



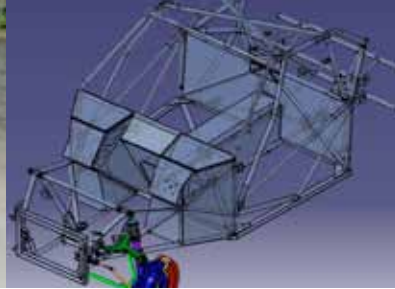
LMS Samtech

TEA Pipe

Transparent Extended Analysis
for Flexible Pipe Analysis

 **LMS**[®]

A Siemens Business



TEA Pipe is a professional product allowing designers and mechanical engineers to perform advanced non-linear mechanical simulation analyses of pipes (flexible pipes and air/water pipes) within CATIA V5.

WHY SIMULATE THE MECHANICAL BEHAVIOR OF PIPES?

Automotive sector has been evolving a lot since the turn of the century. Vehicle manufacturers are constantly trying to come up with more robust and more cost efficient solutions. Design cycles and overall time-to-market must become shorter and shorter. Pipe manufacturers must increase their products reliability by eliminating the expensive iterations during design process. They want to check as soon as possible some key features of their pipes: curvature, number of connectors and supports, detection of possible collisions...

TEA Pipe provides you with a comprehensive and very powerful software for pipes analysis. It allows the use of a Pipe Manufacturer Database.

TEA Pipe Beam

Beam elements are used to model different types of flexible pipes like brake, steering, gearboxes cables or electric cables...

TEA Pipe Beam offers 2 strategies:

- **Simulation:**
The user defines the parameters of the pipe (like length, diameter, material, Connectors position and orientation, stiffeners, spirals, supports...) and how the pipe is linked to the car Kinematics (real configurations imported from DMU Kinematics). Then TEA Pipe calculates the deformed shape, curvatures, efforts and collisions information for successive configurations. This simulation can be performed in the case of quasi-static loading or in dynamics (linear so to check vibrations of a pipe linked to a vibrating car body, or full non-linear so to check inertia effect on, for example, an off-road vehicle). This simulation can also be applied to an assembly of pipes (T junction, octopus...)
- **Optimization (TEA Pipe Optimization):**
The user must explain what are the design variables, the design constraints and must choose the objective function (either minimal length, or maximal safety). Then TEA Pipe performs a parametric study or a real optimization, proposing to the designer a possible optimal design for the pipe (connectors positions or orientations, pipe length...)

TEA Pipe Shell

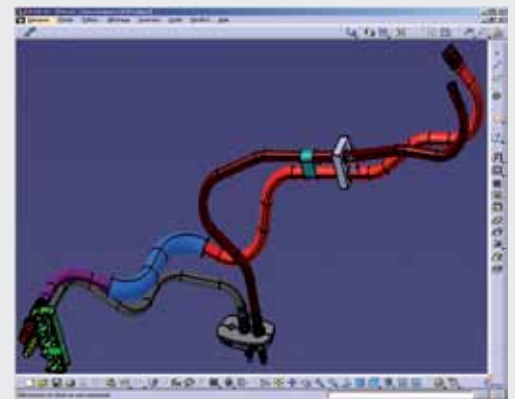
Multi-layer shell elements are used to simulate air, water pipes...

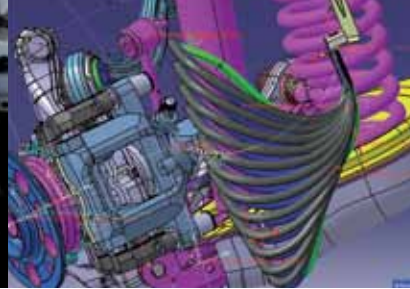
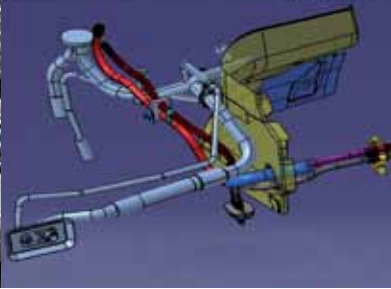
After defining the initial geometry and material, the user performs a simulation taking into account vulcanization process in the case of pre-shaped hoses. The effect of an eventual internal pressure and then of motor displacements are calculated. Deformed positions of the pipe are displayed. This type of model is able to simulate very precisely ovalization or local buckling leading to a very precise calculation of the deformed geometry of the hose.

YOUR BENEFITS

With TEA Pipe, you enter in a cutting edge technology:

- You are able to produce quickly flexible and air/water pipe models by adding specific pipes features to an existing model built within CATIA V5;
- You use a single user interface for the geometry definition, the mechanical analysis data definition, the meshing, the launch of the solver and the post-processing;
- You benefit from SAMTECH recognized expertise in engineering and software quality. SAMCEF Mecano stands on a high world-class position for its powerful non-linear solving capabilities and BOSS quattro is recognized for its advanced features in optimization;
- You perform high level mechanical simulations within a complete and integrated CAE software for mechanical design;
- You use a high quality software able to increase your product reliability by eliminating the expensive iterations during design process;
- You will work with increased efficiency, saving both time and money.





CATIA V5 MODELING ENVIRONMENT

TEA Pipe is perfectly embedded in CATIA V5 for the modeling, the non-linear mechanical analysis and the post-processing of pipes. The results that can be post-processed include deformed mesh, nodal normal distance, curvature, force, moment and successive configurations. Deformed CATIA

geometries linked to the pipe can be generated as well as CATIA DMU objects such as replays or swept volumes. TEA Pipe benefits of advanced analysis visualization tools of CATIA V5.

TECHNICAL CHARACTERISTICS

TEA Pipe Beam:

- General capabilities
 - Solution based on CATIA V5
- Formulation
 - Non-linear Finite Elements
- Transparent Non-Linear Analysis
 - Minimum data definition for non-linear pipe analysis
 - Automatic choice of solver strategy
 - Very robust collision detection algorithms
 - Management of assembly of pipes
 - Static/Transient/Response/Modal analyses
- Pipe Definition
 - Length, section (full or tube), preformed shape
 - Pipe connectors (Length, Position, Directions...)
 - Pipe material (CATMaterial with thermal dependency) and Pipe manufacturer database
 - Pipe auxiliaries: supports, reinforcements, spirals
 - Input Temperature, Acceleration, Pressure
- Movement Definition
 - Mounting customization
 - Kinematical Definition imported from DMU Replay (Kinematics, Tracks...)
- Available results
 - Deformed pipe shape
 - Distance from surrounding surfaces
 - Curvature, Torsion, Bending, Reaction
 - DMU Pipe Replay, Pipe swept volume

TEA Pipe Optimization:

- Parameters: length, connector Positions...
- Constraints: parameter limits, curvature, collisions...
- Objectives: pipe length, minimize bending...

TEA Pipe Shell:

- General capabilities
 - Solution based on CATIA V5
- Formulation
 - Non-linear Finite Elements
- Transparent Non-Linear Analysis
 - Minimum data definition for non-linear pipe analysis
 - Automatic choice of solver strategy
 - Successive configurations
- Pipe Definition
 - Pipe axis line
 - Pipe section (radius or circle)
 - Pipe internal pressure
 - Pipe temperature
 - Pipe orthotropic property
 - Pipe material and Pipe manufacturer database:
 - Behavior: possible use of multi-layer shell Element;
 - MOONEY-RIVLIN material laws available (for elastomers);
 - Orthotropic law for a specific layer;
 - Temperature dependent.
 - Pipe mesh parameters (FE order, number of element in axial and radial directions)
 - Boundary conditions (extremities movement)
- Movement Definition
 - Each movement is defined in one load case by two axis systems
- Available results
 - Deformed pipe shape
 - Corresponding CATIA V5 pipe shape

REFERENCES

Some customers & partners like DAIMLER, PSA Peugeot-Citroën, BMW... use TEA Pipe for their automotive applications.



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Leading partner in Test & Mechatronic Simulation

LMS is a leading provider of test and mechatronic simulation software and engineering services in the automotive, aerospace and other advanced manufacturing industries. As a business segment within Siemens PLM Software, LMS provides a unique portfolio of products and services for manufacturing companies to manage the complexities of tomorrow's product development by incorporating model-based mechatronic simulation and advanced testing in the product development process. LMS tunes into mission-critical engineering attributes, ranging from system dynamics, structural integrity and sound quality to durability, safety and power consumption. With multi-domain and mechatronic simulation solutions, LMS addresses the complex engineering challenges associated with intelligent system design and model-based systems engineering. Thanks to its technology and more than 1250 dedicated people, LMS has become the partner of choice of more than 5000 manufacturing companies worldwide. LMS operates in more than 30 key locations around the world.



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