

About TOYOBO MC Engineering Plastics CAE

CAE analysis technology

Our CAE team has performed analysis for more than 1,000 project proposals over the past 20 years, and we constantly strive to improve our simulation and analysis for molding processes.

We provide high-quality design support through simulation and analysis suited to the characteristics of the highly-reinforced polymer and elastomer material TOYOBO MC's line-up of high quality products. We are particularly strong in structural studies that make full use of topology optimization, which can help to reduce the man-hours needed in the design phase.

In recent years, we have been developing simulation technologies that focus on the heat dissipation and shock absorption properties of materials from the perspective of promoting CASE(Connectivity, Autonomous, Shared, and Electric) technologies in the automotive industry, both in injection molding applications and beyond.

*CAE results are intended as a guideline and are not guaranteed values.

The application examples listed are not intended to guarantee the safety of similar products.

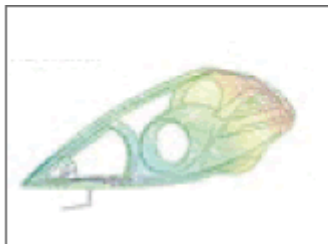
Types of Analysis and Case Studies

Flow Analysis (Injection Molding)

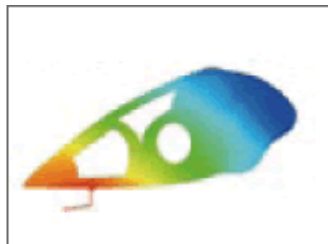
- Predict flow pattern in the mold
- Propose optimal part thickness
- Propose optimal gate location
- Propose mold designs that reduce molding defects
- Automatic calculation of runner optimization



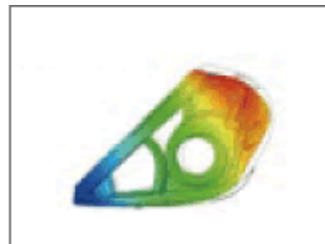
Case Studies Automotive Headlamp Bezel



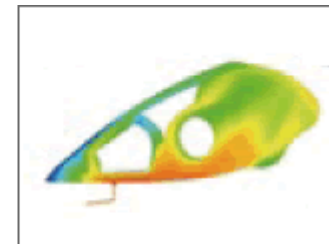
① filling pattern



② Pressure distribution
at the end of filling



③ Temperature
distribution at the end of
filling



④ Warp/deformation
distribution state

Types of Analysis and Case Studies

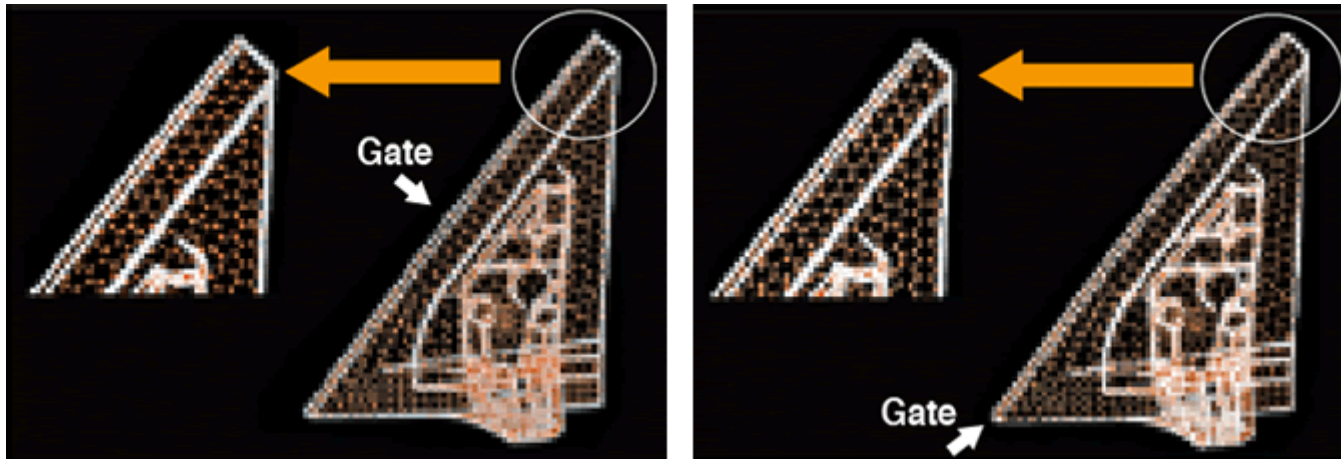
Warpage Analysis

- Proposal of gate location and part thickness to reduce warpage
- Optimization of rib structure to reduce warpage
- Analysis incorporating the effects of fiber orientation in anisotropic material
- Prediction of Mold shrinkage
- Proposal of mold design to minimize the need for extensive prototyping

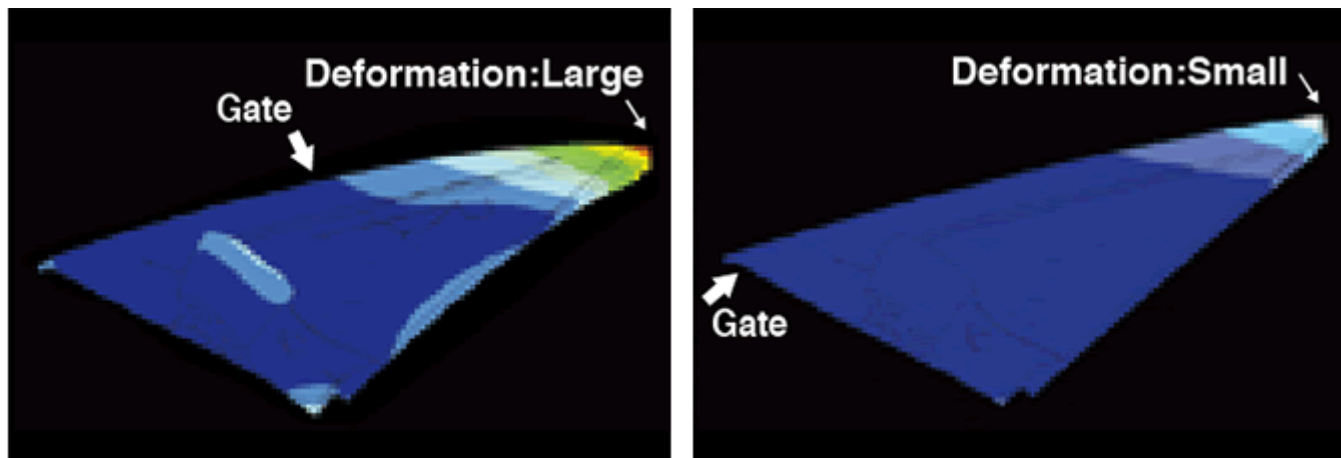
Types of Analysis and Case Studies

Case Studies on Door Mirror Base Bracket

1 .Relationship between gate location and glass fiber orientation



2 .Relationship between gate location and warpage



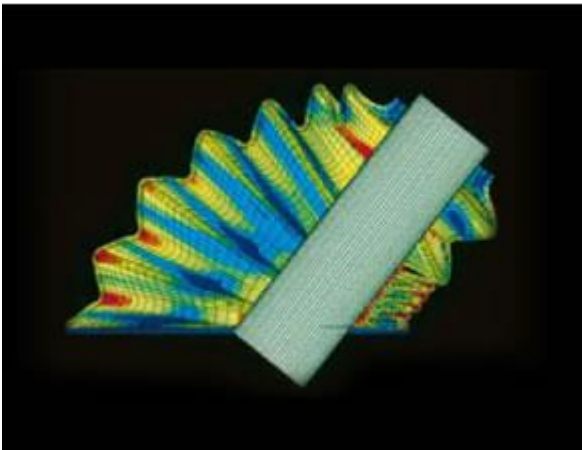
Types of Analysis and Case Studies

Structural Analysis-Large Deformation Analysis

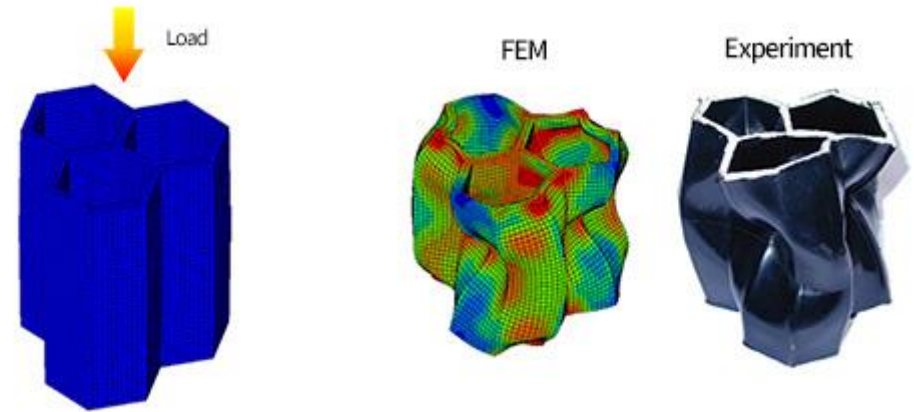
- Prediction of stress and deformation in molded parts
- Design proposal for optimum strength design in molded parts
- Structural design proposals based on impact analysis
- Structural design proposals based on large deformation analysis
- Structural design proposals incorporating anisotropy due to fiber orientation

Case Studies

• Large Deformation Analysis of CVJ Boot

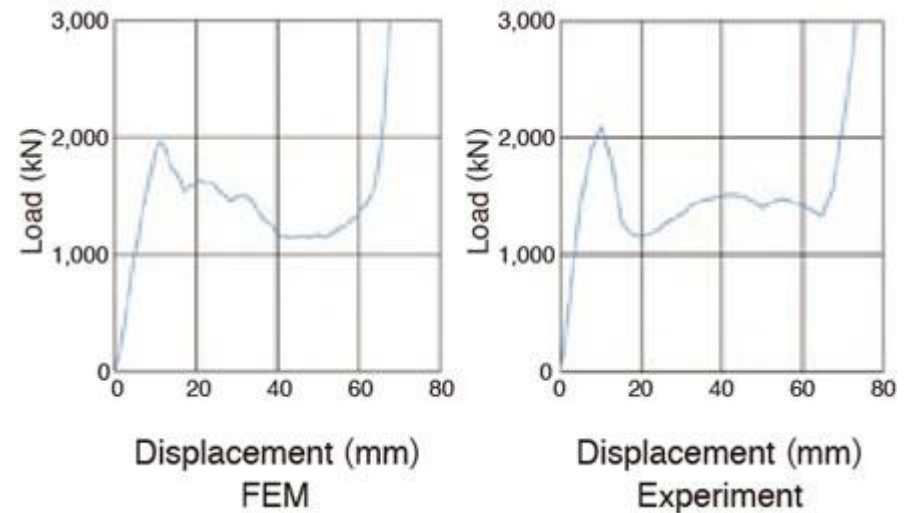


• Impact analysis of honeycomb structure



Honeycomb Structure Analysis Model

Comparison of Deformation Behavior



Comparison of Load-Displacement Curves: FEM vs Physical Testing

Types of Analysis and Case Studies

Vibration Analysis-Eigenvalue Analysis

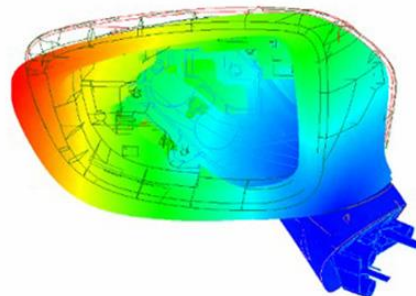
- Proposal of optimal rib pattern and wall thickness for part design
- Proposal of ideal material for your project
- Multi-component assembly analysis is available
- Analysis that incorporating anisotropy due to fiber orientation

Case Studies

Eigenvalue Analysis

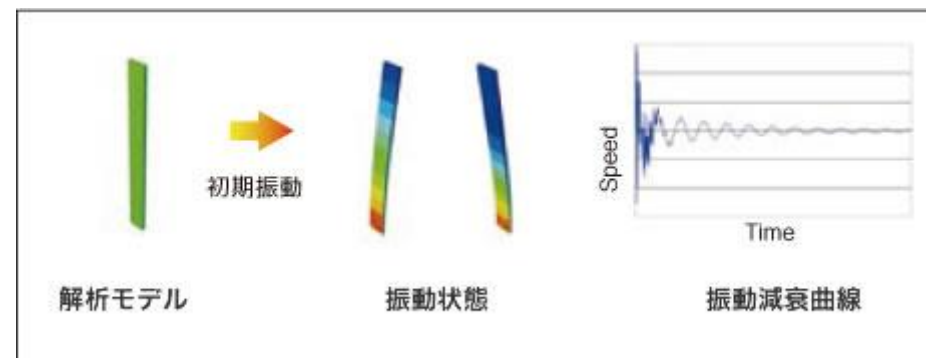


Analysis Model



Vibration Analysis Results

Vibration Damping Analysis



Types of Analysis and Case Studies

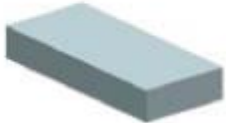


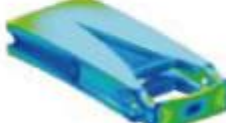
Topology Optimization

- Part Design Proposals
- Part design proposals using 3D printers
- Can speed up the development process
- Proposals for weight reduction based on our injection molding experience

3D printers



Case Study : Topology Optimization

Number 番号	1	2	3	4
Process	Building Solid Model	Topology Optimization	Weight Down Modeling	Evaluation of Mechanical Property
Result image				

Software Lineup

CAE for Injection Molding

- Flow Analysis
- Pressure and Cooling Analysis
- Fiber Orientation Analysis
- Warpage Analysis

Software Lineup

- Autodesk Moldflow
- Software developed in-house

CAE for Fiber Reinforced Thermoplastic Resin

- Anisotropic Mechanical Property Prediction
- Anisotropic Linear Stress Analysis
- Anisotropic Vibration Damping Analysis

Software Lineup

- MSC Marc
- Ansys LS-DYNA
- Simulia Abaqus
- Altair HyperWorks

CAE for Product Design

- Linear Stress Analysis
- Nonlinear Stress Analysis

Software Lineup

- MSC Marc
- Ansys LS-DYNA
- Simulia Abaqus
- Altair HyperWorks

Extrusion Analysis, Blow Molding Analysis

- 3D Flow Analysis through extrusion die
- Parison Formation Flow Analysis

Software Lineup

- TEX-FAN
- Simulia Abaqus

CAE for Thermoplastic Elastomers

- Large Deformation Stress Analysis
- Contact and Material Nonlinear Analysis
- Impact and Creep Analysis
- Vibration Damping Analysis

Software Lineup

- MSC Marc
- Simulia Abaqus

- MSC Marc is a registered trademark of MSC Software Corporation.
- Ansys LS-DYNA is a registered trademark of Livermore Software Corporation.
- Autodesk Moldflow is a registered trademark of Moldflow Corporation, USA.
- Simulia Abaqus is a registered trademark of Dassault Systèmes.
- Altair HyperWorks is a registered trademark of Altair Engineering, Inc.

History of TOYOBO MC

Development Progress

- Melt spinning analysis(1960-)
- Melt-blow analysis(1970-)
- Film forming analysis (1975-)
- Injection molding analysis (1980-)
- Elastomer deformation analysis (1985-)

Awards

Studies on Melt Spinning (1966)

- Best Paper Award, Society of Textile Machinery Society of Japan
- Inducted into the University of Akron Hall of Fame (1996)

Theoretical Analysis of Melt-and Dry-Spinning Processes (1970)

- Society of Polymer Science Technical Award

Studies on Melt Spinning

- Velocity field within the thread (1977)
- Draw resonance as a limit cycle (1977)
- Best Paper Award, Society of Textile Machinery Society of Japan

Elastomer Deformation Analysis (1985-)

History of TOYOBO MC

Dynamic Characteristics of New Material Protective Device For Ship Collision (1999)

- The 15th annual meeting of the Polymer Processing Society POSTER AWARD

Compressive deformation behavior of polyurethane foam materials (1999)

- Poster Award, Japan Society of Polymer Processing

Interfacial Delamination Analysis of Plastic Composites (1999)

- Poster Award, Japan Society of Polymer Processing

Deformation Behavior of Thermoplastic Elastomer Molded Products (2000)

- Dynamic Compression and Deformation Behavior of Honeycomb Shaped Molded Products
- Poster Award, Japan Society of Polymer Processing

Deformation Behavior of Thermoplastic Elastomers with Notched Specimens - Observation by Digital Image Correlation Method During Tensile Testing (2014)

- Poster Award, Japan Society of Polymer Processing

Deformation Behavior of Molded Thermoplastic Polyester Elastomer —Compressive Deformation of Molded Honeycomb Structures— (2017)

- Best Paper Award, Japan Society of Polymer Processing

Nonlinear Finite Element Analysis for Three-point Bending Behavior of Discontinuous and Randomly-Oriented Chopped Carbon Fiber Tape-Reinforced Thermoplastics (2018)

- Technology Award, Japan Society of Composite Materials

Contract Analysis Services

Contract Analysis Services

This is a contract service that supports the development of resin products from product design through the molding process. We support efficient product development by proposing optimal solutions. We offer solutions with short delivery times by utilizing our global network.

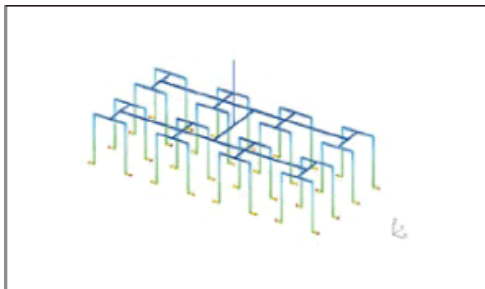
Advantages of Incorporating CAE into Product Development

- Proposal of optimal rib pattern and wall thickness for part design
- Proposal of ideal material for your project
- Multi-component assembly analysis is available
- Analysis that incorporating anisotropy due to fiber orientation

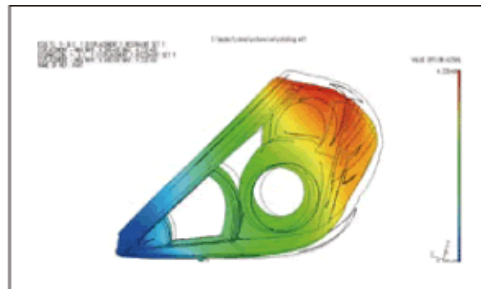
Example Analysis

- Flow analysis, warpage analysis, deformation stress analysis, Vibration Damping Analysis

Vibration Damping Analysis



filling pattern



Sled analysis result

Contract Analysis Services

TOYOBO MC Corporation also offers contract CAE analysis services (for a fee) for plastic products ranging from flexible elastomers to rigid reinforced thermoplastics.

By applying our proprietary numerical analysis technology for resin flow and deformation behavior of polymer materials such as synthetic fibers and films, we provide highly accurate simulations that are useful in the design of molded products and molds based on our many years of experience. While prediction was difficult in the past, we can now perform CAE analysis on large deformation issues with elastomers and warpage deformation of reinforced resins with a high degree of accuracy.

CAE Features

Our CAE technology consists of a combination of general-market software and customized software.

1. Stress analysis of elastomers can predict problems such as large deformation and creep deformation by simultaneously considering nonlinear behavior of geometry, materials, and boundary conditions.
2. Reinforced resin warpage analysis can model the orientation of reinforcing materials in detail and predict molding shrinkage and warpage.
3. Stress analysis and vibration analysis of reinforced resins can be predicted by considering the anisotropy of the material.
4. We have our own CAE measuring instruments, evaluation and testing equipment, injection, extrusion, and blow molding machines, and various other testing facilities, allowing us to quickly measure gather material data and conduct verification experiments.

Contract Analysis Services

Scope of Services

The following items are available as CAE analysis service items. Prices vary depending on the difficulty of the requested simulation.

1. CAE Analysis Services for Injection Molding

- Melt flow analysis
- Pressure-retention cooling analysis
- Glass fiber orientation analysis
- Warp deformation analysis

2. CAE Analysis Services for Product Design

- Linear stress analysis
- Nonlinear stress analysis

3. Elastomer Deformation Analysis Services

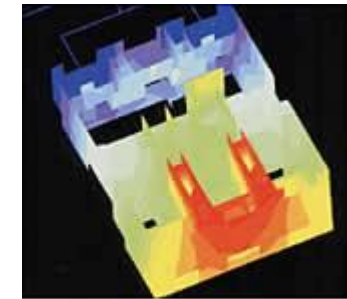
- Large deformation stress analysis
- Contact and material nonlinear analysis
- Impact analysis
- Creep deformation analysis

4. Analysis Services for Reinforced Resin Molding

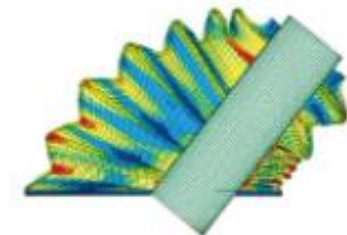
- Anisotropic property prediction analysis
- Anisotropic linear stress analysis
- Anisotropic vibration damping analysis

5. CAE Analysis Services for Extrusion and Blow Molding

- 3D flow analysis through extrusion die
- Parison formation flow analysis



Injection molding CAE analysis



Elastomer deformation analysis

Important Notes

Notes Regarding Liability

- The information provided here pertains to properties under natural or standard black conditions. Please note that properties might vary depending on color.
- The statements provided here are based on our knowledge and experience. These statements can change due to molding conditions or usage methods. Additionally, industrial property rights and legal regulations might be relevant depending on the usage purpose. Prior to usage, please thoroughly consider and evaluate.
- For applications involving medical, military, or food contact purposes, or if the material is used in products that pose a significant risk to life, body, or significant physical damage in case of defects, please contact us separately before use.
- When exporting this material or products using our material, please adhere to relevant foreign exchange and foreign trade laws and regulations.
- Due to chemical regulations in various countries, the chemicals used in this material might be subject to regulation, requiring separate applications or potentially limiting export-import. If you intend to be an importer/exporter of this material, please contact us.
- The content of this document is based on the available information, methods, data, etc. at the time of creation. It might be subject to revisions without notice based on subsequent findings. Please understand.