Shipping Container Design for Ceramic Device Transport

Overview
Air Products has recently developed an innovative ceramic device with no cost effective way of shipping it. Due to its fragility, the device cannot be shipped by standard means. Air Products has challenged Team Precious Cargo to develop a shipping container that keeps accelerations below 4.9 m/s² and cost per device below $100.

Objectives
The objectives of this project were:
- To conduct market research on fragile device transport
- To keep accelerations below 4.9 m/s²
- To keep the cost of shipping per device below $100
- To utilize widely available materials to allow for flexibility in construction

Approach
- Patent search and market research showed the use of foam to dampen vibration.
- The team visited Air Products to gain information necessary to create a plan of action.
- Customer needs were placed in a concept scoring matrix to determine the most suitable concept.
- A CAD model was created to plan prototype construction and validate its strength.
- The team approached the problem by first utilizing computer simulation then physical testing.
- Five foams were tested to determine their spring and damping properties. These were then inputted into the MATLAB Model.
- Model simulated road vibrations via ISTA Procedure 3E for unitized loads as well as a drop test. This provided the team with the information necessary to choose foam for prototype testing.
- A prototype was built and altered over time to allow for forklift and drop testing. Normal forklift handling transferred accelerations of approximately 4.9 m/s².
- Drop testing attempted to validate the model. Results showed that accelerations of upwards of 18.6 m/s² were exerted on the device during a two inch drop test.

Outcomes
- The team recommends that testing be performed without the extruding side rails to obtain more accurate data.
- Packaging multiple devices (4) in one container allowed the team to come in under target ($400) by $150.
- A more thorough foam search may be performed to find the best possible foam.
- A future project recommendation is to combine springs and foam to reduce accelerations further.