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**ABSORPTION AREA MATTERS
IN SYMPHONY ORCHESTRA REHEARSAL ROOMS**

Outline

- Problem
- Data collection - method
- Analysis
- Suggestions, Recommendation
- Discussion



Google-it: «Orchestra Rehearsal Room



Orchestra rehearsal room. | ...
researchgate.net



multi use orchestra rehearsal rooms - Google ...
pinterest.com



concept-A - Orchestra rehearsal hall A...
concept-a.net



Orchestra Rehearsal Room, Hannover ...
saint-gobain-gyproc.com



Orchestra Rehearsal Room, Hannover ...
pinterest.com



Stage acoustic requirements extended ...
peutz.nl



Orchestra rehearsal room. | Download Scientific Diagram
researchgate.net



Orchestra Rehearsal Room, Hannover | S...
saint-gobain-gyproc.com



Adams Center: Orchestra Rehearsal Room - Yale...
music.yale.edu



Danubia inaugurates new rehearsal room | ...
odz.hu



Facilities/Rehearsal Rooms
operacity.jp



LU Rehearsal Room | Acoustica...
acousticalsolutions.com



Danubia inaugurates new rehearsal room | D...
odz.hu



PRACTICE ROOM Studio on T...
twitter.com



Band/Orchestra Rehearsal Hall | ...
pinterest.com



Lieu de tournage Paris Ile-de-france - CNSMDP - Orc...
idf-film.com



ICO Studio | Irish Chamber Orchestra | Widmann | Classic...
irishchamberorchestra.com



Shun Mook Audio, Inc.
shunmook.com



Rehearsal Room for national orchestra Jeddah x Tisseyre+...
planete-acoustique.com

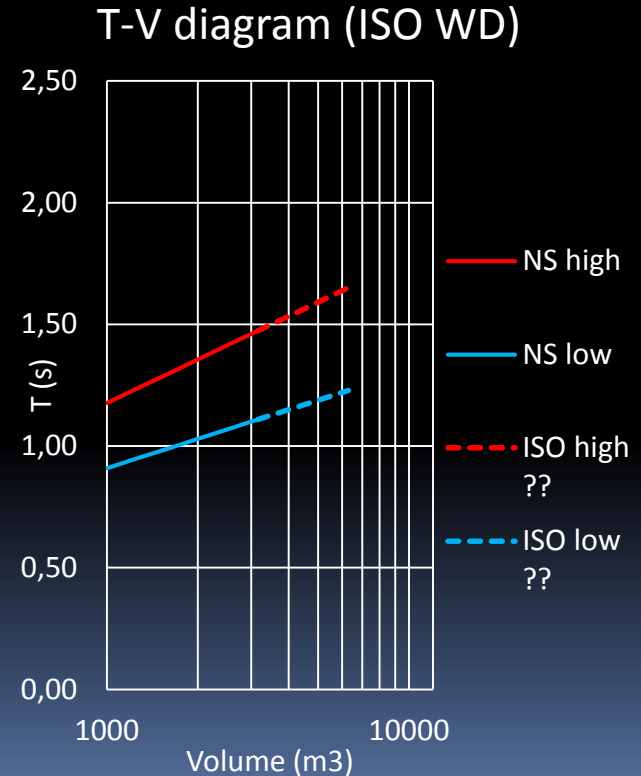


Indian Hill Performance Center - mng-low
mng-low.smugmug.com



Problem

- Wanted:
 - Rehearsal spaces for symphony orchestras
 - Adequate acoustics – recommendations
 - ISO-standard currently in the making
 - Limits in T-V diagram
 - Data from existing rehearsal rooms
 - Ratings, as a basis for limits

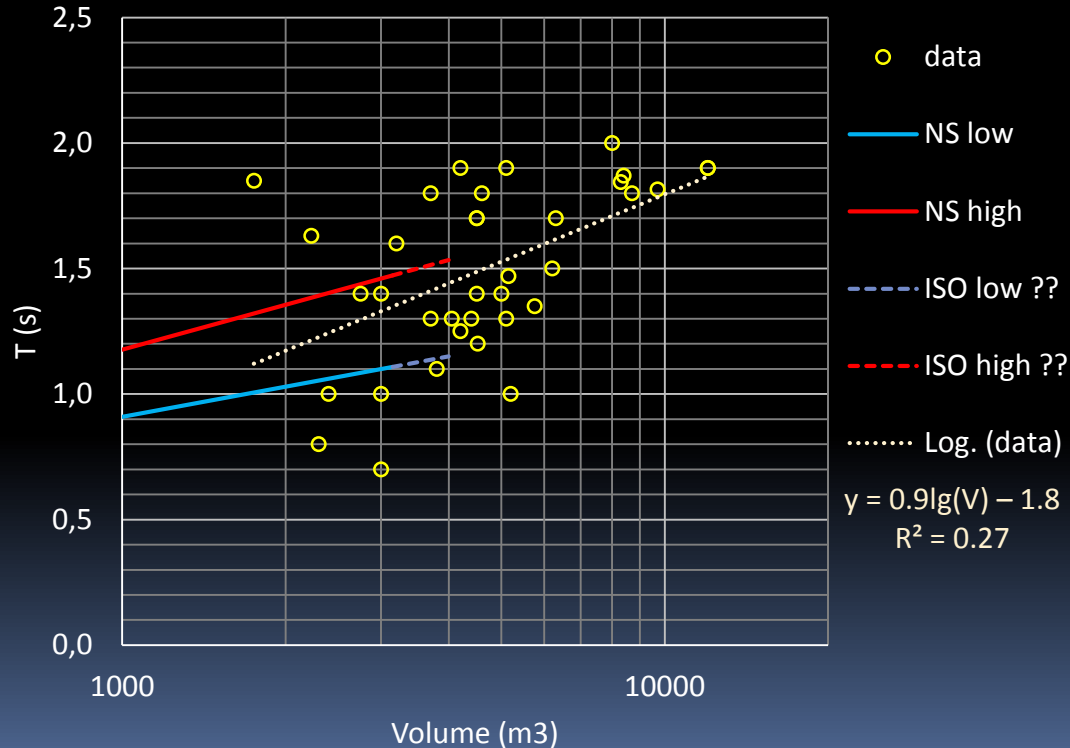


Data collection, sources

- Literature review
- Papers, articles, reports
- Invitation to submit data – www.akutek.info
- Personal communication with acousticians

T-V data collected, 37 rehearsal halls

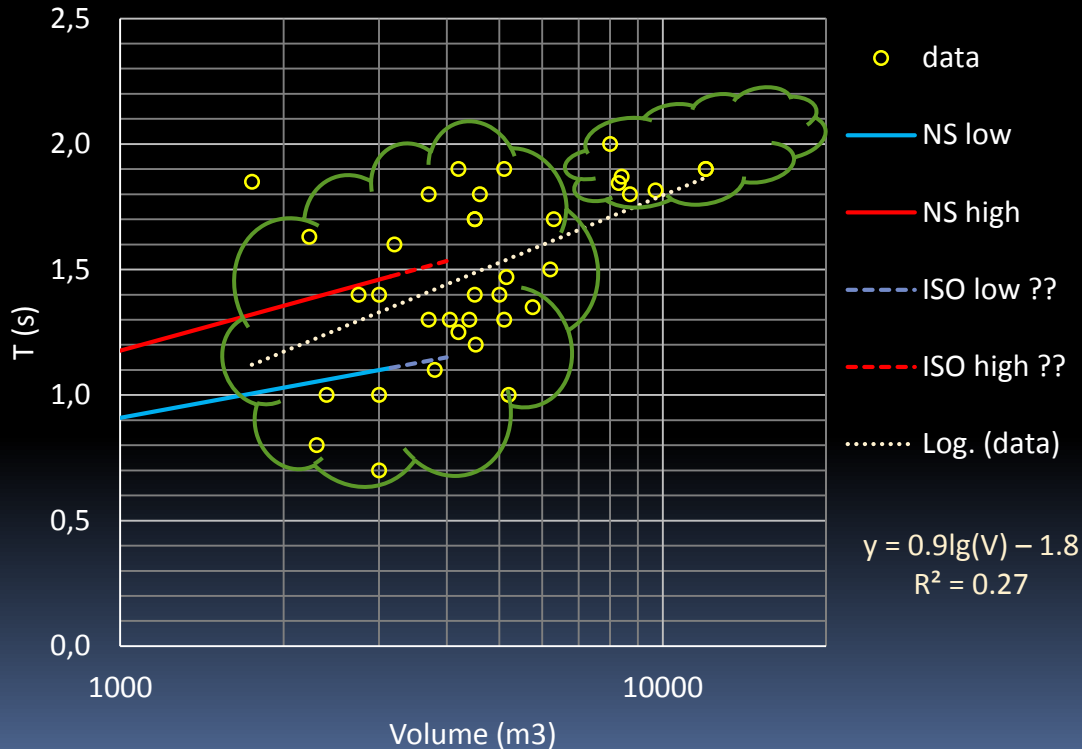
Rehearsal spaces for symphony orchestras (unoccupied)



Small < 6500m³ < Big

Rehearsal spaces for symphony orchestras (unoccupied)

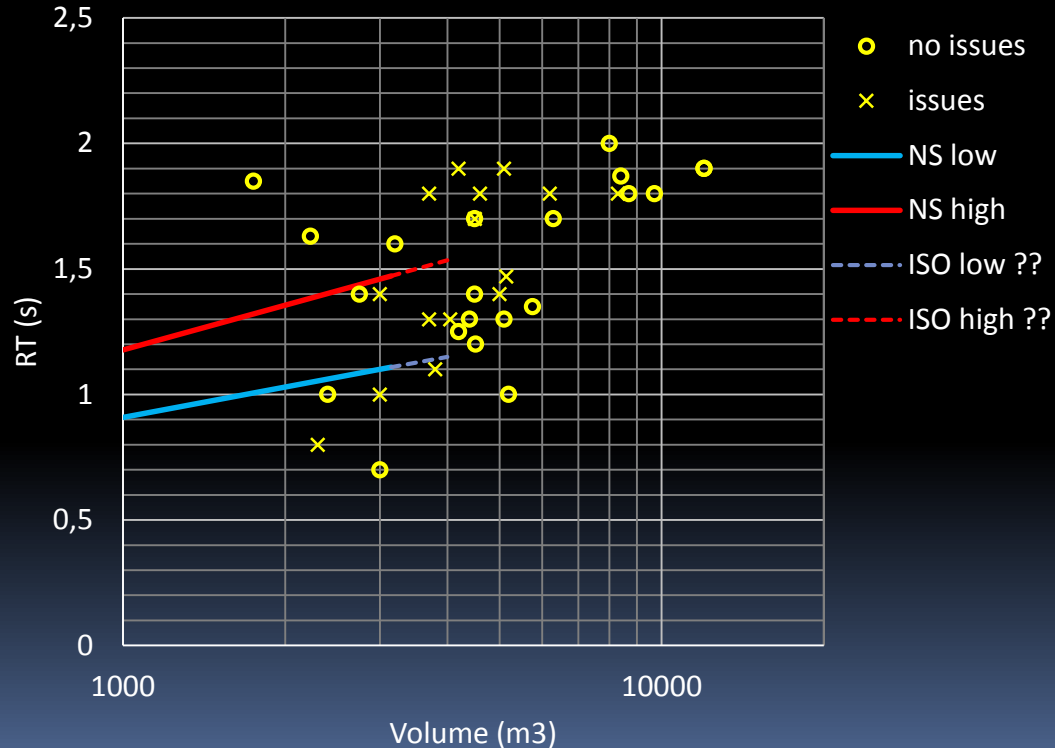
Small V < 6500m³
Big variation
0.7-1.9s



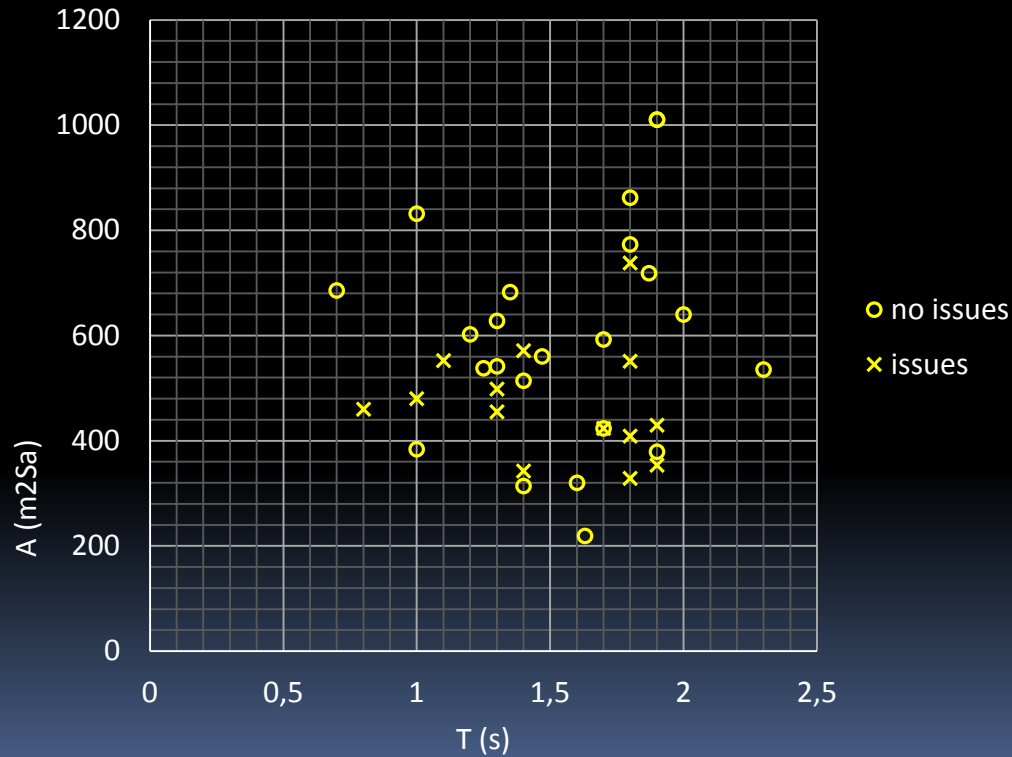
Big V > 6500m³
Small variation
1.8-2.0s

38%, 13 out of 37 cases with 'issues'

Rehearsal spaces for symphony orchestras (unoccupied)

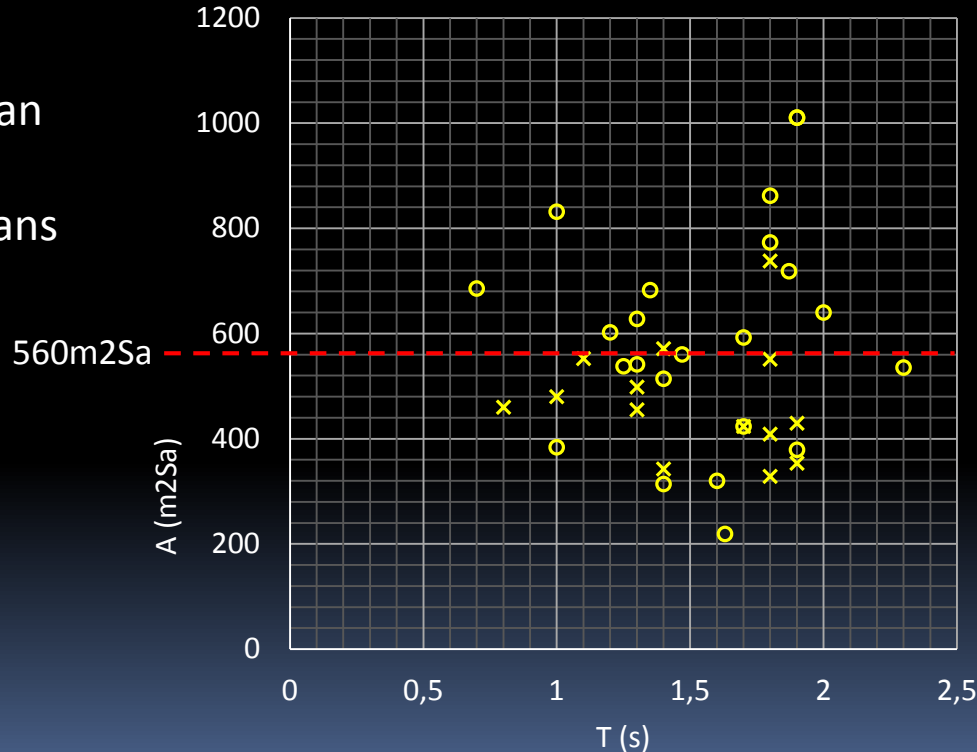


Absorption area



Absorption area suggestion $A > 560 \text{ m}^2\text{Sa}$

Gade (2012):
8 m²Sa per musician
assume >70 musicians
 $70 * 8 = 560$

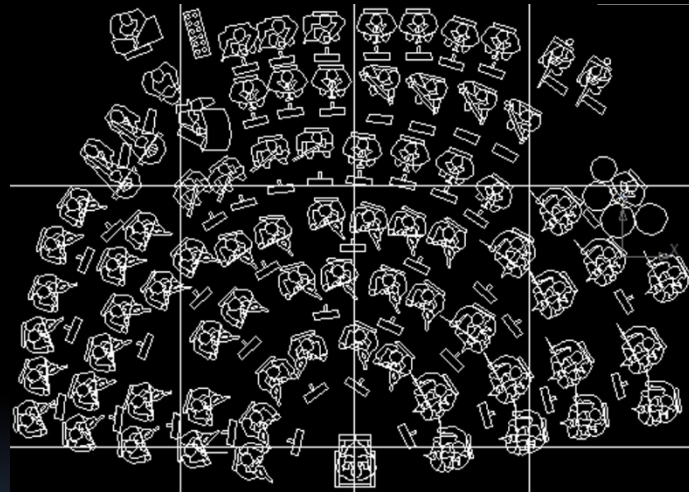


'issues' above limit
 $1/12 = 8\%$

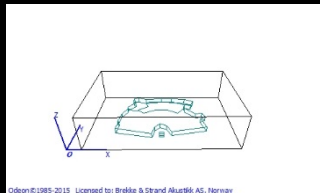
○ no issues
× issues

'issues' below limit
 $13/25 = 52\%$

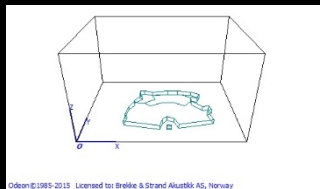
Typical symphony orchestra layout



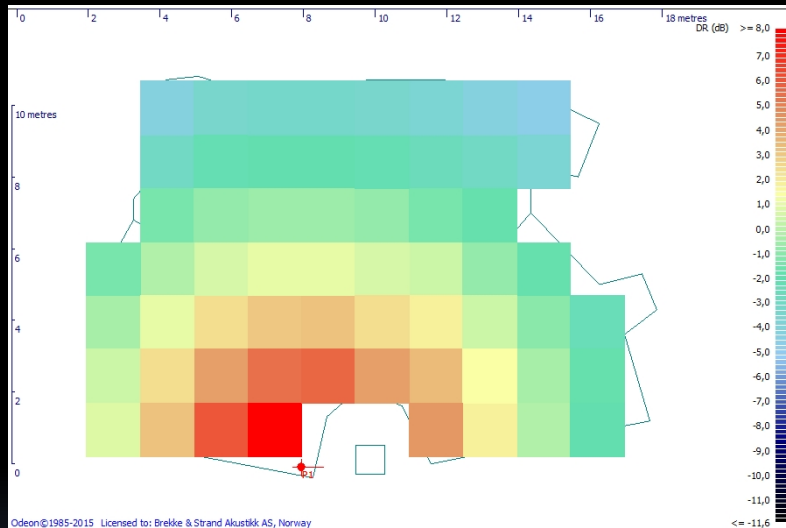
Odeon-models with average $D-R = 0$ dB



2500 m3



8000 m3



Grid response

$V = 5000$ m3

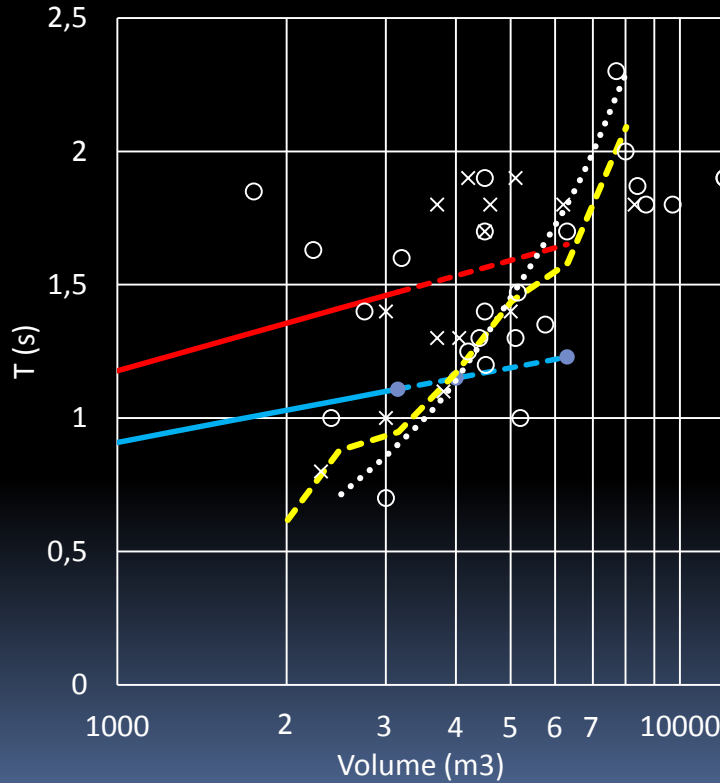
$T = 1.44$ s (unoccupied)

$D-R = 0.0$ dB

7 models
Same 90p orchestra
All average $D-R=0$

V (m3)	T_m (s)	$D-R$ (dB)
2000	0,62	0,0
2500	0,88	-0,1
3150	0,95	0,0
4000	1,17	-0,1
5000	1,44	0,0
6300	1,58	0,1
8000	2,09	0,0

Limits mapped to T-V diagram



Note: Limits are practically equivalent

○ no issues

× issues

— NS low

— NS high

- - - ISO low ??

- - - ISO high ??

..... 560m2Sa

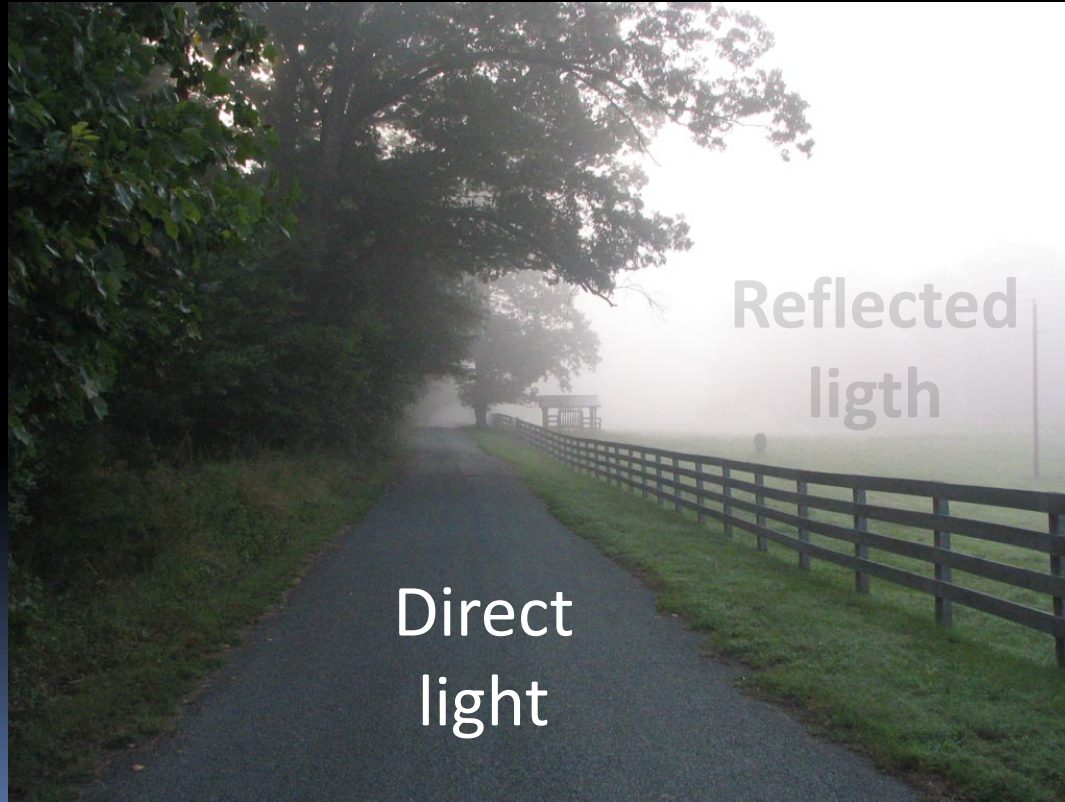
- - - D-R=0

(D-R average over 90p orchestra)

Interpretation of suggested limits

- Direct-Reverb-Balance constant
- Acoustic Transparency constant
 - Reverberation Radius constant
- Mutual Hearing constant
- Ensemble Blend constant
- Possible effects
 - Blend vs Transparency adequately balanced
 - Counteract forced playing and escalating sound levels
 - Happier musicians and conductor

Transparency – optical analogy

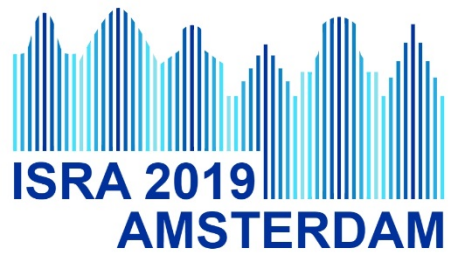


Comments

- $A > 560$, a basic necessity, but not always sufficient
 - early reflections must be considered (early masking, etc.)
- Simulated $D-R = 0$ is a more complete criterion
 - takes energy-time distribution into account
 - requires a 3D-model simulation tool

Summary

- T-V data from 37 SO rehearsal rooms
- $V < 6500\text{m}^3$, wide T-span, $T = 0.7\text{-}1.9\text{s}$
- $V > 6500\text{m}^3$, T like in concert halls $T = 1.8\text{-}2.0\text{s}$
- A-limit accepting 'Issues' in 8% $A > 560\text{m}^2\text{Sa}$
- Gade (2012), $8\text{m}^2/\text{p}$ example $70\text{p} * 8\text{m}^2\text{Sa} = 560\text{m}^2\text{Sa}$
- Inter-orchestral direct-reverb, average $D\text{-}R = 0\text{ dB}$
- Keywords
 - Acoustic Transparency
 - Direct-Reverb-Balance
 - Reverb Radius,
 - Mutual hearing
 - Ensemble
 - Counteract forced playing and escalating sound levels
 - Happier musicians and conductor
- More data welcome



Thank you

Full paper version:

https://www.akutek.info/Papers/MS_orchestra-rehearsal-room_ISRA2019.pdf

More info?

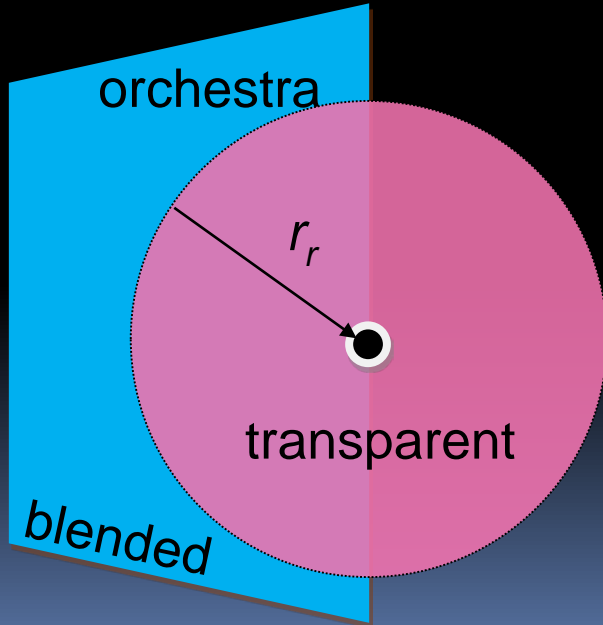
The www center for search, research and open sources in acoustics

www.akutek.info

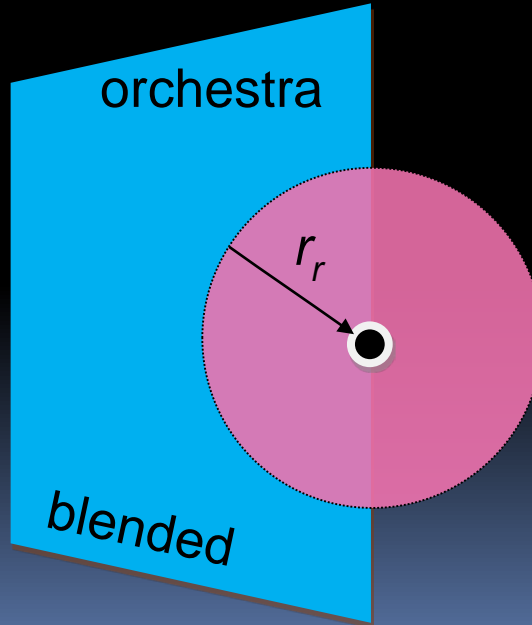
magne.skalevik@brekkestrand.no

Transparent (direct) and blended (reverberant) sound to conductor's ears; Reverberation radius r_r and level G_r

$G_r = 4\text{dB}$



$G_r = 7\text{dB}$



$G_r = 10\text{dB}$

