

HOW CAN A HALL HAVE A SHORT EDT AND A LONG RT60?

alt.sci.physics.acoustics

: "Tony" <tony...@canada.com>

cha: Tue, 13 Aug 2002 05:43:44 GMT

cal: Mart 13 ago 2002 01:43

unto: How can a hall have a short EDT and a long RT60?

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Hello,

I just finished going through M. Barron's book Auditorium Acoustics & Architectural Design, apart from the usual famous halls, Marshall's Christ Church, and Segerstrom Hall perked my curiosity (appendix C). It seems like the trend in all new high-end concert halls is an occupied midband RT of 2-2.2 sec and an EDT of 1.2-1.4 sec. While there seems to be lots of books on how to get a room with RT60 time of 2 secs to sound good, I can't find any literature on how to get that elusive double slope curve with a EDT of almost half the RT60!

Anyone know the secret?

Tony

Higini

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Más opciones 19 ago 2002, 18:31

upos de noticias: alt.sci.physics.acoustics

: h.a...@terra.es (Higini Arau Puchades)

cha: 19 Aug 2002 15:31:29 -0700

cal: Lun 19 ago 2002 18:31

unto: Re: How can a hall have a short EDT and a long RT60?

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"Tony" <tony...@canada.com> wrote in message

<[news:k0169.138082\\$Aq2.7112216@news2.calgary.shaw.ca](mailto:news:k0169.138082$Aq2.7112216@news2.calgary.shaw.ca)>...

> Hello,

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> the trend in all new high-end concert halls is an occupied midband RT of
> 2-2.2 sec and an EDT of 1.2-1.4 sec. While there seems to be lots of books
> on how to get a room with RT60 time of 2 secs to sound good, I can't find
> any literature on how to get that elusive double slope curve with a EDT of
> almost half the RT60!

> Anyone know the secret?

> Tony

Dear Tony,

The EDT is a consequence of the existence of a non-sound diffuse field. It is dependance of an asymmetrical absorption distribution on the room.

None reverberation time theory treat this subject to exception of An improved reverberation formula (H.Arau-Puchades. Acustica (1988) Vol 65. p.163- 180).

And by other hand only we have the experiments realised by O'Keefe (The influence of heigth/width ratio and side wall boxes on room. Acoustics measurements. Inst. of Acoustics, Manchester, October 1999.), who derived that EDT/RT ratio decrease as a function of the heigth to width ratio. For heigth to width ratios greater than 1.0, the EDT/RT ratio is perfectly efficient, or similars. If the height to width ratios les than 1 there is a degradation of the early decay time being possible in a hall with a RT = 2s to obatin an EDT 0.4 s shorter that RT in a low ceiling concert hall.To summarise, in a wide, flat room one can expected the EDT to be much shorter than the RT, EDT/RT ratios could be in the range of 70 to 80%. Also he investigated the effect of the absorption above EDT. As final conclusion obtained the EDT/RT ratio is shown to be proportional to the Height to width ratio and inversely proportional to average room absorption.

Now we will analyse it from the view point of the H.Arau (1988).

In this theory we have: $EDT = RT/d$, being d the factor dispersion, given in equation (34). Therefore: $EDT/RT = 1/d$. If $d=1$ then $EDT = RT$ and therefore we have sound diffuse field.

The d factor was improved in equation (15) in the paper "General Theory of the Energy Relations in Halls with Asymmetrical Absorption.(1998) Higini Arau. Building Acoustics, Vol 5 number 3, p.163-183).

According to theory of H.Arau we have the EDT (there indicated T_i) is dependent in main proportion to the absorption distribution on the several surfaces and second term to the geometrical relations, specially to the heigth/widht ratio.

We assume we have the following cases:

Hall 1: Long 40 m, Witdh = 20 m, Height = 12.5 m

Hall 2: Long 32 m, Witdh = 25 m, Height = 12.5 m

Hall 3: Long 25 m, Witdh = 15 m, Height = 26.66 m

Hall 4: Long 53.33 m, Witdh = 15 m, Height = 12.5 m

Hall 5: Long 50 m, Witdh = 50 m, Height = 8 m.

Hall 6: Long 24.3 m, Witdh = 15 m, Height = 24.3 m.

Hall 7: Long 24.3 m, Witdh = 24.3 m, Height = 15 m.

In all these cases the absorption are: Alfa foor: 0.8, Alfa ceiling: 0.09

alfa walls: 0.09. In these cases we have tried to obtain a mean free path l_m similar.

The values calculated, for $\beta = -2$, are:

Case H/W L/W RTSabine RTArau d EDT/RT l_m alfa mean

1	0.625	2	1.913	2.153	1.257	0.795	12.903	0.273
2	0.5	1.28	1.91	2.12	1.253	0.798	13.22	0.278
3	1.77	1.666	2.939	3.493	1.214	0.823	12.976	0.176
4	0.833	3.555	1.854	2.109	1.254	0.797	12.09	0.262
5	0.16	1	1.358	1.288	1.214	0.823	12.12	0.359
6	1.62	1.62	2.85	3.401	1.224	0.817	13.425	0.188
7	0.6173	1	2.161	2.49	1.252	0.794	13.425	0.249

Analysing these cases we have that:

When the EDT/RT ratio are increasing for high H/W ratio (case 3) or also for very smaller W/H ratio (case 5). In specially the case 6 have a golden proportion related by the fibonacci number. This case is good the EDT/RT ratio is higher. Many old churches of the temple have these proportions. And also is observed that when be greatest the area of maximum absorption (in these cases the floor) will be shorter EDT/RT ratio.

What happens when the absorption is varied?

Analyse first the case 6 putting alfa walls = 0.20, alfa ceiling= 0.09, alfa floor= 0.80,(called case 66) and second changing again putting: alfa walls = 0.45, alfa ceiling= 0.09, alfa floor= 0.80 (called case 666).

And also the case 7 putting: alfa walls = 0.20, alfa ceiling= 0.09, alfa floor= 0.80 (called case 77) and second putting: alfa walls = 0.45, alfa ceiling= 0.09, alfa floor= 0.80 (called case 777)

Case	H/W	L/W	RTSabine	RTArau	d	EDT/RT	Im	alfa
6	1.62	1.62	2.85	3.401	1.224	0.817	13.425	0.188
66	1.62	1.62	2.011	1.845	1.114	0.817	13.425	0.188
666	1.62	1.62	1.205	0.909	1.007	0.993	13.425	0.449
7	0.6173	1	2.161	2.49	1.252	0.897	13.425	0.268
77	0.6173	1	1.741	1.565	1.127	0.887	13.425	0.310
777	0.6173	1	1.207	0.912	1.002	0.998	13.425	0.448

We see that when the absorption is adequately distributed on the surfaces of the hall the the EDT/RT ratio is noticeably improved.
Sincerely yours

Higini

Eric

[Desart](#)[Ver perfil](#) [Traducir al Español](#)[Traducido \(ver original\)](#) Más opciones 19 ago 2002, 20:54

upos de noticias: alt.sci.physics.acoustics

: "Eric Desart" <af...@belgacom.net>

cha: Tue, 20 Aug 2002 02:48:13 +0200

cal: Lun 19 ago 2002 20:48

unto: Re: How can a hall have a short EDT and a long RT60?

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Hello Higini,

Welcome back

Eric

"Higini Arau Puchades" <h.a...@terra.es> schreef in bericht
[news:beec2401.0208191431.1338ca19@posting.google.com...](https://news.beec2401.0208191431.1338ca19@posting.google.com...)

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<[news:k0169.138082\\$Ag2.7112216@news2.calgary.shaw.ca](mailto:news:k0169.138082$Ag2.7112216@news2.calgary.shaw.ca)>...

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Más opciones 20 ago 2002, 05:19

upos de noticias: alt.sci.physics.acoustics

: h.a...@terra.es (Higini Arau Puchades)

cha: 20 Aug 2002 02:19:24 -0700

cal: Mart 20 ago 2002 05:19

unto: Re: How can a hall have a short EDT and a long RT60?

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"Eric Desart" <af...@belgacom.net> wrote in message

<[news:3d6192c5\\$0\\$187\\$ba620e4c@news.skynet.be](mailto:news:3d6192c5$0$187$ba620e4c@news.skynet.be)>...

> Hello Higini,

> Welcome back

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> news:beec2401.0208191431.1338ca19@posting.google.com...

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Hello Eric,

Other I am here with you. But I go to holidays after a time of very hard job .

Spain is ever of feast, and Catalonia land of Gaudi very enjoy, with very sun, good sea and mountains and prairies very green. Come you someone day with me, you can regard that I say you.

Kind regards

Higini

John

O'Keefe [Ver perfil](#) [Traducir al Español](#) Traducido (ver [original](#)) Más opciones 13 sep 2002, 17:29

upos de noticias: alt.sci.physics.acoustics

: John O'Keefe <joke...@aercoustics.com>

cha: Fri, 13 Sep 2002 17:19:54 -0400

cal: Vie 13 sep 2002 17:19

unto: Re: How can a hall have a short EDT and a long RT60?

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For those who might be interested, here is a link to my paper quoted below:

<http://www.aercoustics.com/papers/ioa99/ioa99.htm>

I might also note that, although I have chosen to make the correlation between Height/Width Ratio and the EDT/RT ratio, that was only done so the concept could be easily understood by the rest of the world. For those of us who understand how sound behaves in a room, I could have just as easily chosen a correlation between the ratio of Seat Absorption/Total Absorption vs H/W ratio. My guess is that the latter of these two alternatives (i.e Sabs/Tabs vs H/W ratio) is probably the more physically robust. This concept was part of the presentation in Manchester but I have not written anything about it yet.

... consider it an alt.sci.physics.acoustics scoop ;-)

John O'Keefe

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John

[O'Keefe](#) [Ver perfil](#) [Traducir al Español](#) [Traducido \(ver original\)](#) Más opciones 13 sep 2002, 17:40

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: John O'Keefe <joke...@aercoustics.com>

cha: Fri, 13 Sep 2002 17:30:54 -0400

cal: Vie 13 sep 2002 17:30

unto: Re: How can a hall have a short EDT and a long RT60?

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Higini

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Más opciones 14 sep 2002, 11:08

upos de noticias: **alt.sci.physics.acoustics**

: **h.a...@terra.es (Higini Arau Puchades)**

cha: **14 Sep 2002 08:08:42 -0700**

cal: **Sáb 14 sep 2002 11:08**

unto: **Re: How can a hall have a short EDT and a long RT60?**

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> presentation in Manchester but I have not written anything about it yet.

> ... consider it an alt.sci.physics.acoustics scoop ;-)

> John O'Keefe

Hello John:

From my table of the six cases presented the other day, grouping only H/W ratio and EDT /RT ratio, in were the main absorption in all cases were concentrated in the floor, alfa = 0.8, and the mean chord of the halls are similars, we had:

Case	H/W	EDT/RT
1	0.625	0.795
2	0.5	0.798
3	1.77	0.823
4	0.833	0.797
5	0.16	0.823
6	1.62	0.817
7	0.6173	0.794

Now writing the same H/W ratio from less to higher values of H/W, we

obtain:

Case	H/W	EDT/RT
5	0.16	0.823
2	0.5	0.798
7	0.6173	0.794
1	0.625	0.795
4	0.833	0.797
6	1.62	0.817
3	1.77	0.823

If were posible to draw it, puting H/W ratio in abscises and EDT/RT ratio in ordinates,we would look a curve, that for very low values of H/W we obtain a high value of EDT/RT ratio, increasing the value of H/W then the EDT/RT values are decreasing until a minimum value, after of this minimum, increasing H/W the EDT/RT values obtained are increased.

What physical explanation have it? I will try say something about it: I believe that the EDT is strong dependent with existance of early reflections.

In the case 5 I have a room where the fraction of the walls with relation to the total area surfaces is very small, being in this case the ceiling fraction is very important. In this case the main early reflections only are given by the ceiling because the wall reflections produced are very weak due that the walls are very few influence. When the H/W is increased then the early reflections due to the presence of the walls are increased looking for a equilbrim with the early reflections produced by ceiling. When the early reflections produced by walls are similar to the ceiling reflections produced, or that the area fractions are similars, then we obtain the mínimum of EDT/RT. Following if the fraction area ceiling is dismishid in proportion to the walls fraction, then the early reflections of the walls are very important, more than those produced by ceiling, and in consequence the EDT/RT ratio is increased.

Now I will realise other correlation, you say "a correlation between the ratio of Seat Absorption/Total Absorption vs EDT/RT ratio". In my cases the area seats is the floor. Now I realise the following ratio: (SA / TA) , where are,
Seat absorption (SA) = Floor area x alfa floor, being Total Absorption (TA) = Overall Area surfaces x alfa mean. In the next table I write (SA / TA) related with the EDT /RT values is obtained:

Case	(SA/TA)	EDT/RT
1	0.756	0.795
2	0.761	0.798
3	0.553	0.823
4	0.738	0.797
5	0.960	0.823
6	0.587	0.817
7	0.718	0.794

Now writing the same (SA/TA) ratio from less to higher values, we obtain:

Case	(SA/TA)	EDT/RT
3	0.553	0.823
6	0.587	0.817
7	0.718	0.794

4	0.738	0.797
1	0.756	0.795
2	0.761	0.798
5	0.960	0.823

Now, I do not know what conclusion I must to obtain with these values.

Regards

Higini