

Project Deliverable 6 - Final Design Report

Each team must submit a final design report for the 'Band-in-a-Box' musical instruments design project. **See course shell for due date.** This is a TEAM deliverable, and **each team must submit ONE electronic copy** of the document to the assignment on the course shell (have **one** member of your team submit it). The report is a **technical document** and should be **typed (single spaced)** in paragraph form, with appropriately formatted section headings (use bold and/or underline, and/or larger font size). You should use consistent spacing, formatting, font, and style throughout the report, as well as correct grammar and spelling. Since this is a formal technical document, it should follow all technical writing guidelines discussed in class including: no use of first person (I, we, etc.), numbering each figure/graph and having a small caption below it, numbering each table and having description above it, numbering each equation (and other guidelines discussed in the lectures), and appropriately formatted citations for all references used. Any figures, tables, equations, or data included in the report should be described (referred by number) in the text of the report. Most of the report should be written in **past tense**, since you have completed the project. This should be a cohesive document with transitions from one section to another and a coherence of information presented (individual contributions are seamlessly combined and build upon each other).

The report should include each of the sections listed below. The expected content for each section is also described below. Please also refer to the grading rubric listed in the Appendix. Both the presence and quality of the content will be assessed. Remember that a complete "design" is the entire set of instruments (four instruments total – if you have only three team members, you should be clear about which instrument would be duplicated in the design).

Cover Page

- Project Title
- Team # and team member names
- Date the report was submitted

Introduction

- Brief description of the project & objectives (problem definition)
- Brief description of the design requirements
- Brief description of the structure/content of this document (i.e. what will be discussed in the document, and in what order (structure)?)

Background

- Description of the three types of musical instruments your team has designed and built.
- Briefly discuss the underlying physics of the instrument types (including basic equations)
- Brief description of existing designs that inspired your design and how aspects of those designs appeared in your design (be sure to talk about why you chose to use those aspects). Cite these sources appropriately.

Detailed Design Description

(You can have separate subsection for each instrument in the design)

- Describe your final design in **detail** (in text).
 - Describe all aspects of your design (form and function)
 - Describe how your final design meets all design requirements and satisfy all constraints
 - Briefly describe design trade-offs that have been made
 - Include Detailed Engineering Drawings attached in an Appendix (should include 3 views (top, front, side) with dimensions, units, etc.) of your final instrument designs and a sketch describing how all the

instruments will fit into the box. Make sure to refer to (mention) drawing in this section of your report and tell reader where to find it (i.e. see Appendix 1 for Engineering Drawings of final design)

- Describe the design decisions that were made and why. How did you end up with your final design?
 - Include any evidence/rationale for design decisions made throughout the design process.
 - Include all results of calculations performed to make design decisions. E.g. mention the lengths of the strings, tubes, etc. Relate these design decisions to the underlying physics of the design (equations should appear in Background section and can just be references here and detailed calculations should be included as a part of Appendix 2).
 - Describe the criteria you used to evaluate and choose your final design.
 - Include and describe the decision matrix since it was used to make an important initial design decision (make sure to define the rating scales used, and briefly describe each design compared in the decision matrix).

Design Implementation

(You can have separate subsection for each instrument in the design)

- Include a description and picture(s) (photos) of your final system prototype.
- Final Budget & materials (should be included as a Table)
- Describe the testing procedures you used (when preparing for the final demonstration) to ensure your design's success (data from these tests can be included as a part of Appendix 2...be sure to direct reader to appendix in text).
- Describe any post-processing or editing done in Audacity (any filtering, amplification, trimming, etc.)
- Describe the performance of the musical instruments, including an evaluation of your design
 - How well did your design perform (be quantitative, i.e. report values that describe your design's performance)?
 - You should have a table which compares the theoretical minimum and maximum fundamental frequencies of each instrument with the actual fundamental frequencies produced (from spectrum obtained from Audacity recording of instrument playing these notes*). You should also include a column in your table for percent difference between theoretical and actual values.
 - Plots of spectrum from each instruments' highest and lowest notes should be included in Appendix 2*

Conclusion

- Summarize the work done (for all the instruments combined) in the project and final outcomes
- Summarize the expected performance of commercial musical instruments built based on your prototypes.
 - If you built musical instruments based on your model and would mass produce them, how well would they perform?
 - What issues would need to be considered or improved if you were to go to full scale production of your design based on your model?
- Describe what you would do if you had more time to complete this project (i.e. potential design improvements, testing, etc.)
- Described what you learned while completing this project

References

- Include all references used (also should be cited in the text of the report)
- Use an appropriate citation format (i.e. Chicago Manual of Style, IEEE, etc.)
- See <http://libguides.asu.edu/citing> for helpful information

Appendices

- Appendix 1: **Detailed** Engineering Drawing (should include 3 views (top, front, side) with dimensions, units, etc.) of each instrument. Also, include a sketch showing how all the instruments will fit into the box. Please **include the name** of the individual person who made the engineering drawing for each instrument.
- Appendix 2: **Detailed** Calculations
 - Include detailed calculations of analysis discussed in text (this can be done by hand and scanned if it is done neatly)
 - Show detailed calculation of the lengths of bars/tubes/strings based on frequencies of notes
 - Include plots of spectrum from Audacity for each instrument's highest and lowest notes (8 total spectrum plots). See details below on how to get spectrum.*

**Spectrum of individual notes can be obtained by recording, in Audacity, the instrument playing the single note of interest. Once the note is recorded, go to Analyze (in main menu) → Plot Spectrum... You can then take a screenshot and crop the image (in the Word document or a photo editor) around just the plot and include it in your document. In order to see the fundamental frequencies more clearly, change the Axis option (below plot in the new window) to Log frequency. Increasing the Size (directly above Axis) will cause the peaks to be more sharp but you may get some more spurious low amplitude spikes in the plot. Change the Size field to whichever value makes the fundamental frequency and harmonics the most easily visible. The frequency at which each peak occurs can be found by bringing your cursor near the peak of interest (a reference line should automatically snap to the peak) and the frequency can be read from the Peak field directly below the plot.*

Note: Each Appendix should have a clear label and title at the top of the page (i.e. 'Appendix 1: Detailed Engineering Drawing of Final Design')

Appendix A. Final Design Report Grading Rubric**Names:****Team Number:**

Topic	Max Pts	Score
NO spelling or grammatical errors	5	
Professional quality document (cohesiveness, flow, correct & consistent formatting, typed, labels for figures and tables, etc.)	5	
Cover Page (Title, Date, Team Member Names and Signatures)	Required	
Introduction (introduction to project and objectives, requirements, structure/content of document)	5	
Background		
• Introduction of three types of musical instruments	2	
• Description of underlying physics (equations)	6	
• Description of existing designs that inspired design	3	
Detailed Design Description		
• Detailed description of all aspects of your design (form & function)	10	
• Description of design trade-offs made	5	
• Description of design decisions including evidence/rationale	5	
• Results of calculations performed	7	
• Description of criteria used to evaluate and choose the final design	6	
• Decision Matrix (include rationale for criteria, weightings, and score for each candidate, describe each design briefly)	10	
Design Implementation		
• Description and pictures of final design	6	
• Budget and materials table	6	
• Description of testing procedures and post-processing/editing used	6	
• Evaluation of final design performance (values reported from spectrum)	6	
Conclusion		
• Summary, Lessons learned, Recommendations (what would you do differently next time), etc.	6	
• Recommendations for commercial design	6	
References (cited in text, appropriate formatting, appropriate sources, etc.)	6	
Appendices		
• Appendix 1: Detailed engineering drawings	12	
• Appendix 2: Detailed Calculations and Spectrum	12	
Total	135	