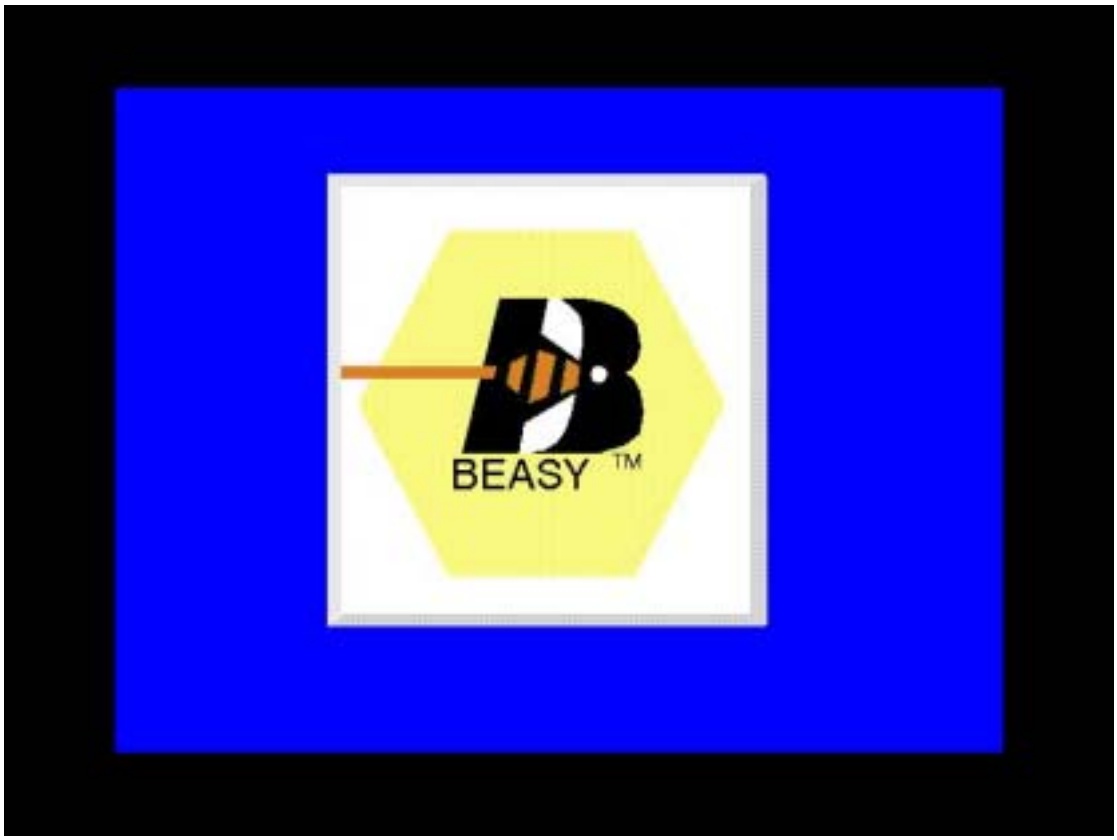
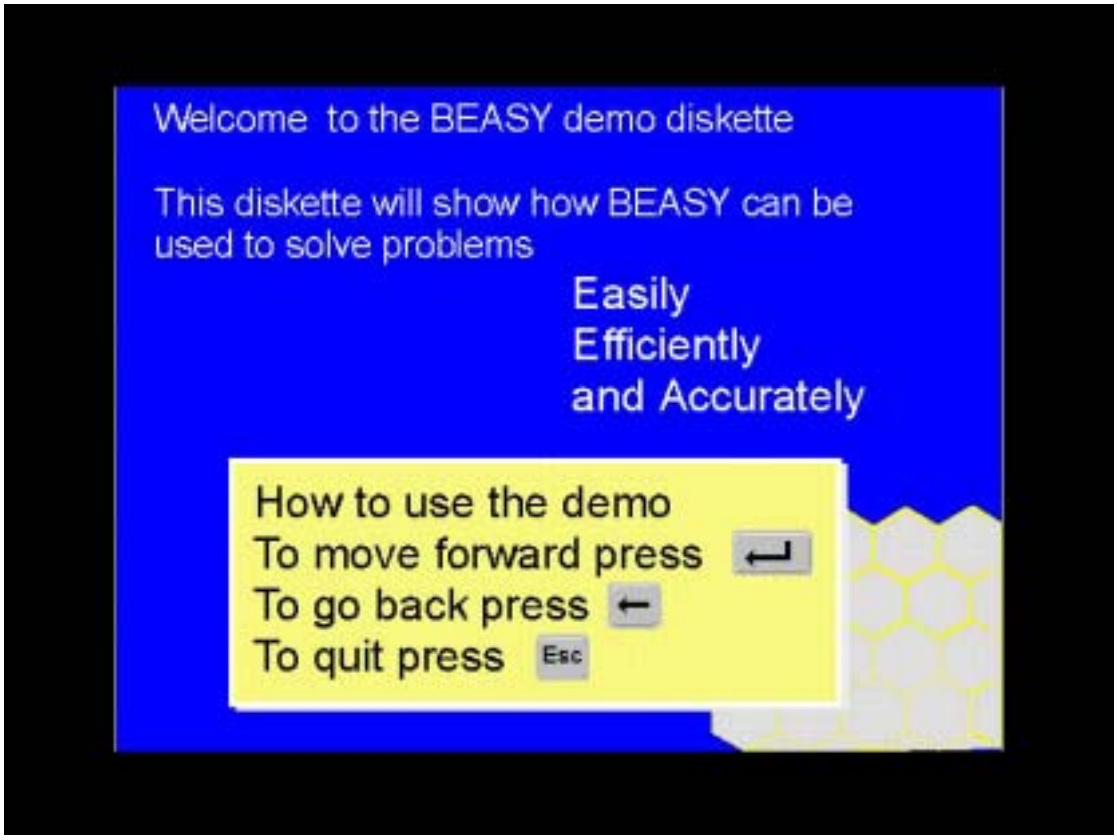

BEASY ™


Welcome to the BEASY demo diskette
This diskette will show how BEASY can be used to solve problems
Easily
Efficiently
and Accurately
How to use the demo
To move forward press
To go back press
To quit press
Esc

What is BEASY

BEASY is an engineering design simulation system which provides solutions for

- Heat Transfer
- Acoustics Design
- Mechanical Stress and deformation prediction
- Mechanical Contact (gap)
- Damage Tolerance and fracture
- Crack growth and fatigue
- Electrostatic Design
- Corrosion and cathodic protection

The BEASY solution

Instead of finite elements, BEASY is based on

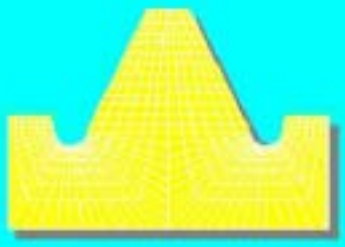
BOUNDARY ELEMENTS

This means the software offers you:

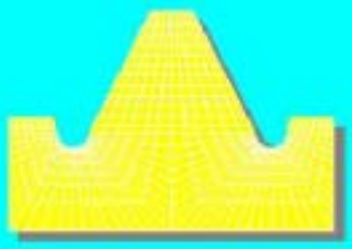
- Very quick and easy, surface-only modeling.
- Highly accurate results
- Quick link to your CAD models

Take a look at the next slide to see how the surface-only elements compare to classical finite element modeling.

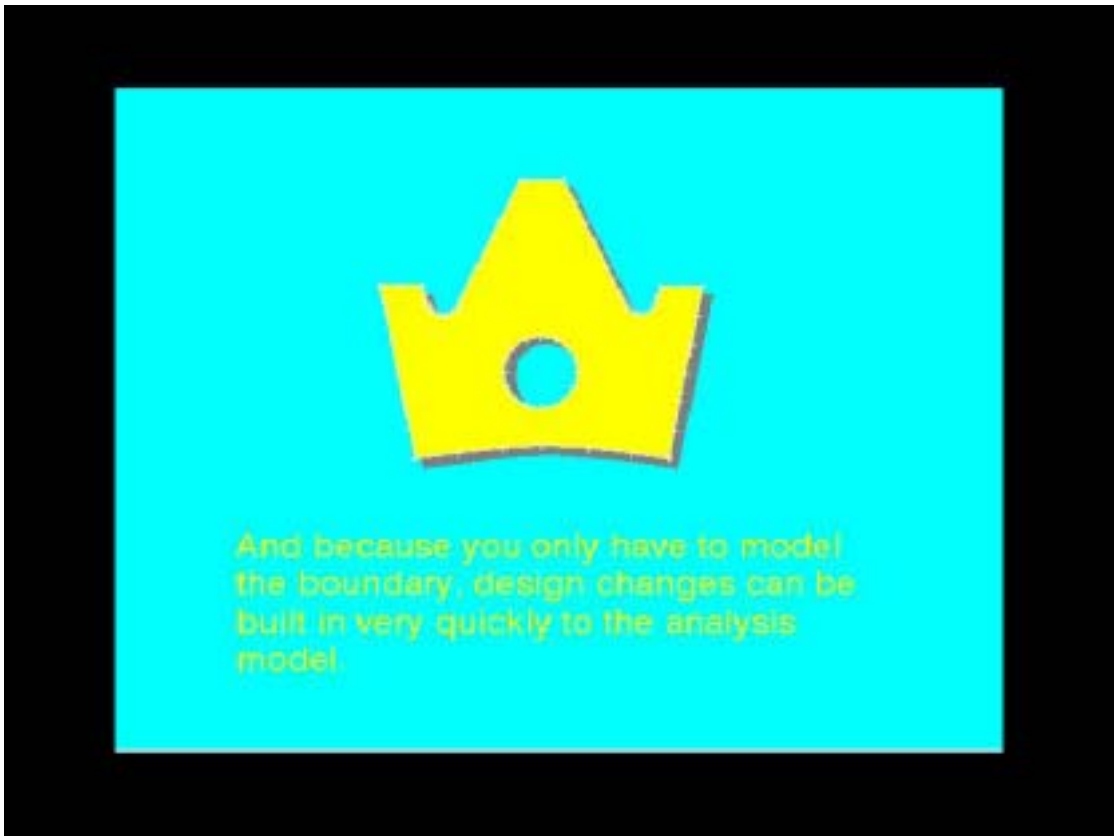
Finite element model of a gear tooth (2D)

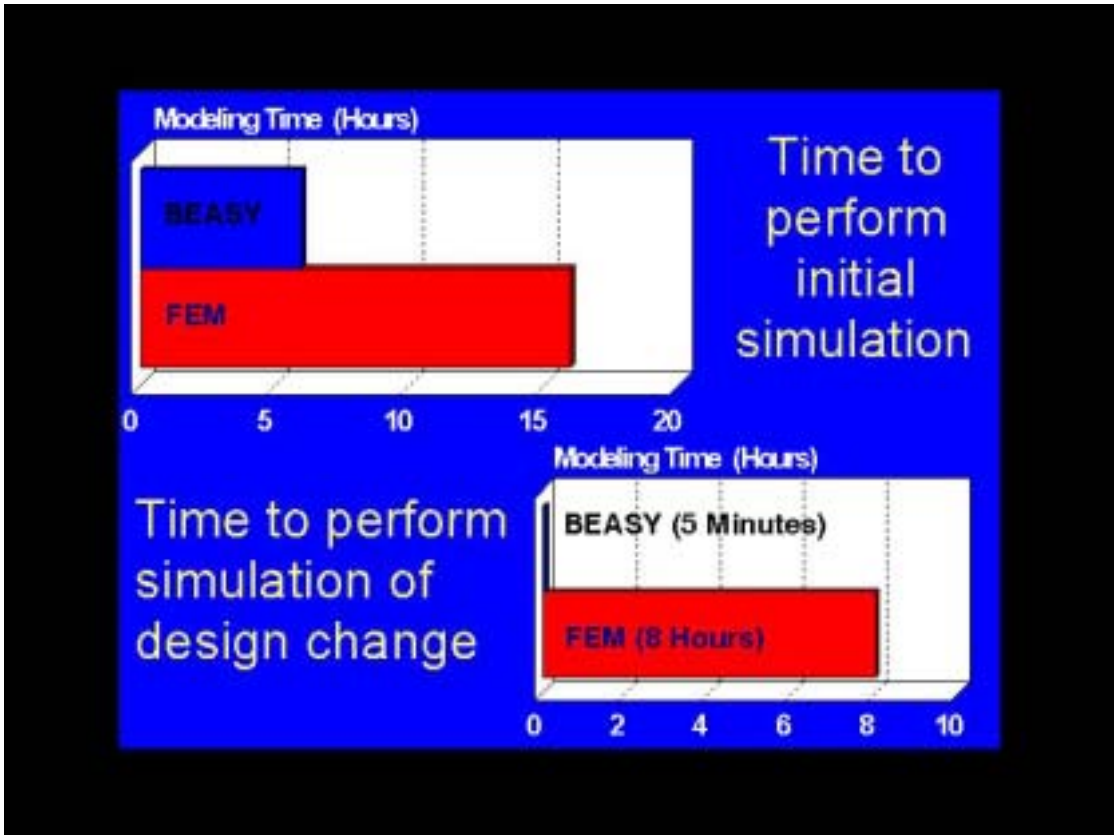


Finite element model of a gear tooth (2D)



BEASY boundary element model of the same component


And because you only have to model the boundary, design changes can be built in very quickly to the analysis model.

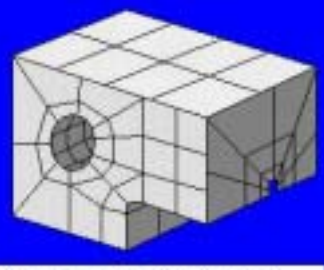

Modeling Time (Hours)
BEASY
FEM
0
5
10
15
20
Time to perform initial simulation
Time to perform simulation of design change
Modeling Time (Hours)
BEASY (5 Minutes)
FEM (8 Hours)
0
2
4
6
8
10

3D modeling made easy

In 3D, the boundary is a surface area. You need to cover the surface with elements.

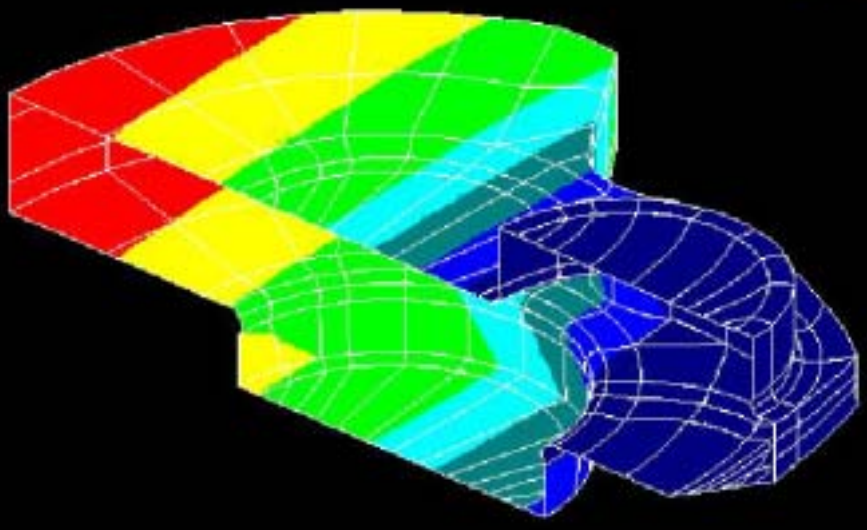
This is very easy because with BEASY you don't even need to match element corners together.

And you don't need to place elements on planes of symmetry. Just leave them open with no elements.



Patch type elements don't need to match with adjacent elements

This can make 3D models look different to finite element models. Look at the crank shaft on the next slide. It looks hollow because you are looking through a plane of symmetry at the elements on the far surface.



Boundary Elements are more accurate than Finite Elements

This is because:

- The results are calculated right on the boundary, exactly where you need them, not extrapolated to the boundary like finite elements.
- Finite elements approximate the behaviour throughout the volume. BEASY works from the exact physical equations through the volume
- In finite elements many result components are derived from other results. Eg in stress analysis the stresses are derived from the displacements . In BEASY most are computed directly
  This gives BEASY a higher order of accuracy for all types of analysis

This means that you can use a very course mesh and still get good results

Integration With CAD

BEASY integrates with CAD systems.

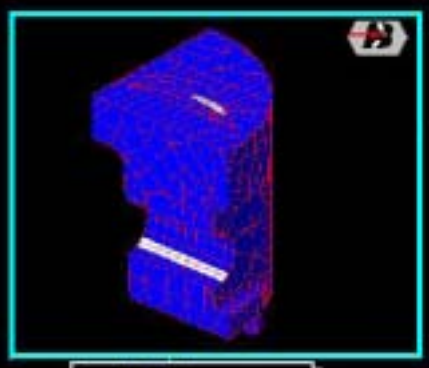
Using your CAD models

The BEASY-IMS preprocessor reads a variety of surface and wireframe models from CAD systems.

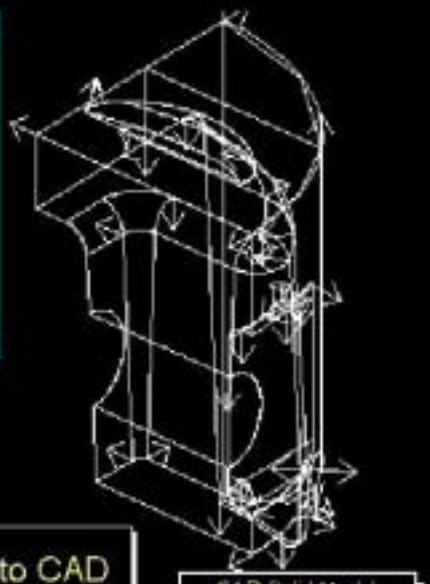
The program automatically meshes multiply curved, trimmed surfaces.

Simply read the CAD surface model, then automesh, and you have almost prepared your BEASY analysis model.

BEASY-IMS meshes CAD trimmed surfaces like this one.

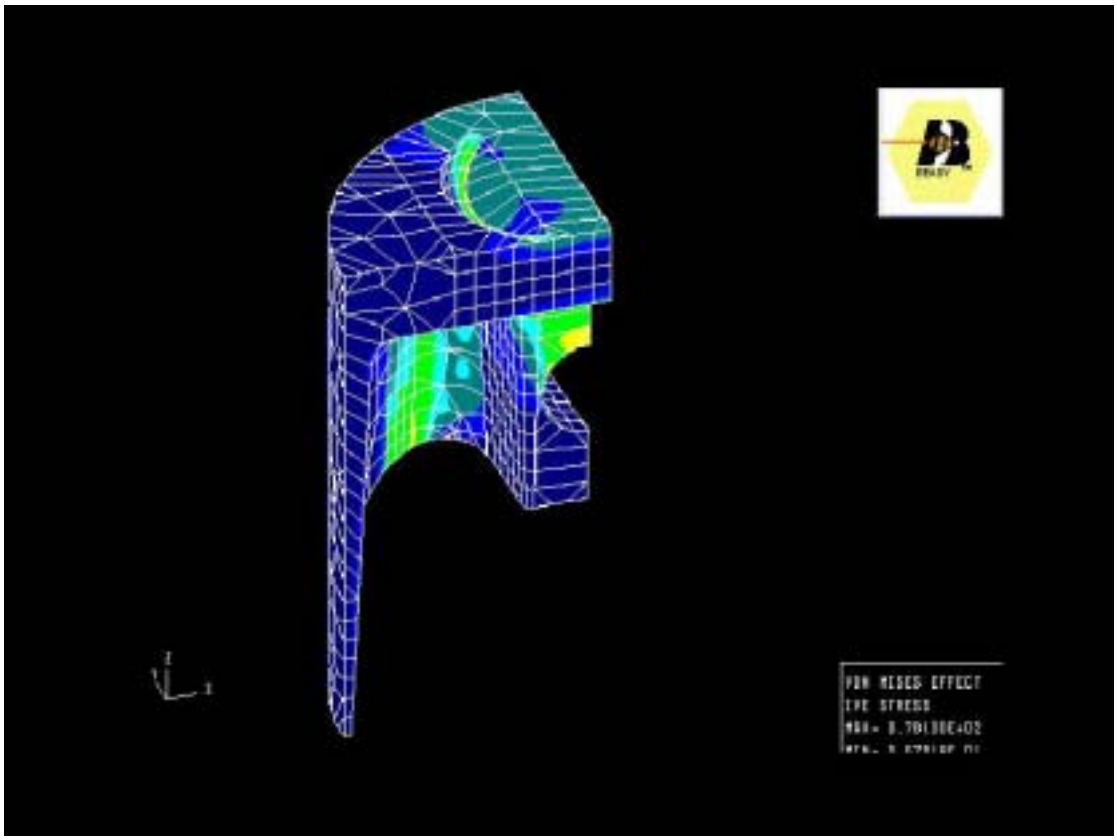


BEASY automatic mesh generation

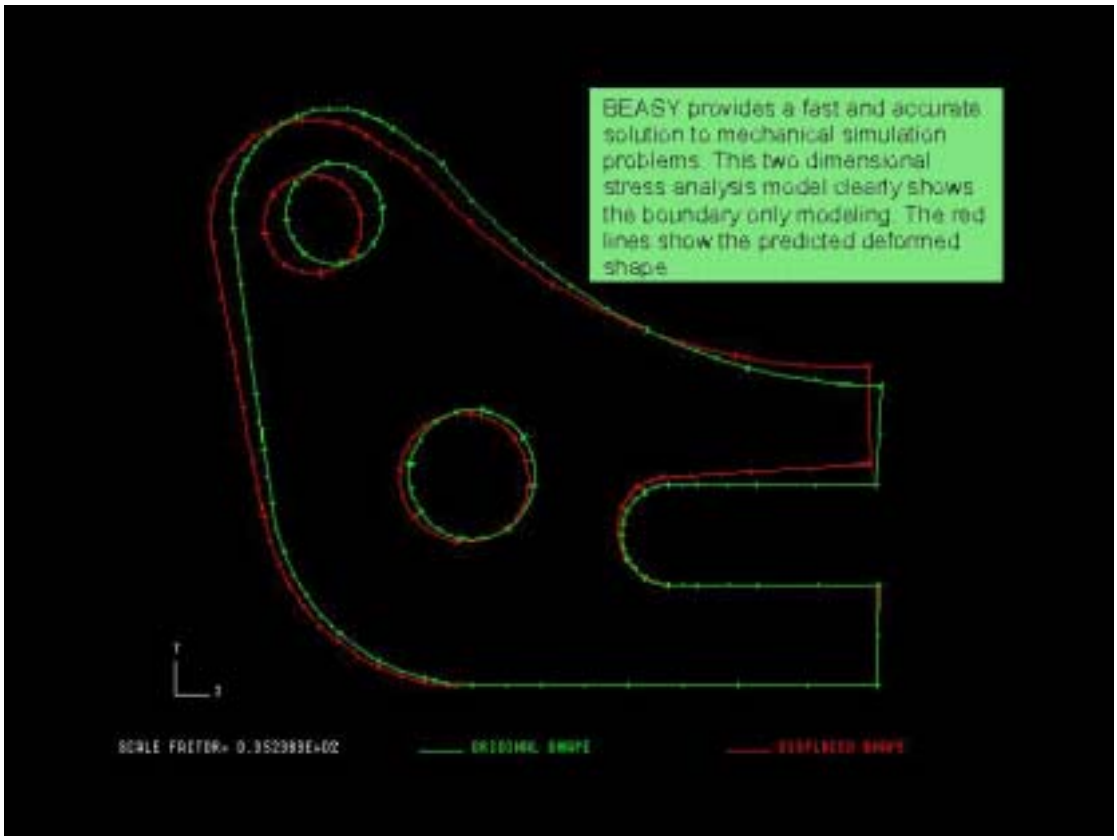


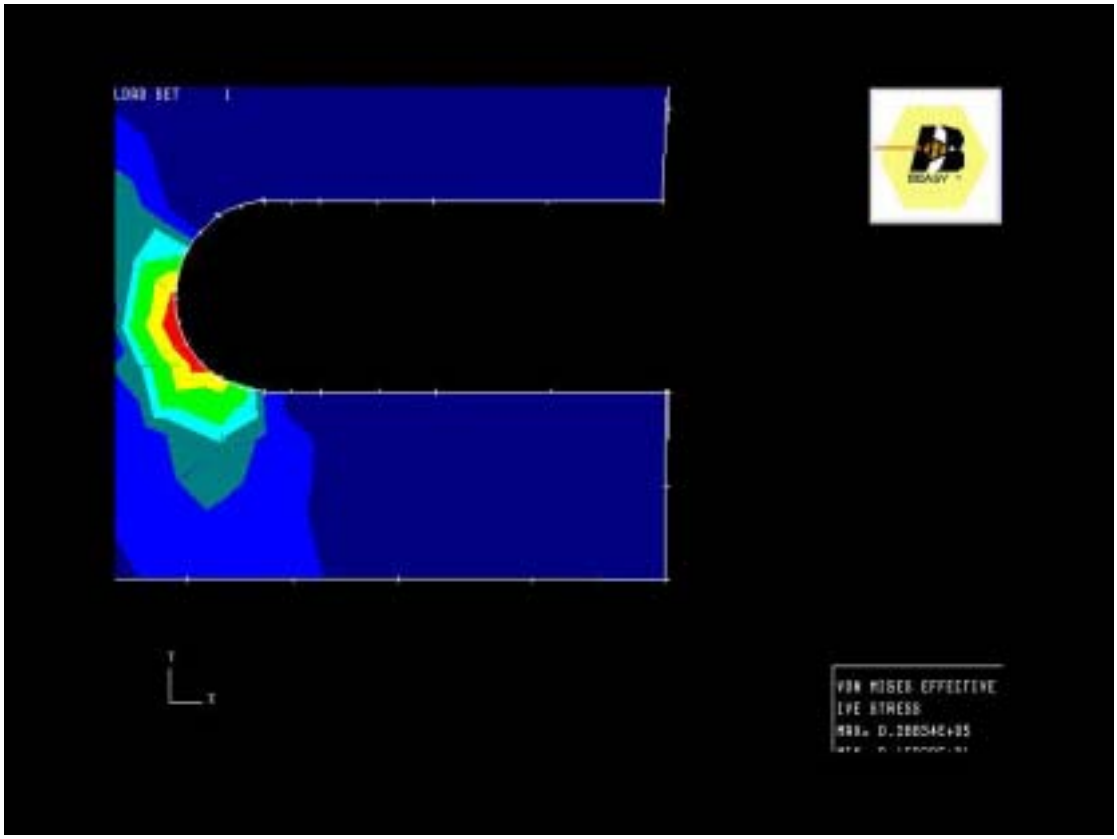
CAD Solid Model

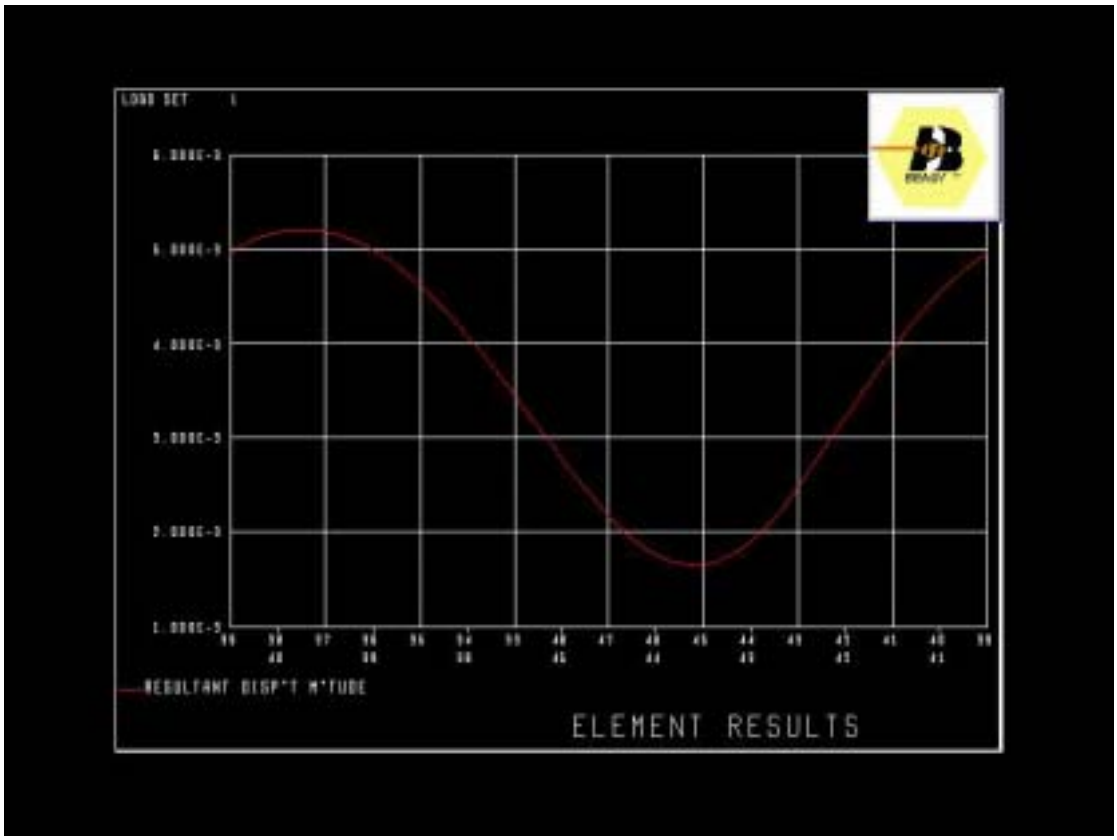
Automatic link to CAD

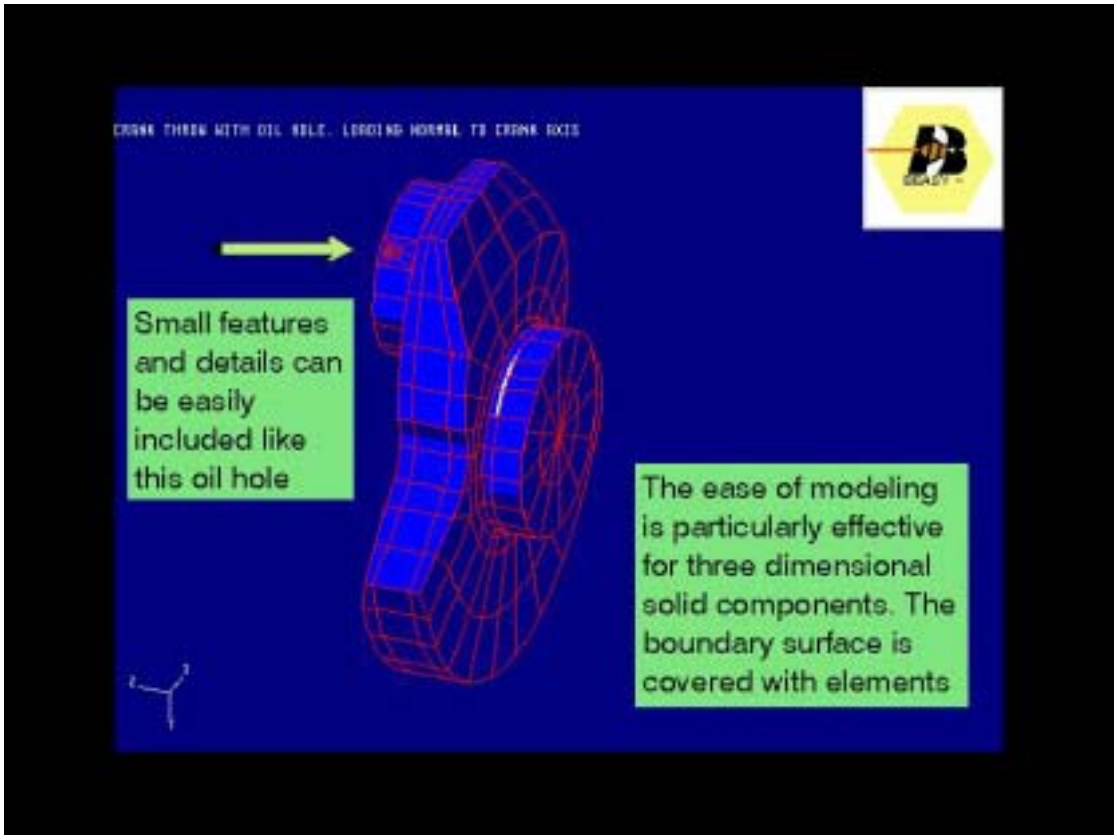


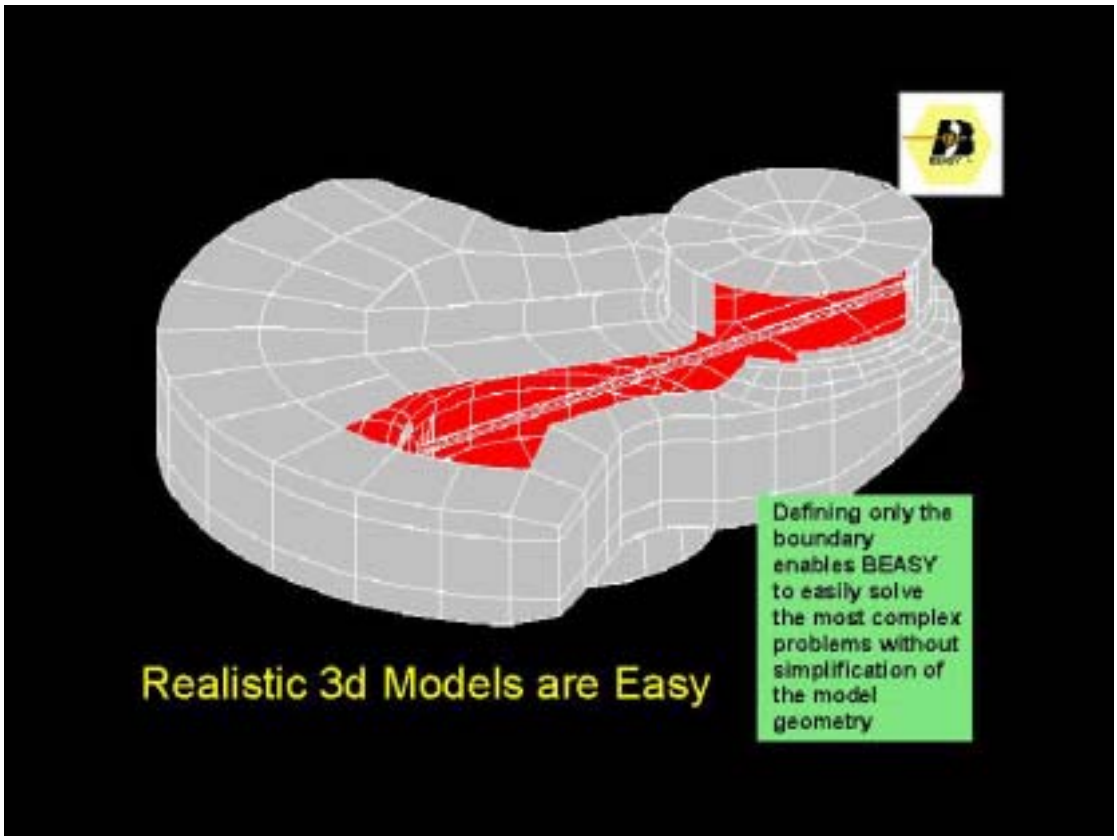
And now some examples...

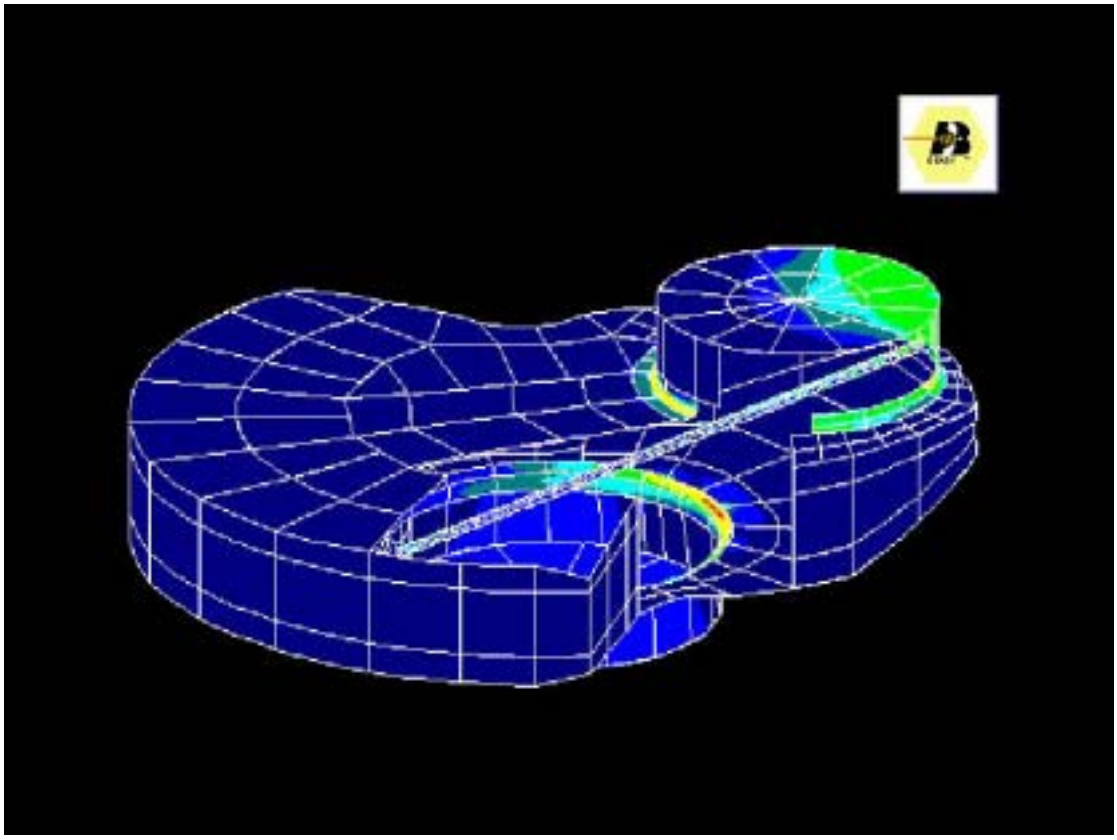

BEASY provides a fast and accurate solution to mechanical simulation problems. This two dimensional stress analysis model clearly shows the boundary only modeling. The red lines show the predicted deformed shape.

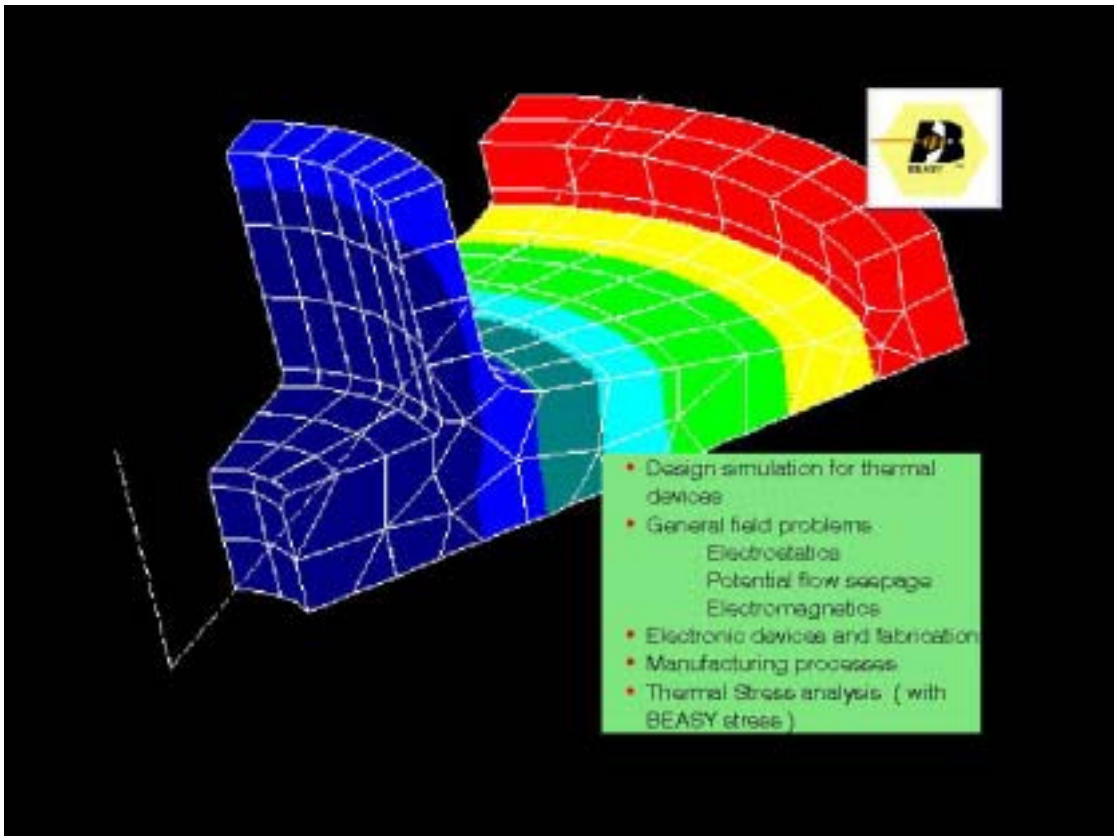

LOAD SET 1
VON MISES EFFECTIVE

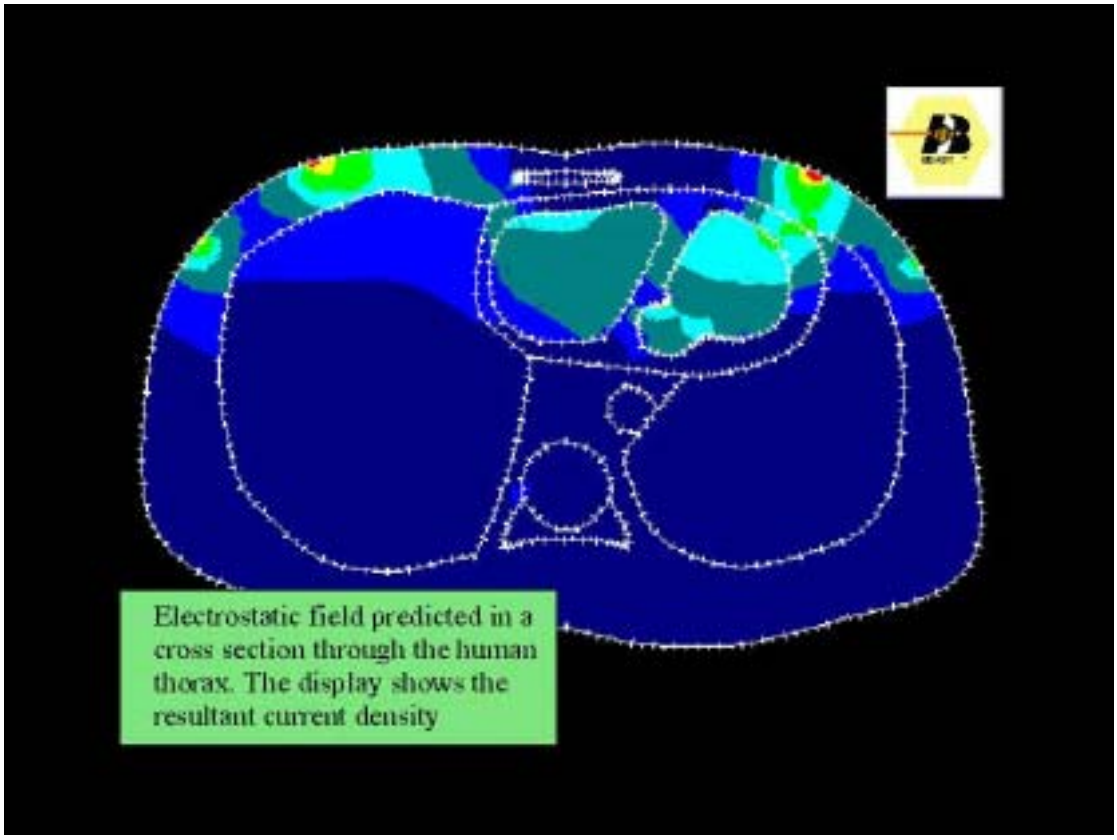

LOAD SET 1
RESULTANT DISP'T M'TUDE
ELEMENT RESULTS

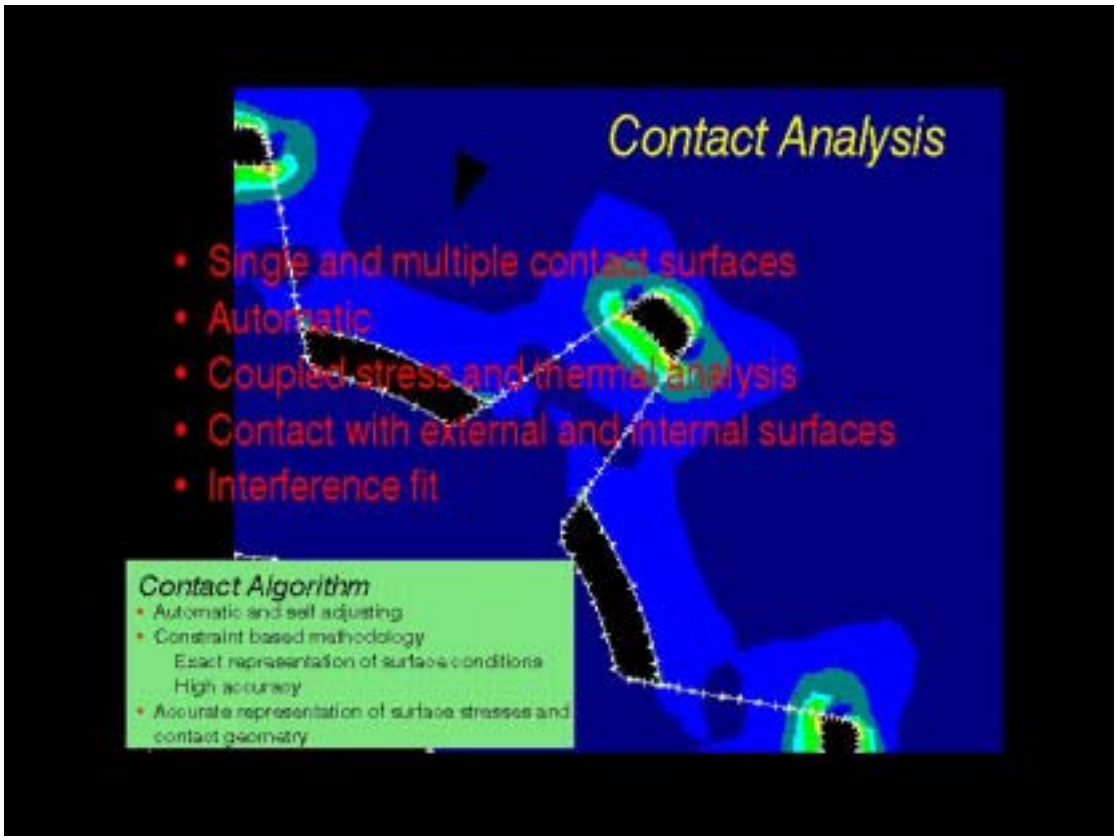

CRANK THROW WITH OIL HOLE. LOADING NORMAL TO CRANK AXIS
Small features and details can be easily included like this oil hole
The ease of modeling is particularly effective for three dimensional solid components. The boundary surface is covered with elements

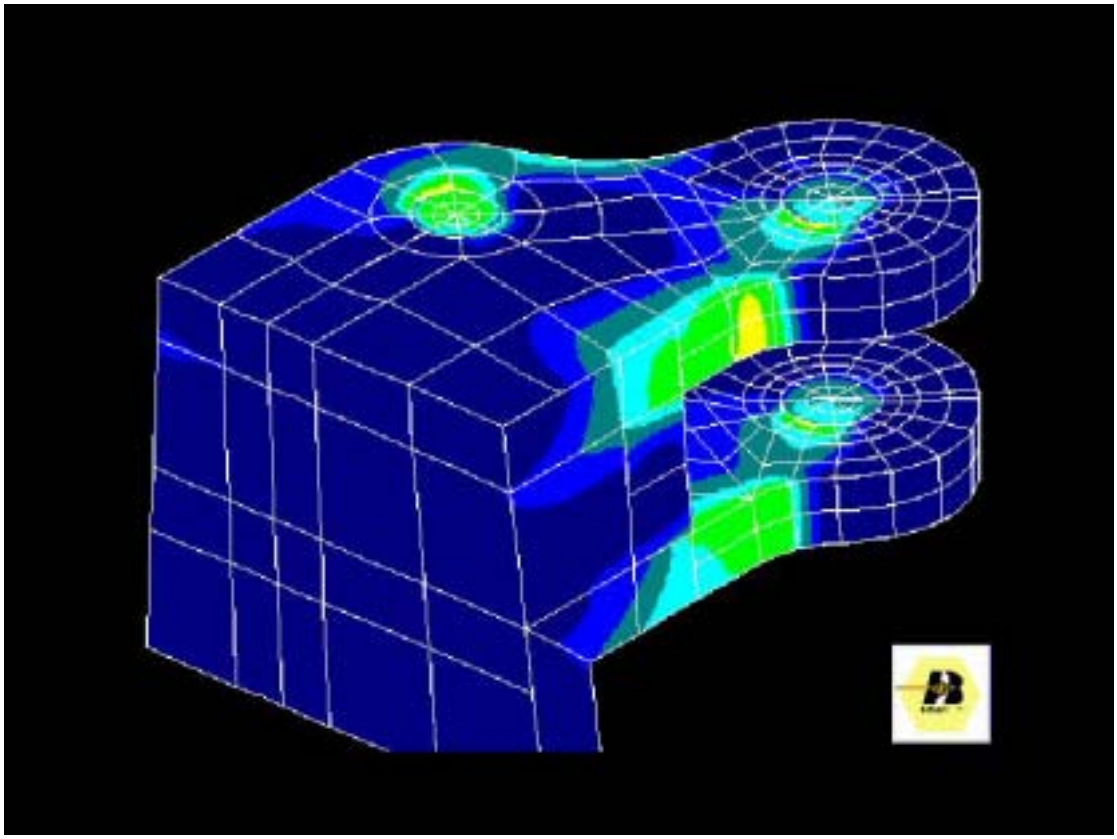

Realistic 3d Models are Easy
Defining only the boundary enables BEASY to easily solve the most complex problems without simplification of the model geometry

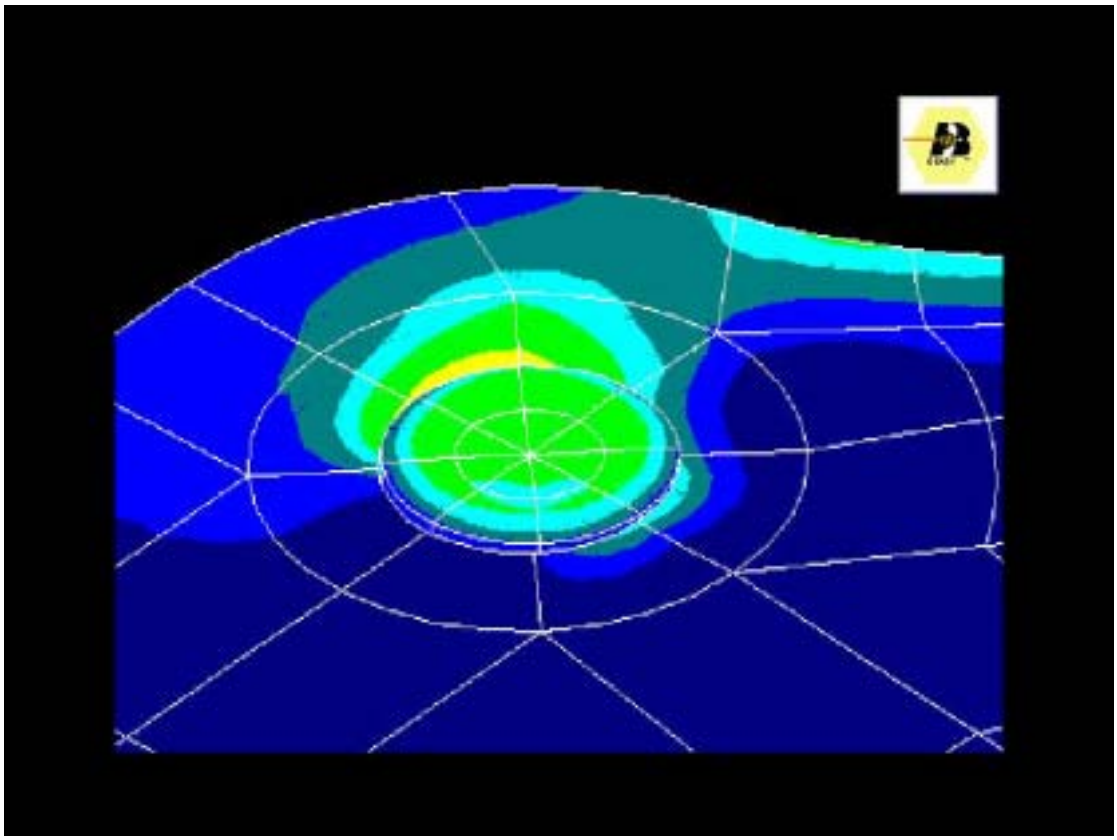



• Design simulation for thermal devices
• General field problems
Electrostatics
Potential flow seepage
Electromagnetics
• Electronic devices and fabrication
• Manufacturing processes
• Thermal Stress analysis (with BEASY stress)


Electrostatic field predicted in a cross section through the human thorax. The display shows the resultant current density


Contact Analysis
• Single and multiple contact surfaces
• Automatic
• Coupled stress and thermal analysis
• Contact with external and internal surfaces
• Interference fit
Contact Algorithm
• Automatic and self adjusting
• Constraint based methodology
Exact representation of surface conditions
High accuracy
• Accurate representation of surface stresses and contact geometry





Fracture mechanics

BEASY is a very effective tool for fracture mechanics analysis. Its accuracy and ease of modeling give you confidence in its quick crack tip solutions for stress intensity factors.
Defining cracked models is simple because you don't need special crack tip elements, and also elements don't need to line up corner to corner.

Detail from 3D crack model

And remember, as BEASY models are so easy to change it is simple to try a different crack length.

BEASY for fracture
It makes 2D predictions simple. It makes 3D predictions practical.

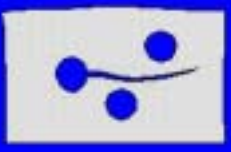
Crack growth analysis

BEASY's crack growth analysis automatically extends a crack, predicting the direction of crack propagation.

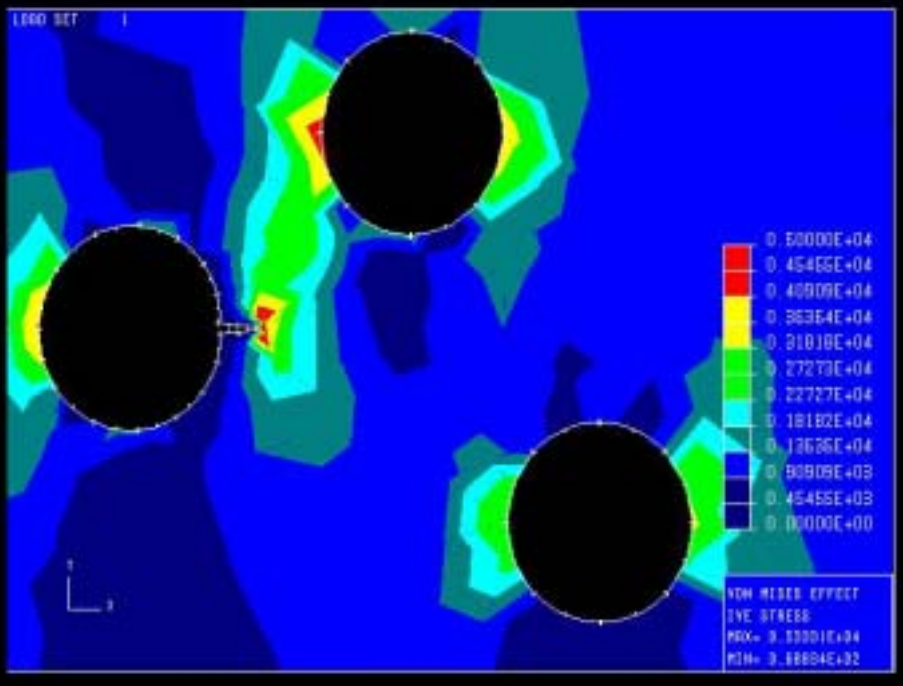
BEASY gives fracture and fatigue properties as a function of crack length.

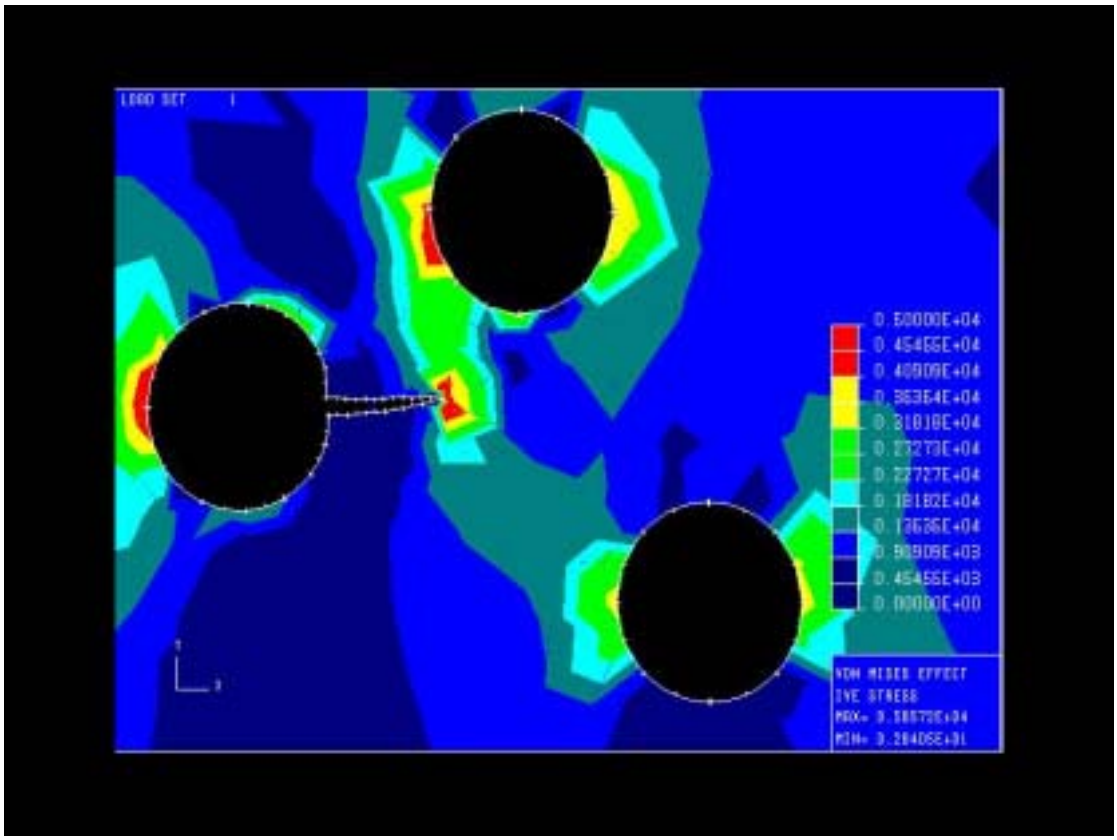
The program handles multiple cracks, curved cracks, branching cracks and also does not have the modeling restrictions imposed by other crack growth simulation methods

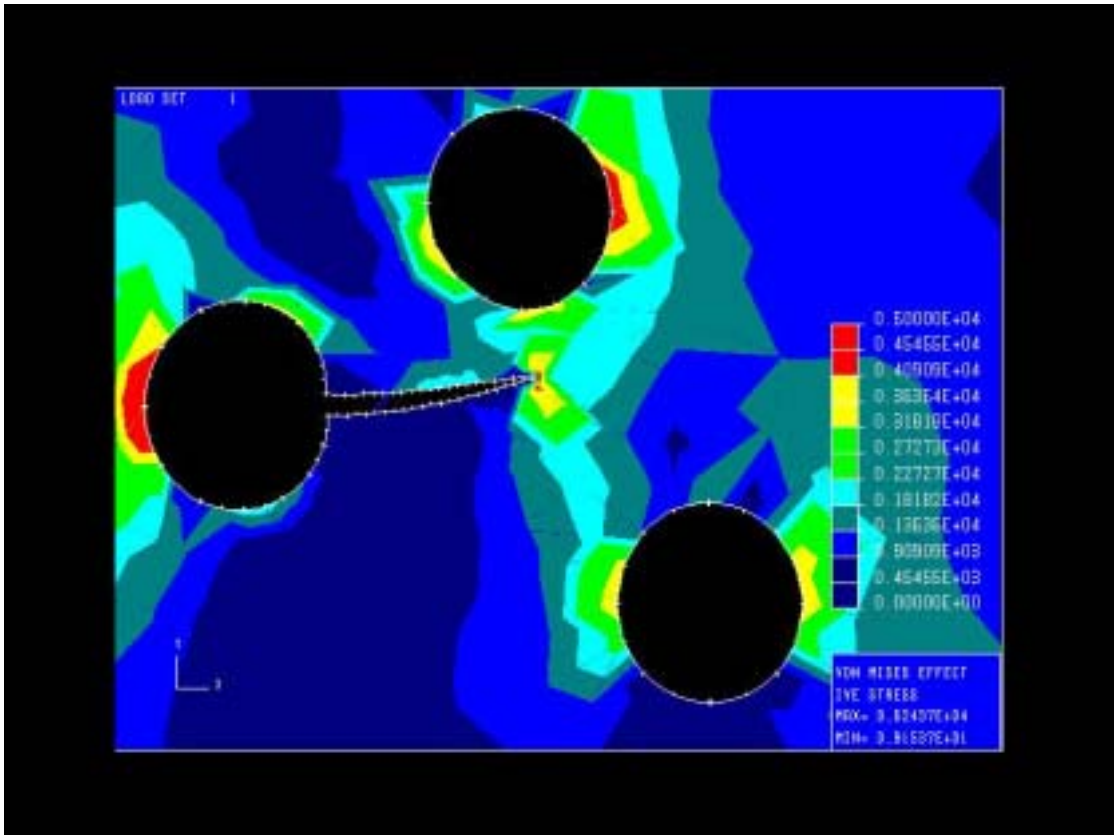
Original model including crack initiation line



Deformed shape of plate after a BEASY crack growth analysis




LOAD SET 1
0.50000E+04
0.45455E+04
0.40909E+04
0.36364E+04
0.31818E+04
0.27273E+04
0.22727E+04
0.18182E+04
0.13636E+04
0.90909E+03
0.45455E+03
0.00000E+00
VON MISES EFFECT
IVE STRESS
MAX= 0.50000E+04
MIN= 0.28405E+01


LOAD SET 1
0.50000E+04
0.45455E+04
0.40909E+04
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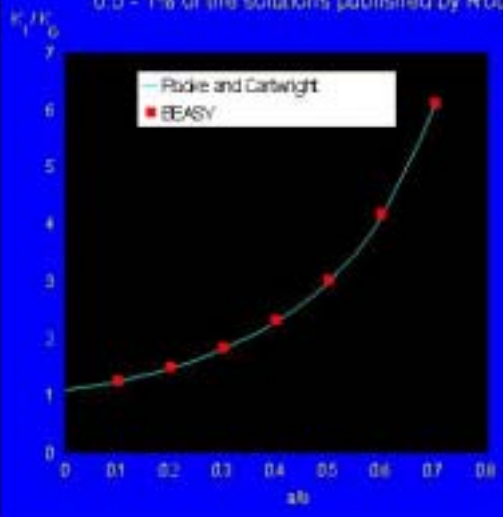
0.31818E+04
0.27273E+04
0.22727E+04
0.18182E+04
0.13636E+04
0.90909E+03
0.45455E+03
0.00000E+00
VON MISES EFFECT
IVE STRESS
MAX= 0.50000E+04

Accuracy of BEASY fracture results

The BEASY stress intensity factors are typically within 0.5 - 1% of the solutions published by Rooke and Cartwright



Damage Tolerance assessment

Single or multiple cracks can be initiated in a model and their progress predicted.

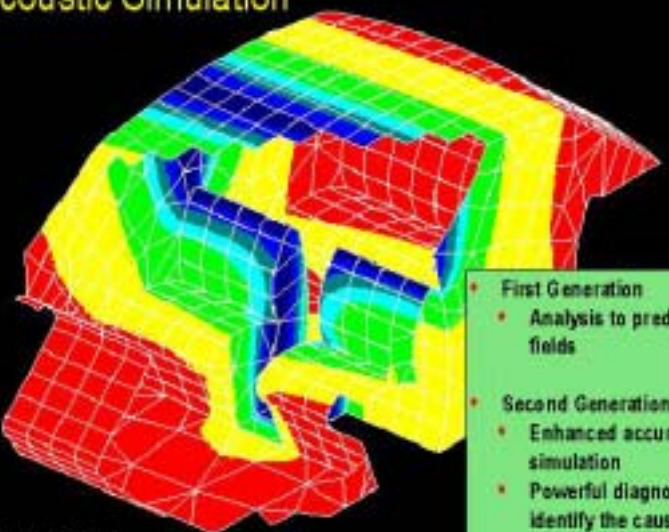
For airplane structures BEASY can model cracks in stiffened panels and include the effects of continuous or riveted connections. Multiple site damage can be predicted including broken stiffeners and connectors.

The stress intensity factors and the fatigue diagrams can be predicted by BEASY. A database of fatigue data is incorporated in the system which is linked to generalised fatigue laws which can be selected by the user.

BEASY CP Applications

- Simulation of galvanic corrosion processes
  - Prediction of the Corrosion of Offshore Structures
  - Corrosion of concrete structures
  - Corrosion of storage tanks, underground utilities and pipelines
  - Design of Cathodic Protection systems for ships and boats
  - Stray current corrosion
- Manufacturing Processes
  - Simulation of electroforming
  - Simulation of plating and deposition processes

Acoustic Simulation



- First Generation
  - Analysis to predict acoustic fields
- Second Generation
  - Enhanced accuracy of simulation
  - Powerful diagnostic tools to identify the causes of the acoustic field and the sensitivity of the solution to changes

BEASY is a second generation system

Diagnostic Analysis

What does it tell us

- Acoustic analysis predicts the sound field
- Diagnostics predict
  - How much sound each part of the structure is generating
  - What are the major contributors to the sound level at any position
  - The sensitivity of the sound level to changes in surface velocity and/or pressure

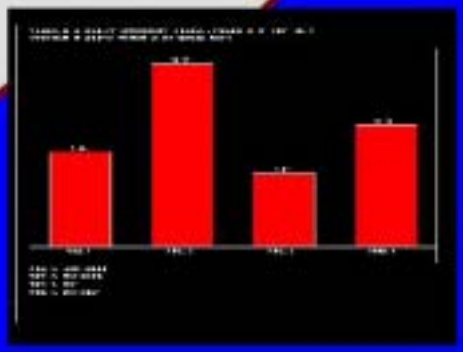
Sensitivity

The change in the pressure due to a unit change in the surface velocity

Eg How much do I have to reduce the velocity on element n to reduce the sound level at this point by 10%

Diagnostic Analysis

Objective: To determine the contributions to the sound perceived by the driver

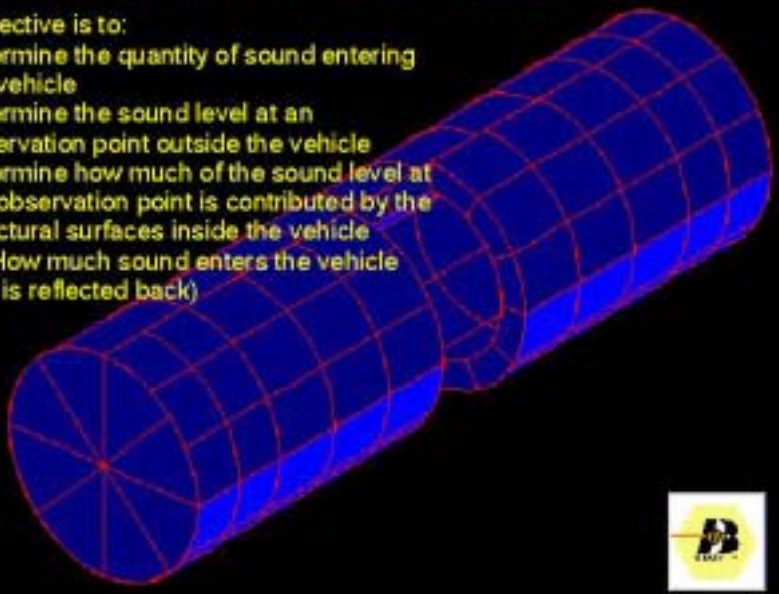


The bar chart shows the percentage of the sound perceived by the driver caused by the structural panels of the vehicle. Eg Roof, side panel etc

Underwater Vehicle near a sound source

The objective is to:

- determine the quantity of sound entering the vehicle
- determine the sound level at an observation point outside the vehicle
- determine how much of the sound level at the observation point is contributed by the structural surfaces inside the vehicle
- (ie How much sound enters the vehicle and is reflected back)



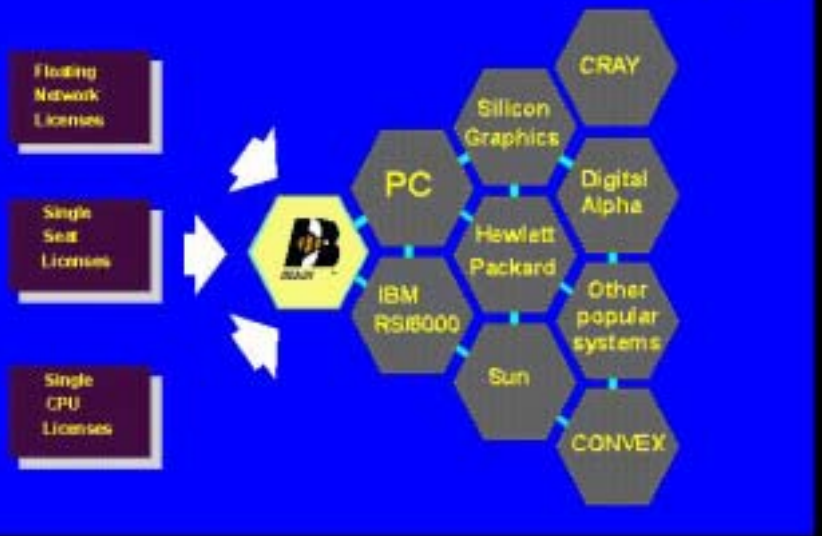
Predicted sound pressure levels in the fluid surrounding the vehicle

BEASY provides all the information to give you confidence in the solution.
Convergence, equilibrium and other measures can be displayed .

```
BEASY Convergence Report
Model equilibrium convergence:
     Sum of surface force in +X and -X directions=-0.55908E-
     Sum of surface force in +Y and -Y directions=-0.42723E-

Zone ID:      1 equilibrium convergence:
                    Surface force in +X direction= 0.25141E+
                    Surface force in -X direction=-0.25142E+
     Sum of surface force in +X and -X directions=-0.55908E-

                    Surface force in +Y direction= 0.22265E+
                    Surface force in -Y direction=-0.22266E+
     Sum of surface force in +Y and -Y directions=-0.42723E-

                      Zone stress error norm=  5.1701    %

Please use cursor to select a command!
```

Accuracy and Confidence

Flexible Licensing



BEASY Users are supported by

A team of highly qualified engineers at Computational Mechanics and its distributors

Access to World leading Research and Developments through our links to Wessex Institute of Technology

This disk has shown you just a few features of the BEASY design analysis and simulation software.

Please contact your nearest BEASY representative or the address below for details of:

- BEASY Purchasing Options
- Upcoming BEASY seminars and courses
- BEASY Starter packs

Computational Mechanics BEASY.
Ashurst Lodge, Ashurst
Southampton, SO40 7AA
UK
Tel: (44)1703 293223
Fax: (44)1703 292853