ENGR 100

Bridge Component Tests

Purpose

The purpose of this activity is to simulate the "Research and Development" aspect of engineering. Your team will act as "engineering researchers" completing a series of component tests to determine the strength and characteristics of the bridge materials. In the end, you will compose an individual memo addressed to the design team summarizing your findings and recommendations. Once this is completed, you will then switch roles, becoming the "designer", and use this information directly to design and build your team's prototype bridge.

Group Assignment

The class will work together on this assignment, with groups completing different tests and then sharing the results. The following is a list of tests:

Test 1 - Tension Test

Test 2 - Compression Test

Test 3 – Torsion and Bending Test

Test 4 - Fishline Tension Test (Optional)

At the end of class, each team will write their results (tables, graphs, findings) on the board for everyone to copy. Each team will then present and explain their findings and we will have a short discussion about how these findings will be useful for bridge design.

Individual Assignment

Each person will be responsible for writing a memo summarizing the results of the tests and making recommendations to a fictitious design team. The purpose of writing this memo, even though you are essentially the design team for whom it is written, is to be introduced to the fundamentals of technical writing.

Feel free to experiment! If you have any ideas about how to change a test or perform additional tests, please let the instructor/TA know.

Test 1 - Tension Test

Objective

The objective of the tension test is to determine a recommended overlap distance for two tongue depressors in tension (taking into account strength and total span length).

Procedure

1. Build the test specimens by gluing two tongue depressors together using different lengths of overlap (max. < 3/4"). Be sure to test at least 3 specimens for a given overlap distance to ensure more accurate results. Reinforce the hole with extra pieces of tongue depressor.
2. Place the sticks in the vice on the testing platform and reinforce the hole at the other end with tape. Test the sticks by pulling straight up with the force gauge. Record the forces (in lbs) required to break each of the specimens in your notebook. Also note how each specimen failed!
3. If you are getting inconsistent results, create several more specimens and try to standardize your testing methods.

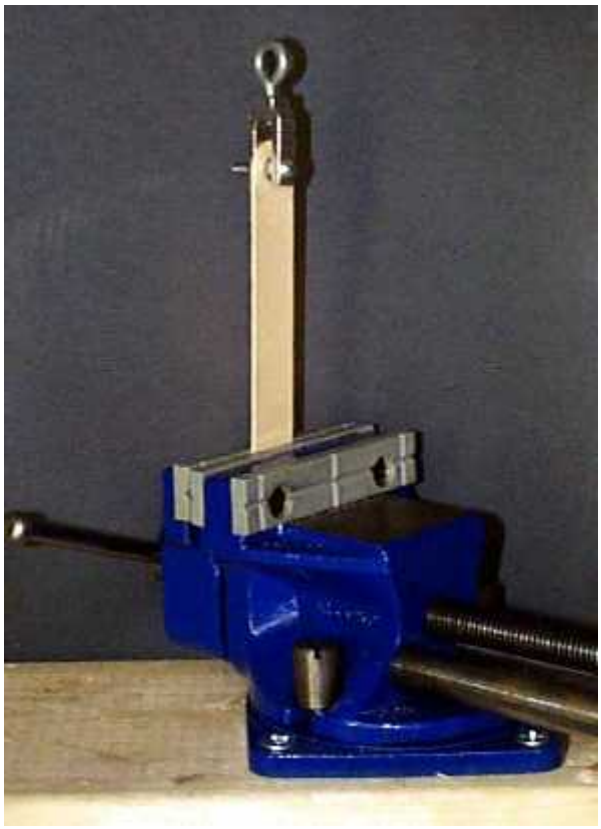

Figure 1. Tension Test

Deliverables (to be included in the memo)

1. How did the different specimens fail?
2. Why you think they may have failed at different places?
3. What is the relationship between failure force and overlap length? From examining the results, what would you recommend for an overlap length? Why?

If you have more time…

Do a similar test using elmers or wood glue. How do the results compare?

Test 2 - Compression Test

Objective

The objective for Test 2 is to determine a maximum length that designers should not exceed, to ensure adequate strength from compressions members.

Procedure

1. Use a ruler to prepare several specimens for the compression test ranging in length from 3" to about 10". For members greater than 6", glue two tongue depressors together with a 1" overlap length and then cut the ends to the desired length. Prepare at least 2 samples for each length to ensure some level of accuracy.
2. To test the specimens, place them upright on the scale and push down as shown in Figure 2 (using pliers may be easier on your hands). Record the force (in grams) required to bend the specimen. Convert the grams to lbs in EXCEL.

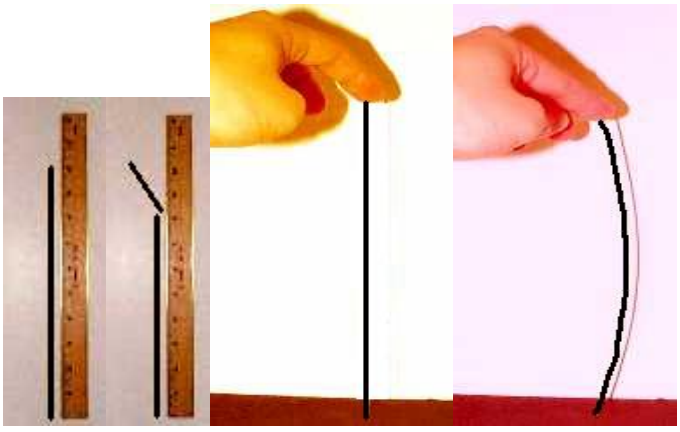

Figure 2. Compression Test

Deliverables (to be included in the memo)

1. Does the location of the 1" overlap glue joint (end or middle) affect the buckling strength?
2. Create a table in Excel showing the specimen length in one column and the failure force in another.
3. Plot the Force (lb) vs. Length (in) **(For accuracy, use "x-y scatter" graph <u>not</u> a line graph).**
4. Look at the graph to see how the force changes as the length changes. Is there a particular point on the graph where the force required to buckle the specimen decreases signficantly with little change in length? If so, the bridge design team should be notified of this length so they can avoid designing a bridge with compression members that are prone to buckle under smaller loads.