SHANTI NIBASH RESIDENTIAL AREA DESIGN: A CASE STUDY OF QUAISH, CHATTOGRAM

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ABSTRACT

Rapid urbanization and continuous population growth in Bangladesh have created serious pressure on housing and land use, especially in major cities such as Chattogram. Unplanned Urbanization has resulted in inefficient land use, lack of community facilities, and poor living conditions. Effective urban planning and land utilization are critical factors in mitigating housing challenges in high-density cities, including Chattogram, Bangladesh. This study proposes a sustainable residential neighbourhood on the city outskirts, aligned with the spatial shift of residential areas to peripheral regions amid advancing commercial development. Following the Private Residential Land Development Rule, 2004 (PRLDR, 2004) standard for ensuring a comprehensive design that meets the requirements for an ideal community and consideration of a number of factors that are important in planning the sites, it was decided to select a location in Quaish, Raozan upazila of 66 acres land area. A key aspect is the inclusivity achieved through the provision of 3, 5, and 7 Katha plots, catering to diverse income levels and fostering a socio-economically diverse community. In accordance with urban planning principles, the design integrates 18% community facilities, 7% open spaces, and 12% well-planned road network, cumulatively 37% of the total 66 acres land area strategically which aligns with PRLDR, 2004 guidelines. This minimizes the need for residents to travel extensively for services, enhancing overall quality of life. Safety and security are prioritized, with a layout designed to minimize hazards and promote a secure living environment. The allocation of community facilities, including spaces for social interaction, education, healthcare, and recreation, is carefully distributed to create community focal points. This promotes resident engagement and contributes to a vibrant, supportive living environment. The integration of commercial facilities within the residential area reduces reliance on distant centres, supporting local economic development for a sustainable and self-sufficient community.

Keywords: *Sustainable Residential Development, Neighbourhood Planning, PRLDR 2004, Socioeconomic Diversity, Community Facilities.*

1. INTRODUCTION

Urbanization in developing countries is largely driven by population growth, economic transformation, and rural urban migration, which together create increasing pressure on housing and urban land management (Cohen, 2006). Urban areas inherently evolve through the interplay of diverse forces such as social, political, economic, and technological dynamics (Islam Shakil et al., 2017). Frequently, unauthorized structures emerge, contributing to the escalating problem of unauthorized housing, particularly prevalent in developing regions (Somiah et al., 2015). Consequently, meticulous planning of residential areas becomes paramount, considering factors such as environmental sustainability, community interests, and cost-effectiveness.Chattogram, the second-largest metropolitan city of Bangladesh and the country's principal port city, has experienced accelerated urban growth due to its commercial and industrial importance. According to the (Population and Housing Census, n.d.), Chattogram district had a population exceeding 9.2 million with a population density of approximately 1,736 persons per square kilometer. The continuous expansion of port-related activities and employment opportunities has further increased housing demand in the city. As centrally located land becomes scarce and expensive, residential development is gradually shifting toward peripheral areas, often without adequate planning control. This research endeavour seeks to propose a residential area in Quaish, Chattogram, designed to align with community standards and legal stipulations. The objective is to craft a prototype for a sustainable and habitable residential enclave, attuned to the contemporary world's requirements. Inhabitation is a basic survival need for humans. It is the most important living constituent and behavior content of humans. A constant foundation for human evolution throughout human history has been the residential area. As a result, the environment in residential areas is very closely related to people. The main port city in Bangladesh's southeast is Chittagong. Chittagong is located at latitude 22.3569° N and longitude 91.7832° E. More than 2.5 million people call the city home. The city is situated between the Chittagong Hill Tracts and the Bay of Bengal on the banks of the Karnaphuli River. In the modern era, Chittagong is a significant South Asian economic hub (Chittagong City Corporation, 2016).

The home of today is not just a comfortable place to live, but also a vital hub for social interaction and enjoyment. When people return home from a busy day at work, the residential area transforms into a bay with a natural and peaceful environment, matching the three elements of work, life, and amusement for modern urban people (Chinese & Form, n.d.). Urban residents have an innate need for a pleasant environment. Having a calm living space is essential when you have free time. Urban dwellers are in their homes for up to two-thirds of the day. As a result, people's physical, mental, and spiritual health are directly impacted by their environment (Chinese & Form, n.d.). Undoubtedly, such a development will increase the need for planners and designers. To put it another way, we need to pay greater attention to residential landscaping as well as the actual development of apartment buildings (Tae et al., 2022). The humanistic planning trend of focusing on individual fate and people's mental activities forms the idea of "Community Planning" and work method in modern cities along with the rapid development of the material civilization (Zhao, n.d.).

The study aims to design and present a residential layout plan at Quaish to provide people with an ideal neighbourhood. To achieve the goals, the following objectives have been followed:

- To select a suitable site for residential development based on physical, locational, and regulatory considerations.
- To prepare a residential layout plan in accordance with PRLDR 2004 and Chattogram Imarat Nirman Bidhimala 2008.
- Ensure safe, affordable and accessible housing for all income groups with adequate community facilities utilities based on population needs.

2. STUDY AREA

Due to the limited availability of land, policymakers and planners must be mindful in formulating comprehensive guidelines for identifying suitable sites for residential area planning, as emphasized by

(MadurikaH, 2017). The study proposes a sustainable residential area design in Quaish, in Raozan upzilla Chattogram. It aims to reduce unauthorized housing, promote healthier living environment and strengthen community development. As stated in the Private Residential Land Development Rules (PRLDR), 2004, residential projects developed outside the city corporation area must have a minimum land area of 10 acres. The selected site exceeds this requirement by a considerable margin, allowing sufficient space for residential plots, community facilities, open areas, and an internal road network. From an environmental and service perspective, the site is located above the highest known flood level, thereby minimizing the risk of flooding and waterlogging, which is a common concern in Chattogram. The 66 acres site features flat terrain, minimal vegetation and scenic charm for modern housing. It is strategically located close to Chittagong-Kaptai Road, which functions as a major regional transport corridor and Evercare Hospital which increases its accessibility and development potential.

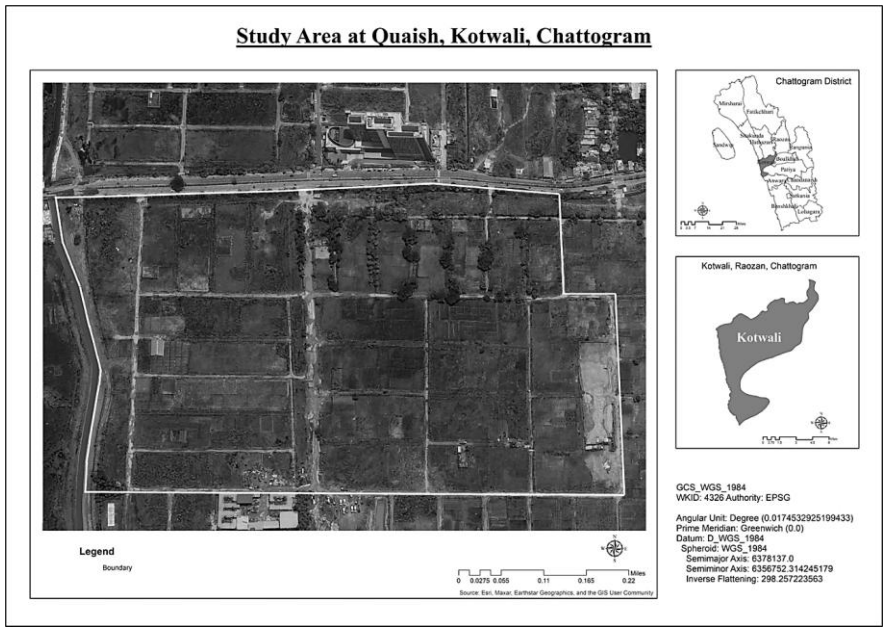

Figure 1: Study Area Map of the site. (Source: Google Earth)

3. DATA AND METHODOLOGY

1.1 Key Concepts of Subdivision Pattern

To achieve the study's goal, all relevant studies and topics should be understood well. Previous research studies done on this topic must be reviewed to gather knowledge and for a better outcome of this study. Most people want their children to grow up in a 'good' neighbourhood where the public schools are effective, where the streets and parks are safe, where other children do not lure them into dangerous or illegal activities, and where adults reinforce the values of responsibility and work. And most people believe that growing up in a "bad" neighbourhood puts a child's future at risk (Ellen & Turner, 1997).

A subdivision plan is a pattern for slicing up raw land into plots of various sizes for the purpose of constructing buildings (residential, industrial, commercial, etc.). It is important in terms of the usage of small areas of land to reduce taxation or for selling off different parts of the land. 'Sub division planning' originated from the thoughts of planning these sub-divisions on the basis of some rationale for the provision of community facilities economically. When subdivisions are used for residential purposes, it is called 'Residential Subdivision'.

In professional practice process, there are various patterns of sub-divisions.

1) Gridiron pattern
2) Modified Grid pattern
3) Curvilinear pattern
4) Rectilinear pattern
5) Cul-de-sac pattern
6) Loop-street pattern
7) Cluster pattern
8) Combination pattern

Out of various patterns of sub-divisions Cul-de-sacs have been strategically incorporated for dead-end roads, enhancing traffic management and creating a safer environment for pedestrians.

1.2 Rules and Regulations

1.2.1 Private Residential Land Development Rule, 2004

Private Residential Land Development Rule, 2004 is a legal tool for controlling land development in private sector housing in Bangladesh. It provides procedures and guidelines for land development protecting the environment. PRLDR 2004 is applicable for those areas which are included in Masterplan according to 'The Town Improvement Act, 1953' and 'The Building Construction Act, 1952'.

- The final layout plan and development should be completed within ten years after the approval.
- If there are existing waterbodies at the site, these have to be preserved and no development is allowed which can hinder the natural flow of the existing water bodies.
- The construction of structures has to follow the rules of 'The Building Construction Act, 1952' and the approved building codes.
- The area of a private residential project should be a minimum of 5 acres if it is inside the city corporation area. On the other hand, if the area is outside the city corporation area, the area of the site must be a minimum of 10 acres.
- The gross density of the population should be 350 persons per acre.
- 30% of the total site area should be kept for community facilities and utility services.
- Provision of three types of roads in the traffic circulation system- Primary Road (60 feet), Secondary Road (40 feet), and Access Road (25 feet).

According to PRLDR 2004, the space standards for community facilities in acres by population size are below in Figure 2:

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Space Standards for Urban Community Facilities in acres by Population size

Community Facilities	Size of Population									Facility per 1000 Population
	2500	5000	10000	15000	20000	25000	50000	100000	150000	
EDUCATION										
Nursery	0.2	0.4	0.8	1.2	1.6	2.0	4.0	8.0	12.0	0.08
Primary School	0.3	0.6	1.0	1.2	1.6	2.0	4.0	8.0	12.0	0.08
Secondary School			1.2	1.5	2.0	2.5	5.0	10.0	15.0	0.10
College*				1.2	1.6	2.0	4.0	8.0	12.0	0.08
HEALTH										
Small Clinic*				0.6	0.8	1.0	2.0			0.04
Hospital*								4.0	6.0	0.04
COMMUNITY ORGANIZATION										
Community Center/Mosque	0.1	0.2	0.5	0.6	0.8	1.0	2.0	4.0	6.0	0.04
RECRIATION										
Play-Ground/ Play-field	0.5	1.0	1.0	1.2	1.6	2.0	4.0	8.0	12.0	0.08
Park	0.5	1.0	1.5	1.8	2.4	3.0	6.0	12.0	18.0	0.12
COMMERCIAL										
Corner Shop/ Market/Kutcha Bazar*	0.2	0.3	0.5	0.6	0.8	1.0	2.0	4.0	6.0	0.04
ROADS										
Residential Roads**	0.9	1.7	3.5	5.0	6.8	8.5	17.0	34.0	51.0	0.34
Total Area for commmunity Facilities (minimum)	2.7	5.2	10.0	14.90	20.0	25.0	50.0	100.0	150.0	1.00
Net Residential Area	4.44	9.08	18.5	27.95	37.14	46.43	92.85	185.71	278.57	
Gross Residential Area	7.14	14.28	28.57	42.85	57.14	71.43	142.85	285.71	428.57	
Persons per Area	350	350	350	350	350	350	350	350	350	

Figure 2: Space standards for urban community facilities in acres by population size

1.2.2 Chittagong Imarat Nirman Bidhimala, 2008

Chittagong Development Authority (CDA) is the statutory planning and development authority for the Chittagong Metropolitan Area (CMA). The authority provides planning permission and uses clearance as per the instruction of Chittagong Imarat Nirman Bidhimala, 2008, which is prepared under the 'Town Improvement Act, 1953'. In the construction of any buildings and projects, Mandatory Open Space, Setback rules, Ground Coverage, FAR, etc. regulations have to be followed. (Source: PRLDR, 2004).

A setback is a distance measured back from the property line which is to be kept free of any building for purposes of road widening, privacy, light and air and fire prevention, etc. the setback required for the highest floor applies to the entire building. Setbacks are meant for providing light, ventilation, and privacy not only to the development under consideration but also to the neighbouring buildings. Setbacks are the minimum required open spaces between the plot boundary and the building proposed to be constructed in a plot. In larger developments, they serve as circulation spaces around the buildings and facilitate the parking of vehicles (Rahman & Akther, 2011).

Floor Area Ration (FAR) is the ratio of the total floor area of a building to the area of the lot on which the building is located. Maximum FAR regulations are used to control the population density, and to reduce negative externalities by restricting the size of buildings accommodating many households (Kono et al., 2010).

$$FAR = \frac{Area\ of\ building}{Area\ of\ land} \tag{1}$$

RAJUK approved Floor Area Ratio (FAR) & Maximum Ground Coverage (MGC) for Residential & Commercial (office) building construction

Sl. No	Size of Plot		Residential Building			Commercial Building (office)		
	Square Meter	Katha	Width of Road (meter)	FAR	MGC %	Width of Road (meter)	FAR	MGC %
01	134 sqm or less	2 katha or less	6.0	3.15	67.50	6.0	2.50	67.50
02	More than 134 sqm upto 201 sqm	More than 2 katha upto 3 katha	6.0	3.35	65.00	6.0	3.00	65.00
03	More than 201 sqm upto 268 sqm	More than 3 katha upto 4 katha	6.0	3.50	62.50	6.0	3.00	65.00
04	More than 268 sqm upto 335 sqm	More than 4 katha upto 5 katha	6.0	3.50	62.50	6.0	3.50	62.50
05	More than 335 sqm upto 402 sqm	More than 5 katha upto 6 katha	6.0	3.75	60.00	6.0	3.50	62.50
06	More than 402 sqm upto 469 sqm	More than 6 katha upto 7 katha	6.0	3.75	60.00	6.0	3.75	60.00
07	More than 469 sqm upto 535 sqm	More than 7 katha upto 8 katha	6.0	4.00	60.00	6.0	4.50	57.50
08	More than 535 sqm upto 603 sqm	More than 8 katha upto 9 katha	6.0	4.00	60.00	9.0	5.50	57.50
09	More than 603 sqm upto 670 sqm	More than 9 katha upto 10 katha	6.0	4.25	57.50	9.0	6.00	55.00
10	More than 670 sqm upto 804 sqm	More than 10 katha upto 12 katha	9.0	4.25	57.50	9.0	6.50	55.00
11	More than 804 sqm upto 938 sqm	More than 12 katha upto 14 katha	9.0	4.75	55.00	9.0	7.00	52.50
12	More than 938 sqm upto 1072 sqm	More than 14 katha upto 16 katha	9.0	5.00	52.50	9.0	7.50	52.50
13	More than 1072 sqm upto 1206 sqm	More than 16 katha upto 18 katha	9.0	5.25	52.50	9.0	8.00	50.00
14	More than 1206 sqm upto 1340 sqm	More than 18 katha upto 20 katha	9.0	5.25	50.00	9.0	8.50	50.00
15	More than 1340 sqm	More than 20 katha	12.0	5.50	50.00	12.0	9.50	50.00
16	Any Size	Any Size	18.0	6.00	50.00	18.0	Non Restricted	50.00
17	Any Size	Any Size	24.0	6.50	50.00	24.0	Non Restricted	50.00

1 sqm = 10.76 sft.

Figure 3: Rajuk approved FAR and maximum ground coverage (source: RAJUK, 2011)

1.3 Strategies Taken

1.3.1 Initial Planning Phase

In the initial phase of the study, a potential residential development site covering 66 acres of land was considered. After taking into account various factors crucial for site planning, the decision was made to choose a location in Quaish, Raozan upazila.
The following methodology was followed described in Figure 4.

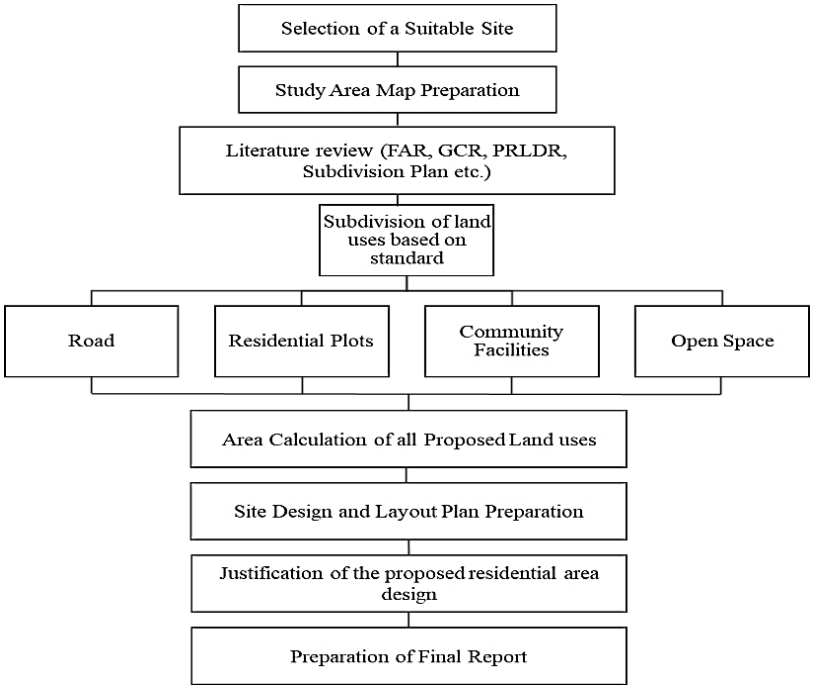


Figure 4: Methodology Flowchart of the whole work

1.3.2 Criteria for Selecting a Site

The process of establishing a supportive housing project, involving the development of housing units, heavily relies on effective site search and selection. Success in the site selection process is achieved when the chosen site aligns most closely with established criteria such as size, location, proximity to services, and cost. These factors play a crucial role in ensuring that the site adequately addresses the needs of the community.

- **Scale:** The size of the site must be appropriate to the demand of housing, organizational capacity and the surrounding building context.
- **Housing Type and Construction Approach:** The housing design appropriateness must be in line with the neighbourhood density and character.
- **Location:** The place should be accessible to transport and employment, services and safe environment.
- **Zoning:** The site should be in accordance to local zoning and permit.
- **Community Acceptance:** The project ought to take into account the support of the community and reduce the possible resistance.

1.3.3 Proposed Design of Residential Plots

- The road network within the shanti nibash residential area has been carefully designed to ensure optimal connectivity and accessibility for all residents.
- Cul-de-sacs have been strategically incorporated for dead-end roads, enhancing traffic management and creating a safer environment for pedestrians.
- All residential plots are guaranteed access from roads on at least one side, promoting convenience and ease of movement.
- Emphasizing a holistic approach to community development, each residential block incorporates community facilities, open spaces, and commercial facilities in a balanced manner.

- The central park serves as a focal point, providing a green oasis accessible to all residents. This park is designed to enhance the overall well-being of the community, offering recreational spaces, walking paths, and areas for social gatherings.
- The proposed residential area includes a diverse range of plot sizes, catering to various income groups. This inclusivity is achieved through the allocation of 3 katha, 5 katha, and 7 katha plots.
- 3 katha plots are particularly in high demand due to their suitability for both lower-middle class and upper-middle class families, promoting economic diversity within the community.
- The availability of 5 katha plots addresses the higher demand for this size, ensuring that the residential area accommodates the preferences and needs of a wide range of residents.
- The buildings within shanti nibash adhere to height restrictions and floor area ratio (far) guidelines. This design choice aims to ensure that every structure receives ample sunlight and ventilation, contributing to a healthy and comfortable living environment.
- Situated above the highest flood level, the elevation of the residential area mitigates the risk of flooding and waterlogging. This proactive approach to environmental safety underscores the commitment to the well-being and safety of the community.

4. RESULT AND DISCUSSION

1.4 Design Proposal of Residential Area

The planned residential development incorporates a variety of plot sizes to accommodate a diverse range of income groups. This inclusiveness is achieved by allocating plots of 3 Katha, 5 Katha, and 7 Katha are shown below in Figure 5.

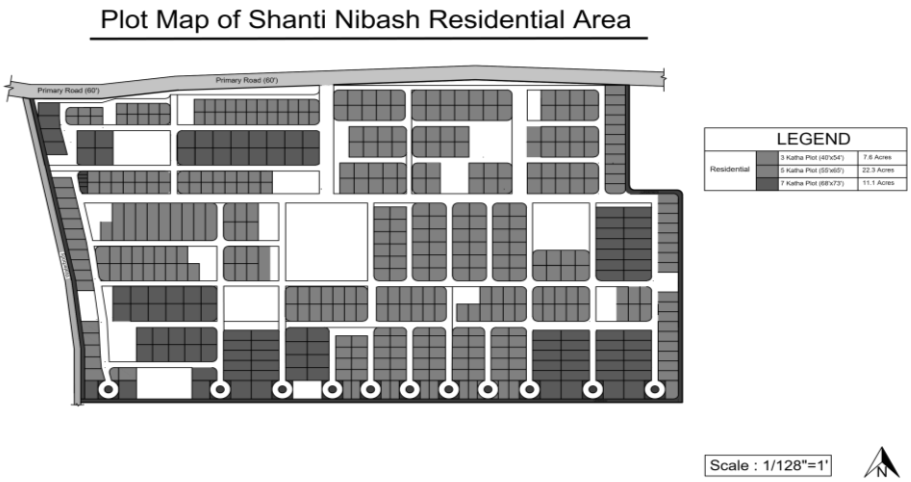


Figure 5: Layout Map of Proposed Design Area.

Area calculation of residential plots are shown below in Table: 1 .

Table: 1 Area Calculation of the Proposed Residential Plots According to PRLDR 2004.

Katha	Number of Plots	Land in acres	Standard for 25000
3 Katha	300	7.3	41 acres
5 Katha	200	22.3	
7 Katha	83	12.1	
Total	**583**	**41.7**	

1.5 Design Proposal of Community Facilities

Community facilities encompass public and semi-public services, offering assistance, recreation, education, and health amenities, open to all residents, fostering an environment conducive to multi-

purpose trips that can save time and money (azmi et al., 2013). Area calculation and layout of area distribution of the proposed community facilities are given in table: 2 and figure 6.

- Sufficient community facilities are provided in adherence to PRLDR 2004 standards, with land areas assessed based on the anticipated population of the proposed residential area.
- Clusters of community facilities are strategically placed on different sides of the site, providing residents the advantage of multitasking and promoting accessibility.
- Four types of educational facilities-two secondary schools, five primary schools, and four nursery schools—are allocated to ensure the safety of children, particularly those in nursery and primary school, by eliminating the need to cross main roads.
- Health facilities include the existing "Evercare Hospital," and plans for three clinics are proposed to serve residents uniformly, located near each housing block. Additionally, two pharmacies adjacent to the hospital and clinics provide convenient access to medicines.
- A community centre, situated near the central park, has the potential to be a focal point in the 'Shanti Nibash Residential Area,' accommodating large community gatherings. A nearby park complements the centre, providing recreational facilities and ensuring a lively and vibrant atmosphere.
- Religious inclusivity is considered, with the provision of mosques and a temple for residents to perform their religious activities.
- Residents have access to a basement parking system, ensuring sufficient parking areas for private vehicles.

Table: 2 Area Calculation of the Proposed Community Facilities According to PRLDR 2004.

Facilities	Number	Provided Land (in acre)	Standard for 25000 (acre)
Nursery School	4	1.71	2
Primary School	5	2.34	2
Secondary School	2	2.1	2.5
Small Clinic	3	1.3	1
Mosque/ Temple	5	1.23	1
Community Center	1	0.13	1
Bazar	2	0.62	-
Shops	23	1.1	-
Parking	7	0.54	-
Total		**11.07**	**9.5**

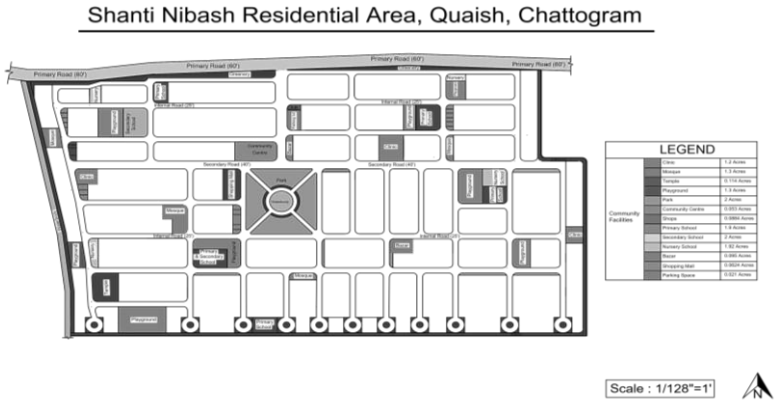


Figure 6: Layout of Area Distribution and Design Proposal of Community Facilities and Open Spaces.

1.6 Design Proposal of Open Space

Open space, in a broad sense, encompasses all land devoid of buildings and structures, playing a pivotal role in any neighbourhood. The advantages of residential open space are manifold, contributing to children's play, active and passive recreation for various age groups, enhancing physical well-being, and bolstering social cohesion within the entire community (Badar & Bahadure, 2020). Area calculation of the open spaces are shown in Table: 3.

In the proposed 'Shanti Nibash Residential Area,' a central park has been designated for recreational purposes. This Park, strategically located in the centre, is in close proximity to a community centre, ensuring it caters to individuals attending events at the centre. Additionally, ample playgrounds are available, with each educational institution featuring its own dedicated play area shown in Figure 6 .

Table: 3 Area Calculation of the Proposed Open Spaces According to PRLDR 2004.

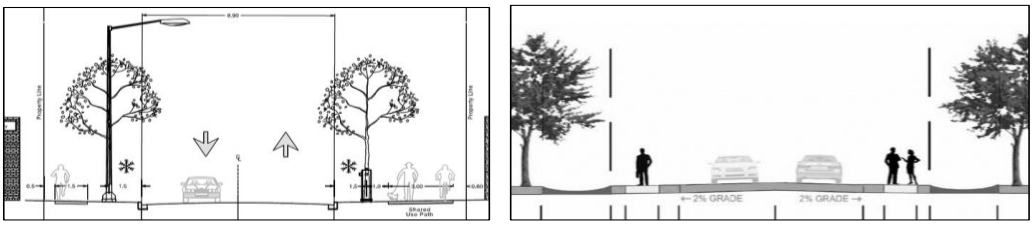
Uses	Provided Land (in acre)	Standard for 25000 (in acre)
Open Space/Play Ground	1.86	2
Park	2.73	3
Waterbody	0.31	-
Total	**4.9**	

1.7 Design Proposal of Transportation Facilities

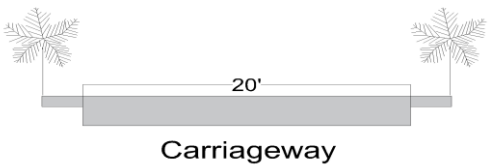
Adhering to the specifications outlined in PRLDR 2004, the 'Shanti Nibash Residential Area' incorporates three distinct types of roads, contributing to the establishment of an efficient transportation system.

- There is the absence of a primary road within the residential area itself. Instead, the Chattogram-Kaptai Road, measuring 60 feet in width, runs alongside the residential zone, serving as a significant thoroughfare. It is having a footpath of 3 meters.
- A secondary road, 40 feet in width, has been implemented. These secondary roads are equipped with pedestrian walkways, fostering a secure environment for walking. They play a pivotal role in collecting and distributing relatively lower volumes of traffic within the area, connecting different sections, community facilities, and open spaces
- An Access Road has been designed to gather traffic from the secondary road, providing direct access to the residential plots. This Access Road, with a width of 25 feet, is specifically designated for quieter traffic flow, having lesser volumes of minor traffic.

The cross-section of these road types is demonstrated below in Figure 7.



(a) (b)



(c)

Figure 7: Cross Section of (a) Primary Road, (b) Secondary Road and (c) Access Road.

The total road area of the Shanti Nibash Residential Area and plan layout are given below in Table: 4 and Figure 8 :

Table 4: Total Area Calculation of the Proposed Roads According to PRLDR 2004.

Land Use	Provided Land (in acre)	Standard for 25000 (in acre)
Transportation Roads	7.7	8.5

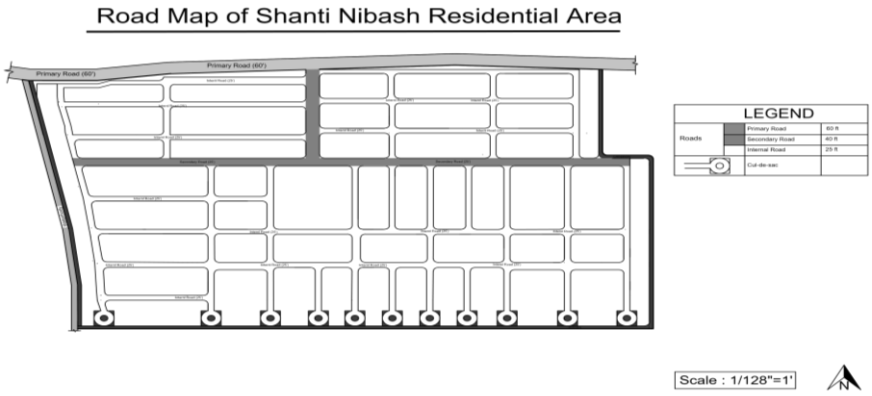


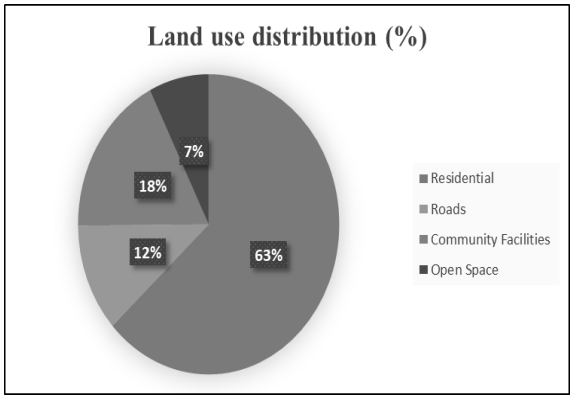
Figure 8: Distribution of Road Layout Plan of Shanti Nibash Residential Area.

1.8 Design Proposal of Overall Design & Layout

Here is a summary of the land use distribution of the "Shanti Nibash Residential Area" provided in Table: 5 and Figure 9 .

Table 5: Summary of the Land Distribution in Different Facilities of Shanti Nibash Residential Area

Land Uses	Provided land in acres	Percentage (%)
Residential	41.7	63.18 %
Roads	7.7	11.67 %
Community Facilities	11.7	17.72 %
Open Space	4.9	7.42 %
Total	**66**	**100 %**



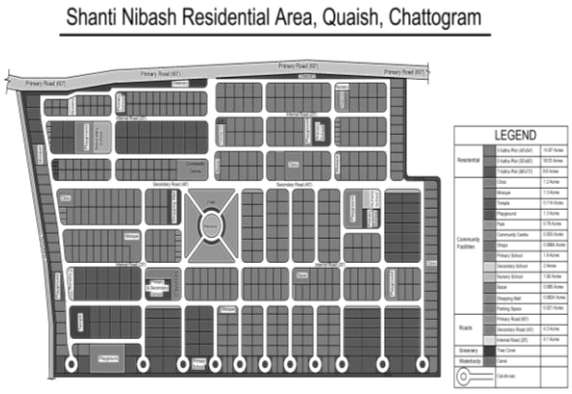


Figure 9 : Overall Land Distribution Pie Chart and Layout Plan of Shanti Nibash Residential Area

5. CONCLUSION

The study aims to design and present a residential layout plan at Quaish to provide people with an ideal neighbourhood. The key findings of the study are stated below:

1. The significant portion dedicated to residential land (63%) reflects the primary function of the development. This suggests a focus on providing diverse housing options for a variety of residents.
2. The allocation for roads and infrastructure (12%) ensures proper accessibility and connectivity within the development and to surrounding areas.
3. The considerable percentage designated for community facilities (18%) indicates a commitment to providing residents with essential services and amenities (such as schools, healthcare facilities, community centres, and recreational spaces).
4. The dedication of open space (8%) is crucial for maintaining a healthy and liveable environment for residents. This area can be used for parks, green spaces, and other recreational activities.
5. The design integrates 18% community facilities, 7% open spaces, and 12% well-planned road network, cumulatively 37% of the total 66 acres land area strategically which aligns with PRLDR, 2004 guideline which was 30% of the total site area should be kept for community facilities and utility services.

Despite of effective distribution of the land in different facilities, there are some limitations remain in this study. They are:

1. The residential layout focused on planning and physical design standards. No Environmental Impact Assessment (EIA) and Climate Resilience assessment (CRA) were included.
2. Population estimation based on standard density assumptions from census report and PRLDR 2004. Actual population may vary based on future household topology, household aspect and development intensity.
3. The economic feasibility and implementation cost such as development and affordability cost were not discussed in this study.

For future application the proposed residential planning model can be used as a reference model to other comparable peri-urban regions of Chattogram and other fast-growing cities in Bangladesh. The model can be extended to allow larger scale sustainable and legally sound residential development with additional refinement, including environmental impact assessment, economic feasibility analysis and community participation.

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DECLARATION THE USE OF AI

During the preparation of this work, ChatGPT, QuillBot, Perplexity and Grammarly was used to improve manuscript clarity, enhance readability and assist in the writing process. After using these tools, we reviewed and edited the content as needed and takes full responsibility for the content of the published article.

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