ADVANCED DESIGN OF GLASS STRUCTURES

Design of glass fin

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Objectives of the lecture

- Design of glass fin

Assess glass fin of the facade – see figure. It is simply supported and suspended from its top support. It is bolted to the inside face of a glass facade and silicone seals provide continuous attachment between the edge of the fin and facade. It is assumed that for short-term gust loads the silicone seals are capable of providing lateral restraint to the edge of fin. It is also assumed that the low modulus of silicone does not permit any T-beam action between the fin and the facade.

\[ L = c_1 \times 6000 \text{ mm} \]
\[ B = c_2 \times 1500 \text{ mm} \]
\[ b = 500 \text{ mm} \]
\[ t = 16 \text{ mm} \]
\[ w = 1,0 \text{ kN/m}^2 \]
\[ \text{unit weight} = 2500 \text{ kg/m}^3 \]

**tension strength of glass**
- float glass (t = 10mm): 28,0 MPa
- toughened glass: 59,0 MPa

**short-term load**
- float glass (t = 10mm): 28,0 MPa
- toughened glass: 59,0 MPa

**long-term load**
- float glass (t = 10mm): 7,0 MPa
- toughened glass: 35,0 MPa
Short term load action

1. Moment (design value) – simple check

\[ M_{Ed} = \frac{1}{8} \gamma_F \cdot w_k \cdot L^2 \leq \frac{E \cdot t^3}{6(1+\nu)} \]

\[ \gamma_F = 1,5 \]

- Wind load \( w = 1,0 \, \text{kN/m}^2 \)
- Load width \( B = c_2 \, 1500 \, \text{mm} \)

\[ w_k = w \cdot B \quad [\text{kN/m}] \]

2. Section modulus

\[ W_y = \frac{1}{6} \cdot t \cdot b^2 \]

3. Short term load action

\[ \sigma = \frac{M_{Ed}}{W_y} \leq f_d \]

- decision about the type of glass
Long term load action

4. Axial load in the fin - self weight for $\rho = 25\text{kN/m}^3$

$$N_{Ed} = \gamma_F \cdot \left( \rho \cdot t \cdot b \cdot L + \rho \cdot t \cdot B \cdot L \right)$$

- glass fin
- glass facade

5. Long term load action from self weight

$$\sigma = \frac{N_{Ed}}{A_{\text{fin}}} \leq f_d$$ - depends on the type of glass
Lateral torsional buckling

6. Lateral torsional buckling of the glass fin according to the Australian standard

\[
M_{CR} = \frac{\left(\pi/L_a\right)^2 (EI)_z \left[ \frac{d^2}{4} + y_0^2 \right]}{2y_0 + y_h} + (GJ)
\]

- \( L_a \) = length of the beam
- \( d = b \) …. height of the glass fin
- \( I_z \) moment of inertia

\[
I_z = \frac{1}{12} b \cdot t^3 \quad I_t = \frac{1}{3} b \cdot t^3
\]

- \( G = 28 \, 700 \text{MPa} \) – shear modulus of elasticity
- \( J = I_t \) …torsional moment of inertia
- \( y_h = 250\text{mm} \) …. location above the neutral axis of the loading point, positive or negative values for suction and compression
- \( y_0 = 250\text{mm} \) …. distance of the restraints from neutral axis
Deformation

7. Check - simple approach

\[ M_{Ed} \leq \frac{M_{cr}}{1.7} \]

8. Vertical deformation

\[ \delta = \frac{5}{384} \cdot \frac{w_k \cdot L^4}{EI_y} \leq \delta_{lim} = \frac{L}{500} \]

\[ I_y = \frac{1}{12} \cdot t \cdot b^3 \]

9. Vibration

\[ f = \frac{16}{\sqrt{\delta}} > 5 \text{ Hz} \]
Thank you for your attention