BIRKHÄUSER

WATER AS CATALYST

Int | AR

Interventions | Adaptive Reuse Vol. **08**

Department of Interior Architecture, Rhode Island School of Design

Int | AR

Interventions | Adaptive Reuse

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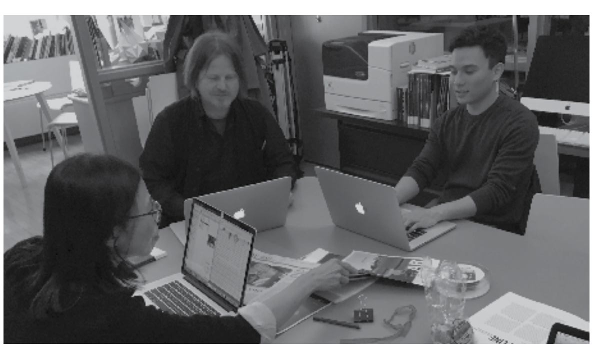

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BREATHE, LOOK, STAND UP

THE SECOND LIFE OF WATER INFRASTRUCTURE

by LINDSAY WINSTEAD

Throughout history, access to water dictated the location of civilizations. Water transport became essential as humankind transformed from a nomadic to a sedentary culture. The development from simplistic drainage channels to complex plumbing networks allowed water to be transported from place to place, as systems deployed to collect, distribute and filter a resource vital to the growth of civilizations.

Early civilizations relied on a close proximity to a fresh water source, with the first known civilization situated between the Tigris and Euphrates Rivers. With subsequent settlements established miles from a water source, the need for water supply to these outer regions triggered infrastructure development. Although commonly accredited to the Romans, water transport infrastructure can be traced back to before the 7th century BC, when irrigation was the main purpose. The first substantial aqueduct, Aqua Appida, was erected in 312 BC and spanned a distance of 16km to service the city of Rome. While water infrastructure has evolved in scope, scale and complexity, the supply of water remains a logistical challenge. Today this resource travels many miles through networks often hidden from the public eye.

The need for sanitation is in tandem with the development of water supply infrastructure. The massive westward expansion initiated by the Industrial Revolution in the United States resulted in the exponential growth of cities and ensuing overpopulation. This

McMillan Slow Sand Filtration Site
Washington, DC

high-density urban living caused outbreaks of diseases that often transferred through water. The spread of diseases such as typhoid and cholera resulted in public health concerns during the 19th century. These epidemics were addressed, in part, through the construction of sewer systems that helped to separate wastewater from clean water. Further developments in sanitation were implemented through the use of chemical treatment as well as sedimentation systems, which filtered water before use. These advanced interconnected systems have permitted a more hygienic expansion of urban life.

Defined as a "set of interconnected structural elements that provide framework supporting an entire development," water's infrastructure has become a key feature in maintenance and day-to-day operations of a city. The continuous expansion of the water supply and the development of water treatment methods demand a constant evolution in the infrastructure. What of obsolescent infrastructure?

Since water sustains itself without the need for air or light, and conforms to any shape, the infrastructure needed for water's containment is simple and many of the spaces designed for its distribution are now underground. As such, the infrastructure that supplies water constitutes a specific typology that does not necessitate human presence. How can one adapt a building type not intended for human habitation, without requisite ventilation, light, or consideration of human proportions? A second life for such infrastructure must incorporate these three requirements.

Separated by distance both physical and cultural, two projects — the DC Exchange in the US and Public Folly in China have in common the conversion of water's infrastructure that incorporates the human elements of ventilation, light, and proportion.

Case Study 1: DC Exchange

Site: *McMillan Slow Sand Filtration Site*
Location: *NW Washington DC, United States*
Size: *25 acres*
Operation: *1905 - 1986*
Proposed Rehabilitation: *2014*
Original Architect: *Army Corp of Engineers*
Proposed Design: *Lindsay Winstead*
Original Use: *Slow Sand Water Filtration center*
Rehabilitation Use: *Community Center, Marketplace, Performance space*

The McMillan Slow Sand Filtration site in Washington, DC, filtered water from the Potomac River, transported by the Washington Aqueduct, from 1905 to 1986. Revolutionary at the time, this chemical free filtration of water through two feet of sand eliminated the typhoid epidemic in Washington, DC. This site was an engineering wonder, constructed by the Army Corps of Engineers

At the McMillan Slow Sand Filtration site, the barrel-vaulted ceilings culminate in a 3-foot diameter manhole

while Frederic Law Olmstead Jr. designed its landscape. The area under the site is divided into 20 one-acre subterranean barrel-vaulted cells and two service courts that house 20 sand bins, 4 regulator houses, and 12 sanitary sand washers.

Although this filtration site is expansive, its original purpose and even existence are unknown to most DC inhabitants. One would think that its structural brilliance and architectural splendor would gain renowned recognition, at least locally and throughout architectural circles. Unfortunately, this is not the case. Its purpose was forgotten once its function became obsolete in 1986 and a more rapid sand filtration site was constructed adjacent to the existing reservoir. Because of this, there is a divide between the neighborhoods surrounding the McMillan Site, and its closure has only exacerbated conflict. The dispute between redevelopment and reuse has been in question for years. Thus, the proposed rehabilitation of the McMillan site into the DC Exchange, a marketplace—a place for expansive gatherings, spontaneous encounters, and personal exchange—would not only activate an obsolete structure but would at the same time strengthen public interaction and create a sense of community.

Case Study 2: Public Folly

Site: *People's Liberation Army No. 1102*
Location: *Shenyang, China*
Size: *20 sq meters*
Operation: *1959 – 1961*
Rehabilitation: *2012*
Original Architect: *Communist Party of China*
Rehabilitation Architect: *META-Project*
Original Use: *Water tower*
Rehabilitation Use: *Exhibition space, Mini Theatre, Viewing deck*

A water tower was constructed in 1959 for industrial production and was located within a dilapidated military campus called the People's Liberation Army No.1102. Founded during the Great Leap Forward, a social and economic campaign led by the Communist Party of China under Mao Zedong, this military factory helped transform China into a socialist society through rapid industrialization. Marked as one of the most significant industrial production regions of China, the Tiexi District water tower was used to supply water for the heavy production needs of factory No. 1102. Even after its disuse, this water tower was well preserved with the hopes of future integration. This vision was realized in 2012 by META-Project, a research and design based firm, which converted this water tower into what is now the Public Folly. While preserving the memory of China's industrial past, META-Project was commissioned by the Chinese real estate firm Vanke to reactivate this

Light box interventions, Public Folly

historically rich site. Without deconstructing the original water tower, the Public Folly adds a new chapter to the tower's history. Through the insertion of two end-to-end funnels, a new interior skin echoes the main installation space. Within its shell, the Public Folly provides space for community activity and performances, while its exterior brightens up the surrounding landscape. META-Project's reuse of this water tower has reactivated its role and involvement in the community.

Breathe In: Air

Similar to water, the flow of air takes the path of least resistance. While prevalent outside, air has difficulty entering contained areas. The circulation of air into a structure designed for water is a feat in itself because of the thickness of walls and its below-grade existence. Water can flow without the presence of oxygen, but humans need a consistent exchange of air within a space. Thus, interventions must take place for air to circulate throughout obsolete infrastructure.

The integration of air circulation within the DC Exchange references the site's original sand washing and replacement cycle and mimics the subterranean distribution network. Below the sand floor of the McMillan cells is a network of water pipes that distributed naturally filtered water for potable use. Within the service court, sand collectors existed for the storage of sand after being cleaned within the industrial washers. Originally the washed sand was kept in these bins and then re-distributed through hoses that pumped the sand back into each cell through above grade manholes or the service ramp. Similar to this process, the DC Exchange repurposes these industrial towers to house new air-handling units. Due to the sand collectors' elevation and the site's lack of built structures, the towers can pull in clean air for supply and return circulated air. Once air is collected it is then transported through ducts that run below ground, mimicking the obsolete water pipes, and enters the cell through floor vents. Return ducting brings circulated air back to the sand bin to either be rejected or re-circulated into the cell through an energy recovery unit. This two-fold ventilation system makes use of the cell's below-grade properties by repelling heat into the ground in the summer and maintaining heat within the ducts during the winter. The DC Exchange's ventilation system preserves the site's integrity through the utilization of its historic structures. Although complex, this method of adaptation creates a similarity between McMillan's past and proposed purpose.

As the systems developed for air circulation have been refined for efficiency and design, a portion of these systems always requires exposure to natural airflow. This basic ventilation approach is the method used in META-Project's Public Folly. Due to the extreme height of the water tower, an abundance of naturally circulating air exists around the site. The original water tower already possesses a number of small voids within its cylindrical form, making the integration of air simple. The existing rectangular openings act as air intake and release ducts, allowing cool air to enter at the bottom and warm air to rise and exit at the top. With the removal of the existing door, a funnel-like steel entrance was added at the base of the water tower, creating an open-air pavilion where air circulates directly from the exterior to the interior. Public Folly's ventilation strategy is simple and causes minimal disruption to the tower's original form.

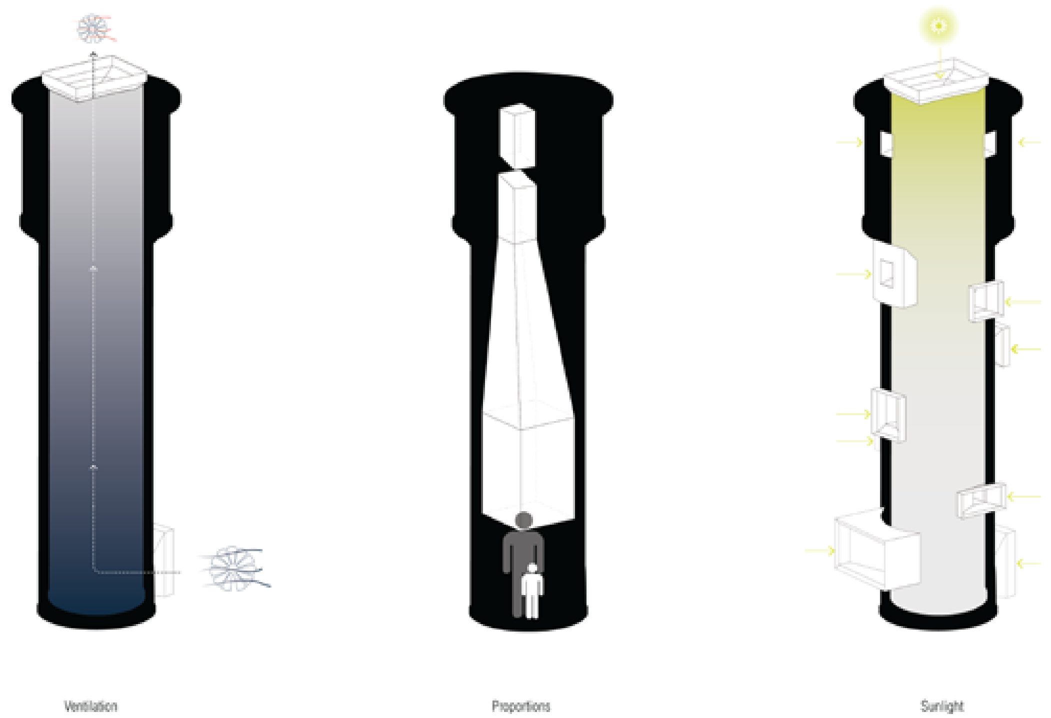
Look: Light

Containment of water is the main purpose for its infrastructure of impregnable walls, constructed in various materials and volumes. This results in a completely enclosed environment, often times located below grade with little to no access to light. Amidst this darkness, the flow of water is unaffected. However, the integration of light is required for human occupancy.

Two methods are used for the integration of light into the subterranean DC Exchange: natural light, both direct and reflected, and electrical light. Each cavernous cell within the McMillan Slow Sand Filtration site is constructed around a 14 x 14 foot column grid, whose barrel-vaulted ceilings culminate in a 3-foot diameter manhole. The regular distribution of the structural grid below ground is mimicked by the circular manholes at its surface. Initially these manholes were used to pump freshly cleaned sand back into the 20 filtration cells. The DC Exchange's approach to lighting requires the removal of the existing manhole covers to bring natural light into the cell below. On the surface, each manhole will be fitted with high performance glass and the shaft's opening will be wrapped in a Mylar treatment to help reflect surface light into the cell. Once light enters the marketplace below, quilted aluminum storage shelves will not only help with insulation, but also with distruibuting the light horizontally. These shelves are designed with a bowed outer face to increase the reflections of sunlight. The angle distributes light at varying degrees depending on where the light rays hit the shelves' surface. In addition, supplemental electricity is needed to illuminate the barrel-vaulted ceiling, helping to showcase the original construction. At the service court, a second sand collector will be repurposed to house a heat pump, plumbing utilities, exhaust ducts, and electrical conduits. The conduits will run along the vaulted ceiling, creating a new grid that mimics the original filtration system, a nod to its history.

The Public Folly's integration of light is also two-fold, with direct light during the day and supplemental electrical light at night. Similarly, META-Project uses

Looking up at the inserted light boxes in Public Folly



Humanizing the water tower, Public Folly

the existing windows, with only minor alterations, for light supply. To maximize the light quality, a viewing deck and five light boxes are introduced, which directs daylight into the expansive cylinder. Reinforced with steel funnels that are inserted into the windows' frames, these extensions are placed with intent and expand outward, making each light box seem larger than it really is. This design increases the exterior surface area, thus maximizing the amount of sunlight that reaches the interior cylinder. Each of the six openings is treated with a different monochromatic scheme, which creates a brilliant array of colored light within. At the top of the water tower, a singular light tunnel is inserted to help reflect daylight from above down to the entrance. Additionally, the Public Folly is designed to emit light outwards and become a beacon viewed from afar. At night, the monochromic light boxes create bursts of floating color while the water tower's masonry form disappears into the darkness. The supply of electricity to the light boxes is made possible by the insertion of an interior skin within the tower. Undisruptive to the original structure, a series of electrical conduits run within this new wall and supply the various light boxes with electricity for evening luminance. By using the properties of a funnel to maximize and distribute light on both the interior and the exterior, META-Project transforms this infrastructural monolith into a public space and community icon.

Stand Up Tall: Proportional Space

While water takes on the form of its container, humans are not as flexible. Driven by the need for minimal clearances, architectural codes are implemented to create space that is comfortable and accessible for all. But because water's infrastructure is only accessed during maintenance, there are no regulations for those dimensions. While some infrastructure is more generous than others, most structures are designed only for operational efficiency. Minimal vertical height and massive wall thickness are common architectural features that lead to cramped quarters. For these areas to be converted into spaces for human use, various forms of expansion have been implemented to create the appropriate proportions.

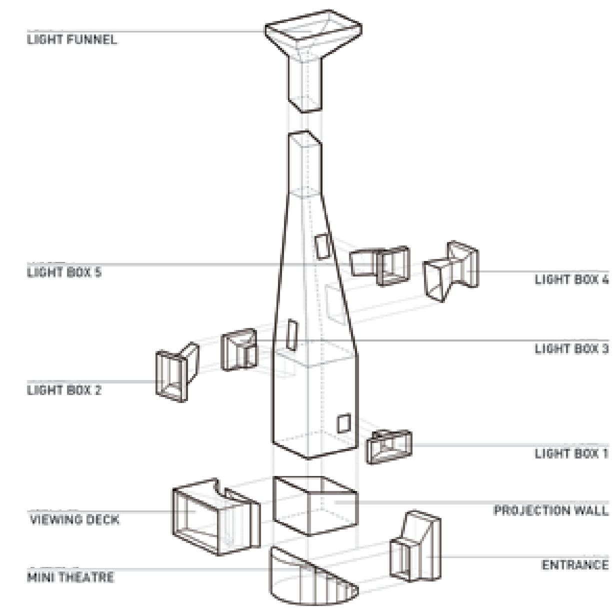
For its first 80 years of existence, the McMillan Slow Sand Filtration site remained below ground, hidden by a beautifully landscaped park. During construction, the topography was dramatically altered by a cut and fill operation. Across the entire site, the extent of re-grading varied from a 12-foot depression at the northern end, to a 16-foot infill at the southern end. As a result, the filtration cells have minimal interior height, but their horizontal width is endless, encompassing one acre. This extreme variance between cell width and height demands vertical expansion. To achieve this, the existing column grid will be broken and an alternate structure inserted to help disperse the concrete vaults' lateral loads. This intervention will be made up of steel cubes that will be elevated off of the sand and rested on the existing column's footing. Acting like a grid within a grid, these steel cubes create zones of uninterrupted space through the removal of 14 x 14 foot sections. When grouped together, larger spaces form and their additional height alter the landscape above. The result is a split-level plan that expands vertically for various levels of activity below. With the introduction of more proportional space, the DC Exchange will create harmony between old and new architecture through vertical expansion and surface manipulation.

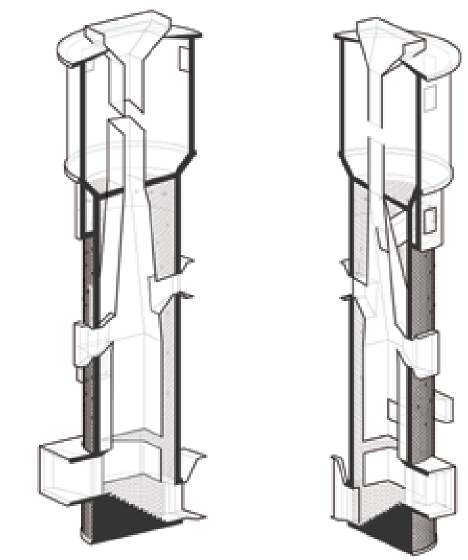
The inherent characteristics of a water tower are centered on the properties of verticality, allowing gravity to play its natural role. Proportionally, this creates a disconnect between extreme height and minimal width. Although the Public Folly expands horizontally, with the insertion of the light boxes, its main alteration is in the vertical plane. Due to its extensive height, the Public Folly uses perspective to create space. META-Project inserts a double-ended funnel that spans the height of the water tower, creating endless depth. This funnel focuses one's view upwards and outwards, rather than within the water tower's confined walls. At the base of the tower, a series of steps help to connect Public Folly's entrance to the interior viewing deck. In terms of square footage this deck is small, but its visual connection with the outside creates the illusion of expansive interiors, blurring the space contained within the water tower with the exterior. While the Public Folly is only a single floor, META-Project utilizes the circulation space, helping to expand the limited square footage of the tower. Although the steps' primary use is circulation, they also function as seating to create a mini-theater within the tower's walls. This approach of maximizing all areas inside the water tower allows the interior to feel larger without expanding the original walls. Through the technique of perspective, META-Project adds proportional space within this obsolete water tower.

Move In

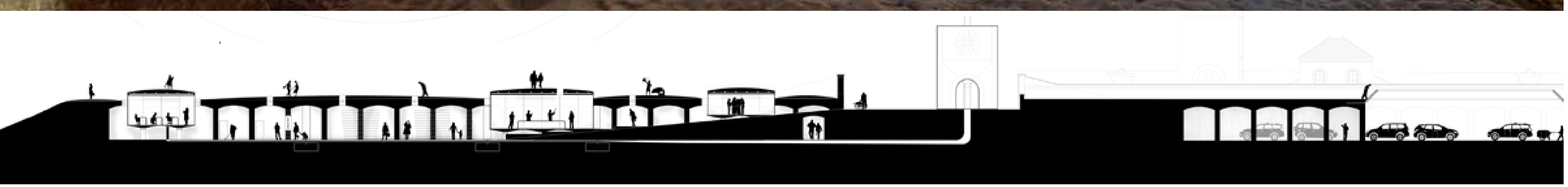
When infrastructure can no longer serve its purpose, it becomes obsolete. More often than not, infrastructure's robust structures surpass its technological relevance, leaving vacant core and shells buildings behind. In order to reactivate these spaces, occupancy is necessary. Through the incorporations of human needs: light to navigate, air to exist and proportions to inhabit, an industrial form can be converted into a multiuse community facility.

Water's infrastructure is a unique typology, which causes difficulty with structural reuse. But through adaptation its lifetime can be extended for years into the future. Whether its built form is contained below ground or elevated in the sky, or its space is constricted by minimal height or limited by finite width, these characteristics can be altered through a myriad of creative





LEFT
Exploded diagram of interventions
RIGHT
Sectional axonometric views



TOP
Sand pits at the McMillan Slow Sand Filtration Site
BOTTOM
Section through the DC Exchange, a proposed conversion of the McMillan Slow Sand Filtration Site

ways. With the integration of proper ventilation, daylight and proportional space, infrastructure built to contain, treat or distribute water can be repurposed for contemporary use.

ENDNOTES:

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EDITORIAL

Project Name_Projecting Change

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BREATHE, LOOK, STAND UP

Project Name 01_ DC ExchangeProject_Site_ McMillan Slow Sand Filtration site_ Location_ Washington DC_ New use 01_ Community center, marketplace, performance_ Project Name 02_ People's Liberation Army No. 1102_ Location_ Shenyang China_ Original architect_ Communist Party China_ Rehabilitation architect_ META-Project_ New use 02_ Exhibition space, mini theatre

Image Credits_ Figure 01,02, 08_ McMillan slow sand filtration site, Washington, DC, Lewis Francis; Figure 03 –07_ Public Folly, Shenyang, China, META-Project; Figure 09_ Courtesy of Lindsay Winstead

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THE TEARS OF THE U.S.S. ARIZONA

Project Name_ A tomb that lives; Location_ Pearl Harbor, Hawaii

Image Credits_ Figure 01_ View of USS ARIZONA taken from Manhattan Bridge on the East River in New York City on its way back from sea trials. December 25, 1916, Library of Congress Prints and Photographs Division Washington, D.C. 20540 USA http://hdl.loc.gov/loc.pnp/pp.print; photographer_Enrique Muller, Jr. / E. Muller; 1916; Wikimedia; Figure 02_ A TOMB THAT LIVES Monument proposal, illustration by author; Figure 03_An aerial view of the USS Arizona Memorial, U.S. Navy photo by Photographer's Mate 3rd Class Jayme Pastoric, Wikimedia

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THE EDGE OF CONDITION

Project Name 01_ Three Mills_ Bromley-by-Bow_ River Lee_ London, England_ Project Name 02_ The White Building_ Lee Navigation Canal_ Hackney Wick_ Stratford, England,_Project Name 03_ The Marine Engine House_ Wlathamstow Reservoirs

Image Credits_ All images courtesy of the authors; Figure 01, 02_Three Mills Island, London_ Figure 03_ White Building_ Hackney Centre Wick_ Stratford_ Figure 04_ The Sinking Future Post Apocalyptic Flood Survival Centre.

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BACK TO THE FUTURE

Image Credits_ Figure 01_ The Big U, Courtesy of Bjarke Ingels Group; Figure 02, 03, 05) by Julia Casol; Figure 04_ Courtesy of H+N+S Landscape Architects; Figure 06_ Dijkdoorbraak bij Bemmel, 1799, Christiaan Josi, naar Jacob Cats (1741 – 1799), 1802, source: Rijksmuseum, Amsterdam

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THE OYSTER BLOCKS PROJECT

Project Name_ The Oyster Blocks Project

Image Credits_ Figure 01 – 07_ courtesy of the author

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THE HAMMAM OF ERBIL CITADEL

Project Name_ Hammam of Erbil; Location_ Erbil, Iraq

Image Credits_ Figure 01 – 04_ courtesy of the authors

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(re)MADE BY WATER

Project Name_ New World Mall, Bangkok, Thailand

Image Credits_ All images courtesy of the author; Figure 01_ Mall; central court, Photograph by Perfect Lazybones; Figure 02_ Floating market in Bangkok, Photograph by Georgie Pauwels: Figure 03_ Mall, escalators, Photograph by Olga Saliy: Figure 04_ Mall, koi, Photograph by Olga Saliy; Figure 05_ Mall, escalators, Photograph by Olga Saliy.

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T-HOUSE

Project Name_ T-HOUSE, theoretical project; Location_ Hains Point, Washington, D.C.

Image Credits_ Figure 01 – 08_ courtesy of the authors

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THE BLUE LINE

Project Name_ blue developments; Location_ Battir, Palestine; Qeparo, Albania

Image Credits_ Figure 01- illustration by author

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ENVIRONMENTAL IDENTITY

Project Name 01_ Caiaques kayaks; Location_ Pinheiros River, São Paulo, Brazil; Artist_ Eduardo Srur; Project Name 02_Pets; Location_ Tietê River in São Paulo, Brazil; Artist_ Eduardo Srur

Image Credits_ All photos courtesy of Eduardo Srur; Figure 01_ Caiaques, kayaks, Pinheiros River, photo_ Eduardo Nicolau; Figure 02_ Caiaques, kayaks, Pinheiros River, photo_Alexandre Schneider; Figure 03_ Pets, Tietê River, photo_Eduardo Srur; Figure 04_ Pets, Tietê River, photo_ Almeida Rocha

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A METROPOLITAN PARK OF WATER

Project Name_ Metropolitan Water Park project, Location_ Saragossa, Spain

Image Credits_ Figure 01_ Bridge Pavilion & Third Millennium Bridge, Río Ebro, Zaragoza, España, Source_Pabellón Puente y Puente del Tercer Milenio, Author_ Juan E De Cristofaro from Zaragoza, España, CC-BY-SA-2.0; Figure 02_Google Earth aerial view of Zaragoza, Spain; Figure 03_ Plano topográfico de la ciudad de Zaragoza del siglo XVIII, Wikimedia;

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BETWEEN RESILIENCY AND ADAPTATION

Image Credits_ All images courtesy of the author; Figure 01_ by author, background_ by Aleks Dahlberg at www.unsplash.com; Figure 02_ by author; Figure 03, 04_ graphic by author, background_ by Frantzou Fleurine; www.unsplash.com

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WATER AS MEDIUM

Project Name 01_ Water tower in Delft, Architect_ Rocha Tombal; Location_ Delft, NL; Project name 02_ Water tower in Brasschaat, Architect_ Crepain-Binst Architects; Location_ Brasschaat, Belgium; Project name 3_ Water tower Sint-Jans convent, Overijssel; Architect_ Zecc Architects; Location_ Overijssel, NL

Image Credits_All images courtesy of the authors_ Figure 01_ typological evolution of the water tower, Source: Inge Donné; Figure 02_ Water tower in Delft (NL), photo by Christiaan Richters; Figure 03, 04, 05_ Water tower in Brasschaat (BE), Crepain-Binst Architects, photo_ Crepain Binst; Figure 06, 07_ Water tower Sint-Jans convent, Overijssel (NL), Zecc Architects, photo_ Stijn Poelstra, http://www.stijnstijl.nl/;

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Michael Leighton Beaman is the founding principal of Beta-field, a design/research office run with Landscape Architect and educator Zaneta Hong. Michael is also a co-founding member of the design nonprofit GA Collaborative. Michael currently teaches at the University of Virginia where he is an Assistant Professor in Architecture and at the Rhode Island School of Design, where he is a critic in the Interior Architecture Dept. In addition to teaching and practice, Michael is a writer for *Architectural Record* focusing on design technologies and techno-centric design practices.

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Alexander Ford earned a B.S. in Architecture from the University of Arizona in 2014, and an M.S. in Historic Preservation from Columbia University in 2016. Ford currently works for Daniel Libeskind in New York. His architectural work has been published internationally.

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EDITORS

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