Large public buildings air tightness in Poland

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Outline

Case studies:
1. Aquapark & sports olympic pool, Poznan
2. Office building, Szczecin
3. R&D Center, Poznan University of Technology, Poznan

Conclusions
1. Aquapark, Poznan

- Second largest water park in Europe
- Public investor - city of Poznan
- PUT – design & energy advisor
- Floor area 20,000 m² ≈ 215,000 ft²
- Volume 220,000 m³ ≈ 8,000,000 ft³
- Winter climate inside/outside
  \[ \Delta T \approx 90°F \approx -18/30°C \]
  \[ \Delta x \approx 15 \text{ g/kg} (4 \times \text{higher than typical}) \]
- Construction:
  - concrete frames + masonry fillings
  - flat roof, steel construction

- Investor was advised to measure airtightness of whole building
- Lack of funds for the test
  - Best price offer was chosen
  - Test company without experience
    (internet course – the only knowledge, theoretical)
- Building tested with AHU’s
- Building divided into 3 zones
- Many mistakes made in the test
1. **Aquapark, Poznan**

**Most important measurement mistakes**

- Trans-zonal uncontrolled flows during test (no simultaneous pressurization of adjacent zones)
- AHU flow measurement with unknown accuracy
- Measuring team not familiar with building and its design
  - Building not prepared for measurement
  - Tests conducted with other ventilation systems operating
  - No control on trans-zonal openings position (doors)
- Differences in n_{50} results: “−” 1.9 ACH, “+” 3.0 ACH
- Final n_{50} results → separately for 3 zones 0.7 / 2.5 / 2.0 ACH → average n_{50} 1.4 ACH (BC fulfilled)
- expected n_{50} value ...

2. **Office building, Szczecin**

- Private Investor, IKEA Development
- Floor area 5.100 m² ≈ 55 000 ft²
- Volume 16.100 m³ ≈ 570 000 ft³
- 8-storey (incl. 2 underground)
- Construction:
  - Envelope ▸ reinforced concrete
  - Typical windows + sealings
  - No special airtightness concerns during designing and construction process
- Building tested by PUT
2. Office building, Szczecin

- double-fan Blower Door used
- \( n_{50} = 0.49 \text{ ACH} \)
- examples of leaky points

3. R&D PUT Center, Poznan

**Mechatronics, Biomechanics and Nanoengineering Centre**

- Public Investor - Poznan University of Technology
- Purpose: laboratories, lecture halls, staff offices
- Floor area 14,000 m\(^2\) \(\approx 151,000 \text{ ft}^2\)
- Int. volume 50,700 m\(^3\) \(\approx 1,790,000 \text{ ft}^3\)
- Special airtight concerns during designing and construction
- Contract’s \( n_{50} \) demand of maximum 1.5 ACH
- Tested by PUT
3. R&D PUT Center, Poznan

Important details
- Filling wall-slab joints (EPDM sealing)
- Window-wall connection
- Walls plastered from inside
- Electricity – ext. wall installed (inner plaster broken)
- VAC shut-off dampers installed close to the envelope (part-time operation)

Airtightness measurement
- 6-fan set provided for the test
- 2 fans were sufficient
- $n_{50} = 0.31$ ACH

- Another result of quality control was also 48% reduction of primary energy demand for heating and DHW (measured in the 1st year of operation) $E_{PH+W}$
  - Real value: 44 kWh/(m²·a)
  - BC legal demand: 85 kWh/(m²·a)

- The building is going to be included in IEE iServ Project, dealing with HVAC components auxiliary energy requirements
Conclusions

- In large building $q_{50} \text{[m}^3/(\text{hm}^2)]$ instead of $n_{50} \text{[ACH]}$ - more accurate indicator
- Multi-fan BD measurement is too expensive, no XXL fans available, that’s why AHUs test tries happen (flow accuracy question?)
- Many tests carried out improperly by inexperienced testers
- $n_{50}$ 0.3-0.5 ACH possible to achieve by 1.5 ACH legal value - limit set too high (?)
- An international project for standardization, experience, and good-practice exchange would be very helpful and valuable for countries form our region

Thank you for your attention!
1. Water park, Poznan

- to avoid condensation of water vapour inside the walls → wall permeability measurement was performed ($q_{50}$)
- wall not plastered from inside and outside, thermally insulated from outside (mineral wool and facade panels)
- test box attached to tested wall surface 18 m² ≈ 200 ft²
- comparative measurement with & without foil from inside at overpressure conditions
- $q_{50} = 0.5$ m³/(m²·h)
- expected value for unplasterred wall