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ENGDYN

Ricardo Software

Powertrain CAE Solutions

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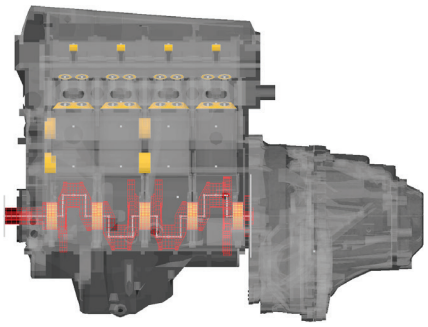


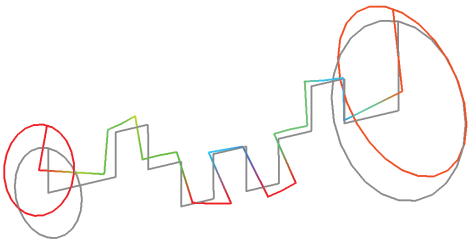
What is ENGDYN?

ENGDYN is a dedicated three-dimensional engine analysis tool essential to the design and development of the crank train, engine structure and associated components, such as bearings, connecting rods and engine mounts.

By offering a range of levels of complexity of components, oil film models and solvers, ENGDYN can be used throughout the entire development programme, from concept through to production.

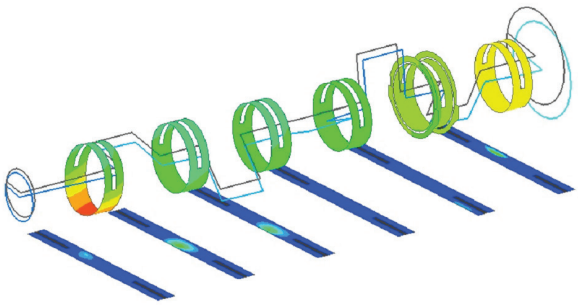
Key product features

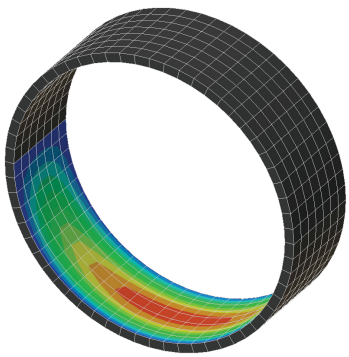
- Hierarchy of models and solution methods within a single easy to use graphical interface
- Kinematic and dynamic solvers
- Mobility based bearing model for rapid kinematic and dynamic solutions
- Advanced EHL mass conserving lubrication model for detailed bearing analysis
- Hydrodynamic and boundary lubrication models
- Direct link with VALDYN, Simulink and Easy5 for time-step integration (co-simulation)
- Link with VALDYN for valvetrain, timing drive and auxiliary drive loading
- Link to FEARCE for automated loading of FE engine models
- 3D graphical interface for rapid model generation and results presentation
- Integrated FEARCE solver for FE matrix reduction
- Vibro-acoustic analysis using integrated acoustic solver



Bearing analysis

ENGDYN directly couples the crankshaft and cylinder block dynamics with the bearing oil film to allow the user to perform a range of analyses to aid bearing design. ENGDYN incorporates a hierarchy of solution methods, from the industry standard Mobility method through to more rigorous hydrodynamic (HD) and elastohydrodynamic (EHD) models. Whether early in a programme, when only concept-level models are available, or when detailed studies are required, ENGDYN provides the tools for the engineer to assess bearing performance.





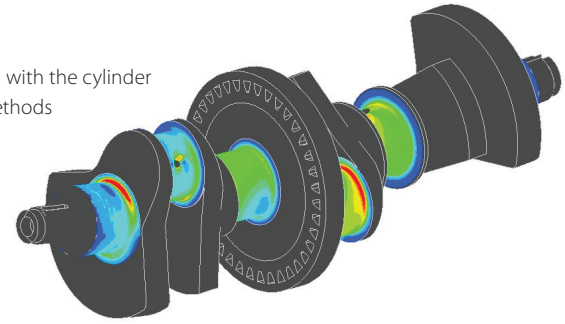
Specific applications

- Bearing type selection
- Bearing durability
- Friction and mass flow calculations
- Load transfer to powertrain

Capabilities

- Direct coupling of crankshaft and crankcase dynamics with bearing
- Simplified and rigorous bearing models
  - Mobility
  - HD
  - EHD
- Mass-conserving hydrodynamic lubrication modelling
- Boundary lubrication modelling
- Thermal balance modelling

Crankshaft analysis



ENGDYN was originally developed to study the dynamics of the crankshaft and its interaction with the cylinder block. As such, crankshaft analysis is at the core of the programme. ENGDYN provides two methods of solution for predicting crankshaft durability, incorporating both a classical approach using simple beam theory as well as a more advanced finite element approach for more definitive studies. ENGDYN calculates both the quasi-static and vibratory loads on the crankshaft, and automatically sets up the necessary FE analysis. With its built-in fatigue module, ENGDYN can also provide both multi-axial and Goodman durability calculations for the key design.

Specific applications

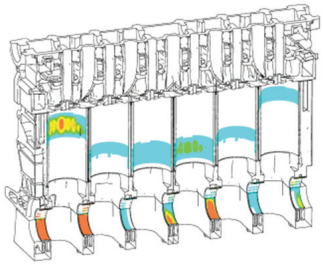
- Crankshaft stress, fatigue and durability analysis

Capabilities

- Concept-level and fully 3D FEA solutions
- Automatic loading of FE models
- Separation of static and vibration loading
- Effect analysis of surface treatment on material strength
  - Fillet rolling, nitriding, induction hardening etc.
- Stress concentration and fatigue notch factors considered
- Uni-axial and multi-axial fatigue algorithms included

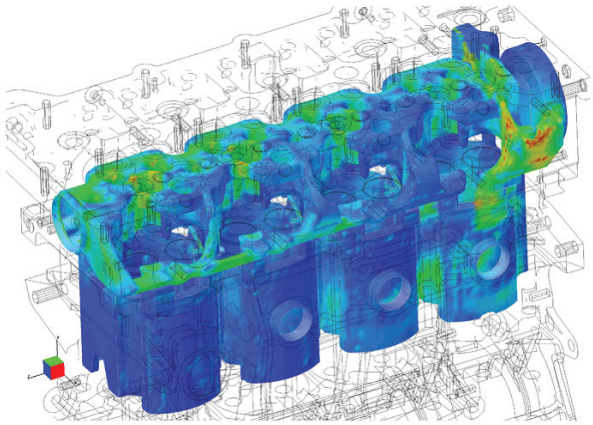
Cylinder block analysis

ENGDYN provides all of the loads required for the concise analysis of the powertrain structure. With its automated model preparation features and integrated finite element solver for model reduction, ENGDYN has all of the tools to build fully three-dimensional systems within one environment. Also included are an extensive array of FEA interface tools that fully automate the process of applying the ENGDYN results as boundary conditions to further FEA structural analyses. These can be set up for all major FEA solvers, or alternatively, ENGDYN can be combined with Ricardo Software's own FEA environment FEARCE to complete the entire process right through to durability analysis.



Specific applications

- Crankcase durability
- Thermo-mechanical simulation of powertrain structure

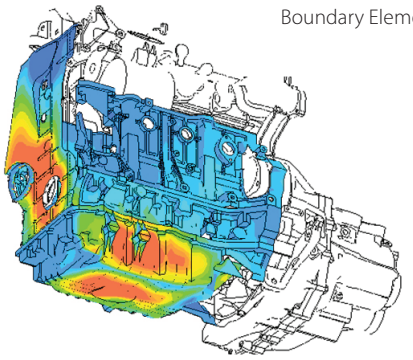


Capabilities

- Automated preparation tools
- Fast model set up
- Internal solver
- Quasi-static time domain solutions
- Frequency and time domain nodal vibration stress analyses
  Integrated FEA interface
- Automatic loading of the FE model for major commercial solvers

Noise and vibration

ENGDYN incorporates an advanced NVH post-processor which allows the user to back-substitute the ENGDYN solution onto a three-dimensional FEA model of the powertrain or ancillary components and to predict nodal vibrations in the structure. These vibrations can be used to predict stresses due to the dynamic loading or by using either the integrated Rayleigh or Boundary Element Method (BEM) acoustic solvers these vibrations can be used to predict structure borne radiated noise.



Specific applications

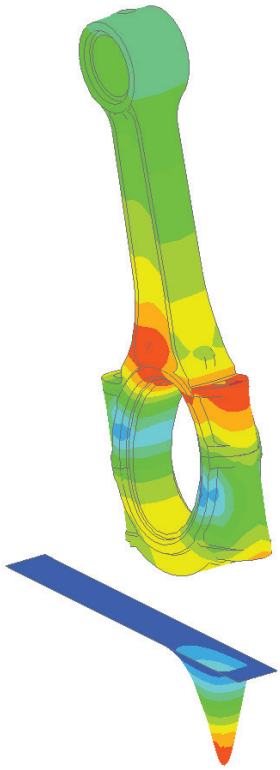
- Vibration analysis
- Vibrational stressing of powertrain components
- Engine mount structural analysis
- Radiated noise predictions

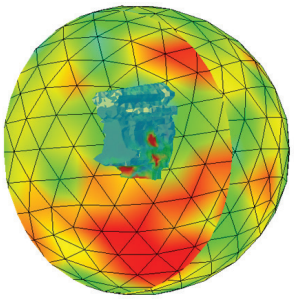
Capabilities

- Integrated NVH module
- Automated analysis set up and control
- Integrated FEA interface
- Ability to work with any major commercial FE solver
- Rayleigh and BEM solutions for radiated noise calculations
- Post processing
- Structural attenuation
- Order plots and Campbell diagrams
- 3D contour plots
- Animation of modes, and displacements
- Sound intensity aid power
- Sound pressure

Connecting rod analysis

The ENGDYN simulation can incorporate a range of connecting rod models from a simplified rigid representation through to fully three-dimensional compliant or dynamic models. By default ENGDYN simply applies loads to the crank-pin and cylinder assuming primary motion. In order to consider the dynamic interaction with the crankshaft, and for analysing bearing behaviour due to dynamic loading the ENGDYN model can be extended to include a dynamic model of the connecting rod at each cylinder. As with the cylinder block studies, all of the tools required to incorporate the three-dimensional models are included within the ENGDYN environment, and the FEA interface tool allow a user to easily apply the ENGDYN results as boundary conditions for further structural analyses.





Specific applications

- Dynamic interaction between the connecting rod and crankshaft
- Big end and small end bearing analysis, including EHL analysis
- Bearing distortion
- Connecting rod durability

Capabilities

- Quasi-static and dynamic analysis
- Hierarchy of model types including rigid, compliant and dynamic models, and half models for symmetric rods.
- Integrated FEA interface for matrix reduction

For further information about Ricardo Software products and services, contact us:

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