Session E64

Noise and Acoustics:
What’s New in the 2018 FGI Guidelines

Ed Logsdon, PE Acoustics
Elizabeth Valmont, PhD
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• Complete the AIA verification form (be sure to check off the sessions you attend) and retain it for your records. CE credits will be uploaded to the AIA transcript system within 6-8 weeks of the close of the conference.

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Ed Logsdon, P.E.
FGI Acoustic Working Group (since 2010) & APRC

- Electrical Engineer, PE – Acoustics (Oregon)
- Member of CAHED, ASHE, ASA and IEEE
- President, National Council of Acoustical Consultants (NCAC) 2004 – 2006
- Hospital Acoustics LinkedIn – Group Manager
- 30 years of experience
  - Executone, Nurse call installer
  - St. Joseph Hospital, Sisters of Mercy, Ann Arbor, MI, Biomed
  - Aspen Labs – R&D Engineer electrosurgical generators, arthroscopic camera, fiber optic light source and automatic cuff/tourniquet
  - D. L. Adams Associates, VP / Acoustical Consultant
Acoustic Working Group (AWG) Activities


1. Research - 12 proposals, 2 funded to date
   - Mayer Rothschild Task Force – residential healthcare

2. Development
   - ANSI (new standard published)
   - USGBC – LEED for Healthcare, 2011
   - IgCC Healthcare criteria
   - CISCA Healthcare criteria
AWG Activities (continued)

3 Education

• 40 seminars & webinars on healthcare acoustics presented in US, UK, EU and Japan

4 Publishing

• “Sound & Vibration 2.0” (2011) – by Springer-Verlag

5 Outreach

• Members work with WHO, CDC, GSA, HUD and other regulatory groups
AWG-Acoustics Proposal Review Committee Mission

• Review the acoustics-related proposals for changes to the 2014 Hospital and Outpatient (H/OP) and Residential (R) documents.

• Review comments to the draft of the 2018 Guidelines.

• Provide acoustical recommendations to the larger group.

• Offer technical expertise on what should be considered minimum requirements.

• Review the acoustical requirements of all three volumes for consistency.
Acoustics Proposal Review Committee

2018-cycle Acoustics Proposal Review Committee (APRC)

- Evaluated ~100 proposals from all sources
- Consists of:
  - Kurt Rockstroh, FAIA
  - Jane Rohde, AIA
  - Paul Barach, MD, MPH
  - Chair David Sykes, MA
  - Six FGI-nominated acoustics consultants

APRC Technical Subcommittee
- David Sykes, chair
- Noral Stewart
- Ed Logsdon
- Bill Cavanaugh
- Jean-François Latour
- Mandy Kachur
Newest APRC Members

Elizabeth Valmont, Ph.D (Architecture), Associate AIA, LEED AP

- Acoustics Faculty, University of Southern California 10 years
- Associate, Arup (Los Angeles)
- “40 under 40 Award” winner (2016 BD&C, CSE Magazines)

Dr. Daniel Fink MD, MBA

- General Internist (retired), Cedars Mt. Sinai
- Chairman, The Quiet Coalition
- Board Member, ATA
- Member, Mayer-Rothschild Task Force
Mayer-Rothschild and FGI-Funded Residential Care Facility Assessment

• Comprehensive assessment of 2014 acoustics requirements to inform 2018 Residential Guidelines proposals/changes

• Retirement Community
  • 1800 residents
  • 10 independent living buildings
  • 1 assisted living
  • 1 skilled nursing
  • 3 community buildings

• Spaces assessed and correlated to resident feedback
  • Residential units: Independent living, assisted living, skilled nursing
  • Assembly spaces: Chapel, Catering hall with stage
  • Dining
  • Recreation: Music, Arts and Crafts, Swimming Pool
  • Outdoor measurements: building equipment, ambient community noise
FGI Critical Support

• Pamela Blumgart, FGI Managing Editor

• Heather Livingston, FGI Associate Editor

• Yvonne Chiarelli, FGI Editorial/Scribe Consultant
FGI Includes Five Sections on Acoustics

2018 proposals were submitted for all sections

- Site exterior noise
  - Block sound through façade
- Speech privacy / Sound Isolation
  - Wall & Floor-ceiling constructions
  - Control of background noise levels
- Speech Intelligibility / Room Finishes
  - Sound absorbing surfaces to control reverberation
- HVAC and building systems
  - Equipment selection and system design to control background sound level
- Building vibration
  - Isolation and structural design
Standalone Outpatient Edition

2010

Guidelines
FOR DESIGN AND CONSTRUCTION OF Residential Health, Care, and Support Facilities
The Facility Guidelines Institute
2014 edition

2014

Guidelines
FOR DESIGN AND CONSTRUCTION OF Hospitals and Outpatient Facilities
The Facility Guidelines Institute
2014 edition

2018

FGI OUTPATIENT FACILITIES
2018
Standalone Outpatient Edition
Importance of Acoustics

• Drive to build more facilities to address growing need - 50,000 Baby Boomers retiring each month
  • “Micro Hospitals”, Outpatient Clinics, Urgent Care Centers, Emergency Care, etc.

• English as a second language
  • Many patients are also challenged with translation

• Facility Owners looking to brand their services
  • Patients react better to quiet environments
Policy Changes

• Nationwide poor HCAHPS scores for noise
  • “During this hospital stay, how often was the area around your room quiet at night?”
  • Typically the lowest score of all questions surveyed

• National issue of “alarm fatigue” in healthcare

• National drive to build “healing environments”
  • Improve sleep quality
  • Lower heart rate, respiratory rates and blood pressure
  • Reduce staff stress
“Hearing loss - “the new norm”

• Noise-Induced Hearing Loss – affects 48 million Americans

• Increased number of hearing disorders in elderly and young people due to environmental, workplace and recreational exposure
  • Personal headphones, loud concerts, raves, sporting events, etc.
Hot Topic - **TELEMEDICINE**

• **Is used to**
  • Support care providers
  • Address more need with less money
  • Reach rural locations

• **Challenges**
  • Quality of calls, i.e., connectivity in remote locations
  • Patient understanding and trust
  • Privacy – need sound isolation and room acoustics
    • HIPAA

• **Solutions**
  • Appropriate acoustics
  • Proper system selection (microphone, display, camera, lighting, etc.)
  • Early design consideration
NOISE IS A PUBLIC HEALTH PROBLEM

International Noise Awareness Day
Center for Hearing and Communication
• Wednesday, April 25, 2018
• 23rd anniversary
• NOISE - You have to make some noise to end it.

“May is Better Hearing Month”
Overview of the APRC’s Recommendations for 2018 FGI Guidelines

1. Site Exterior Noise
2. Speech Privacy / Sound Isolation
3. Speech Intelligibility / Room Finishes
4. HVAC & Building Systems
5. Building Vibration
Site Exterior Noise

Sirens, helicopters, traffic, etc.
Highlights of APRC Activities in Support of 2018 Editions

SITE EXTERIOR NOISE - OITC/STC of façade (H,OP,R)

- **Issue:** Outdoor Indoor Transmission Class criteria are more appropriate than STC for façade evaluation, but test data are sparse
- **Resolution:** 2010 Guidelines listed STC, 2014 Guidelines listed OITC, 2018 will list both providing guidance on how to select.
- **Implications:** More flexibility for the designer.
- **Consistent across all three volumes**

<table>
<thead>
<tr>
<th>Exterior Site Noise Exposure Category</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>General description</td>
<td>Minimal</td>
<td>Moderate</td>
<td>Significant</td>
<td>Extreme</td>
</tr>
<tr>
<td>Day-night average sound level (L_{dn}) (dB)</td>
<td>&lt; 65</td>
<td>65–69</td>
<td>70–74</td>
<td>≥ 75</td>
</tr>
<tr>
<td>Average hourly nominal maximum</td>
<td>&lt; 75</td>
<td>75–79</td>
<td>80–81</td>
<td>&gt; 85</td>
</tr>
</tbody>
</table>

1. Table excerpt
Sound Isolation (STC) Demo

Auralizations of Physician / patient discussion in noisy or 'Live' Room compared to quiet or 'Dry' Room
Flanking Sound

And adding Sound Masking is NOT always the answer!
Need Full Height Walls

**GOAL: STC 45**

- Patient room to Patient Room
- Increase CAC of Tile
- Add fiberglass
- Add return-air boots
Highlights of APRC Activities in Support of 2018 Editions

Speech Privacy / Sound Isolation STC of partitions (H,OP,R)

- **Issue:** Existing text is not clear about wall/ceiling interface and plenum conditions to achieve rated STC of partition
- **Resolution:** Changed wording for clarification. Updated room designations and adjacency combinations so they are relevant to the specific edition.
- **Goal is Consistency across all three volumes**

<table>
<thead>
<tr>
<th>Adjacency Combination</th>
<th>$STC_e^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient room</td>
<td>45$^3$</td>
</tr>
<tr>
<td>Patient room (wall–same floor)</td>
<td>50</td>
</tr>
<tr>
<td>Patient room (floor–to–floor)</td>
<td></td>
</tr>
<tr>
<td>Patient room (floor–to–floor)</td>
<td>50</td>
</tr>
<tr>
<td>Patient room (floor–to–floor)</td>
<td></td>
</tr>
<tr>
<td>Corridor (with entrance)</td>
<td>35$^4$</td>
</tr>
<tr>
<td>Public space</td>
<td>50</td>
</tr>
<tr>
<td>Service area</td>
<td>60$^5$</td>
</tr>
<tr>
<td>Corridor (with entrance)</td>
<td>35$^4$</td>
</tr>
<tr>
<td>Exam room</td>
<td>50</td>
</tr>
<tr>
<td>Public space</td>
<td>50</td>
</tr>
<tr>
<td>Treatment room</td>
<td>50</td>
</tr>
<tr>
<td>Room</td>
<td>25</td>
</tr>
<tr>
<td>Corridor</td>
<td></td>
</tr>
</tbody>
</table>

Table excerpt
Room Acoustics (NRC) Demo

APPROX. AVG NRC

0.8 0.2 0.15 0.1 0.01

APPROX. AVG RT

Note:
Higher Noise Reduction Coefficient (NRC) lowers Reverberation Time (RT)
Added HIPAA speech privacy for Pharmacy (R)

- **Issue:** HIPAA speech privacy requirements were not addressed for pharmacy in the Residential Guidelines.
- **Resolution:** Added criteria and a note about sound masking as an alternative to increase Speech Privacy.
- **Implications:** Reasonable attempts to provide speech privacy, such as placing the waiting area away from the consultation counter and providing background sound level in the waiting area, need to be incorporated into the design.

### Design Criteria for Speech Privacy for Enclosed Rooms and Open-Plan Spaces

<table>
<thead>
<tr>
<th>Level</th>
<th>Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speech Privacy—Closed Plan</td>
<td>PI</td>
</tr>
<tr>
<td>Secure</td>
<td>N/A</td>
</tr>
<tr>
<td>Confidential</td>
<td>≥95%</td>
</tr>
<tr>
<td>Normal</td>
<td>80–94%</td>
</tr>
<tr>
<td>Defining Standard</td>
<td>ASTM E1130</td>
</tr>
<tr>
<td>Speech Privacy—Open Plan</td>
<td>PI</td>
</tr>
<tr>
<td>Confidential</td>
<td>Special consideration required</td>
</tr>
<tr>
<td>Normal</td>
<td>80–94%</td>
</tr>
<tr>
<td>Marginal</td>
<td>60–79%</td>
</tr>
<tr>
<td>Defining Standard</td>
<td>ASTM E1130</td>
</tr>
</tbody>
</table>
Highlights of APRC Activities in Support of 2018 Editions

Speech Intelligibility / Acoustical criteria for unfurnished rooms (R)

• **Issue:** AHJs are having difficulty enforcing the average absorption criteria table, particularly for living units

• **Resolution:** Absorption criteria for living units were eliminated from the main body and moved to the appendix for guidance and explanation

• **Implications:** Speech and noise in Reverberant environments negatively affect the residents.

<table>
<thead>
<tr>
<th>Space</th>
<th>Design Coefficient</th>
<th>Subjective Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private patient room</td>
<td>0.15</td>
<td>“Average” room</td>
</tr>
<tr>
<td>Multi-bed patient room</td>
<td>0.15</td>
<td>“Average” room</td>
</tr>
<tr>
<td>Corridor</td>
<td>0.15</td>
<td>“Average” room</td>
</tr>
</tbody>
</table>
Highlights of APRC Activities in Support of 2018 Editions

Reverberant noise levels in dining rooms (R)

- **Issues:** *Life Safety:* Biggest source of complaints. Affects people’s behavior (e.g., avoidance of busy times, eating in room instead of dining room).

- **Resolution:** Added criteria of seating density and sound absorption per person to reduce noise and reverberation. Also, called attention to controlling noise produced by kitchen equipment.

- **Implication:** A different approach to design, but one that is readily accessible to architects.
Background Noise (NC) Demo
HVAC noise in dining areas (R)

- **Issue:** Resident complaints recorded during Mayer-Rothschild residential study
- **Resolution:** Added criteria in the *Maximum Design Criteria for Noise in Interior Spaces Caused by Building Systems* table. Also added comments about kitchen equipment noise in Appendix.
- **Implications:** Additional noise control measures may be needed in HVAC design. THESE ARE NOT OVERLY STRICT (HUD MINIMUMS)

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**Table 2.5-5: Maximum Design Criteria for Noise in Interior Spaces Caused by Building Systems**

<table>
<thead>
<tr>
<th>Room Type</th>
<th>NC / RC(N) / RNC</th>
<th>dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resident rooms/dwelling units</td>
<td>40</td>
<td>45</td>
</tr>
<tr>
<td>Medication rooms</td>
<td>45</td>
<td>40</td>
</tr>
<tr>
<td>Multiple occupant resident care areas</td>
<td>45</td>
<td>50</td>
</tr>
<tr>
<td>Corridors and community spaces</td>
<td>45</td>
<td>50</td>
</tr>
</tbody>
</table>
Loud Natatoria (R)

• **Issue:** Resident complaints about lack of speech intelligibility in natatoria. This space is often used for physical therapy and instruction. This is a life-safety issue (speech and noise).

• **Resolution:** Added HVAC background sound criteria and sound absorption criteria. TURNING UP THE VOLUME DOESN’T WORK.

• **Implications:** Noise control and sound absorption will have to be addressed for these spaces. It is often neglected.
Vibration

TACOMA BRIDGE COLLAPSE
Revised structural building vibration criteria (H,OP)

• **Issue:** 2014 Guidelines listed limits for different structural types, steel vs wood.

• **Resolution:** Single table to address *footfall*. Vibration limits are specific to the type of equipment and use of the space, not structural type.

• **Implications:** List vibration limits based on type of space. Limits should be consistent in all design volumes. Building equipment is assumed to properly isolated.
### ASIC Design Criteria - References FGI

**Table 6-2. Generic Vibration Criteria Tolerance Limits**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Tolerance Limit(^1), mips</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>—</td>
<td>32,000</td>
<td>Ordinary workshops(^2)</td>
</tr>
<tr>
<td>—</td>
<td>16,000</td>
<td>Offices(^2)</td>
</tr>
<tr>
<td>—</td>
<td>8,000</td>
<td>Computer equipment, Residences(^2,3)</td>
</tr>
<tr>
<td>—</td>
<td>6,000</td>
<td>Hospital patient rooms(^4)</td>
</tr>
<tr>
<td>—</td>
<td>4,000</td>
<td>Surgery facilities, laboratory robots, Bench microscopes up to 100×, operating rooms(^5)</td>
</tr>
<tr>
<td>VC-A</td>
<td>2,000</td>
<td>Microbalances, optical comparators, mass spectrometers, Industrial metrology laboratories, spectrophotometers, Bench microscopes up to 400×</td>
</tr>
<tr>
<td>VC-B</td>
<td>1,000</td>
<td>Microsurgery, microtomes and cryotomes for 5 to 10 μm slices, Tissue and cell cultures, optical equipment on isolation tables, Bench microscopes at greater than 400×, atomic force microscopes</td>
</tr>
<tr>
<td>VC-C</td>
<td>500(^\ast)</td>
<td>High-precision balances, spectrophotometers, magnetic resonance imagers, Microtomes and cryotomes for &lt;5 μm slices, chemotaxis, Electron microscopes at up to 30,000×</td>
</tr>
<tr>
<td>VC-D</td>
<td>250</td>
<td>Cell implant equipment, micromanipulation, Confocal microscopes, high-resolution mass spectrometers, Electron microscopes (SEMs, TEMs) at greater than 30,000×</td>
</tr>
<tr>
<td>VC-E</td>
<td>125</td>
<td>Unisolated optical research systems, extraordinarily sensitive systems</td>
</tr>
</tbody>
</table>

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\(^1\) As measured in one-third octave bands over the frequency range 8 to 80 Hz (VC-A and VC-B) or 1 to 80 Hz (VC-C through VC-E); see Figure 6-2.

\(^2\) Provided for reference only. Evaluate using Chapter 4 or Chapter 7.

\(^3\) Corresponds to approximate average threshold of perception (ASA, 1983).

\(^4\) When required by FGI (2014). Evaluate using Section 6.2.

\(^5\) Corresponds to approximate threshold of perception of most sensitive humans (ASA, 1983). Evaluate using Section 6.2.
Highlights of APRC Activities in Support of 2018 Editions

Change Residential floor to Impact Isolation Class Rating (R)

• **Issue:** 2014 Guidelines list velocity based vibration criteria that are more suitable for hospital environments and construction type

• **Resolution:** Substituted the Impact Insulation Class (IIC) rating for the Residential facilities.

• **Implications:** Criteria now follow the IBC. Hard flooring may require underlayment for spaces without ceilings in the room underneath.

<table>
<thead>
<tr>
<th>Space Type</th>
<th>Footfall Vibration Peak Velocity (micro-in/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resident rooms, dwelling units, and other resident areas</td>
<td>6000</td>
</tr>
<tr>
<td>Examination rooms</td>
<td>6000</td>
</tr>
<tr>
<td>Administrative areas</td>
<td>8000</td>
</tr>
</tbody>
</table>
Rejected Proposals

- **Increase acoustical absorption requirements** in many spaces (H,OP,R)
  - *Costs for premium acoustical products (NRC 0.9 or higher) are prohibitive*

- **Require access to music** as part of the base building requirements (H,OP,R)
  - *Most patients have personal music devices*

- **Allow sound masking systems coupled with a decrease in partition STC** as an alternate to existing STC table (H,OP)
  - *Speech privacy is more than Visual Privacy*
  - *Sound masking is not a panacea to sound isolation*
Where to find Acoustical Consultants?

ncac.com/resources/directory/ Directory of Acoustical Consultants
Thank you for your kind attention!

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303-455-1900  
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Elizabeth Valmont  
310-625-2342  
elizabeth.valmont@arup.com