

COMFORT WITH COURTYARDS IN DHAKA APARTMENTS

Zainab Faruqui Ali
Department of Architecture
BRAC University, 66 Mohakhali
Dhaka-1212, Bangladesh

ABSTRACT

The building activities in the residential arena of Dhaka are primarily involved in mid to high rise apartments of various sizes and styles in almost every available space. The majority of these, mostly six storied, are compact type buildings with no courtyards inside. Hence there is a lack of natural ventilation and daylight in the interior spaces, which affect the level of indoor comfort. The age-old methods of designing in the context have proven that providing natural ventilation is an important strategy for having comfort. The traditional residences, rural or urban, with interior courtyards created a living condition that was and still is, environmentally, functionally, and socially sustainable. The author, through studying a number of residential buildings both with and without courtyards, stresses that introduction of this important environmental element, or the courtyard in the contemporary apartment buildings can provide much better indoor comfort in terms of light, air and coolness. The study is a synthesis of recorded temperatures, questionnaire survey and observations made on various aspects of the plan, section, form, materials and impact of the presence or absence of courtyards. The author also suggests that considering 'value-for-money' factor, new building regulations of floor area ratio, and above all indoor comfort the scope of applying courtyards in residential apartments for good thermal and luminous environment is still possible.

Key words: Residential courtyard, thermal comfort, shading, ventilation, environmental strategies.

I. INTRODUCTION

The local climate dictates that for indoor comfort, shading from solar radiation and cross ventilation through openings and courtyards are required for having comfort in the buildings of warm-humid Bangladesh. The shaded verandahs and courtyards of old town houses or loosely arranged rural huts around a courtyard address the problems of climate quite successfully. Rapid rise in population in the capital city Dhaka, termed as a mega-city [1], has resulted in construction of high density apartment buildings all over Dhaka. Many of these, mostly six stories high, are compact buildings devoid of the traditional environmental element or 'courtyards', and thus have dark interiors and poor ventilation.

This paper suggests that a return to the traditional environmental strategy of courtyards in the modern apartment buildings can provide a much better indoor comfort in terms of light, air and coolness.

II. CLIMATE AND COMFORT ZONE

The yearly temperature, humidity, rainfall and solar radiation of Dhaka the capital of Bangladesh are shown in Figure 1 [2]. The climate is a warm-

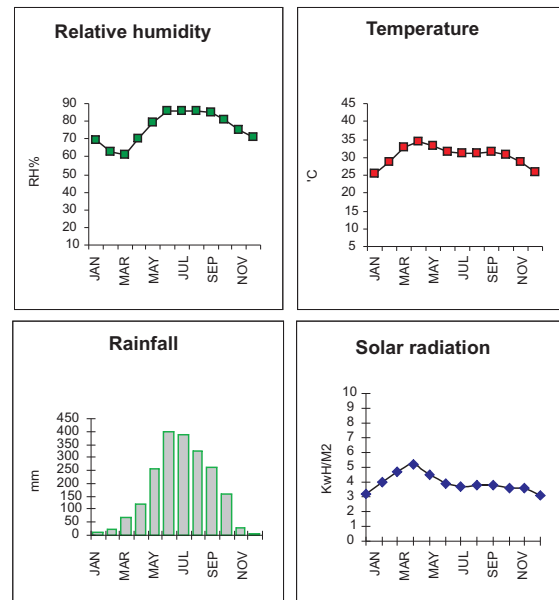


Figure 1: Climate data of Dhaka

humid monsoon type covered under the broader umbrella of tropical climate. In architecture, solar control and ventilation due to warm temperatures

coupled with high humidity need to be addressed, along with protection from heavy rainfall.

The comfort conditions in summer or the Summer Comfort Zone for urban residences lie within temperatures of 24°-32°C and relative humidity of 55-90% for free-running or non air-conditioned residential buildings [3].

III. THE COURTYARD AS AN ENVIRONMENTAL STRATEGY

A. The courtyard as an environment modifier

That the courtyard is a positive environment modifier of the outdoor environment is quite established in traditional housing of warm humid regions [4]. Again, the role of courtyard in bringing comfort to indoors in the hot dry climates has also been recognized for a long time [5].

In the warm humid areas where ventilation is one of the two major issue for comfort [the other being shading], buildings of narrow depth usually promote comfort. When arranged around a courtyard they also cast shadows in outdoor spaces and act as a cool sink. The buildings in traditional settlements of warm humid regions like Bangladesh usually have courtyards allowing air flow from outside to reach them.

But shortage of space and rapid growth of population in the urban areas did not allow the loose courtyard-type arrangement. In spite of this the closed courtyard is seen in some of the urban houses of the early parts of the last century. These urban courtyards acted as functional and social spaces as well as important climate modifiers. The buildings were of single-room depth structures with central courtyards encompassed by verandahs that shaded the walls and openings. The interiors had good ventilation and thus were comfortable due to the presence of courtyards. Other elements helping in this regard were the thick walls, shaded openings, and high ceiling with ventilators for warm air exhaust.

B. The courtyard in the context

Dhaka now has mostly compact type houses often with several stories high with very little spacing, about a maximum of 8 feet, between buildings. As a result there is an inadequacy of ventilation and light in these buildings. With a great demand for housing and inadequate supply, apartments in such buildings are common habitats for the urban population.

In the early government housing developments of the fifties, four-storied apartment blocks first appeared but with plenty of spacing between them and sometimes internalized courtyards between blocks. Although they represented a new way of living the natural ventilation and daylight conditions in them were usually good. In recent times some sensible apartment developments although very few in number have, for the sake of light and ventilation incorporated courtyards in designs.

C. Contemporary buildings in urban Dhaka

The Courtyard Building

The residences of Dhaka built around late nineteenth to the early twentieth century located mostly now in the old city are two to three stories high and have courtyards within them. Almost all of these have small or large verandahs. Some of the larger ones have gardens within. A few bungalow type houses still exist with wrap around shaded verandahs.

Some recent apartment buildings have included courtyards in their design, although not in the style of traditional urban buildings (Figures 2 & 3).



Figures 2 & 3: Recent courtyard type buildings

The plans are compacted and multi room deep without the benefit of running verandahs. But the courtyards are a relief from the typical darker interior spaces of the compact type apartments.

The Non-Courtyard building

As mentioned earlier, modern or contemporary residential architecture in the context does not usually incorporate the courtyard or an open space within the built form (Figure 4). This happens due to many reasons such as client/owner's demand for more rentable space, smaller plot size, inadequate building regulations, lack of awareness about the importance of courtyard or open space in the healthy indoor environment in terms of light and air.



Figure 4: The non-courtyard buildings

III. Study of Thermal PERFORMANCE

A. Study of thermal performance

Two buildings each of the two typologies of apartment buildings i.e. the courtyard type and the non-courtyard type were chosen for comparison of thermal data. Air temperatures were measured on a hot day, 10 April 2006, which was one of the thermally stressful days of the year. Rooms in each of the four that had similar occupancy type, bedrooms, were selected as the test cases.

Indoor and outdoor air temperatures in each of these rooms were recorded with electronic dataloggers at regular intervals over a 24 hour period. Outdoor air temperatures were measured in nearby shaded airy locations. There were variations in outdoor temperatures due to microclimate conditions. This is the time when the outdoor temperatures are high; and relative humidity comparative to other parts of the year, low. Solar

radiation is also high and direct usually in April. None of the rooms have air conditioners but they have ceiling fans which were kept on to simulate real life situation. It is important to mention that the case study buildings are located in an area of the city which is quite dense.

The objective was to examine how these spaces performed in relation to the comfort zone. This study was supplemented by the questionnaire survey and observations made on various aspects of the plan, section, form, materials and impact of the presence or absence of courtyards in the buildings.

B. Study: Courtyard type

Example 1 is a five storied apartment building in dense part of Dhaka. It has a reinforced concrete structure with exterior walls of exposed brick. The apartments are organized around a central paved courtyard. Some rooms have verandahs that open to the courtyard (Figure 5).



Figure 5: *Example 1* - Courtyard type building

The courtyard has play area, seating and is partially green. The presence of the courtyard not only helps cooler air movement but also shades part of the buildings at different times of the day as the sun moves. Data on air temperature was collected over

a 24 hour period in a room in one of the apartments of *Example 1*. Some of the rooms have verandahs opening to the courtyard.

The indoor air temperature was much below the outdoor one during most of the time, and was within the summer comfort range (Figure 6). Difference between peak outdoor and indoor is about 5 hours. The apartment has good natural ventilation. Although it exceeds the summer comfort limit for a few hours, good airflow helps comfort conditions. The green in the courtyard helps keep the air cool. The size of the courtyard is well proportioned with the apartment block. The courtyard is used by both adults and especially children.

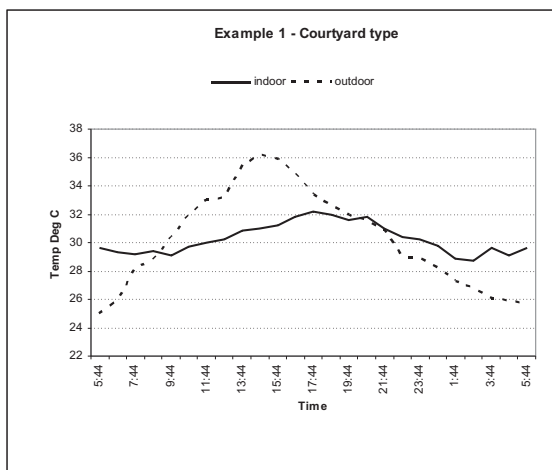


Figure 6: Indoor and outdoor temperatures of courtyard type Example 1, 10 April 2006

Example 2 is also an apartment building, but taller than *Example 1*. It is of reinforced concrete structure, with brick exterior walls having concrete plastered surface. The courtyard is not enclosed on all sides; rather it is open on the east and west (Figure 7). The apartment blocks have east-west elongated axes. The block to the south of the courtyard is lower than the one in the north, which allows air flow to the northern block from the prevailing southerly direction. The courtyard has large play area for children and is landscaped with trees and seating around the edges.

Temperatures were recorded in a room of an apartment in western part of the southern block facing the courtyard. The room has its window directly on to the courtyard. It has a western wall which is solid.



Figure 7: *Example 2* - Courtyard type building

The temperature is within the comfort range for most of the period studied (Figure 8). Due to the natural ventilation and circulation of cooler air from the courtyard, the indoor temperatures are much below the outdoors. The higher indoor temperature than the apartment in *Example 1* could be attributed to the western exposure of the room. The difference of the outdoors and indoors peak temperatures is about 4 hours.

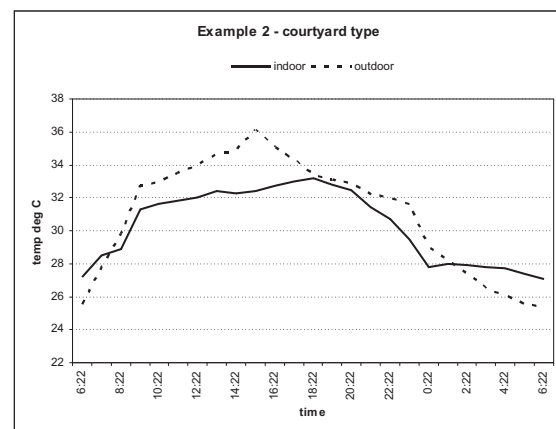


Figure 8: Indoor and outdoor temperatures of courtyard type *Example 2*, 10 April 2006

There is good ventilation inside the apartment. The lower block on the south shades the courtyard well during afternoon hours. Thus the northern block gets cooler air from the courtyard in the afternoons and evenings. Although the user at first complained about the smaller sized rooms, eventually they were happy with the environmental benefits of adequate daylight and breeze. The courtyard has been accepted as a successful social space especially by the young children.

C. Study: Non-courtyard type

Example 3 is a typical six-storied compact apartment block without courtyard in a residential district in Dhaka. The structure is of reinforced concrete with plastered brick wall exterior (Figure 9). Buildings in the neighbourhood are placed close to each other, about eight feet apart in most cases. Except for the apartments that face the street, other apartments receive little light and ventilation. There are no courtyards but a small ventilation shaft, about 4 to 5 feet square, exists for exhausting air from bathrooms, and in some cases kitchen.



Figure 9: *Example 3* Non-courtyard type building

Air temperatures of the apartment in a room facing adjoining building on the south side, and outdoor air temperatures were measured in the same period as the other cases.

Indoor air temperature is higher than the outdoors, and is also above the upper limit of the comfort range for a good portion of the day (Figure 10). Difference between the outdoor and indoor peaks is 3 hours. The block being surrounded closely by built forms of similar heights do not allow for natural ventilation or airflow, and thus results in uncomfortable indoor conditions. And this crowded condition probably adds to the reradiated heat coming from surrounding buildings. The apartment

can not get rid of the indoor heat due to absence of a courtyard or airflow as seen in other courtyard-fed apartments. The daylight is inadequate in the dining and family living areas and bathrooms.

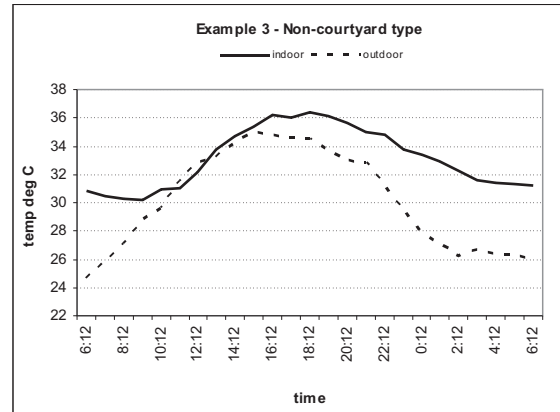


Figure 10: Indoor and outdoor temperatures of Non-courtyard type *Example 3*, 10 April 2006

Example 4 is a six-storied apartment building belongs to a dense location of the capital city



Figure 11: *Example 4* - Non-courtyard type building

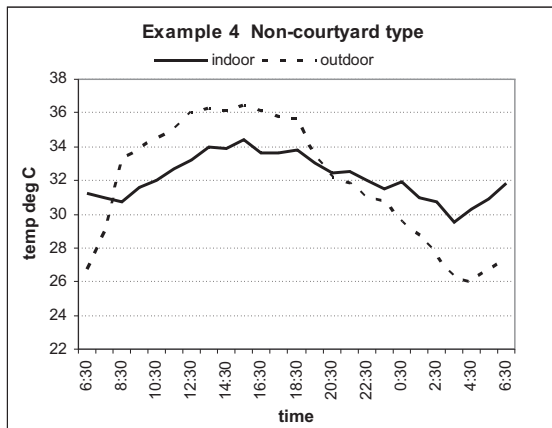


Figure 12: Indoor and outdoor temperatures of Non-courtyard type *Example 4*, 10 April 2006

(Figure10). Although there are large windows on the street façade, the other three sides have much smaller windows, and are surrounded by, as common in the neighborhood, six storied buildings, and therefore natural ventilation is almost nil. The apartment is depended on ceiling fans for airflow which is not adequate since these do not help in removing the heat but rather re-circulates the warm air. Quite recently an air-conditioner has been installed in the master bedroom. Some interior spaces are poorly daylight.

IV. CONCLUSIONS

A. Environment

The temperature, light and ventilation study along with the interviews among users and observations on the form, materials, environmental strategies, reveal that a courtyard apartment building is much more comfortable and thus desirable for the city dwellers of Dhaka.

B. Other recommendations

Economy

A city dweller will demand a place with good indoor environment of light and air, and possibly good view, which is necessary for healthy living. That such a courtyard-fed apartment, of a smaller floor area than without the courtyard, will be more appealing to the clients/developers is a fairly new development [6]. The clients can sell the apartment with a larger price because of the added benefit of good environment of light, airflow and view to the garden/play area. And people are willing to pay more for healthier environment even if they get

lesser amount of living area, as interviews with them suggest.

Building Code / Regulations

Recently the building code has been revised introducing new light and ventilation laws that allow adequate daylight and ventilation in the residential apartment buildings in the dense cities [7]. Some studies have been also made according to the new regulations of habitable urban space-built up area ratio. Thus the courtyard concept may be successfully incorporated in the designs and thus a more comfortable thermal and luminous indoor environment can be achieved in the apartment interiors of the context in question.

ACKNOWLEDGEMENTS

The author would like to thank the following people for their cooperation:

1. The residents of the apartments.
2. Ashiq, Mamun, Risal and Shubhashish, students of Architecture, BRAC University.

REFERENCES

- [1] UN-Habitat, WHO, UNDESA: 'Competing Needs in an Urban Environment', (2002).
- [2] Department of Meteorology, Government of Bangladesh (2000).
- [3] F. H. Mallick: 'Thermal Comfort and Building Design in Tropical Climates' *Energy and Buildings* 23, Elsevier, Laussane (1996).
- [4] Z. Faruqui Ali: 'Environmental Performance of the Buildings designed by the Modern Masters in the Tropics: Architecture of Louis I Kahn and Le Corbusier in India and Bangladesh', Unpublished PhD Thesis, Architectural Association School of Architecture, London, (2000).
- [5] Vastu Shilpa Foundation for Studies and Environmental Design: '*Concepts of space in traditional Indian Architecture*', Mapin Publishing, Ahmedabad, (2005).
- [6] Interviews with Architects and Real Estate Developers, Dhaka, (2006-07).
- [7] House Building Research Institute and Bangladesh Standard Testing Institute: '*Bangladesh National Building Code*', Dhaka, (1993).