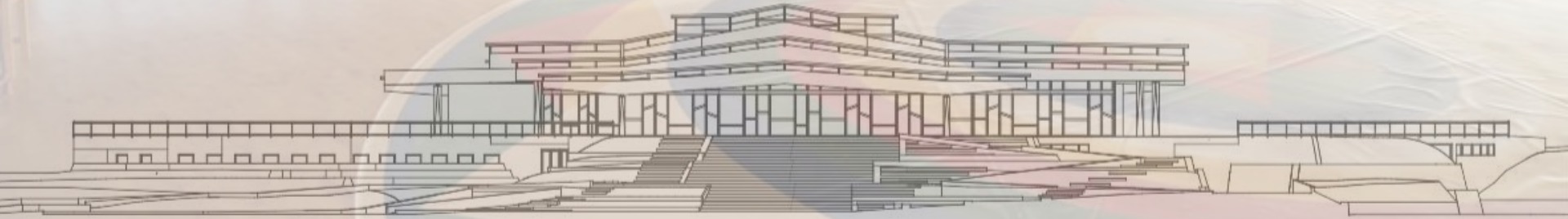
Dzamling Gar Gönpa Hall

Acoustic Treatment Study



Use of the Hall

The great hall of Dzamling Gar is the Gönpa where the activities of Dzogchen Community take place, such as:

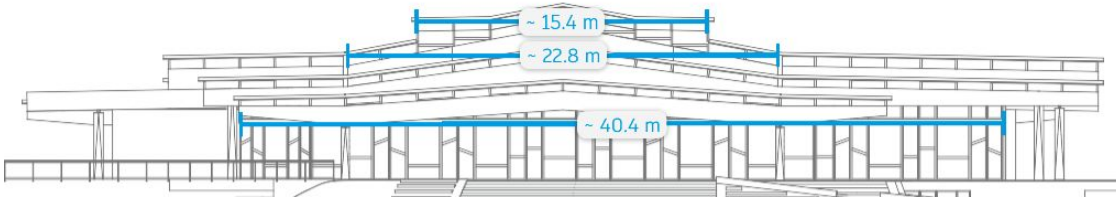
1. Listening to one or more speakers
2. Concert and Choral singing
3. Choreographic dance
4. Folk singing and music
5. Multimedia projection

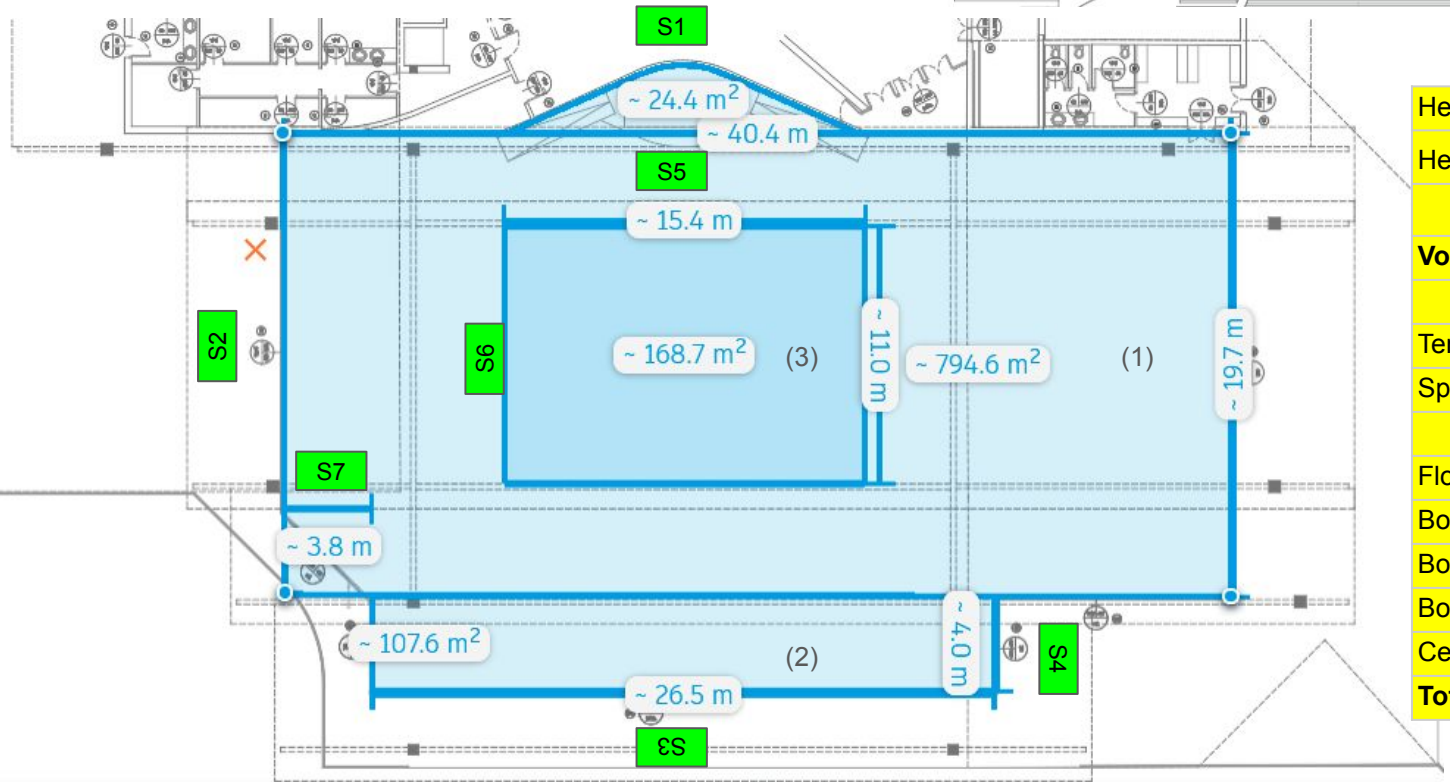
But it is also a hall for conferences, social events, concerts.

on the right or left wing, since in the center the voice cannot be heard clearly

People sit on the floor or move freely, use untuned musical instruments

Gönpa Hall is 919 m^2





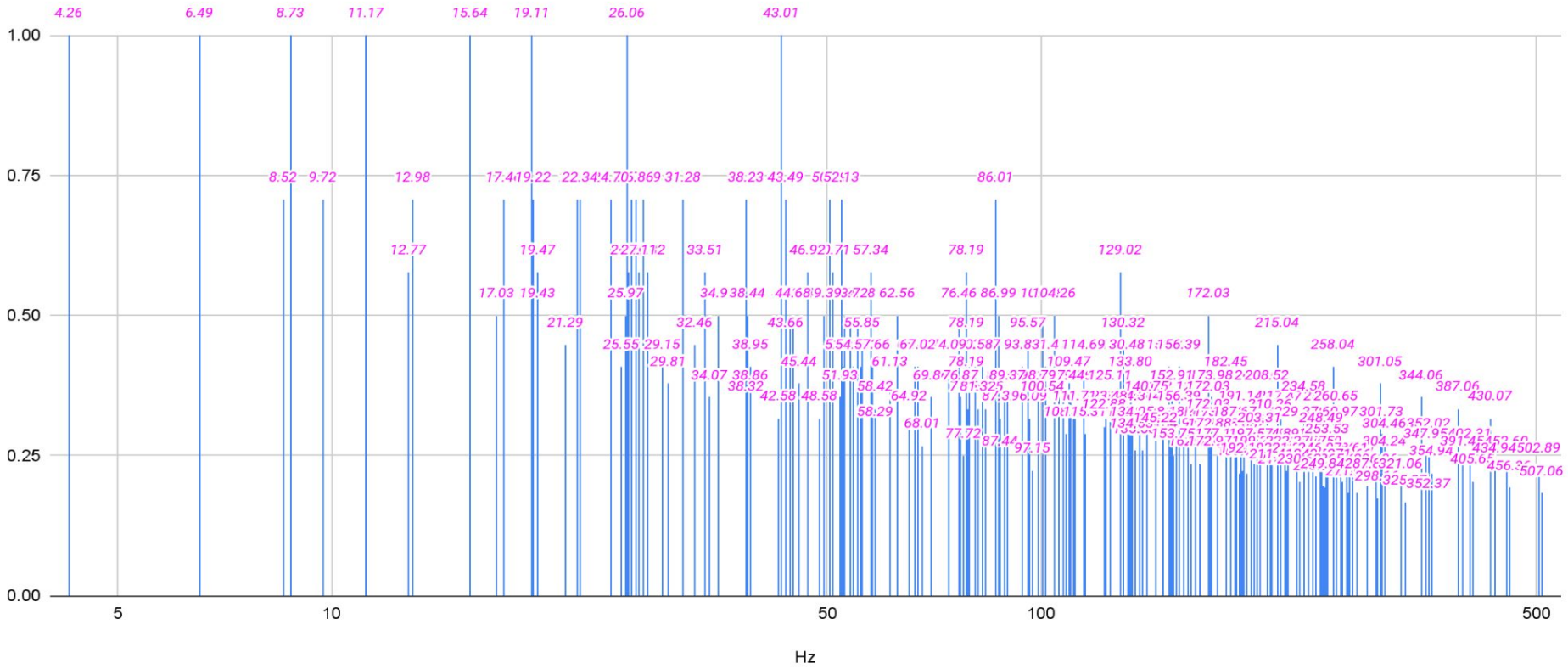
Height (3)	2,4	m
Height (1,2)	~ 6,6	m
Volume	**~ 6433**	**m3**
Temperature	20	C
Speed of sound	344,06	m/s
Floor (stage)	943	m2
Body (1)	537	m2
Body (2)	126	m2
Body (3)	227	m2
Ceiling	919	m2
Total surface area	**~ 2754**	**m2**

Gönpa Hall is 6.6 m high on average

Ceiling is covered with fabrics

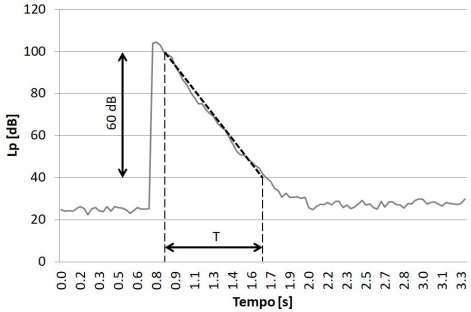
Predicted modes of resonance

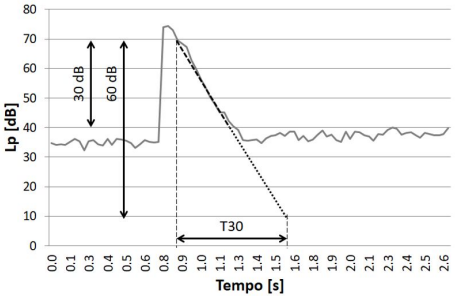
[Calculations Gönpa Hall]



Measurement

Values measured at 2 positions 1.4 m above the ground, in a empty Hall with few things or chairs.





Ideally, you would like to measure the 60dB decay, but the low volume and the considerable sound power required do not allow this. You opt for the optimal T30 measurement version.

ISO 3382 parameters

	50	63	80	100	125	160	200	250	315	400	500	630
EDT (s)	2,267	1,924	2,033	1,976	1,453	1,789	2,414	2,447	2,258	3,045	2,963	2,284
T20 (s)	3,091	2,012	1,681	1,607	1,157	1,397	1,706	2,346	2,444	2,422	2,466	2,332
T30 (s)	7,341	2,324	1,688	1,361	1,203	1,622	1,829	2,377	2,4			
Topt (s)	3,908	2,135	1,682	1,484	1,201	1,426	1,766	2,385	2,5			
T60M (s)												
C50 (dB)	-3,03	-2,55	-1,59	1,68	-3,59	-5,49	-2,65	-2				
C80 (dB)	-2,14	0,14	0,76	1,49	-2,39	-2,87	-0,49	-1,45				
D50 (%)	33,2	35,7	40,9	59,6	30,4	22,0	35,2	36,3				
TS (s)	0,207	0,165	0,158	0,141	0,134	0,155	0,158	0,170	0,			

	800	1.000	1.250	1.600	2.000	2.500	3.150	4.000	5.0
EDT (s)	2,750	2,110	2,117	2,241	2,259	2,403	2,473	2,146	2,
T20 (s)	2,192	2,179	2,104	2,163	2,055	1,938	1,856	1,655	1,5
T30 (s)	2,274	2,207	2,127	2,101	2,007	1,879	1,802	1,590	1,5
Topt (s)	2,286	2,195	2,141	2,126	2,003	1,925	1,826	1,581	1,4
T60M (s)									
C50 (dB)	-1,00	-1,18	-1,24	0,52	-0,37	-1,89	1,12	1,87	5
C80 (dB)	-0,53	-0,69	-0,77	1,16	0,53	-0,33	1,95	2,23	5,69
D50 (%)	44,3	43,2	42,9	53,0	47,9	39,3	56,4	60,6	77,3
TS (s)	0,160	0,125	0,122	0,099	0,109	0,132	0,097	0,075	0,044

	8.000	10.000
EDT (s)		
T20 (s)		
T30 (s)		
Topt (s)		
T60M (s)		
C50 (dB)		
C80 (dB)	8,16	4,94	12,63
D50 (%)	85,0	72,2	93,6
TS (s)	0,029	0,050	0,010

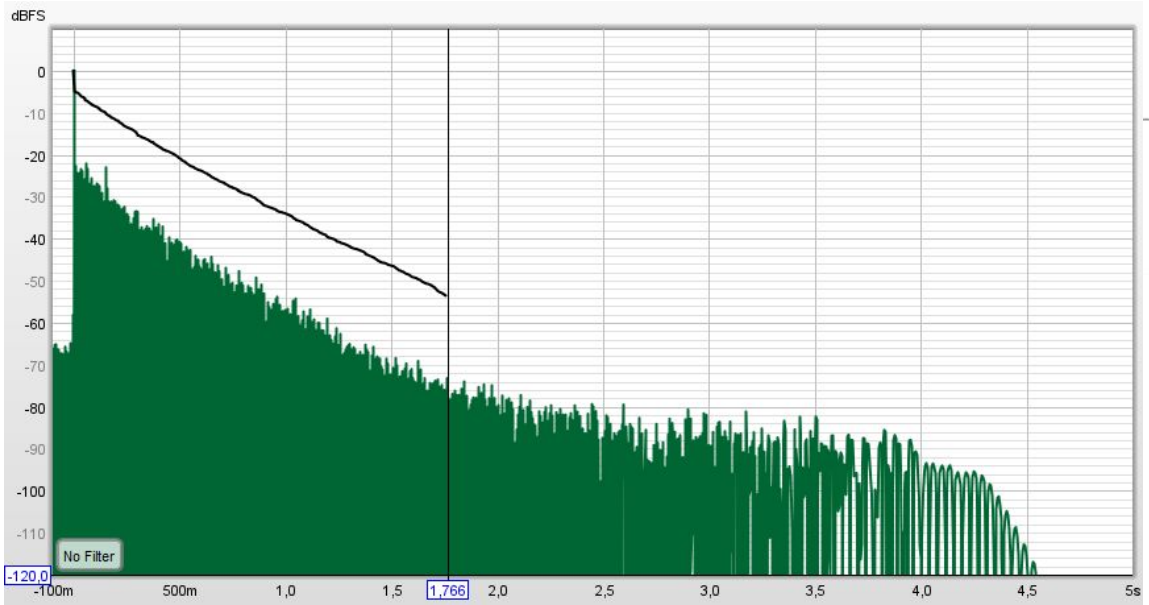
The values will be taken into consideration only when they are reliable, that is when r is at least **-0.99.**

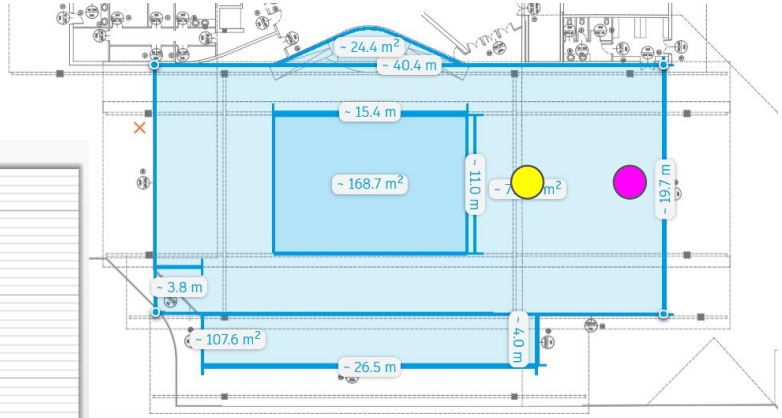
IR measure

1

EDT (s)	T20 (s)	T30 (s)	T60 (s)	C50 (dB)	C80 (dB)	D50 (%)
1.94	2.04	1.90	1.96	2.72	4.14	61.91

Mic 11, near stage R (10 m)





The reverberation time is excessive around 60 Hz and for the frequency range between 160 and 2K Hz; while it improves above 3K Hz,a noticeable comb filter can be seen in the tail.

Normalized graph, T30 detected from -5dB to -35dB, EDT from 0 to -10dB

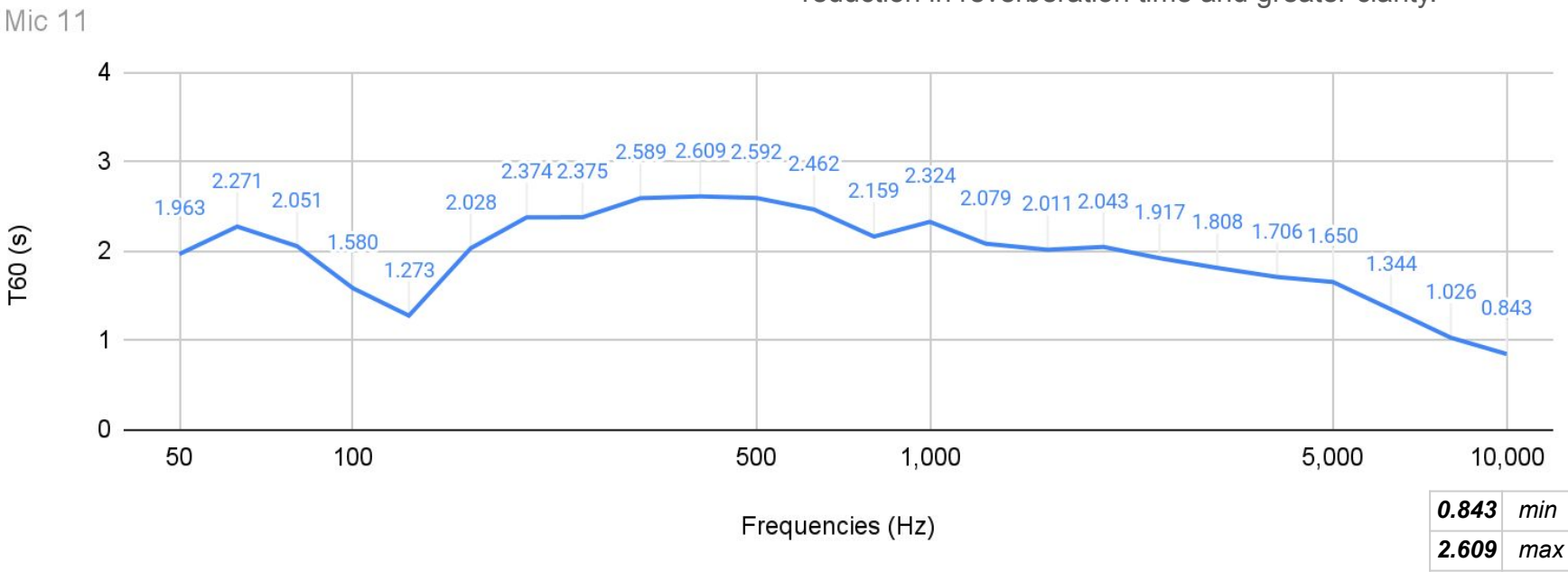
IR measure

1

EDT (s)	T20 (s)	T30 (s)	T60 (s)	C50 (dB)	C80 (dB)	D50 (%)
1.94	2.04	1.90	1.96	2.72	4.14	61.91

Mic 11, near stage R (10 m)

This is the best area for speech, placing the stage on the right and separating it with a mobile acoustic wall form the rest of the Hall. In this area it is realistic to obtain a reduction in reverberation time and greater clarity.



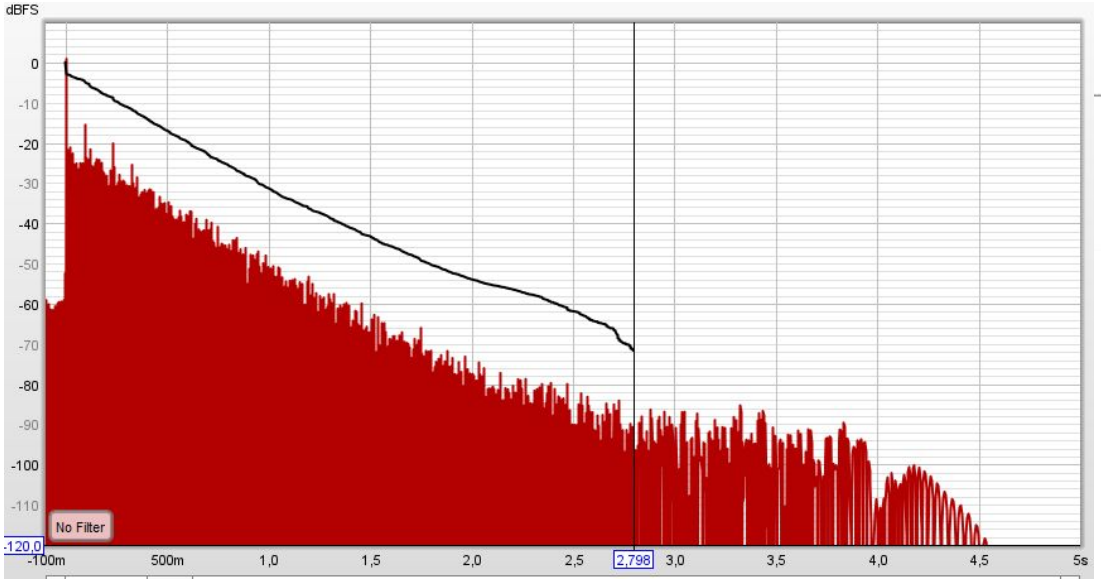
0.843	min
2.609	max

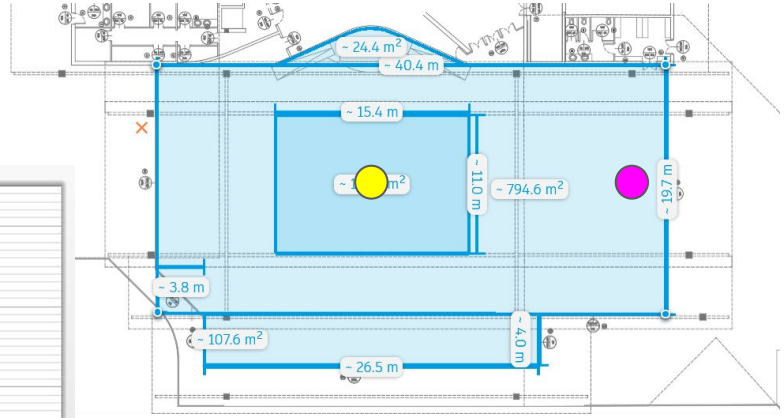
IR measure

2

EDT (s)	T20 (s)	T30 (s)	T60 (s)	C50 (dB)	C80 (dB)	D50 (%)
2.41	1.95	1.9	1.96	-0.14	0.84	48.02

Mic 10, center Hall (20 m from stage R)





The reverberation time is excessive below 60 Hz and for the frequency range between 250 and 2K Hz then it improves then it gets slightly better, a minimal comb filter can be seen in the tail.

Normalized graph, T30 detected from -5dB to -35dB, EDT from 0 to -10dB

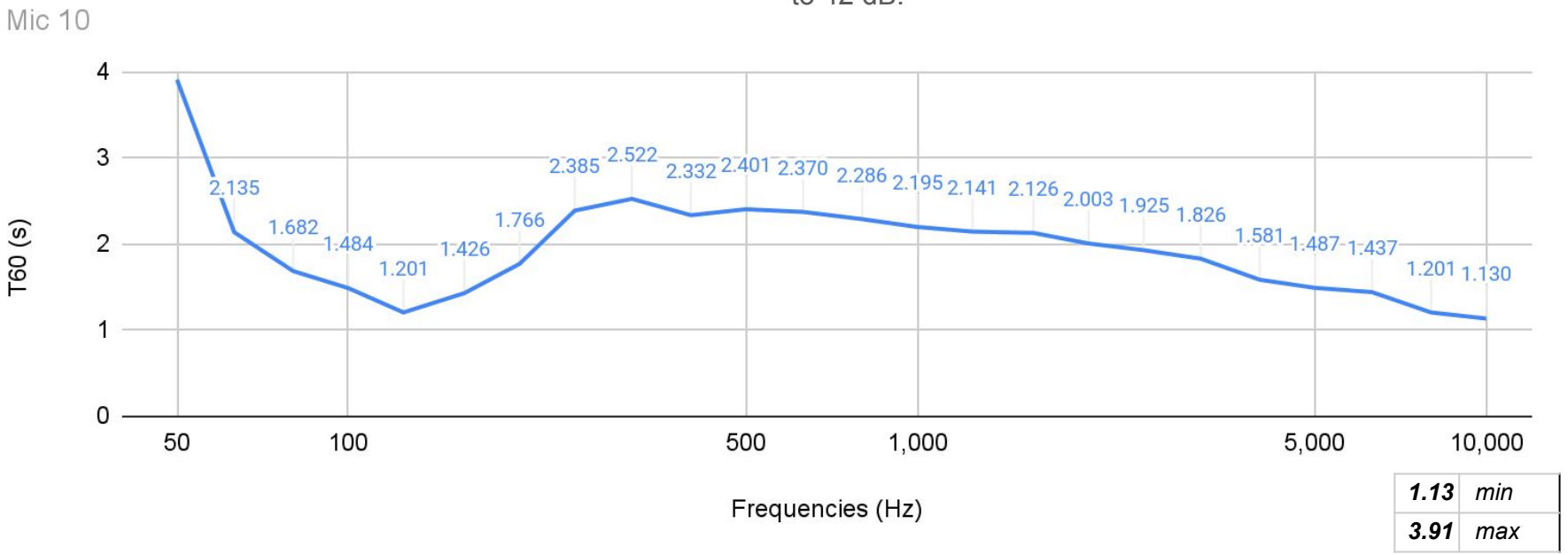
IR measure

2

EDT (s)	T20 (s)	T30 (s)	T60 (s)	C50 (dB)	C80 (dB)	D50 (%)
2.41	1.95	1.9	1.96	-0.14	0.84	48.02

Mic 10, center Hall (20 m from stage R)

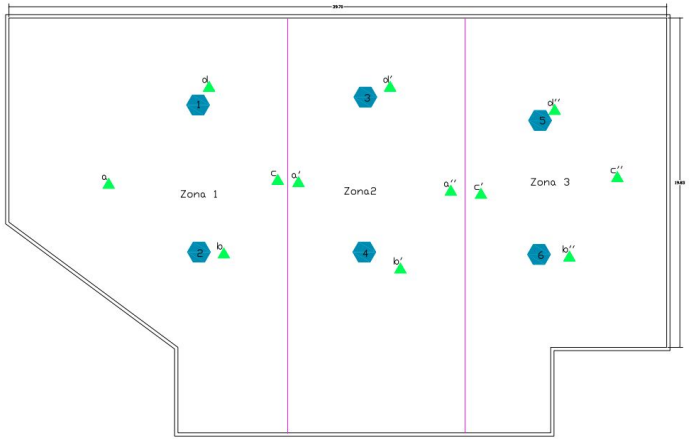
There is probably a mechanical resonance problem that produces low frequency waves, not audible but which are strengthened in the overtones and raise the noise threshold to 42 dB.



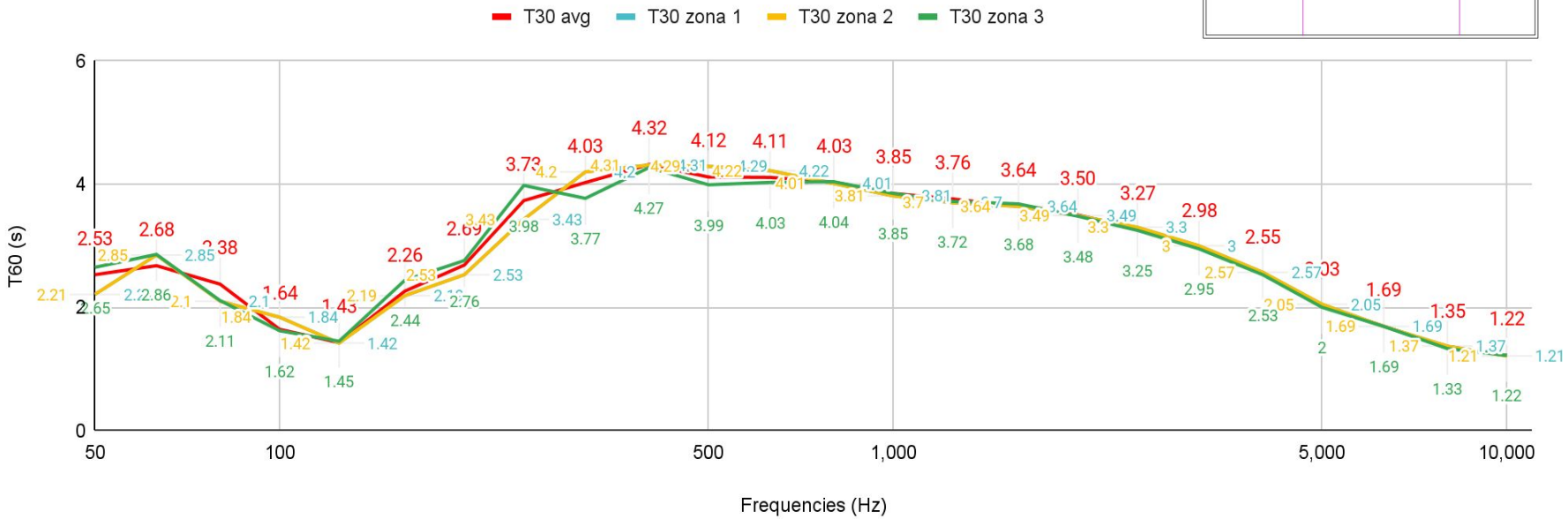
1.13	min
3.91	max

IR measure from previous study

The acoustic measurements performed by INGPROTEC (May 2020) where carried out in the empty Hall, except for a little stage with drapes in the wall and few things around.

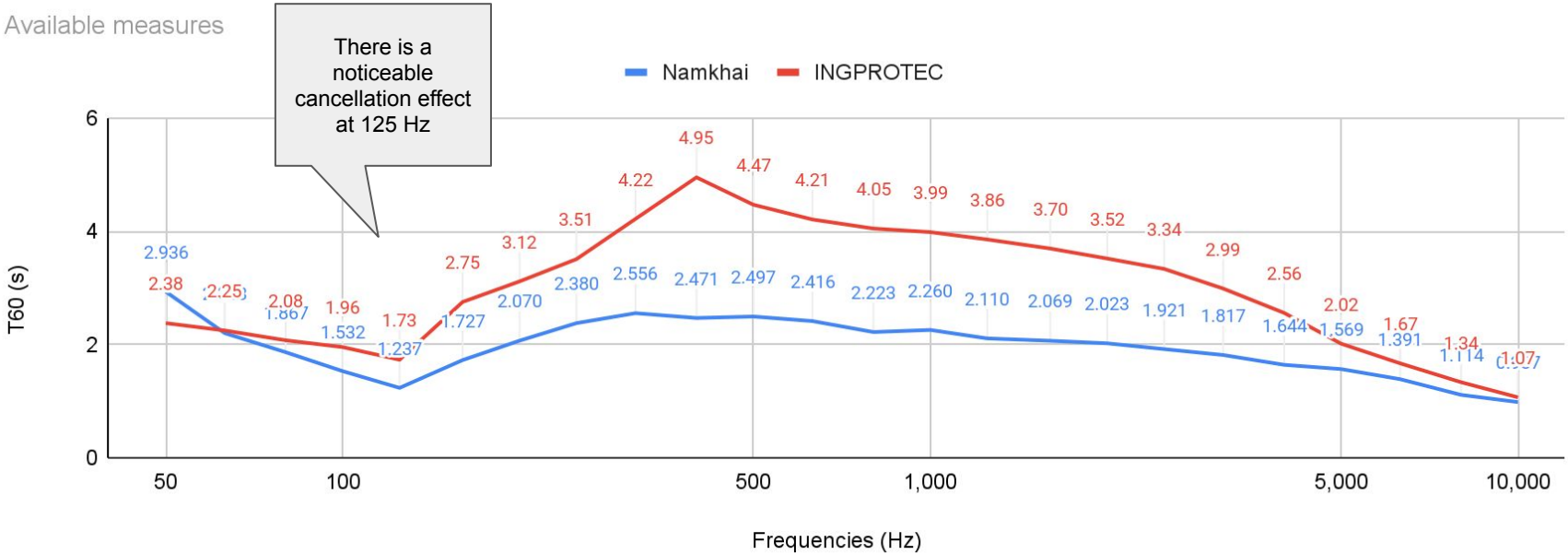


ZONA 1,2,3 avg



IR measure comparison

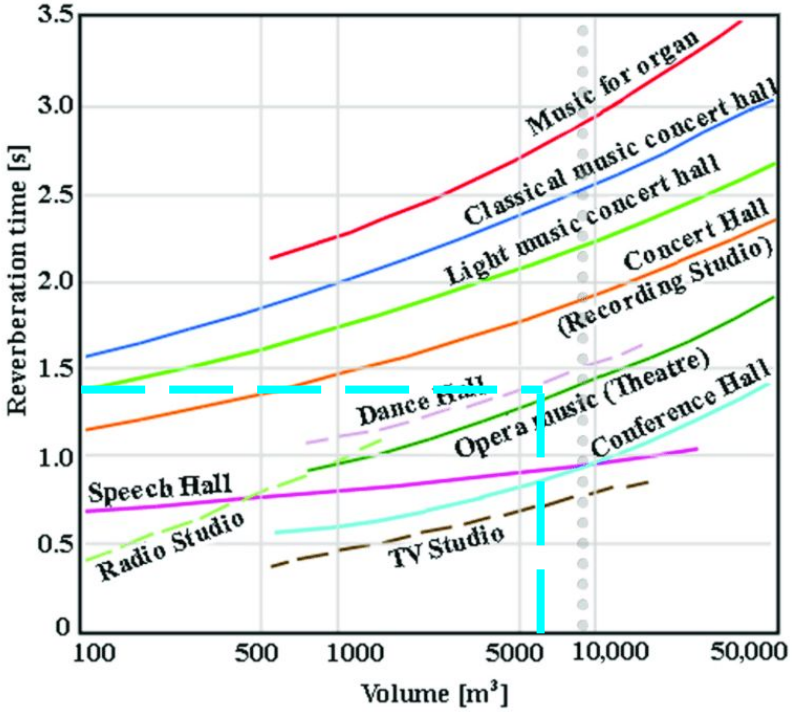
The previous study, although performed with good instrumentation, is contaminated by a methodological error; mid and high frequencies values are misleading. If these measures are accepted, the proposal to lower the RT60 to just over a second, by covering the **entire** ceiling with acoustic panels it is neither reliable nor credible, it would also make it heavier. It could cause mechanical resonance due to the weight, further lowering the frequency with an acoustic effect as well. **The hanging curtains on the ceiling do work well, as if they were sound-absorbing materials**.



Recommended RT60

EDT (s)	T20 (s)	T30 (s)	T60 (s)	C50 (dB)	C80 (dB)	D50 (%)
2.17	2.00	1.90	1.96	1.29	2.49	54.97

with such a volume it is difficult to satisfy all expectations



The literature suggests for mixed use and considered volume an average reverberation time **T60** lower than 1.5 seconds, but it is important to remember that the perception of musicality depends on EDT.

Height (3)	2,4	m
Height (1,2)	~ 6,6	m
Volume	**~ 6433**	**m3**
Temperature	20	C
Speed of sound	344,06	m/s
Floor (stage)	943	m2
Body (1)	537	m2
Body (2)	126	m2
Body (3)	227	m2
Ceiling	919	m2
Total surface area	**~ 2754**	**m2**

Modelling

Equation-based model

Volume	**~ 6433**	**m3**
Temperature	20	C
Speed of sound	344,06	m/s
Altitude	0	m
Humidity	70	%
Total surface area	**~ 2754**	**m2**

Area ass. Sabine	**36.56%**	2.78 m
Area ass. Eyring	**37.68%**	2.82 m
T60 SABINE	**2.70**	coeff. errore
T60 EYRING	**2.62**	0.112
Measures (T30, Namkhai)	**2.01**	0.137
Measures (T30, Ingprotec)	**3.20**	0.229

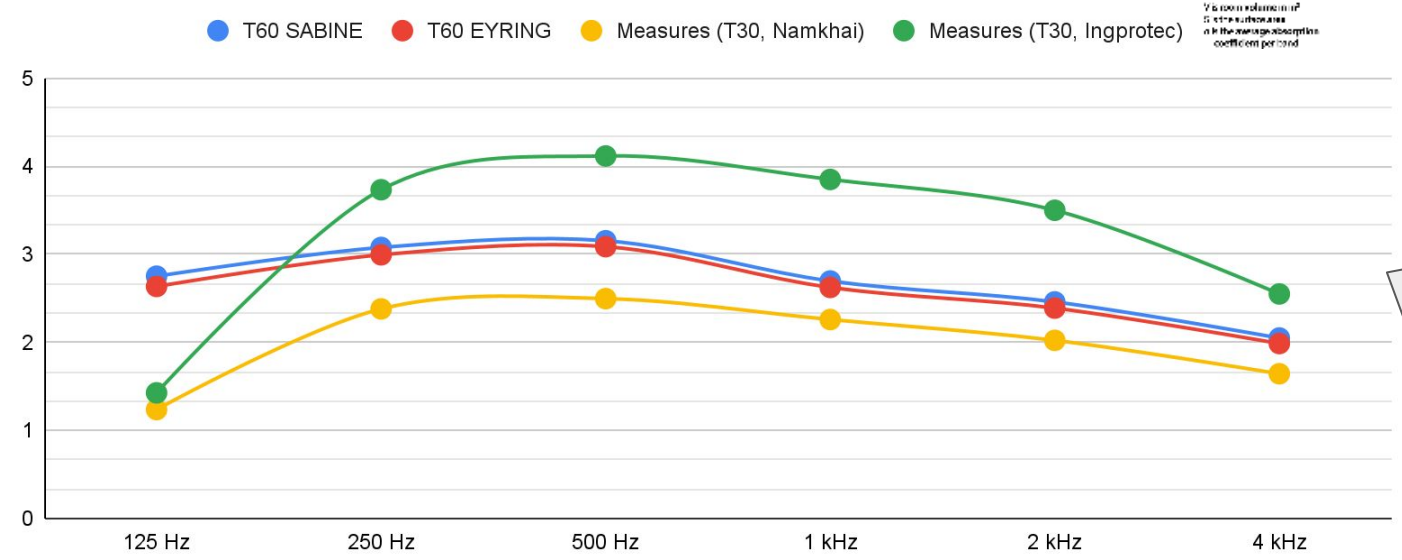
RT60

Sabine

$$T_{60} = \frac{0.161V}{S\alpha}$$

Eyring

$$T_{60} = \frac{0.161V}{-S \ln(1-\alpha)}$$



With the available information, a model is built based on the equations valid for low absorption coefficients in the diffuse field, obtaining a reverberation time similar to the one measured, also taking into account the air given the volume.

Modelling

Fitted equation-based model

Volume	**~ 6433**	**m3**
Temperature	20	C
Speed of sound	344,06	m/s
Altitude	0	m
Humidity	70	%
Total surface area	**~ 2754**	**m2**

Area ass. Sabine	**46.98%**	3.12 m
Area ass. Eyring	**49.25%**	3.18 m
T60 SABINE	**2.15**	coeff. errore
T60 EYRING	**2.07**	0.130
Measures (T30, Namkhai)	**2.01**	0.131
Measures (T30, Ingprotec)	**3.20**	0.273

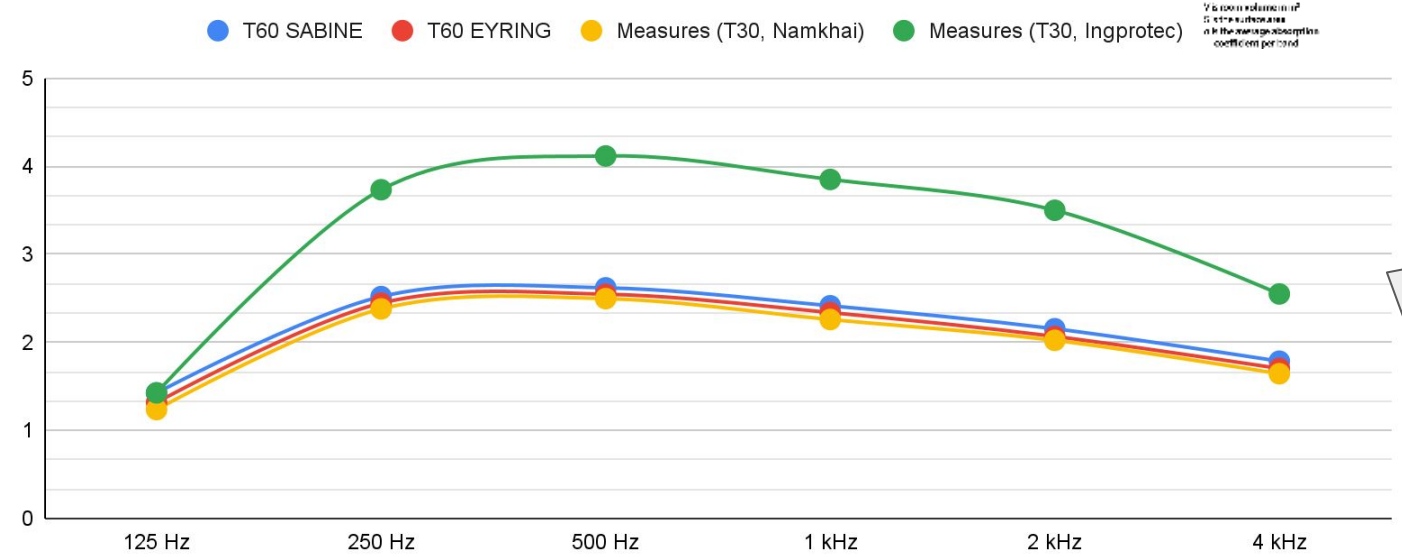
Sabine

$$T_{60} = \frac{0.161V}{S\alpha}$$

Eyring

$$T_{60} = \frac{0.161V}{-S \ln(1-\alpha)}$$

RT60



The curve resulting from the equations is regular with respect to the measurement, further fitting coefficients are applied.

The noticeable cancellation effect at 125 Hz is left unchanged. It is recommended to make an appropriate **phase adjustment** to the signal going to the sub woofer.

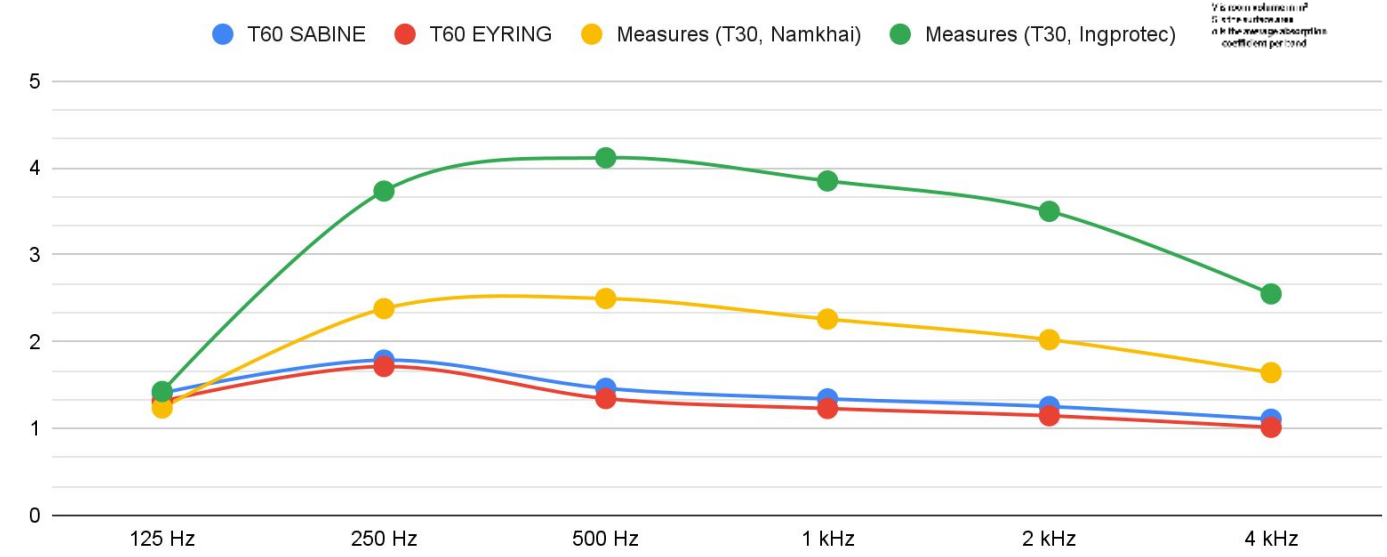
Simulation

This simulation takes into account current cotton hanging curtains.

Area ass. Sabine	**70.82%**	**3.87 m**
Area ass. Eyring	**76.61%**	**4.02 m**
T60 SABINE	**1.39**	**coeff. errore**
T60 EYRING	**1.29**	**0.066**
Measures (T30, Namkhai)	**2.01**	**0.103**
Measures (T30, Ingprotec)	**3.20**	**0.346**

Sabine $T_{60} = \frac{0.161V}{S\alpha}$ **Eyring** $T_{60} = \frac{0.161V}{-S \ln(1-\alpha)}$

RT60

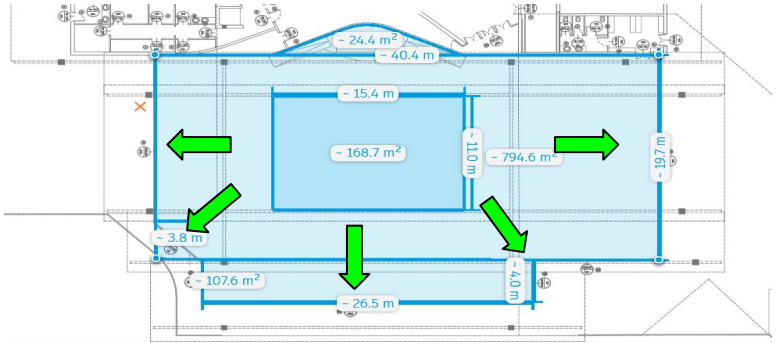


It considers 0.99 as the maximum sound absorption value, so the expected result will be better than the prediction especially for the most disturbing (low) frequencies.

Sound absorbing materials

The simulation involves the use of sound-absorbing materials compliant with the specified acoustic parameters that follows, covering areas indicated in square meters.

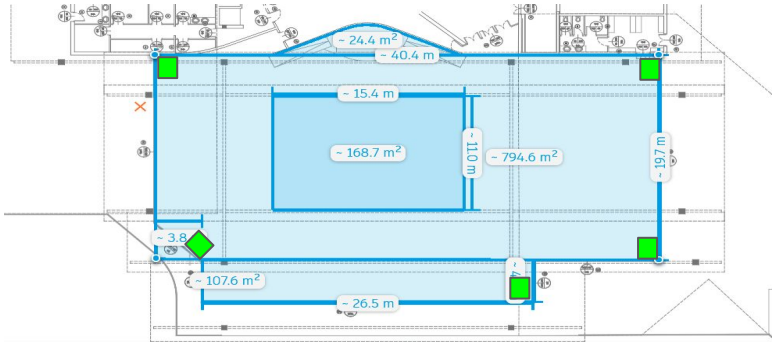
144 m^2 sound-absorbing curtain with equivalent acoustic parameters to VESCOM ELLIS and placed in the corners.



Sound absorbing materials

The simulation involves the use of sound-absorbing materials compliant with the specified acoustic parameters that follows, covering areas indicated in square meters.

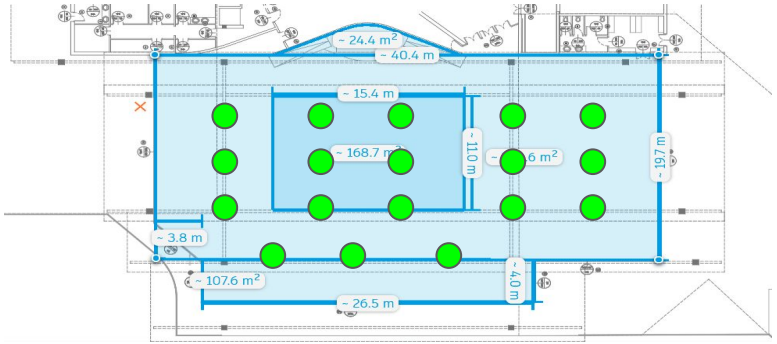
60 m^2 bass-traps cubes stacked in columns (~6.6m) with equivalent acoustic parameters to SKUM Acoustics KUBUS and placed in the corners.



Sound absorbing materials

The simulation involves the use of sound-absorbing materials compliant with the specified acoustic parameters that follows, covering areas indicated in square meters.

50 m^2 sound-absorbing cylinder stacked and hung with lamps or from the ceiling with equivalent acoustic parameters to SKUM Acoustics Rör.



Sound absorbing materials

The simulation involves the use of sound-absorbing materials compliant with the specified acoustic parameters that follows, covering areas indicated in square meters.

130 m^2 sound-absorbing panels with equivalent acoustic parameters as SKUM Acoustics Kilen, to be fixed to the wall and built as moving dividers or walls.