

**Ultimate Performance –
Beyond Concrete**

**Winner of
architects darling award 2015**
Category "Best product innovation"



Product Segments

DUCON Architectural



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INTRODUCTION

DUCON®

= DUCtile CONcrete, UHPC with 3D micro-reinforcement (MicroMat®)
= innovative concrete technology with large spectrum of applications
(international patent, inventor Dr. Stephan Hauser)

Producer

DUCON Europe GmbH & Co. KG

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Applications

DUCON has a full spectrum of applications for the industry. They reach from concrete furniture over freeforms, facades, architectural prototypes, industrial flooring, rehabilitation and strengthening up to anti-terror concrete.

Advantages

Thin, light-weight, high load bearing capacity coupled with high-durability and long-term performance

Execution

Precast elements: Fabrication and delivery by DUCON Europe or by certified partner (e.g. precast factory)

In-situ-concrete: Supply of DUCON material and installation by team DUCON or by licensed installers

High-lights 2015

s. pt. 3 to 6

1. DUCON Technology

DUCON (Ductile CONcrete)

Micro-reinforced and self-compacting high-performance concrete. DUCON® stands for Ductile CONcrete and represents a micro-reinforced high-performance concrete. It is composed of a 3-dimensional micro-reinforcement and an ultra-high performance concrete. The special material set-up allows very slim construction at high load bearing capacity and high resistance against dynamic loading, such as explosion and earthquake. The minimum thickness is 12 mm (0.5").

The required performance is adjusted by variation in the material set-up (i.e. concrete mix, mesh layers and composition).



Fig. 1: Cross section of DUCON® (one variant), homogeneous distribution of micro-reinforcement

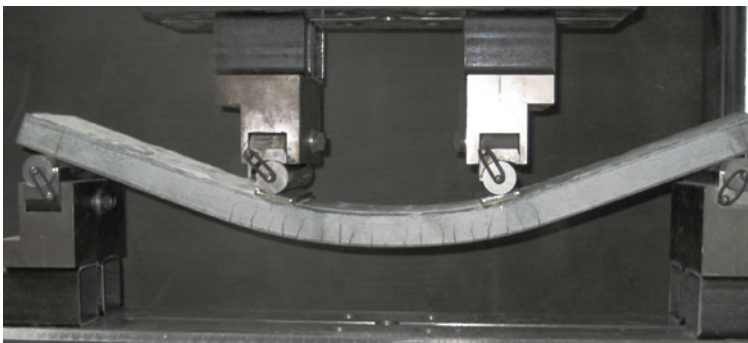


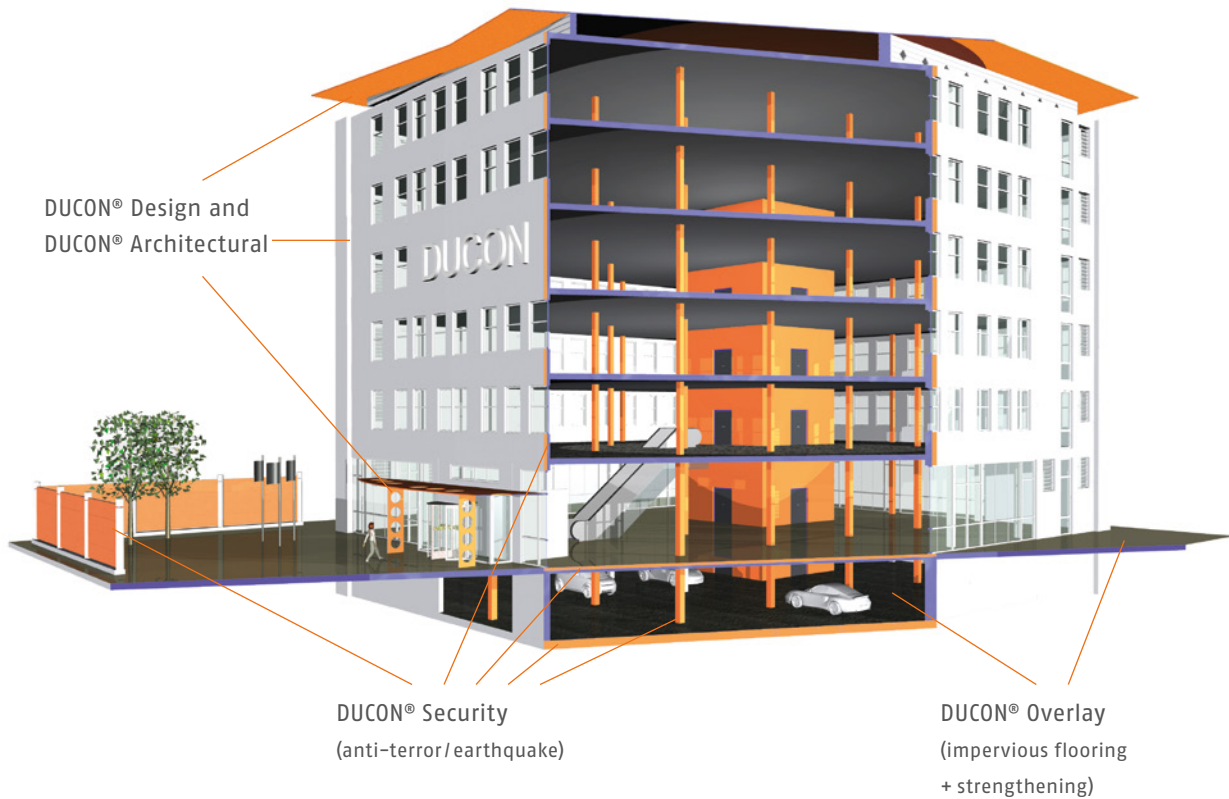
Fig. 2: High ductility (large deformation at high-strength)



Fig. 3: Slim elements ($d = 15 \text{ mm}$, 0.6")

2. APPLICATIONS AND TECHNICAL DATA

DUCON® – a multifunctional construction material with exceptional characteristics beyond standard reinforced concrete – allows tailor-made solutions for various applications and their performance requirements. The spectrum of applications of DUCON® reaches from concrete furniture over free-forms, facades, architectural prototypes, industrial flooring, rehabilitation and strengthening up to hardening of endangered facilities (anti-terror concrete).



Technical data:			
Compressive strength	90 – 180 MPa		13,000 – 26,000 psi
Flexural strength	16 – 75 MPa		2,300 – 11,000 psi
Tensile strength	9 – 20 MPa		1,300 – 2,900 psi
Shear strength	3 – 16 MPa		450 – 2,300 psi
Modulus of elasticity	> 40.000 MPa		5,800 ksi
Density	25 kN/m ³		150 lbs/ft ³
Thickness	> 10 mm		> 0.4"
Ductility	factor		> 6

Other Characteristics:		
Break-through resistance	RC6 at d=75 mm (3"), DIN EN 1627	
Bullet proof	7,62x51APHC,MH at d= 80 mm (3.2") DIN EN 1522	
Explosion resistance	>1,0 bar (14,5 psi) at d= 60 mm (2.4")	
Freeze-Thaw resistant	at d= 50 mm (2"), CDF-test	
Abrasion resistant	Class A3, Böhme-test, DIN EN 13813	
Crack control	<< 0,1mm (0.004")	
Water-tight	1,25 bar water pressure at 50 mm (2")	
Impervious overlays	at 55 mm (2.2"), WHG-LAU, e.g. chemical plants	

3. DUCON Architectural – architectural concrete

The slim DUCON –technology at high strength offers a free-form design in the architectural world.

- Membrane shells
- Thin and large scale façade and roof panels
- Special architectural elements (folded stairs, portals etc.)
- Design objects and furniture

Membrane shell DUCON–“Parapluie”



Fig. 4: “Parapluie” – ultra-thin roof panel, (d=30 mm, 1.2”)

TSUBOI Award 2013 Architects: schneider-schumacher, Engineering: Bollinger-Grohmann



Fig. 5: Membrane shell fixed eccentrically to column, column contains water evacuation



Fig. 6: Load bearing test on cantilever panel, 850 kg (1880 lbs)

DUCON – folded stairs

The folded stairs are free-span and are only supported at the bottom and top end of the element. The basis for the slim structure is that each fold has been executed as a static framework by a special set-up of the micro-reinforcement in order to be capable to transfer the loads without breaking.



Fig. 7: Free-span folded stair (d = 80mm, 3.2")



Fig. 8: Comparison of DUCON® with standard concrete stair



Fig. 9: Black folded stair system (d = 95 mm, 3.7")

Concrete furniture – design objects



Fig. 10: White Lounger (d = 20 mm, 0.8")



Fig. 11: Cantilever tables (d = 25 mm, 1.0")

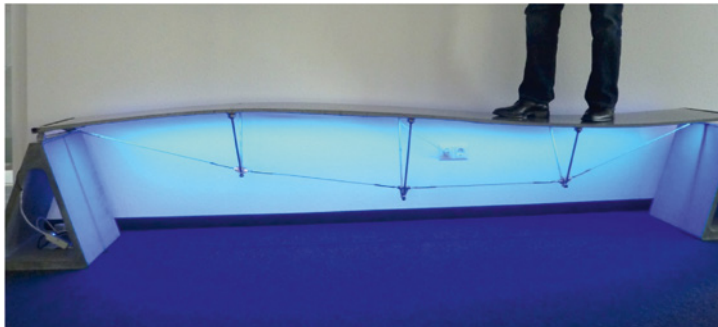


Fig. 12: Flexible bench (d = 15 mm, 0.6")
(see video on website www.ducon.eu/Ducon Technology)



Fig. 13: Bar, counter-tops (d = 25 mm, 1.0")



Fig. 14/15: "Möbius"-bench (d = 20 mm, 0.8" / l = 8 m, 27ft)
Winner Student Competition Campus 2015, Uni Kassel

References architectural concrete

The entrance of the shopping mall "Sevens" has been equipped with white architectural elements out of DUCON®. The DUCON® surface is honed and contains marble aggregate. The composition is like a 3D puzzle with up to 8 m (27ft) long and 70 mm (2.8") thin elements, which had to fit into the existing building structure. In addition the columns and pedestals have been cladded.



Fig. 16: Installation of ceiling panels with up-stands to cover the steel structure (l = 7,5 m, 25 ft / d = 70 mm, 2.8")



Fig. 17: Finished Entrance of "Sevens" (pict. RKW architects), all elements 50 – 70 mm thin

Liberty Park (World Trade Center, New York)

The new Liberty Park next to One World Trade Center is currently being equipped with DUCON-White elements, they include slim benches, planters and façade panels. The slim benches are cantilever pieces just fixed at the footing. The benches are lined up and form large planters. Each of the 3D bench pieces are one of a kind unique complex shapes with multiple angles and facets.

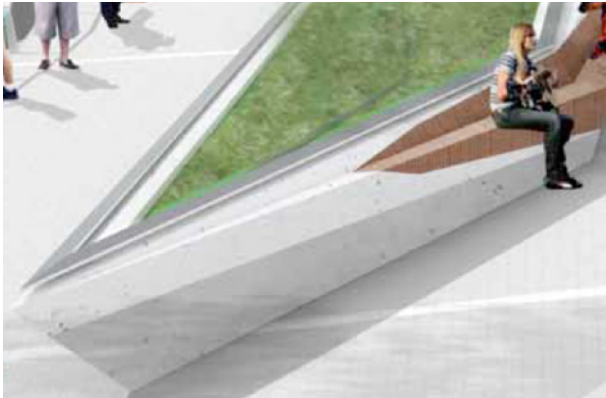


Fig. 18: Planter out of bench pieces (d = 50 mm, 2")



Fig. 19: Façade panels (d = 30 mm, 1.2")

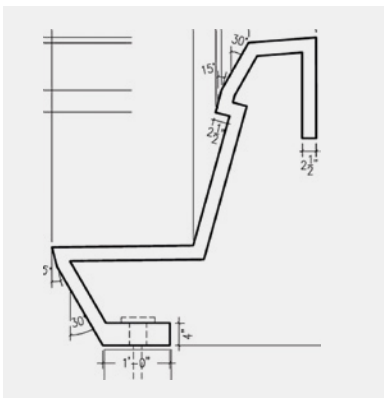


Fig. 20: Cross section of bench elements (d = 50-70 mm, 2"-2.8")

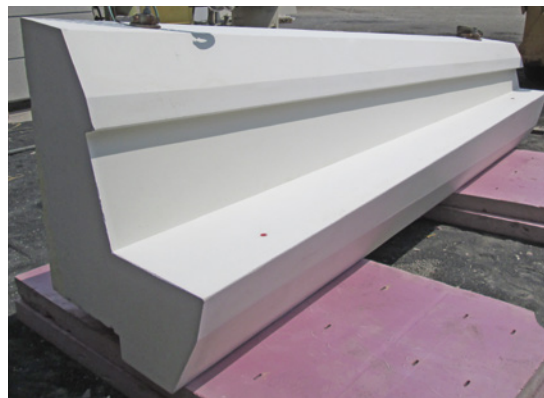


Fig. 21: DUCON-element with Styrofoam backfill



Fig. 22/23: Lined-up DUCON pieces as benches and large scale planters

4. DUCON Security – Explosion- and earthquake protection

Based on the combination of its high ductility at high strength, DUCON® offers the slimmest and most light-weight solution in concrete to protect endangered facilities and critical infrastructures. In addition no penetration and no fragment projectiles occur and at a thickness of 75 mm (2.8") is fulfils the highest requirement of breakthrough resistance RC6, highest ballistic protection of FB7 armor piercing bullets at 80 mm (3.2") as well as high explosion and impact resistance.

- Blast walls
- Blast walls
- Column retrofit
- Spall plates
- Containments



Fig. 24: Contact charge explosion test (Reinforced concrete on left, DUCON® on right), front



Fig. 25: Rear side of panels (DUCON® on left, Reinforced concrete on right)

References

- Execution of most sensible blast walls and spall protection at new World Trade Center site
- Perimeter Blast wall of German Embassy in Kabul

5. DUCON Overlay – Industrial flooring, impervious overlays, slab strengthening

- Impervious overlay (WHG-LAU, chemical and automotive plants)
- Slab strengthening of existing structures
- Industrial flooring, heavily loaded

High-performance flooring, $d = 3\text{--}6\text{ cm}$, 1.2"–2.4", joint-less up to 11.000 m² (118,000 sf)



Fig. 26: DUCON-slurry infiltration into MicroMats®



Fig. 27: DUCON® joint-less ($d = 30\text{ mm}$, 1.2")

6. Current project: DUCON® as energy facade

Project: ETA-Fabrik, energy efficient factory, campus at University of technology Darmstadt
www.eta-fabrik.de

- Activated building envelope out of DUCON® (1.600 m², 27,000 sf)
- Energy harvesting by heat production + cooling function

DUCON® façade and roof panels equipped with mini tube systems, which are filled with water, for

- a) Gain warm water by solar heat
- b) Cooling down of warm water produced by the factory process from inside, DUCON envelope is integrated into the cooling process of the production

Large scale and thin panels: length up to 11m (36ft) thickness d = 55 mm (2.2")

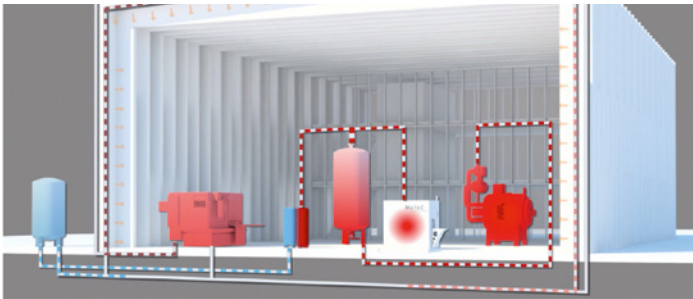


Fig. 28: Integration of DUCON building envelope into cooling and heating process of factory

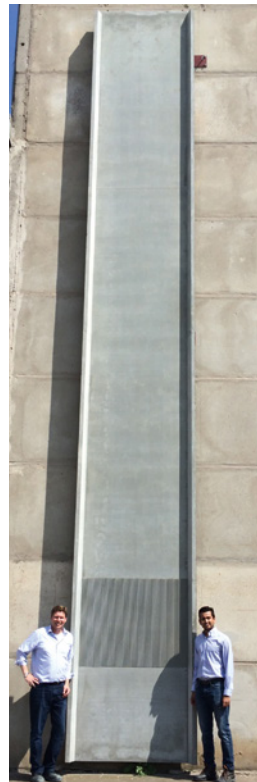


Fig. 29: Mockup-panel,
 l = 11m, 36 ft / d = 55 mm,
 2.2"

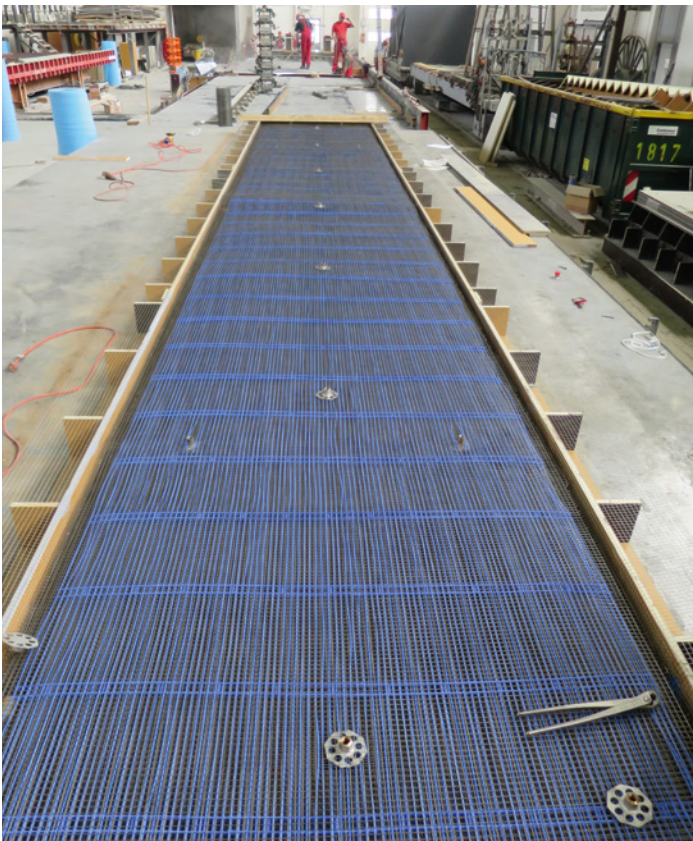


Fig. 30: Integration of mini tube system into DUCON® panel, patent

Project: ETA-Fabrik



Fig. 31: Site-installation of façade and roof panels



Fig. 32: Installed façade (h=10,6 m, 35 ft / l=42 m, 140 ft)

Project: ETA-Fabrik



Fig. 33: Overview ETA-Fabrik



Fig. 34: Activated and load bearing roof panels
(h = 10,6 m, 35 ft / l = 42 m, 140 ft)

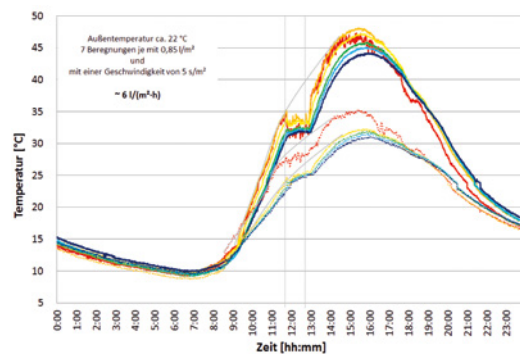
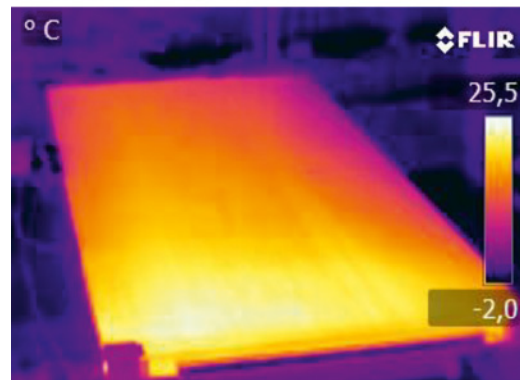
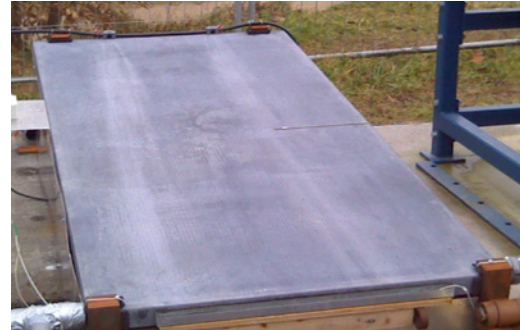
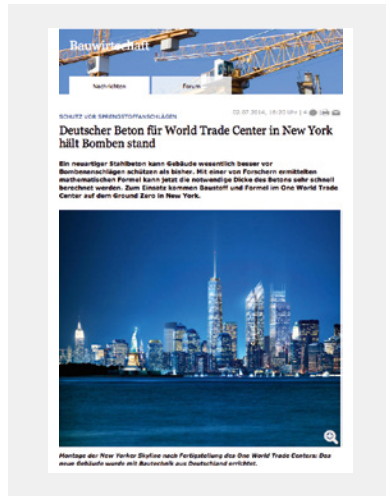


Fig. 35-37: Heat development and energy harvesting in DUCON panel

7. PUBLICATIONS 2014/2015 (GERMANY, extract)



Dachschale Parapluie



DUCON als Sicherheitsbeton beim WTC



„Haus im Weinberg“



Architektur+Sicherheitsbeton WTC



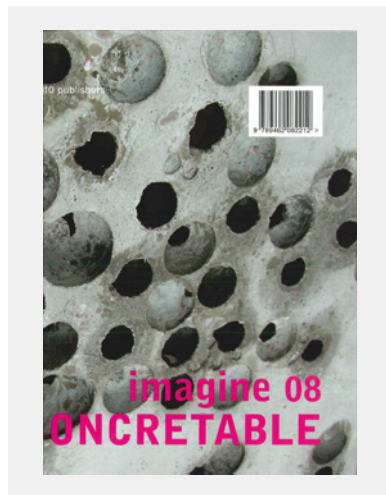
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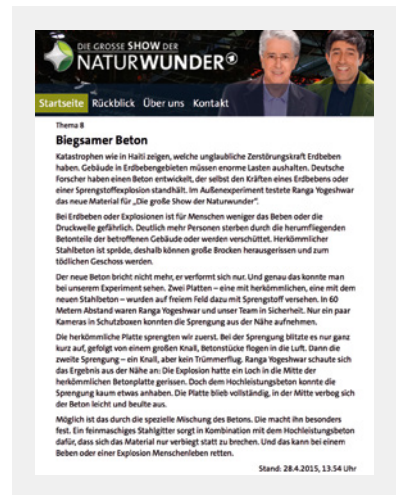
Dünner berechenbarer Beton



Möbiusbank 1. Preis



Fassaden, Dachschalen, Treppen



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