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LABORATORY MEASUREMENT OF THE REDUCTION OF TRANSMITTED IMPACT SOUND OF CERAMIC TILES ON UNDERLAY

Test report ID: T1931

Report prepared by:

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AUCKLAND UNISERVICES LIMITED

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Acoustics Testing Service

LABORATORY MEASUREMENT OF THE REDUCTION OF TRANSMITTED IMPACT SOUND BY FLOOR COVERINGS ON A STANDARD FLOOR

Report prepared for:

Mapei New Zealand
30 Fisher Crescent, Mt Wellington
Auckland 2010, New Zealand

Report prepared by:

Acoustics Testing Services
Dept. of Mechanical Engineering
The University of Auckland

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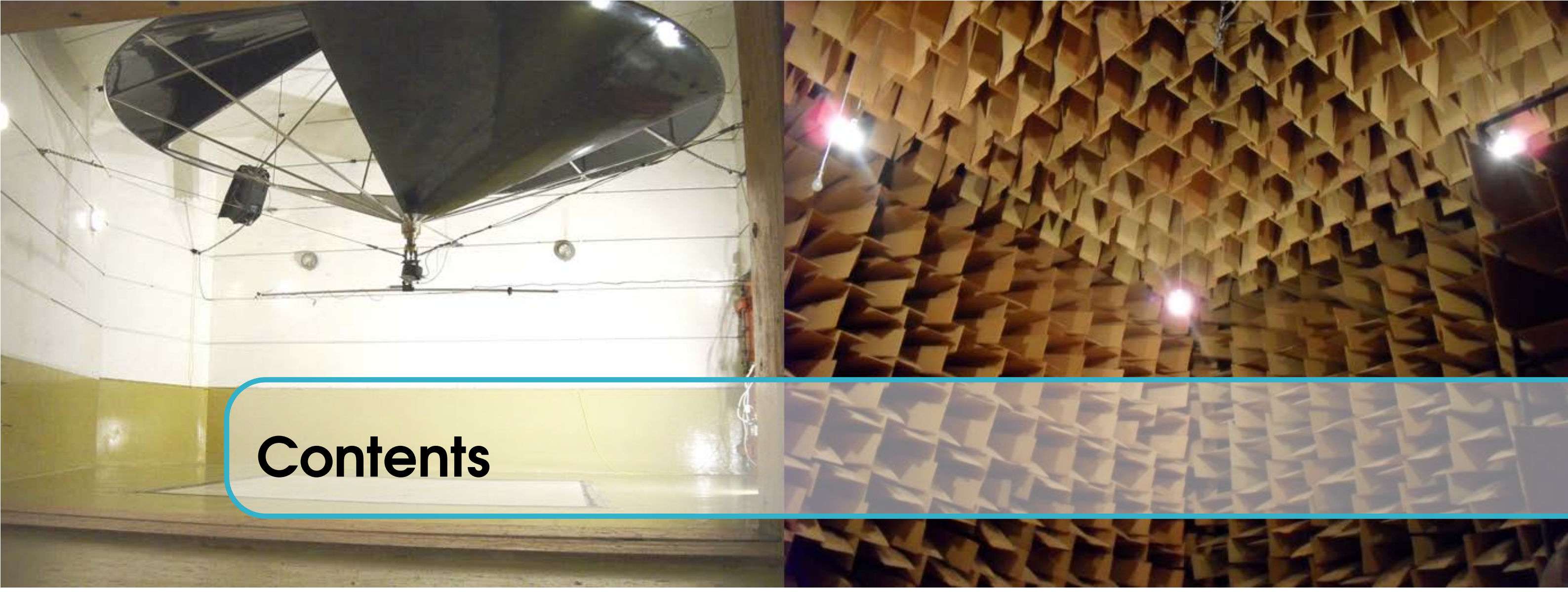

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1. Test Photos

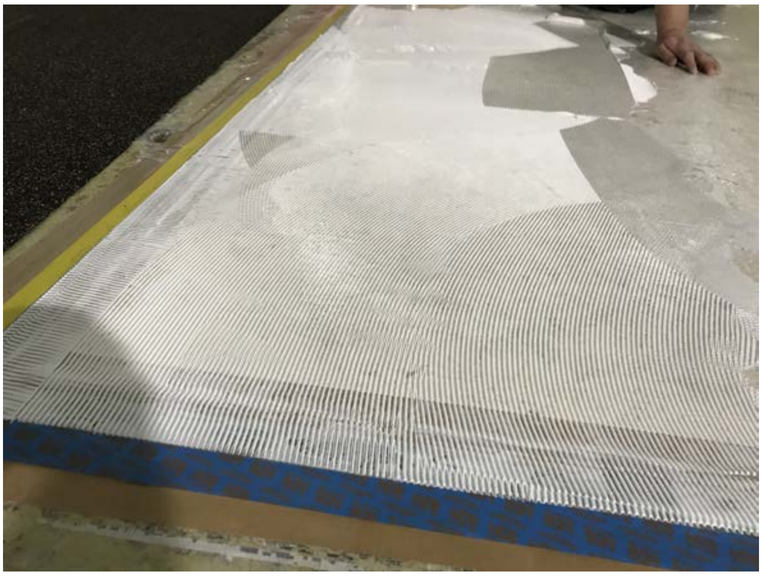


Figure 1.1: Applying Ultrabond adhesive

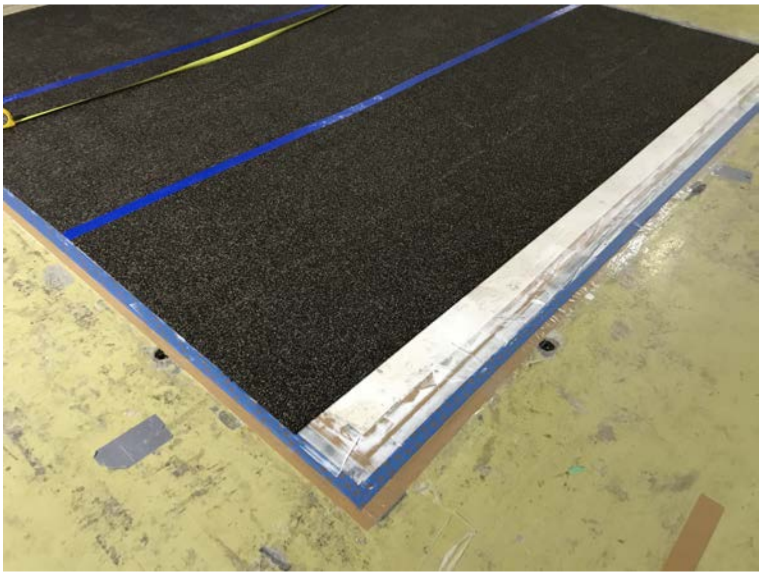


Figure 1.2: Laying underlay

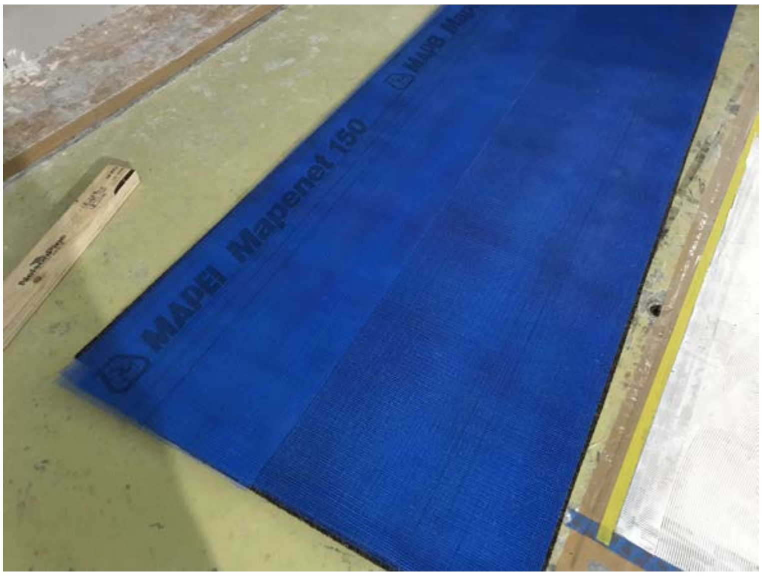


Figure 1.3: Mapenet 150 mesh

Figure 1.4: Applying Mapelastic waterproofing layer

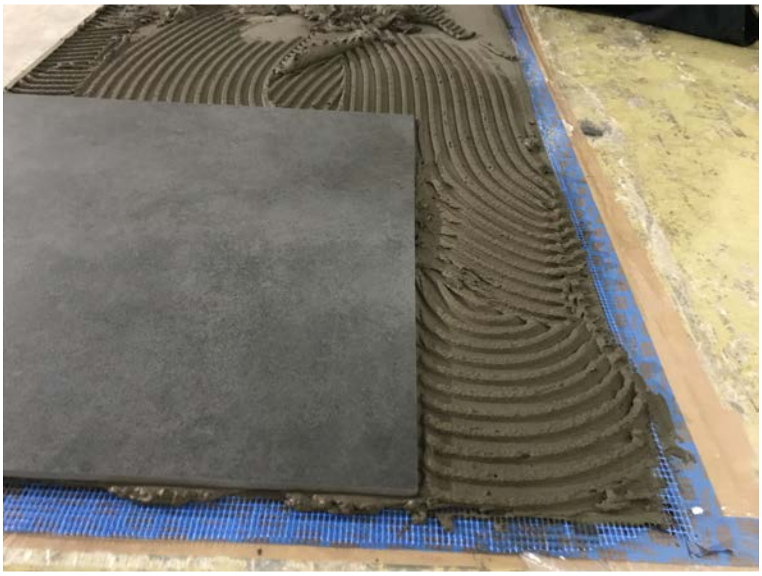


Figure 1.5: Adhering tiles to waterproofing membrane

Figure 1.6: Impact tapping machine on sample

Reduction of impact sound pressure level according to ISO 10140-3
Laboratory measurements of the reduction of transmitted impact sound by floor coverings on a heavyweight reference floor

Client: Mapei NZ Ltd. Manufacturer: Mapei NZ Ltd. Date of test: Friday, 7 June 2019

Test rooms: Reverberation Chambers A and B

Description and identification of the test specimen and test arrangement:

Mapei Acoustic system comprising:

First layer: *Mapesonic CR 4mm underlay* adhered to the test surface with *Ultrabond Eco FIX* applied with a 2mm square notched trowel. (left for 30mins to go tacky before addition of underlay)

Second layer: 2 coats of *Mapelastic Smart Waterproofing Membrane* applied with a flat trowel (approximate thickness per layer 1.5mm) with *Mapenet 150 Mesh* embedded into the body of the first layer. (0.5hrs curing time between coats and 3.5 days curing time before next layer)

Third layer: An array of 600mm x 600mm x 10mm thick *Domino (Napoli Tusk Matt)* ceramic tiles (6.3 tiles x 6.3 tiles 10.24m2) adhered to the waterproofing membrane with *Keraquick S1 Fast-Setting Adhesive* applied with a 10mm square notched trowel (4hrs curing time before grout applied). *Ultracolor Plus* grout applied to the 3mm wide joints between the tiles. (40hrs final curing time after grout application prior to testing)

Source chamber was Chamber A and receiving chamber was Chamber B . Test specimen installed by the client.

Deviation from standard: The bare test floor used is of uniform thickness for an area of only 2.6m x 2.6m. The description of the bare test floor is given in the full report.

Computer Files: : T1931 Slab.pls ID: 16, T1931 Slab.pls ID: 17, T1931 Slab.pls ID: 18, T1931 Slab.pls ID: 0, T1931 Slab.pls ID: 1, T1931 Slab.pls ID: 2 : T1931 Sample.pls ID: 86, T1931 Sample.pls ID: 87, T1931 Sample.pls ID: 63, T1931 Sample.pls ID: 65, T1931 Sample.pls ID: 69, T1931 Sample.pls ID: 70

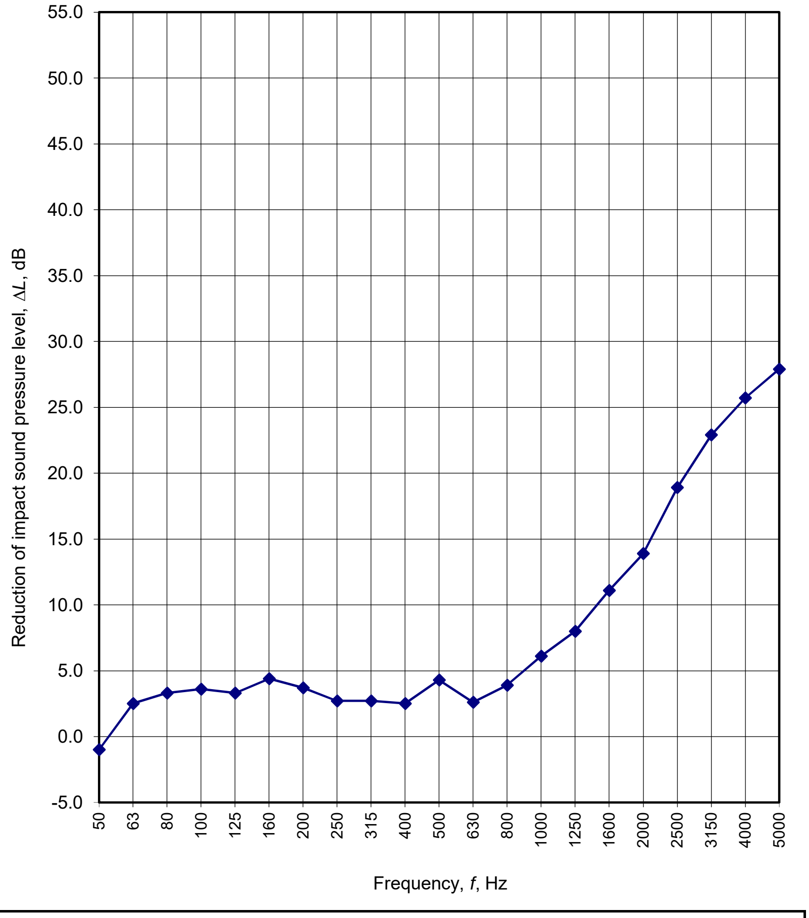
Mass per unit area: 32.71 kg/m^2

Air temp in the test rooms: 18 ^{o}C

Air humidity in test rooms: 63 %

Receiving room volume: 153 m^3

Frequency f Hz	$L_{n,0}$ One-third octave dB	ΔL One-third octave dB
50	56.5	-1.0
63	52.9	2.5
80	59.8	3.3
100	**64.4**	**3.6**
125	**64.8**	**3.3**
160	**66.9**	**4.4**
200	**68.3**	**3.7**
250	**71.0**	**2.7**
315	**69.9**	**2.7**
400	**70.9**	**2.5**
500	**80.3**	**4.3**
630	**76.0**	**2.6**
800	**73.2**	**3.9**
1000	**72.9**	**6.1**
1250	**73.3**	**8.0**
1600	**79.2**	**11.1**
2000	**79.0**	**13.9**
2500	**76.7**	**18.9**
3150	**76.1**	**22.9**
4000	72.4	25.7
5000	68.8	27.9



Notes: #N/A = Value not available. **Bold** values are used to calculate ΔL_w.

< indicates that the true value is lower.

$L_{n,0}$ are the bare floor impact sound levels.

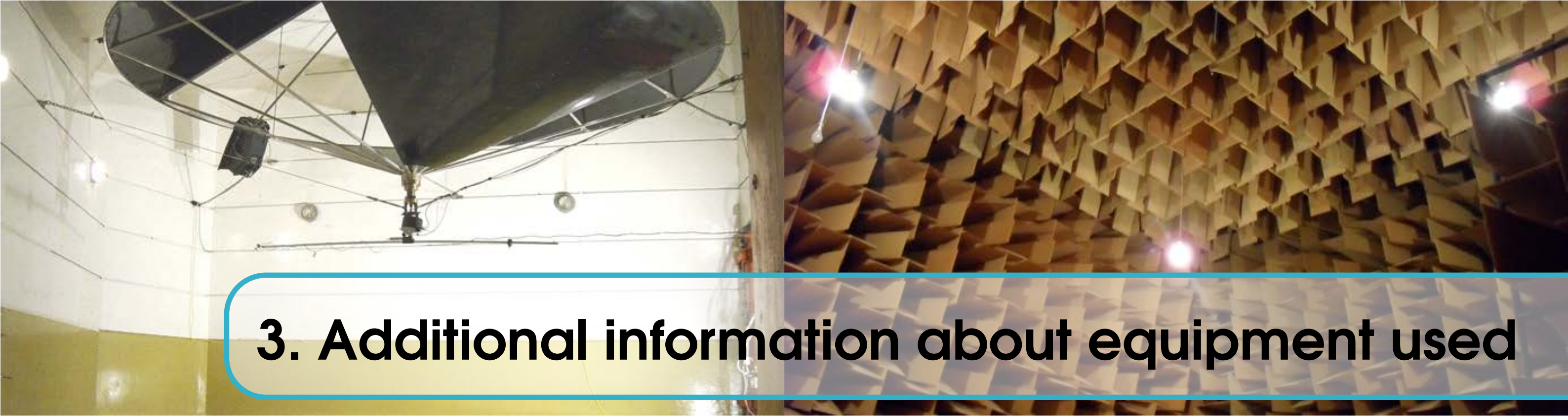
Rating according to ISO 717-2:

ΔL_w = 12 dB $C_{I,\Delta}$ = 7 dB $C_{I,r}$ = -4 dB $C_{I,50\text{-}2500}$ = -4 dB

These results are based on a test made with an artificial source under laboratory conditions (engineering Method) with the specified reference floor.

No. of test report: **T1931** Name of test institute: University of Auckland Acoustics Testing Service.

Date: 14-June-2019 Signature:



3. Additional information about equipment used

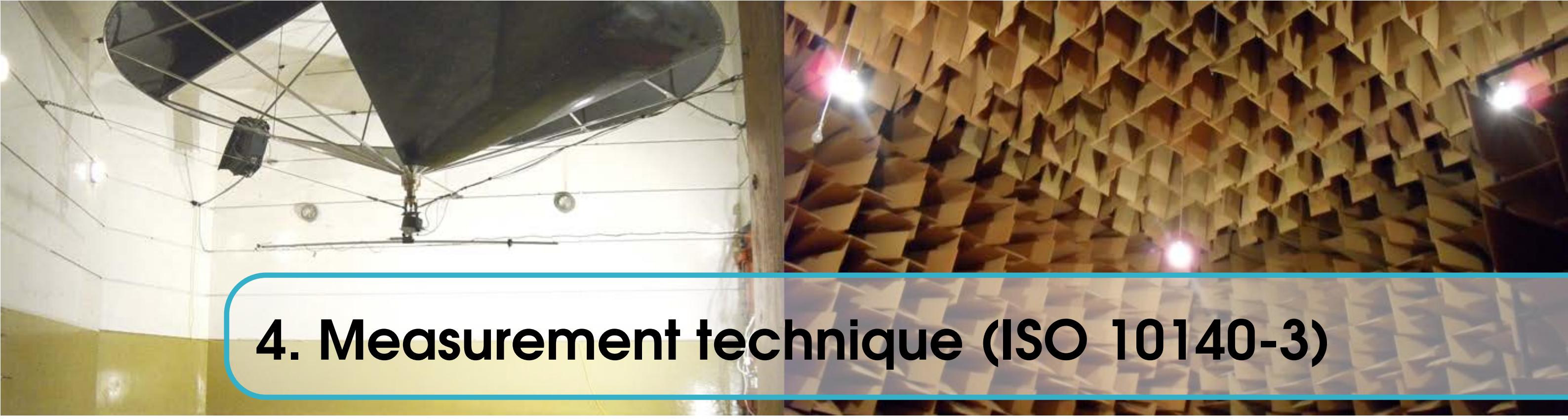
BRÜEL & KJÆR		
EQUIPMENT	TYPE	SERIAL No.
Calibrator	4231	2241899
Analyzer	3160	106456
Rotating boom	3923	936497

GRAS		
EQUIPMENT	TYPE	SERIAL No.
1/2" Microphone	46AE	319875
1/2" Microphone	46AE	319876
1/2" Microphone	46AE	319877
1/2" Microphone	46AE	319878

LOOK LINE		
EQUIPMENT	TYPE	SERIAL No.
Tapping Machine	EM50	F3.090142

NORSONIC		
EQUIPMENT	TYPE	SERIAL No.
Rotating boom	NOR265	29457

Calibration of the above equipment was conducted by Electroacoustic Calibration Services (ECS), an IANZ registered laboratory.



4. Measurement technique (ISO 10140-3)

4.1 Installation of sample

The floor covering is installed on a concrete floor plug that is positioned in the opening between two large reverberation chambers – chambers B and A. These chambers are vibration isolated from each other, which results in a structural discontinuity at the middle of the test opening. This gap is covered over by a wooden collar, which seals the gap and provides for ease of fixing of samples. The concrete floor plug is made of concrete reinforced with steel and is covered with a layer of hard resin. The dimensions of the floor plug are given in the following elevation diagram. If the floor covering is flexible, three samples to be tested are laid by the client following the techniques normally used in practice for that type of floor covering, with the constraint that the concrete floor plug be protected by a layer of thin self adhesive plastic tape if necessary.

4.2 Method

The normalized impact sound pressure levels are obtained in accordance with the recommendations of ISO standard 10140-3 "Measurements of impact sound insulation." The BK3204 tapping machine is placed sequentially in four different positions on the floor. The impact sound pressure level is measured in the room below the floor, using a rotating microphone, in third octave frequency bands. The impact sound pressure levels are normalized against the room absorption. The room absorption is calculated from the reverberation time and room volume. The reverberation time is measured from the decay of a steady state sound field. Corrections are applied, where necessary, for airborne sound transmission and background noise. The airborne sound transmission is determined using a loudspeaker and the microphone.

4.3 Presentation of results

The third octave band normalized impact sound pressure levels L_n are presented in both table and graph formats. Sometimes a highly reflective test sample means that the lower frequency

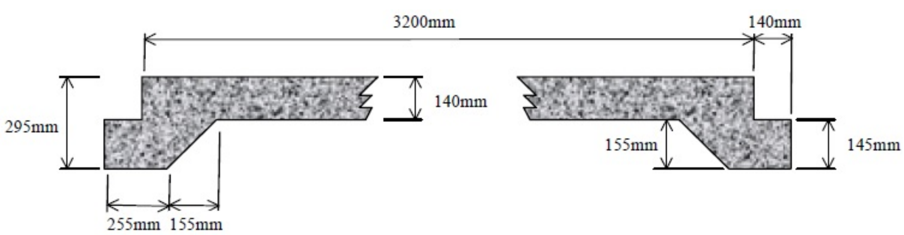


Figure 4.1: Floor/ceiling system

normalized impact sound pressure levels cannot be reliably measured; this is indicated by # N/A in the table of results. Additionally, sometimes the airborne transmission of sound through the floor or loud background noise affects the measurements resulting in only an upper threshold being found; this is indicated by a < sign preceding the tabulated results. Single figure ratings are also presented. The weighted normalized impact sound pressure level $L_{n,w}$, determined according to ISO 717-2, is presented along with a spectrum adaptation term C_l . $L_{n,w}$ is determined by fitting a reference curve to the third octave band normalized impact sound pressure levels Ln from 100Hz to 3150Hz, and gives a single figure determination of the sound levels which are transmitted through the floor from impacts (higher is worse). The spectrum adaptation term C_l is used to suggest the presence of high level peaks in the results over the frequency range 100Hz to 2500Hz, and may be added to Ln,w . For massive floors with effective coverings C_l will be about zero, for light timber floors C_l will be slightly positive, and for concrete floors with less effective covering C_l will range from -15 dB to 0dB. Another spectrum adaptation term $C_{l,50-2500}$, which covers the frequency range from 50Hz to 2500Hz, may also be presented if the low frequency levels are available. The impact insulation class (IIC) determined according ASTM E989 is also presented. This is determined by fitting a reference curve to the third octave band normalized impact sound pressure levels L_n from 100Hz to 3150Hz, but in a slightly different way to ISO 717-2. The impact insulation class measures the insulating abilities of the floor so that higher is better (contrary to $L_{n,w}$).

5. Acoustics Research Centre Facilities

There are three large interconnected reverberation chambers at the Acoustics Research Centre, two at ground level (Chambers C and A) and the third (Chamber B) below A.

All three reverberation chambers may be described as hexagonal prisms; each having 6 vertical sided walls, perpendicular to the floor. The roofs of chamber A and C are plane, but inclined at 12 degrees from horizontal. Chamber B has a plane, horizontal roof which is the floor of chamber A above it. The floor of chamber B is also horizontal, but has two angled sections at its north west and south east ends. The centre section is horizontal because a floor jack is installed there. The floor jack may be raised hydraulically to the ceiling of chamber B, the centre of which consists of a floor plug between the two chambers. This plug may be disconnected from chamber A and lowered down into chamber B, leaving a 3.2m x 3.2 m opening between the two chambers. This allows for the measurement of airborne and impact insulation of floor and roof elements.

The wall of chamber C adjacent to chamber A is left open, and the corresponding wall of chamber A consists of a pair of iron doors that are clamped against the chamber. The clamps may be removed and the iron doors pulled back, leaving the entire wall area (4.6m wide x 2.74m high) between the chambers open. This allows for the measurement of airborne sound insulation of wall elements. The gaps between chamber C and the wall of chamber A are covered with MDF boards when testing is carried out in chamber C.

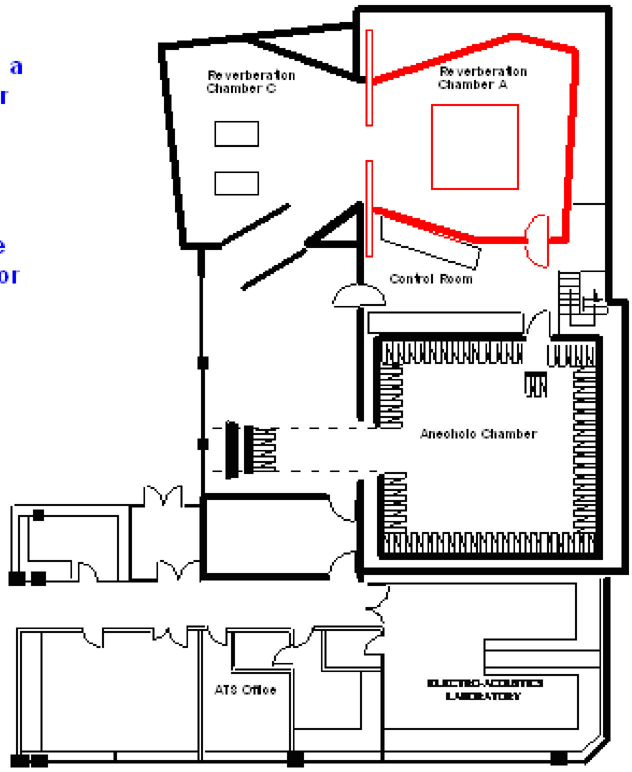
Chamber A has a rotating vane diffuser in a central position with an area (both sides) of about 53 m2. It has the shape of two cones with their bases joined, with the two opposite quadrants of one cone open and the complementary quadrants in the other cone open. Chamber C has a similar rotating vane diffuser but it is smaller, having a total area of about 27 m2.

In addition, up to ten static diffusers may be employed if needed. These are constructed of two laminated layers of dense Formica, of dimensions 2m x 2m. The Formica elements are riveted to a frame constructed of aluminium T section. Four aluminium arms may be bolted onto the frame to allow the diffusers to be mounted as desired. Currently four of these are used in chamber C, and three are used in chamber B.

The volumes and surface areas of the reverberation chambers are as follows:

Acoustics Testing Service Chambers		
	VOLUME (m^3)	SURFACE AREA (m^2)
Chamber A	202 ± 3	203.6 ± 0.9
Chamber B	153 ± 2	173 ± 1
Chamber C	209 ± 4	214 ± 0.9

The three Reverberation Chambers are linked by heavy steel doors and a removable Standard Industrial Floor Section which is removed and repositioned by a hydraulic hoist. The three chambers are vibration isolated from one another so that sound can only pass from one to the other via the intervening Test Wall or Test Floor/Ceiling Section.



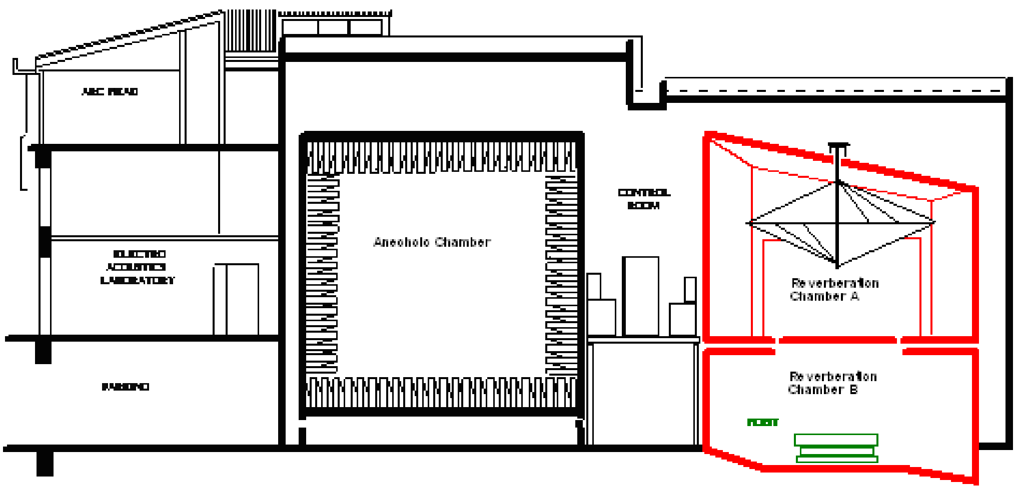


Figure 5.1: Acoutic Testing Service, The red lines show chambers used in measurements