ABSTRACT

Architecture is man’s greatest imagination. But man’s race for development is clear interference with nature, especially in water balance which could lead to Doomsday scenario of a waterless world. This paper attempts to conceive architecture that can avoid the making of such a world. It presents a case study of the province of the Punjab in Pakistan, which currently faces a depleting water table (1—2 meters/year), but simultaneously struggles with a growing population that requires safe and ample shelter. Urban sprawl in some parts of the Punjab has especially given rise to rapid and unplanned expansion. This has come at the cost of efficient design and sustainable development. Using Lahore as a specific example, this paper comparatively assesses water consumption per unit of construction and for maintenance purposes between traditional and contemporary design methods in domestic architecture in the city. It explores the environmental cost-effectiveness of materials, methods of construction, drainage, sanitation and heating/cooling systems vis-à-vis the resulting water budget due to these parameters. Consequently, it aims at presenting clearer conclusions and guidelines about water-efficient and environment-friendly building codes and construction guidelines in similar sub-tropical, arid climates.
Introduction

Lahore is one of the Eastern world’s legendary cities, its origins lost in antiquity, but its presence in the world today ever-growing. Capital of the Pakistani province of the Punjab, this is a city that was adorned with mosques, museums, palaces and other architectural distinctions throughout its Mughal and British administration. Traditionally, its design and landscape remained in reasonable harmony with its intense climate of long, hot summers, a heavy rainy season and very cold winters.

Of late, however, a new approach has been adapted towards its growth and development in marked contrast to the vision of its early planners, who once nicknamed Lahore as the City of Gardens. In fact, it is only the older parts of the city that houses the major green spaces of the city such as the Lawrence Gardens, Race Course Park, Nasir Bagh, the world-famous Shalimar Gardens and Jallo Park. The only similar major green space allocated in about 1000 sq km of newer growth of the city is the Lahore Wild Life Park, situated in Raiwind.

However, this remains more of a commercial venture than one intended to preserve a balance in the water cycle and table of the area in which it is found.

This is just one of the many alarming features of Lahore’s urban sprawl, a phenomenon that has become necessary to house the city’s rapidly growing population. Migration is a common feature for urban centres all over Pakistan because rural areas experience little to no infrastructural or educational development. In fact, about 65% of urbanization in Lahore is due to an influx of migrants. Despite a rising trend in migration, architects have been unable to alert the government to the impending catastrophic situation of water shortage and drainage collapse if more migration is not stopped.

This paper focuses on a few principles on the basis of which a case is made for alternative means for urban growth in Lahore as an example and Pakistan in general. Its success may be replicated the world over in environments similar the type found here. We begin with the assertion that the formula of $E=mc^2$ applies in a philosophical sense, which refers to the power of man to destroy whatever exists, through his indifference, ignorance or greed. However, with reference to water sources, it is when men produce and consume more water than they send back into the aquifer for recharging it that the equation no longer holds. Destruction of one resource appears to be producing no other source of energy. It is only producing waste, pollution, and a general distaste for urban growth.

This paper envisions water scarcity as opposed to its complete absence. This may be due to depletion of water sources (especially groundwater) or because of reduced availability of water fit for human consumption due to its inferior quality. Both can be the grave consequences of unchecked and unplanned urban growth.

2 | A Review of Urban Sprawl

In its broadest sense, sustainable development, according to the renowned Brundtland report, is a concern that the inputs of that growth. In essence, it is the drive for sustainable development that raises the question of whether urban sprawl is a viable option to take into the future.

There are many ways in which the term Urban Sprawl can be analyzed. Sprawl was defined as ‘the lack of continuity in expansion’. It can refer to dispersed development which increases pressure on local government resources such as public transport or water and sewage. Population density in a given area may be low, but the total area that requires servicing to meet human needs is large and usually keeps growing. Another way of looking at the phenomenon is a reference to low-density urban and suburban development of previously undeveloped rural land. This generally situates people far from where they work, study, shop or recreate. Hence, urban sprawl increases the need for cars to remain mobile. Another characteristic of such developments is that they spread onto farmland, forests and even coastal lands lying on the outer edge of cities, which is probably where their negative implications begin from.

Many alternatives to urban sprawl have been suggested and practiced over time. Compact cities are characterized by high population densities over an area in which there is a concentration of urban functions to achieve social and environmental sustainability. The Garden City stresses on the need for and benefit of greenbelts in urban planning. Originally developed by Ebenezer Howard, the concept envisions a central town with not more than 58,000 people in it, which is to be surrounded by smaller self-contained garden cities of 30,000 people each. About 5,000 acres of each garden city should be devoted to green spaces. Transit villages are also proposed as a means to overcome many urban problems, such as expanding water and sewage networks. The idea is to group living spaces and commercial areas close to transportation hubs to reduce the need for expanding cities horizontally and focus more on controlled vertical growth.

‘New Urbanism’ is a strategy for urban growth along the lines of a Main Street model on which a mass transit rail system can function, connecting to pedestrian walkways and mixed housing located close together to reduce ‘personal’ space in
3 | Urban Sprawl in Lahore and Impact on Water Situation

3.1 Poor Drainage System

Lahore is one of the flattest cities in the country with an almost uniform elevation of 712 ft above sea level across its entire span of around 1700 sq km. This contributes to water stagnation, stressing the need for a well-developed and efficient stormwater drainage system. However, the city has only one drainage system in which rainwater and sewage mixes, rendering a clean source of water useless without extensive treatment. Also, much of Lahore’s sewage was directed either into the Ravi or the main Canal that runs the length of the city. This has turned both bodies into massive drains, an extreme compromise on otherwise reliable sources of clean water.

New developments are now being situated directly on sewage drains. Examples include Maulana Shaukat Ali Road-Akbar Chowk drain, which was filled in further up towards Peco Road for road expansion. Hence, greywater, blackwater and refuse now contaminate the ground because they no longer follow a direct drain path. The Shah Garhi-Durand Road intersection in North Lahore is in a similar situation, unable to sustain flash floods due to its filled-in drains. LDA’s latest expansion in South Lahore is also planned along a wide open drain.

A classic example of water channels and natural filtration techniques was found in the Shalimar Gardens’ old infrastructure, which recycled water between the River Ravi and the Gardens. However, its waterways and filters have also been damaged or filled in for urban expansion, causing significant depletion of water in the Ravi as streams are obstructed from returning to the river.

3.2 Uncontrolled Expansion of Impervious Surfaces

Lack of contiguity in major avenues and roads has enhanced the need for adding further paved surfaces (inner streets, access roads, etc.) to connect various residential colonies. For instance, the Lahore Development Authority (LDA) could have employed a checkerboard pattern of residential towns expanding from Model Town into neighbouring developments like Faisal Town, Johar Town, etc. These could have alternated with major green spaces in between them. Suburban development usually acts as a source of various contaminants such as grease, oil and toxic chemicals from road surfaces, which are carried by rainwater towards local surface water sources since seepage is reduced, also reducing water quality.

The poor state of public transport and pedestrian walkways in Lahore is also a cause for concern. It encourages people to use personal cars and other automobiles to remain mobile, which not only adds to air pollution but becomes the major reason why further road construction is needed.
topic three

3.3 Destruction of agricultural land, green spaces and small water bodies

Inappropriate strategy by the LDA for identification of land for residential development has facilitated political coercion in purchasing fertile land at cheaper rates. This is seen in Defence, Phases 6 and 7 along Burki; UET, Valencia and Eden Housing Schemes along Raiwind; and Air Avenue oppose to New Airport along Bedian. This has compromised on extensive vegetative growth, natural streams and ponds, which have been replaced by paved surfaces, further blockage of branches of the main Hudiala Drain and contamination of adjacent agricultural lands’ soil through the mixing of floodwater with sewage water. Inefficient land fills in urban spaces allow synthetic materials like plastic bags and cups to build up non-biodegradable layers in both urban green spaces (e.g. Milad Street, Faisal Town) or agricultural lands (e.g. Raiwind). Additionally, residential construction adjacent to industrial areas like Packages Industrial Estate, Kot Lakhpat, etc. induce effluents and chemicals seepage into ground and water supply of residential area nearby (Defence, Police Lines, Qainchi Chowk).

3.4 Population Pressures

With increased amounts of people living in poorly planned, congested urban spaces, the use of water and energy eventually starts to increase. Such lifestyles can also start giving rise to suburban or periurban heat islands, which ultimately require greater use of water for cooling, bathing and washing purposes. Statistical studies have found that 10 Fahrenheit increases in temperature can be associated with an average monthly increase in water consumption by about 290 gallons for a single-family unit living in more compact developments in Phoenix. In a city like Lahore, where the summer months experience average temperatures in the high 40’s (Celsius), it is common practice for paved surfaces to be washed with water prior to sunset for cooler evenings. Such a practice can be expected to expand as temperatures rise further still due to greater congestion within living spaces. A new trend of constructing ‘farm houses’ at the outskirts of the city has arisen, which acts as a lush weekend retreat for wealthy families away from the noise and heat of the city. This has given rise to one family owning multiple homes within the same city, which means the city is expanding without fulfilling the needs of the poorer working/migrant classes. In addition, farm houses are often constructed on an acre of land, with only about 9000 sq ft of covered area. The remaining space is largely flat green lawn exposed to an average of 13 hours of sunshine/day. This naturally requires extensive amounts of water supply for maintenance and constant irrigation to battle the amount of heat and light plants are exposed to daily.

3.5 Materials and Methods of Construction

Construction in Lahore today witnesses the excessive use of concrete, cement, glass and steel, while several cheaper and more climate-friendly alternatives remain unused. For instance, Portland cement, which requires more time and water for setting, can be substituted by lime and gypsum plaster. Both of these materials are in abundance in Pakistan and while cement

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3.6 Architectural/Environmental Design Paradigms

In the earlier years of Pakistan’s existence, there seemed to be much reliance on the services and design ideas of foreign architects. This was primarily due to the fact that the country did not have adequate professional architects of its own. Often, their philosophies, vision and architectural inclination were at odds with local conditions, native techniques and designs and the cheaper materials available for construction. All of these decisions influence the vision for water consumption in architectural activity in Lahore. Consider Edward Durrell Stone’s design for the WAPDA building in Lahore, an amalgamation of concepts including corrugated façade, a perforated canopy and a great plastic dome in the centre. All of these lead to increased heat gain, stressing the need for greater air-conditioning in a country already facing hydroelectricity shortages due to depleting water sources.

4. Possible Remedial Measures

- Key areas in between residential developments should be identified, where man-made lakes can be dug out to store stormwater runoff from paved surfaces in urban spaces. These can be linked by sloped/angular waterways to direct rainwater towards such lakes in which wells are drilled downwards towards the aquifers in the ground. Not only can such a method aid in the faster recharging of groundwater, but will also provide an alternative to stagnant rainwater within city spaces that is especially common in a flat city like Lahore. A good example of where such a mechanism has been tested and proven successful is the University of the Punjab’s basement wells, built to drain rainwater directly back into the aquifer when large amounts of rain during the monsoon season annually floods the university campuses.
• The urban drain system (sewage) must be separated from stormwater drains within the city. Interconnected culverts on both sides of city roads can be laid down to develop a stormwater drain network independent of sewage drains. Such culverts and a system of linked rainwater catchments can be dug down through sealed wells to direct water towards storage plants through a natural filtration system of soil and charcoal. This water can be used to overcome flooding during the rainy seasons and for irrigation of parks and city green spaces instead of treated water.

• Communal rainwater and precipitate collectors can be installed to store rainwater or humidity from the air. Recent technologies have emerged which make use of simple compounds that have the ability to absorb precipitate in the air and condense it into potable water. This can prove particularly useful in Lahore, where the average annual humidity is 38% and goes up to 80% during the monsoon period from July into October.

• Creation of wide botanical breathing spaces between settlements within the city using natural and indigenous flora and fauna provides a natural means of landscape design that can help sustain a healthy water cycle. Local plants are known to consume less water as they are adapted to the arid climate of the city. These spaces also act as a countermeasure to urban heat islands that are bound to be created in a megacity like Lahore. The concept of the garden city should also be explored along similar lines and objectives as should limits on population in a self-contained administrative unit.

• Revive a trend of greater use of native materials and traditional building methods in the region. These include lime and gypsum plasters, clay mortar and stucco/adobe construction. It also refers to the functional use of space, light and shade, all of which are greatly interlinked with
water consumption, as discussed previously.

- Architects must play a greater role in alerting society to the need for conservation and restoration, in addition to a wiser new development. According to many architects in Singapore, measures taken to protect extant buildings are far cheaper in terms of energy usage than razing buildings/homes and erecting new ones.

- Incorporate water strategies into architectural and urban planning at the very beginning of a project. Too often, cognizance of a water problem takes place towards the end or after a project has been completed, which means that the problem is either ignored or further costs are incurred in tackling the issue. In addition, hurried construction leads to insubstantial construction methods having been applied. Consequently, newer construction within the city of Lahore has been found to be more prone to fires due to short circuiting, water leaks and seepage into walls, poor foundations and collapsing structures, especially during the monsoon seasons. All of these are prime examples of the ways in which poor construction leads to wastage of materials, which use large amounts of water to be produced industrially.

5. Conclusions

This paper has looked at issues in Lahore's urban sprawl from multiple perspectives, including social ideas, architectural philosophy, materials, methods, drainage and the use of space. It has stressed on the underlying principle that water does not only have its use in obvious purposes like irrigation and human consumption. It is an essential in the industrial preparation of electricity, fuel, building materials and many other aspects of architecture and is affected by almost every decision an architect makes. This is why it is important to assess how a variety of concepts in Lahore's modern urban architecture are related to the generation and control of urban heat, provision of cooling and ventilation and the use of light. The paper argues that the city's random expansion and excessive reliance on artificial mechanisms and living styles alien to Lahore's climate and traditions are taxing its water resources extensively in less obvious ways. It proposes that architects and the government explore new technologies combined with tested successful traditional methods of construction, living and infrastructural investment as a model for future expansion of cities in Pakistan.
References

Hussain T., 2008, Gypsum plaster may replace cement in buildings, www.mcarelimited.com
Krier, R., 1979, Urban space. New York, Rizzoli.