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A Computational Model for the Prediction of the Nonlinear Behavior of a Laminated Cylindrical Glass Shell

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Summary

In this study a laminated cylindrical glass shell composed of two thin glass shells bonded by an interlayer PVB (polyvinyl butyral) is considered. Since the laminated glasses are widely used elements in structures the prediction of their true behavior becomes very important for safety reasons. In the analysis of a laminated glass shell, the nonlinear behavior must be taken into account for correct analysis since a thin glass shell can easily undergo large deflections.

Vallabhan et al. [1] have done theoretical and experimental studies on the laminated glass plates. They modeled the laminated glass units and verified their mathematical model by using the results from experiments conducted at the Glass Research and Testing Laboratory at Texas Tech University. Asik and Dural [2] have developed the mathematical model for the laminated glass arch.

Behavior of a laminated cylindrical glass shell can be represented by five nonlinear partial differential equations in case of two layers of thin glass shells and one layer of PVB. Four of the five equations are used to represent the in-surface displacements of glass shells and the fifth one for the transverse (or out of surface) deflection of a laminated unit. For the computational model, the governing differential equations are developed by using variational principles writing total potential energy of a unit as the summation of membrane, bending and force potential energies in terms of displacements. For the numerical calculations, finite difference method and the iterative procedure are employed.

References

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