**8th. World Congress on Computational Mechanics (WCCM8)**
**5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)**
**June 30 – July 5, 2008**
**Venice, Italy**

# EFFECT OF SUPPORT CONDITIONS ON THE BEHAVIOR OF THE LAMINATED GLASS ARCH

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**Key Words:** *Laminated, Glass Arch, Nonlinear, Boundary Conditions.*

## ABSTRACT

Laminated glass as safety glass is widely used in modern world. Since glass is very fragile and dangerous when shattered away, its safety is becoming more important than the other functions when it is used as a structural member. The manufacturers make it safe by sandwiching a thin layer of flexible clear plastic film called polyvinyl butyral (PVB) between two or more pieces of glass. The thin plastic layer (PVB) holds the glass pieces in place when it is broken, helping to lessen injuries from flying glass pieces. Therefore the laminated safety glass helps to keep the occupants in a building getting without any deadly injuries.

The importance of laminated glasses in modern buildings urges the designers to learn more about them. The behavior of laminated glass arches with different boundary conditions is not known very well since there is almost no study that has taken place on them. Due to lack of information about the structural behavior of laminated curved beams or glass arches, they have not been employed much in practice. Since the laminated glass unit consists of very thin glass shells, the large deflections are taking place in the unit. Because of mathematical complexity most of the studies are about the linear behavior of curved beams.

Laminated circular glass arch consists of two or more thin glass shells and an interlayer PVB (polyvinyl butyral). The behavior of laminated glass unit is highly nonlinear since the maximum value of lateral displacement in the units becomes several times larger than the thickness of it, and also shear modulus of the interlayer is very small when compared with that of the glass shell. The effect of nonlinear behavior is considered in the derivation of the field equations and boundary conditions.

Vallabhan et al. [1] studied laminated glass units and verified their mathematical model by comparing the results of the model with the results of experiments conducted at the Glass Research and Testing Laboratory at Texas Tech University. Asik et al. [2] and Asik [3] made contributions by their research on the true behavior of glass units. Asik et al. [4] developed a mathematical model for the nonlinear analysis of laminated glass arches.

In the present study, the effect of the boundary conditions on the behavior of laminated glass arches are investigated by considering the cases of simply supported and fixed supported laminated glass arches. Laminated glass arches considered in this study have two thin glasses and an interlayer PVB holding them together. Three coupled and partial differential equations are obtained through variational principle for lateral and axial displacements of laminated glass arches by writing total potential energy of the unit. The two of the three equations represent the circumferential displacements and the third one shows the transverse deflection of a unit. As a numerical model, finite difference method is employed for the discretization of the equations, and they are solved iteratively. Load is applied at the center of a laminated glass arch. To observe the behavior, force-deformation graphs are drawn and displacements are plotted by solving the equations. The effect of boundary conditions on the behavior is observed in figures of the displacements and stresses.

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