Fabrication, calibration and use of a clip gage

Aim: To fabricate an extensometer and use it to conduct a tensile test.

Equipment needed: Strain gage amplifier, strain gages, spring steel strips, fixing block, clip gage calibrator, power supply, digital voltmeter, solder iron and soldering accessories, strain gage cement and accessories, sand paper,.

Caution: The tensile testing machine uses 220V AC. Take every precaution to prevent an electric shock!

預習報告：(1) 應變計黏貼與焊接程序與注意事項; (2) Wheatstone bridge 理論及應用 （請參考上學期上課講義） (3)梁之應力與應變分佈理論。 (4) 準備一 Labview program, program 功能請參考本講義。

Fabricating your clip gage:

1. Use sand paper for cleaning and abrading positions on the spring steel strips for strain gage installation The position of the strain gage should be as close to the maximum bending stress region as possible. ***Remember to leave enough room for fixing to the connecting block and for solder of connecting wires!*** (see fig.1).
2. Clean the abrading debris thoroughly with cotton and acetone.
3. Mark off the gage alignment lines using light scribing or burnishing with a 4H pencil.
4. Degrease and clean again with acetone, then with iso-propyl alcohol (IPA). Do not touch the surface with finger any more from now on.
5. Use tweezers to take out the strain gages and terminals and position them against the alignment lines. Fix the relative position of gages and terminals to the strip using low tack cellophane tape. The metal foil grid should face up. One end of the cellophane tape should be fixed to the strip. The other end rolled up to expose the backing sheet. (see figures in the lecture notes)
6. Apply a small drop of CN glue to the backing sheet of the strain gage and terminal. Too much glue will not bond.
7. Stick the cellophane tape back in place. Place a plastic sheet over the strain gage position and press hard on it for one minute to squeeze out any excess glue.
8. Remove the cellophane tape carefully.
9. Repeat the above procedure so that strain gages have been attached to each of the four surface of the spring steel strips (fig.1).
10. Solder lead wires to the strain gages. The length of the lead wires should be enough to lead to the terminals on the connecting block. (Remember the unacceptable soldering results mentioned in the lecture notes. ***Faulty soldering may ruin the strain gage amplifiers!***).
11. Fix the spring steel strips in place to the connecting block using the bolt provided.

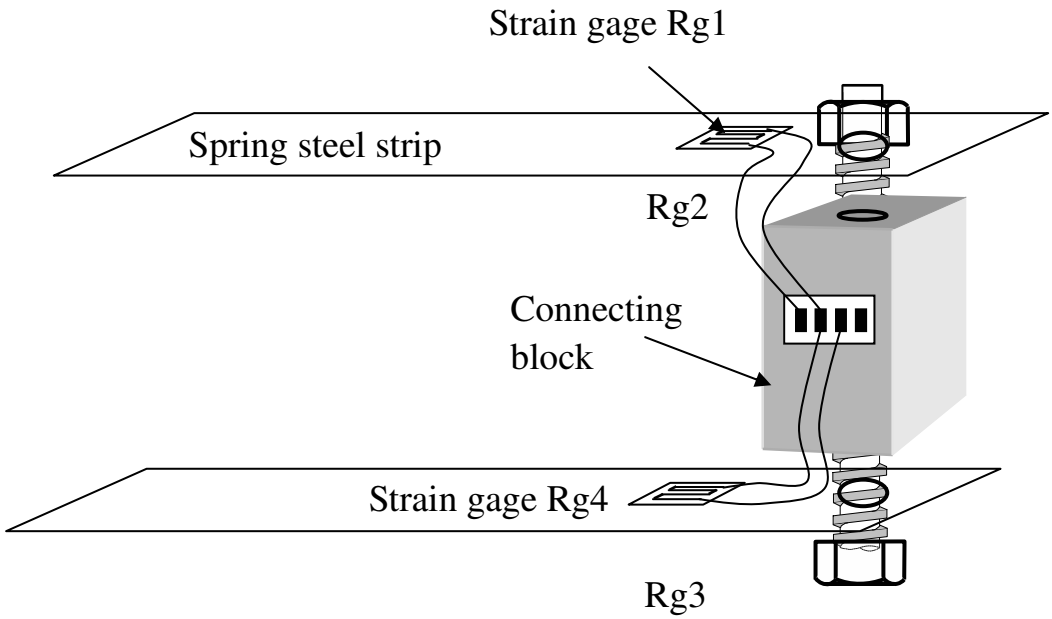

fig.1

Completing the Wheatstone bridge:

1. Solder the lead wires from the strain gages to one side of the terminals to build up the Wheatstone **full** bridge as shown in figure 2. Use systematic color code for the wires!
2. Solder connecting cables to the other side of the terminals.
3. Check gage resistance (350Ω) and inspect for unacceptable bonding conditions.

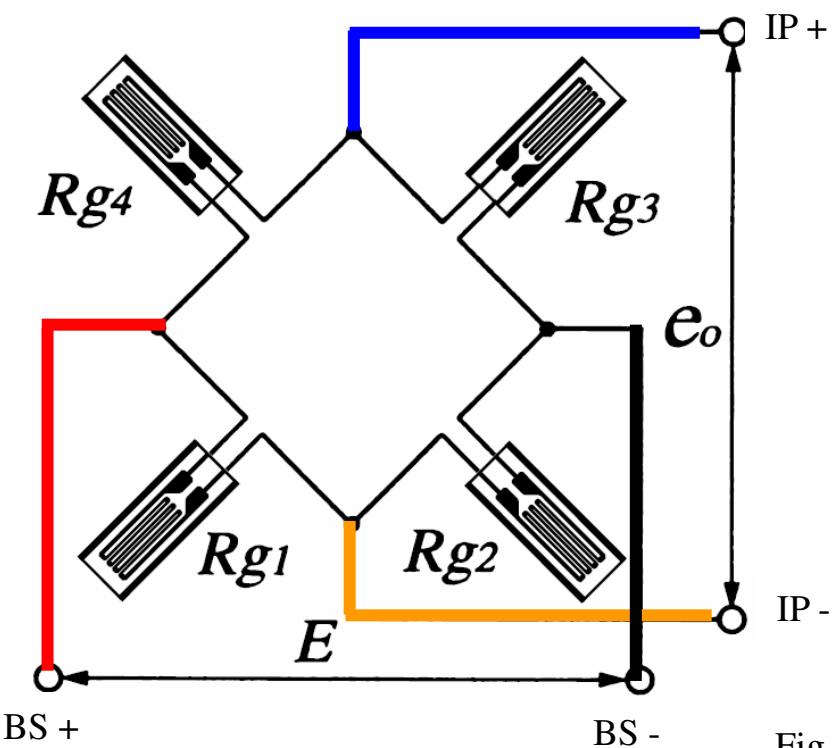

Fig. 2

4. Before connecting to the strain gage amplifier, check resistance across any two of the four connecting wires to make sure you have wired up the bridge correctly.
5. Connect +15V, 0V and -15V power supply to the strain gage amplifier. Do this by switching on

the main power button, adjust for the correct voltage on both supplies, then press the output button on the power supply to apply the voltage.

6. Use a digital voltmeter (DVM) to measure the output from the strain gage amplifier. (O/P and com)
7. ***What happen if BS+ and BS- are interchanged?***
8. ***What happen if the IPs and BSs are interchanged (ie. IP+ is interchanged with BS+ and IP- is interchanged with BS-)?***

Calibration Procedures:

1. After hooking up the strain gage bridge to the strain gage amplifier, check that the bridge supply voltage (BS+/BS-) is 4.00 volts. Adjust the excitation potentiometer if this is not correct.
2. ***Does the DVM read zero when the clip gage is freely lying on the table? If not, why not?***
3. Attach your clip gage to the calibrator provided. Before apply any load, zero your strain gage amplifier output by turning the zero adjustment knob on the strain gage amplifier. ***Why we should not zero the output before doing the calibration?***
4. Decrease the distance between the spring steel strips incrementally. Record the displacement indicated on the dial gage and the strain amplifier output.
5. After decreasing the distance between the spring steel strips to as far as possible, do an unloading calibration. You may repeat the loading and unloading calibration as many times as time allows. ***Plot the DVM reading and the displacement and find out the relation between them.*** Discuss the reproducibility during different cycles of loading and unloading. How do you check the linearity of your clip gage?

Using your clip gage

Caution: The tensile testing machine uses 220V AC. Take every precaution to prevent an electric shock!

1. Prepare a labview program that can do a tensile test. The program should consist of:
    a. output an adjustable voltage to drive the desktop tensile testing machine.
    b. input and record the analog voltage signals from the strain gage amplifiers for the load cell and the clip gage.
    c. Able to stop the machine when the load cell output is zero or at anytime you press a button.
2. Hook up the aluminium tensile specimen in the grips of the tensile testing machine.
3. Attach your clip gage to the specimen.

4. Zero the load cell and clip gage signals.
5. Hook up the strain gage amplifier signals to USB6009 and the machine control signal from USB6009 to the machine controller box..
6. Check every electrical connection is tight and there is on obstacle in the path of the moving actuator of the tensile machine.
7. Actuate your labview program to start the tensile test.
8. After finishing your test, put your tensile data into your own storage media. In your report, ***plot out the tensile curve, find the Young's modulus, 0.2% proof stress, ultimate tensile strength and the strain to fracture.***
9. ***Discuss any possible improvement to the set-up and control of your tensile test.***

Report:

Write up a report detailing the aim, theory, procedures, results and discussion of your work. Pay particular attention to the questions in ***italic*** above. Draw up a suitable conclusions for your report.