



Acoustical modeling of NEST+m Auditorium

ME 465 Sound and Space
Final Project
MingYang Lee, Dachi Tan

NEST+m Auditorium

- A K-12 public school's auditorium
- Came to Cooper for acoustical consultant
- Multi-Purpose Auditorium



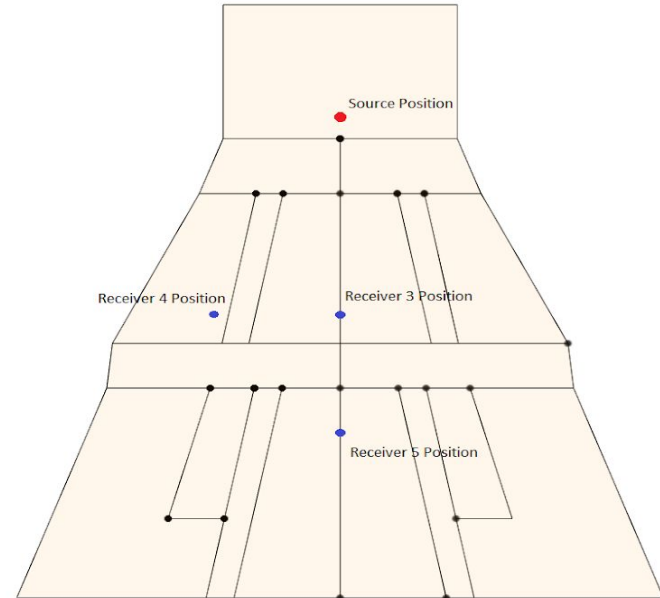
Previous work

- Measured RT and estimated improved RT using Sabin's formula
- Suggested to install 358 ft² of 2" Knauf Acoustic Panel
- School installed twelve 4'by 8' panels (384 ft²)



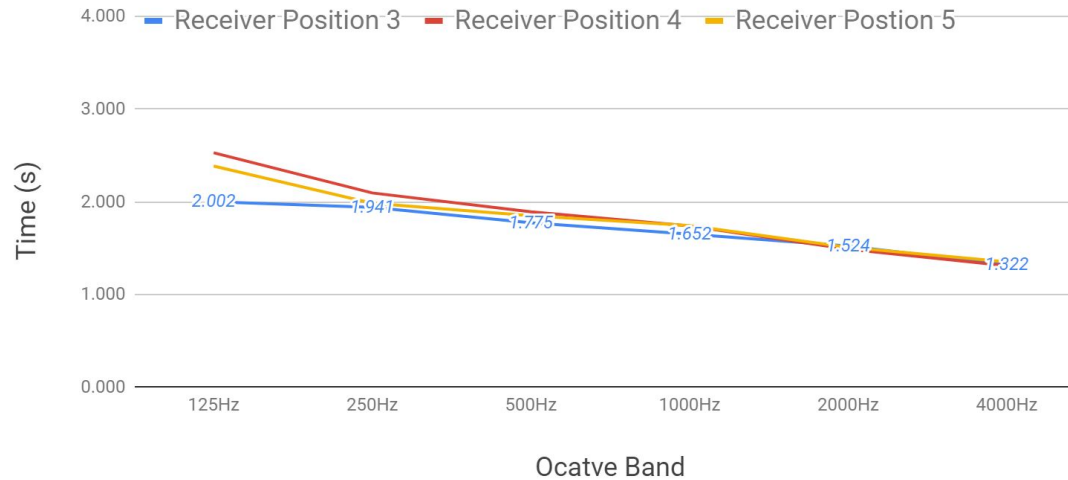
Planer Schematic

- Source at middle of the stage, around 1 meter into the stage and 1.52 meter off the stage floor
- Distance between source and receiver
 - Receiver 3 8.875m
 - Receiver 4 9.606m
 - Receiver 5 14.175m

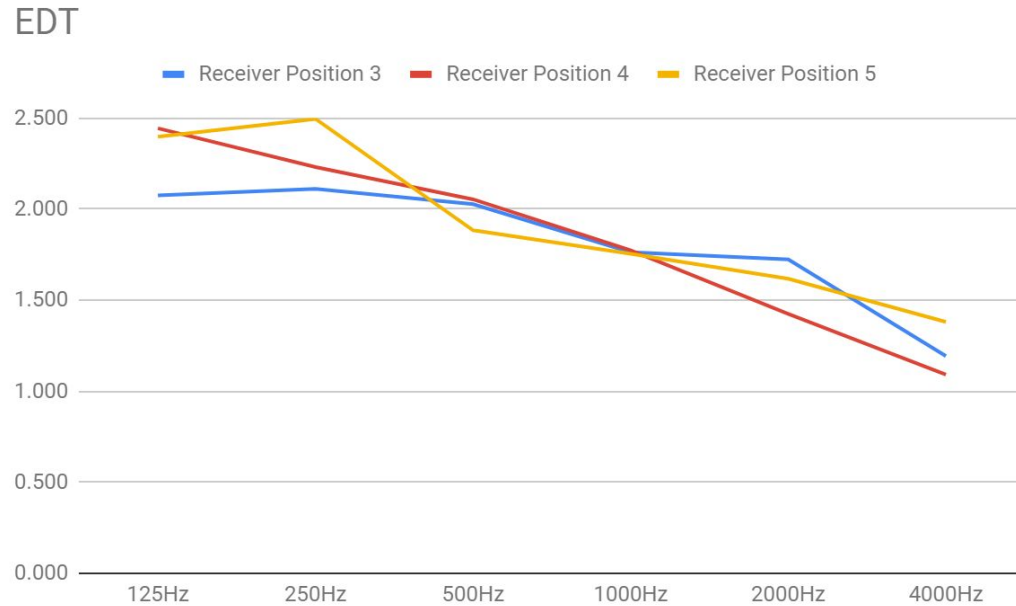


Our measurement (RT)

Octave Band Reverberation Time at Each Position



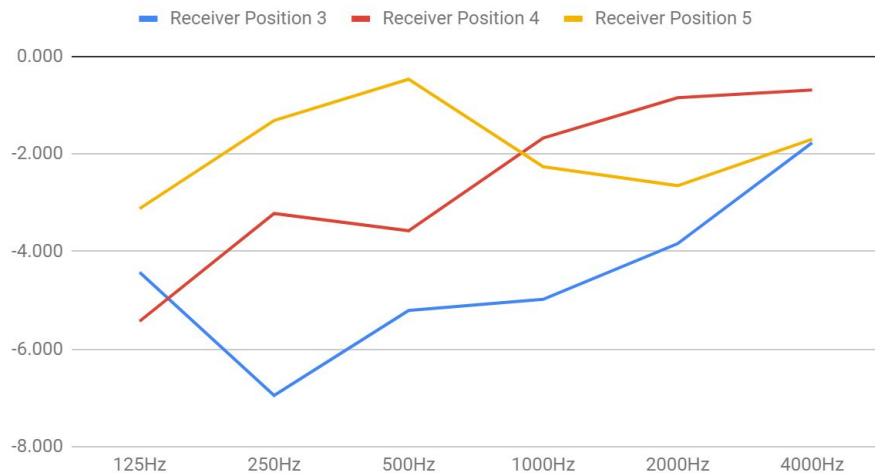
Our measurement (EDT)



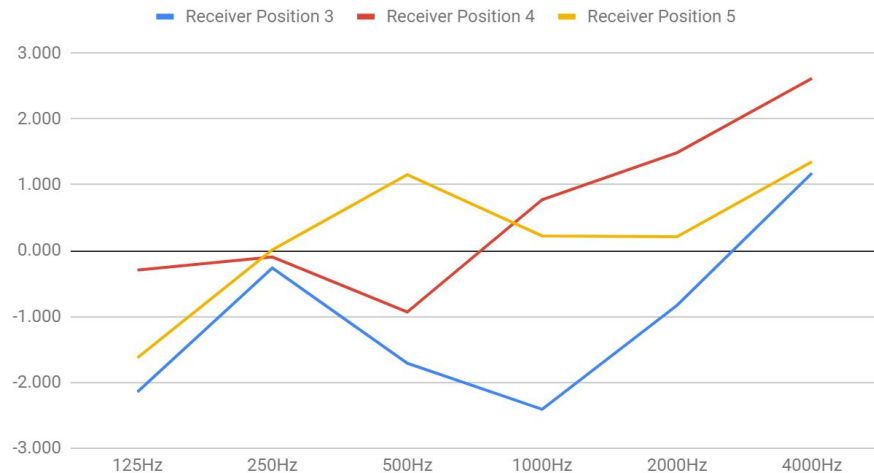
Our measurement (Clarity Index)



C50



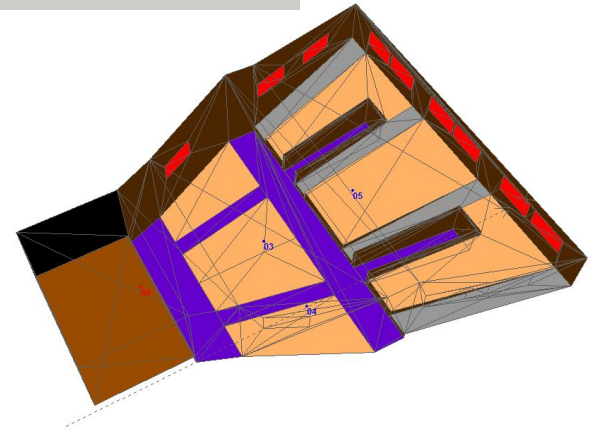
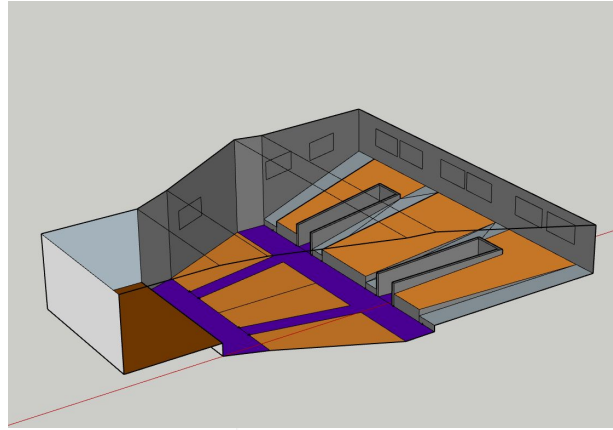
C80



Model



- Use CATT acoustics to model the room
- First tune RT with no-panel data
- Then input panel data from manufacturer's datasheet



Initial absorption coefficient

Initial Assigned Material Absorption Coefficient								
Absorption Coefficients (%)	PANEL	STAIR	AUDIENCE	WALL	STAGE FLOOR	CARPET	CEILING	CURTAIN
125 Hz	2	1	5	2	1	2	2	36
250 Hz	2	1	8	2	7	4	2	26
500 Hz	3	2	10	3	6	8	3	51
1000 Hz	4	2	12	4	6	20	4	45
2000 Hz	5	2	12	5	6	35	5	62
4000 Hz	5	2	12	5	6	40	5	76

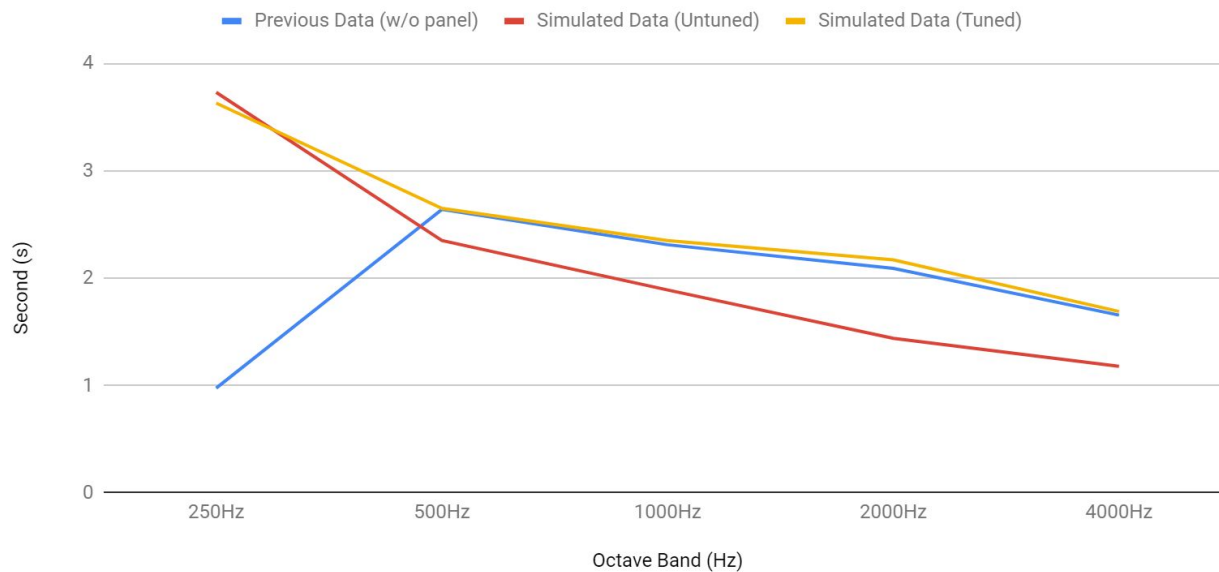
Initial scatter coefficient



Assigned Material Scattering Coefficient			
Scattering Coefficient (%)	STAIR	AUDIENCE	WALL
125 Hz	5	30	10
250 Hz	5	50	60
500 Hz	2	60	50
1000 Hz	3	60	40
2000 Hz	4	70	30
4000 Hz	45	70	40

Tune without panel

Previous Data (w/o panel), Simulated Data (Untuned) and Simulated Data (Tuned)

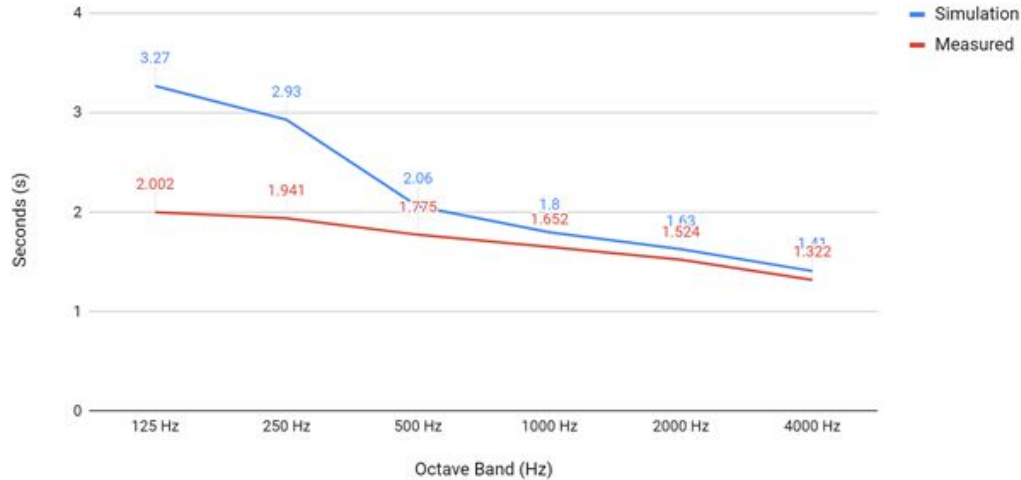


Final absorption coefficient

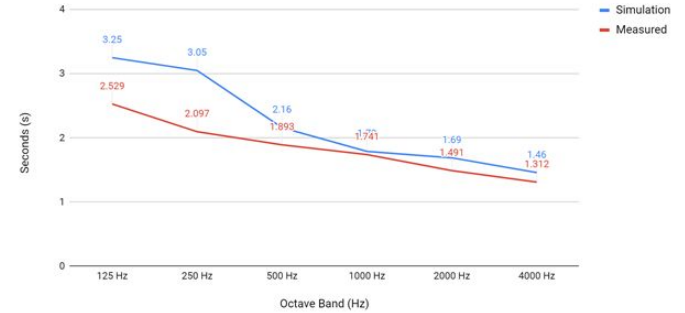
Final Assigned Material Absorption Coefficient								
Absorption Coefficients (%)	PANEL	STAIR	AUDIENCE	WALL	STAGE FLOOR	CARPET	CEILING	CURTAIN
125 Hz	33	1	5	4	1	2	4	36
250 Hz	67	1	8	5	8	3	5	26
500 Hz	100	2	8	7	7	6	7	45
1000 Hz	100	2	9	7	7	10	7	50
2000 Hz	100	2	9	7	7	10	7	50
4000 Hz	100	2	9	7	7	15	6	50

Simulated RT with panel

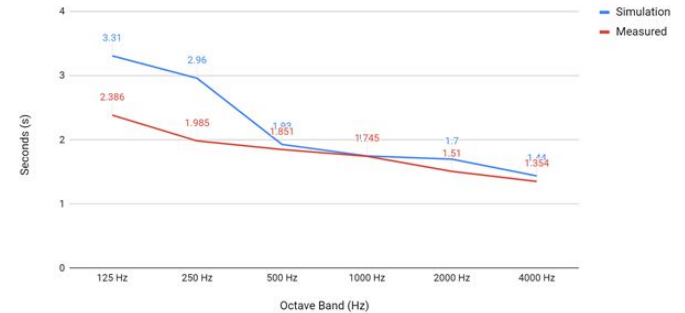
Comparison between final simulated T30 and measured T30 results for receiver position 3



Comparison between final simulated T30 and measured T30 results for receiver position 4

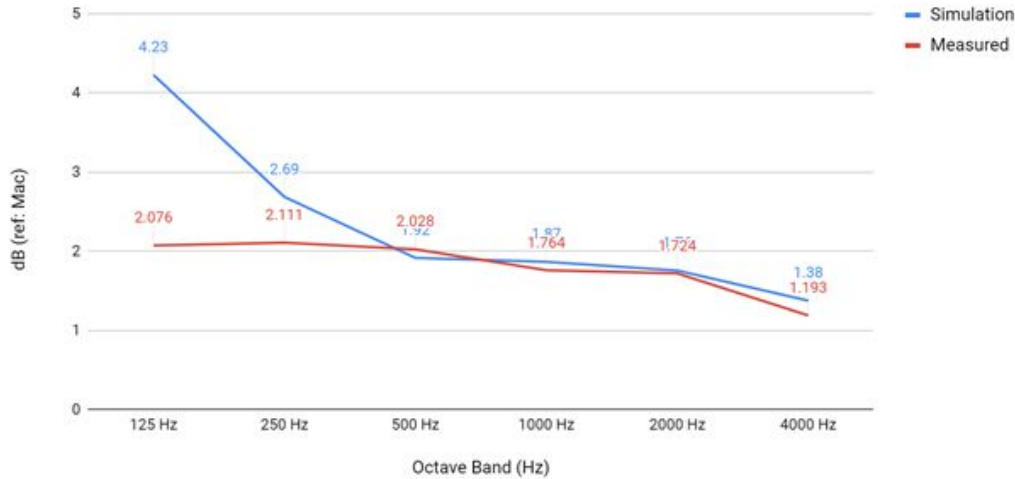


Comparison between final simulated T30 and measured T30 results for receiver position 5

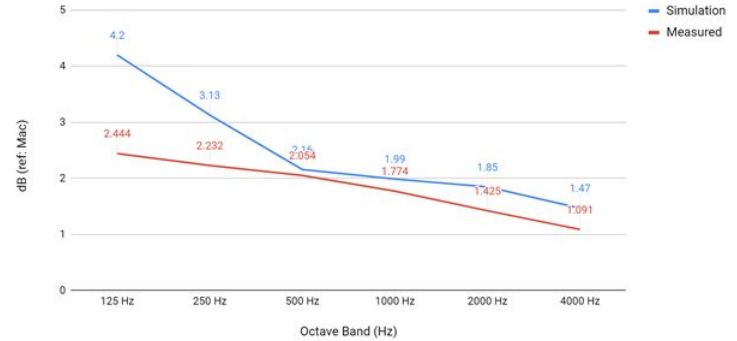


Simulated EDT with panel

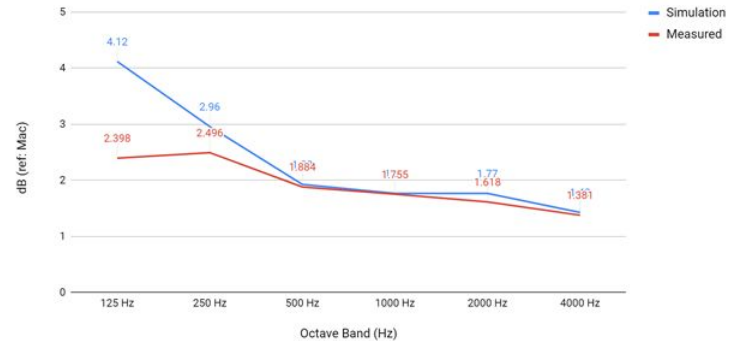
Comparison between final simulated EDT and measured EDT results for receiver position 3



Comparison between final simulated EDT and measured EDT results for receiver position 4

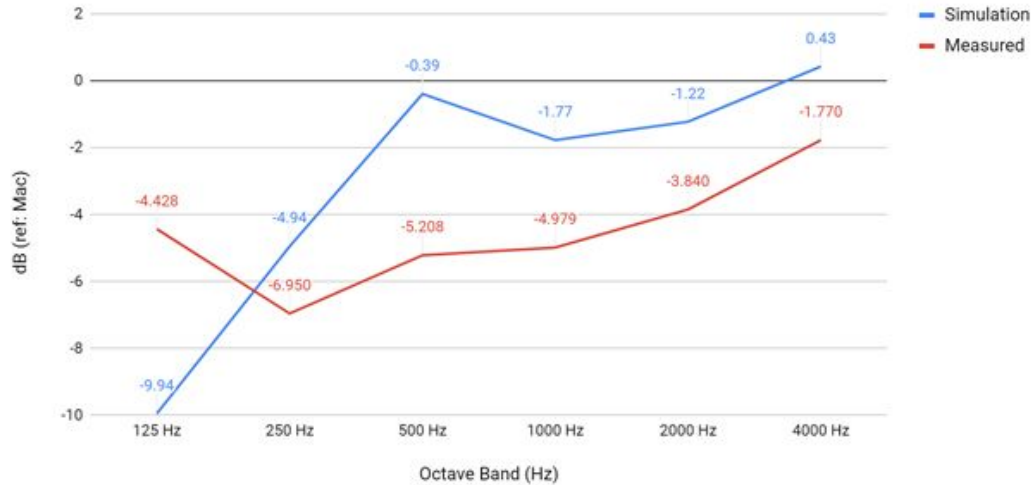


Comparison between final simulated EDT and measured EDT results for receiver position 5

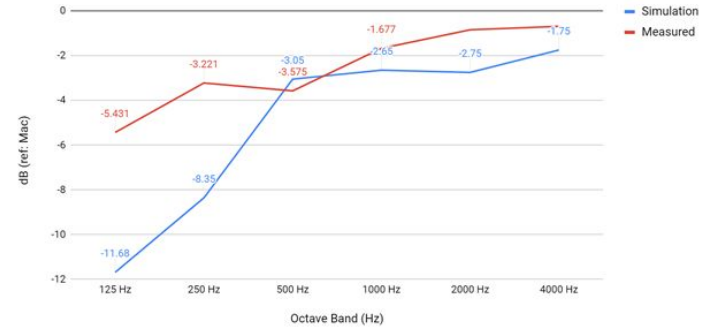


Simulated C50 with panel

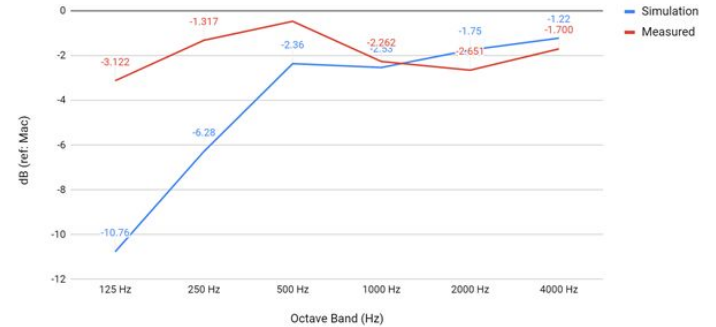
Comparison between final simulated C50 and measured C50 results for receiver position 3



Comparison between final simulated C50 and measured C50 results for receiver position 4

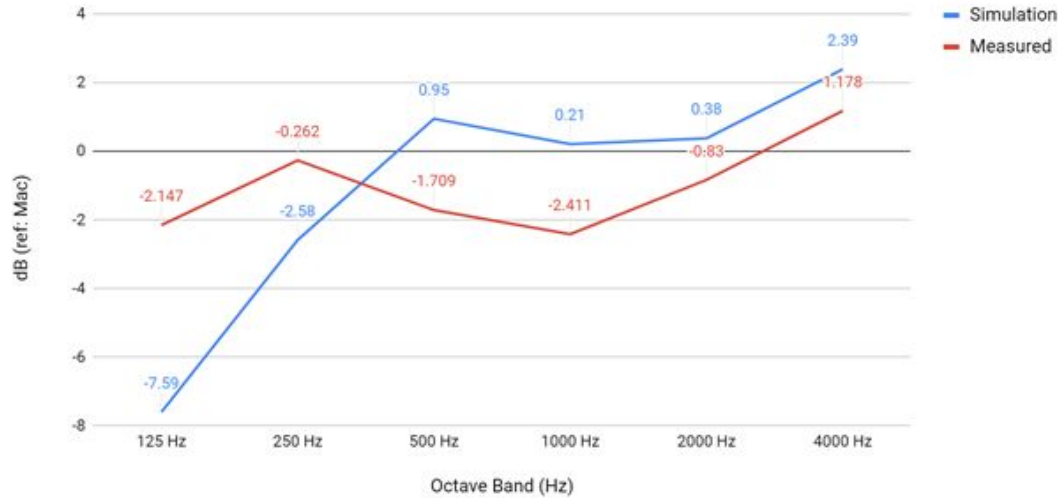


Comparison between final simulated C50 and measured C50 results for receiver position 5

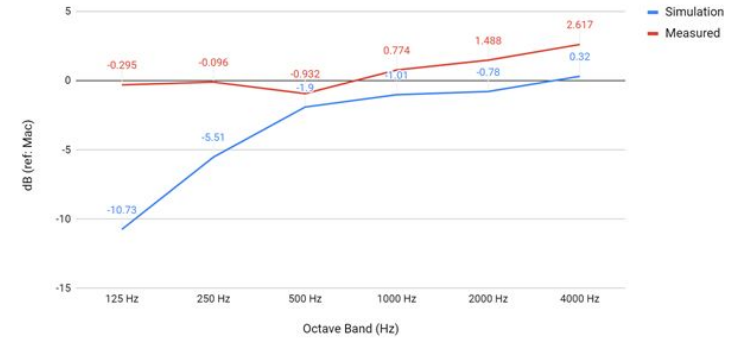


Simulated C80 with panel

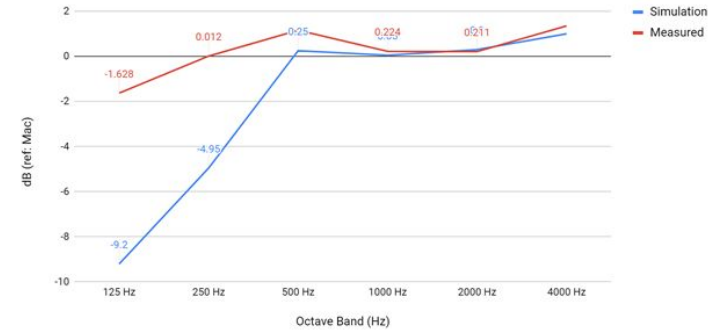
Comparison between final simulated C80 and measured C80 results for receiver position 3



Comparison between final simulated C80 and measured C80 results for receiver position 4



Comparison between final simulated C80 and measured C80 results for receiver position 5



Improvement

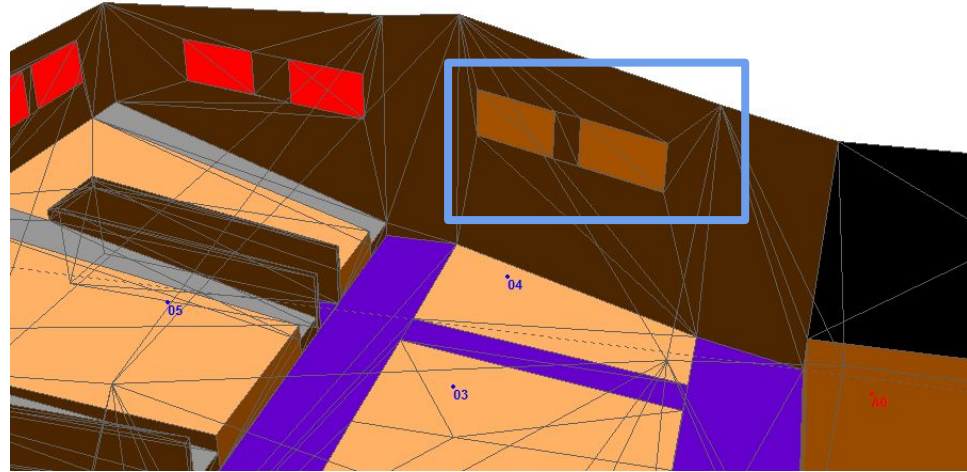


Aim

- Bring down RT especially for 125Hz and 250Hz Octave Band
-
- Easily adjustable between tasks

1. More Panels

- Added in two more panels
- Also ideally making the panels in browns removable from the wall

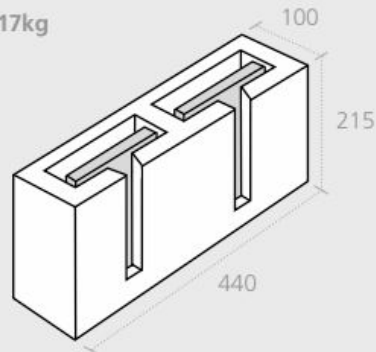


2. Acoustic Masonry

Building Finishes	Sound Frequency					
	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz
Colinwell EchoCheck Block EC215	0.75	0.75	0.60	0.65	0.55	0.50
Colinwell EchoCheck Block EC140	0.55	0.95	0.80	0.65	0.55	0.55
Colinwell EchoCheck Block EC100	0.23	0.80	0.70	0.44	0.42	0.39
Colinwell Acousta Tex Block (<i>all widths</i>)	0.50	0.65	0.50	0.50	0.55	0.55

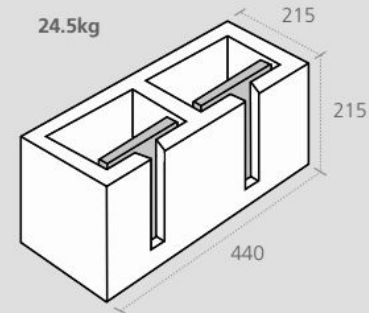
EC 100

17kg



EC215

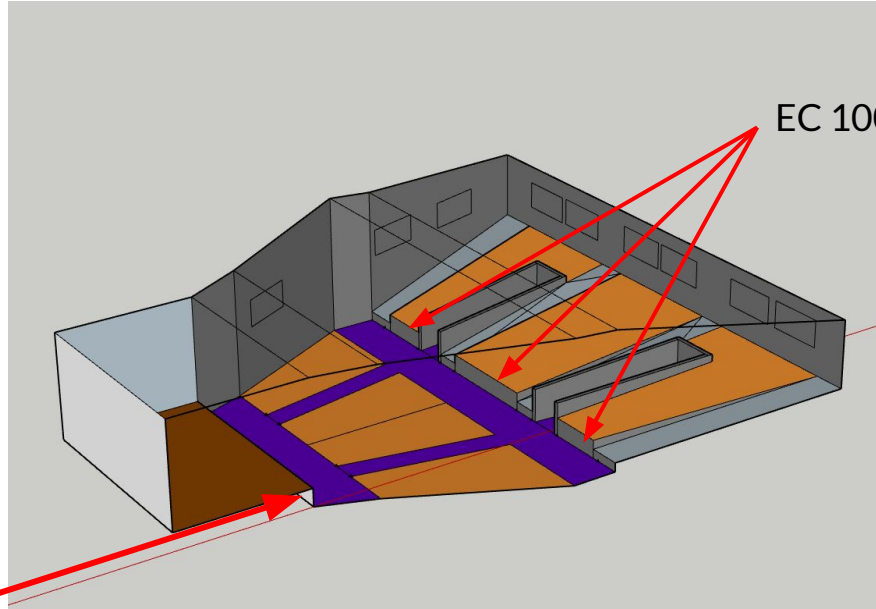
24.5kg



2. Acoustic Masonry

EC215

EC 100



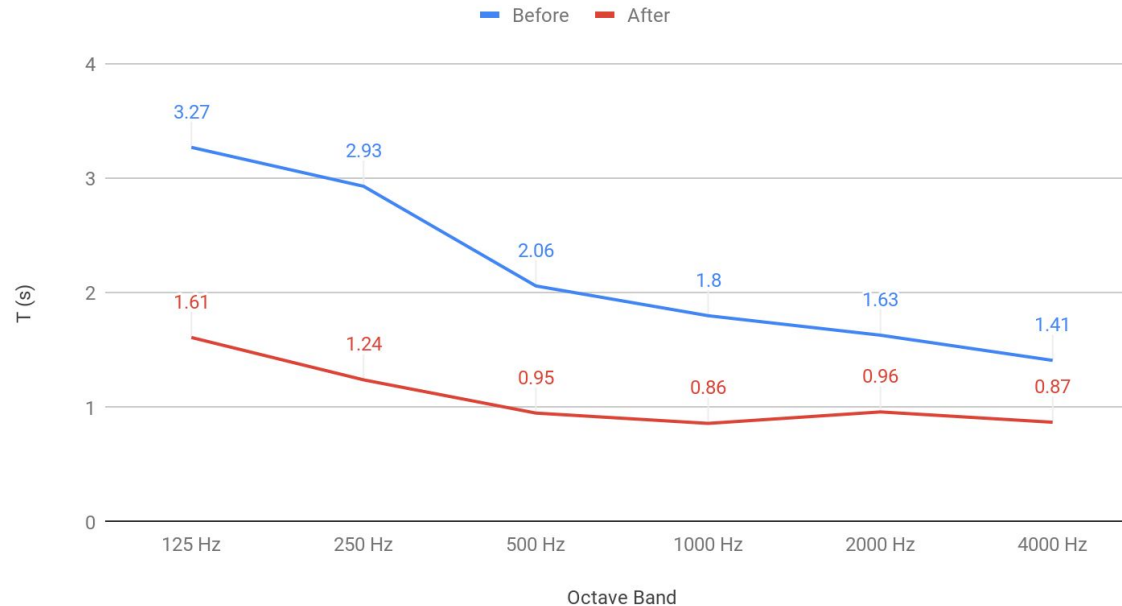
3. Theater seats

- Adding more absorption
- Also reflect how the room would behave if it is occupied



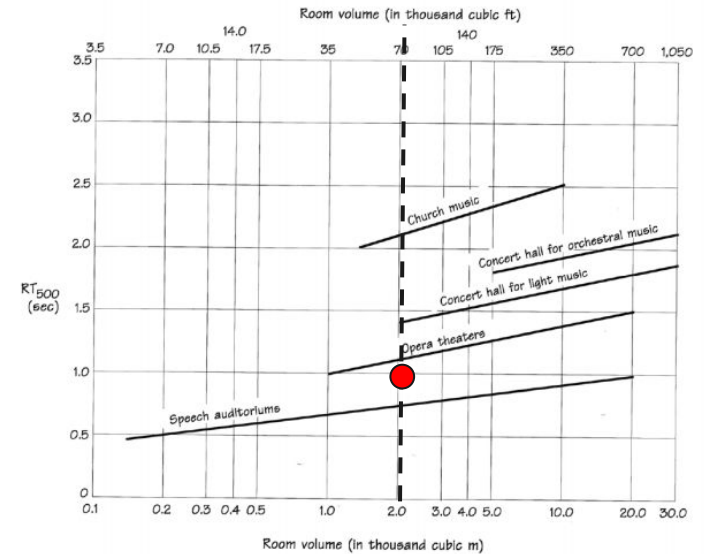
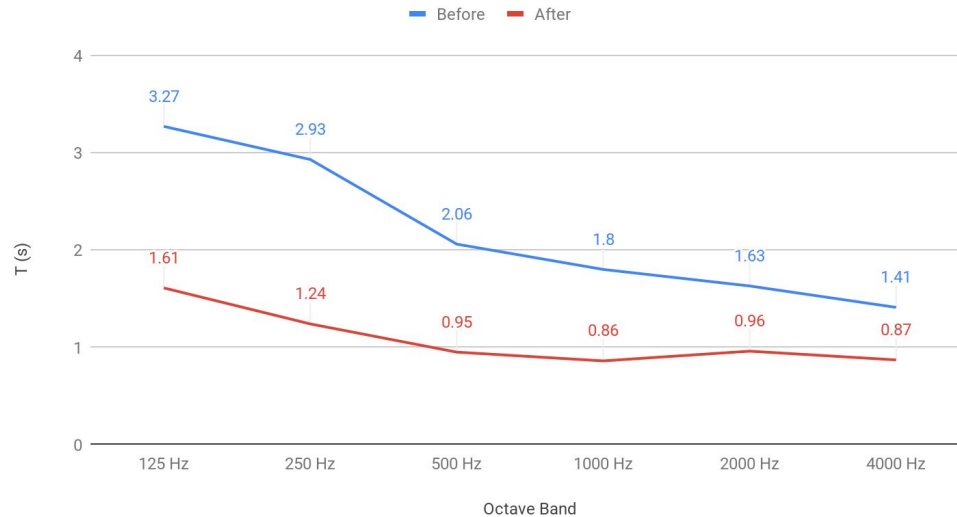
Simulation with improved design

Reverberation Time before and after improvements (R3)



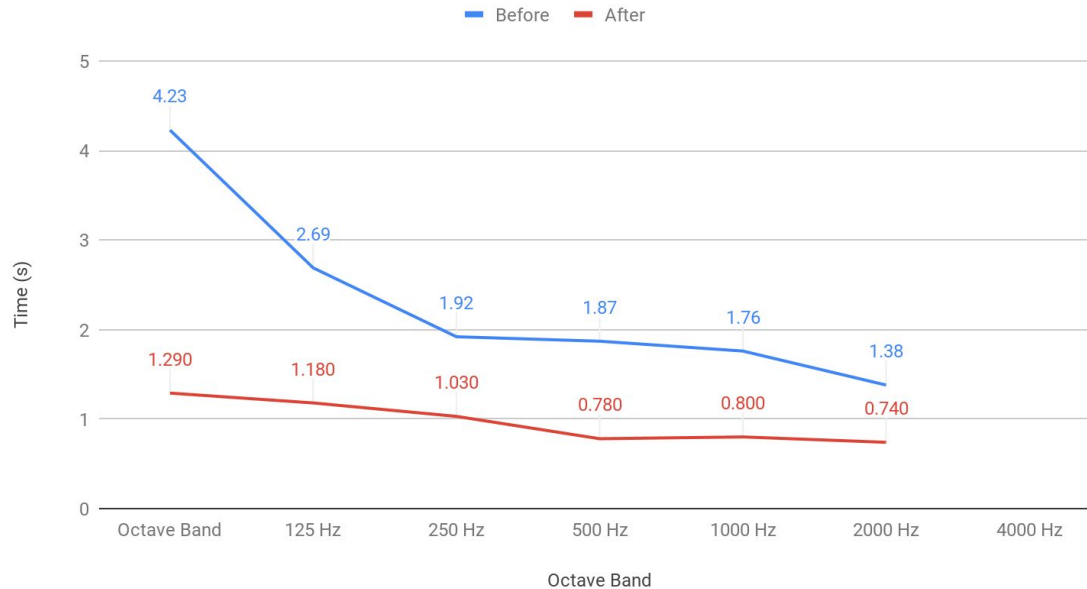
Simulation with improved design

Reverberation Time before and after improvements (R3)



Simulation with improved design

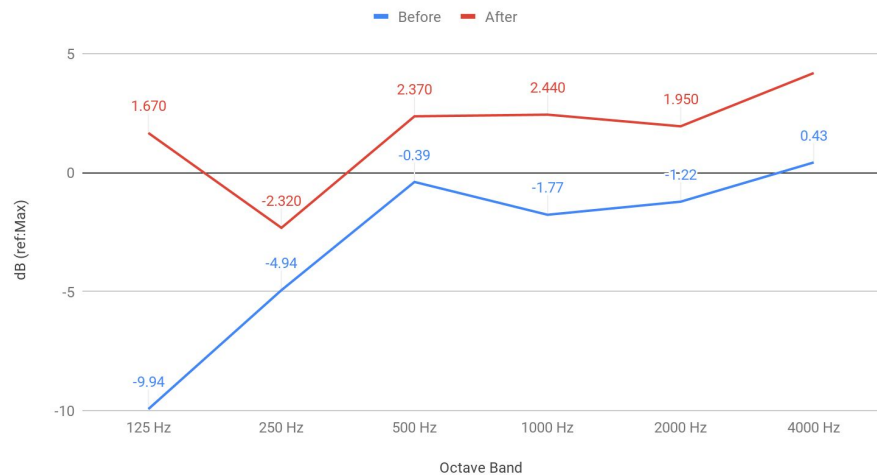
EDT before and after improvements (R3)



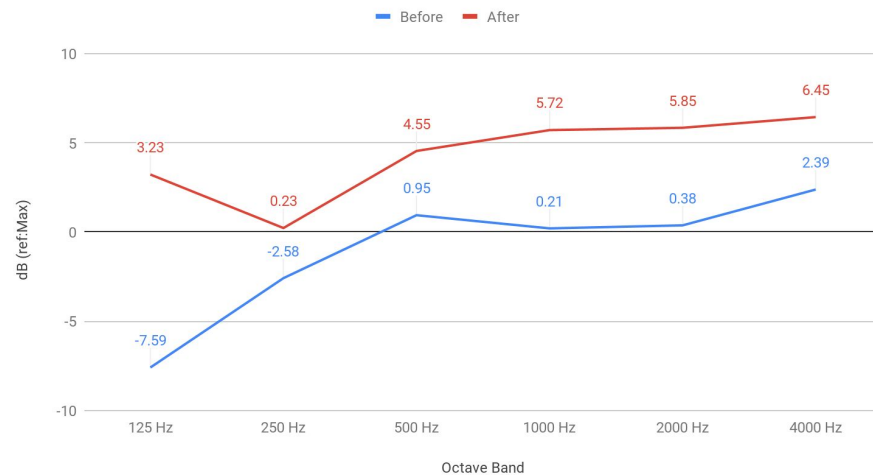
Simulation with improved design



C50 before and after improvements (R3)

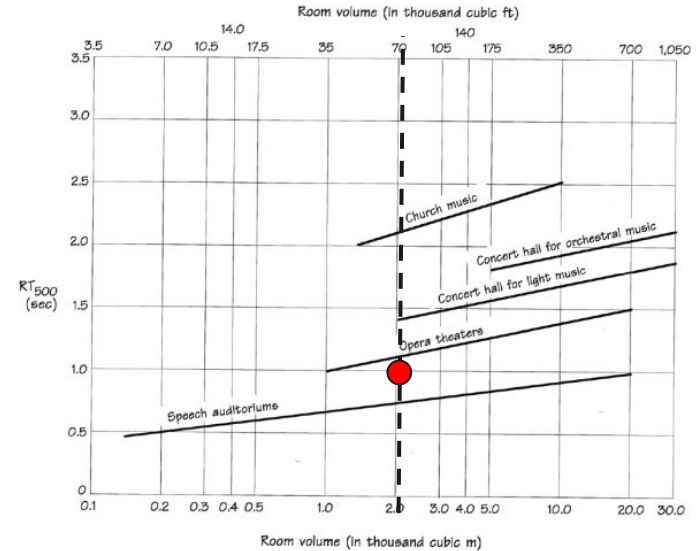


C80 before and after improvements (R3)



Conclusion on improvements

- We achieve significant improvement with the reverberation time, and the clarity index.
- We simulated the room so that it reflects the its behavior when it is occupied
- The room's reverberation time is at the point between Opera Theater and Speech Auditorium, if desire, user could remove some of the panel and made it best suited for Concert Hall



Thank you

