BUILDING
COMMON GROUND

MAX FRANK

Egcobox®

Thermal break balcony connector

Edition North America

www.maxfrank.com

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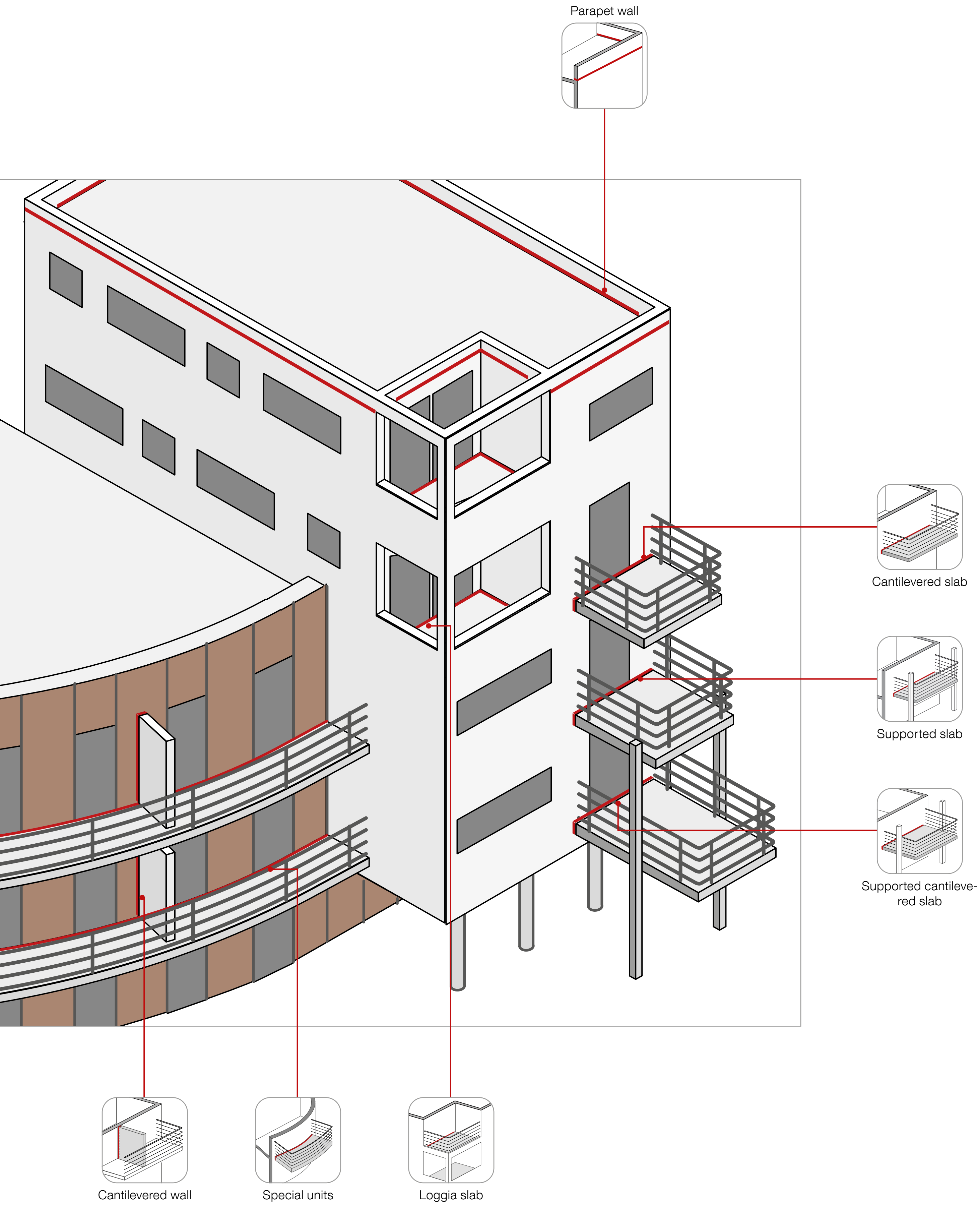
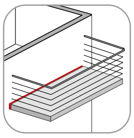
COMMON GROUND

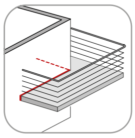
MAX FRANK®

Egcobox®

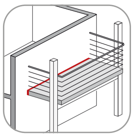

Parapet wall
Cantilevered slab
Supported slab
Supported cantilevered slab
Cantilevered wall
Special units
Loggia slab

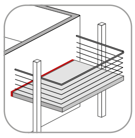
Cantilevered balconies

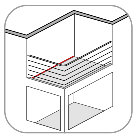

Cantilevered slab (Type M)


Outer corner (Type M-CO)

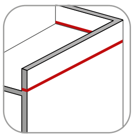
Supported balconies

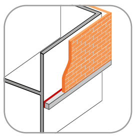

Supported slab (Type V)

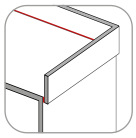

Supported cantilevered slab (Type V±)


Loggia slab (Type M±)

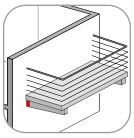
Parapets, corbels, balus-trades

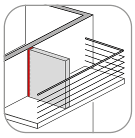

Parapet wall (Type A)

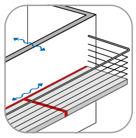

Corbel (Type O)


Projected parapet wall (Type F)

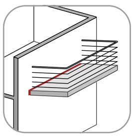
Other standard elements

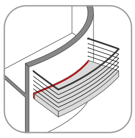

Cantilevered beam (Type S)


Cantilevered wall (Type W)


Short units for special loads (Type M modules)

Special units


Inclined balco-nies


Round balco-nies

MAX FRANK BUILDING COMMON GROUND

Egcobox®

Thermal break balcony connector

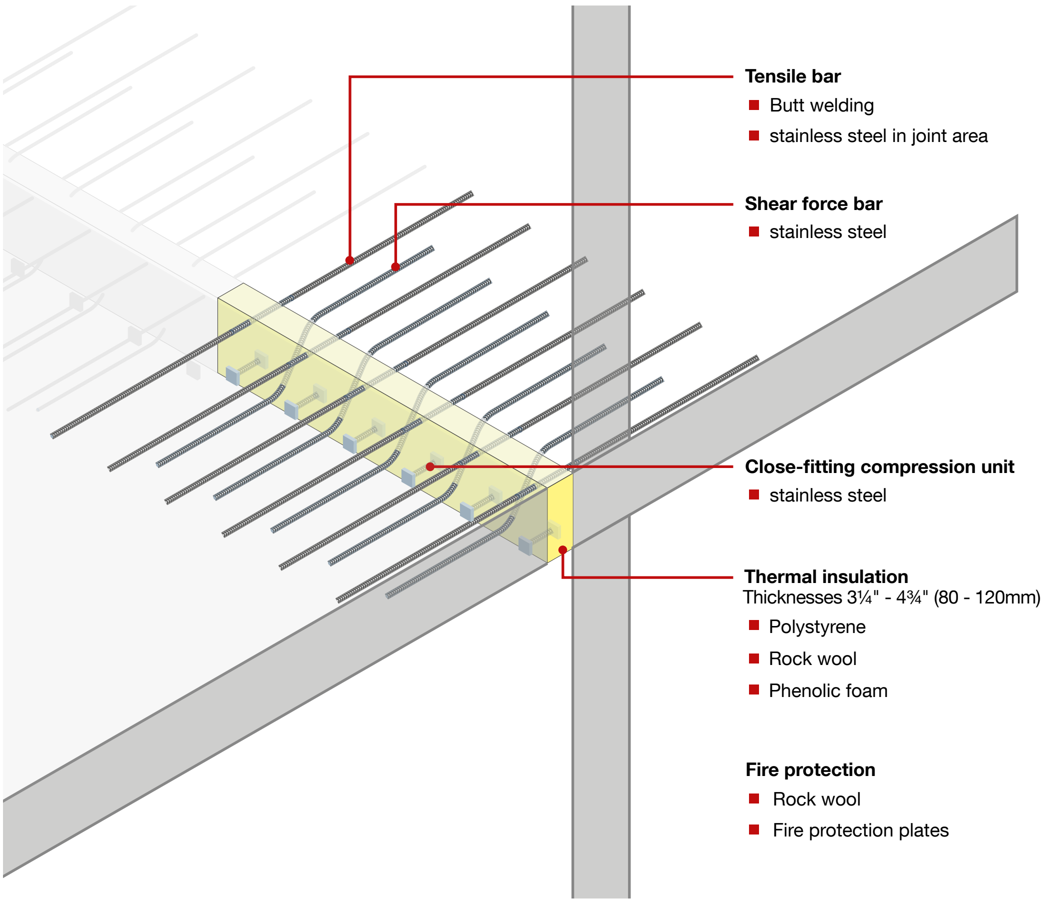
Egcobox® thermal break balcony connector

Types according to ICC: ESR-5212

Building users are demanding ever more in terms of savings on heating costs, a healthy room climate and the associated prevention of condensation and mould formation. Therefore, when planning, attention must be paid to minimizing thermal bridges in the area of the building shell. Thermal bridges can be reduced with the heat-insulating Egcobox® balcony connector. Egcobox® structural connection units thermally isolate an exterior component and an interior component from each other. The structural function of Egcobox® is provided by a bar framework, made from reinforcing steel, which passes through the thermal insulation and thus connects the component to the building.

Advantages

- Types designed for requirements in USA and Canada
- Simple installation due to close-fitting compression units
- All units can be individually adapted to geometric specifications
- Support for your detailed planning with CAD details, BIM files and tender texts
- Fast and simple design with the free Egcobox® design software

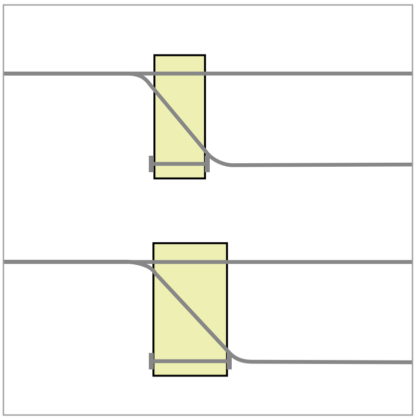


Explanations

Thicknesses and material types of thermal insulation

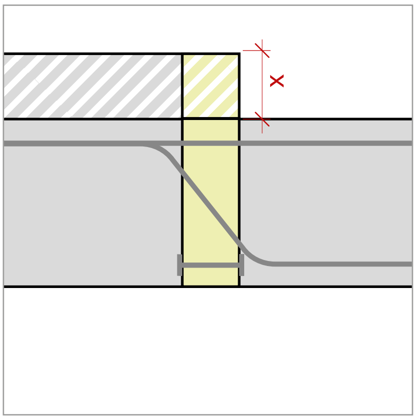
The structural function of the Egcobox® elements is provided by a bar framework made of reinforcing steel, which is passed through the thermal insulation that is usually 3¼" - 4¾" (80 - 120mm) thick. Depending on the project requirements, Egcobox® can be manufactured with any of the following insulation materials:

- Polystyrene 0.215 Btu/(sq ft hr °F) (0.031 W/mK)
- Rock wool 0.257 Btu/(sq ft hr °F) (0.037 W/mK)
- Phenolic foam 0.146 Btu/(sq ft hr °F) (0.021 W/mK)



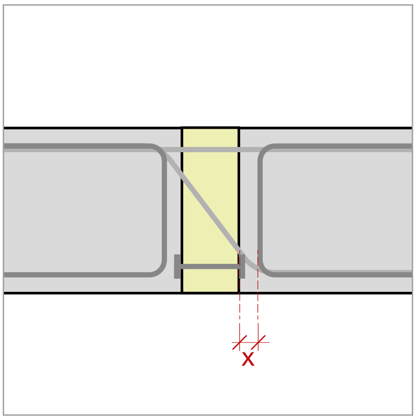
Protrusion of the insulation with various floor slab thicknesses

The Egcobox® cantilever connector is a component adapted to the load situation and the geometrical specifications. When the balcony slab and reinforced concrete floor slab have different connection heights, Egcobox® connectors, with a protruding insulating element, can make construction easier. The insulation of the Egcobox® constitutes the formwork of the thicker component. This reduces the formwork effort for the thicker slab and prevents additional doubling of the insulation on site.



Close-fitting compression units for simple installation

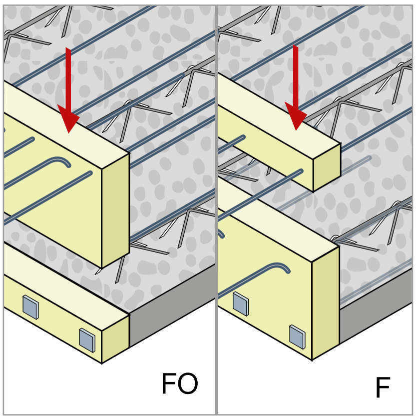
The compression units are fitted close to the insulating body of the Egcobox®. The compression unit thus rests inside the concrete cover and a collision-free installation with the on-site reinforcement is ensured.



Two-part Egcobox® for semi-prefabricated members

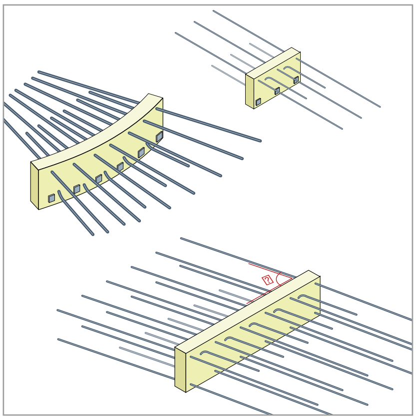
If a balcony is planned as a semi-prefabricated member, the Egcobox® element is manufactured from two parts. Two variants are possible for this purpose:

- **Variant FO** - Bottom section with close-fitting compression units including fixing on filigree element - depending on the load stage, from an overall height of the Egcobox® of 7 ¼" (185 mm) (assumption: concrete cover 1 ½" (40 mm) and thickness semi-prefab slab = 2 ½ (60 mm))
- **Variant F** - Bottom section with compression units and protruding shear force bars (bigger transport dimensions of the filigree element compared to Variant FO) - depending on the load stage, from an overall height of the Egcobox® of 6 ¼" (160 mm)



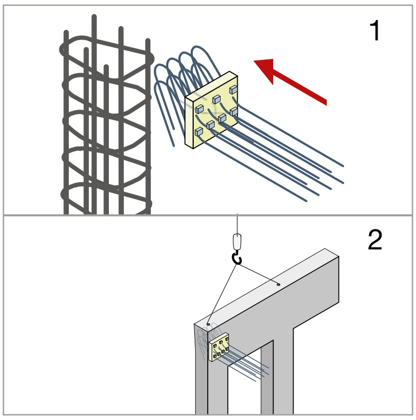
Individual shapes

The Egcobox® cantilever connector can be individually designed according to the geometrical and structural requirements and also adapted to the building or balcony shape. Unlike the standard unit, other unit lengths or a project-specific arrangement of the reinforcement are possible, such as arched Egcobox® units or units with reinforcement running diagonally to the joint.



Special units

Not only can the Egcobox® be adapted to special geometries, but it can also be configured according to the structural requirements. In this way, for example, horizontal shear forces or normal forces can also be absorbed by the Egcobox® unit. Connections from joists or wall panels can also be individually made with the Egcobox® product.
A combination of the Egcobox® with MAX FRANK Coupler tensile bars is also possible in order to optimise the weight or transport lengths.

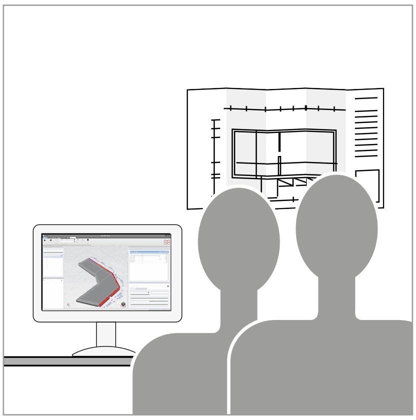


Egcobox software

The free Egcobox software enables the planner to define the right Egcobox® cantilever connectors for their geometrical and structural requirements quickly and easily. Both unusual balcony shapes and almost any effects can also be reproduced with the free input. The 3D visualisation system and the various output options allow the results to be incorporated in the subsequent planning.
Download at: www.maxfrank.com/egcobox-software

Egcobox® application technology

The requirements of cantilever connectors are as varied as the structures themselves. With the Egcobox® standard range and the numerous additional options, almost any kind of Egcobox® element can be configured and produced specifically for the project in question. In the Egcobox® application technology, experienced engineers help you to develop your individual solutions during a personal consultation - come and ask us!

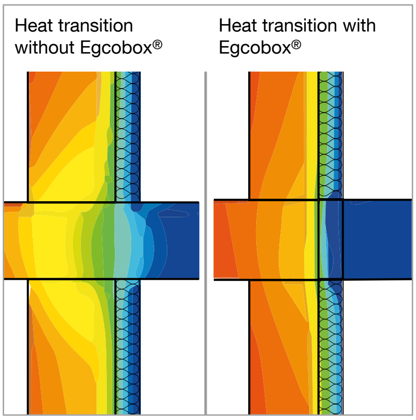


Building physics

Thermal bridges

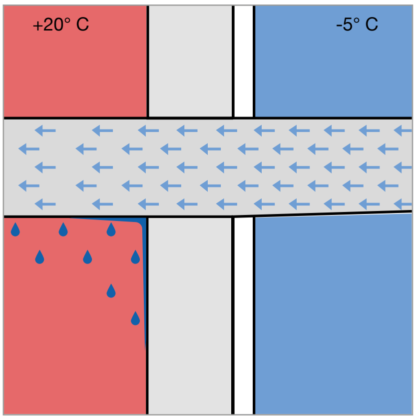
Particular attention is paid to minimising thermal bridges, as represented by a cantilevered balcony slab, for example. In the case of conventionally planned cantilever extensions, such as with concreted balconies, two unfavourable phenomena arise:

- Geometrical thermal bridges: they emerge where the inner component surface corresponds with a much larger outer component surface
- Material thermal bridges: These are caused by the different thermal conductivity values of the materials used, such as masonry and concrete: the Egcobox® units minimise their influence on the thermal transport



Condensation

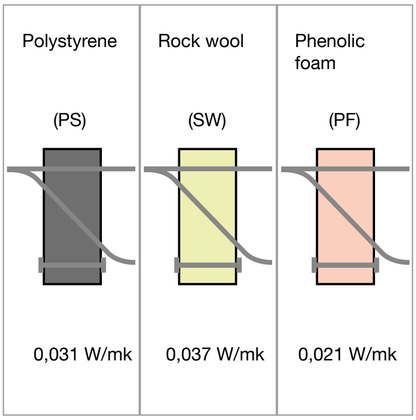
As part of the thermal planning of buildings and structural elements, the focus is on both protecting the environment and saving on heating costs, as is a healthy room climate and hence the prevention of condensation and mildew.



Heat transition coefficient of the thermal insulation

The insulating body of the Egcobox® cantilever connector can be supplied in various materials and with corresponding thermal insulation properties:

- Polystyrene 0.215 Btu/(sq ft hr °F) (0.031 W/mK)
- Rock wool 0.257 Btu/(sq ft hr °F) (0.037 W/mK)
- Phenolic foam 0.146 Btu/(sq ft hr °F) (0.021 W/mK)



Thermal calculation

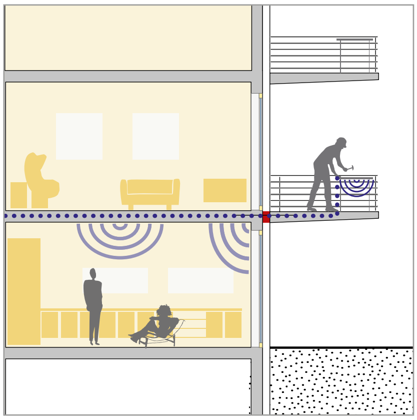
The thermal percentage of individual structural parts as a share of a building's overall thermal balance can be determined using two different methods:

- Blanket method
- Detailed method

Which method is applied is usually determined by the specialist planner responsible. In the course of planning passive houses, thermal bridges should be arithmetically determined, if this does not involve proven so-called "thermal bridge-free designs".

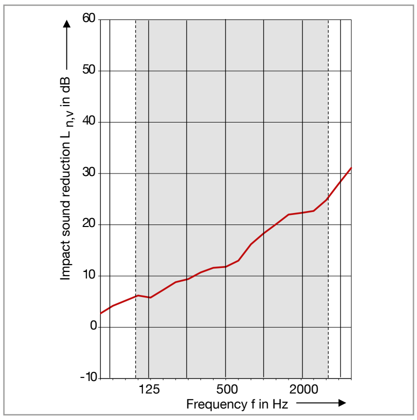
Impact sound protection

Walking, bouncing or simply moving chairs around on balconies or arcades causes vibrations, which are transferred to neighbouring apartments and perceived as noises.
A measure for the intensity of the noises is the evaluated standard impact sound level. Where Egcobox® is used, the transmission of impact sound is reduced, resulting in smaller values of the evaluated standard impact sound level.
The effectiveness of Egcobox® in reducing the standard impact sound level has been tested by independent institutes. Sample results can be seen in the following table.



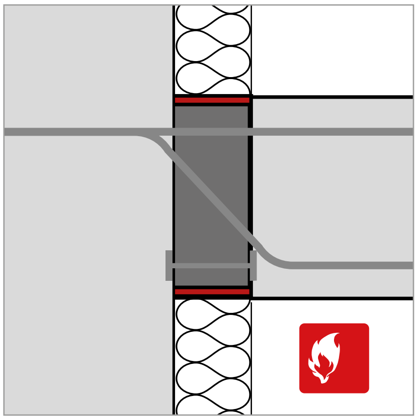
Evaluated standard impact sound level reduction $\Delta L_{n,v,w}$ [dB]

Egcobox® type	Version / fire protection	$\Delta L_{n,v,w}$ [dB]
MM50-V2	Rock wool REI120; Polystyrene R0 / Combi-element REI120-PS-C1 comparable	13.8
MXL50-V2		16.0
MXL80-V4		12.9
VXL97		17.1



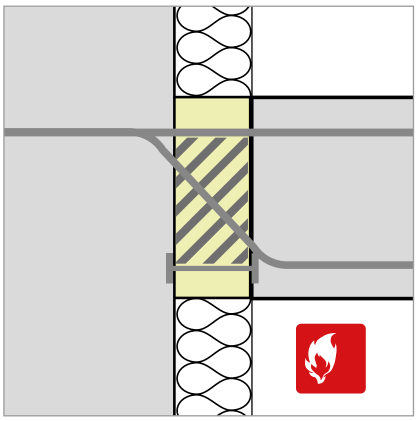
Polystyrene and phenolic foam fire protection

The fire protection requirements of balconies and cantilevered components are governed in the respective building regulations of the federal-states.
The fire protection of the Egcobox® cantilever connectors can be ensured with different versions. This depends on the insulating material selected for the Egcobox® elements.
If polystyrene or phenolic foam is selected as the insulating material, fire-resistant materials are applied at the factory to satisfy the fire protection requirements.
Fire resistance rating REI120 is achieved.



Rock wool fire protection (A1)

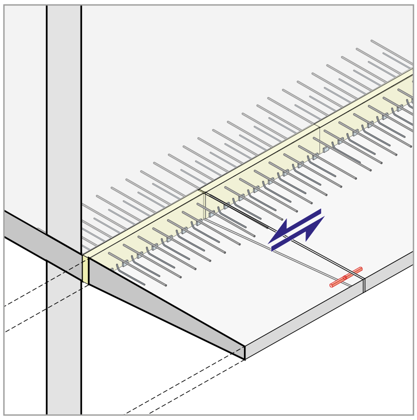
Additional fire-resistant materials are not necessary when using rock wool as the insulating material. Egcobox® units which incorporate rock wool insulation are rated in the fire resistance rating REI120 (2-hour, ICC: ESR-5212).
This fire protection rating applies both to an Egcobox® version made completely of rock wool as well as to an insulating element core made of polystyrene or phenolic foam combined with rock wool strips applied to both sides (Combi-element: designation C1).



Technical Information

Expansion joint intervals

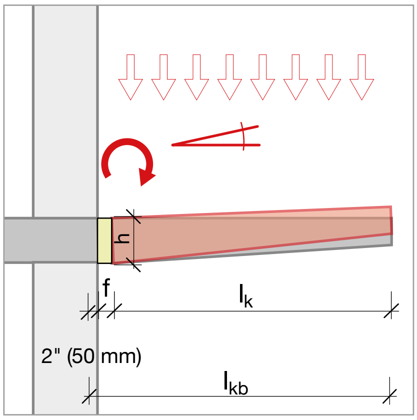
Due to the different temperature-induced expansions between the balcony outside and reinforced concrete floor slab inside, expansion joints must be arranged at certain intervals. The maximum expansion joint intervals permitted for the Egcobox® are demonstrated in the **design tables**.
To prevent a different amount of flexure at the edges of divided balcony slabs, dowels (shown in red in the sketch) are also fitted. You can find more information about dowels in our brochure, Egcodorn® & Egcodubel shear force dowels or on the Internet at www.maxfrank.com.



Deformation on the cantilever slab edge

The overall deformation on the cantilever slab edge results from the torsion of the cantilever slab in the area of the insulation joint (Egcobox®) according to the respective connection stiffness and also from the bending deformation of the cantilever slab, which can be determined by the structural engineer in accordance with ACI 318. This can be used, among other things, to estimate whether a banking on the cantilever slab formwork is advisable, e.g. to ensure the cantilever slab is drained as planned.

The torsion of the cantilever slab is dictated by the rigidity of the cantilever connector, which must firstly be designed and selected.

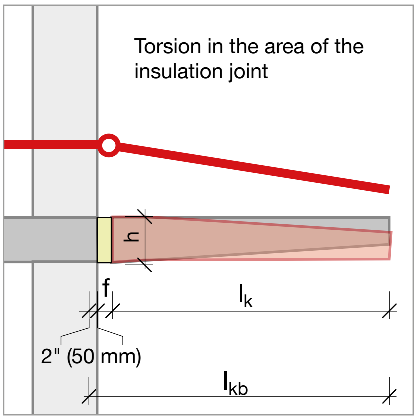


Rotation of the slab in the area of the insulation joint

For the preliminary design of the cutting forces with the aid of FE programs, the spring stiffnesses below are recommended for the cantilever connector:

- Torsion spring: 2,250 kip-ft/rad/ft (10,000 kNm/rad/m)
- Vertical spring: 5,220 kip/ft/ft (250,000 kN/m/m)

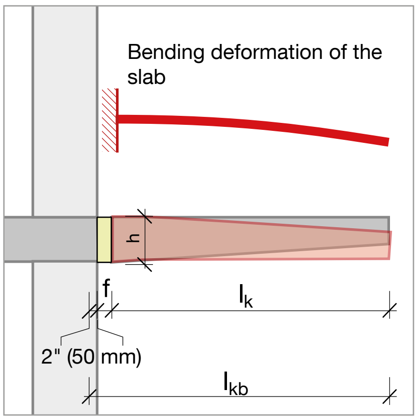
According to the specification of the Egcobox®, the drop on the open edge [mm] resulting from the torsion of the cantilever slab can be determined as follows:
$M_{available}$ [kip-ft/ft] x 1 / rotation spring stiffness [kip-ft/rad/ft] x l_{kb} [ft]
($M_{available}$ [kNm/m] x 1 / rotation spring stiffness [kNm/rad/m] x 1000 x l_{kb} [m])
It is recommended, when determining the moment $M_{available}$, to take into account the M_{Ek} from the dead weight and M_{Ek} from 50 % of the live load.



Deformation of the balcony slab

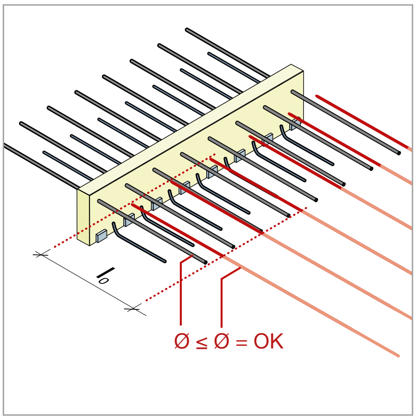
Excess flexure of the balcony slab can be prevented by limiting the bending slenderness. It is recommended to respect the following reference values for maximum cantilever arm lengths for the boundary conditions given in the table.

	max cantilever arm length l_k [ft in] (m)		
Component height h [in] (mm)	**Concrete cover c [in]** (mm)		
	1 ½" (38)	**2"** (51)	**2 ½"** (64)
6 ¼" (160)	**4'-11 ¼"** (1.51)	-	-
7" (180)	**5'-10 ¼"** (1.79)	**5'-3 ¼"** (1.61)	-
8" (200)	**6'-9 ½"** (2.07)	**6'-2 ¼"** (1.89)	**5'-7"** (1.7)
8 ¾" (220)	**7'-8 ½"** (2.35)	**7'-1 ¼"** (2.17)	**6'-6"** (1.98)
9 ½" (240)	**8'-7 ½"** (2.63)	**8'-0 ¼"** (2.45)	**7'-5"** (2.26)
11 ¾" (300)	**11'-4 ½"** (3.47)	**10'-9 ½"** (3.29)	**10'-2 ¼"** (3.10)



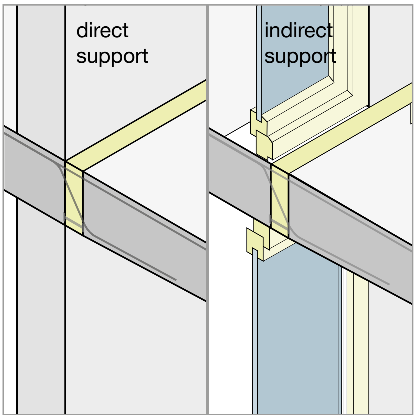
Lap length

The bars on the Egcobox® units, which are subject to tension as planned, are to be joined with the on-site reinforcement. For the continuity reinforcement, as a rule one bar of the same diameter can be placed next to each element tensile bar with a maximum distance of 4 d_s. Only element bars subject to pressure are anchored. No additional reinforcement is necessary for this. Further information about executing the continuity reinforcement can be taken from the design tables.



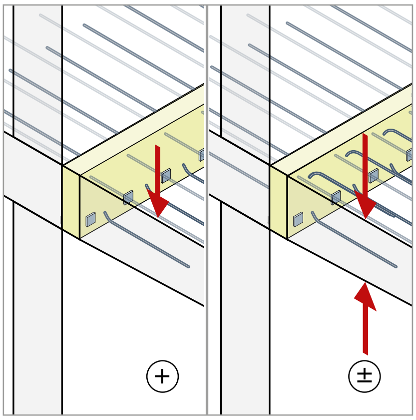
Direct/indirect support

On the component edges facing the Egcobox®, at least one edge surround is to be provided according to ACI 318. On balcony side, it is structurally recommended to design the edge reinforcement to the shear force requirement.
In case of indirect support, a suspension reinforcement ($A_g = \phi V_a / f_{yd}$) must be provided on slab side too. The structural edge surround can be taken into account. Lattice girders with a maximum gap of 4" (100 mm) to the insulation joint can also be taken into account.



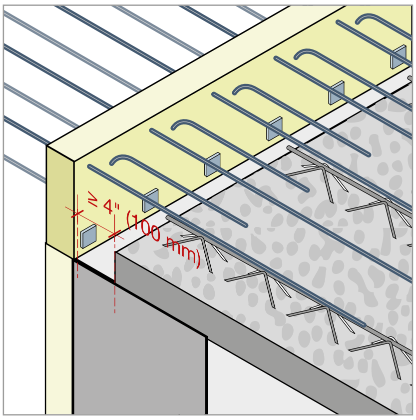
Direct/indirect support with ± elements

In the case of Egcobox® elements with a potentially alternating shear force direction (± elements), the suspension reinforcement is required both on the slab and the balcony side.



Semi-prefabricated members

In conjunction with semi-prefabricated members, the Egcobox® can be integrated during the manufacturing stage, so that the pressure elements bond with the precast concrete.
If the Egcobox® is only installed on the construction site, a In-situ concrete strip at least 4" (100 mm) wide must be made out of in-situ concrete. Particular attention should be paid to the reinforcement layout to prevent collisions of the Egcobox® reinforcement with the semi-prefabricated member. This can be taken into account in the planning by making the bottom concrete cover bigger or by using a wider contraction joint.



Type overview

Select the Egcobox® according to your requirements

- Insulation material (polystyrene, rock wool, phenolic foam)
- Insulating material thickness 3 1/8" (80 mm), other dimensions on request
- Unit length
- Concrete cover
- Reinforcement layout
- Fire protection
- The unit shape can be adapted to the building or the component being connected, e.g. round units for concave or convex outer walls or diagonal elements for inclined balconies.

ICC ES

Type designation

Example: MM70-VS-C45-h200-REI120-PS-C1

Unit type	Insulation thickness	Load stage	Unit shape	Variant (bending shape)	Shear force reinforcement	Concrete cover	Unit height	Fire resistance rating	Insulating material
M	**M (80 mm)**	10	**–**	**–**	**VS**	C30	h160	–	**PS-C1** [1]
M±	L (100 mm)	20	**Standard length**	**straight connection**	V1	C35	h170	**REI120**	Polystyrene
V	XL (120 mm)	25	K		V2	C40	h175		0,031 W/mK
V±		30	Short unit	HVS	V3	**C45**	h180		PS
A		40	Z	BH	V4	C50	h190		Polystyrene
F		50	without constraint	BHS	VS±		**h200**		0,031 W/mK
O		60	CO	WOS	V1±		h210		SW
S		65	Corner unit	WU	V2±		h220		Rock wool
W		**70**	FO / F	WUS	V3±		h225		0,037 W/mK
		75	in two parts for installation in semi-prefabricated slabs		V4±		h230		PF
		80			V6±		h240		Phenolic foam
		110			V7±		h250		
		120			V8±		h280		0,021 W/mK
		130					h300		PF-C1 [1]
		150							Phenolic foam
									0,021 W/mK

Other dimensions and insulating materials on request.

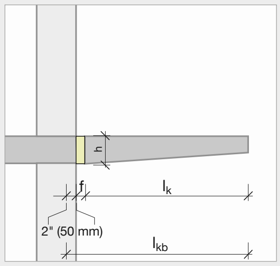
[1] each with rock wool fire protection strips

Brochures and prices can be found online at www.maxfrank.com

Design example

Geometry/boundary conditions

	IMP	SI
Insulation width f	3 $^{1}/_{8}$"	80 mm
Cantilever lk	7'-2 $^{5}/_{8}$"	2.20 m
=> l_{kb} = lk + f + 2" (50 mm)	7'-7 ¾"	2.33 m
Connection height h	8 ¾"	220 mm
Concrete quality	4,000 psi	27.6 Mpa
Conrete cover c	1 ½"	40 mm



Loads

Dead weight concrete slab	1.2 * 8 ¾" * 159.15 psf	= 139.1 psf	1.2 * 0.22 m * 25 kN/m³	= 6.6 kN/m²
Covering	1.2 * 15.7 psf	= 18.8 psf	1.2 * 0.75 kN/m²	= 0.9 kN/m²
Live loads	1.6 * 83.5 psf	= 133.7 psf	1.6 * 4 kN/m²	= 6.4 kN/m²
		= 291.5 psf		= 13.9 kN/m²

Railings, dead weight	1.2 * 0.048 kip/ft	= 0.058 kip/ft	1.2 * 0.7 kN/m	= 0.84 kN/m
Railings, horizontal load in height 3'-3 ¾" (1,0 m)	1.6 * 0.034 kip/ft	= 0.055 kip/ft	1.6 * 0.5 kN/m	= 0.80 kN/m

Calculation

Desing moment

ϕM_a=	291.5 psf / 1000 * (7'-7 ¾")² * ½ + 0.058 kip/ft * 7'-7 ¾" + 0.055 kip/ft * 3'-3 ¾" **= 9.14 kip-ft/ft**	13.9 kN/m² * (2.33 m)² * ½ + 0.84 kN/m * 2.33 m + 0.80 kN/m * 1.0 m **= 40.5 kNm/m**

Desing shear force

ϕV_a=	291.5 psf / 1000 * 7'-7 ¾" + 0.058 kip/ft **= 2.29 kip/ft**	13.9 kN/m² * 2.33 m + 0.84 kN/m **= 33.2 kN/m**

Element selection

Selected type Egcobox®	**MM55-V1-C38-h222-SW** ϕM_n= 9.80 kip-ft/ft ϕV_n= 3.21 kip/ft	**MM55-V1-C40-h220-SW** ϕM_n= 42.3 kNm/m ϕV_n= 3.21 kN/m
rotation spring stiffness Egcobox®	1,484 kip-ft/rad/ft	6,218 kNm/rad/element; Egcobox® length 1 m

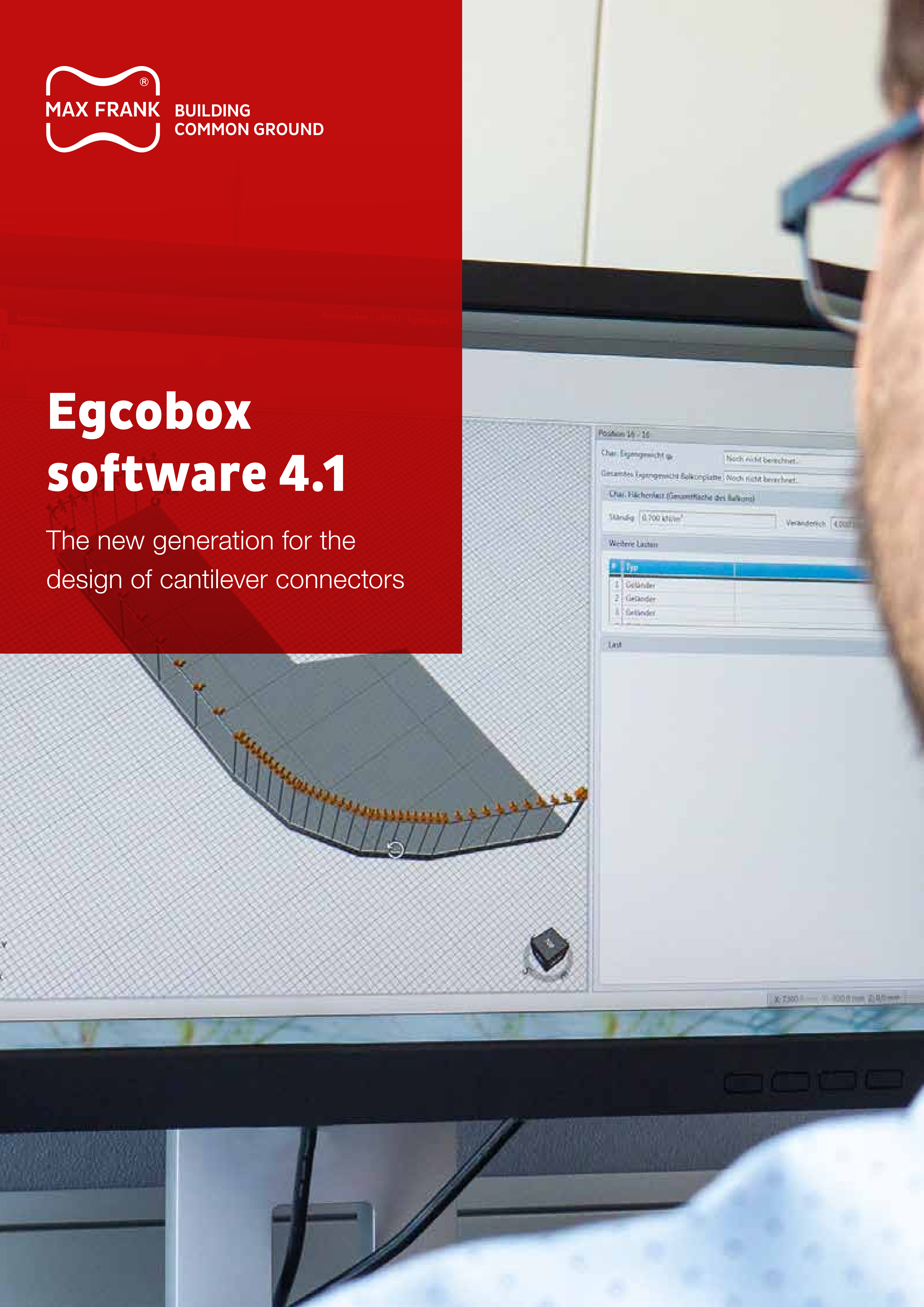
calculation: rotation of the slab in the area of the insulation joint (see page 12)

$\phi M_{available}$=	(8 ¾" * 159.15 pcf + 15.7 psf + 1/2 * 83.5 psf) / 1,000 * (7'-7 ¾")² * ½ + 0.048 kip/ft * 7'-7 ¾" **= 5.43 kip-ft/ft**	(0.22 m * 25 kN/m³ + 0.75 kN/m + ½ * 4.00 kN/m²) * (2.33 m)² * ½ + 0.7 kN/m * 2.33 m **= 24.0 kNm/m**
d=	5.43 kip-ft/ft * 1 / 1,484 kip-ft/rad/ft * 7'-7 ¾" **= $^{5}/_{16}$" (= 0.37%)**	24.0 kNm/m * 1 / 6,218 kNm/rad/m *1,000 * 2.33 m **= 9 mm (= 0.39%)**

MAX FRANK BUILDING COMMON GROUND

Egcobox software 4.1

The new generation for the design of cantilever connectors



Egcobox Software 4.1

The further developed Egcobox software in the new design makes it easier to design MAX FRANK cantilever connectors.

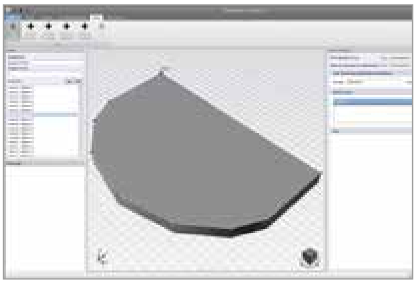
The design software impresses by means of intuitive use, a project management function and ability to customise the country-specific design principles and language.

What functions does the free Egcobox software offer you?

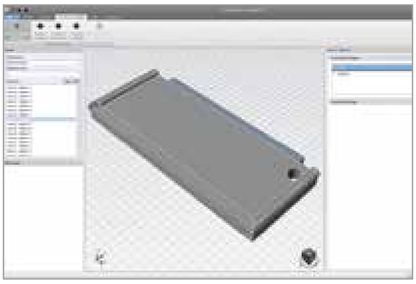
- Graphic 3D view of the input parameters
- Free input of the balcony geometry as well as the support situation and loads
- Accounting for upstands or recesses in the balcony slab
- Free input and positioning of railing, surface, linear and points loads
- Calculation and 3D visualisation of the support loads, deformations and Egcobox® cantilever connectors by means of the finite element method

Result output:

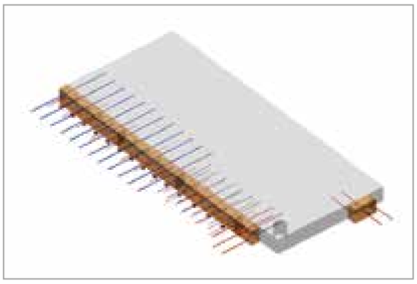
- Output as a short and long report, including cover page
- Output of parts or ordering lists
- 3D-DXF export of the necessary Egcobox® units as an installation plan



Free input and positioning of railing, surface, linear and points loads



Accounting for upstands or recesses in the balcony slab



3D-DXF export of the necessary Egcobox® units as an installation plan

Video tutorials for beginners and advanced users

Use the video tutorials about the Egcobox software on the MAX FRANK YouTube channel. Or take a look at our download page
www.maxfrank.com/egcobox-software

The Egcobox software is free to download!

Let the high performance of the software convince you and simplify your planning.
Free Download at www.maxfrank.com/egcobox-software

References

August-Kühne-Haus, Bremen, Germany

At the historic headquarters of the logistics company, Kühne + Nagel in Bremen, the new August-Kühne-Haus was built. For the precast elements of the supporting exposed concrete façade, the Egcobox® units impressed by excellently transferring the shear forces.

Photo: © Cube Visualisierungen

Citygate, Vienna, Austria

In the 21st district of Vienna, the Citygate residential and office building has been developed with an area of around 20,000 sqm. The thermally insulating Egcobox® cantilever connector copes with all the architectural requirements in the area of the building shell.

Photo: © www.maxfrank.com

Kings Crescent Estate, London, United Kingdom

In the Kings Crescent Estate property project, around 500 new apartments can be moved into. When it came to making the cantilevered components, reducing thermal bridges was critical to reduce condensation and thereby prevent mildew associated with this.

Photo: © Higgins Construction UK

Hotel Arka Medical Spa, Kolberg, Poland

For the modern luxury hotel, Arka Medical Spa in Kolberg, the Egcobox® cantilever connectors were installed for thermal separation purposes.

Photo: © www.fotek.eu

SKY residential and office building, Bietigheim-Bissingen, Germany

For the thermal separation of the balcony slabs, over 1,650 Egcobox® thermally insulating cantilever connectors have been installed in the SKY construction project. The requirements for the variable cantilever lengths of the surrounding balconies were able to be ideally fulfilled.

Photo: © Bietigheimer Wohnbau GmbH

Neuer Kanzlerplatz, Bonn, Germany

On the plot of the former “Bonn Center”, the client constructed three new buildings for modern office solutions. Two buildings are made with a load-bearing outer support design. For optimal transmission of the shear forces, the load-bearing precast concrete elements were connected to the internal component with the Egcobox® thermal separation element.

Photo: © www.bwe-bau.de

Schwabenlandtower, Fellbach, Germany

For the highest residential building in Baden-Württemberg, particular attention was paid to the thermal separation of the balconies. The shape of the building, the geometries of the storeys as well as the structural requirements were able to be implemented with a detailed project solution using Egcobox® elements.

Photo: © Silesia711 (https://commons.wikimedia.org)

Oberfinanzdirektion, Münster, Germany

1,500 Egcobox® cantilever connectors were used in the new tax office headquarters to thermally decouple the reinforced concrete floor slab from the load-bearing external facade.

Photo: © Espendiller + Gnegel

Mahatma Gandhi House, London, United Kingdom

The Mahatma Gandhi House is situated on Wembley Hill Road close to Wembley Stadium and comprises multi-storey residential buildings. For this project, a wide variety of the Egcobox® elements were supplied on the 2nd to 20th floors. Special individual units were also produced for the construction project.

Photo: © parmarbrook.com

No. 12, Kristianstad, Sweden

The residential building with 12 storeys has a total of 76 apartments. No. 12 has been awarded the Nordic eco-label and meets the requirements in terms of materials, construction processes and utilisation phase. The thermally insulating Egcobox® cantilever connector was used in the numerous balconies.

Photo: © www.kanozi.se

We are here for you!

Our aim is to support you through every phase of your project - from planning through to completion.
Find your local contact at:

www.maxfrank.com/contact

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