# 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 m$^2$ ≈ **215 000**
- Volume 220 000 m$^3$ ≈ **8 000 000 ft$^3$**
- **Winter climate inside/outside**
  ΔT≈90°F (-18/30°C)
  Δx≈15 g/kg (4 x higher than typical)
- Construction:
  - concrete frames + masonry fillings
  - flat roof, steel construction



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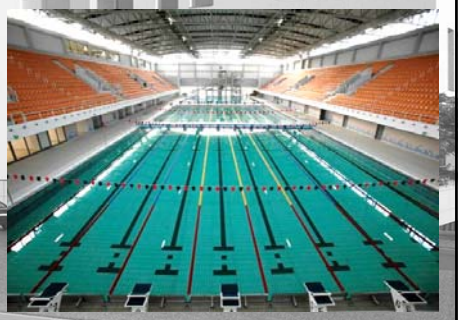
# 1. Aquapark, Poznan

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



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# 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 ...



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# 2. Office building, Szczecin

- Private Investor, IKEA Development
- Floor area 5.100 $m^2$ ≈ **55 000 ft²**
- Volume 16.100 $m^3$ ≈ **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

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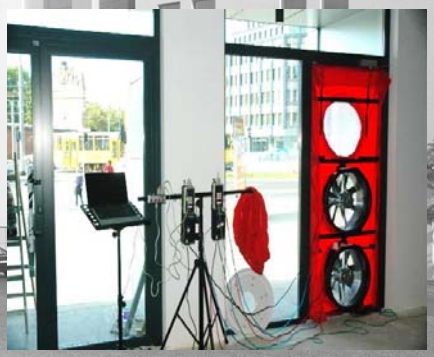
# 2. Office building, Szczecin

- double-fan Blower Door used
- $n_{50}$ = 0.49 ACH
- examples of leaky points







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# 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 $m^2$ ≈ **151 000 $ft^2$**
- Int. volume 50.700 $m^3$ ≈ **1 790 000 $ft^3$**
- Special airtight concerns during designing and construction
- Contract's $n_{50}$ demand of maximum **1.5 ACH**
- Tested by PUT


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# 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)



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# 3. R&D PUT Center, Poznan

**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) $EP_{H+W}$
  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

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# Conclusions

- In large building **$q_{50}$ [$m^3/(hm^2)$] instead of $n_{50}$ [ACH]** - more accurate indicator
- Multi-fan BD measurement is too expensive, no XXL fans avialable, that's why AHUs test tries happen (flow accuracy question?)
- Many tests carried out inproperly by unexpirienced 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 standarization, expirience and good-parctice exchange would be very helpfull and valuable for countries form our region**



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# Thank you for your attention!

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# 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