“MATHEMATICAL MODELLING FOR ENGINEERS”

Two day training course designed to help practising engineers understand and avoid common engineering failures and quantify technical risk.

SUMMARY: A mathematic model is a description of a system using numerical logic. Once constructed a model shows how a system responds to change and gives you a tool to assess risk, to optimise and to innovate. Copying from a library of solutions learn how to build models quickly to cover any engineering system and support technical decisions. Attendees have access to the library, and other resources, both during and after the course. We avoid use of specialist software and only assume that attendees have Microsoft Excel (any version). Discover little known Excel techniques and best practise for mathematical modelling. We take real life examples from theme parks case studies to showcase engineering principles. Attendees work together to build their own rollercoaster and they devise ways of managing their new attraction to avoid failure scenarios.

WHO SHOULD ATTEND: The course is intended for practising engineers of any discipline particularly those involved with design, service provision and engineering management.

COURSE LEADER: John Doyle BSc(eng)., Ceng., MIMechE., ACGI was born in 1965 and is a graduate of London’s Imperial College with some 25 years of experience in solving engineering problems. After graduating he joined Rolls Royce where he attained chartered status with the Institute of Mechanical Engineers. Having risen to the position of Chief Mechanical Engineer with Bombardier Transportation he started his own engineering consultancy in 1995 called MoreVision. It specialises in engineering analyses applied to railway vehicles, construction equipment, oil and gas plant, cranes and mechanical items for theme parks. His client list includes Shell, Bombardier, Siemens, Volvo and Disney. He won a UK Government SMART competition for software innovation and his website attracts over 18,000 unique visitors every month.

Course Highlights

- Dynamic calculations.
- Impact & motion.
- Failure criteria for structures.
- Understand bolt failures.
- How bolts work together.
- How to stop bolt vibrational loosening.
- Size welds for strength.
- Size welds for fatigue life.
- Assess risk.
- Identify critical parameters.
- Rationalise complex decisions.
- Master MS Excel.

Course Activity

- Design and manage your own roller coaster!

Access resources after the course completion.

- Library of mathematical models to copy and paste into your own models.
- Specialist Excel add-ins for engineers.
- Forum of engineering experts for continuing support.
- Library of supporting videos.

Website www.ExcelCalcs.com/training/

Join a scheduled course or arrange custom company training.

Day One: Mathematical Modelling for Engineers	
09:00	**Introduction** Position yourself on the learning tree. **Mathematical Modelling with Excel** • Display cell formulae as mathematical equations. • Checking for errors in cell formulas. • Greek characters and subscripts. • Show algebraic or numeric equations. • Mathematical model libraries.
10:30	Break
10:45	**Loading, Impact and Dynamics**. – Knowledge of loading if often the starting point for assessment of any engineering system. • Energy considerations • Elastic design • In elastic response • Designing for impact • Resonance • Impact Factors • Solving equations of motion Assignment: Design you own roller coaster. Assignment: Excel solutions for resonance and forced vibration.
12:30	Lunch
13:30	**Beams** – Sizing structural members with Excel. • Analysis of beams. • Analysis of columns. • Analysis of frames. • Finite element analysis. • Failure criteria. Assignment: Excel solution for a roller coaster car frame.
15:00	Break
15:15	**Excel Tips and Tricks for Engineers** • 21 Rules for designing, building and testing a spreadsheet. • Getting the best out of Excel Charts. • Cell sized summary charts. • Make Excel read tabular data. • Make Excel read graphical data. • Matrix operations in Excel. • Goal seek and Excel Solver. • Handling units in Excel. • Animate your spreadsheets. • Getting the best out of Excel drawing tools. • Making scale drawings linked to Excel data. • VBA Functions and Macros.
17:00	Close of formal training.
17:00	**Optional Engineering Surgery** • Stay back and discuss your specific problems with course leader.

Day Two: Mathematical Modelling for Engineers	
09:00	**Bolts** - Bolted joints are one of the most common elements in construction and machine design yet they are the root cause of half of the failures investigations undertaken by the course leader. • Modelling of bolted joints. • Modelling of bolt groups. • Why bolt pretension is so important. • How the tightening method controls preload. • What can go wrong with a bolted joint? • Understanding bolted joint diagrams. • Modelling thermal effects. • Differences bolting steel and aluminium. • Preload fatigue benefits. • Fatigue strength of bolted joints. • Special bolting products. • Vibration performance. Assignment: Excel solutions for Preloaded Joints. Quiz - Preloaded Fasteners.
10:30	Break
10:45	**Welds** - Learn how to size welds and avoid fatigue cracking. This course covers both steel and aluminium welding. • Static strength of welds. • Analysis of weld groups • Fatigue design of welds. • How to recognise good and bad welds. • Fatigue classification. • Constant amplitude verses variable amplitude loading. • Fatigue damage and miners rule. • How to enhance fatigue performance. Assignment: Excel solutions for static and fatigue strength of welds. Quiz - Fatigue Design
12:30	Lunch
13:30	**Whirlwind Tour of ExcelCalcs Library** - Two days is simply not long enough to get around the site so John will take you quickly through some of the best areas of the site to whet your appetite for future visits. Here are some popular downloads from the site: *Gusset plate connection for truss; Bolted end plate splice apex connection of portal frame; Wind pressure ASCE 7-05; AISC-weld calculation for built up beams; Contiguous piled wall with ground anchor support; Analysis of a sheet pile-wall; Steel beams with web openings; Base plate design; Flexure and Torsion of Single Angles; Sheet Piling; Clevis and lug design; Rectangular spread footing analysis; Analysis of gabions; Mast design; IBC 2006 seismic analysis; Retaining wall design; US Steel sheet pile design; ASCE705W wind loading; Analysis of pipe flow; Calculator assessment of timber structures to AS1720; Rectangular tank design with horizontal stiffening; Angle seat detail; Thermal effects for buildings; Steel beam with web openings; Steel angle member; Anchor bolt anchorage ACI 318; Geotechnics; Calculator for assessment of cold-formed steel structures to AS4600; Mass Moments of Inertia; Beam analysis; Beam column analysis…* **Examination** Time to see if anyone has been listening.
15:00	Break
15:15	Re-position yourself on the Learning tree and course feedback. **Presentation of Certificates of Course Completion**
17:00	Close.