharge

Static

Construction of tile-suspended ceilings according to DIN 1045-1

DIN 1045-1 is based on a safety concept with partial safety factors. The loads must be multiplied by partial safety factors and the resulting internal forces determined.

Actions (Ed) on a structure

- permanent actions (G) z. B. dead weight, fixed installations or Auslastast variable actions (Q) z. B. traffic load or payload, wind

Partial safety factors for actions

- constant action $\gamma_G = 1{,}35$
- variable action $\gamma_Q = 1{,}50$

Rated load Ed = $1{,}35 \times (G_{\text{ceiling}} + G_{\text{Last expansion}}) + 1{,}5 \times Q_{\text{traffic load}}$ (kN/m^2)

Load resistance (Rd), partial safety factors

The design values for concrete and reinforcing steel are determined by dividing the characteristic values by the corresponding partial safety factors.

- Concrete (C12/15 bis C50/60) $\gamma_C = 1{,}50$
- Concretesteel $\gamma_S = 1{,}15$

Bending proof:

$M_{Ed} \leq M_{Rd}$

$M_{Ed} = Ed \times l_{eff}^2/8$

Shear force:

$V_{Ed} \leq V_{Rd}$

$V_{Ed} = Ed \times l_{eff}/2$

Standard proof of security

Clay suspended ceilings are differentiated according to DIN 1045-1 into partially prefabricated beam, ribbed or slab beam ceilings with lattice girders in accordance with general building inspectorate approval.

- Approval System Filigree: Z-15.1-145, Z-15.1-148

The lattice girders may be used as flexural, composite and shear or shear force control and for the acceptance of ceiling loads in the assembled state. Use is permitted for predominantly static traffic loads and in light duty factories and workshops. Individual loads are to be transferred directly to the ribs by structural measures (eg transverse ribs).
For the concrete skirting, a concrete of strength class C20 / 25 must be used. The height of the prefabricated concrete footings must be at least 5 cm. Between the beams or ribs intermediate bricks are mounted according to DIN 4160.

Beamed ceiling

- Brick ceiling without or up to 3 cm topping
- permissible payloads up to $q_k = 5{,}00$ kN/m²
- Lightweight partitions and arrangements

  In the ceiling tension direction, separate proof must be provided
- Transversal ribs for lateral distribution of loads from approx. 4 m span

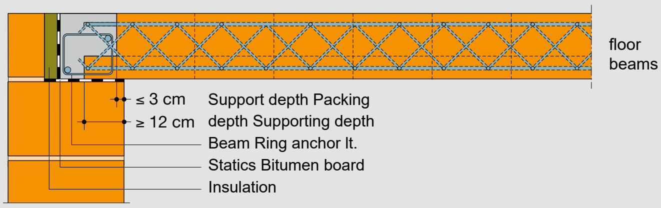
Ribbed floor

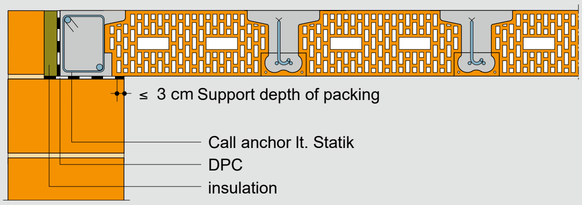
- Brick ceiling with at least 5 cm topping
- a static proof for the Pressure plate is not required
- permissible payloads up to $q_k = 5{,}00$ kN/m²
- Transverse reinforcement, z. Reinforcing steel matt Q 188 A, BSt 500 M with 1.88 cm² / m
- Advantages over beam ceiling at the window effect and lateral distribution of the loads

T-beam ceiling

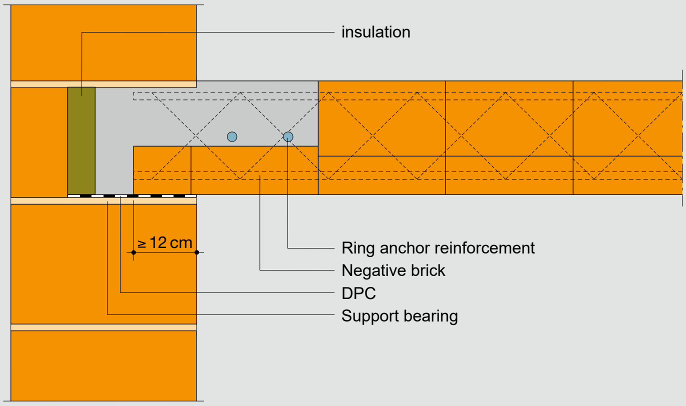
- Brick ceiling with at least 7 cm topping
- very good disc effect and Transverse distribution of the loads
- flexible arrangement of lightweight partition walls taking into account a partition wall surcharge according to DIN 1055-3
- Cross rib design for ceilings in residential buildings (qk ≤ 2.75 kN / m²) from 6 m span

Support for ceilings





Installation of new ceilings in old buildings



After placing the carriers on the height-adjusted wall head and inserting the suspension tiles, a load-bearing composite system is formed by introducing the grouting concrete (C25 / 30, consistency class F3). If necessary, additional application of an overlay of 3 cm to 10 cm thickness can improve the load-bearing capacity and sound insulation.

Through transverse reinforcement in the concrete, the load capacity and lateral distribution of the loads can be increased. For the introduction of horizontal loads from wind and building stabilization in the stiffening walls, the ceiling must be designed as a disc. The ceiling support is therefore to be designed as a ring anchor. The ring anchor forms the tension member of a printed sheet lying in the ceiling panel. According to DIN 1053-1, ring anchors with at least two continuous round bars of at least 10 mm in diameter must be reinforced. In the case of beamed ceilings, the upper support, in particular the outer walls, must be made by a ring beam.

Basically, for all ceiling systems, static proof, individual and object-related, is first created by our engineers. On this basis, the lattice girders are then produced according to the loads and spans on modern facilities. CAD-based installation plans ensure efficient laying and correct placement of the beams on the construction site.

Wienerberger tile-suspended ceiling system Filigran

Technical data system filigree

Brick hanging ceiling, 64.0 cm in grid	21 + 0	18 + 3	18 + 6	25 + 0	21 + 7
maximum span[1] m	5,60	5,70	6,50	6,70	7,70
Payload kN/m²	5,0	5,0	5,0	5,0	5,00
Dead weight of the raw ceiling without plaster, without screed (for load assumptions according to DIN 1055) kg / m²	245	280	355	300	420
Transport weight kg/m²	176	163	163	187	176
grouting[2] C 25/30, consistency Class F3 in l/m² ca. without ring anchors and cross ribs	43	63	85	53	105
Thermal conductivity of the raw ceiling l in W/m·K	0,58	0,61	0,65	0,54	0,71
Sound insulation measure R`w of the ceiling with floating screed3) in dB	53	54	56	54	58
Standard sound pressure level L'n, w, of the ceiling with floating screed3) in dB	51	50	46	48	43
Fire rating	F 90 A	F 90 A	F 90 A	F 90 A	F 90 A

[1] Depending on the payload

[2] Largest grain 8 or 16 mm depending on the type of ceiling

[3] Screed (DIN 18560, Part 2) with m '> 70 kg / m² on insulating material (DIN 18165, Part 2) with dynamic rigidity of 10 MN / m²

[4] ( ) Parent value for soft-elastic floor covering

U-Value

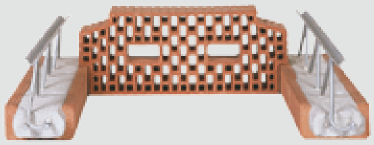
ceiling type	U-values in W / m2K of the clay carrier slabs with insulation thickness *:					
	30 mm	40 mm	50 mm	50 mm	80 mm	100 mm
21 + 0	0,61	0,50	0,43	0,38	0,30	0,25
18 + 3	0,61	0,51	0,43	0,38	0,30	0,25
18 + 6	0,61	0,51	0,43	0,38	0,30	0,25
18 + 7	0,60	0,50	0,43	0,38	0,30	0,25
25 + 0	0,57	0,48	0,42	0,37	0,30	0,25

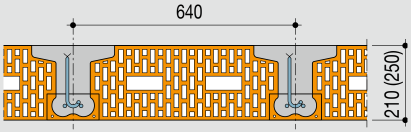
*thermal conductivity λ = 0,03 W/mK

Material requirement

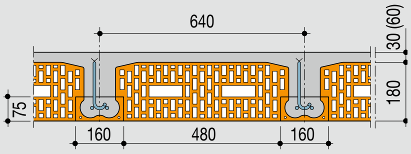
Material requirement per m² (carrier grid)	64,0 cm	51,5 cm
Clay beams 16.0 cm wide	1,6 lfdm.	2,0 lfdm.
Ceiling hanging tiles	6,4 Stück	8,0 Stück
Brick carrier weight approx.	23,5 kg/lfdm.	23,5 kg/lfdm.

This information applies to tile suspended ceilings, System Filigran, for load assumptions customary in the residential sector (payload up to 500 kg / m²). A mounting support of the ceiling beams at a distance of 1.70-2.20 m is required. Technical data for longer lengths or higher load assumptions on request. The production of the carrier takes place only on written order with binding measurements and load data. Delivery time by appointment.





Typ 21 + 0 (25 + 0)



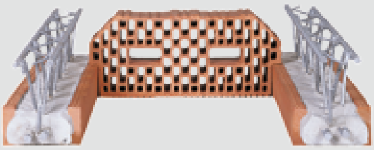
Typ 18 + 3 (18 + 6)

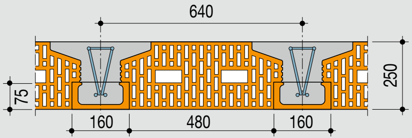
System Filigran

Mounting supports are to be set up every 2 m across the clamping direction. The distances of the mounting supports are removable from the installation plan. For spans longer than 4 m, the girders are to be seen with one stitch (l / 300). All mounting supports must be precisely aligned in the intended ceiling height.

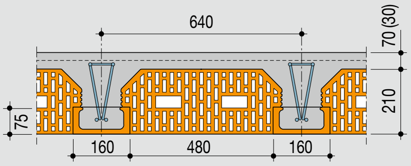
Wienerberger tile suspended ceiling, system V-TEC

By the use of special, particularly stiff lattice girders a support-free laying up to a ceiling span of approx. 5.00 m is possible.





Typ 25 + 0



Typ 21 + 3, 21 + 5, 21 + 7

Technical Data System V-TEC

Brick hanging ceiling, grid 64.0 cm	25 + 0	21 + 3	18 + 6	21 + 7
maximum span1) m	6,70	6,50	6,50	7,80
Payload kN / m²	5,0	5,0	5,0	5,0
perm. clear width without mounting support m	5,09	5,09	4,75	4,40
Net weight of the raw ceiling without plaster (for load assumptions according to DIN 1055) kg / m²	300	320	355	420
Transport weight kg/m²	210	190	190	190
Grouting concrete2) C 25/30, consistency class F3 in l / m² approx. Without ring anchors and transverse ribs	53	63	85	105
Thermal conductivity of the raw slab l in W / m · K	0,54	0,56	0,65	0,71
Sound insulation measure R`w of the ceiling with floating screed3) in dB	54	55	56	58
Standard sound pressure level L'n, w, of the ceiling with floating screed3) in dB	48	48	46	43
Fire rating	F 90 A	F 90 A	F 90 A	F 90 A

1) Depending on the payload
2) Largest grain 8 or 16 mm depending on the type of ceiling
3) Screed (DIN 18560, Part 2) with m '> 70 kg / m² on insulating material (DIN 18165, Part 2) with dynamic rigidity of 10 MN / m²

U-Value

ceiling type	U-values in W / m²K of the brick carrier slabs with insulation thickness *:					
	30 mm	40 mm	50 mm	50 mm	80 mm	100 mm
25 + 0	0,57	0,48	0,42	0,37	0,30	0,25
21 + 3	0,59	0,49	0,42	0,37	0,30	0,25
21 + 5	0,59	0,49	0,42	0,37	0,30	0,25
21 + 7	0,58	0,49	0,42	0,37	0,30	0,25

* thermal conductivity λ = 0,03 W/mK

Material requirement

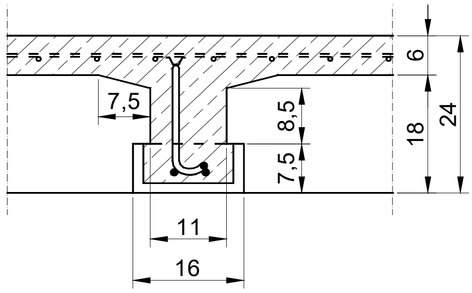
Material requirement per m² (carrier grid)	64,0 cm	51,5 cm
Brick beams 16.0 cm wide	1,6 lfdm.	2,0 lfdm.
Ceiling hanging tiles	6,4 Stück	8,0 Stück
Brick carrier weight approx.	27,5 kg/lfdm.	27,5 kg/lfdm.

This information applies to brick suspended ceilings, System V-TEC, for load assumptions customary in the residential sector (payload up to 500 kg / m²). A mounting support of the ceiling girder (V17) is only required from 4.40 to 5.00 m clear width. Technical data for longer lengths or higher load assumptions on request. The production of the carrier takes place only on written order with binding measurements and load data. Delivery time by appointment.

Filigree brick ceiling (according to DIN EN 1992-1-1 with NA for Germany) Torque and span table, Z 1806-640-1S-2W

Note:
This design aid may only be forwarded to third parties as it is in its present form. The User Design Assistance undertakes to check the results obtained for accuracy and the validity of the approval. Incidentally, the general terms and conditions printed at the end of this page apply. Page printed general terms and conditions.

single carrier



Place concrete: C25/30

Supplements reinforcing steel BSt 500 A/B

Ceiling thickness h= 18 + 6 = 24 cm

carrier spacing = 64,0 cm

Concrete cover c_{nom} = 2,0 cm

Exposition class: XC 1

FILIGRAN S-beam h = 17 cm
Approval Notice No. Z-15.1-145
from 1 January 2014

The assessment aid is valid until the end of 2018 at the latest and until the expiry or modification of the approval at the latest.

Spans single carrier (minimum superelevation)

1. Line: Traffic load Qk [kN / m²], payload category
2. Line: Rated load Ed = G Gk + Q Qk [kN / m²]
(Ceiling weight: 3,55 kN / m², plaster and covering: 1,5 kN / m²) = G_k

No.	Static Pos.	reinforcement lower chord 2 bars	bonus 1 Stab	prev. A_s	M_{Rd}	1,50 A,B 9,07	2,00 A,B 9,82	2,80 A,B 11,02	3,00 A,B 11,32	3,20 A,B 11,62	4,00 A,B 12,82	5,00 C,D 14,32
		mm	mm	cm²	kNm/R	m (cm)	m (cm)	m (cm)	m (cm)	m (cm)	m (cm)	m (cm)
	1	2	3	4	5	6	7	8	9	10	11	12
								Diagonal ø7 mm				
1		10		1,57	13,6	**4,32** (0,3)	**4,15** (0,2)	**3,92** (0,0)	**3,87** (0,0)	**3,82** (0,0)	**3,64** (0,0)	**3,44** (0,0)
2		12		2,26	19,3	**5,15** (1,2)	**4,95** (0,9)	**4,68** (0,5)	**4,61** (0,5)	**4,55** (0,4)	**4,34** (0,2)	**4,10** (0,3)
3		10	10	2,36	19,8	**5,23** (1,3)	**5,02** (1,0)	**4,74** (0,6)	**4,68** (0,5)	**4,62** (0,5)	**4,40** (0,3)	**4,16** (0,3)
4		10	12	2,70	22,5	*5,57* (1,8)	**5,35** (1,4)	**5,05** (0,9)	**4,98** (0,8)	**4,92** (0,8)	**4,68** (0,5)	**4,43** (0,6)
5		10	14	3,11	25,6	*5,94* (2,3)	*5,71* (1,9)	**5,39** (1,3)	**5,32** (1,2)	**5,25** (1,1)	**5,00** (0,8)	**4,73** (0,9)
6		14		3,08	25,9	*5,97* (2,2)	*5,74* (1,8)	**5,42** (1,3)	**5,34** (1,2)	**5,28** (1,1)	**5,02** (0,7)	**4,75** (0,8)
7		12	12	3,39	28,1	*6,13* (2,4)	*5,98* (2,2)	*5,64* (1,6)	*5,57* (1,5)	*5,49* (1,4)	**5,23** (1,0)	**4,95** (1,1)
8		12	14	3,80	31,1	*6,26* (2,5)	*6,21* (2,5)	*5,94* (2,0)	*5,86* (1,9)	*5,78* (1,7)	*5,51* (1,3)	**5,21** (1,4)
9		16		4,02	33,2	*6,40* (2,6)	*6,35* (2,6)	*6,14* (2,2)	*6,06* (2,1)	*5,98* (1,9)	*5,69* (1,5)	**5,39** (1,6)
10		12	16	4,27	34,5	*6,40* (2,6)	*6,34* (2,5)	*6,26* (2,5)	*6,17* (2,3)	*6,09* (2,2)	*5,80* (1,7)	*5,49* (1,8)
11		14	14	4,62	37,4	*6,54* (2,6)	*6,49* (2,6)	*6,40* (2,6)	*6,38* (2,6)	*6,34* (2,5)	*6,04* (2,0)	*5,71* (2,1)
12		14	16	5,09	40,7	*6,65* (2,7)	*6,60* (2,7)	*6,51* (2,6)	*6,49* (2,6)	*6,47* (2,6)	*6,30* (2,4)	*5,92* (2,4)
13		16	16	6,03	47,7	*6,88* (2,7)	*6,83* (2,7)	*6,74* (2,7)	*6,72* (2,7)	*6,70* (2,7)	*6,62* (2,7)	*6,14* (2,5)
14		16	20	7,16	55,1			*6,82* (2,5)	*6,82* (2,6)	*6,82* (2,6)	*6,80* (2,7)	*6,30* (2,5)
	required shear reinforcement:					**ø8mm**	**Diagonal ø9 mm**			**Diagonal ø10mm**		

Italic printed spans exceed the allowable thinness for strain sensitive components (l / d ≤ 150 / l)
The sag was limited to 1/250; Bracket values indicate the minimum overshoot in [cm] - maximum overshoot = l / 250

Calculated values: Steel Under straps f_{yk} = 500 N/mm²
Diagonal f_{yk} = 420 N/mm²
Concrete steel f_{yk} = 500 N/mm²
Concrete C25/30 f_{ck} = 25 N/mm²
It runs bad
Ceiling tile (see sketch): static not cooperative

Mounting support width: 2.07 m with upper flange 40x2

Section properties:
baseboard(C25/30): Height / width = 7,5 cm / 16 cm
Thrust wide single / double girders bo = 11 cm / 27 cm

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Filigree brick ceiling (according to DIN EN 1992-1-1 with NA for Germany) Torque and shear force table, Z 1806-640-1S-2W

Note:
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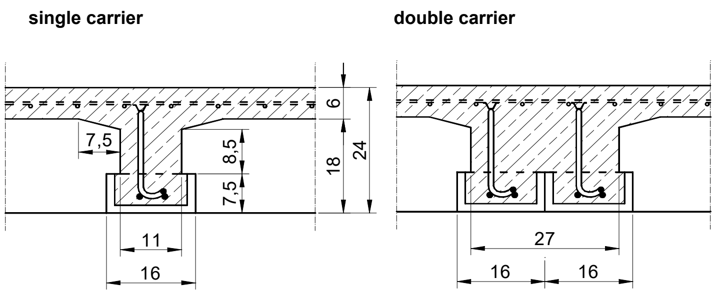
single carrier **double carrier**

Placeconcrete: C25/30

Supplements reinforcing steel BSt 500 A/B

Ceiling thickness h = 18 + 6 = 24 cm

Carrier spacing = 64,0 cm

Concrete cover c_{nom} = 2,0 cm

Exposure classes: XC 1

FILIGRAN S-Beam h = 17 cm
Approval Notice No. Z-15.1-145
from 1. Januar 2014

The assessment aid is valid until the end of 2018 at the latest and until the expiry or modification of the approval at the latest.

Reinforcement / baseboard					single carrier								double carrier								
					Field moment			Transverse force					Feldmoment			Transverse force					
No.	Lower belt 2 bars	bonus 1 bar	prev. A_s	d	M_{Rd}	z	ε_c $\underline{\varepsilon_S}$	$V_{Rd,sy}$ Diagonal ø7mm	ø8mm	ø9mm	ø10mm	$V_{Rd,max}$ *)	M_{Rd}	z	ε_c $\underline{\varepsilon_S}$	$V_{Rd,sy}$ Diagonale ø7mm	ø8mm	ø9mm	ø10mm	$V_{Rd,max}$ *)
	mm	mm	cm²	cm	kNm/R	cm	°/oo	kN/R	kN/R	kN/R	kN/R	kN/R	kNm/R	cm	°/oo	kN/R	kN/R	kN/R	kN/R	kN/R
	1	2	3	4	5	6	7	8	9	10	11	11	12	13	14	15	16	17	18	18
1	10		1,57	20,3	13,6	19,8	1,7	18,5	21,9	25,8	30,1	49,4	26,8	19,6	2,3	40,3	47,1	54,9	63,5	121,1
2	12		2,26	20,2	19,3	19,6	2,1	18,4	21,8	25,6	29,9	49,0	38,0	19,3	3,1	40,0	46,8	54,5	63,1	120,4
3	10	10	2,36	20,0	19,8	19,3	2,2	18,1	21,4	25,2	29,5	48,3	39,0	19,0	3,2	39,4	46,1	53,7	62,2	118,7
4	10	12	2,70	19,8	22,5	19,1	2,5	18,0	21,3	25,0	29,3	48,0	44,1	18,8	23,6	39,1	45,8	53,3	61,7	117,7
5	10	14	3,11	19,7	25,6	18,9	2,8	17,8	21,1	24,8	29,0	47,6	50,0	18,5	19,9	38,8	45,4	52,9	61,2	116,7
6	14		3,08	20,1	25,9	19,3	2,7	18,2	21,6	25,5	29,7	48,7	50,6	18,9	20,6	39,8	46,5	54,2	62,7	119,6
7	12	12	3,39	19,9	28,1	19,0	3,0	18,0	21,3	25,1	29,3	48,0	54,7	18,5	18,1	39,2	45,9	53,4	61,8	117,9
8	12	14	3,80	19,8	31,1	18,8	3,3	17,9	21,2	24,9	29,1	47,7	60,3	18,3	15,7	38,9	45,5	53,0	61,4	117,1
9	16		4,02	20,0	33,2	19,0	3,4	18,1	21,5	25,3	29,5	48,4	64,4	18,4	14,9	39,5	46,2	53,8	62,4	118,9
10	12	16	4,27	19,6	34,5	18,6	23,6	17,7	21,0	24,7	28,9	47,3	66,7	17,9	13,5	38,6	45,2	52,6	60,9	116,2
11	14	14	4,62	19,8	37,4	18,6	21,8	17,9	21,2	24,9	29,1	47,7	72,1	17,9	12,3	38,9	45,6	53,1	61,4	117,2
12	14	16	5,09	19,7	40,7	18,4	19,3	17,8	21,0	24,8	28,9	47,4	78,1	17,7	10,8	38,7	45,3	52,7	61,1	116,4
13	16	16	6,03	19,7	47,7	18,2	15,8	17,8	21,0	24,8	28,9	47,4	90,7	17,3	8,5	38,7	45,3	52,7	61,1	116,4
14	16	20	7,16	19,5	55,1	17,7	12,6	17,5	20,8	24,5	28,6	46,8	104,3	16,7	5,3	38,2	44,7	52,1	60,3	115,0
Shear force resistors with shear allowances 1)								27,5	30,7	34,4	38,5					58,1	64,6	71,9	80,2	

Calculated values: steel lower chords f_{yk} = 500 N/mm²
Diagonal f_{yk} = 420 N/mm²
Concrete steel f_{yk} = 500 N/mm²
Concrete C25/30 f_{ck} = 25 N/mm²
Fuge rau
Ceiling tile (see sketch): static not cooperative.
Direct support with support depth ≥ 12 cm
Cross-section values:
baseboard (C25/30): Height / width = 7,5 cm / 16 cm
Thrust wide single / double girders bo = 11 cm / 27 cm
brick shell = 1,2 cm

Bend design as ribbed ceiling (Z-15.1-145, see Appendix 9)

[1] Diagonal of each column with DH allowancea diagonal ø6mm every 20 cm. VRd, max is always to be kept!

*) Upper limit for the lateral force or composite verification

Filigree brick ceiling (according to DIN EN 1992-1-1 with NA for Germany) Torque and span table, Z 2100-640-1S-2W

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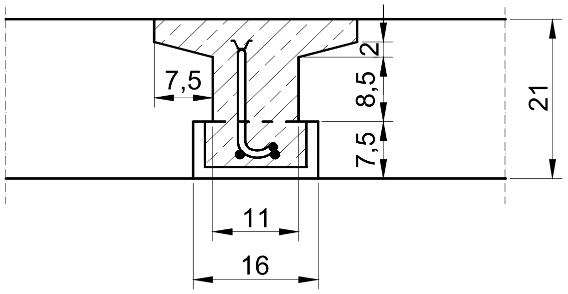
single carrier



situ concrete: C25/30

Supplements reinforcing steel BSt 500 A/B
Ceiling thickness h = 21 + 0 = 21 cm carrier
spacing = 64,0 cm
concrete cover c_{nom} = 2,0 cm
Exposure class: XC 1

FILIGRAN S-Beam h = 15 cm
Approval Notice No. Z-15.1-145
from 1. Januar 2014

The assessment aid is valid until the end of 2018 at the latest and until the expiry or modification of the approval at the latest.

Nr.	Statics Pos.	reinforcement Lower belt 2 Stäbe	allowance 1 Stab	vorh. A_s	M_{Rd}	Spans single carrier (minimum superelevation) 1. Line: Traffic load Qk [kN / m²], payload category 2. Line: Rated load Ed = G Gk + Q Qk [kN / m²] (Ceiling weight: 2.45 kN / m², render and covering: 1.5 kN / m²) = Gk 1,50 A,B 7,58	2,00 A,B 8,33	2,80 A,B 9,53	3,00 A,B 9,83	3,20 A,B 10,13	4,00 A,B 11,33	5,00 C,D 12,83
		mm	mm	cm²	kNm/R	m (cm)	m (cm)	m (cm)	m (cm)	m (cm)	m (cm)	m (cm)
	1	2	3	4	5	6	7	8	9	10	11	12
								Diagonale ø7 mm				
1		10		1,57	11,2	**4,29** (1,0)	**4,09** (0,7)	**3,83** (0,4)	**3,77** (0,3)	**3,71** (0,3)	**3,51** (0,1)	**3,30** (0,2)
2		12		2,26	15,6	**5,04** (2,0)	**4,83** (1,6)	**4,52** (1,1)	**4,45** (1,0)	**4,38** (0,9)	**4,14** (0,6)	**3,89** (0,7)
3		10	10	2,36	15,9	**5,03** (2,0)	**4,89** (1,8)	**4,57** (1,2)	**4,50** (1,1)	**4,43** (1,0)	**4,19** (0,7)	**3,94** (0,8)
4		10	12	2,70	17,9	*5,14* (2,1)	*5,08* (2,0)	**4,84** (1,6)	**4,77** (1,5)	**4,69** (1,4)	**4,44** (1,0)	**4,17** (1,1)
5		10	14	3,11	20,1	*5,24* (2,1)	*5,18* (2,1)	*5,10* (2,1)	*5,05* (2,0)	**4,98** (1,8)	**4,70** (1,4)	**4,42** (1,5)
6		14		3,08	20,4	*5,33* (2,1)	*5,27* (2,1)	*5,17* (2,1)	*5,09* (1,9)	**5,02** (1,8)	**4,75** (1,3)	**4,46** (1,5)
7		12	12	3,39	21,9	*5,36* (2,1)	*5,30* (2,1)	*5,22* (2,1)	*5,20* (2,1)	*5,18* (2,1)	**4,91** (1,6)	**4,61** (1,8)
8		12	14	3,80	23,8	*5,45* (2,2)	*5,39* (2,2)	*5,30* (2,1)	*5,28* (2,1)	*5,25* (2,1)	*5,12* (1,9)	**4,73** (1,9)
9		16		4,02	25,3	*5,56* (2,2)	*5,50* (2,2)	*5,41* (2,2)	*5,39* (2,2)	*5,37* (2,2)	*5,28* (2,1)	**4,83** (1,9)
10		12	16	4,27	25,8	*5,52* (2,2)	*5,46* (2,2)	*5,37* (2,1)	*5,35* (2,1)	*5,33* (2,1)	*5,25* (2,1)	**4,80** (1,9)
11		14	14	4,62	27,5	*5,63* (2,3)	*5,57* (2,2)	*5,48* (2,2)	*5,46* (2,2)	*5,44* (2,2)	*5,35* (2,1)	**4,89** (2,0)
12		14	16	5,09	28,2	*5,69* (2,3)	*5,63* (2,3)	*5,54* (2,2)	*5,51* (2,2)	*5,49* (2,2)	*5,41* (2,2)	**4,95** (2,0)
13		16	16	6,03	28,9	*5,83* (2,3)	*5,77* (2,3)	*5,68* (2,3)	*5,66* (2,3)	*5,64* (2,3)	*5,55* (2,2)	*5,08* (2,0)
	required shear reinforcement:					**ø7mm**	**Diagonal ø8 mm**			**Diagonal Ø9mm**		

Italic printed spans exceed the allowable thinness for strain sensitive components (l / d ≤ 150 / l)
The sag was limited to 1/250; Bracket values indicate the minimum overshoot in [cm] - maximum overshoot = l / 250

Calculated values:	Steel lower straps	f_{yk} = 500 N/mm²
	Diagonal	f_{yk} = 420 N/mm²
	Rebar	f_{yk} = 500 N/mm²
	Concrete C25/30	f_{ck} = 25 N/mm²
	Joint rough	

Montagestützweite:
2,22 m bei Obergurt 40x2

Ceiling tile (see sketch): static not cooperative.

Section properties:
Skirting board (C25 / 30): Height / width = 7,5 cm / 16 cm
Push width single / double carrier bo = 11 cm / 27 cm

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Filigree tile ceiling (according to EN 1992-1-1 with NA for Germany) Moment and shear force table, Z 2100-640-1S-2W

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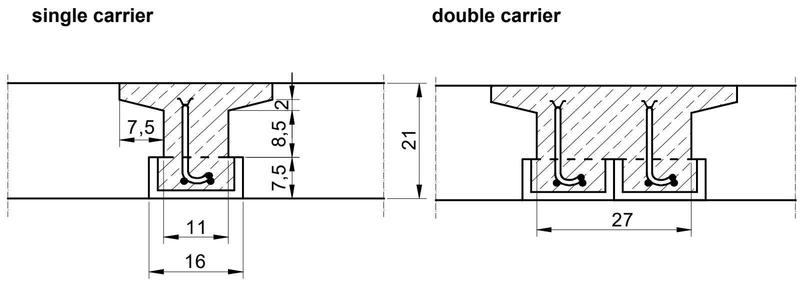

Placeconcrete:: C25/30

Supplements reinforcing steel BSt 500 A/B

Ceiling thickness h = 21 + 0 = 21 cm

Carrier spacing = 64,0 cm

Concrete cover c_{nom} = 2,0 cm

Exposure classes: XC 1

FILIGRAN S-Träger h = 15 cm

Approval Notice No. Z-15.1-145
from 1. Januar 2014

The assessment aid is valid until the end of 2018 at the latest and until the expiry or modification of the approval at the latest.

Reinforcement / baseboard					single carrier							double carrier						
					Field moment			Transverse force				Field moment			Transverse force			
No:	Lower belt 2 bars	Bonus 1 Bar	Prev. A_s	d	M_{Rd}	z	ε_c ε_S	$V_{Rd,sy}$ Diagonal ø7 mm	ø8 mm	ø9 mm	$V_{Rd,max}$ *)	M_{Rd}	z	ε_c ε_S	$V_{Rd,sy}$ Diagonale ø7 mm	ø8 mm	ø9 mm	$V_{Rd,max}$ *)
	mm	mm	cm²	cm	kNm/R	cm	°/$_{oo}$	kN/R	kN/R	kN/R	kN/R	kNm/R	cm	°/$_{oo}$	kN/R	kN/R	kN/R	kN/R
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	10		1,57	17,3	11,2	16,3	22,9	14,7	17,5	20,6	39,4	21,7	15,9	14,3	33,3	39,1	45,6	100,5
2	12		2,26	17,2	15,6	15,8	14,7	14,7	17,5	20,6	39,4	29,8	15,1	8,5	33,1	38,8	45,2	99,8
3	10	10	2,36	17,0	15,9	15,5	13,6	14,7	17,5	20,6	39,4	30,4	14,8	7,8	32,5	38,1	44,4	98,0
4	10	12	2,70	16,8	17,9	15,2	10,9	14,7	17,5	20,6	39,4	33,7	14,3	6,0	32,2	37,7	44,0	97,1
5	10	14	3,11	16,7	20,1	14,8	8,1	14,6	17,4	20,5	39,1	37,2	13,7	4,5	31,9	37,3	43,5	96,1
6	14		3,08	17,1	20,4	15,3	8,6	14,7	17,5	20,6	39,4	37,9	14,2	4,8	32,8	38,5	44,9	99,0
7	12	12	3,39	16,9	21,9	14,8	6,7	14,7	17,5	20,6	39,4	40,0	13,6	3,9	32,3	37,8	44,1	97,3
8	12	14	3,80	16,8	23,8	14,4	4,9	14,7	17,4	20,6	39,3	42,8	12,9	2,9	32,0	37,5	43,7	96,4
9	16		4,02	17,0	25,3	14,5	4,4	14,7	17,5	20,6	39,4	45,1	12,9	2,6	32,4	37,9	44,2	97,6
10	12	16	4,27	16,6	25,8	13,9	3,5	14,6	17,3	20,4	38,9	44,6	12,4	2,3	31,1	36,4	42,5	93,7
11	14	14	4,62	16,8	27,5	13,7	2,9	14,7	17,5	20,6	39,3	45,8	12,4	2,2	31,1	36,4	42,4	93,6
12	14	16	5,09	16,7	28,2	13,3	2,4	14,6	17,3	20,4	39,0	45,9	12,2	2,0	30,5	35,8	41,7	92,0
13	16	16	6,03	16,7	28,9	13,1	2,1	14,6	17,3	20,4	39,0	46,9	11,9	1,8	29,9	35,1	40,9	90,2
Shear force resistors with shear allowances 1)								22,6	25,3	28,3					44,2	49,1	54,8	

Calculated values: steel lower chords f_{yk} = 500 N/mm²
Diagonal f_{yk} = 420 N/mm²
Reinforcing steel f_{yk} = 500 N/mm²
Concrete C25/30 f_{ck} = 25 N/mm²
Fuge rau

Ceiling tile (see sketch): static not cooperative.
Direct support with support depth ≥ 12 cm Cross-section values:
Skirting board (C25 / 30): Height / width = 7,5 cm / 16 cm
Push width single / double carrier bo = 11 cm / 27 cm
brick tray = 1.2 cm

[1] Diagonale der jeweiligen Spalte mit DH-Zulage eine Diagonale ø6mm alle 20 cm.
$V_{Rd,max}$ ist immer einzuhalten!

*) Upper limit for the lateral force or composite verification

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Energy Saving Ordinance EnEV

The EnEV applies to almost all heated or air-conditioned buildings and specifies the requirements for the thermal insulation standard and the system technology. In an energy balance, the energy demand for heating and hot water as well as the system losses are calculated according to prescribed procedures.
With the entry into force of the **EnEV 2014**, Germany followed in a first step of the **European Directive for Energy-Efficient Buildings** (EPBD) of 2010. From 2021 onwards, this will only allow new low-energy buildings (for public buildings as early as 2019). Accordingly, future buildings should be able to demonstrate energy consumption that is extremely low and can be covered to a very substantial extent by renewable energies.

In addition, the **Renewable Energy Heat Act (EEWärmeG)**, which was amended as part of the climate package, includes a requirement for the use of regenerative energy for new buildings. It also determines, among other things, new eligibility criteria for combined heat and power.

Essential contents of EnEV 2014/2016

For content-related coordination of the EnEV amendment 2014, the **Energy Savings Act (EnEG)** was previously amended as the legal basis. The EnEG calls for appropriate and economically justifiable increases in the energy requirements of buildings.

Specifications for building

- Increase of the energy requirements for new buildings from January 1, 2016 by an average of 25 percent of the permissible annual primary energy demand and by an average of 20 percent in the thermal insulation of the building envelope under the important aspect of economic viability.
- No tightening of the renovation of existing buildings.

Specifications for energy certificates

- Introduction of the obligation to provide energy characteristics in real estate advertisements for sale and rental including the energy efficiency class. This includes classes A + to H.
- Clarify the existing obligation to submit and hand over the energy ID card at the time of inspection of the purchase or rental property.
- Introduction of the obligation to display energy certificates in buildings with strong public traffic.
- Introduction of independent spot checks by Länder for energy performance and reports on the inspection of air conditioning systems (according to EU requirements).

KfW assistance

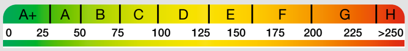
With the above-described higher energy requirements for new buildings according to the EnEV from 01.01.2016, the previous funding standard KfW-Effizienzhaus 70 almost complies with the legal requirements. For this reason, the promotion of KfW Efficiency House 70 will be discontinued as of March 31, 2016.

The two promotion standards KfW-Effizienzhaus 55 and 40 also remain on offer. From 01.04.2016, KfW also introduces the Effizienzhaus 40 Plus, which promotes particularly energy-efficient residential buildings, where a substantial part of the building's energy needs are to be generated and stored. For the KfW Efficiency House 55, a simplified verification procedure "KfW Efficiency House 55 according to reference values" is additionally offered. This procedure offers the possibility of selecting standardized package of measures for the building envelope and the installation technology.


POROTON
Technische Informationen ENEV EEWärmeG
Die 2. Verordnung zur Änderung der EnEV, das EEWärmeG und geltende Normen im Kontext öffentlich-rechtlicher Nachweise. Mit hilfreichen Checklisten.

Download unter:
www.wienerberger.de

Comparative values for the classification of the final energy of buildings



Classification into energy efficiency classes

The energy efficiency classes are derived directly from the final energy consumption or the final energy requirement according to the following table.

Energy efficiency class	Endenergy class [kWh/(m² a)]
A+	< 30
A	< 50
B	< 75
C	< 100
D	< 130
E	< 160
F	< 200
G	< 250
H	> 250

Calculation method

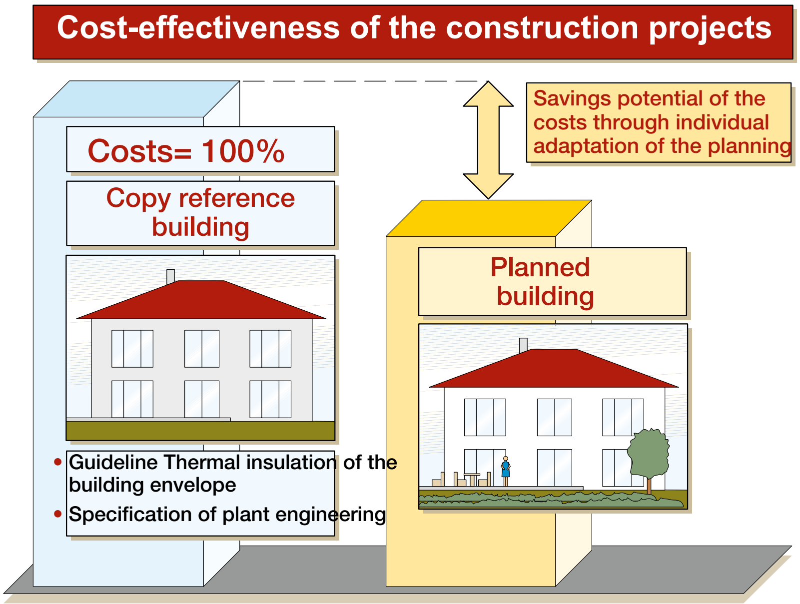
The target figure for all new buildings remains the so-called "annual primary energy requirement" as well as the limitation of the transmission heat loss via the building envelope. The annual primary energy requirement not only takes into account the energy quality of the building envelope, but also the efficiency of the system technology, including the provision of hot water. In doing so, no balance sheet-related but primary-primary balance is created. This means that not only the heat demand is recorded, but also an ecological assessment of energy production and energy carrier takes place. For example, renewable energies such as sun or wood are considered cheaper than electricity or coal.

For planners and builders, balancing the energy-efficient quality of the building shell and the efficiency of the system technology creates the opportunity to create buildings that are as economical as they are energy-efficient. Because strengths and weaknesses of individual parts of the overall "building" system are offset against each other.

This requires an integrative approach from planners and builders that intelligently links architec- tonic-constructive building planning and building technology concept at an early stage. It is important to consider a large number of parameters and constraints in the planning in order to achieve the lowest possible primary energy requirements both economically and ecologically optimized.

The proof can furthermore be carried out alternatively according to DIN V 4108-6 for the building envelope as well as according to DIN 4701-10 for the plant engineering or according to DIN V 18599. In the long term, the proof according to DIN V 4108-6 and DIN 4701-10 should be replaced by the calculation method according to DIN V 18599.

Annex 1, Table 1 of the EnEV specifies the U-values for the external components as well as the technical equipment of the reference buildings. The proof seems simple at first, but you can set for the building to be planned the given values of the reference building - and the proof fits. However, the profitability and the individual planning are left out:



In both calculation methods, the maximum permissible level of the annual primary energy demand is determined by comparison with a reference building identical to the planned building. The reference building is equipped with standardized components and a prescribed system technology.

The so-called "reference building method" was already introduced with the amendment of the EnEV 2007 for non-residential buildings.

Thelimitationofthetransmissionheat losscontinuestobedeterminedbythe typeofbuilding.

Reference buildings

=

- Same geometry
- Same effective area
- Same orientation
- Same usage

Planned building

Calculation method according to EnEV

Dual application of two equal calculation methods

DIN V 4108-6 and DIN V 4701-10	DIN V 18599
■ Calculation method for residential buildings ■ Calculation method since the introduction of the EnEV	■ Already since 2007 calculation methods for non-residential buildings, since 2009 also for residential buildings possible

Wienerberger
Building Material Solutions

Thermal bridges

Above all with connections of different components (ceiling support) as well as with corners and outstanding components (balconies) increased heat losses occur due to thermal bridge effects.

In the context of the EnEV, heat bridges are especially to be optimized to reduce the energy requirement and to avoid building damage. Because the proportion of heat bridge losses in highly insulated constructions can account for up to 20 percent of total transmission heat losses.

A thermal bridge conditional decrease in the room-side surface temperatures especially increases the risk of condensation and can lead to structural damage.

The additional heat transmission losses due to thermal bridges are taken into account as an additional heat transfer coefficient UWB either by a flat-rate surcharge or by the heat transfer coefficients CWB (W / mK).

The use of the homogeneous Poroton brick system with a comprehensive range of heat-insulating bricks sup- plementary products and detailed solutions that are easy to implement in terms of construction can be used to reliably optimize such thermal bridges and reduce them to a minimum.

The itemization of the thermal bridges should be standard in the planning. The high computational effort required for accurate verification often prevents the planner from using the advantages of the individual proofs - instead, the lump sums according to EnEV are used. However, with good detail training and well thought-out planning, masonry construction can already be used to activate substantial savings potential in the transmission heat losses without any additional cost in the design.

For the usual component connections with the Poroton brick system, already calculated thermal bridge details with the proof of the equivalence according to DIN 4108 Supplement 2 for the flat thermal bridge surcharge UWB = 0.05 W/(m²·K) are available in detail. Similarly, CWB values are given for a precise calculation approach. The EnEV planning program from Wienerberger contains a comprehensive thermal bridge catalog, which significantly simplifies the calculation of all values.

Example: consideration of thermal bridges

Well-insulated masonry structures in single-shell brick construction not only comply with the requirements of DIN 4108 Supplement 2, but generally represent a higher energy quality than is calculated. The example on the opposite page documents that, compared to a blanket approach, careful consideration of thermal bridges minimizes transmission heat loss.

The detailed consideration of the thermal bridges in EnEV detection enables economically insulated construction projects. The detailed proof helps to avoid disproportionate insulation measures and at the same time to comply with the requirement level for EnEV and KfW eligibility criteria.

Consideration of the transmission heat loss via thermal bridges:

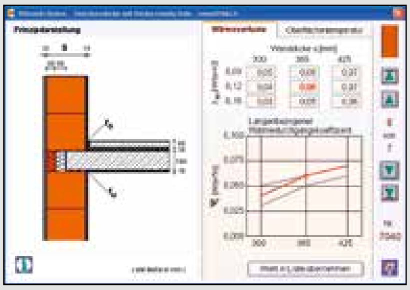
1. Accurate consideration of heat bridges with:

$$\Delta U_{WB} = \Sigma\, l * \Psi / A \; [W/(m^2 \cdot K)]$$

Ψ = length-related heat bridges loss coefficient of the thermal bridge [W / (mK)]

l = Length of the thermal bridge [m]

A = heat-exchanging envelope (of the building) [m²]

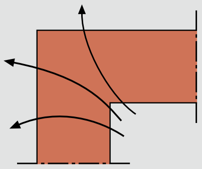


Exact consideration of the heat bridges with the EnEV planning program or the heat bridge catalog (cost-free download at www.wienerberger.de)

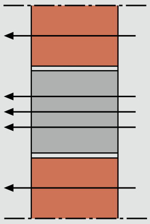
2. Package approach with

$$\Delta U_{WB} = 0{,}05\ W/(m^2 \cdot K)$$

Annotation:
The blanket approach with UWB = 0.10 W / (m² · K) is ignored due to the uneconomic approach.



geometric thermal bridge



material thermal bridge

Thermal insulation of the exterior components

The evidence shows that the insulation of the external components has already reached a high level. Due to the combination of requirements for primary energy demand and the obligation to use renewable energies, there are far fewer requirements for the exterior parts of the EnEV than is generally assumed.

Possible insulation standard for a single-family home under consideration of plant engineering based on renewable energy sources:

Component	U-Value [W/(m²·K)]	Execution z. B.
Top, roof	≤ 0,18	Insulation 22 cm WLG 035
Window	≤ 1,1	Two slices of thermal insulation glazing
Baseplate	≤ 0,35	Insulation 10 cm WLG 035
Masonry	≤ 0,26	Poroton-T 8, -T 9, -Plan-T 10

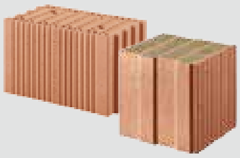
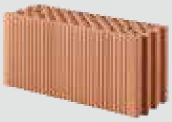
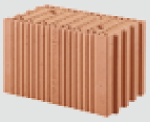
Efficiency principle

The energy efficiency of buildings requires a balanced ratio of insulation and plant engineering. Optimization is only to some extent effective. Beyond this point, a further increase in insulation is economically questionable. Further increases in efficiency can only be achieved through plant technology. Architects and specialist planners must therefore more than ever examine the various possible concepts for construction and plant engineering on the basis of their own goals, requirements and economic framework conditions.

The right answer to the EnEV 2016: Poroton bricks

Whatever you plan and build, with our products you are always on the safe side. And the good feeling of having given his customers a thoroughly future-proof, healthy building material is actually priceless.

Product recommendations

Building type/ construction	Masonry-variant	Detached houses Double / Terraced houses		Apartment buildings	
High quality (KfW Efficiency House)	**Monolithic**		**T7-P/-MW**-36,5/42,5/49,0 **T8-P**-36,5/42,5/49,0 **T8-MW**-36,5/42,5 **Plan-T8**-36,5/42,5/50,0 **Plan-T9**-42,5		**S8-P/-MW**-36,5/42,5/49,0 **S9-P/-MW**-36,5/42,5 **S10-P/-MW**-42,5
	two or more layers		**T8-MW**-24,0 **Plan-T18**-17,5 u. 24,0 **Plan-T12**-24,0 **Plan-T14**-24,0 **Plan-T16**-17,5		**HLz-Plan-T** 0,9, 1,2 und 1,4 17,5 und 24,0 cm
Standard (EnEV 2016)	**Monolithic**		**Plan-T9**-36,5 **Plan-T10**-30,0/36,5 **Plan-T12**-42,5/49,0		**S9-P/-MW**-30,0 **S10-P/-MW**-36,5
	two or more layers		**T8-MW**-24,0 **Plan-T18**-17,5 u. 24,0 **Plan-T12**-24,0 **Plan-T14**-24,0 **Plan-T16**-17,5		**HLz-Plan-T** 0,9, 1,2 und 1,4 17,5 und 24,0 cm

Detailed U-values of exterior wall constructions in Poroton construction, see following pages!

U$_{AW}$-Values of single and multi-shell exterior walls

Product range / Characteristics

Product name	Admission	Gross density [kg/dm³]	Thermal conductivity λ W/(mK)
Poroton-T7-P/-MW*	Z-17.1-1103/-1060*	0,60/0,55*	0,07
Poroton-T8-P/-MW*	Z-17.1-982/-1041*	0,60/0,65*	0,08
Poroton-T9-P	Z-17.1-674	0,65	0,09
Plan-T8	Z-17.1-1085	0,60	0,08
Plan-T9	Z-17.1-890	0,65	0,09
Plan-T10	Z-17.1-889	0,65	0,10
Poroton-S8-P/-MW*	Z-17.1-1120/-1104*	0,75	0,08
Poroton-S9-P/-MW*	Z-17.1-1058/-1100*/-1145*	0,70/0,90*/-0,80*	0,09
Poroton-S10-P/-MW*	Z-17.1-1017/-1101*	0,75/0,80*	0,10
Plan-T12	Z-17.1-877	0,65	0,12
Plan-T14	Z-17.1-651	0,70	0,14
Plan-T18	Z-17.1-678	0,80	0,18
HLZ-Plan-T	Z-17.1-868/-1108/-1141	0,9/1,2/1,4	0,42/0,50/0,58

* Mineral wool filled

Single-shell external masonry plastered on both sides:

Product name	Thermal conductivity (W/mK) DM-Thin-bed mortar LM-Lightweight masonry mortar	U-values (W / m²K) according to DIN EN ISO 6946 (1996-11)for wall thickness in cm			
		30,0	36,5	42,5	49,0
T7-P/-MW	0,07 mit DM	–	0,18	0,16/0,15[2]	0,14
T8-P/T8-MW	0,08 mit DM	0,25	0,21	0,18	0,16/0,15[2]
T9-P/Plan-T9[1]	0,09 mit DM	0,28	0,23	0,20	–
S8-P/-MW	0,08 mit DM	–	0,21	0,18	0,16
S9-P/-MW	0,09 mit DM	0,28	0,23	0,20	–
S10-P/-MW	0,10 mit DM	0,31	0,26	0,22	–
Plan-T8	0,08	–	0,21	0,18	0,15[3]
Plan-T9	0,09	0,28	0,23	0,20	–
Plan-T10[1]	0,10 mit DM	0,31	0,25	–	–
Plan-T12[1]	0,12 mit DM	0,36	0,30	0,26	0,23
Plan-T14/Block-T14	0,14 mit DM/LM 21	0,42	0,35	–	–

[1] with mineral. Fiber lightweight plaster (λ = 0,22 W/mK) [2] 4,0 cm insulating plaster (λ = 0,07 W/mK)
[3] Wall thickness 50,0 cm

Two-shell external masonry with core insulation and. plastered masonry shell

product recommendation	Wall thickness brick in cm	Thermal conductivity (W/mK)	U-values * (W / m²K) according to DIN EN ISO 6946 (1996-11) Insulation thickness in cm (= 0.035 W / mK) Masonry after DIN 1053-1 (Shells distances up15,0 cm)		
			10,0	12,0	14,0
Plan-T14	24,0	0,14 mit DM	0,20	0,18	0,16
Plan-T18	17,5	0,18 mit DM	0,23	0,20	0,18
	24,0		0,21	0,19	0,17
HLz-Plan-T 0,9	17,5	0,42 mit DM	0,26	0,23	0,20
	24,0		0,25	0,22	0,20

* Influence of fasteners 5 pieces / m² is taken into account

Multi-shell exterior masonry with ETICS

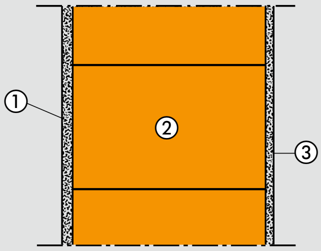
Product recommendation	Wall thickness Brick in cm	Thermal conductivity (W/mK) DM-Thin-bed mortar NM-Normal mortar	U-values * (W / m²K) after DIN EN ISO 6946 (1996-11) Insulation thickness in cm (= 0.035 W / mK)				
			10,0	12,0	14,0	16,0	20,0
HLz-Plan-T 0,9 **HLz-Block-T 0,9**	17,5	0,42 mit DM/NM	0,29	0,25	0,22	0,20	0,17
	24,0		0,28	0,24	0,22	0,19	0,16
HLz-Plan-T 1,2 **HLz-Block-T 1,2**	15,0	0,50 mit DM/NM	0,30	0,26	0,23	0,21	0,17
	17,5		0,29	0,25	0,23	0,20	0,17
	24,0		0,28	0,24	0,22	0,20	0,16
HLz-Plan-T 1,4 **HLz-Block-T 1,4**	17,5	0,58 mit DM/NM	0,30	0,26	0,23	0,20	0,17
	24,0		0,29	0,25	0,22	0,20	0,17

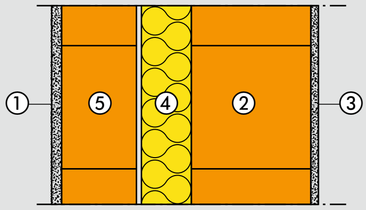
* Influence of the lanyard 5 pieces / m² is taken into account

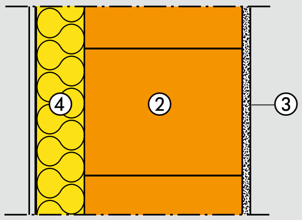
The design values of thermal conductivity for plasters, insulating materials and thermal insulation composite systems may differ. Please take the respective manufacturer information into account.

Wall constructions

① External render 2,0 cm,
Mineral light plaster,
λ 0,31 W/(mK)
② Poroton block, Thick and λ
according to tables
③ Internal plaster 1,5 cm,
Lime gypsum plaster,
λ= 0,70 W/(mK)
④ Insulation,
Thickness according to tables,
λ= 0,035 W/(mK)
⑤ Facing wall11,5 cm
ZWP-Plan-T 0,8 oder
ZWP-Block -T 0,8 λ= 0,39 W/(mK)





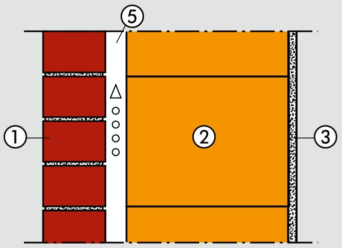


U_{AW}-Values bivalve exterior walls with facing brick

Two-shell exterior masonry with air layer

Product recommendation	Thermal conductivity (W/mK)	U-values * (W / m²K) according to DIN EN ISO 6946 (1996-11) for wall thicknesses in cm	
		30,0	36,5
T8-P/-MW/S8-P/-MW	0,08 mit DM	0,25	0,21
T9-P/S9-P/S9-MW	0,09 mit DM	0,28	0,24
S10-P/S10-MW	0,10 mit DM	0,31	0,25
Plan-T8	0,08 mit DM	–	0,21
Plan-T9	0,09 mit DM	0,28	0,24
Plan-T10	0,10 mit DM	0,31	0,25

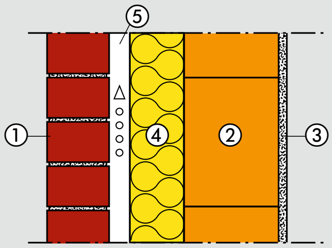
*Influence of the lanyard 5 pieces / m² is taken into account.
Due to the ventilation openings required in accordance with DIN 1053-1, this design falls under the definition of "highly ventilated". The air layer and the facing skin are thus not taken into account in the calculation.



Two-shell exterior masonry with air layer and thermal insulation

Product recommendation	Wall thickness Block in cm	Thermal conductivity (W/mK)	U-values * (W / m²K) according to DIN EN ISO 6946 (1996-11) Insulation thickness in cm (= 0.035 W / mK)		
			DIN 1053-1	Air layer anchor with building inspectorate approval	
			10,0	12,0	14,0
S9-P/S9-MW	30,0	0,09 mit DM	0,16	0,15	0,14
T8-P/-MW/S8-P/-MW	30,0	0,08 mit DM	0,15	0,16	0,14
T8-MW	24,0	0,08 mit DM	0,16	0,15	0,14
S10-P/S10-MW	30,0	0,10 mit DM	0,17	0,16	0,14
Plan-T14	24,0	0,14 mit DM	0,21	0,19	0,17
Plan-T18	17,5	0,18 mit DM	0,24	0,22	0,20
	24,0		0,23	0,21	0,19
HLz-Plan-T 0,9	17,5	0,42 mit DM	0,28	0,24	0,22
	24,0		0,27	0,23	0,21
HLz-Plan-T 1,2	17,5	0,50 mit DM	0,29	0,25	0,22
	24,0		0,28	0,24	0,22
HLz-Plan-T 1,4	17,5	0,58 mit DM	0,29	0,25	0,23
	24,0		0,28	0,24	0,22

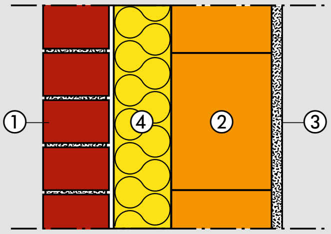
*Influence of the lanyard 5 pieces / m² is taken into account.
Due to the ventilation openings required in accordance with DIN 1053-1, this design falls under the definition of "highly ventilated". The air layer and the facing skin are thus not taken into account in the calculation.



Two-shell exterior masonry with core insulation

Product recommendation	Wall thickness Block in cm	Thermal conductivity (W / mK) DM thin-bed mortar LM light-wall mortar NM standard mortar	U-values * (W / m²K) according to DIN EN ISO 6946 (1996-11) Insulation thickness in cm (= 0.035 W / mK)				
			Masonry after DIN 1053-1 (Shells distances up 15,0 cm)			Air layer anchor with building authority approval	
			10,0	12,0	14,0	16,0	18,0
T8-MW	24,0	0,08 mit DM	0,16	0,14	0,13	–	–
Plan-T12	24,0	0,12 mit DM	0,19	0,18	0,16	0,15	0,14
Plan-T14/Block-T14	24,0	0,14 mit DM/LM 21	0,20	0,18	0,17	0,15	0,14
Plan-T16	17,5	0,16 mit DM	0,23	0,21	0,19	0,17	0,16
Plan-T18 **Block-T18**	17,5	0,18 mit DM/LM 21	0,24	0,21	0,19	0,17	0,16
	24,0		0,22	0,20	0,18	0,16	0,15
Block-T21	17,5	0,21 mit LM 21	0,24	0,22	0,19	0,18	0,16
	24,0		0,23	0,20	0,18	0,17	0,15
HLz-Plan-T 0,9 **HLz-Block-T 0,9**	17,5	0,42 mit DM/NM	0,26	0,24	0,21	0,19	0,17
	24,0		0,25	0,23	0,20	0,18	0,17
HLz-Plan-T 1,2 **HLz-Block-T 1,2**	15,0	0,50 mit DM/NM	0,27	0,24	0,22	0,19	0,18
	17,5		0,27	0,24	0,21	0,19	0,17
	24,0		0,26	0,23	0,21	0,19	0,17
HLz-Plan-T 1,4 **HLz-Block-T 1,4**	17,5	0,58 mit DM/NM	0,27	0,24	0,22	0,19	0,18
	24,0		0,26	0,24	0,21	0,19	0,17

* The influence of fasteners 5 pieces / m² is taken into account.



Wall constructions

① Terca-**Facing Bricks**11,5 cm,
Gross density 1,6,
λ= 0,68 W/(mK)
② Poroton-**Block, Thick and** λ
according to tables
③ **Plaster** 1,5 cm, **Lime gypsum plaster,**
λ= 0,70 W/(mK)
④ **insulation,**
Thickness according to tables
λ= 0,035 W/(mK)
⑤ **layer of air** ≥ 4,0 cm, **heavily ventilated**

The design values of thermal conductivity   for plasters, insulating materials and thermal insulation composite systems may differ. Please take the respective manufacturer's information into account.

Summer heat protection

The summer temperature behavior is of great importance for a pleasant indoor climate and a high level of living comfort. According to the EnEV, it has to be proven that in the summer overheating of rooms is avoided. The calculation is carried out in accordance with updated DIN 4108-2 (2013 - 2), DIN EN ISO 13791 and 13792 and is greatly simplified. In this case, the existing sun input characteristic value Svorh must not exceed the admissible sun entry characteristic value Szul.

By observing the sun input characteristic value Szul, it should be ensured under standard conditions that a certain limit room temperature is not exceeded by more than 10 percent of the residence time. This limit temperature depends on the climatic location and thus on the average monthly temperature of the hottest month of the year. There are three summer climatic regions A, B and C in Germany: summer-cool, temperate and summer-hot areas.

The permissible sun input characteristic value S_{zul} results from the addition of the proportionate sun input parameters S_x:

- for the climate region (A, B or C)
- for the type of construction (light, medium or heavy)
- forapossibleemergencyventilation
- for any sunblind glazing, window inclination and orientation The proportional sun load characteristics can be found in DIN 4108-2.

The existing sun input characteristic value is calculated according to the formula: $S_{vorh} = \Sigma_j (A_{w,j} \cdot g_j \cdot F_{c,j})/A_G$

With: A_w = window area[m²]
g = Total energy transmittance of the glass [-] (manufacturer)
F_c = Reduction factor of a sun protection device [-] (table value)
A_G = Net floor area of the room [m²]

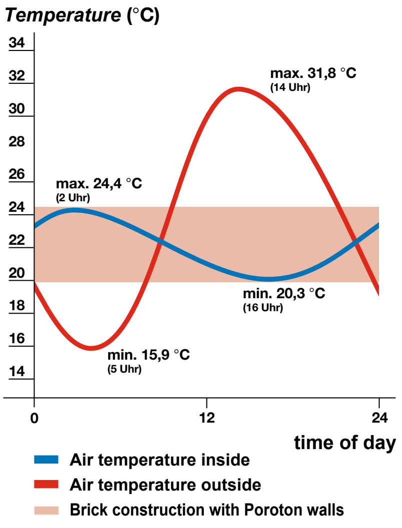
The indoor air temperature on hot summer days is primarily dependent on the window surfaces and their direction of the sky. Only through the additional, cost-intensive installation of external sun protection devices, such as roller shutter boxes or shutters, the room air temperature can be positively influenced. Due to their high heat storage capacity, Poroton bricks compensate for summerly temperature peaks and in this way harmonize the room temperature.

In the room-by-room calculation of the sun input characteristic value Svorh, the massive brick construction has an advantageous effect. The heavy components absorb the heat energy in the summer rapidly rising air temperatures and cool the room. This effect is known to anyone who in the warm season once a building with thick walls, z. B. a church or castle has entered.

Residential spaces enclosed by Poroton brickwork interior and exterior walls can generally be classified as medium or heavy in design.

In the case of residential and residential buildings, proof of summer thermal insulation canbedispensedwith,iftheroomareaorroomgroup-wisereferredtoinDIN4108-2,Tab. 6,referstothenetfloorarea f_{HWG}, not be exceeded.

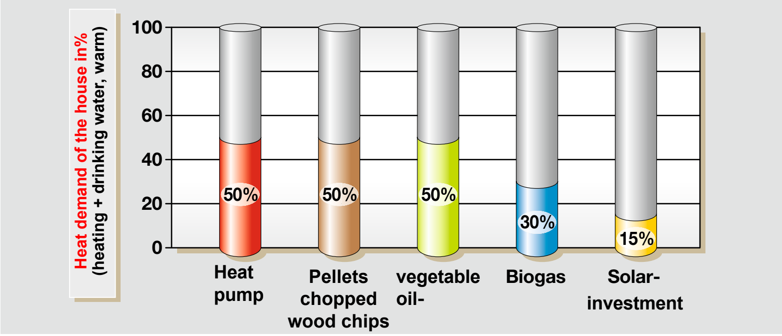
Even at high outside temperatures, the living room temperature with walls made of Poroton remains relatively constant!



Renewable Energy Heat Act (EEWärmeG)

Since January 2009, the "Renewable Energy Heat Act", shortly EEWärmeG, came into force and was amended in 2011. For new residential and non-residential buildings, this law requires the proportionate use of renewable energies to cover the heat energy requirement. The EnEV takes these legal requirements into account in the definition of the plant parameters of the reference building. In addition to the central hot water preparation via the heating heat generator, an improved condensing boiler technology, an additional solar system is defined as the reference standard for DHW heating.

In addition to solar radiation, the EEWärmeG shows other renewable energies, taking into account the corresponding minimum coverage. The following graphic gives an overview.



In general, both quantitative and qualitative requirements are placed on the respective energy sources and their use. Due to the complexity, the following list only covers a few examples.

Solar radiation energy

- Coverage is considered fulfilled if:
  - for residential buildings ≤ 2 WU 0.04 m collector surface / effective area A_N
  - for residential buildings> 2 WU 0.03 m collector surface / effective area A_N can be arranged.
- Use of certified solar collectors

Solid biomass

- Use of pellets, wood chips or firewood in accordance with the ordinance about small and medium combustion plants
- Plant engineering in accordance with the requirements of the BimSchV
- Limitation of boiler efficiency depending on the boiler output
- Certification of a specialist required

Geothermal and environmental heat

- Restriction of annual employment figures
  - Air / water and air / air heat pump ≥ 3.5
  - brine / water and water / water heat pump ≥ 4.0
- Deviating annual work figures are permissible if hot water preparation for the most part via the heat pump or other renewable energy
- Use of heat pumps with heat meter
- Certification of a specialist required

The EEWärmeG enables a combination of different renewable energies and utilization technologies. If the legal requirements for compulsory use are not met, the legislator has formulated alternative measures. An overview is given here.

Alternative measures (Exemption):

Ventilation systems with heat recovery

- Heat recovery rate ≥ 70%
- Covering share of heat energy requirement ≥ 50%
- System performance number ≥ 10

Highly efficient combined heat and power plants (CHP plants)

– Coverage share of heat energy requirement ≥ 50%

Heatenergydemand directlyfromlocaldistrict heatingsupply

– Heat generation for the most part from renewable energies or
– Heat generation of at least ≥ 50% from combined heat and power plants (CHP plants)

Measures to save energy by improving the insulation standard of the building envelope

– Reduction of the annual primary energy demand Q "p and the maximum permissible transmission heat loss H'T by at least 15%.

Normative requirements / condensation protection

The moisture protection is treated in DIN 4108-3.
This standard contains

– Requirements for the condensation protection of components for recreation rooms
– Recommendations for the impact rain protection of walls as well
– Moisture protection information for planning and execution of Buildings.

The requirements, recommendations and instructions of DIN 4108-3 limit the effect of condensation and driving rain on construction constructions in order to avoid damage.

Dew-water protection - condensation formation inside components

According to DIN 4108-3, condensation in components is harmless if the heat protection and the stability of the components are not endangered by increasing the moisture content of the construction and insulation materials. This is the case if the following conditions are met:

- The accumulated during the dew period inside the component water must be released back to the environment during the evaporation phase can.
- The building materials that come into contact with condensation must not be damaged (eg fungal infestation etc.).
- For roof and wall constructions may be a Tauwassermasse of total 1.0 kg / m² should not be exceeded.
- Occurs condensation water at contact surfaces of capillary not water receptive Layers on, so must not be exceeded to limit draining or dripping a dew amount of 0.5 kg / m².
- In the case of wood, an increase of more than 5% in the moisture content by mass and by more than 3% in the case of wood-based materials is inadmissible.

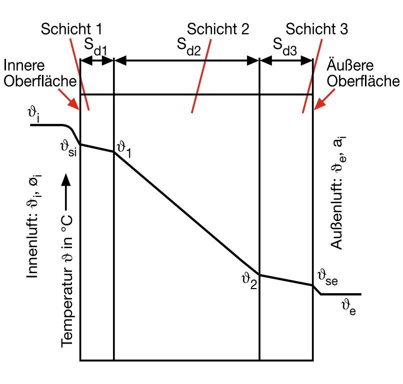
External walls, for which no computational proof of condensation water loss due to vapor diffusion is required with sufficient heat insulation according to DIN 4108-2, are eg. B .:

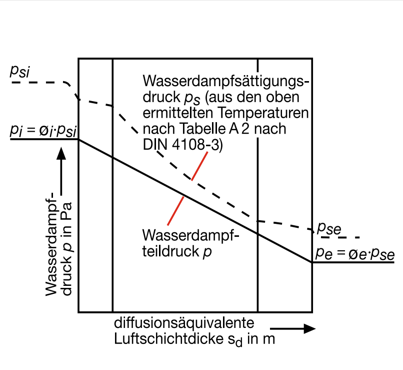
- Masonry according to DIN 1053 made of Poroton bricks without additional thermal insulation layer as a single or double-shell masonry, veneered or plastered
- as well as double-shell masonry with air layer according to DIN 1053-1, without or with additional thermal barrier coating.

The calculation of the amount of condensation water shall be carried out according to Part 5 of DIN 4108, using the "Glaser diagram" for the calculation.

- For defined climatic or boundary conditions, the temperature profile in the Component calculated.
- The temperatures at the surfaces and separating layers are vapor saturation pressure and water vapor partial pressure determined.
- The course of the water vapor pressure curves is shown graphically.
- Based on the curves can be determined whether and in which area of the component the dew water mass WT fails during the condensation period.
- The evaporating water mass Wv, which can be carried out again from the component, is calculated over the duration of the evaporation period.

➔ Condensation occurs when the partial pressure of water vapor in the interior of a component reaches the water vapor saturation pressure.





Schematic representation of the Course of the temperature, the water vapor saturation and partial pressure through a multi-layered component to determine any condensation water loss (in the example, the cross section remains dew-free).

Diffusion properties of brick walls

For the following single and double-shell Poroton exterior wall constructions, dew water calculations according to DIN 4108-5 have been carried out.

		Dew period (Winter)		Evaporation period (summer)	
		Inside	**Outside**	**Inside**	**Outside**
airtemperature	°C	20,0	-10,0	12,0	12,0
Relative humidity	%	50	80	70	70
Water vapor saturation pressure	Pa	2340	260	1403	1403
Watervaporpartialpressure	Pa	1170	208	982	982
Duration of the period	hours	1440		2160	

Konstruktion 1: **Einschaliges Poroton-Mauerwerk**

Characteristics: **U = 0,23 W/m²K** **R_T = 4,17 m²K/W**	**Thermal conductivity - λ**	**thickness d**	**Diffuse number m**	**Diffuse resistance s_d**	**temperature T**	**Saturated-vapor-pressure p_s**	**before steam pressurep**
Wall construction:	W/mK	m	–	m	°C	Pa	Pa
Heattransferresistance Inside R_{si} = 0,13 m²K/W	–	–	–	–	20	2340	1170
					19,1	2212	
1 Lime plaster	0,70	0,015	15	0,23			
					18,9	2192	
2 Poroton-T 9 with DM	0,09	0,365	5	1,83			
					-9,2	282	
3 mineral light plaster	0,31	0,020	10	0,20			
					-9,7	268	
Heattransferresistance Outside R_{se} = 0,04 m²K/W	–	–	–	–	-10	261	209
			Σs_d =	2,25			

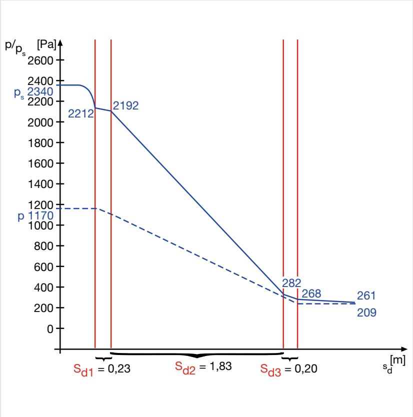
The precipitating amount of condensate is 200 g / m² and year and is well below the evaporation rate of 1984 g / m² and year. The annual balance is positive, the wall construction is almost free of condensation.

Construction 2: **Two-shell faced masonry with core insulation**

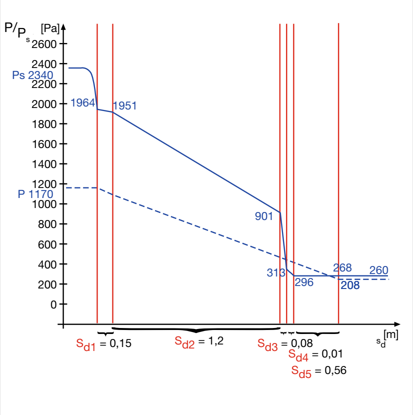
Characteristics: **U = 0,23 W/m²K** **R_T = 4,18 m²K/W**	**Thermal conductivity λ**	**thickness d**	**Diffuse number m**	**Diffuse resistance s_d**	**temperature T**	**Saturated-vapor-pressure p_s**	**before steam pressure p**
Wall construction:	**W/mK**	**m**	**–**	**m**	**°C**	**Pa**	**Pa**
Heattransferresistance Inside R_{si} = 0,13 m²K/W		–	–	–	20,0	2340	1170
					17,2	1964	
1 Lime plaster	0,70	0,015	10	0,15			
					17,1	1951	
2 Planziegel-T14 mit DM	0,14	0,240	5	1,20			
					5,5	901	
3 Fiber insulation after DIN 18165 WLG 035	0,040	0,080	1	0,80			
					-8,0	313	
4 Air (standing), vertical WLG 035	0,08	0,010	1	0,10			
					-8,6	296	
5 Strangverblender (1600 kg/m³)	0,68	0,115	5	0,56			
					-9,7	268	
Heat transfer resistance outside R_{se} = 0,04 m²K/W		–	–	–	-10,00	260	208
			Σs_d =	2,0			

The precipitating amount of condensate with 374 g / m² and year is below the permissible limit of 500 g / m² and year according to DIN 4108-1.
The evaporation amount is 1476 g / m² and year, so that in summer the amount dries out completely. The annual balance is positive.

➔ From a diffusion point of view, the examined exterior wall constructions are classified as harmless.



Graphic pressure curve construction 1
Examination of moisture protection
Glaser diffusion diagram Part:
Exterior wall, Poroton-T 9
d = 36,5 cm



Graphic pressure curve construction 2
Examination of moisture protection
Diffusion diagram according to Glaser Component: Two-shell veneer masonry with core insulation

Conclusion: For single-shell exterior wall constructions, the cross-section remains i. d. R. Dew-free.

Temperature regulation

Exterior components are generally exposed to strong temperature fluctuations.

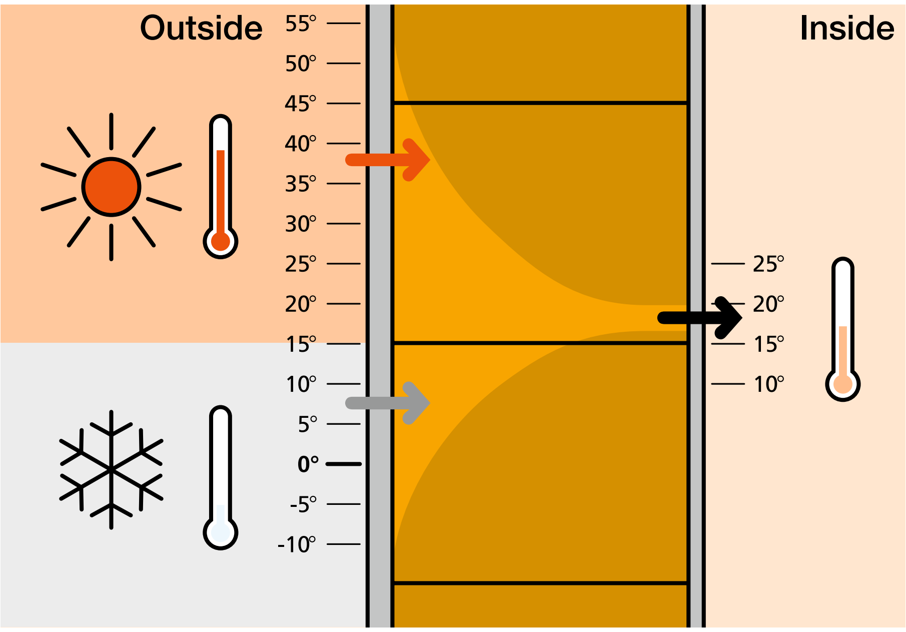
The lower graph shows that

- Brick wall constructions optimally dampen large outdoor temperature fluctuations due to stronger solar radiation and thus

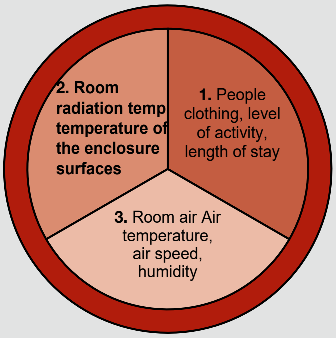
- ensure a pleasant indoor climate with a balanced temperature level in the building interior.

It becomes clear that the heat storage capacity of Block wall constructions is exemplary.

Damming property and heat retention property of Poroton blocks



On hot summer days, the clay block wall stores the heat during the day and only releases it when it cools in the evening.
In winter, the high thermal insulation keeps cold from the outside. Due to their good heat storage, the clay block wall ensures that the rooms cool off slowly at night and warm up quickly in the morning.



Thermal comfort

Conclusion: Clay block thus have a climate and humidity regulating and remove the mold fungus any breeding ground.
Building with clay has always created comfortable comfort, pleasant indoor climate with uniform room temperature and balanced indoor humidity.


Poroton
Wandlösungen
Kleine Bauphysik-Kunde
Grundwissen
Wienerberger

More information can be found in our „Kleinen Bauphysik-Kunde“.

Heat storage capacity

Walls made of Poroton brick have the property, in addition to the increased heat protection without additional insulation to provide appropriate heat storage capacity. The heat storage capacity is calculated from the material bulk density, material thickness and the specific heat capacity per degree of temperature difference according to the equation: **$Q = d \cdot \rho \cdot c$ [kJ/(m²K)]**

Brickstrawdensity kg/dm³	Heat storage capacity Q in kJ/m²K at wall thicknesses of						
	11,5 cm	17,5 cm	24,0 cm	30,0 cm	36,5 cm	42,5 cm	49,0 cm
0,6	69	105	144	180	219	255	294
0,65	75	114	156	195	237	276	319
0,7	81	123	168	210	256	298	343
0,75	86	131	180	225	274	319	368
0,8	92	140	192	240	292	340	392
0,9	104	158	216	270	329	383	441
1,0	115	175	240	300	365	425	490
1,2	138	210	288	360	438	510	588
1,4	161	245	336	420	511	595	686
1,6	184	280	384	480	584	680	784

For both-sided 1.5 cm thick plaster, 51 kJ / (m² K) should be added.

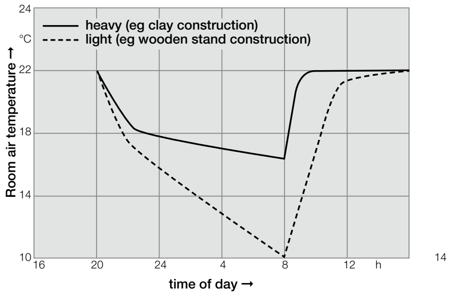
From cool times

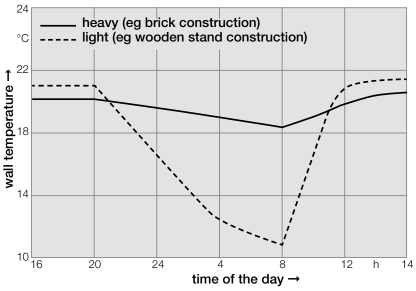
For a comfortable living climate, it is important that the heat energy is stored as long as possible in the masonry and released only slowly. This process is defined by the cooling time. Homes are the more comfortable, the longer their cooling time lasts. In comparison, clay block have the longest cooling times among wall building materials. The cooling time is calculated in hours according to the equation: **$t_a = Q \cdot R \cdot 3{,}6^{-1}$ [h]**

	Gross density class	λ (W/mK)	Cooling times in h at wall thicknesses of					
			17,5 cm	24,0 cm	30,0 cm	36,5 cm	42,5 cm	49,0 cm
Clay block	0,60	0,08	64	120	188	278	376	500
Clay block	0,65	0,09	61	116	181	267	362	481
Clay block	0,65	0,10	55	104	163	241	326	433
Clay block	0,65	0,12	46	87	135	200	274	364
Clay block	0,7	0,14	43	80	125	185	251	333
Clay block	0,75	0,16	40	75	117	173	235	312
Clay block	0,8	0,16	43	80	125	185	251	333
Clay block	0,8	0,18	38	71	111	164	223	296
Clay block	0,9	0,21	32	61	95	141	191	254
aerated concrete	0,4	0,11	31	58	91	135	182	243
Sand-lime stone	1,4	0,70	17	32	50	74	100	133

Cooling a room

Room air and wall temperatures in a room of heavy and light construction during one day period with a 12-hour night setback of the heating in average winter outdoor conditions (outside air temperature -2 ° C).





Source: Lutz, u. a. "Textbook of Building Physics" Teubner

Q = Heat storage capacity [kJ/(m²K)]
d = Wall thickness [m]
ρ = specific weight [kg/m³]
c = specific heat capacity [kJ/(kg K)]

Specific heat capacity c	
Building material	**J/(kgK)**
Inorganic building and insulation materials (bricks)	1000
Wood and wooden materials	2 100
Vegetable fibers and textile fibers	1 300
Foamed plastics and plastics	1 500
Aluminium	800
Other metals	400
Air (r = 1,25 kg/m³)	1 000
Water	4 200

t_a = cooling time [h]
Q = Heat storage capacity [kJ/(m²K)]
R = Thermalresistance [m²K/W]

Wienerberger
Building Material Solutions

Practical moisture content

Building materials are exposed to the influence of moisture. The practical moisture content is also referred to as the hygroscopic water content of building materials, which is expressed as a percentage by volume or mass. The drier a building material is, the lower its thermal conductivity, or the better the thermal insulation effect.

Poroton bricks have a very low practical moisture content of only about 0.5 mass percent compared to binder-bound building materials (concrete, lightweight concrete, aerated concrete and sand-lime bricks). The reported values of the thermal conductivity are related to the practical moisture content of the building materials. On the whole, bricks have the lowest practical moisture content among the wall building materials.

Practical moisture content of building materials

building material	Practical moisture content by volume (u_v %)	Practical moisture content in mass, (u_m%)
Clay block[1]	1,5	–
Lime sandstones	5,0	–
Concrete with a closed structure with dense aggregates	5,0	–
Concrete with a closed structure with porous aggregates	15	–
Lightweight concrete with a porous structure with dense aggregates according to DIN 4226 Part 1	5,0	–
Lightweight concrete with a porous structure with porous aggregates according to DIN 4226 Part 2	4,0	–
aerated concrete	3,5	–
Mineral fiber insulation from glass, stone, blast furnace slag (huts) fibers	–	1,5
Vegetable fiber insulation from seaweed, wood, peat and coconut fibers and other fibers	–	15

[1] Good quality monitoring tests have shown that Poroton bricks generally have a practical moisture content of <0.5%.

Insulation behavior of masonry in case of moisture penetration

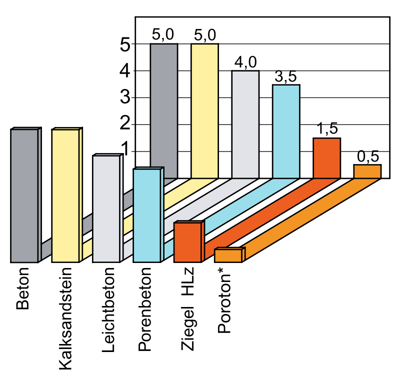
Moisture greatly reduces the insulating effect of wall materials, eg. For example, even 4% more volume moisture can worsen the insulating effect of porous, mineral wall materials by 50%.

For thermal insulation, it is crucial that the building material retains its insulating capacity even under changing humidity conditions and, if it should have become wet once (condensate moisture, driving rain moisture), dehumidifies as quickly as possible. Capillary-conductive Poroton bricks are far superior to other building materials in this respect.

Due to their openness to diffusion and capillary conductivity, Poroton bricks absorb excess indoor air humidity and then release it continuously.

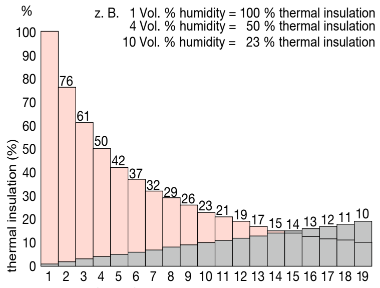
In addition, bricks due to capillary conductivity dehumidify faster than other materials that release moisture only by diffusion.

Practical moisture content according to DIN 4108 in% by volume of some wall building materials in comparison



* Poroton - Leicht-HLz nach Zulassung

Insulation behavior of masonry in case of moisture penetration



Source: After S. Cammerer, Munich

Drying behavior

moisture sources

	Moisture delivery per day
Human	1,0 – 1,5 Liter
Cook	0,5 – 1,0 Liter
Showering, bathing (per person)	0,5 – 1,0 Liter
Tumble drying (4.5 kg) thrown soaking wet	 1,0 – 1,5 Liter 2,0 – 3,5 Liter
Room flowers, potted plants	0,5 – 1,0 Liter

Moisture and thermal insulation

Moisture can greatly reduce the thermal insulation effect of a building material. For the thermal behavior of a wall construction, therefore, not only the thermal insulation is crucial, but also the maintenance of the thermal insulation properties of the building materials under the influence of moisture. Since an external wall can always become humid due to weather conditions and, if necessary, thawing, a rapid drying behavior of the construction is of crucial importance. Ziegelmauerwerk dehumidifies faster than coarse-pored material, such as porous concrete or very dense material, such as heavy concrete or limestone sandstone due to its Kapillarleitfähigkeit.

Drying behavior

The drying behavior of the building materials is, in addition to the external climatic conditions, also influenced more or less by the residential operation. Dehydration is accelerated by consequent ventilation and heating in general, delayed by strong water vapor content without ventilation and heating, possibly even prevented or reversed.

The dehydration time in days can be approximated by Cadiergues for comparison purposes with the formula $\mathbf{t = s \cdot d^2}$ estimated.

Here is: d = Wall thickness in cm, s = Building material parameter in days/cm²

From this it can be deduced that bricks reach by far the shortest desiccation times compared to other wall building materials.

Example * clay block wall

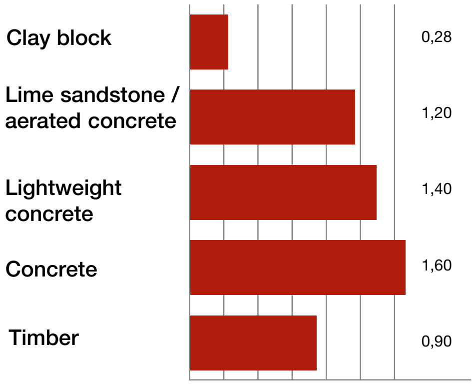
d = 36,5 cm $t = 0{,}28 \cdot 36{,}5^2 = 373$ Days

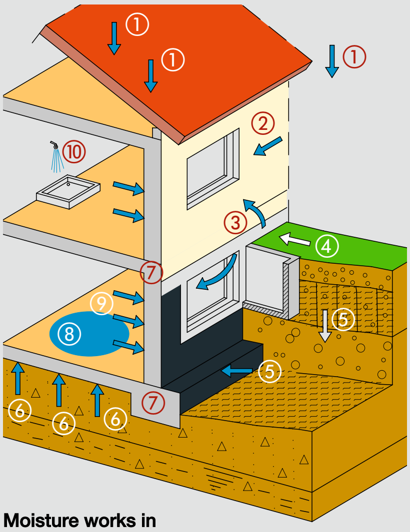
Conclusion: Block masonry dries out after approx. One year according to this approximation formula.

Example dehydration time

Building material parameter s * in days / cm²

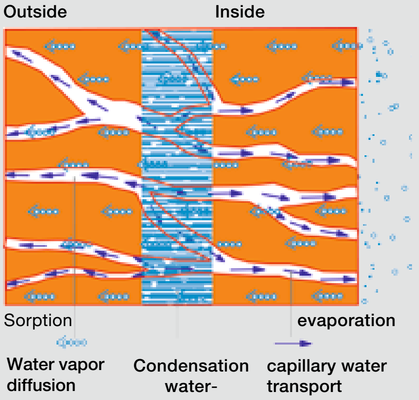
* The stated values are only valid under stationary boundary conditions and can be used for comparison purposes. However, they do not represent physical absolute values.





Moisture works in multiple shape on the components

① Precipitation (rain, snow, ice)
② Driving rain
③ Spray water
④ Surface water
⑤ Laying water, backwater
⑥ Soil moisture
⑦ Capillary water, condensation water in the component
⑧ Pore water, flood, day water
⑨ Room air temperature and relative humidity
⑩ Steam (cold + hot)



Building physics
Soundproofing

Soundproofing

The term "structural sound insulation" is understood to mean measures that reduce a sound transmission emanating from a sound source outside or inside a building. The sound insulation by components is claimed by the resident at any time by perceiving the ambient noise from the neighboring apartment or from the outside more or less insulated. Thus, structural sound insulation is one of the most important criteria for the quality assessment of a dwelling house or an apartment.

Sound

Sound refers to mechanical vibrations and waves of an elastic medium, in particular in the frequency range of human hearing of about 16-20,000 hertz. It is distinguished between airborne and structure-borne noise.

Airborne sound

Airborne sound is the propagation of sound waves in a gaseous medium. When meeting the airborne sound waves on a component this is also excited to vibrate. In the component while the sound is transmitted as structure-borne noise and attenuated by the resistance of the component on the other wall side again released as airborne sound. This resistance is referred to as airborne sound insulation of a component. Depending on their construction and their weight, components can have very different airborne sound insulation dimensions.

Structure-borne sound

Structure-borne noise is the propagation of sound in solids or on their surfaces. The suggestion is z. As by noise through wall installations, closing noise of doors, etc., which put the component in vibration, which in turn produce airborne sound.

Footfall

Impact sound is a type of structure-borne noise, the z. B. caused by walking on ceiling slabs. For such ceiling components, resistance values are also defined as impact sound insulation dimensions.

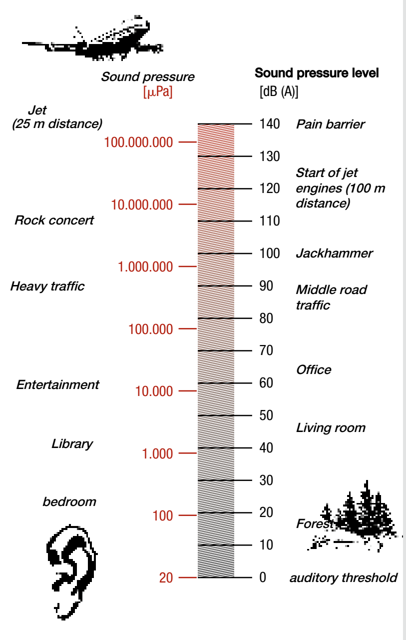
Soundproofing

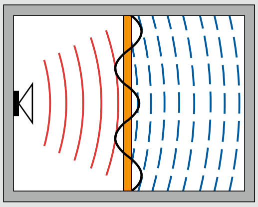
The sound insulation of solid walls depends primarily on the weight per unit area. The area-related mass of the wall results from the thickness of the wall and its density. Additional factors are z. B. masonry openings, plaster application and connection details. As a rule, the sound insulation value of the mas-siv wall is better than that of doors and windows. A hole in the separating surface destroys the protection. In double-skin (double-skinned) partition walls, an unintentional connection (eg mortar bridge) is sufficient to render the protection ineffective.

Normative requirements

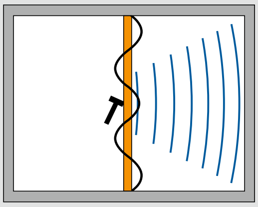
According to building regulations, DIN 4109: 1989 so far stipulates the minimum sound insulation between third-party areas of use. These minimum requirements must not be undercut. Deviating from this, a higher sound insulation can be required if desired. Suggestions for increased sound insulation are provided in Supplement 2 to DIN 4109: 1989 or the VDI Guideline 4100. The requirements defined there must i. d. R. be expressly agreed. There are also suggestions for sound insulation in our own area of use. The minimum requirements of o. A. Norms are not sufficient for apartments and residential buildings, which are marketed under the term "comfort". In any case, the increased sound insulation should be planned and executed here.

Examples of sound pressure and levels of different sounds





Airborne sound stimulation



Structure-borne stimulation

In the event of any acoustic interference occurring, it is necessary to clarify, before taking corrective measures, whether the walls or ceilings will be stimulated in the form of airborne sound or body sound.

What is loud?

Subjectively, noise is perceived to be twice as loud when the sound level increases by 10 dB (A). With very quiet noises, however, a substantially smaller increase is sufficient.

Sound insulation

The **sound insulation index R** describes the airborne sound insulation of components and is calculated from the sound level difference between the so-called transmission room as the emission source and the reception room.

The weighted **sound reduction index Rw** is the single number indication of the sound insulation index for easy identification of the sound insulation of building components. It contains no influence from flank components, which is recorded separately as a bypass transmission and is therefore also referred to as a so-called direct sound insulation. The calculation is carried out according to DIN EN 12354.

The known from the previous practice **construction sound insulation R'w** is determined taking into account the Nebenwegsübertragung the Flankierenden components and thus, in contrast to the aforementioned Rw value is not a pure component characteristic.

As a **side away transfer** all forms of airborne sound transmission between two adjacent rooms are called, which do not take place directly over the separating component.

Sound longitudinal line

A not inconsiderable part of the sound energy is due to the design transmitted through the longitudinal sound conduction over flanking components. For this reason, flanking walls should always be sufficiently heavy and permanently stiff. By contrast, lightweight partition constructions that i. d. R. are not formed supporting, as far as possible decoupled by appropriate connection profiles.

Sound transmission

The resulting sound insulation R'w a separating component, eg. As a housing partition, is largely influenced by the flanking components such as exterior walls, interior walls and ceilings. Each separating component is limited by a total of 4 flanking components. This results in a total of 12 flanking sound transmission paths (Ff, Fd, Df) and the direct sound passage through the separating component (Dd). In the new calculation method, a total of 13 ways of transmitting sound are calculated separately and then summed up.

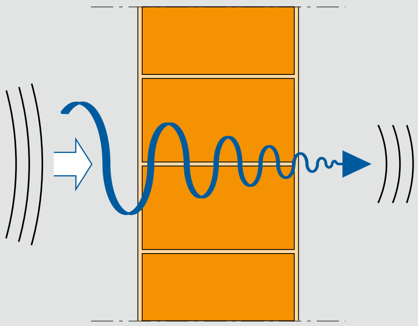
The **flank transmission** is transmitted as part of the secondary path transmission exclusively on the components flanking the separating component.

The **flank insulation mass** describes the related to the area of the separating component Schalldämmmaß on the respective transmission path.

Component connections between the separating component and its flanking components are referred to as joints and i. d. R. T- or cross-shaped. The type of execution of the compounds significantly affects their sound-absorbing effect.

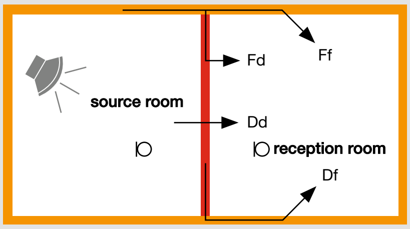
The joint insulation measure is part of the flank insulation and is based on the fact that a joint between the separating and flanking component, depending on the rigidity of the composite of the components and their mass ratios of the propagation of sound opposes.

The weighted standard sound level difference DnT, w characterizes airborne sound insulation between rooms in buildings and also serves to identify sound insulation between the outside environment and the interior. It can be calculated from the rated sound insulation value and the room dimensions of the reception room (area / volume).



Airborne sound insulation
- How much sound reaches the neighboring room?

Differenttransmissionpathsbetween tworoomsandtheirdesignation accordingtoDINEN12354-1orDIN 4109-NEW,wherebythepathDd denotesthedirecttransmissionviathe separatingcomponentandFf,Fdand Dftheflanktransmissionataflank component.



Normative requirements for separating components (DIN 4109, Nov. 1989)

The term "structural sound insulation" is understood to mean measures that reduce a sound transmission originating from a sound source outside or inside a building. Thus, the structural sound insulation is one of the most important criteria for the quality assessment of a residential building or apartment. According to the Building Code, DIN 4109 specifies the minimum sound protection between third-party areas of use. These minimum requirements must not be undercut. Deviating from this, a higher sound insulation can be required if desired. Suggestions for increased sound insulation are provided in Supplement 2 to DIN 4109 and the VDI Guideline 4100. The specifications defined there must i. d. R. be expressly agreed. For sound insulation in the own use area also only suggestions are defined.

Airborne soundproofing of walls to protect against sound transmission

Table 1: Foreign Living and Working Area - Normative Requirements
or suggestions for the increased sound insulation acc. DIN 4109

Components	* Requirements for assessed sound insulation R'_w (dB)	* Suggestions for increased sound insulation R'_w (dB)
1. Storey houses with apartments and work spaces: apartment partitions u.	53	≥ 55
Walls between foreign workstations Stairwell walls & walls next to hallways	52	≥ 55
Walls next to thoroughfares, driveways from collective garages u. Ä.	55	
Walls of play or similar common areas	55	
2. Single-family duplexes and one-family terraced houses: House partitions (apartment partitions)	57	≥ 67
3. Accommodations, hospitals, sanatoriums: Walls between accommodation or hospital rooms	47	≥ 52
Walls between corridors and accommodation or hospital rooms	47	≥ 52

* = Required airborne sound insulation of walls to protect against sound transmission from a foreign living and working area.
** = Proposals for increased airborne sound insulation of walls to protect against sound transmission from a foreign living u. Workspace.

Table 2: Own living and working area
Suggestions for normal and increased sound insulation acc. DIN 4109 Supplement 2

Components	Suggestions for normal sound insulation R'_w (dB)	Suggestions for increased sound insulation R'_w (dB)
1. Residential buildings: Walls without doors between loud and quiet rooms of different uses, eg. B. Living room 2. and children's bedroom	40	≥ 47
3. Office and administrative building: Walls between rooms with usual office work	37	≥ 42
Walls between corridors and rooms with standard office activity	37	≥ 42
Walls of rooms for concentrated mental activity or for the treatment of confidential matters, z. B. between management and anteroom	45	≥ 52
Walls between corridors and o. G. clear	45	≥ 52

Table 3: Requirements for the airborne sound insulation of components between "very noisy" rooms and rooms in need of protection

Kind of rooms	Rated sound insulation R'_w (dB) sound pressure level	
	L_{AF} = 75 bis 80 dB (A)	L_{AF} = 81 bis 85 dB (A)
Rooms with "very noisy" technical installations or parts of installations	57	62
Business premises of craft or commercial enterprises: Sales outlets Kitchen	57	62
rooms of the kitchen equipment of accommodation facilities, hospitals, sanatoriums, gas stations, snack bars and the like	55	
Kitchen rooms as before, but also after 22.00 o'clock in operation	57 *)	
Guest rooms, only until 22.00 o'clock in operation	55	
Guest rooms (Maximum sound level LAF ≤ 85 dB (A) also in operation after 10	62	
pm Rooms of bowling alleys	67	
Guest rooms (maximum sound level 85 dB (A) ≤ LAF ≤ 95 dB (A), z. B. with electro-acoustic equipment	72	

*) If it concerns commercial kitchens and overlying flats as rooms requiring protection, applies to erf. R'_w 62 dB.

R'_w Sound insulation

R'_w is the weighted sound reduction measure taking into account customary secondary roads

The evaluation of the sound insulation according to the new European calculation model according to E DIN 4109 is considered in this brochure starting on page 76.

Sound insulation in building construction DIN 4109, Nov. 1989

Excerpt - Requirements for air-sound insulation of walls to protect against sound transmission from a foreign living and working area.

House partition walls

According to the current state of the art, house partitions are designed as a two-shell construction. Depending on the foundation, the following soundproofing values are expected in accordance with the DGfM leaflet on sound insulation according to DIN 4109 (Berlin, 2006). These requirements will also be included in the new DIN 4109.

Partition situation	Conditions at R'_w (dB)
House dividing walls for living rooms located on the lowest floor (grounded or not) of a building	59
House partitions to stay rooms, under which at least 1 floor (grounded or not) of the building is present	62

Supplement 2, DIN 4109 (not officially implemented)

Excerpt - In some cases, one may exceed the requirements of DIN 4109 going beyond sound protection be desirable. Increased sound insulation of individual or all components according to the adjacent table must be expressly agreed between the client and the author of the draft, with reference to the regulations in DIN 4109 with regard to suitability and quality.

Determination of rated sound insulation $R'_{w, R}$

When demonstrating the soundinsulation of components, adistinction is made between single and multi-shell components. Single-shell components may consist of several firmly interconnected layers, such.B. plastered on both sides masonry exist. Solid bivalve components, separated with air and/or insulating layers, are, forexample, two-shellhouse partition walls or two-shell exterior walls with facing masonry.

Single-shell massive components

The sound insulation of a component results primarily from its area-related mass. However, the prerequisite is that the component has no disturbing defects or cavities. Pipe slots with slot widths up to 150 mm can reduce the sound insulation by 1 dB. Likewise mirror-symmetrically arranged sockets in apartment partitions can negatively influence the sound insulation.

The weighted sound reduction index $R'_{w,R}$ single-shell, rigid walls is according to Supplement 1 to DIN 4109 depending on its area-related mass m'_{ges} to investigate.

Table 4: Surface mass of wall plaster

column	1	2	3
row	plaster thickness	area based size m'_{Putz} von	
	mm	Lime plaster, gypsum plaster kg/m²	Lime plaster, lime cement plaster Cement plaster kg/m²
1	10	10	18
2	15	15	25
3	20	–	30

Table 5: Wall bulk densities of single-shell, rigid walls made of bricks and slabs (calculation values) depending on the masonry mortar

column	1	2	3
row	Stone / plate density	area based size m'_{Putz} von	
	kg/m^3	normal mortar kg/m^3	light mortar (density≤ 1000 kg/m^3) kg/m²
1	2200	2080	1940
2	2000	1900	1770
3	1800	1720	1600
4	1600	1540	1420
5	1400	1360	1260
6	1200	1180	1090
7	1000	1000	950
8	900	910	860
9	800	820	770
10	700	730	680
11	600	640	590
12	500	550	500
13	400	460	410

1) The values given are to be used for all formats of the stones or plates listed in DIN 1053 Part 1 and DIN 4103 Part 1 for the production of walls. Thickness of mortar joints of walls according to DIN 1053 Part 1.

Table 6: Reduction of the wall bulk densities for flat brick masonry

column	1	2	3
row	gross density	density	derating
1	> 1,0	> 1000 kg/m^3	100 kg/m^3
2	≤ 1,0	≤ 1000 kg/m^3	50 kg/m^3

DIN 4109, Supplement 1 Determination of the area-related mass

The area-related mass of the wall results from the thickness of the wall and its wall raw density (Table 5) as a function of the raw density of the bricks used and the masonry mortar. If applicable, a surcharge for single or double-sided plaster must be taken into account (Table 4).

The higher this mass, the better the soundproofing. If you want to do something good in the long term, you should bear in mind when planning that the noise level is constantly increasing and therefore make high demands of sound insulation.

Wall raw density

Table 5 contains calculated values of the wall bulk densities of masonry walls of different stone and slab densities with a Lagerfugenaus education in normal or light mortar.

To determine the area-related mass of seamless walls and walls of storey-high

Slabs can be expected in unreinforced concrete and reinforced concrete made of normal concrete with a density of 2300 kg / m³.

In the case of walls made of flat bricks walled in thin - bed mortar, the

To reduce apparent density according to Table 6.

The weighted sound insulation dimensions $R'_{w,R}$ Single-shell components become dependent on their area-related mass m'_{ges} specified in DIN 4109. These arithmetical values may only be used if the flanking components have an average surface mass $m'_{L, Mittel}$ of about 300 kg / m² and are rigidly connected to the separating component. Sharing under flanking construction are in an apartment wall z. B. continuous floors and subsequent outer and inner walls to understand. Deviating surface weights of the subsequent components are to be considered separately.

Table 7: Rated sound insulation R'w, R1) of single-walled, rigid walls and ceilings (calculated values)

column	1	2
row	area based size m'_{ges} kg/m²	Rated sound insulation $R'_{w, R}$ [1] dB
1	85[2]	34
2	90[2]	35
3	95[2]	36
4	105[2]	37
5	115[2]	38
6	125[2]	39
7	135	40
8	150	41
9	160	42
10	175	43
11	190	44
12	210	45
13	230	46
14	250	47
15	270	48
16	295	49
17	320	50
18	350	51
19	380	52
20	410	53
21	450	54
22	490	55
23	530	56
24	580	57
25[3]	630	58
26[3]	680	59
27[3]	740	60
28[3]	810	61
29[3]	880	62
30[3]	960	63
31[3]	1040	64

[1] Valid for flanking components with a medium basis weight $m'_{L, Mittel}$ from cca. 300 kg/m². Further conditions for the validity of the table see DIN 4109.

[2] If walls are made of gypsum wallboard according to DIN 4103 Part 2 and installed around the edge with 2 mm to 4 mm thick strips of bitumen felt, the weighted sound reduction index $R'_{w, R}$ around 2 dB higher.

[3] These values only apply to the determination of the sound insulation value of double-skin walls made of rigid shells in accordance with DIN 4109.

Table 8: Correction values $K_{L, 1}$ for the weighted sound reduction index $R'_{w,R}$ of rigid walls and ceilings as separating components according to Table 7 in flanking components with the average basis weight $m'_{L, Mittel}$

Type of wall separating	$K_{L, 1}$ in dB for medium basis weightn $m'_{L, Mittel}$ [1] in kg/m²						
	400	350	300	250	200	150	100
Single-shell, rigid walls	0	0	0	0	-1	-1	-1

[1] $m'_{L, Mittel}$ is calculated according to section 3.2.2. to be determined (Supplement 1 to DIN 4109)

Determination of the weighted sound reduction index $R'_{w,R}$

After determining the effective basis weight m'_{ges} of the separating component may be the weighted soundproofing measure $R'_{w,R}$ Table 7 are taken. Intermediate values can be interpolated straight-line and rounded up to whole decibels (dB).

Sound insulation and thermal insulation

Clay block offer the optimal possibility of high thermal insulation, To combine excellent static values and good sound insulation.

Consideration of flanking components

If the average area-related mass of the flanking components deviates from the target value of 300 kg / m², the assessed sound insulation index determined according to Table 7 must be determined $R'_{w,R}$ getting corrected. Correction values $K_{L,1}$ depending on the mean masses of the flanking components $m'_{L, Mittel}$ contains table 8.

The soundproofing dimensions evaluated below $R'_{w,R}$ were in accordance with DIN 4109 Supplement 1, taking into account a surface-related mass $m_{L,\ mittel}$ of about 300 kg / m² for all flanking components. For different average area-related masses see DIN 4109 Supplement 1, section 3.2.

Rated soundproofing dimensions $R'_{w,R}$ according to DIN 4109: 1989-11

A two-sided lime gypsum plaster with a thickness of 15 mm (2 x 15 kg / m2) was considered.
The weighted soundproofing dimensions$R'_{w,R}$ double-shell house partitions apply from the ground floor basement building. If a terraced house does not have a basement or if the basement is in the form of a "white bath", without separating the foundations, a reduction in sound insulation of around 5 dB is to be expected.
Concrete reduction to the respective building construction will be considered in the future calculation procedure of the new E DIN 4109.

description	**density-class**	**single-shell interior walls plastered on both sides**				**two-shell house partitions incl. 3.0 cm parting line with fiber insulation boards**			
		block width [cm]	**Area-related mass m ' [kg/m²]**	**Sound insulation measure $R'_{w,R}$ [dB]**	**Wall thickness [cm]**	**block width [cm]**	**Area-related mass m ' [kg/m²]**	**Sound insulation measure $R'_{w,R}$ [dB]**	**Wall thickness [cm]**
Plan bricks after approval (with thin-bed mortar)									
HLz-Plan-T Z-17.1-868	0,8	11,5	116	**38**	14,5				
	0,9	17,5	179	**43**	20,5	2 x 17,5	328	**62**	41,0
		24,0	234	**46**	27,0	2 x 24,0	438	**66**	54,0
HLz-Plan-T 1,2 Z-17.1-868*/-1108	1,2	11,5*	157	**42**	14,5				
		17,5	223	**46**	20,5	2 x 17,5	415	**65**	41,0
		24,0	294	**49**	27,0	2 x 24,0	558	**69**	54,0
HLz-Plan-T 1,4 Z-17.1-868*/-1108/-1141	1,4	11,5*	180	**43**	14,5				
		17,5	258	**47**	20,5	2 x 17,5	485	**67**	41,0
		24,0	342	**51**	27,0	2 x 24,0	654	**70**	54,0
		Füllziegel							
Planfüllziegel PFZ-T Z-17.1-537 Füllbeton ≥ C 12/15	2,0	17,5	363	**52**[1]	20,5	2 x 17,5	695	**71**	41,0
		24,0	486	**55**[1]	27,0	2 x 24,0	942	**75**	54,0
		30,0	600	**57**[2]	33,0				
Block brick according to DIN V 105-100 / DIN EN 771 (with normal mortar)									
HLz-Block-T	0,8	11,5	124	**39**	14,5				
	0,9	17,5	189	**44**	20,5	2 x 17,5	349	**63**	41,0
		24,0	248	**47**	27,0	2 x 24,0	467	**66**	54,0
HLz-Block-T 1,2	1,2	11,5	166	**42**	14,5				
		17,5	237	**46**	20,5	2 x 17,5	443	**66**	41,0
		24,0	313	**50**	27,0	2 x 24,0	596	**69**	54,0
HLz-Block-T 1,4	1,4	11,5	186	**44**	14,5				
		17,5	268	**48**	20,5	2 x 17,5	506	**67**	41,0
		24,0	356	**51**	27,0	2 x 24,0	683	**71**	54,0
Kleinformate 0,9 **NF – 6 DF**	0,9	11,5	135	**40**	14,5				
		17,5	189	**44**	20,5	2 x 17,5	349	**63**	41,0
		24,0	248	**47**	27,0	2 x 24,0	467	**66**	54,0
		30,0	303	**49**	33,0				
		36,5	362	**52**	39,5				
Mauerziegel 1,4 **NF – 3 DF**	1,4	11,5	186	**44**	14,5				
		17,5	268	**48**	20,5	2 x 17,5	506	**67**	41,0
		24,0	356	**51**	27,0	2 x 24,0	683	**71**	54,0
Mauerziegel 1,8 **NF – 6 DF**	1,8	11,5	228	**46**	14,5				
		17,5	331	**50**	20,5	2 x 17,5	632	**70**	41,0
		24,0	443	**54**	27,0	2 x 24,0	856	**74**	54,0
		30,0	546	**56**	33,0				
		36,5	658	**57**[2]	39,5				
Mauerziegel 2,0 **NF – 5 DF**	2,0	11,5	249	**47**	14,5				
		17,5	363	**52**	20,5	2 x 17,5	695	**71**	41,0
		24,0	486	**55**	27,0	2 x 24,0	942	**75**	54,0
		30,0	600	**57**[2]	33,0				

Rated soundproofing dimensions $R'_{w,R}$ Calculated in accordance with DIN 4109 Supplement 1, structural differences possible.

[1] evaluated soundproofing dimensions $R'_{w,R}$ after aptitude test

[2] Maximum values for single - shell walls in accordance with DIN 4109 Supplement 1

Wienerberger
Building Material Solutions

2-shell house partitions

Rated sound insulation $R'_{w,R}$ of double-shell, in normal or thin-bed mortar bricked house dividers with continuous building dividing line

For two-shell partitions made of two heavy, rigid shells, the parting line must go through to the foundation. The minimum thickness of the parting line is 3.0 cm. To prevent resonances in the cavity and of mortar bridges, the joint cavity must be filled with tightly packed mineral fiber insulation boards in accordance with DIN 18165 Part 2, Type T (footfall plates). In the case of a surface-related mass of the individual shell ≥ 200 kg / m² and joint thickness ≥ 30 mm, the insertion of insulating layers may be dispensed with.

The joint cavity is then to be made with gauges that must be subsequently removed. With a thickness of the parting line ≥ 5.0 cm, the weight of the single shell may be 100 kg / m².

Closed-cell rigid foam panels can not dampen the sound in the cavity. Due to their high rigidity, they produce a sound-technical coupling of both shells. In DIN 4109 they are therefore not mentioned as suitable joint fillers.

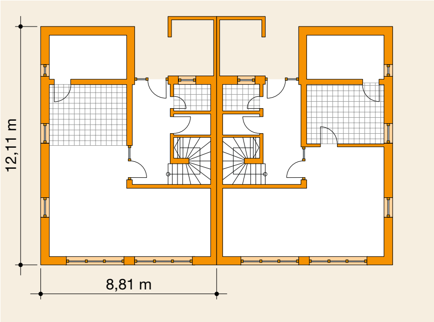
joint thicknesses	≥ 3,0 cm	≥ 5,0 cm
Mass of the single shell:	≥ 150 kg/m²	≥ 100 kg/m²

Calculated values according to DIN 4109, Supplement 1:

The weighted sound reduction index $R'_{w,R}$ is determined from the sums of the area-related masses of both individual shells. On the thus determined $R'_{w,R}$ 12 dB may be used for the double-shell version with continuous parting line.

In the calculation theorem, it is assumed that the parting line below the rooms in need of protection is carried out up to the common foundations in the basement and only applies to living rooms below which one floor is still located. For non-basement buildings or if the basement is a white bath, no calculation mode is defined in DIN 4109 Supplement 1.

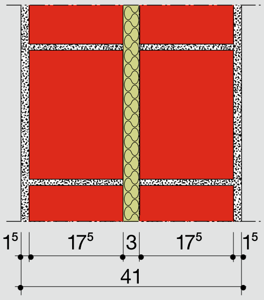
2-shell house dividing walls are used in double and terraced houses for acoustic separation of the building sections.



Floor plan ground floor

View south

Schematic diagram 2-shell house partition



z. B. Gross density class 0.9
Wall surface weight 368 kg / m² $R'_{w,R}$ = 63 dB

The sound insulation value of double-shell house partitions is increased according to construction-practical and scientific findings by the enlargement of the dividing joint thickness over the minimum dimension of 3.0 cm.

According to Gösele, the improvement measure can be calculated approximately with the following formula:

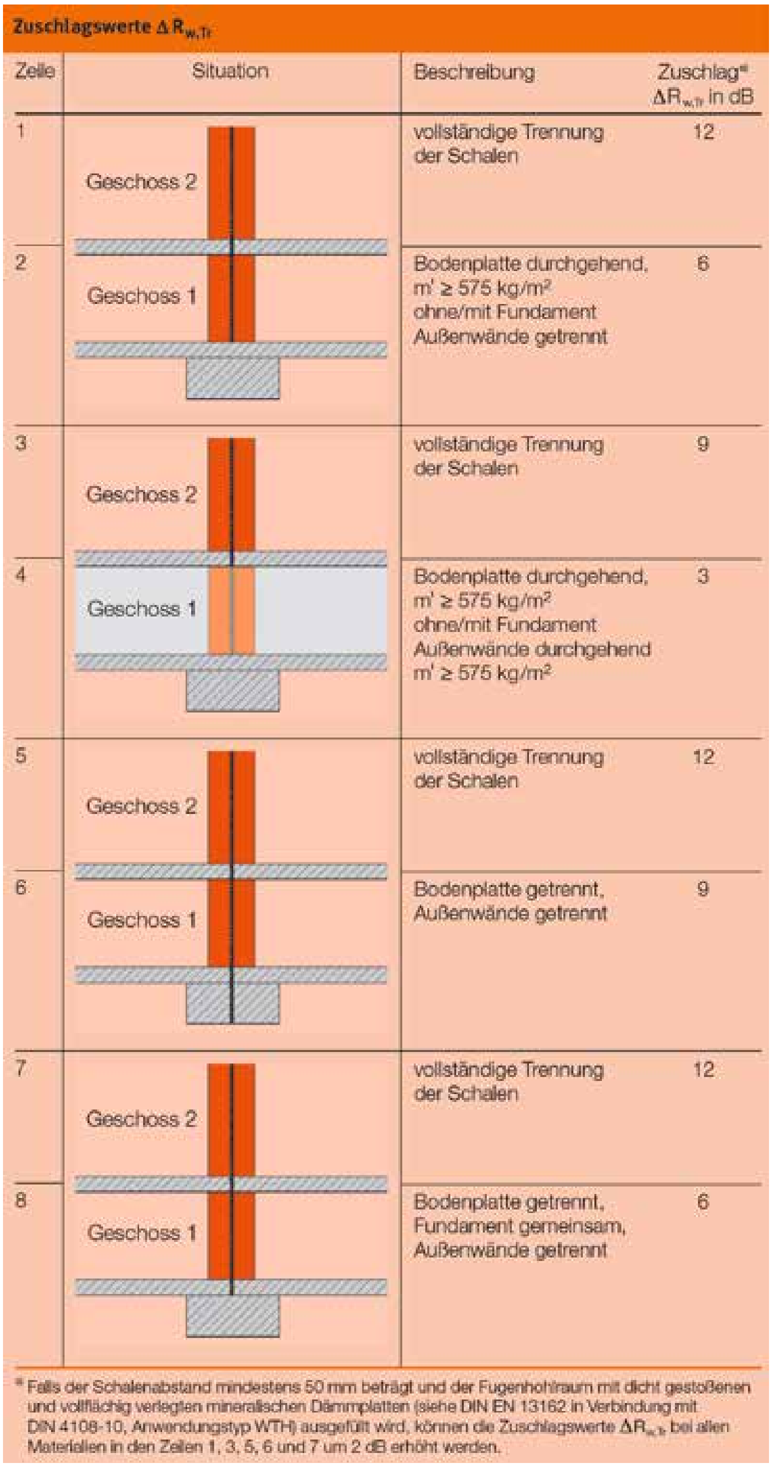
$$\Delta R'_w = 20 \lg \frac{\text{Parting thickness[mm]}}{3{,}0\ \text{cm}}$$

Source: DGfM, Mauerwerk aktuell, 07/84

Dividing joints thick (cm)	Improvement measure (dB)
3,0	0
4,0	2
5,0	4
6,0	6
7,0	7
8,0	8
9,0	9
10,0	10

Influence of the foundation on the weighted soundproofing measure $R'_{w,R}$

In order to be able to realistically predict the influence of a basement or the type of foundation in the calculation, design-dependent graded partition wall surcharges are used $\Delta R_{w,Tr}$ are defined. The surcharges listed in the table below are contained in the booklet "Structural soundproofing with bricks" of the Arbeitsgemeinschaft Ziegel e. V. and also comply with the future regulations of the new E DIN 4109.

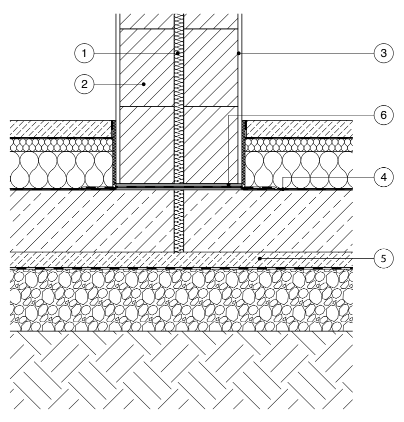


Zuschlagswerte $\Delta R_{w,Tr}$

Zeile	Situation	Beschreibung	Zuschlag* $\Delta R_{w,Tr}$ in dB
1	Geschoss 2	vollständige Trennung der Schalen	12
2	Geschoss 1	Bodenplatte durchgehend, $m' \geq 575$ kg/m² ohne/mit Fundament Außenwände getrennt	6
3	Geschoss 2	vollständige Trennung der Schalen	9
4	Geschoss 1	Bodenplatte durchgehend, $m' \geq 575$ kg/m² ohne/mit Fundament Außenwände durchgehend $m' \geq 575$ kg/m²	3
5	Geschoss 2	vollständige Trennung der Schalen	12
6	Geschoss 1	Bodenplatte getrennt, Außenwände getrennt	9
7	Geschoss 2	vollständige Trennung der Schalen	12
8	Geschoss 1	Bodenplatte getrennt, Fundament gemeinsam, Außenwände getrennt	6

* Falls der Schalenabstand mindestens 50 mm beträgt und der Fugenhohlraum mit dicht gestoßenen und vollflächig verlegten mineralischen Dämmplatten (siehe DIN EN 13162 in Verbindung mit DIN 4108-10, Anwendungstyp WTH) ausgefüllt wird, können die Zuschlagswerte $\Delta R_{w,Tr}$ bei allen Materialien in den Zeilen 1, 3, 5, 6 und 7 um 2 dB erhöht werden.

Detail floor plate, completely separate



① **Insulation board acc.** DIN EN 13162, Typ WTH (3,0 cm)

② Poroton-HLz-Plan-T 1,4 o. (17,5 cm)

③ **Plaster** (1,5 cm)

④ **Seal acc.** DIN 18195

⑤ **subbase**

⑥ **Mortar leveling layer**

To achieve the pre-calculated sound insulation, the clean and complete separation of both wall shells is important.
The use of plan or plan fill bricks with thin-bed mortar or dry-fix adhesive offers the best work results.

Lightweight non-load bearing interior walls

A significant part of the sound energy is due to the design transmitted through the longitudinal sound pipe via flanking components. Therefore, massive flanking wall constructions should always be sufficiently heavy and permanently stiff.

In multi-storey housing often light, non-load-bearing solid walls z. B. as partitions within an apartment used. From a building law point of view, no acoustic requirements have yet been imposed on these walls. However, new studies show that they are significantly involved in the resulting sound insulation of the separating component (eg apartment partition wall). Therefore, the acoustic decoupling of the non-load-bearing inner walls of the separating component will in future become more important. Lightweight non-load-bearing interior wall constructions should always be decoupled by means of corresponding connection profiles. The sound transmission, flank transmission for short, is optimized in this way.

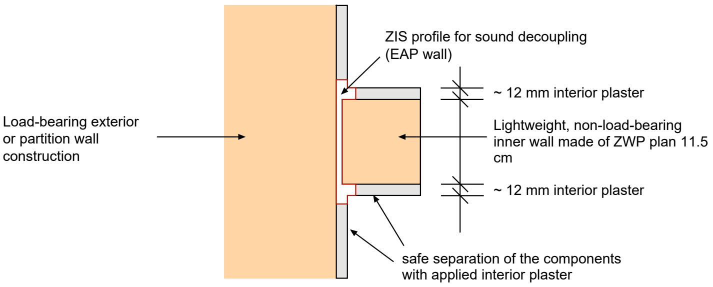
The solution:
Clay block interior wall system ZIS

The ZIS offers the unique and reliable solution for effectively controlling the flanking transmission via non-supporting lightweight inner walls and decoupling the edge insulation by up to 2 dB. In this way, the ZIS will also be able to cope with future acoustic requirements, in particular in contract housing construction.

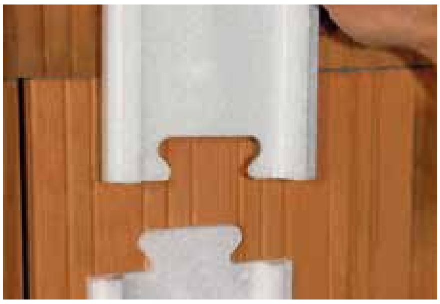
The ZIS consists of:

- Decoupling connection profile (EAP) for wall, single length = 0.95 m
- Decoupling connection profile (EAP) for ceiling, single length = 0.95 m
- Plan / block tiles for lightweight partitions, gross density class 0.8, Wall thickness d = 11.5 cm (plane brick according to approval Z-17.1-868, block brick according to DIN 105-100 / DIN EN 771-1)

Wall connection in horizontal section

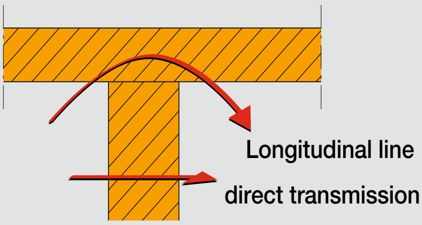


Fixing the wall profile
The wall profile is either fixed with thin-bed mortar applied over the entire surface or fixed with steel nails.



Connecting the wall profiles
When connecting the profiles, make sure that the tongue and groove connection is closed properly.

Horizontal section



Longitudinal conduction and direct sound transmission

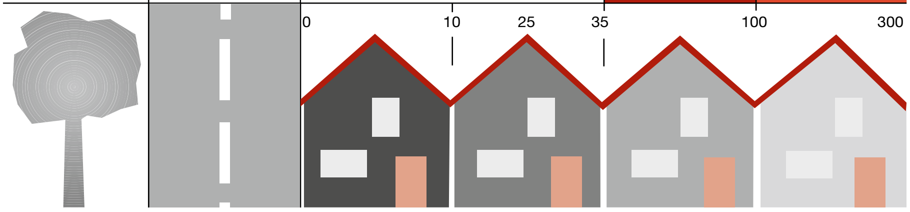
EAP-Wall

EAP-Cover

Normative requirements of exterior components (DIN 4109, Nov. 1989)

Table 9: Rough estimate of road traffic noise and its association with the noise levels.

Traffic load during the day, both directions together vehicles / h	Examples of the assignment of road types to the traffic load	Noise level at distance of the immission location from the middle of the lane in m				
		10	25	35	100	300
<10	Residential street	I				
10 bis 50	Residential street	I-II	I			
50 bis 200	Residential collector road	II-III	I-II		I	
200 bis 1.000	Country road in the local area and outside the local area	≥ V	IV-V	III-IV	II-III	I-II
1.000 bis 3.000	Urban main road		≥ IV		III-IV	
3.000 bis 5.000	Motorway feeder and main road	separate protective measures required			V	III-IV



Additions and deductions according to DIN 4109 were not considered

Table 10: Requirements for the airborne sound insulation of exterior components according to DIN 4109

column	1	2	3	4	5
row	noise level range	Relevant external noise level	room types		
			Bed rooms, infirmary and sanatoriums	Living rooms in apartments, accommodation in accomodation, classrooms and the like	Offices1) and similar
		db (A)	erf. $R'_{w,res}$ of the outer component in dB		
1	I	bis 55	35	30	–
2	II	56 bis 60	35	30	30
3	III	61 bis 65	40	35	30
4	IV	66 bis 70	45	40	35
5	V	71 bis 75	50	45	40
6	VI	76 bis 80	2)	50	45
7	VII	> 80	2)	2)	50

1) On exterior components of rooms in which the penetrating external noise of the activity exerted therein only one makes a subordinate contribution to the indoor noise level, no requirements are made.
2) The requirements are to be defined here on the basis of local conditions.

Influence of the room depth

The sound level in a room is determined by the outside noise level, the Sound insulation dimension of the façade and influenced by the room geometry. For rooms with floor heights of about 2.50 m and room depths of more than 4.50 m, the required airborne sound insulation level can be reduced by 2 dB without further proof. Correction values for other ratio values are facade area / base area

Table 11 below.

Table 11: Correction values for the required resulting sound reduction index (erf. $R'_{w,res}$) depending on the ratio of facade area / base area $S_{(W+F)}/S_{(G)}$

$S_{(W+F)}/S_{(G)}$	2,5	2,0	1,6	1,3	1,0	0,8	0,6	0,5	0,4
correction [dB]	+5	+4	+3	+2	+1	0	-1	-2	-3

$S_{(W+F)}$: Total area of the external component of a living room in m²
$S_{(G)}$: Base area of a living room in m²

Requirements for noise protection

The required noise protection of exterior components is determined by the relevant external noise level, which applies to the façade (exterior wall including windows and doors) and the type of use of the rooms to be protected. According to DIN 4109 the different noise sources are differentiated as follows:

- Road traffic
- Rail transport
- Water transport
- Air traffic
- Commercial and industrial plants

Determination of the relevant external noise level:

The classification in noise levels can be determined by legal regulations, development plans or noise maps.If this is not the case, the classification is according to DIN 4109.

The assignment in noise level areas in traffic depends on

- Road type,
- traffic load,
- Distance of the immission point from the roadway center.

For the side of the building facing away from the causative noise source, the relevant external noise level may be reduced without special proof as follows:

- In open development by 5 dB (A)
- With built-up areas and inner courtyards around 10 dB (A)

Further surcharges or deductions are defined for road intersections, land entries, roads with longitudinal gradients and so on.

Exterior walls - Determination of $R'_{w,R}$ – Values of masonry

Single-shell Poroton block work (Abb.1)

- For walls with single-shell walls, the rated sound insulation measure $R'_{w,R}$ taken from Table 7 depending on the basis weight become.
- Exterior walls with internal or external thermal insulation composite systems are not considered to be single-shell walls in this sense, as they can cause deterioration compared to similar single-walled walls in sound insulation, which reduce the sound insulation value by up to 5 dB.
- For exterior walls with exterior wall cladding to DIN 18516 Part 1 or cladding according to DIN 18515, only the area-related mass of the inner wall is taken into account.

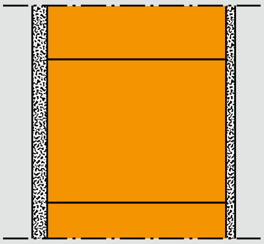


Abb. 1

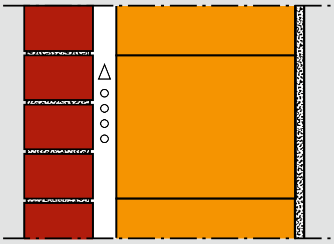


Abb. 2

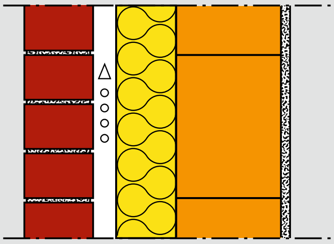


Abb. 3

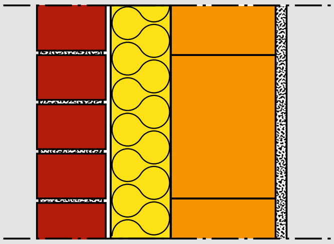


Abb. 4

Double-shell brick facing masonry with air layer and / or insulation (Abb. 2, 3, 4)

To determine the sound insulation index $R'_{w,R}$ the sum of the area-related masses of both shells including existing plaster layers is determined. The determined weighted sound reduction index $R'_{w,R}$ can then be increased by 5 dB, because the air layer and / or insulation layer in the cavity provide additional sound insulation. If the area-related mass of the inner wall of the outer wall abutting-the partition walls is greater than 50% of the mass per unit area of the inner shell of the outer wall, the sound insulation $R'_{w,R}$ increased by 8 dB.

Example

Inner shell of outer wall 24 cm thick of Poroton-Planziegel-T18 of gross density class 0.8, mortared with thin-bed mortar, 1.5 cm interior plaster as lime cement plaster, separating wall to the outer wall abutting 11.5 cm thick of Poroton-Planziegeln the Rohdich -teklasse 1,2, mortared with thin-bed mortar, 2 x 1,5 cm interior plaster as lime-cement plaster.

0,24 x 750 kg/m^3 = 180,0 kg/m^2
1,5 cm Plaster = 25,0 kg/m^2
205,0 kg/m^2
0,115 x 1.100 kg/m^3 = 126,5 kg/m^2
2 x 1,5 cm Plaster = 50,0 kg/m^2
Result: 176,5 kg/m^2 > 50 % von 205,0 kg/m^2

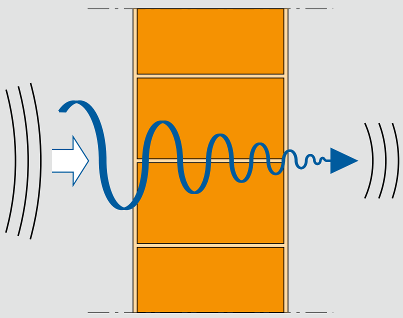
A surcharge of 8 dB instead of 5 dB for the outer wall is possible.

Table 12: Sound insulation dimensions
Rated sound insulation values 1) Double-shell brick faced masonry with shell spacing 3)> 4.0 cm according to DIN 4109

Wall thickness [cm]	Sound insulation [$R'_{w,R}$] in [dB] at brick raw densities in [kg/dm^3], Surcharge for interior plaster25 kg / m^2									
	0,7/ 0,75*		0,8		0,9		1,2		1,4	
	Thinbed mortar		Thinbed mortar		Thinbed mortar		Thinbed mortar		Thinbed mortar	
	Dimensions	$R'_{w,R}$	Dimensions	$R'_{w,R}$	Dimensions	$R'_{w,R}$	Dimensions	$R'_{w,R}$	Dimensions	$R'_{w,R}$
11,5$^{2)}$+17,5	330*	55	337	56	353	56	391	57	400	58
11,5$^{2)}$+24,0	365	56	387	57	409	58	461	59	482	60
11,5$^{2)}$+30,0	–	–	–	–	460	59	–	–	–	–

1) Sound insulation $R'_{w,R}$ determined from the sum of the area-related masses of both shells plus a surcharge of 5 dB.
2) Roofing density of facing bricks 1.6 kg / dm^3, wall sealing 1540 kg / m^3.
3) if necessary, between the shells introduced insulation is not counted in relation to the area-related mass.

Exterior walls - investigation $R'_{w, R, res}$ the facade



The required sound insulation is based on the noise exposure to which the façade, including windows and doors, and the type of use of the rooms to be protected are exposed.

Depending on the relevant external noise level, the facade is assigned to a noise level area. DIN 4109 differentiates between seven noise level ranges. The assignment to one of these noise level ranges results in the requirement for the so-called "resulting" sound insulation index $R'_{w, res}$ of the possibly composed of several individual components outer component (eg., Wall with windows) of the space to be protected. The requirements are shown in Table 10.

The sound quality of facades is essentially dependent on the sound insulation index of the windows used, as they generally represent the weak point.

For exterior components, consisting of two elements (eg exterior wall and window), the following simplified equation for the determination of the following applies according to Supplement 1 to DIN 4109 $R'_{w, R, res}$.

$$R'_{w,R,res} = R'_{w,R,1} - 10\lg\left[1 + \frac{S_2}{S_{ges}} \cdot \left(10^{\frac{R'_{w,R,1} - R_{w,R,2}}{10}} - 1\right)\right] \text{dB}$$

$R'_{w, R, 1}$	Calculated value of the weighted sound reduction index of the wall [dB]
$R_{w, R, 2}$	Calculated value of the assessed sound insulation value of the window / door [dB]
S_{ges}	$S_1 + S_2$ [m²] Area of the entire exterior (including the window / door)
S_2	Area of the window / door [m²]

Resulting soundproofing dimensions $R'_{w,R,res}$ From the combination masonry / window depending on the window area proportion of Table 13 can be seen.

Calculated value of the weighted sound reduction index $R'_{w,R}$ the Wall

For the proof of sound insulation against external noise, the calculation method of DIN 4109: 1989-11 is still to be applied for buildings to be erected in brick masonry. For bricks with a thickness ≤ 24,0 cm irrespective of the apparent density and for bricks with a thickness> 24,0 cm from a gross density class ≥ 1,0, the weighted construction sound reduction index R'w, R is tabulated as a function of areal mass. 1 Supplement 1 to DIN 4109: 1989 determined.

HLz-Plan-T 24,0 – 1,2 EB

Rated Construction Sound Insulation Measurement $R'_{w,R}$ for heat-insulating perforated bricks

To calculate the resulting sound insulation of the facade $R'_{w,R,res}$ is in accordance with the general building-technical approval Z-23.22-1787 the direct sound reduction measure determined and corrected in the test bench without flange transfer $R_{w,Bau,ref}$ according to sheet 3 to DIN 4109: 1996 in a rated construction sound insulation measure $R'_{w,R}$ convert. This calculation value includes a high flat-rate discount for the flanking transmission and is thus on the safe side in the further proof for protection against external noise.

Poroton-S10-36,5-MW

Evidence of airborne sound insulation of a facade against external noise - calculation example

As a rule, there are different outside noise levels d on the facades. H. different levels of noise pollution. For the façade facing away from the noise source, lower external noise levels are often decisive. In order to economically dimension the sound insulation of the exterior parts, each façade should be considered separately and the different outside noise levels taken into account. As an example, the proof of airborne sound insulation is compared to external noise for a corner room. The relevant external noise level LAm should be 62 dB (A) for both facades.

Proof facade 1

1. **Area Detection:**
   Window: $S_F = 1{,}10\ \text{m} \cdot 2{,}325\ \text{m} = 2{,}56\ \text{m}^2$
   Wall: $S_w = 3{,}30\ \text{m} \cdot 2{,}60\ \text{m} - 2{,}56\ \text{m}^2 = 6{,}02\ \text{m}^2$ **total area**
   Cladding: $S_{F+W} = 2{,}56\ \text{m}^2 + 6{,}02\ \text{m}^2 = 8{,}58\ \text{m}^2$
   Basic surface of the room: $S_G = (3{,}30\ \text{m} \cdot 4{,}50\ \text{m}) + (1{,}75\ \text{m} \cdot 0{,}765\ \text{m}) = 16{,}19\ \text{m}^2$
2. Correction required $R'_{w,res}$ taking into account the geometry of the room according to **Tab. 11** S. 66: $S_{F+W}/S_G = 8{,}58\ \text{m}^2 / 16{,}19\ \text{m}^2 = 0{,}53$
   gemäß DIN 4109 Tab. 9 ergibt der Korrekturwert → **– 2 dB**
   erf. $R'_{w,res}$ = 35 dB – 2 dB → **erf. $R'_{w,res}$ = 33 dB**
3. Calculation of the resulting sound reduction index $R'_{w,R,res}$:

$$R'_{w,R,res} = R'_{w,R,1} - 10\lg\left[1 + \frac{S_F}{S_{F+W}} \cdot \left(10^{\frac{R'_{w,R,W} - R'_{w,R,F}}{10}} - 1\right)\right]$$

$$R'_{w,R,res} = 48 - 10\lg\left[1 + \frac{2{,}56}{8{,}58} \cdot \left(10^{\frac{48-32}{10}} - 1\right)\right]$$

$R'_{w,R,res}$ = 37 dB > 33 dB = erf. $R'_{w,res}$ → The required sound insulation level is guaranteed!

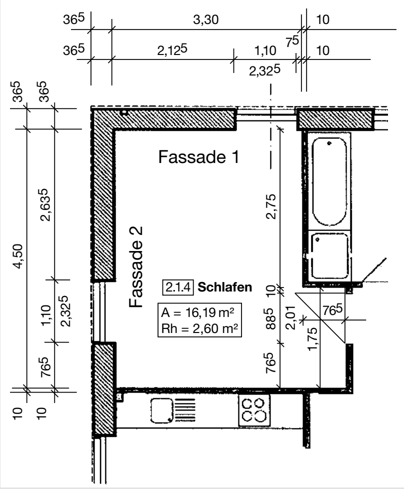
Proof facade 2

1. **Area Detection:**
   Window: $S_F = 1{,}10\ \text{m} \cdot 2{,}325\ \text{m} = 2{,}56\ \text{m}^2$
   Wall: $S_w = 4{,}50\ \text{m} \cdot 2{,}60\ \text{m} - 2{,}56\ \text{m}^2 = 9{,}14\ \text{m}^2$ **total area**
2. Facade: $S_{F+W} = 2{,}56\ \text{m}^2 + 9{,}14\ \text{m}^2 = 11{,}70\ \text{m}^2$
   Basic surface of the room: $S_G = (3{,}30\ \text{m} \cdot 4{,}50\ \text{m}) + (1.75\ \text{m} \cdot 0{,}765\ \text{m}) = 16{,}19\ \text{m}^2$
3. Correction required $R'_{w,res}$ taking into account the geometry of the room according to **Tab. 11**, S. 66: $S_{F+W}/S_G = 11{,}70\ \text{m}^2 / 16{,}19\ \text{m}^2 = 0{,}72$
   according to DIN 4109 Tab. 9 gives the correction value → **0 dB**
   erf. $R'_{w,res}$ = 35 dB +/– 0 dB → erf. $R'_{w,res}$ = 35 dB
4. Calculation of the resulting sound reduction index $R'_{w,R,res}$:

$$R'_{w,R,res} = R'_{w,R,1} - 10\lg\left[1 + \frac{S_F}{S_{F+W}} \cdot \left(10^{\frac{R'_{w,R,W} - R'_{w,R,F}}{10}} - 1\right)\right]$$

$$R'_{w,R,res} = 48 - 10\lg\left[1 + \frac{2{,}56}{11{,}70} \cdot \left(10^{\frac{48-32}{10}} - 1\right)\right]$$

$R'_{w,R,res}$ = 38 dB > 35 dB = erf. $R'_{w,res}$ → The required sound insulation level is guaranteed!



Grundriss 1. OG

Vorgaben:
Raumart – Schlafzimmer
Maßgeblicher Außenlärmpegel
L_{Am} = 62 dB (A)
Gemäß DIN 4109 Tab, 8:
Lärmpegelbereich III
erf. $R'_{w.res}$ = 35 dB

Bauteile:
1. Einschalige Außenwand
36,5 cm Poroton-S10-MW
- aus Prüfstandsmessung
  $R_{w,Bau,ref}$ = 51,1 dB
- gemäß Umrechnung nach Beiblatt 3 zu DIN 4109
  $R'_{w,R}$ = 48 dB
2. Fenster
- gemäß Herstellerangabe
  $R'_{w,R}$ = 32 dB

Calculated $R'_{w,\,R,\,res}$-Values of possible clay block constructions

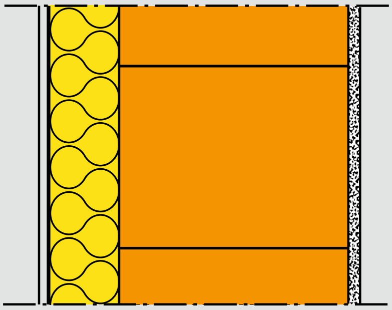
Table 13: Resulting sound insulation index $R'_{w,\,R,\,res}$ Masonry and windows (dB)

	Window		Sound reduction index $R'_{w,\,R}$ (dB) of 1 or 2-shell masonry without windows																	
	$R_{w,R}$ dB	Fläche %	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
normal execution	**25**	20	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
		30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
		40	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
		50	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
	30	20	36	36	36	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37
		30	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35
		40	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
		50	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
	32	20	38	38	38	38	38	39	39	39	39	39	39	39	39	39	39	39	39	39
		30	36	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37
		40	35	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
		50	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35
good execution	**37**	20	41	41	42	42	42	43	43	43	43	43	44	44	44	44	44	44	44	44
		30	40	41	41	41	41	41	42	42	42	42	42	42	42	42	42	42	42	42
		40	40	40	40	40	40	40	41	41	41	41	41	41	41	41	41	41	41	41
		50	39	39	39	39	40	40	40	40	40	40	40	40	40	40	40	40	40	40
high quality	**40**	20	42	43	43	44	44	45	45	45	46	46	46	46	46	47	47	47	47	47
		30	42	42	43	43	44	44	44	44	44	45	45	45	45	45	45	45	45	45
		40	41	42	42	43	43	43	43	43	43	44	44	44	44	44	44	44	44	44
		50	41	42	42	42	42	42	42	42	43	43	43	43	43	43	43	43	43	43
	42	20	43	43	44	45	45	46	46	47	47	47	48	48	48	48	48	48	48	48
		30	43	43	44	44	44	44	45	45	45	45	45	45	45	45	45	45	45	45
		40	43	43	44	44	44	44	45	45	45	45	45	45	45	45	45	45	45	45
		50	43	43	43	43	44	44	44	44	44	44	44	44	44	44	44	44	44	44
	45	20	43	44	45	46	46	47	48	48	49	49	50	50	50	50	50	50	50	50
		30	43	44	45	46	46	46	47	47	48	48	49	49	49	49	49	49	49	49
		40	44	44	45	45	46	46	47	47	47	48	48	48	48	48	48	48	48	48
		50	44	44	45	45	46	46	46	46	47	47	47	47	47	47	47	47	47	47

Exterior walls - protection against external noise

Influence of a thermal insulation composite system (ETICS)

If the thermal insulation of an external wall is realized by means of a thermal insulation composite system, this can generally have a negative effect on the sound insulation against external noise. Due to their high dynamic stiffness, polystyrene insulation panels reduce the weighted sound reduction index of the solid wall by up to 6 dB. The acoustic influence on the external wall is generally defined in the corresponding general building supervisory approval of each ETICS or the approval of the insulation.

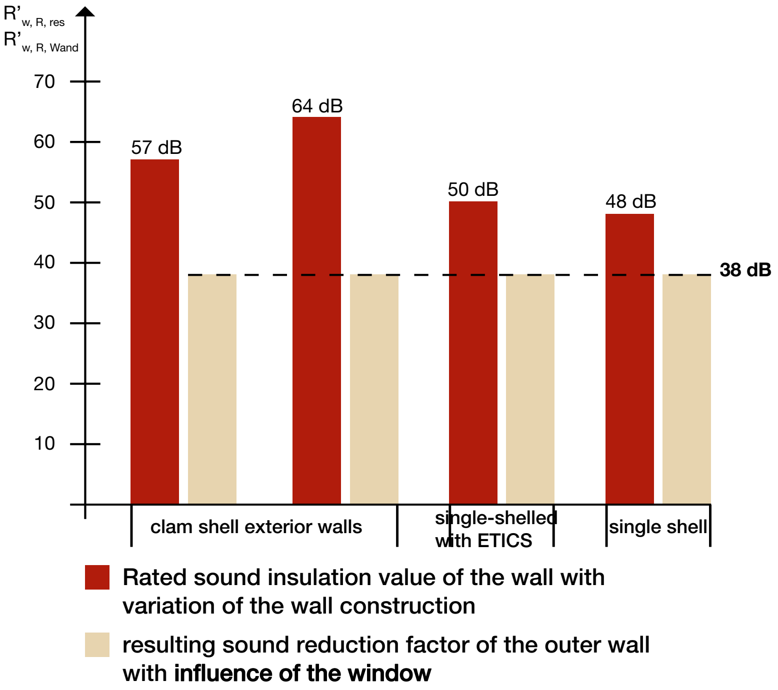


Consider possible reduction of sound insulation by ETICS!

Sound insulation with bricks in the outer wall

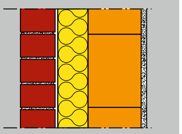
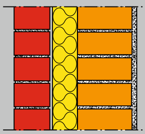
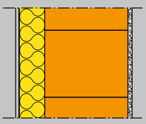
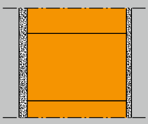
Often the opinion is that you can achieve the sound insulation in the outer wall only by building materials with high density. But that is a mistake. The influence of the wall surface weight on the sound insulation of the wall construction is clearly relativised by the sound-technical weakness window. In this case, the argument to use materials as heavy as possible (eg wall materials with a high bulk density) also in outer walls, as the following example clearly shows, does not offer any noteworthy advantage.

Rated sound insulation of exterior wall with window $R'_{w, R, res}$



Important for the subjective perception of sound is not the Schalldämmmaß a single building material, but the sound-insulating effect of the entire construc tion, z. B. an outer wall including the window.

Table 14: Exterior walls with windows / doors do not show any improvement in the sound reduction index with increasing wall weight $R'_{w, R, res}$ on. The following variation calculation refers to the previous example - proof facade 2.

Wall construction		**bivalve with core insulation and veneer**		**single-shelled with ETICS**	**single shell**
		 **Planziegel-T18**	 **Building bricks**	 **Building bricks**	 **Poroton-S 10-MW**
Inner leaf					
Wall thickness (block size)	[m]	0,24	0,24	0,24	0,365
Density	[kg/m³]	800	2000	2000	800
Wall mortar		DM	NM	NM	DM
Mass of brick wall	[kg/m²]	180	456	456	274
Plaster layers					
1,5 cm Gypsum lime plaster	[kg/m²]	15	15	15	15
2,0 cm minute lightweight plaster	[kg/m²]	–	–	–	20
Facing wall					
10,0 cm Cavity wall insulation		ja	ja	–	–
Wall cladding thickness	[m]	0,115	0,115	–	–
density	[kg/m³]	1600	1600	–	–
Mass of the facing brick	[kg/m²]	177	177	–	–
Heat insulation composite system					
10,0 cm thermal skin		–	–	correction value $\Delta R_{w, R}$ according to ABZ	–
area based size, m'_{ges}	**[kg/m²]**	**372**	**648**	**471**	**309**
rated sound insulation measure of the wall $R'_{w, R, 1}$	[dB]	52	59	55	48
Correction values $\Delta R_{w, R}$	[dB]	+ 5*	+ 5*	- 5**	–
rated sound insulation measure of the wall $R'_{w, R, 1}$	**[dB]**	**57**	**64**	**50**	**48**
Soundproofing dimension of the window $R'_{w, R}$	[dB]	32	32	32	32
Component surfaces					
Area of the window S_F	[m²]	2,56			
Surface of the wall S_W	[m²]	9,14			
total area S_{ges}	[m²]	11,70			
Resulting soundproofing dimension of the outer wall incl. window$R'_{w, R, res}$	**[dB]**	**38**	**38**	**38**	**38**

* According to DIN 4109, the weighted sound reduction index can be $R'_{w, R}$ be increased by 5 dB.
** Depending on the system, the weighted sound reduction index can be $R'_{w, R}$ the wall will be deteriorated. Regulations of the respective general building inspectorate approval must be observed.

Noise calculation according to E DIN 4109 as well as DIN EN 12354-1 and Z-23.22-1787

Future procedures to be used

The construction law introduced detection method for the determination of the resulting airborne sound insulation measure $R'_{w,R}$ according to DIN 4109 (Nov. 1989) is based in part on rough assumptions or generalizations and can u. U. lead to gross errors in the prognosis of the expected sound insulation.

In the future European calculation method of airborne sound insulation between rooms according to DIN EN 12354 and the national E DIN 4109, the importance of flanking sound transmission is taken into account and all transmission paths involved in the sound transmission (components and component connections) are recorded qualitatively and differentiated. The flanking sound transmission thus becomes an elementary planning task and acoustic weak points can be solved in advance of the construction work.

The calculation algorithms of this future standard as well as the current state of the art are already legitimized by **DIBt's General Building Inspection Certificate** Z-23.22-1787 for the construction law proof of sound insulation with Poroton brick and are therefore easy and safe for the planner with the free Wienerberger Sound insulation software applicable. The according to E DIN 4109-2 "Computational proof of fulfillment of requirements" specifies i.a. For the calculation of airborne sound insulation in buildings a holistic accounting procedure is used.

Sound transmission

The resulting sound insulation R'_w a separating component, eg. As a housing partition, is largely influenced by the flanking components such as exterior walls, interior walls and ceilings. Each separating component is limited by a total of 4 flanking components. This results in a total of 12 flanking sound transmission paths (Ff, Fd, Df) and the direct sound passage through the separating component (Dd). In the new calculation method, a total of 13 ways of sound transmission are calculated separately and then summed up.

Calculation of sound transmission

The sound transmission for the separating component is calculated differentiated for each transmission path. The direct sound insulation dimensions are taken into account R_w of the separating and flanking components, the flank sound insulation dimensions $R_{ij,w}$ (Paths Ff, Fd and Df) and the insulation of the joint K_{ij}

Rated soundproofing dimension of the separating component:

$$R'_w = -10 \lg (10^{-RDd,w/10} + \Sigma\ 10^{-Rij,w/10}) \qquad [dB]$$

Direct sound insulation measure of the separating component:

$$R_{Dd,w} = R_{S,w} + \Delta R_{Dd,w} \qquad [dB]$$

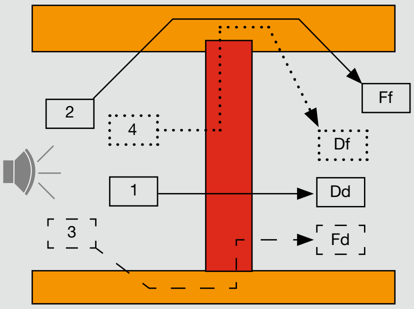
Flank sound insulation measure per transmission path:

$$R_{ij,w} = (R_{i,w} + R_{j,w})/2 + \Delta R_{ij,w} + K_{ij} + 10 \lg (S_S/(l_o{*}l_f)) \qquad [dB]$$

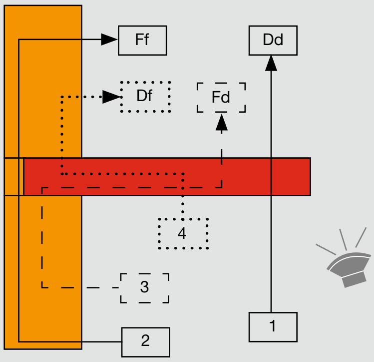
$R_{i,w}$	Soundproofing dimension of the excited component
$R_{j,w}$	Noise reduction of the radiating component
$\Delta R_{ij,w}$	Airborne sound improvement measure by attachment shells (Edge)
$\Delta R_{Dd,w}$	Airborne sound improvement measure by attachment shells Separation component
K_{ij}	Vibration reduction measure
S_s	Surface of the separating component
l_f	common edge length between separating and flank component
l_0	Reference edge length = 1.0 m

Thediagramsshowthedifferent transmissionpathsbetweentwo roomsandtheirdesignations accordingtoDINEN12354-1orEDIN 4109,wherethepathDdisthedirect transmissionviathetren-nende componentandFf,FdandDftheflank transmissiondesignateaflank component.

Sound transmission horizontal



Sound transmission vertical



🟥 separating component
🟧 adjacent flanking component

Path 1: excitation (D) and abstraction (d) by the separating component, transmission path Dd
Path 2: excitation of the flank (F) and radiation through the flank (f), transmission path Ff
Path 3: Excitation of the flank (F) and radiation via the separating component (d), transmission path Fd
Path 4: Excitation of the separating component (D) and emission via the flank (f), transmission path Df

The advantage of the calculation according to E DIN 4109 is that all construction parts and component connections are taken into account in their actual sound transmission. This detection methodology therefore leads to a safe prognosis of the expected sound insulation. The evidence is most useful with computer programs, such. B. the Bauphysiksoftware module sound 4.0 of Arbeitsgemeinschaft Mauerziegel e. V. implement.

In the run-up to the building regulations introduction of the new DIN 4109 - sound insulation in building construction - the German brick and tile industry has developed a software with which the verification can be performed in solid construction.

The building automation software Modul Schall 4.0 enables the implementation of the revised standard series with the help of an acoustic energy balance and predicts the sound insulation in buildings with high reliability.

The sound insulation properties of a single component are characterized from now on by the direct sound insulation measure Rw and the flank transmission, which has a significant influence on the resulting weighted Bauschalldämm measure R'w is evaluated in more detail.

In addition to the transmission of airborne sound between rooms also house partition walls, the impact sound transmission of solid components and the airborne sound of outdoor components can be acoustically investigated and proven.

Clay block-specific influencing factors

Influencing variable: Direct sound insulation measure R_w

To calculate the resulting sound insulation of a separating component, the direct input sound reduction factor is the input parameter R_w the individual components needed. This value designates a bypass-free, component-specific, acoustic property of a separating or flanking component. These R_w-On the one hand, values can be taken from test stands without flank transmission or determined according to E DIN 4109-4 "Component Catalog" depending on the area-related mass. The direct soundproofing measure R_w is not with the previous evaluated sound insulation dimensions $R'_{w,R}$ comparable

The direct sound insulation measure R_w of perforated brick masonry can u. U. may differ from the sound insulation of homogeneous materials. For perforated brick masonry in accordance with DIN EN 771-1 / DIN 105-100, the direct sound insulation index can be determined from the area-related mass. For highly heat-insulating exterior wall tiles in multi-storey residential construction, specially sound-capable products were developed and their suitability proved by measurements in the test bench without flank transmission.

Influence variable: joint insulation measure K_{ij}

The component connections, in the acoustic sense - joints - are mathematically evaluated in the new European calculation method according to DIN EN 12354-1. The shock-absorbing insulation measure K_{ij} describes the transmission of structure-borne noise from the component i into the adjacent component j via the component node. Accordingly, the Stoßstelldämm measure K_{ij} become a key parameter in the calculation of flank insulation.

For this reason, Wienerberger GmbH has had various connection variants examined both in the test laboratory and in completed buildings. The aim was to capture the influence of the joints more precisely and thus to formulate reliable planning and execution recommendations. To take account of these brick-specific component connections, the results of the test bench measurements (Report No. FEB / FS 42/07) were integrated into the calculation software.

The following software can be used with the design software:

- Airborne sound insulation in buildings in solid construction
- Airborne sound insulation of apartment and hall partitions, double-shell house partitions and storey ceilings
- Airborne sound insulation of outdoor components z. B. facades
- Calculation of footfall sound insulation

Advantages of the module:

- latest standard E DIN 4109 integrated
- simple and safe sound Safety prognosis for planning and execution
- intuitive operation
- low training periods
- acoustic weak points local taping
- Consideration of brick specific fischer component connections
- extensive building materials database
- brick-specific component database
- Databases individually expandable
- Output report in Excel or pdf format

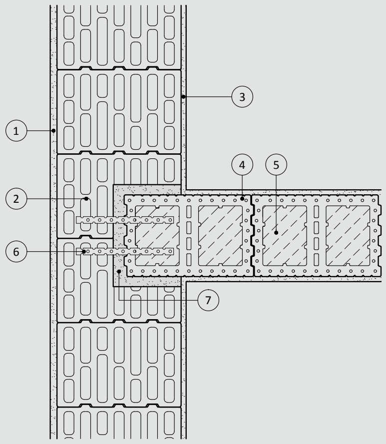
Further information can be found at www.wienerberger.de

Reference values of joint insulation dimensions $K_{i,j}$ of exterior wall partition variants

The rationalization of the construction process and also the use of building materials with different deformation behavior can lead to the fact that the component connections do not always have the necessary sound rigidity stiffness. For example, it is to be expected that the partition walls of heat-insulating external walls of the HVZ will be demolished if these are built from building materials containing binding medium, such as sand-lime bricks or concrete blocks. The reduction in shrinkage of these building materials generates tensile stresses following the non-shrinking perforated bricks, which lead to tearing off when the tensile strength is exceeded. For this reason, heavy dividing walls in brick buildings should always be made from commercially available plan-fill bricks PFZ-T.

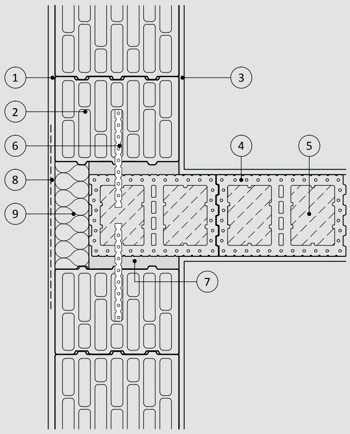
The partition wall connection designed as a butt joint basically shows the lowest joint penetration dimension. Trennwandeinbindun-gene or even -durchbindungen cause very high Stoßstellendämm dimensions on the flank path in the horizontal direction. The examples show the differences occurring in practice in the execution of the details and the expected joint insulation dimensions Ki, j (reference values). As with floor slabs, thermal insulation aspects must also be taken into account in the case of residential partitions.

Floor-to-ceiling slot integration of a filler wall integration depth approx. Half the outer wall thickness



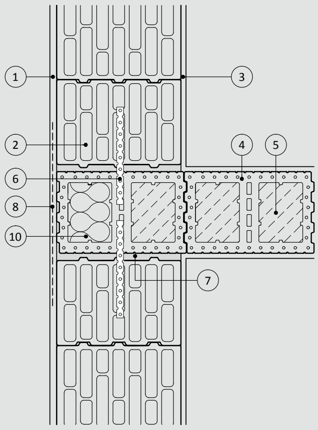
$K_{i,j}$ between 7–8 dB

Floor-high penetration of a filling brick wall with front insulation



$K_{i,j}$ between 8–10 dB

Floor-high through a filler wall with insulated initial brick



$K_{i,j}$ between 8 –10 dB

①external plaster 2.0 cm
②monolithic external masonry
③interior plaster 1.5 cm
④plano tiles PFZ-T 24,0 cm
⑤Concrete filling on site
⑥flat steel anchors according to statics
⑦Thoroughly mortar the connecting joint
⑧Fabric reinforcement in exterior plaster
⑨Thermal insulation WLG 035
⑩ initial tiles with integrated thermal insulation
PFZ-T 24,0 cm – AL/AK

Rated direct soundproofing dimensions $R_{w,R}$ according to E DIN 4109 / DIN EN 12354-1 / Z-23.22-1787

The new European calculation method according to DIN EN 12354-1 or according to future DIN 4109 requires the component-specific direct sound insulation dimensions as input values for the calculation $R_{w,R}$ the separating and flanking components. These direct soundproofing dimensions $R_{w,R}$ are not with the previous sound insulation dimensions $R'_{w,R}$ the valid DIN 4109 (11/1989) comparable!

The computational algorithms of the future standard as well as the current state of the art are already legitimized by DIBt's General Building Inspection Certificate Z-23.22-1787, issued by the working group for building bricks, for the building law proof of sound insulation with bricks.

The following table shows the direct sound insulation dimensions $R_{w,R}$ various wall constructions depending on the bed joint mortar shown. The area-related mass m 'already takes into account the exterior and interior plaster layers. For single-shell exterior walls, 20 mm mineral lightweight plaster and 15 mm lime gypsum plaster were considered (1 x 20 kg / m² and 1 x 15 kg / m²). Single-skinned interior walls receive a lime gypsum plaster with a thickness of 15 mm (2 x 15 kg / m²) on both sides.

Intermediate values or direct sound insulation dimensions $R_{w,R}$ different areal masses m '(for example one-sided plastered shells of bivalve outer walls) can be calculated using the following formula:

$R_{w,R} = 30{,}9 \log (m'/m'_0) - 22{,}2$ [dB] m' = area-related mass of the wall including plaster layers $m'_0 = 1$ kg

description	gross density	Block size [cm]	surface related Dimensions m' [kg/m²]	Direct sound reduction measure$R_{w,R}$ [dB]	Wall thickness [cm]
einschalige, beidseitig verputzte Außenwände im Objektbau					
Planziegel nach Zulassung (mit Dünnbettmörtel)					
S8-P Z-17.1-1120	0,75	36,5	according to Requirement for Supreme Building Supervision (DIBt), approval Z-23.22-1787	**48**1)	40,0
		42,5		≥ **48**2)	46,0
		49,0		≥ **48**2)	52,5
S8-MW Z-17.1-1104	0,75	36,5		**48**1)	40,0
		42,5		≥ **48**2)	46,0
		49,0		≥ **48**2)	52,5
S9-P Z-17.1-1058	0,70	30,0		≥ **48**2)	33,5
		36,5		**49,2**1)	40,0
		42,5		**48,4**1)	46,0
S9-MW Z-17.1-1100	0,9	30,0		≥ **48**2)	33,5
		36,5		≥ **50**2)	40,0
		42,5		≥ **48**2)	46,0
S10-P Z-17.1-1017	0,75	30,0		**48,8**1)	33,5
		36,5		**52,0**1)	40,0
		42,5		**49,1**1)	46,0
S10-MW Z-17.1-1101	0,80	30,0		≥ **48**2)	33,5
		36,5		**51,1**1)	40,0
		42,5		**49,3**1)	46,0
Plan-T 14 Z-17.1-651	0,70	30,0		**48,2**1)	33,5
ingle-shell interior walls plastered on both sides					
Planziegel after approval (with thin-bed mortar)					
HLz-Plan-T Z-17.1-868	0,9	17,5	179	**47,4**	20,5
		24,0	234	**51,0**	27,0
HLz-Plan-T 1,2 Z-17.1-868*/-1108	1,2	11,5*	157	**45,6**	14,5
		17,5	223	**50,3**	20,5
		24,0	294	**54,1**	27,0
HLz-Plan-T 1,4 Z-17.1-868*/-1108 /-1141	1,4	11,5*	180	**47,5**	14,5
		17,5	258	**52,3**	20,5
		24,0	342	**56,1**	27,0
Planfüllziegel PFZ-T Z-17.1-537 Füllbeton ≥ C 12/15	2,0	17,5	363	**56,9**	20,5
		24,0	486	**60,8**	27,0
		30,0	600	**63,6**	33,0
Clay Block after DIN 105-100/DIN EN 771 (with normal mortar)					
HLz-Block-T	0,9	17,5	189	**48,2**	20,5
		24,0	248	**51,8**	27,0
HLz-Block-T 1,2	1,2	11,5	166	**46,4**	14,5
		17,5	237	**51,2**	20,5
		24,0	313	**54,9**	27,0
HLz-Block-T 1,4	1,4	11,5	186	**48,0**	14,5
		17,5	268	**52,8**	20,5
		24,0	356	**56,7**	27,0
Kleinformate 0,9 **NF – 6 DF**	0,9	11,5	135	**43,6**	14,5
		17,5	189	**48,2**	20,5
		24,0	248	**51,8**	27,0
Mauerziegel 1,4 **NF – 3 DF**	1,4	11,5	186	**48,0**	14,5
		17,5	268	**52,8**	20,5
		24,0	356	**56,7**	27,0
Mauerziegel 1,8 **NF – 6 DF**	1,8	11,5	228	**50,6**	14,5
		17,5	331	**55,7**	20,5
		24,0	443	**59,6**	27,0
Mauerziegel 2,0 **NF – 5 DF**	2,0	11,5	249	**51,8**	14,5
		17,5	363	**56,9**	20,5
		24,0	486	**60,8**	27,0

Construction-specific deviations possible.

1) Direct sound insulation dimensions Rw, construction, ref from aptitude test 2) Rw, construction, ref not tested - declared value can be assumed to be on the safe side

Sound insulation planning in the design phase

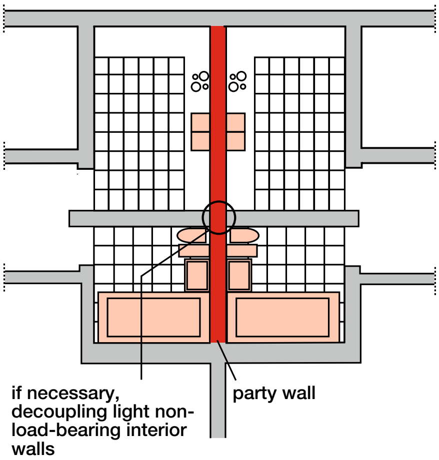
The noise level expected by the user should be fixed before the start of construction together with the planning.

Here, the following criteria should be used:

- Sound-optimizedspatialplanningwiththebasicrule:

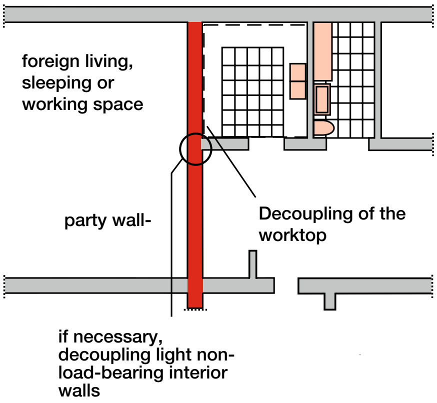
Same use of space - mirror image arrangement

- Sound engineering planning with regard to the future use of the rooms
- Decoupling of light non-load-bearing interior walls



Cheap:

It is favorable, "loud" rooms, such. As kitchens and bathrooms, to place together on an apartment wall.

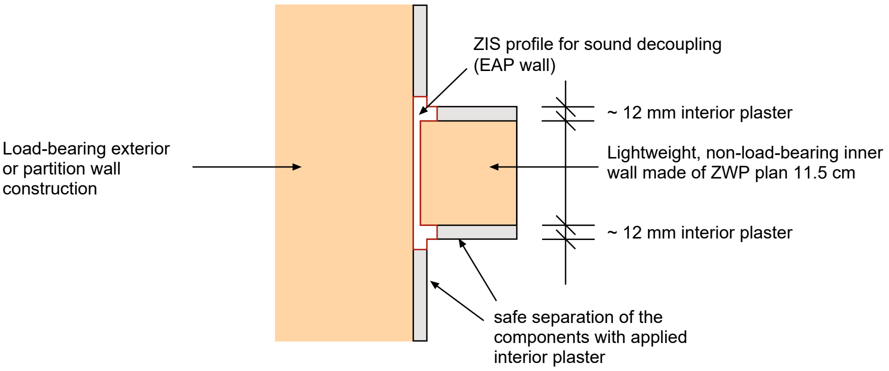


Cheap:

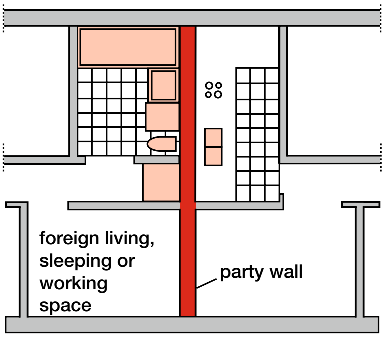
If it is unavoidable to place a kitchen or bathroom next to a common room, as shown here, then at least the installation wall should be separated from the wall of the apartment by an axis. In the illustrated case, it is advisable to provide an attachment shell in front of the apartment partition wall and to ensure decoupling of the countertop from the flanking wall in order to achieve the lowest possible structure-borne noise of the walls due to the noise of kitchen work.

Processing detail

Wall connection light non-load-bearing inner wall with the brick inner wall system (ZIS)

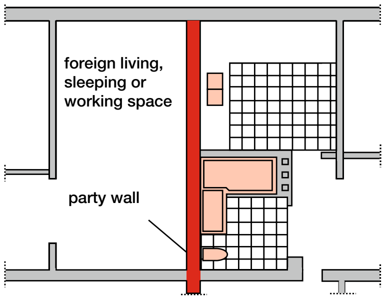


unfavorable:



Although this detail design has taken care to arrange rooms with the same function opposite each other, the rooms with a high degree of installation, bathroom or kitchen, without decoupling of the installations are located on the same apartment wall as the bedrooms or work areas. This design leads to increased noise pollution through structure-borne sound transmission in adjacent "quiet" rooms.

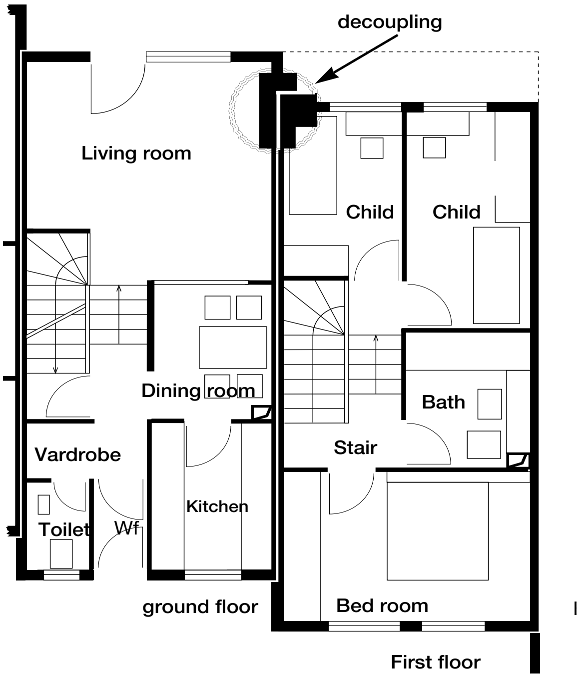
Very unfavorable:



This example shows how one should not make it, namely to place the kitchen and bathroom with the installations directly next to a foreign living, sleeping or working space. If such an arrangement can not be avoided, it is necessary to arrange a continuous facing shell with greater economic outlay in order to achieve good soundproofing.

Sound insulation planning in the design phase -processing recommendations

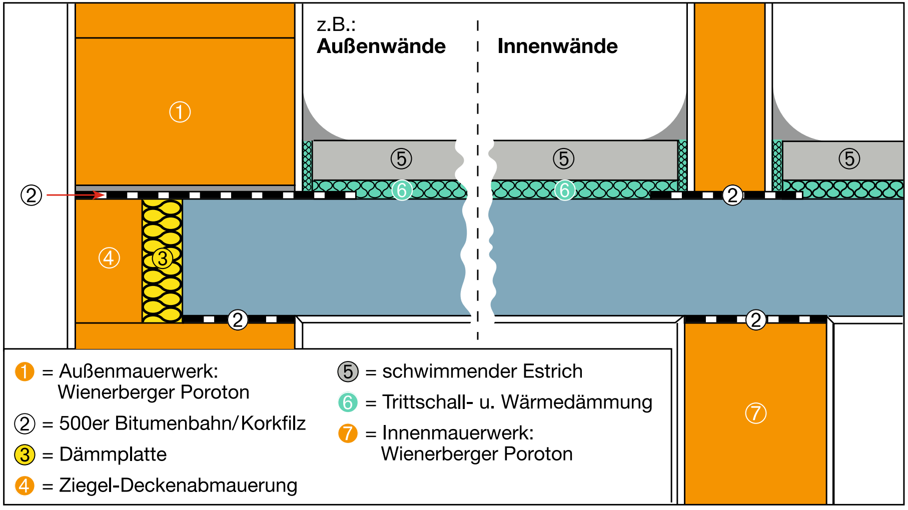
Example: two-shell house partition wall in terraced houses



Important! Sound technical decoupling of components.

Without these important details, the best sound insulation in the wall does not help!

Our recommendation: Soundproofing in detail Ceiling connection detail



Sound insulation

Optimum sound insulation for house partition walls for row houses can be achieved if the soundproof walls are designed as 2-shell, d. H. the living areas are "decoupled".

Improved impact sound insulation

In particular, mention should be made of the increase in sound insulation of the greatly improved impact sound insulation in the stairwell in two-shell Ziegelwandkonstrukti-ons, which can be extremely difficult einschalig realize. The double-shell design of the sound insulation and heat protection is very easy and inexpensive realized.

General requirements for fire protection

The Model Building Regulations (MBO) and the corresponding provisions of the state building regulations provide detailed information on the fire protection requirements for components and the building materials used therein.

One of the most important planning tasks in multi-stores housing construction is structural fire protection. It is essentially about the protection of human life. It must be possible in time to save people who can not help themselves. The requirements include the protection of rescue workers.

The first goal is preventive fire protection, ie the prevention of fires. Secondly, the limitation of fires to their place of origin must be ensured in order to prevent any impairment of other residential units as well as the escape and rescue routes due to fires.

The following principles apply:

- Solid blockwork buildings provide a high level of passive safety in the event of fire.
- The fire protection of buildings is regulated by the respective state building regulations of the individual federal states.
- With regard to the fire protection requirement, a prior coordination with the building authorities is essential, especially in multi-storey housing construction.

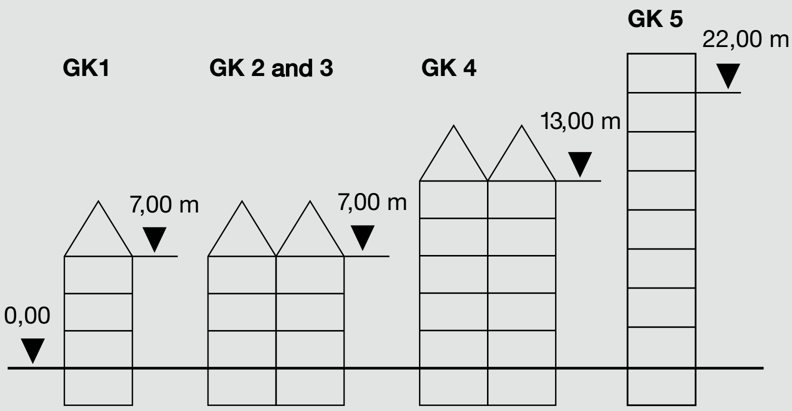
This results in increased demands on building materials and the components produced from them, especially for multi-storey housing construction. These are laid down in the respective building regulations of the federal states, the associated implementing regulations, administrative regulations and guidelines.

Walls made of clay blocks are ideal components for the separation of fire areas, rooms with high fire load and apartments as well as for securing stairwells and corridors.

The following remarks relate to residential buildings and buildings of comparable use. For other buildings special regulations apply in the individual federal states.

Building classes and their meaning

Buildings are divided into the following 5 building classes:



Building classes according to MBO 2002 (last amended 09/2012)	
Building category	**Definition MBO 2002**
1	■ Detached buildings with one height (floor level of the highest floor) up to 7 m and not more than two units of use totaling not more than 400 m² ■ Detached agricultural or forestry buildings
2	■ Buildings with a height of up to 7 m and no more than two utilization units of no more than 400 m²
3	■ Other buildings with a height up to 7 m
4	■ Buildings with a height of up to 13 m and units of no more than 400 m² each
5	■ Other buildings including underground buildings

Example building class 1

Example building class 4

The illustrated assignment of building classes to MBO applies for the states:

Baden-Württemberg
Bayern
Berlin
Bremen
Hamburg
Hessen
Niedersachsen
Mecklenburg-Vorpommern
Rheinland-Pfalz
Saarland
Sachsen
Sachsen-Anhalt
Schleswig-Holstein
Thüringen

The building code of the federal states Brandenburg and North Rhine-Westphalia distinguish between buildings of low height (Floor level up to 7 m above ground level) as well as buildings of medium height (Floor level up to 22 m above ground level).
In all federal states Buildings with a floor level of more than 22 m above ground level are classified as skyscrapers.

Fire protection requirements for components

■ The most important requirements in relation to residential buildings and structures of comparable use can be found in the following tables. To classify the terms "fire-retardant, highly fire-retardant and fire-resistant" as defined by MBO, either a fire resistance class according to DIN 4102 or DIN EN 13501-2 is required.

Essential requirements and execution of firewalls according to §30 MBO 2002 (last amended 09/2012)

building category	2	3	4	5	
Building	Building				Cultivated agricultural buildings
Apartments	≤ 2	> 2			
Height of the uppermost lounge	h ≤ 7 m		h ≤ 13 m (so far h ≤ 22 m)	13 m < h ≤ 22 m	
Requirement	1. As an internal fire wall for subdivision of extensive buildings at intervals of not more than 40 m 2. as the end wall of buildings, when erected at a distance of up to 2.5 m from the property boundary 3. Exceptions for 2 .: buildings without living rooms and fireplaces up to 50 m3 volume (garages); At least 5 m distance to existing or future permissible buildings				1. internal fire wall for subdivision into fire compartments of not more than 10,000 m3 gross volume 2. End wall / inner fire wall between residential buildings and agricultural part
Permitted wall construction if fire walls are required	high fire-retardant F 60 / REI 60		highly fire-retardant even under additional mechanical stress F 60 + M / REI 60-M	fire-resistant, even under additional mechanical stress F 90-A + M / REI 90-M	fire resistant F 90 / REI 90, if the enclosed space of the agricultural building does not exceed 2,000 m3

Required fire resistance duration of supporting walls and columns according to §27 MBO 2002 (last amended 09/2012)

building category	1	2	3	4	5
Building	Detached buildings	building			Residentialbuildingupto thehighhouseborder
Apartments usage units/	≤ 2	≤ 2	> 2	no more than 400 m² living / usable space per unit	
Height of the uppermost lounge or storey	h ≤ 7 m			h ≤ 13 m	13 m < h ≤ 22 m
Normalbullets	no requirement	fire retardant	fire retardant	high fire-retardant	fire-resistant
Basements	fire retardant	fire retardant	fire-resistant	fire-resistant	fire-resistant
Projectiles in the loft	no requirement			highly fire-retardant, if over it still lounges are possible, otherwise no requirement	fire-resistant, if it is still possible to lounge, otherwise no requirement

Required fire resistance duration and design of partition walls according to §29 MBO 2002 (last amended 09/2012)

building category	1	2	3	4	5
Building	Detached buildings	building			Residentialbuildingupto thehighhouseborder
Apartments usage units	≤ 2	≤ 2	> 2	no more than 400 m² living / usable space per unit	
Height of the uppermost lounge or storey	h ≤ 7 m			h ≤ 13 m	13 m < h ≤ 22 m
requirement	1. Between usage units as well as between usage units and differently used rooms, except necessary corridors 2. Completion of rooms with explosion or increased risk of fire (always fireproof) 3. Between lounges and differently used rooms in the basement				
Normalbullets	–	fire retardant [1]	fire retardant	high fire-retardant	fire retardant
Basementbullets	fire retardant [1]	fire retardant [1]	fire retardant	fire retardant	fire retardant
Projectiles in the loft	no requirement			highly fire-retardant, if over it still lounges are possible, otherwise no requirement	fire-resistant, if it is still possible to lounge, otherwise no requirement
execution	no requirement	up to the raw ceiling or under the roof skin			
openings	no requirements	limited to the number and size required for use and provided with fire retardant, tight and self-closing			

[1] no requirements for non-structural components

Classification of building materials

Fire protection terms, requirements and tests are defined in DIN 4102 "Fire behavior of building materials and components" and in DIN EN 13501 for the classification of building materials and DIN EN 1365 in conjunction with DIN EN 1363 for testing.

Fire protection classes of building materials

Building materials, eg. As steel, stones, wood, insulation materials are classified according to their fire behavior in classes. Bricks are not flammable and, as classified building materials, correspond to building material class A1.

Building material classes according to DIN 4102-1 with building authority designation and corresponding Euroclass

Building material class according to DIN 4102-1 / building supervisory designation	euro class	requirement level
A1 not flammable, eg. clay block	A1	without organic ingredients
A2 not flammable	A2	with organic ingredients
B1 flame retardant	B	very low contribution to the fire
	C	low contribution to the fire
B2 normally flammable	D	acceptable contribution to the fire
	E	acceptable fire behavior
B3 easily inflammable	F	no requirements

Fire resistance classes of walls according to DIN 4102-2

Fire rating	Fire resistance duration in minutes	Building supervisory designation
F 30	≥ 30	fire retardant
F 60	≥ 60	high fire-retardant
F 90	≥ 90	fire-resistant
F 120*	≥ 120	highly fire resistant
F 180*	≥ 180	highly fire resistant

* bauaufsichtl. meaningless for housing construction

Fire resistance class F according to DIN 4102-2 and corresponding classifications according to DIN EN 13501-2; the numerical value indicates the fire resistance duration in minutes

Fire resistance class according to DIN 4102-2	Fire resistance class according to DIN EN 13501-2		
	Non-load-bearing partition walls	supporting roomclosingwalls	Carrying non-space enclosing walls
F 30	EI 30	REI 30	R 30
F 60	EI 60	REI 60	R 60
F 90	EI 90	REI 90	R 90
F 120	EI 120	REI 120	R 120
F 180	EI 180	REI 180	R 180

Notes on cleaning

As fire protection effective plasters are also in DIN EN 1996-1-2, the "successor" of already assessed in DIN 4102-4, Section 4.5.2.10 corresponding light plasters according to DIN 18550-4 or gypsum plaster (mortar group P IV) according to DIN 18550-2.

According to European standards gypsum plaster according to DIN EN 13279-1 or light plaster LW or T according to DIN EN 998-1 are effective in terms of fire protection. The inclusion of these plasters in DIN EN 1996-1-2 is aimed at.

Building materials must be selected and components designed so that the requirements of preventative structural fire protection are met. The fire protection classification of building materials and components is regulated in detail in the German fire protection standard DIN 4102. For building materials that have been produced in accordance with harmonized European product standards in Building Regulations List B and marked with the CE mark, the new European classification system DIN EN 13501 applies, which was made applicable with the addition of the Building Regulations List 2002/1. For "non-regulated" products, three proofs of usability can be provided:

1. GeneralBuildingInspectorate ApprovaloftheGermanInstitutefor BuildingTechnology(DIBt)
2. GeneralBuildingInspectorateTest Certificate(ABP)ofarecognized body
3. ApprovalofaSupremeBuilding Inspectorateonacasebycasebasis

The specifications of the general building inspectorate test certificates are to be regarded as equivalent to the normative rules in the sense of the respective regional building regulations.

Clay Blocks are classified according to DIN 4102-4 and Decision 2000/605 / EC as non-combustible building materials in building material class A1.

Influences on the fire resistance of Masonry components

Extensive research projects in the last 20 years have shown that the fire resistance of components is not only influenced by the building material used and the component thickness. Figure 1 shows some other important factors influencing the fire resistance of building parts. These are in particular

- the load
- the utilization of the load capacity
- the type of fire stress (fire effect only from one side or more sides)
- the execution (eg unpoured or plastered)
- the fire resistance duration of adjacent supporting or stiffening components and
- the connections to these components.

Another important aspect is the increase in the fire resistance time of the components of a structure from top to bottom, so as not to jeopardize the function of a component by premature failure of a structural component, see Figure 2.

In contrast, the investigations have shown that the formation of butt joints in plastered brickwork has no influence on the fire resistance.

Together with Supplement A 1, Issue 11-04, DIN 4102-4, Issue 03-94, contains a large number of tables from which the fire classification of masonry from standardized bricks can be determined in detail, depending on all important parameters.

In Eurocode 6, standardized bricks are classified in DIN EN 1996-1-2 / NA.

The fire protection classification of masonry from approval bricks is given in section 3 of the respective building inspectorate approval.

Image 1
Influences on the fire resistance

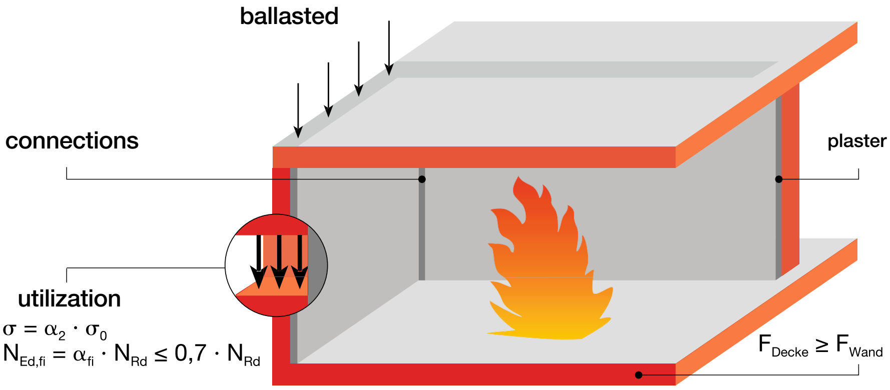
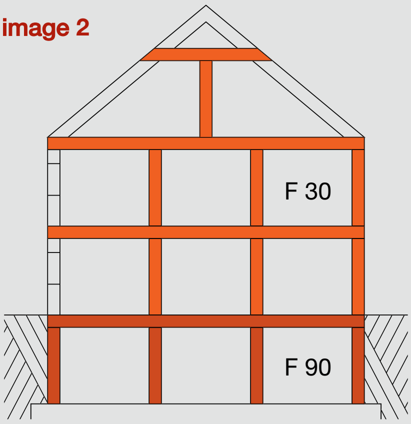
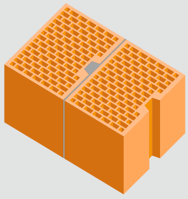


image 2

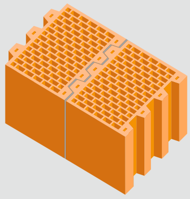


Increasing fire resistance of the load-bearing components from top to bottom

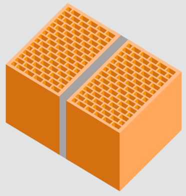
image 3
Permitted butt joint formation according to DIN 4102-4



Butt joint with mortar pocket



Butt joint toothed (tongue + groove)



fully mortared butt joint

All information in DIN 4102-4 applies to all types of butt joints, d. H. mortared butt joints and also ungrounded butt joints with butt joint or mortar pocket, s. Picture 3.

Fire walls

Fire walls must be sufficiently long to prevent the spread of fire to other buildings or fire zones as space-enclosing components for the completion of buildings (building closure wall) or for subdividing buildings into fire compartments (inner fire wall).

In federal states whose building codes define building classes (see page 83), the following exceptions apply in the majority of cases:

1. For buildings of building class 4 walls, which are also highly fire-retardant REI 60-M (F 60 + M) under additional mechanical stress.
2. For buildings in building classes 1 to 3, high-fire-resistant walls range from REI 60 (F 60).
3. For buildings of building classes 1 to 3, building partition walls which, from the inside to the outside, have the fire resistance of the load-bearing and stiffening parts of the building, but at least fire-retardant building components and, from outside to inside, the fire resistance of fire-resistant components.

In contrast to solid construction, in compliance with fire protection class F 60 (highly fire-retardant) and F 90 (fire-resistant) in timber construction, the so-called capsule criterion must additionally be adhered to. It is not enough if the overall construction has a classification of F 60 or F 90. The all-round clothing of the wood construction alone must ensure the required fire resistance F 60 or F 90. In wood construction this applies not only to fire walls, but also to load-bearing walls and columns in building class 4.

The respective state building regulations are always to be observed in individual cases. Our fire protection versions offer important reference values, but they can not replace the individual planning task in the context of a fire protection concept!

Typical applications for firewalls are z. B .:

- Building on or on Property boundaries
- Separation within broader building
- Separation of juxtaposed buildings, however, the state building regulations here often require only fire-resistant (F90 or REI90) walls.

Basically:

- Fire walls must have fire resistance class F 90 and withstand additional mechanical stress
- and non-combustible building materials. Fire resistance class REI 90-M (F 90-A + M)

Design in case of fire according to DIN EN 1996-1-2 / NA

General

The resistance of components to fire is characterized by the fire resistance class. It specifies the minimum duration in minutes that a component can withstand fire exposure. In addition to other influencing factors (see Figure 1), for the corresponding classification of a wall in a fire resistance class in particular their static utilization or the existing ballast is of particular importance.

Exploitation factors in case of fire

In DIN 4102-4 and DIN EN 1996-1-2 / NA and in the general building inspectorate approvals (abZ), masonry has three different utilization factors, the definitions of which are summarized in the table on page 88. In contrast to a design according to DIN 1053-1, the value for full utilization in accordance with DIN EN 1996-1-2 / NA is no longer 1.0, but 0.7, since the design value of the applied normal force NEd, fi is opposite the rated value of the action on the "cold" design NEd is correspondingly reduced:

$$N_{Ed,\,fi} = 0{,}7 \cdot N_{Ed} \qquad (1)$$

Definition of the utilization factors

utilization factor	definition	explanation
α_2	$\alpha_2 =$ 1.0 corresponds to the full load capacity for a design according to the simplified calculation method of DIN 1053-1.	The value is used in DIN 4102-4 and in general building inspectorate approvals for design according to DIN 1053-1.
$\alpha_{6,fi}$	$\alpha_{6,fi} =$ 0.7 corresponds to the maximum permissible load of a masonry component in case of fire when dimensioned according to DIN EN 1996 / NA.	The maximum permissible load usually corresponds to the full load capacity for a measurement according to the simplified calculation method of DIN 1053-1. The value is used in DIN EN 1996-1-2 / NA for all stone types
α_{fi}	$\alpha_{fi} =$ 0.7 corresponds to the full load capacity for a design according to DIN EN 1996-1-1 / NA or according to general building inspectorate approval (abZ) with the design rules according to DIN EN 1996-1-1 / NA.	The value is in general building inspectorate approvals (abZ) as an alternative to the utilization factor $\alpha_{6,fi}$ used.

Utilization factor$\alpha_{6,fi}$

In DIN EN 1996-1-2 / NA the exploitation factor for all types and types of stones regulated there is the utilization factor $\alpha_{6,fi}$ used.

The definition of a new utilization factor $\alpha_{6,fi}$ as a replacement for the known from DIN 4102-4 utilization factor 2 was required because the extensive table values in DIN 4102-4 could not be easily transferred to a design according to DIN EN 1996 / NA without new experiments.

The utilization factor $\alpha_{6,fi}$ takes into account that the maximum permissible normal forces for a design according to DIN EN 1996 / NA can be greater or smaller than for a design according to the simplified calculation method of DIN 1053-1. This, in addition to the computational load-bearing capacity, which is usually higher anyway, results essentially from the newly defined calculation of the load-bearing capacity for buckling as well as due to the newly established - in some cases significantly higher - masonry compressive strengths f_k.

$$\alpha_{6,fi} = \qquad (2)$$

$$\omega \cdot \frac{15}{25-\frac{h_{ef}}{t}} \cdot \frac{N_{Ed,fi}}{l \cdot t \cdot \frac{f_k}{k_0} \cdot \left(1-2\cdot\frac{e_{mk,fi}}{t}\right)} \leq 0{,}7$$

$$\text{für } 10 \leq \frac{h_{ef}}{t} \leq 25$$

$$\alpha_{6,fi} = \omega \cdot \frac{N_{Ed,fi}}{l \cdot t \cdot \frac{f_k}{k_0} \cdot \left(1-2\cdot\frac{e_{mk,fi}}{t}\right)} \leq 0{,}7 \qquad (3)$$

$$\text{für } \frac{h_{ef}}{t} < 10$$

The utilization factor $\alpha_{6,fi}$ determined with the following characteristics:

ω	Adaptation factor of masonry characteristics to the different stone types (stone-mortar combinations) on the basis of fire tests, see page 89
h_{ef}	Kink length of the wall
t	wall thickness
$N_{Ed,fi}$	Rated value of normal force (exposure) in case of fire according to equation (1)
l	walllength
f_k	Characteristic pressure resistance of the masonry
k_0	= 1,25 for wall cross sections < 0,1 m²
	= 1,00 for wall cross sections≥ 0,1 m²
$e_{mk,fi}$	scheduled Ausmitte of $N_{Ed,fi}$ at half height

When using the simplified calculation methods, the following simplifications may be made in equations (2) and (3):

$$\left(1 - 2 \cdot \frac{e_{mk,fi}}{t}\right) \quad \begin{aligned} &= 1{,}0 \text{ at full coverage ceilings } (a/t = 1{,}0) \\ &= a/t \text{ for partially overlying ceilings} (a/t < 1{,}0) \end{aligned}$$

Adjustment factor ω Dependency of the used stone-mortar combination and associated tables for classification in a fire resistance class

Brick according to DIN EN 771-1 in conjunction with DIN 20000-401 and DIN 105-100	Mortar	associated table in DIN EN 1996-1-1 / NA: 2012-05 or DIN EN 1996-3 / NA: 2012-01	ω [-]
Perforated brick HLzA, HLzB, Brick panel brick T1	NM II NM IIa NM III NM IIIa	NA.4 NA.D.1	2,2
Perforated brickHLzW, Brick panel brickT2, T3, T4		NA.5 NA.D.2	1,8
Vollziegel Mz	NM II	NA.6 NA.D.3	3,3
	NM IIa		3,0
	NM III, NM IIIa		2,6
Building bricks	LM	NA.8 NA.D.5	2,2

Utilization factor α_{fi}

In general building inspectorate approvals, the utilization factor is simplified α_{fi} used with the following characteristics:

$$\alpha_{fi} = \frac{N_{Ed,fi}}{N_{Rd}} \tag{4}$$

$N_{Ed,fi}$ Rated value of normal force (exposure) in case of fire according to equation(1)
N_{Rd} Rated value of the vertical load-bearing resistance for "cold design" according to the general rules of DIN EN 1996-1-1 / NA or the simplified calculation methods of DIN EN 1996-3 / NA

The required wall thickness for classification in a fire resistance class can at Application of the factor fi be taken directly from the tables of the general building inspectorate approvals. For a design according to the general rules of DIN EN 1996-1-1 / NA, a lower utilization than the simplified calculation methods of DIN EN 1996-3 / NA can be achieved.


Allgemeine bauaufsichtliche Zulassung

DIBt

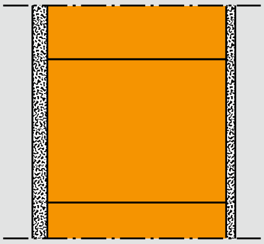
Example Monolithic outer wall

S8-MW-36,5 according to general building inspectorate approval (Z-17.1-1104) with $f_k = 3{,}0$ N/mm²

required fire resistance class: F 90 (fire resistant)

Rohdichteklasse	0,75
Wanddicke	$t = 0{,}365$ m
Auflagertiefe	$a = 0{,}245$ m $\frac{a}{t} = 0{,}67 > 0{,}45 =$ **with** t
N_{Ed}	= 259 kN/m (**adoption**)
N_{Rd}	= 318 kN/m

$$\alpha_{fi} = \frac{N_{Ed,fi}}{N_{Rd}} = \frac{0{,}7 \cdot 259}{319} = 0{,}57 < 0{,}58 = \alpha_{fi} \quad \textit{für S8-36,5-MW} \ \textbf{\textit{Proof provided.}}$$


Monolithic outer wall

Fire protection plan clay block according to DIN 4102-4 / -A1

The following classification into fire resistance classes and fire walls is based on the respective product-related building inspectorate approval. The utilization factors mentioned in addition to the fire resistance classes refer to the verification of stability with the simplified calculation method according to DIN 1053-1, section 6 (utilization factor α_2).

Product Name Poroton block Approval DIBt-	gross density	Wall thickness [cm]	Fire resistance class, utilization factor α_2 = 1,0 unless otherwise described ^{*1} Crude density class filled with concrete ≥ C 20/25, grain size 0 -16 mm ^{*2} utilization factor α_2 =0.48 for strength class 12 or 0.40 for strength class 8 ^{*3} Exploitation factor see calculation according to EC 6 ^{*4} Testing comparable product wall thickness 36.5 cm is available Review Consultation Construction consulting!				fire wall (REI and EI-M 90) Utilization factors according to load-bearing, room-sealing walls (REI), unless otherwise specified	
			non-load-bearing partition walls (one-sided fire) (EI)	load-bearing partition walls (one-sided fire) (REI)	load-bearing walls (multi-sided fire) (R)	supporting pillars or non-closing walls (multi-sided fire stress) (R)	single shell	bivalve
plastered on both sides according to DIN 18550-2 / -4								
T7-P Z-17.1-1103	0,55	≥ 36,5	–	–	–	–	–	–
T7-MW Z-17.1-1060	0,55	≥ 36,5	–	F 90-A	–^{*4}	–^{*4}	●	●
T8-P Z-17.1-982	0,6	≥ 30,0	–	F 90-AB	–	–	–	–
T8-MW Z-17.1-1041	0,65	≥ 24,0	–	F 90-A	–	–	–	–
		≥ 36,5	–	F 90-A	F 60-A	F 60-A ≥ 750 mm Breite	–	–
T9-P Z-17.1-674	0,65	≥ 36,5	–	F 90-AB	–	–	○	○
S8-P Z-17.1-1120	0,75	≥ 36,5	–	F 90-AB	–	–	–	–
S8-MW Z-17.1-1104	0,75	≥ 30,0	–	F 30-A^{*3}	–	–	–	–
		≥ 36,5		F 90-A^{*3}	F 60-A^{*3}	F 60-A^{*3} ≥ 750 mm Breite	●	●
S9-P Z-17.1-1058	0,70	≥ 30,0	–	F 90-AB	–	–	–	–
S9-MW Z-17.1-1100	0,9	≥ 30,0	–	F 90-A	–^{*4}	–^{*4}	●	●
S9-MW Z-17.1-1145	0,8	≥ 36,5	–	F 90-A $\alpha_2 \leq 0,9$	F 90-A $\alpha_2 \leq 0,66$	F 90-A $\alpha_2 \leq 0,66$ ≥ 615 mm Breite	●	●
S10-P Z-17.1-1017	0,75	≥ 30,0	–	F 90-AB	–	–	–	–
S10-MW Z-17.1-1101	0,8	≥ 36,5	–	F 90-A $\alpha_2 \leq 0,9$	F 90-A $\alpha_2 \leq 0,66$	F 90-A $\alpha_2 \leq 0,66$ ≥ 615 mm Breite	●	●
Plan-T8 Z-17.1-1085	0,6	≥ 36,5	F 30-A	F 30-A	F 30-A	F 30-A ≥ 490 mm Breite	–	–
Plan-T9/Plan-T10* Z-17.1-890	0,65/ 0,70*	≥ 36,5	F 30-A	F 30-A	F 30-A	F 30-A ≥ 490 mm Breite	–	–
Plan-T10 Z-17.1-889	0,65	30,0	F 30-A	F 90-A	–	–	●	●
		36,5	F 30-A	F 90-A	F 30-A	F 30-A ≥ 490 mm Breite	●	●
Plan-T12 Z-17.1-877	0,65	24,0	F 30-A	F 30-A	–	–	–	–
		≥ 30,0	F 90-A	F 90-A $^{(mit\ VD)}$ $\alpha_2 \leq 0,8$	F 30-A	F 30-A ≥ 365 mm Breite	● *(mit VD)*	● *(mit VD)*
Plan-T14 Z-17.1-651	0,70	24,0	F 30-A	F 30-A	–	–	–	–
		≥ 30,0	F 90-A	F 90-A	F 30-A	F30-A ≥ 365 mm Breite	● *(mit VD)**2	● *(mit VD)**2
Plan-T16 Z-17.1-651	0,75	17,5	F 30-A	F 30-A	–	–	–	–
Plan-T18 Z-17.1-678	0,8	17,5	F 30-A	F 30-A	–	–	–	–
		24,0	F 90-A	F 30-A	–	–	–	–

Product Name Poroton block Approval DIBt--	**gross density**	**Wall thickness [cm]**	**Fire resistance class, utilization factorα_2 = 1,0 unless otherwise described** [*1] Crude density class filled with concrete ≥ C 20/25, grain size 0 -16 mm [*2] utilization factor α_2 = 0.48 for strength class 12 or 0.40 for strength class 8 [*3]Exploitation factor see calculation according to EC 6				fire wall (REI and EI-M 90) Utilization factors according to load-bearing, room-sealing walls (REI), unless otherwise specified	
			non-load-bearing partition walls (one-sided fire) (EI)	**load-bearing partition walls (one-sided fire) (REI)**	**load-bearing walls (multi-sided fire) (R)**	**supporting pillars or non-closing walls (multi-sided fire stress) (R)**	**single shell**	**bivalve**
plastered on both sides according to DIN 18550-2 / -4								
HLz-Plan-T Z-17.1-868	0,8-1,4	11,5	F 120-A	F 120-A $\alpha_2 \le 0,6$	F 120-A $\alpha_2 \le 0,6$	F 90-A $\alpha_2 \le 0,6$ ≥ 615 mm Breite	–	–
	0,9	17,5	F 120-A	F 120-A $\alpha_2 \le 0,6$	F 120-A $\alpha_2 \le 0,6$	F 90-A $\alpha_2 \le 0,6$ ≥ 240 mm Breite	● $\alpha_2 \le 0,6$	●
		24,0	F 120-A	F 90-A	F 120-A $\alpha_2 \le 0,6$	F 90-A $\alpha_2 \le 0,6$ ≥ 175 mm Breite	●	●
HLz Plan-T Z-17.1-1108	1,2	17,5	F 90-A	F 90-A $\alpha_2 \le 0,77$	F 120-A $\alpha_2 \le 0,67$	F 120-A $\alpha_2 \le 0,67$ ≥ 500 mm Breite	● $\alpha_2 \le 0,77$	● $\alpha_2 \le 0,77$
	1,4	17,5	F 90-A	F 90-A $\alpha_2 \le 0,77$	F 120-A $\alpha_2 \le 0,67$	F 120-A $\alpha_2 \le 0,67$ ≥ 500 mm Breite	● $\alpha_2 \le 0,46$	● $\alpha_2 \le 0,77$
	1,2	24,0	F 90-A	F 90-A $\alpha_2 \le 0,77$	F 120-A $\alpha_2 \le 0,67$	F 120-A $\alpha_2 \le 0,67$ ≥ 500 mm Breite	● $\alpha_2 \le 0,77$	● $\alpha_2 \le 0,77$
	1,4	24,0	F 90-A	F 90-A $\alpha_2 \le 0,77$	F 120-A $\alpha_2 \le 0,67$	F 120-A $\alpha_2 \le 0,67$ ≥ 500 mm Breite	● $\alpha_2 \le 0,46$	● $\alpha_2 \le 0,77$
HLz Plan-T Z-17.1-1141	1,4	17,5	F 90-A	F 90-A $\alpha_2 \le 0,66$	F 120-A $\alpha_2 \le 0,57$	F 120-A $\alpha_2 \le 0,57$ ≥ 500 mm Breite	● $\alpha_2 \le 0,40$	● $\alpha_2 \le 0,66$
PFZ-T Z-17.1-537	2,0[*1]	17,5	F 90-A	F 90-A	F 30-A	F 30-A ≥ 500 mm Breite	●	●
		24,0	F 90-A	F 90-A	F 90-A	F 90-A ≥ 500 mm Breite	●	●
		30,0	F 90-A	F 90-A	F 90-A	F 90-A ≥ 500 mm Breite	●	●
unpainted constructions								
HLz Plan-T Z-17.1-868	0,8-1,4	11,5	–	–	–	–	–	–
	0,9	17,5	F 90-A	F 90-A $\alpha_2 \le 0,6$	–	–	–	–
	0,9	24,0	F 90-A	F 90-A $\alpha_2 \le 0,6$	–	–	–	–
HLz Plan-T Z-17.1-1108	1,2	17,5	F 90-A	F 90-A $\alpha_2 \le 0,77$	F 120-A $\alpha_2 \le 0,67$	F 120-A $\alpha_2 \le 0,67$ ≥ 500 mm Breite	● $\alpha_2 \le 0,77$	● $\alpha_2 \le 0,77$
	1,4	17,5	F 90-A	F 90-A $\alpha_2 \le 0,77$	F 120-A $\alpha_2 \le 0,67$	F 120-A $\alpha_2 \le 0,67$ ≥ 500 mm Breite	-	-
	1,2	24,0	F 90-A	F 90-A $\alpha_2 \le 0,77$	F 120-A $\alpha_2 \le 0,67$	F 120-A $\alpha_2 \le 0,67$ ≥ 500 mm Breite	● $\alpha_2 \le 0,77$	● $\alpha_2 \le 0,77$
	1,4	24,0	F 90-A	F 90-A $\alpha_2 \le 0,77$	F 120-A $\alpha_2 \le 0,67$	F 120-A $\alpha_2 \le 0,67$ ≥ 500 mm Breite	● $\alpha_2 \le 0,23$	● $\alpha_2 \le 0,23$
HLz Plan-T Z-17.1-1141	1,4	17,5	F 90-A	F 90-A $\alpha_2 \le 0,66$	F 120-A $\alpha_2 \le 0,57$	F 120-A $\alpha_2 \le 0,57$ ≥ 500 mm Breite	–	–
PFZ-T Z-17.1-537	2,0[*1]	17,5	F 30-A	F 30-A	F 30-A	F 30-A ≥ 500 mm Breite	–	–
		24,0	F 90-A	F 90-A	F 90-A	F 90-A ≥ 500 mm Breite	–	–
		30,0	F 90-A	F 90-A	F 90-A	F 90-A ≥ 500 mm Breite	●	●

○ Test report available. Detailed regulations of the federal states are to be observed.

Fire protection plan clay block according to DIN EN 1996-1-2 / -NA

The following classification into fire resistance classes and fire walls is based on the respective product-related building inspectorate approval. The utilization factors mentioned in addition to the fire resistance classes refer to a calculation according to DIN EN 1996-1-2 / -NA (utilization factor α_{fi}). The utilization factor α_{fi} corresponds to α_{fi} = 0.7 -In consideration of the rated value of the acting normal force in case of fire $N_{Ed,fi} = 0,7 \cdot N_{Ed}$ – dfull utilization in the cold design according to DIN EN 1996-1-1 / NA (Eurocode 6, more precise procedure).

Product Name **Poroton block** **Approval DIBt--**	**gross density**	**Wall thickness [cm]**	**Feuerwiderstandsklasse, Ausnutzungsfaktor α_2 = 1,0 nach Din 1053-1 wenn nicht anders beschrieben** *1 Calculation acc. Approval for wall height 2,60m and scheduled clearance e ≤ t / 3 *for buckling length calculation to EC 6 *2 Crude density class filled with concrete ≥ C 20/25, grain size 0-16 mm *3 Exploitation factor α_{fi} = 0.20 for strength class 12 or 0.16 for strength class 8 *4 Test comparable product Wall thickness 36.5 cm is available, evaluation Consultation Bauberatung!				fire wall (REI and EI-M 90) Utilization factors according to load-bearing, room-sealing walls (REI), unless otherwise specified	
			non-load-bearing partition walls (one-sided fire) (EI)	**load-bearing partition walls (one-sided fire) (REI)**	**load-bearing walls (multi-sided fire) (R)**	**supporting pillars or non-closing walls (multi-sided fire stress) (R)**	**single shell**	**bivalve**
beidseitig verputzt mit Gipsputzmörtel oder Leichtputz nach DIN EN 1996-1-2:2011-4								
T7-P Z-17.1-1103	0,55	≥ 36,5	–	–	–	–	–	–
T7-MW Z-17.1-1060	0,55	≥ 36,5	–	F 90-A $\alpha_{fi} \le 0,7$	–^{*4}	–^{*4}	●	●
T8-P Z-17.1-982	0,6	≥ 30,0	–	F 90-AB $\alpha_{fi} \le 0,61$	–	–	–	–
T8-MW Z-17.1-1041	0,65	≥ 24,0	–	F 90-A $\alpha_{fi} \le 0,70$	–	–	–	–
		≥ 36,5	–	F 90-A $\alpha_{fi} \le 0,70$	F 60-A $\alpha_{fi} \le 0,70$	F 60-A $\alpha_{fi} \le 0,70$ ≥ 750 mm Breite	–	–
T9-P Z-17.1-674	0,65	≥ 36,5	–	F 90-AB $\alpha_{fi} \le 0,61$	–	–	○	○
S8-P Z-17.1-1120	0,75	≥ 36,5	–	F 90-AB $\alpha_{fi} \le 0,56$	–	–	–	–
S8-MW Z-17.1-1104	0,75	30,0	–	F 30-A $\alpha_{fi} \le 0,55^{*1}$	–	–	–	–
		≥ 36,5	–	F 90-A $\alpha_{fi} \le 0,58$	F 60-A $\alpha_{fi} \le 0,63$	F 60-A $\alpha_{fi} \le 0,63$ ≥ 750 mm Breite	●	●
S9-P Z-17.1-1058	0,70	≥ 30,0	–	F 90-AB $\alpha_{fi} \le 0,57$	–	–	–	–
S9-MW Z-17.1-1100	0,9	≥ 30,0	–	F 90-A $\alpha_{fi} \le 0,57$	–^{*4}	–^{*4}	●	●
S9-MW Z-17.1-1145	0,8	≥ 36,5	–	F 90-A $\alpha_{fi} \le 0,58$	F 90-A $\alpha_{fi} \le 0,42$	F 90-A $\alpha_{fi} \le 0,42$ ≥ 615 mm Breite	●	●
S10-P Z-17.1-1017	0,75	≥ 30,0	–	F 90-AB $\alpha_{fi} \le 0,57$	–	–	–	–
S10-MW Z-17.1-1101	0,8	≥ 36,5	–	F 90-A $\alpha_{fi} \le 0,58$	F 90-A $\alpha_{fi} \le 0,42$	F 90-A $\alpha_{fi} \le 0,42$ ≥ 615 mm Breite	●	●
Plan-T8 Z-17.1-1085	0,6	≥ 36,5	F 30-A	F 30-A	–	F 30-A ≥ 490 mm Breite	–	–
Plan-T9 / **Plan-T10*** Z-17.1-890	0,65/ 0,70*	≥ 36,5	F 30-A	F 30-A	F 30-A	F 30-A ≥ 490 mm Breite	–	–
Plan-T10 Z-17.1-889	0,65	30,0	F 30-A	F 90-A	–	–	●	●
		36,5	F 30-A	F 90-A	F 30-A	F 30-A ≥ 490 mm Breite	●	●
Plan-T12 Z-17.1-877	0,65	24,0	F 30-A	F 30-A $\alpha_{fi} \le 0,6^{*1}$	–	–	–	–
		≥ 30,0	F90-A	F 90-A *(mit VD)* $\alpha_{fi} \le 0,48$	F 30-A $\alpha_{fi} \le 0,58^{*1}$	F 30-A $\alpha_{fi} \le 0,58^{*1}$ ≥ 365 mm Breite	● *(mit VD)*	● *(mit VD)*
Plan-T14 Z-17.1-651	0,70	24,0	F 30-A	F 30-A $\alpha_{fi} \le 0,60^{*1}$	–	–	–	–
		≥ 30,0	F 90-A	F 90-A $\alpha_{fi} \le 0,57^{*1}$	F 30-A $\alpha_{fi} \le 0,57^{*1}$	F30-A $\alpha_{fi} \le 0,57^{*1}$ ≥ 365 mm Breite	● *(mit VD)**3	● *(mit VD)**3

Product Name Poroton block Approval DIBt---	gross density	Wall thickness [cm]	Fire resistance class, utilization factor α_2 = 1.0 according to DIN 1053-1 unless otherwise stated *1 Calculation acc. Approval for wall height 2,60m and scheduled eccentricity e ≤ t / 3 for buckling length calculation according to EC 6 *2 Crude density class filled with concrete ≥ C 20/25, grain size 0-16 mm *3 utilization factor α_{fi} = 0.20 for strength class 12 or 0.16 for strength class 8				fire wall (REI and EI-M 90) Utilization factors according to load-bearing, room-sealing walls (REI), unless otherwise specified	
			non-load-bearing partition walls (one-sided fire) (EI)	**load-bearing partition walls (one-sided fire) (REI)**	**load-bearing walls (multi-sided fire) (R)**	**supporting pillars or non-closing walls (multi-sided fire stress) (R)**	**single shell**	**bivalve**
plastered on both sides with gypsum plaster or light plaster according to DIN EN 1996-1-2: 2011-4								
Plan-T16 Z-17.1-651	0,75	17,5	F 30-A	F 30-A	–	–	–	–
Plan-T18 Z-17.1-678	0,8	17,5	F 30-A	F 30-A	–	–	–	–
		24,0	F 90-A	F 30-A	–	–	–	–
HLz-Plan-T Z-17.1-868	0,8-1,4	11,5	F 120-A	F 120-A $\alpha_{fi} \leq 0,26^{*1}$	F 120-A $\alpha_{fi} \leq 0,26^{*1}$	F 90-A $\alpha_{fi} \leq 0,26\ ^{*1}$ ≥ 615 mm Breite	–	–
	0,9	17,5	F 120-A	F 120-A $\alpha_{fi} \leq 0,36^{*1}$	F 120-A $\alpha_{fi} \leq 0,36^{*1}$	F 90-A $\alpha_{fi} \leq 0,36^{*1}$ ≥ 240 mm Breite	● $\alpha_{fi} \leq 0,24^{*1}$	● $\alpha_{fi} \leq 0,40^{*1}$
		24,0	F 120-A	F 90-A $\alpha_{fi} \leq 0,40^{*1}$	F 120-A $\alpha_{fi} \leq 0,36^{*1}$	F 90-A $\alpha_{fi} \leq 0,36^{*1}$ ≥ 175 mm Breite	● $\alpha_{fi} \leq 0,7$	● $\alpha_{fi} \leq 0,7$
HLz Plan-T Z-17.1-1108	1,2	17,5	F 90-A	F 90-A $\alpha_{fi} \leq 0,54$	F 120-A $\alpha_{fi} \leq 0,47$	F 120-A $\alpha_{fi} \leq 0,47$ ≥ 500 mm Breite	● $\alpha_{fi} \leq 0,54$	● $\alpha_{fi} \leq 0,54$
	1,4	17,5	F 90-A	F 90-A $\alpha_{fi} \leq 0,54$	F 120-A $\alpha_{fi} \leq 0,47$	F 120-A $\alpha_{fi} \leq 0,47$ ≥ 500 mm Breite	● $\alpha_{fi} \leq 0,19^{*1}$	● $\alpha_{fi} \leq 0,31^{*1}$
	1,2	24,0	F 90-A	F 90-A $\alpha_{fi} \leq 0,54$	F 120-A $\alpha_{fi} \leq 0,47$	F 120-A $\alpha_{fi} \leq 0,47$ ≥ 500 mm Breite	● $\alpha_{fi} \leq 0,54$	● $\alpha_{fi} \leq 0,54$
	1,4	24,0	F 90-A	F 90-A $\alpha_{fi} \leq 0,54$	F 120-A $\alpha_{fi} \leq 0,47$	F 120-A $\alpha_{fi} \leq 0,47$ ≥ 500 mm Breite	● $\alpha_{fi} \leq 0,31^{*1}$	● $\alpha_{fi} \leq 0,31^{*1}$
HLz Plan-T Z-17.1-1141	1,4	17,5	F 90-A	F 90-A $\alpha_{fi} \leq 0,45$	F 120-A $\alpha_{fi} \leq 0,39$	F 120-A $\alpha_{fi} \leq 0,39$ ≥ 500 mm Breite	● $\alpha_{fi} \leq 0,16^{*1}$	● $\alpha_{fi} \leq 0,26^{*1}$
PFZ-T Z-17.1-537	$2,0^{*2}$	17,5	F90-A	F 90-A $\alpha_{fi} \leq 0,7$	F 30-A $\alpha_{fi} \leq 0,60^{*1}$	F 30-A $\alpha_{fi} \leq 0,60^{*1}$ ≥ 500 mm Breite	● $\alpha_{fi} \leq 0,7$	● $\alpha_{fi} \leq 0,7$
		24,0	F90-A	F 90-A $\alpha_{fi} \leq 0,7$	F 90-A $\alpha_{fi} \leq 0,60^{*1}$	F 90-A $\alpha_{fi} \leq 0,60^{*1}$ ≥ 500 mm Breite	● $\alpha_{fi} \leq 0,7$	● $\alpha_{fi} \leq 0,7$
		30,0	F90-A	F 90-A $\alpha_{fi} \leq 0,7$	F 90-A $\alpha_{fi} \leq 0,58^{*1}$	F 90-A $\alpha_{fi} \leq 0,58^{*1}$ ≥ 500 mm Breite	● $\alpha_{fi} \leq 0,7$	● $\alpha_{fi} \leq 0,7$
unpainted constructions								
HLz Plan-T Z-17.1-868	0,8-1,4	11,5	–	–	–	–	–	–
	0,9	17,5	F 90-A	F 90-A $\alpha_{fi} \leq 0,36^{*1}$	–	–	–	–
	0,9	24,0	F 90-A	F 90-A $\alpha_{fi} \leq 0,36^{*1}$	–	–	–	–
HLz Plan-T Z-17.1-1108	1,2	17,5	F 90-A	F 90-A $\alpha_{fi} \leq 0,54$	F 120-A $\alpha_{fi} \leq 0,47$	F 120-A $\alpha_{fi} \leq 0,47$ ≥ 500 mm Breite	● $\alpha_{fi} \leq 0,54$	● $\alpha_{fi} \leq 0,54$
	1,4	17,5	F 90-A	F 90-A $\alpha_{fi} \leq 0,54$	F 120-A $\alpha_{fi} \leq 0,47$	F 120-A $\alpha_{fi} \leq 0,47$ ≥ 500 mm Breite	–	-
	1,2	24,0	F 90-A	F 90-A $\alpha_{fi} \leq 0,54$	F 120-A $\alpha_{fi} \leq 0,47$	F 120-A $\alpha_{fi} \leq 0,47$ ≥ 500 mm Breite	● $\alpha_{fi} \leq 0,54$	● $\alpha_{fi} \leq 0,54$
	1,4	24,0	F 90-A	F 90-A $\alpha_{fi} \leq 0,54$	F 120-A $\alpha_{fi} \leq 0,47$	F 120-A $\alpha_{fi} \leq 0,47$ ≥ 500 mm Breite	● $\alpha_{fi} \leq 0,16$	● $\alpha_{fi} \leq 0,16$
HLz Plan-T Z-17.1-1141	1,4	17,5	F 90-A	F 90-A $\alpha_{fi} \leq 0,45$	F 120-A $\alpha_{fi} \leq 0,39$	F 120-A $\alpha_{fi} \leq 0,39$ ≥ 500 mm Breite	–	–
PFZ-T Z-17.1-537	$2,0^{*2}$	17,5	F 30-A	F 30-A $\alpha_{fi} \leq 0,60^{*1}$	F 30-A $\alpha_{fi} \leq 0,60^{*1}$	F 30-A $\alpha_{fi} \leq 0,60^{*1}$ ≥ 500 mm Breite	–	–
		24,0	F 90-A	F 90-A $\alpha_{fi} \leq 0,60^{*1}$	F 90-A $\alpha_{fi} \leq 0,60^{*1}$	F 90-A $\alpha_{fi} \leq 0,60^{*1}$ ≥ 500 mm Breite	–	–
		30,0	F 90-A	F 90-A $\alpha_{fi} \leq 0,58^{*1}$	F 90-A $\alpha_{fi} \leq 0,58^{*1}$	F 90-A $\alpha_{fi} \leq 0,58^{*1}$ ≥ 500 mm Breite	● $\alpha_{fi} \leq 0,43^{*1}$	● $\alpha_{fi} \leq 0,43^{*1}$

○ Prüfbericht liegt vor. Detaillierte Regelungen der Bundesländer sind zu beachten.

Fire protection Block bricks, small formats, soundproof tiles, brick lintels and U-shells according to DIN 4102-4 / A1

Product Name Poroton block DIBt approval * DIN V 105 / DIN EN 771/1	gross density	Wall thickness [cm]	**Fire resistance class, utilization factor α_2 naccording to DIN 4102 Part 4: 1994-03 resp. $\alpha_{6f,i}$ = 0,7 gem. DIN EN 1996-1-2 / NA, unless otherwise specified. Possible higher fire resistance classes with lower utilization factors as well as other pillar dimensions as described below, see above mentioned standards.** *1 Exploitation factor 2 ≤ 0.7 resp. $\alpha_{6f,i} \le 0{,}42$ * 2 only when using solid bricks τ2 ≤ 0.7 or τ6f, i ≤ 0.42 * 3 Utilization factor τ2 ≤ 0.6 or τ6f, i ≤ 0.42 4 only gross density class 5 Crude density class ≥ 1.2 utilization factor $\alpha_2 \le 0{,}6$ bzw. $\alpha_{6f,i} \le 0{,}42$ gross density ≥ 1,4 $\alpha_2 \le 1{,}0$ bzw. $\alpha_{6f,i} \le 0{,}7$				fire wall (REI and EI-M 90) Utilization factors according to load-bearing, room-sealing walls (REI), unless otherwise specified	
			non-load-bearing partition walls (one-sided fire stressing) (EI)	**load-bearing partition walls (unilateral fire exposure) (REI)**	**load-bearing walls (multi-sided fire exposure) (R)**	**supporting pillars or non-space-enclosing walls (multi-sided fire stress) (R)**	**Single leaf**	**Cavity**
plastered on both sides with gypsum mortar or light plaster according to DIN EN 1996-1-2: 2011-4								
Block-T14 Z-17.1-673	0,70	≥ 30,0	F 90-A	F 90-A	F 30-A	F 30-A ≥ 365 mm Breite	–	–
Block-T18/T-21 Z-17.1-383	0,8/0,9	17,5	F 90-A	F 90-A $\alpha_2 \le 0{,}6$	F 90-A $\alpha_2 \le 0{,}6$	–	–	●
		24,0	F 90-A	F 90-A	F 90-A	F 90-A ≥ 300 mm Breite	●	●
HLZ-Block-T Kleinformate DIN 105-100 DIN EN 771-1	0,80	11,5	F 120-A EI 180	F 90-A	F 90-A	F 90-A ≥ 730 mm Breite	–	–
	0,90	17,5	F 180-A	F 180-A	F 120-A	F 120-A ≥ 365 mm Breite	●	●
	0,90	≥ 24,0	F 180-A	F 180-A	F 180-A	F 120-A ≥ 240 mm Breite	●	●
HLZ-Block-T Schallschutzziegel DIN 105-100 DIN EN 771-1	≥ 1,2	11,5	F 120-A EI 180	F 90-A	F 90-A	F 90-A ≥ 730 mm Breite	–	–
		17,5	F 180-A	F 180-A	F 120-A	F 120-A ≥ 365 mm Breite	●	●
		≥ 24,0	F 180-A	F 180-A	F 180-A	F 120-A ≥ 240 mm Breite	●	●
unpainted constructions								
AGZ-T DIN 105-100 DIN EN 771-1 Z-17.1-383[3)]	0,90	11,5	F 90-A EI 120	–	–	–	–	–
		17,5	F 180-A	F 90-A	–	–	–	–
		24,0	F 180-A	F 90-A	–	–	●[*1]	●
		30,0[3)]	–	–	–	–	–	–
		36,5[3)]	F 90-A	F 90-A	–	–	●	●
GWZ-T DIN 105-100 DIN EN 771-1	1,2	24,0	F 180-A	F 180-A	F 90-A	F 90-A ≥ 615 mm Breite	●[*1]	●
		30,0	F 180-A	F 180-A	F 90-A	F 90-A ≥ 490 mm Breite	●	●
		36,5	F 180-A	F 180-A	F 90-A	F 90-A ≥ 490 mm Breite	●	●
HLz-Block-T Kleinformate DIN 105-100 DIN EN 771-1	0,80	11,5	F 90-A EI 120	–	–	–	–	–
	0,90	17,5	F 180-A	F 90-A	–	–	–	–
		≥ 24,0	F 180-A	F 90-A	–	–	●[*1]	●
HLz-Block-T Schallschutzziegel DIN 105-100 DIN EN 771-1	≥ 1,2	11,5	F 90-A EI 120	F 60-A	F 60-A	F 60-A[*2] ≥ 990 mm Breite	–	–
		17,5	F 180-A	F 90-A	F 90-A[*3]	F 90-A ≥ 730 mm Breite	–	●[*4]
		≥ 24,0	F 180-A	F 180-A	F 90-A	F 90-A ≥ 615 mm Breite	●[*5]	●

Fire protection falls and U-shells

Minimum width b and minimum height of load-bearing flat lintels according to Z-17.1-900 and non-load-bearing flat lintels according to Z-17.1-1083 and ausbeto ned U-shells according to DIN 4102-4

Construction features masonry or concrete 	Minimum tension belt		Minimum width b in mm Fire resistance class		
	Concrete cover mm	Height h mm	F 30-A/-AB*	F 60-A/-AB*	F 90-A/-AB*
Prefabricated flat lintels after Z-17.1-900 and Z-17.1-1083	15	71	(115)	(115)	(115)
	20	113	115	115	175 (115)
Concrete U-shells made of bricks	–	240	115	115	175

() Values plastered on three sides
* with thermal insulation lintels

The plaster of the lintel underside can be dispensed with when arranging steel or Holzumfassungszargen.

The required fire protection is defined in the respective state building regulations. Components are classified by classification according to DIN 4102-4 or by fire tests according to DIN 4102-2 / 3 according to the fire resistance duration in fire resistance classes. The fire resistance time is the minimum time in minutes that the component will withstand the fire without losing its function (eg load carrying capacity and / or room closure). Designation of the fire resistance class: F90-A: Fire resistance duration 90 minutes, building material class A non-combustible building materials. The parenthesis values in the table header (EI, REI, R, REI-M 90) represent the analogous classification according to DIN EN 13501-2.

Verification method and design

Introduction

The dimensioning and execution of masonry was regulated for a long time in DIN 1053-1: 1996-11. The design was based on the global safety concept. Here, the scattering of the action and the material was taken into account by means of a global safety factor on the impact side.

In the last 20 years, the global safety concept was gradually replaced by the partial safety concept in the construction industry. In this conversion, collateral flows in via individual partial safety factors on the impact and resistance side (material).

Since 1 July 2013, the partial safety concept has entered the daily work of the planners with the introduction of the Eurocode range. This should give the engineers the opportunity to plan and work for other European countries without having to deal with a fundamentally different safety philosophy. For masonry construction, DIN EN 1996 (Eurocode 6) with relevant national annexes is relevant here. This part was introduced on 01.01.2015.

Brick masonry according to general building inspectorate approvals

The vast majority of brick constructions will continue to be dimensioned and executed in accordance with general construction supervisory approvals.

The conversion of the building inspectorate approvals to the design according to DIN EN 1996 is currently being implemented.

Detection methods

The verification of masonry components can also be carried out according to Eurocode 6 according to a more accurate method (DIN EN 1996-1-1 with national annex) or according to simplified calculation methods (DIN EN 1996-3 with national annex).

In conventional brick components, the simplified calculation methods are generally sufficient, the increased detection effort of the more accurate method is usually not feasible in more economical designs. However, there is no mixture prohibition, so that individual components of a building can be detected with the more accurate method.

Since masonry buildings usually fall within the application limits of the simplified design method, this is primarily dealt with below. For the proof of shear, however, the design algorithm is presented according to the more precise method, since DIN EN 1996-3 does not provide any computational proof here.

POROTON

Statik kompakt

Bemessung von Ziegelmauerwerk nach DIN EN 1996 - 3 (Vereinfachtes Verfahren)

Die DIN EN 1996 bzw. der Eurocode 6 Teile 1-1, 1-2, 2 und 3 liegen vor. Eine bauaufsichtliche Einführung ist zum 01.01.2015 mit einer einjährigen Übergangsfrist der derzeit gültigen DIN 1053-1 geplant. Seitens der Bauaufsicht bestehen bereits heute keine Einwände gegen die Bemessung von Mauerwerk nach Eurocode 6 (siehe http://www.dibt.de/de/DIBt/data/Newsletter/03_2012.pdf)

Download at www.wienerberger.de
- wall solutions
- Download center
- brochures

The parts of the Eurocode 6 - DIN EN 1996

Design and construction of masonry structures
DIN EN 1996-1-1:
General rules for the masonry
DIN EN 1996-1-2: Structural design for fire
DIN EN 1996-2:
Selection of building materials and execution
DIN EN 1996-3:
Simplified calculation methods for unreinforced masonry structures
+ the national annexes

Requirements for the application of simplified calculation methods according to DIN EN 1996-3 with national annex

In the simplified calculation methods certain conditions, z. B .:

- Bending moments from ceiling clamping or support
- unwanted Ausmitten the kink proof
- Wind on load-bearing walls

not to be detected, as they are taken into account at the safety distance which underlies the detection method or by constructive rules. In principle, it is assumed that only bending moments from the ceiling stress or superposition and from wind loads occur in the wall.

Due to the simplifications mentioned, the application of the simplified calculation methods is only permissible under certain boundary conditions. If one of these requirements is not fulfilled, a more exact calculation with the rules of Part 1-1 is mandatory. The necessary boundary conditions are shown in the table.

Table 1

Application limits of the simplified method according to DIN EN 1996-3 with national annex for conventional brick wall constructions

component	Wall thickness [mm]	Clear floor height hs [m]	Traffic load of the ceiling p [kN/m²]	Building height H [m][1] [7]	Ceiling support width l [m]
interior walls	≥ 115 < 240	≤ 2,75	≤ 5,00	< 20 [1] (≤ 10) [6]	≤ 6 [4]
	≥ 240	–			
Single-shell exterior walls	≥ 175 < 240[2]	≤ 2,75			
	≥ 240	≤ 12 · t (3,0) [6]			
Trays of two-shell exterior walls as well as two-shell house partitions	≥ 115 < 175	≤ 2,75	≤ 3,0 including separation wall surcharge	≤ 2 Full floors + converted attic [3]	
	≥ 175 < 240	≤ 2,75	≤ 5,0	≤ 20 (≤ 10) [6]	
	≥ 240	≤ 12 · t (3,0) [6]			

---

[1] for pitched roofs means between ridge and eaves height

[2] in the case of single-storey garages and similar structures which are not intended for the permanent residence of humans, d ≥ 115 mm is also permissible

[3] Distance between stiffening transverse walls ≤ 4.5 m, edge distance from an opening ≤ 2.0 m

[4] Unless the bending moments from the ceiling rotation angle by constructive measures, eg. B. centering by soft fiber strips on the wall head inside, be limited. For biaxially tensioned ceilings, the shorter of the two span sizes is to be expected (not possible with Dryfix masonry)

[5] Including surcharge for non-load-bearing internal partitions

[6] Clamp values apply only to Dryfix masonry

[7] for dryfix masonry max. 3 full floors

The scheduled overbinding according to DIN EN 1996-1-1 must be at least 0.4 · h and at least 45 mm.

The ceiling support depth a must be at least half the wall thickness (0.5 · t) but more than 100 mm. With a wall thickness of 365 mm, the minimum ceiling support depth may be reduced to 0.45 · t.

Classification of Poroton bricks according to application limits

Poroton Clay block	Internal wall	single-shell exterior wall	Carrying tray of two shelled outer walls
	[cm]		
T7-P		36,5 – 49,0	
T7-MW		36,5 – 49,0	
T8-P		30,0 – 49,0	
T8-MW		30,0 – 49,0	24,0
T9-P		36,5	
S8-P		36,5 – 49,0	
S8-MW		36,5 – 49,0	
S9-P		30,0 – 42,5	
S9-MW		30,0 – 42,5	
S10-P		30,0 – 42,0	
S10-MW		30,0 – 42,5	
Planziegel-T8		36,5 – 50,0	
Planziegel-T9		30,0 – 42,5	
Planziegel-T10		30,0 – 36,5	
Planziegel-T12		30,0 – 49,0	24,0
Planziegel-T14		30,0 – 36,5	24,0
Planziegel-T16			17,5
Planziegel-T18			17,5 – 24,0
HLz-Plan-T	11,5 – 24,0		17,5 – 24,0
HLz-Plan-T 1,2	11,5 – 24,0		17,5 – 24,0
HLz-Plan-T 1,4	11,5 – 24,0		17,5 – 24,0
Planfüllziegel PFZ-T	17,5 – 30,0		
Keller-Plan-ziegel-T16		36,5	
Blockziegel-T14		30,0 – 36,5	
Blockziegel-T18/-T21			17,5 – 24,0
HLz-Block-T	11,5 – 24,0		17,5 – 24,0
HLz-Block-T 1,2	11,5 – 24,0		17,5 – 24,0
HLz-Block-T 1,4	11,5 – 24,0		17,5 – 24,0
Gewerbe-ziegel-T		24,0 – 36,5	
Agrarziegel-T	11,5 – 24,0	24,0 – 36,5	17,5 – 24,0
Kleinformat 0,9	11,5 – 24,0		17,5 – 24,0
Schallschutz-ziegel	11,5 – 24,0		17,5 – 24,0

Evidence of predominantly vertically stressed Walls with the simplified calculation methods according to DIN EN 1996-3 with national attachment

Proof

The stability of walls at predominantly normal force load is according to DIN EN 1996-3 with a national annex by comparing the existing normal force NEd with the maximum absorbable normal force N_{Rd} demonstrated.

$$N_{Ed} \leq N_{Rd} \tag{1}$$

Rated value of the acting normal force N_{Ed}

For residential and office buildings may be used:

$$N_{Ed} = 1{,}35 \cdot N_{Gk} + 1{,}5 \cdot N_{Qk} \tag{2}$$

mit

N_{Ed} Rated value of the acting normal force

N_{Gk} Characteristicvalueoftheactingnormalforceduetoconstantloads (eg own weight)

N_{Qk} Characteristic value of the acting normal force due to variable loads (eg payload)

In buildings with reinforced concrete slabs and characteristic payloads (including partition wall surcharge) qk ≤ 3 kN / m2 may be simplified:

$$N_{Ed} = 1{,}4 \cdot (N_{Gk} + N_{Qk}) \tag{3}$$

For larger bending moments around the strong axis (eg windscreens), the load combination max M + min N must also be analyzed:

$$\min N_{Ed} = 1{,}0 \cdot N_{Gk} \tag{4}$$

$$\max M_{Ed} = 1{,}0 \cdot M_{Gk} + 1{,}5 \cdot M_{Qk} \tag{5}$$

Rated value of the absorbable normal force NR_d

$$N_{Rd} = \Phi_s \cdot A \cdot f_d \tag{6}$$

mit

Φ_s Reduction factor, $\Phi_s = \min(\Phi_1, \Phi_2)$

A = l · t Gross cross-sectional area of the wall section to be detected

f_d Rated value of compressive strength

$$f_d = \zeta \cdot \frac{f_k}{\gamma_M}$$

For wall cross-sections <0.1 m², the rated compressive strength is f_d multiply by a factor of 0.8.

f_k characteristic masonry pressure resistance

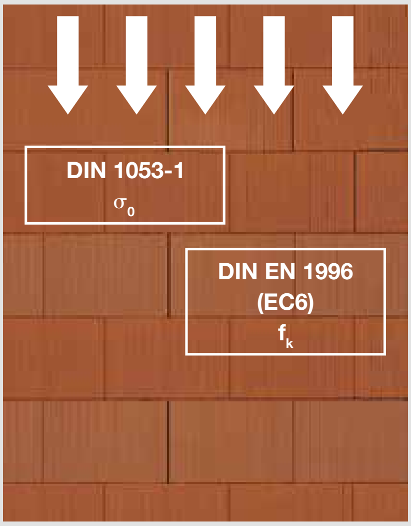
γ_M Partial safety factor for material properties, for permanent and temporary design situations = 1.5; for exceptional design situations (eg earthquake) = 1.3

ζ Coefficient for consideration of long-term effects, i. d. R. applies $\zeta = 0{,}85$

Characteristic masonry pressure resistance f_k

Compressive strength is a material property of the brick. After processing, the characteristic masonry compressive strength results f_k [MN / m²] on the finished masonry, which is included in the static design. With the introduction of the DIN EN 1996 solves the **characteristic masonry pressure resistance f_k** the well-known size of the permissible **masonry pressure clamping** according to DIN 1053-1 σ_0 from.

While the characteristic masonry pressure strengths depending on the compressive strength of DIN EN 1996-3 NA can be deduced for standard products, **the respective building inspectorate approval applies to the currently used flat brick. Down-load the approvals below http://www.wienerberger.de/wand-loesungen/Download-Center**



Reduction factors Φ

Φ_1 for reduced load on the wall head and wall foot due to the ceiling rotation angle at end supports

For ceilings between floors:

for $f_k < 1{,}8$ N/mm² bzw. for $f_k \geq 1{,}8$ N/mm²

$$\Phi_1 = 1{,}6 - \frac{l}{5} \leq 0{,}9 \cdot \frac{a}{t} \quad (7\ a)$$

$$\Phi_1 = 1{,}6 - \frac{l}{6} \leq 0{,}9 \cdot \frac{a}{t} \quad (7\ b)$$

If the payload reduction, due to ceiling rotation angle, by constructive measures, such. B. avoided by centrally located centering or load free strip, it is true regardless of the ceiling support width

$$\Phi_1 = 0{,}9 \cdot \frac{a}{t} \quad (8)$$

The use of centering strips in the middle under the ceiling cover results in splitting tensile forces, which must be verified by a separate proof of the partial surface pressure.
With

a Bearing depth of the floor slab
t wall thickness

For ceilings above the top floor, especially for roofs with low loads:

$$\Phi_1 = \frac{1}{3} \quad (9)$$

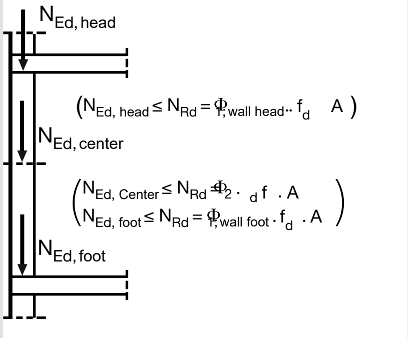
for all values of span l.

Φ_2 at load reduction due to risk of buckling in half wall height

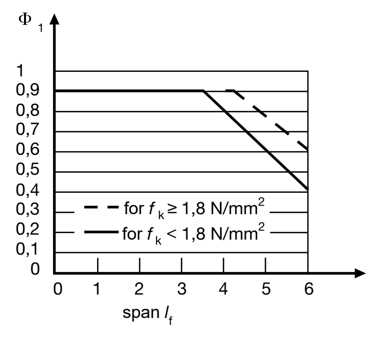
$$\Phi_2 = 0{,}85 \cdot \frac{a}{t} - 0{,}0011 \cdot \left(\frac{h_{ef}}{t}\right) \quad (10)$$

With
h_{ef} buckling length
t wall thickness

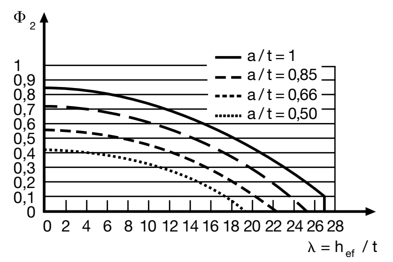
Decisive for the design is the smaller of the values Φ_1 **and** Φ_2**.**



The proof is at the design sites wall head, wall center and wall foot with the respective load N_{ED} in combination with the associated reduction factor Φ respectively.



reduction factor Φ_1 depending on
span l_f For various characteristic values of the pressure resistance of masonry.



Reduction factor Φ_2 in dependence of h_{ef}/t in different circumstances a/t

(all drawings from "The Eurocode 6 for Germany", Verlag Ernst & Sohn and DGfM German Society for Masonry and Housing e.V.)

In the preliminary design, one can prove the buckling resistance in wall center with the maximum occurring loads on the wall foot to estimate a wall.

max $N_{Ed} \leq$ min N_{Rd}

Due to the different influences of the parameters required for the calculation, it is recommended to carry the verification with the corresponding load factor at each of the points described above.

For massive slab ceilings or ribbed ceilings in accordance with DIN EN 1992-1 with national annex with load-distributing beams, the wall clamping in the ceilings on 2-sided walls may be taken into account by reducing the buckling length:

$$h_{ef} = \rho_2 \cdot h \qquad (11)$$

With
h_{ef} buckling length
h clear storey height
ρ_2 reduction factor

$\rho_2 = 0{,}75$ for Wall thickness $t \leq 175$ mm
$\rho_2 = 0{,}90$ for Wall thickness $175 \text{ mm} < t \leq 250$ mm
$\rho_2 = 1{,}00$ for Wall thickness $t > 250$ mm

A reduction of the buckling length with ρ_2 is only allowed if:

$$\begin{aligned} &\text{for } t < 240 \text{ mm: } a = t \\ &\text{for } t \geq 240 \text{ mm: } a \geq 175 \text{ mm} \end{aligned} \qquad (12)$$

The slimming h_{ef}/t may not be greater than 27.

Checking the minimum load

In order to ensure that the effects of wind are transmitted from the outer walls to the adjacent components, proof of the minimum load shall be provided.
Simplified applies:

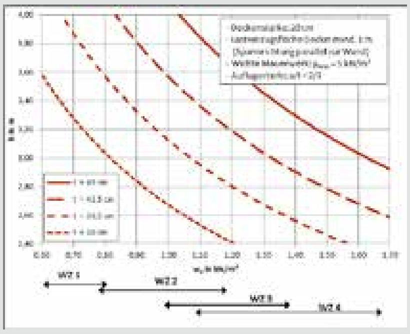
$$N_{Ed} \geq \frac{3 \cdot q_{Ewd} \cdot h^2 \cdot b}{16 \cdot \left(a - \frac{h}{300}\right)} \qquad (13)$$

Where:
h the clear floor height
q_{Ewd} the rated value of the wind load per unit area
N_{Ed} The rated value of the wind viewed per unit area considered projectile

b the width over which the vertical load acts die
a Ceiling support depth

For practical constructions in the wind load zones 1 and 2 the proof can be omitted as a rule (see *)

In the diagram, the permissible maximum wall height h is plotted as a function of the existing rated wind load wd and wall thickness t for a related ceiling support depth a / t = 2/3.



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* Graubner, C.-A. / Schmitt, M. / Förster, V.:
Aid for Practical Design of Masonry, Masonry 2014, p. 176-187

Proof of the lateral force carrying capacity after DIN EN 1996-1-1 with national annex

Proof of the lateral force carrying capacity

A computational proof of the stiffening may be waived according to DIN EN 1996-3 / NA:

- when the floors are designed as stiff discs
- or statically proven, sufficiently rigid ring beams are present
- and if in the longitudinal and transverse direction of the building an obviously sufficient number of sufficiently long stiffening walls is present, which are performed without major weakenings and without Verleger to the foundations.

If it is not clear from the outset that the stiffening of a building is ensured, then according to DIN EN 1996-3 with national annex, NDP to 4.1.1 (1), a calculated proof of the shear capacity according to the more precise method according to DIN EN 1996 -1-1: 2010-12, 6.2, in conjunction with the associated National Annex.

The following applies:

$$V_{Ed} \leq V_{Rdlt} \qquad (14)$$

with

V_{Ed}	Rated value of the acting lateral force
V_{Rdlt}	Minimum design value of the lateral force bearing capacity (disc direction)

$$V_{Rdlt} = l_{cal} \cdot f_{vd} \cdot \frac{t}{c} \qquad (15)$$

t wall thickness

Shear stress distribution factor c

c = 1,0 for h/l ≤ 1,0
= 1,5 for h/l ≥ 2,0
Intermediate values may be interpolated linearly
h clear wall height
l Length of wall plate

Calculated wall length l_{cal}

For the detection of wall plates under wind stress, the following applies:
l_{cal} = 1,125 · l bzw. l_{cal} = 1,333 · $l_{c,lin}$. The smaller of the two values is authoritative. In all other cases l_{cal} = l bzw. $l_{c,lin}$

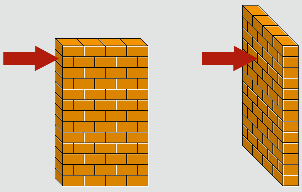
$$l_{c,lin} = \frac{3}{2} \cdot \left(1\text{-}2\,\frac{e_w}{l}\right) l < l \qquad (16)$$

$l_{c,lin}$	Excessive length of the wall plate to be used for the calculation
e_w	Eccentricity of the applied normal force in the longitudinal direction of the wall

$$e_w = \frac{M_{ed}}{N_{ed}} \qquad (17)$$

M_{Ed}	Rated value of the acting moment in the wall longitudinal direction
N_{Ed}	Rated value of the acting normal force

In principle, a distinction must be made between shear load capacity in the disk direction or in the plate direction



When calculating the calculated wall length lcal, values can be given which are longer than the geometric length of the wall or the geometric length of the overpressed area.

Design value of the shear strength f_{vd}

$$f_{vd} = \frac{f_{vlt}}{\gamma_M} = \frac{f_{vk}}{\gamma_M} \qquad (18)$$

γ_M Partial safety factor for material properties ($\gamma_M = 1,5$)
$f_{vlt} = f_{vk}$ Characteristic value of the shear strength

For disc thrust applies:

$$f_{vlt} = \min\,(f_{vlt1}\,;f_{vlt2}) \qquad (19)$$

$$f_{vlt1} = f_{vk0} + 0,4 \cdot \sigma_{Dd} \quad \text{friction failure} \qquad (20)$$

$$f_{vlt2} = 0,45 \cdot f_{bt,cal} \cdot \sqrt{1 + \frac{\sigma_{Dd}}{f_{bt,cal}}} \quad \text{Stone train fail} \qquad (21)$$

f_{vk0} Adhesive shear strength according to Table 2
Is the adhesive shear strength calculated,
In addition, an edge strain test is to be performed
σ_{Dd} Design value of the associated compressive stress for rectangular cross-sections applies:

$$\sigma_{Dd} = \frac{N_{Ed}}{l_{c,lin} \cdot t} \qquad (22)$$

$f_{bt,cal}$ = $0,020 \cdot f_{st}$ for hollow blocks
= $0,026 \cdot f_{st}$ for high hole stones and stones with grip holes or hand pockets
= $0,032 \cdot f_{st}$ for meanstones without handle holes or hand pockets, converted
f_{st} average minimum compressive strength according to Table 3

For the values $f_{bt,cal}$ and f_{st} the respective building authority approval must be observed!

Table 2: Characteristic values f_{vk0} [MN/m²] the adhesive shear strength

	mortar group			
joints	NM II	NM IIa LM 21 LM 36	NM III DM	NM IIIa
un mortared	0,04	0,09	0,11*	0,13
mortared	0,08	0,18	0,22	0,26

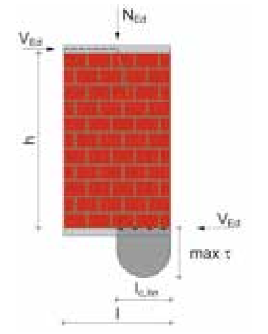
* for plane brick masonry with butt joint teeth

Table 3: Calculated values for f_{st} depending on the compressive strength class

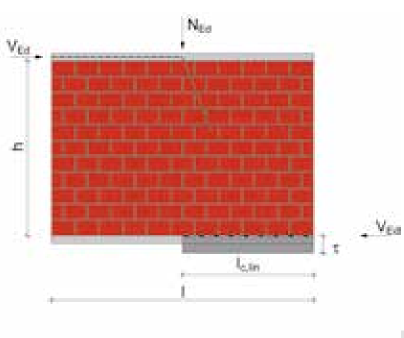
Compressive strength class of bricks and plan elements	4	5	8	10	12	16	20	28	36	48	60
Converted average minimum compressive strength f_{st} N/mm²	5	7,5	10	12,5	15	20	25	35	45	60	75

For proof of shear, no added value is used to take account of long-term effects, as it is usually a short-term load.

Shear stress distribution for slender and squat walls.



Shear stress parabolic for: $\frac{h}{l} \geq 2$



Shear stress constant for: $\frac{h}{l} \leq 1$

Source: Deutsche Poroton GmbH, Technical Information Statics, Edition 1/2015

Edge strain analysis

If the calculated value of the adhesive shear strength is used in the determination of the shear strength, wind gaps with gaping joints are subject to characteristic loads ($e_{w,k}$ > l/6) in addition the computational boundary strain $\varepsilon_R \leq 10^4$ Assign to-*.

$$\varepsilon_R = \frac{\sigma_D}{E} \cdot \left[\frac{l}{l_{c,lin}} -1 \right] \leq 10^{-4} \qquad (22)$$

The modulus of elasticity for brick masonry can be assumed to be E = 1100 · fk.

$$\sigma_D = \frac{2 \cdot N_{Ek}}{A_{c,lin}} = \frac{2 \cdot N_{Ek}}{l_{c,lin} \cdot t} \qquad (23)$$

$$l_{c,lin} = \frac{3}{2} \cdot \left(1\text{-}2 \cdot \frac{e_{w,k}}{l} \right) \cdot l \leq l \qquad (24)$$

Bending pressure bearing capacity

For shear walls subjected to shear stress, the bending pressure detection around the strong axis must always be performed taking into account the load case combination max M and min N. Decisive combination is usually the Wandfuß (2)
The following applies:

$$N_{Ed} \leq N_{Rd} \qquad (25)$$

N_{Ed}	Rated value of the acting normal force
N_{Rd}	Rated value of the absorbable normal force

$$N_{Rd} = A \cdot f_d \cdot \Phi_y \qquad (26)$$

A =	l · T Gross cross-sectional area of the wall section to be verified
f_d	Rated value of compressive strength **

$$\Phi_y = \Phi_{yi} = 1\text{-}2 \cdot \frac{e_{w,i}}{l}^{***} \qquad (27)$$

$$^{*}e_{w,k} = \frac{M_{Ek}}{N_{Ek}}$$

$$^{**}\ f_d = \zeta \cdot \frac{t_k}{\gamma_M}$$; ζ = 1,0 because wind only acts for a short time

$$^{***}e_{w,i} = \frac{\max M_{Ed,\,wi}}{\min N_{Ed,i}} = \frac{H_{Ed} \cdot h}{N_{Ed}} = \frac{1{,}5 \cdot H_{Ek} \cdot h}{1{,}0 \cdot N_{Ek}}$$

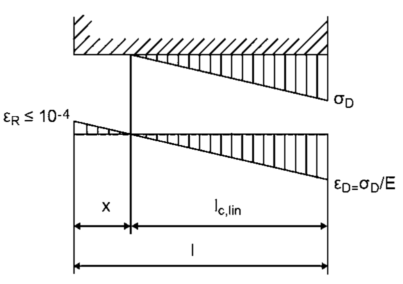
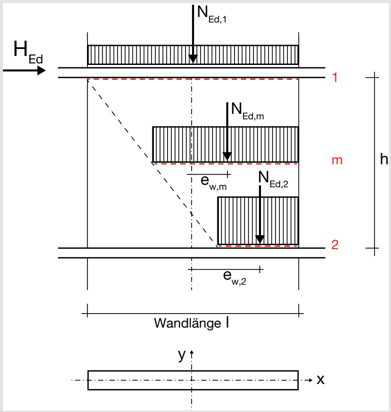


Figure 1: Stress and strain distribution for eccentrically loaded cross sections

This provision takes into account that in the event of a loss of adhesive shear strength due to wind stress, the elongation remains within a minimum range.



Combined stress

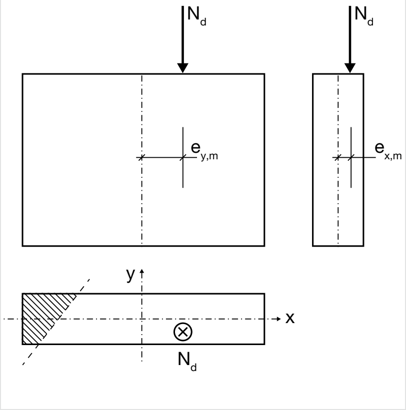
In the case of a combined load from bending around the strong and the weak axis, a bending pressure proof (buckling proof) at half the wall height is to be additionally conducted. For simplification, the reduction factors of the two axes may be combined multiplicatively:

$$N_{Rd,\ Mitte} = A \cdot f_d \cdot \Phi_x \cdot \Phi_{y,\ m} \qquad (28)$$

Φ_x Reduction factor in the middle of the wall for bending around the weak axis ($\Phi_x = \Phi_2$ according to equation 10)

$\Phi_{y,m}$ Reduction factor in the middle of the wall for bending around the strong axis

$$\Phi_{y,m} = 1\text{-}2 \cdot \frac{e_{w,m}}{l} \qquad (29)$$



Non-load-bearing outer walls

Mainly wind-loaded non-load-bearing outer walls (infill areas) can be executed up to a height of 20 m without separate static proof if:

- they are held on four sides (eg by toothing, offset or anchor)
- the scheduled overbinding measure $l_{ol} \geq 0{,}4 \cdot h_u$ is,
- the execution with normal masonry mortar IIa, III, IIIa or thin bed mortar done
- they meet the conditions according to Table 10.

For non-load-bearing internal partitions which are not stressed at right angles to the wall surface, DIN 4103-1 shall prevail.

Table 4: Maximum permissible values of infill areas in [m²] of non-transitory exterior walls without computational proof

Wall thickness t mm	**Height above railing**			
	0 to 8 m		8 to 20 m[1]	
	aspect ratio[2]		aspect ratio[2]	
	$h_i/l_i = 1{,}0$	$h_i/l_i \geq 2{,}0$ or $h_i/l_i \leq 0{,}5$	$h_i/l_i = 1{,}0$	$h_i/l_i \geq 2{,}0$ or $h_i/l_i \leq 0{,}5$
115[3]	12	8	–	–
150[3]	12	8	8	8
175	20	14	13	9
240	36	25	23	16
≥ 300	50	33	35	23

[1] In wind load zone 4, the specified values for heights between 8 and 20 m are permitted only inland

[2] h_i = Height of infill area; l_i =Length of the infill area; Intermediate values may be interpolated in a straight line

[3] When using stones of strength classes ≥ 12, the values of this line may be increased by 33%

Statics

Keller Masonry

Keller masonry of clay

The use of the Keller has changed fundamentally in recent years. While the basement of earlier years was used almost exclusively for the storage of supplies and as a storeroom, today it is more and more included in the actual living area, especially in single-family home construction.

It is used for play, hobby or party rooms, for home work rooms, fitness rooms or the like.

Comfort and well-being through brickwork

With the higher-quality use of the cellar, the demands on living comfort and the indoor climate in the basement area are also increasing. Clay masonry creates the indoor climate desired for utility rooms in the area in contact with the earth. Due to their openness to diffusion and capillary conductivity, Poroton block absorb excess indoor air humidity and then release it continuously when dry.

Keller-Planziegel-T16

Poroton-Keller-Plan brick-T16, 36.5 cm

admission	Density-class	Thermalconductivity λ [W/mK] mit DM	Pressure strength class	DIN 1053-1 permissible masonry pressure - stressσ_0 [MN/ m²]	DIN EN 1996 characteristic masonry pressure resistancef_k [MN/m²]
Z-17.1-651	0,75	0,16	12	1,5	3,9

Simplified proof of basement exterior walls according to DIN EN 1996-3 with national annex

In the case of cellar exterior walls, DIN EN 1996-3 with a national appendix provides that a more precise computational proof of earth pressure can be omitted if the following conditions are met and the design value of the wall normal force is within certain limits:

- Wall thickness t ≥ 240 mm (in DIN EN 1996-3 with national annex erroneously 200 mm)
- Clear height of the basement wall h ≤ 2.60 m
- The basement ceiling acts as a disk and can be created from the earth pressure Absorb forces
- In the influence of the earth pressure on the basement wall is the characteristic Value qk of the traffic load on the terrain surface not more than 5 kN / m²
- The terrain surface does not rise
- The accumulation height is called $h_e \leq 1{,}15 \cdot h$
- No single load greater than 15 kN at a distance of less than 1.5 m to the basement wall available
- No hydrostatic pressure present (eg due to pressurized water)

Keller-Clay block-T16

- Suitable for optimal order the vertical seal, such. B. the thick coating.
- The surface structure of this special cellar tile corresponds to a back wall look (no visible masonry) with the usual color and quality features.

- A uniform appearance can be achieved by a cost-effective paint or a mineral Feinschläm-me.

- U-shells - with a smooth surface as a system supplement for the over-walling of doors and windows are also available.

If these conditions are met, the design value of the relevant wall normal force NEd at half the height of the bedding must be within the following limits:

$$V_{Rd} = \frac{t \cdot f_d \cdot f}{3} \geq N_{Ed,max} \qquad (30)$$

$$V_{lim,d} = \frac{\rho_e \cdot h \cdot h_e^{2} \cdot b}{\beta \cdot t} \geq N_{Ed,min} \qquad (31)$$

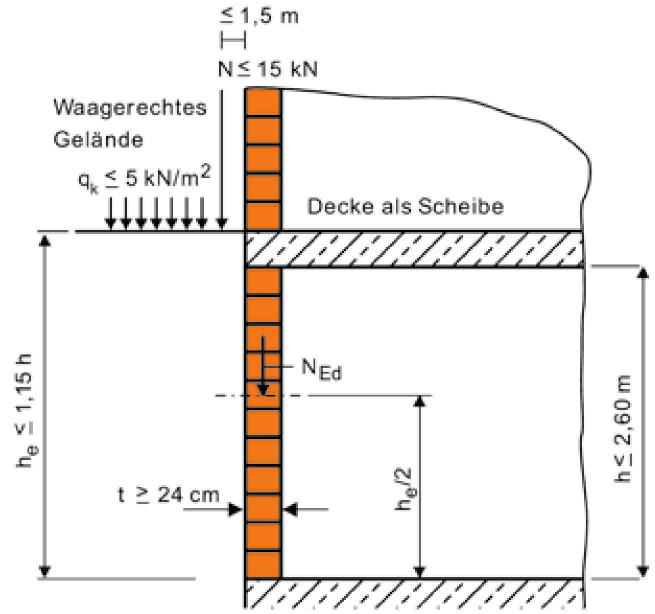


Fig. 1: Boundary conditions for the simplified white of a basement outer wall

Table 1: Minimum Overload $N_{lim,d}$ for basement outer walls in the evaluation of Eq. (31) boundary conditions: h = 2.5 m, ρ_e = 1800 kg/m³ (Distance of the stiffening transverse walls ≥ 2 · h)

Wall thickness t mm	$N_{lim,d}$ in kN / m at a height of the bedding h_e				
	1,0 m	1,5 m	2,0 m	2,5 m	2,875 m
240	9	21	38	59	77
300	8	17	30	47	62
365	6	14	25	39	51
425	5	12	21	33	44
490	5	10	18	29	38

Intermediate values are to be interpolated linearly. For the boundary conditions of Eq. (33) an earth pressure coefficient of 0,33 was used.

- The horizontal sealing (cross-sectional sealing) consists of sanded bitumen roofing membrane R500 according to DIN EN 13969 in connection with DIN V 20000-202, mineral sealing sludge according to DIN 18195-2 or material with at least equivalent friction behavior. Furthermore, it must be ensured that only nonbonded soil in accordance with DIN 1054 [12] and only vibratory plates or rammers with the following properties are used during backfilling and compaction of the working area:

- Width of the compactor ≤ 50 cm
- effective depth≤ 35 cm
- Weight ≤ 100 kg,
  or centrifugal forces≤ 15 kN

b	wall width	
t	wall thickness	
ρ_e	Weights of bedding Design	
f_d	value of masonry pressure resistance	
N_{Rd}	upper limit of wall normal force	
$N_{lim,d}$	lower limitt the wall normal force	
N_{Ed}	Rated value of the wall normal force from the load case max N or min N at half the accumulation height	
β	= 20	for $b_c \geq 2 \cdot h$
	= 60 – 20 · bc/h	for $h < b_c < 2 \cdot h$
	= 40	for $b_c \leq h$
b_c	horizontal distance between stiffening transverse walls or other stiffening elements	
h_e	Height of the bedding	

Dimensioning according to load capacity tables for masonry basement walls to Hammes *

Required load F in kN / m on the wall button of Kellermauerwerk under earth pressure (no hydrostatic pressure).

Anschütt-höhe h_0 (m)	angle of repose β = 0° Wall thickness d in cm			angle of repose β = 15° Wall thickness d in cm			angle of repose β = 30° Wall thickness d in cm		
	30,0	36,5	49,0	30,0	36,5	49,0	30,0	36,5	49,0
Light Keller height h_s = 2,26 m traffic load p = 5 kN/m²									
1,00	1,66	–	–	2,98	0,58	–	9,64	6,06	1,08
1,10	3,20	0,18	–	4,80	2,13	–	12,93	8,81	3,22
1,20	4,85	2,21	–	6,77	3,79	–	16,51	11,79	5,52
1,30	6,60	3,69	–	8,87	5,55	0,94	20,34	14,98	7,96
1,40	8,46	5,26	0,79	11,09	7,41	2,39	24,40	18,36	10,54
1,50	10,41	6,89	2,06	13,42	9,36	3,90	28,67	21,90	13,25
1,60	12,43	8,58	3,38	15,84	11,38	5,46	33,13	25,59	16,05
1,70	14,52	10,32	4,72	18,34	13,47	7,06	37,74	29,41	18,94
1,80	16,65	12,10	6,09	20,91	15,60	8,69	42,46	33,31	21,89
1,90	18,82	13,90	7,47	23,51	17,76	10,34	47,27	37,29	24,89
2,00	21,01	15,72	8,86	26,14	19,94	12,00	52,13	41,30	27,92
2,10	23,20	17,54	10,24	28,77	22,12	13,65	57,01	45,32	30,94
2,20	25,37	19,34	11,61	31,39	24,28	15,29	61,86	49,32	33,95
2,30	27,52	21,11	12,95	33,97	26,41	16,90	66,65	53,27	36,91
Light Keller height h_s = 2,26 m traffic load p = 1,5 kN/m²									
1,00	–	–	–	0,63	–	–	5,37	2,50	–
1,10	0,97	–	–	2,14	–	–	8,09	4,78	0,12
1,20	2,37	0,13	–	3,81	1,31	–	11,10	7,30	2,08
1,30	3,89	1,42	–	5,62	2,84	–	14,39	10,04	4,20
1,40	5,53	2,80	–	7,57	4,48	0,12	17,95	13,01	6,47
1,50	7,27	4,26	0,02	9,65	6,22	1,49	21,75	16,17	8,89
1,60	9,10	5,80	1,23	11,85	8,06	2,91	25,78	19,51	11,44
1,70	11,02	7,41	2,48	14,15	9,98	4,40	30,01	23,01	14,10
1,80	13,02	9,08	3,77	16,54	11,97	5,93	34,40	26,65	16,86
1,90	15,07	10,79	5,09	19,00	14,02	7,50	38,94	30,41	19,70
2,00	17,17	12,53	6,43	21,52	16,11	9,09	43,59	34,25	22,61
2,10	19,29	14,30	7,78	24,08	18,23	10,71	48,31	38,15	25,55
2,20	21,44	16,08	9,13	26,75	20,36	12,33	53,08	42,08	28,51
2,30	23,58	17,85	10,48	29,62	22,49	13,94	57,85	46,02	31,46
Light Keller height h_s = 2,63 m traffic load p = 5 kN/m²									
1,00	1,08	–	–	2,49	–	–	9,61	5,63	0,02
1,10	2,79	0,08	–	4,52	1,50	–	13,28	8,70	2,40
1,20	4,65	1,65	–	6,73	3,37	–	17,30	12,05	4,99
1,30	6,65	3,35	–	9,13	5,38	0,10	21,66	15,68	7,78
1,40	8,80	5,15	0,01	11,69	7,53	1,78	26,35	19,58	10,76
1,50	11,08	7,07	1,51	14,42	9,81	3,56	31,35	23,73	13,92
1,60	13,48	9,08	3,07	17,29	12,21	5,41	36,64	28,11	17,25
1,70	15,99	11,18	4,70	20,31	14,73	7,35	42,19	32,71	20,74
1,80	18,61	13,36	6,39	23,45	17,34	9,35	47,98	37,50	24,36
1,90	21,32	15,62	8,12	26,70	20,04	11,41	53,97	42,45	28,11
2,00	24,10	17,93	9,89	30,04	22,81	13,53	60,15	47,56	31,96
2,10	26,95	20,29	11,70	33,46	25,65	15,68	66,47	52,78	35,89
2,20	29,84	22,69	13,52	36,94	28,53	17,87	72,91	58,09	39,89
2,30	32,77	25,12	15,37	40,46	31,44	20,07	79,43	63,47	43,93
2,40	35,71	27,55	17,21	44,00	34,36	22,29	85,99	68,88	47,99
2,50	38,66	29,99	19,05	47,54	37,29	24,49	92,56	74,29	52,06
2,60	41,58	32,71	20,88	51,06	40,20	26,69	99,10	79,68	56,10
Light Keller height h_s = 2,63 mtraffic load p = 1,5 kN/m²									
1,00	–	–	–	–	–	–	4,99	1,78	–
1,10	0,35	–	–	1,61	–	–	7,97	4,28	–
1,20	1,91	–	–	3,46	0,62	–	11,31	7,08	1,19
1,30	3,62	0,80	–	5,49	2,34	–	15,01	10,16	3,57
1,40	5,47	2,37	–	7,71	4,21	–	19,04	13,52	6,15
1,50	7,47	4,06	–	10,10	6,21	0,78	23,41	17,16	8,93
1,60	9,61	5,85	0,58	12,66	8,35	2,45	28,10	21,05	11,90
1,70	11,88	7,75	2,06	15,38	10,62	4,20	33,09	25,18	15,05
1,80	14,27	9,75	3,61	18,24	13,01	6,04	38,35	29,54	18,35
1,90	16,77	11,83	5,22	21,23	15,50	7,95	43,87	34,11	21,81
2,00	19,36	13,99	6,88	24,35	18,09	9,93	49,61	38,86	25,40
2,10	22,04	16,22	8,59	27,57	20,76	11,97	55,56	43,77	29,11
2,20	24,80	18,51	10,34	30,87	23,50	14,06	61,67	48,82	32,92
2,30	27,61	20,84	12,12	34,25	26,30	16,19	67,93	53,98	36,80
2,40	30,46	23,21	13,92	37,69	29,15	18,34	74,28	59,23	40,75
2,50	33,35	25,60	15,73	41,15	32,01	20,51	80,71	64,53	44,73
2,60	36,65	28,00	17,55	44,64	34,90	22,69	87,18	69,86	48,73

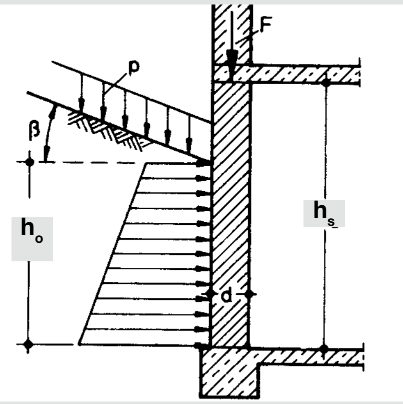
*Die Tabellen wurden von Dipl. Ing. Hammes, Aachen, aufgestellt und von Prof. Mann, TH Darmstadt, in statischer Hinsicht geprüft.

The tables are based on the following arithmetic values:

- ■ Uniaxially stretched basement walls for recipe masonry according to DIN 1053 -1, i. at least compressive strength class 6
- ■Ground weight 19 kN / m³
- ■ Wall friction angleφ = 0°
- ■ Clay raw density class ≥ 0,8
- ■ Traffic load on the site p = 5 kN / m² or p = 1.5 kN / m². The lower value can be z. B. for terraces in front of large windows, where it is ensured that no vehicles move on the open space.

- ■ Masonry in the runners association (Einstein masonry)
- ■ Mortar group IIa, III, IIIa and lightweight masonry mortar or thin-bed mortar

A stiffening of the cellar exterior walls is mathematically not taken into account. The walls are calculated as uniaxial and may be erected with toothed bricks.
The names in the following panels are explained in the figure below.



About binding / dressing

1. General

Masonry is generally a composite of bricks and masonry mortar. The application is regulated by DIN 1053, DIN EN 1996 (EC6) or building inspectorate approvals.

2. Wall Association

Masonry must be performed in association, i. Lay the bricks in layers so that the joints and longitudinal joints of superimposed layers are sufficiently offset from each other. The overbonding dimension is in DIN 1053-1, section 9.3. "Association" and specified in EC 6, 8.1.4 (NCI) and must be at least ≥ 0.4 h and ≥ 4.5 cm, where h is the brick height.

Horizontal forces can be transmitted or absorbed by adhesion and / or friction between brick and mortar through the masonry. The dressing is therefore generally an essential condition for the tensile or flexural stress of masonry. But even under pressure and shear stress, the dressing usually causes a much higher load capacity.

3. Simultaneous bringing up of walls

When constructing the building, it must be ensured that the edges, which are designed to be static at the right angle to the wall level, are actually realized. As an immovable mounting, horizontally held ceiling panels, stiffening transverse walls or other sufficiently rigid components may be considered.

Unmountable bracket may only be accepted if

- the stiffening transverse wall and the auszuschteifende wall made of building materials annaHernd same deformation behavior exist.
- the walls are connected with each other in a tension- and pressure-resistant manner.
- a tearing of the walls due to greatly different deformations is not expected.

The tensile and pressure-resistant connection is considered to be the simultaneous uplifting of the walls in the dressing or by butting with flat steel anchors (see butt-joint technique).

About bond

The overbinding measure (l_{ol}) For the sake of a safer load distribution within the Wall plant association are respected. It follows the formula

$l_{ol} = 0,4 \cdot h_u$ determine.

For small formats applies $l_{ol} \geq 4,5$ cm.

h_u = Stone height in cm

1.Example: Poroton-Clay block with

$h_u = 24,9$ cm

$l_{ol} \geq 0,4 \cdot 24,9 = 9,96$ cm

chosen ü = 10 cm

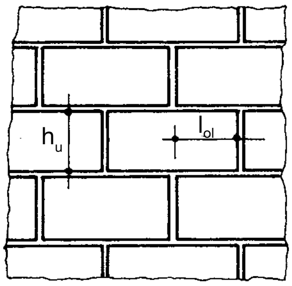
2. Example: small format NF, h = 7,1 cm

$l_{ol} \geq 0,4 \cdot 7,1 = 2,84$ cm

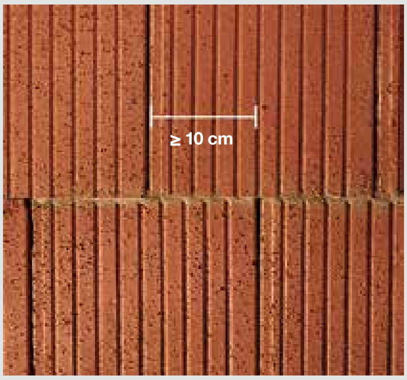
$2,84 \text{ cm} \leq 4,5$ cm

chosen $l_{ol} = 4,5$ cm

wall view

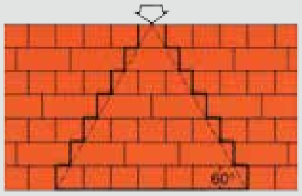


Important: **Regardless of the type and size of the bricks, the overbinding size must always be observed! This also applies to all other wall building materials.**

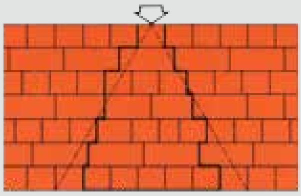


Comply with standard overbinding dimensions

Sense of the overbinding measure



Load distribution while adhering to the over-binding measure. Lateral support of the loaded area by adhesive bond of the bearing joint (60 ° = idealized, calculated load distribution)



Load distribution in "wild" bandage. The heavily loaded area can hardly be supported laterally over the small bearing joint surfaces (effect as a pillar in the wall → Risk of cracking)

Statics

Monolithic construction in the outer wall under static and constructive aspects

The advantages of a monolithic construction, especially from the point of view of sustainability and value retention, are becoming more and more important. For the planning of buildings in monolithic (single-shell) construction of the exterior wall, Wienerberger offers planners and contractors a coordinated and tested system.

Table 5: Product recommendations for the monolithic outer wall as a function of floor space under static aspects

number of floors	Poroton																		
	S8-P			S8-MW			S9-P			S9-MW			S10-P			S10-MW		Plan-T14	
	36,5	42,5	49,0	36,5	42,5	49,0	30,0	36,5	42,5	30,0	36,5	42,5	30,0	36,5	42,5	36,5	42,5	30,0	36,5
6+			✓			✓					✓	✓				✓	✓		
5		✓	✓		✓	✓			✓		✓	✓		✓	✓	✓	✓		✓
4	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

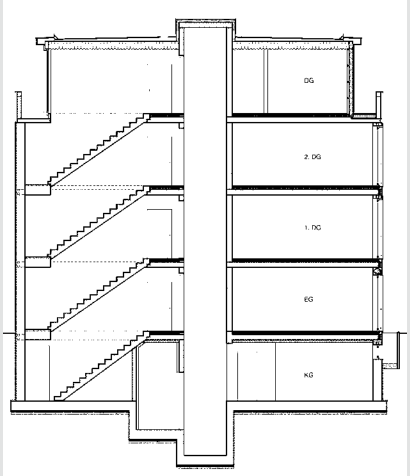


image 2

Boundary conditions to Table 5

Design according to DIN EN 1996-3 NA Simplified process taking into account a partially lying ceiling, load 70 kN / m per floor, floor height 2.75 m, ceiling support width 6.0 m. The overview does not replace static proof!

Ceiling support: movable or clamped

In principle, reinforced concrete parts should be separated from the masonry. Here we recommend a sanded bitumen roofing membrane R500. The separation prevents the fresh concrete from clinging to the underlying masonry and pulling it along when the ceiling is deformed. Their coefficient of friction is similar to that of masonry and mortar (according to DIN EN 1996-3, Section 4.5, a coefficient of friction of 0.6 is used as a basis). Investigations have shown that the installation of a sanded bituminous roofing membrane R500 as a separating layer by its flow behavior has a crack-limiting effect [Source: Mauerwerk Heft 6, 2006 "Current research results on the prevention of crack damage in the area of the wall-ceiling node" Zilch / Schermer / Grabowski / Scheufler].

Whether a ceiling support acts as a plain bearing or not depends primarily on the loads of the overlying floors. An uplifted ceiling works i. d. R. always as a plain bearing, while a einbindende floor slab rather has a certain degree of clamping. Table 6 gives an indication of the required loads with which a support is not a sliding bearing. If the loads are insufficient, the support acts as a plain bearing. Under plain bearings always a ring anchor is to be formed.

Table 6: Required loadings to avoid sliding of the floor slab on the wall head depending on the wall thickness and the selected coefficient of safety according to: Separation layer of bituminous membrane R 500 - DIN 52128

Support Depth in mm	safety factor $\gamma = 1{,}5$ required load in kN / m	safety factor $\gamma = 2{,}0$ required load in kN / m
175	5,6	7,5
240	5,6	7,5
300	7,4	9,8
365	9,0	11,9

Source: Arbeitsgemeinschaft Mauerziegel
"Design of brick masonry according to DIN 1053-1"

Support in the corner area

If loads are too low from the upper storey ceiling and associated lifting forces, they may need to be anchored in the floors below. The tensile forces that occur can be derived by means of tension supports in the outer corners (Fig. 3).

Large ceiling spans

Due to the architecture of the open construction method, large ceiling spans are desired, especially in multi-storey housing construction. Ceiling spans above 4.2 m should be provided with a load-free strip below the ceiling. Again, the consequences of the deformations of the reinforced concrete ceiling, such. Edge chipping, if possible to avoid.

As load free tires are z. B. one-sided self-adhesive dividing wall tapes, width 30 - 50 mm, thickness 5 mm (use in drywall) made of felt, closed-cell soft polyethylene (PE) or cell rubber (Moltopren, sponge rubber).

Attica

An attic always presents a special challenge. The final ceiling is no longer stressed by high loads. Bowels of decks, shrinkage and creep can cause cracks in the visible outside area. It is important to have a continuous separation between bedding, ceiling and rising masonry (Fig. 4).

Overhangs of the rising masonry

Overhangs in the area of the ceiling support, above basements or foundations represent a weakening of the masonry. DIN EN 1996 offers concrete solutions for this, in which the support situation is taken into account in a reduction value. According to the simplified method according to DIN EN 1996-3 and the national appendix thus supernatants of half the wall thickness, with a wall thickness of 36.5 cm even up to 20 cm are possible. **Taking into account the building physics requirements from thermal and sound insulation, as well as the static aspects, it is recommended to apply a ceiling or a support surface of 2/3 of the wall thickness (Figures 5 and 6).**

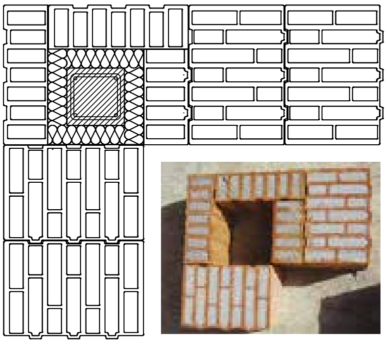


Image 3

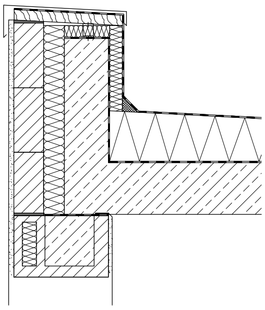


Image 4

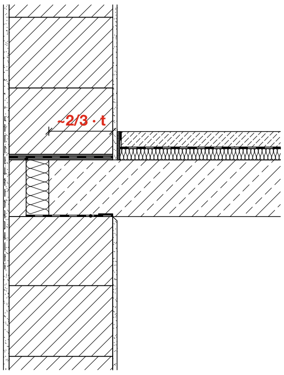


Image 5

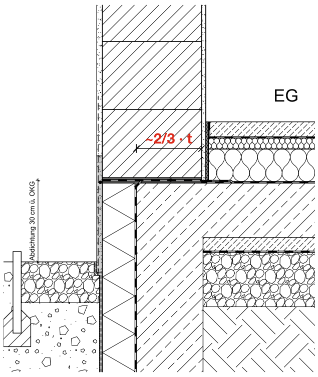


Image 6

Ring anchors and ring beams

Ring anchore are arranged on the wall head tension members. Ring anchors stabilize wall plates (outer and inner walls) which serve to remove horizontal loads. Ring anchors are trained around the building revolving.

Ring beam are lying in the wall plane horizontal bars, the z. B. can absorb bending moments from wind loads. They must always be arranged if the ceilings have no disc carrying effect (eg with wooden beamed ceilings or console roofs).

Ring anchors and ring beams in masonry structures should preferably be made of concrete filled and reinforced brick U-shells / -WU shells. These designs have a significantly lower shrinkage compared to reinforced concrete beams. This is especially important with plastered single-shell exterior walls (see Fig. 8).

Ring anchors and ring beams are to be dimensioned for a horizontal load of 1/100 of the vertical load of the walls and possibly for wind loads (DIN EN 1996-1 NA). In the functional load condition, the ring anchors must be able to absorb a tensile force of 45 kN in accordance with DIN EN 1996-1. This requirement is covered when using a BSt 500 z. With 4 Ø 6 or 2 Ø 8 mm. At least two continuous round bars must be installed. To limit cracking, several smaller diameter irons are more advantageous than a few larger diameter irons.

Expansion joints

With increasing building size, changes in shape due to temperature differences and material-related deformations become more and more relevant. Accordingly, expansion joints should be considered in the planning (Table 5).

An expansion joint has the task to absorb shortening or extensions of a building part or between two components stress-free. The joint thickness is measured according to the expected length changes of the components or of the component.

As a rule, the expansion joint distances made of reinforced concrete components such as floor slabs, ceilings, etc. are decisive for single-shell brickwork.

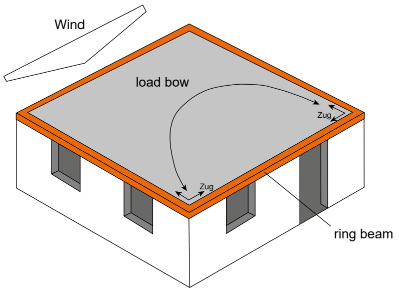
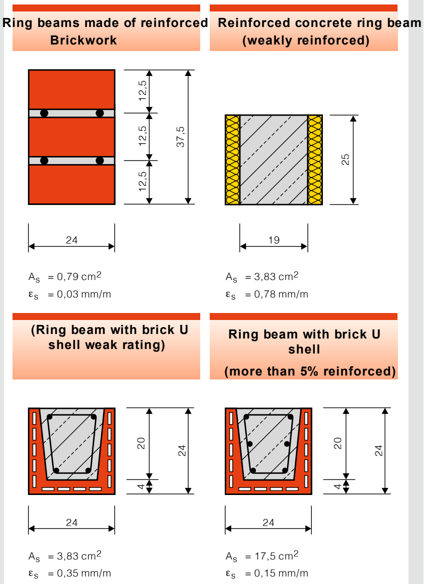


Image 7



Shrinkage dimensions of various ring beam designs after 5 years of storage

Image 8

Table 7
Source: Design of brick masonry in accordance with DIN 1053-1, brochure Arbeitsgemeinschaft Mauerziegel

Masonry off	a_{DFV} (m)	a_{DFH} (m)
1	2	3
Clay blocks	30	9 bis 12
in combination with similar building materials	30	
in combination with other building materials	12 bis 15	
calcareous sandstones	7,5 bis 9	6 bis 8
aerated concrete blocks	6 bis 8	6 bis 8
concrete blocks	6 bis 8	6 bis 8
natural stones	12 bis 15	6 bis 8

Recommended maximum distance from vertical a_{DFV} and horizontal a_{DFH} Expansion joints in non-reinforced supporting and non-supporting monolithic outer walls

Source: "Building properly with bricks" by Hans R. Peters

Possibility of increasing the crack-free wall length or crack resistance are:

- Use of bricks with low shrinkage (poroton)
- Compliance with the overbinding measure ($l_{ol} \geq 0{,}4$ x stone height h_u)
- favorable wall geometry (no flat, long walls)
- bw deformation impediment at the wall foot or wall head, separating layer through a sanded bitumen roof R500
- Good after-treatment (protection against moisture penetration and too rapid dehydration in reinforced concrete components)

Execution of expansion joints

The minimum width of an expansion joint should be at least 10 mm.

The expansion joint must be guided over the entire thickness of the corresponding component. Also, the expansion joint must not be plastered in a masonry wall, but must be continued with a corresponding plaster profile.

The expansion joint should be designed so that it is permanently resistant to rain and driving rain. Suitable for sealing: joint sealants, sealing tapes and cover profiles. The sealing of joint sealants is regulated in DIN 18540-95.

Design example monolithic outer wall
After the simplified procedure according to DIN EN 1996-3

Building height	H ~ 12,70 m ≤ 20 m ✓	
Span	l = 4,90 + 0,5 x 0,24 + 0,667 · 0,365 = 5,26 ≤ 6,0 m ✓	
Wall thickness	t = 36,5 cm	
Support Depth	a = 2/3 · 36,5 cm = 24 cm	**≥ 0,45 · 36,5 cm = 16,4 cm ✓**
clear wall height	h = 2,97 m	≤ 12 · 0,365 = 4,38 ✓

Load assumptions according to DIN EN 1991-1-1 NA
Traffic loads for living spaces with sufficient lateral distribution of the loads = 1,5 kN/m²

+ Partition surcharge (≤ 5 kN/m wall length) = 1,2 kN/m²

$q_{k,Decke}$ = 2,7 kN/m² **≤ 5,0 kN/m² ✓**

Cover over EG, 1. OG, 2. OG = 2,7 kN/m² · 3
= 8,1 kN/m²

The boundary conditions for the application of the simplified calculation methods are fulfilled.

Snow load, zone 2, flat roof:
$q_{k,Snow} = \mu_1 \cdot s_k = 0{,}8 \cdot 0{,}85 = 0{,}68$ kN m²

Dead loads from staggered storey (wooden frame construction) including gravel filling:
Adoption $g_{K,penthouse\ level}$ = 3,75 kN/m²

Dead loads from floor slabs: floor covering, e.g.	= 0,22 KN/m²
Tiles Impact sound insulation 50 + 30 mm = 80 mm	= 0,08 KN/m²
Cement screed 60 mm	= 1,32 kN/m²
Reinforced concrete 22 cm	= 5,50 kN/m²
Ceiling over ground floor, 1st floor, 2nd floor	= 7,12 kN/m² · 3
$g_{K,Roof}$	**= 21,36 kN/m²**

Dead load walls ground floor, 1st floor, 2nd floor

Crude density class 0.75, thin-bed mortar, d = 36.5cm = 3,10 kN/m²
interior plaster, gypsum plaster, 1.5 cm = 0,18 kN/m²
Exterior plaster, light plaster, 2.0 cm = 0,25 kN/m²
= 3,53 kN/m²

$g_{k,Wall}$ **= 2,97 · 3,53 · 3** **= 31,45 kN/m²**

Load indent area of the wall to be dimensioned= 5,63 m²
Length of the wall = 1,49 m

N_{Qk} = $q_{k,Snow} + q_{k,Roof}$ = (0,68 + 8,1) x 5,63 = **= 49,43 kN/m**
N_{Gk} $g_{k,Roof} + g_{k,Penthouse\ level} + g_{k,Wall}$
= (21,36 + 3,75) · 5,63 + 21,45 **= 162,82 kN/m**

Simplified may be stated:
N_{Ed} = 1,4 · (NGk + NQk) = 1,4 · (162,82 + 49,43) **= 297,15 kN/m**

Material:
POROTON-S10-MW, Admission Z-17.1-1101
Crude density class 0.75
Compressive strength class 10,
$f_k = 5{,}2$ MN/m²
$f_d = \zeta \cdot f_k/\gamma_M = 0{,}85 \cdot 5{,}2/1{,}5 = 2{,}94$ MN/m²

$h_{ef} = \rho_2 \cdot h = 1{,}0 \cdot 2{,}97 = 2{,}97$ m → 2-sided, partially suspended ceiling

Payload reduction due to load distribution:
For $f_k \geq 1{,}8$ N/mm²: $\Phi_1 = 1{,}6 - l/6 < 0{,}90 \cdot a/t = 1{,}6 - 5{,}26/6 = 0{,}73 > 0{,}90 \cdot 0{,}24/0{,}365 =$
0,59 $\Phi_1 = 0{,}59$

Load reduction at risk of buckling:
$\Phi_2 = 0{,}85 \cdot a/t - 0{,}0011\ (h_{ef}/t)^2 = 0{,}85 \cdot 0{,}24/0{,}365 - 0{,}0011 \cdot (2{,}97/0{,}365)^2 = 0{,}49$

$\Phi = \min(\Phi_1; \Phi_2) = 0{,}49$

$N_{Rd} = A \cdot f_d \cdot \Phi = 1{,}49 \cdot 0{,}365 \cdot 2{,}94 \cdot 0{,}49 = 0{,}7835$ MN/m = 783,5 kN/m

Proof $N_{Ed} \leq N_{Rd}$ → 297,15 < 783,5 kN/m ✓

Workload 297,15 / 783,5 = 0,38 = 38 %

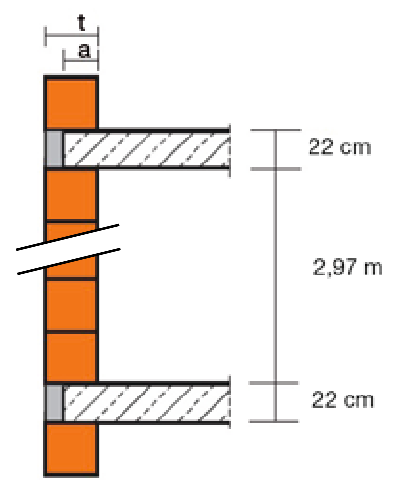


Image 9

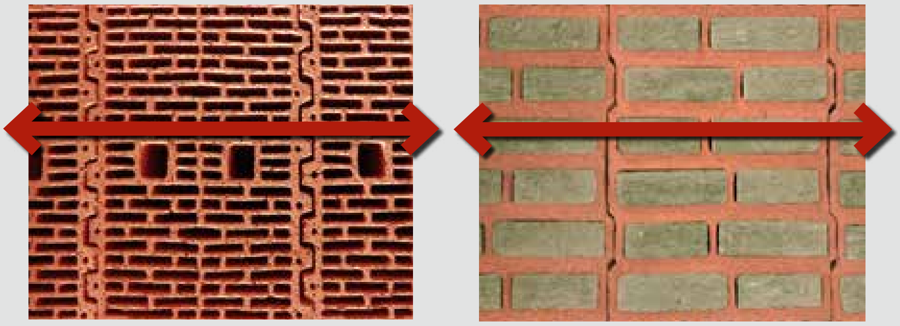
Building in earthquake areas

For common buildings in designated earthquake zones, the rules for the seismic design are included in DIN 4149 [2005-04]. With the introduction of the Eurocode package, the design will in future be carried out in accordance with DIN EN 1998-1 (Eurocode 8). This is not yet introduced. The standard and future Eurocode 8 allow computational proof to be dispensed with by complying with structural requirements up to a certain number of full floors depending on the earthquake zone.

According to DIN 4149, the following requirements apply to the use of brick masonry in German earthquake areas:

1. In principle, all brick and mortar products in accordance with DIN 1053-1 may be used, including all officially approved perforated bricks.
2. In earthquake zones 0 and 1, there are no additional requirements for bricks.
3. In earthquake zones 2 and 3, bricks must either have continuous webs in the longitudinal wall direction or have a longitudinal compressive strength of at least 2.5 N / mm².
4. Bricks of strength class 2 may only be used in combination with products of strength class ≥ 4 without computational proof. They may only be used if at least 50% of the required shear wall cross-sectional area is made up of stones of strength class ≥ 4.

Seismic safety through continuous brick walls in the wall longitudinal direction



Example unfilled thermal insulation tiles **Example filled thermal insulation tiles**

Image 10

Recommendation for the safe compliance of the minimum reinforcement:

- External walls:
Brick of strength class ≥ 6
- Interior walls:
Brick of strength class ≥ 12

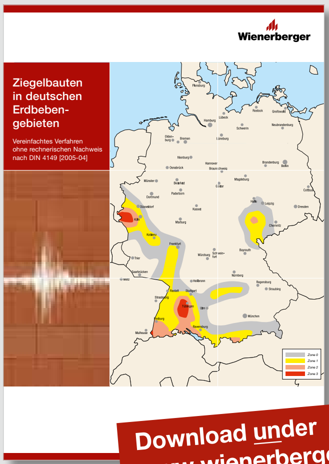
Product recommendations

Our brick products for earthquake zones 0 - 3 have all continuous webs in the longitudinal wall direction:

Table 8

Max. Number of full storeys depending on the seismic zone

Earthquake - zone	Earthquake categories without computational proof	maximum number of full floors
0	No restriction	
1	I – III	4
2	I – II	3
3	I – II	2



Wienerberger

Ziegelbauten in deutschen Erdbeben-gebieten

Vereinfachtes Verfahren ohne rechnerischen Nachweis nach DIN 4149 [2005-04]

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Basic values of the permissible masonry pressure stresses (DIN EN 1053-1) and characteristic masonry pressure strengths (DIN EN 1996)

The following information is not exhaustive and excerpts from technical documentation in which the information is presented in detail in context. They should only be an indication of important technical indicators. On request, we will gladly send you corresponding full technical documentation.

Statics

*) **Notes on the design according to DIN EN 1996 (EC 6):** At the time of printing, the characteristic masonry compressive strengths (f_k-Value) not yet fully confirmed. It can be assumed that the Deutsches Institut für Bautechnik (DIBt) complies with the approval supplements for design according to DIN EN 1996 with a conversion of $f_k = 2{,}64 * \sigma_0$ will start. Further information on the individual approval products can be obtained in the technical construction consultation under (0511) 61070-115.

Plan Clay block

Produkt Zulassung DIBt	**gross density [kg/dm³]**	**Compressive strength class-**	**DIN EN 1996 characteristic wall factory-pressure strength f_k [MN/m²]**	**DIN 1053-1 Perm. Masonry compressive stress σ_0 [MN/m²]**	**suitable for earthquake zones 0–3 ● 0–1 ○**
T7-P Z-17.1-1103	0,55	4/6	1,4/1,9	0,5/0,7	●
T7-MW Z-17.1-1060	0,55	6	1,7	0,65	●
T8-P Z-17.1-982	0,60	≥ 6	1,8	0,7	●
T8-MW Z-17.1-1041	0,65	6	2,1	0,75	●
T9-P Z-17.1-674	0,65	≥ 6	1,8	0,7	●
S8-P Z-17.1-1120	0,75	10	3,0	1,1	●
S8-MW Z-17.1-1104	0,75	10	3,0*)	1,1	●
S9-P Z-17.1-1058	0,70	8	3,1	1,2	●
S9-MW Z-17.1-1100	0,9	10	4,2*)	1,6	●
S9-MW Z-17.1-1145	0,8	10	4,6	1,6	●
S10-P Z-17.1-1017	0,75	10	3,6	1,4	●
S10-MW Z-17.1-1101	0,80	12	5,2	1,9	●
Plan-T8 Z-17.1-1085	0,60	6	1,4	0,55	●
Plan-T9 Z-17.1-890	0,65	6/8	1,4/1,8	0,55/0,7	●
Plan-T10 Z-17.1-889	0,65	6/8	1,8*)/2,3*)	0,7/0,9	●
Plan-T10 Z-17.1-890	0,70	12	2,6	1,0	●
Plan-T12 Z-17.1-877	0,65	6	1,8	0,7	●
		8	2,1	0,8	●
		10	2,6	1,0	●
Plan-T14 Z-17.1-651	0,70	8/12	3,1/3,9	1,2/1,5	●
Plan-T16 Z-17.1-651	0,75	12	3,9	1,5	● 4
Plan-T18 Z-17.1-678	0,8	8/12	3,7/4,7	1,4/1,8	○
HLz-Plan-T Z-17.1-868	0,8	8	3,7	1,4	○
	0,9	12	4,7	1,8	● 2/4
	1,2/1,4	20	6,3	2,4	● 4
HLz-Plan-T Z-17.1-1108	1,2/1,4	20	8,5	3,1	●
HLz-Plan-T Z-17.1-1141	1,4	20	10,2	3,6	●
Planfüllziegel PFZ-T Z-17.1-537	2,0[1]	8/12	4,4/5,8	1,7/2,2	●

Dryfix System

Products approval DIBt	**gross density [kg/dm³]**	**Compressive strength class--**	**DIN 1053-1 Perm. Masonry compressive stress σ_0 [MN/m²]**
T7-MW Dryfix Z-17.1-1093	0,55	6	0,35
T8-MW Dryfix Z-17.1-1092	0,65	6	0,45
Plan-T9 Dryfix Z-17.1-1110 (Zulassung beantragt)	0,65	6/8	0,25/0,35
Plan-T10 Dryfix Z-17.1-1088	0,65	6/8	0,4/0,5
Plan-T18 Dryfix Z-17.1-1094	0,8	12	1,0
HLz-Plan-T Dryfix Z-17.1-1090	0,8/0,9	8/12	0,9/1,2
HLz-Plan-T-1,2 Dryfix Z-17.1-1090	1,2	20	1,6
Planfüllziegel PFZ-T Dryfix Z-17.1-1091	2,0 [1]	12	2,2

Clay block

Products approval DIBt DIN 105-100 DIN EN 771-1	**gross density [kg/dm³]**	**Compressive strength class--**	**DIN EN 1996 characteristic masonry works pressure-resistance f_k [MN/m²]**					**DIN 1053-1 Perm. Masonry compressive stress σ_0 [MN/m²]**					**suitable for earthquake zones 0-3 I 0–1 ○**
			Mortar group			**Lightweight masonry mortar**		**Mortar gruoup**			**Lightweight masonry mortar**		
			II	**IIa**	**III**	**LM 36**	**LM 21**	**II**	**IIa**	**III**	**LM 36**	**LM 21**	
Block-T14 Z-17.1-673	0,70	6	–	2,1	–	1,8	1,5	–	0,8	–	0,7	0,6	●
Block-T18/-T21 Z-17.1-383	0,8	12	3,1	4,2	4,7	2,9	2,3	1,2	1,6	1,8	1,1	0,9	○
	0,9												○
HLz-Block-T DIN 105-100 DIN EN 771-1	0,8	8	3,1	3,9	4,4	3,3	2,5	1,0	1,2	1,4	1,0	0,8	○
	0,9	12	3,9	5,0	5,6	3,3	2,8	1,2	1,6	1,8	1,1	0,9	● 2
	1,2/1,4	20	5,3	6,7	7,5	–	–	1,6	1,9	2,4	–	–	○
small formats 0,9 **Building bricks 1,4/1,8/2,0** DIN 105-100 DIN EN 771-1	0,9	12	3,9	5,0	5,6	3,3	2,8	1,2	1,6	1,8	1,1	0,9	○
	1,4/1,8/2,0	20	5,3	6,7	7,5	–	–	1,6	1,9	2,4	–	–	○ 3
AGZ-T Z-17.1-383 DIN 105-100 DIN EN 771-1	0,9	12	3,9	5,0	5,6	3,3	2,8	1,2	1,6	1,8	1,1	0,9	○
GWZ-T DIN 105-100 DIN EN 771-1	1,2	20	5,3	6,7	7,5	–	–	1,6	1,9	2,4	–	–	●

1 Crude density class filled with concrete $ C 12/15, grain size 0-16 mm
2 wall thicknesses 17.5 / 24.0 cm in Buldern factory on request
3 Mz without hole fraction for earthquake zones 0-3
4 only applies to the products with the designation EB

Calculated values of the dead load

Calculated values of the dead load

Plan clay blocks (thin bedmortar)

Gross densityclass -	Calculated values for the dead load [kN/m³]	Dead load of masonry in kN / m² with wall thicknesses in cm							
		11,5	17,5	24,0	30,0	36,5	42,5	49,0	50,0
0,55	6,5	–	–	–	–	2,37	2,76	3,19	–
0,60	7,0	–	–	–	2,10	2,56	2,98	3,43	3,50
0,65	7,5	–	–	1,80	2,25	2,74	3,19	3,68	–
0,70	8,0	–	–	1,92	2,40	2,92	3,40	–	–
0,75	8,5	–	1,49	2,04	2,55	3,10	3,61	4,17	–
0,8	9,0	1,04	1,58	2,16	2,70	3,29	3,83	–	–
0,9	10,0	1,15	1,75	2,40	3,00	3,65	4,25	–	–
1,2	13,0	1,50	2,28	3,12	3,90	–	–	–	–
1,4	15,0	1,72	2,63	3,60	4,50	–	–	–	–
2,0	20,0	–	3,50	4,80	6,00	–	–	–	–

The requirements of the respective approval or DIN EN 1991-1-1 / NA: 2010-12 apply to the load assumptions.

Clay block and small formats (light and normal mortar)

Gross density class -	Calculated values for the dead load [kN/m³]		Dead load of masonry in kN / m² with wall thicknesses in cm									
			11,5		17,5		24,0		30,0		36,5	
	LM	NM	LM	NM	LM	NM	LM	NM	LM	NM	LM	NM
0,65	7,5		–	–	–	–	–	–	–	–	2,74	–
0,70	8,0	9,0	–	–	–	–	1,92	2,16	2,40	2,70	2,92	3,29
0,75	8,5	9,5	–	–	–	–	2,04	2,28	2,55	2,85	3,10	3,47
0,8	9,0	10,0	1,04	1,15	1,58	1,75	2,16	2,40	2,70	3,00	3,29	3,65
0,9	10,0	11,0	1,15	1,27	1,75	1,93	2,40	2,64	3,00	3,30	3,65	4,02
1,2		14,0	–	1,61	–	2,45	–	3,36	–	4,20	–	5,11
1,4		16,0	–	1,84	–	2,80	–	3,84	–	–	–	–
1,8		18,0	–	2,07	–	3,15	–	4,32	–	5,40	–	6,57
2,0		20,0	–	2,30	–	3,50	–	4,80	–	6,00	–	–

The requirements of the respective approval or DIN EN 1991-1-1 / NA: 2010-12 apply to the load assumptions.

Plan clay block (Dryfix)

Gross density class -	Calculated values for the dead load [kN/m³]	Dead load of masonry in kN / m² with wall thicknesses in cm					
		11,5	17,5	24,0	30,0	36,5	42,5
0,55	5,5	–	–	–	–	2,01	2,34
0,65	6,5	–	–	1,56	1,95	2,37	2,76
0,8	8,0	0,92	1,40	1,92	–	–	–
0,9	9,0	–	1,58	2,16	–	–	–
1,2	12,0	1,38	2,10	2,88	–	–	–
2,0	20,0	–	3,50	4,80	–	–	–

The requirements of the respective approval or DIN EN 1991-1-1 / NA: 2010-12 apply to the load assumptions.

Supplements for plaster

Plaster type	Thickness cm	Dead load kN/m²
lightweight plaster	2,0	0,25
gypsum plaster	1,5	0,18
lime cement plaster	1,0	0,20
insulating plaster	5,0	0,40

Statics

Dimensional stability

Deformations

Shape changes of building materials arise as a function of load, humidity and temperature effects. This shortens masonry under short and long-term stress as well as dehydration (shrinkage) and cooling. Moisture absorption (swelling) and heating prolongs masonry. Therefore, it is important to coordinate material properties and construction and consequently to make the outer and inner walls of the same wall construction material. For all strain types, the table below shows characteristic values consisting of a calculated value and the spreading range. The values, including the moduli of elasticity, were taken from the standard DIN EN 1996-1-1 / NA and the general building inspectorate approvals.

To crawl

Creep strain ε_κ mean a shortening in the load direction and caused by long-term load effects; they are permanent form changes. At the beginning they increase strongly and approach a final value after approx. 3 to 5 years at a relatively constant load and constant climatic conditions. The use of a creep number φ instead of creep is easier since φ In the range of the operating voltage almost constant, that is voltage-independent.

$$\varphi = \frac{\varepsilon_c}{\varepsilon_{el}} = \frac{\varepsilon_c \cdot E}{\text{vorh}\ \sigma}$$

End creep $\varepsilon_{c\infty}$ and final crawl number φ_∞ are the final values extrapolated with respect to test results. Creeping is generally significant for the crack-resistance of masonry. It can increase or decrease voltages.

Dwindle

Shrinking expansions ε_s are load-independent changes in shape, which lead to volume reduction or length reductions when water is released (drying out). Water absorption in turn leads to enlargement (sources ε_q) the dimensions. Bricks have the decisive advantage over the building materials produced with hydraulic binders that the shrinkage process is already completed before they are used by the drying and firing processes. They thus provide the best conditions for crack-free masonry.

Characteristics for creep, swelling or shrinkage and thermal expansion, incl. Elastic moduli

Wall stones		Wall mortar	Final value of the moisture expansion (shrinkage, irreversible swelling)			final creep			Thermal expansion coefficient			modulus of elasticity (identification number) 6) $E = \kappa_E \cdot f\kappa$		
			$\varepsilon_{f\infty}$ 1) [mm/m]			φ_∞ 2) [-]			α_t [10^{-6}/K]			κ_E 7) [-]		
Art	DIN DIN EN	Art	Calculation value	Valuesrange		Calculation value	Valuesrange		Calculation value	Valuesrange		Calculation value	Valuesrange	
				Min	Max		Min	Max		Min	Max		Min	Max
Buildingbricks	105-100	NM	0	-0,1 3)	+0,3	1,0	0,5	1,5	6	5	7	1100	950	1250
	771-1	LM				2,0	1	3						
	105-6	DM		-0,1	+0,1	0,5	-	-						
Lime sand stones 4)	V 106	NM	-0,2	-0,3	-0,1	1,5	1	2	8	7	9	950	800	1250
	771-2	DM												
Poreconcretestones	V 4165-100	DM	-0,1	-0,2	+0,1	0,5	0,2	0,7				550	500	650
	771-4													
Lightweight concretestones	V 18151-100	NM	-0,4	-0,6	-0,2	2,0	1,5	2,5	10; 8 5)	8	12	950	800	1100
	V 18152-100	DM												
	771-3	LM	-0,5	-0,6	-0,3									
Concretestones	V 18153-100	NM	-0,2	-0,3	-0,1	1,0	-	-	10			2400	2050	2700
	771-3													

1) Final value of the moisture expansion is negative for compression (shrinkage) and positive for expansion (sources)
2) final creep $\varphi_\infty = \varepsilon_{c\infty}/\varepsilon_{\psi\lambda}$ with $\varepsilon_{c\infty}$ as final creep and $\varepsilon_{\psi\lambda} = \sigma/E$
3) For bricks < 2 DF the limit applies -0,2 mm/m
4) Also applies to hut stones
5) For lightweight concrete with mostly expanded clay as surcharge
6) $f\kappa$ … characteristic pressure resistance of masonry
7) For the proof of the vertical load in the limit state of the load capacity (kink proof of safety), a modulus of elasticity is deviating from this $E_0 = 700 \cdot f\kappa$ to use

NM: Normal mortar
LM: Light mortar
DM: Thin-bed mortar

Computational proof of crack safety

In order to show the risk of cracking, the evaluation method of Schubert (Mauerwerk calendar 1996) is used. The method takes into account the rigidity ratios and is illustrated in an example (see masonry construction practice according to Eurocode, 3rd edition).

Deformation case V1 - shortening of the inner wall

Outer wall(A): Poroton S10-36,5-MW, DM

$$f_{k,A} = 5{,}2 \ \frac{\mathrm{MN}}{\mathrm{m}^2}$$

$$E_A = 1100 \cdot f_{k,A} = 5720 \ \frac{\mathrm{MN}}{\mathrm{m}^2}$$

$$l_A = 4{,}0 \ \mathrm{m}$$

$$d_A = 0{,}365 \ \mathrm{m}$$

$$\phi_{\infty,A} = 0{,}5$$

$$\varepsilon_{f\infty,A} = 0{,}0 \ \frac{\mathrm{mm}}{\mathrm{m}}$$

$$\Delta T_A = 10 \ \mathrm{K}$$

$$\alpha T_A = 6 \cdot 10^{-6} \ \frac{1}{\mathrm{K}}$$

Inner wall (I): Poroton Honey cone-Plan-T 11,5-1,2; DM

$$f_{k,I} = 6{,}3 \ \frac{\mathrm{MN}}{\mathrm{m}^2}$$

$$E_I = 1100 \cdot f_{k,I} = 6930 \ \frac{\mathrm{MN}}{\mathrm{m}^2}$$

$$l_I = 1{,}0 \ \mathrm{m}$$

$$d_I = 0{,}115 \ \mathrm{m}$$

$$\phi_{\infty I} = 0{,}5$$

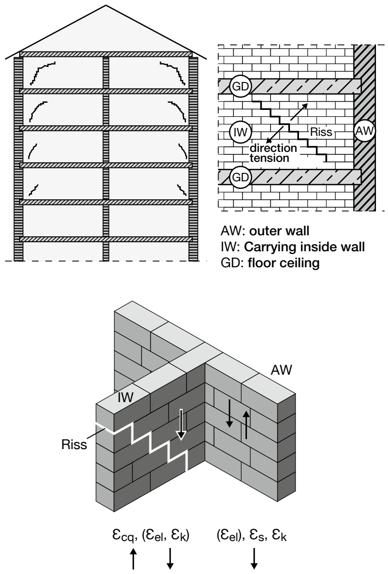
$$\varepsilon_{f\infty I} = 0{,}0 \ \frac{\mathrm{mm}}{\mathrm{m}}$$

$$\Delta T_I = 0 \ \mathrm{K}$$

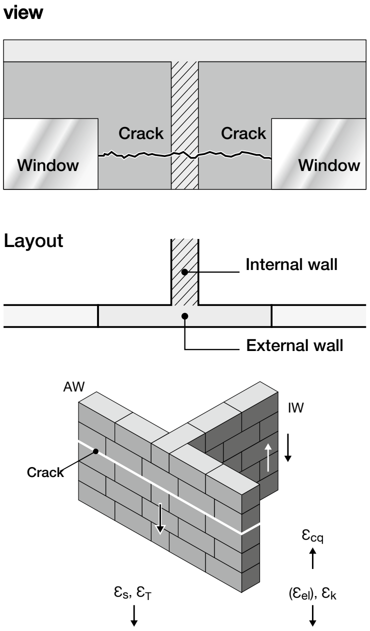
$$\alpha T_I = 6 \cdot 10^{-6} \ \frac{1}{\mathrm{K}}$$

Unfavorable boundary condition:

- great values $\Delta\varepsilon_{0f}$ and $\Delta\varepsilon_{0t}$
- smaller k_1-value: $E_A >> E_I$
- smaller k_2-value: $A_A >> A_I$
- smaller k_3-value: $\phi_{\infty I} >> \phi_{\infty A}$



Cracks caused by differences in shape in vertical direction - Deformation V1: Inner wall shortens more than outer wall



Cracks due to changes in shape Differences in the vertical direction - Deformation case V2: Exterior wall shortens more than inner wall

(Graphics from masonry practice according to Eurocode, 3rd edition, building • Beuth-Verlag)

1) Determination of deformation difference Outer wall (A) - inner wall (I) due to moisture expansion (*f*) and temperature change (T)

$$\Delta\varepsilon_{0,f} = \varepsilon_{f\infty,A} - \varepsilon_{f\infty,I} = 0 \ \frac{mm}{m}$$

$$\varepsilon_{t,A} = \Delta T_A \cdot \alpha_{T,A} = 0{,}06 \ \frac{mm}{m}$$

$$\varepsilon_{t,I} = \Delta T_I \cdot \alpha_{T,I} = 0 \ \frac{mm}{m}$$

$$\Delta\varepsilon_{0,t} = \varepsilon_{t,A} - \varepsilon_{t,I} = 0{,}06 \ \frac{mm}{m}$$

$$\Delta\varepsilon_{0,f,t} = \Delta\varepsilon_{0,f} + \Delta\varepsilon_{0,t} = 0{,}06 \ \frac{mm}{m}$$

2)Determination of stiffness ratio value

$$k_1 = \frac{E_I}{E_A} = 1{,}212$$

$$A_I = d_I \cdot l_I = 0{,}115 \ m^2$$

$$A_A = d_A \cdot I_A = 1{,}46 \ m^2$$

$$k_2 = \frac{A_I}{A_A} = 0{,}079$$

$$k_3 = \frac{1+0{,}8 \cdot \phi_{\infty,A}}{1+0{,}8 \cdot \phi_{\infty,I}} = 1$$

$$k = k_1 \cdot k_2 \cdot k_3 = 0{,}095$$

3) Determination of reduction coefficient α_K (Interpolated)

α_k	k
0,45	4,0
0,50	3,0
0,55	2,0
0,70	1,0
0,80	0,5

$$\alpha_k = k \cdot \frac{(0{,}80-1{,}00)}{(0{,}5-0{,}0)} + 1{,}00 = 0{,}962$$

4) Calculation of the relevant difference in the composition prev $\Delta\varepsilon$

$$\alpha_R = \frac{1}{1+0{,}8 \cdot \phi_{\infty,I}} = 0{,}714$$

$$\text{vorh } \Delta\varepsilon_f = \Delta\varepsilon_{0,f} \cdot \alpha_k \cdot \alpha_R = 0 \ \frac{mm}{m}$$

$$\text{vorh } \Delta\varepsilon_T = \Delta\varepsilon_{0,t} \cdot \alpha_k = 0{,}058 \ \frac{mm}{m}$$

$$\text{vorh } \Delta\varepsilon = \text{vorh\_}\Delta\varepsilon_f + \text{vorh } \Delta\varepsilon_T = 0{,}058 \ \frac{mm}{m}$$

5) Comparison of existing and permissible deformation differences

$$\text{zul } \Delta\varepsilon = 0{,}2 \ \frac{mm}{m}$$

$$\frac{\text{vorh } \Delta\varepsilon}{\text{zul } \Delta\varepsilon} = 0{,}289 \quad < 1{,}0$$

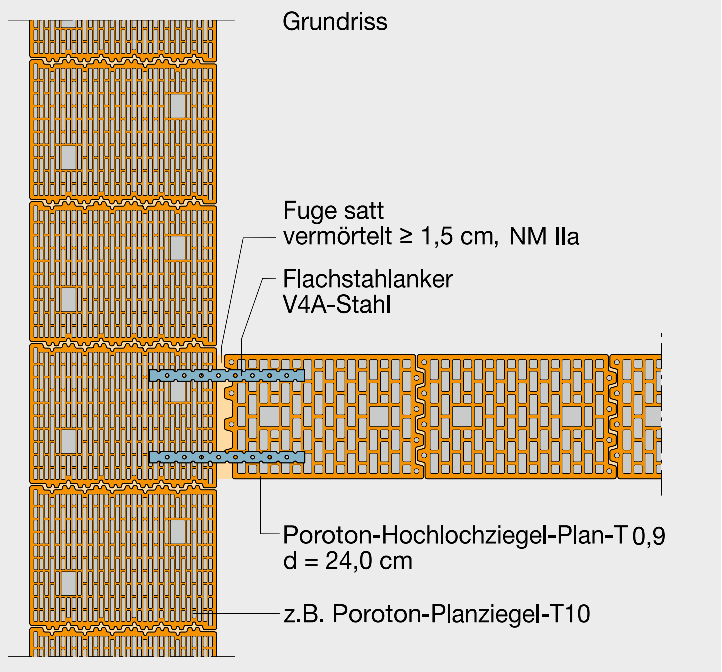
Basics

Butt joint technology as wall connection

By customary and rational butt-joint technology, it is possible to perform tensile and pressure-resistant connections supporting and non-load-bearing wall panels without costly wall factory gears according to DIN 1053-1 and DIN EN 1996. Here, walls are butted against each other without adhering to the association rules. By inserting flat steel anchors made of V4A steel, an additional wall bracket is achieved. Non-supporting interior walls can i. d. R. be held as three or four sided. Butt-crushed load-bearing walls must be dimensioned as two-sided (upper and lower brackets).

Prerequisite for the application of the butt joint technique is a mathematical determination of the required number of flat steel anchors. The basics for the application and dimensioning of butt joints can be found in the standards DIN 1053-1 and DIN EN 1996 respectively.

For structural reasons, it is generally recommended to install flat steel anchors, even if they are not statically required. In order to prevent injuries, the flat steel anchors are lowered up to the counterwalls of the transverse walls. The butt joint is to be filled with NM IIa for static and sound insulation reasons.



When creating sound-relevant walls, z. As apartment partitions, stairwell walls, a connection to adjacent outer walls is preferable by integrating or through the butt joint technique.

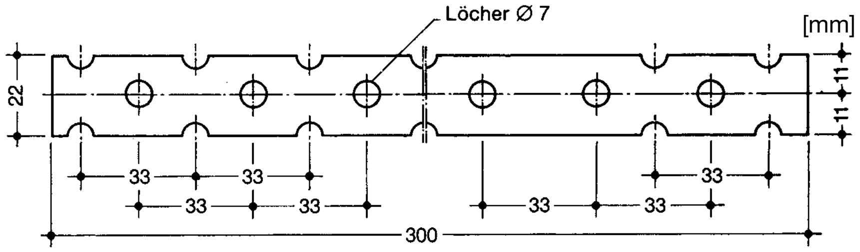
Advantages of the butt joint technique

- Reduced working time requirement due to the elimination of elaborate toothed walls
- Free traffic areas
- Easy connection with different stone formats and heights
- Elimination of thermal bridges in binding inner walls of higher gross densities in high-heat-insulating exterior walls
- Impeccable implementation of the static assumptions
- Use with plan and block tiles, soundproof tiles, small formats

Rated

Butt joint with flat steel anchors (V4A steel, material No. 1.4401)

In exhaust tests, the suitability of the flat steel anchors was demonstrated. 22 mm wide perforated flat anchors with a thickness of 0.75 mm and a length of 300 mm were used.



Taking into account at least 3 times the safety with regard to the average breaking load and compliance with the permissible slip 1 mm, the following indicated anchor loads result depending on the respective type of mortar.

Permissible loads of flat steel anchors after extraction tests[1], [2] and expert opinions[3]:

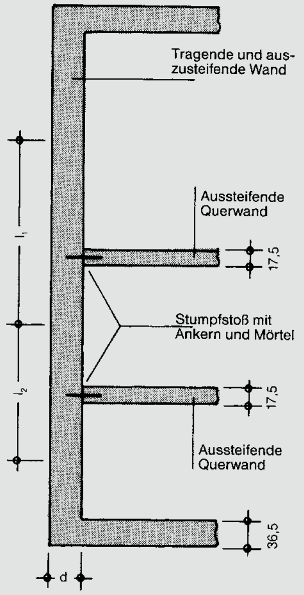
of mortar	Permissible anchor load (kN) insertion length ≥ 15 cm
Normal mortar ≥ MG II and thin-bed mortar	2,0
light mortarLM 21	0,7
light mortar LM 36	1,0

Depending on vertical load and Wandeinflusslänge the number of necessary flat steel anchors can be determined.

Basics for the determination of the required anchor sheets

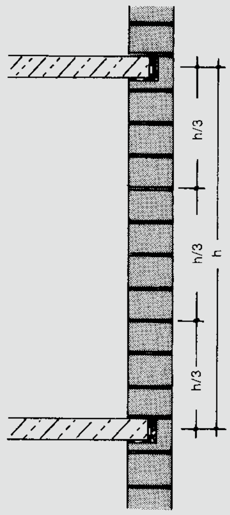
Flat steel anchors are to be dimensioned so that they transfer 1/100 of the vertical load of the load-bearing wall in the one-third of the wall height.
An additional approach to wind suction forces is eliminated, since the design approach (1/100 of the vertical load per third-point) provides adequate safety.
Depending on the vertical load and thus the resulting horizontal load (V / 100 per third-third point) multiplied by the influence length (Figure 11), the number of flat steel anchors can be determined according to the following tables.
The arrangement of the flat steel anchors should preferably take place in the thirds of a third (see Figure 12). If this is not possible, the arrangement can be distributed over the entire wall height.

Image 11 – Layout:



Influence length of the transverse walls to be connected with butt joint

Image 12 – Cut:



Location of the wall anchor

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[1] certificate Nr.: 1319/91 A/Eg der AMPA Bau Hannover
[2] certificate Nr.: 1056/90 Mj/Hi der AMPA Bau Hannover
[3] Expert report on the carrying capacity of insulated masonry connectors, Hannover 1993

Required number of flat steel anchors per wall (always 2 in a storage joint)

Constraint length [m]	Average wall load of the wall auszuschteifenden [kN / m]															
	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
of mortar: NM II / DBM																
3,0	4	4	4	4	4	4	4	4	4	8	8	8	8	8	8	8
4,0	4	4	4	4	4	4	8	8	8	8	8	8	8	8	8	8
5,0	4	4	4	4	8	8	8	8	8	8	8	8	12	12	12	12
6,0	4	4	8	8	8	8	8	8	8	12	12	12	12	12	12	12
7,0	4	8	8	8	8	8	8	12	12	12	12	12	12	16	16	16
8,0	4	8	8	8	8	8	12	12	12	12	12	16	16	16	16	16
of mortar: LM 36																
3,0	4	4	8	8	8	8	8	8	8	12	12	12	12	12	12	12
4,0	4	8	8	8	8	8	12	12	12	12	12	16	16	16	16	16
5,0	8	8	8	8	12	12	12	12	16	16	16	16	20	20	20	20
6,0	8	8	12	12	12	12	16	16	16	20	20	20	24	24	24	24
7,0	8	12	12	12	16	16	16	20	20	20	24	24	24	28	28	28
8,0	8	12	12	16	16	16	20	20	24	24	24	28	28	32	32	32
of mortar: LM 21																
3,0	8	8	4	8	8	12	12	12	12	12	16	16	16	16	20	20
4,0	8	8	8	12	12	12	16	16	16	16	20	20	20	24	24	24
5,0	8	12	12	12	16	16	16	20	20	20	24	24	28	28	28	32
6,0	12	12	12	16	16	20	20	24	24	24	28	28	32	32	36	36
7,0	12	12	16	16	20	20	24	24	28	28	32	32	36	36	40	40
8,0	12	16	16	20	24	24	28	28	32	32	36	40	40	44	44	48

Design example butt-joint technique

Given:

Dimensions:
Removable wall d = 30.0 cm
Stiffening transverse wall d = 17.5 cm
Influence length for the stiffening

wall
l_1 = 6,0 m
Insertion length of the anchor plates
l_E = 15 cm

Building materials:
Poroton perforated brick plan-T
thin-bed mortar

Burden:
Normal force of the supporting wall
N = 140 kN/m

Searched:
Number of flat steel anchors

Calculation:
Wall load = 6,0 m x 140 kN/m = 840 kN

The anchor plates shall be dimensioned at each third point of the wall for a horizontal load of 1/100 of the load in the area of influence. 840 kN / 100 = 8.4 kN (each third point)
The permissible anchor load for thin-bed mortar DBM is 2.0 kN.
The number of laminations required to connect the wall is calculated as:
satisfied n = 8.4 / 2.0 x 4.2
selected: n = 6
Therefore, a total of 12 flat steel anchors must be installed over the wall height (see tab., Thin bed mortar), which are preferably to be arranged in the third point of the wall height.

Statics

Anchorages for two-shell external masonry

Anchorages

The masonry shells are gem. To DIN 1053-1 or DIN EN 1996-2 by means of suitable air-layer anchors made of stainless steel. In this case, the vertical distance between the armatures should be at most 50 cm and the horizontal distance at most 75 cm (see Figure 1). The minimum number of anchors per m² wall area is specified according to DIN EN 1996-2 according to the following table.

Minimum number η_{tmin} of wire anchors per m² of wall surface (wind zones according to DIN EN 1991-1-4 / NA)

building height	Wind zones 1 to 3 Wind zone 4 Inland	Wind zone 4 Coast of the North Sea and Baltic Sea and islands of the Baltic Sea	Wind zone 4 islands of the North Sea
$h \leq 10$ m	7[a]	7	8
10 m $< h \leq 18$ m	7[b]	8	9
18 m $< h \leq 25$ m	7	8[c]	not permitted

a in wind zone 1 and wind zone 2 inland: 5 anchors / m²
b in wind zone 1: 5 anchors / m²
c is a building footprint less than h / 4: 9 anchors / m²

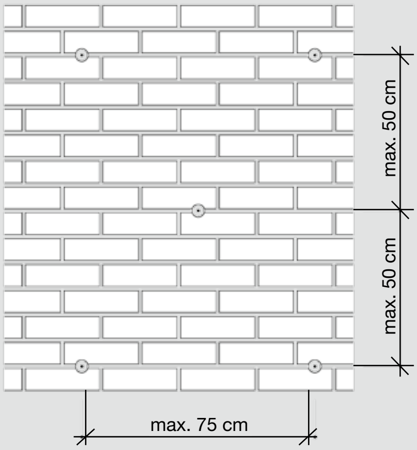


Image 1

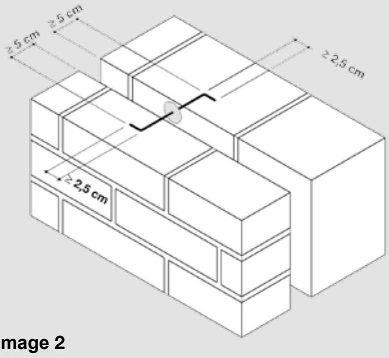


Image 2

In addition, three anchors per lfdm edge length at all free edges to arrange, z. B. of openings, building corners, along the expansion joints and at the upper ends of outer shells. In addition to wire anchors gem. DIN EN 845-1 with a diameter ≥ 4 mm, other types of anchors (eg shaped sheet metal anchors) and dowels in the masonry are also permitted if their usability has been proven in accordance with the building regulations. Special air-layer anchors for surface-slab masonry (Fig. 3) [s. right] can be inserted with their flattened ends in thin bed joints.

For surface brick masonry it is recommended:

Shell distance	Anchoring
40 – 150 mm	Wienerberger air layer anchor (WB LSA), two-piece
100 – 170 mm	Multi-air layer anchor (Bever GmbH)
120 – 210 mm	Multi-Plus air layer anchor (Bever GmbH)

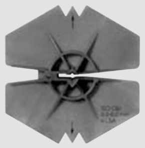
picture 3
Air layer anchors are available in different lengths

Two-piece Wienerberger air layer anchor (WB-LSA) in installed condition.

Advantages

- Safe installation of the molded Sheet metal part in the thin bed joint of plane brick masonry
- Minimum tray distance 40 mm possible
- Subsequent installation of the bent armature wire together with the insulation possible

The use of drip discs or clamping discs with drip-offs (Fig. 5) prevents moisture from passing through the anchor from the outer to the inner shell.



Picture 5
Clamping disc with drip-off nose as insulation attachment

Dowel fixings in Poroton brickwork

Subsequent connections to the masonry are realized via dowels. In solid brick, plastic expansion dowels have proven themselves for the rule. Injection anchors with threaded rods were also successfully used with this tile. The perforated bricks often plastic anchors are used with a long Spreizbe-rich. The attachment in several webs results in a sufficient anchoring. At low loads or rigid attachments also expandable or knotting dowels are sufficient.

A very solid dowel design represent the injection anchors with a volume-limiting sieve sleeve attachments can be connected via an introduced anchor rod or an anchor sleeve.

Dowels and mounting must be matched to the geometry and material properties of the perforated brick. Dowels ensure optimal fixings even in perforated bricks.

General information:

- Rotary drilling **without hammering and hammering**! Due to the high impact energy The drilling machine can break out the drill edges rosette-like
- Use cemented carbide drills ground especially for brickwork
- drill horizontally
- The more bridges are pierced, the better spread corresponding anchor length compressive and tensile forces in the brick
- if requirements are low, nylon expansion dowels / frame dowels (eg Fischer or Würth) with a long expansion part for secure anchorage over several brick bridges (compare loading tables of the anchor manufacturer!)

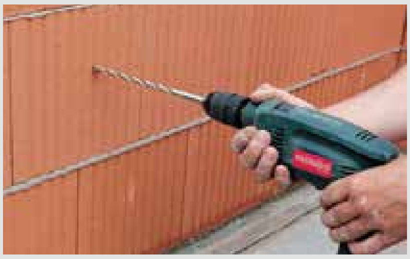
- higher loads z. B. by awnings, canopies, handrails, toilets and Washbasinscanbeinterceptedbyattachmentwithinjectionanchors become
- Dowel joints for load-bearing constructions must be planned by engineering and be measured
- for dowel joints in load-bearing constructions a building supervisory approval by the dowel manufacturer is required

Corresponding anchor systems provide z. B .:

Adolf Würth
GmbH & Co. KG
74650 Künzelsau
Telefon (0 79 40) 15-0
Fax (0 79 40) 15-1000

Fischerwerke
Artur Fischer
GmbH & Co. KG
72178 Waldachtal
Telefon (0 74 43) 12-0

TOX-DÜBEL-
TECHNIK GmbH
Brunnenstr. 31
D-72505 Krauchenwies
Telefon (0 75 76) 9295-0



Drilling without impact function with sharpened carbide drill.

Place dowel (if necessary already with screw).

Hammer in dowels flush with hammer.

Screw in the screw.

Drill with specially ground edge do not need a striking mechanism

normal stone drill with roof-shaped tip

A. Recommended working loads for injection plugs

Metal injection anchor consisting of Fischer threaded rod FIS A M 10, sieve sleeve FIS H Ø 16 mm and injection mortar FIS V 360S.

Areas of application: Fixing of higher loads such as awnings, canopies, WC

of brick	Max. Used load for centric pull, transverse pull and diagonal pull under each angle [1]	
	Rmbedment depth [mm]	
	85	130
Poroton T7-MW Poroton T8-P/MW Poroton T9-P Poroton S8-P/MW	0,47 kN	0,63 kN
Poroton S9-P/MW Poroton S10-P/MW Poroton S11-P	0,55 kN	0,93 kN
Poroton T7 Poroton T8 Poroton T9 bis T18 Poroton Plan-T/ 1,2 / 1,4	0,51 kN	0,58 kN

[1] The specified loads are to be checked by tests on the building.

B. Recommended working loads for plastic frame anchors Areas of application: Fixing wall cabinets, facade substructures ...

of brick	Max. Working load for centric tension, transverse tension and diagonal tension under every angle F_{zul} [1]	
	embedment depth ≥ 70 mm	
	Würth W-UR8[2]	fischer FUR 10[3]
Poroton T7-MW Poroton T8-P/MW Poroton T9-P Poroton S8-P/MW	0,26 kN	0,18 kN
Poroton S9-P/MW Poroton S10-P/MW Poroton S11-P	0,43 kN	0,33 kN
Poroton T7-P Poroton T8 Poroton T9 Poroton T10 Poroton T12	0,14 kN	0,07 kN
Poroton T14 Poroton T16 Poroton T18 Poroton Plan-T/ 1,2 / 1,4	0,11 kN	0,09 kN

[1] Temperature range 50 ° C / 80 ° C. Minimum edge distance 100 mm. For plastered masonry, the values should be halved.
[2] The partial safety factors of the resistances regulated in the approval ETA-08/0190 as well as a partial safety factor of yF ≥ 1.4 are taken into account.
[3] The indicated working loads contain a sevenfold security.


Rotary drilling without punch and hammer work!


Reveal tiles ensure secure attachment


Würth W-UR8

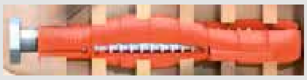

Fischer Fur 10


Dowels in the reveal area for fixing windows

C. Mounts in the middle load range

Areas of application: Fixing of pipelines, washstands ...

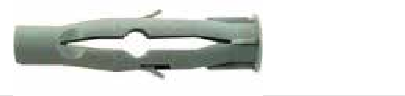
of brick	Max. Working load for centric tension, transverse tension and diagonal tension under every angle[1]	
	PSD-SL 10/90 with wood screw 8x120	PSD-SL 12/90 with wood screw 10x120
Poroton T7-MW Poroton T8-P/MW Poroton T9-P Poroton S8-P/MW	0,46 kN	0,59 kN
Poroton T10 Poroton T12	0,27 kN	0,22 kN
Poroton T14 bis T18 Plan-T/ 1,2 / 1,4	0,33 kN	0,28 kN



TOX PSD-SL

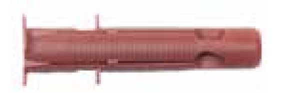
D. Lightweight fastenings with universal dowel:

For light fixtures (baseboards, towel rails, cable ducts, lamps, ...) is suitable for. For example, the fischer universal plug UX / FU or the ZEBRA Shark W-ZX from Würth. Available in any hardware store in the diameters 6 -10 mm.



fischer FU

fischer UX



Würth ZEBRA Shark W-ZX®

Processing aids

Slots and recesses

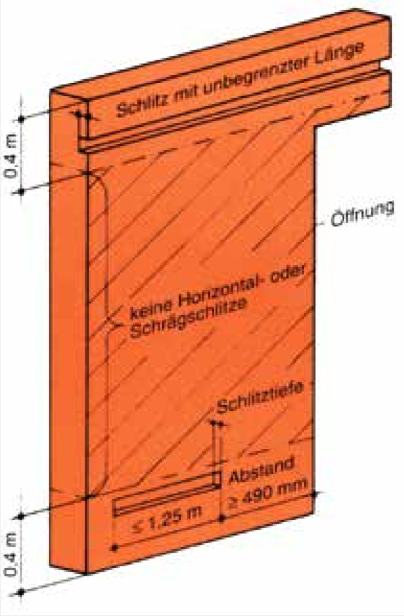
Horizontal and slanted slots without static proof (retrofitted)

Wall thickness in mm	slot depth (in mm)	
	unlimited slot length	Slot length maximum 1.25 m (Distance from openings ≥ 490 mm)
≥ 115	–	–
≥ 175	–	≤ 25
≥ 240	≤ 15	≤ 25
≥ 300	≤ 20	≤ 30

Horizontal and oblique slots are allowed:

- only in the range 0.4 m above or below the raw ceiling,
- only on one wall side.

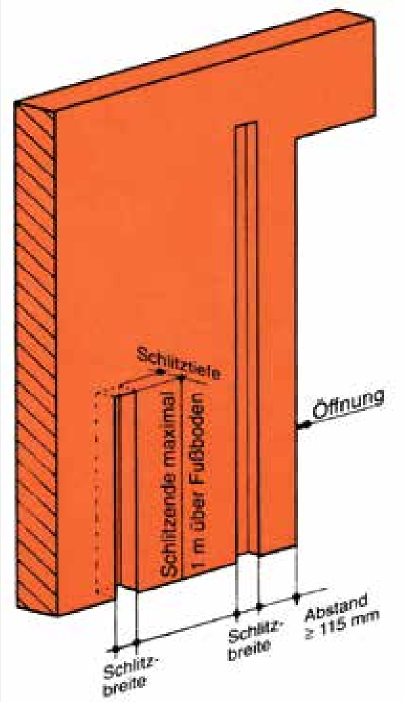
The slot depth may be increased by 10 mm, if tools are used, with which the depth can be kept exactly, eg. B. milling.



Vertical slots and recesses without static proof (subsequently manufactured)

Vertical slots and recesses can significantly impact the load bearing capacity of the wall by reducing or eliminating the lateral stiffening. Savings in soundproofing walls reduce the soundproofing dimension!

Wall thickness in mm	Slot dimensions with unlimited slot length in mm		
	depth	Single width	Total width on 2 m wall length
≥ 115	≤ 10	≤ 100	≤ 100
≥ 175	≤ 30	≤ 100	≤ 260
≥ 240	≤ 30	≤ 150	≤ 385
≥ 300	≤ 30	≤ 200	≤ 385



- Distance of the slots from openings ≥ 115 mm,
- When using milling, 10 mm deep slots are allowed in 240 mm thick walls

are opposite.

Slots up to a maximum of 1 m above the floor may be made with wall thickness ≥ 240 mm to 80 mm deep and 120 mm wide.

Important: In order to comply with the requirements for air or wind tightness in accordance with DIN 4108 and the German Energy Saving Ordinance, slots and recesses should be carefully sealed. This can be z. B. in sockets by deep casting or special operations done.

Corresponding processing devices z. For example:

Atlas Copco Elektrowerkzeuge GmbH
Max-Eyth-Straße 10
71364 Winnenden
Telefon (0 71 95) 12-0

Spezialdosen:
z. B. luftdichte Unterputzdosen
Fa. Kaiser GmbH & Co. KG

Slots and recesses insulation filled brick

Horizontal and oblique slots are permissible if they comply with the table on page 126 and are taken into account in the design.

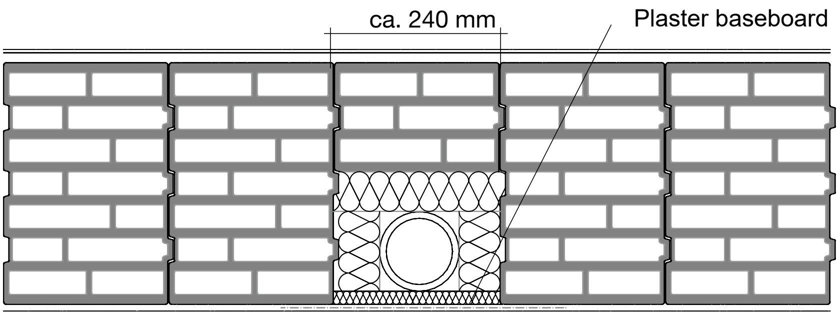
According to DIN 1053-1 or DIN EN 1996 without proof, permissible horizontal and slanted slots and recesses in load-bearing walls (wall thickness ≥ 30 cm):

Slot length up to 1.25 m	· **Slit depth up to 30 mm**
slot length unlimited	· **Slit depth up to 20 mm**

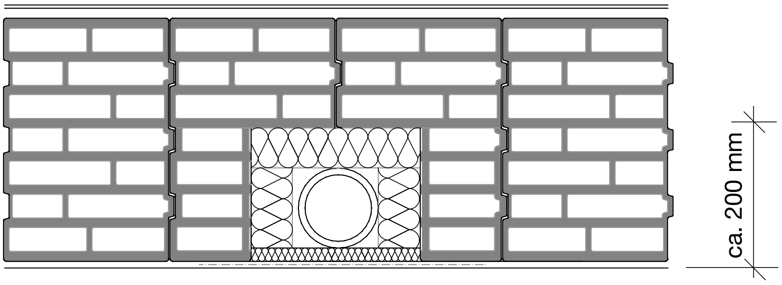
According to the general building inspectorate approvals vertical slots with a width and depth up to 35 mm can be made.
The distance between **vertical** slots must be at least 15 cm from openings. It may be arranged a maximum of such a slot per meter wall length. In piers and wall sections <1.0 meters in length, **vertical slots** are not allowed.

Recesses for downpipes

In order to avoid thermal bridges, as far as possible, no slits should be arranged in high-heat-insulating exterior walls. Are recesses z. For example, for wastewater pipes in an outer wall unavoidable, the plane roof should be cut. In order to reduce the influence of thermal bridges in the reduced area, the recesses should be lined with insulation boards.

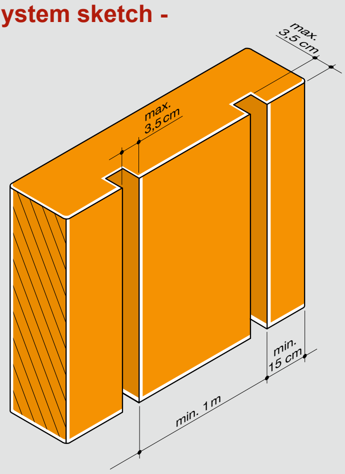


1. Layer with recess



2. Layer with recess

Slots vertical
- System sketch -



Allowed without computational proof

Recommendation:
In order to avoid thermal bridges in the outer wall, recesses should preferably be arranged in or in front of an inner wall. For reasons of sound insulation, however, they should by no means be located in apartment or house partitions.

Sharing the bricks

Sharing / cutting the bricks:
Previously customary hewing for dividing bricks is not permitted with modern thermal insulation bricks. For cutting or cutting, therefore, use dry or wet stone saws. Depending on the field of application and the cutting result, block saws, band saws or electric hand saws are commonly used.

Block stone saw
In the wet cutting process, the water supply should be reduced as far as possible in the case of bricks filled with perlite. Keep pearlite grains away through a sieve / cloth or external circulation pump.

Saint Gobain Abrasives GmbH
Birkenstraße 45 – 49
50389 Wesseling
Deutschland
Tel. +49 (0) 22 36 - 89 11 0
Fax +49 (0) 22 36 - 89 11 31
sales.ngg@saint-gobain.com
www.construction.norton.eu

Band saw
Dry cutting process with high precession. In particular for bricks filled with perlite, the best variant for splitting or creating fitting pieces, including winch cuts.

LISSMAC Maschinenbau GmbH
Lanzstraße 4
88410 Bad Wurzach
Tel. +49 (0) 7564 307-0
lissmac@lissmac.com
www.lissmac.com

Electric hand saw
The flexible version quickly at hand and universally applicable. However, the precision is lower. In the case of bricks filled with perlite, vibrations can also impair the filling more.

DEWALT
Richard-Klinger-Straße 11
65502 Idstein/Taunus
Tel. +49 (0) 6126 21-1
Fax + 49 (0) 6126 21-2770
www.dewalt.de

Storage and general processing instructions

To store

Carefully unload the bricks, store them floor-free, protect them from dirt and the effects of the weather.

Stonewall

Planziegel are processed with Poroton thin-bed mortar (see also "Processing Poroton-Planziegel").
Block bricks are also processed with standard mortar or with light mortar (LM 21 or LM 36) to improve the thermal insulation properties of the masonry. Recommended are factory dry mortar.
In general:

- Monitor mortar preparation.
- Wall in full foot.
- Protect masonry from moisture.
- Clean the wall - keep the scaffolding clean.
- Cover masonry at work interruption.
- Derive precipitation water.

Masonry must be protected from rain and snow (DIN 1053-1)

- All building materials must be protected against moisture before processing.
- Before the end of work, all masonry crowns must be covered.
- For longer lifetimes are the window parapets and masonry crowns with films or the like. Cover.

Masonry work in winter

According to DIN 1053 Part 1 Number 9.4, masonry work may only be carried out in frosty conditions, subject to special protective measures. At temperatures ≤ + 5 ° C, the Poroton thin-bed mortar may no longer be processed.
With decreasing temperatures, the strength of the mortar slows down and virtually comes to a standstill in case of frost. Frost effect in the early stage permanently affects mortar strength. The increase in volume from water to ice destroys fresh and not yet hardened mortar in its structure.

In principle, frozen building materials may not be processed. Depending on the outdoor temperatures, general protection measures below may be required.

General protective measures

- At temperatures below + 5 ° C are the aggregates and the brick masonry cover.
- The use of antifreeze and / or de-icing salts is not permitted, these damage the masonry (flaking and efflorescence).
- On frozen masonry may not be further walled.
- Frost damaged masonry must be removed before further construction.

Terms of execution:

For the execution of the masonry of Poroton bricks, the provisions of the standard DIN 1053-1: 1996-11 - Masonry calculation and execution - unless otherwise specified in the general building inspectorate approvals.

Facing bricks and clinker
The processing instructions can be found in the brochure "Technical Information Facing Bricks", which we will gladly send you.

Terca Fassadenlösungen

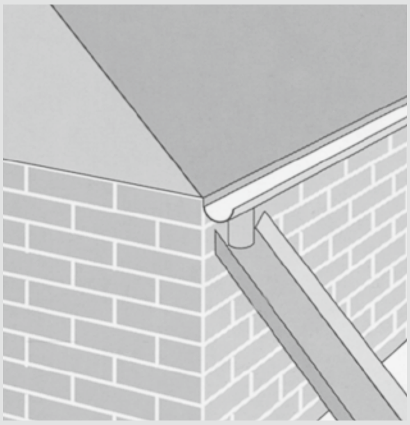
Technische Informationen Vormauerziegel

Wienerberger

Weather protection

Window parapets and masonry crowns are to be protected during the construction phase against the ingress of the day water (rain and snow).

Cover of the wall crowns



Derivation of rainwater

+ 5°

At temp. During the day u. Do not wall at night below + 5 ° C. Protect masonry and material from frost. Do not use antifreeze for the mortar.

Exterior plaster

Requirements for safe cleaning

- Store blocks dry on site
- Prefabricated brickwork, mural crown and parapet in front of

Protect wetting

- Mortarthoroughly
- Warp joint approx. 12 mm average thickness for Poroton block bricks
- Approximately 1 mm bearing joint for Poroton-Planziegel
- Crushed joints on toothed tiles ≤ 5 mm
- Defects> 5 mm close immediately when building
- Avoid mixed masonry to exclude shrinkage cracks
- Maintaining the overbinding measure
- Execution of the masonry according to DIN 1053-1 or DIN EN 1996

Homogeneous masonry = safe plastering

We recommend:

Mineral light plaster systems or thermal insulation rendering systems according to DIN 18550 or DIN EN 998-1. Cleaning profiles and plaster moldings help to define and maintain the thicknesses of plaster layers and secure the edge zones of the plaster.

Processing instructions

1. The masonry made of Poroton brick must be cleaned of dust and dirt and, if necessary, pre-wetted over its entire surface.
2. In general, bricks can be plastered with professional guidance without special preparation work. The flush is two-layered
3. Applied "wet in wet".
4. The fresh plaster must be protected from drying out too quickly and, if necessary, keep it moist by wetting with water.
5. Exterior plasters should have an average plaster thickness of 20 mm.

Suitability of mineral exterior plasters (sub-plasters) on Poroton brickwork

Putzgrund		Normal-plaster	lightweight plaster		insulating plaster
			Typ I Machines lightweight plaster	Typ II Fiber-light plaster, ultralight plaster	
Applies to common plaster surfaces, z. B. to properly executed masonry according to DIN EN 1996 / NA or DIN 1053-1, which are not exposed to increased stress.					
insulation filled	Poroton-S8 -S9/-S10/-S11	✔	✔✔✔	✔✔✔	✔✔✔
	Poroton-T7/T8/T9	–	✔✔✔	✔✔✔	✔✔✔
unfilled	Planziegel-T14	–	✔✔✔	✔✔✔	✔✔✔
	Planziegel -T8/-T9/-T10/-T12	–	✔	✔✔✔	✔✔✔

Special measures, eg. As the application of a reinforcing plaster with full-surface fabric insert on the flush, are in plaster surfaces in which the cleaning system is exposed to increased stress required.

These include, among others:

- special exposure of the façade or component (eg window reveal area)
- Use of special topcoats (fine-grained or dark facade coating)
- increased moisture load
- significant irregularities in the plaster base

– not suitable **✔ conditionally suitable** **✔✔ suitable** **✔✔✔ particularly suitable**

lightweight plaster Typ I: Dry bulk density ≤1300 kg / m3; Strength class CS II; Modulus of elasticity 2500 - 5000 N / mm2; Cleaning mortar group P II according to DIN V 18550

lightweight plaster Typ II: Dry bulk density ≤1000 kg / m3; Strength class CS I and CS II; Modulus of elasticity 1000 - 3000 N / mm2; Cleaning mortar group P II according to DIN V 18550

A sure thing:

The combination of brick, plaster ...

... and profiles!

Latest Recognizes to the Plastering masonry includes the guidelines for plastering masonry and concrete from the industrial association Werkmörtel IWM.

Download unter www.wienerberger.de → Wandlösungen → Downloadcenter → Broschüren

Moisture protection and structural waterproofing

In modern building construction basements are usually planned and built for high-quality use. This requirement leads to increased demands on the dryness of the component surfaces and the room air. For reasons of building physics and construction, it is therefore obvious to use the masonry planned for the further floors in the basement as well.

Brick masonry is due to its load capacity and dimensional stability combined with favorable building physics properties such as thermal insulation and moisture resistance ideal as a building material for the cellar construction.

Depending on the moisture load by:
- Soil moisture and non-accumulating leachate
- Pressurized water from backwater
- Pressurized water from groundwater and flood

sealing is required for earth-contacting masonry. In addition, moisture-protective measures must be taken into account in the base area. The required sealing measures, sealing materials, dimensions and designs are regulated in DIN 18195 Structural waterproofing or separately in general building inspectorate approvals or manufacturer guidelines. Are standardized z. B .:
- Bitumen and polymer bitumen membranes
- Plastic and elastomeric membranes
- Self-adhesive bituminous membranes (KSK)
- Plastic-modified bituminous thick coatings (PMB).

Crack-bridging mineral sealing slurries (MDS), although standardized as waterproofing agents, are explicitly listed in Eurocode 6 as sealants for cross-section seals. However, rules for the sealing of earth-contacting components with MDS are only available in the manufacturer's guidelines.

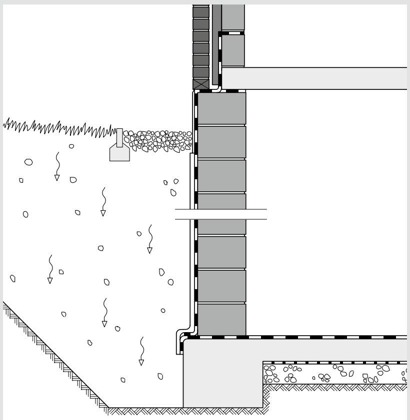
The required sealing of brickwork is reliable with the different sheet-like or liquid sealants easy, fast and economically planable and executable.

An assignment of sealing systems to the different types of load can be found in the following table.

Assignment of types of stress and sealing systems

1	Type of component, type of water, installation situation			Type of water exposure	sealing system
2	earth-contacting walls and floor slabs above the design water level, capillary water, retention water, seepage water	strongly permeable soil (k> 104 m / s)		Soil moisture and non-accumulating leachate	PMB 4); single-layer waterproofing membranes according to DIN 181954; flexible sealing slurries 2)
3		poorly drained soil (k < 104 m/s)	with drainage 1)		
4			without drainage	damming leachate	PMB, one / two-ply geomembranes according to section 93)
5	Earth-contacting walls and floor slabs below the rated water level			pressing water	single / multi-ply geomembranes according to DIN 181956 section 8

1) Drainage according to DIN 4095
2) Arrange execution according to guideline [13] with orderer!
3) to depths of 3 m below ground level, otherwise line 5
4) PMB: polymer-modified bituminous thick coating (polymer modified thick coatings)



Schematic diagram
Waterproofing against soil moisture

Merkblatt zur Abdichtung von Mauerwerk

DGfM Deutsche Gesellschaft für Mauerwerks- und Wohnungsbau e.V.

The "Merkblatt für den Mauerwerk" (German Masonry and Residential Construction) (DGfM) provides a wide range of information on the application of earth-contacting components, the need for waterproofing, planning and execution and the applicable regulations. The leaflet is available in the download area of our homepage or directly from the DGfM.

Ecology

Ecological balance of the tile

Criteria for good ecological assessment of the building material bricks are:

- Environmentally friendly, near-surface degradation of raw materials
- Recultivation of clay pits
- minimal transport routes during production and to the construction site
- optimum use of primary energy during production
- Guarantee of all the residential value performing properties (good heat, sound and fire protection, excellent vapor diffusion properties, high heat storage capacity)
- simple, proven wall constructions with minimal maintenance
- High recyclability (eg reprocessing in production, use in road construction, tennis flour)

Environmental and health compatibility of the tile

- natural ingredients
- no toxin content
- no harmful emissions or outgassing
- no fiber cleavage or dust formation due to abrasion
- minimal natural radiation exhalation
- high corrosion and rotting resistance
- safe and anti-allergic in case of direct skin and mouth contact (TÜV-Appraisals EN 71-3)

Comparison of the primary energy input of different wall building materials Extract from Feist table

Required primary energy use in the production of wall types with the same thermal insulation value						
		Primary energy intake *				
stone	density	MJ/m^3	kWh/m^3	MJ/m^2 (36,5 cm)	kWh/m^2 (36,5 cm)	U value for the wall
Porous bricks	0,8	1181	**328**	431	119	0,40 W/m^2 K
expanded concrete	0,7	1708	471	623	173	0,40 W/m^2 K
aerated concrete	0,55	1708	474	623	173	0,40 W/m^2 K
calcareous sandstone ** + 8 cm thermal skin (polystyrene)	1,4	1219	339	445	124	0,40 W/m^2 K

* Information on primary energy consumption from: primary energy and emission balances of insulating materials. Institute Housing and Environment Darmstadt, Dipl.-Ing. Wolfgang Feist

** Sand-lime brick 293 + polystyrene thermal skin 152 [MJ / m^2]

The table values include the energy requirement for:

- Raw material extraction
- Processing
- Manufacturing
- Transport

Institut Bauen
und Umwelt e.V.

The single-shell exterior brick wall is "ecologically highly recommended"[1]

- very simple, durable constructiontion
- little vulnerable to executionerror
- good repair possibilities
- low material diversity, only minerals organic substances (therefore good reuse options)
- medium to good thermal insulation properties
- good heat storage capacity
- Forwardingoftheheatradiation from outside through the wall possible
- unproblematic dehydration

Behavior in relation to building moisture and condensation in the case of diffusion-friendly plasters

The rear wall with thermal skin (thermal insulation composite system) is "ecologically not recommended for new buildings" [1]

- complicatedconstruction, less durable
- very vulnerable to executionerror
- bad repair possibilities
- higher material diversity, often mine Roman and organic substances in the composite
- badrecyclingpossibilities through the solid composite and the different kind of materials
- Forwarding of the heat input From the outside through the wall is hardly possible by external insulation
- Deterioration of sound insulation properties by 3 dB for non-mineral ETICS

Brick wall constructions do not require any thermal insulation composite systems!

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[1] Study of the National Institute of Construction and applied building damage research NRW, 1.19-1993

Planning and evaluation

More than ever before, the market is asking for affordable housing. It is not usually successful to ostensibly accept cheap construction methods. Cost-saving building begins with careful and early planning down to the last detail:

Building design

- Abandonment of highly articulated structures per (projections and recesses, bay)
- Adjusting the room heights Grid 12.5 or 25.0 cm (elimination of compensation layers)
- Noradiator mixes
- Superior balconies and stairs
- The weak-inclined, not developed roofs
- Central arrangement of the wet rooms / kitchens
- Rational working techniques

Tragwerkplanung

- Tragende Wände übereinander anordnen
- Innenwände tragend/dickenoptimiert
- Deckenspannweiten ≤ 4,50 m
- Anschluss aussteifender Wände mit Stumpfstoßtechnik
- Raumhohe Tür- u. Fensteröffnungen
- Keine überbreiten Fensteröffnungen
- Verwendung von Fertigdecken (Ziegelfertigdecke/Filigrandecke)

Building materials

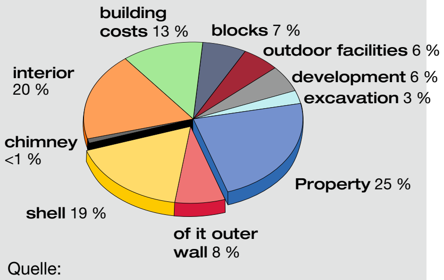
- rational processing
- good heat protection
- high fire safety
- sufficient storage masses
- existing windproofness
- low maintenance costs
- high resale value
- good recycling possibilities

This is what the wall construction material brick offers

- Environmental sustainability
- high heat protection - easy, safe and durable
- Soundproofing -55 dB in the slim wall
- Fire protection - F90-A or fire wall
- Resistant to humidity - living also in the basement
- Statics - high masonry pressure stresses
- Ergonomic properties
- Economy, longevity and quality
- dimensionalstability
- complete clay system

Shell construction costs

The total construction costs are only about 19% of the costs for the shell. About one fifth of the shell costs have to be spent on the exterior wall. The chimney costs just 1% on the cost balance. The outer wall, irrespective of the building material, including the labor costs, accounts for approx. 8%. The decision for the right wall construction material therefore hardly influences the overall construction costs, but is decisive for the quality of the building.



Quelle:
Institute for Urban Development in the family house 2/97, p. 105, graphic modified

The decision for the wall building material hardly affects the total costs, but is decisive for the quality of the building.

Evaluation of new construction wall constructions

The Institute for Building Research e. V., Hannover (IFB) has presented a comprehensive study on the evaluation of typical wall constructions under the aspects ecology, economy and building technology. On the basis of structural, economic and ecological aspects, evaluation criteria were set up which, depending on the requirement profile, enable an evaluation of the sustainability aspects of the respective wall structures as a whole. A high score indicates a good score.

Common to all designs studied is a high degree of market penetration, the guarantee of solidity through simple detailed design with low material diversity and thus high design reliability. All constructions represent proven construction methods which comply with the generally accepted rules of technology.

The evaluation of various massive new building wall constructions by the Institut für Bauforschung e. V., Hannover continues a study of over 10 years by Menkhoff and Gerken and confirms the high quality of brick wall constructions. This applies both to single-family homes and multi-storey areas.

Assessment criteria

Structural Engineering

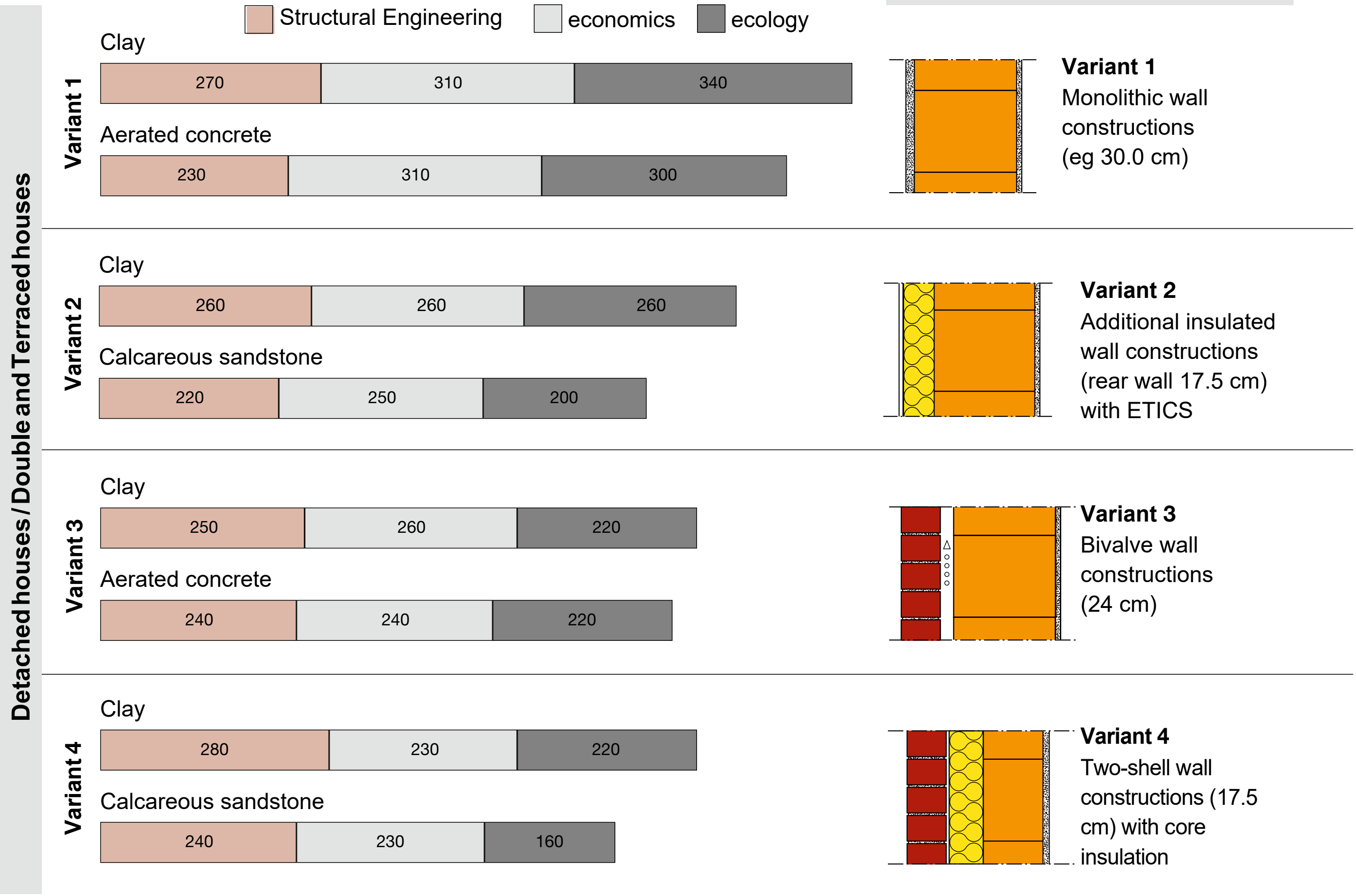
- practical moisture content of a Exterior wall construction
- Thermal insulation in winter as well as in the summer
- Soundandnoiseprotection
- Total thickness of the walls including plaster or insulating layers

Economics

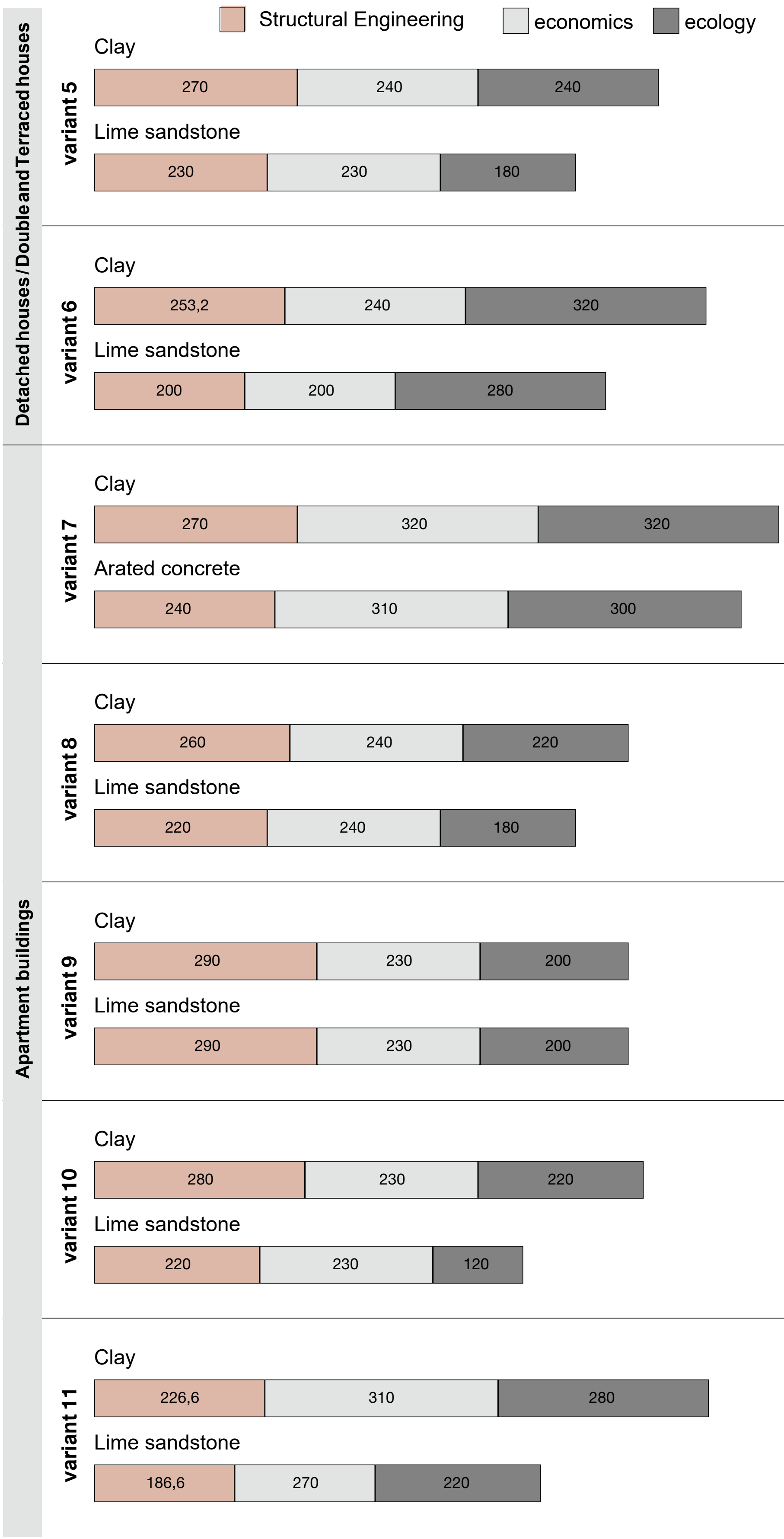
- Production and execution safety
- Durability of the whole wall construction
- investmentcosts
- Capital worth (over a period of observation of 80 years)

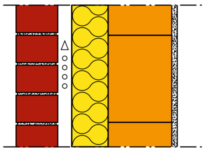
Ecology

- Primary energy content not renewed high energy (PEI)
- Assessment of the global warming potential

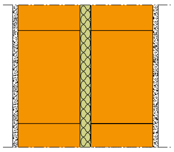


Source: Institute for Building Research e. V., Hanover

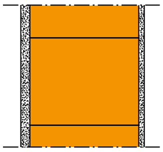




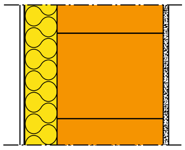
variant 5
Two-shell wall constructions (17.5 and 24 cm) with thermal insulation and air layer



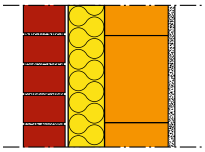
variant 6
House partition walls two-shell (2 x 17.5 cm and 2 x 24 cm)



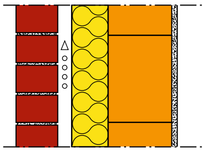
variant 7
Monolithic wall constructions (30.0 and 36.5 cm)



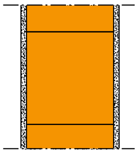
variant 8
Additional insulated wall constructions (rear masonry 17.5 or 24 cm) with ETICS



variant 9
Two-shell wall constructions (17.5 cm) with core insulation



variant 10
Two-shell wall constructions (17.5 and 24 cm) with thermal insulation and air layer



variant 11 Apartment partition walls single-shell (24 cm)

Source: Institute for Building Research e. V., Hanover

General preliminary remarks on tender texts with Poroton brickwork

The design of the building is based on the architect's plans, the static calculation with the position plans, the relevant DIN / EN regulations including the implementing decrees of the federal states for these standards, building inspectorate approvals as well as the client's special contract conditions with safety regulations and additional technical regulations ,

The following building standards, guidelines and fonts are to be considered:

- DIN 1053-1 or DIN EN 1996 "Masonry, design and dimensioning"
- General Building Inspectorate approvals for Poroton bricks
- DIN EN 771-1 "Determination of bricks - Part 1: Bricks"
- DIN 105 - 100 "bricks with special properties"
- DIN 4103-1 Non-load-bearing internal partitions, requirements and verifications
- VOB / C ATV DIN 18299 "General regulations for construction work of any kind"
- VOB / C ATV DIN 18330 "Masonry work"
- General Building Inspection Certificate Z-17.1-900 / Z-17.1-981 "Brickwork and bricklaying",

and the design tables for tile lintels

- general building inspectorate approval Z-17.1-1083 for flat lintels with non-mortared butt joints
- DIN 18202 "Tolerances in building construction - Structures"
- Standard series DIN 4102 "Fire behavior of building materials and components",
- Standard series DIN 4108 "Thermal insulation and energy-saving in buildings",
- Standard series DIN 4109 "Sound insulation in building construction",
- valid version of the Energy Saving Ordinance
- Leaflet of the Bauberufsgenossenschaft Bayern and Saxony on the walling of walls
- Application technical information of the brick industry
- Processing instructions of the brick manufacturer

The services basically include the manufacture of masonry including the supply of all materials and equipment.

Technical preliminary remarks on the service description

- The masonry is perpendicular to all floors and flush, made of flat roof tiles of height 249 mm and a storage joint from thin-bed mortar in accordance with the respective general building inspectorate approval and DIN 1053-1 or DIN EN 1996 - including required supplementary and leveling tiles.
- For the execution of the masonry, the provisions of the standard DIN 1053-1: 1996-11or DIN EN 1996, if included in the the relevant general building inspectorate approvals are not otherwise determined.
- The masonry is to be executed as Einstein masonry in a thin bed process without butt jointing. Only a thin-bed mortar after approval may be used to make the masonry. The processing guidelines for the respective thin-bed mortar must be observed. The masonry is to produce in association with staggered butt joints. It is necessary to observe an overbonding measure of ü ≥ 0.4 h (see, for example, DIN 1053-1, Paragraph 9.3).
- The thin-bed mortar must be applied over the full surface area to the bearing surfaces of the plane brick.
- For the processing of the thin-bed mortar the special mortar rollers of the brick manufacturer are to be used. The processing Please note the instructions of the brick manufacturer and mortar manufacturer.
- The flat roof tiles are close to each other ("crunchy") according to DIN 1053-1, section 9.2.2, to push, push and lot and to bring them into their final position. For joint widths greater than 5 mm, the joints must be on both sides when walling the wall surface are sealed with mortar (DIN 1053-1, Abs. 9.2.2).
- Butt joints> 5 mm or missing parts of the stones must be closed with suitable mortar.
- Applying the first layer of stone has basically with cement mortar MG III or special application mortar (thickness max 3 cm) to be done. The height compensation layer is not calculated separately, but is to be included in the m² price.
- Tolerances of the structural dimensions, angular deviation and flatness deviation are possible in the limits permitted by DIN 18202 - tolerances in building construction, buildings.

■ In this case, at least two masonry connectors in the thirds of the wall height for butt-joint suitable stainless steel masonry connectors must be installed in the bearing joints. The butt joint connection joint is to be completely closed with mortar. Butt joints are not remunerated separately.

When creating sound-relevant walls, z. B. in apartment separation or stairwells walls in multi-storey housing, a connection to adjacent outer walls is preferable by integration or through the butt joint technique.

■ Horizontal geomembranes in masonry as a seal against capillary rising moisture are according to DIN 18195 Part 4
Section 7.2.
■ Masonry non-load-bearing walls are to be decoupled at the wall head, so that no loads are introduced by later ceiling deflection. In addition, the separation of the lower floor ceiling by insert z. B. a brickwork barrier R500 sanded.

■ Non-load-bearing interior walls should be as late as possible, eg. B. bricked up after completion of the shell.

Special services

General protective measures and masonry work in winter

■ Masonry must be protected from rain and snow (DIN 1053-1).
■ Carefully unload the bricks, store them floor-free, protect them from dirt and the effects of the weather.
■ All building materials must be protected against moisture before processing.
■ o. Ä. Cover. According to VOB / C ATV DIN 18299 No. 4.1.10, the securing of the work against rainwater, which must normally be expected and its possibly required elimination, is a requirement for all masonry building materials.

■ At temperatures ≤ + 5 ° C, special protective measures must be taken.
■ In principle, frozen building materials may not be processed. Depending on the outside temperatures, the following protective measures may be required:
At temperatures ≤ + 5 ° C, the Poroton thin-bed mortar may no longer be processed. With decreasing temperatures, the development of strength of the mortar slows down and practically comes to a standstill in case of frost. Frost effect in the early stage has a lasting negative impact on mortar strength. The increase in volume from water to ice destroys fresh and not yet hardened mortar in its structure.
■ At temperatures ≤ + 5 ° C, the aggregates and the unbuilt bricks must be covered.
■ Antifreeze and / or de-icing salts are not permitted. These damage the masonry (flaking and efflorescence).
■ On frozen masonry may not be further walled.
■ Frost damaged masonry must be removed before further construction.

Terms of execution:

■ For the execution of the masonry of plan or block tiles or Poroton-P or -MW, the provisions of the standard DIN 1053-1: 1996-11 or DIN EN 1996 - masonry calculation and execution - unless otherwise specified in the relevant approvals is.

Stonewall

■ Planziegel be with Poroton thin-bed mortar.
■ Poroton-P or MW are created with the VD system.
■ Poroton Dryfix masonry is created with Dryfix glue
■ Block bricks are also processed with standard mortar or to improve the thermal insulation properties of masonry with lightweight mortar (LM 21 or LM 36). Recommended are factory dry mortar.

In general:

■ Monitor mortar preparation.
■ Wall in full foot.
■ Protect masonry from moisture.
■ Clean the wall - keep the scaffolding clean.
■ Cover masonry at work interruption.
■ Derive precipitation water.

Before processing

Our Poroton surface tiles are produced according to normative criteria or requirements of the general construction supervisory approvals and are subject to the strictest quality controls within the framework of quality monitoring. Upon delivery, the following should be noted:

Delivery

The clay blocks are delivered on pallets according to the order. The thin bed mortar is supplied as dry mortar - sufficient for the order quantity. The delivery takes place on a truck with crane jib, so that - provided that the construction site is passable and occupied - the brick pallets can be set down and distributed as needed.

Before the walling

1. Verification of the information on the delivery note

- Manufacturer and factory
- Manufacturer'smark
- Monitoring sign and CE sign
- Number and description of the delivered bricks
- Compressivestrengthclass
- grossdensity
- day of delivery
- receiver
- Name of tile according to DIN / EN and / or approval number

Brick marking and / or information on the packaging film

- Name of tile according to DIN / EN and / or approval number
- Compressivestrengthclass
- grossdensity
- Manufacturer'smark/signwork
- manufacturingdate

2. Storage at the construction site

- Carefully unload
- Store floor-free on as level as possible stable ground (pallet)
- Protect against dirt and weathering
- Never process frozen material

Certification ISO 9001

Living quality management is the basis and prerequisite for successful customer orientation. In addition, with the certification of our quality management in accordance with DIN EN ISO 9001, we document that time and market-oriented solutions for bodyshell are the yardstick of our actions.

The pawn palette

Uniform reusable pallet of the brick industry, in the case of carriage-free return of reusable pallets, the deposit will be refunded.

Calculation times (ARH reference times)

■ The following information on calculation and part times for brick masonry are taken from the Manual Work Organization on Construction, Masonry Work with Large and Small Stones, Edition 2010, and are not exhaustive.

Product designation	**Wall thickness [cm]**	**Format**	**Dimension L x B x H [cm]**	**Material requirement block**		**Working hours Masonry (ARH)**			
				ca. piece/m^3	ca. piece/m^2	**Volume value h/m^3**		**Area value h/m^2**	
						Full	structured	Full	structured
Clay block									
Poroton-T7-P	36,5	12 DF	24,8 x 36,5 x 24,9	44	16	1,20	1,37	0,43	0,50
	42,5	14 DF	24,8 x 42,5 x 24,9	38	16	1,15	1,32	0,49	0,56
	49,0	16 DF	24,8 x 49,0 x 24,9	33	16	1,28	1,49	0,63	0,73
Poroton-T8-P	30,0	10 DF	24,8 x 30,0 x 24,9	54	16	1,25	1,45	0,38	0,44
	36,5	12 DF	24,8 x 36,5 x 24,9	44	16	1,20	1,37	0,43	0,50
	42,5	14 DF	24,8 x 42,5 x 24,9	38	16	1,15	1,32	0,49	0,56
	49,0	16 DF	24,8 x 49,0 x 24,9	33	16	1,28	1,49	0,63	0,73
Poroton-T9-P	36,5	12 DF	24,8 x 36,5 x 24,9	44	16	1,22	1,39	0,44	0,51
Poroton-S8-P	36,5	12 DF	24,8 x 36,5 x 24,9	44	16	1,26	1,43	0,46	0,52
	42,5	14 DF	24,8 x 42,5 x 24,9	38	16	–	–	–	–
	49,0	16 DF	24,8 x 49,0 x 24,9	33	16	–	–	–	–
Poroton-S9-P	30,0	10 DF	24,8 x 30,0 x 24,9	54	16	1,29	1,50	0,39	0,45
	36,5	12 DF	24,8 x 36,5 x 24,9	44	16	1,24	1,41	0,45	0,52
	42,5	14 DF	24,8 x 42,5 x 24,9	38	16	–	–	–	–
Poroton-S10-P	30,0	10 DF	24,8 x 30,0 x 24,9	54	16	1,31	1,52	0,40	0,46
	36,5	12 DF	24,8 x 36,5 x 24,9	44	16	1,26	1,43	0,46	0,52
	42,5	14 DF	24,8 x 42,5 x 24,9	38	16	–	–	–	–
Poroton-T7-MW	36,5	12 DF	24,8 x 36,5 x 24,9	44	16	1,20	1,37	0,43	0,50
	42,5	14 DF	24,8 x 42,5 x 24,9	38	16	1,15	1,32	0,49	0,56
	49,0	16 DF	24,8 x 49,0 x 24,9	33	16	1,28	1,49	0,63	0,73
Poroton-T8-MW	24,0	8 DF	24,8 x 24,0 x 24,9	67	16	1,63	1,92	0,39	0,46
	30,0	10 DF	24,8 x 30,0 x 24,9	54	16	1,27	1,47	0,39	0,45
	36,5	12 DF	24,8 x 36,5 x 24,9	44	16	1,22	1,39	0,44	0,51
	42,5	14 DF	24,8 x 42,5 x 24,9	38	16	1,15*	1,32*	0,49*	0,56*
Poroton-S8-MW	36,5	12 DF	24,8 x 36,5 x 24,9	44	16	1,26	1,43	0,46	0,52
	42,5	14 DF	24,8 x 42,5 x 24,9	38	16	–	–	–	–
	49,0	16 DF	24,8 x 49,0 x 24,9	33	16	–	–	–	–
Poroton-S9-MW	30,0	10 DF	24,8 x 30,0 x 24,9	54	16	1,29	1,50	0,39	0,45
	36,5	12 DF	24,8 x 36,5 x 24,9	44	16	1,24	1,41	0,45	0,52
	42,5	14 DF	24,8 x 42,5 x 24,9	38	16	–	–	–	–
Poroton-S10-MW	30,0	10 DF	24,8 x 30,0 x 24,9	54	16	1,31	1,52	0,40	0,46
	36,5	12 DF	24,8 x 36,5 x 24,9	44	16	1,26	1,43	0,46	0,52
	42,5	14 DF	24,8 x 42,5 x 24,9	38	16	–	–	–	–
Plan-T8	36,5	12 DF	24,8 x 36,5 x 24,9	44	16	1,22	1,39	0,44	0,51
	42,5	14 DF	24,8 x 42,5 x 24,9	38	16	1,15	1,32	0,49	0,56
	50,0	16 DF	24,8 x 49,0 x 24,9	33	16	1,28	1,49	0,63	0,73
Plan-T9	30,0	10 DF	24,8 x 30,0 x 24,9	54	16	1,27	1,47	0,39	0,45
	36,5	12 DF	24,8 x 36,5 x 24,9	44	16	1,22	1,39	0,44	0,51
	42,5	14 DF	24,8 x 42,5 x 24,9	38	16	1,15*	1,32*	0,49*	0,56*
Plan-T10	30,0	10 DF	24,8 x 30,0 x 24,9	54	16	1,27	1,47	0,39	0,45
	36,5	12 DF	24,8 x 36,5 x 24,9	44	16	1,22	1,39	0,44	0,51
	36,5	12 DF	24,8 x 36,5 x 24,9	44	16	1,26	1,43	0,46	0,52
Plan-T12	24,0	10 DF	30,8 x 24,0 x 24,9	54	16	1,33	1,54	0,32	0,37
	30,0	10 DF	24,8 x 30,0 x 24,9	54	16	1,27	1,47	0,39	0,45
	36,5	12 DF	24,8 x 36,5 x 24,9	44	16	1,22	1,39	0,44	0,51
	42,5	14 DF	24,8 x 42,5 x 24,9	38	16	1,15*	1,32*	0,49*	0,56*
	49,0	16 DF	24,8 x 49,0 x 24,9	33	16	1,28*	1,49*	0,63*	0,73*
Plan-T14	24,0	10 DF	30,8 x 24,0 x 24,9	54	13	1,33	1,54	0,32	0,37
	30,0	10 DF	24,8 x 30,0 x 24,9	54	16	1,29	1,50	0,39	0,45
	36,5	12 DF	24,8 x 36,5 x 24,9	44	16	1,24	1,41	0,45	0,52
Plan-T16	17,5	7,5 DF	30,8 x 17,5 x 24,9	74	13	2,11	2,34	0,37	0,41
	17,5	9 DF	37,3 x 17,5 x 24,9	61	13	1,94	2,05	0,34	0,36
Plan-T18	17,5	9 DF	37,3 x 17,5 x 24,9	61	11	1,94	2,05	0,34	0,36
	24,0	12 DF	37,3 x 24,0 x 24,9	44	11	1,33	1,48	0,32	0,36
HLz-Plan-T	11,5	8 DF	49,8 x 11,5 x 24,9	70	8	2,96	3,13	0,34	0,36
	17,5	12 DF	49,8 x 17,5 x 24,9	44	8	1,82	1,94	0,32	0,34
	24,0	12 DF	37,3 x 24,0 x 24,9	44	11	1,37	1,50	0,33	0,36
	24,0	16 DF	49,8 x 24,0 x 24,9	32	8	–	–	–	–
HLz-Plan-T 1,2	11,5	6 DF	37,3 x 11,5 x 24,9	93	11	–	–	–	–
	17,5	9 DF	37,3 x 17,5 x 24,9	61	11	–	–	–	–
	24,0	12 DF	37,3 x 24,0 x 24,9	44	11	1,41	1,58	0,34	0,38
HLz-Plan-T 1,4	11,5	5 DF	30,8 x 11,5 x 24,9	113	13	–	–	–	–
	17,5	7,5 DF	30,8 x 17,5 x 24,9	74	13	–	–	–	–
	24,0	10 DF	30,8 x 24,0 x 24,9	54	13	–	–	–	–
Planfüllziegel PFZ-T	17,5	9 DF	37,3 x 17,5 x 24,9	61	11	2,17	2,34	0,38	0,41
	24,0	12 DF	37,3 x 24,0 x 24,9	44	11	1,51	1,78	0,36	0,43
	30,0	15 DF	37,3 x 30,0 x 24,9	36	11	1,29	1,51	0,39	0,46
Keller-Plan-T16	36,5	12 DF	24,8 x 36,5 x 24,9	44	16	1,26	1,43	0,46	0,52

* practical time reference

The specified working time guidelines (ARH guidelines) are based on a target working group of 4 workers (3 masons, 1 helper) and include not only the actual working hours but also a collective agreement for waiting, distribution and recovery times. In order to determine the working times, a scope of work and working conditions were defined depending on the brick material. The scope of work for the erection of facing brick masonry includes, for example:

Provide	**stonewall**
■ Make mortar ■ Transporting mortar and bricks on the construction site ■ Transport working scaffolding and scaffolding surface ■ Deposit the mortar container and brick packages ready for use at the working level	■ Measure and apply masonry based on the drawing ■ 1st layer on normal mortar joint, which was drawn off with straightening plan ■ Applying the thin-bed mortar with the mortar roll with full-surface capping ■ Applying the thin-bed mortar in a dipping or rolling process ■ Set the flat brick according to plan, align ■ Set up, implement and dismantle working scaffolding within the working sections ■ Convert scaffold decking ■ Roughly clean the work area, remove residual material and work scaffolding

Product designation	Wll thickness [cm]	Format	Dimensions L x B x H [cm]	Material requirement block		Working hours Masonry (ARH)			
				ca. piece/m³	ca. piece/m²	volume value h/m³		area value h/m²	
						full	structured	full	structured
Clay block									
Block-T14	30,0	10 DF	24,8 x 30,0 x 23,8	54	16	1,96	2,19	0,59	0,66
	36,5	12 DF	24,8 x 36,5 x 23,8	44	16	1,51	1,78	0,55	0,65
Block-T18 /-T21	17,5	9 DF	37,3 x 17,5 x 23,8	61	11	2,11	2,40	0,37	0,42
	24,0	12 DF	37,3 x 24,0 x 23,8	44	11	1,94	2,15	0,47	0,52
	24,0	12 DF	37,3 x 24,0 x 23,8	44	11	2,00	2,17	0,48	0,52
HLz-Block-T	11,5	8 DF	49,8 x 11,5 x 23,8	70	8	3,04	3,39	0,35	0,39
	17,5	12 DF	49,8 x 17,5 x 23,8	44	8	2,00	2,22	0,35	0,39
	24,0	12 DF	37,3 x 24,0 x 23,8	44	11	2,00	2,17	0,48	0,52
	24,0	16 DF	49,8 x 24,0 x 23,8	32	8	1,82	2,09	0,44	0,50
HLz-Block-T 1,2	11,5	6 DF	37,3 x 11,5 x 23,8	93	11	–	–	–	–
	17,5	9 DF	37,3 x 17,5 x 23,8	61	11	–	–	–	–
	24,0	12 DF	37,3 x 24,0 x 23,8	44	11	2,00	2,26	0,48	0,55
HLz-Block-T 1,4	11,5	5 DF	30,8 x 11,5 x 23,8	113	13	–	–	–	–
	17,5	7,5 DF	30,8 x 17,5 x 23,8	74	13	–	–	–	–
	24,0	10 DF	30,8 x 24,0 x 23,8	54	13	–	–	–	–
Gewerbeziegel GWZ-T	24,0	8 DF	24,8 x 24,0 x 23,8	67	16	2,53	2,89	0,61	0,70
	30,0	10 DF	24,8 x 30,0 x 23,8	54	16	–	–	–	–
	36,5	12 DF	24,8 x 36,5 x 23,8	44	16	–	–	–	–
Agrarziegel AGZ-T	11,5	2 DF	24,0 x 11,5 x 11,3	278	32	4,61	5,05	0,53	0,58
	11,5	6 DF	37,3 x 11,5 x 23,8	93	11	3,22	3,66	0,37	0,42
	17,5	3 DF	24,0 x 17,5 x 11,3	183	32	2,79	3,02	0,49	0,53
	17,5	9 DF	37,3 x 17,5 x 23,8	61	11	2,11	2,40	0,37	0,42
	24,0	8 DF	24,8 x 24,0 x 23,8	67	16	2,40	2,76	0,58	0,67
	30,0	10 DF	24,8 x 30,0 x 23,8	54	16	2,05	2,45	0,62	0,74
	36,5	12 DF	24,8 x 36,5 x 23,8	44	16	1,71	1,98	0,62	0,72
Kleinformate 0,9	11,5	NF	24,0x11,5x7,1 24,0x11,5x7,1	419	48/96	5,40	5,75	0,62	0,66
	11,5	2 DF	24,0x11,5x11,3 24,0x11,5 x 11,3	278	32/64	4,61	5,05	0,53	0,58
	17,5	3 DF	24,0x17,5x11,3 24,0x17,5 x 11,3	183	32/43	2,79	3,02	0,49	0,53
	24,0	5 DF	30,0 x 24,0 x 11,3	278	26/32	–	–	–	–
	24,0	6 DF	36,5 x 24,0 x 11,3	183	21/32	–	–	–	–
Schallschutzziegel Kleinformate 1,4 / 1,8 / 2,0	11,5	NF	24,0 x 11,5 x 7,1	419	48/96	5,40*	5,75*	0,62*	0,66*
	11,5	2 DF	24,0 x 11,5 x 11,3	278	32/64	4,61	5,05	0,53	0,58
	17,5	3 DF	24,0 x 17,5 x 11,3	183	32/43	2,79	3,02	0,49	0,53
	24,0	5 DF	30,0 x 24,0 x 11,3	107	26/32	2,45	2,76	0,59	0,66
	24,0	6 DF	36,5 x 24,0 x 11,3	107	21/32	–	–	–	–

* ARH guideline time up to gross density class 1.8

Supplements to the masonry (eg small quantities up to 15 m³, unloading by crane, height over 3 to 4 m, reloading, ceiling bricking, spreading of joints) must be considered separately.

All specified ARH guide times are given as volume value h / m³ and as area value h / m². The definition of the full or structured masonry is according to VOB / C - ATV: DIN 18330.

Since the determined ARH guideline times as inter-company performance values - valid for a defined scope of work and working conditions - only represent orientation values, it has proven necessary in practice to determine individual operational guideline times taking into account the normal working routine.

ARH guidelines for bricks with gross density classes deviating from those in the Manual Work Organization were linearly interpolated.
The complete building brick special edition from the Handbuch Arbeitsorganisation Bau is available to you as a free download at www.wienerberger.de.

Product groups

Poroton

Wall solutions

- Effortlessly meet the criteria for KfW efficiency houses and self-sufficient house concepts as well as the requirements of the EnEV
- No further, artificial insulation required
- Best values for fire and sound insulation, statics and energy efficiency
- From a single-family home to a nine-storey multi-family house, the right solution

Koramic

Roof solutions

- Comprehensive portfolio of roof tiles, ceramic and non-ceramic accessories
- Available in a wide variety of colors, shapes and surfaces
- For new construction and renovation
- Innovative wind suction protection Sturmfi x for all geographic locations

Terca

Façade solutions

- For houses with independent character and unmistakable charm
- Extremely solid, wind and weatherproof and practically maintenance free
- Biologically pure natural products
- Value-stable over generations
- Extensive assortment for individual design

Whether straightforward or rustic, whether traditional or modern processing - Wienerberger bricks come in many different colors and shapes. But our bricks also have a lot in common: they are completely free of pollutants and stand for healthy living, long-term value, and maximum energy efficiency.
In our portfolio you will find solutions for walls and roofs, for exterior surfaces, facades and fireplaces. So you can cover the entire construction needs around your house from a single source.

Argeton

Façade solutions

- Absolutely colourfast and lightfast, even under extreme conditions
- Especially fireproof
- Contamination is prevented by sophisticated water supply
- Joint profile protects the façade from lateral displacement, the ingress of driving rain and rattling in the wind

Penter

Paving bricks

- Natural flooring made of high-quality, extra-hard burnt clay
- Extremely resistant to frost, dirt, environmental pollution, chemicals and forces of nature
- Ecologically sensible, as it is virtually unlimited shelf life and reusable
- Extensive range for demanding design tasks
- Selected models also with LED light element

Poroton

Chimney systems

- Suitable for all types of heating
- Even changing the fuel is not a problem
- Fast and uncomplicated setup
- Homogeneous construction through brick sheath
- Also with integrated installation ducts for ventilation, solar, plumbing or electrical installations

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Building Material Solutions