A

PROJECT REPORT

ON

AFFORDABLE HOUSING USING GEOGRAPHICAL INFORMATION SYSTEM

SUBMITTED IN FULFILLMENT FOR THE AWARD OF

BACHELORS OF ENGINEERING

IN

CIVIL ENGINEERING

MUMBAI UNIVERSITY, MUMBAI

SUBMITTED BY

KHAN IBRAHIM (18DCE06)

KOKATE ABDULHADI (18DCE07)

RAIS ASIL (18DCE11)

SHAIKH SAMEER (18DCE17)

UNDER THE GUIDANCE OF

PROF. PARKAR FAUWAZ

DEPARTMENT OF CIVIL ENGINEERING

School of Engineering and Technology

Anjuman I Islam's Kalsekar Technical Campus, New-Panvel.

(AFILIATED TO MUMBAI UNIVERSITY)

2020-2021

CERTIFICATE

This is to certify that the entitled, "AFFORDABLE HOUSING USING GIS" submitted fulfilment of the requirements for the award of Bachelors of Engineering **degree in C**ivil Engineering **during 2020 - 2021 academicy year at the Anjuman I Islam's Kalsekar Technical Campus, New-Panvel is an authentic work carried out by them under my supervision and guidance.**

NAME OF STUDENT :

KHAN IBRAHIM KHALIL (18DCE06)

KOKATE ABDULHADI JAMEEL (18DCE07)

RAIS ASIL AKIL (18DCE11)

SHAIKH SAMEER MOHD ALI (18DCE17)

PROF. PARKAR FAUWAZ	**PROF. DR. R. B. MAGAR**	**DR. ABDUL RAZAK HONNUTAGI**
GUIDE	**HOD**	**DIRECTOR**
	CIVIL DEPT	

DEPARTMENT OF CIVIL ENGINEERING

School of Engineering and Technology

Anjuman I Islam's Kalsekar Technical Campus, New-Panvel.

(AFILIATED TO MUMBAI UNIVERSITY)

2020-2021

PROJECT APPROVAL SHEET

The report entitled **AFFORDABLE HOUSING USING GIS** submitted by **KHAN IBRAHIM KHALIL (18DCE06) , KOKATE ABDULHADI JAMEEL (18DCE07) , RAIS ASIL AKIL (18DCE11) , SHAIKH SAMEER MOHD ALI (18DCE17)** after presenting his thesis work in form of powerpoint presentation is hereby approved fulfillment for the award of Degree of Bachelors in Civil Engineering of Mumbai University, Mumbai.

EXAMINERS : 1) NAME _

2) NAME _

SUPERVISOR : 1) NAME _

2) NAME _

Date:

Place: New-Panvel.

ACKNOWLEDGEMENT

It gives us immense pleasure that we would like to express our most sincere heartfelt gratitude to our guide, **Prof. Parkar Fauwaz** Assistant Professor, Dept. Of Civil Engineering, Anjuman-I-Islam's Kalsekar Technical Campus, New-Panvel for her mentoring and research support throughout our studies.

We are very grateful to **Dr. Abdul Razak. Honnutagi, Director,** Anjuman-I-Islam's Kalsekar Technical Campus, New-Panvel for his devotion; his experience and observations helped us a lot to focus on my work. His technical and editorial advice was essential for the completion of this dissertation. His ability to teach, depth of knowledge and ability to achieve perfection will always be our inspiration.

I express my sincere thanks to **Prof. Dr R. B. Magar**, Head of Civil Engineering Department, Anjuman-I-Islam's Kalsekar Technical Campus, New-Panvel for providing us the necessary facilities in the department. Also, our heartfelt gratitude to all the faculties of Department of the Civil Engineering.

We would like to thank **our dearest parents** for making us believe in my dreams and for constantly supporting us to achieve them.

KHAN IBRAHIM KHALIL (18DCE06)

KOKATE ABDULHADI JAMEEL (18DCE07)

RAIS ASIL AKIL (18DCE11)

SHAIKH SAMEER MOHD ALI (18DCE17)

DECLARATION

We declare that this written submission represents ideas in our own words and where others ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that; we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

KHAN IBRAHIM KHALIL (18DCE06)

KOKATE ABDULHADI JAMEEL (18DCE07)

RAIS ASIL AKIL (18DCE11)

SHAIKH SAMEER MOHD ALI (18DCE17)

Date:

Place: New-Panvel.

INDEX

LIST OF FIGURES

LIST OF TABLES

ABBREVIATION

GIS	Geographical Information System
QGIS	Quantum Geographical Information System
GOI	Government Of India
EWS	Economically Weaker Sections
LIG	Low Income Group
FSI	Floor Space Index
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
PMAY	Pradhan Mantri Awas Yojana
MHADA	Maharashtra Housing And Area Development Authority
GDP	Gross Domestic Product
CRS	Coordinate Reference System
NAR	National Association Of Realtors
NCGIA	National Centre Of Geographic Information And Analysis
MUTP	Mumbai Urban Transport Project
CIDCO	City And Industrial Development Corporation Limited
MMRDA	Mumbai Metropolitan Region Development Authority
MUIP	Mumbai Urban Infrastructure Project

ABSTRACT

Affordable housing is a problem that many countries are taking stock of, world over. In India, the problem is much more stark with an estimated shortage of around 18 million houses, with 99% of this in the economically weaker sections of society. This paper sets out the definitions of affordable housing in India and across the world; the issues with the various definitions of affordable housing; the institutions and agencies responsible for formulating and implementing affordable housing policies in the state; the opportunites and challenges in affordable housing as well as a discussion on learnings from international experience in this sector.

The Government of India (GOI) had estimated a shortage of more than 18.78 million homes at the beginning of 2012, of which 95% were in the EWS (Economically Weaker Sections) and LIG (Low Income Group) segments. Further, the country's total urban housing shortage is projected to be about 30 million by 2022. The Indian Government currently faces an uphill task of providing for more than 2 crore dwellings by the year 2022, which translated to almost 3 million units per year to fulfill its electoral promise of 'Housing for All by 2022'. To achieve this daunting target the government has taken various initiatives to make the affordable housing segment lucrative both for the private developers and the homebuyers. This research paper aims at assessing the impact of the government initiatives on both the parties, i.e., the private developers and the homebuyers and tries to encapsulate their views on the government policies to boost the segment.

Affordable housing refers to delivering cost-effective dwelling units for those families whose income is below the median household income of the society. It is a crucial issue especially in developing nations where a majority of the population is not able to purchase houses at the market price. In the present scenario of complex, expensive and high-quality projects, profit margins have shrunk due to tough competition between developers. Hence for providing affordable housing solutions it becomes imperative to make best utilization of resources by employing efficient technologies and optimization techniques.

Currently, a major drawback of the construction industry is lack of proper data flow and its management. Data is managed either on physically maintained drawing sheets or computer aided drawing and drafting tools, due to which various construction parties like the architect, the contractor, the structural engineer, the MEP, etc. Work on different platforms with their individual expertise. Hence, often the projects are impacted due clashes in members of the structural, non-structural, mechanical, electrical, plumbing and other service utility elements. Moreover, if any change is envisaged by a party, it needs to bring to the notice of all other concerned parties and all need to rectify their individual drawing plans, sections and elevations, which leads to loss of time or rework.

One challenge that many projects face is the escalated construction costs. This is due to materials, equipment and other resources being procured and employed according to individual project needs, availability and expertise. Also, contractors invest a lot of their resources in construction of common utilities, which are piecemeal, and would otherwise be taken together with other projects. This is due to lack of data available with municipality and urban local bodies, let alone the contractors. Many activities are duplicated for different projects due lack of synchronization. Thus, if a group projects are brought on a common geographical platform where their spatial and non-spatial requirements can be serviced, it will lead to considerable saving for all the parties involved. Geographical Information System (GIS) is one such tool which can be used as it has the ability to create, store , manipulate and analyze.

CHAPTER ONE

INTRODUCTION

1. INTRODUCTION :

1.1 HOUSING

1.1.1 GENERAL

Housing is one of the basic necessities and an important economic activity playing a significant role in the socio-psychological development of an individual. The traditional concept of basic human needs focuses on fulfillment of minimum food, clothing and shelter. Providing shelter to its ever growing population has become all so more important for developing countries. Housing not only provides shelter and sanitation facilities but also offers accessibility to education and commercial services, thus significantly contributing to the national income. The construction industry is unique and is the second largest industry in India after agriculture. It makes a significant contribution to the national economy and provides employment to large number of people.

Despite the construction industry being an indicator for growth, it inadvertently experiences cost and time overruns and disputes among parties. Hence, providing housing for all is still a dream far from being realised. Since projects are constrained by time, quality and cost, developers are more interested in a timely project completion with the required quality that yields the maximum return on investment. In light of the recent advancements in systems integration in construction, affordable housing is in need of an optimization system that would yield higher mutual benefits for residents and developers. Lack of affordable housing has many negative impacts on societies, especially in urban areas. Thus, affordable housing should be the priority of the governments to ensure the survival and prosperity of their nation.

1.1.2 URBANIZATION AND ECONOMIC DEVELOPMENT

The increasing rate of rural to urban migration is the main cause of population growth in urban areas, pressurizing the cities to meet their demands with limited resources. The natural growth in cities along with influx of rural populations add more demand for the provision of shelter in urban areas. At present India is on the path of urbanization with around 34% people living in urban areas (World Bank, 2017). The 2011 Census of India reveals that the urban population of the country stood at 377 million or 31.16 % of the total population. This is estimated to have increased to 437 million by 2021, which is about 36 % of the total population. It is projected that the urban population would grow to about 553 million in 2026. The level of urbanization is expected to reach 50 percent mark in the next 3-4 decades. Urbanisation and economic growth

are closely interlinked, as more than 60 percent of Gross Domestic Product (GDP) of the country is contributed by urban India. As India moves ahead to a double-digit growth, obviously a key policy issue has emerged as to how to rejuvenate and strengthen the Urban Centres. Most urban centres are experiencing several challenges like low level of urban services, increasing number of poor people and lack of adequate housing. (National Building Organizatiom, 2013). Maharashtra has the highest urban popluation in India above 5 crores (2011 census) out of which around 39% lives in Mumbai Metropolitan Region (Planning commission, 2012).

Urbanization is a process in which opportunites and challenges form two sides of the same coin. Urban centre attract people as they provide opportunites in the form of employment, increased and regular income, better facilities and livelihood, better access to education, etc. A rapid increase in population results in higher demand for dwelling units. However, it also throws many challenges such as unplanned mushrooming of cities which puts immense pressure on land housing and basic services such as water supply, sanitation, electricity and solid waste management. The consequence has been overcrowding and unhealthy living environment, shortages of basic amenities and finally social and economic scarcity. All major urban areas in our country are gradually being occupied by houses.

Urbanization and economic development always go hand in hand. Proper urban development which takes into account planned development action and concerted efforts of land acquisition is the need of the hour. Urban development shall not only be concerned with identification and creation of new spaces for accomodating populations, but also utilization of spaces occupied by illegal means. Thus, slum clearance and rehabilitation of inhabitants, provision of social and economic infrastructure with a quality of working and living environment in an urbanized area shall be associated with an urban development plan. Urban local bodies help in bridging the gap between state government and the communities, so that adequate facilities are in place for the targeted populations.

In India urban development is a state subject which assists the programmers of urban development, policy framework, legislation support by the way of constitutional amendment, to implement a number of centrally sponsored schemes, processing multilateral/bilateral institutions for state government projects and finally providing technical support and advice for promoting orderly urbanization.

1.2 AFFORDABLE HOUSING

1.2.1 GENERAL

Affordable housing refers to delivering cost-effective dwelling units for those families whose income is below the median household income of the society. It is a crucial issue especially in developing nations where a majority of the population is not able to purchase houses at the market price. Affordable housing, with the right internal environment like room size, thermal insulation, natural light and ventilation is not only important to the health and well-being of people, but also for the smooth functioning of economies. Nevertheless, property prices in urban centers in India have seen a tremendously increase over last few decades. If the same trend continues, huge number of urban households will have to live either in substandard housing or adopt a substandard lifestyle due to property debt, and would not have access to basic facilities like good education, healthcare, etc.

The private contractors do not invest frequently in affordable housing due to the low and unassured returns; especially, in metro cities because of high Floor Space Index (FSI) costs, lack of land availability, density and other issues. Thus, the responsibility to invest in affordable housing is generally taken by Governments and non-governmental organizations that are involved with affordable housing. However, if the private markets realzises the benefits in affordable housing, the construction industry can be propelled to build affordable housing for social interest. There is a potential market that needs to be better studied and considered.

Government of India accepted housing as principal requirement of urban population since independence. The urban development policies in India were expressed mainly through five year plans, which focused on creating devoted institution and formulating programmes and schemes with an emphasis on weaker sections and the poor. Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and Rajiv Awas Yojana (RAY), developed by Ministry of Housing and Urban Affairs, Government of India, necessiated a good development pattern for urban centres, but were not good enough to keep pace with the ever increasing urban population. Hence, Pradhan Mantri Awas Yojana (PMAY) was introduced in 2015, which aims at housing for all by 2022. The main focus is devlopment of affordable urban housing schemes especially for weaker sections of society.

As per the Census 2011, of the total households in the Maharashtra, 81.1 % households were living in owned houses whereas 15.8 % households were living in rented houses. To meet the growing demand of housing policy the state government has been pro-active in its housing polices, to provided an affordable shelter to

the needy people the state government has set up MHADA (Maharashtra housing and area development authority), CIDCO (City and Industrial development corporation limited), MMRDA (Mumbai Metropolitan region development authority, MUTP (Mumbai Urban Transport project) MUIP (Mumbai urban Infrastructure Project providing houses for the project affected families. MHADA is instrumental in housing development by providing houses in Mumbai and other parts of the state at affordable prices, whereas CIDCO also undertakes housing initiatives on a large scale, especially in Navi Mumbai, Aurangabad, Vasai-Virar, NAINA and Khopta regions of the state.

Affordable Housing is fast taking centre stage in the international as well as the national agenda in India. With housing recognized as a basic need, governments at every level are discussing ways and means to provide access to housing for its citizenry so as to increase their productive capital. The importance of affordable housing is neatly captured in the following statement by the Affordable Housing Institute quoting Rakesh Mohan, Deputy Governor of the RBI, in 2007, "...future national competitiveness and economic success will depend on the comparative efficiency of cities. Because housing is where jobs go to sleep at night, the quantity, quality, availability and affordability of housing becomes a key component in national economic competitiveness.

1.2.2 ROLE

The role and function of housing is multifaceted - housing choices impact access to infrastructure, employment, household wealth, health, education, poverty levels, maternal and child mortality, women participation in workforce, and many other wellbeing indicators. As India seeks to improve its living conditions on a large scale, access to affordable housing becomes the first major stumbling block for its citizens.

This article addresses first a diagnosis of the issue of affordable housing (AH) and sets the context for the panel discussion which follows on the state of the AH market in India and policy interventions required to make it better. The current note sets out the academic perspective on AH : first, by defining the term affordable housing, second, by describing the need for focus on AH, third, by analysing the institutional structure of AH delivery in India.

Framing an AH policy firstly involves defining what it is and what it is not: the parameters affordability is measured on. Defining AH is also important to create targeted policies aimed at making financing more accessible, providing mechanisms such as interest rate subsidies, or favourable terms on par with infrastructure financing.

Internationally, housing affordability is defined in multiple ways. One of the most commonly accepted definitions of affordability refers to housing affordability is taken as a measure of expenditure on housing to income of the household. This is also accepted by the Indian Government, which states "**Affordable housing refers to any housing that meets some form of affordability criterion, which could be income level of the family, size of the dwelling unit or affordability in terms of EMI size or ratio of house price to annual income"** (High Level Task Force on Affordable Housing for All, December 2008, p. 7) .

The MHUPA in its 2011 report takes note of both income and size criteria to define the Concept:

	Size	EMI or Rent
EWS	Minimum of 300 sq ft super built-up area Minimum of 269 sq ft (25 sq.m) carpet area	Not exceeding 30-40percent of gross monthly income of buyer
LIG	Minimum of 500 sq ft super built up area Maximum of 517 sq ft (48sq.m) carpet area	
MIG	600-1200 sq ft super built-up area Maximum of 861 sqft (80sqm) carpet area	

(MHUPA, 2011).

Table 1.2.1 : Classification On Basis Of Both Income And Size

Multiple studies in the Indian context have also suggested other metrics of affordability.

Housing affordability is a multi-faceted measure, and while affordability is commonly defined using the expenditure method, there are other perspectives to affordability as well, as discussed in the next sections.

1.2.3 DEMAND FOR AFFORDABLE HOUSING IN INDIA

The demand drivers for AH in India are several. First is the progressive urbanization hand in hand with a growing urban population, from 109 million in 1971 to 377 million in 2011 toward a whopping 600 million by 2030. The consequences of the growing concentration of people in urban spaces is felt in land and housing shortages and congested transit, besides stressing basic amenities such as water, power and lung space. The Ministry of Housing estimated a housing shortage of 18.78 million during the 12th plan period, with 99 percent in the economically weaker and lower income groups (Ministry of Housing & Poverty Alleviation, GOI, September 2013, p. 2). This in turn has led to the proliferation of slums and slum population; 65 million as

per Census 2011 (Ministry of Housing & Poverty Alleviation, GOI, September 2013, p. 2). Second, alongside the growth of the urban population, rising incomes have led to the expansion of the middle class. This has led to a spike in demand for housing that is affordable but includes basic amenities.

Third, the real estate sector is a major component of Indian economy. At Rs.170 Crore, it contributed 4.5 percent Crore in India's GDP and employed 7 percent of the urban workforce in 2006-7. Housing is the largest component of the financial sector and construction sector as well (High Level Task Force on Affordable Housing for All, December 2008, p. 6). A thrust on AH will not only lead to better quality of life, but also significantly provide a boost to the GDP of the country.

AH provisions are important at the national level, the city level as well as the individual level. Cities are engines of economic growth, and housing that can be afforded by the median wage-earner is a pre-requisite for the city to attract and retain the labour force required to ensure its economic success. From a national perspective, AH is one of the indicators of balanced growth in the country. When housing becomes unaffordable, there is either a bubble in the housing market, with serious repercussions to economic policy, or other imbalances in the economy.

1.3 GIS

1.3.1 GENERAL

A geographic information system (GIS) is a conceptualized framework that provides the ability to capture and analyze spatial and geographic data. GIS applications (or GIS apps) are computer-based tools that allow the user to create interactive queries (user-created searches), store and edit spatial and non-spatial data, analyze spatial information output, and visually share the results of these operations by presenting them as maps.

Geographic information science (or, Gi science), the scientific study of geographic concepts, applications, and systems is commonly initialized as GIS, as well. Geographic information systems are utilized in multiple technologies, processes, techniques and methods. They are attached to various operations and numerous applications, that relate to: engineering, planning, management, transport/loGIStics, insurance, telecommunications, and business. For this reason, GIS and location intelligence applications are at the foundation of location-enabled services, that rely on geographic analysis and visualization.

GIS provides the capability to relate previously unrelated information, through the use of location as the "key index variable". Locations and extents that are found in the Earth's spacetime, are able to be recorded through the date and time of occurrence, along with x, y, and z coordinates; representing, longitude (*x*), latitude (*y*), and elevation (*z*). All Earth-based, spatial–temporal, location and extent references, should be relatable to one another, and ultimately, to a "real" physical location or extent. This key characteristic of GIS, has begun to open new avenues of scientific inquiry and studies.

Like the field of geography, the term Geographic Information System (GIS) is hard to define. It represents the integration of many subject areas. Accordingly there us no absolutely agreed upon definition of a GIS (demers, 1997). A broadly accepted definition of GIS is the one provided by the National Centre of Geographic Information and Analysis: a GIS is a system of hardware, software and procedures to facilitate the management, manipulation, analysis, modelling, representation and display of georeferenced data to solve complex problems regarding planning and management of resources (NCGIA, 1990) Geographic information systems have emerged in the last decade as an essential tool for urban and resource planning and management. Their capacity to store, retrieve, analyze, model and map large areas with huge volumes of spatial data has led to an extraordinary proliferation of applications.

Geographic information systems are now used for land use planning, utilities management, ecosystems modelling, landscape assessment and planning, transportation and infrastructure planning, market analysis, visual impact analysis, facilities management, tax assessment, real estate analysis and many other applications.

1.3.2 FUNCTION

Functions of GIS include: data entry, data display, data management, information retrieval and analysis.
A more comprehensive and easy way to define GIS is the one that looks at the disposition, in layers , of its data sets. "Group of maps of the same portion of the territory, where a given location has the same coordinates in all the maps included in the system". This way, it is possible to analyse its thematic and spatial characteristics to obtain a better knowledge of this zone.

1.3.3 APPLICATION

1. Mapping locations: GIS can be used to map locations. GIS allows the creation of maps through automated mapping, data capture, and surveying analysis tools.
2. Mapping quantities: People map quantities, like where the most and least are, to find places that meet their criteria and take action, or to see the relationships between places. This gives an additional level of information beyond simply mapping the locations of features.
3. Mapping densities: While you can see concentrations by simply mapping the locations of features, in areas with many features it may be difficult to see which areas have a higher concentration than others. A density map lets you measure the number of features using a uniform areal unit, such as acres or square miles, so you can clearly see the distribution.
4. Finding distances: GIS can be used to find out what's occurring within a set distance of a feature.
5. Mapping and monitoring change: GIS can be used to map the change in an area to anticipate future conditions, decide on a course of action, or to evaluate the results of an action or policy.

1.3.4 GEOSPATIAL DATA

Geospatial data has both spatial and thematic components. Conceptually, geographic data can be broken up in two elements: observation or entity and Attribute or variable. GIS have to be able to manage both elements. Spatial component: The observations have two aspects in its localization: absolute localization based in a coordinates system and topological relationship referred to other observations. Example: The Department of Geomatics is located at the particular coordinate X,Y or The Department is located between Grattan Street and Old Engineering Building. A GIS is able to manage both while computer assisted cartography packages only manage the absolute one. Thematic component: The variables or attributes can be studied considering the thematic aspect (statistics), the locational aspect (spatial analysis) or both (GIS).

Data for GIS applications includes:

1. Digitilized and scanned data.
2. Databases.
3. GPS field sampling of attributes.
4. Remote sensing and aerial photography.

CHAPTER TWO

LITERATURE REVIEW

2. LITERATURE REVIEW :

2.1 GENERAL

Literature review is done to get information, knowledge and guidance while doing the proposed study of work. In this study, a critical appraisal of the previous work published in the literature pertaining to township planning and GIS has been referred. A holistic review of literature on creating sustainable neighborhood, multi-dimensional and parametric construction, life-cycle assessment of buildings, various methods and solutions of township planning etc. Is carried out.

2.2 OVERVIEW OF LITERATURE

Parrish et al. (2009) have discussed that building owners and operators want their buildings to perform more in less cost. This prima-facie seems impossible but with a sustainable-architectural approach it can be possible by methods for analyzing sustainability on architecture engineering construction (AEC) projects. The AEC industry works on life-cycle cost considerations, furthering the opportunity for a more sustainable built environment. The AEC industry faces stringent performance requirements like higher-performing infrastructure delivered in less time for less cost.

Kimball et al. (2012), Chester et al. (2012) have discussed life-cycle assessment (ICA) which deals with the impacts and costs of a system from initial construction through the end of life. However, this prospective approach includes many of the fundamental analytical methods used in existing infrastructure lCAS but seeks to understand how use of the infrastructure services changes, which requires the use of new methods and thinking for behavioural analysis that traditionally have not been incorporated.

Suhaida et al. (2011); Mulliner et al. (2012); Wallbaum et al. (2012) have discussed
That one of the most important preconditions for the success of any society in achieving sustainable development is providing affordable housing to people. In the united states, the national association of realtors (nar) uses three variables which influences the affordability of a house; namely mortgage rate, median family income, and existing median priced home.

Ndubueze (2009); Hashim (2010) have discussed that variables such as housing or renting price and household income only as the main effective component on housing affordability, and they have measured the housing affordability as (house price/income) or (house renting/income).

Mulliner et al. (2011); Hsalou et al. (2014) have discussed that providing affordable housing is not about cheap and decent homes, it considers a broad range of factors. On the other hand, assessing housing affordability based on the economic criteria (housing costs/household monthly income) is not a complete index. Areas are often regarded as affordable because they are low cost. However, this does not guarantee about the quality of the housing or the environment in which the housing is situated.

Yung et al. (2014) have discussed that adaptive reuse of existing buildings is being promoted as a means of reducing the use of new materials in sustainable housing developments.
Kennedy et al. (2007) have discussed that the increasing global population and urbanization, the urban landscapes have changed nature in such a way that the natural capital and stable climates upon which societies rely are seriously affected.

Berg et al. (1997); Churchill et al. (1999) have discussed that the metabolism of cities—the inflows of water, energy; and materials; and outflows of wastes—have increased considerably in recent decades. In many respects, the unsustainable nature of cities is due to poor planning at the micro or neighborhood level.

Engel-Yan et al. (2005) have discussed that development of a sustainable neighborhood requires strategies that promote: green buildings; integrated water systems; cycling, pedestrian, and transit friendly design; urban forestry; local energy production; and neighborhood waste management. There are, however, some limitations to neighborhood design, including competition for space between different infrastructure elements. Thus, there has to be an integrated approach to neighborhood design.

Baccini et al. (1991); Brunner et al. (2003) have discussed that to design sustainable neighborhood s; there is a need to study the urban metabolism at the neighborhood scale. There have been some studies of swiss household metabolism, which help towards this objective. As a first approximation, the neighborhood metabolism might be determined as a population weighted fraction of a whole urban metabolism. Yet, this might be inaccurate for construction materials as most cities are in a continual state of construction, but neighborhood s may not be. It is necessary to distinguish between the metabolisms of neighborhood s as they are under construction and those that are already built. Moreover, the era of construction, proximity to city centre, and other factors such as average income, will cause the metabolism of neighborhoods to be quite heterogeneous across a city.

The objectives of future planning for high-growth cities are many, such that the public is more sensitive to now-a-days as a city experiences rapid growth is the minimization of traffic congestion. As more and more land is developed and sprawl gets firmly established, the public desire for the preservation of open spaces

increases.

Chambers et al. (2000) have discussed that as sustainable development becomes a more important objective in civil infrastructure planning and policymaking, quality of life (QOL) is an important measure to understand, characterize, and apply effectively in the search for and development of appropriate infrastructure solutions for sustainable development.

Boschmann et al. (2008); Beatley (1995); Jeon et al. (2006) have discussed that as communities are unique, the primary objectives of one community relative to sustainable development may be very different from those of another. Objectives may also change over time for the same community. Thus, it can be assumed that a standard operational definition for sustainable development has not been found.

Steg et al. (2005); Boschmann et al. (2008); feng et al. (2009) have discussed that for an individual, QOL depends factors such as physical and psychological conditions. A person can be described as healthy by looking at the external influences on the individual and also at how he or she responds to or views them. QOL has therefore been described as a "multidimensional construct" as it also gets influenced by many factors.

Papageorgiou (1976) discussed the indicators for QOL may be found in relationship to the natural environment, the built environment, human health, economic vitality, economic achievement, social equity, social interaction, mobility, or any other area which is experienced or perceived by human beings. An indicator has to make possible comparisons at different spatial levels, global, regional, etc. And it should be able to capture changes over time.

Brunner (2013); Blair et al. (2011); Brueckner (2001); Ewing (1997); Berke et al. (2006); Baer (1997) discussed the reasons for cities in India not adopting smart-growth strategies in their development plans, and have reasoned that the use of smart-growth strategies differs among highly populated metropolitan cities versus less-populated cities. There are four barriers—conventional urban planning, not having enough incentive-based practices and resources, ad-hoc planning, and lack of integrated land use transportation and environmental planning prevent smart-growth strategies in India. The urban planners should incorporate in their early stages of planning steps to address the haphazard urban sprawl of cities before they move toward more complex political policies.

Zhu et al. (2012); Liu et al. (2010); jaeger et al. (2010); feng et al. (2012); nelson and French 2002; Huang et al. (2013) have discussed that urban planning researchers across the world believe that planning problems pertaining to sprawl, congestion, and degradation of natural resources can be addressed to some extent by developing smart-growth strategies developed cities in the united states, such as Portland, and developing

cities in china, such as Beijing, were trying to control sprawl by promoting smart-growth strategies and assigning their urban plans to integrate such policies.

Sudhira and Gururaja (2012); Basawaraju et al. (2011); Tamilenthi et al. (2011); Mohan (2010); Sivaramakrishnan (2003, 2011b) have discussed that urban planning researchers in India studied the impact of urbanization and implications of urban sprawl across many Indian cities. They concluded that it is necessary to formulate appropriate urban planning strategies to effectively control the haphazard spatial growth of the country. However, in India, urban planners have overlooked the desire of controlling urban sprawl, resulting in a disorderly urban growth of the country.

Prickett and Bicknell (2010) have discussed that high prices in housing markets around the world are set against a backdrop of continuing efforts in developing sustainable housing through innovative designs, materials, and systems. Eco homes aim to balance the issues of climate change, resource use, and quality of life.

Raparthi (2014) has discussed the need for controlling such an outgrowth of urban sprawl is by examining local development plans and identifying challenges/barriers the country is experiencing in addressing smart growth. The main question that is to be answered by this research is to identify whether or not local development plans of Indian cities promote policies that promote smart growth.

Southworth (2005) has discussed about walkability, which is valued for a variety of reasons. Not only does pedestrian transportation reduce congestion and have low environmental impact, it has social and recreational value. It has been suggested that walking also promotes mental and physical health. The quality of the pedestrian environment is key to encouraging people to choose walking over driving. Six criteria are presented for design of a successful pedestrian network:1) connectivity; 2) linkage with other modes; 3) fine grained landuse patterns; 4) safety; 5) quality of path; and 6) path context. To achieve walkable cities in the united states it is necessary to assess current walkability conditions, revise standards and regulations, research walking behaviour in varied settings, promote public education and participation in pedestrian planning, and encourage collaboration and interdisciplinary education between transportation engineers and the design professions.

G´omez et al. (2004); Tzoulas et al. (2007); Niemelä et al. (2010); G´omez et al. (2011); Naumann et al. (2011); Ergen (2014); Elmqvist et al. (2013) have discussed sustainable urban development faces a series of challenges such as mitigation and adaptation to climate change, the support of urban biodiversity, and the promotion of healthy living conditions as well as maintaining a high environmental quality and quality of life

for local residents. Green infrastructure can offer diverse potentials to meet these demands by providing diverse ecosystem services.

Mathey et al. (2015) have discussed that vegetation-covered urban brownfields provide a number of ecosystem services to help tackle current urban challenges, such as preventing a loss of biodiversity, adapting to climate change, and fostering recreational healthy urban environments. However, the benefits for urban areas can only be realized if such brownfields are accepted as vital elements of the urban green infrastructure. The potentials of different types of green urban brownfields to provide particular ecosystem services with an outstanding relevance for the urban environment and the life of local residents, and ways in which these services can be best exploited in urban areas.

Reshma r Phule et al. (2016) have discussed that for determining the properties of soils, various tests and methods are used. The standard penetration test (spt) is used to obtain n-value of soil layer at different depths by using geostatistical interpolation with the exponential semi-variogram model in ARCGIS 10.3. The maps so developed gave the estimation of spt value at points in the subsurface.

Jeganathan et al. (2017) have discussed that remote sensing provides near-real-time images/data about ground/topography/weather/landcover which can help civil engineers in planning and decision making. Remote sensing technology has provided to see and survey the remote and inaccessible areas from the lab and to record all parameters of the location such as height, slope, aspect, contours, watershed delineation, surface area, volume etc. Without actually going to field.

2.3 SUMMARY

The present need of building owners and operators is that their building should perform more in less cost. Therefore, one of the most important pre-conditions for the success of any society in achieving sustainable development is providing affordable housing. Affordable housing is not about providing cheap and decent homes, it considers a broad area. Areas are often regarded as affordable because they are low cost. National association of realtors (NAR) in the us, uses three variables which influences affordable housing, viz., mortgage rate, median family income, and existing median priced home.

With increasing global population and rapid urbanization, the natural environment and stable climates have been severely affected. The societies have to bear the brunt of such unprecedented development. The cities are becoming more and more unsustainable due to poor planning both- macro and at micro level. The strategies such as green building, integrated water system, transit friendly design, urban forestry etc. Promote

development of sustainable neighborhood . The sustainable neighborhood becomes an important objective in civil engineering structure, its planning and policy making are important measure to understand.

Urban planning researchers believe that planning problem pertaining to sprawl, congestion and degradation of resources can be addressed to some extent by developing smart growth strategies. The cities in India are not completely embracing smart growth strategies in their development plan; it differs from highly populated cities to less populated cities. However, in India urban planners highly overlook the notion of controlling sprawl, resulting in chaotic urban growth of country. Many urban planners discussed the impact and implication of urban sprawl and outgrowth of the city.

Walkability reduces congestion and also has low environmental effect; it has social and recreational value. A pedestrian network can be designed by providing proper connectivity, linkages with other roads, fine grained land use patterns, safety, quality pathway and path context. Moreover, green infrastructure has potential to mitigate and adapt to climate change, support urban biodiversity and promote of healthy living conditions as well as maintaining high environmental standards and quality of life for local residents.

Remote sensing and GIS applications in civil engineering provide diversified data for information such as topographical surveys, structural health monitoring, mapping urban imperviousness, solid waste management, environmental impact assessment, site stability analysis, geological characteristics, water availability if identified, run-off modelling, regional flood frequency etc. City planning diverse demand and supply data such as number of buildings, traffic pattern, quality of living conditions, traffic pattern, electricity and water usage etc. Can be obtained and processed by adopting this technology.

CHAPTER THREE

METHODOLOGY

3. METHODOLOGY :

3.1 GENERAL

In this the principles of planning, building bye laws, the various town planning departments of Navi Mumbai, role of government agencies in town planning, different types of surveys such as reconnaissance survey, demographic survey, area and topographic characteristics, climate, current land rates, the development plan, preparation of AUTOCAD drawings, estimating and costing are done.

3.2 PRINCIPLES OF PLANNING

Before starting the planning for construction of a town, the site for dwellings need to be identified along-with other functional units of the township. The following factors need to be considered:

3.2.1 SELECTION OF SITE

The site for the required building is to be selected very carefully because it gives beauty to the building. It should be on fairly levelled ground. As far as possible it should be at place where filling is minimum. It should not be constructed on the reclaimed soil to avoid differential settlement of building. The soil on which construction takes place shall have adequate bearing capacity to withstand pressures. Topographic features of the area also play an important role in selection of site.

3.2.2 AVAILABILITIES OF FACILITIES

It is very important that civic amenities like networks of water supply, drainage sewers, electric supply, and telephone lines are - easily accessible and commissionable from site. Ground water table at site should not be high, as it creates dampness in the building. The site should be easily approachable by road. The size of the site should be such that it meets the requirements of the building. The site should not be congested areas with small lanes. It should be a fairly open area to have proper ventilations. Residential site should be away from commercial establishments like heavy industries, workshops, factories, powerplants etc.

3.2.3 LIFE-CYCLE COSTING

The planning of various units shall be such that not only the construction cost is reduced, but also the operation and maintenance cost is minimum during the life cycle of the project. This can be so achieved, by meticulous planning of various units and amenities, intelligent transportation systems, proper zoning and landscaping, orientation of buildings etc.

3.3 BUILDING BYE LAWS

Before starting the planning process of a building one must have prior knowledge of bye laws of the area. These bye laws are formulated and amended by the state government/municipals corporation / municipal committees etc. To guide the planner/architect to design a proposed building in systematic manners. These bye laws differ from state to state and are generally applicable in cities. The construction of buildings is strictly in accordance with these bye laws. The building byelaws are defined as standards and specifications designed to ensure maximum safeguards to the workers during construction, to the health and comfort of users and to provide enough safety to the occupants after commissioning. The regulations set out the basic requirements to be observed in the design and construction of buildings. They are applied to new buildings and also to extensions, material alterations, and certain changes in the use of existing buildings.

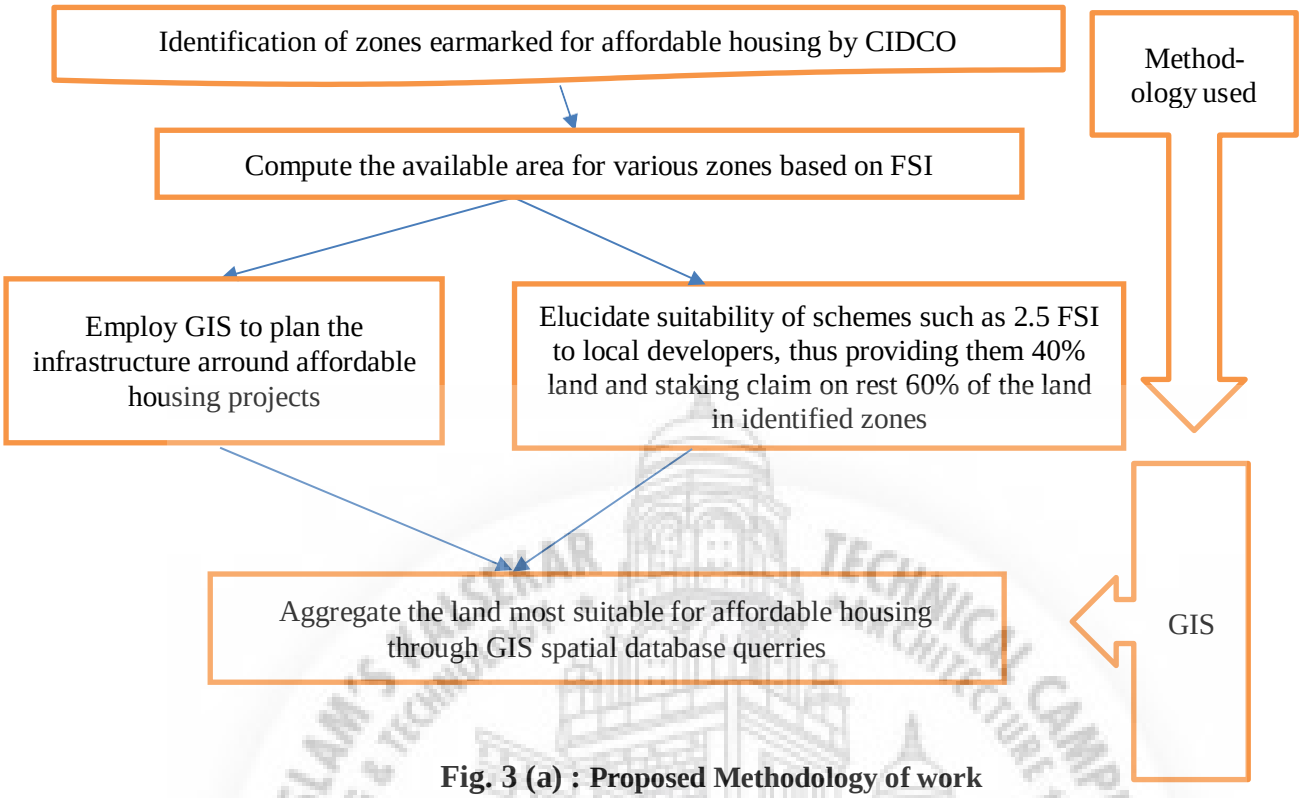


Fig. 3 (a) : Proposed Methodology of work

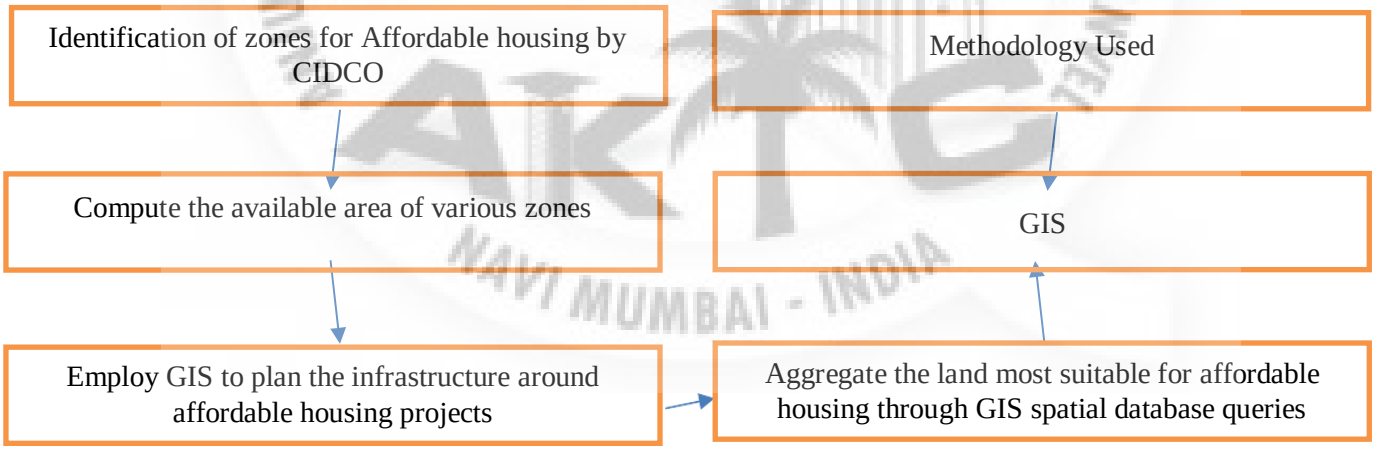


Fig. 3 (b) : Methodology of work

3.4 GEOGRAPHIC INFORMATION SYSTEM (GIS)

A geographic information system (GIS) captures, stores, analyzes, manages, and presents data that is linked to location. GIS is very essential when the need for housing and the provision of related services is required and upgrading at a rapid pace in an urban set up. Even in sub-urban, semi-urban setup or even rural setup, the conventional method of mapping land details on 7/12 utaras and toposheets doesn't hold good as changes in land use are very frequent. The quality of planning and decision making processes can be substantially improved when suitable data are appropriately and efficiently handled. Thus GIS can be very handy for urban analysis. Various querries can be run in GIS to identify best of the potential low income housing sites in the navi mumbai region. This work envisages to demonstrate how a simple open source GIS tool can provide both site specific information on land cover for mapping urban residential land use, and also act as a medium to generate a variety of GIS coverages.

GIS is computer-based information system that when incorporated with the required data helps in decision making. Implementing affordable housing schemes requires making good decisions quickly. GIS can be used to select suitable locations for these affordable housing schemes. Using GIS to map land use and land cover (lulc) over the proposed areas for housing schemes will help the government identify available land. Further, network analysis can provide information on the availability and adequacy of social amenities and infrastructure in the areas. By using these techniques, the government will be able identify locations that require infrastructure and social amenities to make them available and areas that meet all the necessary requirements. Change detection analysis on the other hand will give information of population and development trends such as settlements, agricultural expansion and urbanization. This kind of information will enable the government to estimate the rate at which residential houses are coming up hence the need and demand for housing in a region to sustain the population at the time and future populations. Constructing thematic maps based on population data can be very useful for this.

Secondly, one of the innovative ways for getting funding for the affordable housing proposed by the government is mapping the navi mumbai area to show the lands that pay land taxes and those that do not. In this way the government will be able to identify get the lost revenue once these taxes are enforced. GIS techniques can be used for this.

Hence, GIS can play a big role in meeting the goal of providing affordable housing and shall therefore be supported and explored to its fullest potential.

3.5 STATEMENT OF PROBLEM

Many public sector affordable housing projects have been envisaged in the past, but they have always been appraised by social benefit-cost ratio, rather than traditional benefit-cost analysis. In order to increase the competition, reduce cost and further, improve the quality and magnitude of affordable housing projects, private contractors need to be pulled towards such projects, by proving that they will still make considerable profits if they invest in affordable housing schemes. Although, many individual approaches have been employed on construction projects to make them affordable, a holistic study of combination of modern scientific tools still is in its nascent stage of research. This research encompasses the preparation of a framework, encompassing ga, GIS and bim, along with project management philosophies, which would not only minimize the construction costs due to scientific selection of sites and operational processes, but also would cause reduction operation and maintenance costs during the life cycle of affordable housing projects due to their sustainable construction methods.

3.6 OBJECTIVES OF THE PROPOSED STUDY

Thus, it is proposed to envisage use of GIS along with efficient management techniques to find out whether construction of affordable housing projects can be a reality. This proposed research would present a framework using the above tools for estimating time, cost, technical and social feasibility of such projects that would help government authorities and contractors in the planning of affordable housing projects. GIS can be used to identify the optimum locations for affordable housing projects in and around urban centre and also efficiently and effectively manage the various construction activities. In doing so, various queries can be run in GIS to narrow down on most favorable locations, having low land cost, no or gentle slope, good soil and ground conditions, sufficiently away from watersheds, located proximetly to markets and industries, environmentally safe, easily accessible so that easy commuting by the affordable housing segment to daily travel to cities for their employment requirements, etc. The primary aim of this work is to finding out various fields in which cost can be controlled and hence how various latest techniques can be applied to provide affordable housing solutions, not only minimizing the construction costs, but also providing lesser operation and maintenance costs during the life cycle of such projects. Hence following objectives are set for the research:

1. Collection of primary data using sophisticated online databases, analyzing this data w.r.t demographic and geographical parameters and based on this data suggest affordable housing solutions
2. Macro-level planning for efficient infrastructure facilities using GIS to ensure that basic needs and services are addressed and residents can get easy access to employment and social services.

CHAPTER FOUR

DATA COLLECTION AND ANALYSIS

4. DATA COLLECTION AND ANALYSIS :

4.1 DATA COLLECTION

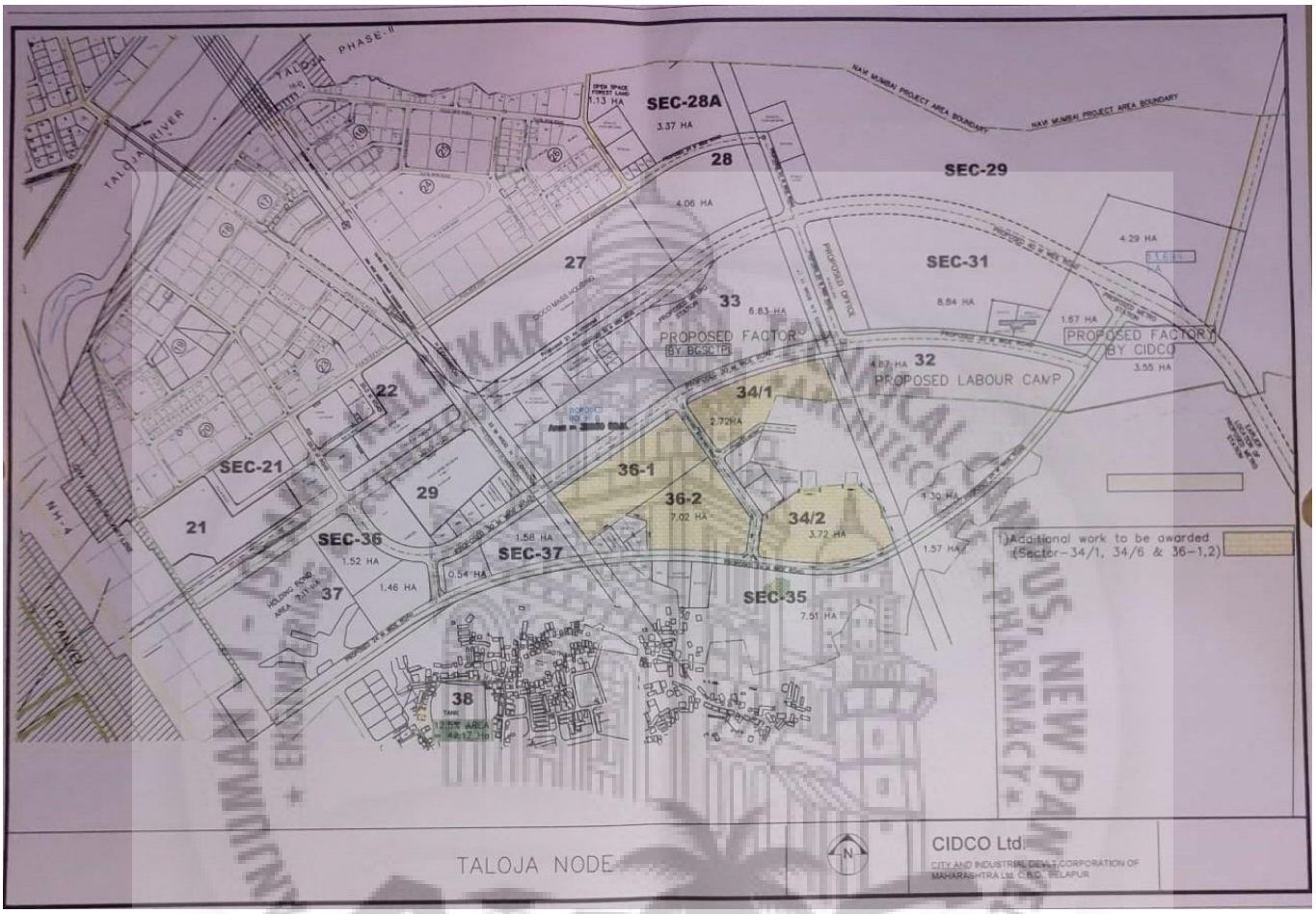


Fig. 4.1 (a) : Taloja Plan Area

Fig. 4.1 (b) : Sector 36-1 Plan Area

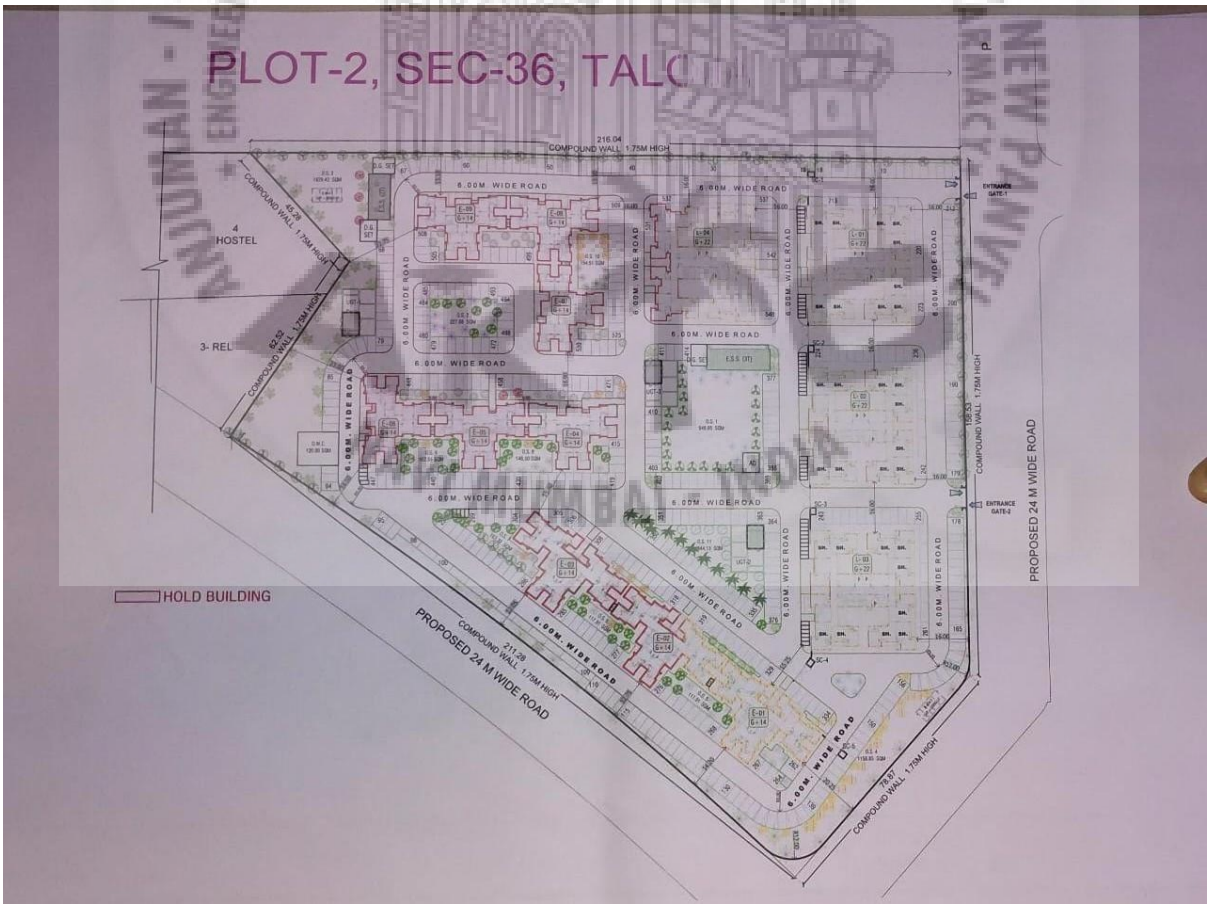
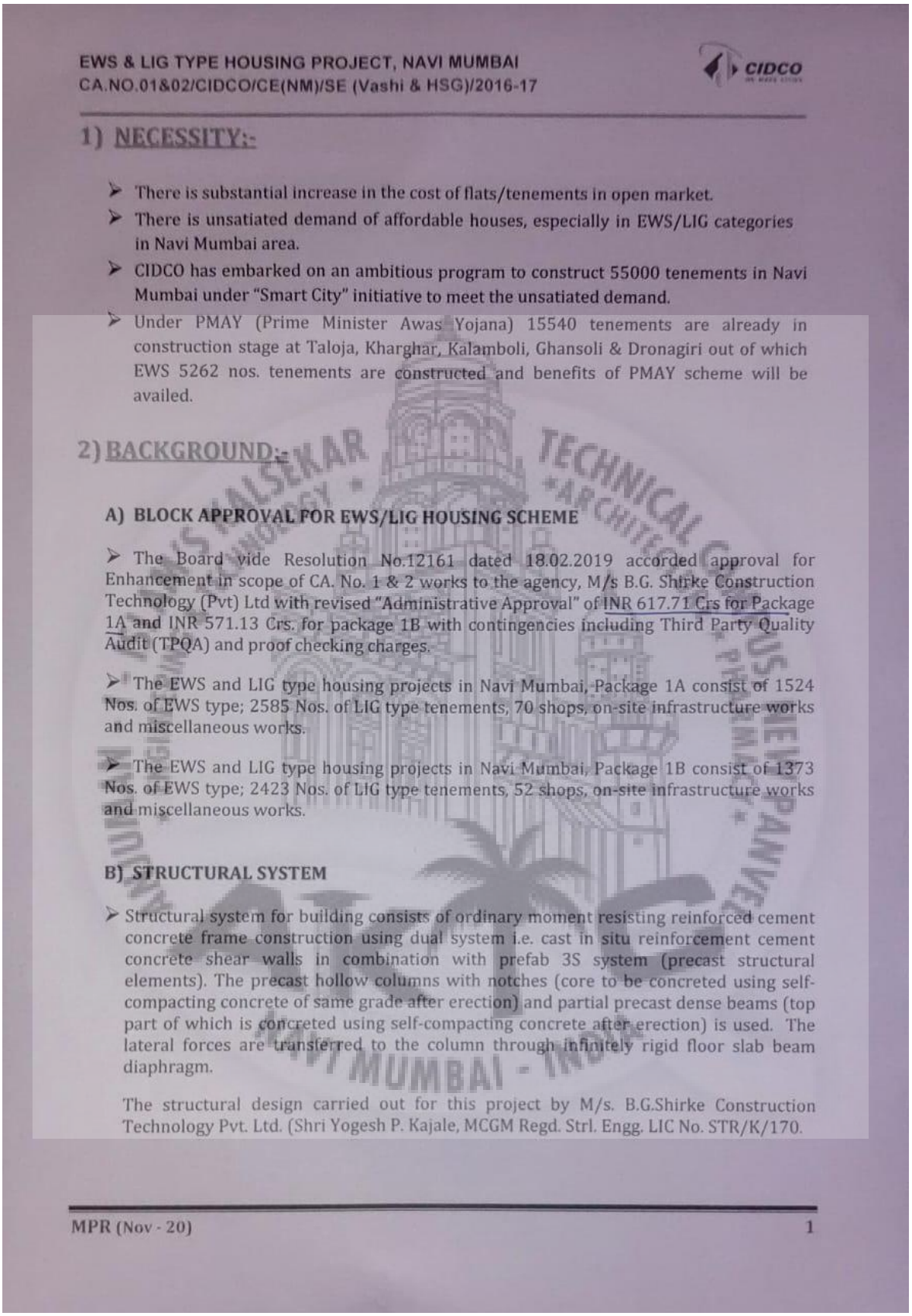


Fig. 4.1 (c) : Sector 36-2 Plan Area



EWS & LIG TYPE HOUSING PROJECT, NAVI MUMBAI
CA.NO.01&02/CIDCO/CE(NM)/SE (Vashi & HSG)/2016-17

CIDCO

1) NECESSITY:-

- There is substantial increase in the cost of flats/tenements in open market.
- There is unsatiated demand of affordable houses, especially in EWS/LIG categories in Navi Mumbai area.
- CIDCO has embarked on an ambitious program to construct 55000 tenements in Navi Mumbai under "Smart City" initiative to meet the unsatiated demand.
- Under PMAY (Prime Minister Awas Yojana) 15540 tenements are already in construction stage at Taloja, Kharghar, Kalamboli, Ghansoli & Dronagiri out of which EWS 5262 nos. tenements are constructed and benefits of PMAY scheme will be availed.

2) BACKGROUND:-

A) BLOCK APPROVAL FOR EWS/LIG HOUSING SCHEME

- The Board vide Resolution No.12161 dated 18.02.2019 accorded approval for Enhancement in scope of CA. No. 1 & 2 works to the agency, M/s B.G. Shirke Construction Technology (Pvt) Ltd with revised "Administrative Approval" of INR 617.71 Crs for Package 1A and INR 571.13 Crs. for package 1B with contingencies including Third Party Quality Audit (TPQA) and proof checking charges.

- The EWS and LIG type housing projects in Navi Mumbai, Package 1A consist of 1524 Nos. of EWS type; 2585 Nos. of LIG type tenements, 70 shops, on-site infrastructure works and miscellaneous works.

- The EWS and LIG type housing projects in Navi Mumbai, Package 1B consist of 1373 Nos. of EWS type; 2423 Nos. of LIG type tenements, 52 shops, on-site infrastructure works and miscellaneous works.

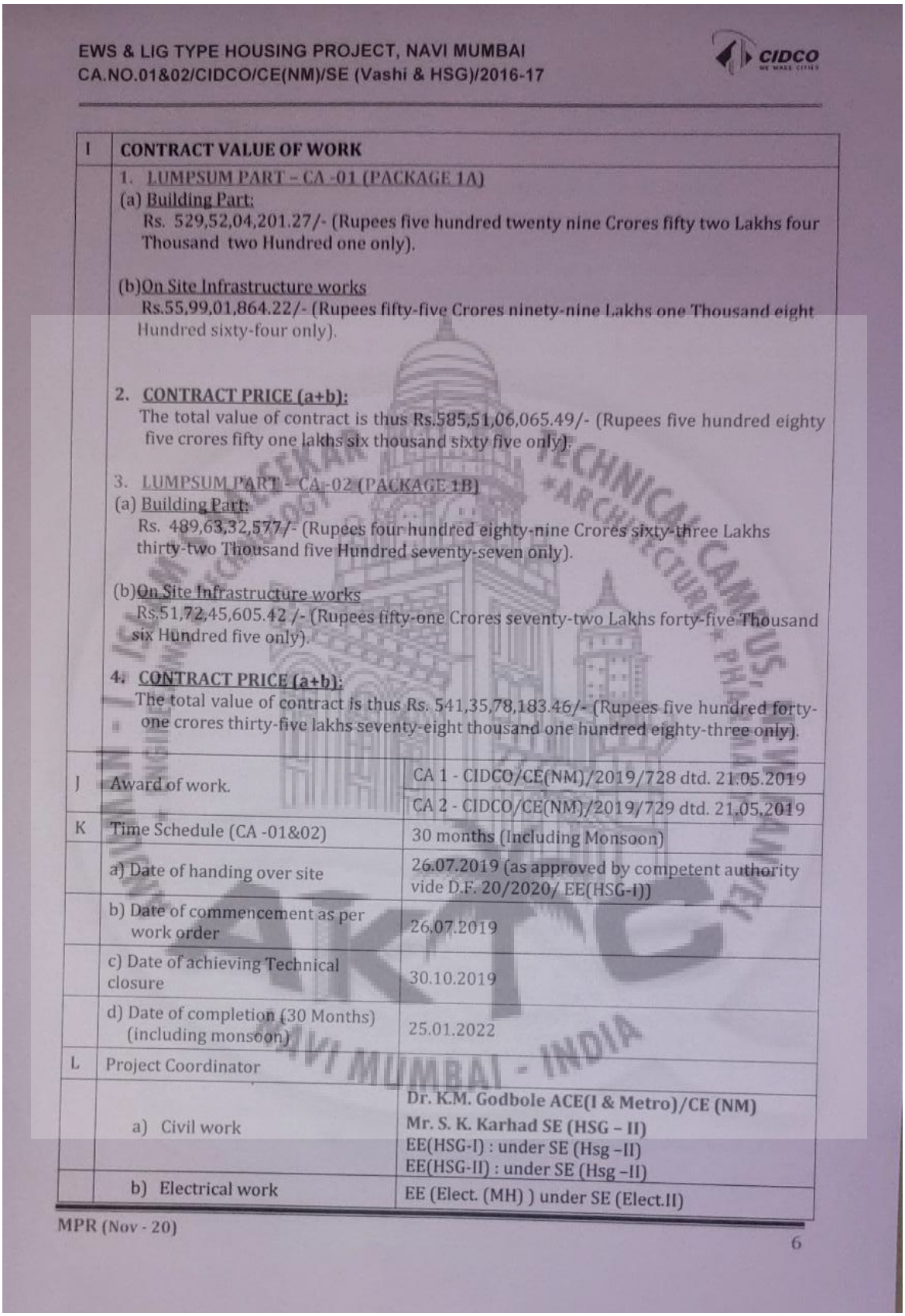
B) STRUCTURAL SYSTEM

- Structural system for building consists of ordinary moment resisting reinforced cement concrete frame construction using dual system i.e. cast in situ reinforcement cement concrete shear walls in combination with prefab 3S system (precast structural elements). The precast hollow columns with notches (core to be concreted using self-compacting concrete of same grade after erection) and partial precast dense beams (top part of which is concreted using self-compacting concrete after erection) is used. The lateral forces are transferred to the column through infinitely rigid floor slab beam diaphragm.

  The structural design carried out for this project by M/s. B.G.Shirke Construction Technology Pvt. Ltd. (Shri Yogesh P. Kajale, MCGM Regd. Strl. Engg. LIC No. STR/K/170.

MPR (Nov - 20) 1

Fig. 4.1 (d) : Data Provided By CIDCO (Page No. 1)



EWS & LIG TYPE HOUSING PROJECT, NAVI MUMBAI
CA.NO.01&02/CIDCO/CE(NM)/SE (Vashi & HSG)/2016-17

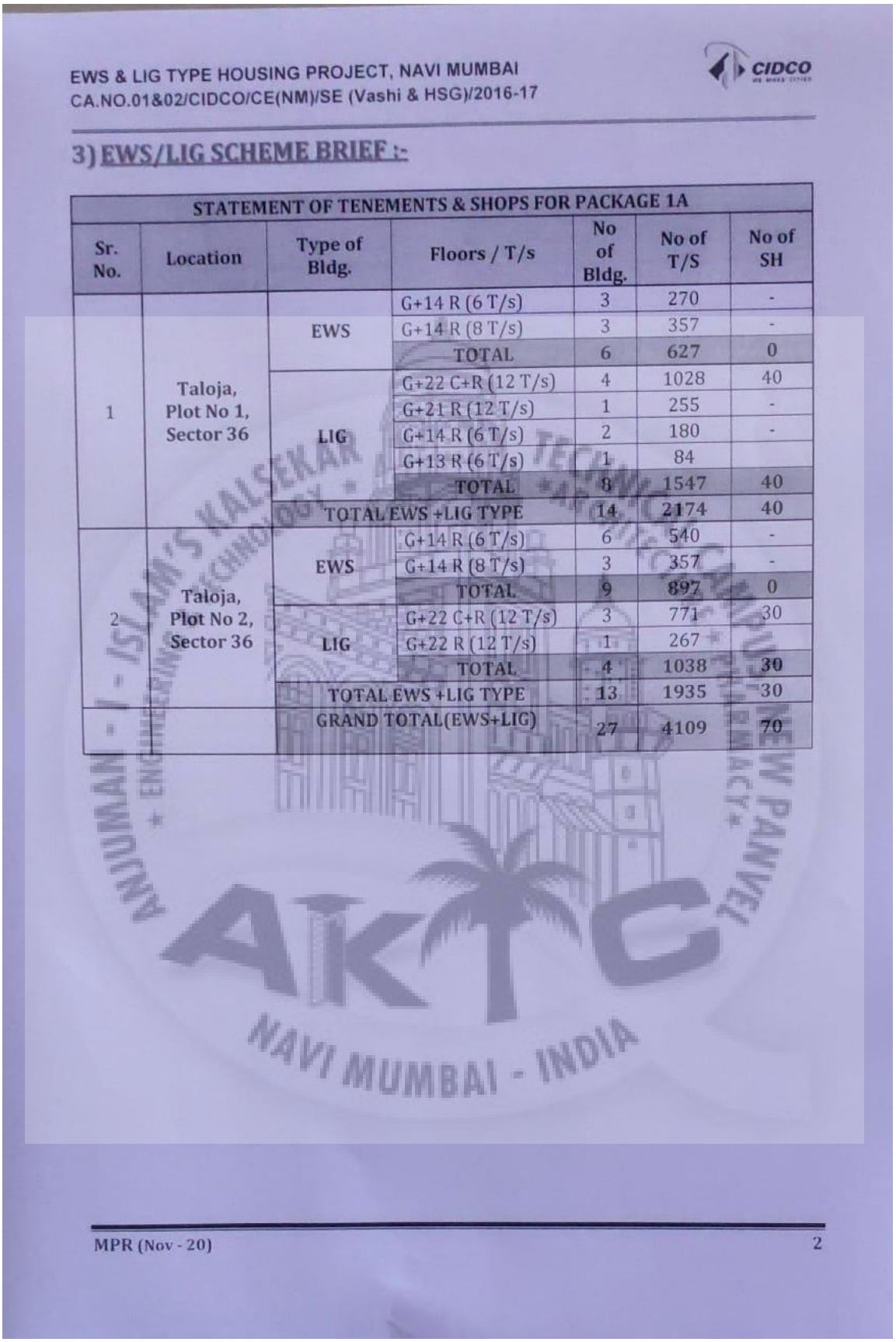
CIDCO

I	**CONTRACT VALUE OF WORK**	
	1. LUMPSUM PART – CA -01 (PACKAGE 1A) (a) Building Part: Rs. 529,52,04,201.27/- (Rupees five hundred twenty nine Crores fifty two Lakhs four Thousand two Hundred one only). (b)On Site Infrastructure works Rs.55,99,01,864.22/- (Rupees fifty-five Crores ninety-nine Lakhs one Thousand eight Hundred sixty-four only). 2. CONTRACT PRICE (a+b): The total value of contract is thus Rs.585,51,06,065.49/- (Rupees five hundred eighty five crores fifty one lakhs six thousand sixty five only). 3. LUMPSUM PART – CA -02 (PACKAGE 1B) (a) Building Part: Rs. 489,63,32,577/- (Rupees four hundred eighty-nine Crores sixty-three Lakhs thirty-two Thousand five Hundred seventy-seven only). (b)On Site Infrastructure works Rs.51,72,45,605.42 /- (Rupees fifty-one Crores seventy-two Lakhs forty-five Thousand six Hundred five only). 4. CONTRACT PRICE (a+b): The total value of contract is thus Rs. 541,35,78,183.46/- (Rupees five hundred forty-one crores thirty-five lakhs seventy-eight thousand one hundred eighty-three only).	
J	Award of work.	CA 1 - CIDCO/CE(NM)/2019/728 dtd. 21.05.2019
		CA 2 - CIDCO/CE(NM)/2019/729 dtd. 21.05.2019
K	Time Schedule (CA -01&02)	30 months (Including Monsoon)
	a) Date of handing over site	26.07.2019 (as approved by competent authority vide D.F. 20/2020/ EE(HSG-I))
	b) Date of commencement as per work order	26.07.2019
	c) Date of achieving Technical closure	30.10.2019
	d) Date of completion (30 Months) (including monsoon)	25.01.2022
L	Project Coordinator	
	a) Civil work	Dr. K.M. Godbole ACE(I & Metro)/CE (NM) Mr. S. K. Karhad SE (HSG – II) EE(HSG-I) : under SE (Hsg –II) EE(HSG-II) : under SE (Hsg –II)
	b) Electrical work	EE (Elect. (MH)) under SE (Elect.II)

MPR (Nov - 20)

6

Fig. 4.1 (e) : Data Provided By CIDCO (Page No. 2)



EWS & LIG TYPE HOUSING PROJECT, NAVI MUMBAI
CA.NO.01&02/CIDCO/CE(NM)/SE (Vashi & HSG)/2016-17

CIDCO

3) EWS/LIG SCHEME BRIEF :-

STATEMENT OF TENEMENTS & SHOPS FOR PACKAGE 1A						
Sr. No.	Location	Type of Bldg.	Floors / T/s	No of Bldg.	No of T/S	No of SH
1	Taloja, Plot No 1, Sector 36	EWS	G+14 R (6 T/s)	3	270	-
			G+14 R (8 T/s)	3	357	-
			TOTAL	6	627	0
		LIG	G+22 C+R (12 T/s)	4	1028	40
			G+21 R (12 T/s)	1	255	-
			G+14 R (6 T/s)	2	180	-
			G+13 R (6 T/s)	1	84	
			TOTAL	8	1547	40
		TOTAL EWS +LIG TYPE		14	2174	40
2	Taloja, Plot No 2, Sector 36	EWS	G+14 R (6 T/s)	6	540	-
			G+14 R (8 T/s)	3	357	-
			TOTAL	9	897	0
		LIG	G+22 C+R (12 T/s)	3	771	30
			G+22 R (12 T/s)	1	267	
			TOTAL	4	1038	30
		TOTAL EWS +LIG TYPE		13	1935	30
		GRAND TOTAL(EWS+LIG)		27	4109	70

MPR (Nov - 20) 2

Fig. 4.1 (f) : Data Provided By CIDCO (Page No. 3)

Fig. 4.1 (g) : Footing Plan Area Of Building (Sector 36-1)

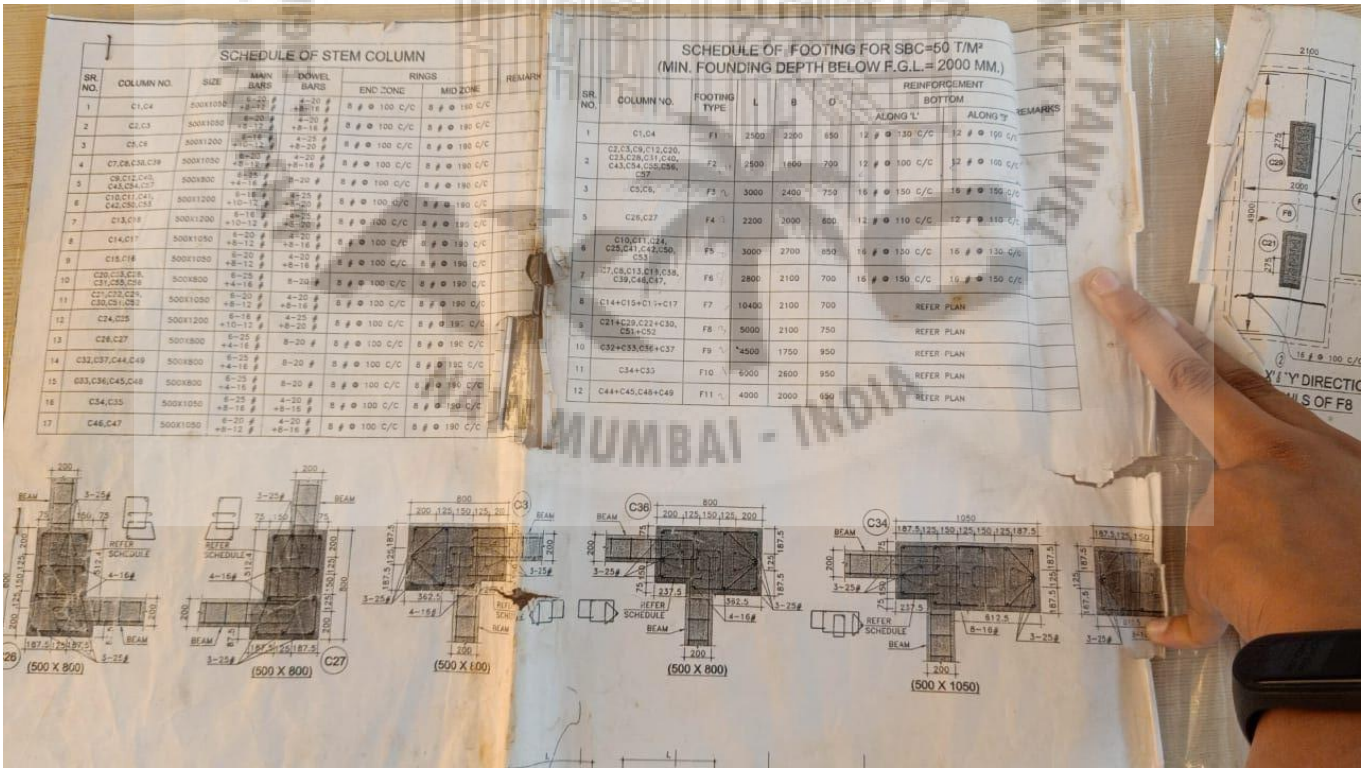


Fig. 4.1 (h) : Schedule Of Column And Footing (Sector 36-1)

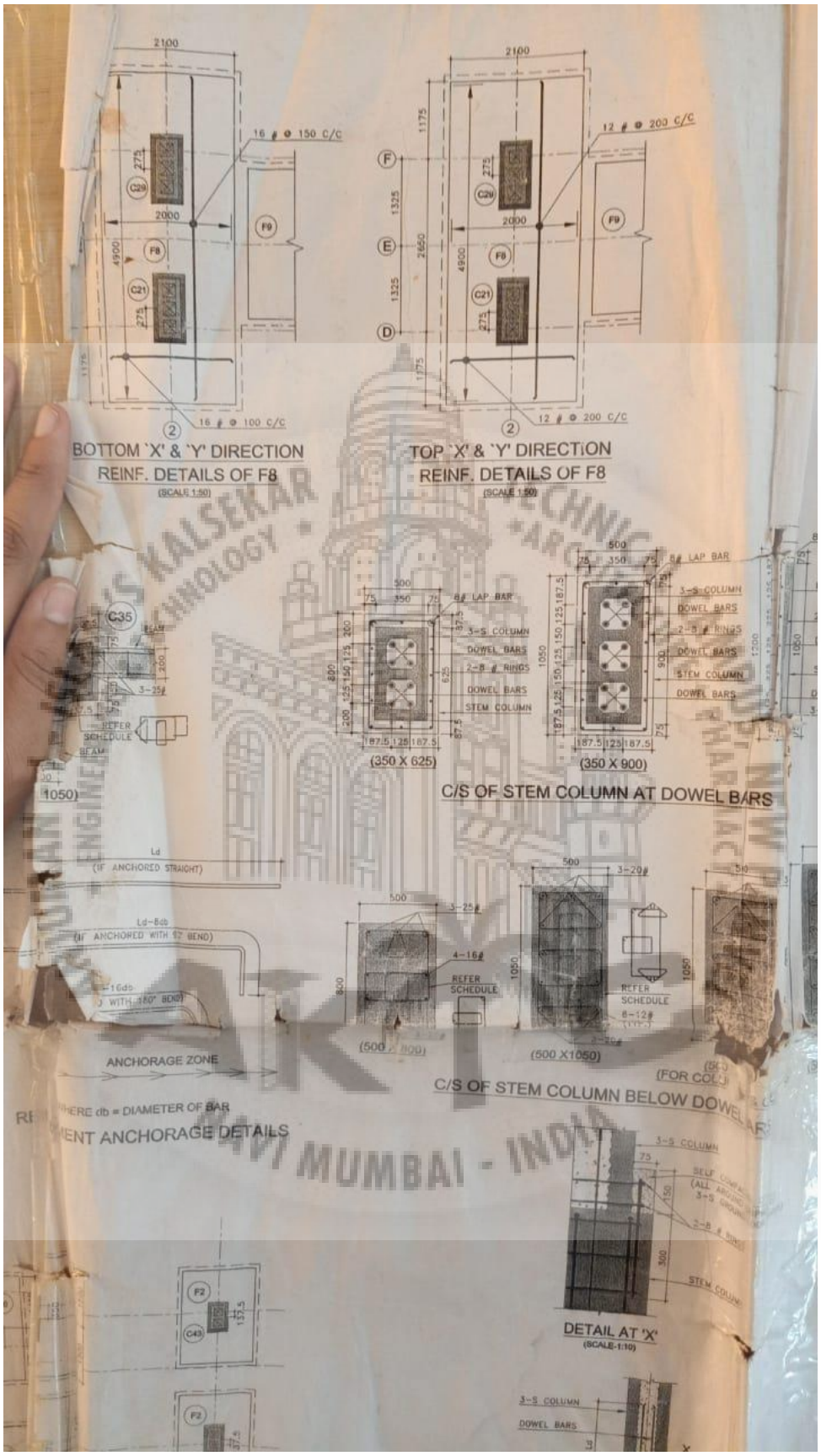


Fig. 4.1 (i) : Cross Section Of Column (Sector 36-1)

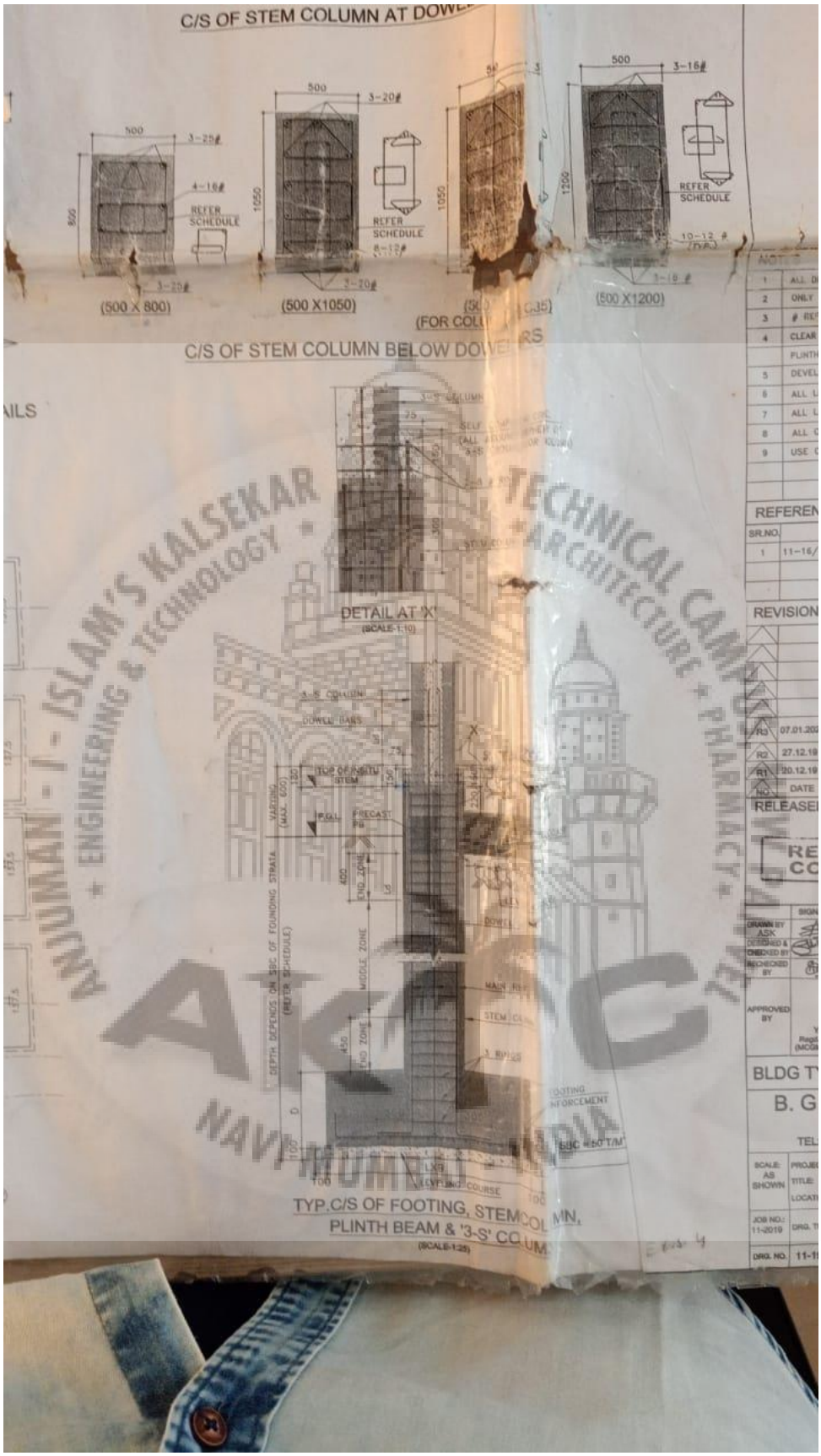


Fig. 4.1 (j) : Cross Section Of Footing (Sector 36-1)

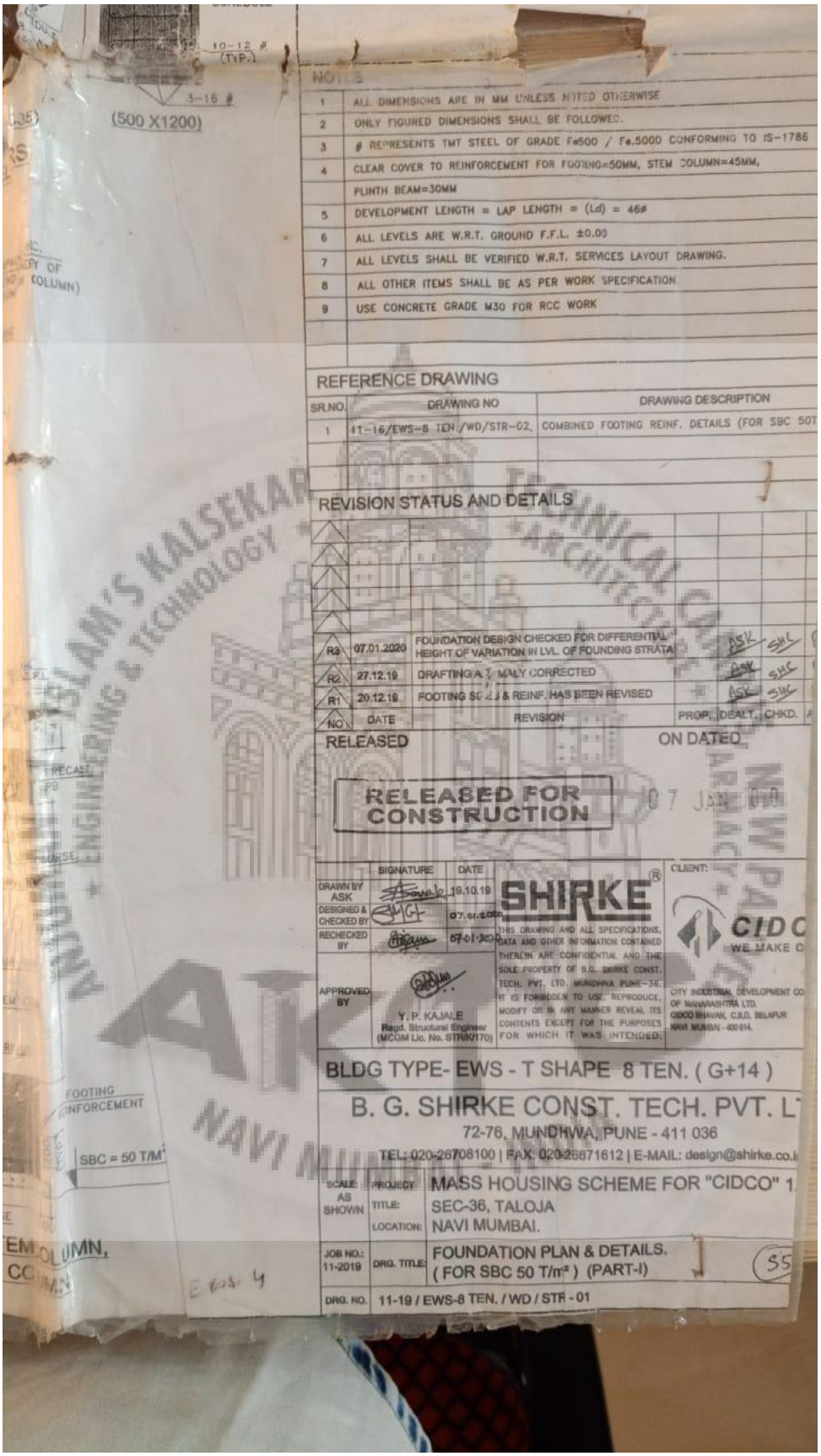


Fig. 4.1 (k) : Notes And Description Of Sector 36-1

4.2 DATA ANALYSIS

4.2.1 SPATIAL ANALYSIS

When the data is downloaded, QGIS is opened to add vector layer by go to layer ‣ add vector layer. Browse and navigate to the folder where the saved files. Hold the shift key and click on the file to select. Select college_inter.shp to open. The directory of the college_inter.shp layer is loaded and opened. The same is repeated for all the others 5 layers. All the shape files will now be loaded in QGIS.

Fig 4.2 (a) shows creating vector layer there-by joining non-spatial data (excel, text file etc) with the feature attribute.

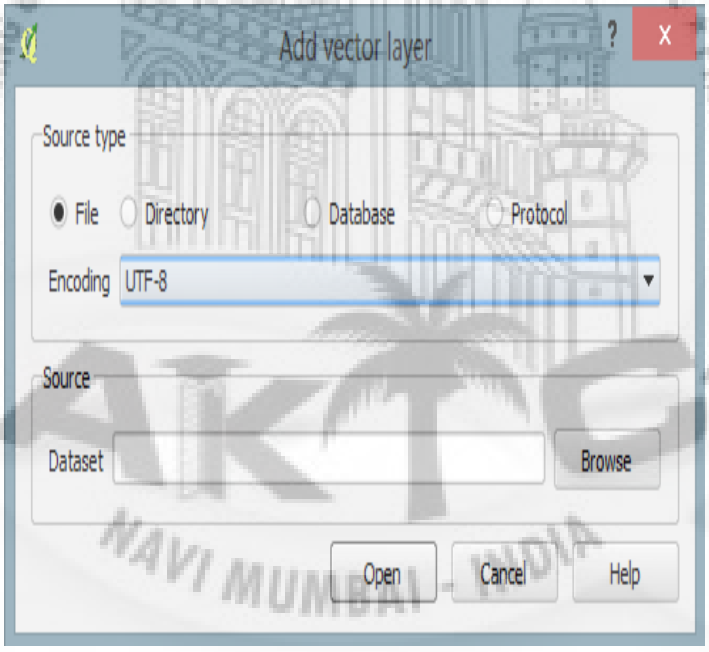


Fig. 4.2 (a) : Vector Later Tab

Now, creating buffers around the point and line layers shall be accomplished. The buffer geo processing tool in QGIS uses layer units to calculate buffer distances. The layers are in geographic coordinate reference system (CRS) with the unit of degrees. This is not appropriate as the analysis is to use meters or kilometers. To archive this, re-project the layers to a projected coordinate reference system (CRS). Right-click on the college_inter and choose save as. In the save vector layer as... Dialog, click browse next to save as and select

the output file location. Name the output file as college_reprojected.shp. Next, click the browse button next to CRS.

Fig 4.2 (b) shows to save the vector layer.

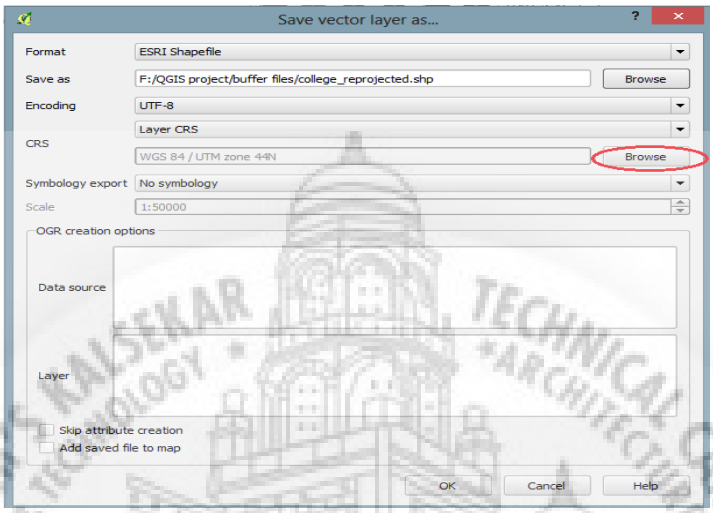


Fig. 4.2 (b) : Save As Vector Layer

Now, choose an appropriate CRS for the purpose. For creating buffers, a wgs 84 44n projection would be best. In the coordinate reference system selector dialog, start searching for wgs 84 and will see the results as shown below. Select the wgs 84 / utm zone 44n.

In save vector layer as ... Dialog, check the box next to add saved file to map. The re-projection process shall be repeated for all the other layers and save them. Now, layers panel will have 12 layers. The boxes next to the original layers shall be unchecked to display only the re-projected layers. The re-projected layers will still be shown in the geographic CRS because of a setting so it is turned that off. The project properties button shall be selected. In the CRS tab of the project properties dialog, un-check the box next to enable on-the-fly CRS transformation. In the main QGIS window, right-click on any one of the re-projected layers and select zoom to layer extent. Now will see the data in the layer's CRS. To satisfy first criteria, the prospective areas within 1km from existing inter colleges shall be found out. Now creating buffers for both the datasets by vector ‣ geoprocessing tools ‣ buffer. In the buffer tool, select college_reprojected layer as input. Enter the buffer distance as 1000. Note a buffer of 1kms and since the CRS units are meters, have to enter 1,000. Enter the output file name as college_buffer_1000.shp. When the buffer processing is over, click the yes to add the newly created layer to the toc.

The same buffer process needs to be repeated for the road_reprojected.shp layers and an output file as road_buffer.shp will be created. To satisfy second criteria, the prospective areas between 1 km to 2 km from

roads needs to be found out. To find out this area and create two buffers around roads. For this, 2km buffer is created and shown. Then, 1 km buffer area is removed from buffer of 2 km to get the area between using difference command. Vector> georeferencing tools > difference. The, area of 1 km buffer is removed from buffer of 2 km to get the area between using difference command. Vector> georeferencing tools > difference.

Fig 4.2 (c) shows tools used to create buffers.

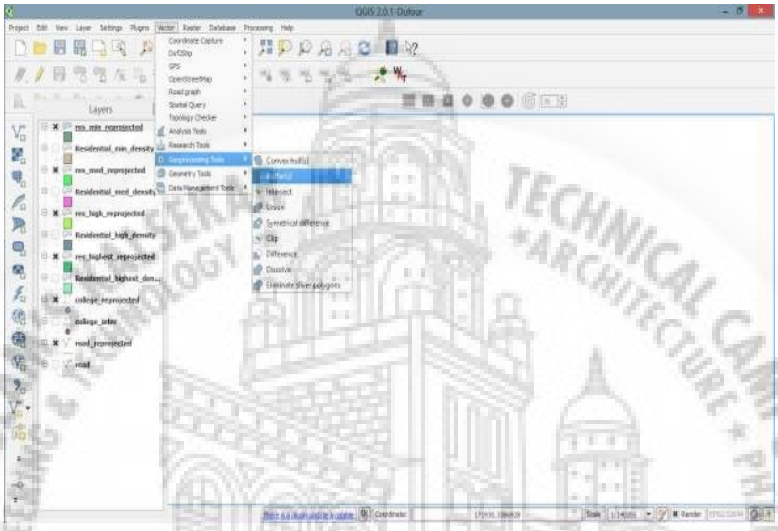


Fig. 4.2 (c) : Georeferencing Tool

4.2.2 LINKING OF SPATIAL AND NON-SPATIAL DATA AND QUERIES

Application of GIS platform for land records management and to create queries to for ease of work.
This is a concept of joining non-spatial data (excel, text file, or output from a program) with the feature attribute table of the spatial dataset along with basic attribute and spatial queries will be covered. In many real-life situations, we get additional non-spatial data in the form of spread sheets or text files. When information is needed that is not in the current table but in another, can link these tables together based on a common attribute. This is possible when a common attribute exists in the tables (often primary and foreign keys). In QGIS user can establish this kind of link by joining. Can load xls files by simply dragging them into QGIS from the file browser or using add vector layer.

4.2.3 SUMMARY

The manual method of planning and placement of residential units etc. Along with roads proved to be more time consuming and tedious. Also, there might be changes in pattern of developments, locating area on site depending on environmental and site conditions. Therefore, it will become very difficult to relate the actual digital data with the physical site data. With the help of QGIS software the planning can be done in a more systematic manner, with which we can relate the actual data with the site data known as spatial and non-spatial data. Thus, this software proves to be more efficient and accurate.

4.2.4 DATA COLLECTED

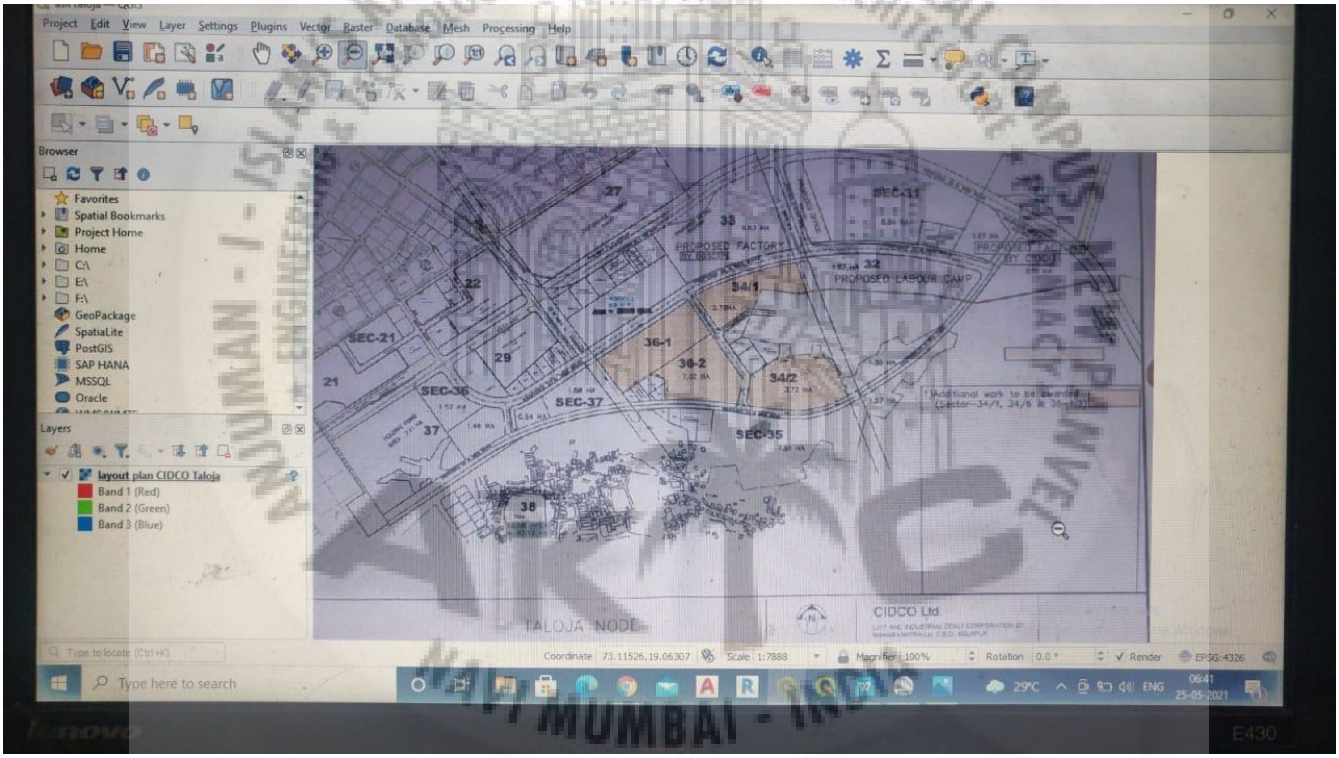


Fig. 4.2 (d) : Taloja Under Plan Area

Fig. 4.2 (e) : Sector 36-1 (Points A And B)

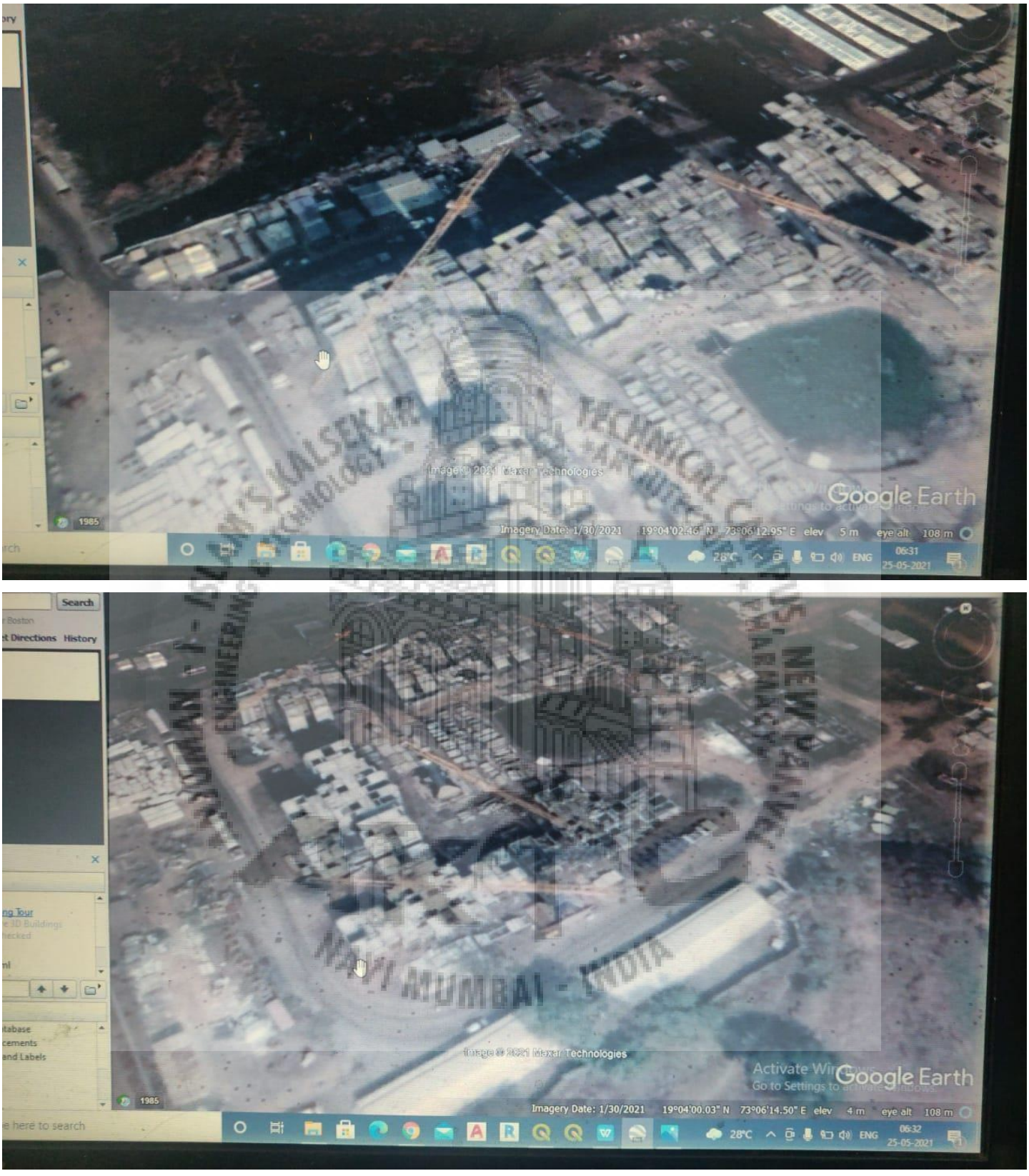


Fig. 4.2 (f) : Sector 36-1 (Points C And D)

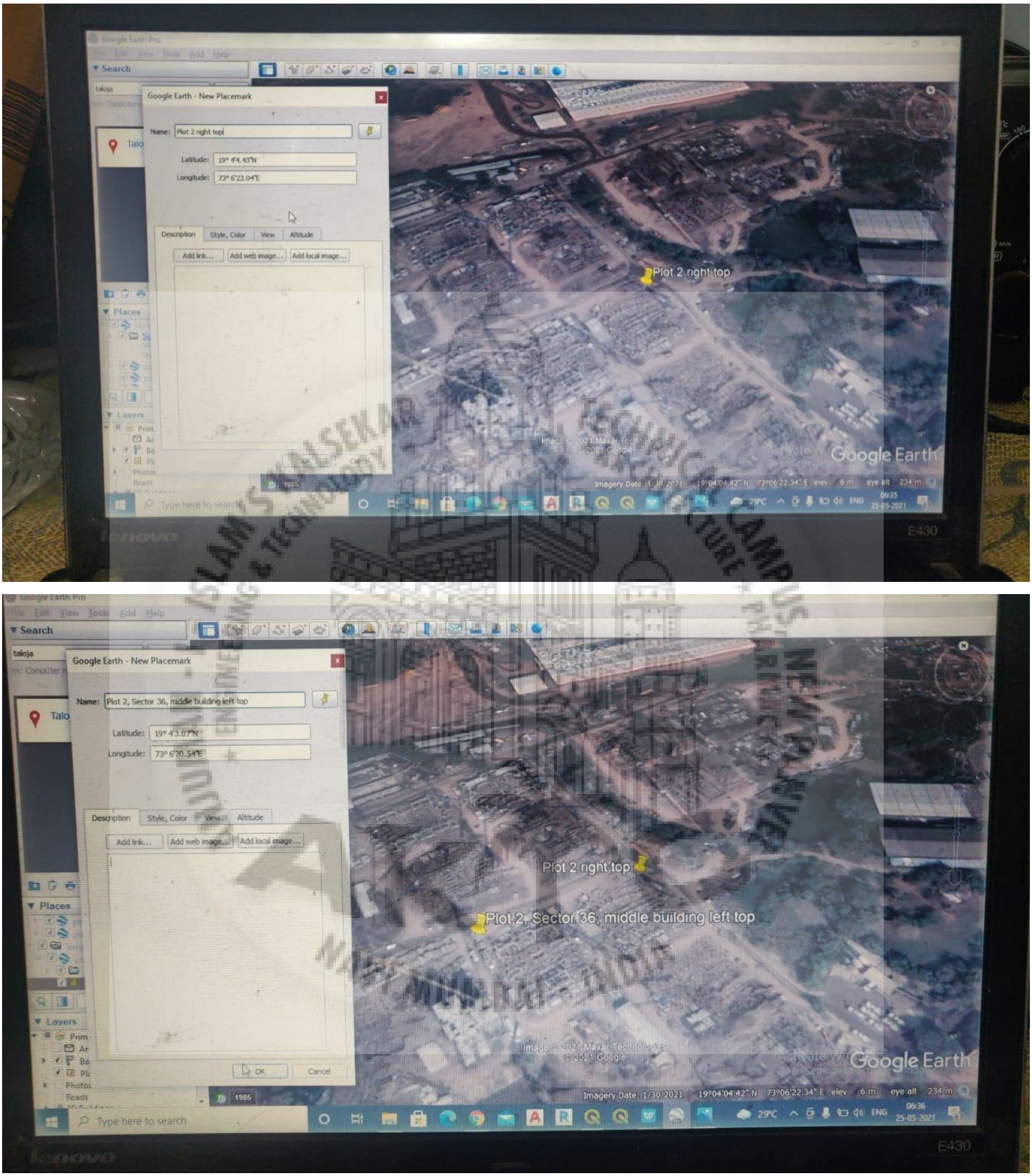


Fig. 4.2 (g) : Sector 36-2 (Points A And B)

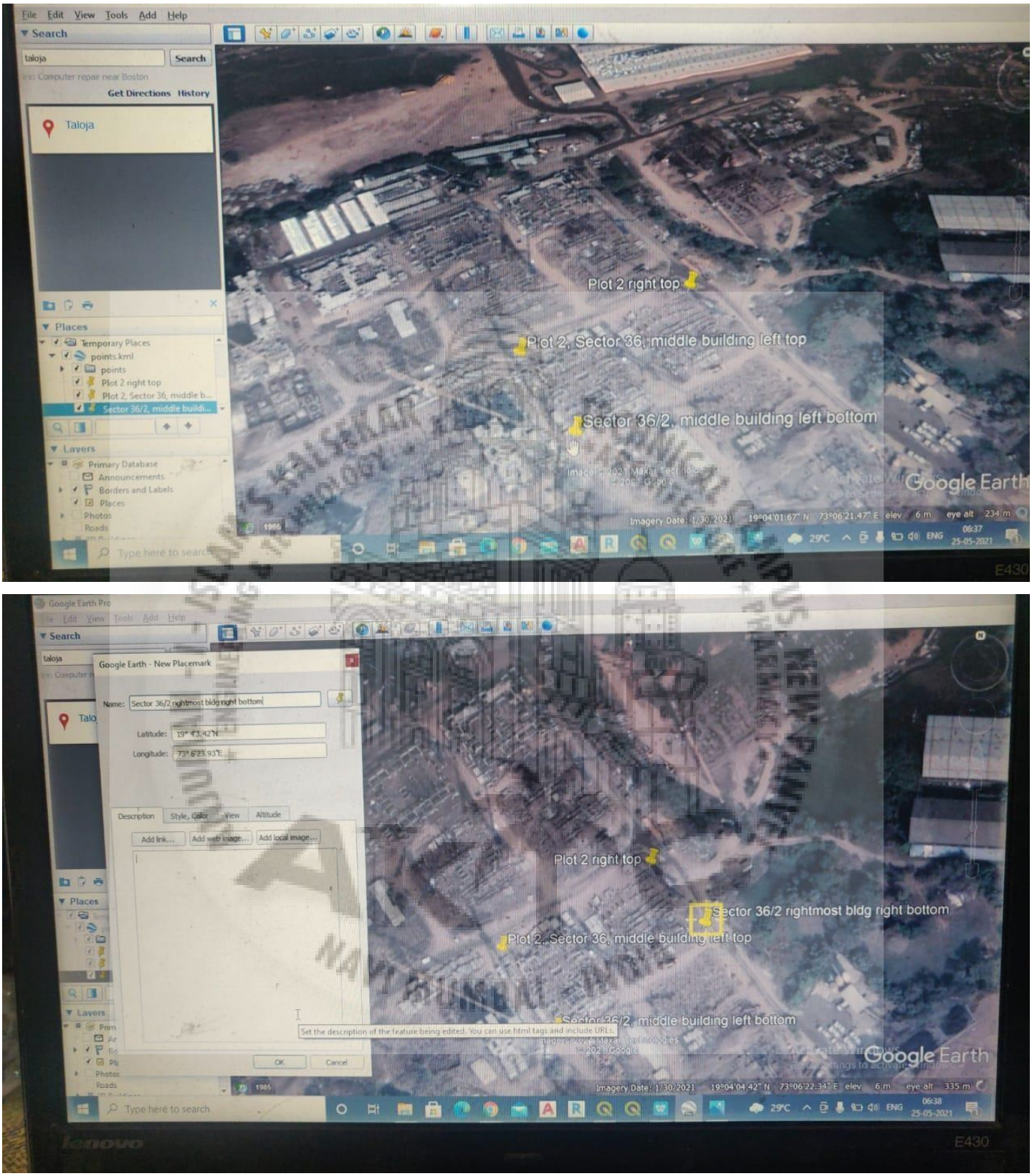


Fig. 4.2 (h) : Sector 36-2 (Points C And D)

4.2.4.1 CO ORDINATE'S OF SECTORS

1. Sector 36-1

Sr No.	Points	Northing	Easting
01	Right Bottom Side	$19°04'05.29''N$	$73°06'22.29''E$
02	Right Upper Side	$19°04'07.41''N$	$73°06'20.76''E$
03	Left Upper Side	$19°04'02.46''N$	$73°06'12.95''E$
04	Left Bottom Side	$19°04'00.03''N$	$73°06'14.50''E$

Table 4.2.1 : Co Ordinate's Of Sector 36-1

2. Sector 36-2

Sr No.	Points	Northing	Easting
01	Right Top	$19°04'04.42''N$	$73°06'22.34''E$
02	Middle Top Left	$19°04'03.07''N$	$73°06'20.54''E$
03	Middle Left Bottom	$19°04'01.74''N$	$73°06'21.44''E$
04	Right Bottom	$19°04'42''N$	$73°06'23.93''E$

Table 4.2.2 : Co Ordinate's Of Sector 36-2

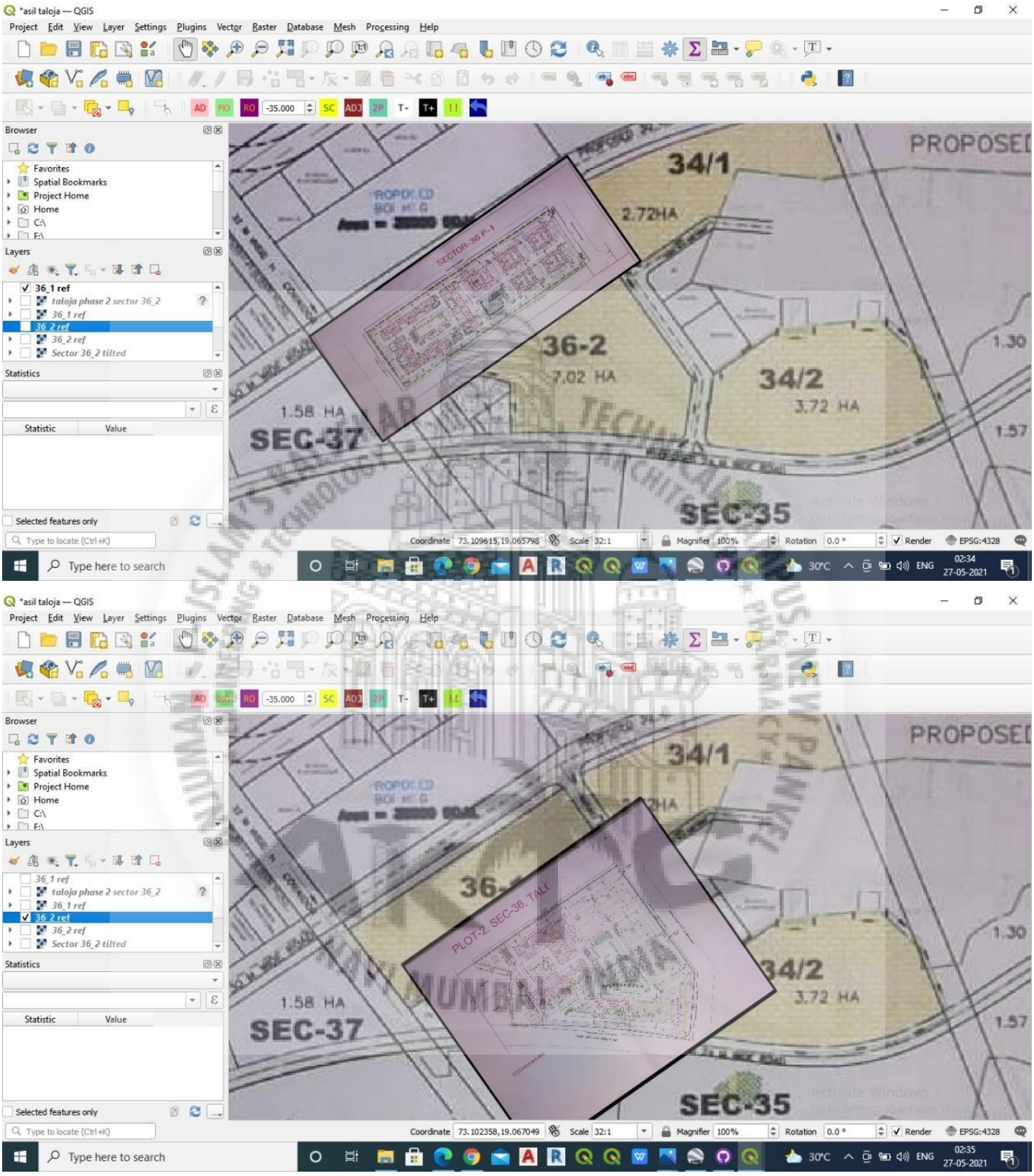


Fig. 4.2 (i) : Merging Sector 36-1 And Sector 36-2 Separately

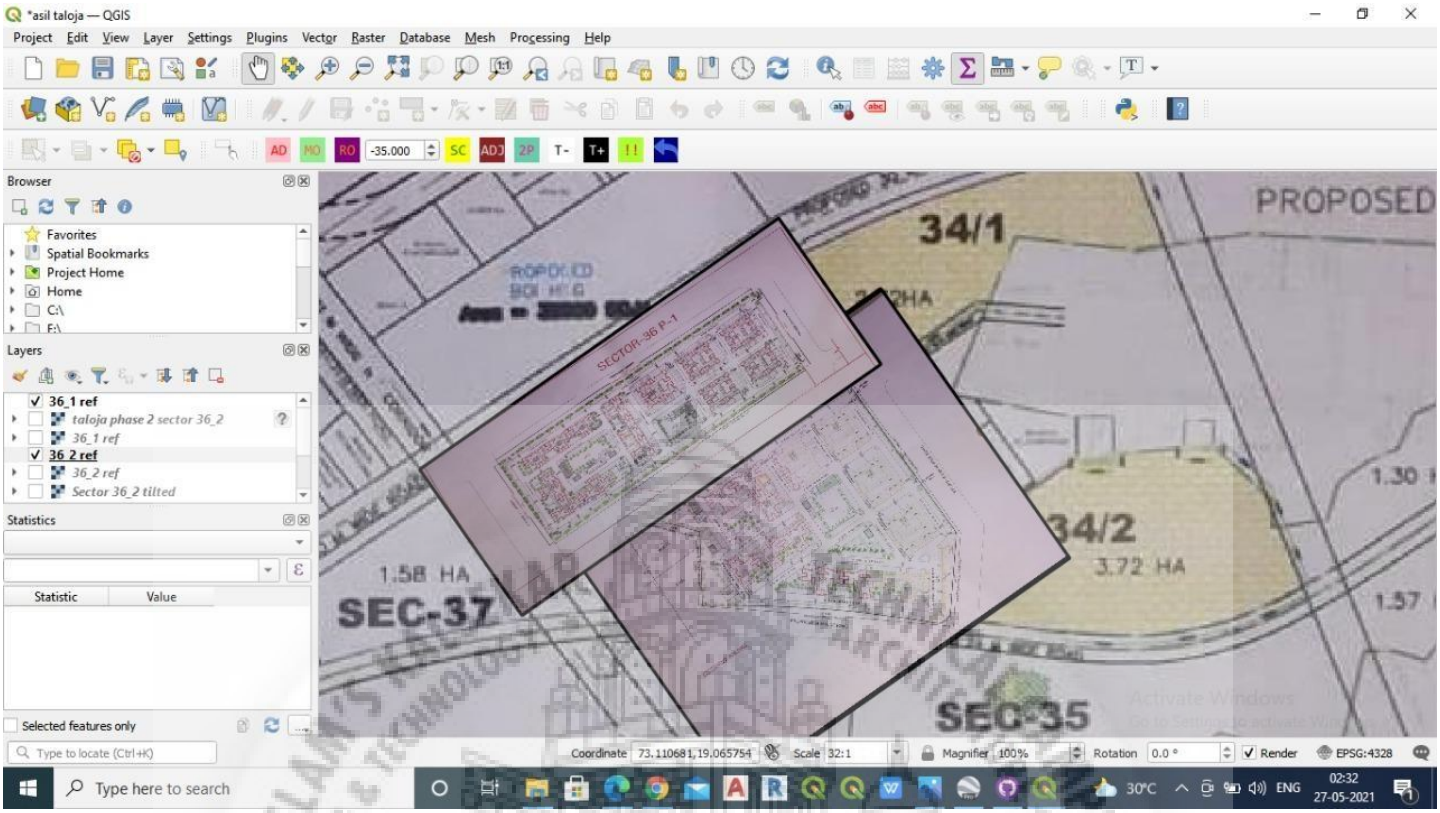


Fig. 4.2 (j) : **Merging Sector 36-1 And Sector 36-2 Combined**

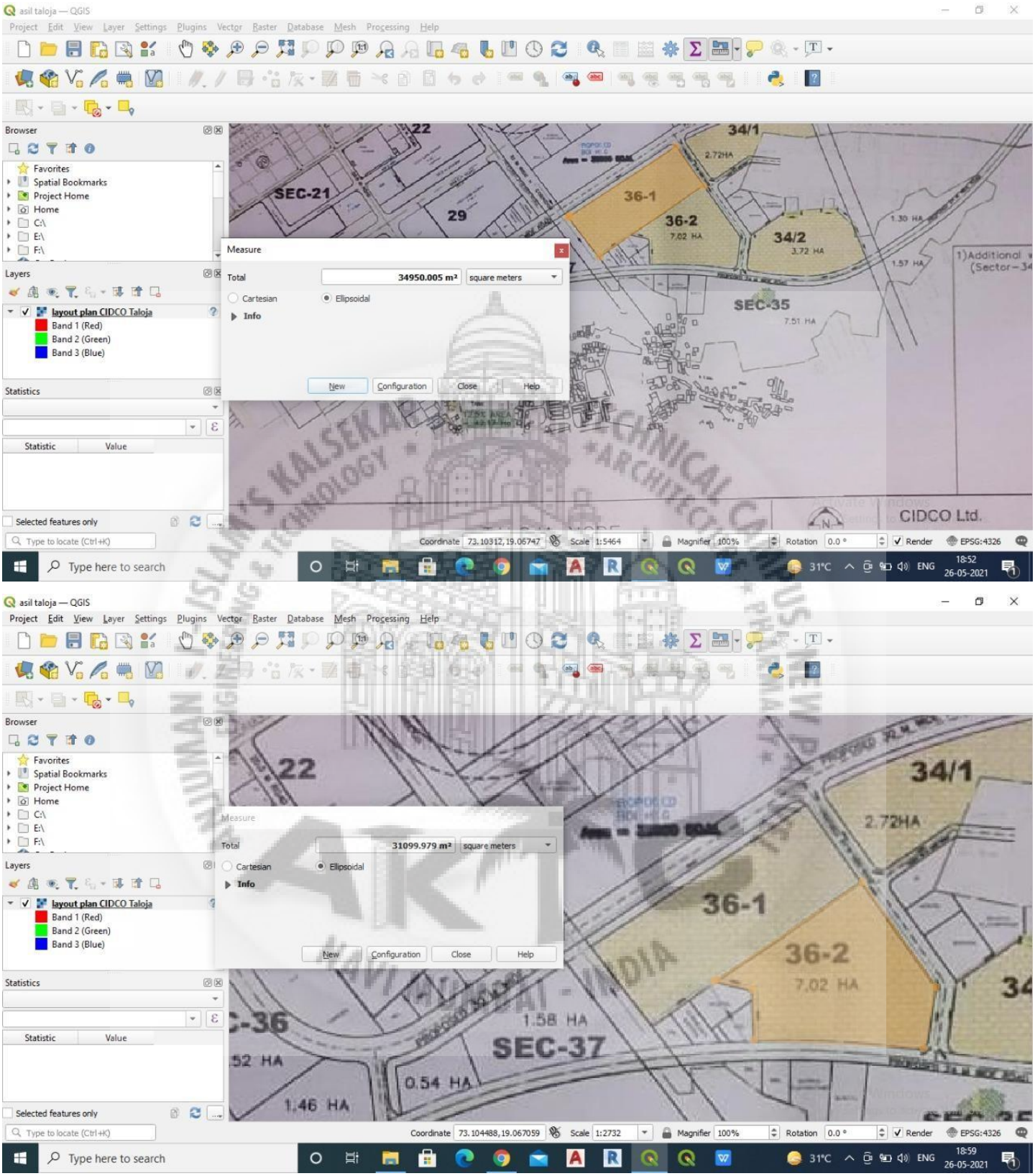


Fig. 4.2 (k) : Area Of Sector 36-1 And 36-2 After Using GIS

4.2.4.2 AREA'S OF SECTORS

Sr No.	Sector No.	AREA
01	36-1	34950.005 Square Meters
02	36-2	31099.979 Square Meters

Table 4.2.3 : Area Of Sectors

CHAPTER FIVE

CONCLUSION

5. CONCLUSIONS :

1. Planning an integrated township with a view of creating affordable residential properties and other facilities by placing all the essential facilities within walking distance of each other.
2. By implementing the QGIS software, planning was done more effeciently. The spatial and attribute data of village was collected. Using this data, the geo refering and digitializing of the village map was done.
3. Hence, it can be concluded that QGIS technology can be efficiently used for systematic urban planning.
4. Geospatical companies have to make their decision, planning, and everything else much smarter than ever before.
5. Explore the scope of the QGIS program in the real estate industry as well as the future research.
6. Research on the township planning by using this technology to develop a real estate information system for the study area and for the future exploring the scope of the QGIS program in the real e state industry as well as the future research will be more effective.
7. Planning an Integrated township with a view of creating affordable residential properties and other facilities by placing all the essential facilities within walking distance of each other.
8. Providing eco-friendly development for the holistic growth and making life easy and comfortable for its residents. However, this planning work was very cumbersome, tedious and time consuming, as it was done manually using only the limited data which was available. Also, there might be changes in demographics of the town during the construction activity, as it is a long process. Hence, the results cannot be completely relied upon, but can be used as a benchmark for further planning by considering some factor of safety.
9. By implementing the QGIS software, planning was done more effectively. The spatial and attribute data of the village was collected. Using this data, the geo-referencing and digitizing of the village map was done.
10. The database was created by layers and polygons and attributes are given to them.
11. Finally, for land record management queries were also created.
12. Hence, it can be concluded that QGIS technology can be efficiently used for systematic urban planning.
13. Research on township planning by using this technology to develop a real estate information system for the study area and for further exploring the scope of the QGIS program in the real estate industry as well as the future research will prove to be more effective.

CHAPTER SIX

REFERENCE

6. REFERENCES :

6.1 PUBLICATIONS

[1] Report of Jones Lang LaSalle, "Housing in India"

[2] Charan Singh, Indian Institute of Management Bangalore (2013)

[3] "Housing market in India: A comparison with the US and Spain".

[4] KPMG report (2010) "Affordable housing a key growth driver in the real estate sector".

[5] JLL & CREDAI report (2014) "Housing for all- Reforms can make it happen sooner".

[6] Rakesh Ranjan (2014) "Housing for all by 2022: Access, Affordability and quality of life".

[7] Affordable Housing in Partnership Scheme Guidelines, Government of India, 2013

[8] Bernhardsen, T. (1999) Geographic information systems : an introduction. Wiley, New York.

[9] Abhirup Bhunia, (2017) phantom demand can trigger a supply glut and lead to realty collapse. Rental market reforms are a viable alternative, the hindu, business line, 10th November 2017.

[10] Amr Mostafa Hussein Fathy, (2015) optimum design of rc affordable housing, master thesis, B.Sc. In construction engineering, construction and architectural engineering department.

[11] Ana Reinbold, (2017), benefits of lean construction for affordable housing, master thesis, international master of science in construction and real estate management joint study programme of Metropolia, UAS and HTW, berlin.

[12] Shirley Ballaney, (2008), "the town planning mechanism in Gujarat", India.

[13] Sahar s. Abdalla, Sarah a. Elariane and Sarah h. El Defrawi, (2016), j. Urban plan. Dev., 2016, 142(1): 04015011.

[14] Berry, M. (2003). Why is it important to boost the supply of affordable housing in Australia and how can we do it ?. *Urban Policy and Research*, *21*(4), 413-435.

[15] MHUPA. (2011). Guidelines for Affordable Housing in Partnership(Amended). New Delhi: MHUPA, Government of India.

[16] Milligan, V., Gurran, N., Lawson, J., Phibbs, P., & Phillips, R. (2009). Innovation in affordable housing in Australia: Bringing policy and practice for not-for-profit organisations together. *Final Report*, *134*.

[17] Mueller, E. J., & Tighe, J. R. (2007). Making the case for affordable housing: Connecting housing with health and education outcomes. *Journal of Planning Literature*, *21*(4), 371-385.

[18] Maharashtra State Road Development Corporation Ltd. (MSRDC, 2018), Draft Development Plan Report for 71 Villages along the Mumbai Pune Expressway

[19] Stew, L. and Gifford, R. (2005), "Sustainable transportation and quality of life." Journal of transport geography, 13 (1), 59-69.

[20] Sudhira, H. S. and Gururaja, K. V. (2012), "Population crunch in India: Is it urban or still rural?" Current Science, 103 (1), 37-40.

[21] Padumadasa and Rehan (2009) "Investigation in to Design Support Systems and Multiple Criteria Decision-Making to develop a web based tender management system", Proceedings of the International Symposium on the Analytic Hierarchy Process.

[22] Papageorgiou, J. C. (1976). "Quality of life indicators." International Journal of Environmental Studies, 9 (3), 177–186.

[23] Phule R. and Nadgouda K. (2016), "Spatial Variability mapping of N-Value of soils of Mumbai City using ARCGIS." ESRI India Regional User Conference-2016.

[24] Pollack, C., Griffin, B. and Lynch, J. (2010), "Housing affordability and health among homeowners and renters." American journal of preventative medicine, 39 (6), 515–521.

[25] Prickett, L., and Bicknell, J. (2010), "LID, LEED, and Alternative Rating Systems–Integrating Low Impact Development Techniques with Green Building Design."

[26] Bhoir V. & Nighot B. (2018), "A study of problems and prospects of housing development schemes by CIDCO in Navi Mumbai"

[27] Abdalla S, Elariane S. and El Defrawi S., (2016), Journal of Urban Planning Development, 2016, 142(1): 04015011.

[28] Arditi D. and Nawakorawit M., (1999), "Designing Buildings for Maintenance: Designers' Perspective", Journal of Architecture Engineering, 5(4): 107-116.

[29] Baccini, P., and Brunner, P. H. (2012), "Metabolism of the anthroposphere: analysis, evaluation, design." MIT Press.

[30] Baer, W. C. (1997), "General plan evaluation criteria : An approach to making better plans." Journal of American Planning Association, 63 (3), 329–344.

[31] Ballaney S., (2008), "The Town Planning Mechanism in Gujarat", India

[32] Ballard G. (2008) "The Lean Project Delivery System: An Update" Lean Construction Journals, pp 1-19

[33] Basawaraju, R., Chari K. B., Mise S. R., Chetti S. B. (2011), "Analysis of the impact of urban sprawl in altering the land-use, land-cover pattern of Raichur City, India, using geospatial technologies." Journal of Geography and Regionional Planning, 4 (8), 455–462.

[34] Cho K. and Hastak M. (2013). "Time and Cost based Optimized Decision Support Model for Fast Track Projects" Journal of Construction Engineering Management, 139(1): 90-101.

[35] Churchill, C. J., and Baetz, B. W. (1999), "Development of decision support system for sustainable community design." Journal of Urban Planning and Development, Vol. 125 Issue 1, 17–35.

[36] Daisy X. M. Z., Thomas S. N. and Kumaraswamy M. M. (2002). "Applying Genetic Algorithm Techniques for Time-Cost Optimization", 18th Annual ARCOM Conference, University of Nothumbria, Vol 02, 801-810.

[37] Devikamalam J. and Jane H.H. (2013). "Resource Scheduling of Construction Projects using Genetic Algorithm" International Journal of Advanced Engineering Technology, Vol.4, Issue no. 3, 113-119

[38] El-Anwar O. and Tamer A., (2014), Integrated Urban-Construction Planning Framework for Slum Upgrading Projects, Journal of Construction Engineering & Management, 140(4): B4014003.

[39] Engel-Yan, J. B., Kennedy, C. A., Saiz, S. and Pressnail, K. D. (2005), "Towards sustainable neighborhood s: The need to consider infrastructure interactions." Can. Journal of Civ. Eng., 32 (1), 45–57.

[40] Fathy A., (2015), "Optimum Design of RC Affordable Housing", Master thesis, B.Sc. in Construction Engineering, Construction and Architectural Engineering Department.

[41] Fatma A. (2014). " Multi objective Genetic Optimization for Scheduling a multi-storey building", Automation in Construction, Vol.4, pp. 119-128

[42] Feng, C. and Hsieh, C. (2009), "Implications of transport diversity for quality of life." Journal of Urban Planning and Development, 135 (1), 13–18.

[43] Feng, J.M., Wang, Y. L., Ma, Z.-G. and Liu, Y.H. (2012), "Simulating the regional impacts of urbanization and anthropogenic heat release on climate across China." Journal of Climate, 25 (20), 7187–7203.

6.2 WEBSITES

[1] www.CIDCO.maharashtra.gov.in

[2] https://bhuvan.nrsc.gov.in

[3] http://soinakshe.uk.gov.in