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Towards An Eco-Friendly Campus Design: A Place for Vibrant Activity Space and Scenic Beauty

¹Sabrin Sultana Zerine, ²Sumita Roy, ¹Nishat Akter, ¹Sabiha Mahbuba, ¹Nusrat Binta Nazir, ²Anutosh Das, ²Nazia Hossain

Abstract: Now-a-days universities referred to as small cities where various complex activities taking place, and which have some serious direct and indirect impacts on the environment. A well-ordered and purposeful landscape design can bring a level of efficiency and maintenance of the campus area. By following campus landscape design process and landscaping principles, the study team used database from both primary and secondary sources for the improvement of existing activity spaces and environmental management of Rajshahi University of Engineering and Technology (RUET) considering people's needs at first. Various complex activity spaces are sub-divided into civic, social, courtyard, residential, street and parking space. The study aims to ensure an aesthetically beautiful and eco-friendly design where activity, safety, and waste management get consideration.

Key words: Eco-friendly, Activity space, Safety, Waste management, Landscaping, Campus Design, Sustainability.

1 INTRODUCTION

Eco-friendly campus landscape claims reduced, minimum or no harm upon ecosystems or the environment. Eco-friendly literally means earth-friendly or not harmful to the environment (Dictionary.com: Eco-Friendly). This refers to practices that help conserve resources like water and energy; prevents contribution to air, water, and land pollution. Actions to sustain ecological systems, flows and functions must be integrated across the human dimensions of landscapes. The continuation of ecological processes across landscapes is the foundation for a sustainable future (Saunders and Briggs, 2002). As activities taking place on campus have a serious impact on the overall environment of the neighboring area and forasmuch as having a location in an extreme climatological condition, RUET has its distinct needs to be designed and landscaped through an eco-friendly strategy. So, with this vision, a task has been taken for landscaping RUET by creating various activity areas through an eco-friendly approach. To achieve this, the benefit of combining plants of native species with various form of permeable pavers has been evaluated, reduction of concrete usage is ensured as much as possible and these strategies have been implemented throughout various activity spaces. Activity space is defined as the local area within which people move or travel during the course of their daily life, it is a measure of individual's spatial behavior which captures individual and environmental differences and offers an alternative approach to studying the spatial reach of travel-

ers (Rai et. al, 2006). Though RUET campus covers an enormous area of land with a lot of natural resources (Plants, water body, wildlife etc.), the absence of organization of these resources in a systematic order reduces the scope of functional user interaction with nature. Hence the aim of the study is to ensure an aesthetically intriguing and environmentally benign design regarding activity, safety, and waste management.

2 LITERATURE REVIEW

Literature review gives the researchers a direction of thinking about the sustainable initialization, implementation, and management of the design. There are many reports, journals, online services and books that briefly discuss the landscape planning of an area.

According to Habib M. Alshuwaikhat and Ismalia Abubakar, universities can be compared as small cities due to many factors like their large size, population and various activities taking places on campuses. And the activities have serious direct and indirect impacts on the environment. A more suitable framework of three strategies namely university Environment Management System; public participation and social responsibility and promoting sustainability in teaching and research was proposed by them to reduce the negative impacts of those activities (Alshuwaikhat and Abubakar, 2008). In context to Rajshahi, Rajshahi University and RUET are the most important and prestigious universities. So the activities taking places in these campuses have serious impacts on the overall environment of Rajshahi. As RUET is selected as the study area by promoting sustainability and ensuring an eco-friendly environment of this campus the overall environment of Rajshahi can be improved.

Landscape master plan & design guidelines of the University of TEXAS at Austin (2014) said that a purposefully ordered landscape is essential to improve the overall condition of a

¹Undergraduate Student, Department of Urban and Regional Planning, Rajshahi University of Engineering and Technology

²Lecturer, Department of Urban and Regional Planning, Rajshahi University of Engineering and Technology
Corresponding Authors:

Sumita Roy, Email: sumitaroy.urp@gmail.com

Sabrin Sultana Zerine, E-mail: sabrinzerin@gmail.com

Anutosh Das, E-mail: anutoshbuet@gmail.com

campus area (Campus master plan, 2014). Different types of landscape for different zones including Civic Landscapes; Streetscapes and Parking Areas; Connective and Interstitial Spaces; Courtyards; Residential Landscapes; Special Places and Gardens; and Natural Areas should be linked together. The design of entrance square in front of the academic building was inspired by the design of BGU University entrance square. The result of this ordered approach of landscape design will be helpful to achieve a stronger quality of unity for the campus. The climate of that country is quite similar to this study area and it is hoped that different types of landscape for different zones of the campus will be helpful to improve overall organization of the study area.

Landscape master plan & design guidelines of the University of Hawai'i at Manoa emphasized that design simplicity should be maintained for the civic space landscaping and the civic spaces are the largest and most identifiable spaces of a campus (Campus master plan, 2014). And the defining feature of the street landscape should be simple, unified tree lined avenue, free of on-street parking and emphasizing the clarity of pedestrian. The campus courtyards should be designed as the public living spaces of the campus where people can feel comfortable studying, socializing, having lunch, or just enjoying the outdoor environment. The landscape design of different zones of the campus is done following these design guidelines.

Greening Campus Landscapes enforced to incorporate environmentally friendly features (i.e. porous pavement and native plants) to achieve eco-friendly environment. The benefits of natural landscapes are diverse and include environmental, social and economic factors. Sustainable landscaping practices can ensure positive impacts on plants, water and land use and it will ensure eco-friendly environment. It also helps to reduce paved surfaces as well as maintenance cost and improve the health of people (Buch M., Divringi E., McCann M., Millard M. & Patten J., 2011). In the proposed design it is tried to incorporate environmentally friendly features and utilize porous pavers to bring sustainable eco-friendly environment in the campus area.

3 METHODOLOGY

The planning procedure began with the site inventory and analysis. This study is based on primary and secondary data sources. Primary database collected through reconnaissance survey is focused on the condition of facilities, problems, environmental condition, road network and existence and current condition of natural elements such as water bodies, plants etc. Soil characteristics, climatic condition, topography, specific plant characteristics, detailed layout map of the area and some other information were collected from different secondary sources with the help of different journals, reports, books, and the internet. The objectives and checklists have been determined thereafter concerning the needs and site requirement. The design process was started with assembling

the principles & guidelines described in the following design ideology section. Some of the conventional principles have been reformulated to meet the location criteria. Eco-friendly design guidelines have been taken into special consideration in the design process. A 2-D sketch of conceptual framework has been designed following the comprehensive set of principles. It was modified several times after conducting a second site inventory and analysis. A final design proposal has been prepared and projected into a 3-D model form afterward. Finally, to ensure proper and efficient management of the project, a detailed report has been submitted as the documentation of the whole procedure.



Fig1. Study Area

4 STUDY AREA PROFILE

4.1. Location

The study area is Rajshahi University of Engineering and Technology which is of 152 acres. RUET is situated in the northern part of Bangladesh, in the city of Rajshahi, the educational center of Bengal. The important land marks that are adjacent to RUET boundaries namely Rajshahi university, kazla road, Talaimari Bazar. Two different portions of RUET: administrative area and some portion of the residential area are designed and the other portion will be a replication of the design.

4.2. Climatic condition, soil character, and topography

The climate of Rajshahi is classified as tropical. The average annual temperature in Rajshahi is 25.8 °C. About 1419 mm of precipitation falls annually [CLIMATE-DATA.ORG]. Here,

Predominant soil textures are Loamy and Clayey and soil pH varies from pH 4.5 to pH 7.9; organic matter contents in the soils are low or medium [Background Information for Rajshahi City, Bangladesh].

4.3. Existing condition

The existing RUET includes buildings, monuments, roads, seating places, water bodies, large big trees, shrubs, herbs, etc. There is no designed parking lot in the campus area. The front side of Administration building is used as the place for parking which is not really suitable. There are some sitting places but their arrangement has not been done properly and lack of adequate gathering places. Existing natural elements include plants like Mango tree, Blackberry, Debdaru tree, Garden croton, seasonal flower, Rose, Jungle flame, Lemon grass, Carpet grass. These plants are habitations of many creatures, specially the birds. At the same time, the plants have a great impact on microclimate. These indicate the importance of plants in an eco-friendly design. There are also some open spaces and some spaces of no use which have the potentiality to be of great use. That is why the campus demands an activity space designing. The site demands to ensure activity to make the site functional at the same time ensuring beauty and security.

5 LANDSCAPE DESIGN PROPOSALS FOR DIFFERENT ZONES

The vision for the proposed landscaping project in the study area was basically to provide an eco-friendly campus framework among various activity areas. To achieve this goal certain environment principles have been adopted such as water conservation, pollution control, tree preservation, wildlife conservation, soil erosion prevention, reduction of heat island, minimize resource consumption, etc. The characteristics of basic landscape principles have been attempted to obtain over all the design proposal. Proper management of waste and security have also been ensured in the design proposal. To define various functional activity areas the study area has been

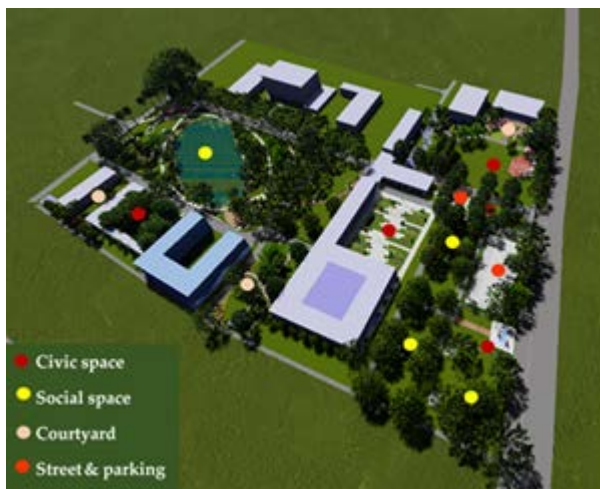


Fig 2. Layout (Administrative portion)

Fig 3. Layout (Residential portion)



divided into several zones based on their distinctive operational characteristics. They are – Civic Space, Social space, Courtyard, Residential area Street & parking. Each zone has been designed carefully according to those principles.

5.1 Civic space

In the hierarchy of campus landscape spaces, the civic spaces are among the largest and most identifiable spaces. The plantings in civic spaces are kept simple and the diversity of plants is kept limited. In our study area, the spaces that are included in civic space landscape are following.

5.1.1 Administration building front

Administration building in one of the most important buildings in our study area. In our landscape design, this space is proposed to turn into a frontage of our campus that is done by using different types and colors of shrubs and herbs which will contribute reducing temperature and permeable pavement to reduce surface runoff. Its main function is to create frontage and give an identity and increase aesthetic view. Plants those can be used here Cosmos, Rongon, Dopati, Rokto kanchon and Daisy flower.



Fig 4. Design proposal for Administration building

5.1.2 In front of Auditorium

In front of Auditorium, a statue is proposed to be installed that will be surrounded by different sizes of herbs and shrubs. By graduating plant sizes away from the Auditorium building the

apparent size of the structure will be increased. This will create an inviting appearance to this entrance. China rose, Rongon, Debbaru and Sonalu can be used for this purpose.

5.1.3 Design proposal for Mausoleum

The grave of three freedom fighters is located beside the proposed parking area. The grave has been signified by proposing a mausoleum. This design includes different types of shrubs and herbs of cool color to obtain the serenity, lighting and less use of hard surface has been ensured.

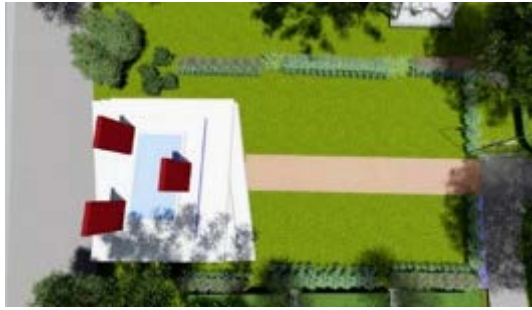


Fig 5. Design proposal for Mausoleum

5.1.4 In front of Shaheed Minar

There is a Shaheed Minar in our study area that is one of the important monuments. The front side of Shaheed Minar is known as "MUKTO MANCHO" that is surrounded by large trees such as Krishnochura and Kadam that will improve physical and chemical properties of soil and increases the level of soil organic carbon cation-exchange capacity. Besides this Debbaru, Neem, Sonalu are the existing trees that will be preserved and this open space will be used to organize different cultural programs or national days of our country on the campus.



Fig 6: Design proposal for Shaheed Minar

5.1.5 Space between Civil building & Fluid and Survey Lab

The space that exit between Civil building & Fluid and Survey Lab is used for the purpose of surveying lab. For this one side of



Fig 7: Design proposal for space between Civil building & Fluid and Survey Lab the space is kept open and Lab the other side can be used for the exhibition where the important and significant works of the stu-

dents of RUET can be shown. There is existing large mango trees that will be preserved and structure and seating will also be provided. China rose, Marigold, Rose, Carpet Grass also can be used for landscape design in this portion.

5.2 Social space

Social space is physical or virtual space where people gather and interact. Social space provides an environmental framework for the behavior of the group. (Peck and Tickell, 2002)

5.2.1 Renovation of water body

There is an existing water body which has been turned to be the main focal point of campus. This water body has been renovated to develop a unique identity. There is an existing guard room for security, water treatment plant in this place that is surrounded by shade trees and small plants to create a soothing visual effect. A permeable pathway has been proposed around the pond to provide good circulation. Different types of seating, lightings, and pergolas are provided to influence activities of the users. The existing trees like koroi and Neem are preserved for shade and drought resistance. Kadam and Krishnochura, Rakto Kanchon, Sonalu, Cosmos, Daisy, Thuja, Rongon, Eugenia can also be used in this site as an ornamental and flowering plant to make this place eco-friendly.



Fig 9: Design proposal for Pond



Fig 10: Design proposal for Green Square

5.2.2 The space in front of Administration building (Green square):

In front of this frontage of Administration building, there exists a row of big trees that will be preserved and the rows of trees will be used to control sound effectively because in front of this rows of trees there is a large open space that will be used as a gathering place of campus. This large open space will be surrounded by hedge and the row of trees will give shade for the students.

5.3 Landscape design proposals for Courtyard

The campus courtyards should be designed as the public living spaces of the campus where people can feel comfortable studying, socializing, having lunch, or just enjoying the outdoor environment. These spaces should differ from the “movement” spaces of the campus and through their design invite people to linger and spend time. The courtyards are designed with rich plantings with seasonal flower, unique colors, and textures for human enjoyment. Since the courtyards are all separate from one another (unlike the civic spaces and street spaces which are all linked) there can be as many design expressions as there are courtyards. Each develops its own character based on the conditions of its location or the population it serves. The themes would ideally relate to the functions within the buildings that surround them.

The open space of cafeteria front is divided into two parts to serve both teachers and students. China rose, Hedge-Box wood and two types of grass Pale-leaf yucca and Pine lilyturf can be used to beautify this site. In front of this courtyard, there is a banyan tree and sitting arrangement is provide around this tree

The space that exists between Transportation & Public Health Lab and Fluid and Survey Lab and the space that exists behind the Administration building is developed by providing a food court, benches, and colorful ornamental plants so that users can feel comfortable socializing or enjoying the outdoor environment. Seasonal plant like Krishnochura, evergreen plant like Kaminy, Tecoma and Carpet grass can be used. Through all over the design, the use of impermeable hard surface was minimized.



Fig 11: Design proposal for Cafeteria Front



Fig 12: Design proposal for space behind Administrative building

5.4 Residential area

The main design proposal has been subdivided in some parts to describe;

5.4.1 Pond

As the pond is adjacent to Desh Ratna Sheikh Hasina Hall, the only Ladies Hall of RUET, it has the potentiality to be a place for recreation. Different types of seating, fountain, kiosk, etc. are provided to invite the students to spend their leisure time here and thus ensures the activity. To design for the female students requires much consideration on the security issue. The roadside portion includes a line of Thuja or Garden croton to restrict the free movement of outside visitors to ensure the safety issue. Different types of lighting are also used for safety at night. There are trash bins to collect the waste and keep the place clean. There are existing large big trees which have a great impact on the ecology; they are kept the same as before to make the design eco-friendly. Different types of shrubs are also used to enrich the ecology of the site as China rose or Jungle flame attracts the birds or other creatures. Bushes are replaced with carpet grass. A permeable walkway is provided to manage storm water and ensure more green. The adjacent wall of ladies hall is also proposed to be a green wall with *Ficus pumila* plant to ensure green and give the users a feeling of being more close to nature.

Fig 13: Pond side landscaping



5.4.2 Building surroundings

The human eye has a tendency to follow the outline of the object. Since the building front yard is being viewed from the road side, the front side has been decorated with seasonal flower plant, shrubs with medium height, and existing large trees and by graduating plant sizes away from the houses, the apparent size of the structure is increased. Existing drainage system around the building is being screened with a line of hedge and the building front is decorated with flower pot garden. The building front is decorated with flower pot garden for ensuring activity. Garden croton is being used to create an outdoor





Fig 14: Pocket space

5.4.3 Building front yard garden

The B2 building front yard garden is designed from the concept of the meditation garden. So green, blue and purple color is mainly used. Seasonal effect is also taken under consideration. Cosmos and Botam plants are used in two layers centering the flower vase. The flowering season of cosmos plant is winter where the Botam flower blooms in summer and rainy season; so there will be any of the plants bloomed with the flower of purple color throughout the year. Blue colored concrete made curved seating which gives a balanced look with the curve of the pattern of the garden, ensures the activity. People can sit here in a calm and cool environment and enjoy some time for himself. The Kufiya plant is used because of its small scale growth and the green herb with blue flowers. The walkway is brick made and includes carpet grass at the middle of the bricks. Green color light has been used in the garden to beautify the night view of the site at the same time for the mental freshness of the residents who will sit in the garden.



Fig 15: Front yard garden

5.4.4 Building back yard garden

The backyard open space is premeditated with a flower shape garden. The garden is designed from the concept of meditation garden. Blue, white, green color herbs have been provided by maintaining a flower shape with a flower vase to make the site aesthetically beautiful. Small size plant has been used herein near to the large mango trees to create a free space for regular

air circulation. Permeable circular walk ways have been provided for storm water management. To make the site more functional seating benches have been provided with two types of light. At night blue color lights, near to the blue color flower vase, add another visual scale to the users. Thus the surrounding environment will ensure residents a friendly environment.

Fig 16: Building backyard garden

5.4.5 Fountain and Play lot

Near to the building front yard and play lot a beautifully designed circular shape fountain has been proposed. It is slightly elevated from the ground that the outer circle of the fountain can be used as sitting wall. Thus the users will be able to enjoy the scenery of the area from each angle. *Wedelia trilobata* and Balsam (purple) are used considering the scale factor to create a harmony, which will improve and enrich the current ecology. The study team proposed blue color lights and two shaded seating to enhance activity spaces both at day and night.



Fig 17: Fountain

There is a children's playground equipped with many playing equipment such as slippers, balancing, marry-go-round, crawl-tube, moving chairs, cradles. There is also provision of wood made sitting bench especially for the parents to look after their children's. A badminton court is proposed adjacent to the bachelor quarter. *Cardia sebestina* tree has been proposed each corner of the zigzag seating with a circle of Balsam (red) herb to break the monotony and to extricate the playground from the b1 backyard garden. No existing large trees have been eliminated. There is gravel made cycling way which connects the entire playground, seating, b1 building backyard and b2 building front yard gardens, fountain, buildings, and also with the roads. The entire playground is covered with ground cover, Carpet grass. There is also provision of lighting for ensuring security at night ensuring security at night.



Fig 18: Children's play ground

5.5 Street & parking

The Road is shaded with broad trees to improve the scale and character of the space. Tree species may be varied along streets to relieve monotony. The space that exists between the two main entrance roads of the campus is designed with a fountain that is used as a focal point and seating are also provide for users passive recreation. The streets along the parking lot are framed with the Hedge. The other streets are also shaded with different types of trees. Lighting is proposed in every important place like the side of a road, near the pond, open spaces and important zones which remove the darkness of night and ensure security. Dustbins are provided in front of social spaces and courtyard. Trash bins are provided along the road sides at a proper distance. Beside the road sides Palm tree, Debdaru, Krishnochura and Coconut Palm Tree can be used to shade and Screen unsightly views.

Fig 19: Design proposal for Main entrance



In residential portion, two roads got more importance for designing. The way to L.H. is one which is shaded with large Mahogany trees. At 5ft distance from the road, the study team proposed one row of Hedge along the two side of the road and China rose is proposed to be planted in between two Mahogany trees along both of the road sides. The shrub Hedge and China rose with red colored flower are proposed because they can grow up in shady areas and this portion of the site is shady because of the giant Mahogany trees. Carpet grass is also used as ground cover. The height of the hedge is 2.5ft-3ft and the row is mainly used for security which will control the free movement of outside visitors



Fig 20: Roads in residential area

Another road, which is covered by large Blackberry trees, nearby the building front yard garden and fountain, is designed with three circular layers of herbs considering each blackberry tree as a center point. First circular layer near to the center ornamented with Balsam (red), second circular layer ornamented with *Wedelia trilobata* and the outer most circular layer ornamented with Balsam (purple). The large shady Blackberry trees work as a buffer zone from the noisy road. The flowers of China rose plant (5ft-5.5ft) will ensure beauty and screen the dustbin along one side of the road. For security purpose, thirty-two street lights are provided by the roadside. A suitable parking lot with enough space that will be surrounded by trees is needed to make the campus area functional.

The Parking lot should be located near major vehicle streets and to the extent possible should not enter into pedestrian areas. That's why the proposed parking lot is located south-western part of the campus close to the main entrance gate just opposite side of the Shaheed Minar. About 10 buses and 15 cars can be parked in this parking lot. A buffer that is about 5



ft. and a separator is about 4 ft. is created around this parking lot. Tree planting is employed to mitigate urban heat island and reduce the visual impact of vehicles. Edges of lots are visually screened with plantings but allow for visual surveillance of the parking lot from surrounding areas. The parking is surrounded by hedges, lawns, and large shady trees that will reduce the visibility of the parking lot. In the residential portion, there are two garages in front of the B1 & B2 building for the

Fig 21: Design proposal for Parking Lot

parking of the cars of the teachers. There are existing five guard rooms and one guard room is proposed beside the pond. These six guard room will ensure security in the study area.

6. Conclusion

A sustainable landscape design seeks to visually highlight the environmental impact in an aesthetically pleasant way through more focusing on nature that incorporates greater consideration of beauty, activity, and sustainability. Waste management, safety, and security have also been ensured through creating a cost effective and low maintenance green

campus framework. An eco-friendly design can go a long term and improve the climatic condition of a city. The whole environmental condition can be influenced by the development of microclimate. At the same time, activity space design ensures the best use of land and makes the site more functional. This design proposal has a great potentiality and can be used further as a strategic framework by other educational institution for achieving eco-friendly campus environment

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