墨西哥城：
重组过程中的水景改造

MEXICO CITY:
A TRANSFORMED WATERSCAPE IN THE PROCESS OF RECONFIGURATION

洛蕾塔·卡斯特鲁·雷古拉–曼塞拉 哈佛大学设计研究生院城市设计硕士
Loreta Castro REGUERA-MANCERA Master of Architecture in Urban Design,
The Graduate School of Design, Harvard University

1. 墨西哥特斯科城地图（1523年）

1. Map of Cortez, Mexico, 1523

1 墨西哥盆地

几千年的一系列地质事件形成了墨西哥盆地，最近的一次地质事件导致了奇奇奥特辛山脉的出现，形成了该地的内流盆地的特征。墨西哥城的水治理专家豪尔赫·莱戈雷塔形容该盆地形如碗状，其汇集了来自周围山脉的雨水径流，且没有任何自然排水口，因此为季节性湖泊的形成提供了完美的条件。“大特诺奇提特兰城”（前哥伦布时期对墨西哥城的名称）就是建造于此，其正位于盆地内最大也是地势最低的水体——特斯科科湖的中心。

墨西哥城的设计基于一种叫作“水中田畦”的生态单元。这片人工的土地拥有肥沃的土壤和源源不断的湿气。由这些单元组成的系统提供了一种优秀的可持续范例，因为它最大限度地利用了其环境脉络的整体性，以及场地中的动植物。它的主要目的是实现合适的农业性地表：高于水平面一定高度以避免洪水，同时植物根部还是能汲取湿气中的水分，从而不受制于雨水多寡。

水中田畦和渠道系统决定了墨西哥城整个社会、经济和政治结构。通过建造水道和大坝，墨西卡人得以控制和战胜城市周围的季节性洪水。尽管洪水频繁出现，但城市已经具备了应对自然的弹性。此外，这一系统还为流动性、农业活动及防御工事提供了基础。其体现了对环境脉络的深入理解，对其特质的惊人操控，从而引导了文明的繁盛。特诺奇提特兰城是我们今天称之为“景观基础设施”的最佳代表之一。

2 无限扩张的城市

虽然水中田畦和渠道系统对于特诺奇提特兰来说具有重要意义，但是它们在当代墨西哥城却仅剩无几，现如今的城市在干旱景观上挣扎和扩展。城市形态在1525年成为殖民地之后发生了彻底的改变，成为了建立在石土系统之上的文艺复兴的翻版，对水的态度也变得敌对而没有再将她视为机遇。从17世纪开始，掀起了宏大的排干湖水系统运动，自那时起这个天然封闭的盆地几经穿孔抽水的折磨。

最极端的变化发生在20世纪。1900年，为了庆祝国家成立100周年，墨西哥开启了大运河计划。这一基础设施的建造是为了保证城市对洪水的绝对防范，通过一系列管道和露天渠道将污水、湖水和雨水等从盆地内引出。这一系统与起到相同作用的深度排水系统相结合。这一基础设施的确立导致很多干涸土地的出现，也促成了城市网络在这片贫瘠土地上的蔓延。伴随着这一趋势的还有人口的激增。在整个20世纪，城市居民增加了20倍，从20世纪20年代的100万居民增长到20世纪90年代的2 000万居民；另外水体从1 100km^{2}的湖水系统缩减至现在不到50km^2。

前文所述的情况致使城市建立在极其不稳定的湖床土地之上。墨西哥城大部分地区受到季节性洪水和土地下沉的影响。同时，城市缺乏淡水来源，不得不挖掘深井，从地下深达128m的地方抽取淡水。如今大都市完全依赖机械化的管道、管线和水泵，这样会消耗大量的能量和巨大的水量，从而导致城市地下含水层及附近流域的干涸。

城市中仍有一小部分还保留着水中田畦系统的遗迹。盆地的南部的霍奇米尔科、提拉霍克和米斯奇克等镇仍保留着基于水中田畦农业的经济模式。尽管在大城市里遍地重建这类系统是不可能也不现实的，但是这些

收稿时间 RECEIVED DATE: 2014-12-24
中图分类号 / TU986.2 文献标识码 / B

摘要

墨西哥城建立于1325年，古名“特诺奇提特兰”，它位于一个内流盆地湖泊系统的中心。其所在的地理位置对于城市的形态起着决定性作用：这里由疏浚过的渠道和“水中田畦”——即人工地块，这种田畦系统对于城市的居住和功能等各个方面有着决定性的作用——组成。作为一个大都市，其充满矛盾的历史发展，深刻影响了它的景观和城市形态。如今，城市发展已经完全不再倚仗水景，而是被改造成由土和石构成的系统，而伴随这一突变而来的却是严峻的后果。由于建造在一个动荡的湖床上并持续受到洪水的影响，这个有着2 200万人口的大都市已经使得自身淡水资源逐渐枯竭，还面临着土地下沉等相关问题。所幸的是，上文所提及的渠道系统并没有完全丧失。在盆地的南侧，那片曾被称为“索奇米尔科”（那瓦特语，意为“播种鲜花的土地”）和提拉霍克（那瓦特语，意为“水之地”）的古镇，还依旧保留着一种通过理解原始景观所蕴藏的益处而生活的方式，他们在经济上、社会上都依赖于水中田畦系统。尽管在盆地各地恢复这一类型的城市肌理的想法不太实际，但它提供了一种与水完全融和的城市设计范式。除此之外，世界上其他城市在处理水景方面也有着成功经验，这使得我们意识到，水可以成为城市的资产而非威胁。这种情况对设计相关的专业人士而言既意味着机遇，也意味着责任，因为提供能够保证城市未来生存力的解决方案是他们所应关注的范畴。本文探讨了墨西哥城在干旱的景观条件下，如何以水为基础并依水而设计。

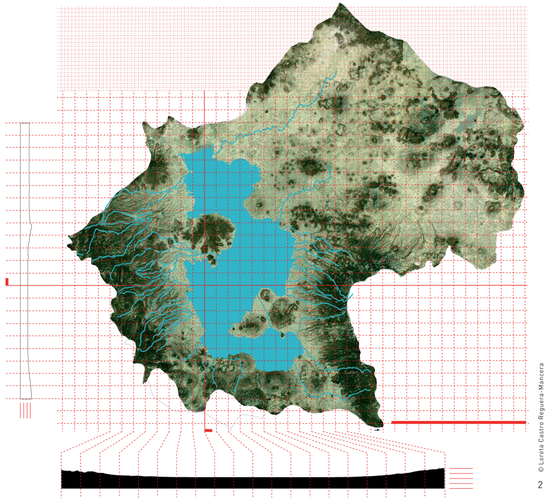
关键词
渠道；水中田畦；水；洪水；弹性

ABSTRACT

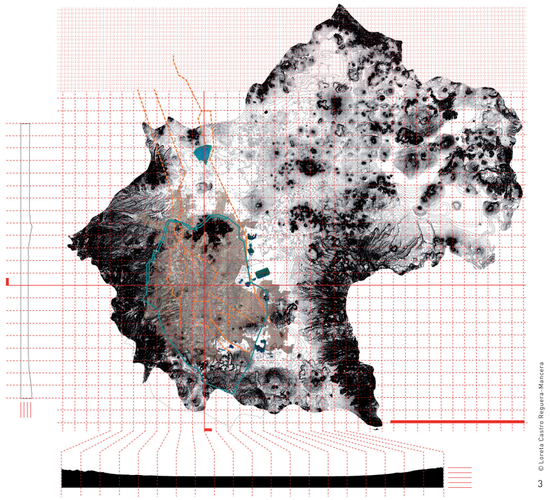
Mexico City was founded in 1325, under the name of Tenochtitlan, in the center of the lake system of an endorheic basin. Its geographical position was fundamental in the conception of its form: a settlement of dredged channels and constructed pieces of land, called chinampas, which determined every aspect of habitability and use. The history of this metropolis has been a conflicting one, profoundly affecting its landscape and urban form. Today, far from having a waterscape, the development of the city has transformed its context into an earth and stone setting with severe effects resulting from this mutation. The 22 million-megalopolis, built upon the unstable ground of a lakebed, continuously floods, has depleted its freshwater sources, and suffers from profound ground subsidence related problems. However, not all traces of the above mentioned city of channels are lost. The southern part of the basin, the former towns of Xochimilco and Tlahuac, still have a lifestyle that relies on the understanding of the benefits that the original landscape provided, economically and socially dependent on the system of chinampas. Despite the fact that it is impossible to recover this type of urban fabric around the basin, these burrows set a paradigm of an urban design fully blended with water. Beyond these examples, several other cities around the world have managed to successfully deal with their waterscapes, making of water an asset instead of a menace. This condition raises an opportunity and an obligation for the design related professionals as it is in their sphere to provide solutions that guarantee the city's future viability. This article tells the story of an ongoing effort to design for and with water in the apparently dry landscape of Mexico City.

KEY WORDS
Channel; Chinampa; Water; Flood; Resilience

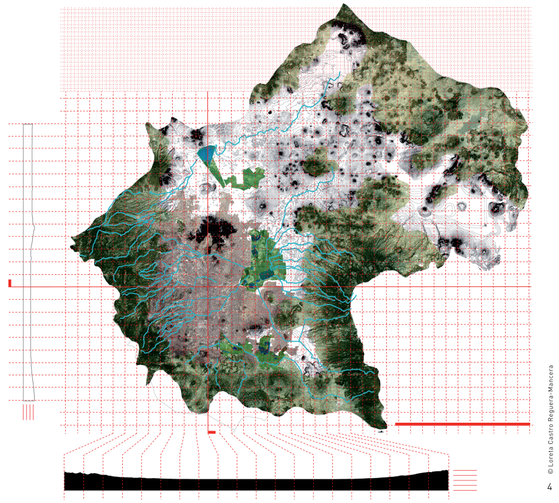
译 张萃 郑燕霖 陆小璇
TRANSLATED BY Cui ZHANG Yelin CHENG Xiaoxuan LU



2



3



4

2–4. 原始盆地、盆地现状，以及未来实施另一种可持续的水利系统之后的预测情形。

2–4. Original basin, current basin situation, foreseeable future when an alternate, sustainable, hydraulic system is implemented. © Loreta Castro-Reguera-Mancera

① 与该主题相关的几个项目得以展开。更多相关信息可访问www.tallerhidrico.com。

系统的存在可以帮助我们理解土地如何成为一个既防洪也供水的弹性基础设施。在这类地区，土地就好像是海绵，正如中国学者俞孔坚博士所理解的那样：当水多的时候，它可以蓄水；当缺水时，能将水释放出来。

3 从全球到地方

墨西哥城所面临的水管理情况亟待可替代的可持续性盆地资源管理方案。出于此，哈佛大学设计研究院于2010年授予的德鲁克旅行奖学金资助了一个为期三年的研究项目，用以搜寻世界各地的案例，发掘其中能够为墨西哥城的情况提供借鉴的适宜的解决方案。这个研究项目包含对世界上几个通过城市设计方法解决了水管理问题的城市的参观考察。在这些案例中，设计将水定位为城市的基础元素。中国的苏州、印度的海得拉巴和巴西的阿雷格里港是与墨西哥城情况最为相关的几个案例。

苏州和同里之间的古运河如今仍旧在发挥功用，它启发人们发掘街道在雨水过剩时充当节储蓄水的角色，并将街道作为公共空间，从而使人和水之间建立一种密切的关系。海得拉巴的水公园则是古代储水池的一种复兴，为公众提供急需的干净的饮用水和娱乐空间。在地球的另一端，巴西的阿雷格里港通过对处理雨水径流的管理，及对私人土地的控制，实现了对雨水过剩导致的洪水的防御。

前文所提及的这几个案例很快使我们联想到了墨西哥盆地的情况，并激发了类似的解决方案。在2011年，由墨西哥国立自治大学建筑学院发表的《城市水车间》论文便讨论了将国际上的范例应用到本地问题的解决上。①

洪水对城市所造成的最严重的问题是对大面积城市区域的破坏，且主要是那些缺乏公共空间的低收入社区。在这些地方，街道成了最好的开放空间，一种前哥伦布时期河道的替代物，也是抵御洪水的良策。如上所述，水道系统可疏导过剩水量，缓解径流及暴雨的影响，但同时又不会阻断城市内的流动性和交流。

一些非常有意思的水管理策略最近被提出，它们试图挽救河道作为洪水预防机制的核心重要性。这也是最近一个名为“作为水利、城市及社会复兴的街道”的竞赛中8个获奖方案中其中一个方案所持的观点。这个获奖方案认识到街道作为公共空间的重要性，但同时也认识到其作为水处理机制的重要性。该项目将街道打造为雨水汇集设施，并根据地下地质条件的不同创造出向地下渗透的可能性。同时还设计了水花园、蓄水池和沟渠。

上述提到的项目对于墨西哥城现在的情况有着极其重要的参照性。除了推动（通常都被浪费了的）雨水的收集和利用，也帮助降低径流流速、削弱洪水灾害、促进下渗，还能产生人们渴望的公共空间，激发非机动的交通方式及市民之中的水文化。街道真正成为了解决墨西哥盆地本质问题的优秀范式。

4 结论

在墨西哥城中周期性的洪水和水资源短缺现象，正是城市对水资源管理不当的表现。这显示了对城市环境脉络理解的缺乏，同时也忽略了景观在缓解这些破坏力的可能性。这是一个不容小觑的问题，一旦水泵管道系统崩溃，这座有着2 200万人口的大都市将处于洪水的威胁当中。

由此可见，建设一个与城市现有的机械系统相协调而又可持续的新式水利系统已是当务之急。墨西哥盆地和世界上其他城市，这些从古至今的例子展示出了多种解决途径。尽管现在城市的水景让人难觅踪影，但它依然是构筑着城市网络的基础。

前文所描述的项目需要在短期内进行实施。这些项目不仅可以保证在墨西哥盆地内对水资源更好地应用，还会促进以水为基础的城市设计。这还将使城市居民与水资源间建立起更好的联系，同时形成城市和水体之间的共生关系。**LAF**

© Google Earth

5

1 The Basin of Mexico

The Basin of Mexico was formed thousands of years ago as the result of a series of geological incidents. The latest one, the appearance of the mountain chain Chichinautzin, is what gave it its endorheic character. Jorge Legorreta, an expert on water management in Mexico City, described the basin's form as that of a bowl, receiving water runoffs from the surrounding mountains without any natural exit, therefore becoming the perfect scenario for a system of seasonal lakes. La Gran Tenochtitlan (the pre-Columbian Mexico City), was built in this setting, precisely in the center of lake Texcoco, the largest and lowest water body of the basin.

The city's design was based on an ecological unit called chinampa. This artificial piece of land combined fertile grounds with the constant availability of humidity. The system generated by these units was an excellent example of sustainability because it took advantage of the totality of the context, including the existing flora and fauna. Its main purpose was to achieve the appropriate agricultural surface: sufficiently elevated from the water level as not to flood meanwhile roots still profited from humidity, becoming independent of rainwater.

The chinampa and channel system determined an entire social, economical, and political structure. Through built waterways and dams the mexicas had an arrangement of elements able to control and pulverize periodic floods around the city. Even though these events continuously happened, the city was resilient to them. Moreover, the same system structured mobility, agriculture practices, and defense strategies. It represented a complete understanding of the context, an impressive manipulation of its qualities, providing an opportunity for a civilization to flourish. Tenochtitlan was one of the best examples of what we call today Landscape Infrastructure.

5. 水中田畦航拍图
6. “作为水利、城市及社会复兴的街道”项目

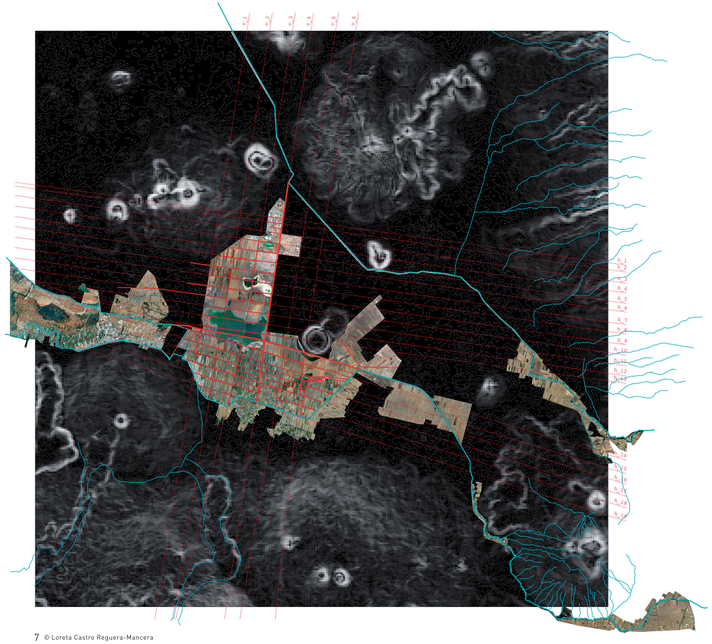
5. Aerial photograph of Chinampa
6. Image of the project “The Street as the Model for Hydraulic, Urban, and Social Recovery"

2 The Infinite City

Despite the importance of the chinampa and channel system for Tenochtitlan, the contemporary Mexico City has few remains of these structures, having found a way to survive and expand in what is more of a dry landscape. The city's form was completely transformed after the 1525 colonization, becoming a renaissance prototype, defined by an earth and stone grid, understanding its relationship with water more as a menace than as an opportunity. Beginning on the 1600's, an impressive effort to desiccate the lake system began. The naturally

© Yazmin Alarcon, Pamela Tejeda, Jose Eduardo Cabrera, Yvonne Labiaga, Jose Jimenez

6



7 © Loreta Castro Reguera-Mancera

closed basin has since suffered several perforations with the objective of draining water out.

The most drastic change happened during the 20 century. Celebrating 100 years of independence, in 1900 the Gran Canal (Great Channel) was inaugurated. This infrastructure was built to definitely safeguard the city from floods, taking sewage water, lake water and rainwater out of the basin through a series of pipes and open-air channels. This system evolved into the Deep Drainage System, serving the same purposes. A lot of dry land appeared as a result of the implementation of these infrastructures, bringing up the possibility of expanding the urban grid on this arid surface. As this happened, a population boom took place. During the entire XX century, the city augmented its dwellers by twenty times. From a 1 million-inhabitant city in the 1920's it became a 20 million-inhabitant megalopolis by 1990's. From having a 1,100-km^2 lake-system, it currently holds less than 50 km^2 of water bodies.

The before mentioned conditions derived into the construction of a city on the lakebed's unstable ground. A large area of Mexico City suffers from periodical floods and ground subsidence. Also, the city lacks freshwater sources, having to dig deep wells and import and pump its fresh water from places as far as 128 m. The present day megalopolis completely depends on mechanical systems of tubes, pipes, and pumps, consuming large quantities of energy and enormous volumes of water that have depleted its aquifer and those of nearby basins.

There is still a small portion of the city that holds the remains of the former chinampa system. The southern part of the basin, the towns of Xochimilco, Tlahuac, and Mixquic, have an economy based on chinampa agriculture. Despite the impossibility and unviability of reconstructing this system around the metropolis, the existence of these units helps to understand how the ground can become a resilient infrastructure for flood prevention and water provision. In these areas the ground works as a sponge in the same sense in which Dr. Kongjian Yu, understands it: It helps retaining water when there is excess and to release it when it is scarce.

3 From Global to Local

The water management situation to which Mexico City is subject desperately calls for solutions that could help create an alternate and sustainable option to manage the resource within the basin. In this sense, a three-year research project, result of the 2010 Druker Travel Fellowship given by the Harvard Graduate School of Design, focused on finding examples around the world that could be adjusted to inform solutions appropriate for Mexico City's conditions. The research project included a visit to several cities around the world that have solved water management through urban design. Moreover, through a design that considers water as a fundamental element for the city's existence. Suzhou in China, Hyderabad in India, and Porto Alegre in Brazil were the most relevant cases informing Mexico City's situation.

The millennial channels of Suzhou and Tongli, still working today, offer a possibility for understanding the street as an element able to hold excess water during the rainy season while providing a type of public space that generates a close relationship with the element. Water Parks in Hyderabad meant the recovery of ancient cisterns in an effort to provide both clean water and recreational space for a population in an urgent need of both. In another sphere, Porto Alegre has solved for excess rainwater causing floods, through the creation of a regulation that deals with rainwater runoffs and their control through privately owned land.

The review of the before mentioned cases immediately pushes the imagination for similar applications in the Basin of Mexico. Since 2011 the Taller Hídrico Urbano, a thesis seminar created in the School of Architecture of the National Autonomous University of Mexico, has focused on applying this international examples to local problems. ①

The most relevant problem that floods produce in the city is the alteration of large urban areas, mainly in low-income neighborhoods where the lack of public spaces is an issue. In these places, the street becomes the open space par excellence, a substitute of the pre-Columbian canal, which was an important flood resilience strategy. As stated before, this network of waterways pulverized the excess of water, product of runoffs and storms, without the interruption of mobility and communication in the city.

Some very interesting water management solutions have been presented lately with the intention of rescuing the essence of the canal as a flood resilience strategy. Such is the case of one of the eight wining projects of the recent competition Acupunturas Hidrourbanas Iztapalapa under the title "The Street as the Model for Hydraulic, Urban, and Social Recovery". This proposal understands the importance of the street as a public space, but also as the element able to deal with water issues. The project uses it as a rainwater catchment facility with the possibility of underground infiltration, depending on the geological conditions of the site. It also implements the use of water gardens, reservoirs and ditches.

Projects like the before described become of extreme relevance regarding Mexico City's current situation. Besides promoting the use of rainwater (which is normally wasted), they help slowing the pace of runoffs, diminish the impact of floods, promote infiltration, generate public spaces where they are most needed, and foster non motorized mobility and water culture among citizens. The street truly becomes the model solution that solves intrinsic problems to the Basin of Mexico.

4 Conclusion

Periodical floods and water scarcity, conditions prevailing in Mexico City, are a signal of urban water mismanagement. There is a lack of understanding of the city's context, ignoring the possibilities that the landscape provides in order to soften the effects of these events. This is no small problem, actually this 22 million megalopolis is under the threat of flooding if the system of pumps and tubes should fail.

There is an urgent need for implementing a sustainable and alternate hydraulic system for the city that should work in coordination with the current mechanical one. Historic and contemporary examples within the Basin of Mexico and from other cities around the world show these types of solutions. The waterscape of the city, although currently invisible, still underlies the urban grid.

The before described projects need to be applied in the short term. They will not only guarantee a better use of water within the basin, but will also promote a water based urban design. This allows for the population to establish a better relationship with the resource, permitting a symbiotic connection between city and water. **LAF**

7. 位于盆地南部的原有的渠道和泽尔高湖现有水域。

7. Image of the southern part of the basin showing traces of the former channels and the remains of lake Chalco.

① Several projects have been developed in this sense and can be known through the web page www.tallerhidrico.com.

REFERENCES

[1] Aguilar, A. (2000). LocalizaciónGeográfica de la Cuenca de México. En La Ciudad de México en el fin del Segundo Milenio. Gustavo Garza. El Colegio de México, Centro de Estudios Demográficos y de Desarrollo Urbano. México: Gobierno del Distrito Federal.

[2] Gonzalez Pozo, A., et al. (2010). Las Chinampas de Xochimilco al despuntar el siglo XXI: inicio de sucatalogación. México: Universidad AutónomaMetropolitana.

[3] Legorreta, J. (2006). El Agua y La Ciudad de México. De Tenochtitlán a la megalópolis del siglo XXI. México: Universidad AutónomaMetropolitana-Azcapotzalco.