Prepare a report using the following outline and guidelines.
(Note: This report does not include other features used in Formal Reports, such as
Acknowledgements, Table of Contents, List of Tables and Figures, Suggested Research, etc.)

Title Page
Include the following: name of institution (California State University, Sacramento); Department
(Department of Civil Engineering); Course number and title (CE113, Structural Laboratory); Section
number and day of the week; Meaningful title of the experiment (Note: it should give the reader an
idea of the purpose of the experiment. E.g., “Verification of the Theoretical K Values in the Euler
Buckling Equation Using Compression Tests on Slender Columns); Team number (e.g., Team 1);
Your name above Team members’ names; Instructor's name (e.g., Prof. Eric Matsumoto); Day and
date of the experiment (e.g., Monday, 9/14/09); Day and date report is due (e.g., Monday, 9/28/09).
As appropriate, include a meaningful photo of the experiment (e.g., test setup with specimen under
load) from the lab as well for a nice touch.

Executive Summary (~3 paragraphs)
Summarize in several paragraphs the test objectives, applicable theory (e.g., key equations), test
approach, specific results using ratios, conclusions, and recommendations. For this relatively short
report, the executive summary does not need to be on a separate page. See Writing Workshop
discussion of Executive Summary for further guidance.

Introduction (~4 paragraphs)
Summarize relevant background and the experiment, stating clearly the objectives and a brief
overview of how the objectives were met using test specimens, equipment, and instrumentation.
State relevant theory, including numbered equations (e.g., equations for bending stress, Hooke’s law
(stress-strain), and flexural strain) on their own line, centered between margins, and place an
equation number such as “Eqn. 2” between the equation and the right margin after each equation.
Briefly outline the remainder of the report, identifying what will be found in the following sections.
Do not give any test results in the Introduction.

Approach (~2-3 paragraphs plus figure)
Briefly explain the test setup for the experiment and include a very professional/neatly schematic
drawn diagram to show the setup, labeled as Figure 1 with a caption (Note: show enough detail such
as key dimensions on the cantilever and cross section, as well as locations of strain gages). Then,
concisely summarize the test procedure using the imperative voice (e.g., Attach, Load, Record, etc.)
Using a numbered list, state the steps one should follow to properly conduct the experiment, but
add a few sentences at the end to explain any steps you may have altered and why the experiment
was not conducted “ideally”. As much as possible, put procedures in your own words. Where you
don’t use the imperative voice, use the passive voice. (Do not simply a cut and paste what is listed
on the website.)

Results (Several sentences with 2 tables and 1 figure)
In a short paragraph, briefly introduce Table 1, Table 2 and Figure 2. Then, provide the tables and
figure. Place the table caption above the table (e.g., Table 1. Measured Flexural Strain for
Wheatstone Bridge Configurations) and place the Figure caption below the figure (e.g., Figure 2.
Applied Load vs. Average Flexural Strain). The figure is the most important result and should occupy its own (entire) page, using landscape orientation.

Discussion (~3 paragraphs)
Discuss your results, demonstrating your understanding of the data in the tables and figures, related to the objectives. Mention ratios but not actual strain values. Explain how measured strains varied with load and how strains differed for the different bridge configurations. Also, compare experimental strains to theoretical strains, and state assumptions, limitations, and anomalies, as appropriate.

Conclusions and Recommendations (1 paragraph)
Briefly state what you can conclude from experimental results and analysis relative to the test objectives. State at least one recommendation, based on test objectives and conclusions. Do not include meaningless statements such as “The experiment was a success.”

References
Provide at least 2 references using guidelines and format found on pages 9-10 of:
http://onlinepubs.trb.org/onlinepubs/shrp2/AuthorGuidelinesSHRP2.pdf
References may include the CE113 website, a reference related to flexure, matweb.com (for E_{\text{ALUM}}), etc. Use a numbered list for references, and, when using the reference in the report, place brackets around the number. For example, use [2] within the report to refer to reference 2.

Appendix
Provide a labeled cover sheet with a number list of what the Appendix includes, followed by a copy of the sample calculations and data sheet. 1) Provide your (neat) calculation for \( P_{\text{max}} \). 2) Show a sample calculation for theoretical strain in terms of applied load, \( P \), and compare it to the experimental value. For example, choose an actual load level for \( P \) and then, using the bending strain equation, calculate the corresponding theoretical bending strain. Then, calculate the ratio of Actual/Theoretical bending strain, using 3-4 significant figures in the ratio (e.g., 1.123 or 0.987). Calculations may be done by hand or typed.

Important Guidelines to Follow in Report
1. Write concisely and accurately. Do not use first person (I, we, our, etc.) in technical report writing. Use 11 point font with 1.5 line spacing and 1-inch margins, and show page numbers centered within the bottom footer, starting with page 1 for the Executive Summary (not cover page). Use past tense primarily. Use block format for paragraphs with a space between paragraphs (or else use indentation without skipping a space). Eliminate all usage of an asterisk (*) to indicate multiplication. Eliminate contractions, run-on sentences, and fragments. Correctly spell “Hooke’s law”.

2. Be careful of units (e.g., use labels of Flexural Strain (Microstrain), Flexural Strain (\( \mu \varepsilon \)), or Flexural Strain (in/in x 10\(^{-6}\)). Do not show more or less significant figures than are reasonable. For example, measured strain is not more accurate than 1 \( \mu \varepsilon \), so do not list the measured strain is 435.0 \( \mu \varepsilon \). However, the real strain or calculated average strain may be shown as 435.5 \( \mu \varepsilon \) strain for accuracy from calculation. For the slope of the line in Figure 2 use 3 or 4 significant figures.

3. Place data from all tests into a table (Table 1) within an Excel spreadsheet and tabulate the data in columns with the first column being the load, then the following columns: strains for one top gage, one bottom gage, the 1/2 bridge measured values, and finally full bridge measured strains. Place the actual measured data into the spreadsheet, directly from your data sheet. Properly label
each column and include units [e.g., Quarter Bridge Strain, Top (Microstrain); note: It is permissible to use the symbol “µε” to designate units of Microstrain to reduce the number of characters used in the tables]. This data is the measured strain for different Wheatstone bridge configurations.

4. Set up a second table (Table 2) with the loads in column 1, then the following columns: strains for each 1/4 bridge in columns 2 and 3, real strains for the 1/2 bridge (i.e., measured values divided by 2) in the next column, and full bridge real strains (measured values divided by 4) in the next column. Then, add another column to Table 2 where you average the four values of real strain. But be sure to use the absolute value for all strains (i.e., change the bottom 1/4 bridge gage to a positive value when averaging strains). Do all the calculations on the spreadsheet. You should get relatively close to the same values for real strains values for all tests, if you conducted the experiment properly.

Now, add another column to Table 2 after the Average Strain, with the heading “Theoretical Strain”. Fill this column with your predicted theoretical strains based on the actual loads you used as stated in your table. Use the equations developed in class. Finally, add a column with the ratio of Actual/Theoretical, with significant digits as follows: 1.123 or 0.987.

Thus, Table 2 includes the actual (measured) strain, average strain, theoretical strain, and Actual/Theoretical strain ratio. All strains are “flexural”.

5. Use the spreadsheet to plot Applied Load vs. Average Real Strain and Theoretical Strain, as given in the last two columns of Table 2. This plot, Figure 2, allows a direct comparison of real strains to theoretical strains. Place the load on the y axis and the strains on the x axis. The test data should be shown as data “points”. In contrast, the theoretical strain should be shown as a solid line without data “points” or symbols—even though you have to plot 2 points to get Excel to plot your theoretical line. Make Excel “hide” the symbols for this theoretical line since the theoretical strain is not actual data. Also include a legend, placed within the plot border so the plot size can be maximized.

Place a trend line through the test data and show the associated linear trend line equation. (Note: Because it is expected that zero load produces zero strain, force the trend line through the origin.) Then compare the slope of the trend line to the slope of the theoretical line (from your hand derived equation) for your comparison of theory to experimental data. This is more meaningful than a comparison of select data. Use 3-4 significant figures for the slopes.

6. Show this plot as a full-page plot in Landscape orientation in your report (for clarity). If printed in landscape mode, the top of the graph will be at the binding side of the report. Do not let Excel place a title at the top of the plot (delete it!); rather, give the plot an accurate and meaningful title in the caption (e.g., Figure 7. Applied Load vs. Flexural Strain), at the bottom of the plot. Properly number and label the graph. Label the axes including units. For flexural strain units, use: “(Microstrain)” or “(in/in x 10^-6)”, rather than other variations. For load, use “(lbs)”.
