Room Acoustics Analysis Questionnaire

Introduction:

The acoustical characteristics of each room are unique. The two elements that will have an impact on how well verbal communications can be distinguished accurately by the listener are the background noise levels ant the reverberation time.

Background noise is the totality of all sounds within the room. In unoccupied space contributions to the background noise levels might consist of noise from adjacent rooms or corridors, sounds form outside the building such as vehicular or aircraft noise, or heating and ventilation noise through the duct system or from a unit within the classroom. When the classroom is occupied further contributions may come directly from the room occupants through their regular activities. Quite often ones own ear is a good measure of making a subjective evaluation of the noise in the room, so listen and look. Move around to determine where the noise sources are coming from. Don't be afraid to note your own observations by listening.

Reverberation time is the time it takes for sound waves to die out to inaudibility once the sound source has ceased. Reverberation is due to the sound wave reflections off of hard floor, wall or ceiling surfaces. In a gymnasium, for instance due to the large volume of the space combined with the very hard surfaces, reverberation can last for several seconds and can be heard quite distinctly. In the classroom reverberation is also frequently present, though may be little less distinguishable than in gym due to the shorter RT and smaller size of the room.

Other elements can also have an impact on speech intelligibility by the listener, they are (a) the distance of the listener from the speaker and (b) the intensity of the speakers voice. These are important elements to consider since the level of the teachers voice at the listeners ear must be about 15 decibels louder than any background noise within the room. This is known as the Signal to Noise ratio S/NR. That is to say the sound level must be 15 decibels higher than the teachers voice which typically will measure about 60 decibels three feet away from the teacher. Unfortunately another element of physics enters into the equation known as the Inverse Law, which dictates that for every doubling of the distance from the signal, the sound will diminish, by 6 decibels. Thus at six feet the sound signal will have diminished to 54 decibels and at 12 feet it will have diminished to 48 decibels.
At a distance of 12 feet from the speaker, with a typical background noise level of 45 decibels the S/NR will only be 3 decibels above the background noise at the listener position.

Uncontrolled noise can actually cause a buildup due to the lack of sufficient quantity or quality of sound absorbing materials in the room. Sound absorbing materials therefore reduce both reverberation and noise build up.
Reverberation time can be calculated but it is important to have an accurate description of the room size and materials used to construct the room. Hard surface walls floors do not very much from one material to another. Carpet thick ness is important to measure and note. Simply press a sharp object into the carpet until it hits the sub floor and measure the distance form the top of the carpet to the point of the sharp object.

Existing suspended acoustical ceilings may be a little more difficult for the average individual to identify. Most often it will be either a fiberglass tile or a harder mineral tile. An accurate description to the tile can alter give a very good clue as to what it is and what its sound absorbing characteristics are. Generally if an existing acoustical ceiling has been painted it will be readily noticeable. Painting ceiling tile frequently reduce the acoustical characteristics quite significantly.

Thickness of the ceiling tile is an important clue, as is the pattern of the tile perforations. Often identifying the tile may be as close as calling the school building and grounds superintendent. So don't be intimidated. At very worst a small sample of the tile can be sent to Mike Nixon.

Return complete questionnaire to:
Acoustical Surfaces Inc.
123 Columbia Court N.
Chaska, MN. 55318
Fax: 952-488-2613
Email: Mike@acousticalsurfaces.com

ROOM ACOUSTICS ANALYSIS QUESTIONNAIRE

CLIENT NAME _____ FACILITY NAME _____

ADDRESS _____ CITY_____ STATE_____ ZIP_____

CONTACT NAME _____ TITLE _____ EMAIL _____

PHONE _____ FAX _____ DATE _____

(a) If available, a copy of the blueprints of your room(s) would be very helpful.

Floor Plan _____ Reflected Ceiling Plan _____ Wall Elevations _____

If a copy of blueprint is not available, a sketch of the floor plan, wall elevations

and reflected ceiling plan would be helpful.

(b) What are the overall room dimensions? (In feet and inches)

Length _____ Width _____ Height _____ When was the school built? _____

(c) What is the primary use of the room? Normal number of student occupants _____

Academic Instruction _____ Lecture Room _____ Gymnasium _____ Science _____ Multipurpose _____

Cafetorium _____ Choir _____ Band _____ Industrial Arts _____ Shops _____ Other _____

(d) Instructor Male _____ Female _____ Soft Voice _____ Loud Voice _____

(e) What are the finishes on the ceiling and floor?

CEILING

_____ Acoustical Tile Glued Up (Painted)

_____ Acoustical Tile Glued Up (Unpainted)

_____ Suspended/Mineral Acoustical tile

_____ Suspended/Fiberglass Acoustical tile

_____ Concrete

_____ Exposed Metal Deck & Joists

_____ Gypsum Board, Plain___ Textured____

FLOOR

_____ Concrete

_____ Floor Tile on Concrete

_____ Carpet glued to Concrete or Carpet & Tile

_____ Wood Floor (Plank)

_____ Wood Floor (Parquet)

_____ Thickness of Carpeting _____

_____ Other (Specify) _____

(f) What are the finishes on each wall? Designate which is North on print. Indicate on Elevations.

North wall _____ South Wall _____

East wall _____ West Wall _____

(g) Door units: Solid door_____ Glazed_____ Fully Glazed_____ Partially Glazed_____ (Y/N)

No Transom above_____ with Transom_____ Is Transom Glass_____ or Louver_____ Is louver in door_____

(h) Windows: Are windows operable_____ Do they fit tight_____ Can you hear clearly through win-

dows_____

What is teacher's assessment of this room? Loud_____ Hollow_____ Muffled_____ Noisy_____

Comments _____

ACOUSTICAL AND NOISE ASSESSMENT

Can you hear noise in the classroom when it is unoccupied? _____YES _____NO

Where do you think the noise is coming from? The heating/ventilation system? _____

Through the window? _____ From outside the building? _____

From inside the school? _____ From the next classroom? _____

Is it clearly audible? _____

- What type of heating and air conditioning is used in the room? _____
- Can you hear the light fixtures humming? _____
- Can you hear traffic noise? _____

If you have reason to be dissatisfied with the classroom please give you assessment as to you why think it is not a good environment.

How well is the classroom furnished? Does it have just desks and chairs or are there other cabinets and furnishings present? A simple diagram of the classroom layout can be very helpful to give a sense of the character of the room.

Does the school system employ an Educational Audiologist? _____
(If so, check with the Ed Aud to see if they have a Sound Meter.)

Do you have access to a sound level meter? (SLM) _____
(An appropriate SLM is one that can measure down to at least 30 dBA – A Radio Shack SLM is not sufficient.)

Ask questions, the school custodian can be of great assistance in helping identify building materials. Ask a child what he/she thinks about the room and whether they can hear and understand everything clearly. Ask the teacher what he/she thinks about the classroom.

Evaluating a classroom or other space involves subjective responses that are as important as quantifying the room characteristics by measurements or calculations. Therefore, as much information as you can gather, is important and helpful in resolving any problems that may exist.

The new proposed ANSI standards recommend a background noise level of not more that 35 dBA. This is about as quiet as your living room, assuming upholstered furnishings and wall-to-wall carpeting. That's pretty quiet.

If you can hear any noise in the unoccupied classroom it is best to take measurements to ascertain the level.
Just because a classroom has carpet & acoustical ceiling tile in the room is no guarantee that the Reverberation time (T60) will be less than the 0.6 seconds recommended.

TAKING SOUND LEVEL MEASUREMENTS

The TES 1357 Sound Level Meter is a simple meter to use to gather sound levels within a space or elsewhere. After clicking on the green power button on the SLM will take a few seconds to power up following which, it will start to record the sound level measurements in the A weighted scale.

Q: What is the A weighted scale?

A: Our ears do not hear all sounds at various frequencies equally. In fact, our sense of hearing is much less sensitive to low frequency sounds than to mid or high frequencies. Circuitry built into the sound level meter allows the SLM to read out to reflect how our ears interpret sounds.

The SLM will display a digital readout that is constantly changing with the fluctuations of the prevailing decibel noise levels expressed as dBA. (The abbreviation for decibel is dB and the A indicates the decibel level is in the A weighted mode). If you press the A/C button the meter will indicate the C weighted decibel level, which will reflect the content of the low frequency noise present. It is a good idea when taking measurements to check the C weighted sound levels periodically to determine if there is a strong low-frequency component to the sound spectrum. If there is a strong low frequency component the C weighted measurements will generally be much higher than the A weighted measurements.

The FAST/SLOW button simply changes the speed of the digital read out of the noise levels. Generally it is recommended that you leave the SLM in the fast mode. The MAX button will record the highest sound level that the meter records or the “peak” sound levels. Since the digital readout is averaging the sound levels the peak levels may not necessarily show up on the digital read out. Peak levels maybe of value when the noise levels are very high and we want to get a better sense of the actual peak levels.

The LEVEL button with up and down arrows allow the SLM operator to more accurately reflect the sound levels in appropriate ranges from 30 dB to 80 dB, from 60 to 110 dB and from 80 to 130 dB. Select the range in which the sounds levels are mostly dominant. (i.e.: in a relatively quiet environment the preferred range is in the 30-80 dB setting) (If the “UNDER” sign shows up on the meter scale switch down to the next level)

When taking measurements in a room for instance, record measurements at several locations. It is generally a good idea to have a pad of paper on which the room layout has been drawn. When recording a measurement note the mid points of the sound levels noted and jot them down on the room layout. After recording the sound levels at 5-6 locations the measurements can later be averaged to provide an average single sound level measurement.

If taking sound measurements in a classroom for instance, be sure to record the sounds with the HVAC both on and off. When the HVAC is on do not place the microphone tin the HVAC diffuser air stream as the microphone will pick up on the air flow velocity and give an inaccurate reading. Indoor measurements with the HVAC on should also be measured in the C weighted scale as HVAC systems tend to have a high, low-frequency content if measuring outdoors in a light wind be sure to put the foam windscreen over the mic to filter out the wind velocity noise.

In measuring sound levels in the A weighted scale an SLM is really only quantifying what you might otherwise be able to hear by simply listening. In measuring the sound level in a room it is wise to measure the room when it is unoccupied. If you need the sound levels in an occupied room measure accordingly but be sure to record what conditions you are measuring under.

TURN OFF POWER AFTER USE.

The following chart provides a comparative scale of decibel levels to common sounds.