Styrodur® C
Europe's green insulation

Reconstruction and Refurbishment

BASF
The Chemical Company

Contents Overview

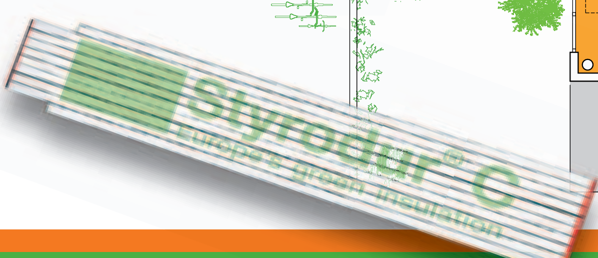
1. Styrodur® C Thermal Insulation

Styrodur® C is BASF's environmentally friendly, extruded polystyrene rigid foam. It is free of CFC, HCFC, and HFC and makes an important contribution toward reducing emissions of carbon dioxide (CO_2).

Due to its high compressive strength, low moisture absorption, durability, and resistance to decay, Styrodur C has become synonymous with XPS in Europe. The compressive strength is the main distinction between the various Styrodur C types.

Effective thermal insulation with Styrodur C reduces energy consumption with the result that the investment in thermal insulation can be offset within a short period of time. It makes for healthy and comfortable living and protects the building from the effects of moisture as well as high and low temperatures.

Styrodur C is manufactured in accordance with the requirements of the European standard DIN EN 13 164. In terms of fire protection, it has been classified as Euro-class E in accordance with DIN EN 13501-1. It is quality-controlled by Wärmeschutz e.V. and has been granted the approval no. Z-23.15-1481 by the DIBt, an institute of the Federal and Laender Governments for a uniform fulfillment of technical tasks in the field of public law.



2. Reconstruction and Refurbishment with Styrodur® C

Most of the buildings from the post-war era and the 60s and 70s require reconstruction due to their age. The facades, roofs, windows, basements, bathrooms, and building services have reached or even exceeded the end of their lifespan, and some buildings already show signs of considerable deficiencies. Taking into consideration today's energy requirements (Energy Saving Ordinance, 2002), even most houses built in the 80s are in need of reconstruction measures.

Furthermore, the already high number of houses requiring reconstruction measures reaches new dimensions when taking into account the recent explosion in energy prices.

Low interest rates and attractive government aids such as credits from KfW (German Development Bank) offer homeowners, private households, and real estate companies the chance to combine necessary reconstruction measures with the energetic improvement of the property.

When planning for a comprehensive reconstruction of the property, homeowners must comply with the requirements of the Energy Saving Ordinance (EnEV) concerning the thermal properties of construction elements, which follow the guidelines of the Energy Saving Law (EnEG).

For pending reconstructions that already incur expenses for scaffolding, site facilities, and the actual reconstruction, the additional costs for the energetic improvement through thermal insulation are amortized within a short period of time, depending on the structural element.

3. Improved Efficiency of Flat Roofs

The majority of flat roofs constructed in the 60s and 70s no longer meet today's energetic requirements according to the Energy Saving Ordinance (EnEV). In most cases, they are only equipped with minimum thermal insulation, e. g., a noninsulated roof with 4 cm of Styropor® WLG 040 and a thermal transmission coefficient of 0.75 W/(m²·K).

The majority of the roughly five million flat roofs in Germany are in need of reconstruction due to old age. Frequently, building a gable end roof onto the flat roof is the first solution that comes to mind. However, this is not only unnecessary in terms of construction physics, but also not recommendable from an economical point of view. The construction of a gable end roof, insulated according to today's energetic requirements, would cost significantly more than the proper reconstruction of a flat roof, either in form of a plus roof or duo roof that incorporates the parts of the roof that are still intact.

Fig. 1: Reconstruction with Styrodur® C.

Fig. 2: Styrodur C is used for the reconstruction project of this old timber-frame house, organized in cooperation with dena (German Energy Agency).

3.1 Plus Roof with Styrodur C

Plus roof construction is suited perfectly to reconstruct an existing noninsulated roof in accordance with today's thermal insulation standards.

Legal situation

The legal requirements for the thermal insulation of flat roofs have constantly increased over the last decades. In the past, thermal insulation in accordance with DIN 4108 was generally sufficient, which only prevents diseases and structural damages by protecting the

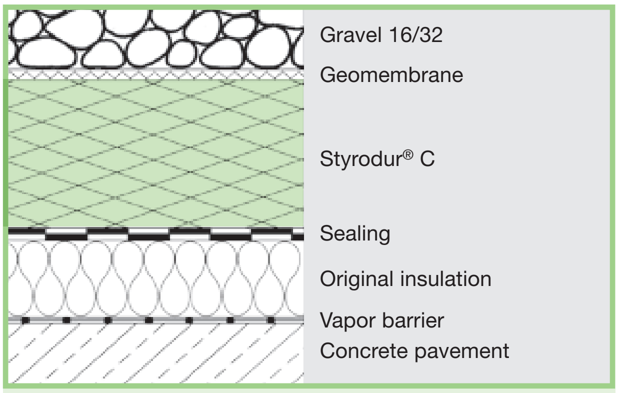


Fig. 3: Plus roof with Styrodur C.

interior surfaces of exterior construction parts from condensation. Heating costs are not reduced by such measures. In order to reduce the nationwide demand for heat energy, the Heat Insulation Ordinance (WSVO) was passed, i. e., the previous Heat Insulation Ordinance from 1995 was replaced with the Energy Saving Ordinance (EnEV) on February 1, 2002. Proof of existing heat insulation is now given by means of the energy accounting process. The annual demand for primary energy of a building must not exceed a given limit. If flat roofs above heated living spaces are replaced, newly constructed, or refurbished in buildings with an average indoor temperature, a maximum thermal transmission coefficient of 0.25 W/(m²·K) must be maintained.

3.2 System Description

Instead of adding another layer of insulation on the old roof and protecting it with another roof sealing, only the layer of Styrodur® C thermal insulation is installed and covered with the already available gravel when opting for the plus roof.

The plus roof is thus a combination of noninsulated roof and inverted roof. The inverted roof with gravel layer, concrete pavement in a gravel bed, or spacers is standardized in DIN 4108-2.

Advantages:

- Simple implementation of details, e. g., roof outlets, fascias, or breaches
- Existing roof construction can be maintained in most cases
- Simple installation of insulation layer
- Installation is not dependent on weather
- Brief construction period
- Savings in energy costs due to insulation with Styrodur C
- Thermal and mechanical sealing protection
- Longer lifespan of inverted roof

3.3 Practical Approach

The existing layer of gravel is removed in sections and stored on the roof, respecting the static requirements. The present sealing is then examined for permeable spots and repaired, if necessary. The same applies for above-grade masonry, domelights, ventilation plugs, and roof gutters. Circuit points must be located 15 cm above the top edge of the gravel for rising parts, and at least 10 cm for roof gutters.

Styrodur 3035 CS (with stepped profile) is then loosely laid with splices being staggered, covered with permeable geomembrane (approx. 140 g/m²) and at least 5 cm of gravel (grain size: 16/32). Under normal circumstances, the bearing capacity of Styrodur 3035 CS is sufficient for gravelled roofs. For higher compressive strengths, Styrodur 4000 CS or Styrodur 5000 CS should be employed. Follow the described technique in sections until the complete roof is reconstructed **(Fig. 6).**

3.4 Approvals

General technical approval is granted for Styrodur C as an insulation material for inverted flat roofs (DIBt approval no. Z-23.4.222). In accordance with this approval, the roof system may also be used for intensive or extensive roof greening.

Fig. 4: Installation of Styrodur® C insulation on roof.

Fig. 5: Installation of thermal insulation under gravel.

3.5 Example of Use

A roof with 14 cm of concrete pavement, 40 mm of Styropor® (WLG 040) thermal insulation, and a bituminous roof sealing layer of 15 mm can be energetically upgraded to a plus roof with a layer of 120 mm Styrodur® C insulation boards.

While the old roof had a thermal transmission coefficient of 0.75 W/(m²·K), the new plus roof coefficient is 0.23 W/(m²·K), thus meeting the requirements of the Energy Saving Ordinance (EnEV).

Fig. 6: Reconstructed inverted roof as plus roof construction.

Fig. 7: Gravelled roof on Styrodur® C.

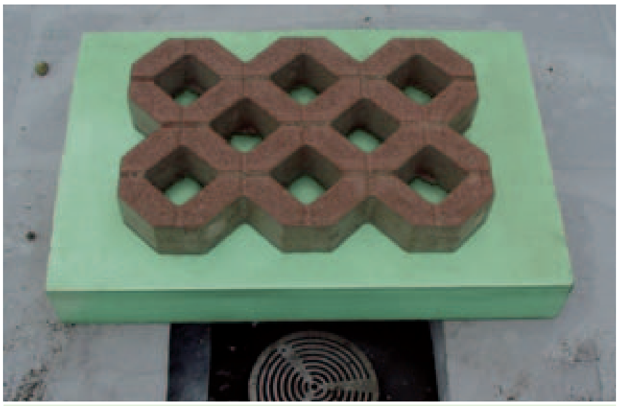


Fig. 8: Compressive strength of Styrodur C.

4. Insulation of Second-floor Ceilings

In most houses built before the end of the 70s, the second-floor ceiling is either insulated poorly or not at all, which leads to a significant heat energy loss through the attic. Not surprisingly, the ratio between investment costs and savings in energy costs is very favorable. With some basic information and technical skills, all necessary measures can be implemented by yourself.

Based on the Energy Saving Ordinance (EnEV), many homeowners are legally obligated to improve the thermal insulation of the second-floor ceiling by the end of 2006, primarily due to economical advantages.

The obligation to retrofit the second-floor ceiling above heated living spaces affects all apartment buildings and houses with accessible but non-walk-on upper ceilings. Subsequent to change in proprietorship, these requirements also apply to single and duplex houses within a period of two years **(Fig. 9)**.

The thermal transmission coefficient of the second-floor ceiling must not exceed 0.30 W/(m²·K).

Extract from the Energy Saving Ordinance (EnEV):

§ 9 – Retrofitting of constructions and buildings – …
(3) Proprietors of buildings with regular indoor temperatures are obliged to insulate accessible but non-walk-on upper ceilings before December 31, 2006, in such manner that a thermal transmission coefficient of 0.30 W/(m²·K) for the second-floor ceiling is not exceeded.
(4) In buildings with up to two apartments, one of which being occupied by the proprietor himself at the time the ordinance comes into effect, the requirements under paragraphs 1–3 are only applicable in case of a change in proprietorship. The term shall be two years from the passage of title; yet it will not expire before December 12, 2006 (…).

Apart from legal regulations, it is advisable for all owners of old/historic buildings to check the heat insulation of second-floor or attic ceilings. Particularly in this case, heating costs can be reduced drastically by installing additional insulation in a simple and economical manner. In addition, the comfort of living in the adjoining rooms will rise noticeably.

The insulation of second-floor ceilings with Styrodur C 3035 CS can vary in thickness or number of layers used. The EnEV requirement of a thermal transmission coefficient of 0.3 W/(m²·K) can be met by installing just 80 mm of Styrodur 3035 CS (or two layers of 40 mm).

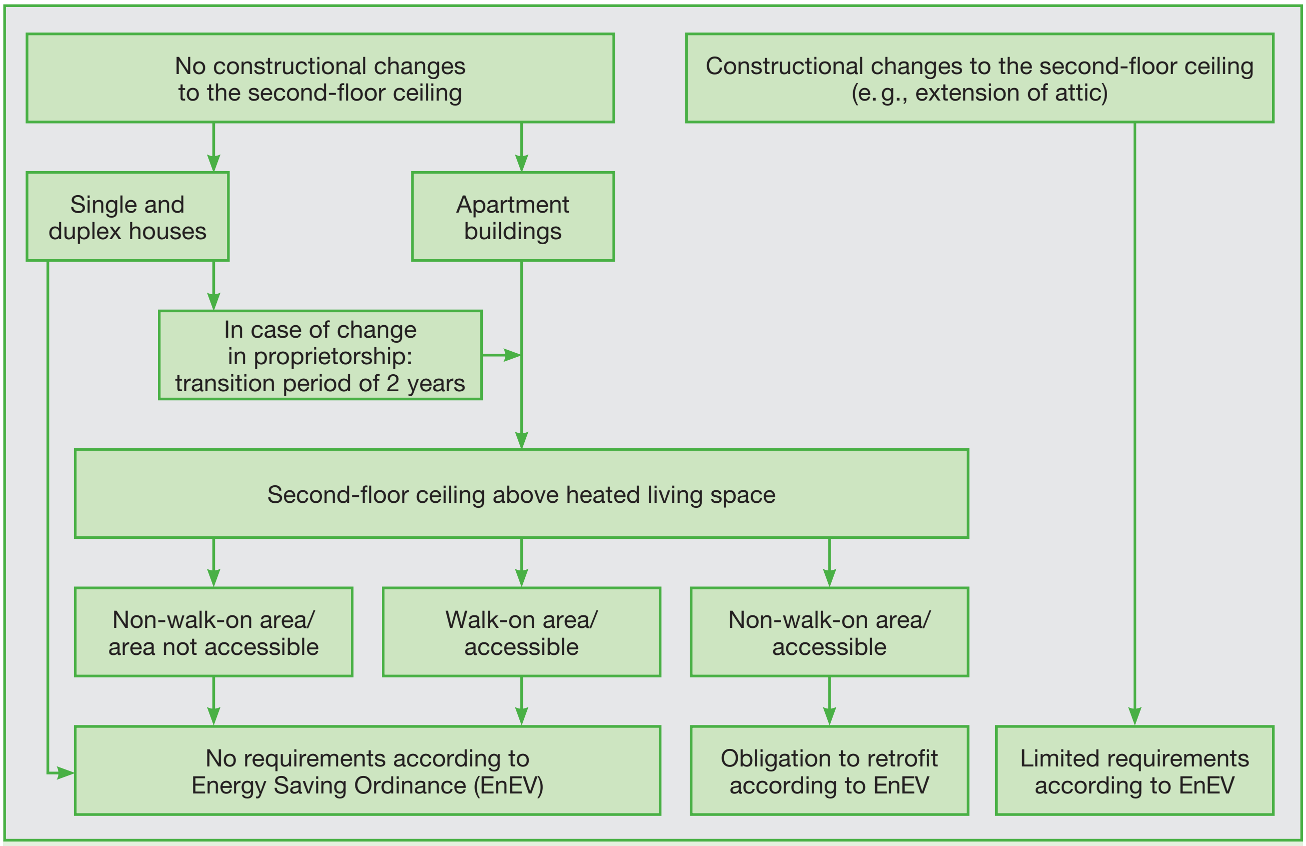


Fig. 9: Requirements for ceiling insulation based on the Energy Saving Ordinance.

In order to make full use of the potential savings, it is recommended to install two layers of 80 mm of Styrodur® C 3035, thus complying with the heat insulation requirements for new constructions (thermal transmission coefficient of 0.17 W/(m²·K)).

Note: For wood-beam ceilings, it might be necessary to install a vapor barrier underneath the insulation. In such cases, each construction should be evaluated individually.

If the attic has to be walked on, e. g., for maintenance purposes, particle boards can be added on top of the insulation layer.

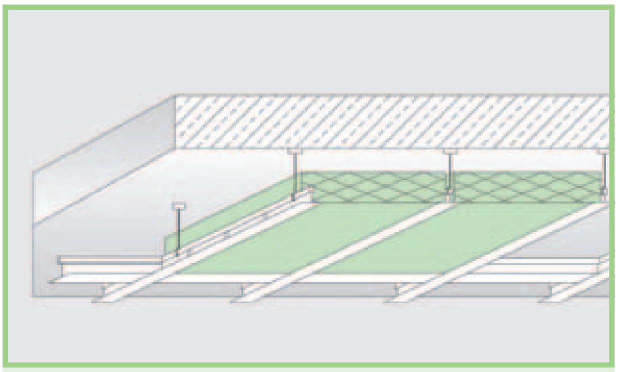


Fig. 11: Indirect fixation of Styrodur C.

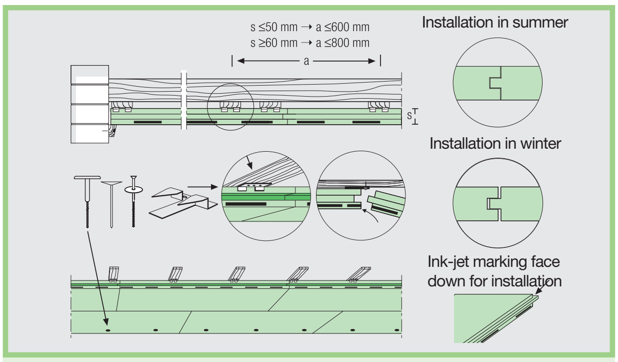


Fig. 10: Installation instructions for Styrodur® C in ceilings.

Fig. 12: Fixation of Styrodur C boards.

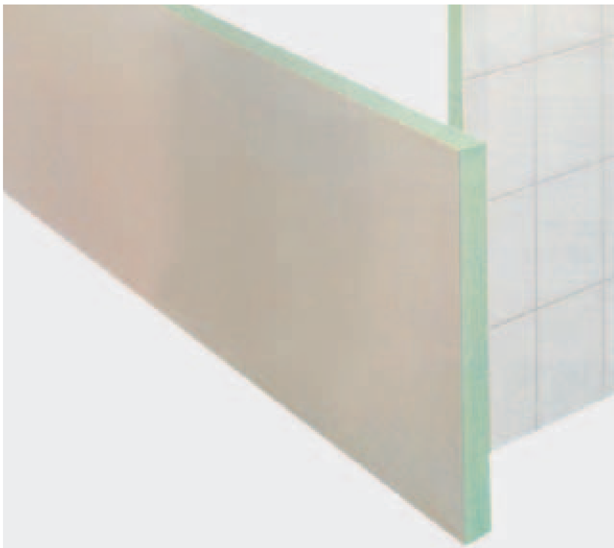


Fig. 13: Tile elements with Styrodur® C.

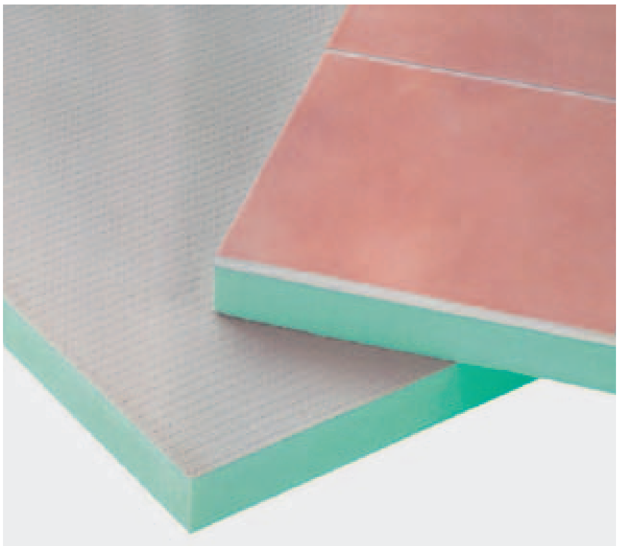


Fig. 14: Tile elements with Styrodur C.

5. Sanitary Equipment

5.1 Refurbishment of Bathrooms with Tiles and Rigid-foam Elements

Many apartments of the post-war era and the 60s and 70s have bathrooms that require reconstruction. New technology, higher standards, and the need for a more pleasant, comfortable, and friendly bathroom environment constitute the main reasons.

However, most people avoid the reconstruction of bathrooms because the whole family intensively uses it on a daily basis, and its restricted availability is far less acceptable than an old-fashioned design, dripping faucets, or a rather questionable hot-water supply for morning showers. Nevertheless, reconstruction makes sense in most cases, if only for economical or aesthetical reasons.

For the quick, clean, and professional reconstruction of bathrooms, so-called tile elements as well as damp-room and rigid-foam structures have established themselves. The combination of an extruded polystyrene rigid-foam core (Styrodur® C) and a double-sided coating of fiberglass mortar provides a solid, water-proof, and heat-insulating ground that is resistant to decay and suitable for all kinds of tiles **(Figs. 13 and 14).**

5.2 Surfaces and Applications

In cases of mixed masonry, load-bearing or cracked surfaces, tile elements level out all unevenness, thus creating the perfect surface for the laying of tiles. Even on top of old tiles, existing layers of paint or plaster, these inherently stable tile elements can be applied easily, safely, and permanently.

Tiles are decorative and easy to clean. New applications and arrangements are constantly added, whether in more traditional areas such as bathrooms, restrooms, wet areas, kitchens, cafeterias, and laboratories or in new areas such as shopfitting or gastronomy.

Whether you build, reconstruct, or refurbish—for the laying of tiles you need materials that are robust. Tile elements are not only suitable for wall and floor surfaces, they can also be used for complete bathroom constructions. Covers for bathtubs and showers, dividing walls, or washbasins can just as easily be installed as storage areas, shelves, or intermediate floors. The alternatives are numerous and, depending on the load and strain, tile elements of different thicknesses are used.

5.3 Trend Toward Barrier-free Structures

The curbless shower is becoming more and more popular in today's bathrooms. Originally designed for retirement homes or homes with assisted living to guarantee wheelchair access, more and more homeowners appreciate the comfort of the curbless shower without threshold entrance. The fact that such a shower is easier to clean and offers an abundance of design options further supports this trend.

Nowadays, working with tiles must be efficient, fast, and accurate at the same time. Tile elements fulfill these demands, and all necessary procedures remain in the hands of the tiler. Due to the material being solid and yet easy to cut, even the most complicated cuts and cut-outs are possible with the use of common tools. Both the the thin-bed and medium-bed method can be used for the laying of tile elements. In wet areas, the surface is covered simply and permanently with a layer of liquid sealant. Contact edges and surfaces are thoroughly glued. Just a few additional tools are required for professional implementation.

Properties at a glance:
- Low weight and high stability
- Uncomplicated and efficient handling
- Universal application and design options
- Resistant to moisture and decay
- Heat-insulating
- High economic efficiency
- Few additional tools required

Fig. 15: Tile elements made of Styrodur® C: bathtub (www.pr1mus.de).

Fig. 16: Tile elements made of Styrodur C: bathroom (www.pr1mus.de).

Fig. 17: Tile elements made of Styrodur C: bathtub (www.pr1mus.de).

Fig. 18: Tile elements made of Styrodur C: bathroom cupboard (www.pr1mus.de).

6. Base Insulation

6.1 Base Insulation with Styrodur® 2800 C

The facade just above the ground is often exposed to severe strain and wear:

- Moisture from splashing water, rain, or snow
- Higher demand for thermal insulation due to thermal bridges above basement ceilings connected from the inside (especially for subsequently insulated basement ceilings) and basement walls
- Increased compressive stress, e. g., from mechanical strains of bicycles, compact vehicles, or ball games

The wall base requires a thermal insulation board that is well suited for plastering resistant to moisture and provides high compressive strength. Styrodur® 2800 C meets all of these requirements.

Styrodur 2800 C with stamping provides high shear strength for the applied plaster, the necessary resistance to moisture, and high resistance to mechanical strain due to its stability.

6.2 Laying

Prior to laying the insulation boards, the ground surface must be examined to guarantee the proper adhesive strength between the surface and the Styrodur C boards. The adhesive bond could be flawed due to loose plaster, sanded concrete, a layer of dust, or residues of formwork release oil. In accordance with VOB (German Construction Contract Procedures), the examination of the ground surface must be performed by the contractor as part of his duty to examine and inform.

Any prospective rework of the ground surface must be handled by the precontractor as part of his warranty assurance.

Fig. 19: Subsequent base insulation with Styrodur® 2800 C.

Fig. 20: Fiberglass grid is fixated onto the plaster.

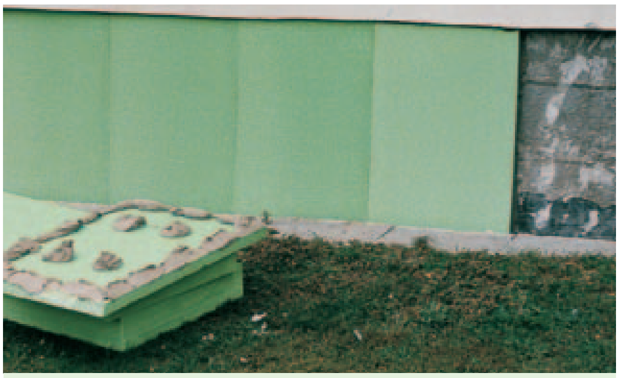


Fig. 21: Retrofitting; fixation of Styrodur 2800 C boards using the dot-and-bead method.

6 Base Insulation

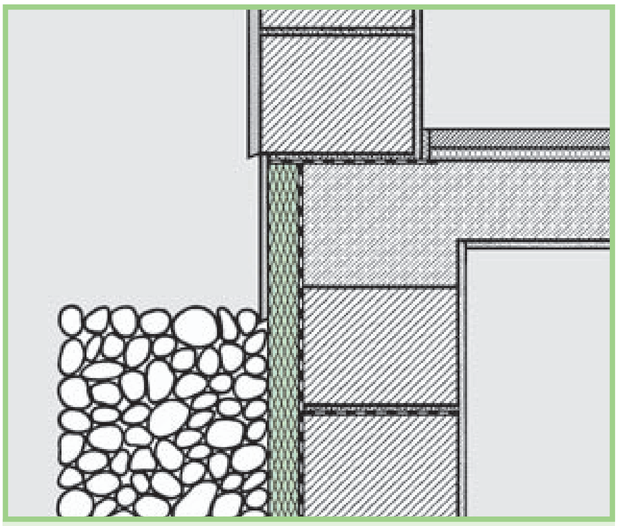


Fig. 22: Base course, perimeter insulation with above-grade heat-insulating masonry.

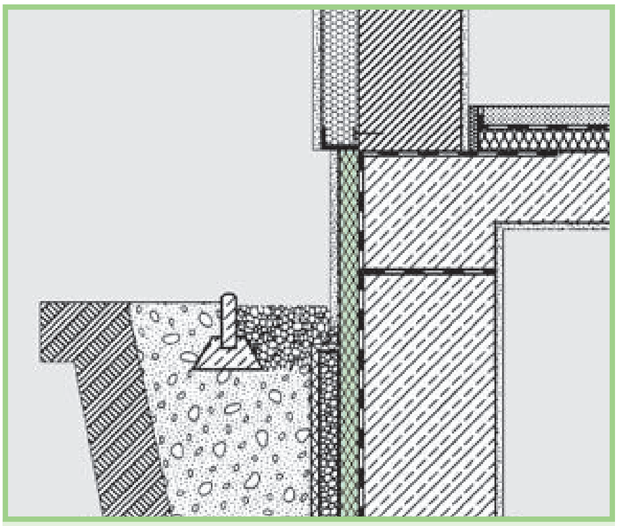


Fig. 23: Base course, perimeter insulation with external thermal insulation composite system.

The Styrodur® 2800 C boards are based approx. 10–30 cm below the top edge of the ground. The boards must be covered with the appropriate adhesive mortar over the entire surface or using the dot-and-bead method. In some cases, the mechanical fixation with insulation anchors is necessary (4 anchors per board).

Styrodur 2800 C boards have even edges. They are tightly slotted and bonded, if laid on expansive areas.

For further information on handling and plastering of our green insulation boards, please refer to "Merkblatt für das Verlegen und Verputzen von extrudierten Polystyrol-Hartschaumstoffplatten mit rauher Oberfläche" (only available in German), which can be downloaded at www.styrodur.de or requested from the Association of Polystyrene Rigid Foam (FPX).

6.3 Structures of Base Insulation

In principle, there are different possibilities for the structuring of base or perimeter insulation:

- Base penetrates the ground marginally.
- Base insulation is extended as perimeter insulation.

Requirements:

- Base insulation/thermal bridge insulation generally does not provide sealing function.
- Vertical and horizontal sealing of building needs to be in place, in accordance with DIN 18 195.
- Precipitation water must be kept away from the facade through constructive measures (e. g., gravel bed or capillary break); pavement or slabs must be constructed separately, exhibiting an incline away from the building.

7. Insulation of Ceilings in Unheated Basements

7.1 Potential Savings from Insulation of Basement Ceilings

Solid basement ceilings without insulation are common in many houses. In accordance with today's standards, the properties of such ceilings, with a thermal transmission coefficient of approx. 1.1 W/(m²·K), are no longer adequate. The consequences are an increase in heat loss, unnecessarily high heating costs, and uncomfortable drafts, contributing to a significant limitation of living comfort. The EnEV benchmark for insulated basement ceilings is a thermal transmission coefficient of 0.4 W/(m²·K).

In unheated basements, the insulation can be installed underneath the basement ceiling. Due to the rather small difference in temperature between living space and basement, the potential savings are lower in comparison to similar measures taken in insulating roofs or facades. However, taking into account the comparatively low costs of this measure, the insulation of basement ceilings should not be disregarded. Depending on the height of the basement, Styrodur® 2800 C insulating boards with a thickness of 6–12 cm can simply be glued or plugged, if necessary, underneath the basement ceiling. The installation can easily be performed without professional help.

For vaulted ceilings or similar ceilings with an uneven surface, installing the insulation above a suspended ceiling construction is recommended.

The connection between basement ceiling and perimeter wall constitutes a thermal bridge that must be addressed with appropriate insulation measures. If the insulation of the basement ceiling is combined with perimeter insulation, the perimeter insulation must be extended down below the level of the basement ceiling in order to prevent thermal bridges, using base insulation with Styrodur C. If necessary, the base insulation, which usually extends approx. 30 cm into the ground, is combined with perimeter insulation reaching down to the foundation.

Insulating basement ceilings is a simple and economic measure that can save up to 5–10% of the original energy demand.

7.2 Applications

In general, vapor barriers are not necessary for the insulation of basement ceilings. Prior to the installation of the insulation boards, drips of concrete, dirt, and other uneven patches, which may weaken the adhesive bond of the glue, must be removed. The insulation material must be fixated to the basement ceiling with special glue across the entire surface of the boards to avoid back ventilation. The use of plastic insulation anchors, as is necessary for other thermal insulation systems, is possible under certain circumstances.

8. Protecting Foundations with Frost-protection Layers

8.1 Standards for Frost Protection

In accordance with DIN EN ISO 13793 for building construction, all elements that are in contact with the ground, especially foundations, must be protected against frost. The formation and expansion of unevenly distributed ice lenses beneath the foundation of buildings may cause severe damage.

The risk of frost heave can be avoided through various measures:

- Foundations can extend below the frost line.
- Frost-prone soil* above the frost line can be removed and exchanged with material less prone to frost.
  * According to DIN 18 196, frost-prone soils are fine- and mixed-grained soils.
- Foundations can be protected with a thermal insulation layer to avoid frost penetration below the foundation.

The application of insulation material with its thermal insulation properties is one of the most important and cost-efficient measures of frost protection.

The minimum frost line for mild climates is stipulated at 80 cm. Heat loss from the building to the ground is lower for unheated buildings as opposed to heated buildings. In order to protect the foundation from frost, thicker insulation material is therefore required for unheated buildings.

8.2 Subsequent Insulation with Frost-protection Layer

Nowadays, a growing number of buildings without basements are constructed on raft foundations rather than strip foundations, without taking into consideration the appropriate frost protection of the base.

During the winter, temperatures beneath the foundation can drop below freezing, creating ice lenses and frost heaves, depending on the condition of the soil. Severe damage to the construction may be the consequence.

The penetration of frost underneath the floor slab can be prevented with the subsequent installation of a frost-protection layer **(Fig. 24),** i.e., the installation of a horizontal thermal insulation surrounding the entire building, approx. 30 cm below the ground. If the ground is covered with paving, 20 cm below the ground is sufficient.

Apart from the level and temporal course of the outside temperature, the extension of the frost-protection layer depends on the thermal insulation of the foundation slab and the inside temperature of the building.

Research has shown that buildings with particularly well-insulated foundation slabs, such as passive houses, represent the least favorable case, since the building transfers only very little heat to the ground. Calculations indicate that a frost-protection layer made of Styrodur® C with a breadth of 1.25 m and a thickness of 8 cm is sufficient in our region to protect the ground beneath the foundation slab from freezing.

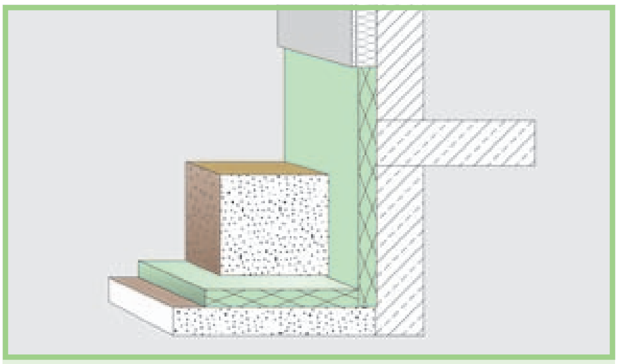


Fig. 24: The frost-protection layer is installed below the frost line.

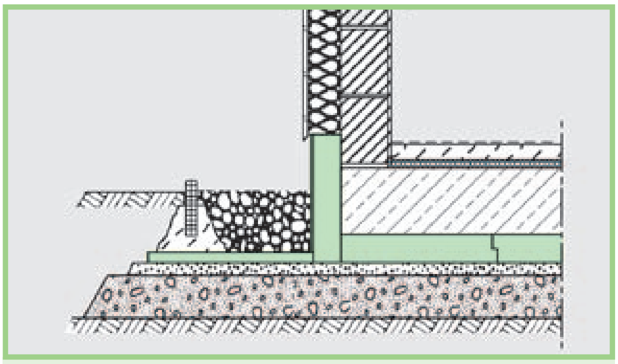


Fig. 25: ETICS construction.

9. Floor Insulation

9.1 Requirements for Floor Insulation with Styrodur® C

Choosing the right type of Styrodur C insulation depends on whether the strain is short-term or permanent. The existing compressive stress on the insulation material must not exceed the maximum acceptable stress level. For more than 40 years, Styrodur C has proved its value in reference to load-bearing applications.

For many applications, compressive strength is the crucial factor in choosing the right insulation material. For construction purposes, it is also important that the insulation material is not subject to brittle fracture when used on uneven or inhomogeneous ground. Despite its high compressive strength, Styrodur C is elastic enough to adjust to any unevenness and responds to local peak loads with plastic deformation rather than material damage.

9.2 Styrodur C in Floors Above Unheated Basements Without Subsonic Noise Protection

For floors in rooms above unheated basements, we suggest a thermal transmission coefficient of ≤ 0.35 W/(m²·K). This value can be achieved with a 16 mm-thick reinforced concrete floor slab, 50 mm of floor pavement, and an insulation layer with 10 cm of Styrodur C.

Fig. 26: Styrodur® C floor insulation is used for the reconstruction project of this house, organized in cooperation with the German Energy Agency.

The Styrodur C boards are tightly slotted on even ground, covered with a polyethylene sheet, and topped with floor pavement.

Fig. 27: Thanks to its properties, Styrodur® C is also suitable for the interior insulation of basements.

Fig. 28: Floor insulation with subsonic noise protection in living areas.

9.3 Styrodur® C in Floors With Subsonic Noise Insulation and Floor Heating Above Unheated Basements

For floor heating, we suggest a thermal transmission coefficient of ≤ 0.35 W/(m²·K) for the construction components between the heated floor and the unheated basement. Should a subsonic noise insulation be necessary, we recommend the combination of soft subsonic noise insulation boards and hard Styrodur® C boards. A layer of 8 cm of Styrodur C is required for a 35/30 subsonic protection board **(Fig. 29).** The subsonic noise insulation board conforms to the unevenness of the slab and together with the soft edge trim guarantees the subsonic noise insulation. The hard Styrodur C board offers the necessary additional thermal insulation while at the same time providing a solid ground for the pipes of the hydronic floor heating.

9.4 Styrodur C Insulation Against the Ground for Floor Heating

For this application, we also recommend a thermal transmission coefficient of ≤ 0.35 W/(m²·K) for the construction components between the heated floor and the ground. Approx. 12 cm of Styrodur C are recommended.

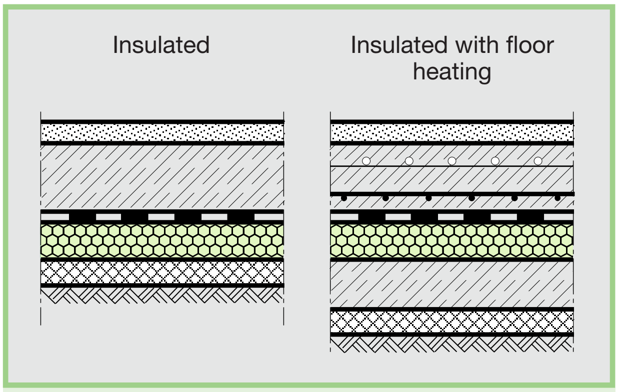


Fig. 29: Floor construction with Styrodur C.

Note:
The data contained in this publication are based on our current knowledge and experience. In view of the many factors that may affect processing and application of our product, these data do not relieve processors from carrying out their own investigations and tests; neither do these data imply any guarantee of certain properties, nor the suitability of the product for a specific purpose. Any descriptions, drawings, photographs, data, proportions, weights, etc. given herein may be changed without prior notice and do not constitute the agreed contractual quality of the product. It is the responsibility of the recipient of our products to ensure that any proprietary rights and existing laws and legislation are observed. (March 2010)

10. Technical Data Styrodur® C

Property	Unit[1]	Code according to DIN EN 13164	2500 C	2800 C	3035 CS	3035 CN	4000 CS	5000 CS	Standard
Edge profile									
Surface			skin	embossed	skin	skin	skin	skin	
Length x width	mm		1250 x 600	1250 x 600	1265 x 615	2515 x 615[2]	1265 x 615	1265 x 615	
Density	kg/m³		28	30	33	30	35	45	DIN EN 1602
Thermal conductivity / Thermal resistance	λ_D [W/(m·K)] / R_D [m²·K/W]		λ_D / R_D	λ_D / R_D	λ_D / R_D	λ_D / R_D	λ_D / R_D	λ_D / R_D	DIN EN 13164
Thickness	20 mm	–	0.030 / 0.65	0.030 / 0.65	– / –	– / –	– / –	– / –	
	30 mm	–	0.031 / 1.00	0.031 / 1.00	0.031 / 1.00	0.031 / 1.00	0.031 / 1.00	– / –	
	40 mm	–	0.032 / 1.25	0.032 / 1.25	0.032 / 1.25	0.032 / 1.25	0.032 / 1.25	0.032 / 1.25	
	50 mm	–	0.033 / 1.55	0.033 / 1.55	0.033 / 1.55	0.033 / 1.55	0.033 / 1.55	0.033 / 1.55	
	60 mm	–	0.034 / 1.80	0.034 / 1.80	0.034 / 1.80	0.034 / 1.80	0.034 / 1.80	0.034 / 1.80	
	80 mm	–	– / –	0.035 / 2.35	0.035 / 2.35	0.035 / 2.35	0.035 / 2.35	0.035 / 2.35	
	100 mm	–	– / –	0.037 / 2.80	0.037 / 2.80	– / –	0.037 / 2.80	0.037 / 2.80	
	120 mm	–	– / –	0.038 / 3.30	0.038 / 3.30	– / –	0.038 / 3.30	0.038 / 3.30	
	140 mm	–	– / –	– / –	0.038 / 3.70	– / –	0.038 / 3.70	– / –	
	160 mm	–	– / –	– / –	0.038 / 4.20	– / –	– / –	– / –	
	180 mm	–	– / –	– / –	0.040 / 4.55	– / –	– / –	– / –	
Compressive stress or compressive strength at 10% deformation	(kPa)	CS(10\Y)	200	200	300	250	500	700	DIN EN 826
Compressive creep over 50 years at < 2% deformation	(kPa)	CC(2/1.5/50)	80	80	130	100	180	250	DIN EN 1606
Rated value of the compressive stress under foundation slabs (kPa)	σ_{perm}	–	–	–	130[3]	–	180	250	DIBT Z-23.34-1325
	f_{cd}		–	–	185	–	255	355	
Adhesive strength on concrete	kPa	TR 200	–	> 200	–	–	–	–	DIN EN 1607
Compressive modulus of elasticity (kPa)	Short-term E	CM	10,000	15,000	20,000	15,000	30,000	40,000	DIN EN 826
	Long-term E50		–	–	5,000	–	10,000	14,000	
Dimensional stability: 70°C; 90% r.h.	%	DS(TH)	≤ 5%	≤ 5%	≤ 5%	≤ 5%	≤ 5%	≤ 5%	DIN EN 1604
Deformation behavior: load 40 kPa; 70°C	%	DLT(2)5	≤ 5%	≤ 5%	≤ 5%	≤ 5%	≤ 5%	≤ 5%	DIN EN 1605
Linear coefficient of thermal expansion Longitudinal	mm/(m·K)	–	0.08	0.08	0.08	0.08	0.08	0.08	DIN 53752
Transverse		–	0.06	0.06	0.06	0.06	0.06	0.06	
Reaction to fire[4]	Euroclass	–	E	E	E	E	E	E	DIN EN 13501-1
Long-term water absorption by immersion	% v/v	WL(T)0.7	0.2	0.3	0.2	0.2	0.2	0.2	DIN EN 12087
Long-term water absorption by diffusion	% v/v	WD(V)3	≤ 3	≤ 5	≤ 3	≤ 3	≤ 3	≤ 3	DIN EN 12088
Water-vapor transmission (thickness-dependent)		MU	200–100	200–80	150–50	150–100	150–80	150–100	DIN EN 12086
Freeze-thaw resistance	% v/v	FT2	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	DIN EN 12091
Maximum service temperature	°C	–	75	75	75	75	75	75	DIN EN 14706

[1] N/mm² = 1 MPa = 1,000 kPa [2] Thickness 30 and 40 mm: 2510 x 610 mm [3] For multilayer laying: 100 kPa [4] Building material class DIN 4102-B1

Further Information on Styrodur® C

- **Product Brochure: Europe's Green Insulation**

- **Applications**
  - Basement Insulation
  - Load-bearing Applications and Floor Insulation
  - Wall Insulation
  - Roof Insulation
  - Ceiling Insulation

- **Special Themes**
  - Reconstruction and Refurbishment
  - Thermal Insulation of Biogas Plants
  - Styrodur® 2500 CNS—Insulation for Underfloor Heating Systems

- **Technical Data**
  - Recommended Applications and Technical Data
  - Technical Data and Assistance Data for Dimensioning

- **Chemical Resistance**

- **Styrodur C Film: Europe's Green Insulation**

- **Website: www.styrodur.com**

KTFS 0807 BE - ENGLISH VERSION - July 2010

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