PETRA™

ARCHITECTURAL MOLDED COMPOSITES

Iconic Projects

With over **25 years** of extensive experience, Petra Design works with architects, designers and engineers to transform ideas into reality.

Operating with CSA approval

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More on this later

- 81 Panels with 8 forms
- A floor every day
- 4th floor [roof] marshalling!

Simple projects made Iconic

With over **25 years** of extensive experience, Petra Design works with architects, designers and engineers to transform ideas into reality.

Operating with CSA approval

More on this later

- Could have been boring metal.
- 6 ft high, 6 ft out origami 3D panels.
- Easy hanging system.

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Agenda

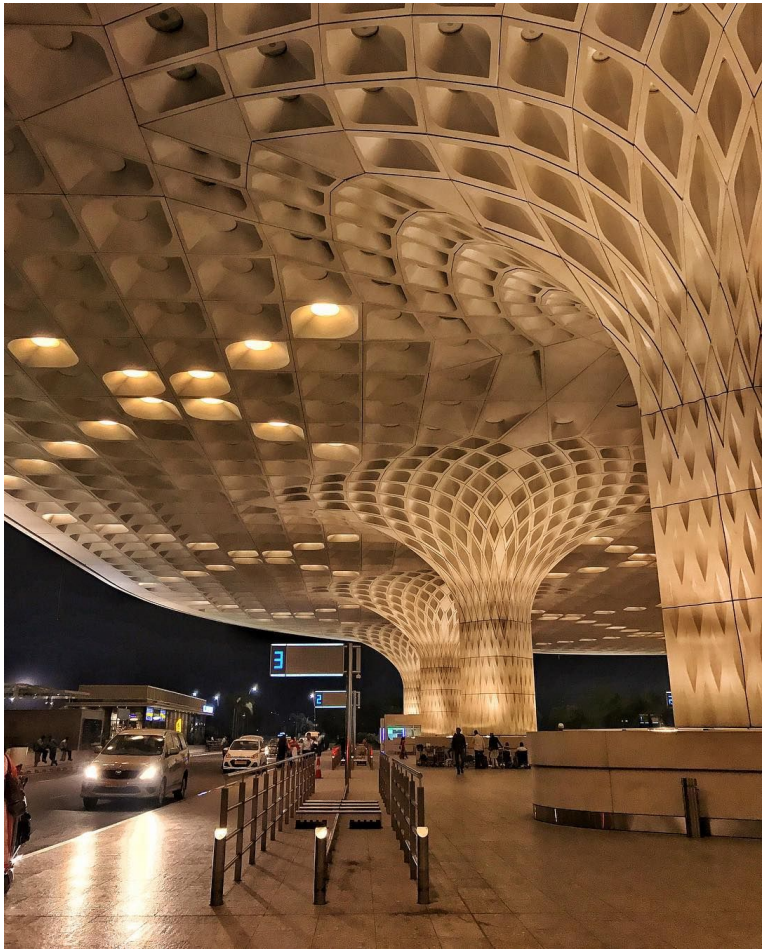
Introduction 01
To Glass Fibre Reinforced Concrete

History 02
About Glass Fibre Reinforced Concrete

Fabrication 03
A complete process of GFRC manufacturing

Application 04
Attachment systems

Projects 05
Petra work examples



01

INTRODUCTION

What is GFRC?

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01

Why does GFRC Matter

*Producing your GFRC project with **Petra Design** gives you the unique benefit of*

GFRC, is a Revolutionary architectural material.

Combines the durability of concrete and flexibility of fibreglass.

Boasting exceptional strength and durability. With compressive strengths surpassing **72 MPa***

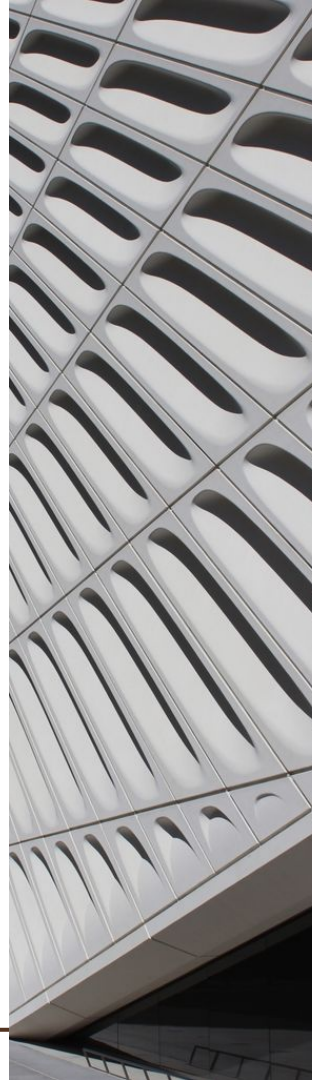
Flexural Strength as high as **4000 psi***

Lightweight With High Strength

High Design Flexibility

High Compressive, Flexural, And Tensile Strength

Environmentally Friendly



*Concrete alone has 35 MPa compressive strength, and almost zero flexural strength so requires rebar.

Comparison

To GFRC vs Conventional Precast

GFRC

Strength & Flexibility: due to matrix of concrete reinforced with glass fibre

Weight: Due to reduce density of glass fibre its Lighter then precast concrete.

Flexibility: Offers gReat flexibility and ductility. Less prone to crack and useful to produce complex shapes.

Cost:
More expensive than precast concrete for simple flat panels, but wildly successful for creative designs.

Conventional Precast

Strength & Flexibility: Less strength because it lacks reinforcing fibres found in GFRC

Weight: Heavier and denser than GFRC.

Flexibility: More susceptible to crackings under tension.

Cost:
Generally more cost effective in simpler, flat panels, much more expensive for GFRC like shaped systems.

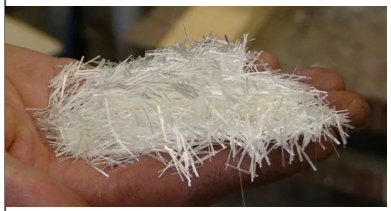
02

History of GFRC

“Fibre” has been used as reinforcement since ancient times.

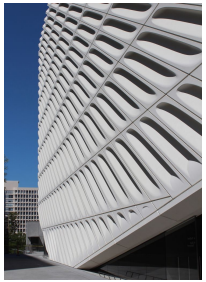
1940s

Glass fibre as concrete reinforcement is first attempted in Russia but the available glass can not withstand the alkalinity of concrete



1960-1970

The GFRC industry is born as advancements in glass technology results in various types of Alkali resistant glass



The Broad
by Diller Scofidio+Renfro

Present

Today, GFRC is a versatile solution used extensively for architectural and design purposes

The Heydar Aliyev Centre
by Zaha Hadid Architects

Properties

Of GFRC

*Producing your GFRC project with **Petra Design** gives you the unique benefit of*

High Strength/ Weight Ratio

With thin cross section

+

Smooth and Uniform Finish

Achieved by spray Casting process

+

Weather Resistance

By using Alkali-resistant fibers

→

Durability

Crack resistance and freeze-thaw resistance

+

Efficient

Installation methods

+

Non Combustible

Material Property

→

CSA Approved Quality Control

A Collaborative Design Process

An experienced Team of Project Manager, Designer, and Crafts person

03

FABRICATION

A Complete Process of GFRC Manufacturing

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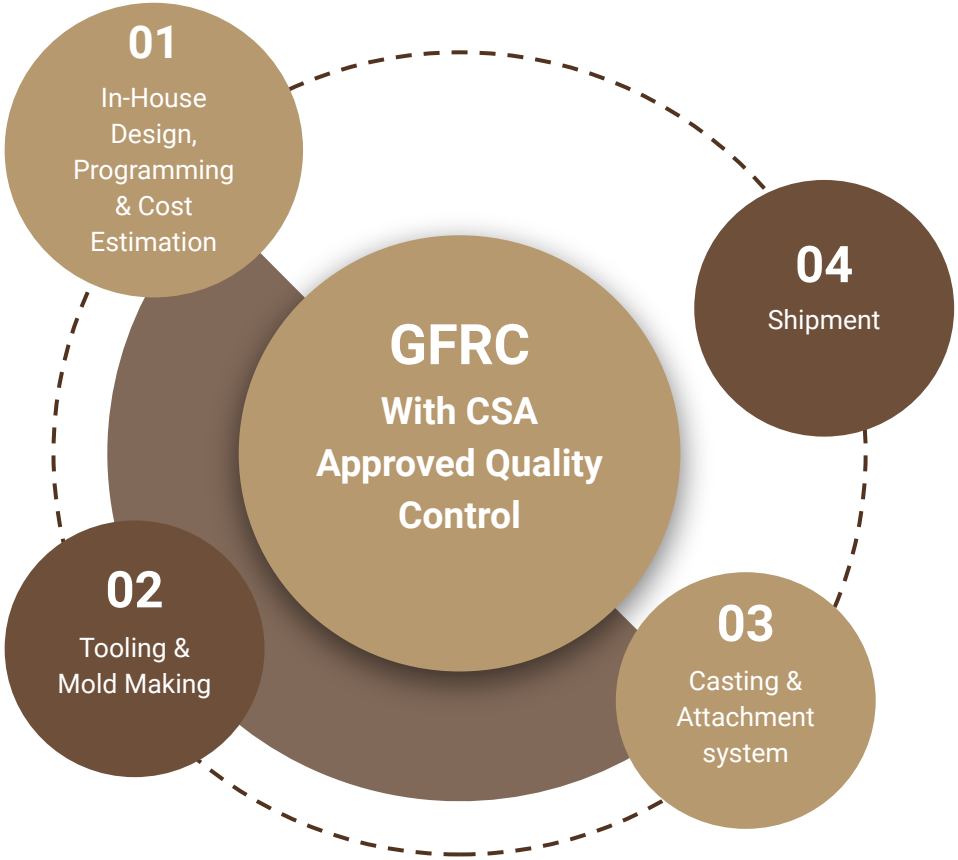
Fabrication

A Stages of GFRC Manufacturing

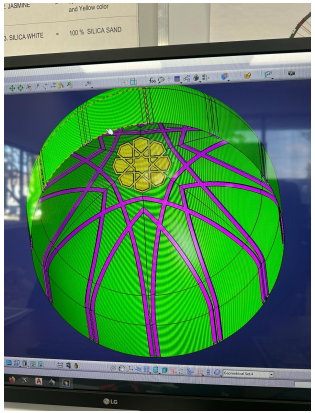
A Collaborative Design Process

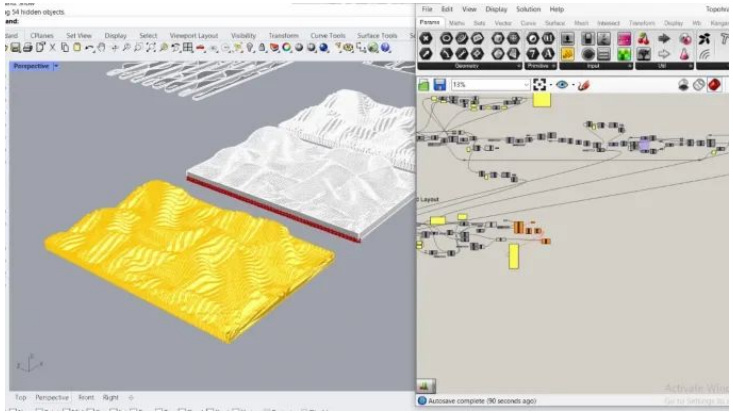
An experienced Team of Project Manager, Designer, and Crafts person



Stage 01

Design
Programming
& Cost estimation





Integrated design and Automation

- For creating of actual scale mold
- CAD-CAM-CATIA integration for Production

Smart Project Management System

- Overall scheduling and project tracking
- Shop tickets/ Barcode to identify parts on site

Cost & Time Efficient Production

- Using integrated automation systems
- Using molds to mass produce the parts

At Petra Design we take pride in our pursuit of cutting edge technology and experienced craftspeople

Stage 02

Tooling & Mold Making

WITH HIGHLY EXPERIENCED TOOLING TEAM

Image: *Wooden mold for Mosque Dome*

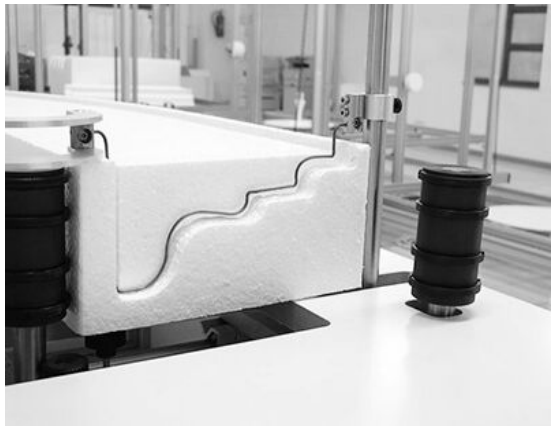
Image: *Wooden+Foam mold for Bench at Calgary Alberta*

Molds are fabricated using a variety of materials, either by skilled craftsmen, or on CNC machines

Stage 02

Tooling & Mold Making

WITH HIGHLY EXPERIENCED TOOLING TEAM



Hot wire Cutting

5 Axis CNC Machine

Stage 03

CASTING & ATTACHMENT SYSTEM

WITH HIGHLY EXPERIENCED TOOLING TEAM

Image: *Ellie Tower Part Production*

- GFRC is cast by SPRAYING. Fluid concrete mixture is sprayed into the forms.
- The process uses a specialized spray gun to apply the fluid concrete mixture and to cut and spray long glass fibers from a continuous spool at the same time

Stage 04

Shipment

Effective Communication Channel
Transportation Management

Image: *Ellie Tower Part Production*

- GFRC is Lightweight which makes it easy to ship and move on lightweight Truck.
- Handling of GFRC requires Lightweight Crane.
- Each GFRC Part should have a unique label or tag that identifies the purpose, and any other relevant information.

04

TECHNIQUES

Attachment Systems

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EFFICIENT MECHANICAL ATTACHMENT SYSTEMS

Compatible with
INDUSTRY
STANDARD
attachment systems

Attachment options
RAIN SCREEN
Wall Assemblies

Options Includes:

1. Z-clips
2. Embedded anchors
3. Brackets
4. Z-Girts
   etc.

Attachment system

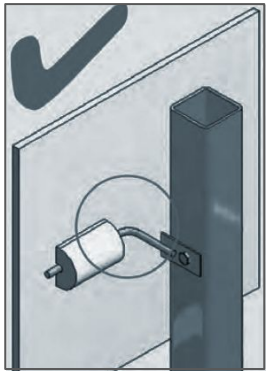
STUD FRAME CONNECTION

- This is by far the most used method in Façade fabrications
- This involves a single GFRC membrane connected to a prefabricated metal frame using L shaped flexible anchors.

FLEX ANCHOR

- provide lateral support for the skin, allow for shrinkage, movement and help retain the shape of the panel.
- In addition it allows for quick removal of the GFRC from the forms, and makes handling and transportation easier.

Application: GFRC membrane connected to prefabricated Metal frame

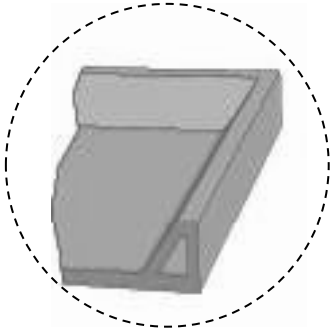


Application: Connection of Flex Anchor Helps to retain the shape

Attachment system

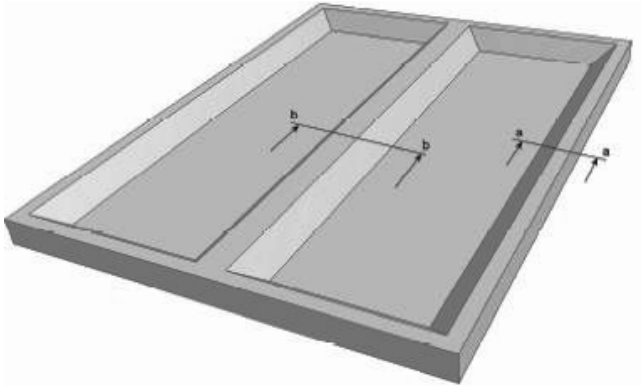
RIBBED PANEL CONNECTIONS

- Flat unreinforced GFRC panels generally are used for small areas.
- To make larger panels, ribs or corrugations are required to strengthen the panels.



Perimeter Flanges

stiffens the edge and provides a bearing surface to seal the joints between the panels.



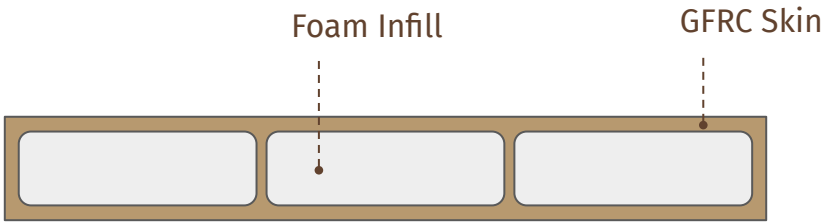
Ribs

can be solid GFRC, or hollow core formed with lightweight foam creating a structural shape like a tube.

Other GFRC Type

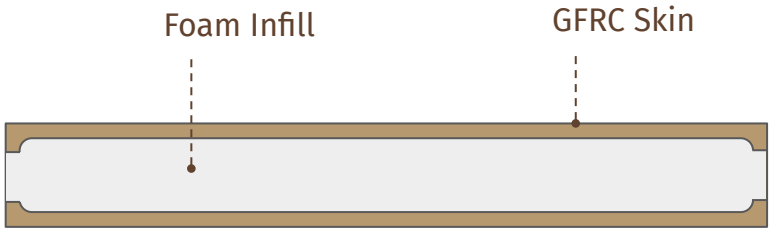
SANDWICH PANEL CONSTRUCTION

- A sandwich panel is two GFRC skins 10 to 15mm thick separated by a lightweight core.



Box-Type Sandwich

The core is totally encapsulated. This is referred to as a box type sandwich. This is not widely used, but exists.



Bonded Sandwich Construction

The core is NOT totally encapsulated but rather exposed at connecting edges.

We Simplify Unique Solutions

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Is it stone?

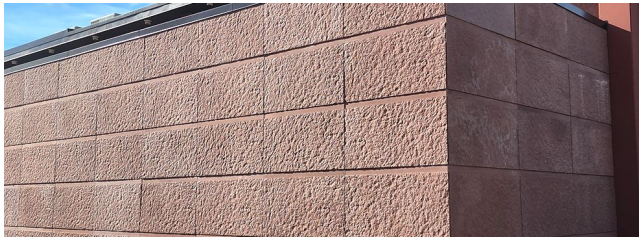
Case in Point:
SETON HALL UNIVERSITY
GFRC EXTERIOR CLADDING

Petra Design works with clients to:

Petra Design works with clients to:

1. design
2. engineer
3. and produce

unique solutions to challenging problems!



Challenge

- EXTRA LARGE panels exceed capacity of available solutions

Solution

- Petra Design designs, engineers, and produces a custom embedded attachment system

WE SIMPLIFY UNIQUE SOLUTIONS.

Petra Design works with clients to:

Petra Design works with clients to:

1. design
2. engineer
3. and produce

unique solutions to challenging problems!

Nothing gets by without testing!
in-house pull-out testing
tensile & compressive stress

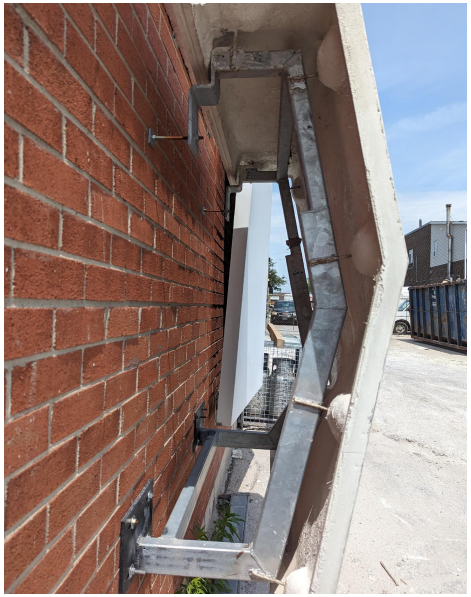


Image: *testing Elise Tower podium spandrel panels by Petra Design*

05

PROJECTS

Petra Work Examples

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ELLIE CONDO

North York, ON

Commercial Tower Cladding
LARGE SCALE GFRC EXTERIOR CLADDING
Fabricated by: Petra Design, Toronto

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North York, ON

Commercial Tower Cladding
LARGE SCALE GFRC EXTERIOR CLADDING
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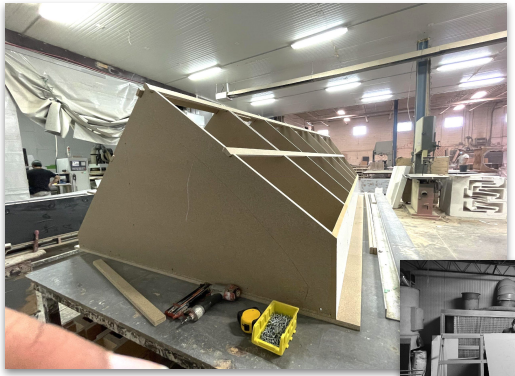


Image: *Mold production for Ellie Tower podium by Petra Design*

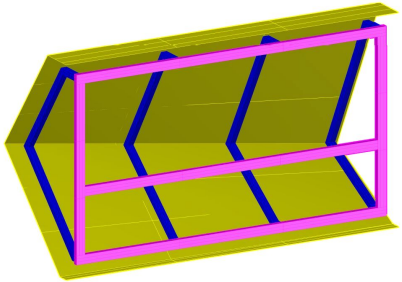


Image: *3d Model Generation for Tooling and Precise size for part*

Image: *HSS Frame Connections works as a armature for GFRC*

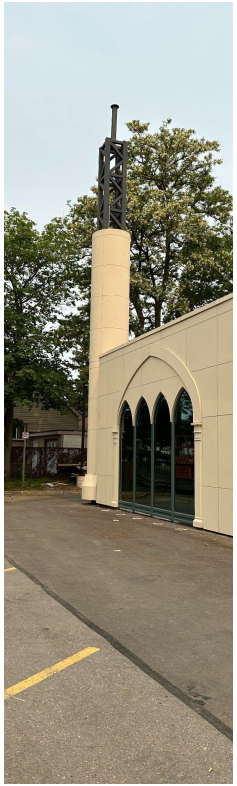
ELLIE CONDO

North York, ON

Commercial Tower Cladding
LARGE SCALE GFRC EXTERIOR CLADDING
Fabricated by: Petra Design, Toronto

OLD KINGSTON MOSQUE

Scarborough, ON



Religious Building

GFRC Cladding + FRP Dome
Fabricated by: Petra Design, Toronto

OLD KINGSTON MOSQUE

Scarborough, ON

Religious Building

GFRC Cladding + FRP Dome
Fabricated by: Petra Design, Toronto

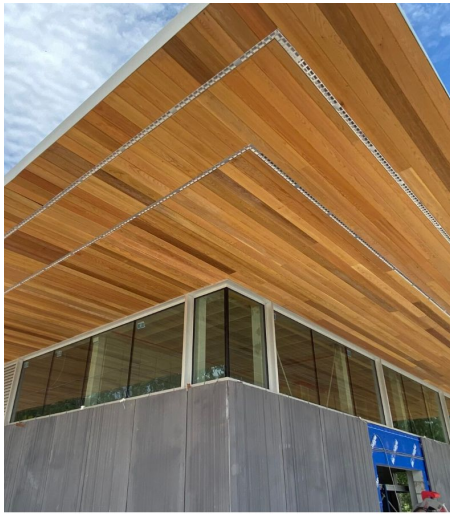
SETON HALL UNIVERSITY

Philadelphia, PA

LARGE SCALE GFRC EXTERIOR CLADDING
Contractor : Component Assembly Systems
Fabricated by: Petra Design, Toronto

BROWNS BAY REVITALIZATION

St. Lawrence Park, Kingston



Recreational

GFRC Cladding
Fabricated by: Petra Design, Toronto

URBAN BENCH

Toronto, ON

Exterior landscaping

GFRC BENCH AND PLANTER
Fabricated by: Petra Design, Toronto

GRAPHIC CONCRETE

Toronto, ON

Fabricated by: Petra Design, Toronto

We find GFRC exciting

- Iconic buildings of course.
- Simple buildings made iconic, maybe you did not consider.
- Material around forever.
- Technology and learning developed in last couple decades. A special capability of Petra and the team we have built. We are very grateful.
- Our best place is at the design table.

You have ideas, and we have ways to make them real.

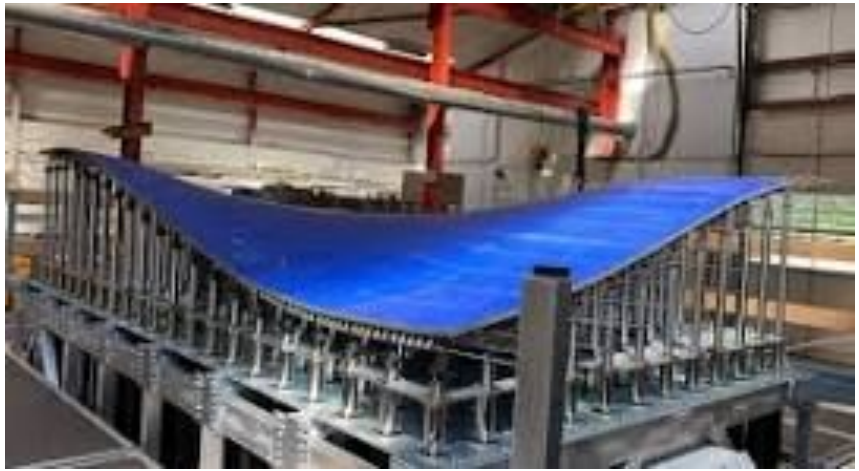
Ultra High Performance Concrete made here at home.

Innovative composition allows for slender designs, making it a preferred choice for robust, long-lasting structures.

Boasting exceptional strength and durability. With compressive strengths surpassing **130 MPa**

Unparalleled resistance to corrosion and wear

Programmable Molds



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Want to see more?

VISIT OUR SHOWROOM!

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Thank you for your time.

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