Iowa State University

Aerospace Engineering

AER E 322 Lab 10
Structure Model Building

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Aerospace Structures Laboratory Report
Lab 10 Structure Model Building
Section 4 Group 2
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Chapter 1

Pre-Lab

1.1. Introduction

Our group was tasked with designing and building an aircraft structure utilizing the PASCO tool kit/building kit. To do so, we utilized the "rapid design, prototyping, and learning" concept. This would allow our group to rapidly come up with a design, then revise the design to get to a structure that was suitable for collecting data. We decided on a fuselage that we made out of two octagons connected by long members. We chose to use long members for connecting the octagons, so the structure would be less stable, in theory providing better data. The octagon was chosen because it was close enough to a circle without making the circumference too large. Our group performed two tests on the fuselage, each with 5 rounds lasting 15 s. Each test had five rounds of testing where each run had an increase in frequency of the wave driver oscillation (1 Hz, 2 Hz, 5 Hz, 10 Hz and 15 Hz). The first test was set up to apply a tension force to the system utilizing two wave drivers. The wave drivers were set to pull on the system simultaneously to provide the maximum tension force. The second test used only one wave driver pulling down on one side of the fuselage to simulate a torsion force. Three 5 N load cells were attached to the members connecting each octagon together. This would allow our group to collect data on different members while performing each test to. Multiple load cells were used on different members to clearly observe the force distribution across the entire system. Two were placed on each side of the fuselage, and one on the bottom.

1.2. Objectives

- Utilize the "rapid design, prototyping, and learning" concept to simulate a part of an aircraft structure.
- Create an aircraft structure that is flexible enough to collect usable data, *i.e.*, flexible enough to have a wave driver apply enough force for deflection.
- Determine if load cells can be used to recover frequency of oscillations.
- Observe how oscillatory forces are transferred throughout the system.

1.3. Hypothesis

Test 1

For test one, we expect to see similar data from all four load cells. Since the system homogeneous, we expect the load to be distributed evenly between the connection members no matter where the load is applied to the system. While the load is applied, the load cells should read out a tensile load due to the whole system being in tension. We also expect runs 1 to 3 to provide the best data. This is because the load cells are only sampling at 20 Hz, so the wave driver oscillation frequency of tests 4 and 5 are too high for the load cells to accurately capture data.

Test 2

Test two will provide different data across the load cells. For the load cell on the vertical part of the octagon on the member which the force is acting, we expect to see higher tensile loads because the system is clamped at the top as the wave driver is pulling down on directly on the load cell. For the other three load cells on, the outputs will still be tension, but the magnitude will be lesser than the load cell directly on the line of action. This is because we expect there to be more energy loss compared to test 1. Similar to test 1, runs 1 to 3 of testing will provide the best data and runs 4 and 5 will provide the worst due to the same reason listed above.

Chapter 2

Lab Work

2.1. Variables

2.1.1. Independent Variables

- Fuselage structure, *e.g.*, the length and radius of the fuselage
- Frequency of the wave driver
- Amplitude or voltage of the wave driver
- Location of wave driver(s)
- Sampling frequency

2.1.2. Dependent Variables

- Force measured by load cells

2.2. Work Assignments

Refer to Table 2.1 for the distribution of work during this lab.

Table 2.1: Work assignments for AER E 322 Lab 10.

Task	**Matthew**	**Peter**	**Natsuki**
Lab Work			
Data Recording	X	X	X
Exp. Setup	X	X	X
Exp. Work	X	X	X
Exp. Clean-Up	X	X	X
Post Lab			
Data Analysis	X		
Report			
Introduction		X	
Objectives		X	X
Hypothesis	X	X	
Variables			X
Materials		X	X
Apparatus		X	X
Procedures	X	X	
Data	X		
Analysis	X	X	X
Conclusion	X		
References	X		
Appendix	X		
Revisions	X	X	X
Editing	X		

2.3. Materials

2.4. Apparatus

2.5. Procedures

2.5.1. Setup

2.5.2. Cleanup

2.6. Data

Chapter 3

Conclusion

3.1. Analysis

3.2. Conclusion