Measurements in Greece of installed windows and comparison between the given air permeability classification and the classification applied to the building envelope

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ABSTRACT

According to the European regulation EN 12207:2017-03, the air permeability of windows and doors is categorized in four different classes and when they are installed on the building envelope, the declared air permeability class should remain unchanged.
The approach is to perform on-site measurements and to confront 40 different cases of windows and doors installed on new and retrofit projects in Athens, Greece.
The purpose is to discover and highlight the most common errors to the correct installation and suggest easy tactics to prevent them.
At the same time, beside the correct installation testing, the measurements registered and confirmed separately on-site each frames air permeability class and compared to the declared one by the manufacturer. The results are that in some cases, the declared classification was different than the classification measured on-site, which means that the product was faulty without any visual confirmation.
The conclusion is that at 95% of the cases, the installed classification was minor of he declared one. This conclusion confirms that the installation methods are not evolved technically as the frame industry has and the given quality of the window manufacturer is not applied on the building envelope. This situation leads to energy losses because of the bad technical instructions, even though the owner of the building has invested on a better-quality product.
This reality urges the need to evolve the legislation and impose mandatory air-tightness checks during every application of window and doors on the building envelope.

KEYWORDS

Air Permeability, Window Measurement, Window Installation, EN 12207

1 INTRODUCTION

Having a large, recorded experience in the energy design of new constructions as well as in the renovation of existing buildings, a large gap has been identified in the field of frames and the airtightness of the building envelope. There is a big difference between the purchase of a certified product and its final application on the wall. This study investigates 40 different cases of airtightness tests on isolated frames, in new constructions and in renovations.

2 METHODOLOGY

Using BlowerDoor GmbH's A-Wert test method, each frame was individually isolated and measured. Two different installations were applied in each frame. First, a strong nylon was placed around the perimeter of the frame, on which a special ring of a certain diameter was applied. With pressure rubbers, the external pressure and the pressure between the nylon and

the frame were measured. An average of 7 measurements were taken for each frame at different pressures, starting at 10 Pa and reaching about 60Pa. After recording the air permeability through the frame at the different pressures, the results were used to calculate the total leakages, given the surface of each frame. A final report was given for the air flow per 1 meter of frame opening length and the total air flow. With the above results, the comparison was made with the data of EN 12207:2017-03 in order to make a classification according to the corresponding category (1 to 4).
The nylon was then removed and placed on the wall, around the frame where the same process followed. In this way we arrived at new data, comparable to the previous measurement according to EN 12207:2017-03.
The measurement tables of the 40 different frames are as follows. In table 1 are described: the surface area, the length of each opening, the air flow per 1 meter of opening length with the frame isolated and the air flow per 1 meter with the frame applied to the wall.
In table 2 and for the same frames, we can find: the total air flow from each frame, first isolated and then applied to the wall.
In table 3 we find the average measurements of all the 40 frames, compared to the specifications of EN12207:2017-03, in both cases, frame first isolated and then measured including the wall.

Table 1: Airflow through 1m joint

Area	Joint Length	Frame Number	Frame only m³/(h*m)	On the wall m³/(h*m)
3,27	5,17	Frame_01	2,51	3,77
5,99	7,62	Frame_02	2,56	5,32
4,50	6,24	Frame_03	3,12	6,06
4,62	6,40	Frame_04	3,52	5,63
2,64	5,16	Frame_05	3,07	6,04
1,20	3,24	Frame_06	5,40	9,50
1,28	3,38	Frame_07	3,94	6,50
4,03	5,70	Frame_08	3,07	6,81
4,00	5,68	Frame_09	3,05	6,76
7,54	8,40	Frame_10	5,74	12,74
6,51	8,30	Frame_11	4,96	11,00
4,20	6,10	Frame_12	3,20	7,09
3,90	5,60	Frame_13	2,97	6,59
2,75	4,86	Frame_14	2,10	4,65
1,89	4,20	Frame_15	1,44	3,18
3,91	5,62	Frame_16	2,98	6,60

2,60	4,60	Frame_17	1,98	4,39
3,90	5,60	Frame_18	2,97	6,59
1,32	3,26	Frame_19	1,01	4,53
2,07	4,07	Frame_20	1,57	3,49
3,50	5,30	Frame_21	2,67	5,91
2,00	4,10	Frame_22	1,52	3,38
1,09	2,95	Frame_23	0,83	1,83
3,50	5,30	Frame_24	2,67	5,91
0,53	2,14	Frame_25	0,40	0,52
0,63	2,25	Frame_26	0,48	0,65
3,50	5,30	Frame_27	2,67	5,91
2,56	4,80	Frame_28	1,95	4,32
0,95	3,00	Frame_29	0,72	1,60
3,00	4,90	Frame_30	2,29	5,07
2,24	4,60	Frame_31	1,71	3,78
3,50	5,30	Frame_32	2,67	5,91
0,82	2,57	Frame_33	0,63	1,39
3,00	4,90	Frame_34	2,29	5,07
6,25	7,50	Frame_35	4,76	10,56
4,00	6,60	Frame_36	3,05	6,76
1,72	3,74	Frame_37	1,31	2,91
4,32	6,00	Frame_38	3,29	7,30
0,82	2,57	Frame_39	0,63	1,39
1,72	3,74	Frame_40	1,31	2,91

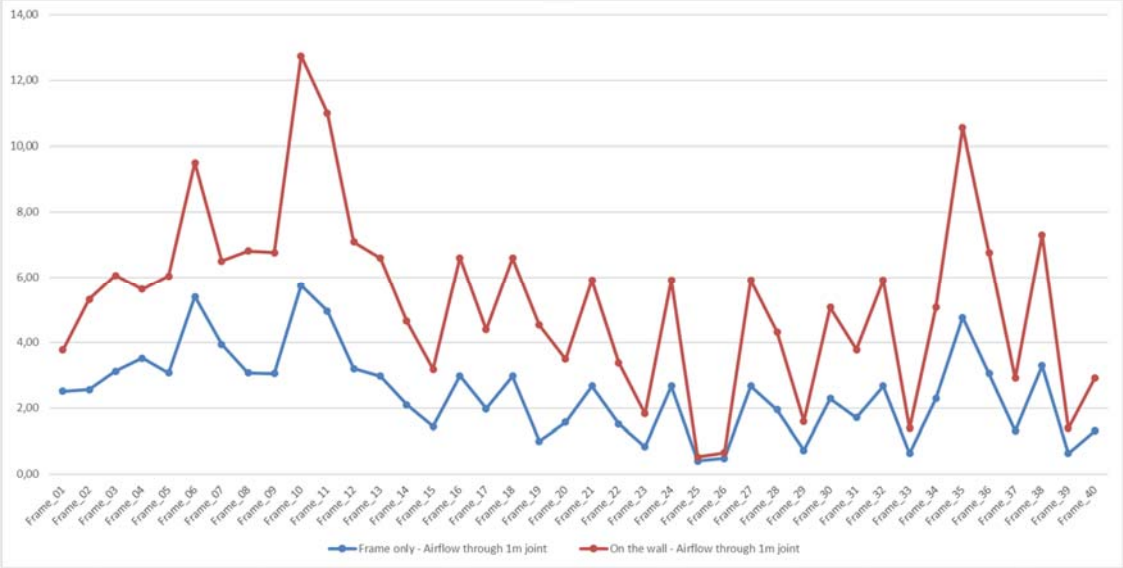

Figure 1: Airflow through 1m joint

Table 2: Total airflow through the window

Area	Joint Length	Frame Number	Frame only m³/h	On the wall m³/h
3,27	5,17	Frame_01	13,00	21,62
5,99	7,62	Frame_02	19,48	40,56
4,50	6,24	Frame_03	19,48	37,81
4,62	6,40	Frame_04	22,51	36,04
2,64	5,16	Frame_05	19,63	38,66
1,20	3,24	Frame_06	17,48	38,66
1,28	3,38	Frame_07	15,83	35,60
4,03	5,70	Frame_08	23,68	31,92
4,00	5,68	Frame_09	23,50	31,81
7,54	8,40	Frame_10	44,26	47,04
6,51	8,30	Frame_11	38,21	46,48
4,20	6,10	Frame_12	24,65	34,16
3,90	5,60	Frame_13	22,89	31,36
2,75	4,86	Frame_14	16,17	27,22

1,89	4,20	Frame_15	11,06	23,52
3,91	5,62	Frame_16	22,93	31,47
2,60	4,60	Frame_17	15,26	25,76
3,90	5,60	Frame_18	22,89	31,36
1,32	3,26	Frame_19	7,75	18,26
2,07	4,07	Frame_20	12,13	22,79
3,50	5,30	Frame_21	20,55	29,68
2,00	4,10	Frame_22	11,74	22,96
1,09	2,95	Frame_23	6,37	16,52
3,50	5,30	Frame_24	20,55	29,68
0,53	2,14	Frame_25	3,11	11,98
0,63	2,25	Frame_26	3,67	12,60
3,50	5,30	Frame_27	20,55	29,68
2,56	4,80	Frame_28	15,03	26,88
0,95	3,00	Frame_29	5,55	16,80
3,00	4,90	Frame_30	17,61	27,44
2,24	4,60	Frame_31	13,15	25,76
3,50	5,30	Frame_32	20,55	29,68
0,82	2,57	Frame_33	4,83	14,39
3,00	4,90	Frame_34	17,61	27,44
6,25	7,50	Frame_35	36,69	42,00
4,00	6,60	Frame_36	23,48	36,96
1,72	3,74	Frame_37	10,11	20,94
4,32	6,00	Frame_38	25,36	33,60
0,82	2,57	Frame_39	4,83	14,39
1,72	3,74	Frame_40	10,11	20,94

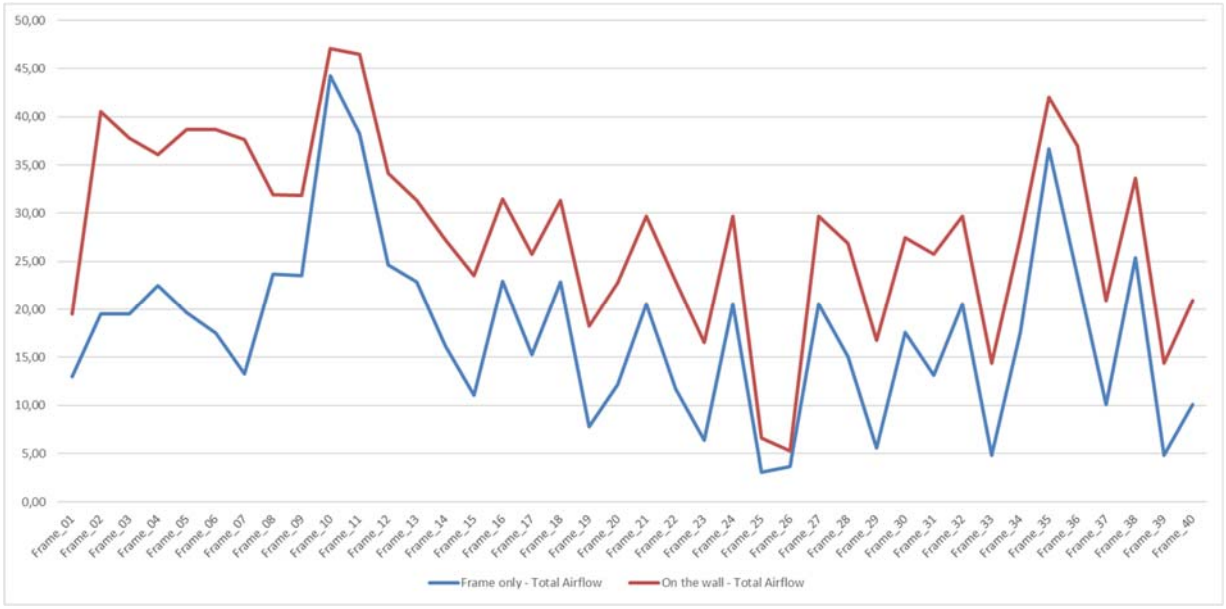

Figure 2: Total airflow through the window

Table 3: Obtained air permeability compared to class 4 requirements

	Requirement Class4 @ 100Pa	**Frame only**	**On the wall**
Total Airflow	3,00	17,61	28,56
Airflow through 1m joint	0,75	2,47	5,26

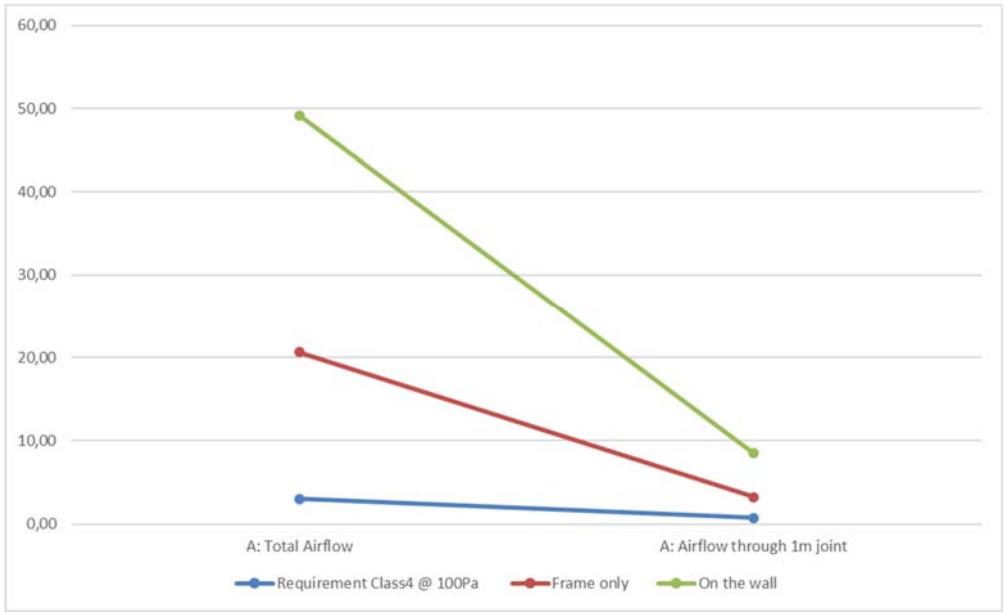

Figure 3: Obtained air permeability compared to class 4 requirements

3 CONCLUSIONS

The main conclusion of the research is that the air tightness quality of a frame, from the factory to the application, loses more than 50% of its value, in almost all cases. This results in the end consumer receiving a lower quality product compared to what was agreed upon, while the worst consequence is overall as energy savings deviate from their target by at least 50%.
More specifically, while a category 4 frame must have 0.75 m^3/(hm), in all the tested frames an average value of 2.47 m^3/(hm) was measured, while applied to the wall 5.26 m^3 was measured /(hm).
In this way investments are not redeemed while huge resources are wasted in an idle and ineffective way. There is a great and immediate need to educate both the construction industry and the public on the importance of detail in achieving the goal of reducing the CO2 energy footprint.

4 ACKNOWLEDGEMENTS

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5 REFERENCES

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