World Academy of Science, Engineering and Technology
International Journal of Civil and Architectural Engineering
Vol:10, No:10, 2016

Influence of Glass Plates Different Boundary Conditions on Human Impact Resistance

Authors : Alberto Sanchidrián, José A. Parra, Jesús Alonso, Julián Pecharromán, Antonia Pacios, Consuelo Huerta

Abstract : Glass is a commonly used material in building; there is not a unique design solution as plates with a different number of layers and interlayers may be used. In most façades, a security glazing have to be used according to its performance in the impact pendulum. The European Standard EN 12600 establishes an impact test procedure for classification under the point of view of the human security, of flat plates with different thickness, using a pendulum of two tires and 50 kg mass that impacts against the plate from different heights. However, this test does not replicate the actual dimensions and border conditions used in building configurations and so the real stress distribution is not determined with this test. The influence of different boundary conditions, as the ones employed in construction sites, is not well taking into account when testing the behaviour of safety glazing and there is not a detailed procedure and criteria to determinate the glass resistance against human impact. To reproduce the actual boundary conditions on site, when needed, the pendulum test is arranged to be used "in situ", with no account for load control, stiffness, and without a standard procedure. Fracture stress of small and large glass plates fit a Weibull distribution with quite a big dispersion so conservative values are adopted for admissible fracture stress under static loads. In fact, test performed for human impact gives a fracture strength two or three times higher, and many times without a total fracture of the glass plate. Newest standards, as for example DIN 18008-4, states for an admissible fracture stress 2.5 times higher than the ones used for static and wing loads. Now two working areas are open: a) to define a standard for the 'in situ' test; b) to prepare a laboratory procedure that allows testing with more real stress distribution. To work on both research lines a laboratory that allows to test medium size specimens with different border conditions, has been developed. A special steel frame allows reproducing the stiffness of the glass support substructure, including a rigid condition used as reference. The dynamic behaviour of the glass plate and its support substructure have been characterized with finite elements models updated with modal tests results. In addition, a new portable impact machine is being used to get enough force and direction control during the impact test. Impact based on 100 J is used. To avoid problems with broken glass plates, the test have been done using an aluminium plate of 1000 mm x 700 mm size and 10 mm thickness supported on four sides; three different substructure stiffness conditions are used. A detailed control of the dynamic stiffness and the behaviour of the plate is done with modal tests. Repeatability of the test and reproducibility of results prove that procedure to control both, stiffness of the plate and the impact level, is necessary.

Keywords : glass plates, human impact test, modal test, plate boundary conditions
Conference Title : ICCBE 2016 : International Conference on Civil and Building Engineering
Conference Location : Paris, France
Conference Dates : October 24-25, 2016

Open Science Index, Civil and Architectural Engineering Vol:10, No:10, 2016 publications.waset.org/abstracts/51418.pdf