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# Urban design guidelines for safer and livable residential design: Case of Neelakantha municipality

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## Abstract

This article focuses on the urban design guidelines necessary for developing safer and more livable neighborhoods in Neelakantha Municipality, Dhading district, Nepal. With rapid urbanization, the municipality faces challenges such as the expansion of informal economies, increased pedestrian activities, and growing public transport needs. Addressing these challenges requires a comprehensive approach to urban design that encompasses the broader neighborhood environment, ensuring that urban growth is managed effectively. The guidelines proposed in this article aim to enhance neighborhood safety, accessibility, and overall quality of life by improving the public realm, optimizing transportation systems, encouraging community participation, and promoting sustainable practices. These principles are intended to guide the development of neighborhoods in Neelakantha Municipality, fostering environments that are resilient, adaptable, and conducive to the well-being of all residents. Through careful planning and implementation, the guidelines aim to support the creation of vibrant, interconnected, and sustainable communities.

**Keywords:** Urban design Guidelines; Livable neighborhoods; Neighborhood safety; Sustainable urban development; Community engagement

## 1. Introduction

Urban design is essential in shaping the arrangement, appearance, and functionality of cities, towns, and rural areas, contributing to the creation of sustainable and holistic human settlements. Effective urban design enhances safety, accessibility, and the quality of life, while poor design can lead to conflicts, inefficiencies, and significant costs for communities [1]. Neelakantha Municipality, located in Dhading district, Nepal, is a rapidly urbanizing area that faces various challenges related to growth in informal economies, pedestrian activities, and public transport usage. Spanning 99.31 square kilometers, the municipality's diverse landscapes range from the Himalayan foothills to the Mahabharat range. As the city evolves, there is an increasing need for comprehensive urban design guidelines that address not only street design but also the broader neighborhood context.

This article presents urban design guidelines aimed at creating safer and more livable neighborhoods in Neelakantha Municipality. These guidelines focus on enhancing the public realm, improving transportation networks, fostering community engagement, and promoting sustainable development. By applying these principles, the goal is to ensure that urban growth contributes positively to the municipality’s structure and enhances the well-being of its residents.

## 2. Material and methods

The material and methods used for creating urban design guidelines for Neelakantha Municipality involved several key steps. First, the study area's context was thoroughly understood through data collection, site analysis, and community feedback. A clear vision and guiding principles were then developed using a SWOT analysis. The urban structure was

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designed to ensure that all elements, like buildings and streets, worked well together, focusing on easy connections, environmental balance, and economic viability. Attention was also given to how buildings and public spaces interact, ensuring they are both functional and visually appealing. Finally, the process included regular follow-ups to monitor progress, involve the community, and update the guidelines as needed.

## 3. Literature Review

This Urban design is a multidisciplinary practice that focuses on the arrangement, appearance, and functionality of urban environments, encompassing both the process and outcome of creating spaces where people live, interact, and engage with their surroundings. The importance of urban design is underscored by its ability to create sustainable and holistic human settlements that are vital to the development of cities, suburbs, and towns. This literature review explores key aspects of urban design, including its principles, elements, and the role of building byelaws in shaping urban environments.

### 3.1. Urban Design principles and importance

Urban design has gained international recognition for its capacity to add value to development processes and play a transformative role in urban areas. It integrates various disciplines such as spatial planning, architecture, landscape architecture, and transportation planning. The goal is to conceptualize and shape the built environment in response to natural, physical, social, and economic factors. Urban design is distinct from other development activities as it emphasizes the creative process of spatial design and land development, aiming to enhance the public environment and the interface between public and private realms [2] .

Key considerations in urban design include the role of public realms, the integration of transport planning with urban planning, and addressing gaps in previous township environments to improve human-scale activities and social enhancement. Urban design should also act as a catalyst for urban regeneration, ensuring that it does not lead to negative impacts like decentralization.

### 3.2. Elements of Urban Design

Urban design involves the coordination and design of elements that shape the physical form, aesthetics, and functionality of cities and towns. Several core elements of urban design are as follow [3]:

- **Buildings**: Buildings are crucial to urban design as they contribute to the physical form and aesthetic of urban spaces. Well-designed buildings enhance the sense of place, urban vitality, and community safety. They should be harmonized in scale, size, and form to create a cohesive urban environment.

- **Public Spaces**: Public spaces are essential for fostering social interactions, recreation, and community engagement. High-quality public spaces enhance urban life by providing places for celebration, relaxation, and cultural expression.

- **Streets**: Streets connect spaces and define the character of urban areas. The pattern and scale of streets contribute to the uniqueness of a city and its overall urban structure.

- **Transport**: A city's transport system, including roads, railways, bicycle paths, and pedestrian networks, is vital for enabling movement and shaping the urban form. Prioritizing pedestrian-friendly designs can significantly enhance urban experiences.

- **Landscape**: The landscape, including parks, street trees, and water features, contributes to the aesthetic and environmental quality of urban areas. Green spaces provide soft contrasts to the built environment and enhance the city's character.

- **Supportive Elements**: Additional elements such as signage, lighting, parking, fencing, street furniture, and building materials also play a role in creating functional and visually appealing urban environments. These elements support navigation, security, and the overall user experience within urban spaces.

### 3.3. Zoning

Zoning is the process of planning for land use by a locality to allocate certain kinds of structures in certain areas. Zoning also includes restrictions in different zoning areas, such as height of buildings, us of green space, density (number of

structures in a certain area), use of lots, and types of businesses. Levels or types of zoning include open space, residential, retail, commercial, agricultural, and industrial. Thus, zoning is a technique of land-use planning as a tool of urban planning used by local governments in most developed countries. The word is derived from the practice of designating mapped zones which regulate the use, form, design and compatibility of development. Legally, a zoning plan is usually enacted as a by-law with the respective procedures

*3.3.1. Process of preparation of Zoning*

The zoning process involves dividing a particular region of land into districts or zones, specifying the types of land uses permitted and prohibited within each zone. The preparation of zoning can be divided into two main stages: the creation of a zoning map and the formulation of zoning ordinances. A zoning map displays areas of contiguous zoning designations, where the rules for what can be built are consistent [4]. The process of creating zoning plans, also known as zone planning, involves various disciplines, including design, art, engineering, and the sciences. Zoning ordinances further divide a town, city, village, or county into distinct residential, commercial, and industrial districts, helping to preserve the unique characteristics of each area. Zoning can be classified differently based on use, height, and density, with zoning by use being the most common approach.

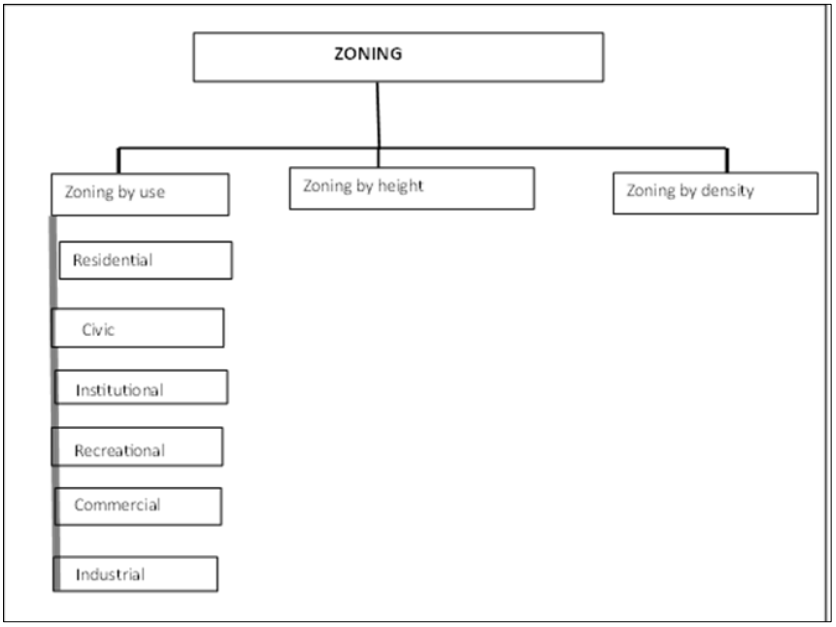


**Figure 1** Classification of zoning

*3.3.2. Preparation of zoning map*

For the preparation of a zoning map for any area, various factors such as the topography of the land, climate, socio-economic conditions, and environmental aspects are thoroughly studied. This data, combined with the current land use, forms the basis for creating a zoning map [5]. The process can generally be divided into the following steps:

- Study of Land: The land system, land type, land capability, geology, topography and natural hazards in the area is studied.
- Study of Land use pattern: The existing pattern of land use in the area is studied.
- Identifying suitability classification of land for various land use purposes: Within the area of study potential areas for residential, commercial, industrial and public utility are identified keeping balanced environment.
- Preparing different categories of zones based on suitability classification: The area is classified into agricultural area, residential area, commercial area, industrial area, public service area and other uses based on the study.

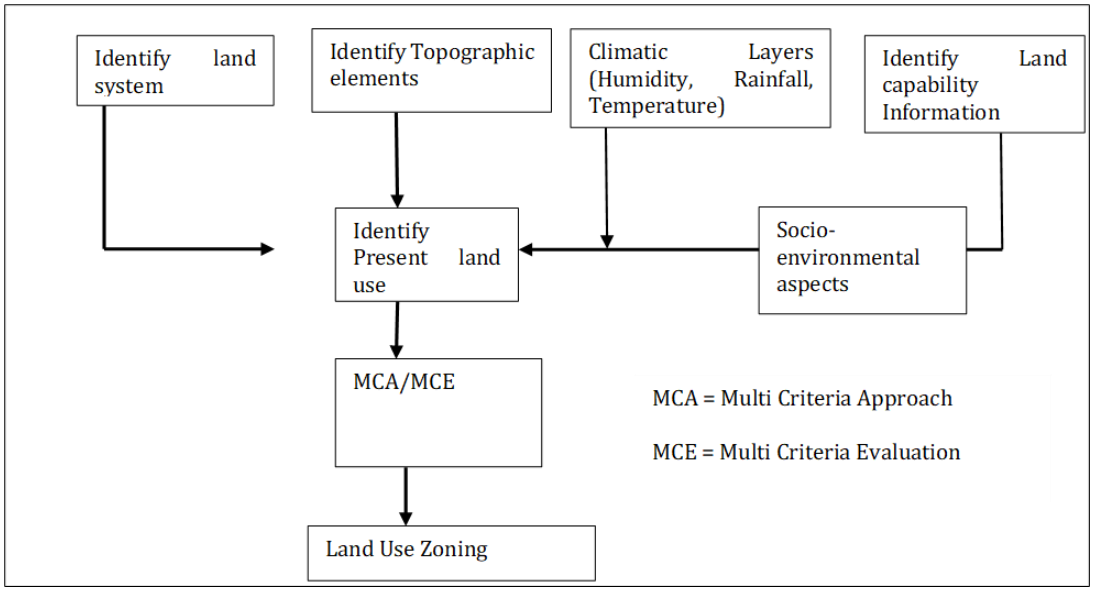


**Figure 1** Work flow of land use zoning

*3.3.3. Preparation of Zoning Ordinances*

The preparation of zoning ordinances establishes rules guiding development across different zones, ensuring alignment with city or municipality goals. Key steps include:

Zoning ordinances are a set of rules and guidelines that govern land use and development within designated zones, as outlined by a zoning map. These ordinances aim to achieve uniformity in character and promote consistent development within specific areas [5]. The process of preparing zoning ordinances involves several steps:

Study of Comprehensive Plan:

Cities or municipalities prepare a comprehensive plan to outline the desired development goals, which include social, economic, and physical development. This plan serves as the foundation for drafting zoning ordinances, ensuring that the zoning aligns with broader city or municipal objectives.

Identifying Zoning Districts Based on the Zoning Map

Once the zoning map is created, different districts such as commercial, residential, industrial, and agricultural zones are identified. These districts guide land use planning in various sectors.

Creation of Special Requirement Zoning Districts

In some cases, broad zoning categories may not be sufficient, and special requirement districts need to be created. These include mixed-use districts, floating districts (which are allowed but not yet placed on the zoning map), and historic districts.

Defining Land Uses in Different Zones

Each zone is assigned specific land uses. These are categorized into permitted uses (allowable activities), conditional uses (requiring a Conditional Use Permit), accessory uses (subordinate uses to the primary use, such as garages or pools in residential zones), and variances (exceptions to zoning regulations due to hardship).

Uniform Regulations across All Zones

Certain regulations, such as parking, noise control, fencing, and signage standards, apply uniformly across all zones, ensuring a consistent standard.

Specific Regulations for Each Zone

Zones also require specific regulations, which may pertain to size (building footprint, height), density (development per acre), and location (setbacks and distance between structures). Additional regulations can address factors like aesthetics and natural resource protection, ensuring that new developments blend with existing structures or preserve environmental features like floodplains [6].

Through these steps, zoning ordinances help maintain orderly and sustainable development within cities and municipalities.

## 4. Case Studies

### 4.1. Review on Hong Kong Urban Design Guidelines

The urban design guidelines of Hong Kong aim to preserve and enhance the city's positive attributes while addressing less satisfactory physical aspects, focusing on encouraging innovative design rather than being overly restrictive. These guidelines operate on three levels: Macro, Intermediate, and Micro. At the Macro level, the focus is on improving the city's overall image, considering factors such as natural settings, axial planning, harbor views, ridgelines, infrastructure, conservation, and urban patterns. The Intermediate level deals with the relationship between buildings and spaces, addressing aspects like composition, massing, architectural design, open spaces, pedestrian linkages, and connectivity. The Micro level focuses on creating a pleasant user environment, considering elements such as human scale, streetscape, signage, materials, and colors. Together, these levels ensure a balanced approach to urban design that promotes aesthetics, functionality, and innovation in Hong Kong [7].

### 4.2. Guidelines on specific major urban design issues

#### *4.2.1. Massing and Intensity in Urban Fringe and Rural Areas*

Hong Kong's design guidelines highlight the importance of massing and intensity in urban fringe areas, which form the transition between developed urban areas and rural landscapes. The guidelines promote a careful balance between these spaces, ensuring that developments respect natural environments and maintain visual and physical connections between urban and rural areas. In rural areas, buildings should harmonize with the surroundings, with height and massing that enhance the local character and the essence of the place.

#### *4.2.2. Development Height Profile*

Height profile guidelines are essential to maintain the relationship between the city and its natural landscape, particularly the ridgelines. To protect the city's iconic views, a building-free zone below the ridgelines is enforced, ensuring unobstructed views from key vantage points.

- For Hong Kong Island: Development height should complement the district’s character and respect the natural backdrop.
- For Kowloon: Building heights should avoid intrusion into view corridors.
- For New Towns: Heights should be highest in the central parts and taper down towards the edges to blend with the landscape.
- For Rural Areas: Varied building heights add interest, with a maximum height of three storeys in sensitive areas.
- For Mega Towers: Placement is based on physical suitability and the building’s functional importance to the city.

#### *4.2.3. Waterfronts*

Victoria Harbour is a vital symbol of Hong Kong, and the waterfront guidelines aim to create an attractive, accessible, and vibrant space. Land uses along the waterfront are reserved for cultural, recreational, and tourism activities, while obstructive infrastructure and incompatible land uses are discouraged. The guidelines emphasize visual access to the harbor and the importance of low-rise developments near the water to preserve views and maintain a human scale.

*4.2.4. Public Realm*

Public realm design aims to create interactive and responsive urban spaces, from streets to open areas. Retail frontage is encouraged in high-pedestrian areas, while architectural detailing at street level adds interest. A balance of hard and soft landscaping, along with public accessibility and visual linkages, creates inviting and functional public spaces.

*4.2.5. Streetscapes*

Streetscapes encompass the aesthetic and functional aspects of streets, including the integration of buildings, street surfaces, and urban fixtures. The guidelines focus on maintaining a coherent and visually pleasing street environment, with wide pavements, clear pedestrian pathways, and greenery to separate traffic from walking areas. Elements such as transparent acoustic barriers, decorative landmarks, and well-designed street crossings are encouraged.

*4.2.6. Heritages*

Heritage buildings are crucial to preserving Hong Kong's cultural and historical identity. The guidelines emphasize conservation and adaptive reuse of heritage features, ensuring new developments respect and complement the existing historical context. The guidelines advocate for the preservation of views to heritage sites and the consideration of height restrictions on nearby developments to protect their setting.

*4.2.7. View Corridors*

A view corridor refers to a distant view of significant buildings or landmarks framed by gaps in surrounding structures. The design and orientation of landmarks, ridgelines, and water bodies play an important role in creating these corridors. To enhance urban openness, these view corridors should be integrated, protected, and strengthened by planners.

*4.2.8. Stilted Structures*

Stilted structures, raised on poles or pillars, often create a negative visual impact, particularly on steep sites. To minimize this, camouflaging with appropriate landscaping and color schemes is recommended, along with developing footprints that reduce visual harm.

*4.2.9. Implementation of Guidelines*

Urban design guidelines are implemented through statutory mechanisms, like master plans that regulate development, and administrative approaches such as lease conditions and urban design studies. These ensure proper planning for large-scale developments and redevelopment projects.

*4.2.10. Air ventilation*

Hong Kong's subtropical climate makes air ventilation essential for urban design. The Air Ventilation Assessment (AVA) study guides the layout of building blocks to maintain airflow through city streets. Buildings affecting view corridors or airflow should be carefully planned to enhance ventilation.

*4.2.11. Site Level*

At the site level, HK guidelines recommend enhancing air circulation by increasing the permeability of urban structures. Setbacks, voids in facades, reduced site coverage, and terraced podium designs are encouraged to improve pedestrian comfort and ventilation.

*4.2.12. Outcome of the study*

Reviewing the Hong Kong guidelines, it is understandable that guidelines can create and preserve urban fabric of city. Attributes such as natural resources, human scale, and surrounding settings and so on should be studied and taken into consideration for designing urban spaces. The standards and guidelines for greening should be applied flexibly having regard to the constraints and opportunities and resource implications. Where possible new conservation zones should be created for areas of conservation value which are lost due to development. The height of buildings should respect the ridgelines and to improve quality of o life, community should be encouraged to appreciate benefits of urban design as well as the broader environmental, economic and social implications so as to lend their support.

Signage are also one of the important attribute which help guide visitors to various arts venues and facilities. Scaling and massing plays vital role in establishing the visual diversity. They ought to be considered to avoid the monotonous built environment. Guidelines should promote pedestrianisation and streetscape for street and public open area

performance through proper design of the pedestrian and public area. Flyovers should be either designed as a linkage element with surrounding or integrated with soft landscape.

#### *4.2.13. Reflection of the study*

While reviewing the Hong Kong guidelines we came across various attributes and found guidelines relating to mental health, disasters are not highlighted. Nepal, despite having similar topography to that of Hong Kong has not been able to restrict the mass and scale of built environment. They need to be controlled and designed considering the ridgelines. Also, in context of Nepal, waterfronts are being occupied by several irrational activities such as squatter's settlement, dumping sites and so on rather than an open space. These spaces shall be properly designed to assure safety, security and comfort among the public. Built forms should respond to human scale to create visual harmony and climatic considerations should be taken into account while preparing the urban design guidelines.

## 5. Study area

### 5.1. Introduction to Nelakantha Municipality


**Figure 2** Location map of Neelakantha Municipality

Source: IOM, UN Migration, 2020

Neelakantha municipality lies in Dhading district, a single district in Nepal which ranges from Himalaya in North and Mahabharat range in south.

The city is situated 90 km west of Kathmandu and it is 16 km west from Malekhu. The county boards are located in the eastern district of Nuwakot; the Western rural town of Jwalamukhi, Siddhalekh, the Netrawati and Tripurasundari rur al townships in the north and Galchhi and Siddhalekh rural townships in the south. It covers 10% of Dhading district's total area. The total area of the town is 99.31 square kilometers, which is almost 50 percent of the total area of the forest, with 199.85 square kilometers. The shape of the land is sloping and terraced [8].

### 5.2. Introduction to Neelkantha Municipality, ward no: 3

Neelakantha Municipality is situated between latitudes of 27°50'45.442" to 27°58'1.27" north and between longitudes of 84°58'49.98" to 84°56'41.37" east. Ward no. 3 occupies total area of 3.08 sq. km.

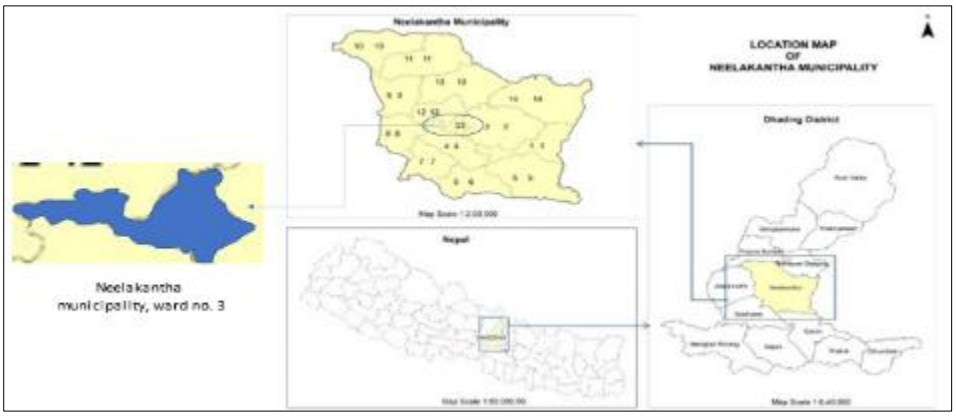


**Figure 3** Location map of Neelakantha Municipality ward no: 3

Source: IOM, UN Migration, 2020

**Table 1** About Neelakantha Municipality, ward no: 3

| **Type:** | **Populated locality - an area similar to a locality but with a small group of dwellings or other buildings** |
|---|---|
| Mindat.org Region: | Dhading, Province no. 3, Nepal |
| Region: | Neelakantha municipality, ward no. 3, Dhading District, Bagmati Zone, Madhyamanchal, Nepal |
| Latitude: | 27.9131° N |
| Longitude: | 84.9089° E |
| Area | 3.08 Sq. km. |
| Population | 8507 people/1829 Household (Source: Central Bureau of Statistics, 2015) |
| Köppen climate type: | Cwa: subtropical, mild and temperate climate |

| Ward no. | Area (sq.m.) | Population density | Female | Male | Total population | No. of households |
|---|---|---|---|---|---|---|
| 3 | 3.08 | 2762 | 4220 | 4287 | 8507 | 1829 |

The population of the municipality is 58,515 according to the 2011 census and this is reported bythe 2015-2016 Annual House Hold Survey at 71,131. This is not true. 17% of the district's total population are in the municipality. Ward No. 3 is more advanced and developed as the principal town in the municipality of 14 wards, including infrastructural development. It is 3.4 according to the 2011 census and has a strong rate of population increase compared to other regions with negative rates [8].

*5.2.1. Building Materials*

The traditionally used materials are adobe or stone wall in mud mortar. Timber and bamboo are also used in the superstructure. Stone or thatch is used for roofing. Stone or brick in mud mortar is used in foundations. [9]

**Figure 4** Traditional houses in Neelakantha Municipality

In newer constructions, RCC is used for building frame while stone or brick masonry in cement mortar is used. The foundation used stone or brick in cement mortar or RCC. Newer buildings use CGI sheets or concrete in roofing.

**Figure 5** New building with R.C.C structure

In recent constructions, mix of traditional materials mainly stone with modern materials such as cement mortar can be found. In many cases, traditional materials are not used at all.

*5.2.2. Physical Infrastructure*

The municipality's road network reaches almost every corner, though road conditions are poor except in ward 3, where well-maintained black-topped roads exist, with limited footpaths and ongoing maintenance efforts. Tracks in remote areas are only functional during dry seasons, restricting year-round four-wheeler movement. Public transport is available on various city routes. In the main city area, a 5 km surface drain has been constructed along black-topped roads, but outer areas with gravel roads lack such drainage, and septic tanks are compulsory due to the absence of a sewerage system. All wards have access to basic and secondary education, with private English medium schools and colleges centralized in ward 3, which is an educational hub. The municipality is also strengthening vocational institutes. Ward 3 houses key healthcare facilities, including Dhading Hospital, Eye Hospital, Sahid Memorial Hospital, and Dhading Animal Hospital. Socio-cultural aspects reflect a focus on agriculture, business, and tourism, with major rivers like Thopal, Aanshi, and Arun, and popular tourism spots such as Chamere Gufa and Jyamarung Durbar. The area is home to several temples, including Bhairavi and Jwalamukhi, and festivals such as Dashain, Tihar, and Teej are widely celebrated. Gurung and Tamang cultures dominate, with agriculture and daily wage labor being the main occupations, while the population consists primarily of Newars, Brahmins, Gurungs, and Chhetris.

*5.2.3. Temperature analysis*

The average annual average temperature of thirty and one years in the nearest weather station shows a rise in the temperature trend every five years. The average temperature of two months (1978-1982 and 2004-2008), which demonstrated an increased tendency was seen as a comparison of the two average temperature variations. The monthly temperature rose by 0.23°C to 1.35°C in the winter month (Dec-Feb). The temperature increased by 0.24°C in pre-monsoon (March-May) to 0.07°C and by 0.23°C in monsoons (June-sept). In the months following the monsoon, it has also been risen by 0.18°C (Oct-Nov) [10].

The statistical record of the Dhading District's temperature figures from 1978 to 2008 showed a growing trend, mostly during the monsoon periods. The annual temperature pattern trend is increasing, showing maximum annual

temperature variations, while winter and pre-monsoon patterns were not very different. However, the trend in the temperature of the monsoon shows that in 1995, maximum temperature has been recorded. The temperature has risen over the period of 31 years. While this trend is more than a worldwide IPCC average, according to the average annual temperature. The warming trend in the respective area is demonstrated by all this alarming fact. This analysis revealed that the perception of local people seems to correspond to the considerable record in the region [10].

*5.2.4. Rainfall analysis*

The increase in rainfall intensity trend showed an average annual and 5 years of average annual precipitation (1979-2008). It was clearly observed that winter precipitation has been reduced by comparison to two average five years (1979-1983 and 2004-2008) of monthly precipitation. Pre-monsoon intensity increased between 40% and 50% in March and May. Similarly, until mid-10-15%, the monsoon (June–September) decreased and increased by 3-5% until the post-monsoon.

**Table 2** Analysis of Rainfall data from 1978- 2008 of Dhading District

| Rainfall mm | Yearly | Winter | Pre-Monsoon | Monsoon | Post-Monsoon |
|---|---|---|---|---|---|
| Mean mm | 1373.7 | 47.72 | 81.06 | 1180.84 | 64.08 |
| Percentage of yearly total | | 3.47 | 5.90 | 85.96 | 4.66 |
| Standard Deviation | 7181.82 | 253.69 | 436.78 | 5972.12 | 345.29 |
| Minimum Rainfall mm | DNA | DNA | DNA | DNA | DNA |
| Maximum Rainfall mm | DNA | DNA | DNA | DNA | DNA |
| Trend (mm/year or season) | 6.53 | 0.41 | 1.07 | 5.79 | -0.75 |
| Total change calculated from the trend (mm/31 years) | 565.5 | 8.6 | 45.6 | 382.0 | 129.3 |

Recorded rainfall data from 1978-2008 showed approximately 85.96 per cent of monsoon rainfall. The annual precipitation trend slightly increases. However, the maximum rainfall was recorded in 1998 and 1999. There is little difference. Pre-monsoon precipitation trend has shown a notable increase in maximum changes while the monsoon precipitation trend shows no big variations, but the number of rains has decreased significantly in the last few years of the study (2005-2007). Despite this trend, the post monsoon platform trend declines significantly, indicating that the maximum rainfall in 1999 varies greatly. Although the trend has decreased substantially after monsoon rainfall, it is clear that the maximum rainfall for 1999 is very different. In the same way, in the July of the monsoon periods, the trend in the Dhading District's monthly average rainfall pattern is increasing significantly. These clearly indicate that local people cannot predict the usual precipitation pattern in such a scenario [10].

## 6. Proposed Urban Design Guidelines

Urban design guidelines translate design principles into actionable recommendations that promote a positive user experience. By applying these guidelines, designers can address key principles such as intuitiveness, learnability, efficiency, and consistency, fostering functional and attractive urban environments.

### 6.1. Proposed Zoning

Zoning helps define a neighborhood's identity, ensuring safety, functionality, and cohesion across different areas. The proposed zones for Neelakantha Municipality include:

- General Residential Zone
- Mixed-Use Residential Zone
- Commercial Zone
- Immediate Urban Expansion Zone
- Low-Rise Institutional Zone
- Future Urban Expansion Zone
- Agricultural Zone

- Forest
- River Bank
- Landslide Risk Zone

### 6.2. Residential mixed-use zone

The purpose of this zone is to provide for primarily medium to high density residential mixed-use developments, with limited commercial, institutional, office and service uses distributed on-site in a manner sensitive to support the urban village where amenities are focused on a local main street [11].

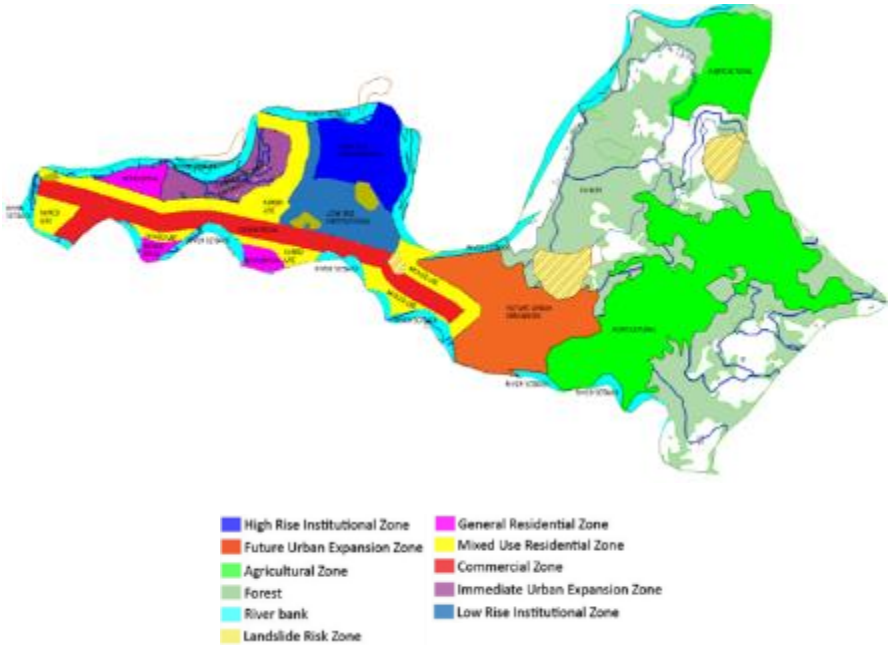


**Figure 6** Proposed Zoning of Neelakantha Municipality

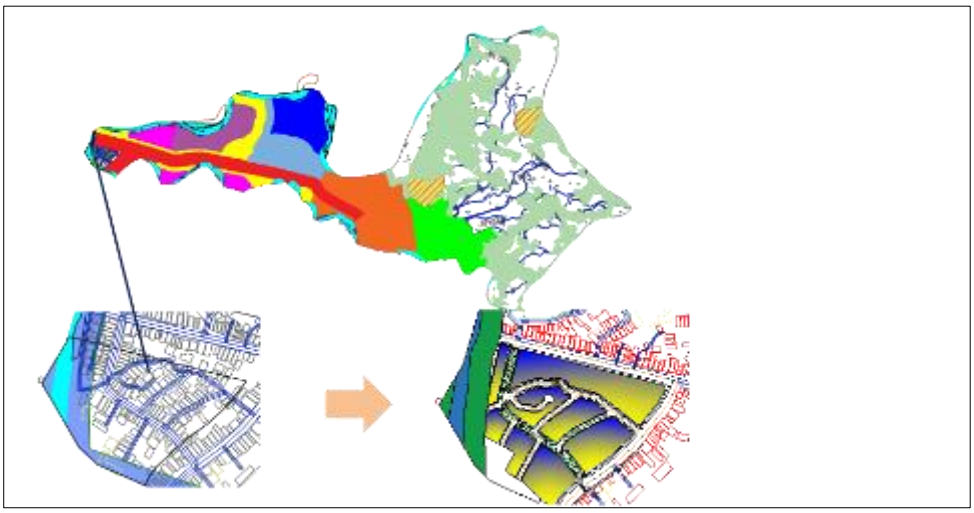

**Figure 7** Existing and proposed residential mixed-use district

Thopal Khola on the south west is taken as one of the edge of the residential mixed-use district. The river setback is taken 30m from the bank of the river which is proposed to be developed as river front development. The road of width 10m and 6m are converted to street with ROW 10m and 6m. The undersigned nodes will have provision of turning lane with zebra crossing and street signage. The haphazard massing of the buildings will be regulated with FAR-3 whereas

the unmanaged street front will be managed with setback of 2m. The unregulated building facades will be regulated contextually in terms of form, color, opening, and hierarchy. The figure below demonstrates how the street will transform adhering to the proposed guidelines.

*6.2.1. Proposed street guidelines*

Street can be defined as a public thoroughfare in a built environment. Streets are also considered as also considered the lifeblood of our communities and the foundation of our urban economies. Street design guidelines transform the street meeting the needs of today and challenging the needs of tomorrow [12]. Street of ROW 10m and 6m has been taken for the urban street design in residential mixed-use zone. For the preparation of street design guidelines of Neelkantha municipality, references from different other guidelines has been taken as Nepal urban road standard, Pune urban street design guidelines, Hongkong urban design guidelines, NACTO.

Street elements

Street elements are those elements that make up city streets, from sidewalks to travel lanes, ROW, land use and stops, all vie for space within a limited right of way [12].

Footpath

Design recommendation of footpath are listed as below:

- Width of the footpath is to be provided as per the street hierarchy, ROW, land use and pedestrian traffic. The 2m wide footpath for 10m ROW in residential mixed-use district is to be provided in both sides which will also cater to multiuse zone.
- There should be vertical clearance of 2.4m.
- The footpath should be150mm above carriage way. Railing/ curbstone as separator should be provided where level difference from carriageway is not possible.
- There should be provision of suitable ramp at entry and exit.
- Footpath should be visually distinguishable from the carriageway with gradual slope towards storm water drain.
- Intersection of footpath should be at same level.
- Footpath should be paved with anti-skid surface. Permeable (interlocking block/ slate with stone dust in joints is recommended to prefer as the interlocking blocks recharges the ground water table.

**Figure 8** Proposed Street

Cycle track

Design recommendation of cycle track:

- The cycle track should have minimum width of 1.5m and should be visually distinguishable despite being in the shared zone.

Carriage way

Design recommendation of carriage way are listed as below:

- ROW- 10m
  - Carriage way of minimum 6m should be provided for two-way traffic flow.
  - The carriage way should be undivided and prefer white asphalt for low heat retention.
  - The carriage way here acts as a multimodal zone.

- ROW- 6m
  - 6m street is to be designed as Public Square where the street is divided with vegetation and street lamps.
  - These streets facilitate emergency vehicles, un/loading one time a day and residential vehicles in a limited way.
  - The streets are designed specially to serve as walking neighborhoods where pedestrian can shop easily and hawkers can roam around.
  - Interlocking block are suggested to be used as paving materials.
  - No parallel parking is allowed in both the streets.

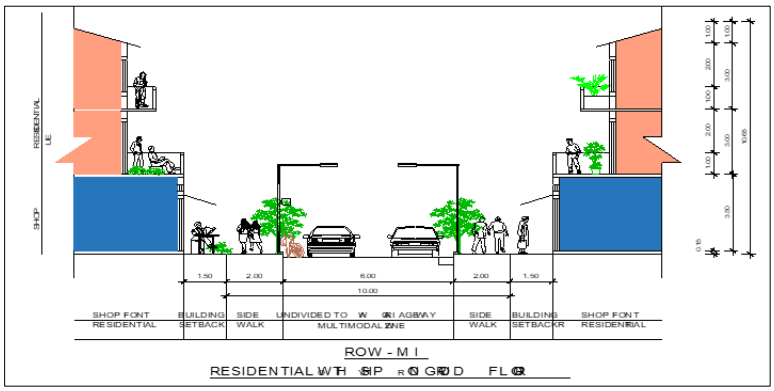


**Figure 9** Sectional view of proposed street (ROW-10m)

Zebra crossing

Design recommendation of zebra crossing are:

- Zebra crossing is to be provided at intersection and within every 150m interval. The distance between stop line and edge of zebra crossing should be 2m.
- The minimum width of zebra crossing should be 3m.
- The 300mm thick white band are placed at interval of 600mm.
- Thermoplastic paint of white color should be used for painting the zebra crossing.

White line

- The dotted line in the middle of carriageway should be 100mm wide and 1500mm long placed at 300mm interval.
- Hot thermoplastic paint should be used to paint it.

Yellow line

- The continuous line at the edge of the carriageway should be provided on both sides.
- These lines are 150mm wide thick.
- Hot thermoplastic paint should be used to paint it.

Speed breaker

- Speed bump should be provided at intersection 10m away from inner edge of major road.
- Molded fiber type material speed bump should be used

Street edge

- The minimum street edge should be 200mm.

Street light

- The street lights are to be provided at 7m interval alternately considering the width of road and height of street light.
- The street lights should be placed 3m away from trees.
- Solar run system is encouraged to light the street bulbs. LED lights should be preferred as they require less energy to operate.

Street furniture

- The foldable benches are suggested to use as they don't obstruct the pedestrians while they are unused.
- Wooden or wood like material should be used for street furniture.

Traffic signals

- Traffic signals are to be provided at intersection and pedestrian crossing.
- They should be placed 1-2m beyond stop line.

Street signage

- Street signage should be at every intersection.
- The height clearance should be 2.4m from the edge of signage board to the ground level.
- The area of the signage board should not exceed more than 180mm sq.
- Environment friendly material which are long lasting with minimum repair required material should be used.

Advertisement

- For the ground structure boards the size should not exceed 3m x3m.
- The maximum height from ground 3.5m is allowed.
- The material used should be environment friendly material.

Trash bin

- Trash bin should be provided at 100m interval.
- The material of trash bin should be environment friendly and local material for example bamboo.

Fire hydrant

- Fire hydrant should be at 60m interval and also at the intersections with 1m radius clearance.

**Figure 10** Street design with amenities

Trees

- Small trees at 7m interval should be provided.
- Trees should not blockage of pedestrian wind and act as cool sinks.

*6.2.2. Multi-utility zone*

Multi-utility zone includes stationary elements in streets like trees, street furniture hawkers, stops, underground and overhead utilities like electric supply, light poles etc.

- Utilities such as street drain, sewage, and manhole should be placed below verge between pedestrian path and carriage way or in MUZ zone.
- Manhole should be provided at edge zone.
- Utilities should not be strictly provided below carriageway.

Curb ramp

- The minimum slope of 1:12 should be used for the design of curb ramp.
- Non- slippery material should be used as a surface material.

Slope ramp

- For the riser greater than 150mm, slope ramp is to be used.
- Non- slippery material should be used as a surface material.

Side walk design

- There should be minimum of 900mm x 1200mm for wheel chair clearance.
- The floor ground area clearance for wheel chair should be 1200mm x 1200mm.
- The clear floor ground area for wheel chair should be minimum 1500mm -1800mm to for roundabout.
- For the cane users, there should be minimum clearance of 750mm min.

**1.** Tactile paving:

- Tactile paving should be provided at entrance/exit of zones.
- It should be placed minimum 300mm prior from the edge and 600mm prior from the warning zones
- Tactile paving should be minimum 900 mm wide.

**Figure 11** Proposed built environment

Intersection

- The turning radius at intersection should be around 3.5m to 4.5m.
- Intersection should facilitate pedestrian crossing.
- No other signage than traffic signals, directional signage, street lights (without advertisements) are allowed in intersections.
- Ducts as Cross ducts should be placed 50m away from intersections.
- The change in direction, new connection, new lines and maintenance to be done from cross ducts.
- Except storm water duct other services can be organized from these ducts.
- Exclude drainage chamber, water supply vault and maintenance shaft in intersections (if any, shift to edge).
- No big trees within 50m of major roads are allowed.

**6.3. Building analysis**

The existing buildings of Dhading were analyzed before proposing the building guidelines. The table below illustrates the findings from the analysis:

**Table 3** Analysis of buildings of Dhading district

| S.N. | Element in buildings | Analysis |
|---|---|---|
| 1. | Roof | Type- slope roof |
| 2. | Façade treatment | Exposed stone, mud plaster, stucco plaster |
| 3. | Openings | Small timber openings and also floor to lintel openings |
| 4. | Balcony | End – end, enclosed in between two rooms (middle zone) |
| 5. | Elements | Arch in porch<br>Circle in blank wall<br>Triangular niches in tulsi plant structure |
| 6. | Patterns | Horizontal and vertical lines, jalis, colonnades |
| | Color | Mud color, white, yellow in façade<br>Blue, green red, brown in openings |

### 6.4. Building design guidelines

To achieve an urban form of development by fronting buildings along streets with parking located behind or underground, the building design guidelines are proposed. The district will pose aligned building facades which will form a consistent street wall where the prominent buildings will terminate or accentuate vistas.

**Figure 12** Existing and proposed built environment

The above figure shows how the regulation and regulate and transform the built environment. For the design of building guidelines reference from various sources as San Francisco urban design guidelines, Hongkong urban design guidelines has been taken. The guidelines are as follows:

*6.4.1. General massing and design*

- All buildings should create a consistent street wall, and to articulate clearly-expressed building bases by using architectural massing elements such as projecting bays, recesses and edge treatments.
- Massing of buildings should aim to provide between a 1:1 and 1:2 relationship between the heights of the street wall to the width of the street to provide a sense of enclosure.
- 45-degree angular plane should be used as a guideline to minimize shadow impacts.
- Above the street wall, the building should step back to provide access to sunlight, sky views and create a human scale (street wall of 2 to 5 storeys generally achieves these goals).
- Building bases are encouraged to be located adjacent to public sidewalks and internal pedestrian pathways to enhance the vibrancy of street.

- Building orientation should be parallel or 30 degrees to the prevailing wind.
- Site, orient and sculpt buildings to reinforce and accentuate built and natural topography.
- Retain and highlight existing features, such as natural areas, rock outcroppings, waterways, and specimen trees.
- Employ environmental technologies and green infrastructure best practices to respond to the site, its surroundings, and local and regional ecological systems
- The setback of the buildings should be 2m.

*6.4.2. Skyline and views*

- Preservation of public views will be an important consideration during design and development of the buildings.
- Use site design to frame visual connections to natural features such as waterways and hilltops.
- 20% building free zone from the ridgeline of natural scape should be strictly provided.
- Buildings should maintain roofline.

*6.4.3. Active façade and pedestrian orientation*

- Design buildings to provide a comfortable environment for pedestrians within the public right-of-way and within the site.
- Bottom 1-3 storeys of the building and should have a positive interface with the public realm.
- Address intersections and corner properties and establish an edge by massing buildings to the corner and providing a height element, material change, or special architectural features.
- Break up long building facades through articulation and/or material change.
- Blank walls should be avoided where non-active facades cannot be avoided, they should be located away from street-facing facades and minimized where possible.
- Material changes, building articulation, display windows and creative lighting may be used to make blank walls appear less imposing, but are not a replacement for active ground floor uses.
- Doors oriented towards the sidewalk with direct access.
- Include a high proportion of vision glass to non-residential facades on the ground floors to provide a visual connection into the building and passive surveillance.

**Figure 13** Building ground floor for active pedestrians

*6.4.4. Building material*

- Diversity of materials will help to visually break up massing, reduce visual bulk, and add interest to the building design.
- Articulation such as recesses and projections in building place that helps to break up the length of long buildings.
- Provide recesses and projections that are a minimum of 230mm deep. Relate articulation to the rhythm of interior units where possible.
- Where there is a horizontal material change, aim to include a slight articulation change to resolve the transition.

- Cornice or cap should complement the style of the overall architecture and be appropriately scaled to the building design.
- Glazing does not need to be evenly spaced, but minimizing the width of blank walls should be considered.
- Utilize transparent glass and glazing along storefronts.
- Develop details and select materials that are consistent with the overall architectural strategy and neighborhood compatibility.
- Exhibit human-scaled detailing, components, and features.
- Color to be inspired from context as shades of mud, other colors used in buildings as green, brown in windows.

*6.4.5. B*uilding façade

- Plinth level should be same of all the buildings i.e. 300mm from the road level.
- Ground floor height must be 3.5m with 60% opening/ glazed area.
- Cornice band provided at same level i.e. 2.4m.
- Above residential floor height to be minimum 3m.
- Building height up to 16m is permitted.
- Express a spatial sequence or experience, material system, structural organization, hierarchy, or relationship to site or context.
- Provide a cohesive expression or composition of neighbourhood compatible components.
- Provide signage, weather protection and lighting at a human scale, proportional to the width of the unit and integrated into the architecture of the building.

**Figure 14** Proposed Building Facade

*6.4.6. Building elements*

- Use lighting to highlight significant building features but do not over-light buildings nor project light into the sky. Employ sustainable or "dark sky" measures to reduce illumination when not needed or visible.
- Design lighting to reinforce pedestrian comfort at the ground level.
- Control the intensity of building and signage lighting and allow for dimming and color variation.
- Orient and size signs to the pedestrian scale, and so as to not overwhelm the building façade.
- Design signs and canopies appropriately to illustrate the hierarchy of entrances and information along facades where there are many elements or uses.
- Various articulation bands can be used in the façade that evolve from the local traditional buildings.

6.4.7. *Roof*

Roof can be designed as flat roof or slope roof as per the need of occupant following the following listed measure:

- Favor slope roof of the site with pitch: 20- 25 degrees.
- Slate or similar material should be considered as primary roofing material.

- Where there is flat roof, the parapet wall of 1m should be provided.
- Consider the roof edge of other corresponding buildings.

*6.4.8. Sustainable principles in building design*

Sustainable principle should be adopted in order to reduce the carbon footprint of buildings. The measures as mentioned below can be taken for employing sustainable principles in building design.

- Use building materials that are made of recycled or renewable resources and/or from local sources (for example. stone, bamboo).
- Employ passive solar design in facade configurations, treatments, and materials.
- Design wall and roof fenestration to enhance natural lighting without negatively impacting interior comfort.
- Create daylight living and working environments to not only reduce energy use, but to connect people to the natural cycle of day and night.
- Provide natural ventilation to reduce energy use and allow access to air flow.
- Reuse existing structures to reduce the use of natural resources.

## 7. Conclusion

In conclusion, the Urban Design Guidelines for Neelakantha Municipality highlight a comprehensive approach to urban planning that not only addresses safety, convenience, and efficiency but also prioritizes the emotional and social well-being of residents. By focusing on the regulation of key elements such as streets and building facades, the guidelines aim to prevent unplanned, chaotic development and instead foster a well-organized, visually appealing urban environment.

The guidelines underscore the importance of creating spaces that encourage social interaction and community cohesion, contributing to a stronger sense of place. Through thoughtful architectural treatments and urban design principles, the municipality seeks to balance modern development with cultural preservation, enhancing the quality of life for its residents. Ultimately, these guidelines serve as a roadmap for creating sustainable, livable neighborhoods that are safe, functional, and culturally sensitive, ensuring that future growth aligns with the vision of a harmonious and vibrant community.

## Compliance with ethical standards

*Disclosure of Conflict of interest*

There is no conflict of interest in this study.

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