

MATERIALS MECHANICS SERIES

This Mechanics of Materials product series adapts to the core teaching curricula of mechanical, energy, aerospace, civil engineering and advanced manufacturing. Focusing on the three core mechanical properties of strength, stiffness and stability, it integrates modern engineering innovation into experimental teaching.

Compliant with standard teaching syllabi, the product range covers full essential knowledge, including basic tension, compression, bending, torsion and shear deformation, as well as complex experiments of bending-torsion combination, asymmetric bending, column buckling, fatigue, creep and impact loading.

Adopting advanced testing technology and integrated multifunctional design, the equipment helps students grasp component load-bearing performance and failure mechanisms, meets engineering demands for new material evaluation and structural safety analysis, and cultivates engineering talents with solid mechanical literacy and problem-solving capabilities.

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Basic Mechanical Properties

▶ MS01 Material Testing Apparatus

02

Basic Deformation and Internal Force Testing

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▶ MS03 Torsion of Shafts Apparatus

▶ MS04 Beam Shear & Moment Apparatus

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Complex Loading and Combined Deformation

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Special Mechanical Behavior

▶ MS09 Curved Beam & Cable Apparatus

▶ MS13 Creep Testing Apparatus

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Portable Demonstration of Mechanics Principles

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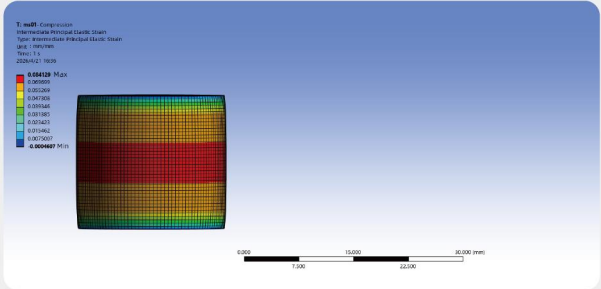


▶ MS01 Material Testing Apparatus

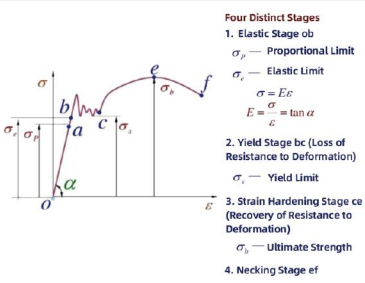
- This precision tester adopts computerized electronic universal testing technology for low-load, high-precision material tests.
- Rated at a maximum 10 kN test force, its fully digital closed-loop system delivers accurate, wide-range loading speed and force readings with sensitive load and displacement detection.
- It performs tension, compression, bending and shear tests on miniature delicate samples such as metal wires, plastic films, fibers and biological tissues. Suitable for lab teaching and industrial quality control across aerospace, chemical, cable, textile, food & pharmaceutical packaging sectors.
- Equipped with dedicated control software, it supports stress, strain, cyclic and user-programmable control. It auto-calculates elastic modulus, yield strength and outputs test reports meeting GB, ISO and ASTM standards, ideal for material mechanical research.

Specimen Material	Acquisition Channels	Error Range	Testing Machine Class
Carbon steel, Stainless steel	5 channels	±5%	Class 1
Display	Product Dimensions (mm)	Product Weight	Input Power Supply
10.1-inch	700 x 370 x 1500	Approx. 200 kg	Single-phase three-wire, 220 V

I FINITE ELEMENT SIMULATION ANALYSIS



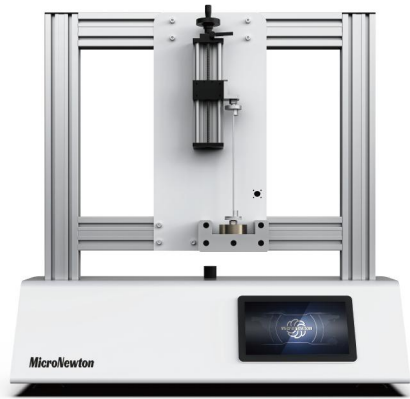
Compression - Elastic Strain



Stress - Strain Curve

I EXPERIMENTAL FUNCTIONS

- 1. Tensile Test:** Determines the modulus of elasticity (E), yield strength, tensile strength, percentage elongation after fracture, and percentage reduction of area.
- 2. Compression Test:** Determines the compressive strength and modulus of elasticity of brittle materials (e.g., small wood blocks, rigid plastics, foam)
- 3. Bending Test:** Performs three-point or four-point bending tests to determine the flexural strength and flexural modulus of materials
- 4. Shear Test:** Determines the shear strength of rivets, pins, or adhesive joints using dedicated shear fixtures

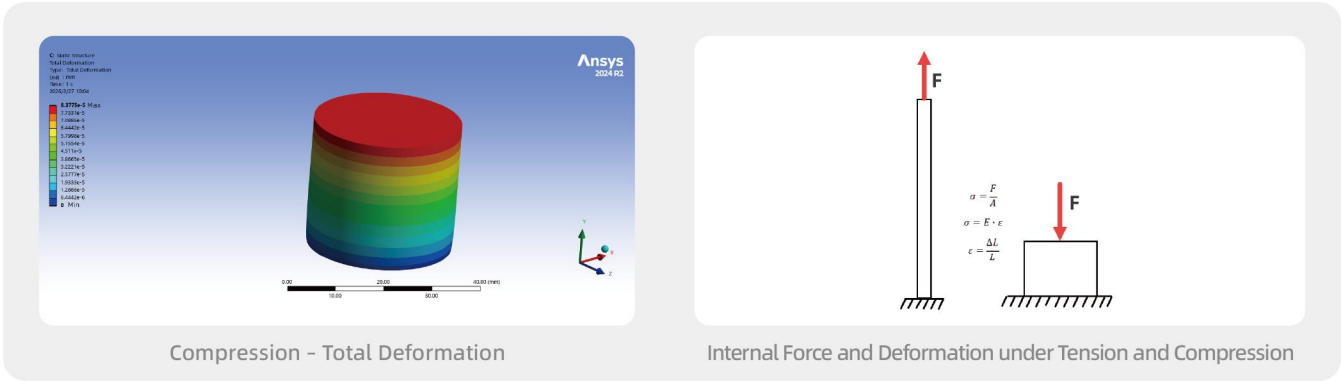


► MS02 Axial Loading Apparatus

- Utilizing multi-channel strain measurement, this apparatus focuses on high-precision quantitative analysis of local stress/strain non-uniformity near load points and cross-sectional discontinuities.
- It visually demonstrates Saint-Venant's Principle, showing end-effect attenuation and stress concentration mechanisms, enabling exploration of the "plane section assumption" and its limitations.
- Equipped with specialized specimens (bars with holes, notches, variable cross-sections) and eccentric loading, it verifies the superposition principle, determines elastic modulus and Poisson's ratio, and investigates neutral axis migration under eccentric tension/compression. It is a core device for cultivating micro-stress analysis skills and engineering safety awareness.

Specimen Material	Acquisition Channels	Error Range	Input Power Supply
Aluminum alloy, POM, Silicone	5 channels	±5%	Single-phase three-wire, 220 V
Display	Product Dimensions(mm)	Product Weight	Loading range
10.1-inch	950 × 300 × 950	Approx. 30 kg	0-400 N

I FINITE ELEMENT SIMULATION ANALYSIS



I EXPERIMENTAL FUNCTIONS

1. **Verification of Saint-Venant's Principle:** The core teaching function of this apparatus
2. **Study of Stress Concentration:** Observe the strain surge phenomenon at geometric discontinuities using specimens with holes, notches, or sudden cross-sectional changes
3. **Determination of Axial Tensile and Compressive Strain Distribution:** Arrange multiple measuring points along the bar axis to record the strain gradient from the loading end to the stable region
4. **Eccentric Tension and Compression Test:** Verify the superposition principle and separate the axial force component and bending moment component from strain gauge readings
5. **Precise Determination of Elastic Modulus E and Poisson's Ratio μ :** calculate E and μ of the material using longitudinal and transverse strain gauge data in the uniformly stressed zone

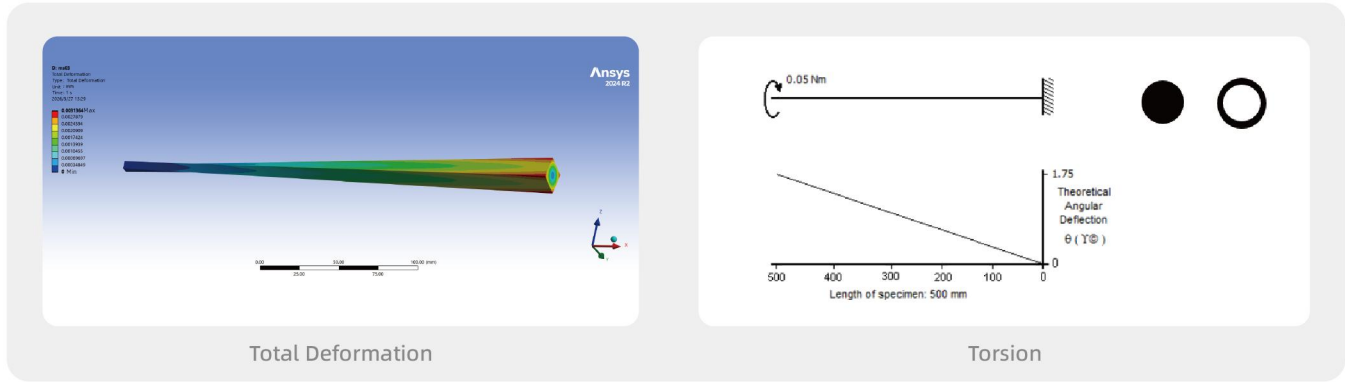


► MS03 Torsion of Shafts Apparatus

- Designed for studying stress distribution and deformation of circular shafts and non-circular bars under torsion.
- Its core lies in verifying shear Hooke's Law and the plane section assumption for circular shafts via high-precision torque measurement and multi-point strain/rotation observation, while revealing the significant torsional resistance difference between open and closed thin-walled bars.
- A key teaching aid for understanding transmission shaft design and torsional stiffness of thin-walled structures (e.g., aircraft fuselages, automobile frame rails).

Specimen Material	Acquisition Channels	Error Range	Loading range
Aluminum alloy, Brass	5 channels	±5%	0-50N·m
Display	Product Dimensions(mm)	Product Weight	Input Power Supply
10.1-inch	950 × 300 × 950	Approx. 30 kg	Single-phase three-wire, 220 V

I FINITE ELEMENT SIMULATION ANALYSIS



I EXPERIMENTAL FUNCTIONS

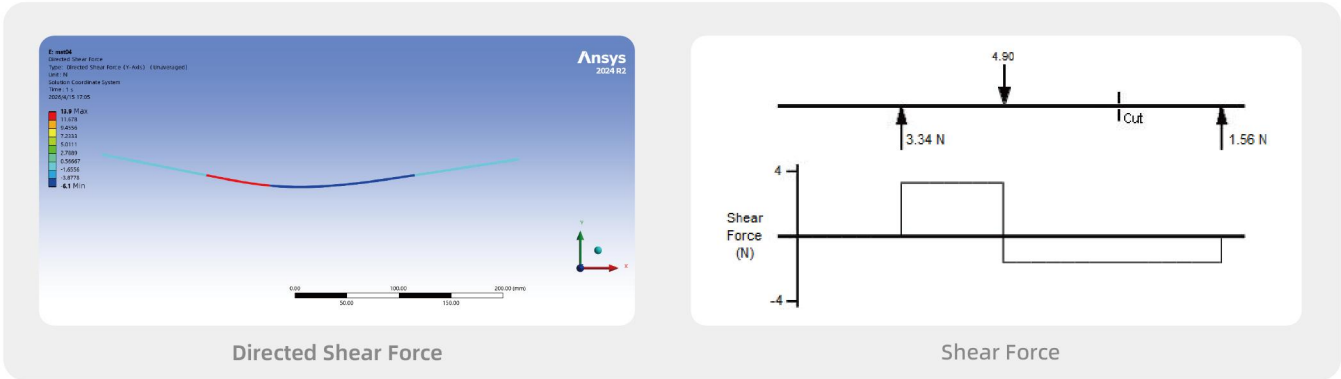
1. **Determination of Shear Modulus G:** Calculate G from applied torque and measured twist angle
2. **Verification of Shear Hooke's Law:** Confirm linear shear stress-strain relationship within the elastic range
3. **Circular Shaft Torsion Theory (Plane Section Assumption):** Observe longitudinal/circumferential line deformation to verify cross-sections remain plane and radii straight
4. **Non-Circular Torsion (Warping):** Compare rectangular bar behavior and observe cross-sectional warping
5. **Open vs. Closed Thin-Walled Bars (Key Highlight):** Compare torsional stiffness of identical-dimension, same-wall-thickness open and closed sections



► MS04 Beam Shear & Moment Apparatus

- A specialized teaching instrument for quantitative measurement of bending moment and shear force at beam sections under stationary or moving loads.
- Its advanced "cut-section" sensor enables direct internal force readout, serving as a core device for verifying the section method, plotting influence lines, and understanding the most unfavorable load positions.
- The high-end version integrates support reaction transducers for synchronous equilibrium verification.

I FINITE ELEMENT SIMULATION ANALYSIS

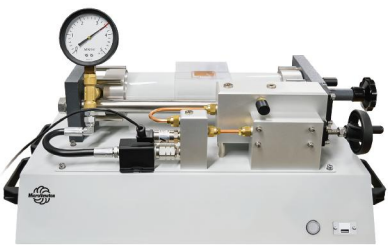
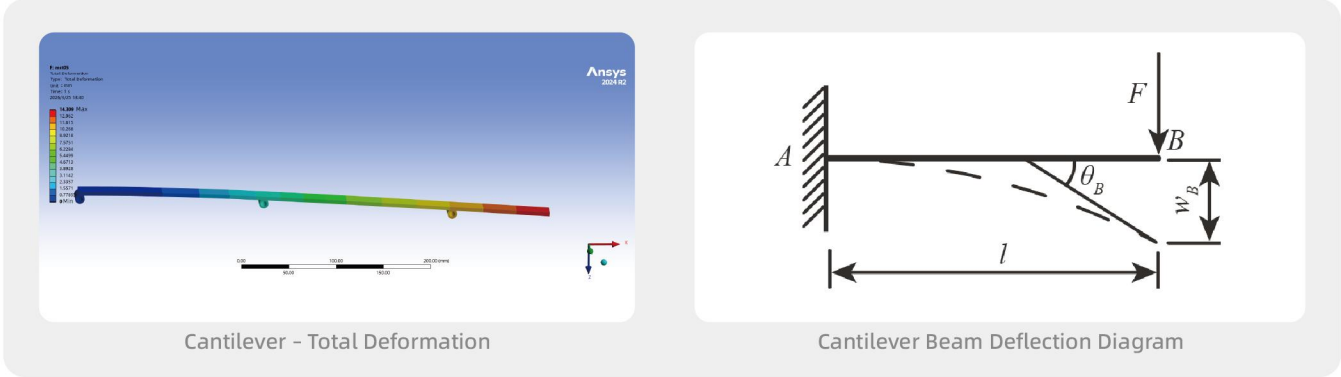


► MS05 Beam Bending Apparatus

- A multifunctional platform integrating both deformation and internal force testing.
- Equipped with a high-precision beam with pre-bonded strain gauges and a static strain indicator, it accurately determines the linear normal stress distribution along the cross-section height in pure bending, while a displacement system maps the deflection curve and determines elastic modulus.
- Supports simply supported and cantilever boundary conditions, intuitively demonstrating core mechanics theories—an ideal teaching aid for verifying the bending normal stress formula and stiffness design.



I FINITE ELEMENT SIMULATION ANALYSIS



► MS06 Thin-Walled Pressure Vessel Apparatus

- Designed for thin-walled shell mechanics, this apparatus uses a high-precision aluminum alloy cylinder to simulate a pressure vessel.
- Applying internal pressure via a hydraulic system, it accurately measures circumferential/axial stresses and radial deformation under complex loading. Integrated strain indicators and displacement sensors intuitively demonstrate membrane theory, the biaxial stress state, Mohr's circle, and Poisson's ratio.
- An ideal teaching device for verifying strength design and deformation laws of thin-walled structures across mechanical, chemical, and mechanics engineering programs.

I FINITE ELEMENT SIMULATION ANALYSIS

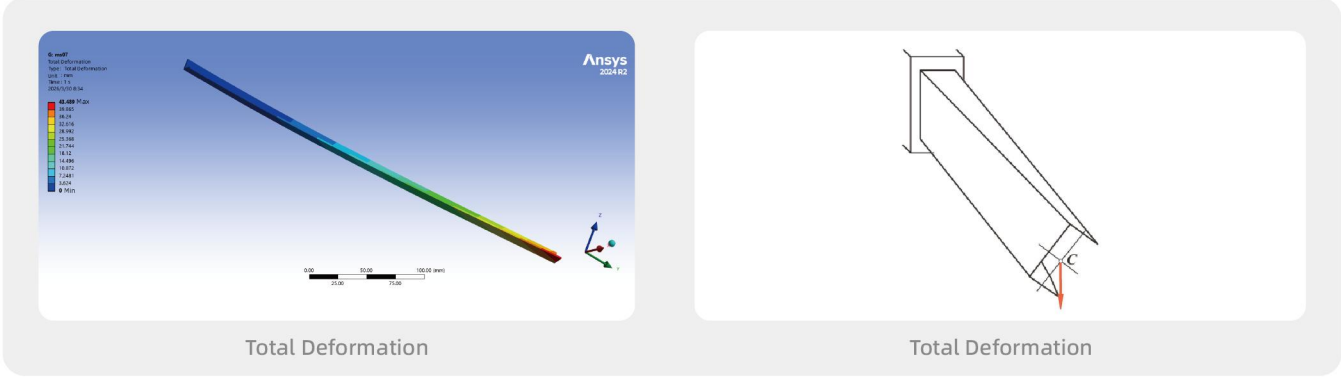


► MS07 Unsymmetrical Beam Apparatus

- An advanced teaching instrument for studying mechanical behavior of complex cross-section beams under bending.
- Its core focus is asymmetry-induced phenomena: the shear center, principal axis orientation, and coupled bending-torsion effects.
- A key apparatus for understanding why channel, angle, and Z-sections are prone to twisting under load.



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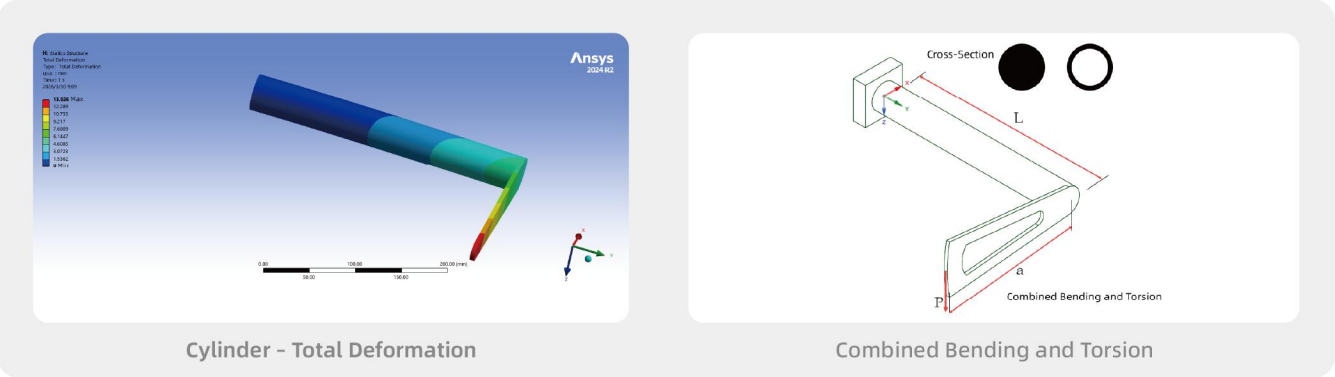




► MS08 Combined Bending & Torsion Apparatus

- Core test apparatus for combined bending (M) and torsion (T) mechanical research.
- It delivers adjustable bending and torque to mimic transmission shafts, crankshafts and loaded cantilevers, aiming to verify the 3rd & 4th strength theories and analyze principal stresses.

I FINITE ELEMENT SIMULATION ANALYSIS



I EXPERIMENTAL FUNCTIONS

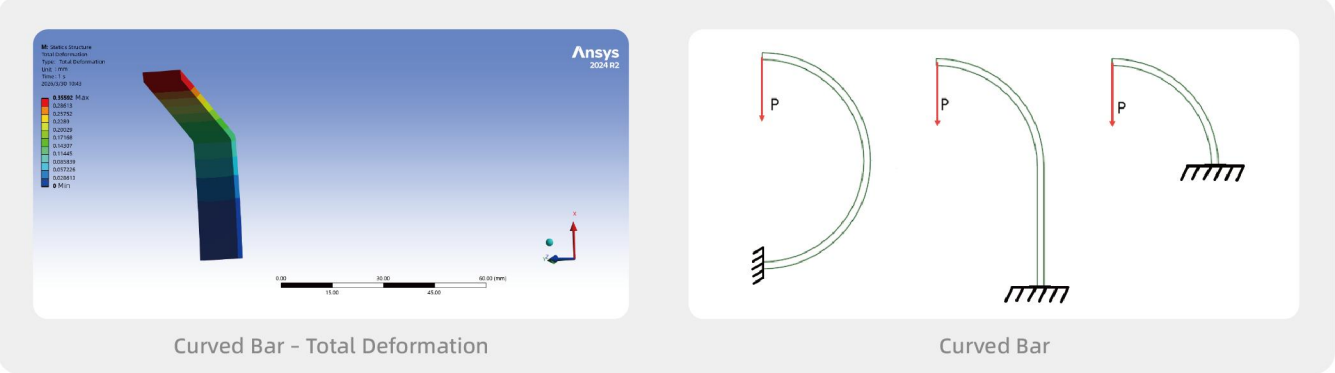
- ① Combined Bending-Torsion Stress Analysis
- ② Principal Stress & Direction Measurement
- ③ Verification of the relationship between internal force diagrams and external forces

► MS09 Curved Beam & Cable Apparatus

- An advanced teaching aid for studying curvature effects on structural deformation.
- Its core explores geometric nonlinearity, verifying Castigliano's Second Theorem and the unit load method for curved bars, while visually demonstrating complex displacement phenomena from axial force, shear, and bending moment coupling under load.



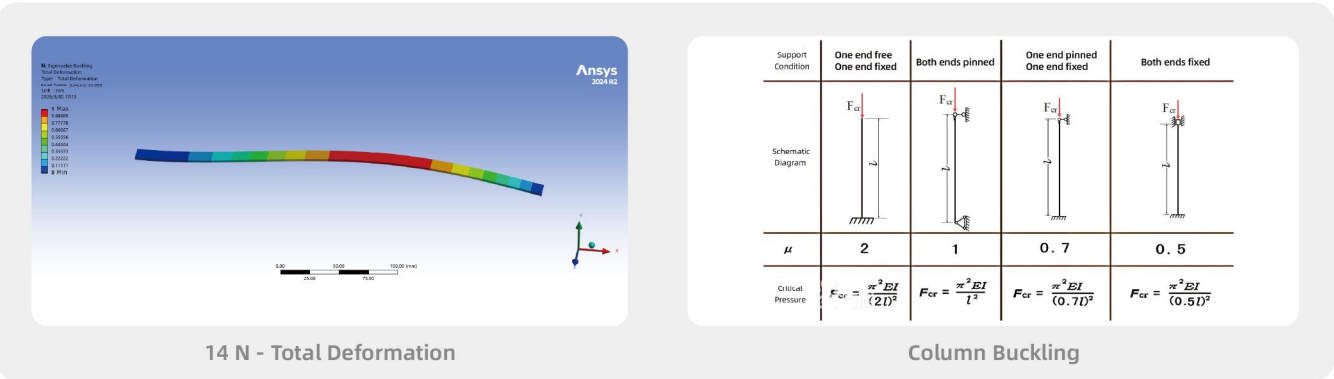
I FINITE ELEMENT SIMULATION ANALYSIS



► MS10 Buckling of Struts Apparatus

- A core apparatus for studying slender column stability.
- It focuses on sudden lateral buckling occurring at stresses far below the material's yield limit.
- A specialized instrument for verifying Euler's formula, studying boundary condition effects on critical load, and observing post-buckling behavior.

I FINITE ELEMENT SIMULATION ANALYSIS



I EXPERIMENTAL FUNCTIONS

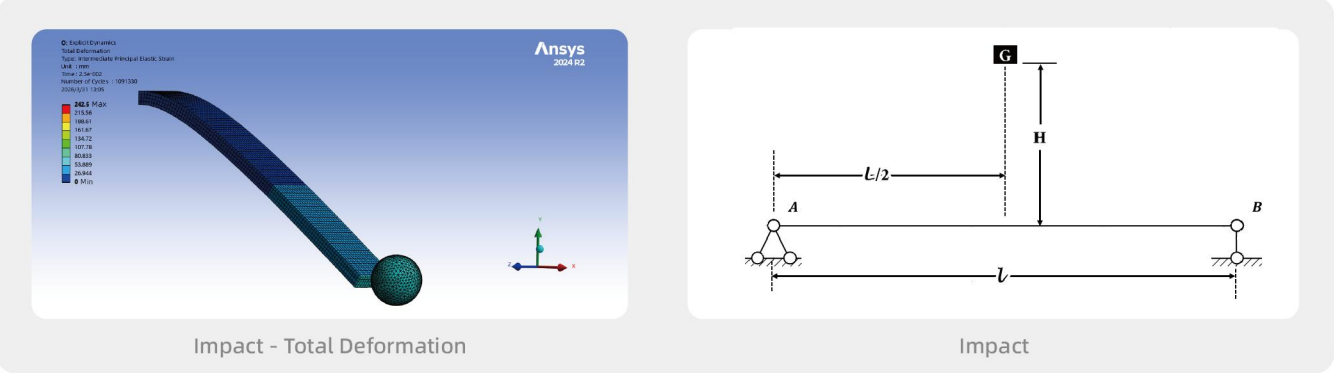
- ① Determination of critical load
- ② Observation of large-deflection post-buckling behavior
- ③ Verification of Euler's formula
- ④ Stress distribution testing (high-end version feature)

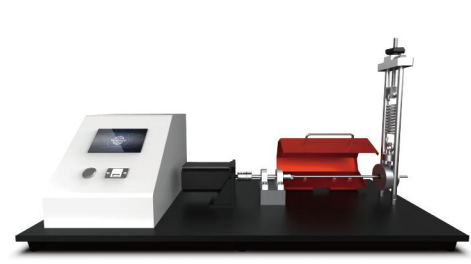
► MS11 Impact Loading Apparatus

- A core apparatus for studying dynamic load effects and validating the energy method applied to impact problems.
- Unlike static loading experiments, it focuses on inertial effects from rapidly varying loads. Its core objective is determining the dynamic load factor—the ratio of maximum response under impact to that under static loading—and verifying the theoretical formula $\delta_d = K_d \cdot \delta_{st}$



I FINITE ELEMENT SIMULATION ANALYSIS

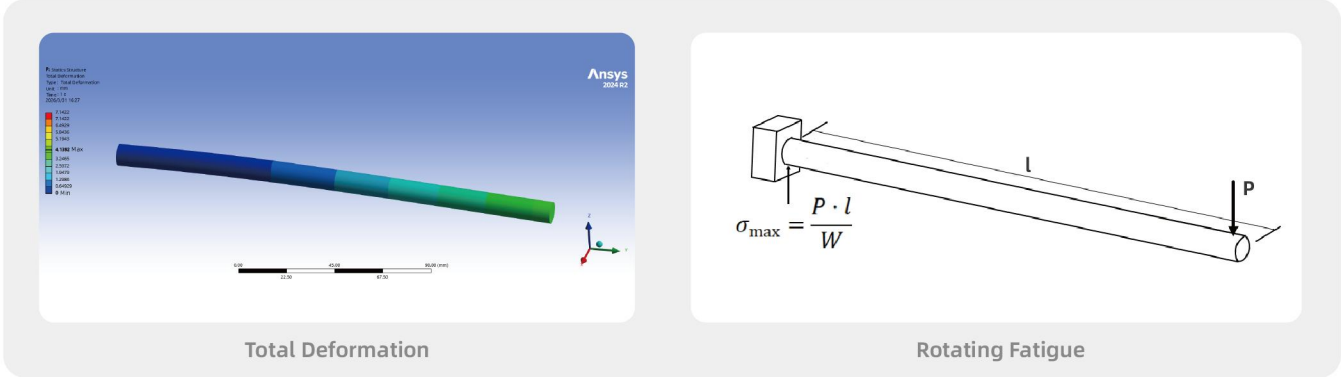




► MS12 Rotating Fatigue Testing Machine

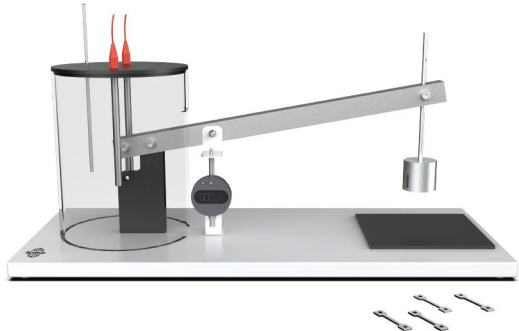
- A key apparatus for studying material failure under alternating loads.
- It focuses on cumulative damage, revealing why metals fracture after millions of cycles at stress far below the yield limit. Core objectives: plot the S-N curve, determine the fatigue limit, and observe typical fatigue fracture surface characteristics.

I FINITE ELEMENT SIMULATION ANALYSIS

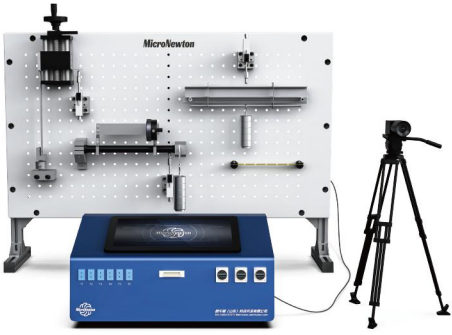
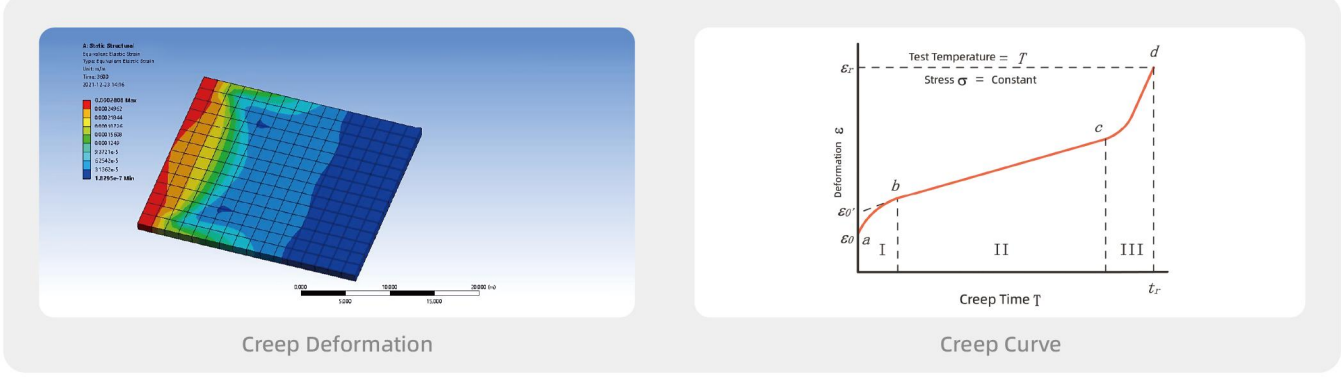


► MS13 Creep Testing Apparatus

- Designed for mechanics and engineering materials instruction, helping students intuitively understand creep.
- Under preset temperature and constant load, it displays the entire slow, time-dependent deformation process in real time, dynamically plotting the creep curve.
- Through hands-on operation, students grasp the three creep stages and their influencing factors, transforming abstract theory into visual cognition—an ideal platform for teaching high-temperature material properties.



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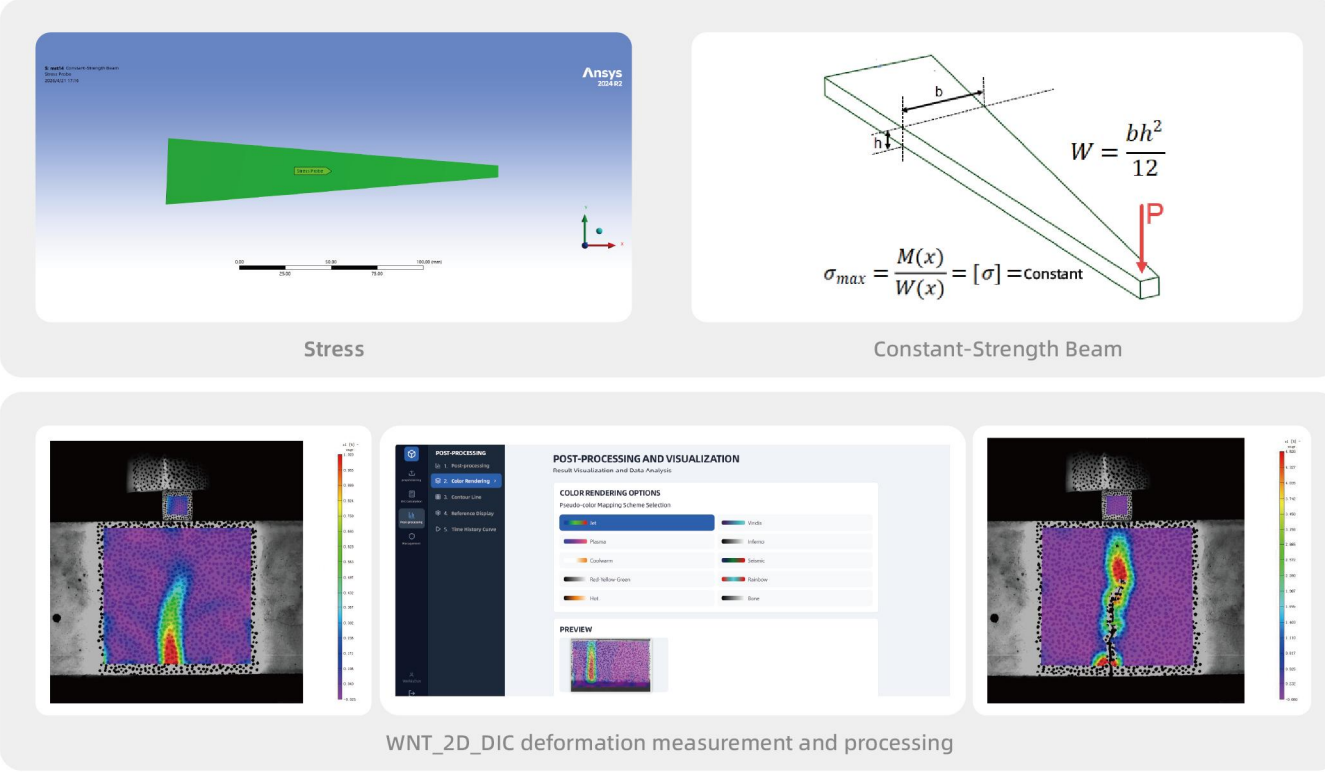


► MS14 Universal Materials Testing System

- This multi-functional tester breaks the limits of single-function equipment. Adopting a mainframe plus modular design, it conducts tension, compression, torsion, bending, column buckling and constant-strength beam tests, with optional WNT_2D_DIC for displacement and strain measurement.
- Lightweight, portable and space-saving, it covers core material mechanics experiments at low cost, ideal for comparative research and skill training.

Specimen Material	Acquisition Channels	Error Range	Measurement Method
Aluminum alloy, POM , Rubber, Carbon steel	10 channels	±5%	Optical measurement, Electrical measurement
Display	Product Dimensions (mm)	Product Weight	Loading range
10.1-inch	960 × 250 × 730	Approx. 30 kg	0-50 N

I FINITE ELEMENT SIMULATION ANALYSIS



I EXPERIMENTAL FUNCTIONS

- ① Tension & compression test
- ② Torsional bar force & deformation test
- ③ Beam bending test
- ④ Combined bending-torsion test
- ⑤ WNT_2D_DIC deformation measurement & analysis
- ⑥ Constant-strength beam stress test
- ⑦ Column buckling critical load & stress test