HOMEWORK PROBLEM #4

Homework #4: Stain-gage based Load Cells – Experiment Design

The purpose of this experimental session is to build a load cell, which can measure loads acting in arbitrary directions.

Using a flat steel blade as the base for the load cell (see next page) prepare suitable circuits to measure three direction orthogonal forces. The flat steel blade has four rosettes connected with the wires, marked as shown in the diagram in next page.

Required:

(i) develop three circuits which can measure three components of a force,
(ii) calibrate each circuit to determine the relation of the mechanical quantity and the voltage output,
(iii) verify calibration with a reference load cell
(iv) applying a single force in an arbitrary direction, determine its magnitude and direction angles. Compare magnitude with a reference load cell

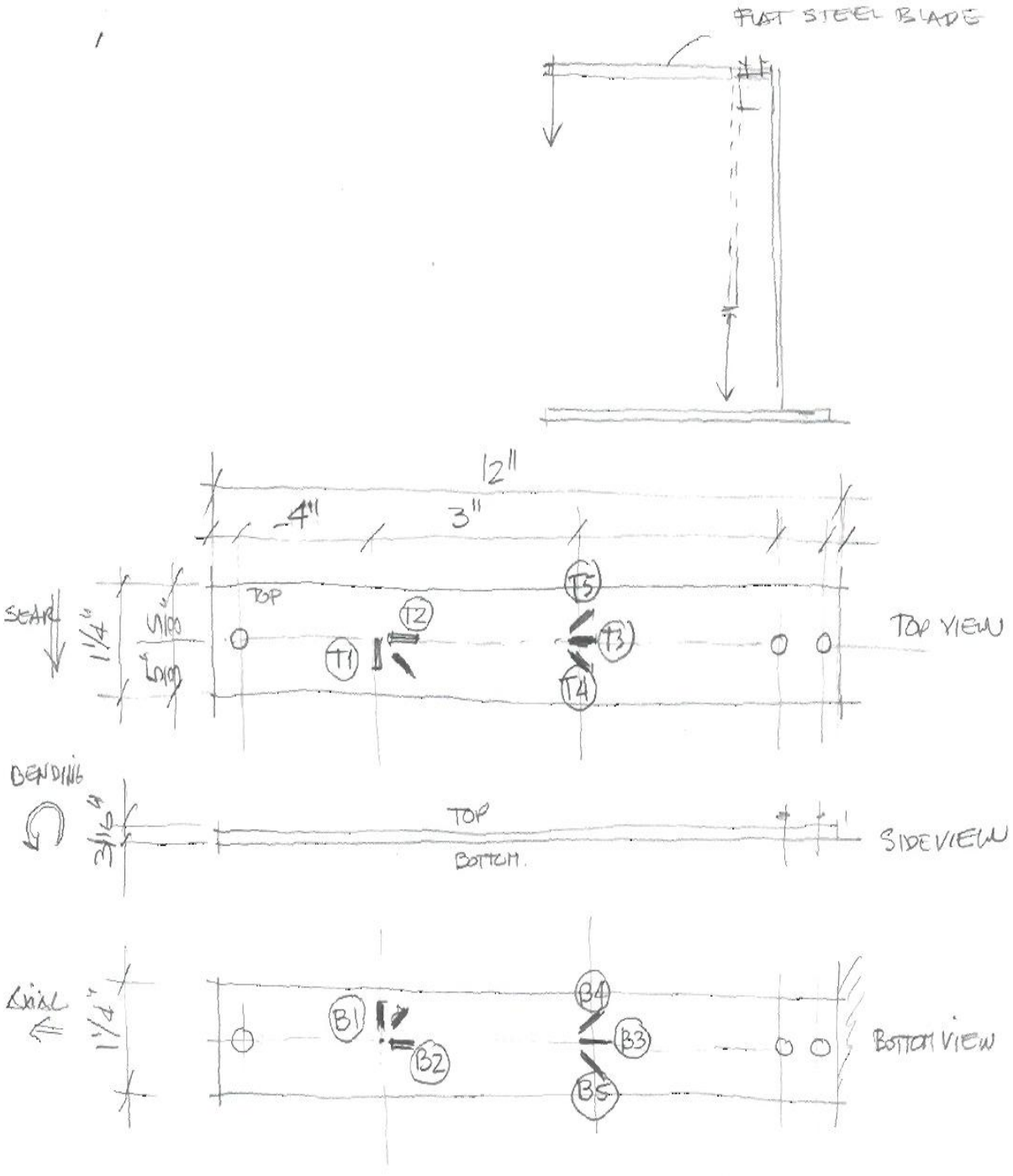
The experiment should follow the following stages:

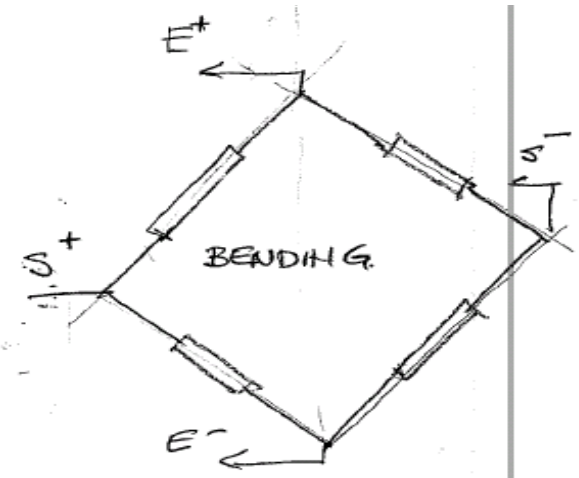
1. Ahead of the experiment date, develop in consultation with the instructor the schematic of the **three circuits using Wheatstone bridges** to measure the axial and the two transversal forces using a cantilever blade shown in page 2, with straingages numbered as marked. Use full bridge configurations if available, and if not use half bridge.
   NOTE: It is suggested to use one "axial load" sensitive bridge, one "shear" sensitive bridge and one "bending" sensitive bridge. On the sketches in page 3 there are the schematics which have to be completed by you. You cannot participate in the experiment if you did not prepared the sketches.
2. Connect each circuit to one channel of a conditioner (Vishey or equivalent), which provides voltage input, completion circuits, amplifications, and can measure output.
3. Calibrate each circuit to provide 5 Volts output at maximum load:
   a. Set the blade in a position to calibrate each circuit. Balance each circuit first.
   b. Apply maximum load (read from an auxiliary load cell) to create an output voltage. Adjust the GAIN to read 5 Volts.
   c. Remove the load, check balance (possibly re-balance) without touching the GAIN.
   d. Repeat (b) until it reads 5 Volts and (c) until it reads 0 without any adjustment.
   e. Record gain and zero offset (if available), record calibration factor [load/volts]
   f. Connect your conditioner to a DAQ system and display output in engineering units.
4. Place the steel blade in a position, which can be loaded in an arbitrary direction. Using a reference load cell, pull the load cell, measure the intensity, and calculate angles of action. Compare with the readings from the steel blade with the reference load cell.
5. Determine and quantify the accuracy, sensitivity, resolution of the steel blade load cell
6. [Suggest how to prepare same calibration using shunt calibration of one gage (except for the shear circuit) - may consult with the instructor]

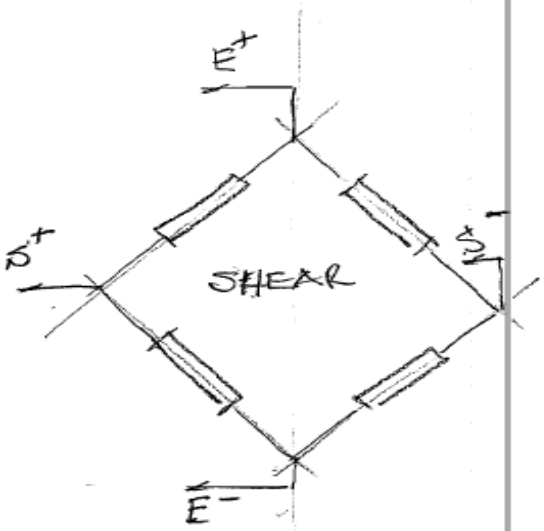
Note: Prepare the report according to standard described in Homework 1

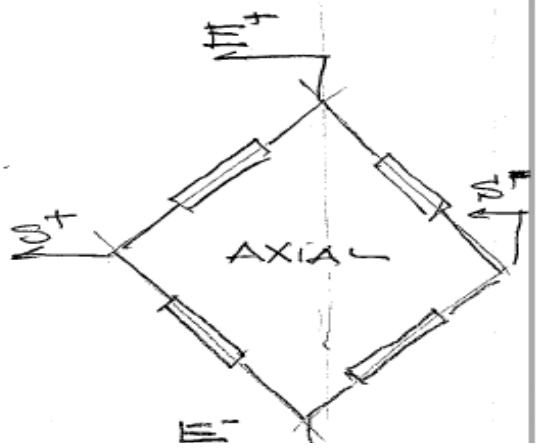
Report Due Date: November 28, 2011 (electronic submission only)

EXPRIMENTAL SETUP









E+ excitation +
E- excitation -
S+ signal output +
S- signal output -