Building physics

Effective heat insulation of thermal bridges

Definition of thermal bridges

Thermal bridges are local component areas in the building shell, in which heat loss occurs. The increased heat loss can either result from the component area deviating from the level form (geometric thermal bridge) or from local materials with increased thermal conductivity being present in the affected region (material-related thermal bridge).

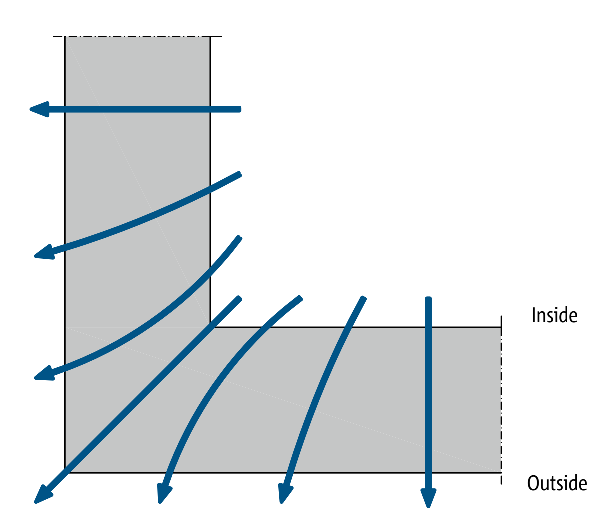

Fig. 1: Geometric thermal bridges

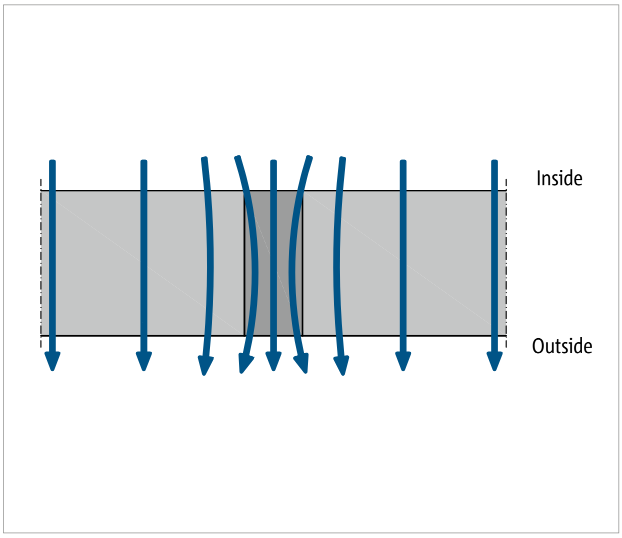

Fig. 2: Material-conditioned thermal bridges

Effects of thermal bridges

In the area of the thermal bridge the locally increased heat loss leads to a lowering of the inner surface temperature. As soon as the surface temperature falls below the so-called “mildew temperature” Θ_S over a longer period, there is a significantly increased risk of mould. What is more, if the surface temperature falls below the dew-point temperature Θ_τ , then the moisture in the ambient air condenses on the cold surfaces in the form of condensate. This can result in long-term damage to the building fabric.
If mould has formed in the area of a thermal bridge, then considerable impairments can occur to health for the resident due to the emitted mould spores in the room. Mould spores cause allergies and can therefore provoke allergic reactions in people, such as, for example, sinusitis, rhinitis and asthma. Through the general long-lasting daily exposure in dwellings there is a high risk that the allergic reactions will become chronic.

Summarised, the effects of thermal bridges are thus:
- Danger of the formation of mould
- Danger of impairments to health (allergies etc.)
- Danger of occurrence of condensation
- Increased thermal energy loss
- Danger of structural damage

Uninsulated cantilevered structural components

With uninsulated cantilevered structural components such as, for example, reinforced concrete balconies or steel girders, the coaction of the geometric thermal bridge (cooling fin effect of the cantilever) as well as of the material-conditioned thermal bridge (breaching of the heat insulating layer with reinforced concrete or steel), there is a strong heat drainage. With this, cantilevers are among the most critical thermal bridges of the building shell. The results of uninsulated cantilevers are considerable heat losses and a significant lowering of the surface temperature. This leads to a marked increase in heating costs and a very high risk of mould in the area of the connection of the cantilever.

Effective heat insulation of thermal bridges

For the reasons mentioned, it is important to observe the requirements relating to protection against moisture and thermal insulation. The use of a load bearing thermal break element for balconies and passageway walks is a standard recognised method and thus reduces thermal losses to a minimum.

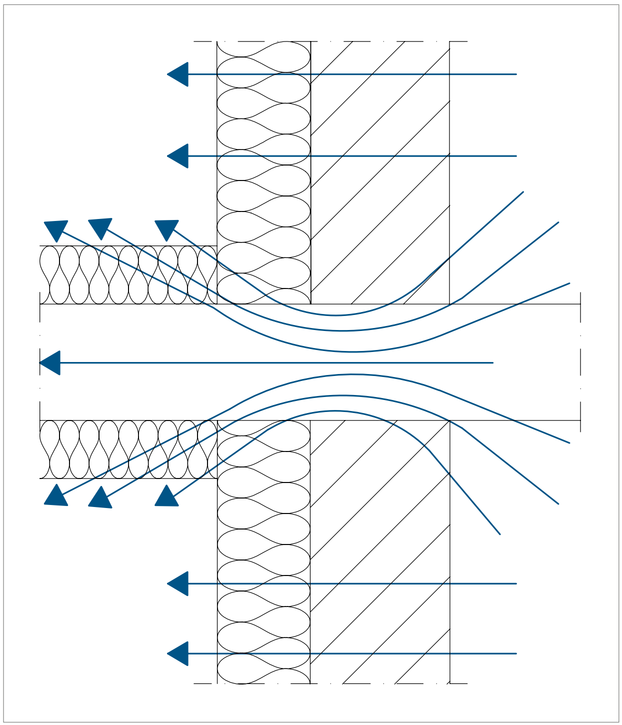

Fig. 3: Increased thermal loss for balconies or passageway walks wrapped in insulation

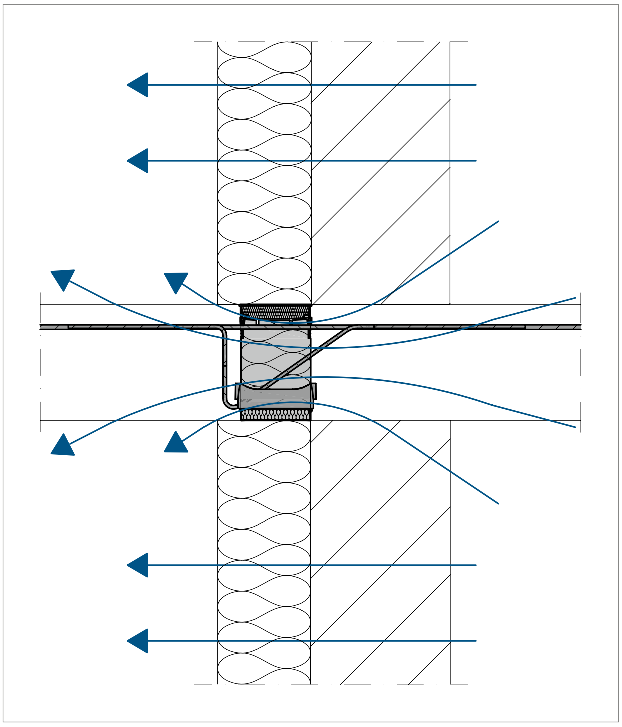

Fig. 4: Minimal thermal loss for balconies or passageway walks with a load bearing thermal break element

Characteristic values of thermal insulation products

Characteristic building-physical values of cantilevered components
Several characteristic values exist for describing the effects of a thermal bridge. The property of a Schöck Isokorb® for preventing heat transfer is described by the equivalent thermal conductivity λ_{eq}. This is a product parameter, just like the equivalent thermal resistance R_{eq} derived from it, which in addition takes into account the thickness of the insulating element of a Schöck Isokorb®. It can be used to compare products with different insulation thicknesses.

Product parameters	Characteristic value	Type of thermal bridge
Equivalent thermal conductivity	λ_{eq}	Cantilevered structural elements such as balconies and parapets, designed with Schöck Isokorb®.
Equivalent resistance to heat transmission	R_{eq}	Cantilevered structural elements such as balconies and parapets, designed with Schöck Isokorb®.

In addition, there are also characteristic values to describe the requirements relating to moisture proofing: $\Theta_{si,min}$ and f_{Rsi} are requirements relating to the temperature of the heat-side wall surface temperature of a building to rule out condensation and mould formation.
There are also requirements relating to the energy loss through the thermal bridge. These are described for linear thermal bridges using the ψ value (length-related heat transfer coefficient) and the point thermal bridges using the χ value (point-related heat transfer coefficient).

Thermal effects	Characteristic value	Type of thermal bridge
Moisture proofing		
Condensation result, mould formation	f_{Rsi} $\Theta_{si,min}$	all
Thermal protection for thermal bridges		
Energy loss	ψ	linear
	χ	punctual

Info
ψ, χ, $\Theta_{si,min}$ and f_{Rsi} are also calculated for a specific thermal bridge – a specific construction in which a specific Isokorb® is embedded. Therefore these values are always dependent on the construction, while λ_{eq} and R_{eq} describe only the thermal insulation effect of a Schöck Isokorb®. So if one modifies characteristics of the construction such as the Isokorb® type or the insulation thickness of the wall insulation, then the heat transfer through the thermal bridge (and with this ψ, χ, $\Theta_{si,min}$ and f_{Rsi}) also changes.

The application of λ_{eq} and the calculation of ψ, χ, $\Theta_{si,min}$ and f_{Rsi} are explained in thedDetailed thermal bridge calculation section.

Equivalent thermal conductivity λ_{eq}
The equivalent thermal conductivity λ_{eq} is the overall thermal conductivity of all components of the Schöck Isokorb® and is – at the same insulating element thickness – a measure for the thermal insulating effect of the connection. The smaller λ_{eq}, the higher the thermal insulation of the balcony connection. λ_{eq} values are determined through detailed thermal bridge calculations. Since each product has an individual geometry and placement specification, each Schöck Isokorb® has an individual number.

The calculation methodology to determine λ_{eq} was validated based on the European Assessment Document – EAD for load bearing thermal insulating elements and – based on this – for Schöck Isokorb® in a European Technical Assessment – ETA.

It is possible to do the calculations using commercially available thermal bridge software by means of the thermal boundary conditions according to SS EN ISO 6946. In doing so, surface temperatures Θ_{si} and the resulting temperature factor f_{Rsi} can be calculated in addition to the heat loss through the thermal bridge (ψ value).

Detailed thermal bridge calculation

Where a detailed thermal bridge calculation is to be provided for the determination of ψ or f_{Rsi} values, the λ_{eq} value can be used in modelling of the connection details. For this purpose, a homogenous rectangle of the same dimensions of the Schöck Isokorb® insulating element is placed into the model in its position and the equivalent thermal conductivity λ_{eq} assigned. Refer to figure. In this way, the building physics characteristic values of a design can be simply calculated.

The individual λ_{eq} values can be found online at:
www.schoeck.com/download-byggnadsfysik/se

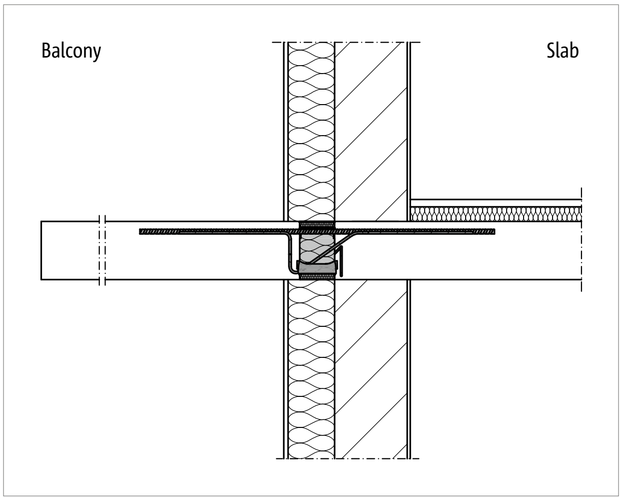

Fig. 5: Representation of a sectional drawing with detailed Schöck Isokorb® model

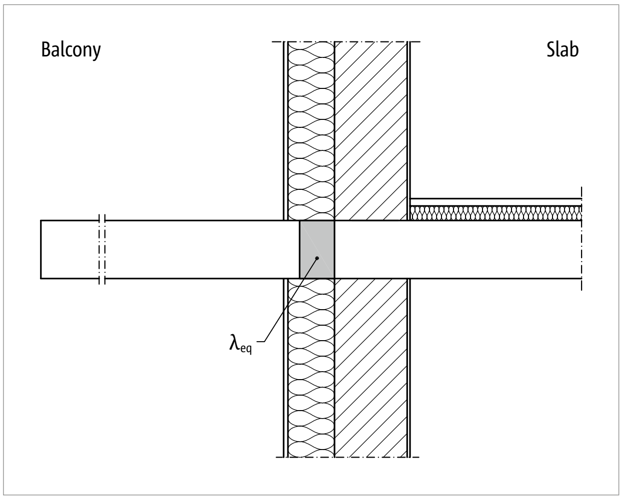

Fig. 6: Representation of a sectional drawing with substitute insulating element

Please note that a large section from the construction is selected so that the areas of the surrounding construction being influenced by the thermal bridge are shown in the model. A spacing of 2 metres around the thermal bridge is normally sufficient to take these boundary effects into account.

Thermal bridge details

Design of balconies, passageway walks and canopies

The Schöck Isokorb® must always be positioned in the insulating layer flush with the inner edge of the insulation. For monolithic constructions such as single-leaf masonry, the Isokorb® is positioned flush with the outside edges of the wall construction. The Isokorb® is also positioned flush with the inner edge of the insulation in the insulating layer of the wall for canopies. However, it is important here that the insulating layer is not interrupted. For the configuration with windows and doors, it is particularly important that they are positioned in the insulating layer.

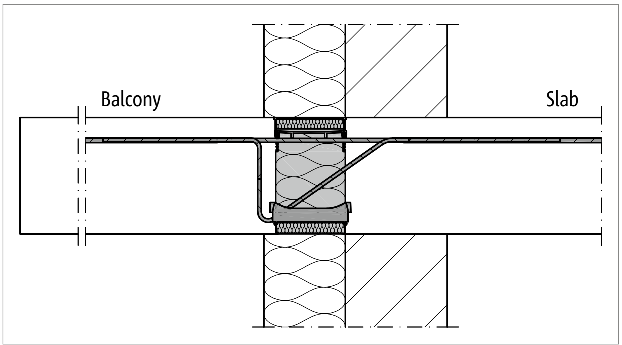

Fig. 7: Schöck Isokorb® XT type K: Connection with thermal insulation composite system (WDVS)

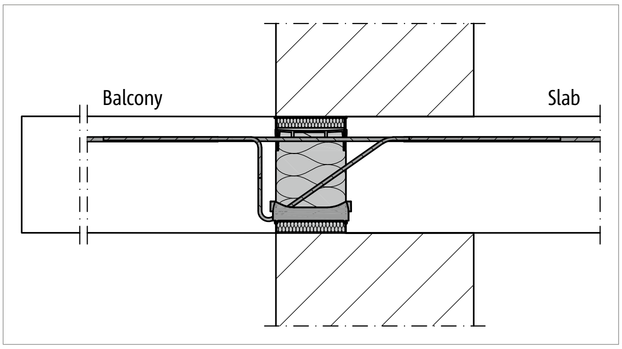

Fig. 8: Schöck Isokorb® XT type K: Connection with single-leaf masonry

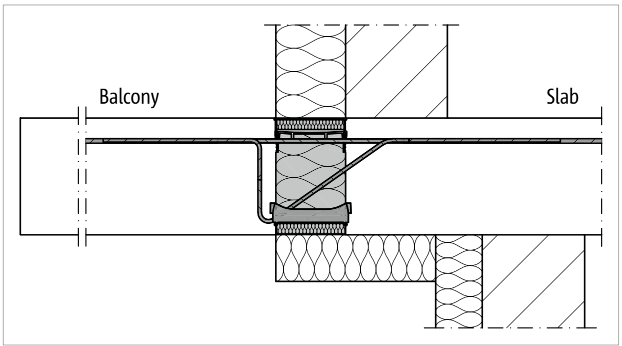

Fig. 9: Schöck Isokorb® XT type K: Connection with indirectly positioned floor and thermal insulation composite system (WDVS)

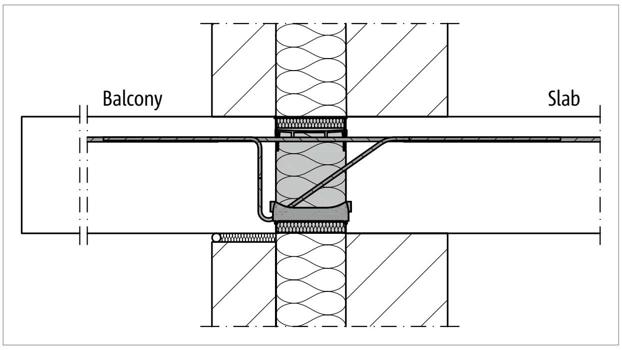

Fig. 10: Schöck Isokorb® XT type K: Connection with filled cavity brickwork with core insulation

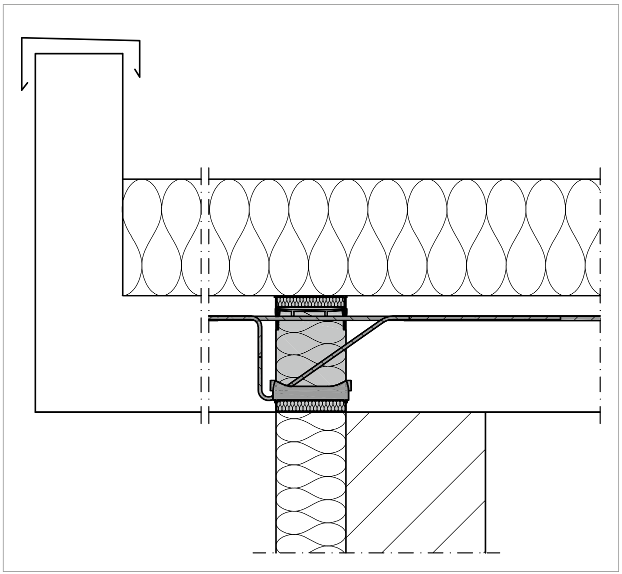

Fig. 11: Schöck Isokorb® XT type K: Connection to a canopy

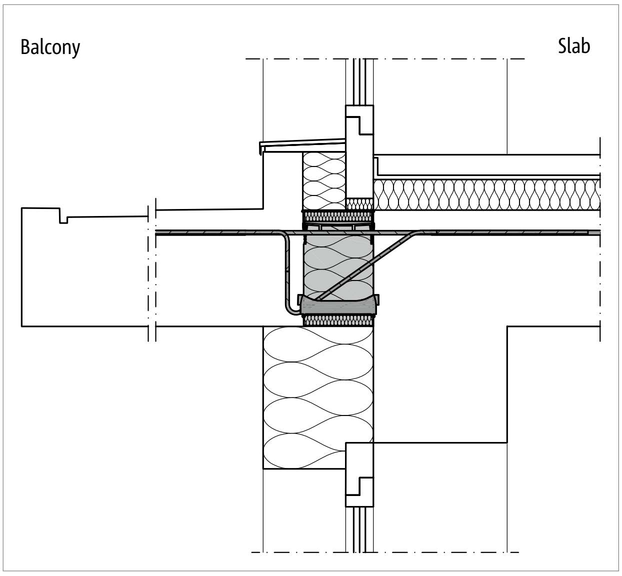

Fig. 12: Schöck Isokorb® XT type K: Connection with window detail above and below the connection

Thermal bridge details

Design of parapets and balustrades

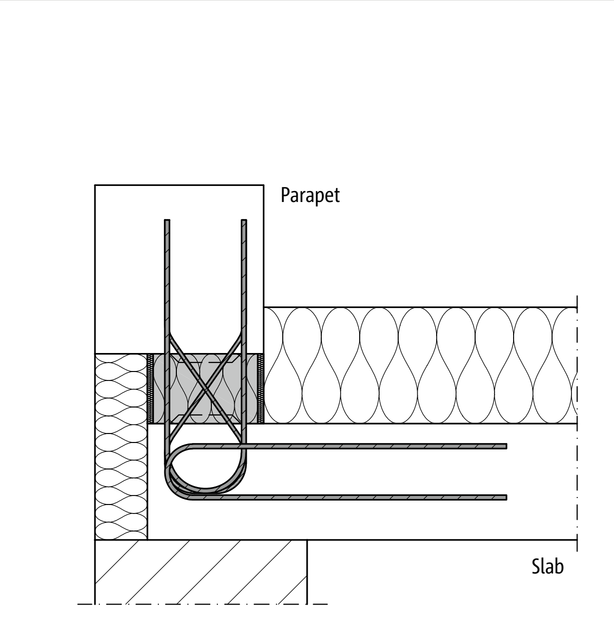

Fig. 13: Schöck Isokorb® XT type A: Connection to a parapet (type A-MM1-VV1)

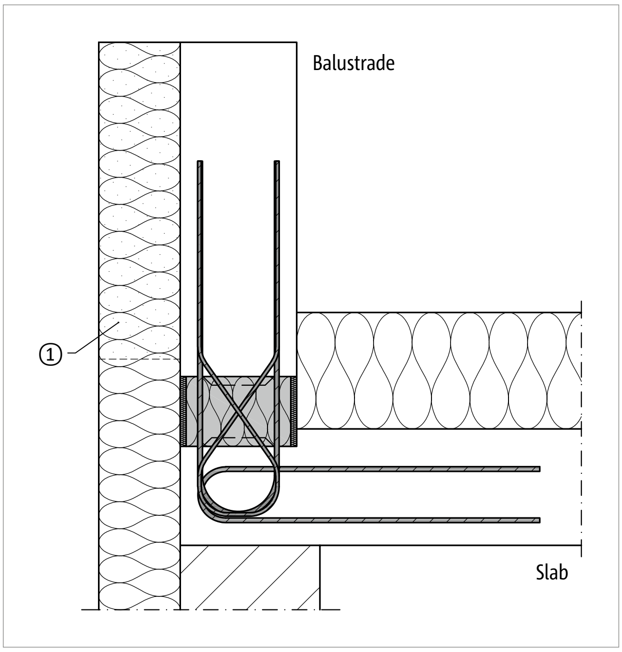

Fig. 14: Schöck Isokorb® XT type A: Connection to a balustrade (type A-MM2-VV1)

For a parapet design, it should be noted that the Schöck Isokorb® is always placed in the insulating layer. It is not necessary to wrap the parapets in insulation. The marked area of insulation ① does not have to be installed for energetic reasons. For practical reasons only, the insulation is usually installed up to the upper edge of the parapet.

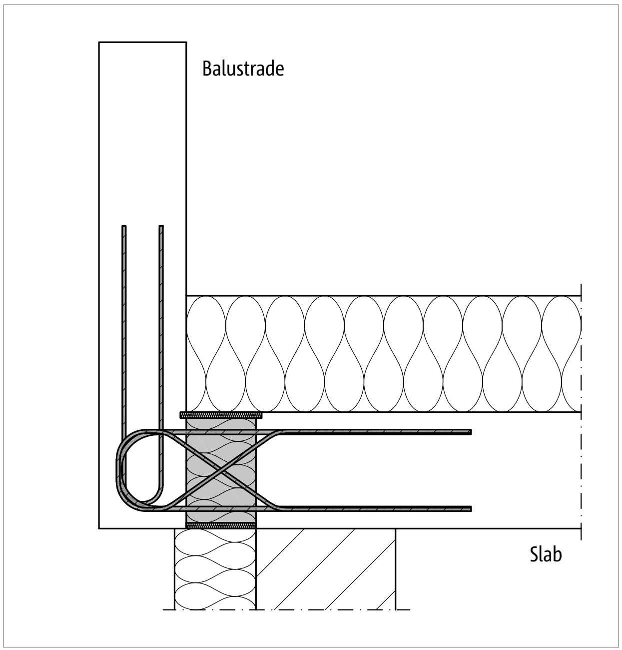

Fig. 15: Schöck Isokorb® XT type F: Connection to a corbelled sill with thermal insulation composite system (WDVS)

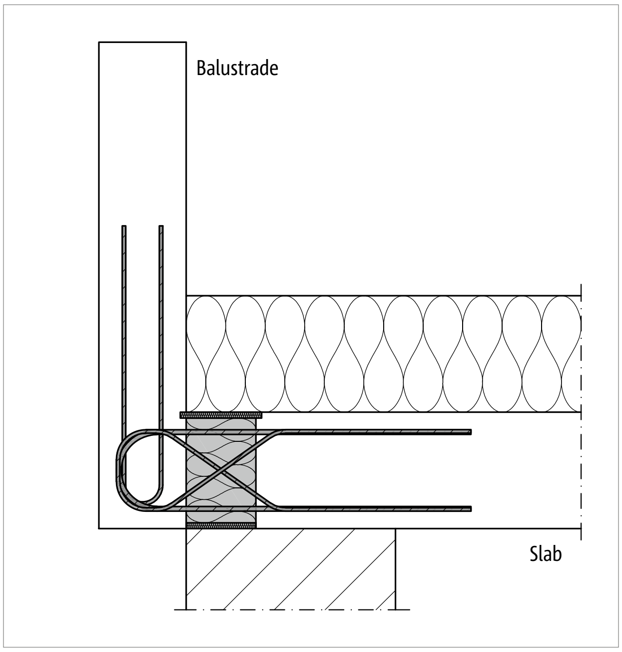

Fig. 16: Schöck Isokorb® XT type F: Connection to a corbelled sill for thermally insulated brickwork