

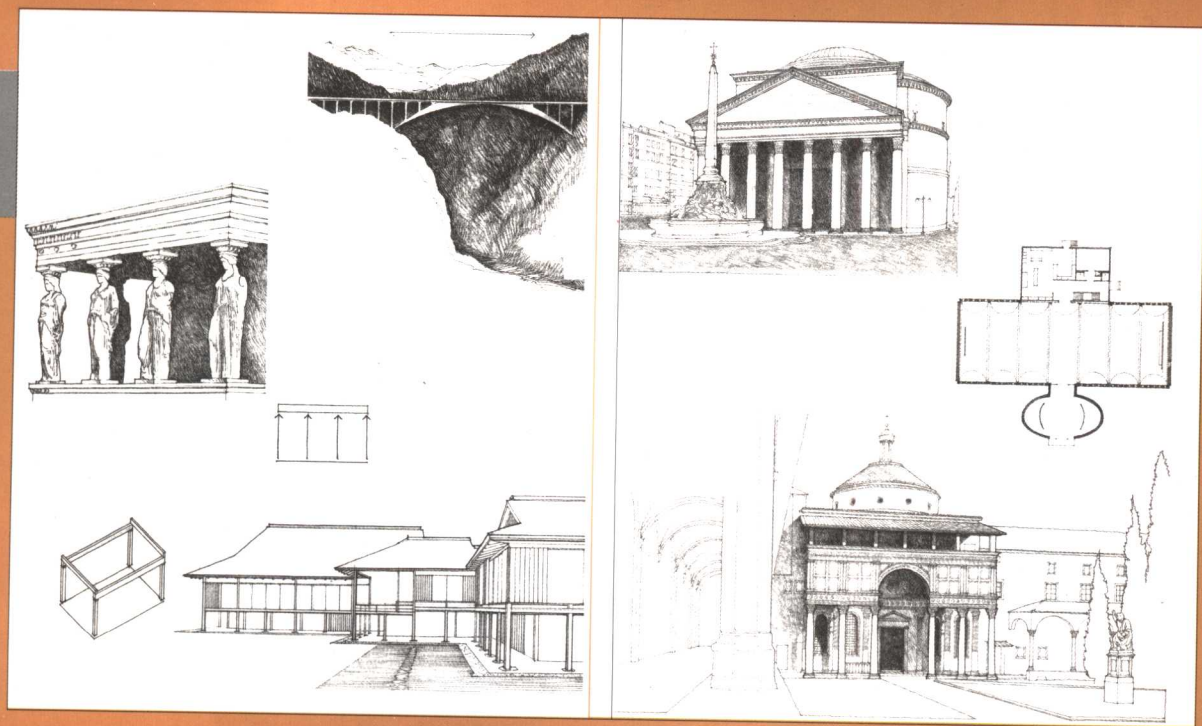
建筑：形式、 空间和秩序

[第二版]

ARCHITECTURE: FORM, SPACE, & ORDER

[Second Edition]

程大锦(Francis D. K. Ching)/著
刘从红/译 邹德侖/审校



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Architecture: Form, Space, & Order

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《建筑:形式、空间和秩序》

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Architecture: Form, Space, & Order

Preface to Chinese Edition

I am pleased and honored to have the opportunity to address architecture and design students and faculty in the People's Republic of China, and to offer my work as a way of looking at, understanding, and conceptualizing form and space as key components of architecture.

It was 30 years ago that I wrote and illustrated the first edition of this text with the intention of providing beginning students with a clear and straightforward guide to understanding fundamental principles and concepts in architectural design. This translation not only continues the original emphasis on illustrating architectural concepts and organizations through the use of comparative examples from various historic periods and cultures but also extends the discourse to a broader and deserving audience. I hope this work not only teaches but also inspires the reader to achieve the highest success in their future endeavors.

Here I also express my appreciation to Mr. Liu daxin of Tianjin University Press and Mr. Hu Hongcai of Archidata for their sterling work during the making of this Chinese edition.

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建筑：形式、空间和秩序

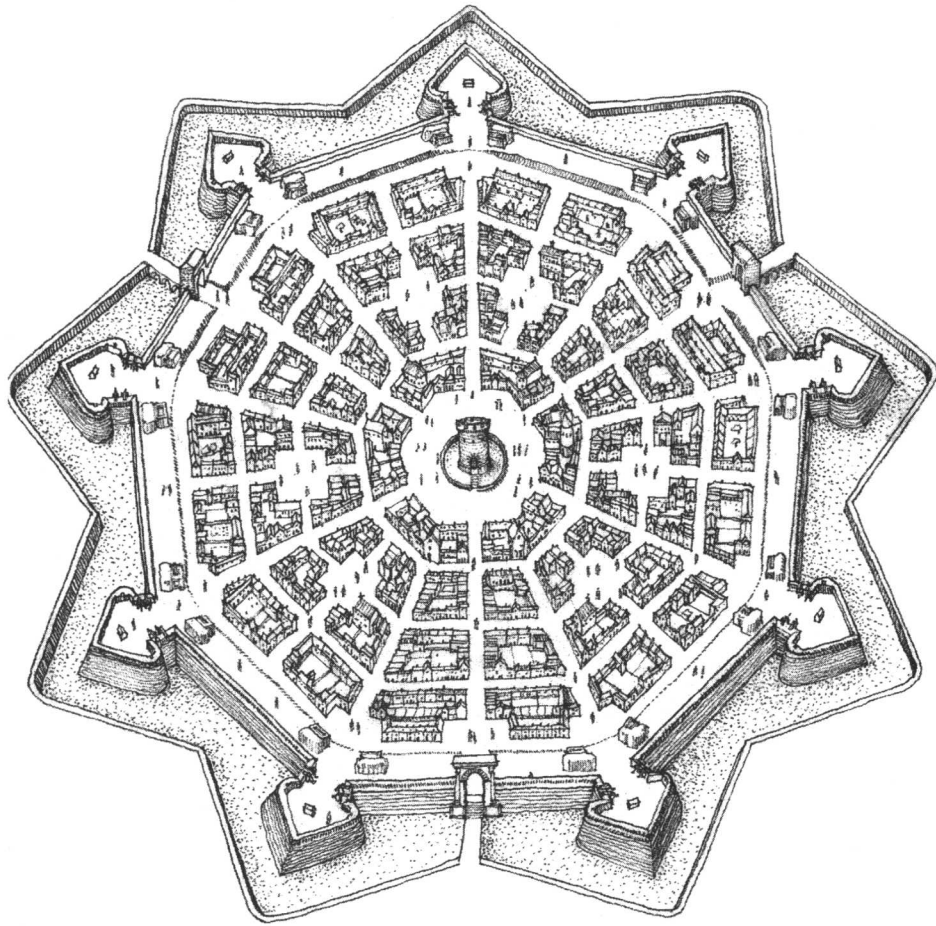
中文版序言

我很高兴，也很荣幸，能有机会与中国建筑与设计专业的学生和教师进行对话，同时将我的作品呈献给大家，作为一种审视、理解和梳理形式与空间的方法，而形式与空间恰恰是建筑中的关键要素。

30年前，我撰写了此书的第一版，并以图解加以说明，目的是为初学者理解建筑设计中的基本准则和概念提供清晰而简捷的方法。这个翻译版本，不仅延续了最初的风格，利用各个历史时期和各种文化形态中可比较的实例，强调图解建筑概念和建筑组合，而且将话题延伸到更广泛、更值得关注的读者群体。我希望这部作品不仅能传授知识，而且能够启发读者在未来的实践中取得最大的成功。

在此，我还要感谢天津大学出版社的刘大馨先生及建筑情报季刊杂志社的胡弘才先生在出版本书过程中所付出的辛勤劳动。

程大锦
建筑学教授
华盛顿大学
西雅图，华盛顿州
美国



The original edition of this study introduced the student of architecture to form and space and the principles that guide their ordering in the built environment. Form and space are the critical means of architecture that comprise a design vocabulary that is both elemental and timeless. While this revision continues to be a comprehensive primer on the ways form and space are interrelated and organized in the shaping of our environment, it has been refined by editing the text and incorporating diagrams for greater clarity, adding selected examples of architectural works, expanding the sections on openings, stairways and scale, and finally, by including a glossary and an index to designers.

This work continues to illustrate the ways the fundamental elements and principals of architectural design manifest themselves over the course of human history. These historical models span time and cross cultural boundaries. While the juxtaposition of styles may appear to be abrupt at times, the diverse range of examples is deliberate. The collage is intended to persuade the reader to look for likenesses among seemingly unlike constructions and bring into sharper focus the critical distinctions that reflect the time and place of their making. Readers are encouraged to take note of additional examples encountered or recalled within the context of their individual experiences. As the design elements and principles become more familiar, new connections, relationships, and levels of meaning may be established.

The illustrated examples are neither exhaustive nor necessarily the prototypes for the concepts and principles discussed. Their selection merely serves to illuminate and clarify the formal and spatial ideas being explored. These seminal ideas transcend their historical context and encourage speculation: How might they be analyzed, perceived, and experienced? How might they be transformed into coherent, useful, and meaningful structures of space and enclosure? How might they be reapplied to a range of architectural problems? This manner of presentation attempts to promote a more evocative understanding of the architecture one experiences, the architecture one encounters in literature, and the architecture one imagines while designing.

这项研究的最初版本向建筑学专业的学生们介绍了形式和空间以及把它们用于建筑环境中的原则。形式和空间是重要的建筑手段，包含着基本的和永恒的设计语言。这本修订版仍然是一部全面的入门书籍，分析了在塑造环境的时候如何把形式和空间联系起来，如何组织形式和空间。此次修订，为了达到更加清楚明确的目的，我们重新编辑了文字，整理了图表，增加了精选的建筑实例，在洞口、楼梯、尺度等章节增添了新的内容，最后为设计人员总结出词汇表和索引。

这本书继续阐明了在人类历史进程中建筑设计的基本要素和原则是如何表达的。这些历史模式跨越了时间和文化的界限。虽然有些时候，某些风格的并置看来可能是唐突的，但书中各种各样的实例都是精心挑选的。把各种因素集结在一起，是为了让读者在看似不同的建筑中寻找相似点，并把目光聚焦于那些最为本质的不同点，因为这些不同点反映了建造的年代和建造的场所。我们鼓励读者去关注那些在个人经历中碰到或想到的其他实例。随着设计要素和设计原则变得越来越熟知，就会建立新的连接方式、新的关系和新的意义。

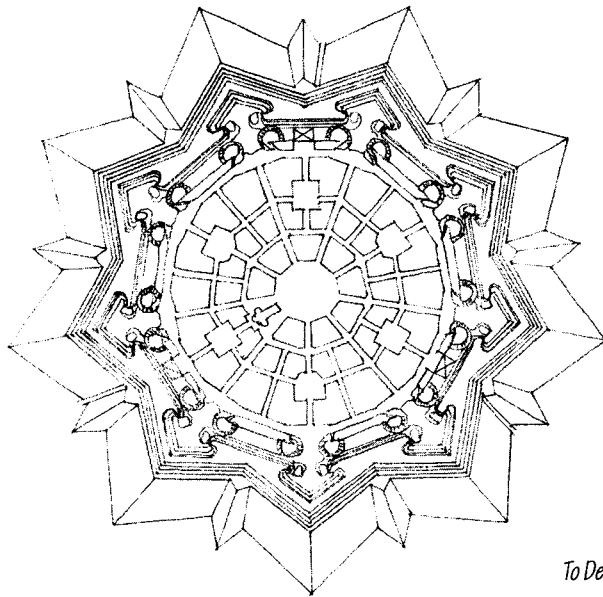
当然，书中引用的建筑实例并不是尽善尽美的，也不一定都是我们讨论的概念和原则所需要的原型。选择这些例子仅仅是为了说明和澄清我们所研究的形式概念和空间概念。这些基本概念超越了历史背景，鼓励人们去思索：如何分析、发现和体验这些原则？如何把这些原则转译成连贯的、实用的、含义丰富的空间结构和围护结构？如何把这些原则重新用于一系列的建筑问题？这种介绍方式可以帮助读者更好地理解人们所体验的建筑、在文献里碰到的建筑以及人们在设计过程中想象的建筑。

I am indebted to the following people for their valuable contributions to the original edition of this work: Forrest Wilson, whose insights into the communication of design principles helped clarify the organization of the material, and whose support made its publication possible; James Tice, whose knowledge and understanding of architectural history and theory strengthened the development of this study; Norman Crowe, whose diligence and skill in the teaching of architecture encouraged me to pursue this work; Roger Sherwood, whose research into the organizational principles of form fostered the development of the chapter on ordering principles; Daniel Friedman, for his enthusiasm and careful editing of the final copy; Diane Turner and Philip Hamp, for their assistance in researching material for the illustrations; and to the editorial and production staff at Van Nostrand Reinhold, for their exceptional support and service during the making of this book.

For this second edition, I want to express my appreciation to the many students and their teachers who have used this book over the years and offered suggestions for its improvement as a reference and tool for study and teaching. I want to especially thank the following educators for their careful and thoughtful critique of the first edition: L. Rudolph Barton, Laurence A. Clement, Jr., Kevin Forseth, Simon Herbert, Jan Jennings, Marjorie Kriebel, Thomas E. Steinfeld, Cheryl Wagner, James M. Wehler, and Robert L. Wright. While I have attempted to incorporate much of their wise counsel for enhancing this second edition, I remain solely responsible for any of its deficiencies.

我要感谢下列人士，他们为本书第一版的问世做出了宝贵贡献。F. 威尔逊谙熟设计原理的资料，他帮助我把材料组织得一清二楚，由于他的协助，使本书的出版成为可能；J. 太斯通晓建筑历史和理论，大大推进了研究的发展；N. 柯罗在建筑教学方面的才能鼓舞我从事这项研究；R. 舍伍德在形式的组合原理方面的研究，有助于秩序原理这一章的深入论述；D. 弗莱德曼为人热情，为本书的最后一稿进行了精心整理；D. 特纳和P. 汉普协助搜集了插图资料；冯·诺斯泉德·莱因霍尔德公司的编辑和出版人员，在本书的制作过程中给予了特别的支持和热情的服务。

对于本书的第二版，我要向很多师生表示感谢。多年来，作为教学参考书和工具书，他们一直使用这本书并为它的修订提出建议。我特别要感谢以下几位教育家，他们对本书的第一版提出了深入细致的批评。这些教育家是L. R. 巴顿、L. A. 克莱门特、K. 弗塞斯、S. 赫伯特、J. 詹宁斯、M. 柯瑞尔伯、T. E. 斯特恩弗德、C. 瓦戈纳、J. M. 韦禾勒以及R. L. 莱特。为了提高第二版的质量，我尽量把他们明智的建议反映在书中。尽管如此，我仍然对该书的不当之处负有全部责任。



*To Debra, Emily, and Andrew, for their love of life,
which ultimately it is the role of architecture to house.*

献给黛布拉、艾米丽和安德鲁，为了他们在生活中付出的关爱，这才是建筑所要承载的最终责任。

Architecture is generally conceived—designed—and realized—built—in response to an existing set of conditions. These conditions may be purely functional in nature, or they may also reflect in varying degrees the social, political, and economic climate. In any case, it is assumed that the existing set of conditions—the problem—is less than satisfactory and that a new set of conditions—a solution—would be desirable. The act of creating architecture, then, is a problem-solving or design process.

The initial phase of any design process is the recognition of a problematic condition and the decision to find a solution to it. Design is above all a willful act, a purposeful endeavor. A designer must first document the existing conditions of a problem, define its context, and collect relevant data to be assimilated and analyzed. This is the critical phase of the design process since the nature of a solution is inexorably related to how a problem is perceived, defined, and articulated. Piet Hein, the noted Danish poet and scientist, puts it this way: "Art is solving problems that cannot be formulated before they have been solved. The shaping of the question is part of the answer."

Designers inevitably and instinctively prefigure solutions to the problems they are confronted with, but the depth and range of their design vocabulary influence both their perception of a question and the shaping of its answer. If one's understanding of a design language is limited, then the range of possible solutions to a problem will also be limited. This book focuses, therefore, on broadening and enriching a vocabulary of design through the study of its essential elements and principles and the exploration of a wide array of solutions to architectural problems developed over the course of human history.

As an art, architecture is more than satisfying the purely functional requirements of a building program. Fundamentally, the physical manifestations of architecture accommodate human activity. However, the arrangement and ordering of forms and spaces also determine how architecture might promote endeavors, elicit responses, and communicate meaning. So while this study focuses on formal and spatial ideas, it is not intended to diminish the importance of the social, political, or economic aspects of architecture. Form and space are presented not as ends in themselves but as means to solve a problem in response to conditions of function, purpose, and context—that is, architecturally.

The analogy may be made that one must know and understand the alphabet before words can be formed and a vocabulary developed; one must understand the rules of grammar and syntax before sentences can be constructed; one must understand the principles of composition before essays, novels, and the like can be written. Once these elements are understood, one can write poignantly or with force, call for peace or incite to riot, comment on trivia or speak with insight and meaning. In a similar way, it might be appropriate to be able to recognize the basic elements of form and space and understand how they can be manipulated and organized in the development of a design concept, before addressing the more vital issue of meaning in architecture.

建筑通常是依据一系列已知条件进行设想(设计)和实施(建造)的。从本质上讲,这些条件可以是纯功能性的,或者说它们也许在不同程度上反映了社会的、政治的和经济的氛围。无论如何,已有的一系列条件(问题)远不能令人满意,于是就需要一系列完美的新条件(答案)。这样一来,建筑的创作活动就是一个从提问题到找答案的过程,或者叫做“设计过程”。

任何设计过程的第一阶段,都是去认识问题的所在,并决心给它找出一个答案来。因此,设计首先是一种意识很强的活动,是一种有目的性的努力。设计师首先必须把问题的现有条件详加整理,弄清它的来龙去脉,收集有关资料并加以消化。这是设计过程中的一个极其重要的阶段,因为发现问题、理解问题和表达问题的方式,与答案的实质有着不可分割的关系。著名的丹麦诗人兼科学家P.海恩这样说过:“艺术在于解决问题,当人们在解决问题以前是不可能有什么模式的。问题的形成就是答案的一部分。”

面临问题,设计师出于本能,不可避免地要预测答案。然而他们所掌握的设计语汇的深度和广度,不仅会影响到对问题的认识,而且也影响到答案的形成。如果某人对于设计语言的理解是非常有限的,那么面对一个问题,其答案的广度也是有限的。因此,本书通过研究建筑的基本要素和基本原则,通过阐述人类历史进程中形成的、许许多多对于建筑问题的答案,来拓展和丰富建筑语汇。

作为一门艺术,建筑不能仅仅满足设计任务书中纯功能上的要求。从根本上说,建筑在物质上的表现是顺应人类活动的。然而,空间和形式要素的编排和组合,则决定建筑物如何激发人们的积极性,引起反响,以及表达某种含义。所以,这项研究虽然集中于形式和空间的构思,但是并不打算贬低建筑在社会、政治、经济等方面的重要性。介绍这些形式和空间的要素本身并不是目的,而是在于把它们当成解决问题的手段,以符合功能上、意图上以及周围关系上所提出的条件,这是从建筑的角度上看问题的。

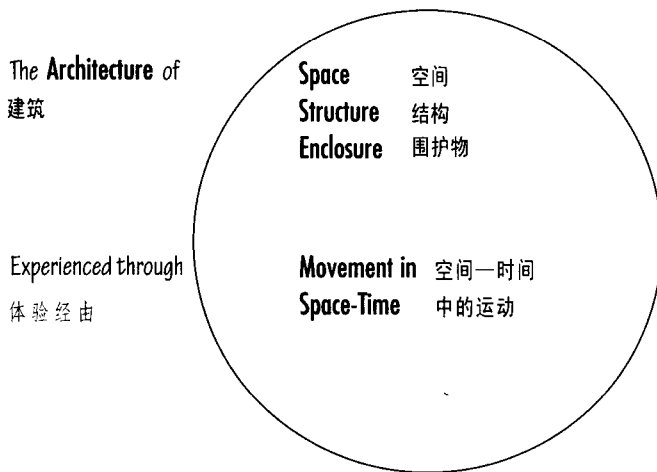
可以打一个比喻,在构成单字和扩展词汇之前,人们必须先学字母;在造句之前,人们必须学会句法和语法;在写文章、小说之类的东西之前,必须懂得作文方法。一旦掌握了这些基本要素,人们便可以尖锐泼辣或气势磅礴地书写文章,可以呼吁和平,亦可煽动暴力;可以评议生活琐事,亦可发表持之有故、言之成理的演说。同样,在表达更为重要的建筑意义之前,必须首先认识形式与空间的基本要素,理解在某一设计构思的发展过程中,如何运用和组织这些要素。

In order to place this study in proper context, the following is an overview of the basic elements, systems, and orders that constitute a work of architecture. All of these constituents can be perceived and experienced. Some may be readily apparent while others are more obscure to our intellect and senses. Some may dominate while others play a secondary role in a building's organization. Some may convey images and meaning while others serve as qualifiers or modifiers of these messages.

为了把这项研究置于恰当的背景中，下面是构成一个建筑作品的基本要素、体系和秩序的概观。这些构成部分都是可以感知和体验的。对于人们的感受来说，有些也许一目了然，有些可能含糊不清；有些在建筑组合中统领全局，有些则扮演次要角色；有些带有形象和含义，有些则修饰和限定这些形象和含义。

Architectural Systems

建筑体系



The Architecture of Building

Space 空间
Structure 结构
Enclosure 围护物

Experienced through Experience

Movement in Space-Time 空间—时间中的运动

Achieved by means of Methods

Technology 技术

Accommodating a Program

Program 设计纲要

Compatible with its Context

Context 周围关系

In all cases, however, these elements and systems should be interrelated to form an integrated whole having a unifying or coherent structure. Architectural order is created when the organization of parts makes visible their relationships to each other and the structure as a whole. When these relationships are perceived as mutually reinforcing and contributing to the singular nature of the whole, then a conceptual order exists—an order that may well be more enduring than transient perceptual visions.

但是无论如何，这些要素和体系应该相互联系，形成一个综合的整体，具有统一的或连贯的结构。当这些要素和体系，作为整体的各个局部业已形成明显的相互关系时，建筑秩序才得以产生。当这些关系被人感知，彼此加强，并完全从属于整体的基本特性时，那么一个概念上的秩序也就应运而生了——这种秩序可能更持久，而绝非转瞬即逝的感性观察所能比拟。

- organizational pattern, relationships, hierarchy
- formal image and spatial definition
- qualities of shape, color, texture, scale, proportion
- qualities of surfaces, edges, and openings
- 组织模式、关系和层次
- 形式表象和空间限定
- 形状、色彩、质感、比例、尺度的特性
- 表面、边缘和洞口的特性

- approach and entry
- path configuration and access
- sequence of spaces
- light, view, touch, hearing, and smell
- 引道和入口
- 通道的形状和进入
- 空间序列
- 光线、视野、触觉、听觉和嗅觉
- structure and enclosure
- environmental protection and comfort
- health, safety, and welfare
- durability
- 结构和围护物
- 环境的保护和舒适
- 健康、安全和福利
- 耐久性
- user requirements, needs, aspirations
- sociocultural factors
- economic factors
- legal restraints
- historical tradition and precedents
- 使用者的要求、需要和愿望
- 社会文化因素
- 经济因素
- 法律上的制约
- 历史传统和先例
- site and environment
- climate: sun, wind, temperature, precipitation
- geography: soils, topography, vegetation, water
- sensory and cultural characteristics of the place
- 基地和环境
- 气候：日照、风向、温度、降水量
- 地理：土壤、地形、植被、水文
- 场所的直觉特性和文化特点

...& Orders

……建筑秩序

Physical **Form and Space** 形式和空间
 物质上的 • solids and voids • 实与虚
 • interior and exterior • 室内与室外

Systems and organizations of 体系和组合
 • space • 空间
 • structure • 结构
 • enclosure • 围护物
 • machines • 机械

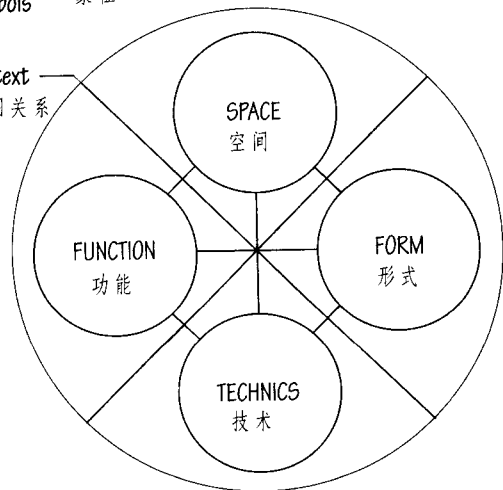
Perceptual *Sensory perception and recognition of the physical elements by experiencing them sequentially in time*
 知觉上的 感官的知觉和时常连续体验到的对物质因素的认识

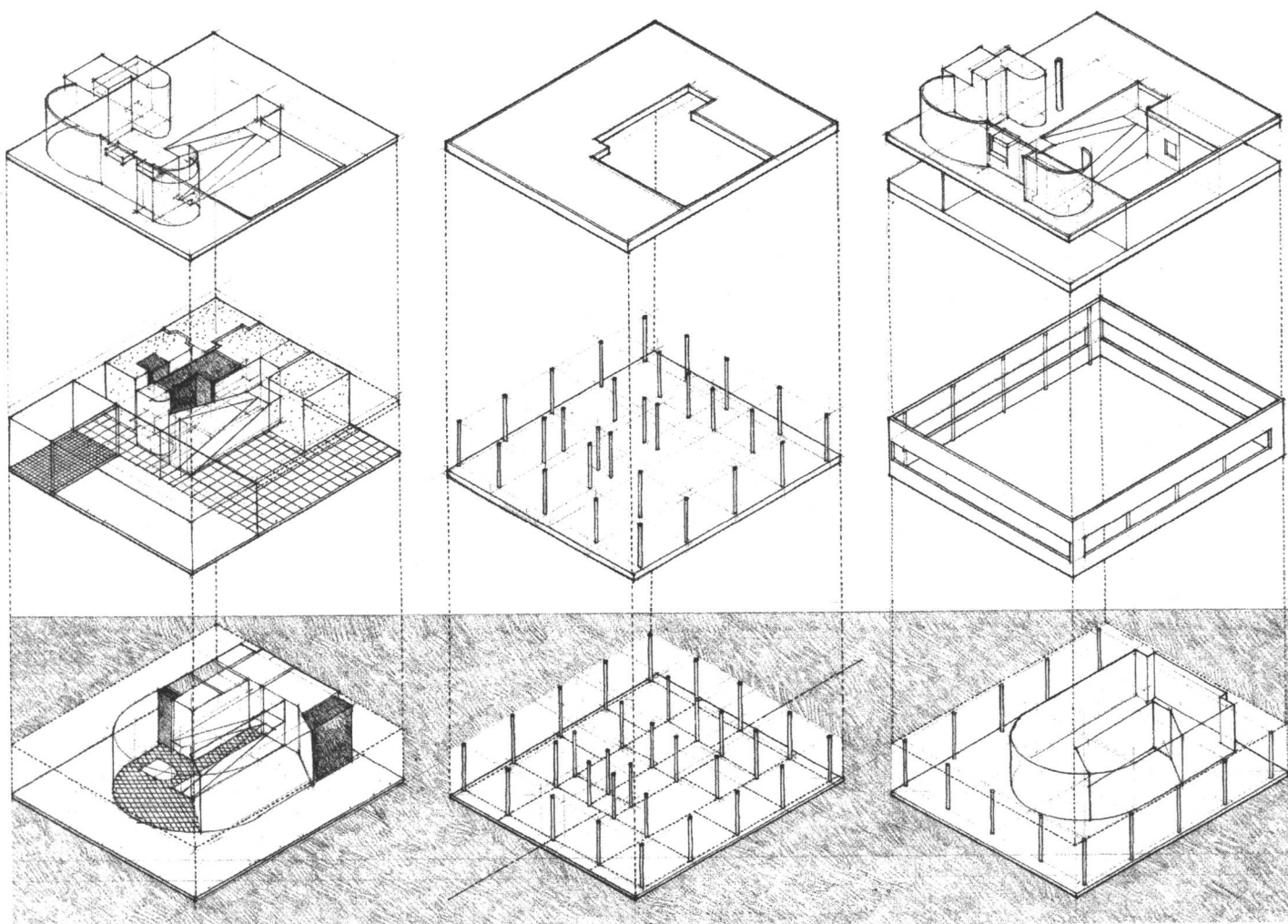
• approach and departure
 • entry and egress
 • movement through the order of spaces
 • functioning of and activities within spaces
 • qualities of light, color, texture, view, and sound
 • 接近和离开
 • 入口和出口
 • 通过空间序列的运动
 • 空间中的功能和活动
 • 光线、色彩、质感、景观和声音的特性

Conceptual *Comprehension of the ordered or disordered relationships among a building's elements and systems, and responding to the meanings they evoke*
 观念上的 在建筑物的要素和体系中，对有秩序或无秩序关系的理解，以及对它们所引起的含义的反应

• images • 形象
 • patterns • 图案
 • signs • 符号
 • symbols • 象征

• context
 • 周围关系





Spatial System

- The three-dimensional integration of program elements and spaces accommodates the multiple functions and relationships of a house.

空间体系

- 由设计纲要的要素和空间构成的三度整体，满足了多样化的功能和一所住宅各要素之间的关系。

Structural system

- A grid of columns supports horizontal beams and slabs.
- The cantilever acknowledges the direction of approach along the longitudinal axis.

结构体系

- 一个柱网支持水平梁、板。
- 悬挑部分标识出通道的方向沿着纵轴。

Enclosure system

- Four exterior wall planes define a rectangular volume that contains the program elements and spaces.

围护体系

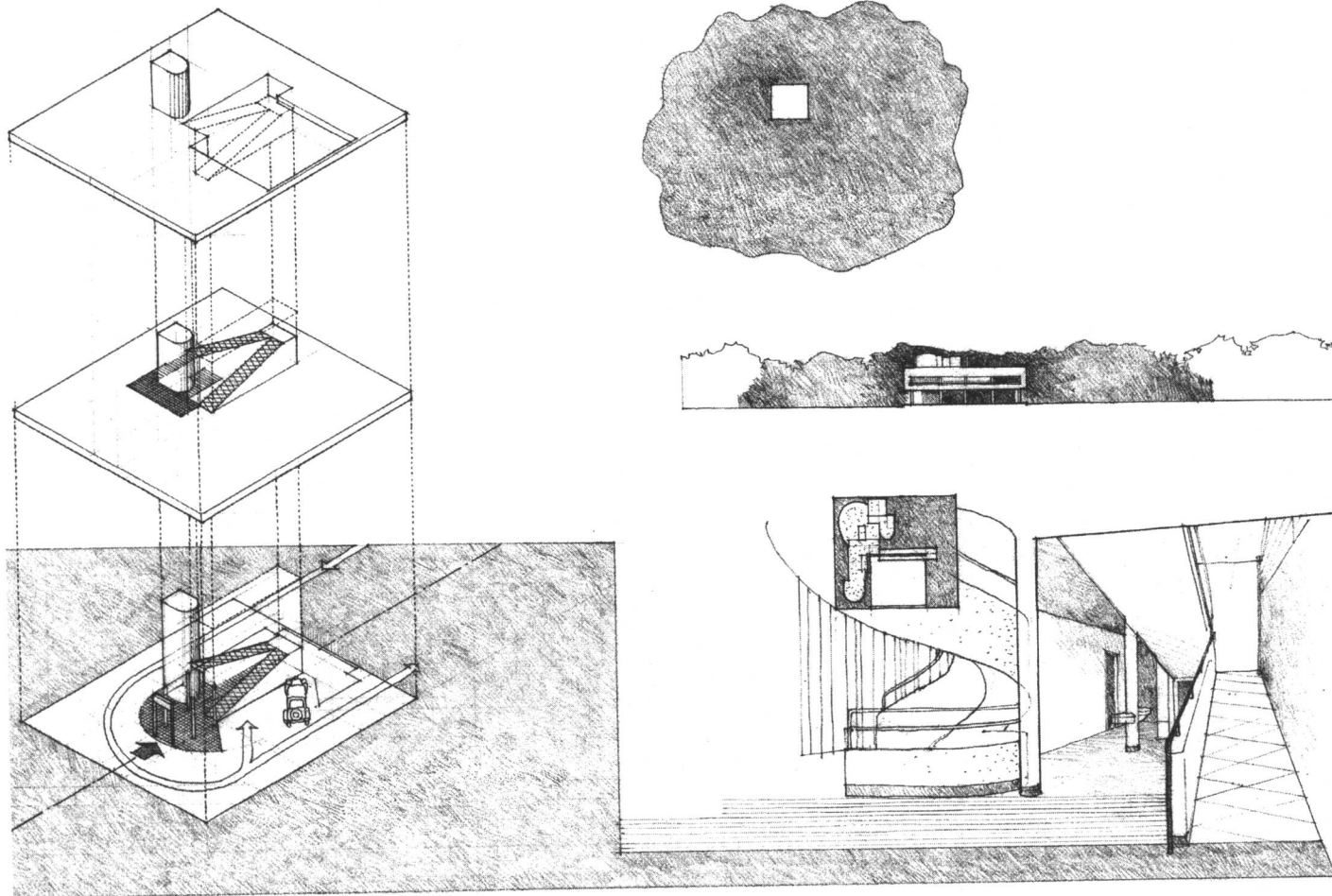
- 有四面外墙的墙面，限定了一个矩形的体量，其中包含着设计纲要的要素和空间。

Villa Savoye, Poissy, east of Paris, 1928–1931, Le Corbusier

萨伏伊别墅，普瓦西，巴黎东部，1928年—1931年，勒·柯布西埃

This graphic analysis illustrates the way architecture embodies the harmonious integration of interacting and interrelated parts into a complex and unified whole.

这个图示分析是建筑方式的具体表达，把建筑中相互作用、相互关联的部分和谐地构成一个复杂和统一的整体。



Circulation system

- The stair and ramp penetrate and link the three levels, and heighten the viewer's perception of forms in space and light.
- The curved form of the entrance foyer reflects the movement of the automobile.

交通体系

- 楼梯和坡道穿越和联结三个楼层，并且增加了观者对空间中的形体和光线的感受。
- 入口门厅的曲线形式反映了汽车的运动轨迹。

Context

- A simple exterior form wraps around a complex interior organization of forms and spaces.
- Elevating the main floor provides a better view and avoids the humidity of the ground.
- A garden terrace distributes sunlight to the spaces gathered around it.

周围关系

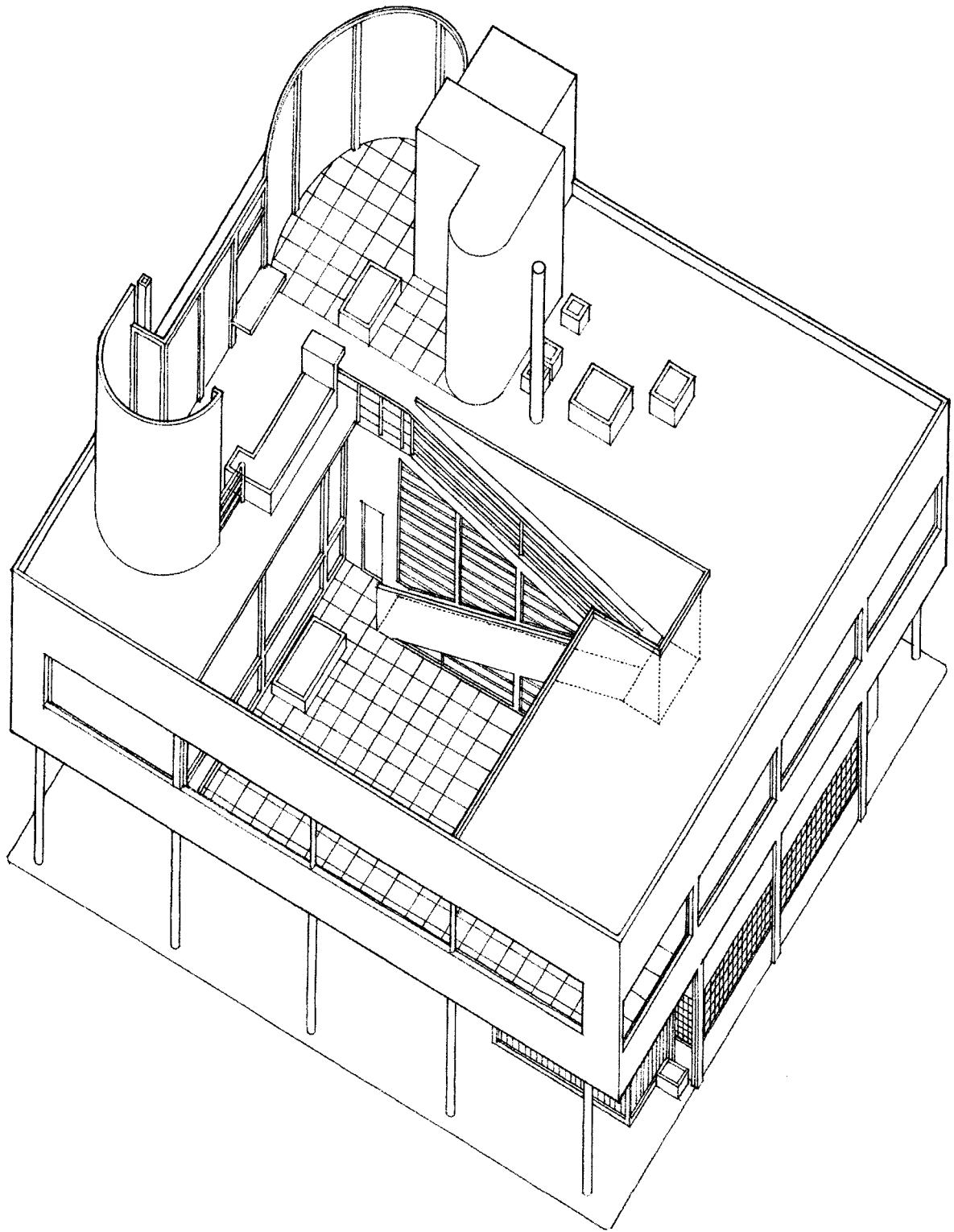
- 一个简洁的外形包裹着内部复杂的形体与空间组织。
- 主要平面升高，提供了良好的视线并且避免了地面的潮湿。
- 一个花园平台为其周围的空间提供阳光。

"Its severe, almost square exterior surrounds an intricate interior configuration glimpsed through openings and from protrusions above. . . . Its inside order accommodates the multiple functions of a house, domestic scale, and partial mystery inherent in a sense of privacy. Its outside order expresses the unity of the idea of house at an easy scale appropriate to the green field it dominated and possibly to the city it will one day be part of."

Robert Venturi, *Complexity and Contradiction in Architecture*, 1966

"其朴素的、几乎是方形的外部，围绕着复杂的内部组合，通过建筑上的洞口和顶部的凸起，内部的复杂性隐约可见……其内部秩序符合一所住宅的多样性功能、家庭的尺度以及在某种意义上私密性所固有的神秘感。其外部秩序，以平和易懂的尺度表达了住宅构思的整体性，与其所处的绿地非常和谐，并且有朝一日该建筑也许仍会与所在的城市和谐相处。"

R. 文丘里，《建筑的复杂性与矛盾性》，1966年



前言	VII	类型概括：空间限定要素	156
致谢	VIII	空间限定要素上的开洞	158
绪论	IX	面上的开洞	160
1 基本要素		角上的洞口	162
基本要素	2	面之间的洞口	164
点	4	建筑空间的特点	166
点要素	5	围合程度	168
两点	6	光	170
线	8	景观	174
线要素	10	4 组合	
从线到面	14	形式与空间的组合	178
线要素限定的平面	15	空间关系	179
面	18	空间内的空间	180
面要素	20	穿插式空间	182
体	28	邻接式空间	184
体要素	30	以公共空间连接的空间	186
2 形式		空间组合	188
形式	34	集中式组合	190
形式的属性	35	线式组合	198
形状	36	放射式组合	208
基本形状	38	组团式组合	214
圆形	39	网格式组合	220
三角形	40	5 交通	
正方形	41	交通：穿过空间的运动	228
基本实体	42	交通要素	229
规则的和不规则的形式	46	通向建筑物的道路	230
形式的变化	48	入口	238
量度的变化	50	路径的形状	252
削减的形式	52	路径与空间的关系	264
削减的和增加的形式	55	交通空间的形式	268
增加的形式	56	6 比例和尺度	
集中形式	58	比例和尺度	278
线式形式	60	材料的比例	279
放射形式	64	结构的比例	280
组团形式	66	制作比例	282
网格形式	70	比例系统	283
几何形式的碰撞	72	黄金分割	286
圆与方	74	控制线	290
旋转网格	76	古典柱式	292
形式的接合	78	文艺复兴理论	298
边和转角	80	模度尺	302
转角	81	间	306
表面的处理	86	人体比例	310
3 形式与空间		尺度	313
形式与空间	92	视觉尺度	314
形式与空间：对立的统一	94	人体尺度	316
形式限定空间	98	7 原理	
水平要素限定的空间	99	秩序原理	320
基面	100	轴线	322
基面抬起	102	对称	330
基面下沉	108	等级	338
顶面	114	基准	346
垂直要素限定空间	120	韵律	356
垂直的线要素	122	重复	357
独立垂直面	130	变换	370
面的L形造型	134	结束语	374
L形面	135	词汇表	376
平行的垂直面	140	参考书目	386
平行面	141		
U形面	146		
四个面：围合	152		

1 基本要素

Primary Elements

"All pictorial form begins with the point that sets itself in motion... The point moves... and the line comes into being—the first dimension. If the line shifts to form a plane, we obtain a two-dimensional element. In the movement from plane to spaces, the clash of planes gives rise to body (three-dimensional)... A summary of the kinetic energies which move the point into a line, the line into a plane, and the plane into a spatial dimension."

Paul Klee

The Thinking Eye: The Notebooks of Paul Klee
(English translation)

1961

“所有的绘画形式，都是由处于运动状态的点开始的……点的运动形成了线，得到第一个量度。如果线移动，则形成面，我们便得到了一个两度的要素。在从面向空间的运动中，面面相叠形成体（三度的）……总之，是运动的活力，把点变成线，把线变成面，把面变成了空间的量度。”

保罗·克利

《思考的眼睛：保罗·克利笔记》

1961年

This opening chapter presents the primary elements of form in the order of their growth from the point to a one-dimensional line, from the line to a two-dimensional plane, and from the plane to a three-dimensional volume. Each element is first considered as a conceptual element, then as a visual element in the vocabulary of architectural design.

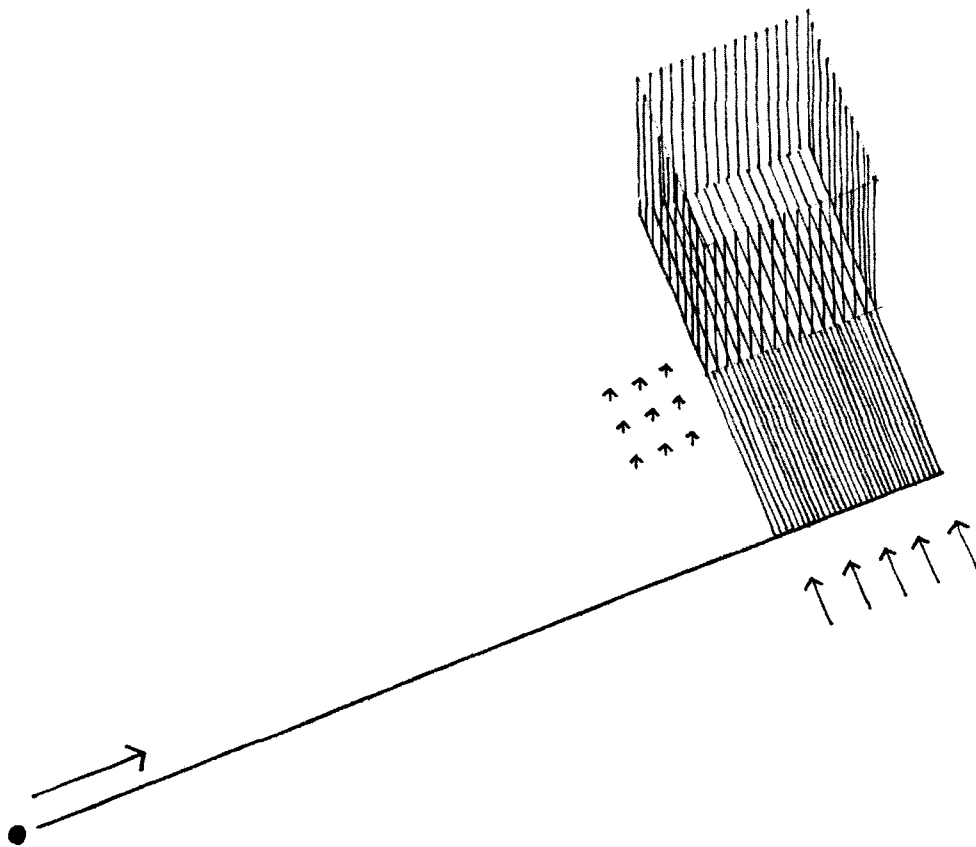
As conceptual elements, the point, line, plane, and volume are not visible except to the mind's eye. While they do not actually exist, we nevertheless feel their presence. We can sense a point at the meeting of two lines, a line marking the contour of a plane, a plane enclosing a volume, and the volume of an object that occupies space.

When made visible to the eye on paper or in three-dimensional space, these elements become form with characteristics of substance, shape, size, color, and texture. As we experience these forms in our environment, we should be able to perceive in their structure the existence of the primary elements of point, line, plane, and volume.

开篇第一章，以基本要素发展的顺序，介绍这些形式的基本要素：从点到一度的线，从线到两度的面，从面到三度的体。每个要素首先都被认为是一个概念性的要素，然后才是建筑设计语汇中的视觉要素。

作为概念性的要素，点、线、面和体是看不到的，只有在头脑中可以感知到。虽然，这些要素实际上并不存在，但是我们能够感觉到它们的存在。在两条线的相交处，我们可以感知点的存在，一条线可以标识出平面的轮廓，平面可以围成一个体，并且这个体量构成了占据空间的实体。

当这些要素在纸面上或在三度空间中变成可见元素时，它们就演变成具有内容、形状、规模、色彩和质感等特性的形式。当在环境中体验这些形式的时候，我们应该能够识别存在于其结构中的基本要素——点、线、面和体。



As the prime generator of form, the
作为形式的基本生成要素，

Point indicates a position in space. •
点 表示在空间中的一个位置。

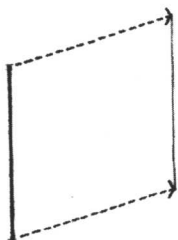
A point extended becomes a
Line with properties of:
• length
• direction
• position

一个点延伸变成一条
线 其特征如下：
• 长度
• 方向
• 位置



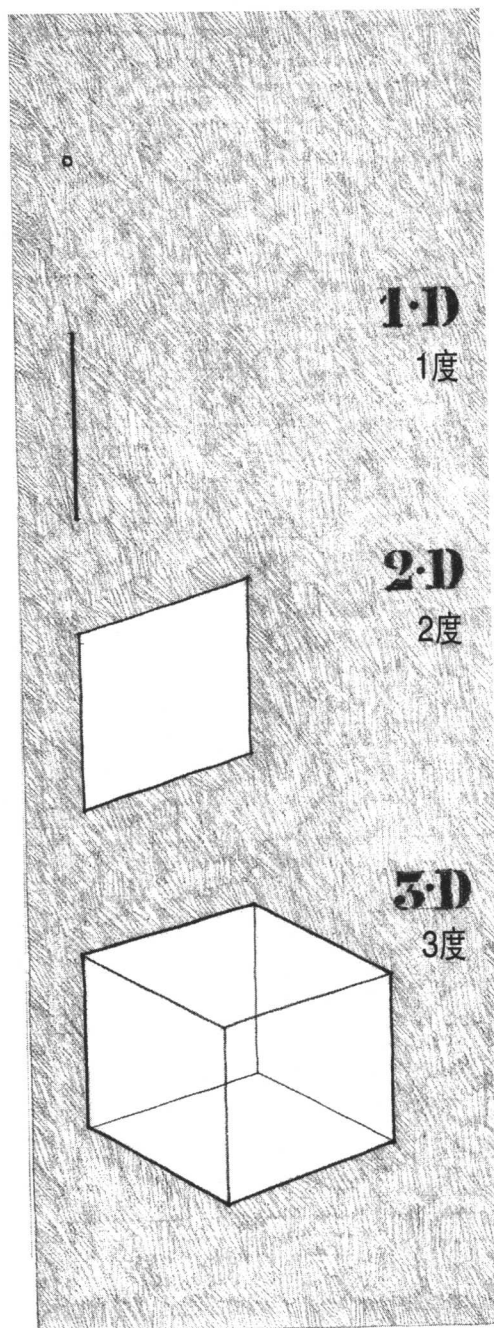
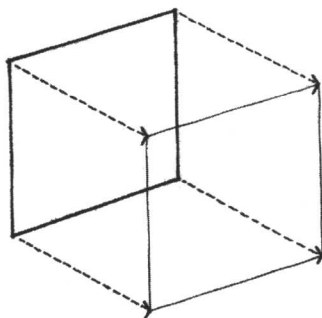
A line extended becomes a
Plane with properties of:
• length and width
• shape
• surface
• orientation
• position

一条线展开变成一个
面 其特征如下：
• 长度和宽度
• 形状
• 表面
• 方位
• 位置



A plane extended becomes a
Volume with properties of:
• length, width, and depth
• form and space
• surface
• orientation
• position

一个面展开变成一个
体 其特征如下：
• 长度、宽度和深度
• 形式和空间
• 表面
• 方位
• 位置



1-D
1度

2-D
2度

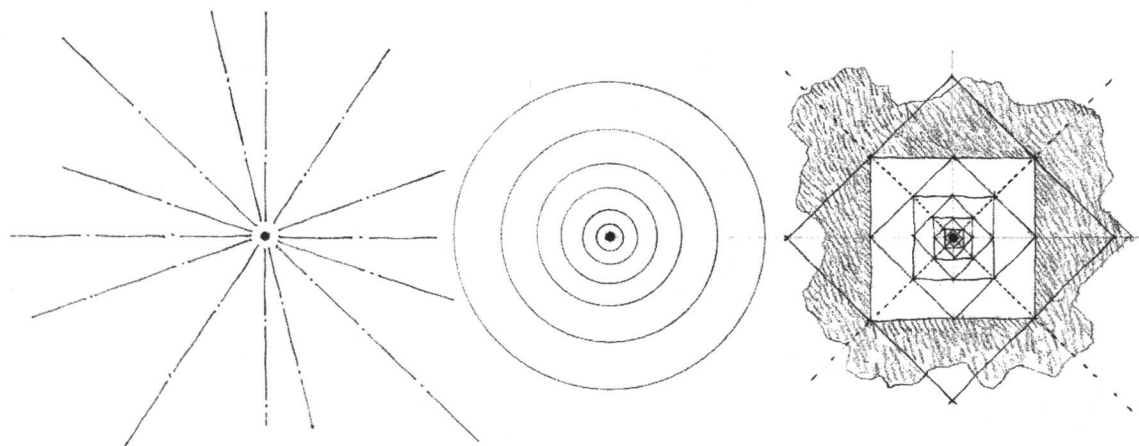
3-D
3度

Point
点

Line
线

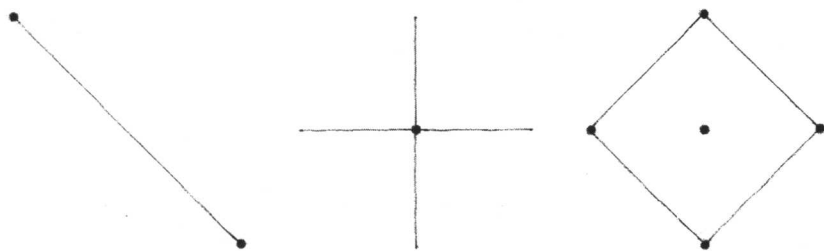
Plane
面

Volume
体



A point marks a position in space. Conceptually, it has no length, width, or depth, and is therefore static, centralized, and directionless.

一个点标出了空间中的一个位置。从概念上讲，它没有长、宽或深，因而它是静态的、集中性的，而且是无方向的。

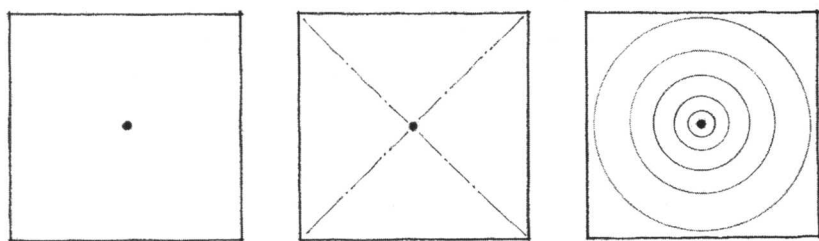


As the prime element in the vocabulary of form, a point can serve to mark:

- the two ends of a line
- the intersection of two lines
- the meeting of lines at the corner of a plane or volume
- the center of a field

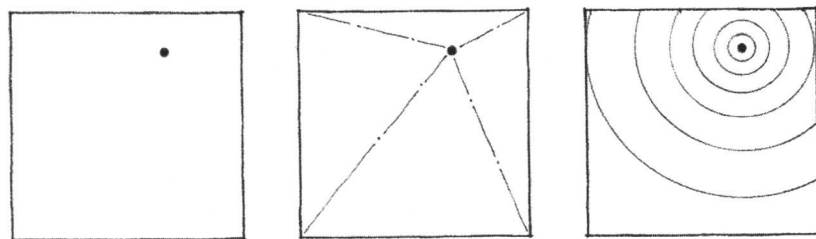
作为形式语汇中的基本要素，点可以标识以下内容：

- 一条线的两端
- 两条线的交点
- 面或体角部线条的相交处
- 一个范围的中心



Although a point theoretically has neither shape nor form, it begins to make its presence felt when placed within a visual field. At the center of its environment, a point is stable and at rest, organizing surrounding elements about itself and dominating its field.

尽管从理论上讲一个点没有形状或体形，当把它放在视野中时，便形成它的存在感。当它处于环境中心时，一个点是稳定的、静止的，以其自身来组织围绕它的诸要素，并且控制着它所处的范围。



When the point is moved off-center, however, its field becomes more aggressive and begins to compete for visual supremacy. Visual tension is created between the point and its field.

但是，当这个点从中心偏移的时候，它所处的这个范围就会变得比较有动势，并开始争夺在视觉上的控制地位。点和它所处的范围之间，造成了一种视觉上的紧张关系。