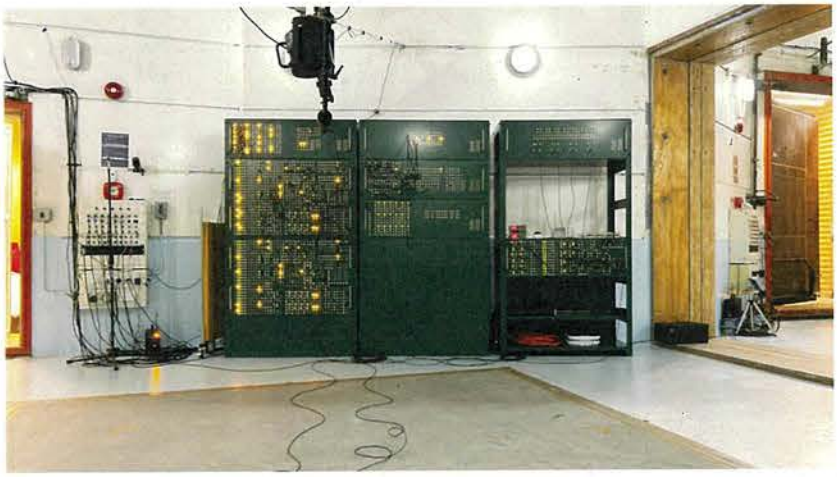
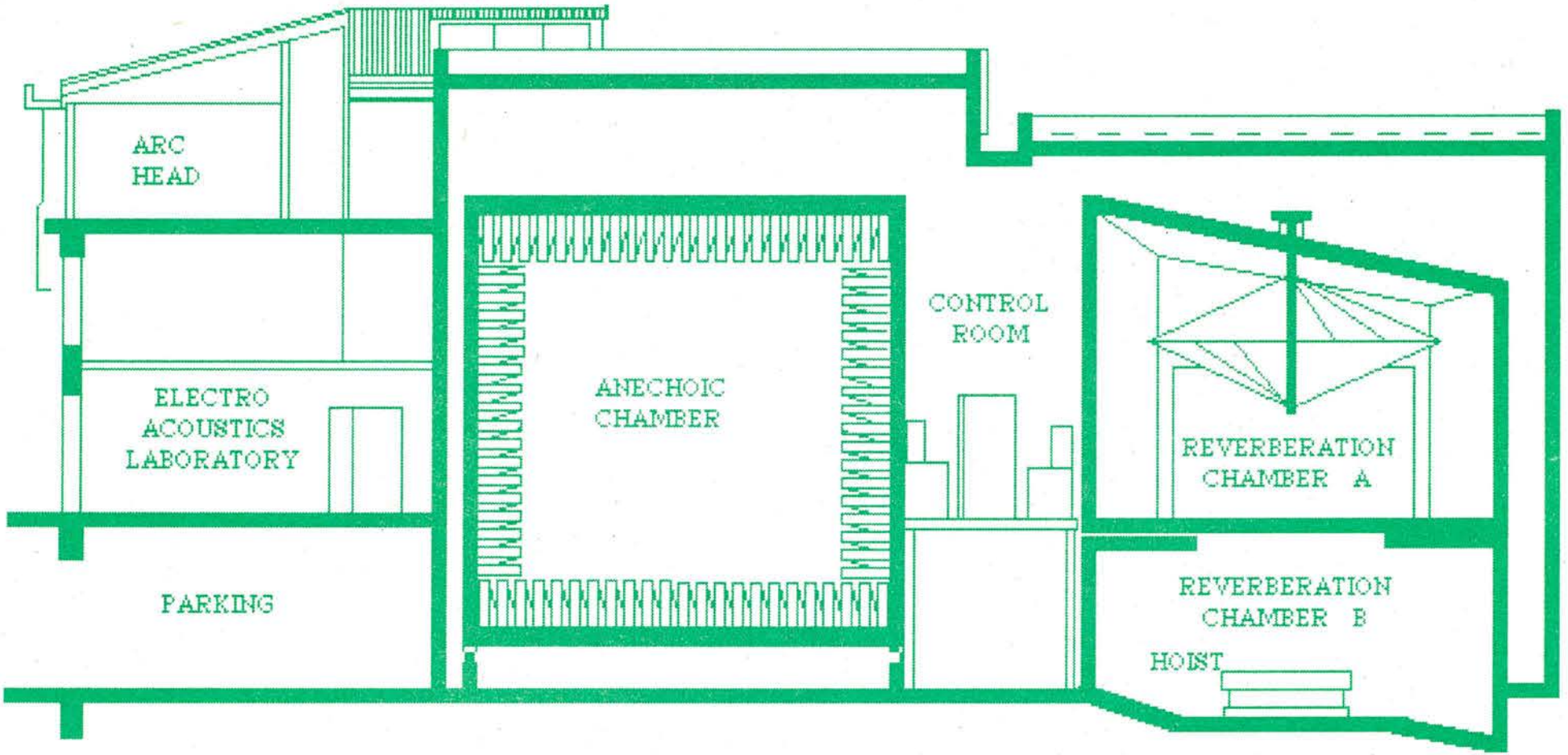
The Observatory Project
Acoustics and Vibration Research Centre

30-11-24
01-12-24



The Acoustics and Vibration Research Centre is comprised of three reverberation chambers and an anechoic chamber used to study acoustics – the field of science associated with the generation, propagation and effects of sound and vibration. Between the 27th November and the 2nd December 2024, The Observatory Project is based at the centre, working in the space to install the Adaptable Sound Interferometry Equipment A SINE, making towards new sound and video artworks, and conducting research towards our concept of "not-measuring events".

Formed in 2017 after encountering gravitational wave sonification, The Observatory Project is the collaborative research-led project of Eamon Edmundson-Wells and Ziggy Lever that explores making in relation to scientific processes. This project operates at the intersection of art and science, by using sound, video, custom-made electronics, and sculptural installation as a means to diagram, interpret, and imagine scientific processes of observation. To facilitate this research, The Observatory Project designed and built the Adaptable Sound Interferometry Equipment (A SINE), a series of modular sound-generating sculptures that span across perspex-housed devices and large steel cabinets. Recent research includes sea-cliff interferometry, 'not-measuring', provisional making in observatories and laboratories, and documentation of machine calibrations.


ARC
HEAD
ELECTRO
ACOUSTICS
LABORATORY
PARKING
ANECHOIC
CHAMBER
CONTROL
ROOM
REVERBERATION
CHAMBER A
REVERBERATION
CHAMBER B
HOIST

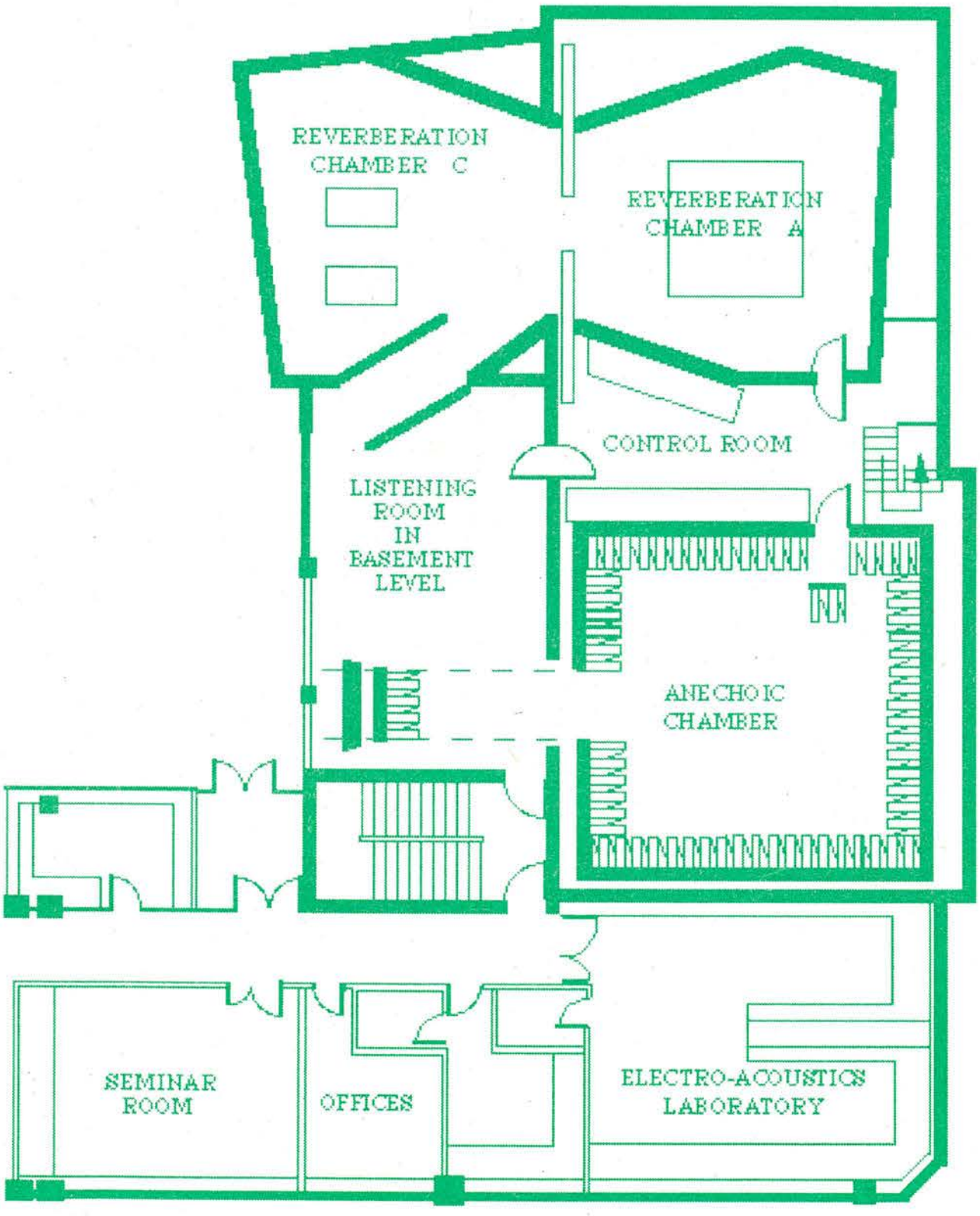

MEASUREMENT
IN PROGRESS
PLEASE CALL SHAWN
BEFORE ENTRY
NO SMOKING
Control Room
154

	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End

NOTES / OBSERVATIONS:

Please return sheet once completed or at end of not-measuring event


REVERBERATION
CHAMBER C
REVERBERATION
CHAMBER A
CONTROL ROOM
LISTENING
ROOM
IN
BASEMENT
LEVEL
ANECHOIC
CHAMBER
SEMINAR
ROOM
OFFICES
ELECTRO-ACOUSTICS
LABORATORY

On Saturday, the 30th of November, and Sunday, the 1st of December, 2024, thirty-three participants were invited to visit The Acoustics and Vibration Research Centre for a tour alongside The Observatory Project led by researchers Dr Andrew Hall, Yousif Badri, and Dr George Dodd. Upon arrival, guests were given clipboards and split into two groups so as to minimise the acoustic interference of our bodies in the four chambers visited (chambers A and C were combined).

In the anechoic chamber, we experienced the quietest room in Aotearoa – a room suspended on springs and "de-coupled" from the rest of the building. We heard about how the material and shape of the 1m deep foam wedges mounted to the ceiling, walls, and floor (under the suspended astroturf field) are designed to minimise reflected sound. Earlier that week, ground impedance measurements were taken, and the floor of the chamber was set up with layers of MDF, Chux cloths, and astroturf to simulate the acoustic properties of grass.[1] After some time, the first sound event occurred.

The other three chambers visited were reverberation chambers. There are no parallel surfaces in a reverberation chamber, decreasing the interference from standing waves and increasing the potential for sonic reflection. As the large door to Chamber C was closed, the sound of birdsong and light rain outside faded and each small movement made was seemingly amplified as the echo increased. Panels mounted to the walls of Chamber C re-directed these reflections, and large rotating vein diffusers mounted to the ceiling further stir up the sound field. In the reverberation chamber, it can be difficult to isolate where the source of a sound is located.

The wall between chambers A and C was removed making both chambers into one space. The *Adaptable Sound Interferometry Equipment (A SINE)* was installed in Chamber A, and was the source of sound events that were heard simultaneously across all four chambers. Attached to the walls under tension were panels of CNC cut MDF – "metamaterial" filters that dampened frequencies around 2000 kilohertz.[2] Not-Measurements of the sonic field were taken by the Observatory Project, as sub-base frequencies pressurised the chambers. Numbers were read and recorded: frequency ranges, decibel levels, distances (in mm), and reflections from surfaces. Twelve-sided speakers were suspended in the corners of the chambers. A small door to an unused silent air supply was opened, releasing some of the pressure and a radio affected by the interference of measuring equipment on the radio field was removed.

1 Go, Sung Tyaek, Michael J. Kingan, Gian Schmid, and Andrew Hall. 'On the Use of Ground-Board Mounted Microphones for Outdoor Noise Measurements'. *Journal of Sound and Vibration* 584 (August 2024): 118432. https://doi.org/10.1016/j.jsv.2024.118432.

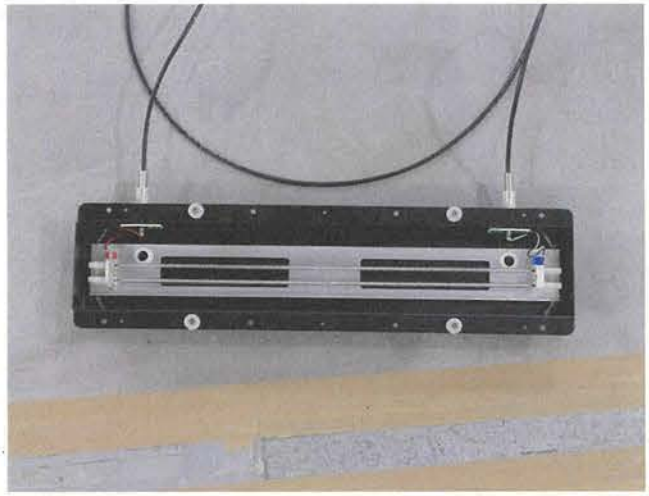
2 Hall, Andrew J, George Dodd, and Emilio P Calius. 'Multiplying Resonances for Attenuation in Mechanical Metamaterials: Part 1 – Concepts, Initial Validation and Single Layer Structures'. *Applied Acoustics* 170 (December 2020): 107513. https://doi.org/10.1016/j.apacoust.2020.107513.


Diffuser Control
CAUTION!

Not-measuring differs from simply not taking measurements. To make a not-measurement, the action of measuring is performed with an intention to not produce data. Any traces of that not-measurement event act as documentation, reframing the event as an artwork. Not-measuring events interrupt the normal processes of making measurements and observations by focusing on the act of *measuring as making*.

In Chamber B, located directly below chamber A, a microphone swung in an arc around the space. The microphone was mounted atop a large hydraulic lift, and looking up, you could see the removable floor that is used for experiments in materials and sound-proofing. Here Andrew and Yousif demonstrated a cylindrical metamaterial filter made to respond to a specific frequency range. Wooden boards and bags of foam rested against the walls and floor, in what at first seemed like a simple storage solution but was revealed to be a specifically positioned arrangement of acoustic absorption and diffusion. We heard how the chamber was built to ISO standards in the 1980's, but that now standards have shifted. In Chamber B they work to change the acoustic quality of the room without building a whole new room.

At the end of the tour, participants were invited to take the first part of this ephemera, and leave their notes and observations behind to be distributed at a later date. Designed to be inserted at the back of the initial ephemera, the following pages feature drawings, notes, and observations made.




HARD HATS
TO BE WORN
AT ALL TIMES

	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
KRISTIAN	~~2~~ 1	? - 2:10 PM

NOTES / OBSERVATIONS:

1.2 M FOAM WEDGES ANECHOIC DOWN TO 40-50 HZ
LEFT WITH WHATEVER IT IS THAT YOU'RE LEFT WITH - BLENDED TINNITUS
BOSS FREQUENCIES LESS DISCERNABLE PANNING WISE
} ANECHOIC

REVERB CHAMBER (1ST)

META MATERIALS - SOUND CLOAKING - ACOUSTIC BLACK HOLES
WHITE NOISE
LOCATION LOCATION LOCATION SURFACESS & ANGLES

REVERB CHAMBER (2ND)

MEASURED REVERBERATION DISSAPATION TIME
FREQUENCY ~~BAND GAPS~~
HELICOPTER
DOMESTIC SCALES ?

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	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Eamon	1	250/25

NOTES / OBSERVATIONS:

1. 28.1
2. 43.6
3. 45.8
4. 46.5
5. 45.1 -925
6. 48 -1139
7. 40.4 -178
8. 43.7 91
9. Number box reset = 91

2nd event - 64

Radio 115am

46.1 -1040
86.4 39

92.3 - 1149
89.7 - -380
82.3 - 26
114.4 - 756
102.6 942

Number box reset 79.2 -912

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	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End

NOTES / OBSERVATIONS:

travelling waves - band gaps

ball speaker

short wave radio parked between two yellow lines on the keep clear territory.

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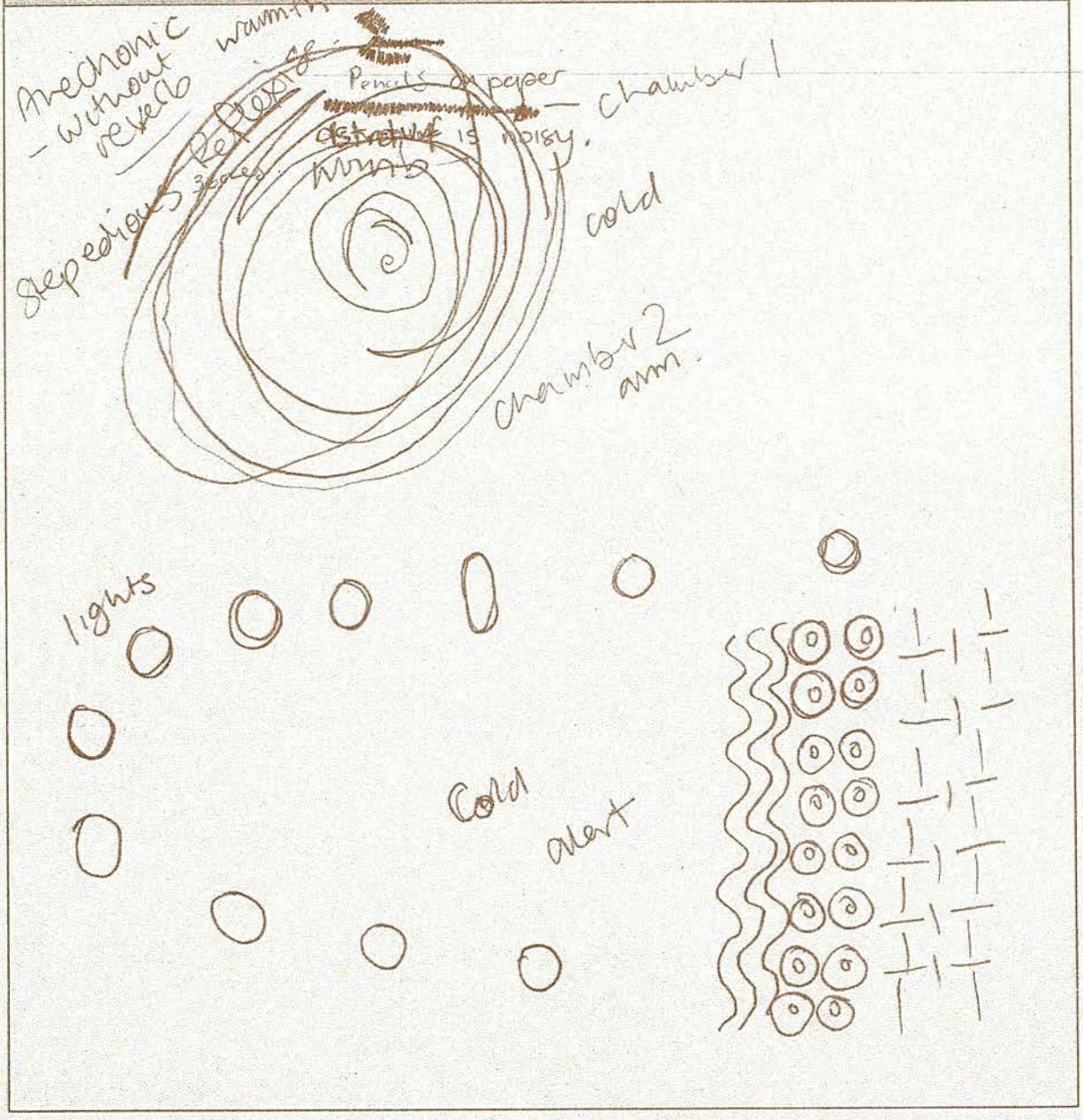
	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Harriet Stockman	1	1.07

NOTES / OBSERVATIONS:



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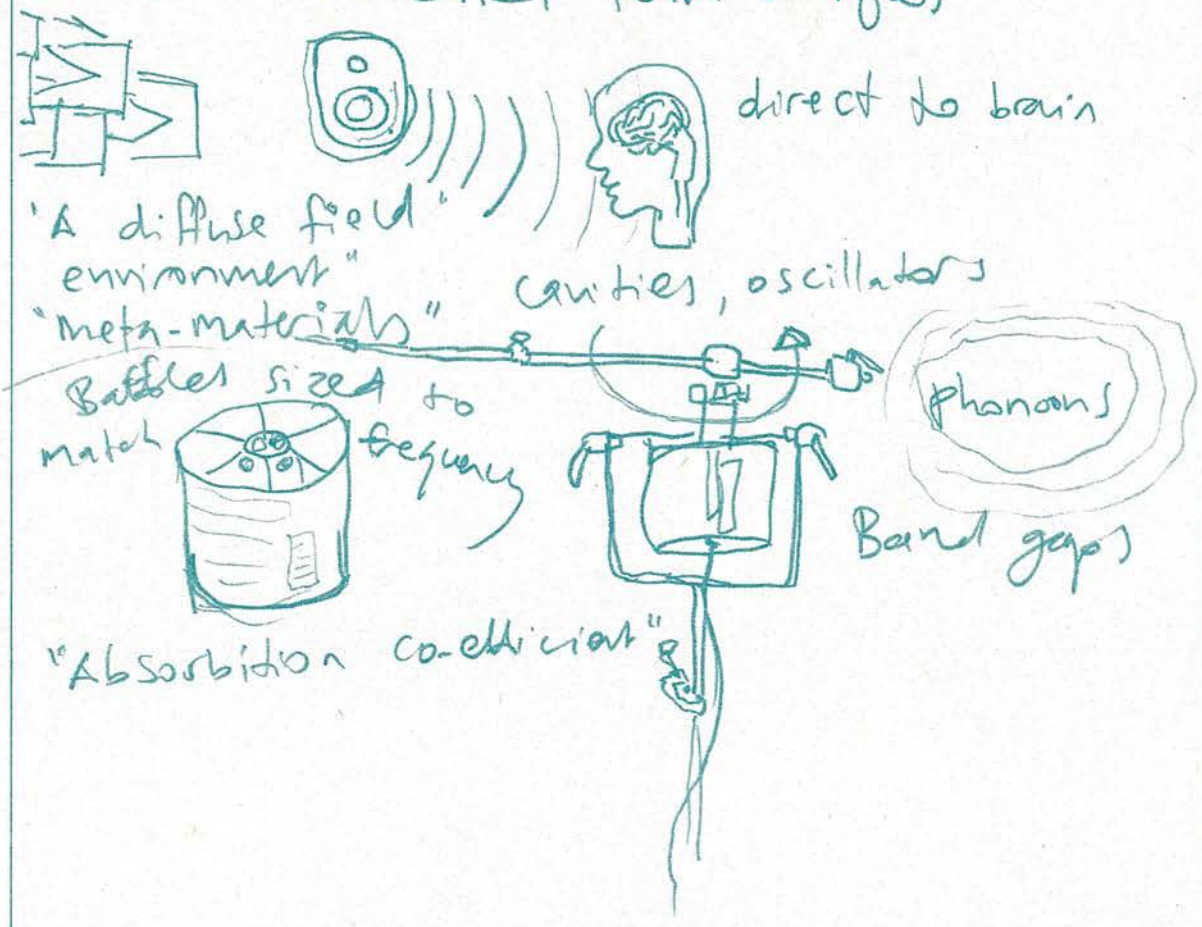
	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Joseph Swift	2A	13:12 – 14:05

NOTES / OBSERVATIONS:

"The quietest room in Aotearoa" "Suspended on rubber" Imbricated foam shingles



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	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Shelley	One	1.10 – 1.50 pm

NOTES / OBSERVATIONS:

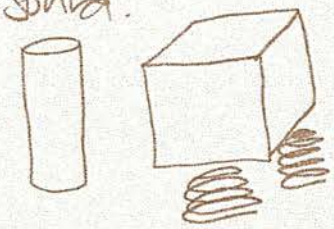
Room 1 – Anechoic Room without reflection... No bouncing sound 1981

Voice sound very dull, clean, clear Snells Law

Feel pressure in your head → your eyes tell you are in a room, but a conflict between what you see + what you hear – delicate things in your ear – muscles (contract) pull little bones inwards to protect them → the Stepedius Affect

Forget to breath, like the body is interrupted... Isolating the body in the environment, less responsive, less embedded

Chamber B – Lower reverb chamber → quite alive with reverb. Panels reflect sound waves all around the room. Stepped floor – angled to reflect sound.



Bass hogs Feels warm in the body.

Ziggy measuring 61.8

Aimon entering into machine – long, loud, low

Eye contact is important

92.3

89.3

82.3. @ 26 1.14.4

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	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Eamon	1	25000/250

NOTES / OBSERVATIONS:

25 -64.8 - 25000
89.7 - 25600
84.1 - 24788
86.5 - 24476
97.6 - 22671
105 - 22929
73.2 - 21285
83.0 - 20165
99.3 - 19255
100.7 - 18527
96.0 - 17934
80.3 - 17705

Reset 17705

5016

Reset - 33652

36.3 - 33403
47.4 - 32105
41.8 31542
43.8-30733
43.3-30422
45.3 -30129
48.9 - 29404
44.4-29015
49.6 - 27841
44.9 27443
53.5 27175

Reset 27175

3353

115 am

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	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Alan Jones	1	

NOTES / OBSERVATIONS:

Room 1

LIKE BEING FIELDS OF DEEP SNOW (ACOUSTICALLY SPEAKING).

NOT AS PROFOUND AS JOHN CAGE MAKES OUT THAT'S FOR SURE.

Room 2

SURROUND SOUND

Room 3

RETRO-FUTURISTIC

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	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Selina Ershadi	2B	

NOTES / OBSERVATIONS:

"I feel like we're in a sci-fi film" -L.

- transmission loss.

Diffusers - diffuse field of sound.
object to receive sound from every angle.
Panels - perforations, patterns, dashes & concentric rings
- passive technique.
- feedback
- Z's hands movements, animating the sound waves
- Sounds of pencils on paper
Standing in the frame of the invisible, missing wall
a threshold
repetition of 2 voices, calling out the measurements. Echoes
Spins a sci-fi spin. Elliptical motion.
Bodies slowly pacing through room
Z w/ a small radio, distr signals disintigrating int static.
Sounds like waves, sea waves.

Enter the anechoic chamber. Abrupt cut of radio transmissions
- Negative DB
- Mass.
- freezing time
- viscosity of air, four types of dissipation.

Z - do people start to feel weird.
- It felt like it was emanating from inside me. - Erotic. Alien. Spiritual.
- "L. - did you hear / feel your heartbeat?"

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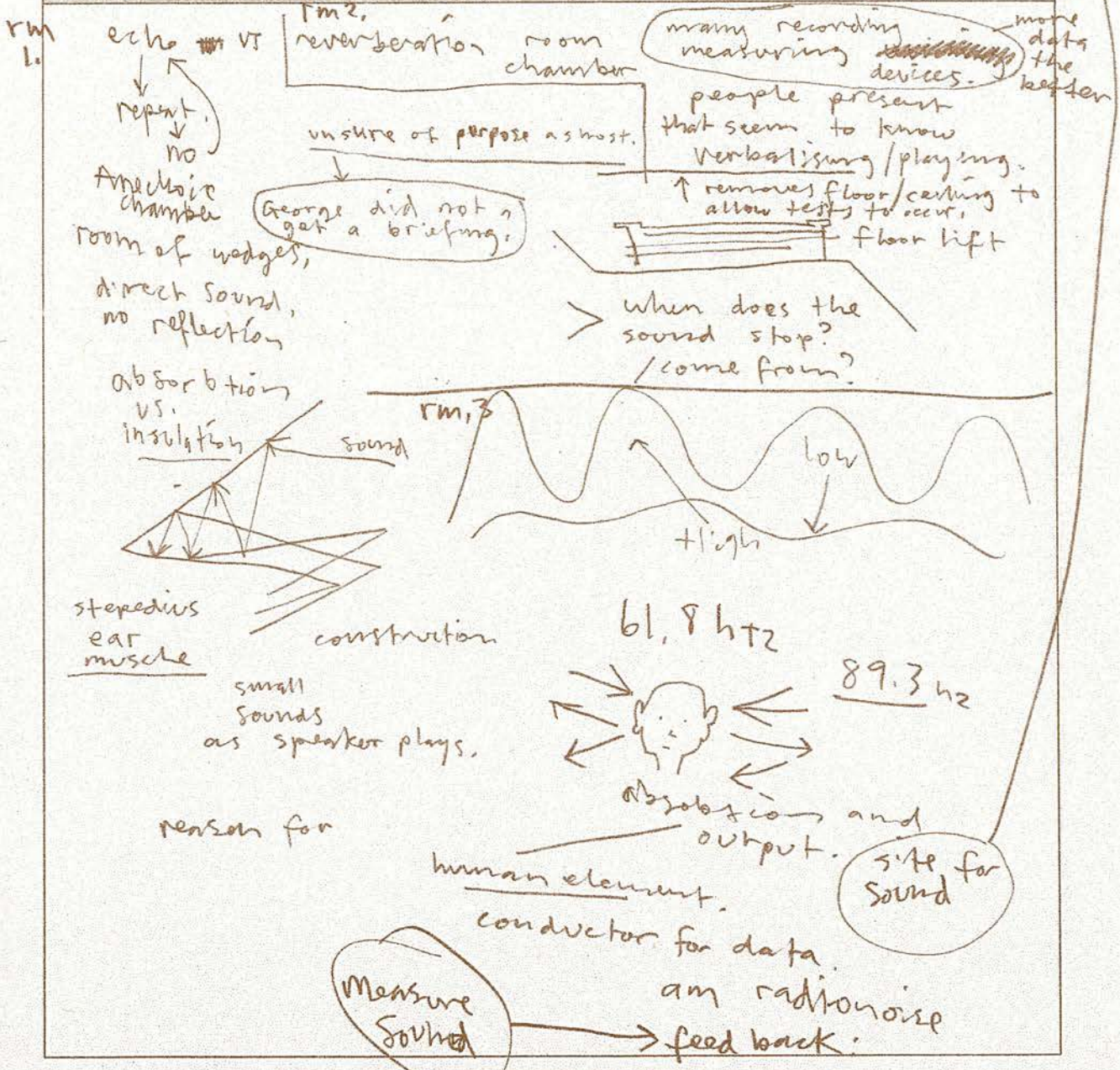
	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Jonathan Alexander Kennedy	ONE	13:00hrs → 14:00hrs.

measurment → use? do the number of people effect experience?

NOTES / OBSERVATIONS:



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	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Stephen Clarke	2B (Sunday)	

NOTES / OBSERVATIONS:

Rm (1) * Y set
'Superposition of sound wave'

Rm (2) - DB
'viscosity of air'

Rm (3) 'Change the volume of the room, without making a new room'

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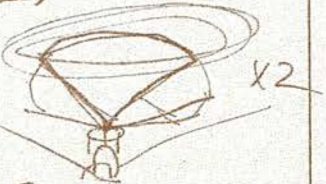
The Observatory Project **Acoustics and Vibration Research Centre** **Acoustics Testing Facility**	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Dikrnde Jansen	A	1pm.

NOTES / OBSERVATIONS:

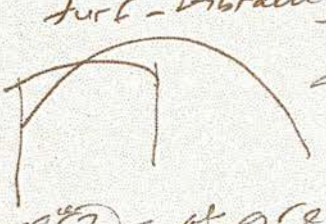
1981 - testing acoustics
Measurement system - absorbing
- through door (1) - into the bunker - reverb chamber
rotating diffusers - no parallel walls
no standing waves

- ears stop below 20hz
effecting people pry-acoustics
listening to explosion with 10s reverb
measuring at 250hz - 29.1 @ 201



frequencies affecting my heartbeat - breathing very
unsettling presence
surviving nuclear holocaust in a bunker with a 1970s computer
- what is silence?
picking up transmissions - frequencies 100

spot (2) - what is silence
separating [illegible] = sound
isolated from context connections
sound moves [illegible] -
my ears are loud - tinnitus - Snell's law
[illegible] - hearing analogue oscillators.
turf - vibrating



spot (3) - at greater depth - has [illegible]
- spins
microphone
light shine scanning pool recording : [illegible] gathering [illegible]

looking for [illegible] - [illegible]
spinning - the centre [illegible]
milling [illegible] - recording studio

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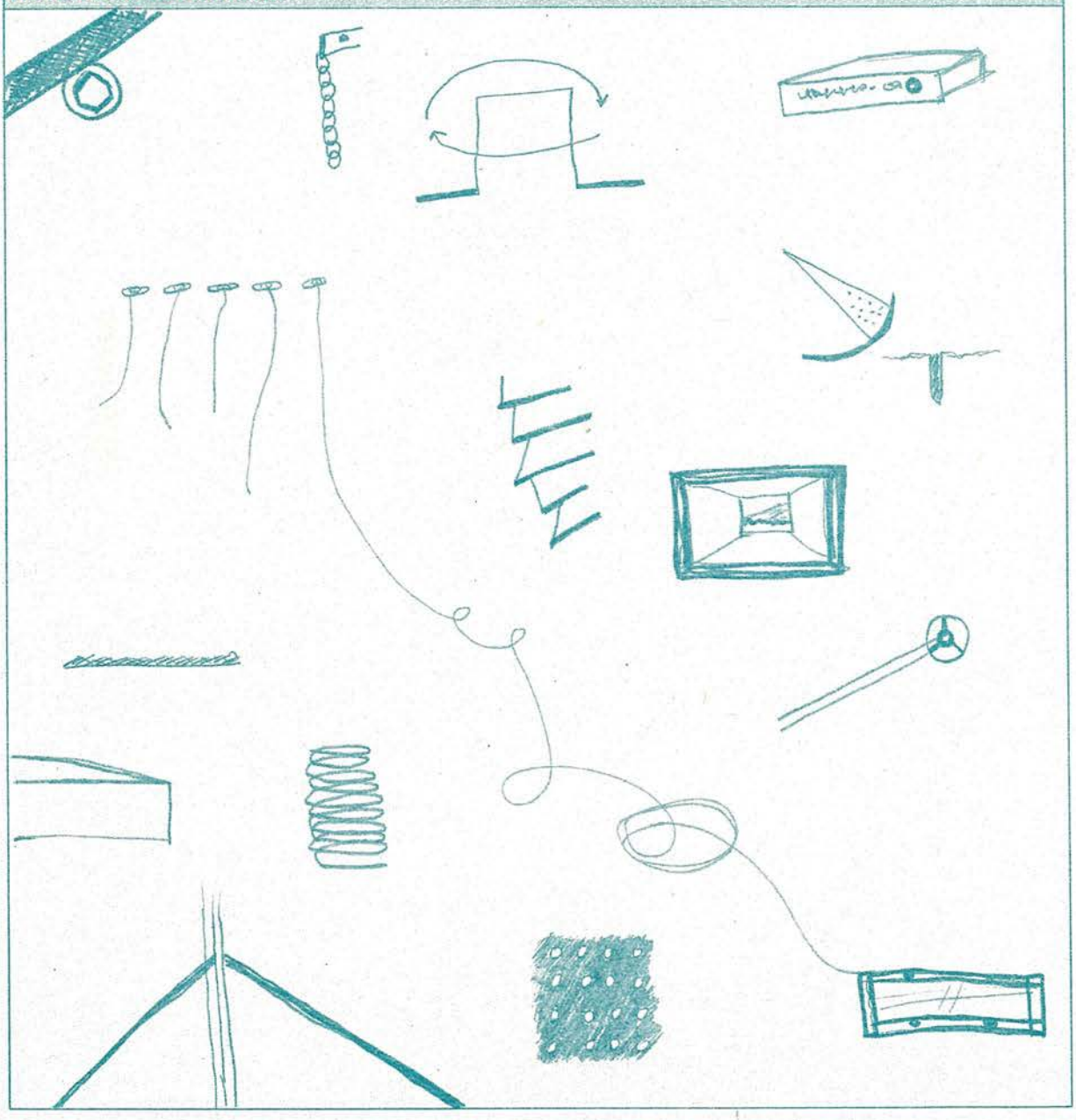
	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Emily O'Hara	2B	1310 – 1420

NOTES / OBSERVATIONS:



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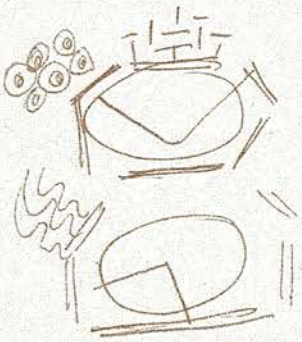
	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

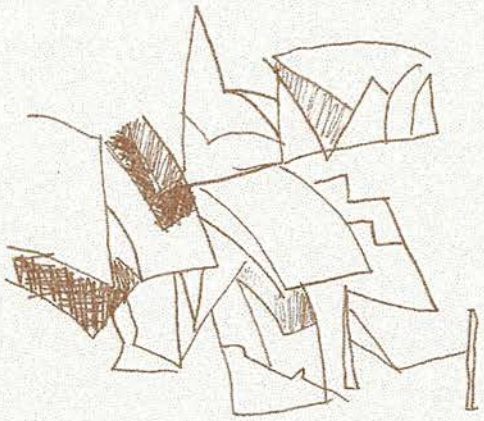
Name	Group Number	Time Start/End
Monique Redmond	A	

NOTES / OBSERVATIONS:

Perforator panels
Take note how you are hearing the space.

<20





know
feel
Does soundlwhat
colour the substrates
are?

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	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Emily O'Hara	2B	0120 : 0210

NOTES / OBSERVATIONS:

- on entering, I want immediately to sing.
- "impulses"
- impulse to sing = high
- hear reverb more than the voices creating the origin sound
- Alien sound
- "Measuring 25hz"
- "64.8"
- "89.7"
- "25.4"
- "84.1"

- moving around to find more resonance
- sound furring inside my ears now
- impulse to sing: LOW
- when it peaks, it enters my body
  I like the rumble

- Is it my timpanic (sp?) membrane that is vibrating?

A.E.C: dissipation of sound
"viscosity of the air"
. sleeping in the jungle

44 - Desire to sing: high (again)
- Wahaaaaaaaaa~~~~~ ~~~~~~ ~~~~~ ~~~~ ~~~~~~~~ ~~~ ~~~~~~ ~~~~ ~~~~ ahhhhhaaeee~~~~

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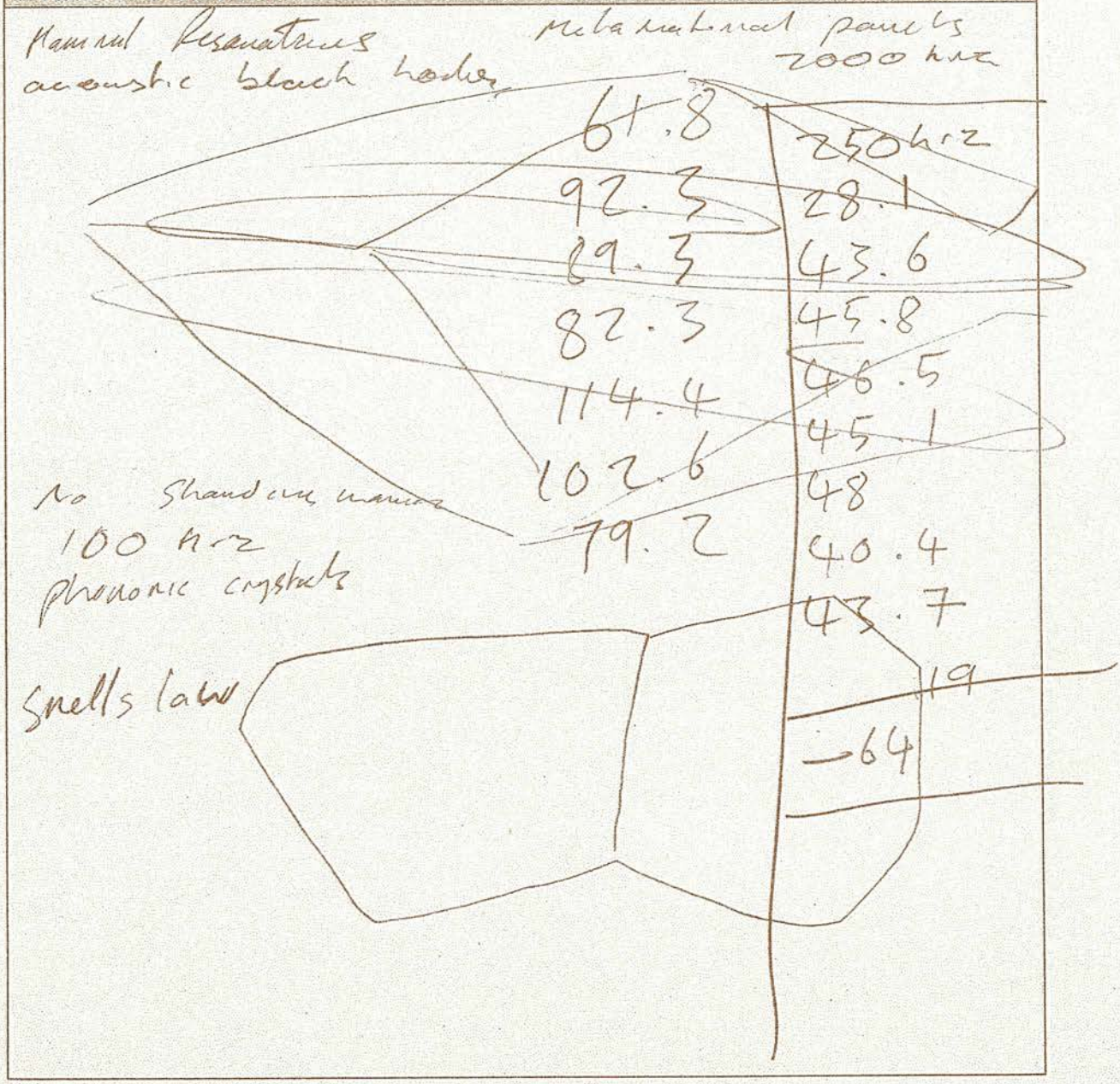
Name	Group Number	Time Start/End
Ziggy Lenn	Group A	

NOTES / OBSERVATIONS:



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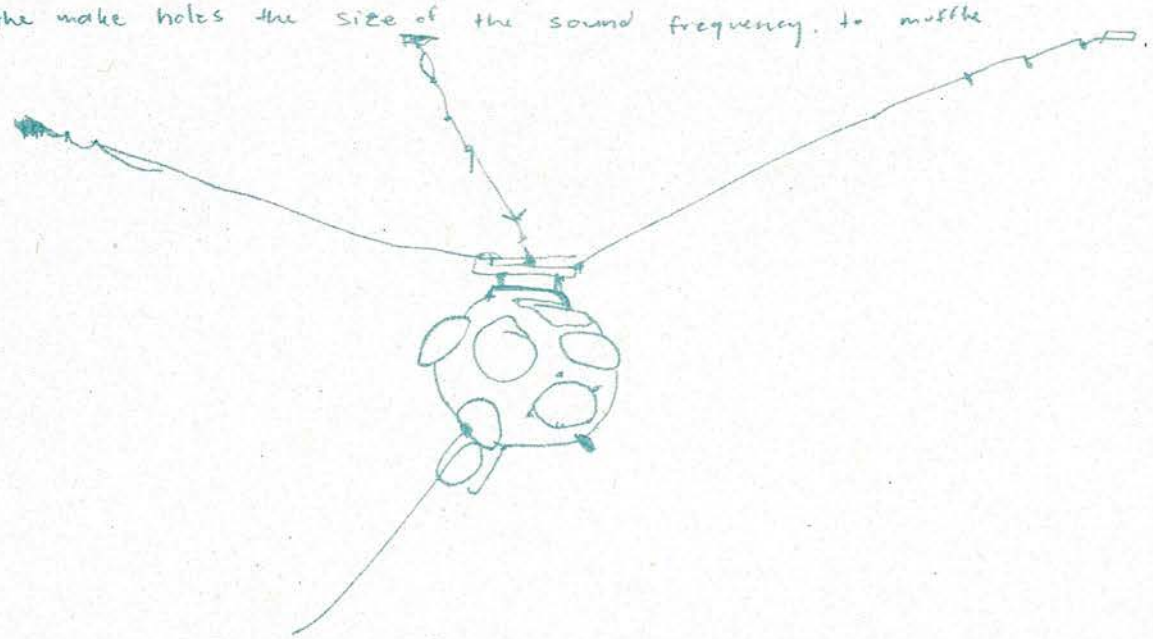
Name	Group Number	Time Start/End
Nikita	1	

NOTES / OBSERVATIONS:

It feels like going deep underwater and the preassuer is in your ears.
the door is funny how you have to lift it.
sound turns into heat
I feel sleepy & peaceful
This Room is like a ship or being in a pool with no water.
the make holes the size of the sound frequency. to muffle



I like it when it goes really pressury in my ears
3553 3553 119 1m 420 cm

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	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Margaret Colligan	A	

NOTES / OBSERVATIONS:

Foam Room

- Calm environment – claustrophobic after a while.
- Sound is lost by being converted into heat
- Snells law Lots of physics involved.
- My pulsitile tinnitus is clearly obvious thud thud – I've got hearing loss.. arrgh its too late :(

Room 3

MRI – Whoa

Scanning us
Feels cold – is it the blue floor ??

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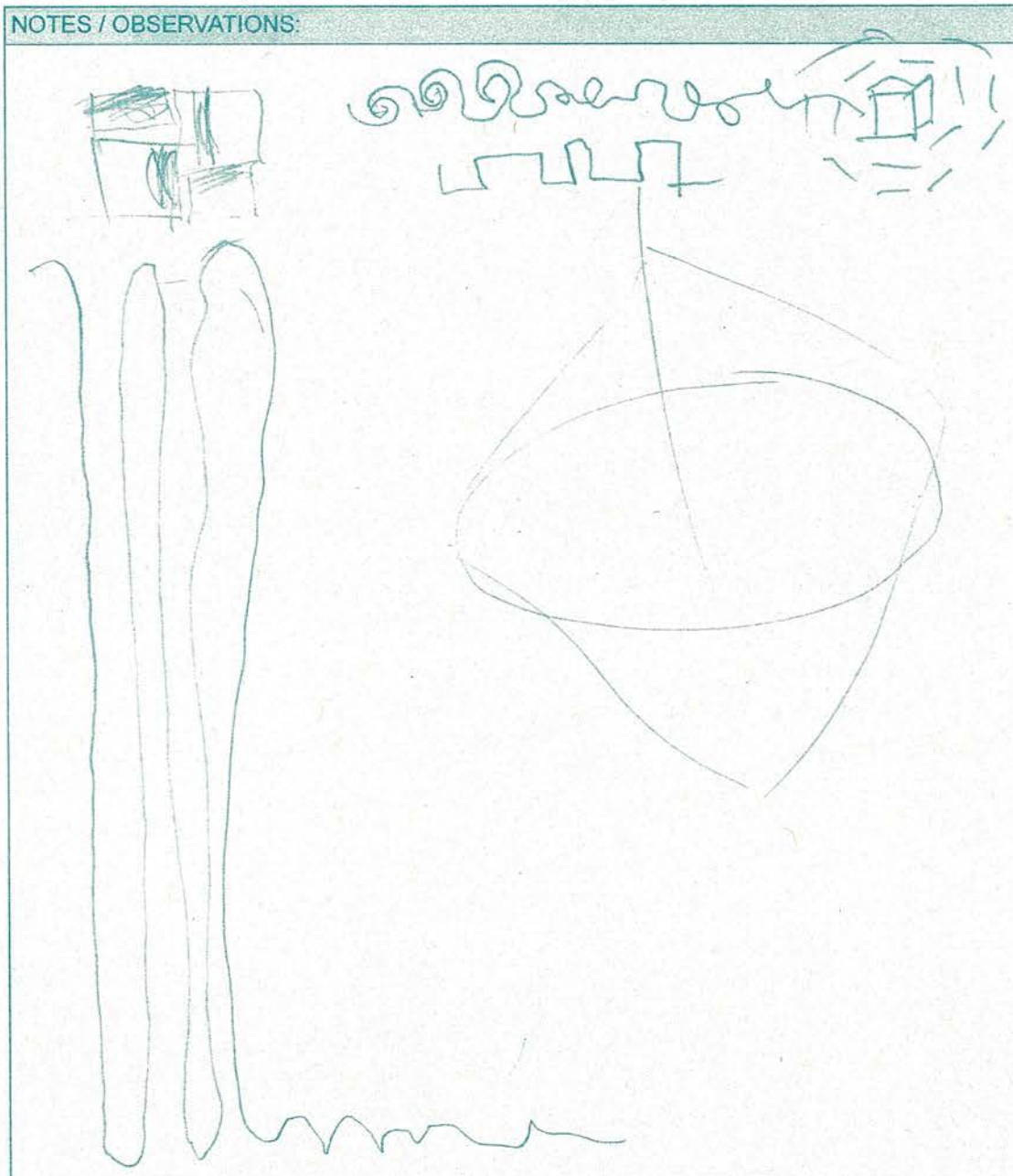
		30-11-24
		01-12-24

Name	Group Number	Time Start/End
	1	

NOTES / OBSERVATIONS:



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Name	Group Number	Time Start/End
Margaret Colligan	A	1300

NOTES / OBSERVATIONS: Chamber One

Hearing the space & my perceptions
Diffuse field chamber - evenly spaced frequency.
∅ parallel walls → eveness of sound

< 20 Hertz ears cannot detect.

Diffusion - wiggly panels
reflections in panels 

Phonotic crystals ~~~ wavelength of panels
Acoustic black holes / acoustic cloak
trap sound

250 Hertz wheel spins → sound thumping Low
Heart starts pumping
thudding !!
About to take off
Really loud band bass

Radio in wall - static ~~
Liken to alien moving into next hemisphere

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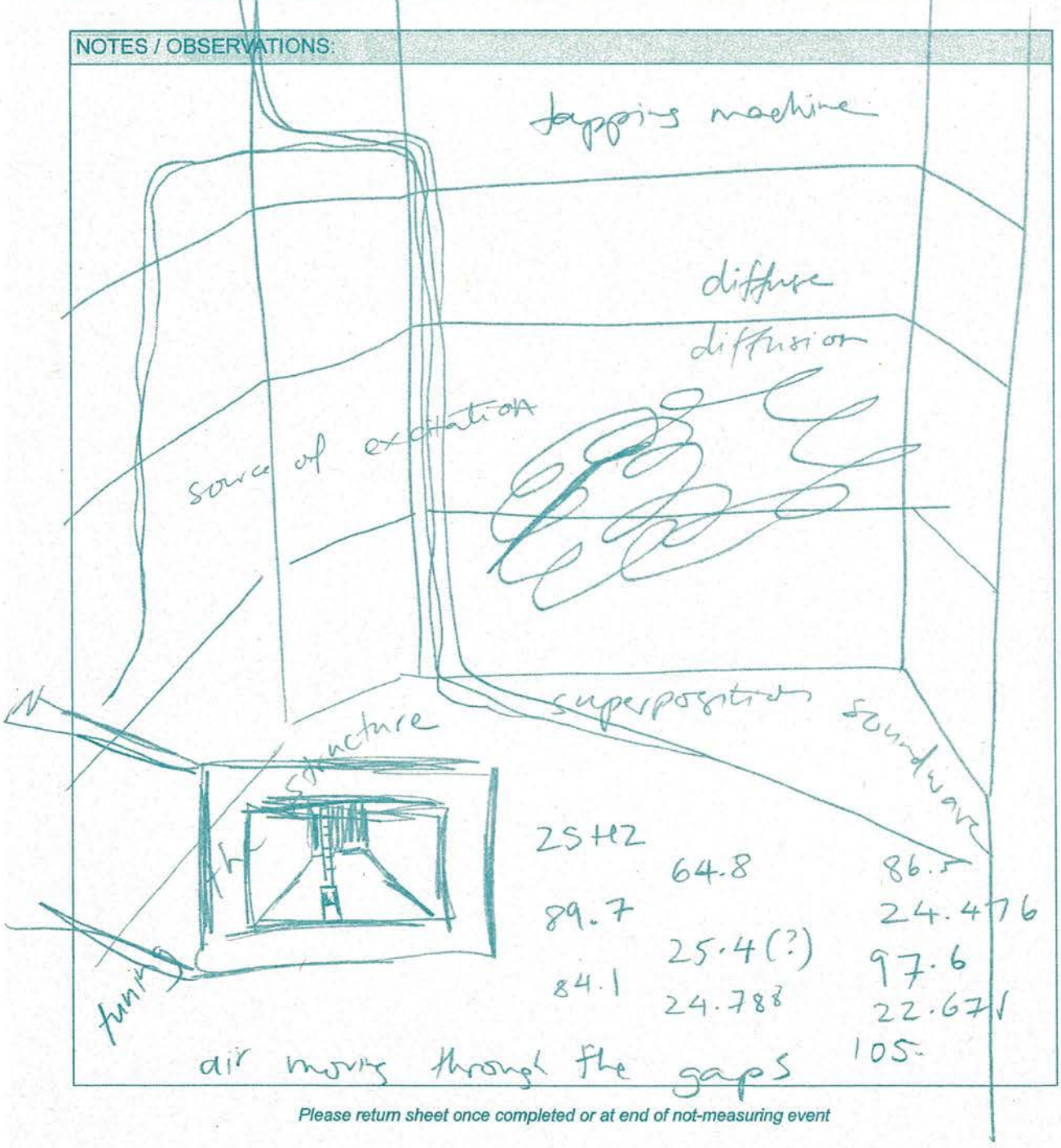
Name	Group Number	Time Start/End
Lucy M	2B	

NOTES / OBSERVATIONS:



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	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Robert Laking	Group A	1-2 pm 30-11-24

NOTES / OBSERVATIONS:

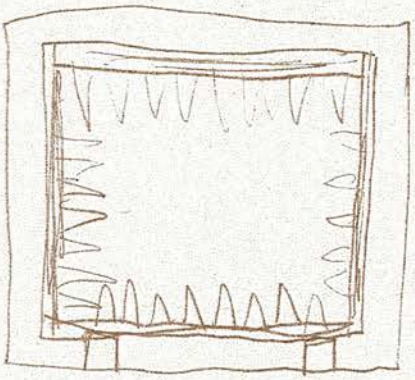
Metamaterials for ducting.

NO ONE KNOWS WHY WE'RE HERE } after George asked us in the anechoic chamber

Binaural sound travelling around the room

Sound insulating vs Sound absorbing materials

Concrete	foam



61.8 @ 25k2

92.3 @ 114

Reverb room
↳ boom mic

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Name	Group Number	Time Start/End
Lucy M	2B	

NOTES / OBSERVATIONS:

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Name	Group Number	Time Start/End
	A	

NOTES / OBSERVATIONS:

Testing - doors
floors
Even waves - diffuse even as possible
Cars don't detect under 3H.
Debated different ways of testing
Testing sound on diffent boards.
Snells law.
Dead room -
Size of material proportionate to height of wave.

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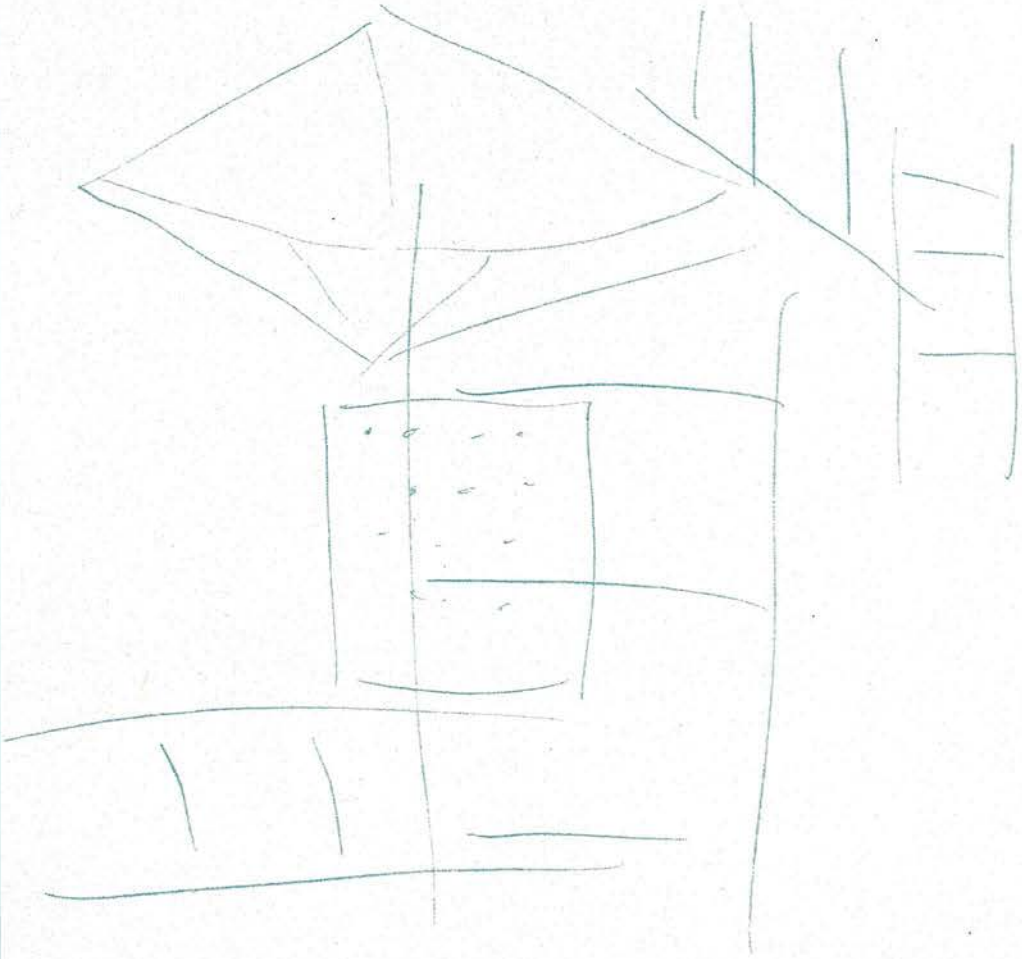
	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Jess Robinson	2	

NOTES / OBSERVATIONS:



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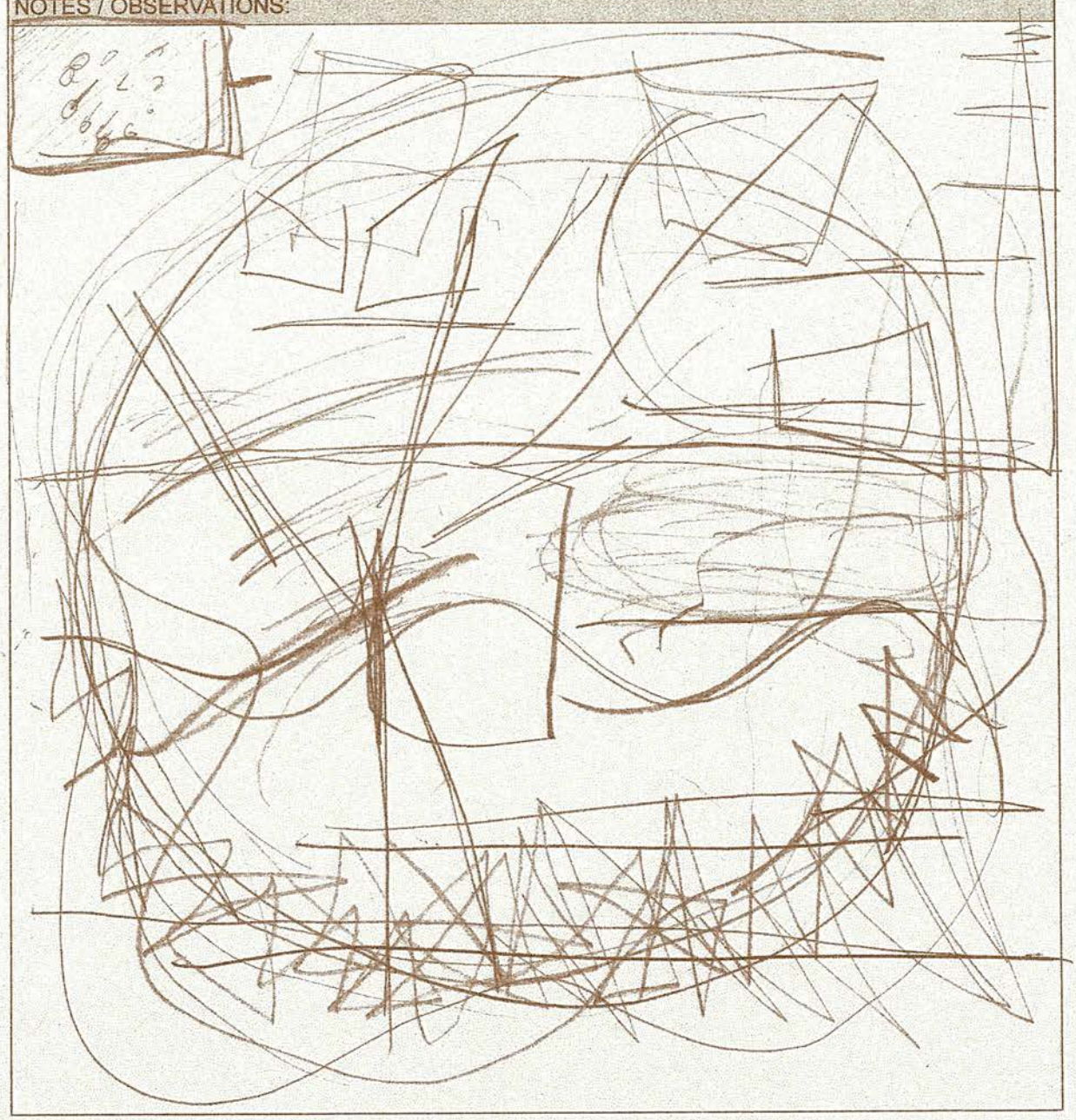
	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Beth Dawson	1 A	13:00-14:00

NOTES / OBSERVATIONS:



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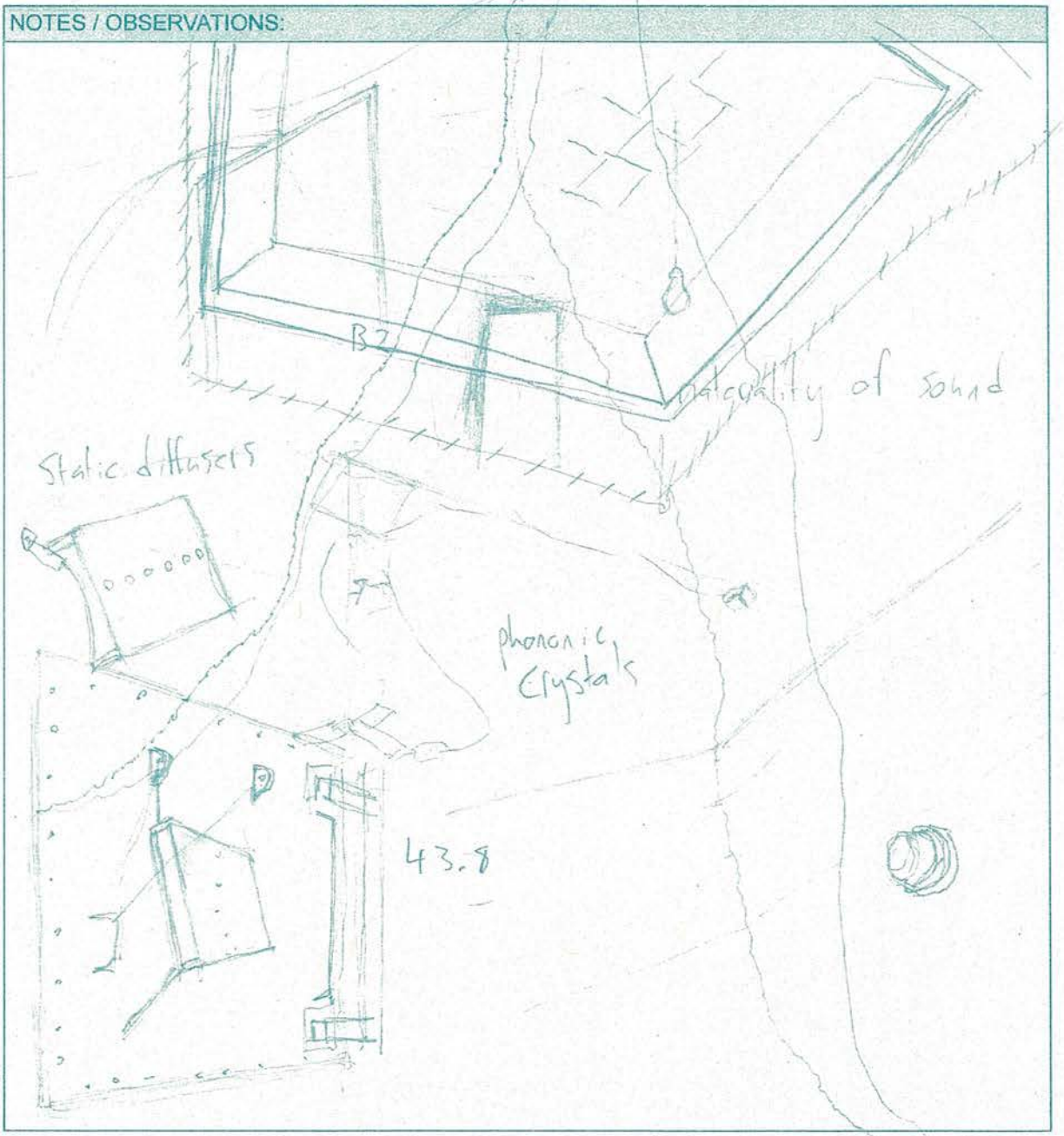
	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Josh Whitaker	#1	[illegible]

NOTES / OBSERVATIONS:



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	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
FRANKLIN BRICE	1	

NOTES / OBSERVATIONS:

Absorbsion Dissipation reflection

anechoic Chamber
Single Point Source is obvious
modulated tones are fatiguing
Looking at speaker is enough to tell whether it is on

Reverb basement
Point Source is also Obvious
tone changes Completely with head movement
Plate 13

SPL upstairs
SPL is almost consistent through the room 1

Echo is Singular repeat
anechoic no tail

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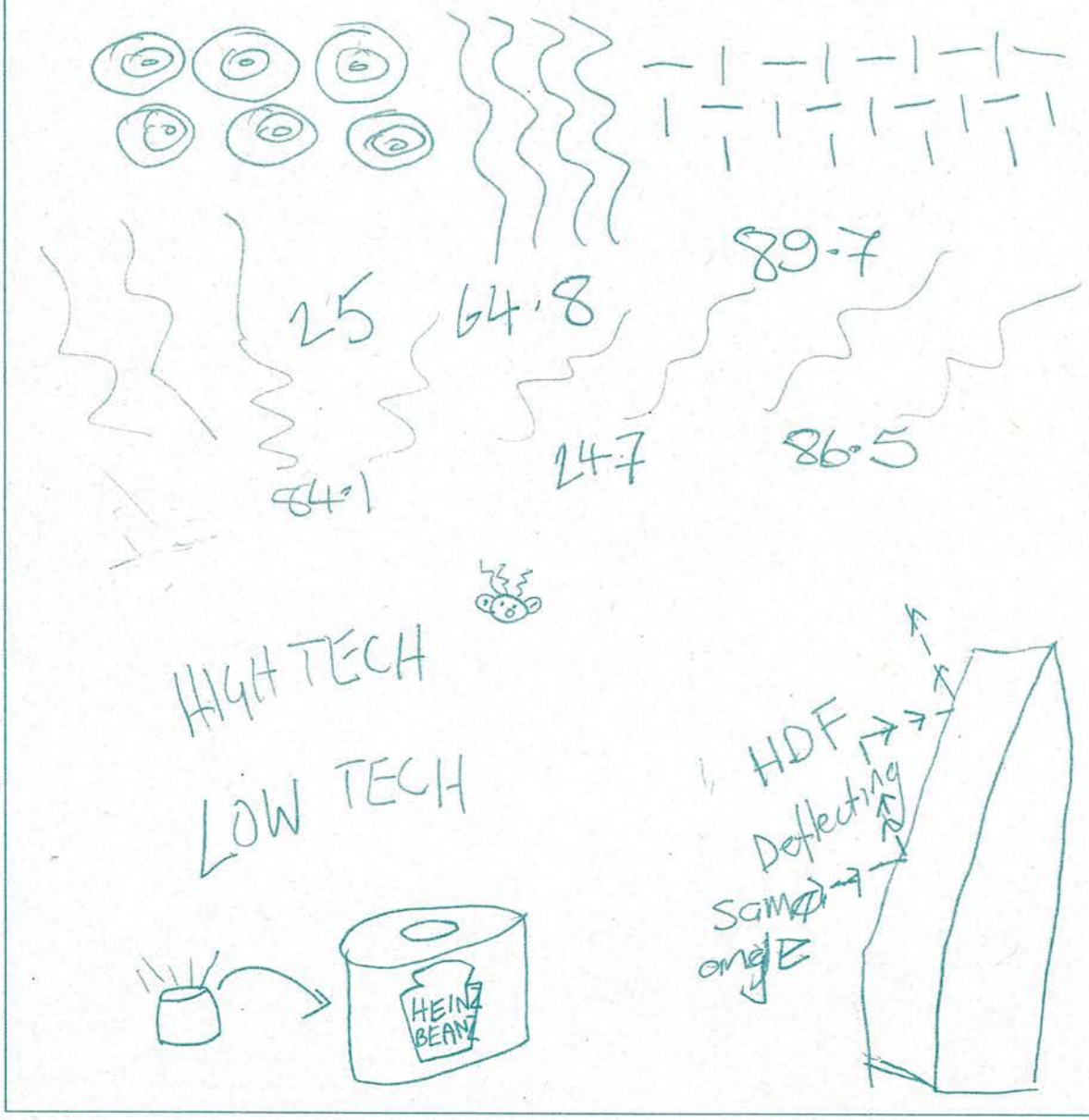
	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Deborah Rundle	2B	

NOTES / OBSERVATIONS:



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	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Shelley	One	

NOTES / OBSERVATIONS:

102.6.
resetting / circling / whomping
79.2. crunching walking stretching
language? Radio frequency / static / attempts.

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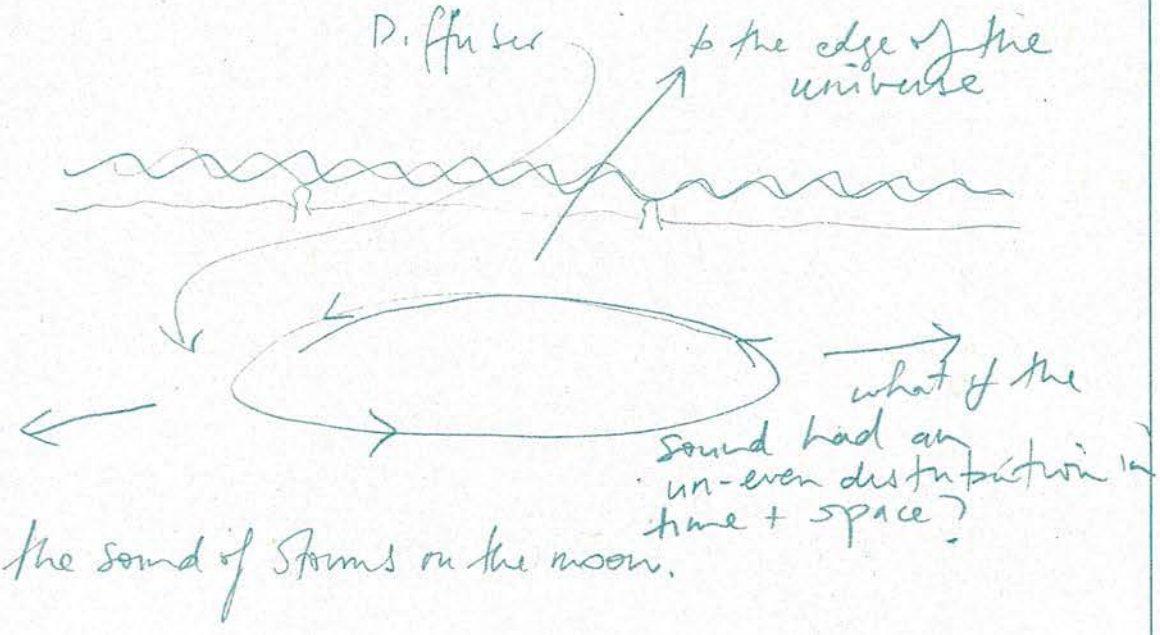
	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Lisa Cowley	2B	

NOTES / OBSERVATIONS:



the sound of storms on the moon.

The measurers. are reading out numbers of differat sizes

anechoic chamber allow sound to have clear direction it doesnt have backwards

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		ISO9001
	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	30-11-24
		01-12-24

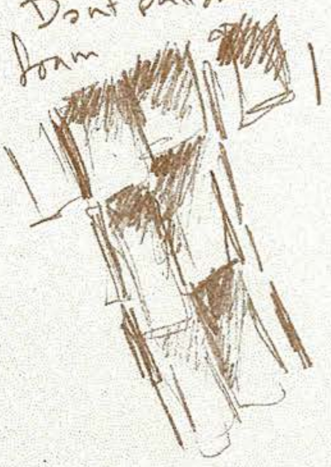
Name	Group Number	Time Start/End
	Group 1	13:11 / 13:55

NOTES / OBSERVATIONS:

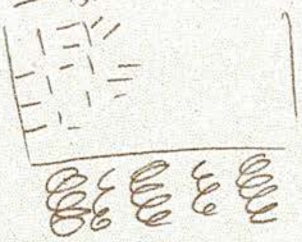
reverb vs echo
too many repeats to make echo

① Anechoic Chamber
direct sound w/out reflection
sound insulation vs sound absorbing
concrete
- impact ear pressure
absorbtion.
sound wave buries into treatment.
friction of rubbing - side

Don't pull on - foam



- isola'

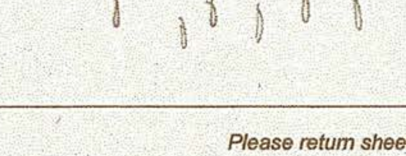


stepedius reflex muscle

Laurie Anderson song pants rubbing
brain creating noise or speaker rumble?

- clear directionality of sound

Room 2 + Chamber 3 - lower reverberation chamber.
sound transmission testing
= tapping machine
- Japanese ball



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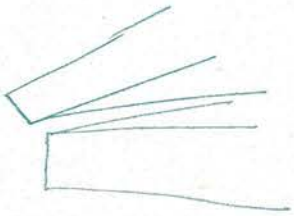
Name	Group Number	Time Start/End
[redacted]	1	13.10

NOTES / OBSERVATIONS:

reflection - absorption



direct sound

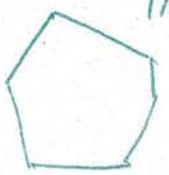
different pulsating frequencies mix together -

my pulse with tinitus and heartbeat

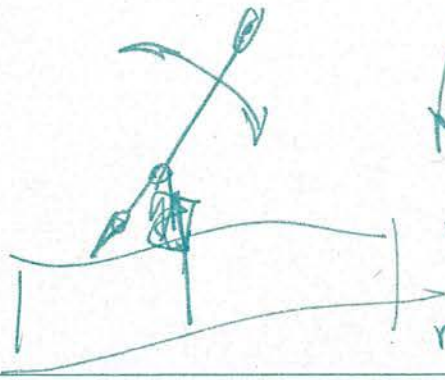
3- static diffusers - room 2

white noise

like a sound trap



hexagon full of holes



frequency changing with rotation

room 3 - rotating diffusers

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	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
TASH VAN SCHAARDENBURG	(1)	1:13 — 1:53

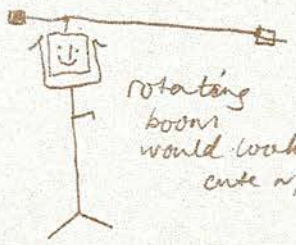
NOTES / OBSERVATIONS:

ANECHOIC
NO REFLECTIONS

- everyone sits very still & moves little when you can hear them move a lot
- pressure

STIFF EAR

- Is rumble the speakers or the blood in my ears? wump wump



- moving head changes the sound quite a bit - almost feels like it changes the timbre but it's not that.

100HZ — 3M

- Everyone goes quiet when Zissy says he's taking a measurement.
- Sub makes floor feel funny, air combo with pressure in ears
- Below the smaller spinning diffusor there is much less overall drone pressure.
- The sound my brain keeps trying to say is the high pitch screech of the spinning diffusors but I know its not, they're silent.
- The wind tunnel could just fit one person inside + freak.
- Soft static radio sounds like rain

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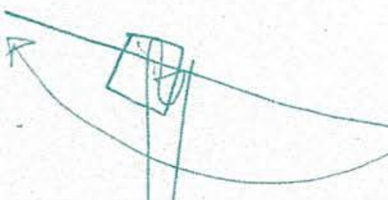
	The Observatory Project **Acoustics and Vibration Research Centre** **Acoustics Testing Facility**	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End

NOTES / OBSERVATIONS:

Andrew + Yusef (Acoustic Centre)
Eamonn + Ziggy
Vibrations + Acoustics testing system
Anechoic chamber.
1/2 metre of foam each side
Wedges shaped to trap noise, stops.
Anechoic down to 40Hz
6 metre wave lengths - ANECHOIC no reflections - direct sound.



a suspended room

- speech masking
- plant sounds — lower frequencies spread out.
- map sound

4 channels
Ideal place for recording the kinetic movement of things.

reverb chamber
Metamaterials - internal structures
what is inside the materials

Material  containers
paper

What happens to sound in a cone?

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Two rotating diffusers - testing walls + windows

	The Observatory Project Acoustics and Vibration Research Centre Acoustics Testing Facility	ISO9001 30-11-24 01-12-24

Name	Group Number	Time Start/End
Sarah Smulskowski	A.	1 pm

NOTES / OBSERVATIONS:

meta materials - internal geometries (like Jizz)
Reverberation Chamber
phonoic crystals
wave length = bending wave - freq

No parrallel walls - no standing waves

100 Hertz - wave 3 meter low sub woofer

40-30 Hertz -
below 20 we can't hear

phyco acoustic
panels =
- scatter bending waves in panels - with geometry

000 - 2000 hertz

low freq absorbing materials - avoid depending on wave length
they push back

Sound pressure waves - is like a gust

acoustic - black hole
- cloak

250
28.1
43.6 - start to hear wave itself - like a pressure on whole body
46.5
- suppress reflections = (absorbing material) weight on concrete =

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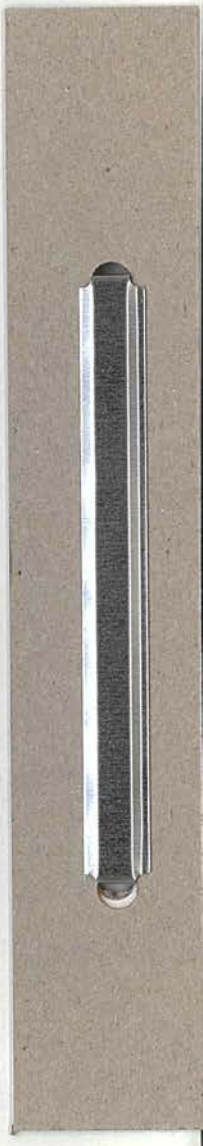

With special thanks to Gian Schmid, Andrew Hall, and George Dodd from the Acoustics Testing Laboratory, and to the Audio Foundation for supporting this event.

http://www.observatory-project.info
https://www.auckland.ac.nz/en/engineering/our-research/discover/research-areas-and-facilities/acoustics.html
https://www.audiofoundation.org.nz/