CPC TECHNOLOGY.

WINNER OF THE:

bauma Innovation Award 2022

CARBON PRESTRESSED CONCRETE

HOLCIM

CPC CONCRETE ELEMENTS. FILIGREE AND STRONG.

CPC concrete elements are robust and light, but very strong. They are easy to install, ecological and durable.

CPC TECHNOLOGY

CARBON PRESTRESSED CONCRETE - THE NEW CONCRETE SOLUTION

CPC concrete panels are based on the „carbon prestressed concrete“ technology, developed in a long-term research project at the Zurich University of Applied Science (ZHAW) and Silidur AG in Switzerland. The technology has been brought to market in the meantime, Andelfingen, Switzerland and has been brought to market in the meantime. Numerous reference projects have already demonstrated the performance and sustainability of the solution.

Since November 2021, the CPC concrete panels have a general technical approval (abZ) by the German Institute for Building Technology (DIBt): abZ Nr. Z-71.3-42. The approval includes a complete structural design methodology for the CPC panels. This means that various structural components, such as stair treads, decking, balcony slabs and exterior wall cladding, can be individually designed. Also modular bridges can easily be built in a resource saving way with CPC panels.

Areas of application

The filigree yet high load bearing panels are suitable for many applications in construction and landscaping. Numerous building products can be realized with CPC panels:

- pedestrian and bicycle bridges
- bridge decks
- balcony slabs
- stairs
- floor slabs
- facade elements
- concrete furniture

In combination with other innovative approaches such as translucent concrete, a variety of approaches are conceivable. Please contact us to discuss your ideas.


Allgemeine bauaufsichtliche Zulassung/ Allgemeine Bauartgenehmigung

Nummer: Z-71.3-42

Antragsteller: Richard Stadel AG Grundstraße 4 8602 ANDELFINGEN SCHWEIZ

Geltungsdauer vom: 18. November 2021 bis: 18. November 2026

Gegenstand dieser Bescheides: Carbonbewehrte, vorgespannte CPC-Platten aus Vergussbeton

Der oben genannte Regelungsgegenstand wird hiermit allgemein bauaufsichtlich zugelassen/genehmigt. Dieser Bescheid umfasst zehn Seiten und drei Anlagen mit 16 Seiten.

DIBt

NOW NEW
with general building authority approval

Link to download the complete approval:

PLANNING GUIDE ACCORDING DIBT APPROVAL FOR GERMANY

The following examples are in accordance with the valid DIBt approval no. Z-71.3-42 for Germany. This approval allows the use of the CPC elements for structural applications subject to predominant shear and bending loads, such as stair treads, decking, balcony slabs and exterior wall cladding. For applications outside of Germany, the local approvals and building code requirements need to be observed.

The components may only be exposed to static and quasi-static loads in accordance with DIN EN 1990:2010-12, 1.5.3.11 and 1.5.3.13 in the sense of predominantly static actions in accordance with DIN EN 1992-1-1/NA:2013-04, NA 1.5.2.6. The elements may be used indoors and outdoors in exposure classes X0, XC1 to XC4 and XF4 according to DIN EN 1992-1-1/NA, NCI Section 4.2, Table 4.1. Components whose failure endangers the stability of the main load-bearing structure (primary structure) - such as load-bearing walls, components with predominant panel loading - and components subject to fire resistance requirements are not covered by the approval. CPC elements must have a thicknesses of at least 20 mm and less than 70 mm.

The CPC elements are reinforced with endless carbon rovings. The carbon rovings are fully stretched and arranged orthogonally across the entire slab with a constant reinforcement content per direction. The spacing of the carbon rovings in one layer is 15 mm on average. The center distance of the outer carbon roving to the outer edge is ≥ 5 mm. The prestressing of the carbon rovings is constant per direction. The prestressing per direction is 2000 MPa (+/-5 %).

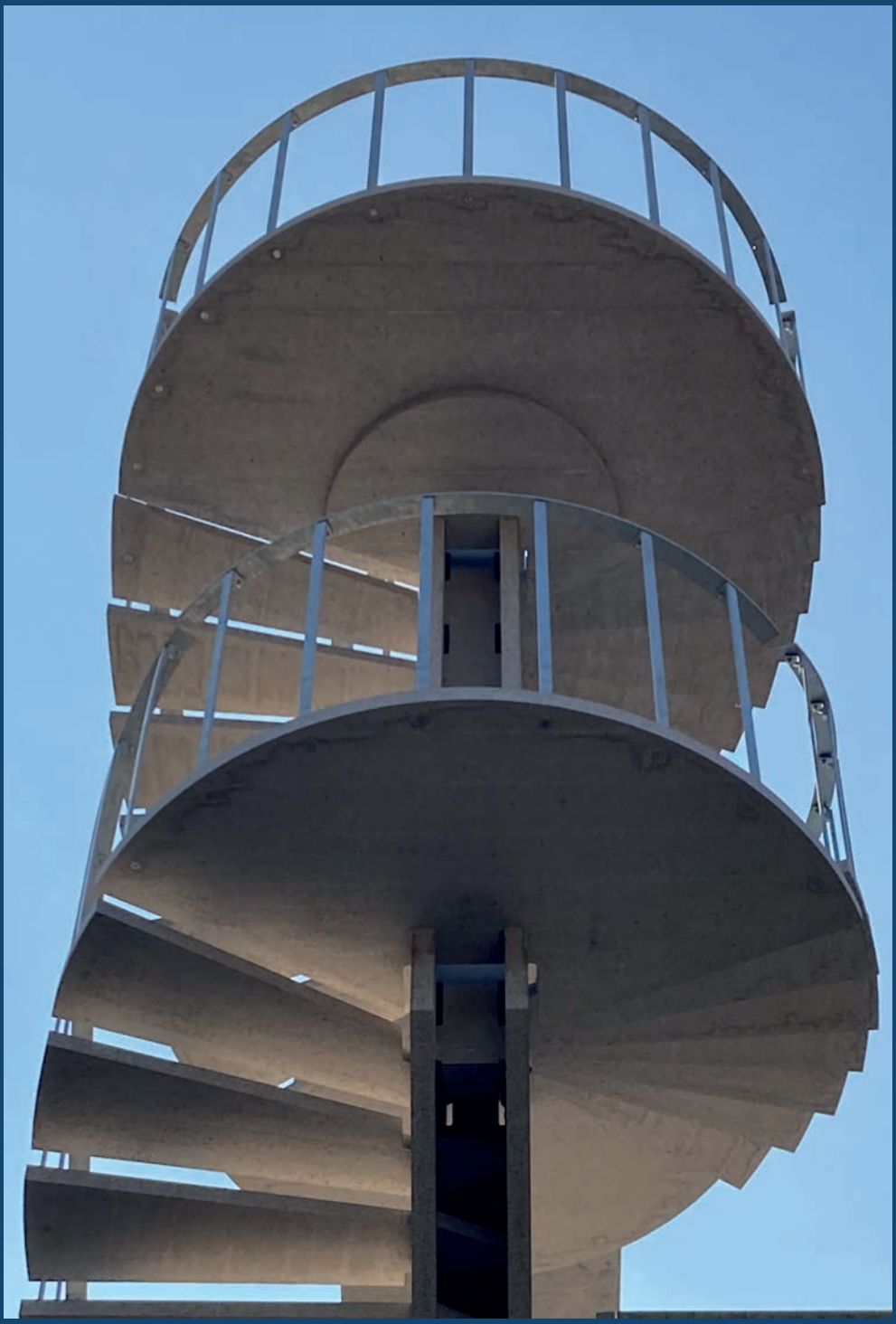
With regard to fire behavior, the large CPC panels meet at least the requirements of building materials class B2 according to DIN 4102-1.

The structural proof for the load-bearing capacity of the CPC elements must be provided in each individual case. The dimensions of the CPC elements and the location of the reinforcement must correspond to the structural design and design drawings.

The following minimum dimensions must be observed for CPC panels: min. length: ≥ 0.40 m min. width: ≥ 0.15 m thickness: ≥ 20 mm and < 70 mm. When producing surface profiling, the specifications of the manufacturer of the CPC panels must be observed.

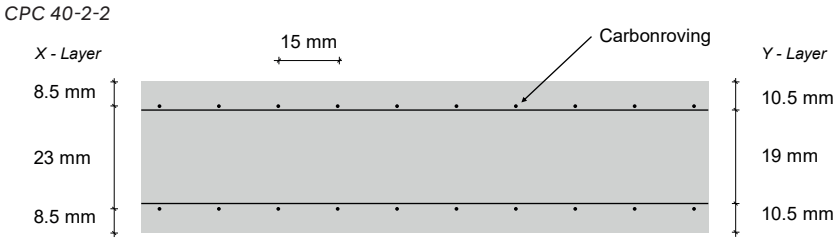
Components using CPC elements must be designed in accordance with local building regulations. The maximum dimension of a CPC element is 3,5m x 17,0m (oversize transport). The CPC elements may be used for predominant shear force and bending loads - such as stair treads, decking, balcony slabs and exterior wall cladding. The CPC elements may only be used on linear supports. Contact corrosion must be avoided. Point-supporting of the CPC elements is not covered by the DIBt approval for Germany.

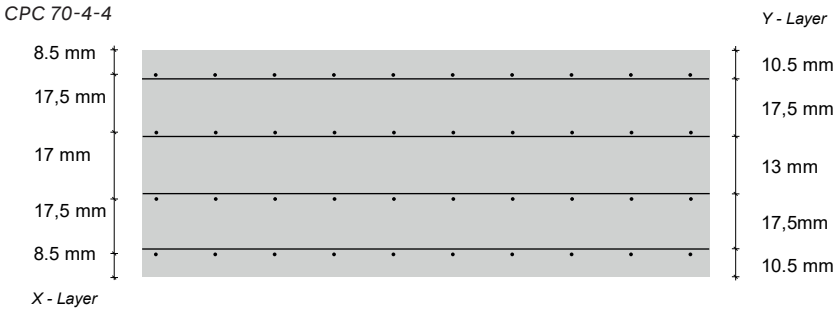
Note: All calculations in this brochure are based on the design values stated in the approval and apply only to Germany.

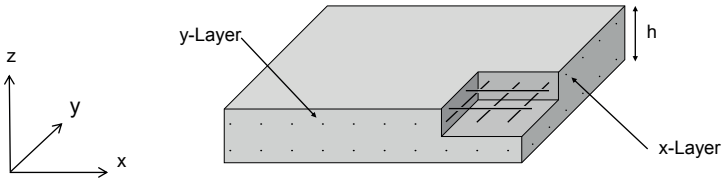


STRUCTURE OF THE CPC PANELS

The height of the carbon rovings is relevant for the structural safety verification of the bending load. To be on the safe side, the design value for bending resistance was calculated with the rovings of the transverse layer (smaller effective depth).







Panel naming convention

From the panel name one can see the panel thickness and number of reinforcement layers in x and y direction.

Example: CPC 40 – 2 – 2

- Number of reinforcement layers in y-direction
- Number of reinforcement layers in x-direction
- Plate thickness [mm]

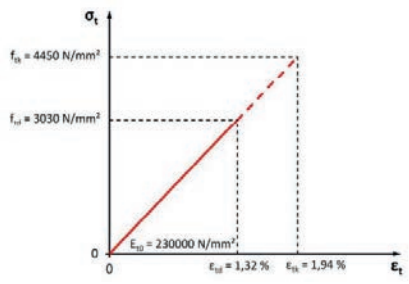
MATERIAL PARAMETERS

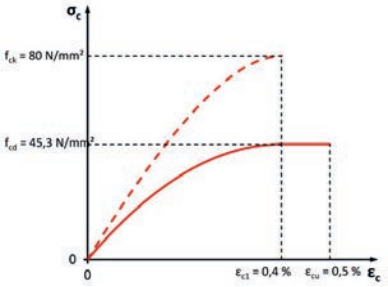
Carbon reinforcement

d_t	=	1	mm	Diameter of a roving
A_t	=	0.445	mm^2	Net carbon area of a roving
f_{tk}	=	4.450	N/mm^2	Characteristic tensile strength of the roving
E_{t0m}	=	230.000	N/mm^2	Modulus of elasticity of the roving
γ_t	=	1,25	-	Partial safety factor
α_t	=	0,85	-	Coefficient for consideration of long-term effects
$f_{td,100a}$	=	3.030	N/mm^2	Design value of the tensile strength of the roving
ε_{tk0}	=	1,94	%	Characteristic elongation of a roving
ε_{td}	=	1,32	%	Elongation when reaching the design value of the roving
σ_{p0m}	=	2.000	N/mm^2	Stress in the roving at time t=0 after the prestressing force has been released
$\sigma_{p0,fav}$	=	1.800	N/mm^2	Prestressing force, acting favorably taking into account the long-term losses
$\sigma_{p0,unfav}$	=	2.100	N/mm^2	Prestressing force, unfavorably acting taking into account long-term losses

Casting Concrete

f_{ck}	=	80	N/mm^2	Characteristic cylindrical compressive strength of concrete
f_{cd}	=	45,3	N/mm^2	Design value of concrete compressive strength
f_{ctm}	=	4,5	N/mm^2	Mean value of the centric concrete tensile strength
E_{c0m}	=	31.000	N/mm^2	Modulus of elasticity as tangent at origin of stress-strain line (concrete)
ε_{c1}	=	0,4	%	Strain at the maximum value of the concrete compressive stress
γ_c	=	1,5	-	Partial safety factor of the concrete
α_{ct}	=	0,85	-	Coefficient to take into account the long-term effects on the concrete
$f_{ctk,0.05}$	=	3,40	N/mm^2	5% fractiles of the characteristic concrete tensile strengtht
$f_{ctk,0.05;85\%}$	=	2,89	N/mm^2	85% of the 5% fractile of the characteristic concrete tensile strength





Abbreviations and terms

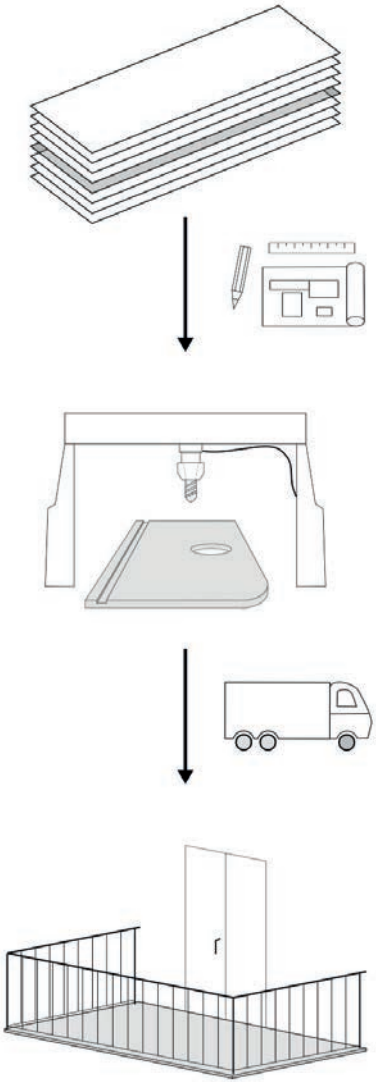
b_w	[mm]	Smallest cross section width
h	[mm]	Panel thickness
N	[-]	Number of reinforcement wires in main load-bearing direction
L	[-]	Number of reinforcement layers in main load-bearing direction
σ_{cp}	[N/mm^2]	Concrete compressive stress due to prestressing

DESIGN VALUES
GERMANY

	Panel type		CPC 40-2-2			CPC 70-4-4		
	Panel width cm		20-50	>50-100	>100	20-50	50-100	>100
Strength	Design values of the bending moment	[kNm/m]						
	Load combination							
	Structural safety	m_{Rd}*	2.40	2.56	2.60	8.00	8.65	8.67
	Rare load case	m_{cr}*	1.30	1.39	1.41	4.30	4.52	4.52
	Frequent load case	m*	not decisive					
	Permanent load case	m_{0d}*	0.64	0.68	0.69	2.17	2.39	2.39
	Design values of the shear force resistance	[N/mm²]						
	Perpendicular to the panel	$v_{zx,Rd} = v_{zy,Rd}$*	0.75	0.78	0.79	0.65	0.69	0.69
	In the panel level	$v_{xy,Rd}$*	2.40	2.56	2.60	2.86	3.06	3.10
	Design values of the normal forces	[N/mm²]						
	Pure tension	$n_{x,Rd} = n_{y,Rd}$*	4.05	4.31	4.38	5.76	6.13	6.24
	Pure compression	$n_{x,Rd} = n_{y,Rd}$*	42.50	42.31	42.26	42.00	41.75	41.69
	Concrete compression due to prestressing	σ_{cp}*	2.40	2.56	2.60	2.86	3.06	3.10
Stiffness	Design values of the modulus of elasticity	[N/mm²]						
	Cross section uncracked (for serviceability verifications allowed)	E_{cm}	31'000					
	Cross section cracked	E_{cm}	1860					
Density	Characteristic properties							
	Raw density	p_x [kg/m³]	2300					
	Weight	g [kg/m²]	100			150		

*The tabulated design values are on the safe side. For exact calculation see Chap. 3 and 4 of the general building approval.

ORDER PROCESS



Large CPC panels

CPC panels are manufactured in large sizes and are available from stock in various thicknesses.

Data transfer

The CAD files of the desired components are transmitted by the customer to Vetra Betonfertigteilwerke GmbH.

Cutting

The panels are cut with a CNC machining center. Almost any shape is possible.

Delivery

The finished machined components are delivered just-in-time. Either to the customer or directly to the construction site.

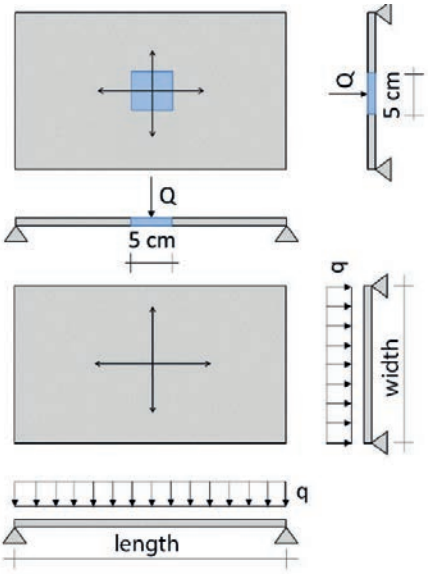
Finished component

The finished components can be assembled on site within a short time.

SUSTAINABLY INFORMED.

https://www.holcim.de/cpc

PLANNING CPC BALCONIES



Dimensions

The panels can have any shape. Maximum production size is: 17 m x 3.5 m / Minimum panel dimensions are 15 cm x 40 cm.

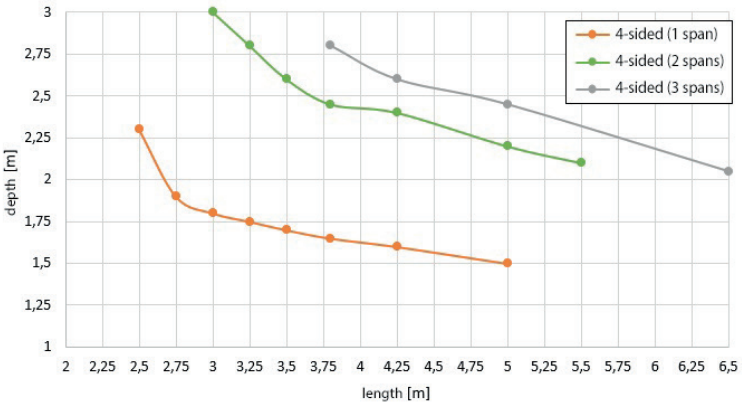
Cutouts

The following assumptions may be made for cutouts: 83 mm from the cut edge, the full tensile strength of the rovings is anchored.

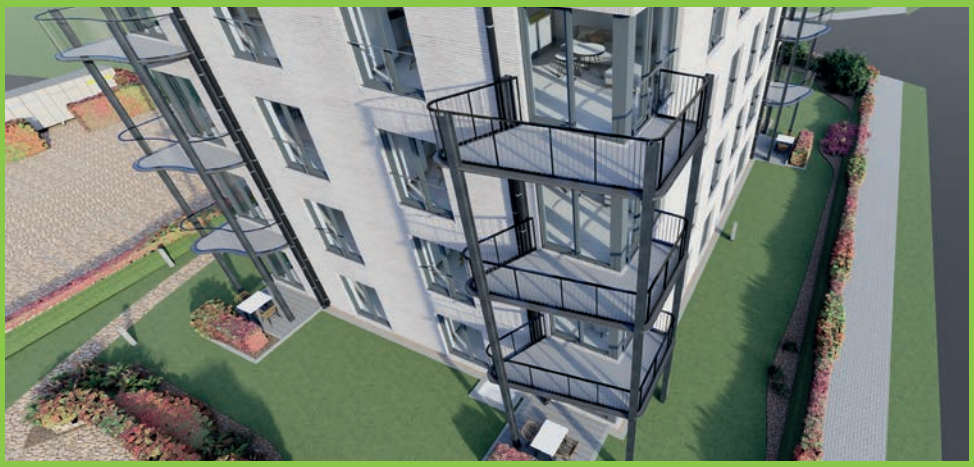
For larger cut-outs at the edge of the slab, the corresponding areas must be assumed to be non-load-bearing.

Balcony slab design aid*

- flat superimposed load
- supported on all sides (freely supported)
- panel thickness 40 mm
- q_k = 4 kN/m² • Q_k = 2 kN (5 cm x 5 cm)
- w ≤ l/350 (frequent load case)
- diagrams valid for design according to Eurocode

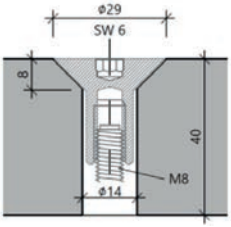


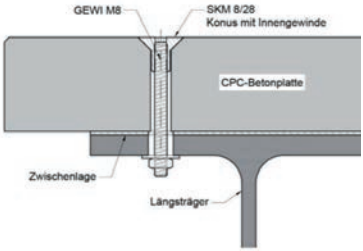
*The design aid represents a guideline and is not associated with any liability. The structural design must be adapted by a qualified planner according to the object-specific requirements and conditions and checked for suitability.

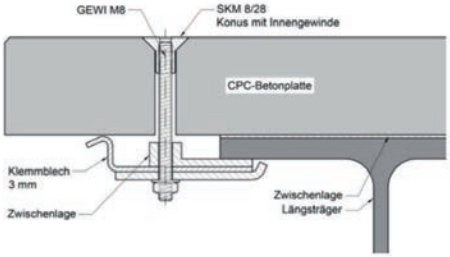


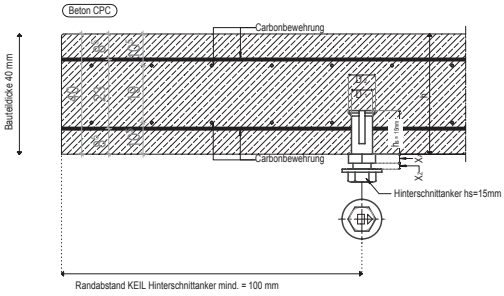
With the Holcim online tool, you can configure your desired balcony in just a few steps:

DETAIL SOLUTIONS









[1] The specified value was verified by tests.

Fastening with the SKM countersunk nut

The SKM 8/28 countersunk nut made of stainless steel (V2A / 1.4301) can be screwed onto any M8 thread - whether screw or threaded steel. The nut is highly corrosion resistant, durable like the CPC plates and is used for the force-locking connection of CPC panels with various materials.

Technical details

- Maximum permissible tractive force: N_{Rd} = 15 kN [1]
- Minimum edge distance: 55 mm
- Recommended steel quality of the counterpart (threaded rod/screw) used by the customer: V2A / 1.4301
- Loctite is recommended to secure the screw.

Application examples

- Joining of several CPC components
- Fastening to steel structures
- Fastening of handrails

Fastening with undercut anchor

A hole is drilled in the CPC panel on the underside. The KEIL undercut anchor is placed in the hole, which guarantees a form-fit and expansion free fastening. The undercut anchor consists of an anchor sleeve, a grub screw and a locking nut.

MAINTENANCE & CLEANING

The instructions listed here are intended as a maintenance aid for the CPC panels.

The CPC panels should be cleaned with warm soapy water and a scrubber several times a year. Before cleaning, always remove loose dirt residues with a broom first. Cleaning agents containing acids and chlorine should be avoided. Thorough rinsing must be carried out with clear water.

Sweep regularly

Leaves, for example, on the panel should be removed with a broom. The leaves contain tannic acids, which can cause brownish stains. These stains will disappear over time.

In general, post-treatment or sealing is not recommended without consulting Vetra Betonfertigteilwerke GmbH. Incorrect curing or sealing may cause damage to the panels. If sealing is carried out, the entire slab (top and bottom) must always be sealed.

It is recommended not to use electric brushes and high-pressure equipment for cleaning, as they can abrade and alter the surface.

The CPC panels should be protected from acid and grease. Acid and grease are absorbed by the panel and are visible over a longer period of time. Grease will work its way back out of the panel over time. If the panels come into contact with acid, this can lead to surface changes.

TRANSPORTATION & INSTALLATION

The CPC panels must be secured during transport and storage in such a way that no cracks occur in the concrete.

The CPC panels are to be stored on linear supports with a spacing of max. 1 meter until installation.

Transportation and installation is ideally done with a vacuum lifter. The type of vacuum lifter depends on the approval and manufacturer's specifications. The following applies in any case:

- Operation only by instructed personnel
- Only use the vacuum lifter as intended
- Observe operating instructions, dead weight and max. loads
- Wear personal protective equipment
- When the vacuum cup is switched on, hold the control unit away from the body, do not reach or look under the suction surface
- Lift loads vertically only, not at an angle or vertically
- Only use suitable load handling attachments with sufficient suction area
- Do not interfere with lifting and lowering movements with manual force
- Check components in advance for cleanliness and damage

Pat. Pend.

REFERENCES AND APPLICATIONS

Components using CPC elements must be designed in accordance with the local technical building regulations. If the installation position of the CPC elements cannot be determined and assigned with certainty because the marking is incomplete or does not correspond to the project details and requirements, the CPC element must not be installed. CPC elements that are damaged, cracked, chipped or deformed must not be installed. During assembly and installation work, it must be ensured that no cracks occur in the CPC dimension panels.

The installing company is responsible to comply with all the local regulations, certifications and documents prior to installing CPC elements. Installation must be carried out by qualified personnel certified by the manufacturer in accordance with the design specifications, the valid approvals and the manufacturer's processing specifications. Before starting and after completing the installation, the entire work must be inspected as part of quality assurance (checklist CPC elements).

BALCONY ELEMENTS

The low dead weight and filigree appearance make CPC panels particularly suitable for balcony slabs in renovations or new buildings.

Apartment building Bahnhofstrasse

Location: Linthal, Switzerland
Execution: Metallbauer Inoxx-Steel AG
Product: CPC 40-2-2 balcony panel
Dimension: 6.280 mm x 2.280 mm
Services: fabrication and delivery

Apartment house Saalsstrasse

Location: Winterthur, Switzerland
Execution: Blaser Metallbau AG
Product: CPC 40-2-2 balcony panel
Dimension: 3.078 mm x 1.728 mm
Services: fabrication and delivery

Apartment house Oberseenerstrasse

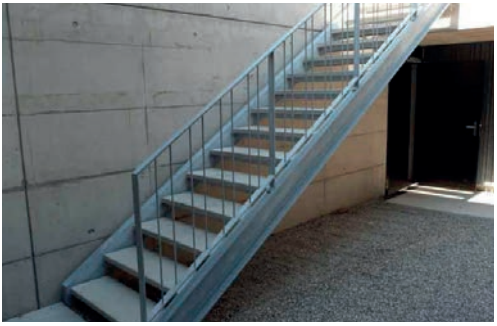
Location: Winterthur, Switzerland
Execution: R & G Metallbau AG
Product: CPC 24-2-2 balcony panel
Dimension: until 6.039mm x 1.080 mm
Services: fabrication and delivery

PAVING PANELS

Thanks to their weather resistance, CPC panels are suitable for outdoor paving solution.

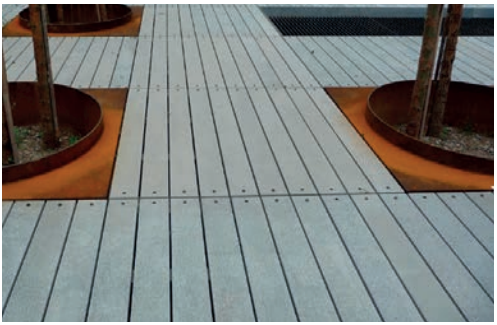
Footbridge Sihluferweg - Bridge decking

Location: Langnau am Albis, Switzerland
Building owner: Baudirektion (Construction Directorate) Kanton Zürich
Product: CPC 40-2-2 deck planks
Dimension: 3.000 mm x 380 mm
Services: support planning, detailed solutions, fabrication and delivery



Apartment house Strittackerstrasse - Stair coverings

Location: Winterthur, Switzerland
Planner: OMG Projekt AG
Product: CPC 40-2-2 staircase steps
Dimension: 1.160 mm x 300 mm
Services: detailed solutions, fabrication and delivery



Commercial building at Schiffbauplatz - Paving

Location: Zürich, Switzerland
Contractor: Spross Ga-La-Bau AG
Product: CPC 40-2-2 deck planks
Dimension: 1.490 mm x 140 mm
Services: fabrication and delivery

MODULAR BRIDGES

Thanks to the filigree design of the modular bridges, the flow profile is only minimally affected. Prefabrication also greatly reduces the installation time.

Bridge over Katzenbach

Location: Turbenthal, Switzerland
Building owner: Municipality Turbenthal
Product: CPC modular bridge Carbo
Dimension: 6.7 m length / 2.2 m width
Services: planning, detailed solutions, fabrication and delivery, monitoring and execution

Bridge over Dorfbach

Location: Zürich, Switzerland
Execution: Holzbau und Bauunternehmung Greil AG
Product: CPC modular bridge Optima, for agricultural vehicles
Services: planning, detailed solutions, fabrication and delivery

Eulachbrücke

Location: Winterthur, Switzerland
Execution: Silidur AG
Product: CPC modular bridge Robusta
Dimension: 7.82 m length / 2.37 m width
Services: planning, detailed solutions, fabrication and delivery

MODULAR BRIDGES

Thanks to the filigree design of the modular bridges, the flow profile is only minimally affected. Prefabrication also greatly reduces the installation time.

Modular Bridge Optima

The CPC-OPTIMA modular bridge system is a foot and bicycle bridge system. It is a trough bridge, which consists of a deck panel and two lateral webs. The webs and the bridge slab act as a structural system and are both made of CPC elements.

Steel cable suspension bridge Andelfingen, Switzerland

The condition of the steel cable suspension bridge in Andelfingen was deteriorating and finally had to be renovated. As part of the renovation, CPC elements were installed as bridge deck solution.

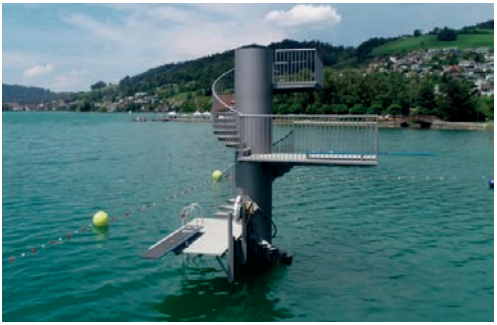
Photo Credit
Page 5: AdobeStock © bongkarn
Other: CPC AG, Holcim (Deutschland) GmbH

SPECIAL SOLUTIONS

There are nearly unlimited application possibilities with CPC panels. For special solutions, you can contact our team (see contact details on back page).

Bike parking Veloparking Schulhaus

Location: Neukirch - Egnach, Switzerland
Execution: Strabag AG
Product: CPC 40-2-2 panels, brushed surface, underside view
Services: detailed solutions, fabrication and delivery



Diving tower Ägeribad - staircase coverings

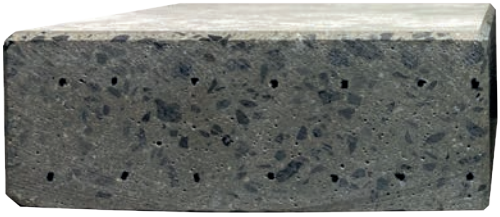
Location: Oberägeri, Switzerland
Execution: Metallbauer Gysi AG
Product: CPC 24-2-2 step treads, rounded, conical CPC 40-2-2 platforms
Services: detailed solutions, fabrication and delivery

Control tower

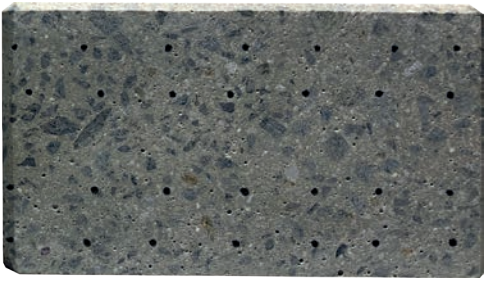
Location: Hüntwangen, Switzerland
Execution: CPC AG
Building owner: Holcim Schweiz AG
Product: complete tower in CPC construction, CPC 60-4-4
Services: detailed solutions, fabrication and delivery, monitoring and execution

ITEM OVERVIEW

CPC elements



Item CPC040
CPC element 40-2-2
Thickness: 40 mm
Weight: 100 kg/m²



Item CPC070
CPC element 70-4-4
Thickness: 69 mm
Weight: 150 kg/m²

Edge treatment

Item CPC100
Edge treatment
3mm chamfer on one side

Item CPC102
Edge treatment
eased, standard

Item CPC101
Edge treatment
3mm chamfer on both sides

Surface treatment

Item CPC111
Surface treatment
grey smooth formwork side in R11

Item CPC110
Surface treatment
grey brushed, R12

Item CPC112
Surface treatment
grey calibrated/ milled in R13 with milling marks

Drill holes

Item CPC120
Hole >d14
not countersunk

Item CPC121
Hole >d14
countersunk

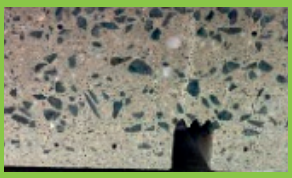
Item CPC122
Hole <d14 or >d40
not countersunk

Item CPC123
Hole <d14 or >d40
countersunk

Milling

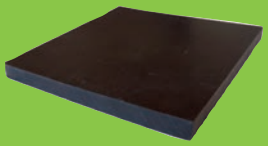
Item CPC150
Milling
individual cut-outs

Item CPC140
Milling
water channel



Item CPC130
Drip edge
max. 3,5m x 3,5m
max. 10cm from the edge

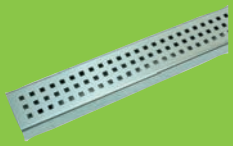
Accessories



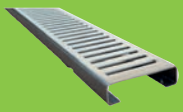
Item CPC150
Elastomer strip

Item CPC0006
Countersunk sleeve nut
SKM 8/28 (10 pieces)

Item CPC007
KEIL undercut anchor
KH type BH
anchor setting depth
hs=15,0mm incl.
grub screw, M6x35 A4
nut with locking teeth A4



Item CPC151
Stainless steel cover
Square perforation for
covering the water channel
20x40mm



Item CPC152
Stainless steel cover
Slot design for covering
the water channel
20x40mm

Holcim (Deutschland) GmbH
Troplowitzstraße 5
20529 Hamburg
www.holcim.de/cpc

Contact

Andreas Borgstädt
Business development precast concrete parts
Phone: +49 151 23876944
E-mail: andreas.borgstaedt@holcim.com

Stephan Ahlers
Internal sales
Phone: +49 5434 944089
E-mail: stephan.ahlers@holcim.com

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