The Lal Darwaza Bath House: Public Space and Water Conservation in Historic Ahmedabad

This paper uses the experience of a group of faculty and students traveling to India in January 2012 as a framework to analyze the different perceptions of water and architecture in Indian society and in the contemporary US, and suggest a new attitude to designing with water that may be appropriate not only to South Asia but also to semi-arid regions of the US.

Nicholas Roberts
Woodbury University

This work proposes that every element of design from water management to the use of light, space and material be rooted specifically in an analysis of local conditions, referring to what Daniel Barber calls 'Militant Architecture', from Antonio Negri's definition of militancy:

> 'Militancy, in this sense, is [based] on the insistence that social conditions are constantly constructed with and by our everyday actions and formalized practices. Within architecture this concept has particular relevance: every project is based in specific social, political, and environmental conditions. The work of the militant architect is to identify and respond to these specific conditions rather than conform to a pre-existing model, to extract from these conditions the political goal most relevant to them. Militancy is the organization of constituent power, power from below, 'capable of crossing all borders and reaching everywhere.'

The project grows from direct field research into the project users and their patterns of need, using a transdisciplinary approach to study social and cultural questions such as gender, class, ritual and the sacred.

In order to celebrate the experience of water, and encourage its presence in the public domain, the project also proposes an architecture of atmosphere, where light, sound, touch, smell, and the experience of material create a sensation that can only be described by direct experience. It proposes a carefully choreographed interaction between architecture, water, light, and the body; (literally) an immersive experience structured by narrative.

We traveled to India prepared by readings[2] lectures, and symposia[3] and an understanding of the looming water crisis affecting semi-arid regions of the world. We had learned that growing demand and a supply made unpredictable by climate change, pollution and environmental challenges have made urban water supply the biggest infrastructure challenge of the 21st century. One billion people worldwide lack access to safe drinking water, and 2.6 billion do not have improved sanitation.[4]

We were familiar with recent models of water supply, "Big Water,"[5] Conservation, and the emerging model known as Integrated Urban Water Management,[6] and how it suggests a successful strategy for urban water systems in the Indian subcontinent, but we quickly realized that it is insufficient to consider water as a technical resource without considering the central role that water has played in the political, cultural and religious life of the country.

In addition to emphasizing the critical role of scale in water design, this essay proposes that it is only by abandoning the instrumental view of water as technical infrastructure, in favor of a more transdisciplinary view of its potential, that a successful water policy can be implemented in the Indian subcontinent. I will illustrate this proposal with examples of student projects that incorporate these ideas into the design of a public bathhouse for the city of Ahmedabad.

THE FAILURE OF TRADITIONAL WATER MANAGEMENT MODELS: BIG WATER

"Big Water" is a model of water management that unfolded across the US in the first half of the twentieth century, and in China and India over the last fifty years. It involves large dams, extensive canals and pumping stations, moving water hundreds of kilometers to its consumers, and has provided the water supply, flood control, and power generation for the spectacular increases in agricultural productivity known as the "Green Revolution."

As a result of climate change and environmental factors, however, Big Water is under challenge: firstly, although overall precipitation may not change in many areas, snowcaps are disappearing. The water that used to be stored in mountain snow, melting slowly throughout the spring and summer, will now fall as rain. In India this will dramatically affect flow in the canals fed by Himalayan snowmelt and, as we have seen in recent weeks, increase the possibility of monsoon flooding.[7]

Secondly, by causing irregular, more intense water events, climate change will mean more severe flooding and more drought years, which will require more storage capacity for cities to survive, and more infrastructure to manage flooding. Thirdly, an increase in surface temperatures and evaporation will increase the need for water for agricultural irrigation.

Finally, public outcry at the environmental damage caused by "Big Water" projects has demanded large reductions in the amounts of water available from these projects in order to repair ecosystems and restore fish and wildlife populations.[8] For example: Northwest India has been reborn as the land of large-scale state-sponsored water projects. The Indira Gandhi canal was completed in the late 50's bringing water from the Himalayas to Rajasthan (NW – next to Pakistan. The Narmada River project in Maharastra was inaugurated in 2008, bringing water to Gujurat, including the city of Ahmedabad. The project, however, ran into severe opposition for its damage to indigenous communities and their livelihood[9] As a result of construction of the dam over 48,269 families spread over 244 villages were displaced and lost their livelihood.

Once complete, the Narmada River project had two serious implications for Gujurat: firstly, because the dramatic increases in crop yield from irrigation are capital-dependent, they enrich the big landowners, but the peasant farmers without capital and access to technology are impoverished and forced to give up their land. Secondly, farmland in the delicate saline semi-desert is often over-watered, resulting in water-logging. After centuries of delicate dry farming, farmland is over-irrigated, increasing its salinity and infertility.[10]

THE ALTERNATIVE: INTEGRATED WATER MANAGEMENT

In contrast to the culture of "Big Water," international agencies such as the UN are now promoting the integrated water management model (IUWM),[11] which integrates the entire water cycle with all its components and their interactions as a framework for water management. Storm water, wastewater, rainwater, groundwater, and natural systems such as aquatic habitats must all be brought into the water supply equation.

The ancient civilizations of India had a profound understanding of this kind of sustainable water management. Rainwater harvesting, groundwater recharge, storm water management and pollution control have been practiced for centuries, and there is now a renewed understanding of integrated water management in India, based on both traditional and contemporary practice.

Over the last 5,000 years the semi-arid climate, seasonal fluctuations and cultural practices of Gujarat have inspired extensive water management systems, many of which are still in use today. Vavs (stepwells) such as the elaborately decorated Adalaj ni Vav (just outside Ahmedabad) and Ranki Vav (in Patan), are subterranean and often shaded water storage systems collected water and provided respite from the heat to locals and travelers. (see book)

Gujarat is scattered with talavs or sarovars, manmade water bodies that retain water for use in bathing, washing and other daily activities, for example the system at Champaner in eastern Gujarat established in the late 1400s, by Mahmud Begada.

Kunds, or water storage tanks, such as the exquisitely decorated Surya Kund, part of the sun temple complex at Modhera, are often found at mosques and temples where they are used for ritualistic cleansing prior to worship.

In addition to such shared initiatives, individual households also developed their own methods of storing the intermittent but heavy monsoon rains. In Ahmedabad's old city, nearly every household collected rainwater on the rooftops and channeled it into an underground storage tank, often connected with an indoor well.[12]

THE WOODBURY UNIVERSITY - CEPT UNIVERSITY JOINT STUDIO

In January, 2012, following a ten-day study tour of northwest India, fourteen students and two faculty members from Woodbury University spent two weeks studying with faculty and students at CEPT University in Ahmedabad.

Nowhere is the water supply crisis more pressing than in northwest India. In Ahmedabad, a city of 7.5 million, and the largest city in the state of Gujurat; the climate is hot and dry for most of the year, with a wet humid rainy season in July-August. The ground water level has fallen from 150' in the 1970's to over 400' today as a result of pumping from the aquifer;[13] The fall in water table has

decimated India's traditional water management structures; for example the water in the great tank at the Palace of Sarkhej Roza is reduced to a puddle, and the water is barely visible at the bottom of the glorious step well at Adalaj ni Vav.. The city of Ahmedabad provides municipal water for only one or two hours per day, prompting many wealthy private landowners to drill their own tube wells to provide water for landscape irrigation, further exacerbating the drop in water table.[14]

Site research for the studio drew on both traditional practices and emerging techniques of water management in South Asia to propose sustainable water management solutions. Their research took the students into the diverse communities of Ahmedabad and its surrounding villages, from modern high-rise apartments to traditional villages and informal "slum" settlements, from mosques and temples, to laundries and water treatment plants, where they observed traditional and contemporary strategies of water management and use for drinking, cooking, bathing, laundry and waste disposal. The studio project culminated in the design of a bathhouse for a densely populated area of the historic walled city of Ahmedabad.

THE TRANSDISCIPLINARY APPROACH

The Woodbury students arrived in India prepared by lectures and readings with an understanding of the contemporary models of water management, but their encounter with their Indian colleagues, faculty, and their experience of daily life opened their eyes to a much broader understanding of the role of water in Indian culture. By living for a short time in a society where water is not merely a technical resource but is part of centuries-old cultural and religious ritual, students were able to understand the wider social importance of water in that particular semi-arid region of India.

As a result of this research, four key relationships with water emerged: Settlement patterns and politics, worship and the sacred, clean and unclean, gender and class separation, and the aesthetics of water.

SETTLEMENT PATTERNS AND POLITICS

Before the advent of piped water supply and drainage, the careful management of soil and water was fundamental to the culture of settlements, their social and spatial formation. As Neelkanth Chhaya showed us, following Patrick Geddes, whose early interest in the science of ecology guided his work in India from 1915–1925[15] the relationship of climate, geology and topography is at the root of traditional settlement patterns in India; an algorithm, so to speak, links settlement patterns with the porosity of the soil and slope of the land.

Crucially, the management of water supplies through flood and drought years has given rise to distinctive political structures. As David Mosse notes "This landscape is not, however, a fixed record of power but one which is constantly changing and being shaped by new political interests, connections, and constituencies."[16]

Internal conflict gave way to colonial rule in a variety of forms, which in turn gave way to Nehru's post-independence statism, and most recently to the free-market economy promoted by NGO's and the World Bank.

Significantly, two models of social organization, one based on cooperation, interdependence and shared decision-making, and the other using game theory

to predict the behavior of rational self-interested individuals, both converge in supporting the value of a locally-based system of water management.[17]

RELIGIOUS IMPORTANCE OF WATER

Water is sacred to many religions. In Islam, worshippers are required to wash face, hands, feet, and mouth before prayers, and Hindus are required to bathe at least once per day. The rivers of India are themselves sacred, bathing in the River Ganges guarantees immortality . . . . . .

> "When I was a child my mother used to bathe me. And when she bathed me we sang a song in which we acknowledged all the rivers of India. I would sing: I am now showering in the Ganges...I am now in the Yamuna...."[18]

In the classic Moghul tomb structures, the dead are graced with a Chahar Bagh or four gardens of paradise, separated by four rivers, with a central reflecting pool to bring the heavens down to the deceased.[19]

The close relationship between water and religion continues at an urban level, as water bodies frequently attracted temple building and were administered by the temple. In cities such as Varanasi, the urban landscape is dotted with sacred ponds associated with temples, and the north bank of the Ganges is framed by the monumental ghats leading down from the temples to the water, the sites of funeral pyres and religious festivals.

The students studied the Sun Temple at Modhera, a synthesis of step well and temple, and visited mosques and temples in the city of Ahmedabad where systems for collecting and storing water, and the facilities for worshippers to wash before prayer were an integral part of the architecture.

CLEAN AND UNCLEAN

Water is a vital need, but it is also a grave danger – too much can be dangerous, and contaminated water can carry pathogens and support disease. As Mary Douglas describes, clean and dirty becomes a philosophical, religious, and social formation.[20] It is the way a society grades its divisions by what she calls the "complex algebra" of the clean and unclean. For example the highest degree of religious purity is necessary for performing an act of worship, the middle degree is the expected normal condition, and finally there is a state of impurity. Contact with a person in the middle state will cause a person in the highest state to become impure, and contact with anyone in an impure state will make wither higher categories impure.

The highest state is only gained by a rite of bathing.

> ' a daily bath which is taken before the household gods are worshipped . . . every attempt is made to finish work that is considered dirty or ritually defiling – carrying manure to the garden or working with an untouchable servant – before the daily bath.'[21]

Our students noted with interest how the distinction between clean and unclean also defined the vessels that were used for water storage; water for drinking was stored in a clay pot called a matka, where the evaporation of moisture kept the water cool, whereas water for bathing and clothes washing was kept in large plastic tanks. When water had to be carried a long distance, a stainless steel matka, lighter and less fragile than clay, was used.[22]

GENDER AND CLASS SEPARATION

Achieving appropriate gender separation and opportunities for expressing class differences are critical for the successful design of a bath house. Our students found a number of approaches to achieving gender separation in bathing: In traditional communities where bathing takes place in a river or lake, either different places are reserved for men and women, or the genders are separated by time, usually the women bathe early so they can pray before beginning the housework and food preparation. In the tight quarters of lower-income housing where only one area is available for bathing, the genders are also often segregated by time rather than by spatial or architectural devices.

The Indian constitution has made illegal discrimination on the basis of caste, which used to forbid, for example, different castes using the same water source. However India is still a profoundly class-ridden society although the new classes may be based more on wealth and family connections than on traditional castes.

AESTHETICS OF WATER

Water lacks all the conventional criteria of aesthetics: it is inherently formless, colorless, textureless, and odorless. It is ungraspable and uncontainable, cannot be worked or assembled like a conventional material, but in its multiple forms, as liquid, solid, vapor, still, flowing, squirting and misting, it can be beautiful and sensuous. Light interacts with water in four ways: by transmission, reflection, refraction and diffusion to create optical sensations that are appreciated by the human eye; in combination with architecture and landscape, water can reflect and refract light to produce rich aesthetic effects.

It is the carefully choreographed interaction between architecture, water, light, and the body that gives water such value in arid climates, and emphasizes the need for integrated management strategies that can bring the experience of water into the public domain. The haptic experience of water can provide a feast for the sense of touch, both hot, as in the Roman baths, and cool, as in the step wells of India, a feast for the ears, like the water organ at the Villa d'Este, and a new relationship between water and the human body such as at the ghats and step wells of India.

DEVELOPING AN ARCHITECTURAL LANGUAGE

The students were encouraged to develop hybrid architectural languages that accepted emerging design and fabrication technology, while at the same time respecting the work of masters of Indian modernism such as Balkrishna Doshi and Charles Correa,[23] and western architects who worked in India such as Louis Kahn and Le Corbusier. The qualities that the students studied included:

- Delight in the experiences of light, space and texture that can be achieved with modest and inexpensive materials, landscape, and water.
- The ambiguity between interior and exterior space that can be seen, for example, in Doshi's campus projects
- A patchwork of courtyards, landscape, and water that we saw at Correa's Gandhi Ashram
- The veiling and layering of space with screens and trellises characteristic of Moghul architecture

- The mutability of the ground plane that we saw at Doshi's Sangath, where a relatively small level change gives access to an inhabitable roof surfaces.
- The formal and spatial innovation of Le Corbusier at Chandigarh and Ahmedabad, and
- The layering of structure, the "building wrapped in ruins," of Louis Kahn's Indian Institute of Management in Ahmedabad.

In addition to the historic architecture that they explored on a ten-day study trip, four recent buildings, two of which they were able to visit in Ahmedabad, made a deep impression on the students and suggested an approach to spatial organization and material practice completely different from their western experience:

1. Sangath, which means "moving together through participation" in Hindi, is the office that Balkrishna Doshi designed for himself in Ahmedabad. A large studio is partially recessed in the ground, making the roof readily accessible from the garden by a series of broad steps that double as an amphitheater. Instead of reading as an object, the entire complex appears as a layered topography. In addition, the tiled surfaces gather rainwater, which is allowed to flow around and down the building to gather in a pond in the garden, strengthening the reading of the architecture as landscape rather than building.

2. In the public spaces for the Indian Institute of Management campus in Bangalore, Doshi creates a tapestry of covered, open, and semi-enclosed spaces in which architecture and landscape become indistinguishable from one another. Covered hallways open to the elements lead to trellised walkways enclosed on one side and to covered walkways bordered with planting open to the sky. The result is a rich mosaic of planting and building that takes advantage of shade and cooling breezes to create comfortable conditions in the tropical climate.

3. Charles Correa's Gandhi Ashram in Ahmedabad is an open-air patchwork of building, courtyard, water, and landscape, that provides display space and seating where visitors can study Gandhi's life and teachings, and enjoy a comfortable shaded space cooled by breezes from the Sabarmati River. An elegantly detailed gridded structure of brick and concrete yields a variety of spatial experiences, thanks to the range of textures and planting filling the courtyards and the subtle arrangement of vertical surfaces. The modesty of the structure and the richness of the experience resonate with Gandhi's teachings.

4. Geoffrey Bawa's design for his own house is another example of the interpenetration of architecture and planting in a tropical landscape. Looking at the plan it is hard to distinguish interior from exterior space as the ground plane flows from living space to courtyard and back in to the interior.

From these projects the students learned to reject the building as isolated object in favor of a tapestry of architecture and landscape, the building as a topography enlivened by the flow of water, an architecture where the primary human experience is that of shade from the intense tropical sun, and the importance of keeping the building porous to cooling breezes. As Doshi said:

> "Is there a binding thread that joins the real and the imagined together? Have we forgotten our sense of wonder, the magic and mystery of light and shadow, appearance and disappearance of surfaces, silhouettes, sounds, and greenery?"[24]

BIOCLIMATIC DESIGN, MATERIALITY AND DURABILITY

Students were strongly influenced by Victor Olgyay's research into building orientation, shading, and ventilation, which they used to optimize the building design for the tropical climate of Ahmedabad.[25]

In their use of simple, durable materials for structure, and thermally active surfaces for environmental control, the buildings are massively performative in the sense advocated by Kiel Moe. In contrast to the lightweight and highly complex responsive building skins used in contemporary European and American projects, this durable and low-maintenance strategy is appropriate for public buildings in India and could also be, as Moe suggests, appropriate for wider global application as an example of "next-use" design.[26]

To develop a material palette, the students looked at the use of brick in structure and decoration in examples as varied as the Victorian English architect William Butterfield, Eladio Dieste, and Louis Kahn.

PRESENTATION MEDIA

The rendered section, the physical model, and the written narrative were the dominant design methodologies. Recognizing the technological limitations on-site in India, the early stages of the design work focused on the diagram and the hand-drawn rendered section. To convey the luminosity of water and quality of light, graphite rendering continued to be important throughout the design process.

TESTING AND EVALUATION OF THE RESEARCH

The student proposals were tested by developing the designs to the considerable level of detail required by NAAB for a comprehensive project.Engineering consultants from Arup and Buro Happold helped with the analysis of structure, materiality, lighting, ventilation and thermal performance.

CEPT faculty in Ahmedabad very familiar with the local conditions reviewed the projects at several stages of development, and the work was exhibited on the CEPT campus in June 2012 with very favorable reviews.

In Eric Arm's project the public is led down a path energized by public laundry and informal commerce to a more serene procession culminating in the large men's' and women's' pools separated by porous masonry that allows the breezes to flow through. Partially buried in the ground, the building consists entirely of topography and has no exterior elevation. His architecture celebrates water in many forms: the still water of the reflecting pools for water treatment, the flowing water that leads the visitor from the entrance to the large pools, and the large waterfall that provides cooling vapor and a refreshing sound.

'The Lal Darwaza Park development creates physical and visual connections between its diverse surroundings through a network of water capture, filtration, and conveyance devices. The spaces alongside these water infrastructures invite the public into the park through outdoor clothes washing stations, public restrooms, an indoor/outdoor cafe, and places for vendors to sell their goods and people to relax and socialize.

> The bathing experience is structured around a series of spaces tied to specific atmospheric conditions. These spaces range from dark, enclosed, and

ENDNOTES

1. Barber, Daniel, 'Militant Architecture, destabilizing architecture's disciplinarity', in Jane Rendell et. al., eds, *Critical Architecture*, Routledge, p.57
2. Some of the readings included: Service, Robert F., 'As the West Goes Dry,' *Science* 20 February 2004: Vol. 303 no. 5661 pp. 1124-1127, Reisner, Mark, *Cadillac Desert, the American West and its Disappearing Water*, Penguin Books, Boxall, Bettina, 'The Energy and Expense of Bringing Water to the Southland' Los Angeles Times, November 13, 2011
3. Drylands Design Conference: Retrofitting the West, Adaptation by Design, Woodbury University, March 22, 2012.
4. WHO/UNICEF, 2006
5. My colleagues Hadley and Peter Arnold of the Arid Lands Institute at Woodbury University coined the phrase "Big Water." I am indebted to their many insights about the subject for the writing of this paper.

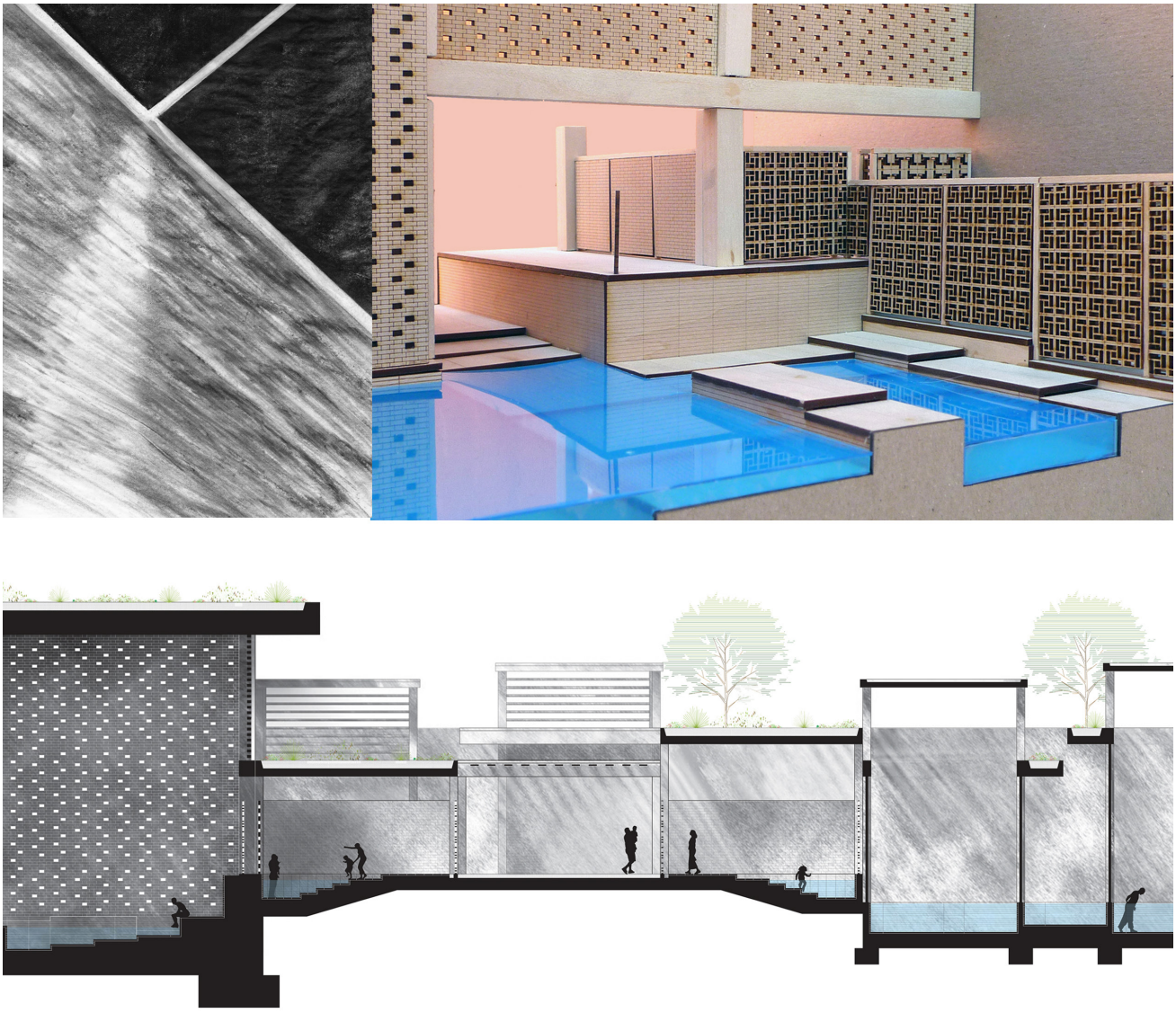

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Figure 1: Lal Dawarza Bathhouse Ahmedabad, Eric Arm

Top left: Atmospheric rendering of light and water, graphite on Strathmore paper

Top right: Photograph of detail model

Bottom: Building section (detail)

contemplative to bright, open, and invigorating. The overall experience is intended to recharge sensorially overloaded urban dwellers . . . and reconnecting them with the primary elements of water, material and light.

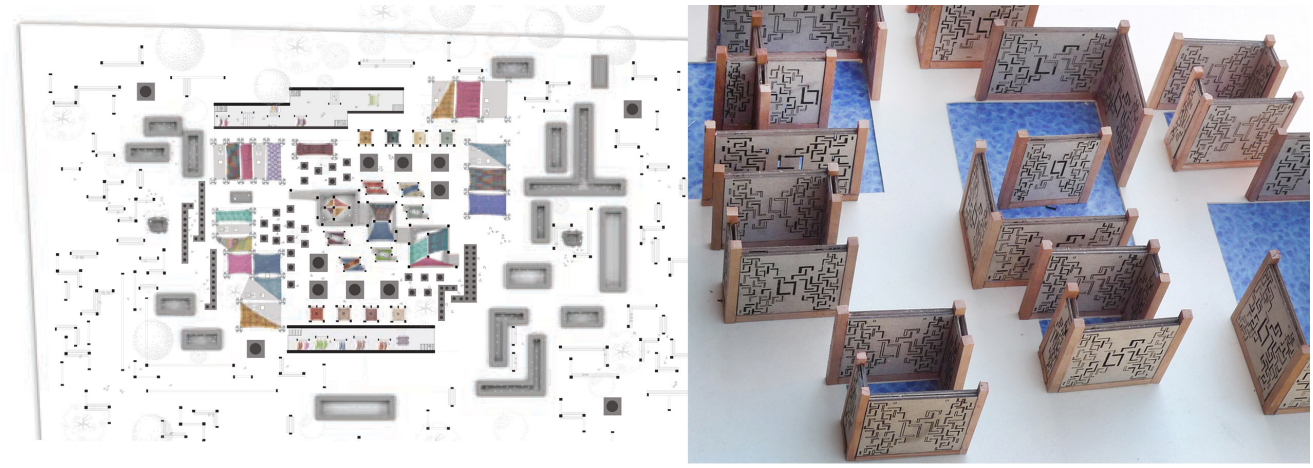
This journey is framed by varying qualities of light and shade, wet and dry, solid and void, open and enclosed, soft and hard, smooth and rough, shallow and deep, quiet and loud. This constant interplay is facilitated by the use of Jalis screens, trellises, light-wells, vegetation, softscape and hardscape, and various forms of masonry construction.'[27]

Marlene Milian took a radical position, with a field of pools designed to be as welcoming to the inhabitants of the adjoining slums as to the middle class city population. As she said in her introduction:

'Each program would be designed as a unit that in its layout would become part of a whole filtration cycle of water; the toilet program would contain a composting system filtering the black water through two processes of filtration while producing methane gas as a stored resource

6. UNESCO Paris-*2007 Statement*, International Symposium on New Directions in Urban Water Management, 12-14 September, 2007,

7. For the impact of climate change on snowmelt in the western US, see Department of the Interior, Bureau of Reclamation, http://www.usbr.gov/uc/water/crsp/cs/gcd.html, accessed 12/23/2011. Between 2000 and 2004, water levels at the upper Colorado River basin dams to fall to 50% of capacity; at Lake Powell, large expanses of dry canyon floor became



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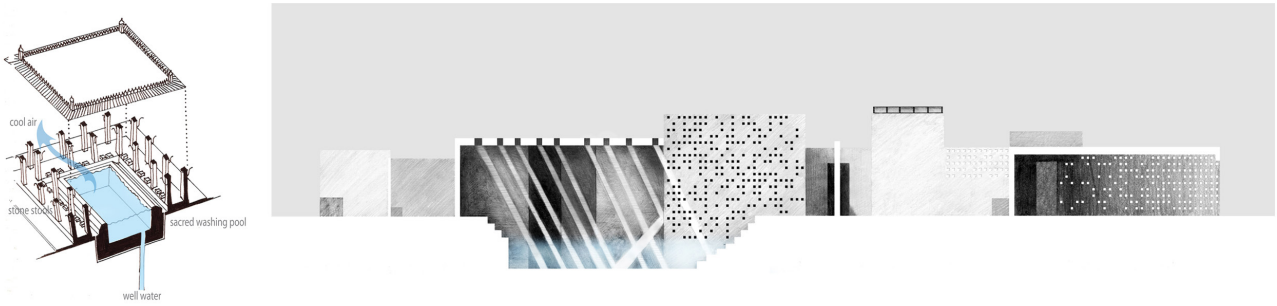

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accessible when needed. After being processed the water would then seep into the earth to recharge the aquifer. The grey water coming from units of washing and showering would go through one filtration process before entering a wetland system (last stage of the filtering process before re-distribution.) The bathing water would also go through the wetland filtration system for before its redistribution.

By recreating the labyrinthine spatiality of the slum passages, the project becomes so porous that there is no single entrance or exit; the most public programs lie on the outskirts and as the inhabitant progresses inward the private programs are revealed. Despite their porosity, the series of walls creating the labyrinth create levels of privacy depending on the inhabitants' location within the project.'[28]

With a series of perforated walls and landscaped courts, Lorik Khodaverdian created a delightful environment of shade and planting.

'The bathhouse is not really solid building but a space separated by light walls that allow light and nature in. The main feature of the buildings is the walls that are perforated by smaller pixels to allow air to flow freely, and more importantly, to set the light level and create an atmosphere. The bathhouse is fairly dark place, to set the mood of relaxation and allow people to hide from the sun. People will walk through dark corridors and be guided by light coming in through the walls. Pool areas have higher ceilings that let air flow up and cool the space. The ceiling will have the same perforated pixels to allow light in to play with the waterand create a glittering effect. To take a break from bathing, people are encouraged to walk into the private gardens that they can see through the pixelated walls to lounge and take in the sun.'[29]

Figure 2: Lal Dawarza Bathhouse Ahmedabad, Marlene Milian

Left: Site plan

Right: Photograph of detail model

Figure 3: Lal Dawarza Bathhouse Ahmedabad, Lorik Khodaverdian

Left: Study of bathing at the Jama Masjid (Friday Mosque) Ahmedabad (with Mirla Montanez)

Right: Building section

visible. By November 2011, a combination of above-average rainfall and conservation brought water levels back up, but only to 65% of capacity

8. Public outcry over social and environmental damage brought a halt to the construction of the Sardar Sarovar dam on the Narmada River, and forced the World Bank to withdraw funding from the project, although the project has subsequently been completed. See for example, http://www.narmada.org/sardarsarovar.html#resources, accessed 12/23/2011

9. For the Narmada River project and damage to indigenous people, see for example, http://www.narmada.org/, Narula, Smita, "The Story of Narmada Bachao Andolan: Human Rights in the Global Economy and the Struggle Against the World Bank" (December 12, 2008), *Human Rights Advocacy Stories*, Deena R. Hurwitz, Margaret L. Satterthwaite, Douglas B. Ford, eds., West, 2009; NYU School of Law, Public Law Research Paper No. 08-62

CONCLUSION

The studio showed that successful architectural design and water management grow from the careful study of bioclimatic conditions, culture, and materiality. While each project was a model of integrated urban water management, the projects also created an elegant and porous architecture of shade that responded well to the climate and cultural context.

By working with the landscape and the natural hydrologic cycle rather than trying to conquer them, and by taking note of historic examples from long-lived communities in semi-arid regions, our students were able to offer long-term and sustainable solutions to urban water supply. They showed how focusing on small-scale water systems, bringing them under local control, and making them part of everyday urban life, helps to raise a community's awareness of the importance of water and the role it plays in the ecosystem. Key to the implementation of this shift in the future is the collection and exchange of knowledge and data between the scientific community, policymakers, and water authorities. This strategy provides the best chance of creating sustainable and robust water systems that can weather the forecast variability in supply resulting from global climate change.

One of the most attractive features of the projects is the visual delight that they bring to the urban environment. Making water and natural systems a visible part of everyday urban life, rather than hiding them in pipes and sewers, reveals the beauty of water in all its manifestations and give an added incentive for its careful management.

10. For an excellent description of the sources of salinity and the consequences of irrigation of saline soils, see Singh, Nirmal T., *Irrigation and Soil Salinity in the Indian Subcontinent: Past and Present,* Lehigh University Press, 2005
11. UNESCO op. cit.
12. For further reading on traditional water management in India and the water structures of Gujurat, see Livingston, Morna, Princeton Architectural Press, 2002.
13. Ahmedabad Municipal Corporation, *City Development Plan for Ahmedabad, 2006-2012*, Ch.3, Environmental Services, p.25
14. Observation by Woodbury faculty and students, January, 2012
15. Tyrwhitt, Jacqueline, *Patrick Geddes in India,* London, Lund Humphries, 1947
16. Mosse, David, *The Rule of Water, Statecraft, Ecology and Collective Action in South India,* Oxford University Press, 2003 p.3Endnotes (CONTD.)
17. Mosse, David, ibid, p.17, referring to Robert Putnam's idea of social capital, ". . . the notion of social capital also stresses path-dependence and historically determined networks, norms, or trust - the more or less stable ties of civic engagement-that serve to overcome the corroding effects of individual interest." See Robert Putnam, 'Bowling alone: America's declining social capital', *Journal of Democracy,* 6(1) 1995, 65-78.
18. Recounted by Professor Neelkanth Chhaya, Dean of School of Architecture, CEPT University, January 2012
19. See, for example, Fairchild Ruggles, who traces the evolution of the tomb and Chahar Bagh in *Islamic Gardens and Landscapes*, Penn 2008
20. Douglas, Mary, *Collected Works: Purity and Danger: An Analysis of Concepts of Pollution and Taboo,* Routledge, 2003, Pyschology Press 1966, p.9
21. Douglas, Mary, op. cit. p.34, quoting Edward B. Harper, 'Ritual Pollution as an Integrator of Caste and Religion,' *The Journal of Asian Studies*, Volume 23, Supplement S1, June 1964, pp 151-197
22. Student observation and interviews, January 2012
23. See, for example Curtis, William J. R., *Balkrishna Doshi, an Architecture for India,* London, Rizzoli, 1988, Smithson, Peter, *Charles Correa*, London, Architectural Press, 1964, and Frampton, Kenneth, Charles Correa et. al., *Charles Correa*, London, Thames & Hudson, 1997
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27. Arm, Eric, *Project Statement*, April 2012
28. Milian, Marlene, *Project Statement,* April 2012
29. Lorik Khodaverdian, *Project Statement,* April 2012