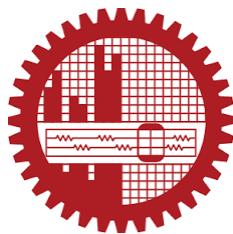


FEASIBILITY STUDY REPORT

Bangladesh University of Engineering and Technology



CE 404: Capstone Project

Project Topic

Reconstruction of Green-Road Staff Quarter

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Group 02, Section B1



Ministry of Housing and Public Works Government of the People's Republic of Bangladesh

Feasibility Study Report on Reconstruction of Green Road Staff Quarter

January 2024

Executive Summary

The project, titled "Reconstruction of Green Road Staff Quarter," situated in Dhanmondi, Dhaka-1205, Bangladesh, is spearheaded by the Public Works Department and sponsored by the Ministry of Housing and Public Works. This initiative aims to enhance the living conditions for approximately 500 families residing within the quarters.

Despite accommodating a significant population, the overall condition of the colony falls short of acceptable standards. Many of the existing buildings are aging, lacking modern amenities, and environmentally friendly features. The absence of high-rise structures among the 27 buildings has resulted in a limited carrying capacity, and the internal road network needs improvement. Furthermore, the absence of dedicated offsite and onsite parking facilities, indiscriminate waste disposal, and the lack of green initiatives contribute to a suboptimal living environment. The drainage system is also in a state of disrepair.

In response to these challenges, the reconstruction project proposes the demolition of the existing 27 small 6-story buildings and the construction of 16 new 13-story(B+G+12) buildings with 4 units per floor with size of 1500 sft. This will provide accommodation for 700 families. Simultaneously, there will be a focus on enhancing drainage systems, waste management, and overall quality of life within the quarters. The project's objectives encompass addressing the accommodation crisis faced by government employees, meeting the rising demand for housing, promoting planned residential areas, expanding the city's capacity, and optimizing land utilization.

The current residents primarily comprise government employees and officers ranging from Grade 8 to Grade 20. Their economic conditions are tied to their respective income grades, all of which are above the poverty line, enabling them to meet their needs. However, unauthorized individuals, including workers and outsiders, currently reside within the quarters, contravening legal regulations. As part of the project, strict measures will be enforced to prohibit the continued residence of these unauthorized occupants, ensuring the project's success in improving the overall quality of the facility.

Project Feasibility Study Report

Section 1: Basic Information

1.	Name of the Project	:	Reconstruction of Green Road Staff Quarter
2.	(a) Sponsoring Ministry/Division (b) Implementing Agency	:	Ministry of Housing and Public Works Public works Department
3.	Project Objectives (Project to be taken based on the study)	:	<ul style="list-style-type: none"> • Reduce accommodation crisis of the government employee • Meet the increasing demand of housing • Promote planned residential area • Expand the capacity of the city • Optimum utilization of Land
4.	Estimated Project Cost (Taka in Crore)	:	510
5.	Sector & Sub-Sector	:	<ul style="list-style-type: none"> • Structural Concept • Geotechnical Concept • Environmental Concept • Transportation Concept
6.	Project Category (Based on Environment Conservation Rules 2023)	:	RED
7.	Project Geographic Location (a) Countrywide (b) Division (c) District (d) Upazila (e) Others (City Corporation/Pourashva)		<p>Bangladesh Dhaka Dhaka Dhanmondi Dhaka South City Corporation</p>
8.	Project Duration	:	2(three) years

Section 2: Introduction

(a) Project Background:

Dhaka city is the capital of Bangladesh with a rapidly growing crisis for housing. The value of land and real property is increasing day by day particularly in the residential areas like Dhanmondi. Appropriate measurement of planning can be helpful to meet this upgrading demand and for better living . There must be a consideration for the economic and environmental condition of area in the residential development and redevelopment which can be measured by built density(Nipun et al., 2016).

Accommodation of Government officials is a crucial problem for densely populated cities like Dhaka. As a result, Government officers are compelled to hire flats or house at a higher rate. In most cases, it becomes difficult for them to afford, so they hire a substandard house. This results in tremendous financial and social problem for the officials. Government officers become frustrated and this in turn reduces the working efficiency of the officers. A proper house is also one of the basic human rights of a person. The quality of house and its environment has huge impact on human psychology. Housing not only refers to the physical structures such as, buildings and neighborhood buildings but also the surrounding setting. Government has initiated many housing projects for the government servants, to meet the increasing demand of housing (Banu, 2022). All the Government employees can stay in these rental housing apartments until they reach retirement. Government employees and officers deserve better house to live. Dhaka city has scarcity of land and it is a crucial problem to accommodate these large numbers of people. Only Government has the ability to allocate lands for the employee and to start as well as maintain this huge budget project. In addition to that, it is also mentioned in the National Constitution of Bangladesh that, every Government servant must receive better housing proper housing and it is the basic need of people (Baten, 2016). Government officers and employees often find it difficult do to afford better apartments with their limited amount of salary. Government housing is essential to provide them with better housing condition as well as this would bring solvency in their lives. On the other hand, housing conditions in Public housing complexes is not satisfactory. In most cases, a design prototype is created and it is clone stamped around the complex, without any consideration of site and context. Visually these projects are densely packed clusters of concrete structures. In most cases, these groups of concrete structures, lack adequate amount of open space, recreational spaces and green. As a result, most apartment flats lack proper ventilation and the residents are deprived from breathing spaces. Monotonously looking apartment buildings also lacks space quality inside the dwelling units. Residential flats do not have provision for adequate light and ventilation(Afroza, n.d.). Our proposed site, Green road staff quarter the current condition of this residential area is indifferent to it. Though it is a huge area, the condition and capacity of the buildings are not satisfactory. There is lack of recreational spot and green zone. Due to small number of flats, every year there is a huge demand for accommodation but a few applications can be granted. So we addressed this problem and proposed this project to reduce the scarcity of accommodation.

(b) Objectives of the feasibility study:

Feasibility studies are preliminary studies undertaken at the very early stage of a project. They tend to be carried out when a project is large or complex. Construction projects require huge investment, in both time and money, and for this reason it is important to establish if the project will be feasible at a very early stage. The purpose of a feasibility study is to-

- Establish if the project is viable.
- Identify numerous feasible options.

- Assist in the development of project execution plans.

(c) Approach and methodology of the feasibility study:

- Demand analysis
- Topographic survey
- Architectural drawing
- Soil report analysis
- Preliminary design
- Preliminary cost estimation
- Environmental Impact Assessment
- Traffic Impact Assessment
- Financial analysis
- Economic analysis

(d) Organization of the feasibility study:

Section 1 : It gives the basic information and overall scenery of the project.

Section 2: Provides Problem background and purpose of the feasibility study.

Section 3: Demand analysis is covered in this section

Section 4: Technical and engineering analysis are shown in this section

Section 5: Environmental Sustainability, Climate Resilience and Disaster Risk Analysis are described in this area

Section 6: Cost-benefit analysis is shown in this section

Section 7,8,9: The following three describe Human Resources and Administrative Support Analysis, Institutional and Legal Analysis, Risk (Uncertainty) and Sensitivity Analysis.

Section 10: Describes the alternates. A comparison has been provided.

Section 11: Recommendation and conclusion are provided

Section 12: The study ends with annexes.

Section 3: Market/Demand Analysis

This section assesses the need for public investments and involves the elements listed below:

- (a) **Problem Statement:** Green-road staff quarter is a government colony bounded within a separate zone which is the living space for almost 500 families. Despite being the habitat to a significant number of people, the overall condition of the colony is not up to the mark. Most of the building of the facility is old and not equipped with any modern or environment friendly facilities. There are almost 27 buildings none of which are high rise building as a result the carrying capacity of the buildings is very low. The buildings of the facility are extremely unorganized and scattered. The internal road network requires improvement. There are no dedicated offsite and onsite parking facilities. From

our initial survey we observed that waste was dumped randomly here and there making the environment of the facility very threatening. There are no green initiatives around the facility. The drainage system is also totally broken.

- (b) **Relevance of the Project Idea:** The proposed project to redevelop the Green-road staff quarter in Bangladesh is highly relevant and aligns with various global and national development plans, policies, and sector-specific objectives. Here's a justification for the project's relevance in the context of Bangladesh:

Sustainable Development Goals (SDGs):

The project aligns with multiple SDGs, including Goal 11 (Sustainable Cities and Communities) by improving living conditions and urban infrastructure, Goal 6 (Clean Water and Sanitation) through the planned water supply system, and Goal 13 (Climate Action) by incorporating environmentally friendly facilities.

Bangladesh Delta Plan 2100:

The project's consideration of climate-resilient infrastructure aligns with the Bangladesh Delta Plan 2100, which aims to address climate change impacts and ensure sustainable development in the delta region.

Seventh Five-Year Plan (7FYP) and Eighth Five-Year Plan (8FYP):

The project aligns with the national development priorities outlined in the 7FYP and 8FYP, focusing on infrastructure development, urban planning, and improved living standards for citizens.

National Housing Policy 2016:

The project is in line with the National Housing Policy of Bangladesh, contributing to the goals of providing affordable, safe, and sustainable housing for all citizens.

Vision 2021 and Vision 2041:

The project aligns with Bangladesh's Vision 2021, working towards becoming a middle-income country, and Vision 2041, which envisions comprehensive development. The redevelopment project contributes to the realization of these visions by addressing critical housing and infrastructure needs.

Bangladesh Delta Plan:

Given the geographic location of Bangladesh and its vulnerability to climate change, the project's focus on climate-resilient infrastructure supports the objectives outlined in the Bangladesh Delta Plan.

Bangladesh Climate Change Strategy and Action Plan (BCCSAP):

The project aligns with BCCSAP by incorporating climate-resilient measures and sustainable practices, contributing to the country's efforts to adapt to and mitigate the impacts of climate change.

National Urban Development Strategy (NUDS):

The project aligns with the NUDS by addressing urban development challenges, including the improvement of internal road networks, housing facilities, and overall livability in urban areas.

Bangladesh Environment Conservation Act:

The project, with its emphasis on environmentally friendly facilities and waste management, complies with the Bangladesh Environment Conservation Act, contributing to environmental sustainability.

Poverty Reduction Strategies:

The redevelopment project contributes to poverty reduction by providing improved living conditions, creating job opportunities during construction, and fostering economic development in the community.

Disaster Management Strategies:

Bangladesh is prone to natural disasters. The project aligns with national disaster management strategies by incorporating resilient infrastructure to reduce vulnerability to disasters.

National Strategy for Water Supply and Sanitation (NSWSS):

The planned water supply system aligns with the NSWSS, contributing to the national objective of ensuring access to safe water for all.

- (c) **Proposed Project Interventions:** We have decided to take upon this project to improve the overall quality of the facility. We will improve all the aspects of structural, transportation, environmental and geotechnical perspective. We will recreate such a master plan of the colony where we will demolish the old buildings and replace them with fewer number of high-rise buildings with higher capacity than before, we will develop a road facility suitable for a residential area, we will ensure a water supply system according to the demand and assess the overall impact created due to this project.
- (d) **Stakeholders:** When considering stakeholder considerations for colony reconstruction, it's important to take into account the various individuals and groups who have a vested interest or are affected by the reconstruction process. Here are some key stakeholders to consider:

Government Authorities: The government will be in charge of financing the project as the overall owner. Depending on the location, various government authorities at the local, regional, or national levels may have jurisdiction over the colony reconstruction. Ensure compliance with building codes, zoning regulations, and any other legal requirements. Coordinate and communicate with the relevant authorities to obtain necessary permits and approvals.

Residents: The primary stakeholders are the residents of the colony who will be directly impacted by the reconstruction. Their needs, preferences, and safety should be prioritized throughout the process. Engage with them through surveys, meetings, and feedback sessions to understand their requirements and incorporate their input into the reconstruction plans.

Local Community: The broader local community surrounding the colony should also be considered. They may be affected by increased construction activities, changes in traffic patterns, or the influx of new residents.

Construction Contractors and Workers: Engage with the contractors and workers responsible for the reconstruction. Ensure that they adhere to safety standards, provide proper training, and create a conducive working environment. Fair labor practices, timely payments, and adherence to environmental regulations should be prioritized.

Environmental Organizations: Consider the potential impact of the reconstruction on the environment. Engage with environmental organizations to develop sustainable and environmentally friendly strategies. This may include minimizing waste, using renewable energy sources, or implementing green building practices.

Utility Providers: Collaborate with utility providers such as electricity, water, and telecommunications companies to ensure uninterrupted services during the reconstruction process. Plan for any necessary infrastructure upgrades or modifications to accommodate the colony's needs.

Investors and Funding Sources: If the colony reconstruction requires significant financial resources, consider the expectations and requirements of investors or funding sources. Communicate project progress, financial plans, and potential returns on investment to maintain their support and confidence in the project.

Architects, Engineers, and Design Professionals: Engage with professionals responsible for the design and engineering aspects of the reconstruction. Collaborate closely with them to ensure that the plans align with the needs and vision of the stakeholders, while also meeting safety and functionality requirements.

(e) Demand Analysis:

Current population: 500 families

$$= 1340 \text{ people}$$

Future Population:

To determine the future value of the population, we will use a simplified approach using the formula:

$$P' = P(1+r/100)^n$$

Here,

P' = Future Population

P = Present Population

r = Growth rate (1.03%)

n = Design Year = 20 Years

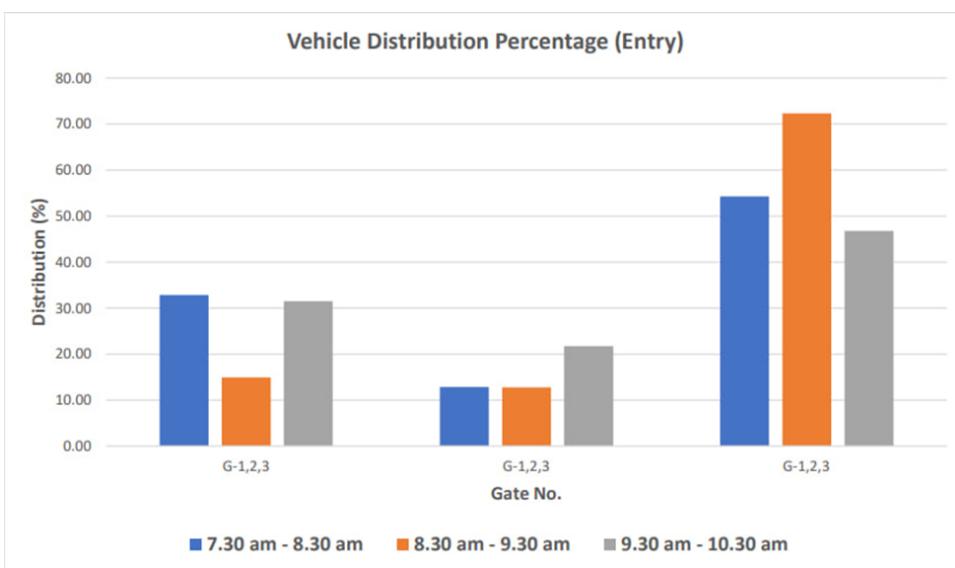
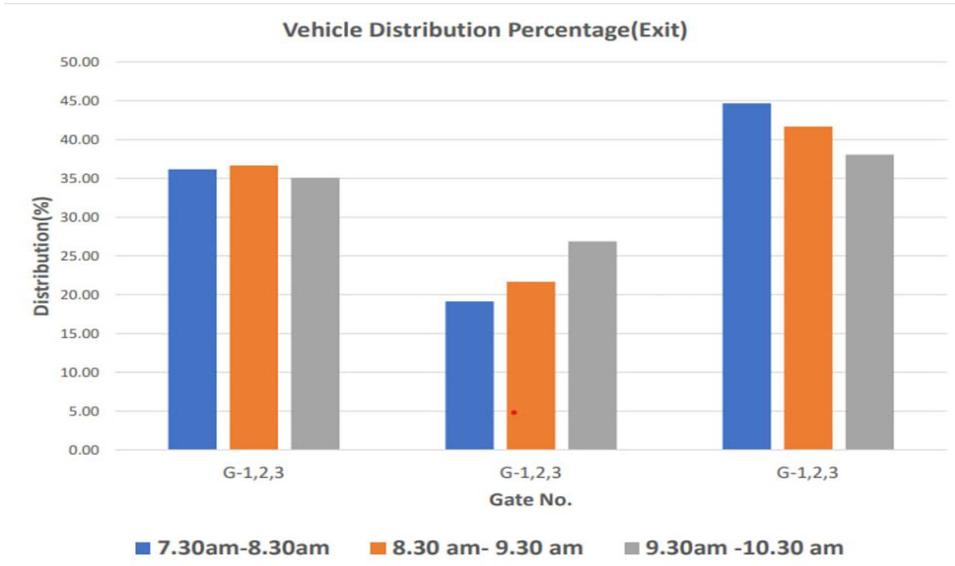
$$P' = 1340 (1+1.03/100)^{20}$$

$$= 1650 \text{ (Approx.)}$$

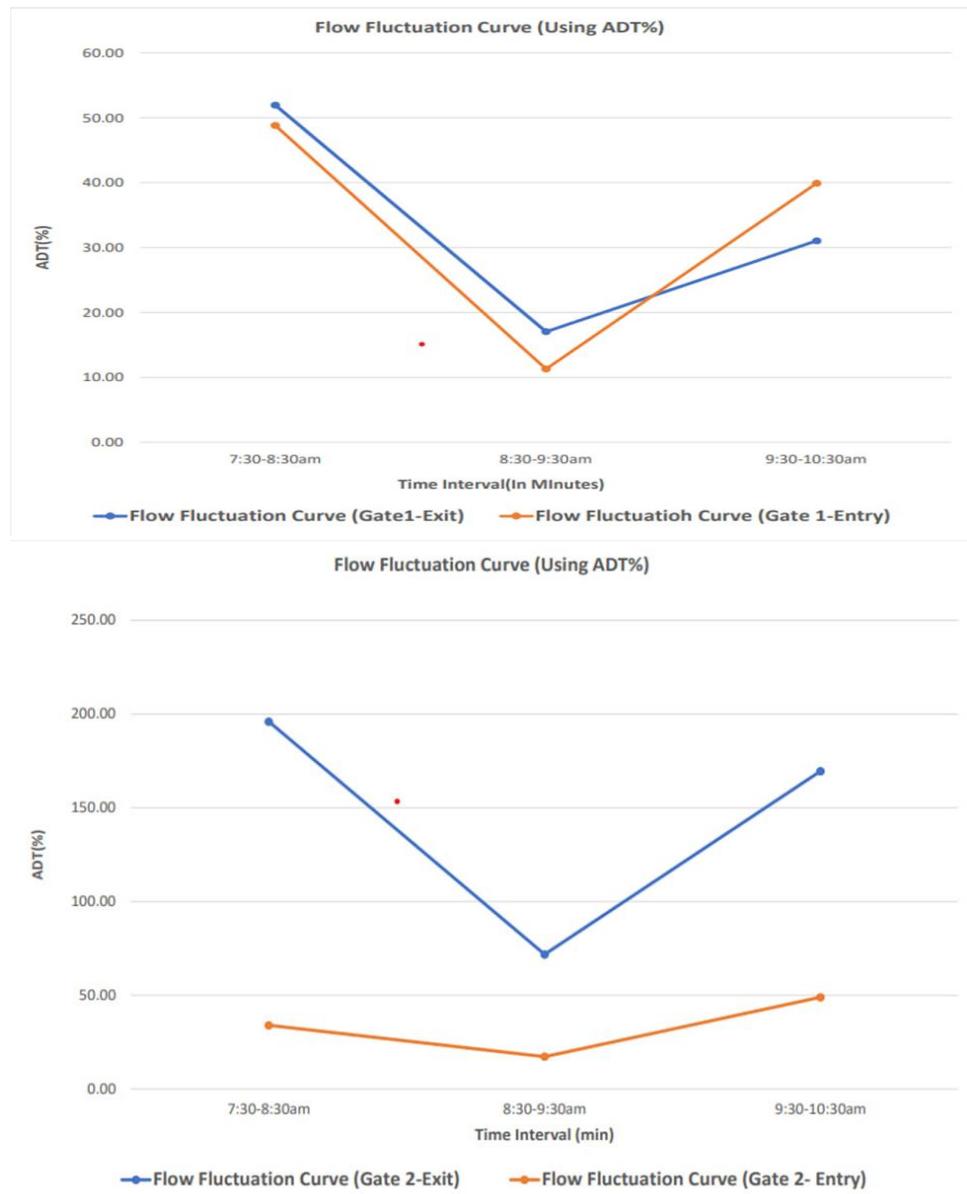
So, Future Population = 1650

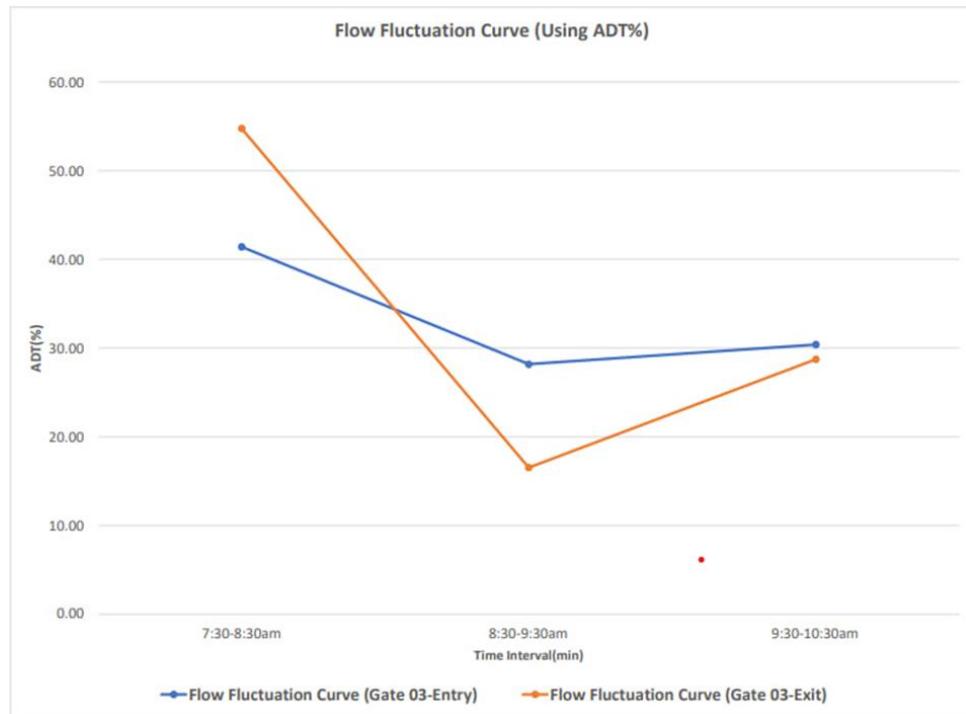
Current traffic data analysis:

Vehicle distribution:



Flow Fluctuation Curves:





Current Water Demand:

There currently exists 3 pumps of 40 Hp for fulfill the water demand.

Future Water Demand:

Total water demand = 9092903.302 lpd

Working horsepower for one pump = 70 Hp (Approx)

Constraints:

As this is a government project aimed at the redevelopment of the Green-road staff quarter, there are specific constraints and challenges that you may encounter:

- Budgetary Constraints.
- Bureaucratic Processes.
- Public Procurement and Tendering.
- Political Considerations.
- Community Engagement and Consultation.
- Legal and Regulatory Compliance.
- Interagency Coordination.
- Project Phasing and Implementation
- Environmental Impact Assessment (EIA).
- Labor and Skilled Workforce.
- Infrastructure Integration.
- Risk Management
- Transparency and Accountability

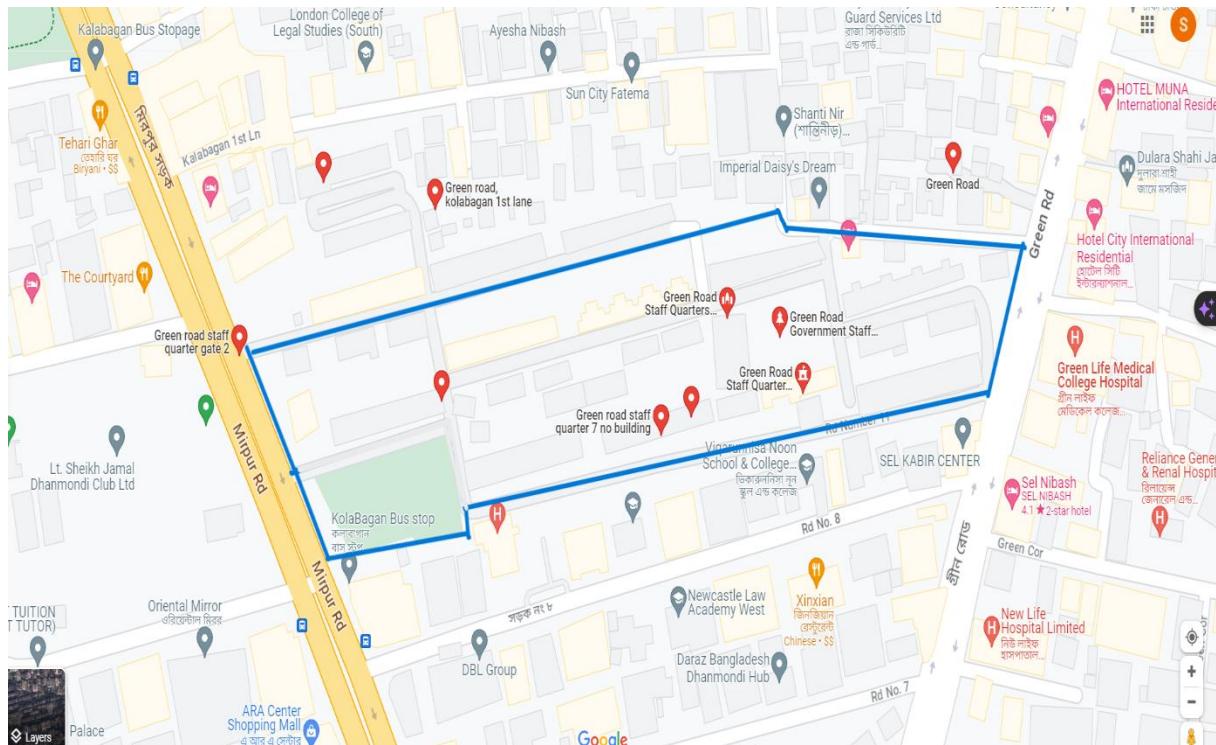
(f) **SWOT Analysis:** A SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) is a strategic planning tool that helps identify and evaluate the internal and external factors affecting a project. Here's a SWOT analysis for the government project "Reconstruction of Green Road Stuff Quarter"

Strength	Weakness
<ul style="list-style-type: none"> • Being a government project provides financial and regulatory support. • Reconstruction contributes to urban development and modernization. • Addressing drainage, waste management, and quality of life. • Creates a holistic and sustainable living environment. • Replacing 6-story buildings with 13-story structures • Maximizes land usage, potentially increasing housing capacity. 	<ul style="list-style-type: none"> • Displacement of residents during construction may lead to community dissatisfaction and protests. • Simultaneous demolition and reconstruction of multiple buildings. • Increases the risk of delays and coordination challenges. • Potential strain on existing infrastructure during construction. • Disruptions in utilities and services for both residents and construction workers.
Opportunities	Threats
<ul style="list-style-type: none"> • Engage with the community for feedback and cooperation which builds public support and reduces resistance to the project. • Integrate eco-friendly designs and materials. • Project stimulates local economy through job creation. 	<ul style="list-style-type: none"> • Potential cost overruns or budget constraints. • Delays and increased costs due to legal battles. • Strong opposition from residents and stakeholders if they don't get good relocation services. • Construction activities are negatively impacting the environment. • Potential legal and public relations challenges.

Section 4: Technical/Technological & Engineering analysis

A summary of the proposed project is presented with the following headings:

- (a) **Location:** The project area is located at Green Rd, Dhaka 1205, Bangladesh
(23°44'46.5"N 90°23'00.4"E)



- (b) **Technical design:**

Seismic Zone: 2

Exposer Category: A

Building Type: High Rise Building

Occupancy Category: A: Residential

Fire Index: 2

Brief Summary of the Master Plan:

• Number of Buildings	16
• Number of Entrance and Exit to the property	3
• Number of Sports-Fields	3
• Number of Mosque	1
• Number of Community Center	1

• Offsite Parking locations	<u>2</u>
• Pumping stations	<u>3</u>
• Flowering Garden	<u>1</u>

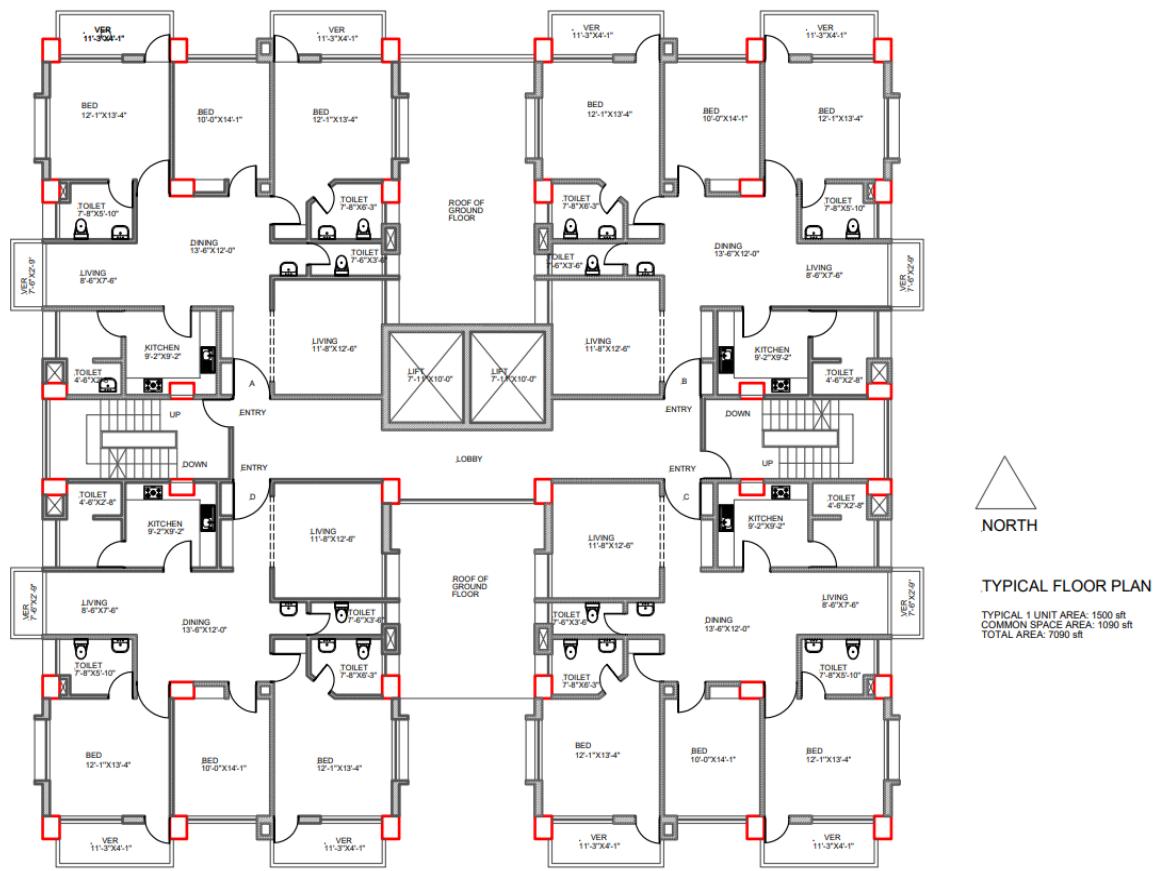
Primary Design Data for buildings:

• Floor specification	<u>B+G+12</u>
• Unit per floor	<u>4</u>
• Size of each unit	<u>1500 sft</u>
• Ground area for each building	<u>7090 sft</u>
• No. of families to be accommodated	<u>700 (Previous number:500)</u>

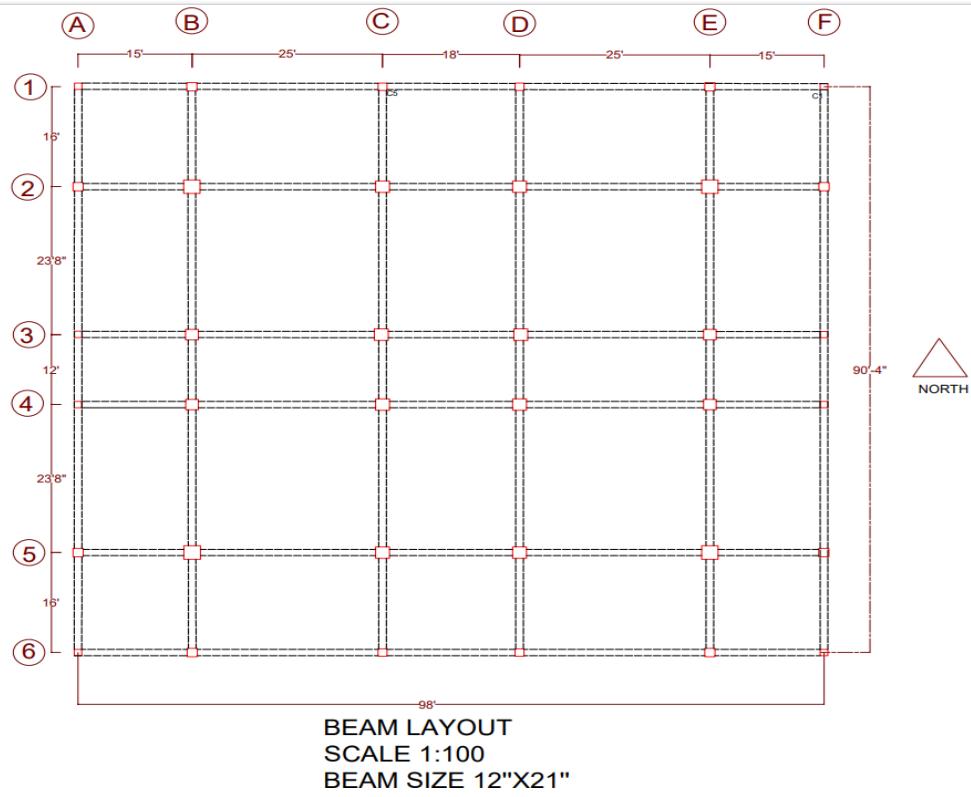
Masterplan Design:



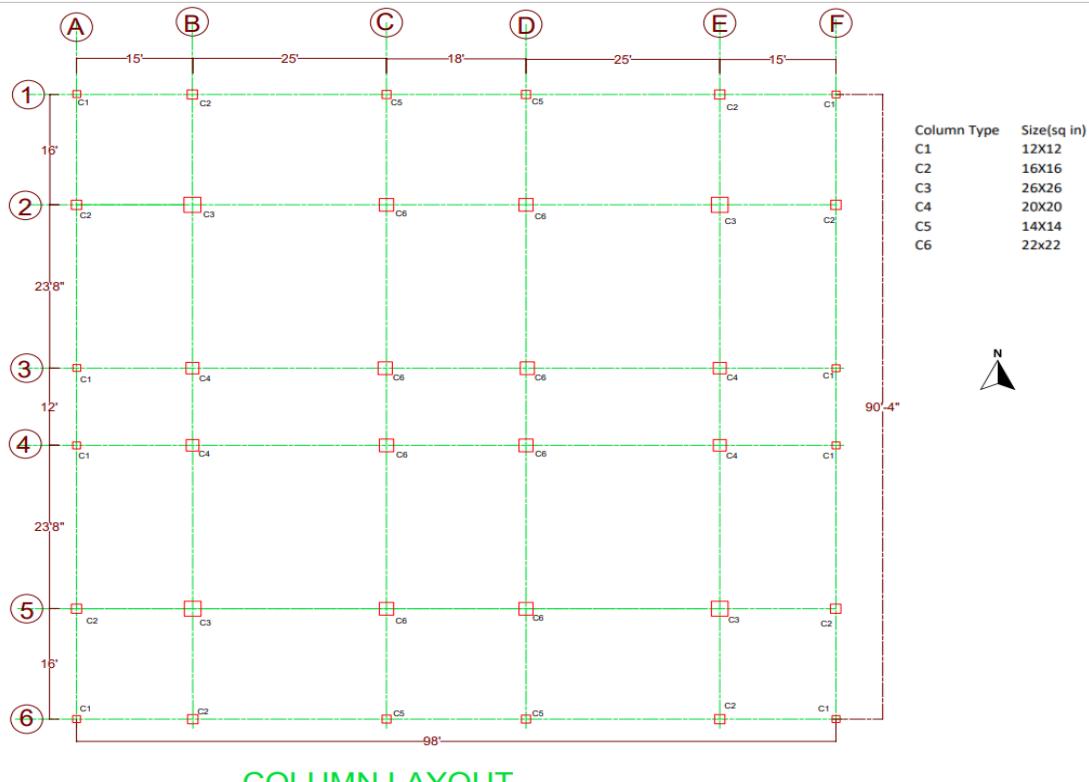
Floor Design:



Beam Layout:

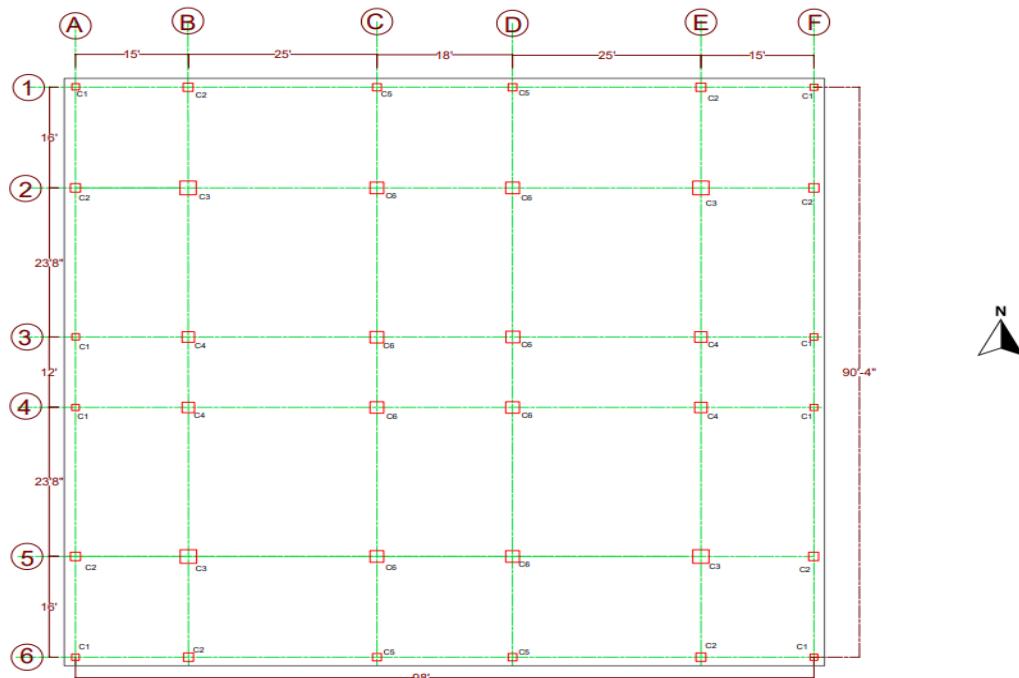


Column Layout:



COLUMN LAYOUT
SCALE 1:100

Foundation Layout:



FOUNDATION LAYOUT
SCALE 1:100
FOOTING SIZE 100'X92'
DEPTH 3.5'

(c) **Output plan:** The reconstruction project in Green Road staff quarter, Dhaka, involving the demolition of 27 small 6-story buildings and the construction of 16 new 13-story buildings, along with improvements in drainage, waste management, and quality of life, is expected to yield several positive outcomes. Here are some potential outcomes that the project aims to achieve:

- **Modernized Infrastructure:** The construction of new 13-story buildings will result in modern and aesthetically pleasing infrastructure, contributing to the urban development of the Green Road staff quarter.
- **Increased Housing Capacity:** The replacement of smaller buildings with taller structures is expected to increase housing capacity, potentially accommodating a larger population within the same area.
- **Improved Quality of Life:** The comprehensive project aims to enhance the overall quality of life for residents by implementing improvements in infrastructure, utilities, and community amenities.
- **Enhanced Drainage Conditions:** The drainage improvements will mitigate waterlogging and flooding issues, creating a more resilient and comfortable living environment for residents.
- **Efficient Waste Management:** Upgrades to waste management systems will lead to more efficient and sustainable waste disposal practices, contributing to a cleaner and healthier community.
- **Sustainable Urban Development:** The project's focus on modern design, sustainable practices, and green spaces contributes to a more environmentally friendly and sustainable urban development.
- **Community Engagement and Satisfaction:** Proactive community engagement, feedback collection, and addressing residents' concerns can lead to higher satisfaction levels and community support for the project.
- **Job Creation and Economic Stimulus:** The construction phase of the project is likely to generate employment opportunities, stimulating the local economy and supporting businesses in the area.
- **Positive Impact on Property Values:** The reconstruction of buildings and overall improvements can potentially have a positive impact on property values in the surrounding area.
- **Government's Commitment to Urban Development:** The successful completion of the project showcases the government's commitment to urban development, infrastructure enhancement, and improving living conditions for its citizens.
- **Enhanced Public Services:** Upgrades to utilities and services to accommodate the increased demand from the new buildings contribute to improved public services for the community.
- **Long-Term Environmental Benefits:** Integration of sustainable practices and green building features contribute to long-term environmental benefits, including energy efficiency and reduced environmental impact.

(d) **Costs estimates:**

Construction cost of one building:

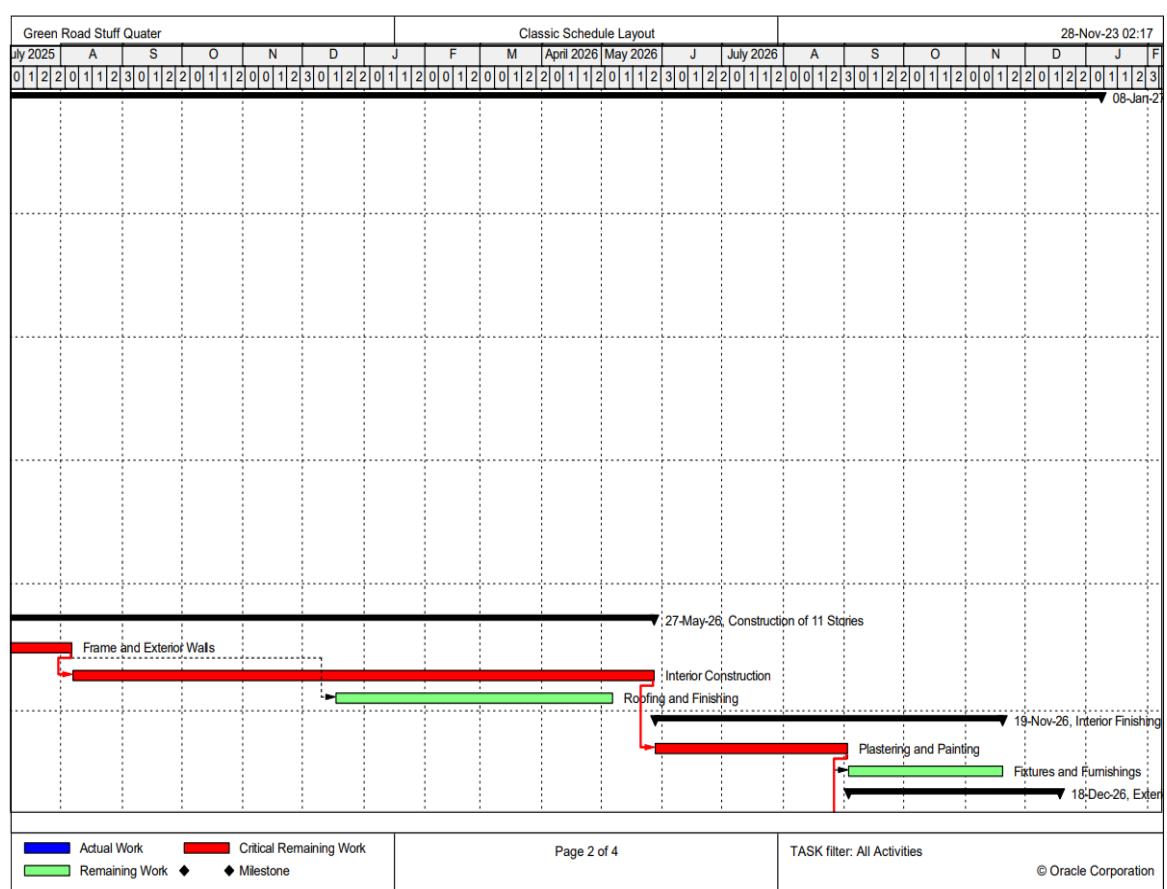
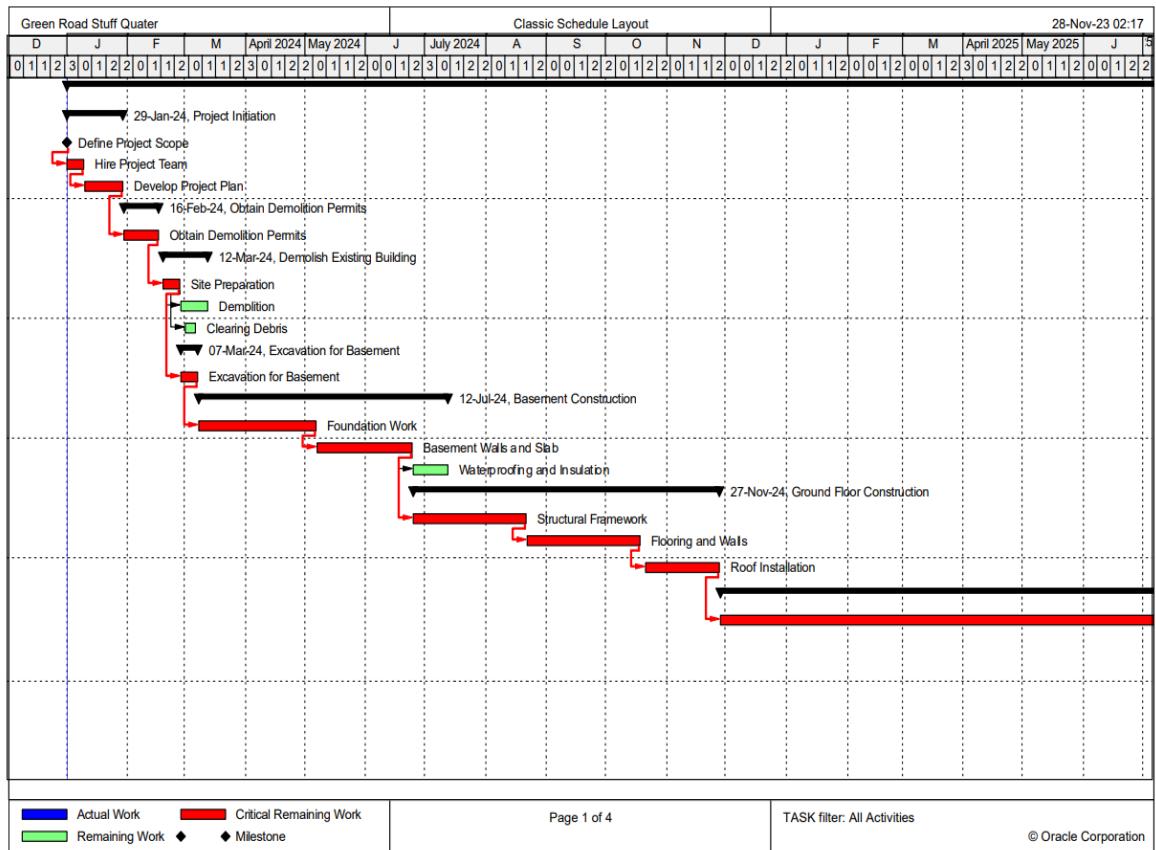
Type	Cost (Tk)
Soil investigation	232,926.00
Foundation	72,242,327.05
Super Structure cost	303,241,093.80
Additional Super Structure Cost	12,584,801.80
Other Building Cost	43,281,880.60
Quality and Testing Cost	4,315,830.29
Contingency or Actual need	21,579,151.46
Grand Total	458,688,011.00

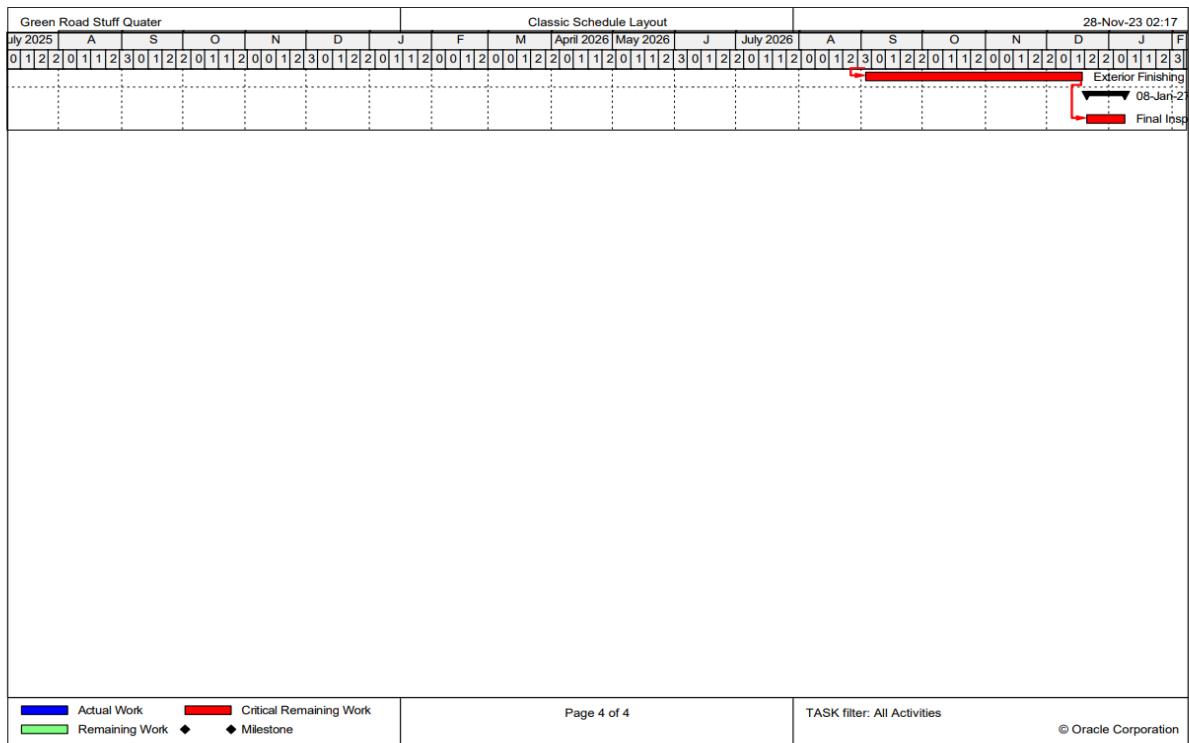
(e) Implementation timeline:

List of Activities:

Green Road Staff Quater			Classic Schedule Layout				
Activity ID	Activity Name	Original Duration	Start	Finish	Calendar	Activity Type	Predecessors
	Green Road Staff Quater	776	01-Jan-24	21-Dec-26	Standard 5 Day Workweek		
	Project Initiation	21	01-Jan-24	29-Jan-24	Standard 5 Day Workweek		
A10	Define Project Scope	0	01-Jan-24		Standard 5 Day Workweek	Start Milestone	
A20	Hire Project Team	7	01-Jan-24	09-Jan-24	Standard 5 Day Workweek	Task Dependent	A10
A30	Develop Project Plan	14	10-Jan-24	29-Jan-24	Standard 5 Day Workweek	Task Dependent	A20
	Obtain Demolition Permits	14	30-Jan-24	16-Feb-24	Standard 5 Day Workweek		
B10	Obtain Demolition Permits	14	30-Jan-24	16-Feb-24	Standard 5 Day Workweek	Task Dependent	A30
	Demolish Existing Building	17	19-Feb-24	12-Mar-24	Standard 5 Day Workweek		
C10	Site Preparation	7	19-Feb-24	27-Feb-24	Standard 5 Day Workweek	Task Dependent	B10
C20	Demolition	10	28-Feb-24	12-Mar-24	Standard 5 Day Workweek	Task Dependent	C10
C30	Clearing Debris	4	01-Mar-24	06-Mar-24	Standard 5 Day Workweek	Task Dependent	C10
	Excavation for Basement	7	28-Feb-24	07-Mar-24	Standard 5 Day Workweek		
D10	Excavation for Basement	7	28-Feb-24	07-Mar-24	Standard 5 Day Workweek	Task Dependent	C10
	Basement Construction	91	08-Mar-24	12-Jul-24	Standard 5 Day Workweek		
E10	Foundation Work	42	08-Mar-24	06-May-24	Standard 5 Day Workweek	Task Dependent	D10
E20	Basement Walls and Slab	35	07-May-24	24-Jun-24	Standard 5 Day Workweek	Task Dependent	E10
E40	Waterproofing and Insulation	14	25-Jun-24	12-Jul-24	Standard 5 Day Workweek	Task Dependent	E20
	Ground Floor Construction	112	25-Jun-24	27-Nov-24	Standard 5 Day Workweek		
F10	Structural Framework	42	25-Jun-24	21-Aug-24	Standard 5 Day Workweek	Task Dependent	E20
F20	Flooring and Walls	42	22-Aug-24	18-Oct-24	Standard 5 Day Workweek	Task Dependent	F10
F30	Roof Installation	28	21-Oct-24	27-Nov-24	Standard 5 Day Workweek	Task Dependent	F20
	Construction of 11 Stories	390	28-Nov-24	27-May-26	Standard 5 Day Workweek		
G10	Frame and Exterior Walls	180	28-Nov-24	06-Aug-25	Standard 5 Day Workweek	Task Dependent	F30
G20	Interior Construction	210	07-Aug-25	27-May-26	Standard 5 Day Workweek	Task Dependent	G10
G30	Roofing and Finishing	100	18-Dec-25*	06-May-26	Standard 5 Day Workweek	Task Dependent	G10
	Interior Finishing	126	28-May-26	19-Nov-26	Standard 5 Day Workweek		
H10	Plastering and Painting	70	28-May-26	02-Sep-26	Standard 5 Day Workweek	Task Dependent	G20
H20	Fixtures and Furnishings	56	03-Sep-26	19-Nov-26	Standard 5 Day Workweek	Task Dependent	H10
	Exterior Finishing and Landscaping	77	03-Sep-26	18-Dec-26	Standard 5 Day Workweek		
I10	Exterior Finishing and Landscaping	77	03-Sep-26	18-Dec-26	Standard 5 Day Workweek	Task Dependent	H10
	Final Inspections and Approvals	0	21-Dec-26	21-Dec-26	Standard 5 Day Workweek		
I20	Final Inspections and Approvals	0		21-Dec-26	Standard 5 Day Workweek	Finish Milestone	I10

Gantt Chart:





Section 5: Environmental Sustainability, Climate Resilience and Disaster Risk Analysis

5.1 Environmental, Climate Change and Disaster Risk Analysis

5.1.1 Introduction

Green Road Staff Quarter refers to a staff housing complex located on or around Green Road in Dhanmondi. This quarter is commonly used by government to provide housing for their employees. Green Road is one of the prominent roads in Dhaka, and it passes through several neighborhoods, including Dhanmondi. Dhanmondi is a residential area located in Dhaka, the capital city of Bangladesh. It's known for being one of the older and more well-established neighborhoods in the city.

The quarter is a restricted place where people of different grades (8-20) in the govt. sector live. The total area of the quarter is 12.23 acres and between Mirpur Road and Green Road. There are currently about 27 buildings of 5 stories, and about 537 families live here. There is a mosque and a community center as well. The buildings of the quarter are very old, and the condition of the buildings is not good at all. The modern facilities are completely absent here and need reconstruction.

5.1.2 Baseline Environment: Physicochemical

5.1.2.1 Physical environment surrounding project site including land use:

The physical environment of the project site is same as Dhaka city. The weather is hot in summer season and have not much rainfall during rainy season. But still sometimes, there can be seen water logging in monsoon. The dust is enough because of the busy roads that surround the project site. The soil is good enough on the site and a good growth of plants can be seen here. Noise level is high at the borders of the site, but less in the middle region.

5.1.2.2 Climate:

Precipitation: Rainfall, mostly caused by thunderstorms, at this time can account for 10-25% of the annual total.

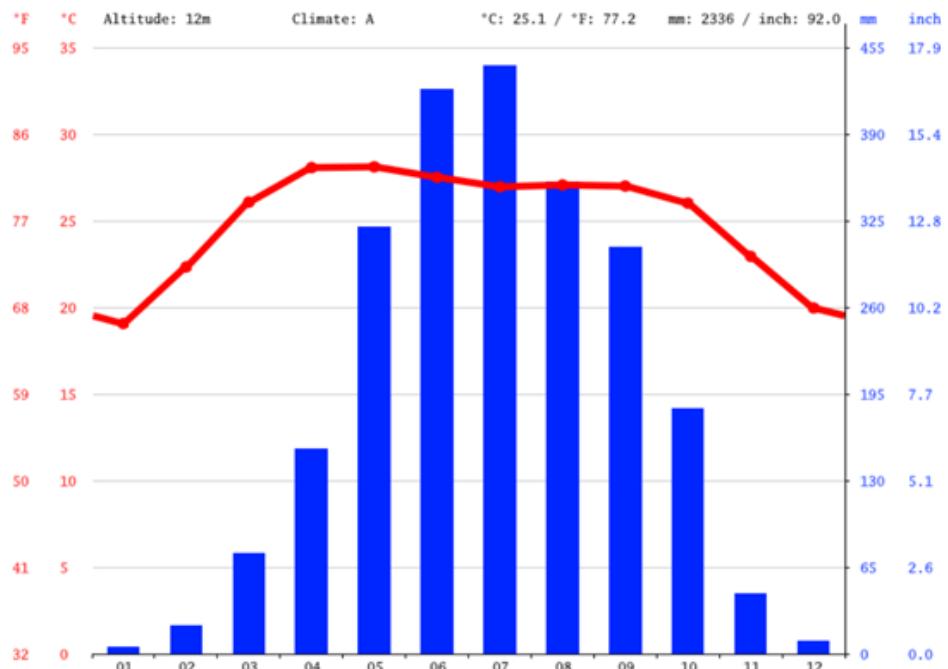


Figure 5.1: Monthly rainfall and temperature distribution at Dhaka

Relative humidity: Relative humidity in the project site is similar to the relative humidity of Dhaka city. The humidity ranges from 43-88%. The highest relative humidity is 88% seen in July and the lowest is 43% that can be seen in February.

Ambient air temperature: The climate of Bangladesh is heavily influenced by the monsoon. The monsoonal influence results in three distinct seasons: Pre-monsoon hot season (from March to May); Rainy monsoon season (from June to October); and Cool dry winter season (from November to February). The pre-monsoon hot season is characterized by high temperatures and thunderstorms. April is the hottest month in the country with mean temperatures ranging from 27°C in the east and south, to 31°C in the western and central parts of the country. After April, increasing cloud-cover reduces the temperature.

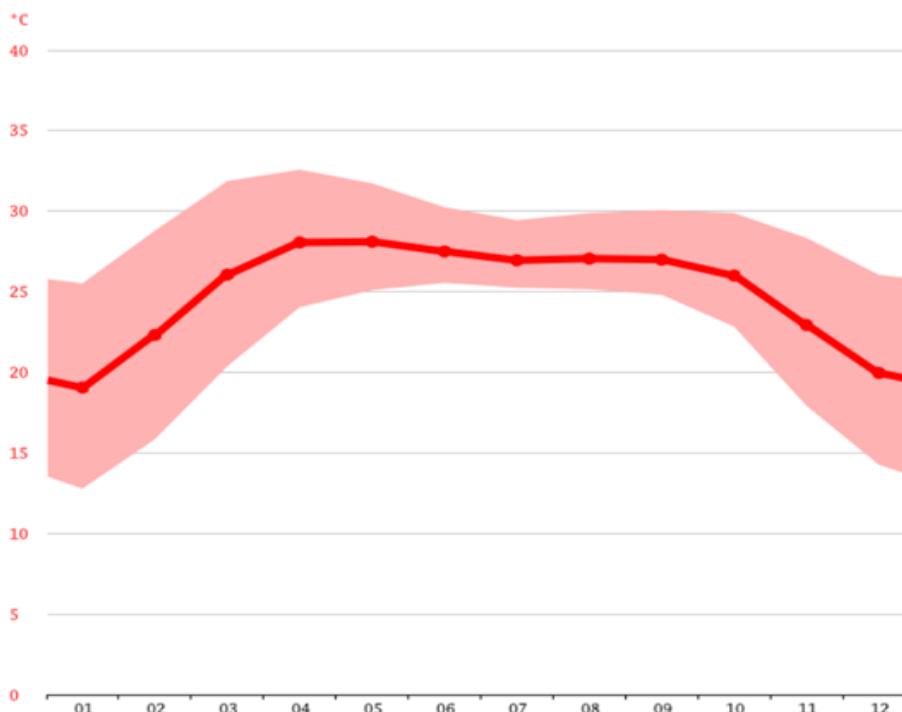


Figure 5.2: Monthly temperature variation at Dhaka

Wind speed and direction: Wind direction is variable during this season, especially during the early part. In order to depict climatic condition of the project area, the data of temperature, rainfall, humidity and wind speed recorded at Dhaka Weather Station from 1991 to 2012 have been collected from Bangladesh Meteorological Department.

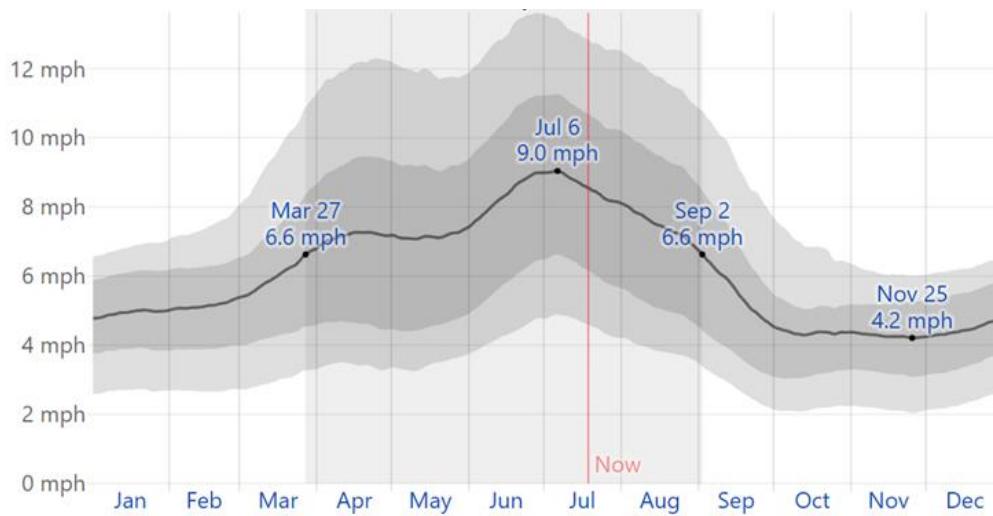


Figure 5.3: Monthly variation of wind speed at Dhaka

5.1.2.3 Topography and Geology:

Soil Characteristics: The elevation of the existing land where the quarter has been proposed to be reconstructed is around 15.85 m (source: Google Earth). The western part of the project area is comparatively less elevated (lowest elevation is around 12.19 m). The top of road level RL is 30m. In Bangladesh, 21 different general soil types have been categorized based on the diagnostic horizons and diagnostic properties of the soil. According to ASTM, the soil type of the project area is defined as soft soil and noted as ASTM D-2487 and D-2488.

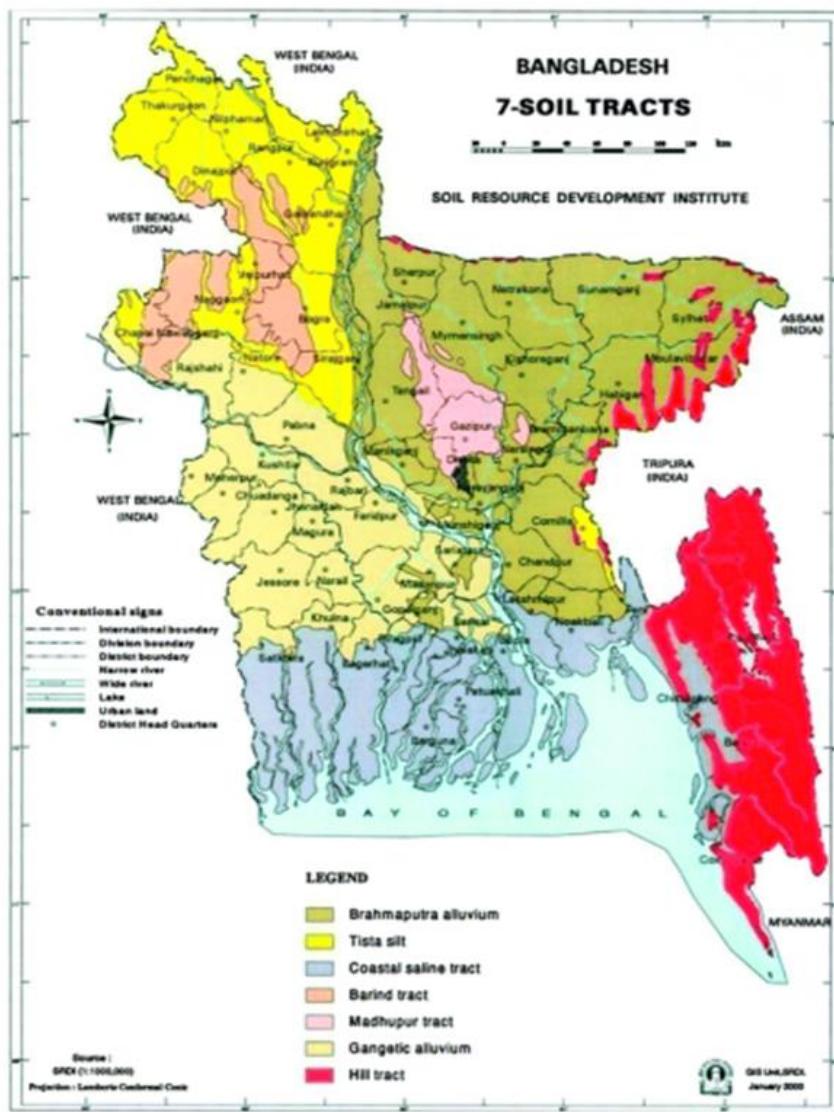


Figure 5.4: Location of Dhaka on the soil tract map of Bangladesh

Seismicity: Bangladesh has been divided into three Seismic Zones, as described by the ranges of the seismic coefficient. Zone I is the most severe area for earthquake intensity and frequency and Zone III is the least severe (GSB, 1979). The project area falls within Zone II and is the second most seismically active region in the country.

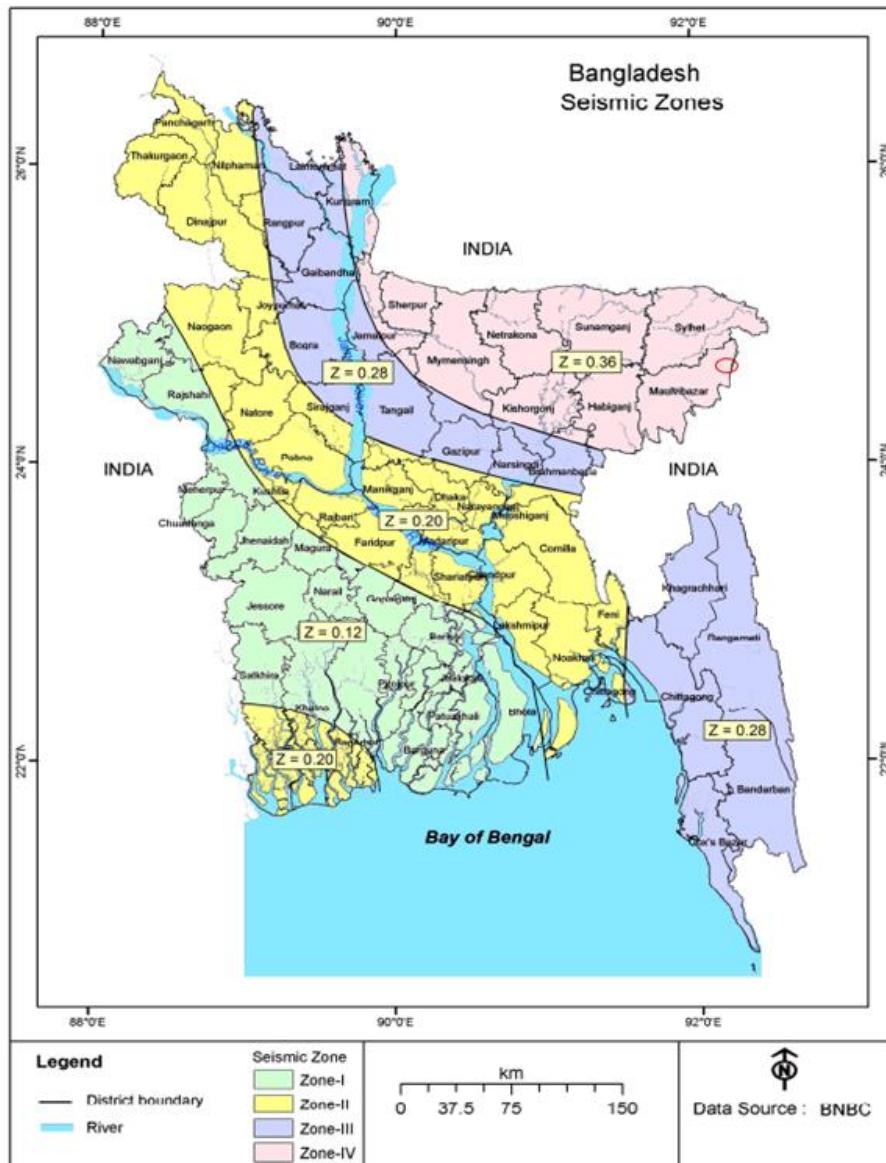


Figure 5.5: Location of Dhaka on the seismic map of Bangladesh (BNBC 2020)

5.1.2.4 Hydrology and Groundwater resources: The surroundings of the project area are being mostly occupied by commercial, residential, and cultural structures. In the project influence area, tap water supplied by Dhaka WASA is being used for drinking and other household purposes. The ground water from a deep tube well source has been collected for laboratory analysis at BUET. According to the test result of the ground water it has been seen that the ground water is free from Arsenic and coliform, but the water contains a huge amount of iron. The rest of the ground water parameters satisfy the drinking water quality standard.

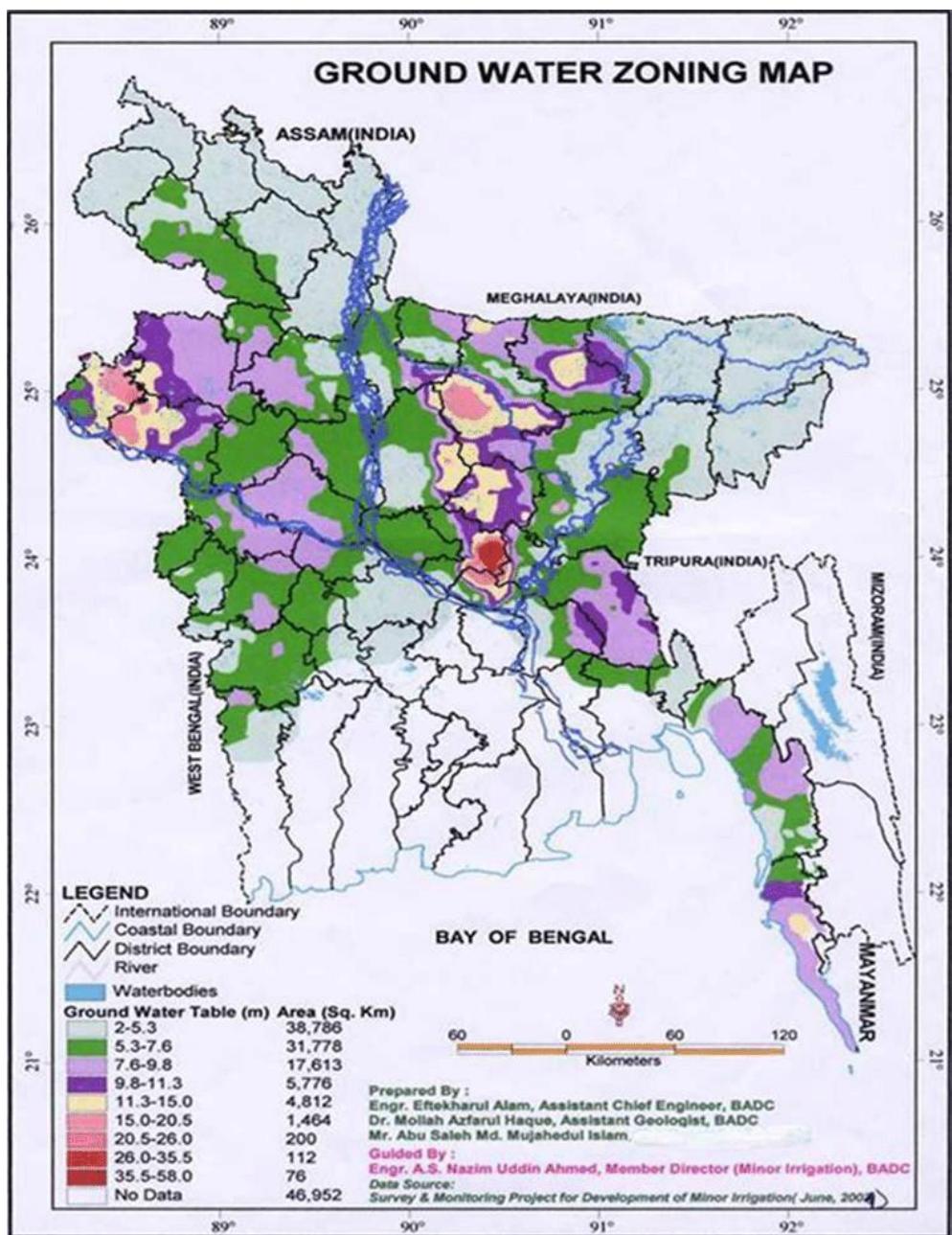


Figure 5.6: Location of project site on the Groundwater Zoning Map 2010 of Bangladesh (Source: Bangladesh Agricultural Development Corporation)

5.1.2.5 Soil and Sediment: Dhaka soil mainly consist of upper and lower Madhupur Terrace with surrounding Holocene floodplains. The terrace consist of the Pleistocene clayey soils and the floodplains are composed of alluvia sandy and clayey soils.

5.1.2.6 Water Quality: The water body that can be seen near the project site is Dhanmondi lake. Current study about Dhanmondi lake shows that due to presence of pollutants in the lake water some basic but quality measure parameters are not unable to meet the standard suggested by the Environment Conservation Rules by Bangladesh. Such as the biological oxygen demand is far higher than the standard value 6 or less mg/L and due to the presence of non-biodegradable materials in the lake, the chemical oxygen demand is also high. It is also found that the value of pH, alkalinity, TDS, TSS and hardness are high for the application and the drinking purpose of such type water will involve so many industrial steps such as filtration, ion

exchanging, pre-activated carbon filtration, reverse osmosis, mineral dosing , ultra violet ray screening etc.

5.1.2.7 Ambient Air Quality: Based on the physical observation during field visit it can be said the ambient air quality in the project area is comparatively good except some anthropogenic sources of dust flow and pollutants from the vehicles. As the area is beside a major highway like Mirpur road, a major amount of dust comes inside the quarter.

5.1.2.8 Noise Level: For the reason of staying by the side of the busiest road Mirpur Road, there is also problem of noise of vehicles all time. Again, there is another busy road like Green road which also contributes noises for the area.

5.1.3 Baseline environment: Ecological environment

5.1.3.1 Methodology:

Study area:

The study area includes Dhanmondi lake, Ramna Park, Buriganga River and the areas around these. The proposed project area currently has a huge number of greeneries which is the habitat of various types of birds and small animals. But the trees and gardens are not well organized and not clean at all. These make a habitat of mosquitos, flies and various types of bacteria also. These are harmful for both animals and human. So the newly constructed project will provide organized garden areas and greeneries for the area.



Figure 5.7: Study area for Ecological environment

Birds survey: There are a huge number of crows, sparrows, pigeons and parrots in the project area. In the winter season, the number of birds increases because of the large greeneries inside the project area. A survey was done in the site and found about 500 crows, 300 sparrows, 100 pigeons and 30 parrots in 3000 square meters.

Herpetofauna survey: In the study area, there is a large number of amphibians and reptiles. They are in both dry and wet areas of the study area. Dhanmondi lake and Buri Ganga River is the native area of huge herpetofauna.

Flora survey: There is a huge number of floral types in the project site. In the survey data, there found about 300 trees and large number of shrubs here and there.

Fish: In Dhanmondi lake, a number of freshwater fish is available and people are seeming to catch fish from there. Buriganga river was also a native place for huge number of fish once. But due to pollution, the number is decreasing to a great extent.

Mammals and Butterflies: Though there is not a good number of mammals in study area, a various number of species of butterflies can be seen in Dhanmondi lake, Ramna Park and also in the quarter inside.

5.1.3.2 Ecological perspective of the proposed project site: The ecological perspective of the project involves considering the environmental impact and sustainability of the project and long-term functionality of the buildings. Some key considerations are:

Biodiversity and Habitat Preservation: During the construction of the project, it is necessary to be careful about biodiversity and habitat preservation. Such type of activities should be avoided which can be a threat of the destruction of biodiversity. Also it is necessary to pay attention about the habitat preservation during the planning of construction project.



Figure 5.8: Wetland reduction in Dhaka

Waste Reduction and recycling: It is necessary to minimize waste during the demolition and construction phases through recycling and responsible disposal. It should be prioritize building materials with recycled content to reduce the demand of new resources.

Water Conservation: Implementation water-efficient technologies and landscaping practices to minimize water consumption is a major fact during construction work.

Climate Resilience: Buildings should be resilient to climate change impact, such as extreme weather events and temperature fluctuations. Consideration should be given to the long-term climate resilience of the reconstructed buildings.

5.1.4 Baseline Environment: Socio-economic environment

5.1.4.1 Socio-economic perspective of proposed project and adjacent sites: These systems and structures impact the distribution of resources, money and power in a community and around the world. This distribution, known as the socioeconomic environment, shapes how communities and individuals can gain the resources needed to meet their basic human needs. In the project area, there mostly live government employees and officers. From 8 to 20 grade employees live here. Their economic condition depends on their income according to their grades. All of them are above poverty line and can meet their necessities. There are also people of workers and outsiders inside the quarter currently which is not legal. So, for the project, they will not be allowed to stay here.

5.1.4.2 Findings from Questionnaire survey:

Age structure: From the survey data from the residents of the quarter, it was found that the age structure is

0-10 years – 11%

10-20 years – 13%

20-30 years – 9%

30-40 years – 20%

40-50 years – 22%

50-60 years – 15%

60-70 years – 6%

70-80 years – 3%

Number of family members: In most of the families, the number of family members was found 5. But there is also families with member of 6 and 7 also.

4 member – 26%

5 member – 39%

6 member – 24%

7 member – 11%

Sex ratio: From the survey data, the sex ratio was found 8:9 of male and female. The percentage of female member was found larger than percentage of male member.

Education: From the survey data, there found most of the people of above 20 have completed their higher secondary education and honors degree. There is also a number of people who have completed only their higher secondary study or only secondary study.

Occupation: Most of the male people here are government employee or government officers. There is a number of female government employee and officers. But most of the female members are housewife here.

5.1.4.3 Observation of the survey team: While doing the survey, we observed that the people here lives a very simple life. They have good relation and good bonding with their neighbors. There is an educated community growing and are aware about their own socio-economic condition.

5.1.5 Public Consultation and stakeholder engagement:

Public Consultations such as Key Informant Interview and Focus Group Discussions (FGDs) should be conducted to achieve the following objectives:

1. To enhance the sustainability of this residential project by taking the opinions from stakeholders(current residence, people living near this area)
2. To determine different types of impacts and plan mitigation plans involving stakeholders.

Public consultation for this project may be carried out with the group of people such as:

- Government Officials(PWD)
- Current residencies
- Shop owners near the project
- People living near the project
- Representatives from Greenlife Hospital and Modern Hospital

Content of the public consultation meetings:

1. Discussion about the suitability of this project, how the stakeholder will be beneficiary by this project
2. Dumping plan about the wastage from demolishing old structures
3. Handling sound pollution
4. Traffic impact on nearby road due to more population
5. About the plan where the current residencies will be moved during construction phase
6. Disturbance about the hospital environment

5.1.6 Identification and assessment of potential environmental, disaster and climate change impacts:

5.1.6.1 Pre-construction stage:

1. Underground gas pipe lines
2. Cutting of trees

5.1.6.2 Construction Phase:

Environmental Impact:

1. Air can be polluted by the transport used for construction and dust generation.
2. Noise will be generated by heavy traffic for construction and construction machinery

3. Excavation for foundation, demolition and construction may create blockage to drainage system
4. Solid waste will create hazards to workers
5. Construction delay during rainy season due to rainfall

Ecological Impact:

1. Loss of habitants
2. Loss of local flora and fauna

Socio-Economic Impacts:

1. The current residencies will have to move another place
2. Employment and Economy: During the construction phase of the project, there will be possibility of generating a lot of jobs. The job opportunities would be created for labors as well as skilled manpower such as engineers. Additionally, further employment gain would result from the supply-chain system for the construction materials and transportation.
3. Construction transport may create congestion on the busy Mirpur road: During the construction stage, transportation of construction materials would increase traffic flow in the project area. The increased traffic could create traffic congestion in the road, specially in peak hours. Traffic congestion may get worse if the construction materials are stored on the street instead of secured shed inside the project area.
4. Community Health and Safety: Improper health and safety policy maintained at the project area during the construction phase may lead to outbreak of different diseases to the surrounding communities through the sick workers working at the project. Vehicles carrying construction materials would increase traffic and would lead to an increased noise level due to vehicle operation and honking. Noise and vibration from the construction machines and equipment may also affect the health of the surrounding community. Emission from the vehicles would increase air pollution level especially in the dry season. Construction activities would also generate dust increasing the particulate matter in the air, especially in the dry season. Poor facilities provided to the workers may affect the environment.

5.1.6.3 Operational stage:

Environmental Impact:

- Drainage system may be blocked due to improper cleaning management
- Improper management of sewage waste may break water borne diseases

Socio-Economic Impacts:

- The lifestyle of the residencies will highly improve because of better housing, sanitation, road condition etc
- During the operational stage, traffic flow would be increased in the project area.

5.1.7 Counter measures taken to reduce the impacts:

5.1.7.1 Pre-construction phase:

- Before starting construction, the gas line will be shifted outside of the boundary line of the quarter with and assistance of Titas Gas Transmission and Distribution Company Ltd.
- To compensate the loss due to tree cutting a lot of trees will be plated after completing construction as there is sufficient empty space.

5.1.7.2 Construction phase:

- To reduce air pollution, vehicles of fuel efficient, fit and good working condition with emission control device must be selected. Also to control dust emission, vehicles should be move with low to medium speed. Water should be sprayed in the construction site. Aggregates should be covered and confined to avoid them being wind-drifted.
- To control noise, good working vehicles should be used and transport must be ran at medium speed. To reduce noise from construction machinery, noise control kits,

lining of truck trays or pipelines, silencers can be used. Affected people must be notified if high noisy activities is undertaken.

- To avoid drainage congestion, pumping is necessary. Foundation work may be avoided during rainy season. All rainwater, storm water waste water etc. should be drain out via sewerage pipelines of DWASA.
- To ensure solid waste management, disposal of all wastes generated during construction should be in an environmentally acceptable manner. Minimization of the production of waste
- materials can be ensured by 3R (Reduce, Recycle and Reuse) approach. Solid waste should not be burnt.
- Re-plantation of trees, re-vegetation or grass turf when soil is exposed.
- The occupants must be shifted to another residential area and given compensation and subsidy.
- To minimize traffic congestion, Restriction will be given to materials deliveries to non-peak periods (night) to minimize traffic disruptions. Also, Restriction will be given to the transport of oversize loads.
- To ensure worker safety, proper sanitation and other facilities for hygienic lifestyle should be provided to the workers.

5.1.7.3 Operational phase:

- To operate drainage system, solid wastes should not be dumped into the drain and Blocked drains should be cleaned properly and debris should be disposed at approved sites on a regular basis.
- To operate sewerage system, septic tank should be maintained. Water quality should be monitored on a regular basis.
- Better traffic management following the recommendations of the traffic impact assessment

5.1.8 Cost for reducing the mitigating impacts:

Mitigation cost for pre-construction stage is 100,000 BDT, for construction stage is 880,000 BDT and for operation stage is 230,000 BDT. So, the total cost was found for mitigation is 1,210,000 BDT.

5.1.9 Required assessment:

Reconstruction of Green Road Staff Quarter along with other facilities involves a considerable amount of construction activities which have both negative and positive impacts on the environment. The construction process is in “RED” category. So, to mitigate the negative environmental impacts and enhance the positive environmental impacts due to construction of the quarter, EIA is required.

The project is the Reconstruction of Green Road staff quarter where the existing structures will be replaced by new constructed and well-facilitated buildings. The new buildings will have sustainable properties and green facilities. The facilities considered are use of solar energy and day Environmental Impact Assessment (EIA) proper solid waste management etc. However, the provision of these facilities has been considered in an environment friendly manner.

5.1.10 Resettlement issues:

Before constructing the project, demolition is needed. So, the current residents are to be shifted from the site. So, the resettlement issue arises. Resettlement issue refers to challenges or problems that arise when individuals or communities are required to move from their current homes or lands to new locations due to various reasons such as infrastructure development projects, environmental concerns, or social and economic changes.

For the resettlement of the current residents, the following steps will be taken:

1. The residents will be given money for relocation near the area as the facility of the school, college and working places they are having near it. They will be given above 50,000 BDT, 40,000 BDT for home rent and 10,000+ BDT for others.
2. They will have legal consideration from government for renting home if required.
3. If some of the residents are to relocate far from the current place, they will have transportation facilities or corresponding money for this.

5.1.11 Recommendations:

To minimize the impacts due to construction, proper monitoring is necessary. Dust and emissions controls and regular maintenance of machinery will be required. Trees will be planted after the construction phase. Solar panels may be installed on the rooftop of the building to ensure sustainable energy consumption.

5.2 Assessment of Disaster Resilience of the Project

5.2.1 Table 1: Detail information of disaster analysis and risk of project area

Detail Information											
Cyclone	Drought: Kharif	Drought: Pre Kharif	Earthquake	Erosion	Flash Flood	Flood	Landslide	Salinity			
Sea Level Rise	Storm Surge	Combined	Exposure Base value	Vulnerability Base value							
District		Dhaka		Area		1477.63					
Indicator	Hazard Level	Exposure Level	Vulnerability Level	Risk Level							
Cyclone	Medium (3)	Very High (5)	Very Low (1)	Medium (3)							
Drought: Kharif	Very Low (1)	Very High (5)	Very Low (1)	Very Low (1)							
Drought: Pre Kharif	Medium (3)	Very High (5)	Very Low (1)	Medium (3)							
Earthquake	Medium (3)	Very High (5)	Very Low (1)	Medium (3)							
Erosion	Medium (3)	Very High (5)	Very Low (1)	Medium (3)							
Flash Flood	Very Low (1)	Medium (3)	Very Low (1)	Very Low (1)							
Flood	Low (2)	Very High (5)	Very Low (1)	Low (2)							
Landslide	Very Low (1)	Very High (5)	Very Low (1)	Very Low (1)							
Salinity	Very Low (1)	Very High (5)	Very Low (1)	Very Low (1)							
Sea Level Rise	Very Low (1)	Very High (5)	Very Low (1)	Very Low (1)							
Storm Surge	Very Low (1)	Very High (5)	Very Low (1)	Very Low (1)							

Close

Disaster risk reduction measure:

From the above table, we can see that there is no major disaster and risk in the project area. Only cyclone, earthquake and erosion have medium risk level. For these, small precautions can be taken.

The elevation of the area is enough for resist any type of water rise. The highest wind speed recorded in Dhaka city is 8.3 m/s and our project buildings are strong enough to resist this.

For earthquake resistance, high strength steel and high strength concrete will be used in building construction.

For erosion control, the bare land of the project area will be surrounded with enough greenery.

5.2.2 Plan for business continuity:

For monitoring the project area, there can be business continuity. For the effect of cyclone, emergency food, water and other necessary commodities can be supplied. For earthquake risks, the immediate measures can be taken by various agencies.

5.2.3 Time for recovery:

The time for recovery is very short, approximately 2-3 days. The buildings then can serve as before, and human life will become normal.

5.2.4 Reporting of residual risks:

Reporting remaining risks after identifying and implementing effective risk reduction measures is not that difficult. It involves documenting any potential risks that still exist despite the implemented safety measures. This reporting should include details about risks, potential consequences and any additional actions or mitigations that can be taken to further minimize the risks. It also included the residents' opinion about the mitigation and safety measures.

Section 6: Cost-Benefit Analysis

6.1 Financial Analysis

❖ Cost:

1. Construction Cost:

Total construction cost of the facility=512 crore

2. Maintenance Cost:

• Routine Maintenance:

Routine maintenance includes **regular, recurring** tasks to keep the building in good condition. This may involve **cleaning, painting, lubricating moving parts, and replacing minor components** like light bulbs and air filters.

Maintenance percentage of total cost=0.1%

• Preventive Maintenance:

Preventive maintenance involves scheduled inspections and maintenance activities designed to prevent breakdowns and extend the lifespan of building systems and equipment. This includes servicing **HVAC systems**, checking **electrical systems**, and inspecting **roofing**.

Maintenance percentage of total cost=0.15%

- **Corrective Maintenance:**

Corrective maintenance covers repairs and replacements needed due to **unexpected breakdowns** or wear and tear. This can include fixing **plumbing leaks**, repairing **roof damage**, or replacing **malfunctioning equipment**.

Maintenance percentage of total cost=0.15%

3.Major Renovations and Upgrades:

Periodically, a building may require **major renovations** or upgrades to meet changing standards, improve energy efficiency, or enhance its functionality. Costs for such projects can vary significantly and may be planned on a **multi-year basis**.

Maintenance percentage of total cost=0.4%

4.Property Management Fees:

If the building is managed by a property management company, there may be management fees associated with their services. These fees typically cover tasks like **tenant communication, property oversight and security; measures**.

Maintenance percentage of total cost=0.1%

5.Security and Safety:

Expenses related to building security, such as **surveillance systems, access control**, and **safety measures**, are also considered in the maintenance budget.

Maintenance percentage of total cost=0.1%

Total Maintenance cost=1% of the total construction cost

- ❖ **Benefit:**

1. **From house rent:**

Considering rent per month per sq.metre=240 tk

Total floor area of all buildings=108108 sq.metre

Total rent per year = $108108 \times 240 \times 12 = 3114$ lakh tk

Increase of rent=60% of the previous rent in every 10 years

2. From Convention center:

Cost of hiring=2 lakh taka

Per month hiring frequency=8

Benefit per year=2*8*12 lakh taka=192 lakh taka

3. Salvage value: Considering 10% of construction cost

Hence, Salvage Value=513.6 lakh

❖ **Net Cash Flow:**

Year	Undiscounted Cost (Lakhs)			Undiscounted Benefits (Lakhs)	Net Cash Flow (Undiscounted) (Lakhs)
	Construction Cost and Relocation Cost	Maintenan ce Cost	Total Cost		
Construction Year-1	17121.00	0.00	17121.00	0.00	-17121.00
Construction Year-2	17121.00	0.00	17121.00	0.00	-17121.00
Construction Year-3	17121.00	0.00	17121.00	0.00	-17121.00
4	0.00	513.63	513.63	3306.00	2792.37
5	0.00	513.63	513.63	3306.00	2792.37
6	0.00	513.63	513.63	3306.00	2792.37
7	0.00	513.63	513.63	3306.00	2792.37
8	0.00	513.63	513.63	3306.00	2792.37
9	0.00	564.99	564.99	3306.00	2741.01
10	0.00	564.99	564.99	3306.00	2741.01
11	0.00	564.99	564.99	3306.00	2741.01
12	0.00	564.99	564.99	3306.00	2741.01
13	0.00	564.99	564.99	3306.00	2741.01
14	0.00	621.49	621.49	5289.60	4668.11

15	0.00	621.49	621.49	5289.60	4668.11
16	0.00	621.49	621.49	5289.60	4668.11
17	0.00	621.49	621.49	5289.60	4668.11
18	0.00	621.49	621.49	5289.60	4668.11
19	0.00	683.64	683.64	5289.60	4605.96
20	0.00	683.64	683.64	5289.60	4605.96
21	0.00	683.64	683.64	5289.60	4605.96
22	0.00	683.64	683.64	5289.60	4605.96
23	0.00	683.64	683.64	5289.60	4605.96
24	0.00	752.01	752.01	8463.36	7711.35
25	0.00	752.01	752.01	8463.36	7711.35
26	0.00	752.01	752.01	8463.36	7711.35
27	0.00	752.01	752.01	8463.36	7711.35
28	0.00	752.01	752.01	8463.36	7711.35
29	0.00	827.21	827.21	8463.36	7636.15
30	0.00	827.21	827.21	8463.36	7636.15
31	0.00	827.21	827.21	8463.36	7636.15
32	0.00	827.21	827.21	8463.36	7636.15
33	0.00	827.21	827.21	8463.36	7636.15
34	0.00	909.93	909.93	13541.38	12631.45
35	0.00	909.93	909.93	13541.38	12631.45
36	0.00	909.93	909.93	13541.38	12631.45
37	0.00	909.93	909.93	13541.38	12631.45
38	0.00	909.93	909.93	13541.38	12631.45
39	0.00	1000.92	1000.92	13541.38	12540.46
40	0.00	1000.92	1000.92	13541.38	12540.46
41	0.00	1000.92	1000.92	13541.38	12540.46
42	0.00	1000.92	1000.92	13541.38	12540.46
43	0.00	1000.92	1000.92	13541.38	12540.46
44	0.00	1101.01	1101.01	21666.20	20565.19
45	0.00	1101.01	1101.01	21666.20	20565.19
46	0.00	1101.01	1101.01	21666.20	20565.19
47	0.00	1101.01	1101.01	21666.20	20565.19
48	0.00	1101.01	1101.01	21666.20	20565.19
49	0.00	1211.11	1211.11	21666.20	20455.09

50	0.00	1211.11	1211.11	22179.83	20968.72
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- **Indicators:**

- **Financial Net Present Value (FNPV):**

For discount rate 8%:

$$\text{Financial Net Present Value (FNPV)} = 1460 \text{ Lakh}$$

For discount rate 9%:

$$\text{Financial Net Present Value (FNPV)} = -5835 \text{ Lakh}$$

- **Financial Benefit Cost Ratio (FBCR):**

For discount rate 8%:

$$\text{Financial Benefit Cost Ratio (FBCR)} = 1.05$$

For discount rate 9%:

$$\text{Financial Benefit Cost Ratio (FBCR)} = .88$$

- **Financial Internal Rate of Return (FIRR):** At this, NPW=0

$$\text{FIRR} = 8.2\%$$

Here, the FIRR value is 8.2% which indicates that the net present worth is zero at this discount rate. Therefore,

For discount rate 9% (greater than 8.2%), FNPV is -5835 Lakh and FBCR is also less than 1 (.88). Both FNPV and FBCR indicate that the project will be non-beneficial from the financial perspective.

For discount rate 8% (less than 8.2%), FNPV is 1460 Lakh and FBCR is also greater than 1 (1.05) indicating financially beneficial at 8% discount rate.

6.2 Economic Analysis

Economic Costs:

- Construction and maintenance cost: We used shadow prices to obtain construction and maintenance costs for economic analysis. We used a conversion factor of 0.8 to convert the financial cost into the economic cost of construction.

Economic Benefits:

- Increased Property Values: Considering the socio-economic conditions in Dhaka, an improvement in the quality of housing and the overall environment can attract a broader range of residents, including middle and upper-middle-class individuals and families which will increase property value. We have assumed 10% of construction cost as an economic benefit due to increased property value.
- Earthquake Risk Reduction: The new 13-story earthquake resistant buildings will be designed and constructed with state of-the-art engineering techniques and materials to withstand seismic forces. This enhanced structural integrity reduces the risk of severe damage or collapse during an earthquake, preserving the building's overall value. We assumed that the loss due to earthquake will be reduced by 10% compared to normal building.
- Fire Safety Enhancement: The new buildings can be equipped with modern fire prevention measures such as fire-resistant materials, automatic sprinklers, fire alarms, fire hydrants. We will be constructing a pond in the quarter area as a fire safety measure. We assumed that the loss due to a fire disaster will be reduced by 10% compared to a normal building which will add to the economic benefit.
- Saving Electricity: Green buildings maximize the use of natural daylight by strategically placing windows and using light-colored interior finishes. This reduces the need for artificial lighting during daylight hours. We have assumed 35% save on total energy for economic benefit analysis.
- Increased Tax Revenue: With increased development, there is often a greater demand for municipal services such as water, gas, and waste management. As more people will live in the area, there will be more need of electricity. Government can charge fees for these services, contributing to increased revenue. We have assumed 15% extra revenue.

Cash Flow:

Year	Construction Cost (lacs)	Maintenance Cost (lacs)	Earthquake Risk Elimination 10% of Total Cost (lacs)	Fire Safety Enhancement (Per Building) 20% of construction Cost (lacs)	Increase In Property Value 10% (lacs)	Economic Benefit							NPV (At 13% Discount Rate) (lacs)	NPV (At 15% Discount Rate) (lacs)	IRR
						Operational Job Creation (lacs)	Savings on Energy .35 Kwh/sqft(lacs)	Increased Tax Revenue (lacs)	Improved Waste Management (lacs)	Total Benefit (lacs)	Net Cash Flow (Undiscounted) (lacs)				
2024.00	13696.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-13696.80				
2025.00	13696.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-13696.80				
2026.00	13696.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-13696.80				
2027.00	0.00	410.90	5120.00	640.00	512.00	22.95	73.71	1.76	1.55	6371.97	5961.06				
2028.00	0.00	410.90	5120.00	640.00	512.00	22.95	73.71	1.76	1.55	6371.97	5961.06				
2029.00	0.00	410.90	5120.00	640.00	512.00	22.95	73.71	1.76	1.55	6371.97	5961.06				
2030.00	0.00	410.90	5120.00	640.00	512.00	22.95	73.71	1.76	1.55	6371.97	5961.06				
2031.00	0.00	410.90	5120.00	640.00	512.00	22.95	73.71	1.76	1.55	6371.97	5961.06				
2032.00	0.00	451.99	5529.60	691.20	552.96	24.79	79.61	1.90	1.67	6881.72	6429.73				
2033.00	0.00	451.99	5529.60	691.20	552.96	24.79	79.61	1.90	1.67	6881.72	6429.73				
2034.00	0.00	451.99	5529.60	691.20	552.96	24.79	79.61	1.90	1.67	6881.72	6429.73				
2035.00	0.00	451.99	5529.60	691.20	552.96	24.79	79.61	1.90	1.67	6881.72	6429.73				
2036.00	0.00	451.99	5529.60	691.20	552.96	24.79	79.61	1.90	1.67	6881.72	6429.73				
2037.00	0.00	497.19	5971.97	746.50	597.20	26.77	85.98	2.05	1.81	7432.26	6935.07				
2038.00	0.00	497.19	5971.97	746.50	597.20	26.77	85.98	2.05	1.81	7432.26	6935.07				
2039.00	0.00	497.19	5971.97	746.50	597.20	26.77	85.98	2.05	1.81	7432.26	6935.07				
2040.00	0.00	497.19	5971.97	746.50	597.20	26.77	85.98	2.05	1.81	7432.26	6935.07				
2041.00	0.00	497.19	5971.97	746.50	597.20	26.77	85.98	2.05	1.81	7432.26	6935.07				
2042.00	0.00	546.77	6449.73	806.22	644.97	28.91	92.85	2.21	1.95	8026.84	7480.07				
2043.00	0.00	546.77	6449.73	806.22	644.97	28.91	92.85	2.21	1.95	8026.84	7480.07				
2044.00	0.00	546.77	6449.73	806.22	644.97	28.91	92.85	2.21	1.95	8026.84	7480.07				
2045.00	0.00	546.77	6449.73	806.22	644.97	28.91	92.85	2.21	1.95	8026.84	7480.07				
2046.00	0.00	546.77	6449.73	806.22	644.97	28.91	92.85	2.21	1.95	8026.84	7480.07				
2047.00	0.00	601.61	6965.70	870.71	696.57	31.22	100.28	2.39	2.11	8668.99	8067.38				
2048.00	0.00	601.61	6965.70	870.71	696.57	33.72	100.28	2.39	2.11	8671.49	8069.88	2529.19	-3000.61	0.1382	
2049.00	0.00	601.61	6965.70	870.71	696.57	36.42	100.28	2.39	2.11	8674.18	8072.58				
2050.00	0.00	601.61	6965.70	870.71	696.57	39.33	100.28	2.39	2.11	8677.10	8075.49				
2051.00	0.00	601.61	6965.70	870.71	696.57	42.48	100.28	2.39	2.11	8680.24	8076.64				
2052.00	0.00	661.77	7522.96	940.37	752.30	45.88	108.30	2.58	2.28	9374.66	8712.90				
2053.00	0.00	661.77	7522.96	940.37	752.30	45.88	108.30	2.58	2.28	9374.66	8712.90				
2054.00	0.00	661.77	7522.96	940.37	752.30	45.88	108.30	2.58	2.28	9374.66	8712.90				
2055.00	0.00	661.77	7522.96	940.37	752.30	45.88	108.30	2.58	2.28	9374.66	8712.90				
2056.00	0.00	661.77	7522.96	940.37	752.30	45.88	108.30	2.58	2.28	9374.66	8712.90				
2057.00	0.00	727.94	8124.80	1015.60	812.48	49.55	116.97	2.78	2.46	10124.64	9396.69				
2058.00	0.00	727.94	8124.80	1015.60	812.48	49.55	116.97	2.78	2.46	10124.64	9396.69				
2059.00	0.00	727.94	8124.80	1015.60	812.48	49.55	116.97	2.78	2.46	10124.64	9396.69				
2060.00	0.00	727.94	8124.80	1015.60	812.48	49.55	116.97	2.78	2.46	10124.64	9396.69				
2061.00	0.00	727.94	8124.80	1015.60	812.48	49.55	116.97	2.78	2.46	10124.64	9396.69				
2062.00	0.00	800.74	8774.78	1096.85	877.48	53.51	126.33	3.01	2.66	10934.61	10133.87				
2063.00	0.00	800.74	8774.78	1096.85	877.48	53.51	126.33	3.01	2.66	10934.61	10133.87				
2064.00	0.00	800.74	8774.78	1096.85	877.48	53.51	126.33	3.01	2.66	10934.61	10133.87				
2065.00	0.00	800.74	8774.78	1096.85	877.48	53.51	126.33	3.01	2.66	10934.61	10133.87				
2066.00	0.00	800.74	8774.78	1096.85	877.48	53.51	126.33	3.01	2.66	10934.61	10133.87				
2067.00	0.00	880.81	9476.76	1184.60	947.68	57.79	136.43	3.25	2.87	11809.38	10928.57				
2068.00	0.00	880.81	10234.90	1184.60	947.68	57.79	136.43	3.25	2.87	12567.52	11686.71				
2069.00	0.00	880.81	11053.70	1184.60	947.68	57.79	136.43	3.25	2.87	13386.31	12505.50				
2070.00	0.00	880.81	11937.99	1184.60	947.68	57.79	136.43	3.25	2.87	14270.60	13389.80				
2071.00	0.00	880.81	12893.03	1184.60	947.68	57.79	136.43	3.25	2.87	15225.64	14344.84				
2072.00	0.00	968.89	13924.47	1279.36	1023.49	62.42	147.35	3.51	3.10	16443.70	15474.81				

Indicators:

- **Economic Net Present Value (ENPV):**

For discount rate 13%:

$$\text{Economic Net Present Value (FNPV)} = 2529.19 \text{ Lakh}$$

For discount rate 15%:

$$\text{Financial Net Present Value (FNPV)} = -3000.61 \text{ Lakh}$$

- **Economic Benefit Cost Ratio (EBCR):**

For discount rate 13%:

$$\text{Financial Benefit Cost Ratio (FBCR)} = 1.1$$

For discount rate 15%:

$$\text{Financial Benefit Cost Ratio (FBCR)} = .85$$

- **Economic Internal Rate of Return (EIRR):** At this, NPW=0
EIRR= 13.82%

Here, the EIRR value is 13.82% which indicates that the net present worth is zero at this discount rate. Therefore,

For discount rate 15% (greater than 13.82%), ENPV is -3000.61 Lakh and FBCR is also less than 1 (.85). Both ENPV and EBCR indicate that the project will be non-beneficial from the economic perspective.

For discount rate 13% (less than 13.82%), ENPV is 2529.19 Lakh and EBCR is also greater than 1 (1.1) indicating economically beneficial at 13% discount rate.

Section 7: Human Resources and Administrative Support Analysis (During Implementation and Post Implementation of the project)

The Green Road Staff Quarter reconstruction project is executed under the purview of the Public Works Department (PWD).

- (a) Managerial and skilled workforces needed during implementation and operational phases of the project:
 - Project Manager
 - Construction Manager
 - Logistics and Supply Chain Coordinator
 - Architects and Designers
 - Engineers
 - Construction Workers
 - Health and Safety Officer
- (b) The reconstruction of the Green-road staff quarter, a government colony, is designated as a governmental project. In this undertaking, the government is well-equipped to supply the requisite manpower, encompassing managerial and skilled workforces.
- (c) The PWD's institutional capacity to sustain the functionality of the 'Reconstruction of Green Road Staff Quarter' project output depends on its financial management and technical expertise. The assessment involves inspecting the adequacy of budget allocations for ongoing operational and maintenance needs, ensuring diversification of funding sources, and implementing efficient financial management systems. Concurrently, its technical capacity relies on the availability of in-house expertise, ongoing training programs to keep technical staff updated, and the formulation of comprehensive maintenance plans.

- (d) PWD can outsource manpower for maintenance and operation.
- (e) Given that the Green Road Staff Quarter reconstruction project falls under the government, it benefits from funding allocated in the government budget. Consequently, the project entity possesses sufficient financial resources to meet its operational requirements and ensure the successful implementation of the initiative.
- (f) Timing of project consistent with organizational capacity.

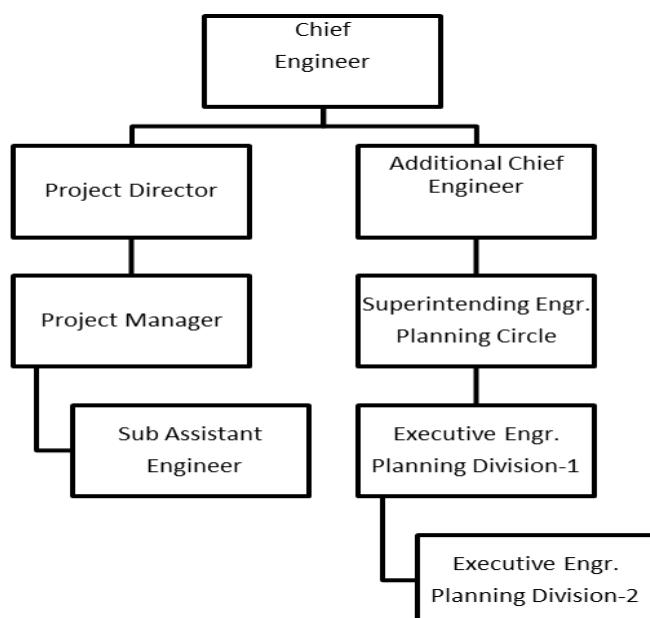


Figure 7-1: Required manpower to be deployed for the project during implementation period



Figure 7-2 Required manpower to be outsourced for the project during operation

Section 8: Institutional and Legal Analysis

- (a) The Public Works Department (PWD) enjoys the legal mandate for reconstruction of green road staff quarter which is located in green road to improve all the aspects of structural, transportation, environmental and geotechnical perspective. Under Bangladesh National Building Code (BNBC),2020; Environmental Conservation Act, 1995; Local Government (City Corporation) Act, 2009; Water Supply and Sewerage

Authority (WASA) Act, 1996; the PWD can take necessary measures to ensure smooth construction of the said structure.

- (b) Resource allocation, personnel competency, infrastructure utilization, adherence to timelines, and effective monitoring mechanisms is crucial to ensure optimal utilization of the agency's capabilities and physical facilities for the Green-road staff quarter reconstruction project.
- (c) There is no need for adjustment in the policy and/or institutional setup.
- (d) No adjustments required before the project is implemented.
- (e) Ensuring institutions possess suitable skills and capacity aligned with project requirements is crucial for project success.
- (f) Incentive: The contract may include a provision for an incentive or bonus payment if the project is completed before the agreed-upon deadline. For instance, 5% of the contract's value could be awarded as a bonus for finishing the construction ahead of schedule.

Penalty: The contract might specify a daily penalty, known as liquidated damages, for each day the project goes beyond the agreed-upon completion date. This penalty is meant to compensate the client for any losses incurred due to the delay.

- (g) There are no critical governance issues that may affect implementation.
- (h) There are no mentionable challenges related to cross-cutting issues to be addressed.

Section 9: Risk (Uncertainty) and Sensitivity Analysis

a. Sensitivity Analysis: Sensitivity analysis determines the effect of change in different variables on the outcome of a project. These variables might include cash inflow, cash outflow, discount rate, project lifetime, etc. It is important to conduct a sensitivity analysis to determine which variables appear to have the most influence on the costing analysis of the project.

Considered variables of the project:

1. Cost
2. Benefit
3. Discount Rate

According to the variation of the considered variables, three cases might generate. These include:

1. Expected Case
2. Pessimistic Case
3. Optimistic Case

Financial Criteria:

1. Expected Case:

Criteria	Expected Cost and Benefit
IRR (%)	<u>8.2</u>
	Benefit Cost Ratio (BCR)
Discount Rate (%)	
12	0.59
10	0.76
9	0.88
8.2	1
7	1.22
6	1.46

Comment: IRR=8.2% which indicates that a discount rate below this percentage will make the project financially viable.

2. Pessimistic Case:

Criteria	Benefit Decreased by 10%	Benefit Decreased by 20%	Cost Increased by 10%	Cost Increased by 20%
IRR (%)	<u>7.5</u>	<u>6.9</u>	<u>7.6</u>	<u>7.01</u>
	Benefit Cost Ratio (BCR)			
Discount Rate (%)				
12	0.53	0.47	0.54	0.49
10	0.69	0.61	0.69	0.63
9	0.79	0.7	0.8	0.73
8	0.93	0.82	0.94	0.86
7	1.1	0.98	1.11	1.02
6	1.32	1.17	1.33	1.22

Comment:

1. All cases indicate high risk and high sensitivity.
2. Effect of benefit decrease, and cost increase are similar.

Criteria	Benefit decreased by 10% and Cost increased by 10%	Benefit decreased by 10% and Cost increased by 20%	Benefit decreased by 20% and Cost increased by 10%	Benefit decreased by 20% and Cost increased by 20%
IRR (%)	<u>7</u>	<u>6.5</u>	<u>6.3</u>	<u>5.9</u>
	Benefit Cost Ratio (BCR)			
Discount Rate (%)				
12	0.48	0.44	0.43	0.39
10	0.62	0.57	0.55	0.51
9	0.72	0.66	0.64	0.59
8	0.84	0.77	0.75	0.69
7	1	0.91	0.89	0.81
6	1.2	1.1	1.06	0.97

Comment: Very high risk and high sensitivity involved.

3.Mixed Scenario:

Criteria	Benefit increased by 10% and Cost increased by 10%	Benefit increased by 10% and Cost increased by 20%	Benefit increased by 20% and Cost increased by 10%	Benefit increased by 20% and Cost increased by 20%
IRR (%)	<u>8.2</u>	<u>7.6</u>	<u>8.7</u>	<u>8.2</u>
	Benefit Cost Ratio (BCR)			
Discount Rate (%)				
12	0.59	0.54	0.64	0.59
10	0.76	0.7	0.83	0.76
9	0.88	0.81	0.96	0.88
8	1.03	0.94	1.12	1.03
7	1.22	1.12	1.33	1.22
6	1.46	1.34	1.59	1.46

Comment:

- 1.Almost similar outcome as the expected case.
- 2.Indicating the effect of similar changes in the cost and benefit will produce similar results.

4.Optimistic Case:

Criteria	Benefit Increased by 10%	Benefit Increased by 20%	Cost decreased by 10%	Cost decreased by 20%
IRR (%)	<u>8.4</u>	<u>9.4</u>	<u>8.8</u>	<u>9.6</u>
Benefit Cost Ratio (BCR)				
Discount Rate (%)				
12	0.65	0.71	0.65	0.74
10	0.84	0.91	0.85	0.95
9	0.97	1.06	0.98	1.1
8	1.1	1.2	1.14	1.29
7	1.34	1.46	1.35	1.52
6	1.61	1.75	1.62	1.83

Comment: Low risk and low sensitivity

Economic Criteria:

1. Expected Case:

Criteria	Expected Cost and Benefit
IRR (%)	<u>14</u>
Benefit Cost Ratio (BCR)	
Discount Rate (%)	
15	0.9
13	1.1
11	1.3
9	1.6
7	2.1

Comment: IRR=14%, which indicates that a discount rate below this percentage will make the project financially viable.

2. Pessimistic Case:

Criteria	Benefit Decreased by 10%	Benefit Decreased by 20%	Cost increased by 10%	Cost increased by 20%
IRR (%)	12.6	11.3	12.7	11.8
Benefit Cost Ratio (BCR)				
Discount Rate (%)				
15	0.8	0.7	0.8	0.8
13	1	0.9	1	0.9
11	1.2	1	1.2	1.1
9	1.4	1.3	1.5	1.3
7	1.8	1.6	1.9	1.7

Comment: 1. All cases indicate low risk and low sensitivity.
2. Effect of benefit decrease, and cost increase are similar.

Criteria	Benefit decreased by 10% and Cost increased by 10%	Benefit decreased by 10% and Cost increased by 20%	Benefit decreased by 20% and Cost increased by 10%	Benefit decreased by 20% and Cost increased by 20%
IRR (%)	<u>11.6</u>	<u>11.2</u>	<u>10.4</u>	<u>9.6</u>
Benefit Cost Ratio (BCR)				
Discount Rate (%)				
15	0.7	0.7	0.7	0.6
13	0.9	0.8	0.8	0.7
11	1.1	1	0.9	0.9
9	1.3	1.2	1.2	1.1
7	1.7	1.5	1.5	1.4

Comment: Moderate to high sensitivity

3.Mixed Case:

Criteria	Benefit increased by 10% and Cost increased by 10%	Benefit increased by 10% and Cost increased by 20%	Benefit increased by 20% and Cost increased by 10%	Benefit increased by 20% and Cost increased by 20%
IRR (%)	<u>13.8</u>	<u>12.8</u>	<u>14.9</u>	<u>13.8</u>
	Benefit Cost Ratio (BCR)			
Discount Rate (%)				
15	0.9	0.8	1	0.9
13	1.1	1	1.2	1.1
11	1.3	1.2	1.4	1.3
9	1.6	1.5	1.7	1.6
7	2.1	1.9	2.2	2.1

Comment: Very low sensitivity and risk

4.Optimistic Case:

Criteria	Benefit Increased by 10%	Benefit Increased by 20%	Cost decreased by 10%	Cost decreased by 20%
IRR (%)	<u>15</u>	<u>16.2</u>	<u>15.1</u>	<u>16.7</u>
	Benefit Cost Ratio (BCR)			
Discount Rate (%)				
15	1	1.1	1	1.1
13	1.2	1.3	1.2	1.3
11	1.4	1.6	1.4	1.6
9	1.8	1.9	1.8	2
7	2.3	2.5	2.3	2.6

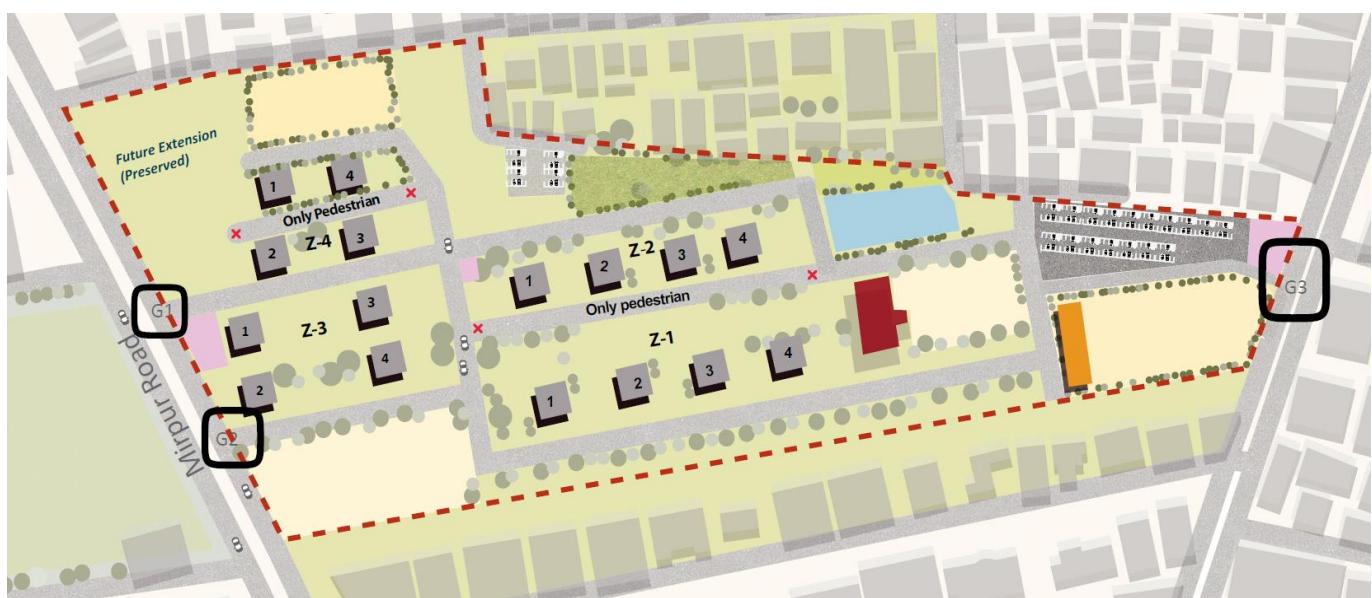
Comment: Low risk and sensitivity

b. **Risk Analysis:** Risk analysis in a project is a systematic process of identifying, assessing, and prioritizing potential risks that could impact the project's objectives. The goal of risk analysis is to understand the uncertainties associated with a project, evaluate their potential impact on project outcomes, and develop strategies to manage or mitigate these risks. It is an essential component of effective project management and contributes to informed decision-

making. Risk analysis helps in the identification of potential issues, informed decision-making, prioritization of risks, resource allocation, cost and schedule management, improved communication, proactive risk management, enhanced stakeholder confidence, contingency planning, and continuous improvement.

The identified risks associated with our project are briefly stated below:

1. Traffic Impact: Due to the implementation of the project, traffic demand will increase due to the increased number of families in the staff quarter. As a result, vehicle discharge through the entry exit point will increase. The colony has three entry-exit points, two of which are connected to the Mirpur Road, and the third one is connected to the Green Road. Both of these roads remain fairly saturated during peak hours. So, an increased vehicle discharge will have a significant impact on these roads. Hence, the consideration of increased vehicle number is important for controlling traffic congestion in the connecting road networks.



Negative impacts due to this might include:

a. Traffic Congestion:

The most immediate and noticeable impact is the potential for increased traffic congestion on the main road. If the road capacity is not sufficient, it can lead to delays, frustration among commuters, and decreased overall traffic flow.

b. Air and Noise Pollution:

Higher vehicle discharge can contribute to increased air pollution and noise levels, negatively affecting the environment and the quality of life for both residents and those using the main road.

c. Safety Concerns:

The increased volume of vehicles can lead to safety concerns, including a higher risk of accidents, especially if road infrastructure and traffic management measures are not adequate.

d. Infrastructure Strain:

The higher demand on the main road may result in increased wear and tear on the infrastructure. Over time, this can lead to the need for more frequent maintenance and repairs.

Mitigation Measures:

1. Traffic Impact Assessment (TIA)
2. Implement traffic management measures such as signal optimization, lane management, and the introduction of roundabouts to improve traffic flow.
3. Upgrade road infrastructure to accommodate increased traffic, ensuring that the road capacity aligns with the growing demand.
4. Enforce and strengthen environmental regulations to mitigate pollution and noise concerns associated with increased vehicle discharge.

2. Relocation Issues: During the demolishing and construction stage the current habitats must be relocated such that the living conditions are similar or better than the current living conditions. But our country is overpopulated and underdeveloped, due to which it is difficult to relocate the current families by maintaining similar living opportunities. In order to properly obtain the required objectives, the following measures will be followed:

a. Comprehensive Relocation Planning:

Developing a detailed relocation plan that includes a timeline, budget, and task list. This will cover all aspects, from logistics to community integration. Proper data analysis and survey will be performed in order to create sustainable relocation planning.

b. Budget Contingencies:

Including contingencies in the budget to account for unforeseen expenses. Having a financial buffer can help address unexpected costs.

c. Professional Transportation Services:

Hiring reputable and experienced moving services to handle logistics, packing, and transportation. Professional movers can help ensure a smoother process and minimize the risk of damage.

d. Communication with the Stakeholders:

Communicating clearly with all stakeholders involved in the move, including family members or employees. Keeping everyone informed about the relocation timeline, tasks, and expectations is important for the preparation and implementation of a proper relocation procedure. Community Engagement Programs must be established to integrate the stakeholders in the planning process.

e. Legal Expertise:

Engaging legal experts to navigate complex legal and regulatory requirements. Ensure that all permits and approvals are obtained before proceeding.

Both relocation and land acquisition require careful planning, attention to detail, and adherence to legal and regulatory requirements. Seeking professional advice and assistance, such as legal counsel and real estate experts, can contribute to a smoother process and successful outcomes.

3. Economic and Financial Risk:

Economic and financial risks in project implementation refer to uncertainties and potential adverse events related to the economic and financial aspects of the project. These risks can impact the project's ability to achieve its objectives, stay within budget, and generate the expected returns. Due to the changes in the different variables of the cost analysis of a project, financial and economic risk might be generated. Here's a breakdown of economic and financial risks:

a. Market Fluctuations:

Changes in market conditions, such as fluctuations in demand, supply, or pricing, can impact the economic viability of a project. Market uncertainties may affect revenue projections and profitability.

b. Currency Exchange Rate Fluctuations:

Different tasks involving international transactions or exposure to multiple currencies are susceptible to exchange rate fluctuations. These fluctuations can impact costs, revenues, and overall project finances.

c. Interest Rate Fluctuations:

Transactions involving debt financing are exposed to interest rate fluctuations. Changes in interest rates can affect borrowing costs and the overall financial performance of the project.

Mitigating economic and financial risks involves thorough risk assessment, scenario planning, and the implementation of risk management strategies. This may include:

- a. Creating a robust financial and economical modeling and sensitivity analysis.
- b. Contingency planning for unforeseen economic challenges
- c. Regular monitoring and adjustments to the project plan in response to changing economic and financial conditions.

4. Contractual Risk: Contractual risk during project implementation refers to the potential uncertainties and adverse events that can arise due to the terms, conditions, and obligations specified in the project contracts. Construction projects involve numerous contracts between various parties, including owners, contractors, subcontractors, suppliers, and consultants. Contractual risk stems from the possibility of disputes, breaches, or failures to meet contractual

obligations, and it can have legal, financial, and operational implications. Here are key aspects of contractual risk in a construction project:

a. Contractual Disputes:

Disputes may arise over contract interpretation, scope changes, delays, quality standards, or payment issues. Disputes can lead to legal proceedings, delays in project completion, and additional costs.

b. Breach of Contract:

A breach occurs when one party fails to fulfill its contractual obligations. This could involve failure to meet project milestones, deliverables, or quality standards. Breaches may result in legal actions, financial penalties, or termination of the contract.

c. Ambiguous Contracts:

Incomplete or poorly drafted contracts may lack clarity on key terms, responsibilities, or dispute resolution mechanisms. Ambiguous contracts increase the likelihood of misunderstandings and disputes.

d. Change in Orders and Variations:

Changes to the project scope, specifications, or timeline may result in changing orders. Failure to manage change orders effectively can lead to disputes over additional costs and delays.

e. Delay and Liquidated Damages:

Construction contracts often include provisions related to project timelines and deadlines. Delays in project completion may trigger liquidated damages, penalties, or claims. Properly managing and documenting delays is essential to mitigate this risk.

f. Failure to meet performance Bonds and Guarantees:

Performance bonds and guarantees are contractual tools to ensure that parties fulfill their obligations. Failure to meet performance guarantees may lead to financial penalties or legal action.

Mitigating Contractual Risks:

a. Comprehensive Contract Review:

Conduct a thorough review of all project contracts to ensure clarity, completeness, and alignment with project objectives.

b. Clear Scope Definition:

Clearly define the project scope, specifications, and milestones in the contract to minimize misunderstandings and scope-related disputes.

c. Dispute Resolution Mechanisms:

Specify effective dispute resolution mechanisms, such as mediation or arbitration, in contracts to facilitate timely and cost-effective resolution of conflicts.

d. Regular Communication:

Foster open and regular communication among project stakeholders to address concerns, changes, and potential issues proactively.

e. Legal Counsel:

Engage legal counsel to review and advise on contract terms, especially for complex or high-value projects.

f. Performance Monitoring:

Implement systems for monitoring and evaluating the performance of all parties involved in the project to identify and address issues promptly.

5. Environmental Risk: Environmental risk in a construction project refers to the potential negative impacts that the project may have on the surrounding environment, as well as the risks posed by environmental factors to the project itself. Managing environmental risks is crucial for sustainable and responsible construction practices. Here are some key environmental risks in construction projects:

a. Soil Contamination:

Construction activities may involve excavation and earthmoving, which can disturb contaminated soil. This poses a risk of spreading pollutants or exposing workers to hazardous materials.

b. Water Pollution:

Construction sites can contribute to water pollution through runoff containing sediment, chemicals, and other pollutants. This runoff may enter nearby water bodies and harm aquatic ecosystems.

c. Air Quality Impact:

Dust and airborne pollutants generated during construction activities can impact air quality, leading to respiratory issues for workers and nearby residents. Emissions from construction equipment also contribute to air pollution.

d. Noise and Vibration:

Construction activities generate noise and vibration, which can disturb local ecosystems and communities. This may affect wildlife, disrupt habitats, and cause nuisance for residents.

e. Habitat Disturbance:

Construction projects can disrupt natural habitats, leading to the displacement or destruction of plant and animal species. Loss of biodiversity and habitat fragmentation are environmental concerns.

f. Waste Generation:

Construction generates significant amounts of waste, including debris, packaging materials, and hazardous substances. Improper disposal of waste can lead to environmental contamination.

g. Energy Consumption:

High energy consumption during construction and operation phases contributes to environmental impact, especially if the energy is derived from non-renewable sources.

h. Climate Change Impact:

Construction materials, processes, and transportation contribute to greenhouse gas emissions. The embodied carbon in materials and the overall carbon footprint of the project can contribute to climate change.

i. Natural Resource Depletion:

The extraction and use of natural resources, such as timber, minerals, and water, for construction purposes can lead to depletion and degradation of these resources.

j. Regulatory Compliance:

Failure to comply with environmental regulations and permits can result in legal consequences, fines, and project delays. Adherence to environmental laws is essential to mitigate regulatory risks.

Mitigating Environmental Risks:

a. Environmental Impact Assessment (EIA):

Conduct a thorough Environmental Impact Assessment before the project begins to identify potential risks and develop mitigation measures.

b. Best Management Practices (BMPs):

Implement best management practices to control erosion, manage stormwater, and minimize the environmental impact of construction activities.

c. Green Building Practices:

Incorporate sustainable and environmentally friendly building practices, such as using recycled materials, energy-efficient design, and green construction technologies.

d. Waste Management Plan:

Develop a comprehensive waste management plan to reduce, reuse, and recycle construction waste. Proper disposal of hazardous materials is crucial.

e. Vegetation Protection:

Implement measures to protect existing vegetation and habitats. Replanting and landscaping efforts can help restore disturbed areas.

f. Noise and Vibration Control:

Use noise barriers, schedule noisy activities during permitted hours, and implement measures to control vibration and minimize disturbances to nearby communities and ecosystems.

g. Energy Efficiency:

Design and construct energy-efficient buildings, utilize renewable energy sources, and incorporate energy-saving technologies.

h. Community Engagement:

Engage with local communities and stakeholders to address concerns, gather input, and foster collaboration in environmental protection efforts.

i. Monitoring and Reporting:

Establish monitoring programs to assess environmental impacts during and after construction. Regular reporting and transparency enhance accountability.

By proactively addressing environmental risks and incorporating sustainable practices, construction projects can reduce their impact on the environment, comply with regulations, and contribute to long-term environmental conservation.

Section 10: Alternative/Options Analysis

Our main option is Beam supported slab and Mat foundation. Our alternative options are flat slab and pile foundation.

Here is the comparison between Beam supported slab and flat slab

Criteria/Slab Type	Beam Supported Slab	Flat Slab
Cost		
Concrete	In slab beam system, the thickness of slab is small while depth of beam is large. Hence less concrete required than flat slab.	In flat slab system, the thickness of slab is large. Hence more concrete is required than beam supported slab.
Form Work	In slab beam system, more formwork is needed. Form work is complicated and hence costly.	In flat slab system, less formwork is needed. Form work is simple and hence not costly.
Reinforcement	In beam-supported slabs, the beams help distribute the load and shear forces, which can reduce the need for excessive shear reinforcement in the slab itself. Reinforcements are commonly provided in one layer.	In flat slab construction, the absence of beams means that the slab itself needs to resist the shear forces that occur due to the loadings. This often leads to a higher demand for shear reinforcement in flat slabs. Reinforcements are commonly provided in two layers.
Material Availability	Required materials are easily available.	Required materials are easily available.

Technology Availability	<p>High-strength concrete: High strength concrete mixes enhance the performance and durability of beam.</p> <p>Reinforcement Material: High strength steel bars improves structural performance of beams.</p> <p>Overall less complex technologies are used.</p>	<p>Punching shear Reinforcement: Technologies like shear studs, punching shear reinforcement bars are used to strengthen flat slab in critical areas.</p> <p>Drop panels and capital beams: To enhance load-carrying capacity of flat slabs.</p> <p>Post-tensioning: This technology is used to increase load carrying capacity and minimize deflection.</p> <p>Overall more complex technologies are used.</p>
Time	Requires more time than flat slab due to complexity of design.	Requires less time than beam supported slab.
Construction Method		
Load distribution	Load distributes from slab to columns through supporting beams , leading to more complex load calculations and structural analysis.	Load transferred directly from slab to columns.
Beam Design	Beam supported slab involve complex construction due to beam, formwork and reinforcement.	No beam design required.
Social Acceptance		
Local Practices	Traditional construction method and perceived as stronger and safer.	same
Speed of construction	Requires more time and materials than flat slab.	Need less time and materials hence construction related disruptions are reduced.
Noise Reduction	Can not provide sound insulation as good as flat slab.	May offer better noise insulation compared to beam supported slabs.
Aesthetic		
Storey Height	Floor system requires more depth and hence there will be increase in storey height as compared to flat slab.	Floor system requires lesser depth and hence there will be reduction in storey height.

Appearance	Illumination is not as effective as in flat slab as beam are present.	Flat ceiling is available which gives attractive appearance. Illumination is better as beams are absent
Qualitative Comparison		
Flexural Strength	Beam supported slab have higher flexural strength thus reduce bending moment and shear force.	Flat slab having more bending moment and shear force as their flexural strength is typically lower than beam supported slabs.
Resistance to Earthquake	It is more resistant to earthquake as it is flexible than flat slab system.	It is less resistant to earthquake as it is less flexible than slab beam system.
Live Load	Live load has no relation with design dead load.	Live load shall not exceed three times the design dead load.

Advantages of Beam Supported Slab

1. In slab beam system, the thickness of slab is small while depth of beam is large. Hence less concrete required than flat slab.
2. The beams help distribute the load and shear forces, which can reduce the need for excessive shear reinforcement in the slab itself.
3. Beam supported slab have higher flexural strength thus reduce bending moment and shear force
4. It is more resistant to earthquake as it is flexible than flat slab system

Disadvantages of Beam Supported Slab

1. Floor system requires more depth and hence there will be increase in storey height as compared to flat slab
2. Illumination is not as effective as in flat slab as beam are present.

Advantages of Flat Slab

1. Less formwork is needed
2. Floor system requires lesser depth and hence there will be reduction in storey height
3. Flat ceiling is available which gives attractive appearance

Disadvantages of Flat Slab

1. The thickness of slab is large. Hence more concrete required than beam supported slab
2. In flat slab construction, the absence of beams means that the slab itself needs to resist the shear forces that occur due to the loadings. This often leads to a higher demand for shear reinforcement in flat slabs.
3. Flat slab having more bending moment and shear force as their flexural strength is typically lower
4. It is less resistant to earthquake as it is less flexible than slab beam system.

The following table describes the comparison between Mat foundation and Pile foundation

Criteria/Foundation Type	Mat Foundation	Pile Foundation
Cost		
Concrete Cost	Generally less concrete required than pile foundation.	Generally more concrete required than mat foundation.
Excavation Cost	Need shallow trench to accommodate the thickness of footing hence excavation cost is lower.	Require excavating deep holes for individual pile, which require more labour, equipment. Hence excavation cost is higher.
Design	Comparatively simply designed shallow foundation that is thick reinforced concrete slab which supports the building and spread the building's load over a larger area of soil.	Long, slender columns made of concrete, steel, timber. They are driven, cast in situ, or both. It has comparatively complex design.
Material Availability	Required materials are easily availabe.	Required materials are easily availabe.
Basement	Mat foundation provide continous concrete slab that distribute the load evenly over wide area making them suitable for basements when soil condition is stable.	Pile foundation can limit the usable space for basement area.
Qualitative Comparison		
Soil Condition	Mat foundation is used when soil conditions are good enough for supporting the weight of structure.	Pile foundation is used when soil condition is poor so structure load need to be transferred to competent soil below.

Advantages of Mat Foundation

1. Concrete Cost Generally less concrete required than pile foundation.
2. Excavation Cost Need shallow trench to accommodate the thickness of footing hence excavation cost is lower
3. Comparatively simply designed shallow foundation that is thick reinforced concrete slab which supports the building and spreads the building's load over a larger area of soil.
4. Mat foundation provides continuous concrete slab that distribute the load evenly over a wide area making them suitable for basements when soil condition is stable.

Disadvantages of Mat Foundation

1. Mat foundation cannot be used when soil condition is poor.

Advantages of Pile Foundation

- Pile foundation is used when soil condition is poor so structure load need to be transferred to competent soil below

Disadvantages of Pile Foundation

- Require excavating deep holes for individual pile, which require more labour, equipment. Hence excavation cost is higher
- Generally more concrete required than mat foundation
- Long, slender columns made of concrete, steel, timber. They are driven, cast in situ, or both. It has comparatively complex design
- Pile foundation can limit the usable space for basement area

Decision Matrix:

1 = Less Suitability

2= Equal suitability

3= More suitability

Type A : Beam supported slab ; Mat foundation

Type B : Flat slab ; Pile foundation

Alternatives	Cost	Design		Material availability	Aesthetic		Qualitative Comparison	Total	Suitability
		Slab	Foundation		Slab	Foundation			
Type A	3	1	3	2	1	3	3	16	More Suitable
Type B	1	3	1	2	3	1	1	12	Less Suitable

Therefore, Beam supported slab and Mat foundation has been accepted

Section 11: Recommendation and Conclusion

From data analysis and conceptual calculation, the basic design considerations and other determinates are determined. Detailed analysis and discussion of these considerations have already been conducted. A summary of the recommended findings are presented below:

Structural Configuration:

- Due to the increased demand of population, the total floor size is increased to 1500 sq.ft and the number of floors is increased to 13.
- Design Type:
 - Beam Supported Slab system
 - Mat Foundation

Environmental considerations:

1. During the demolition process, care should be taken with the existing gas lines and water lines.
2. As a huge number of trees will be cut down for the construction process, many new trees will be planted accordingly.
3. As a huge amount of dust will be generated during the demolition, sheet-cover will be used to reduce dust. Also, continuous water spray will be done to reduce dust emission.
4. To reduce noise pollution, good working vehicles will be used, and transport must be run at a medium speed. Working will be avoided during the night period.
5. To ensure solid waste management, disposal will be done in an environmentally accepted manner.
6. 3R – Reduce, Reuse, Recycle, will be maintained in every step of the construction.
7. Environment Conservation Rules 2023 and the rules of DoE will be followed strictly.

Cost Consideration, Financial and Economic Justification:

- a. Total Cost of the Project= Tk. 896 crore
- b. From financial analysis, IRR is obtained as 8.2%. If discount rate remains below the marginal discount rate, the project will be financially viable.
- c. From economic analysis, the IRR is obtained as 14%. If discount rate remains below the marginal discount rate, the project will be economically viable.

Findings of sensitivity analysis:

- a. Decrease of benefit and increase of cost will increase the financial and economic risk of the project.
- b. Similar amount of changes in benefit and cost will incur almost similar risk factor.

Resettlement Consideration: During the demolition and construction process, current population of the colony must be relocated by maintaining the current living condition of the habitats. Proper data analysis, stakeholder participation and survey must be conducted for proper relocating measure.

Section 12: Annexes

Attach detailed technical and engineering designs, plant prototypes design etc. Financial & Economic models and any supporting documents.

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SAMPLE CALCULATION:

1.Water Demand Calculation:

Water Demand and Pump Design:

As per BNBC 2020

Domestic water demand = 180 lpcd

For mosque = 15 lpcd (per prayer period)

= $15 \times 5 = 75$ lpcd (for 5 prayer period)

Fire Risk Storage = 10 lpcd

For Community center = 90 lpcd

Garage = 15 lpcd

Utility = 10 lpcd

Population Forecast:

Current Population = 1340

$$P' = P(1+r/100)^n$$

$$P' = 1340 (1+1.03/100)^{20}$$

$$= 1650 \text{ (Approx)}$$

So, Future Population = 1650

P' = Future Population

P = Present Population

r = Growth rate (1.03%)

n = Design Year = 20 Years

Water Consumption:

Residential Buildings = $180 \times 1650 \text{ lpd} = 296.94 \text{ Klpd}$

For Mosque = $75 \times 1650 = 123.73 \text{ Klpd}$

For Community Center = $90 \times 1650 = 148.47 \text{ Klpd}$

For Garage = $14 \times 1650 = 24.75 \text{ Klpd}$

For Utility = $10 \times 1650 = 16.5 \text{ Klpd}$

Peak Factor:

Domestic = 2.5

Mosque = 4

Community Center = 4

Garage = 4

Utility = 4

Time Factor:

Domestic = $24/24 = 1$

Mosque = $24/24 = 1$

Community Center = $24/(2 \times 6) = 2$

Garage = $24/6 = 4$

Utility = $24/24 = 1$

For Firefighting:

Let, Diameter, $d=3"$

$$\text{Area of the pipe, } A = (.25\pi \cdot 257) = 05 \text{ ft}^2$$

Velocity of water, $v=3\text{fps}$

$$\text{Discharge of each hydrant, } Q=A*v = .05*3 = 15 \text{ ft / s}$$

$$\text{Volume of water for each hydrant} = Q * t$$

$$\text{No of hydrant working at a time} = 2$$

$$\text{Supply water duration, } t=30 \text{ min}=1800 \text{ sec}$$

$$\text{So, firefighting demand in supply line} = Q*t*2 = 540 \text{ ft}^3$$

$$= 540*28.32 \text{ litre}$$

$$= 15292 \text{ litre}$$

Calculation of Total Water Demand

Building Size	Building No	Present Population	Future Population	Facility Type	Water Demand BNBC 2020 (lpcd)	Water Consumption (lpd)	Peak Factor	Time Factor	Water Demand (lpd)
1500	4	1344	1649.705144	Domestic	180	296946.9259	2.5	1	742367.3146
		1344	1649.705144	Mosque	75	123727.8858	4	1	494911.5431
		1344	1649.705144	Community Center	90	148473.4629	4	2	1187787.703
		1344	1649.705144	Garage	15	24745.57715	4	4	395929.2345
		1344	1649.705144	Utility	10	16497.05144	4	1	65988.20575
1200	4	1152	1414.03298	Domestic	120	169683.9576	2.5	1	424209.8941
		1152	1414.03298	Mosque	75	106052.4735	4	1	424209.8941
		1152	1414.03298	Community Center	90	127262.9682	4	2	1018103.746
		1152	1414.03298	Garage	15	21210.4947	4	4	339367.9153
		1152	1414.03298	Utility	10	14140.3298	4	1	56561.31921
1000	4	960	1178.360817	Domestic	120	141403.298	2.5	1	353508.2451
		960	1178.360817	Mosque	75	88377.06127	4	1	353508.2451
		960	1178.360817	Community Center	90	106052.4735	4	2	848419.7882
		960	1178.360817	Garage	15	17675.41225	4	4	282806.5961
		960	1178.360817	Utility	10	11783.60817	4	1	47134.43268
800	4	960	1178.360817	Domestic	80	94268.86535	2.5	1	235672.1634
		960	1178.360817	Mosque	75	88377.06127	4	1	353508.2451
		960	1178.360817	Community Center	90	106052.4735	4	2	848419.7882
		960	1178.360817	Garage	15	17675.41225	4	4	282806.5961
		960	1178.360817	Utility	10	11783.60817	4	1	47134.43268
				Fire Fighting					290548
								Total Demand (lpd)	9092903.302

Pump Design:

Static head = $(200 + 100 + 130) = 430 \text{ ft}$

Velocity head = $v^2/2g$

$$= 3^2 / (2 \times 32)$$

$$= 0.14'$$

Minimum pipe length = $(500' + 130') = 630'$

Friction head = $(630' \times 10\%) = 63'$

Total Head = $(430' + 0.14' + 63') = 493.14'$

Yield of well, Q = $9.09 \text{ MI/d} = 378870.96 \text{ lph}$

$$= 378870.96 / 227.13 \text{ gpm}$$

$$= 1668.08 \text{ gpm}$$

For one pump,

Working horsepower, WPH = $493.14 \times 1668.08 / (3960 \times 3)$

$$= 69.24 \text{ Hp}$$

$$= 70 \text{ Hp (Approx)}$$

Breaking horsepower,

$$\text{BHP} = \text{WHP} / \eta$$

$$= 70 / 0.7$$

$$= 100 \text{ Hp}$$

Assuming pump efficiency, $\eta = 70\%$

2. Traffic Data Analysis:

Survey Data Summary:

Location	Exit								
	Gate 1			Gate 2			Gate 3		
Group	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00
Time									
Vehicle Type	7:30-8:30am	8:30-9:30am	9:30-10:30am	7:30-8:30am	8:30-9:30am	9:30-10:30am	7:30-8:30am	8:30-9:30am	9:30-10:30am
Light Vehicle	8.00	4.00	8.00	5.00	1.00	6.00	9.00	3.00	7.00
Motor Cycle	3.00	1.00	4.00	0.00	1.00	3.00	4.00	2.00	3.00
CNG	0.00	1.00	1.00	1.00	2.00	1.00	1.00	1.00	2.00
Rickshaw	4.00	0.00	0.00	1.00	0.00	0.00	5.00	3.00	3.00
Cycle	1.00	0.00	0.00	1.00	0.00	0.00	1.00	2.00	1.00
Entry									
Location	Gate 1			Gate 2			Gate 3		
Group	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00
Time									
Vehicle Type	7:30-8:30am	8:30-9:30am	9:30-10:30am	7:30-8:30am	8:30-9:30am	9:30-10:30am	7:30-8:30am	8:30-9:30am	9:30-10:30am
Light Vehicle	3.00	1.00	5.00	1.00	0.00	3.00	5.00	4.00	5.00
Motor Cycle	1.00	0.00	2.00	0.00	0.00	1.00	1.00	3.00	3.00
CNG	0.00	1.00	1.00	1.00	2.00	1.00	1.00	1.00	2.00
Rickshaw	4.00	0.00	0.00	1.00	0.00	0.00	5.00	3.00	3.00
Cycle	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	1.00

PCU/hr Calculation:

Exit G1 (7.30 am -8.30 am)							
Vehicle Composition							
Vehicle Type	Intervals(min)				Total No Of Vehicles	PCU Factor	Total PCU/ hr
Time	0-15	16-30	31-45	46-60			
Light Vehicle	2.00	4.00	2.00	0.00	8.00	1.00	8.00
Motor Cycle	0.00	1.00	2.00	0.00	3.00	0.75	2.25
CNG	0.00	0.00	0.00	0.00	0.00	0.75	0.00
Rickshaw	3.00	1.00	0.00	0.00	4.00	0.50	2.00
Cycle	1.00	0.00	0.00	0.00	1.00	0.50	0.50
Total number of vehicles							12.75

Exit G2 (7.30 am -8.30 am)							
Vehicle Composition							
Vehicle Type	Intervals(min)				Total No Of Vehicles	PCU Factor	Total PCU/ hr
Time	0-15	16-30	31-45	46-60			
Light Vehicle	1.00	2.00	1.00	1.00	5.00	1.00	5.00
Motor Cycle	0.00	0.00	0.00	0.00	0.00	0.75	0.00
CNG	0.00	1.00	0.00	0.00	1.00	0.75	0.75
Rickshaw	0.00	1.00	0.00	0.00	1.00	0.50	0.50
Cycle	0.00	1.00	0.00	0.00	1.00	0.50	0.50
Total Vehicles No							6.75

Exit G3(7.30 am -8.30 am)							
Vehicle Composition							
Vehicle Type	Intervals(min)				Total No Of Vehicles	PCU Factor	Total PCU/ hr
Time	0-15	16-30	31-45	46-60			
Light Vehicle	3.00	4.00	2.00	0.00	9.00	1.00	9.00
Motor Cycle	0.00	2.00	1.00	1.00	4.00	0.75	3.00
CNG	0.00	1.00	0.00	0.00	1.00	0.75	0.75
Rickshaw	3.00	2.00	0.00	0.00	5.00	0.50	2.50
Cycle	0.00	0.00	1.00	0.00	1.00	0.50	0.50
Total Vehicles No							15.75

Entry G1 (7.30 am -8.30 am)							
Vehicle Composition							
Vehicle Type	Intervals(min)				Total No Of Vehicles	PCU Factor	Total PCU/ hr
Time	0-15	16-30	31-45	46-60			
Light Vehicle	0.00	0.00	1.00	2.00	3.00	1.00	3.00
Motor Cycle	0.00	0.00	1.00	0.00	1.00	0.75	0.75
CNG	0.00	0.00	0.00	0.00	0.00	0.75	0.00
Rickshaw	3.00	1.00	0.00	0.00	4.00	0.50	2.00
Cycle	0.00	0.00	0.00	0.00	0.00	0.50	0.00
Total Vehicles No							5.75

Entry G2 (7.30 am -8.30 am)							
Vehicle Composition							
Vehicle Type	Intervals(min)				Total No Of Vehicles	PCU Factor	Total PCU/ hr
Time	0-15	16-30	31-45	46-60			
Light Vehicle	0.00	0.00	0.00	1.00	1.00	1.00	1.00
Motor Cycle	0.00	0.00	0.00	0.00	0.00	0.75	0.00
CNG	0.00	1.00	0.00	0.00	1.00	0.75	0.75
Rickshaw	0.00	1.00	0.00	0.00	1.00	0.50	0.50
Cycle	0.00	1.00	0.00	0.00	0.00	0.50	0.00
Total Vehicles No							2.25

Entry G3 (7.30 am -8.30 am)							
Vehicle Composition							
Vehicle Type	Intervals(min)				Total No Of Vehicles	PCU Factor	Total PCU/ hr
Time	0-15	16-30	31-45	46-60			
Light Vehicle	0.00	1.00	3.00	1.00	5.00	1.00	5.00
Motor Cycle	0.00	0.00	1.00	0.00	1.00	0.75	0.75
CNG	0.00	1.00	0.00	0.00	1.00	0.75	0.75
Rickshaw	3.00	2.00	0.00	0.00	5.00	0.50	2.50
Cycle	0.00	0.00	1.00	0.00	1.00	0.50	0.50
Total Vehicles No							9.50

Exit G1(8.30 am -9.30 am)							
Vehicle Composition							
Vehicle Type	Intervals(min)				Total No Of Vehicles	PCU Factor	Total PCU/ hr
Time	0-15	16-30	31-45	46-60			
Light Vehicle	0.00	1.00	1.00	2.00	4.00	1.00	4.00
Motor Cycle	0.00	0.00	1.00	0.00	1.00	0.75	0.75
CNG	0.00	0.00	1.00	0.00	1.00	0.75	0.75
Rickshaw	0.00	0.00	0.00	0.00	0.00	0.50	0.00
Cycle	0.00	0.00	0.00	0.00	0.00	0.50	0.00
Total Vehicles No							5.50

Exit G2 (8.30 am -9.30 am)							
Vehicle Composition							
Vehicle Type	Intervals(min)				Total No Of Vehicles	PCU Factor	Total PCU/ hr
Time	0-15	16-30	31-45	46-60			
Light Vehicle	0.00	0.00	1.00	0.00	1.00	1.00	1.00
Motor Cycle	0.00	0.00	0.00	1.00	1.00	0.75	0.75
CNG	1.00	1.00	0.00	0.00	2.00	0.75	1.50
Rickshaw	0.00	0.00	0.00	0.00	0.00	0.50	0.00
Cycle	0.00	0.00	0.00	0.00	0.00	0.50	0.00
Total Vehicles No							3.25

Exit G3 (8.30 am -9.30 am)							
Vehicle Composition							
Vehicle Type	Intervals(min)				Total No Of Vehicles	PCU Factor	Total PCU/ hr
Time	0-15	16-30	31-45	46-60			
Light Vehicle	0.00	0.00	1.00	2.00	3.00	1.00	3.00
Motor Cycle	0.00	0.00	1.00	1.00	2.00	0.75	1.50
CNG	0.00	1.00	0.00	0.00	1.00	0.75	0.75
Rickshaw	1.00	1.00	0.00	1.00	3.00	0.50	1.50
Cycle	0.00	0.00	2.00	0.00	2.00	0.50	1.00
Total Vehicles No							7.75

Entry G1 (8.30 am -9.30 am)							
Vehicle Composition							
Vehicle Type	Intervals(min)				Total No Of Vehicles	PCU Factor	Total PCU/ hr
Time	0-15	16-30	31-45	46-60			
Light Vehicle	0.00	1.00	0.00	0.00	1.00	1.00	1.00
Motor Cycle	0.00	0.00	0.00	0.00	0.00	0.75	0.00
CNG	0.00	0.00	1.00	0.00	1.00	0.75	0.75
Rickshaw	0.00	0.00	0.00	0.00	0.00	0.50	0.00
Cycle	0.00	0.00	0.00	0.00	0.00	0.50	0.00
Total Vehicles No							1.75

Entry G2 (8.30 am -9.30 am)							
Vehicle Composition							
Vehicle Type	Intervals(min)				Total No Of Vehicles	PCU Factor	Total PCU/ hr
Time	0-15	16-30	31-45	46-60			
Light Vehicle	0.00	0.00	0.00	0.00	0.00	1.00	0.00
Motor Cycle	0.00	0.00	0.00	0.00	0.00	0.75	0.00
CNG	1.00	1.00	0.00	0.00	2.00	0.75	1.50
Rickshaw	0.00	0.00	0.00	0.00	0.00	0.50	0.00
Cycle	0.00	0.00	0.00	0.00	0.00	0.50	0.00
Total Vehicles No							1.50

Entry G3 (8.30 am -9.30 am)							
Vehicle Composition							
Vehicle Type	Intervals(min)				Total No Of Vehicles	PCU Factor	Total PCU/ hr
Time	0-15	16-30	31-45	46-60			
Light Vehicle	0.00	0.00	2.00	2.00	4.00	1.00	4.00
Motor Cycle	0.00	0.00	1.00	2.00	3.00	0.75	2.25
CNG	0.00	1.00	0.00	0.00	1.00	0.75	0.75
Rickshaw	1.00	1.00	0.00	1.00	3.00	0.50	1.50
Cycle	0.00	0.00	0.00	0.00	0.00	0.50	0.00
Total Vehicles No							8.50

Exit G1 (9.30 am -10.30 am)							
Vehicle Composition							
Vehicle Type	Intervals(min)				Total No Of Vehicles	PCU	Total PCU/ hr
Time	0-15	16-30	31-45	46-60			
Light Vehicle	4.00	3.00	1.00	0.00	8.00	1.00	8.00
Motor Cycle	2.00	2.00	0.00	0.00	4.00	0.75	3.00
CNG	0.00	1.00	0.00	0.00	1.00	0.75	0.75
Rickshaw	0.00	0.00	0.00	0.00	0.00	0.50	0.00
Cycle	0.00	0.00	0.00	0.00	0.00	0.50	0.00
Total Vehicles No							11.75

Exit G2 (9.30 am -10.30 am)							
Vehicle Composition							
Vehicle Type	Intervals(min)				Total No Of Vehicles	PCU	Total PCU/ hr
Time	0-15	16-30	31-45	46-60			
Light Vehicle	3.00	1.00	2.00	0.00	6.00	1.00	6.00
Motor Cycle	0.00	2.00	0.00	1.00	3.00	0.75	2.25
CNG	0.00	1.00	0.00	0.00	1.00	0.75	0.75
Rickshaw	0.00	0.00	0.00	0.00	0.00	0.50	0.00
Cycle	0.00	0.00	0.00	0.00	0.00	0.50	0.00
Total Vehicles No							9.00

Exit G3 (9.30 am -10.30 am)							
Vehicle Composition							
Vehicle Type	Intervals(min)				Total No Of Vehicles	PCU	Total PCU/ hr
Time	0-15	16-30	31-45	46-60			
Light Vehicle	2.00	3.00	1.00	1.00	7.00	1.00	7.00
Motor Cycle	1.00	1.00	1.00	0.00	3.00	0.75	2.25
CNG	0.00	1.00	0.00	1.00	2.00	0.75	1.50
Rickshaw	2.00	1.00	0.00	0.00	3.00	0.50	1.50
Cycle	0.00	0.00	0.00	1.00	1.00	0.50	0.50
Total Vehicles No							12.75

Entry G1 (9.30 am -10.30 am)							
Vehicle Composition							
Vehicle Type	Intervals(min)				Total No Of Vehicles	PCU	Total PCU/ hr
Time	0-15	16-30	31-45	46-60			
Light Vehicle	1.00	0.00	1.00	3.00	5.00	1.00	5.00
Motor Cycle	0.00	0.00	1.00	1.00	2.00	0.75	1.50
CNG	0.00	1.00	0.00	0.00	1.00	0.75	0.75
Rickshaw	0.00	0.00	0.00	0.00	0.00	0.50	0.00
Cycle	0.00	0.00	0.00	0.00	0.00	0.50	0.00
Total Vehicles No							7.25

Entry G2 (9.30 am -10.30 am)							
Vehicle Composition							
Vehicle Type	Intervals(min)				Total No Of Vehicles	PCU	Total PCU/ hr
Time	0-15	16-30	31-45	46-60			
Light Vehicle	0.00	0.00	2.00	1.00	3.00	1.00	3.00
Motor Cycle	0.00	2.00	0.00	1.00	1.00	0.75	0.75
CNG	0.00	1.00	0.00	0.00	1.00	0.75	0.75
Rickshaw	0.00	0.00	0.00	0.00	0.00	0.50	0.00
Cycle	0.00	0.00	0.00	1.00	1.00	0.50	0.50
Total Vehicles No							5.00

Gate Wise Percentage Distribution:

PCU/hr (For Exit)				
Time	Group	PCU/hr	Total	Distribution (%)
7:30-8:30am	G-1	12.75	35.25	36.17
	G-2	6.75		19.15
	G-3	15.75		44.68
8:30-9:30am	G-1	5.50	15.00	36.67
	G-3	6.25		41.67
9:30-10:30am	G-1	11.75	33.50	35.07
	G-2	9.00		26.87
	G-3	12.75		38.06

PCU/hr (For Entry)				
Time	Group	PCU/hr	Total	Distribution (%)
7:30-8:30am	G-1	5.75	17.50	32.86
	G-2	2.25		12.86
	G-3	9.50		54.29
8:30-9:30am	G-1	1.75	11.75	14.89
	G-2	1.50		12.77
	G-3	8.50		72.34
9:30-10:30am	G-1	7.25	23.00	31.52
	G-2	5.00		21.74
	G-3	10.75		46.74

ADT Calculation:

Gate 1 (Entry)							
Time	PCU	HEF	Estimated 24 hr Volume	DEF	Estimated Volume for Week	ADT (PCU/day)	%ADT
7:30-8:30am	5.75	28.99	166.69	7.01	1168.51	166.93	48.80
8:30-9:30am	1.75	22.05	38.59	7.01	270.50	38.64	11.30
9:30-10:30am	7.25	18.80	136.30	7.01	955.46	136.49	39.90
Total ADT						342.07	

Gate 2 (Entry)							
Time	PCU	HEF	Estimated 24 hr Volume	DEF	Estimated Volume for Week	ADT (PCU/day)	%ADT
7:30-8:30am	2.25	28.99	65.23	7.01	457.24	65.32	33.92
8:30-9:30am	1.50	22.05	33.08	7.01	231.86	33.12	17.20
9:30-10:30am	5.00	18.80	94.00	7.01	658.94	94.13	48.88
Total ADT						192.58	

Gate 3 (Entry)							
Time	PCU	HEF	Estimated 24 hr Volume	DEF	Estimated Volume for Week	ADT (PCU/day)	%ADT
7:30-8:30am	9.50	28.99	275.41	7.01	1930.59	275.80	41.42
8:30-9:30am	8.50	22.05	187.43	7.01	1313.85	187.69	28.19
9:30-10:30am	10.75	18.80	202.10	7.01	1416.72	202.39	30.39
Total ADT						665.88	

Gate 1 (Exit)							
Time	PCU	HEF	Estimated 24 hour volume(PCU)	DEF	Estimated Volume for Week	ADT (PCU/day)	%ADT
7:30-8:30am	12.75	28.99	369.62	7.01	2591.05	370.15	51.93
8:30-9:30am	5.50	22.05	121.28	7.01	850.14	121.45	17.04
9:30-10:30am	11.75	18.80	220.90	7.01	1548.51	221.22	31.03
Total ADT						712.81	

Gate 2 (Exit)							
Time	PCU	HEF	Estimated 24 hour volume(PCU)	DEF	Estimated Volume for Week	ADT (PCU/day)	%ADT
7:30-8:30am	6.75	28.99	195.68	7.01	1371.73	195.96	44.83
8:30-9:30am	3.25	22.05	71.66	7.01	502.35	71.76	16.42
9:30-10:30am	9.00	18.80	169.20	7.01	1186.09	169.44	38.76
Total ADT						437.17	

Gate 3 (Exit)							
Time	PCU	HEF	Estimated 24 hour volume(PCU)	DEF	Estimated Volume for Week	ADT (PCU/day)	%ADT
7:30-8:30am	15.75	28.99	456.59	7.01	3200.71	457.24	54.74
8:30-9:30am	6.25	22.05	137.81	7.01	966.07	138.01	16.52
9:30-10:30am	12.75	18.80	239.70	7.01	1680.30	240.04	28.74
Total ADT						835.30	

Preliminary Estimation of Slab, Beam, Column Size

Here,

Compressive Strength of Concrete, $F_c' = 4 \text{ ksi}$

Yield Strength of Steel, $F_y' = 60 \text{ ksi}$

Slab Thickness Determination

For Slab -1,

clear span (of longer side), $L = 13'-4''$

$= 160''$

clear span (of shorter side), $B = 12'-1''$

$= 45''$

aspect ratio, $\beta = L/B$

$= 160/145$

$= 1.10345$

$L/B < 2$

So, this slab is a two-way slab.

Hence,

$$\text{Thickness, } t_{\min} = \ln^*(0.8 + f_y/200) / (36 + 9 \beta)$$

$$= 160 * (.8 + 60/200) / (36 + 9 * 1.10345)$$

$$= 3.83 \text{ in}$$

But, minimum thickness = 5 in

So, thickness = 5 in

Thickness calculation for other slabs is same process.

For slab-2, thickness, $t_{min} = 5.75 \text{ in}$

For slab-3, thickness, $t_{min} = 7 \text{ in}$

For slab-4, thickness, $t_{min} = 5.5 \text{ in}$

For slab-5, thickness, $t_{min} = 5 \text{ in}$

For Baranda-1,

clear span (of longer side), $L = 7' - 6''$

$$= 90''$$

clear span (of shorter side), $B = 2' - 9''$

$$= 33''$$

aspect ratio, $\beta = L/B$

$$= 90/33$$

$$= 2.7$$

$$L/B > 2$$

So, this slab is a one-way slab.

Hence,

$$\begin{aligned} \text{Thickness, } t_{\min} &= 90/24 \\ &= 3.75 \text{ in} \\ &= 5 \text{ in} \end{aligned}$$

For Baranda-2, thickness, $t_{\min} = 5$ in

For Lobby, Thickness, $t_{\min} = 5$ in

Taking the maximum of t_{\min} ,

Thickness of the slab, $t = 7$ in

Panel	L(in)	B(in)	L/B	Slab Type	I_n	t_{\min} (in)
Slab 1	160	145	1.103448	Two-way	160	5
Slab 2	265	160	1.65625	Two-way	265	5.75
Slab 3	291	265	1.098113	Two-way	291	7
Slab 4	254	145	1.751724	Two-way	254	5.5
Slab 5	265	110	2.409091	One-way	265	5
Bar 1	135	49	2.755102	One-way	135	5
Bar 2	90	33	2.727273	One-way	90	5
Lobby	190	110	1.727273	Two-way	190	5

Preliminary Estimation of Beam Size

Assume, Beam width= 12 in

For preliminary, h:

Table 6.6.1: Minimum Thickness of Non-Prestressed Beams or One-Way slabs unless Deflections are calculated

Member	Minimum thickness, h			
	Simply supported	One end continuous	Both ends continuous	Cantilever
Members not supporting or attached to partitions or other construction likely to be damaged by large deflections				
Solid one-way slabs	l/20	l/24	l/28	l/10
Beams or ribbed one-way slabs	l/16	l/18.5	l/21	l/8

Here, Longer span, l = 291in

So, minimum thickness, h= 291/21in

$$= 13.85 \text{ in}$$

$$= 14 \text{ in (rounding 1 in)}$$

So, thickness of beam= (h+2) in $\geq 3*t_{\text{slab}}$

$$= (14+2) \text{ in} \geq 3*7 \text{ in}$$

$$= 16 \text{ in} \geq 21 \text{ in}$$

$$= 21 \text{ in}$$

Hence, **Beam size = 12*21**

Preliminary Estimation of Column Size

Slab thickness, $t = 7"$

Partition wall, $PW = 100 \text{ psf}$

Floor finish, $FF = 25 \text{ psf}$

$$\text{Load on floors, } W_{DL} = ((t/12) * 150 + PW + FF)$$

$$= ((7/12) * 150 + 100 + 25) \text{ psf}$$

$$= 212.5 \text{ psf}$$

$$W_{LL} = 40 \text{ psf}$$

$$W_u = 1.2W_{DL} + 1.6W_{LL}$$

$$= (1.2 * 212.5 + 1.6 * 40) \text{ psf}$$

$$= 319 \text{ psf}$$

Preliminary Estimation of Column Size (based on Gravity Loads):

For Column "A1":

$$\text{Contributing area for A1} = 23200 / (4 * 144) \text{ ft}^2$$

$$= 40.27778 \text{ ft}^2$$

$$P_u = W_u * (\text{contributing area}) * 14 \text{ floors}$$

$$= 319 * 40.27778 * 14 \text{ kip}$$

$$= 179.881 \text{ kip}$$

$$P_u = \alpha \varphi A_g [0.85 f_c' (1 - \rho_g) + \rho_g f_y]$$

Let's assume, $\rho_g = 1\%$

$$f_c' = 4 \text{ ksi}$$

$$f_y = 60 \text{ ksi}$$

$$\Rightarrow 179.881 \text{ kip} = 0.80 * 0.65 * A_g * [0.85 * 4 * (1-1\%) + 1\% * 60]$$

$$\Rightarrow A_g = 87.2224 \text{ in}^2$$

$$\Rightarrow c = 12"$$

Hence, column size(A1) = 12" x 12"

For Column "A2":

$$\text{Contributing area for A2} = (3200 + 36830) / (4 * 144) \text{ ft}^2$$

$$= 104.21875 \text{ ft}^2$$

$$P_u = W_u * (\text{contributing area}) * 14 \text{ floors}$$

$$= 319 * 104.21875 * 14 \text{ kip}$$

$$= 465.441 \text{ kip}$$

$$P_u = \alpha \varphi A_g [0.85 f_c' (1 - \rho_g) + \rho_g f_y]$$

$$\Rightarrow 465.441 \text{ kip} = 0.80 * 0.65 * A_g * [0.85 * 4 * (1-1\%) + 1\% * 60]$$

$$\Rightarrow A_g = 225.688 \text{ in}^2$$

$$\Rightarrow c = 16"$$

Hence, column size(A1) = 16" x 16"

For Column "A3":

$$\text{Contributing area for A3} = 36830 / (4 * 144) \text{ ft}^2$$

$$= 63.94097 \text{ ft}^2$$

$$P_u = W_u * (\text{contributing area}) * 14 \text{ floors}$$

$$= 319 * 63.94097 * 14 \text{ kip}$$

$$= 285.5604 \text{ kip}$$

$$P_u = \alpha \varphi A_g [0.85 f_c' (1 - \rho_g) + \rho_g f_y]$$

$$\Rightarrow 285.5604 = 0.80 * 0.65 * A_g * [0.85 * 4 * (1-1\%) + 1\% * 60]$$

$$\Rightarrow A_g = 138.4656 \text{ in}^2$$

$$\Rightarrow c = 12"$$

Hence, column size(A1) = 12" x 12"

For Column "B1":

$$\begin{aligned}\text{Contributing area for B1} &= (23200+42400)/(4*144) \text{ ft}^2 \\ &= 113.89 \text{ ft}^2\end{aligned}$$

$$\begin{aligned}P_u &= W_u * (\text{contributing area}) * 14 \text{ floors} \\ &= 319 * 113.89 * 14 \text{ kip} \\ &= 508.6278 \text{ kip}\end{aligned}$$

$$\begin{aligned}P_u &= \alpha \phi A_g [0.85 f_c' (1 - \rho_g) + \rho_g f_y] \\ \Rightarrow 508.6278 &= 0.80 * 0.65 * A_g * [0.85 * 4 * (1-1\%) + 1\% * 60] \\ \Rightarrow A_g &= 246.6289 \text{ in}^2 \\ \Rightarrow c &= 16"\end{aligned}$$

Hence, column size(A1) = 16" x 16"

Similarly, calculations for other columns are done.

Column	Contributing Area(ft ²)	Pu(kip)	Ag	Column Size
A1	40.27777778	179.8806	87.22243	12
A2	104.21875	465.4409	225.688	16
A3	63.94097222	285.5604	138.4656	12
A4	63.94097222	285.5604	138.4656	12
A5	104.21875	465.4409	225.688	16
A6	40.27777778	179.8806	87.22243	12
B1	113.8888889	508.6278	246.6289	16
B2	311.7100694	1392.097	675.0151	26
B3	184.4878472	823.9227	399.5126	20
B4	184.4878472	823.9227	399.5126	20
B5	311.7100694	1392.097	675.0151	26
B6	113.8888889	508.6278	246.6289	16
C1	73.61111111	328.7472	159.4065	14
C2	207.4913194	926.6562	449.3271	22
C3	220.7725694	985.9703	478.0879	22
C4	220.7725694	985.9703	478.0879	22
C5	207.4913194	926.6562	449.3271	22
C6	73.61111111	328.7472	159.4065	14
D1	73.61111111	328.7472	159.4065	14
D2	207.4913194	926.6562	449.3271	22
D3	220.7725694	985.9703	478.0879	22
D4	220.7725694	985.9703	478.0879	22
D5	207.4913194	926.6562	449.3271	22
D6	73.61111111	328.7472	159.4065	14
E1	113.8888889	508.6278	246.6289	16
E2	311.7100694	1392.097	675.0151	26
E3	184.4878472	823.9227	399.5126	20
E4	184.4878472	823.9227	399.5126	20
E5	311.7100694	1392.097	675.0151	26
E6	113.8888889	508.6278	246.6289	16
F1	40.27777778	179.8806	87.22243	12
F2	104.21875	465.4409	225.688	16
F3	63.94097222	285.5604	138.4656	12
F4	63.94097222	285.5604	138.4656	12
F5	104.21875	465.4409	225.688	16
F6	40.27777778	179.8806	87.22243	12

Preliminary Estimation and Design of Mat Foundation:

a. Summary of Column Load:

Column Position	Ultimate Load, Pu(kip)	Column Size(inxin)
A1	285.56	12*12
B1	823.9	20*20
C1	985.97	22*22
D1	285.56	12*12
E1	823.9	20*20
F1	985.97	22*22
A2	465.44	16*16
B2	1392.1	26*26
C2	926.7	22*22
D2	465.44	16*16
E2	1392.1	26*26
F2	926.7	22*22
A3	179.9	12*12
B3	508.6	16*16
C3	328.6	14*14
D3	179.9	12*12
E3	508.6	16*16
F3	328.6	14*14
A4	285.56	12*12
B4	823.9	20*20
C4	985.97	22*22
D4	285.56	12*12
E4	823.9	20*20
F4	985.97	22*22
A5	465.44	16*16
B5	1392.1	26*26
C5	926.7	22*22
D5	465.44	16*16
E5	1392.1	26*26
F5	926.7	22*22
A6	179.9	12*12
B6	508.6	16*16
C6	328.6	14*14
D6	179.9	12*12
E6	508.6	16*16
F6	328.6	14*14

Total Load Coming from Column = sum of (A1 to F6) = 23587.1 kip

Center of Load and Footing Area:

Center of Area: Considering Area of Mat=100'x92'

C.g. of Footing: (46', 50')

C.g. of Load:

Along x:

X= (Sum of (Load x Distance from footing Left Corner))/Sum of Load)

$$X = (.5 * (285.6 + 179.9 + 285.6 + 179.9) + 1.3 * (465.4 * 2) + 15.5 * (823.9 * 2) + 16.3 * 1392.1 * 2 + 16.3 * 508.6 * 2 + 40.5 * (328.6 + 1328.6 + 985.97 * 2) + 41.33 * (926.7 + 926.7) + 58.5 * (285.6 * 2 + 179.9 * 2) + 59.3 * 465.4 * 2 + 83.5 * (823.9 * 2 + 508.6 * 2) + 84.33 * 1392.1 * 2 + 98.5 * (985.7 * 2 + 328.6 * 2) + 99.33 * (926.7 * 2)) / 23587.1$$

X=56.1 feet

Along Y:

Y= (Sum of(Load x Distance from footing Top Corner))/Sum of Load)

$$y = ((.5 * 285.6 + 1.67 * 823.9 + 1.83 * 985.97) * 2 + (16.5 * 465.4 + 17.67 * 1392.1 + 17.83 * 926.7) * 2 + (40.1 * 179.9 + 41.27 * 508.6 + 41.43 * 328.6) * 2 + (52.4 * 285.6 + 53.57 * 823.9 + 53.73 * 985.97) * 2 + (83.3 * 465.4 + 84.47 * 1392.1 + 84.63 * 926.7) * 2 + (90.8 * 179.9 + 91.97 * 508.6 + 92.13 * 328.6)) / (23586.1)$$

Y=41.3 feet

So from here, we can see that footing and load center do not coincide. So we need to consider eccentricity effect

Check if Eccentricity is within Middle One-Third of Dimension:

Along x: From footing center, allowable eccentricity in both side= $100'/3=33.33'$

Now, one side allowable eccentricity from footing = $33.33'/2=16.6'$

The eccentricity of load from center of footing= $56.1'-50'=6.1' < 16.6'$ (ok)

Along Y: From footing center, allowable eccentricity in both side= $92'/3=30.7'$

Now, one side allowable eccentricity from footing = $30.7'/2=15.3'$

The eccentricity of load from center of footing= $46'-41.3'=4.7' < 15.3'$ (ok)

Comment: As the load is within middle one-third of the eccentricity in both direction, **no tension will generate in the footing.**

Calculation of Moment Due to Eccentricity:

Along X:

Center of area=50'

Center of load=56.1'

Eccentricity of Load from center along x direction is

$e_x=56.1'-50'=6.1'$ (Towards right of footing area)

$$\text{So, Moment Due to Eccentricity, } M_y = (P_u)_{\text{total}} * e_x = 23587.1 * 6.1 \text{ kip-ft} \\ = 150957 \text{ kip-ft}$$

Along Y:

Center of area=46'

Center of load=41.3'

Eccentricity of Load from center along y direction is $e_y = 45.6' - 41.3' = 4.35'$

(Above footing area)

$$\text{Moment Due to Eccentricity, } M_x = (P_u)_{\text{total}} * e_y = 23587.1 * 4.35 \text{ kip-ft} \\ = 102604 \text{ kip-ft}$$

Formulation for Stress Calculation:

Moment of Inertia:

$$I_x = (92e3 * 100) / 12 \text{ in}^4$$

$$= 6.3e6 \text{ in}^4$$

$$I_y = (100e3 * 92) / 12 \text{ in}^4$$

$$= 7.5e6 \text{ in}^4$$

Area of the Mat : 9200 sq.in

$$\text{Stress, } \delta = (P_u)_{\text{total}} / \text{Area} + (M_x * Y / I_x) + (M_y * X / I_y)$$

$$= 2.6 + .016 * Y + .02 * X \text{ Ksf}$$

Depth of Footing Calculation:

Depth is calculated using Punching Shear criteria.

a. For 12"x12" column:

Maximum $P_u = 285.56$ kip

Now $P_u < \text{Factored concrete capacity}$

$$so, 285.56 * 1000 = .75 * 4 * \sqrt{4000} * b_o * d \dots\dots(1)$$

$$\text{here critical parameter } b_o = 2 * ((12+d) + (12+d)) \dots\dots(2)$$

By Solving 1 and 2,

$$\underline{d=15''}$$

b. For 20"x20" column:

Maximum $P_u = 926.7$ kip

Now $P_u < \text{Factored concrete capacity}$

$$so, 926.7 * 1000 = .75 * 4 * \sqrt{4000} * b_o * d \dots\dots(1)$$

$$\text{here critical parameter } b_o = 2 * ((20+d) + (20+d)) \dots\dots(2)$$

By Solving 1 and 2,

$$\underline{d=27''}$$

c. For 22" x 22" column:

Maximum $P_u = 985.97$ kip

Now $P_u < \text{Factored concrete capacity}$

$$\text{so, } 985.97 * 1000 = .75 * 4 * \text{sq. root}(4000) * b_o * d \dots\dots(1)$$

$$\text{here critical parameter, } b_o = 2 * ((22+d)+(22+d)) \dots\dots(2)$$

By Solving 1 and 2,

$$\underline{d=27''}$$

d. For 16" x 16" column:

Maximum $P_u = 508.6$ kip

Now $P_u < \text{Factored concrete capacity}$

$$\text{so, } 508.6 * 1000 = .75 * 4 * \text{sq. root}(4000) * b_o * d \dots\dots(1)$$

$$\text{here critical parameter, } b_o = 2 * ((16+d)+(16+d)) \dots\dots(2)$$

By Solving 1 and 2,

$d=20"$

e. For 14"x14" column:

Maximum $P_u=328.6$ kip

Now $P_{u\text{c}}=\text{Factored concrete capacity}$

$$\text{so, } 328.6 \times 1000 = .75 \times 4 \times \sqrt{4000} \times b_o \times d \dots\dots(1)$$

$$\text{here critical parameter, } b_o = 2 \times ((14+d)+(14+d)) \dots\dots(2)$$

By Solving 1 and 2,

$d=15"$

f. For 26"x26" column:

Maximum $P_u=1392.1$ kip

Now $P_{u\text{c}}=\text{Factored concrete capacity}$

$$\text{so, } 1392.1 \times 1000 = .75 \times 4 \times \sqrt{4000} \times b_o \times d \dots\dots(1)$$

$$\text{here critical parameter, } b_o = 2 \times ((26+d)+(26+d)) \dots\dots(2)$$

By Solving 1 and 2,

$$\underline{d=32''}$$

From all the criteria, maximum effective depth= **32"**

so, Depth of footing required = $d+3''+1.5''=36.5''$

$$=\underline{\underline{3'-1''}}$$

Provided Footing Depth=3.5'

Allowable Bearing Capacity:

Bearing Capacity of the soil at different depth are provided at the soil test report. Some important Considerations regarding the parameters obtained from soil report are provided below:

- a) The bearing capacity are net allowable bearing capacity with F.S.=3
- b) Ground water level was considered at GL.
- c) Inclination factor, ground factors & base factors have been considered as 1 in calculating Hansen and Meyerhof bearing capacity equation.

The avg. bearing capacity at footing depth=376 kpa

=7.52 Ksf

Stress Check:

Column Position	Stress, $\delta=2.6 - .016*Y + .02*X$ (ksf)	Allowable Net Bearing Capacity (Ksf)	Comment
A1	2.9		Ok
A2	3.1		Ok
A3	3.5		Ok
B1	2.6		Ok
B2	2.8		Ok
B3	3.2		Ok
C1	2.1		Ok
C2	2.3		Ok
C3	2.7		Ok

Column Position	Stress, $\delta=2.6 - .016*Y - .02*X$ (ksf)	Allowable Net Bearing Capacity (Ksf)	Comment
D1	1.7		Ok
D2	1.9		Ok
D3	2.3		Ok
E1	1.2		Ok
E2	1.4		Ok
E3	1.8		Ok
F1	1		Ok
F2	1.1		Ok
F3	1.5		Ok

Stress Check:

Column Position	Stress, $\delta=2.6+.016*Y+.02*X$	Allowable Net Bearing Capacity (Ksf)	Comment
A4	3.7	7.52	Ok
A5	4.1		Ok
A6	4.3		Ok
B4	3.4		Ok
B5	3.8		Ok
B6	4		Ok
C4	2.9		Ok
C5	3.3		Ok
C6	3.5		Ok
			Ok
Column Postion	Stress, $\delta=2.6+.016*Y-.02*X$	Allowable Net Bearing Capacity (Ksf)	Comment
D4	2.5	7.52	Ok
D5	2.9		Ok
D6	3.1		Ok
E4	2		Ok
E5	2.4		Ok
E6	2.6		Ok
F4	1.7		Ok
F5	2.1		Ok
F6	2.3		Ok

Check for Settlement:

a. Immediate Settlement:

Settlement at the center of the footing,

$$Se = 4 * \delta_{max} * B' * (1 - u^2) * (If / Es) * Is$$

here, $\delta_{max} = 4.3 \text{ Ksf}$

$$B' = (92 - ex^2) / 4 = 20.625'$$

$u = .4$ (for Saturated Clay)

$$If = .8$$

$$Is = 0.66 (Df/B)^{-0.19} + 0.025(L/B + 12\mu - 4.6) = .9$$

$$Es = A * Cu$$

Now, $A = 1500$ (for Stiff Clay)
and $Cu = 107 \text{ kPa}$ (from soil test report)

$$Es = A * Cu = 160500 \text{ kPa} = 3370.5 \text{ ksf}$$

So immediate settlement, $(Se)_1 = 4 * .016'$

$$= .057' = 17 \text{ mm}$$

b. Consolidation Settlement:

$$(Se)_2 = Cr \left(H / (1 + e_0) \right)^2 \log_{10} \left((p + \Delta p) / p \right)$$

$$Cr = .015$$

$$\text{Existing pressure, } P = (.12 - .0624) * 24 \text{ Ksf} = 1.44$$

$$e_0 = 1.14$$

$$\text{Additional Pressure, } \Delta p = 4.3 \text{ Ksf}$$

$$H = 11.6'$$

$$\text{so } (Se)_2 = .048' = 14 \text{ mm}$$

$$\text{Total Settlement} = 17 \text{ mm} + 14 \text{ mm}$$

$$= 31 \text{ mm}$$

Maximum Limit for Mat Foundation = 50 mm > 31 mm

(ok)

Cost for Reducing Negative Impact of Environment:

No.	Activities/item	Unit	Rate(BDT)	Quantity	Amount(BDT)
1	A. Preconstruction/Design Stage	MM			
1	DSC (Environmental Specialist/Engineer)	MM	200,000	0.5	100,000
2	Tree cutting & carrying	To be included Civil Works			
3	Shifting of Utilities	To be included Civil Works			
				Sub Total	100,000
	B. Construction Stage (3 years)				
1	DSC (Environmental Specialist/Engineer)	MM	200,000	3	600,000
2	Air Quality	Lum-sum (yearly)			100,000
3	Noise Level Measurement	Lum-sum (yearly)			50,000
4	Drinking Water Quality Testing	Lum-sum (yearly)			30,000
5	Occupational H&S (PPE, First aid Box etc.)	T be included in civil works			
6	Contingency	LS			100,000
	Sub Total			Sub Total	880,000
	C. Operation Stage				
1	Tree Replantation	NO	300	300	90,000
2	Drinking Water Quality Testing	Lum-sum (yearly)			15,000
3	Air Quality Testing	Lum-sum (yearly)			50,000
4	Noise Level Measurement	Lum-sum (yearly)			25,000
5	Contingency	LS			50,000
				Sub Total	230,000
				Total (A+B+C)	1,210,000

Sensitivity Analysis:

Year	Undiscounted Cost (Lakhs)			Undiscounted Benefits (Lakhs)	Net Cash Flow (Undiscounted) (Lakhs)	Net Present Worth (Lakhs)		Internal rate of Return	Discount Rate(%)	NPV of Benefit	NPV of Cost	B/C Ratio
	Construction Cost and Relocation Cost	Maintenance Cost	Total Cost			Total Benefit	(Total Benefit-Total Cost)			Discount rate=8%	Discount rate=9%	
Construction Year-1	17121.00	0.00	17121.00	0.00	-17121.00							
Construction Year-2	17121.00	0.00	17121.00	0.00	-17121.00							
Construction Year-3	17121.00	0.00	17121.00	0.00	-17121.00							
4	0.00	513.63	513.63	3306.00	2792.37							
5	0.00	513.63	513.63	3306.00	2792.37							
6	0.00	513.63	513.63	3306.00	2792.37							
7	0.00	513.63	513.63	3306.00	2792.37							
8	0.00	513.63	513.63	3306.00	2792.37							
9	0.00	564.99	564.99	3306.00	2741.01							
10	0.00	564.99	564.99	3306.00	2741.01							
11	0.00	564.99	564.99	3306.00	2741.01							
12	0.00	564.99	564.99	3306.00	2741.01							
13	0.00	564.99	564.99	3306.00	2741.01							
14	0.00	621.49	621.49	5289.60	4668.11							
15	0.00	621.49	621.49	5289.60	4668.11							
16	0.00	621.49	621.49	5289.60	4668.11							
17	0.00	621.49	621.49	5289.60	4668.11							
18	0.00	621.49	621.49	5289.60	4668.11							
19	0.00	683.64	683.64	5289.60	4605.96							
20	0.00	683.64	683.64	5289.60	4605.96							
21	0.00	683.64	683.64	5289.60	4605.96							
22	0.00	683.64	683.64	5289.60	4605.96							
23	0.00	683.64	683.64	5289.60	4605.96							
24	0.00	752.01	752.01	8463.36	7711.35							
25	0.00	752.01	752.01	8463.36	7711.35							
26	0.00	752.01	752.01	8463.36	7711.35							
27	0.00	752.01	752.01	8463.36	7711.35							
28	0.00	752.01	752.01	8463.36	7711.35							
29	0.00	827.21	827.21	8463.36	7636.15							
30	0.00	827.21	827.21	8463.36	7636.15							
31	0.00	827.21	827.21	8463.36	7636.15							
32	0.00	827.21	827.21	8463.36	7636.15							
33	0.00	827.21	827.21	8463.36	7636.15							
34	0.00	909.93	909.93	13541.38	12631.45							
35	0.00	909.93	909.93	13541.38	12631.45							
36	0.00	909.93	909.93	13541.38	12631.45							
37	0.00	909.93	909.93	13541.38	12631.45							
38	0.00	909.93	909.93	13541.38	12631.45							
39	0.00	1000.92	1000.92	13541.38	12540.46							
40	0.00	1000.92	1000.92	13541.38	12540.46							
41	0.00	1000.92	1000.92	13541.38	12540.46							
42	0.00	1000.92	1000.92	13541.38	12540.46							
43	0.00	1000.92	1000.92	13541.38	12540.46							
44	0.00	1101.01	1101.01	21666.20	20565.19							
45	0.00	1101.01	1101.01	21666.20	20565.19							
46	0.00	1101.01	1101.01	21666.20	20565.19							
47	0.00	1101.01	1101.01	21666.20	20565.19							
48	0.00	1101.01	1101.01	21666.20	20565.19							
49	0.00	1211.11	1211.11	21666.20	20455.09							
50	0.00	1211.11	1211.11	22179.83	20968.72							

Undiscounted Cost (Lakhs)			Undiscounted Benefits (Lakhs)	Undiscounted Benefits (Lakhs)	Net Cash Flow (Undiscounted) (Lakhs)	Net Present Worth (Lakhs)		Internal rate of Return	Discount Rate(%)	NPV of Benefit	NPV of Cost	B/C Ratio
Construction Cost and Relocation Cost	Maintenance Cost	Total Cost	Total Benefit	Total Benefit decreased by 10%	(Total Benefit-Total Cost)	Discount rate=7%	Discount rate=11%	(At this, NPW=0)		At Different Discount Rate	At Different Discount Rate	At Different Discount Rate
17121.00	0.00	17121.00	0.00	0.00	-17121.00	5052.22	-18335.12	<u>0.075</u>	12.000	23624.68	44586.79	0.53
17121.00	0.00	17121.00	0.00	0.00	-17121.00				10.000	32240.29	47064.66	0.69
17121.00	0.00	17121.00	0.00	0.00	-17121.00				9.000	38416.61	48519.85	0.79
0.00	513.63	513.63	3306.00	2975.40	2461.77				8.000	46470.69	50174.45	0.93
0.00	513.63	513.63	3306.00	2975.40	2461.77				7.000	57142.88	52090.65	1.10
0.00	513.63	513.63	3306.00	2975.40	2461.77				6.000	71514.98	54356.65	1.32
0.00	513.63	513.63	3306.00	2975.40	2461.77							
0.00	513.63	513.63	3306.00	2975.40	2461.77							
0.00	564.99	564.99	3306.00	2975.40	2410.41							
0.00	564.99	564.99	3306.00	2975.40	2410.41							
0.00	564.99	564.99	3306.00	2975.40	2410.41							
0.00	564.99	564.99	3306.00	2975.40	2410.41							
0.00	564.99	564.99	3306.00	2975.40	2410.41							
0.00	564.99	564.99	3306.00	2975.40	2410.41							
0.00	621.49	621.49	5289.60	4760.64	4139.15							
0.00	621.49	621.49	5289.60	4760.64	4139.15							
0.00	621.49	621.49	5289.60	4760.64	4139.15							
0.00	621.49	621.49	5289.60	4760.64	4139.15							
0.00	621.49	621.49	5289.60	4760.64	4139.15							
0.00	621.49	621.49	5289.60	4760.64	4139.15							
0.00	683.64	683.64	5289.60	4760.64	4077.00							
0.00	683.64	683.64	5289.60	4760.64	4077.00							
0.00	683.64	683.64	5289.60	4760.64	4077.00							
0.00	683.64	683.64	5289.60	4760.64	4077.00							
0.00	752.01	752.01	8463.36	7617.02	6865.02							
0.00	752.01	752.01	8463.36	7617.02	6865.02							
0.00	752.01	752.01	8463.36	7617.02	6865.02							
0.00	752.01	752.01	8463.36	7617.02	6865.02							
0.00	752.01	752.01	8463.36	7617.02	6865.02							
0.00	752.01	752.01	8463.36	7617.02	6865.02							
0.00	827.21	827.21	8463.36	7617.02	6789.82							
0.00	827.21	827.21	8463.36	7617.02	6789.82							
0.00	827.21	827.21	8463.36	7617.02	6789.82							
0.00	827.21	827.21	8463.36	7617.02	6789.82							
0.00	827.21	827.21	8463.36	7617.02	6789.82							
0.00	909.93	909.93	13541.38	12187.24	11277.31							
0.00	909.93	909.93	13541.38	12187.24	11277.31							
0.00	909.93	909.93	13541.38	12187.24	11277.31							
0.00	909.93	909.93	13541.38	12187.24	11277.31							
0.00	909.93	909.93	13541.38	12187.24	11277.31							
0.00	909.93	909.93	13541.38	12187.24	11277.31							
0.00	1000.92	1000.92	13541.38	12187.24	11186.32							
0.00	1000.92	1000.92	13541.38	12187.24	11186.32							
0.00	1000.92	1000.92	13541.38	12187.24	11186.32							
0.00	1000.92	1000.92	13541.38	12187.24	11186.32							
0.00	1101.01	1101.01	21666.20	19499.58	18398.57							
0.00	1101.01	1101.01	21666.20	19499.58	18398.57							
0.00	1101.01	1101.01	21666.20	19499.58	18398.57							
0.00	1101.01	1101.01	21666.20	19499.58	18398.57							
0.00	1211.11	1211.11	21666.20	19499.58	18288.47							
0.00	1211.11	1211.11	22179.83	19961.85	18750.74							

Undiscounted Cost (Lakhs)			Undiscounted Benefits (Lakhs)	Undiscounted Benefits (Lakhs)	Net Cash Flow (Undiscounted) (Lakhs)	Net Present Worth (Lakhs)		Internal rate of Return	Discount Rate (%)	NPV of Benefit	NPV of Cost	B/C Ratio
Construction Cost and Relocation Cost	Maintenance Cost	Total Cost	Total Benefit	Total Benefit Increased by 10%	(Total Benefit-Total Cost)	Discount rate=8%	Discount rate=9%	(At this, NPW=0)		At Different Discount Rate	At Different Discount Rate	At Different Discount Rate
17121.00	0.00	17121.00	0.00	0.00	-17121.00	6623.06	-1566.21	<u>0.088</u>	12.000	28874.60	44586.79	0.65
17121.00	0.00	17121.00	0.00	0.00	-17121.00				10.000	39404.80	47064.66	0.84
17121.00	0.00	17121.00	0.00	0.00	-17121.00				9.000	46953.64	48519.85	0.97
0.00	513.63	513.63	3306.00	3636.60	3122.97				8.200	54606.65	49824.91	1.10
0.00	513.63	513.63	3306.00	3636.60	3122.97				7.000	69841.30	52090.65	1.34
0.00	513.63	513.63	3306.00	3636.60	3122.97				6.000	87407.19	54356.65	1.61
0.00	513.63	513.63	3306.00	3636.60	3122.97							
0.00	513.63	513.63	3306.00	3636.60	3122.97							
0.00	564.99	564.99	3306.00	3636.60	3071.61							
0.00	564.99	564.99	3306.00	3636.60	3071.61							
0.00	564.99	564.99	3306.00	3636.60	3071.61							
0.00	564.99	564.99	3306.00	3636.60	3071.61	621.49	5197.07	<u>0.088</u>				
0.00	621.49	621.49	5289.60	5818.56	5197.07							
0.00	621.49	621.49	5289.60	5818.56	5197.07							
0.00	621.49	621.49	5289.60	5818.56	5197.07							
0.00	621.49	621.49	5289.60	5818.56	5197.07							
0.00	621.49	621.49	5289.60	5818.56	5197.07							
0.00	621.49	621.49	5289.60	5818.56	5197.07							
0.00	621.49	621.49	5289.60	5818.56	5197.07							
0.00	621.49	621.49	5289.60	5818.56	5197.07							
0.00	621.49	621.49	5289.60	5818.56	5197.07							
0.00	683.64	683.64	5289.60	5818.56	5134.92	752.01	8557.69	<u>0.088</u>				
0.00	683.64	683.64	5289.60	5818.56	5134.92							
0.00	683.64	683.64	5289.60	5818.56	5134.92							
0.00	683.64	683.64	5289.60	5818.56	5134.92							
0.00	683.64	683.64	5289.60	5818.56	5134.92							
0.00	683.64	683.64	5289.60	5818.56	5134.92							
0.00	752.01	752.01	8463.36	9309.70	8557.69							
0.00	752.01	752.01	8463.36	9309.70	8557.69							
0.00	752.01	752.01	8463.36	9309.70	8557.69							
0.00	752.01	752.01	8463.36	9309.70	8557.69							
0.00	752.01	752.01	8463.36	9309.70	8557.69	827.21	8482.49	<u>0.088</u>				
0.00	827.21	827.21	8463.36	9309.70	8482.49							
0.00	827.21	827.21	8463.36	9309.70	8482.49							
0.00	827.21	827.21	8463.36	9309.70	8482.49							
0.00	827.21	827.21	8463.36	9309.70	8482.49							
0.00	827.21	827.21	8463.36	9309.70	8482.49							
0.00	909.93	909.93	13541.38	14895.51	13985.59	1000.92	13894.59	<u>0.088</u>				
0.00	909.93	909.93	13541.38	14895.51	13985.59							
0.00	909.93	909.93	13541.38	14895.51	13985.59							
0.00	909.93	909.93	13541.38	14895.51	13985.59							
0.00	909.93	909.93	13541.38	14895.51	13985.59							
0.00	1000.92	1000.92	13541.38	14895.51	13894.59							
0.00	1000.92	1000.92	13541.38	14895.51	13894.59							
0.00	1000.92	1000.92	13541.38	14895.51	13894.59							
0.00	1000.92	1000.92	13541.38	14895.51	13894.59							
0.00	1000.92	1000.92	13541.38	14895.51	13894.59							
0.00	1101.01	1101.01	21666.20	23832.82	22731.81	1211.11	22621.71	<u>0.088</u>				
0.00	1101.01	1101.01	21666.20	23832.82	22731.81							
0.00	1101.01	1101.01	21666.20	23832.82	22731.81							
0.00	1101.01	1101.01	21666.20	23832.82	22731.81							
0.00	1211.11	1211.11	21666.20	23832.82	22621.71	0.00	23186.70	<u>0.088</u>				
0.00	1211.11	1211.11	22179.83	24397.81	23186.70							

Undiscounted Cost (Lakhs)			Undiscounted Benefits (Lakhs)	Undiscounted Benefits (Lakhs)	Net Cash Flow (Undiscounted) (Lakhs)	Net Present Worth (Lakhs)		Internal rate of Return	Discount Rate(%)	NPV of Benefit	NPV of Cost	B/C Ratio
Construction Cost and Relocation Cost	Maintenance Cost	Total Cost	Total Benefit	Total Benefit Increased by 20%	(Total Benefit-Total Cost)	Discount rate=8%	Discount rate=10%	(At this,NPW=0)		At Different Discount Rate	At Different Discount Rate	At Different Discount Rate
17121.00	0.00	17121.00	0.00	0.00	-17121.00	11786.47	-4077.60	<u>0.094</u>	12.000	31499.57	44586.79	0.71
17121.00	0.00	17121.00	0.00	0.00	-17121.00				10.000	42987.06	47064.66	0.91
17121.00	0.00	17121.00	0.00	0.00	-17121.00				9.000	51222.15	48519.85	1.06
0.00	513.63	513.63	3306.00	3967.20	3453.57				8.200	59570.89	49824.91	1.20
0.00	513.63	513.63	3306.00	3967.20	3453.57				7.000	76190.51	52090.65	1.46
0.00	513.63	513.63	3306.00	3967.20	3453.57				6.000	95353.30	54356.65	1.75
0.00	513.63	513.63	3306.00	3967.20	3453.57							
0.00	513.63	513.63	3306.00	3967.20	3453.57							
0.00	564.99	564.99	3306.00	3967.20	3402.21							
0.00	564.99	564.99	3306.00	3967.20	3402.21							
0.00	564.99	564.99	3306.00	3967.20	3402.21							
0.00	564.99	564.99	3306.00	3967.20	3402.21							
0.00	564.99	564.99	3306.00	3967.20	3402.21							
0.00	564.99	564.99	3306.00	3967.20	3402.21							
0.00	621.49	621.49	5289.60	6347.52	5726.03	10156.03	9404.03	<u>0.094</u>				
0.00	621.49	621.49	5289.60	6347.52	5726.03							
0.00	621.49	621.49	5289.60	6347.52	5726.03							
0.00	621.49	621.49	5289.60	6347.52	5726.03							
0.00	621.49	621.49	5289.60	6347.52	5726.03							
0.00	621.49	621.49	5289.60	6347.52	5726.03							
0.00	683.64	683.64	5289.60	6347.52	5663.88							
0.00	683.64	683.64	5289.60	6347.52	5663.88							
0.00	683.64	683.64	5289.60	6347.52	5663.88							
0.00	683.64	683.64	5289.60	6347.52	5663.88							
0.00	752.01	752.01	8463.36	10156.03	9404.03							
0.00	752.01	752.01	8463.36	10156.03	9404.03							
0.00	752.01	752.01	8463.36	10156.03	9404.03							
0.00	752.01	752.01	8463.36	10156.03	9404.03							
0.00	752.01	752.01	8463.36	10156.03	9404.03							
0.00	827.21	827.21	8463.36	10156.03	9328.83	13541.38	16249.65	<u>0.094</u>				
0.00	827.21	827.21	8463.36	10156.03	9328.83							
0.00	827.21	827.21	8463.36	10156.03	9328.83							
0.00	827.21	827.21	8463.36	10156.03	9328.83							
0.00	827.21	827.21	8463.36	10156.03	9328.83							
0.00	827.21	827.21	8463.36	10156.03	9328.83							
0.00	909.93	909.93	13541.38	16249.65	15339.72							
0.00	909.93	909.93	13541.38	16249.65	15339.72							
0.00	909.93	909.93	13541.38	16249.65	15339.72							
0.00	909.93	909.93	13541.38	16249.65	15339.72							
0.00	909.93	909.93	13541.38	16249.65	15339.72							
0.00	1000.92	1000.92	13541.38	16249.65	15248.73	21666.20	25999.44	<u>0.094</u>				
0.00	1000.92	1000.92	13541.38	16249.65	15248.73							
0.00	1000.92	1000.92	13541.38	16249.65	15248.73							
0.00	1000.92	1000.92	13541.38	16249.65	15248.73							
0.00	1000.92	1000.92	13541.38	16249.65	15248.73							
0.00	1101.01	1101.01	21666.20	25999.44	24898.43							
0.00	1101.01	1101.01	21666.20	25999.44	24898.43							
0.00	1101.01	1101.01	21666.20	25999.44	24898.43							
0.00	1101.01	1101.01	21666.20	25999.44	24898.43							
0.00	1211.11	1211.11	21666.20	25999.44	24788.33							
0.00	1211.11	1211.11	22179.83	26615.80	25404.69							

Year	Undiscounted Cost (Lakhs)			Undiscounted Benefits (Lakhs)	Net Cash Flow (Undiscounted) (Lakhs)	Net Present Worth (Lakhs)		Internal rate of Return	Discount Rate(%)	NPV of Benefit	NPV of Cost	B/C Ratio
	Construction Cost and Relocation Cost	Maintenance Cost	Total Cost Decreased by 10%			Total Benefit	(Total Benefit-Total Cost)	Discount rate=8%	Discount rate=9%	(At this, NPW=0)		
Construction Year-1	17121.00	0.00	15408.90	0.00	-15408.90							
Construction Year-2	17121.00	0.00	15408.90	0.00	-15408.90							
Construction Year-3	17121.00	0.00	15408.90	0.00	-15408.90							
4	0.00	513.63	462.27	3306.00	2843.73							
5	0.00	513.63	462.27	3306.00	2843.73							
6	0.00	513.63	462.27	3306.00	2843.73							
7	0.00	513.63	462.27	3306.00	2843.73							
8	0.00	513.63	462.27	3306.00	2843.73							
9	0.00	564.99	508.49	3306.00	2797.51							
10	0.00	564.99	508.49	3306.00	2797.51							
11	0.00	564.99	508.49	3306.00	2797.51							
12	0.00	564.99	508.49	3306.00	2797.51							
13	0.00	564.99	508.49	3306.00	2797.51							
14	0.00	621.49	559.34	5289.60	4730.26							
15	0.00	621.49	559.34	5289.60	4730.26							
16	0.00	621.49	559.34	5289.60	4730.26							
17	0.00	621.49	559.34	5289.60	4730.26							
18	0.00	621.49	559.34	5289.60	4730.26							
19	0.00	683.64	615.28	5289.60	4674.32							
20	0.00	683.64	615.28	5289.60	4674.32							
21	0.00	683.64	615.28	5289.60	4674.32							
22	0.00	683.64	615.28	5289.60	4674.32							
23	0.00	683.64	615.28	5289.60	4674.32							
24	0.00	752.01	676.81	8463.36	7786.55							
25	0.00	752.01	676.81	8463.36	7786.55							
26	0.00	752.01	676.81	8463.36	7786.55							
27	0.00	752.01	676.81	8463.36	7786.55							
28	0.00	752.01	676.81	8463.36	7786.55							
29	0.00	827.21	744.49	8463.36	7718.87							
30	0.00	827.21	744.49	8463.36	7718.87							
31	0.00	827.21	744.49	8463.36	7718.87							
32	0.00	827.21	744.49	8463.36	7718.87							
33	0.00	827.21	744.49	8463.36	7718.87							
34	0.00	909.93	818.93	13541.38	12722.44							
35	0.00	909.93	818.93	13541.38	12722.44							
36	0.00	909.93	818.93	13541.38	12722.44							
37	0.00	909.93	818.93	13541.38	12722.44							
38	0.00	909.93	818.93	13541.38	12722.44							
39	0.00	1000.92	900.83	13541.38	12640.55							
40	0.00	1000.92	900.83	13541.38	12640.55							
41	0.00	1000.92	900.83	13541.38	12640.55							
42	0.00	1000.92	900.83	13541.38	12640.55							
43	0.00	1000.92	900.83	13541.38	12640.55							
44	0.00	1101.01	990.91	21666.20	20675.29							
45	0.00	1101.01	990.91	21666.20	20675.29							
46	0.00	1101.01	990.91	21666.20	20675.29							
47	0.00	1101.01	990.91	21666.20	20675.29							
48	0.00	1101.01	990.91	21666.20	20675.29							
49	0.00	1211.11	1090.00	21666.20	20576.20							
50	0.00	1211.11	1090.00	22179.83	21089.83							

Year	Undiscounted Cost (Lakhs)			Undiscounted Benefits (Lakhs)	Net Cash Flow (Undiscounted) (Lakhs)	Net Present Worth (Lakhs)		Internal rate of Return	Discount Rate(%)	NPV of Benefit	NPV of Cost	B/C Ratio
	Construction Cost and Relocation Cost	Maintenance Cost	Total Cost Decreased by 20%			Total Benefit	(Total Benefit-Total Cost)	Discount rate=8%	Discount rate=10%	(At this, NPW=0)		
Construction Year-1	17121.00	0.00	13696.80	0.00	-13696.80						12,000	26249.64
Construction Year-2	17121.00	0.00	13696.80	0.00	-13696.80						10,000	35822.55
Construction Year-3	17121.00	0.00	13696.80	0.00	-13696.80						9,000	37651.72
4	0.00	513.63		410.90	3306.00		2895.10				8,000	42685.12
5	0.00	513.63		410.90	3306.00		2895.10				7,000	38815.88
6	0.00	513.63		410.90	3306.00		2895.10				6,000	1.10
7	0.00	513.63		410.90	3306.00		2895.10				51634.10	1.29
8	0.00	513.63		410.90	3306.00		2895.10				7,000	40139.56
9	0.00	564.99		481.99	3306.00		2854.01				6,000	41672.52
10	0.00	564.99		481.99	3306.00		2854.01				6,000	1.52
11	0.00	564.99		481.99	3306.00		2854.01				7,000	41746.08
12	0.00	564.99		481.99	3306.00		2854.01				6,000	43485.32
13	0.00	564.99		481.99	3306.00		2854.01				6,000	1.83
14	0.00	621.49		497.19	5289.60		4792.41					
15	0.00	621.49		497.19	5289.60		4792.41					
16	0.00	621.49		497.19	5289.60		4792.41					
17	0.00	621.49		497.19	5289.60		4792.41					
18	0.00	621.49		497.19	5289.60		4792.41					
19	0.00	683.64		546.91	5289.60		4742.69					
20	0.00	683.64		546.91	5289.60		4742.69					
21	0.00	683.64		546.91	5289.60		4742.69					
22	0.00	683.64		546.91	5289.60		4742.69					
23	0.00	683.64		546.91	5289.60		4742.69					
24	0.00	752.01		601.60	8463.36		7861.76					
25	0.00	752.01		601.60	8463.36		7861.76					
26	0.00	752.01		601.60	8463.36		7861.76					
27	0.00	752.01		601.60	8463.36		7861.76					
28	0.00	752.01		601.60	8463.36		7861.76					
29	0.00	827.21		661.77	8463.36		7801.59					
30	0.00	827.21		661.77	8463.36		7801.59					
31	0.00	827.21		661.77	8463.36		7801.59					
32	0.00	827.21		661.77	8463.36		7801.59					
33	0.00	827.21		661.77	8463.36		7801.59					
34	0.00	909.93		727.94	13541.38		12813.43					
35	0.00	909.93		727.94	13541.38		12813.43					
36	0.00	909.93		727.94	13541.38		12813.43					
37	0.00	909.93		727.94	13541.38		12813.43					
38	0.00	909.93		727.94	13541.38		12813.43					
39	0.00	1000.92		800.74	13541.38		12740.64					
40	0.00	1000.92		800.74	13541.38		12740.64					
41	0.00	1000.92		800.74	13541.38		12740.64					
42	0.00	1000.92		800.74	13541.38		12740.64					
43	0.00	1000.92		800.74	13541.38		12740.64					
44	0.00	1101.01		880.81	21666.20		20785.39					
45	0.00	1101.01		880.81	21666.20		20785.39					
46	0.00	1101.01		880.81	21666.20		20785.39					
47	0.00	1101.01		880.81	21666.20		20785.39					
48	0.00	1101.01		880.81	21666.20		20785.39					
49	0.00	1211.11		968.89	21666.20		20697.31					
50	0.00	1211.11		968.89	22179.83		21210.94					

Year	Undiscounted Cost (Lakhs)			Undiscounted Benefits (Lakhs)	Net Cash Flow (Undiscounted) (Lakhs)	Net Present Worth (Lakhs)		Internal rate of Return	Discount Rate(%)	NPV of Benefit	NPV of Cost	B/C Ratio
	Construction Cost and Relocation Cost	Maintenance Cost	Total Cost Increased by 10%			Total Benefit	(Total Benefit-Total Cost)	Discount rate=8%	Discount rate=9%	(At this, NPW=0)		
Construction Year-1	17121.00	0.00	18833.10	0.00	-18833.10							
Construction Year-2	17121.00	0.00	18833.10	0.00	-18833.10							
Construction Year-3	17121.00	0.00	18833.10	0.00	-18833.10							
4	0.00	513.63	564.99	3306.00	2741.01							
5	0.00	513.63	564.99	3306.00	2741.01							
6	0.00	513.63	564.99	3306.00	2741.01							
7	0.00	513.63	564.99	3306.00	2741.01							
8	0.00	513.63	564.99	3306.00	2741.01							
9	0.00	564.99	621.49	3306.00	2684.51							
10	0.00	564.99	621.49	3306.00	2684.51							
11	0.00	564.99	621.49	3306.00	2684.51							
12	0.00	564.99	621.49	3306.00	2684.51							
13	0.00	564.99	621.49	3306.00	2684.51							
14	0.00	621.49	683.64	5289.60	4605.96							
15	0.00	621.49	683.64	5289.60	4605.96							
16	0.00	621.49	683.64	5289.60	4605.96							
17	0.00	621.49	683.64	5289.60	4605.96							
18	0.00	621.49	683.64	5289.60	4605.96							
19	0.00	683.64	752.01	5289.60	4537.59							
20	0.00	683.64	752.01	5289.60	4537.59							
21	0.00	683.64	752.01	5289.60	4537.59							
22	0.00	683.64	752.01	5289.60	4537.59							
23	0.00	683.64	752.01	5289.60	4537.59							
24	0.00	752.01	827.21	8463.36	7636.15							
25	0.00	752.01	827.21	8463.36	7636.15							
26	0.00	752.01	827.21	8463.36	7636.15							
27	0.00	752.01	827.21	8463.36	7636.15							
28	0.00	752.01	827.21	8463.36	7636.15							
29	0.00	827.21	909.93	8463.36	7553.43							
30	0.00	827.21	909.93	8463.36	7553.43							
31	0.00	827.21	909.93	8463.36	7553.43							
32	0.00	827.21	909.93	8463.36	7553.43							
33	0.00	827.21	909.93	8463.36	7553.43							
34	0.00	909.93	1000.92	13541.38	12540.46							
35	0.00	909.93	1000.92	13541.38	12540.46							
36	0.00	909.93	1000.92	13541.38	12540.46							
37	0.00	909.93	1000.92	13541.38	12540.46							
38	0.00	909.93	1000.92	13541.38	12540.46							
39	0.00	1000.92	1101.01	13541.38	12440.36							
40	0.00	1000.92	1101.01	13541.38	12440.36							
41	0.00	1000.92	1101.01	13541.38	12440.36							
42	0.00	1000.92	1101.01	13541.38	12440.36							
43	0.00	1000.92	1101.01	13541.38	12440.36							
44	0.00	1101.01	1211.11	21666.20	20455.09							
45	0.00	1101.01	1211.11	21666.20	20455.09							
46	0.00	1101.01	1211.11	21666.20	20455.09							
47	0.00	1101.01	1211.11	21666.20	20455.09							
48	0.00	1101.01	1211.11	21666.20	20455.09							
49	0.00	1211.11	1332.22	21666.20	20333.98							
50	0.00	1211.11	1332.22	22179.83	20847.61							

Year	Undiscounted Cost (Lakhs)			Undiscounted Benefits (Lakhs)	Net Cash Flow (Undiscounted) (Lakhs)	Net Present Worth (Lakhs)		Internal rate of Return	Discount Rate (%)	NPV of Benefit	NPV of Cost	B/C Ratio
	Construction Cost and Relocation Cost	Maintenance Cost	Total Cost Increased by 20%			Total Benefit	(Total Benefit-Total Cost)	Discount rate=8%	Discount rate=9%	(At this,NPW=0)	At Different Discount Rate	At Different Discount Rate
Construction Year-1	17121.00	0.00	20545.20	0.00	-20545.20						12,000	26249.64
Construction Year-2	17121.00	0.00	20545.20	0.00	-20545.20						10,000	35822.55
Construction Year-3	17121.00	0.00	20545.20	0.00	-20545.20						9,000	56477.59
4	0.00	513.63	616.36	3306.00	2689.64						8,000	42685.12
5	0.00	513.63	616.36	3306.00	2689.64						7,000	51634.10
6	0.00	513.63	616.36	3306.00	2689.64						6,000	60209.34
7	0.00	513.63	616.36	3306.00	2689.64							63492.09
8	0.00	513.63	616.36	3306.00	2689.64							62508.79
9	0.00	564.99	677.99	3306.00	2628.01							1.02
10	0.00	564.99	677.99	3306.00	2628.01							
11	0.00	564.99	677.99	3306.00	2628.01							
12	0.00	564.99	677.99	3306.00	2628.01							
13	0.00	564.99	677.99	3306.00	2628.01							
14	0.00	621.49	745.79	5289.60	4543.81							
15	0.00	621.49	745.79	5289.60	4543.81							
16	0.00	621.49	745.79	5289.60	4543.81							
17	0.00	621.49	745.79	5289.60	4543.81							
18	0.00	621.49	745.79	5289.60	4543.81							
19	0.00	683.64	820.37	5289.60	4469.23							
20	0.00	683.64	820.37	5289.60	4469.23							
21	0.00	683.64	820.37	5289.60	4469.23							
22	0.00	683.64	820.37	5289.60	4469.23							
23	0.00	683.64	820.37	5289.60	4469.23							
24	0.00	752.01	902.41	8463.36	7560.95							
25	0.00	752.01	902.41	8463.36	7560.95							
26	0.00	752.01	902.41	8463.36	7560.95							
27	0.00	752.01	902.41	8463.36	7560.95							
28	0.00	752.01	902.41	8463.36	7560.95							
29	0.00	827.21	992.65	8463.36	7470.71							
30	0.00	827.21	992.65	8463.36	7470.71							
31	0.00	827.21	992.65	8463.36	7470.71							
32	0.00	827.21	992.65	8463.36	7470.71							
33	0.00	827.21	992.65	8463.36	7470.71							
34	0.00	909.93	1091.91	13541.38	12449.46							
35	0.00	909.93	1091.91	13541.38	12449.46							
36	0.00	909.93	1091.91	13541.38	12449.46							
37	0.00	909.93	1091.91	13541.38	12449.46							
38	0.00	909.93	1091.91	13541.38	12449.46							
39	0.00	1000.92	1201.10	13541.38	12340.27							
40	0.00	1000.92	1201.10	13541.38	12340.27							
41	0.00	1000.92	1201.10	13541.38	12340.27							
42	0.00	1000.92	1201.10	13541.38	12340.27							
43	0.00	1000.92	1201.10	13541.38	12340.27							
44	0.00	1101.01	1321.21	21666.20	20344.99							
45	0.00	1101.01	1321.21	21666.20	20344.99							
46	0.00	1101.01	1321.21	21666.20	20344.99							
47	0.00	1101.01	1321.21	21666.20	20344.99							
48	0.00	1101.01	1321.21	21666.20	20344.99							
49	0.00	1211.11	1453.34	21666.20	20212.87							
50	0.00	1211.11	1453.34	22179.83	20726.50							

Undiscounted Cost (Lakhs)			Undiscounted Benefits (Lakhs)	Undiscounted Benefits (Lakhs)	Net Cash Flow (Undiscounted) (Lakhs)	Net Present Worth (Lakhs)		Internal rate of Return	Discount Rate(%)	NPV of Benefit	NPV of Cost	B/C Ratio
Construction Cost and Relocation Cost	Maintenance Cost	Total Cost	Total Benefit	Total Benefit decreased by 20%	(Total Benefit-Total Cost)	Discount rate=6%	Discount rate=11%	(At this, NPW=0)		At Different Discount Rate	At Different Discount Rate	At Different Discount Rate
17121.00	0.00	17121.00	0.00	0.00	-17121.00	9212.22	-21382.82	<u>0.069</u>	12.000	20999.71	44586.79	0.47
17121.00	0.00	17121.00	0.00	0.00	-17121.00				10.000	28658.04	47064.66	0.61
17121.00	0.00	17121.00	0.00	0.00	-17121.00				9.000	34148.10	48519.85	0.70
0.00	513.63	513.63	3306.00	2644.80	2131.17				8.000	41307.28	50174.45	0.82
0.00	513.63	513.63	3306.00	2644.80	2131.17				7.000	50793.67	52090.65	0.98
0.00	513.63	513.63	3306.00	2644.80	2131.17				6.000	63568.87	54356.65	1.17
0.00	513.63	513.63	3306.00	2644.80	2131.17							
0.00	513.63	513.63	3306.00	2644.80	2131.17							
0.00	564.99	564.99	3306.00	2644.80	2079.81							
0.00	564.99	564.99	3306.00	2644.80	2079.81							
0.00	564.99	564.99	3306.00	2644.80	2079.81							
0.00	564.99	564.99	3306.00	2644.80	2079.81							
0.00	564.99	564.99	3306.00	2644.80	2079.81							
0.00	564.99	564.99	3306.00	2644.80	2079.81							
0.00	621.49	621.49	5289.60	4231.68	3610.19							
0.00	621.49	621.49	5289.60	4231.68	3610.19							
0.00	621.49	621.49	5289.60	4231.68	3610.19							
0.00	621.49	621.49	5289.60	4231.68	3610.19							
0.00	621.49	621.49	5289.60	4231.68	3610.19							
0.00	621.49	621.49	5289.60	4231.68	3610.19							
0.00	683.64	683.64	5289.60	4231.68	3548.04							
0.00	683.64	683.64	5289.60	4231.68	3548.04							
0.00	683.64	683.64	5289.60	4231.68	3548.04							
0.00	683.64	683.64	5289.60	4231.68	3548.04							
0.00	752.01	752.01	8463.36	6770.69	6018.68							
0.00	752.01	752.01	8463.36	6770.69	6018.68							
0.00	752.01	752.01	8463.36	6770.69	6018.68							
0.00	752.01	752.01	8463.36	6770.69	6018.68							
0.00	752.01	752.01	8463.36	6770.69	6018.68							
0.00	752.01	752.01	8463.36	6770.69	6018.68							
0.00	827.21	827.21	8463.36	6770.69	5943.48							
0.00	827.21	827.21	8463.36	6770.69	5943.48							
0.00	827.21	827.21	8463.36	6770.69	5943.48							
0.00	827.21	827.21	8463.36	6770.69	5943.48							
0.00	909.93	909.93	13541.38	10833.10	9923.17							
0.00	909.93	909.93	13541.38	10833.10	9923.17							
0.00	909.93	909.93	13541.38	10833.10	9923.17							
0.00	909.93	909.93	13541.38	10833.10	9923.17							
0.00	909.93	909.93	13541.38	10833.10	9923.17							
0.00	1000.92	1000.92	13541.38	10833.10	9832.18							
0.00	1000.92	1000.92	13541.38	10833.10	9832.18							
0.00	1000.92	1000.92	13541.38	10833.10	9832.18							
0.00	1000.92	1000.92	13541.38	10833.10	9832.18							
0.00	1101.01	1101.01	21666.20	17332.96	16231.95							
0.00	1101.01	1101.01	21666.20	17332.96	16231.95							
0.00	1101.01	1101.01	21666.20	17332.96	16231.95							
0.00	1211.11	1211.11	21666.20	17332.96	16121.85							
0.00	1211.11	1211.11	22179.83	17743.87	16532.75							

Year	Undiscounted Cost (Lakhs)			Undiscounted Benefits (Lakhs)	Undiscounted Benefits (Lakhs)	Net Cash Flow (Undiscounted) (Lakhs)	Net Present Worth (Lakhs)		Internal rate of Return	Discount Rate(%)	NPV of Benefit (Lakhs)	NPV of Cost (Lakhs)	B/C Ratio
	Construction Cost and Relocation Cost	Maintenance Cost	Total Cost increased by 20%	Total Benefit	Total Benefit increased by 10%	(Total Benefit-Total Cost)	Discount rate=7%	Discount rate=11%	(At this, NPW=0)		At Different Discount Rate	At Different Discount Rate	At Different Discount Rate
Construction Year-1	17121.00	0.00	20545.20	0.00	0.00	-20545.20	7332.51	-21392.61	<u>0.076</u>	12.000	28874.60	53504.15	0.54
Construction Year-2	17121.00	0.00	20545.20	0.00	0.00	-20545.20				10.000	39404.80	56477.59	0.70
Construction Year-3	17121.00	0.00	20545.20	0.00	0.00	-20545.20				9.000	46953.64	58223.82	0.81
4	0.00	513.63	616.36	3306.00	3636.60	3020.24				8.000	56797.51	60209.34	0.94
5	0.00	513.63	616.36	3306.00	3636.60	3020.24				7.000	69841.30	62508.79	1.12
6	0.00	513.63	616.36	3306.00	3636.60	3020.24				6.000	87407.19	65227.98	1.34
7	0.00	513.63	616.36	3306.00	3636.60	3020.24							
8	0.00	513.63	616.36	3306.00	3636.60	3020.24							
9	0.00	564.99	677.99	3306.00	3636.60	2958.61							
10	0.00	564.99	677.99	3306.00	3636.60	2958.61							
11	0.00	564.99	677.99	3306.00	3636.60	2958.61							
12	0.00	564.99	677.99	3306.00	3636.60	2958.61							
13	0.00	564.99	677.99	3306.00	3636.60	2958.61							
14	0.00	621.49	745.79	5289.60	5818.56	5072.77							
15	0.00	621.49	745.79	5289.60	5818.56	5072.77							
16	0.00	621.49	745.79	5289.60	5818.56	5072.77							
17	0.00	621.49	745.79	5289.60	5818.56	5072.77							
18	0.00	621.49	745.79	5289.60	5818.56	5072.77							
19	0.00	683.64	820.37	5289.60	5818.56	4998.19							
20	0.00	683.64	820.37	5289.60	5818.56	4998.19							
21	0.00	683.64	820.37	5289.60	5818.56	4998.19							
22	0.00	683.64	820.37	5289.60	5818.56	4998.19							
23	0.00	683.64	820.37	5289.60	5818.56	4998.19							
24	0.00	752.01	902.41	8463.36	9309.70	8407.29							
25	0.00	752.01	902.41	8463.36	9309.70	8407.29							
26	0.00	752.01	902.41	8463.36	9309.70	8407.29							
27	0.00	752.01	902.41	8463.36	9309.70	8407.29							
28	0.00	752.01	902.41	8463.36	9309.70	8407.29							
29	0.00	827.21	992.65	8463.36	9309.70	8317.05							
30	0.00	827.21	992.65	8463.36	9309.70	8317.05							
31	0.00	827.21	992.65	8463.36	9309.70	8317.05							
32	0.00	827.21	992.65	8463.36	9309.70	8317.05							
33	0.00	827.21	992.65	8463.36	9309.70	8317.05							
34	0.00	909.93	1091.91	13541.38	14895.51	13803.60							
35	0.00	909.93	1091.91	13541.38	14895.51	13803.60							
36	0.00	909.93	1091.91	13541.38	14895.51	13803.60							
37	0.00	909.93	1091.91	13541.38	14895.51	13803.60							
38	0.00	909.93	1091.91	13541.38	14895.51	13803.60							
39	0.00	1000.92	1201.10	13541.38	14895.51	13694.41							
40	0.00	1000.92	1201.10	13541.38	14895.51	13694.41							
41	0.00	1000.92	1201.10	13541.38	14895.51	13694.41							
42	0.00	1000.92	1201.10	13541.38	14895.51	13694.41							
43	0.00	1000.92	1201.10	13541.38	14895.51	13694.41							
44	0.00	1101.01	1321.21	21666.20	23832.82	22511.61							
45	0.00	1101.01	1321.21	21666.20	23832.82	22511.61							
46	0.00	1101.01	1321.21	21666.20	23832.82	22511.61							
47	0.00	1101.01	1321.21	21666.20	23832.82	22511.61							
48	0.00	1101.01	1321.21	21666.20	23832.82	22511.61							
49	0.00	1211.11	1453.34	21666.20	23832.82	22379.49							
50	0.00	1211.11	1453.34	22179.83	24397.81	22944.48							

Undiscounted Cost (Lakhs)			Undiscounted Benefits (Lakhs)	Undiscounted Benefits (Lakhs)	Net Cash Flow (Undiscounted) (Lakhs)	Net Present Worth (Lakhs)		Internal rate of Return	Discount Rate(%)	NPV of Benefit (Lakhs)	NPV of Cost (Lakhs)	B/C Ratio
Construction Cost and Relocation Cost	Maintenance Cost	Total Cost increased by 10%	Total Benefit	Total Benefit increased by 20%	(Total Benefit-Total Cost)	Discount rate=8%	Discount rate=11%	(At this, NPW=0)		At Different Discount Rate	At Different Discount Rate	At Different Discount Rate
17121.00	0.00	18833.10	0.00	0.00	-18833.10	6769.02	-13768.47	<u>0.087</u>	12.000	31499.57	49045.47	0.64
17121.00	0.00	18833.10	0.00	0.00	-18833.10				10.000	42987.06	51771.12	0.83
17121.00	0.00	18833.10	0.00	0.00	-18833.10				9.000	51222.15	53371.84	0.96
0.00	513.63	564.99	3306.00	3967.20	3402.21				8.000	61960.92	55191.90	1.12
0.00	513.63	564.99	3306.00	3967.20	3402.21				7.000	76190.51	57299.72	1.33
0.00	513.63	564.99	3306.00	3967.20	3402.21				6.000	95353.30	59792.32	1.59
0.00	513.63	564.99	3306.00	3967.20	3402.21							
0.00	513.63	564.99	3306.00	3967.20	3402.21							
0.00	564.99	621.49	3306.00	3967.20	3345.71							
0.00	564.99	621.49	3306.00	3967.20	3345.71							
0.00	564.99	621.49	3306.00	3967.20	3345.71							
0.00	564.99	621.49	3306.00	3967.20	3345.71							
0.00	564.99	621.49	3306.00	3967.20	3345.71							
0.00	564.99	621.49	3306.00	3967.20	3345.71							
0.00	621.49	683.64	5289.60	6347.52	5663.88							
0.00	621.49	683.64	5289.60	6347.52	5663.88							
0.00	621.49	683.64	5289.60	6347.52	5663.88							
0.00	621.49	683.64	5289.60	6347.52	5663.88							
0.00	621.49	683.64	5289.60	6347.52	5663.88							
0.00	683.64	752.01	5289.60	6347.52	5595.51							
0.00	683.64	752.01	5289.60	6347.52	5595.51							
0.00	683.64	752.01	5289.60	6347.52	5595.51							
0.00	683.64	752.01	5289.60	6347.52	5595.51							
0.00	683.64	752.01	5289.60	6347.52	5595.51							
0.00	752.01	827.21	8463.36	10156.03	9328.83							
0.00	752.01	827.21	8463.36	10156.03	9328.83							
0.00	752.01	827.21	8463.36	10156.03	9328.83							
0.00	752.01	827.21	8463.36	10156.03	9328.83							
0.00	752.01	827.21	8463.36	10156.03	9328.83							
0.00	752.01	827.21	8463.36	10156.03	9328.83							
0.00	827.21	909.93	8463.36	10156.03	9246.11							
0.00	827.21	909.93	8463.36	10156.03	9246.11							
0.00	827.21	909.93	8463.36	10156.03	9246.11							
0.00	827.21	909.93	8463.36	10156.03	9246.11							
0.00	827.21	909.93	8463.36	10156.03	9246.11							
0.00	827.21	909.93	8463.36	10156.03	9246.11							
0.00	909.93	1000.92	13541.38	16249.65	15248.73							
0.00	909.93	1000.92	13541.38	16249.65	15248.73							
0.00	909.93	1000.92	13541.38	16249.65	15248.73							
0.00	909.93	1000.92	13541.38	16249.65	15248.73							
0.00	909.93	1000.92	13541.38	16249.65	15248.73							
0.00	909.93	1000.92	13541.38	16249.65	15248.73							
0.00	1000.92	1101.01	13541.38	16249.65	15148.64							
0.00	1000.92	1101.01	13541.38	16249.65	15148.64							
0.00	1000.92	1101.01	13541.38	16249.65	15148.64							
0.00	1000.92	1101.01	13541.38	16249.65	15148.64							
0.00	1101.01	1211.11	21666.20	25999.44	24788.33							
0.00	1101.01	1211.11	21666.20	25999.44	24788.33							
0.00	1101.01	1211.11	21666.20	25999.44	24788.33							
0.00	1101.01	1211.11	21666.20	25999.44	24788.33							
0.00	1211.11	1332.22	21666.20	25999.44	24667.22							
0.00	1211.11	1332.22	22179.83	26615.80	25283.57							

Year	Undiscounted Cost (Lakhs)			Undiscounted Benefits (Lakhs)	Undiscounted Benefits (Lakhs)	Net Cash Flow (Undiscounted) (Lakhs)	Net Present Worth (Lakhs)		Internal rate of Return	Discount Rate(%)	NPV of Benefit (Lakhs)	NPV of Cost (Lakhs)	B/C Ratio
	Construction Cost and Relocation Cost	Maintenance Cost	Total Cost increased by 20%	Total Benefit	Total Benefit increased by 20%	(Total Benefit-Total Cost)	Discount rate=8%	Discount rate=11%	(At this, NPW=0)		At Different Discount Rate	At Different Discount Rate	At Different Discount Rate
Construction Year-1	17121.00	0.00	20545.20	0.00	0.00	-20545.20	1751.58	-18344.91	<u>0.082</u>	12.000	31499.57	53504.15	0.59
Construction Year-2	17121.00	0.00	20545.20	0.00	0.00	-20545.20				10.000	42987.06	56477.59	0.76
Construction Year-3	17121.00	0.00	20545.20	0.00	0.00	-20545.20				9.000	51222.15	58223.82	0.88
4	0.00	513.63	616.36	3306.00	3967.20	3350.84				8.000	61960.92	60209.34	1.03
5	0.00	513.63	616.36	3306.00	3967.20	3350.84				7.000	76190.51	62508.79	1.22
6	0.00	513.63	616.36	3306.00	3967.20	3350.84				6.000	95353.30	65227.98	1.46
7	0.00	513.63	616.36	3306.00	3967.20	3350.84							
8	0.00	513.63	616.36	3306.00	3967.20	3350.84							
9	0.00	564.99	677.99	3306.00	3967.20	3289.21							
10	0.00	564.99	677.99	3306.00	3967.20	3289.21							
11	0.00	564.99	677.99	3306.00	3967.20	3289.21							
12	0.00	564.99	677.99	3306.00	3967.20	3289.21							
13	0.00	564.99	677.99	3306.00	3967.20	3289.21							
14	0.00	621.49	745.79	5289.60	6347.52	5601.73							
15	0.00	621.49	745.79	5289.60	6347.52	5601.73							
16	0.00	621.49	745.79	5289.60	6347.52	5601.73							
17	0.00	621.49	745.79	5289.60	6347.52	5601.73							
18	0.00	621.49	745.79	5289.60	6347.52	5601.73							
19	0.00	683.64	820.37	5289.60	6347.52	5527.15							
20	0.00	683.64	820.37	5289.60	6347.52	5527.15							
21	0.00	683.64	820.37	5289.60	6347.52	5527.15							
22	0.00	683.64	820.37	5289.60	6347.52	5527.15							
23	0.00	683.64	820.37	5289.60	6347.52	5527.15							
24	0.00	752.01	902.41	8463.36	10156.03	9253.63							
25	0.00	752.01	902.41	8463.36	10156.03	9253.63							
26	0.00	752.01	902.41	8463.36	10156.03	9253.63							
27	0.00	752.01	902.41	8463.36	10156.03	9253.63							
28	0.00	752.01	902.41	8463.36	10156.03	9253.63							
29	0.00	827.21	992.65	8463.36	10156.03	9163.38							
30	0.00	827.21	992.65	8463.36	10156.03	9163.38							
31	0.00	827.21	992.65	8463.36	10156.03	9163.38							
32	0.00	827.21	992.65	8463.36	10156.03	9163.38							
33	0.00	827.21	992.65	8463.36	10156.03	9163.38							
34	0.00	909.93	1091.91	13541.38	16249.65	15157.74							
35	0.00	909.93	1091.91	13541.38	16249.65	15157.74							
36	0.00	909.93	1091.91	13541.38	16249.65	15157.74							
37	0.00	909.93	1091.91	13541.38	16249.65	15157.74							
38	0.00	909.93	1091.91	13541.38	16249.65	15157.74							
39	0.00	1000.92	1201.10	13541.38	16249.65	15048.55							
40	0.00	1000.92	1201.10	13541.38	16249.65	15048.55							
41	0.00	1000.92	1201.10	13541.38	16249.65	15048.55							
42	0.00	1000.92	1201.10	13541.38	16249.65	15048.55							
43	0.00	1000.92	1201.10	13541.38	16249.65	15048.55							
44	0.00	1101.01	1321.21	21666.20	25999.44	24678.23							
45	0.00	1101.01	1321.21	21666.20	25999.44	24678.23							
46	0.00	1101.01	1321.21	21666.20	25999.44	24678.23							
47	0.00	1101.01	1321.21	21666.20	25999.44	24678.23							
48	0.00	1101.01	1321.21	21666.20	25999.44	24678.23							
49	0.00	1211.11	1453.34	22179.83	26615.80	25162.46							
50	0.00	1211.11	1453.34	22179.83	26615.80	25162.46							

Year	Construction Cost (lacs)	Maintenance Cost (lacs)	Total Cost	Earthquake Risk Elimination 10% of Total Cost (lacs)	Fire Safety Enhancement (Per Building) 20% of construction Cost (lacs)	Economic Benefit													
						Increase In Property Value 10% (lacs)	Operational Job Creation (lacs)	Savings on Energy .35 Kwh/sqft(lacs)	Increased Tax Revenue (lacs)	Improved Waste Management (lacs)	Total Benefit (lacs)	Net Cash Flow (Undiscounted) (lacs)	NPV (At 13% Discount Rate) (lacs)	NPV (At 15% Discount Rate) (lacs)	IRR	Discount Rate (%)	NPV of Benefit (lacs)	NPV of Cost (lacs)	B/C Ratio
2024.0	13696.8	0.0	13696.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13696.8	2529.2	-3000.6	0.14	15.0	30264.2	33264.8	0.9
2025.0	13696.8	0.0	13696.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13696.8	13.0	37335.6	34806.4	1.1			
2026.0	13696.8	0.0	13696.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13696.8	11.0	47336.8	36611.4	1.3			
2027.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	59611.1	9.0	62169.5	38815.8	1.6			
2028.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	59611.1	7.0	85431.5	41672.3	2.1			
2029.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	59611.1							
2030.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	59611.1							
2031.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	59611.1							
2032.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6881.0	6424.1							
2033.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6881.7	6425.7							
2034.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6881.7	6425.7							
2035.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6881.7	6425.7							
2036.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6881.7	6425.7							
2037.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7432.3	6935.1							
2038.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7432.3	6935.1							
2039.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7432.3	6935.1							
2040.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7432.3	6935.1							
2041.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7432.3	6935.1							
2042.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7480.1							
2043.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7480.1							
2044.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7480.1							
2045.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7480.1							
2046.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7480.1							
2047.0	0.0	601.6	601.6	6965.7	870.7	696.6	31.2	100.3	2.4	2.1	8669.0	8067.4							
2048.0	0.0	601.6	601.6	6965.7	870.7	696.6	33.7	100.3	2.4	2.1	8671.5	8069.9							
2049.0	0.0	601.6	601.6	6965.7	870.7	696.6	36.4	100.3	2.4	2.1	8674.2	8072.6							
2050.0	0.0	601.6	601.6	6965.7	870.7	696.6	39.3	100.3	2.4	2.1	8677.1	8075.5							
2051.0	0.0	601.6	601.6	6965.7	870.7	696.6	42.5	100.3	2.4	2.1	8680.2	8078.6							
2052.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8712.9							
2053.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8712.9							
2054.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8712.9							
2055.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8712.9							
2056.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8712.9							
2057.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9396.7							
2058.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9396.7							
2059.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9396.7							
2060.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9396.7							
2061.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9396.7							
2062.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	10133.9							
2063.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	10133.9							
2064.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	10133.9							
2065.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	10133.9							
2066.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	10133.9							
2067.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	11094.9	10928.6							
2068.0	0.0	880.8	880.8	10234.9	1184.6	947.7	57.8	136.4	3.2	2.9	12567.5	11686.7							
2069.0	0.0	880.8	880.8	11053.7	1184.6	947.7	57.8	136.4	3.2	2.9	13386.3	12505.5							
2070.0	0.0	880.8	880.8	11938.0	1184.6	947.7	57.8	136.4	3.2	2.9	14270.6	13389.8							
2071.0	0.0	880.8	880.8	12893.0	1184.6	947.7	57.8	136.4	3.2	2.9	15225.6	14344.8							
2072.0	0.0	968.9	968.9	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	16443.7	15474.8							
2073.0	0.0	968.9	968.9	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	16443.7	15474.8							

Year	Construction Cost (lacs)	Maintenance Cost (lacs)	Total Cost	Earthquake Risk Elimination 10% of Total Cost (lacs)	Fire Safety Enhancement (Per Building) 20% of construction Cost (lacs)	Increase In Property Value 10% (lacs)	Economic Benefit											IRR	Discount Rate (%)	NPV of Benefit (lacs)	NPV of Cost (lacs)	B/C Ratio
							Operational Job Creation (lacs)	Savings on Energy 35 Kwh/sqft(lacs)	Increased Tax Revenue (lacs)	Improved Waste Management (lacs)	Total Benefit decreased by 10% (lacs)	Net Cash Flow (Undiscounted) (lacs)	NPV (@ 13% Discount Rate) (lacs)	NPV (@ 11% Discount Rate) (lacs)								
2024.0	13696.8	0.0	13696.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13696.8	-1204.4	5991.7	0.126	15.0	27237.8	33264.8	0.8				
2025.0	13696.8	0.0	13696.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13696.8	-1204.4	5991.7	0.126	13.0	33602.1	34806.4	1.0				
2026.0	13696.8	0.0	13696.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13696.8	-1204.4	5991.7	0.126	11.0	42603.1	36611.4	1.2				
2027.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5734.8	5323.9	5991.7	0.126	9.0	55952.6	38815.8	1.4				
2028.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5734.8	5323.9	5991.7	0.126	7.0	76888.3	41672.3	1.8				
2029.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5734.8	5323.9	5991.7	0.126								
2030.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5734.8	5323.9	5991.7	0.126								
2031.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5734.8	5323.9	5991.7	0.126								
2032.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6193.5	5741.6	5991.7	0.126								
2033.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6193.5	5741.6	5991.7	0.126								
2034.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6193.5	5741.6	5991.7	0.126								
2035.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6193.5	5741.6	5991.7	0.126								
2036.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6193.5	5741.6	5991.7	0.126								
2037.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	6689.0	6191.8	5991.7	0.126								
2038.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	6689.0	6191.8	5991.7	0.126								
2039.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	6689.0	6191.8	5991.7	0.126								
2040.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	6689.0	6191.8	5991.7	0.126								
2041.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	6689.0	6191.8	5991.7	0.126								
2042.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	7224.2	6677.4	5991.7	0.126								
2043.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	7224.2	6677.4	5991.7	0.126								
2044.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	7224.2	6677.4	5991.7	0.126								
2045.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	7224.2	6677.4	5991.7	0.126								
2046.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	7224.2	6677.4	5991.7	0.126								
2047.0	0.0	601.6	601.6	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	7804.3	7202.7	5991.7	0.126								
2048.0	0.0	601.6	601.6	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	7804.3	7202.7	5991.7	0.126								
2049.0	0.0	601.6	601.6	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	7804.3	7202.7	5991.7	0.126								
2050.0	0.0	601.6	601.6	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	7804.3	7202.7	5991.7	0.126								
2051.0	0.0	601.6	601.6	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	7804.3	7202.7	5991.7	0.126								
2052.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	8437.2	7775.4	5991.7	0.126								
2053.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	8437.2	7775.4	5991.7	0.126								
2054.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	8437.2	7775.4	5991.7	0.126								
2055.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	8437.2	7775.4	5991.7	0.126								
2056.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	8437.2	7775.4	5991.7	0.126								
2057.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	9112.2	8384.2	5991.7	0.126								
2058.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	9112.2	8384.2	5991.7	0.126								
2059.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	9112.2	8384.2	5991.7	0.126								
2060.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	9112.2	8384.2	5991.7	0.126								
2061.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	9112.2	8384.2	5991.7	0.126								
2062.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	9841.1	9040.4	5991.7	0.126								
2063.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	9841.1	9040.4	5991.7	0.126								
2064.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	9841.1	9040.4	5991.7	0.126								
2065.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	9841.1	9040.4	5991.7	0.126								
2066.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	9841.1	9040.4	5991.7	0.126								
2067.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	10628.4	9747.6	5991.7	0.126								
2068.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	10628.4	9747.6	5991.7	0.126								
2069.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	10628.4	9747.6	5991.7	0.126								
2070.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	10628.4	9747.6	5991.7	0.126								
2071.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	10628.4	9747.6	5991.7	0.126								
2072.0	0.0	968.9	968.9	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	14799.3	13830.4	5991.7	0.126								
2073.0	0.0	968.9	968.9	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	14799.3	13830.4	5991.7	0.126								

Year	Construction Cost (lacs)	Maintenance Cost (lacs)	Total Cost	Earthquake Risk Elimination 10% of Total Cost (lacs)	Fire Safety Enhancement (Per Building) 20% of construction Cost (lacs)	Increase In Property Value 10% (lacs)	Economic Benefit											IRR	Discount Rate (%)	NPV of Benefit (lacs)	NPV of Cost (lacs)	B/C Ratio
							Operational Job Creation (lacs)	Savings on Energy 35 Kwh/sqft(lacs)	Increased Tax Revenue (lacs)	Improved Waste Management (lacs)	Total Benefit decreased by 20% (lacs)	Net Cash Flow (Undiscounted) (lacs)	NPV (@ 13% Discount Rate) (lacs)	NPV (@ 11% Discount Rate) (lacs)								
2024.0	13696.8	0.0	13696.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13696.8	-4937.9	1258.0	0.113	15.0	24211.4	33264.8	0.7				
2025.0	13696.8	0.0	13696.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13696.8				13.0	29868.5	34804.4	0.9				
2026.0	13696.8	0.0	13696.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13696.8				11.0	37869.5	36611.4	1.0				
2027.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5097.6	4686.7			9.0	49735.6	38815.8	1.3				
2028.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5097.6	4686.7			7.0	68345.2	41672.3	1.6				
2029.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5097.6	4686.7										
2030.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5097.6	4686.7										
2031.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5097.6	4686.7										
2032.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	5505.4	5053.4										
2033.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	5505.4	5053.4										
2034.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	5505.4	5053.4										
2035.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	5505.4	5053.4										
2036.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	5505.4	5053.4										
2037.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	5945.8	5448.6										
2038.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	5945.8	5448.6										
2039.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	5945.8	5448.6										
2040.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	5945.8	5448.6										
2041.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	5945.8	5448.6										
2042.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	6421.5	5874.7										
2043.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	6421.5	5874.7										
2044.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	6421.5	5874.7										
2045.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	6421.5	5874.7										
2046.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	6421.5	5874.7										
2047.0	0.0	601.6	601.6	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	6937.2	6335.6										
2048.0	0.0	601.6	601.6	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	6937.2	6335.6										
2049.0	0.0	601.6	601.6	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	6939.3	6337.7										
2050.0	0.0	601.6	601.6	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	6941.7	6340.1										
2051.0	0.0	601.6	601.6	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	6944.2	6342.6										
2052.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	7499.7	6838.0										
2053.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	7499.7	6838.0										
2054.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	7499.7	6838.0										
2055.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	7499.7	6838.0										
2056.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	7499.7	6838.0										
2057.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	8099.7	7371.8										
2058.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	8099.7	7371.8										
2059.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	8099.7	7371.8										
2060.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	8099.7	7371.8										
2061.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	8099.7	7371.8										
2062.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	8747.7	7946.9										
2063.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	8747.7	7946.9										
2064.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	8747.7	7946.9										
2065.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	8747.7	7946.9										
2066.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	8747.7	7946.9										
2067.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	9447.5	8566.7										
2068.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	9447.5	8566.7										
2069.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	9447.5	8566.7										
2070.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	9447.5	8566.7										
2071.0	0.0	880.8	880.8	12893.0	1184.6	947.7	57.8	136.4	3.2	2.9	12180.5	11299.7										
2072.0	0.0	968.9	968.9	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	13155.0	12186.1										
2073.0	0.0	968.9	968.9	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	13155.0	12186.1										

Year	Construction Cost (lacs)	Maintenance Cost (lacs)	Total Cost	Earthquake Risk Elimination 10% of Total Cost (lacs)	Fire Safety Enhancement (Per Building) 20% of construction Cost (lacs)	Increase In Property Value 10% (lacs)	Economic Benefit										IRR	Discount Rate (%)	NPV of Benefit (lacs)	NPV of Cost (lacs)	B/C Ratio
							Operational Job Creation (lacs)	Savings on Energy 35 Kwh/sqft(lacs)	Increased Tax Revenue (lacs)	Improved Waste Management (lacs)	Total Benefit Increased by 10% (lacs)	Net Cash Flow (Undiscounted) (lacs)	NPV (At 13% Discount Rate) (lacs)	NPV (At 15% Discount Rate) (lacs)							
2024.0	13696.8	0.0	13696.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13696.8	6262.8	-2343.5	0.150	15.0	33290.6	33264.8	1.0		
2025.0	13696.8	0.0	13696.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13696.8	6262.8	-2343.5	0.150	13.0	41049.2	34804.4	1.2		
2026.0	13696.8	0.0	13696.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13696.8	6262.8	-2343.5	0.150	11.0	52070.5	36611.4	1.4		
2027.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7009.2	6598.3	6262.8	-2343.5	9.0	68386.5	38815.8	1.8			
2028.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7009.2	6598.3	6262.8	-2343.5	7.0	93974.6	41672.3	2.3			
2029.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7009.2	6598.3	6262.8	-2343.5							
2030.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7009.2	6598.3	6262.8	-2343.5							
2031.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7009.2	6598.3	6262.8	-2343.5							
2032.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	7569.9	7117.9	6262.8	-2343.5							
2033.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	7569.9	7117.9	6262.8	-2343.5							
2034.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	7569.9	7117.9	6262.8	-2343.5							
2035.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	7569.9	7117.9	6262.8	-2343.5							
2036.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	7569.9	7117.9	6262.8	-2343.5							
2037.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8175.5	7678.3	6262.8	-2343.5							
2038.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8175.5	7678.3	6262.8	-2343.5							
2039.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8175.5	7678.3	6262.8	-2343.5							
2040.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8175.5	7678.3	6262.8	-2343.5							
2041.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8175.5	7678.3	6262.8	-2343.5							
2042.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8829.5	8282.8	6262.8	-2343.5							
2043.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8829.5	8282.8	6262.8	-2343.5							
2044.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8829.5	8282.8	6262.8	-2343.5							
2045.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8829.5	8282.8	6262.8	-2343.5							
2046.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8829.5	8282.8	6262.8	-2343.5							
2047.0	0.0	601.6	601.6	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	9538.6	8937.0	6262.8	-2343.5							
2048.0	0.0	601.6	601.6	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	9538.6	8937.0	6262.8	-2343.5							
2049.0	0.0	601.6	601.6	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	9541.6	8940.0	6262.8	-2343.5							
2050.0	0.0	601.6	601.6	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	9544.8	8943.2	6262.8	-2343.5							
2051.0	0.0	601.6	601.6	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	9548.3	8946.7	6262.8	-2343.5							
2052.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	10312.1	9650.4	6262.8	-2343.5							
2053.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	10312.1	9650.4	6262.8	-2343.5							
2054.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	10312.1	9650.4	6262.8	-2343.5							
2055.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	10312.1	9650.4	6262.8	-2343.5							
2056.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	10312.1	9650.4	6262.8	-2343.5							
2057.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	11137.1	10409.2	6262.8	-2343.5							
2058.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	11137.1	10409.2	6262.8	-2343.5							
2059.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	11137.1	10409.2	6262.8	-2343.5							
2060.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	11137.1	10409.2	6262.8	-2343.5							
2061.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	11137.1	10409.2	6262.8	-2343.5							
2062.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	12028.1	11227.3	6262.8	-2343.5							
2063.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	12028.1	11227.3	6262.8	-2343.5							
2064.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	12028.1	11227.3	6262.8	-2343.5							
2065.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	12028.1	11227.3	6262.8	-2343.5							
2066.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	12028.1	11227.3	6262.8	-2343.5							
2067.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	12990.3	12109.5	6262.8	-2343.5							
2068.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	12990.3	12109.5	6262.8	-2343.5							
2069.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	12990.3	12109.5	6262.8	-2343.5							
2070.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	12990.3	12109.5	6262.8	-2343.5							
2071.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	12990.3	12109.5	6262.8	-2343.5							
2072.0	0.0	968.9	968.9	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	18088.1	17119.2	6262.8	-2343.5							
2073.0	0.0	968.9	968.9	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	18088.1	17119.2	6262.8	-2343.5							

Year	Construction Cost (lacs)	Maintenance Cost (lacs)	Total Cost	Earthquake Risk Elimination 10% of Total Cost (lacs)	Fire Safety Enhancement (Per Building) 20% of construction Cost (lacs)	Increase In Property Value 10% (lacs)	Economic Benefit										IRR	Discount Rate (%)	NPV of Benefit (lacs)	NPV of Cost (lacs)	B/C Ratio
							Operational Job Creation (lacs)	Savings on Energy 35 Kwh/sqft(lacs)	Increased Tax Revenue (lacs)	Improved Waste Management (lacs)	Total Benefit Increased by 20% (lacs)	Net Cash Flow (Undiscounted) (lacs)	NPV (At 13% Discount Rate) (lacs)	NPV (At 17% Discount Rate) (lacs)							
2024.0	13696.8	0.0	13696.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13696.8	9996.3	-1833.1	0.162	15.0	36317.1	33264.8	1.1			
2025.0	13696.8	0.0	13696.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13696.8	9996.3	-1833.1	0.162	13.0	44802.8	34804.4	1.3			
2026.0	13696.8	0.0	13696.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13696.8	9996.3	-1833.1	0.162	11.0	56804.2	36611.4	1.6			
2027.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7646.4	7235.6	9996.3	-1833.1	9.0	74603.4	38815.8	1.9			
2028.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7646.4	7235.6	9996.3	-1833.1	7.0	102517.7	41672.3	2.5			
2029.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7646.4	7235.6	9996.3	-1833.1							
2030.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7646.4	7235.6	9996.3	-1833.1							
2031.0	0.0	410.9	410.9	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7646.4	7235.6	9996.3	-1833.1							
2032.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	8258.1	7806.1	9996.3	-1833.1							
2033.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	8258.1	7806.1	9996.3	-1833.1							
2034.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	8258.1	7806.1	9996.3	-1833.1							
2035.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	8258.1	7806.1	9996.3	-1833.1							
2036.0	0.0	452.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	8258.1	7806.1	9996.3	-1833.1							
2037.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8918.7	8421.5	9996.3	-1833.1							
2038.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8918.7	8421.5	9996.3	-1833.1							
2039.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8918.7	8421.5	9996.3	-1833.1							
2040.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8918.7	8421.5	9996.3	-1833.1							
2041.0	0.0	497.2	497.2	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8918.7	8421.5	9996.3	-1833.1							
2042.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	9632.2	9085.4	9996.3	-1833.1							
2043.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	9632.2	9085.4	9996.3	-1833.1							
2044.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	9632.2	9085.4	9996.3	-1833.1							
2045.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	9632.2	9085.4	9996.3	-1833.1							
2046.0	0.0	546.8	546.8	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	9632.2	9085.4	9996.3	-1833.1							
2047.0	0.0	601.6	601.6	6965.7	870.7	696.5	31.5	100.3	2.4	2.1	10409.8	9804.2	9996.3	-1833.1							
2048.0	0.0	601.6	601.6	6965.7	870.7	696.5	31.5	100.3	2.4	2.1	10409.8	9804.2	9996.3	-1833.1							
2049.0	0.0	601.6	601.6	6965.7	870.7	696.5	31.5	100.3	2.4	2.1	10409.8	9804.2	9996.3	-1833.1							
2050.0	0.0	601.6	601.6	6965.7	870.7	696.5	31.5	100.3	2.4	2.1	10409.8	9804.2	9996.3	-1833.1							
2051.0	0.0	601.6	601.6	6965.7	870.7	696.5	31.5	100.3	2.4	2.1	10409.8	9804.2	9996.3	-1833.1							
2052.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	11249.6	10587.8	9996.3	-1833.1							
2053.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	11249.6	10587.8	9996.3	-1833.1							
2054.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	11249.6	10587.8	9996.3	-1833.1							
2055.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	11249.6	10587.8	9996.3	-1833.1							
2056.0	0.0	661.8	661.8	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	11249.6	10587.8	9996.3	-1833.1							
2057.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	12149.6	11421.6	9996.3	-1833.1							
2058.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	12149.6	11421.6	9996.3	-1833.1							
2059.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	12149.6	11421.6	9996.3	-1833.1							
2060.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	12149.6	11421.6	9996.3	-1833.1							
2061.0	0.0	727.9	727.9	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	12149.6	11421.6	9996.3	-1833.1							
2062.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	13121.5	12320.8	9996.3	-1833.1							
2063.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	13121.5	12320.8	9996.3	-1833.1							
2064.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	13121.5	12320.8	9996.3	-1833.1							
2065.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	13121.5	12320.8	9996.3	-1833.1							
2066.0	0.0	800.7	800.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	13121.5	12320.8	9996.3	-1833.1							
2067.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	14161.3	13290.4	9996.3	-1833.1							
2068.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	14161.3	13290.4	9996.3	-1833.1							
2069.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	14161.3	13290.4	9996.3	-1833.1							
2070.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	14161.3	13290.4	9996.3	-1833.1							
2071.0	0.0	880.8	880.8	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	14161.3	13290.4	9996.3	-1833.1							
2072.0	0.0	968.9	968.9	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	19732.4	18763.6	9996.3	-1833.1							
2073.0	0.0	968.9	968.9	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	19732.4	18763.6	9996.3	-1833.1							

Year	Construction Cost (lacs)	Maintenance Cost (lacs)	Total Cost Decreased by 10%	Earthquake Risk Elimination 10% of Total Cost (lacs)	Fire Safety Enhancement (Per Building) 20% of construction Cost (lacs)	Increase In Property Value 10% (lacs)	Economic Benefit												
							Operational Job Creation (lacs)	Savings on Energy 35 Kwh/sqft(lacs)	Increased Tax Revenue (lacs)	Improved Waste Management (lacs)	Total Benefit (lacs)	Net Cash Flow (Undiscounted) (lacs)	NPV (At 16% Discount Rate) (lacs)	NPV (At 11% Discount Rate) (lacs)	IRR	Discount Rate (%)	NPV of Benefit (lacs)	NPV of Cost (lacs)	B/C Ratio
2024.0	13696.8	0.0	12327.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-12327.1	-1834.4	14386.5	0.151	15.0	30264.2	29938.3	1.0
2025.0	13696.8	0.0	12327.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-12327.1				13.0	37335.6	31325.8	1.2
2026.0	13696.8	0.0	12327.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-12327.1				11.0	47336.8	32950.3	1.4
2027.0	0.0	410.9	369.8	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	6002.2				9.0	62169.5	34934.2	1.8
2028.0	0.0	410.9	369.8	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	6002.2				7.0	85431.5	37505.1	2.3
2029.0	0.0	410.9	369.8	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	6002.2							
2030.0	0.0	410.9	369.8	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	6002.2							
2031.0	0.0	410.9	369.8	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	6002.2							
2032.0	0.0	452.0	406.8	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6881.7	6474.9							
2033.0	0.0	452.0	406.8	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6881.7	6474.9							
2034.0	0.0	452.0	406.8	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6881.7	6474.9							
2035.0	0.0	452.0	406.8	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6881.7	6474.9							
2036.0	0.0	452.0	406.8	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6881.7	6474.9							
2037.0	0.0	497.2	447.5	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7432.3	6984.8							
2038.0	0.0	497.2	447.5	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7432.3	6984.8							
2039.0	0.0	497.2	447.5	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7432.3	6984.8							
2040.0	0.0	497.2	447.5	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7432.3	6984.8							
2041.0	0.0	497.2	447.5	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7432.3	6984.8							
2042.0	0.0	546.8	492.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7534.7							
2043.0	0.0	546.8	492.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7534.7							
2044.0	0.0	546.8	492.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7534.7							
2045.0	0.0	546.8	492.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7534.7							
2046.0	0.0	546.8	492.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7534.7							
2047.0	0.0	601.6	541.4	6965.7	870.7	696.5	31.5	103.3	2.4	2.1	8671.5	8130.0							
2048.0	0.0	601.6	541.4	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	8671.5	8130.0							
2049.0	0.0	601.6	541.4	6965.7	870.7	696.5	36.4	100.3	2.4	2.1	8674.2	8132.7							
2050.0	0.0	601.6	541.4	6965.7	870.7	696.6	39.3	100.3	2.4	2.1	8677.1	8135.6							
2051.0	0.0	601.6	541.4	6965.7	870.7	696.6	42.5	100.3	2.4	2.1	8680.2	8138.8							
2052.0	0.0	661.8	595.6	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8779.1							
2053.0	0.0	661.8	595.6	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8779.1							
2054.0	0.0	661.8	595.6	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8779.1							
2055.0	0.0	661.8	595.6	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8779.1							
2056.0	0.0	661.8	595.6	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8779.1							
2057.0	0.0	727.9	655.1	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9469.5							
2058.0	0.0	727.9	655.1	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9469.5							
2059.0	0.0	727.9	655.1	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9469.5							
2060.0	0.0	727.9	655.1	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9469.5							
2061.0	0.0	727.9	655.1	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9469.5							
2062.0	0.0	800.7	720.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	10213.9							
2063.0	0.0	800.7	720.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	10213.9							
2064.0	0.0	800.7	720.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	10213.9							
2065.0	0.0	800.7	720.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	10213.9							
2066.0	0.0	800.7	720.7	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	10213.9							
2067.0	0.0	880.8	792.7	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	11809.4	10166.6							
2068.0	0.0	880.8	792.7	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	11809.4	10166.6							
2069.0	0.0	880.8	792.7	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	11809.4	10166.6							
2070.0	0.0	880.8	792.7	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	11809.4	10166.6							
2071.0	0.0	880.8	792.7	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	11809.4	10166.6							
2072.0	0.0	968.9	872.0	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	16443.7	15571.7							
2073.0	0.0	968.9	872.0	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	16443.7	15571.7							

Year	Construction Cost (lacs)	Maintenance Cost (lacs)	Economic Benefit																
			Total Cost Increased by 10%	Earthquake Risk Elimination 10% of Total Cost (lacs)	Fire Safety Enhancement (Per Building) 20% of construction Cost (lacs)	Increase In Property Value 10% (lacs)	Operational Job Creation (lacs)	Savings on Energy .35 Kwh/sqft(lacs)	Increased Tax Revenue (lacs)	Improved Waste Management (lacs)	Total Benefit (lacs)	Net Cash Flow (Undiscounted) (lacs)	NPV (At 13% Discount Rate) (lacs)	NPV (At 12% Discount Rate) (lacs)	IRR	Discount Rate (%)	NPV of Benefit (lacs)	NPV of Cost (lacs)	B/C Ratio
2024.0	13696.8	0.0	15066.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-15066.5	-951.4	2641.5	0.127	15.0	30264.2	36591.3	0.8
2025.0	13696.8	0.0	15066.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-15066.5	-951.4	2641.5	0.127	13.0	37335.6	38287.1	1.0
2026.0	13696.8	0.0	15066.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-15066.5	-951.4	2641.5	0.127	11.0	47336.8	40272.6	1.2
2027.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	5920.0	-951.4	2641.5	0.127	9.0	62169.5	42697.3	1.5
2028.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	5920.0	-951.4	2641.5	0.127	7.0	85431.5	45839.6	1.9
2029.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	5920.0	-951.4	2641.5	0.127				
2030.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	5920.0	-951.4	2641.5	0.127				
2031.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	5920.0	-951.4	2641.5	0.127				
2032.0	0.0	452.0	497.2	5529.6	694.0	553.0	24.8	79.6	1.9	1.7	6384.7	6384.5	-951.4	2641.5	0.127				
2033.0	0.0	452.0	497.2	5529.6	694.0	553.0	24.8	79.6	1.9	1.7	6384.7	6384.5	-951.4	2641.5	0.127				
2034.0	0.0	452.0	497.2	5529.6	694.0	553.0	24.8	79.6	1.9	1.7	6384.7	6384.5	-951.4	2641.5	0.127				
2035.0	0.0	452.0	497.2	5529.6	694.0	553.0	24.8	79.6	1.9	1.7	6384.7	6384.5	-951.4	2641.5	0.127				
2036.0	0.0	452.0	497.2	5529.6	694.0	553.0	24.8	79.6	1.9	1.7	6384.7	6384.5	-951.4	2641.5	0.127				
2037.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7432.3	6885.3	-951.4	2641.5	0.127				
2038.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7432.3	6885.3	-951.4	2641.5	0.127				
2039.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7432.3	6885.3	-951.4	2641.5	0.127				
2040.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7432.3	6885.3	-951.4	2641.5	0.127				
2041.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7432.3	6885.3	-951.4	2641.5	0.127				
2042.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7425.4	-951.4	2641.5	0.127				
2043.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7425.4	-951.4	2641.5	0.127				
2044.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7425.4	-951.4	2641.5	0.127				
2045.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7425.4	-951.4	2641.5	0.127				
2046.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7425.4	-951.4	2641.5	0.127				
2047.0	0.0	601.6	661.8	6965.7	870.7	696.6	31.2	100.3	2.4	2.1	8669.0	8007.2	-951.4	2641.5	0.127				
2048.0	0.0	601.6	661.8	6965.7	870.7	696.6	33.7	100.3	2.4	2.1	8671.5	8009.7	-951.4	2641.5	0.127				
2049.0	0.0	601.6	661.8	6965.7	870.7	696.6	36.4	100.3	2.4	2.1	8674.2	8012.4	-951.4	2641.5	0.127				
2050.0	0.0	601.6	661.8	6965.7	870.7	696.6	39.3	100.3	2.4	2.1	8677.1	8015.3	-951.4	2641.5	0.127				
2051.0	0.0	601.6	661.8	6965.7	870.7	696.6	42.5	100.3	2.4	2.1	8680.2	8018.5	-951.4	2641.5	0.127				
2052.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8646.7	-951.4	2641.5	0.127				
2053.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8646.7	-951.4	2641.5	0.127				
2054.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8646.7	-951.4	2641.5	0.127				
2055.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8646.7	-951.4	2641.5	0.127				
2056.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8646.7	-951.4	2641.5	0.127				
2057.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9323.9	-951.4	2641.5	0.127				
2058.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9323.9	-951.4	2641.5	0.127				
2059.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9323.9	-951.4	2641.5	0.127				
2060.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9323.9	-951.4	2641.5	0.127				
2061.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9323.9	-951.4	2641.5	0.127				
2062.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	10053.8	-951.4	2641.5	0.127				
2063.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	10053.8	-951.4	2641.5	0.127				
2064.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	10053.8	-951.4	2641.5	0.127				
2065.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	10053.8	-951.4	2641.5	0.127				
2066.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	10053.8	-951.4	2641.5	0.127				
2067.0	0.0	880.8	968.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	11809.4	10840.5	-951.4	2641.5	0.127				
2068.0	0.0	880.8	968.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	11809.4	10840.5	-951.4	2641.5	0.127				
2069.0	0.0	880.8	968.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	11809.4	10840.5	-951.4	2641.5	0.127				
2070.0	0.0	880.8	968.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	11809.4	10840.5	-951.4	2641.5	0.127				
2071.0	0.0	880.8	968.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	11809.4	10840.5	-951.4	2641.5	0.127				
2072.0	0.0	968.9	1065.8	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	16443.7	15377.9	-951.4	2641.5	0.127				
2073.0	0.0	968.9	1065.8	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	16443.7	15377.9	-951.4	2641.5	0.127				

Year	Construction Cost (lacs)	Maintenance Cost (lacs)	Economic Benefit																
			Total Cost Increased by 20%	Earthquake Risk Elimination 10% of Total Cost (lacs)	Fire Safety Enhancement (Per Building) 20% of construction Cost (lacs)	Increase In Property Value 10% (lacs)	Operational Job Creation (lacs)	Savings on Energy .35 Kwh/sqft(lacs)	Increased Tax Revenue (lacs)	Improved Waste Management (lacs)	Total Benefit (lacs)	Net Cash Flow (Undiscounted) (lacs)	NPV (At 13% Discount Rate) (lacs)	NPV (At 11% Discount Rate) (lacs)	IRR	Discount Rate (%)	NPV of Benefit (lacs)	NPV of Cost (lacs)	B/C Ratio
2024.0	13696.8	0.0	16436.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-16436.2	-4432.1	3403.1	0.118	15.0	30264.2	39917.8	0.8
2025.0	13696.8	0.0	16436.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-16436.2	-4432.1	3403.1	0.118	13.0	37335.6	41767.7	0.9
2026.0	13696.8	0.0	16436.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-16436.2	-4432.1	3403.1	0.118	11.0	47336.8	43933.7	1.1
2027.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	5878.9	-	-	9.0	62169.5	46578.9	1.3	
2028.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	5878.9	-	-	7.0	85431.5	50006.8	1.7	
2029.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	5878.9	-	-	-	-	-	-	
2030.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	5878.9	-	-	-	-	-	-	
2031.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	6372.0	5878.9	-	-	-	-	-	-	
2032.0	0.0	450.0	546.3	5529.6	650.0	552.6	24.8	79.6	1.9	1.7	6393.7	6339.3	-	-	-	-	-	-	
2033.0	0.0	450.0	546.3	5529.6	650.0	552.6	24.8	79.6	1.9	1.7	6393.7	6339.3	-	-	-	-	-	-	
2034.0	0.0	450.0	546.3	5529.6	650.0	552.6	24.8	79.6	1.9	1.7	6393.7	6339.3	-	-	-	-	-	-	
2035.0	0.0	450.0	546.3	5529.6	650.0	552.6	24.8	79.6	1.9	1.7	6393.7	6339.3	-	-	-	-	-	-	
2036.0	0.0	450.0	546.3	5529.6	650.0	552.6	24.8	79.6	1.9	1.7	6393.7	6339.3	-	-	-	-	-	-	
2037.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7423.3	6835.6	-	-	-	-	-	-	
2038.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7423.3	6835.6	-	-	-	-	-	-	
2039.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7423.3	6835.6	-	-	-	-	-	-	
2040.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7423.3	6835.6	-	-	-	-	-	-	
2041.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	7423.3	6835.6	-	-	-	-	-	-	
2042.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7370.7	-	-	-	-	-	-	
2043.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7370.7	-	-	-	-	-	-	
2044.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7370.7	-	-	-	-	-	-	
2045.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7370.7	-	-	-	-	-	-	
2046.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8026.8	7370.7	-	-	-	-	-	-	
2047.0	0.0	601.6	721.9	6965.7	870.7	696.6	31.2	100.3	2.4	2.1	8669.0	7947.1	-	-	-	-	-	-	
2048.0	0.0	601.6	721.9	6965.7	870.7	696.6	33.7	100.3	2.4	2.1	8671.5	7949.6	-	-	-	-	-	-	
2049.0	0.0	601.6	721.9	6965.7	870.7	696.6	36.4	100.3	2.4	2.1	8674.2	7952.3	-	-	-	-	-	-	
2050.0	0.0	601.6	721.9	6965.7	870.7	696.6	39.3	100.3	2.4	2.1	8677.1	7955.2	-	-	-	-	-	-	
2051.0	0.0	601.6	721.9	6965.7	870.7	696.6	42.5	100.3	2.4	2.1	8680.2	7958.3	-	-	-	-	-	-	
2052.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8580.5	-	-	-	-	-	-	
2053.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8580.5	-	-	-	-	-	-	
2054.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8580.5	-	-	-	-	-	-	
2055.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8580.5	-	-	-	-	-	-	
2056.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	9374.7	8580.5	-	-	-	-	-	-	
2057.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9251.1	-	-	-	-	-	-	
2058.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9251.1	-	-	-	-	-	-	
2059.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9251.1	-	-	-	-	-	-	
2060.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	10124.6	9251.1	-	-	-	-	-	-	
2061.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	9973.7	-	-	-	-	-	-	
2062.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	9973.7	-	-	-	-	-	-	
2063.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	9973.7	-	-	-	-	-	-	
2064.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	9973.7	-	-	-	-	-	-	
2065.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	9973.7	-	-	-	-	-	-	
2066.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	10934.6	9973.7	-	-	-	-	-	-	
2067.0	0.0	880.8	1057.0	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	11809.4	10752.4	-	-	-	-	-	-	
2068.0	0.0	880.8	1057.0	10234.9	1184.6	947.7	57.8	136.4	3.2	2.9	12567.5	11510.5	-	-	-	-	-	-	
2069.0	0.0	880.8	1057.0	11053.7	1184.6	947.7	57.8	136.4	3.2	2.9	13386.3	12329.3	-	-	-	-	-	-	
2070.0	0.0	880.8	1057.0	11938.0	1184.6	947.7	57.8	136.4	3.2	2.9	14270.6	13213.6	-	-	-	-	-	-	
2071.0	0.0	880.8	1057.0	12893.0	1184.6	947.7	57.8	136.4	3.2	2.9	15225.6	14168.7	-	-	-	-	-	-	
2072.0	0.0	968.9	1162.7	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	16443.7	15281.0	-	-	-	-	-	-	
2073.0	0.0	968.9	1162.7	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	16443.7	15281.0	-	-	-	-	-	-	

Year	Construction Cost (lacs)	Maintenance Cost (lacs)	Total Cost increased by 10%	Earthquake Risk Elimination 10% of Total Cost (lacs)	Fire Safety Enhancement (Per Building) 20% of construction Cost (lacs)	Increase In Property Value 10% (lacs)	Economic Benefit											IRR	Discount Rate (%)	NPV of Benefit (lacs)	NPV of Cost (lacs)	B/C Ratio
							Operational Job Creation (lacs)	Savings on Energy 35 Kwh/sqft(lacs)	Increased Tax Revenue (lacs)	Improved Waste Management (lacs)	Total Benefit decreased by 10% (lacs)	Net Cash Flow (Undiscounted) (lacs)	NPV (@ 13% Discount Rate) (lacs)	NPV (@ 11% Discount Rate) (lacs)								
2024.0	13696.8	0.0	15066.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-15066.5	-4685.0	2330.6	0.116	15.0	27237.8	36591.3	0.7				
2025.0	13696.8	0.0	15066.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-15066.5				13.0	33602.1	38287.1	0.9				
2026.0	13696.8	0.0	15066.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-15066.5				11.0	42603.1	40272.6	1.1				
2027.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5734.8	5282.8			9.0	55952.6	42697.3	1.3				
2028.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5734.8	5282.8			7.0	76888.3	45839.6	1.7				
2029.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5734.8	5282.8										
2030.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5734.8	5282.8										
2031.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5734.8	5282.8										
2032.0	0.0	452.0	497.2	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6193.5	5696.4										
2033.0	0.0	452.0	497.2	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6193.5	5696.4										
2034.0	0.0	452.0	497.2	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6193.5	5696.4										
2035.0	0.0	452.0	497.2	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6193.5	5696.4										
2036.0	0.0	452.0	497.2	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6193.5	5696.4										
2037.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	6689.0	6142.1										
2038.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	6689.0	6142.1										
2039.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	6689.0	6142.1										
2040.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	6689.0	6142.1										
2041.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	6689.0	6142.1										
2042.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	7224.2	6622.7										
2043.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	7224.2	6622.7										
2044.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	7224.2	6622.7										
2045.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	7224.2	6622.7										
2046.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	7224.2	6622.7										
2047.0	0.0	601.4	6945.7	870.7	696.5	31.5	103.3	2.4	2.1	7804.3	7142.6											
2048.0	0.0	601.4	6945.7	870.7	696.5	33.7	100.3	2.4	2.1	7804.3	7142.6											
2049.0	0.0	601.4	6945.7	870.7	696.5	36.4	100.3	2.4	2.1	7806.8	7145.0											
2050.0	0.0	601.4	6945.7	870.7	696.5	39.3	100.3	2.4	2.1	7809.4	7147.6											
2051.0	0.0	601.4	6945.7	870.7	696.6	42.5	100.3	2.4	2.1	7812.2	7150.5											
2052.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	8437.2	7709.3										
2053.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	8437.2	7709.3										
2054.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	8437.2	7709.3										
2055.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	8437.2	7709.3										
2056.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	8437.2	7709.3										
2057.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	9112.2	8311.4										
2058.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	9112.2	8311.4										
2059.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	9112.2	8311.4										
2060.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	9112.2	8311.4										
2061.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	9112.2	8311.4										
2062.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	9841.1	8960.3										
2063.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	9841.1	8960.3										
2064.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	9841.1	8960.3										
2065.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	9841.1	8960.3										
2066.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	9841.1	8960.3										
2067.0	0.0	800.8	968.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	10628.4	9659.5										
2068.0	0.0	800.8	968.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	11348.8	10311.9										
2069.0	0.0	800.8	968.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	12047.7	11073.8										
2070.0	0.0	800.8	968.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	12843.5	11874.7										
2071.0	0.0	800.8	968.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	13703.1	12734.2										
2072.0	0.0	968.9	1045.8	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	14799.3	13733.6										
2073.0	0.0	968.9	1045.8	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	14799.3	13733.6										

Year	Construction Cost (lacs)	Maintenance Cost (lacs)	Total Cost increased by 20%	Earthquake Risk Elimination 10% of Total Cost (lacs)	Fire Safety Enhancement (Per Building) 20% of construction Cost (lacs)	Increase In Property Value 10% (lacs)	Economic Benefit										IRR	Discount Rate (%)	NPV of Benefit (lacs)	NPV of Cost (lacs)	B/C Ratio
							Operational Job Creation (lacs)	Savings on Energy 35 Kwh/sqft(lacs)	Increased Tax Revenue (lacs)	Improved Waste Management (lacs)	Total Benefit decreased by 10% (lacs)	Net Cash Flow (Undiscounted) (lacs)	NPV (At 13% Discount Rate) (lacs)	NPV (At 9% Discount Rate) (lacs)							
2024.0	13696.8	0.0	16436.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-16436.2	-8165.7	9373.7	0.107	15.0	27237.8	39917.8	0.7			
2025.0	13696.8	0.0	16436.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-16436.2				13.0	33602.1	41767.7	0.8			
2026.0	13696.8	0.0	16436.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-16436.2				11.0	42603.1	43933.7	1.0			
2027.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5734.8	5241.7			9.0	55952.6	46578.9	1.2			
2028.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5734.8	5241.7			7.0	76888.3	50006.8	1.5			
2029.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5734.8	5241.7									
2030.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5734.8	5241.7									
2031.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5734.8	5241.7									
2032.0	0.0	452.0	542.4	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6193.5	5651.2									
2033.0	0.0	452.0	542.4	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6193.5	5651.2									
2034.0	0.0	452.0	542.4	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6193.5	5651.2									
2035.0	0.0	452.0	542.4	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6193.5	5651.2									
2036.0	0.0	452.0	542.4	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	6193.5	5651.2									
2037.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	6689.0	6092.4									
2038.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	6689.0	6092.4									
2039.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	6689.0	6092.4									
2040.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	6689.0	6092.4									
2041.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	6689.0	6092.4									
2042.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	7224.2	6568.0									
2043.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	7224.2	6568.0									
2044.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	7224.2	6568.0									
2045.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	7224.2	6568.0									
2046.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	7224.2	6568.0									
2047.0	0.0	601.6	721.9	6965.7	870.7	696.5	31.5	103.3	2.4	2.1	7804.3	7092.4									
2048.0	0.0	601.6	721.9	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	7804.3	7092.4									
2049.0	0.0	601.6	721.9	6965.7	870.7	696.6	36.4	100.3	2.4	2.1	7806.8	7094.8									
2050.0	0.0	601.6	721.9	6965.7	870.7	696.6	39.3	100.3	2.4	2.1	7809.4	7097.5									
2051.0	0.0	601.6	721.9	6965.7	870.7	696.6	42.5	100.3	2.4	2.1	7812.2	7090.3									
2052.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	8437.2	7643.1									
2053.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	8437.2	7643.1									
2054.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	8437.2	7643.1									
2055.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	8437.2	7643.1									
2056.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	8437.2	7643.1									
2057.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	9112.2	8238.6									
2058.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	9112.2	8238.6									
2059.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	9112.2	8238.6									
2060.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	9112.2	8238.6									
2061.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	9112.2	8238.6									
2062.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	9841.1	8880.3									
2063.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	9841.1	8880.3									
2064.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	9841.1	8880.3									
2065.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	9841.1	8880.3									
2066.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	9841.1	8880.3									
2067.0	0.0	800.8	1057.0	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	10628.4	9571.5									
2068.0	0.0	800.8	1057.0	10034.9	1184.6	947.7	57.8	136.4	3.2	2.9	11348.8	10293.8									
2069.0	0.0	800.8	1057.0	1057.7	1184.6	947.7	57.8	136.4	3.2	2.9	12047.7	11007.7									
2070.0	0.0	800.8	1057.0	11938.0	1184.6	947.7	57.8	136.4	3.2	2.9	12843.5	11755.6									
2071.0	0.0	800.8	1057.0	12893.0	1184.6	947.7	57.8	136.4	3.2	2.9	13703.1	12646.1									
2072.0	0.0	968.9	1162.7	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	14799.3	13636.7									
2073.0	0.0	968.9	1162.7	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	14799.3	13636.7									

Year	Construction Cost (lacs)	Maintenance Cost (lacs)	Total Cost increased by 10%	Earthquake Risk Elimination 10% of Total Cost (lacs)	Fire Safety Enhancement (Per Building) 20% of construction Cost (lacs)	Increase In Property Value 10% (lacs)	Economic Benefit										IRR	Discount Rate (%)	NPV of Benefit (lacs)	NPV of Cost (lacs)	B/C Ratio
							Operational Job Creation (lacs)	Savings on Energy 35 Kwh/sqft(lacs)	Increased Tax Revenue (lacs)	Improved Waste Management (lacs)	Total Benefit decreased by 20% (lacs)	Net Cash Flow (Undiscounted) (lacs)	NPV (At 13% Discount Rate) (lacs)	NPV (At 9% Discount Rate) (lacs)							
2024.0	13696.8	0.0	15066.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-15066.5	-8418.6	7038.3	0.104	15.0	24211.4	36591.3	0.7			
2025.0	13696.8	0.0	15066.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-15066.5				13.0	29868.5	38287.1	0.8			
2026.0	13696.8	0.0	15066.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-15066.5				11.0	37869.5	40272.6	0.9			
2027.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5097.6	4645.6			9.0	49735.6	42697.3	1.2			
2028.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5097.6	4645.6			7.0	68345.2	45839.6	1.5			
2029.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5097.6	4645.6									
2030.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5097.6	4645.6									
2031.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5097.6	4645.6									
2032.0	0.0	452.0	497.2	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	5505.4	5008.2									
2033.0	0.0	452.0	497.2	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	5505.4	5008.2									
2034.0	0.0	452.0	497.2	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	5505.4	5008.2									
2035.0	0.0	452.0	497.2	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	5505.4	5008.2									
2036.0	0.0	452.0	497.2	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	5505.4	5008.2									
2037.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	5945.8	5398.9									
2038.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	5945.8	5398.9									
2039.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	5945.8	5398.9									
2040.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	5945.8	5398.9									
2041.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	5945.8	5398.9									
2042.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	6421.5	5820.0									
2043.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	6421.5	5820.0									
2044.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	6421.5	5820.0									
2045.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	6421.5	5820.0									
2046.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	6421.5	5820.0									
2047.0	0.0	601.4	6449.7	876.5	975.5	31.2	102.3	2.4	2.1	6932.5	6275.4										
2048.0	0.0	601.4	6449.7	876.7	975.5	33.7	100.3	2.4	2.1	6937.2	6275.4										
2049.0	0.0	601.4	6449.7	876.7	975.7	36.4	100.3	2.4	2.1	6939.3	6277.6										
2050.0	0.0	601.4	6449.7	876.7	975.7	39.3	100.3	2.4	2.1	6941.7	6279.9										
2051.0	0.0	601.4	6449.7	876.7	975.7	42.5	100.3	2.4	2.1	6944.2	6282.4										
2052.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	7499.7	6771.8									
2053.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	7499.7	6771.8									
2054.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	7499.7	6771.8									
2055.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	7499.7	6771.8									
2056.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	7499.7	6771.8									
2057.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	8099.7	7299.0									
2058.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	8099.7	7299.0									
2059.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	8099.7	7299.0									
2060.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	8099.7	7299.0									
2061.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	8099.7	7299.0									
2062.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	8747.7	7866.9									
2063.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	8747.7	7866.9									
2064.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	8747.7	7866.9									
2065.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	8747.7	7866.9									
2066.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	8747.7	7866.9									
2067.0	0.0	880.8	964.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	9447.5	8478.6									
2068.0	0.0	964.9	10434.9	1084.6	947.7	57.8	136.4	3.2	2.9	10054.0	9051.0										
2069.0	0.0	964.9	10437.7	1084.6	947.7	57.8	136.4	3.2	2.9	10705.0	9740.0										
2070.0	0.0	964.9	10439.0	1084.6	947.7	57.8	136.4	3.2	2.9	11416.5	10447.6										
2071.0	0.0	964.9	10439.8	1084.6	947.7	57.8	136.4	3.2	2.9	12180.5	11211.6										
2072.0	0.0	964.9	1045.8	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	13155.0	12089.2									
2073.0	0.0	964.9	1045.8	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	13155.0	12089.2									

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							Operational Job Creation (lacs)	Savings on Energy 35 Kwh/sqft(lacs)	Increased Tax Revenue (lacs)	Improved Waste Management (lacs)	Total Benefit decreased by 20% (lacs)	Net Cash Flow (Undiscounted) (lacs)	NPV (At 13% Discount Rate) (lacs)	NPV (At 9% Discount Rate) (lacs)								
2024.0	13696.8	0.0	16436.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-16436.2	-11899.2	3156.7	0.096	15.0	24211.4	39917.8	0.6				
2025.0	13696.8	0.0	16436.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-16436.2	-11899.2	3156.7	0.096	13.0	29868.5	41767.7	0.7				
2026.0	13696.8	0.0	16436.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-16436.2	-11899.2	3156.7	0.096	11.0	37869.5	43933.7	0.9				
2027.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5097.6	4604.5	-	-	9.0	49735.6	46578.9	1.1				
2028.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5097.6	4604.5	-	-	7.0	68345.2	50006.8	1.4				
2029.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5097.6	4604.5	-	-	-	-	-	-				
2030.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5097.6	4604.5	-	-	-	-	-	-				
2031.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	5097.6	4604.5	-	-	-	-	-	-				
2032.0	0.0	452.0	542.4	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	5505.4	4963.0	-	-	-	-	-	-				
2033.0	0.0	452.0	542.4	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	5505.4	4963.0	-	-	-	-	-	-				
2034.0	0.0	452.0	542.4	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	5505.4	4963.0	-	-	-	-	-	-				
2035.0	0.0	452.0	542.4	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	5505.4	4963.0	-	-	-	-	-	-				
2036.0	0.0	452.0	542.4	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	5505.4	4963.0	-	-	-	-	-	-				
2037.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	5945.8	5349.2	-	-	-	-	-	-				
2038.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	5945.8	5349.2	-	-	-	-	-	-				
2039.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	5945.8	5349.2	-	-	-	-	-	-				
2040.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	5945.8	5349.2	-	-	-	-	-	-				
2041.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	5945.8	5349.2	-	-	-	-	-	-				
2042.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	6421.5	5765.4	-	-	-	-	-	-				
2043.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	6421.5	5765.4	-	-	-	-	-	-				
2044.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	6421.5	5765.4	-	-	-	-	-	-				
2045.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	6421.5	5765.4	-	-	-	-	-	-				
2046.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	6421.5	5765.4	-	-	-	-	-	-				
2047.0	0.0	601.6	721.9	6965.7	870.7	696.5	31.5	103.3	2.4	2.1	6932.5	6215.3	-	-	-	-	-	-				
2048.0	0.0	601.6	721.9	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	6932.5	6215.3	-	-	-	-	-	-				
2049.0	0.0	601.6	721.9	6965.7	870.7	696.6	36.4	100.3	2.4	2.1	6939.3	6217.4	-	-	-	-	-	-				
2050.0	0.0	601.6	721.9	6965.7	870.7	696.6	39.3	100.3	2.4	2.1	6941.7	6219.7	-	-	-	-	-	-				
2051.0	0.0	601.6	721.9	6965.7	870.7	696.6	42.5	100.3	2.4	2.1	6944.2	6222.3	-	-	-	-	-	-				
2052.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	7499.7	6705.6	-	-	-	-	-	-				
2053.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	7499.7	6705.6	-	-	-	-	-	-				
2054.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	7499.7	6705.6	-	-	-	-	-	-				
2055.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	7499.7	6705.6	-	-	-	-	-	-				
2056.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	7499.7	6705.6	-	-	-	-	-	-				
2057.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	8099.7	7226.2	-	-	-	-	-	-				
2058.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	8099.7	7226.2	-	-	-	-	-	-				
2059.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	8099.7	7226.2	-	-	-	-	-	-				
2060.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	8099.7	7226.2	-	-	-	-	-	-				
2061.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	8099.7	7226.2	-	-	-	-	-	-				
2062.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	8747.7	7766.8	-	-	-	-	-	-				
2063.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	8747.7	7766.8	-	-	-	-	-	-				
2064.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	8747.7	7766.8	-	-	-	-	-	-				
2065.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	8747.7	7766.8	-	-	-	-	-	-				
2066.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	8747.7	7766.8	-	-	-	-	-	-				
2067.0	0.0	800.8	1057.0	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	9447.5	8390.5	-	-	-	-	-	-				
2068.0	0.0	800.8	1057.0	10034.9	1184.6	947.7	57.8	136.4	3.2	2.9	10054.0	8997.0	-	-	-	-	-	-				
2069.0	0.0	800.8	1057.0	1057.7	1184.6	947.7	57.8	136.4	3.2	2.9	10704.0	9411.0	-	-	-	-	-	-				
2070.0	0.0	800.8	1057.0	1057.0	1184.6	947.7	57.8	136.4	3.2	2.9	11416.5	10359.5	-	-	-	-	-	-				
2071.0	0.0	800.8	1057.0	12893.0	1184.6	947.7	57.8	136.4	3.2	2.9	12180.5	11123.5	-	-	-	-	-	-				
2072.0	0.0	968.9	1162.7	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	13155.0	11992.3	-	-	-	-	-	-				
2073.0	0.0	968.9	1162.7	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	13155.0	11992.3	-	-	-	-	-	-				

Year	Construction Cost (lacs)	Maintenance Cost (lacs)	Economic Benefit																	
			Total Cost increased by 10%	Earthquake Risk Elimination 10% of Total Cost (lacs)	Fire Safety Enhancement (Per Building) 20% of construction Cost (lacs)	Increase In Property Value 10% (lacs)	Operational Job Creation (lacs)	Savings on Energy .35 Kwh/sqft(lacs)	Increased Tax Revenue (lacs)	Improved Waste Management (lacs)	Total Benefit increased by 10% (lacs)	Net Cash Flow (Undiscounted) (lacs)	NPV (At 13% Discount Rate) (lacs)	NPV (At 14% Discount Rate) (lacs)	IRR	Discount Rate (%)	NPV of Benefit (lacs)	NPV of Cost (lacs)	B/C Ratio	
2024.0	13696.8	0.0	15066.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-15066.5	2782.1	-544.5	0.138	15.0	33290.6	36591.3	0.9	
2025.0	13696.8	0.0	15066.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-15066.5				13.0	41065.2	38287.1	1.1	
2026.0	13696.8	0.0	15066.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-15066.5				11.0	52070.5	40272.6	1.3	
2027.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7009.2	6557.2				9.0	68386.5	42697.3	1.6	
2028.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7009.2	6557.2				7.0	93974.6	45839.6	2.1	
2029.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7009.2	6557.2								
2030.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7009.2	6557.2								
2031.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7009.2	6557.2								
2032.0	0.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	1.7	7569.9	7072.7								
2033.0	0.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	1.7	7569.9	7072.7								
2034.0	0.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	1.7	7569.9	7072.7								
2035.0	0.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	1.7	7569.9	7072.7								
2036.0	0.0	452.0	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	1.7	7569.9	7072.7								
2037.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8175.5	7628.6								
2038.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8175.5	7628.6								
2039.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8175.5	7628.6								
2040.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8175.5	7628.6								
2041.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8175.5	7628.6								
2042.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8829.5	8228.1								
2043.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8829.5	8228.1								
2044.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8829.5	8228.1								
2045.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8829.5	8228.1								
2046.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8829.5	8228.1								
2047.0	0.0	601.6	661.8	6965.7	870.7	696.6	31.2	100.3	2.4	2.1	9535.9	8874.1								
2048.0	0.0	601.6	661.8	6965.7	870.7	696.6	33.7	100.3	2.4	2.1	9538.6	8876.9								
2049.0	0.0	601.6	661.8	6965.7	870.7	696.6	36.4	100.3	2.4	2.1	9541.6	8879.8								
2050.0	0.0	601.6	661.8	6965.7	870.7	696.6	39.3	100.3	2.4	2.1	9544.8	8883.0								
2051.0	0.0	601.6	661.8	6965.7	870.7	696.6	42.5	100.3	2.4	2.1	9548.3	8886.5								
2052.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	10312.1	9584.2								
2053.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	10312.1	9584.2								
2054.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	10312.1	9584.2								
2055.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	10312.1	9584.2								
2056.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	10312.1	9584.2								
2057.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	11137.1	10336.4								
2058.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	11137.1	10336.4								
2059.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	11137.1	10336.4								
2060.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	11137.1	10336.4								
2061.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	12028.1	11147.3								
2062.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	12028.1	11147.3								
2063.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	12028.1	11147.3								
2064.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	12028.1	11147.3								
2065.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	12028.1	11147.3								
2066.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	12028.1	11147.3								
2067.0	0.0	880.8	968.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	12990.3	12021.4								
2068.0	0.0	880.8	968.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	13824.3	12855.4								
2069.0	0.0	880.8	968.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	14724.9	13756.1								
2070.0	0.0	880.8	968.9	9476.8	11938.0	1184.6	947.7	57.8	136.4	3.2	2.9	15697.7	14728.8							
2071.0	0.0	880.8	968.9	9476.8	12893.0	1184.6	947.7	57.8	136.4	3.2	2.9	16748.2	15779.3							
2072.0	0.0	968.9	1065.8	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	18088.1	17022.3								
2073.0	0.0	968.9	1065.8	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	18088.1	17022.3								

Year	Construction Cost (lacs)	Maintenance Cost (lacs)	Economic Benefit																	
			Total Cost increased by 20%	Earthquake Risk Elimination 10% of Total Cost (lacs)	Fire Safety Enhancement (Per Building) 20% of construction Cost (lacs)	Increase In Property Value 10% (lacs)	Operational Job Creation (lacs)	Savings on Energy .35 Kwh/sqft(lacs)	Increased Tax Revenue (lacs)	Improved Waste Management (lacs)	Total Benefit increased by 10% (lacs)	Net Cash Flow (Undiscounted) (lacs)	NPV (At 11% Discount Rate) (lacs)	NPV (At 14% Discount Rate) (lacs)	IRR	Discount Rate (%)	NPV of Benefit (lacs)	NPV of Cost (lacs)	B/C Ratio	
2024.0	13696.8	0.0	16436.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-16436.2	8136.8	-3945.3	0.128	15.0	33290.6	39917.8	0.8	
2025.0	13696.8	0.0	16436.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-16436.2	13.0	41065.2	41767.7	1.0				
2026.0	13696.8	0.0	16436.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-16436.2	11.0	52070.5	43933.7	1.2				
2027.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7009.2	6516.1	9.0	68386.5	46578.9	1.5				
2028.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7009.2	6516.1	7.0	93974.6	50006.8	1.9				
2029.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7009.2	6516.1								
2030.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7009.2	6516.1								
2031.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7009.2	6516.1								
2032.0	0.0	450.0	542.6	5529.6	650.0	524.8	24.8	79.6	1.9	1.7	7009.2	7027.5								
2033.0	0.0	450.0	542.6	5529.6	650.0	524.8	24.8	79.6	1.9	1.7	7009.2	7027.5								
2034.0	0.0	450.0	542.6	5529.6	650.0	524.8	24.8	79.6	1.9	1.7	7009.2	7027.5								
2035.0	0.0	452.0	542.4	5529.6	650.0	524.8	24.8	79.6	1.9	1.7	7009.2	7027.5								
2036.0	0.0	452.0	542.4	5529.6	650.0	524.8	24.8	79.6	1.9	1.7	7009.2	7027.5								
2037.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8175.5	7578.9								
2038.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8175.5	7578.9								
2039.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8175.5	7578.9								
2040.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8175.5	7578.9								
2041.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8175.5	7578.9								
2042.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8829.5	8173.4								
2043.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8829.5	8173.4								
2044.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8829.5	8173.4								
2045.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8829.5	8173.4								
2046.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	8829.5	8173.4								
2047.0	0.0	601.6	721.9	6965.7	870.7	696.6	31.2	100.3	2.4	2.1	9535.9	8814.0								
2048.0	0.0	601.6	721.9	6965.7	870.7	696.6	33.7	100.3	2.4	2.1	9538.6	8816.7								
2049.0	0.0	601.6	721.9	6965.7	870.7	696.6	36.4	100.3	2.4	2.1	9541.6	8819.7								
2050.0	0.0	601.6	721.9	6965.7	870.7	696.6	39.3	100.3	2.4	2.1	9544.8	8822.9								
2051.0	0.0	601.6	721.9	6965.7	870.7	696.6	42.5	100.3	2.4	2.1	9548.3	8826.3								
2052.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	10312.1	9518.0								
2053.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	10312.1	9518.0								
2054.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	10312.1	9518.0								
2055.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	10312.1	9518.0								
2056.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	10312.1	9518.0								
2057.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	11137.1	10263.6								
2058.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	11137.1	10263.6								
2059.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	11137.1	10263.6								
2060.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	11137.1	10263.6								
2061.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	11137.1	10263.6								
2062.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	12028.1	11067.2								
2063.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	12028.1	11067.2								
2064.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	12028.1	11067.2								
2065.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	12028.1	11067.2								
2066.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	12028.1	11067.2								
2067.0	0.0	880.8	1057.0	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	12990.3	11933.3								
2068.0	0.0	880.8	1057.0	10234.9	1184.6	947.7	57.8	136.4	3.2	2.9	13824.3	12767.3								
2069.0	0.0	880.8	1057.0	11053.7	1184.6	947.7	57.8	136.4	3.2	2.9	14724.9	13668.0								
2070.0	0.0	880.8	1057.0	11938.0	1184.6	947.7	57.8	136.4	3.2	2.9	15697.7	14640.7								
2071.0	0.0	880.8	1057.0	12893.0	1184.6	947.7	57.8	136.4	3.2	2.9	16748.2	15691.2								
2072.0	0.0	968.9	1162.7	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	18088.1	16925.4								
2073.0	0.0	968.9	1162.7	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	18088.1	16925.4								

Year	Construction Cost (lacs)	Maintenance Cost (lacs)	Total Cost increased by 10%	Earthquake Risk Elimination 10% of Total Cost (lacs)	Fire Safety Enhancement (Per Building) 20% of construction Cost (lacs)	Increase In Property Value 10% (lacs)	Economic Benefit											IRR	Discount Rate (%)	NPV of Benefit (lacs)	NPV of Cost (lacs)	B/C Ratio
							Operational Job Creation (lacs)	Savings on Energy 35 Kwh/sqft(lacs)	Increased Tax Revenue (lacs)	Improved Waste Management (lacs)	Total Benefit increased by 20% (lacs)	Net Cash Flow (Undiscounted) (lacs)	NPV (@ 11% Discount Rate) (lacs)	NPV (@ 15% Discount Rate) (lacs)								
2024.0	13696.8	0.0	15066.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-15066.5	16531.6	-274.2	0.149	15.0	36317.1	36591.3	1.0				
2025.0	13696.8	0.0	15066.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-15066.5				13.0	44802.8	38287.1	1.2				
2026.0	13696.8	0.0	15066.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-15066.5				11.0	56804.2	40272.6	1.4				
2027.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7646.4	7194.4			9.0	74603.4	42697.3	1.7				
2028.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7646.4	7194.4			7.0	102517.7	45839.6	2.2				
2029.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7646.4	7194.4										
2030.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7646.4	7194.4										
2031.0	0.0	410.9	452.0	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7646.4	7194.4										
2032.0	0.0	452.0	497.2	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	8258.1	7760.9										
2033.0	0.0	452.0	497.2	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	8258.1	7760.9										
2034.0	0.0	452.0	497.2	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	8258.1	7760.9										
2035.0	0.0	452.0	497.2	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	8258.1	7760.9										
2036.0	0.0	452.0	497.2	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	8258.1	7760.9										
2037.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8918.7	8371.8										
2038.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8918.7	8371.8										
2039.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8918.7	8371.8										
2040.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8918.7	8371.8										
2041.0	0.0	497.2	546.9	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8918.7	8371.8										
2042.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	9632.2	9030.8										
2043.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	9632.2	9030.8										
2044.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	9632.2	9030.8										
2045.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	9632.2	9030.8										
2046.0	0.0	546.8	601.4	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	9632.2	9030.8										
2047.0	0.0	601.4	6945.7	870.7	696.5	31.5	100.3	2.4	2.1	10409.8	9744.0											
2048.0	0.0	601.4	6945.7	870.7	696.5	33.7	100.3	2.4	2.1	10409.8	9744.0											
2049.0	0.0	601.4	6945.7	870.7	696.5	36.4	100.3	2.4	2.1	10409.8	9747.3											
2050.0	0.0	601.4	6945.7	870.7	696.5	39.3	100.3	2.4	2.1	10412.5	9750.7											
2051.0	0.0	601.4	6945.7	870.7	696.6	42.5	100.3	2.4	2.1	10416.3	9754.5											
2052.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	11249.6	10521.7										
2053.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	11249.6	10521.7										
2054.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	11249.6	10521.7										
2055.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	11249.6	10521.7										
2056.0	0.0	661.8	727.9	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	11249.6	10521.7										
2057.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	12149.6	11348.8										
2058.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	12149.6	11348.8										
2059.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	12149.6	11348.8										
2060.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	12149.6	11348.8										
2061.0	0.0	727.9	800.7	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	12149.6	11348.8										
2062.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	13121.5	12240.7										
2063.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	13121.5	12240.7										
2064.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	13121.5	12240.7										
2065.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	13121.5	12240.7										
2066.0	0.0	800.7	880.8	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	13121.5	12240.7										
2067.0	0.0	880.8	964.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	14121.4	13202.4										
2068.0	0.0	880.8	964.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	14121.4	13202.4										
2069.0	0.0	880.8	964.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	14121.4	13202.4										
2070.0	0.0	880.8	964.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	14121.4	13202.4										
2071.0	0.0	880.8	964.9	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	14121.4	13202.4										
2072.0	0.0	964.9	1045.8	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	19732.4	18666.7										
2073.0	0.0	964.9	1045.8	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	19732.4	18666.7										

Year	Construction Cost (lacs)	Maintenance Cost (lacs)	Total Cost increased by 20%	Earthquake Risk Elimination 10% of Total Cost (lacs)	Fire Safety Enhancement (Per Building) 20% of construction Cost (lacs)	Increase In Property Value 10% (lacs)	Economic Benefit											IRR	Discount Rate (%)	NPV of Benefit (lacs)	NPV of Cost (lacs)	B/C Ratio
							Operational Job Creation (lacs)	Savings on Energy 35 Kwh/sqft(lacs)	Increased Tax Revenue (lacs)	Improved Waste Management (lacs)	Total Benefit increased by 20% (lacs)	Net Cash Flow (Undiscounted) (lacs)	NPV (@ 11% Discount Rate) (lacs)	NPV (@ 14% Discount Rate) (lacs)								
2024.0	13696.8	0.0	16436.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-16436.2	12870.5	-594.0	0.138	15.0	36317.1	39917.8	0.9				
2025.0	13696.8	0.0	16436.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-16436.2				13.0	44802.8	41767.7	1.1				
2026.0	13696.8	0.0	16436.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-16436.2				11.0	56804.2	43933.7	1.3				
2027.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7646.4	7153.3			9.0	74603.4	46578.9	1.6				
2028.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7646.4	7153.3			7.0	102517.7	50006.8	2.1				
2029.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7646.4	7153.3										
2030.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7646.4	7153.3										
2031.0	0.0	410.9	493.1	5120.0	640.0	512.0	23.0	73.7	1.8	1.6	7646.4	7153.3										
2032.0	0.0	452.0	542.4	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	8258.1	7715.7										
2033.0	0.0	452.0	542.4	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	8258.1	7715.7										
2034.0	0.0	452.0	542.4	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	8258.1	7715.7										
2035.0	0.0	452.0	542.4	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	8258.1	7715.7										
2036.0	0.0	452.0	542.4	5529.6	691.2	553.0	24.8	79.6	1.9	1.7	8258.1	7715.7										
2037.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8918.7	8322.1										
2038.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8918.7	8322.1										
2039.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8918.7	8322.1										
2040.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8918.7	8322.1										
2041.0	0.0	497.2	596.6	5972.0	746.5	597.2	26.8	86.0	2.0	1.8	8918.7	8322.1										
2042.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	9632.2	8976.1										
2043.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	9632.2	8976.1										
2044.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	9632.2	8976.1										
2045.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	9632.2	8976.1										
2046.0	0.0	546.8	656.1	6449.7	806.2	645.0	28.9	92.9	2.2	2.0	9632.2	8976.1										
2047.0	0.0	601.6	721.9	6965.7	870.7	696.5	31.5	100.3	2.4	2.1	10409.8	9633.9										
2048.0	0.0	601.6	721.9	6965.7	870.7	696.5	33.7	100.3	2.4	2.1	10409.8	9633.9										
2049.0	0.0	601.6	721.9	6965.7	870.7	696.6	36.4	100.3	2.4	2.1	10409.0	9637.1										
2050.0	0.0	601.6	721.9	6965.7	870.7	696.6	39.3	100.3	2.4	2.1	10412.5	9630.4										
2051.0	0.0	601.6	721.9	6965.7	870.7	696.6	42.5	100.3	2.4	2.1	10416.3	9634.4										
2052.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	11249.6	10455.5										
2053.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	11249.6	10455.5										
2054.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	11249.6	10455.5										
2055.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	11249.6	10455.5										
2056.0	0.0	661.8	794.1	7523.0	940.4	752.3	45.9	108.3	2.6	2.3	11249.6	10455.5										
2057.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	12149.6	11276.0										
2058.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	12149.6	11276.0										
2059.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	12149.6	11276.0										
2060.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	12149.6	11276.0										
2061.0	0.0	727.9	873.5	8124.8	1015.6	812.5	49.5	117.0	2.8	2.5	12149.6	11276.0										
2062.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	13121.5	12160.6										
2063.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	13121.5	12160.6										
2064.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	13121.5	12160.6										
2065.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	13121.5	12160.6										
2066.0	0.0	800.7	960.9	8774.8	1096.8	877.5	53.5	126.3	3.0	2.7	13121.5	12160.6										
2067.0	0.0	800.8	1057.0	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	14163.3	13114.3										
2068.0	0.0	800.8	1057.0	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	14163.3	13114.3										
2069.0	0.0	800.8	1057.0	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	14163.3	13114.3										
2070.0	0.0	800.8	1057.0	9476.8	1184.6	947.7	57.8	136.4	3.2	2.9	14163.3	13114.3										
2071.0	0.0	800.8	1057.0	12893.0	1184.6	947.7	57.8	136.4	3.2	2.9	17124.7	16067.8										
2072.0	0.0	968.9	1162.7	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	19732.4	18569.8										
2073.0	0.0	968.9	1162.7	13924.5	1279.4	1023.5	62.4	147.3	3.5	3.1	19732.4	18569.8										