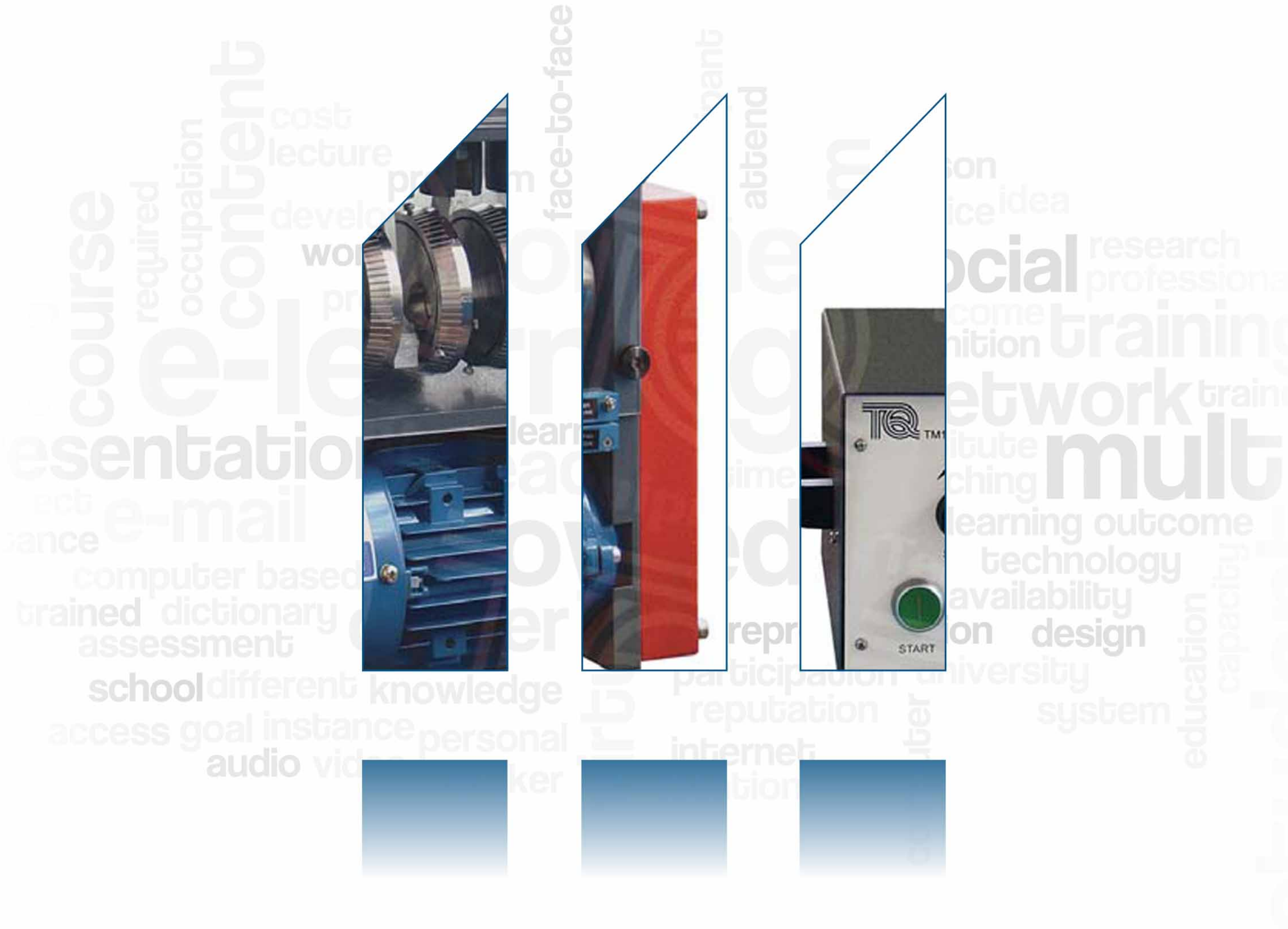


Theory of Machines

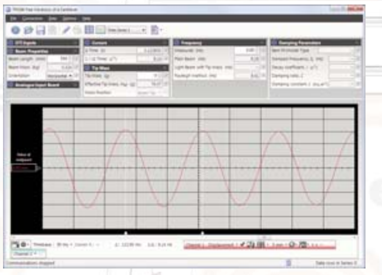
infoWERK
medien & technik

TM166

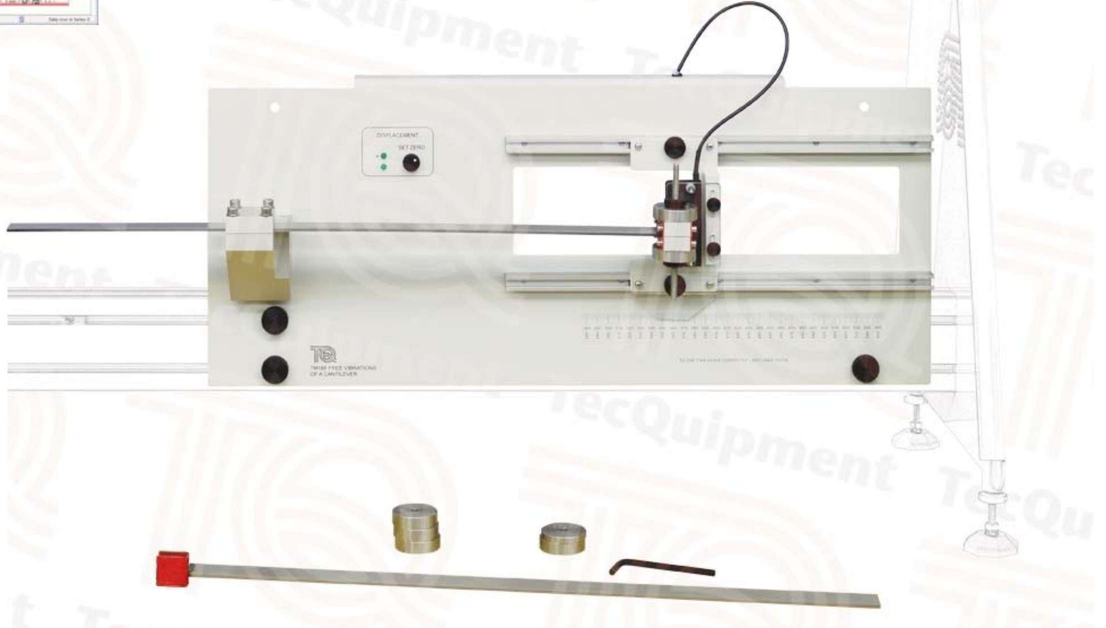
Free Vibrations of a Cantilever

Uses fundamental theory and Rayleigh's approximation to calculate the frequency of oscillation of a cantilever.

Works with VDAS®



Screenshot of the VDAS® (mkII) software



(beam vertically mounted)

- One of a series of modular experiments that explore free vibrations in simple systems
- Quick, safe, and easy for students to use - needing minimal lab supervision
- Integral scales to save time and improve measurement accuracy
- Mounts both vertically and horizontally for alternative analysis
- Includes a plain cantilever and a weighted cantilever with 'tip mass' for a range of experiments
- Non-contacting displacement sensor to see and measure oscillatory motion with negligible damping effect
- Works with TecQuipment's VDAS® (mkII) for real-time display of the beam displacement waveform and its derivatives

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- An ISO 9001 certified company

TM166 Free Vibrations of a Cantilever

Description

This product is part of a range that explores free vibrations in simple 'one degree of freedom' systems.

It introduces students to key scientific terms such as:

- Simple harmonic motion (SHM) and frequency of oscillation
- Beam stiffness
- Rayleigh's method
- Dunkerley's method
- Second moment of area
- Phase difference between displacement and its derivatives

This product fits to the sturdy Test Frame (TM160) for study or demonstration.

A beam with the mass at the end works in a similar way to a mass spring system - the stiffness of the beam simply replaces the stiffness of the spring. However, in a mass spring system, we normally assume a 'light' spring compared to the mass. The vibrating cantilever examines what happens if the spring element (the beam in this case) is not light. Additionally, it examines a beam (with no tip mass) as a complete self-contained system, forming the mass and the spring.

The vibrating cantilever forms a simple and highly visual example of oscillations that may occur in real structures such as aircraft wings.

A back panel fixes to the Test Frame. The panel holds a sturdy clamp and two runners. The clamp holds the beam. Students use the clamp to adjust the oscillating length of the cantilever. The runners hold a non-contacting sensor that measures the oscillations at the end of the cantilever. The sensor has no physical contact with the beam, for negligible damping.

The back panel has a printed scale. Students use it to set the beam length accurately.

The product includes two beams; a plain beam and a beam with tip mass. Students may add extra 'tip mass' to the second beam to test how it affects oscillations.

Students pull the end of the cantilever down and release, allowing it to vibrate. They then find the frequency of oscillation and compare it with that predicted from theory.

Students test the beam with a varying tip mass, changing the ratio of tip mass to beam mass. They discover that for most ratios, the assumption that the beam is 'light' may not give accurate predictions of oscillation frequency. They then learn how Rayleigh's method improves the overall prediction. They also use Dunkerley's method to predict the natural frequency of the beam only, comparing this value with that found by other methods.

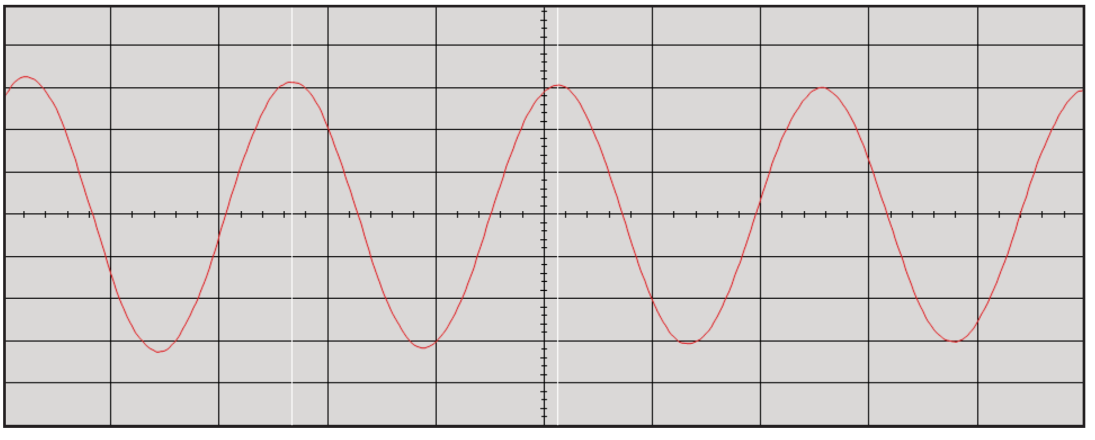
The back panel fixes in both horizontal and vertical direction to allow students to test the beams in both positions.

TecQuipment calibrate the displacement sensor to work with VDAS (mkII) for real-time display and data acquisition of system oscillation waveforms. Students use the software to see the displacement waveform and measure frequency. The software calculates and shows the first two derivatives of displacement - velocity and acceleration.

TecQuipment have specifically designed the TM166 to work with VDAS (mkII). However, the sensor output may be connected to your own data acquisition system or oscilloscope if desired.

Standard Features

- Supplied with lecturer guide and student guide
- Five-year warranty
- Manufactured in accordance with the latest European Union directives



VDAS (mkII) software showing plot of oscillation

TM166 Free Vibrations of a Cantilever

Experiments

- Predicting oscillation frequency using Rayleigh's method and the simplified method assuming that the beam is 'light'
- Phase difference between displacement and its derivatives
- Horizontal cantilever length and frequency of oscillation
- Using Dunkerley's method to predict the 'beam only' frequency
- Comparison of vertical and horizontal cantilevers

Essential Base Unit

Free Vibrations Test Frame (TM160)

Essential Ancillary

- Versatile Data Acquisition System – bench-mounted version VDAS-B (mkII)

Note: This equipment needs VDAS (mkII) and will not work with earlier versions of VDAS. If unsure, contact TecQuipment or your local agent.

Operating Conditions

Operating environment:
Laboratory environment

Storage temperature range:
–25°C to +55°C (when packed for transport)

Operating temperature range:
+5°C to +40°C

Operating relative humidity range:
80% at temperatures < 31°C decreasing linearly to 50% at 40°C

Specifications

Nett dimensions and weight:
(Mounted horizontally) 280 mm high x 670 mm wide x 130 mm front to back and 7.5 kg

Approximate packed volume and weight:
0.07 m^3 and 10 kg

Tools and other parts included:

- Plain cantilever beam
- Weighted cantilever beam
- Beam tip masses 2 x 50 g and 6 x 100 g
- Hexagon Tool

The TM166 in use (other items not included)

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infoWERK is a leading expert in the development of eLearning courseware, learning system solutions, teaching and AV equipment.

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TecQuipment is one of the global leaders in technical teaching equipment for engineering. If you are interested in one of TecQuipment’s products feel free to contact us at:

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