SHAPE MODELER™

AUTOMOTIVE SHAPE MODELER™ SOFTWARE

Optical Distortion Evaluation and Forming Process Simulation

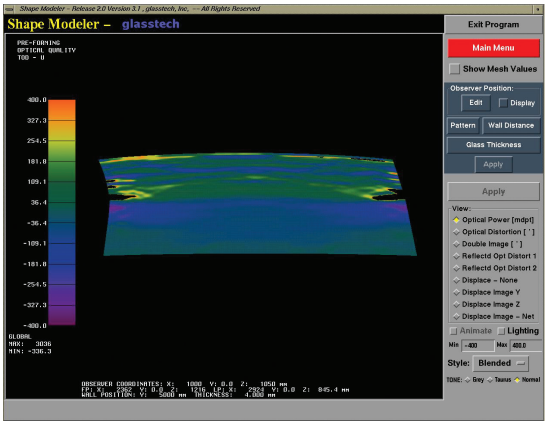
Automotive glass designers and glass producers face continuing challenges. For designers, the challenge is to create vehicles that are lighter, more efficient, yet still distinctive. For producers, the challenge is to translate the designers' styles into distortion-free, cost-effective glass parts.

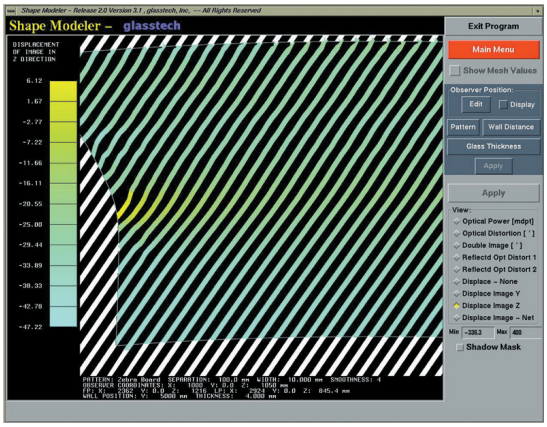
While conducting glass forming research, Glasstech developed mathematical models that simulate the transmitted and reflected optical quality of a design shape when the part is installed at defined angles. Optical quality is strongly dependent on the forming process used and the complexity of the design.

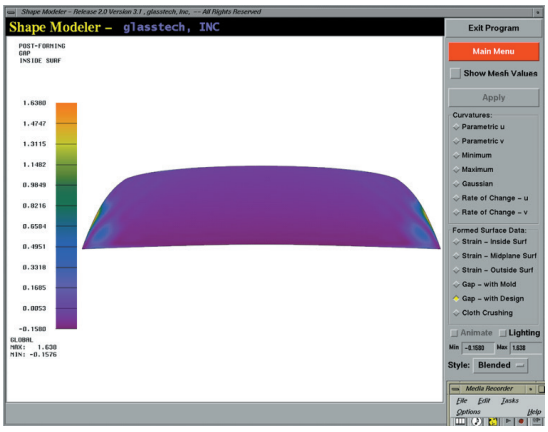
Utilizing these mathematical models, Glasstech perfected Shape Modeler Software, which saves glass processors time and money. This computer program evaluates glass designs while still in the CAD stage and identifies areas of transmitted and reflected optical distortion based on the Glasstech system that will be used to produce the part.

This technology is based on the:

- Thermophysical properties of glass
- Forming method used
- Installation angle
- Design geometry
  - Perimeter continuity to the second degree
  - Tangency
  - Curvature







Glasstech's Shape Modeler Software saves glass processors time and money by:

- Reducing or eliminating intermediate tooling fabrication
- Reducing development costs
- Minimizing the concept-to-prototype time frame
- Facilitating concurrent engineering via the optimizing link between geometry, formability and optical quality

Enhanced capabilities available through Glasstech's advanced research department:

- Generation of alternative glass surfaces with better formability for optimization of optical quality

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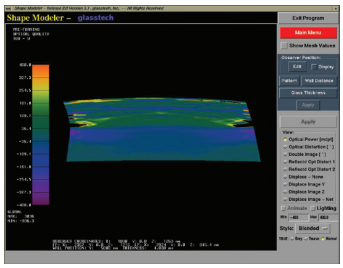
AUTOMOTIVE SHAPE MODELER™ TECHNICAL FEATURES

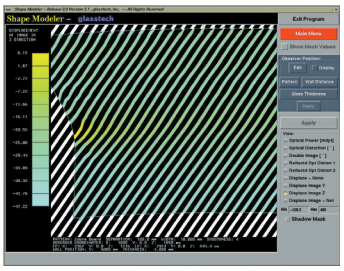
Optical Power

This is a representation of the magnification of an object as seen by an observer through the glass. The glass orientation, the object and observer locations are defined by the user. The units of optical power used are "millidiopters" and numerically correspond to most of the commercially available instruments.



Zebra Board

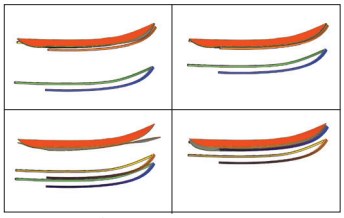
The optical "power" and optical "distortion" results are used for representation of the actual deformation of a pattern of straight bands, such as a zebra board. This is only a qualitative representation of image displacement.



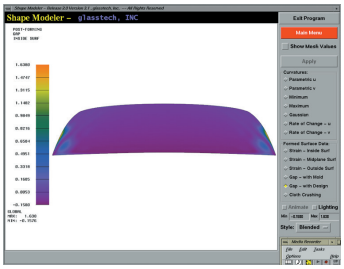
Forming Process

The forming simulation module uses finite element analysis of the glass shape. All thermal and mechanical loads in the glass forming process are modeled. The forming simulation also incorporates the non-linearity of the viscoelastic behavior of glass and the geometric descriptions of the glass and tool surfaces.

The forming simulation results display the deviation of the formed glass from the "actual" design and/or mold surface.

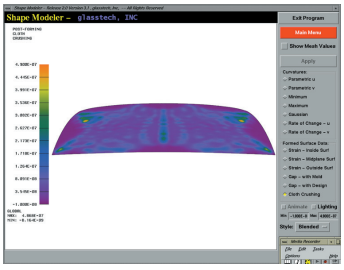


Forming simulation



Deviation of formed surface from intended design

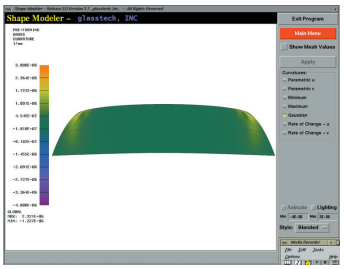
The effect of the "crushing of the mold cloth" is quantified as an indicator of potential distortion due to glass surface damage caused by intense and prolonged contact.



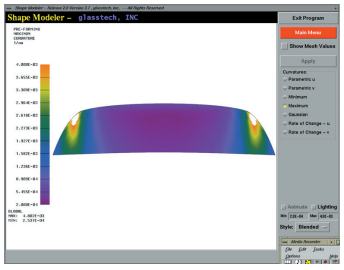
Crushing mold cloth

Curvature of the Glass Surface

The parametric and principal Gaussian curvatures describe the geometric complexity of the surface. The Gaussian curvature is a measure of the "sphericity" of the surface.



Gaussian curvature



Maximum curvature

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