

CATALOGUE OF KEY EQUIPMENT



VP1 – VS1 MICROSTRUCTURE OF BUILDING MATERIALS

Scanning Electron Microscope with an environmental probe with 3D imaging – TESCAN MIRA3 XMU



Microscopic analysis of the microstructure of materials using very large magnification

Equipment description: the equipment is designed for high vacuum as well as low vacuum operations with the possibility of adjusting the chamber's pressure. The low vacuum mode enables the visualization of non-conductor specimens in natural (non-metallic) state. The electron beam is produced using Schottky auto emission cathode.

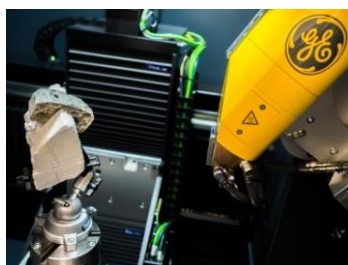
XRD with Rietveld refinement, high temperature chambers and SAXS - PANALYTICAL EMPYREAN

Description: The device is primarily designed to determine the mineral composition of the powder specimen. The Rietveld method enables to establish the quantity and quality composition of the material. The device is also fitted with a high temperature chamber for phase changes analysis during heating (up to temperatures of 1600°C) or cooling in an atmospheric environment, or changes during heating (up to 2000°C) and cooling in vacuum. The device is also fitted with a cryostation for measurements of temperatures close to that of liquid nitrogen and a moisture chamber to determine the composition changes at early stages of hydration. The modern disposition of detectors allow the device to be used as CT with small scale specimens.



RTG tomographer - v|tome|x m300

Device description: Using the computer tomography method it is possible to create a non-destructive, contactless, 3D model of the specimen. It is possible to analyse non-destructively the internal structure of the specimen. Combined with state of the art software tools it is possible to use this method in the reconstruction of the internal structure of the material as well as unique metrological applications



Devices designed to determine thermo-technical properties

Measurements using the following methods:

- guarded hot plates - TLP 300-DTX-1P
- heat flow meter with vacuum arrangement - FOX 200 VACUUM
- rotational heat flow meter - FOX 630 Rotational



Xenon system for accelerated weathering of materials inducing artificial sunlight- Q-SUN XE3HS



Evaluation of polymer and inorganic material resistance against aging using artificial sunlight in the testing chamber; the artificial source of sunlight is produced by xenon lamp/s. The minimal total output of the xenon lamps (provided with automatic air cooling) is 5400 W. The horizontal sample changer has an area of 720 x 450 mm. It is fixed with no possibility of rotation.

Laser granulometer Malvern Mastersizer

This device measures accurately the particle size of building materials. The device allows visualisation of dispersion and agglomeration. It displays the shape and number of particles, area, orientation and fibres parameters. It is capable of measuring sizes ranging from 0.001 mm up to 2 mm.



Fluorescence system for accelerated weathering of materials using UV radiation QUV/Spray/RP



Description: Polymers, textiles and paints are among the most commonly tested materials. The device is fitted with a 2800 W xenon lamp with automatic cooling, a horizontal changeable sample carrier with an area of 500mm x 250mm, UV filters to shade specific bands of radiation and a control system designed to maintain a constant level of radiation according to the degree of intensity ranging from 300 up to 1000 W/ m².

Versatile microscope for transmitted and reflected light - Leica DM4000 M LED



equipped with a device for the preparation of polished cuts.

Description: The microscope can be used with both reflected and transmitted light. The polarization in the transmitted light allows the mineral analysis of thin cuts of materials such as plasters, concretes and other building materials. In the reflected light, observation in the light and dark field is possible. The device also allows fluorescent observation stimulated by UV blue and green light. The software provided enables picture analysis. The microscope is also

Gas adsorption BET - Nova 3200e

Description: The device can detect the features of porous and powder materials. It is a fully automatic volumetric sorption gas analyser designed for quick analysis of single or multilayer BET profiles to determine the surface area, pore size, adsorption and desorption isothermals. The instrument is capable of measuring 3 samples and degassing 4 samples at the same time. The device can also analyse two samples and one referential cell at the same time.



Differential thermal analysis device - Mettler Toledo TGA/DSC 1



Description: It is a dynamic heat analysis method, which is based on the measurement of temperature differences between the analysed sample and the inert reference sample (the standard sample used by this device is virtual) which are both heated in the furnace at the same time. The colouring of the samples during the heating, manifests with maxima and

minima in the exothermic and endothermic areas. Changes in weight during these types of reactions are monitored. The outcome is to determine the amount of components of the analysed material. The device enables analysis of the behaviour of samples at temperatures up to 1600° C. The instrument is also equipped with a device measuring in a specified atmosphere (oxidising, reducing or inert).

VP1 – VS2 BUILDING MATERIALS TECHNOLOGY

Testing presses

Testing press with capacity up to 3000kN

The unit is used to determine the compressive and tensile strength of building materials during bending. The tests are carried out using testing cubes, beams, cylinders, core drilled structures, floor tiles, concrete curbs and other concrete structures. The maximum force: load 3000 kN.

Presses (ranges 10kN, 200kN, 300kN)

Testing presses for compressive and tensile strength tests (bending forces applied) ranging from 10 kN, 200 kN up to 300 kN. The presses are fitted with digital display and data processor. It is also possible to connect the press to a PC.

All-purpose electro mechanic press

It is a highly accurate digital testing device, performs very accurately compressive, tensile and bending tests. The load capacity of the press is 30 kN. Testing is performed following Czech and international standards.

Accessories

Set for tensile tests, set for compressive tests, set for bending tests and universal extensometer.



Corrosion test chambers

Corrosion solution test chamber HKT 500

The testing device is capable of recreating the following four testing environments: salt spray, condensing humidity (humidification), air drying and constant temperature, which are possible to obtain at different temperatures and can be programmed to create cycles.

Corrosion gas chamber HK 800

Designed to simulate the effect of harmful gases (sulphur oxides, nitrogen oxides, carbon oxides, etc.) at controlled temperature and relative humidity with internal space for harmful gases testing (tempered by air jacket). The device for supply and dosage of harmful gases is built-in to a compact compartment next to the testing space in order to supply the required amount and mixture of gases. The attachment of the dosage supplier to the chamber and the outlet for the exhaust gases is done by means of corrosion resistant pipes. The capacity of the testing area is 800 dm³.

Accessories – Saline solution container including electric mixer.



CCL-1703-8s incubator with CO₂ environment



The device is used to determine the diffusion properties of building materials for carbon dioxide (diffusion resistance, coefficient of diffusion resistance, etc.) The determination of the above mentioned properties has a key role in surface finishing (e.g. coating paints, plasters, etc.). It is possible to analyse material behaviour at different CO₂ concentrations and different levels of relative humidity. This allows a unique simulation of the surface finishing behaviour under different atmospheric conditions.

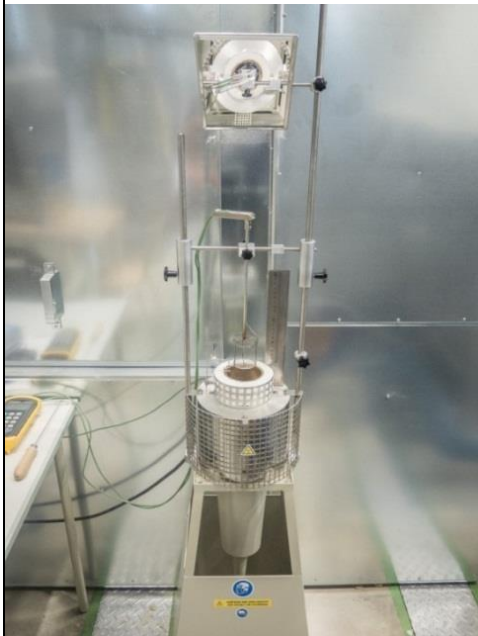
Fire tests

The fire furnace for studying of the behaviour of materials at a high temperature

Description of the device: it is a gas furnace for studying of the behaviour of building materials, constructions and components at high temperatures. Structurally, the furnace is ready for storing of test samples (in particular building elements) on the upper part of the furnace and for monitoring the behaviour of the test samples under the high temperature loading which has an upper limit of 1100 ° C. The maximum load of the test components is 50 kN / m' (the shorter side) and respectively 25 kN / m' (the long side). The test equipment enables the variable loading of samples under different temperature curves (e.g. loading in accordance with ČSN EN 1363-1 - Fire resistance testing), including the possibility of the cyclic loading with temperatures. The furnace has a possibility of thermal loading of whip-type components into the diameter of 60 mm, which is drawn through the furnace in the transverse (short) direction. The internal light dimensions of the furnace space are 1800 x 1000 x 1000 mm. The test area for building components placed on the upper side of the furnace corresponds to the area of 1800 x 1000 mm.



Testing of the fire reaction of the products



The furnace for the flame resistance testing of building materials

Description of the device: the equipment meets the requirements for testing of building materials in terms of the fire reaction in accordance with ČSN EN ISO 1182: Testing of the fire reaction of building products - Test of the flame resistance. This is the electric furnace of a small size, which enables a thermal shock loading of small cylindrical samples with a diameter of about 45 mm and a height of 50 mm. The furnace enables the testing at temperatures of about 800 ° C with the possibility to monitor the state of the test sample using a mirror and with monitoring and recording of the temperature inside the furnace (including the programmable control mode of the temperature inside the furnace during the experiment).

Testing of the combustion heat

The furnace for the testing of the combustion heat

Description of the device: This is a device for testing the fire reaction of building materials, specifically for determining the combustion heat in accordance with ČSN EN ISO 1716 Testing of the fire reaction – The determination of the combustion heat (the calorific value). During the test the tested unit of the specified weight is being burnt, under standard conditions, at a constant volume, in an oxygen environment in a calorimetric bomb. The test device is composed of a calorimetric bomb in the calorimetric container, the mixer, temperature measurement devices, the crucible made of metal. The test result is a combustion heat of the test sample by the crucible or "cigarette method."



Testing of the fire reaction of floorings

The furnace for floorings testing

Description of the device: This is a device for testing the reaction of the floorings to the fire in accordance with ČSN EN ISO 9239-1 Testing of the fire reaction of floorings - Part 1: The determination of the burning behaviour using a radiant heat source. This test provides a basis for the evaluation of one of the aspects of the behaviour of floorings during the fire exposure. The introduced radiant flow simulates the levels of the thermal radiation that are likely to fall down the floor of the corridor, its surface is heated by the flames or hot gases during the early stages of the fire development in the next room or section, under the terms of flame spread against the direction of the air flow. The tested unit (in the horizontal position) is exposed to a gas radiation panel during the test which is tilted at an angle of 30 ° and is exposed to a defined heat flow. The subsequent bursting into flames of the floorings is observed as well as the expanding flame zone in time and the procedure of this zone in the horizontal direction in time. The result is expression of the flame spread in time in the units of length. The development of the smoke during the test of floorings is recorded as the light transmittance in the exhaust chimney. The test is carried out on the tested units with the dimensions of 1050 x 230 mm. The device can be used for a general load of building materials and components with the help of a radiant heat source.



Reaction to fire testing – SBI test

Test chamber for single burning item testing (SBI test)



Description of the device: It is a device designed to test the reaction to fire performance following the ČSN EN 13823 standard – reaction to fire performance testing of construction products – Construction products excluding flooring materials exposed to the effects of single burning item. The test specimen consisting of two wings placed corner-wise is exposed to the effect of a burner placed at the bottom of the corner. The flames from the sand-box burner generate an output of 30.7 kW. Testing is performed over a 20 minutes period. During this time heat release and smoke production are measured and lateral flame spread and the formation of burning droplets and particles are observed visually. It is possible to

record the rate of heat release and smoke production. The test specimen is mounted on the specimen trolley and is then introduced into the test chamber. The test specimen is

composed of two wings, short wing (495 x 1500mm) and long wing (1000 x 1500mm) both wings 20 mm thick at the least. Part of the equipment for the single burning item testing is a combustion gas hood collector, the hood is fitted with sensors capable of monitoring the desired parameters. A cleaning system of burnt gases and a draught regulator are fitted in the hood. The results of testing are graphs where mean rate of heat release, total heat released, rate of fire spread, total smoke production and index of smoke spread are monitored. The total amount of smoke and the total heat released are monitored over a period of 600 s.



Reaction to fire testing – small flame

Test chamber for fire testing reaction of construction materials directly exposed (surface exposure) to gas flame



Description of the device: The device consists of a testing chamber designed to determine the ignitability or flammability of construction products subjected to direct exposure of a small flame with zero draught on vertically mounted specimens according to ČSN EN ISO 11925-2 regulations. Fire reaction testing – Ignitability of construction products directly exposed to flame. Part 2 – Small flame testing. The test specimen consists of a building material: 250 x 90mm of a thickness 60 mm at the most. The equipment consists of test chamber fitted with a burner which can be moved in order to change the distance between the flame and the specimen. The specimen can be exposed to the flame in

vertical position or at 45 degree angle relative to the vertical position. An anemometer capable of monitoring flow is fitted to the chamber in its top part.

RP2-RG1 STRUCTURES AND TRANSPORT CONSTRUCTIONS

Bending Beam Rheometer

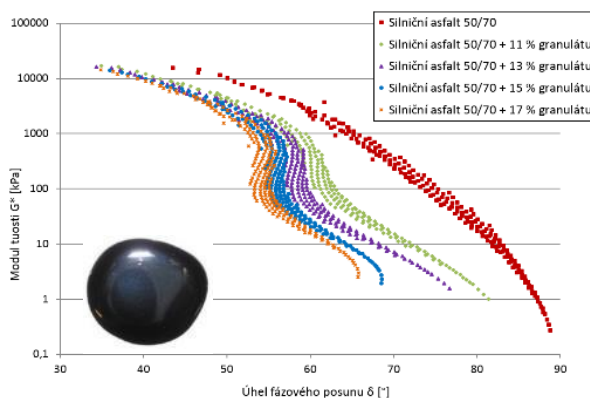


The device is suitable for describing low-temperature behaviour of asphalt binder by means of determining the slow changes in elasticity – stiffness of asphalt binders in the temperature range of +5 °C to -40 °C according to the ČSN EN 14770 standard.



Rotational rheometr

The device is used to determine the rheological properties of liquids, emulsions, dispersions, polymers, paste, gels and suitable solids. It is widely used in the chemical, petrochemical, pharmaceutical, cosmetics and food processing industry and also traffic construction. Shear stress is applied to two plates during the measurement. A sample of the material tested is applied in between the plates. It is possible to determine the shear viscosity or modulus and phase angle. The device enables testing at temperatures ranging from -40°C up to 200°C so the characteristics of asphalt binders can be observed in the whole temperature and stress ranges. It is also possible to design and evaluate possible additives in order to improve the properties of the asphalts.



Equipment for determining the aging resistance of asphalt binders via the RTFOT method



The device is able to evaluate the resistance of the asphalt binder against short term aging due to heat and air. The device simulates the aging of the asphalt binder at the asphalt mixing plant and during laying of asphalt.

Device for determining the complex stiffness and fatigue modulus according to the ČSN EN 12697-24 standard

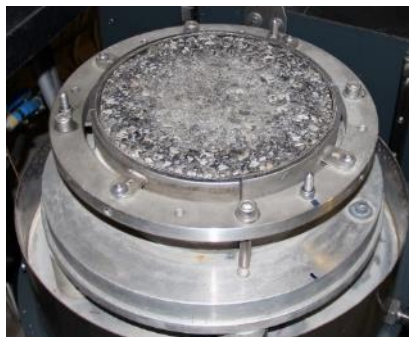
The Cooper device determines the stiffness modulus and the fatigue features of the asphalt mixtures. This is performed as a two-point bending test using trapezoids. During the test, harmonic sinusoidal strain is applied at the free end of the trapezoid and the response of the tested object (asphalt mixture) is measured. The device is capable of measuring stiffness and fatigue features at four trapezoids simultaneously.



Testing equipment for determining the anti-skid properties of materials and road surfaces after smoothing

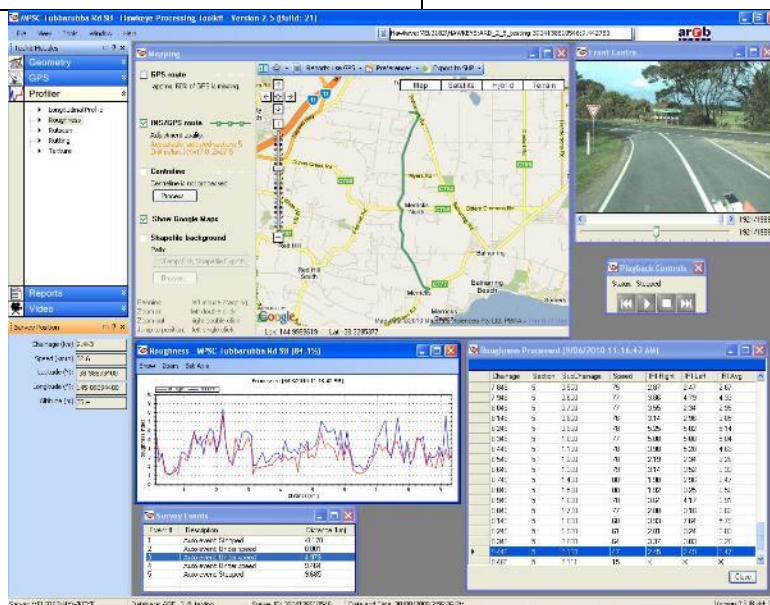


By means of smoothing the tested sample, the equipment is able to simulate the effects of traffic. It is therefore possible to predict the lifespan of different types of road surfaces (asphalt mixtures or concrete surface layers) regarding their anti-skid properties. It is possible to test actual road samples or laboratory samples. The equipment is also suitable for stone polishing testing.



High-speed measuring system Hawkeye

The Hawkeye laser profiler measures the MPD (Mean Texture Depth) values and the IRI (International Roughness Index) of road surfaces. The measurements are carried out in a continuous way and without any traffic restrictions. The acquired data are processed in real time by the control unit. A high definition camera and GPS are fitted to the unit.



Rolling noise measuring equipment

The device measures the equivalent noise level at the tyre – road contact area using Close Proximity method (CPX). The device consists of a pair of microphones located at prescribed distances from the right rear tyre of the measuring vehicle. The signal from the microphones is processed, the outputs of the measurements is the corresponding noise level L_{Aeq} .



Equipment for intersection turning movement survey

The equipment consists of a 16m tall post, a moving camera and a processing unit. The device records and processes the traffic turning movement survey at single level intersections. The results of the acquired data is a matrix of traffic patterns divided into different vehicle categories.



Track grid and load frame structures



The 1:1 scale model of a rail track will serve for long-term (mainly dynamic) testing. The steel frame with bearing beam serves for transmitting the loads into the railroad track. The bearing beam is capable of applying a static 30t load and by means of two vibromotors a dynamic load of 5t. Load and acceleration sensors are placed in the track grid (it is possible to customize and add other sensors e.g. 3-axis

acceleration sensors, track sensors, strain gauges, etc.) The structure is suited for fatigue testing of track grid components, mainly sleepers and under sleeper pads. (e.g. prEN 16730: Railway applications - Track - Concrete sleepers and bearers with under sleeper pads). It is also possible to measure the cross resistance of the sleepers (concrete sleepers, wooden sleepers, steel sleepers) in the ballast. This is performed by a load test.

KRAB Light

It is a track geometry measurement device, which is capable of continuously measuring a whole set



of track parameters. The trolley is capable of measuring track gauges from 1000 mm up to 1435 mm. It has a built-in GPS module for localisation of track defects. The device can measure rail switches (it measures flange width in the frog as well as in the guard rail, the gauge of the switch rails, and the guarding dimensions in the frogs). It is used during the work inspection with railway corridors, high speed tracks, local tracks, railway station track systems, tram tracks and rail switches.

Electrohydraulic load testing unit AH 10-1000 INOVA

The unit is suitable for static, fatigue and dynamic testing of load bearing elements and structures. Testing range 10kN, 100 kN, 500 kN and 1000 kN. The system comprises linear hydraulic motors, hydraulic aggregates and operational and command units. The unit is fully compatible with the load frames of the bend fixtures of the testing facility (hall).



Surface load testing unit

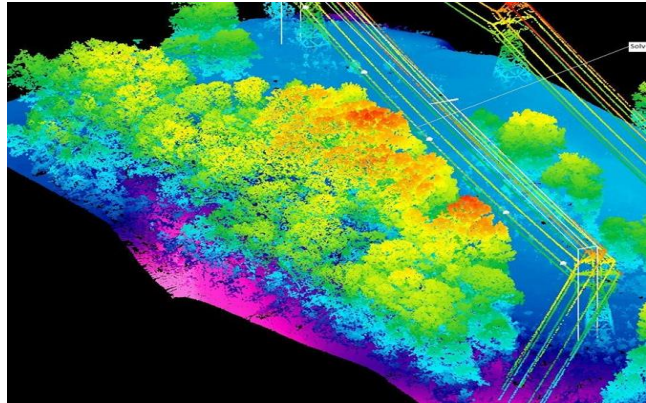
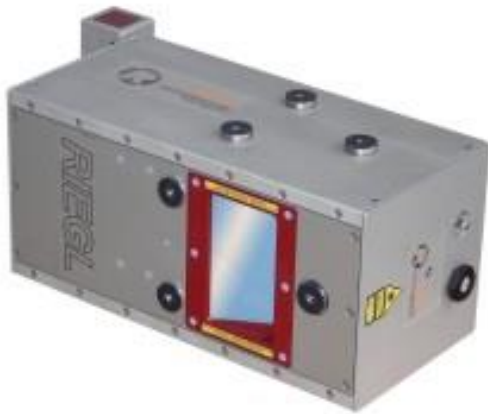
The device is a complex laboratory surface load testing unit of building elements and structures. The load into the samples is primarily applied by vacuum with the possibility of combining surface effects with linear ones (or with point effects) created by a set of hydraulic cylinders. The advantage of such a method (vacuum) of applying forces is the uniformity of the load exerted upon the sample (element). The system is able to exert load of different magnitudes with a maximum of 100 kN/m^2 . The electronic command of the system of vacuum pumps, allows to pre-set different load cycles. The combination of surface and linear loads is achieved through a system of hydraulic cylinders located at the sub frame attached to the load frames. It is possible to perform load tests with the hydraulic cylinders up to a maximum load of 1000 kN. The unit can perform gradual increase of load to the point of failure, as well as previously set levels of intensity (simulation of pressure and wind (pressure simulation and wind draft according to the current standards, e.g. EN, ETAG, etc.). The unit is fitted with a complex measuring system that is able to record the intensity of the linear, point and surface load. At given locations on the tested element, horizontal and vertical deformations can be monitored as well as the strain at critical locations. All the monitored quantities are continuously recorded by the recording unit at the desired time and recording intervals. Loads can be applied horizontally and vertically.



RP2 – RG2 – EGAR

Airborne scanner Riegl LMS-Q780

Equipment description: A unit designed for airborne scanning. The collected information is an agglomeration of laser points which is further analysed and used to create digital models of the scanned terrain. The unit has a wide range of use in the building construction, water management, transport, architecture fields and geotechnical applications. The data can be further used for environmental analysis, for determining the scope of areas covered with vegetation; also as a helpful guide in crisis situations such as floods, landslides, determining the magnitude of soil moved during large scale construction projects such as motorways, railways, dams, etc.





3D laser mobile scanner Riegl VMX-450



The unit is a scanner system suitable for mobile platforms. It can be connected to a digital camera or any other similar device. The scanner offers a detailed 3D documentation of cities and roads. The data acquired is a very dense cloud of laser points and georeferenced colour pictures, which are used to create 3D models of cities, road

documentation and road condition analysis including safety inspections, passports and inventory of property. It is also possible to further use the data to monitor single line constructions, urban studies and analyses, 3D clearance gauge of roads and railway corridors.

Laboratory devices for determining physical properties of soil

Name	Description/Use
Permeameter	Device for measuring soil permeability.
Tri-axial equipment SYSTEM WILLE UL/100 A UL/60	Device for determining shear strength of soil with high accuracy sensors. <div style="display: flex; justify-content: space-around; align-items: center; margin-top: 10px;">   </div>
Consolidation automatic device	Fully automatic consolidation testing system designed for soils. High load level compared to standard oedometer. Possibility of measuring porous pressure and inflicting reverse pressure.

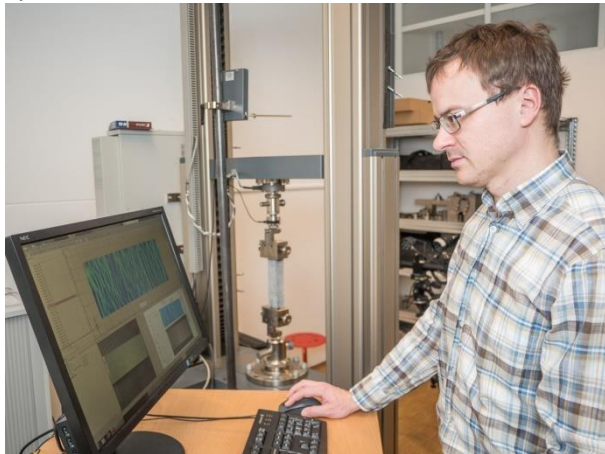
RP2-RG3 MATHEMATICAL MODELLING

Aramis – optical 3D deformation analysis

The ARAMIS two-camera system manufactured by GOM enables detailed information to be gained regarding damage development and the propagation of cracks during loading. This is important for visualising the behaviour of materials and, in later phases, for the validation of computer models and the calibration of their parameters.

The development of new materials also involves the need to faithfully model their response to mechanical strain. The developed numerical models must then be validated with the aid of experiments.

One of the possible ways of obtaining information about mechanical response, in this case primarily with regard to the propagation of cracks in a material under tensile stress, is the use of non-contact camera-based measurement methods to observe deformation on the surface of test specimens or whole construction elements.



3D printer and 3D scanner



Equipment for the rapid formation of extra large functional prototypes consisting of the largest FDM printer on the market and an optical scanner. Maximum print dimensions are 690x690x1900 mm and a resolution of 2.5 microns.

