

The New Sonic Boom: Designing Dynamic Acoustic Environments

Session ID: TH 21

Date: Thursday, June 8, 2006

Time: 1:30 - 3:00 PM

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Conical Shock Wave

Jim Lutz
Architecture Program
University of Memphis

Steve Roden
Sound Artist
Los Angeles

THE NEW SONIC BOOM

Designing Dynamic Acoustic Environments

*How cutting-edge architects and artists are collaborating
to break the architectural sound barrier*

$v_s t$

The American Institute of Architects
2006 National Convention – Los Angeles



THE NEW

SONIC BOOM

LEARNING OBJECTIVES

This session is not about architectural acoustics in the usual sense, rather it is about the use of sound as an architectural medium employed to create, define and embody space.

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1. To present and analyze historical and contemporary works of architecture demonstrating the relationship between sound and space.
2. To expose participants to emerging audio technology and present its potential for architectural applications.
3. To make the concept of sound as an architectural medium real and accessible through a first-person presentation of a case study.



THE NEW

SONIC BOOM

PRESENTATION OUTLINE



THE NEW

SONIC BOOM

PRESENTATION OUTLINE

I. FROM CAVES TO MICROCHIPS:

A Brief History of Architecture, Sound and Music



THE NEW

SONIC BOOM

PRESENTATION OUTLINE

I. FROM CAVES TO MICROCHIPS:

A Brief History of Architecture, Sound and Music

II. SEE HEAR NOW: Emerging Audio Technology



THE NEW

SONIC BOOM

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I. FROM CAVES TO MICROCHIPS:

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II. SEE HEAR NOW: Emerging Audio Technology

III. SPACE + SOUND + TECHNOLOGY:

New Sonic Environments



PRESENTATION OUTLINE

I. FROM CAVES TO MICROCHIPS:

A Brief History of Architecture, Sound and Music

II. SEE HEAR NOW: Emerging Audio Technology

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IV. SUMMARY AND CONCLUSION



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New Sonic Environments

IV. SUMMARY AND CONCLUSION

V. CASE STUDY: Serpentine Pavilion

Steve Roden, Sound Artist



THE NEW

SONIC BOOM

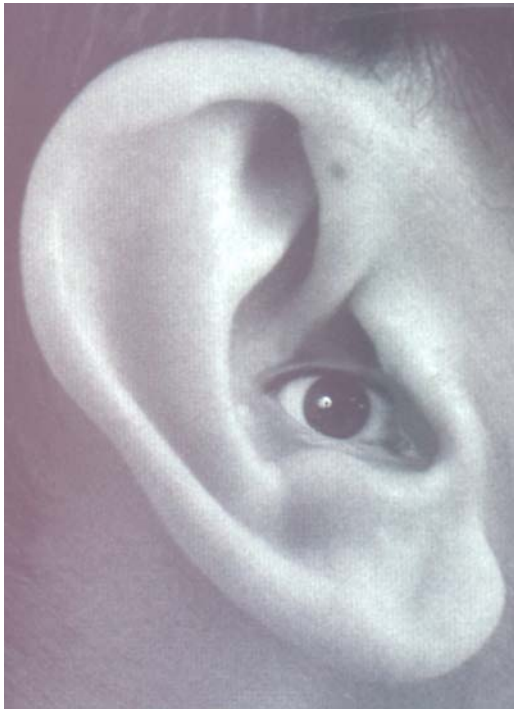
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FROM CAVES TO MICROCHIPS:

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THE NEW

SONIC BOOM

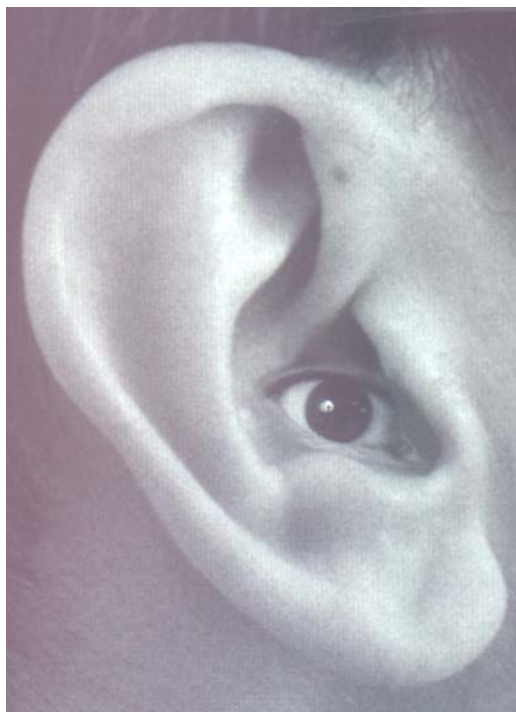


ARCHITECTURE

SOUND

THE NEW

SONIC BOOM



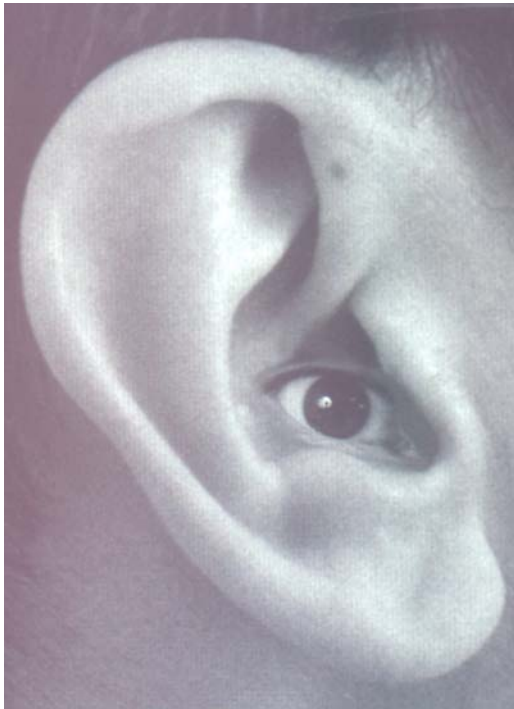
ARCHITECTURE

Permanent

SOUND

THE NEW

SONIC BOOM



ARCHITECTURE

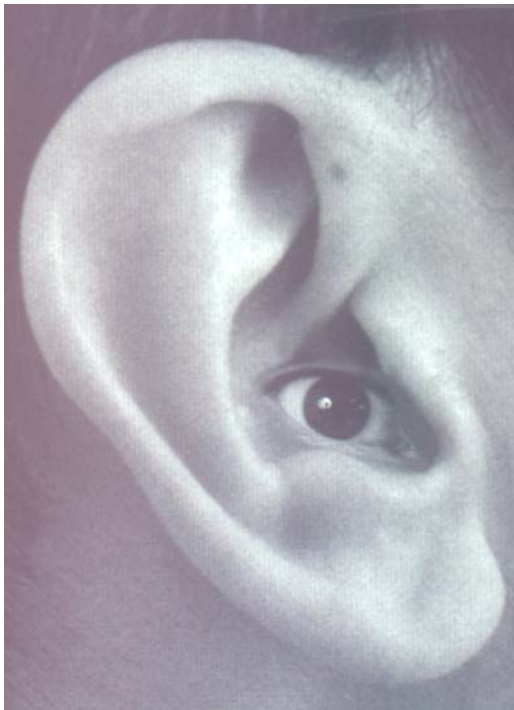
Permanent

SOUND

Ephemeral

THE NEW

SONIC BOOM



ARCHITECTURE

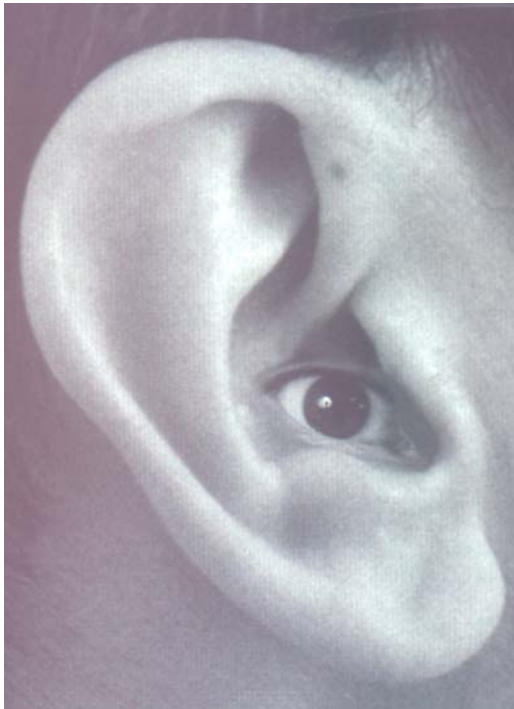
Permanent
Substantive

SOUND

Ephemeral

THE NEW

SONIC BOOM

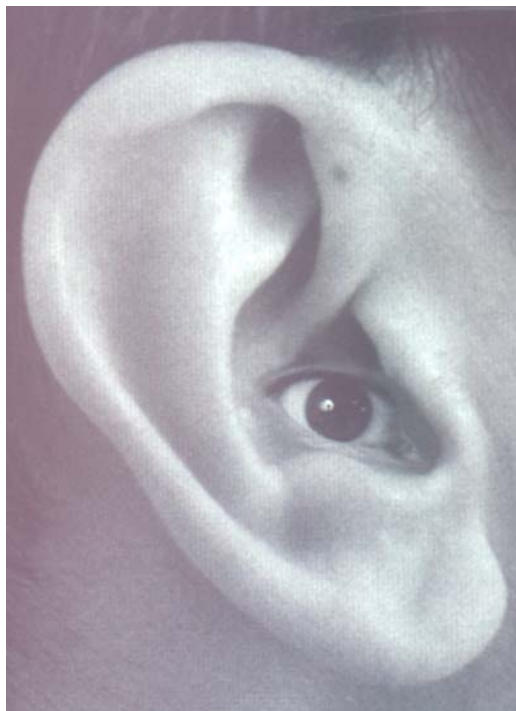


ARCHITECTURE

Permanent
Substantive

SOUND

Ephemeral
Immaterial

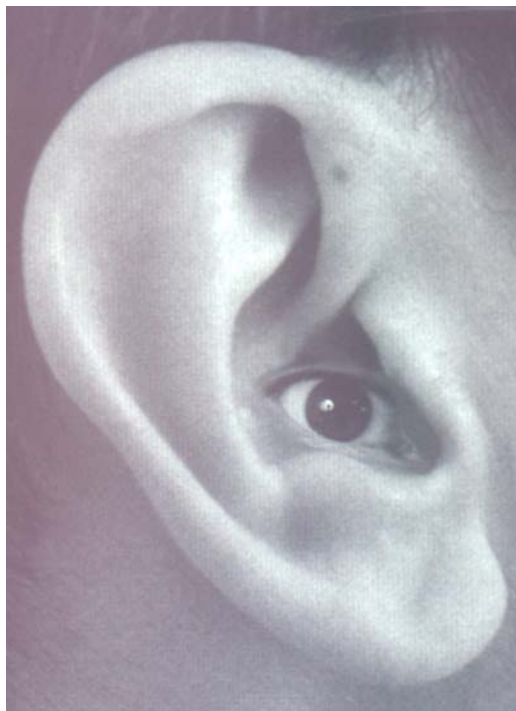


ARCHITECTURE

Permanent
Substantive
Fixed

SOUND

Ephemeral
Immaterial

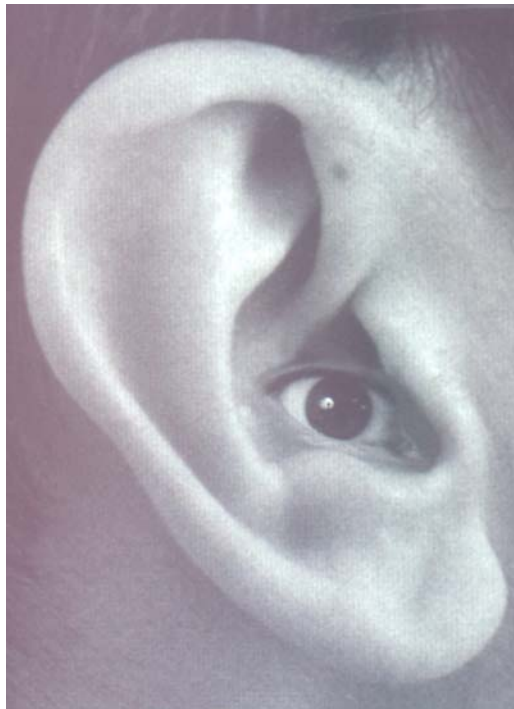


ARCHITECTURE

Permanent
Substantive
Fixed

SOUND

Ephemeral
Immaterial
Dynamic



ARCHITECTURE

Permanent

Substantive

Fixed

1D, 2D, 3D

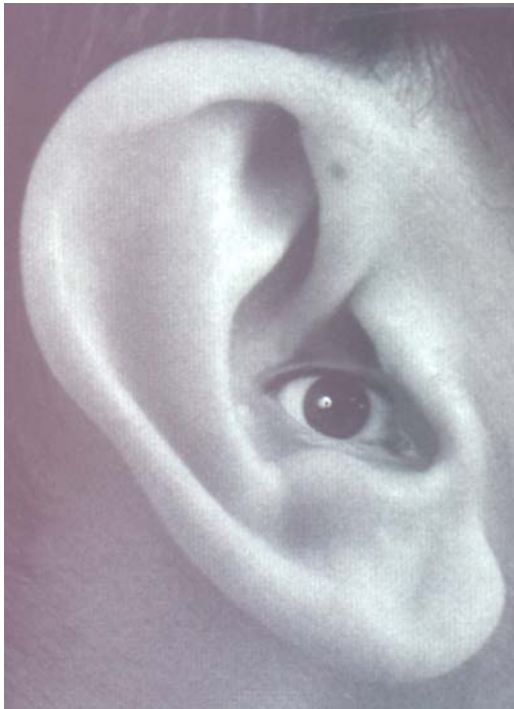
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SOUND

Ephemeral

Immaterial

Dynamic



ARCHITECTURE

Permanent

Substantive

Fixed

1D, 2D, 3D

(Width, Length, Height)

SOUND

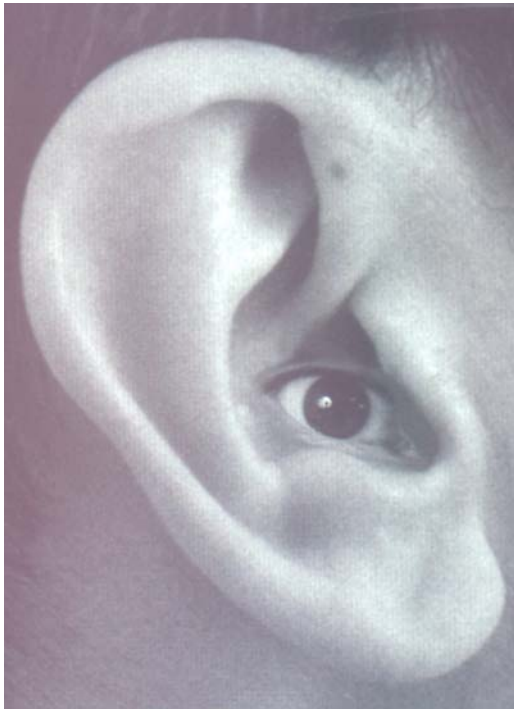
Ephemeral

Immaterial

Dynamic

4D

(Time)



ARCHITECTURE

Permanent

Substantive

Fixed

1D, 2D, 3D

(Width, Length, Height)

SOUND

Ephemeral

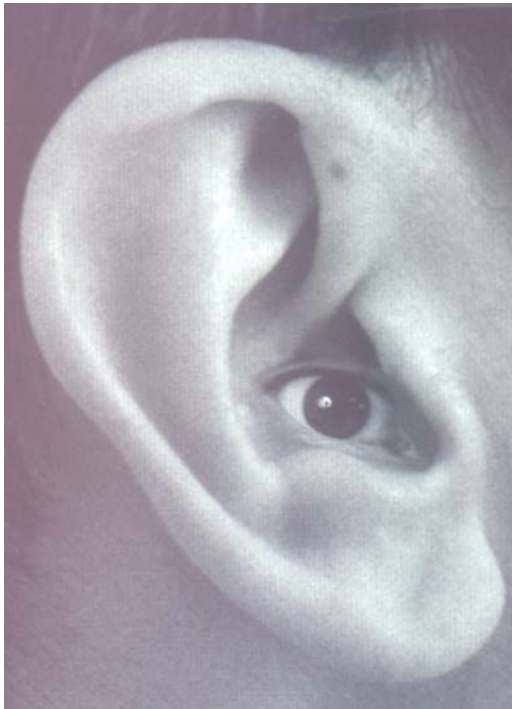
Immaterial

Dynamic

4D

(Time)

MUSIC



ARCHITECTURE

Permanent
Substantive

Fixed

1D, 2D, 3D

(Width, Length, Height)

Functional/
Representational

SOUND

Ephemeral

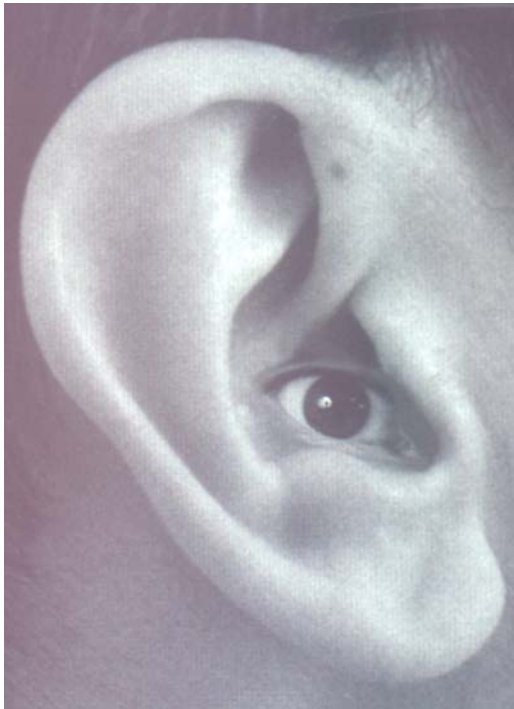
Immaterial

Dynamic

4D

(Time)

MUSIC



ARCHITECTURE

Permanent
Substantive

Fixed

1D, 2D, 3D

(Width, Length, Height)

Functional/
Representational

SOUND

Ephemeral

Immaterial

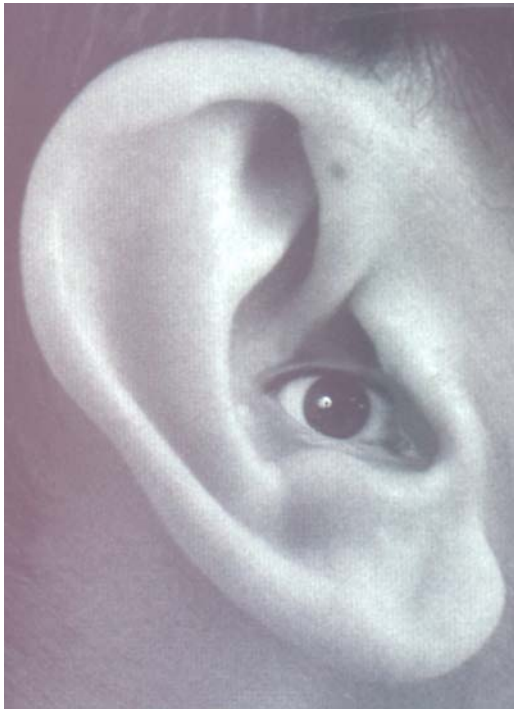
Dynamic

4D

(Time)

MUSIC

Abstract



ARCHITECTURE

Permanent
Substantive

Fixed

1D, 2D, 3D

(Width, Length, Height)

Functional/
Representational
Calculated

SOUND

Ephemeral
Immaterial

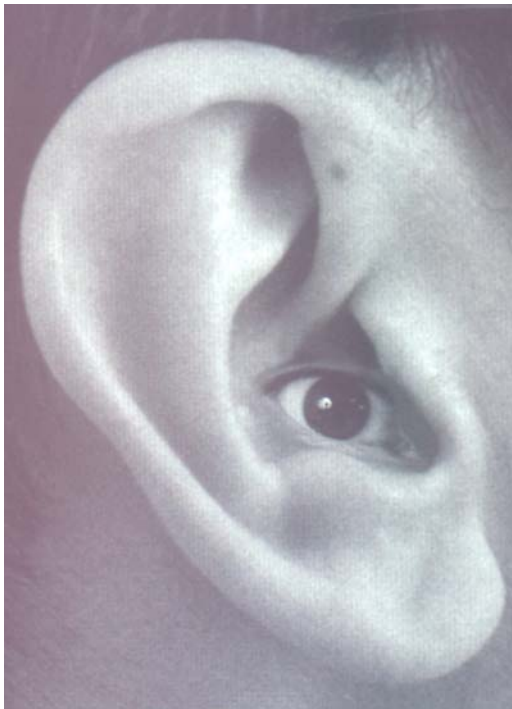
Dynamic

4D

(Time)

MUSIC

Abstract



ARCHITECTURE

Permanent
Substantive

Fixed

1D, 2D, 3D

(Width, Length, Height)

Functional/
Representational
Calculated

SOUND

Ephemeral
Immaterial

Dynamic

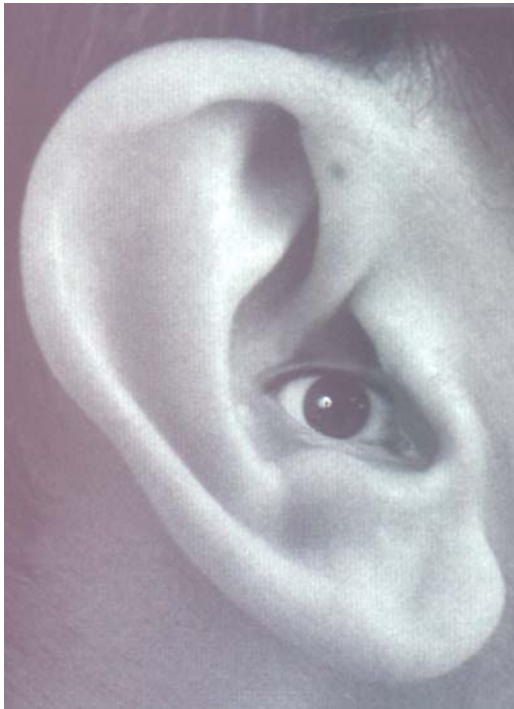
4D

(Time)

MUSIC

Abstract

Improvisational



ARCHITECTURE

Permanent
Substantive

Fixed

1D, 2D, 3D

(Width, Length, Height)

Functional/
Representational
Calculated
Laborious

SOUND

Ephemeral
Immaterial

Dynamic

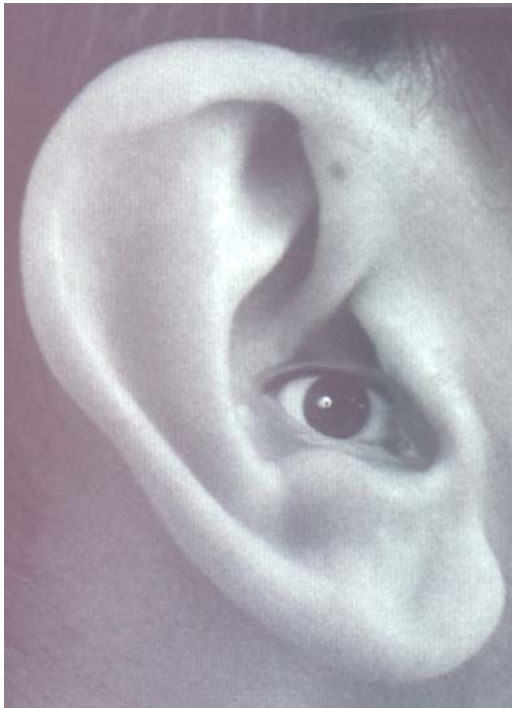
4D

(Time)

MUSIC

Abstract

Improvisational



ARCHITECTURE

Permanent
Substantive

Fixed

1D, 2D, 3D

(Width, Length, Height)

Functional/
Representational
Calculated
Laborious

SOUND

Ephemeral
Immaterial

Dynamic

4D

(Time)

MUSIC

Abstract

Improvisational
Extemporaneous



“The paintings are positioned to correspond with those spots capable of producing prolonged echoes of a particular intensity.”

-Iégor Reznikoff, Anthropologist

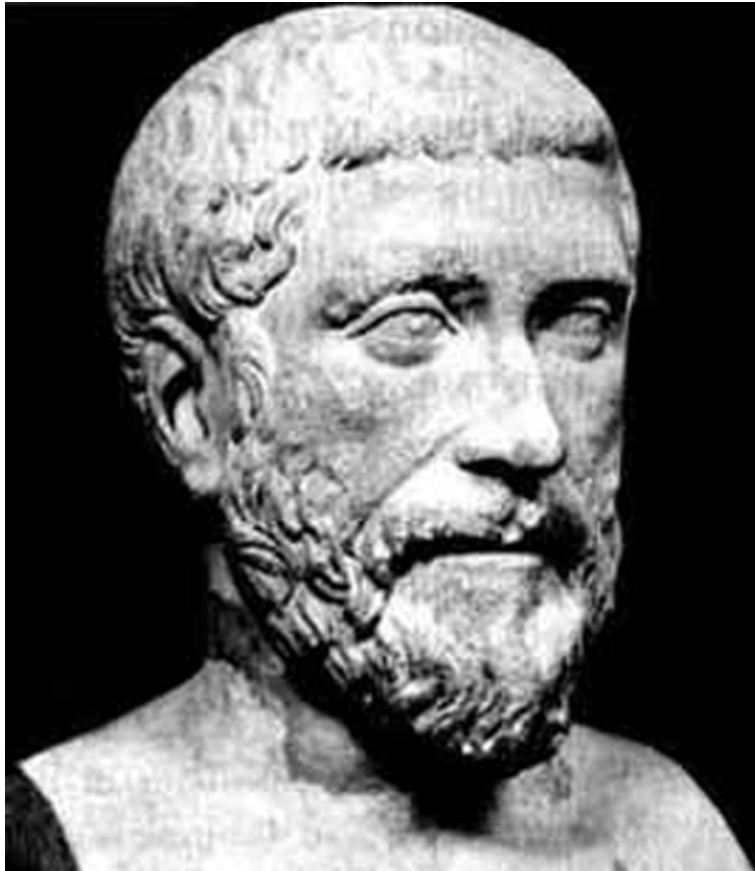
The Music of Caves

Paleolithic Wall Paintings

Grotte de Niaux, Ariège, France

THE NEW

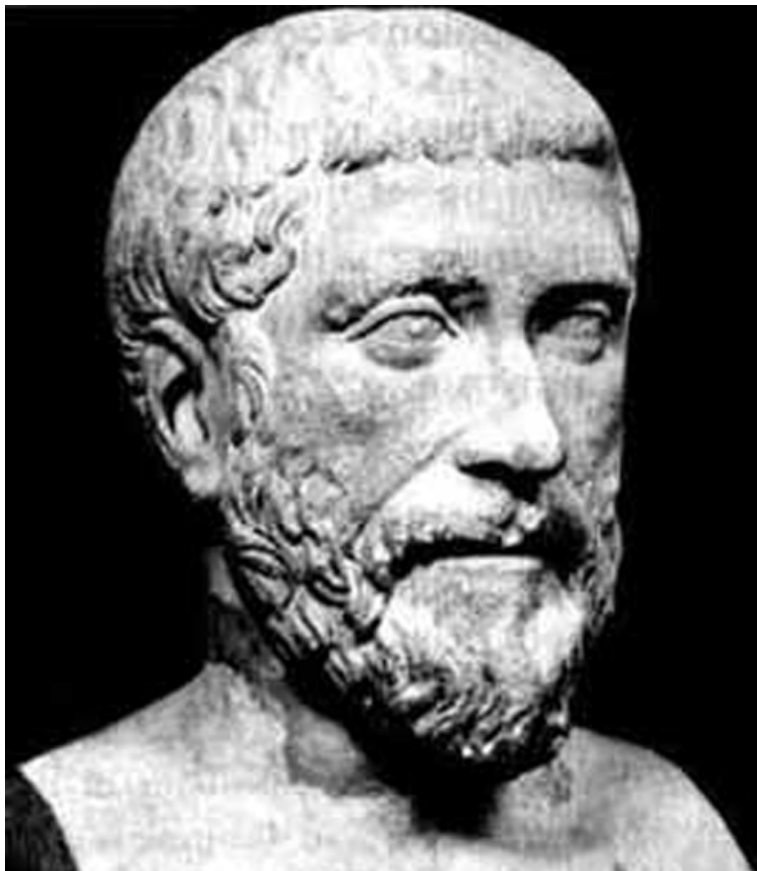
SONIC BOOM



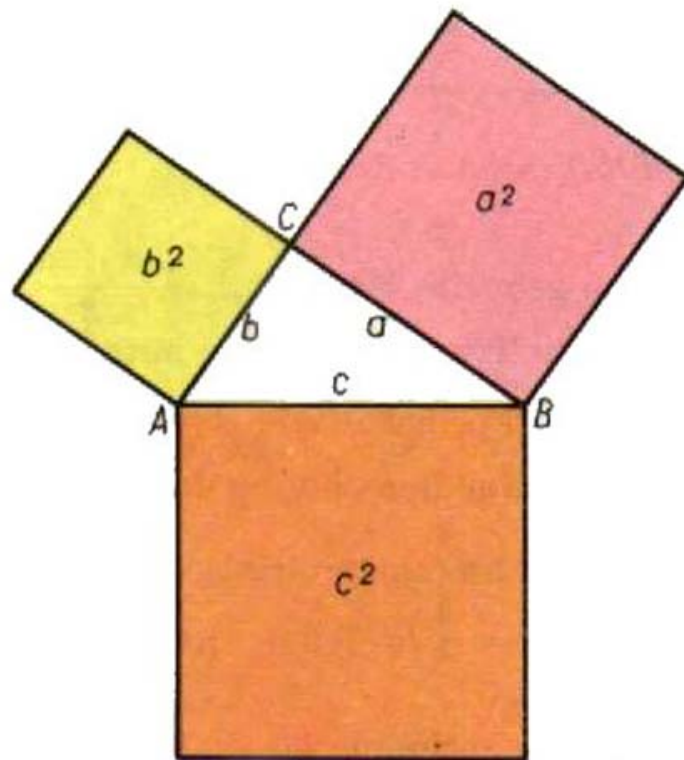
Pythagoras of Samos
Circa 500 B.C.E.

THE NEW

SONIC BOOM

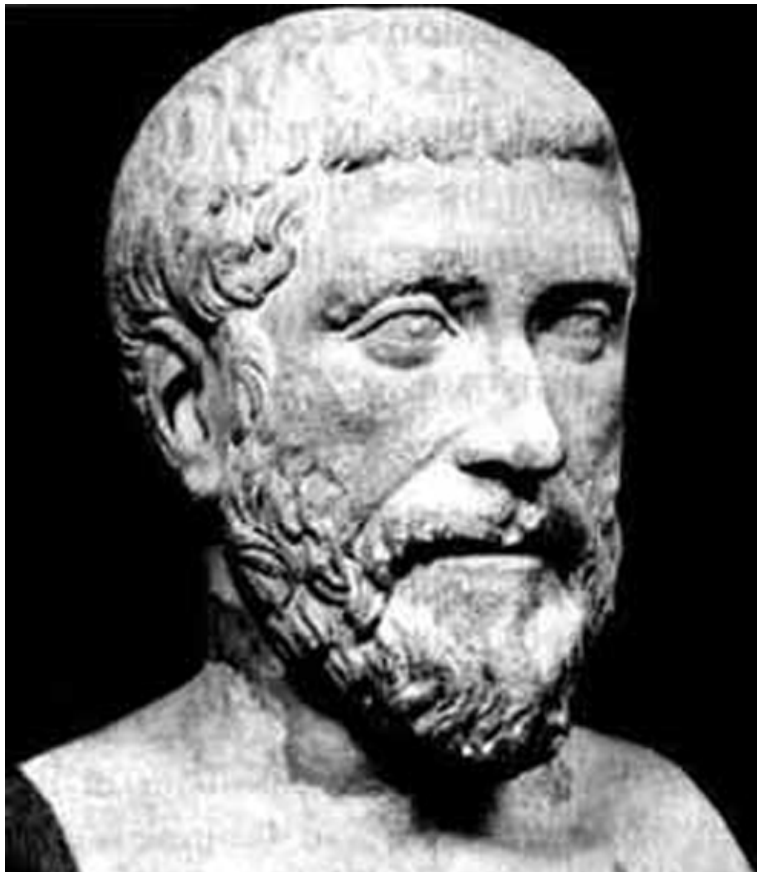


Pythagoras of Samos
Circa 500 B.C.E.



$$a^2 + b^2 = c^2$$

THE NEW SONIC BOOM

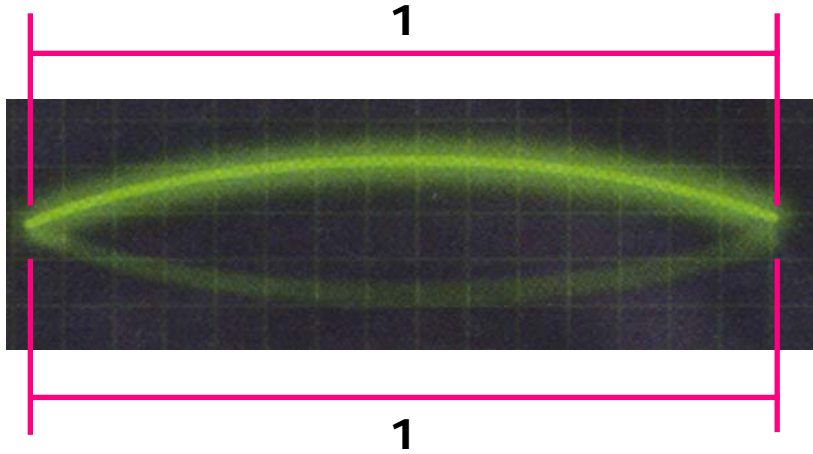


Pythagoras of Samos
Circa 500 B.C.E.



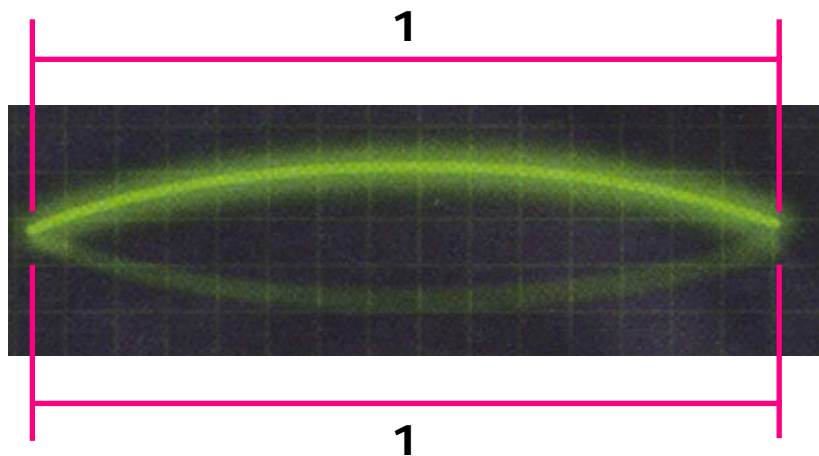
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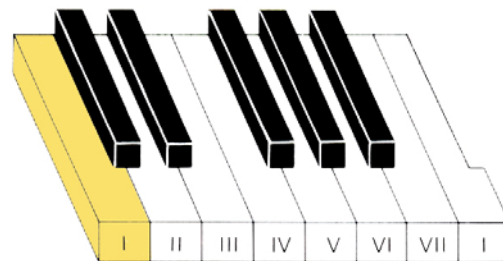


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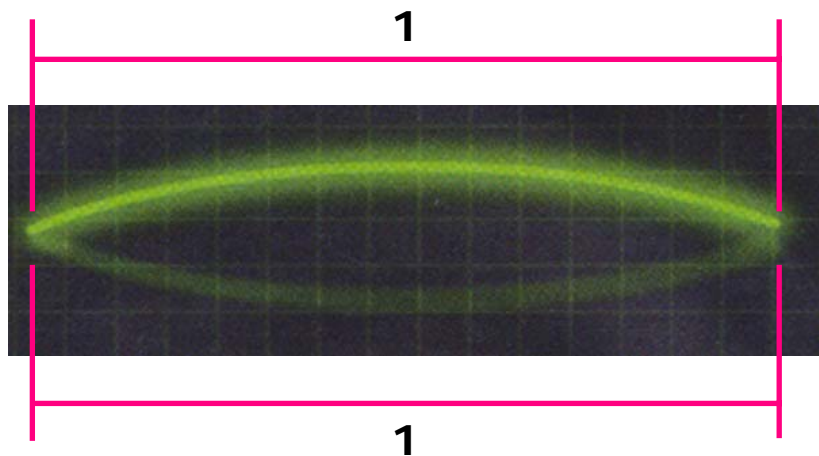
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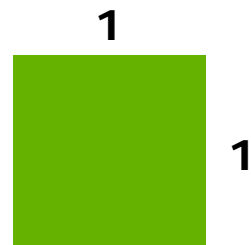
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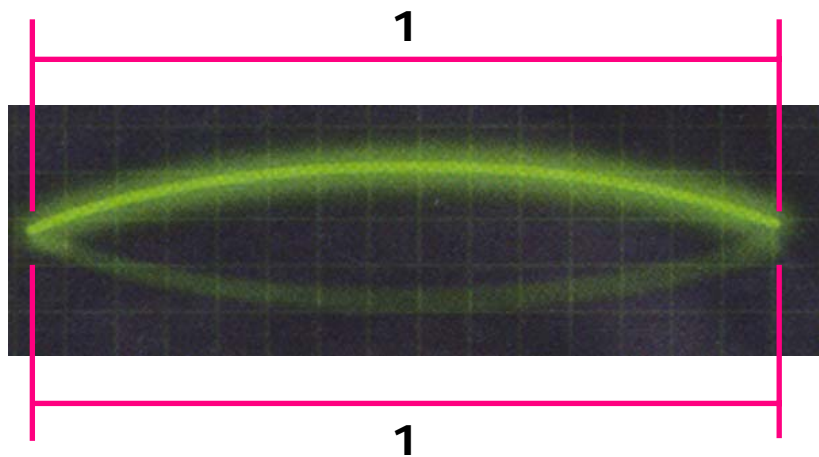


Tonic

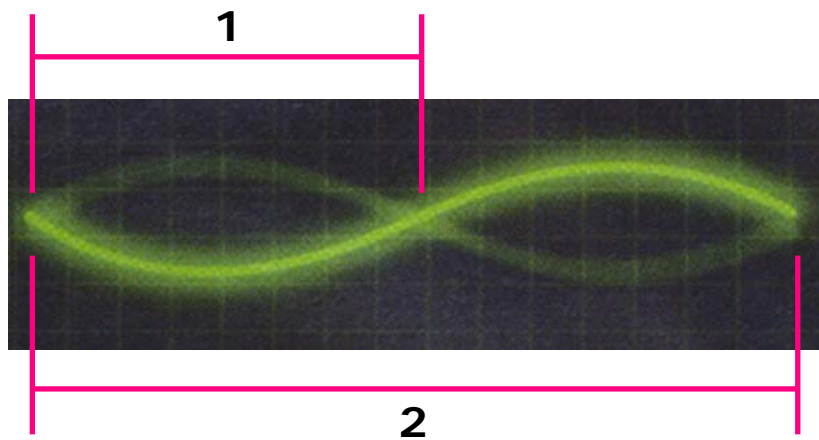
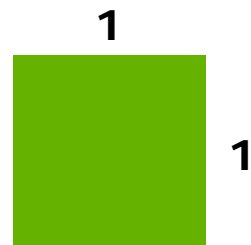


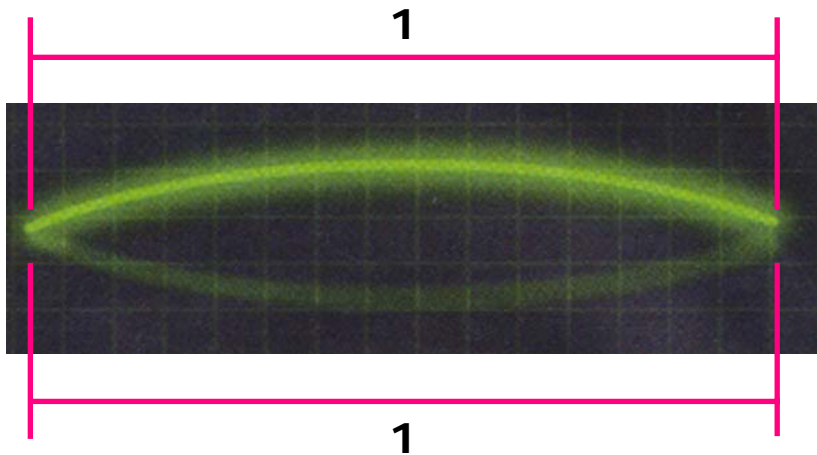
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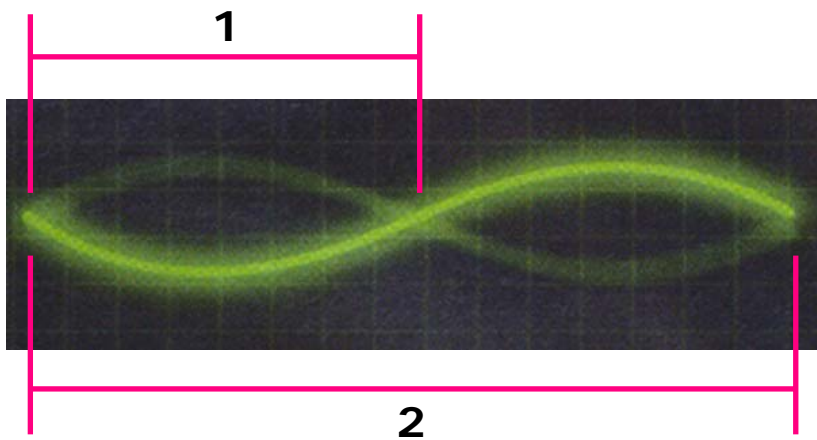
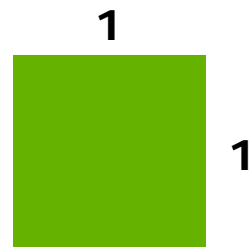


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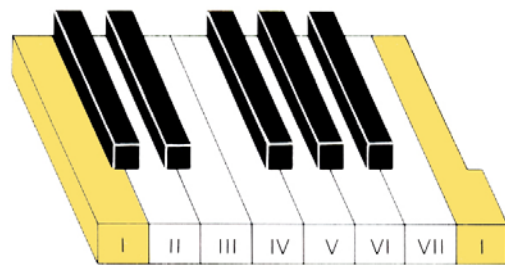




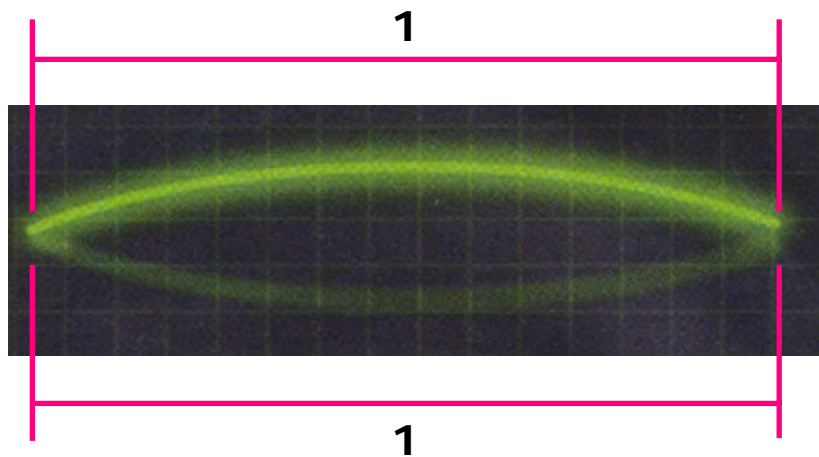
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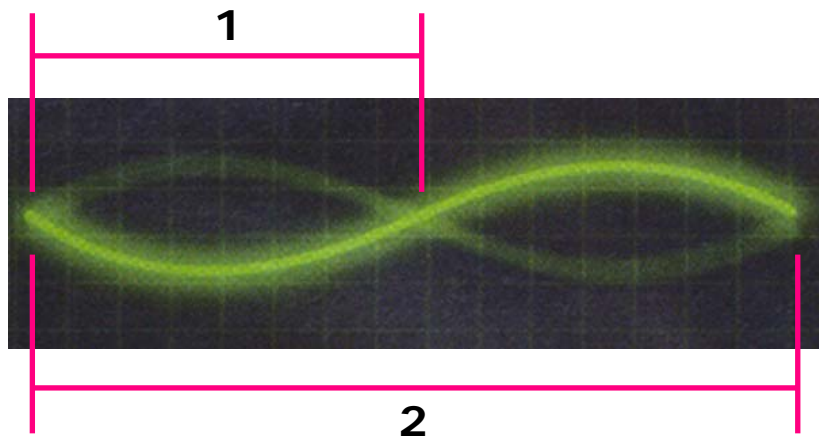
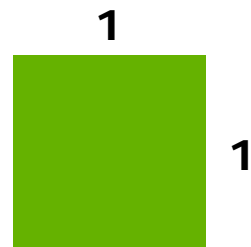
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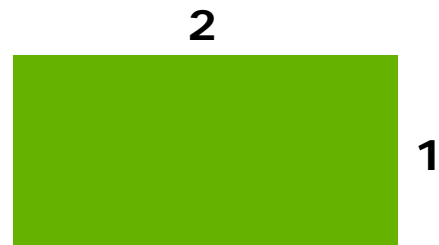
Octave



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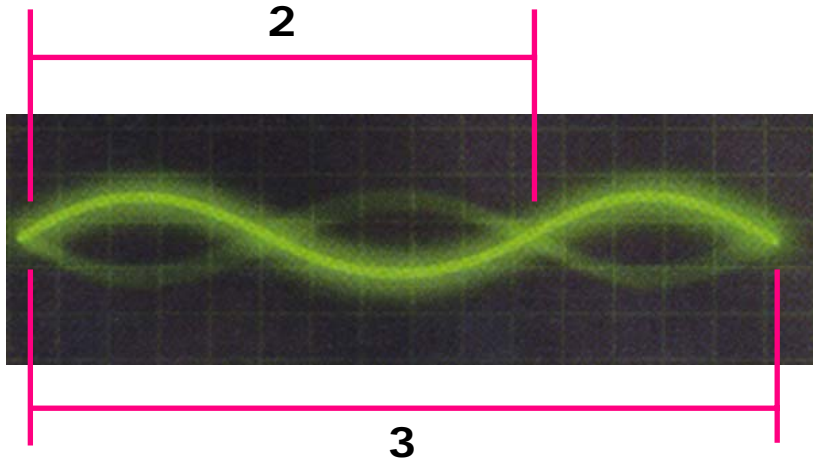


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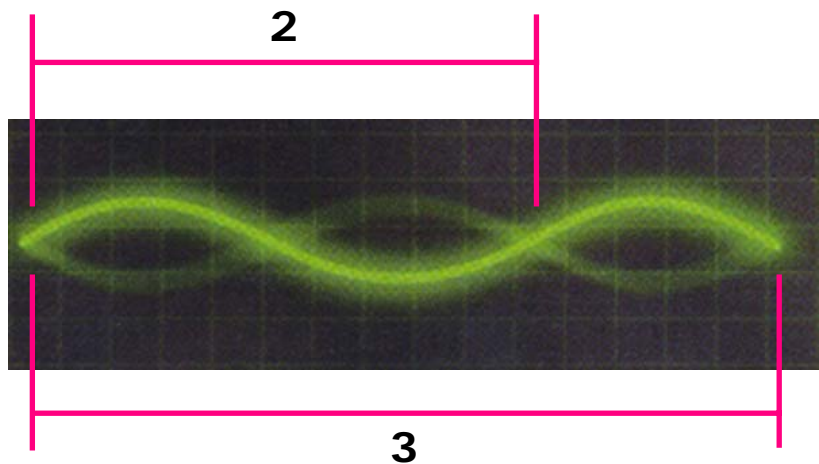
THE NEW

SONIC BOOM

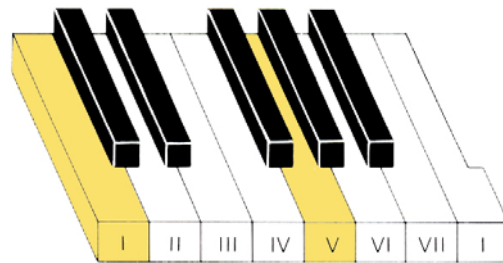


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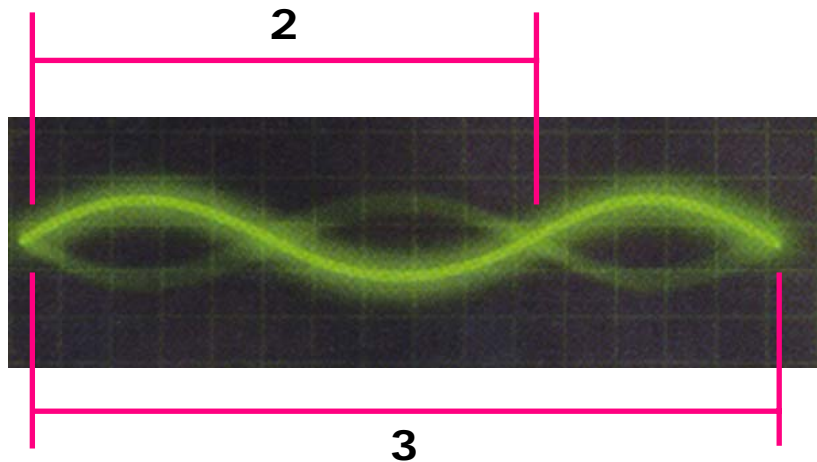
SONIC BOOM



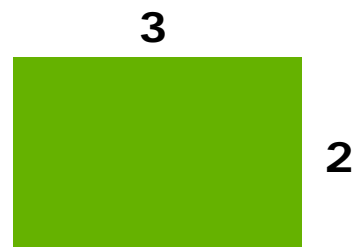
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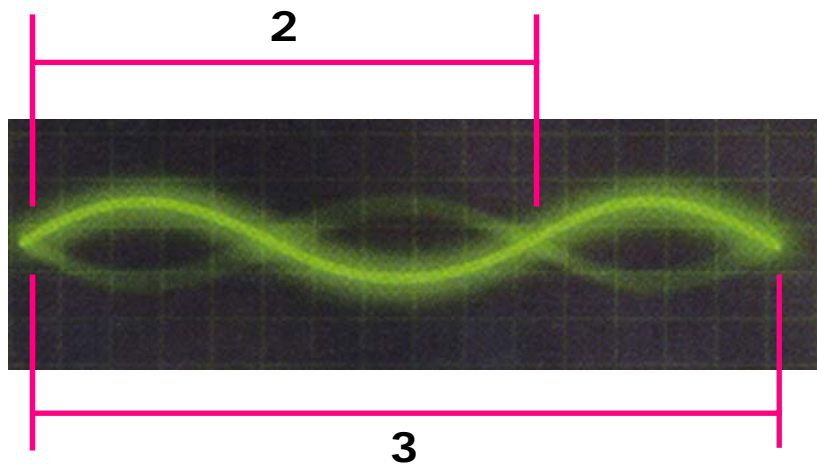


Fifth

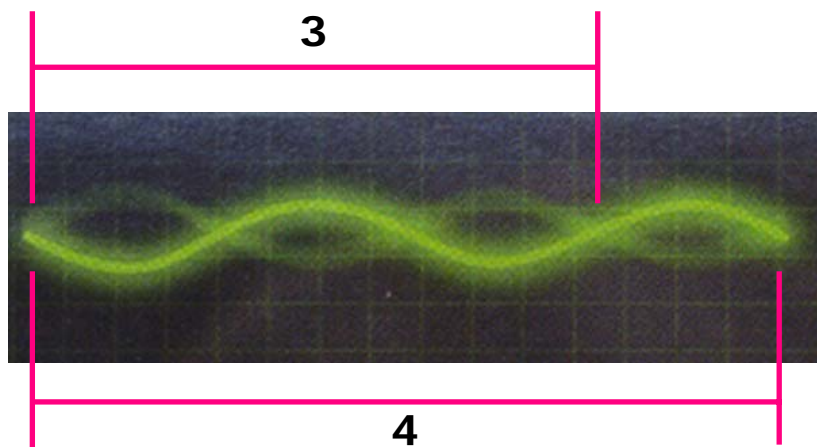
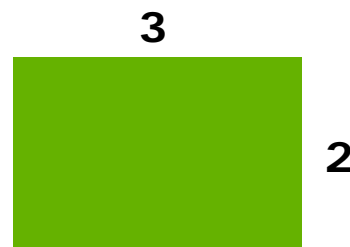


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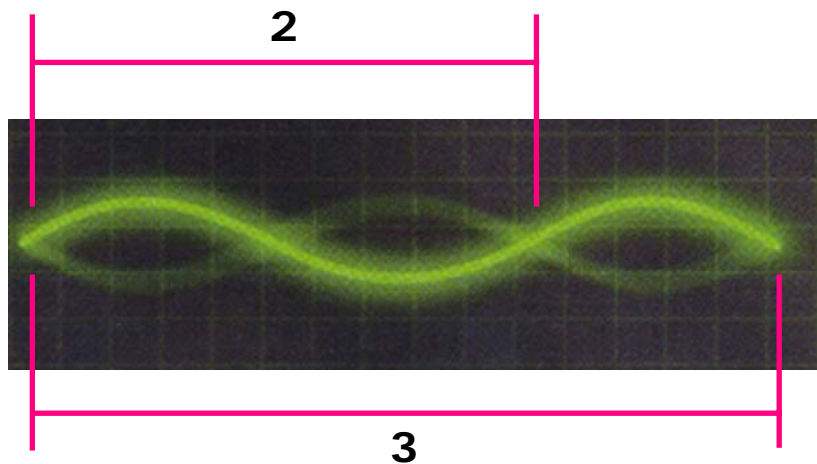


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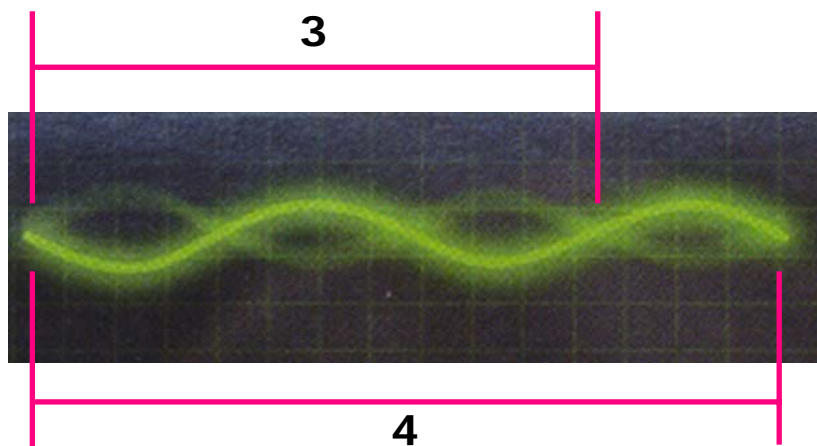
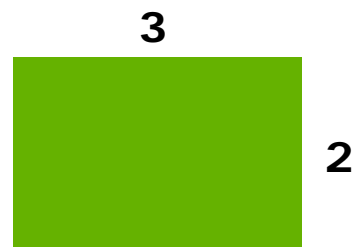


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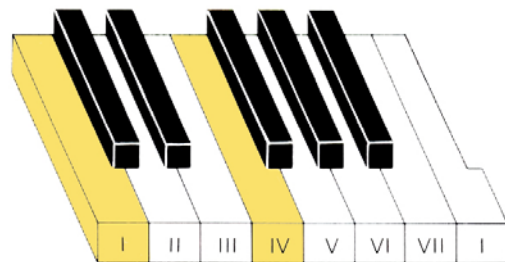
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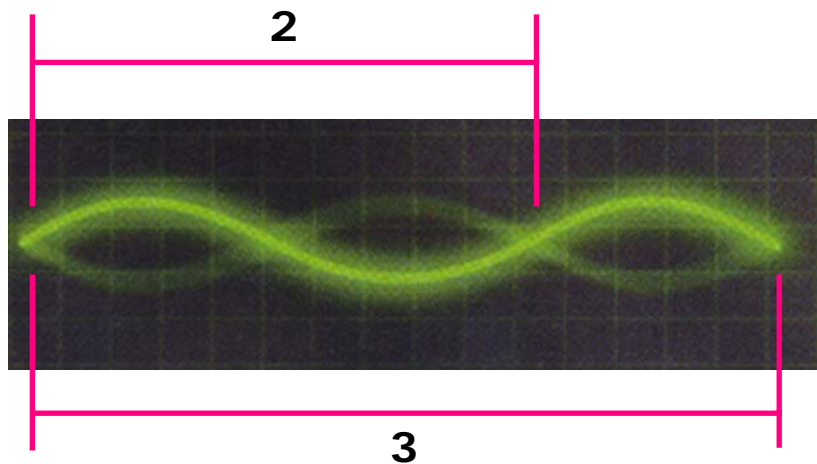
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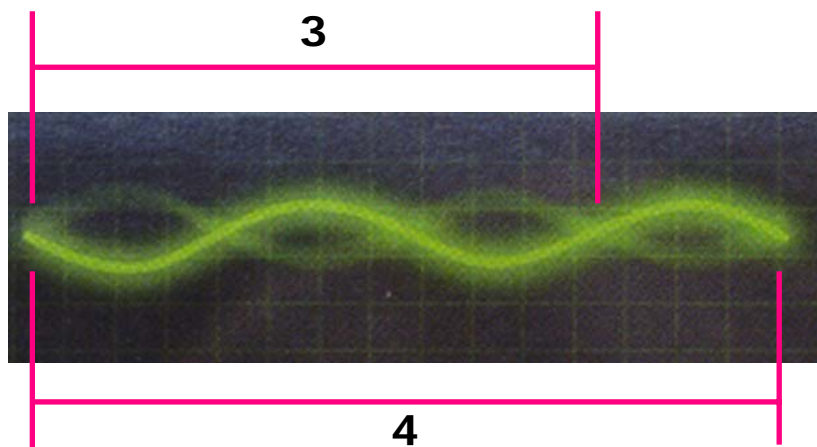
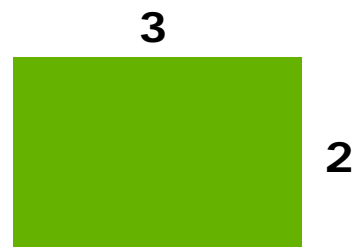
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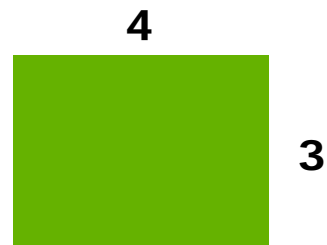
Fourth



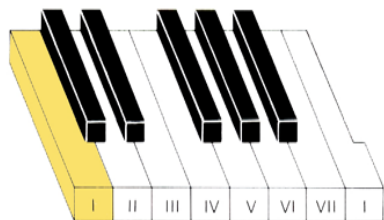
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Harmonic Proportions

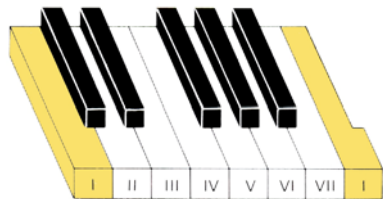


Tonic

1



1:1

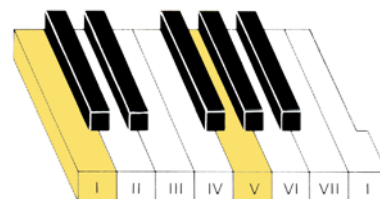


Octave

2



1:2

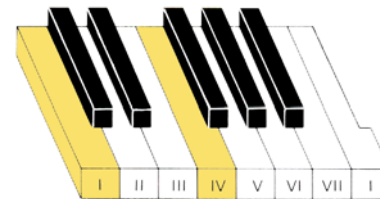


Fifth

3



2:3



Fourth

4



3:4

THE NEW SONIC BOOM

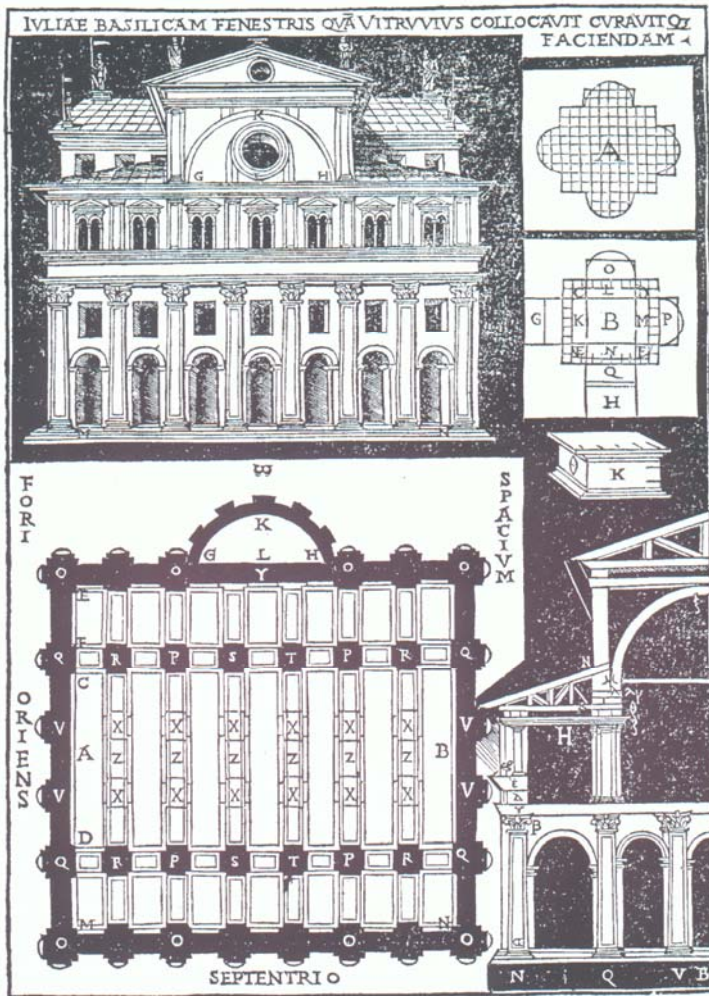


Pythagoras 500 BCE
Greek Mathematician & Philosopher

“All Is Number”



THE NEW SONIC BOOM



Vitruvius

1st Century BCE/CE

“The architect ought also to know music in order to understand canonical and mathematical theory...”

The Ten Books of Architecture

Book 1, Chapter 1

THE NEW SONIC BOOM

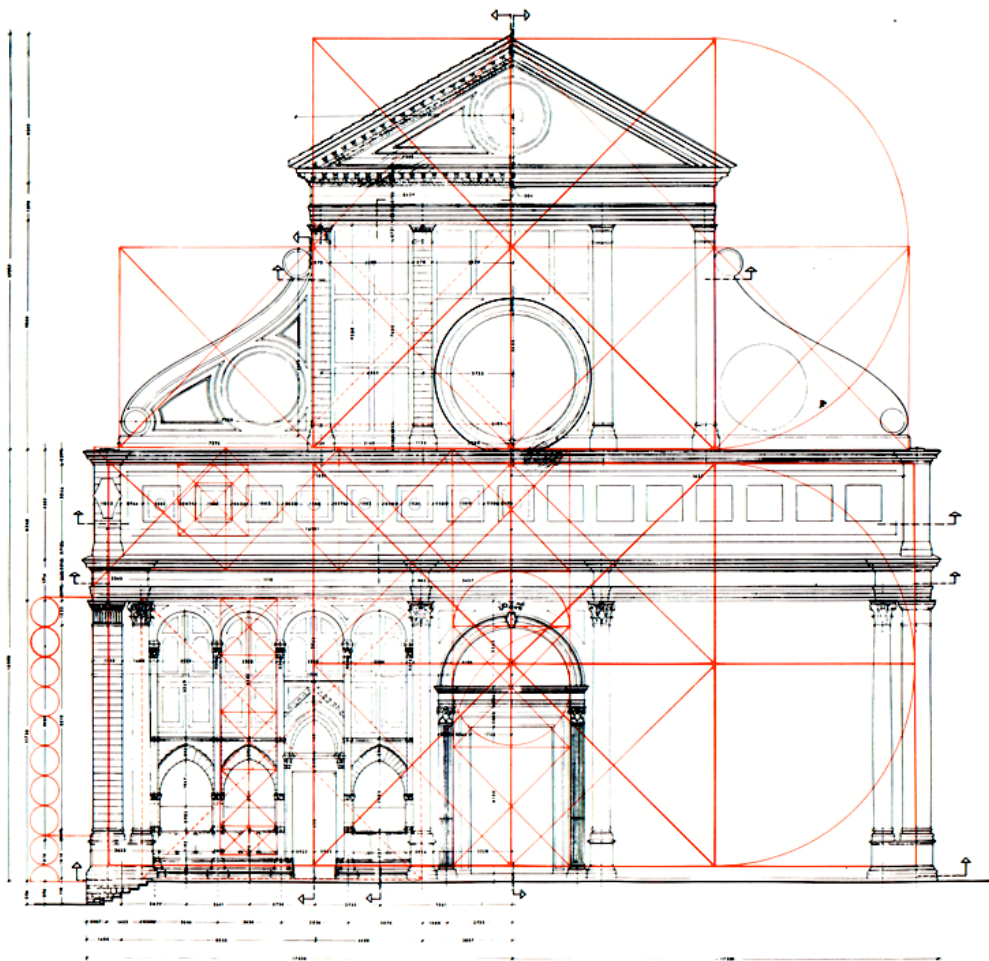


St. Bernard of Clairvaux

Founder of Cistercian order
12th Century

“What is God? He is width,
height, and depth. There
must be no decoration, only
proportion.”

Santa Maria in Cosmedin
Rome, 12th Century



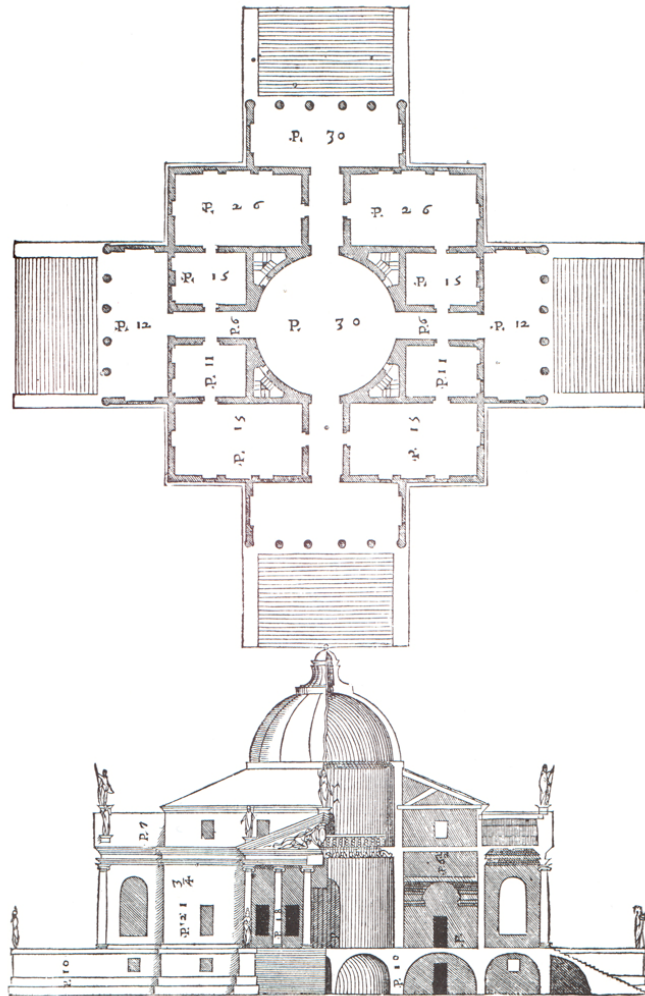
Leon Battista Alberti

15th Century

“These numbers which we have reviewed were not employed by architects randomly or indiscriminately but according to a harmonic relationship.”

On the Art of Building in Ten Books

Book 9, Chapter 6



Andrea Palladio

16th Century

“There are seven types of rooms that are the most beautiful and well proportioned... circular, square (1:1), length equal to the diagonal of the square (1:1.41), square and a third (3:4), square and a half (2:3), square and two thirds (3:5), and two squares (1:2).”

The Four Books on Architecture

Book 1, Chapter 21

The background of the slide features a collage of architectural and scientific motifs. At the top, the words "THE NEW SONIC BOOM" are written in a large, white, serif font. Below the text, there are several overlapping circular diagrams with arrows, resembling a complex geometric or acoustic diagram. The background also shows a blurred image of a building's facade with a grid of windows.

Architectural Theory in 17th Century France

The idea of harmonic proportion was debated and challenged by the French Academy of Architecture in the 17th century.

François Blondel (1617-86) argued for a “Marriage of music and architecture.”

Claude Perrault (1613-88) argued “The taste of our age—or at least of our nation—differs from that of the Ancients.”



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At this point in history the theoretical relationship between music and architecture fell out of favor for the next two centuries, only to be picked up again with particular vigor at the dawn of the 20th century.



THE NEW

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Thinking Outside the (Music) Box

Collaborations between Composers & Architects

“The poet is one who starts from the seat of the unmeasurable and travels towards the measurable, but who keeps the force of the unmeasurable with him at all times.” – Louis Kahn



THE NEW

SONIC BOOM

Successful collaborations between composers and architects are possible because:

Isomorphic correspondences exist between the two allied arts – concepts such as structure, rhythm, harmony/dissonance, metrics, etc. provide a common language for discourse.

Music and Architecture find commonality in Mathematics.

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Philips Pavilion

Brussels World's Fair –1958

Le Corbusier / Iannis Xenakis / Edgard Varese

THE NEW SONIC BOOM



Philips Pavilion

Brussels World's Fair –1958

Le Corbusier / Iannis Xenakis / Edgard Varese

**Performance Space
for *Prometeo***
Venice and Milan – 1983 / 84
Renzo Piano / Luigi Nono



THE NEW SONIC BOOM



Philips Pavilion

Brussels World's Fair – 1958

Le Corbusier / Iannis Xenakis / Edgard Varese

Performance Space for *Prometeo*

Venice and Milan – 1983 / 84

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Pavilion of the Swiss Confederation

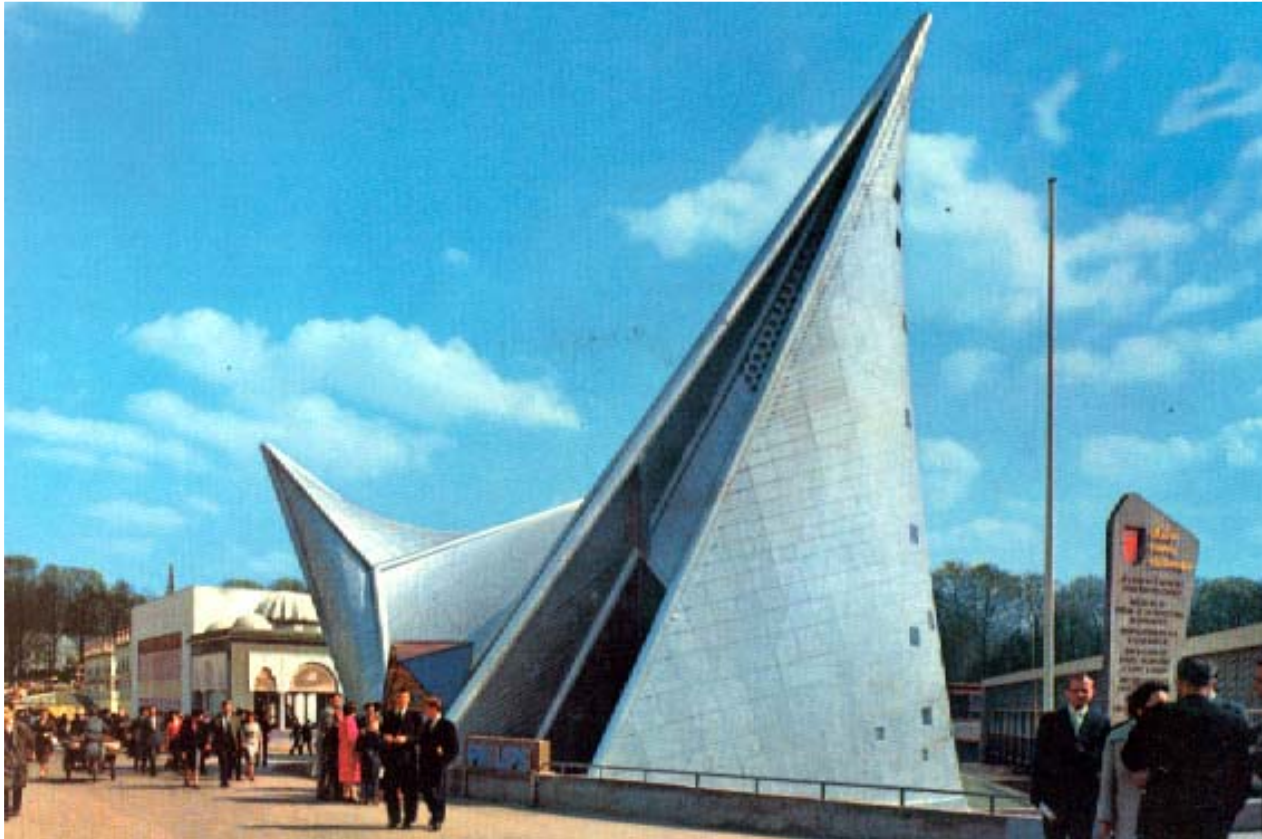
Hanover – Expo 2000

Peter Zumthor / Daniel Ott



THE NEW

SONIC BOOM

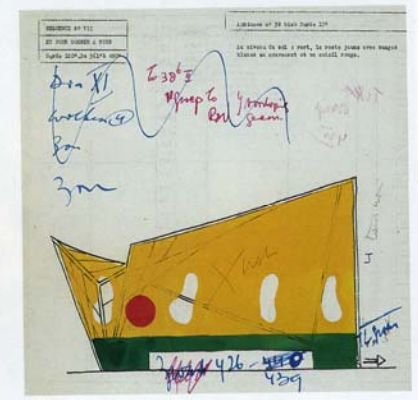
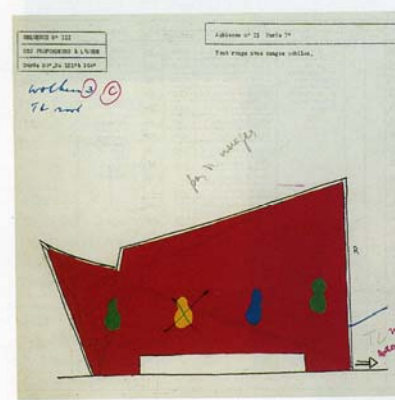


Philips Pavilion

Brussels World's Fair –1958

Le Corbusier / Iannis Xenakis / Edgard Varese

THE NEW SONIC BOOM



“My idea is that music should have a part in this...It is a scenario to be created wholly from relationships: light, plasticity, design and music...It will be the first truly electric work and with symphonic power.” - Le Corbusier

THE NEW SONIC BOOM



**Le Corbusier &
Edgard Varesé**

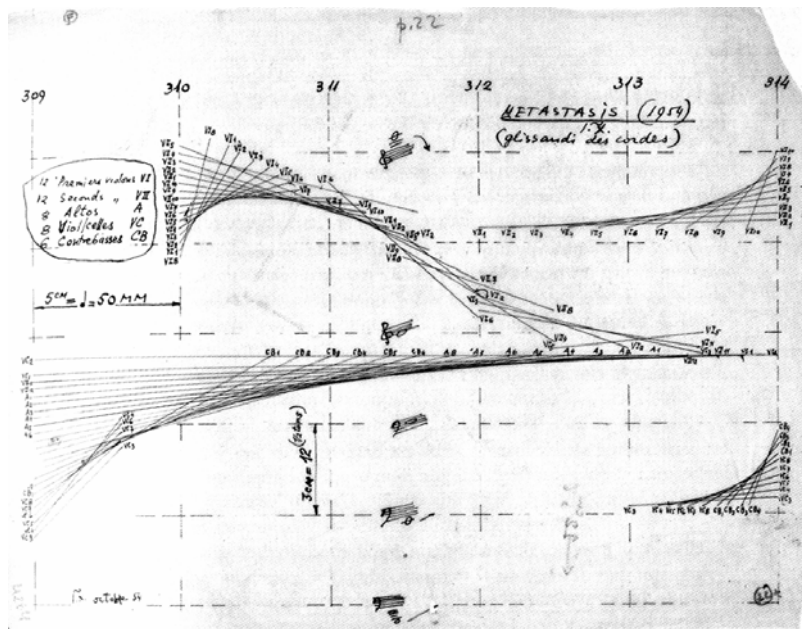
**Le Corbusier &
Iannis Xenakis**



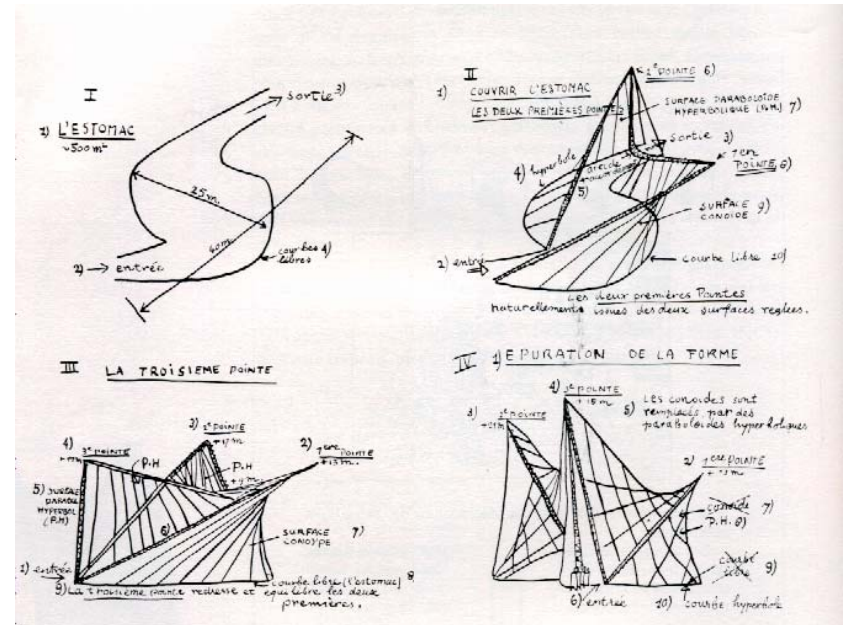
“...I want to let you know immediately that I find your project superb and that I accept with great pleasure your offer of collaboration.” -Edgar Varesé

THE NEW SONIC BOOM

“Metastasis was the source of...The Philips Pavilion...which I designed and made out of ruled surfaces much like my fields of string glissandi.” -Iannis Xenakis



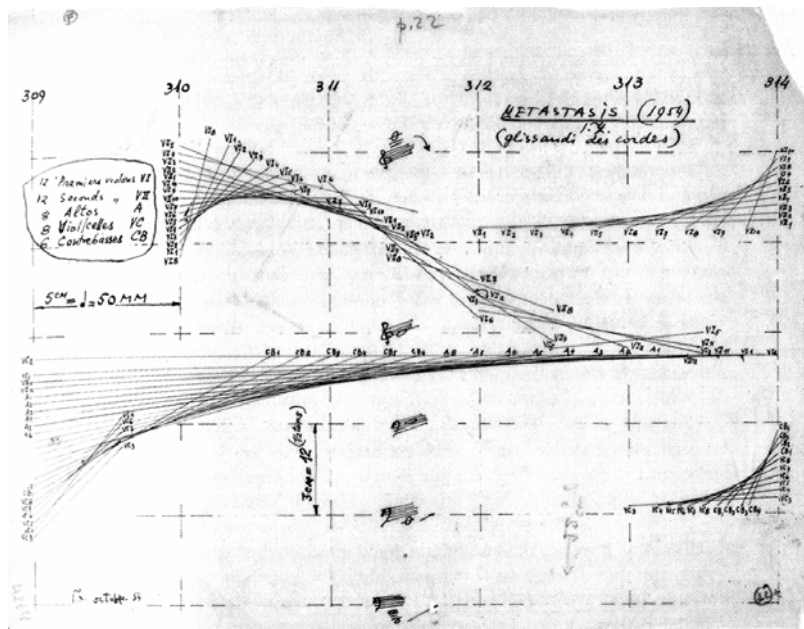
Musical score of glissandi from *Metastasis* 1953 – 1954



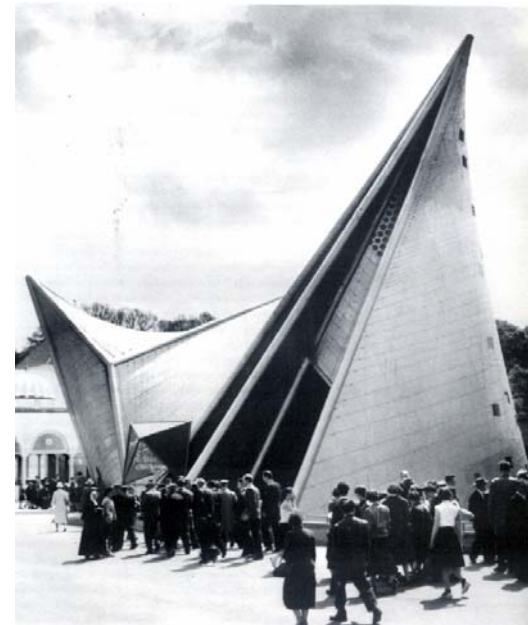
Conceptual sketches by Xenakis showing pavilion's geometry

THE NEW SONIC BOOM

“Metastasis was the source of...The Philips Pavilion...which I designed and made out of ruled surfaces much like my fields of string glissandi.” -Iannis Xenakis



Musical score of glissandi
from *Metastasis* 1953 – 1954



Philips Pavilion
1958

THE NEW

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**Performance Space
for *Prometeo***
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Renzo Piano - Architect

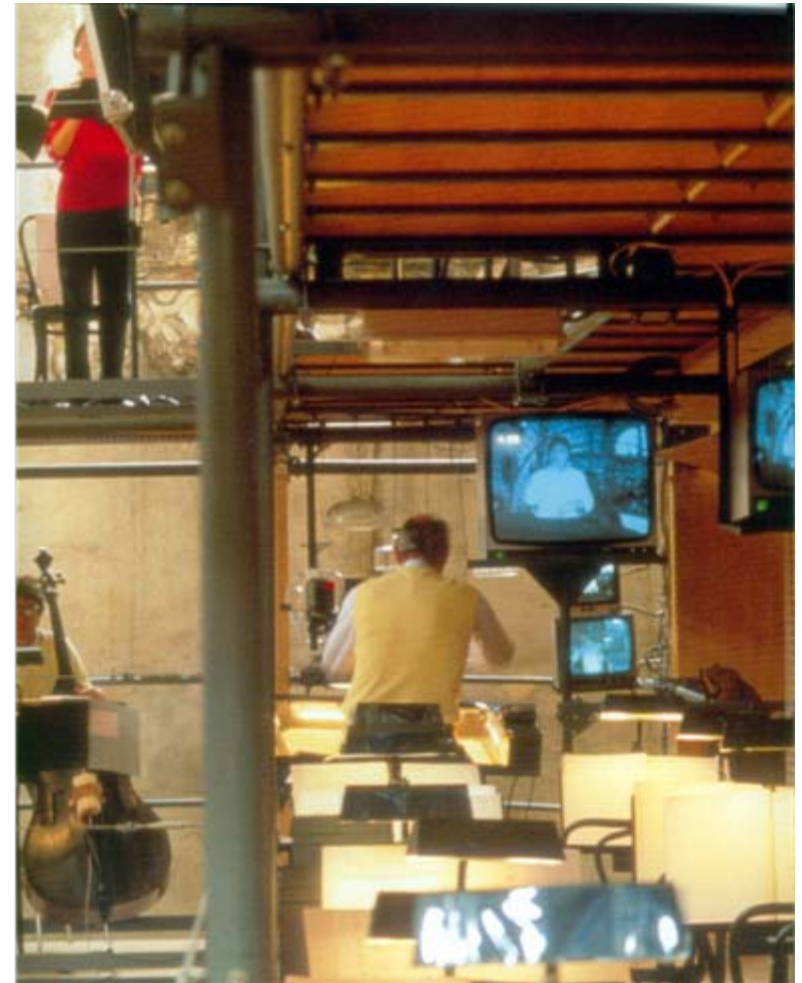


Luigi Nono - Composer

THE NEW SONIC BOOM



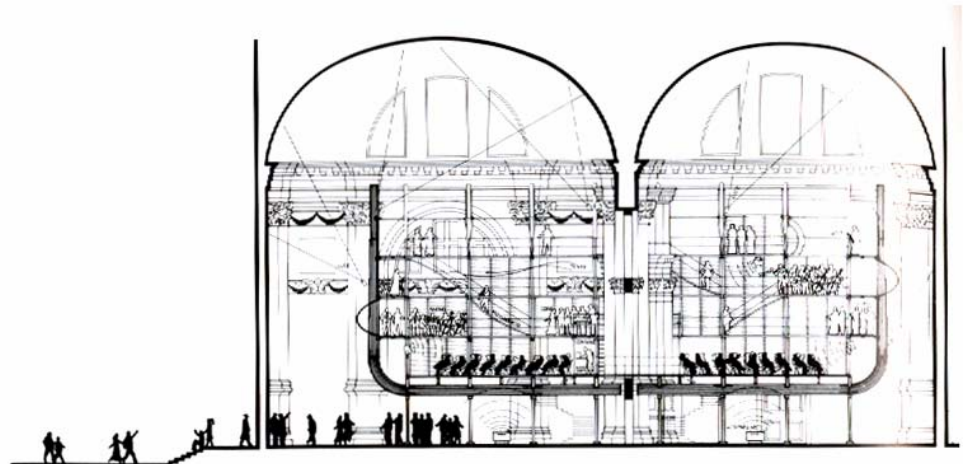
“We must learn to live with the plurality of times and spaces, with multiplicities and with differences.” - Luigi Nono



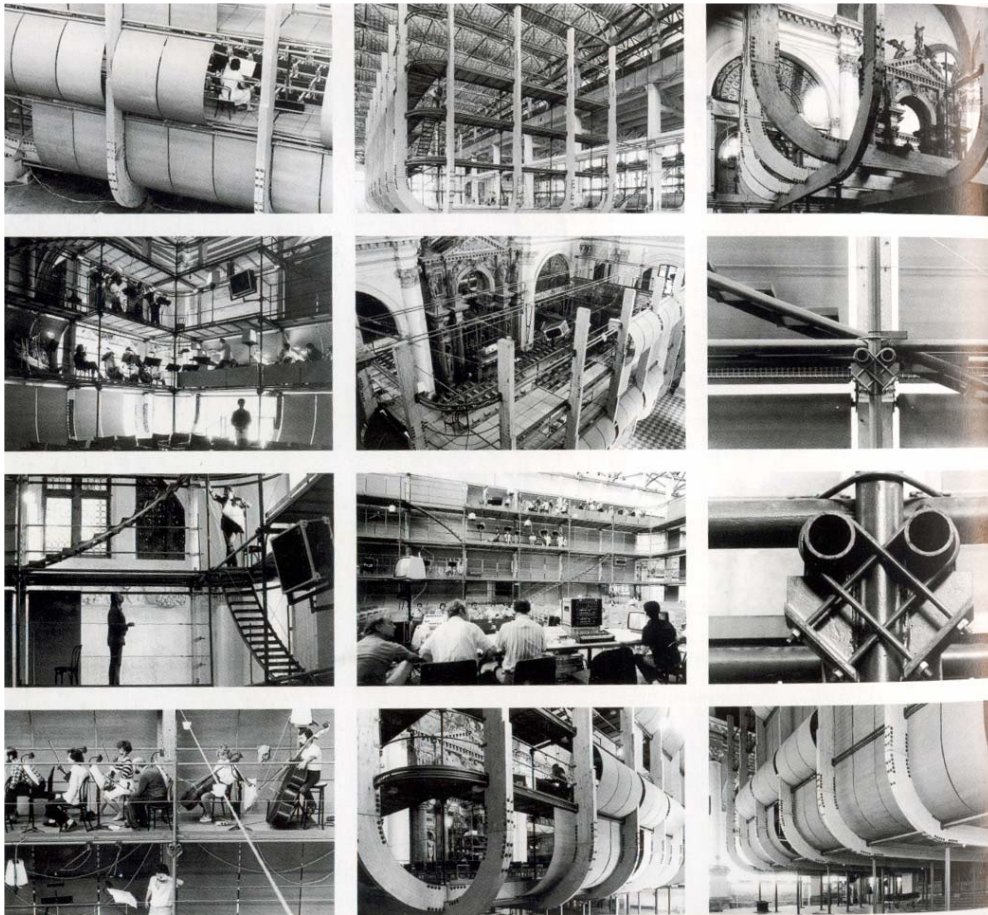
THE NEW SONIC BOOM



"The music in *Prometeo* is not projected into perspective, over the heads of the audience as in traditional opera house, but instead inundates the audience, which becomes fully immersed in the performance." -Renzo Piano



THE NEW SONIC BOOM



“The most beautiful adventure for an architect is to build a space for music. Perhaps it is more beautiful for a luthier to design a violin, but both are about building instruments.” -Renzo Piano

THE NEW SONIC BOOM



Pavilion of the Swiss Confederation

Hanover – Expo 2000

Peter Zumthor / Daniel Ott

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Peter Zumthor

“The spatial and structural engineering is designed to amplify and direct the tone and timbre of the commissioned musical compositions. The image of a large sound-box was used as a basis for the design.” -Excerpt from: *Swiss Sound Box - A handbook for the Pavilion of the Swiss Confederation*

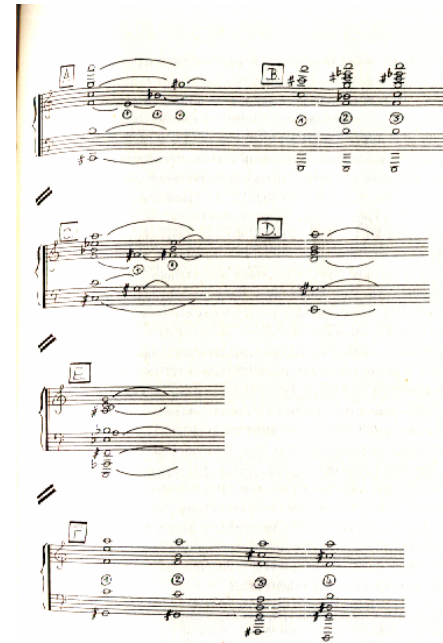
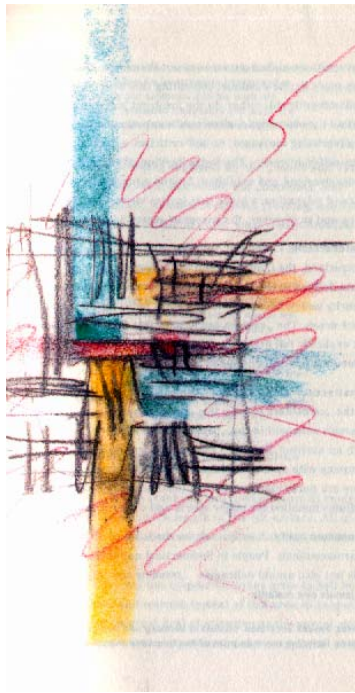


Daniel Ott

“I had this idea of ‘spatial music’ with mobile musicians inside a continually changing sound space...One of the aims is to complement / cross the musical flow, to intervene and disrupt constructively.”
– Daniel Ott

THE NEW SONIC BOOM

“I have to produce images in my mind and in the minds of my collaborators. Any time we work on it, we have an image of how it looks. Then its easy to react on it...” - Peter Zumthor on “form”

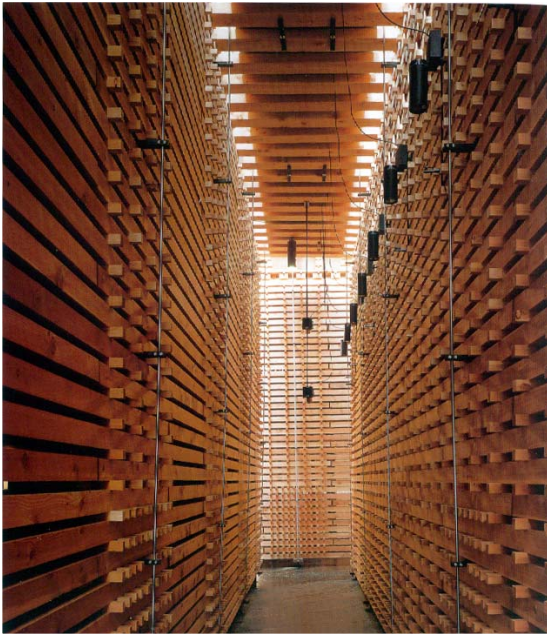


Architectural concept sketches

Musical score

THE NEW SONIC BOOM

The composer has attempted to convert the number that he gathered from the Swiss Sound Box enterprise into a composition and in turn to convert the rows of numbers and proportions produced by the composition into sounds and time-based structures. For example, architectural numbers: twelve stacks, three courts, the number of beam layers within a stack, etc.



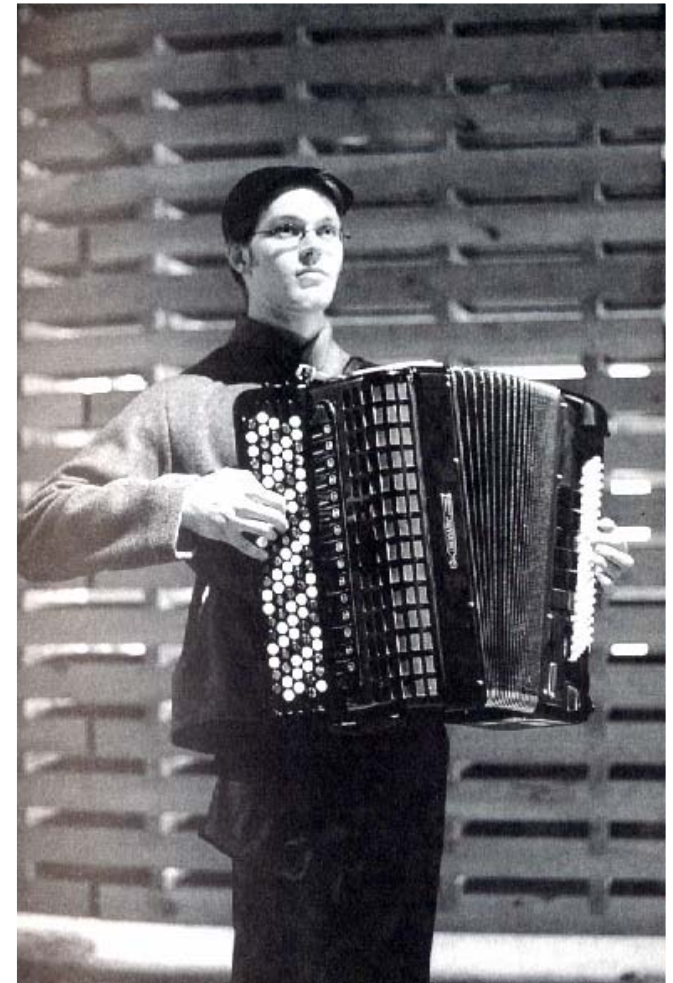
Timber walls in the pavilion



Stacked wood in a luthier's shop

THE NEW SONIC BOOM

“The resulting Sound Box music consists of heterogeneous building blocks that can be reconfigured daily during the 153-day performance.” -Excerpt from: *Swiss Sound Box Handbook* on “Composition Method.”



CONCLUSION

The three buildings cited as examples were constructed as temporary, purpose-built structures, in essence as ephemeral as the music performed within them.

Music and Architecture informed one another through a common language shared by Architect and Composer, allowing for and facilitating collaboration.



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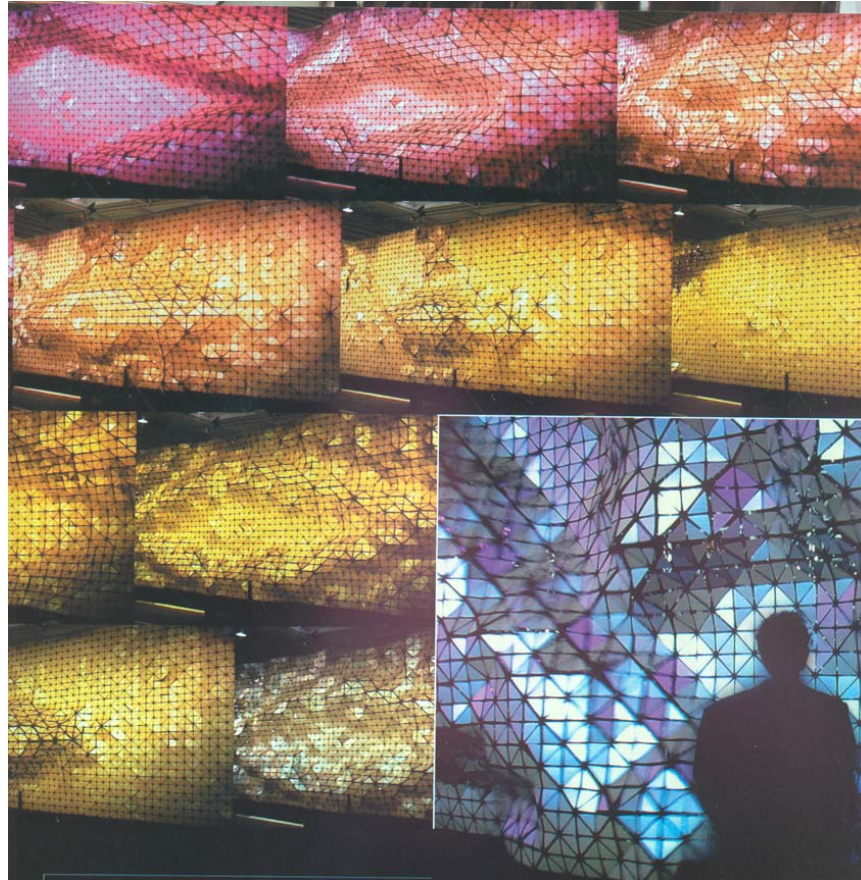
II.

SEE HEAR NOW:

Emerging Audio Technology

THE NEW SONIC BOOM

Digital Audio Control Systems

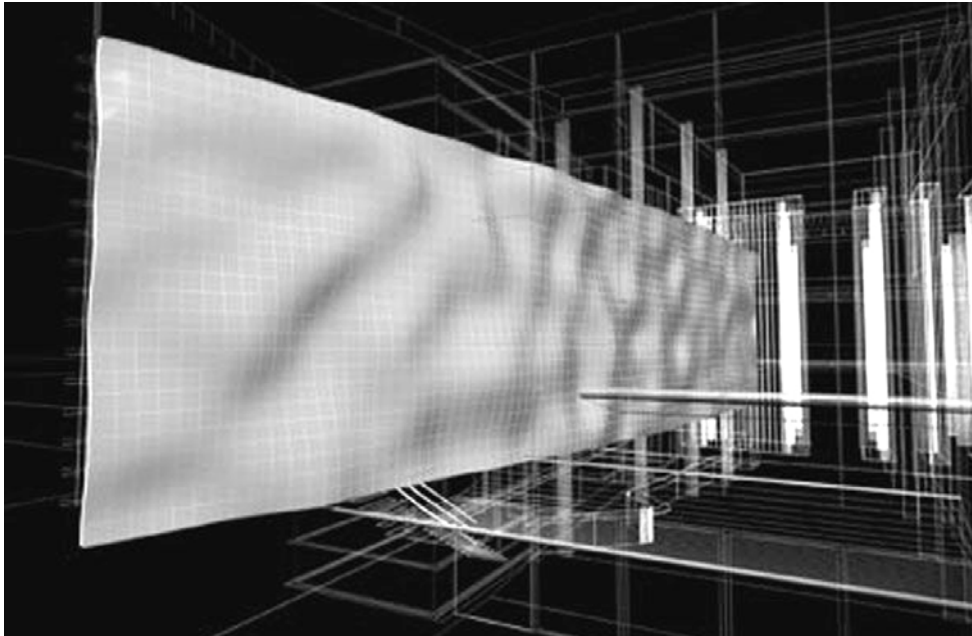


Aegis Hyposurface
Mark Goulthorpe/
dECOi Architects
1999-2001

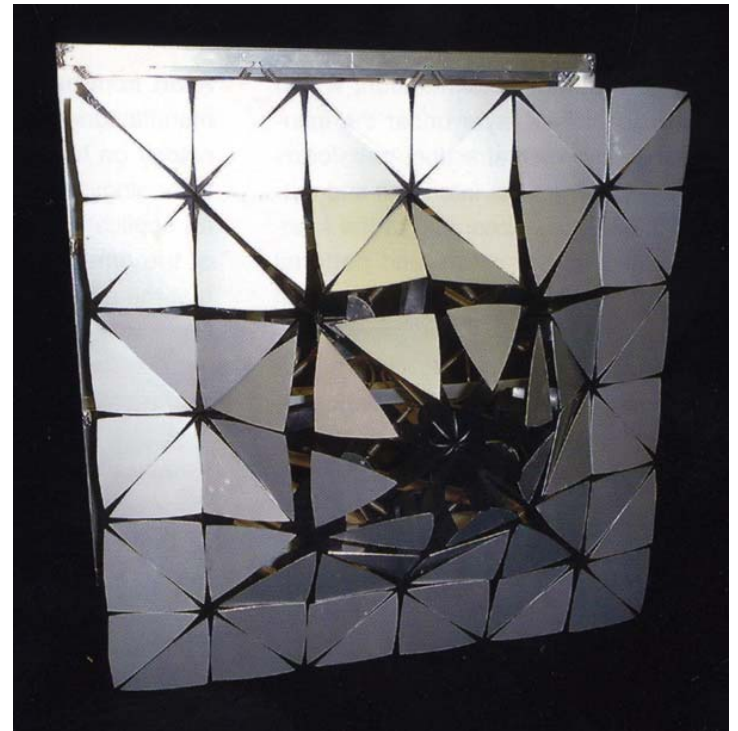
THE NEW

SONIC BOOM

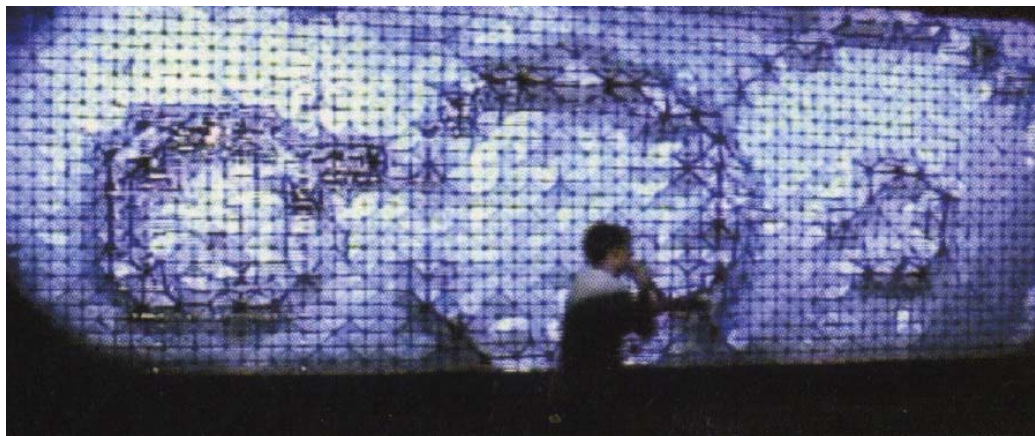
Digital Audio Control Systems



Aegis Hyposurface
Mark Goulthorpe/dECOi Architects
1999-2001



Digital Audio Control Systems



THE NEW SONIC BOOM

Bone Mass Transducers

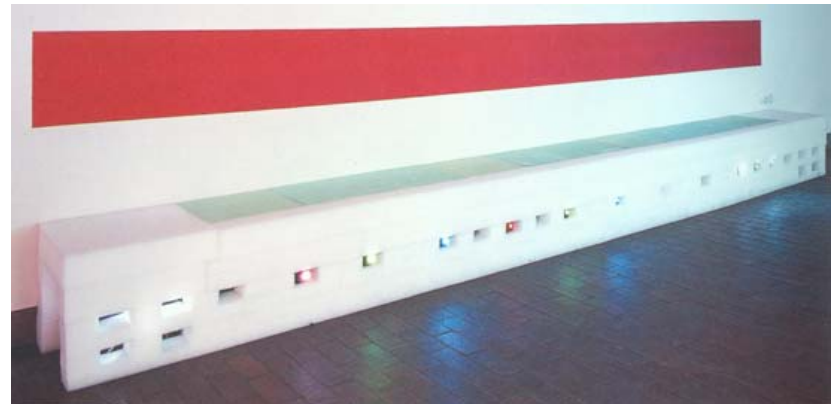


Boundary Interference

Installation at Harvard GSD

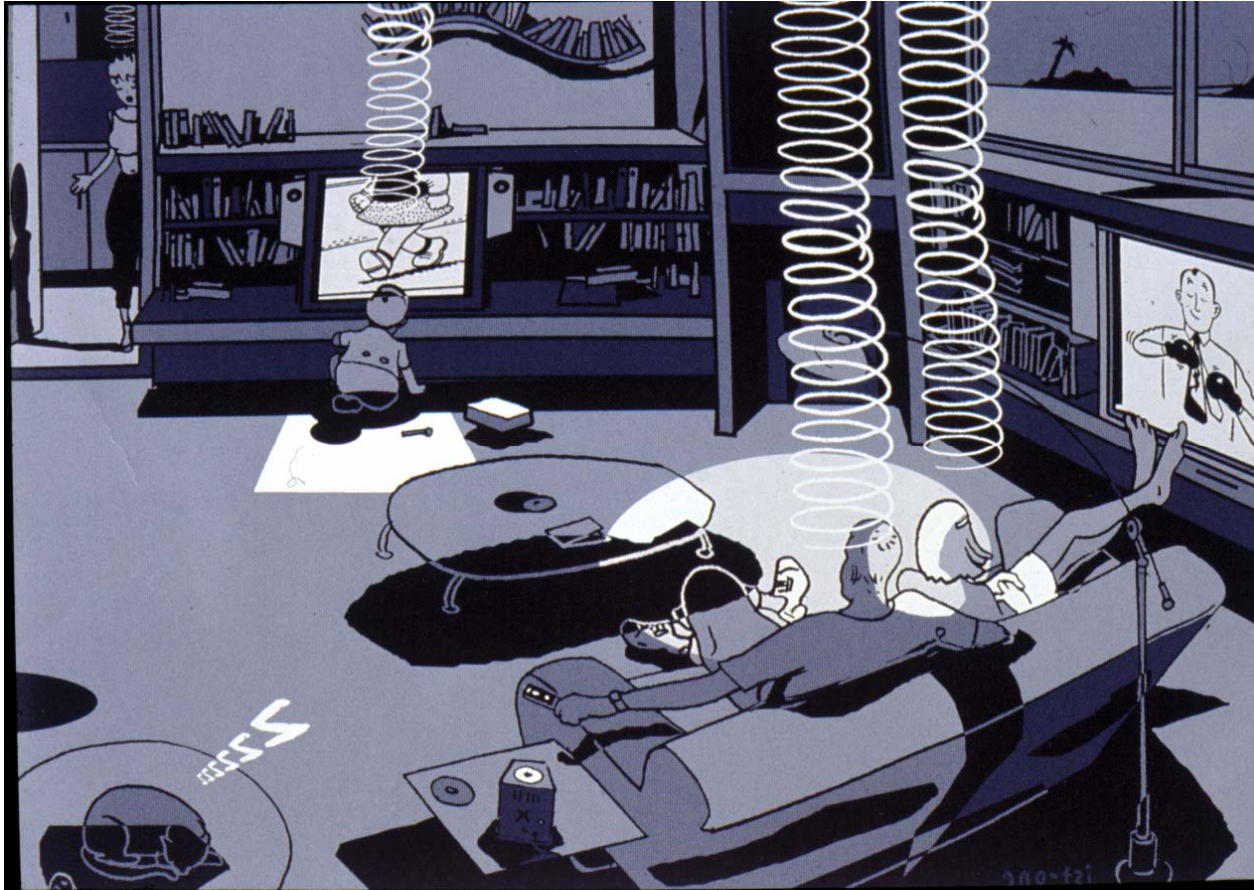
Ean White, Designer

2001



THE NEW SONIC BOOM

Hypersonic Sound



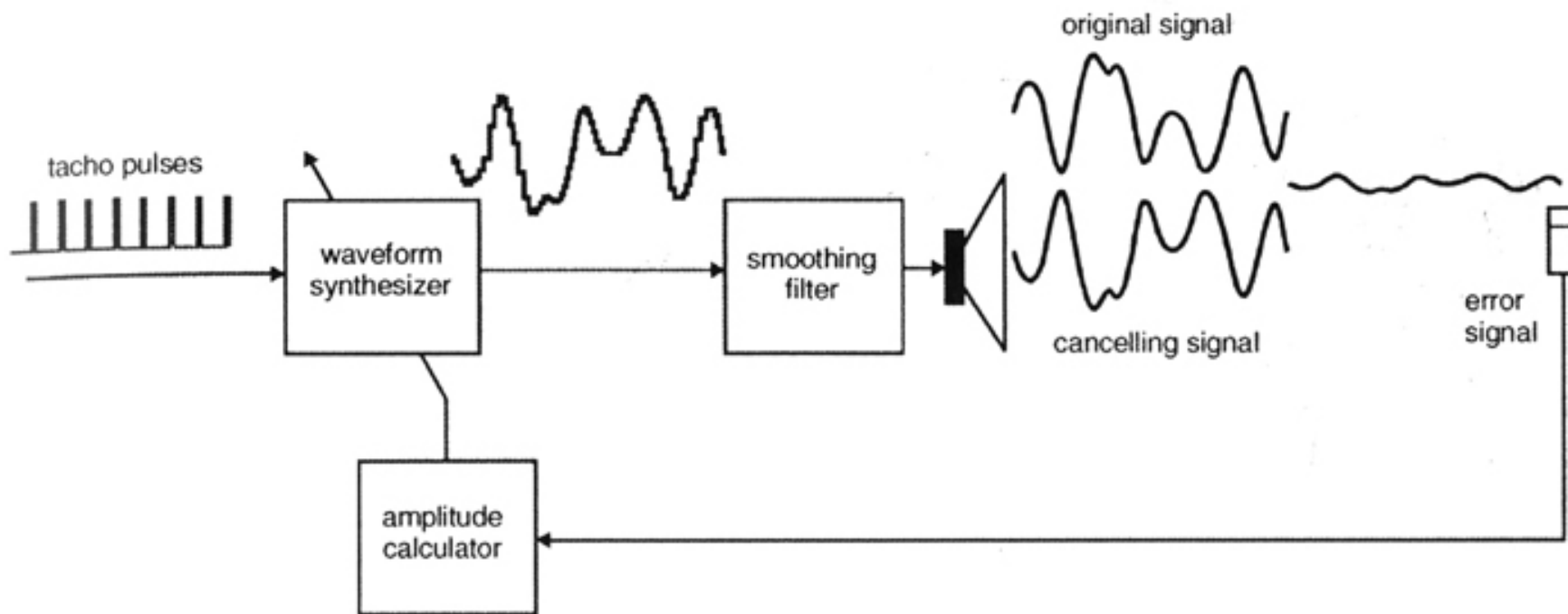
THE NEW

SONIC BOOM

Active Noise Cancellation



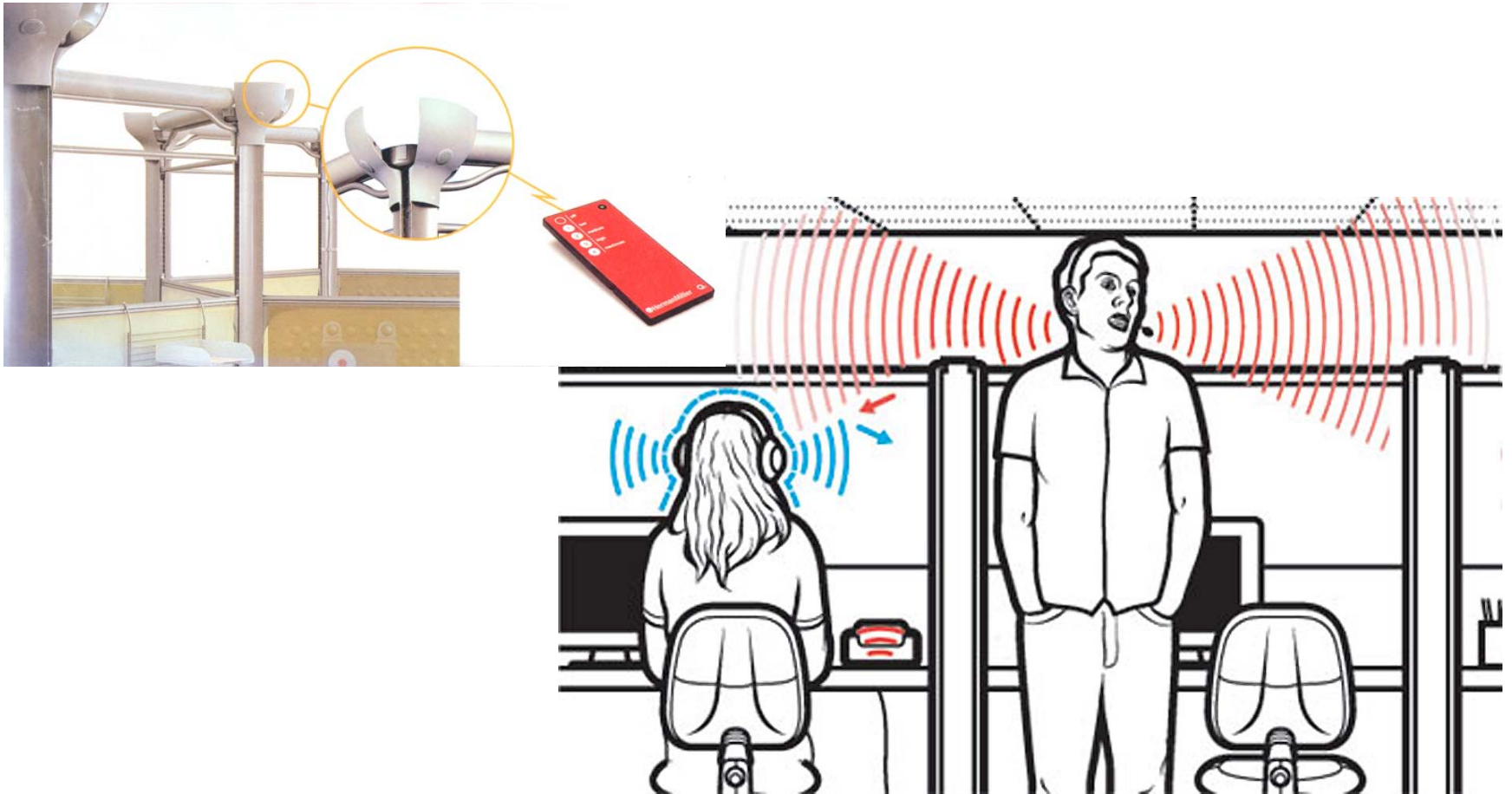
Active/Adaptive Noise Cancellation



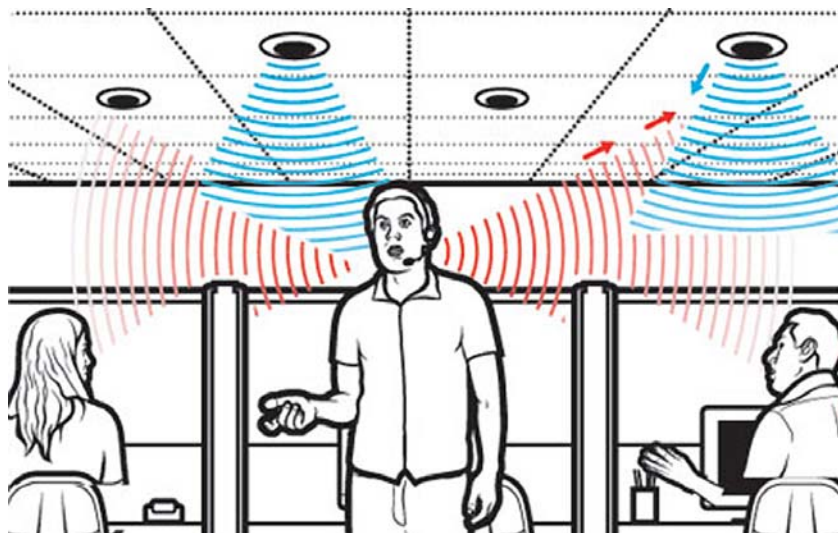
Schematic Diagram

THE NEW SONIC BOOM

Active Noise Cancellation



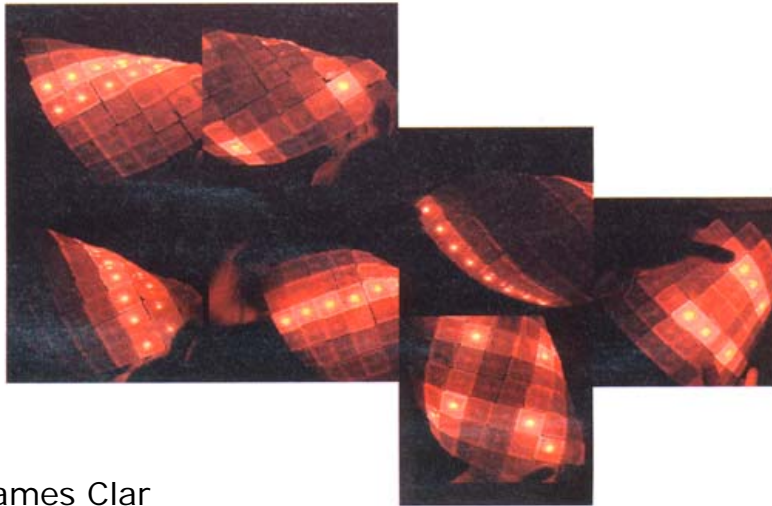
Tunable Pink Noise



Masking Software



Acoustically Responsive Materials



FLEXGRID

Hariri + Hariri with James Clar



URBAN CAMELEON

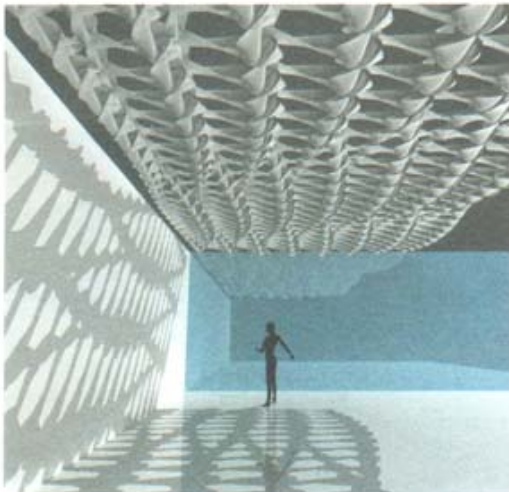
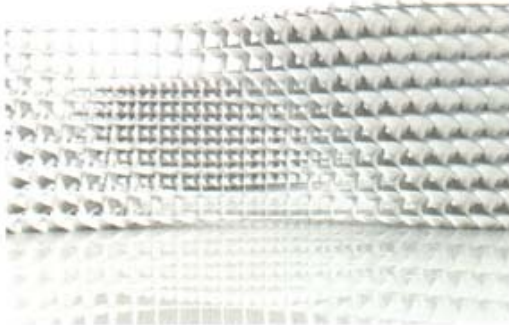
University of Dublin

THE NEW SONIC BOOM

Software

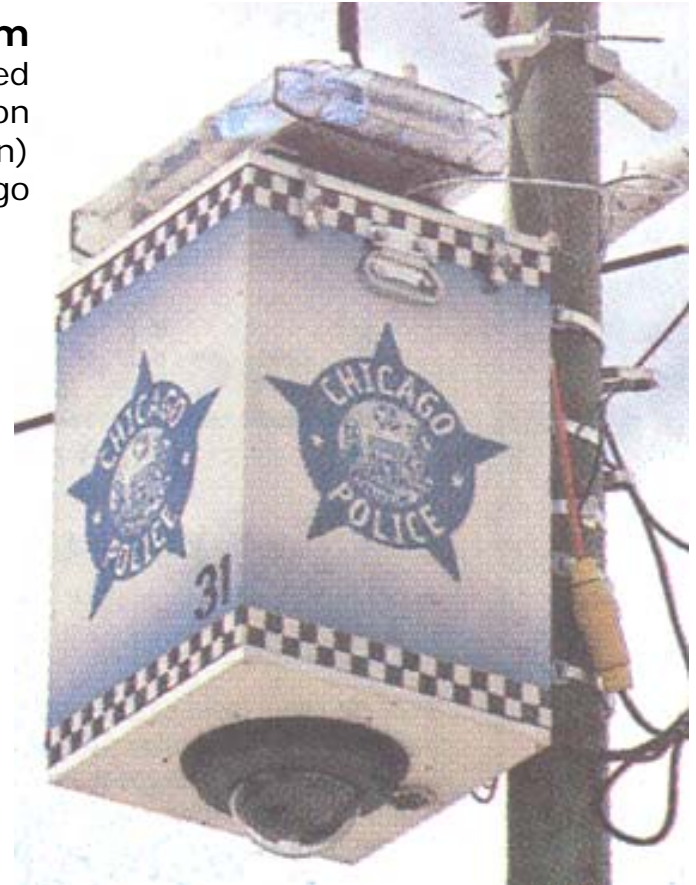
Sentri System

(Smart Sensor Enabled
Neutral Threat Recognition
and Identification)
Chicago



Genware Algorithmic/ Genetic Software

Alisa Andrasek -
Columbia University





THE NEW

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III.

SPACE + SOUND + TECHNOLOGY:

New Sonic Environments

THE NEW SONIC BOOM



BLUR BUILDING

Diller + Scofidio with Christian Marclay
Yverdon-Les-Bains, Switzerland, 2002



THE NEW SONIC BOOM

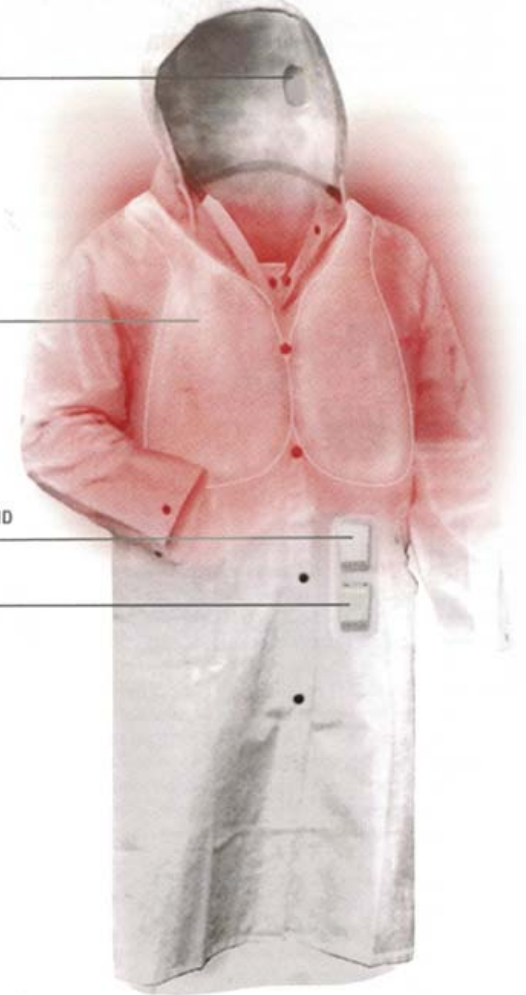


SPEAKER

LUMINOUS DISPLAY

DATA TRANSCEIVER AND
POWER SUPPLY

LOCATION TAG



Braincoats

THE NEW SONIC BOOM



Mind Zone
Zaha Hadid with Ryoji Ikeda
London, 1999-2000



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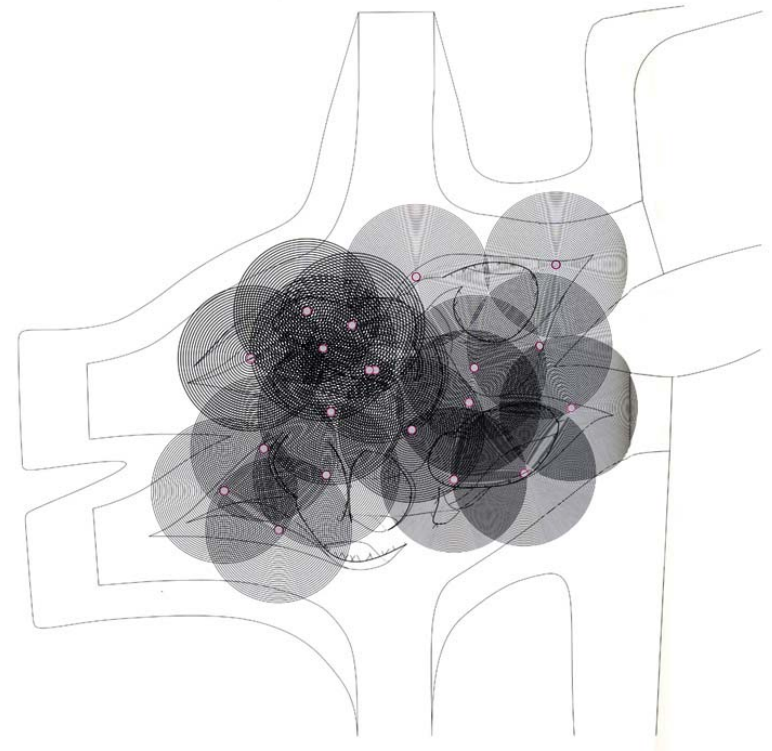
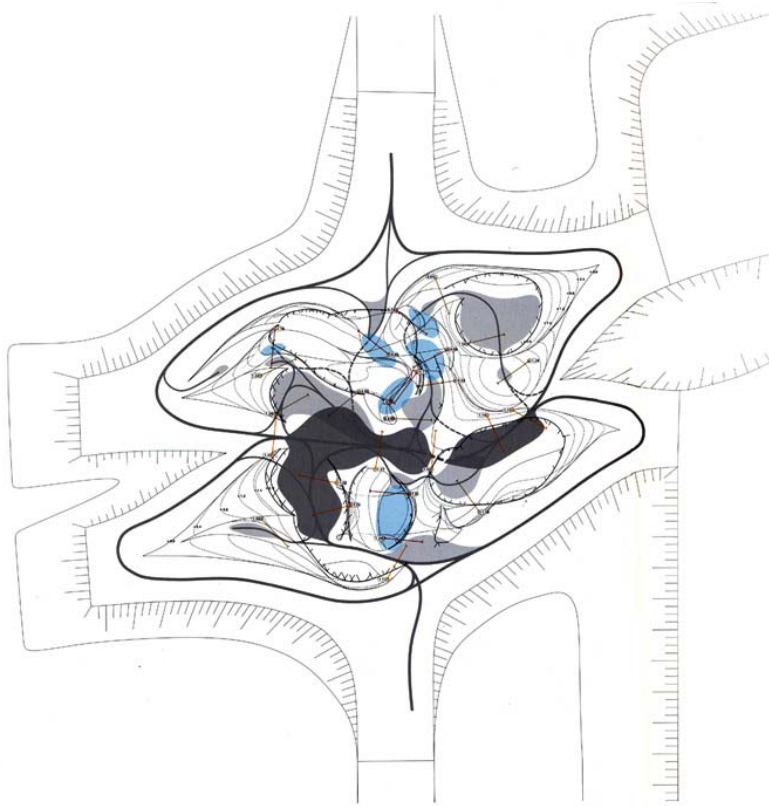


Son-O-House

NOX/Lars Spuybroek with Edwin van der Heide
Son en Breugel, Netherlands, 2002-2004

THE NEW

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Son-O-House

NOX/Lars Spuybroek with Edwin van der Heide
Son en Breugel, Netherlands, 2002-2004



THE NEW

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IV. SUMMARY AND CONCLUSION

The background of the top section features a photograph of a building's exterior under construction, showing wooden scaffolding and concrete elements. Overlaid on this is a technical diagram consisting of several overlapping circles and a horizontal line with arrows at both ends, suggesting a path or flow. The text 'THE NEW' is written in a large, white, serif font across the top.

THE NEW

SONIC BOOM

CONCLUSIONS AND SUMMARY



THE NEW

SONIC BOOM

CONCLUSIONS AND SUMMARY

- I. The relationship between sound and space has a long and important history.

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CONCLUSIONS AND SUMMARY

- I. The relationship between sound and space has a long and important history.
- II. The relationship between architecture and music was renewed with particular vigor during the 20th century.
- III. New sonic technologies are emerging that will allow architects to use sound as never before.
- IV. Architects are using sound in the 21st century to shape form and space.



THE NEW

SONIC BOOM

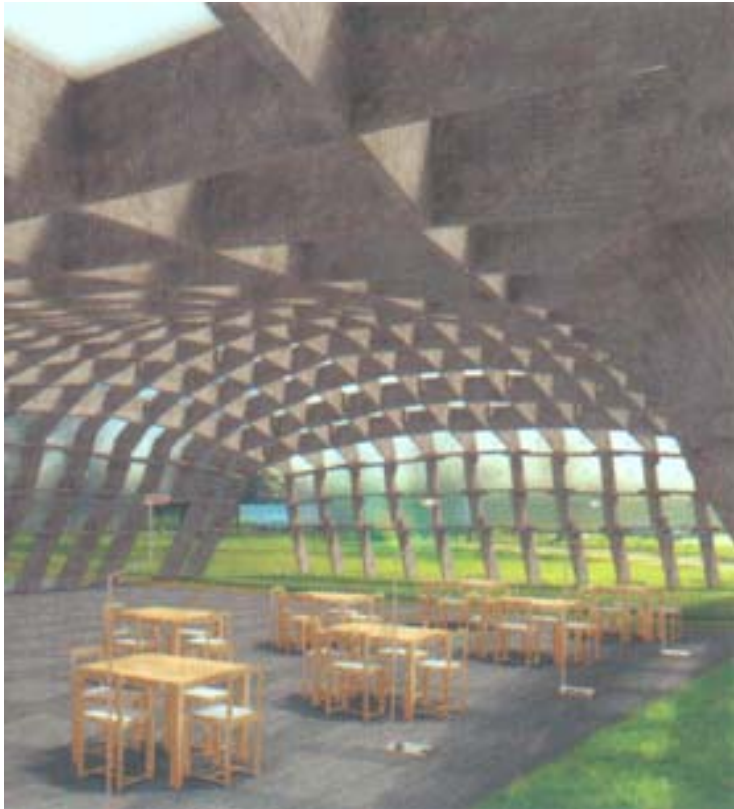
V.

CASE STUDY:

Serpentine Pavilion

Steve Roden, Sound Artist

THE NEW SONIC BOOM



Serpentine Pavilion

Álvaro Siza and Eduardo Souto de Moura
Sound performance by Steve Roden
London, 2005

Conical Shock Wave

Jim Lutz
Architecture Program
University of Memphis

Steve Roden
Sound Artist
Los Angeles

THE NEW SONIC BOOM

Designing Dynamic Acoustic Environments

*How cutting-edge architects and artists are collaborating
to break the architectural sound barrier*

$v_s t$

The American Institute of Architects
2006 National Convention – Los Angeles

Seminar Evaluation

Please take a moment to complete the evaluation form. Thank you.

Moderator: Jim Lutz, University of Memphis
Memphis, Tennessee

Speaker 1: Steve Roden
in between noise
Pasadena, California