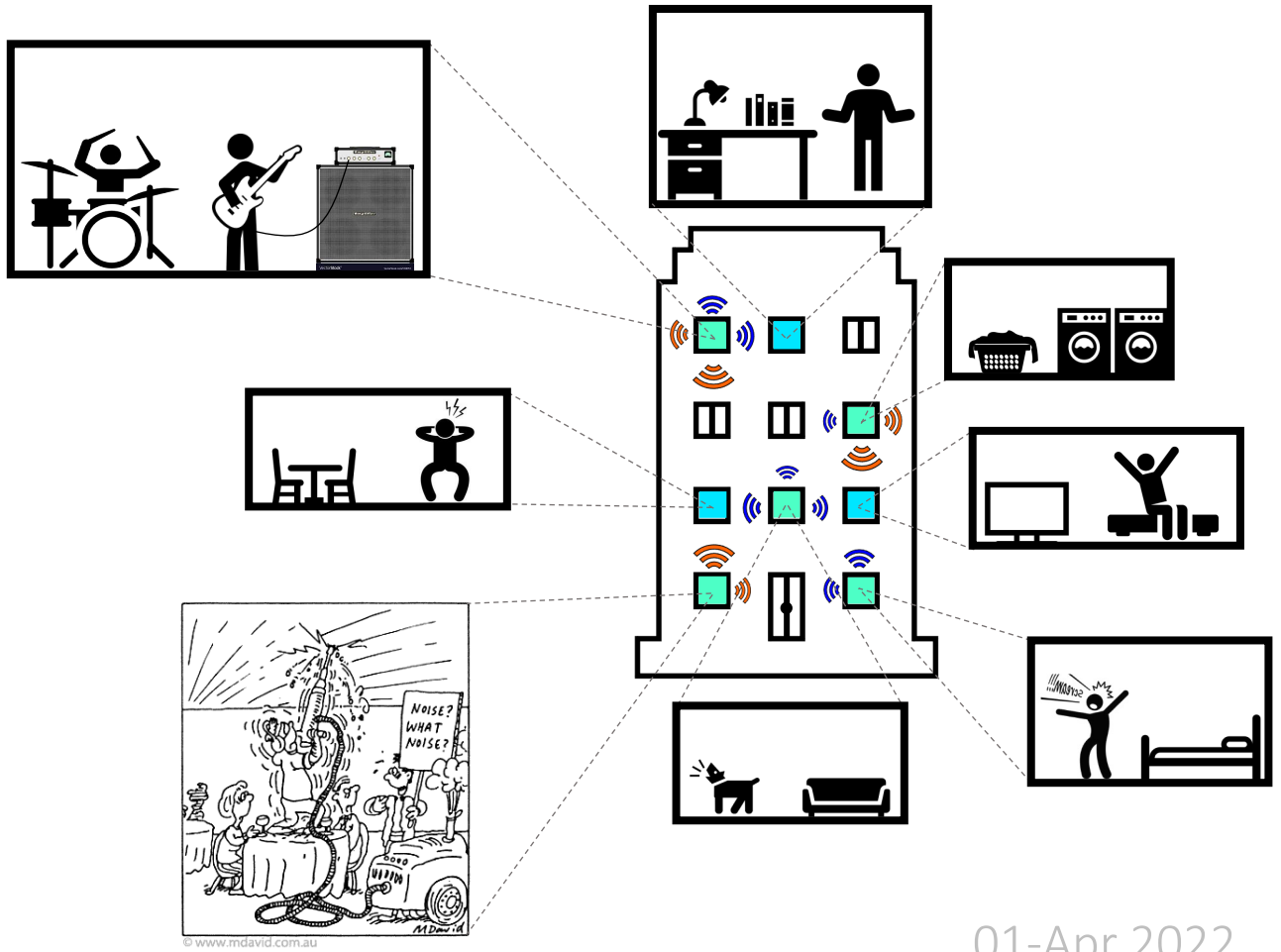
Hand-in Assignment #3: Building Acoustics

7LS8M0: Architectural Acoustics

M.E. (Michalis) Terzakis

Building Acoustic Group



Department of the Built Environment

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Assignments Instructions

- Report
  - No-need of including theoretical background or repeating the questions writen in the guideline.
  - Include the plots in a high quality.
  - Answer the questions in a motivated way.
- Report structure (proposal)
  - Introduction (in-short): What is the purpose of the assignment.
  - Tasks: with a short description + answers.
  - Conclusion (in-short): Summary of the main reamarks with respect to the purpose of the assignment.
  - References.
  - Appendix: MATLAB codes, including comments.

Evaluation Criteria

Introduction to Tutorials

Assignments Evaluation Criteria

- MATLAB-based Assignments
  - Clear structure and language in the report.
  - High quality of references and correct citation.
  - Correct approach and results.
  - Clear and well illustrated figures, including all the information (i.e., title, axes labels, and legends).
  - Correct implementation in MATLAB.
  - Inclusion of explanation comments in MATLAB.
  - Correct intepretation of the results supported by literature.
- Concept Presentation Assignment
  - To be announced later.

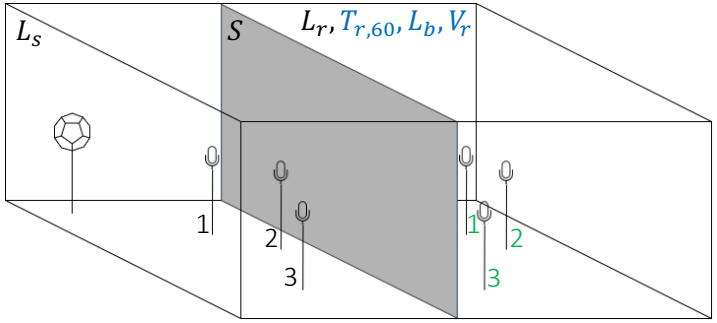
Tasks of the Assignment HA3

- Airborne Sound Insulation
  - Evaluation of the Measured Sound Reduction Index via a Single Quantity

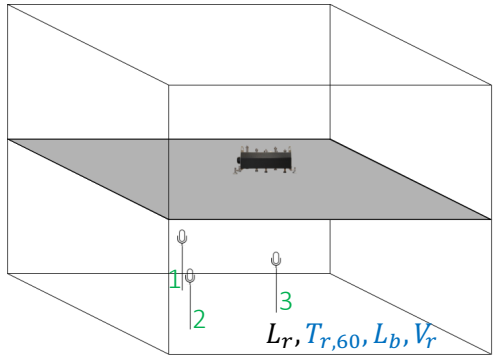
- Impact Sound Insulation
  - Evaluation of the Measured Impact Sound Level via a Single Quantity

Expression of the Measured Quantities

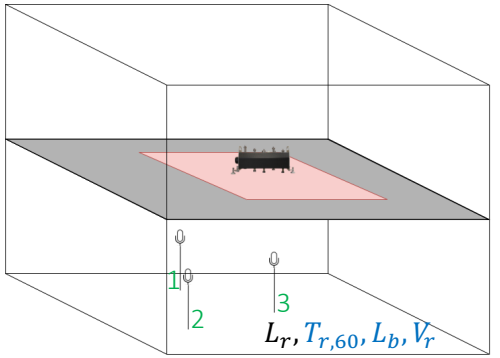
- Airborne Sound Insulation [R: Sound Reduction Index (dB)]
  - Airborne energy transmitted from one room to the other room.
  - $L_{s,m}(\mathrm{dB}), L_{r,m}(\mathrm{dB}), T_{r,60,m}(m^2)$ per 1/3-octave frequency band and position m.
  - $R = L_s - L_r + 10\log_{10}\left(\frac{S}{A_r}\right)$.
  - L_s, L_r, A_r: Average Values per 1/3-octave frequency band.
  - $T_{r,60} = 0.161\frac{V_r}{A_r} \rightarrow A_r = 0.161\frac{V_r}{T_{r,60}}$.
  - $L_{b,m} \rightarrow L_b(\mathrm{dB})$ per 1/3-octave frequency band and position m. [Measurements Quality]



- Structure-borne Sound Insulation [L_n: Impact Sound Level (dB)]
  - Structure-borne energy transmitted via uncovered and covered floor.
  - $L_{r,m}(\mathrm{dB}), T_{r,60,m}(m^2)$ per 1/3-octave frequency band and position m.
  - $L_n = L_r + 10\log_{10}\left(\frac{A_r}{A_0}\right),\ A_0 = 10m^2$.
  - L_r, A_r: Average Values per 1/3-octave frequency band.
  - $T_{r,60} = 0.161\frac{V_r}{A_r} \rightarrow A_r = 0.161\frac{V_r}{T_{r,60}}$.
  - $L_{b,m} \rightarrow L_b(\mathrm{dB})$ per 1/3-octave frequency band and position m. [Measurements Quality]



Setup 1: Without Carpet



Setup 2: With Carpet

Evaluation of the Measured Quantities via Reference Quantities

- Fitting of Reference Curves to Measured Curves
  - Increment of the reference curve by 1dB

$$L_{fit,ref} = L_{ref} + 1dB \text{ or } L_{fit,ref} = L_{ref} + (-1dB)$$

  - Fitting Criterion: The sum of unfavorable deviations should be as large as 32dB.

$$L_{diff} = \log_{10}\left(10^{\Sigma(L_{fit,ref} - L_{meas})}\right), \forall f_c: L_{fit,ref} > L_{meas}$$

  - Unfavorable Deviations:

$$L_{fit,ref} - L_{meas}, \forall f_c: L_{fit,ref} > L_{meas}$$

Associated to Annoyance

  - Weighted Signle-Quantity Index

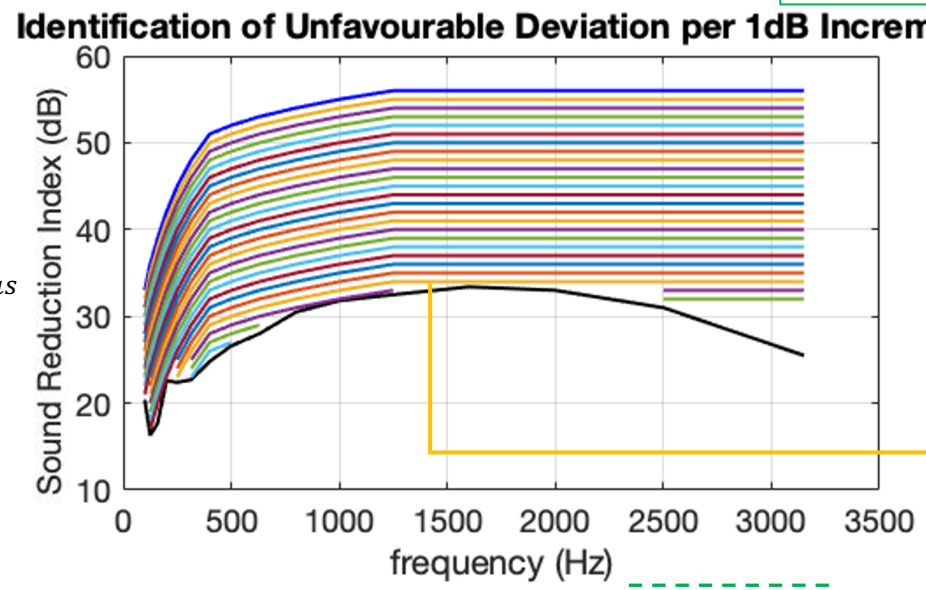
$$L'_{fit,ref} = L_{fit,ref} \text{ at } 500Hz$$

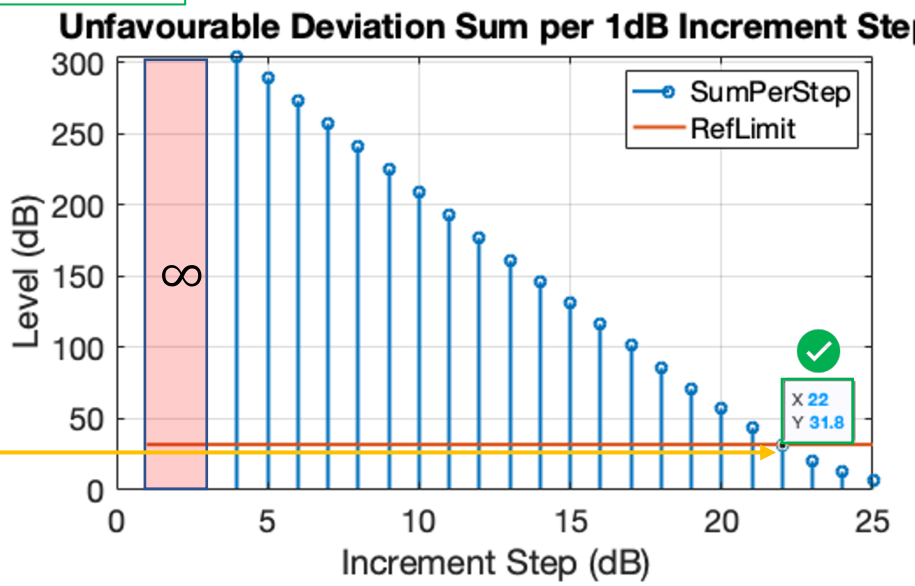
  - For Airborne Sound Insulation: $L_{ref} = R_{ref}$, $L_{meas} = R$, and $L'_{fit,ref} = R'_w$.
  - For Impact Sound Insulation: $L_{ref} = L_{n,ref}$, $L_{meas} = L_n$, and $L'_{fit,ref} = L'_n$

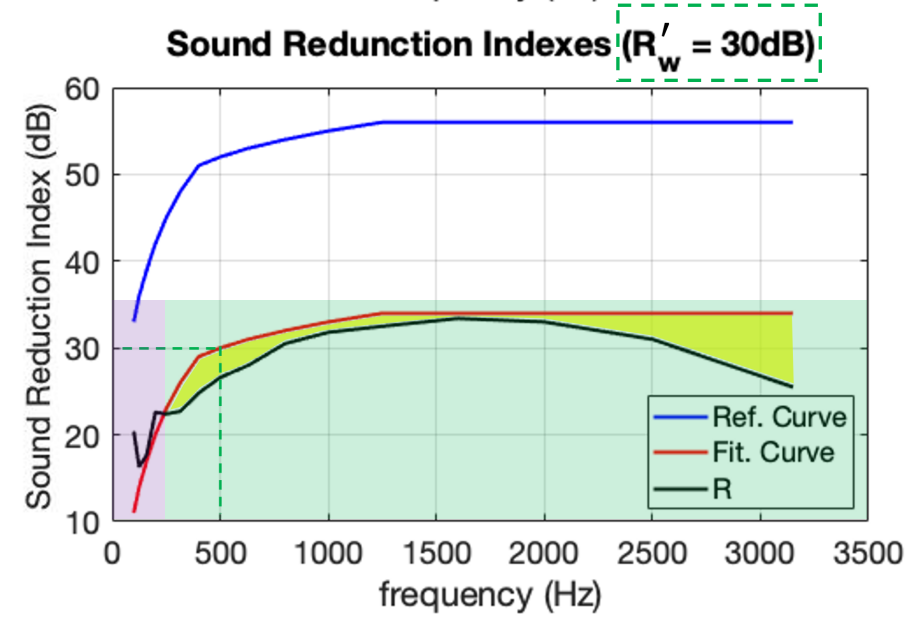
Fitting Curve: Example

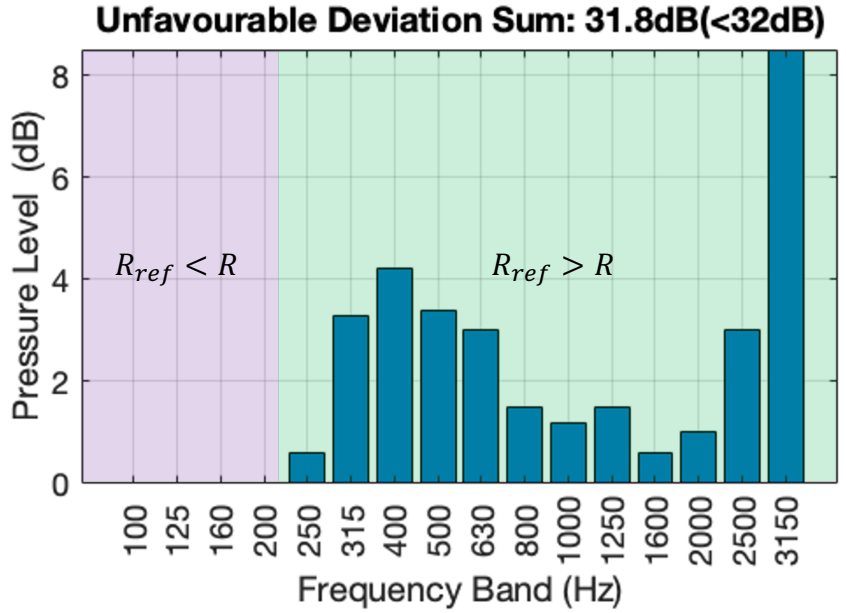
$L_{fit,ref} = L_{ref} + (-22\text{dB})$

$\forall f_c: L_{fit,ref} > L_{meas}$









Annoyance: Weighted Single-Quantity Index

- Airborne-Sound Insulation (Dwellings - Parallel Rooms)
  - Speech: 30%
  - Music : 39%

  → $46\text{dB} \leq R'_w \leq 65\text{dB}$

- Impact Sound Insulation (Dwellings – Vertical Room)
  - Footfall Noise: 85% → $41\text{dB} \leq L'_{n,w} \leq 60\text{dB}$

- Case Studies:
  - How would you characterize the airborne and impact sound insulation between the measured rooms?
  - How would you characterize the influence of the carpet in the impact sound insulation?

Final Remarks

- Read (very) very carefully the *guideline*.
- For questions [e-mail and/or StudyHub Hours on Fridays].
- HA3 deadline: 13-04-2022 @ 23:59.