PART B

Chapter 2

Acoustics

This chapter describes the acoustic performance of concrete masonry used in buildings to:

- Reduce reflected noise within a building, and
- Resist the passage of airborne and impact sounds through walls, as necessary by the National Construction Code (NCC) – Building Code of Australia (BCA)

Contents

2.1 BASIS OF DESIGN

2.1.1 BACKGROUND

Noise travels from its source through the air, passing through walls, floors, ceilings, open windows or doors and into living or office spaces. It may be controlled by isolating the noise at its source by enclosing it within walls that will absorb and dissipate it, or by preventing the noise from reaching the living or office spaces by erecting sound-resistant walls in its path.

When sound impinges on a wall it divides into reflected and absorbed sound. Absorbed sound is partly dissipated within the wall and partly transmitted through the wall. In addition to the sound transmitted through the wall material, the total sound detected on the quiet side may include radiated transmission caused by the vibration of the wall or wall lining.

Designers should consider both:

- the control of reflected noise generated within a room, and
- the reduction noise transmitted into a room from outside via the roof, ceilings, walls, floors and openings.

The Building Code of Australia considers only the latter (reduction of noise transmitted from outside a room).

Control of noise that is transmitted mechanically through the building structure and noise originating from equipment or machinery are beyond the scope of this Manual. The most effective treatments will include dampening and isolating the source from the structure.

Subjective Reaction	dB	Origin of Sound
	200	Rocket launch at 100 m
	190	
	180	
	170	
	160	
	150	
Threshold of pain	140	
	130	Loud air raid siren
		Artillery fire
Threshold of comfort (1 W/m²)	120	Loud thunder
		Elevated train
Extremely loud	110	Woodworking shop
		Rock band/loud motorcycle
	100	Loud car horn at 6 m
		Power lawnmower
Very loud	90	Printing plant
		Very loud radio
	80	Noisy factory
		Shouting
Loud	70	Busy street
		Noisy photocopying room
	60	Average radio/air terminal
		Stadium
Noisy	50	Average conversation
		Restaurant/store
Normal	40	Corridor
		Private office/study room
	30	Soft radio/library
Quiet		Quiet conversation/TV studio
	20	Recording studio
		Whisper at 1 m
Very faint	10	'Sound-proof' room
		Quiet human breathing
Threshold of hearing 1000–4000 Hz (10^{-12} W/m²)	0	Acoustical test room

Figure 2.1 *Intensity Levels of Some Familiar Sounds*

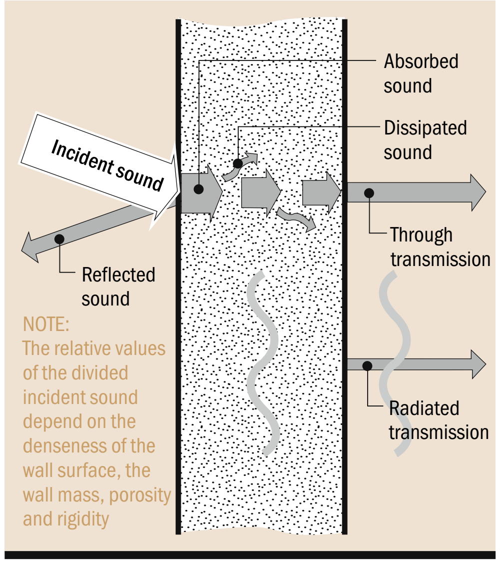


Figure 2.2 *Sound Transmission, Absorption and Reflection*

2.1.2 CONTROLLING REFLECTED NOISE

The sound absorption characteristics of a material depend on the size, shape and configuration of its surface texture and on the frequency spectrum of the incident sound. Materials with rough and open surface textures are generally more absorbent than those with smooth textures. Such features may be incorporated into walls, floors, ceilings or furniture.

Noise reduction coefficients as high as 0.6 are attainable with some concrete masonry units of very open texture and even higher values are possible with specially-designed acoustic blocks. Such surfaces allow the incident noise to enter the interior of the wall. Part of the absorbed sound is dissipated in the pores of the concrete, while the balance passes through the air spaces in the wall to the other side. Since sound absorption is a surface effect, it is not influenced by the thickness of the wall. Therefore, in a wall of constant thickness, it may be necessary to strike a compromise between sound absorption and sound resistance. Alternatively, wall systems may be custom-designed incorporating an inner leaf of sound absorbing masonry and an external masonry leaf of high sound resistance.

Sound absorption is maximised with units consisting of lightweight aggregates or units with unpainted open texture and high internal porosity, such as no-fines concrete. Unrendered and unpainted concrete masonry absorbs more sound than surface-treated walls. A light spray painting reduces sound absorption only marginally, although paint that is brushed on tends to seal the outer pores, reducing sound entry and dissipation.

Not all reflected sound is objectionable. It would be most undesirable to have a room in which all sound generated from within was absorbed. Such a room would be described as acoustically dead and could have unpleasant psychological effects on occupants. Sound-absorbing materials are commonly used to quieten noisy rooms such as airport lounges or hotel bars. Excessive echoing within a building can interfere with hearing. Sound absorbing materials may be used to adjust the reverberation time (echo time) of auditoriums, theatres or concert halls to achieve a satisfactory clarity and volume of sound for the particular type of performance to be given.

A *Noise Reduction Coefficient* is a measure of the ability of a wall to absorb sound. **Figure 2.3** shows the estimated Noise Reduction Coefficients for concrete masonry walls with various combinations of surface texture and finish. Although these figures provide a useful guide, in critical situations tests should be carried out on the actual materials intended for use.

See various references from Portland Cement Association (USA) and National Concrete Masonry Association (USA) in **Part B:Chapter 1, Clause 1.13.2**.

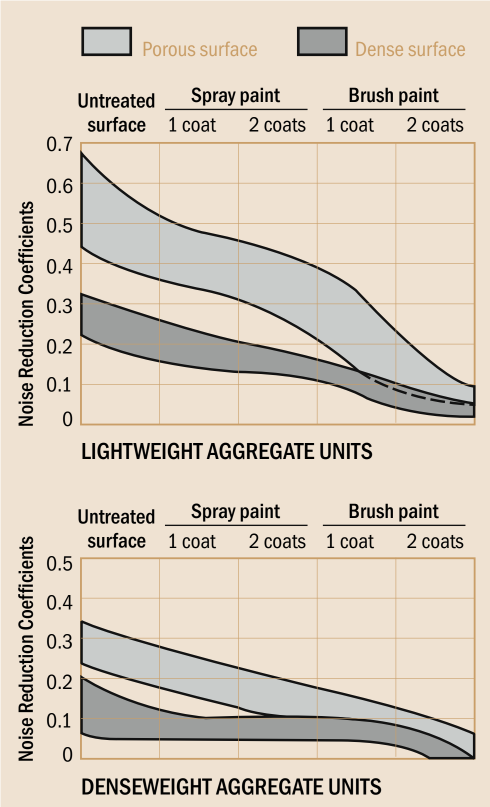


Figure 2.3 *Estimated Noise Reduction Coefficients for Concrete Masonry Walls*

2.1.3 CONTROLLING TRANSMITTED NOISE

There are three distinct modes of sound transmission through walls (see **Figure 2.4**).

- At frequencies below the resonant frequency of the wall, the stiffness of the wall is of greatest importance, and the mass and damping have little effect. As the frequency increases, the mass of the wall becomes more important and the wall may start to resonate.
- At frequencies beyond those which cause resonance, the mass of the wall provides a damping effect. It is in this region that concrete masonry (being a "high mass" system) provides a significant advantage over lightweight alternatives. Although the mechanism is not well understood, the resistance to sound transmission increases by approximately 6 dB for each doubling of the frequency or for each doubling of the mass.
- At frequencies above the critical frequency, the coincidence of the sound waves control the behaviour. For masonry, the critical frequency is relatively low when compared to other lighter materials. A coincidence dip immediately above the critical frequency indicates a loss in airborne sound resistance.

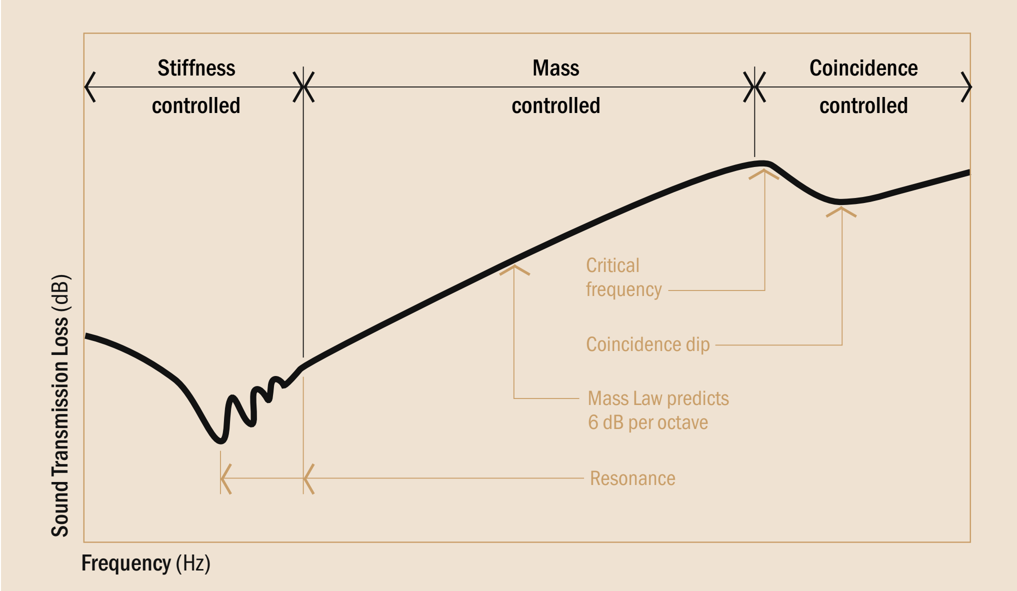


Figure 2.4 *Characteristic Sound-Transmission-Loss Curve* [After EBS Technical Study 48]

In addition to providing walls with a high resistance to sound transmission, the following factors should be considered.

- Doors and windows of lower acoustic performance than the walls will reduce the resistance to sound transmission, as will leaving them open, however slightly. Even very fine cracks or badly fitting doors or windows will allow the passage of considerable noise.
- Ducts and plenums provide paths for noise transmission unless correctly treated. In critical cases, air conditioning ducts may need to be baffled or lined internally with sound-absorbing material to prevent sound from travelling along them from one space to another.
- Suspended ceilings of sound absorbing material are very effective when properly used. Although they can absorb a great deal of sound originating within a room, they are often responsible for the transmission of this noise through the ceiling spaces into adjacent rooms. This can be prevented by extending the walls acting as sound barriers up to the roof or underside of the floor above, or by providing some sound resistance layer above the absorbing panels.
- Environmental noise from outside the building can be controlled by providing external walls of high sound resistance. As in the case of internal walls, special attention must be paid to doors, windows, gaps and cracks.

2.1.4 AIRBORNE SOUND RESISTANCE

To achieve high sound transmission resistance, the opposite properties from those required for good sound absorption are required. The following factors affect the airborne sound resistance.

Porosity

Bare porous masonry will have a lower sound transmission resistance than non-porous masonry. The sound transmission resistance of a masonry wall can typically drop by 5 to 10 dB with small increases in porosity. Greater increases in porosity will result in sound transmission resistance reductions of 20 dB or more. The sound transmission resistance of both porous and non-porous masonry can be improved by surface treatments such as the application of render or claddings. To maintain an adequate sound transmission resistance of a common wall it is important to apply surface treatments across the whole wall, including that part of the wall above the ceiling.

Render

The use of render has a two-fold effect. It increases the mass of a masonry wall and it can fill any residual gaps which may be present in the wall surface, thus reducing its porosity. Render can increase the sound transmission resistance of the wall by typically 2 to 5 dB. However the application of render can reduce the impact rating of a masonry wall by typically 2 to 4 dB. This is because the hard render finish provides less cushioning to impacts than the softer masonry surface.

Cladding such as plasterboard or fibrous cement

Cladding can be applied in the following forms.

- Directly fixed to the masonry surface
- Mounted on furring channel directly to the wall
- Mounted on furring channel with resilient clips to the wall
- Mounted free standing on studs adjacent to the wall.

Plaster cladding directly fixed to the wall using glue, screws or furring channels can improve the high frequency sound transmission loss performance of the wall but may reduce its performance at low frequencies. Generally, the addition of mass to the wall will improve the sound transmission resistance. However, performance at low frequencies is generally degraded by resonance of the cladding material (acting as a sprung mass) with the air in the gap between the cladding material and the wall acting as a spring. If the resonant frequency also coincides with the natural resonant frequency of the wall (called the "coincidence frequency"), then acoustic energy is transferred effectively through the wall and may reduce its sound transmission resistance performance by up to 8 dB. The resonance can be damped by the inclusion of acoustically-insulating material within the cavity. The "cross-over frequency" F_c which is defined as the frequency above which the sound transmission loss performance of the masonry wall plus cladding is better than that of the bare wall alone but below which the sound transmission loss is degraded, is:

$F_c = 108 /(M.d)^{1/2}$ for empty cavities or

$F_c = 60 /(M.d)^{1/2}$ for cavities filled with fibrous sound-aborbing material

Where:

M = surface mass of the drywall (kg/m²)

d = depth of cavity (m)

Acoustic Insulation in Cavity

Absorptive materials, such as polyester insulation, may be used in the cavity between the masonry wall and cladding. The polyester insulation provides damping and absorbs the resonant energy, improving the sound transmission resistance performance by up to 4 dB. Absorptive materials are also valuable in mitigating the effects of sound leakage through small cracks or penetrations in the wall. The deterioration in the sound transmission resistance of a wall is generally not as great when absorption is present in the cavity behind the cladding.

Resilient Impact Clips

Resilient impact clips are masonry anchors with embedded rubber isolation treatment incorporated into the fixing bolt. The interposed rubber reduces the vibration transmitted from the cladding to the wall. The use of resilient impact clips generally improves the sound transmission resistance by 3 to 7 dB. Where space permits, the application of cladding to free-standing stud work, not fixed to the masonry wall, can provide even greater sound transmission resistance improvements.

2.1.5 IMPACT SOUND RESISTANCE

When bedrooms or other quiet areas are positioned adjacent to bathrooms, kitchens and the like, it is important to reduce the sound transmitted through the wall as a result of a blow to the other side of the wall or attached furniture.

The impact sound resistance of a wall is measured by generating noise with a machine having multiple steel hammers, which impact on a steel plate placed in contact with the wall. The sound passing through the wall may be measured in a manner similar to that used for airborne sound resistance.

Resistance to impact sound requires properties different from those for resistance to airborne sound. A dense stiff material will vibrate when it is struck, while a soft material will simply absorb the blow without transmitting it. For example, hard dense plaster or render has a lower impact sound resistance than the softer commercially available plasterboards. Soft or resilient connections between the external skin and the body of the wall will also reduce the amount of impact that is transmitted.

The impact sound resistance of a wall can generally be improved, over a bare wall, by the use of cladding fixed directly to steel furring channels. The use of resilient impact clips can improve the impact insulation performance over a bare wall by typically 3 dB. The use of free-standing cladding without any attachment to the masonry will provide better results.

2.1.6 PRACTICAL CONSIDERATIONS FOR MASONRY WALL CONSTRUCTIONS

Where surface treatments such as cladding and render are applied to masonry walls to achieve a target sound transmission resistance, the treatment should be applied full-height, from floor slab to soffit to ensure that no degradation in wall performance occurs.

Gaps between masonry units, which may result from poor laying techniques or when mortar shrinks during the drying process, reduce the sound transmission resistance of the wall. Masonry walls have higher sound transmission resistance when full-mortar joints are used throughout the wall. Walls tested in laboratories generally have full joints and this must necessarily be replicated in the field to ensure the same sound transmission resistance.

Gaps around the vertical edges of a wall, and at the soffit junction can greatly diminish the sound resistance of a wall. For example a gap which is 0.l% of wall area (corresponding to a 3 mm gap along the length of a 3 m high wall) can reduce the sound transmission resistance by typically 10–20 dB. Gaps around the periphery of walls should be sealed using a high-density acoustically-rated mastic or similar sealant. These sealants should have a typical density of 1600 kg/m³. Sealants should be applied to both faces of the wall and should be applied to a depth equal to the width of the gap.

Typical penetrations in walls include mechanical services ducts, refrigerant pipes, hydraulic reticulation lines, waste pipes and fire sprinklers and electrical cables. To maintain the sound transmission resistance of masonry walls it is essential to provide an acoustically-rated seal around the penetration.

Chases in walls can introduce acoustic weaknesses. The two main effects are the removal of excessive amounts of material from the masonry units themselves, potentially exposing the inner core, and the disturbance of the mortar in the joints between masonry units. Both of these effects can reduce the sound transmission resistance of the wall and care must be taken to ensure that chasing of pipes not diminish the wall ratings. Wherever possible chases should not extend deeper than 25mm into the wall. All chases should be rendered over after the pipes or cables are installed.

2.2 DESIGN REQUIREMENTS

2.2.1 NATIONAL CONSTRUCTION CODE – BUILDING CODE OF AUSTRALIA – VOLUME ONE REQUIREMENTS

These requirements apply to:

- Class 2 Buildings, containing two or more sole-occupancy units, each being a separate dwelling, other than a Class 1 Building. Class 2 Building would include most blocks of home units
- Class 3 Buildings, residential buildings other than Class 1 and Class 2, being the common living place for a number of unrelated people. They include boarding houses, guest houses, hostels or lodging houses, the residential parts of hotels and motels, the residential parts of schools, accommodation for the aged, disabled or children and the staff accommodation areas of health care buildings
- Class 9c Buildings, aged-care buildings.

The sound transmission and insulation requirements are set out in NCC–BCA Vol One Part F5, and the principal points are summarised below. It should be noted that some states have varied these requirements and the means of satisfying them.

The objective set out in NCC–BCA Vol One Clause FO5 is to:

"… safeguard occupants from illness or loss of amenity as a result of undue sound being transmitted –

(a) between adjoining sole-occupancy units; and

(b) from common spaces to sole-occupancy units; and

(c) from parts of different classifications to sole occupancy."

This objective is further expanded for walls in NCC–BCA Vol One Clause FF5.1 NCC–BCA Vol One Clauses FF5.2 and FF5.5, which spell out the particular applications where there are requirements to provide both airborne sound resistance and impact sound resistance. NCC–BCA Vol One Clauses FF5.3 and FF5.6 further state that the sound insulation must not be compromised by doors or pipes. It is worth noting that the NCC–BCA Vol One does not aim to reduce the noise entering a room from outside the building, only to restrict sound passing from room to room or room to public space within the building.

Insitu Verification of Walls

NCC–BCA Vol One Clause FV5.2 provides for verification of walls constructed in a building based on insitu tests to AS/NZS 1276.1 or ISO 717.1

Deemed-to-Satisfy Provisions

NCC–BCA Vol One Clauses F5.0 to F5.7 provide the means of satisfying the performance requirements. The particular requirements of Clause F5.3 for walls may be summarised as follows:

Class 2 and 3 Buildings

- Any walls that separate sole occupancy units in a Class 2 or 3 building:

  $R_w + C_{tr}$ (airborne) not less than 50,
- Any walls that separate a habitable room of a sole occupancy unit in a Class 2 or 3 building from a bathroom, sanitary compartment, laundry or kitchen of another unit:

  $R_w + C_{tr}$ (airborne) not less than 50, and Impact sound resistance.

  Walls requiring impact sound resistance shall consist of two leaves separated by a gap of at least 20 mm and where necessary for structural purposes, connected by resilient ties.
- Any walls that separate a sole occupancy unit in a Class 2 or 3 building from a stairway, public corridor, public lobby or the like:

  R_w (airborne) not less than 50
- Any walls that separate a sole occupancy unit in a Class 2 or 3 building from a plant room or lift shaft:

  R_w (airborne) not less than 50
- A door assembly incorporated in a wall that separates a sole occupancy unit in a Class 2 or 3 building from stairway, public corridor, public lobby or the like:

  R_w (airborne) not less than 30
- Walls required to have a sound insulation shall be constructed to the underside of:

  • a floor above, or
  • a ceiling with the same acoustic rating, or
  • a roof above.

Class 9c Aged-care Buildings

- Any walls that separate sole occupancy units in a Class 9c building:

  R_w (airborne) not less than 45
- Any walls that separate a sole occupancy unit in a Class 9c building from a kitchen or laundry:

  R_w (airborne) not less than 45, and Impact sound resistance.

  Walls requiring impact sound resistance shall consist of two leaves separated by a gap of at least 20 mm and where necessary for structural purposes, connected by resilient ties.
- Any walls that separate a sole occupancy unit in a Class 9c building from a bathroom, sanitry compartment (not en-suite) plantroom or utilities room:

  R_w (airborne) not less than 45
- Walls required to have a sound insulation shall be constructed to the underside of:

  • a floor above, or
  • a ceiling with the same acoustic rating, or
  • a roof above.All design and detailing shall comply with the requirements of AS 3700 and the NCC–BCA.

2.2.2 NATIONAL CONSTRUCTION CODE – BUILDING CODE OF AUSTRALIA –VOLUME TWO REQUIREMENTS

These requirements apply to Class 1 Buildings, single dwelling houses, terrace houses, town houses, row houses and villa houses, boarding houses, hostels, group houses and dual occupancy houses in which not more than twelve persons would normally reside and residential buildings of not more than three storeys and containing not more than two sole-occupancy units, located one above the other and each with separate means of egress to the road or open space.

The sound transmission and insulation requirements are summarised below. It should be noted that some states have varied these requirements and the means of satisfying them.

The objective set out in NCC–BCA Vol Two Clause P2.4.6 is to:

"… provide insulation against the transmission of airborne … and impact generated sound sufficient to prevent illness or loss of amenity to the occupants". The extent of the requirement is varied in some states. The objective is further amplified, *"The required sound insulation of walls must not be compromised by the incorporation or penetration of a pipe or other service element."*

Insitu Verification of Walls

NCC–BCA Vol One Clause 3.8.2 V2.4.6 provides for verification of walls constructed in a building based on insitu tests to AS/NZS 1276.1 or AS/NZS ISO 717.1 (Not applicable in Northern Territory)

Acceptable Construction Practice

NCC–BCA Vol Two Clauses 3.8.6.1 to 3.8.6.4 provide the means of satisfying the performance requirements and may be summarised as follows:

- Walls that separate a room (other than a bathroom, sanitary compartment, laundry or kitchen) of one Class 1 building from a habitable room in an adjoining Class 1 building (dwelling):

  $R_w + C_{tr}$ (airborne) not less than 50
- Walls that separate a bathroom, sanitary compartment, laundry or kitchen of one Class 1 building from a habitable room (other than a kitchen) in an adjoining Class 1 building (dwelling):

  $R_w + C_{tr}$ (airborne) not less than 50, and Discontinuous construction
  (i.e. for masonry, a minimum of 20 mm cavity between two separate leaves, which if required for structural purposes, may be connected with resilient ties)
- Walls required to be detailed in accordance with NCC–BCA Vol Two Clause 3.8.6.3, which make provision for the sealing of sound insulated walls at junctions with perimeter wall and roof cladding. This clause also requires that masonry joints be filled and provides for sound insulated articulation joints.
- NCC–BCA Vol Two Clause 3.8.6.4 makes provision for services in uninsulated walls.

2.3 STANDARD DESIGNS

All design and detailing shall comply with the requirements of AS 3700 and the NCC–BCA.

All control joints, chases and openings shall be insulated such that the acoustic attenuation of the wall is maintained.

Mortar joints shall be as follows.

- All bed joints and perpendicular joints for solid or cored masonry shall be completely filled with Type M3 or Type M4 mortar.
- All bed joints and perpendicular joints for hollow masonry shall include ironed M3 or M4 mortar to at least the full thickness of the face shell at their widest point.

All masonry units shall comply with the General Specification set out in this manual (**Part C:Chapter 2**).

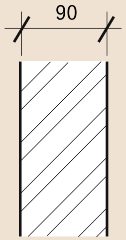
Deemed-To-Satisfy Construction
The National Construction Code (NCC) – Building Code of Australia Volumes One and Two provide a limited number of construction types that are deemed to satisfy the performance requirements for airborne sound attenuation and impact sound attenuation.

Sound Attenuation Tests
Masonry manufacturers also have a significant body of test data on the acoustic performance of various masonry wall systems (some incorporating various combinations of other components such as render, plasterboard, resilient ties, furring channels and insulation). It is recommended that designers contact the masonry manufacturers to obtain this data and specific recommendations. Some typical test results for sound transmission resistance of masonry walls are demonstrate in the following Charts.

CHART INDEX

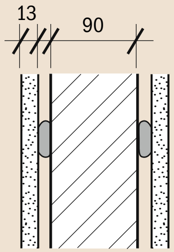
STC TEST RESULTS – Masonry Walls with and without Various Claddings

90-mm BASALT CONCRETE BRICK WALL



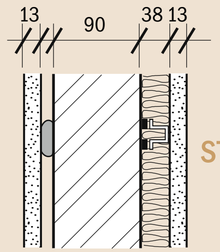
STC 43

(a) Bare Wall



STC 47

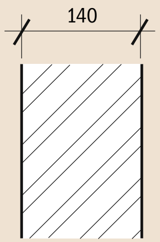
(b) 13-mm Plasterboard Glued to Both Sides



STC 51

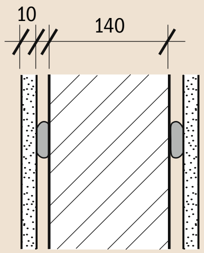
(c) 13-mm Plasterboard Glued to One Side, 13-mm Plasterboard on 28-mm Furring Channels with 10-mm Resilient Mounts and Polyester Insulation on Other Side

140-mm CALCIUM SILICATE BRICK WALL



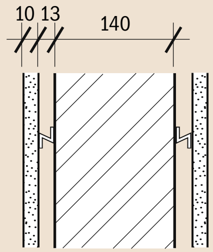
FSTC 47

(d) Bare Wall



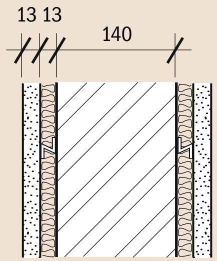
FSTC 39

(e) 10-mm Plasterboard Glued to Both Sides



FSTC 44

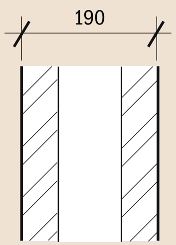
(f) 10-mm Plasterboard and13-mm Resilient Channels, Both Sides



FSTC 51

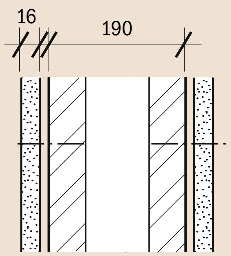
(g) 13-mm Plasterboard,13-mm Resilient Channels and 13-mm Polyester Insulation, Both Sides

190-mm HOLLOW CONCRETE BLOCK WALL (Small Cores)



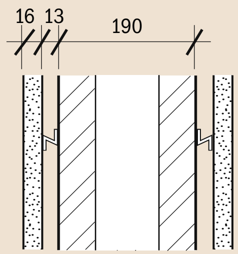
STC 50

(h) Bare Wall



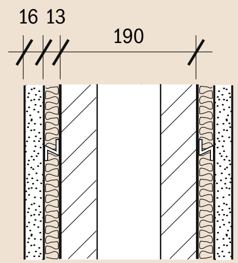
STC 49

(i) 16-mm Plasterboard Screwed to Both Sides



STC 49

(j) 16-mm Plasterboard and13-mm Resilient Channels, Both Sides



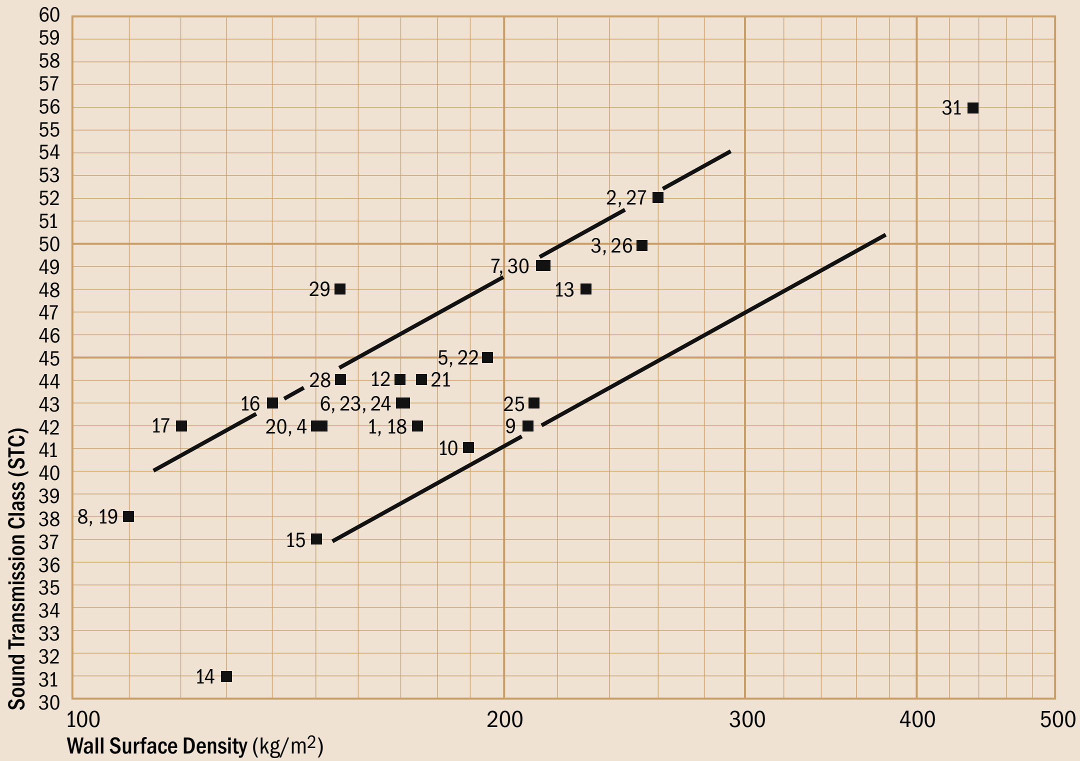
STC 52
(insulation 1 side only)

STC 49
(insulation both sides)

(k) 16-mm Plasterboard, 13-mm Resilient Channels and 19-mm Fibreglass Insulation

Note: These test results yield Sound Transmission Class (STC) which is similar to, but not identical to, Weighted Sound Index (R_w)

STC TEST RESULTS – Bare Masonry Walls

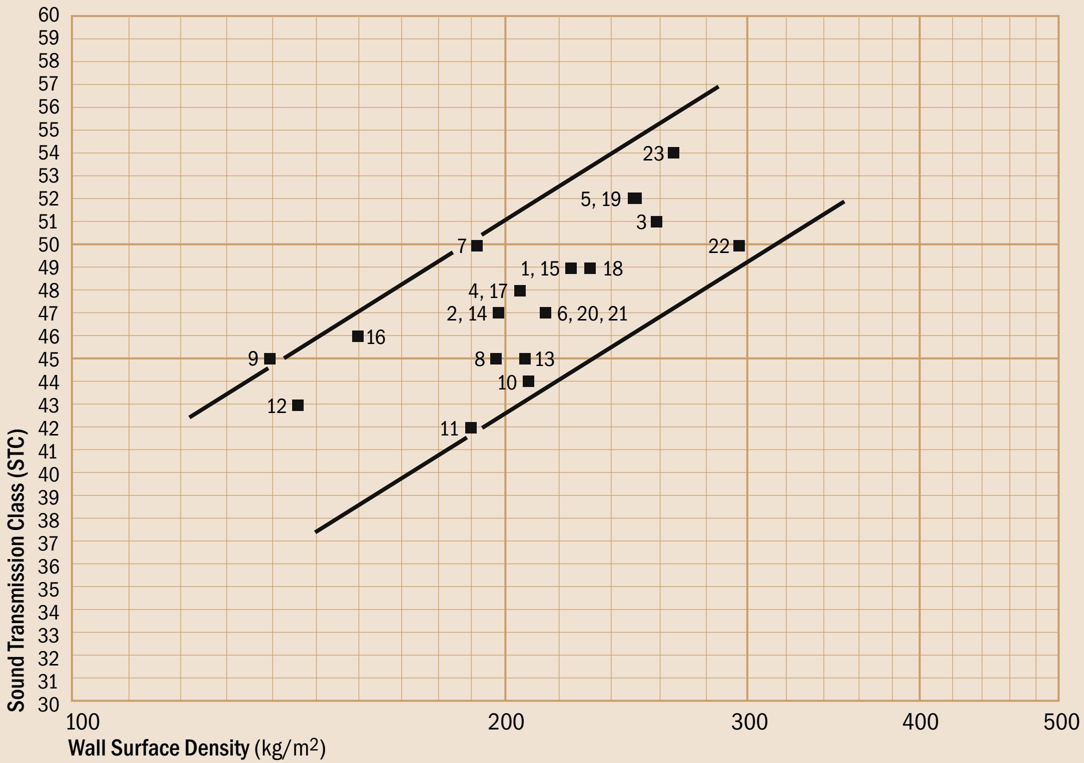


DATA DETAILS

Data number	STC	Surface density (kg/m^2)	Unit thickness (mm)	Unit material	Notes	Test reference
1	42	174	90	Basalt brick		EBS1044
2	52	260	140	Dense hollow		EBS1051
3	50	253	140	Dense hollow		EBS1192
4	42	151	110	Clinker brick		EBS238
5	45	195	110	Dense brick		EBS257
6	43	170	150	Dense hollow		EBS287
7	49	214	200	Dense hollow		EBS407
8	38	110	110	Lightweight concrete		EBS449
9	42	208	110	Dense hollow		LCA 529-83
10	41	190	110	Scoria		LCA 1122-88
11	16	156	110	Basalt/scoria		LCA 1287-90
12	44	170	150	Dense hollow		LCA 2192-1-75
13	48	230	200	Scoria		LCA 2192-3-75
14	31	130	90	Scoria		RTA T621-01F103
15	37	150	90	Scoria		RTA T621-01F120
16	43	140	90	Scoria/basalt		RTA T621F168
17	42	120	110	Scoria lightweight		RTA T621F171
18	42	174	90	Dense brick		CMAA Internal Report
19	38	110	110	Concrete		EBS No. 48 ref no. 7011-1
20	42	150	110	Concrete		EBS No. 48 ref no. 6068-1
21	44	175	110	Concrete		EBS No. 48 ref no. 6078-1
22	45	195	110	Concrete		EBS No. 48 ref no. 6078-3
23	43	170	140	Clay	Bagged	EBS No. 48 ref no. 6017-1
24	43	171	140	Dense hollow	Bagged	CMAA Internal Report
25	43	210	140	Dense concrete		CMAA Internal Report
26	50	253	140	Dense hollow		CMAA Internal Report
27	52	260	140	Dense hollow		CMAA Internal Report
28	44	156	190	Lightweight concrete		CMAA Internal Report
29	48	156	190	Lightweight concrete	Paint one side	CMAA Internal Report
30	49	215	190	Dense concrete		CMAA Internal Report
31	56	435	190	Lightweight concrete	Paint one side	CMAA Internal Report

Note: These test results yield Sound Transmission Class (STC) which is similar to, but not identical to, Weighted Sound Index (R_w)

STC TEST RESULTS – Rendered Masonry Walls

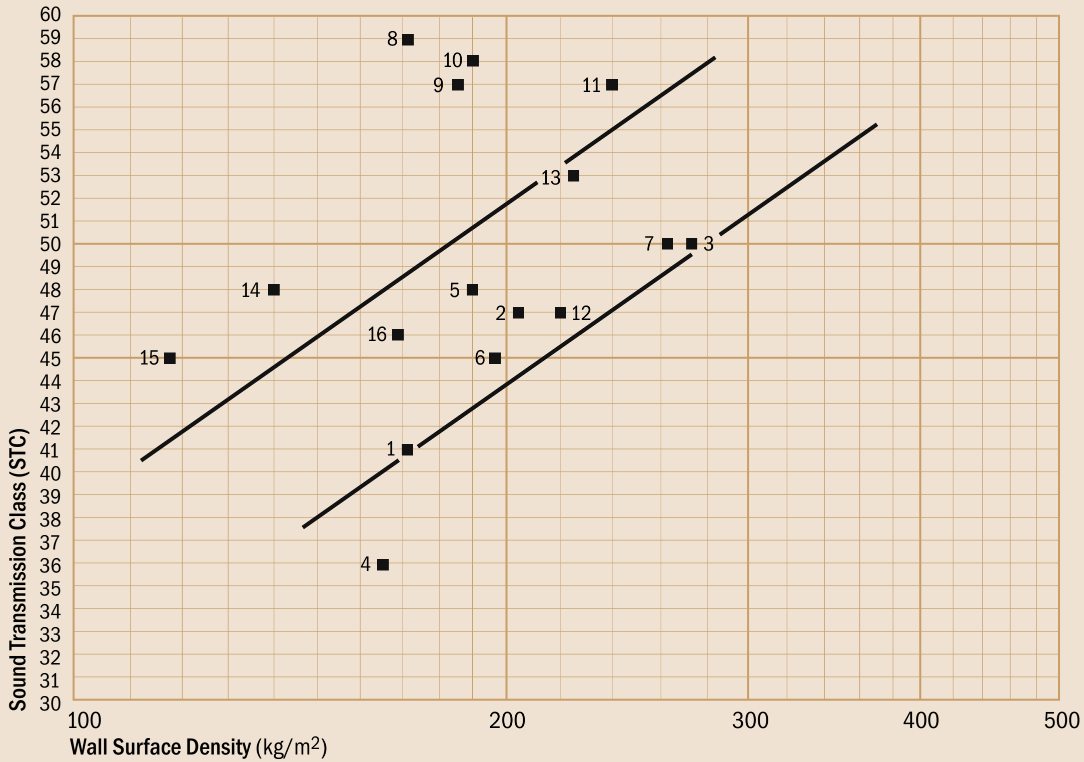


DATA DETAILS

Data number	STC	Surface density (kg/m^2)	Unit thickness (mm)	Unit material	Render	Test reference
1	49	224.0	90	Basalt brick	13-mm, 2 faces	EBS1044
2	47	199.0	90	Basalt brick	13-mm, 1 face	EBS1044
3	51	258.0	110	Dense hollow	13-mm, 2 faces	EBS1469
4	48	205.0	110	Clinker brick	13-mm, 2 faces	EBS238
5	52	249.0	110	Dense brick	13-mm, 2 faces	EBS257
6	47	215.0	150	Dense hollow	13-mm, 2 faces	EBS287
7	50	192.4	110	Basalt/scoria	13-mm, 2 faces	LCA 1293-90
8	45	198.0	114	Boral concrete	13-mm, 2 faces	LCA 2884-1-77
9	45	139.0	90	Scoria	13-mm, 2 faces	RTA T621F126
10	44	209.0	190	Scoria	13-mm, 2 faces	RTA T621F138
11	42	190.0	90	Scoria lightweight	13-mm, 2 faces	RTA T621F167
12	43	145.0	90	Scoria lightweight	13-mm, 2 faces	RTA T621F179
13	45	208.0	90	Dense hollow	13-mm, 2 faces	CMAA Internal Report
14	47	199.0	90	Dense brick	13-mm, 1 face	CMAA Internal Report
15	49	224.0	90	Dense brick	13-mm, 2 faces	CMAA Internal Report
16	46	160.0	110	Concrete brick	13-mm, 2 faces	EBS No. 48 ref no. 7011-2
17	48	205.0	110	Concrete brick	13-mm, 2 faces	EBS No. 48 ref no. 6068-2
18	49	230.0	110	Concrete brick	13-mm, 2 faces	EBS No. 48 ref no. 7112-01
19	52	250.0	110	Concrete brick	13-mm, 2 faces	EBS No. 48 ref no. 6078-4
20	47	215.0	140	Dense concrete hollow	13-mm, 2 faces	CMAA Internal Report
21	47	215.0	140	Dense concrete hollow	13-mm, 2 faces	EBS No. 48 ref no. 6017-2
22	50	295.0	150	Woodwaste & cement, hollow	13-mm, 2 faces	EBS No. 48 ref no. 7063
23	54	265.0	190	Dense concrete	13-mm, 2 faces	EBS No. 48 ref no. 6079

Note: These test results yield Sound Transmission Class (STC) which is similar to, but not identical to, Weighted Sound Index (R_w)

STC TEST RESULTS – Masonry Walls With Plaster Cladding

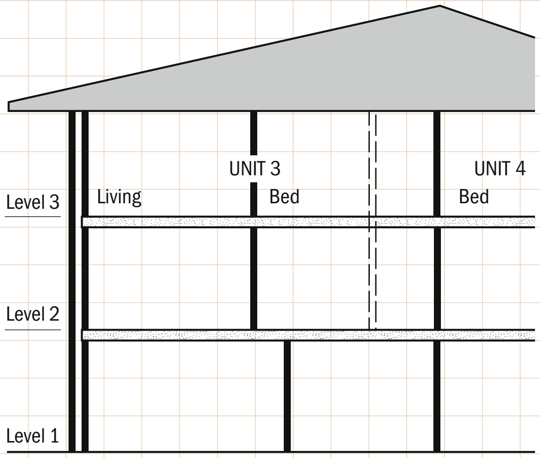


DATA DETAILS

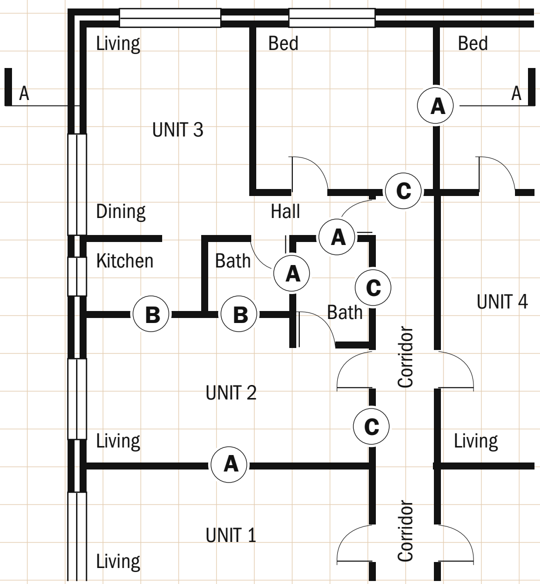
Data no.	STC	Surface density (kg/m^2)	Unit thickness (mm)	Unit material	Plaster-board thickness (mm)	Notes	Test reference
1	41	171.4	110	Basalt/scoria	10	Plasterboard glued	LCA 1295-90
2	47	206.0	110	Scoria brick	10	Plasterboard glued	LCA 1127-88
3	50	273.0	140	Dense hollow	10	Plasterboard glued	LCA 1267-90
4	36	164.0	110	Basalt/scoria	10	1 face only	LCA 1291-90
5	48	190.0	110	Dense hollow	10	1 face only	LCA 1639-92
6	45	198.0	110	Scoria brick	10	1 face only	LCA 1123-88
7	50	263.0	140	Dense hollow	10	1 face only	LCA 1268-90
8	59	171.0	190	Lightweight concrete	13	Metal furring, insulation	CMAA Internal Report
9	57	186.0	190	Lightweight concrete	13	Timber & metal furring, insul.	CMAA Internal Report
10	58	190.0	190	Lightweight concrete	13	Timber & metal furring, insul.	CMAA Internal Report
11	57	240.0	190	Lightweight concrete	13	Resilient timber studs, insul.	CMAA Internal Report
12	47	220.0	140	Dense concrete	13	1 face, resilient studs	CMAA Internal Report
13	53	225.0	190	Dense concrete	13	1 face, resilient studs, insul.	EBS No. 48 ref no. 6029-1
14	48	140.0	110	Scoria lightweight	13	Plasterboard glued	RTA T621F172
15	45	117.0	90	Scoria lightweight	13	Plasterboard glued	RTA T621F175
16	46	168.0	90	Scoria brick	13	28-mm furring channel	RTA T62-01F121

Note: These test results yield Sound Transmission Class (STC) which is similar to, but not identical to, Weighted Sound Index (R_w)

2.4 WORKED EXAMPLE



SECTION A-A



PLAN LEVEL THREE

DESIGN BRIEF

Design the internal walls of a home unit for the sound transmission requirements of the NCC–BCA.

Applicable regulation

Home unit is a Class 2 Building.

Therefore the NCC–BCA Vol One applies

Sole occupancy unit any room to sole occupancy unit any room [walls 'A']

Requires: $R_w + C_{tr}$ (airborne) not less than 50

NCC–BCA Vol One F5.5(a)(i)

Design: Use manufacturer's test results

Sole occupancy unit bathroom, laundry, kitchen to sole occupancy unit habitable room [walls 'B']

Requires: $R_w + C_{tr}$ (airborne) not less than 50, and discontinuous construction (impact sound resistance)

NCC–BCA Vol One F5.5(a)(ii). F5.5(a)(iii), F5.3(b)

Design: Use cavity masonry wall with resilient ties and R_w based on manufacturer's test results

Sole occupancy unit any room to stairway, public corridor or the like [walls 'C']

Requires: R_w (airborne) not less than 50

BCA Vol 1 F5.3(b)

Design: Use manufacturer's test results

Typical Data

Masonry weighted sound reduction index

R'_w = 55 dBA

Masonry weighted sound reduction index & spectrum adaptation term

$R'_w + C'_{tr}$ = 50 dBA