

# Assignment

## Homework HW4

Master program in Music and Acoustic Engineering

Musical Acoustics

course code: 051483

Academic year 2023/2024



**POLITECNICO**  
MILANO 1863

December 22, 2023

## Problem

### Design of a recorder flute and prediction of its sound

Goal: design the positioning of the finger holes on a flute and create a simple model that can sound.

**Question 1: bore dimensioning** The resonator is shaped as a cone whose conical semiangle is  $0.75^\circ$ . The instrument is aimed at being a treble recorder, with a length of 0.45m. For the sake of simplicity, we consider that only two finger holes are present.

Find the diameter of the cone at the resonator head and foot so that the note produced when all the finger holes are closed is E4 (329.63 Hz).

**Question 2: first hole positioning** Find the position of the last finger hole (i.e. the one closest to the resonator foot) in order to produce the note F4 (349.23 Hz) when it is open. Consider the finger hole diameter to be equal to the bore diameter at the resonator foot (simplification).

**Question 3: second hole positioning** Find the position of the second last finger hole in order to produce the note G4 (392 Hz) when the two finger holes are open. Consider the finger hole diameter to be equal to the bore diameter at the resonator foot (simplification).

**Question 4: prediction of the input impedance** Using the model of the tube as a transmission line introduced during the analysis of the woodwinds, based on transmission lines, and updating it for the considered case (i.e. the tube is conical and not cylindrical), predict the input impedance for the three configurations:

- all finger holes closed;
- only the last finger hole open;
- both finger holes open.

Provide the solution by January 23, 2024, using the WeBeep assignment tool.

- The report must fit in 7 pages of the Latex template available at <https://www.overleaf.com/read/rnkchgybrasm>;
- Answer concisely;
- Describe – concisely - the procedure used to obtain the results: if an error is present, I cannot identify the reason – numerical or conceptual - if the procedure is not described: in grading I will be forced to use the worst-case option.
- All students who participated to the same group must upload the report;
- In the PDF file and in the filename, specify the name, surname and ID of all the students participating to the HW, if more than one student worked on it.