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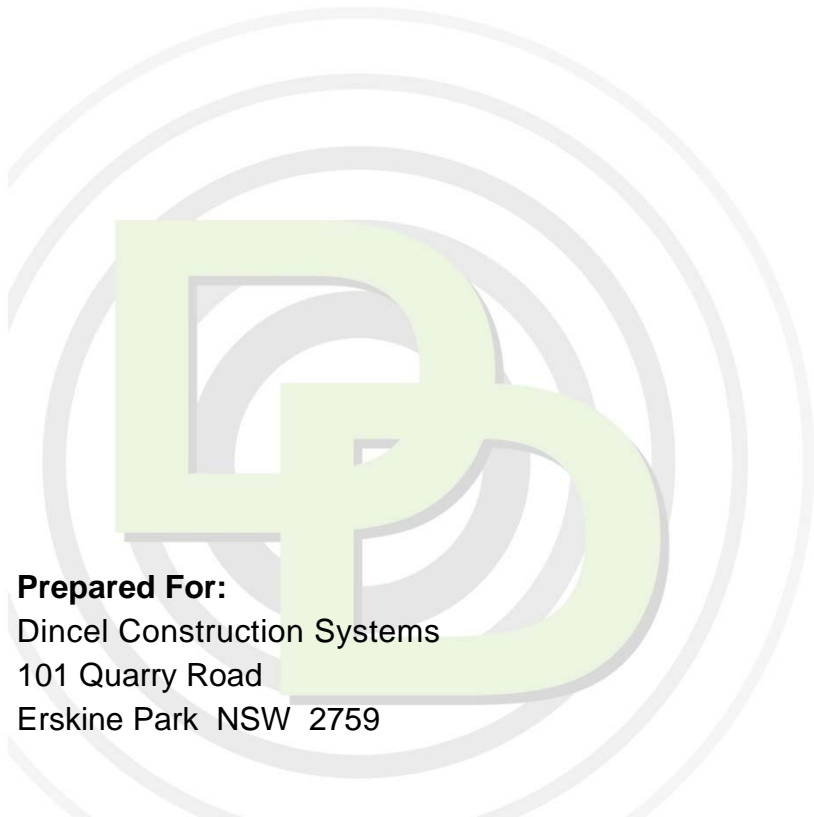
Acoustic Opinion

Dincol 155 mm Wall Systems

REPORT No
5880-4.1R Rev B

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Prepared For:
Dincol Construction Systems
101 Quarry Road
Erskine Park NSW 2759



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Acoustic Opinion**1.0 CONSULTING BRIEF**

Day Design Pty Ltd was engaged by Dincel Construction Systems to provide Acoustic Opinions on the R_w and $R_w + C_{tr}$ ratings for a range of walls constructed using their DCS 155 wall system. The objective is to provide acoustical data useful to building designers for inclusion in technical publications.

Scope of Work:

- Review the results of systems incorporating the DCS 110 and DCS 200 walls tested at CSIRO, Highett and NAL, Chatswood provided by Dincel.
- Model basic wall systems using acoustic modelling software.
- Compare the R_w and $R_w + C_{tr}$ predictions with test results.
- Provide Acoustic Opinions on the R_w and $R_w + C_{tr}$ ratings for a range of DCS 155 systems to meet the Deemed-to-Satisfy Provisions in the BCA.
- Prepare an Acoustical Opinion Report.

2.0 PREDICTION OF R_w AND C_{TR}

R_w (weighted sound reduction index) provides an acoustic rating of the sound insulation of walls and partitions due to airborne sound of the human voice. Sound insulation varies with frequency and is dependent on the type of wall construction, however, the R_w provides a convenient method of rating sound insulation using a single number. The higher the R_w rating the better the sound insulation provided by the partition.

C_{tr} is a correction factor to account for the sound insulation performance in the lower frequencies. The C_{tr} factor is added to the R_w rating to get an overall $R_w + C_{tr}$ airborne rating. For masonry walls, the C_{tr} factor is typically between -5 and -3 while for plasterboard walls the factor may often be as low as -12 , depending on the construction type.

The Acoustic Opinions expressed in this report are based firstly on calculations made using the Marshall Day Acoustics 'Insul' software and secondly by comparison with Sound Transmission Loss tests for similar plasterboard constructions. Acoustic opinions are then provided in the light of our general acoustic experience. Factors taken into account in our calculations include: the surface mass of the plasterboard, Young's Modulus, the critical frequency and speed of sound in plasterboard, the effect of air cavities and acoustic insulation between studs.

We are of the opinion that using the 'Insul' software and making corrections based on comparison with test results that our prediction accuracy is in the order of ± 2 dB.

Because of the complexity of such calculations, approved laboratory test results (in accordance with Australian Standard AS1191:2002 and AS/NZS1276.1:1999) are always preferred.



Acoustic Opinion**3.0 MATERIALS USED FOR SOUND REDUCTION****3.1 Dincel Wall Systems**

The Dincel wall systems in this report have specifications as detailed in Table 1 below:

Table 1 Dincel Wall

Product Name	Thickness (mm)	Finished Bulk Density (kg/m ³)
DCS 110	110	2,350
DCS 155	155	2,350
DCS 200	200	2,350

3.2 Plasterboard

In compiling this schedule of acoustic ratings for various plasterboard constructions Dincel has worked closely with Knauf Plasterboard. The density of the plasterboard used for the tested systems and the plasterboard used in the recommended wall systems are shown in Table 2 below.

Table 2 Plasterboard Densities

Product Name	Thickness (mm)	Bulk Density (kg/m ³)
Gyprock*	10	650
MastaShield*	10	640
	13	623
FireShield*	13	808
	16	766

* Similar or higher density plasterboard may also be used.

3.3 Insulation

Acoustic insulation specified have bulk densities as follows:

Table 3 Knauf's Insulation Densities

Product Name	Thickness (mm)	Approx Bulk Density (kg/m ³)
Glasswool	25	24
Earthwool	50	11

Thicker or higher density of the same bulk insulation may be substituted for wall systems in this report.

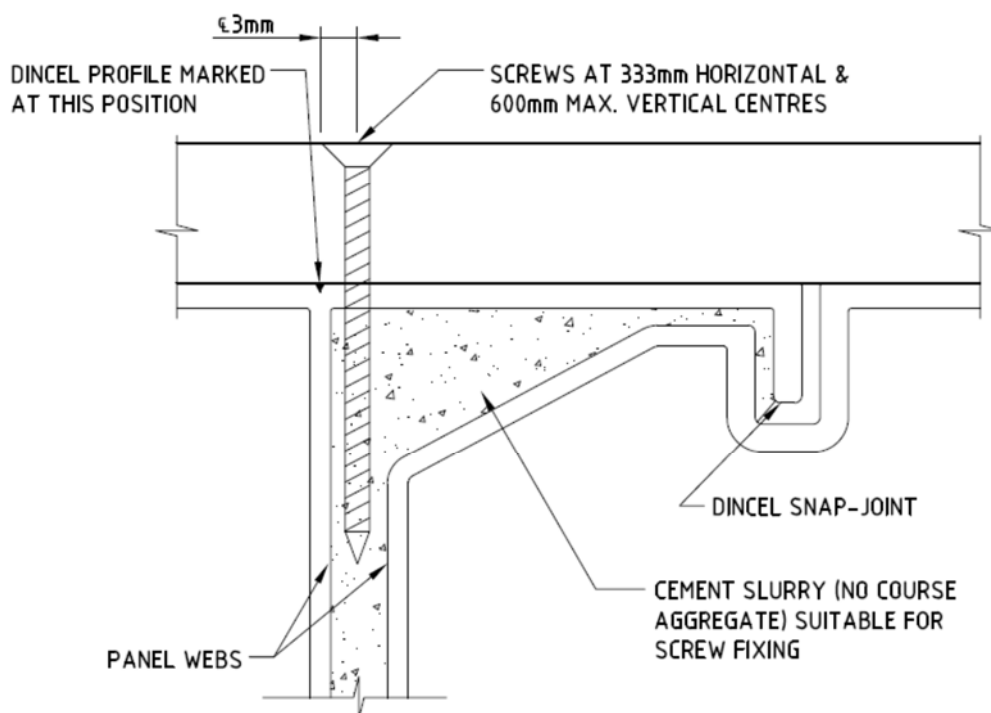


3.4 Studs

All systems with a separate steel stud leaf include an option for 51 mm or 64 mm steel studs.

3.5 Direct Fixing to Dincel

Plasterboard can be direct fixed to Dincel either by screwing or a combination of gluing and screwing. The following diagram indicates how conventional screwing can be used with the Dincel wall.



DIRECT FIXING DETAIL OF PLASTERBOARD AT EACH FACE OF DINCEL

3.6 Electrical Services within the Dincel Wall

We recommend that services be provided within the furring channel or stud cavity where applicable.

In accordance with the Building Code of Australia, services must not be chased into sound rated Dincel walls.



Acoustic Opinion**4.0 BUILDING CODE OF AUSTRALIA – ACOUSTIC REQUIREMENTS**

The information in this section is extracted from the Building Code of Australia (BCA), which is now part of the National Construction Code (NCC), Part F5 “Sound Transmission and Insulation”. The acoustic requirements and the building solutions in this report are based on the Deemed-to-Satisfy Provisions of the BCA.

The *Objective* of this Part 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 units*.

The Objective only applies to a Class 2 or 3 building or a Class 9c *aged care building*.

4.1 F5.5 Sound insulation rating of walls – Class 2 and 3

A wall in a Class 2 or 3 building must -

- (i) have an $R_w + C_{tr}$ (airborne) not less than 50, if it separates *sole-occupancy units*; and
- (ii) have an R_w (airborne) not less than 50, if it separates *sole-occupancy unit* from a plant room, lift *shaft*, stairway, *public corridor*, public lobby or the like, or parts of a different classification; and
- (iii) be of discontinuous construction if it separate -
 - (A) a bathroom, *sanitary* compartment, laundry or kitchen in one *sole-occupancy unit* from a *habitable room* (other than a kitchen) in an adjoining unit; or
 - (B) a *sole-occupancy unit* from a plant room or lift *shaft*.

Discontinuous construction means a wall having a minimum 20 mm cavity between 2 separate leaves, and

- (i) for masonry, where wall ties are required to connect leaves, the ties are of the resilient type; and
- (ii) for other than masonry, there is no mechanical linkage between leaves except at the periphery.

A door may be incorporated in a wall in a Class 2 building that separates a *sole-occupancy unit* from a stairway, *public corridor*, public lobby or the like, provided the door assembly has an R_w not less 30.



Acoustic Opinion

Where a wall *required* to have sound insulation has a floor above, the wall must continue to -

- (i) the underside of the floor above; or
- (ii) a ceiling that provides the sound insulation *required* for the wall.

Where a wall *required* to have sound insulation has a roof above, the wall must continue to -

- (i) the underside of the roof above; or
- (ii) a ceiling that provides the sound insulation *required* for the wall.

4.2 F5.5 Sound insulation rating of walls – Class 9(c)

(c) A wall in a Class 9c *aged care building* must have an R_w not less than 45 if it separates -

- (i) *sole-occupancy units*; or
- (ii) A *sole-occupancy unit* from a kitchen, bathroom, *sanitary compartment* (not being an associated ensuite), laundry, plant room or utilities room.

(d) In addition to (c), a wall separating a *sole-occupancy unit* in a Class 9c *aged care building* from a kitchen or laundry, plant must comply with F5.3(b).

(e) Where a wall *required* to have sound insulation has a floor above, the wall must continue to -

- (i) the underside of the floor above; or
- (ii) a ceiling that provides the sound insulation *required* for the wall.

(f) Where a wall *required* to have sound insulation has a roof above, the wall must continue to -

- (i) the underside of the roof above; or
- (ii) a ceiling that provides the sound insulation *required* for the wall.

4.3 F5.6 Sound insulation rating of services

(a) If a duct, soil, waste or water supply pipe, including a duct or pipe that is located in a wall or floor cavity, serves or passes through more than one *sole-occupancy unit*, the duct or pipe must be separated from the rooms of any *sole-occupancy unit* by construction with an $R_w + C_{tr}$ (airborne) not less than -

- (i) 40 if the adjacent room is a *habitable room* (other than a kitchen); or
- (ii) 25 if the adjacent room is a kitchen or *non-habitable room*.

(b) If a storm water pipe passes through a *sole-occupancy unit* it must be separated in accordance with (a)(i) and (ii).



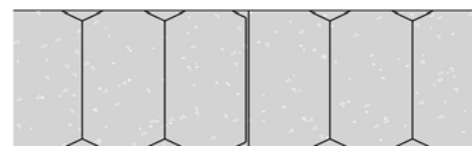
Acoustic Opinion**5.0 DINCEL WALL SYSTEMS – LABORATORY TESTED**

Several systems incorporating the Dincel Construction System 200 mm wall have been tested at the National Acoustic Laboratories in Chatswood NSW.

5.1 DCS 110 -1**Laboratory Tested System**

110 mm Dincel Wall

Wall Width (mm)	Laboratory Tested $R_w (R_w + C_{tr})$
110	48 (43)

5.2 DCS 200-1**Laboratory Tested System**

200 mm Dincel Wall

Wall Width (mm)	Laboratory Tested $R_w (R_w + C_{tr})$
200	53 (48)

5.3 DCS 200-2**Laboratory Tested System**

10 mm Gyprock plasterboard, screw fixed

200 mm Dincel Wall

10 mm Gyprock plasterboard, screw fixed

Wall Width (mm)	Laboratory Tested $R_w (R_w + C_{tr})$
220	51 (46)



Acoustic Opinion**6.0 155 DINCEL WALL – RECOMMENDED WALL SYSTEMS**

The acoustic opinions below are based on comparable laboratory tests, 'Insul' software as well as our own experience.

6.1 $R_w + C_{tr}$ 40 – Service Riser Wall**Acoustic Opinion**

155 mm Dinzel Wall

Wall Width (mm)	Laboratory Tested $R_w (R_w + C_{tr})$
155	51 (45)

6.2 R_w 50**Acoustic Opinion**

13 mm Knauf MastaShield plasterboard, direct fix
155 mm Dinzel Wall

Wall Width (mm)	$R_w (R_w + C_{tr})$
168	50 (45)

6.3 R_w 50 - Corridor Wall

No services on the wall

**Acoustic Opinion**

13 mm Knauf MastaShield plasterboard, direct fix
155 mm Dinzel Wall
13 mm Knauf MastaShield plasterboard, direct fix

Wall Width (mm)	$R_w (R_w + C_{tr})$
181	50 (45)



Acoustic Opinion**6.4 Rw 45 – Class 9(c) Wall**

Electrical services on one side

**Acoustic Opinion**

10 mm Knauf MastaShield plasterboard, direct fix

155 mm Dincel Wall

28 mm furring channel @ 600 mm centres, 30 mm cavity

No insulation

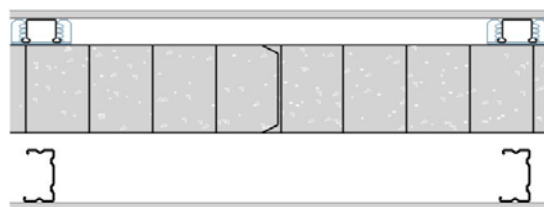
10 mm Knauf MastaShield plasterboard, screw fixed to furring channel

Wall Width (mm)	R _w (R _w + C _{tr})
205	48 (43)

6.5 Rw 45 – Class 9(c) Wall - Discontinuous

Services on both sides

Discontinuous wall

**Acoustic Opinion**

10 mm Knauf Mastashield plasterboard, screw fixed

28 mm furring channel @ 600 mm centres, 30 mm cavity

No insulation

155 mm Dincel Wall

51/64 mm steel studs @ 600 mm centres, overall 71/84 mm cavity

No insulation

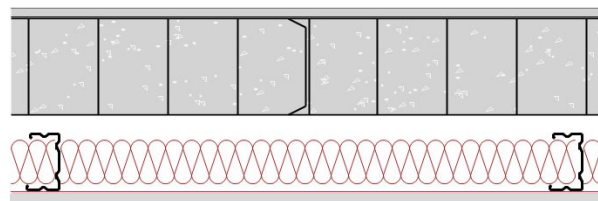
10 mm Knauf Mastashield plasterboard, screw fixed to studs

Wall Width (mm)	R _w (R _w + C _{tr})
276 with 51 mm steel studs	51 (43)
289 with 64 mm steel studs	52 (44)



Acoustic Opinion**6.6 $R_w + C_{tr} - 50$ – Intertenancy Wall (Discontinuous)**

Discontinuous wall
Services on one side

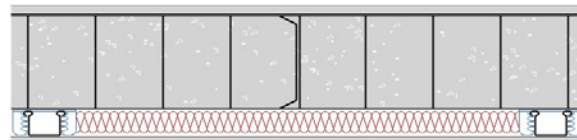
**Acoustic Opinion**

10 mm Knauf MastaShield plasterboard, direct fix
155 mm Dincel Wall
20 mm air gap
51/64 mm steel studs @ 600 mm centres, overall 71/84 mm cavity
50 mm Knauf Earthwool insulation in the cavity
10 mm Knauf MastaShield plasterboard, screw fixed to studs

Wall Width (mm)	$R_w (R_w + C_{tr})$
246 with 51 mm steel studs	58 (50)
259 with 64 mm steel studs	58 (51)

6.7 $R_w 50$ – Corridor Wall

Electrical services on one side

**Acoustic Opinion**

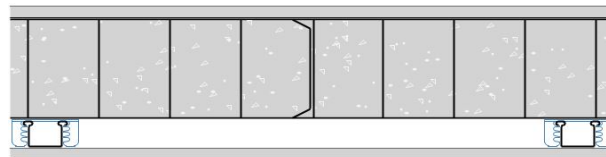
10 mm Knauf MastaShield plasterboard, direct fix
155 mm Dincel Wall
28 mm furring channel @ 600 mm centres, 30 mm cavity
25 mm glasswool insulation in cavity
10 mm Knauf Mastashield plasterboard, screw fixed to furring channel

Wall Width (mm)	$R_w (R_w + C_{tr})$
205	55 (48)



Acoustic Opinion**6.8 R_w 50 - Corridor Wall**

Electrical services on one side

**Acoustic Opinion**

16 mm Knauf FireShield plasterboard, direct fix

155 mm Dintel Wall

28 mm furring channel @ 600 mm centres, 30 mm cavity

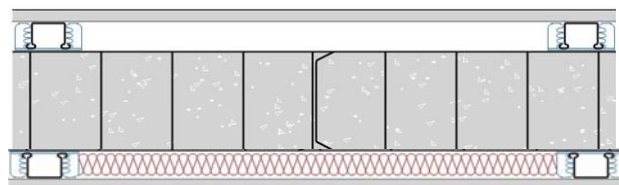
No Insulation

16 mm Knauf FireShield plasterboard, screw fixed to furring channel

Wall Width (mm)	R _w (R _w + C _{tr})
217	50 (43)

6.9 R_w 50 - Corridor Wall

Electrical services on both sides

**Acoustic Opinion**

10 mm Knauf MastaShield plasterboard screw fixed to furring channel

No insulation

28 mm furring channel @ 600 mm centres, 30 mm cavity

155 mm Dintel wall

28 mm furring channel @ 600 mm centres, 30 mm cavity

25 mm glasswool insulation in cavity

10 mm Knauf MastaShield plasterboard screw fixed to furring channel

Wall Width (mm)	R _w (R _w + C _{tr})
235	51 (38)



Acoustic Opinion**6.10 R_w 50 - Lift Shaft or Plant Room Wall (Discontinuous)**

Discontinuous wall
Services on one side

**Acoustic Opinion**

155 mm Dincel Wall

20 mm air gap

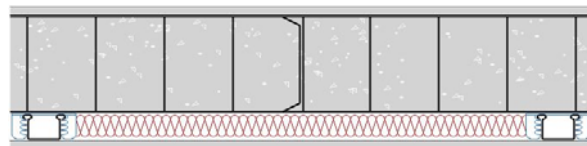
51/64 mm steel studs @ 600 mm centres, overall 71/84 mm cavity

10 mm Knauf MastaShield plasterboard fixed to studs

Wall Width (mm)	R_w ($R_w + C_{tr}$)
236 with 51 mm steel studs	54 (45)
249 with 64 mm steel studs	56 (48)

6.11 $R_w + C_{tr}$ - 50 - Intertenancy Wall

Services on one side

**Acoustic Opinion**

13 mm Knauf MastaShield plasterboard, direct fix

155 mm Dincel Wall

28 mm furring channel @ 600 mm centres, 40 mm cavity

25 mm glasswool insulation in cavity

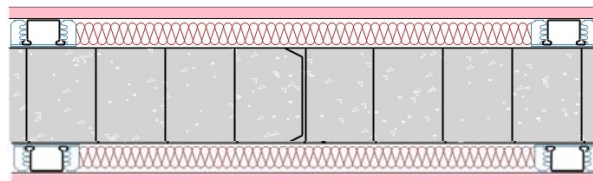
13 mm Knauf MastaShield plasterboard, screw fixed to furring channel

Wall Width (mm)	R_w ($R_w + C_{tr}$)
221	56 (50)



Acoustic Opinion**6.12 $R_w + C_{tr} - 50$ - Intertenancy Wall**

Electrical services on both sides

**Acoustic Opinion**

16 mm Knauf FireShield plasterboard screw fixed to furring channel

25 mm glasswool insulation in cavity

28 mm furring channel @ 600 mm centres, 45 mm cavity

155 mm Dintel wall

28 mm furring channel @ 600 mm centres, 45 mm cavity

25 mm glasswool insulation in cavity

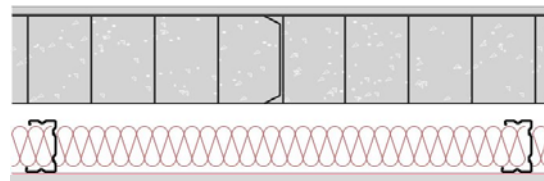
16 mm Knauf FireShield plasterboard screw fixed to furring channel

Wall Width (mm)	R_w ($R_w + C_{tr}$)
277	66 (52)

6.13 $R_w + C_{tr} - 50$ - Intertenancy Wall (Discontinuous)

Discontinuous wall

Services one side

**Acoustic Opinion**

13 mm Knauf MastaShield plasterboard, direct fix

155 mm Dintel Wall

20 mm air gap

51/64 mm steel studs @ 600 mm centres, overall 71/84 mm cavity

50 mm Knauf Earthwool insulation in cavity

13 mm Knauf MastaShield plasterboard, screw fixed to studs

Wall Width (mm)	R_w ($R_w + C_{tr}$)
252 with 51 mm steel studs	63 (51)
265 with 64 mm steel studs	64 (52)

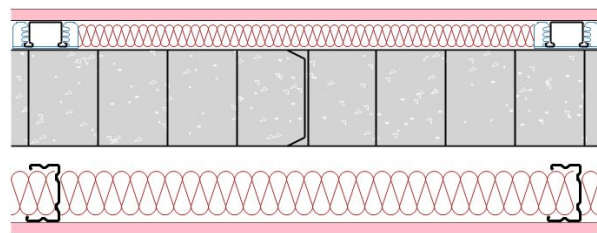


Acoustic Opinion**6.14 $R_w + C_{tr} - 55$ - Intertenancy Wall (Discontinuous)**

Superior acoustic performance

Discontinuous wall

Services both sides

**Acoustic Opinion**

Knauf 13 mm/16 mm FireShield plasterboard, screw fixed to furring channel

28 mm furring channel @ 600 mm centres, 30 mm cavity

25 mm glasswool insulation in the cavity

155 mm Dintel Wall

20 mm air gap

51/64 mm steel studs @ 600 mm centres, overall 71/84 mm cavity

50 mm Knauf Earthwool insulation in the cavity

Knauf 13 mm/16 mm FireShield plasterboard, screw fixed to furring channel

Wall Width (mm)	Plasterboard Thickness (mm)	R_w ($R_w + C_{tr}$)
295 with 64 mm steel studs	13 mm	70 (55)
288 with 51 mm steel studs	16 mm	69 (55)
301 with 64 mm steel studs	16 mm	70 (57)



Acoustic Opinion**7.0 STATEMENT OF EFFECT**

We are confident that provided the walls are built of the materials specified in a workmanlike manner in accordance with the manufacturer's instructions (taking due care to seal all joints and use constructions that will avoid flanking transmission problems), they will provide the sound insulation ratings listed in the Acoustic Opinions section of this report.



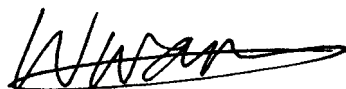
Stephen Gauld, BE (Mech), MEngSc (Noise and Vibration), MIEAust, MAAS
Principal Acoustical Engineer
for and on behalf of Day Design Pty Ltd

Attachments:

- Summary of DCS155 Dinzel Wall Systems



The undersigned hereby certifies that this Report has been checked and approved in accordance with our Quality Management System.








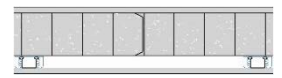
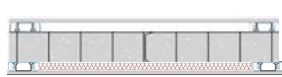


Date: 12/2/18



Acoustic System Summary – 155 mm Dintel Wall


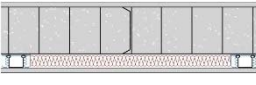
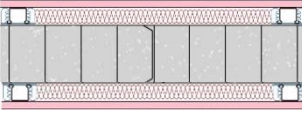
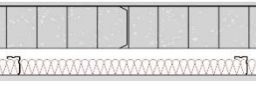
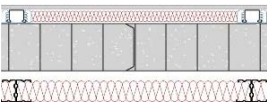


System N ^o R _w /R _w +C _{tr}	WALL LINING SIDE 1	155 mm DINCEL WALL CONCRETE DENSITY 2,350 kg/m ³	WALL LINING SIDE 2
155-6.1 51 / 45	Nil, painted or rendered	Wall width: 155mm 	Nil, painted or rendered
155-6.2 50 / 45	13mm Knauf MastaShield plasterboard, direct fix	Wall width: 168mm 	Nil, painted or rendered
155-6.3 50 / 45	13mm Knauf MastaShield plasterboard, direct fix	Wall width: 181mm 	13mm Knauf MastaShield plasterboard, direct fix
155-6.4 48 / 43	10mm Knauf MastaShield plasterboard, direct fix	Wall width: 205mm 	10mm Knauf MastaShield plasterboard, direct fix screw fixed to 28mm furring channel (30mm cavity)
155-6.5 51 / 43 ¹ 52 / 44 ²	10mm Knauf MastaShield plasterboard, screw fixed to 28mm furring channel (30mm cavity)	Wall width: 276mm ¹ 289mm ² 	10mm Knauf MastaShield plasterboard, screw fixed to studs at 600mm cts 20mm air gap (71 ¹ /84 ² mm cavity)
155-6.6 58 / 50 ¹ 58 / 51 ²	10mm Knauf MastaShield plasterboard, direct fix	Wall width: 246mm ¹ 259mm ² 	10mm Knauf MastaShield plasterboard, screw fixed to studs at 600mm cts 20mm air gap (71 ¹ /84 ² mm cavity) 50 mm Earthwool in cavity
155-6.7 55 / 48	10mm Knauf MastaShield plasterboard, direct fix	Wall width: 205mm ¹ 	10mm Knauf MastaShield plasterboard, screw fixed to 28mm furring channel (30mm cavity) 25mm glasswool in cavity
155-6.8 50 / 43	16mm Knauf FireShield plasterboard, direct fix	Wall width: 217mm 	16mm Knauf FireShield plasterboard, screw fixed to 28mm furring channel (30mm cavity)
155-6.9 51 / 38	10mm Knauf MasterShield plasterboard, screw fixed to 28mm furring channel at 600mm cts (30mm cavity)	Wall width: 235mm 	10mm Knauf MasterShield plasterboard, screw fixed to 28mm furring channel at 600mm cts (30mm cavity) 25mm glasswool in cavity



Acoustic System Summary – 155 mm Dintel Wall



System N ^o R _w /R _w +C _{tr}	WALL LINING SIDE 1	155 mm DINCEL WALL CONCRETE DENSITY 2,350 kg/m ³	WALL LINING SIDE 2
155-6.10 54 / 45 ¹ 56 / 48 ²	Nil, painted or rendered	Wall width: 236mm ¹ 249mm ² 	10mm Knauf plasterboard, screw fixed to studs at 600mm cts 20mm air gap (71 ¹ /84 ² mm cavity)
155-6.11 56 / 50	13mm Knauf MastaShield plasterboard, direct fix	Wall width: 221mm 	13mm Knauf MastaShield plasterboard, direct fix screw fixed to 28mm furring channel (40 mm cavity) 25 mm glasswool in
155-6.12 66 / 52	16mm Knauf FireShield plasterboard, screw fixed to 28mm furring channels at 600mm cts (45mm cavity) 25mm glasswool in cavity	Wall width: 277mm 	16mm Knauf FireShield plasterboard, screw fixed to 28mm furring channels at 600mm cts (45mm cavity) 25mm glasswool in cavity
155-6.13 63 / 51 ¹ 64 / 52 ²	13mm Knauf MastaShield plasterboard, direct fix	Wall width: 252mm ¹ 265mm ² 	13mm Knauf plasterboard, screw fixed to studs at 600mm cts 20mm air gap (71 ³ /84 ⁴ mm cavity) 50 mm Earthwool in cavity
155-6.14 70 / 55 ³ 69 / 55 ⁴ 70 / 57 ⁵	13/16mm Knauf FireShield plasterboard, screw fixed to 28mm furring channel (30mm cavity) 25 mm glasswool in cavity	Wall width: 295mm ³ 288mm ⁴ , 301mm ⁵ 	13/16mm Knauf FireShield, screw fixed to studs at 600mm cts 20mm air gap (84 ³ /71 ⁴ /84 ⁵ mm cavity) 50 mm Earthwool in cavity

¹ 51mm steel studs

³ 64mm steel studs, 13mm plasterboard

⁵ 64mm steel studs, 16mm plasterboard

² 64mm steel studs

⁴ 51mm steel studs, 16mm plasterboard

The acoustic ratings provided above are opinions based on test data of comparable laboratory tests and acoustic modelling carried out by Day Design acoustic consultants.

