



Ductal[®]

INNOVATIVE
ARCHITECTURAL
SOLUTIONS

2018
2019



A technology of
LafargeHolcim

www.ductal.com

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INNOVATION STRATEGY BASED ON CUSTOMER-DRIVEN RESEARCH AND DEVELOPMENT

Research & Development The key to innovation

Our capacity for innovation stems from extensive R&D activities at LafargeHolcim's Research & Development Center in Lyon, France.

Successful innovations are the result of solid technical expertise, ranging from materials science to civil engineering, with a capacity for modeling and experimentation under real conditions. Our innovation strategy is also based on an important international network of academic and industrial partners.

LafargeHolcim's collection of patented families is steadily growing as a result of these R&D efforts, resulting in the largest, most diversified range of innovative, quality products and solutions for the cement and concrete industry.

For the past 20 years, the R&D Center, together with its research and industrial partners, has collaborated on a patented family of ultra-high performance concrete (UHPC) solutions known as Ductal®.

To build innovative, sustainable structures for the future, you need an innovative material, and Ductal® delivers with a unique combination of properties including strength, durability, ductility, and aesthetics - with unprecedented design flexibility.



200 engineers and technicians



20 nationalities



270 active patent families



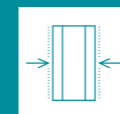
2,000 granted, national patents or patent applications.

Discover *Ductal*®

Ductal® is an Ultra-High Performance Concrete (UHPC) blended with fibers, resulting in an optimized microstructure with an extremely low water/cement ratio.

With superior properties including durability, ductility and aesthetics, our innovative Ductal® products may be used in a vast range of architectural and structural creations.

Mechanical performances



Compressive Strength
100 to 200 MPa



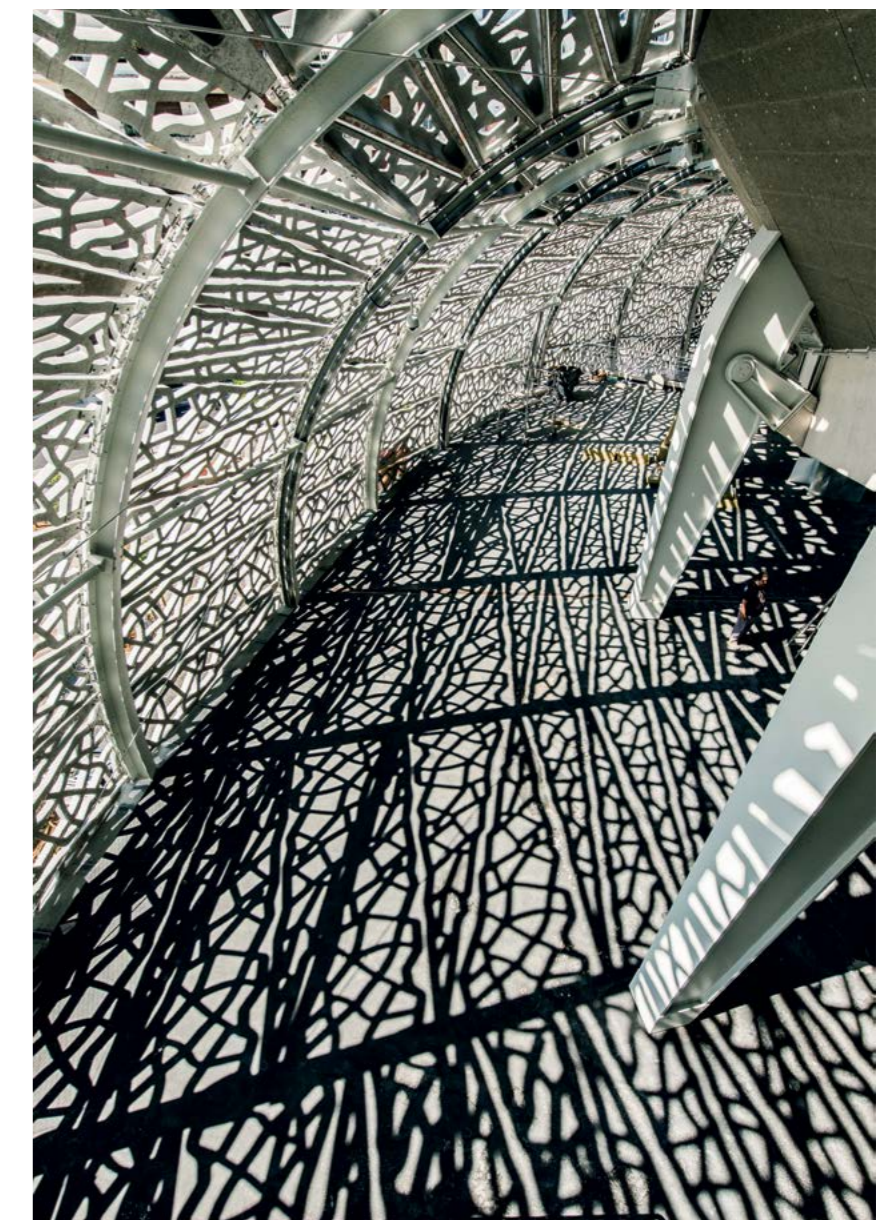
Flexural Strength
10 to 30 MPa



Superior durability:
High to very high



Superior durability:
High to very high





1

Perforated

facades

Ductal® combines technical performance
with architectural creativity

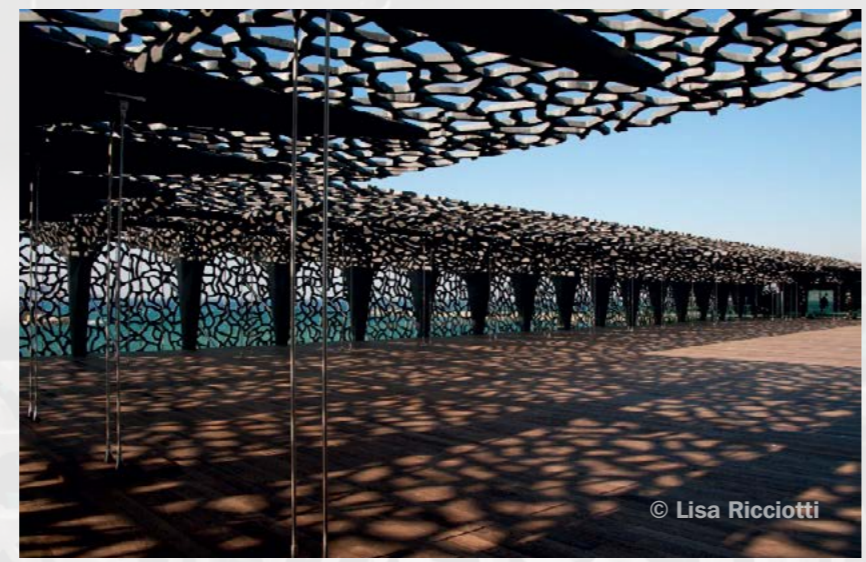
**"PRESTRESSED DUCTAL® COLUMNS WERE INSTALLED VERTICALLY WITH ONLY MILLIMETERS OF DEVIATION"
PATRICK MAZZACANE AND ROMAIN RICCIOTTI**

MuCEM

Designed by architect Rudy Ricciotti, a great ambassador for concrete, the magnificent "MuCEM" is an avant-garde creation that required several technical feats, made possible with Ductal® ultra-high performance concrete.

A concrete place for culture and sharing!

On the waterfront of the Old Port in Marseille, France, architect Rudy Ricciotti has designed an exceptional building called "MuCEM", the first museum in the world dedicated to European and Mediterranean Civilizations. MuCEM creates a dialogue between the two shores of the Mediterranean Sea and opens new horizons to residents of the city. Ricciotti explains, "With the MuCEM, I wanted a place of leisure and culture, a popular museum offering a different kind of trip around the Mediterranean Sea."



© Lisa Ricciotti

Ductal® at the heart of architectural creation

Many unique Ductal® elements used to create this remarkable structure are considered a "world first". For instance; it was the first to feature prestressed Ductal® columns. Another novelty is the flooring, which was prefabricated, then laid on scaffolding and bound with the columns. The result: visitors can enjoy large column-free spaces in which to admire in which to admire the artworks.



.....
ACI Excellence Award 2015

- Location: France**
- Architect: Rudy Ricciotti**
- Precaster: Bonna Sabla**

..... **15,000 m²**
building

..... **135 m**
length of the footbridge linking MuCEM to Fort Saint-Jean

..... **384**
384 Ductal® lattice panels

..... **308**
structural arboresque style columns

© Lisa Ricciotti

Aga Khan Center

Pritzker Prize-winner Fumihiko Maki has completed an educational center with a series of roof spaces, terraces and courtyards for the Aga Khan Foundation in London. The project was recently completed with the use of Ductal®.

Combining pure utilitarian use of natural sun-shades and inspiration from Arabic communities around the world, this original lattice design brings tasteful cultural reference within the garden's spaces on roofs, terraces and courtyards inside the educational center. Also, Ductal® has just completed the refined lattice works of the "Garden of Light". Such refined patterns were achieved following careful structural analysis of white Ductal® stainless steel precast panels.



- Location: England
- Architect: Fumihiko Maki
- Precaster: Thorp

FIRST LINK OF MOROCCO'S HIGH-SPEED RAIL

Kenitra Train Station

Ductal® adorns the new train station in Kenitra, one of the strategic points of Morocco's high-speed rail route between Tangiers and Kenitra, and a new symbol of economic development in the country.

This station forms part of the first link of Morocco's high-speed rail line project which aims to provide the country with 1,500 km of high-speed rail lines by 2030.

An innovative, durable design was required for the facade and the Moroccan architect Omar Kobbité, partner in the Italian firm Silvio Dascia, accepted the challenge by using Ductal®.

The building's facade measures 6,225 m² and is made from approximately 4,175 3D Ductal® panels, triangular in shape and white on both sides. Measuring 1.37 m wide by 1.18 m high, and between 1.5 cm (in height) and 2 cm thick (for greater resistance at ground level), the monolithic panels are composed of a flat plane, the exterior surface and a vertical return which allowed inserts and attachments to be installed in order to attach the panels to the building's metallic structure. All wood and glass parts were assembled on-site once the panels were installed.

- Location: Morocco
- Architect: Omar Kobitté
- Precaster: Be Arch

4,175
3D triangular Ductal® panels

PUCCI DE ROSSI CALLIGRAPHY BLENDS SUBTLY WITH THE MONOGRAM

Le Vérone Vente-privée.com

The building is visible from A1 highway, opposite the Stade de France, on the outskirts of Paris. The exposure is significant; every day nearly 45,000 cars drive by the remarkable, airy Ductal® lacework which subtly incorporates Pucci de Rossi's calligraphy of the company's monogram: vente-privée.com

Each Ductal® lattice panel is reinforced with stainless steel fibers and measures a standard length of 4 m with a thickness of 10 cm. The cross section of the web is flat on the back but rounded in the front in order to soften the light that passes through the designer's lattice concept.

3,900 m²
of Ductal® façade

- Location: France
- Architect: Willmotte
- Precaster: Méditerranée Préfabrication

Shum Yip UpperHills Loft

The Shum Yip UpperHills Loft, an Urbanus project, is a high-end commercial complex in Shenzhen, China, with 6 high-rise towers containing offices, hotels and business apartments.

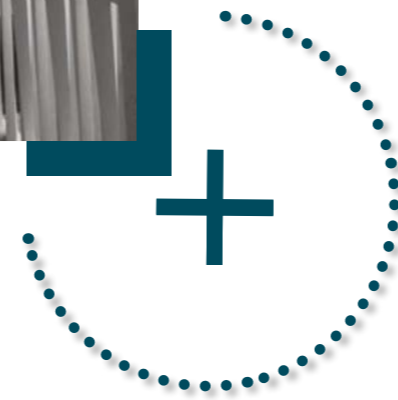
Considering the fluctuating climatic impacts in this coastal city, the project demanded a high-quality, extremely durable solution.

The facade panel required finishing on both sides. Ductal® has very good fluidity, which allows it to be cast in a closed mould and achieve a high-quality surface finish. Designed as a grill, with 50% perforation ratio and panel frame of 20 mm thick. By comparison to a traditional concrete or a GFRC solution, Ductal® easily achieved the desired perforated ratio, with no need for rebar, prestressing for reinforcement.



- Location: China
- Architect: Urbanus
- Precaster: Egrow

..... **13,400 m²**
of white Ductal®



Casa Japão

Situated in the middle of Paulista Avenue, in São Paulo, Brazil, one of the most important and iconic avenues in the country, "Japan House" is a tribute to Japanese culture. Built by the Japanese government, it was designed by the renowned Japanese architect Kengo Kuma, in partnership with the Brazilian architecture firm of FGMF Architects.

The building facade is a perfect combination of the Japanese millenary tradition with a Hinoki panel system constructed from centuries-old woods imported from Japan and a panel system inspired by the traditional Brazilian COBOGÓ, a technique of hollow concrete blocks that allows light to pass through. Thus, Kengo Kuma has successfully united the two cultures and materials to create a beautiful facade for Japan House.

The COBOGÓ panel system was made with Ductal®, covering a surface area of 116 m². The Ductal® panels are also in the lateral facade giving access to the main entrance of the building and composed of 220 overlapping pieces, measuring 70 cm x 80 cm, with two interlaced levels.

**UNITED THE TWO CULTURES
AND MATERIALS TO CREATE
A BEAUTIFUL FACADE
FOR JAPAN HOUSE.**



- Location: Brazil
- Architect: Kengo Kuma
- Precaster: Stone

Résidence Odalys Prestige Nakâra

This Ductal® facade measuring 3,833 m² plays a role in the unity of the residence; a reinterpretation of eastern mashrabiyas, it combines both large canopies and facades with small pergolas and fascias. Ensuring continuity between the interior and exterior, it serves as both a sun shade and privacy panel, whilst complying with low-energy building obligations.

From a technical point of view, this project is a complete success; the Ductal® lacework is so fine and the repetitiveness of production vastly improved. All of this contributes to an impressive visual effect that is in line with the architect's initial design.

- Location: France
- Architect: Jacques Ferrier
- Precaster: Bonna Sabla

..... **3,833 m²**
of white Ductal® lattices



2

Custom

Building Envelopes

A Ductal® solution for each type of project

A "MATHEMATICAL FIELD PUNCTUATED BY DASHES OF SHADOWS AND LIGHTS"

Marseillaise Tower

Architect Jean Nouvel designed the Marseillaise Tower as a "mathematical field punctuated by dashes of shadows and lights", colored in pastel tones. In other words; a self-supporting, colored, mineral facade with a repetitive grid.

From the earliest conceptual stages, Ductal® UHPC met the demand of a long-lasting, randomly colored monolithic facade element. Blue as the sky, white as the horizon and clouds, red as the color of bricks and roofs... the patriotic colors of the Marseillaise also reflect the surrounding landscape. The project, anchored in its immediate surroundings, stands in dramatic opposition to generic glazed curtain wall towers that offer no sense of scale or color.

From a technical standpoint, the facade envelope was required to be lightweight while ensuring full air and water tightness, thermal insulation, as well as solar control. It can also be used for building maintenance and fire partitioning in accordance with the regulations for high-rise towers. Given the proximity to the Mediterranean Sea, the facade also had to provide long-lasting resistance to saltwater spray.

ACI Excellence
Award 2018

- Location: France
- Architect: Jean Nouvel
- Precaster: Méditerranée Préfabrication



LEED Gold and HQE
Certified

135 m
high

39,560 m²
total developed area

2,100
tonnes of Ductal®

3,500
Ductal® solar shades



Fondation Louis Vuitton

The Fondation Louis Vuitton, a magical and enchanting building designed by Frank Gehry at the request of Bernard Arnault, President of the LVMH group, was inaugurated in October 2014 in the heart of the Bois de Boulogne in Paris.

The Canadian-American architect, Laureate of the Pritzker Architecture Prize in 1989, has designed a building swathed in an array of vast glass sails (large glass surfaces), consisting of concrete facades with geometric shapes as original as they are complex. Known as "Icebergs", these shapes were produced in Ductal®, using a unique manufacturing process that received an award from the French Fédération de l'Industrie du Béton.

- Location: France
- Architect: Frank Gehry
- Precaster: Bonna Sabla

A MASTERPIECE OF ARCHITECTURAL DESIGN THAT NECESSITATED SIX YEARS OF WORK



- 9,000 m² facade
- 19,000 Ductal® panels
- 25 mm Thick

Campus EDF

Built by the architecture firm Emmanuel Combarel Dominique Marrec Architectes (ecdm) in partnership with the LafargeHolcim Group, the EDF campus is distinguished by the remarkable size of its audacious façades. This technical feat was achieved through the innovative use of sprayed Ductal®, a new formula and application process that was made possible with our partner Betsinor.

26,000 m² floor surface

12,000 m² facade, including

4,000 m² sprayed Ductal®

- Location: France
- Architect: Emmanuel Combarel Dominique Marrec Architectes (ecdm)
- Precaster: Betsinor



Jean Bouin Stadium

Jean-Bouin Stadium, designed by the architect Rudy Ricciotti, is covered by an asymmetric, curving envelope made from 3,600 light grey, self-supporting triangular panels in Ductal®.

The roof panels create a 12,000 m² waterproof roof, and the horizontal façade panels create a total surface area of 11,000 m².

ASYMMETRIC AND CURVING ENVELOPE

Lattice panels with more than 50% open space

- Location: France
- Architect: Rudy Ricciotti
- Precaster : Bonna Sabla






"CONCRETE AS A STRUCTURE AND A FINISH", CHRISTINE BINSWANGER, PARTNER AT HERZOG & DE MEURON

Pérez Art Museum Miami

"Concrete as a structure and a finish," summarizes Christine Binswanger, Partner at Herzog & de Meuron, when talking about the Pérez Art Museum Miami (PAMM). The challenge was to open up all the internal spaces to the lush vegetation of the surrounding park and Biscayne Bay, at the same time as protecting its exhibits and visitors from the heat and onshore winds

"The use of Ductal® and the extensive canopy are part of an overall strategy to keep the heat outside the building," explains Christine Binswanger. Ductal® was used to produce approximately 100 long-span vertical mullions - up to 4.80 m in length - that support the building's expansive curtain wall glazing system. The architects chose Ductal® to ensure that the mullions blend with the structural elements to create a soft contrast with the surrounding vegetation.

The material's superior strength enabled the design of extremely thin and sinuous mullions that permit unobstructed views and superior resistance to hurricanes. Ductal® also provides excellent resistance to corrosion and abrasion in this marine environment.

-  Location: USA
-  Architect: Herzog & de Meuron
-  Precaster: Coreslab



Dumbo Townhouses

The corner of Pearl and Water Streets in Brooklyn, New York has undergone a major makeover with the creation of a new residential development called the "DUMBO* Townhouses".

The building, created by Alloy, is comprised of five luxury townhouses (each about 278.7 m²) which have been designed with energy-efficient building systems and a high-performance building envelope that incorporates a unique, louvered facade panel system made with Ductal®.




Each of the large-scale (5,5 m long x 3,4 m wide) Ductal® panels contain a series of ribs, covering a total surface area of 803,6 m².

*DUMBO : «Down Under the Manhattan Bridge Overpass».



ENERGY-EFFICIENT BUILDING SYSTEMS

PCI Design Award in «Best Custom Solution» category

-  Location: USA
-  Architect: Alloy
-  Precaster: Gate Precast

"THE FACT THAT DUCTAL® ALLOWED US TO PERFORATE THE SCREEN SO MUCH MEANS THAT NIKE WAS ABLE TO ACHIEVE MAXIMUM VISIBILITY AS WELL AS SHADING FROM THIS FEATURE." JACKIE GONZALEZ TOUZET, TOUZET STUDIO

Nike Miami

Located in Miami Beach, Nike's new two-storey, 31,000 m² "retail experience" is an impressive sight.

Its south-and west-facing facades are wrapped by a unique brise-soleil of 180 Ductal® perforated panels, designed to incorporate the classic Nike pattern. The result is an intricate casting that allows light to filter through to the interior while providing shade outside, creating a distinctive synergy with the surrounding promenade.



-  Location: USA
-  Architect: Nike Retail Design and Touzet Studio
-  Precaster: DEX Industries



The Montpellier TGV Station roof – South of France

Architect Marc Mimram has drawn inspiration from the Mediterranean surroundings in his design which includes a perforated Ductal® UHPC, roof made of 115 Ductal® palm fronds, allowing natural light to filter through to the station's interior.

Each panel is just five cm thick, but spans over 18 m, made possible by the strength and durability of Ductal® UHPC. They are perforated in a random pattern, allowing the sun's passage throughout the day.

Major execution challenges included the control of the fresh UHPC rheology for casting, controlling the fiber orientation and precision of the stressing tendons location. These factors helped to stop cracking that could occur during demoulding and transportation phases (before post-tensioning). There was also a very high need for geometrical, size and shape control of the canopies, because the installation allowance was so tight (+/- 2 mm tolerance for the bearing points).

THE ROOF IS MADE OF 115 PRECAST MODULAR DUCTAL® PALM FRONDS

..... **10,000 m²**
cover in Ductal®

..... **115**
Ductal® Palm Fronds

All roofing elements (10,000 m² in total) were prefabricated within four months and installed with tight geometrical requirements in only two weeks.

Whatever the weather may be, this unique Ductal® roof ensures it's always sunny in Montpellier!

ACI Exellence
Award 2018

- 📍 Location: France
- 👤 Architect: Marc Mimram
- 🏭 Precaster: Méditerranée Préfabrication and Delta Préfabrication





3

Rainscreen

cladding panels

All the qualities of Ductal®
in one standard offer

ESTP Cachan

Designed by Architecture Studio, this new building is a major part of École Spéciale des Travaux Publics (ESTP's) new dynamic. It gives the school a new image and will be an important part of the campus's future development.

The building is wrapped by a Ductal® skin with refined folds beginning on the east facade, enveloping the roof and then downward, on the west side, perfectly covering the building's large gathering hall.

The oversized panels (with precision cuts performed in the factory) offered superior durability and aesthetics. Overall, the Ductal® cladding system was the architect's best solution for this mineral skin, without compromising the project's budget.

 Location: France

 Architect: Architecture Studio

 Precaster: Fehr and Josselin Préfabrication

**DUCTAL® CLADDING
WAS THE
ARCHITECT'S
BEST SOLUTION**

Student Residence Porte de Vanves

The street-facing facade of the new Porte de Vanves student residence consists of several superimposed flat walls, giving the apartments a variety of view points. The dimensional options provided by the Ductal® cladding solution were used to address the building's complex pattern layout. Large panels were used, some of which include a vertical or horizontal return to cover the various wall thicknesses throughout the complex on the edges of the flat walls.

The facade surface, at approximately 1,000 m² is clad with 100 or so white, smooth-textured Ductal® panels, manufactured with an architectural formulation.

The panels have been given a dirt and smog repellent coating that guarantees the facade's aesthetic durability in an area that is subject to heavy traffic.



Low Energy Building Qualitel label

External Thermal Insulation solution

Use of a High Environmental Quality approach secured an award of the "Low Energy Building" Qualitel label. The wall's thermal performance is provided by an External Thermal Insulation solution while the protective layer of Ductal® cladding contributes to its overall durability and sustainability.

**DUCTAL® CLADDING
CONTRIBUTES TO ITS
DURABILITY
AND SUSTAINABILITY**

 Location: France

 Architect: Jacques Ripault Architecture

 Precaster: Fehr

RESPONDING TO THE INHERENT CONSTRAINTS OF AN INNOVATIVE DESIGN

Gasholders, London

King's Cross in London, England is one of the largest urban redevelopments in Europe, and the area's rich industrial heritage is integral to its renaissance.

The walls encircling the central courtyard are clad with precast Ductal® panels in pale gray with a fine vertical rib texture. Walkways connecting the blocks are slung off the wall on three levels, and break up the vertical space.

The 180 Ductal® panels have a self-finished Reckli rubber mold that give them their texture. The ground floor panels were underslung and were transported into place using specially fabricated trolleys.

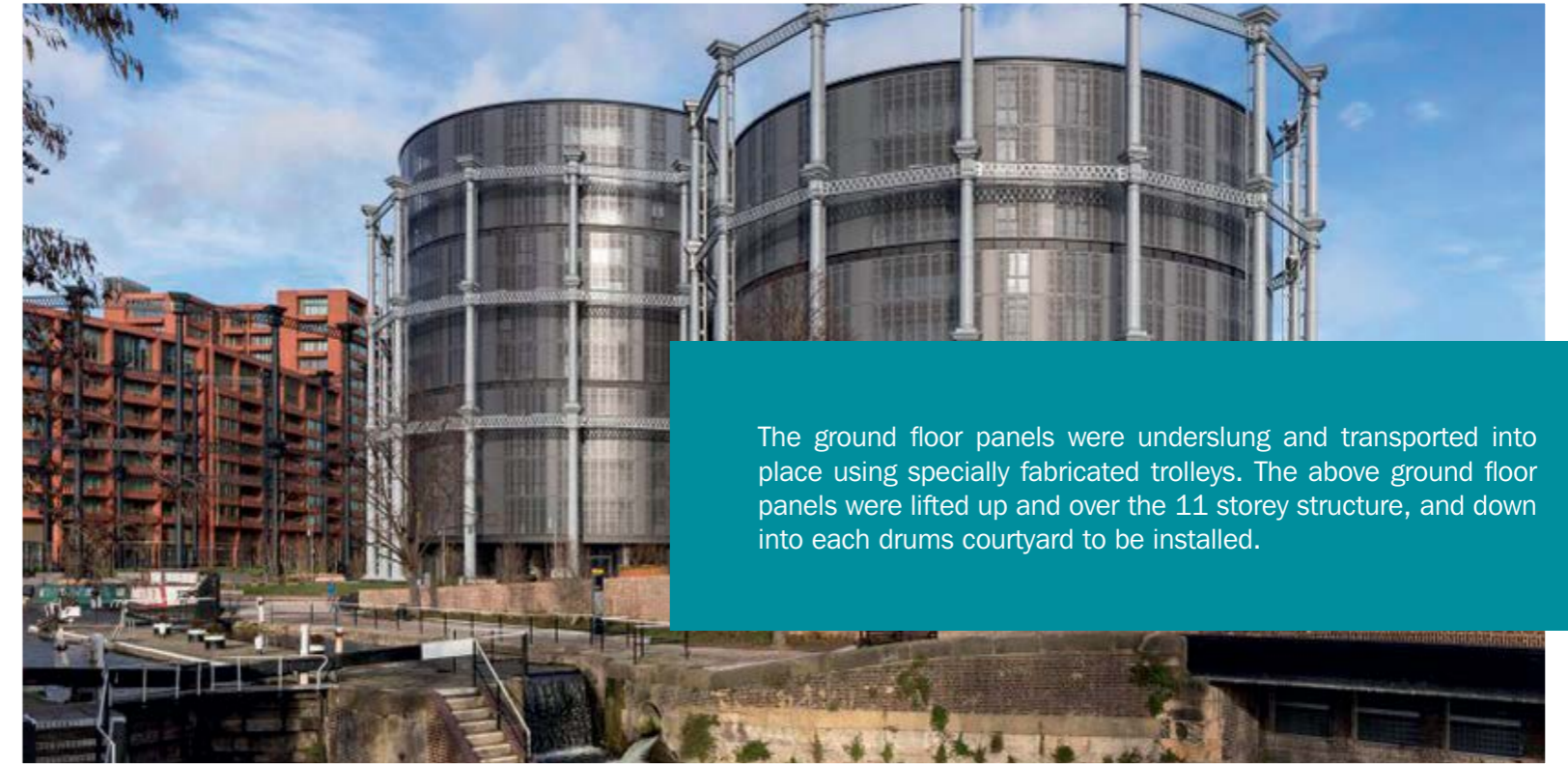
 **Location: England**

 **Architect: Wilkinson Eyre**

 **Precaster: Thorp**



..... **180**
Ductal® panels



The ground floor panels were underslung and transported into place using specially fabricated trolleys. The above ground floor panels were lifted up and over the 11 storey structure, and down into each drums courtyard to be installed.

Oran Shopping Mall

Situated next to the wholesale fruit and vegetable market, the Italian architecture studio Fabris & Partners realized the design for the Oran shopping Mall.

The 74,265 m² building (opening in 2019) will be clad with large Ductal® panels covering more than 10,000 m². The large panels, with an invisible fastening system, were delivered on site and ready to install, according to the layout chosen by the architect.

The use of textured panels with a smooth, brushed finish allows light to reflect in different ways off the facade, and creating distinctive effects on the facade. The color is reminiscent of the land in Algeria and local spices such as saffron or paprika.

**RED FACADE
INSPIRED
BY ALGERIAN
COLORS**

..... **74,265 m²**
of floor area

..... **10,000 m²**
covered with Ductal® cladding panels

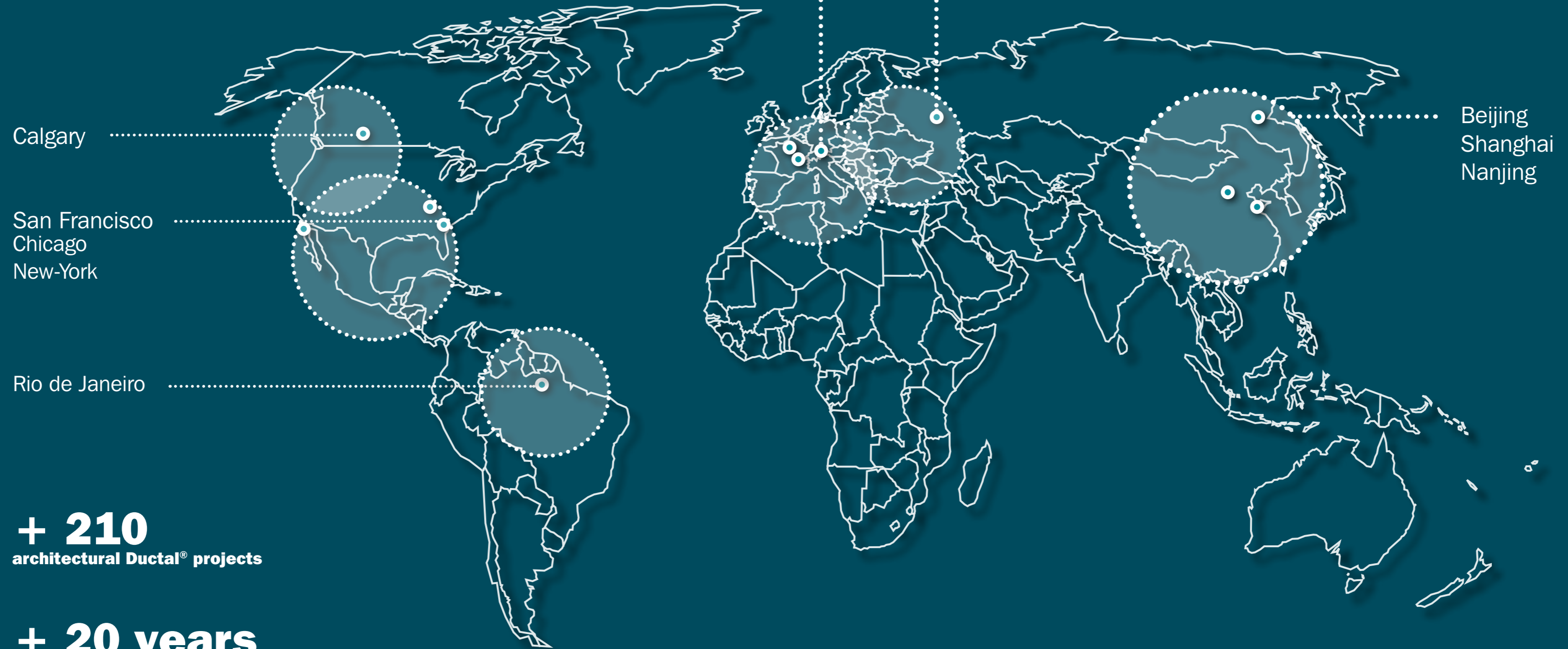
 **Location: Algeria**

 **Architect: Fabris & Partners**

 **Precaster: Zanette**



LOCATIONS AROUND THE WORLD



+ 210
architectural Ductal® projects

+ 20 years
of research and development

+ 270
active patent families

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Ductal[®]

2018

2019



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