for a better future KEP

Through continuous innovation and new value creation, KEP will be the premier chemical company providing humanity with solutions for a better future.

CAE supports for customers

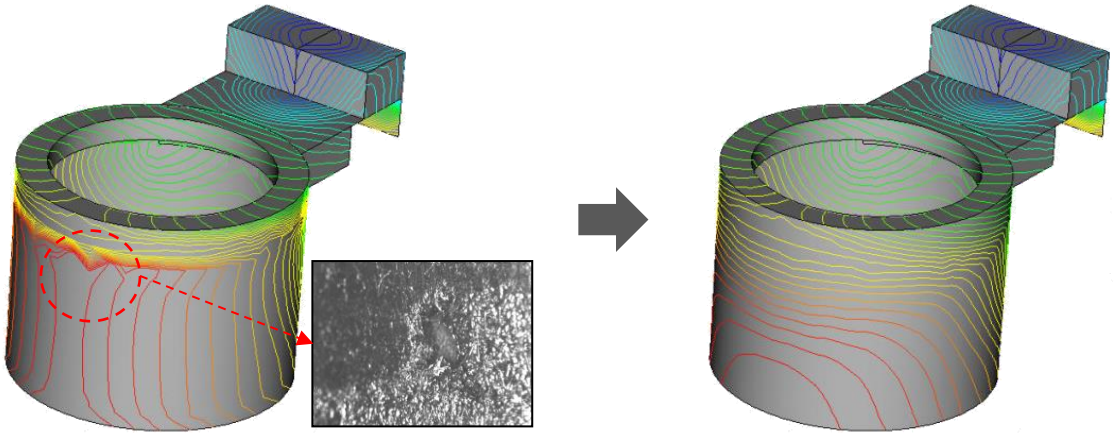
KOREA ENGINEERING PLASTICS

Contents

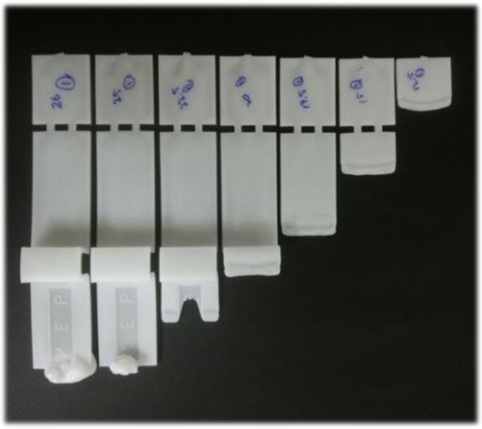
Short Shot

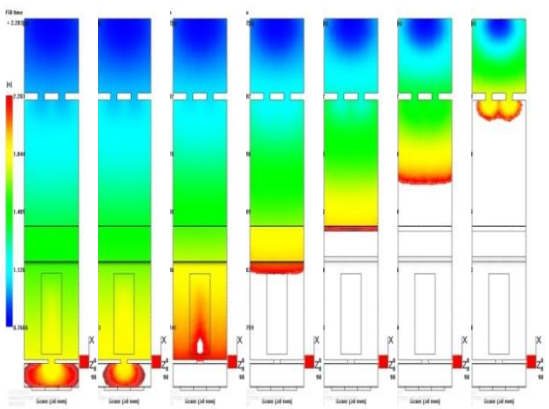
❖ Troubleshooting Short Shot

- Simulating short shot can derive improved solutions.
- Short shot is caused by various factors such as part thickness, gate sizes, gate locations, etc.



- If necessary, correlation between injection molding sample test and analysis can improve accuracy.

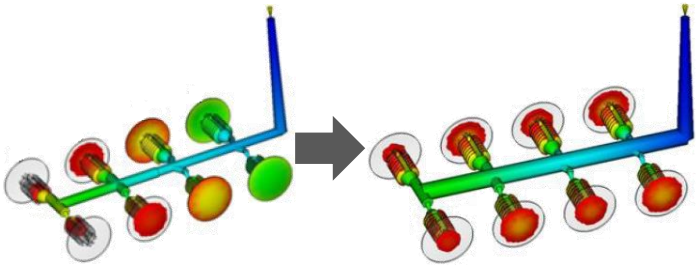


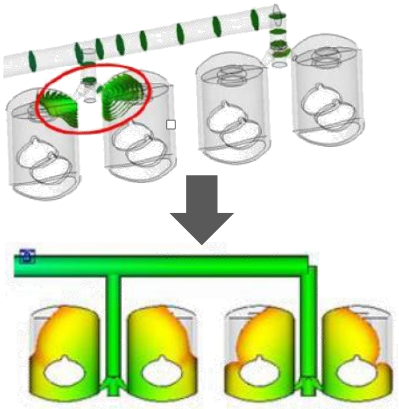


Runner Balance

❖ Runner Balance

- Uniform injection pressure to all part areas can be simulated by adjusting runner system and gate sizes before mold is produced.

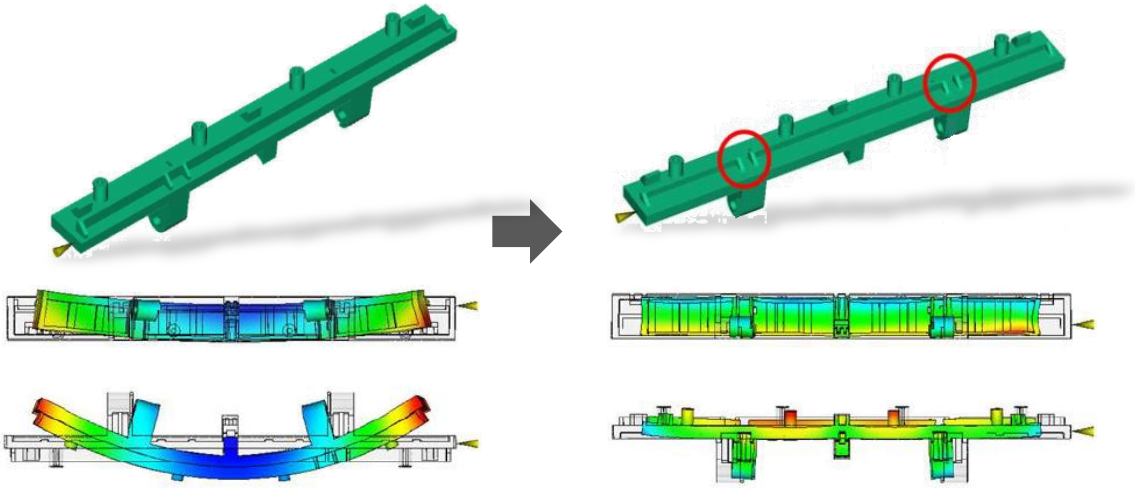




Deflection

❖ Improvement of Deflection

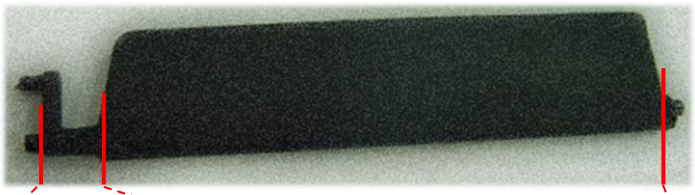
- Deflection after injection molding can be estimated by simulation.
- Changing model design, injection conditions, cooling channel can minimize deflection.

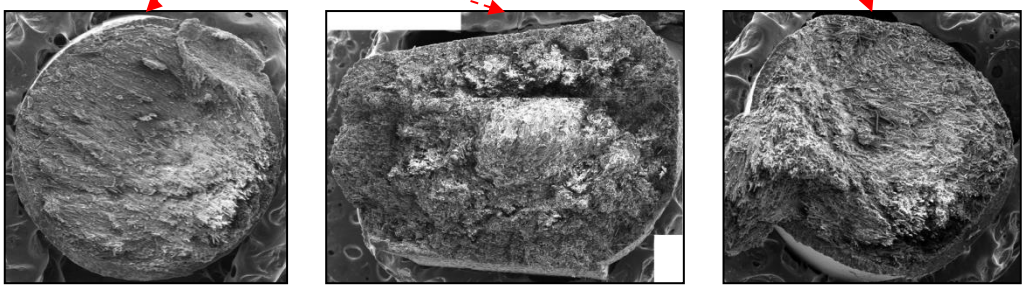


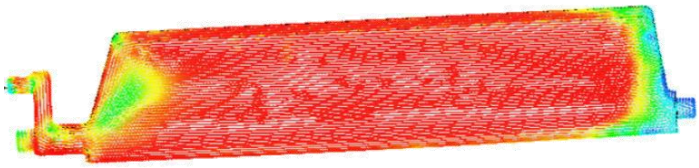
Fiber Orientation

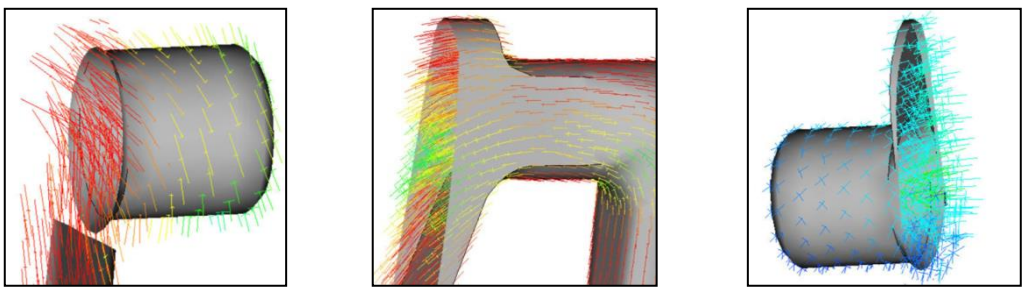
❖ Examination of Fiber Orientation

- The regional strength of a product depends on the orientation of the glass fiber after injection molding.
- Before the mold is confirmed, product strength can be guaranteed by adjusting fiber orientation derived from gate location change.





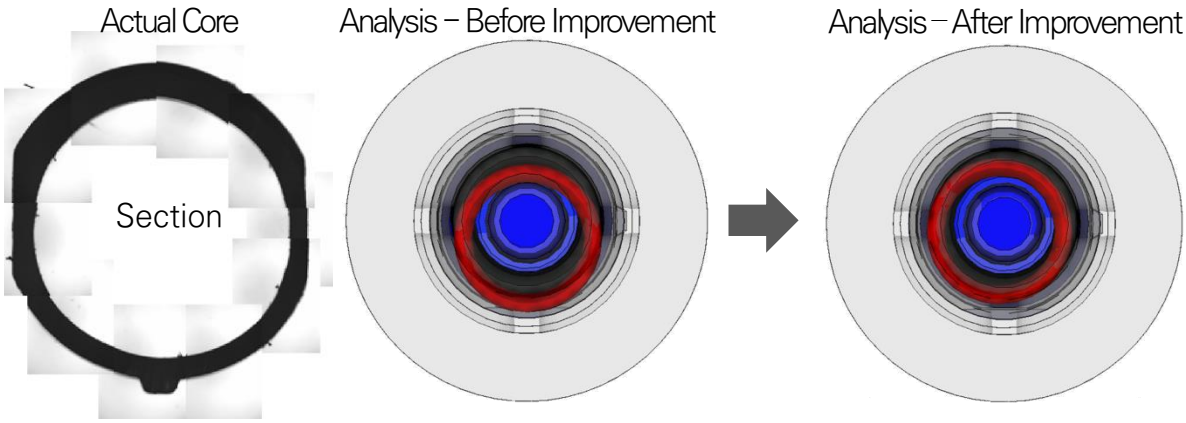




Core Shift

❖ Core Shift Effect

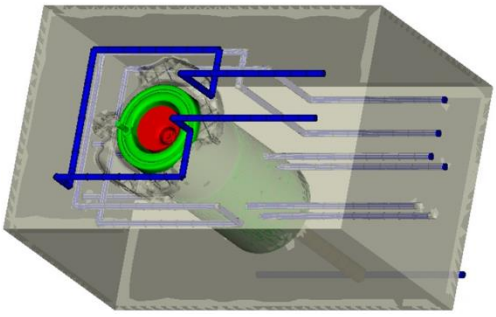
- If the mold cores are long and thin, they can be shifted by injection pressure. The injection molding simulation indicates symptoms and possible solutions in advance.

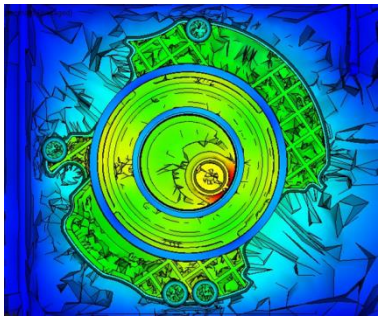


Cooling Channel

❖ Efficiency of Cooling System

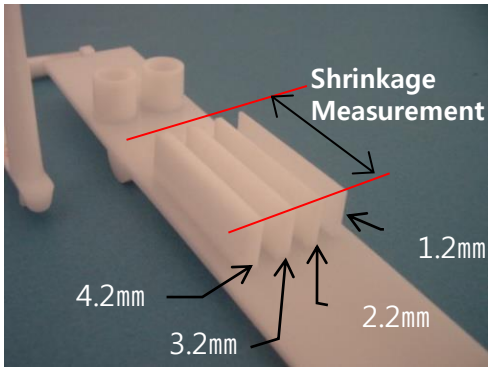
- Injection molding analysis using actual mold design and cooling system can minimize the difference between the actual injection result and theoretical analysis.

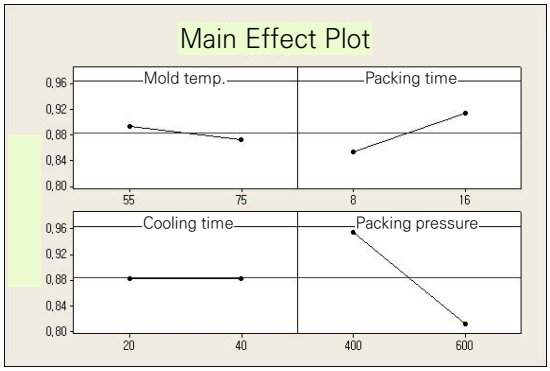




DOE

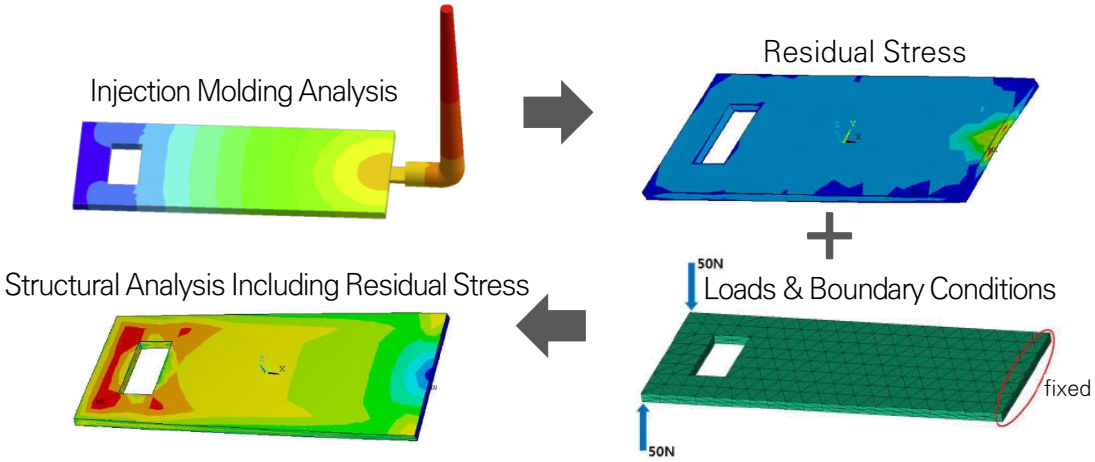
❖ Design Of Experiment
- Quality objectives (shrinkage, deformation, etc.) can be surveyed in accordance with the changes of main molding parameters (mold temp., packing pressure, etc.) to get the best possible product quality.





Injection Molding to Structural

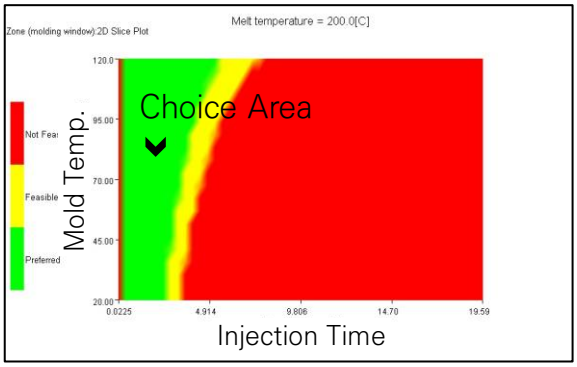
❖ Linked Analysis from Injection Molding to Structural
- After the injection molding process, products can have residual stress and material property changes due to fiber orientation.
- In structural analysis of the molded parts, factoring in those effects results in a much more accurate test.

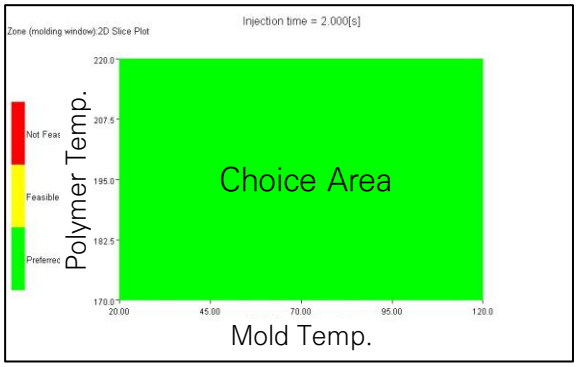


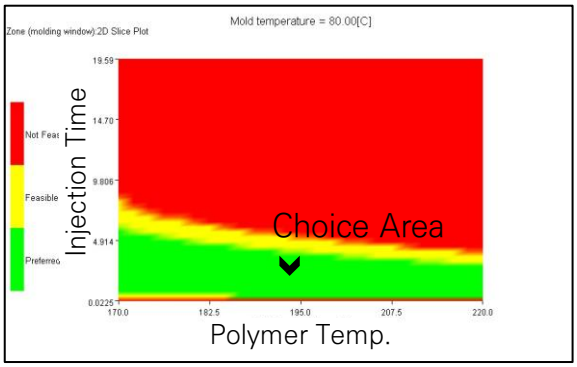
Optimization

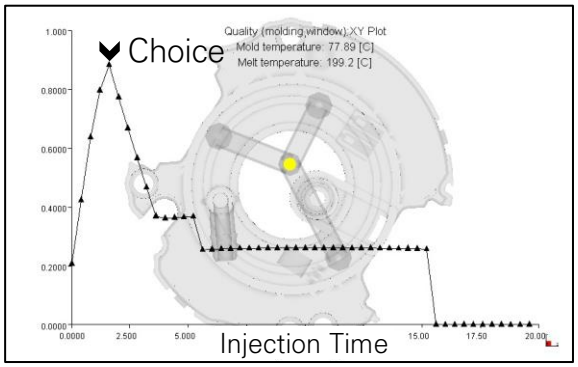
❖ Choosing Optimal Injection Conditions through Molding Window

– The molding window displays guides for appropriate injection molding conditions which are the optimum for the product.

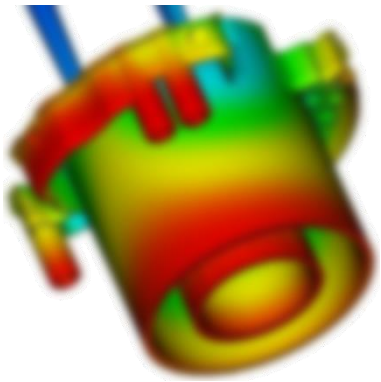




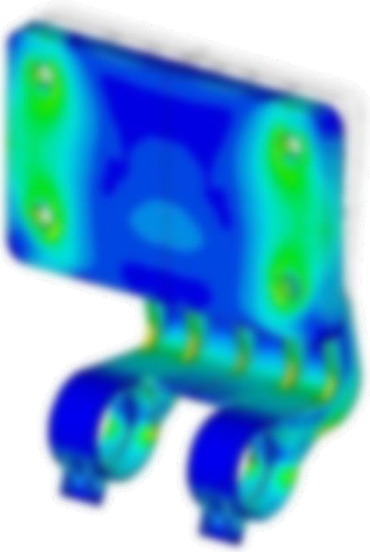




Fill Pattern of Balanced Runner

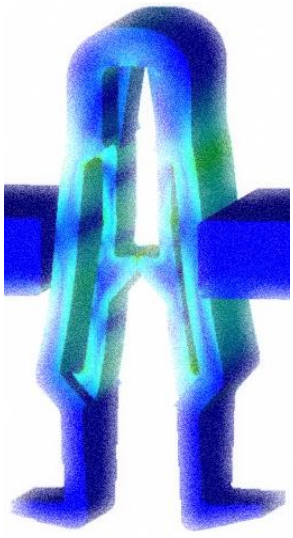


Structural

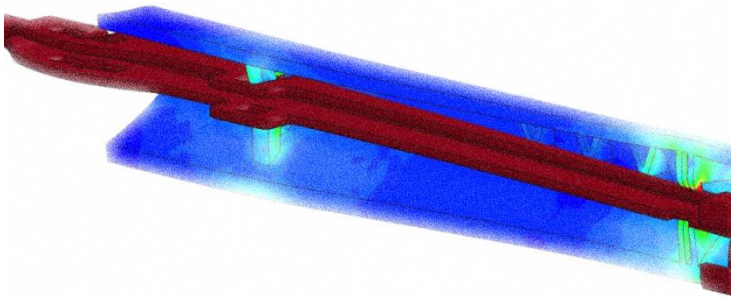


❖ General Nonlinear Static Analysis

- Most structural analyses belong to this group.
- It contains material, geometric, boundary nonlinearity.
- Structural weakness (stress concentration) can be derived and improved.
- Transient and repeated loading effects are excluded.



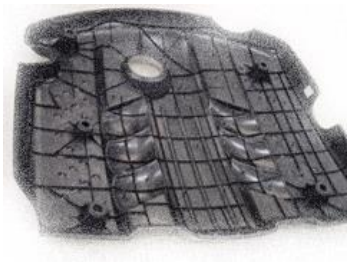
- Assembling process of clips or window wipers can be simulated in order to check insertion force or stability of assembled condition in advance.

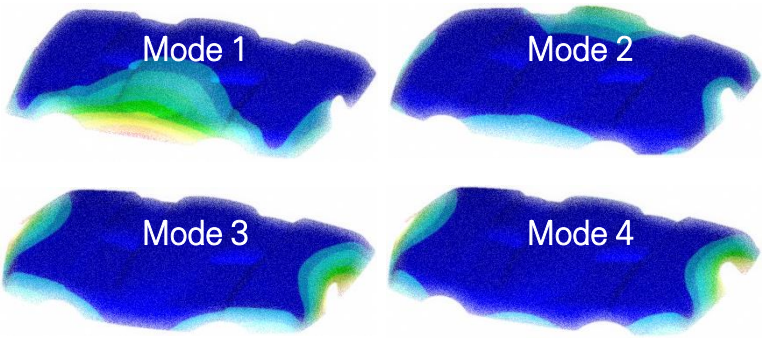


Vibration

❖ Normal Mode Extraction of Parts and Assembly Modules

- As the external vibration grows closer to the natural frequency of a product, the damage risk increases.



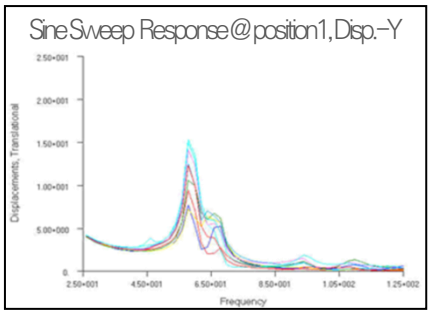


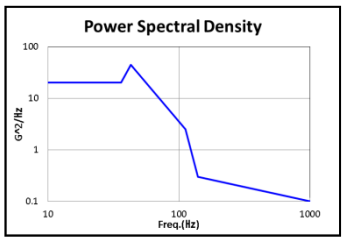
❖ Forced Response & Random Vibration Analysis Using Extracted Modes

- Forced vibration : Vibration at a specified frequency with an acceleration
  (ex) 15Hz-20G vibration
- Random vibration : Vibration representing road conditions or industrial sites, a statistical approach (PSD) is used.

Input : 25Hz~125Hz, 1G

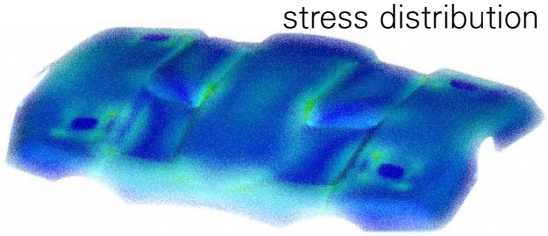
Output : Response amp. in accordance with excitation freq.





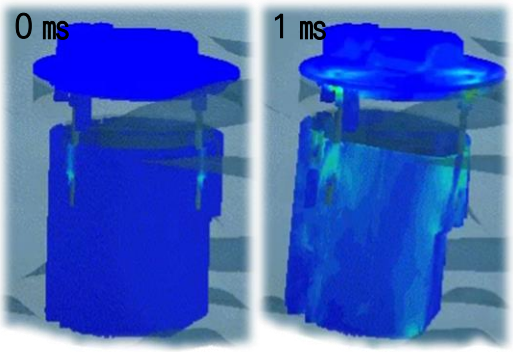
Input : PSD

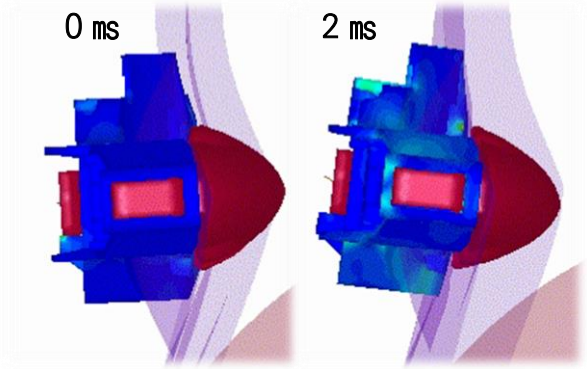
Output : Stochastic stress distribution



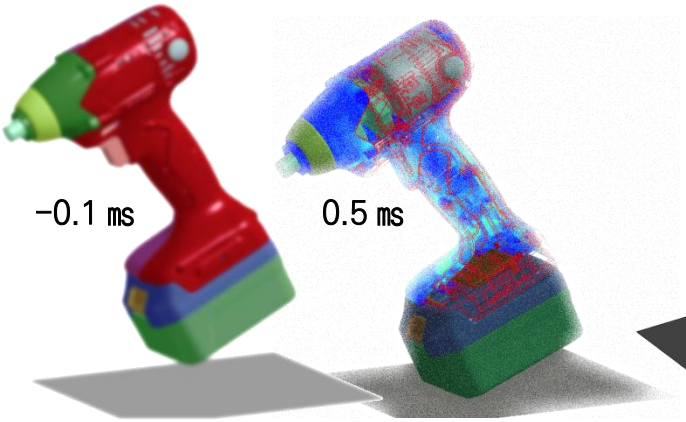
Shock/Impact

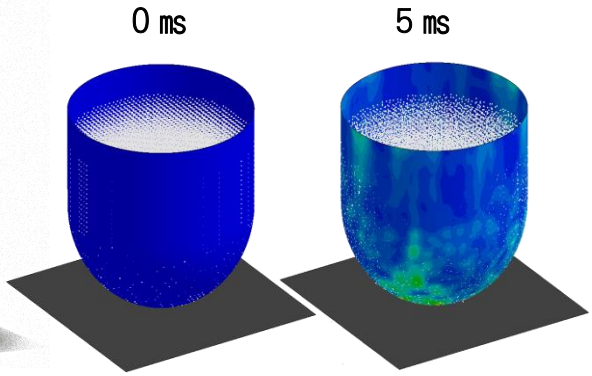
❖ Transient Structural Analysis for Automobile Parts and Modules at Car Crash Conditions.
- At various car crash conditions (ex: initial velocity 60㎞/h, acceleration-duration 40G-5㎳), stress and strain of fuel pump modules and door handles can be evaluated in real time.





❖ Strength Evaluation under Free Drop Condition or Transient Shock with a Duration Time.
- Under very short-duration external shock or drop conditions, momentary stress changes of parts used in many industries can be evaluated and observed.
- In addition, stress and strain changes of containers that store fluids (water, fuel, etc.) can be observed.

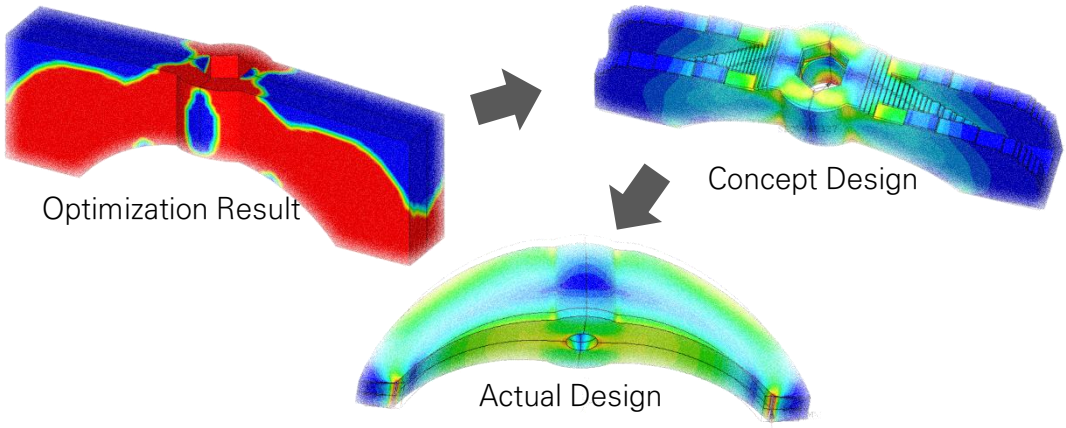




Optimization

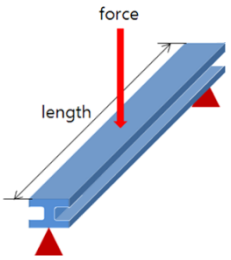
❖ Topology Optimization

- An optimally designed model satisfying special constraints can achieve the smallest possible volume through topology optimization.

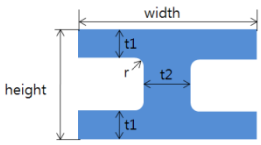


❖ Design Parameter Optimization

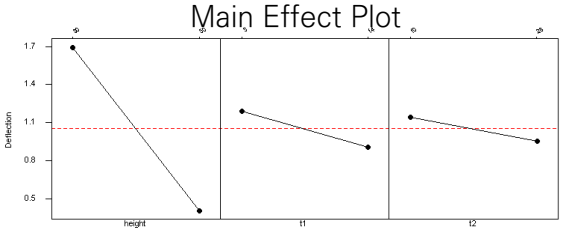
- Some typical products have limited design dimensions and physical properties whose values affect target quality.
- As design parameters are changed, an optimal values satisfying the best possible target objective can be obtained. (Optimization methods such as DOE/RSM are available.)



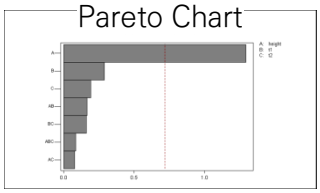
Design Parameters



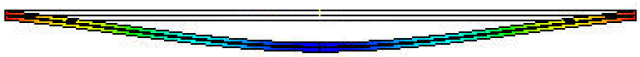
Main Effect Plot



Pareto Chart



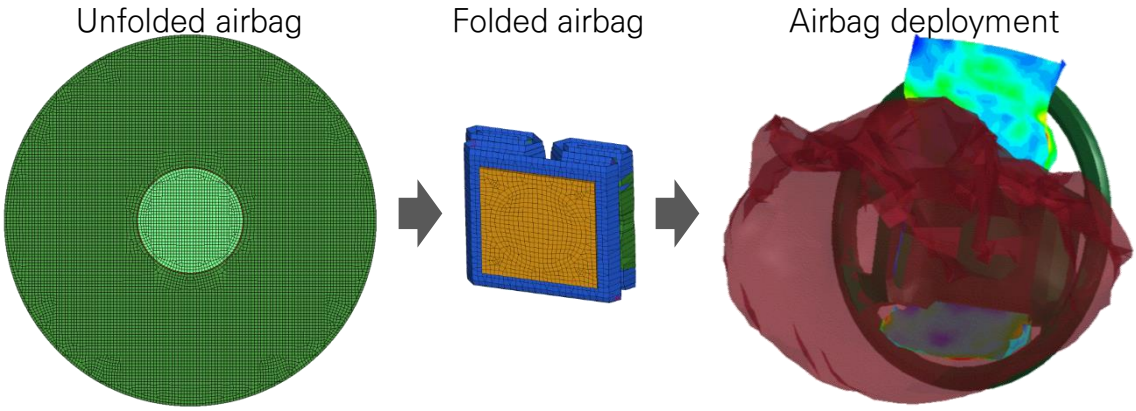
Objective : Minimizing Deflection



Airbag

❖ Airbag Deploying Analysis for Strength Evaluation of Airbag Module Parts

- After airbag has been modeled as unfolded, it can be installed in the airbag module through the folding process.
- Generally, an airbag is fully deployed within 2㎳, and strength evaluation of airbag module parts can be done by the deploying shock.

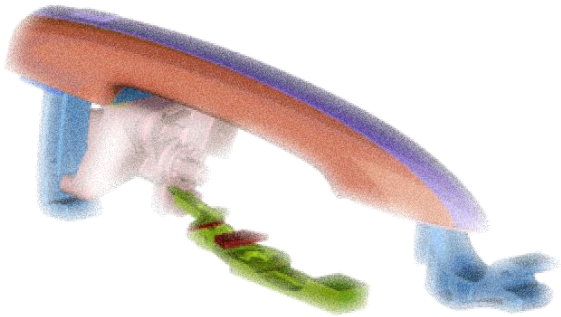


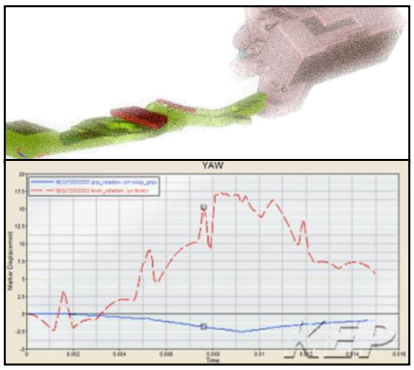
Note : It is best to get folded airbag model and analysis conditions directly from the customers.

MBD (Multi-Body Dynamics)

❖ Verifying Locking Operation of Door Handle Assembly under Shock Condition

- Handle assembly must be verified if it works properly under car crash conditions. During the simulation, all parts are assumed to be rigid bodies.

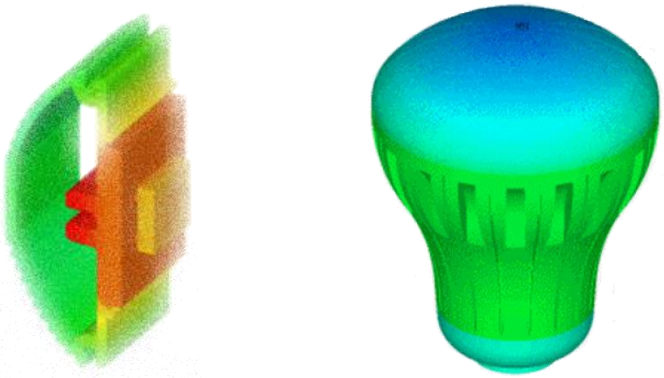




Thermal

❖ Deriving Transient Thermal Distribution

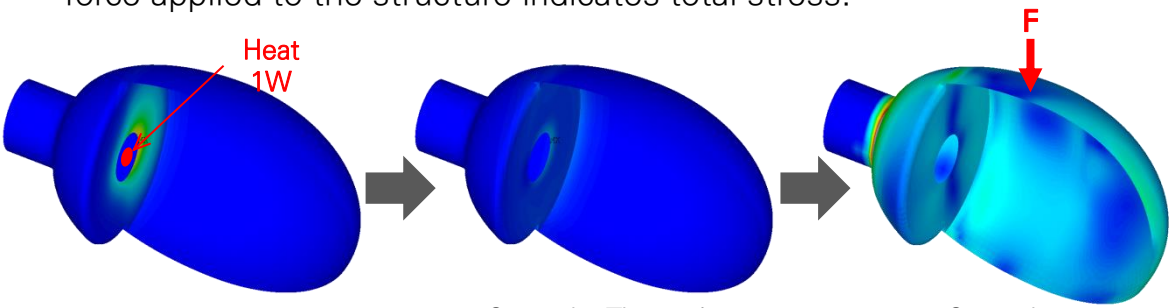
- Thermal distribution can be derived from the effect of thermal load and 3 major heat transfers such as conduction, convection, radiation. (ex : Transient temperature distribution of electric light bulb from electric power(W) and heat transfer)
- Temperature distribution and heat loss due to heat convection can be calculated at the thermal equilibrium.



Unit : Heat flow rate(W), thermal conductivity(W/m℃), specific heat(Kcal/kg°C), convection coefficient(W/m2℃)

❖ Strength Evaluation under Combined Condition of Thermal Transfer, Thermal Expansion and Physical Force

- In many actual conditions, thermal load and external force are applied simultaneously.
- For example, if inside heat generation 1W and external force 10N are applied, partially different thermal expansion along temperature distribution can be derived from thermal analysis, and additional external force applied to the structure indicates total stress.



Temperature Distribution by Thermal Analysis

Stress by Thermal Expansion along Temperature Distribution

Stress by Thermal Expansion + External Force

Software

❖ Current KEP CAD & CAE S/W lists

Category		S/W	Purpose
CAD		NX	3D CAD
		Pro/E	3D CAD (Mold)
CAE	Preprocess	Patran	Pre/Post Processor for Nastran
		Hypermesh	General Pre/Post Processor
		Mentat	Pre/Post Processor for MARC
	Injection Molding	Moldflow	General Purpose Injection Molding
		Moldex3D	Specialized in 3D Injection Molding
	Structural	Nastran	Linear & Non-linear Structural, Vibration, Thermal Etc.
		Ansys	
		MARC	
		LS-Dyna	Non-linear & Crash, Impact
	Optimization	Matlab	Optimization, DOE, Programming

❖ 3D CAD data formats for CAE requests are recommended as below.

Recommended

*.prt(NX/Pro-E)	*.stp/step	*.x_t	*.iges/igs
Native file with history	Neutral file for 3D solid		Neutral file for 3D surface

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