AN INTRODUCTION TO THE USERS GUIDE TO THE BUILDING CODE OF AUSTRALIA

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Abstract

This paper introduces the Users Guide to the BCA. It presents a summary of the acoustical provisions of the May 2004 Building Code of Australia. The objectives are to provide guidance on the BCA compliance process, the acoustical design process and to provide guidance on detailing and other issues which need to be considered during the design and construction process. Examples and scenarios are presented to identify areas where acoustical standards have had to be raised to enable conflicting building occupancies to coexist. Inconsistencies and potential discrepancies in the May 2004 Building Code of Australia are also highlighted and discussed.

Nomenclature

R_w	Weighted sound reduction index
C_{tr}	Spectrum adaptation term
C_I	Spectrum adaptation term
$L_{n,w}$	Weighted normalised impact sound pressure level
$D_{nT,w}$	Weighted standardised level difference
$L'_{nT,w}$	Weighted standardised field impact sound pressure level

Introduction

This paper covers some of the information presented in the BCA Sound Insulation Guideline. The guideline and this paper supplement and describe the acoustical provisions of the BCA 2004.

The BCA was amended in response to increasing evidence that earlier BCA sound insulation requirements were not meeting community expectations. The purpose of the sound insulation requirements is to reduce sound transmission between attached dwellings or units and also between dwellings or units and other areas within buildings.

The new acoustical provisions of the BCA came into force in May in NSW, VIC, TAS, SA & ACT. Western Australia, Queensland and the Northern Territory have not implemented these provisions.

Compliance with the BCA

Prior to investigating the sound insulation provisions of the BCA, the method by which compliance with the BCA is achieved will first be described. The Options to satisfy the BCA are summarized below:

Option 1 Prescriptive Approach–Laboratory Tested Systems.

Option 2 Performance Approach – Verification Methods – Field test.

Option 3 Performance Approach – Expert Judgement.

Option 4 Performance Approach – Comparison with Deemed-to-Satisfy systems.

Option 5 Performance Approach – Documentary Evidence.

Option 1

The elements of this option are to:

1. Use building element systems which have been tested in an approved laboratory or are deemed-to-satisfy.
2. Develop designs which reduce noise leakage through flanking paths.
3. Build and install the building element so that their performance is not degraded, i.e. in accordance with requirements.
4. Inspect during construction.
5. Rectify any defects.
6. Document compliance with the described method of construction of the building element.
7. Issue certification

Option 2

The elements of this option are to:

1. Use building elements and systems that are likely to meet the BCA requirements.
2. Same as Option 1.
3. Same as Option 1.
4. Same as Option 1
5. Same as Option 1
6. Same as Option 1
7. Conduct a risk assessment to establish how many building elements, and which building elements are to be tested
8. Field test acoustic performance of building elements.
9. Issue certification

Option 3

The process of compliance with Option 3 is similar to Option 1 except that instead of using building element systems which are deemed-to-comply or laboratory tested, the proposed building element systems have been tested in a non-approved manner but in the opinion of an expert will still comply with the BCA.

Option 4

The process of compliance with Option 4 is similar to Option 1 except that instead of using building element systems which are deemed-to-comply or laboratory

tested, the proposed building element systems have been tested in a manner to compare their performance to that of the deemed-to-satisfy systems. A judgement was then made to establish that the proposed systems are no worse than the deemed-to-satisfy systems in the BCA.

The ability of the expert to make that judgement, and the important information used to make that judgement are to be documented.

Option 5

The process of compliance with Option 5 is similar to Option 1 except that instead of using building element systems which are deemed-to-comply or laboratory tested, the proposed building element systems have been certified by an accredited testing agency.

Agencies which can gain accreditation include state or territory Building Code bodies or those which have been accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

No building partition systems currently have this type of certification.

BCA 2004 Provisions

The Building Code of Australia

A shorthand summary of the new BCA acoustical provisions is presented in Tables 1 to 4. Note that the provisions for Class 9c Building remain unchanged.

Table 1 - Class 2 & 3 Buildings – Building element Separating spaces

Partition Scenario	Separating Floor Rating	Common Wall Rating	Entry Door Rating
#1	R_W+C_{tr} =50 *(Previously R_W 45)*	R_W+C_{tr} =50 *(Previously R_W 45)*	Door not to degrade wall or floor rating *(Previously no clear guidance, some states consider this provision had always been in effect, other states had no rating, requirement)*
#2		R_W+C_{tr} =50 and wall DISCONTINUOUS *(Previously R_W 50 + impact rating)*	
#3	$L_{n,w}+C_I$ = 62 *(Previously R_W 45)*	R_W =50 and wall DISCONTINUOUS *(Previously R_W 45)*	
#4		R_W = 50 *(Previously R_W 45 generally)*	R_W = 30 *(Previously no rating)*

Partition Scenario #1

Building partition between sole occupancy units – general rating with exceptions listed below:

Partition Scenario #2

Partition separating a bathroom, sanitary compartment, laundry or kitchen from a habitable room (other than kitchen) in another unit

Partition Scenario #3

Partition separating a unit from a plantroom or lift shaft

Partition Scenario #4

Partition separating a unit from a stairway, public corridor, public lobby, or the like OR areas of different classification

Table 2 - Class 1 Buildings – Building element Separating Spaces

Partition Scenario	Common Wall Rating
#2	R_W+C_{tr} =50 and wall DISCONTINUOUS *(Previously R_W 50 + impact rating)*
#1, #3 & #4	R_W+C_{tr} =50 *(Previously R_W 45)*

Table 3 - Class 2, 3 & 9c Buildings – Separation barriers for ducts or for soil, waste, water supply or storm water pipe

Room under or adjacent to service	Barrier Rating
Habitable room other than kitchen	$R_W + C_{tr}$ = 40 *(Previously R_W 45)*
Kitchen or non-habitable room	$R_W + C_{tr}$ = 25 *(Previously R_W 30)*

Table 4 – Comparison with Laboratory and Field performance requirements.

Laboratory Rating	Equivalent Field Rating	Numerical Reduction To Field Rating
R_W	$D_{nT,w}$	5 dB
R_W+C_{tr}	$D_{nT,w}+ C_{tr}$	5 dB
$L_{n,w}+C_I$	$L'_{nT,w} +C_I$	0 dB

Design Practices

Good design practices should minimise the amount of noise entering a dwelling and also minimise the cost of construction.

Noise intrusion can be limited by considering a range of factors. Good and bad design practices are summarized below. Some of these items are direct requirements of the BCA whilst others follow the intent of the BCA The following items nevertheless should be considered during the design process to manage risk in the building process.

GOOD DESIGN PRACTICES

Good design practices have been categorised into issues to be considered during planning, issues related to walls floors, doors & windows, penetrations, services and building movement

Planning:

- Plan quiet areas in a unit adjacent to quiet areas in adjoining units, Figure 1.

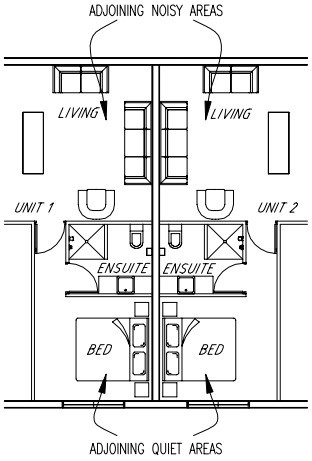


Figure 1 – Example of Layout Planning - Good Acoustic Practice

- Plan buffer areas between units where possible.
- Locate services away from sensitive areas in a unit.

Walls and floors:

- Indicate where impact-rated wall systems are required.
- Design walls to be full height, to underside of soffit or roof above, where an acoustically rated ceiling is not used, refer to Figure 2.
- Design a break in the floor boards under the boundary walls of a unit. Figure 3
- Ensure that discontinuities in walls and floor/ceilings can be maintained.
- Design acoustic seals for joints to remain effective over the life of the building.

Penetrations:

- All penetrations in acoustically-rated building elements, are to be designed to not reduce the acoustical rating of the building element.

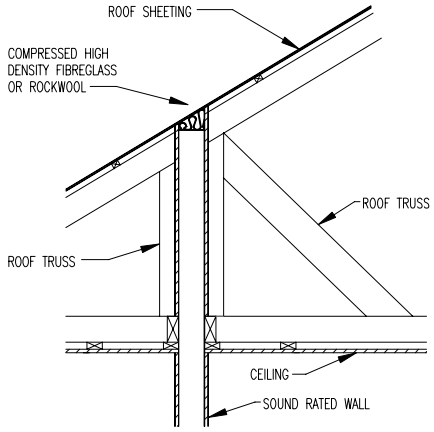


Figure 2 – Sound Rated wall penetration to Roof

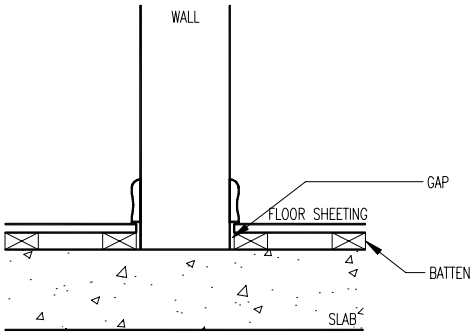
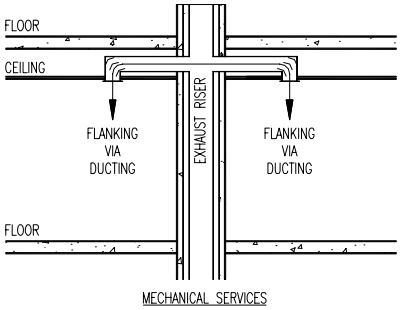


Figure 3 – Floor Lateral Vibration Isolation - Good Design practice

- Design acoustic seals at penetrations to last as long as the building.
- Reduce the incidence of penetrations and other flanking paths in sound-rated walls and floors.



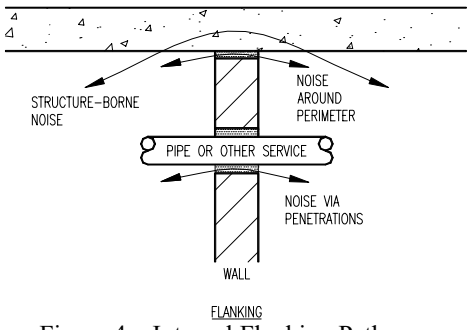


Figure 4 – Internal Flanking Paths

Building Movement:
- Maintain acoustical ratings by using a design which allows for building movement, especially at penetrations and junctions.
- Design for flexible acoustic seals between internal walls, between common walls and façade, and between walls and floors/ceilings.

Doors and Windows:
- Use full perimeter acoustical seals on access doors and sensitive windows.

Services:
- Design for sufficient noise isolation in common ventilation ducts and risers.
- Use flexible connectors on pipes to pumps.
- Reduce the number of bends and elbows in pipes and ducts.
- Reduce the flow velocity in pipes and ducts.
- Resiliently fix pipes and ducts to walls and structures.
- Use quieter proprietary pipe constructions to reduce noise generated by pipes.

BAD DESIGN PRACTICES

Bad design practices have been summarized into issues associated with walls, floors, doors, windows, penetrations and services:

Walls and floors:
- Design wall-mounted furniture to be fixed across wall discontinuities for support.
- Replace carpet with acoustically non-compliant hard floor coverings.

Penetrations:
- Using non-sound rated downlights or other fittings in sound-rated ceilings.

Doors and Windows:
- Locate windows and doors of a unit adjacent to those of the adjoining unit.
- Undercut sound-rated doors.

Services:
- Designing insufficient space which causes pipes or lagging to contact ceilings, hangars, bulkheads or risers.
- Fix pipes or ducts to the neighbouring side of a common wall.
- Chase pipes into common walls.
- Designing air grilles into bulkheads which contain hydraulic services or ductwork.
- Designing power outlets and light switches to be installed back-to-back.

Construction Practices

The following tips for construction and good practice should be applied during the building phase:

General
- No substitutions should be permitted which have not been thoroughly documented and approved by an acoustical consultant, manufacturer, supplier or testing authority.
- All building element systems are to be constructed and installed in strict accordance with manufacturing requirements.
- Consult designers where clashes occur which have not been documented.
- Conduct thorough inspections and document during construction.

Windows and Doors
- Make sure that the acoustic seals on all sound-rated doors and windows are properly adjusted and operational.

Penetrations and Gaps
- Ensure that there are no residual gaps around full-height walls.
- Ensure joints at wall and floor perimeters are sealed and airtight, using an approved mastic.
- Ensure that the depth of mastic in joints is sufficient.
- Joints in dissimilar materials may open up if there is building movement. Ensure that the acoustic seal in joints will accommodate the anticipated building movement.
- The wall/floor around any large penetration needs to be rebuilt with the same material. Small residual gaps at penetrations can be sealed with a suitable mastic, refer Figure 5

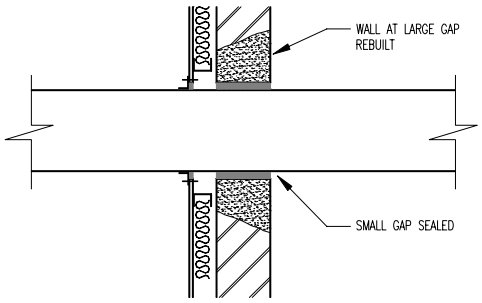


Figure 5 – Treatment of Gaps Around Penetrations

- Sealing should be effective, resilient, resistant to the surrounding environment and designed to last for the life of the building.
- Cut sizes of holes to suit. Do not knock large holes into walls by using a sledge hammer or other similar method.

Floor/ceiling
- Ensure that the resilient rubber underlay used for isolated floors is not 'bridged' or short circuited by

nails and screws connecting the floor to the slab underneath.

- Ensure that isolated floors are not installed in contact with side walls. Isolation is also required between the floor and side wall, refer to Figure 6

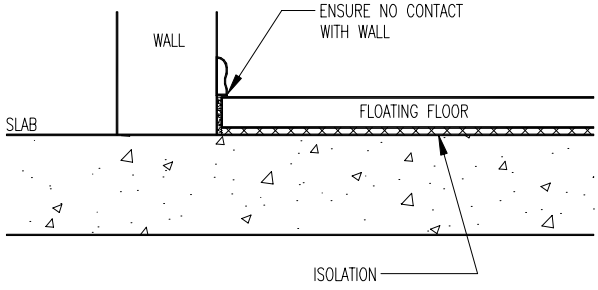


Figure 6 – Treatment Around the Perimeter of Isolated Floors

- Do not bridge across breaks or vibration isolation joints in floor and ceiling constructions.
- Any penetrations in an acoustically-rated ceiling to be acoustically treated refer to Figure 7

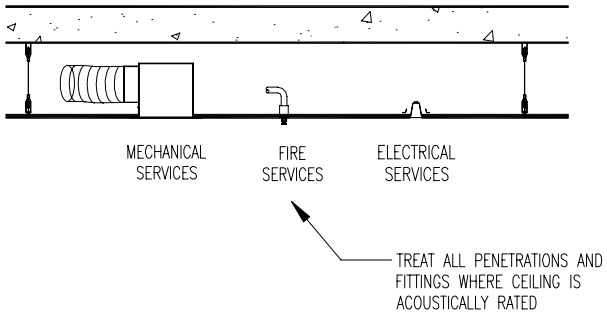


Figure 7 - Ceiling Penetration Treatments.

Sheeted Walls

- Ensure joints in sheeting in dry wall systems are staggered and, where multiple layers of material are used on walls, that the joints do not overlap. Refer to Figure 8

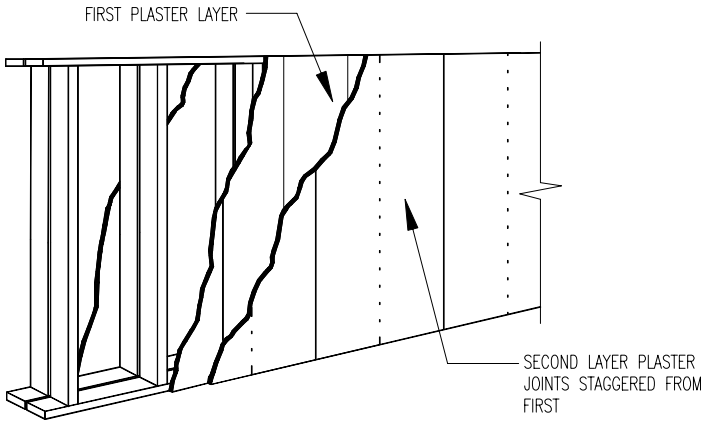


Figure 8 – Optimum Dry wall Sheeting Configuration

- Ensure that there are no residual gaps around full-height sound-rated walls, especially at the soffit, or around roof structure such as rafters and purlins, refer to Figure 2.
- Ensure that the discontinuity in isolated walls is not 'bridged' or short circuited by nails, screws.
- Ensure that the discontinuity in isolated walls is not 'bridged' or short circuited by noggins, battens or packers.
- Ensure that no building debris or rubbish is left in wall or ceiling cavities. This material can span the discontinuity causing bridging or short circuiting.
- When installing toilets onto walls do not install noggins which span across the discontinuous studs on both sides of the wall.
- Mount cupboards, wall furniture, appliances and toilet cisterns onto the cladding/supports of the front wall only. Do not support from wall elements behind a wall discontinuity.
- In timber constructions install walls and ceilings on isolation mounts to improve impact isolation between floors, refer to Figure 9

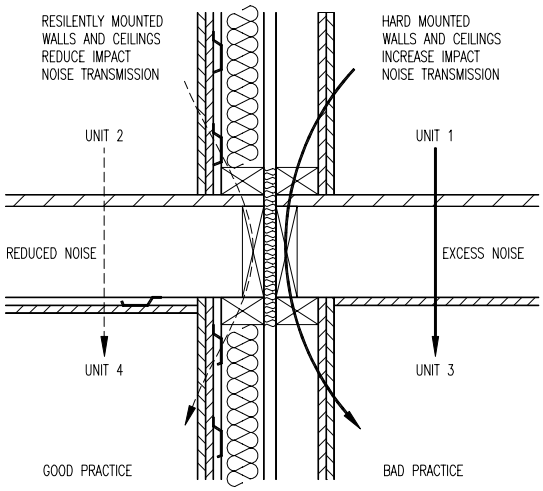


Figure 9 – Wall and Ceiling Isolation in Timber constructions

Masonry Walls

- Ensure joints in sheeting in drywall/masonry combination systems are staggered and, where multiple layers of material are used on walls, the joints do not overlap.
- Ensure that full height walls do not stop short of the slab soffit or roof above.
- Ensure that there are no residual gaps around full-height sound-rated walls, especially around roof structure such as rafters and purlins, refer Figure 2.
- Mount cupboards, wall furniture, appliances and toilet cisterns onto the cladding/supports of the front wall only. Do not support from wall elements behind a wall discontinuity. Refer to
- Figure 10.
- Full-mortar joints to be used where an acoustically rated masonry wall system is used. Special care

required at perp ends to ensure full-mortar joints, refer to Figure 11.

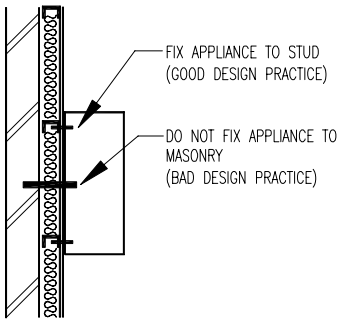


Figure 10 – Mounting of Wall Furniture.

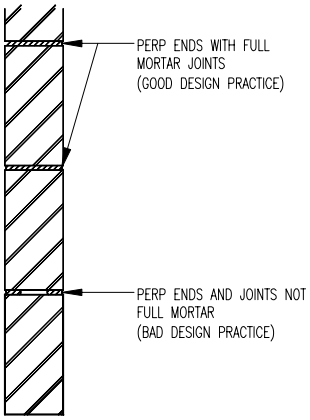


Figure 11 – Treatment of joints in Masonry walls

- Make sure that insulation is evenly spaced throughout the entire cavity where needed.

Services

- Only use acoustically treated waste pipes, supply pipes, stormwater pipes and ductwork in ceiling cavities and risers. Alternatively acoustically treat the ceilings and riser walls themselves as well as any penetrations in these surfaces.
- Installation of pipe/duct lagging should be gap-free and in strict accordance with the manufacturers requirements.
- Do not cover electrical wiring or lighting with acoustic blankets if not designed to be covered.
- Ensure that flexible connectors in pipes are operational and not "bridged."
- Do not introduce unnecessary bends and elbows in pipes and ducts.
- Use resilient fixings of pipes and ducts to party-walls.
- Only attach pipes and ducts to the side of the wall to which the services belong. Do not bridge across wall discontinuities.

BCA Issues Requiring Future Discussion

The following may need to be considered for future BCA editions

- Lnw + Ci should be either Lnw or Lnw – Ci
- Plantroom/lift shaft/stairway/public corridor walls and the like should be rated the same as the floor i.e. Rw + Ctr = 50
- Rw + Ctr rating of 25 for waste pipe separation barriers is a slight reduction from the previous Rw 30 requirement
- No clear delineation about the required separation rating of a waste pipe over a combined kitchen/living room – could be Rw 30 or Rw 45
- Door rating of Rw 30 – Standard solid core doors with acoustic seals typically reach Rw 28.
- Impact rating of walls – no criterion is presented and no method of testing is envisioned. The previous method of testing was not carried forward

Conclusions

The BCA 2004 is a major upgrade of the acoustical requirements within residential buildings. The increase in standards is commensurate with the expectations of occupants.

New provisions have been introduced which cover items not previously covered in the BCA. Invariably there is a 'bedding-in' period which allows for the uptake and use of the new standards. Through this process weaknesses in the BCA will be detected and rectifications to these issues will be developed

Acknowledgement

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References

[1] Australian Building Codes Board, "Building Code of Australia 2004"

[2] Australian Building Codes Board, "Building Code of Australia Acoustic Guideline - 2004"