

Petra Ultra High-Performance Concrete systems



ARCHITECTURAL MOLDED COMPOSITES

Developed for infrastructure – Excellent for Facade

LAFARGE Largest global cement producer

- **ductal** developed for infrastructure; bridges, tunnels, ocean barriers. Behaviours of strength / weight and volume of material, extremely low water absorption, flexibility in manufacturing forms and shapes and high design freedom.
- Exactly the attributes needed for facades.
- [Petracast](#) is particularly suited for manufacturing of UHPC panels, as recognized by Lafarge.

Let's learn why





AGENDA

Ultra High Performance Concrete

THE BASICS

- ductal®
- UHPC
- From Infrastructure
- To Façade
- Petra Cast

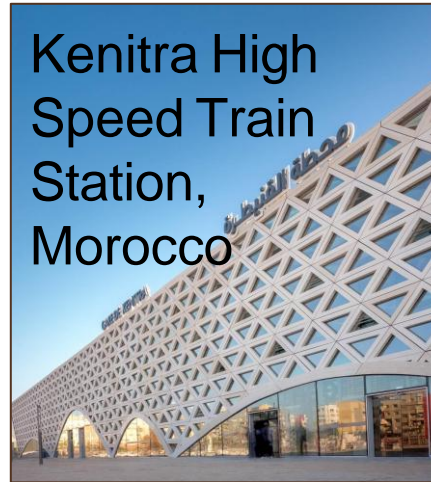
DUCTAL | UHPC Projects | Around the World



Al Nahr,
Zeena
Tower,
Beirut



Chinese Cultural Center
Belgrade



Kenitra High
Speed Train
Station,
Morocco



École Spéciale des Travaux
Publics Cachan, France



Platform Basket
Poviglio



Gasholders King's Cross, U.K.



Louis Vuitton Fondation, France

DUCTAL | Chemical Durability

Chemical Stability & Resistance to Leaching

- Ductal® is not subject to endogenous deterioration processes (delayed ettringite formation, alkali-reaction, etc.) and has extremely long service lifetimes even under extreme conditions.

Resistance to Acid Attack

- Ductal® demonstrates high resistance even under extremely harsh conditions where ordinary concretes would suffer serious damage. Ductal® samples have shown resistance to various aggressive elements (calcium sulfate, sodium sulfate, acetic acid, ammonium sulfide, nitrates, seawater).

Self-Healing Properties

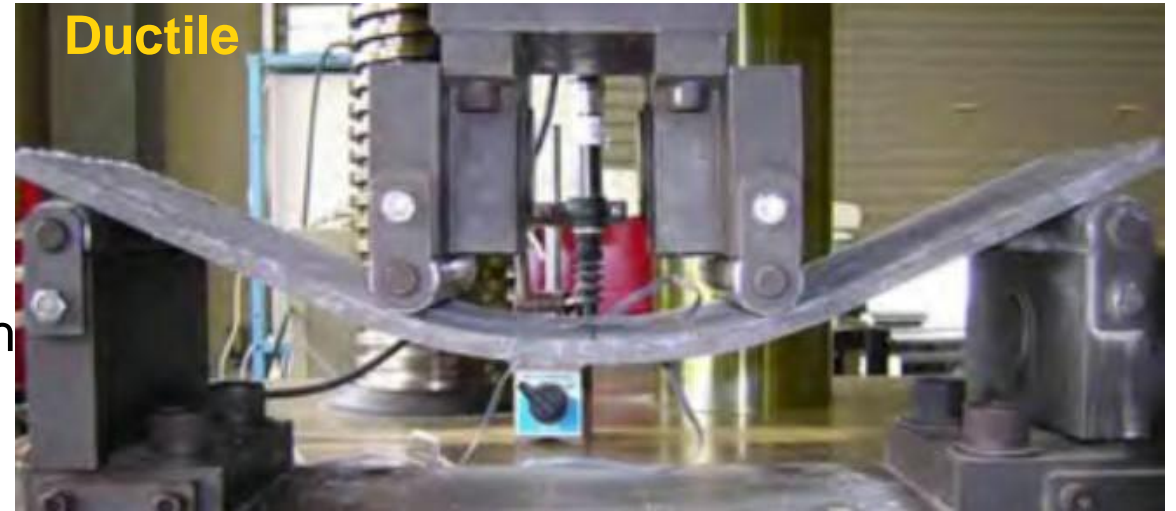
- Aging tests have highlighted Ductal®'s ability to 'heal' itself under the correct conditions, resulting in diminished maintenance requirements.

Impermeability

- Due to its fine constituents and discontinued pores structure, 1 in. (25 mm) thick of Ductal® is virtually impermeable.

DUCTAL | Fundamental Characteristics

- 100 year lifecycle expected minimum
- Uniformly reinforced with PVA or Steel fibres.
- 128MPa compressive strength – 3-5x other cement-based products.
- Excellent Energy Absorption and Tensile Strength
- Extremely low water absorption (%) and depth of infiltration (<10mm)



Bending strength test



Microscopic view

DUCTAL | Long Term Durability

Water absorption and extreme environment testing US Army Corp of Engineers

- Chloride profiles revealed penetration to a **depth of only +/- 10 mm.**
- Electrochemical corrosion of steel fibres* effects at a cover depth of only 25 mm following 20 years.
- **No concrete failure.**



Treat Island, Maine. Extreme Climate



Comprehensive and extended testing process.

DUCTAL | If used on bridges and precast...facades?

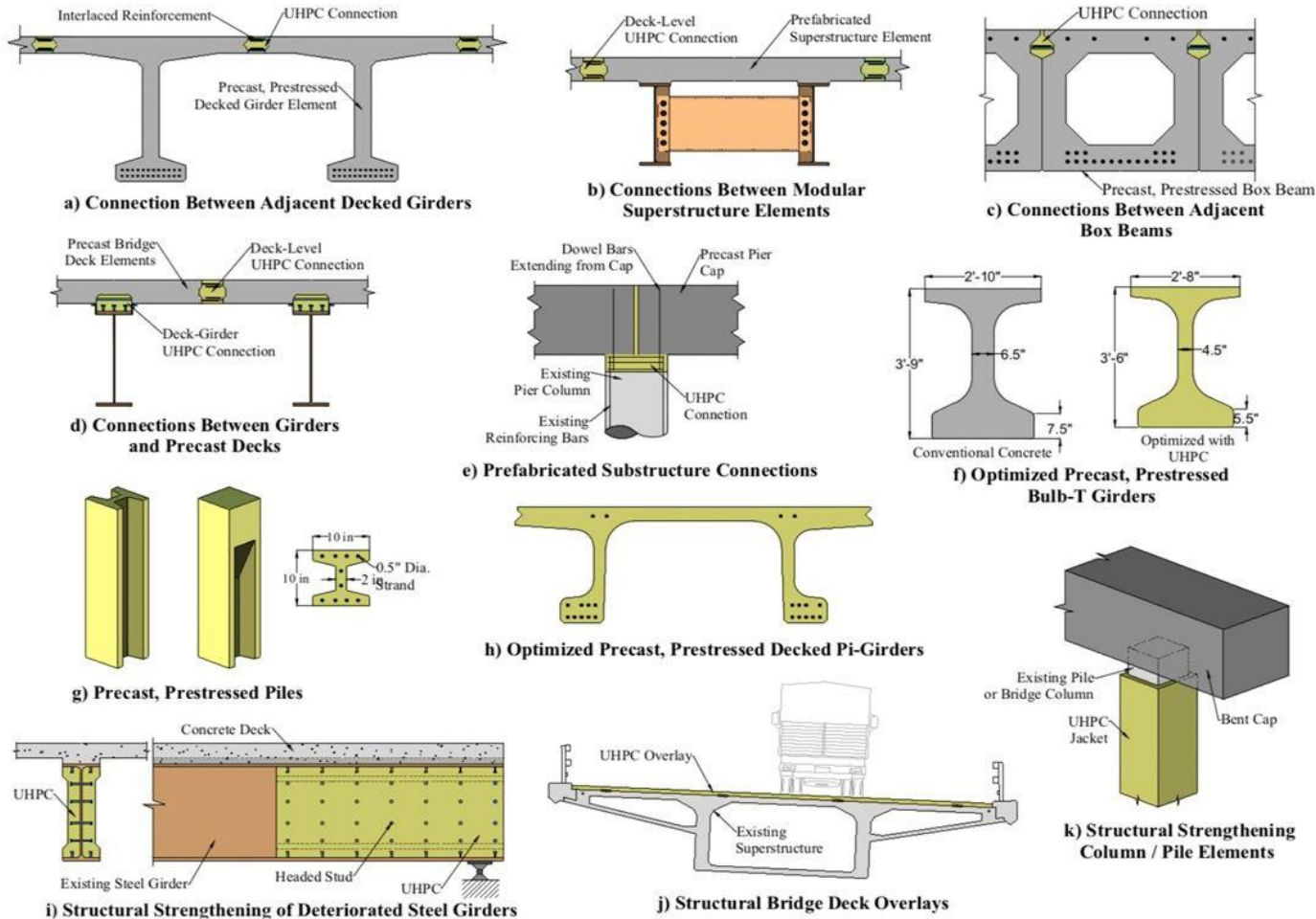
Accelerated and more durable Construction

Connect Precast Concrete, Steel or Wood Elements with UHPC with simplified connections.

UHPC joints are much simpler. Smaller joints, reduced rebar congestion, easier to install panels, no post-tension required.

Improved long-term performance.

Higher quality precast elements increase durability, and UHPC joints will last longer still, with little future maintenance.

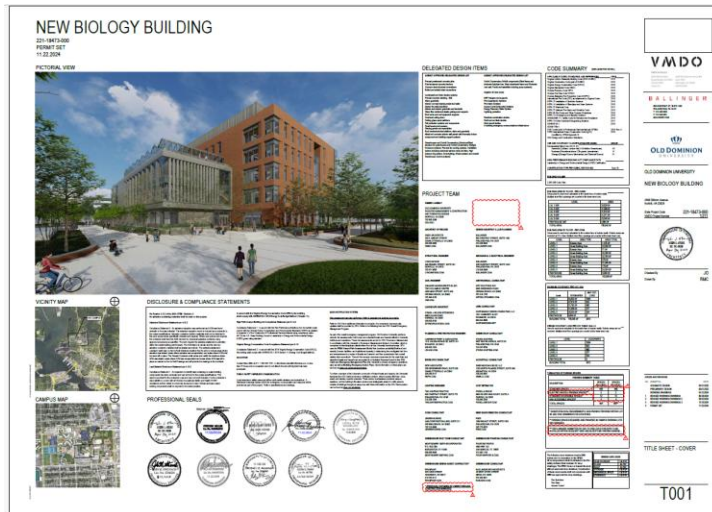


From Infrastructure to UHPC Facade



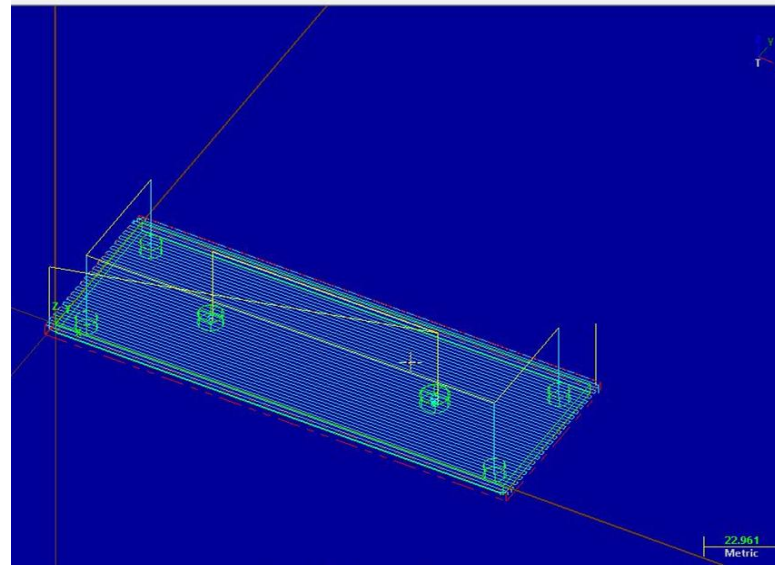
Seamless Architecture Model to Mfg. Model to Shop Tickets

Stage 01
Design



Architectural model

- Direct design inputs from architectural Revit or other form of models.



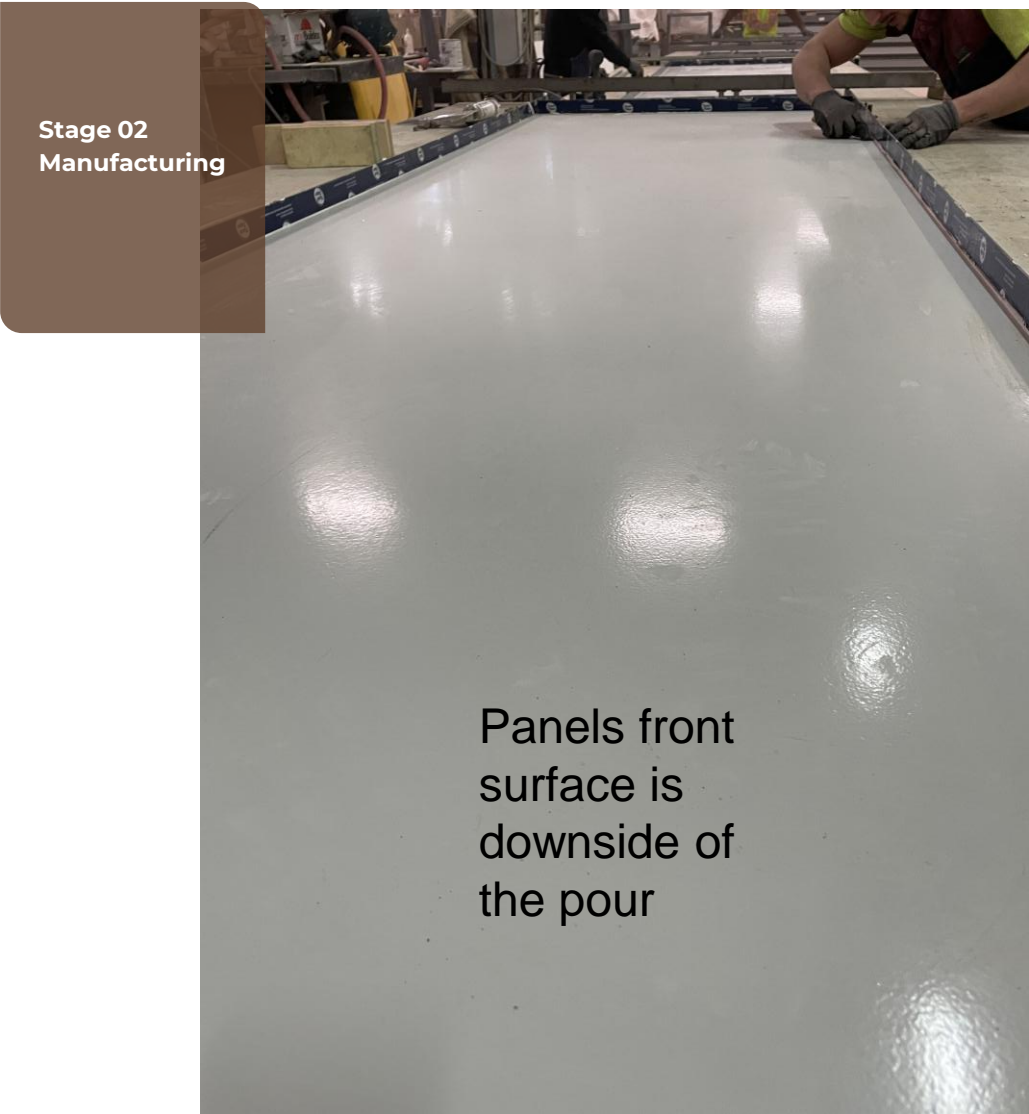
Integrated design and tooling automation

- CAD-CAM-CATIA integration for Production
- Direct design of tooling



Shop ticket process

- Direct input to manufacturing
- Human intervention for quality, not errors.



Stage 02
Manufacturing

Panels front
surface is
downside of
the pour

This client
chose
smooth
surface and
square
edges and
corners –
perfect!



Notice conveyor line
of frames and panel
manufacturing

Stage 02
Manufacturing



Quality control sampling

Flowable Material

Factory frame for simple
leveling and material shop floor
flow.

Integrated fastening points

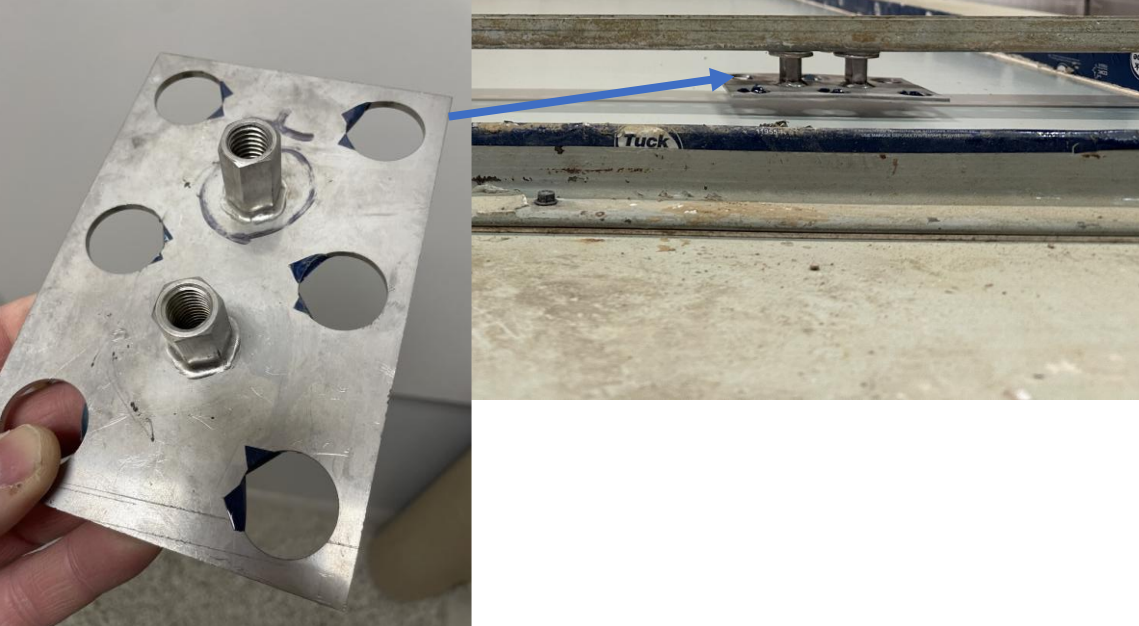
Stage 02
Manufacturing

Boss himself smoothing back
side of panel. {not necessary}



Stage 02 Manufacturing

Embedded Custom Fastener System



Frame system
designed in house
for repeatable
quality and speed.
From floor to kiln
to truck





Large size – infrastructure cladding material for transport client
Custom stainless attachment designed by Petra
Conveyor line developed by Petra to optimize panel flow, curing and shipping.



Summary of Attachment Methods

[the attachment of the panels to any substrate or subsystem]

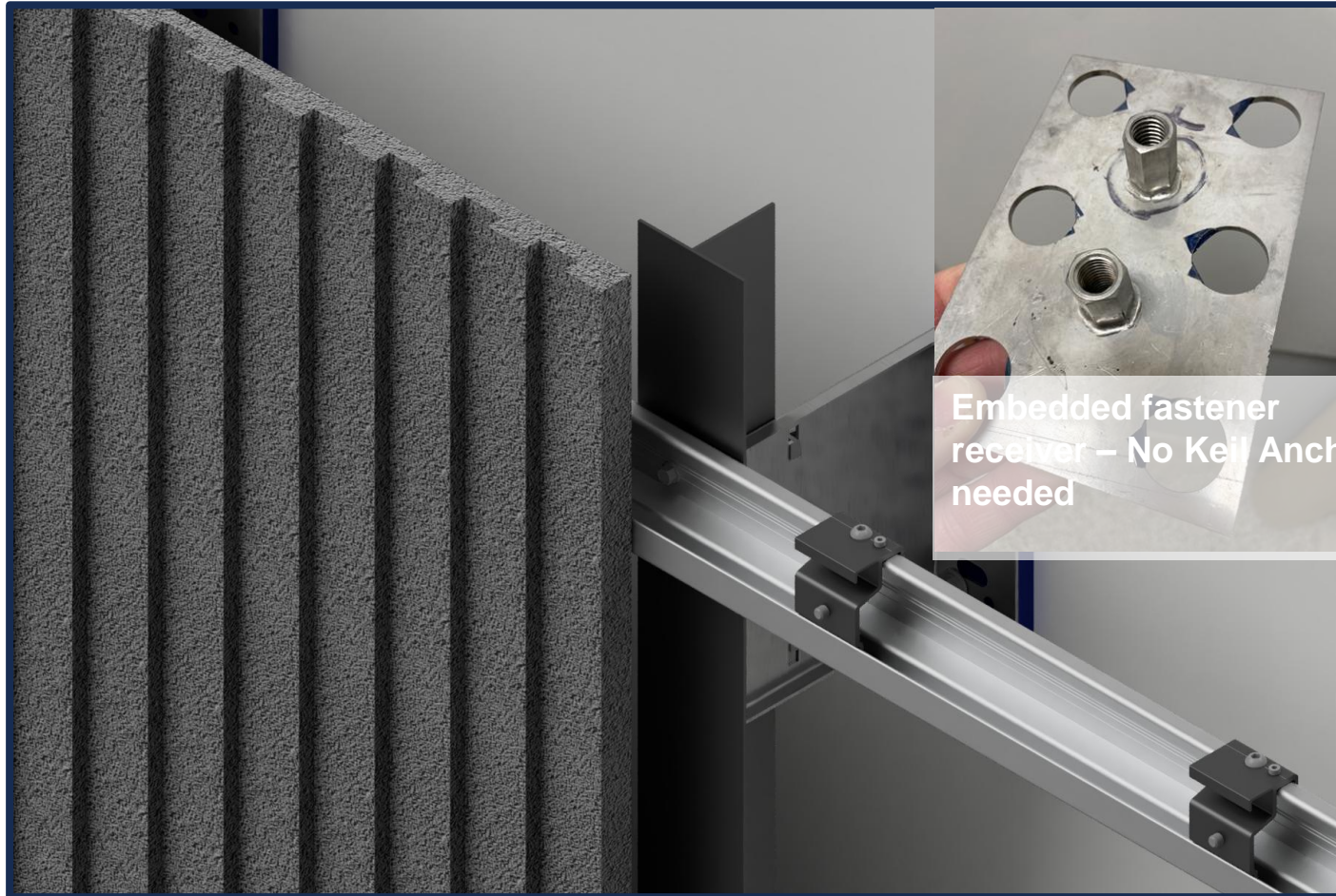
Industry Standard

- Exposed fasteners, screws or rivets
- Concealed fasteners, although we use cast in attachment.
- Kerf – slot in panel edge, supported by continuous aluminum rail.

Custom

- Anything to suit purpose.
- Simple embedded tabs
- Complex high load fasteners

Industry Standard Concealed System Rail and Hangar



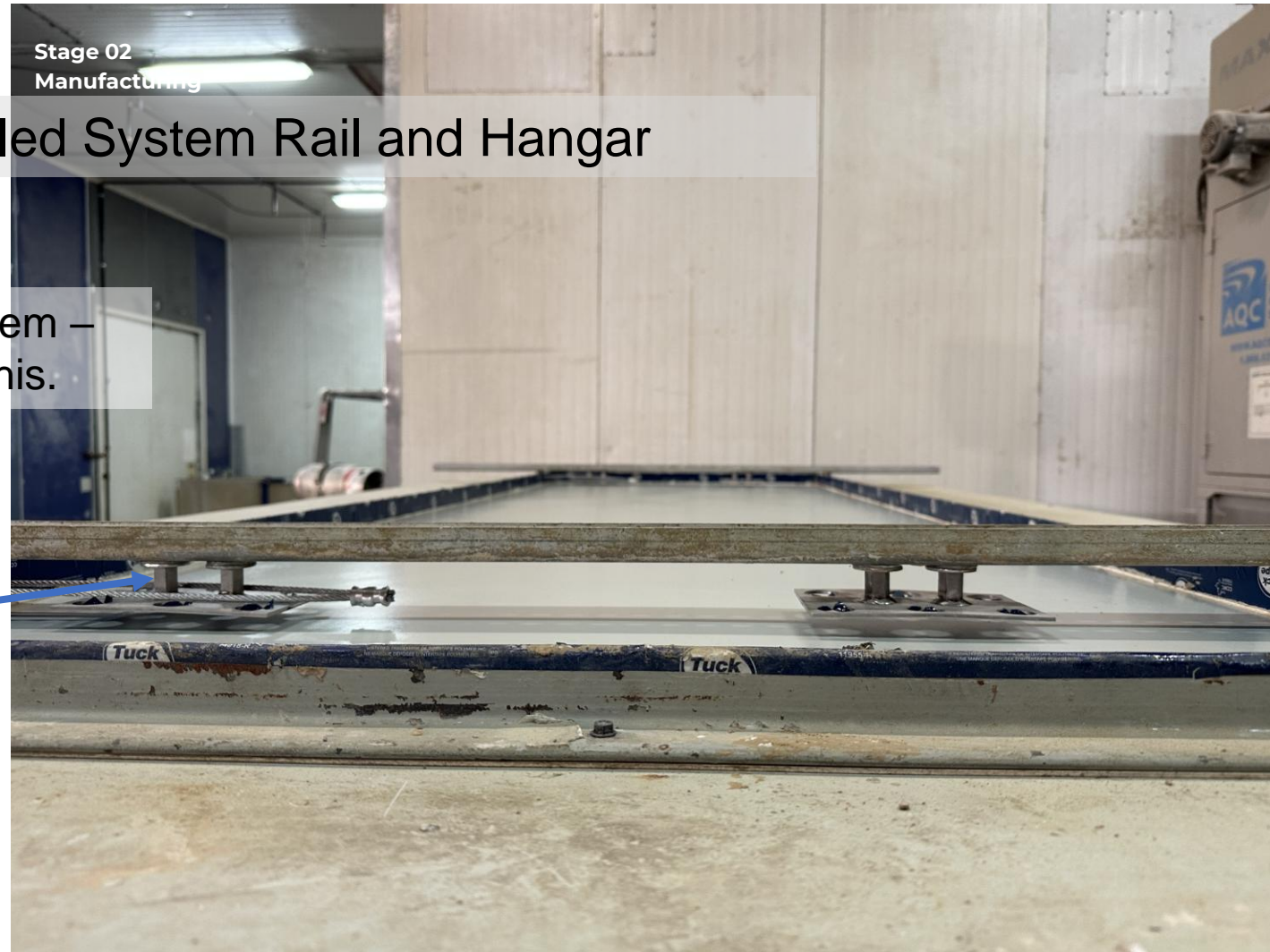
- Solely accountable for comprehensive façade design and supply system.
- Preconstruction design and budgeting service.
- Post award complete engineering and design of system + panel fabrication drawings

one source.

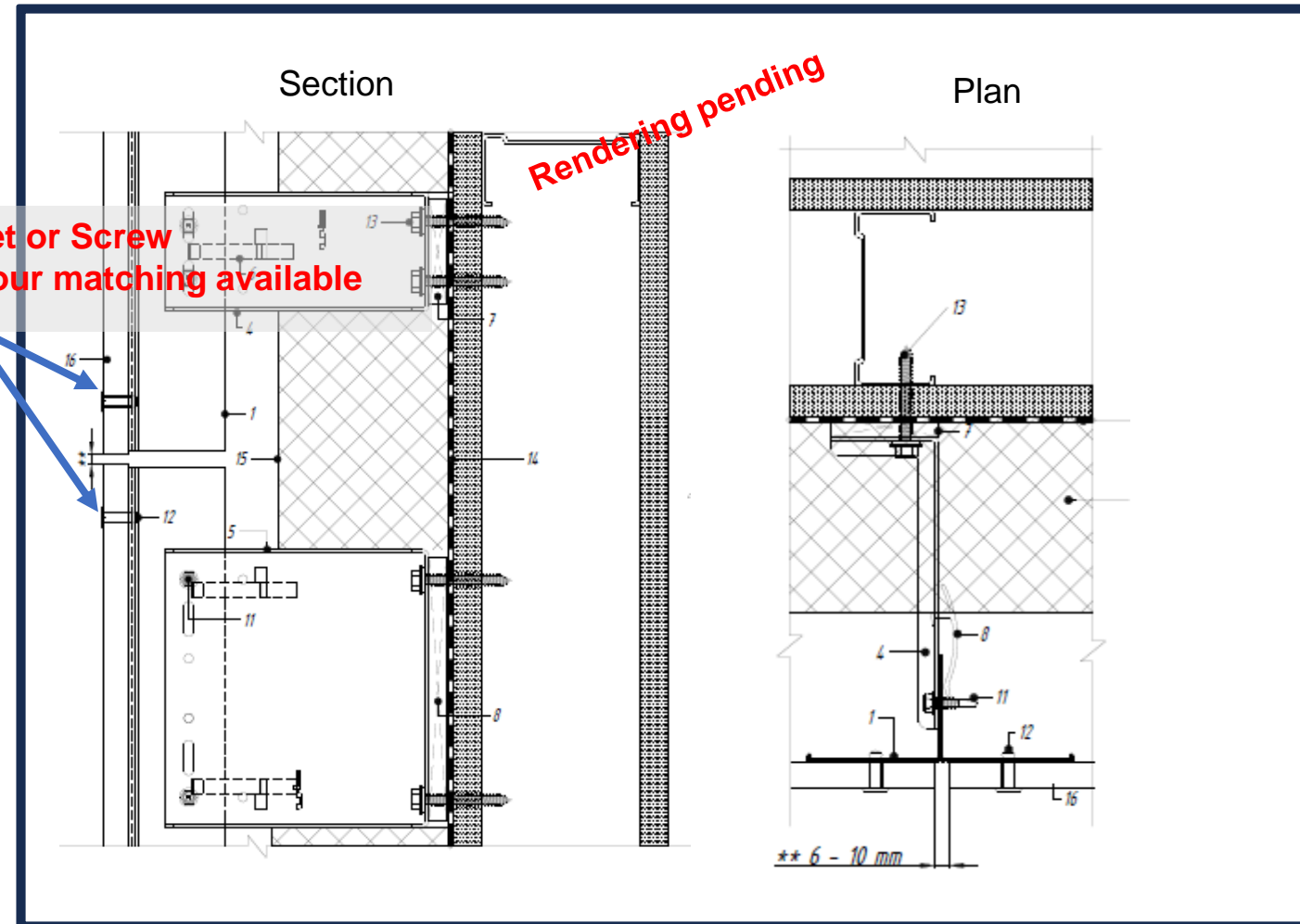


Industry Standard Concealed System Rail and Hanger

Embedded Fastener System –
one of many ways to do this.



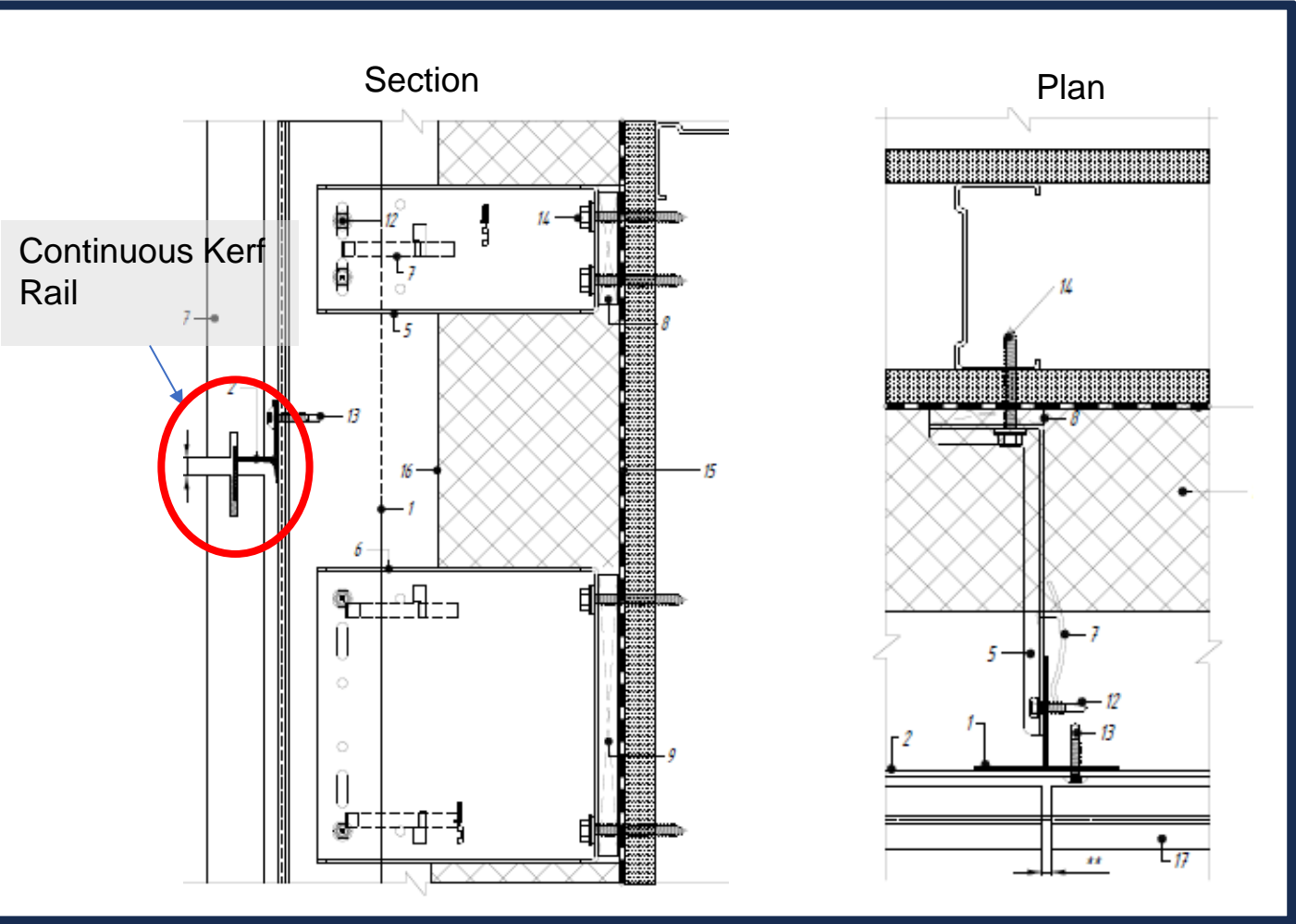
Industry Standard Exposed Fastener System – rivets or screws



- Solely accountable for comprehensive façade design and supply system.
- Preconstruction design and budgeting service.
- Post award complete engineering and design of system + panel fabrication drawings

one source.

Industry Standard Kerf System – often used in stone assembly



Simple tabs – any design available.



**Note panel is GFRC, so back is not flat. Same application as UHPC.

High load panels – custom stainless steel

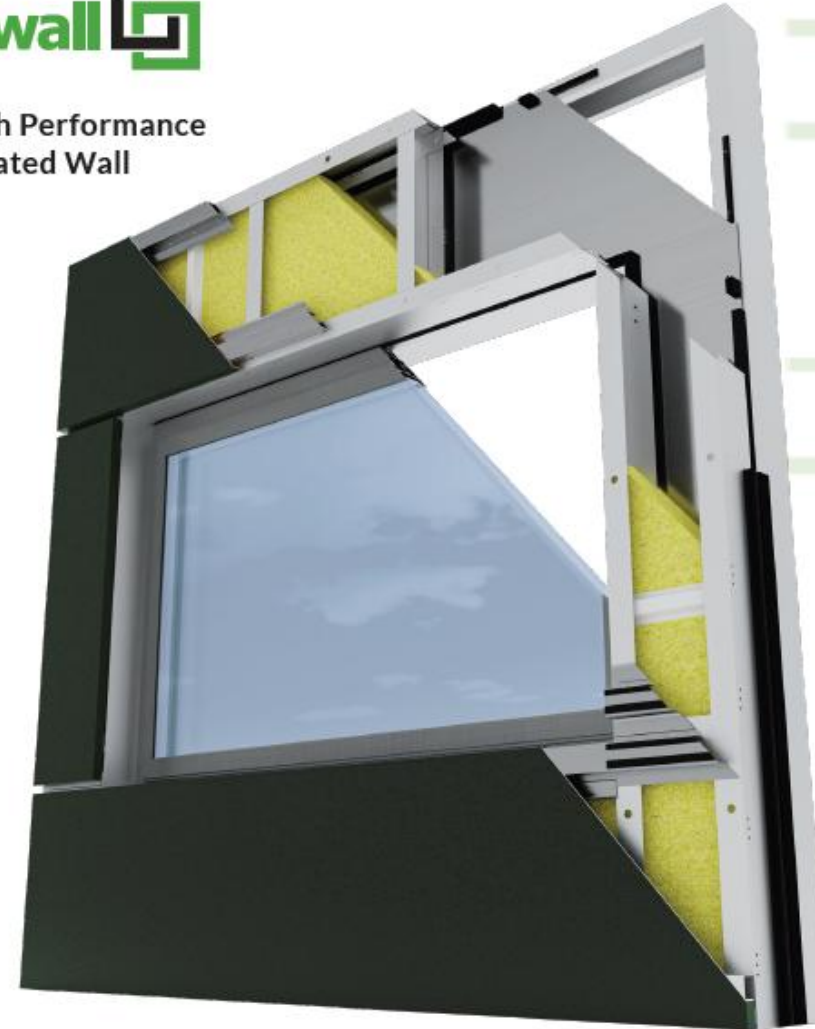




Petra UHPC well suited for prefabrication wall assemblies and modular construction.

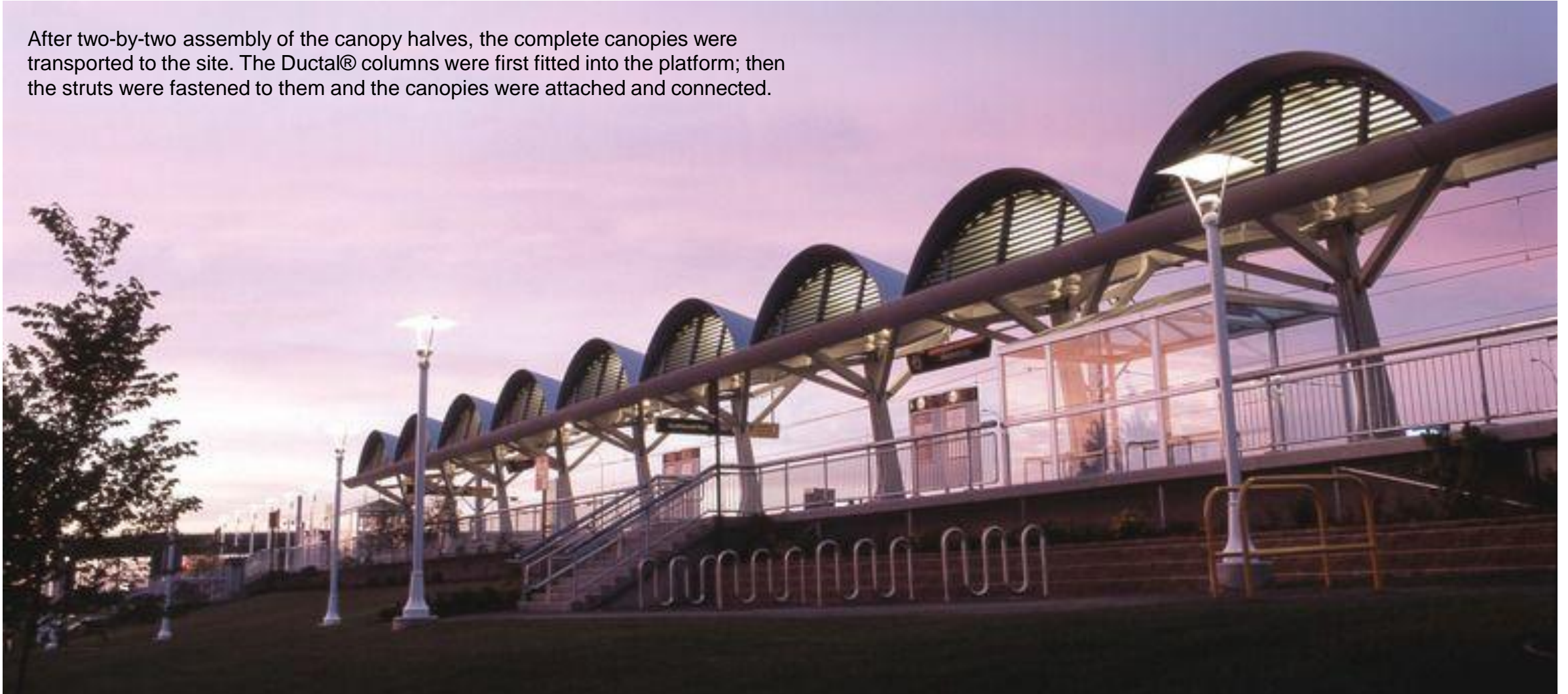


Ultra-High Performance
Prefabricated Wall
Systems



DUCTAL | Projects | Shawnessy LRT, Calgary

After two-by-two assembly of the canopy halves, the complete canopies were transported to the site. The Ductal® columns were first fitted into the platform; then the struts were fastened to them and the canopies were attached and connected.



ductal®

DUCTAL | Projects | Lewis Farm Fire Station



Pattern achieved with formliner



Located in an estate neighbourhood, the project had an art component which allowed custom design of the facade's textured panels. (The Edmonton Arts Council conducted a "public art competition" in accordance with the City of Edmonton's policy, "Percent for Art", which designates one percent of the budget "to provide and encourage art in public areas").

DUCTAL | Projects | The Atrium, Victoria

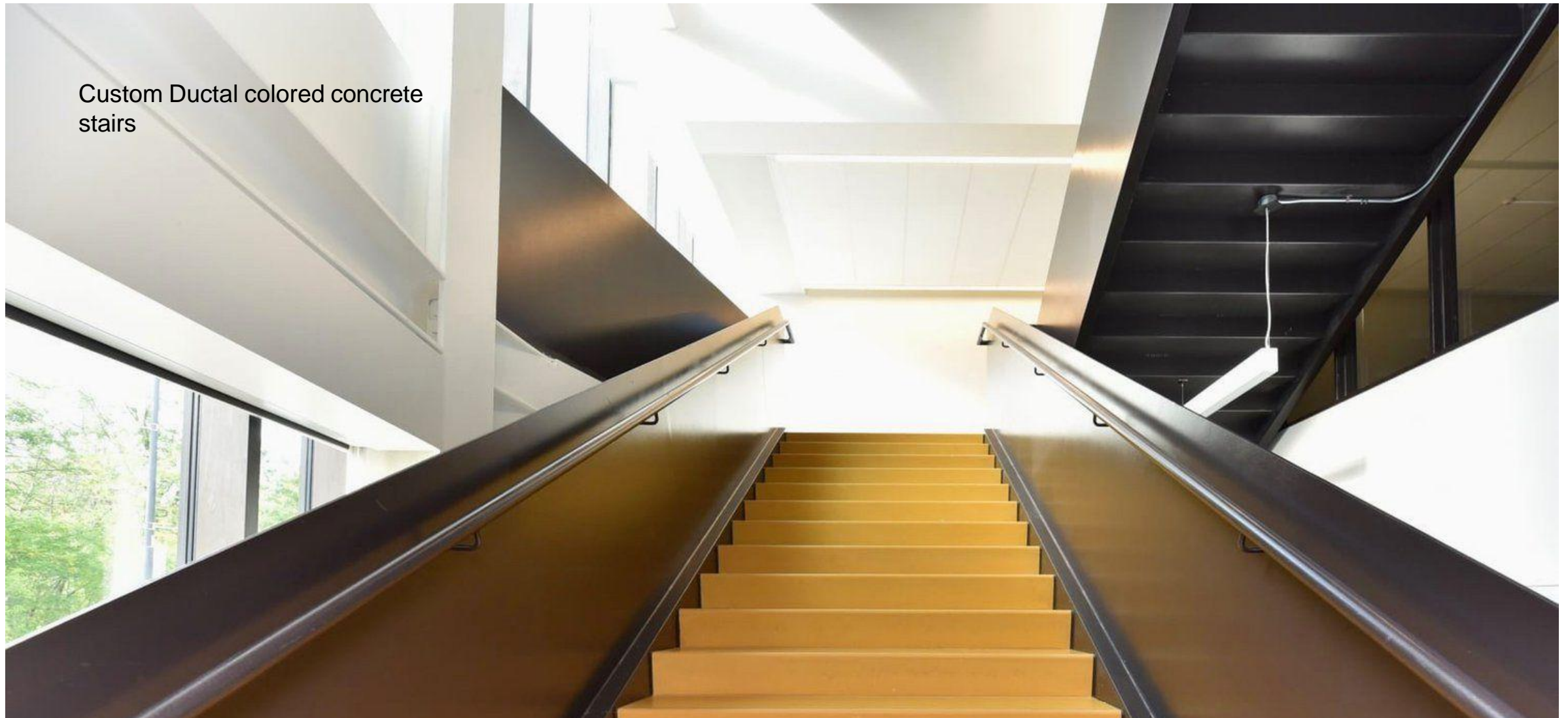
The Atrium is a high efficiency, state-of-the-art building which demonstrates the many advantages that are possible with a precast Ductal® envelope



ductal®

MEMBER OF
25
LAFARGE

DUCTAL | Projects | Carleton University, Ottawa



Custom Ductal colored concrete stairs

ductal®

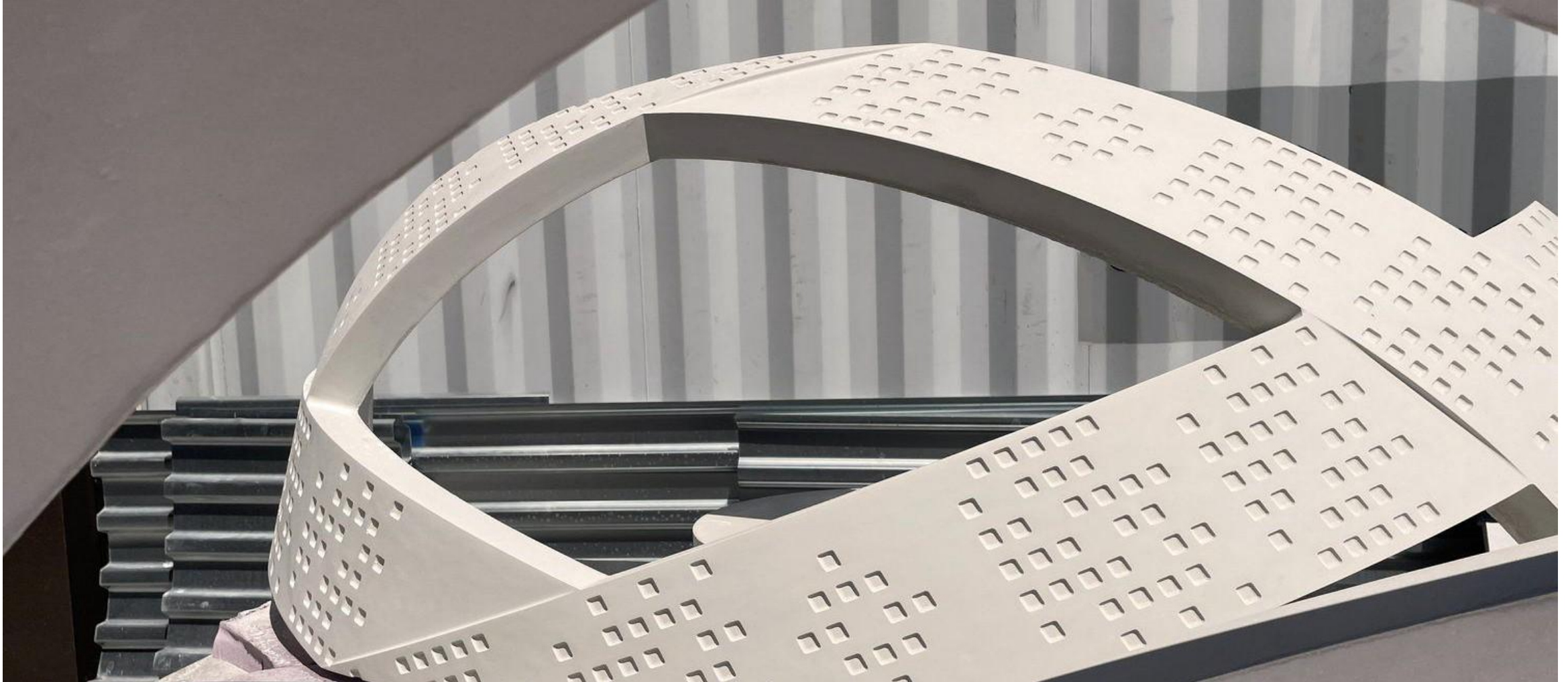
DUCTAL | Projects |

Rotman School of Management, Toronto

The architect's design criteria was ambitious because the university, preferred a long span façade panel (up to 5.5 m.) that was thin and lightweight with a hard, durable exterior wall surface that would endure for a long time--with little to no visible signs of wear from elemental impacts.



DUCTAL | Projects | Outdoor Sculptures and Furniture, Montreal



ductal®

MEMBER OF
28
LAFARGE

Petra Systems – 25 years in architectural composites

UHPC

Lafarge Ductal flat panel with customizable surface shape and texture (form liner, sandblasting, aggregates).

Reinforced with PVA or steel fibers

128 MPa compressive strength, **3-5x precast, GFRC or other concretes.**

very low water absorption—superior on freeze-thaw climates.

Excellent substitute for flat panel GFRC and FRC.

100+ Year lifecycle

GFRC

Custom product using standard cement and glass fibers,

3D molded with integrated steel structure.

Texture options include form liners, sandblasting, and aggregates.

Sprayed material process with infinite design flexibility.

Brick Faced GFRC

Everything GFRC +

Innovative brick shapes. 1” brick slips with grooves and mechanical fastening, cast in GFRC for strength.

Uses low water, fast to apply and cure lime-based mortar for accurate aesthetic.

Infinite design flexibility

GRG

Custom product. Interiors only.

Very precise
Industry standard gypsum.
Industry standard glass fibres.

3D mold process, design skills critical.

Texture with form liner, sand blasting, aggregate choice
Hand laid and sprayed material process.

Infinite design flexibility

Common to all

Integrated design and mfg. essential.

High design freedom.

Light, little to no slab reinforcement

100-year durability

Precise design = molds = precise results..



Extruded GFRC

Strength & Flexibility: Mesh not fibre. Cement more traditional compressive and tensile strengths. Result in enhanced support and durability.

Weight: Similar.

Flexibility: No form liner option, smooth to rough options.

Cost: More expensive.

Locality: European manufacturing. Project flexibility sacrificed vs Petra Toronto proximity.

Comparison

To UHPC vs Conventional Precast

Conventional Precast



Strength & Flexibility: Less strength because it lacks reinforcing fibres found in UHPC. More susceptible to crackings under tension.

Weight: >10x Heavier and denser than UHPC: 10x. Value engineering in slab and structure reinforcement.

Flexibility: Similar surface shape flexibility. Superior coverage area and 2-D shapes. Some integrated fenestration. Restrictions on creative shapes.

Cost: Less expensive for flat large panels, or integrated brick slips. As soon as creative approach, cannot or will not engage.



North York, ON

ELISE TOWER

**Commercial Tower Cladding*

LARGE SCALE GFRC EXTERIOR
CLADDING
Fabricated by Petra Design, Toronto

PETRA™

Brick Faced - GFRC

Note very light lifting harness



Approach

Petra Cast promotes a collaborative approach, investing in early development with architects and builders.

Optimize fabrication and construction **processes and costs** while enhancing the design intent.

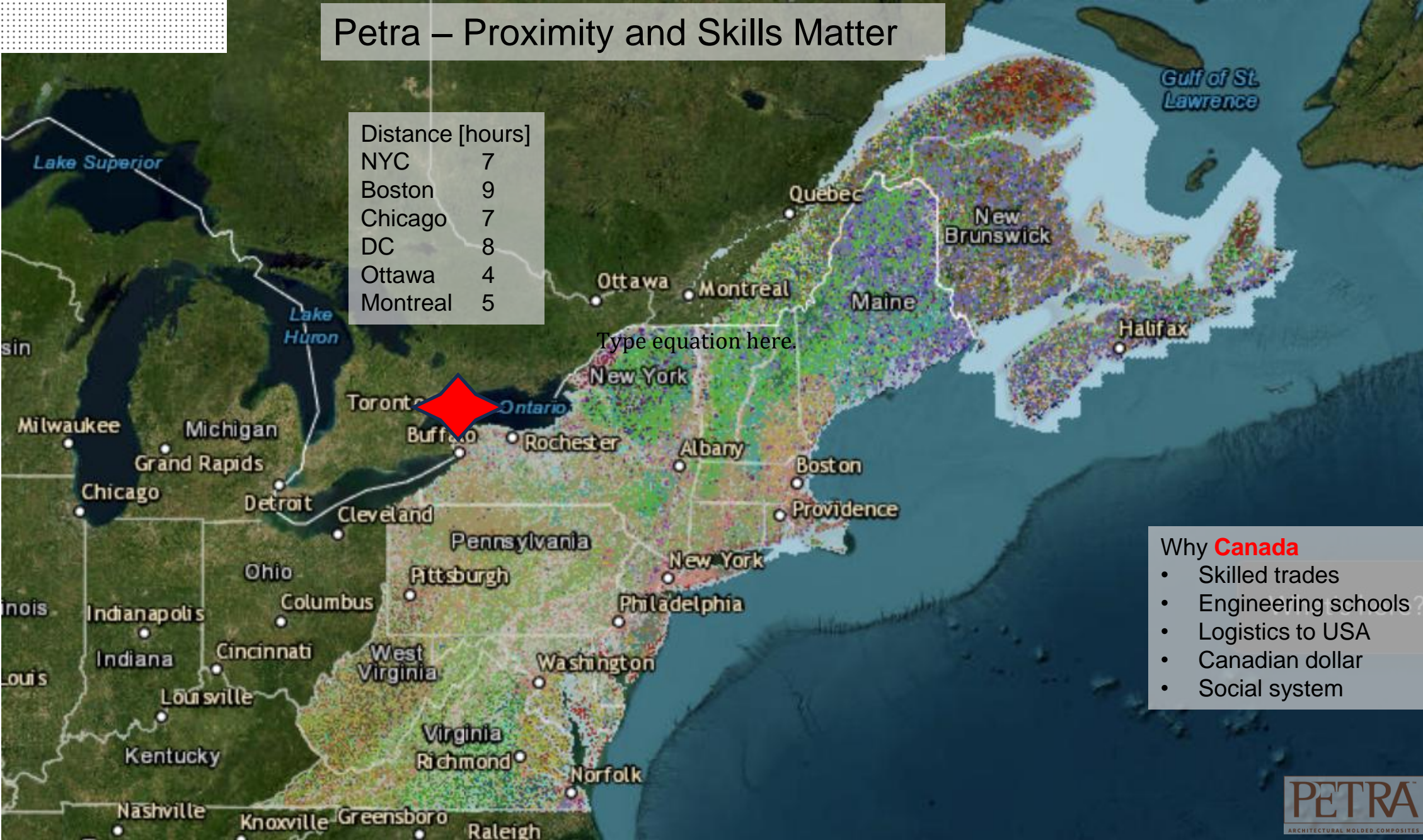
We believe that precision is free, even less expensive than trying to make up design tolerance compromises later in the process

Services

- **Budgeting**
- Initial structural and fabrication design
- **Comprehensive** preconstruction proposal.
- Design **collaboration** and value engineering.
- Post award **engineering** and design including façade support system.
- Manufacturing
- Delivery
- **Construction collaboration**

Proximity Pays Off

Petra – Proximity and Skills Matter



BD_I like to personalize these presentations



Petra Cast – Mahmoud Al Fayed



Façade Systems Inc – Blair Davies P.Eng.

Thank You – Questions?

Petra UHPC



ARCHITECTURAL MOLDED COMPOSITES