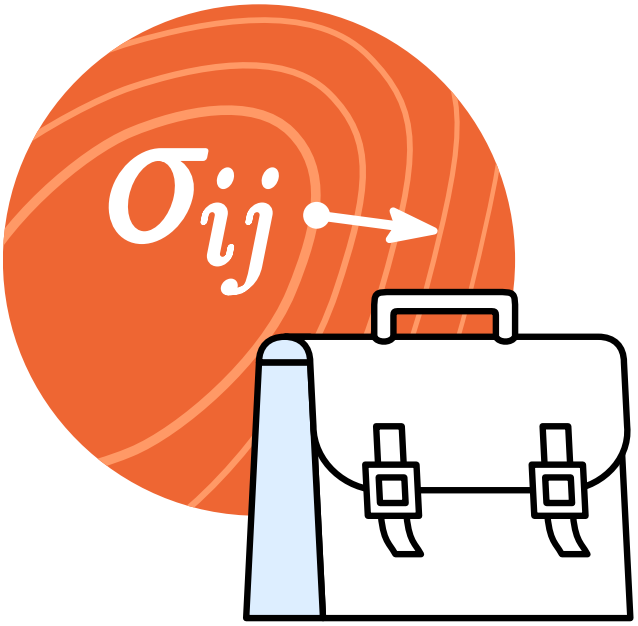

SEMINARS 2025

Introductory and advanced
courses for the FEM user material
model MF GenYld + CrachFEM

July 2025

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Ingenieurgesellschaft mbH

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GET IN TOUCH WITH CRACHFEM ...

MATFEM has developed the comprehensive material model MF GenYld + CrachFEM. The model is designed to be modular and extensible and it can be coupled to a variety of commercial FE codes with explicit time integration.

MF GenYld covers the elasto-plastic behaviour of metals and polymers with great flexibility in yield loci, flow rules and hardening. CrachFEM allows for the prediction of localised necking in sheet metals and provides different fracture criteria for metals and polymers. These physical failure criteria are useful in the predictive simulation of technical structures.

The material models offer many functions and therefore require a sound theoretical background before they may be put to productive use. The seminars on these models should help users to apply the material model efficiently.

Introductory tours are meant to showcase the capabilities of GenYld + CrachFEM. They don't go into depth and are open to everyone. The rest of the seminars address regular users of CrachFEM.

The **basic seminars** are mainly theoretical, but examples are presented and worked out at the computer. The aim is to provide the theoretical fundamentals to the software.

There are two courses on **material properties** of metals and polymers. These courses highlight important aspects of material behaviour for various classes of metals, polymers and composites and show how to model them based on experimental data.

Advanced seminars extend the scope of the basic courses. These seminars cater for the individual needs of our customers.

Hands-on **workshops** help to integrate our material model into the existing simulation environment.

… FROM YOUR COMFY ARMCHAIR

The coronoavirus pandemic had forced us to keep our distance. Meanwhile, the pandemic has subsided, but some habits formed during the days of contact restrictions are still with us and have proved useful.

Therefore, we have decided that we don’t offer the seminars as face-to-face meeting in our office or on your premises. And we don’t offer the seminars on pre-scheduled dates. Instead, seminars must be **arranged individually**. They are held as **web conference**.

The seminars are split into smaller chunks of about four hours. This should help the attendees to stay focused. It also allows to digest the subject between sessions and prepare questions.

We hope that you find the seminars helpful and we look forward to seeing you.

INTRODUCTORY TOUR OF MF GENYLD + CRACHFEM FOR METALS OR POLYMERS

This brief tour addresses engineers who want to look into MF GenYld + CrachFEM's abilities of deformation and failure prediction for metals or polymers.

MF GenYld + CrachFEM is a comprehensive material model. It can describe the deformation and failure of various materials. This includes materials with highly anisotropic and non-linear elasto-plastic behaviour as well as materials that are prone to various failure modes.

This brief tour should give you an overview of the key characteristics of MF GenYld + CrachFEM without going into too much depth. It is a sales pitch to interest potential customers in projects with MATFEM and in trying out MF GenYld + CrachFEM.

The tour comes in two basic flavours: Depending on your needs, we offer a tour of features that are essential to modelling either **metallic metarials** or **polymers**.

This course is a single session of about 2 ½ hours, plus half an hour for questions.

The tour will be held online as a video conference for a small group of people. The focus should be on what MF GenYld + CrachFEM can do for you to improve your simulations, but there is time for discussions after the tour.

The introductory tours are offered free of charge.

If you would like to arrange an introductory tour session, please get in touch with Dr Helmut Gese.

SHEET-FORMING SIMULATION WITH MF GENYLD + CRACHFEM – BASIC COURSE

This course addresses existing users of MF GenYld + CrachFEM with experience in forming simulation who want to model plasticity and predict failure in sheet metals.

The formability of parts is assessed by means of virtual methods. Such simulations of forming processes should predict the dimensional accuracy of the formed part as well as possible failure during the process.

Sheet metals are the predominant material in the construction of structural parts. New generations of advanced high-strength steels, aluminium alloys and magnesium alloys have been introduced to optimise designs for weight. Most of these materials have lower failure limits than classical mild steels. A physically motivated failure model is a prerequisite for predictive simulation.

The user material MF GenYld + CrachFEM incorporates a range of plasticity and fracture models and can account for various effects observed in industrial metal materials. It may be coupled to several commercial explicit FE codes.

This course is divided into two sessions of about 4 hours each, usually held on consecutive days.

Thin sheets of ductile metals are prone to tensile instability, which leads to a localisation of strain and in turn to fracture. This failure mode can be accounted for with the algorithm Crach. Crach is a module of MF GenYld + CrachFEM.

- Brief introduction to micro and mesostructure of metals
- Strain hardening and strain-rate sensitivity in MF GenYld
- Yield loci for metallic materials in MF GenYld
- Brief introduction to isotropic-kinematic and anisotropic hardening in MF GenYld
- Fracture models for metals in CrachFEM
- Coupling MF GenYld + CrachFEM to FEM solvers
- Input format for the modules in MF GenYld + CrachFEM
- Derivation of material parameters from experiments
- Creation of an example material card
- Practical application and post-processing
- Discussion and open questions

CRASH SIMULATION WITH MF GENYLD + CRACHFEM FOR METALLIC BODY-IN-WHITE COMPONENTS – BASIC COURSE

This course addresses existing users of MF GenYld + CrachFEM with focus on metal failure in body-in-white components.

Fracture occurs frequently in crashes and impacts. Simulations of such events usually treat fracture and the change of stiffness and force paths in the structure by eliminating elements transiently. This method requires correct prediction of fracture, which in turn depends on correct representation of the deformation.

The main structure of transportation vehicles and aircraft that undergo impacts are made from a variety of metallic materials such as cold-formed and hot-formed sheet metals, metal profiles as well as low-pressure and high-pressure die castings. For different classes of materials, different characteristics are dominant. All thin-walled metal structures like sheets and profiles are prone to tensile instability. All metallic materials are prone to ductile normal fracture and ductile shear fracture. The prediction of fracture has to include the local change of material properties by the manufacturing process.

This course is divided into two sessions of about 4 hours each, usually held on consecutive days.

The user material MF GenYld + CrachFEM incorporates a range of plasticity and fracture models. It can account for various effects observed in industrial construction materials. It allows the user to incorporate effects of forming simulations and to alter the behaviour locally by element initialisation. It may be coupled to several commercial explicit FE codes.

- Basic concept of the material model MF GenYld + CrachFEM
- Input format and further functionality of MF GenYld + CrachFEM
- Overview on elasticity, viscoplasticity and failure of metallic materials
- Modelling plasticity and failure of sheet materials and extrusion profiles
- Modelling plasticity and failure of low-pressure and high-pressure die cast components
- Short overview on mapping of manufacturing processes
- Modelling techniques for cut edges, small notches and heat-affected zones
- Influence of element discretization

CRASH SIMULATION WITH MF GENYLD + CRACHFEM FOR NON-METALLIC MATERIALS USED IN PEDESTRIAN AND OCCUPANT SAFETY – BASIC COURSE

This course addresses existing users of MF GenYld + CrachFEM with experience in safety simulation who want to predict failure in polymers, composites and glass.

Besides the metallic body-in-white, many non-metallic materials are used in various places of a car: dashboards, interior linings, front-ends, headlamps, windshield, bumper foams etc.

These parts are relevant in assessing the safety of occupants and pedestrians in crashes as well as the insurance ranking. The used materials – non-reinforced polymers, short-fibre reinforced thermoplasts, composite fabrics, glass compounds and crushable foams – cover a large range of different characteristics. Plastic, viscoelastic and failure behaviour must be modelled accurately to ensure a faithful representation of energy absorption and force feedback.

Note: This seminar does not address the modelling of dummies, restraint systems and airbags.

This course is divided into two sessions of about 4 hours each, usually held on consecutive days.

The user material MF GenYld + CrachFEM incorporates a range of plasticity and fracture models. It can account for various effects observed in industrial construction materials. It allows the user to incorporate effects of process simulations and to alter the behaviour locally by element initialisation. It may be coupled to several commercial explicit FE codes.

- Basic concept of the material model MF GenYld + CrachFEM
- Input format and further functionality of MF GenYld + CrachFEM
- Overview on viscoelasticity, viscoplasticity and failure of polymers
- Modelling non-reinforced polymers
- Modelling short- and long-fibre reinforced polymers with mapped fibre orientation for mold-filling simulation
- Modelling glass fibre fabrics and glass fibre UD laminates with thermoplastic matrix
- Overview on linear-elastic fracture mechanics of glass
- Modelling windshield compound (glass–polymer–glass)
- Modelling crushable foams

INCORPORATING EFFECTS OF MANUFACTURING INTO CRASH SIMULATIONS WITH MF GENYLD + CRACHFEM

The course addresses existing users of MF GenYld + CrachFEM who already know the fundamentals of modelling the elasto-plastic and fracture behaviour and who want to employ advanced techniques to represent effects of manufacturing in subsequent simulations.

Material in structural components is rarely in a virgin state. It has usually undergone manufacturing processes that strongly influence component behaviour. Deep-drawing, stretch-drawing or bending, for example, introduce local hardening in metal sheets. Cutting may reduce the ductility at the edge of sheets. High-pressure die casting leads to local porosity in aluminium and magnesium alloys. Mould injection has an influence on the fibre orientation of short-fibre reinforced polymers.

The representation of the material behaviour can be improved if these effects are taken into account in the simulation. The material model MF GenYld + CrachFEM offers various methods to initialise individual elements according to their manufacturing history. This course gives an overview on these methods and shows examples of their application.

This course is divided into two sessions of about 4 hours each, usually held on consecutive days.

- Brief recapitulation of MF GenYld + CrachFEM
- Overview on initialisation and mapping
- Data transfer between MF GenYld + CrachFEM simulations
- Cross-solver solutions
- Basic initialisation with MF GenYld + CrachFEM
- Versatile user-defined initialisation in MF GenYld
- Incorporating results from sheet-metal forming simulations
- Incorporating results from die-casting simulations of light alloys
- Incorporating results from mould-injection simulations of polymers
- Techniques to initialise material properties derived from experiments, e.g. reduced ductility in cut edges or increased hardening around spotwelds
- Incorporating various effects into complex models
- Discussion and open questions

MATERIAL PROPERTIES OF METALS

The course addresses existing users of MF GenYld + CrachFEM who want to get detailed knowledge of material behaviour for various classes of metals and who want to learn which experiments are needed to derive material data for finite- element analyses.

This course is divided into two sessions of about 4 hours each, usually held on consecutive days.

Many structural components of vehicles and aircraft are made of metals, a material class that comprises many materials with different properties. The employed metals may be mild steels, high-strength steels, aluminium alloys or magnesium alloys. They may be rolled, die-cast or forged. They may have undergone previous deformation or heat-treatment.

The material model MF GenYld + CrachFEM allows users to model many aspects of a material's behaviour. Ideally, each aspect should be backed up with experimental data.

This course aims to give an overview on which aspects of elasto-plastic deformation and failure are important for which classes of metals. This helps to understand which modules should be incorporated into a set of material properties, which experiments should be carried out and where the deficiencies lie with simpler material models. The course is based on MF GenYld + CrachFEM, but the shown results can also be applied to other models.

- Mechanisms of plastic deformation in metal
- Experiments to determine plastic behaviour
- Mechanisms of fracture and instability in metal
- Experiments to determine fracture curves
- Experiments to calibrate instability models
- Relevant modules in MF GenYld + CrachFEM
- Properties of rolled steel sheets (mild steel, HSS, AHSS, UHSS)
- Properties of aluminium sheets, extrusions and cast alloys
- Properties of magnesium sheets, extrusions and cast alloys

MATERIAL PROPERTIES OF POLYMERS

The course addresses existing users of MF GenYld + CrachFEM who want to get detailed knowledge of material behaviour for various classes of polymers and who want to learn which experiments are needed to derive material data for finite- element analyses.

This course is divided into two sessions of about 4 hours each, usually held on consecutive days.

Polymers are increasingly used for structural and interior components of cars. There are many different types of polymers, for example thermoplasts and duroplasts. In addition, these polymers may be reinforced with short fibres of glass or carbon. The polymer itself, the reinforcements and the mould-injection process account for a wide range of deformation and failure behaviour.

The material model MF GenYld + CrachFEM allows to model many aspects of a material's behaviour. Ideally, each aspect should be backed up with experimental data.

This course aims to give an overview on which aspects of elasto-plastic deformation and failure are important for which classes of polymers. This helps to understand which modules should be incorporated into a set of material properties, which experiments should be carried out and where the deficiencies lie with simpler material models. The course focuses on MF GenYld + CrachFEM, but the shown results can also be applied to other models.

- Mechanisms of plastic deformation in polymers
- Experiments to determine plastic behaviour
- Mechanisms of failure in polymers
- Experiments to determine fracture curves
- Relevant modules in MF GenYld + CrachFEM
- Properties of non-reinforced polymers
- Properties of short-fibre reinforced polymers
- Properties of short- and long-fibre reinforced polymers
- Properties of thermoplatics reinforced with glass-fibre fabrics (so-called organic sheets)
- Properties of composites with endless unidirectional fibres
- Non-uniform property distribution in components as result of the mould-injection process

WORKSHOP:
CRASH SIMULATIONS
WITH MF GENYLD + CRACHFEM

The workshop addresses existing users of MF GenYld + CrachFEM working in crash simulation who want to prepare their models for the use with MF GenYld + CrachFEM.

The basic courses CB and FB focus on the theoretical aspects of material modelling. The proper use of MF GenYld + CrachFEM in complex simulation models requires further considerations, however.

In order to help users to get familiar with using MF GenYld + CrachFEM in their everyday simulation environment, we offer hands-on workshops in the customer's office. The details of how to integrate the material model depend on the customer's environment. Therefore, the lecturer should know what the focus of the simulations is and which tools are used in the daily simulation routine. These particulars should be planned with a contact from the customer before the course. Because our lecturers are not familiar with your environment, the contact person should attend in the workshop to assist with the demonstrations. The steps to take when replacing standard material models by MF GenYld + CrachFEM are outlined by means of an example model provided by the customer.

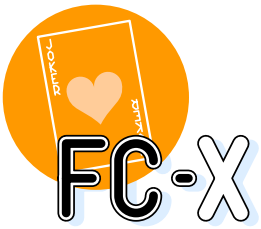
There are no fixed dates for this course. Courses are offered on request. The price and the conditions vary according to the customers' needs.

In the workshop, users learn:

- how to replace the material data in an existing FE model.
- when to model materials as isotropic.
- how to deal with anisotropic materials.
- how to request additional output for failure risks.
- how to interpret the additional output in a post-processor.

Further topics can be addressed if they are discussed with the customer's contact before the course. Workshops can be booked as online seminars. The schedule and how the seminar can be integrated into the customer's work environment should be discussed beforehand.

If you would like to arrange a hands-on workshop, please get in touch with Dr Helmut Gese.



ADVANCED COURSES ON FORMING OR CRASH SIMULATION WITH MF GENYLD + CRACHFEM

The course addresses experienced users of MF GenYld + CrachFEM. who want to know more in a particular field of forming or crash application.

Basic courses provide the theoretical foundation to the material model MF GenYld + CrachFEM. Advanced applications require more profound knowledge of the material model. We offer advanced courses on MF GenYld + CrachFEM, treating material modelling for forming or crash applications. These courses are not part of the regular seminar programme and do not have a fixed content. Course topics are tailored to individual needs in consultation with the customer.

There are no fixed dates for this course. Courses are offered on request for € 1,820·00 per day for 3 to 6 participants.

Like basic courses, advanced courses should be arranged individually. They are held as web conference. Because such courses require additional preparation, they are a bit more expensive than regular courses.

If you would like to arrange an individual seminar, please get in touch with Dr Helmut Gese.

OUR LECTURERS

Dr Helmut Gese is the head of MATFEM's CommonLab department. He is specialised in experimental assessment and characterisation of metals and has expertise in forming and crash simulation.

Dr Andrew Heath is the head of the methods and research department and has extensive experience in numerical methods, material modelling and forming simulation.

Gernot Oberhofer is the head of MATFEM's software development department and is specialised in theoretical material models, polymer characterisation and modelling process chains.

SEMINAR DETAILS

There are no fixed dates for the seminars. Courses must be arranged individually. The price is € 1,490·00 per basic course FB, CB, SB, CM, MP-M or MP-P. This price does not include the value-added tax (VAT).

The lecture notes in English are included in the price. Payment is requested by invoice. Members of academic institutions are eligible for a discount of 50%.

Get in touch and arrange a seminar web conference for your work group now!

The courses will be held online as a web conference. It is not easy to stay concentrated for a longer time in web conferences. Therefore, the courses are split into smaller chunks across consecutive days.

The individual advanced seminars FC-X may address topics beyond the scope of basic courses described in this programme. These seminars are tailored to the customer's needs. The price is € 1,820·00 per course.

There must be at least three participants to a seminar. The maximum number of participants is six. For each further participant, we charge a fee of € 100·00 per person. For individual advanced seminars, this additional fee is € 125·00 per person.

The courses will be held in English unless all participants speak German. In any case, the documentation will be in English. The participants receive a certificate after the course. For questions, please contact Dr Helmut Gese (helmut.gese@matfem.de).

These conditions do not apply to the introductory tours, which are offered free of charge.