ISRA 2019
AMSTERDAM

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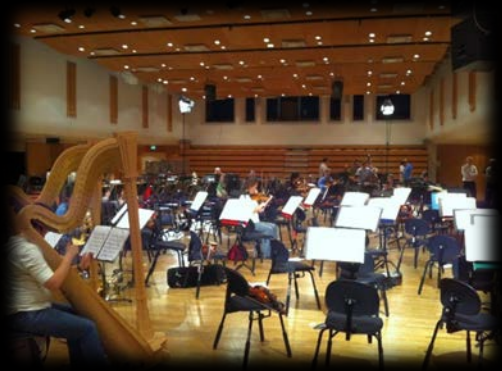
ABSORPTION AREA MATTERS IN SYMPHONY ORCHESTRA REHEARSAL ROOMS

Outline

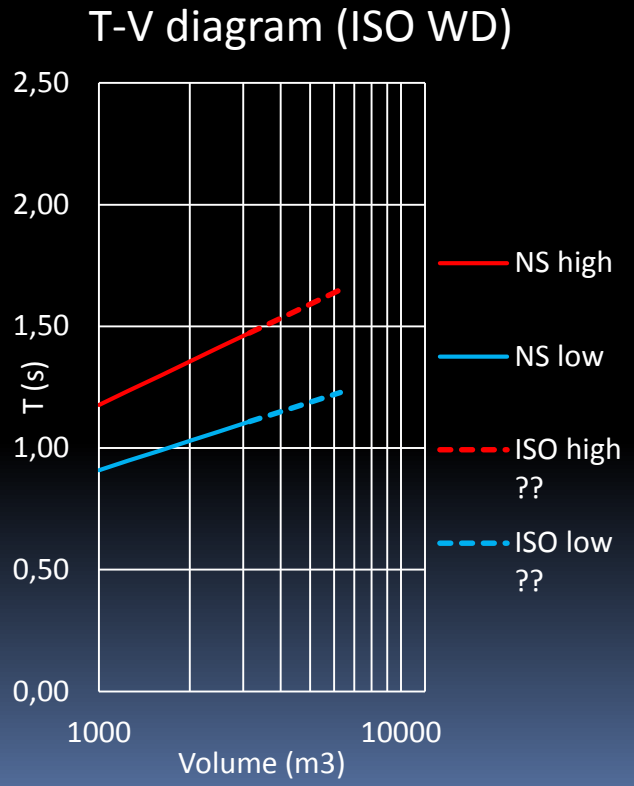
- Problem
- Data collection - method
- Analysis
- Suggestions, Recommendation
- Discussion



Google-it: «Orchestra Rehearsal Room

Problem

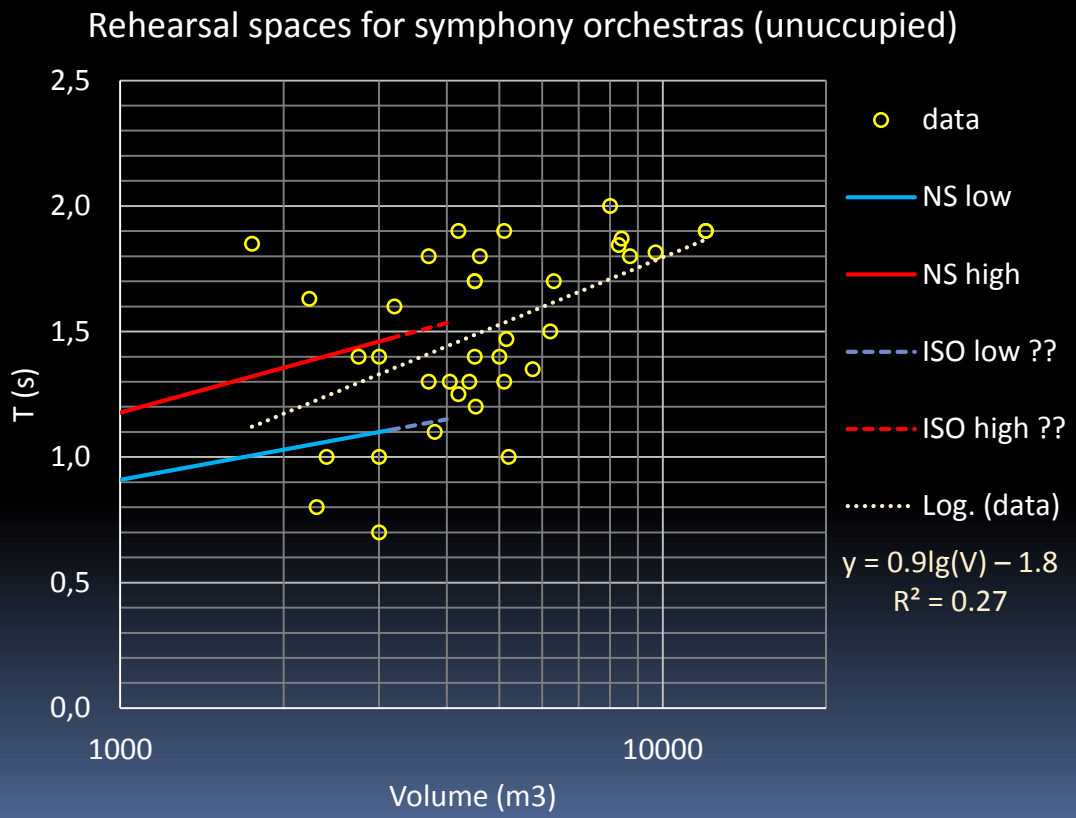
- Wanted:
  - Rehearsal spaces for symphony orchestras
  - Adequate acoustics – recommendations
  - ISO-standard currently in the making
  - Limits in T-V diagram
  - Data from existing rehearsal rooms
  - Ratings, as a basis for limits



Data collection, sources

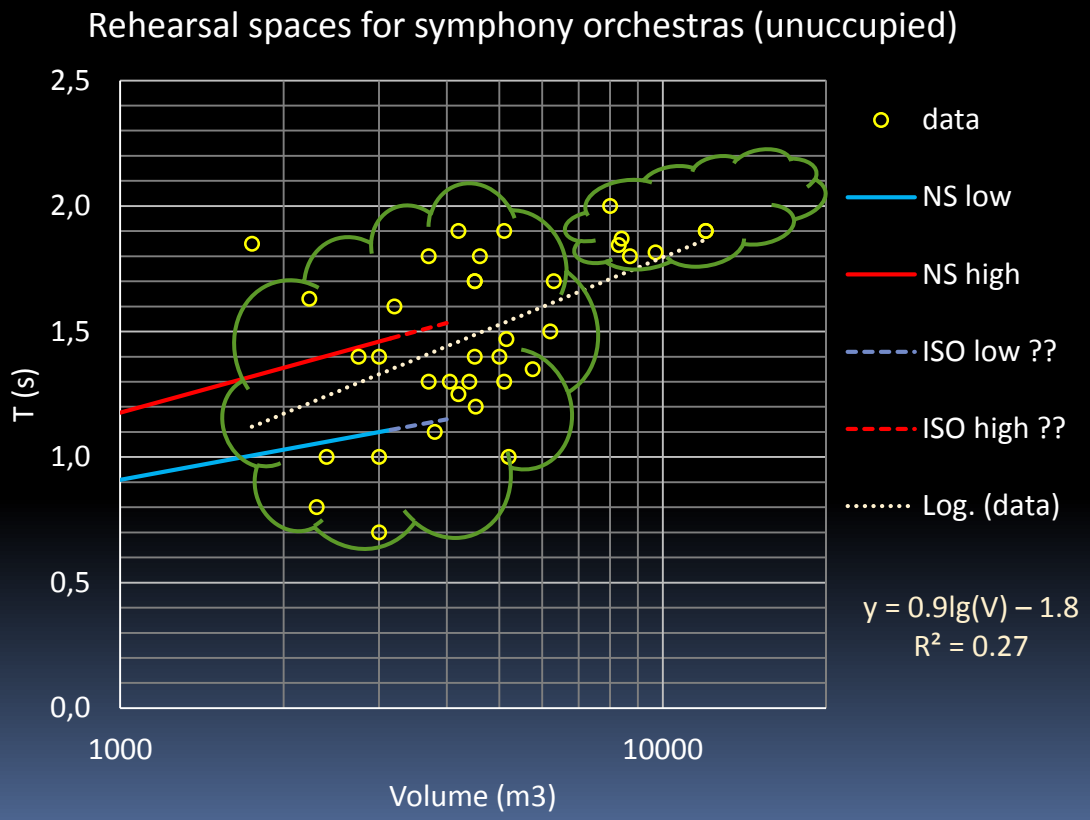
- Literature review
- Papers, articles, reports
- Invitation to submit data – www.akutek.info
- Personal communication with acousticians

T-V data collected, 37 rehearsal halls



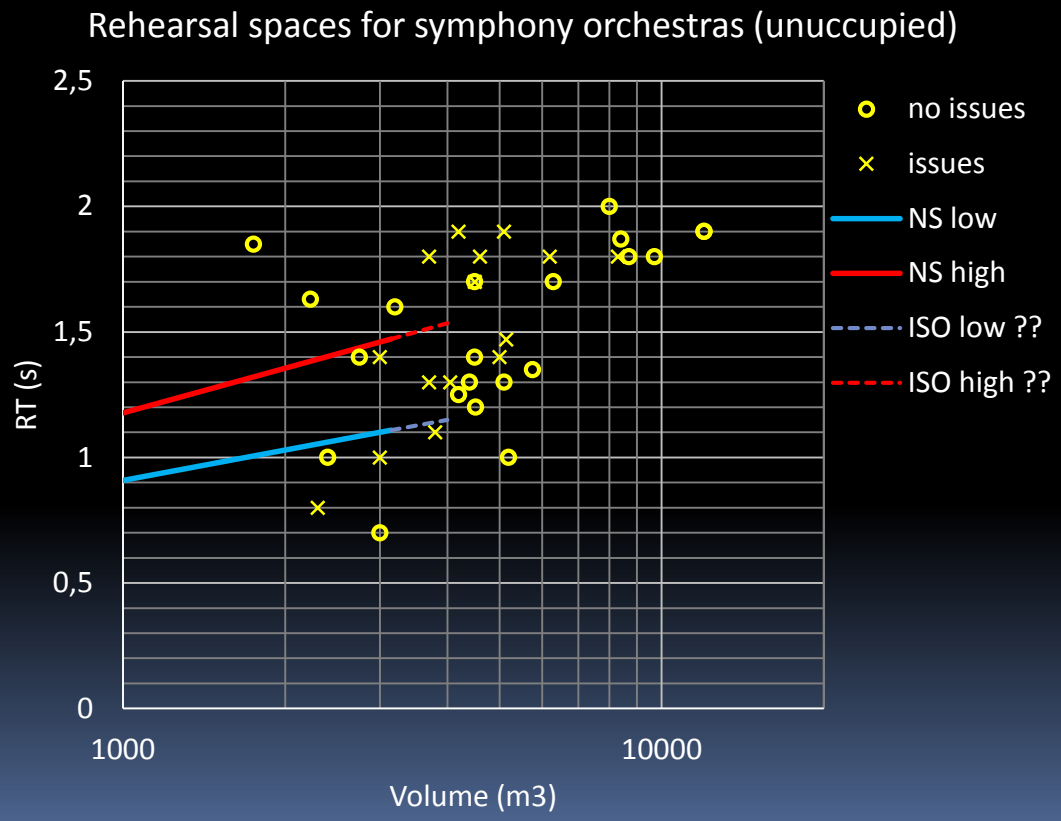
Small < 6500m3 < Big

Small V < 6500m3
Big variation
0.7-1.9s

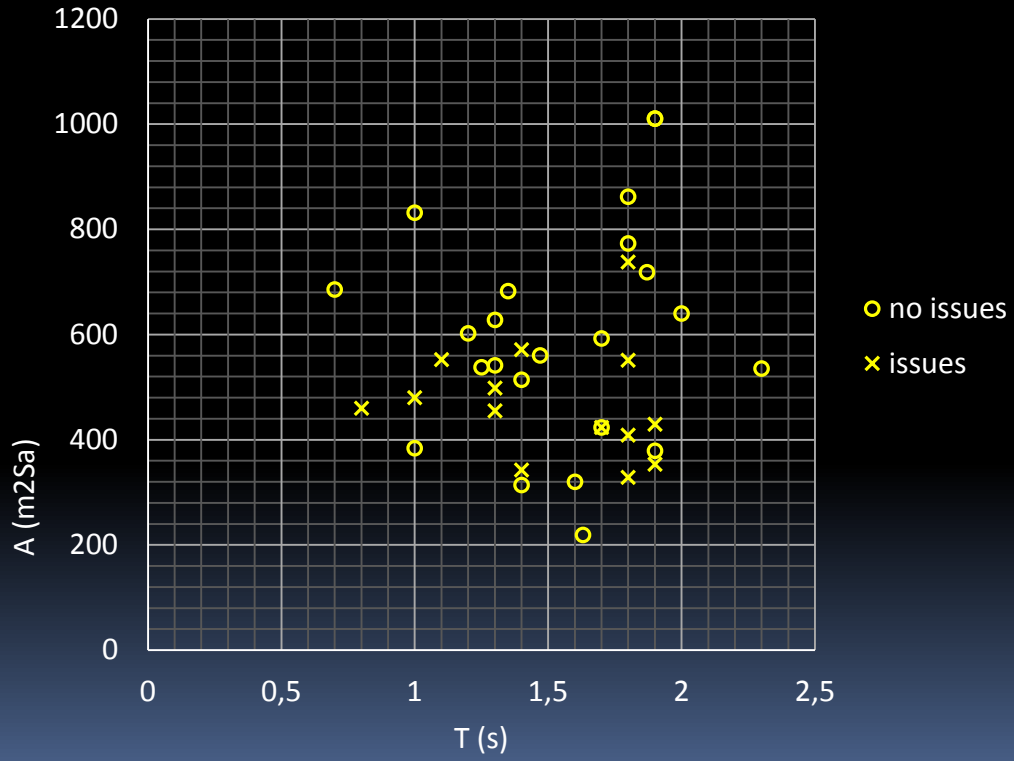


Big V > 6500m3
Small variation
1.8-2.0s

38%, 13 out of 37 cases with ‘issues’



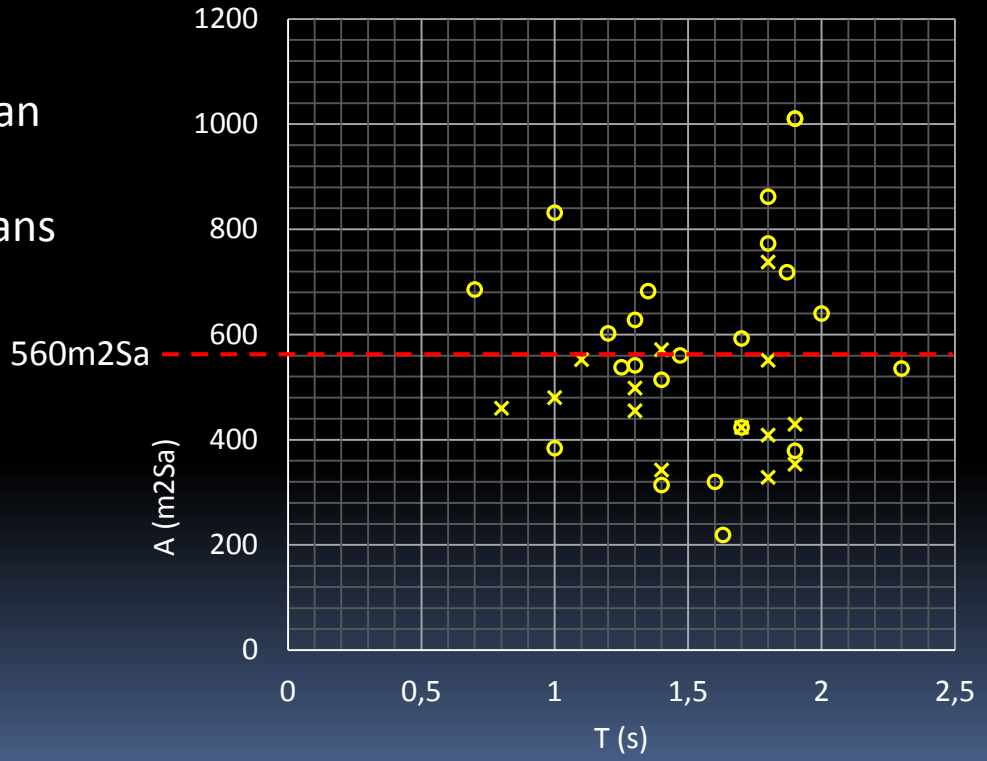
Absorption area



Absorption area suggestion A > 560 m2Sa

Gade (2012):
8 m2Sa per musician

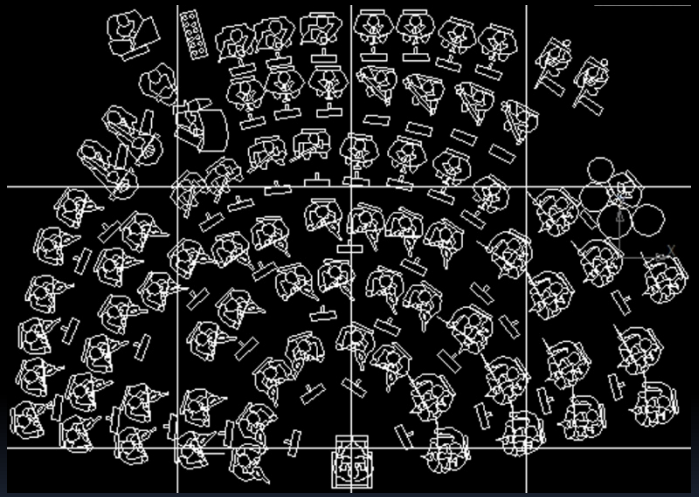
assume >70 musicians
70*8 = 560



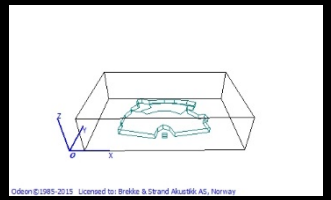
'issues' above limit
1/12 =8%

'issues' below limit
13/25 =52%

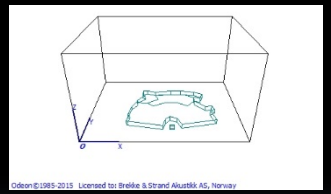
Typical symphony orchestra layout



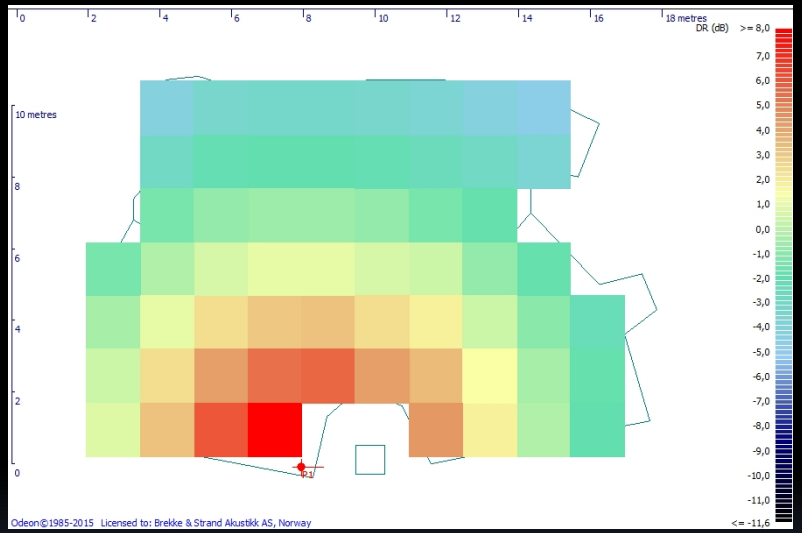
Odeon-models with average *D-R = 0 dB*



2500 m3



8000 m3

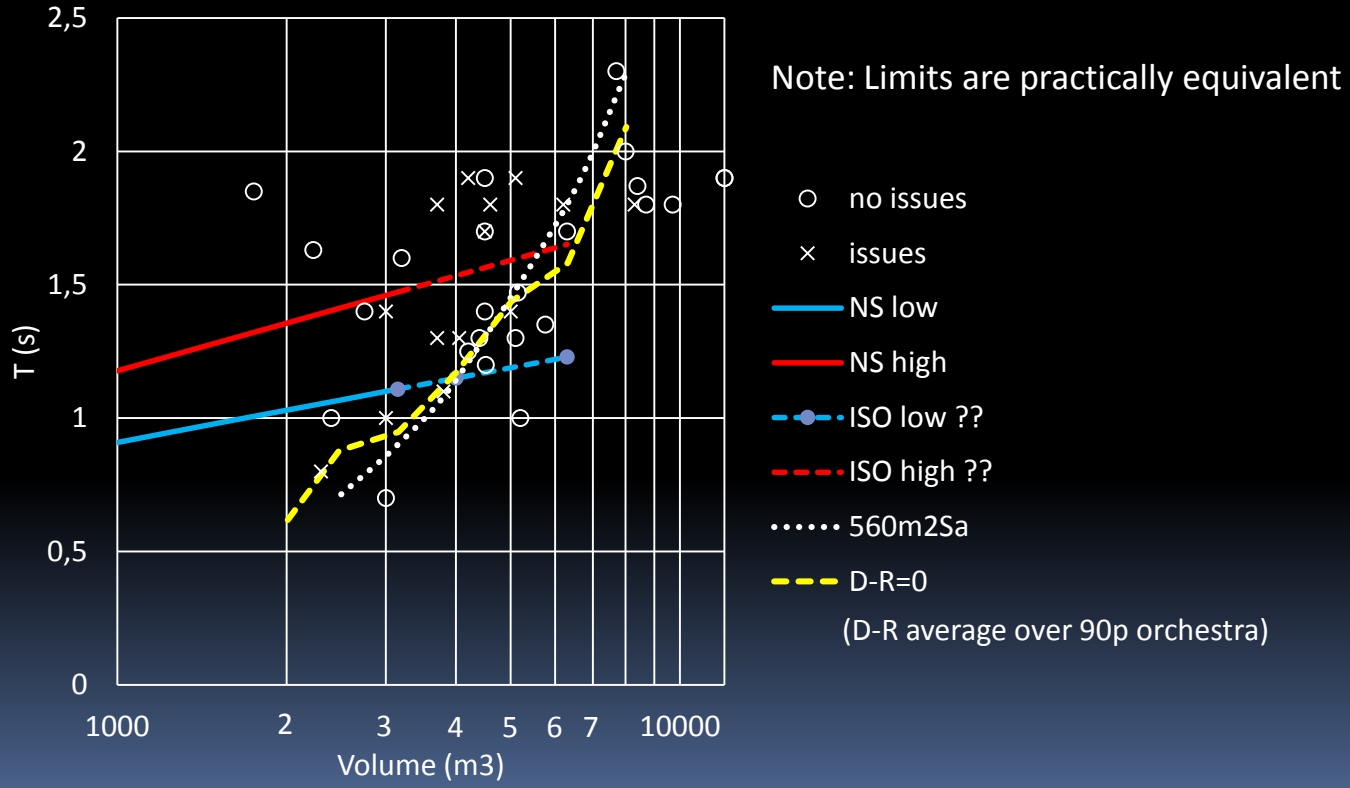


Grid response
V = 5000 m3
T = 1.44s (unoccupied)
D-R = 0.0 dB

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

V (m3)	Tm (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

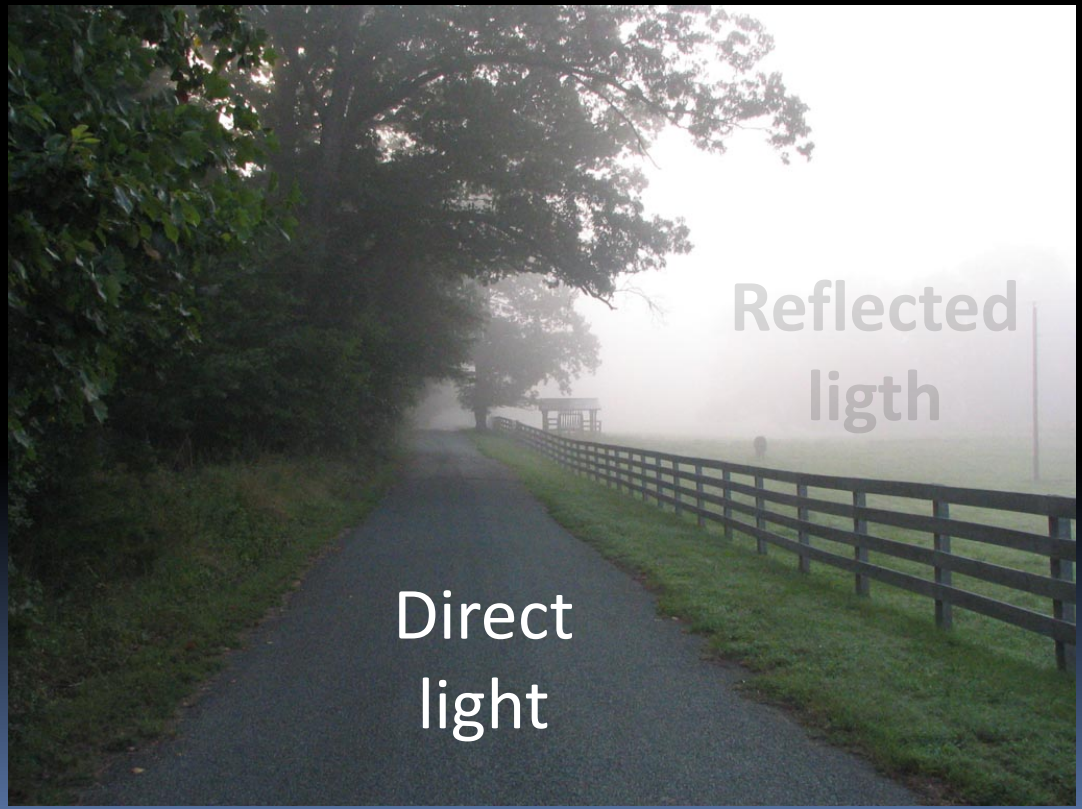
Limits mapped to *T-V* diagram



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<6500m3, wide T-span, *T = 0.7-1.9s*
- V>6500m3, T like in concert halls *T = 1.8 -2.0s*
- A-limit accepting 'Issues' in 8% *A > 560m2Sa*
- Gade (2012), 8m2/p example *70p*8m2Sa = 560m2Sa*
- Inter-orchestral direct-reverb, average *D-R = 0 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

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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

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