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OUTSIDE-INSIDE TRANSMISION CLASS OF CONCRETE MASONRY WALLS

TEK 13-4
Sound (2008)

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INTRODUCTION

Providing a quality indoor acoustic environment is becoming a higher priority in many cases; often in urban environments where noise from traffic and other outside sources can be a significant distraction, particularly in schools, homes and the workplace. Concrete masonry walls provide excellent noise control due to their ability to effectively block airborne sound transmission over a wide range of frequencies.

The ability of a wall to insulate a building interior from outdoor noise can be indicated by the wall's outside-inside transmission class (OITC), with higher OITC values indicating better sound insulation.

OITC is one rating system available to help compare the acoustic performance of various wall systems. Others include the sound transmission class (STC) and the noise reduction coefficient (NRC). Both OITC and STC indicate a wall's ability to block the transmission of sound from one side of the wall to the other. OITC differs from the STC rating in that the OITC was developed specifically to indicate transmission of noise from transportation sources. STC was developed primarily for indoor noise sources, such as human speech. Unlike OITC and STC, NRC indicates the ability of a wall to absorb sound, which is useful for controlling sound reverberations within a room.

This TEK presents OITC values for a variety of common concrete masonry exterior walls. STC and NRC values for concrete masonry walls can be found in TEK 13-1B, *Sound Transmission Class Ratings for Concrete Masonry Walls*, and TEK 13-2A, *Noise Control With Concrete Masonry* (refs. 1, 2), respectively.

OUTSIDE-INSIDE TRANSMISSION CLASS

The OITC is a rating intended for exterior building facades, and is an estimate of the wall's ability to reduce typical transportation noise. It is determined in accordance with ASTM E 1332, *Standard Classification for Determination of Outdoor-Indoor Transmission Class* (ref. 3). E 1332 presents a standard procedure to calculate OITC based on tested sound transmission loss (TL) across the wall or wall element at specific frequencies from 80 to 4,000 Hz. These TL values are measured either in the laboratory or in the field using ASTM E 90, *Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements*, or ASTM E 966, *Standard Guide for Field Measurements of Airborne Sound Insulation of Building Facades and Facade Elements* (refs. 4, 5).

OITC is calculated using these tested TL values along with the sound spectrum of a reference sound source. This reference sound spectrum is an average of typical spectra from three transportation noise sources: aircraft takeoff, freeway and railroad passby. The reference sound spectrum is A-weighted to better correlate to human hearing (A-weighting is a frequency response adjustment that accounts for the changes in human hearing sensitivity as a function of frequency).

Although higher OITC values indicate more effective sound insulation from noises similar to the reference sound spectrum, it should be noted that the accuracy of the rating depends on the actual exterior noise spectrum and the surface area of the wall. The OITC is intended to be used to compare various facades, rather than as a predictor of performance.

The OITC can be applied to walls, doors, windows, or combinations thereof. As presented in this TEK, the OITC values apply to the masonry portion of the wall only, without windows or other openings.

CONCRETE MASONRY OITC VALUES

OITC Values Based on E 90 Test Data

Many ASTM E 90 sound transmission loss tests have been performed on a wide variety of concrete masonry walls. OITC values for some of these walls have been calculated in accordance with ASTM E 1332 from E 90 test data, and are presented in Table 1. In general, for concrete masonry walls, heavier walls have higher OITC values.

Note that the ASTM E 1332 OITC calculation requires transmission loss (TL) test data from 80 Hz to 4,000 Hz, while ASTM E 90 test reports often do not include TL values at 80 Hz. Test reports which do include 80 Hz show that the TL value of concrete masonry walls at 80 Hz is typically about the same or higher than that at 100 Hz. For the purposes of this TEK, where TL values at 80 Hz were not reported, the 80 Hz TL was assumed equal to the 100 Hz TL.

Estimated OITC in the Absence of Test Data

Ideally, OITC should be based on tested transmission loss values. In recognition that this data is not always available, however, the information in Figure 1 is presented as a tool to help designers estimate OITC values.

It has been well established (ref. 6) that the STC of concrete masonry walls is directly related to wall weight. Using this knowledge and the calculated OITC values in Table 1, a correlation between concrete masonry wall weight and OITC has been developed:

$$OITC = 11.5W^{0.356} \quad \text{Equation 1}$$

where W = the average wall weight based on the weight of the masonry units; the weight of mortar, grout and loose fill material in voids within the wall; and the weight of surface treatments and other components of the wall, psf.

For multi-wythe walls where both wythes are concrete masonry, the weight of both wythes is used in Equation 1.

Tabulated wall weights for concrete masonry walls can be found in TEK 14-13B, *Concrete Masonry Wall Weights* (ref. 7).

Table 1—OITC Ratings Based on ASTM E 90 Test Data for Single Wythe Concrete Masonry Walls

Wall description:	Wall finish(es):	Wall weight, psf:	OITC:	Test designation:
4-in.	no finishes	20.7	32	KAL 359-1-66
4-in.	two coats of paint on each side	26.5	36	Riverbank TL 67-99
4-in.	plaster on each side	32.0	42	Intercon 684-11
4-in.	plaster on each side	42.0	42	Intercon 684-12
4-in.	two coats plaster on each side	36.2	43	KAL 359-7-66
6-in.	no finishes	25.1	37	KAL 359-4-66
6-in. 100% solid	two coats plaster, total thickness of $^9/_{16}$-in., on each side	54.0	45	LECA Wall A
8-in.	no finishes	36.2	39	KAL 359-3-66
8-in.	paint on each side	33.5	40	Riverbank TL 67-61
8-in.	two coats of paint on each side	36.2	42	KAL 359-5-66
8-n.	no finishes	48.4	42	TL-88-356
8-in.	two coats plaster, total thickness of $^9/_{16}$-in., on one side	38.0	45	LECA Wall E
8-in. 100% solid	two coats plaster, total thickness of $^9/_{16}$-in., on each side	67.0	50	LECA Wall C
10-in.	two coats plaster, total thickness of $^9/_{16}$-in., on each side	49.0	48	LECA Wall G
10-in. 100% solid	two coats plaster, total thickness of $^9/_{16}$-in., on each side	81.0	50	LECA Wall D
Cavity wall: 4-in. split rib CMU, $3^1/_2$-in. air space, $2^1/_2$-in. glass fiber panel, 8-in. CMU, $^5/_8$-in. gypsum wallboard screwed to CMU		88.6	64	TL-88-431
Cavity wall: 4-in. split rib CMU, 4-in. air space, 2-in. rigid board insulation, 8-in. CMU, $^5/_8$-in. gypsum wallboard screwed to CMU		88.1	57	TL-88-432

OITC REQUIREMENTS

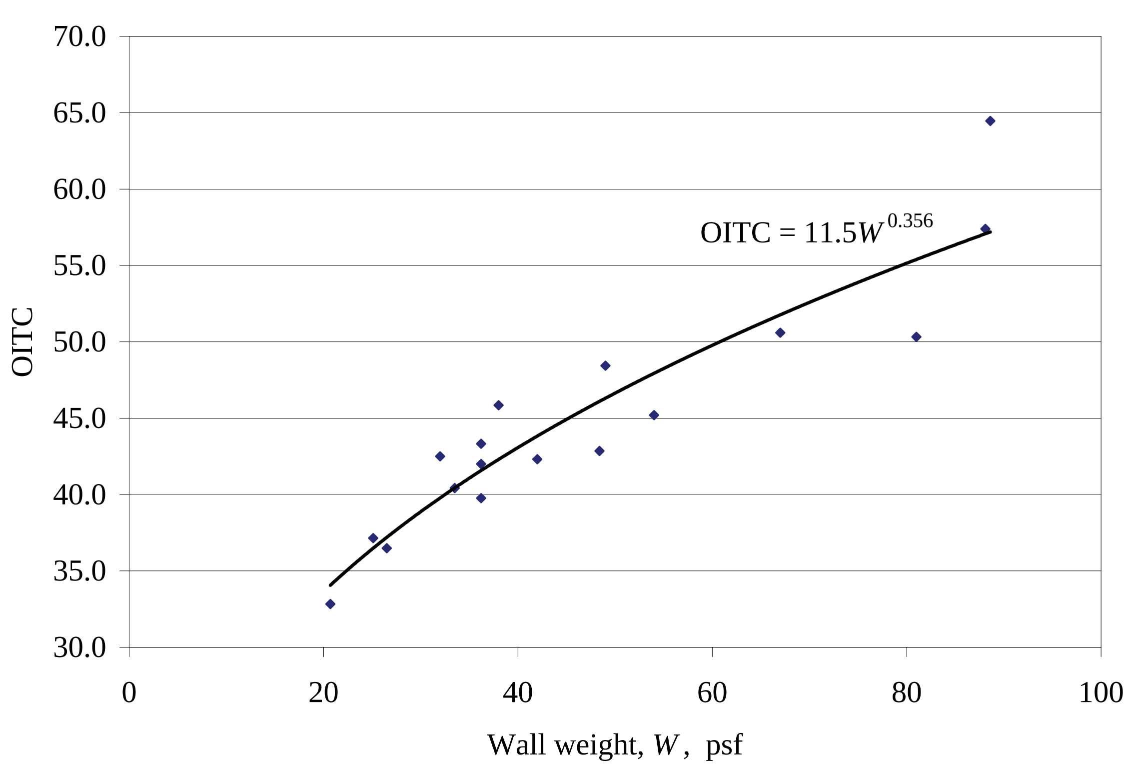
Although not currently required by the *International Building Code* (ref. 8), designers sometimes include an OITC requirement in the construction documents, particularly for buildings close to railroads, airports and highways.

DESIGN AND CONSTRUCTION

In addition to transmission class values for walls, other factors also affect the acoustical environment of a building. Seemingly minor construction details can impact the acoustic performance of a wall. For example, screws used to attach gypsum wallboard to steel furring or resilient channels should not be so long that they contact the face of the concrete masonry substrate, as this contact area becomes an effective path for sound vibration transmission.

Through-wall openings, partial wall penetration openings and inserts, such as electrical boxes, as well as control joints should be completely sealed.

The reader is referred to TEK 13-1B, *Sound Transmission Class Ratings for Concrete Masonry Walls*, and TEK 13-2A, *Noise Control With Concrete Masonry* (refs. 1, 2) for more detailed information on the above as well as additional design and building layout considerations to help minimize sound transmission.



Where W = the average wall weight based on the weight of the masonry units; the weight of mortar, grout and loose fill material in voids within the wall; and the weight of surface treatments (excluding drywall) and other components of the wall, psf

Figure 1—OITC Data and Correlation to Concrete Masonry Wall Weight

REFERENCES

1. *Sound Transmission Class Ratings for Concrete Masonry Walls*, TEK 13-1B. National Concrete Masonry Association, 2008.
2. *Noise Control With Concrete Masonry*, TEK 13-2A. National Concrete Masonry Association, 2007.
3. *Standard Classification for Determination of Outdoor-Indoor Transmission Class*, ASTM E 1332-90(2003). ASTM International, 2003.
4. *Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements*, ASTM E 90-04. ASTM International, 2004.
5. *Standard Guide for Field Measurements of Airborne Sound Insulation of Building Facades and Facade Elements*, ASTM E 966-04. ASTM International, 2004.
6. *Standard Method for Determining the Sound Transmission Class Rating for Masonry Walls*, TMS 0302-07. The Masonry Society, 2007.
7. *Concrete Masonry Wall Weights*, TEK 14-13B. National Concrete Masonry Association, 2008.
8. *International Building Code. International Code Council*, 2003 and 2006 editions.

NATIONAL CONCRETE MASONRY ASSOCIATION
13750 Sunrise Valley Drive, Herndon, Virginia 20171
www.ncma.org

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