ADVANCED CONCRETE TECHNOLOGY

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Research interest: sustainable waste material, **concrete technology**, **Lightweight concrete**, green concrete, Concrete durability, sustainable development, sustainable energy production, **Geopolymer concrete**, Building Information Modelling (BIM).

Floating Structures

Floating Island, Seoul, South Korea

Built in The Han river which divides Seoul in half, the complex consists of three structures, representing the three stages of a blooming flower: seed, bud, and blossom.

Floating Prison, New York City, USA

Recognized by the Guinness Book of World Records as the largest operational prison ship in the world, the barge was built as a result of overcrowding prisons in 1980s.

Concept

Materials + Buoyancy concept = Floating structures

Cronulla Marina (Australia)

UTM UNIVERSITI TEKNOLOGI MALAYSIA

Concept

- Combination of binder, reinforcement and buoyancy materials.
- Binder = concrete, polymer, composite, etc
- Reinforcement = fiber, wire mesh, etc
- Buoyancy materials = Styrofoam, EPS, etc



Process

Process

Lightweight Concrete

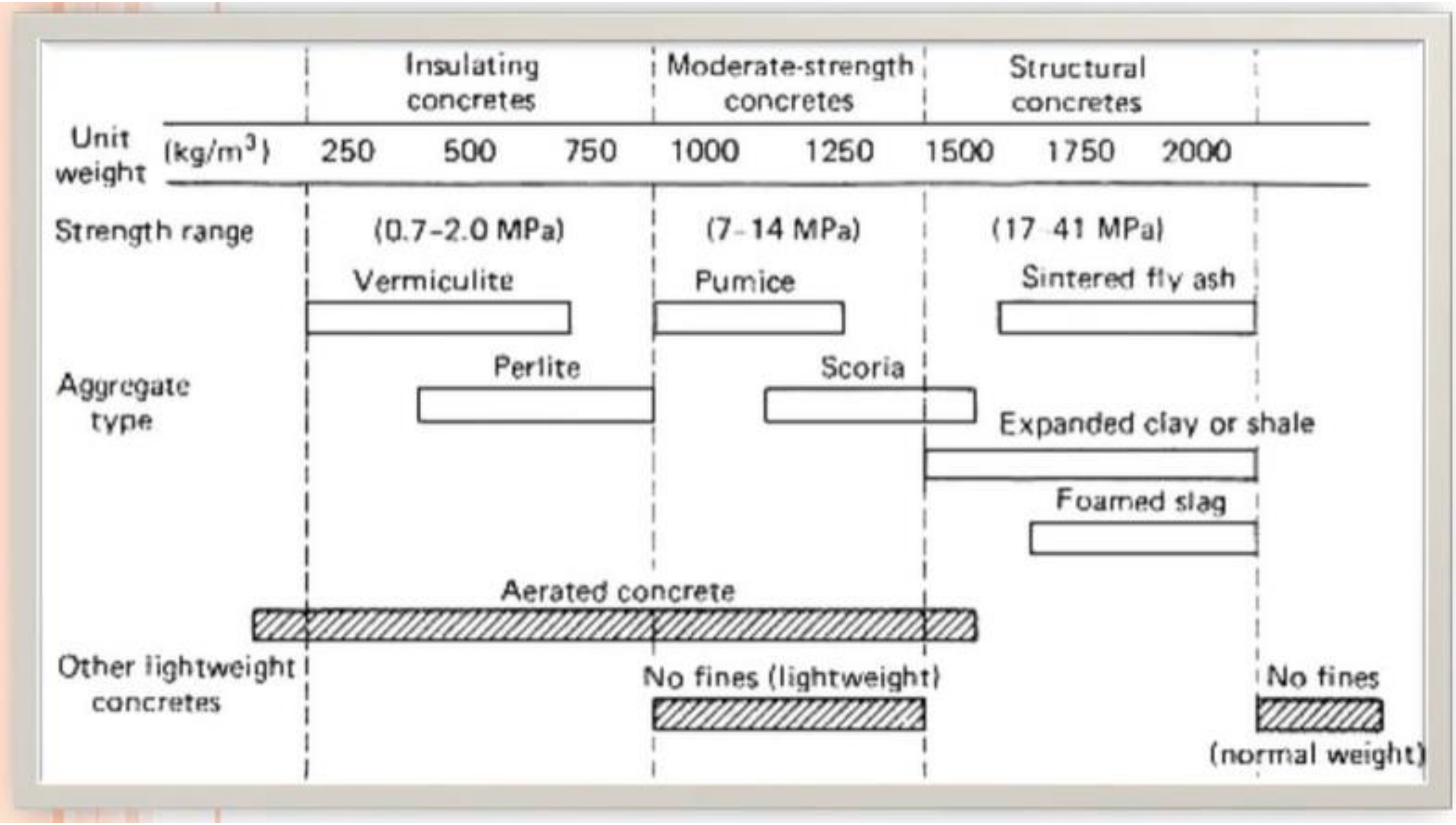
- Special concrete which weighs lighter than conventional concrete
- Density is considerably low (300 kg/m^3 to 1850 kg/m^3) when compared to normal concrete (2200 kg/m^3 to 2600 kg/m^3).

Lightweight aggregates concrete

Aerated concrete

No - fines concrete

Lightweight Concrete



Classification

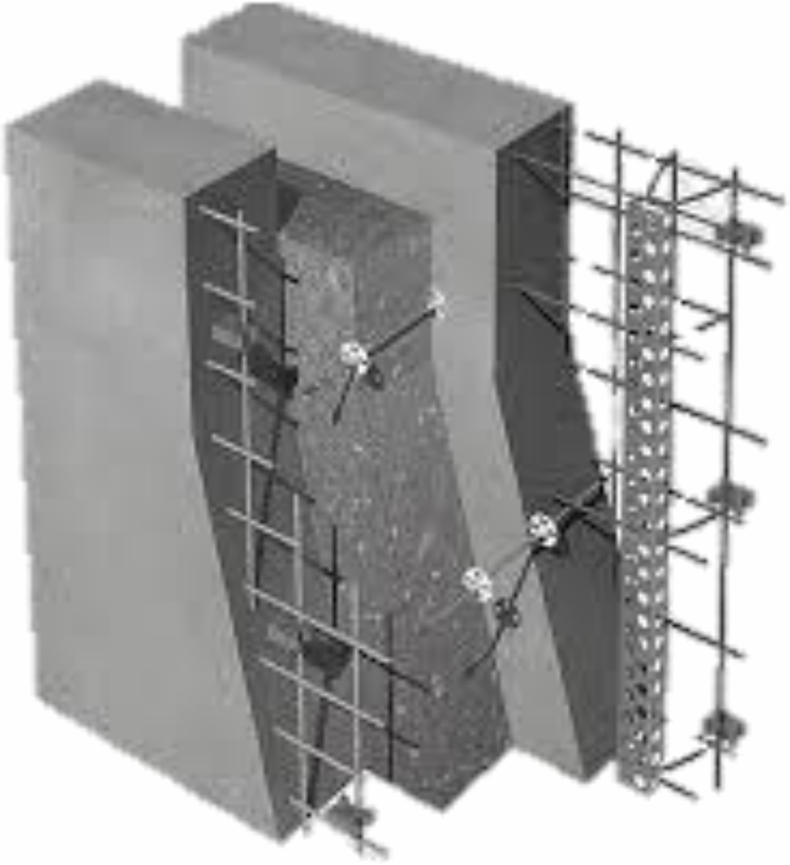
1. Low Density Concrete

These are employing chiefly for insulation purposes. With low unit weight, seldom exceeding 800 kg/m^3, heat insulation value are high. Compressive strength are low, regarding from about 0.69 to 6.89 N/mm^2.

Classification

2. Moderate Density Concrete

The use of these concrete requires a fair degree of compressive strength, and thus they fall about midway between the structural and low-density concrete. These are sometimes designed as ‘fill’ concrete. Compressive strength are approximately 6.89 to 17.24 N/mm^2 and insulation values are intermediate.



Classification

3. Structural Concrete

Concrete with full structural efficiency contain aggregates which fall on the other end of the scale, and which are generally made with expanded shale, clay, slates, slag, and fly-ash. Minimum compressive strength is 17.24 N/mm^2.

Most structural LWC can produce concrete with compressive strength in excess of 34.47 N/mm^2.

Lightweight Aggregates


unisel
UNIVERSITI SELANGOR
Peneraju Transformasi
UTMCanoe

Applications

First Use of High Strength Lightweight Precast Concrete in New Zealand*

*Article Summary : From “The Wellington Stadium, New Zealand’s First Use of High Strength Lightweight Precast Concrete” by Leonard G. McSaveney, Golden Bay Cement, Division of Fletcher Concrete & Infrastructure, Ltd., Auckland, New Zealand.

2002

4000 precast lightweight components accommodated rapid construction

Rapid Construction – Scheduled major sporting and entertainment events presented the contractor with a demanding timetable that favored precast elements. With the nearest precast factory approximately 60 km away, the use of lightweight reduced the transportation costs for the 4,000 individual precast components needed. It also ensured that even the largest pieces of concrete could be transported on standard truck and trailer units. The need for special transporters, pilot vehicles, permits and other expenses were avoided.

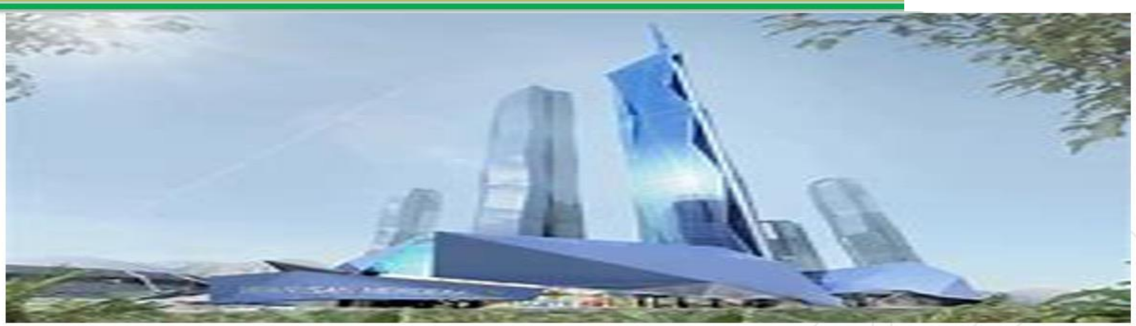
Applications

54 STORIES OF PUMPED LIGHTWEIGHT CONCRETE

Chicago, IL was selected to provide approximately 14,000 cubic yards of steel fiber reinforced, 4000 psi lightweight concrete for a 742-foot, 54-story skyscraper located at 150 North Riverside, right on the Chicago River in downtown Chicago. The concrete mix called for the use of expanded shale, lightweight aggregate to achieve a maximum equilibrium density of 110 pounds per cubic foot. Pumping lightweight concrete this high requires a pumpable mix meeting the weight specification to achieve design dead-loads and to provide the optimum strength and fire rating to protect the building's tenants and visitors. The mix also required good placement, workability and finishability characteristics to stay within the concrete construction's allotted timeline.

Applications

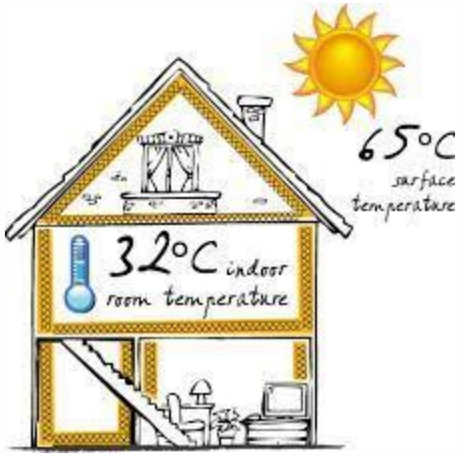
PNB 118 - KL



LAKEPARK RESIDENCE – KL NORTH

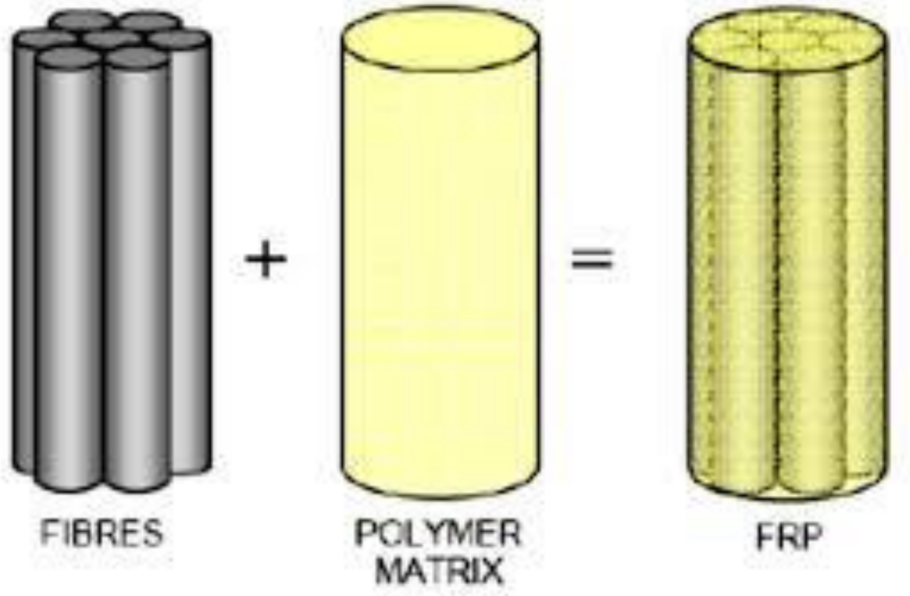
Advantages

1. Reduced dead load of wet concrete allows longer span to be poured un-propped. This save both labor and circle time for each floor.
2. Reduction of dead load, faster building rates and lower haulage and handling costs.
3. The use of LWC has sometimes made its possible to proceed with the design which otherwise would have been abandoned because of excessive weight.
4. Relatively low thermal conductivity.



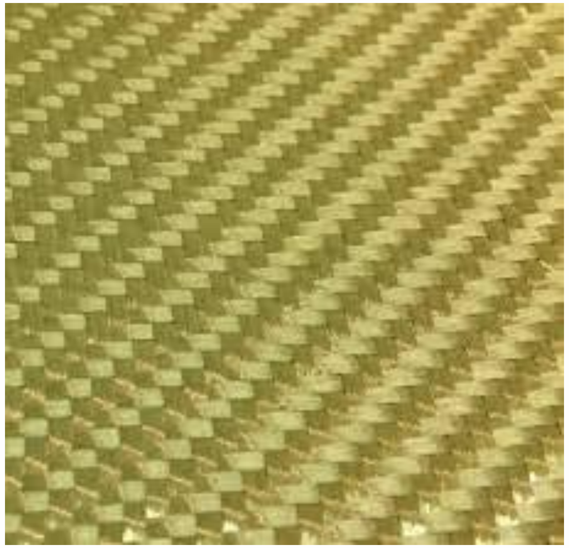
Fibre Reinforced Polymer (FRP)

FRP	=	Fibre	+	Polymer
		Carbon		Thermoset
		Aramid		Thermoplastic
		Glass		



Types of Fibres

Glass Fibre



Aramid Fibre

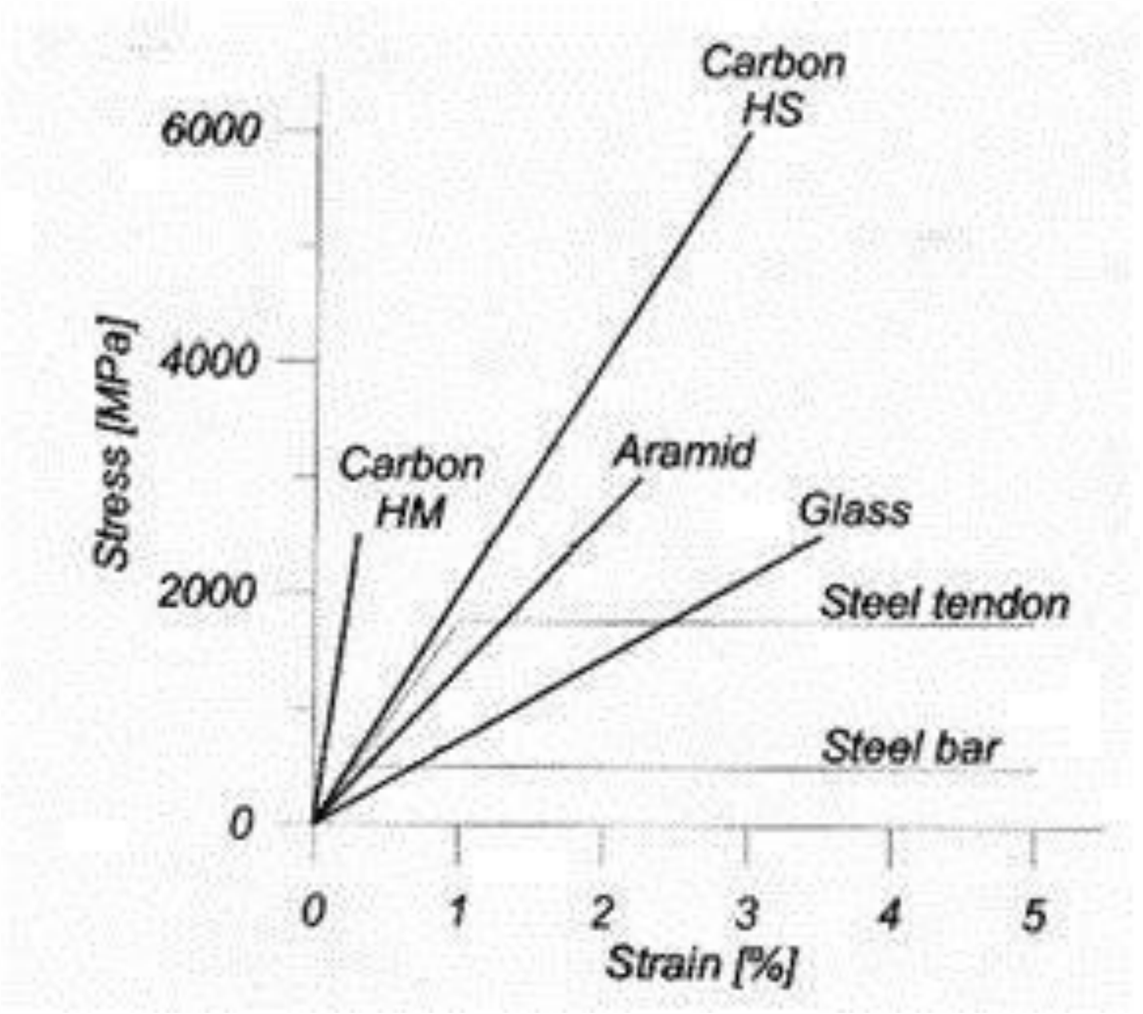
Carbon Fibre

Why use FRP?

- Durable solve corrosion problem
- Lightweight but strong
- Vandalism problem missing manhole cove
- New material for better performance
- Others

Advantages

- High tensile strength (3-to-5 times stronger than steel)
- Low weight (no foundation adjustments required)
- Corrosion resistance and protection
- Chemical protection
- Waterproof
- Rapid repair capability
- Versatile
- Minimal investment when compared to complete structural replacement.



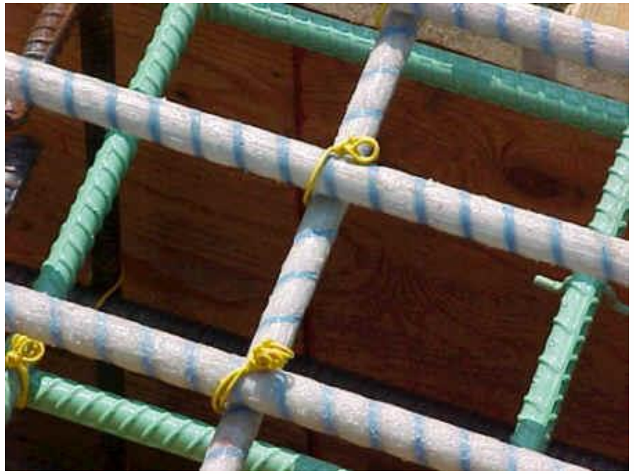
Applications

- RENEWAL OF CIVIL STRUCTURAL INVENTORY
  - Rehabilitation
    - Repair
    - Strengthening
    - Retrofitting
  - New Construction
    - All FRP
    - New Composite Systems

Applications

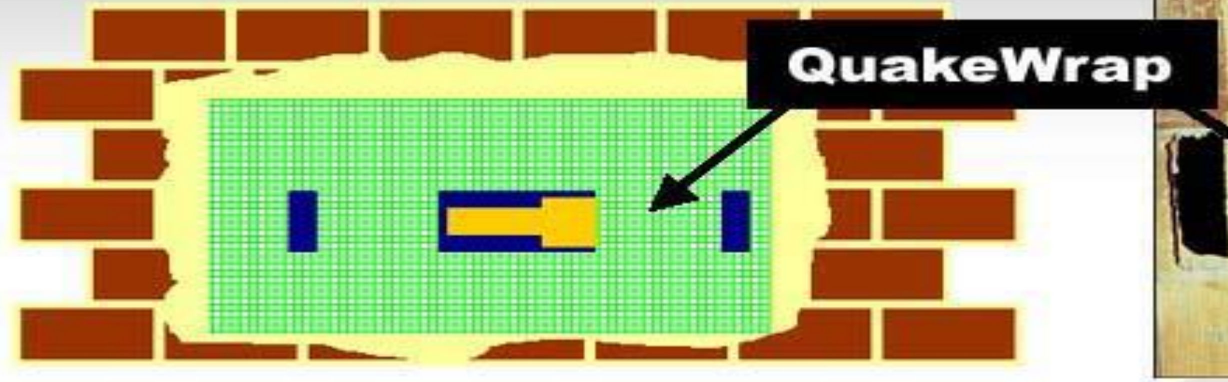
Demian Bulwa / The Chronicle

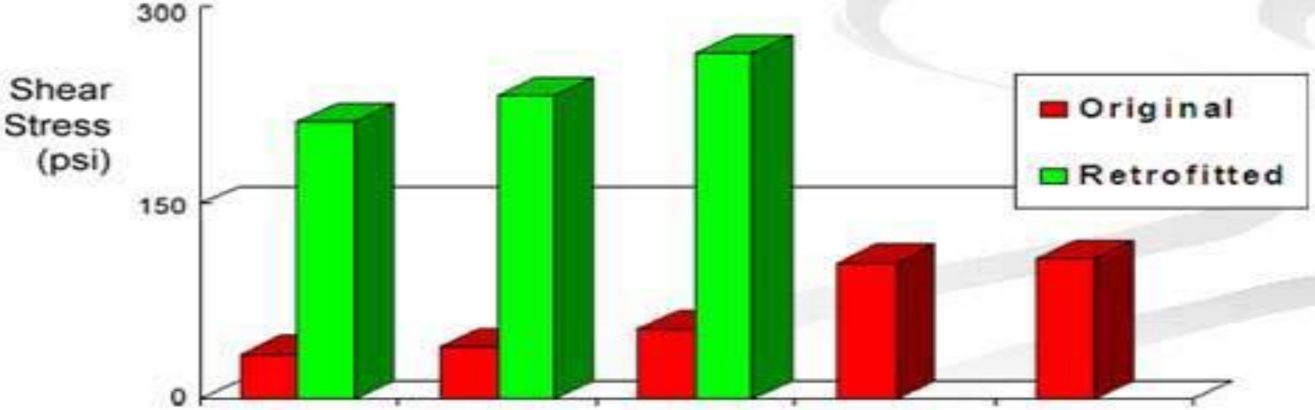
Applications



Retrofitting with FRP

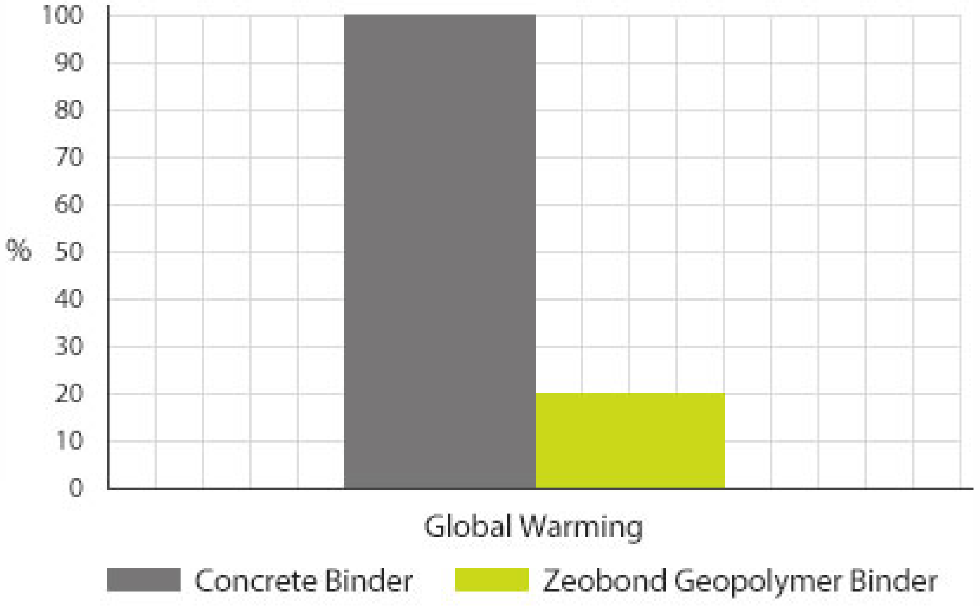
Push Test for Shear Strength of FRP





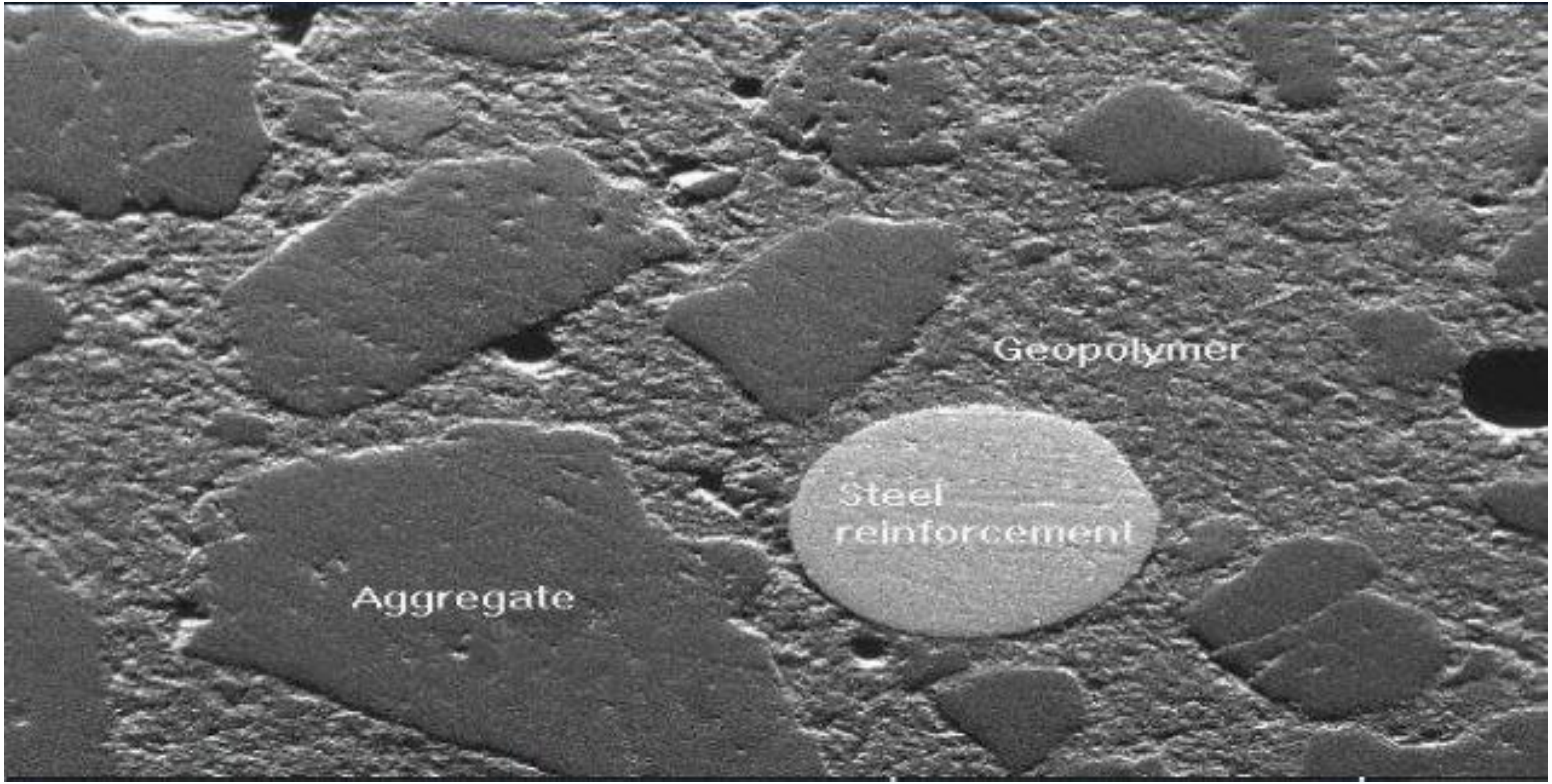
Geopolymer concrete

Source: https://theconstructor.org/



Comparng 1 m3 'Concrete Binder' with 1 m3 'Zeobond Geopolymer Binder';
Method: geobond CO_2 V2.02 / IMPACT 2002+ / character
Source: Netbalance LCA report 2007

Geopolymer concrete



Geopolymer concrete

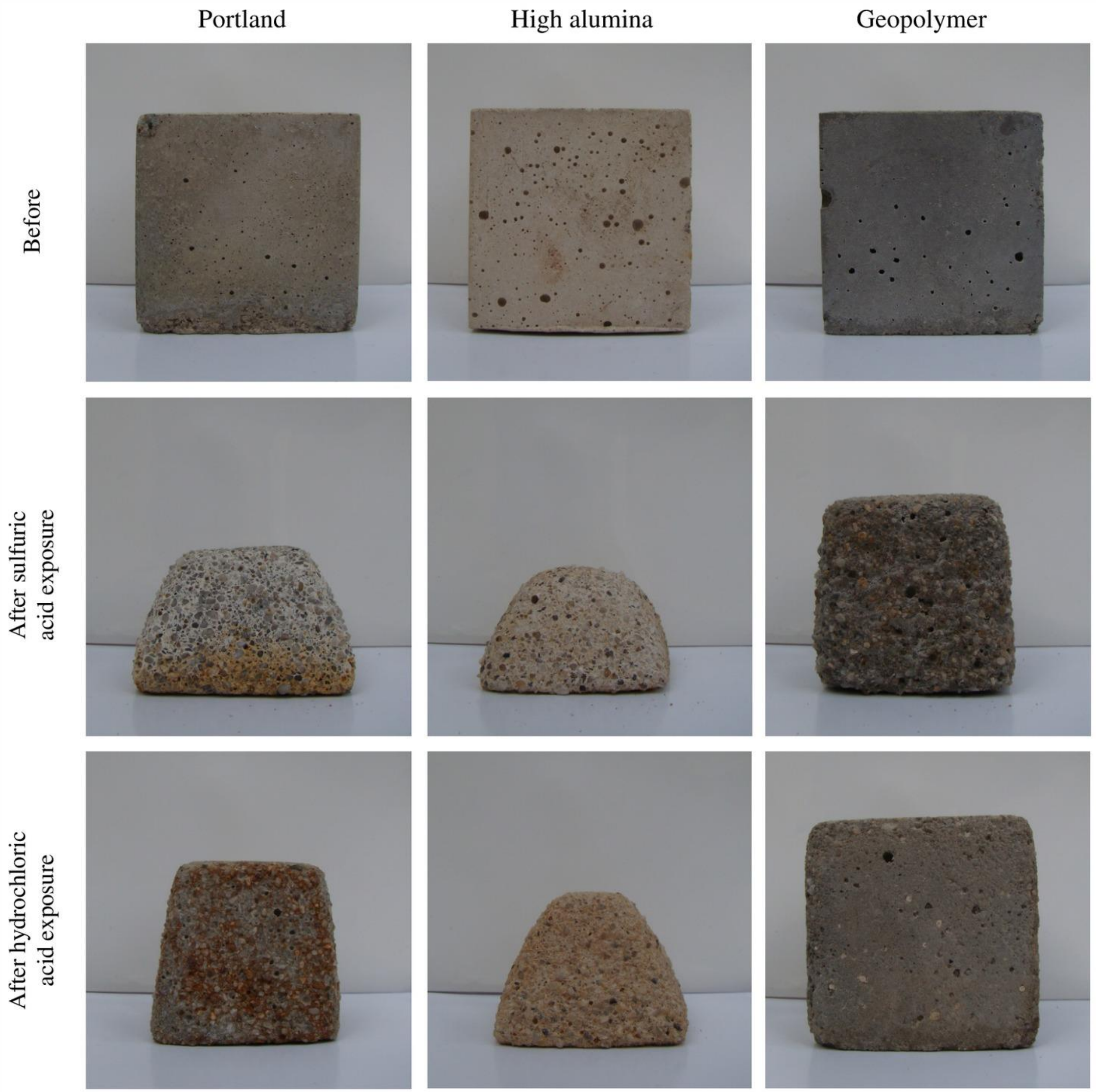
Advantages

- Cutting the world's carbon
- Better compressive strength
- High fire resistant
- Low permeability
- Excellent properties against aggressive environments

Challenges

- Different source materials
- Industry regulations / standard
- New material
- Lack of awareness
- Need skill labour
- Expensive cost

Geopolymer durability



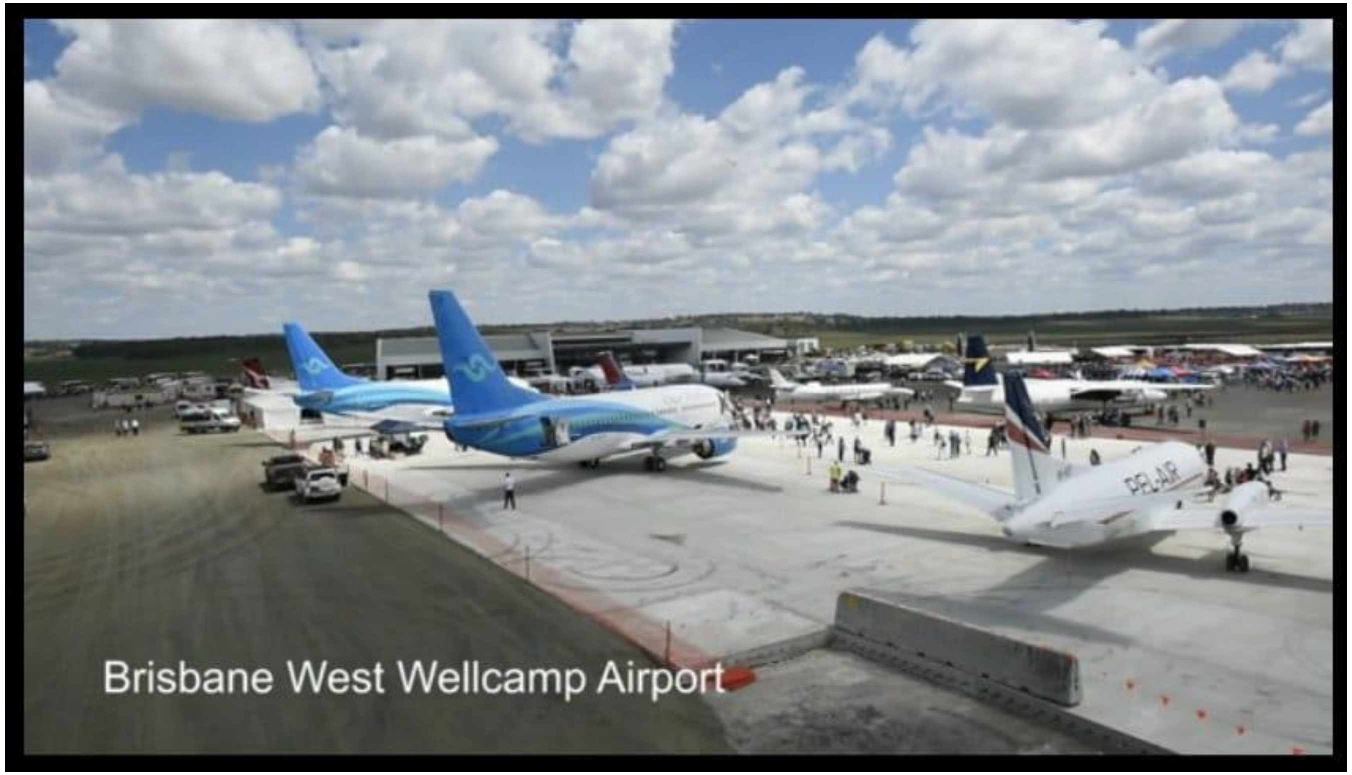
Application

Queensland's University GCI building with 3 suspended floors made from structural geopolymer concrete in 2013. The 4-story high building, for general public use, comprises 3 suspended geopolymer concrete floors involving 33 precast panels.

Credit: Hassel Architect

Credit: Wagners

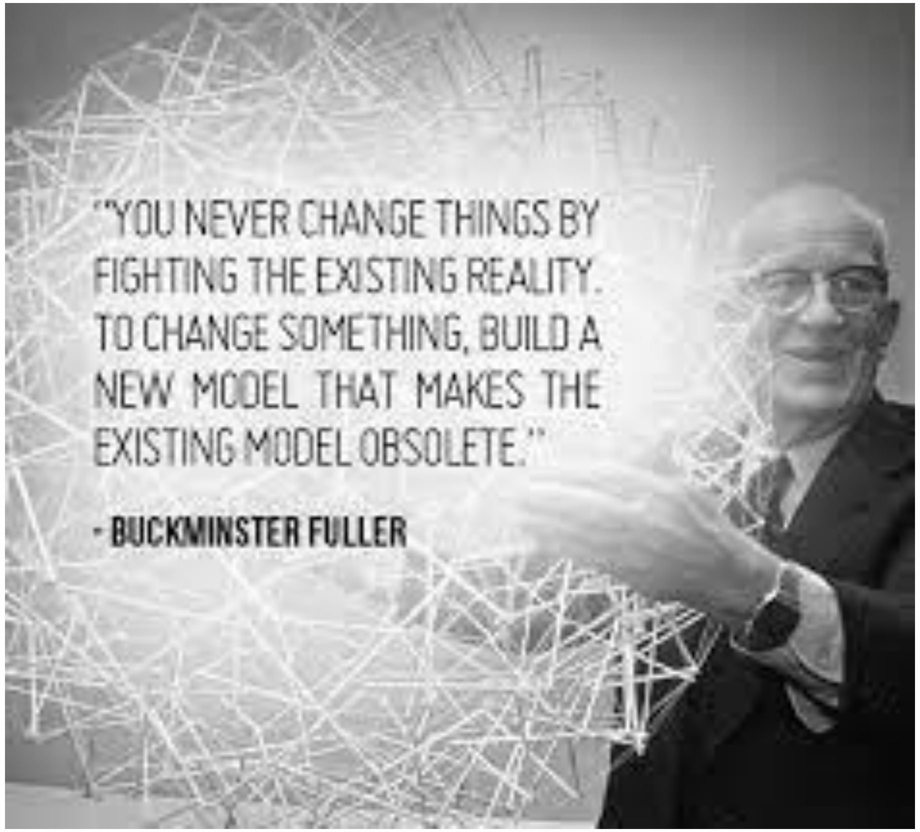
Application



Credit: *The Chronicle 29 Sept. 2014*

Brisbane Wellcamp airport becomes the greenest airport in the world in 2014. More than 30,000 cubic metres of the world's lowest carbon, cement-free geopolymer concrete, Wagners' Earth Friendly Concrete (EFC), was used to save more than 6,600 tonnes of carbon emissions in the construction of the airport.

Thank you



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