Influence of the window profile on the final quality of the product

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Abstract *The current product on the market offers a wide range of diverse profiles for producing windows that are made of different materials, width and order of grills depending on the profile. Within the framework of this research the windows with same dimensions shall be elaborated, those which are made of the same production capacity and use the same fittings but different types of PVC profiles. The aim is to prove what kind of influence the used profile has over the final quality of the product. For this research, two groups and six subgroups will be tested. In each subgroup, one tests five windows made of the same profile. The groups are divided according to the used fittings. The testing of the quality shall be conducted in accordance with the European norms EN 1026:2016 (Windows and doors - Air permeability - Test method), EN 1027:2016 (Windows and doors - Water tightness - Test method), EN 12211:2016 (Windows and doors - Resistance to wind load - Test method).*
Keywords*: CONSTRUCTION CARPENTRY, WINDOW, AIR PERMEABILITY, WIND RESISTANCE, PVC PROFILES*

1. Introduction

The quality of one product is a characteristic worth being considered when it is proven that the same satisfies the needs for which it is produced. Having in mind that the purpose of one window is to provide light and desirable ventilation of a room, and, at the same time, to protect the object from external influences such as air permeability, water tightness and resistance to wind, we state that the window is of a higher quality as much as it can guarantee all these conditions. The window as a product is of complex content from diverse materials and parts. As different parts of the window we enlist the following below: Frame – the frame is a construction of the jamb and the construction of the side jamb.

Glass – the content of the construction that can be made of glass and glass packet.

Hinge – design, window handle, window lockers which offer the sliding of the window, meaning, the possibility for its opening and closing.

Throughout the production of window parts, different types of materials are used:

Frame – wood profiles from different types of wood, PVC profiles, aluminum profiles, as well as a combination of these materials.

Glass – one glass (4mm, 6mm), glass packet out of two, three or four glasses with different combinations of glasses layered with different protective paints.

Fittings – metal, plastic, rubber.

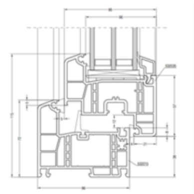
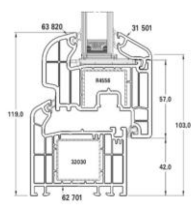
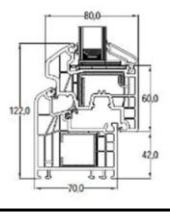
Un-plasticized Poly Vinyl Chloride is relatively new to the building industry as a material for windows and doors. UPVC is based on poly vinyl chloride(PVC), one of the most versatile polymers found. UPVC is prepared with a special formulation in which different stabilizers and modifiers are added to poly vinyl chloride to make rigid and suitable for use as window frames. UPVC contains poly vinyl chloride(PVC), calcium carbonate(CaCo3) and titanium dioxide (TiO2). PVC forms the major constituent of blend composition. Unlike other polymer PVC is heat sensitive and requires additives during processing. Hence the properties of PVC can be increased through additives like light and UV stabilizer, fillers, pigments and lubricants can be added during the blending process. Titanium dioxide is an expensive pigment used for imparting natural white color to the UPVC profile and provide necessary UV stability for the product. Calcium carbonate are fillers which are inorganic minerals as fine particles homogenized in PVC blend. Usage of filler has effect on mechanical property like tensile strength, elongation, impact strength, shrinkage and cost. Production of UPVC involves a complex extrusion process. Extrusion is a manufacturing process where material is drawn through a die of required cross section. The main advantage of extrusion process is that it can create very complex sections and also can be used for brittle objects. Additionally this process provide excellent surface finishes. UPVC extrusion process can be recycled. UPVC has excellent insulation properties resulting in high energy efficiency.(1)

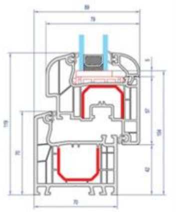
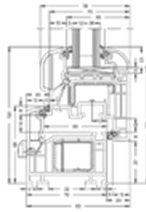
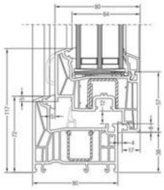
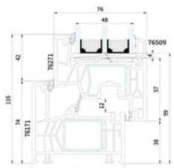
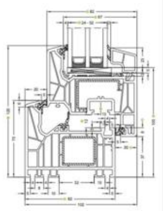
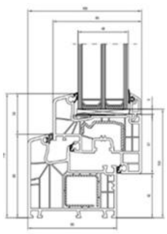
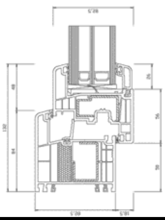
The non-polyvinyl chloride as a material offers possibilities for creating different window profiles in terms of the dimensions and the order of the grills. This paper has the aim of researching how much the diversification of the profiles influences the final quality of the window. The quality will be elaborating on the water tightness, air permeability as well as resistance to deformity on wind load.

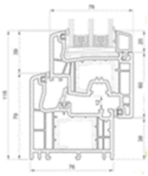
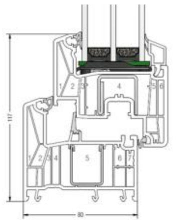
2. Materials and research metod

The samples which are subject of the research are divided into two groups. In each group there are six subgroups, each consisting of five windows. All the samples' dimensions are 800mm width and 1400 mm height. All the samples in the subgroup are made of the same production capacity and the same type of fittings and profile is used for their making (Table 1). For all the samples in the subgroups a different type of profile is used..

Table 1: *Groups of the test samples*

Subgroup	Picture of the sample	Profile of the sample
Group 1 Windows with dimensions 800/1400mm Fitting AGB		
Subgroup 1		REHAU GENEO [2] 
Subgroup 2		ALPHACAN 70R [3] 
Subgroup 3		ALPHACAN PRESTIGIO [3] 

Subgroup 4		ALUPLAST IDEAL 4000 [4] 
Subgroup 5		SCHUCO SYSTM CT 70 [5] 
Subgroup 6		REHAU SYNEGO [2] 
Group 2 Windows with dimensions 800/1400mm Fitting Sigenia		
Subgroup 7		KOMMERLINK [6] 
Subgroup 8		SCHUCO SI 82 [5] 
Subgroup 9		ALUPLAST IDEAL 8000 [4] 
Subgroup 10		GEALAN S9000 [7] 

Subgroup 11		SALAMANDER STREAMLINE MD76 [8] 
Subgroup 12		TROCAL 88mm [9] 

3. Results

3.1. Results of the air permeability

The testing of the air permeability is conducted with pressure and absorption of the different air pressure. The mean values for every subgroup will be presented individually in a diagram, just as the class according to the EN 1026:2016 “Windows and doors - Air permeability - Test method” standard. [10]

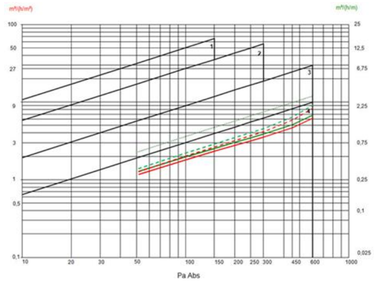


Fig.1 *Air permeability measures for subgroup 1*

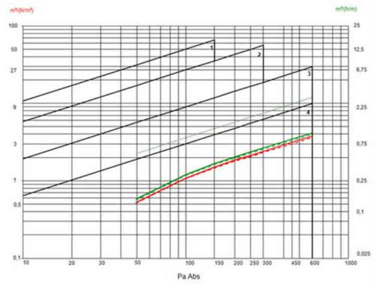


Fig.2 *Air permeability measures for subgroup 2*

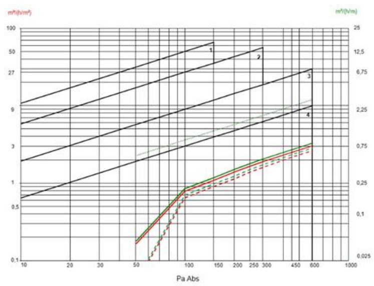


Fig.3 *Air permeability measures for subgroup 3*

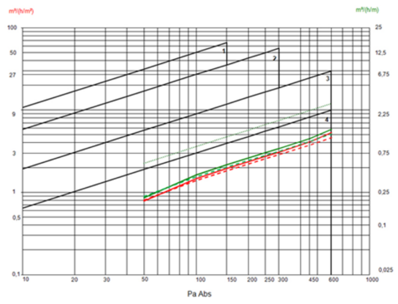


Fig.4 *Air permeability measures for subgroup 4*

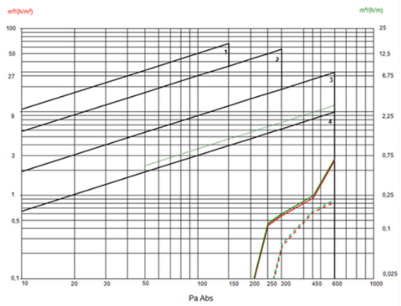


Fig.5 *Air permeability measures for subgroup 5*

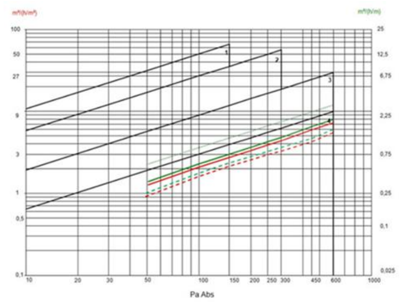


Fig.6 *Air permeability measures for subgroup 6*

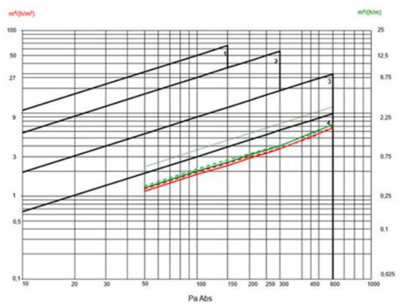


Fig.7 *Air permeability measures for subgroup 7*

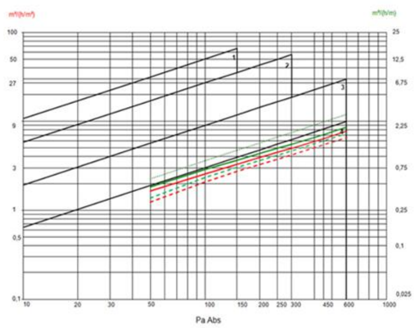


Fig.8 *Air permeability measures for subgroup 8*

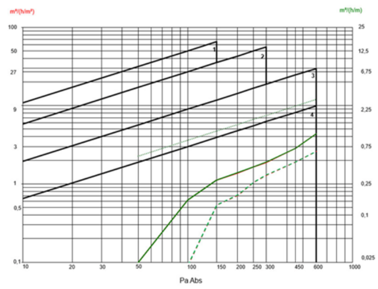


Fig.9 *Air permeability measures for subgroup 9*

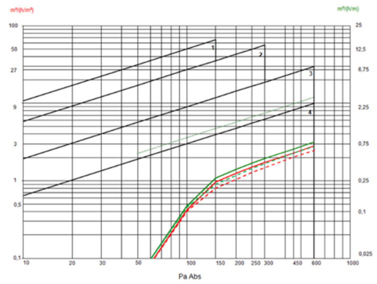


Fig.10 *Air permeability measures for subgroup 10*

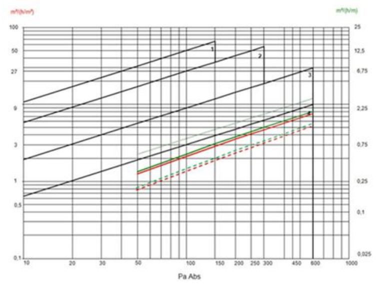


Fig.11 *Air permeability measures for subgroup 11*

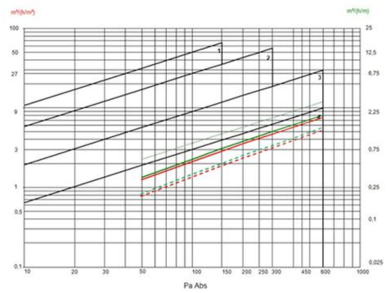


Fig.12 *Air permeability measures for subgroup 12*

3.2. Results – water tightness

Class according to the EN 1027:2016 "*Windows and doors - Water tightness - Test method*" standard. [11]

Table.2: *Subgroup 1 – water tightness*

class	Pressure in Pa		Time	Water strance		Observation
	Normal	Actual		Dripping	Flowing	
A1	0	0	15:00	**00:00**	**00:00**	**OK**
A2	50	50	05:00	**00:00**	**00:00**	**OK**
A3	100	100	05:00	**00:00**	**00:00**	**OK**
A4	150	150	05:00	**00:00**	**00:00**	**OK**
A5	200	201	05:00	**00:00**	**00:00**	**OK**
A6	250	250	05:00	**00:00**	**00:00**	**OK**
A7	300	301	05:00	**00:00**	**00:00**	**OK**
A8	450	449	05:00	**00:00**	**00:00**	**OK**
A9	600	601	05:00	**00:00**	**00:44**	**NOT OK**

Table.3: *Subgroup 2 – water tightness*

class	Pressure in Pa		Time	Water strance		Observation
	Normal	Actual		Dripping	Flowing	
A1	0	0	15:00	00:00	00:00	OK
A2	50	50	05:00	00:00	00:00	OK
A3	100	100	05:00	00:00	00:00	OK
A4	150	149	05:00	00:00	00:00	OK
A5	200	201	05:00	00:00	00:00	OK
A6	250	251	05:00	00:00	00:00	OK
A7	300	300	05:00	00:00	01:25	NOT OK

Table.4: *Subgroup 3 – water tightness*

class	Pressure in Pa		Time	Water strance		Observation
	Normal	Actual		Dripping	Flowing	
A1	0	0	15:00	00:00	00:00	OK
A2	50	50	05:00	00:00	00:00	OK
A3	100	100	05:00	00:00	00:00	OK
A4	150	148	05:00	00:00	00:00	OK
A5	200	201	05:00	00:00	00:00	OK
A6	250	251	05:00	00:00	00:00	OK
A7	300	300	05:00	00:00	00:14	NOT OK

Table.5: *Subgroup 4 – water tightness*

class	Pressure in Pa		Time	Water strance		Observation
	Normal	Actual		Dripping	Flowing	
A1	0	0	15:00	00:00	00:00	OK
A2	50	50	05:00	00:00	00:00	OK
A3	100	100	05:00	00:00	00:00	OK
A4	150	149	05:00	00:00	00:00	OK
A5	200	199	05:00	00:00	00:00	OK
A6	250	249	05:00	00:00	00:00	OK
A7	300	301	05:00	00:00	03:13	NOT OK

Table.6: *Subgroup 5 – water tightness*

class	Pressure in Pa		Time	Water strance		Observation
	Normal	Actual		Dripping	Flowing	
A1	0	-9	15:00	00:00	00:00	OK
A2	50	50	05:00	00:00	00:00	OK
A3	100	100	05:00	00:00	00:00	OK
A4	150	150	05:00	00:00	00:00	OK
A5	200	200	05:00	00:00	00:00	OK
A6	250	251	05:00	00:00	00:11	NOT OK

Table.7: *Subgroup 6 – water tightness*

class	Pressure in Pa		Time	Water strance		Observation
	Normal	Actual		Dripping	Flowing	
A1	0	0	15:00	00:00	00:00	OK
A2	50	50	05:00	00:00	00:00	OK
A3	100	100	05:00	00:00	00:00	OK
A4	150	150	05:00	00:00	00:00	OK
A5	200	200	05:00	00:00	00:00	OK
A6	250	251	05:00	00:00	00:00	OK
A7	300	300	05:00	00:00	00:00	OK
A8	450	451	05:00	00:00	00:00	OK
A9	600	600	05:00	00:00	00:00	OK

Table.8: *Subgroup 7 – water tightness*

class	Pressure in Pa		Time	Water strance		Observation
	Normal	Actual		Dripping	Flowing	
A1	0	0	15:00	00:00	00:00	OK
A2	50	50	05:00	00:00	00:00	OK
A3	100	100	05:00	00:00	00:00	OK
A4	150	150	05:00	00:00	00:00	OK
A5	200	201	05:00	00:00	00:00	OK
A6	250	250	05:00	00:00	00:00	OK
A7	300	300	05:00	00:00	00:00	OK
A8	450	451	05:00	00:00	00:17	NOT OK

Table.9: *Subgroup 8 – water tightness*

class	Pressure in Pa		Time	Water strance		Observation
	Normal	Actual		Dripping	Flowing	
A1	0	0	15:00	00:00	00:00	OK
A2	50	50	05:00	00:00	00:00	OK
A3	100	100	05:00	00:00	00:00	OK
A4	150	151	05:00	00:00	00:00	OK
A5	200	200	05:00	00:00	00:00	OK
A6	250	250	05:00	00:00	00:00	OK
A7	300	300	05:00	00:00	00:00	OK
A8	450	450	05:00	00:00	00:00	OK
A9	600	602	05:00	00:00	00:00	OK

Table.10: *Subgroup 9 – water tightness*

class	Pressure in Pa		Time	Water strance		Observation
	Normal	Actual		Dripping	Flowing	
A1	0	0	15:00	00:00	00:00	OK
A2	50	50	05:00	00:00	00:00	OK
A3	100	100	05:00	00:00	00:00	OK
A4	150	152	05:00	00:00	00:00	OK
A5	200	200	05:00	00:00	00:00	OK
A6	250	250	05:00	00:00	00:00	OK
A7	300	302	05:00	00:00	00:00	OK
A8	450	452	05:00	00:00	04:28	NOT OK

Table.11: *Subgroup 10 – water tightness*

class	Pressure in Pa		Time	Water strance		Observation
	Normal	Actual		Dripping	Flowing	
A1	0	0	15:00	00:00	00:00	OK
A2	50	50	05:00	00:00	00:00	OK
A3	100	100	05:00	00:00	00:00	OK
A4	150	150	05:00	00:00	00:00	OK
A5	200	200	05:00	00:00	00:00	OK
A6	250	250	05:00	00:00	00:00	OK
A7	300	299	05:00	00:00	00:00	OK
A8	450	450	05:00	00:00	00:00	OK
A9	600	603	05:00	00:00	00:00	OK

Table.12: *Subgroup 11 – water tightness*

class	Pressure in Pa		Time	Water strance		Observation
	Normal	Actual		Dripping	Flowing	
A1	0	0	15:00	00:00	00:00	OK
A2	50	50	05:00	00:00	00:00	OK
A3	100	100	05:00	00:00	00:00	OK
A4	150	150	05:00	00:00	00:00	OK
A5	200	200	05:00	00:00	00:00	OK
A6	250	250	05:00	00:00	00:00	OK
A7	300	302	05:00	00:00	00:00	OK
A8	450	453	05:00	00:00	04:01	NOT OK

Table.13: *Subgroup 12 – water tightness*

class	Pressure in Pa		Time	Water strance		Observation
	Normal	Actual		Dripping	Flowing	
A1	0	0	15:00	00:00	00:00	OK
A2	50	50	05:00	00:00	00:00	OK
A3	100	100	05:00	00:00	00:00	OK
A4	150	152	05:00	00:00	00:00	OK
A5	200	200	05:00	00:00	00:00	OK
A6	250	250	05:00	00:00	00:00	OK
A7	300	301	05:00	00:00	00:00	OK
A8	450	449	05:00	00:00	00:00	OK
A9	600	602	05:00	00:00	00:00	OK

3.3. Results – resistance to wind load

Class according to the *EN 12211:2016 "Windows and doors - Resistance to wind load - Test method"* standard. [12]

Table.14: *Maximum deflection to the classification at the base width*

Class		f (mm)
(a-c) 1250 mm		
A	(a-c)/150	8.33
B	(a-c)/200	6.25
C	(a-c)/300	4.67

Table.15: *Results of the frontal deflection in mm section/pressure – Subgroup 1*

Pa	1(a)	2(b)	3(c)	f (mm)
2000 Pa	0.64	3.11	0.37	2,60
0 Pa	0.00	0.00	0.00	0.0
-2001 Pa	0.79	2.09	0.50	1.45
0 Pa	0.03	0.02	0.00	0.01

Table.16: *Results of the frontal deflection in mm section/pressure – Subgroup 2*

Pa	1(a)	2(b)	3(c)	f (mm)
2001 Pa	0.46	5.41	0.95	4.71
0 Pa	0.01	0.04	0.01	0.03
-2003 Pa	0.29	5.31	0.76	4.79
0 Pa	0.00	0.01	0.00	0.01

Table.17: *Results of the frontal deflection in mm section/pressure – Subgroup 3*

Pa	1(a)	2(b)	3(c)	f (mm)
1999 Pa	0.50	5.44	0.85	4,77
0 Pa	0.01	0.04	0.01	0.03
-2001 Pa	0.27	5.38	0.72	4,89
0 Pa	0.00	0.01	0.00	0.01

Table.18: *Results of the frontal deflection in mm section/pressure – Subgroup 4*

Pa	1(a)	2(b)	3(c)	f (mm)
2003 Pa	0.59	6.02	0.36	5,54
0 Pa	0.05	0.04	0.04	0.01
-2001 Pa	0.41	6.82	0.49	6,37
0 Pa	0.02	0.00	0.00	0.01

Table.19: *Results of the frontal deflection in mm section/pressure – Subgroup 5*

Pa	1(a)	2(b)	3(c)	f (mm)
2003 Pa	0.54	0.85	0.36	0.40
0 Pa	0.10	0.07	0.05	0.01
-2000 Pa	0.53	0.85	0.50	0.34
0 Pa	0.00	0.00	0.00	0.00

Table.20: *Results of the frontal deflection in mm section/pressure – Subgroup 6*

Pa	1(a)	2(b)	3(c)	f (mm)
2007 Pa	0.58	5.17	0.68	4.54
0 Pa	0.00	0.00	0.00	0.00
-2003 Pa	0.83	5.23	0.93	4.35
0 Pa	0.00	0.00	0.00	0.00

Table.21: *Results of the frontal deflection in mm section/pressure – Subgroup 7*

Pa	1(a)	2(b)	3(c)	f (mm)
2005 Pa	0.51	6.06	0.42	5.60
0 Pa	0.00	0.00	0.00	0.00
-2006 Pa	0.22	4.56	0.21	4.35
0 Pa	0.00	0.00	0.00	0.00

Table.22: *Results of the frontal deflection in mm section/pressure – Subgroup 8*

Pa	1(a)	2(b)	3(c)	f (mm)
2001 Pa	2.54	2.89	0.60	1.29
0 Pa	0.00	0.00	0.00	0.00
-2004 Pa	1.21	1.45	0.37	0.66
0 Pa	0.00	0.00	0.00	0.00

Table.23: *Results of the frontal deflection in mm section/pressure – Subgroup 9*

Pa	1(a)	2(b)	3(c)	f (mm)
2008 Pa	0.34	1.08	0.85	0.49
0 Pa	0.00	0.00	0.00	0.00
-2005 Pa	0.16	0.72	0.45	0.42
0 Pa	0.00	0.00	0.00	0.00

Table.24: *Results of the frontal deflection in mm section/pressure – Subgroup 10*

Pa	1(a)	2(b)	3(c)	f (mm)
2010 Pa	0.68	1.60	0.58	0.97
0 Pa	0.00	0.00	0.00	0.00
-2012 Pa	0.38	0.79	0.41	0.40
0 Pa	0.00	0.00	0.00	0.00

Table.25: *Results of the frontal deflection in mm section/pressure – Subgroup 11*

Pa	1(a)	2(b)	3(c)	f (mm)
2010 Pa	0.56	5.90	0.66	5.29
0 Pa	0.05	0.06	0.04	0.02
-2012 Pa	1.00	4.57	0.96	3.59
0 Pa	0.01	0.00	0.00	0.01

Table.26: *Results of the frontal deflection in mm section/pressure – Subgroup 12*

Pa	1(a)	2(b)	3(c)	f (mm)
2007 Pa	0.23	1.44	0.38	1,14
0 Pa	0.00	0.00	0.00	0.00
-2008 Pa	0.14	0.85	0.35	0.61
0 Pa	0.00	0.00	0.00	0.00

4. Conclusion

From the analyzed results and their comparison of the individual samples, the following can be confirmed:

- The profile used for producing windows has a minimum influence on the air permeability. The examined samples which were made in the same production capacity, were divided into two groups and six subgroups. Each subgroup had six samples. All the samples of one group had the same fittings, but different type of PVC profile. The samples of the subgroups are of same profile, fittings and dimensions. The results given from the windows slightly differed and they circulated in one class of sustainability of the air permeability. The authors, in the form: initials of the first names followed by last name (only the first letter capitalized with full stops after the initials),

. - The profile used for producing windows has significant influence over the water tightness. The examined samples which were made in the same production capacity, were divided into two groups and six subgroups. Each subgroup had six samples. All the samples of one group had the same fittings, but different type of PVC profile. From the analysed samples a greater water tightness is shown at the windows made of the profile with greater dimensions and bigger sagging of the jamb and side jamb.

- The profile used for production of windows has significant influence over the deformities of the window itself. The examined samples which were made in the same production capacity, were divided into two groups and six subgroups. Each subgroup had six samples. All the samples of one group had the same fittings, but different type of PVC profile.The analysis of the results brought conclusion that the windows are made of profile which is strengthened with more steel making it more resistant to deformities when hit by wind load.

5. References

1. S. Vallabhy1, M. Arun Kumar2, V. Bharath2, E. Dhakshina Moorthy2, Hitesh Kumar Jain2 - DESIGN OF UPVC WINDOWS FOR LATERAL WIND LOADS SANDWICH WITH

HURRICANE BARS FOR MULTISTOREY STRUCTURES (2019)
2. www.rehau.com (28-10-2022)
3. www.alphacan.com (28-10-2022)
4. www.aluplast.net/de/index.php (28-10-2022)
5. www.schueco.com/com/ (12-11-2022)
6. www.koemmerling.com (12-11-2022
7. www.gealan.de/en/ (12-11-2022)
8. www.salamander-windows.com/en (14-11-2022)
9. www.trocal.com (14-11-202)
10. EN 1026:2016 “Windows and doors - Air permeability - Test method” standard
11. EN 1027:2016 “Windows and doors - Water tightness - Test method” standard
12. EN 12211:2016 "Windows and doors - Resistance to wind load - Test method" standard