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WIRE GLASS IN BUILDING CONSTRUCTION

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Abstract: *Wire glass is frequently used in present-day building projects, not only as a filling material, but also for load-bearing members. Thus, there are the special requirements for glass, and it is necessary to assess the reliability of glass structures. In the framework of European standardization, there is not yet sufficient documentation for implementing standards for glass structures. However, a standardisation committee for structural glass has recently been established, and work is being done in this field. The present paper discusses use of the wire patterned glass and assessment of its design characteristics.*

Keywords: ***Wire glass, failure, strength.***

1. Introduction

Wire patterned glass is applied in a number of existing and new building structures. The wire mesh should prevent brittle failure and subsequent collapse of structural members. The design of a load-bearing member made of wire patterned glass should take into account actual properties of the material. Unrealistic design strengths have recently been published in the Czech Republic for wire patterned glass structures. This paper discusses the use of wire patterned glass, and proposes partial factors for glass strength based on previous experience and a limited amount of experimental data.

2. Wire glass

Wire glass may fracture due to local non-homogeneities such as notches created when the glass is cut, and air cavities in the material formed when the wire mesh is embedded into the molten glass before rolling, initial corrosion of wires at edges of panels, etc. (see Figs. 1 and 2). The strength of glass is also affected by climate. When a glass panel is broken the mesh holds parts of the material together. However, this type of product cannot be considered as a safety glass, because the fragments are very sharp and dangerous. Glass deforms proportionally to the load, and it breaks suddenly. It is a brittle material, and the failure occurs suddenly when the limit stress in tension is reached. The strength is usually determined as the flexural strength of glass, and is significantly variable.

3. Assessment of the partial factor for the flexural strength of the wire glass

Based on a limited amount of experimental results, the partial factor for the strength of the wire glass is assessed using principles given in CSN EN 1990 (2011). The partial factor γ_M is obtained as a product of the model uncertainty factor γ_{Rd} and partial factor of material γ_m. The model uncertainty factor $\gamma_{Rd} = 1{,}2$ accounts for imprecision of the applied resistance model. More specifically, it reflects influences of local non-homogeneities and values of the thickness of glass members lower than the nominal value.

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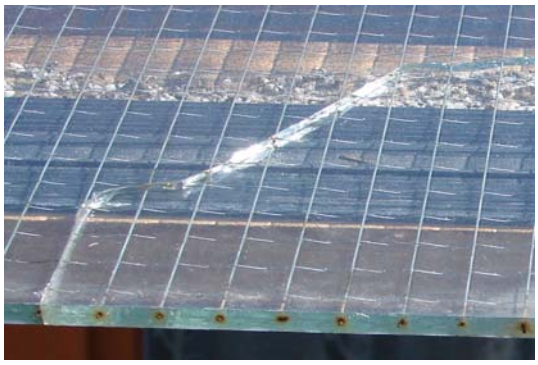

Fig. 1: Fracture due to corrosion of wires

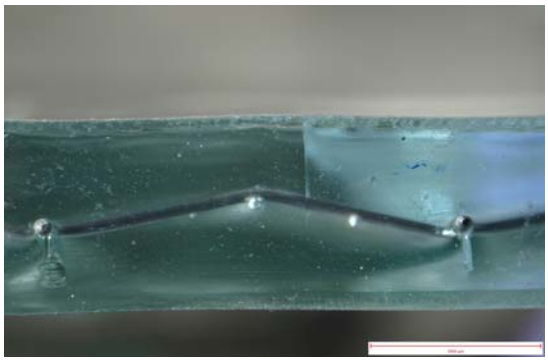

Fig.2: Notches caused by the cutting

Partial factors γ_m that can be used as a first approximation in practice are estimated by the following values:

- $\gamma_m \approx 1{,}4$ for the Reliability Class RC1 (see CSN EN 1990 (2011)),
- $\gamma_m \approx 1{,}6$ for RC2,
- $\gamma_m \approx 1{,}8$ for RC3.

4. Recommendations for practical applications

On the basis of long-term experience with the design of structural glass and evaluations of tests, careful consideration of the following aspects is recommended in practical design of the wire glass:

1. tolerance of panel thickness (use of the lower limit of the tolerance interval is advised in common cases),
2. assessment of the characteristic value on the basis of tests unless specified by a producer,
3. account for influences likely affecting structural glass and hardly covered by laboratory tests (for example ageing, surface damage due to transport and assembly and size effect), using a conversion factor η,
4. application of the model uncertainty factor γ_{Rd} that if relevant, shall describe inaccuracy of the resistance models due to insufficient regard of the following factors:
   - fracture of the glass due to local non-homogeneities (notches, air cavities, wire corrosion).
   - thickness of the glass lower than the nominal value reduced by a tolerance limit,
   - etc.
5. assessment of potential consequences of failure, and selection of an appropriate reliability class.

5. Conclusions

Due to a production process a characteristic strength of the wire glass is significantly lower than the characteristic strength of the soda-lime-silicate glass declared in CSN EN 572-1 (2004) as 45 MPa. The design of structural wire glass should take into account local non-homogeneities and degradation effects. For structural members exposed to climatic effects the use of modern safety glass is preferable.

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