ANSYS Multiphysics Solution

Engineers using our flagship products can easily leverage the full breadth and depth of ANSYS physics in their Multiphysics simulations. Industry-leading software from ANSYS enables engineers and scientists to simulate the interaction among structural mechanics, heat transfer, and fluid flow. Using ANSYS solutions, engineers gain the flexibility they need to perform Multiphysics simulations at the level of fidelity and physics coupling they need to solve their problems and design their products. Solutions range from extended physics in flagship products, to one-way data transfer and mapping methods that "glue" physics together, to full two-way coupling for really complex interactions.

Fluids

Fluid dynamics software can help you understand how fluid forces impact your structures and how they can cool or heat your equipment when combined with Multiphysics simulations.

Structures

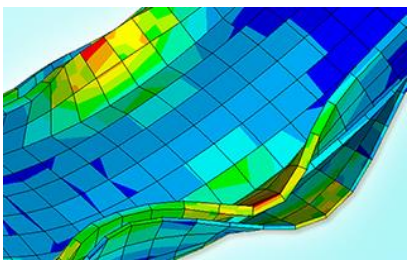
Structural simulation software can give the insight into how structures respond to fluid forces, or thermal changes when included as part of a Multiphysics solution.

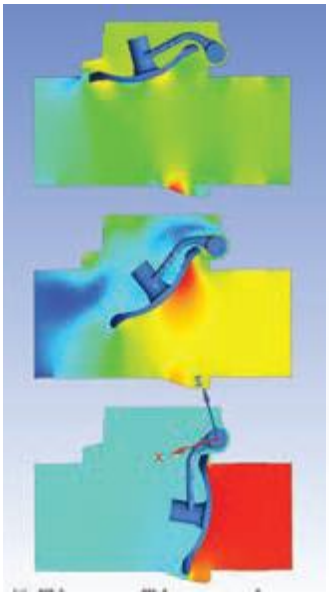
The connections between our product families are the result of a detailed understanding of what it takes to combine physics solvers for high fidelity **Multiphysics** simulations. The options for sharing data among our **Multiphysics**-enabled products enable engineers to deploy their simulation resources wisely.

The flow of fluids through pipe connections, flow meters, valves and distributors — and offshore platform, turbine blades and other structures — can generate unsteady forces on the surrounding parts that cause them to move. Sometimes this movement is intentional and necessary, and sometimes it is unintentional but unavoidable. In either case, it is important to understand the impact of fluid forces on the surrounding equipment and its performance. **ANSYS Multiphysics solutions** can help you to understand and solve product design challenges related to this fluid–structure interaction (FSI).

The underlying technology, associated capabilities and ability to extend to **Multiphysics** at any time are what truly make **Multiphysics** with ANSYS the best solution for engineers.

Transient analysis of rigid/flexible suspension mechanism using kinematic joints, springs and contacts





Cameron used ANSYS Multiphysics technology to develop a new line of check valves for the petrochemical industry. The engineering team coupled fluid dynamics and mechanical analyses with optimization tools to reach record performance.

"What was acceptable yesterday was simulating one single component, but it becomes more important today to simulate the full assembly, because each part interacts."

Christophe Avejian
Research and Development Manager Valves & Measurement
Cameron Inc.

ANSYS Mechanical – Capabilities Chart

Capabilities	Mechanical
Geometric Idealization	
Spring	•
Mass	•
Damper	•
Spar	•
Beam	•
Pipe/Elbow	•
Shell - Thin	•
Layered Shell - Thin (Composite)	•
Shell - Thick (Solid Shell)	•
Layered Shell - Thick (Solid Shell) (Composite)	•
2D Plane / Axisymmetric	•
3D Solids	•
Layered 3D Solids (Composite)	•
Infinite Domain	•
2.5D	•
Reinforced	•
ROM	•
Substructuring / Matrix	•
Modeling Capabilities	
Contact - Linear	•
Contact - Nonlinear	•
Joints	•
Spot Welds	•
Birth and Death	•
Gaskets	•
Rezoning and Adaptive Re-meshing	•
Materials	
Basic Linear Materials (Linear, Anisotropic, Temperature Dependent).	•
Basic Nonlinear Materials (Hyper, Plasticity, Rate Independent, Isotropic, Concrete).	•
Advanced Nonlinear Materials (Rate dependent, Anisotropic, Damage Models, Geomechanics Materials, and Multiphysics).	•
Field Dependent	•
Reactive Materials	•
Fracture Mechanics	•
Composite Materials	
Material Definitions	•
Layers Definitions	•
Solid Extrusion	•
First-ply Failure	•
Last-Ply failure	•
Delamination	•
Draping	•

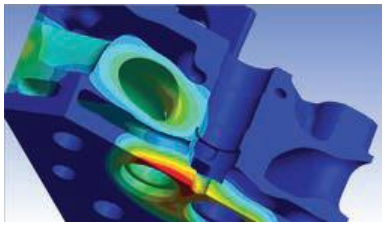
Capabilities	Mechanical
Structural Solver Capabilities	
Linear Static	•
Nonlinear Static	•
Pre-Stress effects, Linear perturbation	•
Nonlinear Geometry	•
Buckling - Linear Eigenvalue	•
Buckling - Nonlinear Post Buckling Behavior	•
Buckling - Nonlinear Post Buckling Behavior- Arc Length	•
Steady State Analysis applied to a Transient Condition	•
Advanced Wave Loading	•
	•
Multi Analysis	
Submodeling	•
Data Mapping	•
Trace Mapping	•
Initial State	•
Advanced Multi-Stage 2-D to 3-D Analysis	•
Vibrations	
Modal	•
Modal - Pre-Stressed	•
Modal - Damped/Unsymmetric	•
Transient - Mode-Superposition	•
Harmonic - Mode-Superposition	•
Harmonic - Full	•
Spectrum	•
Random Vibration	•
Mistuning	•
Rotordynamics	•
	•
Nonlinear Transient Dynamics	
Rigid Body Mechanisms	•
Rigid Body Dynamics with CMS components for flexible bodies	•
Full Transient	•
CMS with Substructuring	•
Explicit Dynamics	
FE (Lagrange) Solver	•
Implicit-Explicit Deformations	•
Implicit-Explicit Material States	•
Mass Scaling	•
Natural Fragmentation	•
Erosion Based on Multiple Criteria	•

ANSYS Mechanical - Capabilities Chart

Capabilities	Mechanical
Durability	
Stress-Life (SN)	•
Strain-Life (EN)	•
Safety Factor	•
Vibration Fatigue (Harmonic & PSD)	•
Python Scripting Customization	•
Wave Hydrodynamics	
Diffraction and Radiation	•
Frequency & Time Domain Motions Analysis	•
Moorings, Joints & Tethers	•
Load Transfer to Structural Analysis	•
Thermal	
Steady State Thermal	•
Transient Thermal	•
Conduction	•
Convection	•
Radiation to Space	•
Radiation - Surface to Surface	•
Phase Change	•
Thermal Analysis of Layered Shells and Solids	•
Additional Physics	
1-D Thermal-flow	•
1-D Coupled-field Circuits	•
1-D Electromechanical transducer	•
MEMS ROM	•
Piezoelectric	•
Piezoresistive	•
Electroelastic	•
Electromagnetic	•
Vibro-acoustics	•
Migration	•
Diffusion -Pore-fluid	•
Diffusion-Thermal Structural-Electric	•
Structural-Thermal-Electric-Magnetic	•

Capabilities	Mechanical
Topology Optimization	
Static Structural	•
Modal Analysis	•
Design Validation Tranfer	•
Manufacturing Constraints	•
Optimization	
DesignXplorer Included	•
Parameters	•
Design Point Studies	•
Correlation Analysis	•
Design of Experiments	•
Sensitivity Analysis	•
Goal Driven Optimization	•
Six Sigma Analysis	•
Miscellaneous and Usability	
ANSYS SpaceClaim	•
ANSYS Customization Suite (ACS)	•
Support ACT Extensions	•
Command snippet support	•
Batch run capability	•
External Code Interfaces	•
HPC – Structures	
Default Number of Cores 2 (DMP + SMP), MAPDL, 2 for Explicit, 2 for RBD, 2 for AQWA	
Parallel Solving on Local PC	•
Parallel Solving on Cluster	•

-- DMP: Distributed Memory Parallel
-- SMP: Shared Memory Parallel
-- MAPDL: Mechanical APDL Explicit = AUTODYN



"Any culture shift is difficult, requiring vision, leadership, planning and tangible benefits. The Analysis Led Design initiative — a Cummins corporate program to change the prevalent test-first culture — uses ANSYS software, has driven considerable change, and has proven to be of tremendous value."

Bob Tickel
Director of Structural and Dynamic Analysis
Cummins Inc.

ANSYS CFD - Capabilities Chart

Capabilities	CFD
General Solver Capabilities	
Comprehensive Inlet and Outlet Conditions	•
Steady-State Flow	•
Transient Flow	•
2-D and 3-D Flow	•
Time Dependent Boundary Conditions	•
Customizable Materials Library	•
Fan Model	•
Periodic domains	•
Dynamic/moving-deforming mesh	•
Overset Mesh	•
Immersed-solid/MST method for moving parts	•
Flow-driven solid motion (6DOF)	•
Pressure-based coupled solver	•
Density-based coupled solver	•
Automatic on-the-fly mesh generation with dynamic refinement	•
Dynamic Solution-Adaptive Mesh refinement	•
Single Phase, non-reacting flows	
Incompressible Flow	•
Compressible Flow	•
Porous Media	•
Non-Newtonian Viscosity	•
Turbulence - Isotropic	•
Turbulence - Anisotropic (RSM)	•
Turbulence - Unsteady (LES/SAS/DES)	•
Turbulence - Laminar/Turbulent Transition	•
Flow Pathlines (Massless)	•
Acoustics (Source Export)	•
Acoustics (Noise Prediction)	•
Heat Transfer	
Natural Convection	•
Conduction & Conjugate Heat Transfer	•
Internal Radiation - Participating Media	•
Internal Radiation - Transparent Media	•
External Radiation	•
Solar Radiation & Load	•
Particles Flows (Multiphase)	
Coupled Discrete Phase Modeling	•
Inert Particle Tracking (With Mass)	•
Liquid Droplet (Incl. Evaporation)	•
Combusting Particles	•
Multicomponent Droplets	•
Discrete Element Model (DEM)	•
Break-Up And Coalescence	•

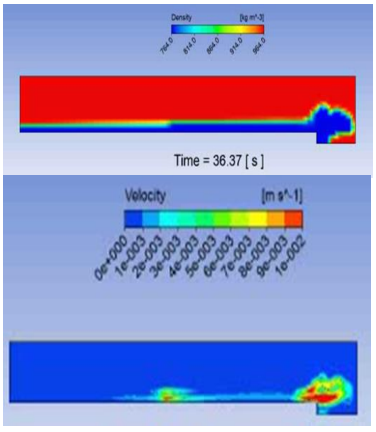
Capabilities	CFD
Free Surface Flows (Multiphase)	
Implicit And Explicit VOF	•
Coupled Level Set/VOF	•
Open Channel Flow And Wave	•
Surface Tension	•
Phase Change	•
Cavitation	•
Dispersed Multiphase Flows (Multiphase)	•
Mixture Fraction	•
Eulerian Model	•
Boiling Model	•
Surface Tension	•
Phase Change	•
Drag And Lift	•
Wall Lubrication	•
Heat And Mass Transfer	•
Population Balance	•
Reactions Between Phases	•
Reacting Flows	
Species Transport	•
Non-Premixed Combustion	•
Premixed Combustion	•
Partially Premixed Combustion	•
Composition PDF Transport	•
Finite Rate Chemistry	•
Pollutants And Soot Modeling	•
Sparse chemistry solver with dynamic cell clustering and dynamic adaptive chemistry	•
Ability to use Model Fuel Library mechanisms	•
Internal Combustion Engine Specific Solution	•
Comprehensive surface-kinetics	•
Chemical and phase equilibrium	•
Flamelet table generation	•
Turbomachinery	
MRF/Frozen-Rotor	•
Sliding-Mesh/Stage	•
Transient Blade Row	•
Pitch Change	•
Fourier Transformation	•
Harmonic Analysis	•
Blade Flutter Analysis	•
Forced Response Analysis	•
Shape Optimization	
Adjoint Solver for Sensitivity Analysis	•

ANSYS CFD - Capabilities Chart

Capabilities	CFD
High Rheology Material	
Specialty Fiber Spinning Models	•
Multiphysics	
Advanced, Automated Data Exchange	•
Accurate Data Interpolation Between Dissimilar Meshes	•
Drag-n-Drop Multiphysics	•
Direct Coupling Between Physics	•
Collaborative Workflows	•
Fully Managed Co-Simulation	•
Flexible Solver Coupling Options	•
Fluid Structural Interaction	
Force Induced Motion/Deformation	•
Fluid Thermal Deformation	•

Capabilities	CFD
Electro-Thermal Interaction	
Convection Cooled Electronics	•
Conduction Cooled Electronics	•
High Frequency Thermal Management	•
Electromechanical Thermal Management	•
Other Coupled Interactions	
Aero-Acoustics	•
Acoustics-Structural	•
HPC – Fluids	
Parallel Solving On Local PC Option	
Parallel Solving Over Network Option	
CPU Support	•
GPU Support	•

ANSYS CFD solutions are used throughout the oil and gas industry for subsurface, pipeline, transport, processing and refining applications; almost all these oil and gas applications involve multiphase flows. The most advanced companies in the world are deploying CFD simulation in a big way to meet and beat market demands. But CFD is no longer just for specialists. Now simulation tools are being used by more companies and by less-specialized engineers across a broad range of industries and products. They are discovering the increased accuracy, functionality and expandability of serious CFD — solutions that provide greater insight, give you greater confidence and reveal unexpected behavior.



Using ANSYS Fluent helped Baker Hughes determine if the design of a new setting tool based on phase change was feasible, and what changes and additional simulations were required to further develop an effective tool.

Baker Hughes

Realize Your Product Promise
Multiphysics Analysis

FLUID CODES