Schöck Isokorb® Structural Thermal Break

Schöck Isokorb® Products

Schöck Isokorb® Structural Design

Schöck Isokorb® Installation
Thermal Insulation
Thermal efficiency

Minimizing our use of energy and natural resources are vital components of the global strategy to protect our environment and mitigate climate change. Buildings and the construction sector represent a large portion of total global energy and resource consumption. The USA has responded to this awareness with a tightening of building energy and performance standards. ASHRAE 90.1 has significantly reduced the energy that can be consumed by a building.

In the USA a large percentage of the energy consumed in buildings is space heating. Therefore, improving the building envelope using innovative construction methods and products is an efficient way to save on operational energy and improve building durability. Standard improvement strategies include reducing the window to wall ratio, using high-performance window systems and improving facade insulation by reducing thermal bridging.

Uncontrolled thermal bridging, such as balcony slabs running through the building envelope, results in high values of energy loss and the potential for premature structural damage. The impact of thermal bridging increases proportionally with the overall thermal performance of the building envelope when the sources of the bridging and the associated temperature differential are not adequately addressed.

What is a thermal bridge?

Thermal bridges are localized assemblies within the building envelope where high levels of heat loss occur and result in low internal surface temperatures, which create conditions for condensation and mold growth. Typical thermal bridging assemblies include uninsulated balcony slabs or steel beams penetrating the building envelope, conductive window frames, and gaps in the continuity of insulation.

In the case of uninsulated balcony slab connections, the interaction of the geometrical thermal bridge (cooling fin effect of the balcony slab) and the material-related thermal bridge (high heat conductivity of a reinforced concrete slab) results in a great deal of heat loss, meaning that the uninsulated balcony connection is one of the most critical thermal bridges in the building envelope.

Impact of thermal bridges

In the area surrounding the thermal bridge, the additional local heat loss leads to a reduction in the internal surface temperatures. If the surface temperature drops below the dew point temperature, moisture in the air will condense on the cold surfaces. As soon as the surface temperature drops below the so-called mold temperature there is a risk of mold spores entering the room air. Mold has very serious health impacts and can trigger asthma and cause strong allergic reactions. The low surface temperatures also lead to unnecessary thermal discomfort due to radiant heat loss.

Summary of the effects of thermal bridge:

- Risk of mold and dew formation
- Risk of effect on health (allergies etc.)
- Additional heating energy loss
- Discomfort

Increased risk of mold with uninsulated balconies
Additional heat loss with uninsulated balconies
Thermal Insulation
Thermal bridging

The Schöck Isokorb® Solution for Steel constructions

For steel constructions, we offer Schöck Isokorb® Type S22. The Isokorb® Type S22 is reinforced with stainless steel (k = 15 W/(mK)) which is encompassed with high quality insulating material (k = 0.031 W/(mK)). The following diagrams show the difference between a continuous steel beam (k = 50 W/(mK)) through the insulation layer and thermal break with the Schöck Isokorb® Type S22.

The diagrams above illustrate the difference between a conventional construction method and thermal insulation using Schöck Isokorb®. In a conventional building structure, the heat can freely flow out of the interior, which causes low surface temperatures $\theta_{\text{min}}$. Schöck Isokorb® can minimize the loss of thermal energy, and prevents damp walls and associated structural damage.

Illustration of a conventional building structure without thermal insulation of the balcony structure, with typical building component characteristics.

Illustration of a balcony structure with thermal insulation provided by the Schöck Isokorb®, with typical building component characteristics.

The use of Type S22 applications are shown on page 14. The reference plane for the analysis is 180 mm [7"] (width) to 353 mm [14"] (height)
Thermal Insulation
Thermal bridging

Thermal protection with Schöck Isokorb®
Schöck Isokorb® Type CM makes it possible to thermally insulate the balcony detail at the insulated wall by replacing the continuous reinforced concrete with a thermally insulated connection using the Schöck Isokorb® component.

The Schöck Isokorb® solution for concrete construction
Reinforcing steel (k = 50 W/(mK)) is replaced with stainless steel (k = 15 W/(mK)), and the concrete (k = 1.6 W/(mK)) is replaced with insulating material (k = 0.031 W/(mK)). This reduces heat conductivity in the connection area by approximately 90%, and minimizes the heat loss via the balcony by about 80%. The thermal insulation provided by the Schöck Isokorb® increases the surface temperature in the living area by more than 62.6°F (17°C) (minimum surface temperature Θ_{min} is explained on the next page), depending on the nature of the structure, see the illustration below. The risk of mold formation is also minimized, and the insulated building envelope is effectively made continuous.

Illustration of a conventional building structure without thermal insulation of the balcony structure, with typical building component characteristics.

Illustration of a balcony structure with thermal insulation provided by Schöck Isokorb® Type CM, with typical building component characteristics.

The diagrams above illustrate the influence of an Isokorb® in a concrete structure. With a non-insulated balcony slab, the heat can flow out freely, yet with Schöck Isokorb® heat loss will be reduced and the inside surface temperature will be increased.
Thermal Insulation
Key thermal values for the products

Equivalent thermal conductivity $k_{eq}$

The equivalent thermal conductivity $k_{eq}$ is the average overall thermal conductivity of the Schöck Isokorb® insulating element for the different surface proportions. If the insulating elements are of the same thickness, it is a measure of the thermal insulation effect of the connection. The smaller $k_{eq}$ is, the greater the thermal insulation of the balcony connection. Since the equivalent thermal conductivity of the surface proportions of the materials that are used is taken into consideration, $k_{eq}$ is dependent upon the load capacity of the Schöck Isokorb®.

Thermal transmission resistance $R$ and $R_{eq}$

The R-value is a measure of heat conduction through a certain layer of a given thickness. It is dependent on the thermal conductivity $k$ and the layer thickness of a material. With multi-layer components, the R-value for the entire component results from the sum total of all R-values. The greater the R-value, the better the thermal insulating characteristic. The equivalent thermal transmission resistance $R_{eq}$ describes the thermal conductivity $k$ through the Schöck Isokorb® and can be expressed as:

$$ R = \frac{d}{k} = \frac{\text{Component thickness}}{\text{Thermal conductivity}} $$

$$ R_{eq} = \frac{d_{\text{Isokorb}}}{k_{eq}} = \frac{80 \text{ mm [3 1/8'] thickness of the Isokorb}}{\text{equivalent thermal conductivity of the Isokorb}} $$

Keep in mind, the $R_{eq}$-value does not include the surface air film.

The minimum surface temperature $\Theta_{min}$

The lowest surface temperature that occurs in the vicinity of a wall section determines the potential formation of condensation or mold. The minimum surface temperature therefore dictates the effects of a thermal bridge with regard to moisture effects.
# Thermal Insulation

## Key thermal values for the products

<table>
<thead>
<tr>
<th>Isokorb® type</th>
<th>units</th>
<th>Isokorb® height H</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>180 mm [7&quot;]</td>
<td>200 mm [7 7/8&quot;]</td>
</tr>
<tr>
<td>CM10-VV1</td>
<td>W/mK [Btu/(h*°F*ft)]</td>
<td>0.161 [0.093]</td>
</tr>
<tr>
<td>CM20-VV1</td>
<td>W/mK [Btu/(h*°F*ft)]</td>
<td>0.193 [0.112]</td>
</tr>
<tr>
<td>CM30-VV1</td>
<td>W/mK [Btu/(h*°F*ft)]</td>
<td>0.225 [0.130]</td>
</tr>
<tr>
<td>CM40-VV1</td>
<td>W/mK [Btu/(h*°F*ft)]</td>
<td>0.257 [0.149]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Isokorb® type</th>
<th>units</th>
<th>Isokorb® height H</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>80 mm [3 1/8&quot;]</td>
<td></td>
</tr>
<tr>
<td>2 x S22</td>
<td>W/mK [Btu/(h*°F*ft)]</td>
<td>1.405 [0.814]</td>
</tr>
<tr>
<td>continuous steel beam</td>
<td>W/mK [Btu/(h*°F*ft)]</td>
<td>4.120 [2.387]</td>
</tr>
</tbody>
</table>

For further values please contact the Schöck design department at info@schock-us.com

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1) The use of Type S22 applications are shown on page 14. The reference plane for the analysis is 180 mm [7"] (width) to 353 mm [14"] (height)
2) fire protection class, see page 33
# Product Description and Applications S-line

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**Building with Schöck Isokorb® S-line**

Typical applications for Schöck Isokorb® S22 are cantilevered steel constructions such as canopies in institutional buildings. Furthermore the Schöck Isokorb® S22 is suitable for various applications such as steel balconies, roof extensions, steel columns etc. in institutional as well as residential buildings.

**Placement details for Schöck Isokorb®**

This sample detail illustrate the incorporation of Schöck Isokorb® S22 at a typical canopy. Schöck Isokorb® S22 modules are located at the wall section between the exterior and interior wall providing a continuous insulation layer. The product separates the exterior structure thermally from the interior structure.
Product Description and Applications S-line
Placement details for the Schöck Isokorb® S-line

Sample detail at a typical steel canopy for reference purposes
**Product Description and Applications S-line**
Design and materials for Schöck Isokorb® S-line

**Naming of Schöck Isokorb® type S22 components**

Schöck Isokorb® is a structural thermal break element and mainly works as follows:
1. The insulating element thermally separates the balcony and canopy structure from the interior slab or structure and therefore reduces thermal bridging.
2. Schöck Isokorb® transfers loads from the external supporting structure to the interior supporting structure.

**Schöck Isokorb® type S22: Internal view**
## Product Description and Applications S-line

Design and materials for Schöck Isokorb® S-line

### Comparable Steel Materials

Material used in the fabrication of Schöck Isokorb® S-line modules conform to ANSI/AISC 360-10 standards for structural steel. The table below shows the mechanical properties and chemical composition of the materials used in the Schöck Isokorb® along with a comparable structural steel per the US specifications.

The Engineer of Record (EOR) should verify this and employ sound engineering judgement when specifying Schöck Isokorb® for use under jurisdiction of the US specifications.

### Materials for Schöck Isokorb®

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<tr>
<th>Materials for Schöck Isokorb®</th>
<th>Material</th>
<th>Comparable to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel</td>
<td>Mo-Cr-Ni-austenitic stainless steel compliant with German Standard grades 1.4401, 1.4404 and 1.4571 (Choice of Grade at Manufacturer’s Discretion).</td>
<td></td>
</tr>
<tr>
<td>Threaded rods M22 dₘ = 22 mm [7/8”]</td>
<td>S460 (German Standard) Nominal Tensile Strength T₁₅ := 600 MPa Minimum Yield Stress T₁ := 390 MPa Nominal Shear Stress Fₓ := 300 MPa</td>
<td>ASTM A307 Grade A F₁, Tensile Stress = 60 ksi</td>
</tr>
<tr>
<td>Rectangular hollow profile w/h/d = 50 mm [1 15/16”] / 50 mm [1 15/16”] / 3 mm [1/8]</td>
<td>S 355 (German Standard) Nominal Tensile Strength T₁₅ := 510 MPa Minimum Yield Stress T₁ := 355 MPa</td>
<td>ASTM A500 Grade B F₁, Tensile Stress = 58 ksi F₁, Minimum Yield Stress = 46 ksi</td>
</tr>
<tr>
<td>Type S22 End Plate</td>
<td>S 275 (German Standard) Nominal Tensile Strength T₁₅ := 430 MPa Minimum Yield Stress T₁ := 275 MPa</td>
<td>ASTM A36 F₁, Tensile Stress = 58-80 ksi F₁, Minimum Yield Stress = 36 ksi</td>
</tr>
<tr>
<td>Insulation material</td>
<td>Polystyrene hard foam (Neopor®) k = 0.031 W/(m × K)</td>
<td></td>
</tr>
<tr>
<td>Sliding film</td>
<td>PTFE film (PolyTetraFluorEthylene)</td>
<td></td>
</tr>
</tbody>
</table>
Product Description and Applications S-line
Scope of application/anti-corrosion protection/fire protection

In order to transfer the load from the exterior structure into the interior structure, the load bearing components penetrate the insulating layer.
The supporting components are threaded rods, pressure plate, and a square tube. All load-bearing components are made from stainless steel.

The product transfers normal forces and shear forces horizontally and vertically.
To transfer bending moments, at least two Schöck Isokorb® type S22 are arranged above one another.
Isokorb® S-22 modules vertical spacing vary dependent upon forces where multiples can be arranged beside or above one another. Insulating shims can be arranged between individual Schöck Isokorb® type S22 components so the connection can be adjusted with respect to steel member dimensions and the load on the cross-section of the steel member to be connected. The horizontal distance between the threaded rods is fixed at 100 mm [3 15/16”].
The identification sticker on the top of the Schöck Isokorb® contains information about the type, height, manufacturer, and installation leaflets, which are supplementary to the detailed installation instructions that are provided with the delivery.

Anti-corrosion protection

- The stainless steel used for Schöck Isokorb® type S22 corresponds to material no.: 1.4401, 1.4404 or 1.4571 or ASTM A312 TP 316.
The S22 components will have a typical corrosion resistance expected for Mo-Cr-Ni austenitic stainless steels.
This can be more accurately quantified by reference to specialist literature such as http://www.steel-stainless.org/designmanual/Docs/En/English.pdf

- Bimetallic corrosion
  The area of the galvanised steel is greater than the area of the stainless steel (bolts, washer and butt stop). As a result bimetallic corrosion that could lead to failure can be excluded for Schöck products, when using Schöck Isokorb® type S22 with galvanised or paint treated front plate.

- Stress corrosion cracking
  An appropriate Schöck protection system needs to be provided in environments with a high chlorine content (e.g. inside indoor swimming pools, …). For more information please contact our design department.

Fire protection
The same on-site fire safety measures that apply to the overall load-bearing structure also apply to any freely accessible components of the Schöck Isokorb® type S22 or to any components situated inside the insulating layer. For more information please contact our Schöck design department.
Product Description and Applications S-line
Steel construction with the Schöck Isokorb® S-line

Canopy steel structure without thermal insulation (facade layout not shown)

Schöck Isokorb® type S22: Canopy steel structure with thermal insulation (facade layout not shown)

The traditional steel member is thermally separated by the Isokorb® type S22. For this purpose, head plates are welded onto the steel members in order to transfer the loads into Schöck Isokorb® type S22. An example for designing head plates for steel members is described in the chapter titled "Schöck Isokorb® Structural Design: Schöck Isokorb® S-line End plate designing".

Materials for connecting components

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<th>Building regulations</th>
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<td>End Plates</td>
<td>ASTM A572 Grade 50</td>
<td>ASTM A572</td>
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**Schöck Isokorb® Load-bearing Behavior S-line**

Load resistance and load transmission

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**Schöck Isokorb® type S22: Load distribution**

**Load distribution**

The load distribution for a canopy or a balcony with Schöck Isokorb® is determined in accordance with the ASCE 7-10. The illustration shows an example load case for dimensioning Schöck Isokorb®.

The maximum load case is to be assumed.

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**Schöck Isokorb® type S22: Moment diagram**

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**Schöck Isokorb® type S22: Shear force diagram**

**Schöck Isokorb® Load-bearing Behavior S-line**

Load resistance and load transmission

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**Moment transfer**

Thermal breaks for cantilever canopies or balconies must be able to transfer moments and shear forces into the interior structure. The bending moment is transferred through the bolts of the upper Schöck Isokorb® type S22 and the bolts in combination with the Rectangular hollow profile of the lower Schöck Isokorb® type S22, broken down into a pair of forces (tension and compression force). The moment results from the force \( F \) multiplied by the inner lever arm \( a \).

\[
M = F \times a
\]

The bigger the lever arm, the higher is the moment capacity.

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**Vertical Shear transfer**

It is assumed that the vertical shear force is on the safe side and only received by the lower Schöck Isokorb® type S22 in the pressure zone.

The exterior head plate of the steel structure transfers the shear forces into the pressure plate of Schöck Isokorb® type S22 via the threaded rods.

The shear forces are then further guided through the welded square tube and then back into the interior pressure plate of the steel structure via the head plate of Schöck Isokorb® type S22.

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**Head plate of the subsequent steel structure**

An example for designing head plates for steel members is described in the chapter titled "Schöck Isokorb® Structural Design: Schöck Isokorb® S-line End plate designing".

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**Load-bearing Behavior S-line**

**Load resistance and load transmission**

**Horizontal shear force transfer**
The exterior head plate of the steel structure transfers the horizontal shear forces into the head plate of Schöck Isokorb® type S22 via the threaded rods. The horizontal shear forces are then further guided through the welded square tube and then back into the interior pressure plate of the steel structure via the pressure plate of Schöck Isokorb® type S22.

**Interaction**
Steel connections can be formed with several Schöck Isokorb® types S22 allowing them to transfer bending moments as well as horizontal and vertical shear forces at the same time. In this process, a single type S22 can transfer normal forces and shear forces via the threaded rod and the hollow section. In this case, the following interaction formula must be taken into account:

\[3V_{r,h} + 2V_{r,v} + P_r = \max P_r \leq P_c\]

The formula takes the interaction for the threaded rod and the square tube into account.
Load-bearing Behavior S-line
Behavior in the event of temperature changes – Fatigue

During temperature changes, the lengths of steel members change. Depending on the outdoor temperature, the exterior steel members either expand or contract. If the Schöck Isokorb® type S22 components are connected to steel members that cannot freely adjust their lengths perpendicular to the axis of Schöck Isokorb® type S22, a horizontal load is exerted on the Schöck Isokorb® type S22. Schöck Isokorb® has been tested for fatigue stress due to fluctuating temperatures.
Load-bearing Behavior S-line
Behavior in the event of temperature changes – Fatigue

Therefore we recommend designing the connecting steel structure in such a way that no fatigue loads from temperature deformation affect the Schöck Isokorb® type S22. For this purpose the secondary structure can be attached to the primary structure in such a way to allow for the horizontal movement or the end plate can be designed with horizontal elongated holes.

Otherwise, we recommend limiting the length of the canopy or balcony slab to a certain size, depending on the Schöck Isokorb® type. This must be verified by the Engineer of Record (EOR) and adjusted if necessary. For design assistance please contact the Schöck design department.

The permitted effective deformation length $l_{eff}$ is the maximum range in which 2 or more Schöck Isokorb® type S22 components may be arranged if the structure connected to the Schöck Isokorb® type S22 cannot freely expand in length, thus leading to shifts in the Schöck Isokorb® type S22. This length is indicated in the product section.

![Schöck Isokorb® type S22: elongated holes to allow movement in the secondary structure](image-url)
# Product Description and Applications C-line

![Image](image.png)

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Product Description and Applications C-line
Building with Schöck Isokorb® C-line

Typical applications for Schöck Isokorb® are cantilevered constructions such as balconies in high-rise residential or canopies in institutional buildings. Solutions are available for concrete and steel structures.

Placement details for Schöck Isokorb®

The sample details illustrate the incorporation of Isokorb® at a typical balcony with brick cladding on the exterior wall and window wall. Schöck Isokorb® is located outboard of the backup wall to avoid structural interference with the attachment of steel stud tracks or window wall deflection header. Special consideration has also been paid to allow for a practical construction detail at the Isokorb® / concrete slab interface while maintaining waterproofing continuity and serviceability by illustrating removable flashings.
Product Description and Applications C-line
Placement details for Schöck Isokorb® C-Line

Sample detail at a typical balcony with EIFS backwall for reference purposes

Sample detail at a typical balcony with brick wall for reference purposes
Product Description and Applications C-line
Design and materials for Schöck Isokorb® C-line

Schöck Isokorb® type CM: Component designations

Identification sticker

Tension bar

Interior slab

Balcony
The Schöck Isokorb® is a load-bearing thermal break element and mainly works as follows:
1. The insulating element thermally separates the balcony slab from the interior slab and therefore reduces the thermal bridge.
2. The Schöck Isokorb® transfers the loads from the balcony slab into the interior slab.
Product Description and Applications C-line
Design and materials for Schöck Isokorb® C-line

In order to transfer the load from the balcony slab into the interior slab, the load bearing components penetrate the insulating element. The load bearing components are tension bars, shear force bars and HTE modules. Consisting of micro-steel fibre reinforced high-performance concrete, enclosed in plastic casing, the HTE modules are embedded in the insulating element. They act as a pressure bearing, and transfer the pressure force from the balcony into the interior slab.

Tension bars have a diameter of 12 mm (1/2”) and are held in position by the upper plastic rail. Shear force bars have a diameter of 8 mm (5/16”).

The Schöck Isokorb® is available with different load bearing capacities, depending on the real loads. Load bearing capacities differ in their number of tension bars, shear force bars and HTE modules. The Schöck Isokorb® type CM is available in different heights, ranging from 180 mm (7”) to 250 mm (9 7/8”).

The identification sticker on the top of the Schöck Isokorb® contains information about the type, the load capacity, the height, the manufacturer, and the installation leaflets, which are supplementary to the detailed installation instructions that are provided with the delivery.
### Product Description and Applications C-line

#### Materials for Schöck Isokorb® / Fire protection

**Materials for Schöck Isokorb®**

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<thead>
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<th>Materials for Schöck Isokorb®</th>
<th>Material</th>
<th>Conforming to</th>
<th>equivalent to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tension bar</td>
<td>High-yield ribbed reinforcement bar BSt 500 B</td>
<td>German Standard DIN 488-1</td>
<td>ASTM A615 - 12</td>
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<td></td>
<td>Stainless steel ribbed reinforcement BSt 500 A NR material no. 1.4362, minimum nominal yield</td>
<td>German Standard DIN 488-1</td>
<td>ASTM A955M-96</td>
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<tr>
<td></td>
<td>strength 700MPa [101.5 ksi]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shear force bar</td>
<td>High-yield ribbed reinforcement bar BSt 500 B</td>
<td>German Standard DIN 488-1</td>
<td>ASTM A615 - 12</td>
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<tr>
<td></td>
<td>Stainless steel ribbed reinforcement BSt 500 A NR material no. 1.4362, minimum nominal yield</td>
<td>German Standard DIN 488-1</td>
<td>ASTM A955M-96</td>
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<tr>
<td></td>
<td>strength 700MPa [101.5 ksi]</td>
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<td></td>
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<tr>
<td>HTE pressure bearing</td>
<td>High-strength, fibre reinforced concrete</td>
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<tr>
<td></td>
<td>Plastic sleeve of HD-PE plastic</td>
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<td></td>
</tr>
<tr>
<td>Insulation material</td>
<td>Polystyrene hard foam, k = 0.031 W/(mK) [0.02 Btu/(hr ft F)]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire protection boards</td>
<td>Lightweight building boards, material class A1</td>
<td>made from fibre-glass cement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cement bound fire safety boards, mineral wool</td>
<td>bonded board complying</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\rho \geq 150 \text{ kg/m}^3 \quad [9.37 \text{ lbs/ft}^3] \quad \text{Melting point} \quad T \geq $</td>
<td>with DIN 4102-2 : 1977</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1000 °C [1,832°F]</td>
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<tr>
<td>Fire safety strips</td>
<td>made from Roku-strip</td>
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</tbody>
</table>

**Schöck Isokorb® fire protection**

Schöck Isokorb® is available with or without fire protection. If fire safety requirements apply, CM and CV types (with HTE modules) are available in a R120 version (120 minutes fire resistance), and types CMD, CVB and CEQ (without HTE modules) in a R90 version (90 minutes fire resistance). Integrated fire safety strips (type CM), made of intumescent material, and fire protection plates close the gaps opening under exposure to fire, ensuring that the Isokorb® reinforcement is protected from hot gas; the fire protection plates protrude by 10 mm [3/8"] on the top of the Schöck Isokorb® types CMD, CV, CVB and CEQ. R90 resp. R120 classifications are achieved with these versions, even without additional on-site fire safety measures (e.g. mineral coating). The picture shows Schöck Isokorb® type CM in R120.
Product Description and Applications C-line
Concrete slab construction with the Schöck Isokorb®

Schöck Isokorb® type CM: Balcony connection indirectly supported

Balconies and other external structural components should be designed by the Engineer of Record (EOR) in agreement with ACI-318-11.

Schöck Isokorb® structural thermal breaks create a new design situation compared to a traditional continuous slab condition where the balcony is designed as an extension of the interior floor. Using Schöck Isokorb, a continuous slab is separated into two individual slab conditions, an exterior slab (balcony) and an interior slab. Schöck Isokorb® provides structural integrity and solutions to resist forces created both by direct and indirect supported slabs situations.

The following materials are assumed for the connecting components:

Materials for connecting components

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Product Description and Applications C-line
Schöck Isokorb® C-line Cast-in-place reinforcement

Reinforcement for interior slab and balcony slab to be designed by the Engineer of Record (EOR) of the base building.

Reinforced concrete cantilever balconies require upper and lower reinforcement and reinforcement surrounding the free borders. When using the Schöck Isokorb® the following cast-in-place reinforcement is required.

Schöck Isokorb® type CM: Overlap length \( l_o \), concrete cover \( CC \)

The bar lengths are designed to meet the lap splice length requirements of ACI-318-11. The standard minimum concrete cover (CC) is defined by the Schöck Isokorb® as 40 mm [1 9/16"] (alternatively 55 mm [2 3/16"]).

Reinforcement of a traditional balcony slab
Product Description and Applications C-line
Schöck Isokorb® Cast-in-place reinforcement

Please note the following for the placement of slab reinforcement with Schöck Isokorb®:

The lap splice of the Schöck Isokorb® tension and shear force bars must be provided both at the interior and the balcony side. The required lap splice reinforcement \( a_i \) must be at least equal to the Schöck Isokorb® reinforcement \( (req. a_i \geq exist. a_i) \).

Two longitudinal bars (minimum \#3) are required parallel to the insulating element at the balcony side, one bar being arranged in the upper reinforcement layer, the other in the lower.

Two longitudinal bars (minimum \#3, parallel to the insulating element) and U-bars (surrounding the free borders) are required at the interior slab.

The final reinforcement design and arrangement depends on the Isokorb® types. Please see the Isokorb® product chapters for further details.

The existing slab reinforcement can be taken into account for the required reinforcement of connections with Schöck Isokorb®.
Load-bearing Behavior C-line

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Load-bearing Behavior C-line
Load resistance and load transmission

**Moment transfer**
Isokorbs for cantilever balconies must be able to transfer moments and shear forces into the interior slab. The bending moment is transferred through the tension bars (top side) and the pressure bearings (bottom side), split into a pair of forces (tension and compression force). The moment results from the force F multiplied by the inner lever arm a.

\[ M = F \times a \]

The higher the Isokorb® (and the bigger the lever arm), the higher is the moment capacity. The maximum moment that can be transferred is termed as \( \Phi M_n \), as per ACI 318-11.

**Vertical Shear transfer**
The vertical shear force is transferred into the bent corner of the tension bar. There it is split into a tension and a compression component, the tension component being transferred by the shear force bar and the compression component by the pressure bearing. The maximum possible shear force that can be transferred is termed as \( V_s \), as per ACI 318-11.
### Load-bearing Behavior C-line

#### Load resistance and load transmission

**Load distribution**

The load distribution for a balcony with a Schöck Isokorb® is determined in accordance with ASCE 7. The illustration shows an example load case for dimensioning the Schöck Isokorb®. The fixing should be assumed to be 100 mm (3 15/16") behind the Schöck Isokorb® C-line. The maximum load must be determined from the load cases of the applicable codes.

**Notes**

- The example load distribution requires stiff slab edges with direct support using an existing load-bearing wall or drop beam or alternatively with indirect support using stirrups within the existing slab edges created using Schöck Isokorb. This implies downward loadings (negative moments) at the connection of the balcony. In that case Isokorb® type CM is the solution.
Load-bearing Behavior C-line
Load-bearing behavior in earthquake load case

Buildings in seismic zones (earthquake zones) have to resist additional loads from the earthquake. The balcony is considered to be an external component. Country-specific regulations apply to this.

The earthquake load is a rare load, in which case safety reserves may be activated in the Schöck Isokorb®. The Schöck Isokorb® type CEQ absorbs the loads from earthquakes in interaction with the Schöck Isokorb® type CM.

The loads can also be absorbed in interaction with type CV and CMD, for further information please contact the Schöck Design department.

The required number of Schöck Isokorb® types CEQ is determined in accordance with the earthquake load analysis. Earthquake loads typically result in the following movements: horizontal in the direction of both building axes, upwards and downwards. The balconies follow these movements after a delay. Resulting loads are explained below.
Load-bearing Behavior C-line
Vibration behavior

In the context with balconies, the term “slenderness” describes the ratio of slab thickness to cantilever length. This slenderness will influence the vibration behaviour of the balcony slab. Therefore, we recommend limiting the slenderness; for further details, please see the product chapter.
Load-bearing Behavior C-line
Deflection behavior

Deformation of a balcony slab without Schöck Isokorb®

Deformation of a balcony slab with Schöck Isokorb®

Deflection

Balcony deformation is a result of loading, twisting of the interior slab and deformation of the balcony. Generally, the deformation is measured at the tip of the cantilever.

The Schöck Isokorb® is simulated by two springs, the top spring simulating the tension bar, the bottom spring simulating the HTE pressure bearing. When exposed to a bending moment, the bottom spring is compressed, and the top spring is expanded. This produces a twist angle $\alpha$ in the Schöck Isokorb®, statically simulated by a torsion spring as illustrated.

With the Schöck Isokorb® being located between the floor slab and the balcony slab, deformation $w_f$ from the Schöck Isokorb® must be taken into consideration in addition to the deformation $w_b$ of the balcony slab. Please see the product chapters for specification of the deformation factor $\tan \alpha$. 
Load-bearing Behavior C-line
Deflection behavior

Camber
In order to optimise the deformation of the balcony, the formwork can be cambered during installation. Usually, camber will be designed to counter deformation due to self weight, allowing tolerance of ± 5 mm [3/16”]. Drainage direction should be taken into account. Camber should be reduced for outward drainage and increased for inward drainage.

The total Camber "w" for a balcony depends on several factors:

- the amount of deformation from the angle of rotation of the interior slab
- the amount of deformation of the balcony slab,
- the amount of deformation from the Schöck Isokorb® and
- the drainage direction of the balcony.

All these points must be taken into consideration when determining the camber.
Load-bearing Behavior C-line
Behavior in the event of temperature changes – expansion joints

Temperature deformation and possible crack formation in a balcony slab without Schöck Isokorb®

Contraction of a balcony slab due to cooling, horizontal compression load on Schöck Isokorb®

Expansion of a balcony slab due to heating up, horizontal tension load on Schöck Isokorb®
Load-bearing Behavior C-line
Behavior in the event of temperature changes – expansion joints

A balcony slab expands when heated up and contracts when cooled down. With a continuous balcony slab, cracks can occur in the concrete slab due to constraint. One result can be the ingress of moisture.

The Schöck Isokorb® forms an expansion joint. The tension bars and the shear force bars in the Schöck Isokorb® repeatedly deflect slightly across their axis.

Fatigue tests were conducted for the following loads applied to the Schöck Isokorb® type CM:
- 100 load reversals, movement distance ±2.0 mm [5/64”],
- 2000 load reversals, movement distance ±1.7 mm [1/16”],
- 20000 load reversals, movement distance ±1.1 mm [3/64”].

For a symmetrical balcony slab, the tension bars and shear force bars of the Schöck Isokorb® at the edges of the balcony slab deflect more than the bars in the centre of the balcony slab.
Load-bearing Behavior C-line
Behavior in the event of temperature changes – expansion joints

Therefore, we recommend limiting the length of the balcony slab to a certain size, depending on the Schöck Isokorb® type. This must be verified by the Engineer of Record (EOR) and adjusted if necessary.

For corner balconies, only half of the length should be used, starting from the corner.

If a balcony slab is longer, expansion joints must be provided. To form an expansion joint, the slab is cut and a Schöck dowel type ESD is arranged between the two slabs in order to prevent different slab levels.

Expansion joint formation

Schöck Isokorb® type CM: recommended maximum expansion joint spacing