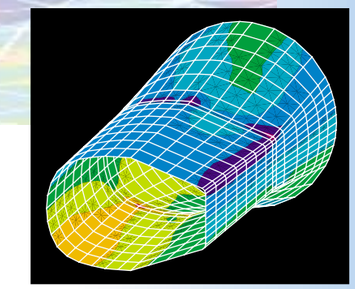
Analysis software to meet the needs of composite engineering

Engineers worldwide are constantly seeking ways of cutting design times whilst optimising the performance of their composite components. The best way to achieve this is to use analysis software that specialises in providing cost-effective solutions for all aspects of composite analysis and design. LUSAS *Composite* has been specifically developed for the composites industry and is founded on the well proven technology of the LUSAS FE system. Regarded as a leader in engineering analysis, LUSAS *Composite* is rich in powerful and advanced features to meet your analysis needs and extend your design capabilities.



Powerful and cost-effective solutions ....

State-of-the-art analysis software

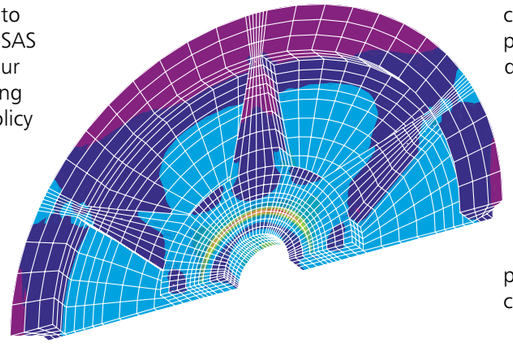
LUSAS *Composite* contains a comprehensive range of unrivalled engineering analysis facilities to cater for all types of composite design. From simple failure prediction using a number of failure criteria including Tsai-Hill, Hoffman and Tsai-Wu through to advanced failure modelling, LUSAS *Composite* will help shorten your design and checking times giving reliable results every time. A policy of continuous development ensures that LUSAS *Composite* stays at the leading edge of technology, so you will always be using state-of-the-art software to produce cost-effective designs.

Quick and easy to use

The intuitive Graphical User Interface (GUI) gives easy access to the full range of powerful modelling and results processing facilities, together with on-line help. LUSAS *Composite* runs on the full range of PCs and workstations giving complete freedom of choice. Because the same GUI is used across all PCs and workstations LUSAS *Composite* has the same 'look and feel' on all computers. This enables you to easily change between computers and gives you the additional benefit of being able to work in a mixed environment of PCs and workstations if you wish.

Ideal for all analysis

By using the unrivalled state-of-the-art element libraries and material models of LUSAS *Composit*e a host of composite engineering problems can be solved. All models are created with built-in associativity allowing rapid design changes to be made. Automatic meshing is available and for certain types of problem LUSAS *Composite* will automatically solve to a user-specified accuracy using



adaptive procedures. Extensive GUI results processing facilities allow extensive contouring, graphing and plotting of composite specific results.

Fully customisable

By using the advanced parametric language facilities, user-defined menus and forms can be added allowing specific repetitive analysis tasks to be performed with a minimum of user involvement. Complete analyses from modelling to results processing can be automated - and all tailored to your way of working.

Easy lay-up definition

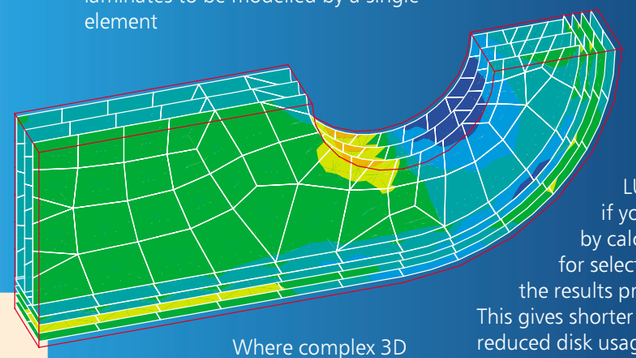
LUSAS *Composite* offers a quicker and simpler way than ever before to define composite lay-ups independent of the component to be analysed. The properties of each laminate are defined in a table and each layer given a unique name for use in results processing - extremely useful where ply drop off occurs. A lay-up icon provides a useful visual check before the lay-up is automatically assigned to the underlying geometry. These unique lay-up procedures dramatically reduce the chance of errors.

Advanced analysis and design

Unlike some systems, LUSAS *Composite* goes well beyond your everyday analysis needs. Advances in composite technology require advanced software solutions. LUSAS *Composite* offers these solutions now to give you the edge over your competitors. LUSAS *Composite* gives you an advanced element set, use of all LUSAS material models, Fast Iterative Solver Technology, and access to advanced analysis options. A software key system means that you can call us at any time for a key to unlock these powerful options so that you can tackle new analyses straightaway.

Advanced composite elements

In addition to shell elements, a 3D solid composite element reduces the model size by allowing a number of laminates to be modelled by a single element



Where complex 3D components are built from a number of composite blocks butted together LUSAS *Composite* can be used to automatically generate constraint equations to tie dissimilar meshes together. This powerful facility can also be used to provide rapid mesh grading of elements in high stress areas giving you faster solution times. In addition, linear and nonlinear modelling of adjacent laminates is possible, allowing you to analyse mixed material lay-ups.

Comprehensive nonlinear analysis

LUSAS *Composite* is also rightly regarded as the leader in nonlinear analysis with superior problem solving capabilities. Powerful facilities for geometric, material and boundary nonlinearity are available for problems involving large deformations, plasticity and collapse. Fully automatic load incrementation, automatic recovery from convergence failure and restart features are all designed to enable newcomers to nonlinear analysis to quickly become proficient in solving a wide variety of nonlinear problems. Results processing facilities provide automatic load-displacement graphs and viewing of yielded material.

Advanced technology

Because composite components have different failure characteristics to non-composite components, and are often a complex combination of materials, they pose unique analysis problems. The use of traditional modelling techniques for composites can be prohibitively expensive due to the large number of elements required. Whilst some analysis systems allow laminate properties to be integrated together to form an homogeneous material matrix, such systems can only predict failure with a linear analysis. To model failure correctly, and to assess the residual strength, nonlinear analysis with LUSAS *Composite* is necessary in which the individual laminate behaviour is modelled.

Dynamic analysis

Forced response, vibration and transient dynamics problems can be solved quicker with LUSAS *Composite* and, if you wish, interactively by calculating the response for selected loadcases using the results processing facilities. This gives shorter analysis times and reduced disk usage compared to a full transient dynamics assessment.

Impact and contact analysis

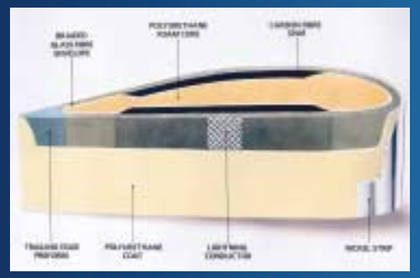
For low or high speed impact and contact problems LUSAS *Composite* leads the field. Contacting elements are automatically detected and specially developed 'slidelines' and 'slidesurfaces' handle the interaction that takes place at contacting regions greatly simplifying your analyses in 2D or 3D.

Advanced composite analysis

.... using well proven FE technology

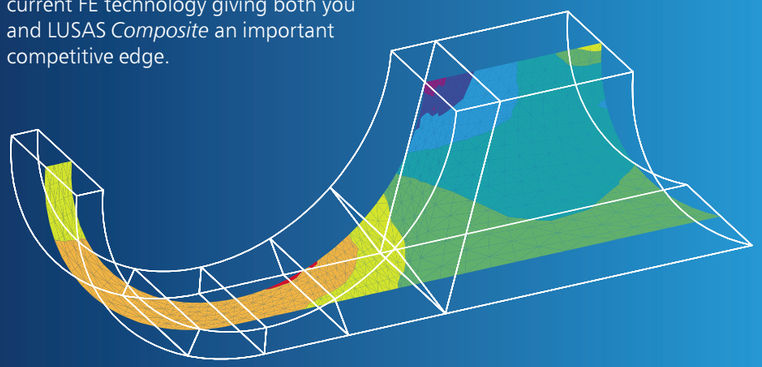
Working with CAD data

Model information can be exchanged with a wide range of CAD systems using industry standard exchange formats such as IGES and DXF, as well as directly with specific CAD systems using proprietary data exchange formats.



Software developments and updates

A policy of continuous development ensures LUSAS *Composite* always contains the most up-to-date facilities to help you stay ahead of your competition. Our industrial and academic collaborative projects are continually advancing the frontiers of current FE technology giving both you and LUSAS *Composite* an important competitive edge.



Quality assurance

The accurate and reliable results you get from LUSAS *Composite* come not only from our continuous development program but also from our use of an automatic installation and testing system for each computer type and operating system. With our quality control procedures, designed to comply with ISO9001, you can use each new improved version of LUSAS *Composite* with the same confidence as the last.

Hot-line technical support

Should you need assistance help is no more than a telephone call away. Our dedicated support engineers are experts in providing sound modelling and analysis advice to composite engineers in a friendly and informative manner which will help you meet deadlines and capitalise on your investment.

Consultancy services

If you need greater assistance than that available through the hot-line service, then our team of engineering consultants are here to help. Whether you have a difficult analysis to carry out, or need help with a peak workload, our rapid and cost-effective consultancy service will ensure you get the best out of your designs.

Training services

Our training services get you up-to-speed quickly, and ensure that you have sufficient knowledge of the relevant facilities in LUSAS *Composite* to tackle the types of analysis that you want to do.

Find out more

Clients worldwide are benefiting from the commercial advantage that LUSAS *Composite* gives. Contact FEA or your local distributor to ask for more details or arrange a demonstration.

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LUSAS Composite plus

A feature-rich engineering analysis system for advanced composite analysis consisting of :-

- **Extended advanced high-performance element library**

Including: Bars, thick + thin beams, plane stress/strain continuum, axisymmetric solid continuum, solid continuum (high order), flat thin membranes, curved thin semiloof shells, curved thick shells, axisymmetric membranes, axisymmetric thin shells, axisymmetric solid continuum with non-axisymmetric loading, generalised joint/springs/gaps.

- **Advanced materials**

Including: Isotropic, orthotropic, anisotropic and rigidity models, composite lay-ups for shells and solids, temperature dependency.

- **Integrated GUI**
- **Fast Iterative Solver Technology**

For: Linear static stress, linear buckling, natural frequency, fatigue, nonlinear and dynamic analysis problems when used with the appropriate LUSAS *Composite plus* option.

LUSAS *Composite plus* Options

Nonlinear Analysis

- Large displacement, large rotation and large strain geometric nonlinearities
- Material nonlinearity including plasticity, concrete, damage, crushable foam, rubber, creep, phase change, temperature dependent and user supplied models
- Incremental, iterative (MNR or NR), line search and arc length solution procedures
- Follower forces, centripetal stress stiffening
- Slideline/slidesurface contact algorithms

Dynamic Analysis

- Spectral and Forced Response
- Modal or Rayleigh Damping
- Modal synthesis
- Transient Dynamics (Implicit and Explicit)
- Automatic time step selection
- Nonlinear Dynamics
- Time dependant materials and loading

Other Software Available

- **LUSAS *CAD Toolkit*** for interfacing to other systems via DXF, IGES, and other proprietary interfaces.

Local distributor

a specialist application using proven FE technology

LUSAS Composite

advanced composite analysis