Mechanical Material Characterization II

Several methods may be used for determining the Young's Modulus of a specimen. One of them is based on the traditional methodology of a beam-type specimen submitted to a bending test. This experience explores the use of strain gauges for the measurement of strain and the determination of mechanical material characteristics (Young's Modulus and Poisson's Ratio).

The system uses two beams of a given material with rectangular cross section fixed on one end, figure 1.

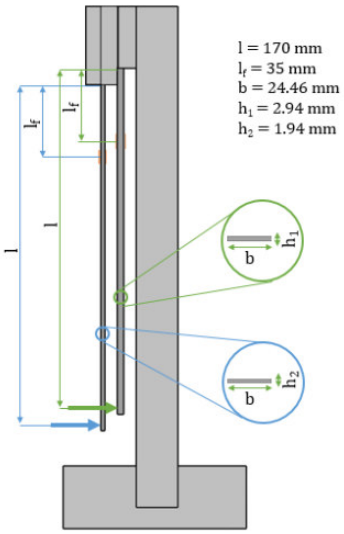

Figure 1

Each beam is instrumented with four strain gauges symmetrically bonded on opposite surfaces to the top and bottom surfaces of the beam. The strain-gauge assembly setup in each beam surface is depicted in figure 2 by a sketch and in figure 3 by a photo of the real system. The two sets of strain gauges (longitudinal and transverse) were integrated in two Wheatstone bridges (supply voltage V_0 = 1.25 V) in a half-bridge configuration. The analogue output voltage of each Wheatstone bridge is then amplified and converted into digital signal.

The load is applied at a point close to the free end of the beam, at a distance l from the support. The cantilever beams are loaded separately depending on the direction in which the DC motor runs.

The displacement with a range of approximately 5 mm is measured using Hall Effect sensors and the force is measured using two strain gauges integrated in a Wheatstone half-bridge within a range from 0 up to 15 N. A LDR sensor used to measure the room light level and a

dedicated lamp are used to guarantee light during the experience proceeding 24h. Two PIC microcontrollers are used. One PIC microcontroller is used to process and compute the sensor signals, the other connected by a SPI communication to the first one is used to implement a webserver. The interface uses HTML and JavaScript and is embedded in the Moodle Platform.

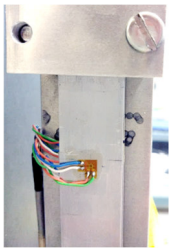

Figure 2 Figure 3

Two modes for user interactivity have been implemented on the remote friendly user interface. In the manual mode the user may impose loads to be applied to the beam and observe on the remote interface the system response, as well as the values corresponding to the applied force and Wheatstone bridges output.

The automatic mode, once started by the user, executes a defined procedure that acquires 3 points. The system stabilizes on each applied load level, the corresponding force and Wheatstone bridge output voltage values (for longitudinal and transversal strain gauges) are measured. After performed the automatic mode test for each beam, the measured values can be saved in the Moodle file system with the desired file name.

The *Information* button opens a new window with some relevant information about the setup.

Side figures represents the experimental setup comprising the following components:

1. Cantilever support for two beams;
2. Actuator system for loading beams and load cell;
3. Webserver;
4. System for signal conditioning, monitoring, processing and control;
5. IP cam for live video;
6. Strain gauges sensors;
7. Cantilever beams with free end;
8. Deflexion sensors;
9. Live video window.