



Simulation Tools in Sound Reinforcement: Multichannel Digital Audio Cinema Design

**Athens Course UPM94
17-21 November 2014
Madrid**



INDEX

1. A SHORT HISTORY OF CINEMA SOUND
2. CINEMA MULTICHANNEL DIGITAL AUDIO FORMATS
3. DESIGN AND DIMENSIONING OF A CINEMA THEATRE
4. **ACOUSTIC SETTINGS**
5. SCREEN CHANNELS
6. SUBWOOFERS (LFE) CHANNEL
7. SURROUND CHANNELS
8. SYSTEM SETTINGS
9. PHOTO GALLERY



ACOUSTIC SETTINGS



- The main sources of noise in a movie theatre are:

The audience

The air conditioning and ventilation systems

Noise transmission from the outside or adjacent rooms

- Is considered that in the process of sound mixing in the of post-production studio has been taken into account a certain level of masking noise in the room due to the audience.



ACOUSTIC SETTINGS



- In terms of the noise produced by air conditioning systems, is that it can be approximated by the noise criterion of NC-30 curve (it is recommended that you can reduce even NC-25 or NC-20 curves).
- As to the noise produced by the adjacent rooms, is considered that the interference produced may be perceivable during 1% of the time, maximum.
- These two conditions will give an idea of the necessary isolation in a room with a few highs of 95-105 dB.



ACOUSTIC SETTINGS



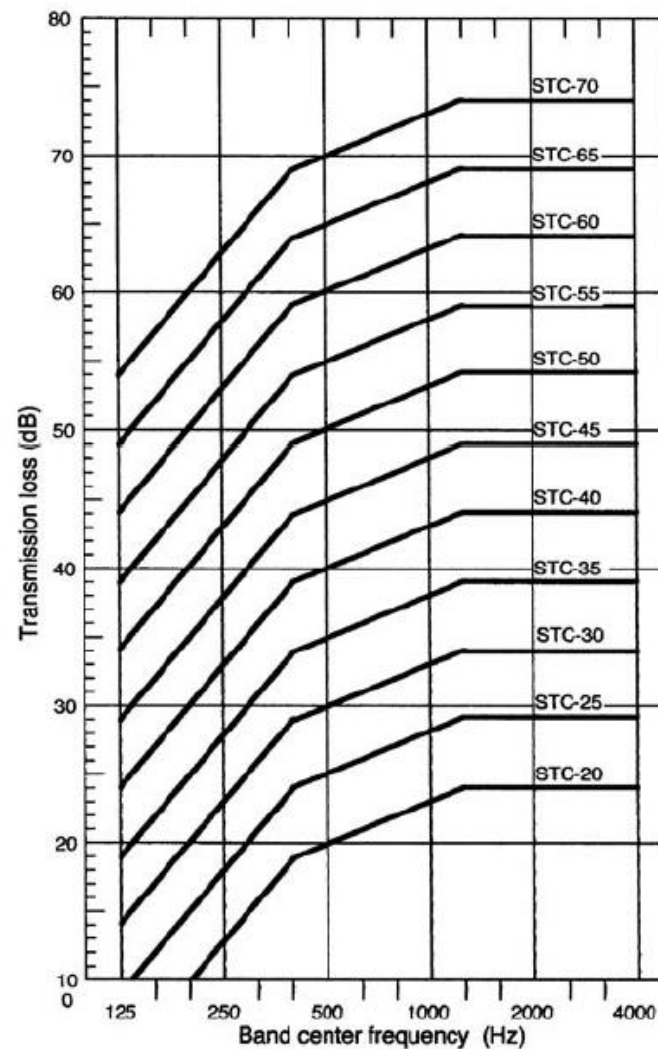
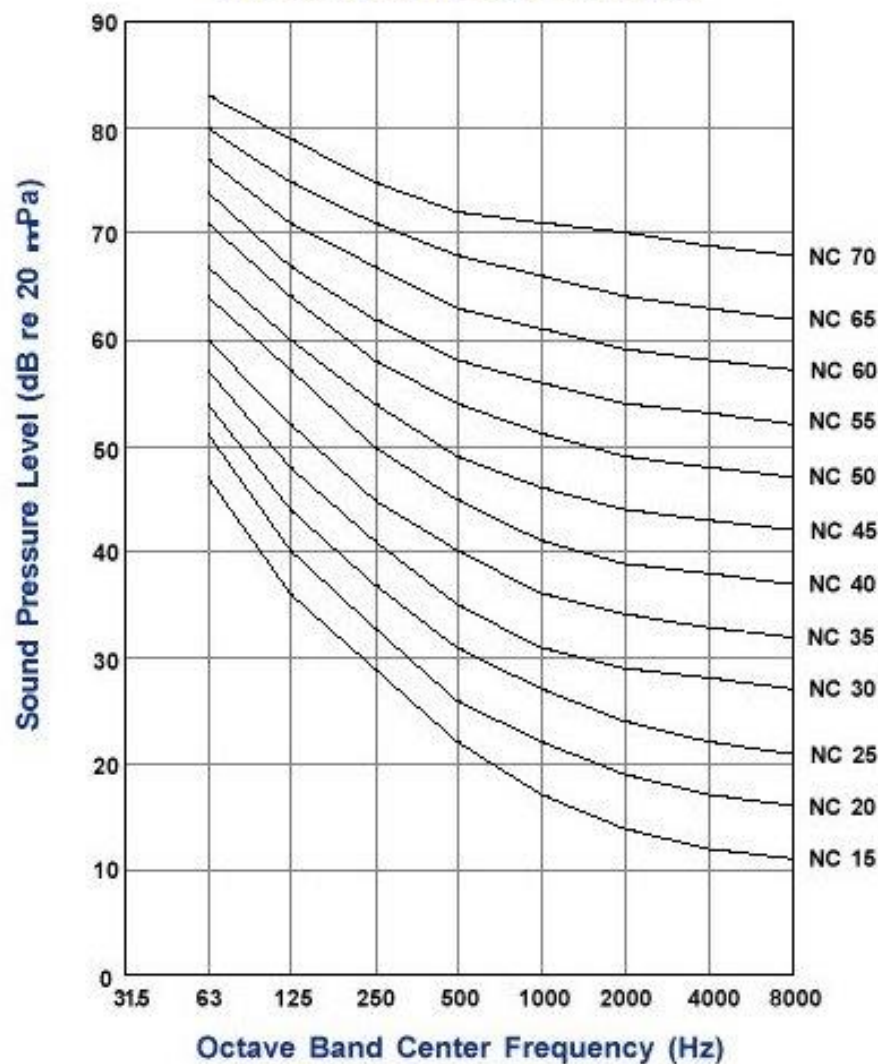
- To calculate insulation we use the criterion of STC curves, which in our case should be 65 to 75 dB.
- The construction of double air chamber intermediate partitions or solid partitions with absorbent material is required to comply with these specifications.
- Must be especially careful with the design of multiple rooms, in which case it is recommendable to leave free galleries of service between rooms, with the consequent problem of space that will lead to.



ACOUSTIC SETTINGS



NOISE CRITERIA CURVES





ACOUSTIC SETTINGS



Noise Criterion	Octave Band Center Frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
	Sound Pressure Levels (dB)							
NC-15	47	36	29	22	17	14	12	11
NC-20	51	40	33	26	22	19	17	16
NC-25	54	44	37	31	27	24	22	21
NC-30	57	48	41	35	31	29	28	27
NC-35	60	52	45	40	36	34	33	32
NC-40	64	56	50	45	41	39	38	37
NC-45	67	60	54	49	46	44	43	42
NC-50	71	64	58	54	51	49	48	47
NC-55	74	67	62	58	56	54	53	52
NC-60	77	71	67	63	61	59	58	57
NC-65	80	75	71	68	66	64	63	62

Noise rating curve	Application
NR 25	Concert halls, broadcasting and recording studios, churches
NR 30	Private dwellings, hospitals, theatres, cinemas, conference rooms
NR 35	Libraries, museums, court rooms, schools, hospitals operating theaters and wards, flats, hotels, executive offices
NR 40	Halls, corridors, cloakrooms, restaurants, night clubs, offices, shops
NR 45	Department stores, supermarkets, canteens, general offices
NR 50	Typing pools, offices with business machines
NR 60	Light engineering works
NR 70	Foundries, heavy engineering works



ACOUSTIC SETTINGS



- For the acoustic characteristics of the room, reverberation and echoes, is considered to be "neutral". Indeed, the reverberation is not a major problem in most of the rooms (which allows to apply the rule of the spherical divergence in the calculation of levels produced by the speaker system).
- It is essential to eliminate the initial reflections in the room, normally produced by the lateral walls and ceiling, which is achieved with the appropriate treatment of these surfaces with absorbent materials.



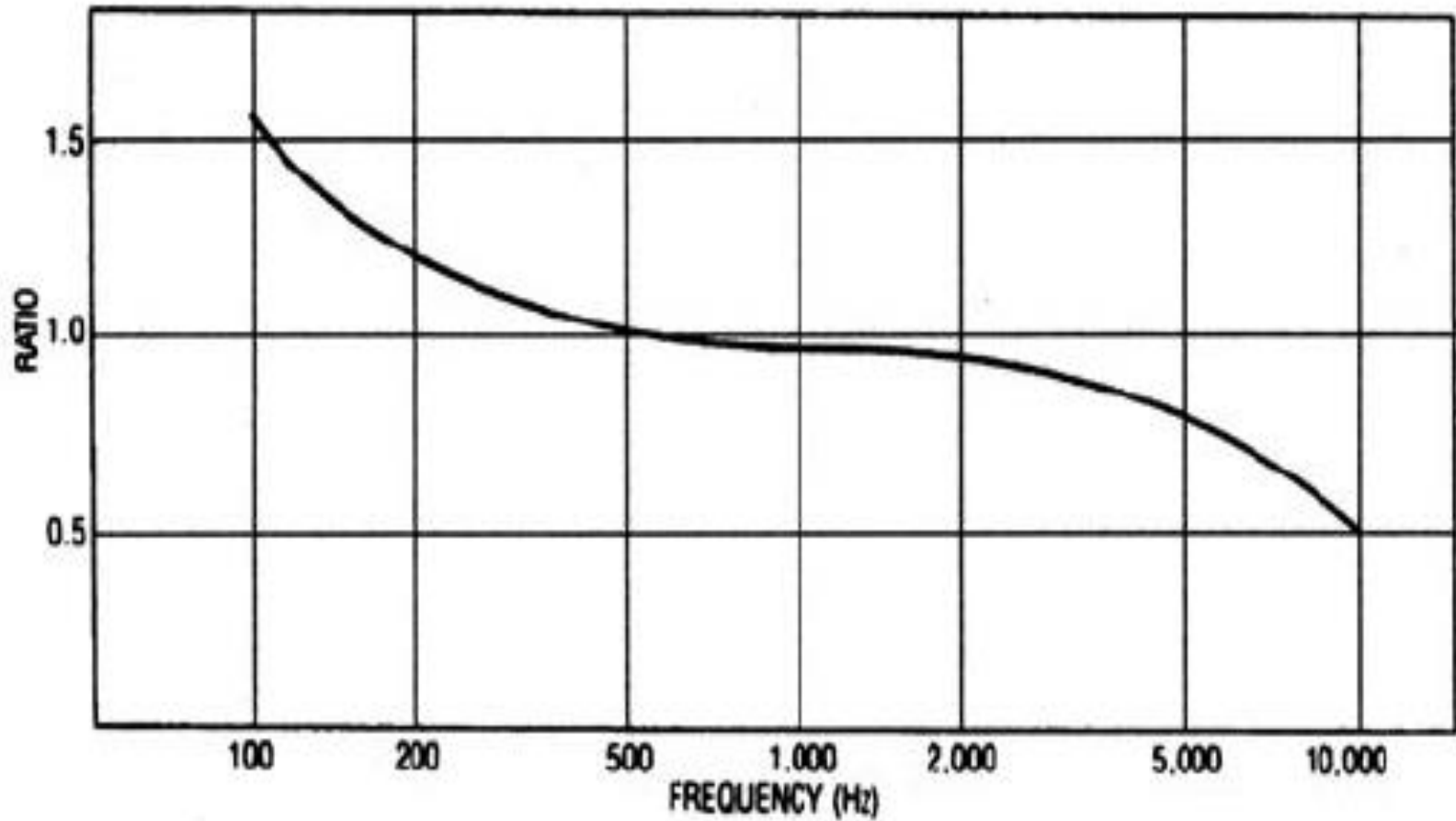
ACOUSTIC SETTINGS



- The reverberation time is considered that it must be between 0.5 and 2 seconds, and must not exceed this value in any frequency range of 100-10000 Hz.
- It must not tend to create excessively dry rooms, as a bit of reverberation is often considered as beneficial.
- Pay special attention to late reflections in the room are at least 10 dB below the level of the direct signal, so they are not regarded as annoying echoes.



ACOUSTIC SETTINGS



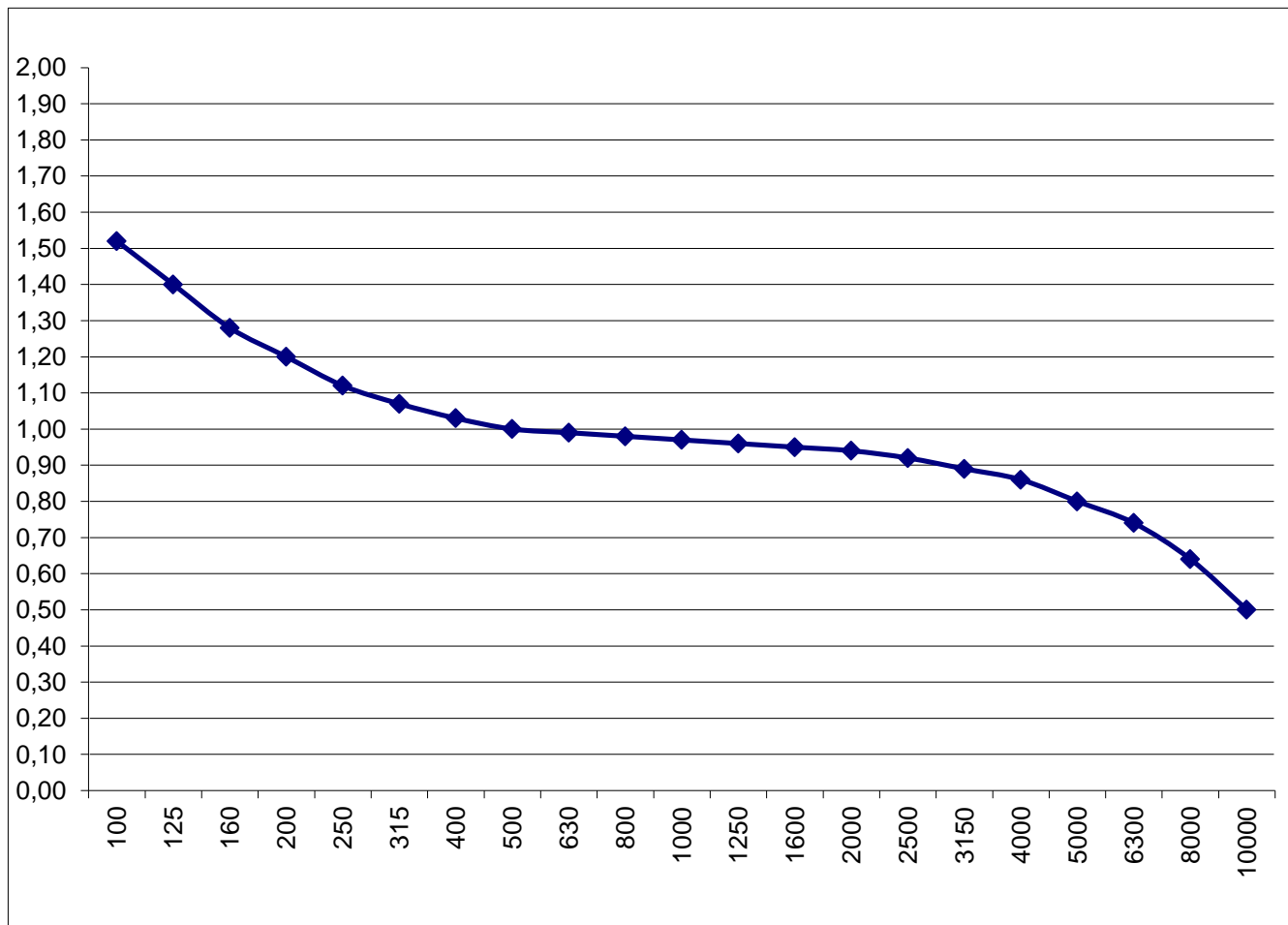


ACOUSTIC SETTINGS



Sala 400 butacas

Banda (Hz)	TR500 ratio
100	1,52
125	1,40
160	1,28
200	1,20
250	1,12
315	1,07
400	1,03
500	1,00
630	0,99
800	0,98
1000	0,97
1250	0,96
1600	0,95
2000	0,94
2500	0,92
3150	0,89
4000	0,86
5000	0,80
6300	0,74
8000	0,64
10000	0,50





ACOUSTIC SETTINGS



- The number of seats (spectators) that will host must have into account when it comes to sizing up the room. He is considered the average per seat in a movie theatre volume must be 5.6 m^3 (200 ft^3). This leads us to the following rule:

Asientos	Volumen	TR_{500}
75-125	695 m^3 (25000 ft^3)	0.28-0.45 s
125-250	1390 m^3 (50000 ft^3)	0.36-0.58 s
250-500	2780 m^3 (100000 ft^3)	0.47-0.70 s
500-1000	5560 m^3 (200000 ft^3)	0.56-0.85 s



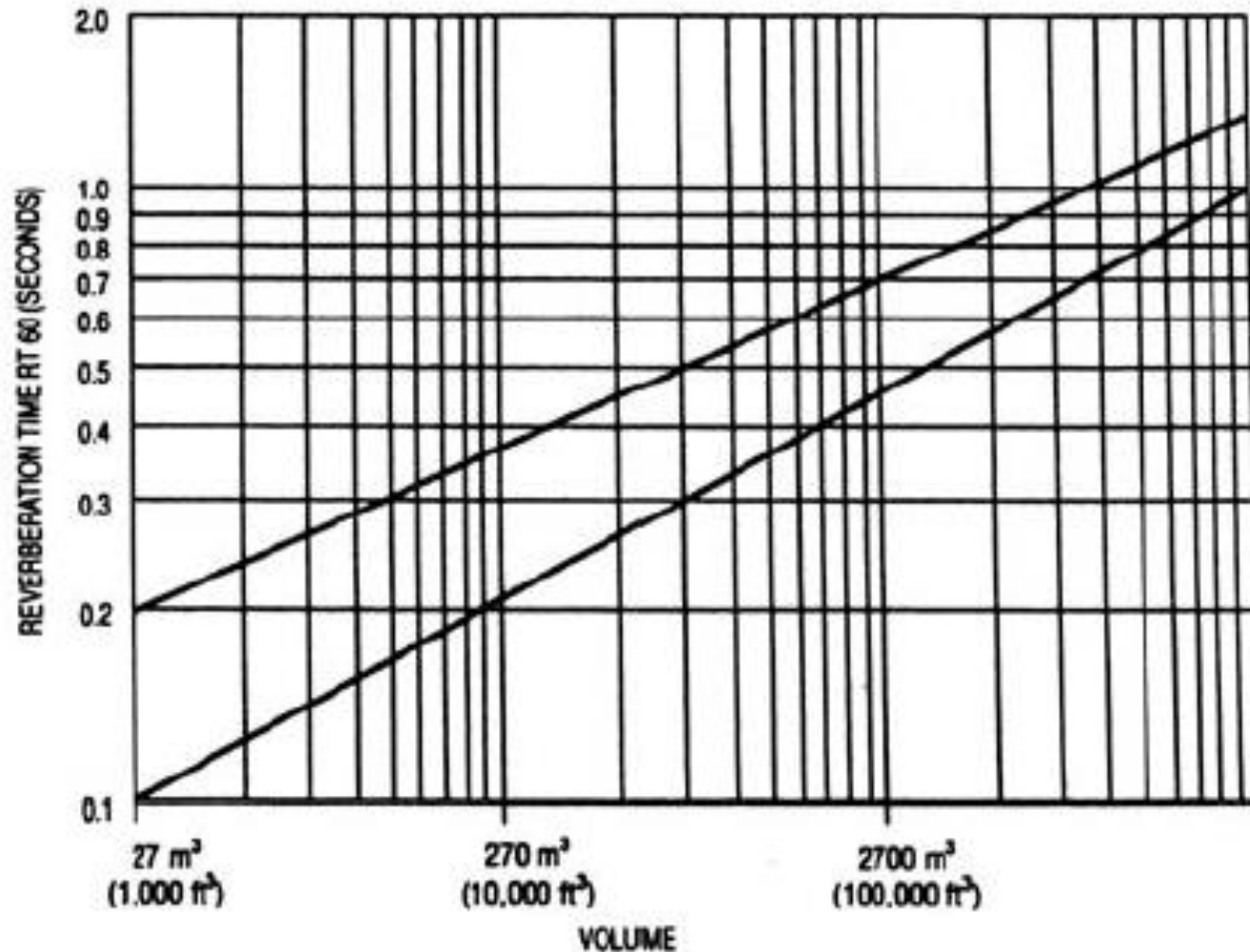
ACOUSTIC SETTINGS



- If we look at the graph of variation of reverberation on the 500 Hz time, we can see that you for medium and high frequencies, the reverberation time will be between values of 0.50-0.77 s to 2 kHz and 0.28-0.43 s at 10 kHz, which allows you to justify that for the calculation of levels at frequencies midfrequency and treble, the reverberant field will be small and used the criterion of the spherical divergence.
- Otherwise, in the part of low-frequency if it should take into account the effect of the reverberant field for calculation of levels produced by serious systems and subwoofers.



ACOUSTIC SETTINGS

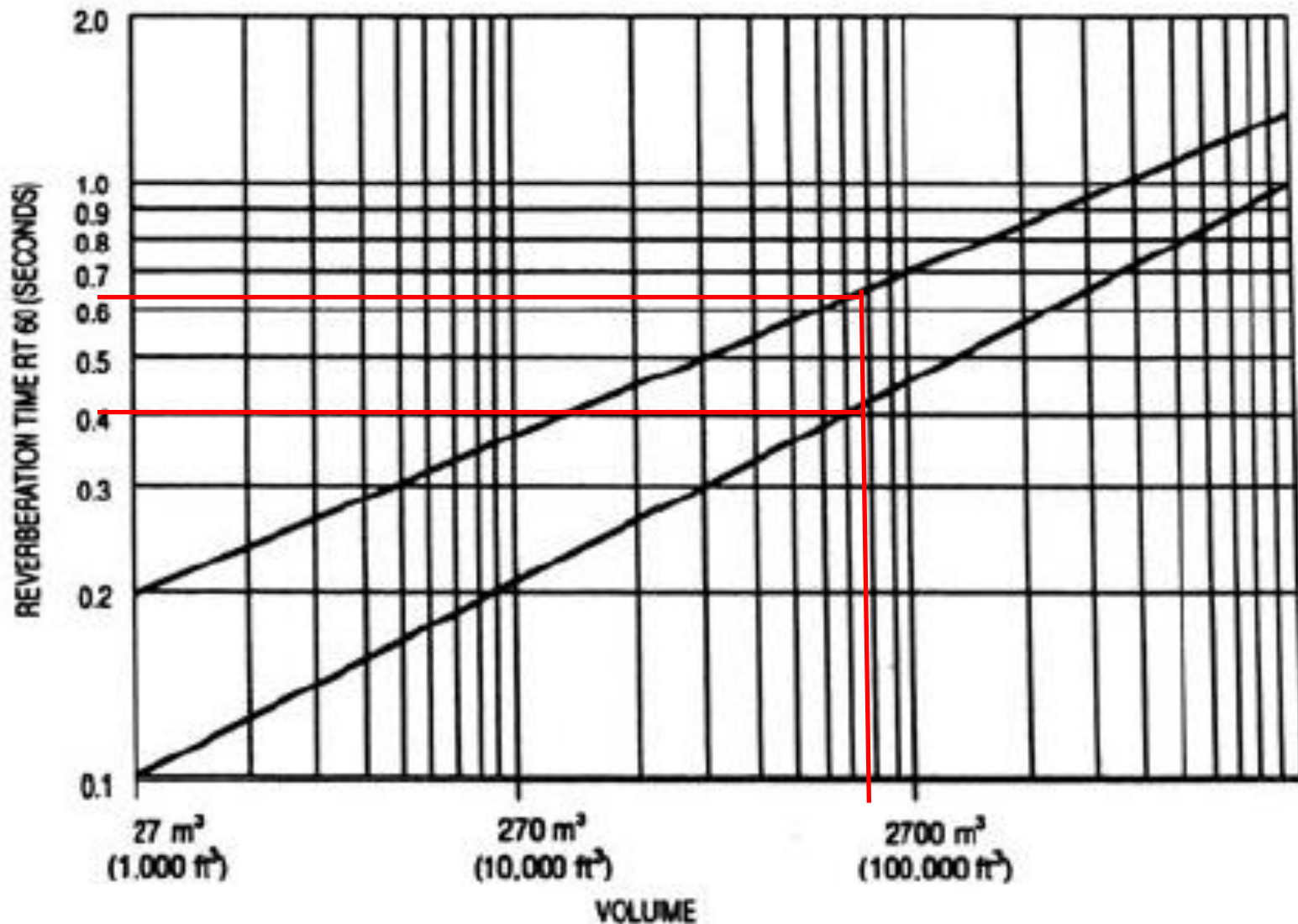




ACOUSTIC SETTINGS



Cinema 400 seats



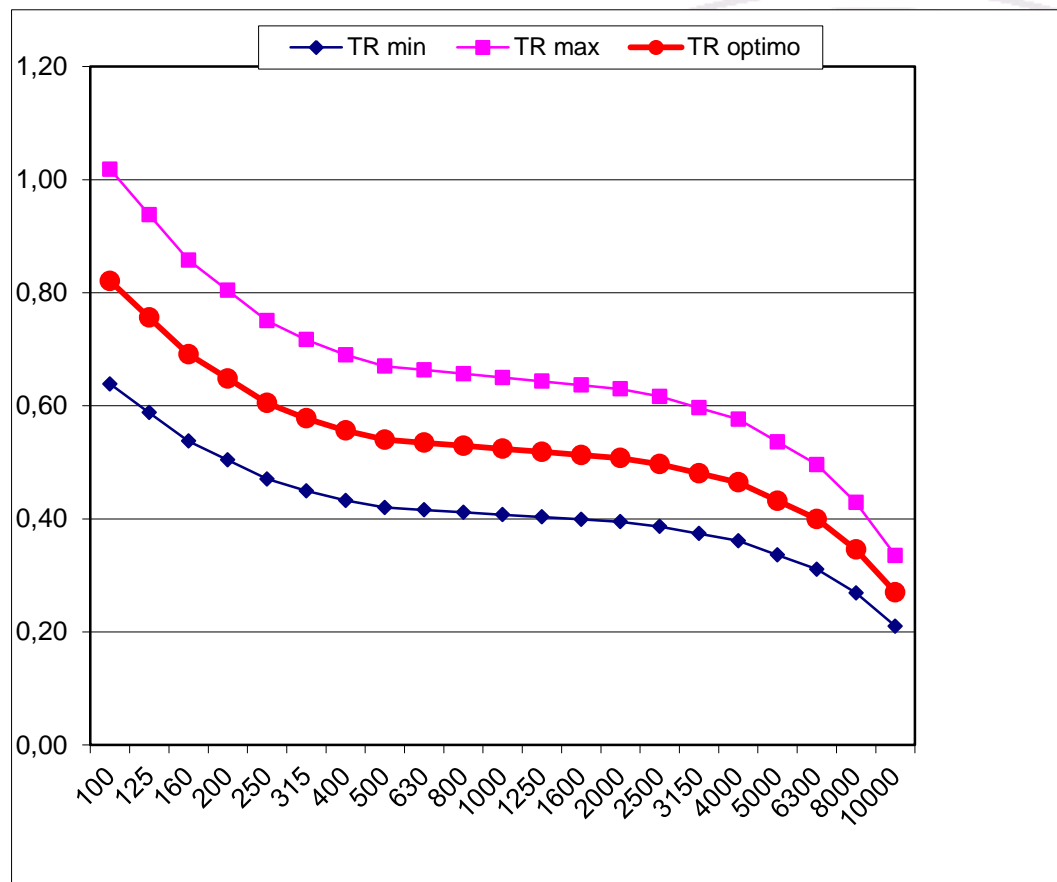


ACOUSTIC SETTINGS



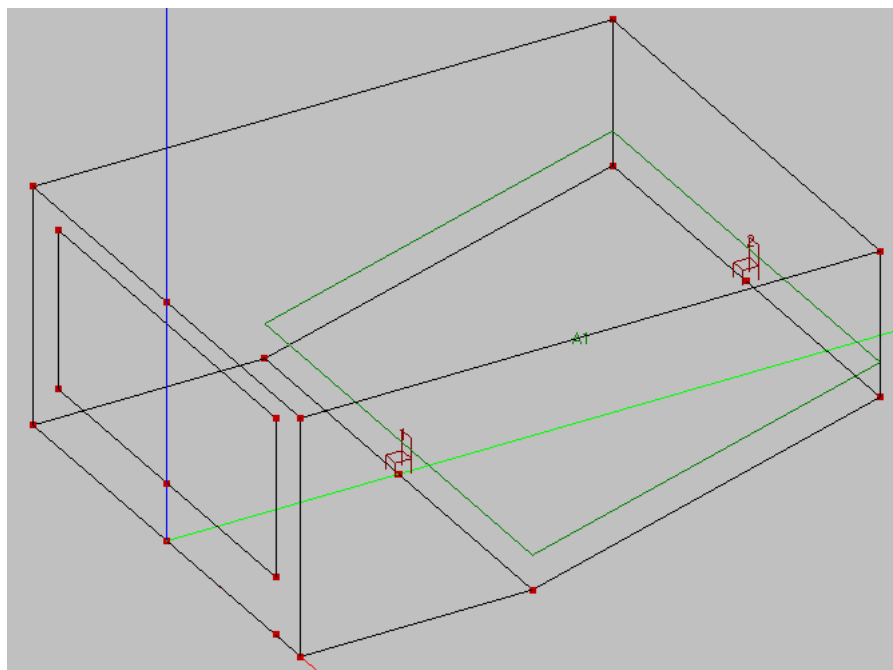
Volumen	2319m3		
	TR500min (s)	TR500min (s)	TR500op (s)
TR500 (s)	0,42	0,67	0,53

Banda (Hz)	TR500 ratio	TR min (s)	TR max (s)	TR optimo (s)
100	1,52	0,64	1,02	0,81
125	1,40	0,59	0,94	0,74
160	1,28	0,54	0,86	0,68
200	1,20	0,50	0,80	0,64
250	1,12	0,47	0,75	0,59
315	1,07	0,45	0,72	0,57
400	1,03	0,43	0,69	0,55
500	1,00	0,42	0,67	0,53
630	0,99	0,42	0,66	0,52
800	0,98	0,41	0,66	0,52
1000	0,97	0,41	0,65	0,51
1250	0,96	0,40	0,64	0,51
1600	0,95	0,40	0,64	0,50
2000	0,94	0,39	0,63	0,50
2500	0,92	0,39	0,62	0,49
3150	0,89	0,37	0,60	0,47
4000	0,86	0,36	0,58	0,46
5000	0,80	0,34	0,54	0,42
6300	0,74	0,31	0,50	0,39
8000	0,64	0,27	0,43	0,34
10000	0,50	0,21	0,34	0,27



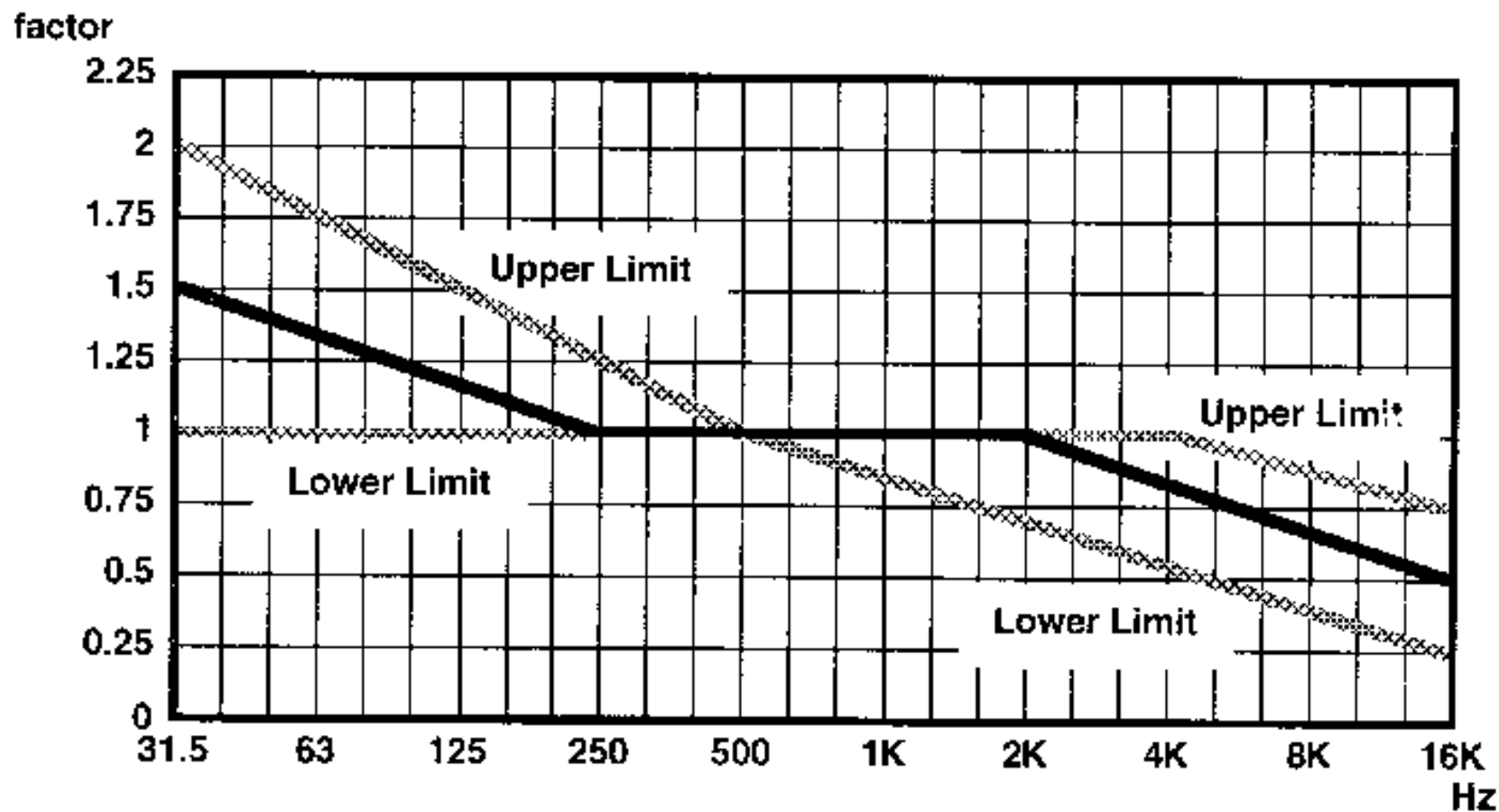


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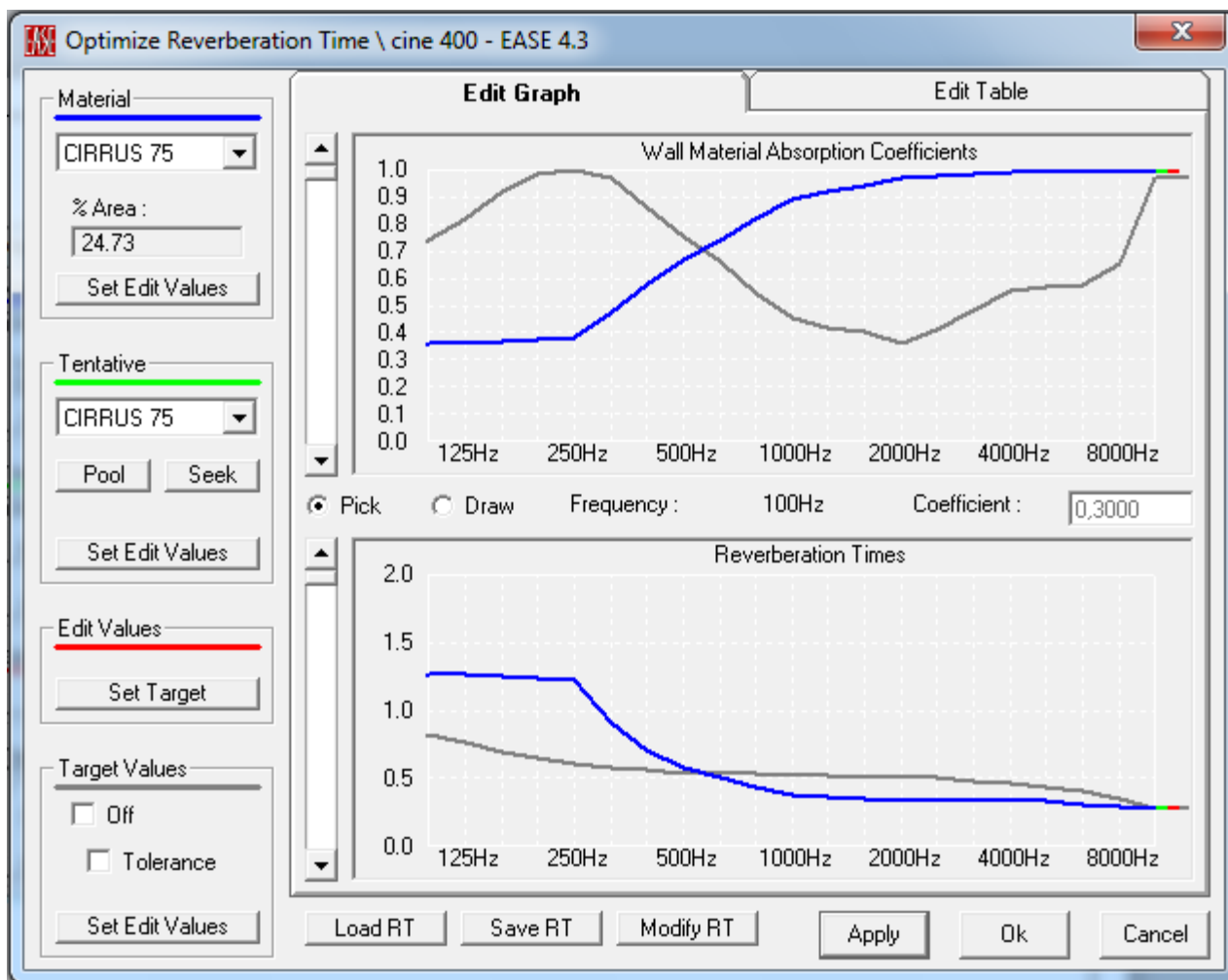


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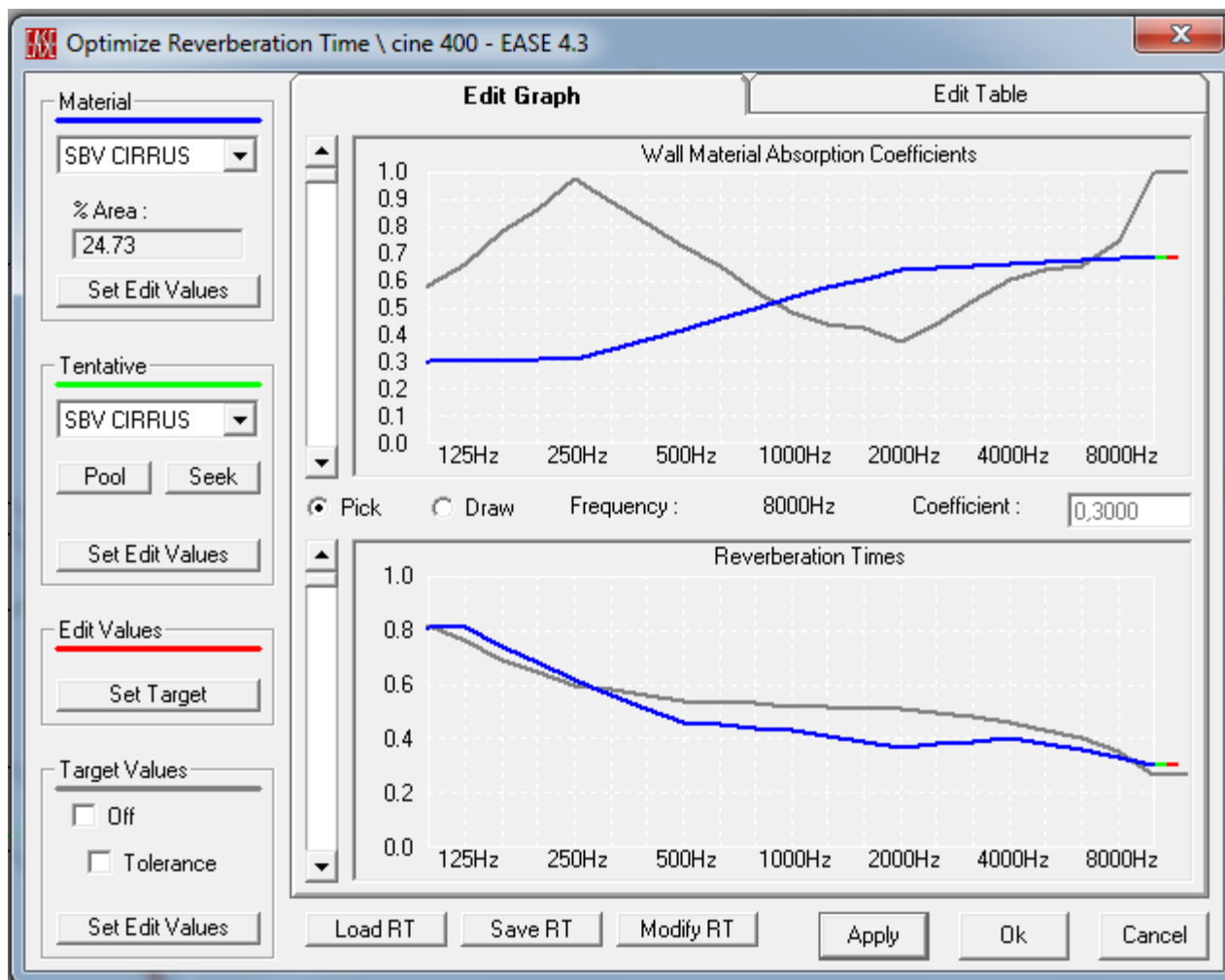


ACOUSTIC SETTINGS





ACOUSTIC SETTINGS





ACOUSTIC SETTINGS



Optimize Reverberation Time \ cine 400 - EASE 4.3

Material

SBV CIRRUS

% Area : 24.73

Set Edit Values

Tentative

SBV CIRRUS

Pool Seek

Set Edit Values

Edit Values

Set Target

Target Values

☐ Off

☐ Tolerance

Set Edit Values

Edit Graph

Edit Table

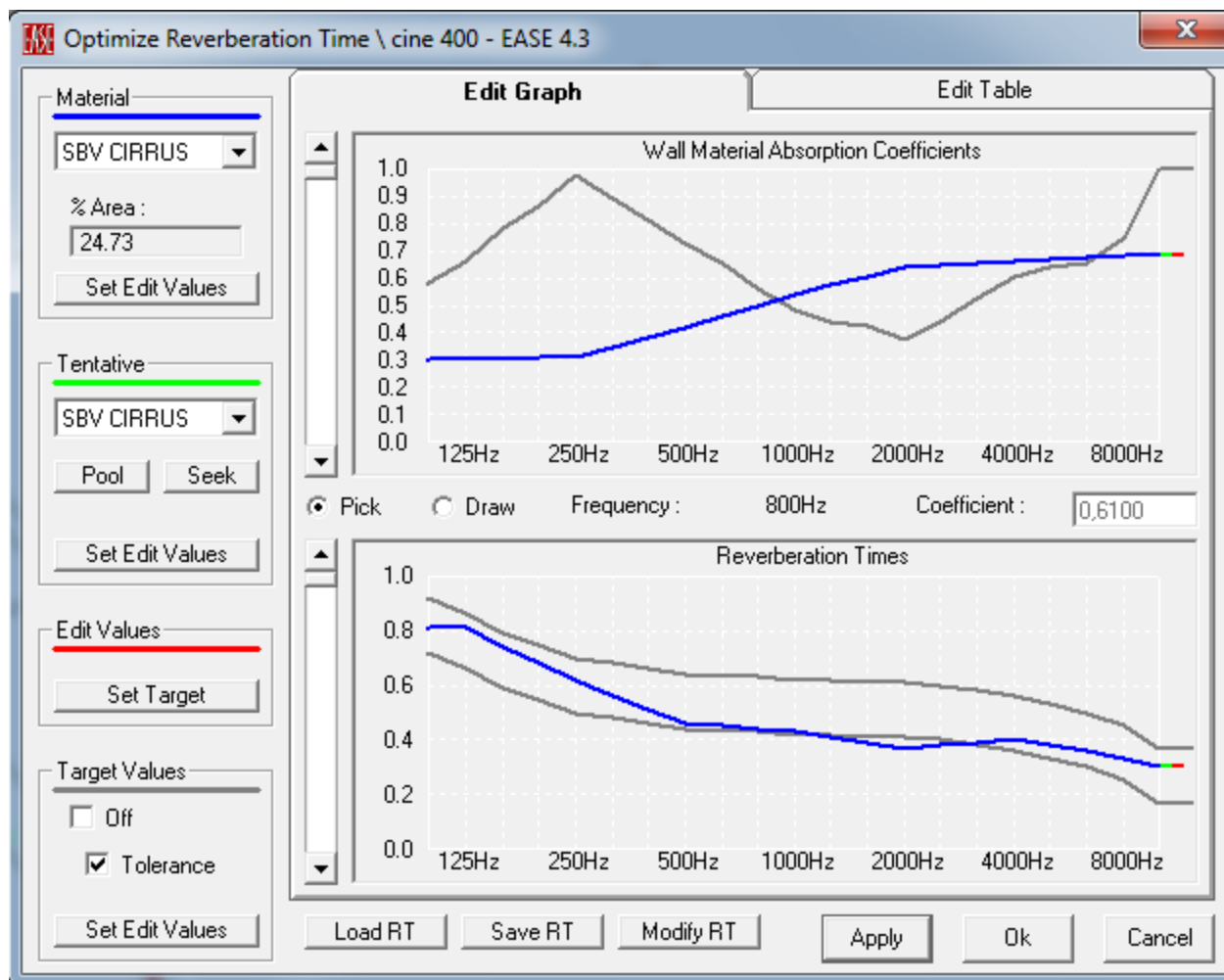
Edit Value : Tentative Value : Room Value : Target Value :

	Alpha	RT	Alpha	RT	Alpha	RT	Alpha	RT
100Hz	0.3000	0.81	0.3000	0.81	0.3000	0.81	0.5840	0.82
125Hz	0.3000	0.81	0.3000	0.81	0.3000	0.81	0.6628	0.76
160Hz	0.3033	0.74	0.3033	0.74	0.3033	0.74	0.7827	0.69
200Hz	0.3067	0.68	0.3067	0.68	0.3067	0.68	0.8650	0.65
250Hz	0.3100	0.62	0.3100	0.62	0.3100	0.62	0.9743	0.60
315Hz	0.3467	0.56	0.3467	0.56	0.3467	0.56	0.8904	0.58
400Hz	0.3833	0.51	0.3833	0.51	0.3833	0.51	0.8086	0.56
500Hz	0.4200	0.46	0.4200	0.46	0.4200	0.46	0.7290	0.54
630Hz	0.4600	0.45	0.4600	0.45	0.4600	0.45	0.6555	0.53
800Hz	0.5000	0.44	0.5000	0.44	0.5000	0.44	0.5578	0.53
1000Hz	0.5400	0.43	0.5400	0.43	0.5400	0.43	0.4840	0.52
1250Hz	0.5733	0.41	0.5733	0.41	0.5733	0.41	0.4413	0.52
1600Hz	0.6067	0.39	0.6067	0.39	0.6067	0.39	0.4226	0.51
2000Hz	0.6400	0.37	0.6400	0.37	0.6400	0.37	0.3758	0.51
2500Hz	0.6467	0.38	0.6467	0.38	0.6467	0.38	0.4397	0.50
3150Hz	0.6533	0.39	0.6533	0.39	0.6533	0.39	0.5265	0.48
4000Hz	0.6600	0.40	0.6600	0.40	0.6600	0.40	0.6073	0.46
5000Hz	0.6667	0.38	0.6667	0.38	0.6667	0.38	0.6366	0.43
6300Hz	0.6733	0.36	0.6733	0.36	0.6733	0.36	0.6547	0.40
8000Hz	0.6800	0.33	0.6800	0.33	0.6800	0.33	0.7445	0.35
10000Hz	0.6800	0.30	0.6800	0.30	0.6800	0.30	1.0000	0.27

Load RT Save RT Modify RT Apply Ok Cancel

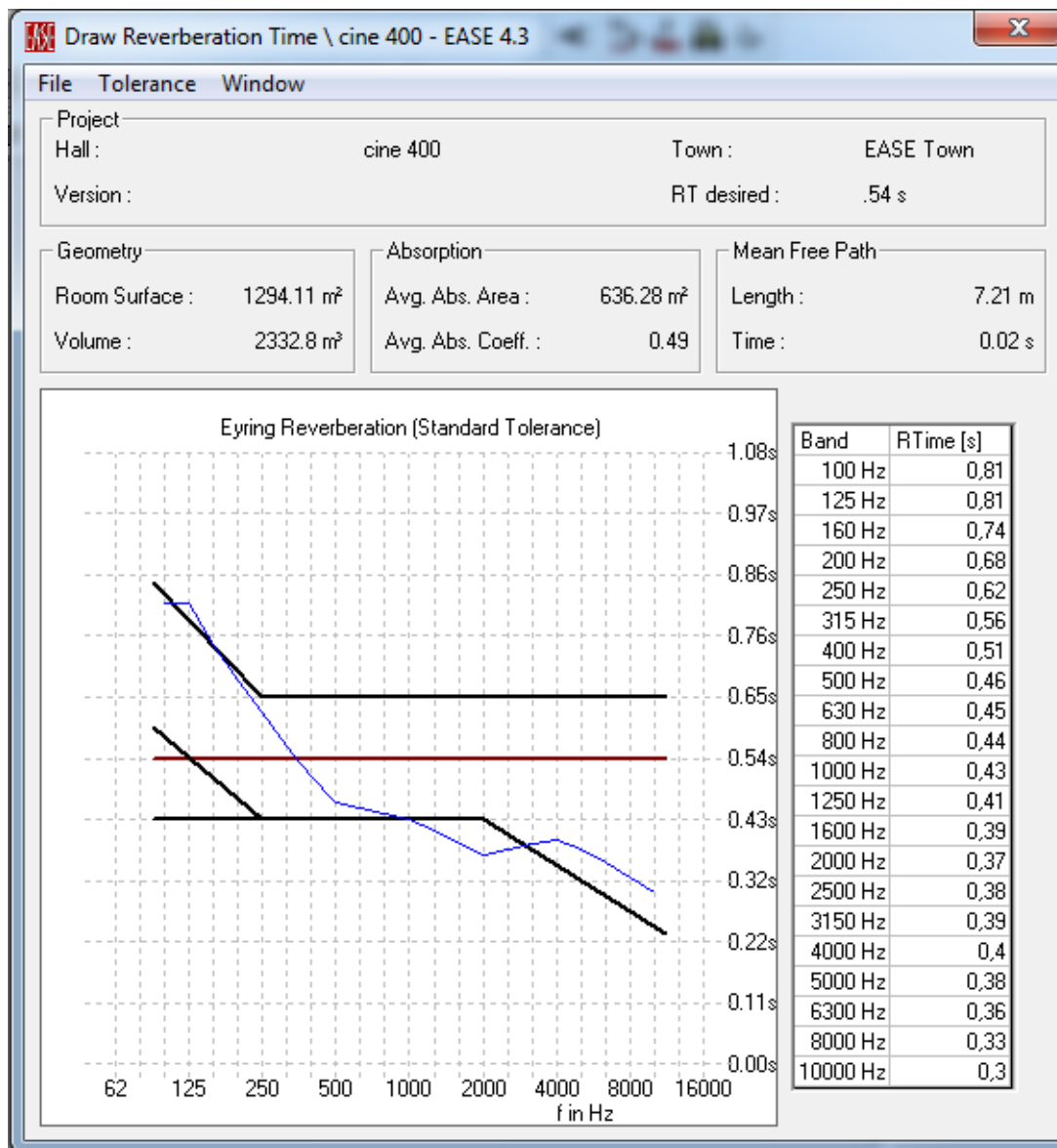


ACOUSTIC SETTINGS





ACOUSTIC SETTINGS

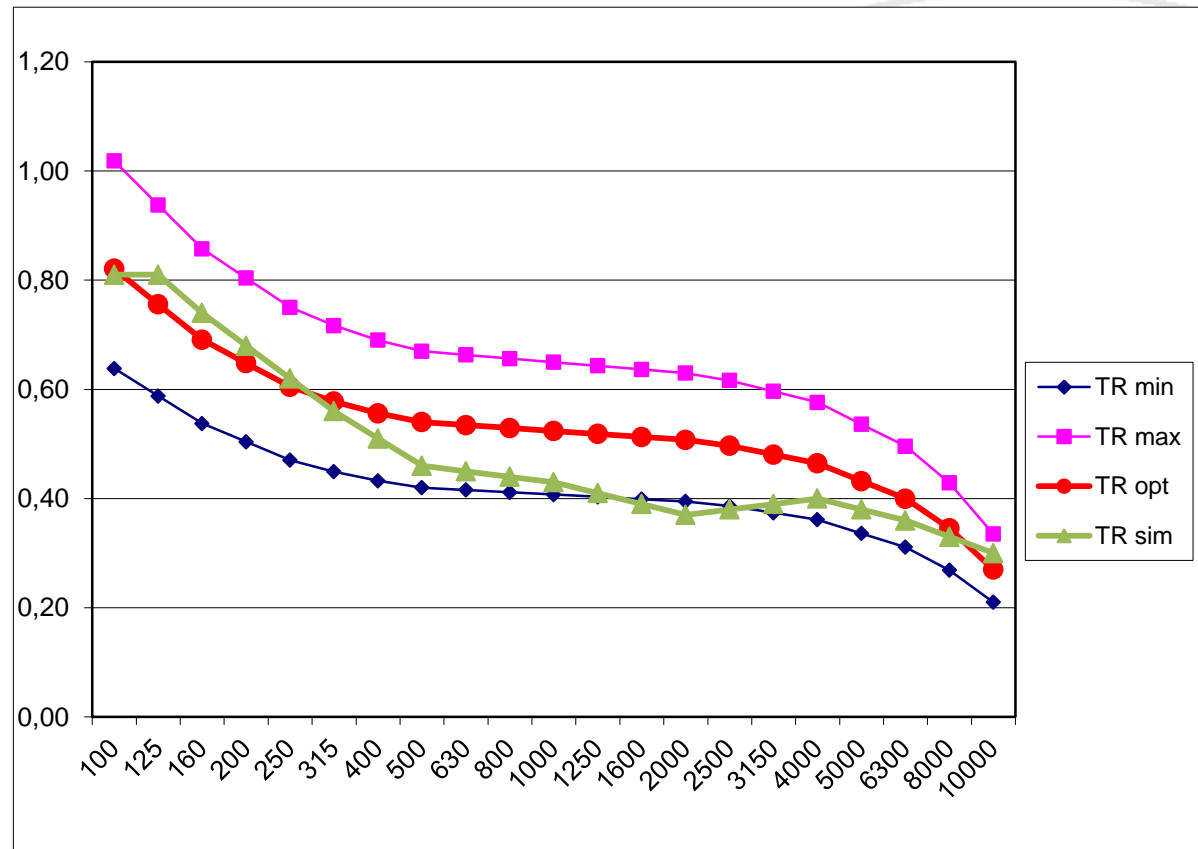




ACOUSTIC SETTINGS



Banda (Hz)	TR optimo (s)	TR simulado (s)
100	0,82	0,81
125	0,76	0,81
160	0,69	0,74
200	0,65	0,68
250	0,60	0,62
315	0,58	0,56
400	0,56	0,51
500	0,54	0,46
630	0,53	0,45
800	0,53	0,44
1000	0,52	0,43
1250	0,52	0,41
1600	0,51	0,39
2000	0,51	0,37
2500	0,50	0,38
3150	0,48	0,39
4000	0,46	0,40
5000	0,43	0,38
6300	0,40	0,36
8000	0,35	0,33
10000	0,27	0,30





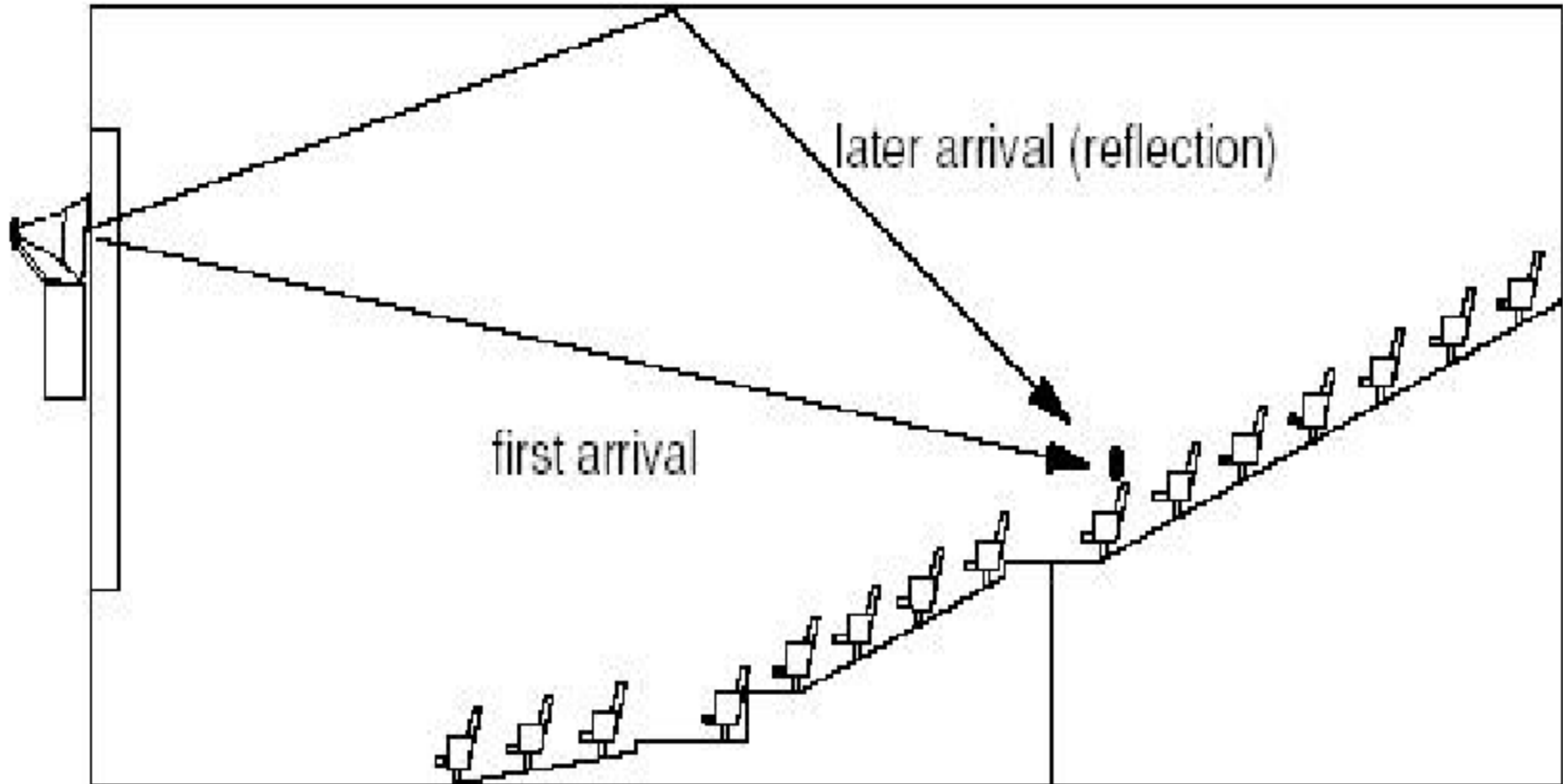
ACOUSTIC SETTINGS



- It must be a special treatment from reflections on the back wall of the room, especially to prevent a second order reflection on the screen and to reach viewers with a few 100 ms delay (which would reduce the intelligibility of the room). This problem of controls with the placement of absorbent material on this surface.
- It is also necessary to treat the posterior surface of the screen with absorbent material to prevent the formation of standing waves between the screen and the back wall.



ACOUSTIC SETTINGS





ACOUSTIC SETTINGS



Sala	Asientos	Volumen	Longitud
Pequeña	<200	1275 m ³ (45000 ft ³)	<12 m
Mediana	200-350	2230 m ³ (78750 ft ³)	<21 m
Grande	350-500	3190 m ³ (112500 ft ³)	<30 m
Extra-Grande	>500	<6375 m ³ (225000 ft ³)	<60 m