

## Lab 4: Wood Bond Preparation and Testing

### Objective

To compare the effects of glues and adhesives commonly used in the secondary wood processing industries in terms of their lap-shear strength under simulated indoor and outdoor exposures.

### Background

The secondary wood processing and furniture manufacturing industries are largely dependent on high performance cold setting adhesives that do not require elevated temperatures to polymerize and harden the glue joint. Normally, clamping overnight is sufficient to produce a lasting high-strength joint.

These laboratories are designed to showcase some of the different adhesives used and one of the simple tests to evaluate wood-glue bonds. You will prepare bonds using different glues and then test these bonds after they have been exposed to one of two different conditioning treatments.

*Q: What properties of the wood will affect the bond strength? List and explain.*

### Laboratory format

This lab will take place over two lab sessions. During the first session, the wood bonds will be prepared. There will be no data measurement during the first session. For the second lab session, all data is to be submitted to the teaching assistant **before** leaving the testing session of this lab.

### Data Analysis

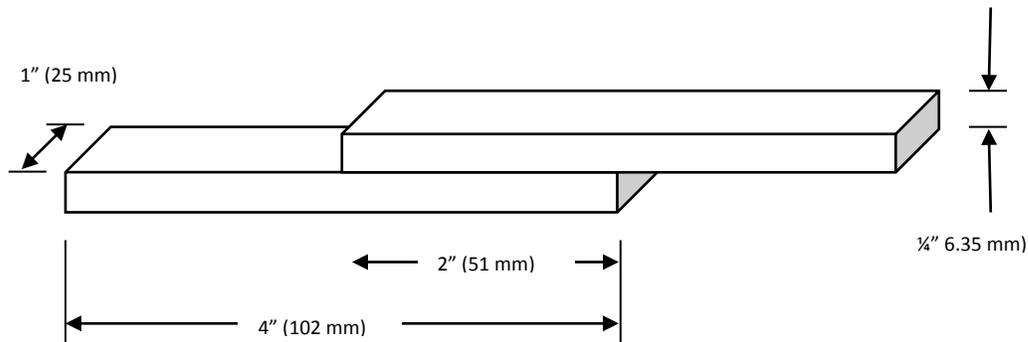
The teaching assistant will provide a template on which the results for each group will be recorded and each group must submit their raw data **before** leaving the laboratory. This data will be made available for download from the server as an MS Excel workbook file.

In addition to the usual ANOVA analysis for the using the data from all groups, perform an ANOVA analysis for the data collect by your group only. Comment on the difference between the two analyses.

## Lab 4, Part 1: Sample preparation

### Procedure

Bonds will be made between matched pairs of adherends to form lap-shear samples for later evaluation. Pairs of hardwood adherends will be bonded together using different adhesives. Two pieces of wood 4 x 1 x ¼ in. (102 x 25 x 6.35mm) are joined with a single glue-line to make a two-ply laminate product with a 2 in. (51 mm) overlap (see diagram below). You should mark each piece of wood to ensure accurate overlap.



The adhesives listed below will be used to make lap-shear samples: The adhesives are cold setting and the mixing and spreading instructions are provided according to the manufacturers' recommendations.

- Cross-linked polyvinyl acetate (cPVA)
- cPVA with nanocrystalline cellulose mixed into the adhesive (1% w/w of dry adhesive)
- Epoxy
- Hot melt

Each group will prepare 4 bonds for each adhesive combination (i.e., a total of 16 assemblies). These assemblies should be clamped to ensure good contact during adhesive curing. Excess glue that squeezes out of the bond should be wiped away. The bonds will be held under the necessary pressure at least overnight.

**Samples should be labeled in the following format:** Group # + adhesive + replicate (ie. Group 5 + adhesive b + replicate 3 = 5b3)

### Experimental design

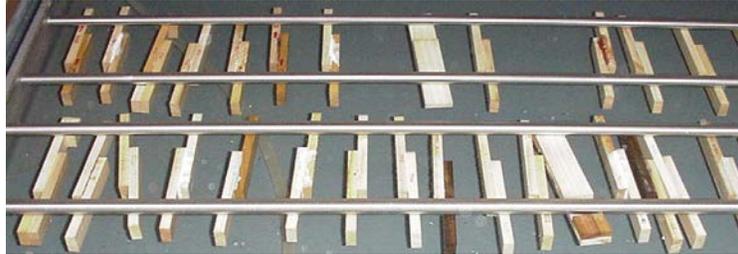
This experiment will compare the effect of resin type on the bond strength obtained for each resin.

Constants:	Replicates: 2	Variables:	1 resin types	4
			2. Conditioning	2
			Total number cells	16

### *Conditioning treatments*

Two samples for each adhesive will be tested in the dry condition. These samples will be conditioned in a constant temperature and humidity (CTH) room for at least one week prior to testing.

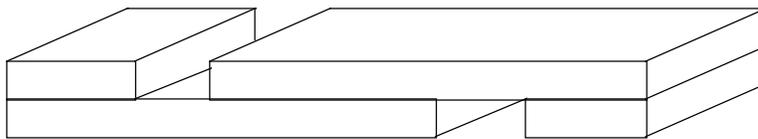
Two samples of each adhesive will be subjected to a cold soak treatment prior to testing. In this treatment the samples are immersed in cold water for at least 24 hours prior to testing. This treatment will be performed for you prior to the testing session lab.



### **Lab 4, Part 2: Testing**

Prior to the samples being tested in tensile shear (i.e., the sample is pulled apart and the glue line fails in shear), two small pieces of wood should be glued to your test samples as shown in the diagram below. These pieces should be of the same species as the adherends. These pieces reduce the twisting of the sample during the test and give a truer test result. You should also estimate percentage wood failure (to the nearest 10% for each specimen tested).

You will need to co-ordinate the times at which you perform your tests the other groups since all the tests cannot be completed within one 3-hour time period. The teaching assistant will have a sign-up sheet for you to book your times. Each group should be able to complete their tests in a little over 1 hour.



Tabulate all the data gathered. Perform any relevant statistical analyses to describe the data (i.e., mean, standard error (preferably a 95% confidence interval), and statistically significant differences between data sets). Discuss the suitability of adhesives tested under the conditions of your tests for the production of commercial products. If possible, take into account economic factors such as costs of the different adhesives, resin consumption and market value of some of the products for which a particular resin is recommended/suitable.

**Record your results in a table and submit to the TA.**