IMPACTS THAT WINDOWS ARE SUBJECTED TO IN THE BUILDINGS

Classification of the loads that the windows are subjected to in the buildings they are installed;

1. Movement produced by the building
2. Movement produced by the window
3. Outdoor wind loads
4. Outdoor precipitation effect
5. Outdoor solar effect
6. Outdoor noise effect
7. Indoor temperature and humidity effect

1. **Movement Produced by the Building:** As is known, buildings are living structures. Due to vibrations created by earth movements and environmental effects, buildings mostly move in a way that is imperceptible to human. Building is a combination of various structural materials. One of these materials is window. To avoid damage to the window while the building moves, these movements shall be dampened. Therefore, windows are manufactured slightly smaller than the window spacing measured during estimation. This is called measurement allowance and these allowances are determined as follows:

Window Spacing	**up to 1.5 m**	**1.5 – 3 m**	**3 – 4.5 m**	**above 4.5 m**
White Window	10 mm	10 mm	15 mm	20 mm
Wood Texture	15 mm	15 mm	22 mm	28 mm

As shown in the above table, allowance to be reserved increases with the increased window spacing. Also, another important point is that the greater allowance required for wood textured windows. The reason for this is not the building movement but the window movement which we will discuss in the following article.

2. **Movement Produced by the Window:** As is known, all materials have an elongation coefficient. Elongation coefficient of PVC window profiles is 90 x 10^{-6} cm/cmK^{o}. With a simpler definition, maximum elongation rate of PVC window profiles is 2% as stipulated in EN 12608 standard. In order to minimize this change of shape that will occur in window profiles due to effect of heat, it is required to use Reinforcement steel in window profiles.

   Therefore, not only the presence of reinforcement steel in window profiles but also the accuracy of the method of application shall be questioned. Reinforcement steel is a component which inhibits the PVC profile that is prone to elongation or shrinkage. Also, reinforcement steel is the component which ensures resistance against wind loads, this issue will be discussed in the further articled. For this reason, following points shall be taken into consideration in reinforcement steel applications:

- reinforcement steel shall be used in all horizontal and vertical profiles.
- reinforcement steel inside the profile shall be single piece.
- reinforcement steel shall be applied in the profile leaving a 1.5 mm room at the edges of the profile support sheet chamber. A profile which remains small in the reinforcement steel chamber cannot offer sufficient strength.
- reinforcement steel shall be installed to the profile with screws and the minimum distance between these screws shall be 40 cm.

Using the suitable reinforcement steel in PVC window profiles minimizes elongation coefficients, however, room is left by using the values indicated in the above table to prevent deformations due to thermal effect. The reason for leaving greater room in wood texture windows while doing such is the greater heat absorption rate of the wood texture profiles due to their color.

Since heat absorption rate of wood texture windows is higher as specified above, this hot air produced inside the profile chambers shall be discharged. For this purpose, natural ventilation is realized within the profile. This can be ensured with the following channels which we call vacuum channels. With this ventilation channel which opens to the top horizontal plane of the profile, air introduced from here is discharged from the water discharge channel located on the bottom horizontal plane and accumulation of hot air inside will be prevented and changes in form and deformations caused by thermal effect will be minimized.

3. **Outdoor Wind Loads :** One of the most important loads that the windows are subjected to in the structures is wind load. Wind load changes according to the parameters of the building location and building height. Wind loads that windows are exposed to are classified under 3 main groups according to EN 12210 standard:

Wind Load Groups	**A**	**B**	**C**
Wind Load Value (Pa)	Up to 150 Pa	Up to 300 Pa	Up to 600 Pa
Building Height (m)	up to 8 m	up to 20 m	up to 100 m

First of all, evaluation is made to determine which group the window belongs to among A, B and C wind load groups. According to the selected group, by taking the admissible deflection amount for L/300 window as basis, it is checked whether the architectural form of your window offers the required inertia using the calculation module we offer you under engineering calculations section. If this is not realized you are required to increase the inertia value of the sheet metal you use. You can refer to the calculation module for sheet metal inertia value.

Here, we would like to emphasize a point which is widely misunderstood. It is not sufficient to take only thickness parameter into account to increase strength of the sheet metal, in other words inertia momentum. As is known, inertia momentum value is dependent to the geometry. In other words, geometry of the sheet metal is as important as its thickness. For instance, "reinforcement steel shall be 2 mm" expression which we encounter in most applications is just insufficient. Parameter to be given for the sheet metal is the inertia momentum value. Because, if 2 mm reinforcement steel that is used is flat steel strength cannot be realized.

In the case that strength value cannot be satisfied even if inertia momentum of the sheet metal is increased in the calculations that are made, this means architectural design of this window is not suitable for the wind load. In some application we can see that windows which are very large and mainly containing glass are designed to offer architectural aesthetics In the course of creating these designs calculations we have specified for windows shall be always made.

In the case that the window satisfies the required strength in terms of wind load, evaluation shall be made on air permeability. Windows are classified under 4 different air permeability classes according to EN 12207 standard: This classification is in correlation with the flow rate of air towards indoor from the window. Class 4 window has the least amount of air permeability. Values are as follows:

Air Permeability Classes	**Test Pressure (Pa)**	**Air Permeability in Relation with 1m^2 Window Surface (m^3/hm^2)**	**Air permeability in relation with 1m^2 window joint length (m^3/hm^2)**
1	150 (A)	50	12.5
2	300 (B)	27	6.75
3	600 (C)	9	2.25
4	600 (C)	3	0.75

The final stage for the window with completed architectural design and ensuring sufficient inertia in terms of inertia momentum according to the wind load is air permeability test. Air permeability test is carried out in the window test device where your windows are manufactured identically according to EN 1026 and air permeability class it belongs to among the above ones is determined.

In the case that your window belongs to class 4, it is the highest class in terms of air permeability. If it belongs to a lower class and you require a higher class new solutions shall be realized with regard to window design and accessories that are used.

Turkey’s first TÜRKAK accredited window laboratory FUDEL is operating in this field under Fırat Plastik. Our laboratory which accredited in wind load, inertia calculations, air permeability, water-tightness tests and heat conductivity coefficient calculations offers service to all construction companies, architects and engineers for window designing.