POST-TENSIONED GLASS BEAMS WITH ADHESIVELY BONDED TENDONS

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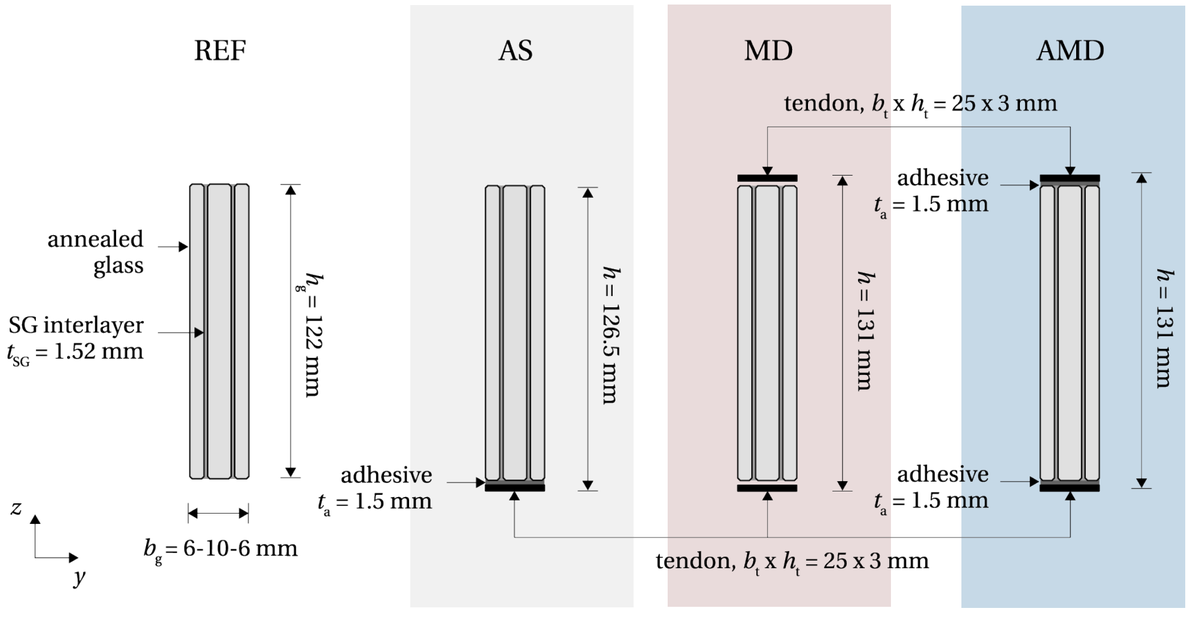
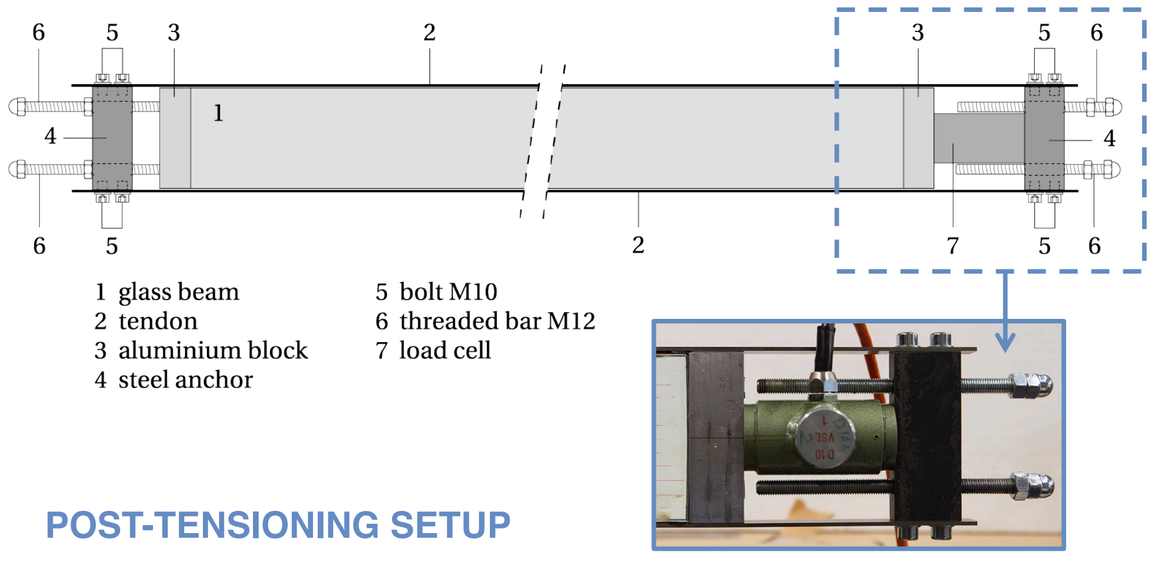
Post-tensioned glass beams are hybrid structural components comprising glass beams reinforced and pre-stressed with ductile tendons to **enhance the load-bearing capacity and post-fracture behaviour of glass**. This novel beam system increases material efficiency and safety of glass beams, while preserving a high level of transparency. **Three variations** of the system – **AS, MD, AMD** - with single or double stainless steel tendon, with and without the application of adhesive, were designed and investigated in an extensive **experimental study**, accompanied by **numerical modeling** and **analytical interpretation of results**. The research has demonstrated that the **adhesive plays an integral role** in transferring the post-tensioning loads into the glass, securing lateral stability and enhancing the residual load-bearing capacity in the event of glass fracture. **A demonstrator – 6m long glass bench ATLAS** - was designed, fabricated and installed at the EPFL campus in Lausanne, sponsored by industrial partners, and presented at the international fair *glasstec 2018*.

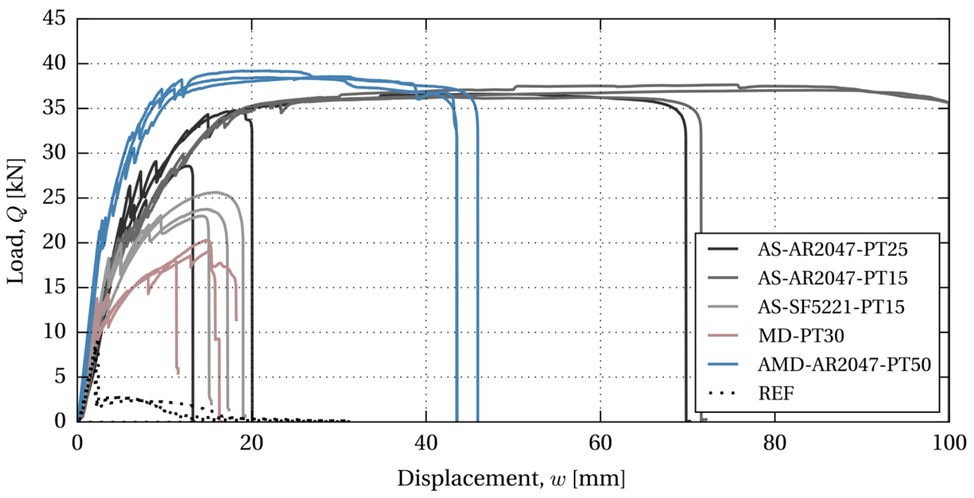
EXPERIMENTAL PROGRAMME
Cross-sections of investigated glass beam typology



POST-TENSIONING SETUP



COMPARATIVE TEST ANALYSIS
Four-point bending tests on 1.5m long beam specimens

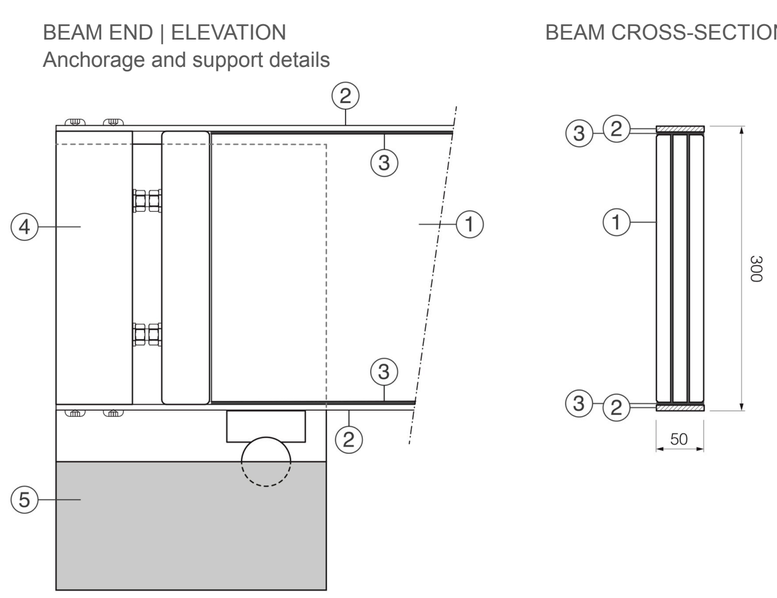


Series	Q_{in} [kN]	Q_{max} [kN]	Q_{in}/Q_{max} [%]
REF	8.64	2.63	31
AS-SF5221-PT15	14.38	24.14	172
AS-AR2047-PT15	16.96	**36.99**	220
AS-AR2047-PT25	**20.80**	33.33	166
MD-PT30	13.25	19.18	145
AMD-AR2047-PT50	**20.03**	**38.76**	194

AMD-AR2047-PT50: BEAM TYPE | ADHESIVE | PRE-LOAD [kN] APPLIED THROUGH THE TENDON(S)

- 1.5 – 2.4x higher initial fracture load Q_{in} when compared to reference glass beams (REF)
- Up to 15x higher ultimate failure load Q_{max}
- Superior performance of bonded series - composite action, lateral stability, full flexural capacity, structural integrity in post-fracture state

DEMONSTRATOR I 6m long glass bench supported by UHPFRC blocks



Cupać, J., Nussbaumer, A., and Louter, C. (2021). **Post-tensioning of glass beams: Analytical determination of the allowable pre-load**. Glass Structures & Engineering. https://doi.org/10.1007/s40940-021-00150-0

Cupać, J., Nussbaumer, A., and Louter, C. (2021). **Flexural behaviour of post-tensioned glass beams: Experimental and analytical study of three beam typologies**. Composite Structures 255. https://doi.org/10.1016/j.compstruct.2020.112971

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