HOMEWORK PROBLEM #5

Homework #5: Staingage 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. Develop schematic of the three circuits using Weatstone bridges to measure the axial and the two transversal forces You should 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.
2. Connect each circuit to a conditioner, which provides voltage input and can measure circuit output.
3. Set the blade in a position to calibrate each circuit. Balance each circuit, and apply incremental loads to create an output voltage. Monitor the circuit output with a voltmeter or with a DAQ display.
4. Determine the maximum force you want to measure and determine the amplification gain such that the maximum will corresponds to 5.0 volts.
5. Connect your conditioner to a DAQ system and display output in engineering units. Complete calibration curves for each direction.
6. Prepare same calibration using shunt calibration of one gage (except for the shear circuit)
7. 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.
8. Determine and quantify the accuracy, sensitivity, resolution of the steel blade load cell..

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

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LOAD CELL DESIGN: CIRCUIT ASSEMBLY & CALIBRATION