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**CONCERT HALL ACOUSTICS, ONLINE RATING, AND  
BERANEK'S DATA COLLECTION**

# Abstract

One of Leo Beranek's special contributions in concert hall acoustics was his work on rank ordering of concert halls, based on qualified assessors' preference for their acoustics. In his papers as well as in his book *Concert Halls and Opera Houses*, Beranek presented the rank orderings together with objective data from the halls included in the ranking.

By making this collection of subjective and objective data available for the scientific society, it was possible to investigate the degree to which preference could be explained by the physical and acoustical properties of the halls.

This author has tried to take up this legacy by extending the collection of halls, in particular by including halls built after the publication of Beranek's rank ordering. For this purpose, the Online Concert Hall Acoustics Rating Survey has been launched, inviting all concert hall goers to submit their rating at <https://no.surveymonkey.com/r/MMFMZ5W>.

Indeed, in his last paper in JASA, April 2016, Beranek referred to the preliminary results. In this paper, an updated report from the survey will be presented, together with an analysis of how the current ratings correlate with Beranek's rank orderings.

An example of how to combine data from Ranking, Rating and objective data in Beranek's data collection, to predict rating of future halls, is presented.

# Data

- 2003, Beranek, *Subjective rank-orderings and acoustical measurements for fifty-eight concert halls*,
- 2004, Beranek, *Concert Halls and Opera Houses*
- 2012-2017, AKUTEK, Online Rating of Concert Hall Acoustics
- 2016, Beranek, *Concert Hall Acoustics – Recent Findings*, JASA, April 2016.

# 2003: Rank ordering 58 halls

1\_Vienna

2\_Boston

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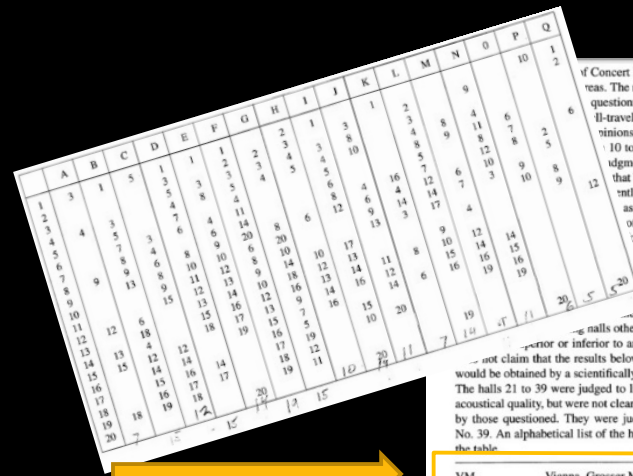
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...

57\_Buffalo

58\_London (R.A. Hall)



Non-parametric  
method

of Concert Halls According to Acoustics. The rank ordering presented here questionnaires involving conductors, ill-traveled concert aficionados. No opinions on more than 20 halls, and 10 to 15. The list is compiled by judgments using a non-parametric method planned or completed re-assess in judging the efficiency of the sound fields in the halls. or concerts and today the author renovations marked (br)

s from one person to another have different acoustics. use of this list by any party halls other than for research, or listing prior or inferior to any other. Further, the author not claim that the results below are the same as those that would be obtained by a scientifically rigid procedure.

The halls 21 to 39 were judged to lie below the first 20 halls in acoustical quality, but were not clearly separated from each other by those questioned. They were judged superior to those after No. 39. An alphabetical list of the halls in that group is given in the table.

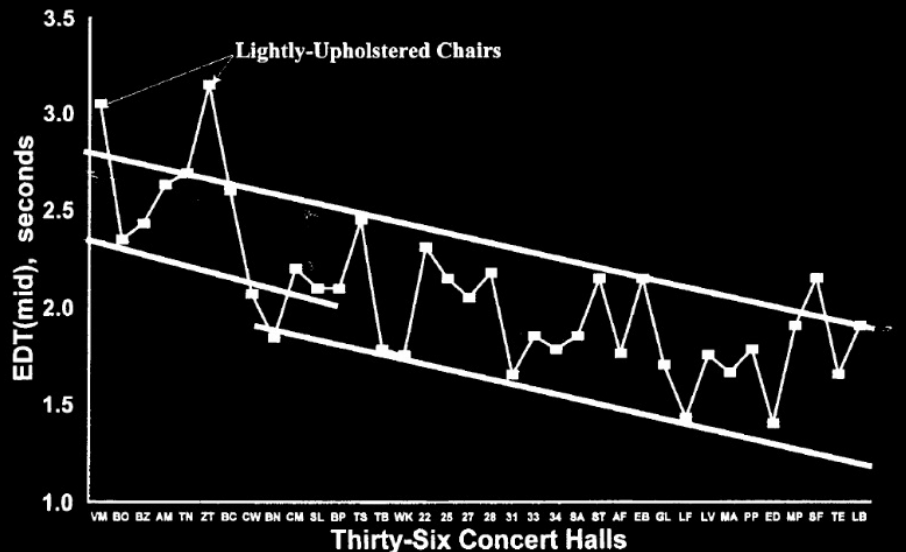
VM	Vienna, Grosser Musikvereinsaal
BO	Boston, Symphony Hall
BA	Buenos Aires, Teatro Colon (Concert Shell)
BZ	Berlin, Konzerthaus (Schauspielhaus)
AM	Amsterdam, Concertgebouw
TN	Tokyo, Tokyo Opera City TOC Concert Hall
ZT	Zurich, Grosser Tonhalleaal
NY	New York, Carnegie Hall
BC	Basel, Stadi-Casino
CW	Cardiff, St. David's Hall
DA	Dallas, McDermott/Meyerson Hall
BN	Bristol, Colston Hall
SO	Lenox, Seiji Ozawa Hall (Rear Door Open)
CM	Costa Mesa, Segerstrom Hall
SL	Salt Lake City, Abravanel Symphony Hall
BP	Berlin, Philharmonie
TS	Tokyo, Suntory Hall
TB	Tokyo, Bunka Kaikan (Orchestra Shell)

Table II. Continuation.

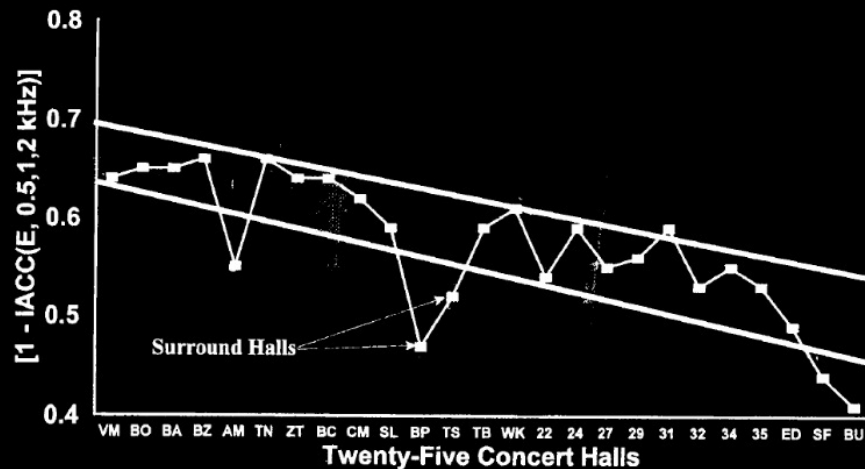
BR	Brussels, Palais des Beaux Arts (Renovated)
BM	Baltimore, Meyerhoff Symphony Hall
	Bonn, Beethovenhalle
	Chicago, Civic Center
	Chicago, Orchestra Hall (br)
	Christchurch, Town Hall
	Cleveland, Severance Hall (br)
	Gothenburg, Konserthus
21	Jerusalem, Binyanei Ha'Oomah
	Kyoto, Concert Hall
10	Leipzig, Gewandhaus
39	Lenox, Tanglewood Music Shed
	Munich, Philharmonie Am Gasteig
	Osaka, Symphony Hall
	Rotterdam, De Doelen Concertgebouw
	Tokyo, Metropolitan Art Space
	Tokyo, Orchard Hall, Bunkamura
	Toronto, Roy Thompson Hall (br)
	Vienna, Konzerthaus (br)
	Washington, JFK Concert Hall (br)
	Washington, JFK Opera House (set)
SA	Salzburg, Festspielhaus
ST	Stuttgart, Liederhalle, Grosser Saal
AF	New York, Avery Fisher Hall
CR	Copenhagen, Radiohuset, Studio I
EB	Edinburgh, Usher Hall (br)
GL	Glasgow, Royal Concert Hall (br)
LF	London, Royal Festival Hall (br)
LV	Liverpool, Philharmonic Hall (br)
MA	Manchester, Free Trade Hall (Replaced)
PP	Paris, Salle Pleyel (br)
ED	Edmonton, No. Alberta Jubilee Auditorium (br)
MP	Montreal, Salle Wilfrid-Pelletier (br)
TK	Tokyo, NHK Hall (3677 Seats)
SH	Sydney, Opera House Concert Hall (br)
SF	San Francisco, Davies Symphony Hall (br)
TE	Tel Aviv, Fredric R. Mann Auditorium (br)
LB	London, Barbican, Large Concert Hall (br)
BU	Buffalo, Kieinhans Music Hall (br)
LA	London, Royal Albert Hall (5080 Seats) (br)

# 2003: Rank vs Technical data

## EDT vs Rank, 36 halls



## BQI vs Rank, 25 halls



## 2004: *Concert Halls and Opera Houses*

## 80 Concert halls

## Collection of measurements

## Parameters

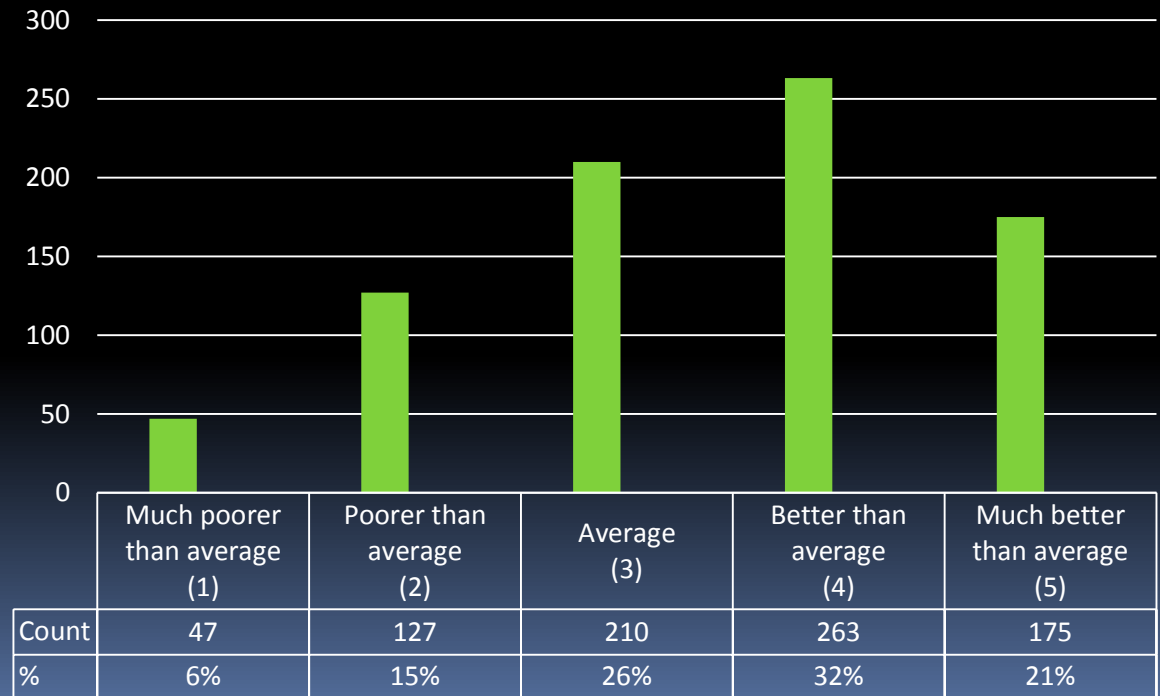
## Seat count, hall volume and dimensions

[illegible]

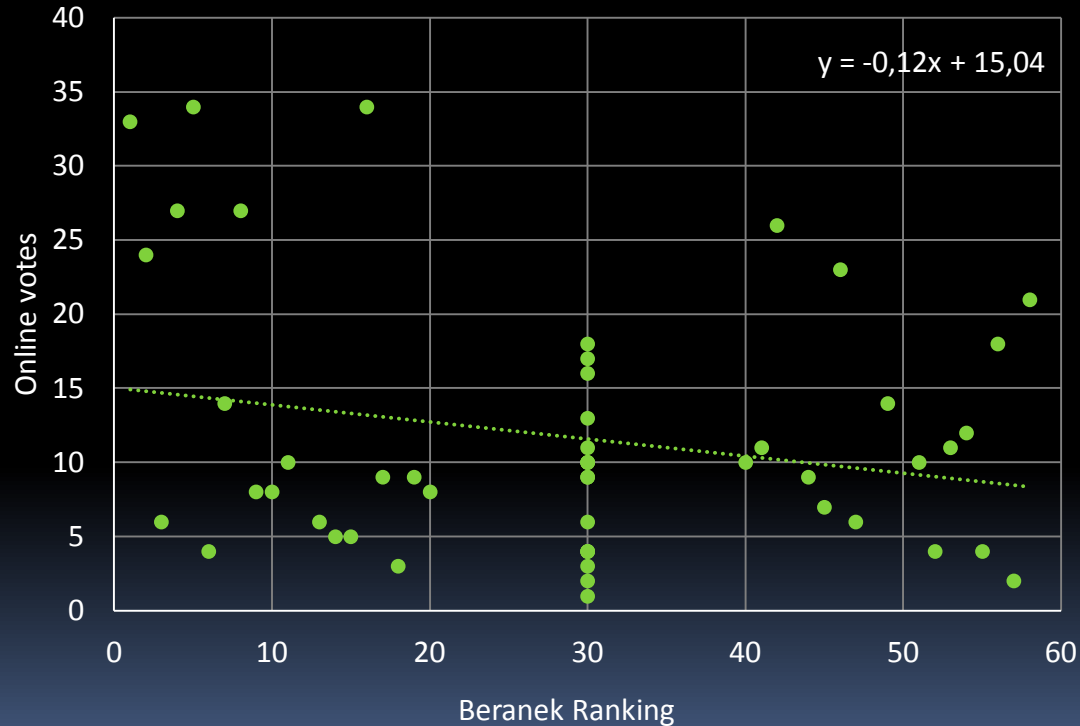
# 2012- AKUTEK Online Rating Survey

“In those halls in the list where you have attended a concert with a symphony orchestra once or more, how do you rate the acoustics there?” (On a 1-5 scale)

80 halls  
807 votes  
84 voters  
mean vote =3.5



# High ranked halls more frequently assessed

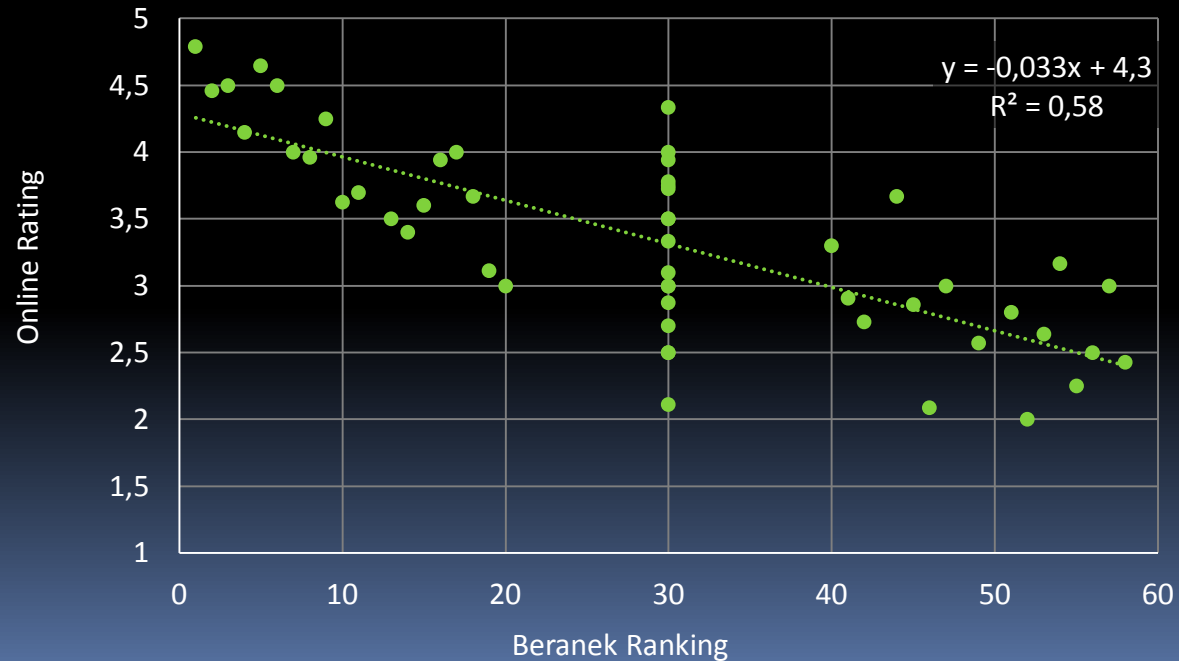


Explaining why average rating (3.5) is better than «average» (3.0)



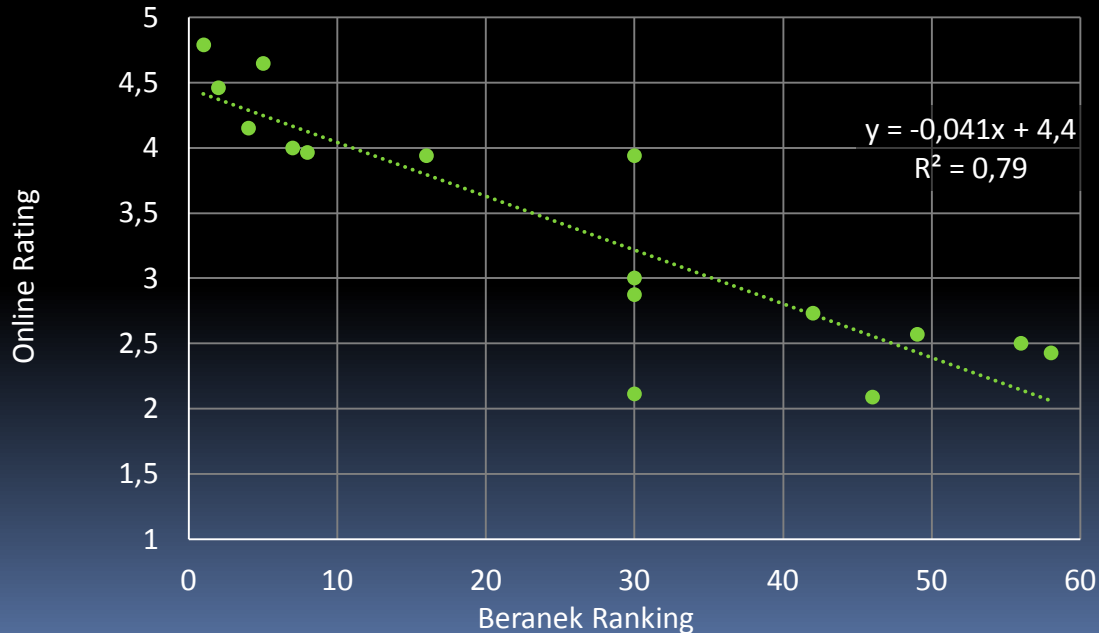
# Online Rating vs Beranek Rank

52 halls in Beranek's rank-ordering  
received least 1 vote in online rating



# Online Rating vs Beranek Rank

16 halls in Beranek's rank-ordering  
received at least 12 votes in online rating



# Beranek, JASA, April 2016

Hall	Type	Beranek 58 Ranking	Online Rating
Vienna, Musikvereinsaal	Shoebox	1	4,8
Boston, Symphony Hall	Shoebox	2	4,4
Amsterdam, Concertgebouw	Shoebox	4	4,6
Berlin, Konzerthaus	Shoebox	3	4,1
Tokyo, Opera City Concert Hall	Shoebox	5	4,3
Basel, Stadt Casino	Shoebox	8	4,4
Birmingham, Symphony Hall	Parallel walls	N/A	4,4
Lucerne, Cultural Ctr. Hall	Shoebox	N/A	4,3
Cardiff, St. David's Hall	Surround	9	4,0
Dallas, Meyerson Center	Parallel walls	10	4,3
Cardiff, St. David's Hall	Surround	9	4,0
Berlin, Philharmonie	Surround	16	3,9
Tokyo, Suntory Hall	Surround	17	3,8
Mexico City, Salla Nazahualcoyotl	Surround	N/A	3,7
Rotterdam, De Doelen	Surround	23	3,2
Toronto, Roy Thompson Hall	Surround	24	3,0
Philadelphia, Verizon Hall	Surround	N/A	2,7

# Involving more parameters than «shoe-box /non-shoebox»

1. Using Beranek ranking to determine optimum parameter values
2. An attempt to use deviations from optima to predict rating of future halls

# 1. Using Beranek ranking to estimate optimum parameter values $P_0$

$P_0$  = parameter-value that best explains Beranek ranking

C and G are calculated from T and V with Barron Revised Theory (BRT)

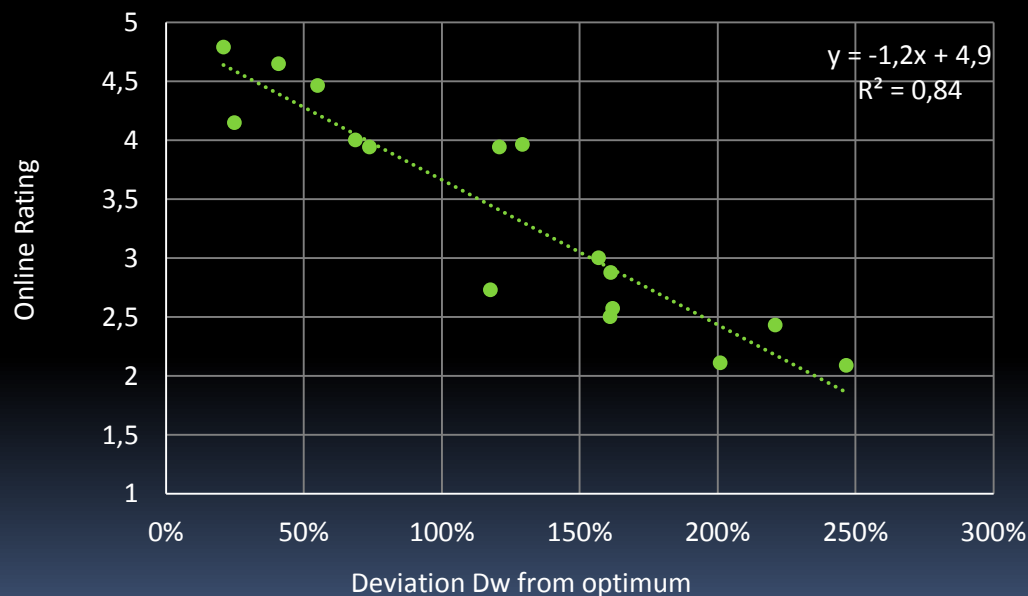
Parameter	$T$	$T_{125}$	$C$	$G$	$G_{125}$	$G_L$	$H/W$	$W$
$m$ = average in B52	1,82	2,21	-0,1	1,6	2,4	-1,3	0,64	30
$s$ = st. dev. in B52	0,26	0,40	0,8	1,7	1,7	1,8	0,23	8,1
<b><math>P_0</math> = optimum value in B52</b>	<b>1,97</b>	<b>2,89</b>	<b>-0,7</b>	<b>3,4</b>	<b>5,1</b>	<b>0,8</b>	<b>0,86</b>	<b>21</b>

Next: Evaluate each hall by its total deviation from these optima

Then: Compare Deviation with Online Rating

## 2. An attempt to use deviations from optimum to predict rating of future halls

Trend: Online Rating =  $4.9 - 1.2 Dw$       Error (RMS) = 0.3



$Dw$  = average deviation from optimum, weighted by parameter's correlation with Beranek Rank  
(100% = 1 standard deviation in a parameter)

# Closing remarks

- AKUTEK intends to continue Beranek's work
- Online Rating includes recent halls
- Online Rating correlates well with Beranek Ranking
- Ranking and Rating indicate 9 of top 10 halls are Shoebox
- Rating of future halls can be predicted with  $\text{Error(RMS)}=0.3$ 
  - Based on technical data known prior to building
- Concert goers are encouraged to take part in Online Rating Survey on [www.akutek.info](http://www.akutek.info)
- All acousticians are encouraged to submit technical data on recent concert halls
- Note: Scientific purpose only

# Thank you

Want more info?

**Link to Online Rating Survey**

The www center for search, research and open sources in acoustics

**[www.akutek.info](http://www.akutek.info)**

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