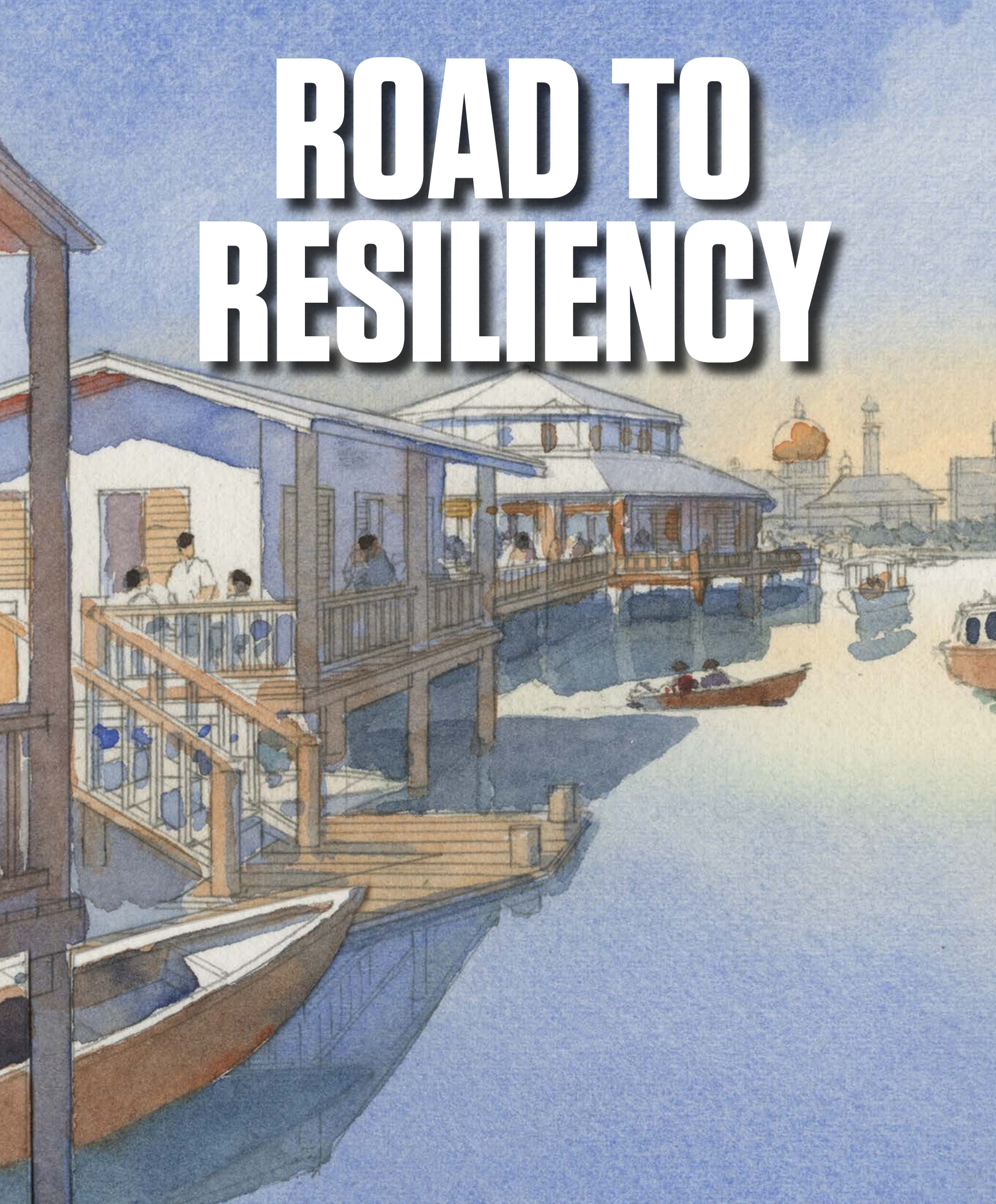
ROAD TO RESILIENCY



Architects and engineers design for the world's highest at-risk region for natural disasters.

WRITTEN BY **KATHARINE LOGAN**

Resilient design takes stock of the hazards a project is likely to face—earthquakes, storms, extremes of temperature, floods, fires, or a combination—and builds in the capacity to adapt and recover. In Maritime Southeast Asia, where hazard exposures span a wide range of type and intensity within a small, densely populated area, three current projects respond to risks at three levels of urgency.

In the disaster-prone Philippines, a sports complex is designed to double as an emergency shelter. In Indonesia, the region's largest economy, a super-tall office tower and adjacent mosque are designed to remain functional even if the city's power grid fails. And in developing Brunei, a master plan based on biomimetic (synthetic methods that mimic biochemical processes) principles will enable the capital city to mitigate flood risks while strengthening its identity and sense of place.

Regardless of geography or urgency, the questions guiding resilient design are the same, says Luke Leung, PE. Leung is director of sustainable engineering at Skidmore, Owings & Merrill (SOM) and an author of the U.S. Green Building Council's (USGBC) new pilot credits in resilient design. The first question, he says, is always, "What are the vulnerabilities?" Project teams need to make a realistic assessment of the types of hazards their project may face. Then, depending on the nature of the project, the second question is "how to design/plan for the potential threats?" This can include questions similar to: What are the plans for the top challenges at the site? How long can the building provide thermal comfort for its occupants if it loses power? Will the occupants survive when there are no utilities from the outside?

Philippines

According to the Index for Risk Management (InfoRM), which is a collaborative project of the Inter-Agency Standing Committee and the European Commission, the Philippines' hazard and exposure score ranks among the world's top 10 (8.1 out of a theoretical 10). The capital, Manila, the world's most densely populated city, straddles multiple geological fault lines, and each year some half dozen typhoons pound the city. Especially vulnerable are the large urban poor communities living in shanty towns built of light materials, where building safety, fire, and health codes are not enforced, and sanitation and water supplies scarcely exist.

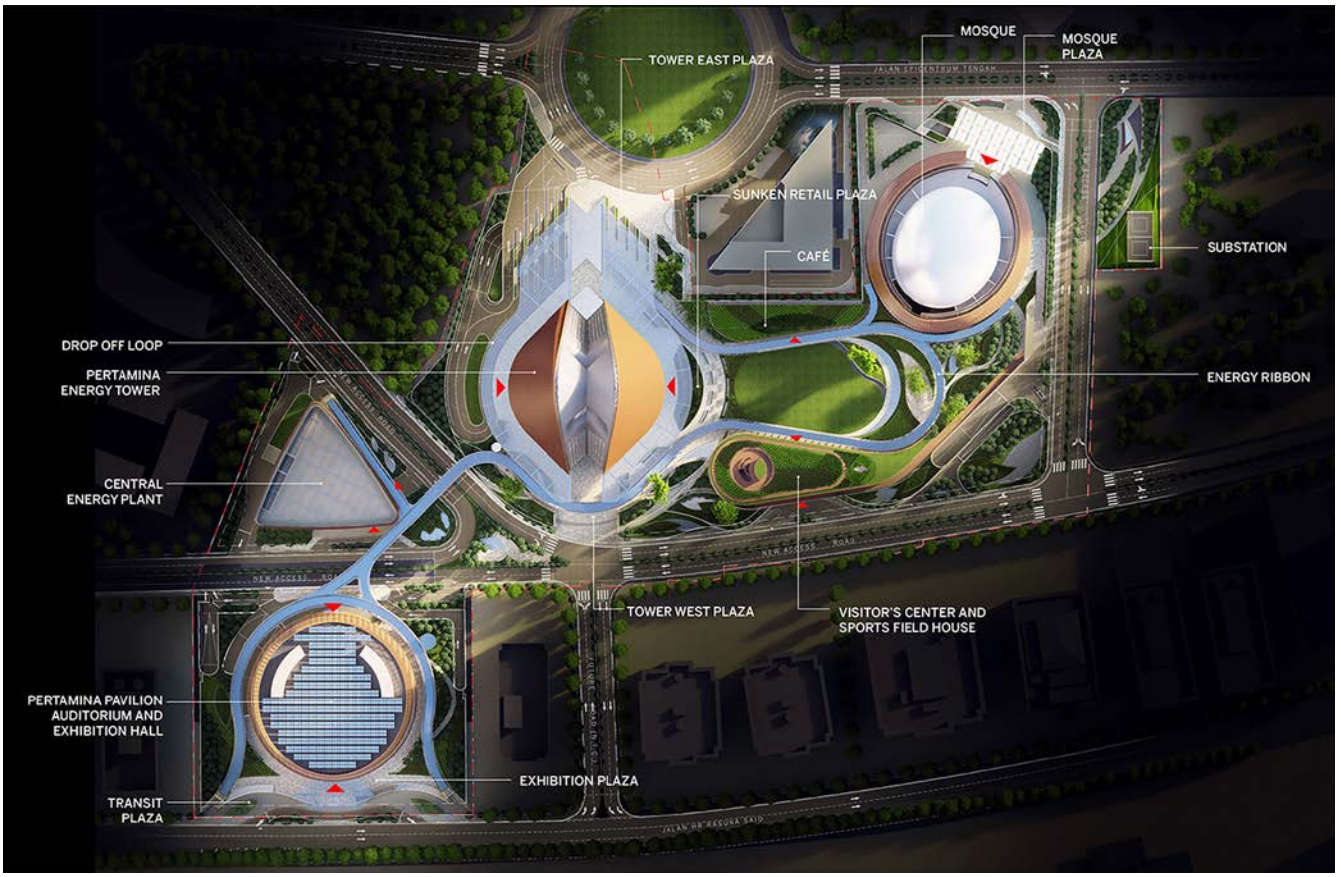
To improve its residents' security and quality of life, one of the municipalities forming part of metropolitan Manila, the city of Pasig, has recently embarked on a plan to create a healthier and greener city, including provisions for resilience in the face of disaster. "Pasig is going full out in addressing these problems," says Edwin Barcia, a partner with Manila-based T.I. Vasquez Architects & Planners (TVA&P). "Fortunately, the city is relatively well off, with public and private leaders who understand what's needed."

Integral to the city's initiative is a new athletic facility, the Pasig City Sports Complex (PCSC), designed by TVA&P now under construction. The PCSC comprises a 440,000-sq-ft arena building and a 73,000-sq-ft natatorium, as well as auxiliary buildings and outdoor facilities and parks. Beyond its daily uses, "The PCSC can double as a first-rate emergency facility," says Barcia, "to host hundreds of dislocated families affected by typhoon, flooding, or fire."

The Pasig City Sports Complex was designed by TVA&P. Beyond its daily uses, the complex can double as an emergency facility to host hundreds of dislocated families affected by typhoon, flooding, or fire. Rendering courtesy T.I. Vasquez Architects & Planners Inc.

This page: Rendering of the Pertamina Energy Campus site plan. Opposite page: Rendering of observation deck of the tower west plaza.

Images courtesy SOM / © 3D World | SOM



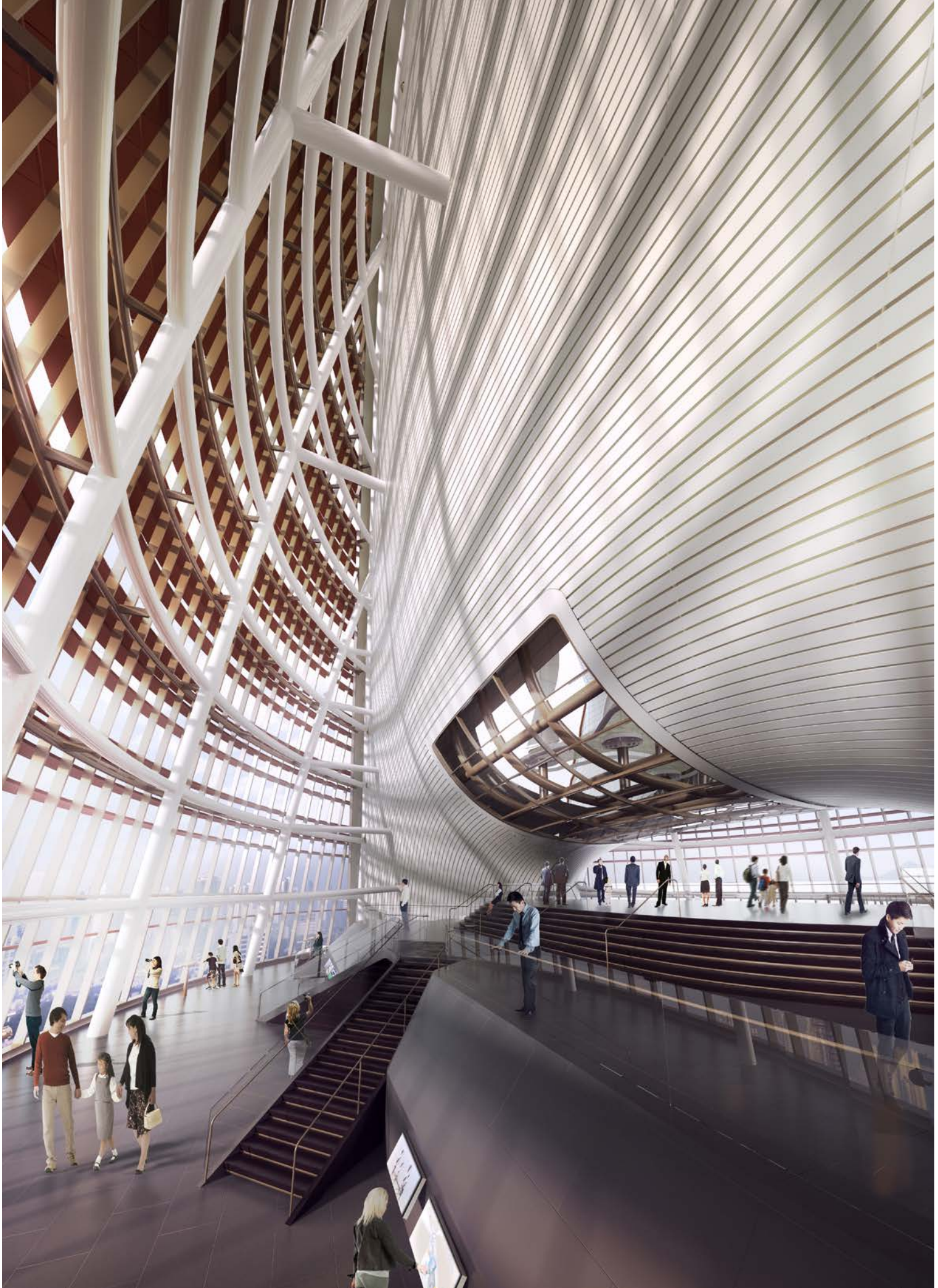
Unlike many existing civic facilities whose own vulnerability to disaster limits their effectiveness as relief centers, the PCSC is built on bored piles with a superstructure designed to withstand typhoon and earthquake forces, and elevated a meter above the adjacent road to prevent flooding.

The first two floors of the natatorium are designed to accommodate evacuees, medical services, and food preparation and distribution. The larger arena building, comprising an open parking area, an indoor basketball court, a mezzanine level for indoor sports, lecture rooms, a library, and offices, and a third floor football field with covered spectator seating for 2,000. It can also accommodate many more evacuees if needed, with food services from the natatorium, and sanitary facilities distributed between both buildings. The arena building can also serve as a back-up city hall. It will be the first such center in the Philippines and will significantly improve Pasig's resilience as well as its residents' quality of life.

Indonesia

Indonesia, Southeast Asia's largest economy, may not lie directly athwart the typhoon path as the Philippines do, but it still scores a very high 6.5 on InfoRM's hazard and exposure index. Each year, two or three earthquakes hit magnitudes of seven or higher on the Richter scale, causing casualties and damaging infrastructure. Volcanoes define the landscape. And monsoon season brings regular floods.

The new Pertamina Energy Campus, designed by SOM for Indonesia's state-owned oil and natural gas company, and scheduled for tender later this year, will sit seven meters above Jakarta's 100-year flood line—"like a big ship," says Leung. To prevent run-off from flooding its downhill neighbors, the project is also designed to achieve net-zero water: All rainwater falling on the site, as well as all water used in the building, is recycled in cooling towers, irrigation, or



This page: Rendering of tower from the west. Image courtesy SOM / © Smilodon CG
Opposite page: Rendering of tower crown section. Image courtesy SOM / © 3D World | SOM

toilets; absorbed through retention and infiltration; or returned to the aquifer through a recharging well.

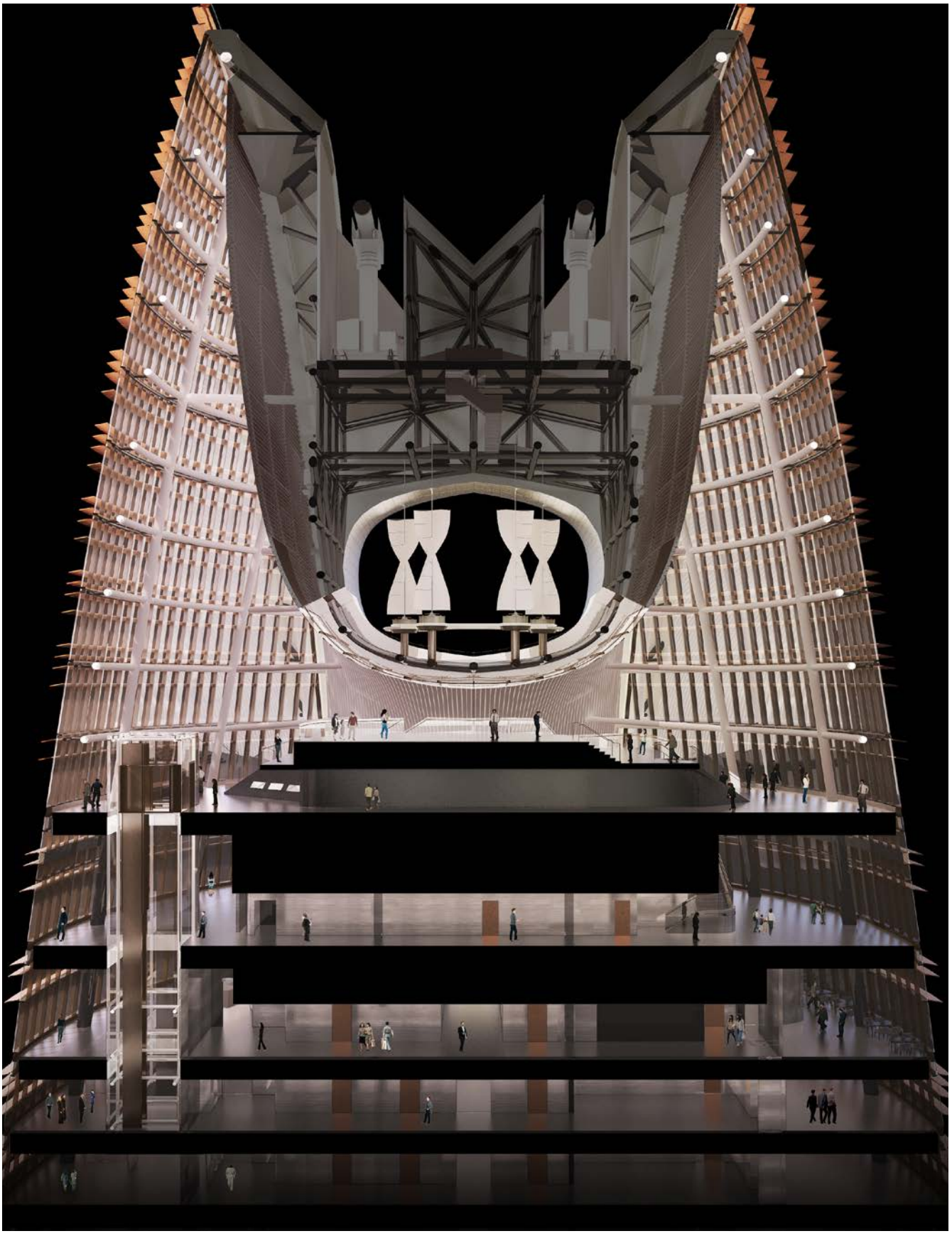
If the Pertamina campus's water management is impressive, its energy achievements may be more so. The campus will be the world's largest net-zero energy project. Ten times larger than any net-zero achievement in the world to date, it is designed to remain functional without outside utilities indefinitely.

The campus comprises a 523-m super-tall tower, complemented by a performing arts and exhibition pavilion, a mosque, and a central energy plant. The mosque is designed to be entirely passively cooled and daylit. The tower reduces its energy demands for cooling and lighting with a building form defined by the path of the sun. Shade-fins minimize insulation and maximize daylighting. The energy plant then leverages the dynamic geology that contributes so heavily to Indonesia's hazard index: Drawing on deep-well geothermal energy, it taps heat nearly two miles beneath the Earth's surface to generate combined cooling, heat, and power for the entire campus. The project also uses shade canopies of photovoltaics along campus paths to generate solar energy, and wind turbines set in the tip of the tower will take advantage of higher wind speeds at higher altitudes.

If utilities are disrupted, says Leung, "you can survive as long as you have running water and the building doesn't overheat. Otherwise, you're going to have to abandon that building really quick—especially in a hot and humid climate like Jakarta's." The Pertamina campus's suite of overlapping energy strategies is designed so it not only remains habitable but operational, too.

Brunei

By contrast with the region's more hazard-prone, populous, and bustling countries, the country of Brunei, which means "Abode of Peace," seems to warrant its name. A tiny country on the leeward side of the island of Borneo, Brunei boasts a hazard and exposure index (0.3) that ranks among the world's lowest. Hazards do exist, but they're slower moving. "Resilience is seen as a subset of sustainability," says Chris Fannin, senior vice president at HOK and director of the firm's Asia Pacific planning group. HOK



The master plan for Brunei's capital, Bandar Seri Begawan, will reestablish the river as an element of green infrastructure to manage frequent flooding in the city center.

led the development of an award-winning master plan for Brunei's capital, Bandar Seri Begawan.

Located on Brunei's coast, at the confluence of three rivers, Bandar Seri Begawan in recent decades has channelized its river, increased paving cover, and developed laterally at the expense of the surrounding rain forest, all of which have compromised the landscape's capacity to manage its rainfall. "Flooding is huge," says Fannin. "The amount of rainfall is phenomenal. Combine that with high tides and rising sea levels, and it is the perfect worst situation."

The development master plan (DMP) seeks to re-establish the river as an element of green infrastructure to manage frequent flooding in the city center, and to establish an urban growth boundary to preserve the forest. The design for the riverfront eco-corridor encompasses some 370 acres of naturalization areas and over 50 acres of built-up landscape. Principles governing its development include improving the flow and function of the rivers, naturalizing upstream riverbanks to improve stormwater absorption, and adding waterways and bio-swales through urban neighborhoods to promote rain infiltration and manage runoff.

Advantages of these resilience-based initiatives ripple beyond their functionality. Although the river eco-corridor originated as a flood management strategy, through stakeholder meetings it has grown to encompass tourism and urban regeneration. Moreover, the resilience-based initiatives contribute to the revitalization of Brunei itself. "The rainforest and the river," says Fannin, "that's the cornerstone of Bruneian identity."

Yet, perhaps commensurate with the country's low hazard index, uptake of the DMP has been slow. A fall in the price of oil (Brunei's primary source of wealth), the absence of a development review process, and the implementation of projects at odds with the plan have all hampered progress toward the vision for a more vibrant, sustainable, and resilient city. Recently, however, Fannin has seen signs of a push to get back on track. "It seems clear that the government wants to find a way—and quite frankly they have to find a way—to move forward."