

# ACOUSTICAL CHALLENGES FOR ACHIEVING ENHANCED ACOUSTICAL PERFORMANCE WITHIN SCHOOLS REQUIRED BY LEED®

**Zohreh Razavi**

Acoustical Consultant, Stantec Consulting Ltd., zohreh.razavi@stantec.com

## ABSTRACT

Based on the ANSI 12.6-2002(R2009) standards, a core learning space is defined as a location within building where students assemble for educational purposes such as: classrooms, conference rooms, libraries and music rooms. Spaces where good communication is important but informal learning is the primary function are called ancillary learning spaces which include gymnasiums, cafeterias and corridors.

The LEED® minimum acoustical performance – IEQ Prerequisite 3 - is to achieve a maximum background noise level of 45 dBA from HVAC systems within classrooms and core learning spaces, and for core learning spaces smaller than 566 m<sup>3</sup>, confirm that 100% of the ceiling or equivalent surface areas are covered with acoustical material achieving NRC of 0.70 or higher. For space larger than 566 m<sup>3</sup>, the reverberation time should be 1.5 seconds or shorter.

The LEED® Enhanced Acoustical Performance - IEQ Credit 9 – is building shell, classroom partitions and other core learning spaces partitions should meet the STC requirements of ANSI S12.6-2002 standard, except windows, which must meet an STC rating of at least 35. Background noise level from HVAC in classrooms and other core learning spaces shouldn't exceed 40 dBA.

The main acoustical challenges within schools where achieving enhanced acoustical performance are required by LEED® would be large windows and doors with unknown acoustical performances. A few challenges within schools will be discussed in this paper.

## 1. INTRODUCTION

The Leadership in Environmental and Energy Design (LEED®) is an internationally recognized green building certification system. Acoustics for schools was added to this rating system by the US Green Building Committee (USGBC) in 2007 and revised in 2009 [2]. In 2007, achieving a maximum background noise level in classrooms and other primary learning space of 40 dBA and 35 dBA would be approved for 1 and 2 points, respectively. In 2009, the maximum approved points for LEED® for schools is allowed to be 1 point which can be earned by meeting enhanced acoustical performance requirements. To achieve the requirement, the building shell, classroom partitions and other core learning space partitions should be designed to meet the STC requirements of ANSI Standard S12.60-2002, except windows, which must meet an STC rating of at least 35.

## 2. LEED® FOR SCHOOLS - USGBC

LEED® for schools addresses design and construction activities for both new school buildings and major renovations of existing school buildings approved under Indoor Environmental Quality –IEQ with USGBC. To earn one point with USGBC LEED® for schools, the IEQ prerequisite 3 – Minimum Acoustical Performance requirement and IEQ Credit 9 – Enhanced Acoustical Performance requirement should be met.

### 2.1 IEQ Prerequisite 3 - Minimum Acoustical Performance

The minimum acoustical performance to qualify for LEED® certification registration is to provide the required performances included in IEQ Prerequisite 3: Minimum Acoustical Performance which is as follows:

- Achieving a maximum background noise level of 45 dBA from HVAC systems in classrooms and other core learning spaces. And,
- For all classrooms and core learning spaces smaller than 566 m<sup>3</sup> confirm 100% of all ceiling areas (excluding lights, diffusers and grills) are finished with a material that has a Noise Reduction Coefficient (NRC) of 0.70 or higher. The alternative would be that the total areas of acoustical wall panels, ceiling finishes, and other sound-absorbent finishes equal or exceed the total ceiling area of the room (excluding lights, diffusers and grills).
- For all classrooms and core learning spaces larger than 566 m<sup>3</sup> confirm through calculations described in ANSI Standard S12.60-2002 that they are designed to have a reverberation time of 1.5 seconds or less.

### 2.2 IEQ Credit 9 - Enhanced Acoustical Performance

IEQ Credit 9 – Enhanced Acoustical Performance is to design the building shell, classroom partitions and other core learning space partitions to meet the Sound Transmission Class (STC) requirement of ANSI Standard S12.60-2002, except windows, which must meet an STC rating of at least 35.

## 3. ANSI STANDARD S12.60-2002

Based on ANSI standard S12.6-2002, a core learning space is defined as a location within a building where students assemble for educational purposes such as classrooms. Spaces where good communication is important but informal learning is the primary function

other than formal instruction are called ancillary learning spaces such as gymnasias. In LEED® for schools only acoustical performance within core learning spaces, as per ANSI S12.6-2002 standard, is considered.

### 3.1 STC Rating Requirements

An STC rating for every wall, floor, and ceiling assembly in a core learning space should comply with the tabulated levels in Table 1, as part of the ANSI S12.6-2002 standard.

**Table 1 - The required STC rating for demising walls between classroom and various adjacencies**

Adjacent Space Type	Minimum STC Rating
Other Classrooms, Speech clinics, Healthcare rooms	50
Outdoors	50
Bathrooms/Washrooms	53
Corridor, Staircase, Office or Conference room	45
Offices, Conference/Meeting Rooms	45
Music Rooms	60
Mechanical Equipment Rooms	60
Cafeteria, Gymnasium, Indoor Swimming Pool	60

### 4. LEED® FOR SCHOOLS - CaGBC

The Canadian rating systems are an adaptation of the US Green Building Council's (USGBC) LEED® System, tailored specifically for Canadian climates, construction practices and regulations. The ANSI S12.60 Standards have not been adopted in Canada. To this author's knowledge, no provincial building standards regarding classroom acoustics currently exist. However, meeting with the required performances included in USGBC would provide Innovation in Design (ID) credit under the Canadian Green Building Committee (CaGBC) LEED® Rating System.

### 5. PRACTICAL LIMITATIONS OF LEED® FOR SCHOOLS

The required acoustical performance on the doors and windows for STC rated partitions for core learning spaces are listed below:

- The STC rating of windows in all STC rated partitions should be 35;
- Doors into classrooms or other core learning spaces would be laboratory STC 30 rated or more;
- The STC rating for interior entry doors into, or between, music rooms shall be not less than STC 40.

The industry limitations that make designers decide not to pursue the LEED® for schools credit are listed below:

- A typical window assembly that achieves STC 35 is 25mm standard insulating glass (e.g. 6 mm glass – 12.7 mm air space – 6 mm glass) which is expensive for school projects;
- No information on the custom made window assemblies are available;
- No information on the STC rated doors are available from suppliers and/or manufacturer;
- To maintain the STC ratings for the doors, they should be sealed and inspected regularly which is costly and not practical for schools.

### 6. CONCLUSIONS

Over the last decade in which the LEED® rating system has been used and applied to projects, the rating system has not included acoustical credits. LEED® for schools was the first of the rating systems to adopt direct points related to acoustics. LEED® for schools – IEQ prerequisite 3 and Credit 9 address acceptable levels of reverberation time, background noise level and STC requirements for demising partitions between classrooms and their adjacencies. STC rated windows and doors are required to obtain the LEED® for schools point and unfortunately performance information is not readily available by these product manufacturers. Revisions of these requirements by evaluating the environmental noise impact and required speech privacy between classrooms and their adjacencies should be considered.

### 7. COST EFFECTIVE CONSIDERATION

The following cost saving considerations in developing the LEED® requirements would have lead in designing and building more schools with Enhanced Acoustical Performance.

- Evaluation of the environmental noise impact to determine the STC rating of the demising walls between classrooms and outdoor;
- Determining the required STC ratings of the windows within STC rated partitions with regards to its application (e.g. operable or not);
- Determining the required STC ratings of the doors depending on the required speech privacy between classrooms and their adjacencies (e.g. corridors)

### REFERENCES

- [1] ANSI S12.6-2002, Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools, (Approved June 26, 2002).
- [2] LEED Reference Guide for Green Building Design and Construction; For the Design, U.S. Green Building Council, 2009 Edition.