Architectural Fractals

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Principles of Construction

Iteration

Self-similarity

Scaling

Questioning

Which phenomena in nature, technology and design show these principles?

How strict can the principles be applied?

How can the principles be systematized?
Koch curve, Koch snowflake, photographs of snow flakes
Pont du Gard, photograph and rendering
5 Euro bill
Tetrahedron inside of a cube
From: Zeitler/Neidhardt: Fraktale und Chaos

Stars by M.C. Escher
Fractal of the tetrahedron, steps 0 to 3, the first step is the Stella Octangula
Fractal of the cube, three-dimensional analogon to the Koch curve, Illustration from: Zeitler/Neidhardt, Fraktale und Chaos – eine Einführung

Rendering after four iterations

Kazimir Malevich, Architecton
Koch curve of regular hexagons in steps 1 through 3. From: Zeitler/Neidhardt, Fraktale und Chaos
Fractal of the Oktahedron, steps 1, 2 and 3
Sierpinski carpet constructions on several polygons

Menger sponge, the fourth iteration of the construction process
Proposal for a fractal roof according to the sierpinski carpet
Natural sponge, fractal curve

Steven Holl,
Simmons Hall, Massachusetts Institute of technology (MIT)
Cambridge, MA, United States, 1999-2002
Pinwheel fractal. Being obtained from substitutions, the pinwheel tiling can also be seen as a fractal.
Lab Architecture Studio, Ronald Bates und Peter Davidson: Melbourne Federation Square, 1997-2002
Lab Architecture Studio, Ronald Bates und Peter Davidson: Melbourne Federation Square, 1997-2002

The façade makes use of the Pinwheel tiling, an aperiodic tiling proposed by John Conway and Charles Radin.
A sequence of scales, relevant for:
Architecture

World
Continent
Country
Region
City
District / quarter
Street / square / block
Building / house
Wing / flat
Room
Furniture
Drawer
Box

Traffic routes
Highway
Interstate road
Main road
Minor road / side street
dirt road / Zufahrt
Hallway / Corridor
Room

»Goldsmith drawings of Basle«. From: Paul Naredi-Rainer, Harmonie – Maß, Zahl und Proportion in der abendländischen Baukunst
James Wines, groop SITE (Sculpture in the Environment), Highrise of Homes, 1981
Project, ink and charcoal on paper, 55.9 x 61 cm
Louis I. Kahn, traffic scheme, project, Philadelphia, Pennsylvania, 1951-53
Traffic planning for Chicago
Le Corbusier
Le Corbusier, plan voisin, Paris
Manhattan, detail
Manhattan, another detail
Konrad Wachsmann, wooden construction

Skeleton of the right arm of a human
Fractals in Berlin
River Spree railing
Ceiling of the New National Gallery (Mies van der Rohe)
Bridge of the transportation system
Girder fractal

DIN-paper format (proportion 1 : sqrt (2))
Container fractal in space (proportion: $1 / 2^{(1/3)} : 1 : 2^{(1/3)}$)

Module for the container fractal
Container fractal with tubular module
Cantor set (preserves area)
Cantor dust in two dimensions

Castle fractal, based on the two-dimensional Cantor dust
Pythagorean trees and tiling
Y-fractal, made with a 3-d-printer at the 3D LAB B25, Institute of Geometry, TU Dresden
Branching fractals, 2006
Yuken Teruya, Notice-Forest 2005, cover, detail

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Town hall Osnabrück, Lower Saxonia, window

(One Location of the end of the Thirty Years’ War. On 15 May 1648, the Treaty of Osnabrück was signed.)
Landscape of Corse with a fictional building