

City of Water: Architecture, Infrastructure and the Floods of Phnom Penh

This work documents the relationships between water, architecture, and infrastructure in Phnom Penh, Cambodia, records the architectural and urban conditions sustained by and subject to the cyclical floods of the city's rivers, and describes the challenges faced by Phnom Penh as it rapidly urbanizes in a flood plain..

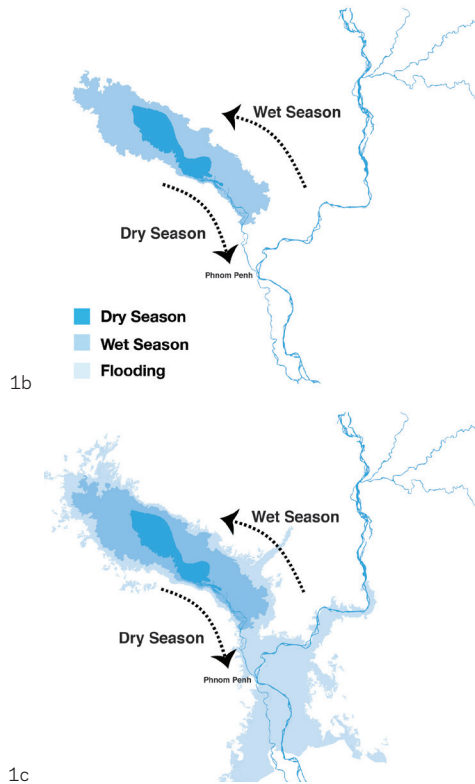
The following research, resulting from a yearlong Fulbright Grant, serves as a means to explore the nature and agency of design in relation to these topics, with a focus on education and public outreach as tools for engaging the urban changes facing Phnom Penh.

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SITE: MEKONG DELTA + THE TONLE SAP FLOOD PULSE

Cambodia's capital, Phnom Penh, is located at the confluence of the Mekong, Tonlé Sap, and Basaac rivers, an intersection known as 'Chaktomuk' or the 'Four Faces'. The city is home to 1.5 million people, many of whom live and work along its riverbanks. Millions more Cambodians are sustained by these rivers, their flood cycles, and the accompanying deltaic landscape. The recent environmental challenges facing Phnom Penh are urgent, serious, and intensified by its relationship to the seasonal floods of the Mekong River. The Mekong descends through six culturally diverse countries, demonstrating the scope of shared interests and competition in the region, as well as the complexity of conducting environmental and design research in Southeast Asia.

The result is a topography defined by an intense interdependence between the inhabitants of the region and its rivers. Each year, monsoons and snow-melt cause the Mekong River to flow into the Tonlé Sap with such force at their intersection in Phnom Penh, that the Tonlé Sap reverses flow and floods the surrounding region to roughly four times its dry season area and depth, resulting in one of the most delicate and diverse ecosystems in the world. Flood management must achieve a delicate balance: to preserve the benefits of the flooding while reducing the costs and impacts to life and property. As Phnom Penh rapidly urbanizes in the flood plain, achieving this balance becomes increasingly urgent.



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1d

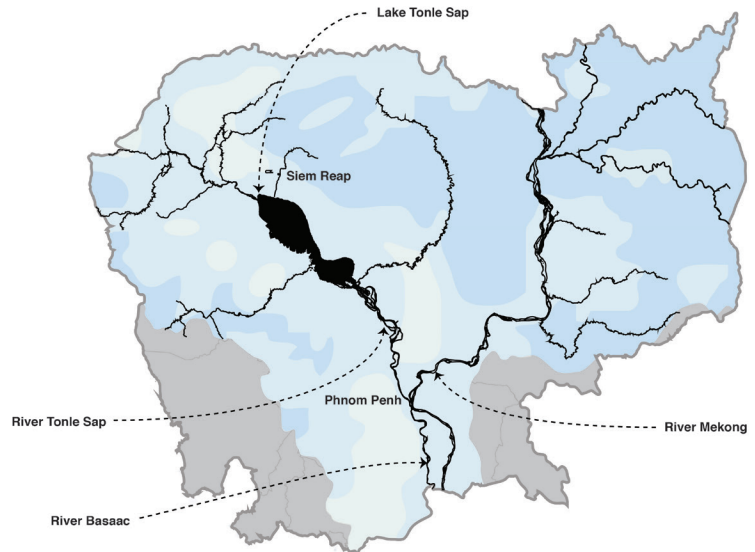
Figure 1a: Cambodia's capital, Phnom Penh, is located at the confluence of the Mekong, Tonlé Sap, and Basaac rivers, an intersection known as 'Chaktomuk' or the 'Four Faces'.

Figure 1b: Top: Map of a typical Tonlé Sap Flood Surge.

Figure 1c: Map of the 2011 floods redrawn by author from a United Nations Map.

Figure 1d: Kampong Khleang a floating and stilted village on the Tonlé Sap Lake during dry season.

These villages are dependent upon the Tonlé Sap flood surge for food production, primarily fishing and agriculture. Photo by author.



1a

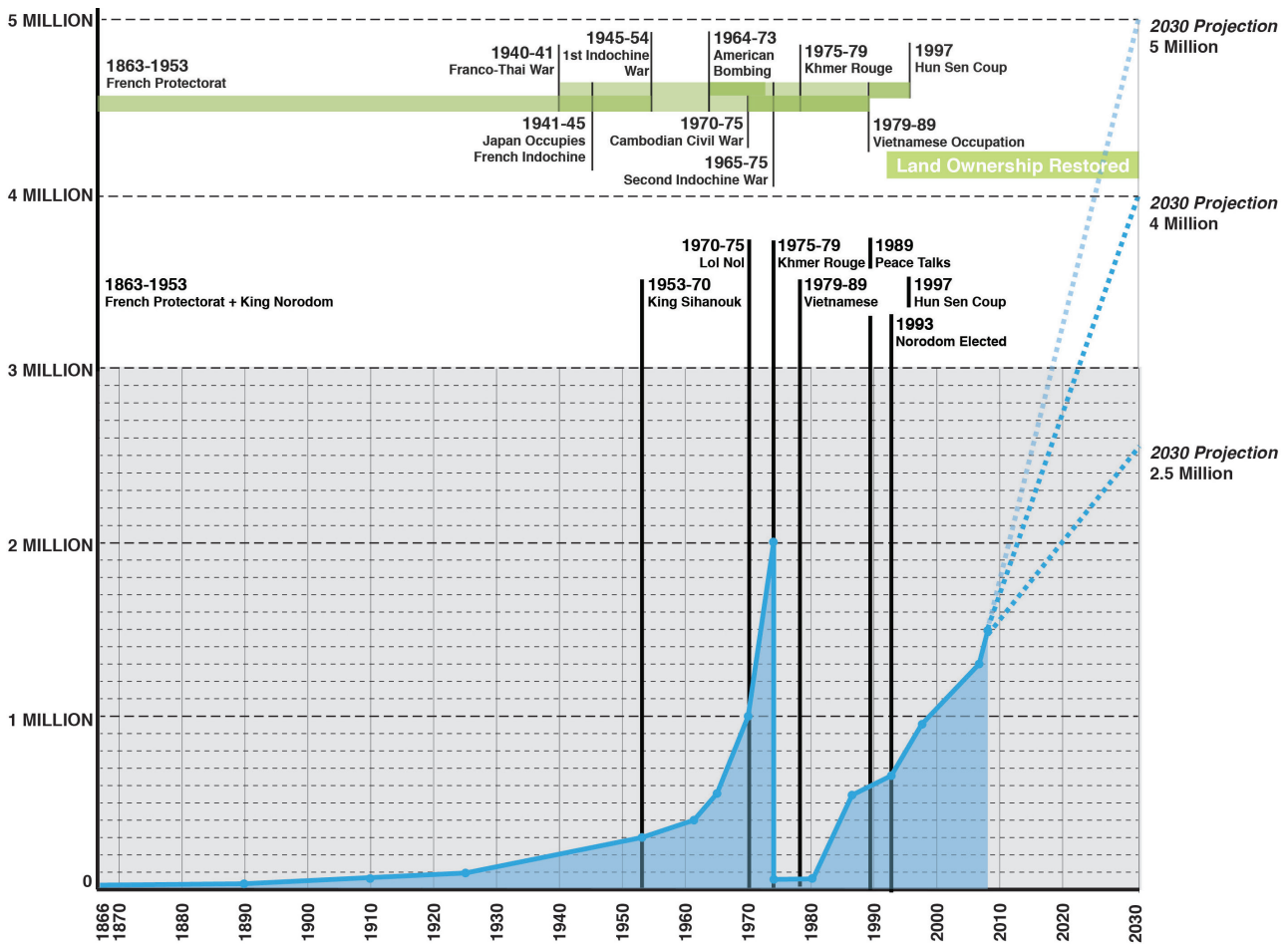
Additionally, dozens of hydropower dams are planned or under construction on the northern Mekong River placing further pressure on the region's flood cycles. The unknown impacts of climate change magnifies these pressures. According to the World Wildlife Federation, "The Greater Mekong is one of the most vulnerable places on Earth to the impacts of climate change." For the Mekong, climate change compounds existing and projected threats affecting the region's people, biodiversity and natural resources. This is likely to have cascading effects, such as water scarcity leading to reduced agricultural productivity, leading to food scarcity, unemployment and poverty (World Wildlife Fund, 2009a).

HISTORIC CONTEXT

While the intent of this work is to convey the contemporary conditions of Phnom Penh its historic context is crucial to understanding these conditions. French planning decisions in the 19th century and decades of war combined to create the physical and conceptual framework that defines the challenges facing Phnom Penh today. The following discussion of historical context is not intended to be comprehensive but rather to provide a sense of how the traces of history are manifest in the present day city. While little design literature exists about Phnom Penh, the resources relied upon here are: Vann Molyvann's *Modern Khmer Cities*, Helen Grant Ross and Darryl Leon Collins' *Building Cambodia: 'New Khmer Architecture' 1953-1970*, and Penny Edwards *Cambodge: The Cultivation of a Nation 1860-1945*.

FRENCH PROTECTORATE

Following the fall of the Angkor Empire, the Cambodian capital moved first to Phnom Penh (1432 to 1505) then several times over the centuries between Tuol Basan, Pursat, Longvek, Lavear Em and Udong. In 1863, Cambodia became a protectorate of France and Phnom Penh was reinstated as the capital. This was an important move as it not only positioned Phnom Penh as an international trading hub but also placed the Cambodian capital within the Mekong flood plain.

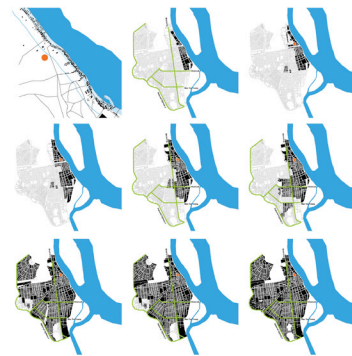


2a

Penny Edwards writes in *Cambodge*: In the early years of the Protectorate, “the city was best known for its vast tracts of mosquito-infested swamp-land, the stench of stagnant water and human waste, and frequent outbreaks of cholera. In the wet season, boat travel was necessary between different sections of Phnom Penh.”

According to architectural historian Helen Grant Ross, one of the most significant changes introduced by the French was the authorization of construction on land only. This policy contradicted both Khmer law and tradition, which posited that the King owned all of the land and that construction required his consent, which was typically granted only for palaces, temples and monasteries. Therefore at the time of French arrival in 1863, Phnom Penh’s building pattern reflected this tradition: the city had grown linearly along the banks of the river, stilted above the water or floating upon the water itself. The architecture was constructed primarily of wood, thatch and lightweight materials that could be seasonally repaired and replaced as necessary. This construction model also protected the city from floodwaters by capitalizing on the riverbank’s natural berm as well as a series of *preks* - constructed earthworks that control flooding and produce intentional dry season ponds.

The decision to move all construction inland had radical implications upon the future development of the city. The French colonists began the task of transforming the riverside village into a geometric cityscape that paid



2b

Figure 2a: Y Axis: Population of Phnom Penh 0-5 million X Axis Top: Armed Conflict and Occupation in Cambodia by Year X Axis Middle: Governmental Administrations in Cambodia by Year X Axis Bottom: Dates 1866-Present Dates. Graph drawn by author. From various sources listed at www.cityofwater.wordpress.com/2012/01/17/phnom-penh-population-vs-conflicts

Figure 2b: City development from 1866-1993. Redrawn from maps by the Bureau of Urbanization.



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Figure 3: Top to Bottom: The White Building Basaac Riverfront, Library Royal University of Phnom Penh, Exhibition Hall Royal University of Phnom Penh, National Sports Complex 'Olympic Stadium'. All located in Phnom Penh. Photos by author.

tribute to Rene Descartes' vision of a "well-ordered town laid out on a vacant plane as suits [the engineer's] fancy." They began this process by projecting a rectilinear street grid of concrete and stone onto the marshy wetland and perpendicular to the river. During the early years of the protectorate the colonial administration made various attempts to resolve the recurrent problem of flooding by filling in several small natural lakes and digging a series of interlinked canals to provide better drainage. These canals also served to physically segregate Phnom Penh into quartiers, based primarily on the ethnicity of residents. These comprised a quartier Cambodgienne, a quartier Annamite, a quartier Chinoise and a quartier Européen.

Through the 1890s the development of French Phnom Penh grew under the direction of architect and town planner Daniel Fabre (1850-1904) whose work also included several buildings, most notably the Central Post Office, and the renovation of Wat Phnom. In 1925, architect and town-planner Ernest Hébrard drew up a plan for the extended urbanization of Phnom Penh. Thereafter, the Indochina Town Planning Service (Service de l'architecture et de l'urbanisme de l'Indochine, founded by Hébrard two years earlier in Hà Noi) was responsible for overseeing the systematic development and rationalization of much of Phnom Penh.

THE GOLDEN AGE

In 1940, the French Vichy government allowed Japanese troops to enter Indochina, which then became an autonomous province of the Japanese Empire and was eventually annexed by the Japanese in 1945. Consequently, H.M. King Norodom Sihanouk declared an end to the French protectorate. However, with the defeat of Japan and the arrival of allied forces, French colonial rule was reinstated until November 1953, when Cambodia at last gained its independence.

In 1955, Norodom Sihanouk abdicated the throne to his father H.M. King Norodom Suramarit in order to become Prime Minister, and later Head of State. No longer a monarch, Norodom Sihanouk began to build his vision of a new nation. He was a composer, writer, poet and lyricist, filmmaker, interior designer, and a patron of the arts.

The city of Phnom Penh became a physical manifestation of independent Cambodia through a movement known as New Khmer Architecture, which blended modern architecture principles with Cambodian tradition. This period of innovative architecture and urban planning made Phnom Penh known as the 'Pearl of the Asia'.

This period is best known through the designs of Cambodian architect Vann Molyvann. In 1926, Vann Molyvann obtained a scholarship to pursue his studies in Paris, France, and completed an architecture degree at the School of Fine Arts in Paris (Ecole Nationale Supérieure des Beaux-Arts) and was a student of Le Corbusier. He studied in the Arretche studio and returned to Cambodia in 1956, the first fully western-trained Cambodian architect. Upon his return he was appointed Head of Public Works and State Architect by Norodom Sihanouk.

The Vann Molyvann Project, which aims to preserve and disseminate his work, says of Vann Molyvann: he "adapted a modern vocabulary to Cambodia's culture, climate, geography and its vernacular and ancient architectural

traditions. In particular, the buildings elevate what we now call 'green' technologies—double roofs, cross-ventilation, brise-soleils, indirect lighting, evaporative cooling, use of local materials—into exquisite architectural form.”

SECOND INDOCHINA WAR + THE KHMER ROUGE

By 1975, Phnom Penh's population doubled in size to an estimated 2 million people as rural Cambodians fled the American bombing campaign in the east and Lon Nol's civil war in the countryside (1968-1974). Everything in Phnom Penh changed on April 19, 1975. The Khmer Rouge waged war upon the city and its population as emblems of capitalism and corruption. Following the forced evacuation of Phnom Penh by the Khmer Rouge in April 1975, approximately 50,000 people remained in the city as the new government set about to radically reorganize Cambodia into their utopian vision of a rural, agriculture-based communal society. Property ownership was eliminated and the urban development of Phnom Penh ceased.

Estimates of the total number of deaths resulting from Khmer Rouge policies, including disease and starvation, range from 1.7 to 2.5 million, approximately one quarter of the country's population of 8 million. Although Vann Molyvann escaped the Khmer Rouge by fleeing to Switzerland, not everyone in the design community was so fortunate. Their loss created a void in the education and continuity of the profession, severing contemporary practice from the time of New Khmer Architecture. The ramifications of this lost generation have far-reaching and still developing impacts on contemporary architecture and planning practice within Cambodia.

CONTEMPORARY CONTEXT

RAPID POPULATION GROWTH

In 1979, communist Vietnam invaded Democratic Kampuchea and toppled the Khmer Rouge regime. Vietnamese occupation continued until peace talks began in Paris in 1989 under the State of Cambodia, culminating two years later in October 1991 in a comprehensive peace settlement. The United Nations Transitional Authority in Cambodia (UNTAC) mandated a cease fire, addressed refugees, and disarmament. A new Cambodian government was installed in 1993; a constitutional monarchy operated as a parliamentary representative democracy.

In a 1997 coup Hun Sen seized full control of the government from Co-Prime Minister Prince Norodom Ranariddh, and remains Prime Minister of Cambodia and leader of the Cambodian People's Party (CPP). Hun Sen has been in power for more than 10,000 days making him one of the longest-serving political leaders in the world.

During the 1990s land ownership rights were gradually restored to Cambodians thereby releasing Phnom Penh from the evolutionary stasis of the previous 20 years. Since the 1975 evacuation, development of the city was hindered, and nearly halted, by war and occupation. As Cambodia began to politically stabilize the people of Phnom Penh began to physically and economically rebuild. Since 1997 Phnom Penh has grown from a city of 500,000 to 1.5 million. If current or even accelerated growth rates continue and as people migrate from the provinces seeking economic opportunities, the city could double or triple in size by 2030.

LACK OF MASTER PLAN

In 2005, the French Bureau of Urban Affairs proposed a Master Plan for Phnom Penh: a 330-page document entitled the “Livre blanc du développement et de l’aménagement de Phnom Penh”. The document provides a comprehensive description of both historical and current characteristics of the capital, ending with a strategic master plan leading up to year 2020. However, as 2020 approaches the master plan has yet to be formally adopted by the government and therefore remains a set of suggestions and recommendations rather than a force guiding the city’s development. The result is rapid uncontrolled development characterized by a lack of building code, no zoning enforcement, and few development laws and regulations. The suburbs in particular are experiencing sweeping changes in land use, as former agricultural land is bought up and rapidly developed into built projects.

While in the surrounding provinces buildings are still being constructed in response to the floods - raised, floating and stilted homes - such constructions, though once common in the city as well, have nearly disappeared from Phnom Penh. Rather, the ground floor, often enclosed, has become a valuable commercial space. Sidewalks have become parking space and nearly the entire city is paved, with few existing or planned parks to absorb seasonal rains.

As the city changes without the guide of a master plan, its most vulnerable residents are being displaced by development. Rights groups report over ten percent of Phnom Penh’s population has been displaced during the past decade. Since a full cadastre map of the city does not exist, evictees often do not hold ‘hard title’ and have little if any political or judicial recourse. Often they are relocated to sites without economic opportunity or basic infrastructure and inadequately compensated for their lost property.

LAKE INFILLING

A network of wetlands, streams and ponds, which are currently being filled with earth to create developable land, surrounds Phnom Penh. This process raises both human rights and environmental concerns. One motivation for this infilling is that water is not a constructible area since it belongs to the State. Therefore, developers in partnership with officials fill in waterways, thereby transforming them into land that is physically and legally suitable for construction.

A recent and politically contentious example is Boeung Kak Lake, a lake of nearly 90 hectares, filled in by Shukaku Incorporated, owned by Cambodian People’s Party Senator Lao Meng Khin, to create a site for a “multi-purpose living and recreation center.” Nearly 3,500 (nearly 20,000 people) of 4,200 households on the site have been evicted to make room for the development

PUBLIC PARKS + OPEN SPACE

Compounding the issues of lake infilling is the lack of park space or open space to absorb rainy season waters. The inner *kahns* (districts) are home to a series of formal parks and gardens but they are often hardscaped, formally planted and home to decorative, rather than functional water features.

WASTEWATER TREATMENT

A network of wetlands, streams and ponds into which over 1 million cubic meters of the city’s household wastewater and storm water are discharged daily surrounds Phnom Penh. There is no formal wastewater treatment in

Figure 4a: Rainy season afternoon flooding Street 154, October 2012.

Figure 4b: Sewage canal, Tra Bek Lake.

Figure 4c: Thompom Lake peri-urban agriculture.

Figure 4d: Sewage canal, Street 105 overflowing during an afternoon rain event.



4a

the city. Instead, sewage and other wastewaters from households, businesses and industries combine in a series of covered and open canals that flow through the city and combine with seasonal rainwater and floods.

A 2007 study by the Royal University of Agriculture of Phnom Penh entitled "Food, Incomes and Urban Waste Water Treatment in Phnom Penh, Cambodia" estimated that 20% of the total daily vegetable consumption of Phnom Penh comes from these lakes and wetlands within the city. Therefore these wastewater-fed aquatic vegetables are, despite their potential health risks, very important in supplying the city's vegetable markets and thus meeting the demands of the growing population of Phnom Penh.

However, as these lakes are infilled, the city's wastewater is discharged more rapidly into the Mekong without treatment and the need for a more formalized system grows. An infrastructure retrofit of this scale would be extremely costly and is unlikely to happen, threatening the health of the Mekong, Phnom Penh, and its downstream neighbors.

FLOODS OF PHNOM PENH

Flood events in Phnom Penh are twofold – almost daily rainy season flood events and episodic larger scale flood plain events. During the rainy season (May-October) monsoon rains fill low-lying streets, some to nearly 1.5 meters deep. The near daily rain floods during the rainy season reframe the experience of inhabiting the city, altering its landscape and blurring the distinction between water and land. Roads become waterways and sidewalks disappear beneath the muddy waters. Curbs and tree roots are hidden from



4b



4c



4d



5a



5b



5c

Figure 5a: *Mekong Flux* installation

Figure 5b: Urban Lab archive.

Figure 5c: *Water Curse of Blessing* Exhibit.

view, hindering walking and driving. Businesses unfurl overhangs, open umbrellas, and hang tarps, expanding available dry space. Traffic slows to a near stop as cars, motos, and bicycles navigate the water and intermittently stall out or dip into deep unseen potholes.

The population anticipates the rains and has adapted to the accompanying flooding and its perceived cleansing effects. Nonetheless, the floods disrupt the flow of daily business and activity. Additionally, flooded streets carry potential disease as the storm water mixes with human waste and street drains are blocked by municipal trash, slowing drainage and posing a possible public health threat.

As for larger scale flood events, Phnom Penh was founded in the alluvial plain of the Mekong River, which varies upwards of 12 meters in depth between the dry and wet seasons. The most devastating flood risk comes from the Mekong River cresting over its natural berm into the city. The volume of water produced by a Mekong flood could take weeks or even months to recede, evaporate or penetrate into the ground.

The factors contributing to the potential for increased flooding in Phnom Penh are: deforestation, the unknown impacts of climate change, overbuilding in catchment areas, the damming and diversion of natural waterways, and the infill of canals and lakes, combined with no formally accepted or followed master plan.

RESEARCH METHODOLOGY: EDUCATION + OUTREACH

Cambodia is a post-conflict country with an opaque government. Much original archival material has been moved to collections in the United States and France, the local universities have yet to develop a coherent library system, and Non-Governmental Organizations (NGOs) often do not coordinate or share their data, due to a variety of constraints and limitations. Government municipalities are difficult to gain access to and, in the case of this research, do not have or will not share documents.

Therefore, this research was primarily conducted through observation, photographs, drawings, video, and interviews. In response to the lack of available urban data, a tenet of the research was to share all documents, drawings and statistics gathered or produced via www.cityofwater.wordpress.com as an open sourced and public resource. Additionally, several educational and outreach initiatives emerged to address the challenges of information access and the agency of design to engage in the ongoing development of Phnom Penh. They are as follows:

PHNOM PENH MAPPING MEET-UP

Available and accurate urban data for Phnom Penh are almost non-existent. Much of this data does not exist or is not in the public domain. This includes, contemporary, verifiable and publicly available digital maps of Phnom Penh to describe land use, building footprints, roads, building heights, and topography. Therefore, a dedicated group of map makers and Geographic Information System (GIS) users, known as the Open Development Cambodia and Engineers Without Borders joined together with *City of Water* to create the Phnom Penh Mapping Meet-Up. The goal of the group is to increase data coordination between sectors and mapping accuracy in Phnom Penh. The Meet-Up is

a group of professionals who meet monthly to discuss mapping strategies, to collect and disseminate open source map data for Cambodia, including an ongoing effort to increase the accuracy of Open Street Map.

URBAN LAB PHNOM PENH

To further address limited information access, a complementary educational and outreach project emerged, the Urban Lab Phnom Penh, during a public festival in Cambodia the *2012 Our City Festival: Urban Currents: Art, Architecture, and Ideas*.

The Urban Lab was a free architectural summer school for Cambodian university students which included technology seminars and lectures from local and international architects. The Lab was housed by the Bophana Audiovisual Resource Center, which aims to collect and preserve lost Cambodian photography and films. Following the Lab the Bophana Library received a donation of urban research materials: maps, files, articles, and most importantly 140 architecture and urban design books collected by Manolis House, a preservation and urban heritage non-profit in Phnom Penh.

During the *Our City Festival* the Lab culminated with an exhibition of student proposals for the future of Phnom Penh, including a prototype for a bus stop, a workshop with visiting international architects, an exhibition *Water Curse or Blessing?* that traveled from Berlin to present 25 water and infrastructure projects implemented in Asia, and an installation entitled *Mekong Flux* that physically graphed upon the city the 10-meter seasonal depth change of the Mekong River, to convey the spatial magnitude of the floods. www.urbanlabphnompenh.wordpress.com

UNIVERSITY ARCHITECTURE + URBAN DESIGN COURSES

Additionally, several studio and seminar courses were conducted during three semesters at a Cambodian university, with selected work appearing in the Urban Lab and Season of Cambodia exhibits:

MAKING IN CAMBODIA: FABRICATION SEMINAR

Making in Cambodia was a fabrication seminar that explored available contemporary fabrication technologies and designing with reused or recycled materials. The title recalls the common clothing label: 'Made In Cambodia' and challenges existing notions associated with the phrase. *Making in Cambodia* aimed to rethink the social and economic realities of creating and designing work in Cambodia. www.makingincambodia.wordpress.com

PROJECTING PHNOM PENH: TA KHMAO STRIP STUDIO

Projecting Phnom Penh was an architecture and urban design studio which explored projecting the conceptual future and physical extension of Phnom Penh onto the strip of land and highway between the wetlands and river connecting Phnom Penh to Ta Khmao. The studio took as its starting point the mapping strategies and attitudes of *Learning from Las Vegas*, a theoretical text rarely taught and not readily available in Phnom Penh.

CITY OF WATER STUDIO: HOUSING, WATER, + TRANSIT FOR TRA BEK LAKE

City of Water was an architecture and urban design studio which explored public transit and urban design as methods for addressing the treatment of



5d



5e



5f

Figure 5d: *Making in Cambodia* reused wood furniture.

Figure 5e: Urban Lab Bus Stop prototype.

Figure 5f: Parsons the New School Art, *Water + Politics* exhibit.

sewage and waste water collected at Tra Bek Lake, which is scheduled to be infilled with sand in the coming years.

A CONTEMPORARY HISTORY OF URBAN PLANNING + THE FUTURE OF PHNOM PENH SEMINAR

The Future of Phnom Penh was a website and collection of conceptual and analytical drawings and writings about contemporary urban conditions in Phnom Penh, Cambodia. www.futureofphnompenh.wordpress.com

AEDES SMART CITY WORKSHOP

Following the success of the Urban Lab and the *Water Curse or Blessing Exhibition?! AEDES* sponsored another student workshop: *Phnom Penh Smart City Workshop*. The initial intent was to further explore the questions posed by the *City of Water* research and to produce design proposals in relation the challenges of urban flooding.

However, the students were encouraged to propose projects that inspired them and out of this work came several projects focused on 'greening' the city, producing walkable sidewalks, and public space. Additionally, their work addressed the challenges of a city without a mass transit system. Traffic during rush hours brings the city nearly to a halt and frequent traffic accidents remain an ongoing concern for a rapidly developing city. As life-long residents of Phnom Penh the students identified these as the city's most urgent design and infrastructure issues. This work and two Cambodian students then traveled to Berlin for a week-long workshop exploring the notion of 'Smart' Southeast Asian cities.

PARSONS + SEASON OF CAMBODIA

This work then traveled to New York City for a recent exhibition which presented the *City of Water* research, Cambodian student work, and Parsons student work in the context of the *Living Arts City* a Parsons initiative of the Season of Cambodia Festival, a performing and visual artists festival.

CONCLUSIONS

Development has brought many benefits to Phnom Penh such as relative political stability, economic opportunity, and potential access to education and health care. However, the price of urbanizing a deltaic landscape cannot be ignored. A major, sustained flood in Phnom Penh could undo much of the progress achieved during the last twenty years. The scope and complexity of urbanization touches upon those issues, both internal and external, ranging from land tenure to health and climate change to human rights.

Many of the advancements necessary in Phnom Penh - an agreed upon master plan, redeveloped flood and sanitation infrastructure, a building code - rely upon thoughtful governance, careful law making and independent lobbying.

The projects described here seek to explore education and public outreach as tools for promoting intellectual freedom, access to information, and engagement in the development of Phnom Penh, a politically and environmentally complex city where criticism of the government, and its urban development strategies, is often unwelcome, censored, ignored, or in the most extreme cases leads to unjust jail sentences (See: Boeng Kak 13, Mam Sonando) or state sanctioned murder (See: Chut Wutty). These projects explore the agency of design, design education, and public outreach as means for addressing the challenges of a rapidly developing city.

The themes of this work continue as a Summer 2013 studio entitled Pan Asia Mekong with the University of Houston, which further explores Mekong urbanization in both Phnom Penh and Ho Chi Minh City. The studio will pursue two primary questions: What are the methods available to successfully document a river and a rapidly developing city as they are changing? And can new documentation methods and design strategies provide the groundwork for improved information access, documentation, and knowledge dissemination within and beyond the Basin?

These questions serve to frame future research initiatives in Vietnam, Cambodia, Laos, Thailand, Myanmar, and China that explore the environmental and design issues resulting from the rapid urbanization of the Mekong River Basin.

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