



Masonry Material and Structure 砌体材料与结构

凤凰空间·华南编辑部 编

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Masonry Material
and Structure

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凤凰空间·华南编辑部 编

Preface

In a famous quote, the architect Louis Kahn rhetorically posed the question to a brick "what it wanted to be?" – and let the brick answer "I like an Arch". However, I believe that one of the reasons brick is such an ingenious and enduring concept is that it doesn't insist on wanting to be just one thing. Brick is a patient, unobtrusive and sometimes even quiet material, which lends itself to a variety of uses and tends to outlast the various periodic styles that it becomes incorporated in. It has a basic dignity, which is no surprise since it has existed for several millennia, which can only be said for a few of the thousands of materials that form part of any standard construction today.

First and foremost, brick is a module, a way of thinking rather than a preconceived way of building – and as such it opens up a whole plethora of possible options rather than limiting choices from the outset. As the projects in this book demonstrate, the rectangular nature of the brick in no way prevents other shapes and curves from being realized in brickwork, and the geometric patterning variations are endless.

Brick buildings can appear massive, like monolithic carved volumes. Or they can appear light, airy and translucent – just like the material itself can form a sculpted block, or a porous air brick, or even more complex shapes. Although bricks come in a variety of dimensions depending on local traditions and individual design, the basic scale of masonry however is something that any architect in the world will have an instinctive feeling for.

In our own work, we have always explored the possibilities of masonry as an integral part of the Scandinavian modernism with its expression of simplicity, restrained choice of materials, and textural richness. But brick architecture is not just a matter of expression, although the use of exposed brick façades remains a favourite worldwide, because of its durability, low maintenance and immediate association to quality.

The use of brick can lend more than appearance to a building, since it can also become part of a sustainability strategy that any project should by necessity address: Starting from the possible local procurement (using available means and resources), to the simple transportation and on-site handling, and on to the ease of adaptations and changes that must be expected in the building lifetime, the tiny module of the brick is perfectly suited even when used on a grand scale. Even when used invisibly inside a structure, brick can still contribute to a good indoor climate by regulating temperature and humidity in buildings, by providing thermal mass, by controlling acoustics – an all-round healthy material in many combinations.

Looking at the role of brick in contemporary architecture reveals a very broad spectrum of uses and applications, ranging from the most basic, sometimes even nostalgic, to experiments in technology exploring the brick module with logic similar to the pixels of a screen. At one end of the spectrum, reclaimed brick and the inevitable uncovered brick partition walls of the archetypical loft-type space are celebrating modest constructions that where never really meant to be highlighted in the first place – at the other end of the spectrum, bricks become integrated components in highly engineered mathematical high-tech cladding systems, something which arguably has nothing to do with actual masonry, yet can lead to interesting hybrids in its own right if done cleverly.

In these ways, a continuous process of re-invention and recycling is keeping masonry and brickwork at the forefront of the construction development, and we find great joy in that – and in contributing to demonstrate the genius of such a deviously simple building block.

Julian Weyer
Partner, architect
C.F. Møller Architects

序言

20 世纪最杰出的建筑师之一、同时也是用砖大师的路易·康在强调建筑材料对建筑师灵感的重要性时，经常提到以下的一段寓言式的对话。

他问砖：“你要做什么，砖？”

砖说：“我要做一个拱。”

他对砖说：“瞧，我也想要做一个，但拱要花很多钱，要不做个混凝土过梁，你看怎样？”

砖说：“我要做一个拱。”

然而，我认为砖之所以在路易·康的眼中是一个如此机智而执着的化身的原因之一，就是它不会把自身局限于某种特性之中。如果用人的性格来打比方的话，那么砖的“性格”就是如此富于耐性，不事张扬，有时甚至让人觉得它非常沉静。它用途广泛，能适应不同时期风格的建筑，却拥有比任何一个时期的建筑都要长久的生命力。毋庸置疑，砖在建筑材料领域中备受尊崇，因为在应用于当今任何一座标准建筑的数千种材料当中，砖是为数不多的几种拥有几千年悠久的历史材料之一。

首先，砖是模块，是一种思考的方式，而并非一种预设好的建筑方式——就其本身而言，它展示出众多可能的选择，而并非在建造的开始就局限于有限的几种选择之中。正如本书的项目所呈现出来的一样，长方形的砖块能砌成不同的弧度与造型的建筑并天衣无缝地融入其结构当中，丝毫不显得突兀。除此之外，砖还能砌成变化无穷的几何图案。

砖建筑或呈现为精雕细刻、整齐划一的大型建筑群，或呈现为轻盈、宽敞、通透的小型建筑——这一点就像砖材本身也分成雕刻砖、多孔空心砖，或其他形状更为复杂的砖一样，其形式丰富多彩。尽管根据不同建筑所在地的传统及其具体的设计，建筑师会采用各种不同规格的砖，但世界上任何一个建筑师对砖的基本规格却都保持着一种本能的直觉。

在我们的建筑作品中，我们一直在探索砖砌体作为斯堪的纳维亚现代主义建筑的一部分所能发挥的各种作用，以及砖砌体如何体现斯堪的纳维亚现代主义建筑表现形式的简洁性、选材的限制性与肌理的丰富性。尽管清水砖立面因其耐久性、低维护性以及与建筑品质密切相关的特性而备受全世界建筑师的欢迎，但砖建筑不仅限于建筑表达的范畴，还涉及其他方方面面。

砖材的使用方式不仅能影响到建筑的外观，还能影响到建筑的其他方面，这都是因为砖材的使用方式是任何建筑项目都必须强调的可持续发展策略的一部分：从建造之始在建筑所在地购买材料（例如采用简易的方式和利用现成的资源），到运输和现场施工，再到建筑在其全寿命周期内必须面临的各种修葺、改建、扩建工程，小型砖块均能满足以上可持续发展策略的需求，即使在大型砖建筑中，小型砖块也能做到这一点。即使建筑结构中的砖是不可见的，但砖仍然能与各种环保材料的不同组合方式，起到保持室内恒温恒湿、蓄热与隔声的作用，从而有助于营造出舒适的室内微气候。

如果审视砖在当代建筑中所承担的角色，我们就能发现砖的用途极为广泛，这些用途可组成一个连续的谱系，从最基础、甚至是最怀旧的建筑，到对建筑的像素表皮上砖块的砌筑方式进行的技术层面上的探索实验，应有尽有。在谱系的一端，回收砖和露头砖砌成的典型的阁楼式住宅中的隔断墙体现出建筑的含蓄低调之美，而这种美起初并未受到真正的重视；而在谱系的另一端，砖成为数字化高科技立面系统不可分割的一部分，这种系统可以说与实际中具体的砖块无关，但如经巧妙的设计，砖砌体可凭借其自身的特性，在该系统的整合下营造出趣味盎然的视觉效果。

由于以上种种事实的存在，回收再生的持续过程使砖砌体结构一直在建筑发展中保持着领先地位，我们从中发现了无限乐趣——而且，我们也在为展现简单的砖砌体建筑的精妙之处的过程中体验到无限乐趣。

朱利安·威尔
C.F. Møller 建筑公司

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Brick

Brick has been used for a long time and covers a wide range of buildings, from classical architecture to modern architecture. Though it is impossible for traditional masonry structure to be used as main structure in modern sophistications, masonry structure still functions as load bearing structure and facing masonry in a way. The design of masonry structure has a significant impact on the overall construction and function of a building. Masonry material determines thermal insulation and sound insulation to a large extent.

Brick masonry is a composite material consisting of two fundamental elements: brick and mortar. Common bricks include clay brick, shale brick, cinder brick and gangue brick. Brick masonry is used primarily for constructing walls, such as load bearing wall, shear wall, building enclosure and infilling wall. On one hand, the choice of brick and mortar, brick patterns and brick bonds are closely related to durability, seismic design and strength of a building; on the other hand, the shape, size, texture, interplay of bricks and craft rules of constructing a masonry building have a direct influence on the visual effect of façade and the overall shape of a building.

砖砌体

砖砌体在建筑领域中拥有悠久的历史,从古典建筑到现代建筑都能看到它的踪影,其使用范围十分广泛。尽管现代高层建筑中已不可能采用传统砌体结构作为其主要结构,但在许多建筑中,砌体结构依然承担着某种意义上的承重作用与装饰作用。砌体结构的设计会对建筑的整体结构与功能产生重大影响,而砌体材料则很大程度上决定了建筑的保温、隔热、降噪等环保性能。

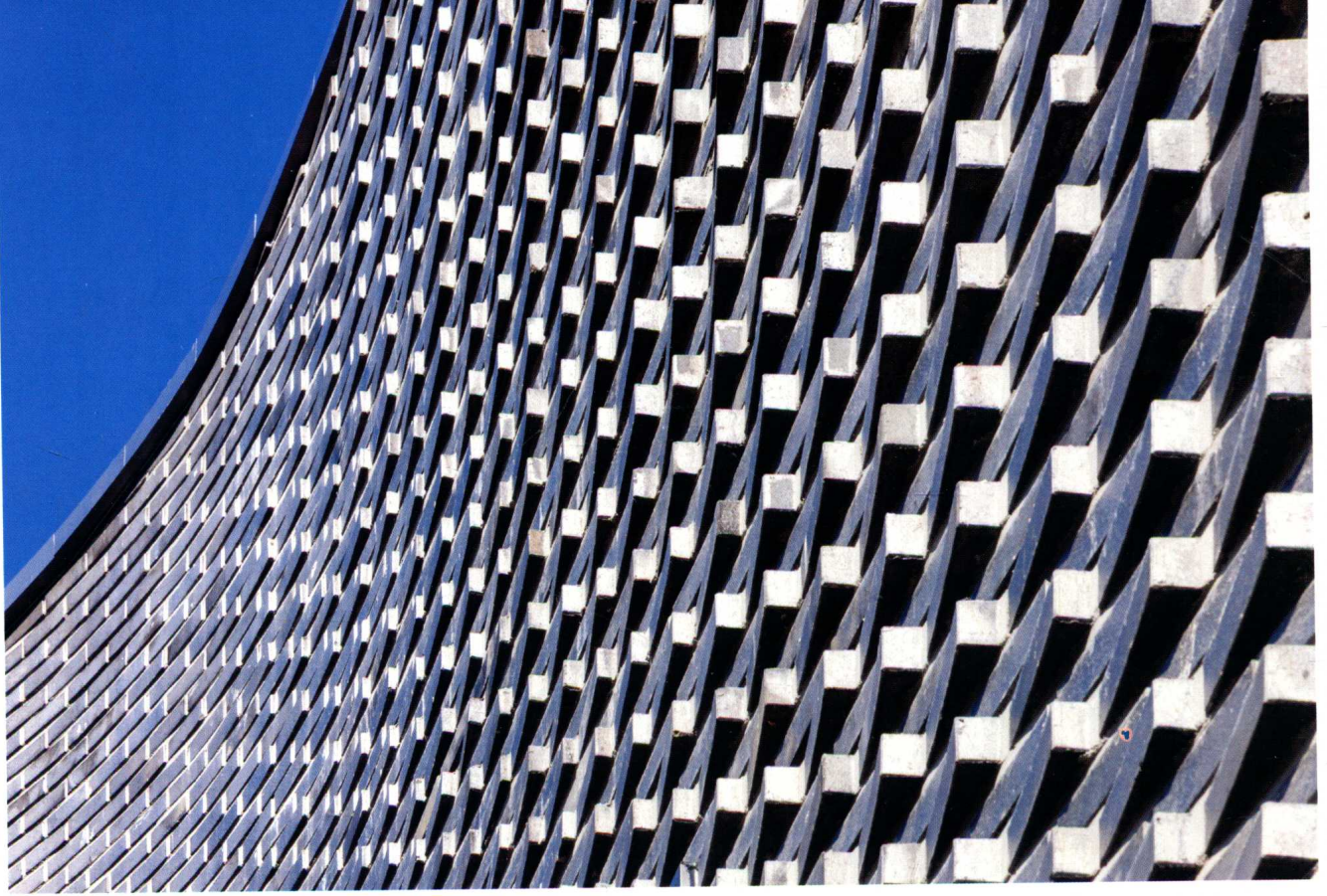
砖砌体是一种复合材料,包括两个基本组成部分:砖和砂浆。常见的砌筑用砖包括黏土砖、页岩砖、煤渣砖和煤矸石砖等。砖砌体主要用于建造墙体,如承重墙、剪力墙、围护墙体和填充墙体。因此,一方面,砖材与砂浆的选择以及砖的砌筑方式能直接影响建筑的耐久性、抗震性与强度;另一方面,砖的形状、尺寸、纹理,砖块的相互作用以及建造砌体建筑的工艺标准则能影响立面的视觉效果与建筑的整体造型。

Creative Bond

In modern architecture, it is hard to define or categorize special brick bonds in terms of traditional bonds. These flexible brick bonds highlight construction and texture of buildings and display designers' inspiration and creativity. The precision of brick layering and construction efficiency has been enhanced through the new technical approaches of digital construction modeling and robotic fabrication.

创意砌筑

在现代建筑中，不少特殊的砌筑方式均难以从传统砌筑的角度进行界定和分类。这些砌筑方式灵活多样，使建筑的结构与肌理强烈地凸显出来，并充分体现出设计师的灵感与创意。设计师通过采用数字化建模与机器砌筑等新型技术手段，极大地提升了砌筑的精准度与施工效率。

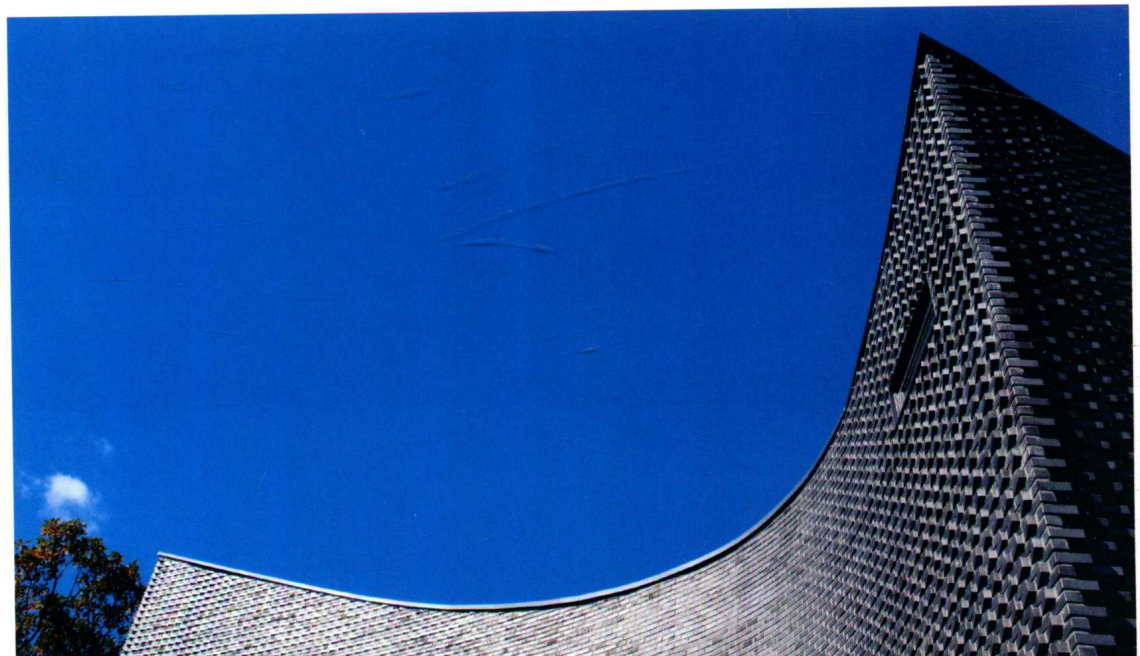


The Curving House

弧形屋

It was a rare residential lot with an open view to the south at the dead end of a small path beneath Mt. Gwanggyo. What was unique about this lot was that it was very hard to turn the car to come out of the path after more than 2 cars parked, because it was a small path only 4 m in width. Ironically, the fundamental challenge was not only solving the parking problem but also creating a space for both parking and gardening to coexist. It was closely related to the lifestyle of home owner to decide whether to create a garden directly accessible from the living room or to emphasize a visual garden. To resolve this issue, the overall shape was formed to encase the lot with more curves and lifted about 2 m from the ground using pilotis for more efficient parking. The shape of the mass resembling a concave lens was created by the parking needs and the topographical condition of the lot.

The mountains penetrate the sky and the sky contains the mountains as nature. Here, the mountains form lines and the lines remember the mountains in the land. The terrains of Mt. Gwanggyo flow low above the lot and the lot displays the entire view as if it responds to the graceful flow. At this site, the land is the proof of space and everything about the substance. The shape created here contains the sky as an earthenware jar and displays the potentiality of land as a spatial substance. It draws a shape, but creates a space that shows the sky outside the shape to hide itself in nature. Should the line be hidden in nature or should the nature be displayed in the hidden line? This was the essential challenge of this land and the sincere response to the background. This is directly related to how the topographies should be interpreted in Korean traditional spaces. Korean traditional spaces have pursued the shape that is not completely hidden in nature yet beautifully harmonized with surrounding nature. It is based on the post-dualistic beauty of harmony that proves its existence while hiding in nature rather than dominating nature with its shape and lines.





The pilotis for parking naturally serves as an opening for air ventilation. The summer breeze coming down from the mountain ridge circulates the air around the building thus reducing the heat load. Also, each room has windows for cross-ventilation and is planned to allow natural circulation of air. The motorized window on top of the living room can release heated air in summer for air circulation triggered by the difference in temperature known as stack effect. The staircase to the north is planned to serve as a buffer of air against the freezing northwestern winds in winter to minimize heat loss. The front windows facing the south allow sufficient sunlight in winter to maximize energy efficiency with natural sunlight. In particular, the ceiling is also diversified to invite as much natural light as possible into the building to control illumination naturally.

The flow of space was borrowed from the method of handling the flow of air in traditional Korean homes. In detail, the pilotis on the bottom expands the surface of volume exposed to outer air to reduce the load of heat energy and allows natural ventilation in summer. This is similar to the principle of open living rooms in Korean traditional spaces. It means that the entire building allows ventilation to keep the building cool. In winter, on the other hand, the concrete floor is made as thick as

possible as a thermal mass, similar to Ondol floors of Korean traditional architecture for maximum insulation, to block the cold air from the underground. Also, the interior space of the second floor has an open living room, bedroom, and kitchen which can be divided and combined flexibly with sliding doors for different needs. This is a modern reinterpretation of the variable space of Korean traditional homes that can be used either as a big room or as smaller individual rooms.

The rough texture of the traditional bricks interprets the lot in a different way in combination with the property of highly reflective stainless steel. The skies and nature reflected on the stainless steel surface distort what the true substance is to break the boundaries between shapes and texture. Unlike the rough texture of ceramic bricks, the stainless steel used on the front and on the side reflects the surrounding landscapes to make itself disappear. If the bricks reveal themselves by the change of light and shadow, the stainless steel de-materializes itself by making itself disappear in nature. Such contrasting textures have different properties and confront each other in a single mass, but they ultimately establish balance through the extinction and reflection of light.

Architect 建筑公司
JOHO Architecture

Project Architect 建筑设计
Jeonghoon LEE

Project Team 项目团队
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Construction 施工
Dong-jin Chea(DL donglim construction)

Client 客户
Im-jeong Choi

Photographer 摄影师
Sun Namgoong

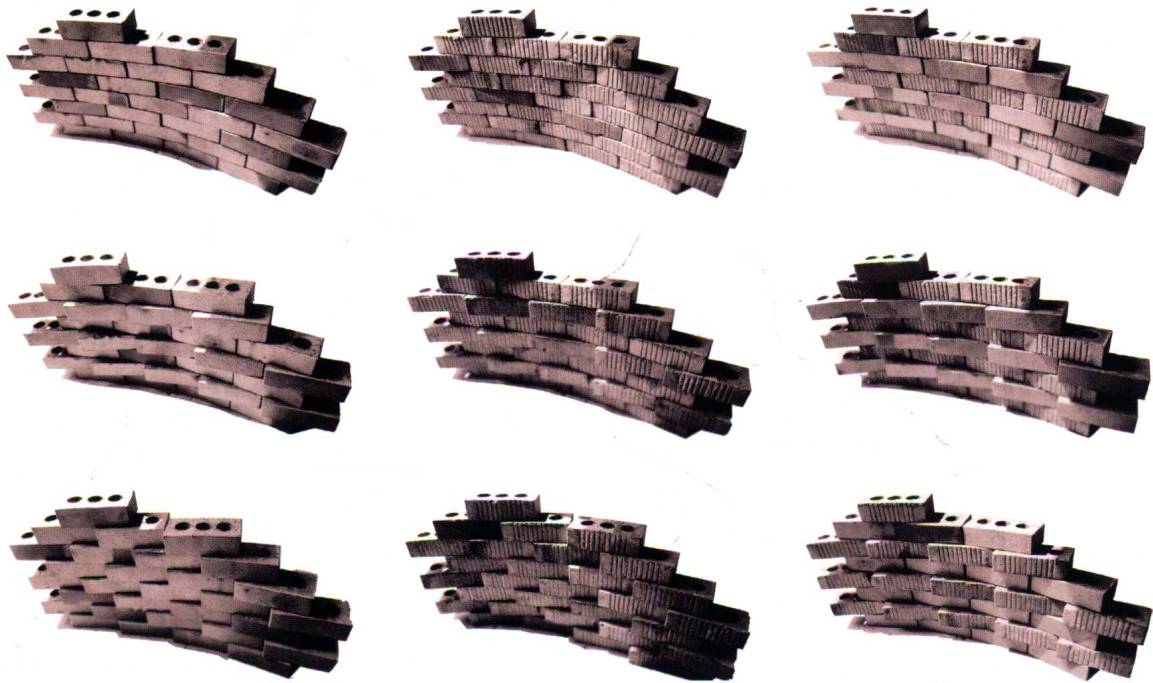
Text 文案
Jeonghoon LEE

Location 地点
Yongin-si, Gyeonggi-do, Korea
韩国京畿道龙仁市

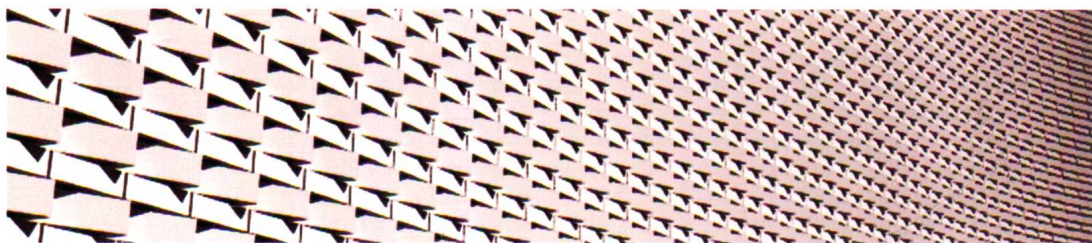
Site Area 场地面积
529.00 m²

Building Area 建筑面积
140.57 m²

Brick Façade Area 砖立面面积
284.58 m²



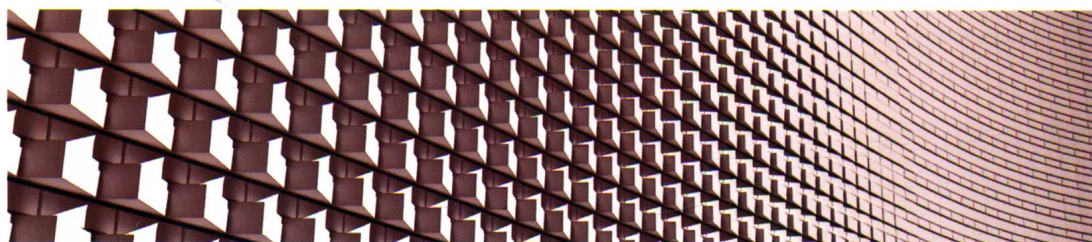
Brick Stacking Model 砖块砌筑方式模型



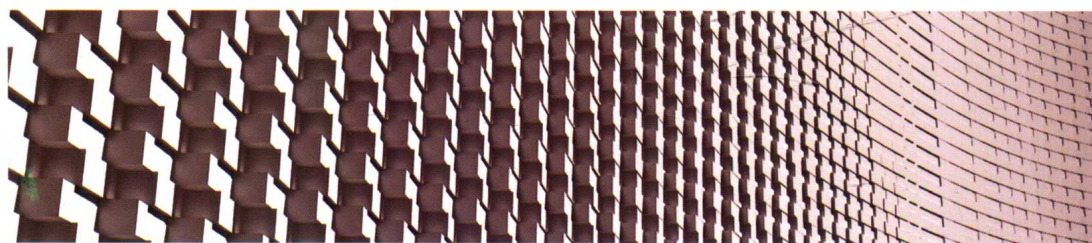
Type A. one row tilted with same angle A 类 每皮砖突出的角度一致



Type B. one row turned according to the end of the lower one with various angle B 类 相邻的两皮砖中，上一皮砖根据下一皮砖的最后一块突出的角度作出不同角度的



Type C. one row turned according to the center of the lower one with various angle C 类 相邻的两皮砖中，上一皮砖根据下一皮砖中间的一块突出的角度作出不同角度的



Type D. both rows turned with various angle change 相邻的两皮砖均以不同的角度旋转

Brick Façade Detail 砖立面细节图



Analysis of Material and Structure 材料与结构分析

Ash-colored Brick and Darkgray-color cement mortar are used in this project. The Brick size is 185 mm x 85 mm x 55 mm. Basalt brick is used in the Fence. Other material is exposed concrete and STS panel (mirror type). The odd-row is horizontally arranged while the even-row is turned w/ angle variation 0° to 25°. The ash-colored bricks (traditional bricks) embrace the concrete surface as fish scale while slightly altering the angles. The traditional bricks used for this project have silver water-repellent coating on the surface and show sentimentality different from the rough surfaces of their tops

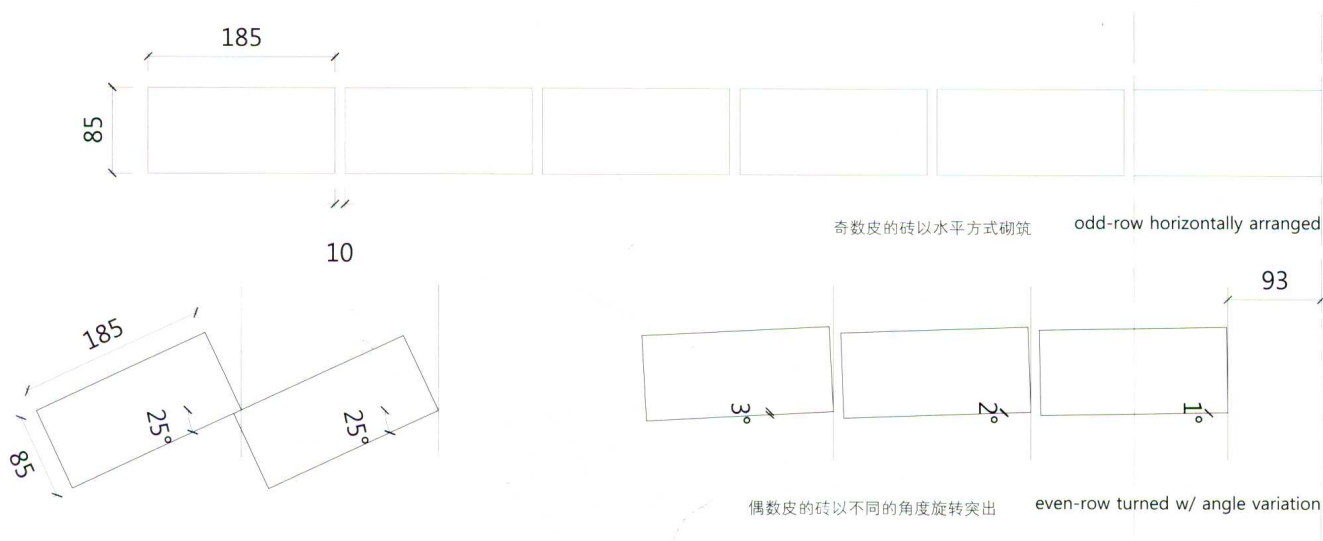
本案采用浅灰色的砖和深灰色的水泥砂浆。砖的尺寸为 185 mm x 85 mm x 55 mm，栅栏采用玄武岩砖砌筑。其他材料为清水混凝土和 STS 镜面面板。奇数皮的砖均按水平方式砌筑，而偶数皮的砖则以从 0° 到 25° 不等的角度朝外突出。这些浅灰色的砖属传统砖材，它们以逐渐变化的角度稍稍突出，如同鳞片一样覆盖了整个混凝土立面。砖砌体为建筑表面覆上了银色的防水外层，使其与顶部和底部粗糙不平的表面明显地区别开来。砖块拥有两种不同的表面，它们以一种

and bottoms. The bricks with two different surfaces were piled to form a certain pattern from angles 1° through 25°. In other words, the variation of angle is another way how the outer skin in the shape of a concave lens facing south defines its existence. The shadow of the brick wall caste as the Sun moves converts the flow of lines into the subtle change of the outer skin. The variation of the brick surface is intended to read the entire mass differently according to the perspective of incomer and the perspective of viewing the images from the mountains.

特定的方式叠砌起来，朝外突出的角度从 1° 到 25° 渐次递增。换言之，对于这座凹透镜造型的建筑来说，其角度的变化就是外表皮界定建筑自身存在的一种独特方式。当太阳在天空中运行至不同方位时，外墙上的砖块便根据日照的不同角度投下了不断变幻的阴影，建筑表皮上也相应地发生了微妙的变化。砖立面根据观赏者与建筑的距离及在附近山上所处位置角度的不同而呈现出不同的视觉效果。

Bricks are divided into sectors that held together and diversify structural load through supporting iron embedded in reinforced concrete structure. The brick improves the insulating efficiency. The air can be trapped between brick layer and insulation layer applied on the surface of concrete, which would function as an effective insulation. Because of the air gap, the brick façade could have a better efficiency in terms of sound and heating insulation. Through tilted bricks with various angles, the brick façade gives both aesthetically and functionally high satisfaction to the occupants.

所有的砖块被划分为不同部分，作为承重结构的一部分所承受的重量也各不相同。它们均由钢筋混凝土结构中的钢筋支撑起来，成为一个整体。砖块的使用有助于提高建筑整体隔声、隔热的性能。混凝土立面的砖层和隔热层能把间隙中的空气有效地蓄存起来，减少内外热量的交换，从而起到了隔热保温的作用。而由于气隙的存在，砖立面同时也能起到了隔声的作用。设计师通过采用这种把砖块朝渐变角度斜向砌筑的方式，使砖立面在功能与美学上均能满足业主的需求。

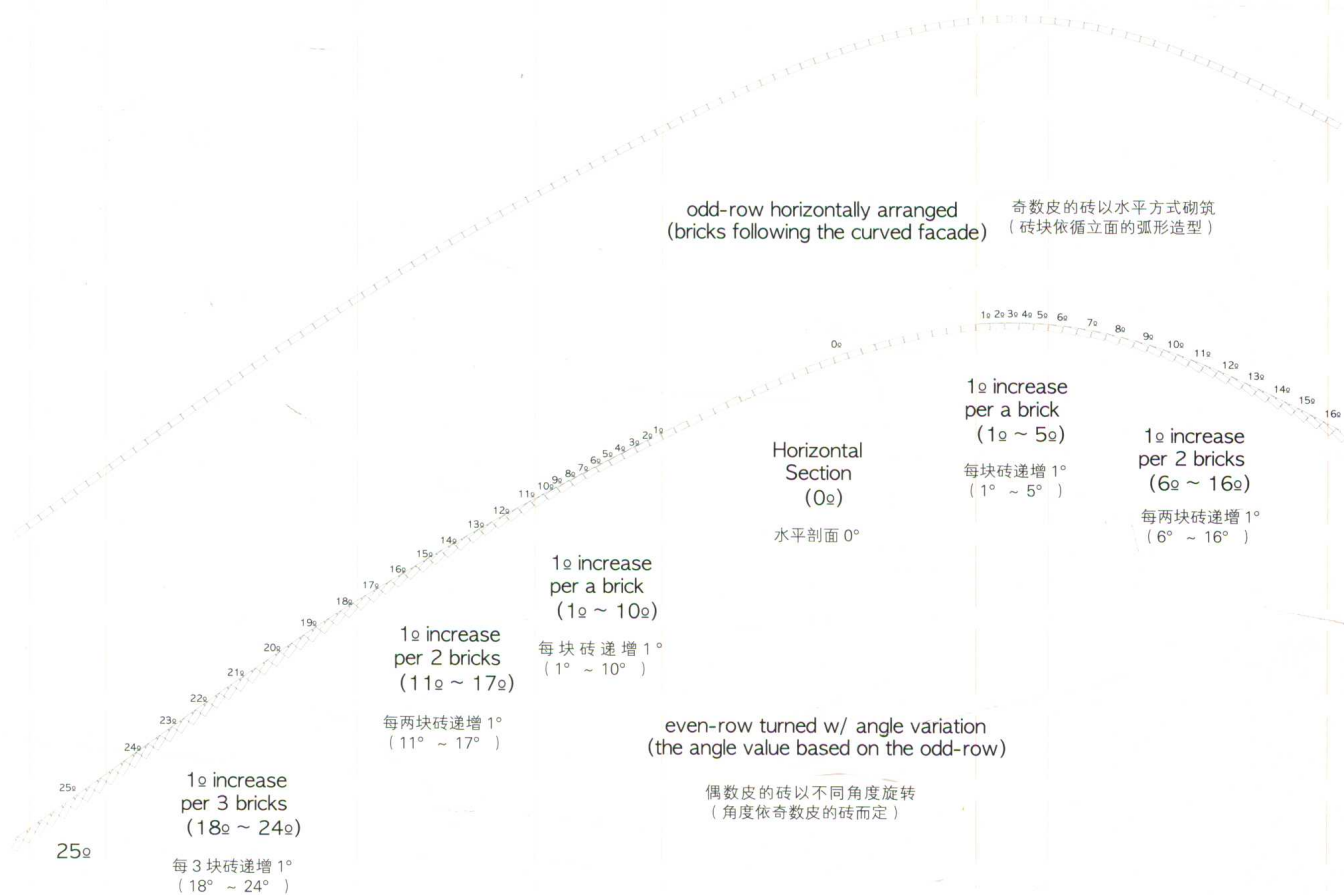
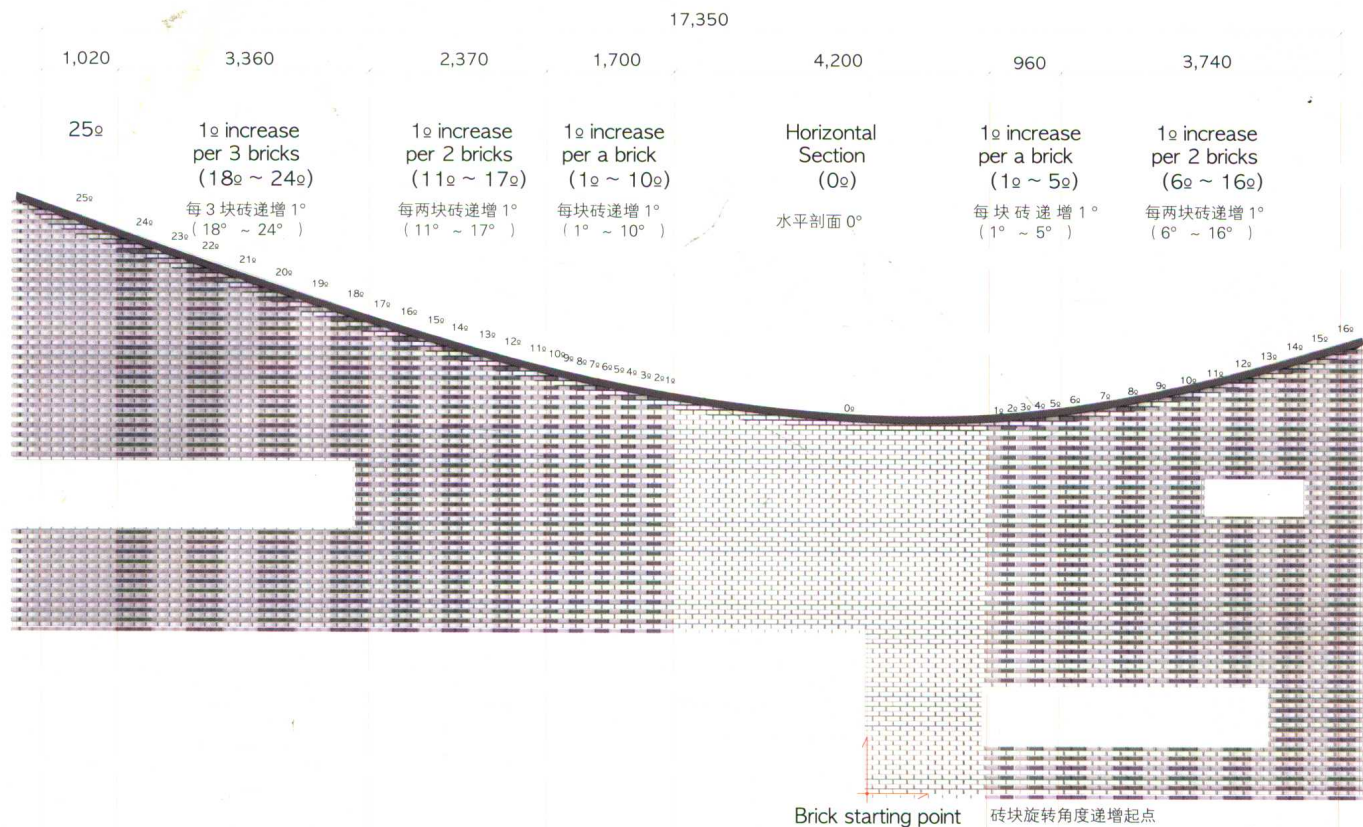


Typical brick turning plan (top view)

- based on the center of lower brick, gradually increase the turning angle value starting from 0°

基于下一皮砖中间砖块的角度，从 0° 开始，以渐次递增的角度向外旋转

BrickTurningTypical Plan 砖块旋转平面图



Main Façade Detail 主立面细节图

