A presentation of 4 different cases to inspire Blower Door-test operators

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Case 1: NOVO Office building

Tested whit a traditional BlowerDoor multifan-test.

- Volume at 112968 m^3
- Floor area 20259 m^2
- The arrangement is with 9 fans.
- The building owner has order the test. To fulfill demand form the government/building code.

Results

- n_{50}=0,11 h^{-1}
- w_{50}=0,17 l/s pr. $m^2_{floor\text{-}aria}$

The setup was 3 groups with 3 fans. Baseline was placed in two directions: One on the East-side, and another on the West-side of the building.
The Pressure differences, in the Building, are often a problem: Therefore two channels are used for measuring the difference. One channel between top and bottom and one between North and South.

In this case it was only necessary to use 2 Minneapolis Blower Door-fans. This is a commend situation with large Buildings: You have to plan the test after the demands in the planning phase and the rules in the building code,) which in this case means that it was planned for using 15 Minneapolis Blower Door-fans.

To save resources, it makes sense to plan the test below 50 Pa. in the area between -25 Pa to -50 Pa. as the EN 13829 allows.
Example:

- Buildin code are max 1,5 l/s pr. m^2 at 50 Pa.
- Fan capacity at 50 Pa. are 2000 l/s (Minneapolis Blower-Door) at 25 Pa. capacity is estimated to 2000 / 0,6 = 3333 l/s
- Number of fans for this building is 20259 m^2 * 1,5 l/s pr. m^2 /3333l/s = 9,11 fans
- If the building is passing just below the building code, it should be possible to test in the area 25 Pa. to 50 Pa. This is what the DS/EN 13829 defines as accepting.

In Denmark we have decided that buildings have to be tested above 50 Pa. But is that reasonable? In this case I meant that we should have brought 15 fans in, and at the test only used 2 fans. I think not, because it gives us unreasonable costs to test very large buildings.

So today a lot of my work is done out from the building code, but certainly also out from my knowledge about how air tight the, concrete, contractor in generally builds. This means that in this case, where the contractor made a failure in the building, and build a leaky building, I would not have an enough fans to establish 50 Pa.

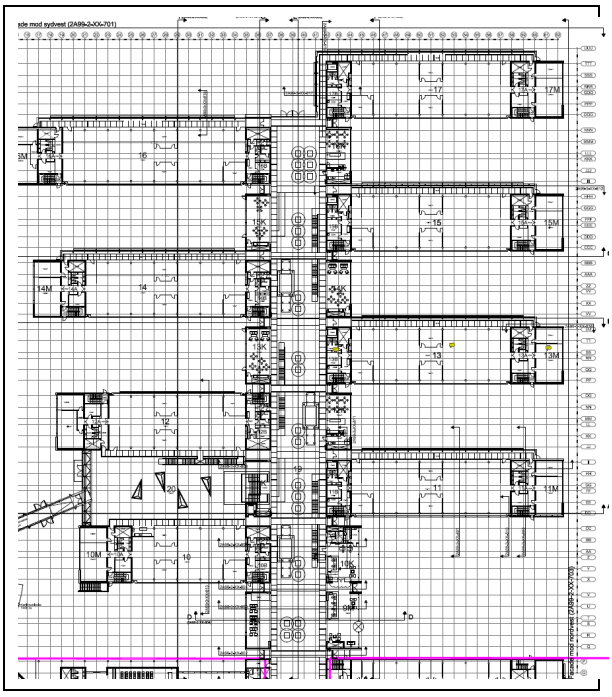
If you like me, work like this, it is important that you tell the contractor about these conditions.

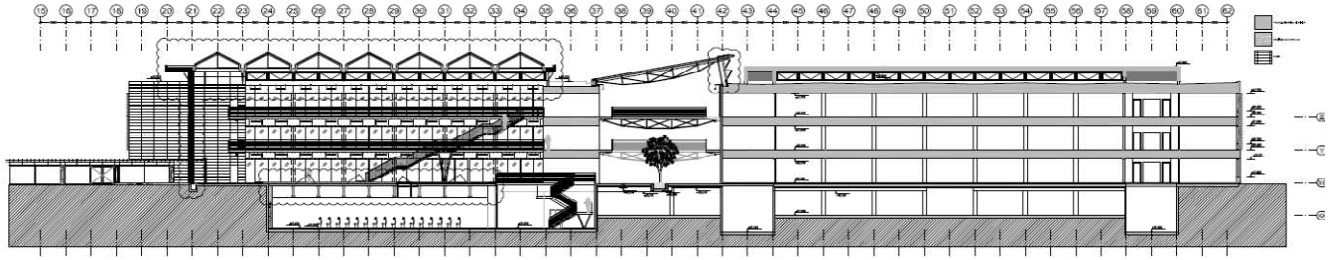
A test at lower cost can often result in some unexpected problems: Say if; the building is leakier than I estimated, this means that you have to make a test, on conditions which is not recommended. But all constructers like to save money, so this is never a problem. In extreme situations, you cannot make the test even in the area between -25 Pa and -50 Pa., but in that case the building will not pass the test, because it is too leaky, so it doesn't matter: You must come back, after repair, and make a new test that fulfills the demands of EN 13829.

Case 2: Office building at 300.000 m³

Tested in zones and finally controlled whit thermography, under depressor establish whit 9 BD-fans, combined whit the ventilations system

- Volume at approximately 300.000 m³
- Floor aria 53.000 m^2
- Zone 1
  - Volume 12000 m^3
  - Floor area 3200 m^2
  - A test at an early stage was carryout mainly to see whether there were any air-leaks, in the building envelope.
- Zone 2
  - Volume 12000 m^3
  - Floor area 3200 m^2
  - Results
  - n_{50}=0,81 h^{-1}
  - w_{50}=0,83 l/s pr. $m^2_{floor\text{-}aria}$





In this case it was the constructor who ordered the Blower Door-test. ISOLINKs assignment was in this case, from start to finish, to ensure the constructer, that the finely building would pass the Blower Door-test. And also make a level of control, to ensure the building owner that, the quality of the hole building envelopes air-tightness was good.

The construction period was 1.5 year, so to ensure the constructer that the final building would pass, it was not possible to just test the final building.

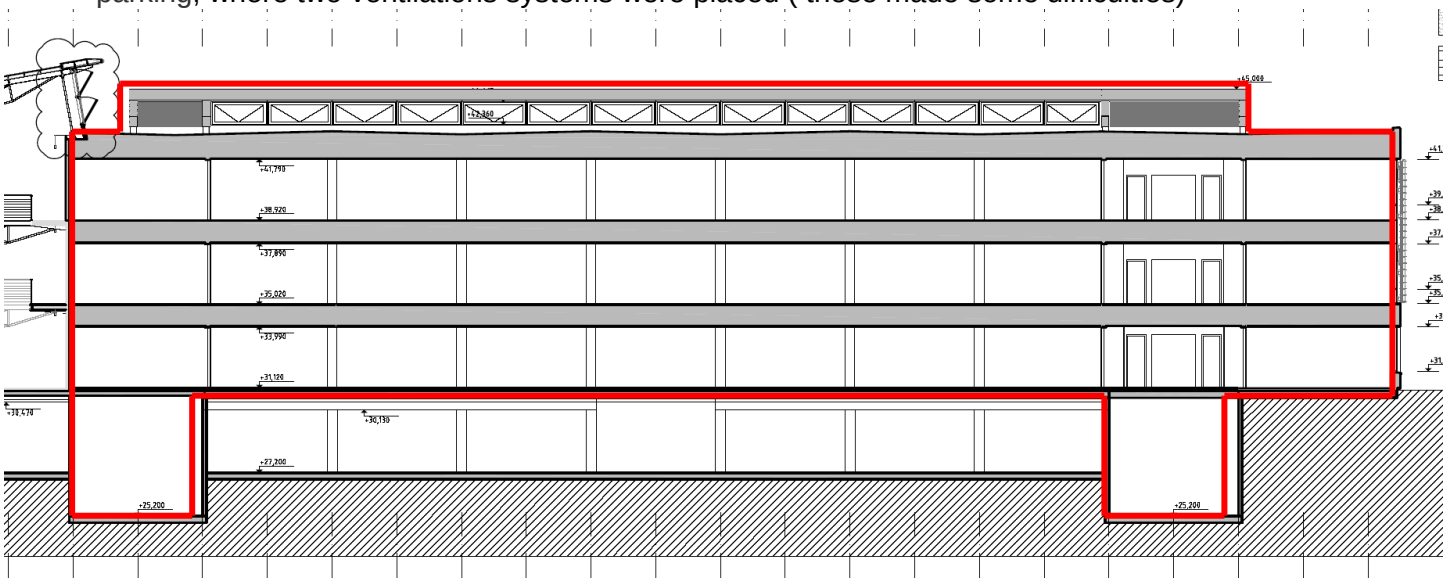
ISOLINK suggested the following plan.

The building is designed whit 9 almost identical office “fingers” connected whit at large Atrium.

The constructor should pick out 1 office finger to make a primary control: This was performed whit thermography combine with at depressor of 3 Blower Door-fans. The setup was not a Blower Door-test because parts of the envelop was not finish.
But if you are able to make a depressor at 50 pa with 3 fans (3fansX2000 l/s /3200 m^2 = 1,87 l/s pr. m^2) you can tell that everything is going in the right direction.
On the basis of the thermography it was possible to perform a checklist which showed the buildings critical details. This checklist was used at al the 9 office “fingers” and eliminated all the big leaks.
ISOLINK carried out a visual control on basis of the checklist at all 8 remaining building “fingers”.

For testing the next zone the building owner picked random one of the 9 office “fingers” for testing.

The red marking shows the building envelop, under the building there was a underground parking, where two ventilations systems were placed (these made some difficulties)



Therefore the test was performed with a 3 zone test because it was difficult to seal the ventilation system
One zone was establish at the ventilations system, placed in the underground parking area, the second ventilation system was at the time not possible to close effective so also here we established a section. “So instead of using a lot of times to seal the ventilation channels, 2 extra test zones were established. (This way all contributions from ventilation were eliminated.)

A 100% thermography was made in 2. test zone, and in that way you had referees for the rest of the building.

Just before takeover a depressor was establish at all 300.000 m^3 this whit 9 Blower Door-fans and the 23 ventilation systems in the building.
These easy establish -50 Pa. and conditions for an effective thermography for air-leeks were established.

Thermography was made by an IR-telelens so it was possible to work from the atrium floor and controlling the glass roof effectively.

The 9 office “fingers” was controlled, whit the reference form the Blower Door-test.

Case 3 University of AArhus at 142.296 m³

1/5 tested by a traditional 1-zone test, and finely the hole building is tested in a combination of 3 Blower Door-fans combine with the ventilation system

- Volume at 142.296 m³
- Floor aria 26.626 m^2
- 1-zone test at 4076 m^2 (20.000 m^3) performed as traditional Blower Door-test
- 0,66 h^{-1}
- w_{50}=0,92 l/s pr. $m^2_{floor\text{-}aria}$

- Finely the whole building is tested in a combination with 3 Blower Door-fans and the ventilation system.
  The whole building tested only at depressor.

- n_{50}=0,41 h^{-1}
- w_{50}=0,51 l/s pr. $m^2_{floor\text{-}aria}$

The agreement to carry out the Blower Door-test was signed whit the contractor.
At an early stage in the build period, the contractor wanted, to know if the final outcome would consist the building code demand of air-tightness. (w_{50}≤1,5 l/s pr. m^2)

As can be seen in the photo, the adjoining, building is fully open, and therefore there was a need to put up a tempera air-tight wall towards the not yet closed atrium.

The work to set up an airtight temporary wall in a 5 floors (basement included) required relatively large resource.
And I learned that it was necessary to personally be present in the building of this tempera section wall, because it seems that craftsmen had difficulty to understand that airtight meant airtight. Today I have only one company I call in if I need to put-up temporary section walls.

Required resources used:

- 2 craftsmen for 5 days
- 1 Blower Door operator for 5 days.

It is important that the contractor gets informed that work with sectioning requires 4 times more resources than preforming the test itself.
To conduct a preliminary Blower Door-test as in the example here led to the knowledge that tests of small sections is more expensive than the test on the entire building..

Finely the whole building was tested in a combination with Blower Door- fans and ventilation fans.

The capacity of the 4 ventilation systems was 4x15.800 m^3/h, this means that the ventilation system should be able to establish -50 Pa. at an air-tightness at (4x15.800 m^3/h)/142.296m^3=0,44h^{-1}

Supplied whit 3 Minneapolis Blower Door-fans it comes to (4x15.800+3x7500)m^3/h/142.296m^3 = 0,60h^{-1} At the primarily test in zone 1 the result was 0,66 h^{-1} so whit 4 time ventilation system and 3 BD-fans the capacity should be acceptable.

In practice the test was performed whit 2 time ventilation and 3 BD-fans.

Case 4 HORTEN building with three-dimensional facade

Building at 56.000 m³

Critical parts of the envelope were tested with a Membrane-Blower Door-test.

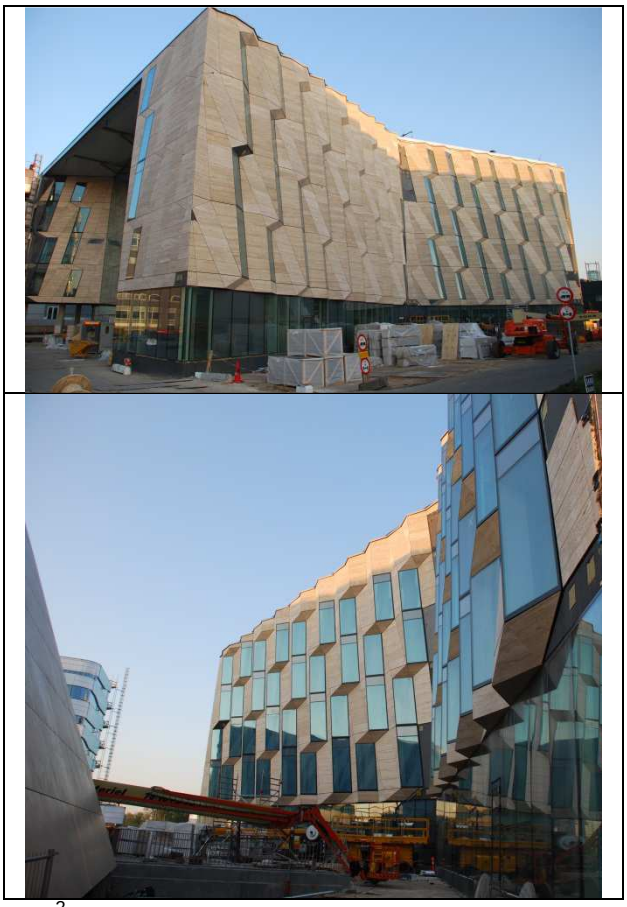
A Power Point presentation can be found at my website. www.BlowerDoor.dk.

I made a presentation about this test in 2012

- Volume at this building 56.000 m^3
- Envelop area at 6606 m^2
- Floor area at 8450 m^2
- Demand form building code w_{50}≤1,5 l/s pr. m^2

It was in this case not difficult to point out which part of the envelope that was the critical part regarding the airtightness.

The demand form the building code was recalculated from a value regarding floor area to a value regarding envelope aera.



q_{50}= w_{50}xfloor aria / envelope aria = 1,92 l/s pr. $m^2_{envelope}$

The most critical parts of the envelope was pointed out and tested whit the membrane Blower Door-test and these test should give results below 1,92 l/s pr. $m^2_{envolup.}$ And the idea was that if the most critical parts of the envelope can pass that value, the rest can as well.

Membrane Blower Door-test result. (Window and Door Measurement System)

- MBD-test 1 q_{50}=0,82 l/s pr. $m^2_{envelope}$
- MBD-test 2 q_{50}=0,77 l/s pr. $m^2_{envelope}$
- MBD-test 3 q_{50}=0,74 l/s pr. $m^2_{envelope}$
- MBD-test 4 q_{50}=1,81 l/s pr. $m^2_{envelope}$

- MBD-test 5 q_{50}=0,58 l/s pr. $m^2_{envelope}$
- MBD-test 6 q_{50}=0,38 l/s pr. $m^2_{envelope}$
- Traditional zone Blower Door-test, gave the result 1,12 l/s pr. $m^2_{envelope}$ in same aria as MBD-test 6
- MBD-test 7 q_{50}=0,28 l/s pr. $m^2_{envelope}$
- MBD-test 8 q_{50}=0,16 l/s pr. $m^2_{envelope}$

Test number 8 are 12 times more airtight than the demand in building code.