

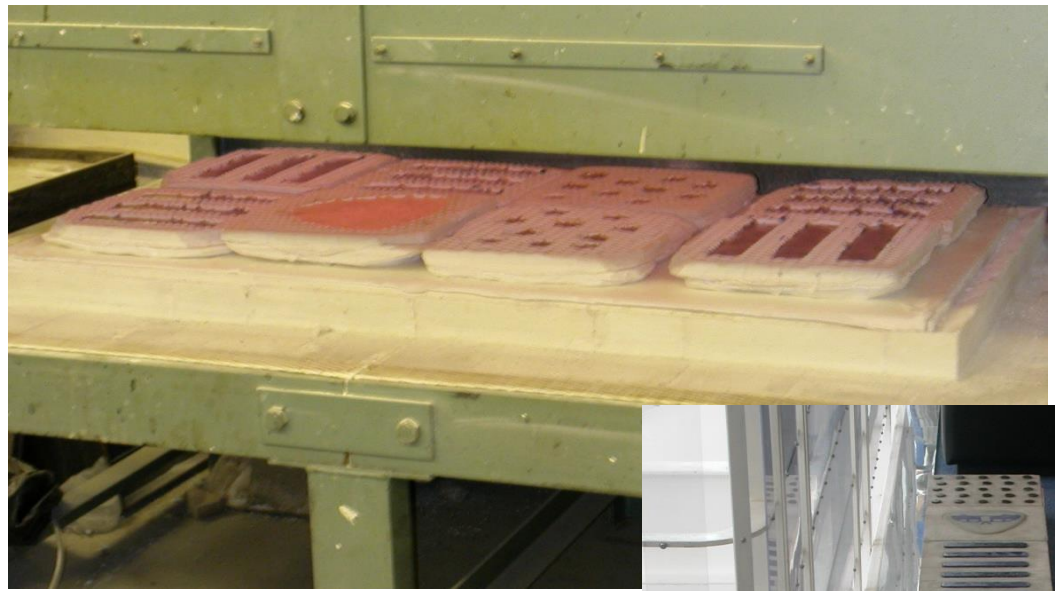
Faculty of Architecture, Computing and Engineering (FACE) Research Seminar

19th April 2017

Recycled glass applied to construction

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tyra.oseng-rees@uwtsd.ac.uk





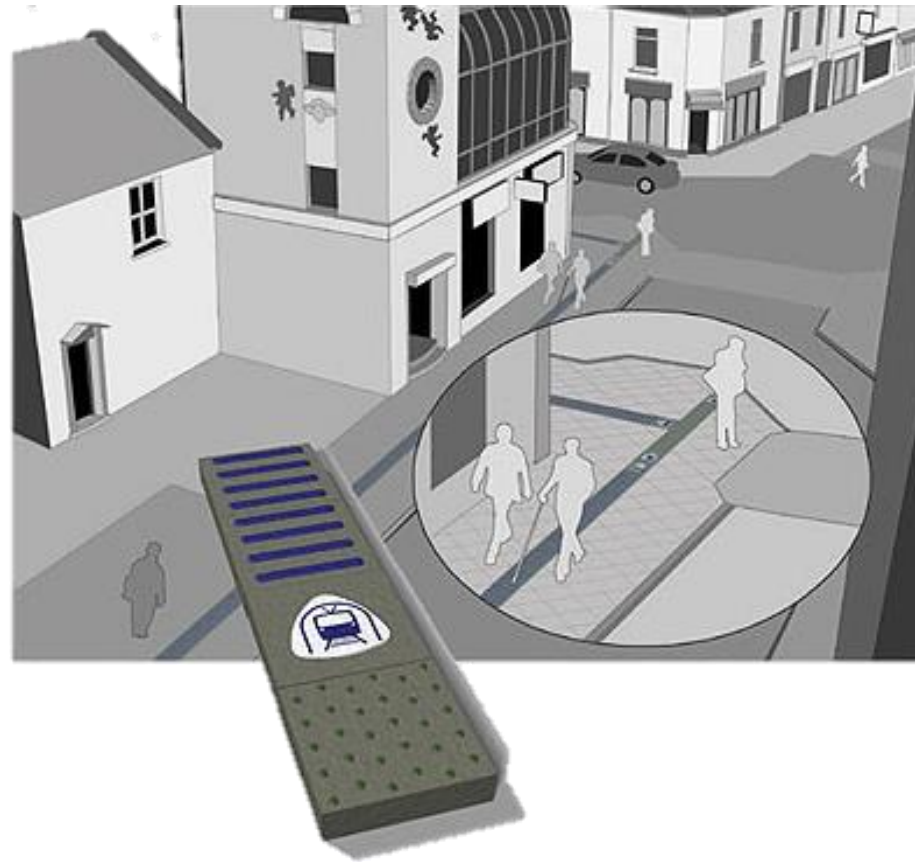
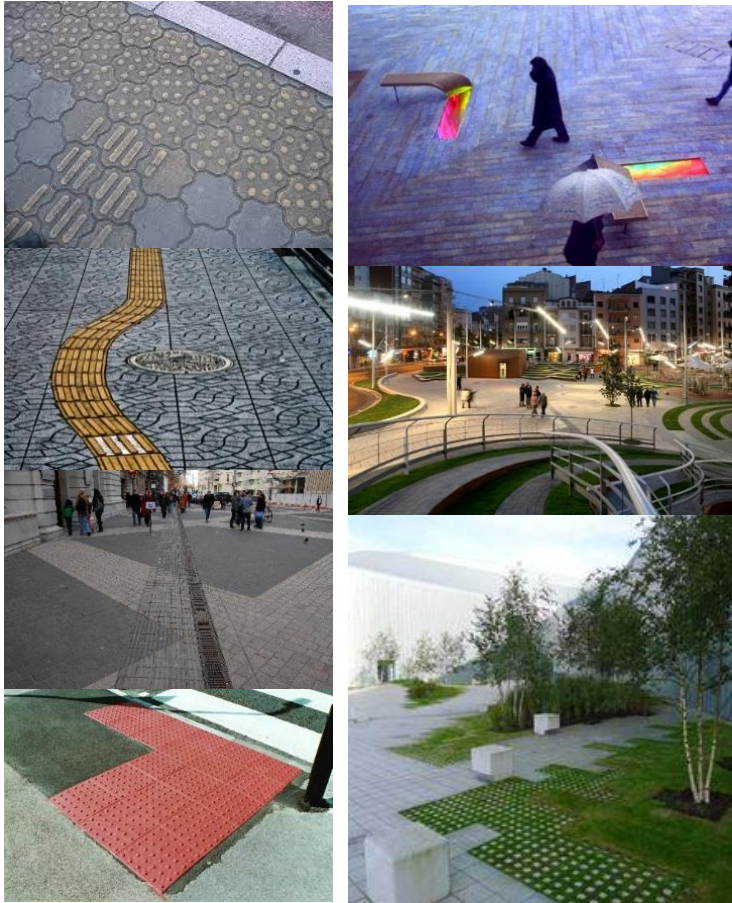
Research proposal

Recycled glass urban paving

The application?

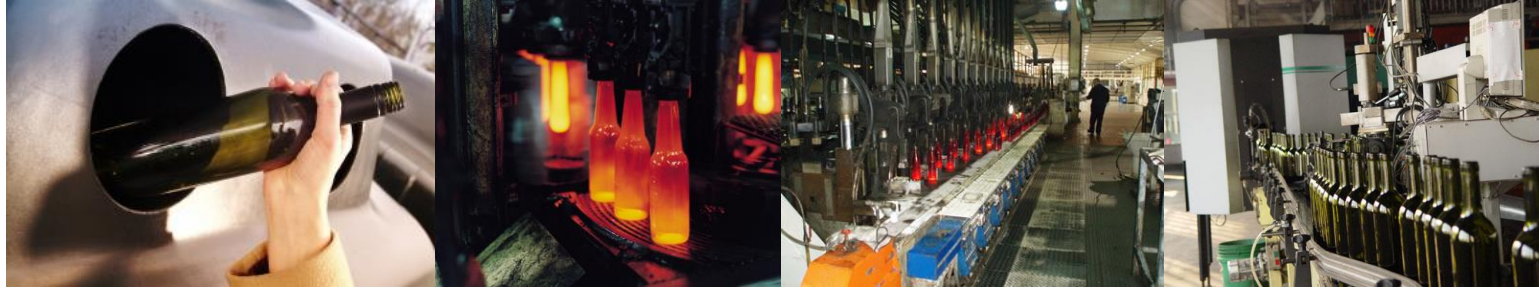
Tactile paving
Inclusive design
Aesthetic
Materiality
Sustainability

PhD 2009
Physical and Aesthetic
Properties of Fused
Recycled Bottle Glass



Recycled Glass,

Circular
Economy



Up-cycling



Down-cycling





The process of working with bottle glass; Fusing/Sintering versus Hot Glass Melt

Temperatures between:

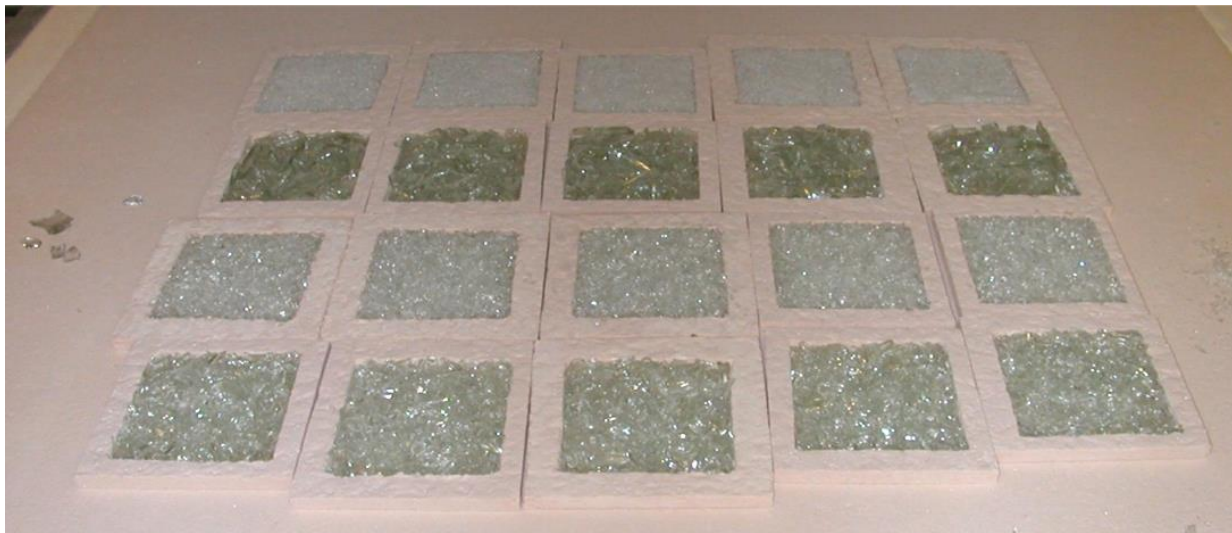
- 800°C to 900°C for fusion
- Above 1040°C for hot glass melt

Fragment sizes between:

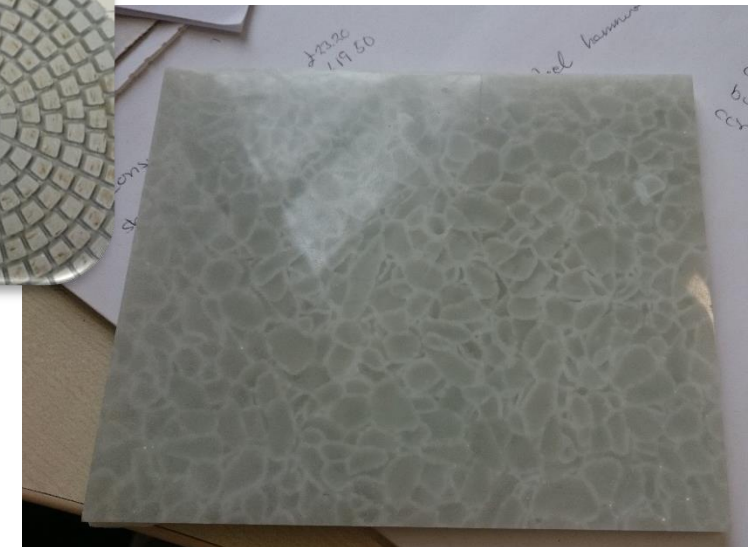
- 0-2 mm, 2-6mm, 6-12 mm and above 12mm for fusion
- N/A for hot glass melt



The process of working with bottle glass; Cleaning, crushing, fusing



The process of working with bottle glass; Fusing and cold working



Tiled splashback in bathroom



Details of tiles in bathroom



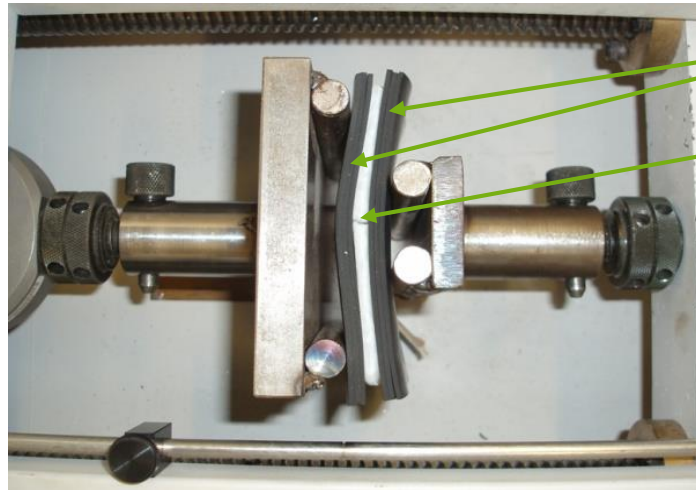
The process of working with bottle glass; Colour



The process of working with bottle glass; Colour

% frit added Frit added to 35g glass		Blue (B), Yellow (Y), Red (R), White(W)												
		B	B/Y	B/Y	B/Y	B/Y	B/Y	B/Y	Y	Y/R	Y/R	R	R/B	W
		100	50/50	25/75	20/80	15/85	10/90	5/95	100	75/25	50/50	100	50/50	0
Complementary colour added	0.1g													
	0.5g													
	1.0g													
Frit-to-glass ratio	3.0g													
	2.0g													
	1.0g													
	0.5g													
Marble effect	1.0g													
	3.0g													

The process of working with bottle glass; Strength



Neoprene cushioning

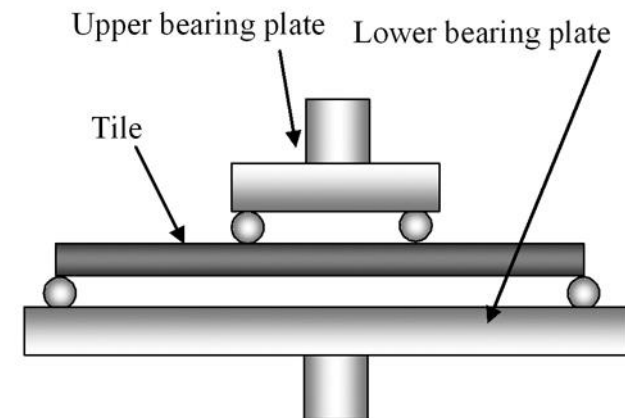
Glass tile

- The specimen is clamped between two bearing plates (upper and lower).
- An increasing load is applied to the centre of the specimen.

- The instrument automatically generates Force versus Displacement data.
- The energy and maximum force required to break the sample can be measured.
- The maximum break force allows the Modulus of Rupture (R) for the sample to be calculated.

$$R = \frac{PL}{bd^2}$$

Where P = maximum breaking force, L = span length between the outer supports of the lower bearing plate, b = sample width and d = sample depth.



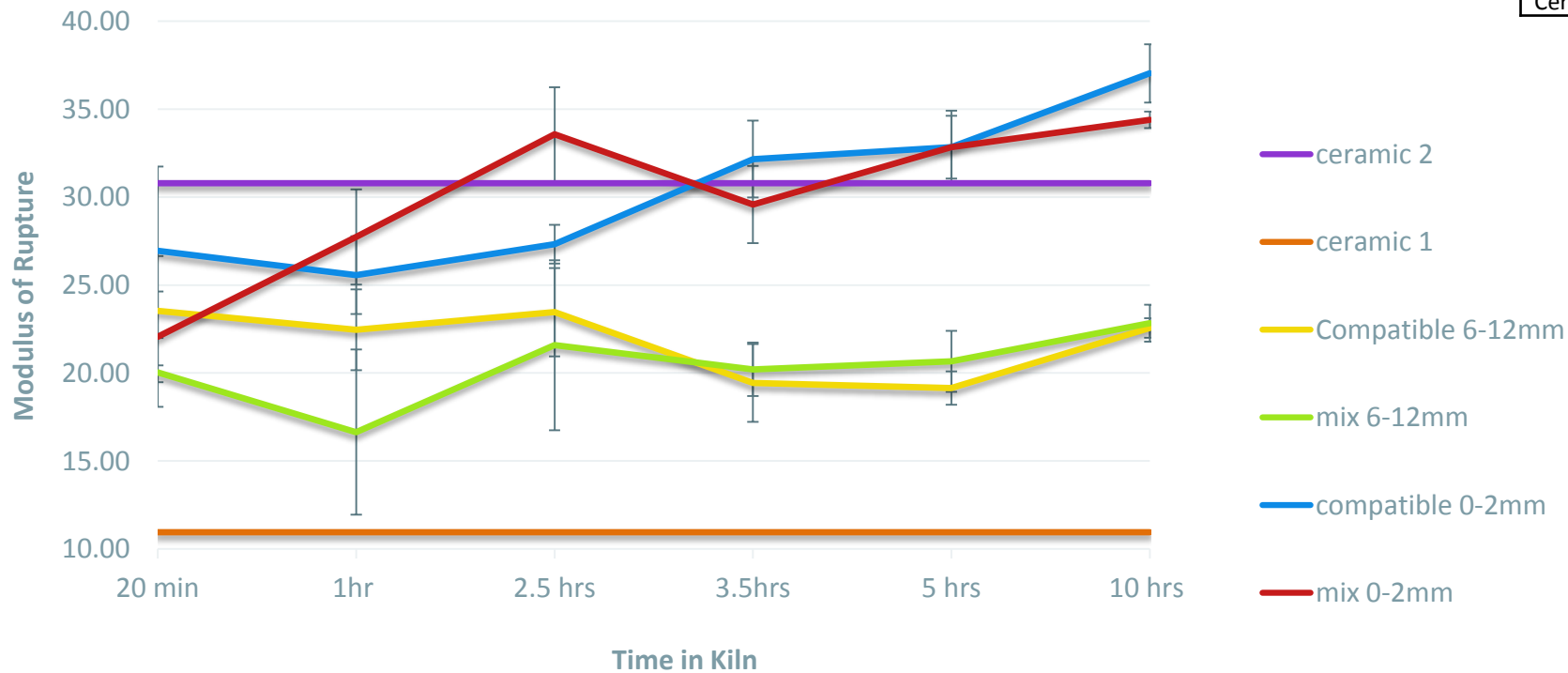
The process of working with bottle glass; Strength

Time in kiln	6-12mm					
	compatible			mix		
	MPa	R	stdv	MPa	R	stdv
20 min	6.23	23.54	3.11	9.64	20.03	1.96
1hr	7.12	22.46	2.30	9.77	16.64	4.69
2.5 hrs	4.69	23.46	2.51	4.58	21.58	4.83
3.5hrs	1.29	19.43	2.21	1.34	20.21	1.52
5 hrs	0.93	19.14	0.95	0.98	20.66	1.73
10 hrs	1.12	22.56	0.56	1.12	22.83	1.05

0-2mm					
compatible			mix		
MPa	R	stdv	MPa	R	stdv
5.01	26.94	4.80	4.14	22.06	2.58
3.84	25.56	2.21	3.49	27.73	2.71
3.07	27.32	1.10	3.55	33.57	2.68
1.73	32.16	2.19	1.61	29.58	2.19
1.47	33.13	1.78	1.16	32.84	2.07
1.50	37.03	1.66	1.26	34.39	0.47

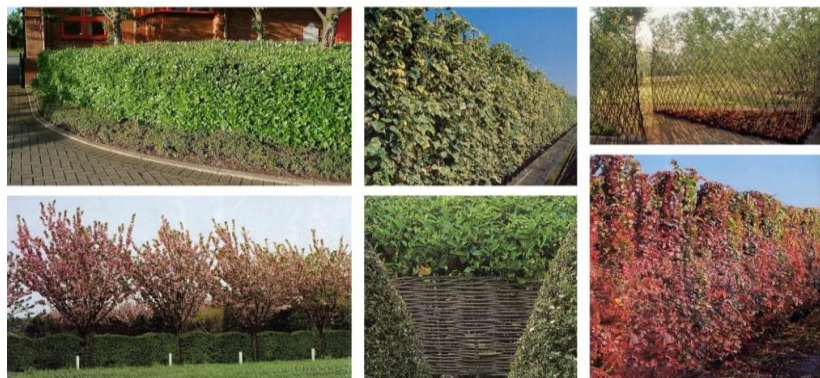
Commercial tiles	R
Ceramic 1	10.95
Ceramic 2	30.79

Modulus of Rupture with Increased Time in Kiln



The Gwalia Project

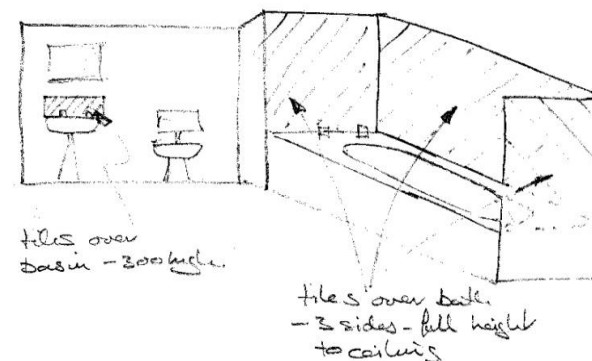
Grŵp Gwalia working with
architects Philip Roberts
and Elfed Roberts



Gŵyr Homes



DIA - BATHROOM LAYOUT - TILING



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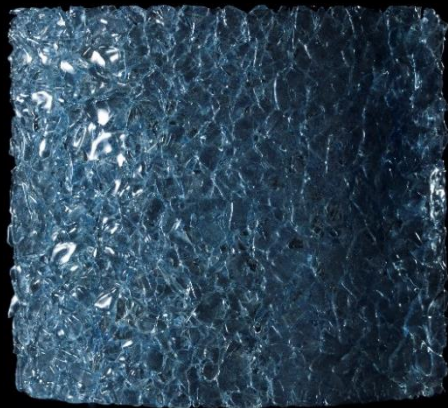






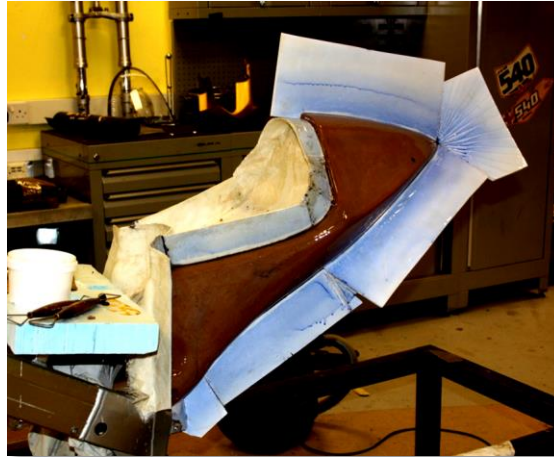
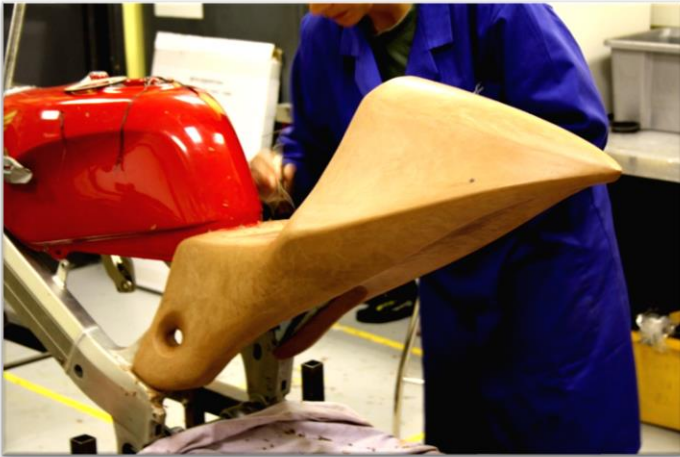
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Next Logical step after the PhD?

Design and Manufacture of Motorsport Carbon Fibre Structures





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the guardian
UNIVERSITY
AWARDS
Winner
2013



Back to focus....

...pursuing the recycled glass research...

Research proposal presented May 2015

Recycled glass urban paving for SA1

Wider benefits

What to do?

Cross disciplinary

Engineering

- Freeze/thaw cyclic testing
- Impact test
- Durability
- Accelerated weathering tests

Product design

- Product development
- Urban design
- Mass manufacturing /upscaling production line

Art & Design

- Design development
- Aesthetic development

Psychology

- Likability test
- Behavioral change towards sustainable products

Business

- Business case for spin-out
- Industrial links

Architectural /Built environment

- Building specs
- Space development

Why do it?

Raise UWTSD profile in Sustainability

Economic

- Research funding (EPSRC/ AHRC)
- Business investment for equipment, test center and manufacturing
 - Stone Care Swansea,
 - GlassTech
 - HOS Civils Ltd
 - Premier Concrete
 - Tidal Lagoon
- Business to establish at SA1 Innovation Quarter

Social

- Public realm
- Usability test
- Community engagement with UWTSD
- Research support staff
- PhD scholarship
- Jobs in the industry
- Safeguarding and creating jobs

Environmental

- Recycled material
- Locally manufactured
- Locally sourced material

A unique sustainable architectural showcase for Swansea Waterfront Innovation Quarter

Increase expertise and reputation

- Heritage from Swansea College of Art
- Business links/ R&Ds
- Spin-out companies
- Create a test centre
- University collaborations
- Oslo and Akershus University College
- Sheffield University,
- Cardiff University

Research funding

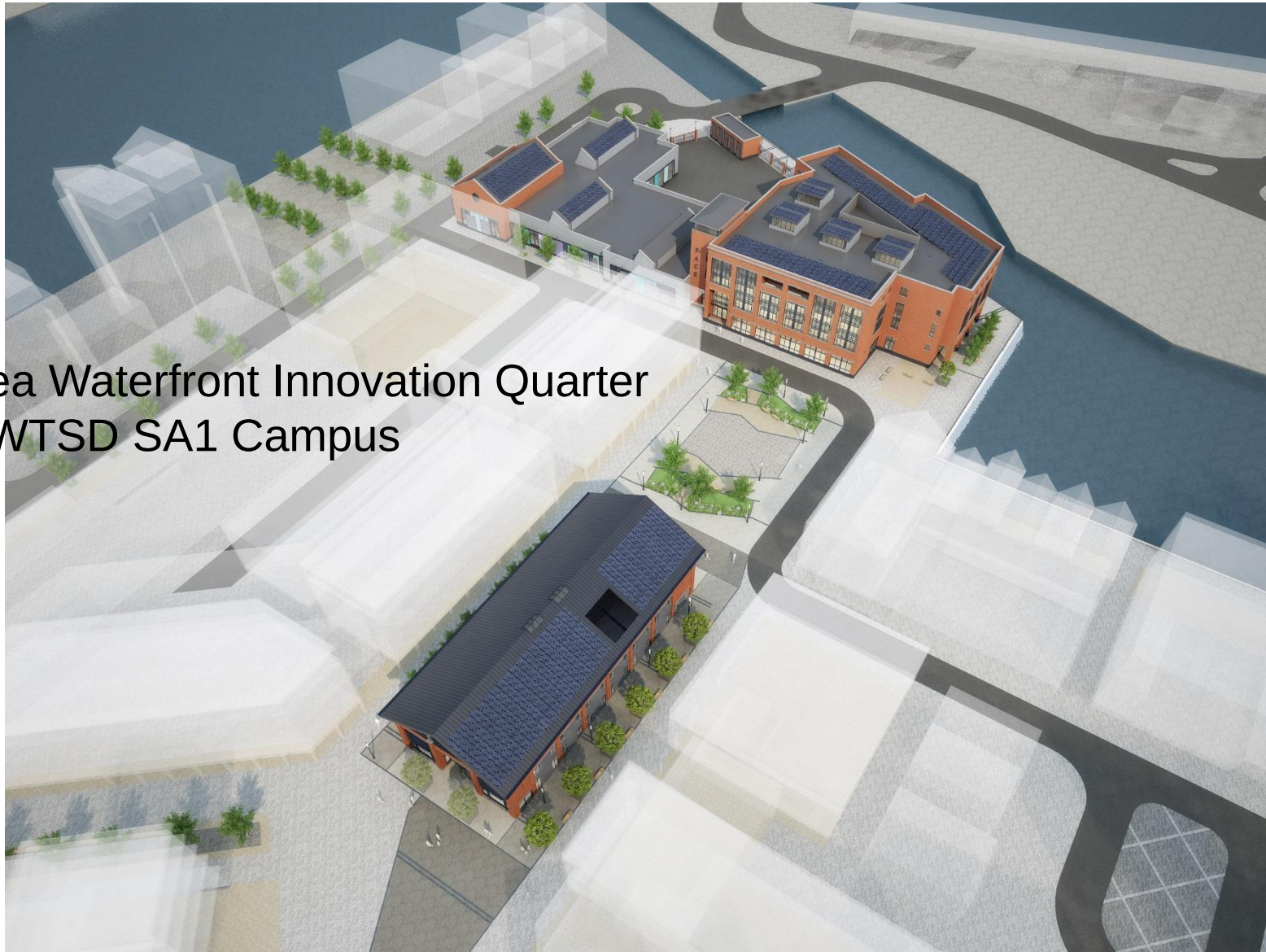
- EPSRC, AHRC

Interdisciplinary research environment

- REF outputs
- PhD scholarship

Recruit students and post doctoral

- Feed into teaching
- MA in sustainability



Swansea Waterfront Innovation Quarter New UWTSD SA1 Campus



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2.72 Materiality

The emphasis here is on a base set of materials that are honest, simple and natural. Recycled, rugged and of the earth. At the same time these will be softened by warm and sound absorbing materials such as felt and cork.

Texture, colour and surface are inspired by minerals and timbers in the environment, worn and weathered by time.

The concept design will build on these and bring together a harmonious set of finishes that are fit for purpose and the design concept.



Low temperature fused recycled glass as an interior installation for the new UWTSD campus at Swansea Waterfront Innovation Quarter

Outcome: Café servery at ground floor. Design of the bar / counter and also feature floor finish / moat surrounding the bar area.

- There will be a requirements to **comply with certain technical specifications** if they were to incorporate into a functional aspect of the scheme
- An **understanding of the behaviour** of recycled glass as a design material
- **Design and manufacture** of architectural products from recycled glass with an evaluation of sustainability and strength for design application

Student projects:

1. Revising the methods of crushing glass by refurbishing/updating/modifying existing technology
2. Research and test the methods of hardening stainless steels for glass crushing purposes
3. Characterising the mechanical properties of glass products
4. Carbon footprint and life cycle analysis
5. Aesthetic exploration of the recycled glass material
6. Furniture development



Artistic visualisation of a reception desk made from fused recycled glass by interior architect Kenton Simmons

Low temperature fused recycled glass as an interior installation for the new UWTSD campus at Swansea Waterfront Innovation Quarter



Project director: Dr Tyra Oseng-Rees, Swansea College of Art, tyra.oseng-rees@uwtsd.ac.uk

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Dr Gregory Owen, Engineering, gregory.owen@uwtsd.ac.uk

Dr Lara Hopkinson, Architecture, Built and Natural Environments, lara.hopkinson@uwtsd.ac.uk

Allan Nantel, Built and Natural Environments, allan.nantel@sm.uwtsd.ac.uk

Lisa Burkl, Glass, Swansea College of Art, lisa.burkl@uwtsd.ac.uk

One panel made from Low Temperature Fused Recycled Glass
with light shining onto and light passing through the same panel



The process of working with bottle glass;
Texture and Colour



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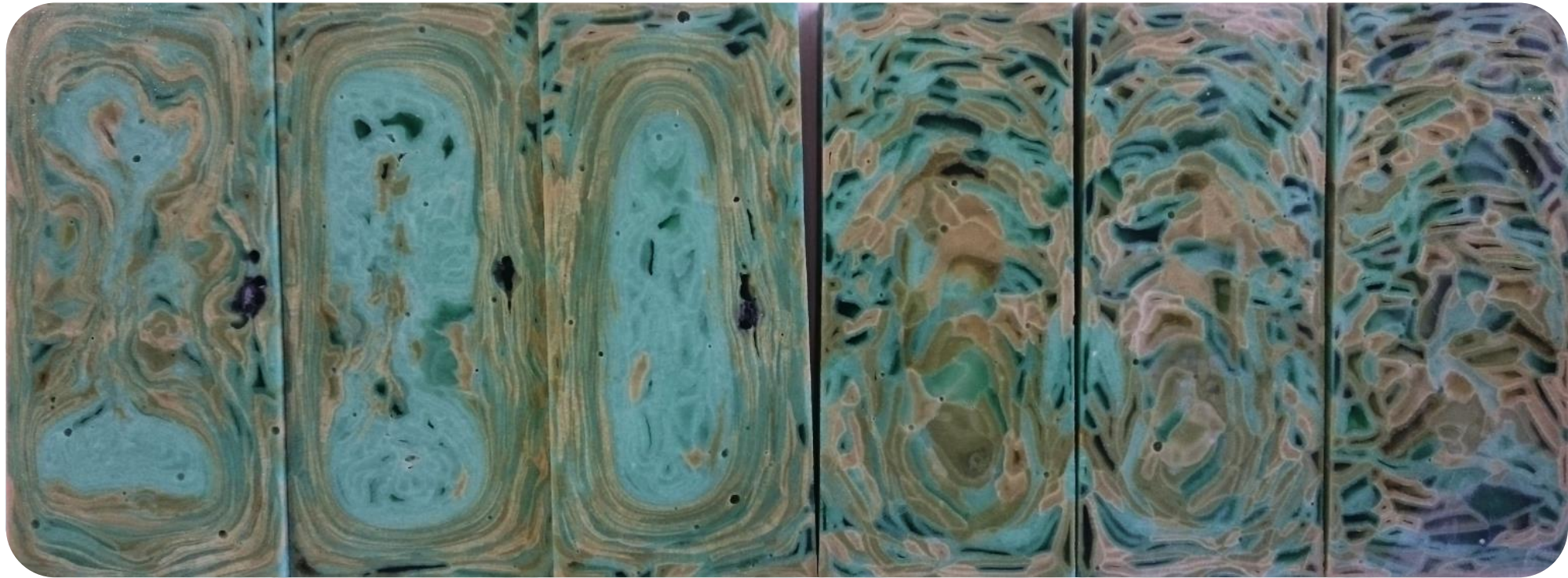
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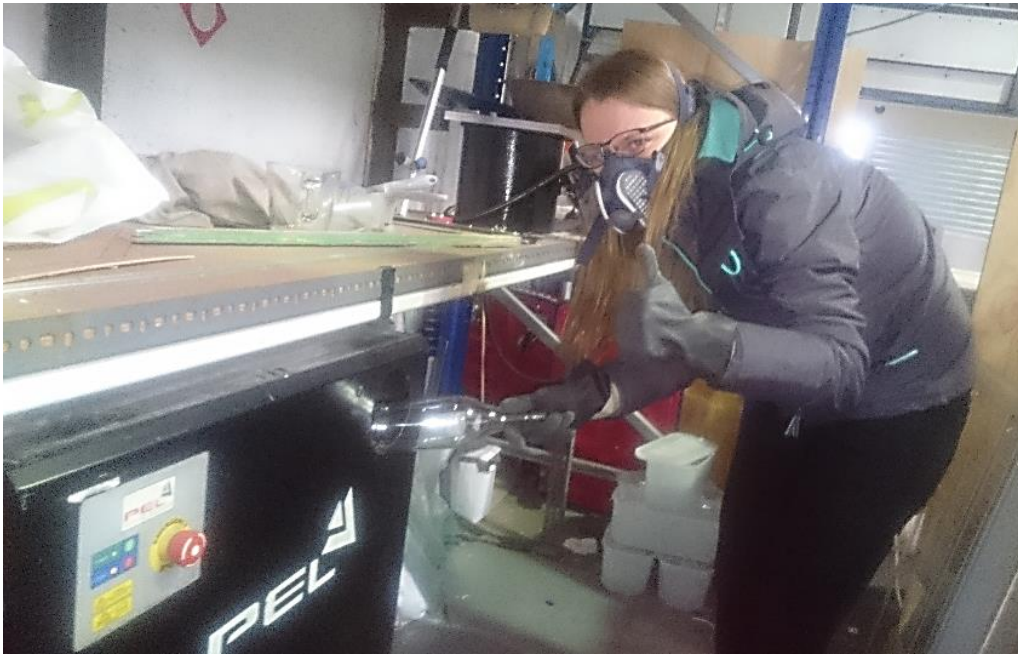


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The process of working with bottle glass; Texture and Colour

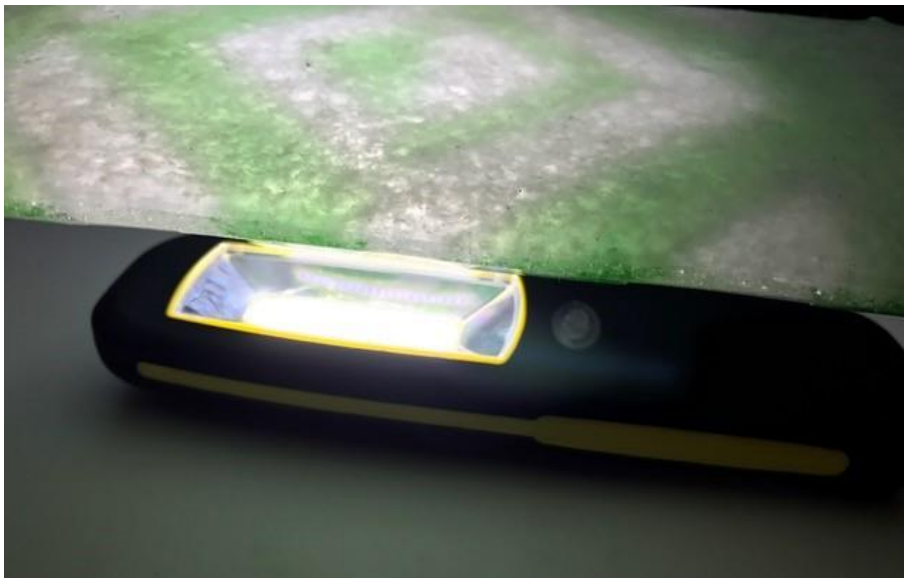


Design exploration by glass art student Jana Kleprlikova





Art work by Jana Kleprikova





Jana Kleprlikova



Art work by Jana Kleprlikova



Desk design to accommodate wheel chair access
Option for glass work surface on support backing panel
Lighting to panels can be either back lit or end lit



FACE MATERIAL IN RECYCLED GLASS PANELLED SYSTEM ON
SUPPORT FRAMEWORK WITH SILICONED BUTT JOINTS



RECEPTION DESK OPTION - Elevation

Desk design to accommodate wheel chair access
Option for glass work surface on support backing panel
Lighting to panels can be either back lit or end lit



Fluted slab option lit at ends and ribbed slab lit behind with LED lights

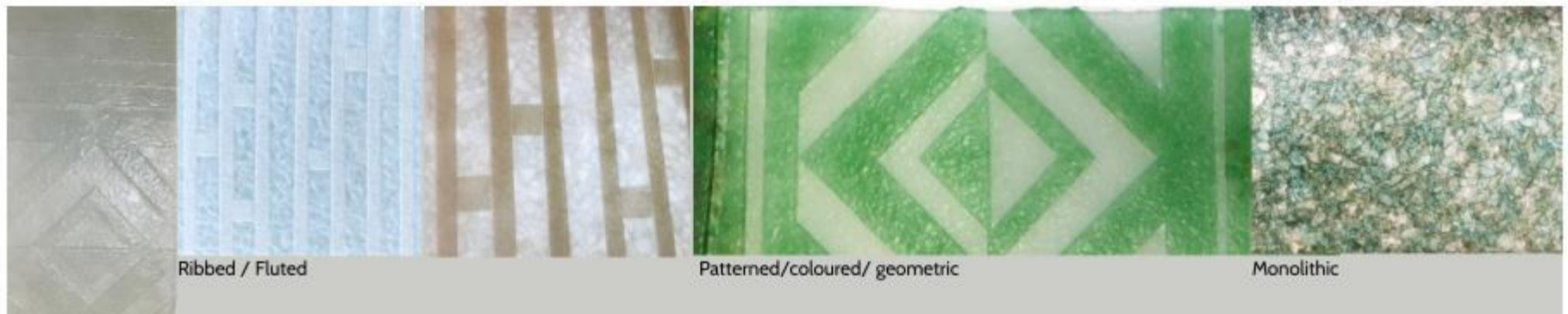
RECEPTION DESK OPTION - Elevation

Desk design to accommodate wheel chair access
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Fluted glass slab option lit at ends with LED lights

RECEPTION DESK OPTION - Elevation



A selection of the recycled glass patterns

Patterned

Recycled glass work surfaces possibilities:
 A Tile or slab on fully supported deck
 B Slab on support framework aperture



reception desk plan

RECEPTION DESK INDICATIVE PLAN



Desk design to accommodate wheel chair access
Option for glass work surface on support backing panel
Lighting to panels can be either back lit or end lit

FACE MATERIAL IN RECYCLED GLASS PANELLED SYSTEM ON
SUPPORT FRAMEWORK WITH SILICONED BUTT JOINTS

RECEPTION DESK ISOMETRIC VIEW

Desk design to accommodate wheel chair access
Option for glass work surface on support backing panel
Lighting to panels can be either back lit or end lit

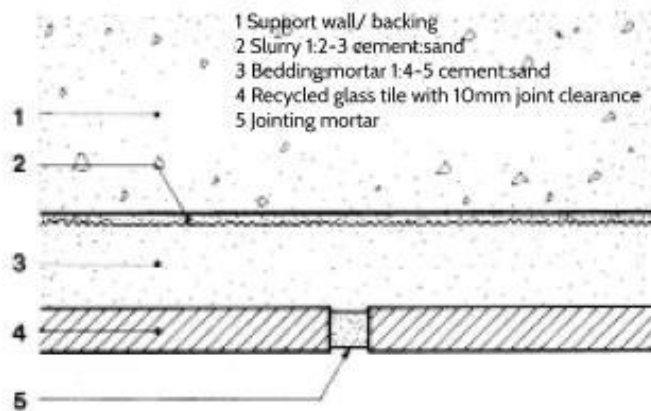


reception desk side view



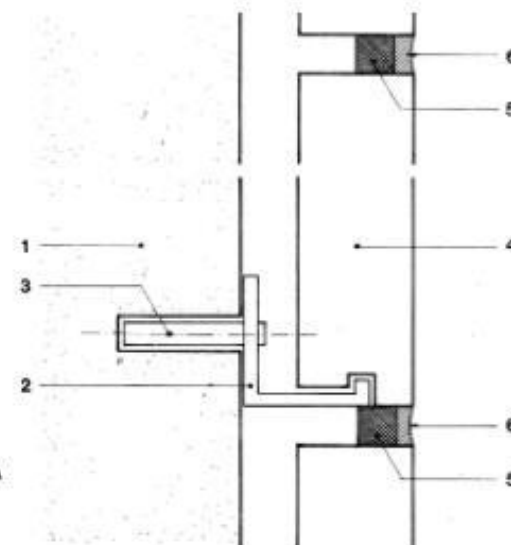
Riven slab option

RECEPTION DESK SIDE VIEW



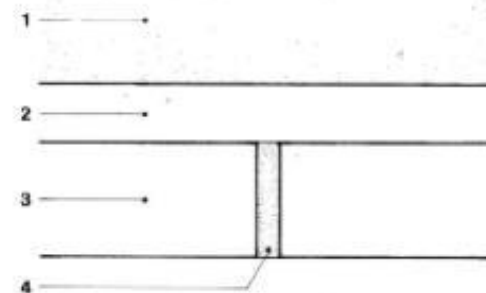
RECYCLED GLASS TILE FORMAT TO MASONRY BACKING WALL

A



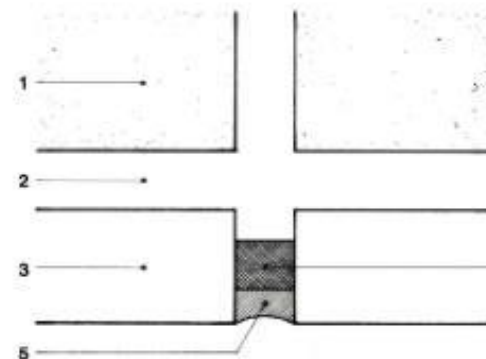
A - SECTION THROUGH VERTICAL FACE RECYCLED GLASS FACING PANEL

B



B - PLAN THROUGH VERTICAL JOINT RECYCLED GLASS FACING PANEL

C

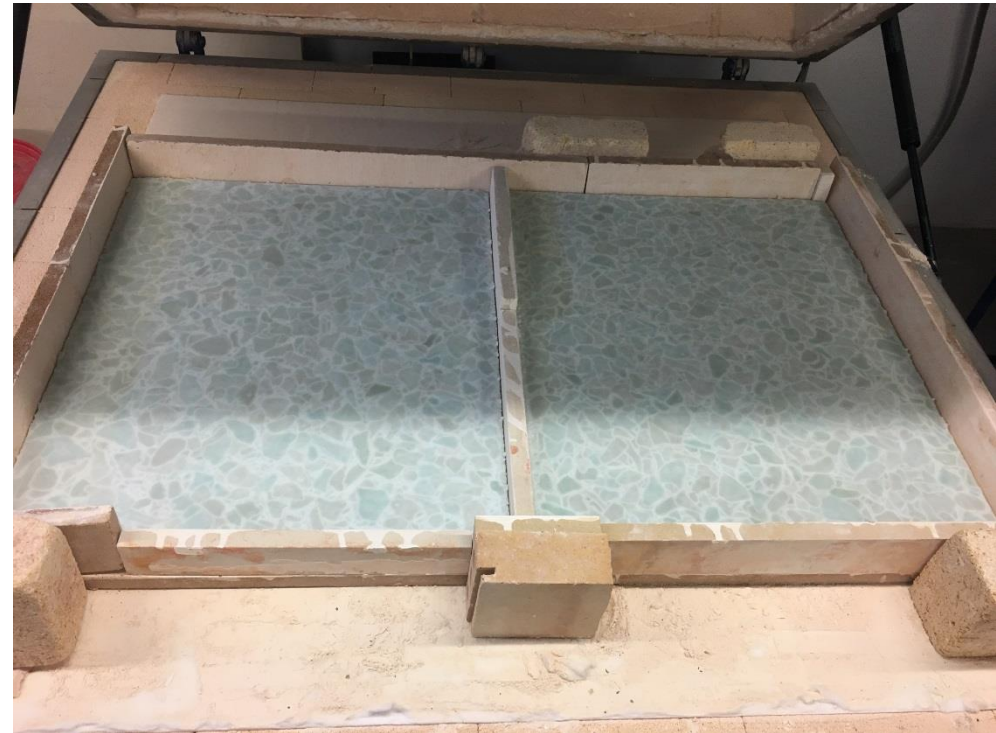


C - PLAN THROUGH VERTICAL MOVEMENT JOINT RECYCLED GLASS FACING PANEL

RECEPTION DESK - Detailing



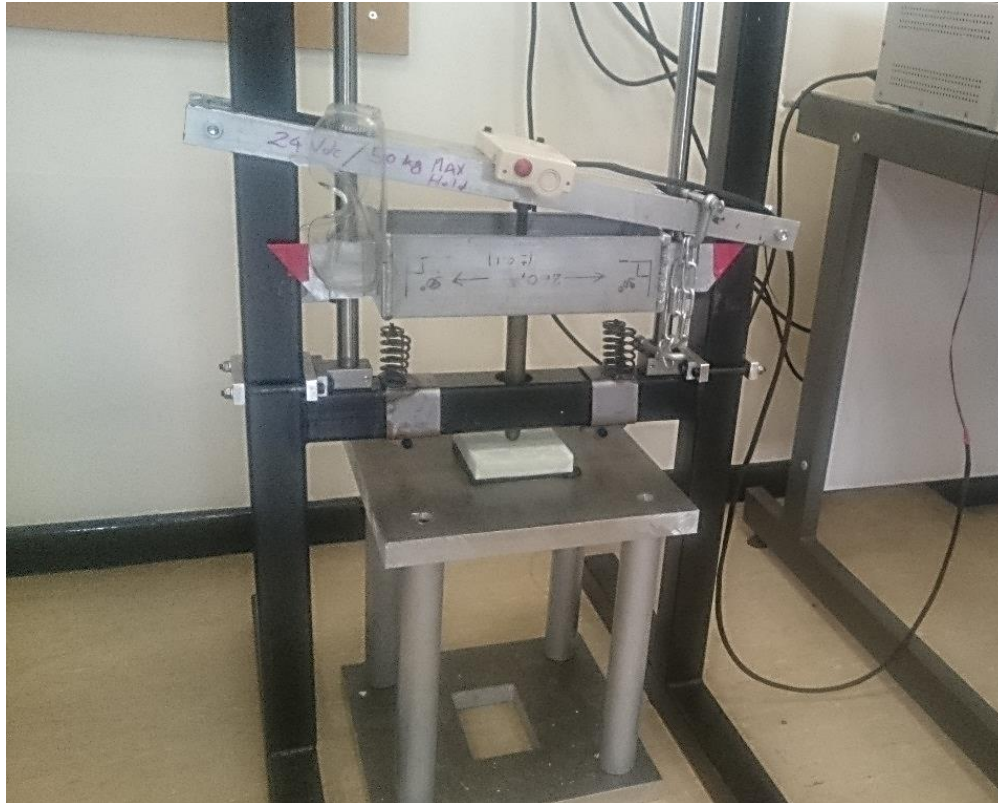
Material Integrity and testing by David Halley, Project and Construction Management

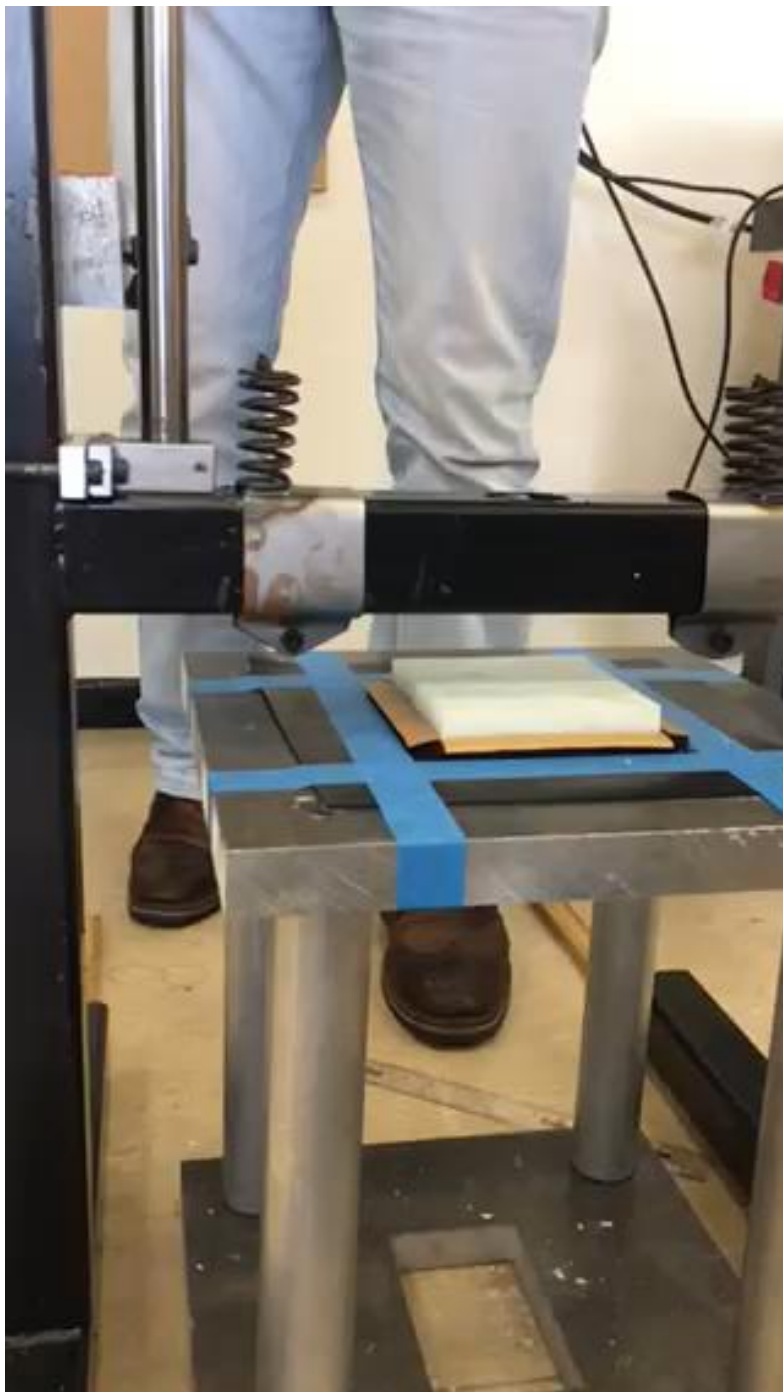


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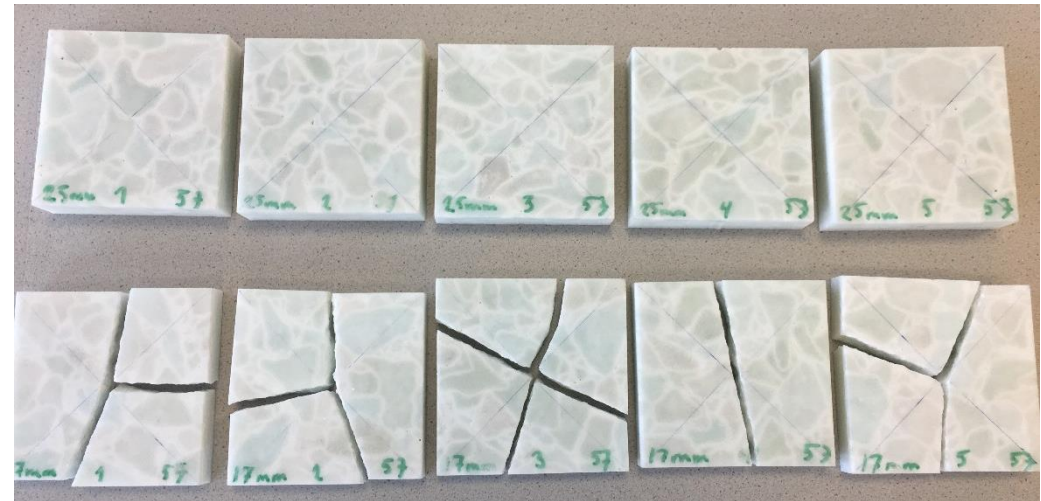
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Early test results



Dissertation by David Halley:
The Resistance to Impact of Recyclamine
Coated and Non-Coated Low
Temperature Fused Recycled Glass for
the Use as a Reception Desk

What next?

Long term view

Prevention

Integration

Collaboration

Involvement

Thank you



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 @TyraOsengRees

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