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AN ANALYSIS OF EXPERIMENTAL STUDY OF GLASS MULTILAYER COLUMNS MADE OF THERMALLY STRENGTHENED GLASS

Currently, various scientists [1, 2] are making a lot of efforts to build load-bearing structures of glass. Beams, slabs and portals are already implemented. The glass staircase at Arnhem City Hall in the Netherlands is an example where glass was used as a glass plate. Another example of glass used as a load-bearing element is the Apple store built in New York, USA. The ceiling, walls and beams, were made of glass, only the joints were made of another material. This building shows that most load-bearing elements can be made and designed from glass.

In the studies colleagues from China [2] twelve glass multilayer columns 2.7 m high with different number of layers of glass and different material of the layer between them were tested for axial static load and change in ambient temperature. The results of experimental researches are presented and the calculation of glass columns is carried out. The parameters which studied included the type of layer, the number of layers of glass, the coefficient of pliability, the duration of the load and the ambient temperature. Using the Ayrton-Perry formula [3], bending curves are proposed for glass columns bearing different axial loads and temperature conditions. Also, based on numerical

analysis, a design curve was developed for tempered glass columns corresponding to a load (10 years) at an ambient temperature of up to 50 C.

Scientific studies that would research and explain the work of glass columns haven`t yet been conducted in Ukraine. There are no norms and recommendations for the design of such structures. Therefore, conducting a comprehensive study of glass multilayer columns on the central-axial compression will help solve the problem.

A study of glass multilayer columns of the VII series, which were made of heat-strengthened glass by triplexation [4]. The geometric dimensions of the columns are presented in table.1

Table 1

Characteristics of prototype samples

Series	Type of columns	Section, mm	Height, mm	The thickness of one layer of glass, mm	Characteristics of Glass [5]	
					Compressive strength, MPa	Specific weight, kg / m3
VII	КС-7.1.1	70x70	900	10	700	2500
	КС-7.1.2					
	КС-7.1.2					

The experimental test was performed on central-axial compression by short-term loading with floating fixation on supports. Floating fastening of supports of glass columns was achieved with the use of metal "boots" [6] (fig. 1) in which plywood 6 mm thick was laid. The test was performed, using the developed methodology, which is described in [4].

Fig. 1. General type of supports in the form of metal "boots" [Ошибка! Источник ссылки не найден.**]**

The KS-7.1.1 glass column collapsed at N_u=675 kN, KS-7.2.1 at N_u=680 kN and KS-7.3.1 destructed at N_u=625 kN. The discrepancy between the test results of the test

samples was 8.09%, which indicates a high repeatability of the results. No cracks were detected during the tests. At the moment of the destruction, cracks appeared in the form of a web along the entire height of the glass column, which led to the destruction. Columns made of heat-strengthened glass destructed elastically. During the destructive loading of all columns of the VII series, a visible bend was formed with the opening of cracks in the form of a web, which was observed for approximately 180 seconds, after which there was a destruction typical for heat-resistant glass. Graphs of the dependence of relative deformations on stresses are shown in fig. 2.

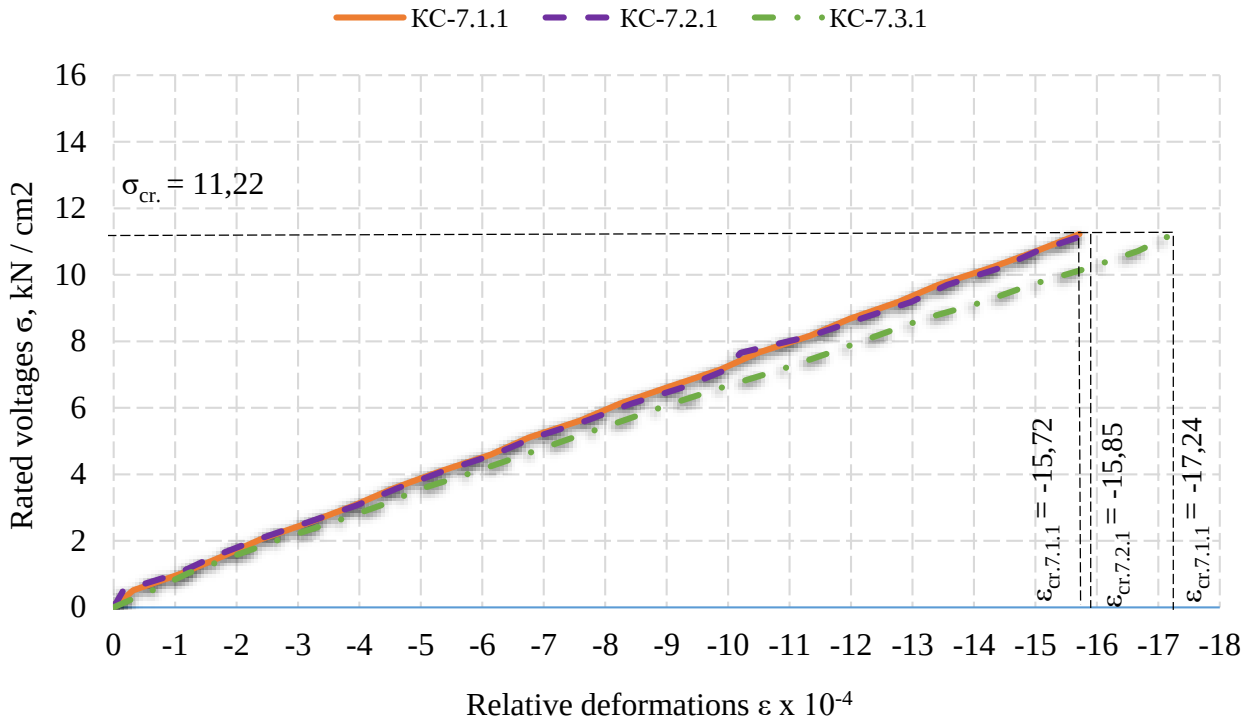

Fig. 2. Graphs of dependence of relative deformations on external glass surfaces from normal tension

The graph shows the operation of glass columns VII at 80% of the destructive load, because at N_u·0,8 all mechanical devices were removed to avoid their damage during the destruction of the prototype. As can be seen from the graph, the relative deformations of the columns of the VII series increased elastically as the load increased.

Conclusions

1. The value of the destructive load of the glass type multilayer column KS-7.1.1

was N_u = 675 kN, KS-7.2.1 - N_u = 680 kN, and columns KS-7.3.1 - N_u = 625 kN;

2. Scientific studies that would research and explain the work of glass columns haven`t yet been conducted in Ukraine. There are no norms and recommendations for the design of such structures.

References:

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