Sound of Silence

Acoustically rated fenestration products are now available in different styles, framing materials and operating systems

By John Johnston and David Martin

façade noise infiltration through windows, doors, roofs, gables, walls, roof vents, exterior walls and soffits often affects interiors of commercial and architectural facilities.

However, the primary source of noise intrusion is through the windows. Using the right window can mean the difference between performance-enhancing serenity and nightmarish distraction. Today, acoustically rated fenestration products are available in different styles, framing materials and operating systems. Buildings with large window sizing requirements often involve commercial aluminum windows for their structural strength. Curtain wall and storefront represent a separate market.

'Of all the varieties of modern pollution, noise is the most insidious'

— Robert Lacey and Danny Danzinger, *The Year 1000 (What Life was Like at the Turn of the First Millennium).* London: Little, Brown and Co., 1999

Contract glaziers who venture into acoustical window work should look for guidance from acoustic-window consultants or specialists. They are trained experts who understand the unique characteristics of a building's proximity to noise, story level, window load factors and frequency-sensitive characteristics of the street. They work with leading commercial window manufacturers who specialize in acoustic windows.

Glazing contractors can develop a reputation for acoustical work by identifying themselves to community officials and architects who have allied themselves with the green building movement. Local public officials have strong interest in combating noise pollution in growing communities across the United States. Special programs providing grants or incentives for making property improvements may be available in your area.

How to develop the niche

Following are some of the definitions contract glaziers need to understand to operate in the acoustic openings market.

Targeting noise-impacted facilities

Commercial and institutional buildings most affected by noise problems include schools, places of worship, hotels and motels, condos and lofts, office buildings and community buildings such as libraries and courthouses and hospitals. To interest owners of such facilities in windows for sound abatement, learn more about the way they work.

Acoustically rated products

Acoustic windows and glazed doors meet Sound Transmission Class and Outdoor-Indoor Transmission Class design requirements based upon noise-generated sources. In addition, lower frequency—longer wave length—generated noises are often factored into the design of acoustical windows.

Sound Transmission Class is a single number, representing an acoustically rated window's attenuating ability. The higher the number, the more sound filtered. The rating assesses airborne transmission performance between frequencies of 125 hertz and 4,000 hertz per ASTM International's standards, ASTM E 413. These STC ratings do not address low-frequency sound transfer. Separate consideration must be given to low-frequency generated noise sources.

Outdoor-Indoor Transmission Class provides a single-number rating that can be used for comparing the sound isolation performance of building façade elements. The rating has been devised

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Reprinted from Glass Magazine® © National Glass Association, December 2004.
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to calculate the ability to reduce the perceived loudness of ground and air transportation noise transmitted into buildings. The ASTM E 1332-90 standard establishes a single-number rating by defining the spectrum of ground and air transportation noise. This spectrum is used with sound-transmission-loss data, measured in a laboratory using the ASTM E 90 method, and a mathematical relationship, given in the standard, to calculate the OITC rating. The OITC ratings are usually 5 to 10 decibels lower than STC ratings due to calculation differences between ASTM methods E 1332 and E 413.

Concepts and terms in an acoustically rated and certified fenestration product:

- **Mass** – increased glass thickness
- **Decoupling** – the use of dissimilar glass thicknesses
- **Airspace** – glass separation
- **Flanking** – closing off weak leak points
- **Assembly** – quality sash and frame joinery

"ASTM standards are always under revision," says Julie Schimmelpenningh of Solutia Inc. of St. Louis, Mo., and a member of the ASTM International Committee on Acoustical Window Standards. "As new testing methods and technologies are developed, they will be modified to improve both precision and bias. Anticipated changes may have an impact on single window ratings [either STC or OITC]."

Both ratings are product-specific. Using either of the above standards, only fenestration products with laboratory certified reports should be specified and used.

Acoustically rated products include double- and single-hung, sliding, fixed, awning, hopper and casement windows; and sliding and terrace swing doors.

Standard products have single or insulating glass sashes. STC ranges from high 20s to 40, depending on the window configuration. Split or dual window products have ratings from high 30s to 50-plus. Since STC rating requirements are found in more than 80 percent of all specifications, it remains the industry benchmark.

case studies

Three acoustical window case studies

Mingay Adult School is in the 65 decibel Community Noise Exposure Level surrounding the Burbank-Glendale-Pasadena Airport in California. The school was awarded several grants, including a $3 million award, part of which was used to insulate the school. Such CNEL contours are used primarily in California, while other parts of the country utilize a Day Night Level. Both measurement levels assess a 10-decibel penalty for nighttime noise between 10 p.m. and 7 a.m.

The renovated school openings featured a Guardian split sash, used to incorporate a 1-inch miniblind between the glass requirements while meeting a mid-40s STC specified requirement. Both internal and applied muntins were utilized for aesthetic enhancement. When installation was completed, field testing, with procedures specified by ASTM E99, revealed a 46 STC reading that, when combined with other construction trade specs, assured the 5 decibel reduction, as set forth by the Federal Aviation Administration guidelines.

William Penn House in Philadelphia, a 30-story brick luxury cooperative apartment building, experienced environmental problems including annoying street noise, unwanted solar heat gain and ultraviolet sun fading of furnishings. In 2002, 1,609 sliding windows and 228 sliding glass doors were replaced with Graham Series 0275 commercial windows. The HC-50 rated windows featured a 1-inch insulating glass system consisting of low-emissivity coated out-board panel and laminated clear Viracon interlayer on the ¼-inch in-board panel. Graham Series 0900 doors feature 1-inch IG system consisting of ¼-inch tempered low-e glass outboard panel and ⅜-inch glass inboard panel with Viracon interlayer. (Viracon STC: 39.) Tenants reported an end to street noise and sun-fading problems, better year-round comfort and lower electric heating bills.

Graham Architectural Products will soon start shop drawings on the addition to the **Inter-Continental Hotel** in Miami. This is an unusual project due to the required acoustical requirements as well as the Florida impact requirements relating to the property being located close to the coastline. Graham will be furnishing series 1100 fixed windows with an insulating glass unit with laminated heat absorbing glass on the exterior, split sash and single clear glass on the interior, meeting the specified 48 STC and 80 design pressure requirements. g

Graham 1100 window

From testing to installation

Wausau provides acoustic windows for university law center

By Katy Devlin

With seemingly constant noise pollution from Baltimore's busy highways, city streets and airways, architects of the University of Maryland's new law center took extra acoustic considerations when choosing windows and frames to ensure quiet learning environments.

Wausau Window and Wall Systems, of Wausau, Wis., provided the Nathan Patz Law Center and Thurgood Marshall Law Library with high-performance windows that block out the noise while allowing temperature and moisture levels to be kept in a safe range for the numerous law materials kept in the library. But only after rigorous acoustical testing could the beveled-face windows that use laminated, low-emissivity insulating glass pass muster.

"In acoustical testing, the window test specimen, both frame and glass, is installed in a heavy wall separating two echoic chambers, just the opposite of the sound-deadening walls used in a recording studio," says Steve Fronek, Wausau's vice president of research and development. " 'White noise' of a specific frequency range is broadcast in the 'loud' side, and a rotating-boom microphone on the receiving side measures sound-pressure levels on the 'quiet' side." Sound-pressure level is a measure of loudness and is typically expressed on a logarithmic scale in units of "decibels," named after Alexander Graham Bell.

The difference between the source room and receiving room sound-pressure level is plotted as the "transmission loss" at that particular frequency range. Test technicians change the frequency one-third octave band at a time, and repeat the process through the full range of frequencies perceptible to the human ear. Criterion curves or formulae are used to combine results and arrive at a "single-number" rating, either STC (Sound Transmission Class) or OITC (Outdoor-Indoor Transmission Class).

"Lower frequencies are harder to address, because they inherently require more energy to be absorbed for attenuation," Fronek says.

To improve acoustical performance, Fronek says, window manufacturers address three areas: mass, damping or cushioning and resonance. Strengthening of one specific area can improve the window's performance throughout certain frequencies.

For example, to improve mid- to high-frequency performance, resonance must usually be addressed, while low-frequency performance is improved by increasing glazing mass. Increasing the air space of dual- or triple-glazed infills improves performance at all frequencies. Obviously, acoustic products should be airtight to prevent "flanking" sound transmission.

"Increasingly, we're finding acoustical consultants more concerned with addressing certain octave band frequencies of concern for their specific site," Fronek says.

Architects for the University of Maryland law center paid close attention to blocking exterior noise, particularly in low frequencies created mostly by traffic and aircraft sources. They decided on Wausau's 2250-E Series Epic windows, a beveled-face, thermal-barrier aluminum window line. The windows use high-performance, low-emissivity laminated insulating glass with conventional spacers.

"Conventional systems like the Epic Series can achieve STC ratings between 30 and 40, but STCs above 44 require custom designs," Fronek says. "A 'point of diminishing returns' is reached, where incremental improvement in acoustic performance becomes prohibitively expensive, aesthetically inflexible and more costly to maintain."

In addition to blocking low frequency noise, the windows used in the law center will also help soften the higher frequency sounds of conversations, music and street traffic.

Key acoustical commercial window markets

Schools and the hospitality industry are two markets that have the broadest need for acoustical windows.

Educational facilities have long recognized the importance of acoustic building materials. A 1995 study by the Government Accountability Office found environmental noise to be the single most significant problem in schools.

With the recent adoption of a strictly voluntary standard by the American National Standards Institute S12.60-2002, "Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools," designers and school boards will see the importance of incorporating the standard into the design process. The penalty for not incorporating the standard in areas with noise generated from aircraft, traffic, and trains is the continued impairment of student productivity and the learning process. Potential long-term health problems is the other negative effect of elevated classroom noise.

Responsible design with the knowledge of acoustic principles and mathematical calculations is known to improve learning and test scores. According to the Acoustical Society of America, the unoccupied noise level in classrooms should not exceed the level of conversation of 35 decibels. "The standard speaks to new construction and major renovations," says Paul Schomer, ASA standards director.

Research on the effects of aircraft noise and children's learning suggest potential problems in the areas of "reading, motivation, language and speech acquisition, and memory (Evans, 1998)," according to a release by the Federal Interagency Committee on Aviation Noise titled, Relation Between Aircraft Noise Reduction in Schools and Standardized Test Scores.

Hotels and motels are another promising acoustical window market. Besides schools, this segment of the market is considered a prime target for acoustical windows. The capital outlay for installing acoustical fenestration products has been proven to be cost-effective where buildings are located in noisy areas, thus preventing lost revenues. The last thing a premium hotel owner wants is for his guests to feel sleep-deprived in the morning, or even worse, to check out in the middle of the night after paying $300 for a room.

Building owners should work with an acoustical consultant in the planning stage to receive quality acoustical window and doors. Doing so will ensure that the owner gets proper rated windows, taking into consideration specific noise frequencies. As with any laboratory certified product, repeated testing should be performed. This will help assure performance expectations and long-term performance.

Comparison in sound-pressure level and loudness

Change in decibels	Change in perceptible loudness
1	Imperceptible change
3	Just barely distinguishable
5	25
10	50
15	63
20	75

Federal Aviation Administration guidelines for schools

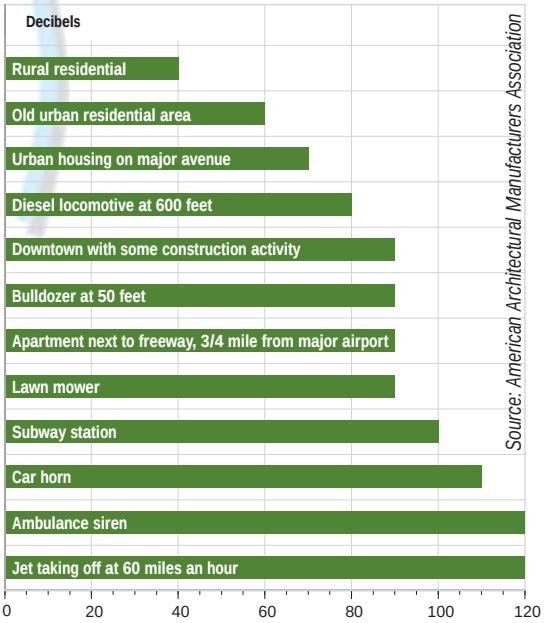
The FAA guidelines for examining school building noise reduction are identified in the FAA's Airport Improvement Handbook, Order 5100.38B, Chapter 8, Section 2 — Noise Compatibility Projects, Section 812 — Noise Insulation Projects, paragraph "c."

The FAA's two goals for improving noise reduction are:

1. Accomplish an interior average A-weighted sound level of 45 decibels or less during school hours of 8 a.m. to 3 p.m.

2. Achieve an improvement in noise levels of at least 5 decibels.

Typical noises



Resources

- American Architectural Manufacturers Association, www.aamanet.org
- Acoustical Society of America, www.asa.air.org
- Federal Aviation Administration, www.faa.gov
- U.S. Government Accountability Office, www.gao.gov
- National Council of Acoustical Consultants, www.acoustics.com