Building Airtightness Tests under Different Wind Conditions in a High Building

Presentation by Stefanie Rolfsmeier
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Agenda

- Test Object
- Expected Conditions and Requirements of Test Standard
- Setup of Test Equipment
- Additional Test Equipment because of weather conditions
- Test Results

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Test Object: High Passive House Building

- Multi Family Building
- Freiburg (South of Germany)
- Refurbishment to Passive House
- 16 floors
- Building height ≈ 60 m
- Building Volume ≈ 22.000 m³

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Aim of the Airtightness Test

Airtightness test:

- airflow at 50 Pa: V_{50} = ?
- air change rate at 50 Pa: n_{50} = ?

Requirement:

- $n_{50} \leq 0{,}6$ 1/h (Passive House)

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Expected Conditions during the test

- Weather conditions: test in wintertime
  - large temperature difference between inside and outside?
  - wind?
- High and big building
  - high natural building pressure because of thermal stack effect
  - pressure drop inside of the building during test possible

Risk

Is it possible to do the test according the EN 13829?

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Requirements of the EN 13829 Standard

- **Zero-flow pressure difference < 5 Pa**
  - … if … the average value of the zero-flow (natural or baseline) pressure difference is greater than 5 Pa (absolute value) do not perform the test.
- **Uniform pressure in whole building**
  - … a uniform pressure is maintained within a range of less than 10% of the measured (induced) inside/outside pressure difference.

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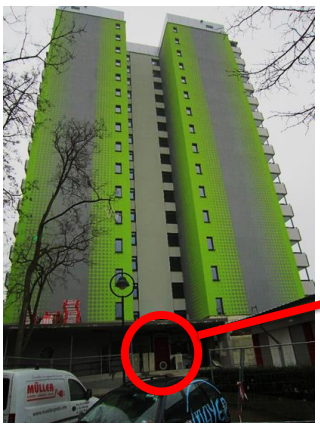
Setup of Test Equipment



One BlowerDoor system

Setup in exterior door of ground floor

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Weather Conditions During Tests

Test 1 Strong Wind		Test 2 Low Wind
4 Beaufort	Wind	1 Beaufort
19 °C	indoor temperature	17 °C
10 °C	outdoor temperature	3°C

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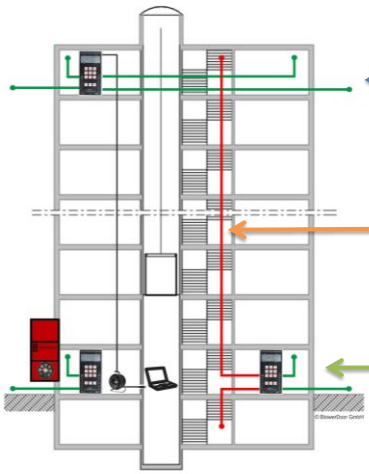
Additional Test Equipment Because of Weather Conditions



2 test points to control building pressure at top of building

control pressure drop inside of building

3 reference test points for building pressure difference

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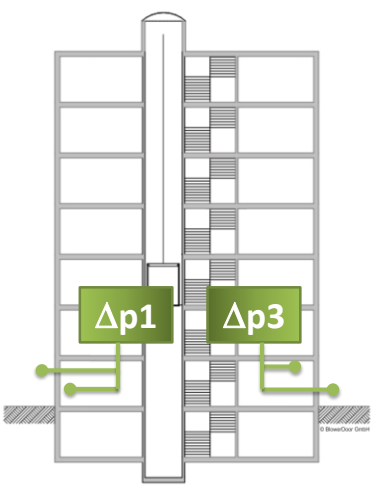
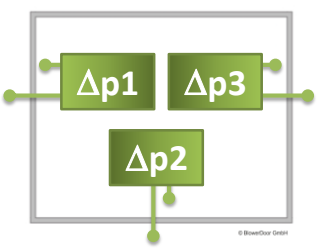
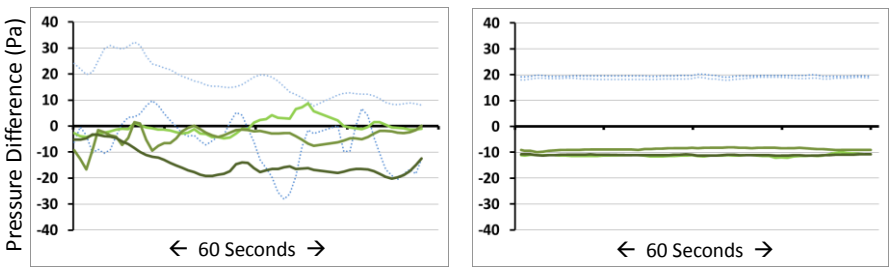
Natural Pressure Difference (Bottom of Building)



Three reference test points
for
building pressure difference



Test 1 Strong Wind	Test 2 Low Wind



Natural Pressure Difference (bottom of building)

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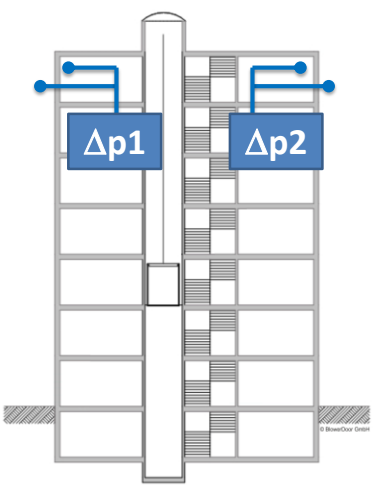
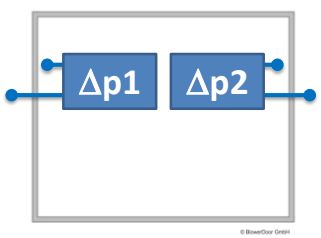
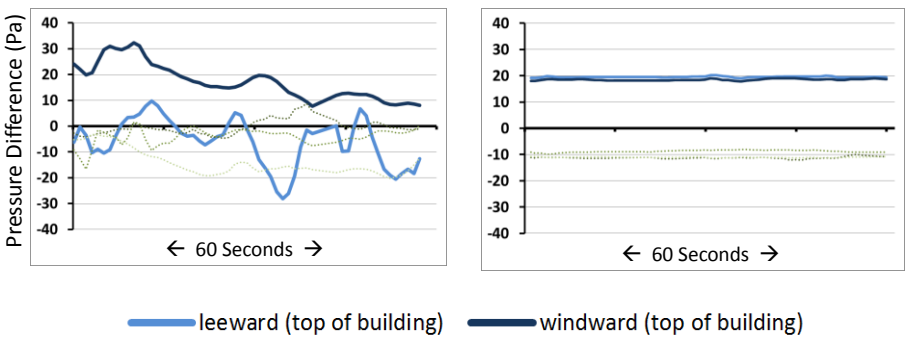
Natural Pressure Difference (Top of Building)





Tow test points for natural pressure difference at the top of building

Test 1 Strong Wind	Test 2 Low Wind



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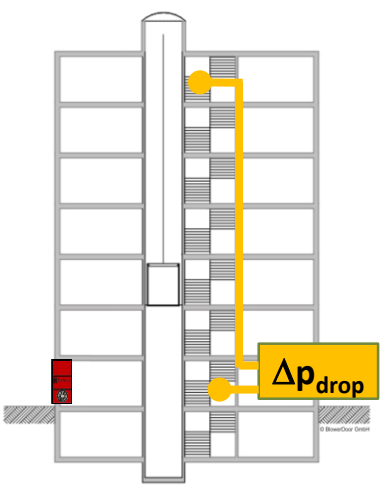
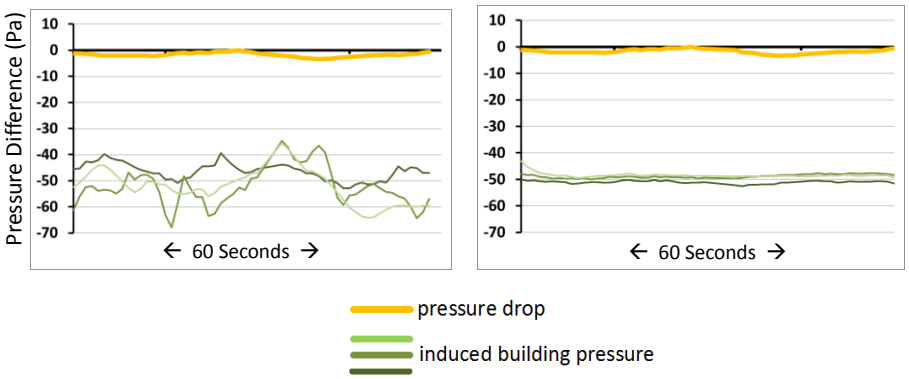
Check Pressure Drop Inside of Building



Check if there is pressure drop between the top and bottom of the building during the airtightness test.

Test 1	Test 2
Strong Wind	**Low Wind**



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Test Results: Airflow at 50 Pa

Test 1		Test 2	Difference
5567 m³/h	← underpressure →	4833 m³/h	*-13%*
4219 m³/h	←overpressure →	4859 m³/h	*+15%*
4893 m³/h	**← average →**	**4846** m³/h	***-1%***

n_{50} = 0,2 1/h < 0,6 1/h (Requirement Passive House)

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Conclusion

- Possible to test the high building
- Additional controls to take into account the wind and temperature conditions.
- Ensure a uniform pressure inside of the building
- Average of under- and overpressure for V_{50}
- My Questions
  - Same results in summertime?
  - Same results in a building with more leakages?
  - What should we do with the requirements of EN 13829?

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Thank you very much for your attention!

Questions?

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