# LABORATORY PLANNING GUIDE

# L10 Strength of Materials Laboratory

Content



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Covered subjects according to the curriculum

Major topics of learning content:

- Elastic deformation of statically determinate or indeterminate beams under bending load
- Elastic torsion of round bars under torque
- Influence of material, cross-section and clamping length on deformation
- Investigation of all relevant buckling problems
- Verification of the Euler theory of buckling
- Methods of force and deflection measurement
- Eccentric application of force and transverse loading
- Verification of the Rankine yield criterion and the Tresca yield criterion
- Multi-axial loading by pure bending, pure torsion or a combination of the two
- Deformation of a beam on two or more supports under point loads (e.g. single-span beam)
- Deformation of a cantilever beam under point loads
- Maxwell-Betti coefficients and law
- Application of the method of sections to determine internal reactions of the beam
- Direct indication of shear force and bending moment at a section on the beam
- Basic introduction to measurement with strain gauges
- Strain gauge types and application techniques
- Photoelastic experiments on models subjected to mechanical loading
- Investigation of diffusion of stresses with plane or circular polarised light
- Interpretation of photoelastic fringe patterns
- Elastic deformation of curved-axis beams (circular, semi-circular and quadrant beams)
- Elastic behaviour of tension springs under load
- Hooke’s law

## Main concept

The laboratory is designed for accommodation of 24 students + 2 laboratory staff:

- 2 - 4 students form a team and work together at a workstation / training system
- 28 workstations with 9 different experiment units
- Each experiment unit on its own table to allow short prepare times
- Each workstation is equipped with a manual containing technical information, basic theory, experiment instructions, evaluation help and safety advice.
- Student teams are scheduled to change workstations from lab session to lab session in order to perform the entire range of experiments within the course duration.
- Average time per experiment: 90 to 120 minutes.
- 2 workstations for laboratory staff (with PC and internet access)
- 1 printer for common use
- 1 cupboard for small parts, consumables, tools, paper etc.

## Initial training provided for laboratory personnel

Trainer: Specialized engineer of G.U.N.T. Gerätebau GmbH, Germany.
To be conducted immediately after installation and commissioning of the equipment.
General topics to be covered for any of the educational systems:

- Basic familiarization with the system.
- Functions and components.
- Overall system configuration aspects.
- Start-up and operational aspects.
- Conduction experiments, including evaluation and calculation.
- Using the system with and without the software (where applicable).
- Trouble shooting and maintenance aspects.
- Hands-on, practical familiarization aspects.
- Seminar participants with the delivered system.
- Details of the manuals.
- Safe operation and preventive maintenance.

## Requirements / Utilities

Power supply:

- 230 V / 50 Hz / 1 phase – at least 10 power sockets distributed according to lab lay-out.

Laboratory computer network:

- 2 internet connections for staff

Location:

- Laboratory space min 120 m²
- This laboratory could be installed on any floor (e.g. ground floor or 1st floor)

Schedule of requirements

| Item No. | Description | Code | Quantity |
|---|---|---|---|
| Item 1 | Deformation of bars under bending or torsion | WP 100 | 4 pcs. |
| Item 2 | Buckling behaviour of bars | WP 120 | 4 pcs. |
| Item 2.1 | Set of 10 specimens | WP 120.01 | 4 pcs. |
| Item 3 | Verification of stress hypotheses | WP 130 | 4 pcs. |
| Item 3.1 | Set of 4 specimens alum., copper, steel brass, 1 each | WP 130.01 | 4 pcs. |
| Item 4 | Deformation of straight beams | WP 950 | 3 pcs. |
| Item 5 | Beam on 2 supports: shear force & bending moment diagrams | WP 960 | 3 pcs. |
| Item 6 | Strain gauge training system | FL 100 | 3 pcs. |
| Item 6.1 | Tension rod, brass | FL 100.01 | 1 pcs. |
| Item 6.2 | Tension rod, copper | FL 100.02 | 1 pcs. |
| Item 7 | Photoelastic experiments with a transmission polariscope | FL 200 | 3 pcs. |
| Item 8 | Deformation of curved-axis beams | FL 170 | 3 pcs. |
| Item 9 | Hooke's law | TM 400 | 1 pcs. |

Laboratory drawing