Hot Topics in Noise

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Paper 3pID2 -- 6 June 2001
Increased public concern about **NOISE**

In response, the noise technical community has developed:

- New methods for assessment
- New means for control
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OUTDOORS
- Soundscapes
- Natural quiet
- Theme parks & amphitheaters
- International environmental noise policy
- Extreme Hearing Protection (mil aircraft)

INDOORS
- Room noise descriptors
- Classroom acoustics
- Product sound quality
SOUNDSCAPES
- Brigitte Schulte-Fortkamp
  Carl von Ossietzky University
  Oldenburg, Germany

Interaction of people and sound

The way people consciously perceive their environment.
• Berglund (2001) - characterize residential soundscapes in three dimensions: “adverse”, “reposing” and “affective”
• Ipsen (2001) soundscape components: the context, the focus of attention, and personal knowledge/experience.
• Schulte-Fortkamp (2000) - interaction of living space and noise sources moderating effects for noise annoyance
• Hohmann (2000) - surroundscapes which demonstrate harmonic / disharmonic effects of an urban environment
• Genuit (2000) - aurally-related psychoacoustic analyses objective description of subjectively perceived sound
• Chtouris (2001) - sound interpreted in urban environments characterized by high density of activity
• Giuliani (2001) - relationship of visual and acoustical space Soundscape analysis - improved quality environments
The moderator soundscape

- A positive evaluation of the landscape reduces annoyance of the soundscape whereas a negative evaluation of the landscape increases annoyance (Maffiolo)

- A subjective soundscape - dependent on which parts people relate to & how they relate

Example: the Sunday walker will clearly have a different experience of a street than a Monday morning late-for-work bus chaser. (Fyhri & Klaboe)
Natural Quiet

• Aircraft overflights & snowmobiles in national parks
• Arctic National Wildlife Refuge – “Loud Turbines” (Washington Post)
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Theme Parks & Amphitheaters

Bill Cavanaugh (Cavanaugh-Tocci)

• Sound intrusion on communities

• Signal to Noise (S/N)
• Limit $L_1$ minus $L_{90}$

$L_1 - L_{90}$

$< 5 \text{ dB}$  rarely audible
minimal complaints

$5 \text{ to } 15 \text{ dB}$  sometimes audible
significant complaints

$> 15 \text{ dB}$  generally audible
widespread complaints
International Environmental Noise Policy

Larry Finegold – (Finegold & So)
Current Status of Noise Policies in the U.S. and Europe - Implications for International Consensus

• Adverse effects of noise on people are the major purpose for noise research and policy-making activities (i.e., “protection of the public health”)

• International economic competition (Product Sales) is becoming more important each year

• Noise exposure is still increasing around the world – problem is worst in large cities, especially transportation noise

• No international research agenda or coordinated funding

• No international coordination on noise management policies

• New European noise policy initiatives will impact all countries that export manufactured products to Europe
How does the US compare with the rest of the world?

- New World Health Organization “Guidelines for Community Noise”
  - [http://www.who.int/peh/](http://www.who.int/peh/)
- European Commission Initiatives – new Noise Directives (Outdoor Equipment, Environmental Noise, etc.)
- Real progress being made in individual countries in Europe, Asia, etc. – Japan is the leader in Asia
Guidelines for Community Noise

edited by
Brigitta Berglund
Thomas Lindvall
Dietrich Schwela
Kee-Tai Goh

World Health Organization
Sustainable Development and Healthy Environments
Protection of Human Environment
Occupational and Environmental Health

Ministry of the Environment
Institute of Environmental Epidemiology
### Community Noise: Guideline values I

<table>
<thead>
<tr>
<th>Environment</th>
<th>Critical effect</th>
<th>$L_{eq}$ [dBA]</th>
<th>Time base [h]</th>
<th>$L_{max}$ [dBA]</th>
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<td>Bedroom Sleep disturbance</td>
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<td>Outdoor (day) Serious annoyance</td>
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<td>16</td>
<td></td>
<td>-</td>
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<td>School Speech interference</td>
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<td>6</td>
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<tr>
<td>School courtyard Serious Annoyance</td>
<td>55</td>
<td>play-time</td>
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<td>-</td>
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[Image of a world map with noise guideline values]
Current Status of Noise Policies in the U.S. and Europe - Implications for International Consensus

European Commission Noise Directives

Directive on Environmental Noise

- Two readings in the European Parliament and the Council will probably lead to further changes.
Directive on Noise from Equipment Used Outdoors

The administrative and legal position is given in Directive 2000/14/EC.

An ad hoc Working Group, number 7, shepherds the new Directive and helps on the old directives that are to be repealed as the new one has come into force.
Current Status of Noise Policies in the U.S. and Europe - Implications for International Consensus

Example European Commission Noise Directives

Environment Directorate-General

- Construction Plant Equipment - 79/113/EEC
- Type Approval for Construction Plant and Equipment - 84/532/EEC
- Compressors - 84/533/EEC
- Tower Cranes - 84/534/EEC
- Welding Generators - 84/535/EEC
- Power Generators - 84/536/EEC
- Concrete Breakers - 84/537/EEC
- Lawnmowers - 84/538/EEC
- Hydraulic Excavators - 86/662/EEC
- Household Appliances - 86/594/EEC
Example European Commission Noise Directives

Other Directorate-Generals

- Motor Vehicles - 70/157/EEC
- Motor Cycles - 97/24/EC
- Subsonic Aircraft - 80/51/EEC
- Subsonic Jet Aeroplanes - 89/629/EEC
- Limitation of the Operations of Aeroplanes - 92/14/EEC

Expected New Directives:

- Tyre/Road Noise
- Noise from recreational crafts
Summary – US Noise Policy-Making Efforts

• Noise must be considered as a significant environmental “Public Health” problem - Most of the world’s developed countries accept this and are making good progress on managing noise exposure

• The U.S. was once the world’s leader in addressing environmental/community/transportation noise, but this momentum has been lost

• Federal agencies and professional organizations need to make a renewed commitment to addressing noise management problems in the 21st Century
  – Noise effects research, noise control technologies, and noise management policies
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Extreme Hearing Protection
(military aircraft)

- Richard McKinley (civ AFRL/HECB)
  (Wright-Patterson AFB)

Thanks to: US Navy
US Air Force
### Tactical Aircraft Near-Field Noise

**Worst Case Aircraft Noise Levels - @ 50 ft**

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>Mil Power A/B Power</th>
<th>A/B Power</th>
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<td>F-22</td>
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*8 hr Limit, 85 dB*
Aircraft Carrier Flight Deck
Launch Noise Time History
F-18 Mil power Bow Catapult
Carrier Near Field Noise
Crew Positioning Challenges
Carrier Near Field Noise
Crew Positioning Challenges
Carrier Near Field Noise
Crew Positioning Challenges
Carrier Personnel Noise

Crew Positioning Challenges

Checkers in front & Behind During Launch

Launch Crew between the Catapults

Directors during STOVL Operations on L-Class Ships
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For 85 dBA criterion
(8 hours, 3 dB doubling)

30 dB attenuation reach exposure limit
7 to 30 seconds

Current program achieving improved attenuation 38 – 40 dB
New Room Noise Criteria

- Paul Schomer - CERL
Room Noise Criteria (RNC)

• Problem--S12.2
  – Beranek--NCB
  – Blazier--RC

• Very different at low frequencies
  – Beranek--Well behaved HVAC as in a concert hall
  – Blazier--Inexpensive “office” HVAC. May have rumble and surging
Beranek--NCB Room Noise Criteria Curves

![Graph showing octave-band center frequency vs sound pressure level with thresholds of hearing and A region labeled.](image)
Blazier--RC Room Noise Criteria Curves

Are Curves Below the Threshold of Hearing at Low Frequencies A Mistake?
Why The Difference Between Beranek and Blazier?

• Beranek--Concert Halls, “well designed” HVAC
• Blazier--Surging, Rumbling HVAC

Is This Heard?  The LEQ is Below the Threshold of Hearing.
RNC Room Noise Criteria

• Correction to NCB-like curves
  – A function of frequency and AMPLITUDE
  – Detect with fast-time-response to simulate the integration time of human hearing
  – Use 1/3rd octave bands each ~100 ms
  – Maintain log10 arithmetic

• Find the low-frequency correction for 16, 31 and 63 Hz

• Use loudness-level contour arithmetic--the hearing function at 31 Hz--5 dB change in SPL is a 10 phon change.
Proposed New--RNC (Room Noise Criteria) Curves
A Test of New Room Noise Criteria (RNC)

- John Bradley--1994 study
  NRC Canada
- 9 Subjects
- Main Frequency--31 Hz Band
- Modulation Depth--10 dB, 17 dB
- Modulation Frequencies: 0 (none), 0.25, 0.5, 1, 2, 4 Hz

- Results:
  - Difference RNC-Bradley: 1.2 dB
  - Standard deviation: 1.1 dB
  - Correlation Coefficient 0.92

- THIS SEEMS TO WORK
Classroom Acoustics Standard

- David Lubman – Consultant
The ability to hear & be heard is central to all language based learning.
  – Students of all ages need good acoustics. Lifelong learning is paramount in new world economy.

• Demanding new standards are being developed for noise and reverberation control in schools.
  – Higher standards expected to greatly increase the acoustical content of future school design.
  – More acoustically trained architects and mechanical engineers will be needed for the school building boom.
Inclusive vs. exclusive classroom acoustics

Good classroom acoustics are *inclusive* for:

- Non-native listeners and talkers.
- Students & teachers with hearing or voice impairments.
- Young children & inexperienced learners
- Fatigued learners
- Poorly motivated learners
- Elderly
New Standards for Classroom Acoustics to Benefit All!

- ANSI S12 standard nearing completion
  - Draft 9 approved by S12 in spring.
  - Full ANSI approval of draft 10 possible by fall
  - Noise levels not to exceed 35 dBA
  - Reverberation times under 0.7 sec (small classrooms)
- New noise guideline in Alberta, Canada
  - Standards & guidelines for school facilities
- New HVAC noise guidelines for NYC schools
- LA expected to endorse 35 dBA for new schools
Product Sound Quality

- David Bowen – R. H. Lyon Corp
WE (every acoustician)

Are All Ambassadors

For NOISE