VIRTUAL SPACE

SPACE

Retail and Office

虚拟空间

商业、办公楼

1

VIRTUAL SPACE

Retail and Office

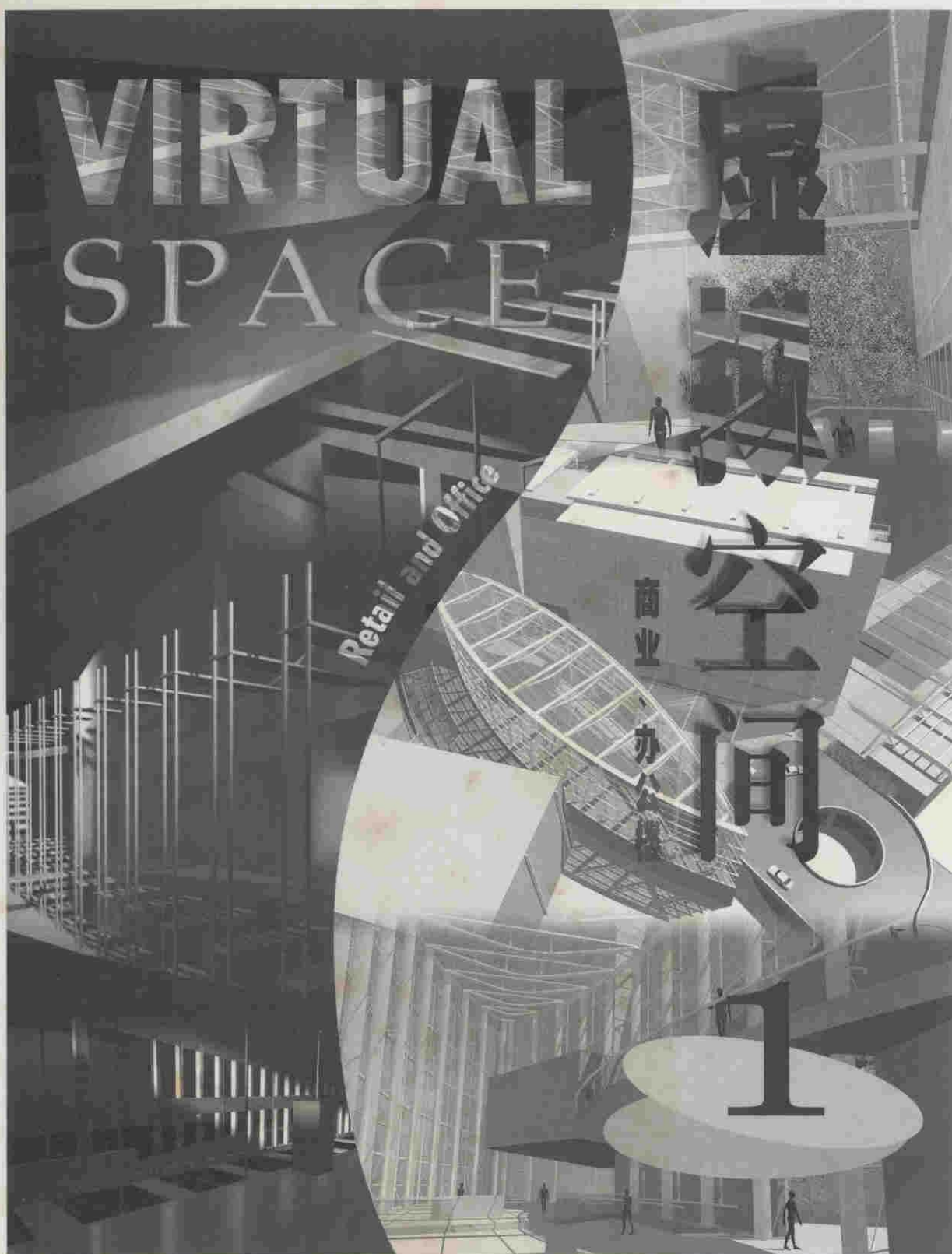虚拟空间

商业·办公楼

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导言

(一)

1997年初,《现代建筑效果图》一书出版不久,在一个雾烟氤氲、纷纷藉藉的办公室内,不同的头脑想着不同的东西:如何加速出版步伐?如何出版好书?这些表面上很容易回答的问题,在落实时往往因为种种客观和主观因素而变得很复杂。《现代建筑效果图》的成功令大家相信市场对这方面的图书需求殷切,但如何寻找突破?终于,一个大概念,就从一个小房间的烟雾中孕育了出来。

时间如烟一般的飞逝。幸好一切都已经电脑化。不但制作如此,资料搜集也一样。例如,我们可以通过电脑网络和世界各地取得联系,获取工程资料。效果图既然用电脑制作,所以在搜集资料时,我们利用盛载数码资料的容器传递,不但加快了制作速度,管理起来也容易,而且避免了扫描过程中的失真。一本涉及电脑效果图的书,本身与电脑也有千丝万缕的关系。

今天,《虚拟空间》的出版,可谓拨开云雾见青天了。本书之所以能顺利出版,全靠一些热心建筑师和设计师的鼎力支持。他们不但给我们提供了宝贵的资料,而且还推荐了很多新的资料源泉,令全书生色不少,我们衷心地感谢他们。在此,我们还要特别感谢为我们撰写文章的多位朋友,他们在百忙之中抽空为本书出力,实在难得。

(二)

《现代建筑效果图》收录的效果图以电脑制作的居多,我们去年底出版的《电脑效果图:百家案例》,也是全部收录电脑效果图的。至于《虚拟空间》,更是把电脑效果图推至一个巅峰状态,因为我们把电脑效果图虚拟出来的空间当作工程一般报导,电脑效果图的地位已提升到与摄影照片平起平坐的地步了。有人认为电脑进入建筑界是一种后现代的现象,如詹克斯,他相信电脑能够由激增而产生差异,并取代现代主义那千篇一律的单调划一。事实上,后现代主义这词正是源自建筑界,旨在反对柯布西埃拒绝装饰的现代主义建筑。

电脑和后现代的关系的确很密切。因为电脑所依仗的高科技,使复制变得易如反掌(而复制概念又是后现代文化理论中一个重点话题)。我们可以轻易拷贝档案,就如建筑师拷贝他们的图像来作演示、作售楼书一样,编制《虚拟空间》这本书,十分方便,只要按一下键盘或是拖曳一下鼠标就行了。久而久之,我们发现,真正的原作不复存在,我们已不能明确指出,送给发展商的那幅展示板、刊登在售楼书内的那一页,还是在本书出现的那一幅才是原作。甚至建筑师自己也有五、六个同一幅画的拷贝。因此,原作变得不再重要,一切都变成了"没有原本的东西的摹本。"即"类象"。

"类象(simulacrum)不再是对一个领域的模拟,对一个指涉性存有(referential being)的模拟,或是对一种本质的模拟。它不需要原物或实物,而是以模型来产生真实:一种超真实(hyperreal)。"(布希亚,1983, 2)

当摄影挑战了传统写实绘画时,今天,电脑摹视又向摄影伸出了挑战之手。它不再真实,但却比真实还要真实,因为它已成为众人模拟的对象。真正的真实都要依靠这种超真实为蓝本,这个说法一点也不夸张,吴恩融在"建筑设计中先进的光学摹视"一文就提出:客户以后会用他们的对照技能去找出已摹视的和实际建造的之间的差异。当真实的东西不如已摹视的那样好的时候,小至1%的差异也会成为产生惊异的原因。因此他在文中要求光学摹视要做得更准确。在这个层次上,模拟出的实体已成为了真实本身的判断标准。

这是人工化发挥到极点的表现。我们已不满足于仅从切面或立面构想整幢楼宇的全貌,不安于水彩过份柔弱、浪漫化,炭笔过分概念化,而是要求一幅能够提供绝对比例、真实外形、真实颜色的建筑效果图,最好是能让我们先进入去逛逛……

效果图是类象,那么《虚拟空间》就是类象的类象。古人著书立说,总有一个手稿,但《虚拟空间》全部电脑化,图片是拷贝的拷贝,文字亦然,实无手稿可言。布希亚的类象概念是有批判性的,这要牵涉到更多的讨论,然而,我们认为,单从类象这概念出发,述说这一社会现象,也不失意义。至少,我们知道,电脑效果图,作为类象,本身就有自己独立的生命,所以,绝不可轻视它们!

(三)

电脑对建筑界的影响是否就只有摹视和演示?答案是否定的。现在已有人进行研究工作,希望有一天,建筑物可以从零开始,直至完工,都由电脑一手包办。高竟祥和冯颖佳就在这建筑一体化方面进行了研究。

"我们希望有一天,建筑师设计时,不再需要考虑防火通道等问题,而是可以把所有注意力放在美感和空间运用上。所有建筑规则、条例都由中枢网络做好,从而控制建筑物的外型和内部,只要电脑知道平面有多大和每个空间的用处,中枢网络就会自动算好一道程式。然后就是一个整合过程,这个以物为本的建筑物包括了地库、裙楼、典型楼层等,电脑是有智能的,能生成平面图。只要输入参数,平面、三维图都可以制造出来。这是把建筑、结构、服务结合在一起的结果,整合后就接近于利用机器人建造的地步了。"

难度自然是有的。例如,系统必须是一个定义好、符合规则但又灵活的电脑数据结构。一般电脑内的模型只可代表一件东西,但要做到整合性,就必须是同一个模型做不同东西而仍然涉及到一件东西。现在的摹视通常用表层模型制造,眼睛看见一个平面就是一个平面,而作分析用的则必须用更耗时的实心模型。

据高氏和冯氏所说,建筑一体化设计的好处,是可以缩短建筑物由构思到落成之间的时间,日后整幢建筑物可以轻而易举地从荧光屏中制造出来,并能在不影响工序的前提下,在施工过程中更改设计,还可以确定评估而更改价格。

从现在流行的电脑效果图到一体化电脑规划设计,也许还需要一段时间,但很明显,我们已进入了一个以模拟为本的年代。我们的日常生活、居住空间,都将由电脑内的影像主导,电脑的渗透性真的不可忽略!

廖淑勤

1997.1.5

Introduction

(1)

Early in 1997, after the publication of the "Architectural Renderings" book, in an office enshrouded in cigarette smoke, several minds were mulling away over the usual Holy Grails: how to quicken the pace of publishing titles; indeed, how to publish good books! These seemingly easy questions always become complicated when put into practice though, due to both objective and subjective reasons. The success of "Architectural Renderings" however proved that there is a demand in the market for more books on a similar subject. But how to break through? The germ of an idea hence took root from the smoky atmosphere of a small room.

Time drifts away like smoke. Everything was computerised, not only in the final production stage, but initially in the collation of data. Surfing on the Information Superhighway, we also found projects via the Internet. Since all renderings are computer-generated, we were able to store them digitally. This does not only accelerate the pace of publishing, but permits easier information and administrative management, and ensures minimal colour distortion of images in the scanning process. A book on computer renderings has a thousand and one links with computers itself.

And now, seeing the successful launch of "Virtual Space" is just like seeing a clear blue sky from the dispersing mist. The series is, of course, the result of much support from architects and designers. They did not only submit valuable information for the books, but also referred us to more sources of information. We wish to express our heartfelt thanks to them. We also thank all the authors of the articles too.

(2)

Most of the images included in "Architectural Renderings" were done on computer. Another publication of ours, "Computer Renderings," which was published at the end of 1996, is also a self-explanatory collection. Now, "Virtual Space" has pushed the entity of computer renderings to an extreme in justifying computer renderings as having an equal status professionally with traditional 2D media and photographs by describing them in building project terms and not just pictorially.

Some people believed that the penetration of computers into the architectural genre is a post-modern phenomenon. Theorists like Charles Jencks suggested that the computer could aid replacement of the stereotypical uniformity of modernism by multiplying difference. Indeed, the term "post-modernism" originated from architecture as a protest against Le Corbusier's non-decorative modernism.

Computers do have close relationship with the post-modern world. Advanced technology inside computers has lent itself to "reproduction" (as the reproduction concept widely discussed in post-modern cultural theory.) We can now easily duplicate files, just as architects duplicate their visuals for presentations or brochures. And to submit projects for "Virtual Space" it's a simple matter of pressing a key or clicking the mouse. Soon we found out that the original material no longer exists, because we cannot distinguish whether the presentation illustrations given to the developer, or in the page of the brochure, or as the image appearing in "Virtual Space" is the original or not. Even the architects themselves might have a collection of 5 or 6 duplicates of the same file. Therefore the original has lost its importance, and everything is a copy of the original: a "simulacrum."

"Simulacrum is not a stimulation from a realm, neither is it a stimulation of a referential being, nor a stimulation of a origin. It does not need a prototype or a real object, because it uses model itself to create reality: a hyperreal." (Baudrillard, 1983a: 2)

Long ago, photographs challenged the traditional 'realism' paintings; today, computer visualisation contests photographs. Computer visualisation is not real, but it is more real than real, because it becomes the object to be "simulated" by the masses. Even reality needs to be based on this hyperreal as its model, which is no exaggeration, as Edward Ng stated in his article, "clients will later apply their comparison skills to see the differences between what has been presented and what is actually built. And as little as a 1% difference will be a cause of alarm - especially when the real thing is not as good as what has been presented." Therefore, he asks for more accurate lighting simulations in renderings. On this level, objects simulated have become the judges of reality.

Maybe there is an excess of artificiality. We are no longer content with imagining a whole building from a section or an elevation, and water-colours appear to be too weak and soft whilst pencil drawings too conceptual. What we seem to be demanding is for renderings that can provide exact proportions, exact appearances and exact colours, that let us enter and have a walk around, please, if possible.

If a rendering is a simulacrum, then "Virtual Space" is a simulacrum of simulacra. Almost every book by our forefathers were derived from an original manuscript, but computerisation has handed "Virtual Space" with no souvenir draft: images and text are all duplicates of duplications. The notion of simulacrum introduced by Baudrillard meant to be a critique, which requires further investigation outside the scope of "Virtual Space." However, we believed that using this principle of simulacrum is useful in describing the social phenomenon of the computer age, and of computer renderings. At least we can regard a computer rendering as having its own individual life, being a simulacrum, so therefore never look down upon one!

(3)

So do computers only render for architecture? Definitely not. Researchers are already conducting studies in the hope that one day, computers can construct a completed building from scratch. Ko King Cheung and Guy Fung are amongst those in the quest.

"We hope that one day, architects will no longer need to consider problems like fire-proofing, but could pay full attention to aesthetic and space planning. All building regulations and ordinances are inputted and considered by the computer's neural network. The computer will determine the exterior and interior of the building: all it needs are the total area of the site, the usage of each space etc., and the neural network will then calculate a suitable template. Then comes the aesthetic and spatial conformity process. This object-oriented building includes a basement, podium, typical floors etc.. Computers will have intelligence, and be able to generate floorplans. All that is required is to input parameters, then all the plans and 3D graphics can be automatically created. This is the result of an integration between architecture, building structure and services. After the conformity phase, the building process reaches the stage of construction - using robots."

There are difficulties, of course. The system must have a well-defined but flexible computer data structure. Most of the current computer models can only represent one aspect of a design. But in order to achieve the desired conformity, a design that is truly "integrated" must have a model that is multi-functional for handling different aspects but at the same time can still represent one integral design. Visualisation is today mostly created by surface modelling - a surface is only a surface. For analytic purposes, solid modelling must be used which, due to its present infancy, is more time-consuming and probably more expensive. Software based on an object-orientated engineering approach are already being developed by one or two companies.

According to Ko King Cheung and Guy Fung, the merits of integration is that it can speed up the process from creation of initial design ideas to completion of actual buildings. In future, the whole building should be easily erected from the screen. Moreover, any subsequent, quick alterations of design should be more feasible because they should not affect the construction process, and in addition, exact alteration fees can be calculated.

From computer renderings to full computer integrated design, there is still have a long way to go, but it is quite clear that we have already moved into an era of simulation. Soon all our everyday working environments, and our living space, will be determined by images from computers. Their permeation should not be ignored.

Amy Liu
1997.1.5

论文

Essays

香港建筑署谈虚拟方案

香港建筑署

Architectural Services Department, Hong Kong Government

Application of Virtual Projects/Visualisation at the Architectural Services Department, Hong Kong

虚拟方案的性质

每一个建筑项目都会经过不同的阶段才得以建成。在这过程中会有不同形式的讨论、交涉和研究。它需要有许多的表述，如口头和书面的描述，二维图纸或与实物成比例的模型。这些虚拟方案实际上是供有关各方了解和研究建议中的设计。

业主的要求同样也以各种方式表示，例如使用表或组织图表。它们由建筑师转换成以平面图或剖面图表达的某种形式的空间计划。为了使人更容易了解建议，研究模型也是常用的沟通媒体『1.1』。

各种表达形式未必会使创作过程复杂化；相反，它使参与者能探究问题的性质，评价各种可性能，和帮助他们作出明智的决定。

换言之，虚拟方案实际上是另一种表达形式。它在建筑项目的兴建中起重要作用。很经常地，虚拟方案暴露出建议的不足之处和提示对其它方案的探讨。

新的机会

建筑师运用最新技术能更方便地表达他们的概念和设计。以往他们不得不依赖二维平面图和剖面图或按比例的模型。现在，电脑可以建立数码模型，对各种情况，如直观效果、行人流动、大型设备的移动作研究。设计上的限制也可用三维图说明，并产生可供选择的方法供进一步讨论。优点是这些新的设计工具的最后产物易于为建筑师及其客户所理解。毫无疑问，各方面关心的问题都能在设计最终拍板前，得到更好的理解。

使用同样的工具来制定说明和施工文件是很重要的。保持数据的完整性也很重要，因为数据不须在工具与工具之间进行转换，以致丢失信息。这保证在前期的模型和透视制作中作出的努力能带到后期的文件制作阶段。

建立一个项目信息的三维数据库有突出的利益，除了再使用数字化的信息可节省时间外（例如从土地信息中心可得到数码地图；从产品制造厂可得到配件库存资料），电脑数码模型更成为以后更改和增加工作的基础，其它计划也可以此为本，甚至可作为一个设施管理的工具。

当我们要处理大量项目的情况下，电脑辅助设计可以在不同建筑形式的使用面积和辅助面积之间提供不同的系数以作比较，或在拟订将来的项目方案设计中作为功能空间的样板。

在项目的开发过程中要经历几个阶段，即开始阶段，设计和发展阶段及施工阶段。

The nature of virtual projects

A building project takes on many forms before it is realized on site. It exists in different configurations for discussions, negotiations and further studies. It appears in many presentations such as verbal and written descriptions, two-dimensional drawings or scale physical models. Virtual projects are, indeed, vehicles for the concerned parties to understand and to study the proposed design.

Client requirements, too, are expressed in various formats, e.g. schedules of accommodation or organisation charts. They are translated by architects into some form of spatial planning

1.1 中国江苏歌剧院竞赛项目参赛的比例模型。
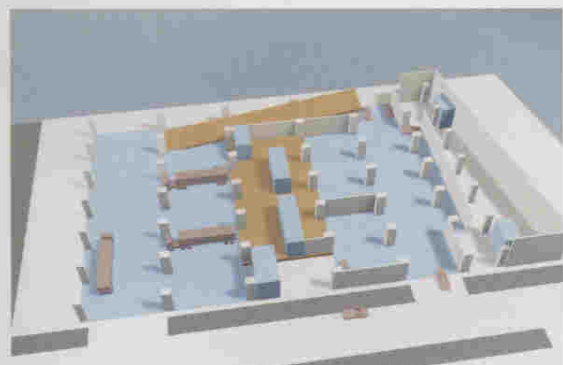**A scale model of the competition entry for the Jiangsu Opera House, China.**

1.2 香港政府物料供应处的港口前中央货库设施方案设计的外观图。
Exterior view of the schematic design of the harbour-fronted Centralised Godown facilities for GSD.
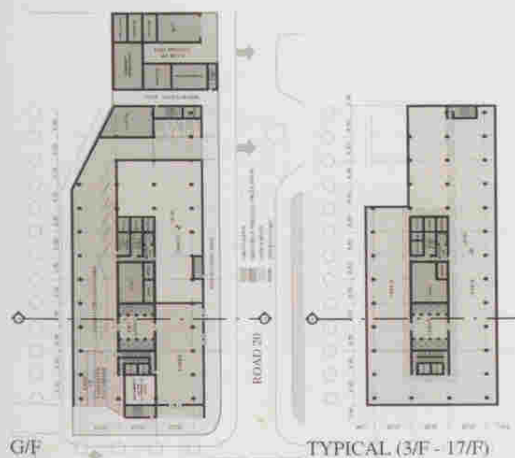
represented by plans and sections. In order to give a better grasp of the proposal, study models [1.1] are often commissioned.

The variety of expression does not necessarily complicate the creation process- on the contrary, it allows participants to inquire into the nature of the problem, to evaluate options and to help them make informed decisions.

In other words, a virtual project is really another form of expression. It plays an important part in the creation of building projects. On many occasions, a virtual project can highlight the shortcomings of a proposal and prompts the exploration of alternatives.

New Opportunities

With the aid of the latest technology, architects are able to communicate more freely their concepts and designs. Hitherto they have had to rely on two-dimensional plans and sections or perhaps scale models. Now a digital model can be constructed within a computer. Various scenarios, such as visual impact, pedestrian flow, movement of large equipment, can be studied. Design constraints can be illustrated three-dimensionally and options can be generated for further discussion. The advantage is that the end-products of these new design tools can easily be understood by the architect and his client. No doubt this promotes a better understanding of each others' concerns before a commitment is made to the final design.

1. 开始阶段

接到客户的要求后，必先了解用户的需要。然后，设计人员要进行初步的项目可行性研究，借此探讨空间的具体安排是否能满足功能要求。

在此过程中，要考虑现场的具体情况，如容积率、建筑物高度和车辆的进出，要总体安排出所有设施最好的摆放位置。这种工作显示并评价建议中的建筑物能在多大的程度上满足客户的期望。

就以政府物料供应处的中央货仓设施这一工程为例，把设施的空间要求转换为空间形式，就能作出一全面的评价〖1.2及1.3〗。在其它工程如沙田和九龙城的政府办公楼，利用电脑辅

1.3 柴湾香港政府物料供应处仓库大楼的功能分区简图。
Schematic functional zoning of the GSD Godown Building, Chai Wan.

G/F   TYPICAL (3/F - 17/F)

1.4 沙田政府办公大楼建议的平面图。
An illustration of the Shatin Government Offices proposal.

1.5 九龙城政府办公大楼建议的外观图。
Exterior view of the Kowloon City Government Offices proposal.

助研究,可以帮助决定哪一个项目可以进入下一阶段,即详图设计和发展阶段〖1.4 及 1.5〗。

食品及药物研究所的透视图表明在不同的场址限制下各种可供选择的设计方法〖1.6 及 1.7〗,例如现有的高度限制、最大基地容积率等。用电脑绘制的透视图可以方便地了解和比较各种功能要求。
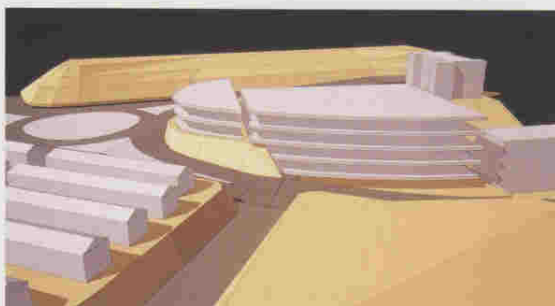
2. 设计和发展阶段
　　a) 增强了解
　　此阶段的主旨,是在进行下一步工程之前,令工程有关的各方能对该设计有更深认识。

利用不同表达方法(如图纸和动画)的好处,就是能鼓励参与者对最终产物、其性能和满足用户要求的程度提出问题。设计人员也会就施工造价、计划、外观及内部布置等方面向用户说明。如对原来的设计有任何改变,可以追加以适应期望的功能要求。

　　b) 表达思想和概念的工具
　　认定和采用最好的表达手段以便使人能全面了解建议是很重要的。适当媒体的选择取决于其正确传递信息的有效性。摹真的效果图与用电脑线图再加手工修正,两者之间并无优劣分别。
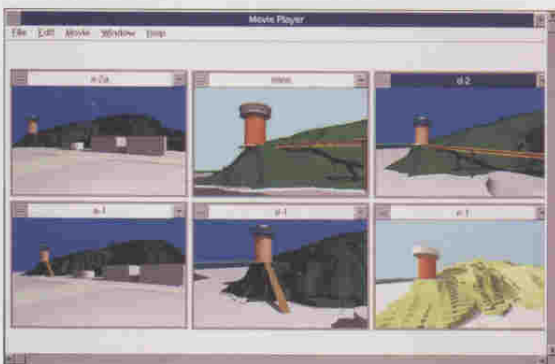
现在建筑师可以轻易

1.6 表示各种地块限制条件(有现存房屋高度限制)下设计的建议方案。

Illustrations showing proposals designed under different sets of site constraints, with the current building height restrictions.

1.7 表示各种地块限制条件(没有现存房屋高度限制)下设计的建议方案。

Illustrations showing proposals designed under different sets of site constraints, without the current building height restrictions.

1.8 使用 Quicktime VR 动画研究昂船洲讯号台的道路工程策略布置。

The use of Apple's Quicktime movie to explore the strategic arrangement of roadworks associated with the signal tower to Stonecutters' Island.

It is important to use the same tool for presentation as for producing construction documents. The maintenance of data integrity is important also as data does not have to be translated between applications resulting in the possible loss of information. This ensures the continued effort spent in presentation exercises will be carried forward to the documentation stage.

There are distinct advantages in constructing a three-dimensional database of project information. Not only does it save time by re-using digitized information, e.g. digital maps available from the Land Information Centre or library parts from product manufacturers, but the digital computer model becomes the basis for subsequent alteration and additional works and for other planning purposes such as a facilities management tool.

With the large number of projects handled by the department, it can be used to provide rule-of-thumb ratios between usable and supporting areas of different building types or as a template for functional spaces in developing the schematic design of future projects.

During the course of project development, it passes through several stages, namely, inception stage, design & development stage, and construction stage.

1. Inception stage

Upon receipt of the clients' requirements, an assessment of users' needs will be made. The design team proceeds to produce the Preliminary Project Feasibility Study. The study explores whether functional requirements can be met with a physical arrangement of spaces.

In the process, site specific conditions, such as plot ratio, building height and vehicular access, will be considered. It summarises the preferable strategic location of facilities. Such exercises expose and evaluate how well the proposed building will meet the expectations of the client's requirements.

In the case of the Centralised Godown facilities for the Government Supplies Department, the spatial requirements of the facilities were transformed into spatial form so as to make an overall assessment possible [1.2 & 1.3]. In other projects, such as for the government offices at Shatin and Kowloon City, the studies concluded which project was viable to proceed into the next stage, the detail & development stage [1.4 & 1.5].

Illustrations of the proposed Food & Drug Institute indicate various design options under different site constraints [1.6 & 1.7], e.g. existing height restriction, maximum site plot ratio etc.. By using computer-generated perspectives, functional requirements can be easily understood and compared.

2. Design and development stage

Three areas are considered of importance:
a) More understanding
The essence of this stage is to allow all parties concerned to get more understanding of the proposed design before committing additional resources to the development of the schematic design.

By use of different presentation materials, e.g. drawings, animation, participants are encouraged to raise questions about the end-product, its performance and effect on users' operational requirements. The design team explains to the client department the design, from the aspects of construction cost, programme, visual appearance, to the internal arrangement. Any late changes, if any, to the original brief can be added to suit anticipated functional needs.

1.9 根据同一设计制成不同颜色的方案以说明索罟湾码头天篷的"欢乐"精神。
Based on the same design, different colour schemes are produced to illustrate the 'festive' spirit for this canopy for the ferry berth at Sok Kwu Wan

地得到电脑辅助制作的透视图、动画及照片融入图。事实上,这种电脑媒体制作所需的时间与传统的表达媒体,如手绘透视图或实体模型相比,其实差不多。

我们对于 Quicktime VR 电影和 Real VR 在项目上的使用作了试验〖1.8〗。由于它们与传统的电脑动画相比有较短的引入时间和其"互动功能",用户可以更方便地控制场景。这些试验的确开创了一些用传统表达手法做不到的创作空间。

电脑辅助设计工具提供的灵活性在某些场合简化了用户意见的征询和采纳工作,例如提供不同颜色的方案供考虑〖1.9〗。

c) 验证设计
在沟通的过程中,重要的是要检查建议方案从审美观点到满足基本功能要求上都能完全符合用户的要求。

赤鱲角机场的辅助航空交通管制大楼和八号货柜码头的海上交通控制塔是本部门工作的实例。前者说明新塔与现有塔之间的具体关系〖1.10〗,而后者解除了客户对的观望台上可能有盲区的顾虑〖1.11〗。

对于更技术性的问题,最新的软件可以对建议方案的具体环境作有选择的模拟。在惩教署职员会所案例〖1.12〗中,用了一照明设计软件模拟半遮蔽的室外游泳池在向上的照明情况。这工作不仅核实了屋宇装备工程师所作的照明计算,也令客户和建筑师对建议的照明设计有更深入的评价。

在医院管理局大楼的设计阶段,材料的选择是利用照片融入加以说明的〖1.13〗。在为鼓形会议厅选择一室外壁饰过程中,电脑图象起了关键作用,因为它们补充了实体比例模型的不足,更全面地表达建议中的设计〖1.14〗。没有这些工具,就不大可能作出及时的决定。

随着设计的发展能要进行一次技术评议以找出在不同的建造服务系统和结构设计之间的任何矛盾。这种早期的磨合可避免现场修改。

3. 施工阶段
虽然电脑辅助建筑设计系统在施工阶段的需要性不很明显,但也不排除它的作用。例如,它可以将最新的立法要求结合进去。在特殊项目中,如香港会议展览中心扩建部分的大厅作主权移交仪式的会场准备时,座位及照相机布置的显像被用于协助整个议程的计划〖1.15〗。为了保持三维数据库的前后一致,信息必须定期按特别的改变作更新。

1.10 建议中的赤鱲角机场的辅助航空交通管制大楼全貌。背景为现有指挥塔。
General view of the proposed Backup Air Traffic Control Tower, Chek Lap Kok Airport, with the existing control tower at the back.

1.11 从到岸船上看建议中的八号货柜码头的海上交通控制塔。
View of the proposed Local Marine Control Tower at Container Terminal No. 8 from approaching vessel.

b) presentation aids of ideas & concept
It is important to identify and adopt the best means of communication so that the proposal will be fully understood. The choice of suitable media should be based on its effectiveness in getting the right message across. There is no preference for photorealistic renderings over computer-generated line drawings with manual modifications.

Computer-generated perspective drawing, animation and photographic montage are now within easy reach of our architects. The lead-in time for the preparation of this media is also comparable to that for traditional presentation media, such as hand-drawn perspective drawings or physical models.

1.12 懲教署職員會所的有遮蓋的半露天游泳池的向上照明效果。
Uplighting effect of a covered semi-external swimming pool, Staff Club for Correctional Services Department.

Tests have been carried out on the use of Quicktime VR movies and RealVR on projects [1.8]. Because of their relatively shorter lead-in time in comparsion with traditional computer animation and its 'interactiveness', users can manipulate the scenes more easily. These experiments did open up some opportunities not previously available by using conventional presentation aids.

The flexibility offered by computer-aided design tools, on some occasions, simplifies the incorporation of clients' feedback, such as providing different colour schemes for consideration [1.9].

c) Verification of design assumptions
During the communication process, it is essential to check if the proposal fully complies with the clients' brief in terms ranging from aesthetic appreciation to compliance with basic functional requirements.

The Backup Air Traffic Control Tower at Chek Lap Kok and the Local Marine Traffic Tower at Container Terminal 8 are examples of the department's work. The former illustrates the physical relationship between the new and existing towers [1.10] while the latter alleviated the clients' concern of possible blindspots at the tower's viewing platform [1.11].

For the more technically orientated, the latest software allow a selective simulation of the proposed physical environment. In this case of the CSD Staff Club [1.12], a lighting design software was used to simulate the uplighting condition of a semi-covered external swimming pool area. The exercise not only verified lighting calculations done by the building services engineer, it also allowed the clients and the

1.13 九龙医院管理局大楼大堂的电脑图象方案。
Computer-generated image of the proposed entrance lobby, Hospital Authority Building, Kowloon.

architect an in-depth appreciation of the proposed lighting design.

During the design stage of the Hospital Authority Building, the choice of materials was illustrated by photorealistic renderings [1.13]. In the selection of an external mural for the drum-shaped conference hall, computer-rendered images played a crucial role because they supplemented scale physical models to convey the proposed design more holistically [1.14]. It is unlikely that a timely decision would have been reached without these tools.

1.15 香港会议展览中心扩建部分大厅，主权移交仪式的舞台设计和照相机位置。
Stage design and camera positions of the Handover Ceremony, Grand Hall, Hong Kong Convention and Exhibition Centre Extension.

1.14 医院管理局大楼的电脑图象方案，并附已拍板的壁饰设计。
Computer-generated image of the proposed Hospital Authority Building with the approved mural design.