Title: **A Responsible Urban Rejuvenation of Jakarta**

Authors: Patrick Daly, Design Director & Principal, Woods Bagot
Paolo Testolini, Global Sector Leader Cities and Places, Woods Bagot

Subject: Architectural/Design

Keywords: Master Planning
Mixed-Use
Parametric Design
Sustainability
Urban Planning

Publication Date: 2019

Original Publication: CTBUH Journal 2019 Issue IV

Paper Type:
1. Book chapter/Part chapter
2. **Journal paper**
3. Conference proceeding
4. Unpublished conference paper
5. Magazine article
6. Unpublished

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Patrick Daly

Paolo Testolini

Authors

Patrick Daly, Design Director & Principal
Woods Bagot
88 Kearny Street
San Francisco, CA 94108-4650
USA
t: +1 415 314 5259
e: patrick.daly@woodsbagot.com

Paolo Testolini, Global Sector Leader Cities and Places
Woods Bagot
313 Emarat Atium
Dubai
UAE
t: +971 52 902 2533
e: paolo.testolini@woodsbagot.com

Patrick Daly has led the design of some of the past two decades' most enduring and recognizable architecture, with a special focus on tall and supertall buildings. Throughout his career, he strives to discover superior solutions to create timeless, innovative architecture. Daly is focused on designing lasting work that manifests a project's higher purpose and potential, while seamlessly considering its programmatic parameters. Utilizing a process that optimizes efficiency and responds to each project's unique demands, Daly has built a versatile and distinguished portfolio.

Paolo Testolini is Woods Bagot's Global Leader for Cities and Places, with 20 years of experience in Urban Planning and Environmental Design. He has worked internationally across a range of sectors, with specific expertise in mixed-use, retail and residential projects. His work regarding the approach to and realization of Smart Cities has been published widely. Testolini participated in the CTBUH 2018 Middle East Conference and has taken part in other international events as a panelist and speaker, sharing his passion for creating sustainable spaces and places for people to work, live and play.

Abstract

Sinking faster than any other big city on the planet, over 40% of Jakarta is now below sea level. Solutions to prevent the decay of one the world's great cities must address permeability, reducing sprawl and building dense high-rise communities. Aquifers are being depleted by both legal and illegal wells pumping out water and, consequently, the city is sinking. Future-thinking urban planning—intrinsically connected to nature and biomimicry, and building tall can reverse the damage and save the city. The centerpiece of the plan is the preservation of Jakarta as one of the region's leading cities with a macro urban concept, using advanced sustainable strategies currently deployed successfully in other regions of the world, whilst underscoring Jakarta's identity through quality places and a sustainable economy.

Keywords: Architecture, Master Planning, Mixed-Use, Sustainability, Parametric Design, Urban Planning

Introduction

Jakarta is sinking faster than any other big city on the planet. The aquifers on which the city sits are being depleted by legal and illegal wells pumping out groundwater and, as a result, the ground level is falling. More than 40% of the land area is now below sea level. Jakarta's equatorial location also makes it the region's most vulnerable city to climate disasters such as flooding (see Figure 1). Land subsidence exacerbates these risks. Sharing common causes, those threats have to be addressed together.

This ecological crisis raises the question of how Jakarta can continue to grow as Indonesia's economic engine. Indonesian President Joko Widodo (see Figure 2) has proposed relocating the capital outside of

Figure 1. Urban flooding is a persistent problem in Jakarta. © Afriadi Hikmal

Figure 2. Indonesia president Joko Widodo.
© Oscar Siagian

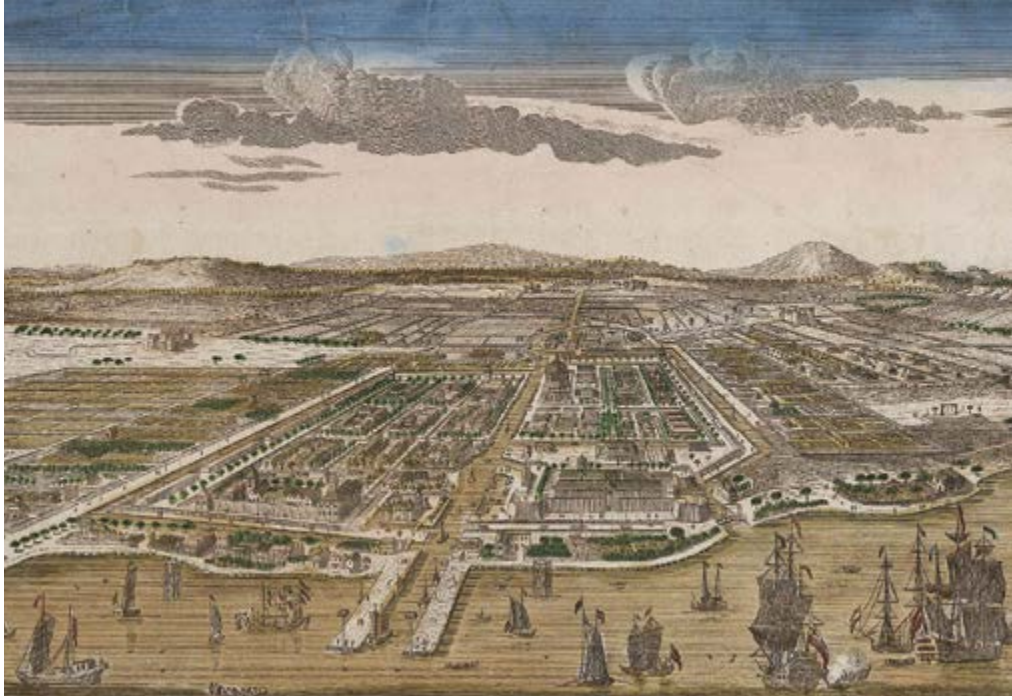

Figure 3. Historical Jakarta (then called Batavia) circa 1780. Source: Tropenmuseum

Jakarta. But with 10 million current residents, Jakarta is too important to abandon, especially if solutions are available.

A Vision for Modernization

Two issues—ecological and economic—need to be reframed to generate a vision of modernization that heals instead of damages a delicate ecology. The key to fixing the urgent problem of subsidence is to rehabilitate the underground water. As these water systems actually begin above ground, their rehabilitation goes hand-in-hand with re-establishing the city with restorative strategies.

The authors' team has developed a new plan that provides data-driven analysis to interconnect the natural context with urban parameters, producing an overall urban regeneration strategy that intervenes strategically within the fabric of the city by mitigating the sinking challenges while activating growth. The team will also develop a public, interactive platform, including mapping the underground aquifers, so that citizens, officials, and developers can learn more about their city's challenges and participate in its rejuvenation.

Existing Context

Jakarta is bounded on the south by Mount Gede and on the north by the Java Bay and Java Sea just beyond the inlet. Thirteen rivers flow through the plains north towards the sea, with the main Ciliwung arterial cutting the length of the Basin and dividing it east to west. The porous alluvial floor once captured the ample rains and allowed that water to seep underground into the aquifers that buoyed the land.

Figure 4. National monument Monas in Merdeka Square. © Healza Kurnia Hendiastutjik / EyeEm

When the Dutch arrived in the 1600s, they built a district, Kota, in the far north of the city, where to this day one of the region's most active ports operates (see Figure 3). Importing the Amsterdam model, they built a series of canals that still course through the area. While the original buildings still stand, the location is also sinking at a high rate of three-to-four inches per year, and the effects—abandoned buildings and markets, high floods—are glaringly apparent.

The current capital resides in the center of the city, around Merdeka Square (see Figure 4), critical to the Indonesian peoples' sense of freedom, as it commemorates their independence on August 17th, 1945. Aside from housing the administrative services for

> “The macro urban concept aims to increase the density of mixed-use high-rise development throughout the central spine of the city, using advanced sustainable strategies.”

the city, this area is also home to major cultural monuments: The National Monument, the Istiqlal Mosque, the Presidential Palace, Jakarta Cathedral, Immanuel Church, Irian Jaya Liberation Monument, and the National Gallery of Indonesia.

As the population continues to grow, unchecked development has meant the decrease of upland forest vegetation and hardscaping over the swamplands for building purposes. Unfiltered and unable to sink into the ground, runoff from this location flows north, clogging the waterways and making Jakarta more prone to floods. While depletion of underground water sources causes subsidence, without greenery to help the watershed retain water, aquifers cannot recharge at the necessary rates, compounding the depletion caused by public demand—as the infrastructure for piped water is still rare and uneven in the city. Subsidence also raises flood water because the land surface is depressed, allowing rising seas and storm surges to further swamp the city (see Figure 5).

As a result, the city suffers from a chain of related water management issues:

- Deep groundwater is seriously exploited, causing land subsidence.
- The prevalence of hardscape has created a ground condition of impermeability, keeping water from reaching and refilling the aquifers.
- The habitat is widely compromised or non-existent.
- Untreated water currently drains from roadways and developments directly into canals.
- Overburdened water channels are prone to more frequent and dramatic floods.

Growth has been largely haphazard, often ignoring the underlying natural systems. Yet there is still a vibrant natural and cultural landscape that can be restored and activated (see Figure 6). As the city moves forward, it needs a path to modernization that does not compromise its health, but contributes to it both environmentally and economically.

Proposed Design Solution

Proposed design principles offer a framework for sustainable urban redevelopment that builds on work successfully delivered throughout China, Australia, and the Middle East, including:

- Restoring water balance with wetlands and blueways
- Linking eco-corridors through responsible agriculture and oxygenating the heart of the city
- Retrofitting the city into an optimized, measurable infrastructure and communicating the energy system
- Reinforcing Jakarta’s identity by reviving it as a sustainable metropolis

In conjunction with these bio-remedial strategies, the centerpiece of the urban plan will be to preserve the current capital location with a macro urban concept that

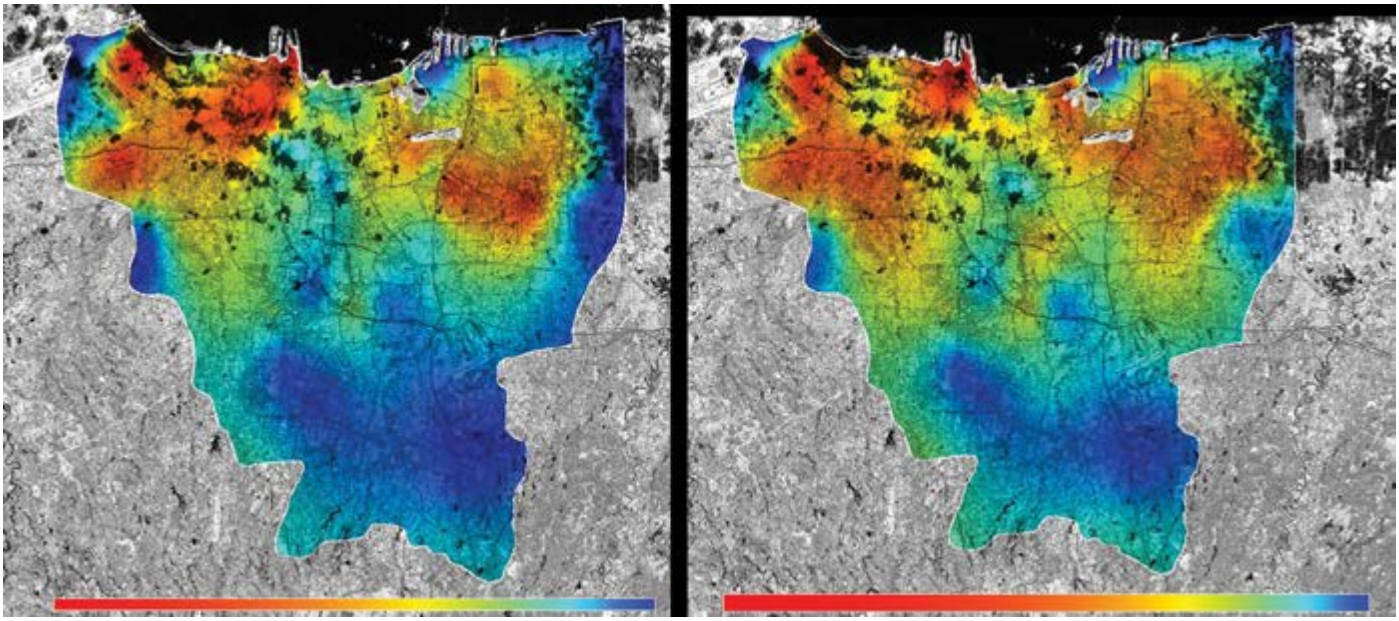

Figure 5. Rates of land subsidence in Jakarta during the period of 1974–1991 (left) and 1991–2010 (right). © Irwan Gumilar of Geodesy Research Group of ITB

aims to increase the density of mixed-use high-rise development throughout the central spine of the city, using advanced sustainable strategies. This central spine aligns with the Ciliwung River and planned mass transit network, becoming the anchor for new development that will restore the waterways and create vibrant new neighborhoods. By embracing water as the driver of placemaking, this threatened—and at once over-abundant—element can become the greatest opportunity for urban regeneration.

The following four-point plan and associated case studies illustrate the proposed way forward to achieve an historical, cultural and urban solution for Jakarta.

1. Restore water with wetlands and blueways
Resolving the water issues necessitates an integrated groundwater management and development solution (see Figure 7). To re-establish groundwater conditions, porosity is essential. For that, an intricate system of wetlands and blueways would be introduced throughout the city to capture, filter, and return water to the aquifer or above-ground water channels.

Wetlands and water catchments: The Ciliwung corridor also serves an important ecological function for the larger Jakarta region. The river is tied to a series of flood control canals. The city invests in cleaning these waterways periodically due to their visibility at key locations. The current flood control canals, however, do not allow the water to permeate back into the ground. To correct this, the corridor will include a series of infiltration ponds for water that has been filtered and cleaned by wetlands immediately to the south. These infiltration ponds will not only allow water to seep underground to recharge stressed aquifers, but can also be recreational and aesthetic amenities.

Storm water treatment: Instead of storm water discharging directly from streets and developments straight into canals and rivers, flows can aggregate across sites to form successively larger drainage ways.

Figure 6. Waterways along Ciliwung River. © Miguel Torres Curado

Figure 7. Pollution in waterways. © Ed Wray

The water will then run through a series of low-impact development (LID) storm water management facilities, green streets, and wetlands, then into larger treatment areas before being discharged into the rivers.

Further resilience for the city's water systems will be delivered via rainwater harvesting on all roofs and at ground level, through the use of water catchments, canals, bioswales, and other water bodies that will weave through the city. As a result, the canals will be transformed from urban blights into ecological corridors, providing wildlife habitats and water quality treatment to storm water flows, while tracing the path through Jakarta's rejuvenated neighborhoods.

Figure 8. Historical colonial building along waterway. © Florian Blümm

Figure 9. Kota Intan bridge along Ciliwung in Kota Tua (old town). © Thierry Falise

2. Eco-corridors linking responsible agriculture with the oxygenated heart of the city
Eco-corridors use nature as a heat sink, increase oxygen levels, filter the air through trees, and zero out carbon emissions. This design strategy of green fingers and ribbons not only achieves ecological reconstruction, but also provides pedestrian open space and green amenities currently lacking in the city (see Figure 8).

Green fingers/ribbons, running the length of the Ciliwung, can comprise a diverse range of eco-friendly networks—including natural wetlands, parks, bioswales, raingardens, ponds and lakes—will weave and connect neighborhoods with a green frame of parklands and wetlands. The river bank offers a natural setting for an elevated linear park to energize surrounding neighborhoods. City centers will provide a percentage of public parks and green spaces (currently at about 10%) at ground level, with green roofs and vertical gardens adding depth to the urban core that emulates nature with a tiered canopy. The combination of dense planting and collected rain/gray water from local development will nourish the buildings, green corridors, and canals with fresh water.

3. Retrofit the existing city into an optimized, measurable communication and energy infrastructure system, including,

- Geothermal Energy
- Algae Biomass Harvesting
- Electric Vehicle Support
- High Energy Efficiency Clusters
- Energy Efficiency Retrofits

4. Reinforcing Jakarta's identity by reviving it as a sustainable metropolis
Jakarta is comprised of different districts with their own characters, and important cultural, natural, and commercial sites. The Ciliwung and its series of flood control canals synch with the city's most visible landmarks—from the northern historic district of Fatahillah Square to the central Merdeka Square and the business district, which become anchors for concentrated urban development (see Figure 9). Also, along the Ciliwung corridor, a new mass transit system is underway.

The first phase of this network runs from the Hotel Indonesia Roundabout in the center to the south of the city. Phase two will extend this line to the old Dutch port of Kota in the north, completing the north-south connection, potentially reducing sprawl, easing the burden on Jakarta's notoriously jammed roads, decreasing pollution, and catalyzing development for this growing city.

Strategically weaving together commercial spaces, residences, public parks, and eco-corridors with lively streetscapes and ground-level commerce, this plan provides the required programmatic uses, while simultaneously prioritizing the activation of the public realm. Each site presents opportunities to integrate water remediation and greenery, as well as other passive, low-carbon strategies, incorporating year-round prevailing winds from the west and overhead sunlight to minimize energy use. Taken together, they can sustain the environment in profound ways.

Case Studies

The following three case studies are precedent-setting examples of how the above proposed design strategies can enhance the historic, cultural and urban environment in Jakarta.

Merdeka Square: Pertamina Headquarters—Creating a Renewed Urban Condition

Merdeka Square is central to the national identity and is located in the heart of the current government capital. This area is also where the subsidence of the city is most extreme. Yet, understanding that reversing subsidence and saving this location requires fixing the underground water system, and that achieving this requires above-ground rehabilitation—we have a chance to address the deeper urban ecology while exhibiting a new model of development. This is what Pertamina sets out to do.

A landmark tower, the new site for the Pertamina Headquarters, is an opportunity to create a revived urban condition in this historically rich neighborhood. Adjacent to Merdeka Square, Pertamina is designed as an extension of the park itself—emulating the arrival into a grand park space. A series of sky gardens punctuating the sculpted form offer visual connectivity to the local landmarks, an outdoor amenity to users, while capturing and cleaning both air and water (see Figure 10).

On three sides the site is bounded by the Ciliwung River. In fact, the flood control canal links back into the Ciliwung exactly at the point where Pertamina and the Istiqlal Mosque meet. The design employs bio-remediation strategies that can participate in the cleansing of the river, while at the same time elevating the quality of the garden environment of the site itself. The constantly flowing water from the river estuary is channeled through reed beds, wetlands, and landscaped areas that naturally filter pollutants and toxins from the water before returning a clean supply to the city. Rainwater and air-conditioning condensation water will be recycled through the building and further cleanse the river water. Ultimately the ground plane of the Pertamina Headquarters and the river become one co-beneficial system.

This design demonstrates the kind of ultra-low carbon and sustainable design operations that future buildings can emulate. Optimized passive design is harmoniously integrated with simple and renewable systems that are easy to maintain and cost-effective—including building-integrated photovoltaic (BIPV) glazing, enthalpy heat recovery systems, open-loop water-source heat pumps, and utilizing the flowing wetlands as a heat sink.

North—Fatahillah Square: Reviving the Old Cultural Heart With New Transit Links

Further north, beside where the Ciliwung runs into the Java Bay, is Fatahillah Square—the center of Jakarta Old Town (old Batavia), now called Kota. This inner walled city square is surrounded by the original Dutch structures that house a cluster of museums, cafés and other cultural attractions (see Figure 11). Historically one of the most active ports and fishing areas in the region, this location has been largely disregarded, and many of the old buildings remain vacant.

Supporting a conservation plan for Fatahillah Square as a destination for visitors and locals, as well as the viability of the surrounding economies and ecology, will protect this cultural legacy while connecting it to greater Jakarta. The new transit line will

Figure 10. Merdeka Square. © Abdul Azis

Figure 11. Fatahillah Square, historical center of the old Batavia. © Didier Martiexactly

Figure 12. Menara Taspen project aerial rendering. © Woods Bagot

reach Fatahillah Square, potentially spurring development that can preserve the city's architectural roots. Steps toward rejuvenation have already been taken—such as the closing of surrounding streets to vehicles and attempts to put the site on the UNESCO heritage list.

South—Taspen (BUMN City): A Transit-Oriented Development's Commercial Center that Engages the Ciliwung Canal

This new commercial center is also at a key location along a Ciliwung flood canal and transit corridor. The project employs a combination of dense planting and collected rain/grey water that nourishes both the Badan Usaha Milik Negara (BUMN) site, as well as the adjacent flood control canal with fresh water. The city is already planning for riverwalks along this canal, which will be populated with foot traffic from the adjacent mass transit. Building on those plans, the site proposes a system of recurring riverwalks adjacent to these newly restored waterways throughout the city—creating a public space that fosters the intersection between commerce and culture.

> "The Taspen master plan solutions address flooding risk by highlighting rainwater collection, redistributing the water effectively by returning bio-remediated water into the flood canal, as a way of encouraging the canal's future as an amenity."

The Menara Taspen/BUMN City strategy entails a landscaped hub, which will become the exemplar for a transit-first, dense urban development (see Figure 12). This government-endorsed strategy represents the best of Jakarta through world-class design and first-rate public space, whereby the development becomes the center of civic and cultural activity in Jakarta.

The project's initial aspirations mandate that the development:

- Nests within a cluster of iconic towers
- Sits on the brink of the historic city center and the new center of growth
- Links to a future metro station and existing bus rapid transit station
- Sits on a highly visible location along a main artery of the city
- Provides dramatic, panoramic city views.

This project is also located in an area with low-lying portions that are highly susceptible to flooding. The master plan solutions address this issue by highlighting the rainwater collection, redistributing the water effectively by returning bio-remediated water into the flood canal as a way of encouraging the canal's future as an amenity.

A New Urban Vision for Jakarta

The design principles and case studies outlined above offer a framework of urban sustainability based on the area's natural grid, combining strategies of remediation, mobility, density, and enhanced public realm around a restored network of green fingers and canals. With water driving placemaking, the city's ample green and blue arteries can serve as a basis for rejuvenation, pedestrian flow, neighborhoods, and energizing the overall connectivity. Bringing nature, development, and transit together along the Ciliwung Corridor, the plan provides solutions for the environmental sustainability and future economic growth of Jakarta. ■