Point-fixed Glazing – Materials and Processing

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Summary

During the last decades structural glazing became the leading technique in realising building envelopes, especially for larger buildings. Due to the requirements of energy conservation and in order to establish the architectural vision of maximal transparency it became necessary to reduce the number of bearing elements thereby enforcing the point-fixed glazing. As forces are transmitted by plates and bolts in and around a hole, stress concentrates in this area. Therefore in most point-supported glass elements the maximum stress arises at the bore edge. This makes the design of the point-fixing the critical point as glass does not have the ability to plastify and the dimensioning is adapted to the stress peak. A lot of research has been done and still is in progress to minimize this stress by optimizing the point supports regarding their geometry and the materials used. A survey of state-of-the-art constructions and new developments will be given below.

Keywords: Structural glazing, point-fixed, material, glass, processing, stress concentration, drilling.

1. Material

The bending tensile strength of glass is not a material specific value, but a measurement for the quality of the glass surface [2]. It is influenced by

- mechanical treatment of the glass surface
- stress distribution on the surface
- climatic influences and age
- loading rate and duration
- surface pre-stressing

As the design concept for glass is based on a probability concept regarding the adverse coincidence of high surface stresses and (unavoidable) surface defects, the drilling becomes the critical area. At the bore edge stress peaks coincide with a highly defected surface.

2. Drilling techniques

The standard drilling method is diamond drilling from both sides to avoid the break-out of small shivers when reaching the opposite side. The disadvantage of this method is, that drillings

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penetrating the glass from both sides are not perfectly centered with respect to each other. As a result a small burr remains that forms a larger notch on the one hand, and leads to a stress peak for in-plane loads on the other hand.

Drilling from one side only avoids these defects on the drilling surface, but causes small break-outs on the counter surface. These defects partly can be removed by chamfering the edges with conical drills.

Another common method is water-jet drilling: the glass is cut by a high pressure water jet with abrasive additives. As this method is applied from one side only, it shows the same problems as one-sided diamond drilling.

3. Comparative tests

The best experimental method to investigate the bending tensile strength in the drilling area is the double-ring bending test. Support and loading is performed through two concentric rings, thus yielding a uniform stress distribution along the bore edge.

In a first step the conventional drilling method (diamond drilling) is investigated. In the first series the one-sided and the two sided drilling is compared.

Although the average maximum stress is smaller for one-sided drilling, the characteristic values of the bending tensile strength almost match exactly for all tested drilling methods due to the smaller standard deviations. For a detailed analysis more tests have to be carried out, which is currently being done.

4. Conclusion

Due to the high efforts and the resulting higher costs of tempered glass, there is a strong interest in using float glass, and especially laminated float glass, for point-supported glass elements. Up to now this is not possible in most cases, as no reliable data on the strength of float glass around the bore hole is available.

The running investigation described above is a first step to gain more information about the influences on the drilling quality and the resulting material strength.

References

Please refer to full paper.