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Rollbook Number: 7

1. P- Δ Effect on Slender Wood Columns
2. **What Category is your Project?** Engineering
3. **What is the leading question of your research project?** How does a gravity load, P , affect the performance of slender wood columns when subjected to lateral load, V .

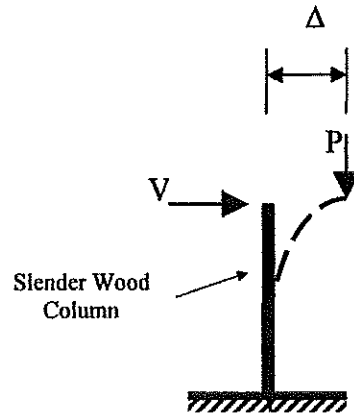


Figure 1 Slender Column Subject to Lateral Load, V , and Vertical Gravity Load, P

The vertical load P represents a heavy roof and floor load on a structural column in a building, and the lateral load V represents a wind or earthquake load.

4. **What will you measure?** First, the lateral load V will be incrementally increased (with $P = 0$) and a deflection Δ measured at each increment. This will be the control in the experiment. Second, I will reload the column again with lateral Load V ; however, at each increment of load V , a constant vertical load P will be applied. P will increase the deflection Δ and thus adversely affect the strength of the column. In each experiment, I will measure deflection Δ verses the applied load V , given P .
5. **List the variable involved in this experiment:** As shown in Figure 2, several individual experiments will be done. In the first, I set $P = 0$; then, vary load V and measure displacement Δ . For this single experiment, V is the variable. Then, I do subsequent experiments. For example, I now set $P = 10$, then, vary load V and measure displacement Δ . The third experiment will be similar except, I change load $P = 20$. Note that when looking at all the experiments together P becomes the

variable. In Table 1, I list an example of the experiments to be done. More experiments may be done depending how sensitive the measured Δ is with the different loads P . Also, we use a single wood species for these experiments (Douglas Fir Larch) which is the primary structural lumber used in northern California. If local lumber yards have other species of lumber, we may expand the test matrix to include one other species.

6. **List the control(s) in this experiment:** The control in the experiment is the performance of the column under load V acting alone without P . Its performance will be measured as a plot of V versus Δ , where $P = 0$.

7. **What do you see as the hardest aspect of this project?** The most difficult aspect of this project is likely the application of the vertical load P . I will likely turn the column on its side and clamp it with a vice. Then the load V can be applied using weights suspended from a wire held tray. The Load P can be applied using hand held spring scale.
8. **How did you come up with this idea?** I was thinking of doing something about what building materials are best to use. My mother works for an insurance company and frequently works on claims due to natural hazards such as hurricanes and earthquakes and suggested that I look at how homes are affected by such hazards. Later, I talked to my dad who is an engineer and he suggested that I could investigate how wood columns behave when loaded by gravity loads and lateral wind/earthquake loads.
9. **Why do you care about this topic?** This project has implications in helping to build safer homes that can withstand strong winds and large earthquake forces.
10. **Why would the public care about this topic?** Strong wood buildings will reduce the likelihood of people dying in natural disasters such as hurricanes and earthquakes. In addition, a person's home is a major financial investment.
11. **With integrity, please circle the statement that best describes your project:** An internet search would reveal that there are projects similar to this; however, my idea is different in the following ways. The "P- Δ effect" has been studied in the engineering field in the past. However, this has been studied on steel columns and not extensively on wood columns. This is important because wood buildings are now being built higher than two to three stories and the wood columns are subjected to heavier gravity loads.
12. **It's okay to have a mentor. Do you currently have a mentor helping you with the project?** Yes, my father is my mentor on this project. He is a structural engineer.
13. **What is your initial hypothesis regarding the outcome of this experiment? What do you predict the conclusion will be? Please explain your logic.** The control case with $P = 0$ should result in the column supporting a higher load V and at a larger displacement Δ . As shown in the graph below, it is anticipated that with increasing gravity load P that the column will fail at lower loads V and smaller displacements Δ .

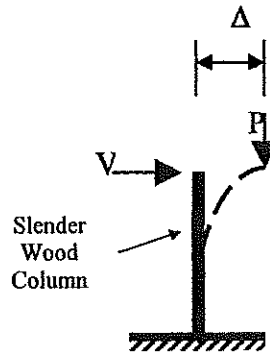
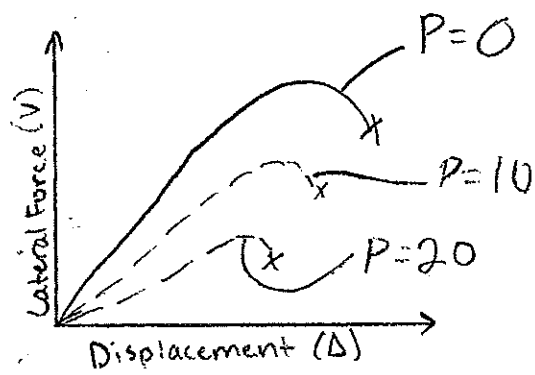


Figure 2 Expected Experimental Results

TABLE OF EXPERIMENTS

Load or Displ.	Experiment #1	Experiment #2	Experiment #3
Vertical Load, P	No Load ($P=0$)	Constant Load ($P=10$)	Constant Load ($P=20$)
Lateral Load, V	Vary Load, V	Vary Load, V	Vary Load, V
Lateral Displacement, Δ	Measured Displacement	Measured Displacement	Measured Displacement