Outline

1. Typical acoustical issues in classrooms
2. 2006 and 2009 CA CHPS criteria
3. Typical acoustical strategies to achieve compliance with CHPS criteria
4. Case studies
5. CHPS submittal for EQ3
6. Acoustics verification for CA CHPS Verified 2006 and 2009 projects (W.I.P.)
7. Approach dilemma: Design for CHPS compliance or design for CHPS intent, i.e. adequate acoustics?
1. Reverberation
   • Sound reflects off hard surfaces and arrives to listeners' ears at multiple times. Too many reflections cause sound to build up, “reverberate”.
   • “Unwanted sound” (i.e. background noise and occupants’ noise) builds up and degrades intelligibility of “wanted sound” (e.g. teacher’s speech)
   • “Wanted sound” (e.g. teacher’s speech) is less intelligible, as speech phonemes tend to become “blended together”.

2. Background Noise
   • Noise from adjacent spaces
   • Airborne noise from upstairs
   • Impact noise from upstairs
   • Corridor noise
   • Yard noise
   • Transportation noise
   • HVAC noise

Brain Decoding Issue

Ready Set Go
CHPS criteria

1. Reverberation
   • Pre-requisite (regardless of credit points claimed): reverberation time (“RT60”) must be 0.6 seconds or less in typical classroom (0.7 seconds in large classrooms)
   • No credit points
   • 2006 version: no difference between small and large classrooms (0.6 seconds for both)

2. Background Noise
   • Pre-requisite: Level of sum of all background noises must be 45 dBA or less
   • 1 credit point: Level of sum of all background noises must be 40 dBA or less
   • 3 credit points: Level of sum of all background noises must be 35 dBA or less (ANSI* standard)

   * American National Standards Institute.
   ANSI facilitates the development of American National Standards (ANS) by accrediting the procedures of standards developing organizations (SDOs). These groups work cooperatively to develop voluntary national consensus standards. Accreditation by ANSI signifies that the procedures used by the standards body in connection with the development of American National Standards meet the Institute’s essential requirements for openness, balance, consensus and due process.

Typical strategies: background noise

1. From interior sources
   • Walls between classrooms
   • Floor-ceiling assemblies
   • Corridors, restrooms, machine rooms, music room, multi-purpose rooms, special ed. room etc.

2. Transportation noise and yard noise
   • Building envelope and windows (quantitative)
   • Buffer spaces

4. HVAC noise
   • Equipment selection and location, location, location….
   • "Casing-radiated noise": roof-ceiling assembly
   • "Fan noise": silencers, lined ductwork, size of ductwork
   • "Break-out noise": ceiling mass → implications for absorption treatment for reverberation
Typical strategies: reverberation

1. Suspended, lay-in, acoustical tile ceilings
   - “Trapped air space” between ceiling and deck above dissipates sound energy
   - Not crucial whether tile is more or less porous (fiberglass slightly better than mineral fiber)
   - Issue if noisy HVAC units are positioned right above classroom
   - Issue if noise “breaks out” of ventilation ductwork above ceiling
   - Often some ceiling area is taken up by soffits or other architectural features → need to supplement

2. Surface-applied sound-absorbing treatments
   - a.k.a. “wall panels” or “ceiling panels”
   - Must be porous (fiberglass much better than mineral fiber)
   - Thickness matters (2” panels absorb more sound than 1” panels → need less sq.ft. !!!)
   - Location matters (not just for reverberation but also for echoes)

Case study: A/C unit over classroom

- Silencers at SA and RA and internally lined ductwork (to attenuate noise in the ducts, therefore both ductborne and break-out noise)
- Heavy gage ductwork (to limit break-out noise)
- Gypsum board soffit (to attenuate break-out noise)
- Resilient channel on interior face of clerestory side wall (to attenuate “casing radiated” noise)
Case study: Original 2\textsuperscript{nd} floor finish

- Resilient clip system ceiling
- QuietRock Walls

Original hardwood floor

Impact Noise

CHPS submittal for EQ3

- Narrative stating measures adopted to achieve criteria
- RGDL uses this narrative as “finalized recommendations summary”
- Architect can use narrative as a checklist
- Required: list of specifications sections
- Reverberation calculations (Excel template or .pdf)
Acoustical performance verification

- 2009 CA CHPS criteria for acoustics state that “acoustical verification should be included in commissioning plan”
- 2009 CA CHPS include ad-hoc acoustical performance verification protocol
- 3 CHPS Verified projects have passed the construction review in California to date
- Verification of acoustical performance
- Design acoustical consultant may be hired to do testing, if required
- Test of reverberation times easy, test of background noise levels more complicated
- CHPS Operations Report Card, may be used for verification in the future

CHPS criteria

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Is 45 dBA acceptable?

- Canadian schools, 30 classrooms
- Average unoccupied background noise: 42 dBA
- Average occupied background noise: 49 dBA
- Average level of teacher’s voice: 60 dBA
- Signal-to-Noise Ratio (SNR) = 60 – 49 = 11 dBA
- 6th graders: only 50% would score 95% or more
- 1st graders: 11% would score 95% or more
- Decrease background noise
- Provide speech reinforcement for teachers?

References:


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