A Model Community Design
for Equitable, Responsible, and Viable Development

A Sustainable Standard

A creative project submitted to the Graduate School in partial fulfillment of the requirements for the degree

Master of Architecture

by

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January 2011
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This Creative Project would not have been possible without the support of many individuals. I would like to record my gratitude to Professor Wesley R. Janz, committee advisor, for his insightful advice and guidance for the project. He also played an instrumental role in my enrollment at Ball State University.

I would like to thank my chairman advisor, Professor Joshua Coggeshall who supervised, supported, and encouraged me from the beginning to the end of the project. I would also like to thank Professor George Elvin, committee advisor, for his guidance.

I gratefully acknowledge Professor Stephen Kendall for suggesting that I join studio group.

Special thanks to Daniel Earl Walker for editing my paper throughout the evolution of my project.

I am indebted to my family members, especially parents, for supporting and encouraging me to pursue this degree. Without their support, I would not have finished the degree.

Sangita Shakya
# Table of Content

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acknowledgement</td>
<td>3</td>
</tr>
<tr>
<td>Table of Content</td>
<td>4</td>
</tr>
<tr>
<td>Chapter 1 - Introduction</td>
<td>6</td>
</tr>
<tr>
<td>1.1 Outline of chapters</td>
<td>8</td>
</tr>
<tr>
<td>1.2 Importance of study</td>
<td>12</td>
</tr>
<tr>
<td>1.3 General background</td>
<td>13</td>
</tr>
<tr>
<td>Chapter 2 - Growing Population</td>
<td>17</td>
</tr>
<tr>
<td>2.1 Urban population growth</td>
<td>18</td>
</tr>
<tr>
<td>Case I - Caracas City</td>
<td>20</td>
</tr>
<tr>
<td>Case II - Hong Kong City</td>
<td>22</td>
</tr>
<tr>
<td>2.2 Population growth in Nepal</td>
<td>24</td>
</tr>
<tr>
<td>2.3 Rapid urbanization in Kathmandu</td>
<td>26</td>
</tr>
<tr>
<td>Chapter 3 - Present Issues and Concerns</td>
<td>29</td>
</tr>
<tr>
<td>3.1 Housing condition</td>
<td>31</td>
</tr>
<tr>
<td>3.2 Vulnerability issues</td>
<td>34</td>
</tr>
<tr>
<td>3.3 Eroding social activities and cultural heritage</td>
<td>35</td>
</tr>
<tr>
<td>3.4 Brownouts (power outages)</td>
<td>36</td>
</tr>
<tr>
<td>3.5 Environmental issues</td>
<td>37</td>
</tr>
<tr>
<td>3.6 Brick: demand and issues</td>
<td>38</td>
</tr>
<tr>
<td>3.7 Climatic study</td>
<td>43</td>
</tr>
</tbody>
</table>
chapter 4 - selection of site for creative project

4.1 importance of site: dhulikhel
old historic place
scenario environment
existing amenities

chapter 5 - project ideas

5.1 main ideas
5.2 supporting ideas

chapter 6 - final creative design

master plan: site layout
master plan: part 1
community building
hotel residence building
master plan: part 2
permanent residences type 1
permanent residences type 2 & 3
interior: economical design

chapter 7 - conclusion

bibliography
Brownouts are a fact of life in Nepal. Imagine if Washington D.C. was subject to brownouts regularly lasting over half a day. It is hard for those living in a developed country such as the United States to imagine an unreliable supply of electricity. This is the current situation of Nepal's capital city, Kathmandu.

“When it gets cold during Nepal’s winter nights, Yem Prasad Gurung turns on his heater run by liquefied petroleum gas. When it gets dark, he switches on the lights that rely on a solar inverter – and to make sure he gets water, he turns on a generator-powered water pump.”¹

This is the story of a citizen of Kathmandu. Mr. Gurung, tired of long electricity cuts up to 12 hours a day and water shortages has started finding alternative solutions to basic challenges. Currently in Kathmandu, most families have a similar story like Mr. Gurung.

The reason for selecting this topic for a Creative Project was my own experience as a resident of the Kathmandu Valley. The development of this project occurred over two semesters. The first semester was spent researching literature, studying issues, and finding alternative solutions for those issues. Site selection, conceptual programming, and final design were undertaken during the second semester.

Sustainability is a key issue facing the entire world. Previous actions are impacting lives today and the choices we make today will affect the future. According to the World Commission on Environment and Development report, ‘Sustainability’ is defined as the ability to “meet the needs of the present without compromising the ability of future generations to meet their own needs.”

Furthermore, sustainable development of cities means improving the quality of life in a city. Sustainable development requires fair access to knowledge, resources, and equitable opportunities.

Resources are scarce in the Kathmandu Valley. Industry, education, health care, and every resident are affected by insufficient resources in the city. Population growth is often blamed for this situation. Kathmandu Valley is a hub for politics, business, education and health care. These factors create an attraction for migrants living in rural settings from around the country. Such a rapid increase in population has created further strain on the ability of the government and private industry to meet the needs of the people. Population growth generates serious issues such as pollution, overcrowding, escalating housing expenses, lack of electricity and chronic water shortages. In addition, housing is haphazardly growing due to rapid immigration from outside the city in search of all types of jobs, skilled and unskilled.

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The aim of this creative project is to understand the complex issues of the Valley as they relate to sustainability and find a sustainable approach for new development. It addresses how to accommodate population growth, and how to create jobs opportunities while mitigating environmental impacts.

1.1 outline of chapters

Chapter 1:
This chapter introduces the chapters outline, importance of the study, and the general background of Nepal and Kathmandu.

Chapter 2:
This chapter covers two cases studying around the world. It discusses the problem in a global context through the use of two case studies: Caracas City and Hong Kong City. The chapter provides specific data on population growth in Nepal. Rapid urbanization in Kathmandu is also discussed in this chapter.
Chapter 3:

Chapter 3 reviews present issues and concerns about population growth in the Kathmandu Valley. Various issues relating to population growth are interpreted in this chapter such as housing conditions, vulnerability issues, and brownouts. This chapter explains the life of the average brick maker, and the reasons behind why the concerns related to brick fabrication are of great importance. Emerging brick making technology is also discussed in this chapter.

Key terms finding issues and concerns with social structure, economic condition and environment issues: affecting cycle of sustainability

- over-crowding
- fading traditional culture
- public spaces occupied
- over crowded housing
- air-pollution
- traffic pollution
- brownout
- water shortages
- population
- temporary living
- unemployment
- expensive
Chapter 4:

This chapter discusses the selection of the site. Background and current condition of the site is studied. The chapter also describes why the site is an important area. Many significant characteristics make the site a choice location for this project such as the site’s historical nature and different amenities such as health care, education, and potential for tourism.

key terms for site selection

Chapter 5:

Chapter 5 outlines the project ideas. It explains the main and supporting ideas to be implemented in the creative design. It explains the benefits with the selection of design elements such as brick kiln, mixed use housing, and community building. The project cycle is analyzed with the production of brick and its uses.
Chapter 6:

The result of the research and findings is the Final Creative Project. The Creative Project deals with site layout, master planning, multipurpose buildings, creation and use of public spaces, and demonstrating connections between different levels of social, economical, and environmental organizations. The model community design is presented in this chapter as an example for sustainable development.

Chapter 7:

Chapter 7 summarizes the output of chapters 1 through 6 and arrives at the conclusion that the new developments such as housings, industries, and other infrastructures are required to decentralize from Kathmandu to relieve pressures generated by population growth.
There is an Urban-Rural population shift in Nepal, and rural communities are shrinking. Urban cities in developing countries are more affected by this shift as resources and opportunities are limited compared to developed cities. For a developing country like Nepal, this issue has hit hard. Kathmandu is turning into brick and concrete jungle without a clear vision of development. Cultivated lands are being developed and the cost of living in the city is escalating. The infrastructure is limited and the numbers of occupant are increasing. This imbalance is degrading the quality of life for people living in the city.

Kathmandu is in a transition stage and it is giving birth to multiple issues relating to the social welfare, the economy, and the environment. This uncontrolled population growth might generate bigger issues as in some of the cases of overpopulated cities such as Caracas’s self-built housing and Hong Kong’s rooftop communities. Therefore it is important to understand the issue at different levels from city planners to small firms who unintentionally contribute to the creation of hazardous development by building houses with unclear vision of development. Living in a seismically unstable zone, the building owners and occupants are also required to understand their responsibility. Awareness is required to avoid chaotic situations during an earthquake such as those in experienced in Haiti.
Nepal is a landlocked country nearly equal to the area of Illinois. It lies between the world’s two most populous countries, China and India. The current population of Nepal is almost 30 million. The annual growth rate is 2.25% and the population has grown by 4.7 million in the past ten years. Agriculture is the mainstay of the economy of the country providing income for 75% of the population.

Nepal is divided into 75 districts. There are 3,915 Village Development Committees (VDC) and 58 Municipalities including one Metropolitan and four Sub-Metropolitan cities. Each VDC has 9 wards and the numbers of wards in a municipality ranges from 9 to 35.

**Facts of Nepal**

<table>
<thead>
<tr>
<th>Location</th>
<th>Northern Hemisphere, South Asia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital</td>
<td>Kathmandu</td>
</tr>
<tr>
<td>Total Land Area</td>
<td>0.03% of Total Land Area of World and 0.3% of Land Area of Asia</td>
</tr>
<tr>
<td>Area</td>
<td>147,181 Sq. Kilometers</td>
</tr>
<tr>
<td></td>
<td>Average Length (east-west) - 885 Kilometers</td>
</tr>
<tr>
<td></td>
<td>Average Width (north-south) - 120 Kilometers</td>
</tr>
<tr>
<td>Topography</td>
<td>Altitude Ranges from 230 feet - 29,000 feet</td>
</tr>
</tbody>
</table>

(CBS\(^3\))

Kathmandu Valley is the political, commercial and cultural hub of Nepal. It holds an exotic and fascinating cultural value. The Valley is roughly oval (bowl) shaped, that measures 15 miles east-west and 11.8 miles north-south. It is the most important urban concentration of Nepal. In comparison to the rest of Nepal, Kathmandu valley possesses amenities such as water supplies, electricity, gas, telecommunications, roads, sanitary sewer, education, security, and a public transportation system. Almost all new products and services are first launched in the valley and then spread to other cities.

Kathmandu, Lalitpur, and Bhaktapur, are three districts of Kathmandu valley. The valley encloses the entire area of Bhaktapur district, 85% of Kathmandu district and 50% of Lalitpur district. Kathmandu Valley has five major cities:

1. Kathmandu Metropolitan City
2. Lalitpur Sub-Metropolitan City
3. Bhaktapur Muncipality
4. Kritipur Muncipality
5. Madhaypur Thimi Muncipality

Kathmandu Valley Profiles

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KMC (Kathmandu Metropolitan City) is the largest city in Nepal, and is ranked among the oldest human settlements dating back 2,000 years. The current city core was known as Kathmandu which was a compact zone with temple squares and narrow streets.

**Facts of KMC**

City Area - 50.67 square kilometers

Population - 671,846 (CBS census 2001)

Annual Growth Rate - 4.6%

Population Density - 13,225 per square kilometer

Number of Households - 152,155 (CBS census 2001)

Residential Building - 66,236

Rate of Building Construction - 18.4% per year

Average household size - 4.4 per household

**Land use -**

- Residential - 53.12%
- Agricultural - 17.84%
- Business - 1.87%
- Service - 10.94%
- Greenery - 6.13%
- Mixed use - 7.01% \( (KMC^5) \)

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The United Nations Educational, Scientific and Cultural Organization (UNESCO) has listed four of the temple complexes (Hanuman Dhoka Durbar Square, Swayambhunath, Pashupatinath and Bouddhanath) as World Heritage Sites. Wood Craftsmanship, stone carving, weaving, pottery, and metal casting are some of the major handworks that local people are known for. The city is known for its rich art and architecture which is reflected in ancient temples, residential houses, and palace buildings. A majority of these are located in the city core. A British visitor more than two hundred years ago, made the often-quoted observation, “There are as many temples as there are houses and as many idols as there are men.”6 In addition to numerous of temples and idols, there are 106 monastic courtyards (known as baha or bahi).

Kathmandu is the main center for several major industries such as tourism, carpets, garments, finance, health, and educational services. This city also has been a center of trade throughout history because it is a major route between Tibet and India. Commerce has always been important for people living in Kathmandu. According to KMC, the city’s economic output exceeds $2.4 billion per year. The major sectors of trade are – finance - 21%, manufacturing – 19% with manufacturing and export of garments and carpets, agriculture – 9%, education -6%, transportation – 6% and hotels and restaurants -5%.

Tourism is considered an important source of income for Kathmandu as it is a gateway to 90% of the foreign visitors to the country. Tourism is also boosted by the fact that Kathmandu is the only city in the mountainous country with an International airport.7

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The global population is on track to reach 7 billion in 2011, just 12 years after reaching 6 billion in 1999. According to U.S. Census Bureau, the current estimate for world population as of November, 2010 is 6,884,732,452. The birth rate is 20 births per 1,000 populations whereas death rate is 8 deaths per 1000 population. Put simply, 245 births each minute and 102 people die each minute. The rate at which the world population is growing each year is about 1.3 percent. Around 60% of the world’s population lives in Asia: the continent with largest number of developing countries.\(^8\) In general, developing countries are more affected by growing population than industrialized countries. The estimated projection of population growth of developing countries and industrialized countries (figure-2.1) gives a clear picture that the fastest population growth is happening in developing countries. With this, the issue with population growth could be worse in the future. This demands great attention.

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2.1 urban population growth

In 1900, 10% of the world’s population was living in cities and it is estimated that 75% will live in cities by 2050. Cities have always had a magnetic pull, large populations move to cities to find jobs and opportunities.

World Changing Urban Population

<table>
<thead>
<tr>
<th>Year</th>
<th>Developing</th>
<th>Developed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>40%</td>
<td>60%</td>
</tr>
<tr>
<td>1960</td>
<td>44%</td>
<td>56%</td>
</tr>
<tr>
<td>1970</td>
<td>49%</td>
<td>51%</td>
</tr>
<tr>
<td>1980</td>
<td>55%</td>
<td>45%</td>
</tr>
<tr>
<td>1990</td>
<td>62%</td>
<td>38%</td>
</tr>
<tr>
<td>2000</td>
<td>67%</td>
<td>33%</td>
</tr>
<tr>
<td>2010</td>
<td>72%</td>
<td>28%</td>
</tr>
<tr>
<td>2020</td>
<td>75%</td>
<td>25%</td>
</tr>
<tr>
<td>2030</td>
<td>78%</td>
<td>22%(^9)</td>
</tr>
</tbody>
</table>

\(^9\) The Endless City, pg 58.
In 2020, it is predicted that 1.4 billion people will be living in slums. All problems become more concentrated in the close confines of urban areas, yet cities are poised for rapid growth. Cities are threatened by scarce resources, environmental problems, uncontrolled growth, and migration. One billion people who now live in squatter settlements came to cities searching for jobs. Skilled and unskilled people can find opportunities in city, which is giving economic support to some, but making many people live in informal settlements lacking infrastructure. Growing cities are creating informal settlements as the people are not able to afford the expenses of city living.¹⁰ During my research, two examples of rapidly growing urban centers came to the forefront: Caracas, Venezuela, and Hong Kong.

¹⁰ *The Endless City.*
In Caracas city, one half of population lives in self–built neighborhoods. The developers’ version of the city and the people’s version as in figure-2.2: barrios built over 25-30 years, a flexible city that is constantly adapting itself to the growth of surroundings and families, plugging into existing electricity and water supplies, and adding rooms and floors. This city has grown from a small provincial town to a contemporary metropolis of 5 million people in 50 years. On average, population of the city doubled every twenty years. And the population growth is mainly due to immigration from different countries: from Colombia, Spain, Italy, Portugal, Middle Eastern nations, Chile, Uruguay, Argentina, and Cuba.

Informal settlements in mountainous areas are built using the following technique: houses are built by cutting out parts of the mountain; a concrete structure is built on foundations. This unstable frame is later filled with the cheapest available block - which is bright red - leaving steel rods poking out: a symbol for continued growth and construction. As buildings get taller, the steel rods and concrete are increasingly stressed. Caracas lies in an earthquake zone and sooner or later, thousands of houses will come crashing down. The hazardous environment created will result in huge tragedy for those living in the improvised structures. 11

![figure 2.2 - scenario with people's self-built and developer's version. Source: Informal City: Caracas](image)

The pictures of city (figure-2.3 and 2.4) give a clear idea that how the city is getting dense both in plan and vertical extensions. Life is already insecure in the city with the frequent occurrence of robbery, murder and other types of crimes. But with the continued growth of population the result is unimaginable. The examples within Caracas offer a new urbanism which may apply to cities around the world and makes the need for an insightful change in our understanding of urban culture evident.
case- II hong kong city

The case of Hong Kong’s urban growth is very distinct. “Portraits from Above- Hong Kong’s Informal Rooftop communities” by Stefan Canham and Rufina Wu shows the self-built informal settlements on the roofs of high–rise buildings (figure-2.5 and 2.6) which now define Hong Kong’s urban landscape. Hong Kong has a small land area with a high density of population. The escalating rooftop communities are closely linked to the migration history from the Chinese Mainland to Hong Kong. The people who have been living on the roof for twenty to thirty years are the ones who helped to build the city. As new immigrants added, they will be adding more rooftop housings.12

The roofs look like a village where no one has any idea from the outside how they live on the inside. As shown in figure 2.7, it is difficult to believe how they are sustaining their life on top of high rise buildings managing water, electricity and other basic requirements. It is chaotic. The roof is a maze of corridors with narrow passageways between dwellings. These are usually built with wood, sheet metal, brick, and plastics. The roof top communities also have ladders leading up to a second level.

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These rooftop community people do not want to relocate as they are afraid that there might not be opportunities for them in other places. The rooftop settlement in Hong Kong is a critical issue that has almost existed for a half century and will continue to exist for at least that long. It is difficult to determine when this type of settlement will disappear because there will always be those at the bottom who cannot afford the formal lifestyle in the city. Ironically, these people wind up living atop multi-million dollar high-rises. It is unbelievable to see how uncontrolled urban growth is forcing low quality of life to immigrants who come to city with the expectation of opportunities. These issues definitely create numerous questions about what steps should be taken and what alternatives could make it better.
Nepal has experienced significant migration from the north and south. Tibetans first began migrating to Nepal, followed by Indians from the south. Brahmins and Rajputs were group of people from south who were fleeing the religious crusades of invading Mughals known as Indian Muslims and their suppression of Hindus. Migrants were lured by the possibilities of the Terai region. In 1991, huge numbers of Indians from Bihar and other neighboring areas entered Nepal. Having an open border with India has impacted the population growth in the Terai region of Nepal (figure-2.8). This also ultimately effected in the population growth of main cities like Kathmandu.

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<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Mountain</td>
<td>1,443,130</td>
<td>1,690,263</td>
<td>17.1</td>
</tr>
<tr>
<td>Hill</td>
<td>6,417,889</td>
<td>10,271,506</td>
<td>59.4</td>
</tr>
<tr>
<td>Terai</td>
<td>8,628,078</td>
<td>11,252,912</td>
<td>30.4</td>
</tr>
</tbody>
</table>

Figure 2.8 - Percentage increase in population by region of Nepal

Source - CBS, Nepal

The estimated population of Nepal according to the CIA, July 2010 is 28,951,852. In about three decades, 9 million people have been added to the country as the total population of Nepal was 15,022,839 according to 1981 census. The major consequence of population growth is the imbalance of people and land. The shortage of land has greatly affected Nepal’s predominantly agrarian society and raised land values in the city.

Nepal was considered as one of the least urbanized countries in the world, with only 6.3 percent of its total population of urban areas in 1981. In the 1970's and early 80's, Nepal experienced a major urban influx of population. The urban population began to increase at an annual rate of more than 8.4%. The urbanization rate in the early 1990's was around 8%. At that time, there were only 23 settlements designated as urban areas. The 1991 census listed 33 urban areas with an urban population of 1.6 million.\textsuperscript{14}

Urban population: 17% of total population (2008)
Rate of urbanization: 4.9% annual rate of change (2005-10 EST.)

(source - CIA World Factbook)

The rapid urbanization in Kathmandu has become an important issue in context of population growth in Nepal. It is stretching municipal boundaries and is rapidly converting open spaces and agricultural fields into a brick and concrete jungle (figure-2.9). The agriculture land has decreased from 62% to 42% between 1984 and 2000. It has been estimated by different sources that if this trend continues there will be no agricultural fields left in the Valley by 2025.\textsuperscript{15}

Among 58 municipalities in the country, Kathmandu Valley has five of them with 30% of the total urban population. The most congested city, Kathmandu, has more than 20% of the total urban population. The population of the three districts of Kathmandu Valley: Kathmandu, Patan and Bhaktapur have increased from 1,107,370 in 1991 to 1,647,092 in 2001. It has been estimated by different sources that if present growth continues, the population of the Valley will reach 2.5 million in 2020.

The population distribution sizes of Kathmandu valley based on census report of 2001, the bigger the patch size, (figure-2.10) the higher the population concentration in particular area. Heavy population pressure can be observed in the northern center of the valley. The biggest patch is Kathmandu metropolitan city, whereas the second biggest adjacent patch represents Lalitpur sub-metropolitan city.

The population of Kathmandu city (figure-2.11) is escalating faster than other cities in the Valley. Large areas around the municipalities in the Valley have low population distribution (figure-2.12 and 2.13). The southern part of valley seems to have low population pressure compared to other surrounding villages due to high mountain topography and unstable land for living. Some areas in the valley have very low density as 71 people per square kilometer whereas some places have more than 13,000 people per square kilometer.
figure 2.12 - Population distribution size in the valley based on Census report 2001

figure 2.13 - Population density pattern in the valley based on Census report 2001

source: Pradip Raj Pant and Devendra Dongol, Kathmandu Valley Profile, Briefing Paper.
chapter 3
present issues and concerns

The Kathmandu Valley is no more as it was. The scenario of Kathmandu has changed with the growing population. This change is generating numerous complex issues. Rapid growth has also had a profound impact on the physical environment of the Kathmandu Valley. The growth in population, housing, roads, and small-scale industries in Kathmandu over the past three decades has created very serious health hazards, states Dr. D.D. Joshi, director of Nepal’s National Zoonoses and Food Hygiene Research Centre (NZFHRC).16

The level of urban quality of life is already low by western standards as there is no adequate supply of water, electricity, building materials, and pollution control. The availability of energy and use of locally produced energy will also determine how vulnerable Kathmandu is for its energy needs. Use of individual electricity generators are bad indicators of sustainability in the long run, as they consume petrol and need a regular supply of spare parts, and do

not enjoy an economy of scale for energy production.

Thousands of people migrating to Kathmandu city, for different purposes are resulting in houses being constructed haphazardly on every possible developed and underdeveloped plot. To provide housing for this increasing population, the newer houses are mostly congested, unplanned, and without any aesthetic value. The issues relating to the lack of electricity, water, and traffic are raised and the quality of life is decreased creating an unhealthy environment in the city. These issues require new ways of planning, new ways of developing community, and implementing sustainable development practices for the Kathmandu Valley.
Kathmandu Valley is the central attraction for people because of its infrastructure, which is comparatively advanced when one considers the other regions of Nepal. The city has been expanding horizontally and vertically with three different urban fabrics: the inner core, the outer periphery and the urban fringe. The present cityscape is the result of a lack of proper planning and development regulation. This has already destroyed many historical residences of inner core area.

The study of Ward no. 20 of Kathmandu by Dr. Bijaya K. Shrestha explained the destruction of traditional buildings by division, partial demolition, new construction and addition uses. There are many buildings in Ward no. 20 which are in bad condition and some of them are uninhabitable (figure-3.3). The addition of floors (figure -3.4), vertical division, and new tall and narrow buildings (figure-3.5) are few examples the vulnerability of Kathmandu to natural disaster in the Valley. The narrow dark alleys (figure - 3.6), and access underneath the buildings (figure -3.7) are disaster prone and generate risks to safety, security and quality of life.17

figure 3.4 - addition of floors on existing building

figure 3.5 - vertical division of building

figure 3.6 - narrow dark alleys

figure 3.7 - access underneath the building

source: Shrestha, Dr. Bijaya K.
The demand for housing has motivated land owners to sell agricultural land for quick profit. The new migrants who can afford to buy are attracted to land in the fringes because the building codes are not strict. People can build as they like, there is no government intervention. The unplanned settlement is the growth of substandard housing in the fringe of Kathmandu City. Lack of natural light and ventilation, inadequate water supply and sanitation, poor access, and bad road conditions are indicators of substandard housing. The cost of the construction of infrastructure services in such cases renders the housing on agricultural land more expensive in the long run than on developed land.

There are also informal settlements in Kathmandu, which are known as “Sukumbasi Basti,” they provide housing for poor people who migrated from rural areas. Most of these informal settlements are on government land. Due to lack of jobs and expensive life of the city, they are forced to live substandard housing.
3.2 vulnerability issues

Geological, topographical, and climate conditions expose the valley to multiple hazards. Haphazard land use, increased population pressure, extensive deforestation, lack of awareness, and unplanned development of infrastructure are additional causes contributing to the increased vulnerability of the Valley to natural disaster. The entire Valley could experience a severe earthquake of magnitude 8. It has been predicted that the earthquake might damage the Kathmandu Valley with great loss. The majors are: 60% of the buildings could be heavily damaged with a potential death toll of 40,000, and 95,000 of the people seriously injured (Table-1). Evidence from recent history such the 1934 earthquake (figure-3.8) show that earthquakes are an unavoidable part of Kathmandu Valley's future. Poor building practices and insufficient emergency and hospital preparedness elevate the risk of mass mortality and injuries from collapsed structures during an earthquake.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human deaths</td>
<td>&gt;40,000</td>
</tr>
<tr>
<td>Injuries</td>
<td>&gt;95,600</td>
</tr>
<tr>
<td>Building destruction/collapse</td>
<td>&gt;60 %</td>
</tr>
<tr>
<td>Homeless people</td>
<td>&gt;700,000</td>
</tr>
<tr>
<td>Bridge collapse/damage</td>
<td>&gt;50 %</td>
</tr>
<tr>
<td>Road length damage</td>
<td>&gt;10 %</td>
</tr>
<tr>
<td>Water supply pipeline damage</td>
<td>&gt;95 %</td>
</tr>
<tr>
<td>Telephone exchange building</td>
<td>Most</td>
</tr>
<tr>
<td>Telephone lines</td>
<td>&gt;60 %</td>
</tr>
<tr>
<td>Electric substations</td>
<td>Most</td>
</tr>
<tr>
<td>Electric lines</td>
<td>40 %</td>
</tr>
</tbody>
</table>

*Table - 1 : Predicted earthquake disaster risk in Kathmandu Valley*

3.3 eroding social activities and cultural heritage

The social activities where the entire city celebrates festivals and community activities are fading away as the open and public space are being occupied as private property or for commercial use (figure-3.1). The increasing population of the city is impacting the social activities resulting loss of culture and traditions of the Valley. United Nations Educational, Scientific and cultural Organization (UNESCO, 2003)\(^{20}\) listed Kathmandu Valley on the List of World Heritage in Danger. The issues mentioned were Urban pressure; Earthquake, Rapid growth of population.

Nepal is not generating enough electricity to meet demand. The term “brownout,” can also be called a “load-shedding.” Load shedding is a demand reducing technique that “selectively and continuously shut off electricity in a region.”\(^{21}\) Kathmandu Valley is dark at night, and even in the day time there is no guarantee that electricity will be available to light interior spaces, run computers, or pump water. The power outages last up to sixteen hours per day. Important sectors of the social and economic realm are often left to rely on temporary sources of electricity to bridge the gap between supply and demand. Businesses and wealthy people depend on private generators as backups. People without such means depend on candle light (figure-3.8) to provide illumination. The government continuously states that the nation is in an electricity crisis. Load-shedding is meant to save electricity but this has become a big problem for people living in the city. The crime has increased during the dark hour of load shedding.

3.5 environmental issues

The Valley is especially vulnerable to air pollution due to rapid and haphazard urbanization. Valley centric industrialization and significant increase of vehicular transports have escalated the pollutions affecting life of people living. Health issues are arising and noise pollution is uncontrollable.

The Kathmandu resides in a bowl-shaped Valley, and this greatly enhances the likelihood of air pollution problems. The valley’s unique shape prevents the escape of industrial and vehicle fumes. As vehicle emission is the main source of pollution in Kathmandu, air pollution levels are highest during peak traffic hours and at places where traffic density is highest (figure-3.9). Similarly, areas around polluting industries, mainly brick kilns situated at the southern part of the Valley are major source of air pollution. The impact on tourism has been estimated to the loss of NRs. 0.5 billion (Nepalese currency) per year due to air pollution in Kathmandu Valley (World Bank, 1997).

One major factor for air pollution is the brick kilns as brick is one of the major building materials used in Kathmandu Valley. Demand for building materials is high because of demand generated by new construction, which is raising demand of brick production. The issue with brick kilns is an important issue for the city because it is one of the hopes for economic growth in the city.

figure 3.9- traffic congestion in main roads of city
Brick is a locally available primary building material in Kathmandu Valley. It is considered as a traditional craft in the Valley. There are numerous examples of traditional brick buildings. We can see excellent examples of brick work in temples, old residences and palaces in the Valley. Hence, Brick is an important building material for maintaining the traditional architecture (figure-3.10) of Kathmandu.

brick: an important building material for Kathmandu

“STUDY & KNOW LOCAL MATERIALS - their availability, performance, costs, techniques & workmen who know how to use them.”

- Laurie Baker
In 2001, the Environment and Public Health Organization (ENPHO) estimated that consumption of brick in Valley itself is about 4 billion bricks annually. In early the 1950’s, the demand of brick escalated and local brick kilns (called “Thaado Bhatta”) were displaced by Bull’s Trench Kilns (BTK) Movable chimney. BTK has covered 87% of brick production in the Valley; they produce artistic bricks using traditional methods with religious significance.\(^2^2\) According to Animal Nepal, there are 500 brick kilns.\(^2^3\) Most of these brick kilns do not have any pollution control devices which are causing significant environmental and health impacts to brick workers and local neighborhood. The concern has been shown from different sectors as demand of brick in the valley is going up with the environmental issues. This demands a clean and efficient technology for making brick. The government of Nepal has provided options for cleaner technologies for brick making in Nepal and among them, the technology developed in China, Vertical Shaft Brick Kiln (VSBK) is one of them. Use of alternative technology instead of BTK technology is now necessary and this VSBK technology is different than the traditional brick making technology.


In Kathmandu Valley, the necessity has been seen to upgrade the brick kiln type (figure-3.13) as old traditional brick kilns are polluting the environment. The vertical shaft brick kiln (VSBK) is classified as a continuous updraft kiln and represents a comparatively new and unique method of firing bricks. It is a revolutionary type of brick kiln, combining the simplicity and low cost of updraft firing with very impressive fuel economy, plus the benefits of continuous operation. It represents a very energy efficient low cost method of firing bricks on low grade coal fines. The fired quality of the bricks is high with a low wastage. The kiln is cheap and straightforward to build, and requires very little maintenance once constructed. VSBK can reduce air pollution (figure-3.14), which can ensure future growth of the industry resulting in employment opportunities.24

figure 3.13 - old traditional brick kiln need to upgrade with new technologies

figure 3.14 - emission from VSBK is less compare to old brick kiln types (source 23)


In Nepal, the brick industry is one of the largest employers of unskilled or semi-skilled seasonal migrants. They live a dismal life lacking basic facilities such as proper housing, clean drinking water, and sanitation. The health and safety risks in the workplace are numerous, but the environmental issue of the brick industry has always overshadowed these social issues.

Brick workers are a specific migrant type; generally they migrate alone to find employment at a city. After finding a job, they relocate their family as well. But due to the expensive rental houses near the brick kiln, they usually build their own temporary houses (figure-3.11) near by the kiln and settle their family or travel long distance to their job. Few people are able to pay rent for the old houses nearby work, but still they live in a temporary settlement as they don't have continuous job. The brick kiln workers generally work for half of the year because the kilns do not have proper coverage during the rainy season to dry the brick. This reduces the workers income.

The brick makers’ families rarely work outside, as it is very difficult to find work in the city. Therefore, the brick maker has to support their whole family. The families struggle with the expensive city life with less income. They somehow maintain their daily life, growing vegetables where they can, and perhaps obtaining somewhat regular supplies of electricity through living in stack housing (figure-3.12).
figure 3.12- brick workers maintaining their life somehow
living in old houses which needed repairing
temporary connection for electricity
brick stack as part of temporary building
plastic covering for rain water protection
growing vegetables - kitchen garden to sustain
temporary roof with whatever is available around

figure 3.11- temporary house for brick worker and his family
source: Sachin Shakya

source: Sachin Shakya
The climatic study is an important parameter in a building design. The successful design of buildings depends upon an appropriate understanding of climate. Incorporated and appropriate climatic design can help in form a comfortable and energy efficient building.

geographic location of kathmandu

Kathmandu lies between the latitudes 27º36' to 27º50' north and longitudes 85º7' and 85º37' east and is located at a mean elevation of about 1,340 meters above sea level. In winter-time temperatures are relatively low, ranging between 0°C at night and 15 to 20°C in the daytime. The cold air, typically for a valley location like Kathmandu, keeps temperatures between December to February uncomfortably low. However, the frequent and strong solar radiation, which is common during this season, improves the situation and provides an excellent opportunity for passive solar room conditioning. The pre-monsoon season is hot and dusty, mainly in May and the first half of June. Temperatures rise up to 35°C in daytime and drop to around 20°C at night. The solar radiation is often intense, and protection is required. Dust storms frequently occur during this season. The average rainfall is 1,400 millimeters, most of which falls during June through August.25

New buildings in the Kathmandu Valley have little response to local climate. Kathmandu has a cool temperature in general and incorporating solar energy in the building can make the building energy efficient, which can save a lot of money for building users in long term.

Utilization of sunlight to generate electricity is an effective method of reducing the impact of human activity on the environment. Solar radiation is a clean and inexhaustible source of energy. Nepal lacks fossil fuel resources, but is ideally located for solar energy. Nepal receives solar radiation between 4.5-5.5 kwh/m² which peaks of up to 6.0 kwh/m² on average (figure 3.13). Nepal receives 300 days of sunshine in an average year. In Nepal, there is a possibility for solar technology to provide cost-effective electricity.
The Solar Photovoltaic was started in the mid 1990s, it have been applied to rural areas.\footnote{RIDS - Nepal. “Rural Electrification in Humla.” Solar Photo Voltaic. http://www.rids-nepal.org/index.php/Solar_Photo_Voltaic.html (accessed April 18, 2009).}

The Solar Electric Light Fund (SELF), a Washington, D.C. based organization, in collaboration with the Center for Renewable Energy (CRE) in Kathmandu brought solar electricity (figure-3.14) to the rural area of Nepal; Pulimarang. The isolated village, lack of natural energy resources made photovoltaic power the only feasible way to supply electricity to the region and it was not scheduled to receive formal electricity for decades. Pulimarang, a solar powered village, was supported by Moriah fund and solar home systems were installed in 65 homes. The villagers enjoy the brighter light, no fumes, safety, and substantial savings from reduced kerosene consumption. They also cited better education, entertainment, and improved earnings as direct benefits of the solar systems.\footnote{SELF. “Nepal.” Solar Electric Light Fund. http://www.self.org/nepal1.shtml (accessed May 8, 2009).}

The use of photovoltaic technology in rural Nepal is setting an example for use of sun energy. This could be a solution of brownouts in the City area. Solar villages can provide a lesson to Kathmandu in terms of the applications for solar energy.
The selection of site is the most critical part of this Creative Project Program. Educational services, hospitals, and political activities have centralized in the Kathmandu Valley. Multiple issues generated such as pollution (industries, vehicle emissions), population growth, traffic congestion, vulnerability to environmental disasters, substandard and overcrowded housing conditions, and dwindling open space are pointing the developers to rethink the future developments in the Kathmandu Valley. The proposed development introduces sustainable development concepts for an increasing number of migrants, which could provide a healthier environment, job opportunities across income levels, and housing.
Studies of different sites were done to find the best site for new development. The planned development would be far more difficult if the new development were located at a site featuring fewer existing amenities. The site was selected for its advantages such as a location close to the old historic area, hospital, and university. These amenities are walking distance from the site. After alternatives were studied, it was determined the best site for this project is Dhulikhel. This site shows potential for sustainable development. Dhulikhel is located eight miles from Kathmandu (figure-3.15) which has many of the amenities needed to implement the proposed sustainable design solution. The site is located within a small town of 11,000 inhabitants (one of the smallest municipalities in Nepal)
4.1 importances of site (dhulikhel)

The selected site Dhulikhel is one of the oldest urban areas in Nepal. Many people are migrating from this area to Kathmandu valley and the population is decreasing. However, the site has a number of existing amenities (figure-3.16) which include a renowned university, resorts, and a top quality hospital. People from Kathmandu commute back and forth to this area for study and work. They make a reverse-commute as they come from city to this place for opportunities. Therefore, this site already shows demand from target populations such as students, doctors, visitors and travelers. The fact that it attracts people from the larger city shows that it has significant potential for growth. The site holds potential for addressing social, economic, and environmental issues associated with Kathmandu because of the amenities of Dhulikhel.

![Amenities of Proposed site](image)
The oldest part of Dhulikhel is an assembly of fine old Newari houses, their most valuable assets are the beautifully carved windows and doors, fine examples of traditional Newari craftsmanship. The artistic skill and urban ethos of its Newar inhabitants have created a place of charm and beauty. The open yards surrounded by the traditional houses with pagoda-style temples (figure-3.17) and glittering Gajurs (top part of temples) shows the rich history and the cultural heritage of the people. There are organically developed compact settlements (figure-3.18) around Dhulikhel. There are numerous temples in the town depicting an example of traditional and old Newari craftsmanship of Dhulikhel. These are important places of worship for local people. The core area of Dhulikhel has interesting narrow cobbled streets and lanes embedded with number of Hindu Shrines, a few Buddhist Stupas and worn brick buildings (figure-3.19).
The first destination of most of the tourists visiting Nepal is the capital city of Kathmandu and whole of the Kathmandu valley is becoming more and more overcrowded and polluted. The valley is converting into a chaotic “Concrete Jungle.” There is a growing need to develop a touristic destination in a nearly pollution free environment. Hence, Dhulikhel is the most idyllic hill destination because of its location advantage and natural gift. Additionally, it is a medieval city full of ancient heritage and rich traditional and cultures.

The spectacular snow mountains seen from Dhulikhel are one of the finest panoramic views (figure-3.20) in Nepal. The panorama offers a majestic undisturbed view of the Himalayan ranges stretching from Mount Annapurna in the far west to Mount Karolung in the Far East. Dhulikhel has been an important trading centre on the ancient commercial route linking Nepal to Tibet for many centuries. Since prehistoric times, people of Nepal traveled to Tibet to bring home salt and gold. Likewise, the Tibetans every year with their flocks of sheep enter into Nepal during Dashain, the greatest Hindu festival. After adjoining with Tibet by vehicle road in 1965, Dhulikhel got a face lift and developed as a tourist destination. Dhulikhel is famous as an ideal place to stay while going to Tibet and coming back to Kathmandu.
The site is close to amenities such as a large hospital and university. Thousands of people travel from Kathmandu to Dhulikhel for jobs and school. The site itself could support housing for job holders and students, which make this site more appropriate for developing housing for growing population. Generally, people from different places migrated to city where there are jobs, education, health care and opportunities. Here people travel from city to rural for jobs and studies.

The top hospital (figure-3.21) and university (figure-3.22) in Nepal are located in this site context. This is also an important trading route to Tibet. The site meets some of the existing requirements to the target people who will need housing. Therefore, there is a demand of housing for different target groups such as students, doctors, visitors, and travelers.28

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The idea for the conceptual program arrived as a result of a detailed study of many issues affecting the Valley such as air pollution, population growth, and unreliable energy supply. Studying the issues and alternative possibilities, the understanding has been developed that the urbanization in Kathmandu is one of the reason for supporting population growth. The demand of housing is to be fulfilled; the new development is to be placed in such a site where there is possibility of sustainable development. Therefore, the selected site: Dhulikhel has been chosen since the site already has amenities such as health care, education, and tourism business (figure-3.23).
5.1 main ideas

This hypothetical project tackles issues at multiple levels. The developed program for the creative project comprises various elements such as brick kiln, community building, and housing (figure-3.24). In addition, a water collection system area and open public spaces are a few other features incorporated in the design. Each of the elements chooses for this creative project input for sustainable development of the community design. The availability of health care and education will create jobs in the area. The project program with a brick kiln, housing, and community building will create different types of jobs. The existing and new amenities will help to create a sustainable program overall (figure-3.25).

![Figure 3.24 - Program of a Project](image-url)
Among the issues identified during my study, the manufacture of bricks in a traditional kiln has become the focus of my attention due to the high levels of air pollution generated by the traditional kiln process. As brick is a local, traditional, and cheap building material, there is a high demand for brick in the Valley. This industry has the potential to support economic sustainability that can generate job opportunities for a growing population. Utilizing new technologies can solve the issues associated with brick kilns such as high air pollution. As a result, the environment will be healthier for the brick kiln workers and for all users of the site.

Community building has been incorporated in this project for several reasons. It will bridge between existing villagers and new resident in different ways. The open space in the community building can be used for multiple uses: as open market place, open space for celebrating group functions. Villagers can use as
the market area to sell their vegetables. The vegetables grown in this site area are sent to Kathmandu Valley, where they are to be sold to generate income for these new residences. Villagers will save the transportation cost from sending to city, which will improve the life of villagers. Kathmandu is famous for its culture and tradition; there are several festivals and occasions, which need a big open space for gathering. The open space with open seating can be used as an outdoor theatre space which will contribute to preservation of the culture and strengthen the social network between different level type people. The community building is used for promoting small scale industries. Nepal is famous for hand craftsmanship and this will again preserve the Nepali tradition. And the site is located at highway connecting Nepal to Tibet, the community building can also act as a model community where tourist can come and have glimpse of Nepalese art and architecture. From the tourism point of view, having community building in the project will support the new development. The tourism business in Kathmandu Valley is degrading due to issues generated in the Valley. This new development in this site area could be next spot for development of tourism.
In the site layout, there are different types of residences. These residences are designed for different target groups of mix-use housing (figure-3.26):
Temporary Residences target travelers, students, and hospital visitors. Travelers have used this site area as a transition place while traveling through Arniko Highway. It connects Nepal to Tibet. The site area is located with a good panoramic view of mountains; the travelers can enjoy the beauty of nature along with getting familiar with Nepali art and architecture. The hospital visitors can use the hotel area for short time such as for 1–7/8 days and hostel for month. In some cases, since the hospital is far from main City, patients’ families have to travel back and forth every day. These varieties of housing give an option for users to choose to live close to the patient for short time of period. Students going to university who are commuting from Kathmandu Valley can have alternatives to stay in the hostel residences. Living closer to campus will save their time for traveling in traffic of busy roads in Kathmandu Valley. They can also choose varieties of residences from hotel, hostel or as a paying guest in permanent residences. Nepal has a tradition of living in a joint family up to three generations so there are always empty rooms in homes, which could be used to rent and make some extra income for residence people.

Permanent Residences are targeting skilled and unskilled people working in brick kiln, people who are trying to move from compact city to the fringes of Valley, professors teaching in university and hospital doctors. This target groups are selected with their demand for housing, with job availability and creating new job opportunities. Mixed users will be benefited having diverse groups of people. Social bonding will increase between different level groups. In the context of Nepal, people need each other’s help to complete many tasks of daily life. This is mainly because, people depend upon manual labor instead of using machines for their daily works (washing dishes, laundry, gardening, cleaning and labor work). Having brick kiln in the project is going to give job
opportunities for skilled and unskilled both (figure-3.27). Having solar drying system could solve the issue of seasonal work in the kiln due to rainy season. More detailed study can be done for applying these techniques; this project is making aware of presence of the technologies that can be adopted.

figure 3.27 - work opportunities from program
Open spaces for public are considered in program for multiple uses. The neighborhood courtyard will act as a semi-public space which could be used by groups of people for their daily activities (figure-3.28). And the open space in the community can be used by all community residences users for different purposes (play ground, big festivals- figure-3.29).
The project cycle is a part of sustainable development. The kiln will produce brick as a building material which will be used for housing. The housing will collect rain water by adapting water collection system in their houses which will be used for non potable purposes. The excess amount of water can be used by the kiln for making bricks. These simple functions form a cycle (figure-3.30) that is self-supporting.
- The collected rainwater could be used in brick kiln and for non-potable purpose (household uses) for residences.
- The housing has the option of installing solar and PV panels. The slope of the roof is designed to increase the amount of solar energy captured from the sun.
Use of brick instead of wood for outer screen and in built interior elements (figure-3.32) is economical and structurally sound. Wall screens with different designs and opening sizes (figure-3.33) can be used in buildings instead of wooden windows which reduce the cost of building. The size of opening and design can control the amount of sunlight let into the building and ventilation. It could mainly be used in semi-private areas like staircase and common areas.
All ideas were compiled into this final creative design. The 2D drawings and 3D renderings are produced to give a clear picture of the proposed end-product. The master plan has been laid out in such a way that exploits the natural landscape in its design. The sloping site is facing south; therefore the buildings on different levels are oriented towards the south to obtain maximum solar energy. To minimize wind impact from west, trees are planted as a windbreak parallel to the west side of the site. The connection of buildings in the site has public and private access, the outer roads surrounding buildings are used for public access and the inner roads are for a pedestrian environment. The placement of buildings is done with a priority on function. The community building is placed at the top of the sloped site, close to main road as this is a building that will connect the proposed community with the established community. The other reason for this placement is to maximize visibility to tourists traveling the main road. The community center is a place for supporting local business and small scale handcraft business; it will have shops for selling
products in ground floor. The hotel building is meant to serve the needs of those who plan to stay temporarily, namely tourists and visitors to the hospital. They are placed near the community building so that they could benefit one another. The north side has a panoramic view of the mountains, while the opposite side has a wide view of Nepalese housing. Therefore, it has a potential to expand tourism business.

The hostel is targeted for student groups. This building is located in between the hotel and permanent housing with the intent to create a transition area between the temporary and permanent types of housing tenure. The numbers of students and visitors could vary so these buildings are designed with concept of open architecture, with intent to have a building that is adaptive to changing needs.

Permanent housing is placed after temporary residences. It is close to the brick kiln which serves as a source of employment within walking distance for residents of the area. The skilled/unskilled who work at the kiln are encouraged to live in this housing. Residence Type 1 is designed for high income level groups which are individual houses. Housing Types 2 and 3 are for low income level groups. A non-potable water collection tank is located close to Type 2 and 3, as these groups of people will use non-potable water. Different housing layouts are designed to meet the varied needs of a diverse population whose lifestyle might change rapidly. The interior of the low-income housing has cost-saving features such as energy efficient design and built-in structural furniture.

The site itself is a part of village growing down a sloping hill. The design will create a community that will provide housing for different income levels and will benefit current and future residents.
Different housing types have separate common spaces and a public common sharing space for whole community. This gives an environment of connection with people of different incomes. As the proposed site is located at economical place, it will be affordable to rent an apartment by brick maker. Work will be available for the whole year and family members may have other work opportunities due to the considerations made by this study. Implementation could be possible in few years over which brick workers would be slowly able to improve their life style. The economical design strategy could use brick instead of wood for in built interior elements which is economical and structurally sound. Wall skins with different designs and opening sizes can be used in buildings instead of wooden windows, which reduce the cost of building. The size of opening and design can control the amount of sunlight into the building and also the flow of air. It could mainly be used in semi-private areas like staircases, and common areas.
master plan: site layout

dwg1 - over all site layout plan

dwg 2 - sectional elevation of site

dwg 3 - overall view of proposed community design

- community building
- recreational building
- hotel residences
- hostel residences
- permanent residences type 1
- permanent residences type 2
- permanent residences type 3
- water collected - for non-drinking purposes
- open ground - multi-purpose use
- brick kiln
- wind direction

master plan: site layout

- community building
- recreational building
- hotel residences
- hostel residences
- permanent residences type 1
- permanent residences type 2
- permanent residences type 3
- water collected - for non-drinking purposes
- open ground - multi-purpose use
- brick kiln
- wind direction
master plan: part 1
community building, hotel residences and hostel residences
dwg 6 - view between community building and hotel residence (view - B)
community building

steps for market & seating area for watching events
open space for multipurpose events
ground floor shops & community activities
upper floor
open space for multipurpose events
public seating space

view - C

dwg 7 - plan of community building

dwg 8 - view of community building from back (view - C)
hotel residence building

dwg 9 - plan of hotel residence

dwg 10 - view of hotel residence (view - D)
Dwg 11 - entrance view of hotel residence (view - E)

Dwg 12 - inner courtyard view of hotel residence (view - F)
**Dwg 13** - plan connecting courtyard between hotel residences

**Dwg 14** - view of connecting courtyard between hotel residences (view - G)
Fig 15 - Pillar detail with iron as main structure and wood covering (structure holding maximum load, preserving traditional design)
master plan: part 2
permanent residences (type 1, 2 & 3), water collecting system and open space
permanent residences type 1

dwg 18 - residence type 1 (individual houses)

private courtyard for neighborhood

option for renting - providing separate entrance door

dwg 19 - neighbourhood view of residence type 1
permanent residences type 2 & 3

dwg 20 - residence type 2 & 3

dwg 21 - neighbourhood view of residence type 2 & 3 (view - H)
interior: economical design

dwg 26 - interior with built-in furniture with brick

in-built furniture:
can be used as bed or storage area

in-built brick storage rack.
brick window:
allow light and air flow

controllable ventilation
for ventilation

straw carpet:
work as thermal mass to store heat

dwg 27 - interiors adapting energy efficient strategies
This creative project is about studying the changing cityscape of Kathmandu Valley with population growth. Researches were done finding possible solution to tackle complex issues in the Valley. This project took two semesters of research and designing during the studio and it continued with the guidance of my advisors.

The investigation for the project was difficult to be done because of the distance. The project context is more than 7000 miles away therefore it was not possible to visit during the academic year. The project issues were aware to me as I lived my whole life in the same city before coming to Ball State University, USA. The experience with the city helped me during investigating the detail for the project.
The thesis proposal began with researching the cityscape of Kathmandu starting with population growth continuing with issues that carries out of that research. In this project, I proposed a solution that attempts to balance many of the demands on Kathmandu’s urban environment. These demands place a strain on social relationships, the environment, and the economy. It was very difficult to outline the study for conducting the research. This project therefore connected with various specific issues. To fit the project in a time frame, I narrowed my project by selecting few target groups for the project.

The site selected for this project holds potential for addressing complex issues associated with Kathmandu because of some the key characteristics. First, there is a demand of housing for existing amenities and second is one by population growth. The issue with brick kiln dragged my attention as it is affecting the Valley in many distinguished areas of economy – jobs of brick makers and production of brick, environment – producing air pollution and social – temporary living of brick makers. The economic stability has been answered by the construction of a new kiln, and a community building for small scale businesses thus providing jobs. The brick kiln incorporated in the design produce a local source of construction material which mitigate the environmental issues and instability of full year brick production. The mixed-use housing further creates different levels of jobs for skill and unskilled groups. The residences are designed for different income levels. High and low technologies are employed where practical. An approach has been taken to make the project result model example of development.
This project is the approach of a sustainable standard; it is just a beginning for understanding the issues in detail and proposing possible solutions. Further study could be done to understand the detail of these issues. The City demands attention in various sectors to mitigate challenges.

This final product is a blend of an architectural perspective and my own experience gained as a citizen of Kathmandu. I believe this creative project has been able to picture the complex issues and give an understanding of these demanding changes. It is not a final solution, but an approach towards creating a model community for equitable, responsible and viable development.
bibliography


