Development of a conservation compatible window

Alexandra Troi, EURAC research
Conservation compatible window
Windows in the building stock ...

... are usually

- not thermally insulating
  e.g. CS1 Waaghaus / Bozen:
  → 33 kWh/m²
  = 11% of total transmission losses

- not airtight
  e.g. CS1 Waaghaus / Bozen:
  → ~40 kWh/m²
What to do?

- original windows with heritage value
  - restoration of the existing window
- if original windows have already been replaced – as e.g. in 3ENCULT CS1
  - new energy efficient and aesthetically fitting window
This was the challenge for …

3ENCULT Partner Menuiserier Andre with their development expert Franz Freundorfer

… in close collaboration with the consortium!
1st meeting at CS1

with Mrs. Kofler Engl, the director of the regional conservation authority in Bozen to understand

→ the specific demands of CS1, the Public Weigh House
→ But also „typical“ demands

• Window size is typical for a baroque window
• Since the windows had been changed in the mid of the 20th century and there is no documentation about the original ones, the conservator recommends a “baroque” window, as typical for the region:
  • Two sashes with two sash bars each
  • Both box-type and coupled window are possible
• Documents & drawings
Workshop in Bozen
... start of simulation with the profile of a historic casement window

Heat flow = 27,9970 W

$U_f = 1,234 \text{ W/(m}^2\text{K)}$

$\Psi_{Spacer} = 0,0493 \text{ W/(mK)}$

$U_w = 2,266 \text{ W/(m}^2\text{K)}$

horizontal cross-section
... first variant with thermal pre-tensioned thin window glass

Heat flow = 17,2830 W
U_f = 1,009 W/(m²K)
PsiSpacer = 0,0423 W/(mK)
U_w = 1,167 W/(m²K)
... second variant with Passive House Quality

Heat flow = 8,4520 W
U_f = 0,635 W/(m²K)
Psi Spacer = 0,0267 W/(mK)
U_w = 0,687 W/(m²K)
... simulation of compound window

Heat flow = 8,65040 W

$U_f = 0,85 \text{ W/(m}^2\text{K)}$

$Psi_{\text{Spacer}} = 0,0203 \text{ W/(mK)}$

$U_w = 0,7260 \text{ W/(m}^2\text{K)}$
1st prototype for CS1, the Weigh House
Efficiency of the prototype
“I do have overall a positive impression as regards frame & sash bar dimension as well as subdivision & proportions. The optic of the outer glazing seems to me exaggerated, both the too irregular reflection from outside, and distortion from inside. And I ask whether a 3-pane glazing for Bolzano climate is really needed.
2nd prototype

Using thin glass → 2mm!

- 2+8+2+8+2
  = 22 mm
- 4+12+4
  = 20 mm

Heat flow = 9,13 W

\[ U_f = 1,00 \text{ W/(m²K)} \]
\[ \Psi_{\text{Spacer}} = 0,023 \text{ W/(mK)} \]
\[ U_w = 0,7220 \text{ W/(m²K)} \]
Flexibility of the concept
Flexibility of the concept

Outward opening
Flexibility of the concept

Existing baroque window
Résumé
André/Freundorfer

- Very high energy efficiency & conservation are compatible!
- Preservation of the historic “substance” and the appearance in listed buildings have first priority
- If the window has to be exchanged → choose class phA!
- Box-type / coupled window?
  Depends on regional context and installation situation
- Always calculate psi-values (thermal bridge) of built-in situation!
- There is no standard solution
  → but there are construction principles for project related solutions
- Both conservation & Passivhaus support craftsmanship
Workshop on site
Offene Punkte:
- Kontrolle der Maße
- Farbe Rahmen und Flügel (innen + außen)
- Farbe des Glasrandverbandes
- Art des Griffes
- Verglasung außen (Restaurierter Befund)
- Farbe der inneren Sichtung
- Farbe Silikonfügen
- horizontale Profilierungen innen + außen
- Verglasung innen (E/B/E/B/E)

Anmerkungen:
- Die für die jeweilige Nutzung benötigte Belüftung kann nicht über das Fenster gesteuert werden.
Effekte Punkte:
- Maximale der Makro Schicht (Makro) für die Fensterprofile und Flügel. Unten im Bild ist die Schichtgrößenbeschreibung
- Vergütung von Schrauben und Nieten
- Notwendigkeit von Schutz vor Feuchtigkeit und Verwitterung
- Anmerkung: Für die jeweilige Nutzung benötigte Belüftung
- Das Fenster ist geschlossen und verriegelt
- Änderungsmarkierungen innerhalb der Zeichnung
- Veranlassung (beispielsweise 2.3.4.5.6.7)
Alexandra Troi alexandra.troi@eurac.edu