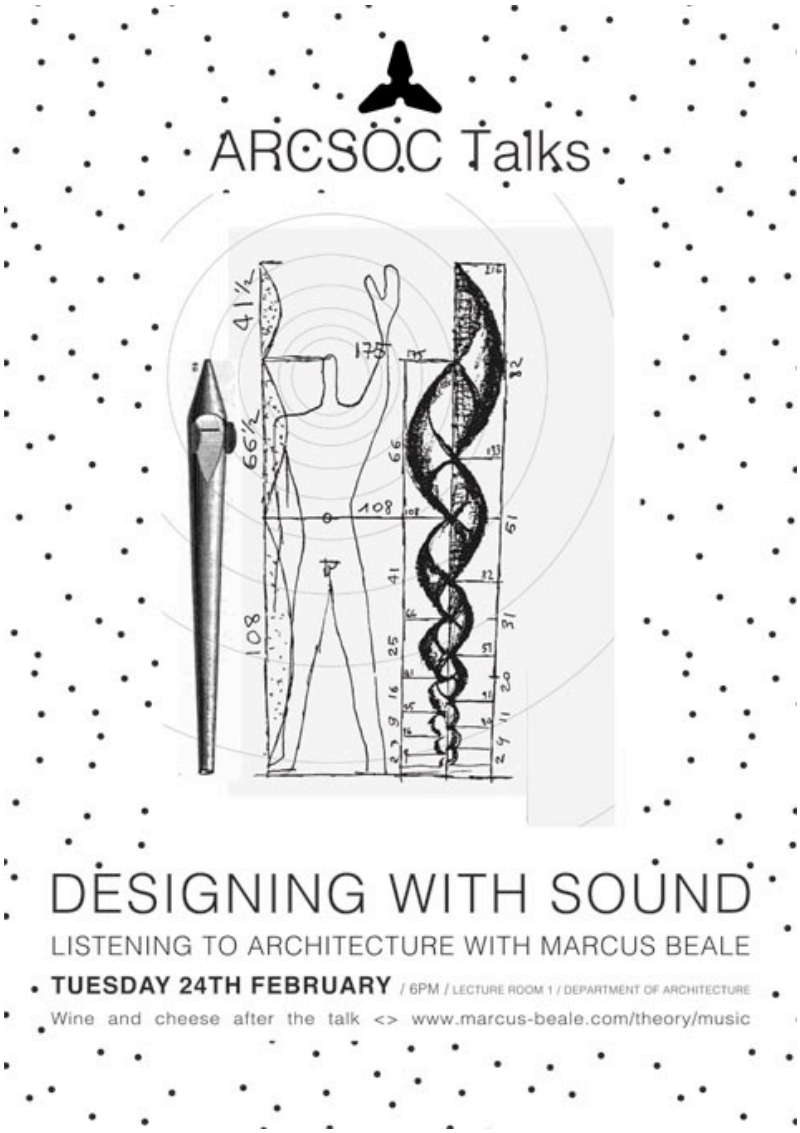


Designing with sound, or
- how to modify and influence mood and behaviour
- with enclosure.

introduction

Despite the fact that we ‘design’ = think at the tip of a pencil, Architecture is **not a visual art**. It is **not about what buildings look like**. What we see in architecture is the surface, the boundary between air and solid. We can see the the edges of the space, a superficial understanding. Neither can architecture be described sufficiently by its three dimensional **form and materials**. It is not only about where buildings are and what they are made of. This describes the enclosure itself, but does not begin to address what is enclosed.

MBA homage to Sandy Wilson, house SW London 2012-2013

Architects do not create space. When we make a wall, **we exclude and include**. We carve out, differentiate, separate one place from another. We create here and there, inside and outside. This has social, political, economic, dimensions. We need **consent** in order to build. Architecture is more than the materiality of the wall, it is about **what it encloses**, and how this **affects people’s lives**.

Think of what is useful to society.
‘Sustainable...Places for people.’ [National Planning Policy Framework 2012]. Places to live, work and play.

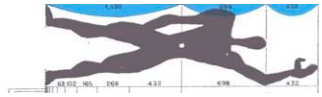
So what is architecture, if not a visual art? A **spatial** art, of a particular kind, differentiating architecture from sculpture, architecture provides space to be **inhabited**. Its whole purpose is inhabitation. It ‘comes alive with inhabitation’.

It is certainly not silent. Death alone is silent.
We are designing cities, not mausoleums.
Architectural space is neither void, nor empty, uninhabited.
It is full, noisy, harmonic. We can’t see architectural space, but we can hear it, a direct sensory perception of inhabited space.

The Materiality of air.

Ansell Adams L. Tenaya

We live under an ocean of air. Our ears are tiny tributaries. An atmosphere of pressure at sea level equivalent to about 10,000 kg/m2 . Think of this as a metre square board with 10 x 10 x100 high 1kg bags of sugar balanced on it. This pressure is bearing all around us, sideways, up and down. Look at the surface of the water. Water and air at equal pressure. Feel the weight of the air arch of the sky above us. Air is heavy, powerful stuff.



Corb at the seaside

All human life involves water and is accompanied by the sounds of water. The body has the same density and salinity as the sea. Air cavities within the body are concentrated in the head and chest, so we will float face up on our backs if we fall asleep in the sea.

Rome from the air, could be any example city, e.g. Oxford

This highly pressurised air fills every space, between solid walls and essentially liquid body.

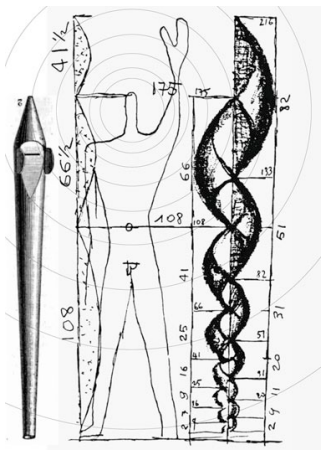
As a city we all breathe, speak into and listen from this one body of air. This single air-body is modulated into squares and streets, alleyways, courtyards and rooms; all interconnected.

Air is moving. Consider how it moves:
- flows, with wind and breezes
- it quivers with heat and mechanical vibration, or sound

If air is massive, heavy, pressurised **sound is energy** - pure energy, no mass, temporary information, of the air, or water, steel, timber.

Perfectly real, measurable, completely immaterial. Movement. Giving form to matter, temporary information.

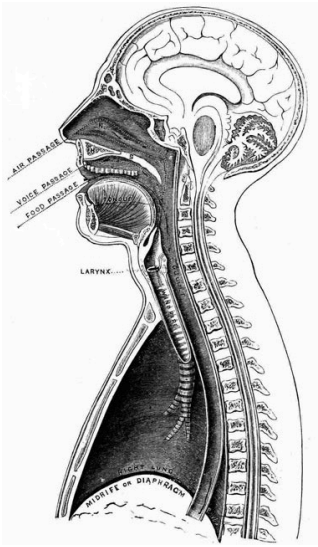
The Body.



The essentially
- liquid body,
- gaseous air filled space,
- solid enclosure.

Exploring the boundaries between these three.
Sculpting volumes of space that clothe the body with an intervening body of air.

The body's boundaries are less obvious than one might expect. Air to skin, air to epithelium, air to sinuses where bone meets air directly.



The body always moving, made to move, walk, run, animated, breathing, wheezing sneezing, speaking, working, with its own internal rhythms, of limb movement, breath, heartbeat and tremors, including the sound of oneself, the fizz of the central nervous system.

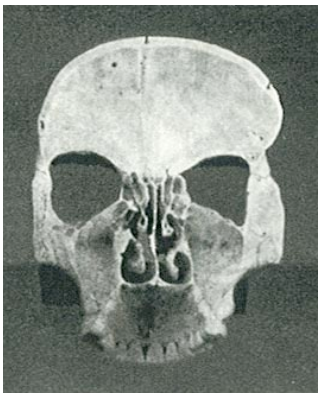
Evolved for a **high fidelity/low noise environment**.
Living in **low fidelity/high noise environments.** e.g. cities

Hearing and other senses considered together, because our experience is synaesthetic. All senses combine to 'make sense' of place in time.

We are all syntesthetes. for example: shapes and sounds:
Bouba and tiki tiki [1927 Gestalt experiment]

The 'five external senses'. This is convention. Different cultures have different numbers of senses.
The question of heat: it is the skin seeing?
Do we categorise by the phenomenon or the organ of perception?
And what about the internal senses:
proprioception - a sense of body position
kinaesthesia - a sense of body movement.

So we consider hearing with speaking, because we want to see how humans react to sound and how to modify behaviour through space and acoustics. In everyday life our primary means of communication is to see what effect our voice has on others. Speaking and hearing are part of a feedback loop. We modify our voice, our behaviour, according to what we hear. We are actors, not only spectators in the aural world.Speaking/listening active and passive modes of the same thing.



Cross section through the front of the nose showing the turbinated bones. Hooters.

What we say includes the vast array of sounds we all make through our own bodily actions.
The internal rhythms and periodicities of the body
Torso, whole arm, forearm, lower arm, wrist, fingers, etc.
Footfall, as well as the voice.

<u>The voice.</u>

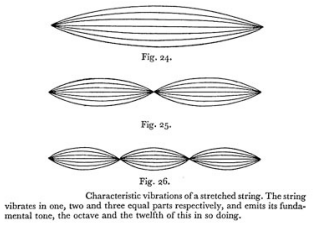


Fig. 24.

Fig. 25.

Fig. 26.

Characteristic vibrations of a stretched string. The string vibrates in one, two and three equal parts respectively, and emits its fundamental tone, the octave and the twelfth of this in so doing.

production

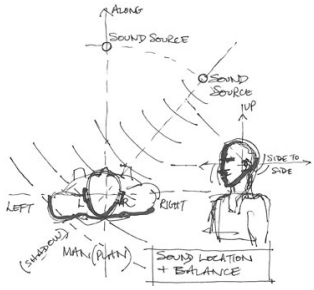
breath, diaphargm

pharynx, larynx, resonating tubes

harmonic sound.
[tube]
[sung example- overtones]

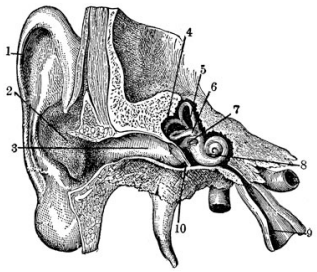
dem bones

<u>Hearing</u>

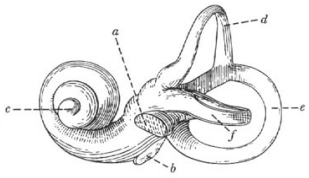


Our ears in the stable, upper part of body. Allows us to keep our head level when running.

Two either side, broadly take a hemisphere each
sound coming from left or right
fully three dimensional in all directions. spatial position, direction, moving - stone throwing mammal



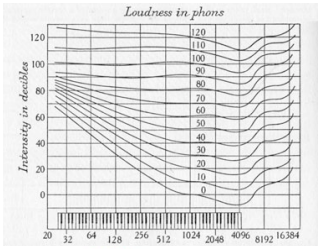
If we follow the ear tributary past the:
- pinnae, the outer ears which give us unique and infinitely varied hemispheres, into the
- air filled outer ear, spiralling down to
- eardrum
- the tiny bones connect to fluid filled organs,

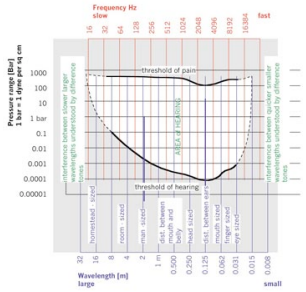


Here is the air/fluid connection - and the organs of the inner ear
- the cochlea, with a comblike basilar membrane and the
- labyrinths, our organs of the three dimensions of space and balance.

Our sense of three dimensions comes from the labyrinths of the inner ears. [Three dimensions of space not invented by Descartes, but inbuilt.]
- motion and orientation from the inner ear.

Sound and soundscape.





Sound propagation
- shockwaves,
- pure energy
- speed of sound
- frequency/wavelength

Since the speed of sound is about one third of a kilometre a second, or 333m/s (it varies slightly with temperature, but this is a good mnemonic) it is equivalent to see a sound as a size or a repetition. A sound repeating once a second will come at us with 333m space between the drumbeats. A sound in the midfield of human nearing,say 1000 vibrations per second, will therefore have a wavelength of 33cm. For architects the best way to conceptualise and express the pitch of sound is as wavelengths in air whose size easily relates to those of the body and architecture.

The range of ear-audible sounds

These wavelengths in air relate in size to the body and architecture.

The smallest sound we can hear is the size of a fingernail (17mm); the most sensitive fist sized, mouth sized; the average the distance from mouth to belly; the sound of a baritone the size of a man; the longest, lowest the size of a ballroom (17m).

Beyond sound heard as tones, operating at slower rates of repetition and longer wavelengths are the sounds we hear as rhythm, giving us no upper limit to the perception of wavelength except our ability to recognise repeated events.

So the range of hearing can be said to extend from the size of a fingernail to the size of a city and beyond.

So ear hearing gives us
- motion and orientation
- three dimensions horizontal and diagonally left and right
- full 3D spatial direction
- distance (loudness),
- size (wavelength)
- memory, recognition, history.

Whole body hearing = dancing?

Up is not the same as along - refraction, temperature

soundscape, like landscape

the form but also

the significance of the sounds we make and hear.

This significance, cultural as well as biological, helps us understand what is meant by noise and its opposites:

The Art of Noise and its opposites

and the machinery of city life

Luigi Russolo and the Art of Noise 1913.

Cage quietness and silence

The anechoic chamber at Harvard, expecting to hear silence,

non intentional sound

microsounds

4’33” = -273ºC = 0ºK, where molecular vibration stops = no sound.
A concerto for architecture [Brian Eno]


John Cage

Designing with Sound.
A design method
begins and ends with the human body.

Architecture encloses activity, reflecting sound back into itself as
air meets wall and
air meets body,

the sound modulated by the shape, materials, and micro-porosity of its surfaces and boundaries.

Walls reflect sound better than a mirror reflects light.
Reflecting sound back into itself.
walls and reflection.
1/20 17m rule 8.5m

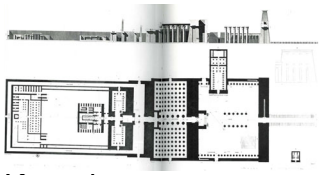
echo and reverberation
reflection and absorption
diffusion
focusing
diffraction - up not the same as along
temperature inversion

Important to keep human body at the centre, because as architects we want to modify mood and behaviour through enclosure.

We want to design places that feel good.

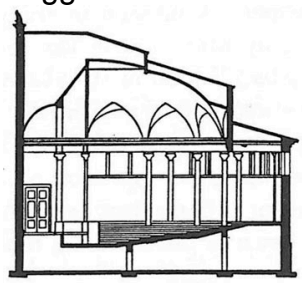
Activity, enclosure, activity, a feedback loop.
clothe the activity with volumes of air and enclose these with solid architecture

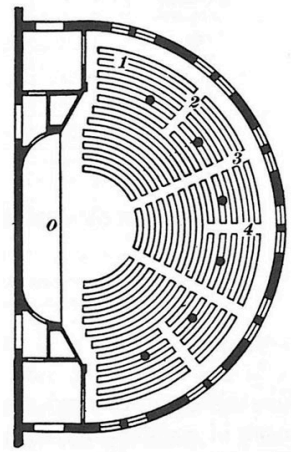
Semi-anechoic chamber at NPL. Twickenham



Karnak

Fogg





Lecture-room, Fogg Art Museum: position of observer at *O*; positions of absorbent at 1-4, and in the dome.

Modifying behaviour through sound - OR what do you mean by a wall?


Palestine separation fence

We modify behaviour according to the place we are in, according to how we and it sound. Architectural acoustics can be used as a design tool to modify the perception of self and space and thereby affect mood and behaviour.

Ambience. A background room acoustic or ambience can be made formal, cosy, intimidating, confusing, consoling, larger or smaller than it actually is.

If we consider the human activities of a place and the sounds that evidence them, we can, by modulating sound, create appropriate and supportive environments.

imagine the sound and human activity of the places we are making, we feel what it is like to be here before it exists

Moving from a flat wall to complexity.


Flatwall_MBA

Look at how sound connects speaker and listener
- creating quiet space
-symmetric/asymmetric relationships
- openings arcades, apertures

Connecting the landscape with bells. cornwall 5km network


Plaza Real Barcelona

We can explore the opposite:
how sound disconnects
separation of communities.
- reflecting sound back into itself,
- isolation and exclusion
- political significance of walls.


Separation fence at Bethlehem

We can identify sound environments that promote disease,
- traffic noise
- mechanical noise
- hums
- whizzes


Sound-bombing

Even sound as a weapon of punishment and war:
- Tango at Stalingrad
- Heavy Rock at Waco and for Noriega in Panama City
- sonic booms in Gaza

What do yo mean by a wall?
- sound
- movement
- imagination?

What is permeable and impermeable? What are you trying to include and exclude? e.g. air movement, body movement, sound, visibility,

There are various degrees and modes of permeability, from a sign saying ‘private’ through paper screens, railings, lattices, grilles, and arcades to castle walls.

Tools available to the designer,
- form
- layout
- creating protected spaces of quiet in an urban environment

the form and topography of the existing city

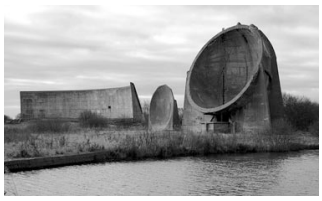

Oriel

Layout, arrangement, organisation, sequence and narrative of interrelated places

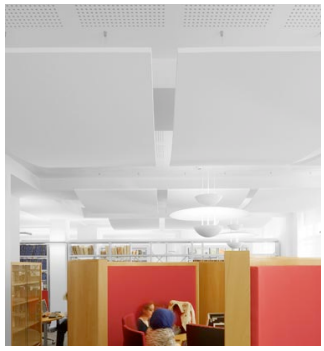
- arrangement,

Shape of rooms - rooms are considered in themselves as enclosing human activity, but also connections and permeabilities, visually and acoustically.

Half and double wavelength about the limits for focussing or diffusing sound.



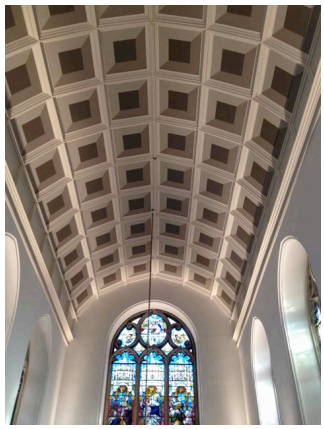
Sound reflectors at Denge



Pharmacy Library

materials,

porosity, density, acoustic properties of absorption/reflection and in themselves



working creatively with natural sounds of

wind,
water and its many voices as it entraps air,

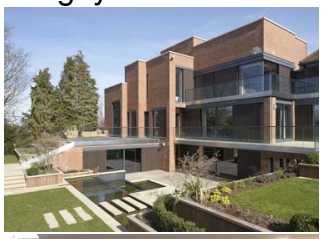
Wind and water are seen as latent sonic elements,

Latent sound = Aristotle's "potential sound"

the building potentially a musical instrument itself within a landscape of sound.

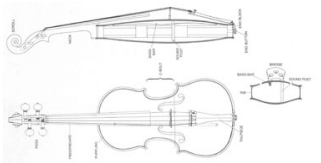
sounds of inhabitation, footfall, gravel

water bubbles
Gargoyles



sonic properties of the building itself,
air and structure
the sounding, resonating and amplifying elements of the building.

timber under stress, timber floors



Violin and timber floor

Active acoustic interventions and their effect on human health, mood and behaviour

Careful disposition of active sound sources

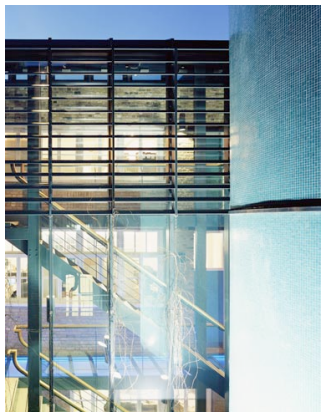
Intentional:

- fountains and masking sound
- bells, clocks
- geese
- alarms
- public address systems
- pink noise
- classical Music at Vauxhall Station
- ambient music for shopping

non intentional:
- mechanical hums
- electrical hums
- fans
- pumps
- air noise in ducts

Figure 9.5. *Wells Cathedral, West Front, view showing (i) the four quatrefoil niches containing the ?singers' ports and (ii) the row of eight ?trumpet ports high in the gable. (Photograph: Graeme Lawson.)*

To summarise:



Materiality of the air
The body, speaking, listening,
Sound and noise?
Modifying behaviour through sound, positive and negative health effects
Designing with sound:
- layout
- form,
- materials,
- found sound,
- sonorities,
- active acoustics

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- practicing architect in London, specialising in conservation: managing change whilst preserving cultural significance.
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