Background

CoDA is a product of the Composites Group of the NPL Materials Centre. It is based on several years research, which included extensive experimental validation, supported by the DTI. Major UK companies assisted with the developments through advisory panels and additional funding. Further modules are being developed and validated including for the design and performance of sandwich structures, for design of composite material flanges, for predicting impact loading responses and for fatigue strength predictions.

CoDA software is used worldwide in a range of industrial sectors (material suppliers, end users and fabricators) and universities.

System requirements

PC with Intel Pentium or compatible processor, Windows 95/98/NT/2000, 32Mb RAM, 5Mb hard disk space, high resolution display recommended, CD-ROM for installation.

Prices, ordering and training

CoDA is available as individual modules, while further modules can be ordered at any time. The modules are fully integrated. Four modules (material layer synthesis, panel, beam and joints) have parametric options that enhance the capability of these modules.

Details of pricing structure and payment methods are given on the CoDA Order Form, which can be obtained by fax, by mail, or directly from the Internet **www.npl.co.uk/cog/**. Corporate Purchase Orders for payment by 30-day invoice are normally accepted, subject to approval. On-line ordering is available.

Site licences are available. Discounts are available for upgrades and academic users. Academic establishments can apply for a 40% discount (for educational use only). Standard delivery is free. Allow up to 14 days for processing and despatch. The CoDA Software Licence Agreement can be obtained before ordering, please call for a copy.

Further information on the CoDA Program, similar products and future developments can be found at www.anaglyph.co.uk.
Please contact NPL if interested in training courses.

Further details from:

Anaglyph Ltd
Suite 33
10 Barley Mow Passage
London, UK, W4 4PH
Tel: +44 20 8987 6056
Fax: +44 20 8994 1533
E-mail: sales@anaglyph.co.uk
Website: www.anaglyph.co.uk

or,

Dr Graham D. Sims
Composites Group
NPL Materials Centre
Teddington
Middlesex, UK, TW11 0LW
Tel: +44 20 8943 6564
Fax: +44 20 8614 0433
E-mail: graham.sims@npl.co.uk
Website: www.npl.co.uk/cog/

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CoDA

for

Component and Composite Design Analysis

VERSION 3
NEW ENHANCED

Panel Design

Beam Design

Parametric analyses

Predicted loads, stresses and displacements

Fracture and buckling failures predicted

Section and geometry databases

Laminates and sandwich lay-ups

Input from CoDA-2, LAP and text files

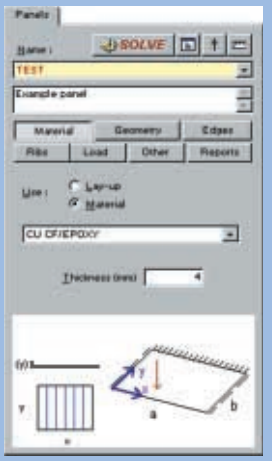
Joints Analysis

Output to FEA

Bearing and by-pass failures

Composite Material Property Synthesis

Fibre and matrix databases



NPL
National Physical Laboratory

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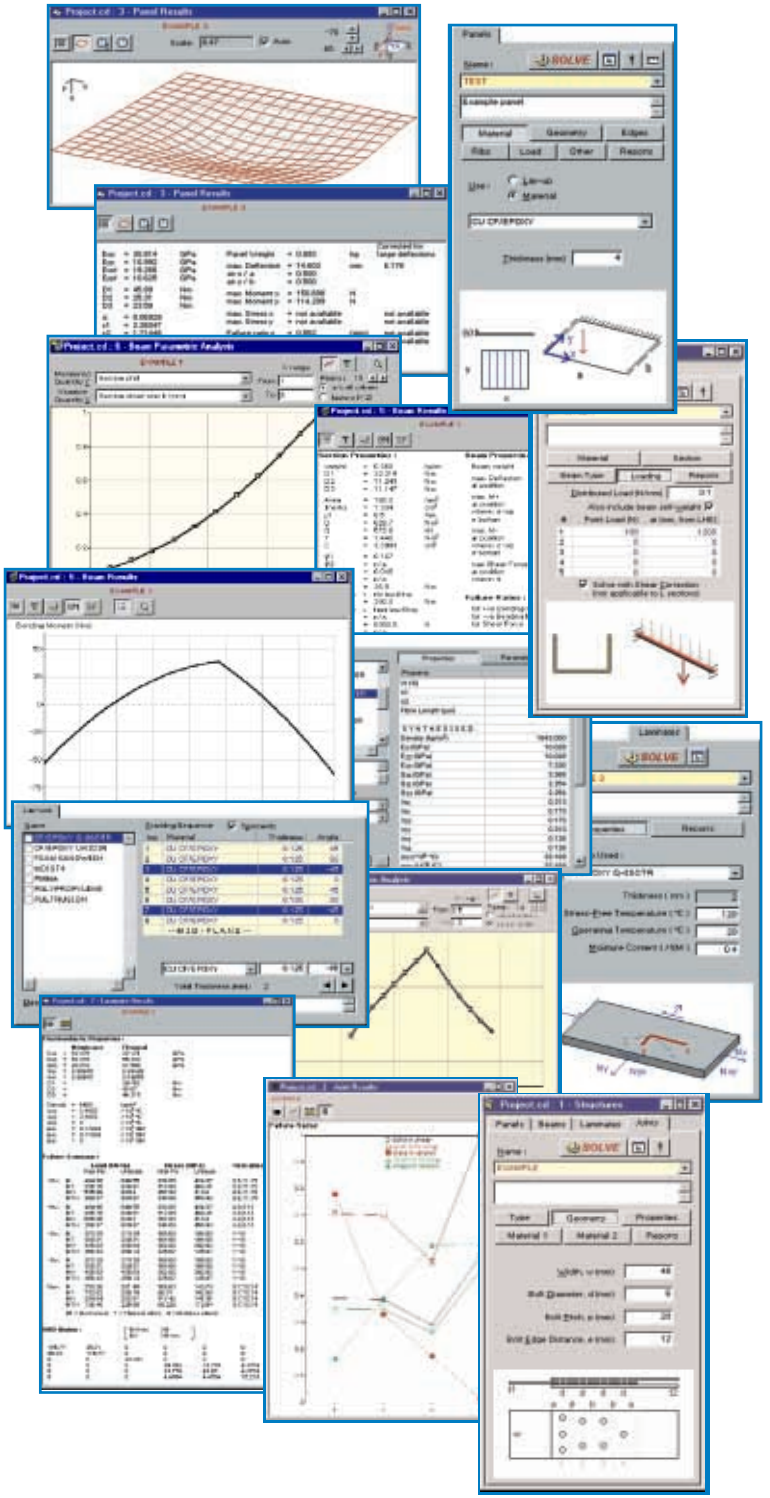
What does CoDA do?

The CoDA Program enables preliminary design analysis of components or sub-components with plate or beam geometries to be quickly and easily undertaken. CoDA allows rapid assessment of the effect of choosing different design solutions and gives high degree of physical appreciation of the relative effects of different input parameters (eg different edge conditions such as clamped, simply supported and free for both beam and panel analysis). This allows a preliminary analysis to be undertaken to determine feasible combinations of material and geometry prior to more detailed analysis or "build and test". Material properties can be isotropic (eg steel, aluminium) or anisotropic. For material systems where property data are not easily available, CoDA can synthesise the properties of composite materials, laminates and sandwich structures from fibre and matrix, or material databases.

As experimental data is often incomplete predicted, user or mixed properties can be used within the design modules. The integration of the modules allows the effect of changes on any input data (eg fibre properties) or laminate parameters (eg fibre angles, skin thickness) on the design solution to be instantaneously assessed in a seamless manner. In addition, three modules have parametric options that allow "what if" scenarios to be rapidly assessed for all output data as a function of variations in the input data. The effect of a particular input parameter on all output parameters can also be readily scanned. The synthesis capability of CoDA is used to predict the 3D properties of potential development materials, assess the effect of alterations in composition (eg fibre modulus or volume fraction) and to check experimentally measured material, and component, data.

Enhancements in new version

- The entire graphical user interface has been redesigned, to include all the features expected of a professional, state-of-the-art, technical software application.
- Multiple database files can be open simultaneously.
- Parametric facilities on three modules.
- Generic reports can be defined to obtain professional quality printed output of text and graphics efficiently, print preview available.
- The desktop layout of the various working windows can be saved for easy return to a particular problem.
- Drag-and-drop copy operations between CoDA files can be used for any database object, such as a material, lay-up, etc.
- Text interfaces for data quantities can be used to import or export information and communicate with other applications.
- Text interfaces for results can be used to export results to files or to the Windows clipboard for instant transfer to spreadsheets, word processors, or custom application software.
- The new version of CoDA has increased capability for importing and exporting files. In addition to text interfaces, it is possible to import files from CoDA version 2 and LAP, and to export both materials and laminate data to finite element analysis programs.
- A unique Trace window gives detailed information on the internal calculations.
- Easier integration for planned new modules.
- Lockable databases.



PANELS MODULE

- Rectangular or circular panels.
- Individual edge conditions (clamped, simply supported or free).
- Point, line, and pressure loads. Point and line loads can be offset.
- Displacement and stress calculated. Graphical presentation of deflections.
- Corrections for large displacement membrane effects.
- Ribs, transverse (X and Y directions) and diagonal.
- Design mode allows new thickness or rib combinations of rib width/height and spacing to be predicted.
- Parametric option allows any output parameter (eg maximum deflection) to be assessed as a function of only input parameter (eg plate thickness).

BEAMS MODULE

- Beams of different geometry (eg. Angle, T, I, channel, box, tube).
- Deflections, stresses, failure loads (tensile, compressive and shear), failure modes (including shear and compression buckling) calculated.
- Beam loading geometries include simple beams, stepped beams, off-set loads and torsional loads. Both uniform and up to five point loads can be applied to the simple beam. Includes self-weight and shear corrections.
- Tabular or graphical presentations of results available.
- Easily assessed graphs of displacements, bending moments, shear stresses along the beam.
- Constraint coefficients included for clamped open sections.
- Support conditions include clamped, simply supported and free; cantilevered beams can be configured.
- Parametric option allows any output parametrer to be assessed as a function of variation in the input parameters.

LAMINATES MODULE

- The Classical Laminate Theory assumptions, which lie at the core of the solution, are software controlled to yield material properties.
- Failure criterion used following experimental validation is Tsai-Wu.
- Hygroscopic, Thermal and Mechanical loadings are all supported. Their effects can be viewed in isolation instantly.
- Layer properties input by the user or selected from the synthesised database, or a combination used.
- Sandwich structures, can be analysed with foam and honeycomb cores.
- Full thermoelastic properties predicted.
- First, intermediate and last ply failure loads and stresses calculated.

LAYER SYNTHESIS MODULE

- Micro-mechanics solutions used to predict 3D layer properties of a material layer or type.
- Extensive testing has resulted in reliable predictions using correlation factors.
- Fibre formats can be continuous or discontinuous, aligned or random.
- Parametric option allows the effects of fibre and resin modulus, fibre length and volume fraction to be assessed.
- Fibre, matrix and material databases available for user entries.

JOINTS MODULE

- Double shear mode, bolted and bonded.
- Single and multiple pin arrays.
- Bearing, shear-out, pin shear and by-pass tensile failure predicted.

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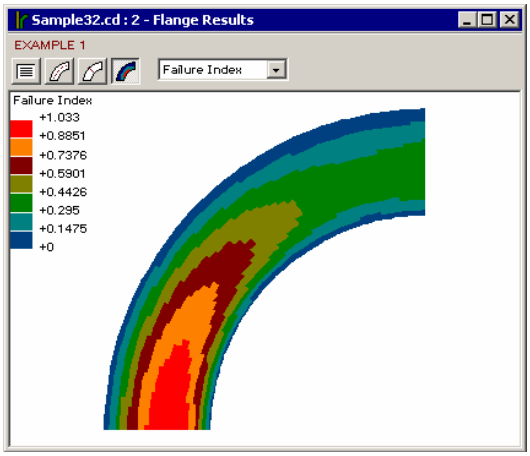
UPDATED VERSION

CoDA 3.2 Component and Composite Design Analysis

The popular Component Design Analysis (*CoDA*) package from the National Physical Laboratory (NPL) has been enriched with two new modules, FLANGES and PREDICT. In addition, full 3D properties are now calculated for laminates in the LAMINATE module. The software has now sold hundreds of modules to small manufacturers, medium sized companies, consultants, universities and major companies.

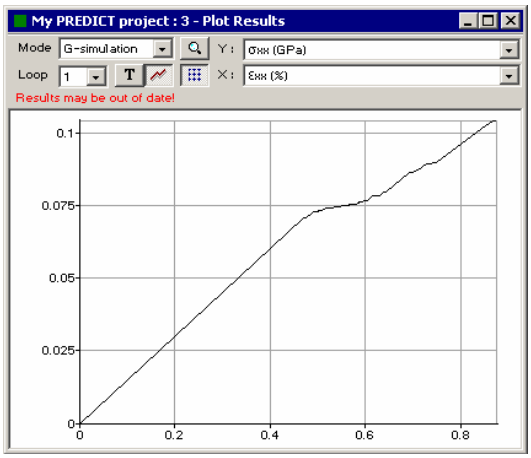
FLANGES



There are numerous examples of premature failure of laminated composite components due to the general lack of appreciation of their relatively low through-thickness strength. This is particularly true for structures such as flanges and curved beams, which are found in most industrial applications. The **Flanges** module uses geometry and material properties to calculate the stress distribution and ultimate load capacity of simple curved beams, subjected to moment and shear loading. Detailed and expensive finite element analyses can be circumvented by the use of the CoDA Flanges module. The analysis has been verified for laminates by comparing finite element analysis, analytical methods and experimental results.

Ref:- G. Hinopoulos, D.Ferriss, J.Niklewicz and G.D.Sims, "Procedures for the local design of flanges and curved composite structures", NPL Report CMMT(D) 295, 2000

PREDICT



This module is mainly used to simulate the progressive formation of ply cracks in a single orientation during the monotonic loading of a general symmetric composite material laminates. The results include the variation of laminate mechanical properties with increasing crack density or applied stress or strain, while the effects of ply thickness, temperature changes, etc. on laminate mechanical behaviour can be studied. General in-plane loading can be analysed, as would arise in many engineering structures. The tool can easily be used to determine the first ply-failure stress, and the temperature changes needed to cause failure during cooling following manufacture at elevated temperatures, or for cryogenic applications.

Ref:- L.N.McCartney, "Physically based damage models for laminated composites", Proc. Instn. Mech.Engrs. Vol.217, Part l: J.Materials Design and Applications.

Further modules are being developed and validated at both the material and structural component level (e.g. fatigue strength, sandwich structures). NPL and Anaglyph are pleased to receive suggestions for further modules and facilities.

National Physical Laboratory
NPL Materials Centre
Queen's Road
Teddington
TW11 0LW, UK
+44 20 89436564
graham.sims@npl.co.uk
http://www.npl.co.uk/cog/index.html

Anaglyph Ltd
Suite 33
10 Barley Mow Passage
London
W4 4PH UK
+44-20-89876056
sales@anaglyph.co.uk
http://www.anaglyph.co.uk