Disorders window openings – family house in Lipno nad Vltavou

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Abstract. The aim of this paper was to assess the state of the window openings and the height positioning of the sliding window HST portal (heroal S 77 HI) and the design of the repair. During the construction-technical survey, it was found that this is an unfinished (unconditioned) new building of the family house. It is a freestanding detached family house, the object is partially recessed into the terrain. The building is built of brick technology with a wooden roof structure. It has been found that the windows are visibly damaged by the connection gap, especially from the interior side in the lower corners of the windows. At this point, the cleaner APU strip was detached from the plaster and the plaster was severely damaged. Further, measurements were made to reveal the frames of the windows and their glass fillings towards the interior. In addition to all the fixed windows, the rest of the windows fitted also showed a slight deflection and lack of anchoring. Fitting the HST portal goes against the owner’s requirements to a zero transition between the clean floor of the interior and the minimization of the staircase towards the terrace of the building.

1. Introduction
The aim of the article was to assess the condition, defects in window apertures and height positioning of the elevator-sliding window HST portal (heroal S 77 HI).

During the construction-technical survey, it was found that this is an unfinished (unconditioned) new building of the family house. It is a freestanding detached family house that is partly recessed into the terrain. The building is built of brick technology with a wooden roof structure. The roof is above the northeastern part of the building with a paneled concrete pavement, in the southwest part of the pavilion with sheet metal folded roofing. During the construction visit, the house was almost completed. They only missed completion of interior finishing work and landscaping around the building.

2. Construction-technical survey
The basic inspection was conducted on 6.11.2015. A detailed photo-documentation of the facts was carried out and the state and execution of the window apertures were determined.

When looking at the filler holes, it was found that they were plastic open windows and unopened (fixed) windows. Window profile is VEKA SOFTLINE 82 MD, profile section 7 chamber frames. Profiles of opening wings are 6 chambers. The construction depth of the windows is 82 mm. Glazing
is made of insulating triple glass $U_g = 0.5 \, [W / (m^2K)]$. Furthermore, it has been found that the windows are visibly damaged by the joining gap, especially from the interior side in the lower corners of the windows. At this point, the cleaner APU strip is detached from the plaster and the plaster is severely damaged. Further, measurements were made to reveal the frames of the windows and their glass fillings towards the interior. In addition to all window FIX windows, the rest of the windows fitted also showed a slight deflection and insufficient anchoring. Mounting the HST Portal against the owner's requirements on a zero transition between the clean floor of the interior and the minimization of the stairs towards the terrace of the building. On the spot, it was found that the windows were mounted on 8.12. 2014.

3. Results and discussions

3.1. Evaluation of the window installation procedure manufacturer

Since at the time of the construction and engineering survey, the windows were already brick-built, so without dismantling and revealing the joining joints it cannot determine whether the assembly procedure was chosen correctly. The only joining gap that was not installed is the bottom of the window sill, from which it is clear that the windows were fitted with window-mounted turbo-screws for direct mounting. It is not possible to determine the overall correctness of the assembly of the windows, in particular the positioning and positioning of the anchor elements and the washers, and the overall correctness of the installation with regard to allowing the expansion of the borehole to be dilated at the actual state of the structure without disassembly and detection of the connection joint.

We believe that the window supplier, Manufacturer has roughly underestimated the expansion of the windows in the connecting splice during installation. According to the general technical requirements for buildings and other valid standards regarding the correct installation of window openings, the anchoring of the opening must be made to allow trouble-free expansion of the window without the risk of disproportionate compressive forces on the window and its subsequent deformation. The width of the expansion joint dilation was not respected and the heat applied to the plastic frames caused their bulk changes due to thermal expansion. Thermal expansion is a phenomenon that changes the dimensional dimensions (body volume) when heat is delivered to the body (heating the body at a certain temperature). For this reason, the window frames were stretched and began to act on the brick lining of the building holes by compressive forces. These compressive forces have caused excessive deformation of the windows in the form of the frames of the frame in relation to the longitudinal axis as well as the angled glass fillings. The pressure forces of the windows acting on the lining of the building holes also caused deformation and cracking of the connection gap, especially from the interior side in the lower corners of the windows. The connecting joint in such a state does not meet one of its basic requirements, and that is air permeability. Air permeability $V \, [m^3 / s]$ characterizes the amount of air in m3 that passes through a unit of time through a building structure, in this case, a connecting joint. The judged windows have a damaged connection gap that cannot meet the airborne values declared by the supplier in its declaration of performance of the product.

3.2. Window failure evaluation

The windows have broken connection joints due to the thermal expansion of the frames and the compressive forces acting on the lining of the building opening. The windows are over-distorted in the form of the frames of the frame in relation to the longitudinal axis and the angled glass panels towards the interior. During a personal inspection of the structure, the following window deflection of the frame profile to the longitudinal axis was measured on the four claimed non-opening windows with dimensions 1 - 2200mm x 2170mm, window 2 - 2200mm x 2170mm, window 3 - 1960mm x 2170mm and window 4 - 2200mm x 2170mm - 11,62mm (figure 1), window 2 - 9,59mm (figure 2); window 3 - 7,28mm (figure 3) and window 4 - 5,09mm. According to Czech State Standard 746077 Windows and external doors - requirements for installation is the maximum permissible deviation of the plane of the frame profile (deflection of the frame profile to the longitudinal axis) of the embedded product is
3 mm for length and width up to 2000 mm inclusive and 5 mm for length and width over 2000 mm. According to this Czech state standard, deflection of the profile to the longitudinal axis does not meet either of the windows. The standard further states that the tolerance does not apply to the deflection of the profile of the frame structure which may arise due to the thermal expansion of the profiles if this deflection does not affect the functionality and durability of the product. Bending of the frame profile results in a breakage of the joining gap and the product does not meet the requirements of air permeability, thus deflection adversely affects the functionality and durability of the product. [1]

Figure 1. Measuring the deflection plane of the window by the window 4

Figure 2. Measuring the deflection plane of the window by the window 2
On the basis of the building survey, we also checked the opening windows of the rest of the building and found the following results. The deflection of the frame profile to the longitudinal axis of the other opening windows is between 6-8 mm, so the other windows do not meet the permissible deviation of the flatness of the frame profile according to the Czech State Standard 746077 Windows and external doors - installation requirements. [2]

3.3 Evaluating whether windows are able to perform all of their functions according to the features specified by the manufacturer without further intervention, repair or modification

The installed windows do not meet the airworthiness stated by the manufacturer, see paragraph 3.1.

Evaluation of the window installation procedure manufacturer. Without professional repairs, they are not functional, and consequent deterioration of the joining joints will be its gradual degradation, such as the formation of mold on the lining of the lining.

Consequently, the current deflection of the glazing on some fix windows is so great that it is a question of how the glazing in the frame will behave during a full heating season. It is not excluded that after flooding in the house and future use of the building there will be no further unexpected degradation of the lining and / or windows as a product (frame + glazing). [3]

We cannot now determine the possible amount of future damage resulting from the new use of the object. We now can only evaluate the current state and conditions in the object at a local investigation. [4]

4. Conclusions

The deflection of the frames of the examined windows and the other does not comply with the Czech State Standard 746077 [3] Windows and external doors - requirements for installation and not tolerated or tolerated deflections in the complaints of the supplier. The overall design and status of the windows, as it is in the current state, does not comply with all the relevant standards generally technical requirements for the window installation. In addition, it contravenes the recommendation of the Czech Chamber of Light Circumference, whose purpose is to promote the quality of products and the high professional level of suppliers of lightweight cladding, windows, doors and aperture panels. Excessive deflection is caused by insufficient expansion of the window frames in the connection splice. Because of the thermal expansion of the window, the pressure forces are applied to the lining

![Image of window deflection measurement](image-url)
and the frames of the windows are subject to the deformation, the compressive forces visibly breaking the brickwork of the joining joints of the windows and the functionality of the connecting joints as a whole. Incorrectly connected and inoperative connecting joints result in condensation on the inner surface but also inside the connecting joint, further, degrading the thermal insulation, long-term functionality and, above all, molding on the absorbent surfaces (plaster lining). Demonstration of the assembly of windows always indicates the low professional level of the supply company.

Troubleshooting Window Faults. The only correct solution to correct the defects is the complete dismantling of the window openings and the new installation by an expert company, which will follow the Czech State Standard 746077 Windows and external doors - requirements for installation, general technical requirements for constructions and recommendations The Czech Chamber of Light Circuits of tires. For dismantled window openings, it is necessary to assess their suitability for reassembly. First of all, an expert has to assess whether the disassembled window can be re-used or whether it is necessary to make a new one in two planes. Secondly, it is necessary to assess whether the window is elastically flattened after dismantling and is able to fulfill all the functions guaranteed by the supplier. And lastly, it is necessary to assess whether the window dimensions are too large for the dimensions of the opening and there is little room for expansion. In this case, it is necessary to produce a new window, or to enlarge the building opening. All repair work must be done in the most painstaking manner so as not to damage the construction of the family house in any other way.

References
[1] J. Salazar, “21 – Life cycle assessment (LCA) of windows and window materials,” Eco-efficient Construction and Building Materials., Eco-Labelling and Case Studies., pp. 502–527, 2014.
[2] ČSN 74 6077 Windows and exterior doors - Installation requirements, p. 28, 2014 (in Czech).
[3] A. Kralj, M. Drev, M. Žnidaršič, B. Černe, J. Hafner and B. P. Jelle, “Investigations of 6-pane glazing: Properties and possibilities,” Energy and Buildings, vol. 190, pp. 61-68, 2019.
[4] V. Nývlt and K. Prušková, “Building Information Management as a Tool for Managing Knowledge throughout whole Building Life Cycle,” IOP Conference Series: Materials Science and Engineering, vol. 245, 2017.