THE POWER OF QUALITY

Arch. Christophe Debrabander, Ir. Arch. Kristof Neutens

Bostoen
Koninginnenlaan 2-3
Drongen, Belgium

ABSTRACT

Through the experiences gained by building a sufficient number of air-tight buildings, the author will illustrate the ease of detailing and constructing an air tight building.
Using parallels to conventional building typologies, the methods of making an air-tight building enveloppe will be explained. The presentation will be divided into following chapters:

1. Precicious building methodology.

   When everything is detailled and executed with precision and according to art and best practices (e.g. finishing the interior of the windows with plaster in stead of using wood; using windows 'better' than class 4; correct placement of the vapour barrier to prevent internal condensation; using correct materials in the correct application; …), the n50 value will already be astonishingly low.

   All of these precautions taken to improve the quality of the building, benefit the airtightness. So the measures taken are a logical choice.

2. Quantity.

   Our tests prove that applying these logical choices lead to a great number of succesful tests (e.g. 10 tests a week, all of them lower than 0,6/h. Examples: 0,50/h; 0,43/h; …).

3. Example.

   The best examples are 2 of the employees of Bostoen who build their own passive zero-energy house. They took into account the quality precautions and reached immediately the n50 value of 0,47/h.

4. Quality through mentality and motivation.

   The example and our experience prove that you can have a good blower-door score without making any special and/or expensive interventions. The quality of the materials, the mentality and the motivation of everyone involved suffices to be able to build and design air-tight buildings. One of the only prerequisites for buildings with an n50 that's smaller than 0.6/h, is that all the people working on it, from architect to construction worker are aware of what they're doing.

5. Other areas of application.

   When we keep in mind that a cooler for fruit has a n50 value of around 0.05, we know that we still can do better.

KEYWORDS

Air-tightness, precicious building, detailling, building methodology, passive houses, zero energy building, blowerdoor

INTRODUCTION

Through the experiences gained by building a sufficient number of passive houses and zero energy buildings, the author will illustrate the ease of detailing and constructing an air tight and well ventilated building.
This year (2011) already 45 passive houses and zero energy buildings were finished, each of them with a possitive ventilation report and each of them with an n50 value < 0,6/h.

INSURING AIR-TIGHTNESS

Detailling

Using parallels to conventional building typologies, the methods of making an air-tight building enveloppe will be explained.

The first important element is precicious building methodology.
When everything is detailled and executed with precision and according to art and best practices, the n50 value will already be astonishingly low. We will demonstrate this through a number of examples.

Figure 1.

The example shown in Fig. 1, shows one of the triangles beneath the roof that won’t be visible after the rooms are finished. So strickly for the functionallity and the appearance of the room, they normally don’t have to be covered with plaster, yet to immediately do so while plastering the wall, requires only little extra effort. Otherwhise, when we perform a blowerdoor test, air is going to infiltrate between the bricks. This infiltration, depending on how many triangles are present, can cost a few thenths of a point for the n50 value.

Figure 2.

Figure 2 shows the connection between a steel I beam that carries the hollow core slabs. When the open space above the slabs isn't filled with cement or plaster, there will be a considerable amount of air infiltration. (cfr Figure 3a)

So there are 2 option, either the space is filled up with concrete or cement when the construction workers fill up the holes between the slabs as shown in Figure 3b, or the workers who plaster the walls also fill up the I-beam on both sides.

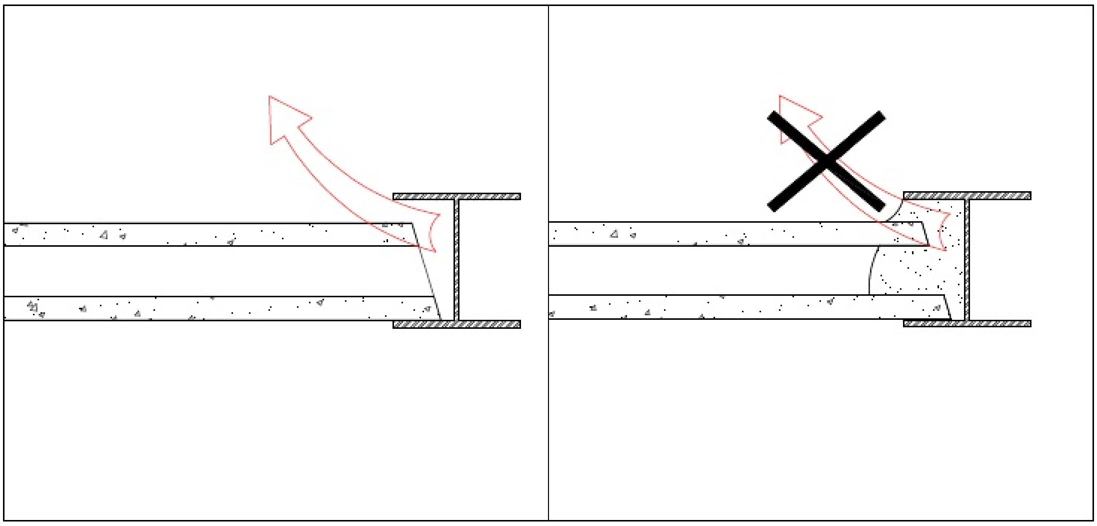


Figure 3a. Figure 3b.

Figure 4.

In figure 4 we can see the holes in the hollow core slab. The edges of the slabs have to be filled with concrete even if it is not strictly necessary for stability purposes. This prevents air from flowing through the canals and entering the house where holes are drilled in the slabs to allow ventilation and electricity to pass (cfr. Figure 5).

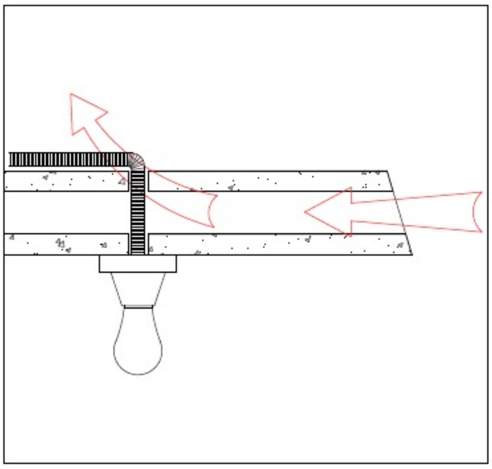


Figure 5.

Figure 6.

The situation as depicted in Figure 6, shows a way to insure that there are no air leaks through the connection between the bricks and the hollow core slab. When applying cement to the base of the wall, one can make sure that there’s no air infiltration between the concrete and the brick. By choosing plaster to finish the walls on the inside, we make sure that the entire wall is air tight.
Again, this measure doesn’t require a lot of time or money, but has a big inpact on the blower door test.

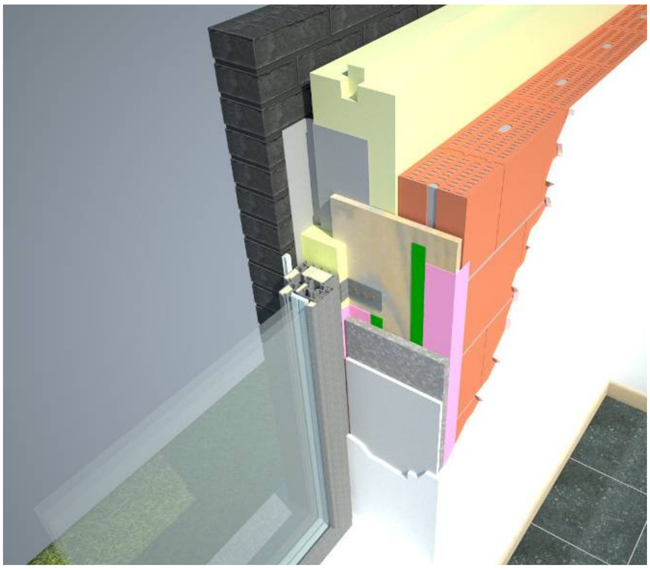
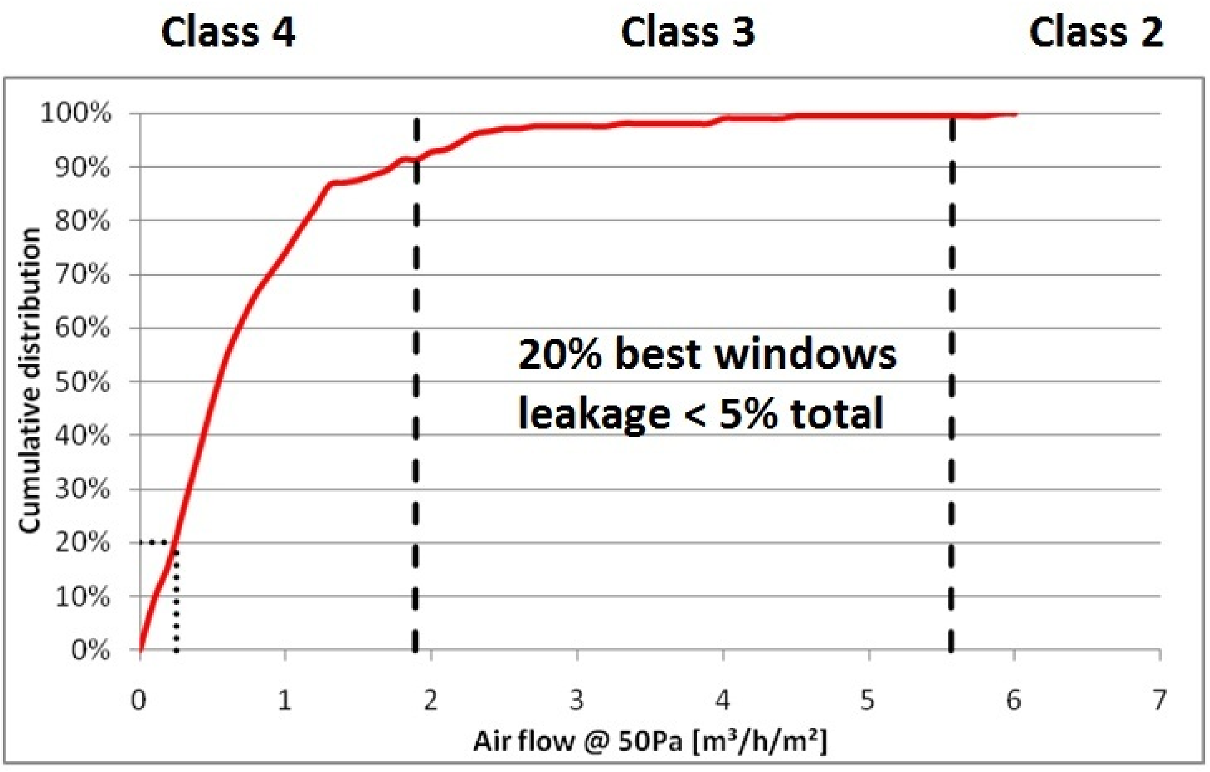


Figure 7.

When detailing the connection between the windows and the wall, one should keep in mind that the air-tightness is of the utmost importance.
In this render we can see the various air-tight foils (pink in picture) and their connection to the plywood and the brick wall. Everything is done so no air will infiltrate and to see to it that the best thermal resistance is achieved.

To insure the air-tighness of the building, an excellent detailing isn't the only step one should take. The use of windows that have an air-tightness 'better' than class 4 is also recommended. This way you allow yourself some room for errors, be it in the execution of the details or little faults in the materials. It speaks for itself that air-tight detailing is of little use, when using windows from class 3, 2 or 1.



Graph 1.

All of these precautions shown in Figures 1 - 7, are taken to improve the quality of the building and benefit the airtightness. The measures taken are a logical choice and demand little extra effort.

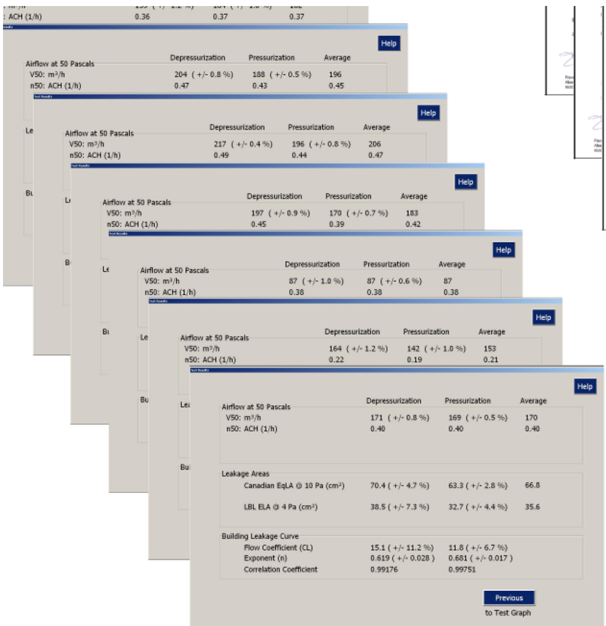
The 3 M’s

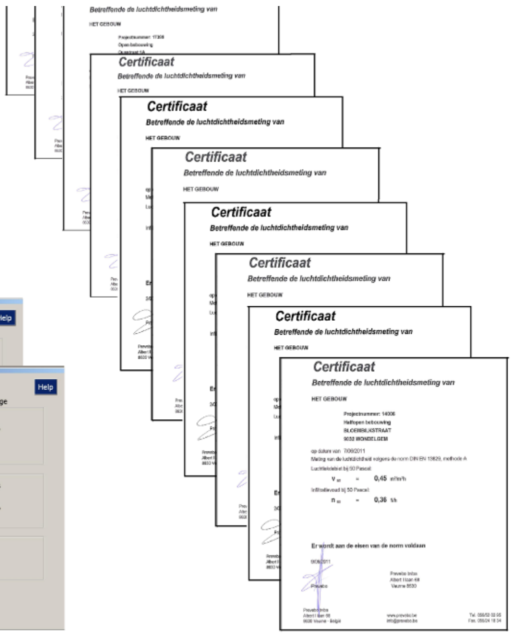
Quality through mentality and motivation is another important issue in this matter.
The quality of the **materials**, the **mentality** and the **motivation** of everyone involved suffices to be able to build and design air-tight buildings. One of the only prerequisites for building with an n50 value that’s smaller than 0.6, is that all the people working on it, from architect to construction worker are aware of what they’re doing.
This can be achieved by providing adequate (materials, mentality and motivation) training for everybody involved and allowing feedback from every level of the chain of command.

Figure 8.

The proof

Our tests prove that applying these logical choices (as shown in Figures 1 - …) and a correct mindset (as illustrated above), lead to a great number of succesful tests (e.g. 10 tests a week, all of them lower than 0,6 cfr. Appendix I - IV).





The best examples are 2 of the employees of Bostoen who build their own passive zero-energy house. As we can see in the pictures, they took into account the quality precautions and immediately reached the n50 value of 0,47/h.

Figuur 10: The ends of the hollow core slabs have been filled with concrete

Figuur 11: Air-tight finishing of the wooden roof

Figuur 9: Insulation and installation of the windows

These examples and our experience prove that you can have a good blower-door score without making any special and/or expensive interventions.

CONCLUSION

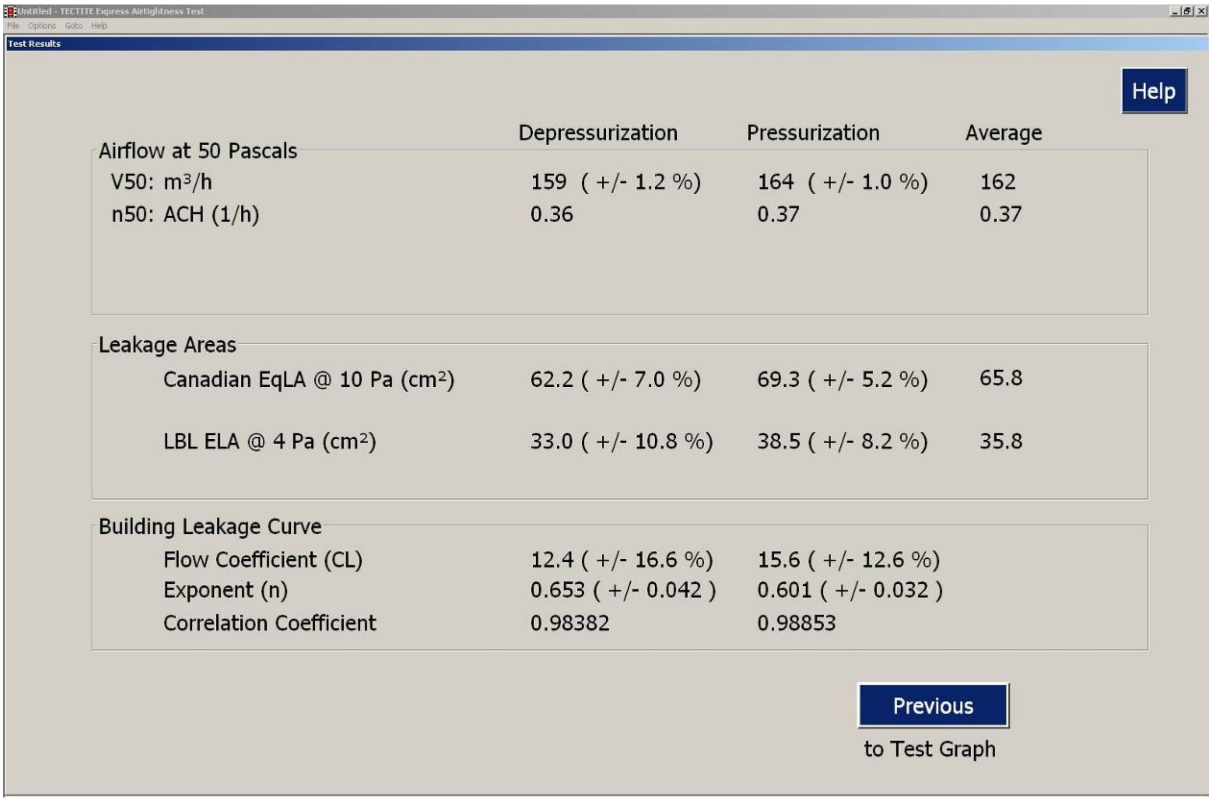
When one strives to build with an n50 value < 0.6, there are a couple of things that can help to achieve that goal.

The building should be designed with the utmost care as not to allow any in- or exfiltration of air. This does not only concern construction details, but the entire building concept. All the steps of the building process, from the construction of the walls to the installation of the ventilation, have to be in tune with each other.

To insure a good execution, the construction workers and everyone involved should be properly trained and have to be aware of what they are doing. An investment in the schooling of the personel rapidly repays itself.

APPENDIX I

Housing project Temse
Net Volume: 430.40 m³
n50 Value : 0.37



Test Results

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	Depressurization	Pressurization	Average
Airflow at 50 Pascals			
V50: m³/h	159 (+/- 1.2 %)	164 (+/- 1.0 %)	162
n50: ACH (1/h)	0.36	0.37	0.37
Leakage Areas			
Canadian EqLA @ 10 Pa (cm²)	62.2 (+/- 7.0 %)	69.3 (+/- 5.2 %)	65.8
LBL ELA @ 4 Pa (cm²)	33.0 (+/- 10.8 %)	38.5 (+/- 8.2 %)	35.8
Building Leakage Curve			
Flow Coefficient (CL)	12.4 (+/- 16.6 %)	15.6 (+/- 12.6 %)	
Exponent (n)	0.653 (+/- 0.042)	0.601 (+/- 0.032)	
Correlation Coefficient	0.98382	0.98853	

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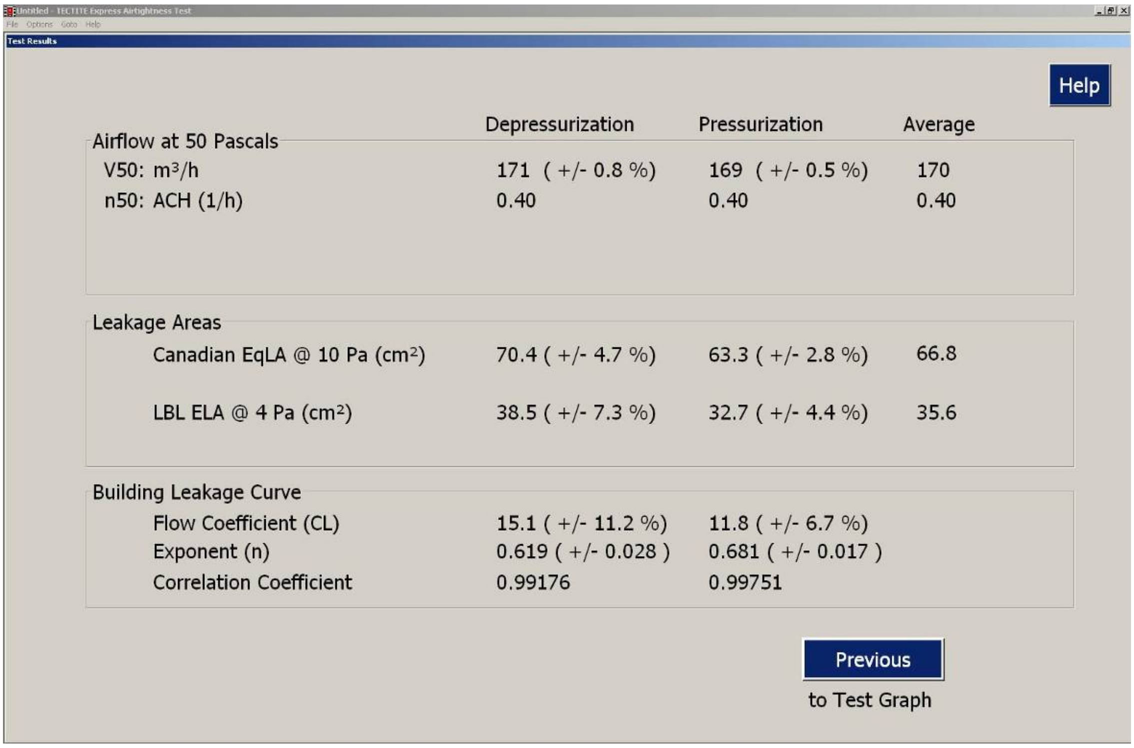
APPENDIX II

Housing project Eke (16179)
Net Volume: 426.93 m³
n50 Value : 0.40


Help

	Depressurization	Pressurization	Average
Airflow at 50 Pascals			
V50: m³/h	171 (+/- 0.8 %)	169 (+/- 0.5 %)	170
n50: ACH (1/h)	0.40	0.40	0.40
Leakage Areas			
Canadian EqLA @ 10 Pa (cm²)	70.4 (+/- 4.7 %)	63.3 (+/- 2.8 %)	66.8
LBL ELA @ 4 Pa (cm²)	38.5 (+/- 7.3 %)	32.7 (+/- 4.4 %)	35.6
Building Leakage Curve			
Flow Coefficient (CL)	15.1 (+/- 11.2 %)	11.8 (+/- 6.7 %)	
Exponent (n)	0.619 (+/- 0.028)	0.681 (+/- 0.017)	
Correlation Coefficient	0.99176	0.99751	

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APPENDIX III

Housing project Oostende
Net Volume: 263.81 m³
n50 Value : 0.38

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Test Results

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Airflow at 50 Pascals

	Depressurization	Pressurization	Average
V50: m³/h	86 (+/- 1.6 %)	113 (+/- 1.1 %)	99
n50: ACH (1/h)	0.33	0.43	0.38

Leakage Areas

	Depressurization	Pressurization	Average
Canadian EqLA @ 10 Pa (cm²)	31.9 (+/- 8.0 %)	42.7 (+/- 6.3 %)	37.3
LBL ELA @ 4 Pa (cm²)	16.4 (+/- 12.3 %)	22.2 (+/- 9.8 %)	19.3

Building Leakage Curve

	Depressurization	Pressurization
Flow Coefficient (CL)	5.9 (+/- 18.9 %)	8.1 (+/- 15.0 %)
Exponent (n)	0.684 (+/- 0.047)	0.673 (+/- 0.038)
Correlation Coefficient	0.98128	0.98739

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APPENDIX IV

Housing project Hove
Net Volume: 738.44 m³
n50 Value : 0.21

Test Results

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Airflow at 50 Pascals	Depressurization	Pressurization	Average
V50: m³/h	164 (+/- 1.2 %)	142 (+/- 1.0 %)	153
n50: ACH (1/h)	0.22	0.19	0.21

Leakage Areas	Depressurization	Pressurization	Average
Canadian EqLA @ 10 Pa (cm²)	55.9 (+/- 7.2 %)	47.9 (+/- 6.4 %)	51.9
LBL ELA @ 4 Pa (cm²)	27.5 (+/- 11.1 %)	23.4 (+/- 9.9 %)	25.5

Building Leakage Curve	Depressurization	Pressurization
Flow Coefficient (CL)	9.2 (+/- 17.1 %)	7.8 (+/- 15.3 %)
Exponent (n)	0.735 (+/- 0.043)	0.742 (+/- 0.039)
Correlation Coefficient	0.98651	0.98928

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