MASTER'S DISSERTATION AT STRUCTURAL MECHANICS

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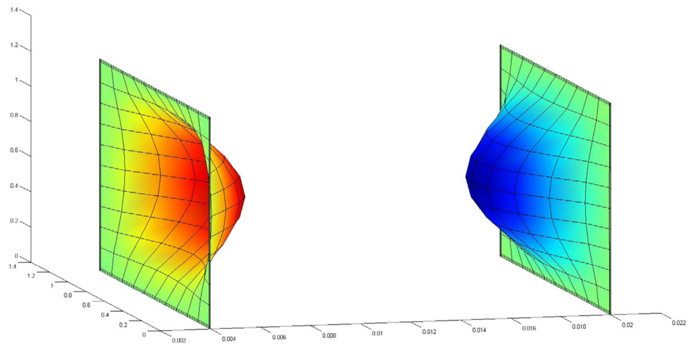
COMPUTATIONAL METHOD FOR BULGING IN INSULATING GLASS UNITS



An insulating glass unit (IGU) normally consists of two or three glass panes which are separated by a spacer. The spacer creates a cavity between the glass panes which is filled with a gas to increase the insulating capacity of the IGU. To keep the gas in the cavity and to stop vapor from getting in, the cavity has to be hermetically sealed. This makes the IGU sensitive to pressure change and volume change which may occur if the unit is subjected to temperature changes, changes in ambient pressure or lateral loads such as wind loads. Any of these load cases will inflict a change in the gas pressure that changes the cavity volume. When the gas pressure changes the glass panes will bulge and stresses will occur.

To study this problem a computational method was created with the finite element method. In the method, was a three dimensional model created to calculate the displacement and the stress in the glass that occurs when the unit is subjected to various loads. The computational method handles different dimensions of the IGU but is restricted to rectangular shapes. The method uses the ideal gas law to find the solution by iterations.

FE-models were also created in Abaqus to evaluate the developed method for different dimensions and load cases. The Abaqus model used hydrostatic fluid elements to represent the gas in the cavity. The difference between the Abaqus model and the computational method was small and a difference of 8% was the largest when comparing displacements.

The computational method was also compared with the results from the master thesis made by Martin Andersson and Simon Nilsson, who made experimental tests and FE-analyzes of insulating glass units subjected to temperature change. The developed method had a difference of 2-5 mm in comparison with the experimental results, which was similar to the difference between the experimental results and their FE-analysis.

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