In search of the holy grail of adhesives for cast glass structures: Two contradictory case studies, the Crystal Houses façade in Amsterdam and a small glass pavilion in Greenland

CertBond
COST Action CA18120

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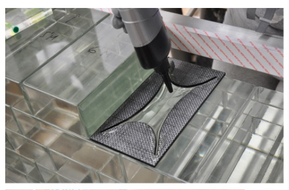
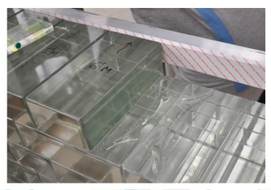
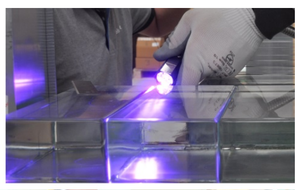
Architects: MVRDV (Crystal Houses, NL), Konstantin Arkitekter (Glass pavilion, GL)

Crystal Houses – The challenge: A fully transparent, self-supporting façade of extreme dimensional accuracy

The completed façade

Bonding steps clockwise from top left : 1. Application of the adhesive with the aid of the PURE® mould. 2. Resulting X pattern. 3. Local hardening of the adhesive by a UV beam light for preventing capillary action. 4. UV-lamp used to cure the adhesive for 60—120 seconds.

Quick facts:
Cast glass structure dimensions: 10x12 m
Typical glass block unit: 105/210x210x65 mm
Location: Amsterdam, NL
(access by road, electricity provided)
Climate: Moderate maritime
Budget for construction: high
Building crew: highly-skilled team
Status of construction: Completed (2016)

Adhesive requirements:

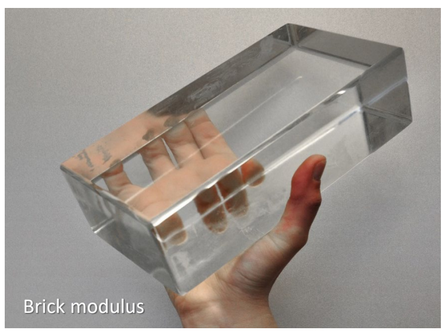
Structural performance
- good short & long term compressive behaviour
- establish high bond strength with glass
- provide a rigid structure
- good resistance to weathering
- good aging behaviour

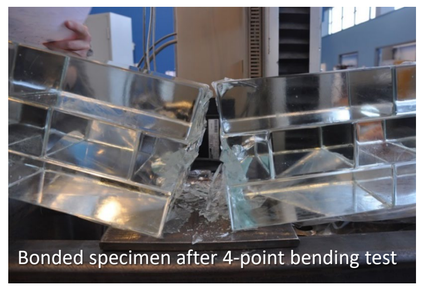
Visual performance
- completely transparent/colourless
- should not discolour when exposed to sunlight

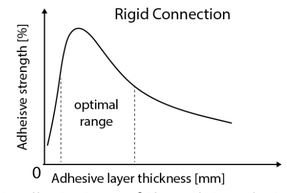
Ease-of-assembly
- fast fixing & curing time
- have no emissions of noxious or poisonous
- chemicals during processing and curing

Selected Adhesive:
Delo Photobond 4468
(colourless, one-component, UV-curing acrylate)
- Setting time (100% strength): 60-120s under UV light
- Application thickness: 0.25 mm

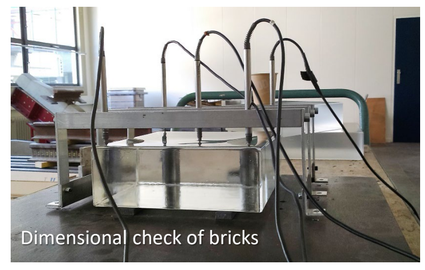
Main challenges during construction:
Virtually zero adhesive thickness (0.25 mm) required resulting in:
- extreme precision in construction / inability to accommodate dimensional tolerances.
- need of post-processing of the bricks (increasing the cost)
- need of highly-skilled building crew
- need for homogeneous spread of adhesive / relatively slow construction


Brick modulus

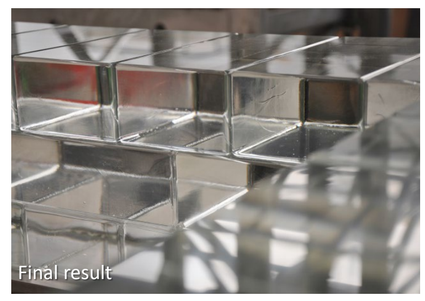

Bonded specimen after 4-point bending test



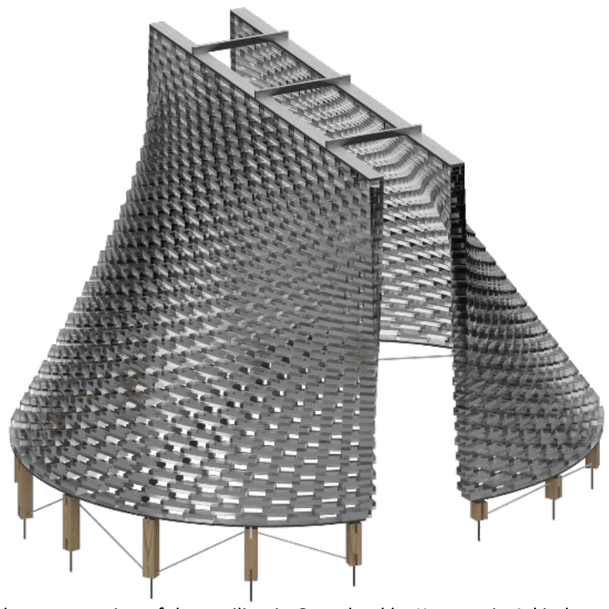
Schematic illustration of the relation between a stiff adhesive's strength and thickness


Dimensional check of bricks


Sealing process


Final result

A glass pavilion in Greenland – The challenge: A transparent, self-supporting structure in an extreme, remote location


3D-visual representation of the pavilion in Greenland by Konstantin Arkitekter


Application of the DOWSIL EA-3838 adhesive. Status of the construction on mid-August 2021

Quick facts:
Cast glass structure dimensions: 3m x 2.5 m
Typical glass block unit: 246 x 116 x 53 mm
Location: Arctic Circle, Greenland
(no access by road, no electricity)
Climate: Tundra/Polar
Budget for construction: low
Building crew: amateur/volunteering team
Status of construction: under construction (2021)

Adhesive requirements

Structural performance:
- tensile strength 1-10 MPa
- service T as low as -30ºC
- elongation at break: 15 – 50%

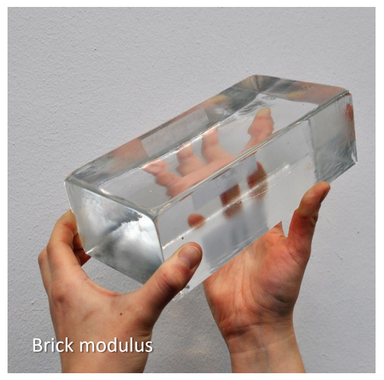
Visual performance:
- transparent or light in colour
- can be easily spread

Ease-of-assembly:
- fast fixing & curing time
- thickness should accommodate dim. tolerances

Selected adhesives:
3M™ Scotch-Weld™ Polyurethane Adhesive DP610 (colourless) for the 9 lower layers
- setting time: 10min, ≈ 2h for 100% strength
- application thickness: 1-2 mm

DOWSIL™ EA-3838 (white) for the upper layers
- setting time ≈ 20min, ≈ 24-48h for 100% strength
- application thickness: 2-3 mm

Main challenges during construction:
No access to electricity and highly-skilled crew, and cold climate resulting in:
- need of an easy and fast construction that can be made locally
- need of an adhesive that can accommodate size deviations and eliminate any need for post-processing of the bricks
- need of battery gun for sealing and for the application of DOWSIL
- particular caution on sealing in order to resist water ingress / frost


Brick modulus

Bonded specimens after shear testing
(adhesive used: A: 3M DP610, B:Teroson MS 9399, C: DOWSIL EA-3838)


Levelling the bricks during construction


Use of 3M transparent tape to form a spacer for applying the glue in the desired thickness and stabilizing the brick during installation


Application using manual glue-gun of the 3M DP610 adhesive


Brick placement

Funded by the Horizon 2020 Framework Programme of the European Union

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY