欧洲最长的可持续性滞水步道

Europe's longest sustainable waterretention-promenade

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1 简介

在欧洲卢森堡的南部，一块曾是钢铁厂的工业用地如今转变为一处具魅力的工作和生活空间。

场地所在的新城名叫贝尔瓦尔，靠近法国的边界。这里最终会形成四块生活和工作区，而一条滞水的步道将会如一根绿色脊骨一样连接这些区域。步道由滞水阶梯和一条自行车与人行道组成，穿越了北贝尔瓦尔居住区，由恩·贝尔瓦尔公园一直延伸至曾经的冶炼炉台——现在是大学、国家图书馆、摇滚大厅和德克夏银行总行的所在地。整个场地面积约为 120 hm^2。

2 生态与城市发展

随着城市的发展，这块区域的地下排水管网系统已经达到了极限，至少这块特殊区域是一定如此的。目前，我们急需一个替代性的方案来实现延续兼具可持续性的水处理系统。并且，已非常明显城市的发展也必须结合生态的可持续性。

滞水阶梯设计是最接近区域最原始、自然的地块，可以看作是对原有景观的复原。尽管工业破坏了大部分原来的景观，温西巴格小溪仍然有一部分残留下来。但是，这些残留的区域并不完整，植物和动物群落都受到了工业活动的影响，已不是一个能够维持正常自我生态功能的湿地系统。为了恢复这里的湿地生态系统，我们将小溪进行了最大程度的生态修复，无法修复的区域则人为修建出新的小溪流。首先，我们引入先锋植物，由此引发一系列的生态演变过程，最后将形成一个具有更高生物多样性的湿地。

我们认识到了恢复湿地栖息地和保护水资源的重要生态意义，也为此观点找到了充足的支持依据。建立水管理和生态系统的决定不仅仅是基于当前传统水管理系统下地下管网的限制，还有很多其他因素。显而易见，这将对市民们提升他们的生态意识产生积极的影响。对于已具备生态意识的居民，这将指导他们形成更合理的生态思维方式。我们现在已经能够看到居民们更好的融入到生态环境中，这也带动了社会凝聚力的增强。

城市设计需要考虑对原有景观的保护和修复。北贝尔瓦尔的居住区就是以这样的一种方式在设计，以保护现有景观的地形坡度基础上建立起来的。建筑如巨石般，却被小心翼翼的放置，绿色自然的草甸作为公共绿地穿插其间。私人的花园被缩减到最小面积，并设有严格的要求。这样能够有效避免整体景观变得杂乱无章，从而为居民们提供一个高质量的生活环境，并优化生态环境。

贝尔瓦尔是卢森堡第一个将多区域的雨水管理与景观设计结合的大型城市项目，而现在我们已能够看到这两者之间的互惠互利。

3 水理念：再利用与可见性

水处理的理念中有一个特别的观点认为迅速的、局部的下渗并不是一个好的选择。因为钢铁厂仍然存在，并占据着整个场地，它仍然需要水用于工业冷却。因此所有来自建筑和道路的雨水需要通过开放的池塘来收集，然后用于工业冷却，最后排入现有水系的下游中。由于缺乏局部下渗，对局部滞水的要求增加了。事实上，局部的滞水本应运用于任何情况。因此 26 个由欧洲橡木杆制成的挡水墙将会放置在小溪中，在不同水位组成一个绿色的“滞水阶梯”，在暴雨季节降低水的流速，防止水系下游的负荷过重。

这 26 个挡水墙滞留住了周边区域的水。通过在较低的区域设置挡水墙，较高处挡水墙周边的水流不断溢流到较低的阶层，形成不同级别的溪流。这使得上游的水不会泛滥，下游也不会处于干旱的状态。通过这种方式，创造出一种整体性的湿地和生态过渡区。

水沿着自然的斜坡和原生的植被流动，

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1 滞水林荫道（平面图）
The water-retention Boulevard

2-3 三座桥结合成一个整体，作为一个突出的景观元素
This ensemble of three bridges is a clear landscape design element

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在需要的地段设计了有开口的沟渠。由于水在整个过程中十分重要，整个水系统尽可能设计在地面之上。地下管网的使用则被压缩至最小。通过这种方式，水的主题得到了更直观的表达。在四种不同的居住、工作和购物区域中，水系统的设计亦不相同。在北贝尔瓦尔，小的沟渠边缘设置了锐利的混凝土条，用于检验水质，也使整个结构开放可见。恩·贝尔瓦尔公园中设置了明沟、蓄水池和浅水三角洲。在冶炼炉台区域，炉台的遗迹和水景结合在了一起。在麦尔广场，旧的冷却设施得到了重复利用，用于储水并将在未来用于娱乐休憩功能。

4 步道

沿着滞水阶梯布置了一条并行的人行和自行车道，以一种自然的方式连接了场地周边所有的生活、工作和购物区域。这条自行车道不仅是连接周边区域的一个脊骨，更是国家自行车路线的一个重要节点。

为了应对暴雨时上涨的水位，步道建在了距地面 1.6m 处，并用石笼搭建了护墙。这些石笼和路面铺装所用的石头被称作“卢森堡砂岩”，都精心挑选自当地的采石场。自行车道由现浇混凝土筑成，相对较窄的步行道则由砾石筑成。在这条步道上一共设置了 33 条排水道，其编号清晰地刻在耐候钢板上。钢板安装于石笼网栏杆上，回应了曾经冶炼炉台的历史。雨水能通过排水道由步道排向滞水阶梯。

场地中一共种植了 86 株多干的欧洲桤木（Alnus Glutinosa），它们有趣的外表与林荫道严谨正式的设计有效地产生了对比。

5 桥，座椅与平台

桥体的设计粗犷有力，与林荫道的比例相匹配。桥体由当地的欧洲橡木与钢材结合制成。场地一共有 6 座桥。林荫道上的步行道和自行车道大部分是分开的，在与北贝尔瓦尔相接处则合并在一起，成为一个自行车和步行共用的桥，从而融入进整个居住区域的道路系统中。在这里三座桥结合成一体，成为一个明显的景观元素并强化了现有的湿地生态系统。在晚上，桥和排水道的 LED 灯将会打开并照亮整条步道，如在远处的建筑处观看桥体时，会呈现出一种童话般的氛围。

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座椅和平台的设置为骑行者和步行者提供休憩和赏景的场地。平台的设计比桥体会更加通透，但亦由欧洲橡木筑成。

6 可持续性

以“从摇篮到摇篮”的思想为指导，尽

4 桥的设计粗犷有力，与林荫道的比例相匹配。桥体由当地的欧洲橡木与钢材结合制成
The bridges have a robust design, matching the proportions of the boulevard and are made of local, European oak combined with steel

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可能多的使用本土的与可持续性的材料。

这片冶炼炉台上耐候钢的使用一方面强化了方案的可持续性，同时也是对场地历史的回应。石笼所用的石头和鹅卵石均来自当地的采石场。当地钢厂的钢材和很多工业制品也得到了重新利用。整个项目以其在建造和规划上的可持续性，获得了德国可持续性认证系统的金奖认证。

7 更大的尺度

过去工业活动占据了主导地位，尤其是在卢森堡的南部，自然和生态环境受到了威胁。并没有多少旅行者愿意前来这个有着美丽山地景观的地方。卢森堡现在是一个致力于将自然与城市发展相结合的国家，并且尝试提供高质量的工作环境与良好的生活和旅游环境。在这个项目中可以看出，水系统管理、自然景观和湿地的修复与可持续的城市设计能够成功结合在一起。这是卢森堡首个采用这种思路的项目，能够为未来更多的项目提供启发和经验。

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项目委托方：AGORA 开发公司和卢森堡 S.A.R.L. 公司
设计时间：2006 年—2010 年
建成时间：第一阶段 2010 年—2012 年，第二阶段 2012 年—2015 年
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5 我们现在已经能够看到居民们融入到生态环境中，这也带动了社会凝聚力的增强
We can see already inhabitants embracing their ecological environment and we can see the positive effect this has on social cohesion.

6 小的沟渠边缘设置了一条突出的混凝土条
The small ditches are combined with a sharp concrete rim

1 Introduction

In the south of Luxembourg, Europe, an industrial area, in earlier days used by the steel industry, is being transformed into an attractive working and living environment.

It is near to the French border and this new city has been called Belval. There will be eventually four living and working quarters. These quarters are connected by a green back bone, the water-retention-promenade. This is a water-retention-staircase combined with a cyclist and pedestrian promenade and from the north of the site it passes the residential area Belval Nord, the park 'Um Belval' to end on the 'Terasse des Hauts-Forneaux', the old blast furnace terrace that now houses the University, the National Library, the rock Hall, and the head office of the Dexia Bank. The site is in total 120 ha of size.

2 Ecology and urban development

With urban development the system of transporting all the stormwater through underground pipes has reached it limits, at least it did in this specific area. An alternative water-concept was needed to have a consistant and sustainable water management. It was clear as well that the urban development had to be combined with ecological continuity.

The water-retention-staircase is close to the natural, original state of the area, and one could see it as a restoration of the former landscape. Although the steel industry destroyed much of the old landscape, remnants of the old creek 'Wuenschelbach' were still intact. But it was not complete and the flora and fauna suffered much under the industrial activities. At least it was not a functioning wetland ecosystem. In order to reclaim this wetland ecosystem the creek was restored where possible, and where restoration was not possible an artificial, new creek was made. Pioneer vegetation was welcomed, beginning a chain of ecological succession that will lead to a more biodiverse wetland.

We feel that this reconquest of wetland habitats and conservation of water resources is of significant ecological importance and we have found great support for this believe. The decision of making the water management and ecological system clear and visible is not only based on the existing limits of the traditional water management system with underground piping. There are

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7 水质监测的节点均被设计为开放、可视的元素
Inspection places for water-quality control are designed as open, visible elements.

8 卢森堡美丽的山体景观
The beautiful mountainous landscape of Luxembourg

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more factors involved. Clearly, there is a positive influence on the ecological awareness of the citizens. For other inhabitants it is already in line with their existing ecological awareness and for this reason a logical way to go. We can see already inhabitants embracing their ecological environment and we can see the positive effect this has on social cohesion.

As a consequence of maintaining and restoring the existing and former landscape, the urban design is influenced. The living area Belval Nord for example is designed in such way that the existing landscape with it's slopes could be maintained. The buildings are carefully fitted in as monoliths and the green, natural meadows in between are commonly owned. Private gardens are reduced to a minimum and under strict rules. This so cluttering of the landscape could be prevented, with as a resultant a higher living quality for the inhabitants as well as an improved ecological environment.

Belval is the first major city project in Luxembourg to integrate the concept of rainwater management of the various districts with a landscape design and we can now see how both benefit.

3 Water-Concept: Re-use and Visibility

One of the special features of the water-concept is that immediate, local infiltration was not an option. Because there is still steel industry, which is owner of the site, there is still a need for water for industrial cooling purposes. So all the rainwater of the buildings and roads had to be collected and transferred to open ponds where parts it will be used to cool industrial plants and then will be transported with existing water systems downstream. As a consequence of not having local infiltration, the need for local water-retention increases. But to be frank, local water-retention would have been a tool needed in any case. For this reason 26 water-barriers of European oak poles will be made. Thus create in the creek different water-levels and make it a green 'water-retention-stairway', where the speed of the water-transport will be slowed down in periods of heavy rainfall. And preventing in this way an overload of the water-system will downstream.

All of these 26 barriers retain the water of the adjacent areas. By making lower parts within a barrier, it can have an over spill, so that the water from a higher situated barrier and its adjacent areas gets divided over the different lower lying creek levels. This prevents the water-retention-stairway

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9-10 平台的设计比桥更加通透，但亦由欧洲橡木筑成
The platforms are more transparent than the bridges, but are made of European Oak as well.

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to be filled up upstreams and being mostly empty more downstream. In this way, we could create overall wetland and ecological interesting transition area.

The natural slopes with their indigenous vegetation are used to transfer the water, and where necessary open ditches have been created. Because the water is such an important aspect in this development, the choice has been to design all elements of the water-chain as visible as possible. And the use of underground pipes was minimized. In this way the water-theme has been made literally touchable. In all of the four different living, working, shopping quarters, the water-system is designed differently. In Belval Nord the small ditches are combined with a sharp concrete rim to increase visibility and inspection places for water-quality control are designed as open, visible elements. In Park 'Um Belval' there are open ditches, retaining ponds and a natural water delta. On the 'Terrasse des Hauts-Fornaux' water elements were combined with the remnants of the blast-furnace. On the Square Mile were still studying on re-using the old cool basins for retaining water and further recreational functions.

4 The Promenade

Alongside from the water-retention-stairway a pedestrian and cyclist promenade has been made to connect all living, working and shopping areas of

11 林荫道上种植的有众多主枝的欧洲桤木
Multi-trunk Alnus Glutinosa on the boulevard
12 雨水能通过排水道由漫步道排向滞水阶梯
The spillways transport the storm-water from the promenade into wetlands of the retention-staircase.

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the site in a natural way. It is not only the backbone taking care of the accessibility within the site, the cyclist promenade is as well an important joint in the national cycle-path routing.

The promenade lies approximately 1.6m above the ground level, necessary because of the water-levels during the heavy rainfalls and has gabions for the necessary parapet-function. The filling of the gabions and the pavement stones come from a carefully selected local quarry and it is called “grès de Luxembourg”. The path for the cyclists is made of so called 'Ortsbeton', locally made concrete and the smaller pedestrian footpath is made of self-binding gravel. On this promenade 33 spillways have been made, clearly visible by numbered Corten steel elements on the gabion-parapet, referring to the former steel blast furnace with all it's numbered equipment. The spillways transport the storm water from the promenade in to the retention-staircase.

In total 86 multi trunk Alnus Glutinosa have been planted, with their more playful appearance a nice and pleasant contrast with the more strict and formal design of the boulevard.

5 The bridges, benches and platforms

The bridges have a robust design, matching the proportions of the boulevard and are made of local European oak combined with steel. There are in total six bridges. Where on the boulevard there are separate pedestrian and cyclist bridges, for the connection to Belval Nord they combine to one bridge for pedestrians as well as cyclist, thus matching with the road system in this living quarter. Here the three bridges combine to one ensemble. This ensemble of three bridges is a clear landscape design element, emphasizing the existing wetland ecosystem. At night the bridges and spillways are lit with LED-lighting, thus giving the promenade visibility and a fairy-like atmosphere clearly visible from the building blocks alongside.

Benches and platforms have been designed and installed to give cyclists or pedestrians a chance to have a pleasant rest and to enjoy the scenery. The platforms are more transparent than the bridges, but are made of European Oak as well.

6 Sustainability

With the cradle-to-cradle philosophy in mind as many as possible local and sustainable materials have been used.

The use of Corten steel on this former steel furnace plant is as well as referring to the history as a sustainable choice. The stones for gabions and cobble stones come from a local quarry. The steel from the local steel industry and many industrial artifact's are re-used. The total project has a gold GBKN（German Certification System for Sustainability）pre-certification, for sustainability in building and planning.

7 On a bigger scale

From the old days, industrial activities were dominant, especially in the South of Luxembourg and the natural, ecological qualities suffered. Not many tourists would come to this in basic beautiful mountainous landscape. Luxembourg is now a country that has the ambition to combine nature with urban development, and tries to offer high quality working area as well as good living and touristic areas. In this project it has been made visible that one can combine water management, reclaiming of natural landscapes and wetlands with durable urban design. It is the first project within Luxembourg to do so, and can be an inspiration for future projects.

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Location: Belval Luxembourg, Europe
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Commissioned by: société de développement AGORA；s.à.r.l. Esch-sur-Alzette, Luxembourg
Period of design: 2006-2010
Implemented in: stage 1：2010-2012；stage 2：2012-2015
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13 在冶炼炉台区域，炉台的遗迹和水景结合在一起
Water elements were combined with the remnants of the blast-furnace
14 在这条步道上一共设置了 33 条排水道，其编号被清晰的刻在耐候钢板上。钢板被安装在石笼网栏杆上，突显曾经冶炼炉台的历史
On this promenade 33 spillways have been made, clearly visible by numbered Corten steel elements on the gabion-parapet, referring to the former steel blast furnace with all it's numbered equipment.
15 在晚上，桥和泄水道的 LED 灯将会打开并点亮步道，从远处的建筑观看桥体时，呈现出一种童话般的氛围
At night the bridges and spillways are lit with LED-lighting, thus giving the promenade visibility and a fairy-like atmosphere clearly visible from the building blocks alongside.