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STUDY OF ECOLOGICAL IMPACT OF VEGETATION IN URBAN RESIDENTIAL PLOT AND ITS IMPACT ON OUTDOOR ENVIRONMENT

MEHNAZ TABASSUM & SHIRAJOM MONIRA KHONDKER

Lecturer, Department of Architecture, Ahsanullah University of Science & Technology, Institute of Architects Bangladesh (IAB), Dhaka, Bangladesh

ABSTRACT

Urban planning and design should basically aim at improving the quality of space in order to improve the living environment of the people. Present urban planning and design in Dhaka Inhibit urban residents to form any meaningful relationship with their present urban outdoor settings and lifestyles are increasingly becoming introverted. Ensuring an acceptable standard in the quality of urban indoor and outdoor spaces has become a great challenge for planners, architects and policy makers. Progressive degradation of the physical environment is the most visible effect of rapid and unplanned urbanization. Findings of the research are the green application in front of the building was tends to experience outdoor temperature. So this research work is provide an introduction or preliminary guide line for thermally responsive architecture on the basis of thermal performance of the greenery application system in Bangladesh and it provides a sustainable, energy saving, comfortable and healthy environment.This research investigates two residential areas to show how green application on residential plot is more appropriate as a thermal comfort strategy for the modern design of Bangladesh.

KEYWORDS: Thermal Comfort, Vegetation, Residential Plot, Outdoor Environment, Dhaka

INTRODUCTION

The preservation of vegetated areas, or green spaces, and creating and expanding more green space in and around the cities can improve the quality of life by providing people with natural settings for leisure and recreation, and by safeguarding the quality of precious life-giving resources. Green areas also have the potential for affording citizens the opportunity to get direct economic benefits through urban agriculture or forestry (IADB, 1997).

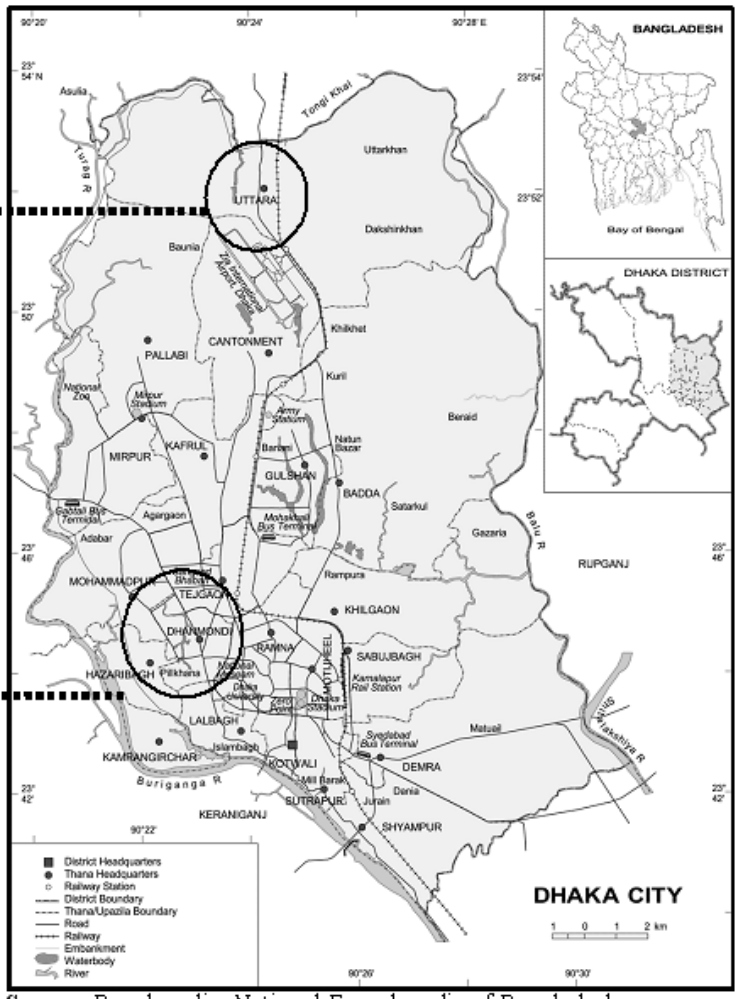
Because of the process of rapid urbanization, Bangladesh has experienced high economic growth. Urban growth resulted in tremendous increase of energy consumption. High levels of population density and carbon monoxide concentration in each city region have been considered as human indices for low quality of urban environments. Urban planning in Dhaka means plotting and design of individual plots of land without relating that plot with surrounding plots or the community or the city. Thus there is a tendency develop as much as of the plot as possible giving rise to various problems, e.g., indiscriminate increase in density, heat islands in summer, invasion of privacy, lack of open space and vegetation, etc. Within the broader aspect of urban planning, each of the following aspects needs careful elaboration and how they are to be implemented, these are- Site and area planning; Building and planning codes; Set-back rule and Floor Area Ratio (FAR); Landscape and preservation of existing trees and vegetation; Water bodies and drainage channels, and other natural heritage; Energy issue; Environmental issue; Seismic risk, etc. The above issues are important in the sense that people use spaces, which consists of both indoor spaces and outdoor spaces of a plot.

Natural green has significant effect on overall life satisfaction and improve the occupant’s well-being. Satisfaction plays significant role in attachment to a green space, where increase in satisfaction and preference typically influence the

attachment levels of human. Comparably attachment to green space is depended upon one's satisfaction towards the physical attributes that green space has to offer in residential building. As a result conservation and quality improvement of existing green spaces and development of more green land uses are suggested as the main policies for middle and longtime environmental improvements at the whole city scale. The natural green plants and flora in front of building presents natural quality, hence, provide a sense of meaning and shaping preference and green attachment of urban residents in dense Dhaka City to the green space. Green network offers residents the ability to make sense of their visual Comfort environment. The green plants and flora in front of house are influence the feeling of harmony, simplicity and authenticity. Natural green has significant effect on overall life satisfaction and improve the occupant's well-being.

Sources: Dhaka City Corporation

Figure 2: Uttara Residential Area



Source: Banglapedia, National Encyclopedia of Bangladesh

Figure 1: Location Map of Dhaka City

Sources: Dhaka City Corporation

Figure 3: Dhanmondi Residential Area

The study takes up few plots in planned residential area with their adjacent road—they are Dhanmondi residential area and Uttara residential area.The following pages intend to give the reader some ideas regarding the climatic condition of Bangladesh; the two residential areas and the quality of space in some particular plot they contain; using of vegetation in those residential plot and its impact on outdoor environment.

OBJECTIVE

The investigation Aims to show the thermal condition of residential plot for using green in outdoor space of building.

METHODOLOGY

This research has undertaken reconnaissance survey to depict the physical environment, with particular focus to the plot under study.Firstly some residential plots are selected for this study in two residential area of Dhaka; they are Dhanmondi residential area (Case study area-01) & Uttara residential area (Case study area-02). Among them some are with green space, some are with green and paved area & some are without green for a comparative analysis and vegetation typology of these plot also considered. To judge physical condition of outdoor spaces of a plot, that was taken into account by measuring ambient temperature, humidity and airflow. External air temperature and relative humidity were measured for evaluate the thermal performance of green application in outdoor space of building. Adjacent road temperature, humidity & wind velocity also carried out to compare. Collected data was then analyzed to get the answer of the research question.The study also investigated through different rapid methodologies i.e., mapping, observations and photography documentation. A literature review has also been made.

CLIMATE IN BANGLADESH

Geographically Bangladesh is a great alluvial floodplain formed by some of the world's great rivers – the Padma (Ganges), the Jamuna (Brahmaputra) and the Meghna. Bangladesh is also characterized by its very low elevation. Except for some hilly areas nearly 50 per cent of the elevation of land surface of Bangladesh is below 25 feet (8.3 meters). Moderate to heavy rainfall characterizes Bangladesh, which is on average 80-100 inches (2000- 2500 mm) per year. High temperatures also characterize Bangladesh in the summer (June-August) ranging from 35-42 degree Celsius. Humidity ranges from 45-65 percent in the dry winter season (November-January) and 85-100 percent in the summer and monsoon **(Islam, 1996).**

The topographic setting of the region also funnels up storms to cyclonic intensities every year. Perhaps nowhere on earth does so much water and silt flow into such a small land area in such a short space of time as in Bangladesh during the monsoon. The outflow carries about 2.5 billion tons of silt and 2.4 billion cusecs of water every year. Dhaka is located almost in the middle of Bangladesh. The city experiences climatic conditions as elsewhere in the country. To design indoor and outdoor spaces planners and Architects in Bangladesh must take into consideration the relatively high temperature, high precipitation level, flooding, etc.

THERMAL COMFORT OF OUTDOOR ENVIRONMENT

Comfort is a relative term and depends on the ambient temperature, light, humidity, Vegetation, etc. In a natural environment, specifically in an outdoor environment, peoples' comfort is not limited to thermal comfort; they are affected by other factors as well. Their antinational capacity is most of the times overwhelmed by their state of mind and their surrounding environment. Discomfort, tension, friction, etc. refer to the opposite state of comfort, which produce a disturbed state of mind when the tolerable limit is exceeded.

Indoor spaces were judged on the basis of privacy, quality of view, degree of satisfaction of living in that particular community, natural ventilation, natural light, intensity of use of artificial ventilation systems (such as, ceiling fan/ AC/ exhaust fan) during summer, and intensity of use of artificial lighting for use of spaces during daytime. To judge comfortable outdoor spaces criteria that were taken into account were ambient temperature, precipitation/ humidity, airflow, planning and landscape of the total community and design of built structures and their visual impacts. Neighborhood livability, street life, social interactions between neighbors and level of outdoor activities were also taken into account. Urban services and residential functions were also considered important in both types of spaces.

ENVIRONMENTAL EFFECT OF VEGETATION

Trees and other vegetation can mitigate the urban heat island effect because they shade buildings, intercept solar radiation, and cool the air by evapotranspiration by cooling, trees reduce evaporative emissions from vehicles and other fuel storage, and by cooling homes and offices, trees reduce power generation emissions. General cooling also reduces the speed of chemical reactions that lead to the formation of ozone and particulate matter. Trees and other vegetation also can improve air quality as well as provide other amenity and aesthetic benefits such as shade and beauty. A tree store carbon and vigorously growing natural forests act as carbon sinks. In addition to providing carbon storage, properly placed trees in developing areas can provide cooling shade, which results in less electricity required to operate air conditioners. Trees also indirectly contribute to energy conservation through landscape and dark surfaces.

Mitigation of Heat Islands Effects

- Trees and vegetation cool the air by providing shade and throughevapotranspiration (the evaporation of water from leaves). Shade reduces the amount of solar radiationtransmitted to underlying surfaces, keeping them cool. Shaded walls may be 9 to 36°F (5° to 20°C) cooler than the peak surface temperatures of that surfaces which are not shaded. These cooler walls decrease the quantity of heat transmitted to buildings, thus lowering air conditioning cooling costs. Cooler surfaces also lessen the heat island effect by reducing heat transfer to the surrounding air.
- A key factor determining a trees cooling effect is its transmittance: the fraction of radiant energy that, having entered the trees canopy, reaches the ground. Transmittance varies by tree or vegetation type, but for deciduous species – which shed their leaves in winter – transmittance ranges from 6 to 30% in the summer and 10 to 80% in the winter.
- Another way trees and vegetation cool the air is by absorbing water through their roots and evaporatingit through leaf pores. This process uses heat from the air to convert water contained in the vegetation into water vapor. A mature tree with a 30-foot crown transpiresapproximately 40 gallons of water per day. Evapotranspiration alone can result in peak summer temperature reductions of 2 to 9°F (1° to 5°C). While this process reduces air temperatures, it does add moisture to the air. The positive cooling effect of vegetation usually outweighs any undesirable gains in humidity.
- The U.S. Department of Agriculture Forest Service estimates that every 1% increase in canopy cover results in maximum mid-day air temperature reductions of 0.07 to 0.36°F (0.04° to 0.2°C). However, trees and vegetation are one factor among many that affect prevailing weather conditions.

Removal of Air Pollutants

Trees also remove pollution by intercepting airborne particles. Some particles can be absorbed into the tree, though most particles that are intercepted are retained on the plant surface. The intercepted particle often is resuspended to the atmosphere, washed off by rain, or dropped to the ground with leaf and twig fall. Consequently, vegetation is only a temporary retention site for many atmospheric particles.

Quality of Life

Trees and vegetation can help reduce noise, which may be highly valued in urban areas. They also provide shade from harmful ultraviolet radiation, particularly in playgrounds, schoolyards, and picnic areas. In addition, trees and

vegetation may increase property values, as several studies have shown that home values are higher on tree-lined streets. Lastly, community gardens and neighborhood parks can help reduce physiological stress, aesthetically improve an area, and provide an urban habitat for birds, animals, and insects.

ROLE OF PLANTS

Eco-design or green architecture or so on are the terms that revolves around plantation or natural inter-relationship of elements constituting our living environment. Vegetation is an important ingredient in this intricate relationship. Therefore it is briefly discussed in the following sections. Trees, shrubs and other plants play a significant role in moderating the built environment by providing shade to the buildings and spaces, intercept solar radiation and cool air by "evapotranspiration"(Mowla1999b).*akasia,babla,karai,jam,shishu,amloki,raintree,ipil-ippil* supplies nitrogen to the soil thus making it fertile but *kathal,neem,eucaliptus,gamar,shegun ,shal,Aam, jam, mehegon*i etc. reduces the nitrogen content in the soil.

The selection of trees mainly depends upon the types of soil and climatic conditions of the locality. plant selection may be determined by information regarding areas receiving full sun shine, partial and deep shade egrongon demand full sun, spider plant needs partial shade whereas,Aluminum plant demands full shade. as a rule of thumb evergreen plants can adapt in any shading conditions. Deciduous trees shading the south and west sides of building or roads or spaces blocks the summer sun thereby reducing the cooling energy by as 30% while allowing sun during winter then altitude of sun is low thereby reducing heating cost(Mowla,1985b).trees help filter up to 75% of particulate air pollutants such as dust, pollen,smoke,odours and fumes, making the air healthful for the outdoor space users (Rubenstein,1992). some of the trees which have the ability to endure air pollution are suitable where heavy traffic congestion occurs. for saline and dump areas *sundari, keura, jhau, raintree ,ipil-ipil, narkel, babla and shishu are recommended while shegun, Aakashmoni, Shal, Babla, karai, shishu, gamar ,raintree and eucaliptus* can endure very high temperatures and draught.

There are certain hardly local plants which can withstand such pollutions such as*korobi, kolke and akasia.*For every city, dust and smoke in the air is a big problem. Mandar and Neem are dust and smoke hardy tree. Some evergreen plants have the ability to receive the dust from the air. So this kind of trees also has to be considered for the roadside plantation where the dust of the air is heavy (Mowla, 2005).

Table 1: Some of the Local Trees which have the Ability to Bear the Air Pollution

Common Name of the Trees(English Name)	Ability to Bear the Air Pollution (%)
Shirish (Women's tongue)	52
Sonalo (Indian Laborum)	54
Neem (AzadirachtaIndica)	38
Tetul (Imli/Tamarind)	30
Mohua(MaducaIndica)	18
Bel (Wood Apple)	18
Aam (Mango)	11
Jam (Black Berry)	10
Polash	10
Chatim (Devil's Tree)	9
Jhau (Casuarina)	7
Shishu (Sissu)	6

Source: Mowla, 2005
Based on PWD Manual of Plantation and Nursing

Table 2: Some Dust Enduring Local Trees

Common Name of the Trees(English Name)	Ability to Receive the Dust from Air/sq.m
Mandar	6.02
Arjun(ArjunaMyrobalan)	4.49
Aam(Mango)	4.05
Kanchan	3.09
Polash	3.05
Neem(AzadirachtaIndica)	2.92
Sonalo(Indian Laborum)	2.24

Source: Mowla, 2005
Based on PWD Manual of Plantation and Nursing

DATA ANALYSIS

Dhanmondi Residential Area (Case Study Area-01)

Dhanmondi is a planned residential area of Dhaka city. Dhanmondi residential area (DRA) was designed and developed by the public works department (PWD) and department of architecture (Darch, GOB) under the supervision of the government architect R. McConnel. Originally 1084 plots, measuring 16 and 33 decimal, were designed and developed under site and service scheme over a land measuring 472.64 acres. Out of the Dhanmondiresidential area (DRA) the land allocated for the lake and its surrounding green space was about 120 acres. Subsequently 1007 plots were leased out to the public for residential use. Dhanmondi was planned and developed with large plots, wide roads and good environment, located within five kilometers from the CBD of Dhaka city.For this investigation some residential plots area selected according to their built area ratio.

Some Images of these plots area are given bellow in Figure 5 to Figure 13.Here Table 3 describe about the adjacent roads temperature, wind velocity & humidity &Table 4 shows the plots physical measurement and also the vegetation type which area seen. Last of all to find the result a comparison draw through bar graph & line graph. The bar graph describe temperature, wind velocity &humidity which differs by plots configuration. On the other hand, line graph shows the comparison between plot and adjacent roads physical measurement (Figure 14 to Figure 19).

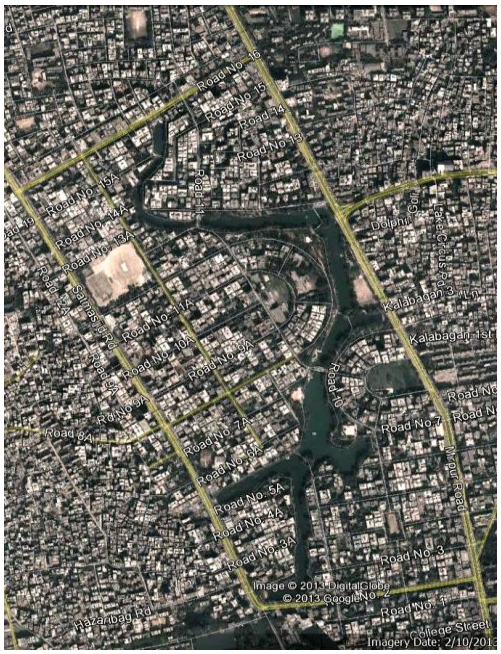


Figure 4: Aerial View of Dhanmondi

Figure 5: House No: 49, Road No: 15A

Figure 6: House No: 58, Road No: 15A

Figure 7: Adjacent to Main Road 27

Figure 8: House No: 330/D, Road No: 28

Figure 9: House No: 52, Road No: 05

Figure 10: House No: 50, Road No:15A

Figure 11: House No: 63, Road No: 15A

Figure 12: House No: 22, Road No: 28

Figure 13: House No: 4/1, Road No: 4

Table 3: Selected Road and their Temperature, Wind Velocity and Humidity

Adjacent Road			
Location/ Time & Date	**Temperature**	**Wind Velocity**	**Humidity**
Dhanmondi			
Time: 12.45pm-3.15pm Date :17/03/2011	**35max--21min**	**(15-5)km/h**	**(58-40)%**
Road-27	28.8max--28.6min	7.2km/h	49%
Road-15A	31.4max--30.7min	5km/h	45%
Road-15A	31.4max--30.7min	5km/h	45%
Adjacent to Lake,Road-15A	32.9max--32.9min	9.7km/h	50%
Road-15A	33.1max--32.2min	5km/h	38%
Road-5 Near To Lake	32.7max--32.2min	3.9km/h	50%
Road-28	34max--32.4min	9km/h	44%
Road-28	32.8max--31.7min	3.6Skm/h	47%
Road-4	33.6max--32.9min	3.8km/h	39%

Table 4: Selected Residential Plot and their Wind Velocity, Temperature, Humidity, Build Area Ration and Vegetation Type

Dhanmondi Residential Area(Selected Study Plot)						
Road No.	**Address**	**Temperature**	**Wind Velocity**	**Humidity**	**Approx. Ratio**	**Vegetation Type**
Time:12.45pm-3.15pm Date : 17/03/2011						
Road-27	Adjacent main road	31.4max--31.0min	3.9km/h	50%	Built area-35%, Pave area-15% & Green area-50%.	Mango,Kathal.Mehgoni, Koroi, Krishnochura, Nim,Arjun, Narkel.
Road-15A	House no:49	At entry 31.2max-30.6min In court near to lake 29.2	At entry 6.8km/h In court 5.4 km/h	At the entry 50%, in court it vary 57-64%	Built area-50% Paved area-20% landscaping-30%, lake side building	Landscaping with flower tree and Near lake krishnochura, Nim,Sonalu,Kanchan ,Kathal& Mango.
Road-15A	House no:50	31.4max--30.9min	2.5km/h	38%	Built area-80%,Pave area-20% but no green	
Adjacent to Lake,Road-15A	House no:58	31.6max--30.9min	10.9km/h	64%	Built area-45% Green area-35% Pave area-10%	krishnochura,Mehedi ,Mehgoni,Jambura,Guava,Jam,kathal,Nim ,Bokul,Tetul,Narkel, Mango& flower tree.
Road-15A	House no:63	32.4max--32.1min	4.3km/h	39%	Built area-90%,Pave area-10% but no green	
Road-5 Near To Lake	House no:52	32.8max--32.6min	3.9km/h	51%	Built area-70% Green area-5% Pave area-30% large tree but adjucent to the lake	Nim,Mehedi, Mango, Krishnochura.
Road-28	House no:22	32.6max--32.1min	5km/h	In pave with green area 46%& inside the building 39%	Built area-82% &Paved area-18% with large tree	Debrau,Mehedi,Baganbilash, Nim,Mango.
Road-28	House no:330/D	32.1max--31.6min	4.3km/h	52%	Built area-40%,Green area-35%&Paved area-15%	Tetul,Mango,Guava, Banana,Kathal,Pepe, Bel,Nim,Koroi,Jam,Jambura&Flower tree.
Road-4	House no:4	33.3max--32.4min	4.6km/h	46%	Built area-65%,Paved area-20% &Green area-15% with trees	Narkel,Kathal,Gondhoraj,NimMango,Debdaru.

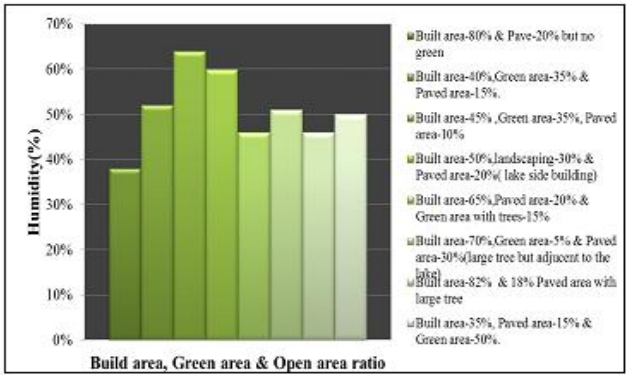


Figure 14: Humidity of Plot According to their Configuration (Build Area, Paved Area & Green Area)

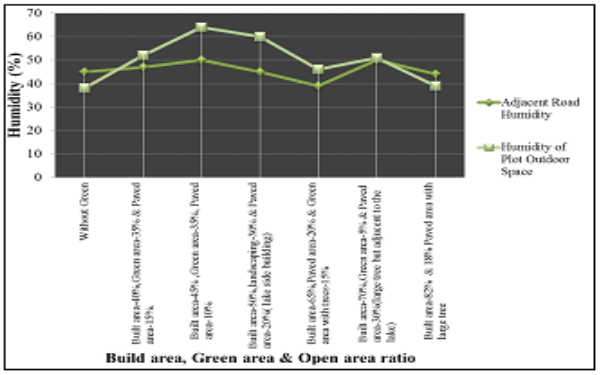


Figure 15: Comparison of Humidity between Plot & Adjacent Road

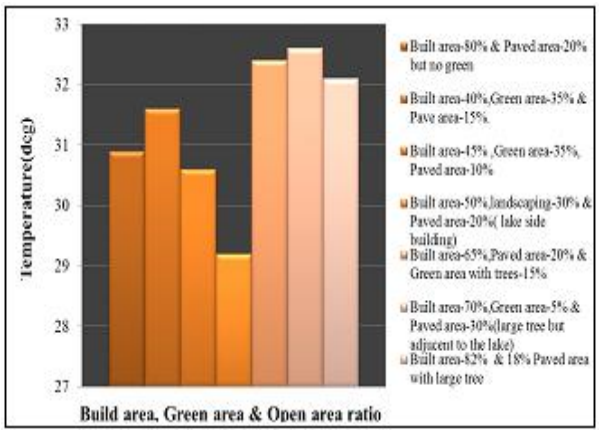


Figure 16: Temperature of Plot According to their Configuration (Build Area, Paved Area & Green Area)

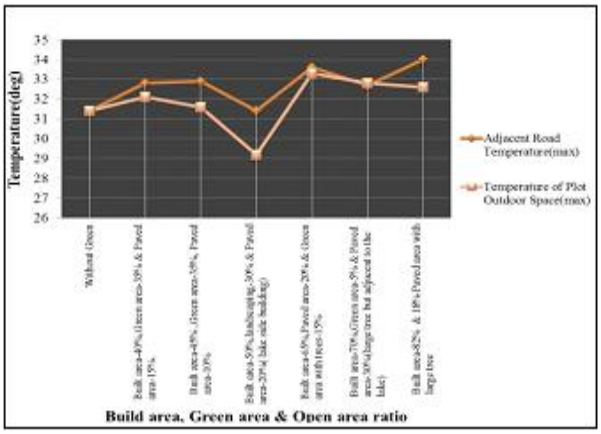


Figure 17: Comparison of Temperature between Plot & Adjacent Road

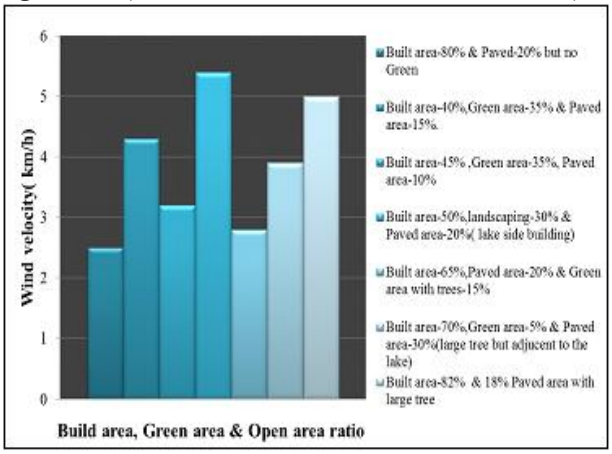


Figure 18: Wind Velocity of Plot According to their Configuration (Build Area, Paved Area & Green Area)

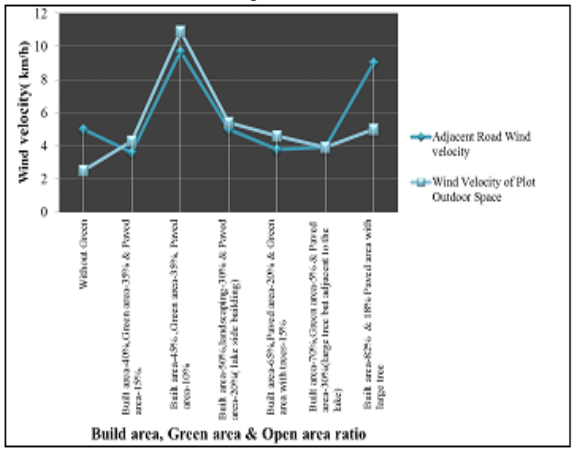


Figure 19: Comparison of Wind Velocity between Plot & Adjacent Road

In Dhanmondi residential area, on the study date 17.03.011 the maximum temperature was 35deg C, wind velocity 15km/h (max) & humidity 58%.The maximum road temperature was 34 deg C, humidity 50% & wind velocity 9.7km/h. According to the study for application of green in residential plot the temperature is reduce from0.3deg C to 2.5deg C. Humidity also increase, the highest value was 64%. On the other hand wind velocities also vary according to the plot. In reversely, without application of green in a residential plot the difference may not see. Here house no: 58 in road 15 near to lake 45% built area, 35% green & 10%pave area shows the maximum humidity, lowest temperature & maximum wind velocity.

Uttara Residential Area (Case Study Area-02)

Uttara is primarily a residential suburb, and is divided into several "sectors". The residents are generally from an upper & higher-middle-class or middle-class background, who favor its distance from the congestion and pollution of Dhaka city. Indeed, well into the 1990s, Uttara retained its quiet, leafy suburban character. The suburb is well-served by a proliferation of shopping complexes, shops, and schools & college.Uttara is planned by Rajukand divided into 14 sectors, starting from sector 1 to sector 14. Originally it was planned that the odd-numbered sectors (1, 3, 5, 7, 9) were to be situated on the west side of Dhaka-Mymensingh Highway, and the even-numbered sectors (2, 4, 6, 8) on the east side. SomeImages of the selected plots are given bellow in figure 21 to figure 25.Table-05 &Table-06 are described here about roads & plots temperature, wind velocity & humidity & also the vegetation type in plot. Line & bar graph depicts to compare & find results which are shown here in Figure 26 to Figure 31.

Figure 20: Aerial View of Uttara

Figure 21: House No: 14, Road No: 13

Figure 22: House No: 30, Road No: 3

Figure 23: House No: 43, Road No: 4

Figure 24: Vacant Plot, Road No: 2 **Figure 25: House No: 31, Road No:4**

Table 5: Selected Road and their Temperature, Wind Velocity and Humidity

Adjacent Road			
Location/ Time & Date	**Temperature**	**Wind Velocity**	**Humidity**
Uttara			
Time:1.15pm-3.15pm Date : 10/03/2011	**30max--26min**	**(15-5)km/h**	**(58-40)%**
Main Road	32.5max--32.1min	3.6km/h	36%
Road-2	32.2max--31.1min	3.4km/h	36%
Road -3	30.4max--29.9min	4.3km/h	56%
Road -4	33.6max--32.9min	4.6km/h	39%
Road -11	31.7max--31.4min	2.5km/h	42%
Road -13	31.4max--31.3min	1.8km/h	38%

Table 6: Selected Residential Plot and their Wind Velocity, Temperature, Humidity, Build Area Ration and Vegetation Type

Uttara Residential Area (Selected Study Plot)						
Road No.	**Address**	**Temperature**	**Wind Velocity**	**Humidity**	**Approx. Ratio**	**Vegetation Type**
Time:1.15pm-3.15pm Date : 10/03/2011						
Road-2	Vacant plot	31.8max--31.2min	2.5km/h	38%	Built area-50%, Paved area-25%& boundary covered with tree.	Mango, Kathal, Krishnochura, Nim, Koroi, Narkel, Guava
Road -3	House no:30	30.8max--30.6min	2.5km/h	42%	without green	
Road -4	House no:43	31.5max--31.2min	3.2km/h	40%	Built area-60%, Paved area-40%& boundary covered with tree.	Mango, Kathal, Koroi, Mehedi
Road -11	House no:31	30.9max--30.2min	4.3km/h	45%	Built area-65%, Paved area-5% & Green area-35%.	Mango, Ucaliptas, Kathal, Guava, Nim
Road -13	House no:14	29.9max--29.6min	2.5km/h	41%	Built area-50%, Paved area-25% & Green area-25%. Area.	Mango, Kathal, Dalim, Mehdi & Landscaping

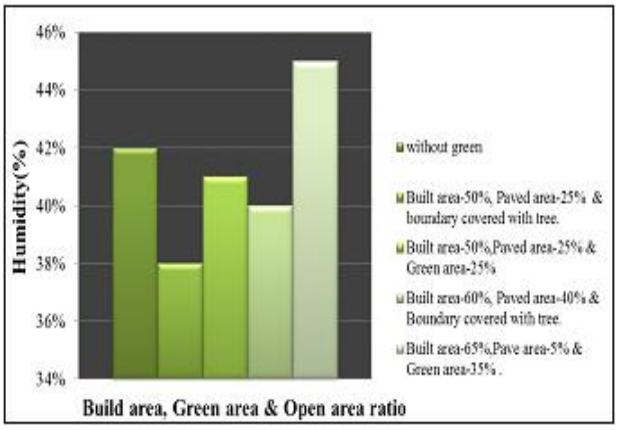


Figure 26: Humidity of Plot According to their Configuration (Build Area Paved Area & Green Area)

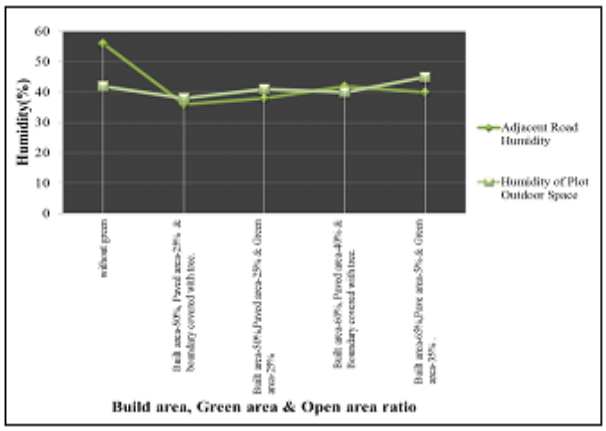


Figure 27: Comparison of Humidity between Plot & Adjacent Road

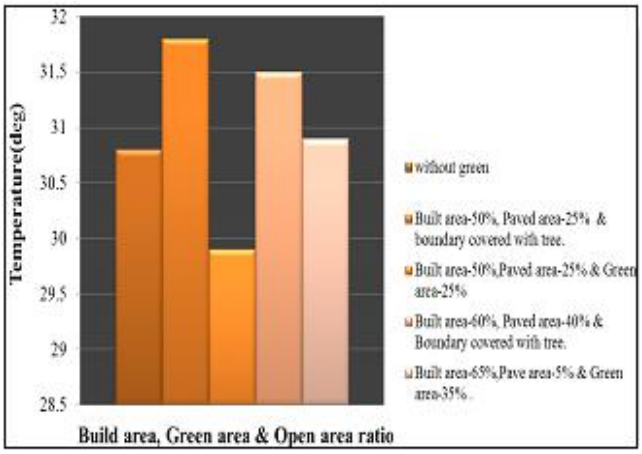


Figure 28: Temperature of Plot According to their Configuration (Build Area, Paved Area & Green Area)

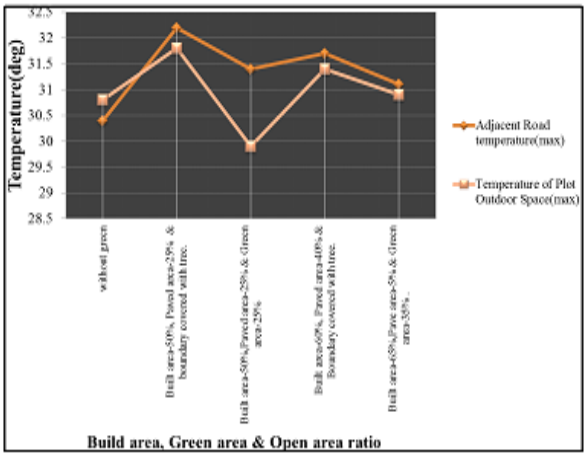


Figure 29: Comparison of Temperature between Plot & Adjacent Road

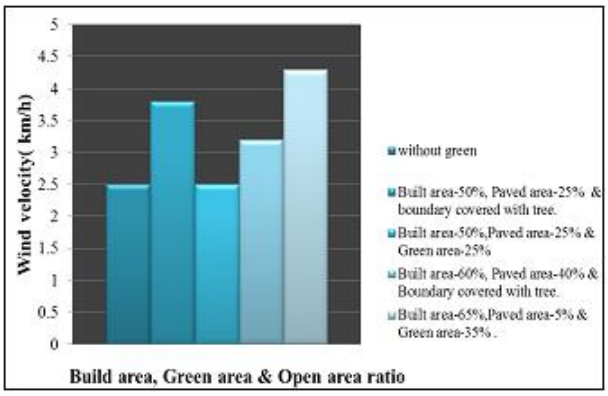


Figure 30: Wind Velocity of Plot According to their Configuration (Build Area & Green Area)

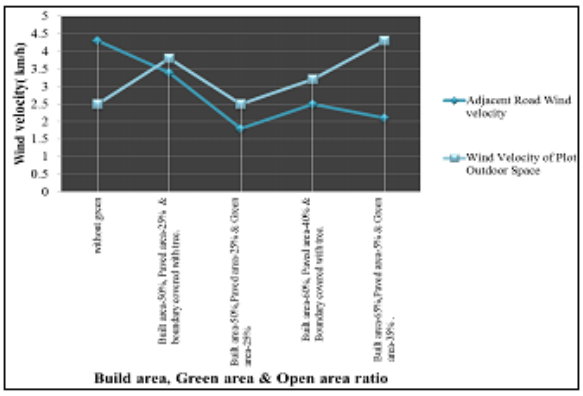


Figure 31: Comparison of Wind Velocity between Plot & Adjacent Road

In Uttara residential area, from the above study we can see that, on the study date 10.03.011 the maximum road temperature was 32.2 deg C, humidity 56 % & wind velocity 4.3 km/h. according to the study for application of green in residential plot the temperature is reduce from0.6degC to 2.8degC, humidity also increase because of vegetation, the highest value was 64%. & wind velocity also vary, in reversely without application of green in residential plot the difference may not be seen. It has been seen that in residential plot vegetation has playing an important role for ensuring thermal comfort. Here House no 31, where 65% was build area, 35% green area & 5% pave area was most effective in this case.

DISCUSSIONS AND CONCLUSIONS

Ecological design or Eco-design involves the holistic consideration of the careful use of energy and materials in a designed system. It is the endeavor to reduce the impacts if interference on the natural environment, over the lifecycle of the designed system from source to sink. (Mowla, 2000).From this study we can understand that, the natural green plants and flora in front of building presents natural quality, hence, provide a sense of meaning and shaping preference and green attachment of urban residents in dense Dhaka city to the green space. Green network offers residents the ability to make sense of their visual comfort environment. Results have also suggested that residents respond positively towards maintaining the green landscape and environment because it has value to individual and community inurbane areas.

The result concludes that green application contributes to reducing energy consumption for passive cooling load of residential building in the Bangladesh. It can reduce air temperature during day and night. Green as a passive cooling mean, its related thermal benefits are essential for architectural design strategy in warm-humid tropical climate of Bangladesh. This research work provides an introduction or preliminary guide line for thermally responsive architecture on the basis of thermal performance of the green application system. The green application in a residential plot is more appropriate in warm humid tropical climate of Bangladesh.

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