Acoustic Values

In addition to providing insulation and acting as a substrate for roofing, in many situations roof insulations also need to provide noise reducing characteristics. Building constructions near airports or other high noise areas require noise reduction principles to be employed. Today, the noise reduction properties of roof insulation must be known to properly design structures in high noise areas. Designing constructions to control noise requires, at a minimum, a basic understanding of terms and methods used to develop design values for various constructions.

Sound travels through a building component because it sets up vibrations in that component. Almost all building materials are sufficiently elastic to transmit sound. Therefore, almost all building materials can be set into motion by sound waves impinging upon them. Once a construction is set into vibration, it will transmit sound from the source through the construction and the sound will be heard on the opposite side of the construction. The result is sound transmission through the construction.

The ability of a construction to transmit sound is dependent upon its mass. The higher its mass, the more it is resistant to vibration caused by sound. If the mass were extremely small, even faint sound pressure could move it, and thus transmit sound.

In addition to mass, numerous other factors must be considered in proper sound control design. Such factors include background noise level, and transmission through floors, walls and penetrations through the construction (which also includes insulation joints). An acoustical engineer should be consulted when dealing with acoustical design.

From a material or system point of view, the acoustical engineer will require basic acoustical values derived by standard test procedures as part of his design requirements. Standard test procedures are defined by ASTM E 90 and interpretation is made using ASTM E 413 for determination of Sound Transmission Class (STC).

The STC is a measure of the noise reduction of a construction or material when measured over the human hearing range of 125 to 4000 cycles per second. Specific cycles per second for sound source (or noise) on one side of the construction are established in ASTM E 90; the sound transmitted through the construction is measured on the opposite side of the construction. The sound transmission loss in decibels is measured at each frequency. Each test sample is subjected to sound at 125, 175, 250, 300, 500, 700, 1000, 2000, and 4000 cycles per second.

For example, if a generated sound level of 80 decibels (db) is measured on the outside of the building and 30 db measured in an interior room, the reduction in sound intensity by the intervening construction is 50 db. The construction is then referred to as having a 50 db sound transmission loss. The higher the transmission loss of a system, the better it functions as a barrier to the passage of sound.

To facilitate analysis of transmission loss for a wide range of building materials, an STC number has been developed. The procedure for developing an STC number is covered by the ASTM E 413 Standard. Prior to the development of the STC number, arithmetic averages of sound transmission loss at selected sound frequencies were sometimes unreliable because a good average could be ascribed to a construction that performed poorly at an important sound frequency. The example of wall constructions in Figure 1 shows both walls having the same average sound transmission loss of 37.6 db. However, the non-masonry wall clearly performs poorly at the 500 cps sound level. Failure of sound insulation at certain frequencies is called an "acoustical hole." Figure 1 also shows the ASTM standard STC contours used in developing STC numbers for construction materials. In this example the concrete masonry wall would have an STC of 37 while the non-masonry wall would have a much lower STC.

When comparing STC values of rated constructions, it should be remembered that a 3-decibel difference is the smallest sound difference the human ear can clearly detect. Thus, STC points of 1 or 2 may be considered negligible.

When it comes to sound transmission, a significant difference can exist between the design and what is actually constructed. One of the most important sources of sound transmission in construction is joints between materials and penetrations through the construction. For example, a joint that is just 0.007 inches wide and extending 12.5 feet would let as much sound through the construction as a hole that is 1 inch square. Consequently, insulation systems that do not have through joints in the construction inherently reduce one major source of sound transmission.

Table 1 lists STC values for various Siplast Lightweight Insulating Concrete Systems constructions. Following this table are the test results supporting the values.

Table 1
Acoustical Values

System Construction

Structural Substrate	ZIC System	Roofing	STC
26 ga. Corrugated Steel	2" 1:6 ZIC above flutes	BUR/Gravel	41
26 ga. Corrugated Steel	1" Insulperm 2" 1:6 ZIC above Insulperm	BUR/Gravel	36
22 ga. Corrugated Steel	2" 1:4 ZIC on flutes 7" Insulperm EPS 2" 1:4 ZIC above Insulperm	Paradiene 20/30	43
22 ga. Corrugated Steel	2" 1:4 ZIC on flutes 7" Insulperm EPS 4" 1:4 ZIC above Insulperm	Paradiene 20/30	44
22 ga. Corrugated Steel	2" 1:4 ZIC on flutes 12" Insulperm EPS 4" 1:4 ZIC above Insulperm	Paradiene 20/30	46
4" Structural Concrete	3" Insulperm 1 ½" NVS Concrete above Insulperm	Modified bitumen/Gravel	55

Note: STC values are for the roof deck construction only. When a ceiling system is installed beneath the roof deck, 7 to 12 additional STC points can be added to the deck only values. Consult your ceiling supplier for specific values.

Figure 1
Examples of STL and STC Criteria