Room Acoustics Analysis
Reverberation and Sound Field Modeling

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Abstract

This technical report presents computational analysis of room acoustics including reverberation time calculations using Sabine and Eyring equations, sound absorption modeling, and acoustic parameter optimization.

1 Introduction

Room acoustics determines sound perception quality in enclosed spaces. The reverberation time T_{60} is the primary metric.

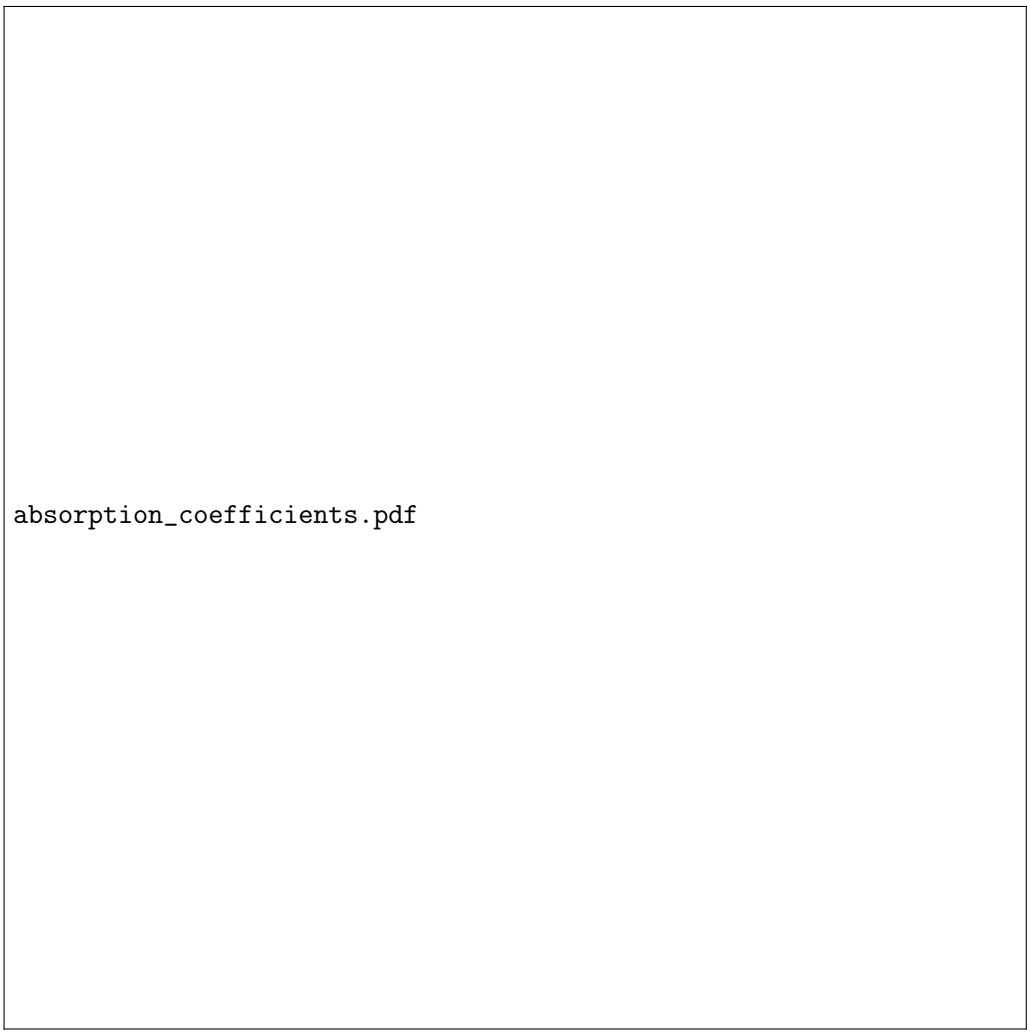

Figure 1: Frequency-dependent absorption coefficients for common materials.

2 Sabine Reverberation Time

The Sabine equation: $T_{60} = \frac{0.161V}{A}$

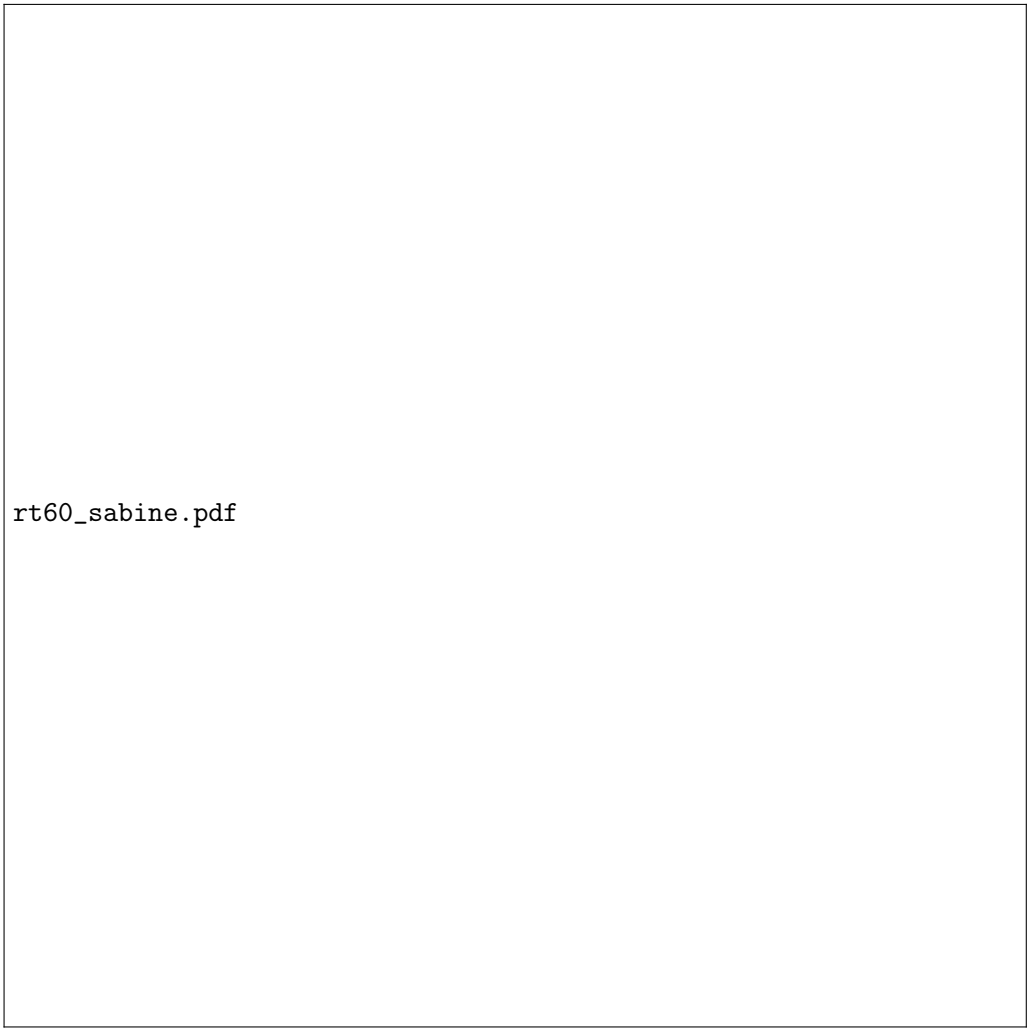

Figure 2: Sabine reverberation time across frequency bands.

3 Eyring Reverberation Time

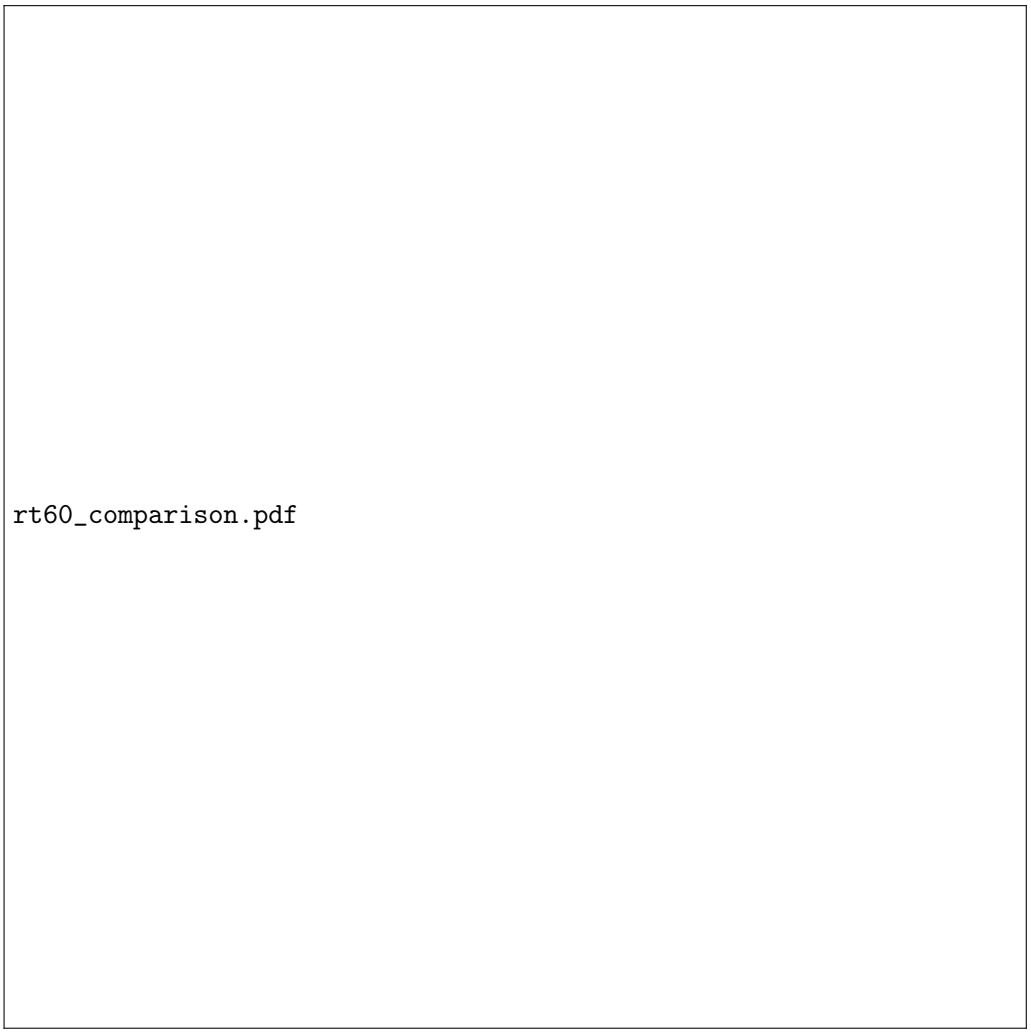

Figure 3: Comparison of Sabine and Eyring predictions.

4 Sound Pressure Level Distribution

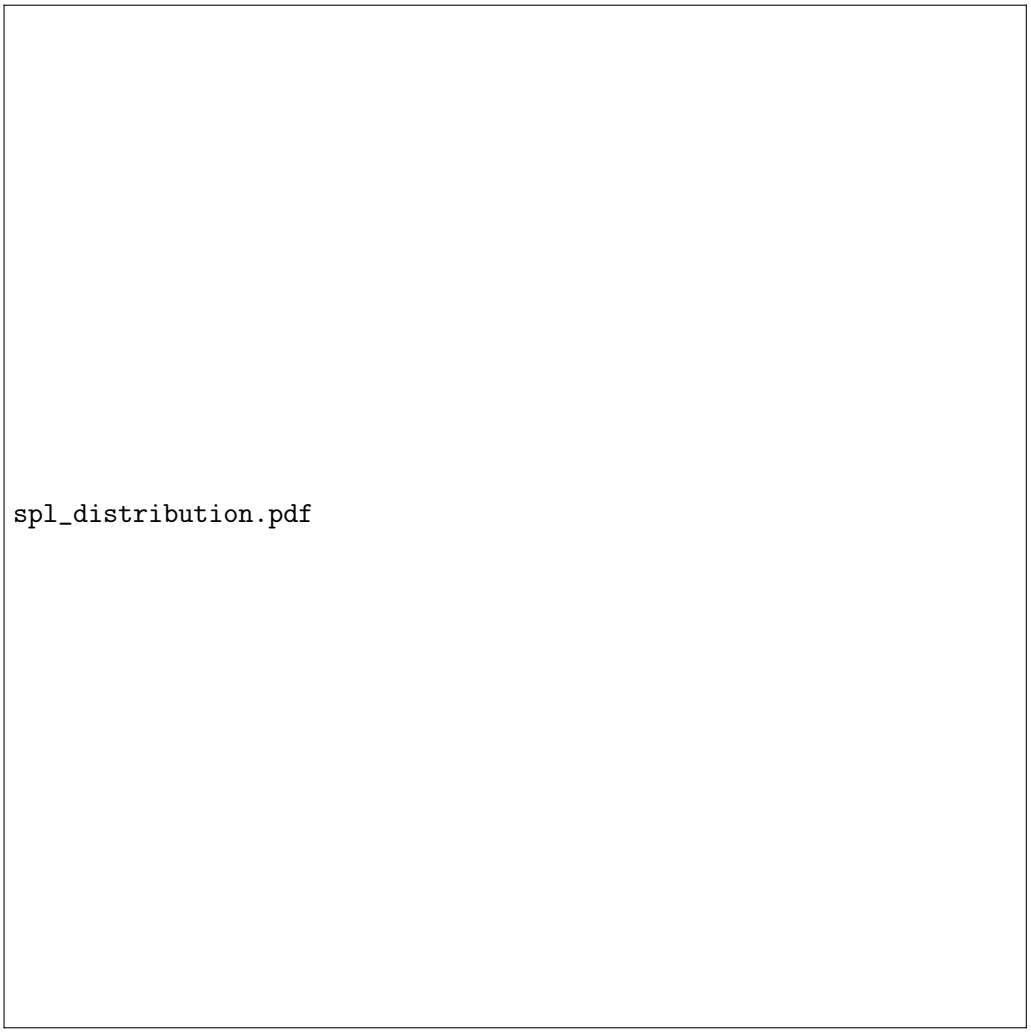

Figure 4: Sound pressure level as function of distance.

5 Room Modes

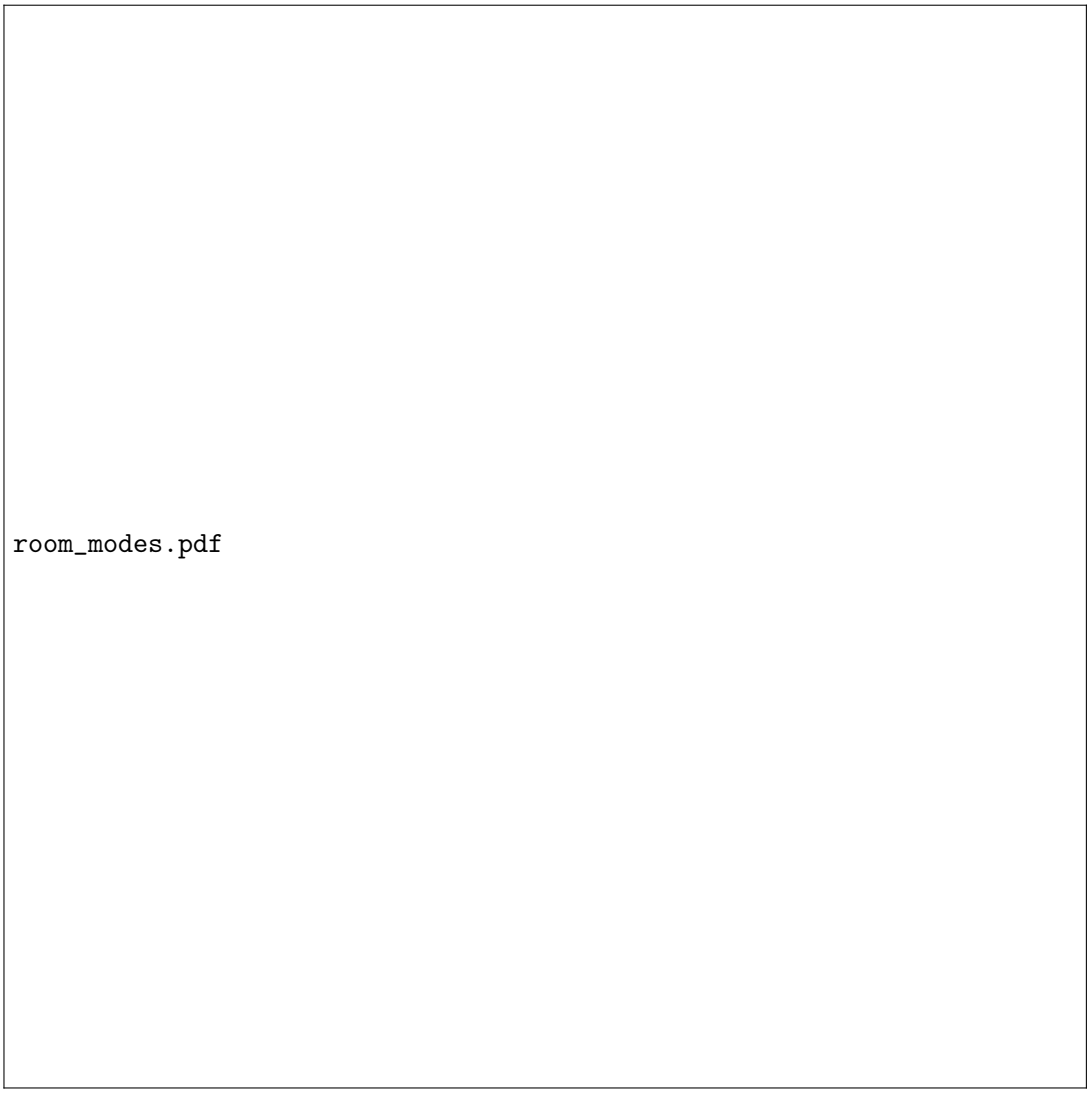

Figure 5: Room mode distribution in low-frequency range.

6 Clarity Indices

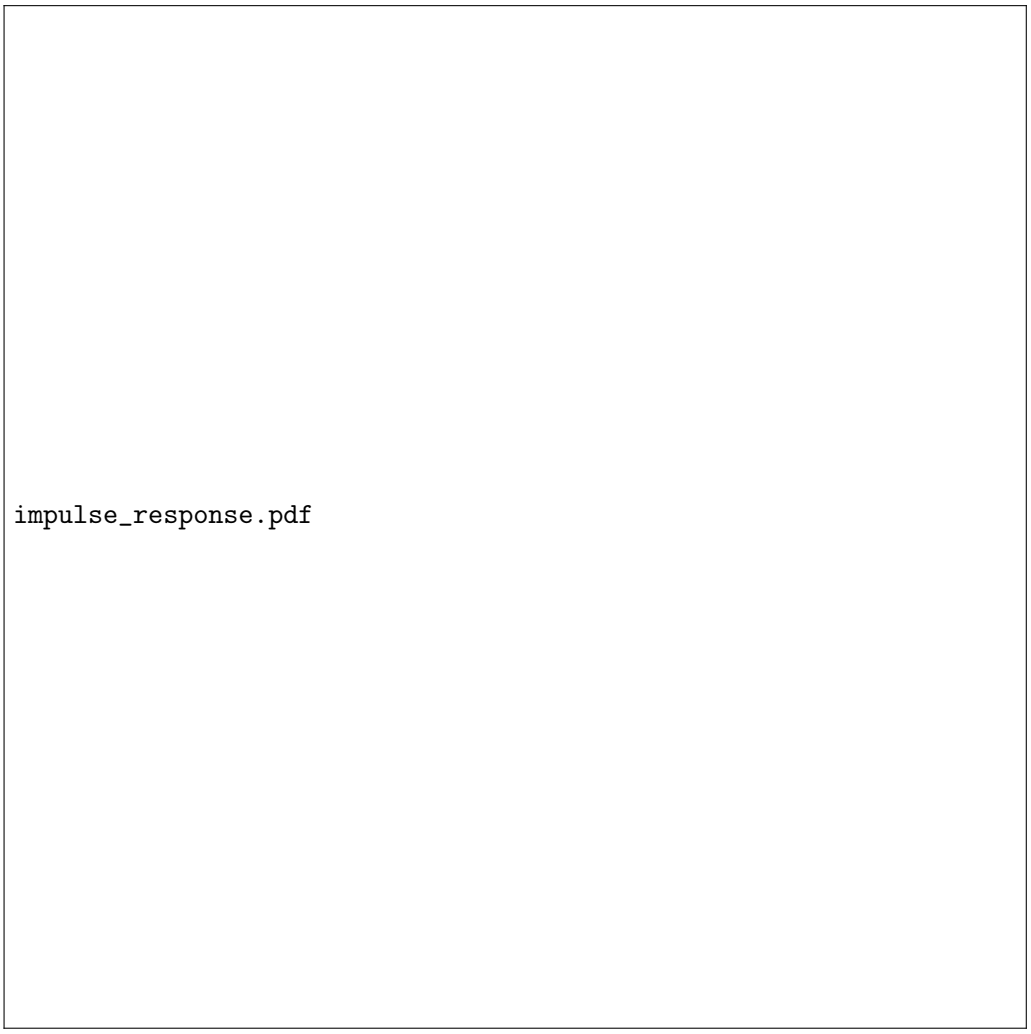

Figure 6: Room impulse response energy decay curve.

7 Optimization

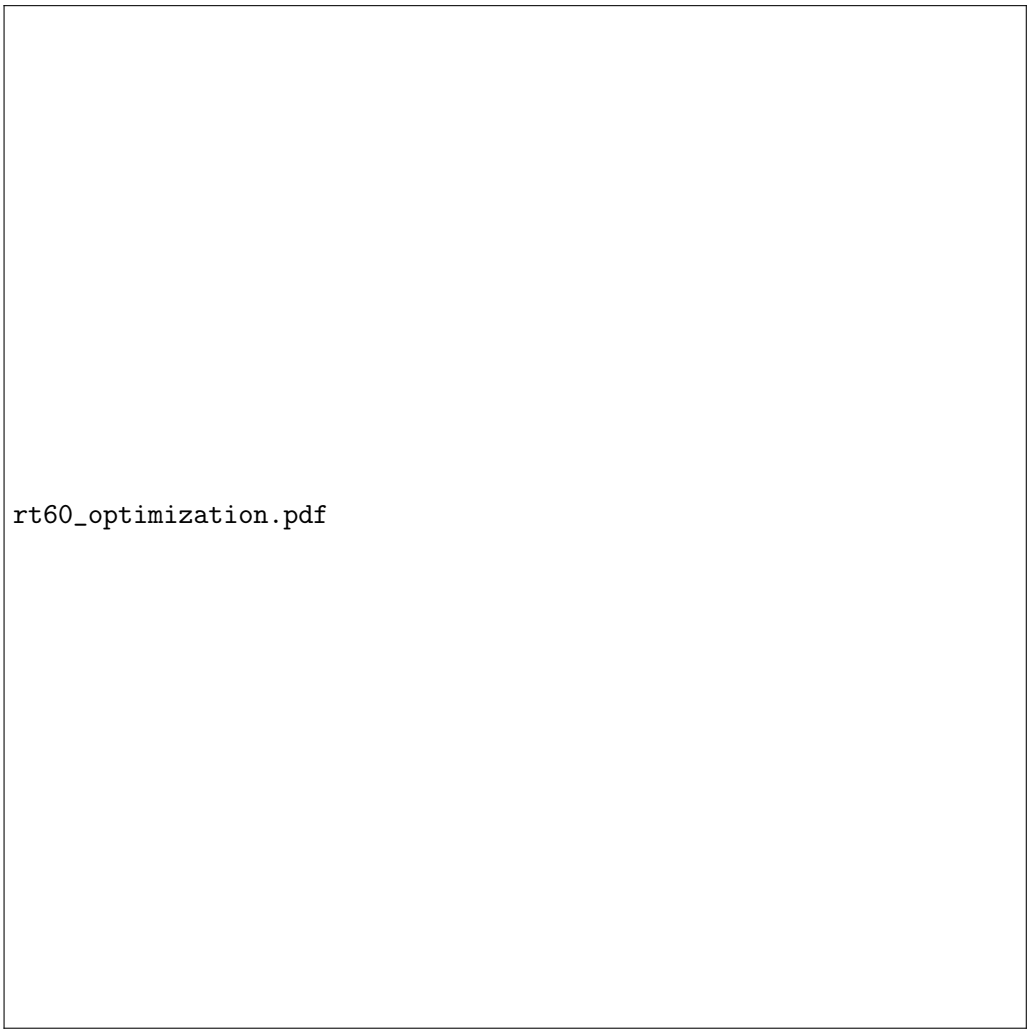

Figure 7: T_{60} optimization via ceiling treatment.

8 Results

Key metrics: $r_c =$ **??** m, $C_{50} =$ **??** dB, $f_s =$ **??** Hz.

9 Conclusions

The room configuration provides acceptable reverberation for multipurpose use. Optimal ceiling coverage is **??**%.