

## **AN ABSTRACT OF A THESIS**

# **FREE VIBRATION ANALYSIS OF SHELL PANELS WITH BEZIER CUBIC CROSS SECTIONS USING THE GRÖBNER BASIS METHOD**

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Many examples of vibration problems can be seen just by looking around the modern world. Car panels experience vibration from repeated wind loads and engine vibration, and buildings experience vibrations from earthquakes, hurricanes, and also from simple, repeated live loads. Many industries rely on being able to avoid vibration related failures, such as resonance, or more specifically, flutter failure. Analyzing the free vibration of structures helps to predict how the structure will react to vibration loads, and in turn helps to avoid these kinds of failure.

The objective of the current study was to analyze the free vibration of finite length shell panels with Bezier cubic cross sections using the finite element method. Since the geometry is the foundation of free vibration analyses, it is important to be accurately modeled. For this reason, the Bezier cubic functions were used in conjunction with the Gröbner basis method to create the cross sections of the shells used in the study. The Bezier cubic functions were helpful because they not only create an easily controllable set of curves represented by polynomial equations, but can also be used to control the tangents at the beginning and end of the curve. The Gröbner basis method was then able to create the exact parallel lines to the Bezier curve which were used for a brick element mesh and to model a set of constant thickness layers for use in a composite material study. Once the shell geometries were produced, a shell element in MANOA, a research based finite element program, shell elements in ANSYS, a commercial finite element program, and a 3-D brick element in ANSYS were employed to extract the first 20 frequencies and mode shapes based on different boundary conditions and material parameters. The results from all of the elements based on the desired case studies were compared and found to be in good agreement.