

Structures

text - shape - object - space - light

Educational Material

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lecture notes

■ NDS Professur für Architektur und CAAD
Dr. Leandro Madrazo

ETH Zürich

Nachdiplomstudium

October 1996

STRUCTURES

TEXT
SHAPE
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LIGHT

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Professur für Architektur und CAAD
Nachdiplomstudium
ETH Zürich, October 1996

The on-line document can be accessed at: <http://caad.arch.ethz.ch/~nds> or
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STRUCTURE: DEFINITIONS

The English word **structure** derives from Latin *structura*, which comes from the verb *struere*, to build. In classic Latin the word *structura* was used in three different senses: 1. the architectural schema of a building 2. the ordering of the organs in the human body 3. in rhetoric, the ordered connection between the thoughts and the words in a speech. (see P. Bora, *Strukturalismus, in the Europäische Enzyklopädie zu Philosophie und Wissenschaften*, vol. 4, p.461).

According to Jean Piaget, *“une structure est un système de transformations, qui comporte des lois en tant que système (par opposition aux propriétés des éléments) et qui se conserve ou s’enrichit par le jeu même de ses transformations, sans que celles-ci aboutissent en dehors de ses frontières ou fasse appel à des éléments extérieurs. En un mot, une structure comprend ainsi les trois caractères de totalité, de transformations et d’autoéglage.”* (Jean Piaget, *Le structuralism*, Presses Universitaires de France, Paris, 1968, p.6-7).

“Structure, in its basic sense, is the created unity of the parts and joints of entities. It is a pattern of dynamic cohesion in which noun and verb, form and to form, are coexistent and interchangeable; of interacting forces perceived as a single spatio-temporal entity.

It is no quibble to separate the notion of structure from such related concepts as order, form, organized complexity, whole, system or Gestalt. Each historical era seeks and needs a central model of understanding. Structure seems central to our time -the unique substance or our vision.” (Gyorgy Kepes, *Structure in Art and in Science*, George Braziller, 1965, p. ii)

“Structure is also central to our understanding of our ways of understanding. Studies of our perceptual and cognitive processes by Gestalt psychologists show that psychological events do not occur through the accumulation of individual elements of sense data but through the coordinated functioning of clearly patterned networks of sensation determined by structural laws”. (Ibid., p.iii)

“When the exact ordering of parts is in mind, it is usually better called: STRUCTURE”. (Lancelot L. White, *Atomism, Structure and Form*. In *Structure in Art and in Science*, Gyorgy Kepes, editor, George Braziller, 1965, p.21)

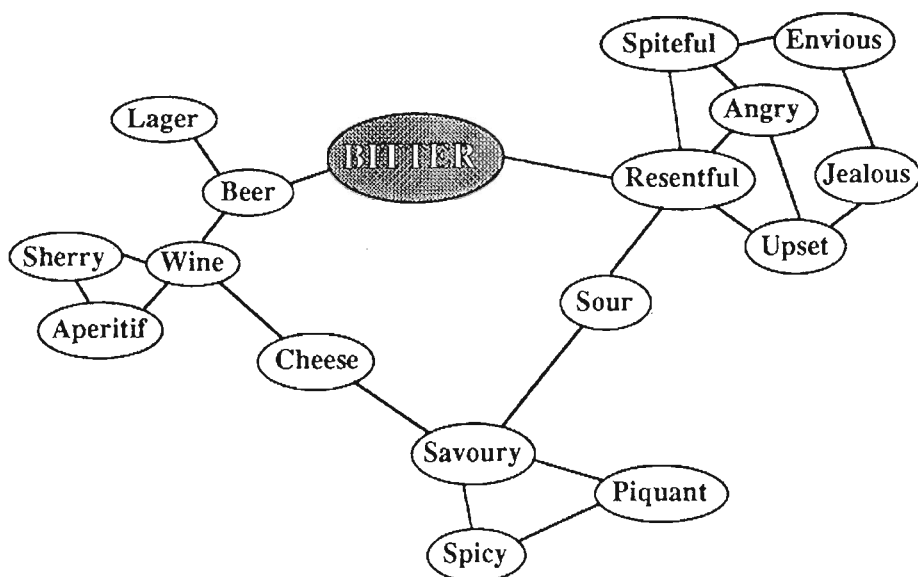
Hypertext and hypermedia

The term Hypertext* was coined by Theodor Nelson (A File Structure for the Complex, the Changing and the Indeterminate, 1965, Proceedings of ACM 20th National Conference), who proposed the idea of a computer system able to perform 'nonlinear writing'. A similar idea had been proposed twenty years earlier, before the birth of the digital computer, by Vannevar Bush. He invented a machine called 'memex' (i.e. memory extender) which was able to record articles, pictures, sketches and notes, and to connect the different informations with associative links. The basic idea of associative indexing, according to Bush, is that "any item may be caused at will to select immediately and automatically another. This is the essential feature of the memex. The process of tying two items together is the important thing."

**The terms hypertext and hypermedia are used somewhat interchangeably. Hypertext is the earlier, more general term. Hypermedia emphasizes that the document contains more than text and static pictures, though many use the term hypertext for all such documents, regardless of the media they include". (*Designing And Writing Online Documentation*, William Horton, John Wiley and Sons, 1990, p. 291)

With this device, Bush pretended to externalize the association paths that are in the mind. This way, the same 'paths' would be in the mind and in the structured information.>ASSOCIATION

ASSOCIATION: The notion that the mind works by means of association of ideas was anticipated by the Empiricist philosopher David Hume. Hume's theory of association of ideas can be summarized as follows: "At a given moment a man has only one individual idea before his mind, but because of the resemblances which he has found in his experience, the one individual idea is associated with others of the same kind, which are not actually present to the mind at the time but which would be called up by the stimulus of a suitable experience or a suitable word. Thus, the possession of a general idea or a concept becomes a mental disposition, the readiness, engendered by custom, to have some idea belonging to a given kind, when the appropriate stimulus occurs, and the acquisition of a concept will be the gradual process of (1) learning by experience and habituation to recognize instances and to discriminate between them and instances of a different concept and (2) having the appropriate associations and dispositions set up in one's mind. To have a concept *actually* in mind at any given time is to have in mind an individual idea plus the appropriate associative dispositions." (A. D. Wozzley, Universals, *The Encyclopedia of Philosophy*, vol.8, p. 202, Collier-MacMillan Limited, London, 1967)

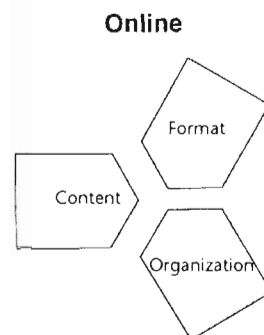
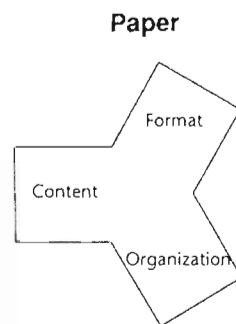
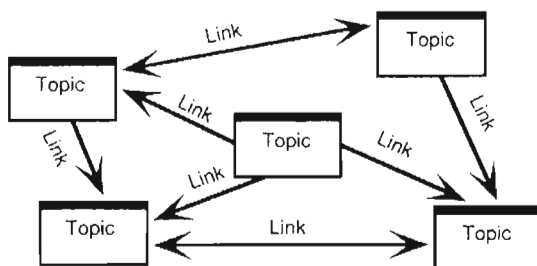


A semantic network of the word BITTER, showing associations of other words/concepts that denote bitterness. The length of the connecting lines reflects the degree of closeness from the associated words to BITTER.

Hypermedia versus text

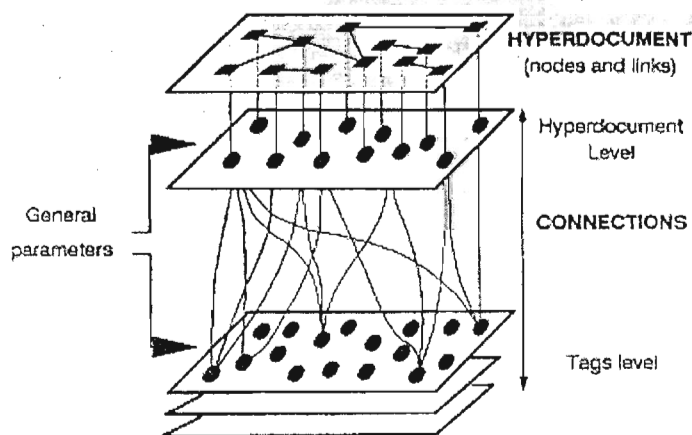
At the outset, a basic distinction between hypermedia (i.e. online) documents and printed documents can be formulated: in a printed text, the *content*, *format*, and *organization* are bound together, while in online documents these three elements could be separated. (see *Designing And Writing Online Documentation*, William Horton, John Wiley and Sons, 1990, p.5)

A hypertext document basically consists of TOPICS and LINKS connecting them. A TOPIC can be any piece of information that can be described in digital form (text, image, sound, video). The LINK reflects the nature of the relationship between two topics like, for example, explanation, refutation, illustration or clarification.



The promises of hypertext

Advocates of hypermedia claim that this media liberates the text from the limitations imposed by printing. It is often contended that the printed document freezes the structure of the text, and that this in turn limits the possible readings. In opposition to the traditional text "a hypertext system more closely models the deep structure of human idea processing by creating a network of nodes (modules) and links (webs), allowing for three-dimensional navigation through a body of information" (Patricia Ann Carlson, "Hypertext: A way of Incorporating User Feedback into Online Documentation". In *Text, ConText, and HyperText: Writing with and for the Computer*. Cambridge, The MIT Press, 1988, pp. 93-106).



A graphic representation of the multiple levels in a hypermedia document.

"The essential advantage of hypertext and hypermedia is that users can move in any direction they feel appropriate in their quest for information. They can follow up on an interesting point, look up a definition, check a bibliographic reference, or see a contrasting viewpoint. They are free to navigate what Geri Younggren calls 'n-dimensional information space'." (William Horton, *Designing and Writing Online Documentation*, p. 301).

"In a single hypertext we may embody multiple hierarchies of classifications and many trails of narrative and experience". (Tim Oren, *The Architecture of Static Hypertexts*. In *Hypertext '87 Papers*. Chapel Hill, University of North Carolina, 1987, pp. 291-306).

Different theories have been formulated to explain how text comprehension takes place in the reader's mind: "It seems obvious that readers draw inferences from particular sentences and form representations at different levels of what is happening in the text. Various models of comprehension have been proposed to explain this. Thorndyke (1977) proposed a set of 'grammar rules' by which the reader forms a structure in their mind of how the story fits together. Van Dijk and Kintsch (1983) proposed a very detailed model involving an analysis of the propositions of a text, leading to the development of a 'macropropositional hierarchy' influenced by the reader's model of the situation represented in the text. More recently, Johnson-Laird (1983) and Garnham (1986) have proposed a 'mental models' approach to text comprehension that involves the reader representing the meaning of the text as an imaginary, updatable model in their mind." (see Cliff McKnight, Andrew Dillon, John Richardson, *Hypertext in Context*, Cambridge University Press, 1991, p.47)

The dissappointments with hypertext

The most widespread criticism made to hypertext documents is that the user can easily get lost in the net of associative links. 'Getting lost' in the information space means that the user does not have "a clear conception of the relationships within the system or knowing his present location in the system relative to the display structure and finding difficult to decide where to look next within the system". (Elm and Woods, 1985; quoted in Cliff McKnight, Andrew Dillon, John Richardson, *Hypertext in Context*, Cambridge University Press, 1991, p.65)

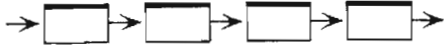
Navigation structure and content structure

With regard to the 'readability' of a hypertext it is necessary to distinguish between two kinds of structure: *navigation structure* and *content structure*. The first one refers to the organization of the document in modules (files, cards) and the connections between them, as well as the design of the user interface. In the case of the printed text, this structure would correspond to the division of a book into table of contents, chapters, sections, footnotes, index and the like. The second kind of structure -the content structure- is embedded in the document. This structure cannot be made as explicit as the navigation structure, since it depends on the "domain knowledge of the subject matter, interpretation of the author's argument, and a sense of how this knowledge is organised to come into play now". (Cliff McKnight, Andrew Dillon, John Richardson, *Hypertext in Context*, Cambridge University Press, 1991, p.74). It can be argued that the ideal hypertext document is such in which the navigation structure coincides with the content structure. In such a case, there would be no reason -theoretically at least- for a user to get lost in information space.

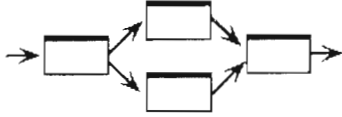
There is, however, a risk when trying to achieve this matching between the two kinds of structure, namely, that a complex content might be over-simplified for the sake of facilitating navigation through the document: "One common but subtle difficulty in hypertext systems is that sometimes it's unnatural to break your thoughts into discrete units, particularly if you don't understand the problem well and those thoughts are vague, confused, and shifting". (Begeman and Conklin, *The Right Tool for the Job: Even the Systems Design Process Falls Within the Realm of Hypertext*. *Byte*, October 1988, p. 260). This "balkanization of teaching with computers", as Seymour Papert has put it, represents an additional risk to knowledge. We must not forget that knowledge is more than the mere collection and grouping of facts, no matter how sophisticated and numerous the connections between those facts might be.

The following diagrams show different kinds of structure used to create hypertext documents: sequential or linear, matrix, hierarchical and web.

SEQUENTIAL STRUCTURES



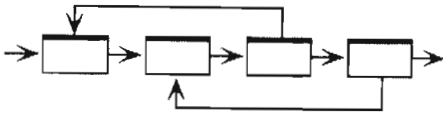
pure sequence



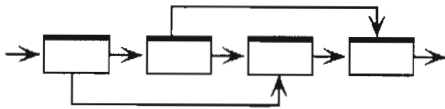
sequence with alternatives



sequence with side notes



sequence with backtracking

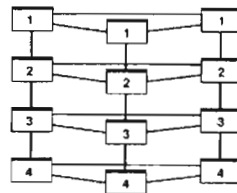
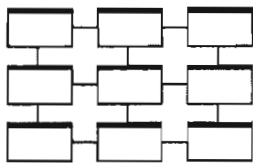


sequence with shortcuts



circular

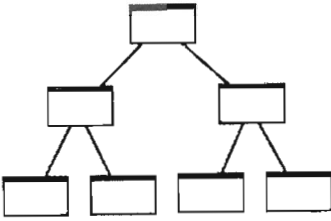
GRID STRUCTURES



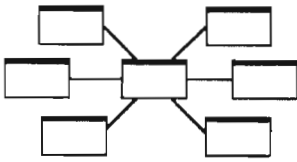
Diagrams source: William Horton, *Designing and Writing Online Documentation*, 1990

HIERARCHICAL STRUCTURES

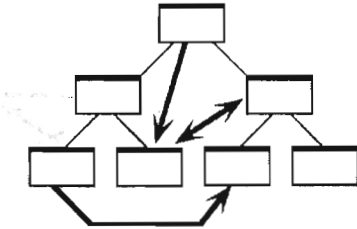
pure hierarchy



star

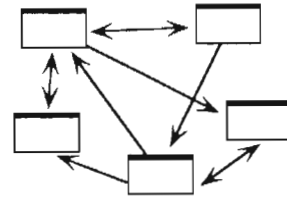


hierarchy with cross-references

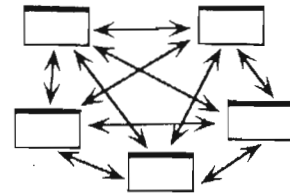


WEB STRUCTURES

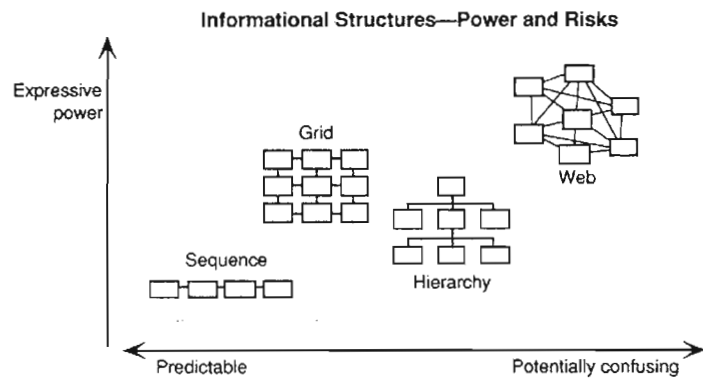
partial web



total web



These structures (sequential, hierarchical,...) have different levels of predictability and expressive power. At one extreme there is the linear sequence: it is the most predictable and the less expressive. At the other extreme it would be the web; the structure that has more expressive power, although it can easily lead to confusion (See W. Horton, *Designing and Writing Online Documentation*, 1990).



Diagrams source: William Horton, *Designing and Writing Online Documentation*, 1990

PHRASE STRUCTURE

4.1 Customarily, linguistic description on the syntactic level is formulated in terms of constituent analysis (parsing). We now ask what form of grammar is presupposed by description of this sort. We find that the new form of grammar is *essentially* more powerful than the finite state model rejected above, and that the associated concept of "linguistic level" is different in fundamental respects.

As a simple example of the new form for grammars associated with constituent analysis, consider the following:

- (13) (i) $Sentence \rightarrow NP + VP$
 (ii) $NP \rightarrow T + N$
 (iii) $VP \rightarrow Verb + NP$
 (iv) $T \rightarrow the$
 (v) $N \rightarrow man, ball, etc.$
 (vi) $Verb \rightarrow hit, took, etc.$

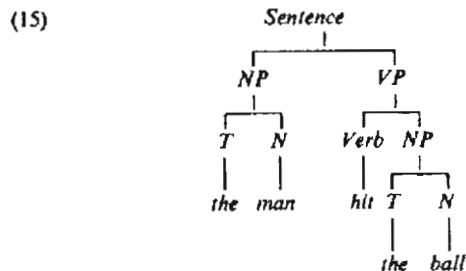
Suppose that we interpret each rule $X \rightarrow Y$ of (13) as the instruction "rewrite X as Y ". We shall call (14) a *derivation* of the sentence "the man hit the ball." where the numbers at the right of each line of the derivation refer to the rule of the "grammar" (13) used in constructing that line from the preceding line.¹

¹ The numbered rules of English grammar to which reference will constantly be made in the following pages are collected and properly ordered in § 12, *Appendix II*. The notational conventions that we shall use throughout the discussion of English structure are stated in § 11, *Appendix I*.

In his "Axiomatic syntax: the construction and evaluation of a syntactic calculus," *Language* 31.409-14 (1955), Harwood describes a system of word class analysis similar in form to the system developed below for phrase structure. The system he describes would be concerned only with the relation between $T + N + Verb + T + N$ and $the + man + hit + the + ball$ in the example discussed

- (14) *Sentence*
 $NP + VP$ (i)
 $T + N + VP$ (ii)
 $T + N + Verb + NP$ (iii)
 $the + N + Verb + NP$ (iv)
 $the + man + Verb + NP$ (v)
 $the + man + hit + NP$ (vi)
 $the + man + hit + T + N$ (ii)
 $the + man + hit + the + N$ (iv)
 $the + man + hit + the + ball$ (v)

Thus the second line of (14) is formed from the first line by rewriting *Sentence* as $NP + VP$ in accordance with rule (i) of (13); the third line is formed from the second by rewriting NP as $T + N$ in accordance with rule (ii) of (13); etc. We can represent the derivation (14) in an obvious way by means of the following diagram:



The diagram (15) conveys less information than the derivation (14), since it does not tell us in what order the rules were applied in (14).

in (13)-(15); i.e., the grammar would contain the "initial string" $T + N + Verb + T + N$ and such rules as (13iv-vi). It would thus be a weaker system than the elementary theory discussed in § 3, since it could not generate an infinite language with a finite grammar. While Harwood's formal account (pp. 409-11) deals only with word class analysis, the linguistic application (p. 412) is a case of immediate constituent analysis, with the classes $C_{i, j}$ presumably taken to be classes of word sequences. This extended application is not quite compatible with the formal account, however. For example, none of the proposed measures of goodness of fit can stand without revision under this reinterpretation of the formalism.

The transformational grammar proposed by Noam Chomsky in *Syntactic Structures*, 1957, comprises three sections or components: the phrase-structure component, the transformational component, and the morphophonemic component. Each component consisted of a set of rules operating upon certain input to produce a certain output. A sentence, for example, would be the result of applying recursively a series of rules. Accordingly, a sentence could be represented by a tree diagram that starts with the simplest decomposition of the sentence into Noun phrase and Verb phrase.

Narrative structures in literature

The idea of a net of associative links has been pursued in the realm of literature in some revolutionary works like *Finnegans Wake*, of James Joyce, or the *Ficciones* of Jorge Luis Borges.

In *Finnegans Wake*, Joyce wanted to express the true nature of a dream in a literary way. He could not use the normal language to express the world of dreams, because the structured nature of language conveys an ordered, logical world; quite distinct to the world of the unconscious. To express this world, Joyce had to question the rules of syntax, to discover new forms of narrative and also to invent new words. Indeed, he created a new language, made up of puns and words that were combinations of words of different languages. (i.e. 'vlossyhair', 'wlosy' being Polish for the English 'hair').

In *Finnegans Wake* Joyce attempted to write a book which would take all history and knowledge for its subject matter and the workings of the dreaming mind for its form. If one takes a page at random from *Finnegans Wake* one may find reference to subjects as disparate as chemistry, Irish mythology, philosophy, American history, details from Joyce's life, all woven together in a language which constantly creates new words by fusing and shortening old ones or by borrowing from the many European languages that Joyce knew. The result of this deformation of language is that every word carries more than one meaning and each sentence opens out onto an infinity of interpretations. Joyce explained his method to a friend when he said: "In writing of the night, I really could not, I felt I could not, use words in their ordinary connections. Used that way they do not express how things are in the night, in the different stages—conscious, then semi-conscious, then unconscious." The difficulty of the language is compounded by difficulty of divining what story this extraordinary language is recounting. Figures change name and transform themselves into their opposites, appear and disappear without any obvious rationality. Joyce's claim for his method was that it enabled the articulation of areas of experience which were barred from conventional language and plot.

(Colin MacCabe, *An Introduction to Finnegans Wake*. In *James Joyce's Finnegans Wake. A Casebook*. Edited by John Harty. Garland Pub., New York, 1991, p. 23).

"One great part of every human existence is passed in a state which cannot be rendered sensible by the use of wideawake language, cutandry grammar and goahead plot". (James Joyce, quoted in Richard Ellmann, James Joyce, Oxford University Press, London, 1959).

Once upon a time and a very good time it was there was a moocow coming down along the road and this moo-cow that was coming down along the road met a nicens little boy named baby tuckoo....

His father told him that story: his father looked at him through a glass: he had a hairy face.

He was baby tuckoo. The moocow came down the road where Betty Byrne lived: she sold lemon platt.

O, the wild rose blossoms

On the little green place.

He sang that song. That was his song.

O, the green wothe botheth

When you wet the bed, first it is warm then it gets cold. His mother put on the oilsheet. That had the queer smell.

His mother had a nicer smell than his father. She played on the piano the sailor's hornpipe for him to dance. He danced:

Tralala lala

Tralala tralaladdy

Tralala lala

Tralala lala.

the first till last alshemist wrote over every square inch of the only foolscap available, his own body, till by its corrosive sublimation one continuous present tense integument slowly unfolded all marryvoising moodmoulded cyclewheeling history (thereby, he said, reflecting from his own individual person life unlivable transaccidentated through the slow fires of consciousness into a dividual; chaos, perilous, potent, common to allflesh, human only, mortal).

(Excerpts from J.Joyce, *Finnegans Wake*).

manifesto

Manifestoes of Modern Art and Architecture

(Manifesto: a public declaration of motives and intentions by a government or by a person or group regarded as having some public importance)

The Manifesto was a favorite form of expression used by artists in the first decades of this century to communicate their ideas. As a literary form, the manifesto is characterized by its conciseness and by the provocativeness of its content. Typically, it consists of short sentences that put into question established beliefs about art and architecture (i.e. 'We reject all aesthetic speculation, all doctrine, and all formalism'). In order to reject the past, modern artists had to reject the language with which the art works had been named and criticized. It became necessary to invent a new artistic vocabulary to express new artistic concepts (i.e. 'anti-cubic, plastic architecture').

WAT IS DE 8?

DE 8 IS de kritische reactie op de architectonische vormgeving van dezen dag.

DE 8 IS realit in zijn streven naar noodzakelijke resultaten.

DE 8 IS idealist in zijn geloof aan een internationale culturele coöperatie.

DE 8 IS opportunist uit maatschappelijke overtuiging.

DE 8 IS soch voor noch tegen groepen en richtingen.

DE 8 IS slechts voor feiten.

DE 8 ZEGT het is niet uitgesloten dat het waar beter voor de toekomstig, dan past hem voor slechte plannen zich ondergeschikt aan de geschiedenis.

DE 8 W I L geen wettelijke archiveren van vermaatschappij van de verleden.

DE 8 W I L rationeel zijn in de meest wijzen voor de toekomst.

DE 8 W I L streven naar een voor de moderne maatschappij in een goed ken tot een hure van de afbalans.

DE 8 STRIJDT meer voor de SCHAAP dan voor de mens.

DE 8 STREEFT naar een plaats in de menselijke levings sferen.

BEELDEND BEDRIJFS-ORGANISATOR

DE 8 IS A-AESTHETISCH

DE 8 IS A-DRAMATISCH

DE 8 IS A-ROMANTISCH

DE 8 IS A-KUBISTISCH

DE 8 IS RESULTANTE

Ultimately, the need to express new ideas in a radical way leads to question the limits of the vehicle through which the ideas are expressed, namely, the structure of language. Instead of a narrative structure we find manifestoes that are a collection of keywords, put together according to some basic syntactic rules. (i.e., The materials are concrete iron glass; Living. Changing. New).

The statements made in the manifestoes should be seen in connection with the artistic production of the artist (painting, building, painting-building). It might happen that the manifesto is a theoretical premise that then is materialized in the work, or, alternatively, that the manifesto is a reflection, made a posteriori, to express in words what had been already expressed in form.

Carregadoende Adres, Architectuur van de 20e eeuw, B. Merlebach, Arch. Nieuwstraat 72, Amsterdam. Tel. 52971

In some cases, artists gave to their written texts a visual-formal quality.

In order to make the message more effective, they cared especially about the graphic design of the document (layout, typography).

'Manifestoes' resemble contracts that the undersigned make with themselves and with society. As with all contracts, manifestoes imply certain rules laws and restrictions. But they soon become independent from their authors. At this point, a masochistic relationship begins between the author and the text itself, for the manifesto-contract has been drafted by the very person who will suffer from the restrictions of its clauses. No doubt such carefully devised laws will be violated. This self-transgression of self-made laws adds a particularly perverse dimension to manifestoes. In addition, like love letters, they provide an erotic distance between fantasy and actual realisation. In many respects, this aspect of manifestoes has much in common with the nature of architectural work. It plays on the tension between ideas and real spaces, between abstract concepts and the sensuality of an implied spatial experience. (B. Tschumi, preface of *Architectural Manifestoes*, London, 1979).

EXERCISE

The exercise is to analyze and re-present the content of one of these three manifestoes:

1. Ludwig Mies van der Rohe: Working theses, 1923. Originally published in first issue of 'G'.
2. Theo van Doesburg: Towards a plastic architecture, 1924. Originally published in *De Stijl*, XII, 6/7, Rotterdam 1924.
3. Le Corbusier/Pierre Jeanneret: Five Points towards a new architecture, 1926. Originally published in *Almanach de l'Architecture moderne*, Paris 1926.

These are some of the issues that could be addressed in the study of these texts:

- identification of the critical vocabulary used by the writer. Compare the meaning-s that the author gives to certain keywords with other meanings (dictionary definitions, usage of the same term by other authors, your own interpretation of the term).
- relationships between the written ideas and the art works of a particular artist. Eventually, create a 'visual translation' of the written text, illustrating, for example, the ideas of the text with images of the author's work or from any other author or historical period.
- if possible, identify possible structures in the arguments presented: linear or sequential, hierarchical, matrix, ...
- optional: identify possible points in common between the three texts. Suggestion: this can be done in forms of links between works of different students.
- optional: eventually, you can create your own architectural manifesto, in which you can give expression to the following questions, for example: which are the urgent questions that contemporary architecture should address? what are the architectural works you consider as the most representative of today's architecture? against what has to stand the architecture of our time?.

The work will be presented as a hypertext/hypermedia document written in HTML (HyperText Mark-up Language). The work will be presented to the class by every student with the program Netscape.

Time for the exercise: 1 week.

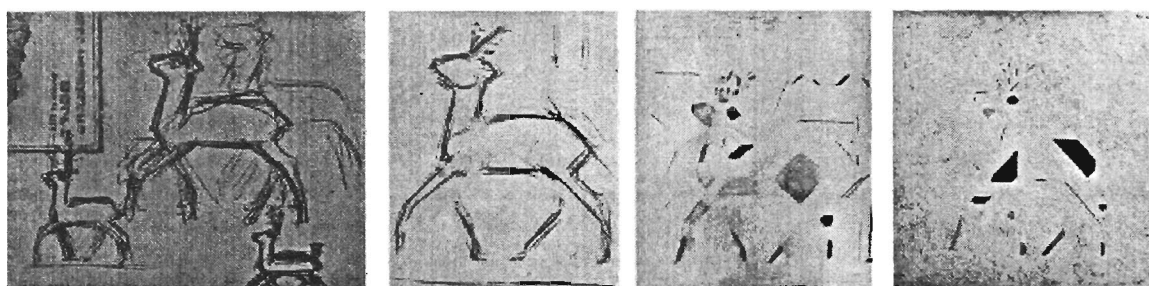
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2 STRUCTURE AND SHAPE

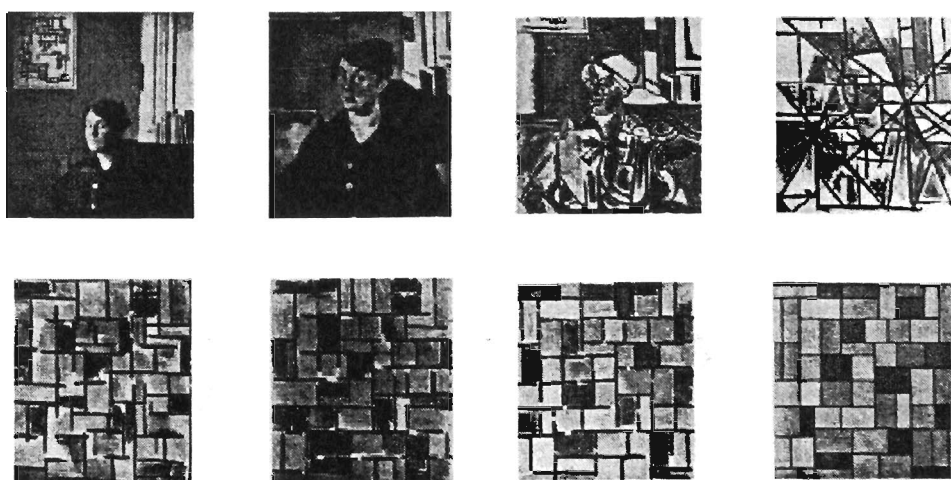
Abstraction and Realism

The rejection of figuration and realism in painting and the adoption of an abstract, geometric formal language is a fundamental characteristic of Modern Art. In the early works of the artists related to the group De Stijl, the path that took them from figuration to abstraction can be followed almost step-by-step. In this drawing, Van der Leek starts with a figure and then proceeds to eliminate the outline or contour, ending up with a composition of a color patches. From these elementary shapes, the outline of the original figure could still be formed in the viewer's mind.



Bart Van der Leek. Stag.

Similarly, some of Van Doesburg's early works were conceived as a process of abstraction that started with a 'naturalistic' image (i.e. a photograph, a naturalistic painting) which was then transformed, step-by-step, into an abstract **composition** of geometric shapes. We must assume that, in spite of the transformation, a connection between the the 'naturalistic' image and the final 'abstract' painting in Van Doesburg series of paintings nevertheless persists. What is common to both representations -the naturalistic and the abstract- is the inner structure, i.e. the idea. Abstraction then would be a process through which the accidental features are discarded, until only the essential remains, i.e. the idea. This idea can only be expressed through the language of geometry.

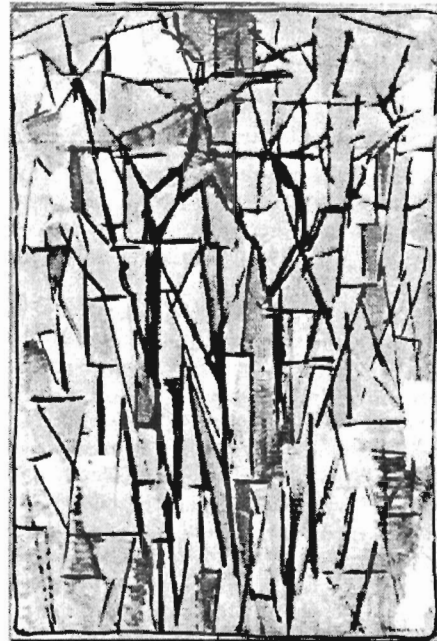


Theo van Doesburg. Studies, 1919.
From Nature to Composition.

Some of the early abstract paintings were 'abstract' only to some extent, since they did not completely abandon the realm of figuration. For example, Mondrian's trees still resemble the object tree insofar as the outline of a tree is a recognizable shape in the painting.

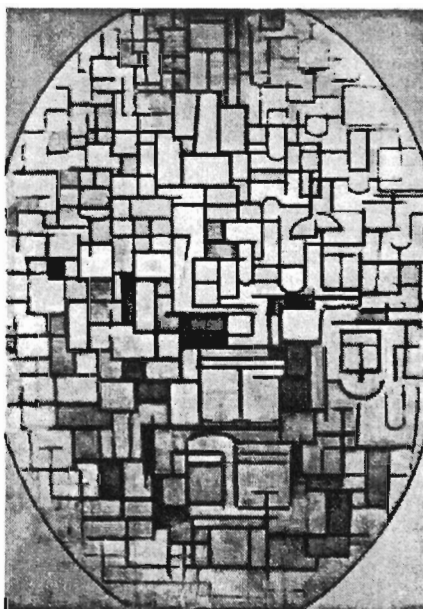


Mondrian. Tree. 1912.

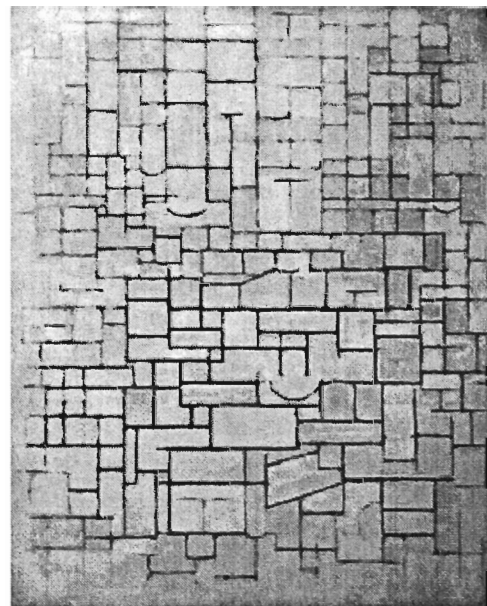


Mondrian. Composition with tree II. 1912.

In later paintings, the resemblance between painting and object became less noticeable, until it disappeared completely. Before that happened, however, there was still a series of paintings in which it was possible to distinguish a certain outline of the composition, that separates the figure from the ground, like the oval compositions for example. Now the figure has almost disappeared, being replaced by compositions of lines and colors. But there is still an outline (the oval figure) which separates the figure from the ground.



Mondrian. Oval Composition.
1914.



Mondrian. Composition I. 1914.

Abstract versus concrete

At some point in his artistic development, Van Doesburg found necessary to reformulate the notion of abstract art. He thought then that abstract art should not be the result of simplifying the sensible images of nature. To have significance, a painting does not need to be associated to a particular object. Rather, the painting should have a meaning in itself. He then proposed the term 'concrete' -as opposed to abstract- as the most appropriate one to characterize Modern art.*

According to this conceptualist view of art, painting has its own inner laws, its own structures, which constitute its own reality. In concrete art, the work has a reality in itself, it does not need to refer to the external world to be meaningful. Thus, the relation between abstraction and figuration is reversed. The painting is not the product of the natural image, as abstract painting was first thought to be. Rather, in concrete art, reality is the by-product of the painting. As Max Bill put it:

"Concrete art is the opposite of abstract...Concrete is the 'representation' of something that was previously not visible, not palpable...The purpose of concretion is to translate abstract ideas into reality so that they can be perceived...." (quoted in Margit Staber, op. cit., p. 169)

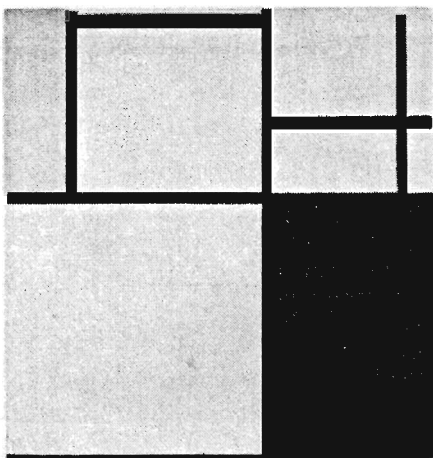
Painting as language

Painting can be considered to be an abstract system of signs which, like the system of language, is made of elements (the geometric shapes, the pictorial vocabulary) and syntactic rules to combine them. Also, in much the same way as in language, the relation between painting and reality is something that the beholder establishes, since it is not implicit in the signs themselves. Just like the word 'tree' is an arbitrary sign that designates a particular class of objects (the natural tree, a particular kind of diagram) an abstract painting can also be thought as an arbitrary sign susceptible of being associated to a multiplicity of objects.

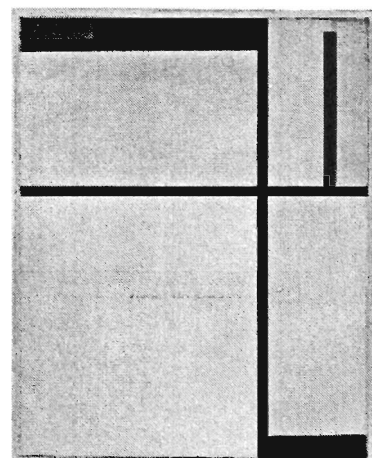
The idea of a pictorial language, having its own rules to combine signs, was the leit-motiv of the mature work of Mondrian. He explored, in endless combinations, the possibilities of a language that could only be expressed through the compositions themselves. Each composition was an utterance of the pictorial language.

*"Concrete Art: This designation was introduced in 1930 by Theo van Doesburg. He and a number of like-minded painter friends founded a group and magazine by that name in order to give a programmatic as well as firm theoretic basis to the new artistic conceptions which up until that time had appeared under the most contradictory nomenclature -one spoke (and still does today) of absolute, non-objective, non-representational, abstract, and finally of 'entirely abstract' art." (Margit Staber, *Concrete Painting as Structural Painting, in Structure in Art and in Science*, G. Kepes, editor, p. 165).

"Painting is a form of thinking" (G. Kepes).



Mondrian. *Composition with Yellow, Blue, and Blue-White*, 1922.



Mondrian. *Composition with Red, Black, Yellow, Blue, and Gray*, 1922.

*FREGE'S THEORY OF MEANINGS. According to this theory, propounded by Gottlob Frege in 1892, the meaning of a proper name has two aspects, the *sense* and the *reference*. The reference of a proper name is that which it is a name of. Thus, the reference of "Sir Walter Scott" is Sir Walter Scott. Frege claimed that there must be, besides the reference, another aspect of the meaning of such a name. "Sir Walter Scott" and "the author of Waverley" have the same reference, but it would be most implausible to say that they have the same meaning. The aspect of meaning that distinguishes "Sir Walter Scott" from "the author of Waverley" is called the sense of the proper name.

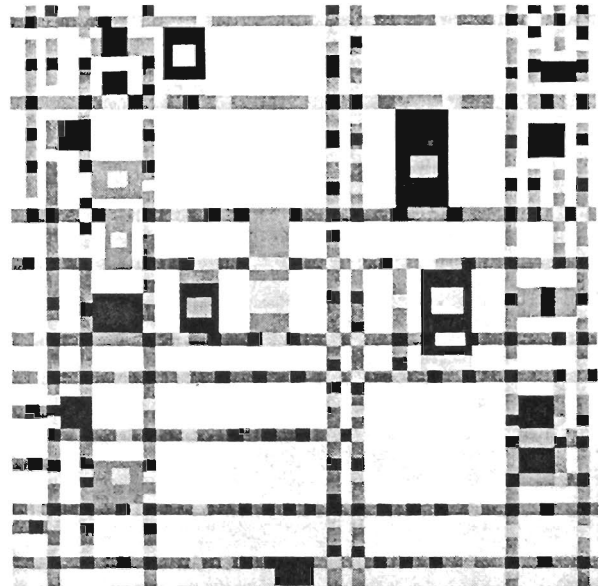
It should be noted that this is a theory of the meaning of proper names, not common names. It is for common names that John Stuart Mill first introduced his distinction between *denotation* (the objects to which the common name is properly applied) and *connotation* (the characteristic or set of characteristics that determines to which objects the common name properly applies). (*The Encyclopedia of Philosophy*, Paul Edwards, editor, vol. 5, 1967, p.68)

One of the questions that Mondrian's compositions raise is that of the relation between abstract composition and reality, between sign and reference*. *Broadway Boogie Woogie*, for example, is an abstract composition of lines and colors that could represent: 1. the rhythm of a piece of jazz 2. the grid of New York city 3. the dynamism of the streets 4. the yellow taxis moving through the streets. 5. a map of the subway 6. the play of lights in the city skyline. All of these interpretations are valid because Mondrian's painting does not depict a particular object (reference), but it creates its own object. In this regard, the less important thing is the resemblance between the painting and the depicted object, for example, between the grid of the painting and the grid of the city. The most important thing is that the painting becomes an autonomous formal system, to which every viewer can attribute a different meaning.

"Art is unthinkable without the effort of the individual. Order on the other hand is impossible without an objectifying structure.

This means that art can originate only when and because individual expression and personal invention subsume themselves under the principle of order of the structure and derive from it a new lawfulness and new formal possibilities". (Max Bill, *Structure as Art? Art as Structure?*, in *Structure in Art and Science*, G. Kepes, editor, p.150)

Mondrian. *Broadway Boogie Woogie*. 1942-43.



*"Music, theoretically considered, consists altogether of lines of tone. It more nearly resembles a picture or an architectural drawing, than any other art creation; the difference being that in a drawing the lines are visible and constant, while in music they are audible and in motion. The separate tones are the points through which the lines are drawn; and the impression which is intended, and which is apprehended by the intelligent listener, is not that of single tones, but of continuous lines of tones, describing movements, curves and angles, rising, falling, posing -directly analogous to the linear impressions conveyed by a picture or drawing" (P. Goetschius, *Elementary Counterpoint*, quoted in G. Kepes, *Language of Vision*, p. 59).*

822 Kompositionen

Boogie Woogie (Pine Top's Boogie Woogie)
 K: Clarence »Pine Top« Smith. C: 1929. V: State Music Pub. Co. Inc., Chicago.

Teil C

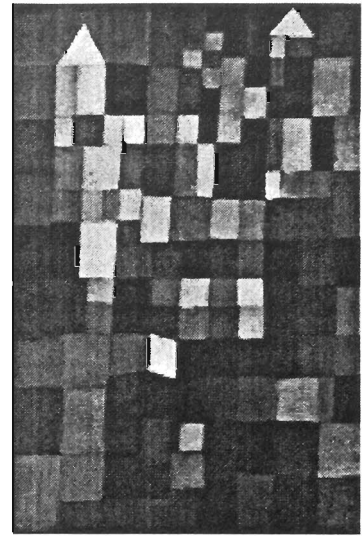
Der Titel des Stückes soll dieser pianistischen Spielart des Blues den Namen gegeben haben, Tempo moderato, wurde erst in der Swing-Ära allgemein bekannt, besonders durch Deane Kincaides Instrumentierung für Tommy Dorsey (1938). S: Cleo Brown, Casa Loma Orchestra, Tommy Dorsey, »Pine Top« Smith.

From Reclams Jazzführer, C. Bohländer, K.H. Holle, 1977

Symbolic, Iconic

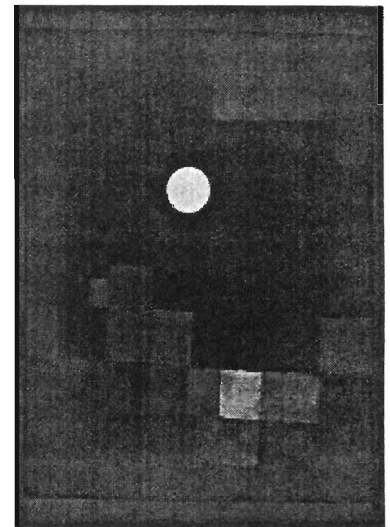
In the language of painting, a sign can have different degrees of iconicity and symbolism-> PEIRCE. This can be understood comparing the painting of Mondrian with one of Klee. Like Mondrian's *Boogie-Woogie*, Klee's *Architektur* is also based on a vocabulary of geometric shapes laid out on a grid. But Klee introduces other shapes like triangles, that remind the forms of the roofs of buildings. These triangular shapes are more iconic than symbolic, since they are likenesses or resemblances of the actual roofs. In the painting of Mondrian, however, there is no resemblance -theoretically, at least-between painting and object: the geometric shapes are basically symbolic.

Paul Klee: "The object expands beyond its appearance because of our knowledge of what lies behind it". (quoted in Margit Staber, op.cit., p. 166)



Paul Klee. Architektur. 1923.

For Klee, the boundaries that separate naturalism and abstraction were less clear than for Mondrian. The painting *Mondaufgang*, for example, can be described as a composition of geometric elements. However, it cannot be said that this is a purely abstract painting. We recognize at the top the dark sky with the full moon, and at the bottom the stepped skyline of the city. The circle is both a *symbol* (i.e. a purely geometric shape, amenable of multiple connotations) and an *icon* -a depiction of a real object (i.e. the moon). Klee places simple geometric shapes in a context in which they get a specific meaning; a meaning that, unlike Mondrian's *Broadway Boogie Woogie*, seems to be intrinsic to the painting.

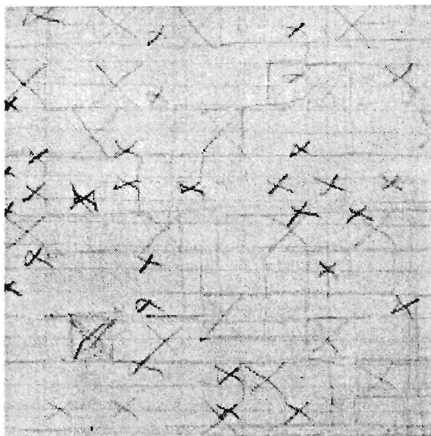


Paul Klee. Mondaufgang. 1925.

The symbolic nature of Mondrian's pictorial signs is most clearly expressed in his sketches. In the study for *Broadway Boogie Woogie* we see the layout of a grid, and crosses placed inside some grid cells. These crosses are markers, place-holders or symbols awaiting to get a more specific definition in the finished painting. For example, the crosses will be replaced by a specific color in the finished painting.

PEIRCE: The American philosopher Charles S. Peirce, the founding father of semiotics -the science of signs- proposed a distinction between icon, index and symbol. An *icon* is a Sign that represents its Object in resembling it. An *index* is a Sign that represents its Object without being actually connected with them. A *symbol* is a Sign that represents an Object essentially because it will be so represented. (in Charles S. Peirce, *Selected Writings*, Dover Publications, 1958, p.368)

MONDRIAN's Working Process



"From 1920 on, Mondrian had struggled to correct the misconception that his art could be characterized as geometric. He insisted again and again that he did not work according to a system, but rather that intuition served as his sole creative guide. Neither friend nor foe seemed able to accept this entirely, and countless attempts have been made to decode the supposedly fixed and mathematically proportional relationships within his work. All such efforts have been fruitless, since it is demonstrably clear that Mondrian's compositional method was anything but systematic or mathematical. The surfaces of his canvases are rich in subtle variations of texture and brushwork. Nothing was predetermined. Reworking, rethinking, and refining characterized his resolution of every problem". (From the catalogue Piet Mondrian, 1872-1944, Leonardo Arte, Milan, 1994, p. 295)

Mondrian. Study for Broadway Boogie Woogie. 1942-43.

Gestalt psychology

The psychology of the Gestalt broke away with the inductive approach that had been applied in the past to explain visual perception, according to which the image would be formed in the eye as a result of the sensorial impressions transmitted through light. To this atomistic theory of perception, Gestalt psychologists opposed the notion of Gestalt (i.e. structure or configuration). A Gestalt is more than the mere aggregation of separate parts: it is a whole or a structure in which, as Wertheimer stated, "what happens to a part of the whole is determined by intrinsic laws inherent in this whole." (quote in the article Gestalt Theory, *The Encyclopedia of Philosophy*, vol. 3, p.318).

In Gestalt theory, to perceive means to recognize the totality of a structure on the perceived object, as opposed to its individual parts. To recognize a structure on something it is necessary the active participation of the beholder. Something is perceived when a matching occurs between the inner structure of the object and the structure that the beholder forms in the mind. In this process of matching, the beholder -following the law of Prägnanz- will attempt to find out the simplest (i.e. the most stable, regular and symmetrical) possible structure from the received sensorial impressions.

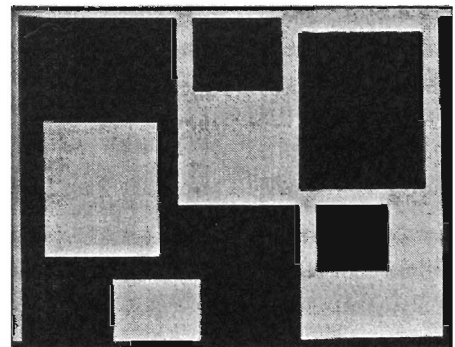
There is a manifest relation between the theories formulated by Gestaltpsychologie and the works made by modern painters. As we have seen, the paintings of Mondrian and Van Doesburg demand the participation of the viewer to be *aesthetically understood*. ->HUSZAR

This link between Gestalt theories and Modern art was explicitly formulated by Gyorgy Kepes in his book *Language of Vision*, 1947. In the introduction of the book, he writes: "To perceive a visual image implies the beholder's participation in a process of organization. The experience of an image is thus a creative act of integration. Its essential characteristic is that by plastic power an experience is formed into an organic whole. Here is a basic discipline of forming, that is, thinking in terms of structure, a discipline of utmost importance in the chaos of our formless world." (Ibid., p.13) To perceive is a process of creation in itself, what Kepes calls a 'plastic' experience: "Independent of what one 'sees', every experiencing of a visual image is a forming; a dynamic process of integration, a 'plastic' experience. The word 'plastic' therefore is here used to designate the formative quality, the shaping of sensory impressions into unified, organic wholes"(Ibid., p.15).

Kepes understands perception as the process by which the mind imposes an order onto the chaotic amount of information that reaches the eye from outside: "The external forces are light-agents bombarding the eye and producing changes on the retina. The internal forces constitute the dynamic tendency of the individual to restore balance after each disturbance from the outside, and thus to keep his system in relative stability." (Ibid., p. 16) He understands an image as a living organism: "The living quality of an image is generated by the tension between the spatial forces; that is, by the struggle between the attraction and repulsion of the fields of these forces"(Ibid., p.36). When these forces are cancelled out, then a state of 'dynamic equilibrium' is reached. This equilibrium can only be maintained for a limited time though, since perception is essentially a dynamic process involving the continuous formation of structures: "The image as a living experience cannot long exist in a frozen structure. For the image to remain a living organism, relationships within it must be constantly changing. The eye and the mind must be fed with changing visual relationships". (Ibid., p52)

HUSZAR: The abstract painting considered as Gestalt experiment: Yve-Alain Bois considers that the pictorial contribution of Vilmos Huszar to De Stijl was "the elementarization of the ground, or rather the figure/ground relationship, which he reduced to a binary opposition. In one of his most successful works, a black and white linocut published in De Stijl, it is impossible to discern the figure from the ground."

(Y.A. Bois, *Painting as a Model*, 1993, p.104-105)



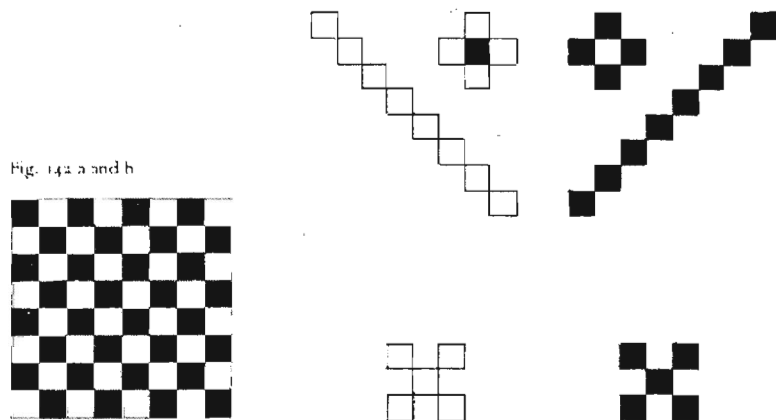
Vilmos Huszar, Composition 6, 1918

"Exposed to a visual field that in its light-quality is to the slightest degree heterogeneous, one organizes that field at once into two opposing elements; into a figure against a background" (Kepes, Ibid. p.31).

Like Kepes, Rudolf Arnheim also applied the ideas and principles of the Gestalt to the study of art. But Arnheim made a different interpretation of Gestalt theories. For Arnheim the outer world was not chaotic, as for Kepes, but ordered. He believed that every percept (i.e. the organized visual information received by the senses) carries the norm, pattern or structural skeleton that the beholder understands as the essential form of the object. This structural skeleton is for Arnheim "the simplest structure obtainable with the given shape". (R. Arnheim, *Art and Visual Perception*, 1954, p. 94).

The approach adopted by Ernst Gombrich in his artistic theory seems to be, at first sight, similar to the one followed by Arnheim. However, the source of Gombrich's theories is not the Gestalt psychology but the philosophy of science of Popper.* Popper had questioned the validity of the inductive method in science according to which theories are derived from the observation of facts. Rather, he contended that theories come always first and that in a second step they are corroborated by the facts. Gombrich believes that the paradigm of the generate-test cycle, that Popper applied to science, can be extended to perception and to art. He thinks that perception is a process of matching a simple visual scheme (the counterpart of the scientist's hypothesis) is with the sensory images: "Without some initial system, without a first guess to which we can stick unless it is disproved, we could indeed make no 'sense' of the millions of ambiguous stimuli that reach us from our environment." (E. Gombrich, *Art and Illusion*, p.231). In the case of painting this means that there cannot be such a thing as a direct copy of nature. In order to depict nature faithfully, a painter needs to have first the schema in his mind. Thus, the artist "begins not with his visual impression but with his idea or concept" (Ibid., p. 62), meaning that "every artist has to know and construct a schema before he can adjust it to the needs of portrayal" (Ibid., p.99)

*According to Gombrich, Arnheim's theories "stress the tendency of perception towards simple form, while my interpretation of the facts (influenced by the philosophy of Karl Popper and the techniques of information theory) has led me to a radically different emphasis. I believe that in the struggle for existence organisms developed a sense of order not because their environment was generally orderly but rather because perception requires a framework against which to plot deviations from regularity" (E. Gombrich, *The Sense of Order*, 1984, p.xii).



Gombrich discusses the instability that results in the perception of a checkerboard pattern: "Test the field for continuities of colour, and the diagonal rows of black or white squares will dominate the impression. Focussing on a white square and regarding it as a centre of a black cross, you can test the rest of the field for redundancies and see that there is no contradiction; identical black crosses can be found anywhere. Let the eye stray to a black square and you will find the configuration of white crosses around a black centre repeated. If, finally, you are tempted to look for a cross along the diagonal axes of a square, such a figure of fivesquare (a quincunx) will obediently come into prominence either in black or in white. Up to a point the experience suggests that we are in control of the apparatus and can switch to various test patterns at will, but it turns out that this control is limited. We cannot hold our readings for long, because the 'break-spotter' is designed in such a situation to probe for alternatives and so the pattern will appear to fluctuate in front of our eyes." (E. Gombrich, *The Sense of Order*, p.131).

EXERCISE

The topic of the exercise is to analyze the structure of Mondrian's *Broadway Boogie Woogie*. Redraw the original painting with a CAD program to discover the basic vocabulary of the composition. Distinguish between individual shapes and shapes that can be grouped in blocks or compound objects. Suggest hypothesis regarding the laws of composition: the rhythm of the grid, the rhythm of color. Represent the multiple readings that can be made of the composition by means of a layer structure. Once you have understood the structure of the work, create at least two variations of it.

Import an image of the original *Boogie Woogie* in Photoshop and analyze the painting from the point of view of color. Explore the different transformations that can be generated with the tools that this program provides (filters, transformations, decomposition in layers, image morphing).

The work will be summarized and presented as a hypermedia document in the web. These are some proposals for issues that could be considered in the presentation of the work:

- associate a piece of music to the different readings/structures you have discovered in Mondrian's composition
- associate ideas, objects or feelings to the abstract signs and compositions.
- optional: take an image or object of your choice and represent it through the formal language of Mondrian's work. Even more optional: create a formal language of your own to express the same image or object.

Time for the exercise: 2 weeks

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3 STRUCTURE AND OBJECT

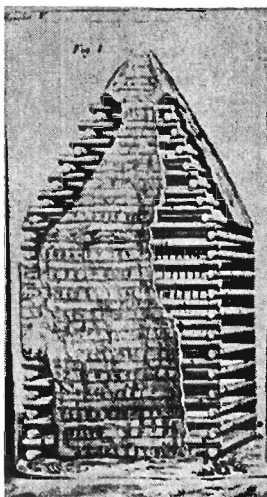
“While we find ourselves inclined to think of ‘construction’ as the result of an activity which is ‘to construct’, we don’t seem to think as easily of ‘structure’ as the result of a conscious activity which is ‘to structure’. The real difference between these two words is that ‘construction’ carries a connotation of something put together consciously while ‘structure’ refers to an ordered arrangement of constituent parts in a much wider sense”.

(Eduard F. Sekler, *Structure, Construction, Tectonics*. In *Structure in Art and in Science*, Gyorgy Kepes, editor. George Braziller, New York, 1965, p.89)

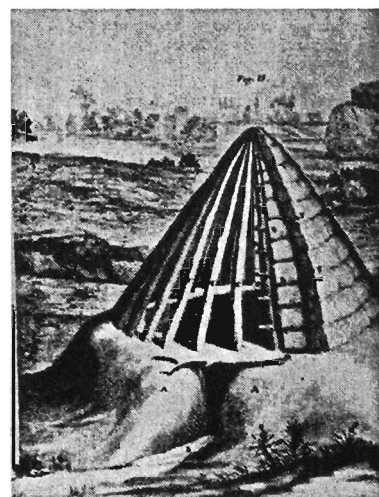
The structural frame as generator of architectural form

Vitruvius, in his *De architectura libri decem*, had considered the structural framework as a precondition of architectural form. Vitruvius described two primitive constructions. The first, the one of the Colchians in Pontus, was built in the following manner: “They lay down entire trees flat on the ground to the right and the left, leaving between them a space to suit the length of the trees, and then place above these another pair of trees, resting on the ends of the former and at right angles with them. These four trees enclose the space for the dwelling. Then upon these they place sticks of timber, one after the other on the four sides, crossing each other at the angles, and so, proceeding with their walls of trees laid perpendicularly above the lowest, they build up high towers. The interstices, which are left on account of the thickness of the building material, are stopped up with chips and mud. As for the roofs, by cutting away the ends of the crossbeams and making them converge gradually as they lay them across, they bring them up to the top from the four sides in the shape of a pyramid” (II,1,4).

The second model of primitive house described by Vitruvius is the one of the Phrygians, who lived in an open country where timber was scarce. This was the reason why, according to Vitruvius, they came up with a sort of construction that required less wood. First, they made a trench on the ground and then they built a pyramidal roof of logs which they covered with reeds and brushwood. In both models of primitive construction, Vitruvius implies that the geometric forms are the consequence of direct operation with physical objects rather than abstractions that pre-existed in the mind of the builder.



The primitive house of the Colchians. From the French translation of Vitruvius made by Claude Perrault.



The primitive house of the Phrygians. From the French translation of Vitruvius made by Claude Perrault.

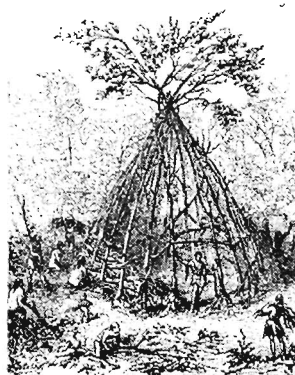
From these primitive structures, according to Vitruvius, the architectural orders developed later: "In accordance with these details, and starting from carpenter's work, artists in building temples of stone and marble imitated those arrangements in their sculptures, believing that they must follow those inventions"(IV,2,2). It can be contended that the skeletons of Vitruvius' primitive houses were a materialistic version of the Platonic Idea: they stood for the image-idea that guides the artist-architect in his creation.



Laugier. *La cabane primitive*.

Laugier's cabane: structure as perceived form.

The structural form of the primitive house was also a key issue in the theory proposed by Marc-Antoine Laugier in the 17th-century. As Vitruvius, Laugier also places the origins of architectural forms in nature: the first dwelling was built in the forest, with branches and trees. In spite of these materialistic connotations, Laugier's *cabane* differs from the previous theories of Vitruvius in one important aspect: the *cabane* is an abstract concept as much as it is a material construction. For Laugier, the architect derived the *idea* of the building from the primitive house: "*Les pieces de bois élevées perpendiculairement nous ont donné l'idée des colonnes. Les pieces horizontales qui les surmontent, nous ont donné l'idée des entablements. Enfin les pieces inclinées qui forment le toit, nous ont donné l'idée des frontons: voilà ce que tous les Maîtres de l'Art ont reconnu.*" Thus, the primitive house, that is, the basic structural skeleton, represents the first architectural idea.



Viollet-le-Duc. The first house. From *Histoire de l'habitation humaine*.

"Structure, then, is on the one hand, the technique by which the art of architecture is made possible; and, on the other hand, it is part of its artistic content. But in the first case it is subject to mechanical laws purely, in the second, to psychological laws. This double function, or double significance, of structure is the cause of our confusion. For the aesthetic efficacy of structure does not develop or vary *pari passu* with structural technique. They stand in relation to one another, but not in a fixed relation. Some structural expedients, though valid technically, are not valid aesthetically, and vice versa." (Geoffrey Scott, *The Architecture of Humanism*, W.W. Norton, New York, 1974, p.95)

The primitive house of Viollet-le-Duc: the rationality of construction as generator of architectural form

In *Histoire de l'habitation humaine*, Viollet-le-Duc offered his particular view of the origins of the first house in the form of a legend. He argued, that it was the necessity to get protection against rain, wind and beasts, which prompted a man, Épergos, to build the first house. He came up with the idea to tie up the upper part of two nearby trees. Then, he asked other people to bring more trees and to tie them together in a similar way. The trees were tied up with branches and the whole structure was covered with mud. Finally, the door was placed in the side protected from the action of wind and rain.

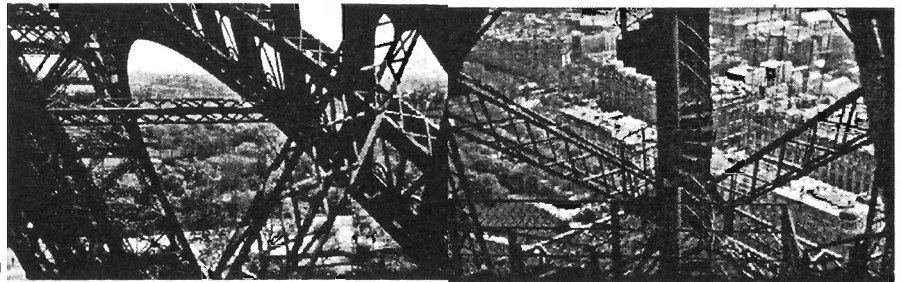
This account of the origins of the first house formulated by Viollet-le-Duc cannot but remind us of the primitive dwellings described by Vitruvius. As a matter of fact, the conical form of the house described by Viollet-le-Duc corresponds to one of the two models described by the Roman author, the one built by the Phrygians. But apart from this coincidence, there are some significant differences between the descriptions of the primitive house provided by Vitruvius and Viollet-le-Duc; differences that reveal the different conception of architecture that both authors had. For Vitruvius, the primitive house was more a creation of nature than of man. Viollet-le-Duc, on the other hand, emphasizes the rationality of the men who built the first house. Furthermore, Viollet-le-Duc assumes that the construction system itself has its own logic, and that this logic determines the architectural forms. Hence, the conical form was the result of a technique consisting in fastening the trees in their upper part. The form of the hut, therefore, was not an idea first conceived in the mind, but the consequence of the logical construction technique. Furthermore, the idea of the first house is associated with the structural form, which for Viollet-le-Duc constitutes the essence of architectural form.

The novel forms of the nineteenth century constructions

In the 19th-century, markets, railway stations, warehouses and bridges offered architects and engineers an opportunity to create novel forms. One of the most original forms created in this period, the Eiffel tower, is a purely structural form. It is not simply a translation of the traditional 'tower' into iron, but an original new form. This gigantic building demanded from the viewer new forms of perception, distinct to the traditional notions of proportion and eurhythmia that had dominated classical aesthetics. The Eiffel tower is not a static composition, in the classical sense, but a dynamic form, whose force emanates from the base and continuous vertically along four asymptotic lines that meet at the apex.->TATLIN, *Monument for the Third International*

The significance of the tower does not stem only from the originality of its form but also from the new spatial conception that entailed->GIEDION. At the turn of the twentieth century, the idea that space was the abstract system of relations -as opposed to the cavity or void- was widespread.

GIEDION: "To a previously unknown extent, outer and inner space are interpenetrating. This effect can only be experienced in descending the spiral stairs from the top, when the soaring lines of the structure intersect with the trees, the houses, churches, and the serpentine windings of the Seine. The interpenetration of continuously changing viewpoints creates, in the eyes of the moving spectator, a glimpse into four-dimensional experience". (S. Giedion, *Space, Time and Architecture*, Cambridge, 1954, p. 282)



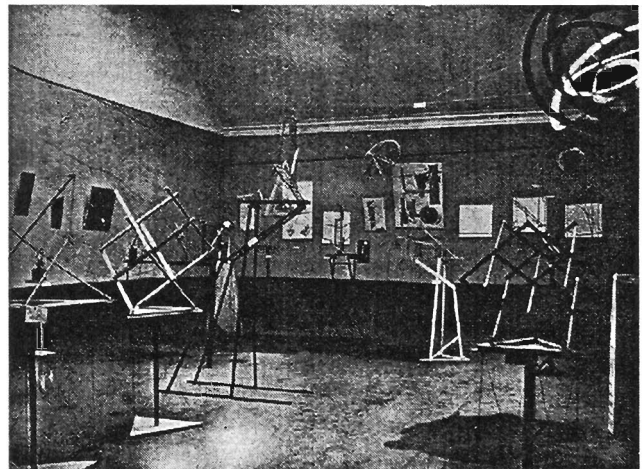
SPACE PERCEPTION



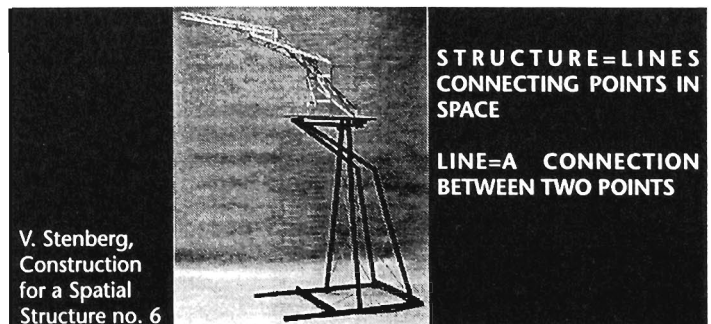
Russian constructivism: the crossing boundaries between reality and representation

The intersections between the world of abstraction and the world of physical reality was revealed by the objects created by constructivists. In Russian constructivism, a structure was both an abstract arrangement of lines in space and a physical construction*. As a matter of fact, the word *construction* could be applied indistinctively to both kinds of structures, abstract and physical. Lissitzky, for example, considered that "every organized piece of work -whether it be a house, a poem, a painting- was a practical object", i.e. a PROUN.

*In the declaration of the First Working Group of Constructivists was stated that "construction is the system by which an object is realized from the utilization of material together with a predetermined purpose". (Liniya Rodchenko 1921; quoted in Christina Lodder, *Russian Constructivism*, 1990, p. 27)



View of the third OBMOKhu exhibition, Moscow, 1921.

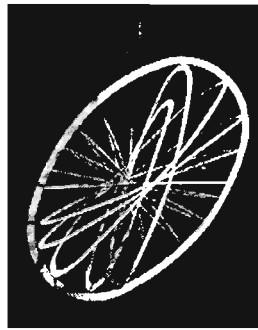


V. Stenberg,
Construction
for a Spatial
Structure no. 6

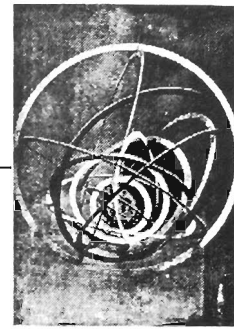
STRUCTURE=LINES
CONNECTING POINTS IN
SPACE

LINE=A CONNECTION
BETWEEN TWO POINTS

The spatial constructions of Rodchenko are as much physical as they are meant to be abstract. They are objects floating in an abstract three-dimensional space. Their ultimate purpose is to escape from the constraints of the physical realm, to exist only in an abstract, non-gravitational space. It is the expression of the contemporary space-time concept: the object changes continuously its position, there is no absolute space where things stay fixed. The dynamic dimension is built in the object itself: the recursive repetition of one element (the circle) suggests the idea of time.



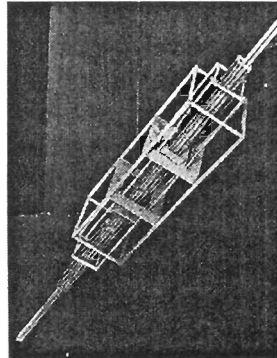
Aleksandr Rodchenko, Spatial Construction/Spatial Object, 1920-21.



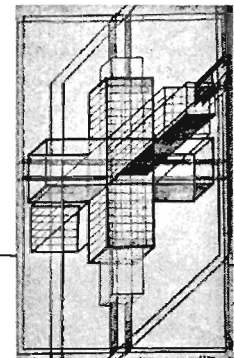
Aleksandr Rodchenko, Spatial Construction/Spatial Object, 1921.

form-space

Similar ideas are present in the work of Klutis. His spatial construction floats in space, hanging from the ceiling, as if it would negate the force of gravity. The object is built through the recursive repetition of a basic element, in this case a three-dimensional figure, i.e. the prismatic frame. In the pictorial representation of the right, the axonometric projection allows for a diversity of readings, each one of them implies a different orientation of the object in space. However, the same effects are achieved either with the physical construction or with the pictorial representation: space is non-gravitational, the object is in continuous motion.

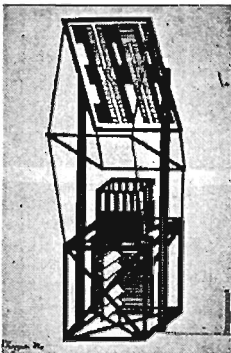


Gustav Klutis, Spatial Construction, 1921.



Gustav Klutis, Construction, 1921.

abstract-physical



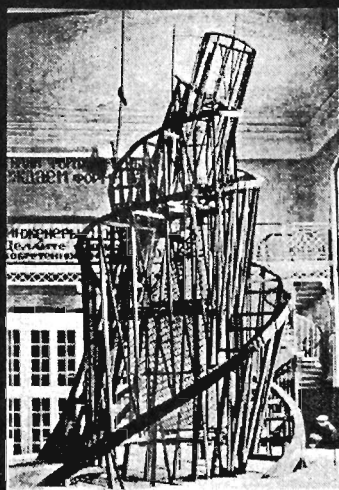
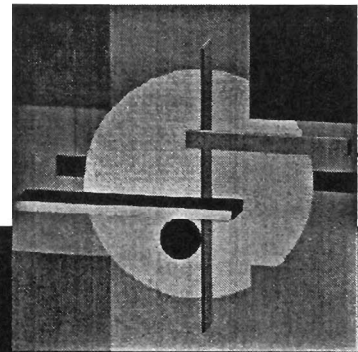
Klutis' Design for a Screen-kiosk is as much a physical artifact as it is an abstract construction: it seems as if the kiosk would have been built by assembling individual components in an abstract-pictorial space.



Some of Lissitzky's Prouns also reflect the interweaving of abstract and physical realms. The prismatic solids remind us of wooden blocks, but the space that contains the objects is more abstract than real.

G. Klutis, Design for a screen-tribune-kiosk, 1922.

El Lissitzky, R.V.N.2, 1923.



V. Tatlin, Model of the Monument to the Third International, 1920.

The monument consists of three great rooms of glass erected with the help of a complicated system of vertical pillars and spirals. These rooms are placed on top of each other and have different, harmonically corresponding forms. They are to be able to move at different speeds by means of a special mechanism. The lower storey, which is in the form of a cube rotates on its axis at the speed of one revolution per year. This is intended for legislative assemblies. The next storey, which is in the form of a pyramid, rotates on its axis at the rate of one revolution per month. Here the executive bodies are to meet (the International Executive Committee, the Secretariat and other administrative bodies). Finally the uppermost cylinder, which rotates at the speed of one revolution per day, is reserved for information services: an information office, a newspaper, the issuing of proclamations, pamphlets and manifestos- in short all the means for informing the international proletariat; it will also have a telegraphic office and an apparatus that can project slogans onto a large screen. These can be fitted around the axis of the hemisphere. Radio masts will rise up over the monument. It should be emphasised that Tatlin's proposal provides for walls with a vacuum (thermos) which will help to keep the temperature in the various rooms constant. (N. Punin, Tour de Tatline, Veshch' No.1/2, 1922; reprinted in Andersen, Vladimir Tatlin, p.57)

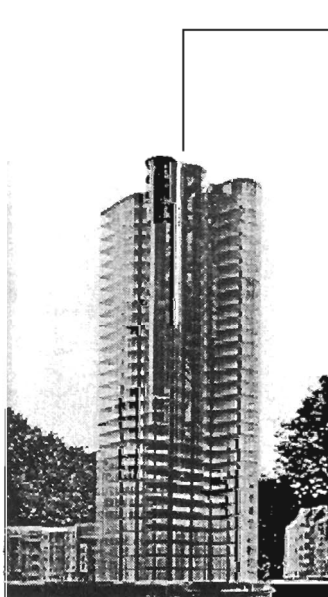
MODERN ARCHITECTURE: FRAME VERSUS VOLUME

Alexander and Viktor Vesnin,
Competition entry for
the Pravda, 1924.

The objects built by constructivists had an undeniable architectural character, but it could not be said that they were architecture. The Vesnin brothers attempted with the Pravda project to create a building with the same aesthetic qualities as the constructions of Klutskis. It is a relatively small project: a square plan of 6m., five stories high. As in Klutskis' objects, the structural frame is the key element of this construction/building. Also, as in Klutskis' kiosks, the project includes loudspeakers, antennas, and other instruments for political propaganda. Scale is a critical issue in this design. In the perspective, it looks like an enlarged kiosk, rather than a properly scaled building. Would it not be for the elevators and balconies, one could think that the building was much taller than it actually was to be.



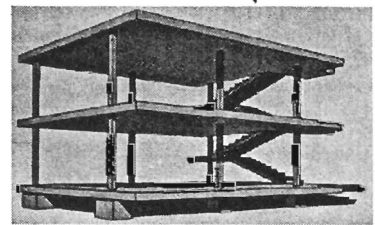
Lines and surfaces are the basic compositional elements of the Pravda project. The notion of frame as lines connecting space can be seen on the wedge that is projected out of the facade. Surfaces are very much dependent on the forms defined by the structural frame. Its basic role is to enclose, to fill the gaps of the structure.



Mies van der Rohe. Project for
a glass-skyscraper, 1920-1.

In Mies' glass skyscraper, on the other hand, the relation between frame and glass enclosure was the reverse as in the Pravda project. Here the volume is defined by the outer undulating skin, while the structure skeleton becomes a stack of plates enclosed by the glass wall. Even though there is the intention to reduce the wall to its minimum expression, the outer plane -rather than the structure- is the form-generator device of the building.

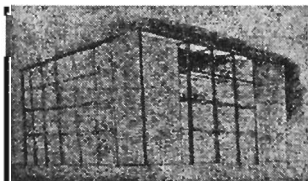
In Le Corbusier's Domino project, the frame is isolated, detached from the enclosing volume. But, the frame is not an active element in design: the overall form of the building is determined by the volumetric envelope.



Le Corbusier. Structural skeleton of
Maison Domini, 1914-15.

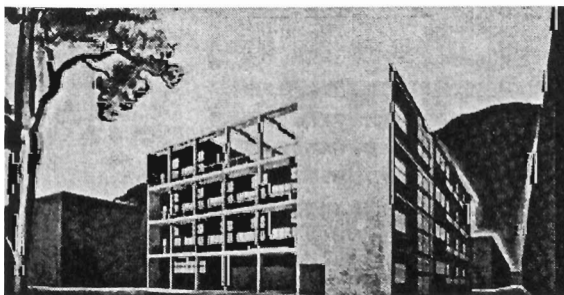
The Domino diagram pictures a one-room structure, defining it with two horizontal slabs (floor and ceiling), supported by a columnar system pulled in from the room's perimeter. The diagram makes clear that any vertical plane that might be added to this space -wall partition, window panel- is utterly independent from this structural skeleton. Implicit in this diagram are some of the standard features of modern architecture as we have known it: the free plan, the curtain wall. What is also implicit is that inside this space, the occupant inhabits the conceptual center of a three-dimensional lattice. As he stands inside and looks out, he is therefore given the structure as pure diagram, as the bodying forth of a system that is transparent to this ability to think it. The rational premises of this space are decipherable. The aesthetic pleasure it affords is tied to the pleasure of decipherment. (R. Krauss, *Death of Hermeneutic Phantom*, in P. Eisenman, *Houses of Cards*, p. 180).

solid-frame



G. Terragni. Sketch
for the Casa del
Fascio.

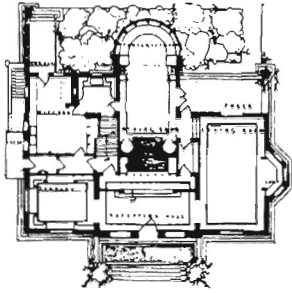
In Terragni's Casa del Fascio, two formal systems -the frame and the solid- played a role in the form generation process. Seen from the outside, it is hard to say if the building is a three-dimensional grid whose infills have been closed by walls, or if, alternatively, it is a solid mass that has been carved out. At the front, the grid has more presence than the solid mass. But on the sides and the back, the building is read more as a solid mass than as a three-dimensional grid.



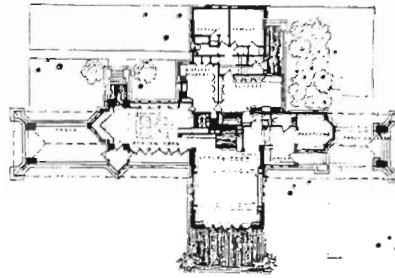
G. Terragni. Casa del Fascio.
1934.

SOLID versus PLANE

We find, in the development of modern architecture, another line of thought mostly concerned with the relation between *solid* and *plane*, as opposed to the relation between *solid* and *frame* that we have observed before. The origins of this line of the development can be traced back to Frank Lloyd Wright and his notion of 'destruction of the box'. In a step-by-step process, Wright succeeded in liberating himself from the inherited Palladian model. In the successive designs for the Prairie houses (from the Winslow house to the Willitts house) it can be observed how Wright steadily broke away from the closed volume to end up creating a new conceptual model based on the free arrangement of planes in space.



F. L. Wright, Winslow house, 1893.

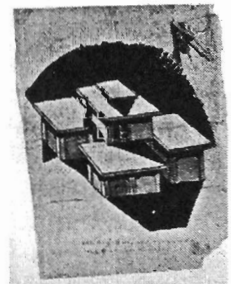
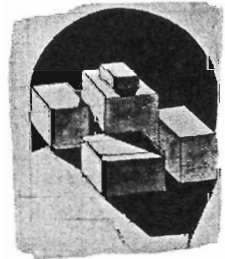


F. L. Wright, Willitts house, 1902.

Wright's work found a continuation in the formal investigations of Van Doesburg. Van Doesburg's main goal was to decompose the solid into planes. He, like Wright, associated the volume (i.e. solid) with inherited form-types. By decomposing volumes into planes he expected to open a new path in architecture; one that would lead to the creation of new, original forms. ->MANIFESTO

An early attempt to carry out this decomposition of the solid into planes can be observed in the drawings for the design of a refreshment building, 1922. One drawing shows a composition of solids in axonometric projection. The solids cast shadow on each other, and the different shading of the faces are an indication of the incidence of light. The space where the solids are lying is not a pure representation of physical space, according to the conventions established after the Renaissance. There is a timid attempt to break away with the distinction between ground and sky, top and bottom, that will not reach its full expression until the later counter-constructions.

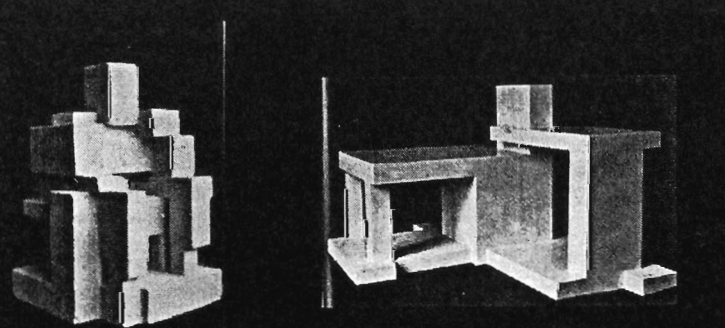
In a second drawing, the same volumes are now transformed into planes. The horizontal planes at the top become particularly accentuated. The corners are reinforced with vertical volumes, transforming the sides of the original solids into the infills of the frame. This timid, and aesthetically not very successful, attempt to move from a vocabulary of solids to one based on planes, found a continuation in the designs that Van Doesburg did later together with Van Eesteren.



Theo van Doesburg. Design for a refreshment building, 1922.

precedent

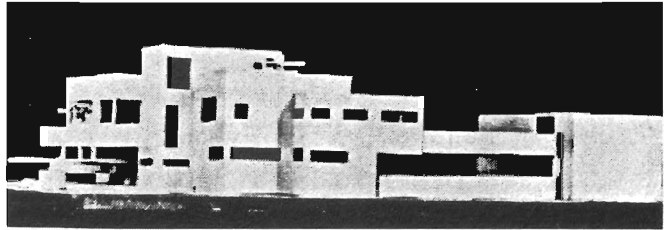
G. Vantongerloo, Composition of volumes.



**IN THE REALM OF ABSTRACTION,
SCULPTURE=ARCHITECTURE=SOLID**

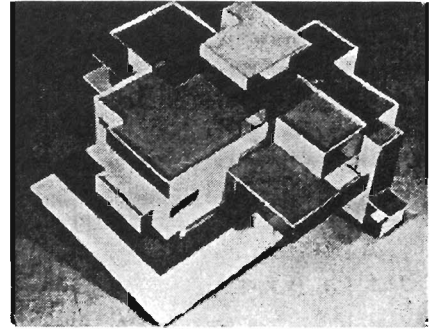
**WHERE IS THEN THE LINE THAT
SEPARATES A GEOMETRIC FORM
FROM AN ARCHITECTURAL
FORM?**

The first project that Van Eesteren and Van Doesburg did together, the house for Leon Rosenberg, 1923, is basically a composition of solids, very much in the line of the previous projects made by Oud.

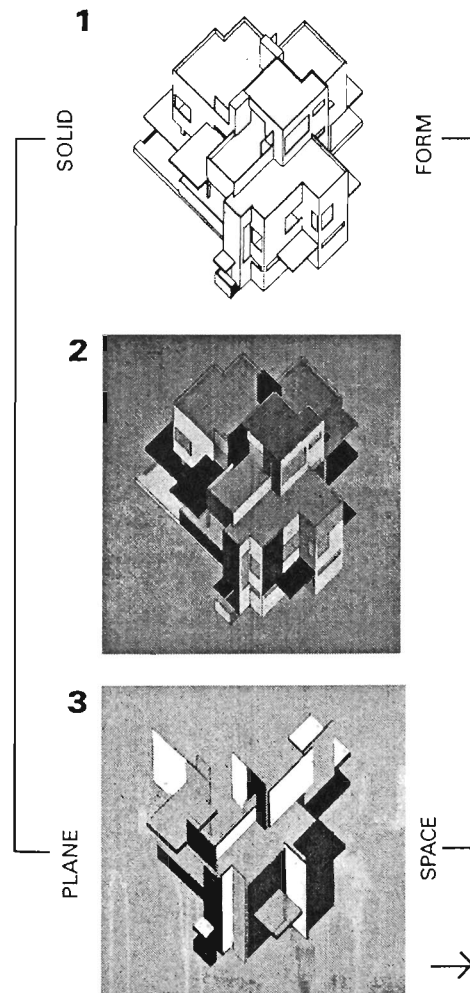


Van Eeesteren and Van Doesburg. Model for Maison Rosenberg, 1923.

The participation of Van Doesburg in the project was rather scarce. But, in a second project, la maison particulière, the influence of Van Doesburg seem to have been decisive to move from a language of solids to a language of planes. In the axonometric drawings, the house can still be read as a composition of solids. However, starting from these drawings, Van Doesburg started a process of decomposition of the solid into the plane by means of the application of color to the surfaces (1-2-3). This process of decomposition reached its maximum expression in the analytical drawings, i.e. the counter-constructions. In these drawings, one of the goals of the architecture of Wright -the destruction of the box- is expressed in a radical way. There is no distinction between inside and outside spaces, between top and bottom, or between front facade and back facade. Windows are not perforations in the wall, but rather gaps that are left between the planes (incidentally, an old dream of Wright was to get rid of punched windows).

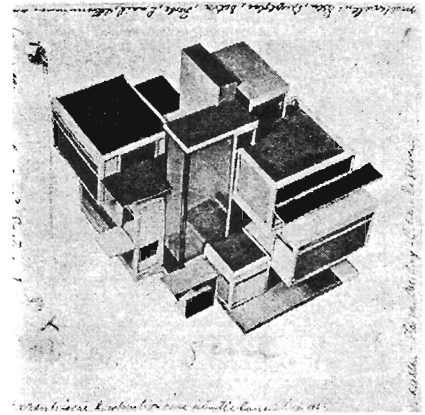


Van Eeesteren and Van Doesburg. Model for Maison Particulière, 1923.



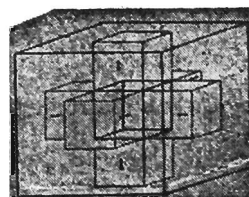
Van Doesburg. Maison particulière, 1923.

It is however in the third project, -la maison d'artiste- where this process of decomposition reaches its ultimate consequences. In this case, the model of the house already reflects the notions of form and space achieved before through the counter-constructions.



Van Doesburg and Van Eeesteren. Model for Maison d'artiste, 1923.

The experiments of the three projects made by Van Eesteren and Van Doesburg ended up being both an architectural and a pictorial achievement. The architectural feat was the three unbuilt projects that conform to the principles of the Wrightian model: substitution of the volume by planes, elimination of punched openings, predominance of space over form. From the point of view of painting, the result was a series of 'counter-constructions' painted by Van Doesburg, which gave expression to the contemporary conception of architectural space. It can be said that the unity of the different arts -one of the programatic goals of De Stijl- was reached with these designs.

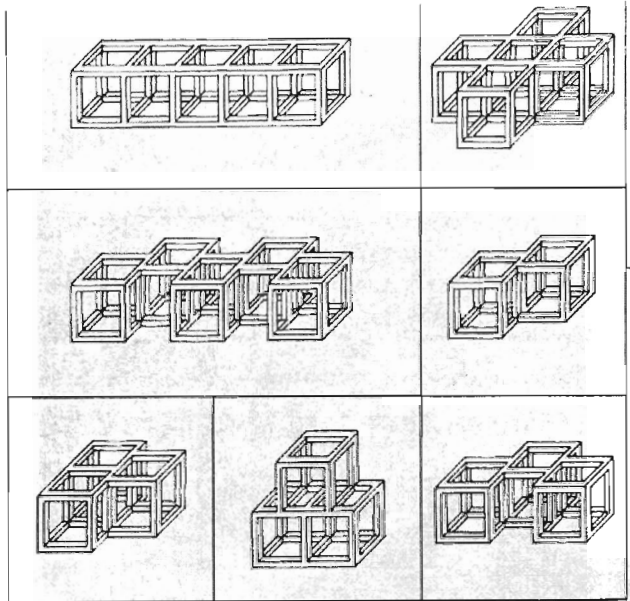


NEXT STEP: TESSERACTIC SPACE (hypercube)

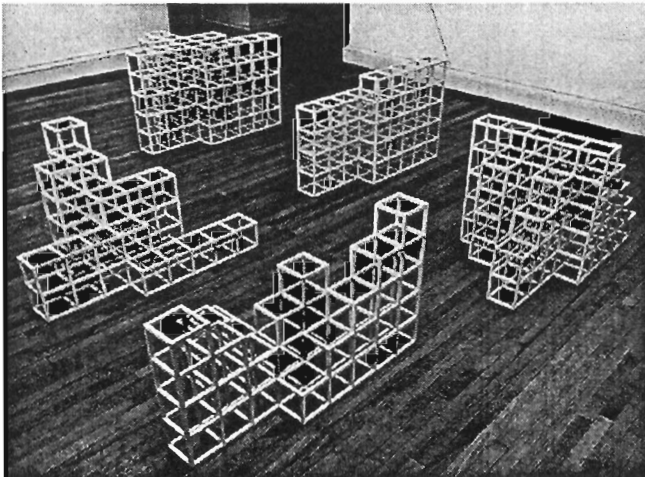
Syntactic investigations of the frame

The greatest achievement of the artistic movements of the beginning of this century was the definition of a new formal vocabulary in the different arts. The influence of that achievement can still be felt in our time. The works of Sol Lewitt, Peter Eisenman or Bernard Tschumi stem directly from the aesthetic created by De Stijl and the Russian constructivists. What today is missing, however, is the cultural milieu in which the original works originated. In the absence of that cultural background, contemporary art has limited itself to the exploration of the syntax of the formal languages created at the beginning of the century.

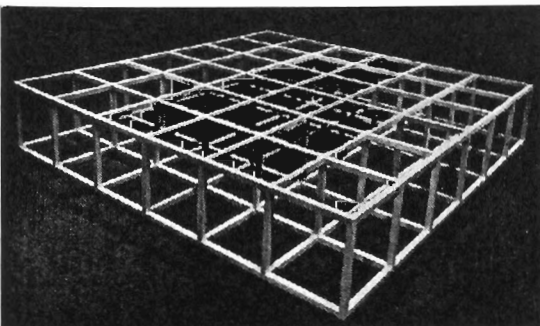
A point in case is the work of Sol Lewitt. His 'structures' explore the multiple combinations of the frame, in strictly syntactic terms, without pretending to give any particular meaning to the objects. Almost invariably, the cube is the basic element of composition. Frame structures result from the multiple combinations of the cube. The creation of the object proceeds from the bottom-up. The overall figure of the complete structure does not seem to be a concern for the artist. The most important thing is the systematization of the rules by which a basic vocabulary of elements is combined to create larger compound objects.



Sol Lewitt, Drawing for seven structures, 1977.



Sol Lewitt, Five Modular Structures (Sequential permutations on the number five), 1972.



Sol Lewitt, Modular Floor Structure, 1966.

"LeWitt has written about his own work and working methods from time to time, but has not discussed such questions of history. However, since 1962 LeWitt has titled his three-dimensional work 'structures' rather than 'sculptures'. The implication here is that in some important respect these works are to be distinguished from the types of objects we associate with the category 'sculpture'. His contemporary Donald Judd made a similar point in 1965 when he opened his essay 'Specific Objects' with the sentence 'Half or more of the best new work of the last few years has been neither painting nor sculpture but three-dimensional work'. So, on the one hand Greenberg maps out a tradition of 'construction-sculpture' which appears to but doesn't allow for the inclusion of LeWitt's and Judd's work; on the other hand, LeWitt and Judd make 'three-dimensional work' which suggests in its materials and means of fabrication a link with earlier types of constructed sculpture, a link which they refuted. If this seems confusing, it should at least be clear that the distinction between sculpture and structure meant something far more specific than a change of basic techniques or materials. Greenberg recognised that carving and modelling had been pretty much displaced from the sculptural mainstream by the 1930's. He could point to a line of 'constructed' work - from Brancusi and Picasso through Tatlin and Gonzalez to David Smith - in support of a claim that this represented the most advanced and demanding sculpture of the twentieth century. It is hard to imagine Judd or others finding much to disagree with in this. Clearly, then, the differences between 'sculpture' and 'structure' lay somewhere within the broadly accepted category of 'construction', and not between it and some other category, such as carving." (David Bachelor, *Within and Between*, in the catalogue of *Sol Lewitt-Structures 1962-1993*, The Museum of Modern Art, Oxford, 1993, p.15)

→ Eisenman, Tschumi

Architecture as object

There is a close link between the conceptualist works of artists like Sol Lewitt and the early investigations carried out by Peter Eisenman in a series of house projects. In these projects, Eisenman is mostly concerned with the systematization of an architectural formal language. The process of design becomes an exploration of the syntactic combination of elements (beam, column, frame), as in Lewitt's structures. The design of a building becomes a sequence of transformations based on well-defined rules. As a result, the process of design becomes the object of the design.

In spite of the strong links that existed between the structures of Lewitt and Eisenman's 'architectural objects', it is not possible to equate both works completely. The structures of Lewitt are objects in themselves. They could have any meaning we are willing to assign to them but, in principle, these structures are not representations of something else. On the other hand, the models and drawings of Eisenman are representations of a building, of a larger object that will be built later. In the architectural language, however, there is a relation between signifier and signified that does not occur necessarily in the structures of Lewitt. A frame in Eisenman's model is, ultimately, a sign of the structural frame that will support the actual building.

The emphasis that Eisenman places on the representation of architecture has, as a logical consequence, the negation of the reality of the building itself. What it matters is the conceptual realm of architecture. The real building, the constructed house, is for Eisenman 'cardboard architecture', an enlarged version of the small model.

1. Cardboard is a term which questions the nature of the reality of the physical environment.
2. Cardboard is a term which attempts to shift the focus from existing conceptions of form to a consideration of form as a signal or a notation which can provide a range of formal information.
3. Cardboard is a means for an exploration into the nature of architectural form itself, in both its actual and conceptual states.

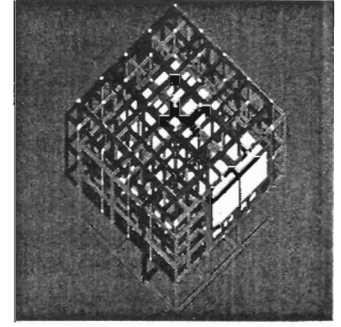
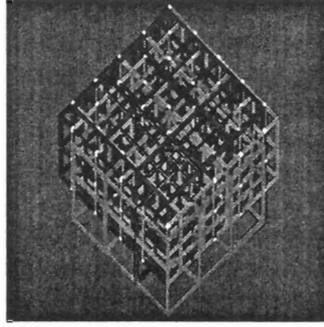
P. Eisenman, *Cardboard Architecture*. Casabella 374

From an aesthetic point of view, Eisenman's starting point is the pioneering work developed by van Doesburg, Le Corbusier or Terragni. The formal expression of the house projects owes much to the original works developed earlier by modern artists. Also, the idea that each art had a formal language which could be object of certain systematization was already proposed by Van Doesburg. Eisenman's contribution was to give a new impulse to these ideas, merging them with contemporary theories of linguistics and information theory.

← van Doesburg, counter-construction

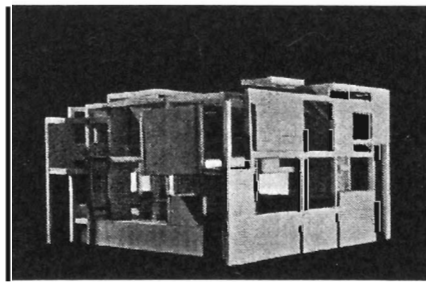
P. Eisenman, *Diagrams of House VI*.

Eisenman's concern with the idea of an architectural formal language began with his doctoral dissertation, 'The Formal Basis of Modern Architecture', 1963. In this work Eisenman attempted to demonstrate that "implicit in Le Corbusier's diagrams [the diagrams of the four compositions] are the vocabulary, grammar, and syntax of a formal language". (Ibid., p.6) Eisenman's purpose was to make the rules of that language explicit.

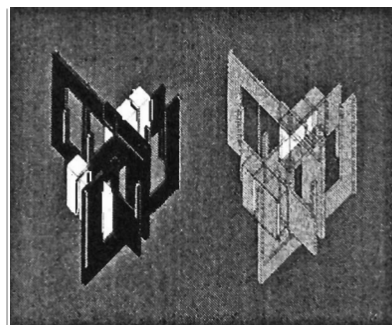


P. Eisenman, *Diagrams of House VI*.

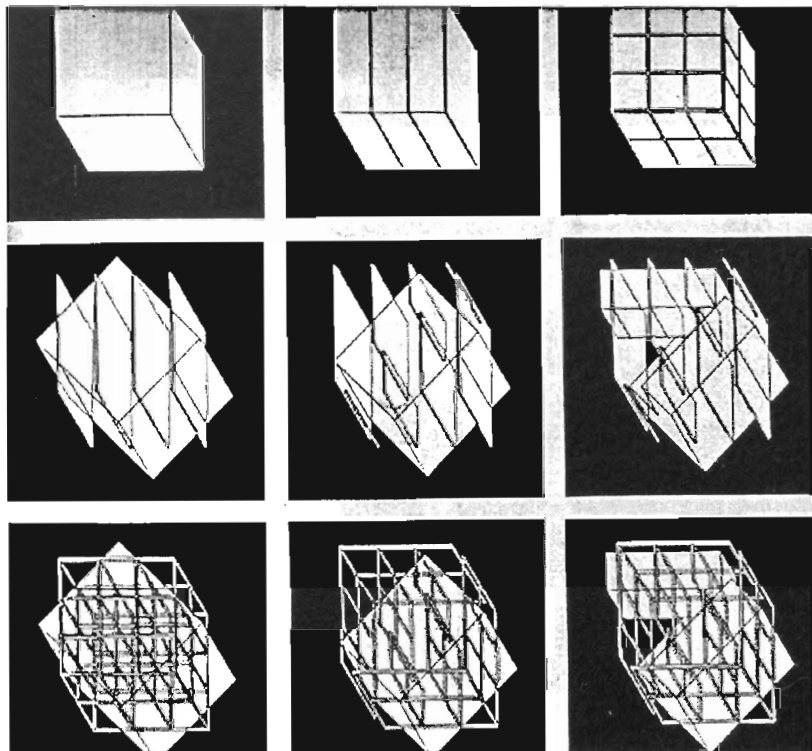
"Conscious of the initial efforts of modernism, the houses of this book take up anew the project of autonomy, in a sense, take it up for the first time and use it to dislocate that traditional symbolism of modernism. This project consisted of two parts: first, the search for a way to make the elements of architecture—the wall, the beam, the column—self-referential; and second, the development of a process of making that could produce self-reference without referring to the formal conventions of modernism. The elements were the freestanding column and the free plan of Le Corbusier. The result is an attempt to free the house of acculturated meaning whether traditional or modern. When conventions and external referents are stripped from an object, the only referent remaining is the object itself. Hence, all those extraneous meanings like the column as a surrogate for a man's body, doors and windows oriented in relation to man's verticality, rooms scaled to his size, ordering principles and plans in conformance with the classical hierarchies—all of which, however, remained disguised in the work of modernism—have been suspended." (P. Eisenman, *Misreading*, in *Houses of Cards*, Oxford University Press, 1987, p. 172)



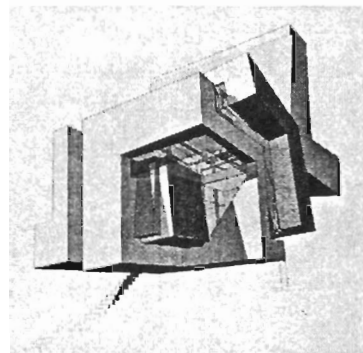
P. Eisenman, *Model of House IV*, 1971.



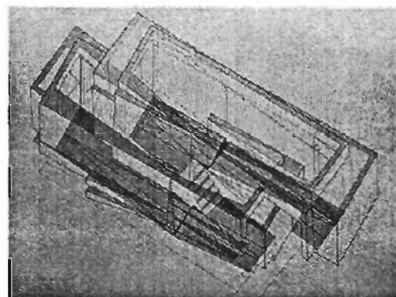
In Eisenman's early projects, transformation was a step-by-step procedure by which one element is substituted by another: a volume is divided into planes, parallel planes become a grid, the grid is rotated, and so on. In later projects, the notion of transformation has acquired a more expressive character: the project becomes the materialized record, the trace of the transformation process. In the Guardiola house, for example, the design seems to be the result of letting an L-shape roll down the hill where the project is located. In later projects, this dynamic notion of transformation is also pursued. At the same time, the origin of the forms is sought in themes that are related to the location or character of the project. In the pavilion of a video exhibition in Holland, the zig-zag of the shapes is supposed to derive from the paths that the electronic beams followed in a CRT display.



P. Eisenman, Diagrams of House III.



P. Eisenman. Guardiola House, Cadiz, 1988.



P. Eisenamn. Pavillion for video exhibition, Groningen, 1990.

It can be argued that one of the fundamental premises of architecture has been that the conceptual structure -i.e. the perceived form of the building- should coincide as much as possible with the physical structure of the building. This premise takes us back to the very origins of architecture, when a building was more than anything else a structure whose form derived from the laws of construction and the proper use of materials. As architecture evolved as an art form, the original unity of structural and architectural form was put many times into question. There have been periods in the history of architecture where such unity was consciously sought (i.e. Greek architecture), while in others was purposely neglected (i.e. Baroque). In neo-classicist thought, the separation between visual structure and physical structure was considered problematic. Laugier's theory of the primitive hut can be interpreted as a defense of the lost unity between two kinds of structure.

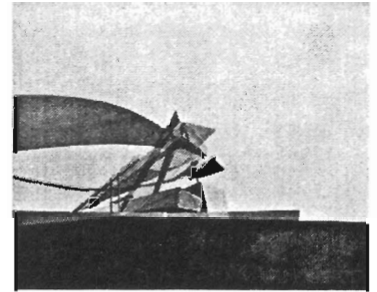
In the architecture of recent years the term folding has been used to describe a form-generating process whose ultimate goal is to break away with the fixed idea, image of type in architecture. The form of the building would be the expression of a process of 'becoming': "The building evades its cartesian definition: not representing an essential form, but a form of 'becoming'" (P.Eisenman, commentary on the Alteka office building Japan, in *Architectural Design Profile*, n. 102, p.28). There is also an attempt to overcome the duality form-space, to achieve the continuity of space, that is, the continuous flow from outside-inside-outside.

Deconstruivist architecture

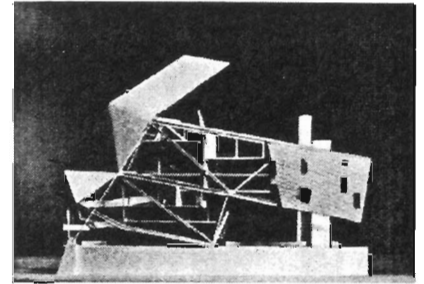
In the catalogue of the exhibition *Deconstruivist architecture*, Russian constructivism is presented as the antagonist of Modernism: the first created unstable, dynamic structures; the second, pure, stable compositions. The quest for stable forms, postulated by Modern Movement architecture, would be only a self-imposed constraint that prevented modern architects from exploring other formal possibilities. In contrast to modern architects, "The Russian avant-garde posed a threat to tradition by breaking the classical rules of composition, in which the balanced, hierarchical relationship between forms creates a unified whole". (M. Wigley, *Deconstruivist architecture*, p 11).

This opposition between stable and unstable forms, it is now believed, was an artificial one. The pure form contains in itself the germ of impurity. Moreover, "the more carefully we look, the more unclear it becomes where the perfect form ends and its imperfection begins; they are found inseparably entangled". (Ibid. p.17)

The works of the exhibition represent a mixture of both approaches: the modern and the constructivist. As the catalogue claims, they are not the mere reproduction of constructivism: "The projects can be called deconstructivist because they draw from Constructivism and yet constitute a radical deviation from it"(ibid. p.16). Accordingly, the goal is not so much to dismantle organized, stable formal structures as to raise the conceptual framework one step higher, i.e. 'displacing' the original meaning of the inherited formal structures.



Z. hadid. The Peak, Hong-Kong, 1982.

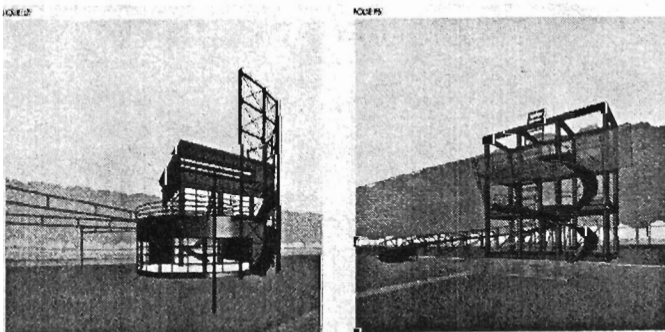


Coop Himmelblau. Apartment building. 1986.

Composing, de-composing, re-composing

The aesthetic sources as well as the conceptual framework of Tschumi's project for the Parc de la Villette participate of the spirit of Eisenman's work. But the notion of architecture as text, equally present in Eisenman's discourse, is Tschumi's most significant contribution to the contemporary architectural debate. As in language, an architectural form is susceptible of being associated with a multiplicity of meanings. The grid of the park, for example, can be read as a reference to the grid of the streets of Paris. The relation between the grid of the park and the grid of the city is not based on formal similarity, because one is orthogonal and in the other is dominated by the centrifugal axes. The connection between both kinds of grid lies at a deeper level: it is the structure that underlies both urban sites, a structure without a particular visible form.

Similarly, the color of the folies can be interpreted in a variety of ways, and all of them can be simultaneously true. It can be said that the red color is a celebration or remembrance of the slaughterhouse that existed in the same location where the park has been built. Alternatively, it can be interpreted as an homage to the Russian constructivism and/or to the Russian revolution. Thus, the folies are, as Tschumi contends, 'multireferential anchoring points.'



B. Tschumi. Parc de la Villette. Folies J7, P6.

"In each structure, the cube remains legible. But the dismembered cube is not simply reassembled into a number of new stable forms, by rearranging the kit of parts. Instead, the elements are embedded in each other in unstable assemblages: they are placed in conflict with each other and with the cube. The cube has been distorted by elements that were extracted from it. These distorted cubes are then deformed further in order to accommodate different functions (restaurant, arcade, and so on). They become folies in the park: freestanding structures linked by broken galleries that twist through a fractured topography." (B. Tschumi, in the catalogue of Deconstructivist architecture, MOMA, New York, 1988, p. 92)

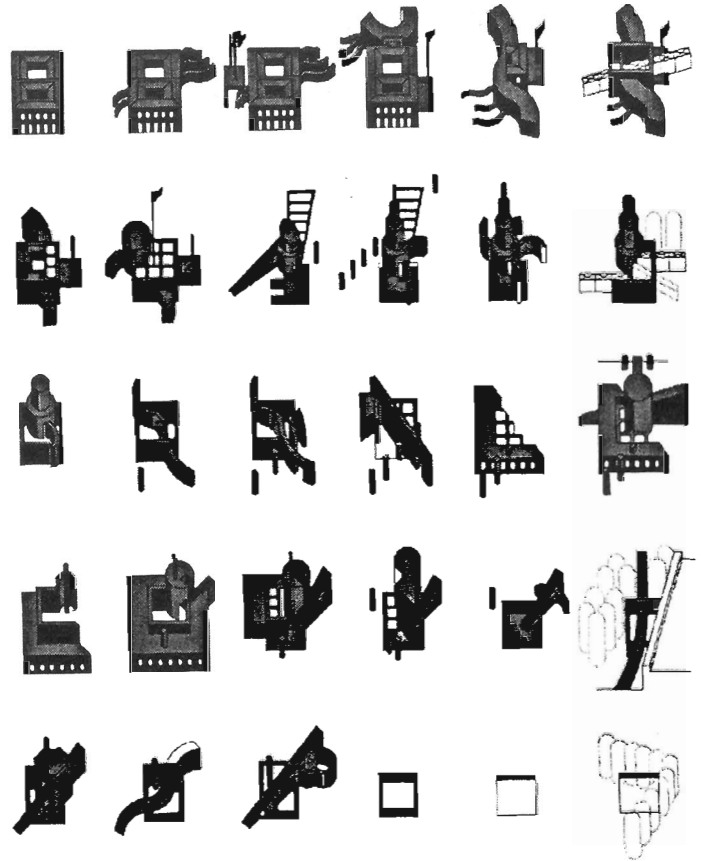
Si les Folies partent d'une structure constructive simple, certaines déviations peuvent altérer le rapport à la trame. Celle-ci devient alors un simple support, autour duquel une architecture transgressive se développe par rapport à la norme originale.

Ce rapport normalité/déviante nous a suggéré une méthode d'élaboration des Folies:

Dans un premier temps, des exigences et contraintes liées au programme et au site sont analysées et traduites en une solution architecturale de base: « la norme ».

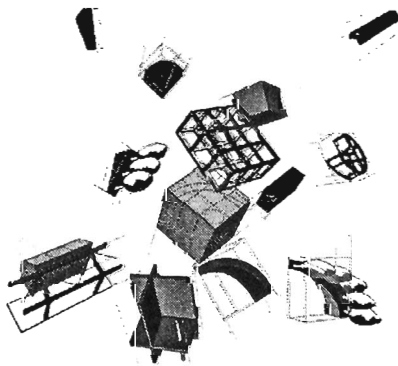
Dans un deuxième temps, cette norme est transgressée, sans pour autant disparaître. Une dérivation par rapport à la forme originale en résulte: la « déviante ».

La déviante est à la fois rationalité exacerbée et irrationalité. Elle va au-delà des images architecturales usuelles, parce que justement elle prend comme point de départ une solution qui cherche à tendre vers l'exactitude. La norme contient les termes de l'éclatement, la déviante les libère. La normalité tend vers l'unité, la déviante vers l'hétérogène et le dissocié. Il ne s'agit pas ici de couples, d'opposés, mais simplement d'une affaire de degré. La Folie est plus ou moins des degrés divers. Comment ces degrés de déviante sont-ils déterminés ? Par l'économie, le temps, l'argent, les circonstances. Une Folie « normale » ne se réalise pas de la même manière qu'une folie « déviante ». (B. Tschumi, *Cinégramme folie. Le Parc de la Villette, Champ Vallon*, p. 27)



Principe de base de combinaison et de transformation des éléments architecturaux de la grille ponctuelle des folies allant d'un élément figuratif existant (pavillon bourse 1865) à l'abstraction du cube.

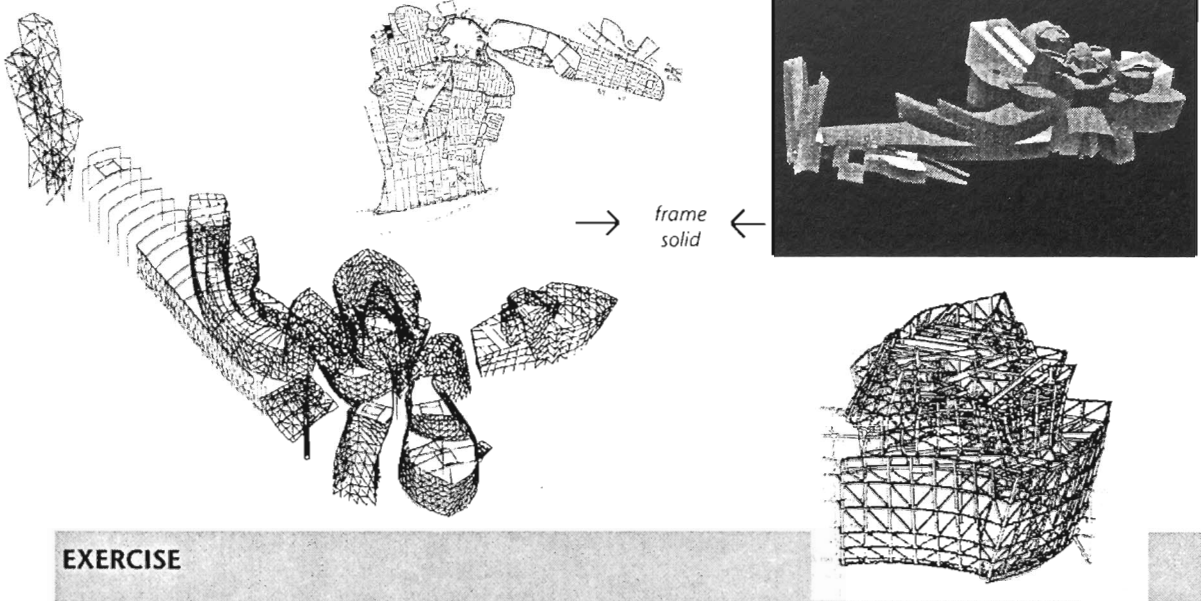
Unlike Eisenman, Tschumi is not so much concerned with language as a system of signs, nor with the understanding of the rules of syntax of a hypothetical architectural language, but with the connection between language and thought, even between language and anomalous thought, as schizophrenia. The word folie implies craziness, and this is precisely one of the arguments that Tschumi has used to explain the project: "The schizophrenic places words and things on the same plan without distinguishing their respective origins. In this analogy, the contemporary city and its many parts (here la Villette) are made to correspond with the dissociated elements of schizophrenia" (B. Tschumi, *Architecture and Disjunction*, The MIT Press, p. 177).



Many of the critical terms in Tschumi's discourse have literary, formal and psychological connotations like: limits, violence, madness, pleasure, transgression, discontinuity, distortion, fragmentation, repetition, transference, rupture, interruption, dislocation.

B. Tschumi, Folie éclatée, 1984.

Frank Gehry, Guggenheim Museum, Bilbao.



EXERCISE

The purpose of the exercise is to explore the possibilities of three different formal languages: solid, plane, frame. The topic for the exercise is the architectural object. Select a theme of your choice to create this object: an abstract object, a pavilion, a monument..... Explore the intersecting territories that take place among the different art forms: pictorial, sculptural and architectural.

It is important to explore the interrelations between three formal languages (solid, plane, frame). The form-making process can start with one of these languages, for example, the frame. The object can then be *translated* into a set of volumes. Then, the form-making process can continue further working within the language of the solid. Explore different kinds of translations between formal systems (from solid to plane, from solid to frame), as well as the combinations between different languages (frame and solid, frame and plane).

Be aware of the different sense of scale that the representation of the object in axonometric or perspective conveys. Axonometric views are more appropriate to express the 'objectness' of a design. Exploded axonometrics can be used to show the inner composition of parts. A linear perspective, on the other hand, inevitably brings a sense of scale, a relation between object in viewer, which is absent in the axonometric view.

Implement the inner structure of the objects with the techniques that a computer-aided design program provides. In particular, objects that are the result of the repetition of parts or modules, can be modelled using 'blocks' or 'types and instances'. In any case, the use of layers also provides with a mechanism to represent the inner structure of the object in the computer model. A critical point is the naming of the components that make up the object: think of the relation between formal sign and linguistic sign.

Time for the exercise: 2 weeks

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4 STRUCTURE AND SPACE

“All architecture is a structuring of space by means of a goal or a path. Every house is an architecturally structured path: the specific possibilities of movement and the drives towards movement as one proceeds from the entrance through the sequence of spatial entities have been pre-determined by the architectural structuring of that space and one experiences the space accordingly.”

(D. Frey, *Grundlegung zu einer vergleichenden Kunstwissenschaft*, 1949, p.6)

Concepts of space: philosophical and mathematical

Two basic conceptions of space were already formulated in the Antiquity: one according to which space is the perceived relation between objects, and a second for which space would be basically the container of things. The first conception of space is related to orientation and measuring, fundamentals of the science of geometry. The second conception of space was mostly the concern of philosophers. In early philosophical thought, space and matter were sometimes indistinguishable. Thus, the Pythagoreans seem to have identified air with the void, i.e. space. Later philosophers began to distinguish between place (topos) and matter. Archytas argued that “since what is moved is moved into a certain place and doing and suffering are motions, it is plain that place, in which what is done and suffered exists, is the first of things” (Max Jammer, *Concepts of Space*, 1993, p. 10). The concept of space of Archytas “is therefore not some pure extension, lacking all qualities or force, but is rather a kind of primordial atmosphere, endowed with pressure and tension and bounded by the infinite void.” (Ibid. p.10). The idea of space as an abstract void in which objects are placed was later formulated by Lucretius: “All nature then, as it exists, by itself, is founded on two things: there are bodies and there is void in which these bodies are placed and through which they move about.” (Ibid. p.12) At this point, philosophers seemed to be ready to admit that something could exist without having a physical existence (i.e the void, the empty space)

In the description of the universe made by Plato in the *Timaeus* three forms of reality are considered: the reality of visible images or appearances, always in continuous change; the reality of invisible, eternal ideas; and a third form of reality, chora, which he refers (1) as the material receptacle that receives all things, and (2) as the space which can only be apprehended by reason.->PLATO

PLATO: (1)“(Chora) never alters its characteristics. For it continues to receive all things, and never itself takes a permanent impress from any of the things which enter it, making it appear different at different times.” (*Timaeus*50-52)

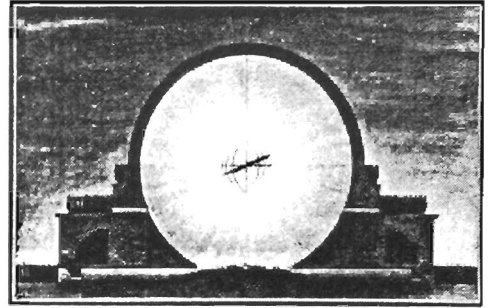
(2) “It must be agreed that there exist, first, the unchanging form, uncreated and indestructible, admitting no modification and entering no combination, imperceptible to sight or the other senses, the object of thought: second, that which bears the same name as the form and resembles it, but is sensible, has come into existence, is in constant motion, comes into existence in and vanishes from a particular place, and is apprehended by opinion with the aid of sensation: third, space which is eternal and indestructible, which provides a position for everything that comes to be, and which is apprehended without the senses by a sort of spurious reasoning and so is hard to believe in- we look at it indeed in a kind of dream and say that everything that exists must be somewhere and occupy some space, and that what is nowhere in heaven or earth is nothing at all.” (Ibid.)

Aristotle made a distinction between space and place (topos): space was the sum total of all places occupied by the bodies, while place was that part of space whose limits coincide with the limits of the occupying body. (see Jammer, op.cit., p.17)

In the *Principia*, Newton found necessary to begin drawing a clear distinction between two different realms, the physical and the sensible: "I do not define time, space, place and motion, as being well known to all. Only I must observe, that the common people conceive those quantities under no other notions but from the relation they bear to sensible objects. And thence arise certain prejudices, for the removing of which it will be convenient to distinguish them into absolute and relative, true and apparent, mathematical and common..." Thus, on the one side there is what is absolute, true and mathematical; on the other, what is relative, apparent and common; a distinction which, incidentally, echoes Plato's duality between the world of ideas and the world of images. Next, Newton introduces the distinction between absolute and relative space: "Absolute space in its own nature, without relation to anything external, remains always similar and immovable. Relative space is some movable dimension or measure of the absolute spaces; which our senses determine by its position to bodies; and which is commonly taken for immovable space; such is the dimension of a subterraneous, an aerial, or celestial space, determined by its position in respect to the earth." Newton's work marks the separation between the abstract, mathematical concept of space from the space of actual experience, a separation that would further increase in theories proposed by following generations of physicists.->EINSTEIN

EINSTEIN: When mathematical propositions refer to reality they are not certain; when they are certain, they do not refer to reality. (*Geometrie und Erfahrung*, 1921, p.3)

Boullée. Newton's Cenotaphe.



O Newton ! Si par l'étendue de tes lumières et la sublimité de ton génie, tu as déterminé la figure de la terre, moi j'ai conçu le projet de t'envelopper de ta découverte. C'est en quelque façon t'avoir enveloppé de toi-même. Eh ! comment trouver, hors de toi, rien qui puisse être digne de toi! C'est d'après ces vues que j'ai voulu, par la figure de la terre, caractériser ta sépulture. C'est à l'instar des anciens, et dans le dessein de te rendre hommage, que je l'ai entourée de fleurs et de cyprès.

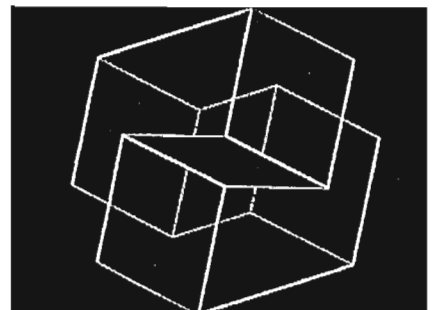
L'intérieur de cette sépulture est conçu dans le même esprit. En me servant, Newton, de ton divin système pour former la lampe sépulcrale qui éclaire ta tombe, je me suis rendu, ce me semble, sublime. C'est la seule décoration dont j'ai cru devoir faire usage. J'aurais pensé commettre un sacrilège si j'eusse décoré ce monument d'une autre manière.

Boullée: *Essai sur l'art*, Hermann, Paris, 1968, p.137.

Kant gave its own formulation to the concept of absolute space, which, unlike Newton's, was more metaphysical than physical: "*In den anschauenden Urteilen, dergleichen die Messkunst enthaelt, ist der Beweis zu finden, dass der absolute Raum unabhängig von dem Dasein aller Materie und selbst als der erste Grund ihrer Zusammensetzung eine eigene Realität haben*". (Kant, *Gesammelte Werke*, vol.16). The philosophy of Kant was a reaction against the Empiricists, who claimed that all knowledge derived from sensory experience. George Berkeley, for example, had believed that all ideas, including the idea of space, derived from sensory impressions. He claimed that the third dimension was not present in the retinal image (which he considered to be as flat as a painting) and therefore concluded that the sense of depth could only be acquired by experience, mainly through the sense of touch. For Kant, space, and also time, were pure forms of intuition (*reine Anschauung*), intellectual constructs of the mind that could not be derived from experience. Space and time are for Kant a priori categories that cannot be found in the world of experience, categories without which the very act of perception would not take place.

The belief that perception of space is an innate capability of the mind, was contested later by Hermann Helmholtz in the 19th century. In his *Handbuch der physyologischen Optik*, Helmholtz provided experimental evidence to show that spatial perception was a learning process. Helmholtz's investigations gave rise to the nativist-empiricist controversy regarding the nature of perception. The controversy could not be settled in one or another way. The later empirical work of some schools of psychology, like the Gestalt, confirmed the existence of innate notions of form and structure, in line with the synthetic, a priori categories of Kant.

The geometric conception of space went through a revolution in the first half of the 19th century, as Bolayi, Lobachevsky and Gauss demonstrated the existence of non-Euclidean geometry. They proved that the fifth axiom of Euclid was not satisfied in the case of hyperbolic and spherical geometries.



Joseph Albers. *Structural Constellation*, 1953.

Art forms as expression of the cultural paradigms of the time

At this point, the following questions should be raised: to which extent is the notion of architectural space depending on the concepts of space developed in realms like philosophy or mathematics?. Does the notion of architectural space participate of the same *Weltanschauung* as other disciplines? Or alternatively, is there a notion of space which is specific to architecture and therefore independent from the spatial conceptions formulated by other disciplines? Sigfried Giedion, in his *Space, Time and Architecture*, gave support to the believe, propagated by some avant-garde artists and writers, that modern art should give expression to new scientific concepts, namely, to Einstein's theory of relativity which questioned the simultaneity of space-time. According to this belief, a cubist painter, by abandoning perspective and superimposing a multiplicity of view points or projections, would be expressing a similar concept of relativity with pictorial means.

GIEDION: "The essence of space as it is conceived today is its many-sidedness, the infinite potentiality for relations with it. Exhaustive description of an area from one point of reference is, accordingly, impossible; its character changes with the point from which it is viewed. In order to grasp the true nature of space the observer must project himself through it. The stairways in the upper levels of the Eiffel Tower are among the earliest architectural expression of the continuous interpenetration of outer and inner space.

Space in modern physics is conceived of as relative to a moving point of reference, not as absolute and static entity of the baroque system of Newton. And in modern art, for the first time since the Renaissance, a new conception of space leads to a self-conscious enlargement of our ways of perceiving space. It was in cubism that this was most fully achieved." (Giedion, op. cit., p. 432)

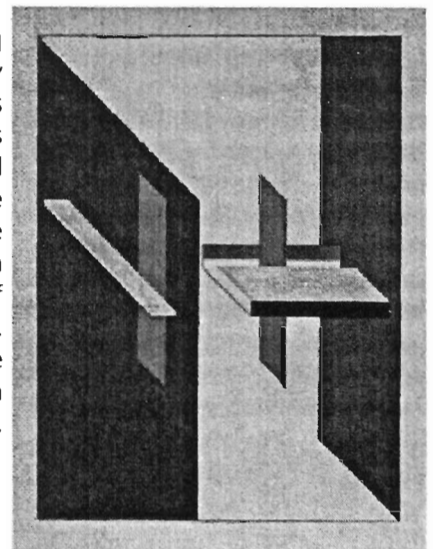
Behind the statements of Giedion lies the question of the relation between science and art in contemporary culture. Giedion thinks that in modern society the two realms, scientific and artistic, have become too separated¹. In a way, he is proposing a return to the lost unity, when like in the Renaissance for example, science and art were still indistinguishable.²

¹The awareness that science and art constituted two separate realms existed already in the 17th-century. In that time, it was thought that the rapid scientific progress was not accompanied by a similar progress in the arts (see, for example, the arguments maintained by Claude Perrault in relation to the *Querelle des Ancients et Modernes*).

²Leonardo, for example, had considered painting a science.

In the case of modern art, there is another sort of explanation for the emergence of Cubism and this has to be found only within the realm of painting. After the work of the impressionists, and particularly the work of Cézanne, painters were ready to break away with figuration, to do away with the outline and contour. In painting, form and space make an indissoluble unity: one cannot be changed without affecting the other. For that reason, the use of perspective representation of space in Renaissance painting was inseparable of figurative representation, as Alberti's *De Pictura* reveals. By the same token, the rejection of figuration by modern art necessarily gave rise to a new space representation, not necessarily based on the laws of perspective.

The nature of the relation between space and form in modern painting can be understood in the work of Lissitzky. His Prouns are not only abstract compositions of forms/objects. Moreover, the abstract objects give pictorial expression of a different concept of space, one that breaks away from traditional perspective. In this regard, Lissitzky was well aware of the theoretical consequences of his work: "We saw that the surface of the Proun ceases to be a picture and turns into a structure round which we must circle, looking at it from all sides, peering down from above, investigating from below. The result is that the one axis of the picture which stood at right angles to the horizontal was destroyed. Circling round it, we screw ourselves into the space. We have set the Proun in motion and so we obtain a number of axes of projection" (In Sophie Lissitzky-Küppers, *El Lissitzky:Life.Letters.Texts*. London, 1968, p. 343)

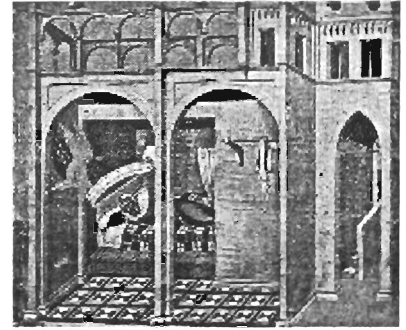


Lissitzky, Proun, ca. 1923.

PICTORIAL SPACE IN THE RENAISSANCE

Space has been often represented in paintings by means of architectural elements. In paintings of the early Gothic, loggias and porticos were used to convey the sense of space. In the painting by Lorenzetti, the frontal plane of the portico coincides with the picture plane, while the lines converge in the direction away from the viewer. The viewer, however, does not have the impression of being part of the scene. Space has not yet been systematized according to the laws of the *perspectiva artificialis*. What we see is a depiction of a *perspectiva naturalis* that attempts to imitate the optical phenomenon of perspective projection, as it is perceived by the eye.

Pietro Lorenzetti. The dream of Sobach, 1329.

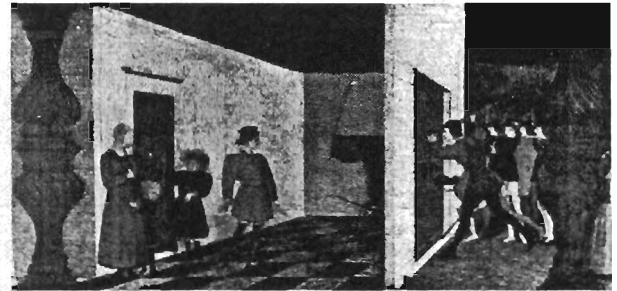


The painting of Giotto has a more naturalistic character than the previous one. The representation of the architectural object approaches more the conventions of artificial perspective: main lines converge to a vanishing point located inside the canvas, the horizon line can be easily followed as it passes through the heads of the figures, the capitals of the columns, the small window on the back wall. Nevertheless, a viewer still has the impression of being outside the space represented in the painting.

Fra Angelico. The Annunciation, c. 1450.



This painting by Uccello represents a scene taking place simultaneously in two different spaces, separated by a wall. Here perhaps the laws of *perspectiva artificialis* came in contradiction with the need to represent two events happening in two different spaces at the same time. The absent wall, that coincides with the picture plane, has been removed to allow the view of the inside. In a way, this is a step forward -although still unsuccessful if compared with the contemporary work of the Flemish school- in the attempt to engage the eye of the viewer in the represented space. The perspective construction is not completely canonical, since not all parallel lines converge to the same vanishing point.



Paolo Uccello. The Jew's Attempt to Destroy the Host, c. 1468



The painting of Piero della Francesca represents a culminating point in Italian Renaissance painting. The conspicuous geometrization of both form and space can be considered a consequence of the strict application of the perspective method. The figures are lacking expresiveness and naturality, they are eminently geometric bodies. The detailed depiction of light effects represents a progression with regard to previous Italian paintings, but it is still distant from the level reached by the Dutch school.

Piero della Francesca, Madonna di Brera.



"A painting will be the intersection of a visual pyramid at a given distance, with a fixed centre and certain position of lights, represented by art with lines and colours on a given surface." (Alberti, *De Pictura*)



The strong link between architectural form and spatial conception can be seen in this painting of Raphael. The architectural form is represented by the centralized temple, while the space conception is symbolized by the central perspective. The geometrization of the space, however, does not affect the physiognomy of the figures to the extreme of Piero's painting. In this case the figures have a naturalistic character: they are endowed with life.

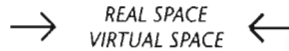


Raphael, Marriage of the Virgin, 1504.

The continuity between represented space and real space, that Bramante exploited in Santa Maria presso San Satiro, evidences the intimate connection between painting and architecture in the Renaissance. The question that arises is then: is the painted choir the projection of the real space onto the pictorial plane, or, conversely, is the real space an extension of the painted one?

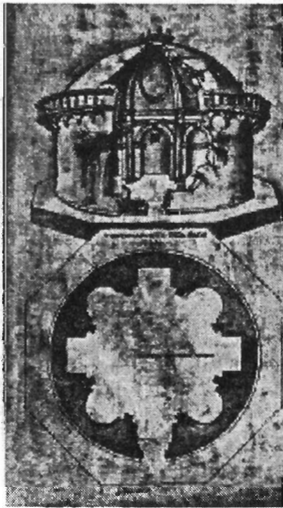


Bramante, Santa Maria presso San Satiro, Milano.



Space representation in architecture

Borrowing a concept from Giedion, we could affirm that the creation of the inner space, the shaping of the void, is a 'fundamental fact' of the architecture of all times. But architects become consciously and intellectually aware of space only in the Renaissance. According to Argan, Brunelleschi was the first who thought of architecture in terms of space: *"il Brunelleschi è il primo a pensare l'architettura come spazio, cioè come la manifestazione -e la sola possibile- di un'interna legge costruttiva dell'universo, che soltanto all'uomo può rivelarsi perché l'uomo è dotato di ragione e quella legge, ch'è poi la legge divina della creazione (la "divina proporzione"), è per eccellenza razionale."* (G. C. Argan, *Brunelleschi*, 1978, p. 113.)



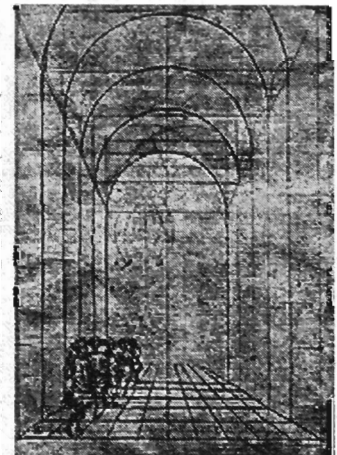
Architects shared with painters the problem of the representation of inner space. In the drawing of Sangallo, the walls of the building are drawn as if they would have been broken, to allow the view of the inside. Later, more abstract techniques to represent the inner space in section and inner elevation were developed. As Wolfgang Lotz has shown, the discovery of new techniques in architectural representation during the Renaissance was closely related to the will to design the inner space (W. Lotz, *The Rendering of the Interior in Architectural Drawings of the Renaissance*, in *Studies in Italian Renaissance Architecture*, The MIT Press, 1977).

Giuliano da Sangallo, antique circular temples.



Brunelleschi, Santo Spirito, Florence.

Giulio Carlo Argan once contended that the Renaissance architect *represented* space, and that only in the Baroque the architect started to *create* space. This drawing by Pisanello, seems to confirm this view. The space that the architect represents in this drawing is a conventional longitudinal space. In this regard, there is nothing innovative in the space conception. The novelty lies in the use of perspective drawing as a design technique, to control the shape of the inner space. Something similar can be said about the spaces created by Brunelleschi. As spatial schemes, the centralized plan and the longitudinal nave were known to the Antiquity, but Brunelleschi systematized the space, giving it a mathematical character that was not known in the past.



Pisanello, drawing of an interior.

Perception of Space: Eye and Body

Only in relatively recent times, art historians and critics have acknowledged the importance of space in architecture. The concern with space arose mainly among German speaking writers at the end of the 19th century and beginnings of the 20th. In the writings of Konrad Fiedler, August Schmarsow, Adolf von Hildebrand or Paul Frankl, the concept of Raum emerges as a critical issue, not only in architecture but in relation with the other arts. The concern of those art critics with Raum needs to be seen within an overall concern with the perception of form and space, coming from the new science of experimental psychology.

Psychological theories developed in the second half of the 19th century stressed the importance of the tactile senses in the perception of space. It was thought that the projected image in the retina did not suffice to derive from it the spatial depth, and that this was achieved by the motion of the body in space. This intimate connection between perceived object /space and the soul of the viewer was given the name of empathy (*Einfühlung*).

The book from Adolf von Hildebrand, *Das Problem der Form in der bildenen Kunst*, 1893, exerted a notorious influence on contemporary theorists and artists. Some of the most innovative contributions of Hildebrand stem from the distinction he made between *Fernbild* and *Nahbild*, far image and close image. According to Hildebrand, when a viewer stands far away from the object of perception, he gets an overall two-dimensional image or *Fernbild*. As the viewer moves closer to the object, he loses the overall picture, being able to get only partial glimpses of it. The image thus perceived is not purely visual but also tactile. The *Nahbild*, therefore, conforms better to the reality of the object because a matching occurs between the movement of the eyes tracing the object and the object's real form. This unity between the two senses is achieved in the plastic arts: "*Die bildende Kunst allein stellt die Tätigkeit dar, in der sich das Bewußte nach dieser Richtung hin entwickelt, und welche die Kluft zwischen der Formvorstellung und den Gesichtseindrücken aufzuheben und beide zu einer Einheit zu gestalten sucht.*"

Paul Frankl, in *Die Entwicklungsphasen der neueren Baukunst*, 1914, defended the specificity of the perception of architecture in the following terms: "*Architektur sehen heißt die Reihe von dreidimensional gedeuteten Bildern, die sich im Abschreiten der Innenräume und im Umschreiten der äußeren Schale ergeben, zu einer einzigen Vorstellung zusammen beziehen. Wenn ich vom architektonischen Bilde rede, so meine ich diese eine Vorstellung.*" (P. Frankl, op. cit., pp.125-126) This mental image is more or less difficult to form in the mind, depending on the characteristics of the architectural style*. Renaissance architecture lends itself to the formation of a single image, and therefore it is called '*einbildig*'. Baroque architecture, on the other hand would be '*vielbildig*', given the impossibility to summarize the experience of seeing a Baroque building with a single, unitary image.

*Frankl contends that "*in der ersten Phase [e.g. Renaissance] genügen erstaunlich wenig Standpunkte, um die Vollständigkeit des architektonischen Bildes zu erobern; das architektonische Bild ist hier ein einmaliges Bild; von soviel Seiten man es auch ansieht, es ist immer dasselbe, es deckt sich mit der tatsächlichen Gesamtform.*" (Ibid., p. 127) As an example, Frankl mentions Bramante's S. Pietro in Montorio. In this building, he says, the viewer does not have to move around much in order to grasp its form, since "*das Auge übersieht sofort die Situation, von einem einzigen, von jedem beliebigen Standpunkt aus ist das Bild -das architektonische Bild- fertig gegeben; nichts lockt uns, um das Gebäude herumzugehen, weil wir sofort sehen, daß es keinerlei Überraschung geben kann.*" (Ibid., p. 127) Therefore, he concludes, "*die Architektur der ersten Phase ist einbildig.*" (Ibid., p. 130)

In the anglosaxon culture, Geoffrey Scott echoed the German contemporary preoccupation with space, in his book *The Architecture of Humanism*, 1914, where he wrote: "The functions of the arts, at many points, overlap; architecture has much that it holds in common with sculpture, and more that it shares with music. But it has also its peculiar province and a pleasure which is typically its own. It has the monopoly of space. Architecture alone of the Arts can give space its full value. It can surround us with a void of three dimensions; and whatever delight may be derived from that is the gift of architecture alone. Painting can depict space; poetry, like Shelley's, can recall its image; music can give us its analogy; but architecture deals with space directly; it uses space as a material and sets us in the midst." (G. Scott, op. cit., p. 168)

As the German theorists did, Scott stressed the relation between space and motion, and between space and body. The inner void marks the pace of our movements, it makes motion possible: "When we enter the end of a nave and find ourselves in a long vista of columns, we begin, almost under compulsion, to walk forward: the character of the space demands it. Even if we stand still, the eye is drawn down the perspective, and we, in imagination, follow it. The space has suggested a movement". (G. Scott, op.cit., p. 169)

Later authors, like Bruno Zevi's *Saper vedere l'architettura*, 1951, revived the thesis developed at the beginning of the century, which emphasized the importance of space in architecture. In a book appeared at the end of the fifties, Rasmussen distinguished between designing with solids and designing with voids: "Instead of letting his imagination work with structural forms, with the solids of a building, the architect can work with the empty space -the cavity- between the solids, and consider the forming of that space as the real meaning of architecture". (S. E. Rasmussen, *Experiencing Architecture*, p. 46)

Only in recent history we can find explicit statements made by architects that stress the importance of space in architecture. The concept of *Raumplan*, used to describe the architecture of Adolf Loos is a point in case. Loos himself had once declared: "I do not design plans, facades, sections, I design space. Actually there is neither a ground floor, an upper floor or a basement, there are merely interconnected spaces, vestibules, terraces. Every room needs a specific height -the dining room a different one from the pantry- therefore the floors are on varying levels. After this one must connect the spaces with one another so that the transition is unnoticeable and natural, but also the most practical" (in Karel Lhota, *Architekt Adolf Loos, Architekt SIA 32, Prague, 1933*. Trans. in *Villa Müller, A work of Adolf Loos*, Leslie van Duzer, Kent Kleinman, Princeton Architectural Press, 1994)

In a previous occasion, Loos had written: „Was will denn der Architekt eigentlich? Er will mit Hilfe der Materialien Gefühle im Menschen erzeugen, die eigentlich diesen Materialien noch nicht innewohnen. Er baut eine Kirche. Die Menschen sollen zur Andacht gestimmt werden. Er baut eine Trinkstube. Die Menschen sollen sich drinnen gemütlich fühlen. Wie macht man das? Man sieht nach, welche Bauwerke schon früher im Stande waren, diese Gefühle zu erzeugen. An die muß man anknüpfen. Denn der Mensch hat sein Lebenlang in gewissen Räumen gebetet, in gewissen Räumen getrunken. Das Gefühl ist ihm anezogen, nicht angeboren. Folgerichtig hat der Architekt, wenn es ihm überhaupt mit seiner Kunst ernst ist, auf diese anezogenen Gefühle Rücksicht zu nehmen.“

A. Loos, *Die alte und die neue Richtung in der Baukunst*, 1898

The experience of space

Christian Norberg-Schulz, in *Existence, Space and Architecture*, 1971, proposes a notion of space which places man and his feelings at the center of the spatial experience. Architectural space, Norberg-Schulz contends, needs to take into account man and his emotions. It should not be reduced to a geometric concept of space, nor to a subjective perception of a place. The different spatial systems (social, mathematical) should be subsumed under a single concept of space: the existential space, which is 'man's stable image of his environment' (Norberg-Schulz, op.cit., p. 11). Today, the debate about space is dominated by the influence of the mediatic image, with its intrinsic dematerialization and negation of direct spatial experience->interviews.

Im virtuellen Architekturmodell läßt sich der Raum nicht mehr vom Parcours trennen; das Verhältnis zum Raum definiert sich hier geradezu durch diese „Navigation“ und erzeugt eine Art Ballistik des Sich-Im-Raum-Verhaltens. Insofern bietet das virtuelle Architekturmodell im Gegensatz zu den herkömmlichen Raumdarstellungen die Möglichkeit, die Aktivierung des Raums durch das Trajekt mit einzubeziehen. Das Trajekt ist ein Element, das aus der Beziehung von Subjekt und Objekt entsteht. So gibt es zum Beispiel ein Trajekt des Körpers oder des Blicks. Und ich glaube, daß eine zukünftige Architektur, wie auch immer sie benutzt werden mag, auch eine trajektive Vorstellung des Raums haben mußte.

Andreas Ruby In Gespräch mit Paul Virillio, *Der Architekt*, März 1996

Andreas Ruby: Der Raum der Architektur wird oft mit den drei Dimensionen gleichgesetzt. Daß dieser Raum auch etwas mit Zeit zu tun hat, hört man dagegen eher selten.

Wolf. D. Prix: Bei den Boxenbauern der sogenannten neuen Einfachheit reichen die drei Dimensionen ja auch meistens, weil man den Raum sozusagen im ersten Angriff erfassen kann. Wird ein Raum jedoch komplexer, dann wird er nur begreifbar, wenn man ihn begeht. Und ein begehbarer Raum braucht Zeit, um begangen zu werden. Zeit gehört zur Perzeption des Raumes unabdingbar dazu. Jeder Raum, der eine Geschichte ausbreitet, auf welcher Empfindungsebene auch immer, impliziert begehbare Zeit. Wenn man mehrere Geschosse erfassen, oder mehrere sich verschränkende Räume begreifen will, ist die Zeit wirklich die vierte Dimension, die zur Erfahrung des Raumes dazugehört.

A.R.: Dennoch wird Architektur zum großen Teil in statischen Bildern vermittelt. Geht diese Dimension dann nicht wieder verloren?

W.P.: Ja, weil dabei Kopf und Körper getrennt werden. Die körperlose Architektur kann man medial kommunizieren. Die Medienarchitektur ist ja keine Architektur, die durch Medien entsteht (was ja eigentlich der Fall sein müßte), sondern eine, die durch Medien transportiert wird. Nun sind Medien eindimensional, daher körperlos und nur über die Augen erfahrbar. Es fehlt die Dimension des Körpers. Begehbarkeit und damit Zeit brauchen aber den Körper. Der Körper verfällt ja auch mit der Zeit. Architektur, Zeit und Körper gehören zusammen. Eine körperlose, „geruchslose“ Architektur ist eine Medienarchitektur.

A.R.: Beim Entwurf einer solchen Architektur müßte man die Bewegung durch den Raum eigentlich mit der selben Wertigkeit gestalten wie seine Höhe, Breite und Tiefe

W.P.: Das kommt ganz zwangsläufig. Deswegen sind in unseren Entwürfen Raumsequenzen auch ganz wichtig, weil sich das Psychogramm des Raumes aus Sequenzen zusammensetzt. Das Umklappbare unserer Entwurfstechnik, wo der dreidimensionale

Raum erst in einer Dimension gezeichnet, dann aufgeklappt und gedehnt wird (erst in der Zeichnung, dann im Modell), läßt Räume entstehen, die zeitlich bedingt sind. Und dann ist auch der Entwurfsprozeß selbst ein zeitlicher Prozeß.

A.R.: Nun kommt der größte Teil der gebauten Architektur kaum über das Formenvokabular der Box hinaus. Werden diese einfachen Formen nicht auch durch die herkömmlichen Entwurfsmittel wie Grundriß, Schnitt und Ansicht begünstigt, in denen Raum nur auf einzelne Flächen verteilt bearbeitet werden kann?

W.P.: Hier wirkt einfach noch ein additives Raumverständnis fort, in dem sich der Raum aus den Seiten eines Würfels zusammensetzt. An der Schwelle zu einem neuen Jahrtausend wäre es Zeit, diese herkömmlichen Darstellungsmethoden von Raum zu verändern und komplexe Sehweisen einzuführen, in denen eben die vierte Dimension hinzukommt. Auch die Notationssysteme von Raum müßten sich hier verändern. Wobei hinzugefügt werden muß, daß die konventionellen Darstellungen wie Grundriß und Schnitt vor allem in der Bautechnik notwendig sind und hier nach wie vor ihre Berechtigung haben.

A.R.: Besonders in der ersten Hälfte unseres Jahrhunderts ist oft auf die Verwandtschaft von Film und Architektur hingewiesen worden. Inwiefern haben für Sie die bewegten Bilder des Films die Raumerfahrung in der Architektur beeinflusst?

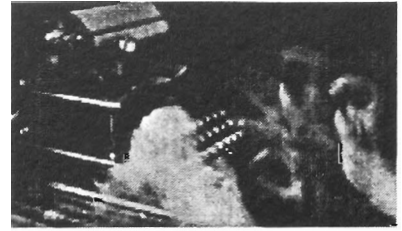
W.P.: Mit dem Film gab es auf einmal ein Medium, das die Erfahrungen, die man in der alltäglichen Realität machte, abstrahieren, überhöhen und manipulieren konnte. In diesem Sinne hat die Erfindung des Films und die Darstellung von Architektur in Filmen ganz sicher das Bewußtsein für bestimmte Qualitäten des Raums geschärft, zum Beispiel für seine Übergänglichkeit durch die Bewegung von Augen und Körper oder auch für seine ständige Veränderung im Zusammenspiel mit dem Tageslicht.

Andreas Ruby im Gespräch mit Wolf D. Prix, in *Der Architekt*, März 1996.

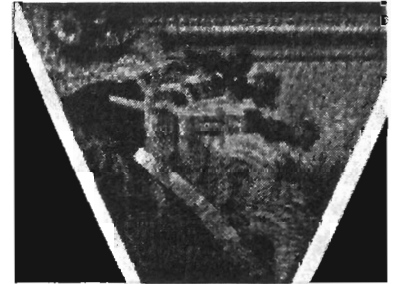
Pictorial representation of motion in space

The Italian futurists attempted with their paintings to give expression to what they considered to represent the values of the culture of the time: motion and velocity. Moving bodies, cars, and other artifacts were the themes of their paintings. The images created in photography and cinema influenced futurist paintings. Some of the paintings were inspired by the simultaneous recording of images, made possible by the photographic camera. Indeed, these first paintings had not really departed from previous figurative representation: the figure, the outline was still clearly recognizable. Moreover, they were more imitative than abstract, since they imitated the images created by photography.

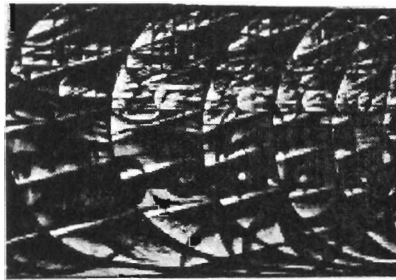
Soon, some painters took the significant step to move away from figuration and imitation. Instead of representing a *moving car* they gave expression to *movement* by means of abstract forms, as in Balla's *Abstract Speed*. What these paintings show is that to represent a new concept of space, i.e. space-time, it was necessary to do it with a new formal vocabulary.



A. Giulio and A. Brogaglia, Typist, 1911.



Giacomo Balla. The Hand of the Violinist, 1912.



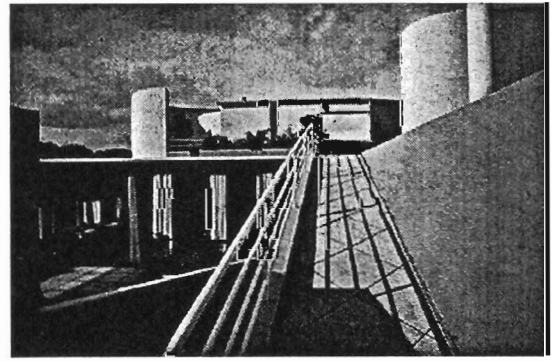
Giacomo Balla, Abstract Speed, 1913.



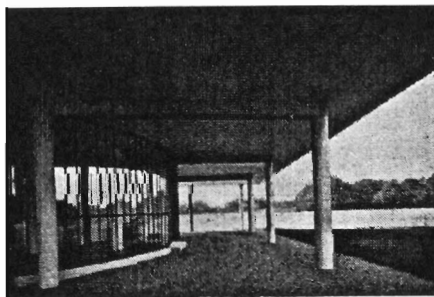
Luigi Russolo, Dynamism of a Car, 1912-13.

Modern architecture: the flow of space

In modern architecture, the notion of a dynamic space found its more clear expression in the designs of Le Corbusier. The projects for houses made by Le Corbusier's in the twenties need to be understood from the point of view of the moving body. The movement through the building is channelled through architectural elements, like the ramps in the villa Roche and villa Savoye. Other elements, like the spiral stair in the Villa Savoye, express in their forms the idea of dynamism and movement. If in painting form and space make an inseparable unity, the same could be said about the architecture of Le Corbusier. The forms give expression to the new spatial concept: a space that flows continuously throughout the house, from the inside to the outside, i.e. *la promenade architecturale*.



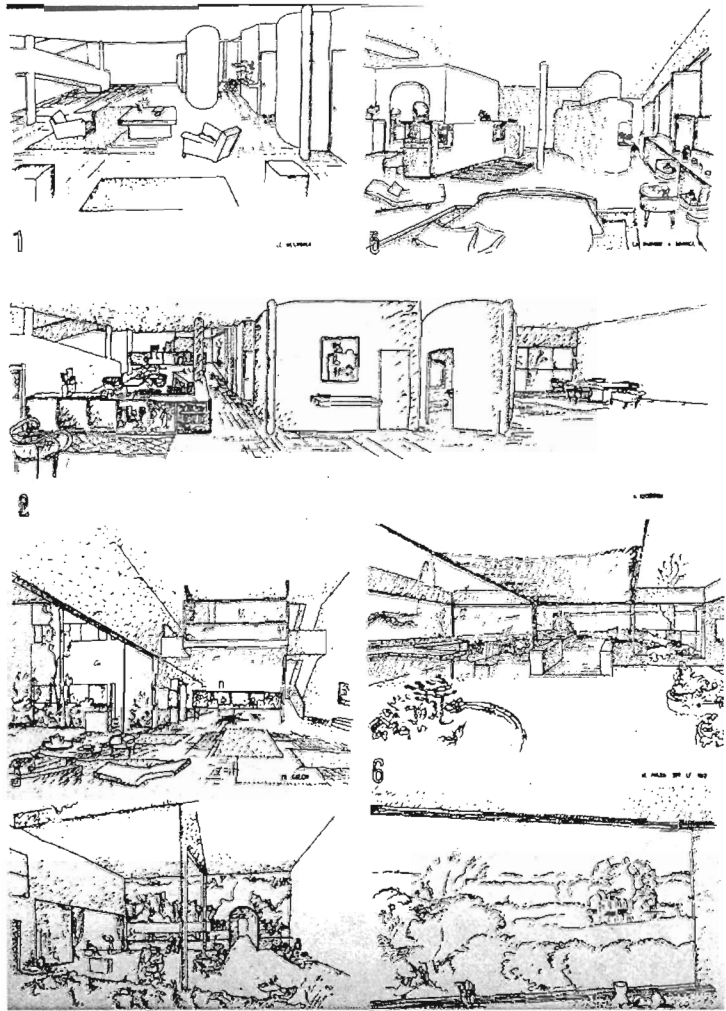
Le Corbusier, Villa Savoye.



In the ground floor of the villa Savoye, the curved body suggests that a dynamic force going through space (the moving car) has carved out the original cubic mass.

Unlike the spaces of Loos, the space of Le Corbusier's projects is more an a-priori, abstract space, populated by objects. Columns, stairs, walls are abstract objects that punctuate space. They become references that help the visitor to reproduce in the mind the spatial configuration of the house.->compare to the flow of space in Mies' Barcelona pavilion

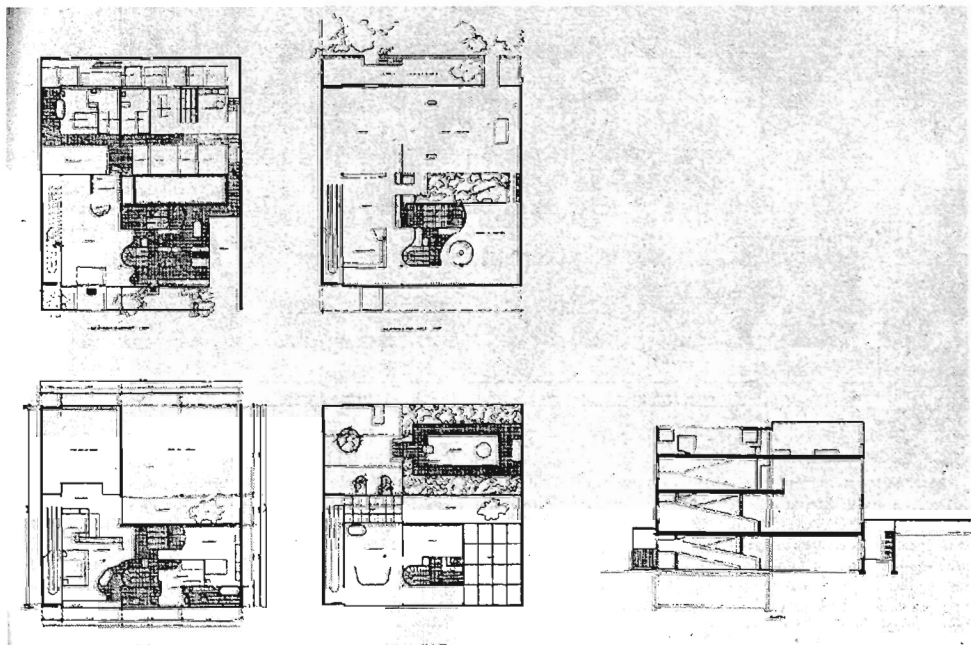
In the project for Mme. Meyer, 1925, Le Corbusier drew a sequence of vignettes to accompany the written description of the project sent to the owner. The sketches are like a guided tour through the house. We start with a view of the entrance hall as we enter the house at the ground floor. In the second scene we have moved already to the first floor. The perspective is taken from the same direction as the previous one, but this time the point of view is not the one of the actual viewer, but it is placed outside the house. The plane of the facade has been removed to allow a panoramic view of the spaces at both sides of the vertical core that traverses vertically the house. In the two vignettes, the ramp appears in the same position. The ramp represents the vertical flow of space. In the third vignette, the two-story space of the living room is showed from the opposite point of view. From the living room we move to the covered garden, located at the same floor. One floor up, there is the bedroom, and finally, as culminating point of the tour, the roof garden, with the openings in the walls that frame the view of the forest outside.



↓
 perspective
 vs.
 plan
 ↑

"No man ever built a building worthy of the name architecture who fashioned it in perspective sketch to his taste and then fudged the plan to suit. Such methods produce mere scene-painting. A perspective may be a proof, but it is no nurture..." (Frank Lloyd Wright, *In the Cause of Architecture*, Horizon Press, p. 196)

"Le plan est le générateur[...]Le plan nécessite la plus active imagination. Il nécessite aussi la plus sévère discipline. Le plan est la détermination du tout; il est le moment décisif. Un plan n'est pas joli à dessiner comme le visage d'une madone; c'est une austère abstraction; ce n'est qu'une algèbrisation aride au regard. Le travail du mathématicien rest tout de même un des plus hautes activités de l'esprit humain." Le Corbusier, *Vers une architecture*, 1923, pp. 35-36.



Le Corbusier. Second project for the Villa Meyer, Paris, 1925.

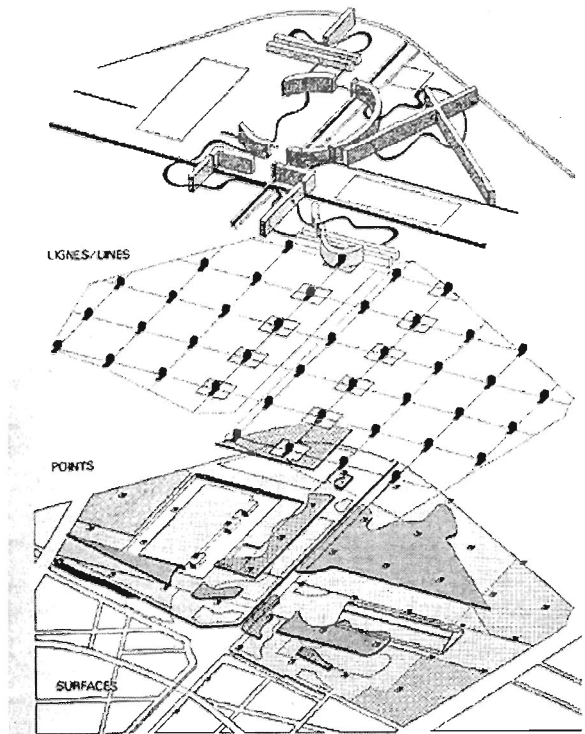
The image of the city

The form of the city can be understood in the visual or conceptual sense. An example of the first case is the contemplation of a city skyline from a distance, or the view of a city from an airplane. The second kind of perception occurs when we build up in our mind a mental map of a city as we move through it.

This second kind of perception was the main concern in Kevin Lynch's book *The Image of the City*. The question that Lynch was addressing was: how can we build up in our minds the form of a city, when this is an organism in continuous change, whose size prevents us from apprehending the form at a single glance? For Lynch, the form of a well-designed city should be easily apprehended, that is, its form can be 'read' without difficulty. This 'legibility' of the cityscape means for Lynch "the ease with which its parts can be recognized and can be organized into a coherent pattern. Just as this printed page, if it is legible, can be visually grasped as a related pattern of recognized symbols, so a legible city would be one whose districts or landmarks or pathways are easily identifiable and are easily grouped into an over-all pattern" (K. Lynch, *The Image of the City*, The MIT Press, 1960, p.3) According to this, a city has a readable form, when its inhabitants can easily reproduce in their minds the structure of the city, i.e. its form. In this regard, Lynch, very much like Arnheim did in the realm of artistic perception, identifies ordered structure with beauty: "Complete chaos without hint of connection is never pleasurable" (Lynch, op. cit., p.6). The mental image that the inhabitant has of the place where he or she lives does not depend only from the intrinsic characteristics of the city, but also from the experience and memory of the individual. The mental image then transcends the individual: it is a collective property of the inhabitants of a city.

Five are the elements of the city image, according to Lynch: *paths, edges, districts, nodes* and *landmarks*. Each of these formal elements constitute a layer, a separate structure of the city. Each element is defined as follows:

Paths. Paths are the channels along which the observer customarily, occasionally, or potentially moves. They may be streets, walkways, transit lines, canals, railroads. For many people, these are the predominant elements in their image.



B. Tschumi, *Cinéma Folie*, Le Parc de la Villette. La superposition des trois systèmes de points, lignes, surfaces, constitue le parc en créant une série de tensions soigneusement agencée qui renforce le dynamisme du lieu. Chacun des trois systèmes possède sa propre logique et indépendance.

Edges. Edges are the linear elements not used or considered as paths by the observer. They are the boundaries between two phases, linear breaks in continuity: shores, railroad cuts, edges of development, walls.

Districts. Districts are the medium-to-large sections of the city, conceived of as having two-dimensional extent, which the observer mentally enters 'inside of', and which are recognizable as having some common, identifying character.

Nodes. Nodes are points, the strategic spots in a city into which an observer can enter, and which are the intensive foci to and from which he is traveling. They may be primarily junctions, places of a break in transportation, a crossing or convergence of paths, moments of shift from one structure to another.

Landmarks. Landmarks are another type of point-reference, but in this case the observer does not enter within them, they are external. They are usually a rather simply defined physical object: building, sign, store, or mountain." (op.cit., pp. 47-48)

What matters is the unity of the overall structure of the city, the city as a whole: "In such a whole, paths would expose and prepare for the districts and link together the various nodes. The nodes would joint and mark off the paths, while the edges would bound off the districts, and the landmarks would indicate their cores. It is the total orchestration of these units which would knit together a dense and vivid image, and sustain it over areas of metropolitan scale." (Ibid., p. 108)

CADRAGES ET SÉQUENCES DE JARDINS

La promenade des jardins ou promenade cinématique est un élément fondamental du Parc de La Villette et devrait, par son originalité, en devenir l'une des parties les plus mémorables. Cette promenade est conçue comme une bande de film, où la bande-son correspond au cheminement général des piétons et la bande-image correspond aux cadrages successifs des jardins particuliers. La linéarité des séquences (promenade des jardins) ordonne mouvements, événements, espaces, dans une progression qui rassemble ou juxtapose des esthétiques ou des activités divergentes.

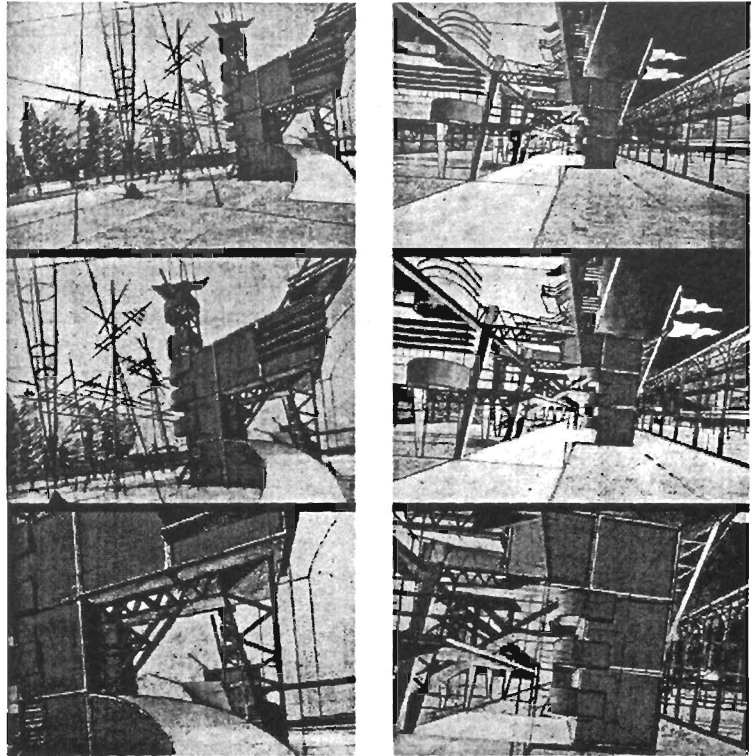
Chaque cadrage (jardin) de la séquence qualifie, renforce ou altère la partie qui la précède ou la suit. Les associations ainsi formées suggèrent une pluralité d'interprétations plutôt qu'un seul fait singulier. Chaque jardin, par exemple, est donc à la fois complet et incomplet. Si la structure générale de la séquence des jardins exige l'indétermination de son contenu (d'où le rôle du maître d'œuvre général comme metteur en scène de séquences), son contenu particulier s'affirme comme détermination (celle découlant des maîtrises d'œuvre particulières). La séquence est souvent de l'ordre du général, le cadre de celui du particulier.

Le Parc est aussi usage et suggère une autre interprétation des cadrages et une séquence programmatique suggère une collection d'événements et d'activités tous assemblés le long d'une collection d'espaces, épisode après épisode, cadrage après cadrage.

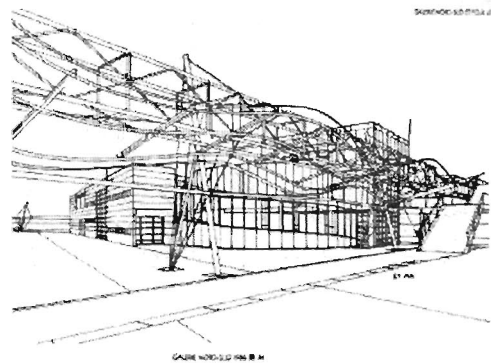
A La Villette, nous appellerons cadrage chacun des segments de la séquence: dans la promenade des jardins thématiques, chaque cadrage délimite donc un jardin. Chacun de ces cadrages peut faire l'objet d'un travail particulier (maîtrise d'œuvre particulière).

Définition: « on appelle cadrage la détermination d'un système relativement clos, qui comprend tout ce qui est présent dans l'image, décors, personnages, accessoires. » (G. Deleuze, dans *Image-Mouvement*)

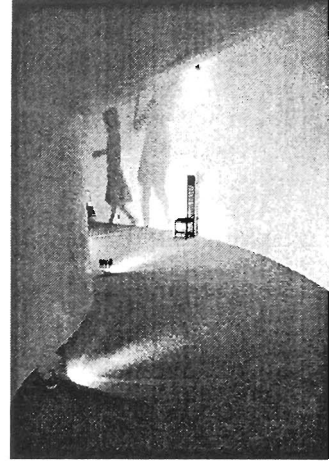
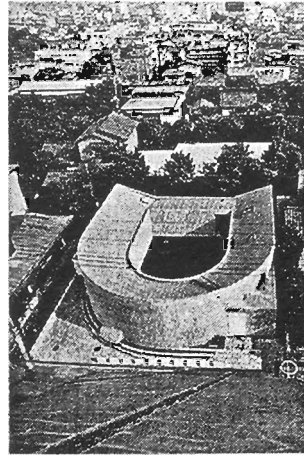
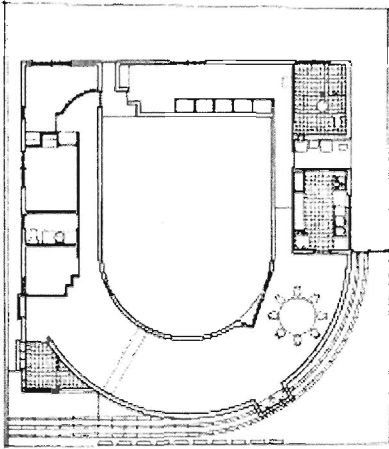
(B. Tschumi, *Cinégramme Folie, Le Parc de la Villette*, Champ Vallon, p.40)



B. Tschumi. Parc de la Villette. Séquences, 1984.



Si, à travers le Parc, le système des points d'intensité se matérialise dans la trame des Folies, celui des lignes est caractérisé par la sinueuse Promenade Cinématique, les allées d'arbres, et surtout par les Galeries couvertes nord-sud et est-ouest, véritables axes de coordonnées du site. (B. Tschumi, *op.cit.*, p.40)



Toyo Ito. White U. Tokyo, 1976.



EXERCISE

The theme of this exercise is the conception and representation of space. There are two options for this exercise: 1. to create a sequence of interior spaces, a *promenade architecturale* 2. to focus on exterior space, exploring the spatial system created by a group of objects. In both cases, you should take into account the association between space and motion. For the first choice, interior space, the following issues could be addressed: the structure or ordering of spaces (i.e. access, circulation, nodes and paths); the hierarchization of spaces (i.e. main spaces, transition spaces, connecting spaces); the characteristics of each individual space (i.e. silence, warmth, crossing); the materialization of the path as architectural form (i.e. ramps, elevators). For the second choice, these are some of the issues that could be considered: motion paths from object to object; hierarchies between objects (i.e. vertical objects, repetitive modules); visibility from object to object (i.e. frontal views, views along axis); associations between objects. Whatever option is chosen, it is recommended to draw a storyboard at the beginning of the exercise to clarify the nature of the proposal.

The exercise will be presented with 'static' representations (sections, plans, axonometrics, storyboard) and dynamic images (animation).

Time for the exercise: 2 weeks.

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Structure is the giver of light. When I choose an order of structure that calls for column alongside of column, it presents a rhythm of no light, light, no light, light, no light, light. A vault, a dome, is also a choice of a character of light.

(Louis Kahn, *Between Silence and Light*, p.34)

Concepts of light: between optics and physics

In the antiquity, light was studied in relation to the eye and vision. Pythagoras thought that light consists of rays travelling in straight lines from the eye to the object. According to this, an object is seen when the rays coming from the eye touch the object. By the time of Epicurus the prevalent theory was that light is emitted by source, and enters in the eye after being reflected by an object. In the middle ages, the Pythagorean hypotheses had been definitively abandoned, and the accepted theory was the one that considers that rays travel from the object to the eye.

Socrates: Surely when there is sight in the eyes, and the man who has sight tries to use it, and there is colour in the visible objects, still you know that unless a quite different third thing which exists just for this end is also present, sight will see nothing, and colour will be invisible.

Glaucon: To what do you refer?

Socrates: It is what you call light.

Plato, *The Republic* 507e

The idea of the rectilinear propagation of light is one of the fundamentals of the Renaissance perspective, as it was established by Alberti. It is significant thought, that Alberti rejected to discuss whether the rays originate in the eye or in the object. This was for him a philosophical question that was irrelevant for the purposes of the perspective method he was proposing: "These rays, stretching between the eye and the surface seen, move rapidly with great power and remarkable subtlety, penetrating the air and rare and transparent bodies until they encounter something dense or opaque where their points strike and they instantly stick. Indeed among the ancients there was considerable dispute as to whether these rays emerge from the surface or from the eye. This truly difficult question which is quite without value for our purposes, may here be set aside. Let us imagine the rays, like extended very fine threads gathered tightly in a bunch at one end, going back together inside the eye where lies the sense of sight." (Alberti, *De Pictura*, Book 1).

Alberti's perspective method was based on a theory of vision eminently geometric and visual -> ALBERTI. Johannes Kepler published in 1604 a book on Optics where he explained the process of image formation in terms that were more physical than geometric. He contended that an extended object could be regarded as a multitude of separate points, each point emitting rays of light in all directions.

*ALBERTI: In his treatise *De Pictura*, Alberti established that painting had to be divided in three parts: *circumscription*, *composition*, and *reception of light*. *Circumscription* is the outline of the figure, that represents the space occupied by the object. *Composition* is the assembly of surfaces together, within the outline. *Reception of light* deals with the colouring of the surfaces. (Alberti, *De Pictura*, Book II)

The other approach to study of light is to think of it in terms of physical phenomena. In modern physics, light is considered as energy travelling through empty space. This energy is constantly moving from place to place, bouncing from one surface to another. The reflected light carries some information about the source and the objects through which it has travelled. This energy extinguishes when there is no energy left to be reflected. In today's physics, there are two predominant theories of the propagation of light: one that considers light as waves and other as particles. In second half of the 19th century, physicists formulated a new theory according to which light was described as electromagnetic waves, rather than straight lines. In 1905, Einstein showed that there are certain situations in which light behaves as if all the energy were concentrated in small particles, called photons.

SPACE AND LIGHT IN DUTCH PAINTING

The Dutch school of painting has traditionally distinguished itself by its unique depiction of light. The paintings below have several features in common: they represent interior spaces; it is a scene of daily life; light enters the room invariably from the left; the light source (i.e. the window) is visible in the painting; pictorial space seems to flow towards the real space, where the viewer stands. In the painting of Van Eyck, the mirror on the wall adds another level of sophistication to the relation between viewer and painting. The mirror reflects the backs of the two persons that would stand in front of the couple in the 'real space', that is, in the space which is represented in the painting.



Gerrit Dou, Die Wassersüchtige Frau, 1663.



Jan Vermeer, Die Goldwägerin, 1665.



Jan van Eyck, Giovanni Arnolfini and his wife, 1434.

DUTCH SCHOOL vs. ITALIAN RENAISSANCE

small things

light reflected off objects

the surface of objects,
their colors and textures,

unframed image

no clearly situated viewer



a few large things

objects modeled by light
and shadow

the placement of objects
in a legible space

framed image

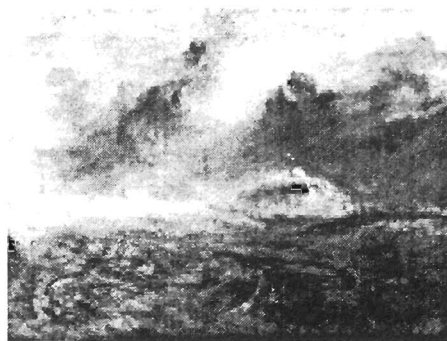
clearly situated viewer

Svetlana Alpers, has compared the Dutch school of painting and the Italian Renaissance in the following terms: "...attention to many small things versus a few large ones; light reflected off objects versus objects modeled by light and shadow; the surface of objects, their colors and textures, dealt with rather than their placement in a legible space; an unframed image versus one that is clearly framed; one with no clearly situated viewer compared to one with such a viewer. The distinction follows a hierarchical model of distinguishing between phenomena commonly referred to as primary and secondary: objects and space versus the surfaces, form versus the textures of the world".

(Svetlana Alpers, *The Art of Describing: Dutch Art in the Seventeenth Century*, University of Chicago Press, 1983, p.44)

Light and vision in 19th-century painting

Subjectivity is a term that is often used to refer to 19th-century painting. The paintings of Turner, for example, are the expression of the direct confrontation of the individual with the forces of nature. There is no geometrization that mediates between reality and representation. As Turner's work evolved, the lines and contours disappeared progressively from the painting, ending up with pure representations of light. Some of the more mature paintings can be interpreted either as faithful representation of atmospheric phenomena, or as illusory visions that could only exist in the artist's mind.



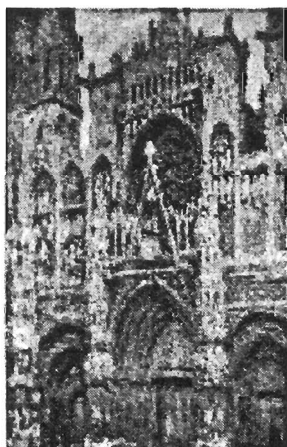
J.M.W. Turner. Rough Sea with Wreckage, 1830-35.

In the nineteenth century, the search for new ways to represent light run parallel to the abandonment of figuration and perspective representation. In the series *La cathédrale de Rouen*, from Claude Monet, the goal is not so much to represent the building as to depict the different states of light reflected by the building. The world that Monet was representing was not purely phenomenal -the continuous changing of the light- but also has a personal dimension: the blurry image of the cathedral was expression of visions that existed only in the imagination of the artist.*



J.M.W. Turner. Mountain Scene with Lake and Hut, 1840-45.

"...chaque jour j'ajoute et surprends quelque chose que je n'avais pas encore su voir. Quelle difficulté, mais ça marche, et quelques jours encore de ce beau soleil, et bon nombre de mes toiles seront sauvées. Je suis rompu, je n'en peux plus, et j'ai eu une nuit remplie de cauchemars: la cathédrale me tombait dessus, elle semblait bleue ou rose ou jaune" (C. Monet, letter to his wife Alice, April 1892)

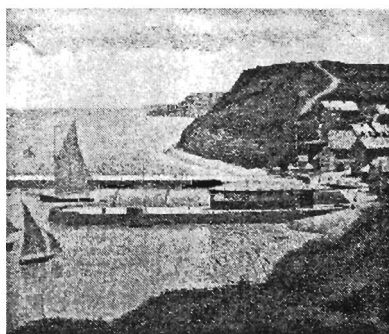


C. Monet, La cathédrale de Rouen, le portail, temps gris, 1892



C. Monet, La cathédrale de Rouen, le portail et la tour Saint-Romain, plein soleil, harmonie bleue et or 1893

"Now, these artists do not seek to give what can, after all, be but a pale reflex of actual appearance, but to arouse the conviction of a new and definite reality. They do not seek to imitate form, but to create form; not to imitate life, but to find an equivalent for life. By that I mean that they wish to make images which by the clearness of their logical structure, and by their closely-knit unity of texture, shall appeal to our disinterested and contemplative imagination with something of the same vividness as the things of actual life appeal to our practical activities. In fact, they aim not at illusion but at reality". (Roger Fry, *The French Post-Impressionists*, in *Vision and Design*, Oxford University Press, 1981, p.167)



G. Seurat, Port-en-Bessin, 1888

YOUNG-HELMHOLTZ THEORY. It was the phenomena of colour mixing that led Thomas Young in 1802 to postulate that there are three receptors, each one especially sensitive to one part of the spectrum; these receptors were thought to convey messages to the brain, and, depending on how strongly they were stimulated by the coloured light, the combined message would be interpreted as that due to the actual colour. The theory was developed by Hermann Ludwig Ferdinand von Helmholtz, and is called the Young-Helmholtz trichromatic theory. As expressed in modern terms, it is postulated that there are three types of cone in the retina, characterized by the presence of one of three different pigments, one absorbing preferentially in the red part of the spectrum, another in the green, and another in the blue. A coloured stimulus—e.g. a yellow light—would stimulate the red and green receptors, but would have little effect on the blue: the combined sensation would be that of yellow, which would be matched by stimulating the eye with red and green lights in correct proportions of relative intensity (*Britannica*).

It is often contended that impressionists represented the world as it was projected in the retina. They represented the world as it was, rather than as it was thought to be. The canvas matched the retinal image: in both cases the image is formed as a combination of color points. In this regard, the investigations undertaken by painters parallel the ones carried out by physiologists like Helmholtz. The goal of impressionists was to reduce the light coming from the real world to its essential structure and to represent this structure in the painting. Again, like in the Renaissance, painting becomes in the end of the 19th-century a sort of empirical science whose goal is the investigation of human vision.

Image and Visual Perception

In the nineteenth century, physiology dominated the study of vision. Vision was considered an empirical phenomenon, namely, as the excitation of the cells of the retina by the light rays. As Cray contends, in the 19th c. "man emerges as a being in whom the transcendent is mapped onto the empirical. It was the discovery that knowledge was conditioned by the physical and anatomical structure and functioning of the body, and in particular of the eyes."

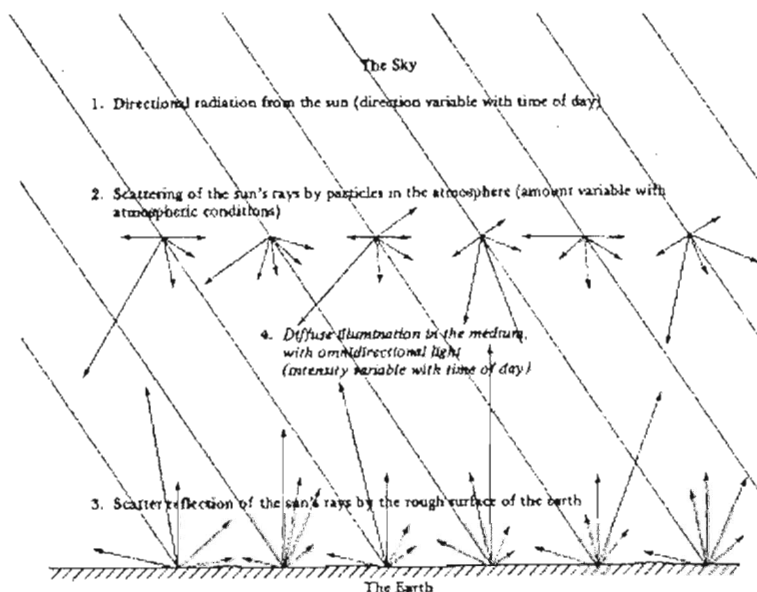
As a result, "The physical surface of the eye itself became a field of statistical information: the retina was demarcated in terms of how color changes hue depending on where it strikes the eye. Also measured were the extent of the area visibility, of peripheral vision, the distinction between direct and indirect vision, and the location of the blind spot." (Jonathan Cray, *Modernizing Vision*, pp.29-44, in *Vision and Visuality*, Hal Foster editor, Bay Press, 1988)

An example of a purely empirical explanation of vision is the theory formulated by Johannes Müller, who enumerates in the first half of the 19th-century enumerated the different causes the give rise to the sensation of light: "The sensations of light and color are produced wherever parts of the retina are excited 1) by mechanical influences, such as pressure, a blow or concussion 2) by electricity 3) by chemical agents, such as narcotics, digitalis 4) by the stimulus of the blood in a state of congestion" and lastly "by the undulations and emanation which by their action on the eye are called light". (quoted in Cray, op.cit., p.39)

The comparison between the two dimensional image (i.e. a painting or a photograph) and an image of the world as perceived by the eye has been drawn many times in the past. Renaissance theorists, for example, considered that the three-dimensional world is projected onto a plane, and that this projection is what the eye perceives. Hence, while looking at a perspective drawing, the viewer could reverse the process and perceive a three-dimensional scene from the visual cues contained in the perspective projection.

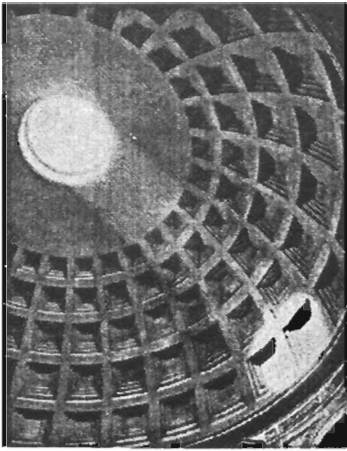
In the nineteenth century, physiologists formulated the stimulus-response theory of vision: when the light rays reached the inner eye, an image, made up of colored points, is formed on the surface of the retina. Within this concept of vision, an impressionist painting, for example, could be thought as the reproduction of the pattern of colored points in the retinal image. Similarly, the retina could be compared with the sensitive film located inside the photographic camera.

These theories of vision, based on the comparsion between two-dimensional image and visual image, have been recently contested by the American psychologist J.J. Gibson. In his book *The Ecological Approach to Visual Perception*, 1979, Gibson recalls us that "A picture is not like perceiving" (ibid., p.281) and that "Painting can reach a degree of perfection, we are told, such that viewers cannto tell whether what they see is a canvas trested with pigments or the real surfaces that the painter saw, viewed as if through a window." (ibid., pp. 280-281). Questioning this ancient believe, Gibson claims that "only the eye considered as a fixed camera can be deceived. The actual binocular visual system cannot. A viewer can always tell whether he is looking at a picture or a t a real scene through a window. ...The illusion of reality is a myth " (ibid., p.281) After the Renaissance it was thought that "a picture was a patchwork of visual sensations. By analogy the picture in the eye was a patchwork of colored light on the retinal surface" (ibid., p.285) Against such claims, Gibson argues that "No one ever saw the world as a flat patchwork of colors...The notion of a patchwork of colors comes from the art of painting, not from any unbiased description of visual experience. What one becomes aware of by holding still, closing one eye, and observing a frozen scene are not visual senstions but only the surfaces of the world that are viewed now from here". (ibid., p.286)



The steady state of reverberating light in an illuminated medium under the sky. From J.J. Gibson, *The Ecological Approach to Visual Perception*.

Gibson's 'ecological' theory of perception is an attempt to do away with the influence of geometry, mathematics and pictorial representation in the study of visual perception. Gibson understands that the theories and models provided by those fields of knowledge have led to many misunderstandings regarding the nature of visual perception. He claims that there is a difference between such geometric terms as plane and line and the perceived surfaces and edges: "Surfaces and the medium are ecological terms; plans and space are the nearest equivalent geometrical terms, but not the differences. Planes are colorless; surfaces are colored. Planes are transparent ghosts; surfaces are generally opaque and substantial. The intersection of two planes, a line, is not the same as the junction of two flat surfaces, and edge or corner." (ibid. p.33). Similarly, he contends that from the point of view of visual perception space is not the empty void of geometry consisting of points. Rather, ecological space consists of places (i.e. locations or positions).



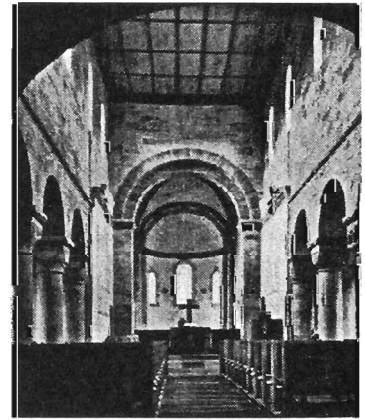
Pantheon

To bring light to the interior space is one of the fundamental architectural experiences. If the Pantheon represents a culminating point in the history of architecture is mainly because this building symbolizes a whole conception of the universe by means of three basic elements: light, form and space (the light coming from above, the dome as image of the heavens, the finite spherical space).

The centralized space of the Pantheon invites the visitor to stand at the center, from where he can look up and contemplate the distant light source. The light source can only be contemplated, since the distance between the body and the light source cannot be overcome. In the longitudinal spaces of the Romanesque churches, on the other hand, the light at the end of the nave is an invitation to walk towards the altar. It is a different conception of the world (one that conforms to the principles of Christianity) and also a different relation between space, form and light. The architectural problem was to give form to the end of the nave. An immediate solution was to perforate the flat wall at the end of the space. In more refined solutions, the light at the end of the longitudinal space filled the space of the choir.



Nave of Romanesque church in Eberbach.

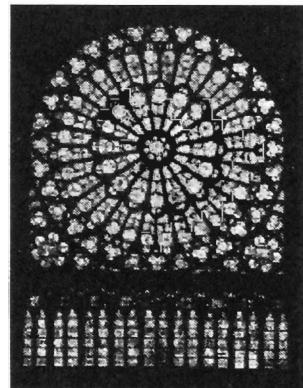


Nave of the Abbey church of St. Mary, Faurdu, Württemberg, 1220-30.

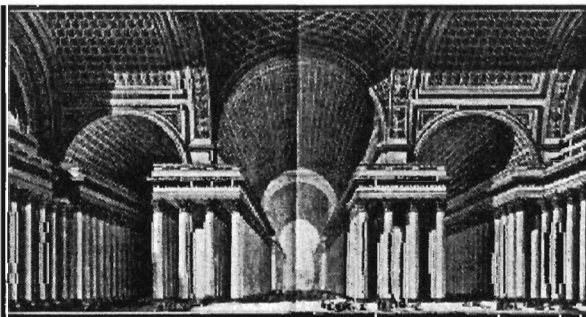
"Je raisonnai ainsi: C'est la lumière qui produit les effets. Ceux-ci nous causent des sensations diverses et contraires suivant qu'ils sont brillants ou sombres. Que je puisse parvenir à répandre dans mon temple de magnifiques effets de lumière, je porterai dans l'âme du spectateur le sentiment du bonheur; je n'y porterai au contraire que celui de la tristesse quand le temple ne présentera que des effets sombres. Si je peux éviter que la lumière arrive directement et la faire pénétrer sans que le spectateur aperçoive d'où elle part, les effets résultants d'un jour mystérieux produiront des effets inconcevables et en quelque façon une espèce de magie vraiment enchanteresse." (E. L. Boullée, Architecture. Essai sur l'art, Paris, 1968, p.90-91)

"Ce qui me satisfait actuellement, c'est que je crois avoir conçu, le premier, la manière d'introduire la lumière dans un temple et que mes vues à ce sujet me semblent neuves et philosophiques." (ibid., p.95)

Gothic architecture celebrates more than any other style the penetration of light in the interior of the nave. Light is not forced to go through small apertures, but clashes against the large surfaces of glass that the Gothic structural system makes possible. After going through the stained glass, the light rays get the color of the glass, filling the inner space with a magic atmosphere.



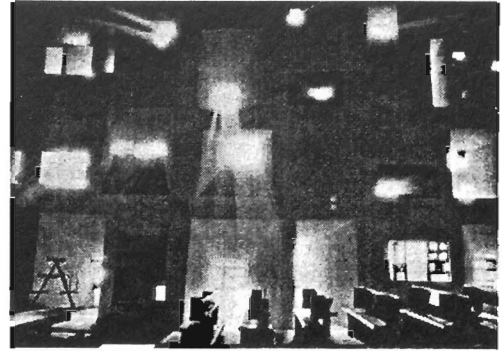
Rose window, north transept. Notre-Dame, Paris, c.1200



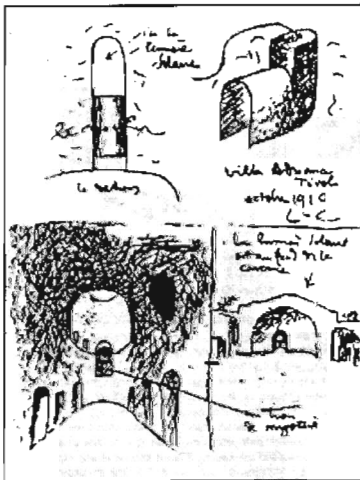
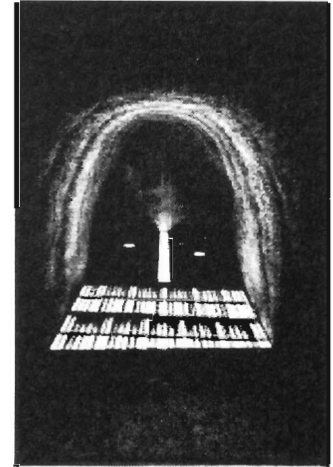
E. Boullée, *Métropole*, inner view.

Ronchamp: Light, Form and Space

The visit to the Hadrian villa left a deep impression on Le Corbusier. He discovered in the Roman buildings a fundamental fact of architecture, one that does not belong to a particular period or style but to the architecture of all times: the relation between light, form and space. In the project for Ronchamp he found the appropriate occasion to give a unique architectural expression to those fundamental facts. The building is a compendium of different formal devices to control the penetration of light in the interior space. Light can reach the inside through the gaps left between the different components that make up the building. For example, through the gap between the roof and the supporting walls, or between the south wall and the wall of the altar. This aperture is closed by a brise-soleil structure that avoids the direct incidence of the light. In the south wall, the relation between light and architectural form is expressed in a more dramatic way: the wall seems to have been perforated by the force of the light rays. The towers are another mechanism to get the light inside the building. They raise from the lower mass to capture the light coming from the sky and to conduct it to the inside.

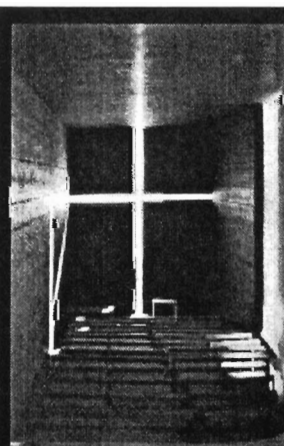
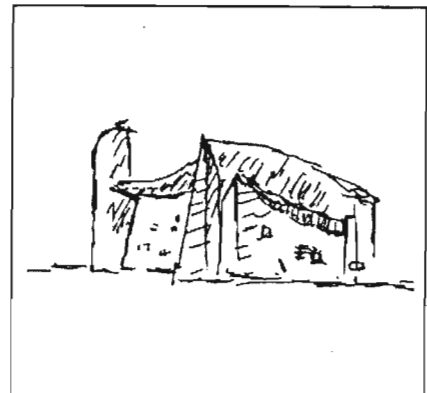


Le Corbusier, Ronchamp.



This sketch illustrates the relation between light and inner surface. What is shown on it is not the building as a mass seen from the outside, but rather the shell that encloses and defines the interior space.

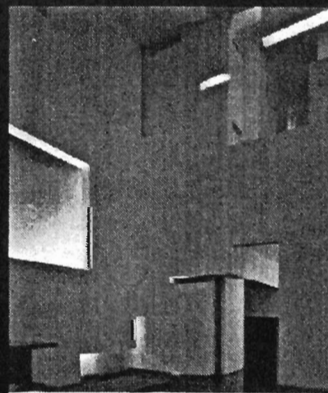
In Ronchamp, an unsurpassed balance between interior space and exterior form has been achieved. It is one of the few buildings in the history of architecture that is recognizable through the images of its interior space. But, the strong *Prägnanz* of the interior does not prevent the exterior masses from having a clear composition, a recognizable architectural form. In this building, interior space and exterior form are inseparable components of a unique organism.



Tadao Ando, Chapel with the light, 1987-88.

This project faces one of the permanent facts of architecture: the closing of the end of a longitudinal space. The solution adopted reminds the evolution of the Christian church in the Romanesque: an opening is cut on the enclosing plane. In this case, the opening has a symbolic significance: the cross-shape.

← Romanesque



Stephen Hall, Shaw offices, New York, 1991.

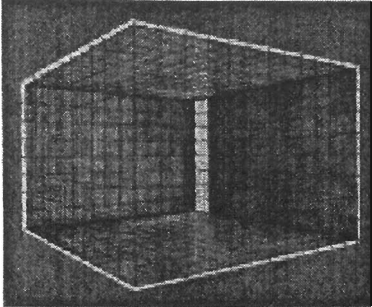
This project is an example of a design conceived from the point of view of the interior space. The enclosing walls are like facades, with windows that open towards the interior/exterior space. The openings in the walls are illuminated with artificial light. The colouring of the light adds a particular aesthetic quality to the space, in a way that remains the works of artists like James Turrell and Dan Flavin.

→ Light-Space

Space and Light: the minimalist approach

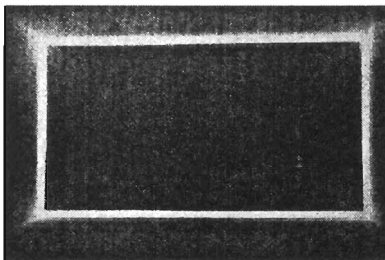
The installations of James Turrell are experiments made exclusively with light and space. Turrell's working materials are artificial and natural light. The surfaces that define the spaces do not exist as material objects but as phenomenal surfaces created by light. Transparent coloured planes are projected in space, creating transparent partitions that the body can traverse.

Turrell avoids the direct view of the light sources. In some cases, however, a visible trail of light marks the direction of movement in the space.



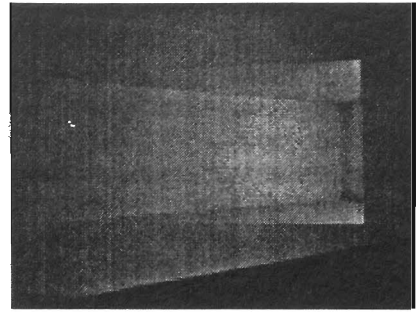
James Turrell, Graphite on paper, 1967.

Turrell uses different mechanisms to create form in space using light. One consists of the projection of an intense light on the intersections of the walls of the installation space. This early drawing is an study for this kind of projection.

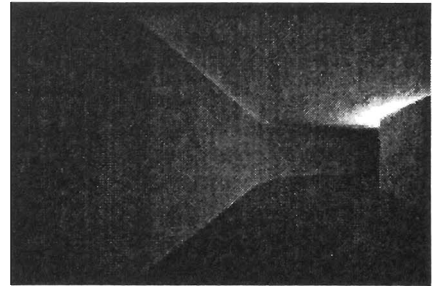


James Turrell, Raemar, Fluorescent light, 1968.

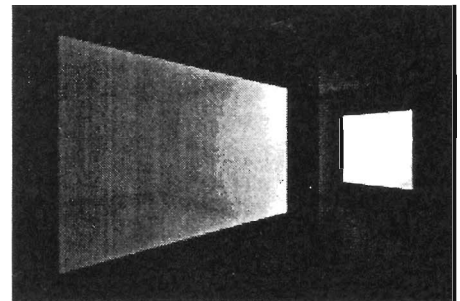
Another mechanism is to force the light to go through restricted apertures. In this case, the light sources behind the plane, create a light that surrounds the plan, extending along the intersecting edges of floor and walls. As a result, the wall appears as if it would be floating in space, wrapped in an halo of light.



James Turrell, Fluorescent light, Whitney Museum, New York, 1980.

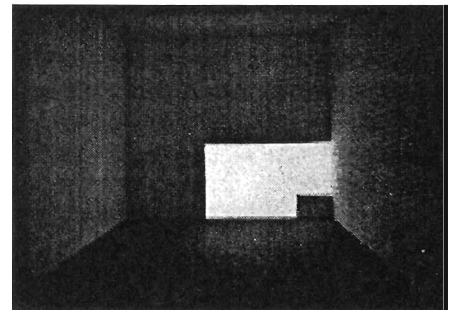


James Turrell, Red around (night), Fluorescent light and natural mix. 1983.

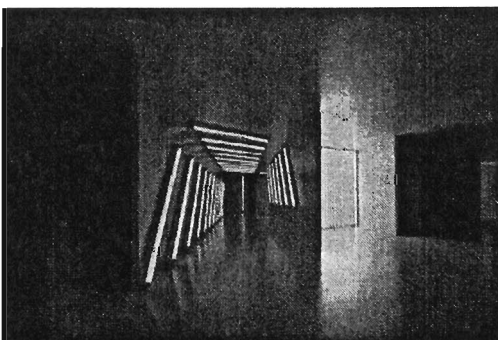


James Turrell, Kono-Orca, Helium and Argon light, 1984.

The photographs can only give a limited idea of the spaces created by these installations. They need to be experienced to be properly understood. Some of the illusionistic effects of light only make sense in the installation itself. For example, by projecting an intense light on the corner of the room, Turrell fabricates the illusion of a real window. Many visitors believe that the projected light is indeed an opening on the wall, until they touch the surface of the wall and realize that their expectation was wrong.



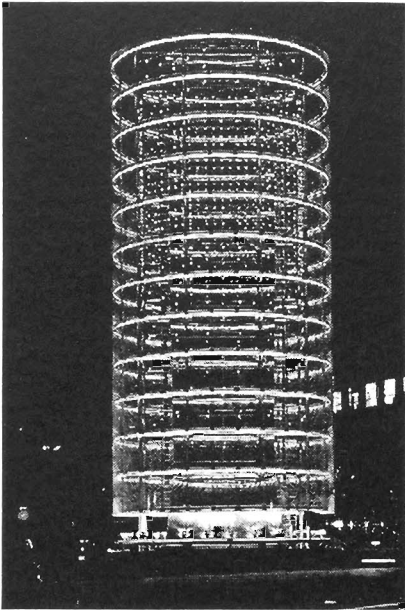
James Turrell, Porter Powell, Xenon projection, 1967.



Dan Flavin, Los Angeles, 1982.

Unlike Turrell, Dan Flavin often uses light fixtures as composition elements. The colored, fluorescent tubes create a rhythm of luminous lines.

In the Tower of Winds, by Toyo Ito, artificial light is used to achieve the continuous transformation of the building's appearance. Light becomes a form-giving factor. The geometric properties of the building form play a secondary role, as compared to the importance assigned to light and color. In this example, the phenomenal takes over the conceptual.



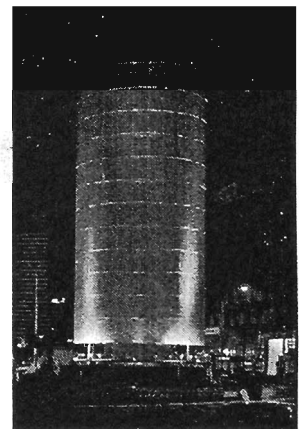
A 21-metre high tower in the centre of a roundabout near Yokohama train station was covered in synthetic mirrored plates and encased in an oval aluminium cylinder. Floodlights positioned within these two layers, when lit, give the tower the appearance of a giant kaleidoscope.

The reflective properties of the aluminium panels emphasise the tower's simple metallic form during the day. At night the 'kaleidoscope' is switched on, presenting a brilliant display of reflection upon reflection.

The tower consists of 1,280 mini-lamps and 12 bright-white, vertically arranged neon rings. Thirty computer-controlled floodlights (24 on the interior, the remainder on the exterior) make patterns of light within the tower, according to the time of day. Natural elements such as noises, and wind-speed and direction affect the intensity of the floodlights: the result is a controlled 'natural' phenomenon. The panels sometimes become a translucent film, at other times they appear to rise floodlit to the surface.

Architectural Monographs, n. 41, Academy Editions, p. 49.

Toyo Ito. Tower of Winds, Yokohama, 1986.



The computer, like the camera, (and the pencil and the paintbrush that preceded them), is a most remarkable intermediary and replicator of aspects of the three-dimensional reality of our world. As incredible tools they have extended and enriched our capacities immeasurably. New technologies will doubtless replace or develop existing ones ever further. Yet, however awesome these tools may become, we should vigilantly avoid being misled, beguiled or deluded by them into believing that they are in themselves full substitutes for, or total equivalents of nature's reality. At best, they should be utilized where appropriate to bring us into greater sustainable compatibility with, not in opposition to or destructive toward, each other and the natural world. Structure and color in space and light in the reality of nature and in the parallel reality of art and architecture can only flourish symbiotically through continual recognition of their distinct differences, their hierarchies and their forever newly unfolding harmonies.

Structure and Color in Nature: Toward Symbiosis in Art and Architecture. In *The Structurist*, no. 31/32, 1991/92.

EXERCISE

The purpose of this exercise is to explore the relation between space, form and light ('natural' and 'artificial') using a light simulation program, like Radiance or Lightscape. The exercise can be approached in two different ways: concentrating on a building's interior space (i.e. Ronchamp), or in the envelope or skin of the building (i.e. Yto's Tower). In the first case, use a solid modelling program to design the interior space. In the second case, the structure of the building exterior can be modelled using blocks or 'types and instances'.

Concentrate on the relation between conceptual and phenomenological dimensions of architectural space. For example, a geometrically simple void can be transformed into a complex array of illuminated surfaces by means of light. In this regard, you can explore the successive changes in the space that occur as a result of the movement of the sun position. You could create, for example, a sequence of scenes to show how the character of a space changes with the light.

Time for the exercise: 2 weeks

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