Course engineering mechanics

GUNT Structure Line

A course on engineering mechanics

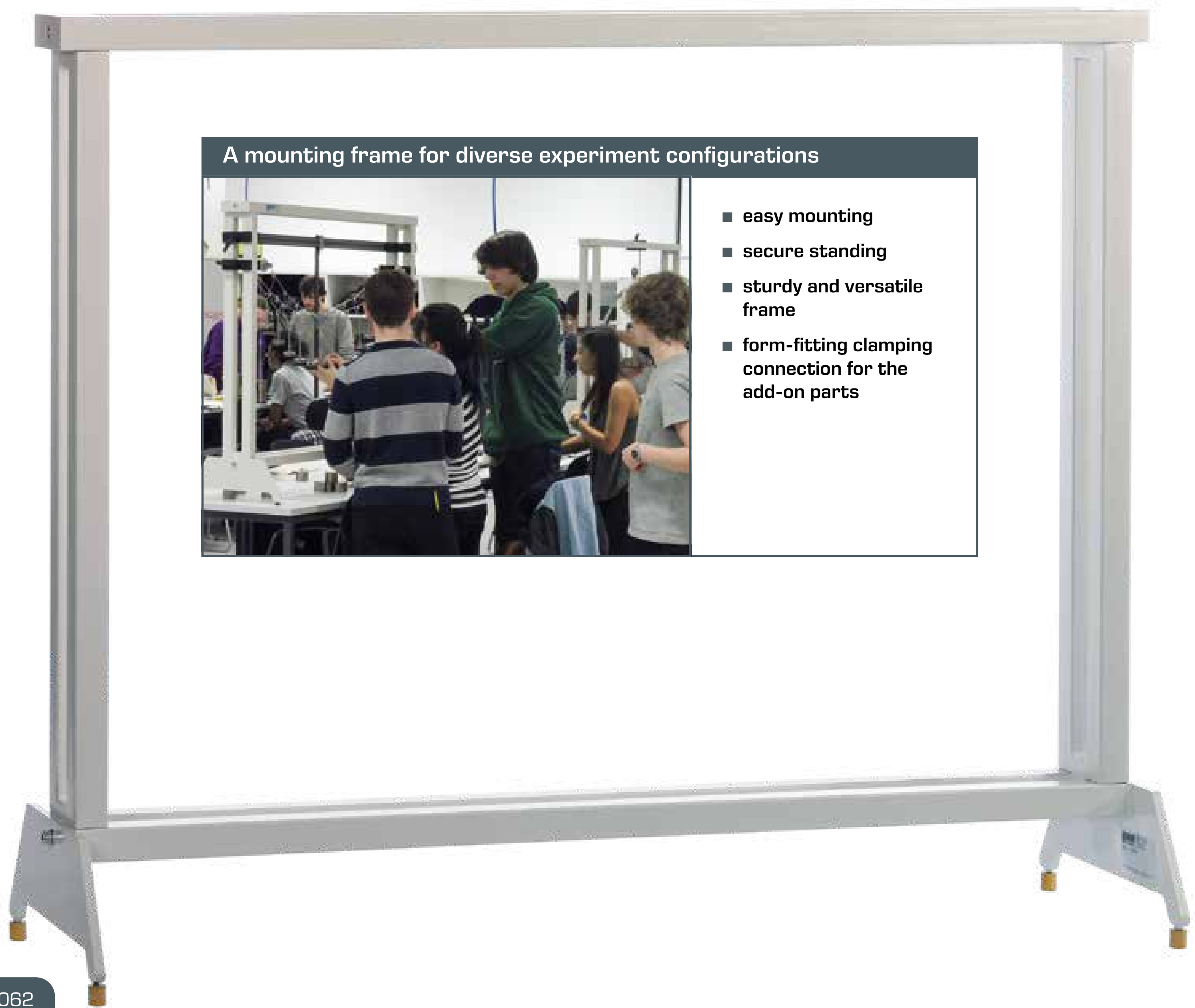
Course engineering mechanics

In GUNT, the term "structure" refers to a supporting structure or a building structure. The term "line" refers to a GUNT series of units. The GUNT Structure Line is a series of units that has been specially developed by GUNT to support teaching basic engineering principles with practical exercises.

The series of units offers a variety of opportunities to learn about common topics such as equilibrium conditions, forces and deformations or stability and buckling and to develop a more in-depth understanding.

The GUNT Structure Line offers the following advantages:

- meaningful compilation of experiment subjects
- wide range of experiments: one frame is combined with different add-on parts
- easy to transport and space-saving storage of the add-on parts thanks to stackable storage systems
- orderliness when conducting experiments, thanks to individual parts being stored in clear foam inserts
- safe storage of small parts such as screws, adapters, or tools in transparent boxes
- stable mounting frame, easy to assemble and disassemble, with rubber feet for secure standing
- easy-to-install add-on parts can be fitted at any point on the frame using adjustable clamping levers

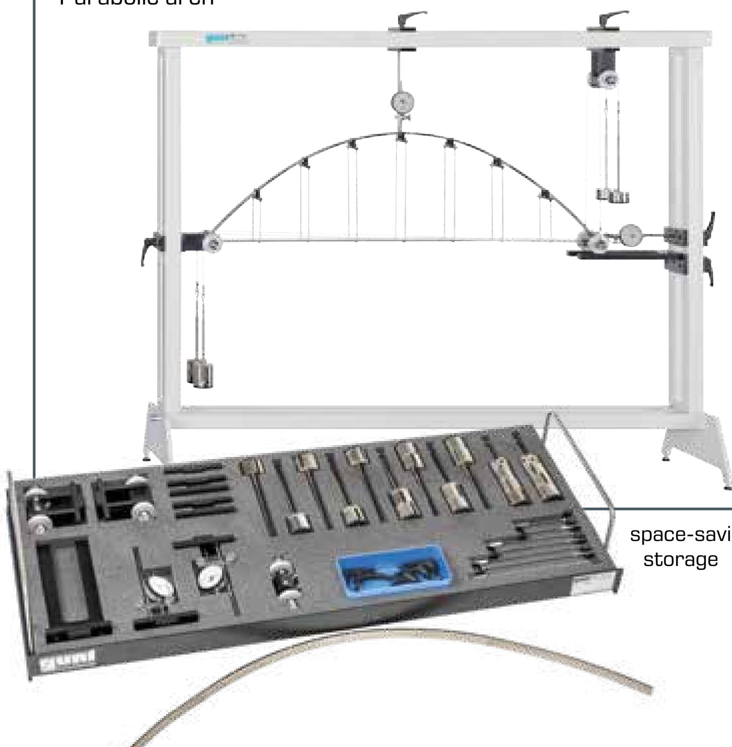


A mounting frame for diverse experiment configurations

- **easy mounting**
- **secure standing**
- **sturdy and versatile frame**
- **form-fitting clamping connection for the add-on parts**

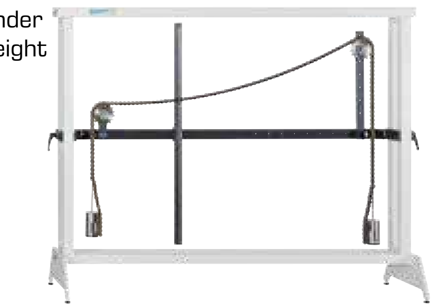
Experiments on statics

SE 110.16
Parabolic arch

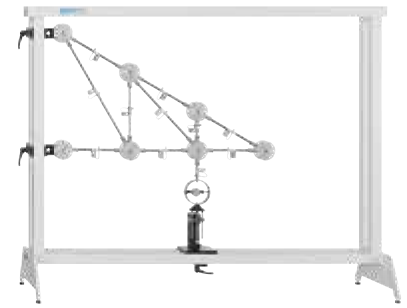


space-saving storage

SE 110.50
Cable under dead-weight



SE 110.21
Forces in various single plane trusses



Experiments on strength of materials

SE 110.44
Deformation of trusses

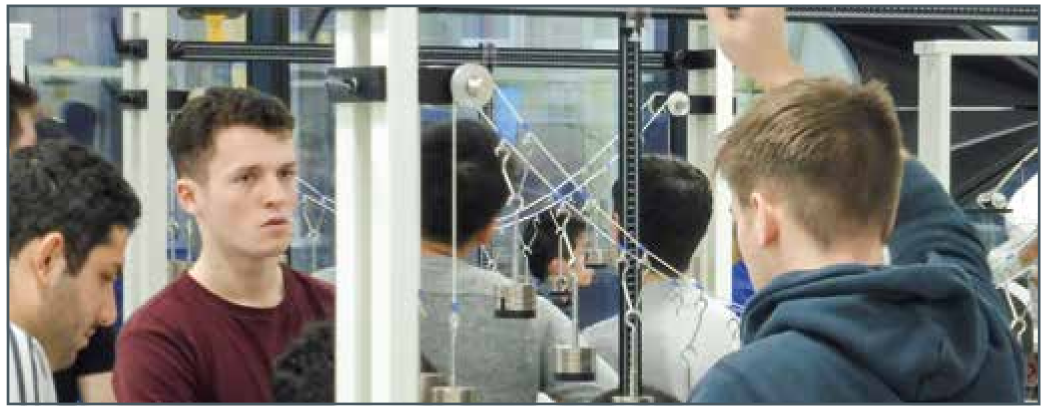
SE 110.47
Methods to determine the elastic line

SE 110.19
Investigation of simple stability problems

space-saving storage

Didactic concept of the GUNT Structure Line

The GUNT Structure Line allows you to build an extensive laboratory on the fundamentals of engineering. In this way, the rather abstract contents of the lecture can be practically simulated and clearly represented through small-group experiments. This promotes students' long-term learning success. Meanwhile, group participants' social skills are encouraged in addition to their more technical skills.



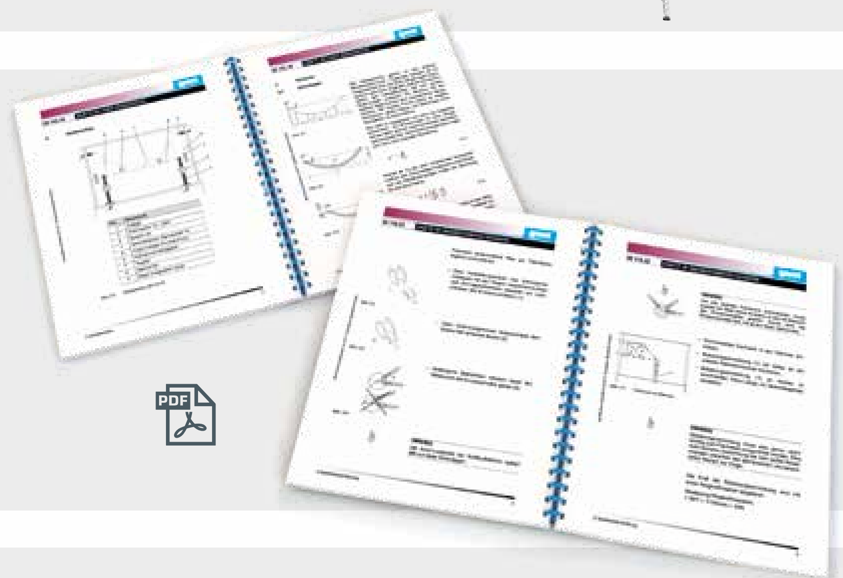
Manual experimentation promotes the following capabilities:	How does manual experimentation promote skills?
■ planning experimental series ■ setup of experiments ■ encouraging abstraction skills ■ encouraging manual work and technical ability ■ encouraging effective teamwork	■ The abstract structural diagram must be implemented in a real experimental setup. This requires imagination, judgement and manual dexterity. Students learn how to technically realise abstract concepts such as clamping or flexible supports. The limits of idealisation are also made clear.
■ implementing theoretical teaching subjects in the experiment ■ developing an understanding of forces and stresses	■ Terms such as stability and balance of a system are illustrated by the manual application of the load. ■ The load on the experimental setups, mainly from weights, gives students a feeling for masses and forces.
■ evaluating results ■ estimating errors	■ Measuring the deformation using dial gauges provides direct feedback of the load. The factors of slack, friction and the resulting hysteresis – which are almost always present in real systems – can be experienced.

Mechanical experimental setup

Frame, components and connecting elements are combined into a functioning experimental setup. The points of action for loads, their effect on the support structures and structural elements and the use of fixed and movable supports are tested.

This makes the function and the processes in support systems easy to observe and understand and it ensures a lasting learning experience.

Didactic material in paper form and in digital form as PDF



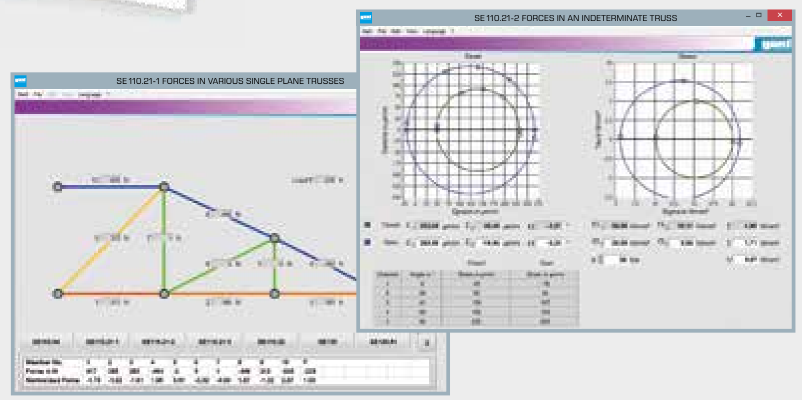
A fundamental section with the relevant theory and model-based experiment instructions allow an intensive preparation for the experiment. Sample experiment results allow a qualified assessment of the students' own results.

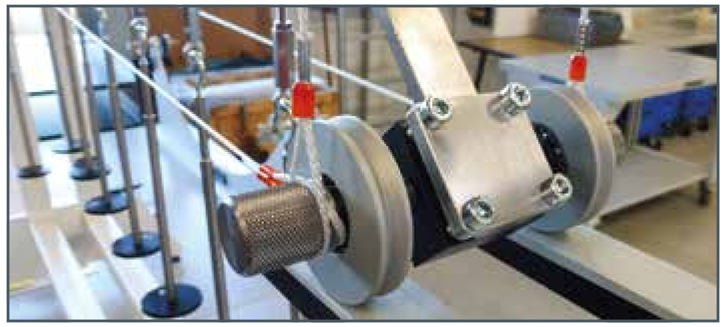
Our didactic materials offer excellent support when preparing lessons, when conducting the experiments and when reviewing the experiment.

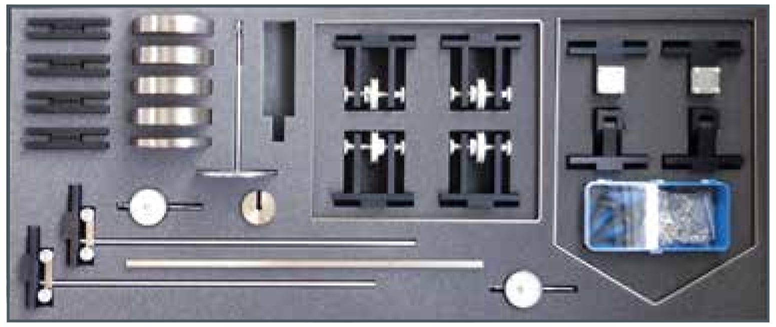
Unit-specific, supplementary GUNT software

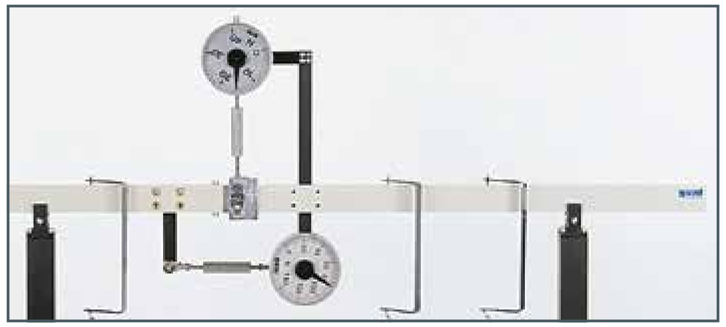
The software forms a bridge between the mechanical model and the didactic material in paper form.

Trusses can be simulated and configured in the software. Similarly, the behaviour of truss systems is reflected in concrete measured values and the bar forces are graphically displayed (SE 110.21, SE 110.22).









Contents of the GUNT Structure Line

A wide range of experiments with a variety of options

The series of units covers topics such equilibrium conditions, forces and deformations or stability and buckling.

The units represent self-contained learning units, complementing the experimental units from a topic in terms of the learning objectives.

For a complete experimental setup, the components of an experimental unit are assembled in the SE 112 mounting frame.

Equilibrium conditions

SE 110.50
Cable under dead-weight

- determine catenary of a free-hanging cable
- measure sag
- compare calculated and measured values

SE 110.53
Equilibrium in a single plane, statically determinate system

- the main principle of the practical experimentation: free-body diagrams in statics
- calculation of support forces
- application of the 1st and 2nd equilibrium conditions of statics

Bridges, beams and arches

SE 110.12
Lines of influence on the Gerber beam

- application of the method of sections and the equilibrium conditions of statics to calculate the support forces
- determine the internal reactions under static load

SE 110.16
Parabolic arch

- mechanical fundamentals of the parabolic arch
- differences between statically determinate and statically indeterminate arches
- influence of load on the support forces and deformation of the arch

SE 110.17
Three-hinged arch

- investigation of how the load affects the horizontal thrust in the supports
- determine the influence lines for the supports under a moving load

SE 110.18
Forces on a suspension bridge

- calculate supporting cable force
- observe the effect of internal moments in the carriageway under uneven load

Forces and deformations in a truss

SE 110.21
Forces in various single plane trusses

- dependence of bar forces on external forces
- comparison of measuring results with mathematical solutions using: the method of joints and Ritter's method of sections

SE 110.22
Forces in an indeterminate truss

- distribution of forces in a plane truss, depending on the use of a redundant bar
- dependence of bar forces on an external force

SE 110.44
Deformation of trusses

- work-energy theorem and deformation energy
- application of Castigliano's first theorem for calculating deformation at a defined point
- comparison of the deformations of different trusses under the same load

Elastic and permanent deformations

SE 110.14
Elastic line of a beam

- elastic line under different loads / support conditions
- demonstration of Maxwell-Betti's theorem

SE 110.47
Methods to determine the elastic line

- principle of virtual work (calculation), Mohr's analogy (Mohr's method on an area of moments; graphical approach)
- applying the superposition principle of engineering

SE 110.20
Deformation of frames

- interaction between stress and strain on the frame
- first-order law of elasticity for statically determinate and indeterminate systems

SE 110.29
Torsion of bars

- shear modulus and polar second moment of area
- angle of twist as a function of the clamping length / twisting moment
- influence of torsional stiffness on twist

SE 110.48
Bending test plastic deformation

- load of a bending beam with a point load
- create a force-path diagram

Stability and buckling

SE 110.19
Investigation of simple stability problems

- determine the buckling force
- investigate buckling behaviour under the influence of additional shear forces or pre-deformation

SE 110.57
Buckling of bars

- investigate buckling behaviour under the influence of different supports, clamps, cross-sections, materials, or additional transverse stress
- test Euler's theory: buckling on elastic bars
- calculate the expected buckling force with Euler's formula
- graphical analysis of the deflection and the force

Vibrations in a bending beam

SE 110.58
Free vibrations in a bending beam

- free vibration in a vertical and horizontal bending beam
- determine the natural Rayleigh frequency
- how do clamping length and mass affect the natural frequency