



ISHIK UNIVERSITY

FACULTY OF ENGINEERING

Department of INTERIOR DESIGN

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MSc in Sustainable Building Technology

BIOPHILIC ARCHITECTURE AND BIOPHILIC DESIGN

CONTENTS

- . Biophilia
- . Biophilia and Biourbanism
- . Biophilic Design
- . Biophilic Design dimensions
 - Naturalistic
 - Structural
 - Cognitive

BIOPHILIA

is the innately emotional affiliation of human beings to other living organisms

“**Wilson** and other Biophilia theorists assert that human beings not only derive specific aesthetic benefits from interacting with nature but that the **human species has an instinctive, genetically determined need to genetically determined need to deeply affiliate with natural setting and life-forms.**” (Besthorn & Saleeby, 2003)

Picking up a word coined by Edward Wilson, we define **biophilic architecture** is the architecture is the one capable of supplying our inborn need of a connection to life and to vital processes.



Biophilia and biourbanism

“For human survival and mental health and fulfillment, we need the natural setting in which the human mind almost certainly evolved and in which culture has developed over these millions of years of evolution.”

- An intersection between psychology and biology the **connection is genetic** – it resides in the common parts of our **DNA**

...why the underlying processes
of **nature and traditional**
architecture are able to create
harmony and beauty without
effort, while the processes of
modern urban construction are
not able to do so...
(scientific question)



The **biophilic space** is an environment that strengthens life and **supports the sociological and psychological components**, or is able to support:

- our **cognitive system** (in collecting and recognizing more information in the quickest and most efficient way);
- our **sensorial system** (neuro-motorial influence) avoiding both depressive and too exciting effects;
- and reinforce emotive and neurobiological **equilibrium**;
- the neuro-endocrine and immunological system, especially in people suffering of poor physical condition.

(Serafini, 2009; Caperna, 2010)

BIOPHILIC DESIGN

- create an environment usable by all people and that reflect the inherent human affinity for nature
- nourish our biological, physiological and psychological systems
- respect the “genetic structure” of the site, create a coherent geometric whole

(Caperna, 2011)

Biophilic design features:

- **a naturalistic dimension;**
- **wholeness**, or “the basic/genetic structure of the place” ;
- **“geometric coherency”**

HOW

space-syntax structured along:

- Patterns
- life sciences laws
- Cognitive response

Addressing cities as real structures with relevant intentionality to life

- Cities are not just environment, they have a **structure**
- Such a structure is **not neutral**. It affects social interactions, feeds back city's identity and metabolism, and responds to physical laws.
- Structure is physical, but it has cultural effects, and cultural causes. It's at the intersection of human nature.

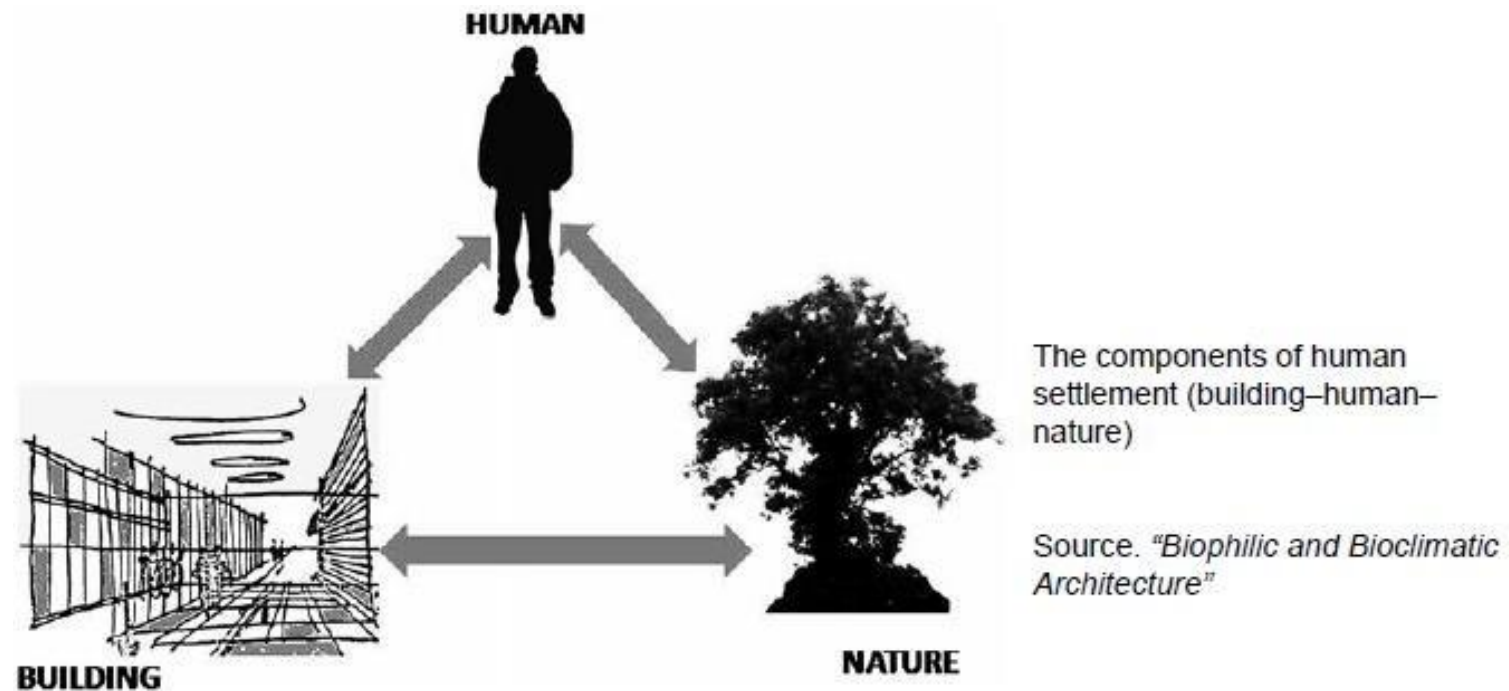
BIOPHILIC DESIGN NATURALISTIC DIMENSION

So, what is sustainability?

Design must deal with
energy- and environment saving
technical solutions,
but also with **functional**
and restorative
connections to the human
neurophysiological system.



naturalistic dimension of biophilic design, defined as shapes and forms in the built environment that directly, indirectly, or symbolically reflect the inherent human affinity for nature.



Views with less visual richness, such as a blank wall, are processed in the small forward portion of the visual cortex and trigger far fewer of the receptors, **triggering less pleasurable mental reactions**

(Biederman & Vessel, 2006).



Neuroscientists have found that views of complex, dynamic natural scenes is literally a **pleasurable experience**.

Physiological effects of walking through forest

(on average compared with those who walked through urban areas)

- salivary cortisol (a stress hormone) was 13.4-15.8% lower,
 - pulse rate was reduced by 3.9-6.0%,
 - systolic blood pressure was lower in individuals who walked through the forest,.
- Most impressive, overall parasympathetic activity — which occurs when we feel relaxed — increased by 56.1%, whereas sympathetic activity — which occurs when we feel stressed — decreased by 19.4% in subjects who walked through the forest (Park, 2010).



Nature is critical in children's formative years.

Studies show that **nature provides children with a buffer against life's stresses**, and enables **them to form social bonds**.

A study of day-lighting in schools also showed that **children learn 20-26% faster in natural daylight**.

Wells & Evans, 2003; Heschong, 2003.



Communities with higher quality environments reveal more **positive valuations of nature, superior quality of life**, greater neighbourliness, and a **stronger sense of place** than communities of lower environmental quality. These findings also occur in poor urban as well as more affluent and suburban neighbourhoods.



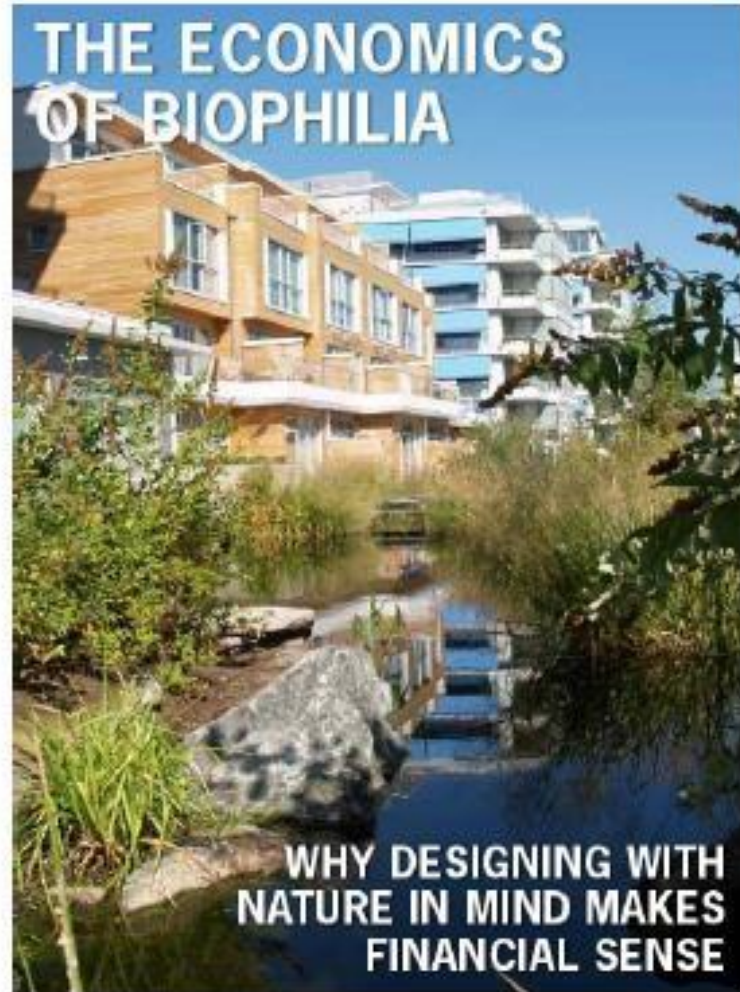
•Contact with nature has been found **to enhance healing and recovery from illness and major surgical procedures**, including direct contact (e.g., natural lighting, vegetation), as well as representational and symbolic depictions of nature (e.g., pictures).



Photos courtesy of Legacy Health System



The Economics of Biophilia



10%
of Employee absence can be attributed
to architecture no connection to nature



Stress (Ulrich, 1993)

- heart rate, blood pressure, relax muscle tension, increase alpha waves that associated with relaxation. (Ulrich et al., 1991)
- immune system functioning (Parsons,)1991
- anxiety, fear, anger, aggression and increased feelings of well begin are common responses to natural settings (Ulrich, 1979, Hartig, Mang, & Evans,)1991
- Interaction in natural environments also increase problem solving, creativity, capacity to concentrate and focus (Ulrich, 1993, Katcher& Wilkins,)1993
- Enhances feelings of awe, mystery, spiritual transcendence (Besthorn& Saleeby, 2003)



The Economics of Biophilia

NATURAL VIEWS REDUCE

LENGTH OF HOSPITAL STAY (AND SAVE MONEY)

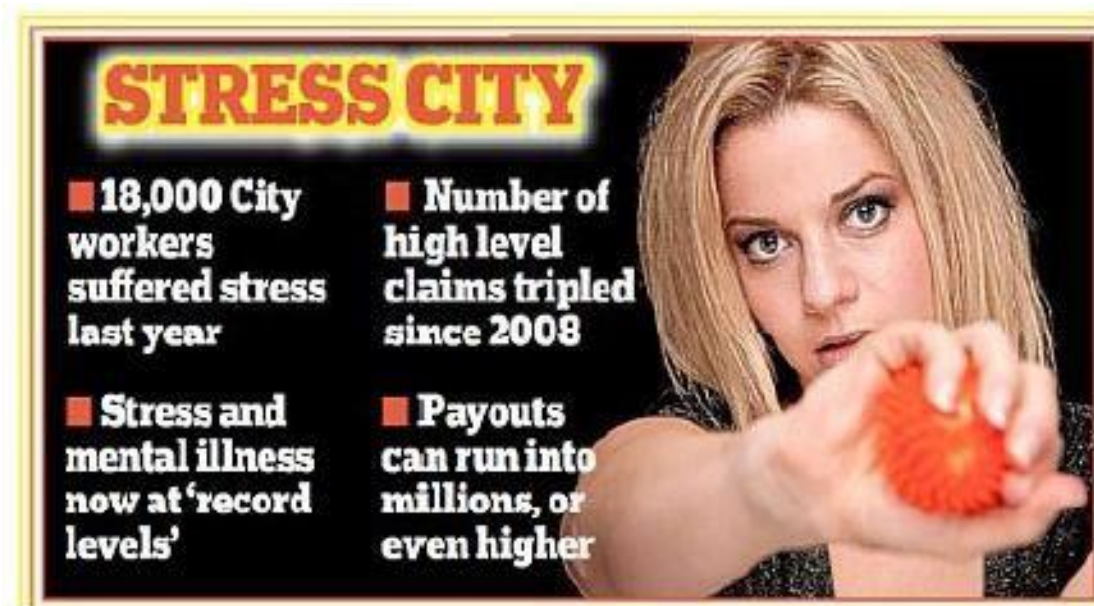
Reducing the average length of stay in hospitals by 0.41 days can amount to \$ 93 million in reduced hospital costs every year.

According to scientific studies, adequate access to day lighting and other biophilic elements can impact the health of patients in such a positive way that they can achieve and possibly go beyond these estimated savings.

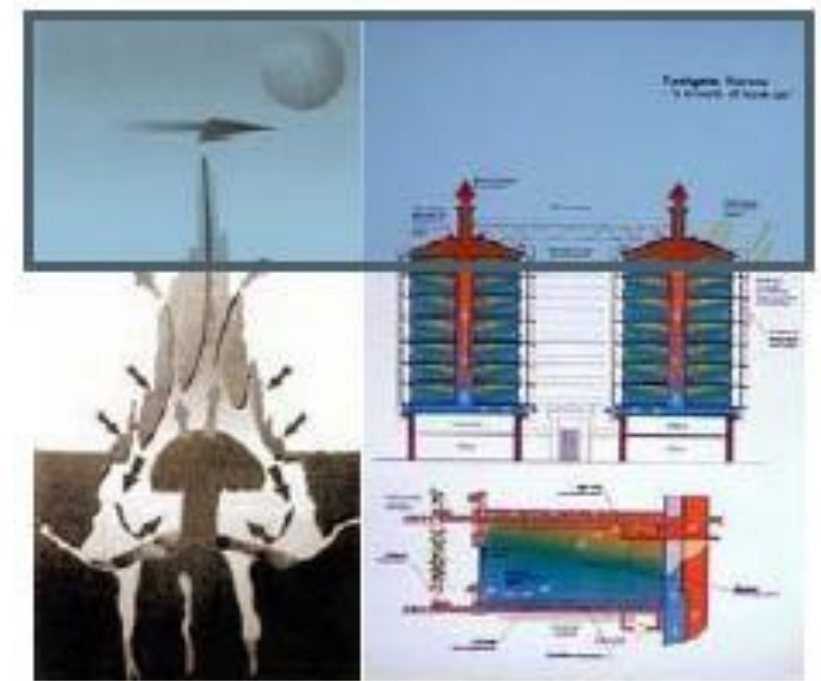
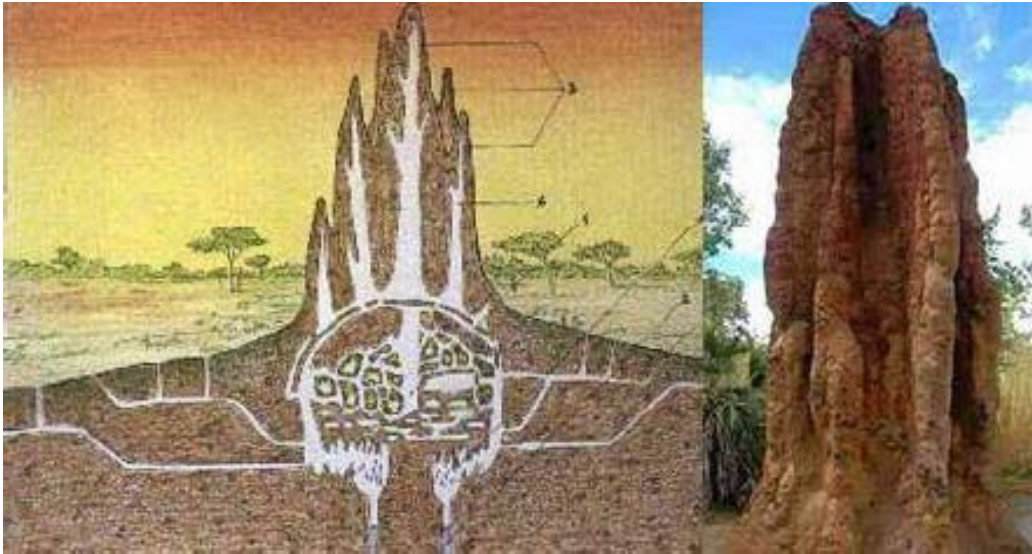


One in four people in the U.S.A. suffers from stress, and the associated annual cost to society is estimated to be \$300 billion

Source. R.Z. Goetzel et al., "The Relationship between Modifiable Health Risks and Health Care Expenditures," *Journal of Occupational and environmental Medicine*, 40 (1998) pp.213–222.



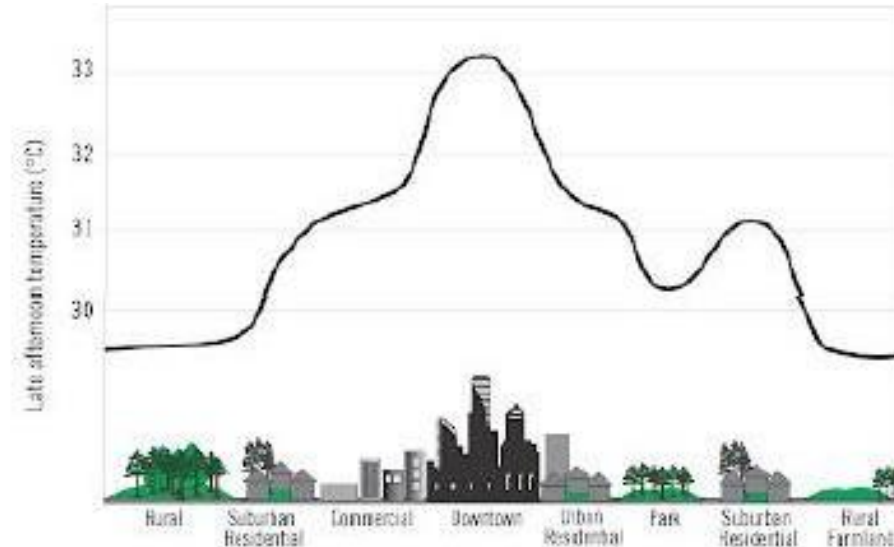
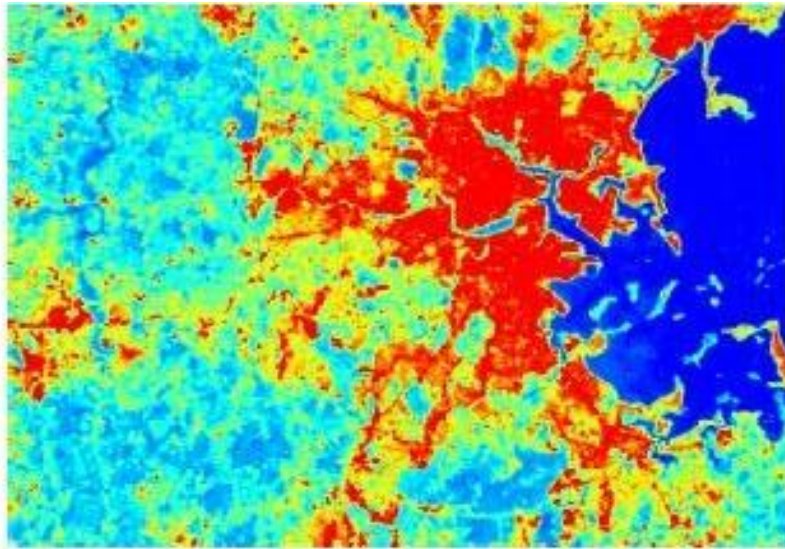
The most astonishing ventilation systems, however, have been developed by various species of termites.



one example of sustainable architecture that uses dramatically less energy by imitating the successful strategies of indigenous natural systems. The building, the country's largest commercial and shopping complex, uses the same heating and cooling principles as a local termite mound

Environmental

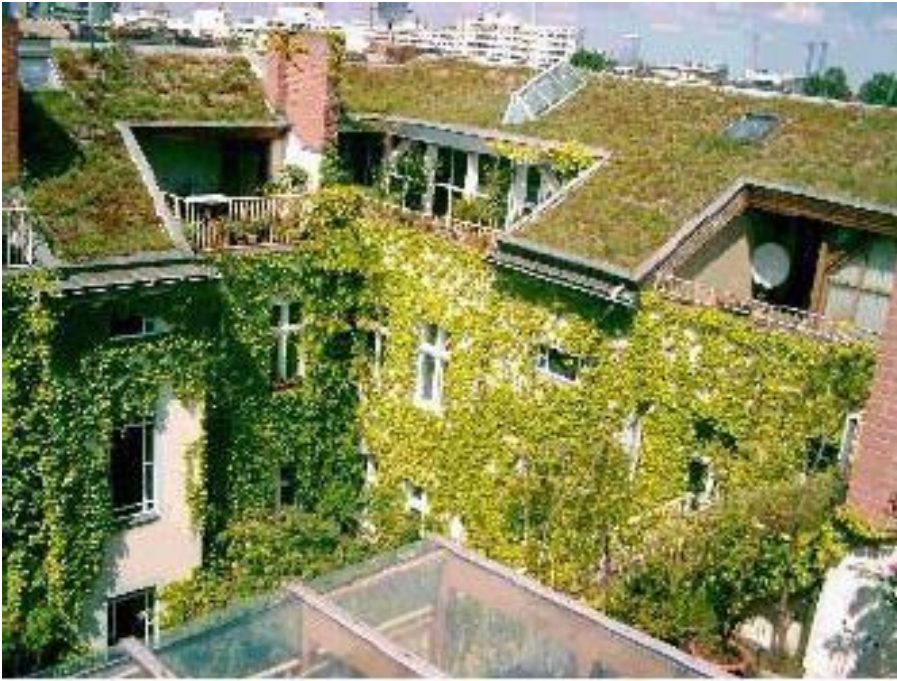
the influence of the soil on the microclimate may be greatly modified by vegetation. The effect of forests and trees on the microclimate is very complex. Cautiously positioned trees can save up to 50% of a household's energy consumption for heating and cooling



Urban 'Heat Island's effect

The presence of trees generally:

- reduces the day–night variation
- in summer, shading and evapotranspiration from trees can reduce surrounding air temperatures as much as 5° C and air temperatures directly under trees by up to 14°C.
- increases the air humidity and decreases the wind speed;
- plants can be used as shading as well as windbreaks to control heat gain and loss correspondingly.



Vegetable Façade

Advantage of Vegetable Façade:

- Edible fruits (e.g. Wine)
- Biomass production
- Dust reduction
- Heavy metal reduction
- Thermal insulation
- Energy savings
- Noise reduction
- Biodiversity
- Evapotranspiration cooling





Via verde, Rio de Janeiro



A sensory garden: A self-contained area that concentrates a wide range of sensory experiences.



The Sonic Garden Lab at "Castello del Bisarno", Firenze

Elements and Attributes of Biophilic Design

Dimensions, Elements, and Attributes of Biophilic Design

by Stephen R. Kellert

Environmental features

Color

Water

Air

Sunlight

Plants

Animals

Natural materials

Views and vistas

Façade greening

Geology and landscape

Habitats and ecosystems

Natural patterns and processes

Sensory variability

Information richness

Transitional spaces

Integration of parts to wholes

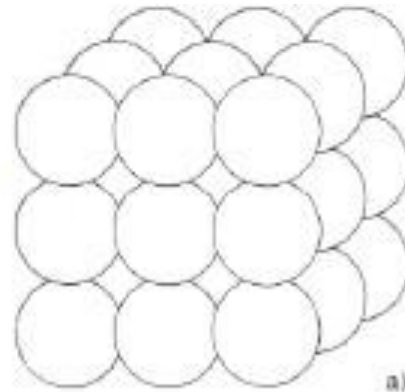
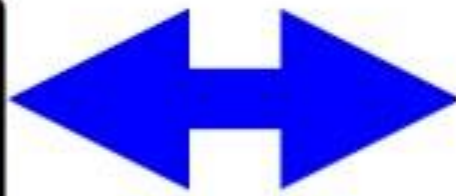
Dynamic balance and tension

Fractals

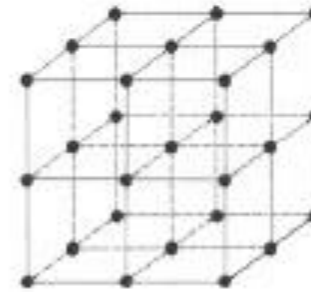
Hierarchically organized ratios and scales

Biophilic Urban Elements across scales

scale	Biophilic design elements
Building	Green roof-top Sky gardens and green Rooftop garden Green walls Daylight interior spaces
block	Green courtyards Clustered housing around green areas Native species yards and spaces
street	Green street Sidewalk garden Low impact development Trees Vegetated swales and skinny streets Edible landscaping High degree of permeability
neighbourhood	Stream delighting, stream restoration Urban forests Ecology parks Community gardens Neighbourhood parks and pockets parks Greening gray fields and brown fields
community	Urban creeks and riparian areas Urban ecological networks Green schools City tree canopy Community forest and community orchards Greening utility corridors
region	River systems and floodplains Riparian system Regional green space system Greening major transport system
Source: Modified from Girling and Kellert (Beatly, 2008)	



a)



b)

COLLECTION OF MATERIAL ELEMENTS LIKE:
PEOPLE, CARS, MOLECULES, HOUSES, WATER, ETC.

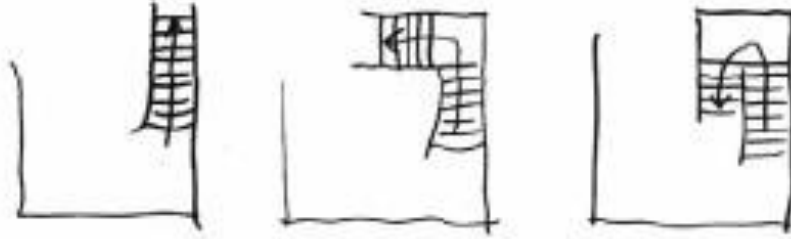
WHEN THIS
ELEMENTS WORKING
TOGETHER OR CO-
OPERATE



SYSTEM

ALEXANDER'S MODEL = TOWN AS SEMI-LATTICE

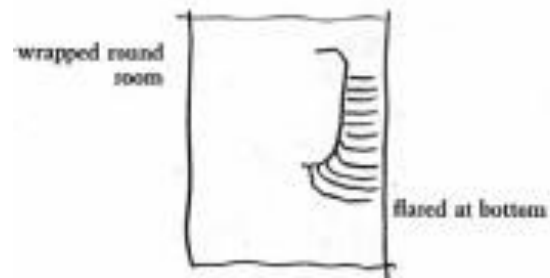
CHANGES IN A PART CAN CAUSE STRESS IN OTHER PARTS



Examples of stair rooms.



Stair seats.



Patterns for stairs. Alexander argues that stairs that merely connect two levels of a building work further to disconnect the building and tear its processes apart. In the patterns for stairs, he suggests flaring out the bottom and widening them as well as, if possible, making the stairs part of the outer perimeter of the room so the steps can be used as seats. Such patterns transform stairs into social spaces where people would be naturally inclined to sit, chat or engage in other activities.

(Pattern 133: 'Staircase as a Stage', A Pattern Language, pp. 637–40.)

MEDITERRANEAN URBAN AND BUILDING CODES AND SYMBOLS

Examples of specific codes

The essence of the traditional system prevalent in the Mediterranean region is found in the ethics and values related to habitat

FINA: This is an invisible space about 1.00-1.50 meters wide alongside all exterior walls of a building which is not attached to other walls, and primarily alongside streets and access paths. It extends vertically alongside the walls of the building. The owner or tenant of the building has certain rights and responsibilities associated with his fina. Maintenance of streets and private passage ways, by keeping them clean and safe from obstructions, was also related to the responsibilities associated with using the fina.



FINA

A street in old Tunis, Tunisia.

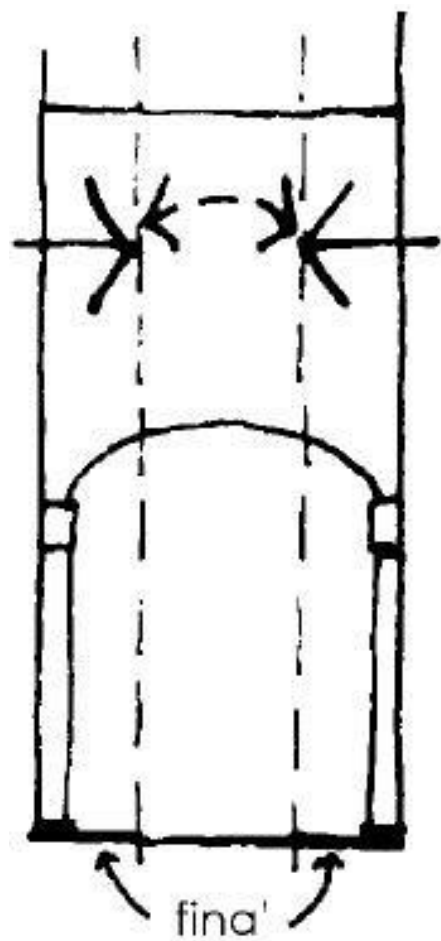
Note the steps for the house on the right are within the fina. Windows above eye level, and the sabats.

Photo taken by Besim Akim in the mid-1970s.



A street in Amorgos town on the island of Amorgos, Greece. Note the steps to the houses on the right, the balconies on the upper level, and the upper level room projection are all within the fina space of the houses. Sketch by author after a photo in Greek Island Villages by Norman F. Carver Jr.



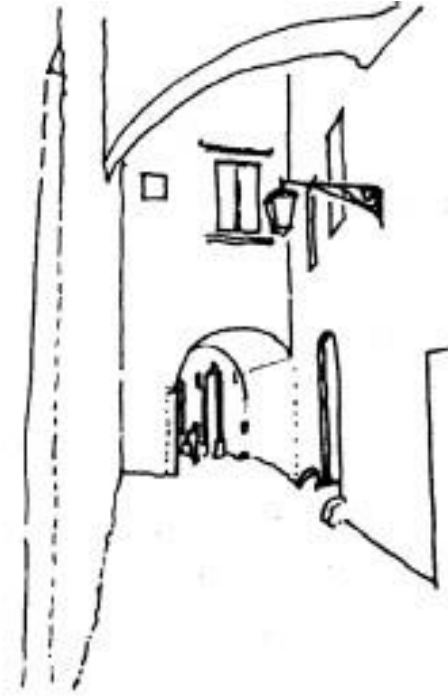


The 'Sabat' concept is related to the idea of utilizing the air space of the Fina' on both sides of street

Source. Besim Akim



A street in Ostuni, Puglia region, Italy, near the Adriatic coast.
Note the projecting lamp is high enough for traffic below and it, and it is within the fina of the house.
The sabat belongs to the house on the right. The arch spanning the street is built to reinforce the stability of the walls, implemented after agreement between owners of the houses across the street.
Sketch by author after a photo in Italian Hilltowns by Norman F. Carver Jr.



A street in Casares, Andalucia region, Spain.
Note the steps to the front doors of the houses on the right are within the fina space of the houses.
Source. Besim Hakim
Photo courtesy: [Casares](#)

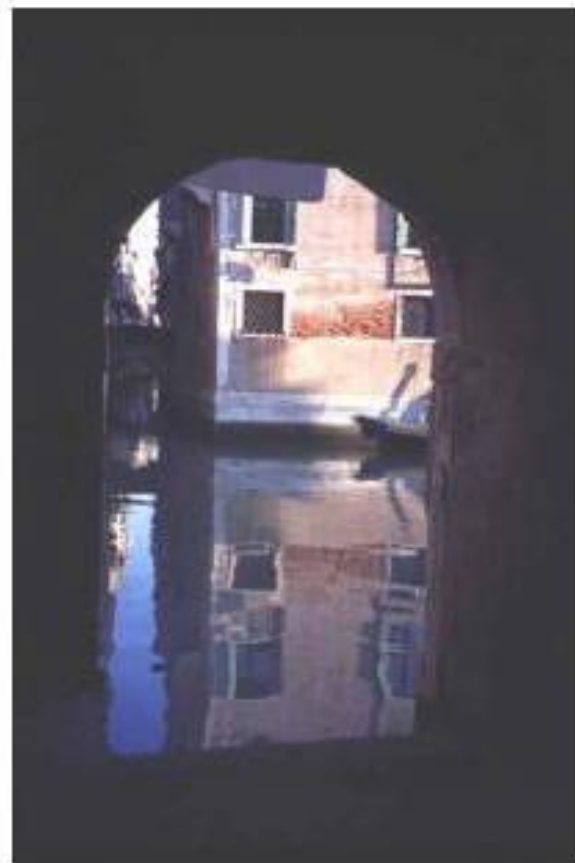


Calle Tintor, Campo S. Giacomo dall'Orio, Santa Croce

As passageways get longer, the tunnel sensation is reinforced.

Calle de Mezzo, looking onto Rio del Megio, Santa Croce

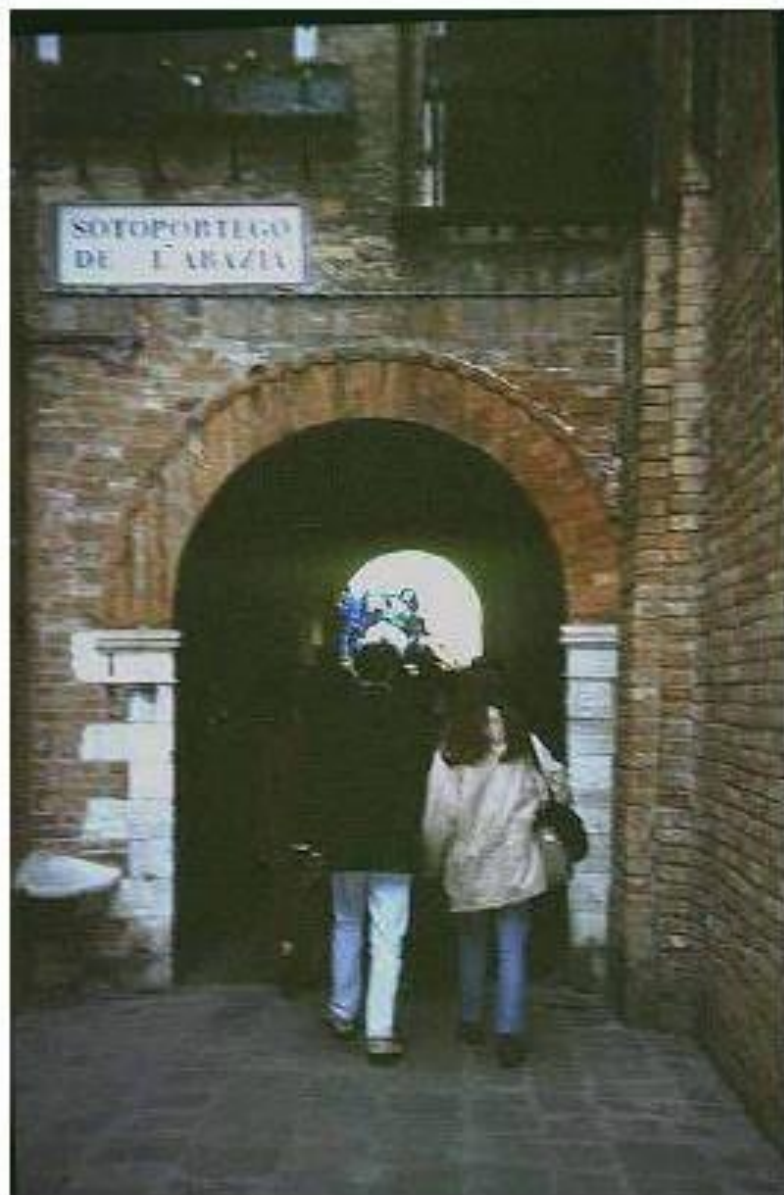
Occasionally, such a passage will terminate at a canal, with or without the benefit of water stairs.



Abbazio S. Gregorio, Dorsoduro

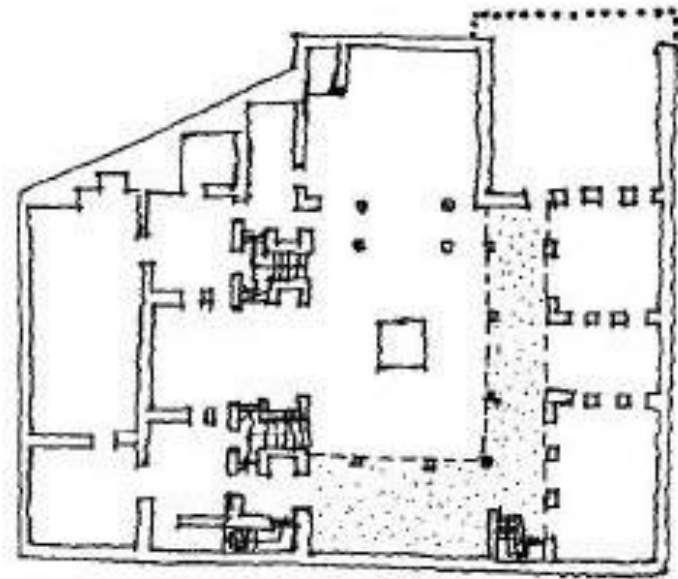
This *sottoportego* is on a processional route, one of the main ways to reach the Salute church by land.

Anthropologists find liminal (threshold) moments in most rituals, including procession. Here we have a physical threshold, extended beyond the typical short span involved in crossing a doorsill, which thereby intensifies the psychological effects of participating in the ritual.



Habitat Spaces with Thermal Role. Habitat spaces on bioclimatic concept in arid climate

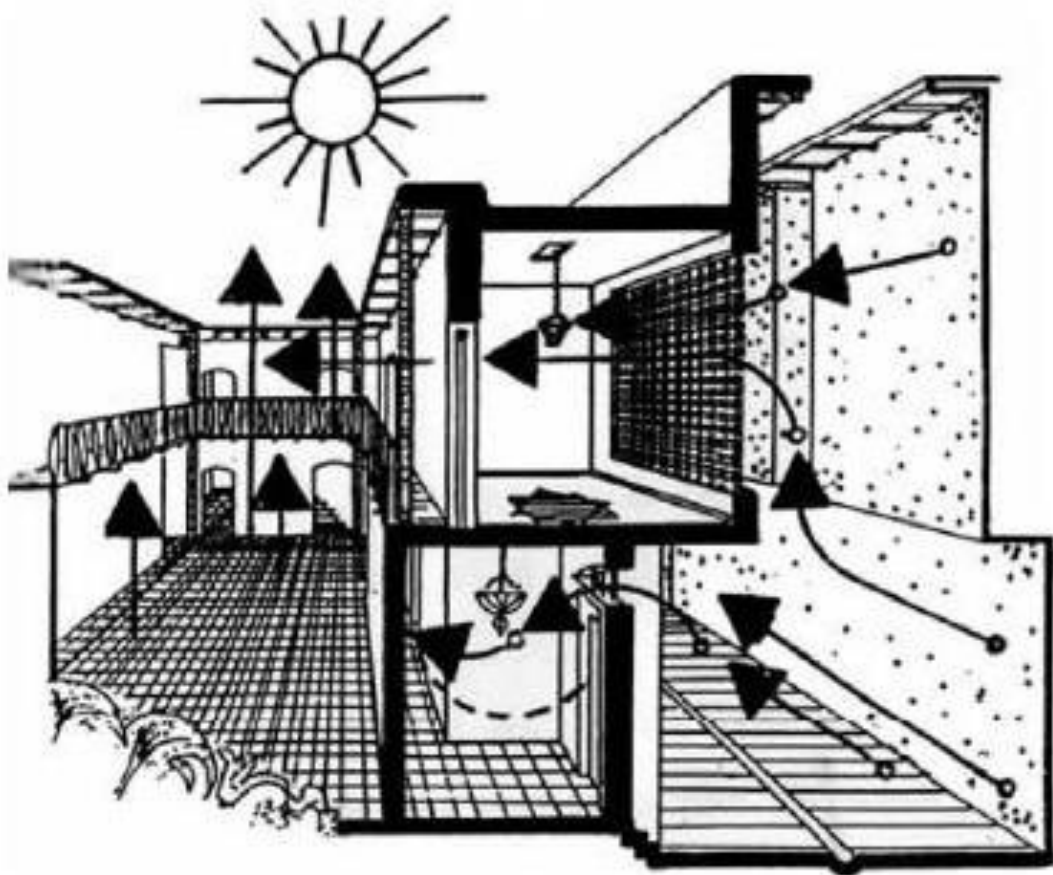
Gallery. This is an intermediary space surrounding the patios; it is an outside open corridor with a porch used for traffic. It protects not only the doors, the windows but also external walls



Loggia.

is an architectural feature that refers to a gallery or corridor at ground level, sometimes higher, on the façade of a building and open to the air on one side, where it is supported by columns or pierced openings in the wall.

Habitat Spaces with Thermal Role. Habitat spaces on bioclimatic concept in arid climate



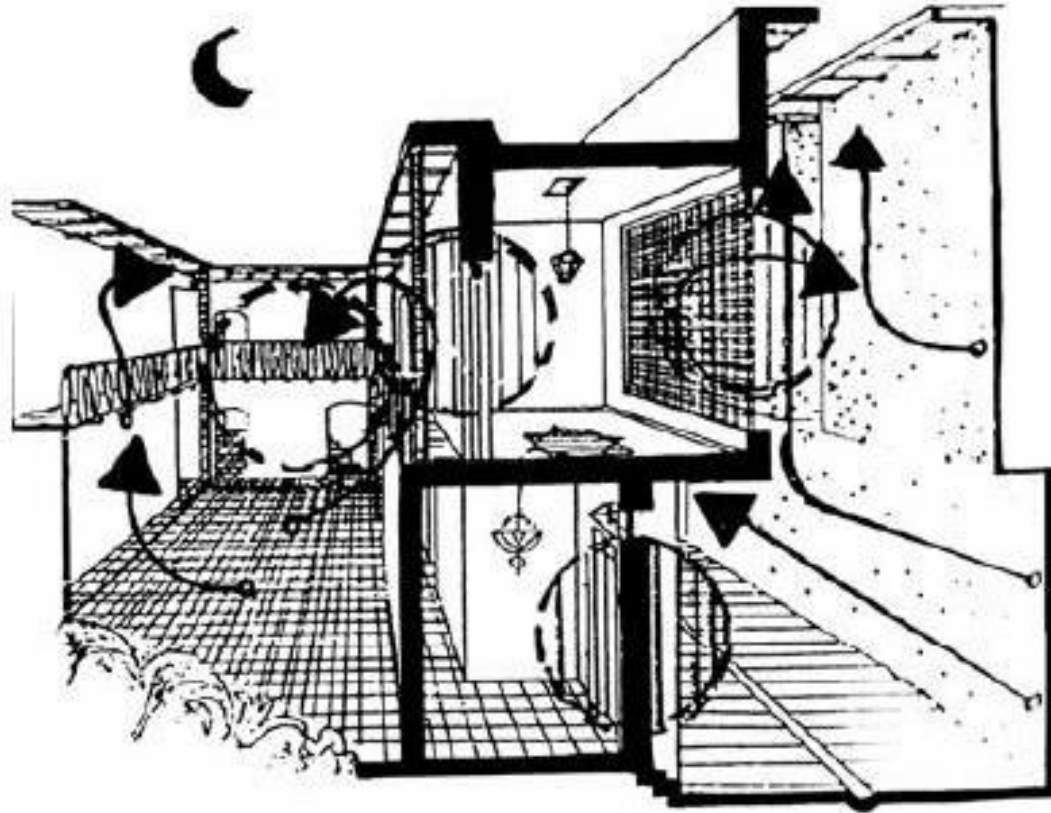
Traditional Patio function in the day (Basrah, Iraq)

Patio (courtyard).

is for the traditional dwelling the outside space that **creates a microclimate** and the most efficient form of using the inside space of house. The system's efficiency can be amplified by supplying the place with fountains, water pools, and big leaves plantations.

The water pools and the vegetation get warmer during the day and keep a convenient temperature during cold night period

Habitat Spaces with Thermal Role. Habitat spaces on bioclimatic concept in arid climate



Patio (courtyard).

The air stays due to the difference of density in the upper part of the patio and allows a comfortable environment in the lower part of the patio

Traditional Patio function in the day (Basrah, Iraq)

Habitat Spaces with Thermal Role. Habitat spaces on bioclimatic concept in arid climate



A simple Sahn, with a howz in the middle. Notice flanking domed arcade.

Almost every mosque and traditionally all houses and buildings in areas of the Arab World contain a courtyard known as a sahn (Arabic صحن) which are surrounded on all sides by rooms and sometimes an arcade.

Sahns usually feature a centrally positioned pool known as a howz.

If a sahn is in a mosque, it is used for performing ablutions. If a sahn is in a traditional house or private courtyard, it is used for aesthetics and to cool the summer heat.

Habitat Spaces with Thermal Role. Habitat spaces on bioclimatic concept in arid climate



Courtyard from a traditional house in Damascus, Syria



Calle Zambelli, Santa Croce

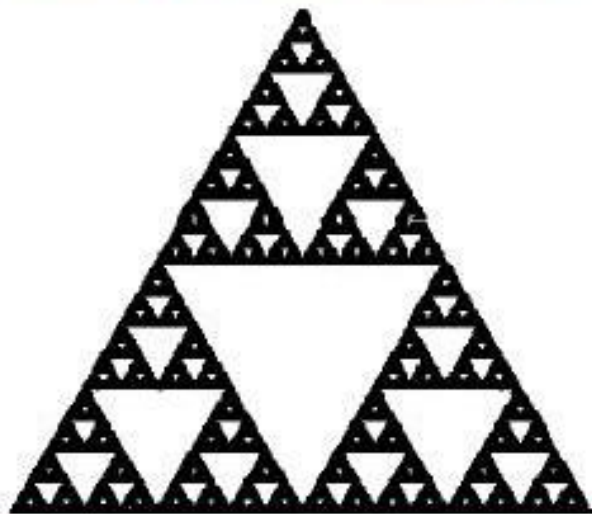
Here it is very clear how the tunnel was created from an existing passage that had been open to the sky. Note that across the courtyard at the end of the passage, there is another *sottoportego*.

8. Corte Oscura, Rio Terra dell'Isola, Santa Croce

This and the following picture show the two exits from a small courtyard, as they go through the buildings that surround the open space.



Anagni Cathedral



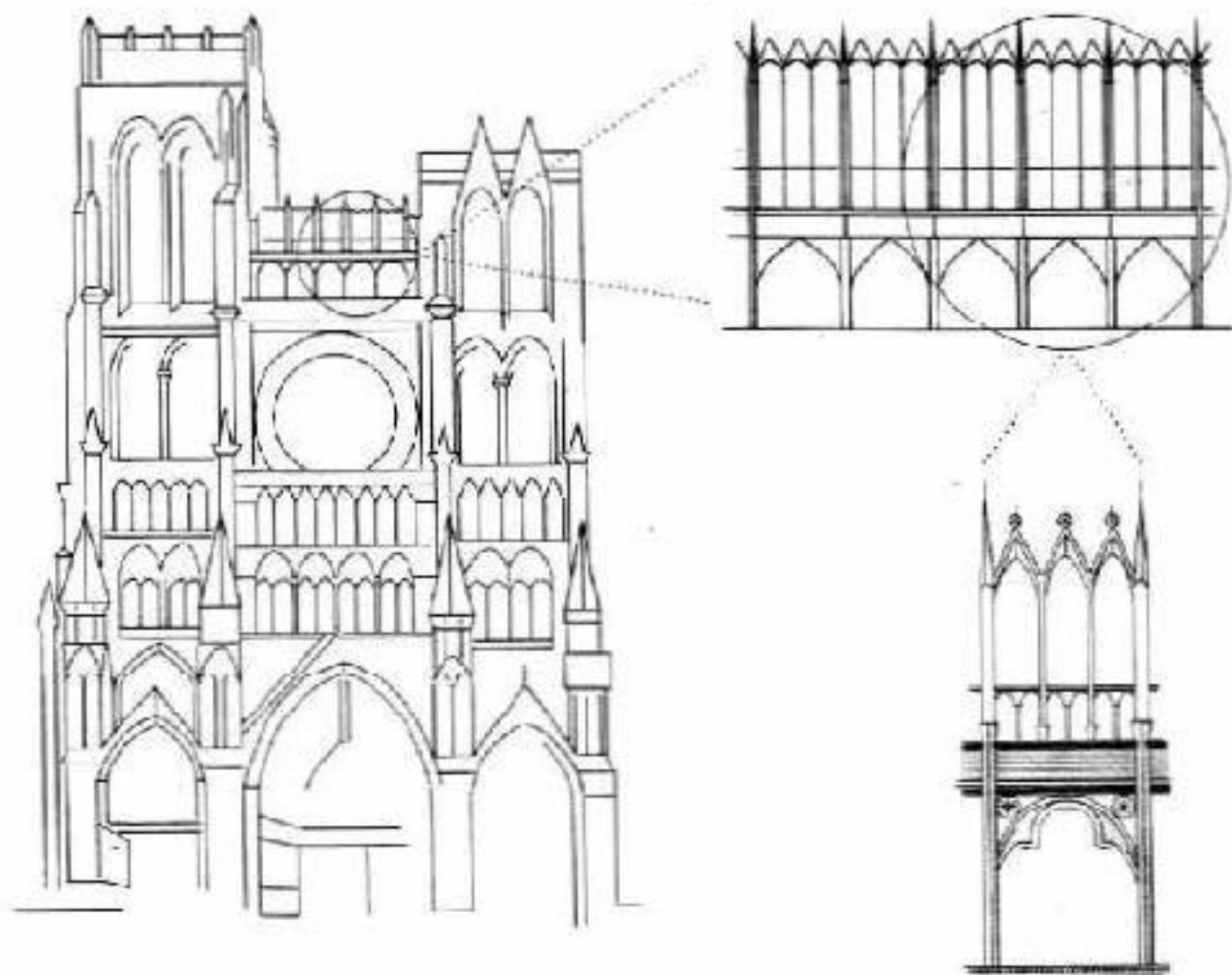
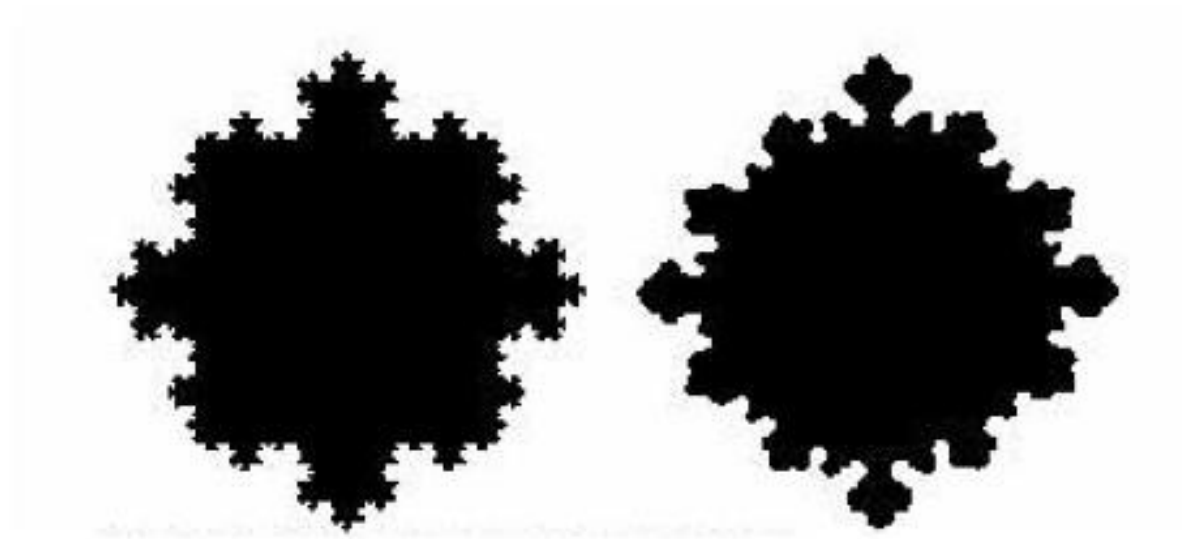


Figure 4 Schematic drawing to illustrate fractal appearance of Gothic cathedrals which show self-similar (but not identical) features on multiple scales of magnification. (Drawings by A. Rose.)



Scaling over four stages in a Doric cornice.



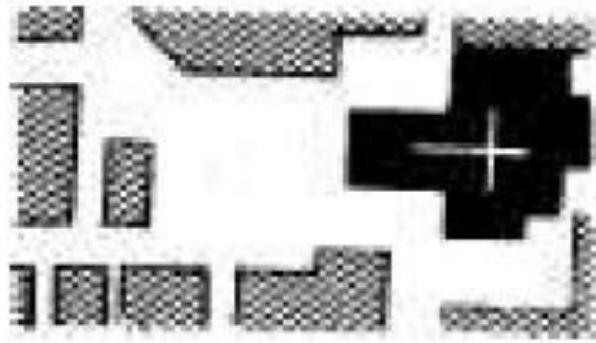
Koch curve and Gothic column compared.



One of the numerous monumental
public-religious squares in the
Italian historical towns.
The example of Moncalieri (Nord
Italy)



Churchs and urban sapaces

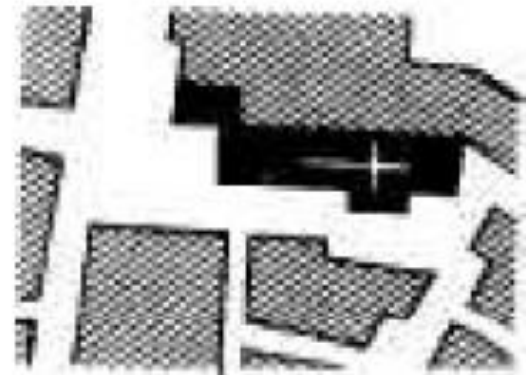


Verona. Piazza del Duomo

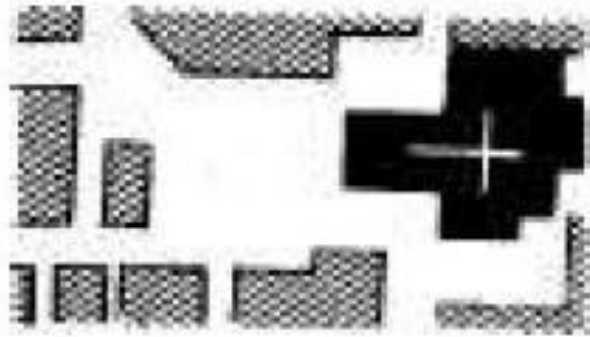
Verona. S. Fermo Maggiore



Padova. S. Giustina.



Verona. S. Anastasia



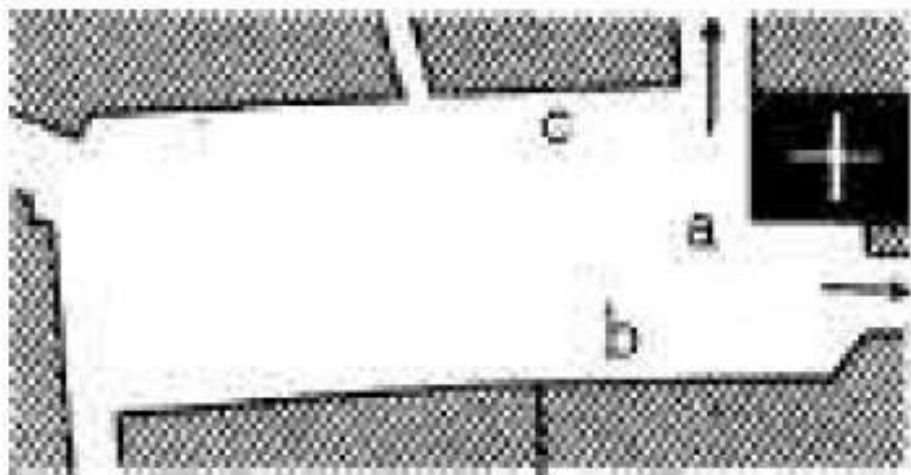
Verona. Piazza del Duomo



Enclosed space defines the character of the square

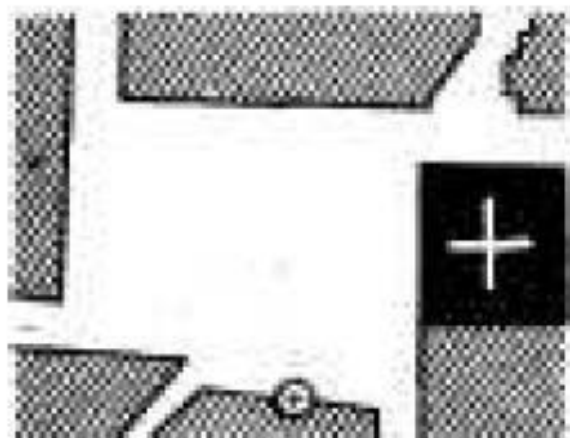
The roads are generally placed in the corners, so as to give continuity to the fifth of the square to the effect of perspective





Mantova. Piazza S. Pietro. a, San Pietro;
b, Palazzo ducale; c, Palazzo Vescovile





Ravenna. Piazza del Duomo

