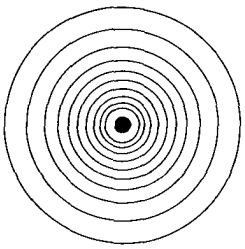
Carolinas Concrete Masonry Association

CONCRETE MASONRY

# Sound Control



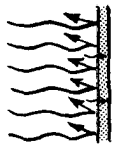
The demand for quiet rooms in hotels, motels, apartment buildings, hospitals, schools and office buildings has focused attention on the use of construction materials that resist the transmission of sound.

## MEASURING SOUND

Sound is measured in decibels. A decibel is roughly equivalent to the smallest change in sound energy that the average ear can detect. The level of zero decibels is the threshold of hearing. At the other extreme is the threshold of pain, about 130 decibels. Between these extremes are situations that we usually encounter in everyday life. The noises that we hear in our homes range from 30 to 40 decibels, depending on the activity.

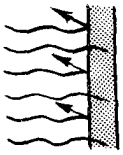
Sound transmission is usually measured in decibels. The amount of sound reduction afforded by a wall panel is called "sound reduction coefficient" or "transmission loss coefficient."

Hard plaster or glass absorbs only about 3% of incident sound — 97% "bounces back."

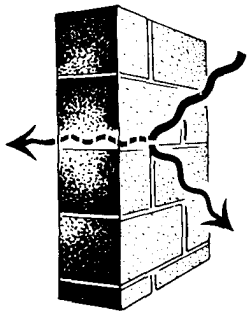


absorbs only 3%

Lightweight concrete masonry units with a 50% coefficient will absorb half of sound striking wall.



absorbs 50%



## CONTROL

Noise reduction is achieved in one of two ways depending on where the source of the sound comes from with reference to the listener. If the listener is in the same room as the source, reduction is achieved by sound absorbing material in the same room. If the listener is in the room next to the source, reduction is achieved by a wall with a high transmission loss. Concrete masonry walls have an important role in both types of solution to the noise problem. With attention to surface texture of finish, a concrete masonry wall will absorb almost as much of the sound that strikes it as does acoustical tile — 40 to 50 percent. And the heavy limp mass of the concrete masonry wall is without equal as a sound barrier or noise insulation against transmitted sounds.

## SOUND TRANSMISSION

The transmission of sound through rigid partitions is accomplished principally by the forced vibration of the wall; that is, the entire rigid wall is forced into vibration by the impact of the sound waves against it. The vibrating wall thus becomes a secondary source of sound and radiates a certain amount of sound to the space on the opposite side. It is therefore to be expected that the noise insulation value of a wall will depend primarily upon the mass or inertia of the wall, the stiffness of the wall, and the internal damping of the wall. The ideal noise insulator is a "limp-heavy" wall. When one side is sealed with paint, plaster, or gypsum board, the concrete masonry wall fits this description precisely.

To determine the effectiveness of a wall construction as a means of sound insulation, or noise insulation, a two-room test is employed. In this test, ASTM E-90, a steady sound is generated and measured on one side of a wall, and the sound which passes through is measured in an adjacent room. The measurements are made at sixteen different frequencies over a range of 125 to 4000 cycles per second, called "hertz" (HZ). The difference in sound levels indicates the transmission loss of the wall. The higher the transmission loss of a wall, the better it functions as a barrier to the passage of unwanted noise.

The measurements made at the sixteen different frequencies are reduced to a single STC (sound transmission class) number by means of a prescribed ASTM procedure. The STC rating is obtained by comparing a plotted curve of test results against a standard set of curves or contours. STC numbers are used to specify the minimum noise insulation needed in a building. For example, the minimum STC values acceptable for multi-family housing under HUD are shown in Table 1.

Tables 2 through 8 summarize recent STC tests on concrete masonry walls ranging in thickness from 4 to 12 inches, and of various configurations and surface treatments.

Note: Portions of the information above and the tables to follow are reprinted with permission from NCMA TEK- 13.1.

**Table 1 HUD Sound Transmission Requirements for Walls in Multifamily Housing**

| LOCATION OF PARTITION | STC |
|---|---|
| Living unit to living unit, corridor (1) or public space, average noise (2) | 45 |
| Living unit to public space and service areas, high noise (3) (4) | 50 |

**NOTES:**
(1) These values assume floors in corridor are carpeted; otherwise increase STC by 5.

(2) Public space of average noise includes lobbies, storage rooms, stairways, etc.

(3) Areas of high noise include boiler rooms, mechanical equipment rooms, elevator shafts, laundries, incinerator shafts, garages, and most commercial uses.

(4) Increase STC by 5 when over or under mechanical equipment which operates at high noise levels.

**Table 2 STC Tests on 8-Inch Single Wythe Concrete Masonry Walls**

| *Wall Description* | *Wall Weight lb/sf* | *STC* | *Test Identification* |
|---|---|---|---|
| NO SURFACE TREATMENT: | | | |
| hollow, lt. wt. | 30 | 45 | KAL 359-3-66 |
| hollow, lt. wt. | 39 | 49 | KAL 1144-1-71 |
| hollow, lt. wt. | 43 | 49 | KAL 1144-2-71 |
| hollow, lt. wt., cells filled w/insul. | 40 | 51 | KAL 1144-4-71 |
| hollow, norm, wt. | 53 | 52 | KAL 1144-3-71 |
| hollow, norm. wt. | 55 | 46 | GH USG-142FT |
| SURFACE SEALED WITH PAINT: | | | |
| both sides, hollow, lt. wt. | 30 | 46 | KAL 369-5-66 |
| both sides, hollow, lt. wt. | 34 | 48 | TL 67-61 |
| both sides, hollow, lt. wt. | 35 | 44 | TL 67-89 |
| both sides, hollow, lt. wt. | 32 | 46 | TI 67-88 |
| both sides, hollow, norm. wt. | 55 | 46 | GH USG-146FT |
| SURFACE SEALED WITH PLASTER: | | | |
| one side, hollow, lt. wt. | 38 | 52 | LECA wall E |
| both sides, solid, norm. wt. | 67 | 56 | LECA wall C |
| SURFACE SEALED WITH GYP BOARD: | | | |
| ½", both sides, hollow, norm. wt. | 55 | 49 | GH USG-143FT |
| ½", one side—hollow, norm, wt., paint, one side | 43 | 50 | TL 67-93 |
| ½", one side, hollow, lt. wt. | 40 | 56 | KAL 933-1-70 |
| ½", one side—hollow, norm. wt., paint, one side | 55 | 48 | GH USG-145FT |
| ½" + 1" insul, both sides, hollow, norm. wt. | 60 | 46 | GH USG-147FT |
| ½", both sides—hollow, norm. wt., 1" insul, one side | 60 | 49 | GH USG-144FT |
| SURFACE BONDED WALLS: | | | |
| ⅛", both sides, hollow, lt. wt. | 34 | 42 | CK 734-33 |
| ⅛", both sides, hollow, norm. wt. | 47 | 47 | CK 734-28 |
| ⅛", both sides, hollow, norm. wt. | 49 | 48 | CK 734-32 |
| ⅛", both sides, hollow, norm. wt., cells filled with insulation | 48 | 48 | CK 734-29 |
| ⅛", both sides, hollow, norm. wt. cells filled with concrete grout | 92 | 56 | CK 734-31 |
| REINFORCED AND GROUTED WALLS: | | | |
| No surface treatment | 73 | 48 | KAL 1023-1-71 |
| Surface sealed with: | | | |
| paint, both sides | 73 | 55 | KAL 1023-2-71 |
| ½" plaster, both sides | 79 | 56 | KAL 1023-9-71 |
| ½" gyp. board, both sides | 77 | 60 | KAL 1023-3-71 |

**Fig. 1 Acoustical Laboratories Represented in Table 2 Through Table 8**

| *Identification* | *Laboratory* |
|---|---|
| CK | Cedar Knolls Acoustical Laboratory<br>Cedar Knolls, New Jersey |
| KAL | Kodaras Acoustical Laboratories<br>Elmhurst, New York |
| LECA | C-O A-S Norsk LECA<br>Osloe, Norway |
| NGC | National Gypsum Company<br>Buffalo, New York |
| NRC | National Research Council<br>Ottawa, Canada |
| TL | IITRI, Riverbank Acoustical Laboratory<br>Geneva, Illinois |
| DO | Domtar Research Centre<br>Senneville, Quebec, Canada |
| VA | Vibro-Acoustics Ltd.<br>Toronto, Ontario, Canada |
| GH | Geiger & Hamme, Inc.<br>Ann Arbor, Michigan |

**Table 3 STC Tests on 6-Inch Thick Concrete Masonry Walls**

| *Wall Description* | *Wall Weight lb/sf* | *STC* | *Test Identification* |
|---|---|---|---|
| NO SURFACE TREATMENT: | | | |
| hollow, lt. wt. | 21 | 44 | KAL 359-4-66 |
| hollow, norm. wt. | 43* | 45 | NRC |
| SURFACE SEALED WITH PAINT: | | | |
| both sides, hollow, lt. wt. | 28 | 46 | KAL 933-2-70 |
| one side, hollow, lt. wt. (Soundblox) | 35 | 49 | KAL 365-1-66 |
| one side, hollow, lt. wt. (Soundblox) | 38 | 47 | KAL 365-2-66 |
| one side, hollow, lt, wt. | 32 | 43 | KAL 365-3-66 |
| both sides, hollow, norm. wt. | 39 | 48 | KAL 1379-1-72 |
| SURFACE SEALED WITH PLASTER: | | | |
| ½", both sides, hollow, lt. wt. | 31 | 46 | CK 664-30 |
| both sides, solid, norm. wt. | 54 | 52 | LECA wall A |
| SURFACE SEALED WITH GYP BOARD: | | | |
| ½", one side, hollow, norm. wt. | 45* | 45 | NRC |
| ½", one side, hollow, norm. wt. | 45* | 46 | NRC |
| ½", one side, hollow, norm. wt. | 45* | 49 | NRC |
| ½", both sides, hollow, norm. wt. | 47* | 44 | NRC |
| ½", both sides, hollow, norm. wt. | 47* | 45 | NRC |
| ½", both sides, hollow, norm. wt. | 47* | 47 | NRC |
| ⅝", both sides, hollow, lt. wt. | 35 | 49 | CK 664-29 |
| ½", one side—hollow, lt. wt., paint, one side | 27 | 53 | KAL 359-6-66 |
| ½" + 1" insul., one side, hollow, | 45* | 50 | NRC |
| norm. wt. | 45* | 51 | NRC |
| ⅝", one side—hollow, lt. wt., ½", one side | 38 | 47 | NRC 404-PY |
| ½", both sides—hollow, norm. wt. 1" insul., one side | 48* | 49 | NRC |
| ½" + 1" insul, both sides, hollow, norm. wt. | 48* | 46 | NRC |
| ½" + 1" insul, both sides, hollow, norm. wt. | 48* | 48 | NRC |
| SURFACE BONDED WALLS: | | | |
| ⅛", both sides, hollow, lt. wt. | 30 | 43 | CK 734-30 |

*Estimated Weight

**Table 4 STC Tests on 4-Inch Thick Concrete Masonry Walls**

| *Wall Description* | *Wall Weight lb/sf* | *STC* | *Test Identification* |
|---|---|---|---|
| NO SURFACE TREATMENT: | | | |
| hollow, lt. wt. | 18 | 40 | KAL 359-1-66 |
| hollow, lt. wt. | 22 | 29 | DO 69-57-2 |
| hollow, norm. wt. | 27 | 45 | TL 66-132 |
| hollow, norm. wt. | 33 | 45 | VA R6705 |
| hollow, norm. wt. | 39 | 46 | VA R6702 |
| solid, norm. wt. | 40 | 46 | NRC |
| SURFACE SEALED WITH PAINT: | | | |
| both sides, hollow, lt. wt. | 26 | 41 | TL 67-99 |
| both sides, hollow, lt. wt. | 22 | 43 | KAL 1379-5-72 |
| both sides, hollow, lt. wt. hollow cells filled with sand | 34 | 43 | TL 67-100 |
| both sides, hollow, norm. wt. | 32 | 44 | TL 67-92 |
| both sides, hollow, norm. wt. | 29 | 44 | KAL 1379-3-72 |
| one side, solid norm. wt. | 40 | 47 | NRC |
| SURFACE SEALED WITH PLASTER: | | | |
| ½", both sides, hollow, lt. wt. | 35 | 44 | TL 67-102 |
| ½", both sides, hollow, lt. wt. | 30 | 48 | KAL 359-7-66 |
| ½", both sides, hollow, lt. wt. | 32 | 49 | CK 684-11 |
| ½", both sides, hollow, lt. wt. | 33 | 45 | DO 69-78-2 |
| ⅝", both sides, hollow, lt. wt. | 42 | 50 | CK 684-12 |
| ⅝", both sides, hollow, lt. wt. | 37 | 43 | TL 67-103 |
| ⅝", both sides, hollow, norm. wt. | 43 | 48 | VA R6707 |
| ⅝", both sides, hollow, norm. wt. | 50 | 51 | VA R6704 |
| SURFACE SEALED WITH GYP. BOARD: | | | |
| ½", both sides, hollow, lt. wt. | 25 | 45 | CK 684-27 |
| ½", both sides, hollow, lt. wt. | 27 | 40 | DO 69-88-2 |
| ½", both sides, hollow, lt. wt. | 26 | 47 | KAL 1379-4-72 |
| ½", both sides, hollow, norm. wt. | 32 | 48 | KAL 1379-2-72 |
| ½", + 1" blanket insul. & block sealer, one side, solid, norm. wt. | 43 | 51 | NRC |
| ½", both sides +1" insul. & block sealer, one side, solid, norm. wt. | 44 | 52 | NRC |
| ½", both sides, block sealer, one side, solid, norm. wt. | 44 | 44 | NRC |
| ½", one side, block sealer, one side, solid, norm. wt. | 42 | 46 | NRC |
| ½", both sides, block sealer +¾" perlite board, one side, solid, norm. wt. | 45 | 47 | NRC |
| SURFACE BONDED WALLS: | | | |
| 1/16", both sides, hollow, lt. wt. T&G | 28 | 43 | KAL 1709-74 |

**Table 5 STC Tests on 10-Inch Thick Single Wythe Concrete Masonry Walls**

| *Wall Description* | *Wall Weight lb/sf* | *STC* | *Test Identification* |
|---|---|---|---|
| NO SURFACE TREATMENT: | | | |
| hollow, lt. wt. | 47 | 44 | NRC |
| hollow, norm. wt. | 57 | 47 | NRC |
| SURFACE SEALED WITH PAINT: | | | |
| both sides, hollow, lt. wt. | 47 | 47 | NRC |
| both sides, hollow, norm. wt. | 57 | 49 | NRC |
| SURFACE SEALED WITH PLASTER: | | | |
| both sides, hollow, lt. wt. | 49 | 55 | LECA wall G |
| both sides, solid, lt. wt. | 81 | 58 | LECA wall D |
| SURFACE SEALED WITH GYP. BOARD: | | | |
| ½", both sides, hollow, lt. wt. | 51 | 50 | NRC |

**Table 6 STC Tests on 12-Inch Thick Single Wythe Concrete Masonry Walls**

| *Wall Description* | *Wall Weight lb/sf* | *STC* | *Test Identification* |
|---|---|---|---|
| NO SURFACE TREATMENT: | | | |
| hollow, lt. wt. | 53 | 39 | NRC 90-1A |
| hollow, norm. wt. | 69 | 49 | NRC |
| solid, norm. wt. | 121 | 55 | NGC 3002 |
| SURFACE SEALED WITH PAINT: | | | |
| one side, hollow, lt. wt. | 53 | 51 | NRC 90-1B |
| both sides, hollow, lt. wt. | 53 | 50 | NRC 90-1D |
| one side, hollow, norm. wt. | 69 | 50 | NRC |
| SURFACE SEALED WITH PLASTER: | | | |
| ⅝", both sides, hollow, lt. wt. | 56 | 50 | NRC 93-2A |
| ⅝", one side—hollow lt. wt., paint, one side | 56 | 50 | NRC 93-2B |
| ⅝", both sides, hollow, lt. wt. | 59 | 50 | NRC 93-2C |
| ½", one side—hollow, norm. wt. paint, one side | 72 | 52 | NRC |
| ½", both side, hollow normal wt. | 75 | 49 | NRC |
| SURFACE SEALED WITH GYP BOARD: | | | |
| ⅝", one side, solid, norm. wt. | 124 | 58 | NGC 3003 |
| ½", one side—hollow, lt. wt., paint, both sides | 55 | 49 | NRC 90-1F |
| ⅝" + 1½" insul. one side, solid, norm. wt. | 124 | 56 | NGC 3004 |
| ½" one side—hollow, lt. wt., paint, one side | 55 | 57 | NRC 90-1C |
| ½" + 1" insul, one side—hollow, lt. wt., paint, one side | 55 | 50 | NRC 90-1E |
| SURFACE BONDED WALLS: | | | |
| ⅛", both sides, hollow, lt. wt. | 67 | 51 | CK 734-27 |

**Table 7 STC Tests on 10-Inch Cavity Walls of Concrete Masonry**

| *Wall Description* | *Wall Weight lb/sf* | *STC* | *Test Identification* |
|---|---|---|---|
| 4" concrete brick exterior; 2" air space; 4" hollow lightweight block | | | |
| no surface treatment | 56 | 54 | KAL 1023-6-71 |
| ½" plaster on block surface | 59 | 57 | KAL 1023-8-71 |
| ½" gyp. board on block surface | 58 | 59 | KAL 1023-7-71 |
| Normal weight, hollow block (4-2-4) | | | |
| no surface treatment | 60 | 46 | NRC |
| paint, one side | 60 | 47 | NRC |
| insulate cavity & paint one side | 60 | 49 | NRC |

**Table 8 STC Tests on 8 Inch Composite Brick and Block Walls**

| *Wall Description* | *Wall Weight lb/sf* | *STC* | *Test Identification* |
|---|---|---|---|
| 4" concrete brick exterior plus 4" hollow lightweight block interior: | | | |
| no surface treatment | 58 | 51 | KAL 1023-4-71 |
| plaster on block surface | 61 | 53 | KAL 1023-10-71 |
| ½" gyp. board on block face | 60 | 56 | KAL 1023-5-71 |

## SOUND ABSORPTIVE BLOCKS

Special sound absorptive blocks are available from the concrete masonry industry. Drawings of some of the sound absorptive blocks available in the Carolinas are shown in Section VI of this manual. The section is entitled "Sizes and Shapes". Designers desiring more information should contact the nearest member of the Carolinas Concrete Masonry Association or the CCMA office.

# Construction Details

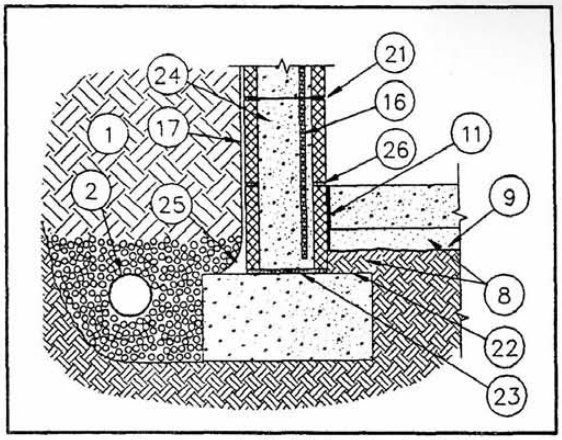
Carolinas Concrete Masonry Association

**Table 1804.6**
**Thickness of Foundation Walls**

| Foundation Wall Construction | Nominal Thickness, inches | Max. Depth of Unbalanced Fill, feet |
|---|---|---|
| Masonry of Hollow Units, Ungrouted | 8 | 4 |
| | 10 | 5 |
| | 12 | 6 |
| Masonry of Solid Units | 8 | 5 |
| | 10 | 6 |
| | 12 | 7 |
| Masonry of Hollow or Solid Units, Fully Grouted | 8 | 7 |
| | 10 | 8 |
| | 12 | 8 |
| Masonry of Hollow Units Reinforced vertically with #4 bars and grout at 24" o.c. Bars located not less than 4 1/2" from pressure side of wall | 8 | 7 |
| Plain Concrete | 7.5 | 7 |
| | 10 | 8 |
| | 12 | 8 |

1 in = 25.4 mm
1 ft = 0.305 m






**Basement Wall Footing Detail**

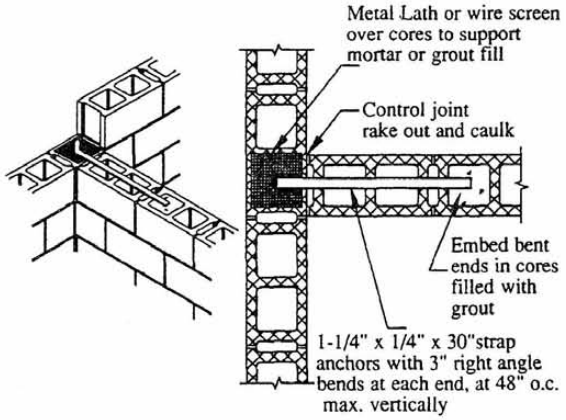
**DESIGN NOTE:** The above **Table 1804.6** is based on a **maximum wall height** of **8 ft.** and where the **Equivalent Fluid Weight of Unbalanced Backfill** does not exceed **30 PCF. Where either of these conditions are exceeded please refer to NCMA TEK Note 15-1A, Design of Concrete Masonry Foundation Walls.**

Special care should be taken in building basement walls to assure dry conditions within the basement. The illustration at right shows the proper methods to be used to assure a weathertight wall.

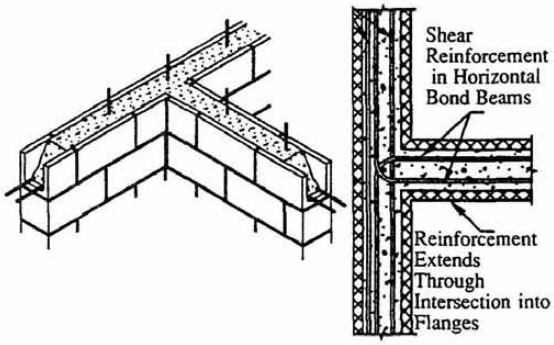
The placing of a line of drain tile along the outer side of footings is recommended in all basement foundation walls. This drain line relieves the pressure of any water that is built up behind the wall. The tile line should have a fall of at least 1/2 inch in twelve feet and slope to a suitable outlet. In no case should the tile be lower than the footing. Pieces of roofing felt should be placed over the joints to prevent sediment from entering the tile.

## LEGEND

1. Free draining backfill.
2. Four inch perforated pipe perimeter drain with 12 inches of cover.
8. Two inch sand or gravel levelling bed.
9. Waterproof membrane below slab.
11. Edge of concrete floor slab cast against waterstop material turned up from beneath slab along the basement wall.
16. Vertical bars held in position at top and bottom with bar positioners.
17. Dampproofing. Includes 1/2 inch of portland cement parging and a dampproof coating. Alternative dampproof methods may be used in lieu of parging.
21. Vertical bar positioner in mortar bed joint one course below bond beam and 2 courses above footing. Bar location to be 5/8 inch from outside (earth side of wall).
22. Top of footing within ±1/2 inch of specified elevation. Footing thickness shall be a minimum of 6 inches and the width shall be 8 inches plus twice the wall thickness.
23. First block course to be set in full mortar bed. Use Type M or S mortar throughout the wall.
24. Cells containing vertical reinforcing bars to be grouted. Grout proportions to be 1 part portland cement, 2 1/4 to 3 parts sand, plus (optional) 1 to 2 parts gravel. Grout to be consolidated by puddling or vibrating.
26. 3/8 inch mortar joint using Type M or S mortar. Faceshell mortar bedding,except at cells containing grout. Mortar to confine grout.




Unbonded Intersection




Bonded Intersection

**Figure 6**
**Intersecting Shear Walls**

For further information on intersecting walls see NCMA publication TEK No. 14-7.

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