
Introduction
CAE Engineering
2004

Content

Company Overview

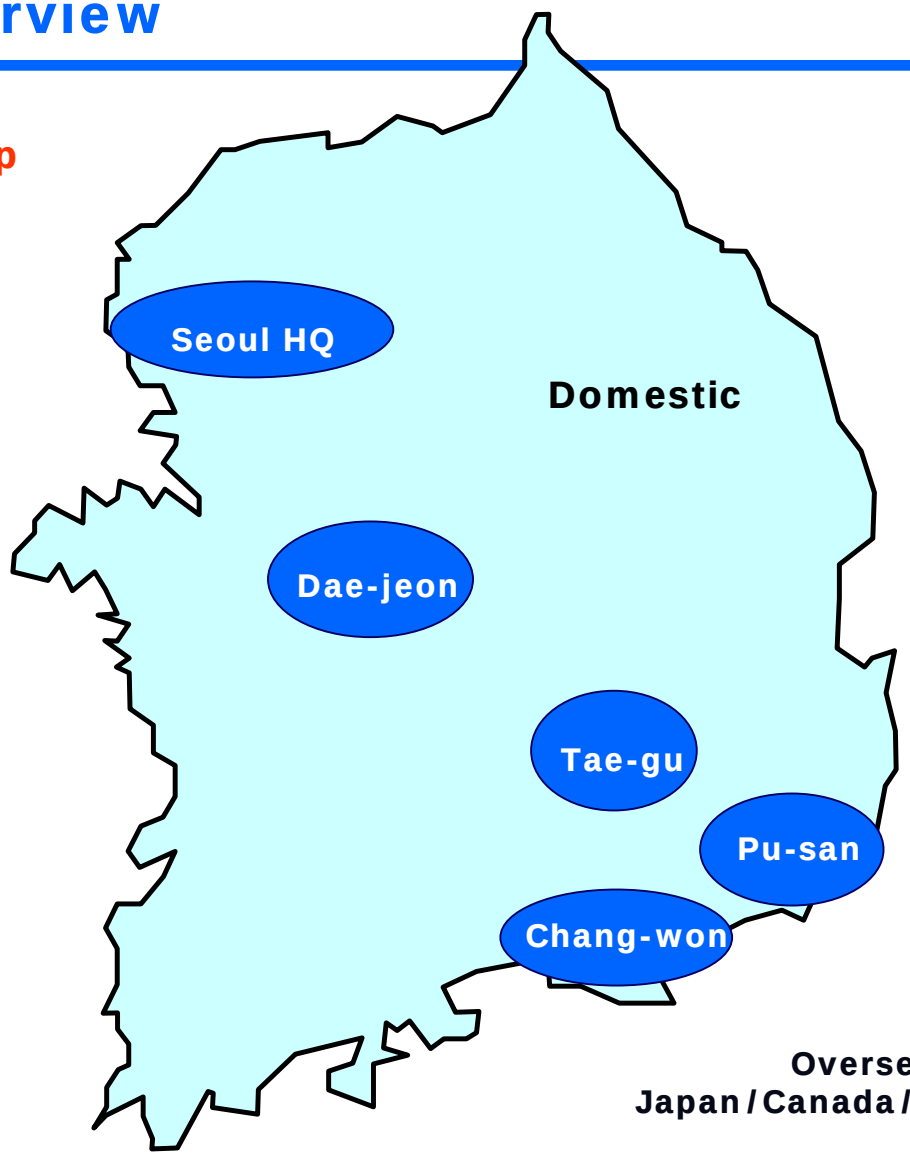
Althrough we have a short history, CIES/ATES/iNOPS has emerged as recognized engineering solutions and consulting company and gained a unique position in Korea.

- Location : 12F, e-BIZ Center. 170-5 Guro-Dong, Kuro-Gu, Seoul, Korea
- CEO : Lee, Kee-Hun
- Establishment : Dec 27th, 1990
- Consolidated Engineer & Sales : 203 Person (ATES 58, iNOPS 25)
- Consolidated Turnover : 70 M $ (2003 Year)
- Business Field : CAD/CAM/CAE/PDM/E-BUSINESS
  - * CIES : CAD/CAM Solution & Engineering
Digital Manufacturing Solutios
e-Business
  - * iNOPS : PDM S/W Development, Consulting & Implementation
  - * ATES : CAE & CFD Solutions, Product Engineering Services
- Users : 800 Sites (Domestics & Overseas)

Our company's foundation is a continuously expanding and highly motivated technology base, currently consisting of over 200 highly qualified professionals, and is well positioned to meet the needs of our customers with the highest quality solutions in a wide of engineering disciplines.

Company Overview

☞ **Organization Map**



Overseas
Japan / Canada / Germany / China

Company Overview

☞ History of ATES

Founded in 1995, Advanced Technology Engineering Service(ATES) has grown to become one of the automotive industry's better known firms in Korea, providing Computer Aided Engineering(CAE) consulting services. Our mission is to serve the global automotive industry as the leading supplier of CAE services. The foundation of our success is the close corporation we have with the development and test in departments of our business partners. We support our customers throughout the entire development process from initial concepts to mass production.

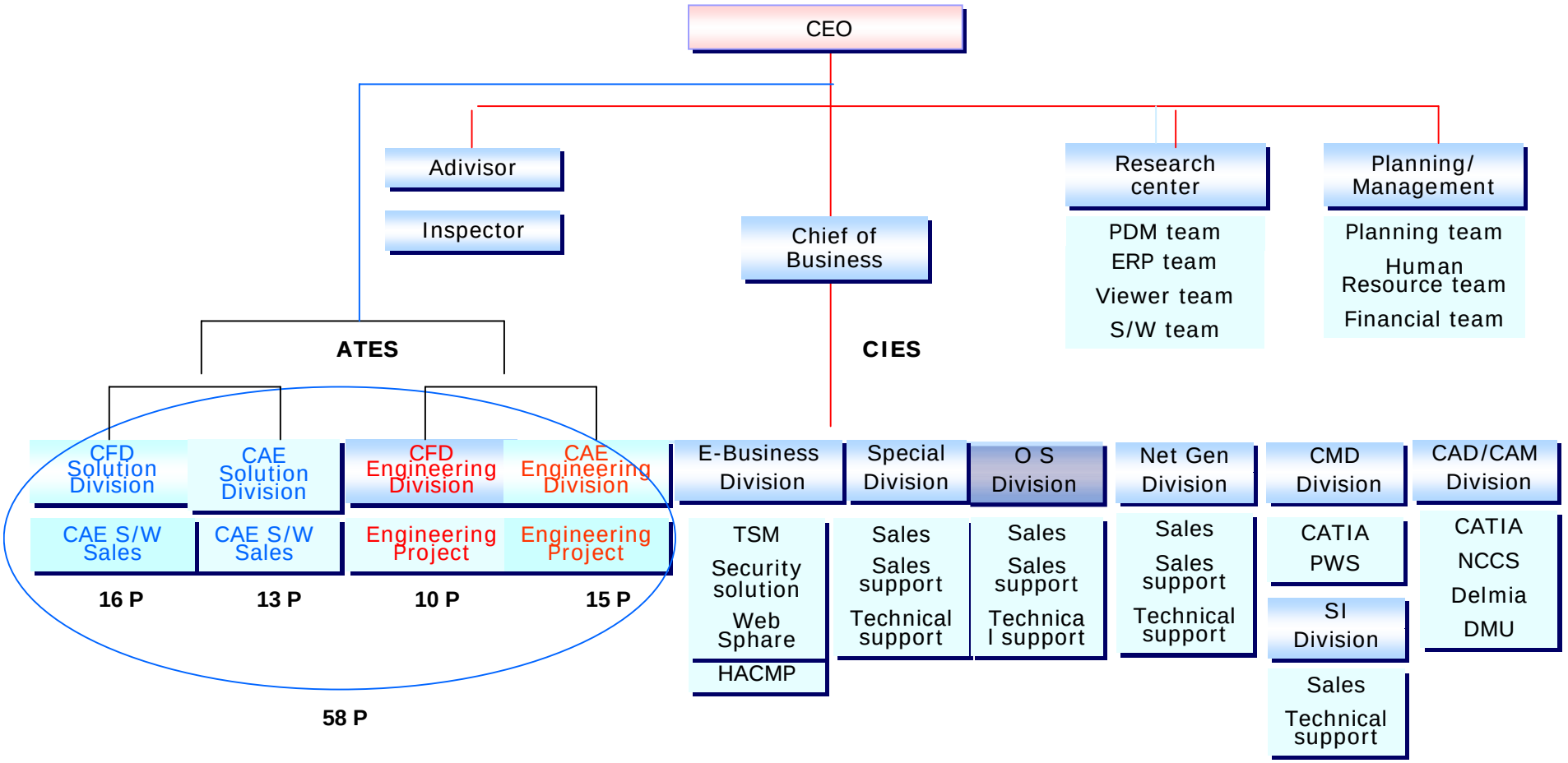
Our Services:

- Drawing up of the calculation model
- Performing simulations
- Consulting on analysis of results
- Optimization of components and products
- Advice throughout the development process

A significant segment of ATES's business is in the placement of qualified candidates on-site with out customers, primarily the automotive company. We also maintain a lot of projects in-house. The majority of these positions are for finite element analysts; However we have open positions for programmers, systems analysts, system administrators and computer information technology specialists as well. With our ability to provide engineering solution globally, a vast majority of Fortune 200 companies in Korea choose ATES as their prefered product engineering and consulting company

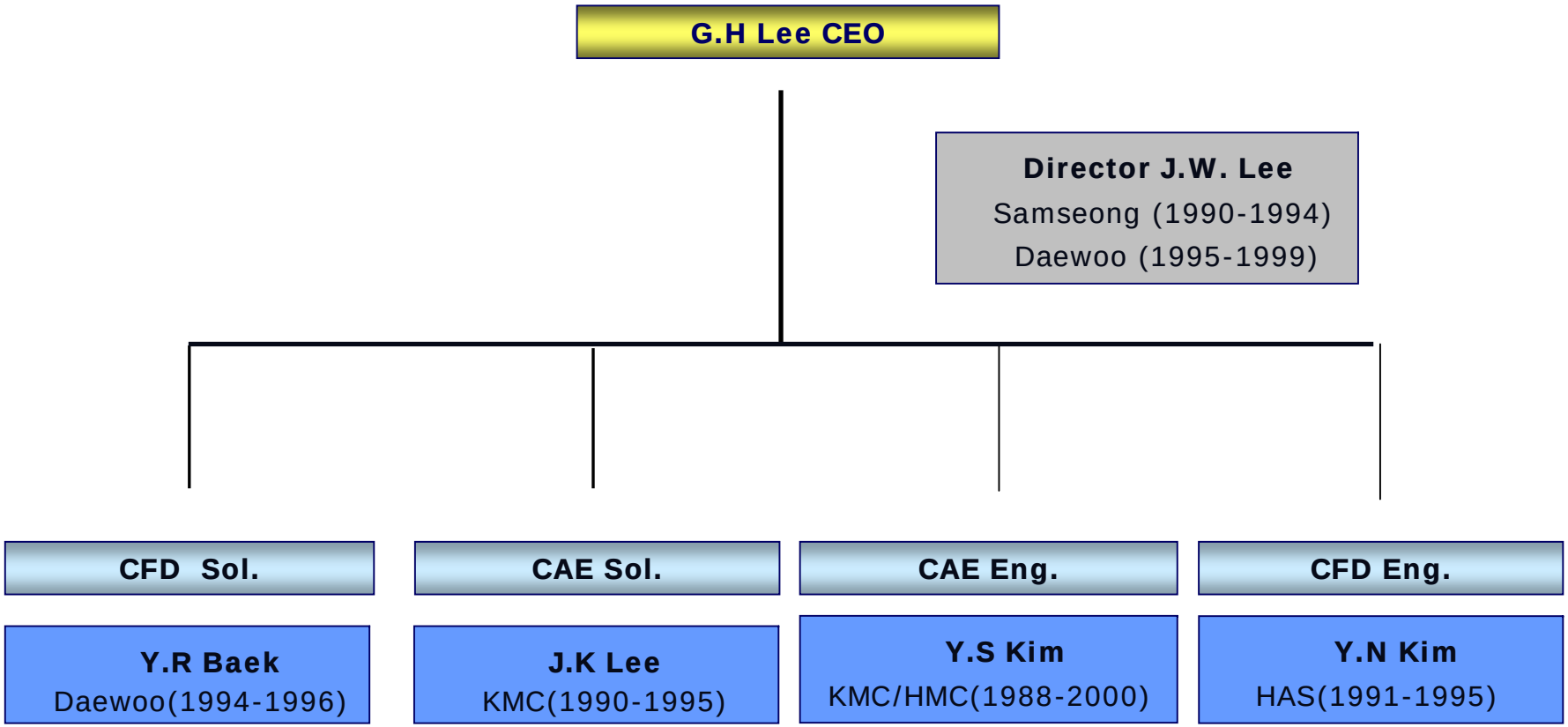
Company Overview

☞ Organization Map



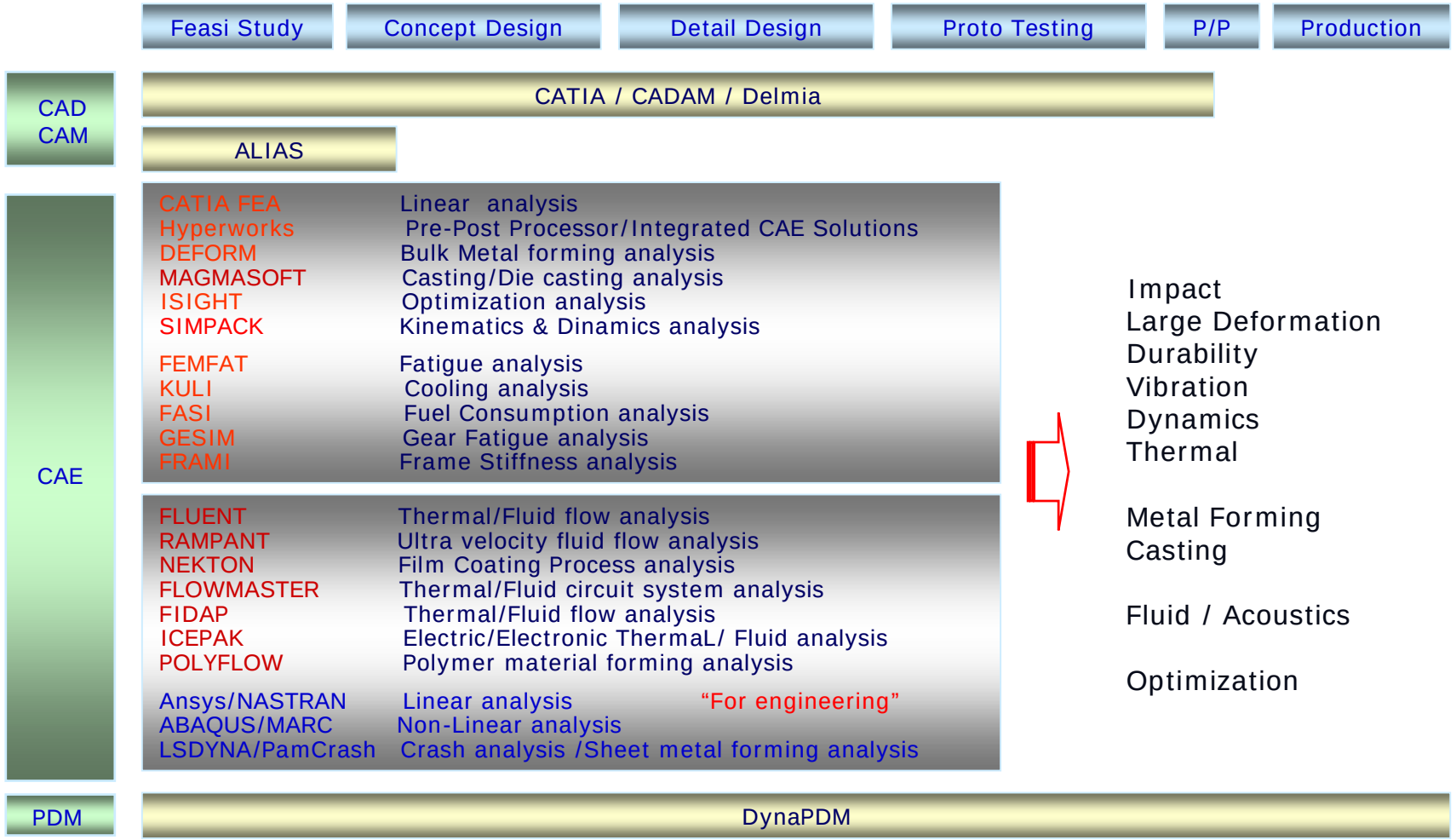
Company Overview

☞ Organization Map



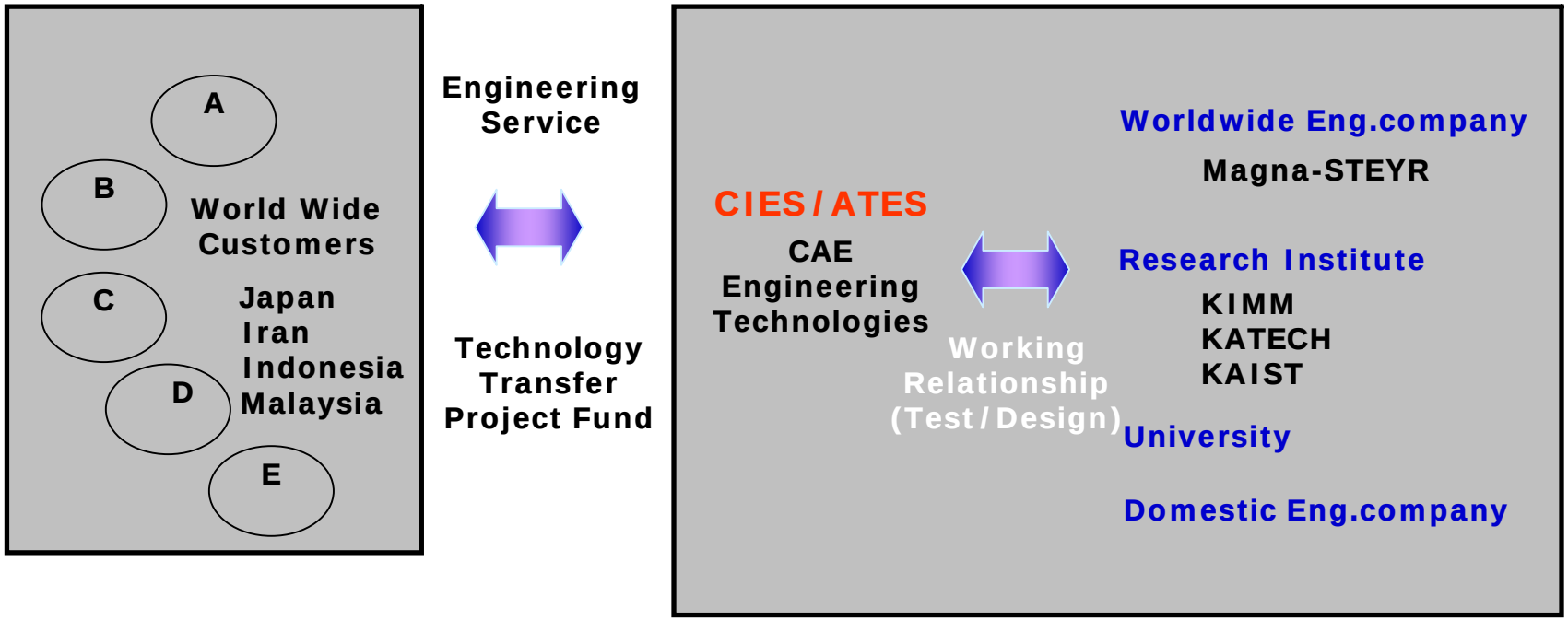
Company Overview

☞ Software / Map



Company Overview

☞ Engineering Service System



- Automobile / Railway
- Construction / Aviation / Machinery
- Electronic / Environment

- Consulting
- Engineering
- Technology Assessment
- Technology Support

- Computer / Software
- Test/Facility
- Development Experience
- Information

Product Engineering

■ Design

With the staff with management experience surpassing 10 years, ATES established a standing reputation in Korea for providing innovative conceptual design support through release level design. The key to our success lies in our ability to seamlessly integrate with client product teams, leveraging the management experience of our global operations and intelligently applying technology to expedite the design the process.

As an entended enterprise partner, we provides our clients the competitive advantage necessary to complete in a demanding global market.

ATES provides design support in specialized area including

- Needs Assessment
- Project Definition
- Packaging
- Concept Development
- Theme Development
- Virtual Validation / Optimization
- Final Concept Selection
- Detailed Design Development
- Prototype Development
- Test Validation
- Validated Concepts

Product Engineering

☞ Feasibility Study

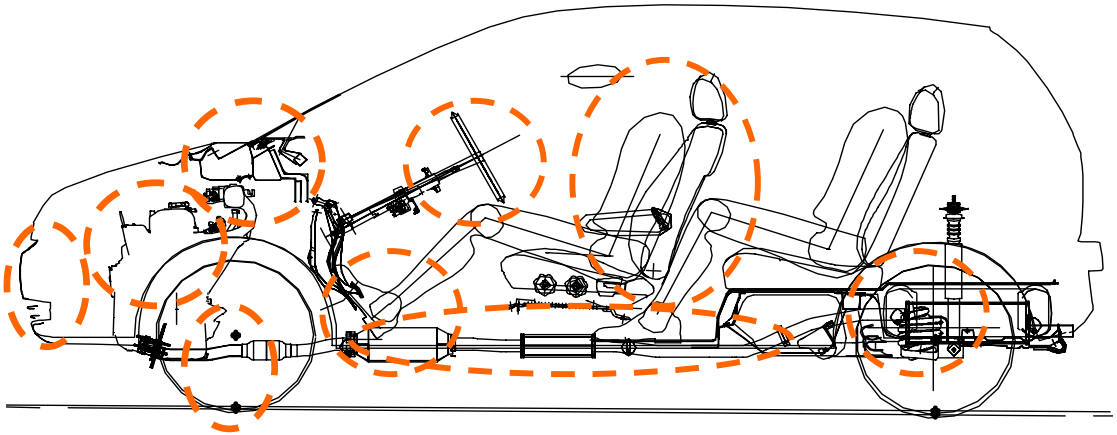
-.Exterior / Interior
-.Seating / Engine Room

☞ Master Drawing / Detail Drawing

-.BIW
-.Moving Parts
-.I/P
-.Interior Trim
-.Exterior Attachment Parts

☞ Package L/O

-.E/G Room
-.Interior
-.Instrument Panel
-.HVAC
-.Chassis
-.Seating System
-.Total L/O

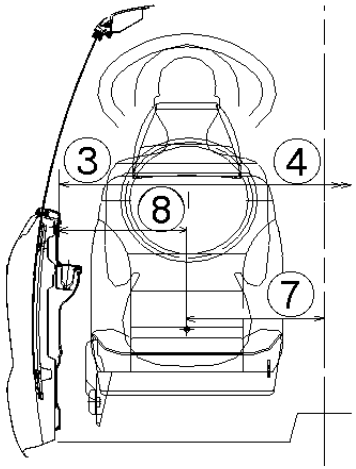


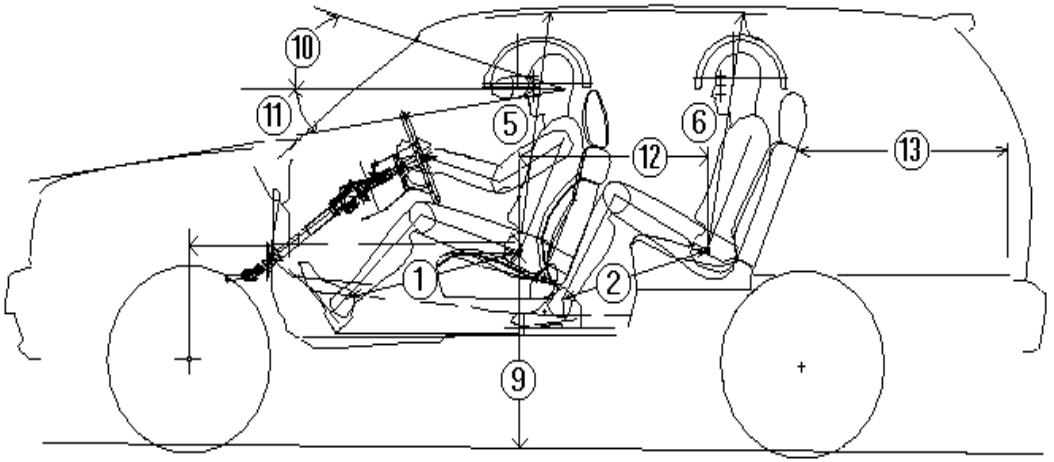
☞ Project Management

-.Concept Setting and Development
-.Development Target Setting
-.Event Management
-.Project Scheduling

Product Engineering

☞ Package L/O

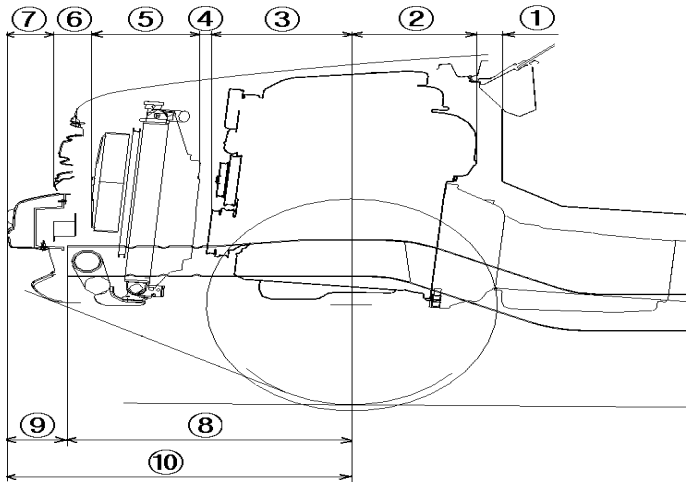




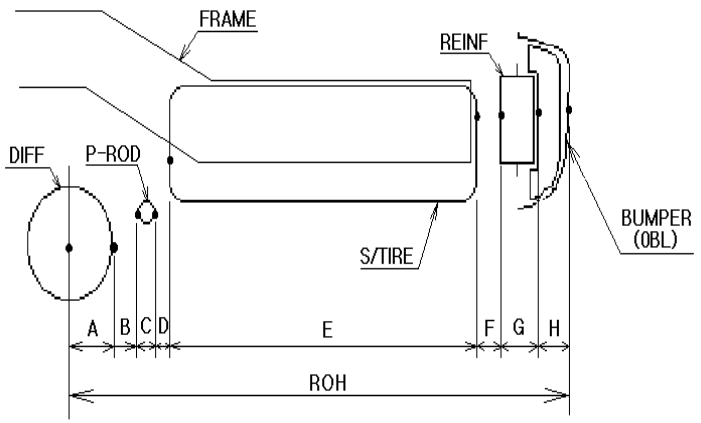
①② LEG ROOM
③④ SHOULD ROOM
⑤⑥ HEAD ROOM
⑦⑧⑨ H-POINT
⑩⑪ VISUALIZATION
⑫ COUPLE DISTANCE
⑬ LUGGAGE SPACE

Product Engineering

☞ F.O.H & R.O.H L/O



F.O.H

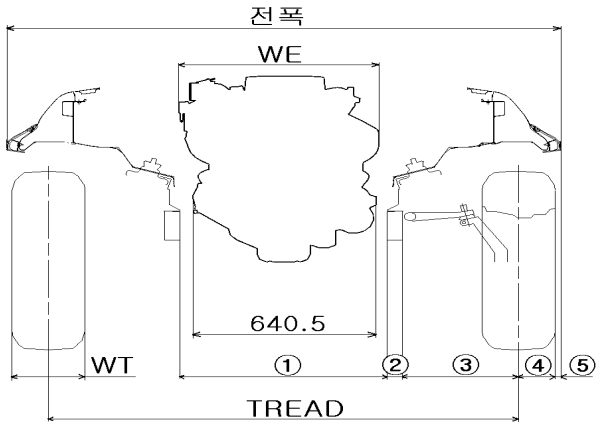


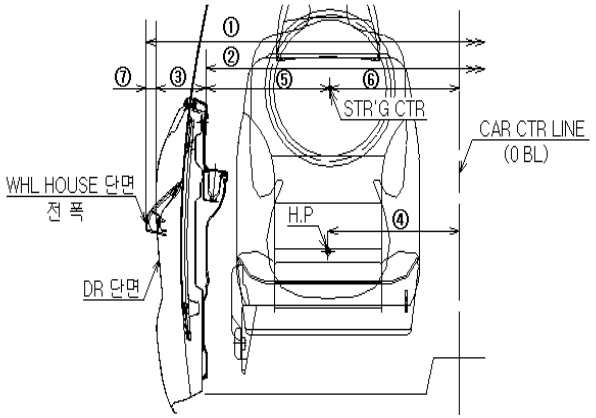
R.O.H

① E/G REAR - DASH PANEL
② WHL CTR - E/G RR
③ WHL CTR - E/G FRT
④ E/G FRT - RAD.FAN
⑤ RAD.FAN - AIR COND. FAN
⑥ AIR COND.FAN - RAD GRILL FRT
⑦ BUMPER FRT SPACE
⑧ WHL CTR - FRAME FRT
⑨ FRAME FRT - BUMPER FRT

Product Engineering

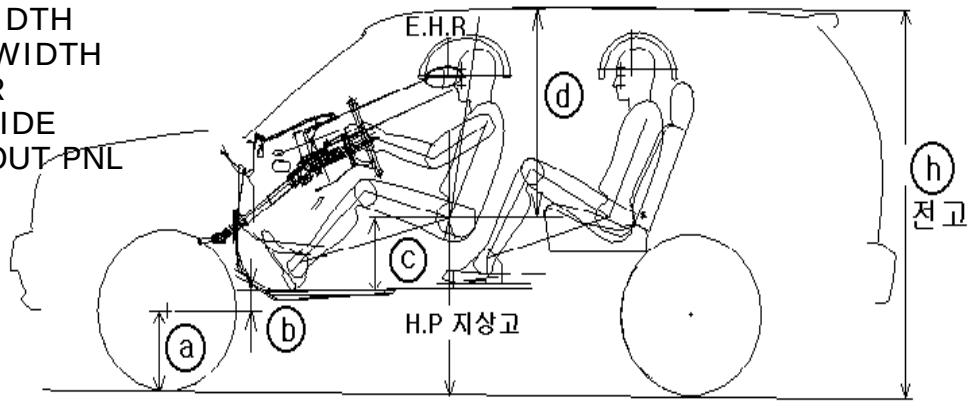
☞ Hight / Tread / Driving Room L/O





Ⓗ HIGHT
ⓐ WHL HIGHT
ⓑ WHL CTR - A.H.P
ⓒ A.H.P - H.P
ⓓ H.P - ROOF
HIGHT
FFFECTIVE HEAD ROOM
TIRE SIZE

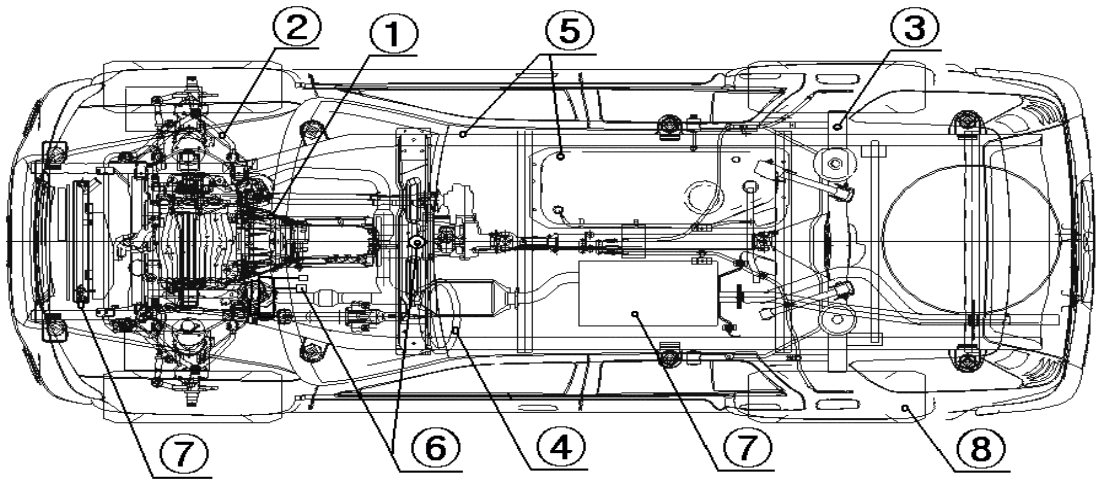
① FRAME INSIDE WIDTH
② FRAME SECTION WIDTH
③ FRAME - WHL CTR
④ WHL - TIRE OUTSIDE
⑤ TIRE OUTSIDE - OUT PNL



① TREAD
② SHOULDER ROOM
③ DOOR WIDTH
④ H.P Y COORD.
⑤ H.P - DOOR TRIM
⑥ STR WHL Y COORD.
⑦ DOOR - TREAD DIST.

Product Engineering

☞ Platform L/O



① POTER TRAIN (E/G + T/M + T/F)
② FRT SUSPENSION & AXLE SYSTEM
③ REAR SUSPENSION & AXLE SYSTEM
④ STEERING SYSTEM
⑤ FRAME & FUEL SYSTEM
⑥ BRAKE & CONTROL SYSTEM
⑦ COOLING & EXHAUST / INTAKE SYSTEM
⑧ TIRE & MOUNTING

Product Engineering

■ Engineering

Applying CAE to automate the product design process is our core expertise. Supporting the automotive, heavy equipment, naval, aerospace, and consumer product industries, ATES specializes in mechanical systems, structural engineering.

ATES's product design synthesis process integrates our unsurpassed industry experience with the latest advances in CAE technology to provide clients with the most efficient, robust engineering support available today.

Engineering Disciplines:

- Linear structural analysis : NVH, Durability, Fatigue
- Structural crashworthiness
- Structural Optimization : Topology, Topography, Size-Shape, Multi-Discipline
- Safety
- Dynamic and kinematic mechanical systems
- Manufacturing simulation
- Material selection / utilization
- Computational fluid dynamics

Safety & Regulation Analysis : Impact / Deformation / Fatigue
Performance Analysis : Optimization / CFD
Manufacturing Analysis : Deformation

Product Engineering

☞ Crash Engineering

ATES is the market leader in CRASH Engineering and providing OEMs, Suppliers, and regulatory agencies with full vehicle and occupant crash technologies. Our professionals works closely with engineers in design validation and development to comply with FMVSS requirements, emerging regulations, and “due-care” safety concerns.

▸ Interior / Exterior Safety Analysis :

-.In/Panel : FMVSS 208, 203, 207, 210
-.Seat : North American and ECE Regulations
-.Pillar : Nice capabilities in assessing and recommending head impact safety(FMVSS 201)
-.Bumper : Complete simulation of barrier, pendulum, pole, and offset impacts
-.Moving Closures : Door & Trunk fatigue performance from closing

▸ Full Vehicle Crashworthiness Analysis :

-.Reverse Engineering of vehicles : the validation in full frontal, IIHS, side impact
-.Side Impact Dummy(SID) : FE model development and validation
-.Development of Moving Deformable Barrier Model for FMVSS 214 and ECE regulations
-.Engineering of Pedestrian protection safety for ECE regulations

Product Engineering

☞ Durability Engineering

ATES provides a wide range of CAE support for vehicle BIW structure, suspension, powertrain, subassemblies and components. We provide methodologies that ensure the highest quality services. Using our expertise oriented , application specific software, ATES delivers fast and accurate solutions for assembly and full vehicle performance

▸ Virtual Proving Ground Simulation

ATES has industry leading expertise in the development of BIW and suspension link systems that enhance product quality and passenger & commercial comfort. Using high productivity software and methodologies, we predict the real time fatigue performance with service loading condition. This streamlined CAE technology provides an event-based simulation of nonlinear, dynamic problems, Integrated at an earlier stage of the design process, this is proven to reduce time, reduce cost with quality.

-.Engineers full car fatigue life at the system level
-.Subsystem and Component analysis with the real driving state
-.Predicts road load
-.Eliminates the need for multi-prototyping and testing

Product Engineering

▸ Fatigue Simulation

ATES services the fatigue analysis in combination with widely used FEMFAT software to ensure the full and convenient integration into our existing CAE process, commonly used interface to multi-body and measurement systems are also integrated.

-.Engineers linearly or non-linearly calculated FE stress for static and dynamic loading
-.Provides the strength data of non notched material specimen
-.Predicts the time histories from multi body systems or measurement for the fatigue analysis of multi axially loaded components
-.Predicts the fatigue life of the joint Assembly such as arc welding seams, spot welding
-.Performs fatigue analysis for thermally induced mechanical strain.
-.Performance fatigue analysis for Gear

Product Engineering

☞ NVH Engineering

ATES provides a wide range of CAE support for vehicle BIW structure, suspension, powertrain, subassemblies and components. We provide methodologies that ensure the highest quality services. Using our expertise oriented , application specific software, ATES delivers fast and accurate solutions for assembly and full vehicle performance

-.Vibration Analysis
-.Fatigue & Durability Analysis
-.Thermal Stress Analysis
-.Multi Functional Optimization
-.Mass Reduction
-.Transient Noise Analysis
-.Linear & Nonlinear Strength and Stiffness Analysis

Product Engineering

☞ Specialized Engineering

▸ Rapid Door Seal Engineering

ATES has industry leading expertise in the development of seal systems that enhance product quality and passenger comfort. Using high productivity software and methodologies, we predict closing forces, contact pressures and the potential for water and noise penetration. Our ability to simulate the complete seal assembly process reduces the need for costly and time intensive prototyping and testing.

-.Engineers door, window and body seals at the system level
-.Predicts closing force, contact pressure and contact area
-.Predicts potential for water and/or noise penetration
-.Simulates seal assembly process
-.Eliminates the need for multi-prototyping and testing

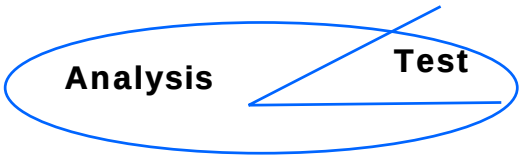
Product Engineering

☞ **Activities**

Product Planning | **Product Design** | **Product Pre-Mecha & Test**

Benchmarking & Concept Analysis → **New & Modification Design Analysis** → **Validation Analysis**

Design & analysis co-work — **Test & analysis co-work**



Impact(20%)
Stiffness & Fatigue(20%)
NVH (10%)
Nonlinear (10%)

Deformation (10%)
Casting (10%)

CFD (40%)

★ **with Concept & Target for development**
Working Structure
Working Sites
Working Period
Partnership

Flexible System

Analysis field & Technology

Product Engineering

☞ Capacities

8 Teams / 4 Parts

Impact Anlysis Team 5M

- F/system Impact analysis
- S/system Impact analysis
- Occupant Kinematics

Non-Linear Analysis Team 5M

- Geometry Non-Linear
- Material Non-Linear
- Heat/Contact analysis

CFD analysis Team 15M

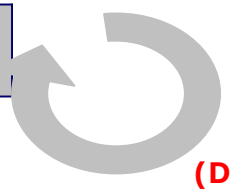
- Thermal analysis
- Fluid noise analysis
- Fluid Dynamic analysis
- Code development
- Fluid, Acoustic
- System analysis

Vibration Analysis Team 3M

- Structural Vibration
- Transient Vibration

Fatigue Analysis Team 3M

- Strength / Welding
- Multi-Axial Fatigue
- R/Time Load Stress



Fexible working system.
With multi analysis tech.
For the concept of development.
(Development Phase →Production Phase)

Optimization Analysis Team 3M

- System & Component Weight Optimization
- Component Geometry/Thickness Optimization
- Performance Optimization

Deformation Analysis Team 3M

- Forging analysis
- heat treatment analysis
- Press analysis

Casting Analysis Team 3M

- Casting analysis
- Residual stress analysis
- h/treatment analysis

Product Engineering

☞ **Engineering Items with vehicle**

	BODY	CHASSIS	E/G	IN/EXTERIOR	P/TRAIN
Component Analysis	.Sus & E/G Linkage Panel Stiffner .Moving & Linkage	.Steering .Axle .Brake .Suspension .E/G MTG .Dampers	.Intake/Ex Manifold .Valves	.In-Panel .Wiper .Seat .WireHarness .Lamps .Molds	.M/T Comp. .A/T Comp. .P/SHAFT
Sub-System Analysis	.BIW Durability Deformation Crash .Moving Glass lifting Opening	.Steering .Axle .Braking	.Heat Flow .Friction .Cooling	.Aircon	.D/Shaft
Full System Analysis	Crashworthiness Occupant kinematics Durability Vibration / Noise Riding/Handling F/Consumption Cooling /Power				

Motivation :

1. Time Reduction of design and development
2. Cost Reduction
3. New Regulations and requirements

These moves have resulted

1. Shoter vehicle design & validation period
2. Reduction the nember of prototype phases

CAE Engineering Projects for Vehicle

2002-2003 year

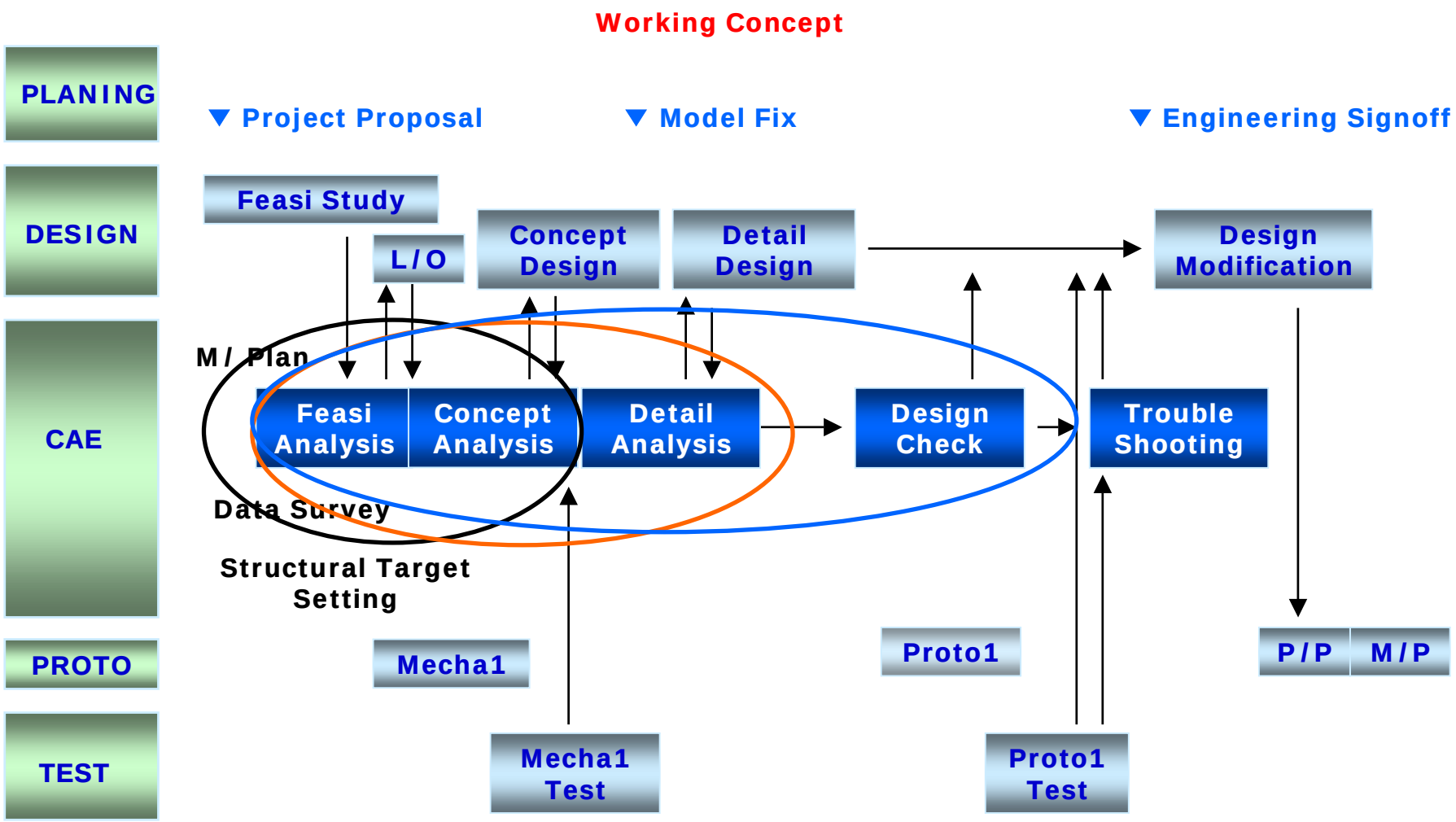
- Side Impact Analysis
- Door Seal Optimization Analysis of Passenger Car
- Deformation Analysis of Bumper reinforcement & Center Panel
- Seat & Seatbelt Anchorage Strength Analysis with FMVSS regulation
- Durability Analysis of Pulley
- Torgue Convertor Stiffness Optimization Analysis
- BIW & Frame Fatigue Structure Analysis of CNG Roof on Bus
- CFD & Heat-Transfer & Heat-Fatigue Analysis of Exhaust Manifold
- Alloy Wheel Impact & Durability Analysis
- Stiffness Optimization Analysis of Muffler valuable Valve Spring
- Sub-Frame A'ssy Strength Analysis
- Pedestrian Protection Analysis with EURO new regulation
- FMH Analysis with new FMVSS201 regulation
- 5MPH Impact Analysis of Gas Injection Bumper
- Steering Vibration Analysis of Passenger Car …..

ATES is the 1'st vendor of HMC/KMC in field of Product engineering with CAE

ATES is carrying out the structural analysis to satisfy the target safety performance with 4 passenger cars and 2 SUV cars in 2004 year (Durability & NVH & Crashworthiness)

- HMC : New highway Bus Structure Analysis
  -.Stiffness / Strength / Fatigue / Impact
- HMC : SUV Weight Reduction Analysis
  -.Stiffness / Strength / Fatigue / Impact
- HMC : Passenger Car Seat W/Down Analysis
  -.Anchorage Strength /Rr Sled Impat
- KMC : P/C & SUV Moving closure Analysis
  -.Stiffness / Strength / Vibration / Fatigue
- KMC : Pedestrian Impact Analysis
  -.Performance Tagrget Setting of Module
- Mando : BCM System Optimizition Analysis
  -.Nonlinear Stiffness / Strength / Fatigue
- Mando : Al Knuckle Analysis
  -.Stiffness / Fatigue
- FMH Impact analysis : Placor, Koryeo, DS
- Seat & Seat Belt Anchorage Analysis : DB/DW/DU/HI
  -.Nonlinear Strength / Impact
- Muffler CFD & Valve Spring Optimizing Analysis :Seo
  -.CFD & Nonlinear Stiffness
- Steering System Optimizing Analysis : Du
  -.Nonlinear Strength / Impact
- Frt End Module Analysis : Proton
  -.Nonlinear Strength / Impact

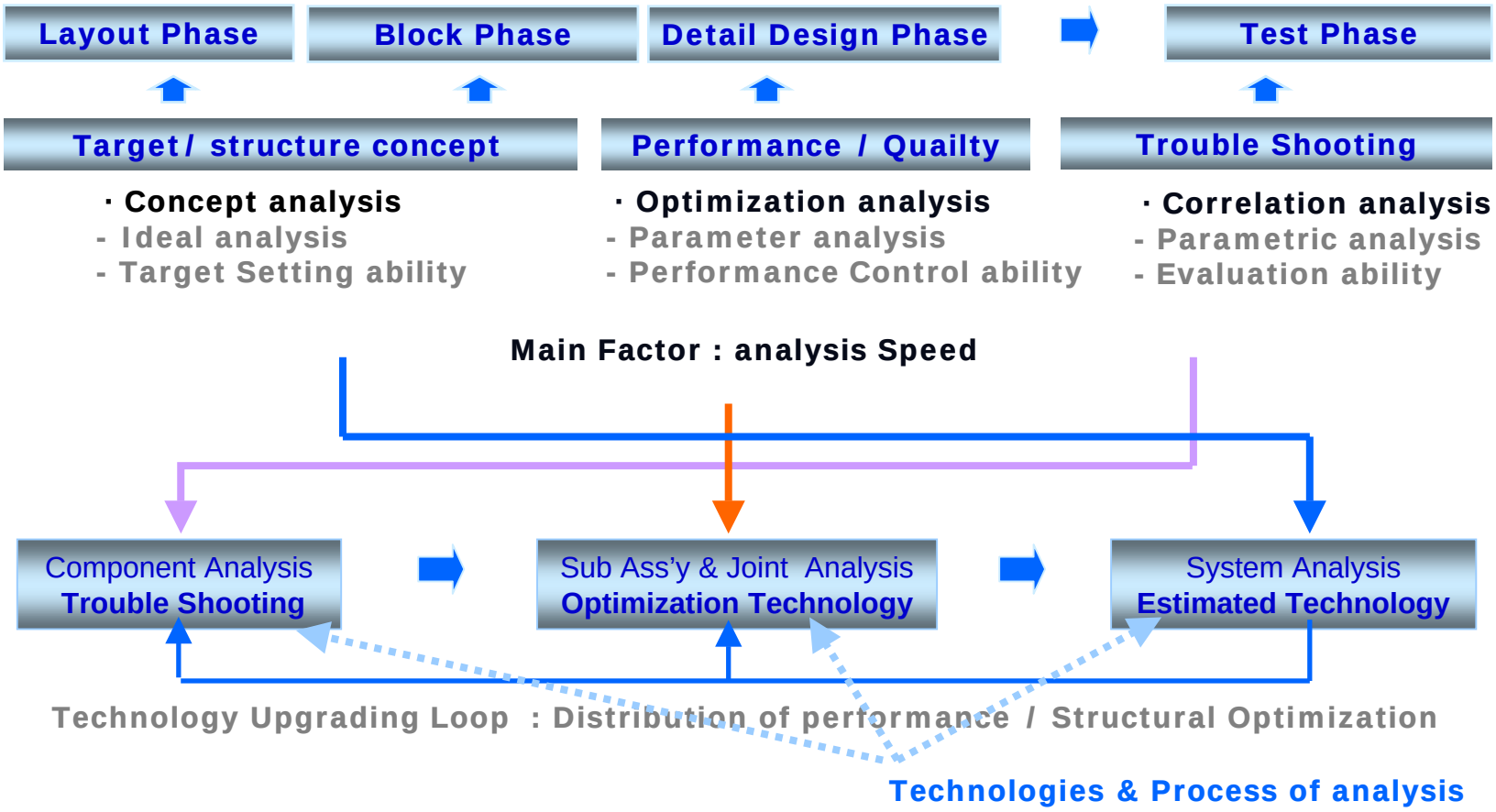
Product Engineering



Decide the working target & process with the development concept

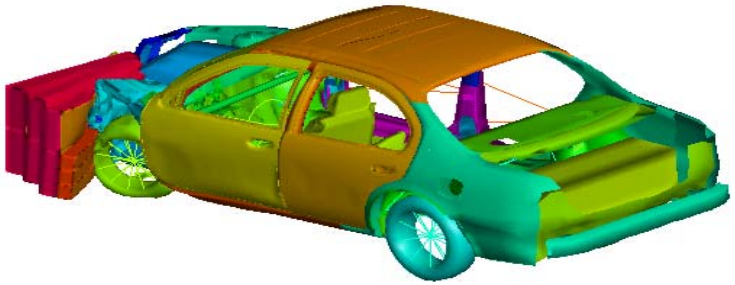
Product Engineering

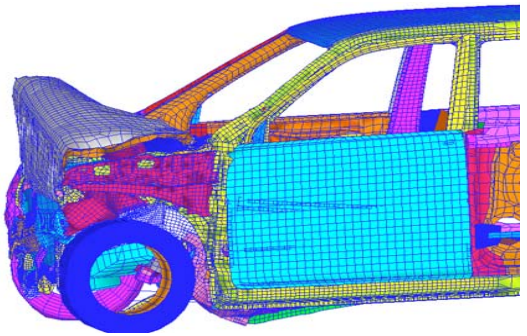
Technology Transfer Concept

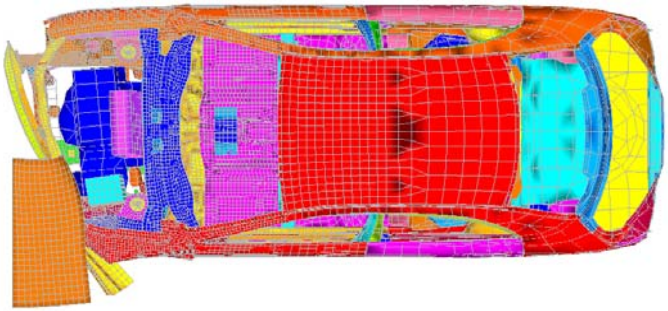


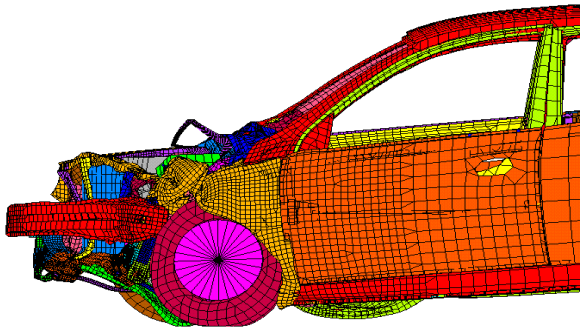
Product Engineering

☞ Frt Crash Impact Analysis







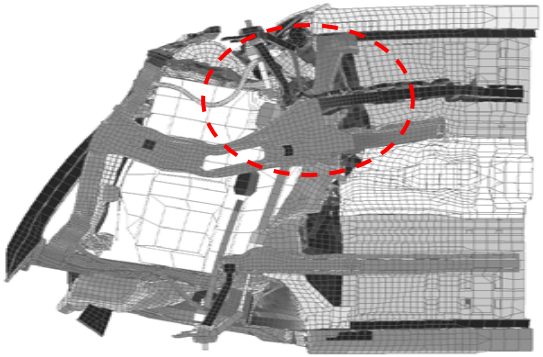


Crashworthiness analysis measures the vehicle structure's capability to absorb the crash kinetic energy and restraint system ability to provide adequate protection to the vehicle occupants in surviable crash.

*** FMVSS / ECE regulation & NCAP simulation**

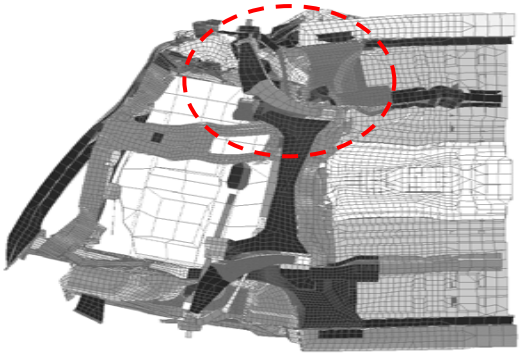
Product Engineering

☞ Frt Crash Impact (Offset Barrier Impact) Analysis



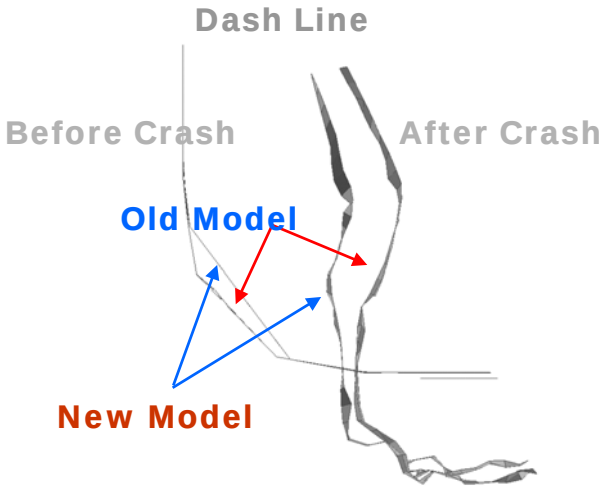
Old Model
(Kick up frame)

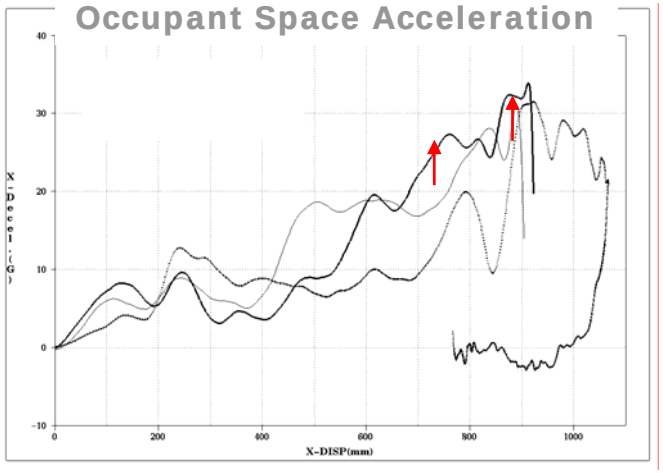
Occupant Space
Deformation : high



New Model
(I-type frame)

Occupant Space
Deformation : Low

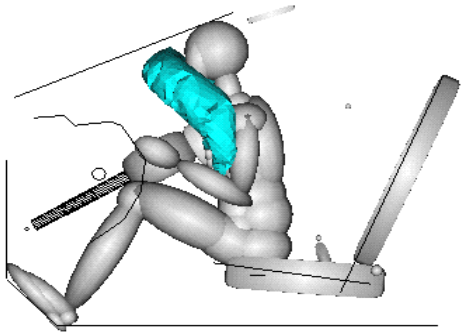




▶ **The high acceleration of the occupant space is caused by the high stiffness of the under-joint structure.**
The energy obsorbing capacity of the interior should be upgraded.

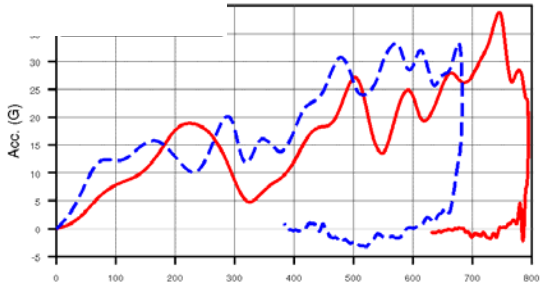
Product Engineering

☞ Occupant Kinematics Analysis

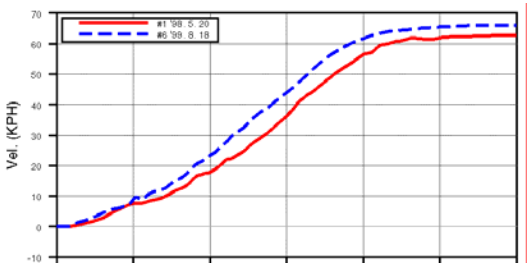


I/P Line Change
No contact : Dummy Head & S/Wheel
Wide Contact : A/Bag & Dummy Chest

The initial Stage for structure design for offset



The final Stage for structure design for offset
Deformation ↓ (Offset ↑)
Acceleration ↑ (Ncap ↓)

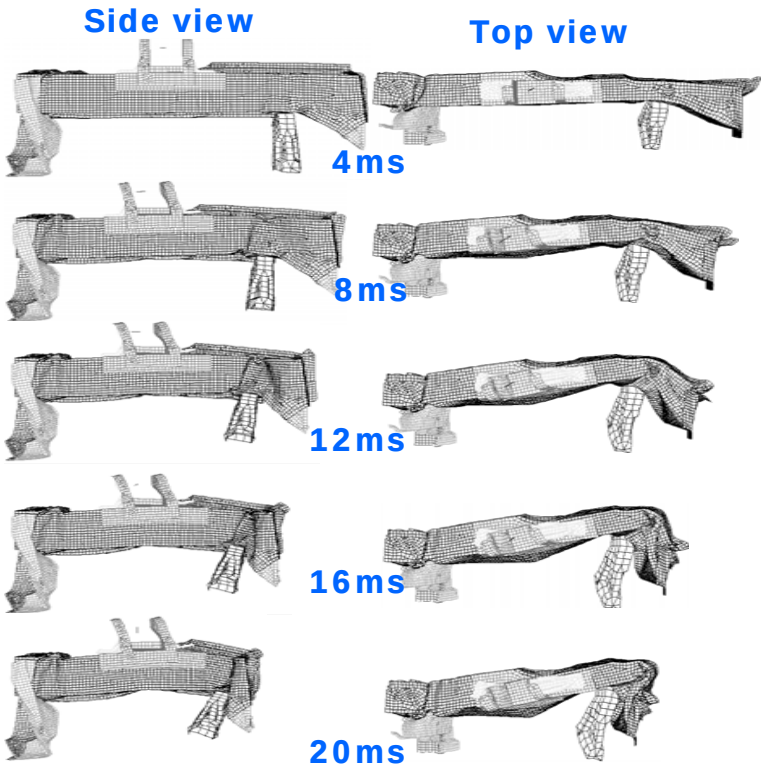


Deformation Velocity Up :
36 KPH → 44 KPH (60 msec)

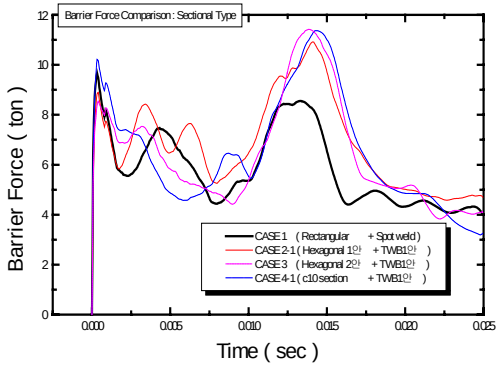
▷ **From this analysis, measures driver & passenger's kinematics to absorb the crash kinetic energy and restraint system (belts, airbags, knee bolsters, etc.) and to evaluate the injury criteria of human**

Product Engineering

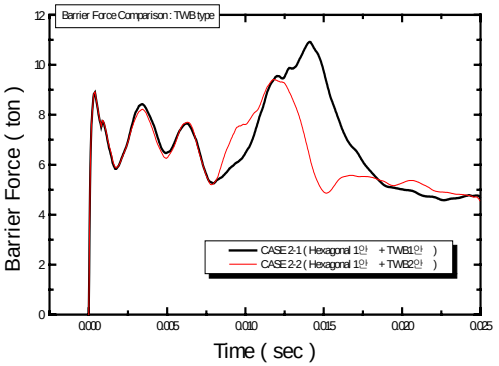
☞ Frame Impact Analysis



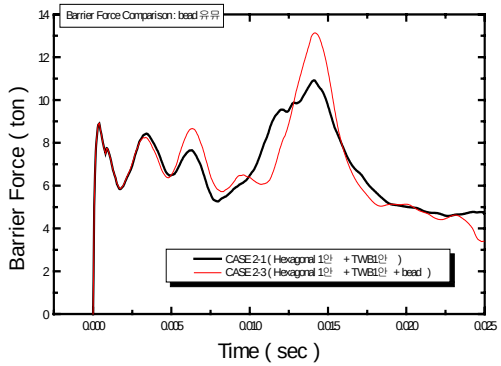
For Section



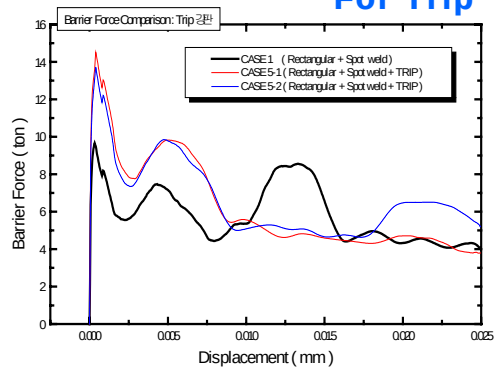
For TWB



For Hexa Section



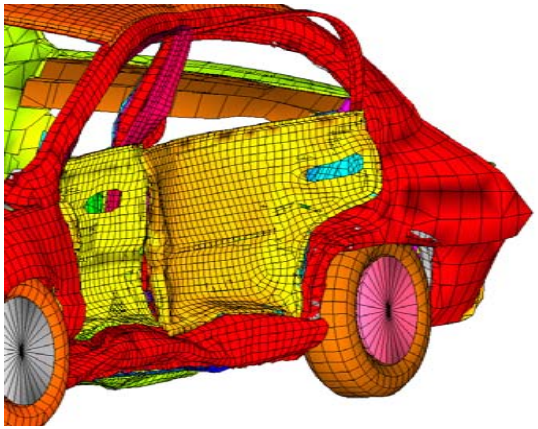
For Trip



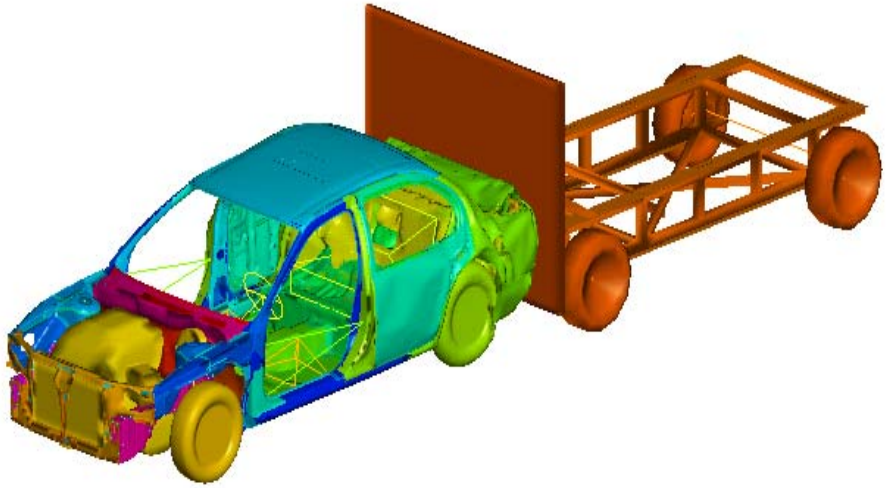
▷ **Crashworthiness analysis measures the frame structure's capability to absorb the crash kinetic energy and to provide adequate protection to the vehicle deformation with a lot of frame typies**

Product Engineering

☞ Side Impact Analysis



☞ Rear Impact Analysis

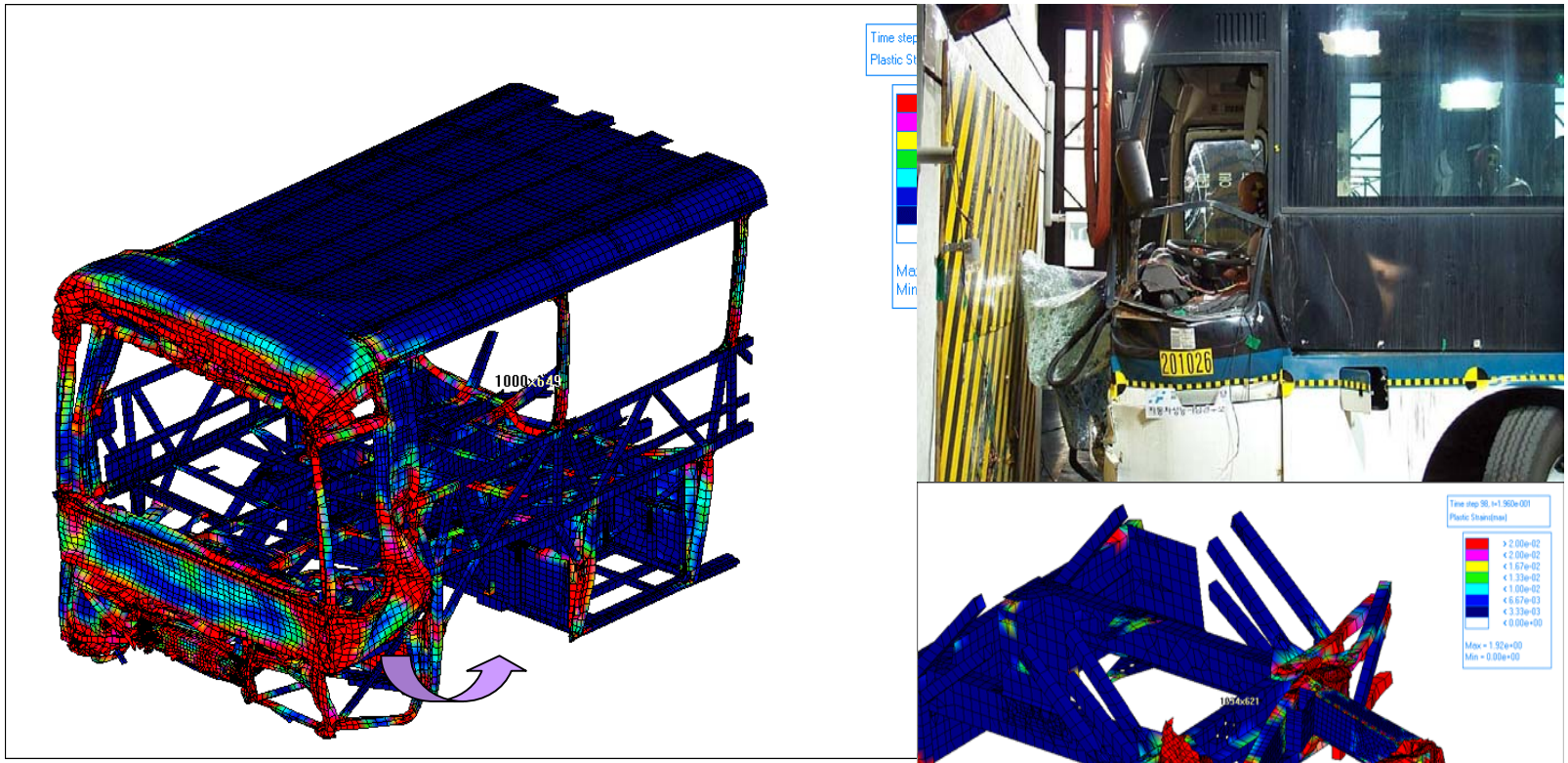


- ▷ The purpose of rear impact analysis is to reduce the fuel spillage after vehicle crashs
- ▷ The requirements of the FMVSS 214 dynamic side impact and expected SINCAP (side impact new car assessment program) tests present new challenges to car makers

  * Short crush stroke
  * Limited energy absorption area

Product Engineering

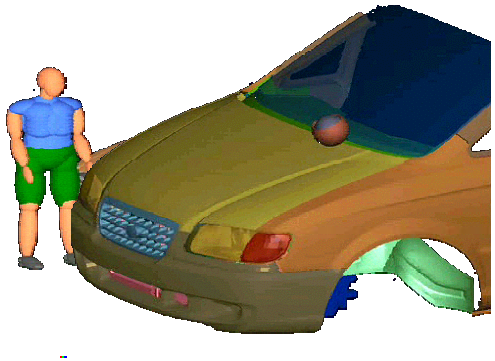
☞ Bus Analysis

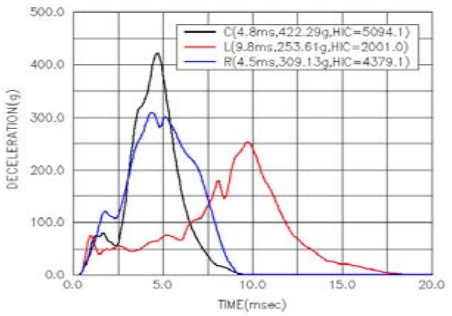


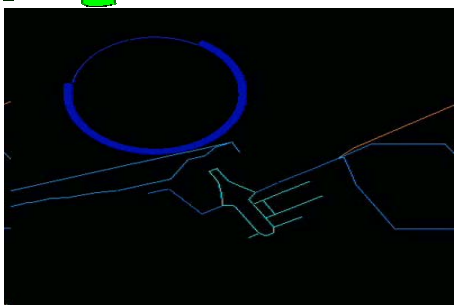
▷ **Crashworthiness analysis for bus structure also measures the vehicle structure's capability to absorb the crash kinetic energy in surviable crash.**

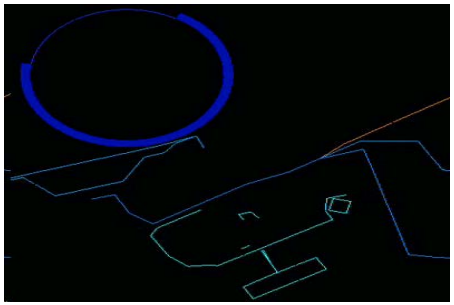
Product Engineering

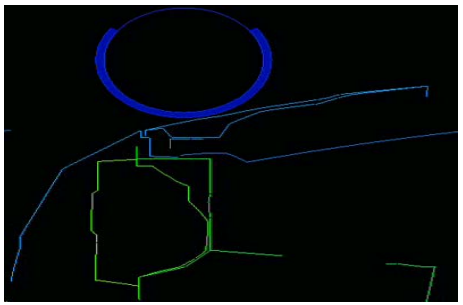
☞ Pedestrian Impact Analysis









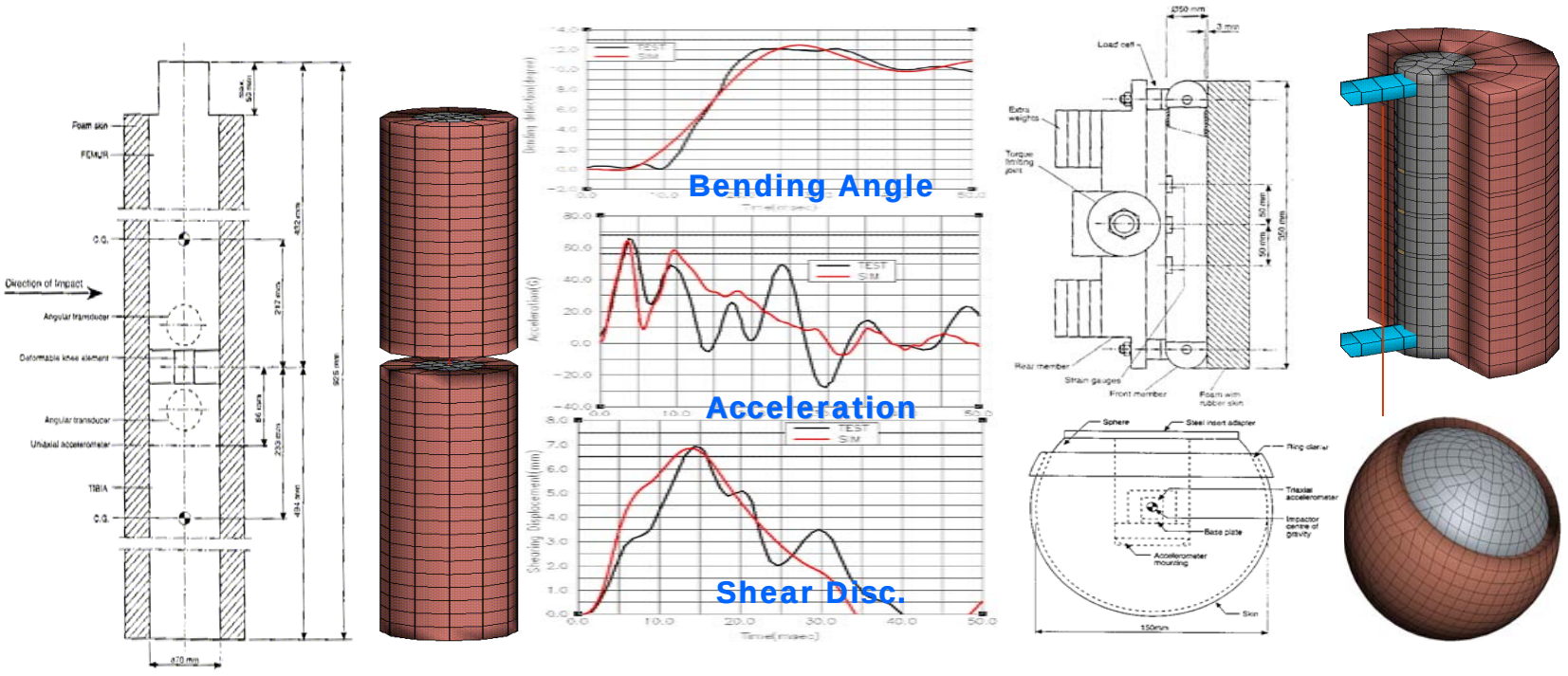


Wiper Spindle A. Wiper System mt'g A. Hood Hinge A.

▷ **EEVC has developed a set of test procedures for evaluating the safety performance of cars when they strike pedestrians. And the same test specification already forms part of the safety assessment of selected vehicles under the Euro-NCAP.**

Product Engineering

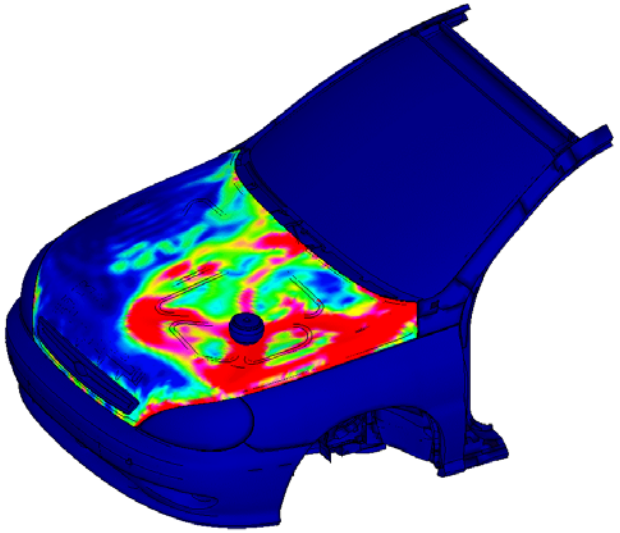
☞ Impactor Development

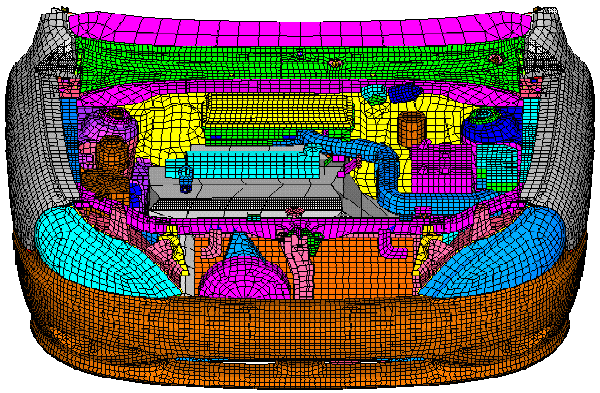


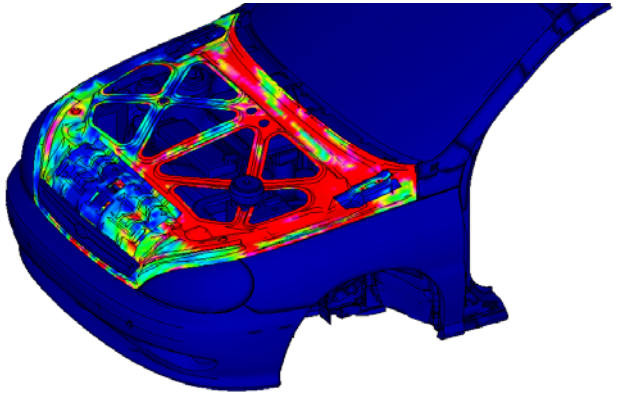
▷ **The test consists of three component subsystem tests simulating impact by the low leg, knee joint against the bumper, the upper leg and hip against the bonnet leading edge, and child and adult heads against the bonnet top.**
Validaty of the impactor models for the three components subsystem tests is very important with a vehicle model.

Product Engineering

☞ Pedestrian Impact Analysis



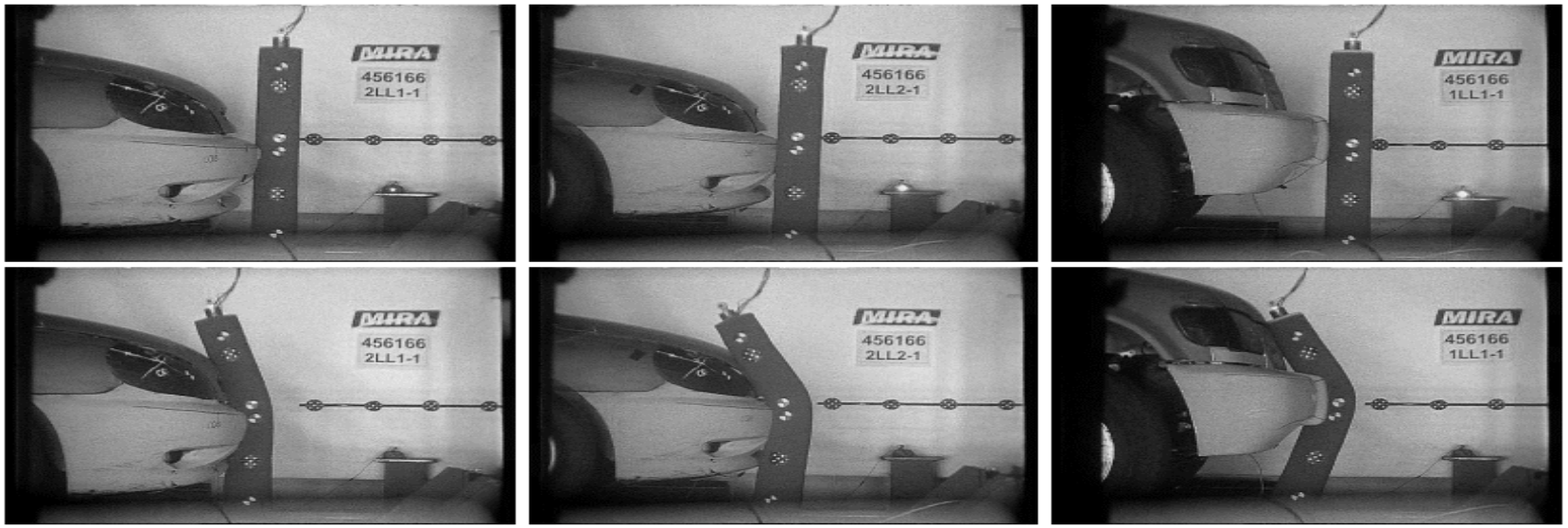


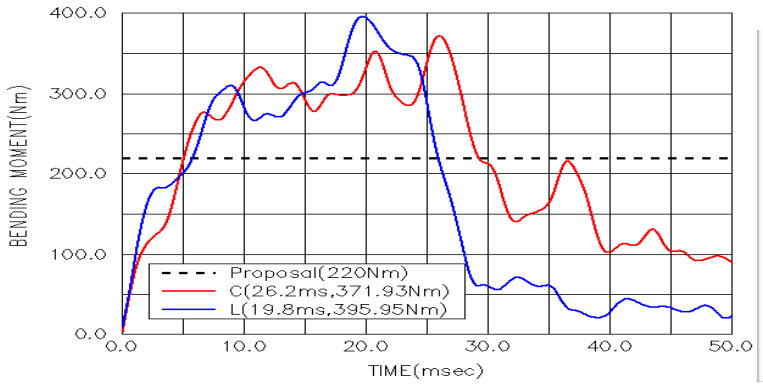


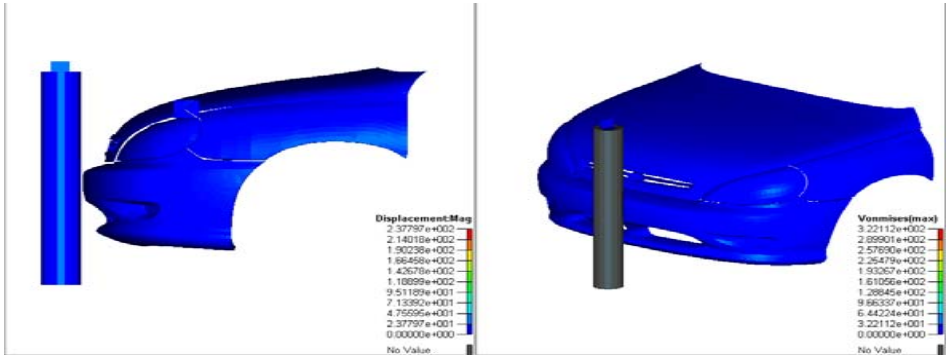
▷ **Detail Component analysis Correlation / Full Vehicle analysis Correlation with test**
*** Sensitivity for material, velocity, joint method**

Product Engineering

☞ Pedestrian Impact Analysis

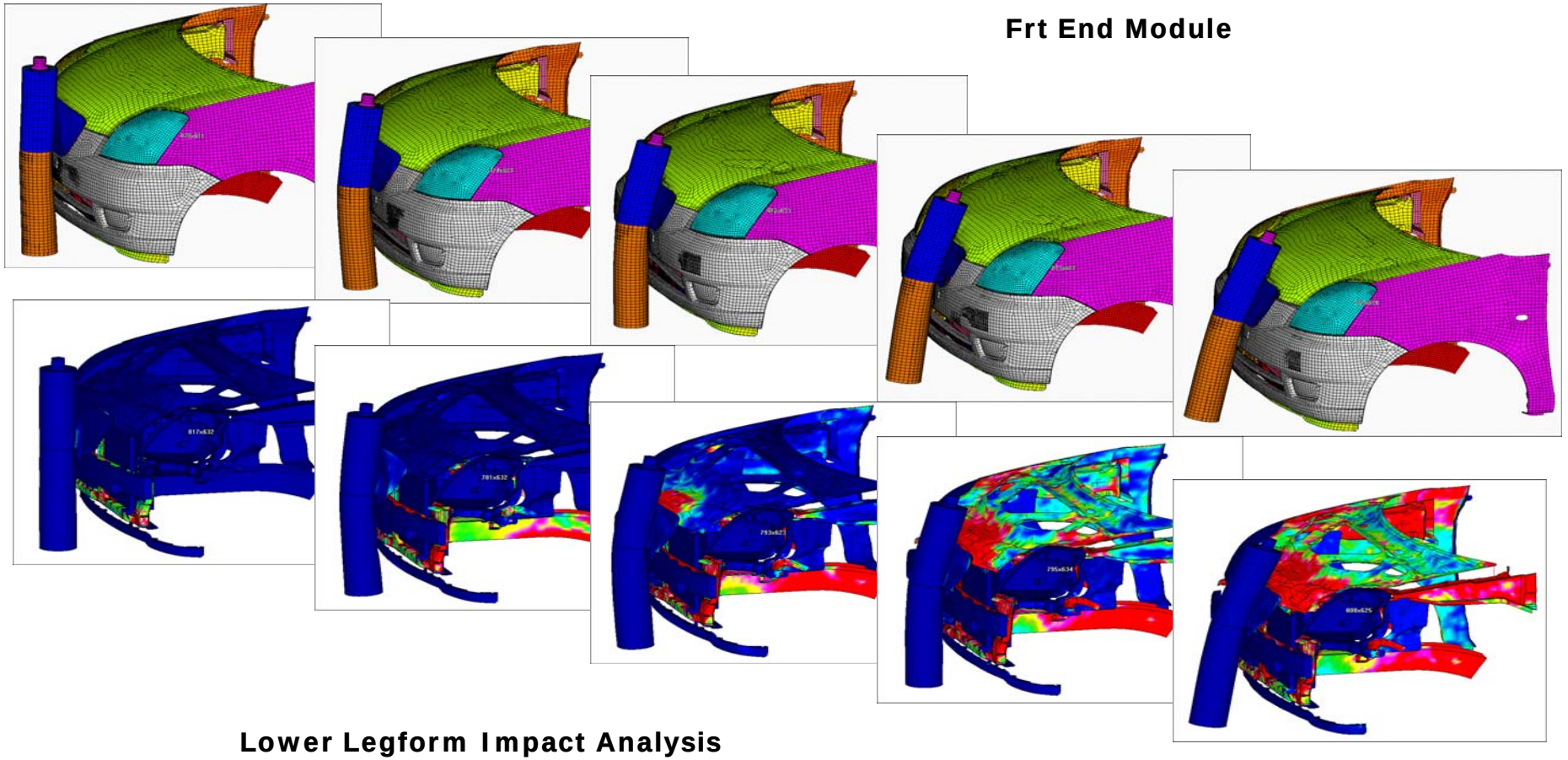






Product Engineering

☞ Pedestrian Impact Analysis



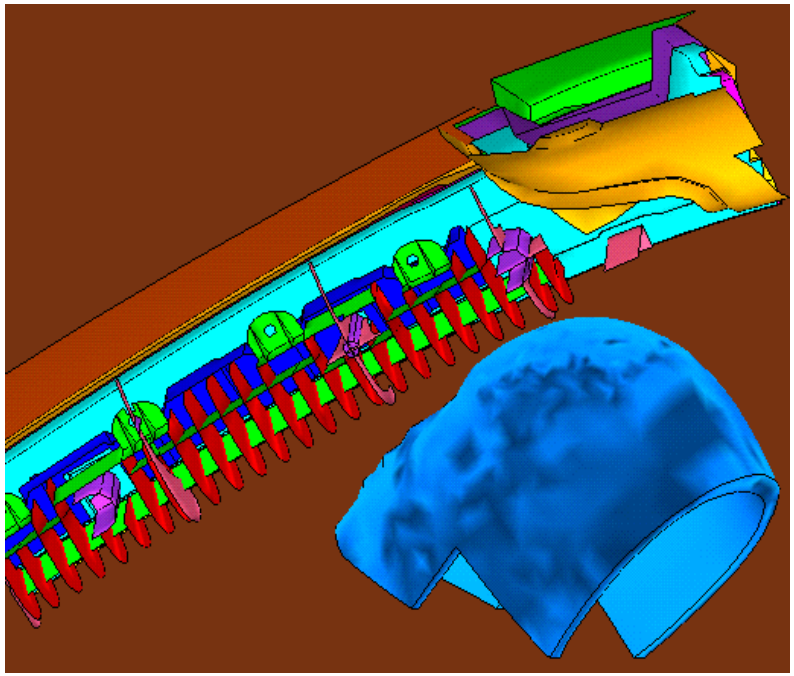
Frt End Module

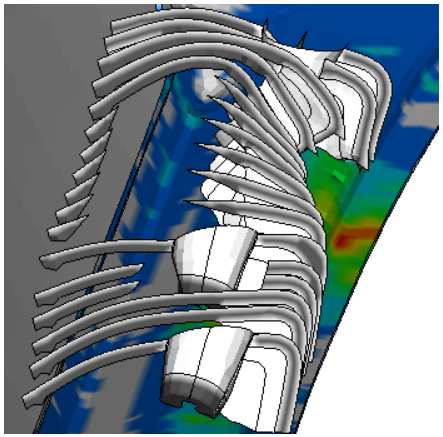
Lower Legform Impact Analysis

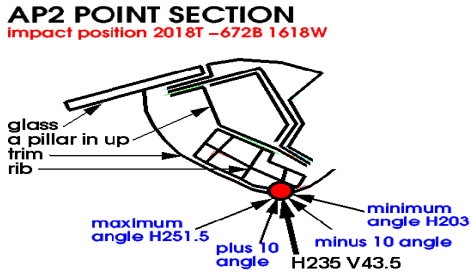
Product Engineering

Impact Engineering

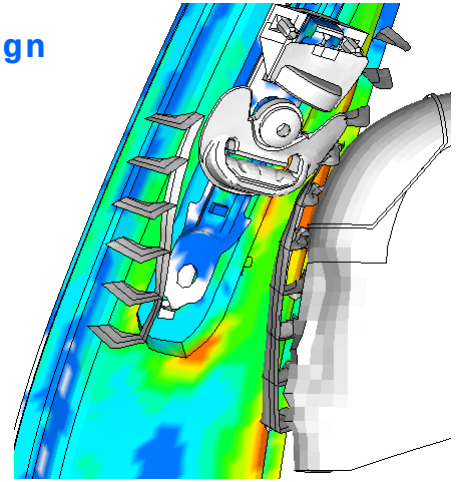
☞ **Free Motion Head Foam Impact Analysis**







-.Pillar & Interior L/O Design
-.Rib/Foam Design
-.Section Design

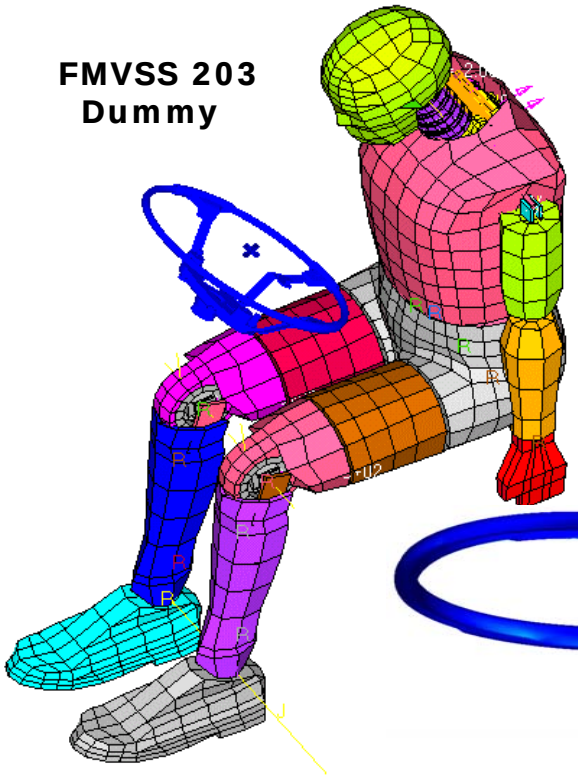


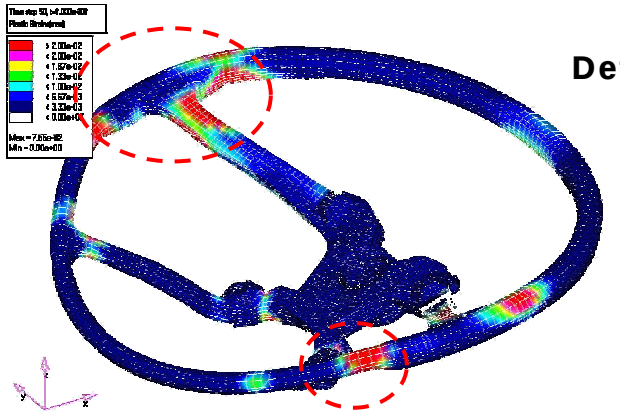
▷ **Minimizing the impact load can be achieved by thickening the energy absorbing pad, But this would reduce the visuality and interior space. It is important to develop energy absorbing materials and structures as thin as possible**

Product Engineering

☞ FMVSS 203 Steering Impact

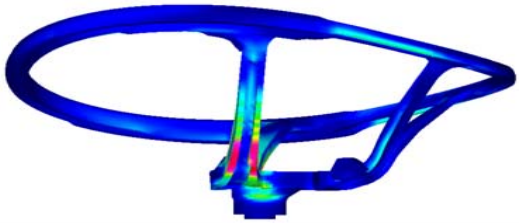
FMVSS 203
Dummy

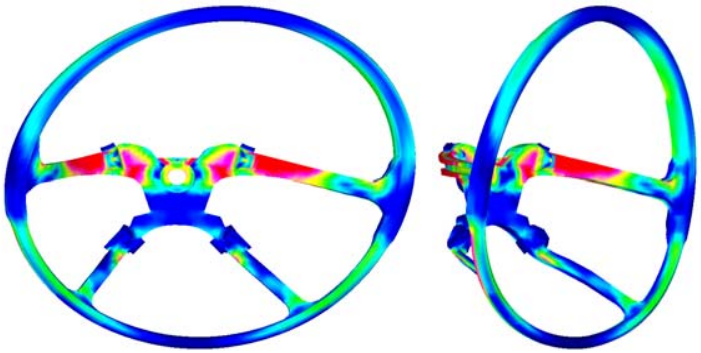




Deformation Mode

Vibration Mode



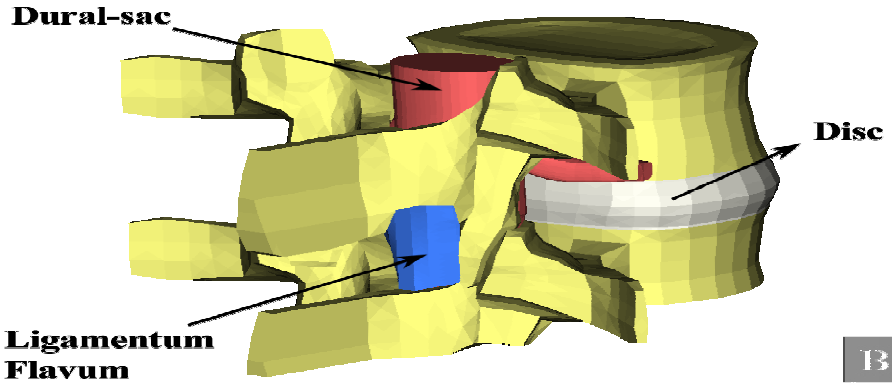


▷ **Minimizing the impact load can be achieved by optimized wheel structure,**
It is important to develop energy absorbing materials and structures with low weight
*** Magnesium / Aluminum**

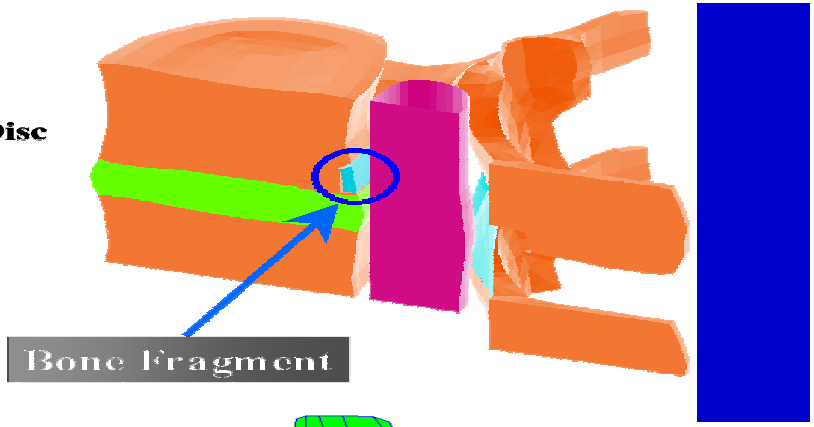
Product Engineering

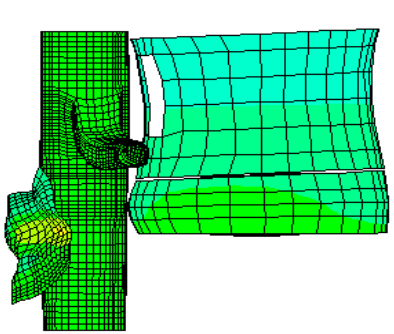
☞ **Bio-Mechanical Analysis**

Intact model

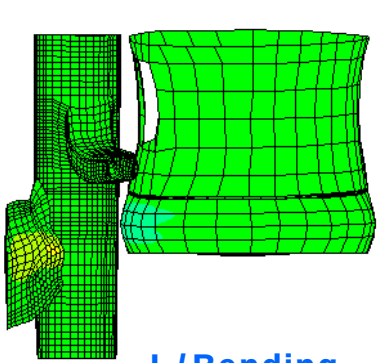


Model with Fragment

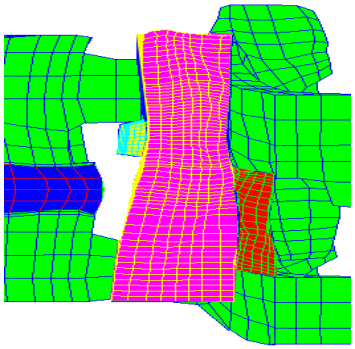




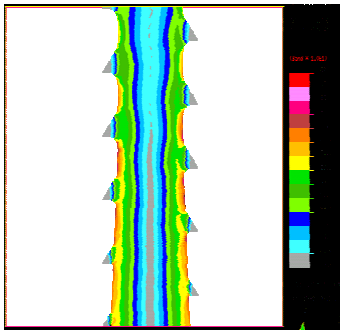
Extension



L/Bending



Compression

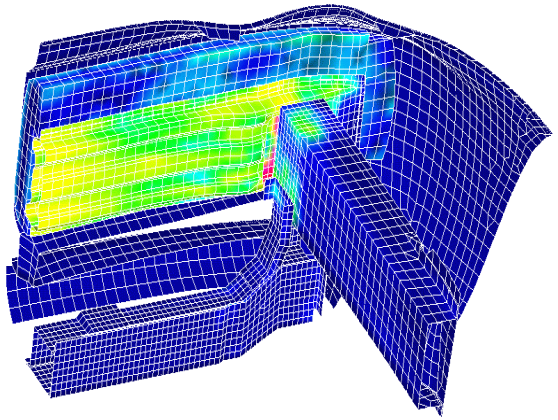


Implant

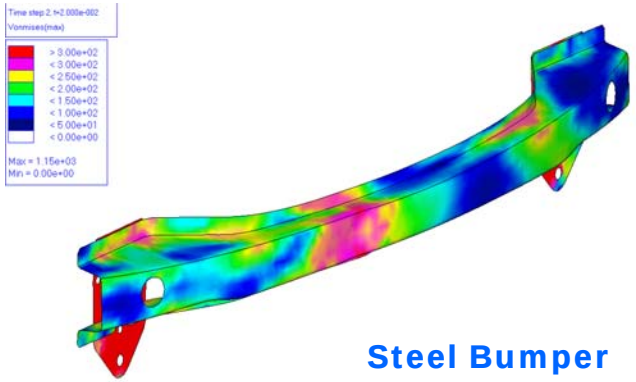
▷ **Behavier analysis of human body would be performed by viscoelastic analysis with F.E.M Model development of the spine**

Product Engineering

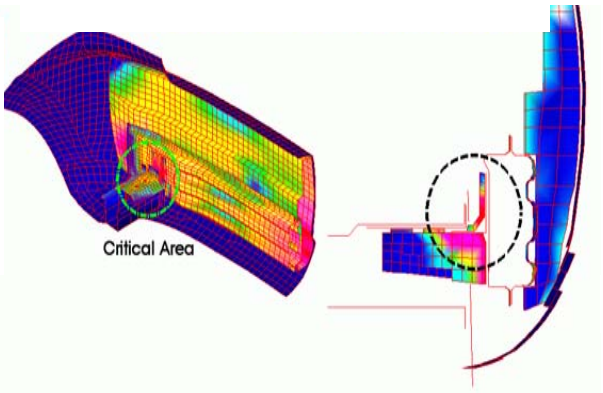
☞ Bumper Impact Analysis



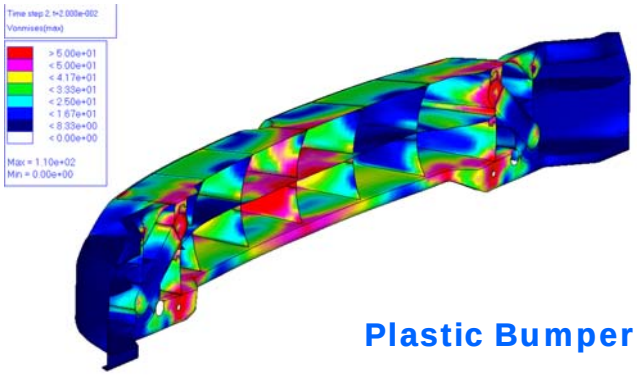
Front Bumper



Steel Bumper



Rear Bumper

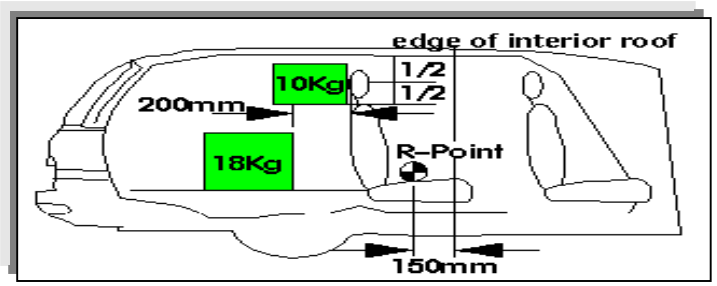


Plastic Bumper

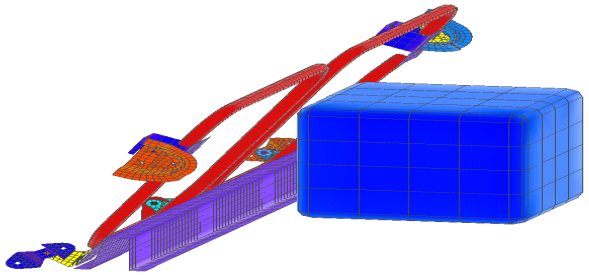
▷ **For the requirements of U.S.A &Europe, minimizing the impact load can be achieved by the energy absorbing structure with low speed collision. But this would effect the crush space for the frontal impact impact. And it is important to develop energy absorbing structures with good exterior design.**

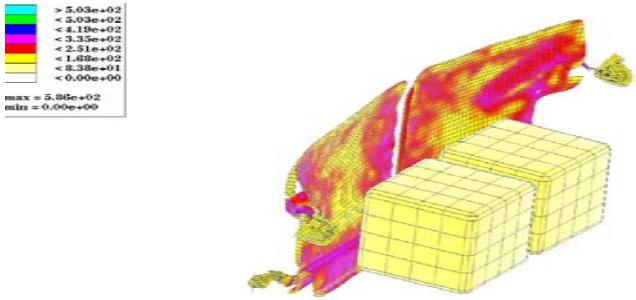
Product Engineering

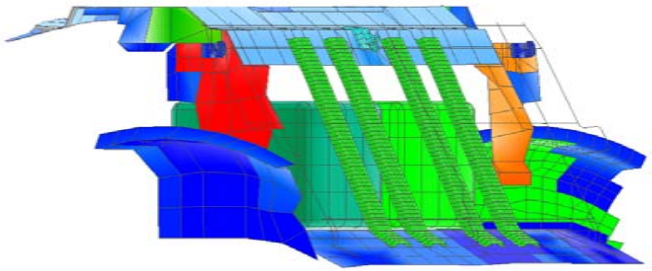
☞ Seat Luggage Impact Impact Analysis

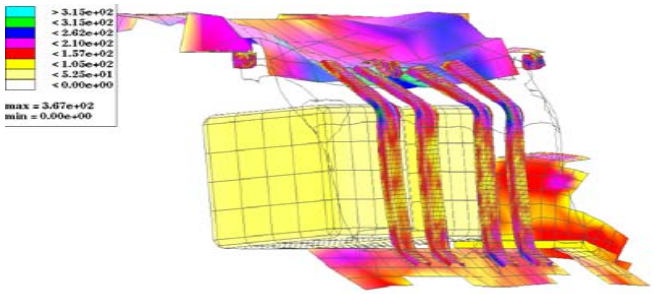


▷ **To reduce occupant injury from forward moving luggage in the frontal impact condition, the seat & attached area would be reinforced by the energy absorbing structure with low weight incresement.**

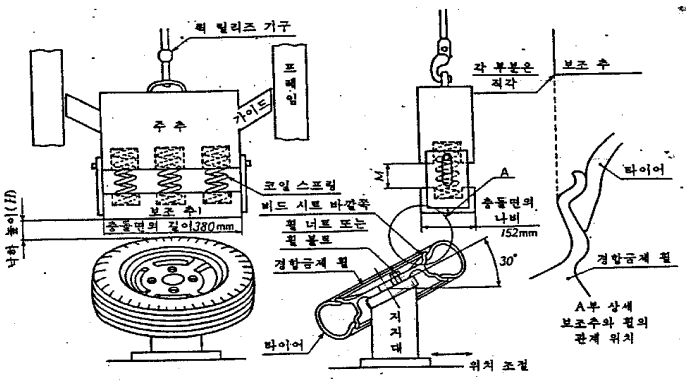


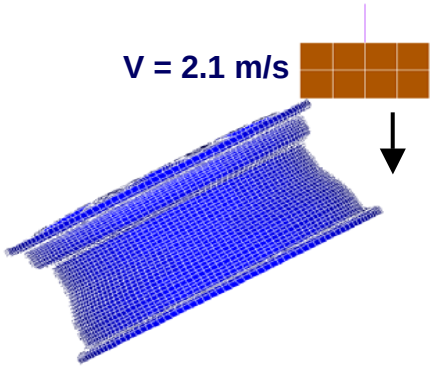


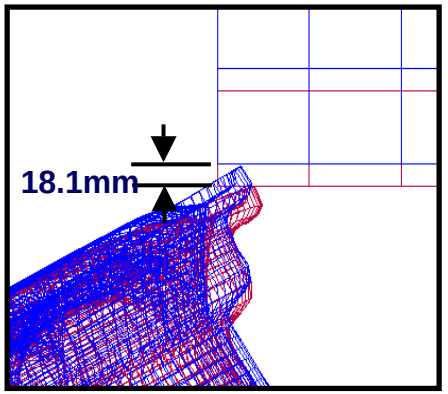


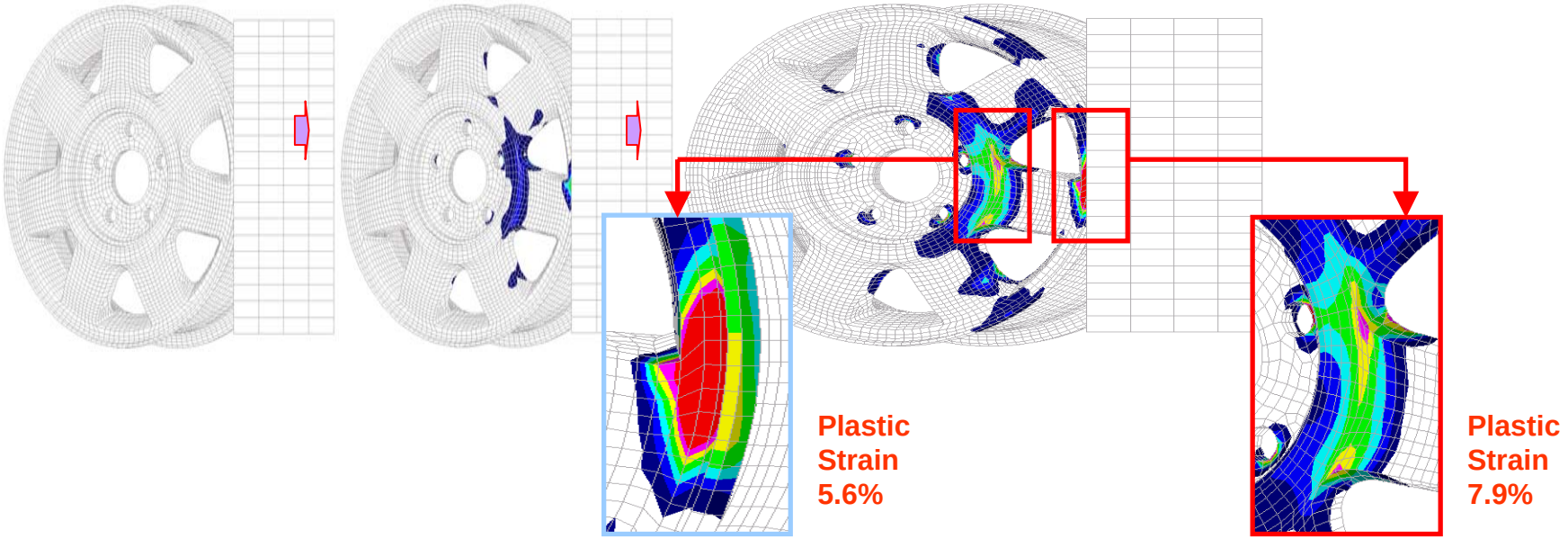


☞ Alloy Wheel Impact Analysis



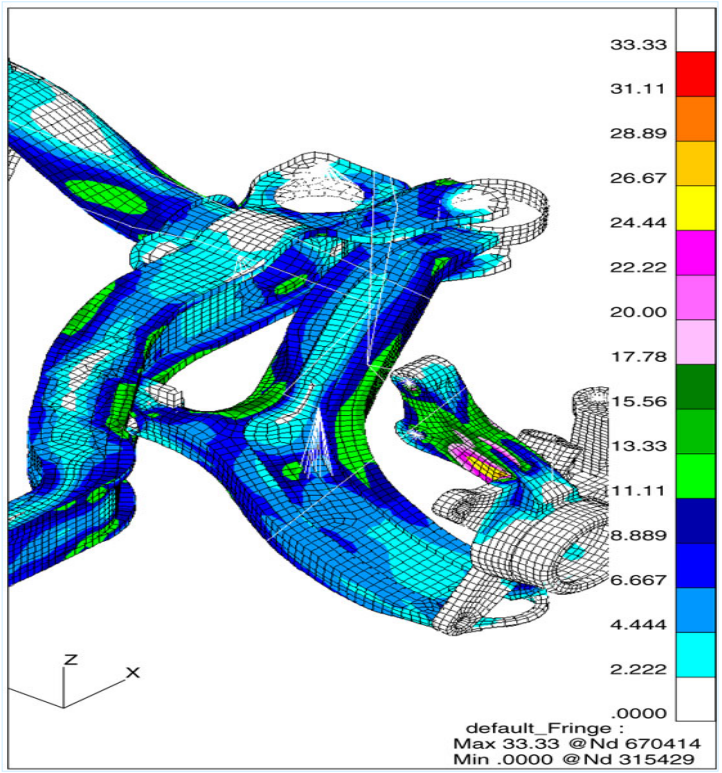




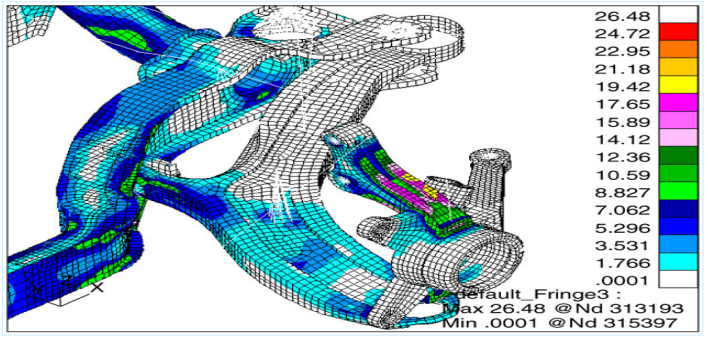


Product Engineering

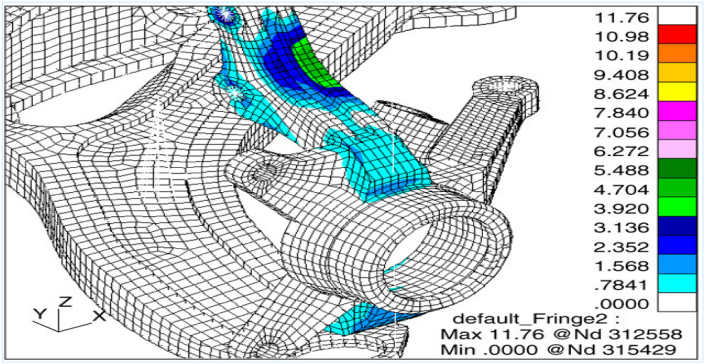
☞ Suspension Component Strength Analysis



Braking Load



Cornering Load

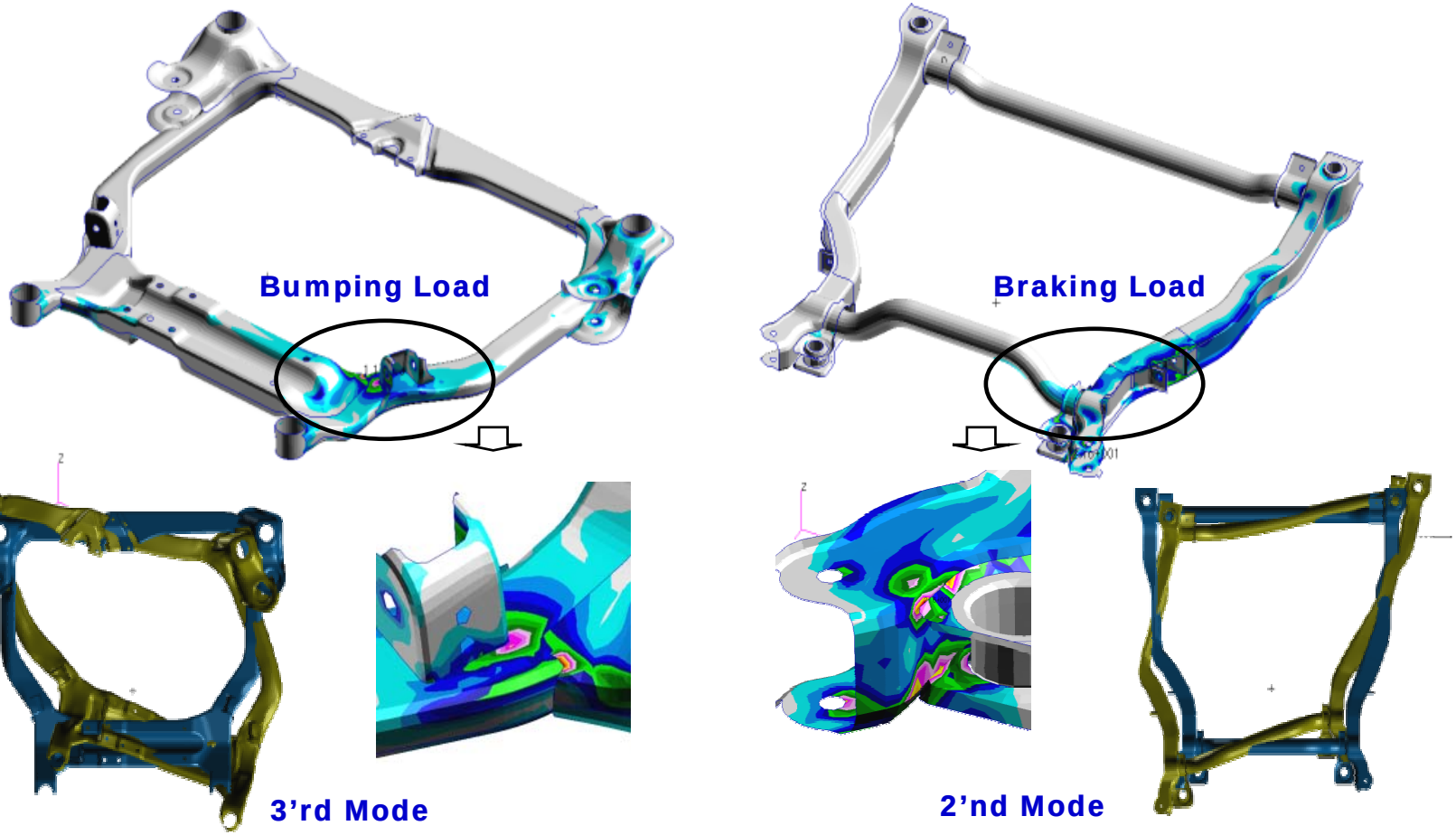


Bumping Load

▷ **For the durability performance of sus-Component structure would be evaluated by strength & stiffness, and then optimized with fatigue analysis.**

Product Engineering

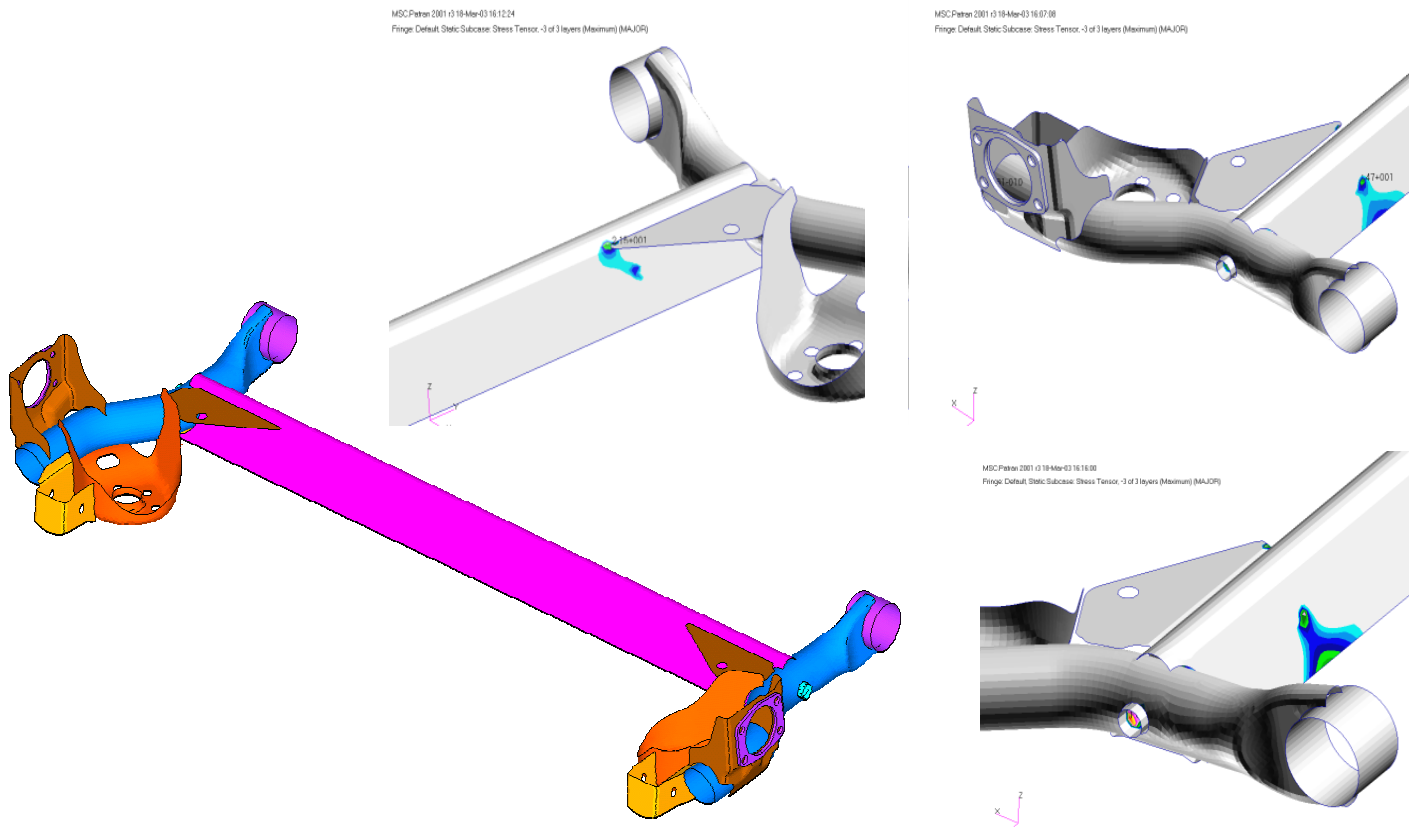
☞ **Sub-Frame Strength Analysis**



▷ **For the durability performance of sus-Linkage area also would be evaluated by strength & stiffness with the Service loading condition & Belgian Loading**

Product Engineering

☞ Lateral Bar Strength Analysis

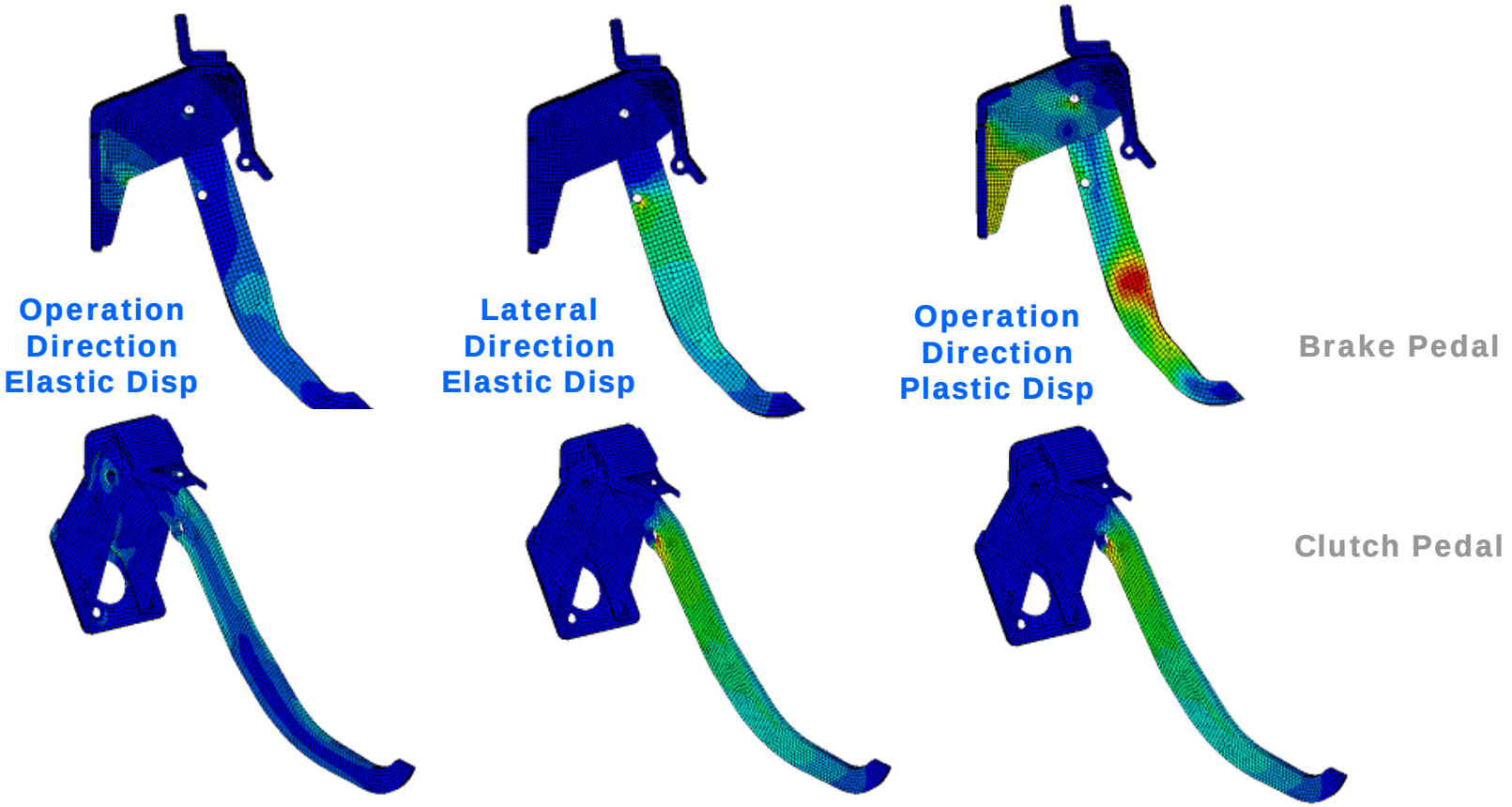


▷ **For the durability performance of sus-Linkage area also would be evaluated by strength & stiffness, and then optimized with fatigue analysis.**

Product Engineering

Durability Engineering

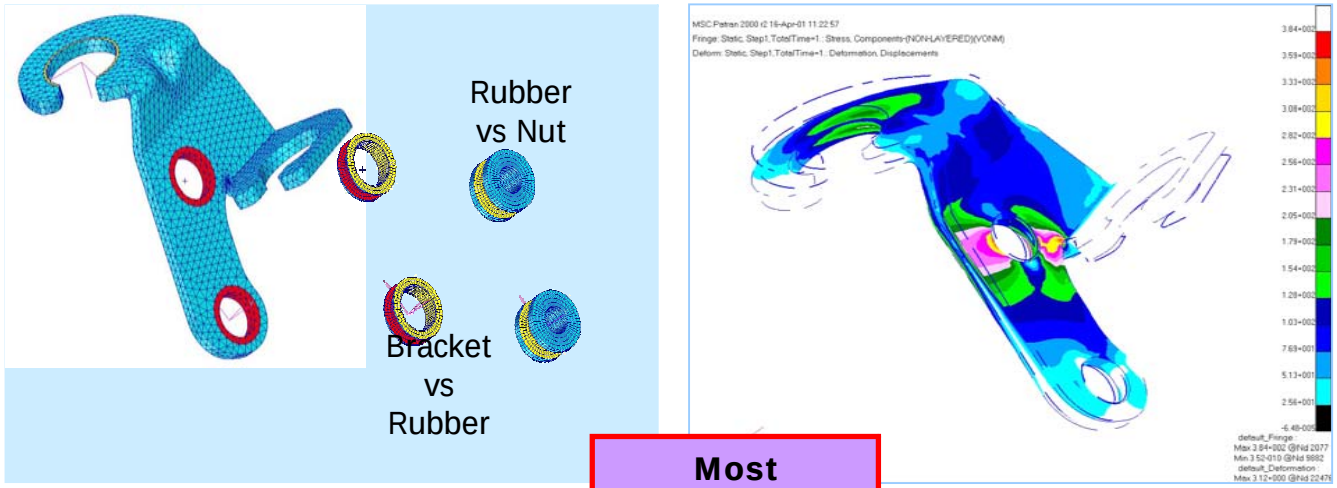
☞ **Pedal Strength Analysis**

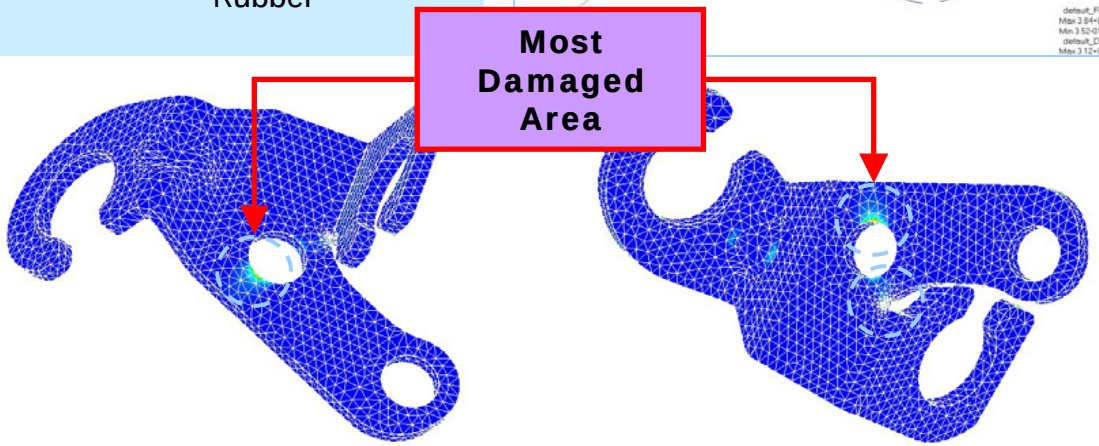


▷ **For the operation performance of the padal structure would be evaluated by strength & stiffness, and then optimized**

Product Engineering

☞ Lever Strength & Fatigue Analysis



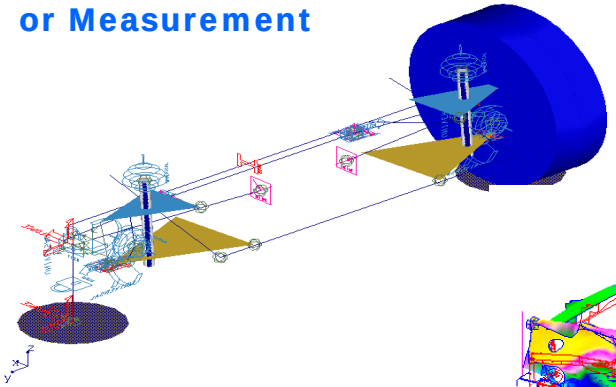


Test : 82000 Cycles
Ana. : 87336 Cycles

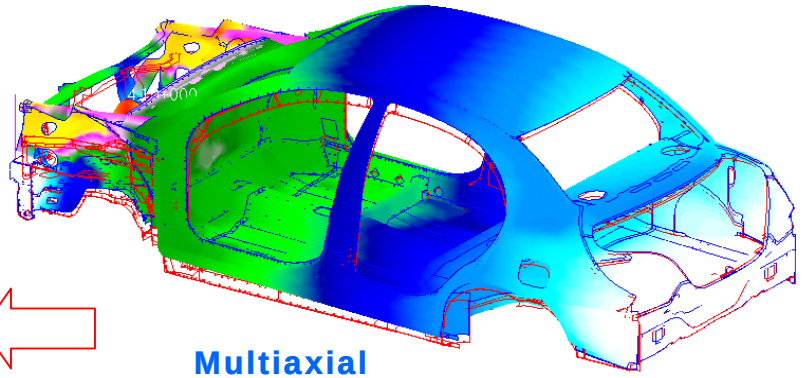
Product Engineering

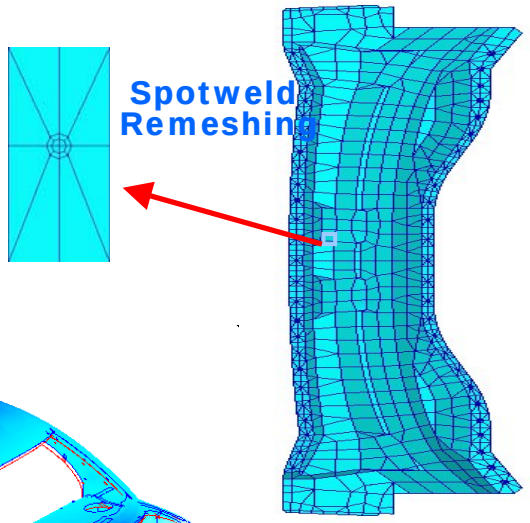
☞ **B.I.W Fatigue Analysis**

Load Data by MBS or Measurement

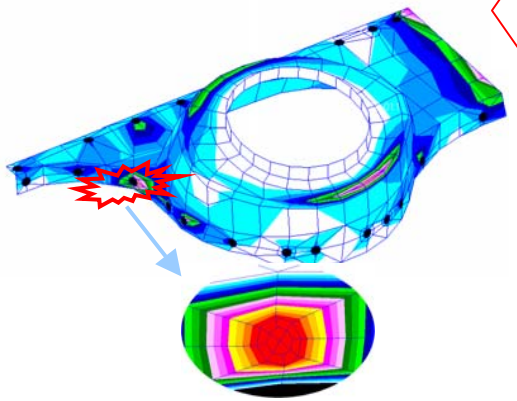


Channel Based or Transient Loads





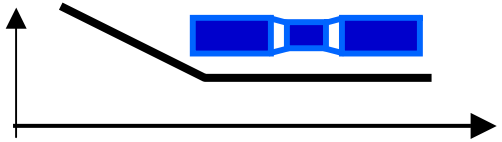
Spotweld Remeshing



Multiaxial Fatigue Analysis

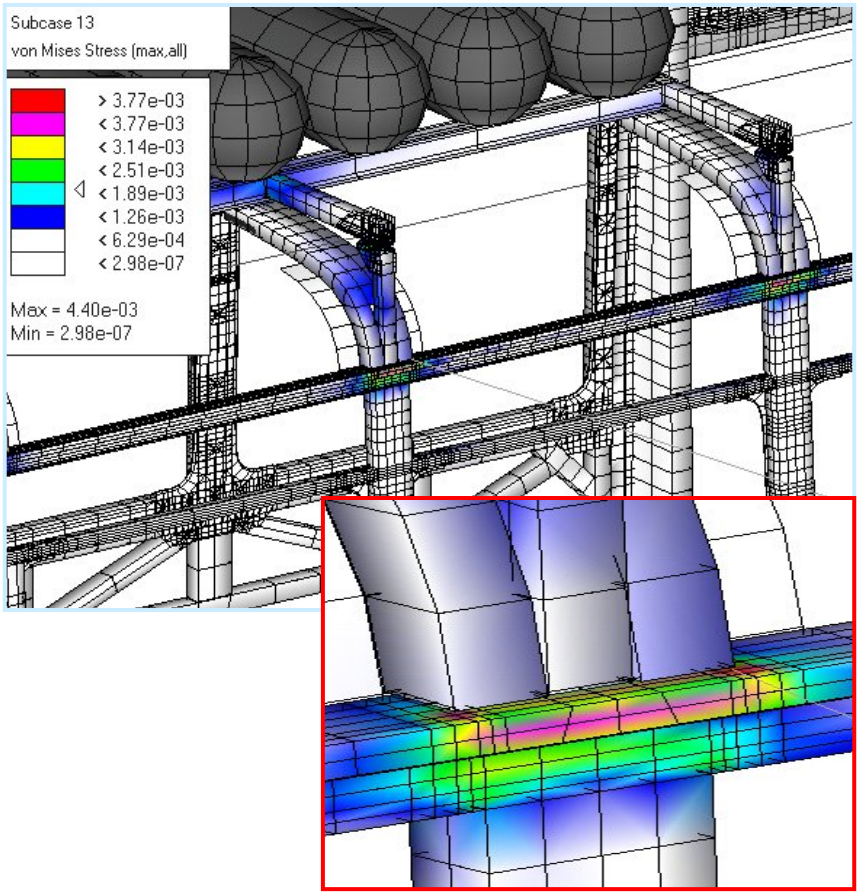
- **Damage Values,**
- **Endurance Safety Factors,**
- **Analysis Report**

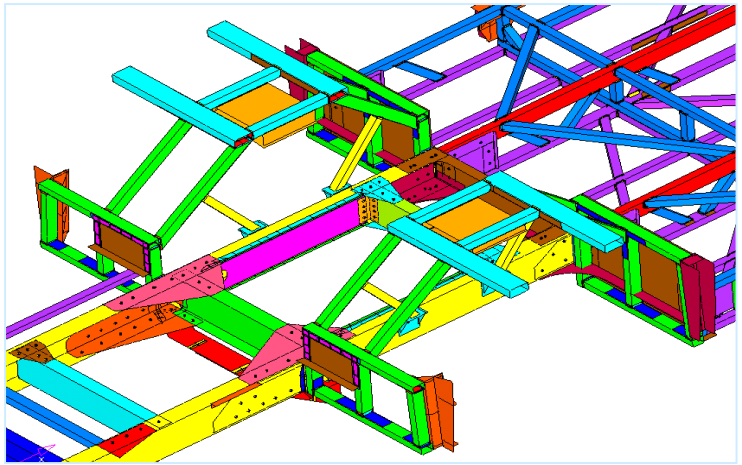
Specimen Material Data

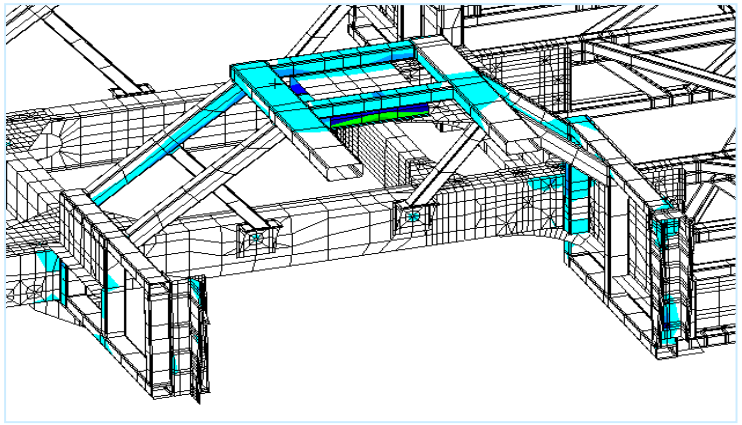


Product Engineering

☞ BUS B.I.W Fatigue Analysis

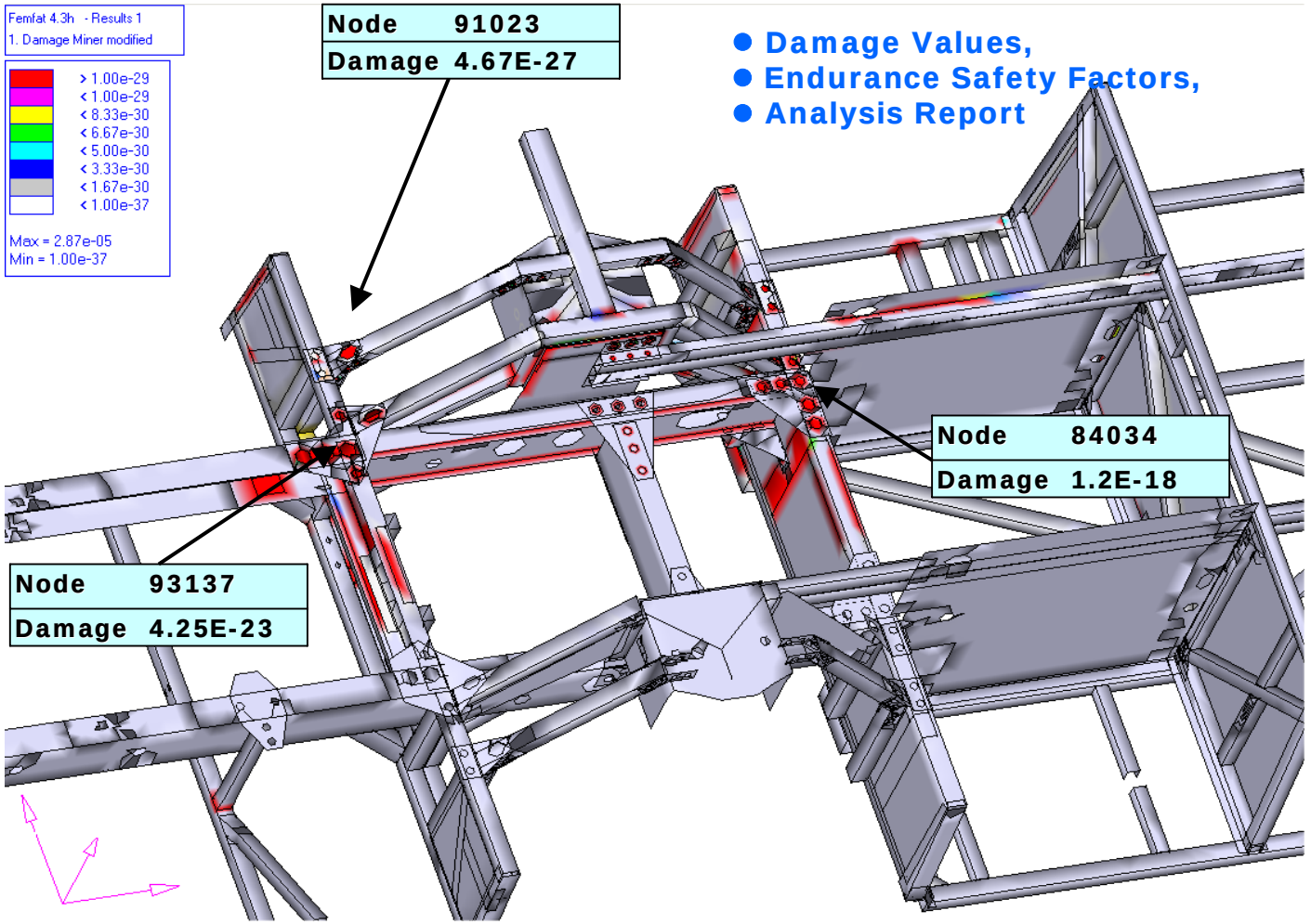






Product Engineering

☞ BUS B.I.W Fatigue Analysis

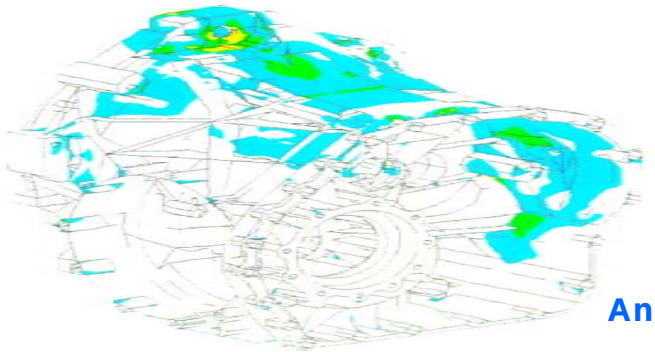


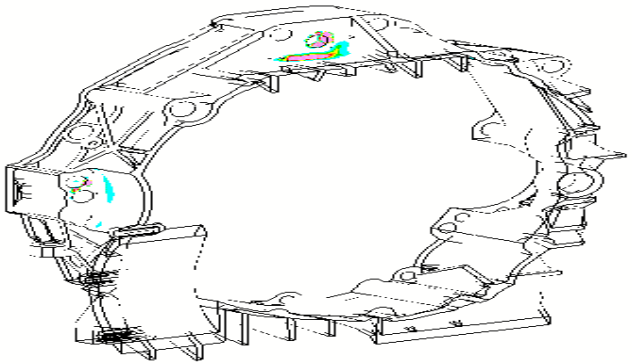
- Damage Values,
- Endurance Safety Factors,
- Analysis Report

Product Engineering

Durability Engineering

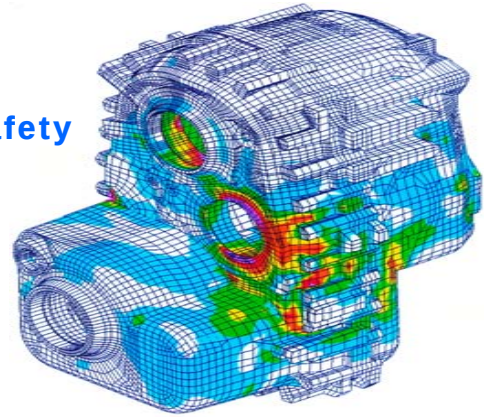
☞ T/M Housing Fatigue Analysis





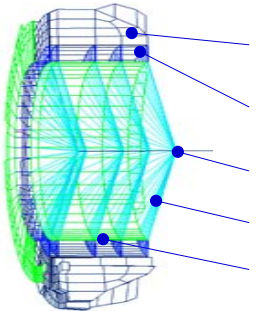
☞ Gearbox Fatigue Analysis

Rupture Safety Factors



Analysis/ Test : Ratio 2.2

Detail: Taper Roller

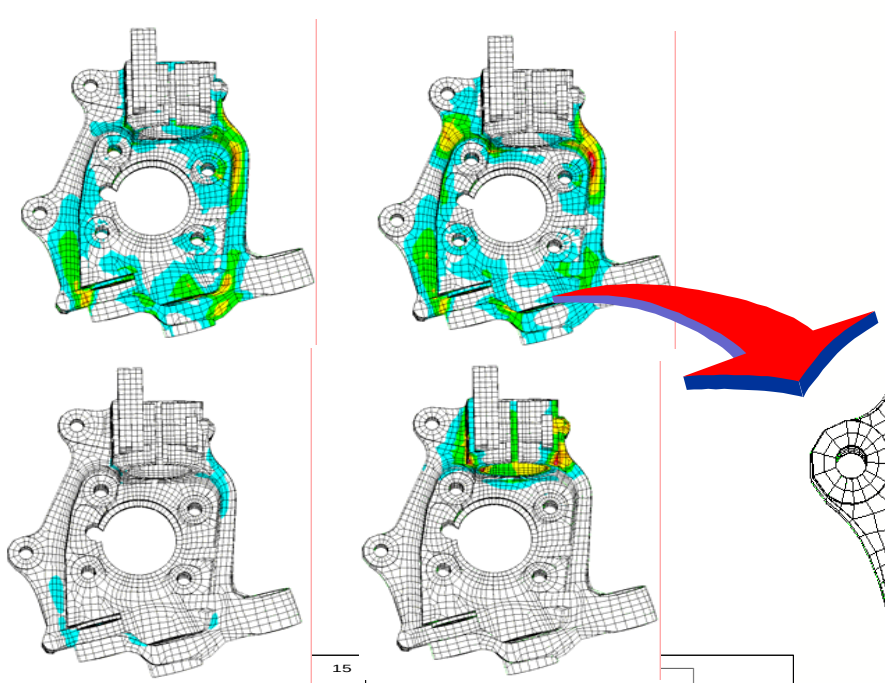


▷ **The calculating the fatigue life of component would be based on a lot of influence factors. It is impossible to know fatigue cycle with the classic method of notch factor, welding factor, multi loading factor. Due to FEMFAT simulation, it is possible to design optimised prototypes of dynamically loaded components, which is the main reason for cost savings in the development phase.**

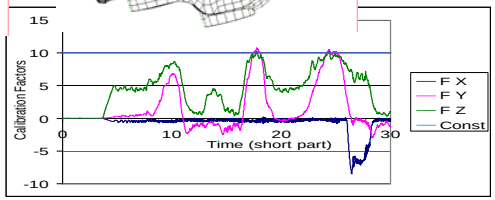
Product Engineering

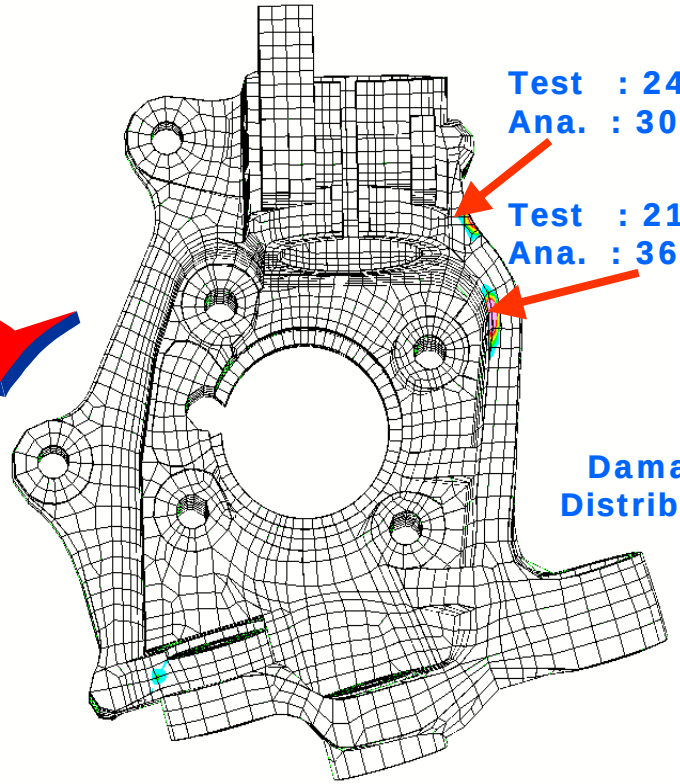
Durability Engineering

☞ **Axle Component Fatigue Analysis**



von Mises Stress
and Histories
Unit Load Cases





Test : 2420 Cycles
Ana. : 3020 Cycles

Test : 2160 Cycles
Ana. : 3690 Cycles

Damage
Distribution

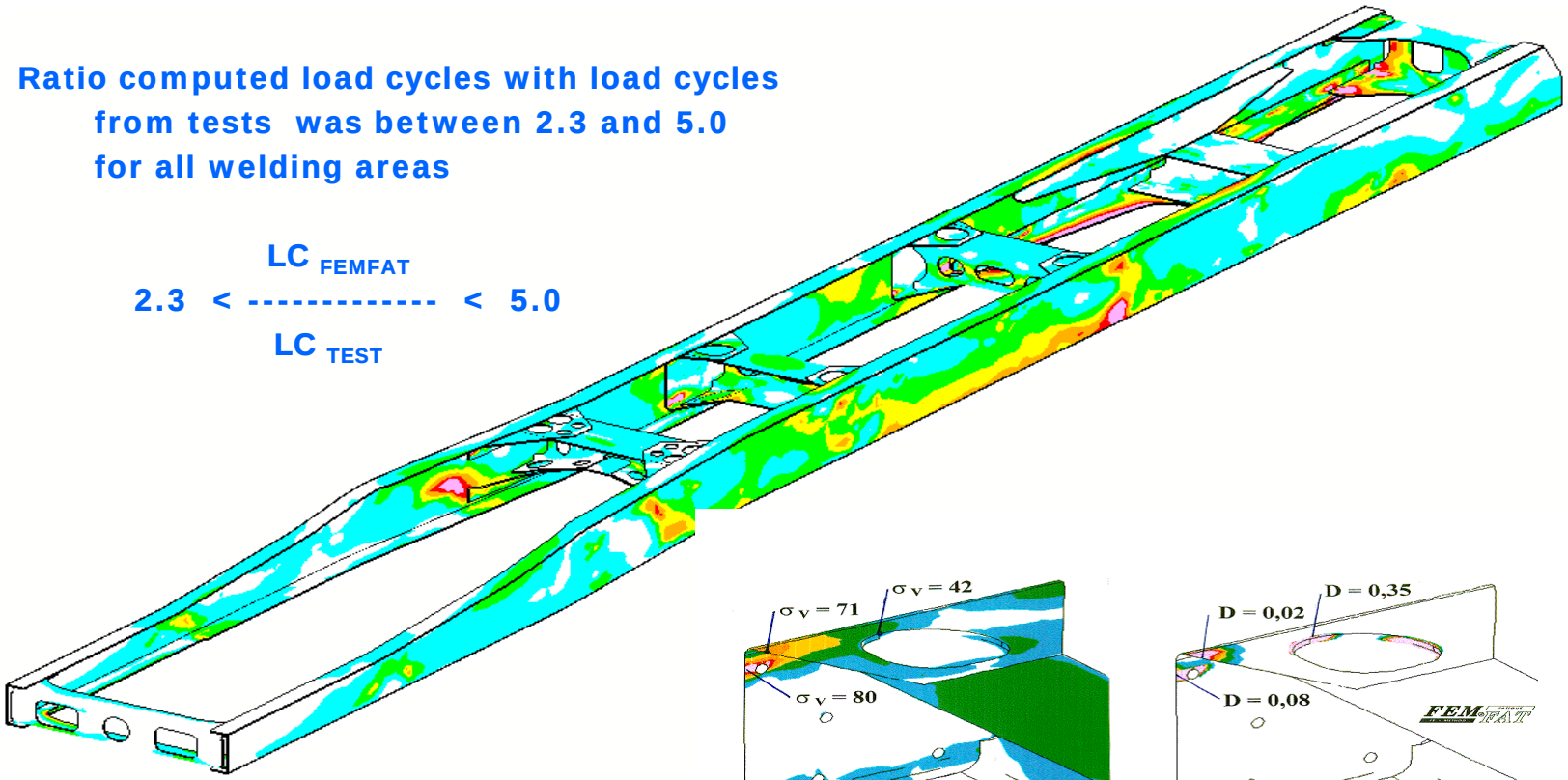
Product Engineering

Durability Engineering

☞ Frame Fatigue Analysis with welding area

Ratio computed load cycles with load cycles from tests was between 2.3 and 5.0 for all welding areas

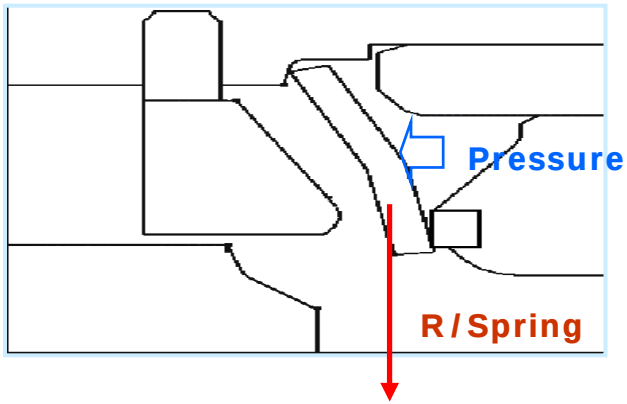
$$2.3 < \frac{LC_{FEMFAT}}{LC_{TEST}} < 5.0$$

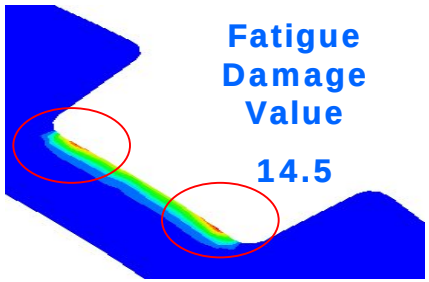


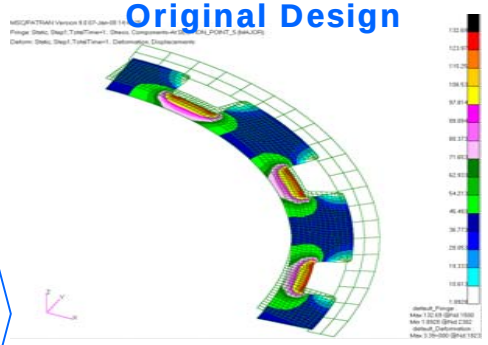
Product Engineering

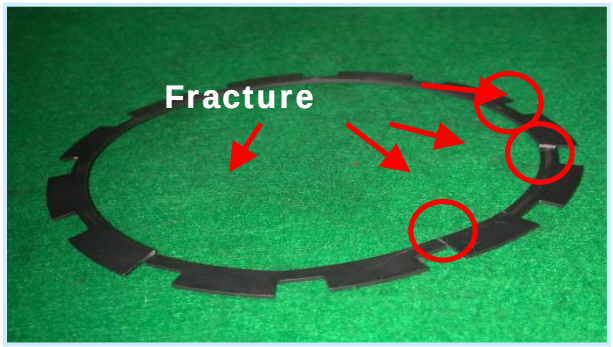
Durability Engineering

☞ **Disc Spring Nonlinear & Fatigue analysis**

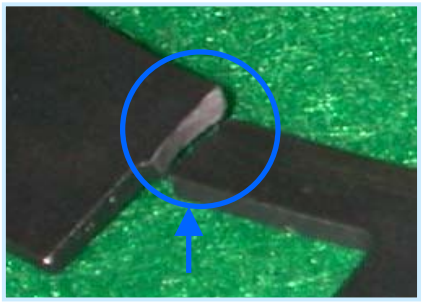


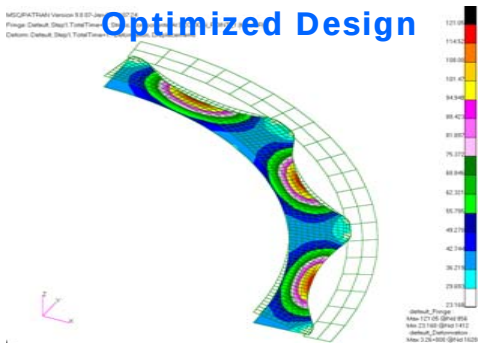






Test : 75,600 Cycles
Ana. : 81,000 Cycles



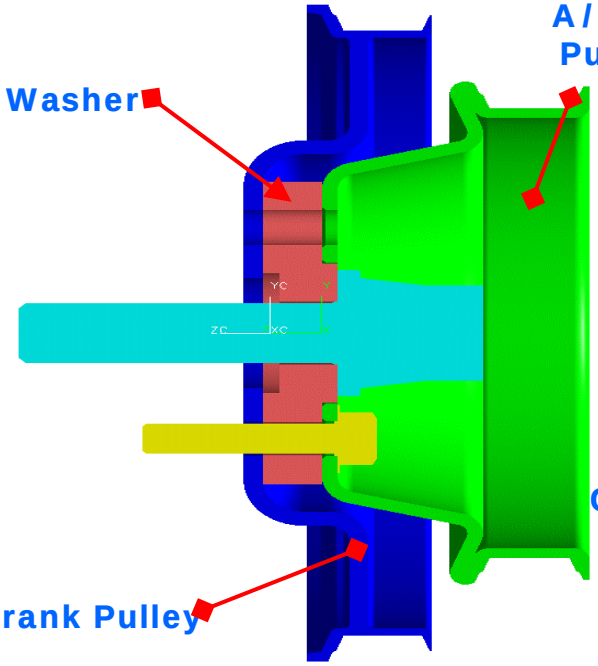


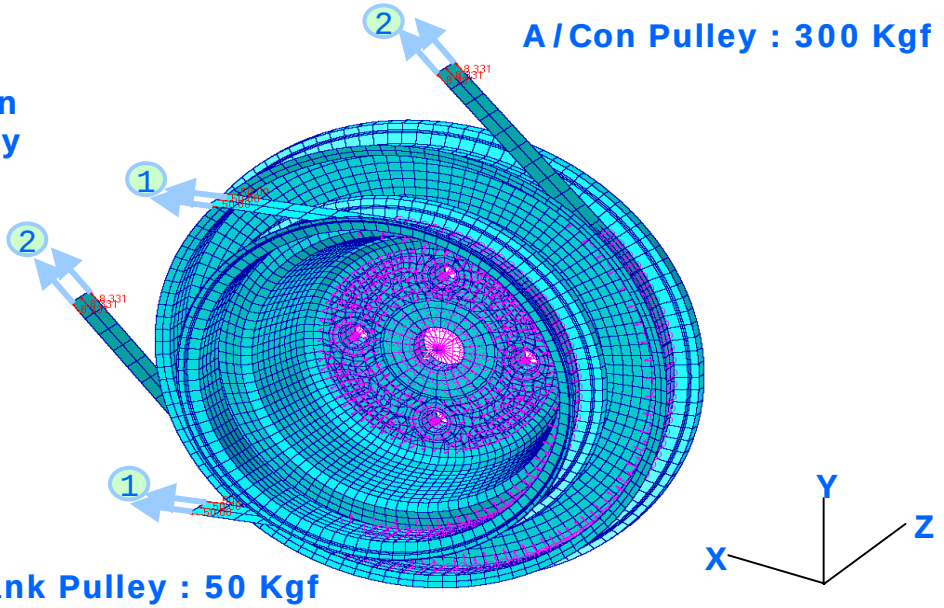
▷ **The calculating the fatigue life of component would be based on the evaluation of operation behavier. The combined analysis between fatigue analysis and the non-linear analysis, impact analysis will be able to apply for calculation of durability**

Product Engineering

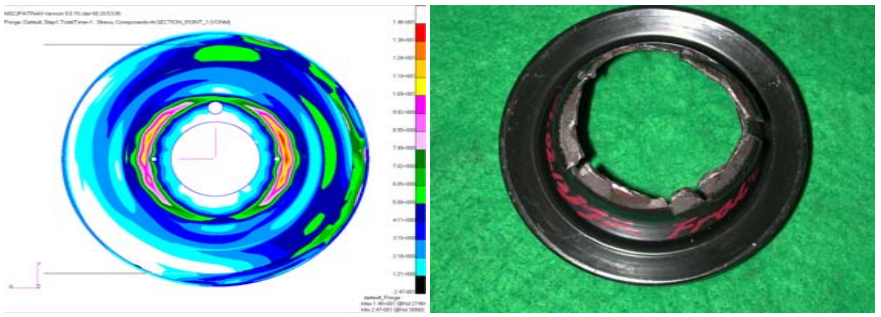
Durability Engineering

☞ E/G Pully Nonlinear & Fatigue analysis





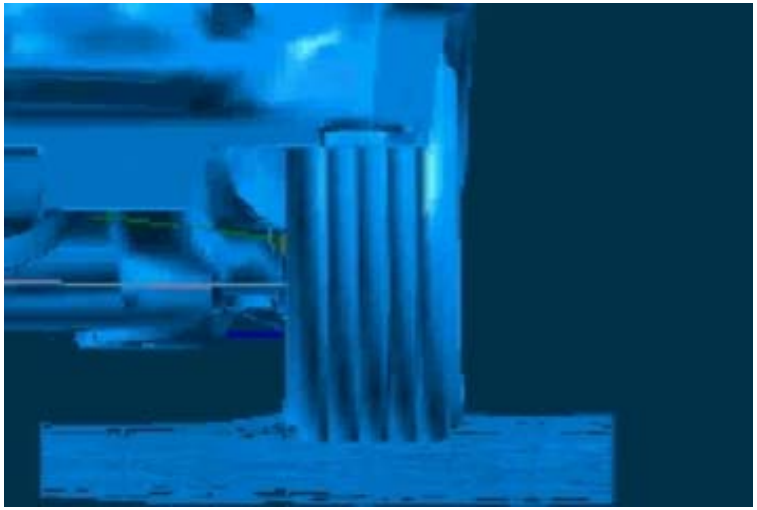
Test : 190,000 Cycles
Ana. : 220,000 Cycles



Product Engineering

☞ Virtual Proving Ground Analysis

Real Time Bench Drum Simulation

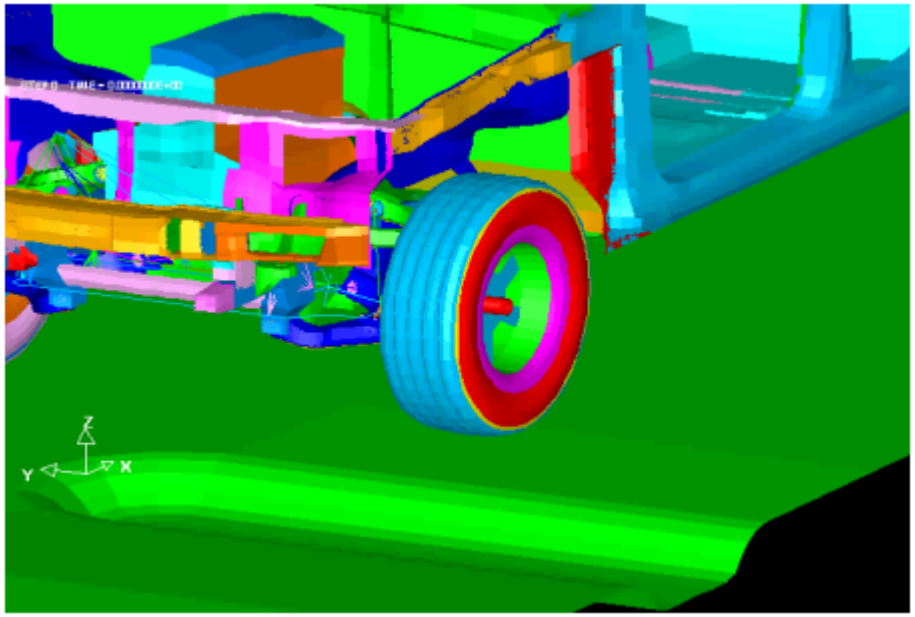


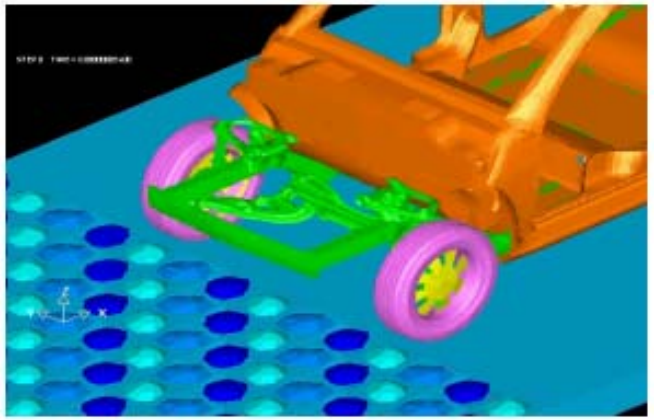
▷ **VPG analysis with LSDYNA is a revolutionary new systems analysis. This streamlined analysis technology provides an event-based simulation of nonlinear, dynamic problems. Integrated at an earlier stage of the design process, this is proven to reduce the analysis process & the period of the component design for the development of next car.**

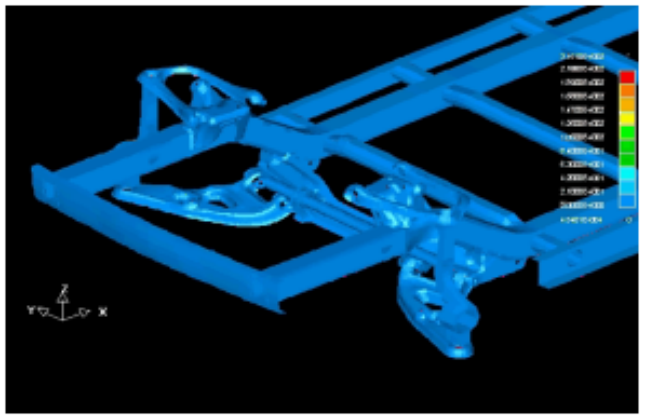
Product Engineering

☞ Virtual Proving Ground Analysis

Real Time Stress analysis with a lot of load types



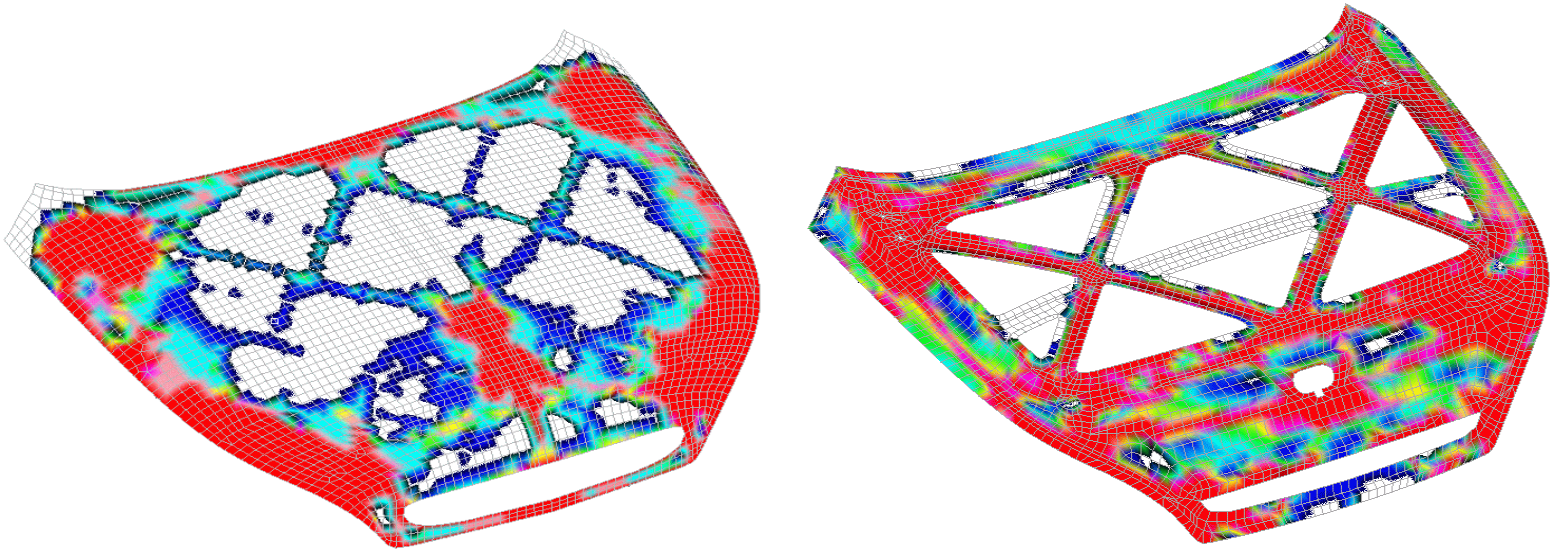




▷ **VPG analysis provides the approach method to develop for the fatigue evaluation mode with a lot of road conditions**

Product Engineering

☞ **Optimization Analysis**



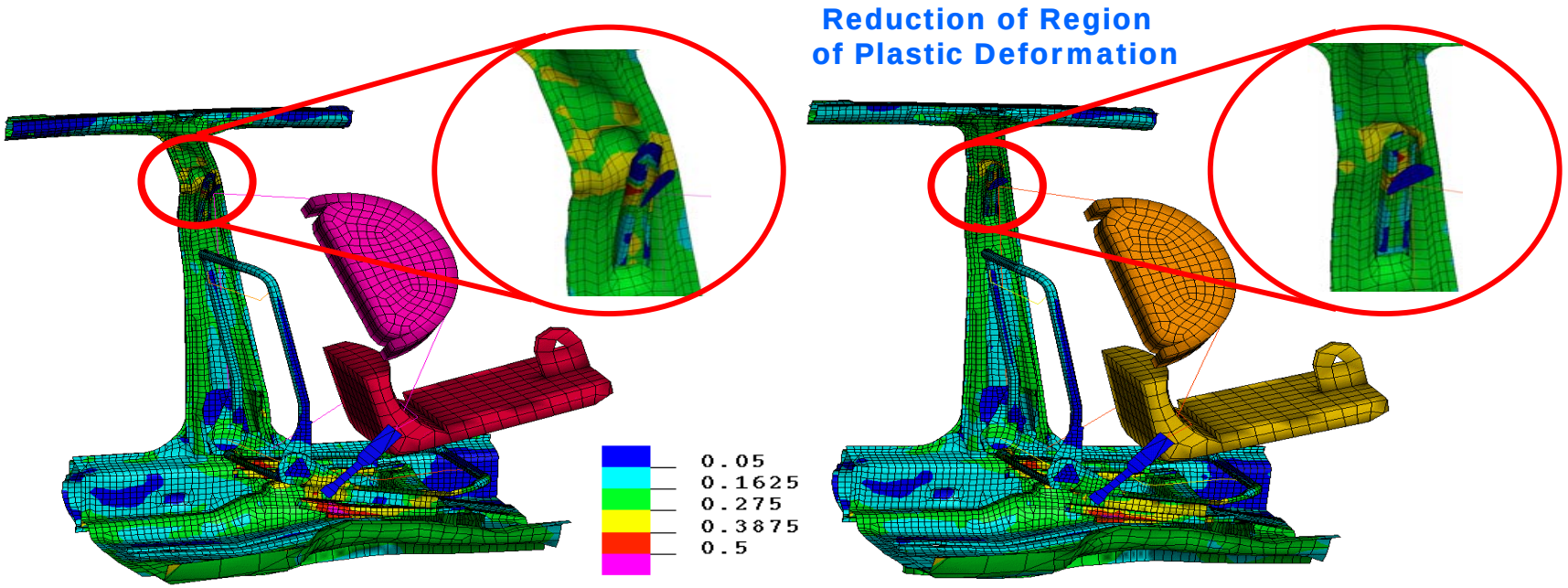
Topology Optimization
*** Factor : Strength, Stiffness, Vibration**

▷ **Design is represented by design units, and a design variable is a feature of a design unit. (size, density, thickness, shape ..) Optimization analysis can be effectively used for leading design in the early stage of design. But rigorous modeling quidelines and engineering processes along with software are important for the successful implementation of optimization. Organizational support of optimization as a formal process is crucial for multidisciplinary design optimization**

Product Engineering

Large Deformation Engineering

☞ **Seat & Seat Belt Anchorage Analysis**



Basic Model (BIW+Block+Belt)

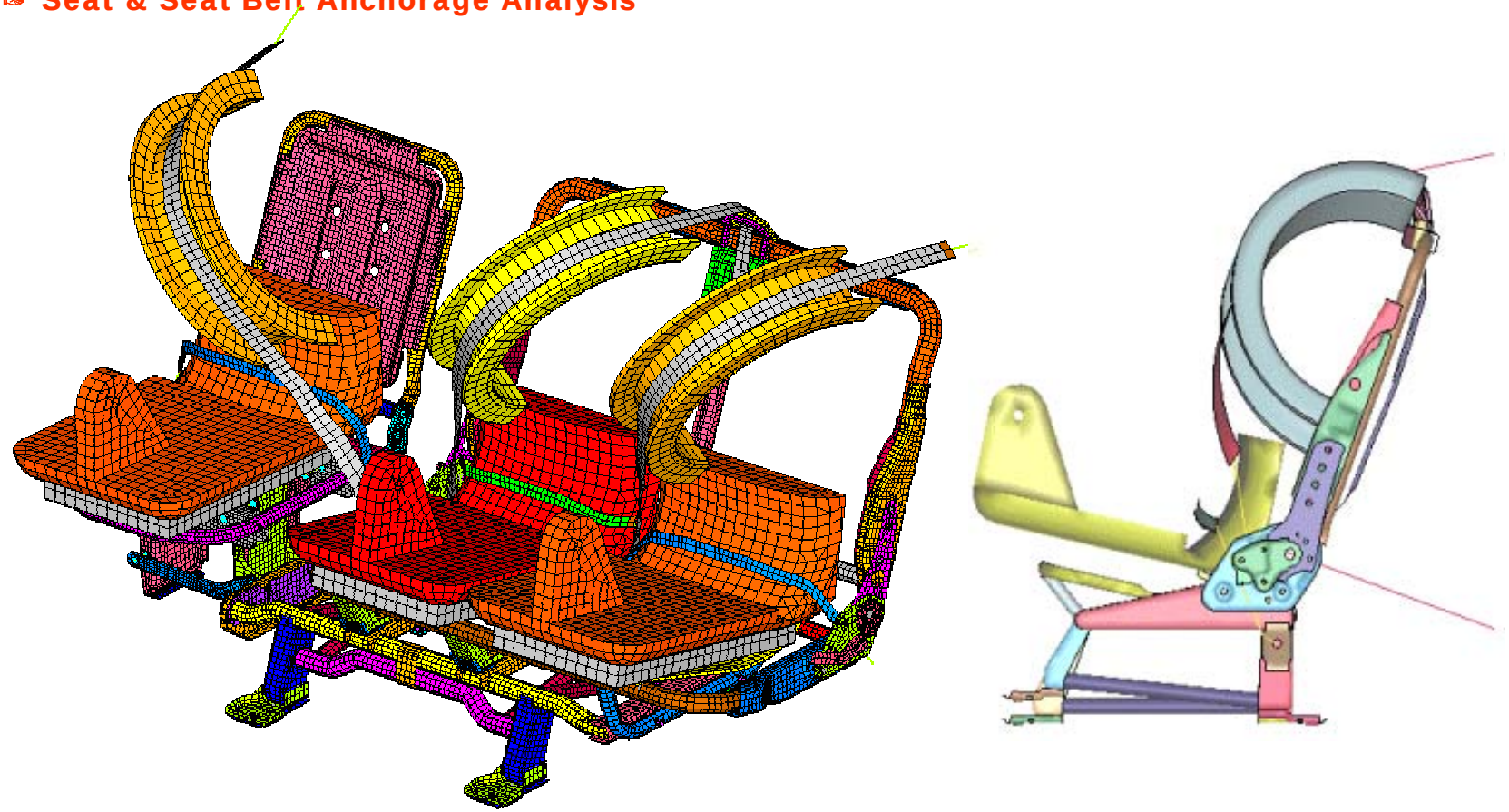
Modified Model

▷ **The result of analysis is compared with experimental results.**
This numerical simulation can be used reliably for simulating BIW with regulation test.
It can be of great assistance in predicting "most critical" conditions, in understanding the performance of systems

Product Engineering

Large Deformation Engineering

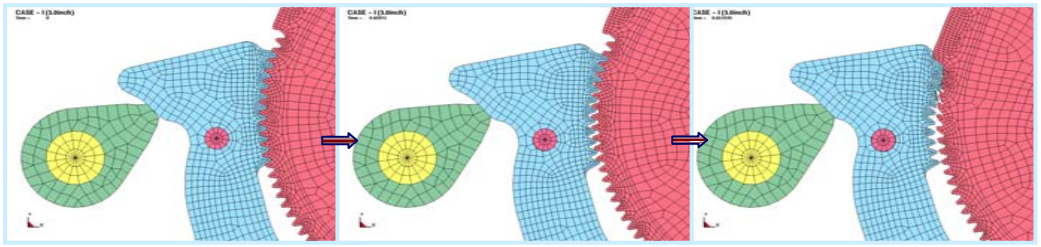
☞ **Seat & Seat Belt Anchorage Analysis**



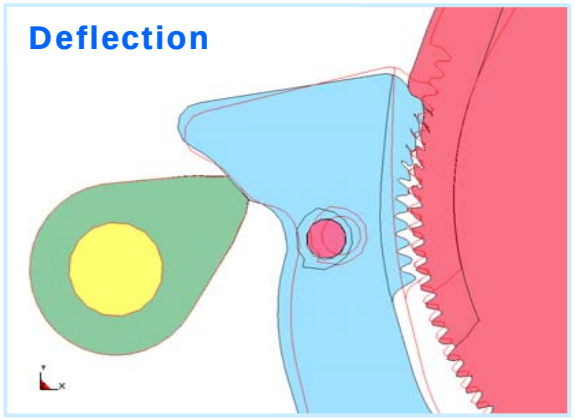
▷ **This numerical simulation can be used reliably for simulating seat tests.**
It can be of great assistance in predicting “most critical” conditions, in understanding the performance of seat systems & component

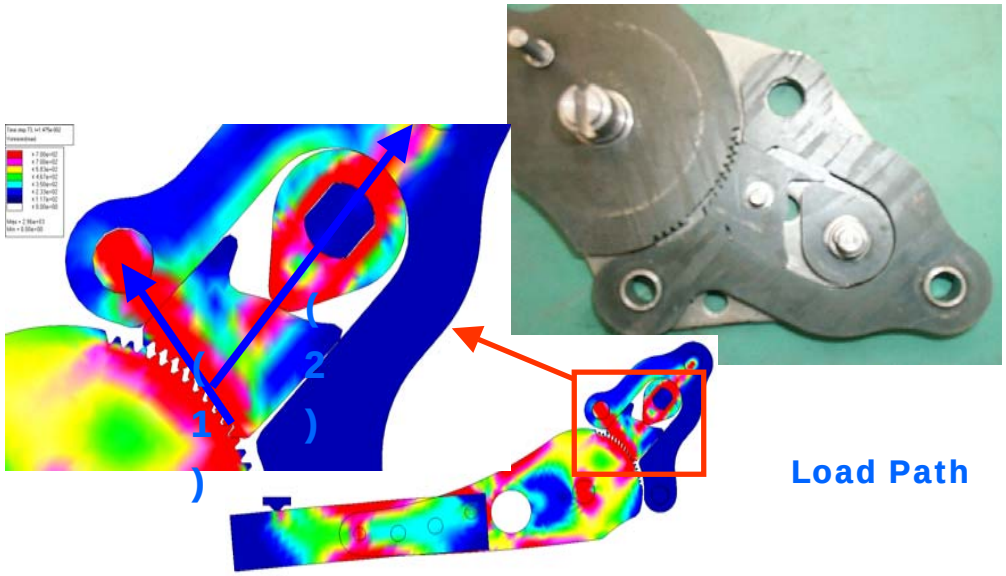
Product Engineering

☞ Recliner Impact Analysis

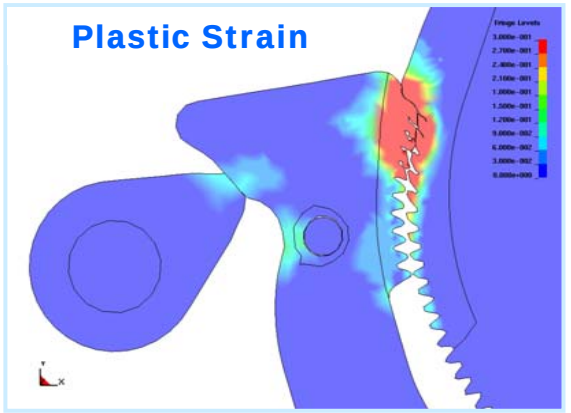


0 msec 0.020 msec 0.024 msec





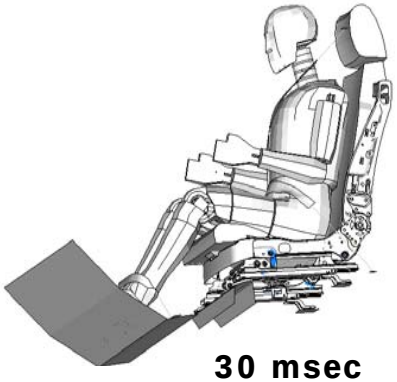
Load Path



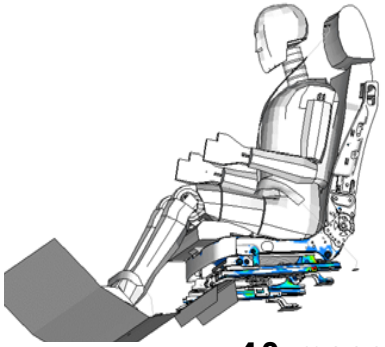
▷ **Recliner system analysis can be of great assistance in predicting the performance of tooth cracking and in understanding the behavior of deformation & loadpath**

Product Engineering

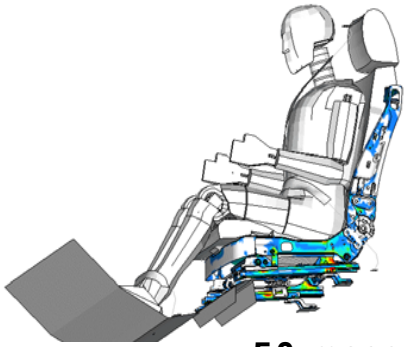
☞ Rr Sled Impact Analysis



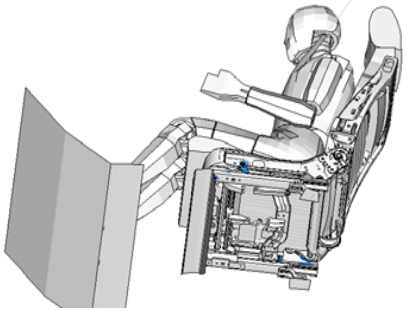
30 msec

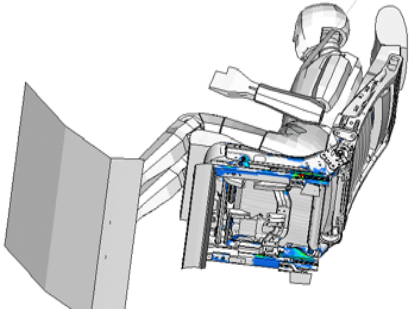


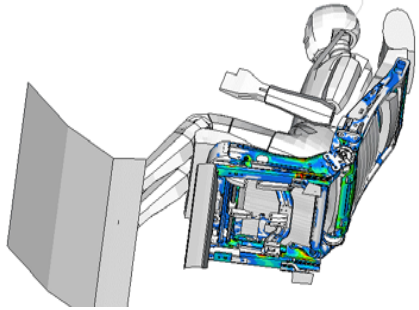
40 msec



50 msec





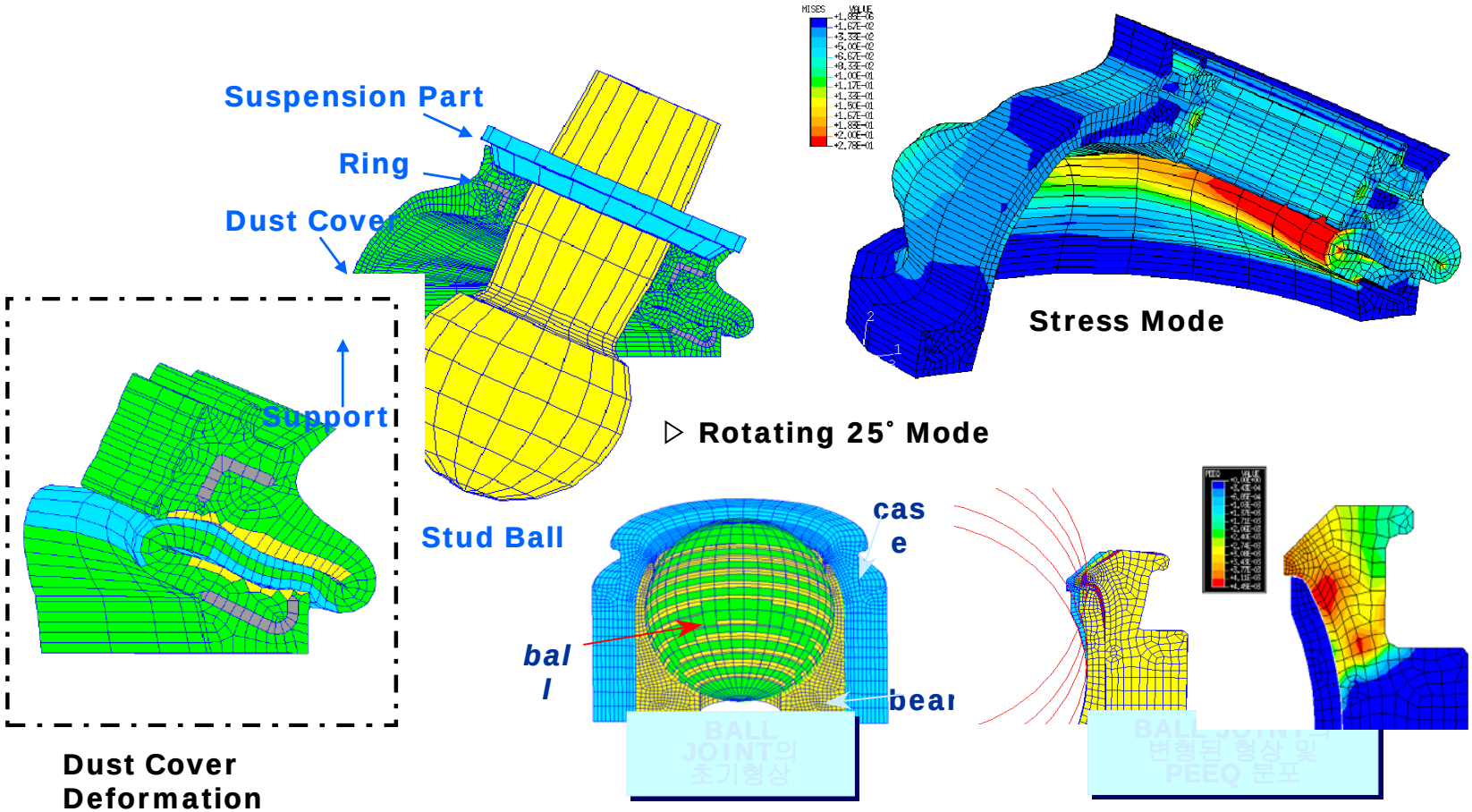


▷ **Rr Sled Impact analysis can be of great assistance in predicting occupant kinematics of the seating system and in understanding the behavior of deformation & loadpath**

Product Engineering

Large Deformation Engineering

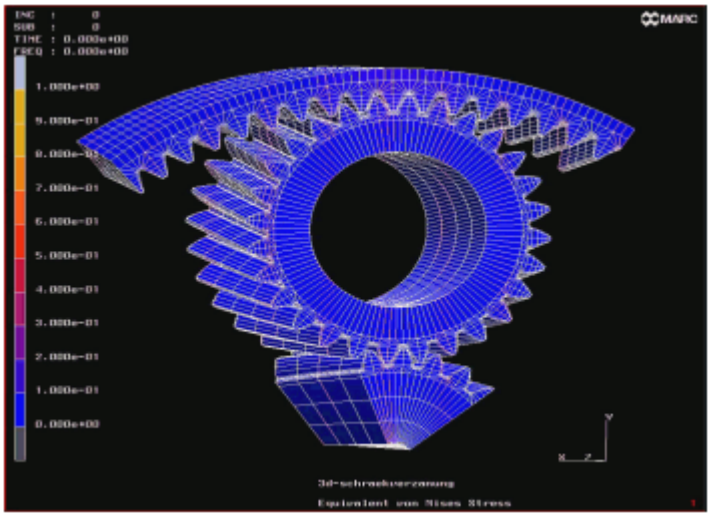
☞ **Rubber Boot Non-linear Analysis**

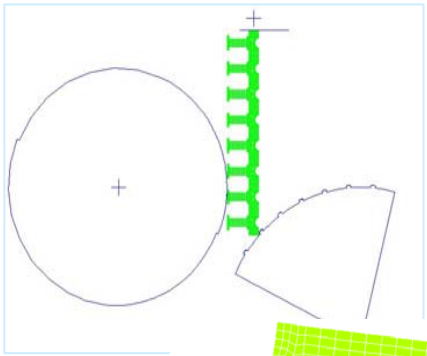


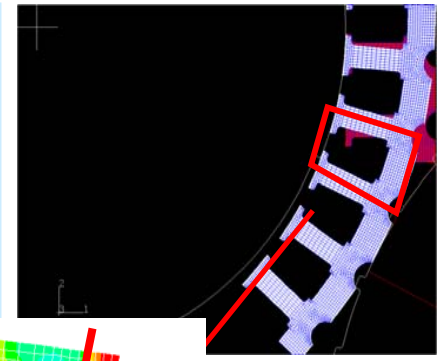
Product Engineering

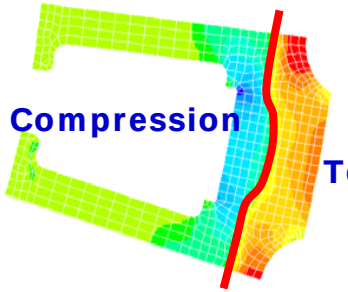
Kinematic & Contact Engineering

☞ **Kia Analysis**









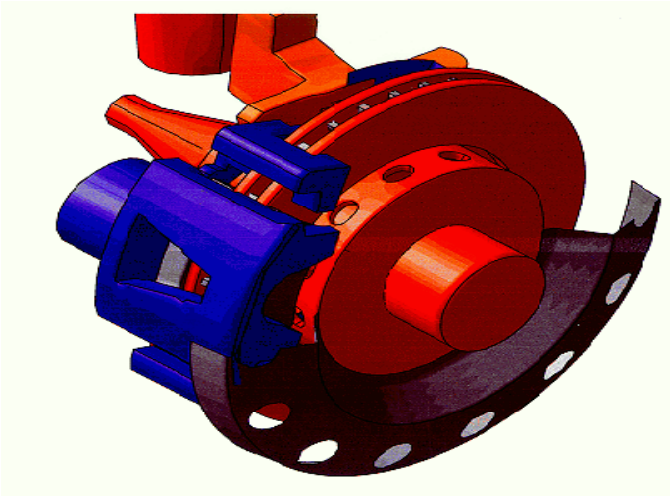
▷ **Every items of machinery has moving parts, bearings, gears, slides, seals and many others. The successful operation of moving mechanical equipment is dependent on the smooth running and long life of these parts. But, the complexity of the geometries and the intricacies of the mechanical assemblies have made it difficult to develop a detailed rotionale for a sound and economic design of these parts, especially gears.**

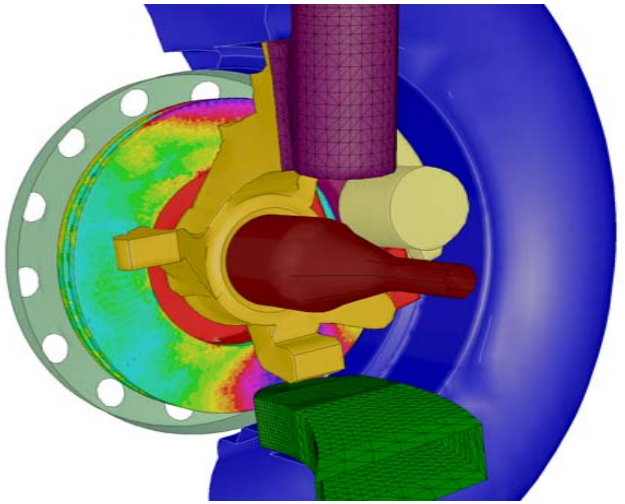
Gear analysis provides load distribution, bending strength, pitting resistance, thermal capacity, tribology or other factors affecting the potential life of individual gears & gear sets

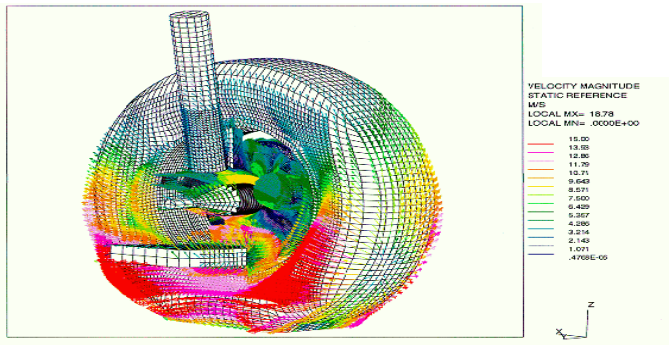
Product Engineering

Kinematic & Contact Engineering

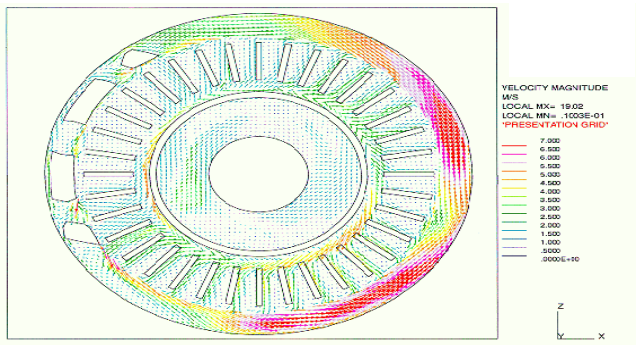
☞ **Brake Rotor heat Analysis**







Velocity Vector Around Wheel

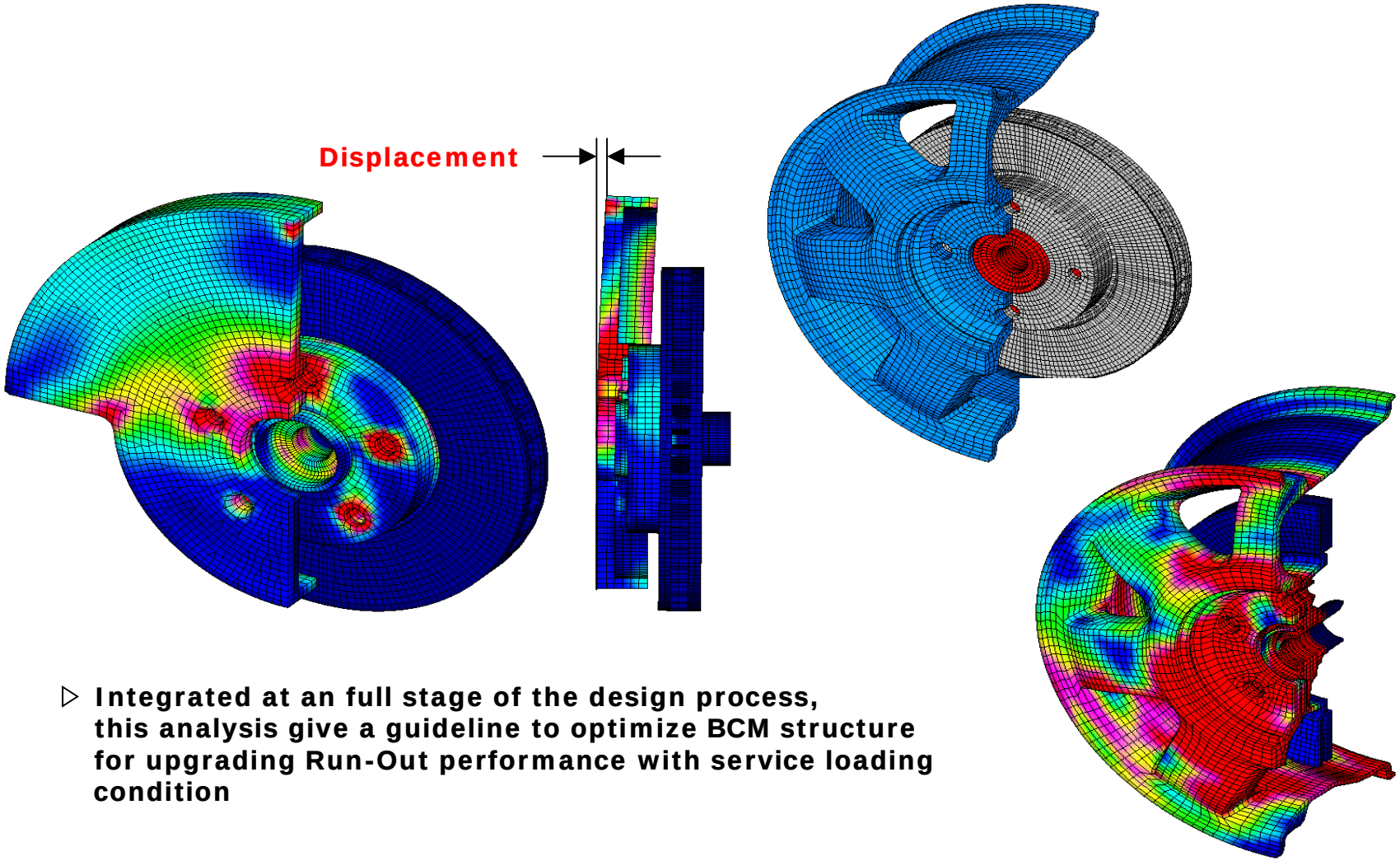


Velocity Vector at Rotor

Product Engineering

Kinematic & Contact Engineering

☞ **Brake Control System Run-Out Analysis**

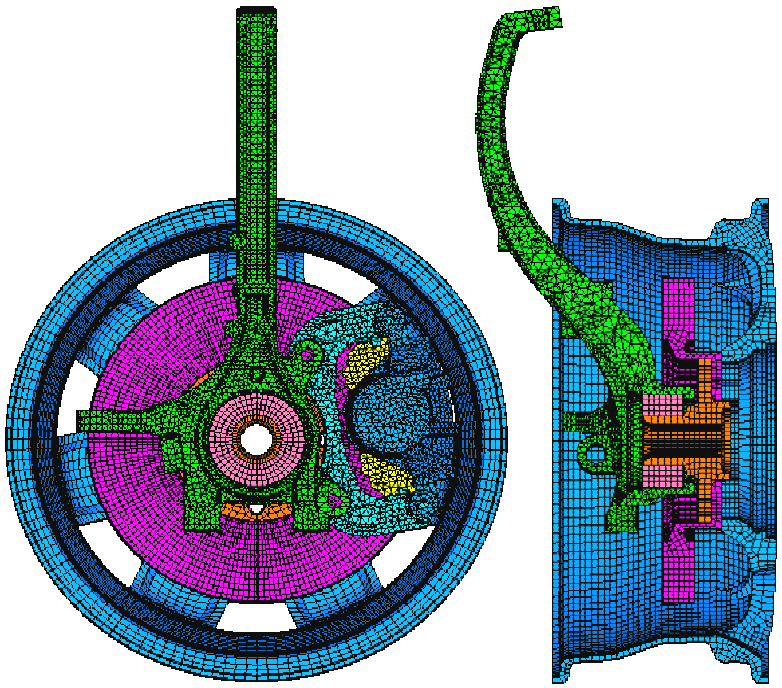


▷ **Integrated at an full stage of the design process, this analysis give a guideline to optimize BCM structure for upgrading Run-Out performance with service loading condition**

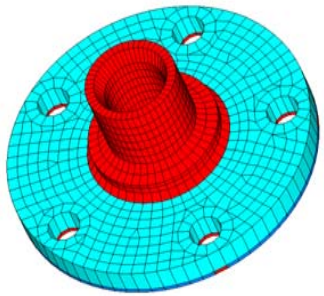
Product Engineering

Optimization Engineering

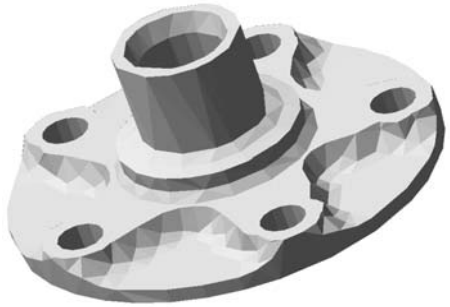
☞ **Topology & Shape Otimization Analysis**



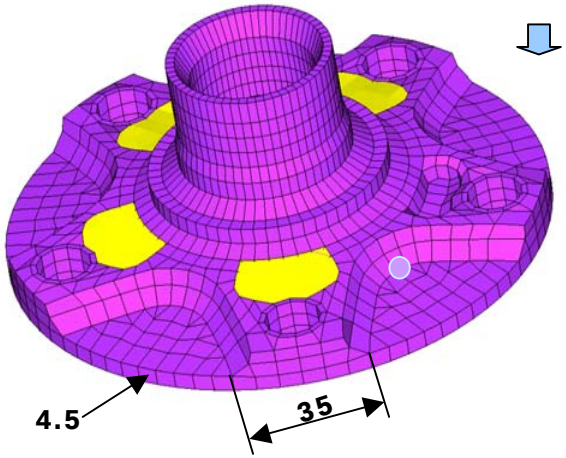
BCM + Knuckle System

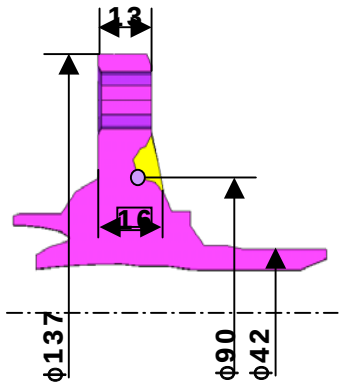


2'nd : Weight 45 g Down



1'st : 2.11 Kg → 1.725 Kg
Weight 385 g Down

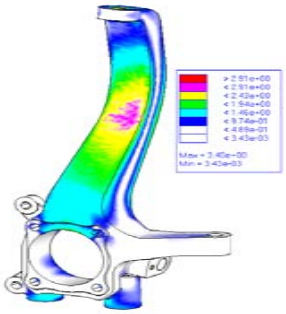




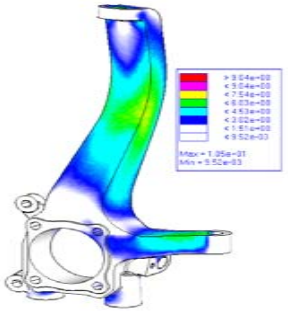
Product Engineering

Optimization Engineering

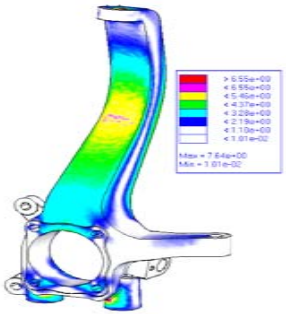
☞ **AL Knuckle topology & Shape Otimization Analysis**



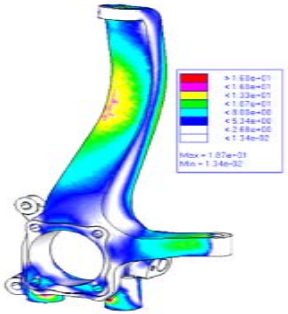
3G Bumping



1G Braking

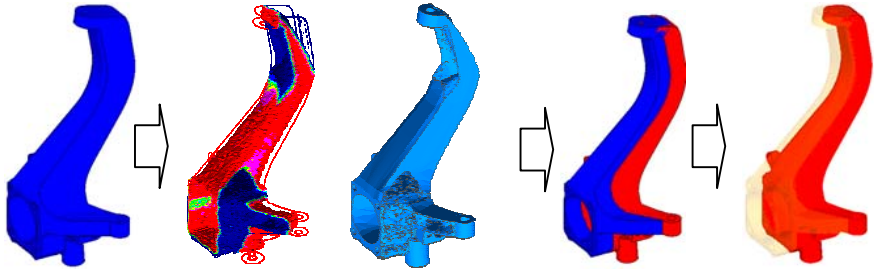


1G Cornering

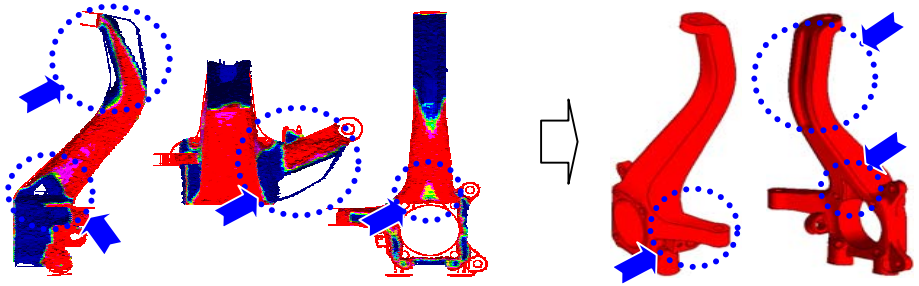


Curb Impact

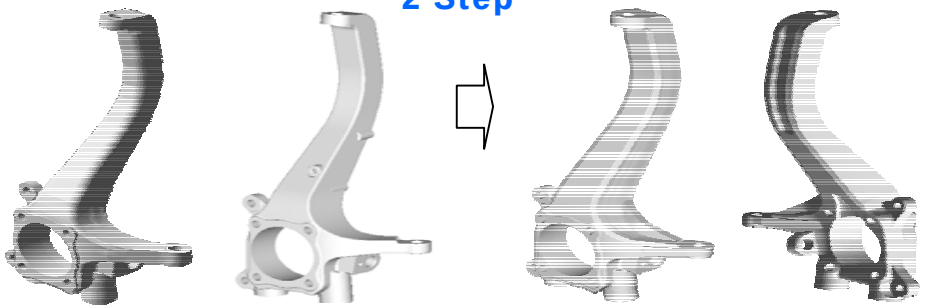
Factor :
Stiffness / Strength / Fatigue / Weight



1 Step



2 Step

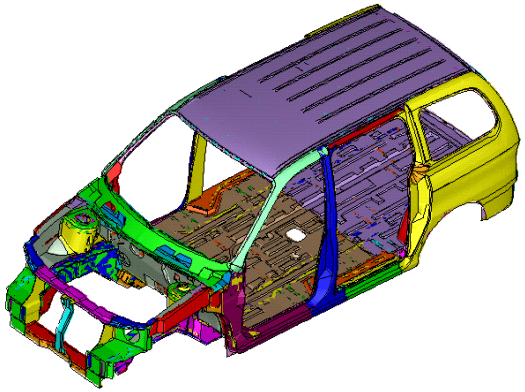


3 Step

Product Engineering

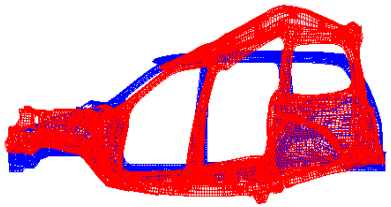
N.V.H Engineering

☞ B.I.W Vibration Analysis of SUV

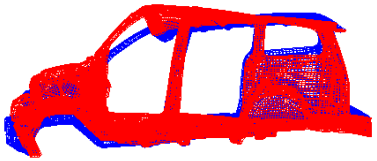


Analysis items

- *Bending Stiffness*
- *Torsional Stiffness*
- *Vibration Mode*



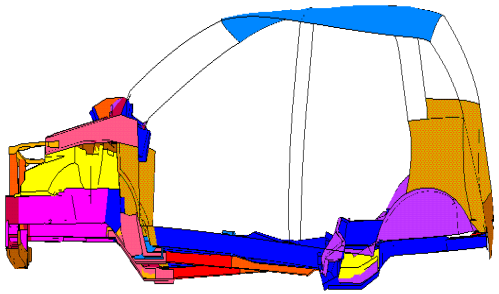
1st Bending Mode



1st Torsion Mode

- ▷ **L/O Design**
- ▷ **Joint Design**
- ▷ **Section Design**

Concept Analysis

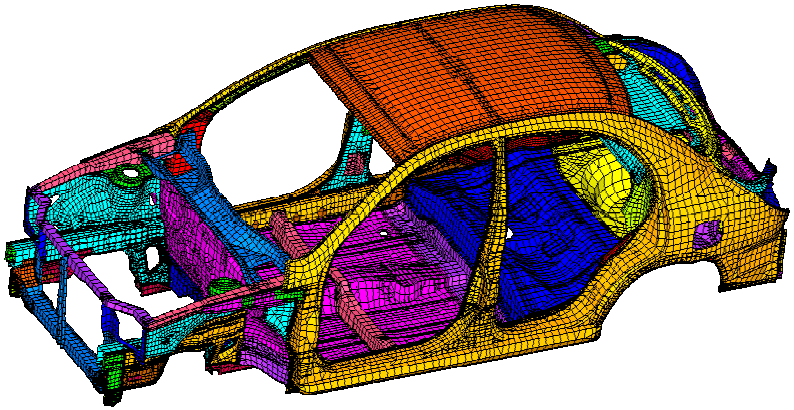


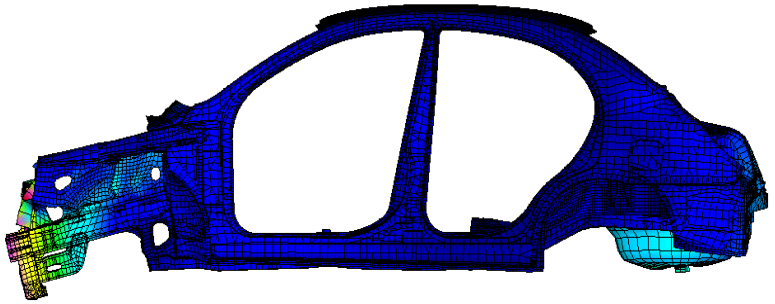
▷ **B.I.W analysis programs are carried out to evaluate stiffness and vibration, estabilish targets for new products and to provide the detailed information required to estabilish individual performance criteria for major component and sub body system**

Product Engineering

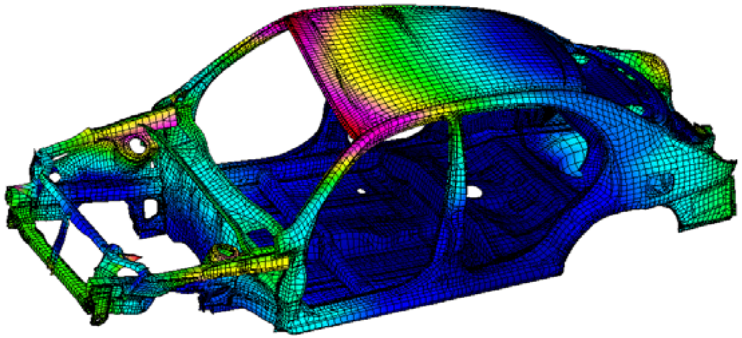
N.V.H Engineering

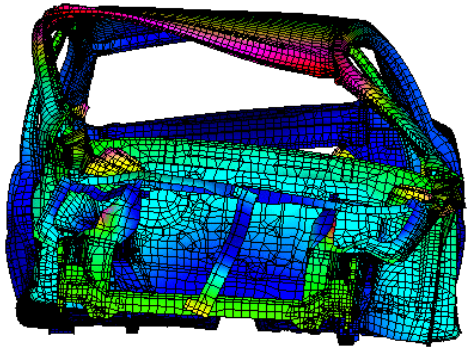
☞ **B.I.W Vibration Analysis of Passenger Car**





1’st Bending Mode : 33.0 Hz



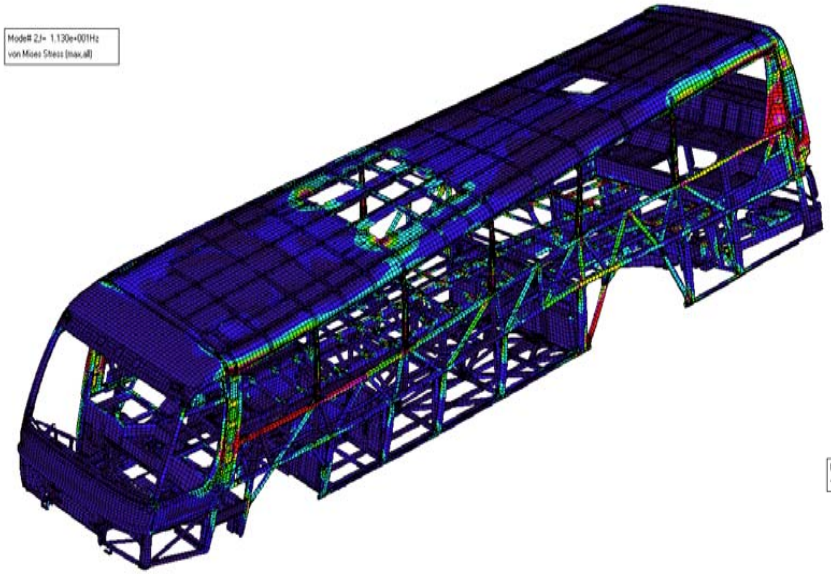


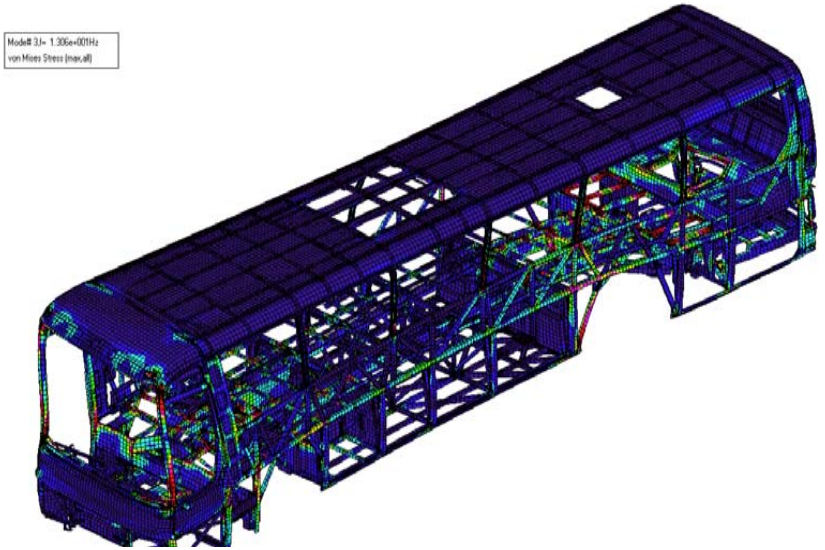
1’st Torsion Mode : 25.3Hz

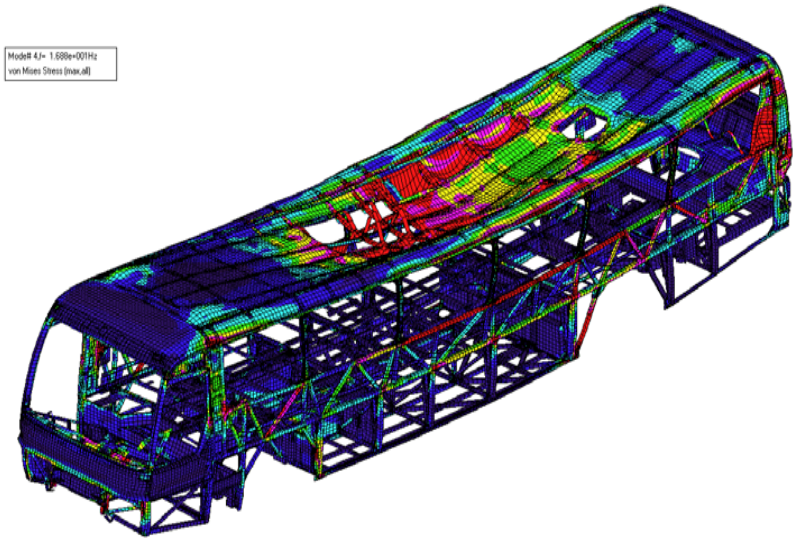
Product Engineering

N.V.H Engineering

☞ B.I.W Vibration Analysis of BUS







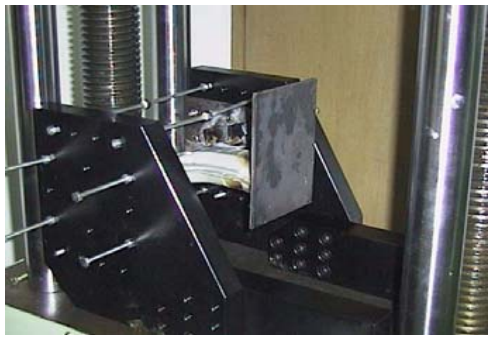
Torsion Mode
Vertical Bending Mode
Lateral Bending Mode

Product Engineering

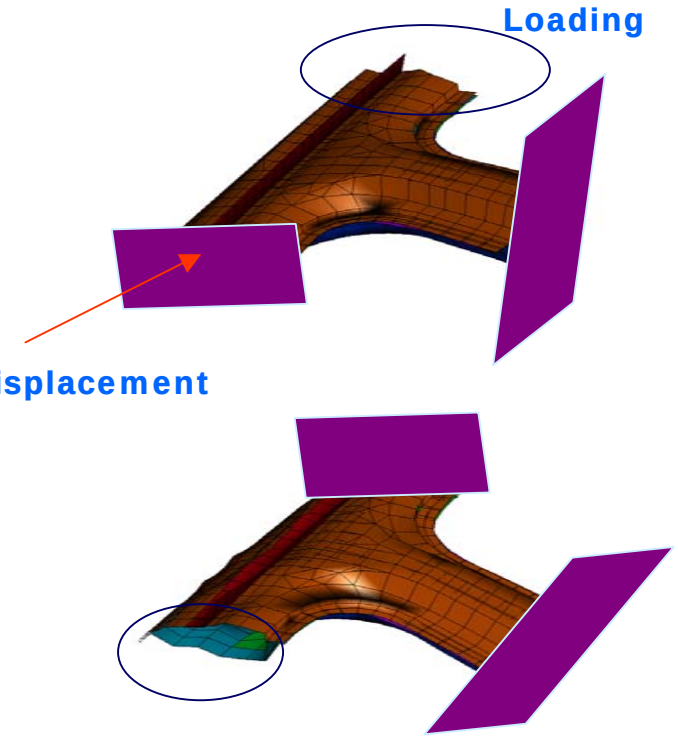
N.V.H Engineering

☞ **B.I.W Junction Stiffness Test & Analysis**

Initial State



At 80 mm deflection

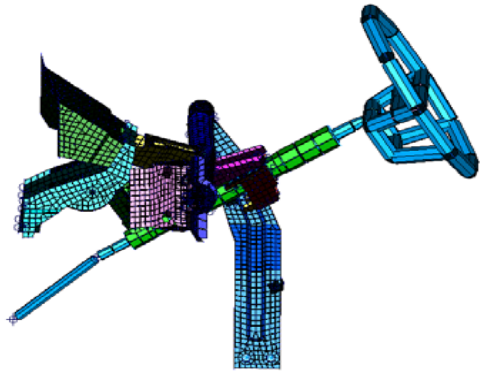


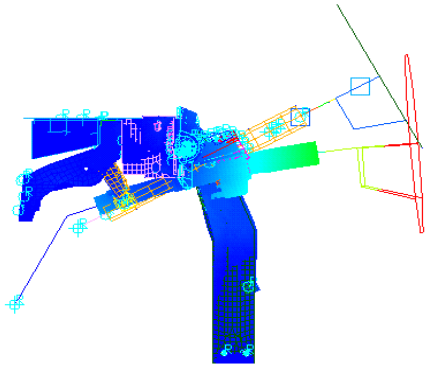
▷ **B.I.W stiffness is dominated three fators with joint stiffness, L/O, section of B.I.W. Joint stiffness analysis provides the detailed information required to estabilish Roof Crush performance & Side Impact performance and to direct joint leg design**

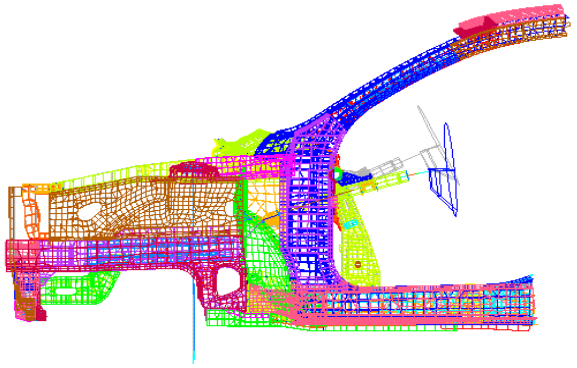
Product Engineering

N.V.H Engineering

☞ Steering Column Vibration Analysis

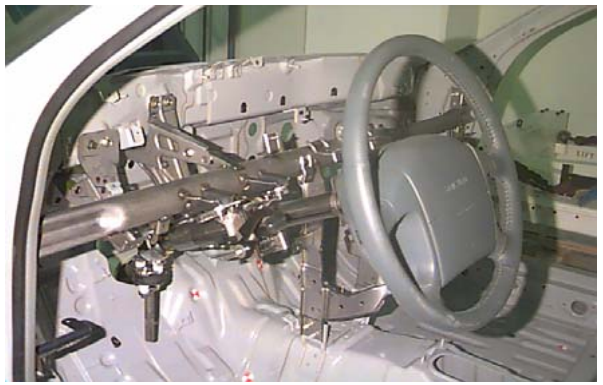






▷ **Steering column vibration is caused by the vibration induced by road roughness and can be influenced by any component suspension, body, tire, frame..**

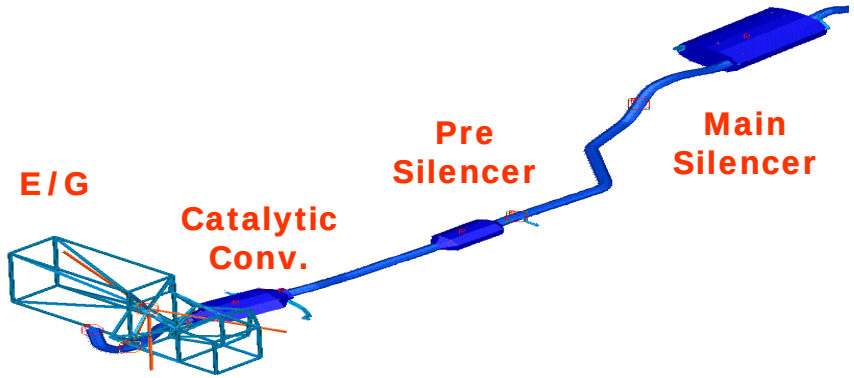
Steering vibration spectrum is strongly influenced by the vibration characteristics of linkage structure such suspension, dash panel, I/p



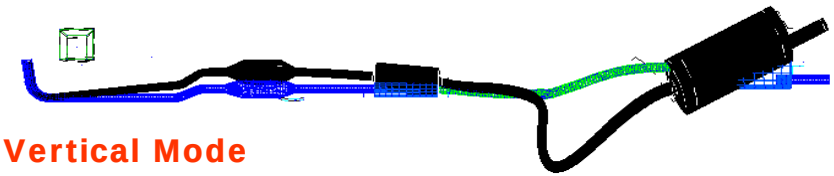
Product Engineering

N.V.H Engineering

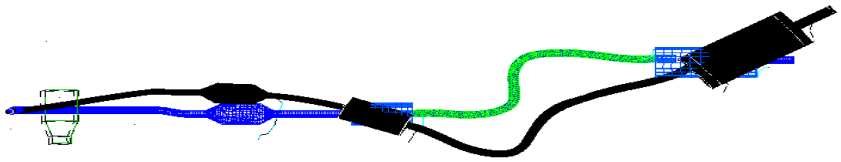
☞ **Exhaust System Vibration Analysis**



- Hanger Point L/O
- Component Size
- Weight Design



Vertical Mode

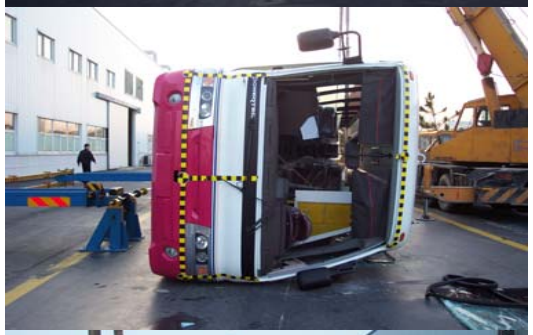


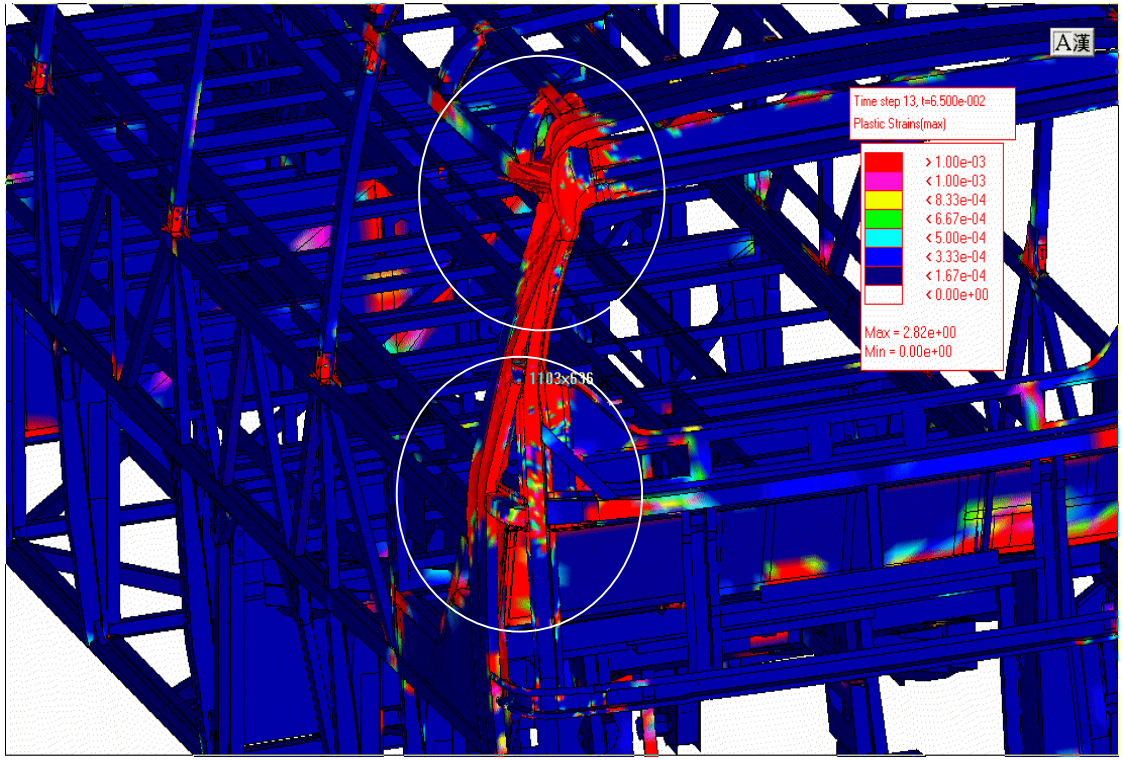
Lateral Mode

▷ **Exhaust system vibration analysis provides the detailed information required to find the hanger point with B.I.W and to get down thevibration transfer rate from E/G.**

Product Engineering

☞ Rollover Analysis



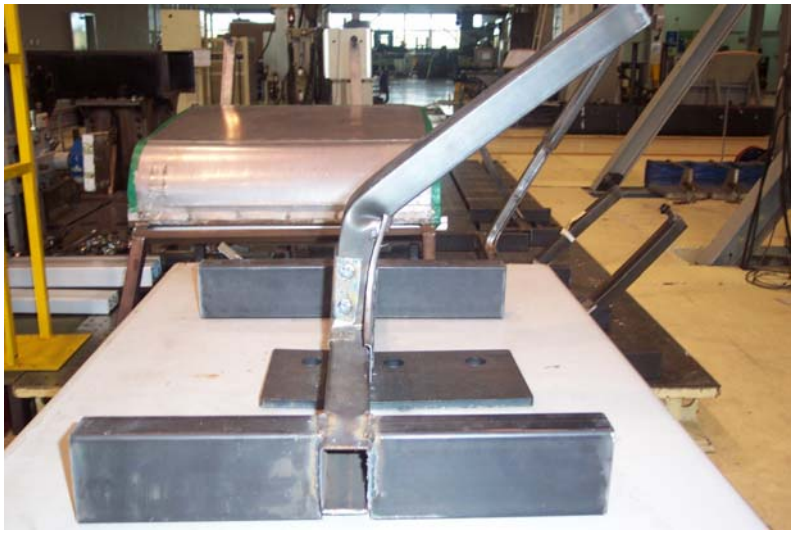


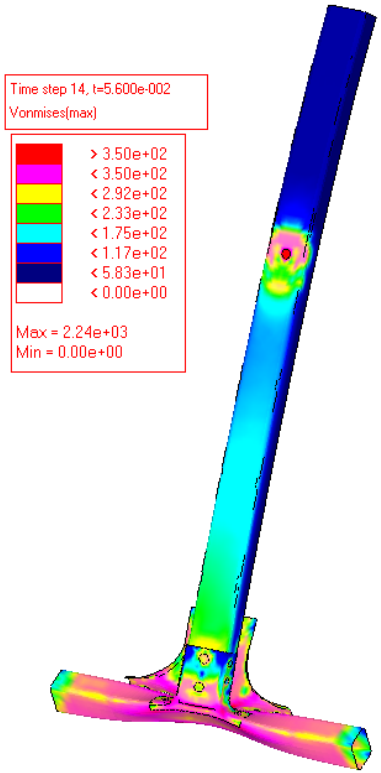
▷ **Full car' drop impact analysis provides the detailed information required to estabilish structure design for BUS rollover regulation**

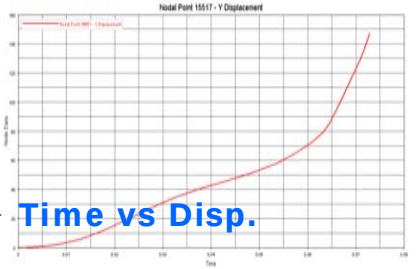
Product Engineering

Impact & Nonlinear Analysis

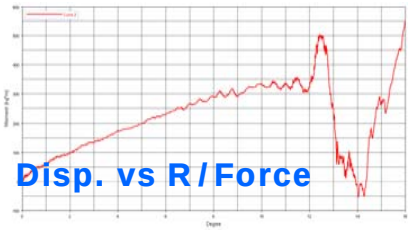
☞ **Pillar nonlinear Analysis**



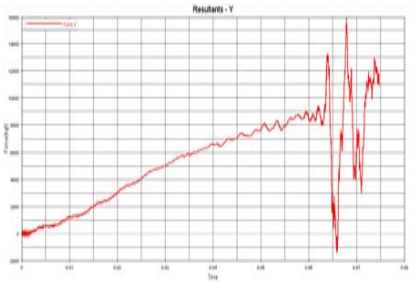




▶ **Time vs Disp.**



▶ **Disp. vs R/Force**

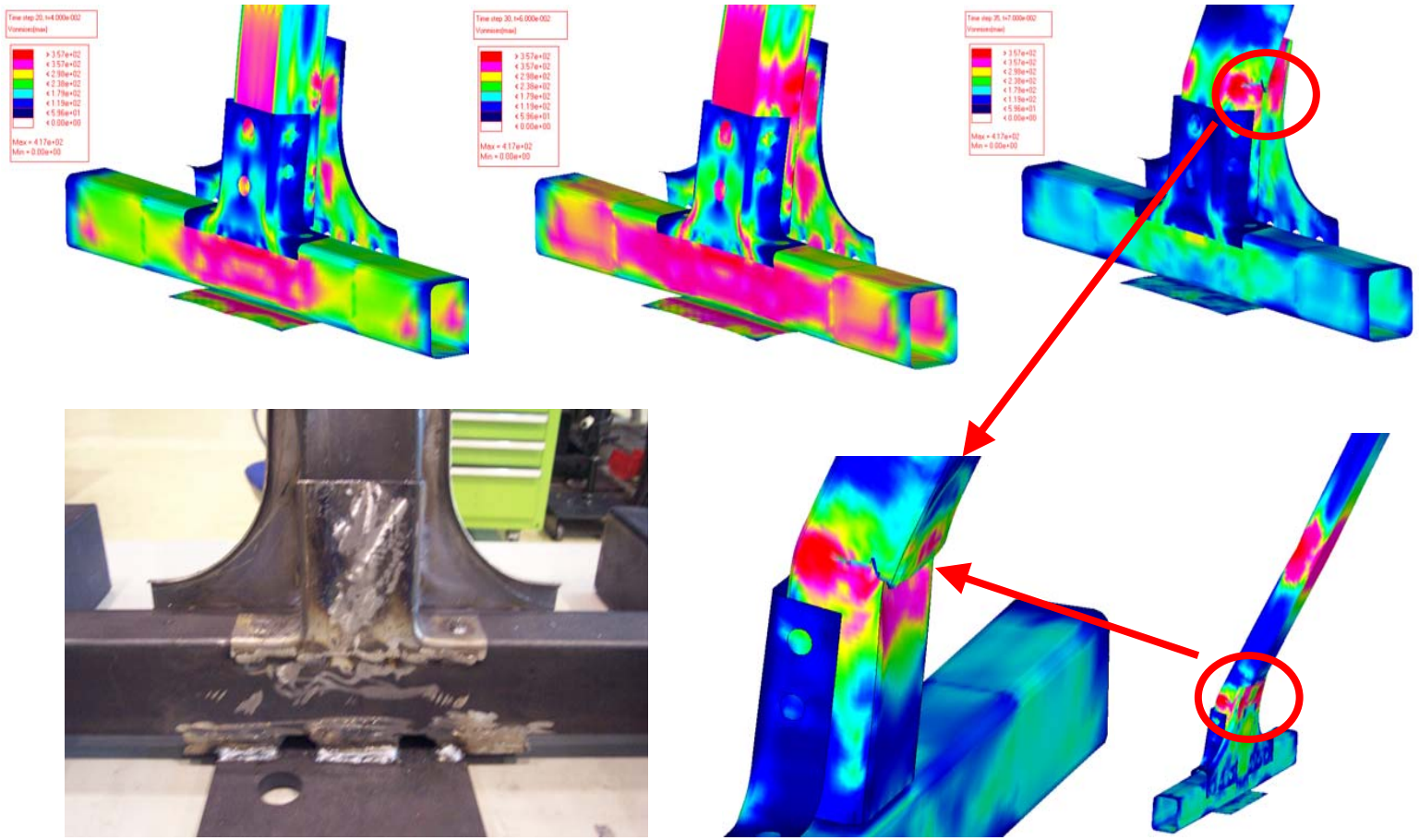


▶ **Time vs R/Force**

▷ **The rollover performance of BUS is dominated by the joint deformation behavior. Pillar deformation analysis provides the detailed information to design for joint & upperbody**

Product Engineering

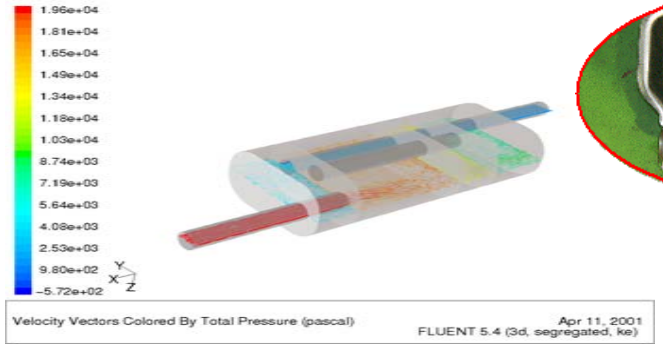
☞ Pillar nonlinear Analysis

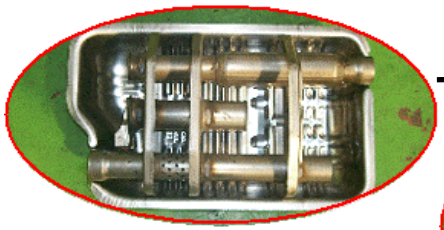


Product Engineering

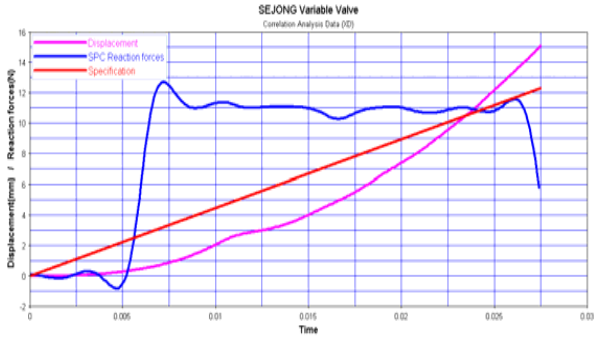
CFD + Optimization Engineering

☞ **Valve Spring Analysis (CFD+Nonlinear Analysis+Optimization analysis)**



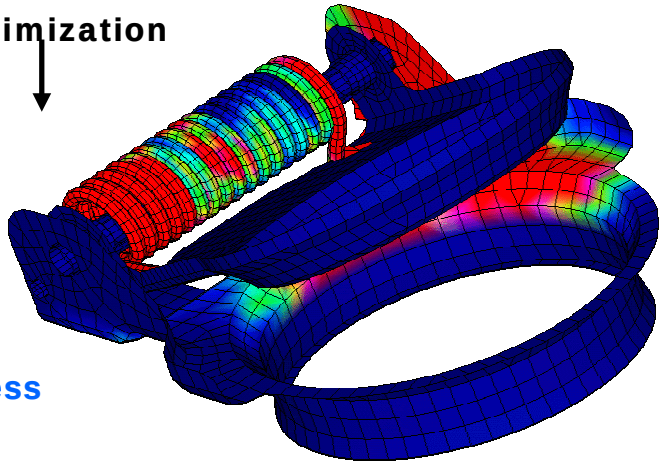


CFD Pattern / Pressure



Displacement / Reaction Force

Spring System Optimization



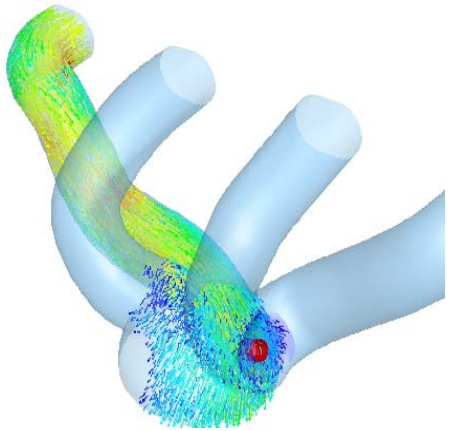
Stress

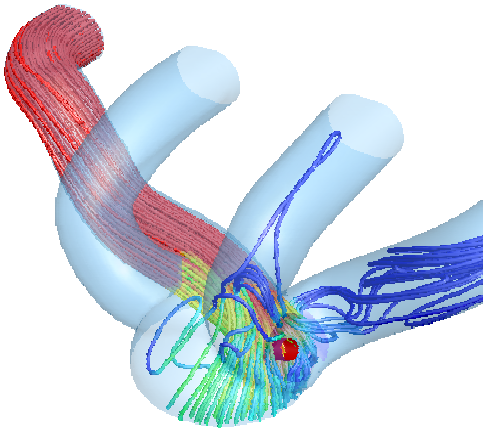
- **The structural analysis combined the fluid dynamic analysis provides can give good informations for the control of system and also in upgrading the performance of the nonlinear stiffness & strength**

Product Engineering

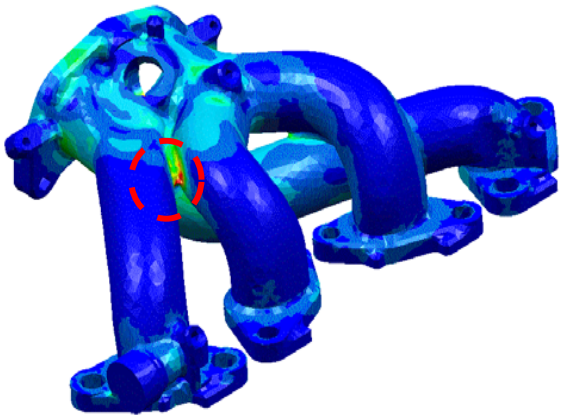
CFD + Durability Engineering

☞ **Exmanifold Characteristics analysis**

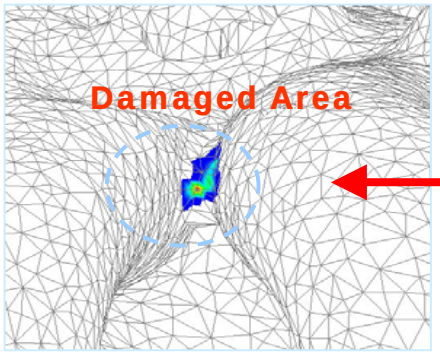


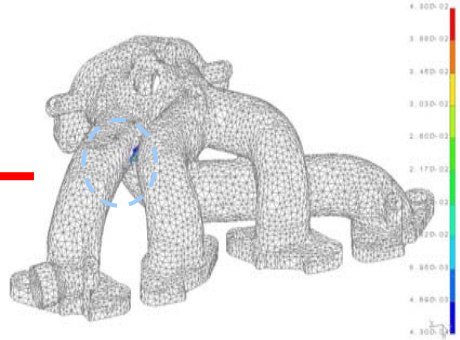


▷ **Unsteady State CFD Analysis**
- O2 Sensor Location

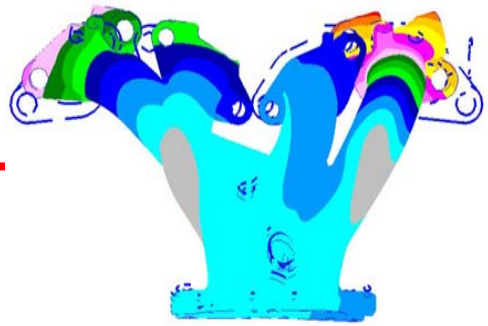


▷ **Heat Stress & Transfer Analysis**





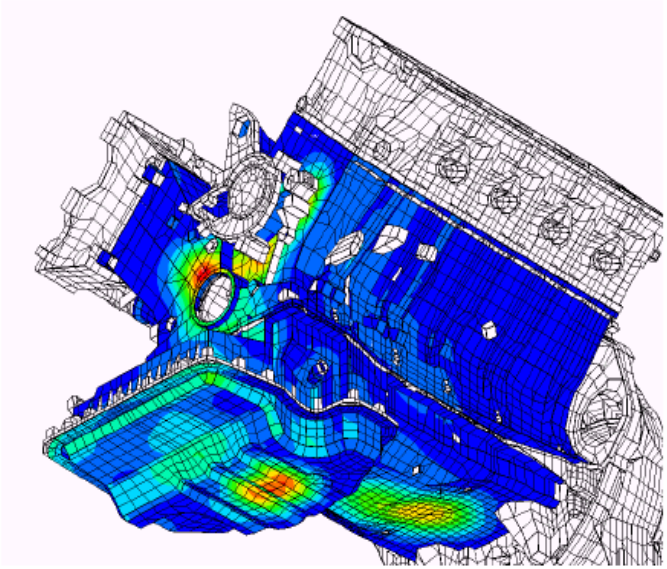
▷ **Heat Fatigue cycle**

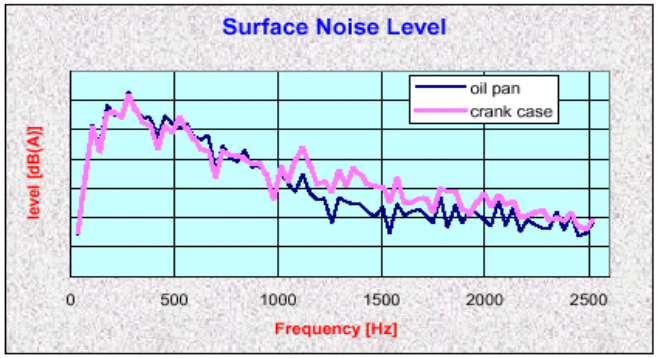


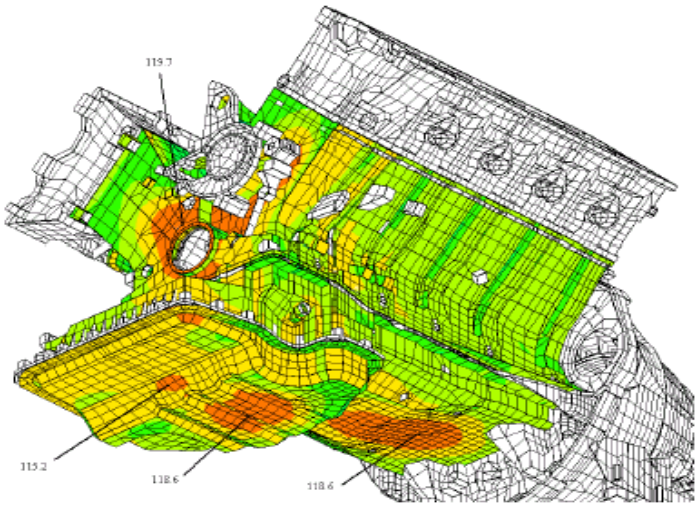
▷ **Vibration Analysis - Stiffness**

Product Engineering

☞ Acoustic Characteristics analysis



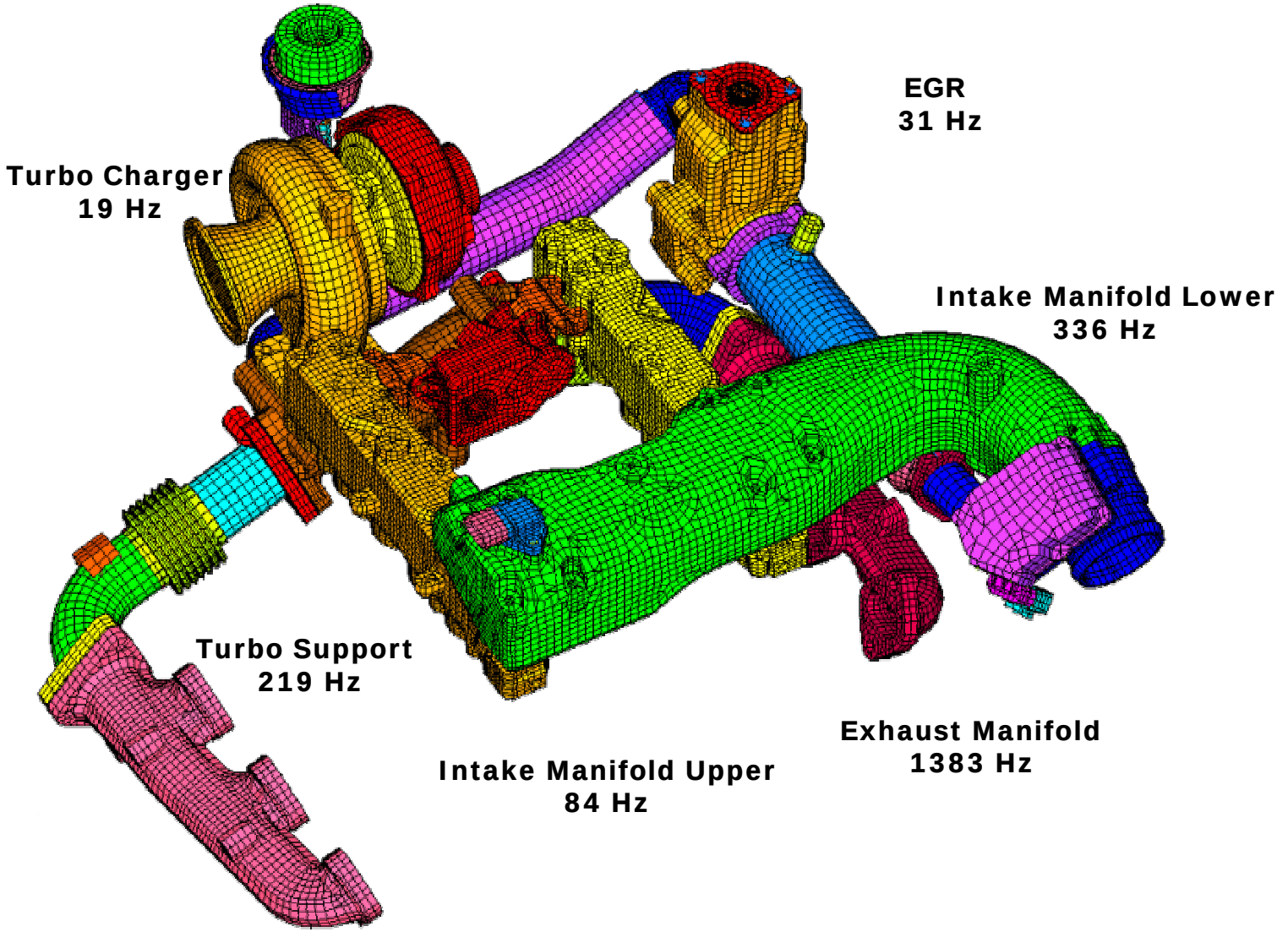




▷ **Surface Noise (Radiation) level**
- frequency response method
- random response method

Product Engineering

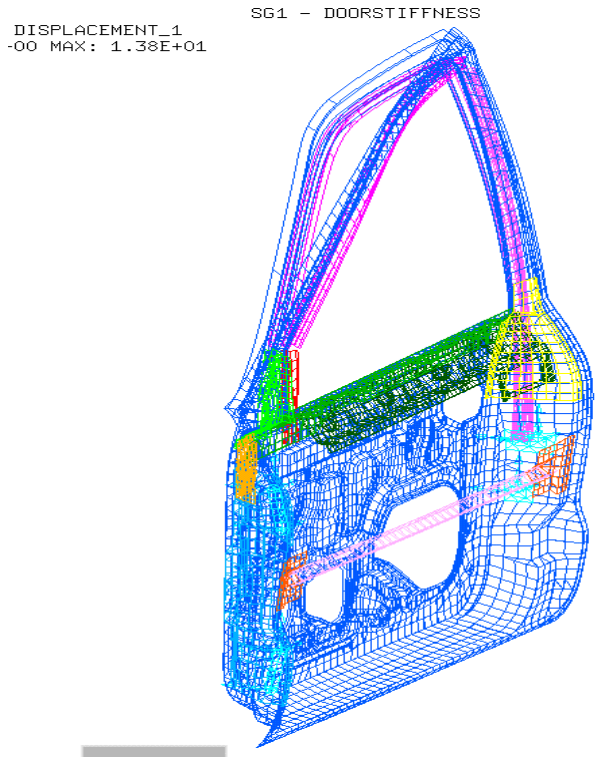
N.V.H Engineering

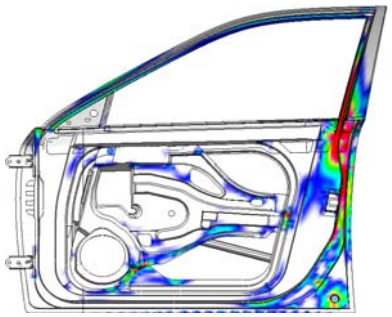


Product Engineering

Specialized Engineering

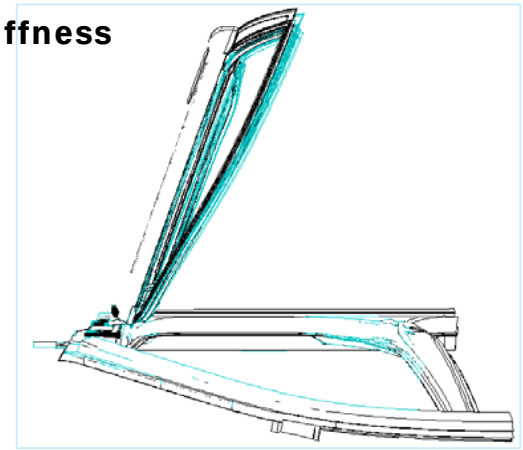
☞ Door Stiffness & Strength Analysis

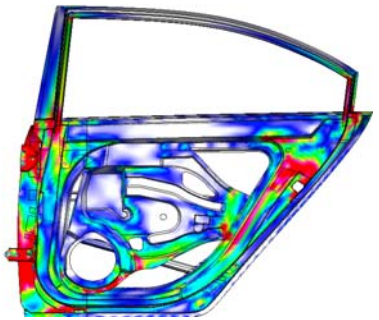




Glass Frame Stiffness

Door Beltline Stiffness & Strength
Glass Frame Stiffness & Strength
Sagging Stiffness & Strength
Denting Stiffness & strength



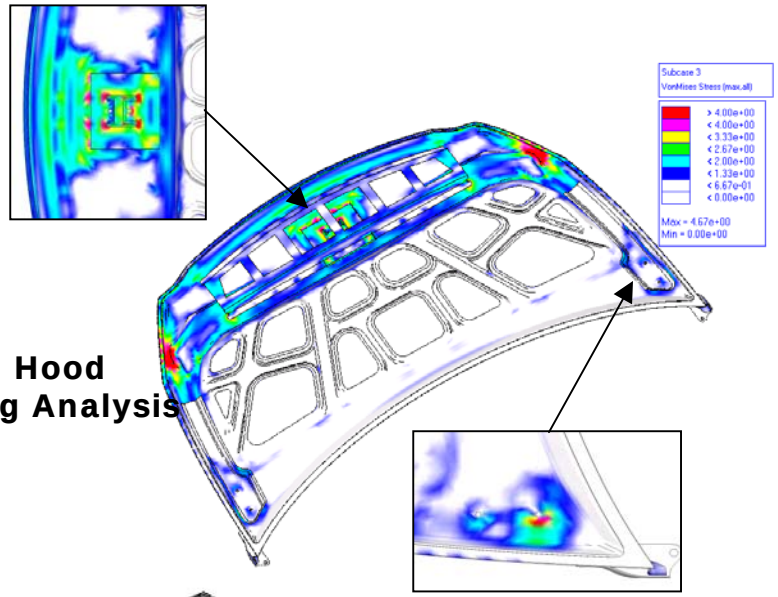


Sagging

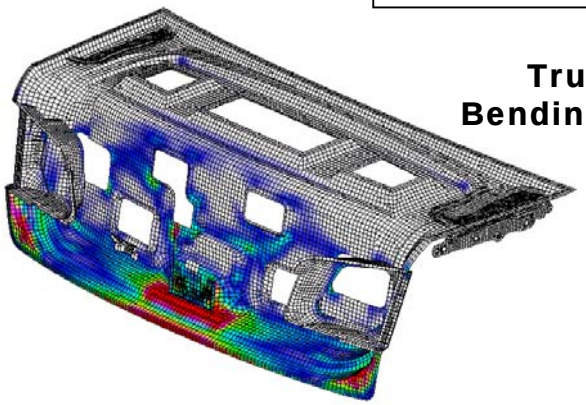
▷ **The quality of car is strongly influenced by the door**
It has a lot of the assembly systems, the requirements are found in regulations.
Door analysis provides the detailed information required to satisfy basic performance.

Product Engineering

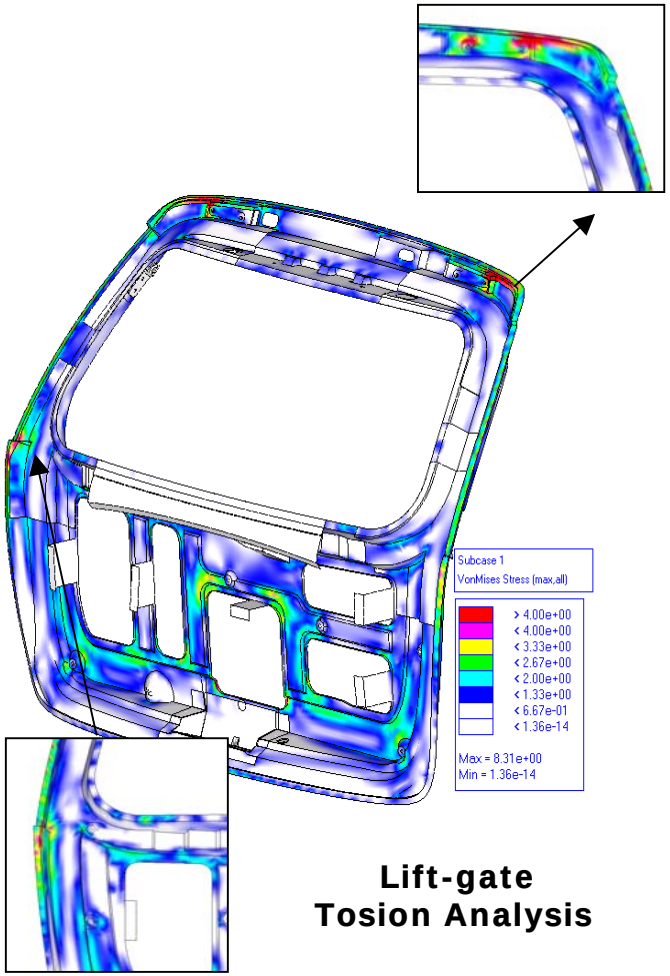
☞ Moving Closures Analysis



Frt Hood Bending Analysis



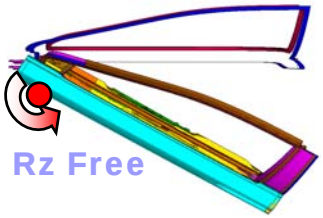
Trunk Lid Bending Analysis

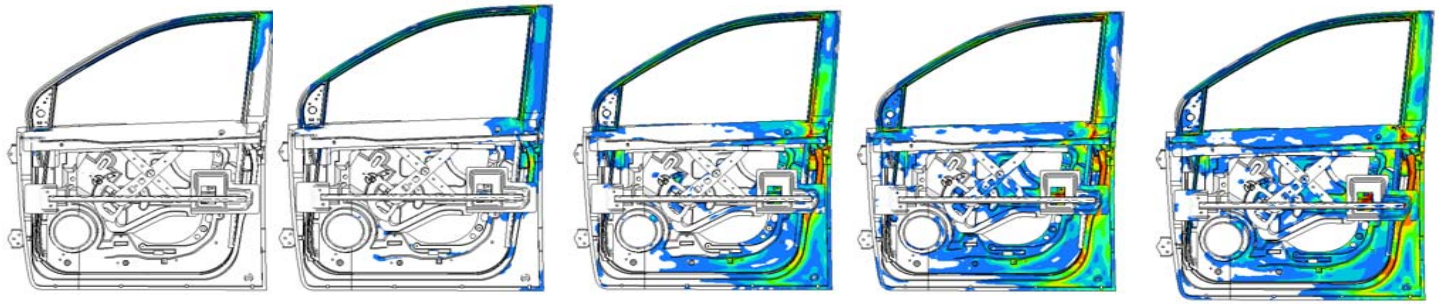


Lift-gate Tosion Analysis

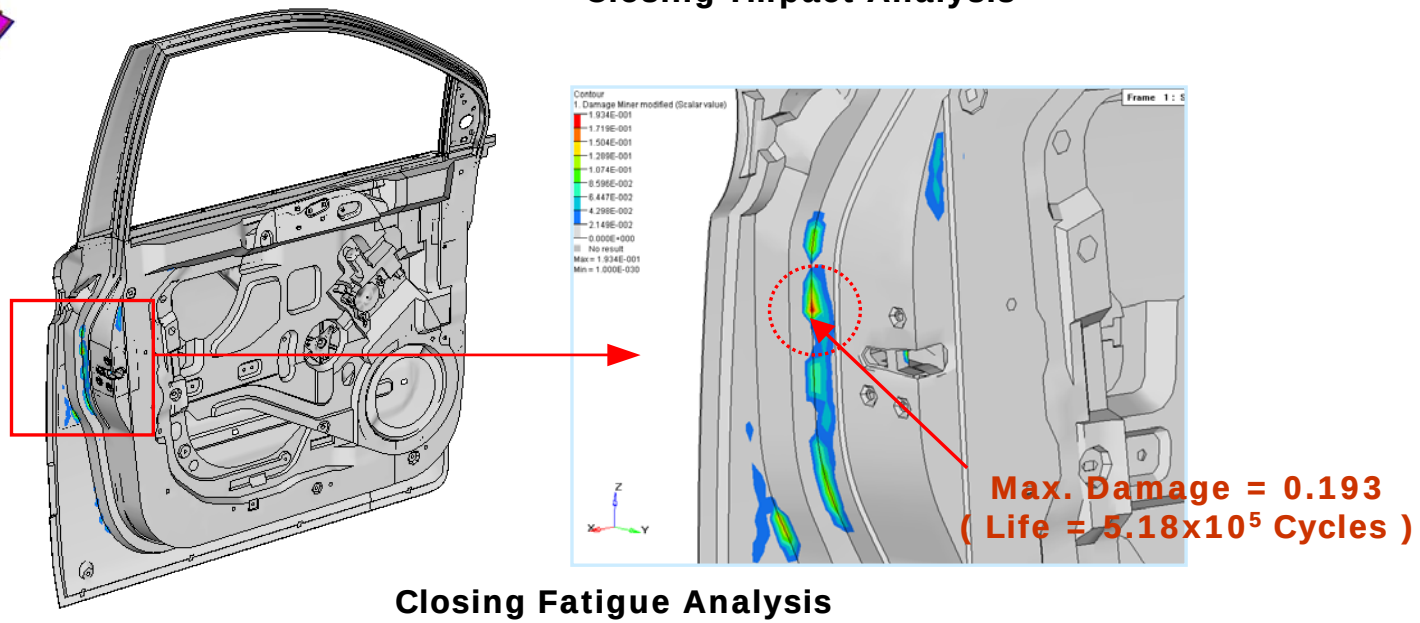
Product Engineering

☞ Closing durability Analysis





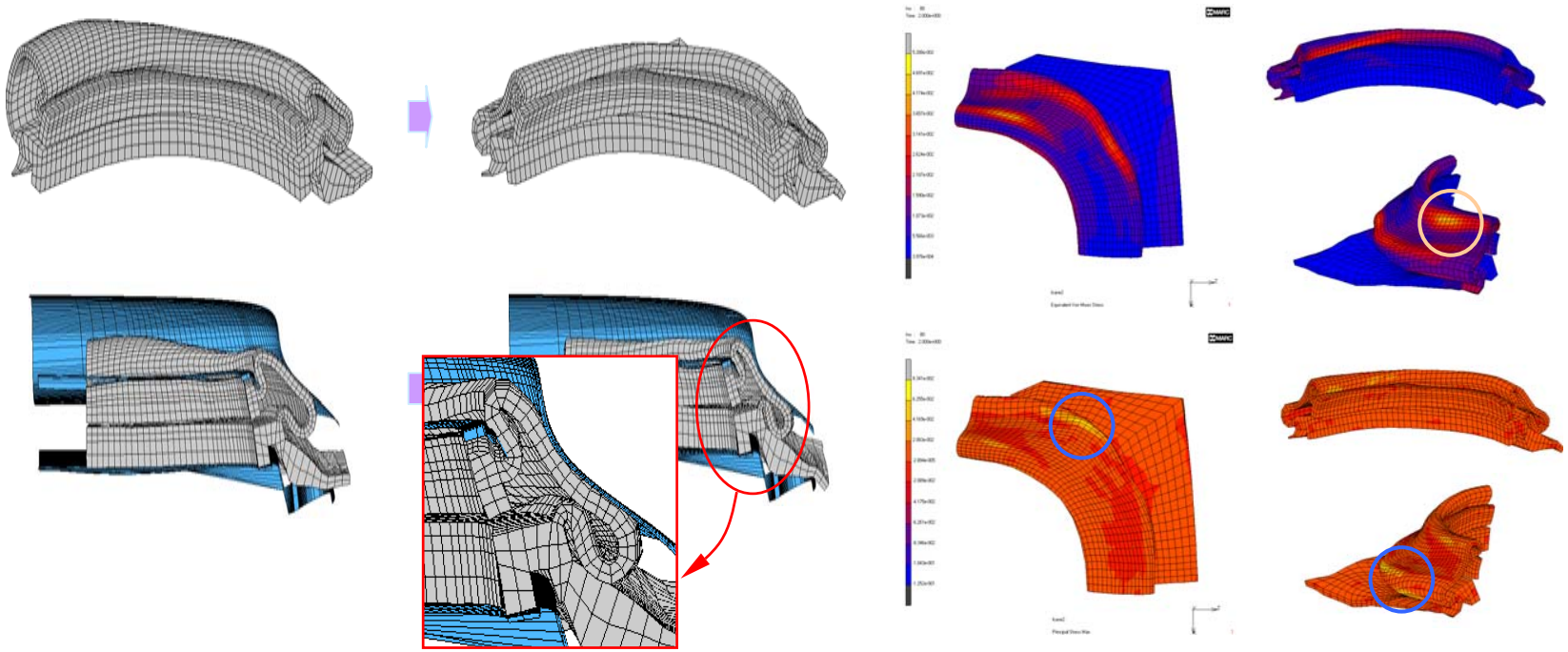
Closing Impact Analysis



Closing Fatigue Analysis

Product Engineering

☞ Door Seal Analysis

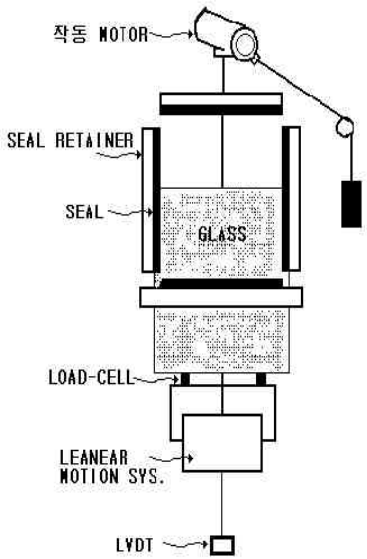


▷ **Durability of door and feeling from door vibration in closing state is dominated by W/Strip behavior. The seal analysis with large deformation provides the detailed design information required to satisfy these performance.**

Product Engineering

Specialized Engineering

☞ Door Glass Lifting Test & Analysis

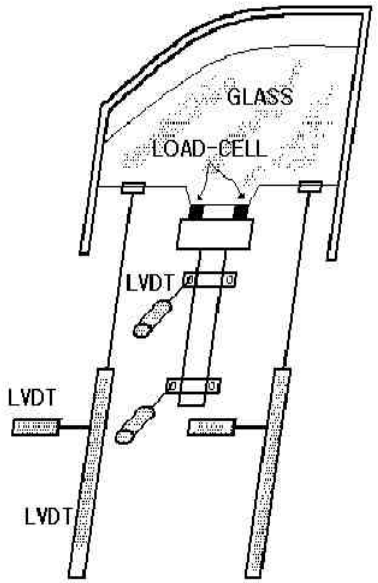


Seal Friction Test Model

DATA ACQUISITION
- -lifting Force
- -displacement
- -Time

DATA EVALUATION
- -displacement & Force & velocity & avarage velocity

DATA 활용
- -Glass lifting analysis Input Data



Glass lifting Correlation Test Model

DATA ACQUISITION
- -Glass lifting Force & Disp.
- -R/Guide disp.
- -lifiting Time

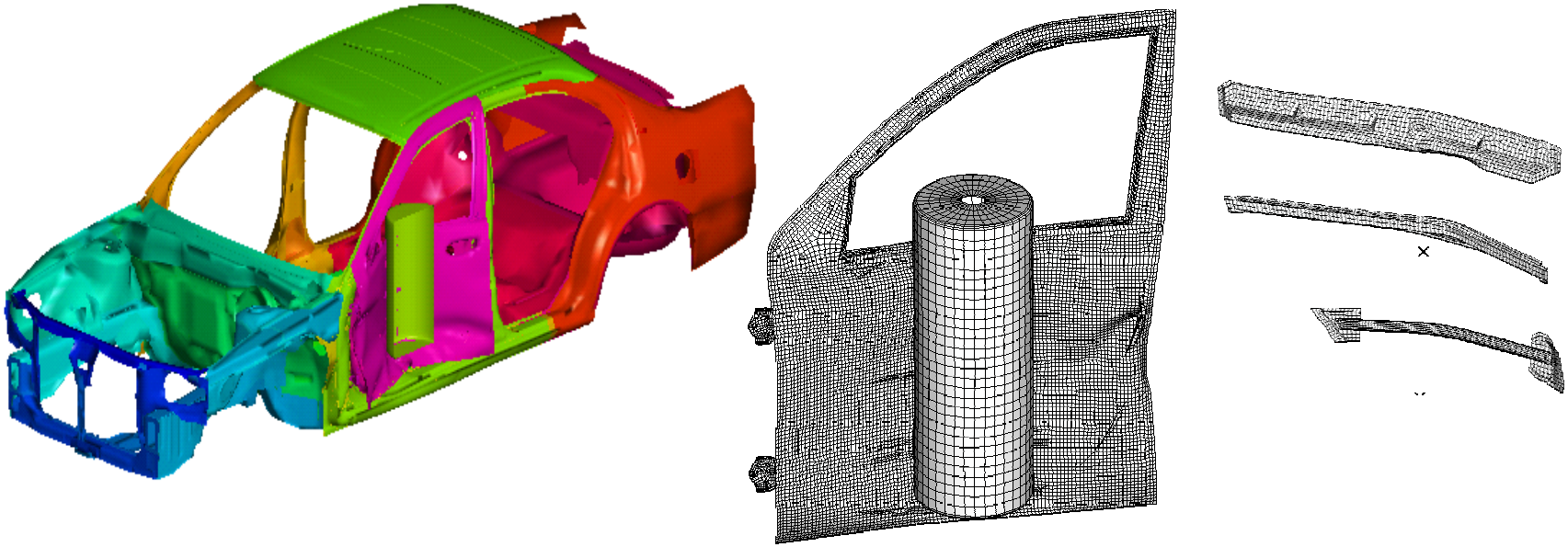
DATA EVALUATION
- -disp. & Force
- -disp. & velocity
- -avarage velocity

DATA 활용
- -Glass lifting analysis Correlation
- -factor study

▷ **Glass Lifting is activated by the complicated behavior with multi-kinetic system. And it is satisfied by moving durability performance. Door lifting analysis can give a information about friction force, moving direction.. This analysis should be correlated the test result.**

Product Engineering

☞ Door Side Intrusion (FMVSS 216)



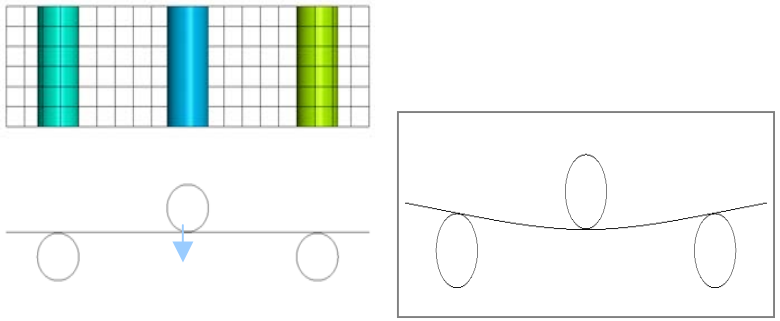
▷ **For the requirements of the FMVSS 214 side intrusion strength tests, door & attached area with pillar should be able to sustain an average crush resistance against the large deformation with 18 inch. During the analysis, the loading device is placed with its axis vertical and cylindrical surface in contact with the door surface for application of the load.**

Nonlinear strength analysis with ABAQUS or MARC enables engineers to optimize full door structure with impact beams.

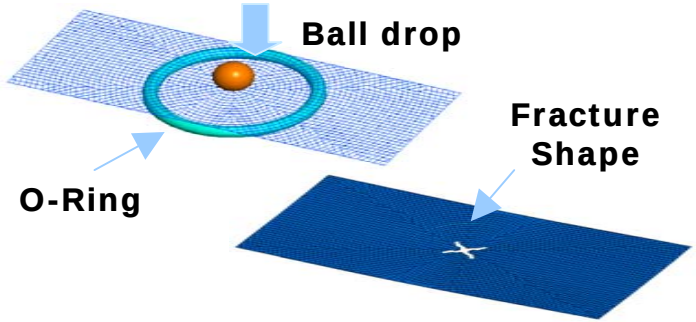
Product Engineering

Electronics

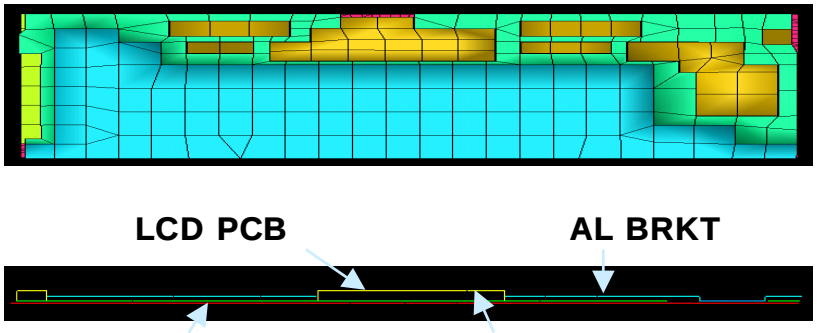
☞ LCD Panel Analysis

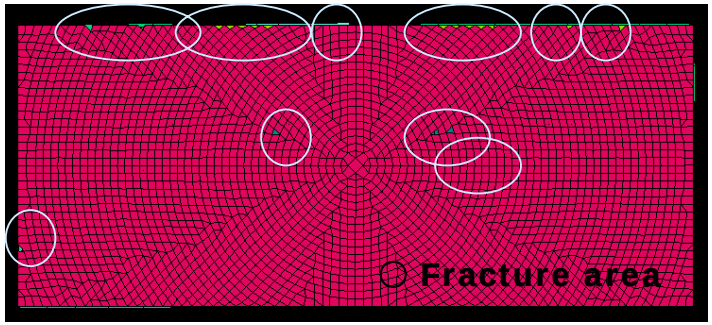


Panel Bending analysis



Ball drop analysis





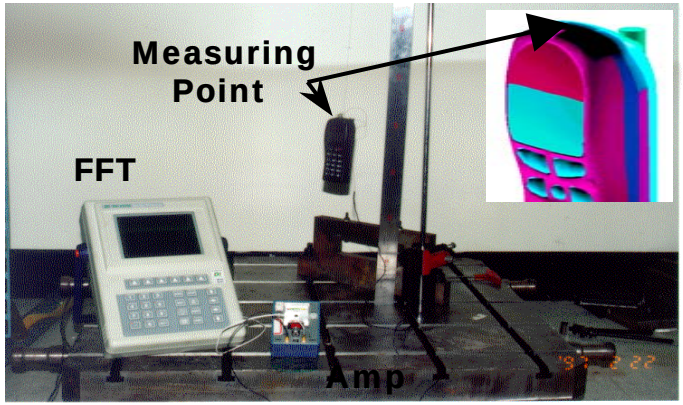
Drop analysis of LCD Module

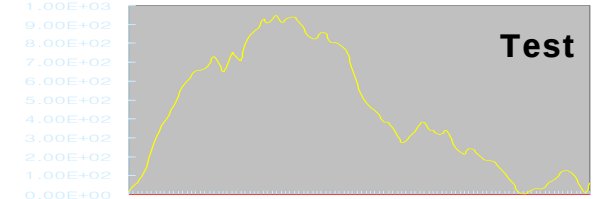
▷ LCD Drop Impact analysis measures the LCD Ass'y structure's capability to absorb the crash kinetic energy and give a guideline of Modeling & design

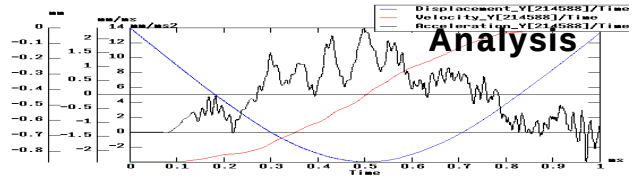
Product Engineering

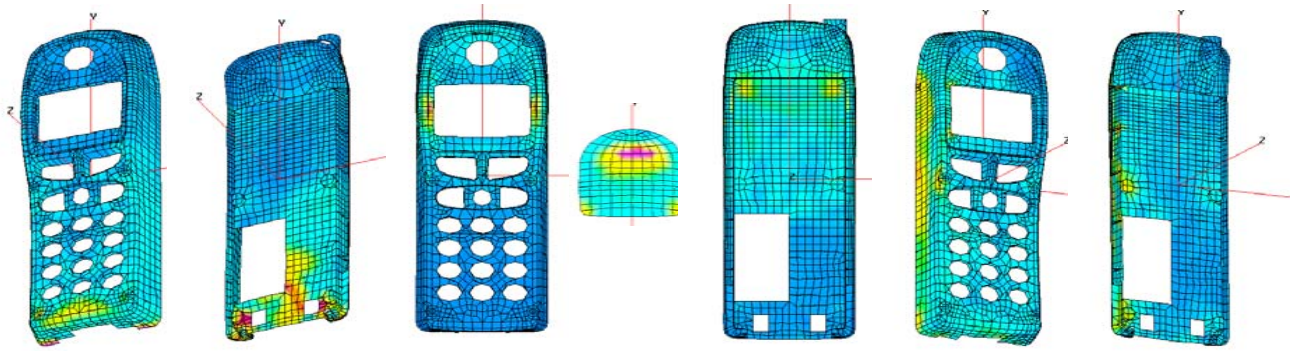
Electronics

☞ Portable Handy Phone Analysis

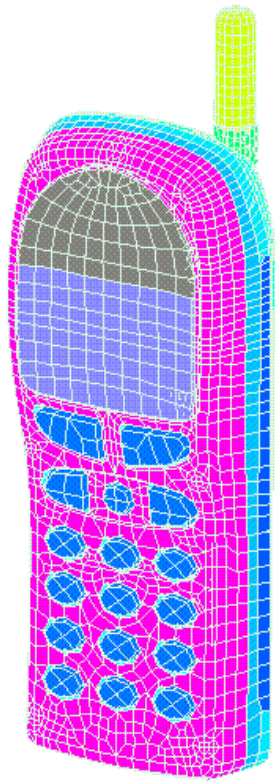








Bottom Drop Front Drop Lateral Drop

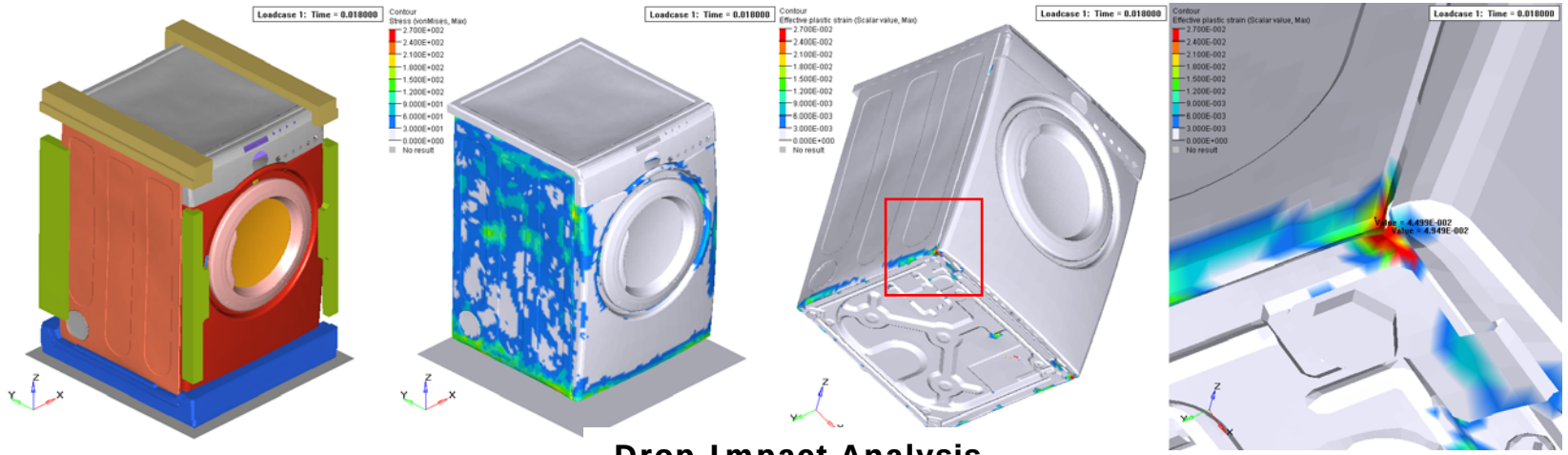


▷ **Fragility analysis measures the handy phone structure's capability to absorb the crash kinetic energy in service drop condition and give a guideline of design (Housing, PCB, Shield etc.)**

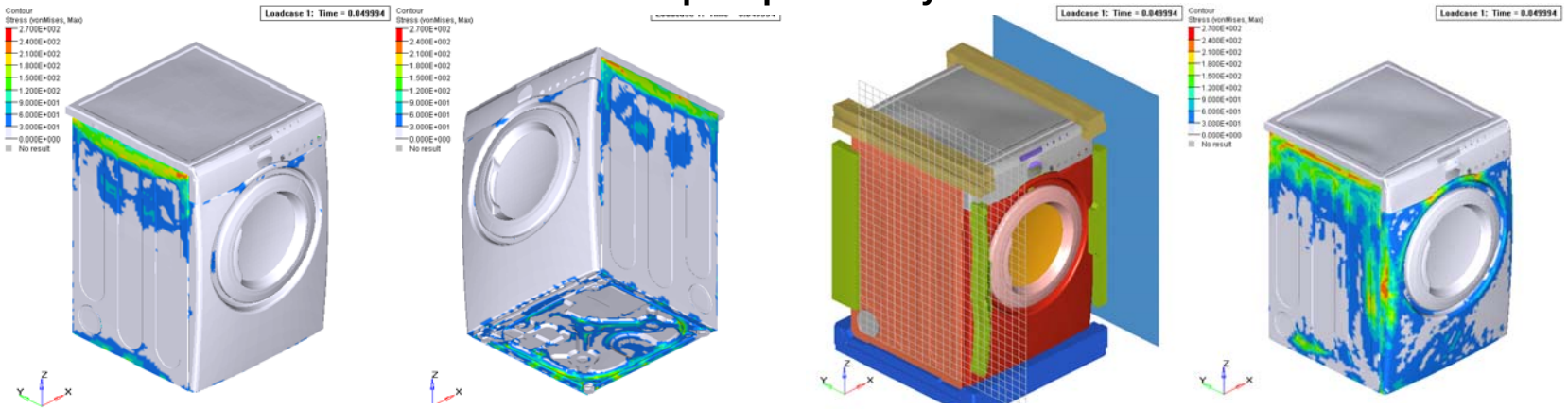
Product Engineering

Electronics

☞ Dryer Analysis



Drop Impact Analysis



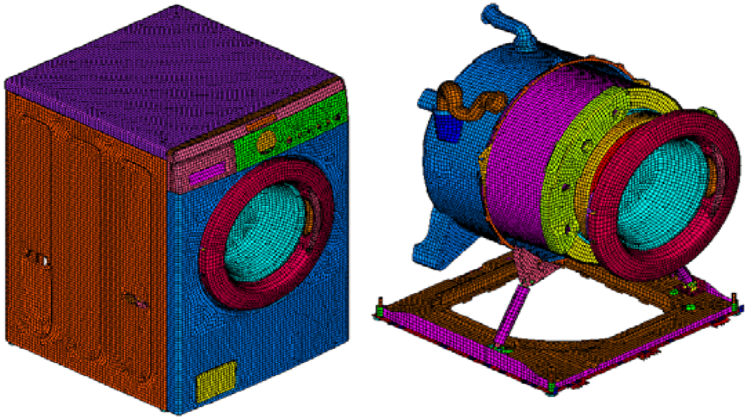
Warehouse Stacking Analysis

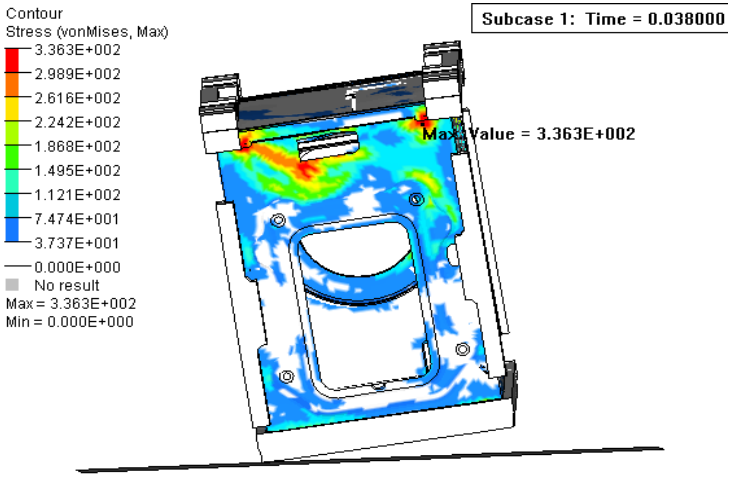
Clamping Analysis

Product Engineering

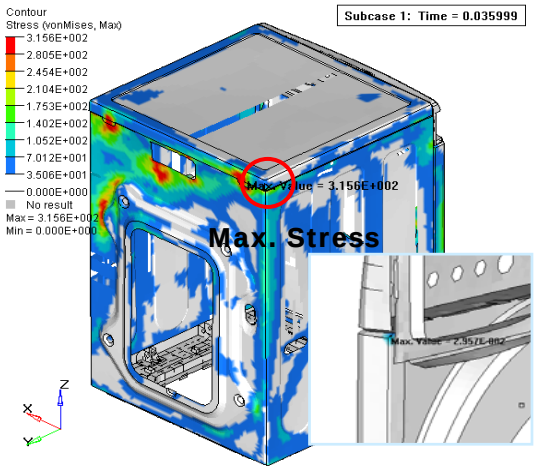
Electronics

☞ Washer Analysis

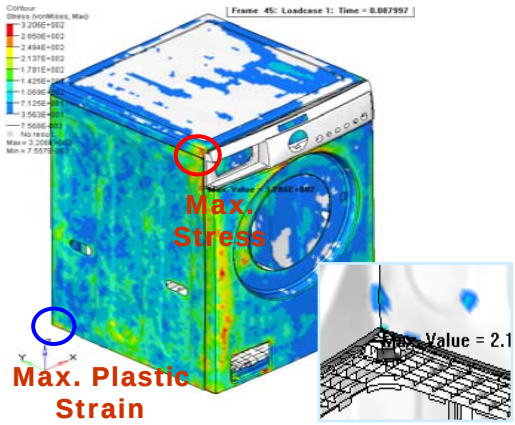




Drop Impact Analysis



Bolt Hazard Analysis

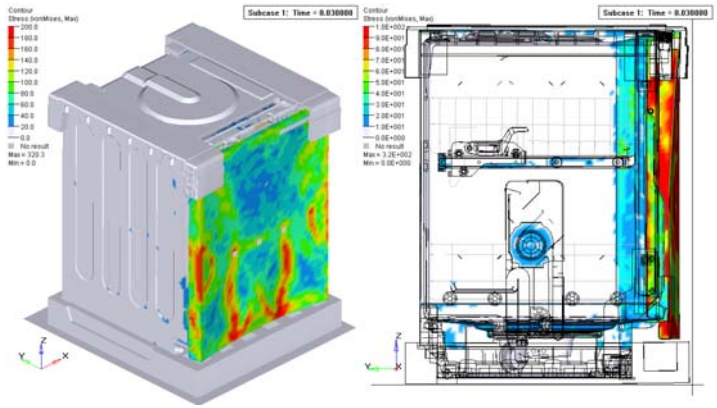


Clamping Analysis

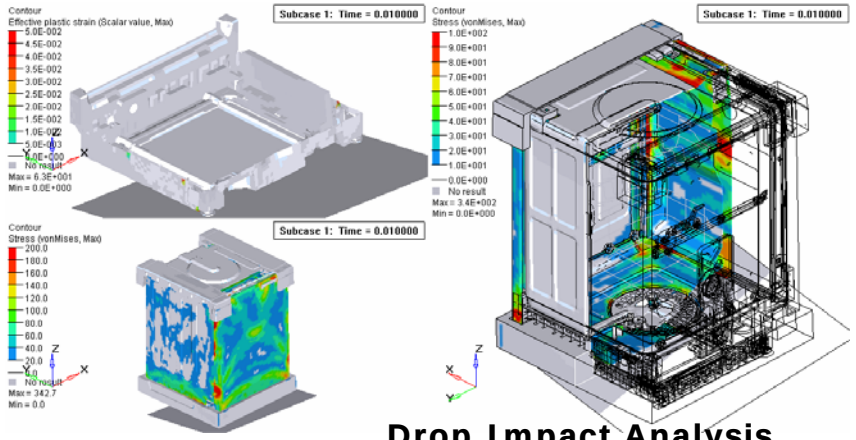
Product Engineering

Electronics

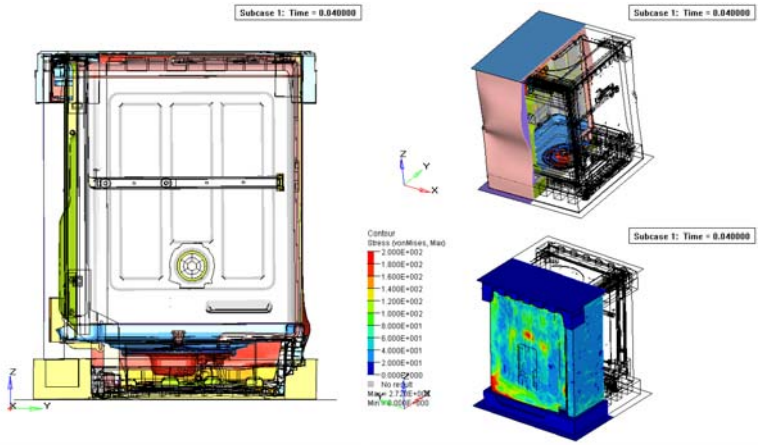
☞ Washer Analysis



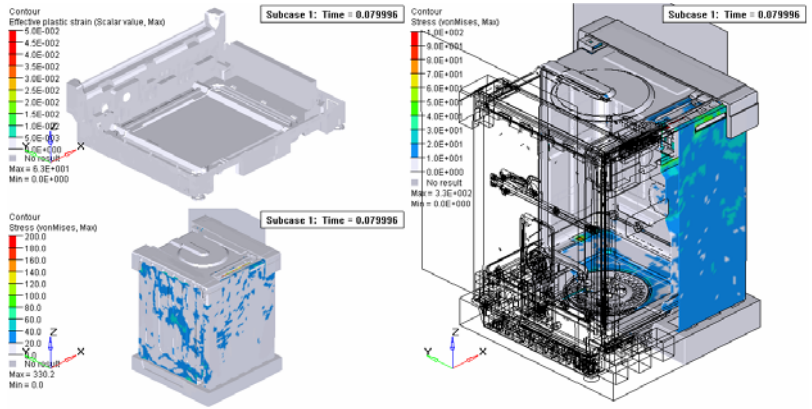
Warehouse Stacking Analysis



Drop Impact Analysis



Bolt Hazard Analysis



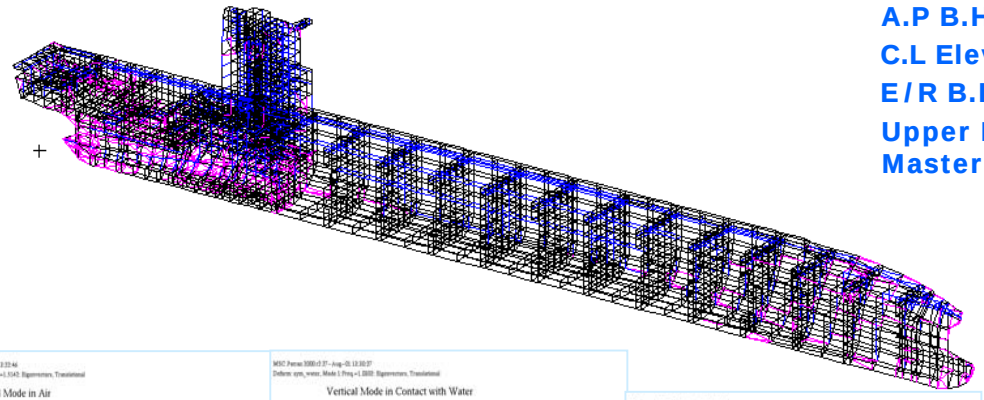
Clamping Analysis

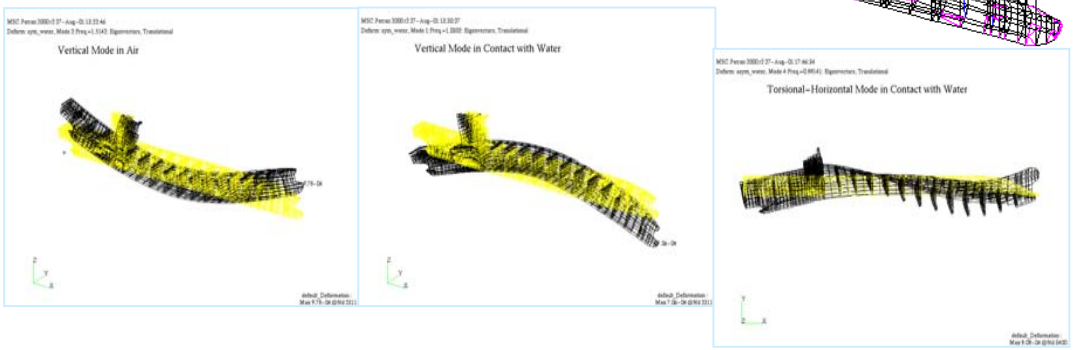
Product Engineering

Ship Building

☞ Exhaust System Vibration Analysis

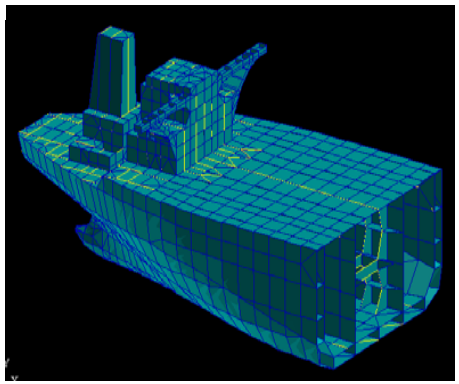
Global Hull Concept Model

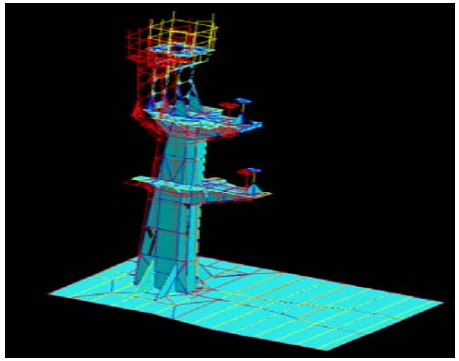




Global Hull Detail Model

Tank-top
A.P B.H.D
C.L Elevation
E/R B.H.D
Upper Deck
Master



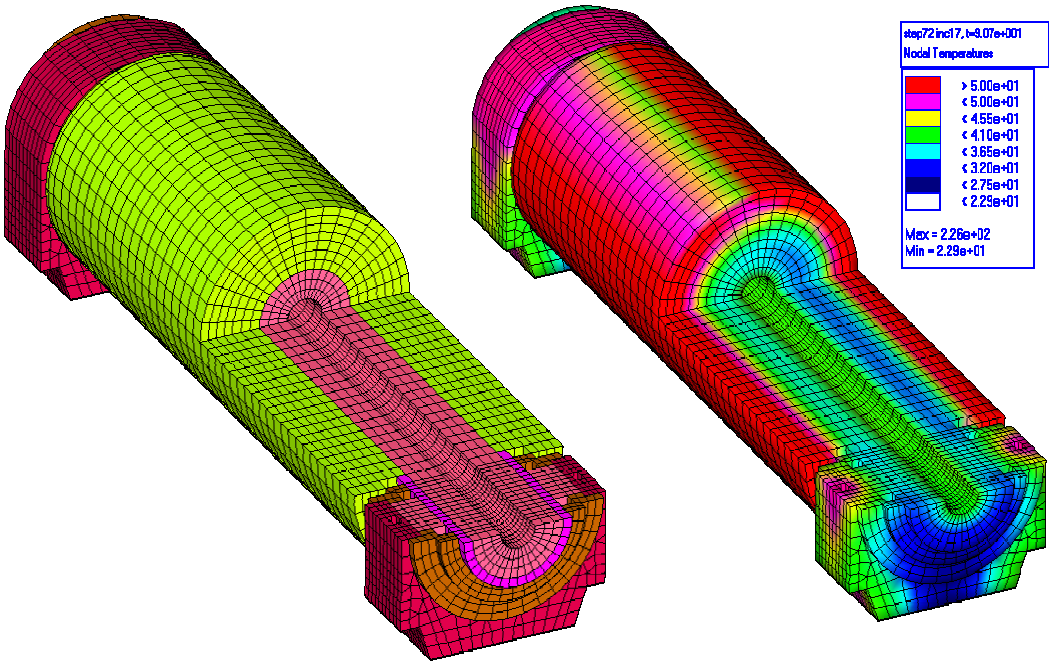


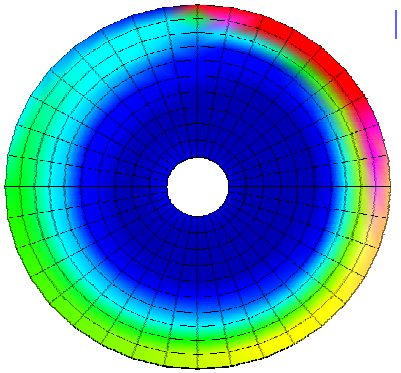
▷ **B.I.W vibration analysis are carried out to evaluate stiffness and vibration, estabilish targets for new products and to provide the detailed information required to estabilish individual performance criteria for major component and sub body system**

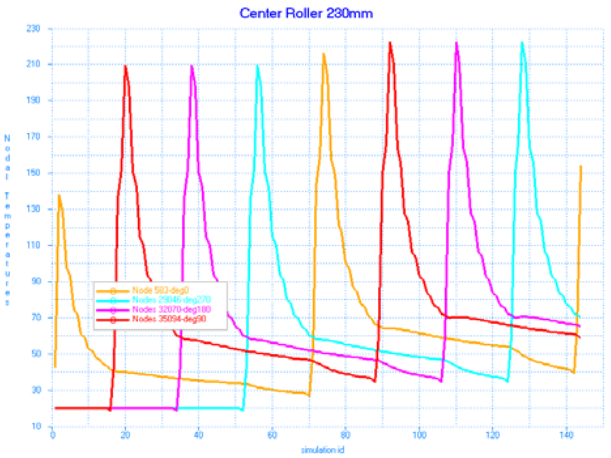
Product Engineering

Steel Making

☞ Roller Heat Stress Analysis





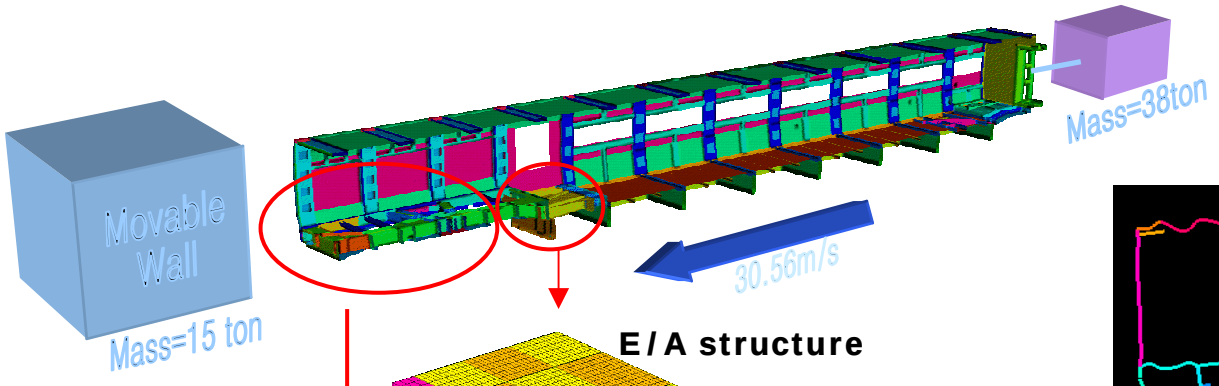


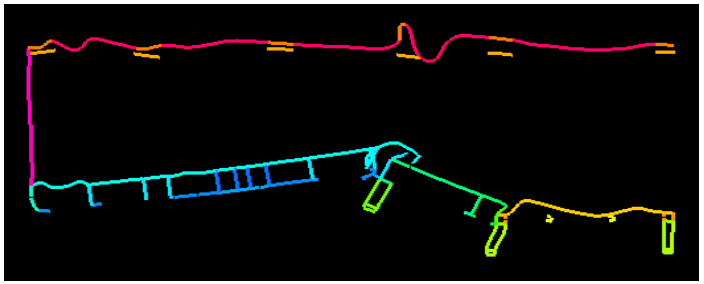
- **Heat transfer analysis & heat stress analysis can be of great assistance in prodicting the weak area for the heat stress with cyclic heat loading & transient condition**

Product Engineering

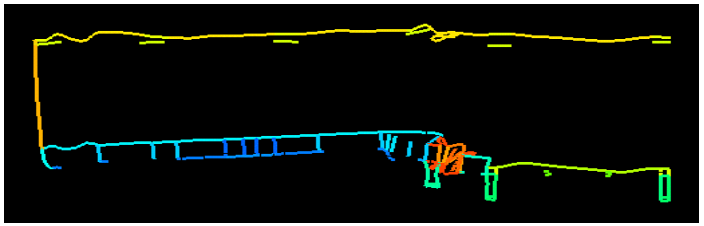
Heavy Vehicle

☞ **High Speed Train Crash Analysis**

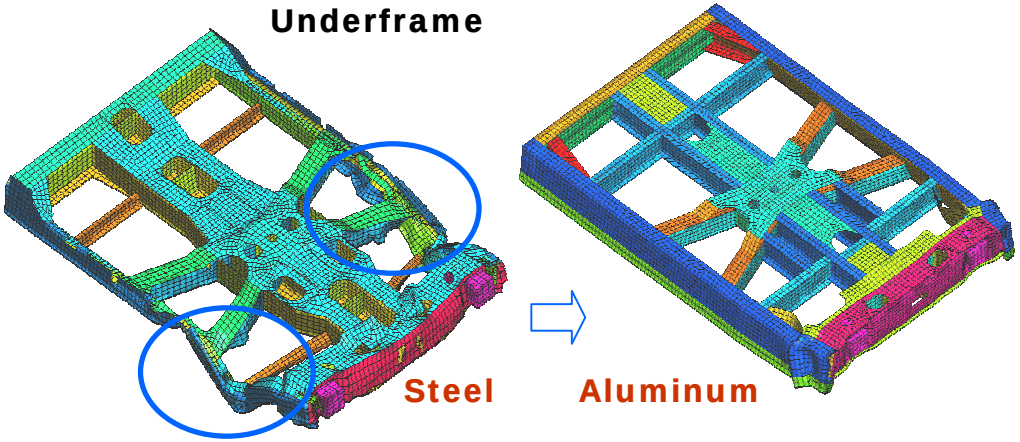




Without E/A Member



With E/A Member



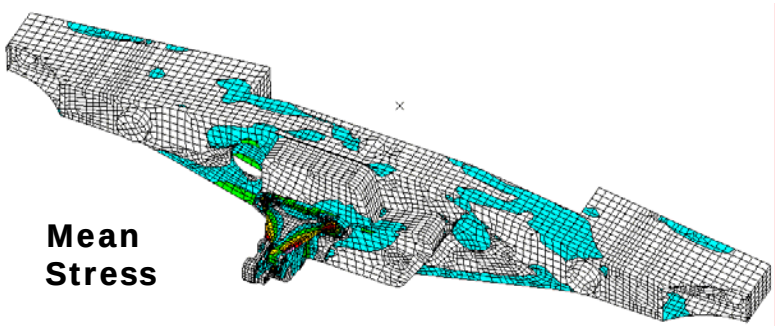
Hinging Area

No hinging / Section & Thickness upgrade / Weight down

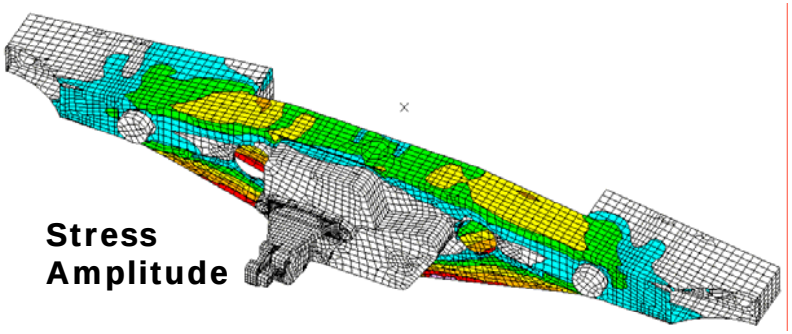
Product Engineering

Heavy Vehicle

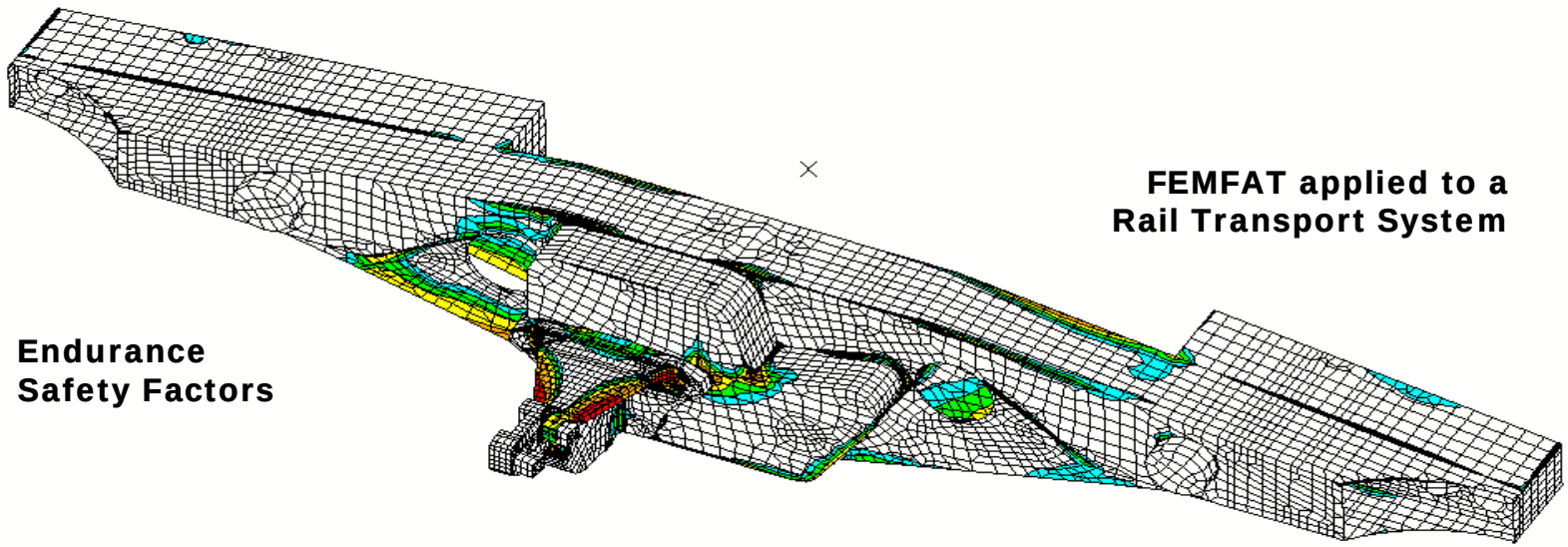
☞ **Rail transport system fatigue Analysis**



Mean Stress



Stress Amplitude



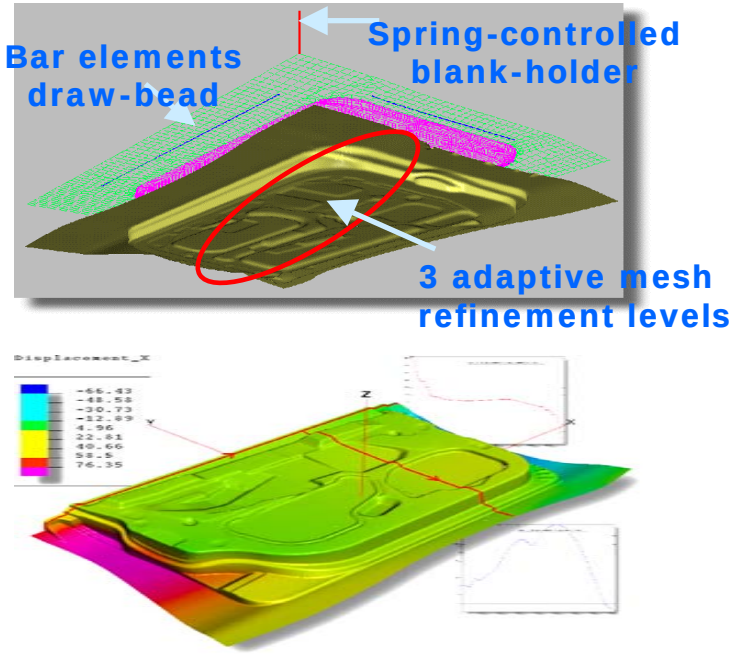
Endurance Safety Factors

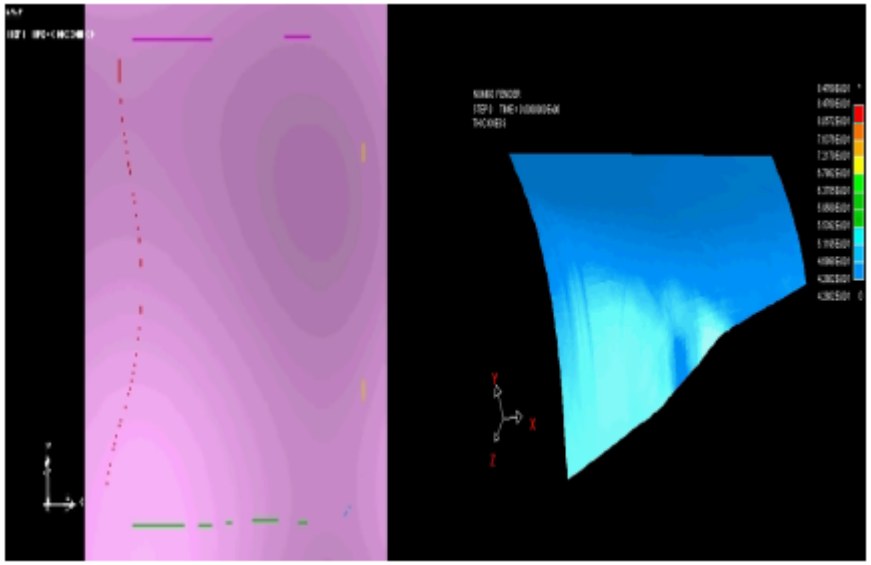
FEMFAT applied to a Rail Transport System

Product Engineering

Manufacturing Engineering

☞ **Door Inner Panel Stamping Analysis**



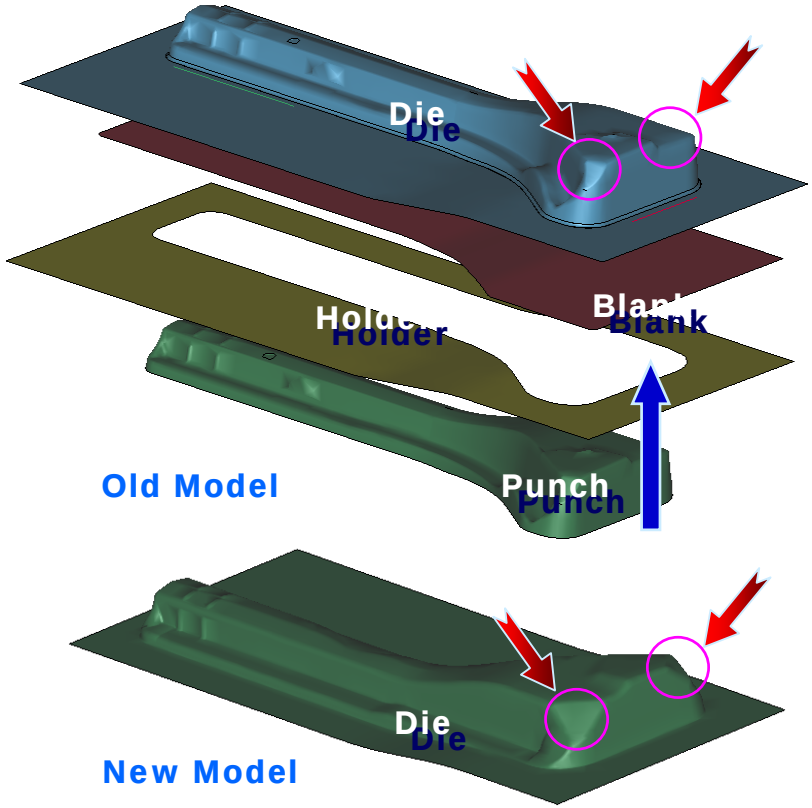


▷ **The analysis must predict correctly the final geometry and distribution of thickness with sufficient accuracy, predict to help a avoiding wrinkling and rupture of the blank, and the outer body parts avoid the sliding over the angles of the die.**
In addition optimizing the material losses and the number of strokes is essencial for the overall benefit.

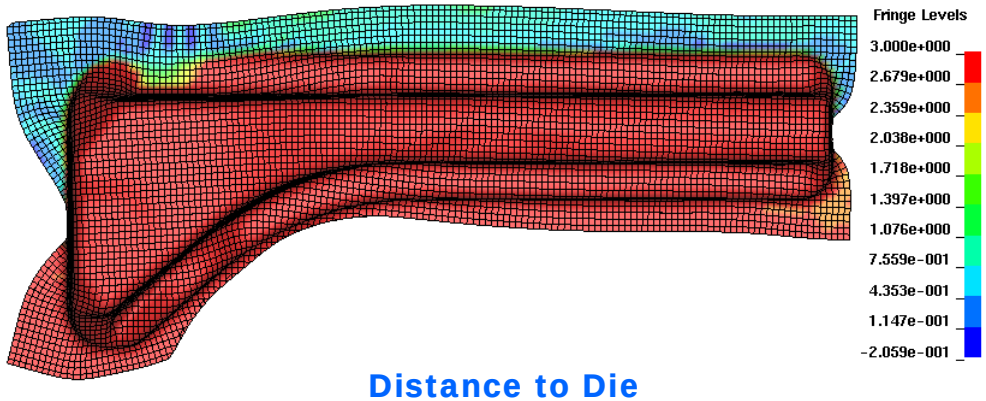
Product Engineering

Manufacturing Engineering

☞ Panel Stamping Analysis



■ Wrinkle

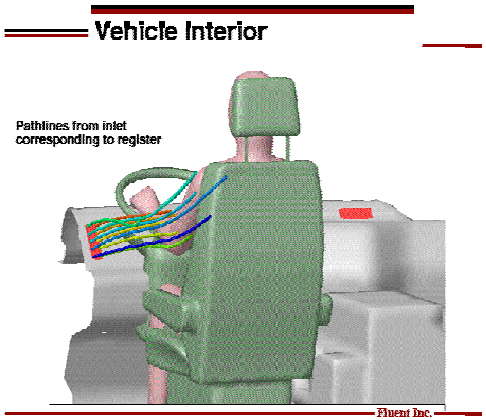


Distance to Die

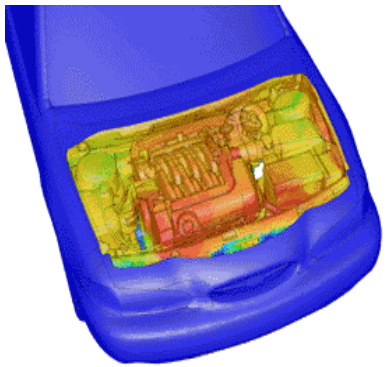
▷ **Blanking holding force should be upgraded to cancel wrinkle generation**

Product Engineering

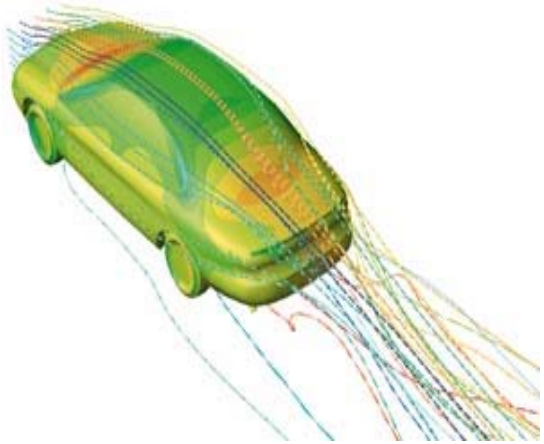
☞ Vehicle Airo-dynamis & Cooling Analysis



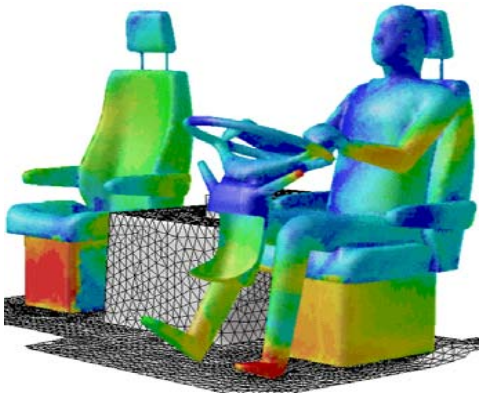
Cabin Inner Flow

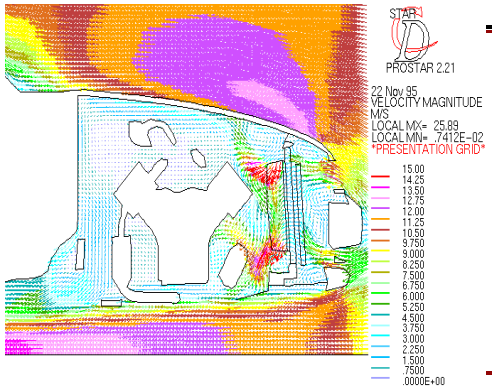


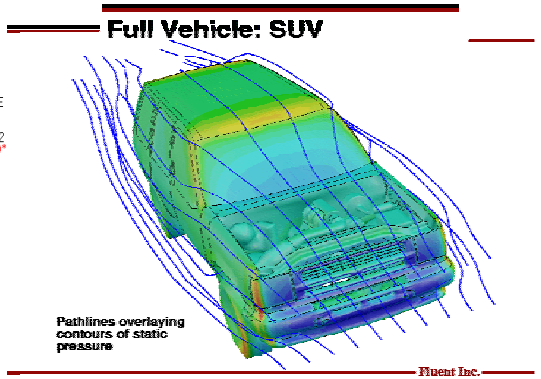
Underhood Flow



External Aerodynamics





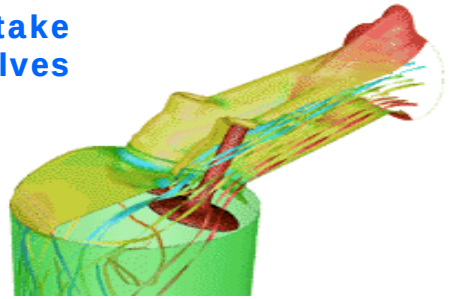


Product Engineering

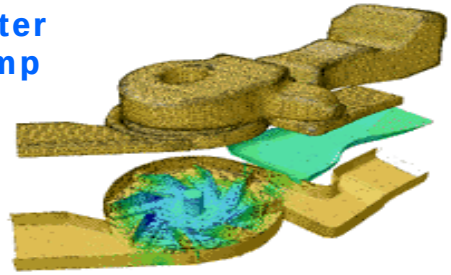
CFD Engineering

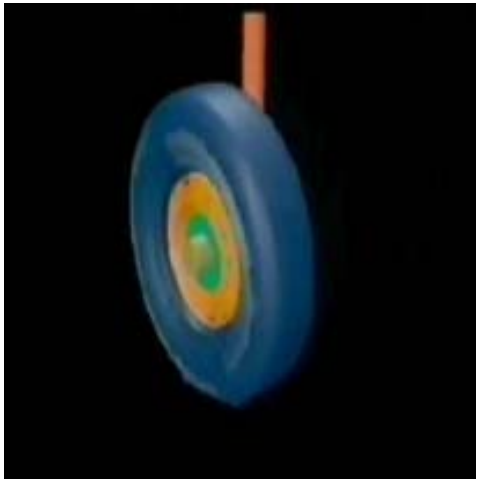
☞ **Component Airo-dynamis & Cooling Analysis**

Intake Valves

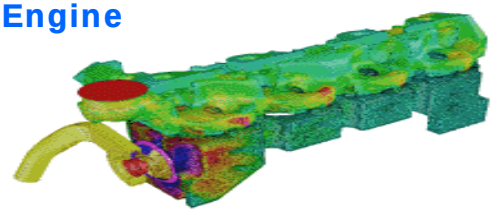


Water Pump

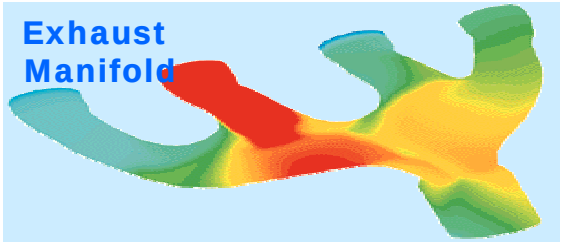




Engine



Exhaust Manifold



▷ **Comparisons with experimental measurements showed that numerical simulation can provide accurate predictions of the air flow and contaminant transport in the cavity. It rquires a proper selection of simulation parameters. Obstacles and objects in the room have an unpredictable effect on the air flow, so it is difficult to develop general guidelines concerning optimal ventilation performance. Each configuration requires a specific assessment.**