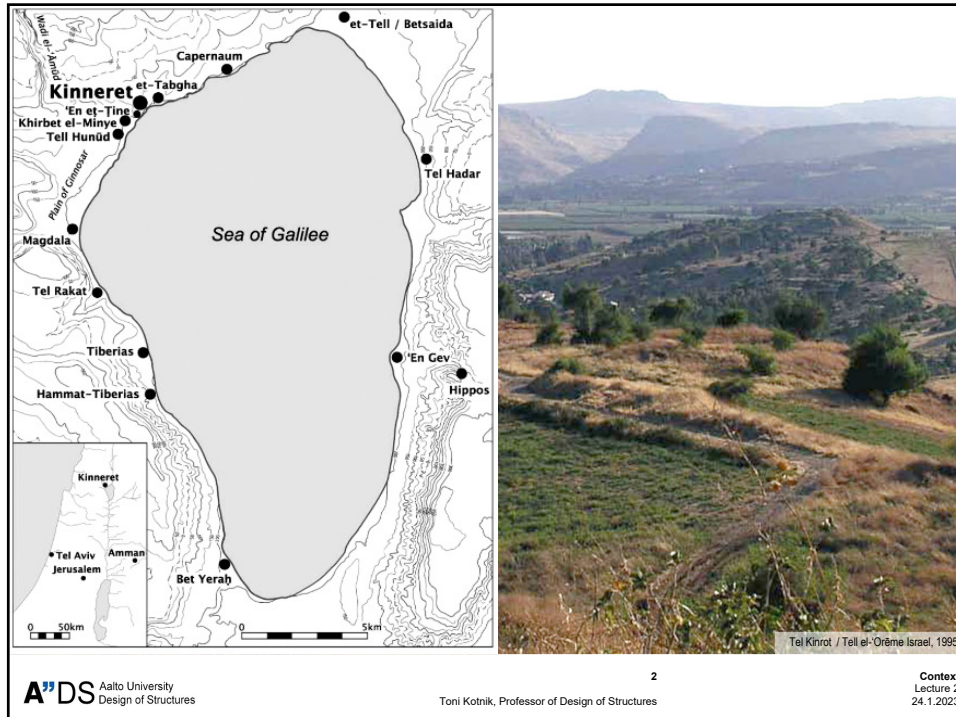


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Design of Structures
Input 2: Context

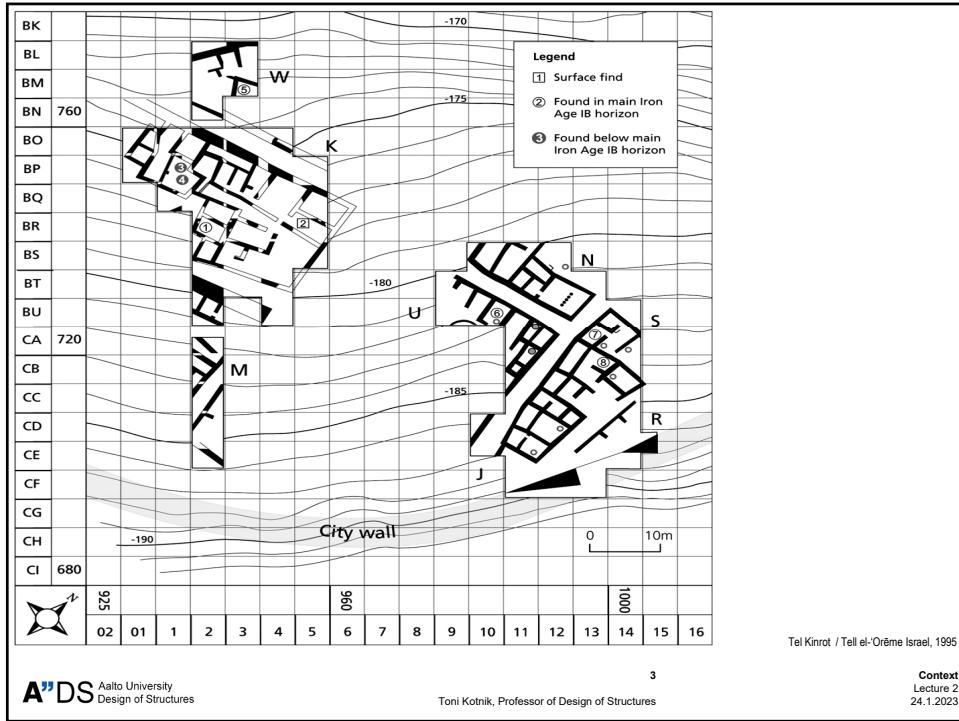
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Professor of Design of Structures
Department of Architecture
Aalto University

1



2

1



3

"Imagine the purely physical world. This would have to be a giant aggregate composed of all the physical stuff in the universe. There is nothing nonphysical in this, but most philosophers prefer a less amorphous characterization; they begin with all physical objects, or all particles, or all space-time points. ... To add even this small amount of structure - the differentiation of the amorphous mass into individuals of some kind - is already to broach the mathematical."

Penelope Maddy

Mathematics is the science of patterns based on bodily or mental perception of the surrounding world.

Mathematics is a construct of the human brain!

When is a stone a stone and when is a stone part of a wall?

Tel Kinrot / Tell el-'Orâme Israel, 1995

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Context
Lecture 2
24.1.2023

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"Imagine the purely physical world. This would have to be a giant aggregate composed of all the physical stuff in the universe. There is nothing nonphysical in this, but most philosophers prefer a less amorphous characterization; they begin with all physical objects, or all particles, or all space-time points. ... To add even this small amount of structure - the differentiation of the amorphous mass into individuals of some kind - is already to broach the mathematical."

Mathematics is the science of patterns based on bodily or mental perception of the surrounding world.

Mathematics is a construct of the human brain!

Penelope Maddy

visual thinking: basic laws of organization in Gestalt theory

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"A set is a collection M of well-distinguished objects of our perception or our thinking (which we call the elements of M) into a new whole."

Georg Cantor, Beiträge zur Begründung der transfiniten Mengenlehre, 1895

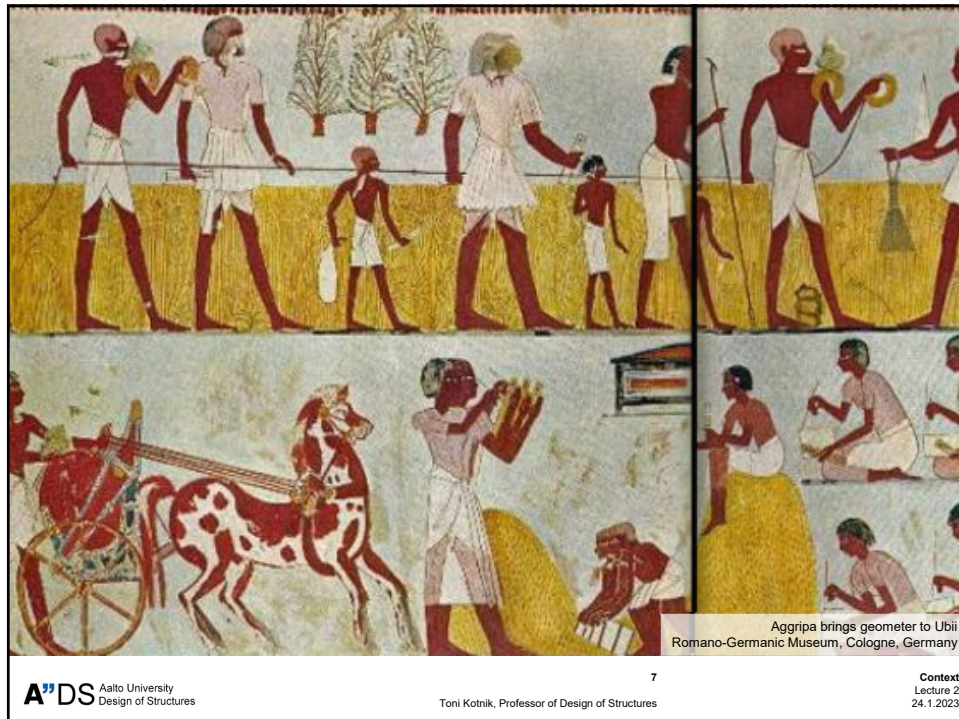
mathematics as science of patterns

- Structures of Hierarchy**
focus on comparison
 $a \leq b$
quantity
- Algebraic Structures**
focus on operations
 $a + b$
combinatorics
- Topological Structures**
focus on neighborhood
 $|a - b|$
quality

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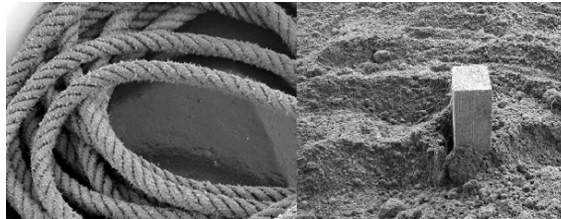
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Euclidean Geometry



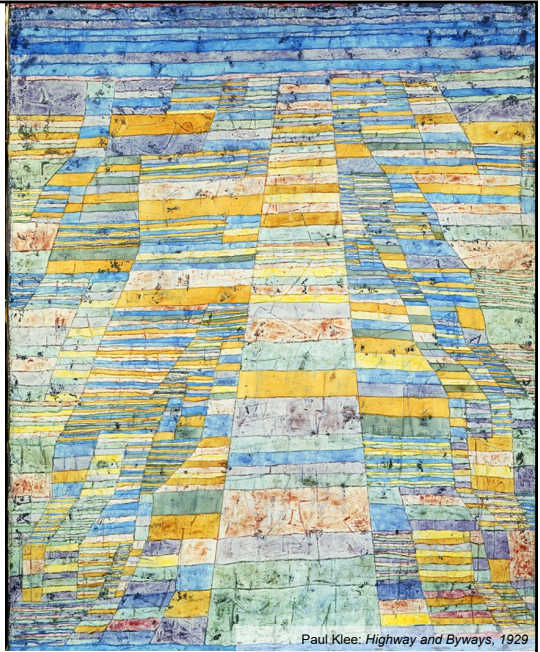
1. A straight line may be drawn from any point to another.
2. A straight-line segment may be extended indefinitely along a straight line.
3. A circle may be described with any point as its center and any distance as its radius.
4. All right angles are identical.
5. Finally, if two straight lines intersect a third in such a way that the sum of the inner angles on one side is less than two right angles, then the two straight lines must at some point intersect on that same side if extended indefinitely.

Five Postulates of Euclidean geometry

8

4

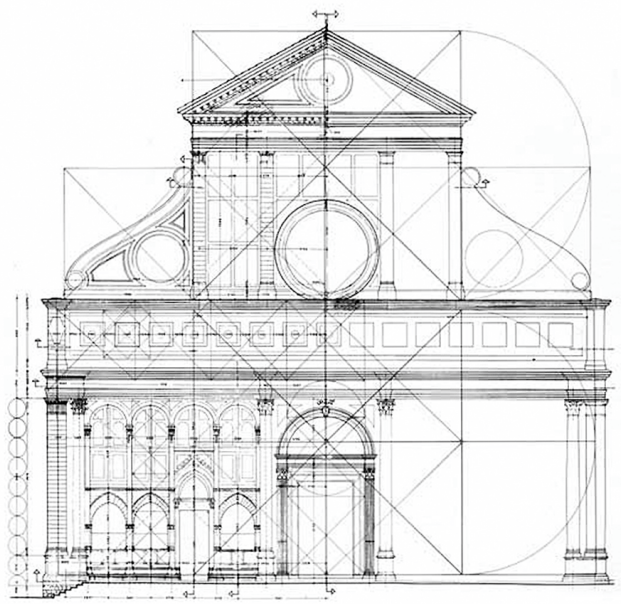
Euclidean Geometry
harpedonaptai



Paul Klee: Highway and Byways, 1929

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Euclidean Geometry
Architectural Order

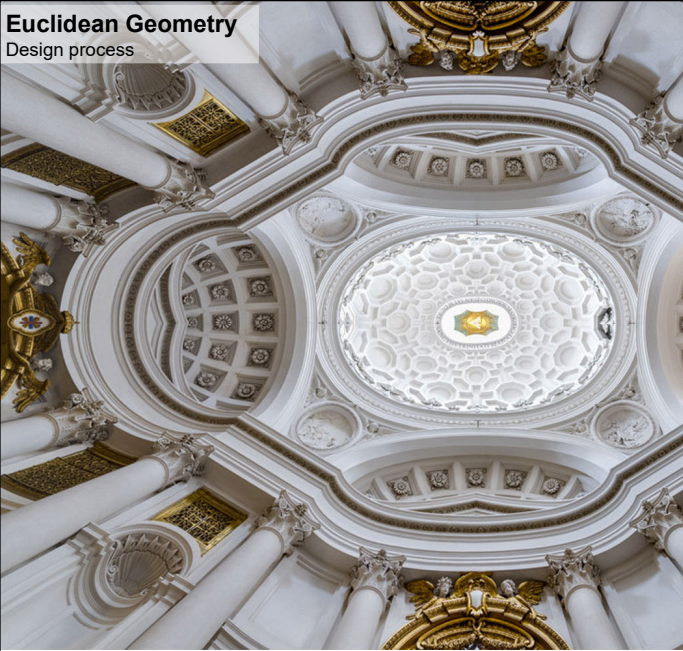


Leon Battista Alberti: Santa Maria Novella
Florence; Italy, 1456-1470

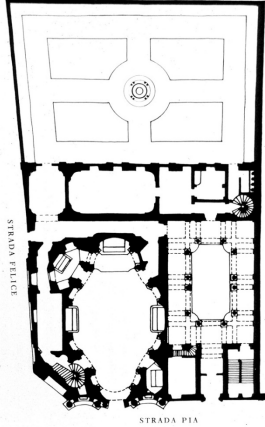
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Euclidean Geometry
Design process



church at the monastery of the Trinitarian order



Borromini: San Carlo alle Quattro Fontane
Rome, Italy, 1638-1677

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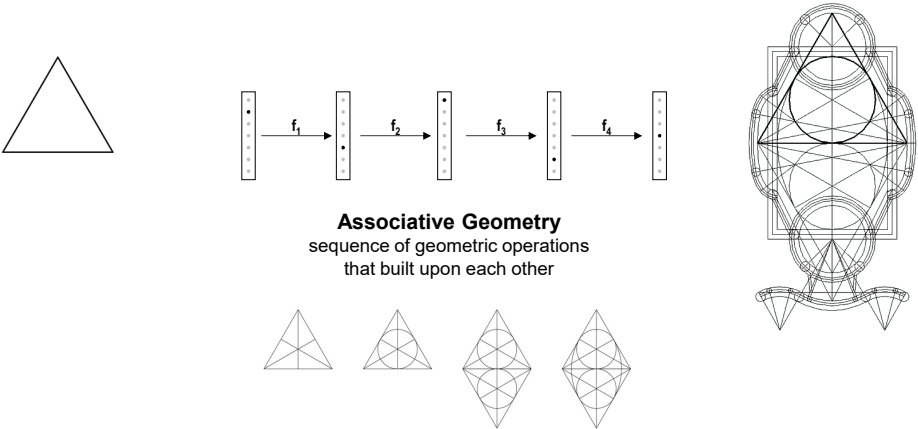
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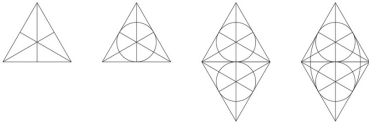
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Euclidean Geometry
Design process



Associative Geometry
sequence of geometric operations
that built upon each other



association (lat. *associare*: to unite, to ally)
uniting in a common purpose / work together for one goal

Borromini: San Carlo alle Quattro Fontane
Rome, Italy, 1638-1677

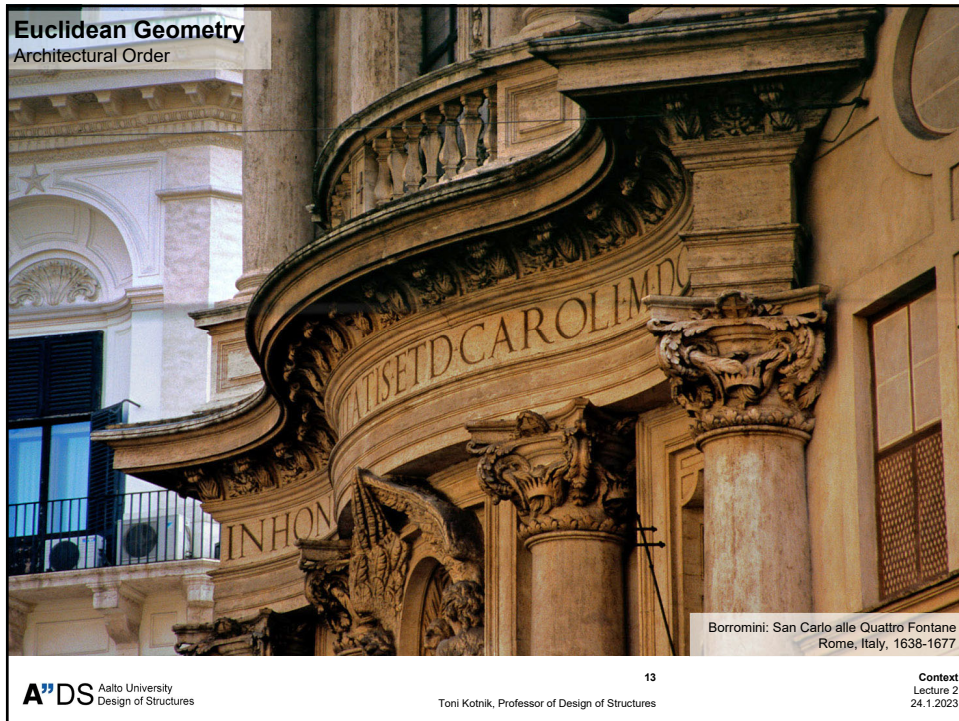
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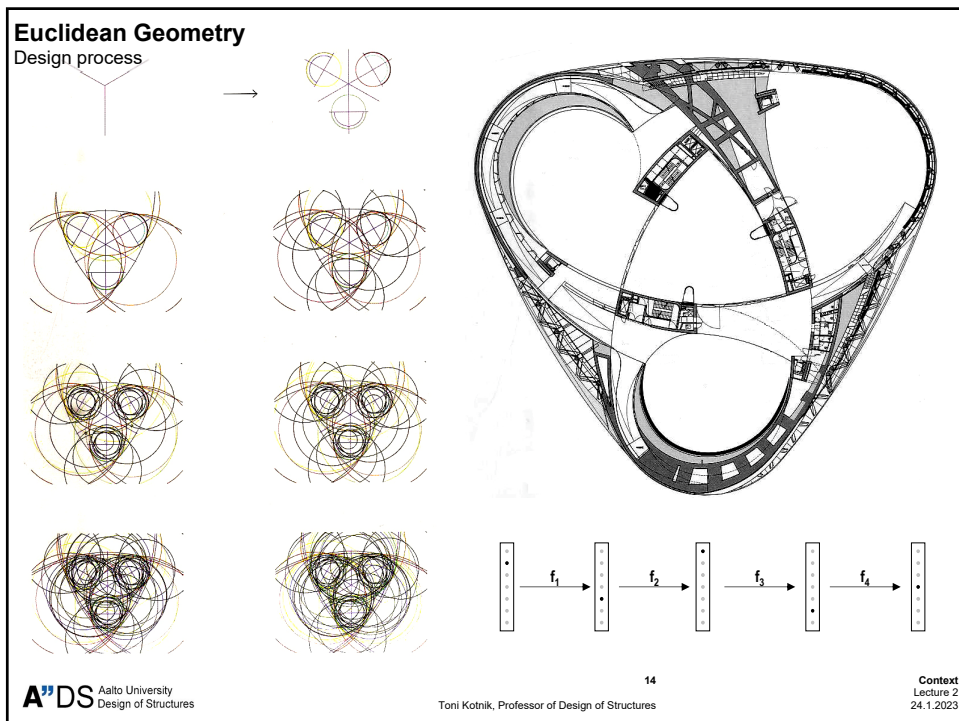
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Euclidean Geometry
Design process



UN Studio: Mercedes Benz Museum
Stuttgart, Germany, 2001-06

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Design = Order

```

    graph LR
      in1[in1] --> T1[T1]
      T1 -- out1 --> T2[T2]
      in2[in2] --> T2
      T2 -- out2 --> dots[...]
      dots --> Tn[Tn]
      in_n[in_n] --> Tn
      Tn -- out_n --> out_n[out_n]
      T1 == Tproj[Tproj]
      in_proj[in_proj] --> Tproj
      Tproj --> out_proj[out_proj]
  
```

the design process carries an inherent logic defined by the sequence of geometric operations

architectural form
is a
mathematical function
defined by
a sequence of operations

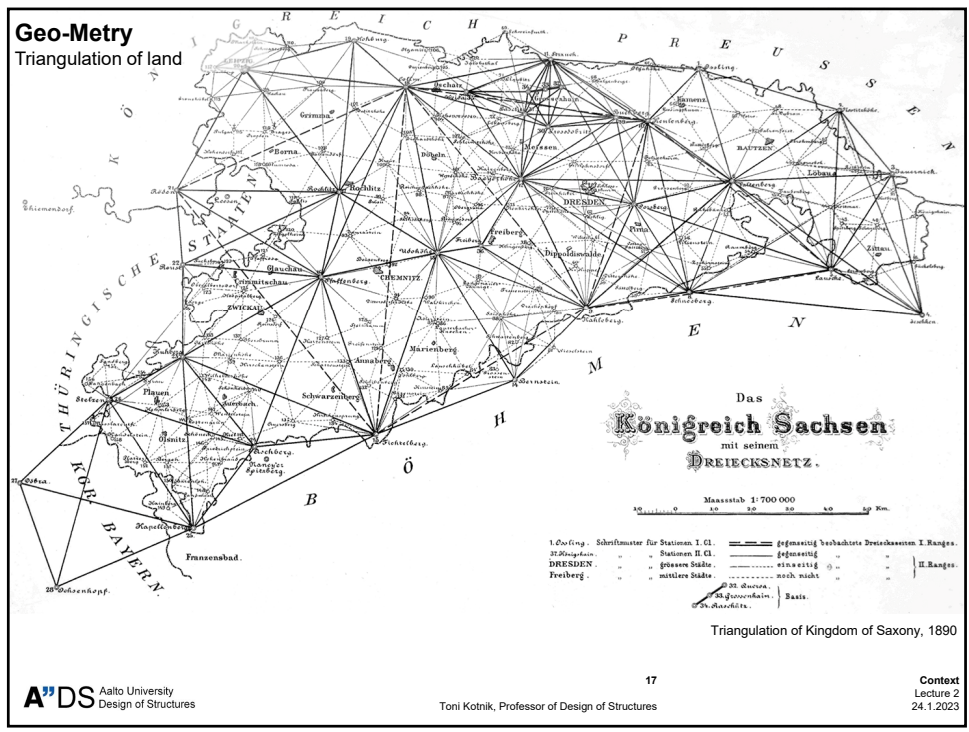
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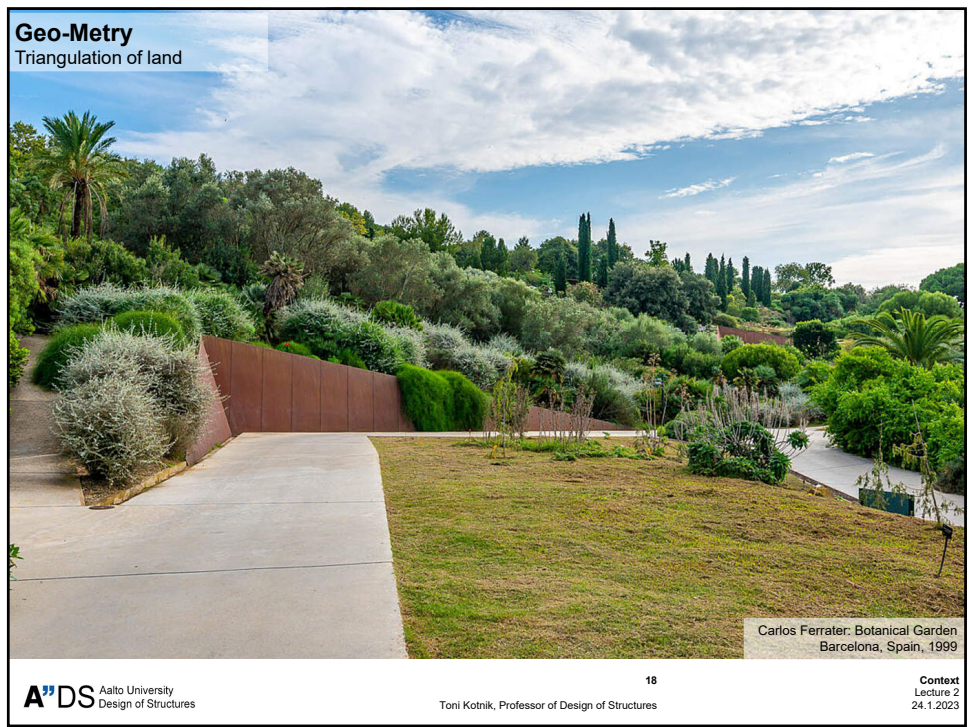
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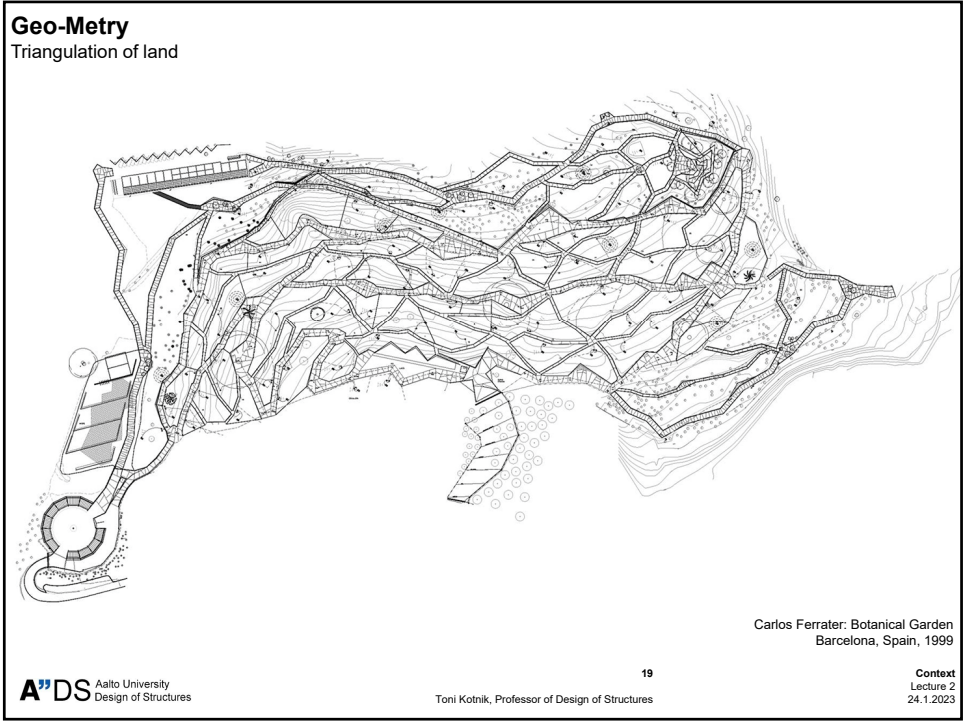
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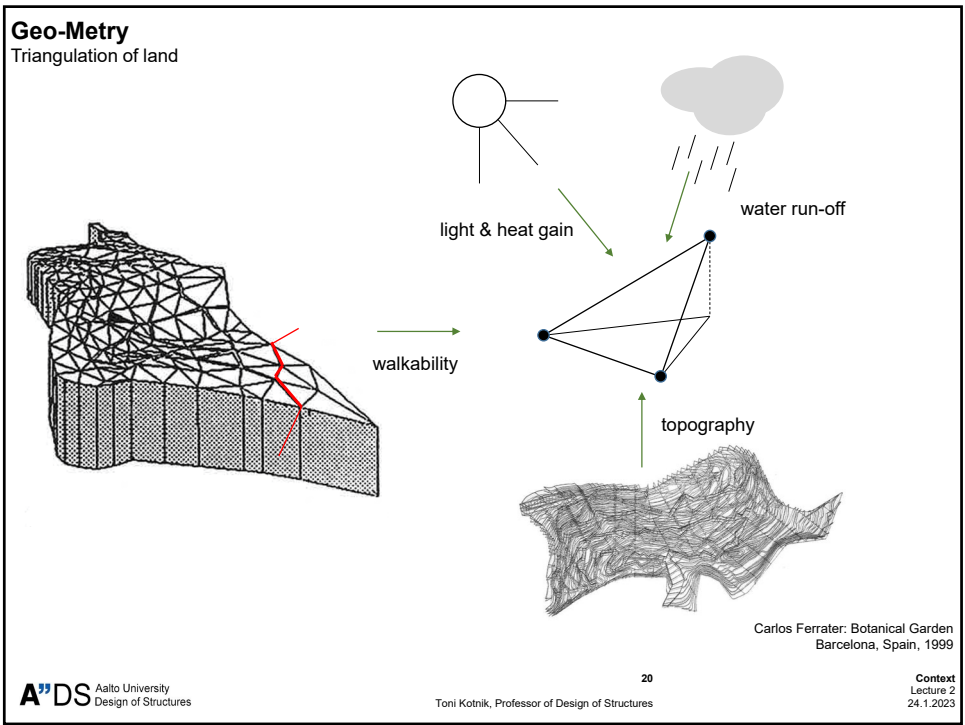
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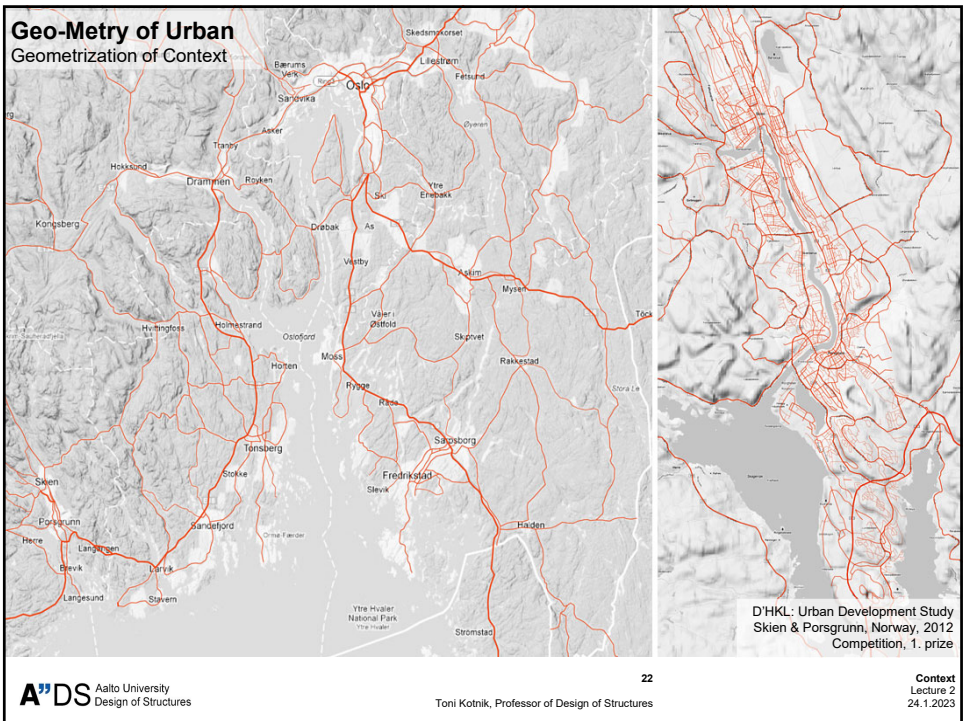
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Geo-Metry of Urban Geometrization of Context

REACH WEIGHTED

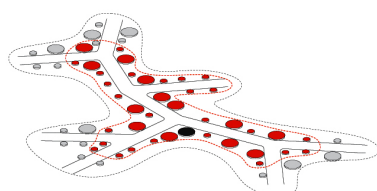
$$Reach[i]^w = \sum_{j \in G} W[j]$$


Fig. 09 Parameter Reach Weighted

- G → Set of the nodes of the Graph
- i → Node from which the calculation is performed (origin)
- j → Node to which the calculation is performed (destination)
- d[i,j] → Shortest path distance i and j
- G* = {j ∈ G - {i} : d[i,j] ≤ r} → Set of nodes j that in G are reachable from i at a shortest path distance of at most r
- W[j] → Weighted j node

STRAIGHTNESS

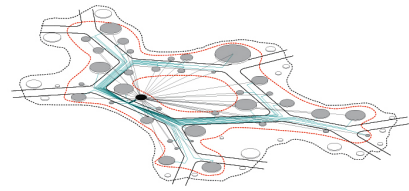
$$Straightness[i]^w = \sum_{j \in G} \frac{\tilde{d}[i,j]}{d[i,j]} \cdot W[j]$$


Fig. 10 Parameter Straightness

- G → Set of the nodes of the Graph
- i → Node from which the calculation is performed (origin)
- j → Node to which the calculation is performed (destination)
- d[i,j] → Shortest path distance i and j
- G* = {j ∈ G - {i} : d[i,j] ≤ r} → Set of nodes j that in G are reachable from i at a shortest path distance of at most r
- $\tilde{d}[i,j]$ → Straight-line Euclidean distance between i and j
- d[i,j] → Shortest past distance between i and j

D'HKL: Urban Development Study
Skien & Porsgrunn, Norway, 2012
Competition, 1. prize

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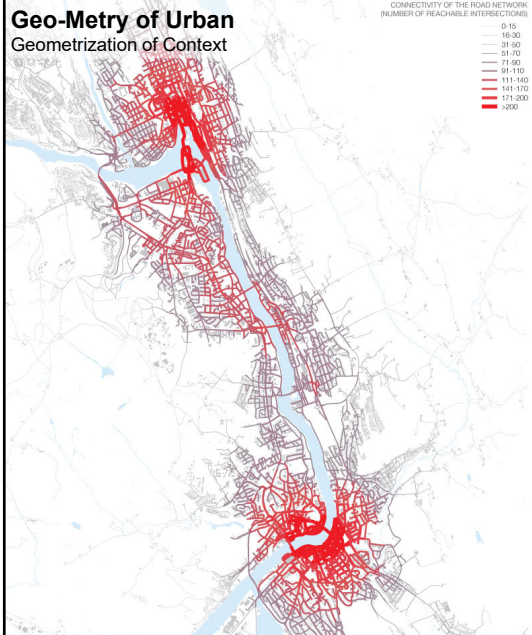
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Geo-Metry of Urban Geometrization of Context

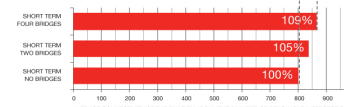
**CONNECTIVITY OF THE ROAD NETWORK
(NUMBER OF REACHABLE INTERSECTIONS)**

- 0-15
- 16-30
- 31-50
- 51-70
- 71-90
- 91-110
- 111-140
- 141-170
- 171-200
- >200



**INCREMENT IN POTENTIAL
URBAN GROWTH - GRENLAND**

9%



Scenario	Percentage Increase
SHORT TERM FOUR BRIDGES	105%
SHORT TERM TWO BRIDGES	105%
SHORT TERM NO BRIDGES	100%

D'HKL: Urban Development Study
Skien & Porsgrunn, Norway, 2012
Competition, 1. prize

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Geo-Metry of Urban
Geometrization of Context

RIVERSIDE DINNING
SKIEN

BRIDGE-TOP GARDENS
MERSTAD

ISLAND DAY SPA
BORRESTAD

TELEMARK AMPHITHEATER
ISGRUNN

D'HKL: Urban Development Study
Skien & Porsgrunn, Norway, 2012
Competition, 1. prize

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Snøhetta: Office Building
Porsgrunn, Norway, 2017-

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GIS Geometrization of Context

disjoint/layered sets of data

INVENTORY

WOODLANDS REPORT

Time

Ian McHarg: Layer Model, 1969

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GIS Layered Collage

James Corner: Fresh Kills Park
New York, USA, 2013-2040

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GIS
Layered Collage

James Corner: Fresh Kills Park
New York, USA, 2013-2040

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GIS
Layered Collage

Bernard Tschumi: Parc de la Villette
Paris, France, 1979-83

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GIS Layered Collage

INVENTORY

WOODLANDS REPORT

time

Bernard Tschumi: Parc de la Villette
Paris, France, 1979-83

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Computational Context

INVENTORY

WOODLANDS REPORT

time

interacting sets of data

revised Figure-Ground

horizontal action (within layer)

vertical action (between layers)

mapping

projection

figuration

context as ground ...

... for new design

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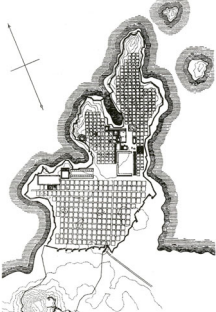
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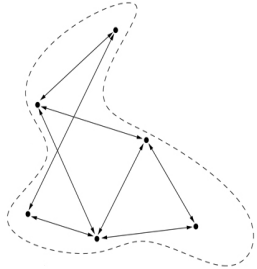

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Computational Figuration
Design as Network Interaction



Milet cityplan, around 400 BC

Zaha Hadid: Kartal Masterplan
Istanbul, 2006

internal design logic
interacting network of basic elements

external adaptation
interaction of network with context

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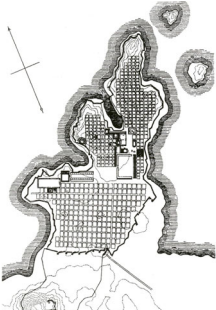
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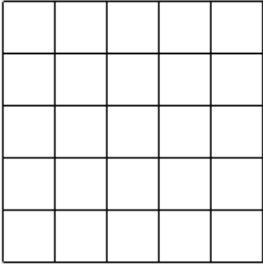

Context
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Computational Figuration
Design as Network Interaction



Milet cityplan, around 400 BC

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Istanbul, 2006

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interaction of network with context

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Context
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lines

rectangle

corner points

Voronoi

internal design logic
interacting network of basic elements

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Context
Lecture 2
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lines

rectangle

corner points

Voronoi

context

erase all rectangles that get intersected

external adaptation
interaction of network with context

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Context
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lines

rectangle

corner points

Voronoi

context

erase all corner points that get intersected

external adaptation
interaction of network with context

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