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# Acoustical Comparisons of Existing Facilities and New Facilities in a Special Education School

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## 1. ABSTRACT

Comparisons of reverberation times, background noise levels and STC ratings between existing buildings on the campus and newly constructed buildings will be presented for a school for students with special needs in central Florida. The project began with site visits and acoustical measurements with the design team on school days to observe children with a variety of learning, physical and emotional disabilities in their learning environments. Acoustical ceiling tile and limited ceiling heights were used in the new classrooms to limit reverberation times to less than 0.6 seconds in middle frequencies. Existing classrooms had temporary walls built between them with many openings and doors with no acoustic seals. Effective NIC ratings measured were less than 40 in many cases. There are buffer spaces and full height masonry walls between adjoining classrooms in the new building with STC ratings of 50 and above. Mechanical rooms were provided outside the classroom space for fan coil units with ductwork and silencers to maintain sound levels of NC 30 inside the classrooms. Existing classrooms had through the wall heat pump units with NC levels above 45.

## 2. INTRODUCTION

Sidney Lanier School in Gainesville, Florida is a facility for children with a variety of physical, emotional and learning disabilities. The school buildings were originally constructed in 1939. Several buildings had been added in the 1940's, 1950's and 1970's. The existing buildings were constructed of brick exterior walls with a wood truss roof construction with asbestos shingles. Floors were vinyl tile or terrazzo for easy cleaning. Many of the students who come to school at Sidney Lanier are brought by their parents or are bussed from locations throughout the district. The school houses programs for children from the whole school district in their specialized facilities.

## 3. METHOD

A site visit to observe classes in session was conducted in 1998 during the programming phase of the project. Acoustical issues noted during the site visits and identified during programming to be addressed in the design of the building were excessive loudness from through the wall heat pump units in many classrooms resulting in background noise levels of NC 45 and higher. While the exterior walls of the building were brick, many of the partitions between classrooms were temporary because they had been reconstructed over time. There were many openings in the walls. The result was plainly audible sound leaks from one room to another and field measured NIC ratings of 40 and below. Sound leaks that disturbed classes also resulted from the single loaded corridor design of the school. Children had to walk past the doors of all of the classrooms in a wing to get to the lunch, music or physical education. Older buildings on campus had plaster or gypsum board ceilings or ceilings with acoustical tiles that had been painted over so many times that it was no longer sound absorbent. Reverberation times in these rooms were 1

second and longer. Only the newest building had acoustical ceiling tile. Floors were made from vinyl tile or terrazzo due to maintenance issues. Many of the children required assistance for normal classroom activities as well as to eat and use toilet facilities. Walls were made of brick, gypsum board or plaster and glass from windows.

There was a 7 part design process that was used in the project that allowed the acoustical design criteria to be successfully integrated in the overall building design.

1. Acoustical measurements of background noise from HVAC systems and student activities, reverberation times, and NIC ratings of construction assemblies were taken in a representative sample of rooms to provide design criteria for the new buildings. The measurements were used in discussions with the Architect and school building committee to identify areas of acoustical concern and improvement for the new building.
2. Acoustical design criteria were provided to the Architect as part of the programming process so funds could be allocated for acoustical treatment within the construction budget.
3. Acoustical planning principles were identified and implemented in the basic design of the building by the Architect during Schematic Design and Design Development phases of the project.
4. Preliminary selections of wall assemblies, finish materials and design guidelines for HVAC system design were also provided for the design team during Schematic Design.
5. Detailed analysis of the HVAC system and acoustical review of materials, wall assemblies, etc. occurred during Construction Documents.
6. Acoustical review of shop drawings and submittals for acoustical items as well as periodic review of critical construction items occurred during construction.
7. Post construction measurements of acoustical systems were made after the building was completed but before it was occupied. Compliance with ANSI 12.60 was reached for all rooms with systems operating.

## 4. RESULTS

The basic design has a series of buildings consisting of groups of 4 classrooms arranged around a central corridor. There are also toilets, storage and teacher planning areas between adjacent classrooms that serve as buffer spaces to reduce noise transmission between adjoining rooms. Sound must pass between at least 2 walls to get from one classroom to the next one. The walls between each classroom are painted concrete masonry units that run from the floor to the roof deck above sealed appropriately. The initial sections presented during design development showed walls that only extended as far as the suspended ceiling. These were increased in height as a result of acoustical review. Solid core wood doors with acoustical seals are used at doors between the classrooms and the corridor, the bathrooms and the teacher planning office to reduce sound transmission between rooms and afford privacy for students being assisted in the bathrooms.

The ceilings in the classrooms are acoustical ceiling tile with an NRC of 0.70. The floors are vinyl tile. The reverberation times in the classrooms when occupied with typical furnishings are less than 0.60 seconds.

The rooms are air-conditioned by individual fan coil units located in a Mechanical Room behind each classroom. Each room has individual temperature control. The fan coil units are located so there is adequate duct work running at appropriate air velocities to reduce HVAC system noise. There are also duct silencers or sound attenuators located in both the supply and return ducts to reduce noise to the 35 dBA called for in the new standard. A duct silencer or sound attenuator is a prefabricated device that is inserted in place of straight duct with a series of perforated baffles located in the air stream. There is a sound absorbent fill inside the baffles often enclosed in a tedlar wrapper so the glass fiber or mineral fiber fill does not come into direct contact with the moving air stream. These units attenuate significantly more sound in each foot of length than straight duct.

Exhaust air inlets are located in each bathroom. Air is supplied to each bathroom in the typical manner. Air is not returned from Bathrooms so odors and contaminants can be dissipated in outside air. The exhaust ducts in each bathroom are connected to an exhaust fan also located in the Mechanical Room. The length of duct between the fan and the bathroom and the use of a silencer in the duct keep the background noise levels in the bathrooms with the fans operating within the requirements of the standard as well.

The Contractor attempted to substitute materials for the acoustical ceiling tile, acoustical wall panels and acoustical metal deck used in the gymnasium that had lower sound absorption coefficients than specified. These submittals were rejected and the proper materials were installed.

## 5. CONCLUSIONS

It is possible to design schools to meet the requirements of ANSI 12.60 even on very modest budgets. The case of a school for disabled students presents a challenge to the design team because of the practicalities of maintenance, use etc. that must be met in this facility that are not required in a main stream school. The acoustical success of the project is primarily attributed to the collaboration of the Architect and Acoustical Consultant early in the project during programming and schematic design phases to identify acoustic systems and materials required; provide basic planning for the school that would allow them to be implemented; provide items in the project budget for acoustical materials; and to follow the process through construction so the required materials were installed in the project.

Simple, cost effective strategies were used for all acoustical systems. This included the Architect's planning of the buildings so there were buffer spaces between classrooms and between classrooms and mechanical rooms; integrating acoustical finish materials in the design of the rooms; and integrating simple acoustical design principles in the design of the HVAC system. The project came in over $500,000 under the budget and has been well-received by the users.

## REFERENCES


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## FIGURES AND TABLES

Table 1. Comparison of acoustical measurements made in existing and new classrooms.

| Room | Reverberation Times | Background Noise Level | NIC of classroom wall |
|---|---|---|---|
| Existing Classroom | 0.6 to 1.2 s | 51-57 dBA<br>NC 45 | 30-40 |
| New Classrooms | 0.5-0.6 s | 32-35 dBA<br>NC 25-30 | 50+ |

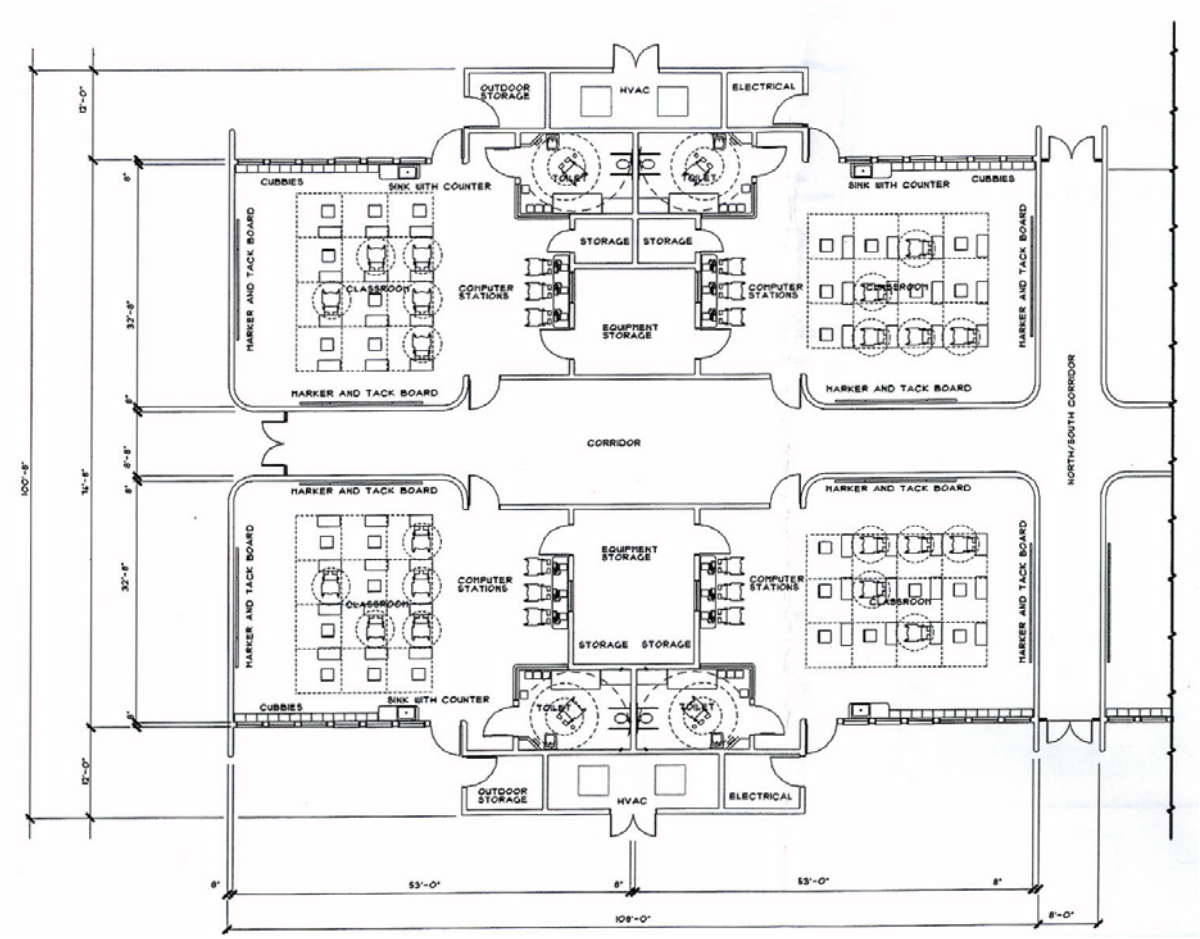


Figure 1. Floor plan of Classroom Building

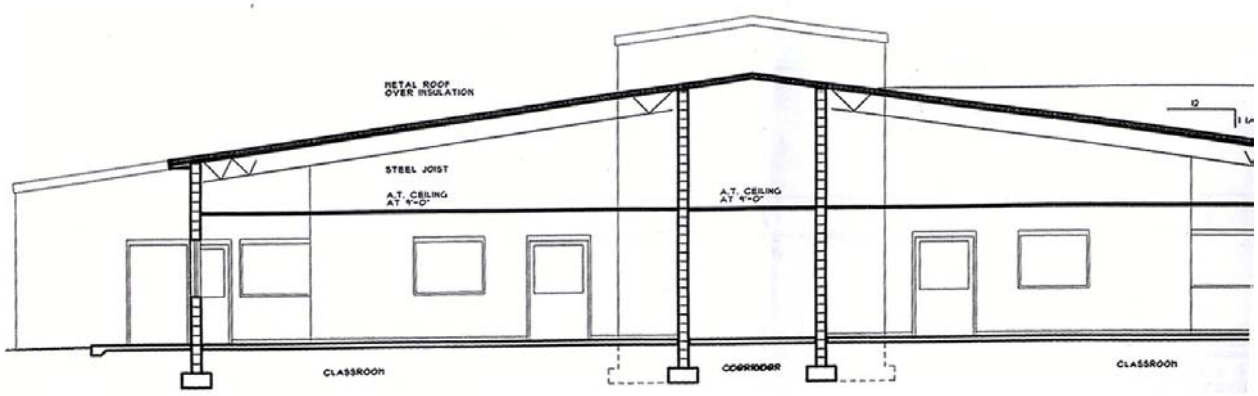


Figure 2. Section of Classroom Building.