DISSERTATION REPORT ON

"COMMERCIAL DEVELOPMENT-ICONIC TOWER" 'KARKARDUMA'

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF:

BACHELOR OF ARCHITECTURE BY
JANHVI PRIYA SINGH
1150101032

DISSERTATION GUIDE
AR. ANKUR SAXENA

SESSION
2019-20

TO THE
SCHOOL OF ARCHITECTURE AND PLANNING
BABU BANARASI DAS UNIVERSITY
LUCKNOW.

SCHOOL OF ARCHITECTURE AND PLANNING
BABU BANARASI DAS UNIVERSITY, LUCKNOW (U.P.).

CERTIFICATE

I hereby recommend that the dissertation entitled, “**COMMERCIAL DEVELOPMENT-ICONIC TOWER, KARKARDUMA**” under the supervision, is the bonafide work of the students and can be accepted as partial fulfillment of the requirement for the degree of Bachelor’s degree in architecture, school of Architecture and Planning, BBDU, Lucknow.

______________________ ______________________

Prof. Mohit Kumar Agarwal Prof. Sangeeta Sharma

Dean of Department Head of Department

Recommendation Accepted

Not Accepted

______________ ______________

External Examiner External Examiner

BABU BANARASI DAS UNIVERSITY, LUCKNOW (U.P.).

Certificate of dissertation submission for evaluation

Name: JANHVI PRIYA SINGH
Roll No.: 1150101032
Dissertation Title: ICONIC TOWER, KARKARDUMA

Degree for which the dissertation is submitted: …………………………………….

Faculty of University to which the dissertation is submitted:
Yes / No

Dissertation preparation guide was referred to for preparing the dissertation.
Yes / No

Specification regarding dissertation format have been closely followed.
Yes / No

The content of the dissertation has been organized based on the guidelines.
Yes / No

The dissertation has been prepared without resorting to plagiarism.
Yes / No

All the sources used have been cited appropriately. Yes / No

Submitted 3 hard bound copied plus one CD. Yes / No

The dissertation has not been submitted elsewhere for a degree.
Yes / No

………………………………….. ……………………………….

(Signature(s) of the supervisor)
Name:

(Signature of the Candidate)
Name: Janhvi P. Singh
Roll No.: 1150101032

ACKNOWLEDGEMENT

I take this opportunity to extend my gratitude to all those who have contributed to the completion of this dissertation in any manner large or small.

To begin with, I would like to thank my dissertation guide **AR. ANKUR SAXENA** who has guided me throughout the whole dissertation. My sincere regards to him for helping me with the discussions & for leading to a better design.

Also, I would like to thanks **AR. URVASHI TIWARI**, for her valuable suggestion and motivation during the dissertation.

I would like to express my gratitude towards my family who has helped me during my dissertation say, financially or emotionally. They were with me at times I felt low, and let down. They encouraged me and supported me in any possible way they could do so.

I am grateful to the dissertation coordinator **AR. URVASHI TIWARI** and **AR. SHAILESH KUMAR YADAV,** for providing their useful comments at the stage submissions.

My all faculties, guidance and support, encouragement and guidance has given me the strength to embark on this rigorous journey.

I would also like to express my gratitude to Rishabh Singh without whose help this dissertation would not be possible.

Janhvi Priya Singh

CONTENTS

CHAPTER 1.0 INTRODUTION

1.1 Definition of Mixed-used Development

One of the Urban Design Principles which cuts across many urban areas around the globe is the principle of mixed- use development. Mixed-use development is the practice of allowing more than one type of use in a building or set of buildings. In planning terms, this can mean some combination of residential, commercial, industrial, office, institutional or other land uses. This tends to create shorter distance between work, residence and recreation and goes a long way to enhance the livelihood of the inhabitants.

1.2 What is a skyscraper?

Skyscraper, very tall, multistoried building. The name first came into use during the 1880s, shortly after the first skyscrapers were built, in the United States. The development of skyscrapers came as a result of the coincidence of several technological and social developments. The term skyscraper originally applied to buildings of 10 to 20 stories, but by the late 20th century the term was used to describe high-rise buildings of unusual height, generally greater than 40 or 50 stories.

WHY BUILD TALL?

There are a number of interrelated reasons for the development of skyscrapers. Some of the drivers that have increased the need of tall building are:

Driver A: Land Prices and Return on Investment

The higher cost of land typical of city centers-where the vast majority of support infrastructure located-has always been a driver for tall building. The higher land cost drives both the developer's need to offset that cost by creating more floor area for sale or rent, and the opportunity for a greater on investment by developing tall.

Driver B: Building as Corporate Branding and Skyline as Global Branding

Whereas tall buildings have been used throughout their history as marketing tools to portray the vitality of a corporation, now they are increasingly being used to portray the vitality of a city or country on a competitive world stage.

Driver C: Rapid Urbanization and Climate Change

There are other, perhaps more compelling, reasons for the increase in tall buildings than just corporate or urban branding. It is believed that there are now almost 200,000 people urbanizing on this planet every day, requiring a new city of about one million inhabitants every week.

1.3 T.O.D.

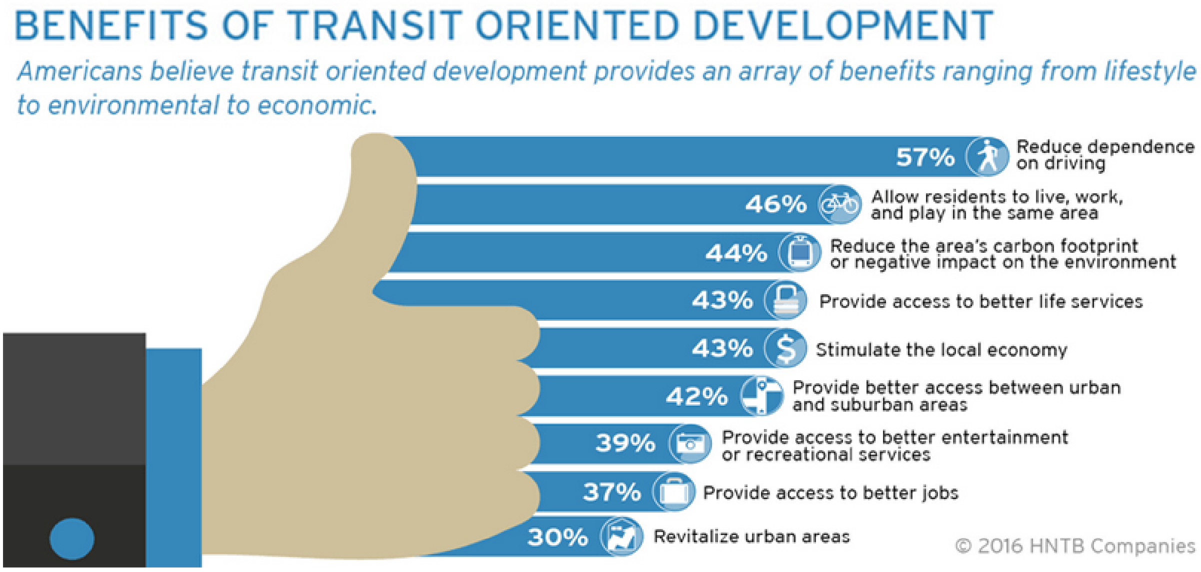
Transit Oriented Development is the exciting fast-growing trend in creating vibrant, livable, sustainable communities. Also known as TOD, it's the creation of compact, walkable, pedestrian-oriented, mixed-use communities centered around high-quality train systems. This makes it possible to live a lower-stress life without complete dependence on a car for mobility and survival.

Transit oriented development is regional planning, city revitalization, suburban renewal, and walkable neighborhoods combined. TOD is rapidly sweeping the nation with the creation of exciting people places in city after city. The public has embraced the concept across the nation as the most desirable places to live, work, and play. Real estate developers have quickly followed to meet the high demand for quality urban places served by rail systems.

CONCEPT OF T.O.D.

Following are TOD’s commonly shared elements, each reflected in these definitions: (called “THE 6-DS”):

1. **DIVERSITY IN LANDUSE**, Housing, and Jobs (Mixed-Use & Mixed income Development;
2. **DIVERSITY** to Transit & Multimodal Integration;
3. Higher residential and employment **DENSITIES**;
4. Walkable **DESIGN**;
5. Public spaces & stations as **DESTINATION**;
6. **DEMAND** management measures that discourage automobile trips.



1.4 Aim

To understand the needs of the corporates, residents and to design a commercial building catering to the needs of all commercial purposes and the corporate set-ups and analyze TOD as the best mixed-use approach. Mixed-use in the 'vertical' as a catalyst for city development and unlocking the barriers involved in achieving mixed-use development.

1.5 Need of Project

Every man needs a special environment that imparts tranquility to the spirits and stimulants to mind. India has earned itself a reputation of an IT superpower. Software technology parks of India has played a seminal role in accomplishing this status. Today, Commercial Development across the country are synonymous with excellent infrastructure and statutory support aimed at furthering growth of corporate in the country.

1.6 Objectives

- To identify some of the urban design principles used in solving the urban design problems of congestion (vehicular and human), urban sprawl, etc.
- To conduct a research into the concept of mixed-use developments as an urban design approach
- To identify the various types and functions of mixed-used developments.
- To show how the concept of mixed-use development can be used to solve some of high-density urban problems.
- To study emergence of Business Park
- To study features of a Commercial Development
- Studying the interaction of areas within the built spaces.

- For office spaces to stay relevant, they should respond to the current needs that are flexible and adaptable spaces supporting innovation.
- The project represents an opportunity to explore an architecture that is contemporary and responsive to the context.
- The creation and sustenance of an active public space can be explored.
- With current frenzy of buildings leading to an architecture that has little to do with context, there is merit in exploring a kind of way that is conscious of place as well as time.

1.7 SCOPE OF WORK AND LIMITATIONS

- The scopes of the projects are Office areas, Retail Spaces, Hotel, space for parking, landscaping, small restaurants.
- They are present in suburbs so the surroundings may provide a calm and peaceful environment to work in, that is also pollution free.
- The project is concerned in built form so; there will be limited research and study on feasibility of project and detailed site suitability will not be analysed.
- The project will not cover all the details related to green design incorporated, though research will be made and required level of detailing will be done to meet the architectural requirement.

1.8 THE PURPOSE OF THE STUDY

The purpose of the study is outlined below:

- To determine the factors that lead to the creation of the various mixed-use development
- To determine the various factors affecting people's decision as to where to live, work, play and learn
- To study certain planned mixed-use development and their effects on its residents and the urban environment as a whole.
- To determine whether the deliberate creation of several types of mixed-use development will help alleviate some of East Delhi's urban problems such as traffic congestion etc.

CHAPTER 2.0 STUDY

2.1 HIGH-RISE BUILDINGS

Tall buildings emerged in the late nineteenth century in the United States of America. They constituted a so-called "American Building Type," meaning that most important tall buildings were built in the U.S.A. Today, however, they are a worldwide architectural phenomenon. Many tall buildings are built worldwide, especially in Asian countries, such as China, Korea, Japan, and Malaysia. Based on data published in the 1980s, about 49% of the world's tall buildings were located in North America. The distribution of tall buildings has changed radically with Asia now having the largest share with 32%, and North America's at 24%. This data demonstrates the rapid growth of tall building construction in Asian during this period while North American construction has slowed. In fact, eight of the top ten tall buildings are now in Asia and only two, the Sears Tower and the Empire State Building, are in North America.

Traditionally the function of tall buildings has been as commercial office buildings. Other usages, such as residential, mixed-use, and hotel tower developments have since rapidly increased as Figure 1 shows. There has been some skepticism regarding construction of tall buildings since September 11, 2001, however, they will continue to be built due to their significant economic benefits in dense urban land use.

Tall building development involves various complex factors such as economics, aesthetics, technology, municipal regulations, and politics. Among these, economics has been the primary governing factor. This new building type itself would not have been possible, however, without supporting technologies. A structural revolution – the steel skeletal structure – as well as consequent glass curtain wall systems, which occurred in Chicago, has led to the present state-of-the-art skyscraper. While this review paper encompasses the development spectrum of tall building's structural systems, there is emphasis on current trends. Speculations of future prospects of structural developments in tall buildings are based on this review.

Brief History

In the late nineteenth century, early tall building developments were based on economic equations – increasing rentable area by stacking office spaces vertically and maximizing the rents of these offices by introducing as much natural light as possible. In order to serve this economic driver, new technologies were pursued that improved upon the conventional load-bearing masonry walls that had relatively small punched openings. The result was the iron/steel frame structure which minimized the depth and width of the structural members at building perimeters. Consequently, the larger openings were filled with transparent glasses, while the iron/steel structures were clad with other solid materials such as brick or terra cotta. Different from traditional load-bearing masonry walls, these claddings did not carry any loads from buildings except their own weights and the lateral wind pressure. A new cladding concept – curtain walls – was developed with the emergence of the new structural systems.

The symbolic power of skyscrapers being recognized, a notable phenomenon occurred from the turn of the century. A skyscraper height race began, starting from the Park Row Building in New York, which had already reached 30 stories in 1899. This height race culminated with the completion of the 102-story tall Empire State Building in 1931. Even though the heights of skyscrapers were significantly increased during this period, contrary to intuition, there had not been much conspicuous technological evolution. In terms of structural systems, most tall buildings in the early twentieth century employed steel rigid frames with wind bracing. Among them are the renowned Woolworth Building of 1913, Chrysler Building of 1930 and Empire State Building of 1931 all in New York. Their enormous heights at that time were accomplished not through notable technological evolution, but through excessive use of structural materials. Due to the absence of advanced structural analysis techniques, they were quite over-designed.

In terms of architectural expression of tall buildings at this time period, as can be observed from many eclectic style tall buildings, architects returned to the traditional architecture for representational quality, after a short pursuit of a new style for a new building type based on new technologies mostly by Chicago architects in the late nineteenth century. However, the rebirth of the early Chicago spirit and the application of European modern movements to tall buildings were only a matter of time.

The mid-twentieth century, after the war, was the era of mass production based on the International Style defined already before the war, and the technology developed earlier. The major driving force of tall building developments was economy. Even the once-prevalent height race did not occur after World War II until the construction of the World Trade Center in New York and the Sears Tower in Chicago, completed in 1973 and 1974, respectively.
Structural systems for tall buildings have undergone dramatic changes since the demise of the conventional rigid frames in the 1960s as the predominant type of structural system for steel or concrete tall buildings. With the emergence of the tubular forms still conforming to the International Style, such changes in the structural form and organization of tall buildings were

necessitated by the emerging architectural trends in design in conjunction with the economic demands and technological developments in the realms of rational structural analysis and design made possible by the advent of high-speed digital computers. Beginning in the 1980s, once-prevalent Miesian tall buildings were then largely replaced by the façade characteristics of postmodern, historical, diagrid and deconstructivist expressions. This was not undesirable because the new generation of tall buildings broke the monotony of the exterior tower form and gave rise to novel high-rise expressions. Innovative structural systems involving tubes, mega-frames, core-and-outrigger systems, artificially damped structures, and mixed steel-concrete systems are some of the new developments since the 1960s.

CHAPTER 2.2; EVOLUTION OF STRUCTURE

Structural development of tall buildings has been a continuously evolving process. There is a distinct structural history of tall buildings similar to the history of their architectural styles in terms of skyscraper ages (Ali & Armstrong, 1995; Huxtable, 1984). These stages range from the rigid frame, tube, core-outrigger to diagrid systems. A brief account of past developments in tall buildings is presented below.

CLASSIFICATION OF TALL BUILDING STRUCTRAL SYSTEM

In 1969 Fazlur Khan classified structural systems for tall buildings relating to their heights with considerations for efficiency in the form of "Heights for Structural Systems" diagrams. This marked the beginning of a new era of skyscraper revolution in terms of multiple structural systems. Later, he upgraded these diagrams by way of modifications. He developed these schemes for both steel and concrete.

Khan argued that the rigid frame that had dominated tall building design and construction so long was not the only system fitting for tall buildings. Because of a better understanding of the mechanics of material and member behavior, he reasoned that the structure could be treated in a holistic manner, that is, the building could be analyzed in three dimensions, supported by computer simulations, rather than as a series of planar systems in each principal direction. Feasible structural systems, according to him, are rigid frames, shear walls, interactive frame-shear wall combinations, belt trusses, and the various other tubular systems.

Structural systems of tall buildings can be divided into two broad categories: *interior structures* and *exterior structures*. This classification is based on the distribution of the components of the primary lateral load-resisting system over the building. A system is categorized as an interior structure when the major part of the lateral load resisting system is located within the interior of the building. Likewise, if the major part of the lateral load-resisting system is located at the building perimeter, a system is categorized as an exterior structure. It should be noted, however, that any interior structure is likely to have some minor components of the lateral load-resisting system at the building perimeter, and any exterior structure may have some minor components within the interior of the building.

Interior Structures

The two basic types of lateral load-resisting systems in the category of interior structures are the moment-resisting frames and shear trusses/shear walls. These systems are usually arranged as planar assemblies in two principal orthogonal directions and may be employed together as a combined system in which they interact. Reinforced concrete planar solid or coupled shear walls have been one of the most popular systems used for high-rise construction to resist lateral forces caused by wind and earthquakes. They are treated as vertical cantilevers fixed at the base. When two or more shear walls in the same plane are interconnected by beams or slabs, as is the case with shear walls with door or window openings, the total stiffness of the system exceeds the sum of the individual wall stiffnesses. This is so because the connecting beam forces the walls to act as a single unit by restraining their individual cantilever actions. These are known as coupled shear walls.

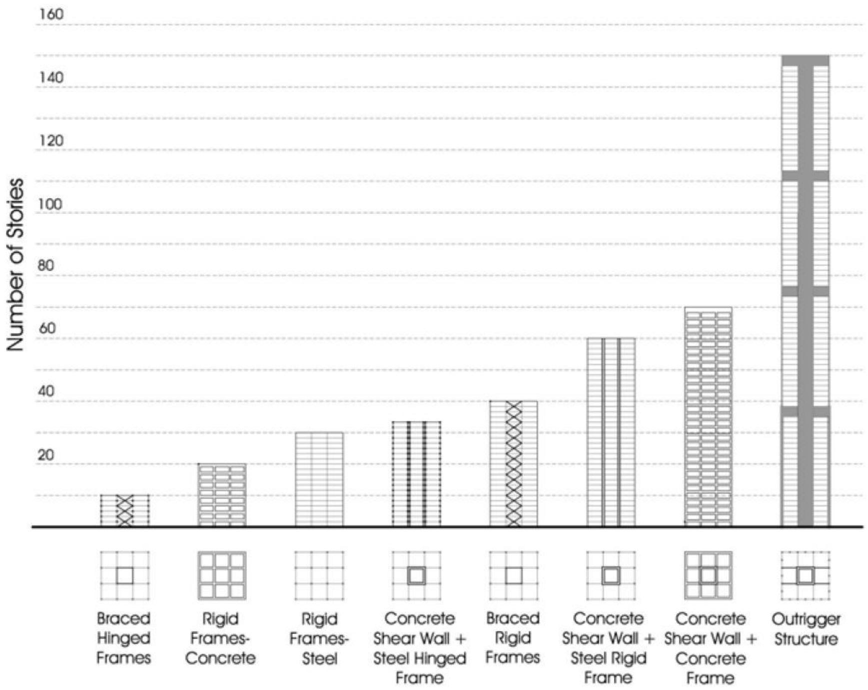


Figure 4-1: *Interior structures.*

Table 2-1: Interior Structures.

Category	Sub-Category	Material / Configuration	Efficient Height Limit	Advantages	Disadvantages	Building Examples
Rigid Frames	–	Steel	30	Provide flexibility in floor planning. Fast construction.	Expensive moment connections. Expensive fire proofing.	860 & 880 Lake Shore Drive Apartments (Chicago, USA, 26 stories, 82 m), Business Men's Assurance Tower (Kansas City, USA, 19 stories), Seagram Building, 30th to the top floor (New York, USA, 38 stories, 157 m)
		Concrete	20	Provide flexibility in floor planning. Easily moldable.	Expensive formwork. Slow construction.	Ingalls Building (Cincinnati, USA, 16 stories, 65 m)
Braced Hinged Frames	–	Steel Shear Trusses + Steel Hinged Frames	10	Efficiently resist lateral loads by axial forces in the shear truss members. Allows shallower beams compared with the rigid frames without diagonals.	Interior planning limitations due to diagonals in the shear trusses. Expensive diagonal connections.	Low-rise buildings
Shear Wall / Hinged Frames	–	Concrete Shear Wall + Steel Hinged Frame	35	Effectively resists lateral shear by concrete shear walls.	Interior planning limitations due to shear walls.	77 West Wacker Drive (Chicago, USA, 50 stories, 203.6 m), Casselden Place (Melbourne, Australia, 43 stories, 160 m)
Shear Wall (or Shear Truss) - Frame Interaction System	Braced Rigid Frames	Steel Shear Trusses + Steel Rigid Frames	40	Effectively resists lateral loads by producing shear truss - frame interacting system.	Interior planning limitations due to shear trusses.	Empire State Building (New York, USA, 102 stories, 381 m), Seagram Building, 17th to 29th floor (New York, USA, 38 stories, 157 m)
	Shear Wall / Rigid Frames	Concrete Shear Wall + Steel Rigid Frame	60	Effectively resists lateral loads by producing shear wall - frame interacting system.	Interior planning limitations due to shear walls.	Seagram Building, up to the 17th floor (New York, USA, 38 stories, 157 m)
		Concrete Shear Wall + Concrete Frame	70	"	"	311 South Wacker Drive (Chicago, USA, 75 stories, 284 m), Cook County Administration Building, former Brunswick Building (Chicago, USA, 38 stories, 145 m)
Outrigger Structures	–	Shear Cores (Steel Trusses or Concrete Shear Walls) + Outriggers (Steel Trusses or Concrete Walls) + (Belt Trusses) + Steel or Concrete Composite (Super) Columns	150	Effectively resists bending by exterior columns connected to outriggers extended from the core.	Outrigger structure does not add shear resistance.	Taipei 101 (Taipei, Taiwan, 101 stories, 509 m), Jin Mao Building (Shanghai, China, 88 stories, 421 m)

Exterior Structures

The nature of building perimeters has more structural significance in tall buildings than in any other building type due to their very tallness, which means greater vulnerability to lateral forces, especially wind loads. Thus, it is quite desirable to concentrate as much lateral load-resisting system components as possible on the perimeter of tall buildings to increase their structural depth, and, in turn, their resistance to lateral loads.

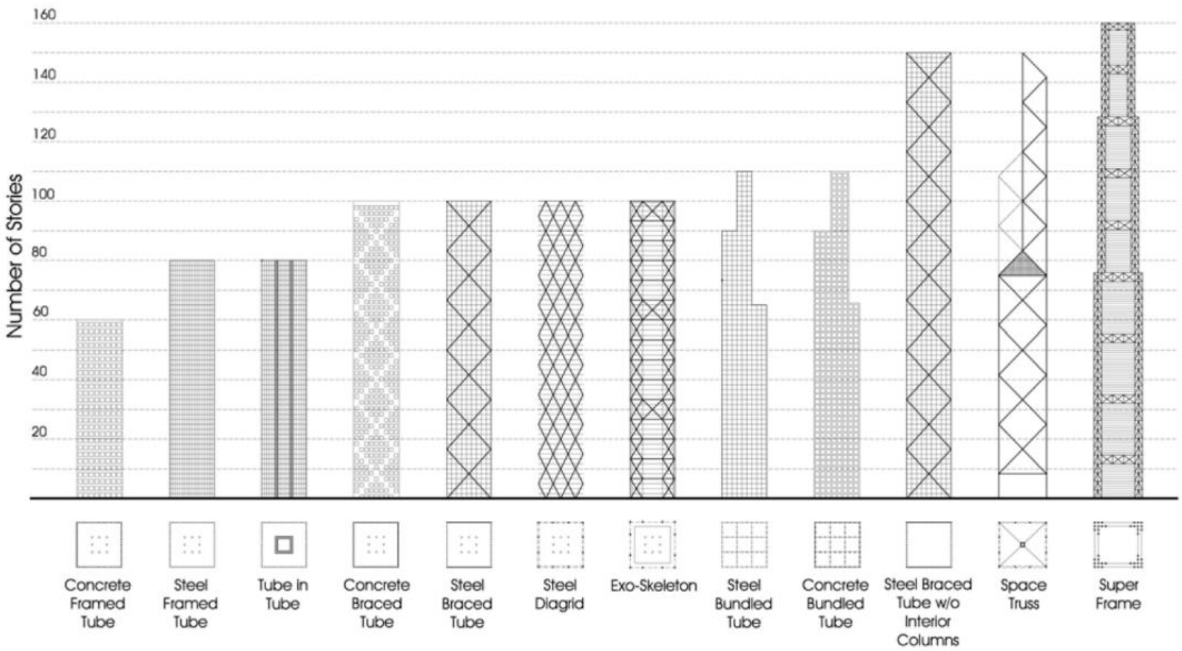


Figure 4-2: *Exterior structures.*

One of the most typical exterior structures is the tube, which can be defined as a three-dimensional structural system utilizing the entire building perimeter to resist lateral loads. The earliest application of the tubular notion is attributed to Fazlur Khan, who thought of this concept in 1961 and designed the 43-story DeWitt-Chestnut Apartment Building in Chicago, completed in 1965, the first known building designed as a framed tube. A few other world's tallest buildings using this concept are the 110-story Sears Tower, the 100-story John Hancock Center, and the 83-story Amoco building, all in Chicago, and the 110-story World Trade Center Towers (destroyed in 2001 by a terrorist attack) in New York. Many other recent buildings in excess of 50 stories have employed the tubular concept or a variation of it. The introduction of tube systems has been revolutionary since for the first time the three-dimensional response of buildings was directly exploited to advantage departing from the conventional rigid frame system consisting of rigidly connected planar beam-column grids. Tubular forms have several types depending upon the structural efficiency that they can provide for different heights.

The 110-story Sears Tower completed in 1974 was the first bundled tube structure in which nine steel framed tubes are bundled at the base, some of which are terminated at various levels along the building's height with two tubes continuing between the 90 floor and the roof. Such flexibility of organizing the floor areas, from very large at the base to much smaller at the top, gave the bundled tube system an added advantage. The bundled tube concept also allowed for wider column spacing in the tubular walls, which made it possible to place interior frame lines without seriously compromising interior space planning of the building. The bundled tube system thus offers great freedom in the architectural planning by creating a powerful vocabulary for a variety of existing building forms.

The diagrid can be compared with another prevalent structural system, the outrigger structures. Properly designed, an outrigger structure is effective in reducing the overturning moment and drift of the building. However, the addition of the outrigger trusses between the shear core and exterior columns does not add lateral shear rigidity to the core. Thus, tall buildings that employ outrigger systems still require cores having significant shear rigidity. The diagrid structure provides both bending and shear rigidity. Thus, unlike outrigger structures, diagrid structures do not need high shear rigidity cores because shear can be carried by the diagrids located on the perimeter, even though supertall buildings with a diagrid system can be further strengthened and stiffened by engaging the core, generating a system similar to a tube-in-tube.

Other types of lateral load-resisting systems in the category of exterior structures include space trusses, super frames and exoskeleton. These have been occasionally used for tall buildings. *Space truss* structures are modified braced tubes with diagonals connecting the exterior to interior. In a typical braced tube structure, all the diagonals, which connect the chord members – vertical corner columns in general, are located on the plane parallel to the facades. However, in space trusses, some diagonals penetrate the interior of the building. Examples include the Bank of China Tower of 1990 by I. M. Pei in Hong Kong.

A *superfram*e is composed of megacolumns comprising braced frames of large dimensions at building corners, linked by multistory trusses at about every 15 to 20 stories. The concept of superframe can be used in various ways for tall buildings, such as the 56-story tall Parque Central Complex Towers of 1979 in Caracas, Venezuela and the 168-story tall Chicago World Trade Center proposed by Fazlur Khan in 1982.

In *exoskeleton* structures, lateral load-resisting systems are placed outside the building lines away from their facades. Examples include Hotel de las Artes in Barcelona. Due to the system's compositional characteristics, it acts as a primary building identifier – one of the major roles of building facades in general cases. Fire proofing of the system is not a serious issue due to its location outside the building line. However, thermal expansion/contraction of the system, exposed to the ever-changing outdoor weather, and the systemic thermal bridges should be carefully considered during design.

Table 2-2: Exterior Structures.

Category	Sub Category	Material / Configuration	Efficient Height Limit	Advantages	Disadvantages	Building Examples
Tube	Framed Tube	Steel	80	Efficiently resists lateral loads by locating lateral systems at the building perimeter.	Shear lag hinders true tubular behavior. Narrow column spacing obstructs the view.	Aon Center (Chicago, USA, 83 stories, 346 m)
		Concrete	60	"	"	Water Tower Place (Chicago, USA, 74 stories, 262 m)
	Braced Tube	Steel	100 (With Interior Columns) – 150 (Without Interior Columns)	Efficiently resists lateral shear by axial forces in the diagonal members. Wider column spacing possible compared with framed tubes. Reduced shear lag.	Bracings obstruct the view.	John Hancock Center (Chicago, USA, 100 stories 344 m)
		Concrete	100	"	"	Onterie Center (Chicago, 58 stories, 174 m), 780 Third Avenue (New York, USA, 50 stories, 174 m)
	Bundled Tube	Steel	110	Reduced shear lag.	Interior planning limitations due to the bundled tube configuration.	Sears Tower (Chicago, USA, 108 stories, 442 m)
		Concrete	110	"	"	Carnegie Hall Tower (New York, USA, 62 stories, 230.7 m)
	Tube in Tube	Ext. Framed Tube (Steel or Concrete) + Int. Core Tube (Steel or Concrete)	80	Effectively resists lateral loads by producing interior shear core - exterior framed tube interacting system.	Interior planning limitations due to shear core.	181 West Madison Street (Chicago, USA, 50 stories, 207 m)
Diagrid	–	Steel	100	Efficiently resists lateral shear by axial forces in the diagonal members.	Complicated joints.	Hearst Building (New York, USA, 42 stories, 182 m), 30 St Mary Axe, also known as Swiss Re Building (London, UK, 41 stories, 181 m)
		Concrete	60	"	Expensive formwork. Slow construction.	O-14 Building (Dubai)
Space Truss Structures	–	Steel	150	Efficiently resists lateral shear by axial forces in the space truss members.	Obstruct the view. May obstruct the view.	Bank of China (Hong Kong, China, 72 stories, 367 m)
Superframes	–	Steel	160	Could produce supertall buildings.	Building form depends to a great degree on the structural system.	Chicago World Trade Center (Chicago, USA, 168 stories, Unbuilt)
		Concrete	100	"	"	Parque Central Tower (Caracas, Venezuela, 56 stories, 221 m)
Exo-skeleton	–	Steel	100	Interior floor is never obstructed by perimeter columns.	Thermal expansion / contraction. Systemic thermal bridges.	Hotel de las Artes (Barcelona, Spain, 43 stories, 137 m)

Recent Developments in the Form of Tall Buildings

The direction of evolution of the tall building's structural systems has been toward efficiently increasing the lateral stiffness against lateral loads – primarily wind loads. In order to obtain the necessary lateral stiffness, introduced first were braced frames and MRFs followed by tubular structures, core-supported outrigger structures, and more recently diagrid structures. The interrelationship between this structural evolution and the accompanying architectural aesthetics is worth discussing. Several contemporary directions of design strategies in terms of generating new forms "outside the box," such as aerodynamic, twisted.

Structural Evolution and Architectural Expression

The inherent monumentality of skyscrapers resulting from their scale makes their architectural expression very significant in any urban context where they soar. Thus, constructing any tall building requires careful studies on aesthetic adequacy of the new structure within the existing urban context. Some structural systems for tall buildings have had major impacts on the building aesthetics, while others have had only minor impacts.

In the traditional braced frames, the braces – the main lateral stiffness provider – were generally constrained within the interior cores, and serve only for structural performance. Consequently, no aesthetic expressions had been sought from these bracings until the emergence of the exterior-braced tubular structures such as the John Hancock Center in Chicago.

Regional Expression

As has been discussed earlier, the setting of most active tall building development has been shifting from North America to Asia over the last decade. The most significant trend of tall buildings constructed in various Asian countries is that they use their own regional architectural and cultural traditions as main design motives. This trend can be easily seen from notable recent tall buildings such as the Jin Mao Building in Shanghai, Petronas Towers in Kuala Lumpur (Figure 14), Landmark Tower in Yokohama, and Taipei 101 Tower in Taipei (Figure 15). Behind the traditional images are the products of the contemporary technology such as the tubular structures in the case of the Landmark Tower or the core supported outrigger structures in the cases of the Jin Mao Building and Taipei 101. Even though there is a certain level of diversity in this regional design trend, this new direction generally produces contextual architecture.

Emergence of Twisted Forms

An interesting approach in contemporary tall building design is twisted forms. Twisted forms employed for today's tall buildings can be understood as a reaction to boxed forms of modern architecture. In fact, this contemporary architectural phenomenon is not new in architecture. It is comparable to twisted forms of Mannerism architecture at the end of Renaissance architecture. For example, in Cortile Della Cavallerizza at Palazzo Ducale in Mantua, Giulio Romano designed twisted columns. This twisted form can be found again in today's tall building designs such as the Turning Torso, apartment and office tower, in Malmo, Sweden and the proposed Chicago Spire Project in Chicago designed by Santiago Calatrava.

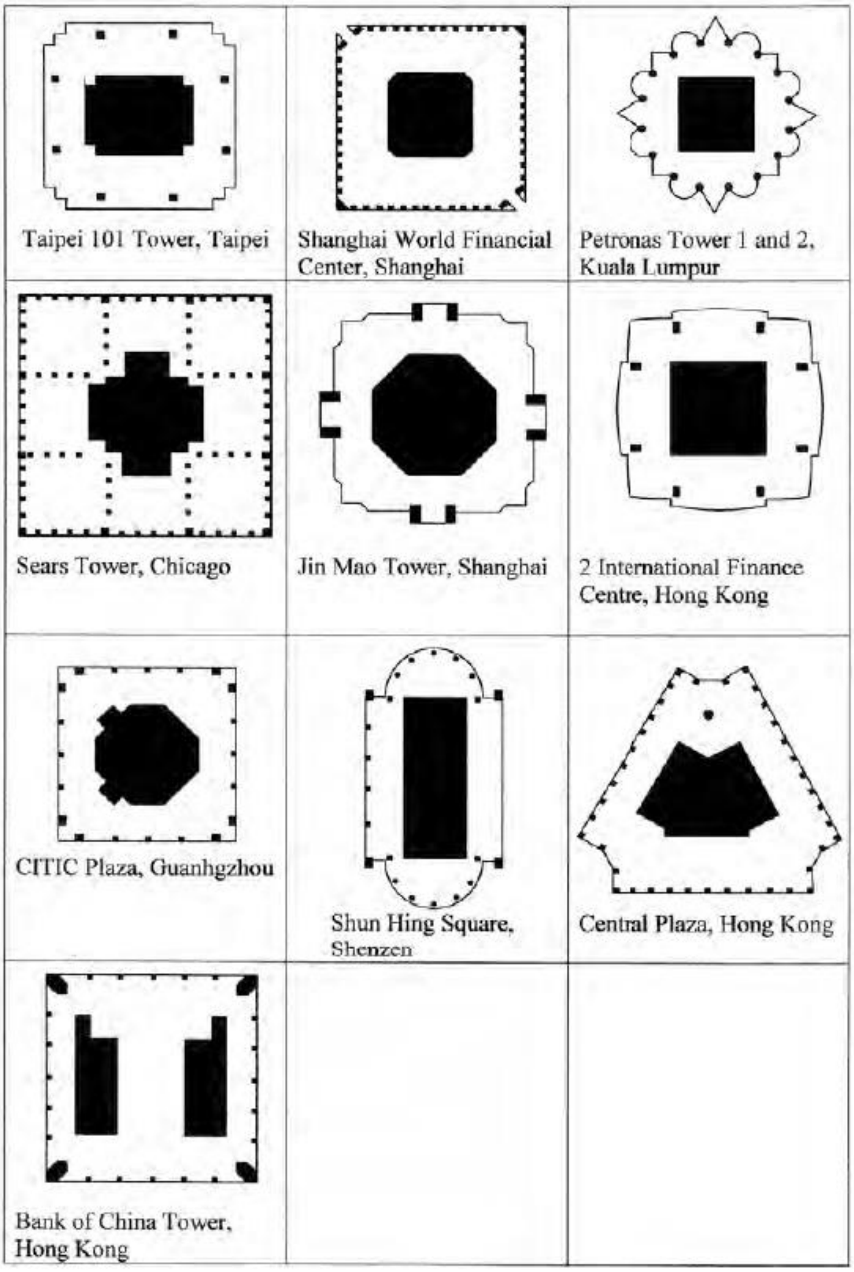
In general, twisted forms are effective in reducing vortex-shedding-induced dynamic response of tall buildings by disturbing vortex shedding. In terms of static response, twisted forms are not beneficial. If solid sections are considered, the moment of inertia of a square plan is the same regardless of its twisted angle (Figure 16). Thus, the displacements due to bending are the same as well. However, if the building type frames are considered, the lateral stiffness of the twisted forms is not as large as that of straight forms.

Free Forms

The number of free-form tall building projects has been rapidly increasing these days. In the past, only a few free-form tall building projects were proposed by some architects like Peter Eisenman and Frank Gehry, but they were never built. Within the context of tubular design, however, free-form structure is exemplified by the Sears Tower and One Magnificent Mile Building, both in Chicago, which employed a bundled tube system (Ali, 1990). Today, many free-form tall buildings are designed and actually constructed. It was quite a difficult task to perform the structural designs and analyses of irregular free-form tall buildings in the past. It can now be done relatively easily with the development of sophisticated structural design and analysis using computer software. Relying on the powerful support of contemporary structural engineers, some architects find their design solutions in free forms feasible. These architects include Daniel Libeskind, Zaha Hadid and Thom Mayne of Morphosis. Even though the supporting structural systems behind the free forms vary depending on the project-specific situations, diagrids are often employed as primary structures for free-form tall buildings as can be observed from Daniel Libeskind's Fiera Milano Tower and Morphosis' Phare Tower in La Defense. Other contemporary free-form (poetic, cinematic and tilted) tall buildings include Hadid's Dancing Tower in Dubai and Peter Pran's Oil Company Headquarters in Jeddah and The Sail at Marina Bay in Singapore.

The range of the heights of these recently proposed megastructures are from about 600m tall Holonic tower to 4000m tall X-Seed 4000. A building height of 500m is already reached by Taipei 101, and 700m will probably be reached soon by Burj Dubai. For the future megastructures in megacities, it is expected that the building height will be continuously increased in conjunction with the improvements in technology in structural systems, materials, elevators, fire protection, energy efficiency, and damping systems. Better strategies of integration are required to accomplish high-performance skyscrapers in the future. The future primary structural system may be speculated as an unprecedented newly developed system, or a variation of an existing system, or possibly a logical vertical combination of two or more existing systems to build higher.

CHAPTER 2.3; SPACE EFFICIENCY



Factors affecting the design of high-rise buildings vary from country to country, such as local climate, zoning regulations, cultural conditions, technological opportunities, and etc. For instance, in Germany, where building codes dictate shallow floor slabs of 8.0 m, efficiencies of 60-70% are common, whereas London's Canary Wharf Tower, can achieve a net-to-gross ratio in excess of 80% with floor slabs of 2500 m2, and 11.0 m lease span. In this respect, when the high-rise office buildings of Turkey are investigated, conceivable space efficiency is not achieved when compared with the examples from the world. As Watts and et al. (2007) stated in their article that "fat is happy", the highest office buildings of Turkey are happy, however, they are not so successful in respect to space efficiency. Therefore, this research tends to compare and reveal the similarities and differences between the tallest office buildings at abroad and in Turkey in terms of space efficiency.

The least sufficient workplace can be observed in the typical floor plans of Garanti Bank Headquarters with multiple columns dispersed throughout the floor slab (Figure 1b). Although this building has a workplace organized into one space, the interior columns prevent the flexibility and efficiency of this usable space, presenting the disadvantage of a non-column-free floor slab as stated above.

Leasing Depth

Leasing depth or lease span is the distance of the usable area between the exterior wall and the fixed interior element, such as the core or the multi-tenant corridor. Although it depends on the functional requirements and is closely related with the structural frame and the material, there are considerable varieties in different markets. For example, in Germany maximum leasing depth is determined by building codes and cannot be more than 8.0 m, whereas in Japan it is typically 18.0 m. In the United States, floor slab areas began to expand after the World War II with the help of technological innovations, such as air-conditioning and artificial lighting. Today there are high-rise office buildings with 17.0m lease span in United States and Asia.

	Name of Building	Leasing Depth (m)	Floor-to-floor height (m)	Floor-to-ceiling height (m)	Structural floor material
WORLD	Taipei 101 T.	13.9 – 9.8	4.20	2.80	Composite
	Shanghai WFC	12.5	4.20	2.75	Composite
	Petronas T. 1-2	13.0 – 8.3	4.00	2.65	Composite
	Sears Tower	22.9	3.92	2.70	Composite
	Jin Mao Tower	14.8 – 11.8	4.00	2.79	Composite
	Two International Finance Center	14.5	4.00	2.70	Composite
	CITIC Plaza	11.3	3.90	2.70	Composite
	Shun Hing Square	12.5 – 12.0	3.75	2.65	Composite
	Central Plaza	13.5 – 9.4	3.90	2.60	Reinforced concrete
	Bank of China	17.6	4.0	2.80	Composite
	Average	**12.1**	**3.98**	**2.7**	

Smaller core-to-exterior window dimensions allow the users to maintain a relationship with the outside, thus benefiting from the natural light. According to Ali and Armstrong (1995) the depth of lease span must be between 10.0 and 14.0 m for office functions, except where very large single tenant groups are to be accommodated. Maximum leasing depth has remained relatively static over the last 30 years as it is recognized that the maximum income for office development is achieved when a high percentage of the workers are located within an 8.0 m zone of the perimeter wall. Corner offices and the articulation of the façade significantly improve the ability to provide more space efficiency and quality than spaces with greater leasing depth. As floors become deeper, the marketability of the space significantly decreases.

Floor-to-floor / Floor-to-ceiling Height

The floor-to-floor height of an office building is typically the same for all occupied floors except for the lobby and floors for special functions. In high-rise office buildings, additional floor-to-floor height significantly entails greater cost on structural elements, cladding, mechanical risers, and vertical transportation.

Commercial functions require a variety of floor-to-ceiling heights ranging between 2.7 and 3.7 m, and the depth of the structural floor system varies depending on the floor loads, size of structural bay, and type of floor framing system. In the case of steel floor framing, an allowance for fire-proofing must be made. However, in steel systems, increasing the structural depth will result in decreased weights of rolled sections. Trusses, which permit the passage of ducts, provide structural depth without increase in floor-to-floor height.

Core Integrity

The core of the building comprises all of the vertical circulation elements, such as elevators, fire-stairs, mechanical shafts, toilets, and elevator lobbies. In early office buildings, these elements tended to be dispersed on the floor rather than concentrated, while today's contemporary buildings include all these elements in a specific zone, which is mainly the core. Many of the key structural elements, such as the shear walls that provide lateral stability, are integrated into the core in order to simplify the architectural design.

Layout of the core is critical to the development efficiency and operational effectiveness of a high-rise office building, while also playing a significant role in the way the structure copes with lateral loads. Building cores can be arranged in several ways. Central cores integrating with the outer structure resist lateral loads more effectively and open up the perimeter for light and view, enabling efficient workplaces. Buildings with side cores have the advantage of homogeneous workplaces, which is usually organized into one space. This building type is very attractive to users without cellular offices and has until recently been the standard in Japan and Korea. Multiple cores are common in low-rise buildings, which have very large or narrow floor slabs.

	Name of Building	Number of cores	Location of core		Core integrity		Core Area (m^2)	Core/ GFA (%)
			Center	Outside	Yes	No		
WORLD	Taipei 101 Tower	Single	X			X	665	25
	Shanghai WFC	Single	X		X		750	30
	Petronas T. 1-2	Single	X			X	530	25
	Sears Tower	Single	X			X	1113	22
	Jin Mao Tower	Single	X			X	800	29
	Two International Finance Center	Single	X		X		740	26
	CITIC Plaza	Single	X			X	480	22
	Shun Hing Square	Single	X			X	570	26
	Central Plaza	Single	X		X		560	25
	Bank of China	Double	X			X	800	30

The design of the core significantly affects the overall space efficiency of the buildings, vertical circulation, and distribution of mechanical and electrical shafts. The lifting strategy drives the core size and has a major impact in terms of design on all high-rise office buildings. One of the drivers is the acceptable period of time for users to get from ground floor to their destination. The ideal solution balances a number of factors such as the number and the speed of lifts, group sizes, building zones and the core arrangement, considering the space usage as well as cost. In order to achieve the maximum space efficiency of a high-rise office building, the core must be reduced to an acceptable ratio of the gross floor area, while coping with the fire regulations and achieving an effective vertical transportation with the elevators.

In many high-rise office buildings structural elements within and around the core interact with the perimeter frame. These structural elements can be constructed with either steel or reinforced concrete, or both. In the case of a reinforced concrete core, its structural weight can be very heavy, thus inducing an additional cost for the foundation. In United States, steel is commonly used as the structural material and lightweight fire-rated drywall is used to form the walls in order to reduce its
thickness and save the foundation cost and construction time. However, in Asian countries, the use of the structural steel with drywall forming is less common because their costs are higher than the conventional reinforced concrete construction. High-strength concrete is generally used to reduce the thickness of reinforced concrete core wall enabling more efficient spaces.

Future Prospects

Development of new technology occurs based upon necessity, and the technology evolves towards enhanced efficiency. The development of braced frame structures to produce more rentable spaces in dense urban lands by constructing tall buildings in the past and their evolutionary paths up to the present towards even taller and more efficient structures to maximize land uses more economically are within this track. Tall buildings, which began from with 10-story office towers in the late nineteenth century, have evolved to megastructures like the Burj Dubai, which is over 150 stories and will be the tallest building in the world at the time of its completion in 2009.

There continues to be a need for building upward. Populations worldwide have grown rapidly, and migration of populations from rural areas to urban, has resulted in high-density mega cities. Denser cities with megastructures are more efficient in terms of energy consumption and land use. By making a city smaller and denser, the power grid becomes smaller, making the transfer of electrical energy more efficient. The need for automobile transportation declines as well as the need for personal transportation, which is a large contributor to the problems of efficient energy consumption and pollution. By creating denser cities with tall buildings, more natural green areas can be saved globally. However, compactness will result in crowding and hence a balance must be struck.

The idea of a megastructure, which can be viewed as an extremely large multi-use tall building containing almost a city within it, is not new. In 1956, Frank Lloyd Wright proposed the Mile-High Illinois Tower in Chicago. It was composed of five vertical zones of 100 stories each. More recently proposed megastructure projects include the Bionic Tower in Shanghai designed by Celaya, Pioz & Cevera Architects, Sky City 1000 in Tokyo (Figure 20) and Holonic Tower developed by Takenaka Corporation, X-Seed 4000 in Tokyo designed by Taisei Construction Corporation, and Millennium Tower in Tokyo designed by Norman Foster (Figure 21).

The range of the heights of these recently proposed megastructures are from about 600m tall Holonic tower to 4000m tall X-Seed 4000. A building height of 500m is already reached by Taipei 101, and 700m will probably be reached soon by Burj Dubai. For the future megastructures in megacities, it is expected that the building height will be continuously increased in conjunction with the improvements in technology in structural systems, materials, elevators, fire protection, energy efficiency, and damping systems. Better strategies of integration are required to accomplish high-performance skyscrapers in the future. The future primary structural system may be speculated as an unprecedented newly developed system, or a variation of an existing system, or possibly a logical vertical combination of two or more existing systems to build higher.

With regard to the auxiliary damping system, the primary direction of its evolution has been toward the enhanced performance of motion control. In

addition to this trend, future damping devices will be used not only for dissipating energy but also for generating energy-harnessing building motions. Considering the increased interest in sustainable architecture that includes energy-efficient design, it is expected that the research on this design direction will become very important in both academia and practice.
Another prospected direction, especially with regard to the design of mass-type damping devices, is developing space-saving strategies through the system integration between the damper mass and other existing building systems. For the best performance, mass type dampers are installed close to the top of the building, occupying, in a sense, the most valuable near-top building space. By system integration, this space can be saved for other functions. Damping systems are traditionally treated by designers as an expensive supplemental item added to a building to reduce motions for occupant comfort. For more tall buildings changing the city's skylines, this notion should be changed. Rather than considering it as an afterthought, if necessary, damping systems should be thought of as a basic ingredient of structural design of tall buildings and implemented in innovative ways in which they occupy little space and are more effective.
Finally, it is expected that architects and engineers will be exploring the aesthetic potentials not only of the primary structural systems but also of the auxiliary damping systems.

CHAPTER 2.4; RELEVANT BUILDING CODE & BYE-LAWS

1.ENTRANCE WIDTH & HEIGHT CLEARANCE

Section: -As per section 4.6 (c) of part C & 7.4.1(d) of part IV of N.B.C.

Every High-rise building should have at least 2 means of access, one remote to the other, of minimum width 4.5m with height clearance of 5m. This minimum width is essential to facilitate free movement of fire units.

2. SETBACK OR OPEN SPACES

Section: As per table 2 of section
8.2.3.1 of part III of N.B.C.

Sufficient open space (setbacks) around residential buildings, as indicated alongside, is essential to facilitate free movement & operation of fire Service vehicles.

Section: As per section 4.6 (b) of appendix B of part III of N.B.C.
If the setback area/open spaces are more than 12 meters, the provision of car parking. Can be done in the setback or open spaces at the periphery of the courtyard leaving the 6-meter motor able road.

3. CAR PARKING

Section: As per section B/8 of appendix ‘B’ of pert III of N.B.C.

Car parking shall have to be done at the basement with provision for minimum 2 ramps one remote to other.

4. STAIRCASE

Section: As per section 12.18 of part III, 8.5.1 (Table 24), 8.6.2.8.9.8.10.8.13, 9.3.5(a), 10.4.1, 11.3.2 of part IV & Appendix D1.3, D1.4 of part of N.B.C.

a) Every high-rise building has minimum 2 number of Staircases.
b) Width of staircases varies from 1m-2m.
c) For residential building width of staircases should be 1 meter.
d) Out of 2 staircases, 1 can be used as a fire escape staircase.

e) Width of fire escape should be minimum 0.75 meter.
f) Number of staircases shall be given as per the travel distances
g) Staircase shall not be extended to basement to prevent smoke, heat & gases. From the basement smoke, heat 7 gases can be travel to upper floors.
h) Access to the basement from the ground should be through a separate staircase, which is not connected to main staircase (i.e. it should be remote to each other.)
i) Staircase shall be of enclosed type to prevent entry of smoke & fire to the staircase & vice versa.
j) Spiral staircase shall be provided up to 9-meter height.
k) External staircase normally shall not be allowed.

5.LIFTS

Section: As per section 18 of part III & 6.18 & appendix A.15 of part IV of N.B.C.

a) Minimum 1 lift capable of carrying minimum 8 persons weighing 545 kg shall be provided for every high-rise building.
b) Landing doors of lifts shall open to ventilated lobby & shall have a fire resistance of 1 hour.
c) 1 lift shall be designed as a "fire lift"
d) "Fireman Switch" shall be provided for each lift.
e) Lifts shall not be used as means of evacuation.
f) Collapsible gates shall not be provided for the lift.
g) if more than 1 lifts are installed the partition wall should be of minimum 2 hours fire resistance.

6. THE REFUGE AREA

Section: As per section 8.12.3 on part IV of NBC, the refuge area shall be provided on the periphery of the floor & open to air at least on one side protected with suitable railing.

a) For floors above 24m & up to 39m one refuge area on the floor immediately above 24m.
b) For floors above 39m one refuge area on the floor immediately above 39m & so on after 15m refuge area shall be provided.

7. SERVICE DUCTS

As per appendix D1.9 part IV of N.B.C.

All the services ducts, if provided, should have to be enclosed by walls of at least 2-hour fire resistance & should have to be sealed at every alternate floor with non-combustible materials having at least 2-hour fire resistance. The sealing at floor level is to prevent travel of smoke & fire to the upper floors through the ducts.

8. BUILT IN FIRE FIGHTING SYSTEM

Wet riser cum down comer system

Wet riser: It is a vertical pipeline (dia. Depends on the floor area of the building) connected to a bottom tank (underground water tank).
Down comer: It is a vertical pipeline (dia. depends on the floor area of the building) connected to an overhead tank.
Dry riser: It is a vertical pipe which is always kept dry to avoid the freezing of water.
Hydrant: It is a horizontal pipe line with outlet of 63mm. dia connected to underground water tank.

- Wet riser cum down comer or only down comer system shall be provided for residential building.
- For commercial building only wet-riser system shall be provided.
- For hotels wet-riser cum down comer both the systems shall be provided.
- Diameter of riser will be 150mm for all the buildings.
- For each 1000m^2 floor area or its part one riser shall be provided.
- At every landing twin outlet each of 63mm dia. Shall be provided (one should be connected to hose reel & another should be to hose & branch).
- Length of hose should be shall that it should reach at the last point of floor area.
- Minimum two courtyard hydrants shall be provided (courtyard hydrant will be an extension to riser).
- Hose reel hose of 12mm dia. Shall be provided from landing valve to wet-riser at each floor.
- A separate fire service inlet shall be provided at the ground floor.
- Location of wet-riser shall be preferable as near to staircase.

9.FIRE ALARM SYSTEM

1) Manually operated electrical fire alarm system.
(M.O.E.F.A.)
2) Automatic Fire Alarm System (A.F.A.)

- Depending on the occupancy, M.O.E.F.A. system or automatic operated system shall be provided in the building.
- Every building more than 15m in height shall provide both i.e. M.O.E.F.A. & A.F.A.
- One has to manually operate the glass in M.O.E.F.A.S.
- M.O.E.F.A.S. requires a special person or separate person to operate.

10. FIRE DETECTION SYSTEM

Section: As per section 7.9 of part IV of NBC (8 of Appendix A).

- Different types of detectors area provide as per the risk involved in the area.
- Zones are made as per the risk or as per the floor.
- 2 Way communication system to be provided which will help to conduct from ground floor to specific floor or vice-versa.
- Mike on every floor has to be provided.
- On mike instructions can be given as per situation.
- Manual call Points, automatic detector & public address system shall be interlinked.
- Detectors shall be installed as per IS 2189/1988.

11. SPRINKLER SYSTEM

Section: As per section 7.10.7 of part IV of N.B.C.

- Sprinkler system is a must for basement parking & other risk areas where large quantities of combustible materials are stored.
- Each sprinkler should cover 6.96m2 area.
- Normally a separate sprinkler should be provided for a separate car.
- Sprinklers may connect to main water tank & pump, but capacity of the tank & pump shall be increased in that proportionate.
- The capacity of water tank shall be calculated on the basis of sprinklers.

12. WATER TANK

1. Under Ground Water Storage Tank
2. Terrace Level Tank
3. Mid-level storage tanks

- Underground water storage tank varies from 50,000 liters to 250,000 liters. Depending on the type & occupancy of the buildings.
- The capacity of terrace level water storage tank varies from 10,000 liters to 20,000 liters depending on the type & occupancy of the building.

Above mentioned water tank capacity is for 1 riser. If the number of risers will be more than 1, than quantity of water shall be increased in that proportionate. In addition to this if automatic sprinkler, drenchers area provided for special risk then this will be additional quantity of water.

13. ALTERNATE POWER SUPPLY

As per appendix D-1.5 of part IV of N.B.C. a stand by generator should be installed to supply power for staircase lighting, corridor lighting, fire pump, pressurization fan & blowers, in the event of disconnection of failure of main supply.

14. PORTABLE FIRE EXTINGUISHERS

Section: As per section 7.10.4 part IV of N.B.C.

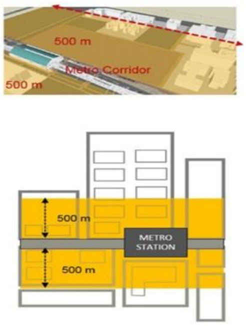
- First aid firefighting appliances shall be provided & installed in accordance with latest IS 2190.

15. Provision of helipad

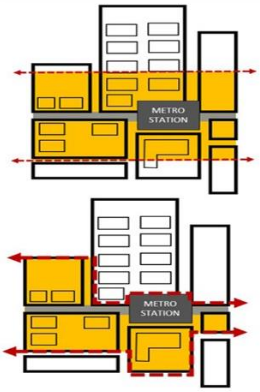
Section: As per D 10(Appendix D) of part IV of N.B.C.

For High rise Buildings above 60m in height provision for a Helipad should be made.

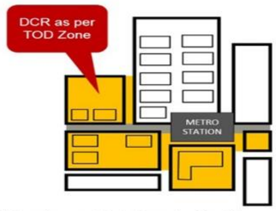
T.O.D. NORMS



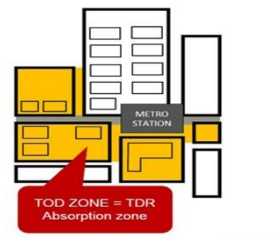
i) About 500 m. wide belt on both sides of centre line of the existing and planned/ approved MRTS Corridors is designated as Influence Zone which has been identified in the respective Zonal Development Plans, along with stations, except for the exclusions mentioned in para (vi) below. The same will be updated by DDA from time to time.



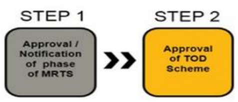
ii) Entire approved plan of a TOD integrated scheme will be included in the zone if more that 50% of the plan area falls inside the influence zone. The TOD integrated scheme to be submitted by DE will be of the area under his ownership/ entitlement and not of the adjoining area.



iii) Development Controls applicable will be as permissible under TOD Zone specified in Delhi Master Plan 2034.



iv) This TOD zone may be also used as TDR absorption zone and the TDR regulations for the same will be prepared by DDA.

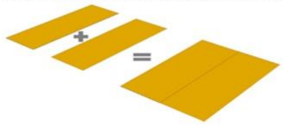


v) The approval of schemes will be granted after the approval / notification of the respective phase of MRTS

vi) Higher FAR and height can be availed through the preparation and approval of comprehensive TOD integrated scheme. Wherever height is restricted by any regulatory authorities like AAI, NMA; in order to enable the DE to utilize the permissible FAR, a relaxation in ground coverage and setbacks, without compromising the green public open space viz 20%, in such TOD integrated scheme shall be allowed subject to the clearance from Fire department as per Delhi Fire Services Act.

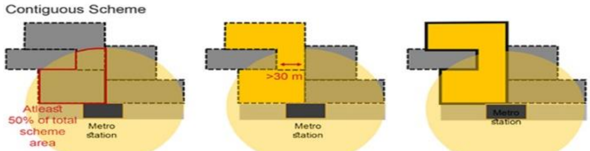
2 - AMALGAMATION

Amalgamation and reconstitution of the plots for planning purpose will be permitted in all redevelopment schemes, including TOD. In order to participate in TOD, individual/ group of owners may need to partner with other adjoining land owners/ property owners to form a Developer Entity (DE), and prepare a single contiguous scheme of minimum 1 Ha.

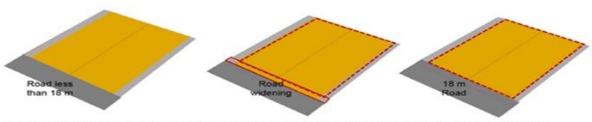


Local body will simultaneously modify the layout plan.

Contiguous Scheme



"Contiguous scheme" means any TOD scheme which may comprise of two or more parcels of land touching along any side with a minimum overlap of 30 metres (100 ft.), to allow for continuity in circulation networks, green spaces, etc. subject to at least 50% of total scheme area, comprising of two or more parcels, falling within the influence zone as defined above.



In case of TOD schemes falling on Road RoW less than 18m, the local body shall consider the approval of the scheme if the DE/ group of DE's surrender the land for road widening with contiguous connectivity, such that road widening can take place from junction to junction at the same time. The widened RoW must meet the nearest existing Road RoW of 18 m width or above. In such cases, DE will have to surrender the land to the road owning agency after the approval of TOD integrated scheme and before the submission of building plans for sanction.

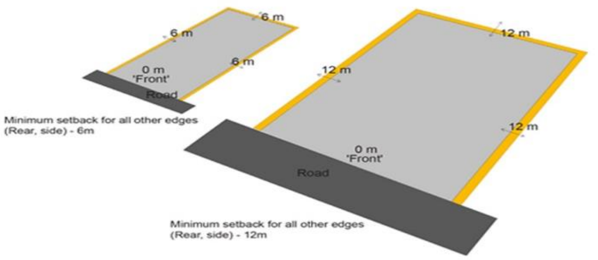
3 - EDGES

The urban edge can be defined in terms of the visual boundary of a space. It is essentially a transition zone that facilitates exchange of information between territories. Within the TOD policy, the idea is to have permeable edges, thereby reducing the emphasis on the concept of setbacks.

Minimum Setbacks for integrated TOD schemes

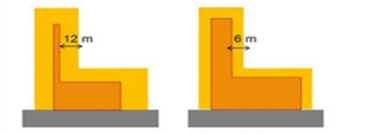
Setback to be handed back to local body as public roads- at least 20% of plot/ scheme area

Plot size >3,000 up to 10,000 sq m — Plot size >10,000 sq m



Minimum setback for all other edges (Rear, side) - 6m

Minimum setback for all other edges (Rear, side) - 12m

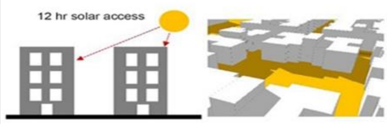


Setback – 12 m But Ground coverage less than 40% !!!

Reduce Setback to accommodate Ground coverage to 40%

i) In case the permissible coverage is not achieved with the above given setbacks, the setbacks of the preceding category may be allowed.

ii) TOD schemes shall be located on existing roads having a minimum width of 18m RoW. In TOD schemes, any edge of plot facing an existing public ROW >18 m shall be considered as "front".



iii) The setbacks are subject to requirements of height and ventilation as per building byelaws. TOD schemes shall be planned as per above setback norms, while endeavouring to ensure that all dwelling units get a minimum 2-hour solar access in at least one habitable room on the shortest winter day, and have the option for natural ventilation.

" SETBACK RELAXATION NOT ALLOWED IN TOD ZONE "

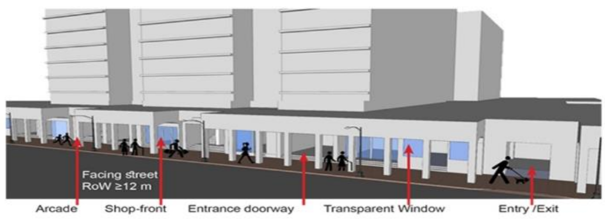
iv) The Technical Committee of DDA will not relax setbacks, ground coverage and height in special circumstances except in TOD integrated schemes.

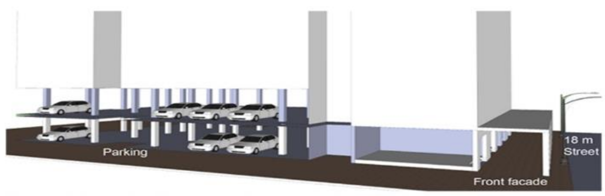
v) ESS wherever required to be provided within the plot setbacks.

[ESS:Electric Substation]

Active Frontage

For TOD integrated schemes, the main building facade(s) shall face the public street(s) without setback and have an active frontage to facilitate visual surveillance of streets. ≥ 50% building frontage at built-to RoW line to have active frontage. There is no minimum active frontage requirement when RoW is ≤12 m.Active frontages include arcades, shop-fronts, entrance doorways, access points, entry / exits and transparent windows of active areas facing the main street. Commercial frontages shall have minimum 50% transparency (untinted) at ground floor level.

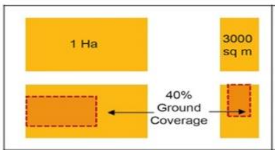




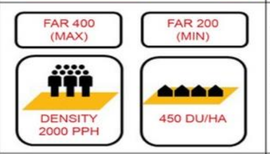
The ground floor of all parking structures / podiums or stilts must be lined with active frontage facing the main streets.

4 – FAR AND DENSITY

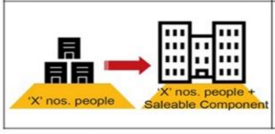
The floor area ratio (FAR) is representative of the total floor area of the building as a fraction of the total area of the plot the building is located on. It is used by government bodies in zoning regulations as an instrument to control the density of a place by imposing permissible FAR norms.



a. TOD norms of FAR and density may be availed through the preparation and approval of comprehensive integrated scheme of minimum size 1 Ha, with maximum ground coverage of 40%. In case of MRTS/ Government Agencies, the minimum plot size for development shall be 3000 sq.m., but all other development norms apply as per this Chapter.



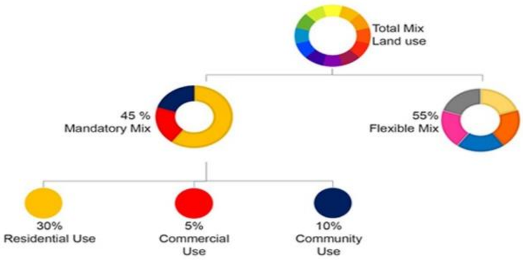
b. For any integrated scheme, a max. FAR of 400 and a maximum density of 2000 persons per hectare (PPH) i.e. approx. 450 du/ha is permissible. The entire amalgamated plot will be considered for calculating the FAR and density. FAR utilization shall not be less than 200. Mandatory EWS FAR of 15% over and above the maximum permissible FAR shall be applicable.



c. All residents residing in that scheme area shall have to be accommodated within the same scheme only, with no induced displacement of existing residential population.

5- LANDUSE MIX

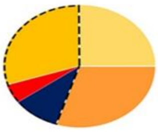
In all integrated schemes, a minimum of 30% of overall FAR shall be mandatory for Residential use, a minimum 5% of FAR for commercial use and minimum 10% of FAR for community facilities. At least 50% of the total FAR shall be as per ZDP use.



Indicative mix of uses within TOD Zone

i. Residential land use

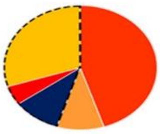
45 % Mandatory Mix	
Residential Use	30%
Commercial Use	5%
Community Use	10%



55 % Flexible Mix	
Residential Use	25%
Others	30%

ii. Commercial land use

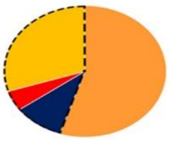
45 % Mandatory Mix	
Residential Use	30%
Commercial Use	5%
Community Use	10%



55 % Flexible Mix	
Commercial Use	45%
Others	10%

iii. Mixed Use land use

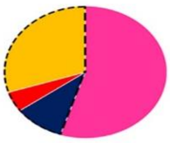
45 % Mandatory Mix	
Residential Use	30%
Commercial Use	5%
Community Use	10%



55 % Flexible Mix	
Others	55%

iv. Industrial land use

45 % Mandatory Mix	
Residential Use	30%
Commercial Use	5%
Community Use	10%



55 % Flexible Mix	
Industrial Use	55%

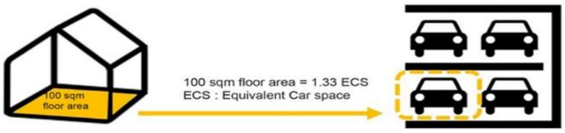
NOTES

a) The minimum component of 30% residential shall comprise of units not more than 93 sq.m. (1000 sq.ft.).

Unit Size ≤ 93 sq. m (1000 sq.ft.)

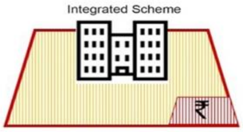
6 - PARKING STANDARDS

In TOD zones, the permissible ECS (Permissible Equivalent Car Spaces) per 100 sqm. of floor area is 1.33.



Equivalent Car Space (ECS) is the land required to park a car including the space occupied by the vehicle as well as the minimum space needed to move it into and out of the space.

Integrated Scheme

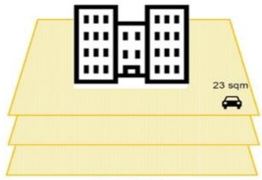


Area ≤ 2000 sq. m

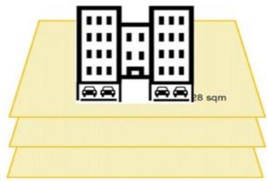
Additional parking may be created within integrated schemes only as paid, shared parking facilities accessible to general public at all times.

Planned commercial centres may be developed/ redeveloped as per integrated schemes, in which mixed use component may be introduced along with comprehensive Parking Management Districts (PMD) plans, feeder systems, public spaces, etc.

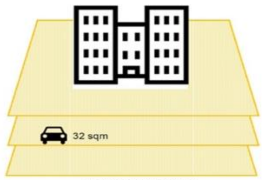
Space Standards for Parking



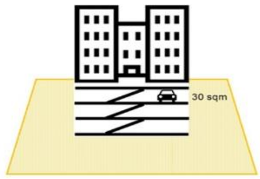
Open Parking



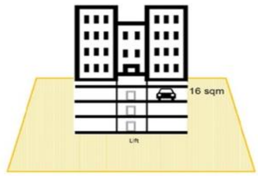
Ground floor covered parking



Basement Parking



Multi-level with ramps



Automated multi-level with lifts

Parking space for different modes of travel in relation to ECS

Distribution by mode per 1 ECS / 100 sq. m of built up area within TOD Zone

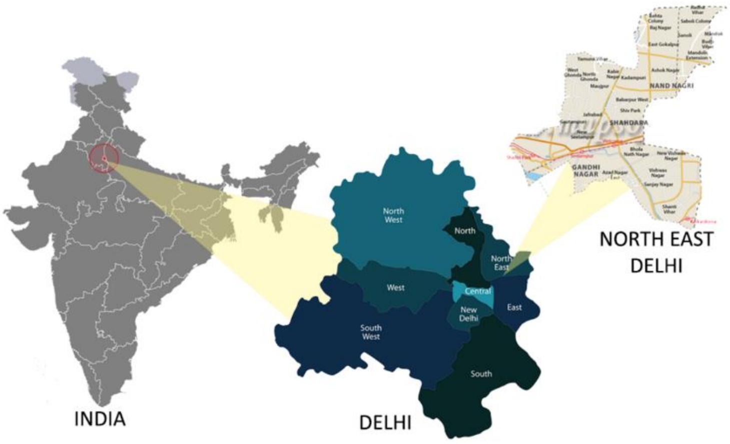
CHAPTER 3.0 SITE ANALYSIS

ABOUT THE CITY

Delhi, city and national capital territory, north-central India. The city of Delhi actually consists of two components: Old Delhi, in the north, the historic city; and New Delhi, in the south, since 1947 the capital of India, built in the first part of the 20th century as the capital of British India.

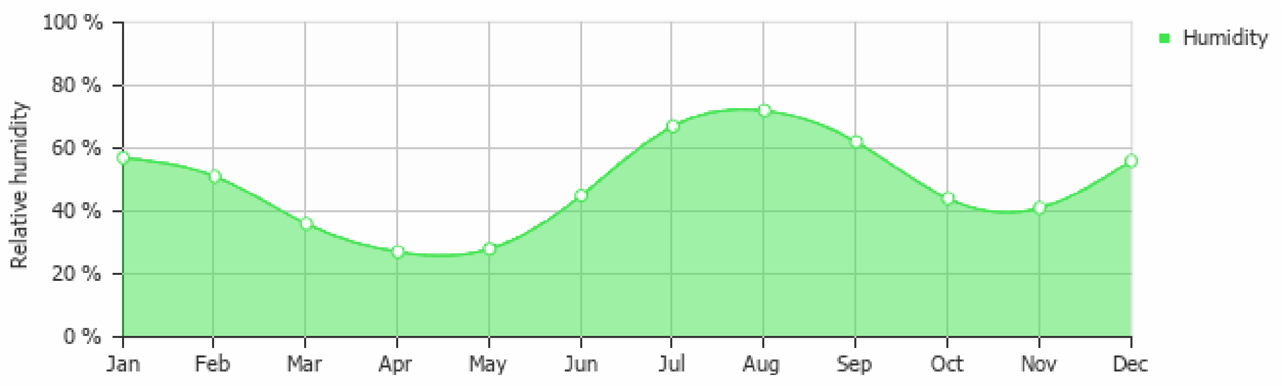
PHYSIOGRAPHY

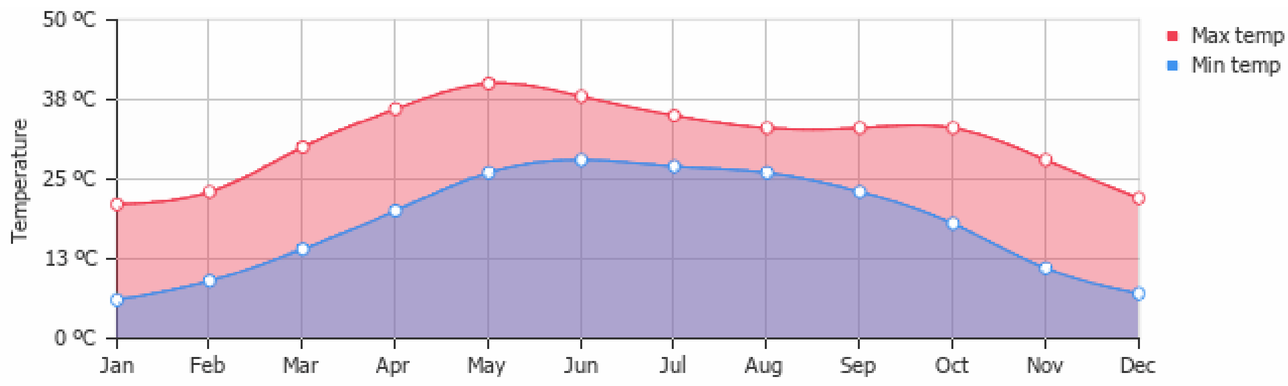
One of the country’s largest urban agglomerations, Delhi sits astride (but primarily on the west bank of) the Yamuna River, a tributary of the Ganges (Ganga) River, about 100 miles (160 km) south of the Himalayas. The national capital territory embraces Old and New Delhi and the surrounding metropolitan region, as well as adjacent rural areas.

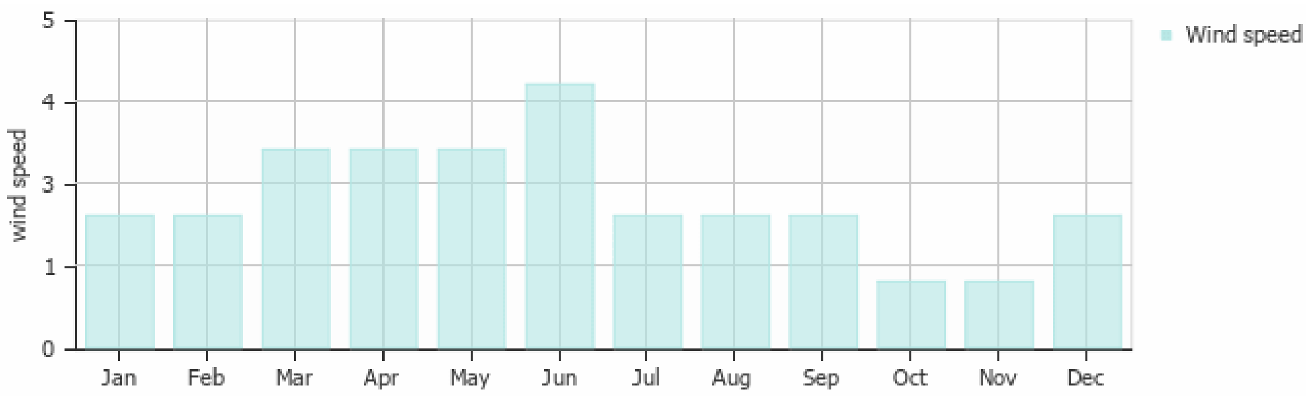


CLIMATE

The summer season lasts from mid-March to the end of June, with max. temp. Typically reaching about 100 °F (about 37 °C) & min. temp. falling into the high 70s F (about 25 °C); it is characterized by frequent thunderstorms & squalls, especially in April & May. The monsoon season normally begins in July & continues until the end of September. It is during these months that Delhi receives the bulk of its rainfall—roughly 23 inches (600 mm), or nearly three-fourths of the annual average. October & November constitute a transition period from monsoon to winter conditions. The dry winter season extends from late November to mid-March. The coldest month is January, with high temperatures in the low 70s F (about 21 °C) and low temperatures in the mid-40s F (about 7 °C).







AVERAGE TEMPERATURE: 12°-32°C
AVERAGE MAX. TEMPERATURE: 20°-39°C
AVERAGE MIN. TEMPERATURE: 7°-27°C
AVERAGE RAIN DAYS: 0-8cm

LINKAGE
Delhi has significant reliance on its transport infrastructure. The city seeks to develop a highly efficient public transport system with the introduction of the Delhi Metro, which is undergoing a rapid modernization & expansion as of 2006. There are 16.6 million registered vehicles in the city as of 30 June 2014, which is the highest in the world among all cities.

RAIL: Connected to INDIAN RAILWAYS
Nearest RAILWAY STATION is ANAND VIHAR TERMINAL 4.8KM
Other station to reach Delhi are:
1.New Delhi Railway Station,
2.Old Delhi Railway Station,
3.Hazrat Nizamuddin Railway Station,
4.Sarai Rohilla

BUS: Nearest BUS STATION is
ISBT Anand Vihar in Trans-Yamuna area 4.7KM
Highways: NH 1, NH 2, NH 8, NH 10 and NH 24
Bus services: The other 2 inter-state terminals in city are:
ISBT Kashmere Gate in Northern Delhi
ISBT Sarai Kale Khan in South Delhi

Airports: Indira Gandhi International Airport (IGI); both domestic and international connections 30KM

METRO: At KARKARDHOOMA METRO STATION

ABOUT THE LOCATION

East Delhi (a.k.a. Trans Yamuna) is an administrative district of the National Capital Territory of Delhi in India. It is bounded by the Yamuna River on the west, North East Delhi to the north, Ghaziabad District of Uttar Pradesh state to the east, and Gautam Buddha Nagar District of Uttar Pradesh to the south.

CO-ORDINATES OF SITE: 28°38’58”N 77°18’19”E

DEMOGRAPHICS		
DESCRIPTION	2011	2001
POPULATION	17.09LAKHS	14.64LAKHS
ACTUAL POPULATION	1,709,346	1,463,583
MALE	907,500	794,074
POPULATION GROWTH	16.79%	43.06%
AREA SQ.KM.	63	63
DENSITY/SQ.KM.	27132	29869
PROPORTION TO DELHI POPU.	10.18%	10.19%
SEX RATIO(PER 1000)	884	843
CHILD SEX RATION(0-6 AGE)	871	865
AVERAGE LITERACY	89.31	84.91

ON-SITE CONSIDERATION:

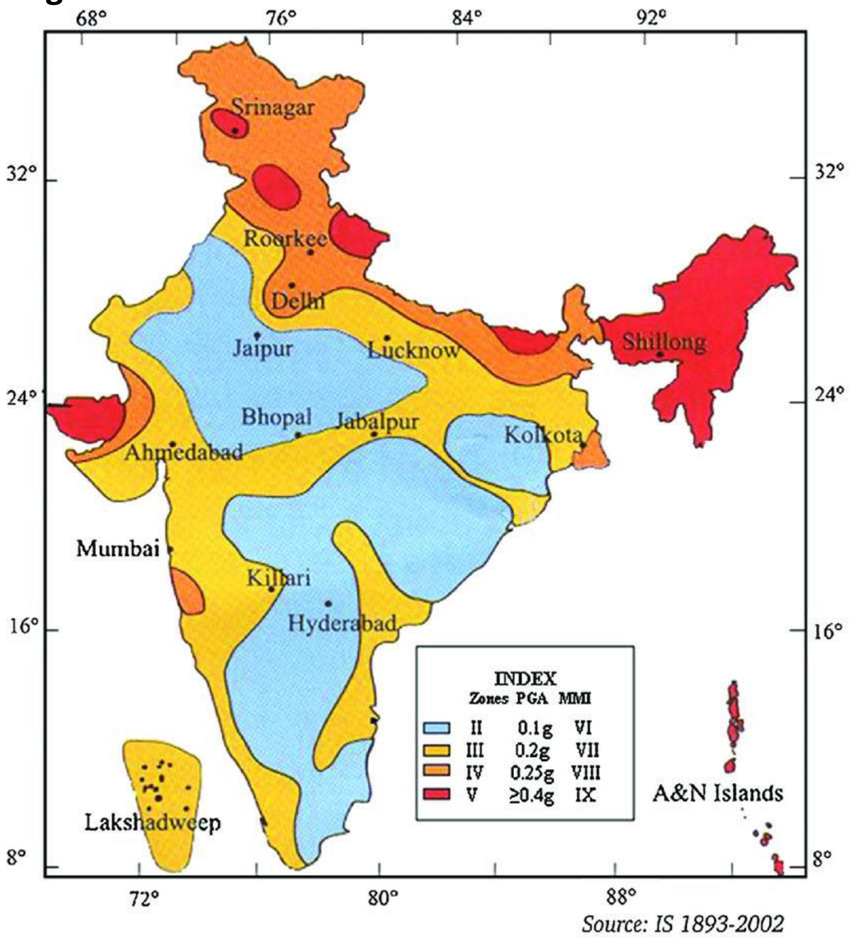
The site for the Iconic tower

INTRODUCTION

Project is proposed by the Delhi Development Authority as a part of Transit Oriented Development (T.O.D.) scheme around the karkarduma metro station. It focuses on creating an environment that focuses on social integration, communication and diversification.

The site for the Iconic tower

SEISMIC CONSIDERATION
Delhi sits on top of three active seismic fault lines: Sohna fault line, Mathura fault line and Delhi-Moradabad fault line. The site lies in zone-4. The site falls under seismic zone IV
On Modified Mercalli scale: 8 & above
On Richter magnitude scale: 6 & above



ORIENTATION
The side of site facing the road is WEST. The Pink line metro is on north & blue line metro is on SOUTH. The Proposed site for T.O.D. is towards EAST. The iconic tower is placed near to the 30m wd vikas marg road. The major wind coming to the tower is from the north-west & west direction.

WIND STUDY
It is so far the most important factor for any high-rise building's construction, design, or habitability. the maximum wind velocity at our site through over the year is 12.6 kmph in the month of May, studied at an height of 10 metres from the ground level, while the calmest experienced velocity went down to around

5.6 kmph in the month of November, with North-West & West as the direction of prevailing winds.

The Study of The Velocity of Wind becomes a major factor while designing the skyscrapers. The speed of wind at the site ranges from 5.6km/h in the month of November to 12.6 km/h in the month of May.
While this speed stated is at a height of 10m from the ground. To calculate the speed at any height we use the formula:

$$V_z = Vbk1k2k3$$

where, V_z-Design wind speed at any ht. z in m/s
k_1-Probability factor (risk coefficient)
k_2- Terrain, ht. & structure size factor
k_3- Topography factor

Wind Loads
Design Wind Pressure is given by the formula,

$$Pd=0.6\ Vz2$$

Where, Pd -Design wind pressure in N/m2 at height d. Vz -Wind velocity at height z mt
While the wind load on individual members is given by:

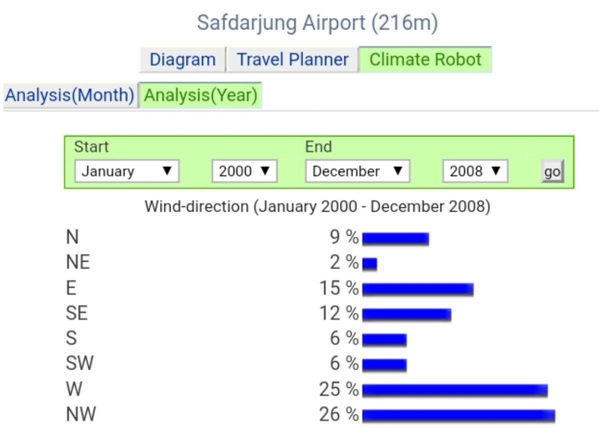
$$F=(Cpe-Cpi).A.pd$$

Where, C_{pe}= external pressure coefficient,
C_{pi}= internal pressure coefficient,
A=surface area of structural element or cladding unit,
p_d=design wind pressure


Safdarjung Airport (216m)
Diagram | Travel Planner | Climate Robot
Analysis(Month) | Analysis(Year)
Start: January 2000 — End: December 2008 — go
Wind-force per Day (January 2000 - December 2008)

Jan	Feb	Mar	Apr	May	Jun	
8.0	**9.1**	**10.0**	**10.5**	**12.6**	**11.0**	[km/h]
88	88	88	88	88	88	Data availability[%]
Jul	Aug	Sep	Oct	Nov	Dec	
10.7	**9.9**	**8.6**	**6.4**	**5.6**	**6.1**	[km/h]
88	88	82	75	77	77	Data availability[%]

Averaged Value (January 2000 - December 2008) : **9.0 km/h**



SOIL PROFILE
Soils of the region are of mixed type & there is no distinct boundary between any two types of soil. Tonal variation in the satellite data indicates the difference in soil texture, intensity of weathering & mineral composition of soil. Soil on site-alluvium soil consisting of fine sand, silt clay with kankar. The soil on site is Silty-clay to clayey silt along with sandy loam. The soil bearing capacity of the site's soil is 95.69kN/M2

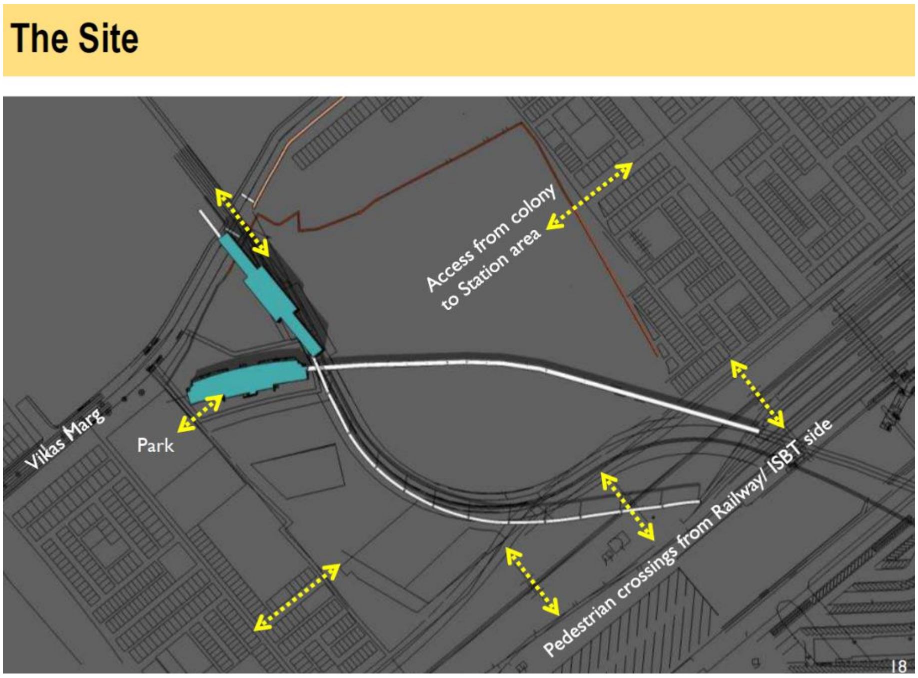
TOPOGRAPHY
Mostly flat surface with gentle slope towards east & north.
Water flow in east direction.
Highest Elevation: 209M
Lowest Elevation: 207M

HYDROLOGY
Ground water at approx. 5-10m below the ground level, depending upon the different seasons. Thus, basement construction is easy & desirable. Rain water harvesting is to be essential incorporated in design.

VEGETATION
Babul, Wild grass & shrubs
The site is sparsely vegetated thus it become essential to plan a well-designed landscape scheme to reduce the energy consumption of the building & make the environment more habitable.

ELECTRICITY
A Transformer is located on the edges of site boundary of electric supply 11KVA which is stepdown to220V on site.
Electric pole & Street Light also there on the edges of site.

WATER
Overhead tank is situated near the site(485M)



S.W.O.T. ANALYSIS:

STRENGTH

1. LOCATION OF SITE: THE SITE IS SITUATED IN THE PREMISES OF THE MAJOR TRANSIT STATION.
2. PROMOTE PEDESTRIAN AND WALKABLE DESIGN.
3. ALL MAJOR SERVICES ARE AVAILABLE NEAR BY.

WEAKNESS

1. SITE SURROUNDING IS STILL NOT DEVELOPED FOR SUCH KIND OF PROJECT.
2. NO INTERESTING VIEW SIDE.

OPPORTUNITIES

1. TO RETAIN THE TEMPLE STRUCTURE.
2. TO CREATE AN ICONIC LANDMARK.

THREAT

1. DENSITY WILL BE HIGHER AS IT IS.
2. THE CONSTRUCTION WILL BE A CAUSE OF POLLUTION WHICH IS A MAJOR ISSUE IN DELHI.

CHAPTER 4.0 CASE STUDY: INFOSYS, HYDERABAD

INTRODUCTION

Architects - Sundaram Architects Pvt. Ltd.

Location - Pocharam, Hyderabad, India

Project Year - Completed in September, 2010

Green consultant - EDS
The building houses 2600 employees and has been planned on 460 acres of land. Due to its highly acclaimed green building achievements, the building has been ac-knowledged by
researchers in Germany and the Lawrence Berkeley National Lab as one of the 'Best Practices Guide for High Performance Indian Office Buildings'.

HIGHLIGHTS OF THE PROJECT

LEED NC- Platinum
Glass used-
Vision Panel: SKN 444 (Futura) in (6mm - 16mm argon gap - 6mm) combination.
Daylight Panel: PLT T (Pristine White) in (6mm - 12mm - 6mm)
Energy Efficiency- 56% savings from the base ca: was achieved.
Daylighting -
70% of the overall floor plate was daylight with daylight panel.
100% of the work area is perfectly daylighted.
Additional points achieved through glass - Re-gional material: Glass manufactured in sriperumbudur plant and processed near by the project site.

ANALYSIS
1.Building: Software Development Block (SDB)-1, Hyderabad
2.Total area:240,000sqft (excluding central wing, which is not occupied)
-Conventional side:120,000sqft
-Radiant side:120,000sqft
-Total occupancy:2600
-Conventional side:1340
-Radiant side:1260

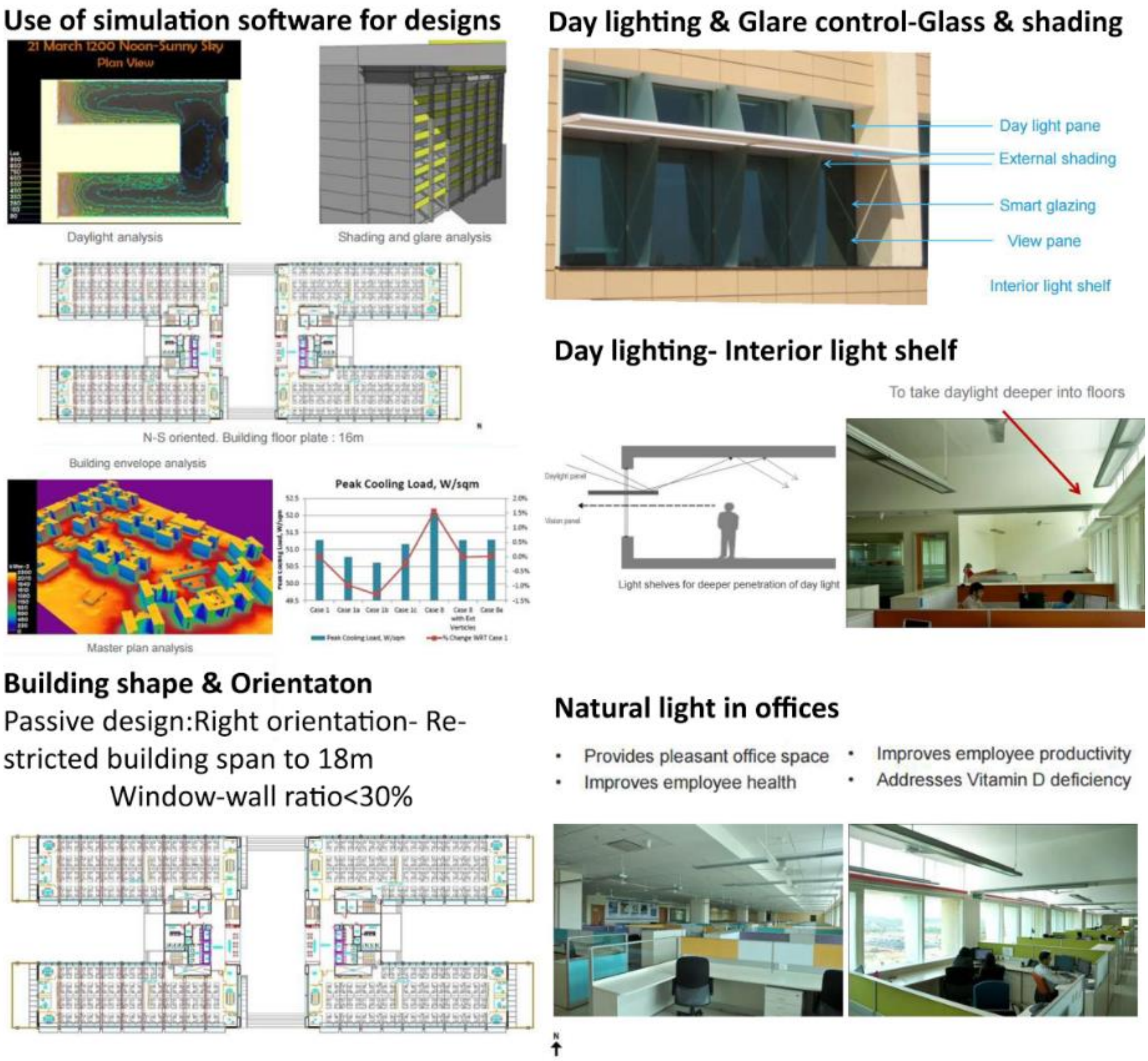
ROLE OF GLASS
- The combined use of PLT TG and SKN 444 II - high-performance double-glazed Saint-Gobain Glass has been coupled up with the ideal orientation of the building, limiting the facades opening to the East and West (where the direct morning and evening sun strike).
- The long faces of the building have been oriented towards north and south with shading devices provided adeptly, especially towards the south.
- The narrow floor plate of 16m made it possible for 84% of the regularly occupied spaces to have adequate day-light.

ENERGY CONSUMPTION

- The building is 40% more efficient than the globally accepted ASHRAE standard. While the ASHRAE standards for heat gain is 0.9W/sqft, SDB1 managed a .4W/sqft.
- The building has an efficient envelope - with a double walled insulation and an insulated roof with reflective tiles. The heat gain of the envelope has been calculated to a 1W/sqft.

EFFICIENT SYSTEM- RADIANT COOLING

1.Requires 75% less air compared to conventional systems
2.30% more efficient than conventional HVAC systems
3.Higher thermal comfort on account of better mean radiant temperature
4.Highest indoor air quality
5.Radient system equipment requires lesser space



CASE STUDY: SUPERNOVA SPIRA

ARCHITECT:BENOY, LONDON
PROJECT:KNIGHT FRANK,
ADVISORS:LONDON
CONTRACTORS:SUPERTECH

INTRODUCTION

The Supernova Spira will be the tallest building in the National Capital Region of Delhi expanding to a height of 300 metres, a total floor count of 80 floors featuring a helipad on its tp along with an observatory.
The construction of the building started in 2012.
It will be completed by the end of the year 2020.

TYPOLOGY

The whole project named Supernova by Supertech Limited is a mixed use development with fully dedicated commercial (Attrillis) and residential towers and a mixed use tower (Spira). it also comprises of a mall in the campus itself.

APPROACH TO THE SITE:

LOCATION: Plot 3, Sector 94, Noida 201301,Uttar Pradesh, INDIA

SITE AREA-17.3 Acre (approx)
TOTAL BUILTUP-6,97,026 SQ. M
LANDSCAPING AND GREEN AREA- 67%
PEAK HEIGHT-300M
TOTAL BUILDINGS-7
BUILDING NAMES-
SPIRA
(300M HT.)
ASTRALIS
(OFFICE)
NOVA EAST
(RESIDENTIAL)
NOVA WEST
(RESIDENTIAL)
AURORA
(EXCLUSIVE RETAIL)
QUEEN TOWER
(RESIDENTIAL FOR B'WOOD A-LISTERS)
RADIANCE PLACE
(SHOPPING AND RESTAURANTS)

AREAS & PARKING

1. The area of 6,97,026 sq. m excludes the three-level basement parking facility.
2. The campus is lush with services with total 70 passenger and service elevators and 100% power backup.
3. Building is planned to segregate vehicular and pedestrian traffic, as well as business and casual traffic through landscaping and planning.
4. There are a total of 8 ramps in number 4 for entry and 4 exits.
5. They have a separate parking for disabled and VIP parking on the ground level.
6. Double level parking with 1500 capacity on each floor distributed over 2 basements.

DESIGN FEATURES

1. The basement is spread through over the site to provide spaces for the parking and services.
2. Around 67% of the total site area is dedicated to greenery and landscaping. The services have been spread in the basement at locations but are shared commonly by 2-3 buildings, spira has separate services due to the scale of services req.
3. The ramps are provided are on the outer periphery of the buildings towards the site boundary to prevent any vehicular movement in the mid area and facilitate free pedestrian movement.

SERVICES

THE BASEMENT WORKS AS THE HUB OF SERVICES FOR THE PROJECT APART FROM IT ARE SERVICE FLOORS IN EACH OF THE ALREADY BUILT BUILDINGS.

Chiller Plant

16 water tanks(1,20,000-L each)
(Flushing, Fresh, Domestic, Fire)

PUMP ROOM CONSISTS OF THE PUMP FOR WATER SUPPLIES, AND FOR HYDRANT AND SPRINKLERS.

THE STP IS AT B3 LEVEL AND RECIEVES WASTE WATER FROM THE WASTE WATER TANK AND TREATS IT AND SUPPLIES WATER INTO THE FLUSH WATER TANK, THUS REUSING IT.

Pump Room
(With Jockey Pump, Main Pump, DG etc.)

Water Treatment Plant

Hydrant Line
(for various Floors with PRVs)
(Pressure- 3-4 kg)

Primary & Sec. Pumps, Lines
(P- Cool water(narrow); S- Return Water(broad))

THE SLAB IS A FLAT SLAB WITH DROP PANELS TO GET MORE CLEAR HEIGHT. THE THREE BASEMENTS EACH HAVE A HEIGHT OF ARUND 4.2M.
PARKING WILL BE MECHANICAL OF TWO LEVEL IN THE BASEMENT LEVEL 2 & 3.

THE CHILLER PLANT IS ON BASEMENT 3 AND FEATURES A DOUBLE HEIGHT SLAB, THE CHILLER ROOM HAS PRIMARY AND SECONDARY PUMPS AND A SEPERATE DG. IT HAS A DEDICATED FIRE LINE FOR IT.

LIFT PIT
Another feature as observed by me was the Lift Pits for all the elevators that ended at the ground floor or B1 level, usually the lift pits observed end at the lowest level and have the lift pit below the lowest floor's floor level. The lifts had their pits on the floor adjacently lower to them, and also have a storage space beneath it.

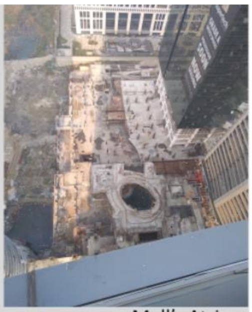
MACHINE ROOM
The pulling system for the liftss was observed at the 38th floor, which was a service floor. as the above floors were exclusive, they had seperate lifts, the machine rooms for which would be at the upper floors.

VRV Ducts & Sprinklers

AIR CONDITIONING DUCTS
The Buildings was cooled by chiller plant and HVAC, while few apartments were cooled by VRV units, the image to the left shows the ducts for VRV. adjoining it also is running the sprinkler system's pipe.

Water Tank (at service floor)

WATER TANK
The water tank for fresh water on the service floor, fresh water from the basement is dlivered to this tank and then the water is supplied to the lower floors.



Mall's Atrium (as from 40th floor)

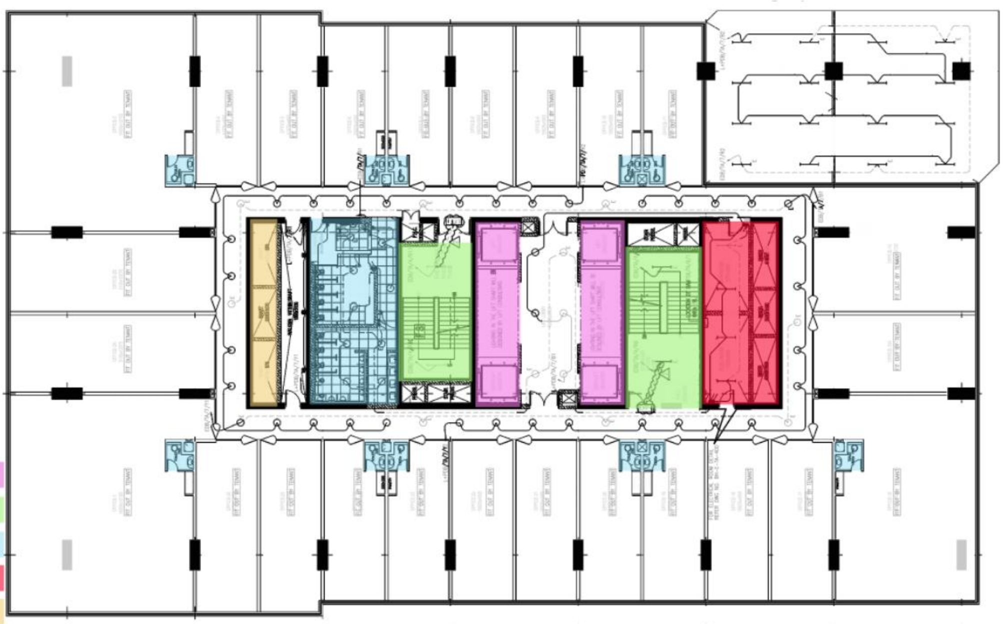
VIEWS FROM THE 40TH FLOORS
The picture above shows the mall's atrium the mall will be at the floors 1,2 & B1. it also shows the astrilis 1tower. on the picture at the bottom, we can see the service floors, covered by louvered M.S. Panels. in grey colour.

- Water Tanks are total 16 in number for purposes of flushing, fresh water supply, domestic use, and Fire.

- The WTP for treatment of water for domestic use in the building. Running Main is termed for the cable carrying the mains current from the L.T. panel room, it is connected with servo motors which help maintain the voltage losses.

- Cast Iron Pipes are used in 5 bottom floors for waste water & soil. CI Pipes are approximately 3 times costlier than the CPVC Pipes.

ENTRANCE OF MALL



LEGENDS

- LIFT
- STAIRCASE & LOBBY
- WASHROOMS
- ELECTRICAL ROOM
- SHAFT

CHAPTER 5.0 LITERATURE STUDY: KOHINOOR SQUARE, MUMBAI

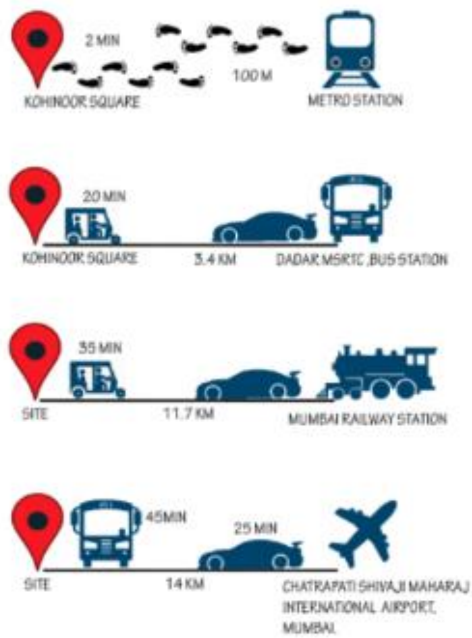
LOCATION: DADAR WEST MUMBAI, INDIA
ARCHITECT: SSA ARCHITECTS
TYPOLOGY: MIXED USE COMMERCIAL
SITE DETAIL:
SITE AREA= 4.6 ACRES
FAR= 3.75
BUILTUP AREA= 400136 M2
GROUND COVERAGE= 39332M2
PROGRAM: OFFICES, RESIDENTIAL, RETAIL, EXHIBITION HALL, MEDIA ROOM, AMPHITHEATURE, RESTAURANT

SITE CONDITION :
THE SITE IS STRATEGICALLY LOCATED ON THE JUNCTION OF L J ROAD AND GOKHALE ROAD AT THE CENTRE OF SHIVAJI PARK. THE SITE IS THUS SURROUNDED BY SHIVAJI PARK ON EAST SIDE, DG RUPARELL COLLEGE ON WEST SIDE AND SOUTH SIDE COVERING THE PATIL WAADI AREAS.

CLIMATE :
MUMBAI'S CLIMATE CAN BE BEST DESCRIBED AS MODERATELY HOT WITH HIGH LEVEL OF HUMIDITY. ITS COASTAL NATURE AND TROPICAL LOCATION ENSURES TEMPERATURES WON'T FLUCTUATE MUCH THROUGHOUT THE YEAR

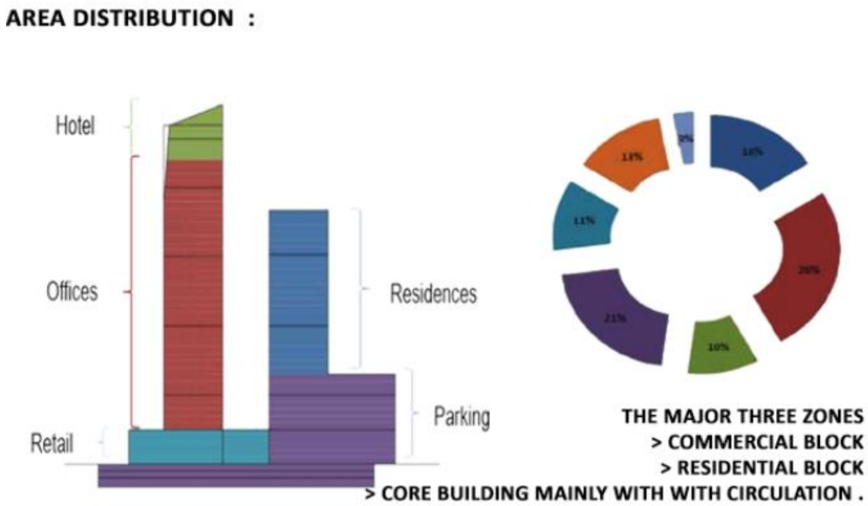
FIG : SATELITE IMAGE OF KOHINOOR SQUARE

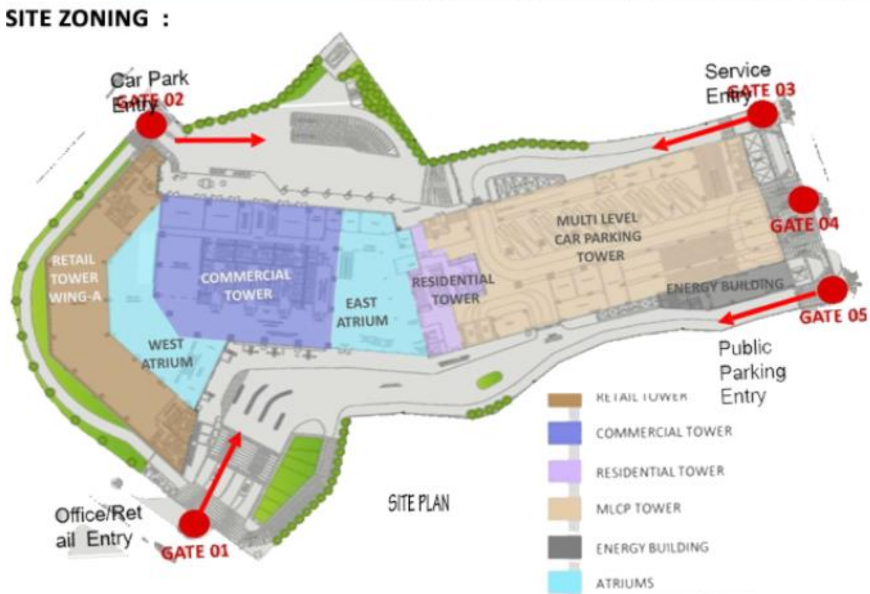
APPROACH :



PROJECT INTRODUCTION:

- It is a semi-twin Mixed-use skyscraper in Mumbai.
- The main skyscraper is about 52 floors 203 meters and the residential skyscraper is about 35 floors 142 meters.
- The first five floors of the main building are used for a high-end shopping mall and the remaining 47 floors of the main building is utilized for a commercial office and five-star hotel.
- The first 13 floors of the residential building are used as a parking garage for both the buildings and the remaining 19 floors is residences.





- 3 Lobbies of 6 Lifts serving levels 25th to 39th
- Spaces between the lifts are used as toilets with dust at either side: 2 lifts from this pack of 6 are assessable to lower floors as well
- 1 lobby of 4 lifts serving levels 1st to 24th
- 2 services lifts travelling throughout the building
- 2 Stair cases are also placed in the core.
- The Central Core is surrounded by the office spaces.
- There are segregated office space from 6th to 14 floors with toilets to each office and with common toilets.
- 13 stories of parking in below floors. 132 residential units.
- 8 units on each floor.
- Central Core: 3 lifts and 1 service lift 2 Stairs are also placed in the core.

SUSTAINABLE FEATURES :

VISUAL STUDY :

SKY GARDENS:

- 15 double height landscaped Sky Gardens & more than a dozen double height Terraces, to act as tranquil and refreshing breakout zones.
- Low flow faucets, dual flush toilets, grey water systems and storm water & rainwater management systems – all a part of our commitment to the environment

HIGH PERFORMANCE FACADES:

- The façade consists of faceted unitized aluminum curtain walls with provisions for high performance double glass façades on the tower.
- Diamond edges of the building having aluminum flashing with LED lighting are the unique feature and make it complicated façade design.
- All the Glasses are articulated glasses & can sustain design wind pressure of 4.5 to 5.0 kPa.

STRUCTURE SYSTEM:

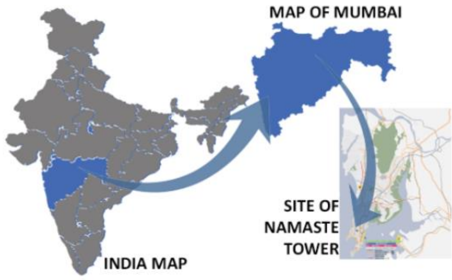
- The structure comprises a concrete core and post- tensioned concrete slab and spandrel beams. The average center to center distance between columns is 9.5 m. The column is of 1.8 Mx1.8 m.
- The tube system concept is based on the idea that a building can be designed to resist lateral loads. This assembly of columns and beams forms a rigid frame that amounts to a dense and strong structural wall along the exterior of the building.
- Foundation: The combined pile raft foundation system is used. It is a geotechnical composite construction that combines the bearing effect of both foundation elements raft and piles.

LITERATURE STUDY: NAMASTE TOWER, MUMBAI

Status: Under construction
Type: Residential, Commercial
Location: Lower Parel, Mumbai
Construction started: 2011
Estimated completion: 2022
Height: 316 meters (1,037 ft)
Technical details-
Floor count: 63
Floor area: 116,000 m2 (1,250,000 sq.ft)
Design and construction-
Architect: WS Atkins Plc
Developer: Jaguar Buildcon

PROJECT LOCATION :

THE NAMASTE TOWER IS LOCATED IN LOWER PAREL, MUMBAI, ON LAND PREVIOUSLY OWNED BY AMBIKA MILLS. THE LAND WAS ACQUIRED BY THE BUILDERS USING REDE-VELOPMENT MODELS.



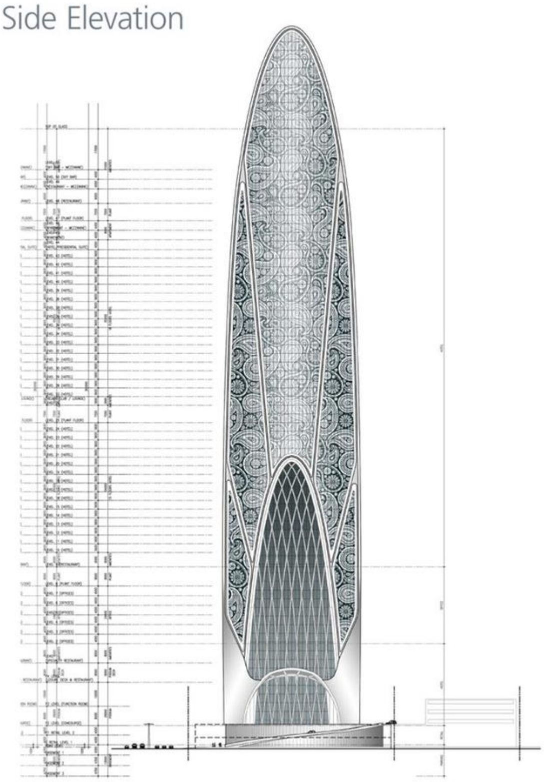
CLIMATE :

MUMBAI'S CLIMATE CAN BE BEST DESCRIBED AS MODERATELY HOT WITH HIGH LEVEL OF HU-MIDITY. ITS COASTAL NATURE AND TROPICAL LOCATION ENSURES TEMPERATURES WON'T FLUCTUATE MUCH THROUGHOUT THE YEAR

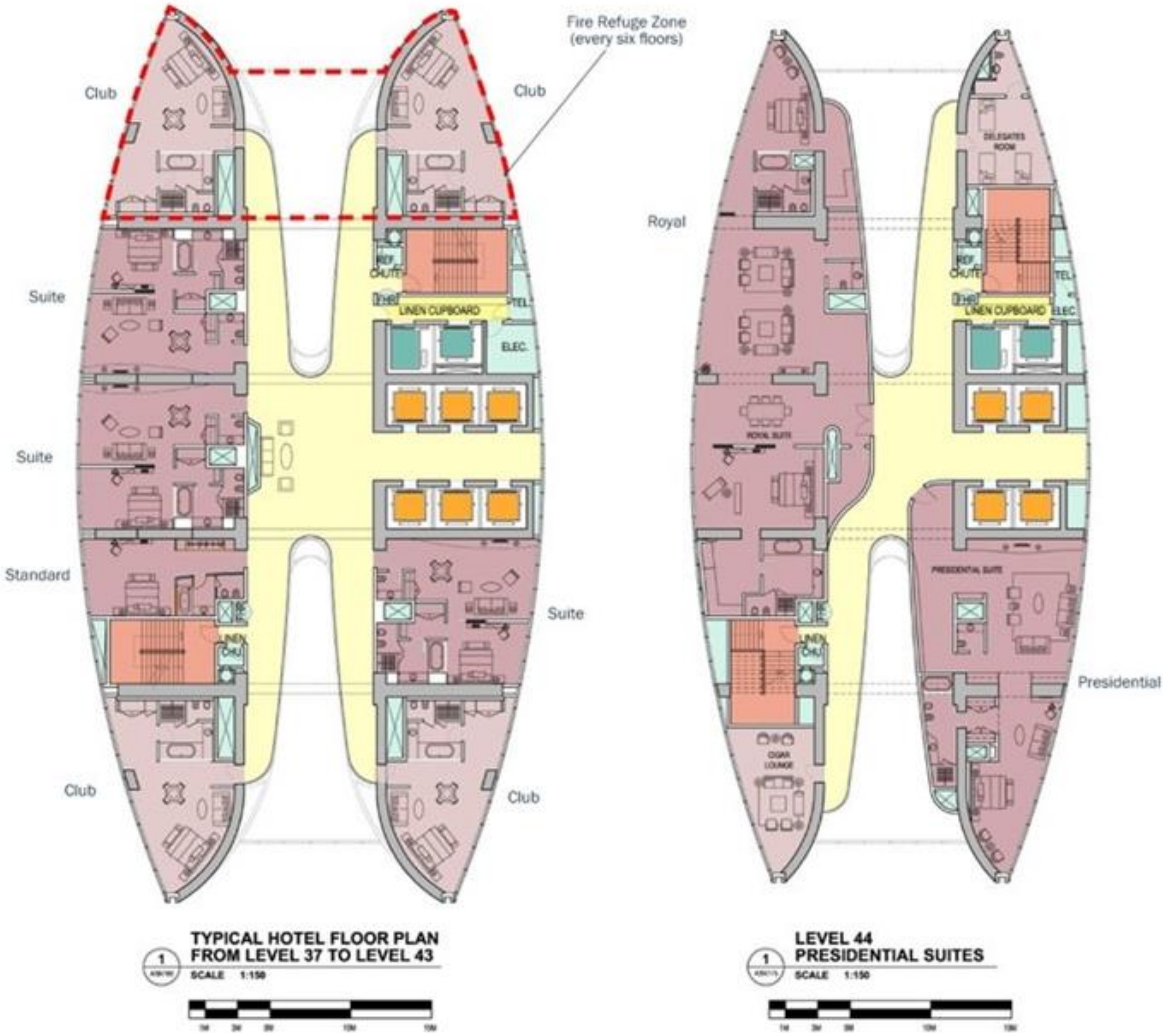
ABOUT THE PROJECT:

Namaste Tower is a 316 m (1,037 ft) tall skyscraper currently under construction in Mumbai, India. It will be a mixed-use skyscraper with 63 floors that will house a 380-room W Hotel, office and retail space. It has been designed by Atkins, Dubai. The design resembles the Namaste gesture: two wings of the hotel are clasped together like hands greeting.

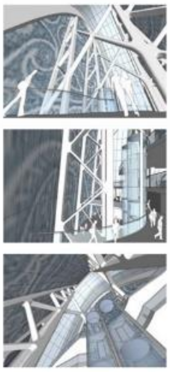
Side Elevation

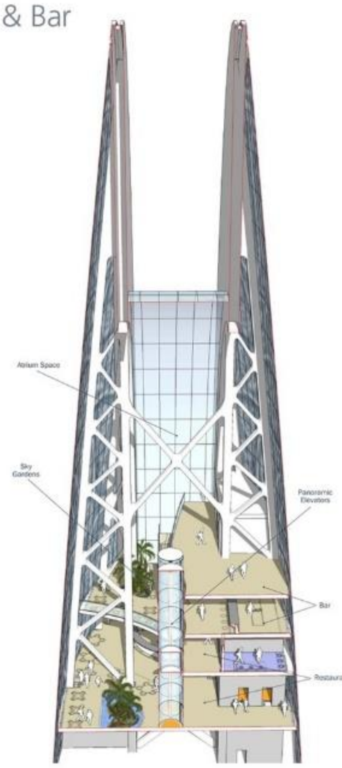


Club Rooms with Suites (L37 - L43) Presidential, Royal Suites (L44)

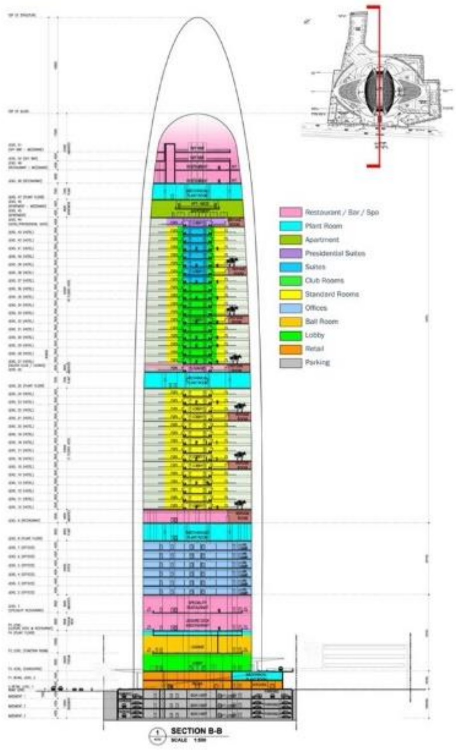


Sky Restaurant & Bar

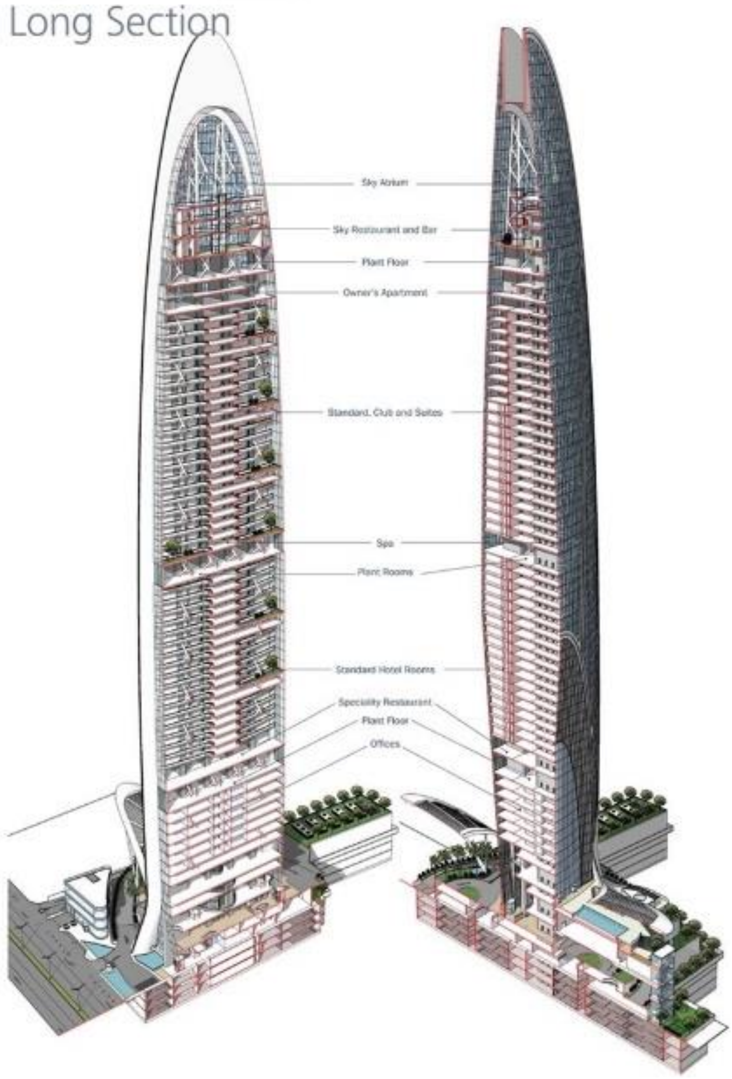




Long Section



Long Section



FIRE FIGHTING

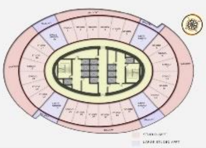
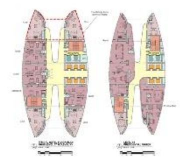
The 6m drive way with 13m turning radius allows fire trucks a complete 360o access around the base of the tower. Fire can be fought from directly in front of the building as well as from the back (at the office drop-off) which has clear access to the refuges above.

Office Drop-off

Ball Room Drop-off

Retail Drop-off

Fire Fighting Zones

TOPIC	CASE STUDY 1- SUPERNOVA	CASE STUDY 2- INFOSYS	LITERATURE STUDY 1-KOHINOOR SQUARE	LITERATURE STUDY 2- NAMASTE TOWER
LOCATION	SECTOR 94, NOIDA (U.P.)	POCHARAM,HYDERABAD	BORIVALI, MUMBAI	LOWER PAREL, MUMBAI
ARCHITECT	BENOY,LONDON	SUNDARAM ARCHITECT PVT. LTD.	SSA ARCHITECT	WS ATKINS PLC
TYPOLOGY	MIXED USED DEVELOPMENT	OFFICE BUILDING	MIXED USE DEVELOPMENT	RESIDENTIAL & COMMERCIAL
PROJECT YEAR	ESTIMATED COMPLETION 2020	SEPTEMBER,2010	MARCH, 2013	ESTIMATED COMPLETION 2022
ARCHITECTURAL CHARACTER	VIRTUALLY DYNAMIC FLOOR PLATES	GREEN BUILDING	OVERALL GLASS FACADE	ANCIENT INDIAN EXPRESSION
PARKING	7000		3500	602
GREEN BUILDING CERTIFICATION	LEED CERTIFIED (PLATINUM)	LEED CERTIFIED (PLATINUM)	LEED CERTIFIED (GOLD)	LEED CERTIFIED (GOLD)
PEAK HEIGHT	300M	28M	203M	316M
FLOORS	80	6	52	63
SITE AREA	17.3 ACRES	460 ACRES	4.6 ACRES	17.5 ACRES
TOTAL BUILT-UP	6,97,026 SQ.M.		400,136 SQ.M.	116000 SQ.M.
GROUND COVERAGE			39,331 SQ.M.	100,900 SQ.M.
LIFT	70 APPROX	6 IN EACH BLOCK	MORE THAN 28	28
STAIRCASE	2 IN EACH BLOCK	6 IN EACH BLOCK	2	4
INFERENCES				
PLANNING				

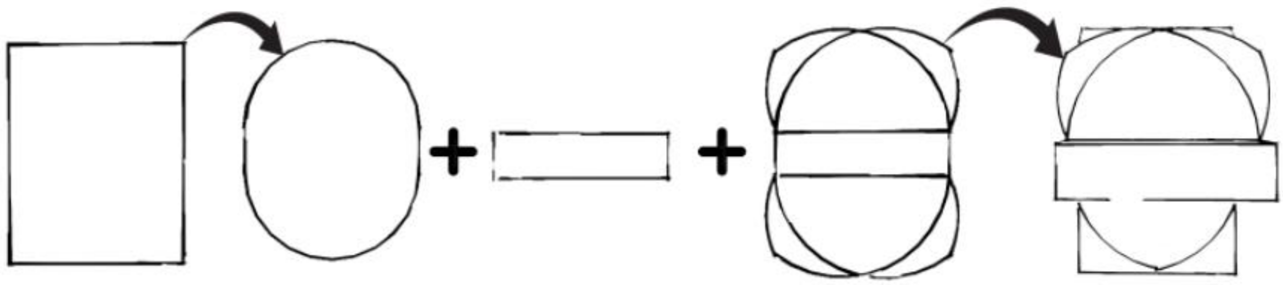
CHAPTER 6.0 CONCEPT

The basic form was a rectangle which later evoluted into an oval shape as oval behaves similar to a circle & reduce the wind load on the structure.
The softly curvilinear form of this tall, elegantly slender wing a tower is aerodynamically shaped to “confuse the wind”, minimizing the negative effects of wind action on the tower. Wind vortex shedding is also mitigated by the south-facing sky gardens, which break up wind currents around the tower. THE WING B HAS FLOOR PLATES WHICH ARE DECREASING AS THE HEIGHT INCREASES.

UNITY

the idea behind the design component unity is to create element that support each other and all work together toward a common goal.
Visual unity: A group of elements all aligned to a common axis.
Conceptual unity: Each work of art that is successful in conveying an idea or theme to you, is an example of concept unity in art.

FORM EVOLUTION



FINAL FORM

1. The entries for different areas are provided separately.
2. The lower floors have the shopping complex, which is linked to the main pedestrian access.
3. the middle floor is office area, which are distributed in both the wings.
4. taller wing that is wing b has observatory which provides better views of the surroundings.
5. stepped floor plates and curved edges reduces wind load the structure system is diagrid framed tube. (A diagrid is a framework of diagonally intersecting metal, concrete or wooden beams that is used in the construction of buildings and roofs. It requires less structural steel than a conventional steel frame. The diagrid obviates the need for columns and can be used to make large column-free expanses of roofing.)

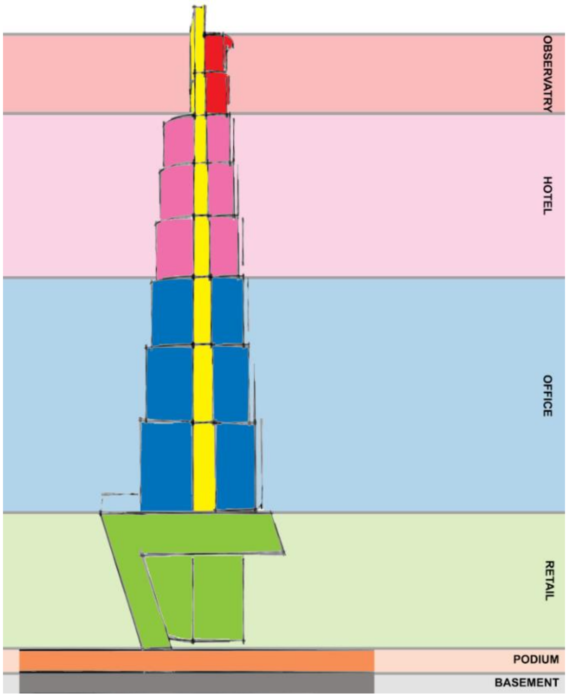


fig. vertical stacking

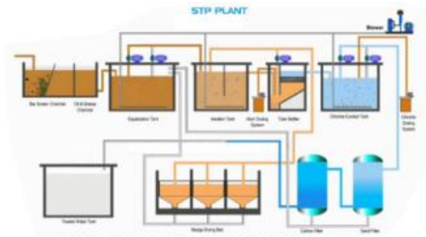
1. FEELING OF "GRANDEUR" EVEN WHEN INSIDE THE BUILDING.
2. MAXIMIZING VIEWS
3. SKY GARDENS
4. STRUCTURAL CONSTRAINTS
a. Height to base ratio should be less than 8:1 for economic feasibility
b. Structural System-Steel Diagrid-30% more efficient than conventional structural system
c. Foundation-Raft & Pile foundation
5. SPACE EFFICIENCY
a. Use of double decker & twin lifts.
b. Efficient structural system-Diagrid
c. Column free office spaces
d. Automated Mechanical parking
6. WIND LOAD
a. Curved edges
b. Openings for wind to pass through
7. SAFETY
a. No dead ends
8. SUSTAINABILITY
a. Natural lighting ventilation
to all spaces

ENVIRONMENTAL IMPACT

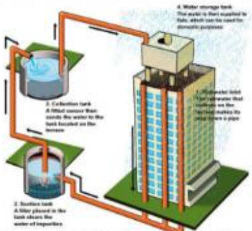
THE AMOUNT OF STEEL, CONCRETE, AND GLASS NEEDED TO CONSTRUCT A SINGLE SKY-SCRAPER IS LARGE,& THESE MATERIALS REPRESENT A GREAT DEAL OF EMBODIED ENERGY. IT IS CLEAR THAT THERE ARE NUMBER OF FACTORS TALL BUILDING DRIVERS AS POPULATION, LAND PRICE & GLOBAL ICON.BUT TALL BUILDINGS CREATE MANY PROB-LEMS SUCH AS WIND FLOW,SUN LIGHT-SHADE & SHADOW,ENVIRONMENTAL POLLU-TION & FRESH AIR.

SOME ARCHITECTURAL FEATURES PROPOSED TO BE USED IN THE ICONIC TOWER ARE:

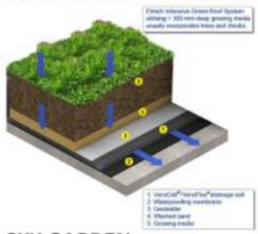
1. RAIN WATER COLLECTION
2. SKY GARDENS & GREEN ROOF
3. HIGH PERFORMANCE FACADE
4. HIGH EFFICIENCY VENTILATION SYSTEM
5. DAYLIGHT HARVESTING & DIMMING CONTROLS
6. NATURAL VENTILATION ON SERVICE FLOOR
7. NATIVE ADAPTED LANDSCAPE
8. ONSITE WASTE WATER TREATMENT
9. RECYCLABLE SORTING & COLLECTION



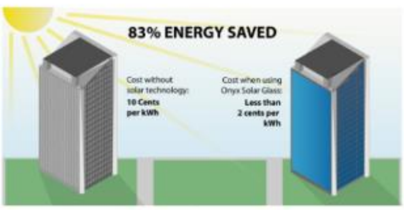
SEWAGE TREATMENT PLANT



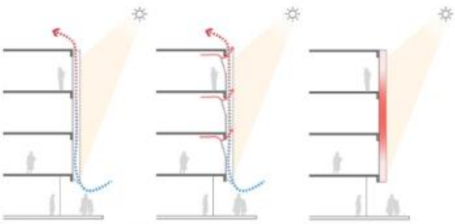
RAIN WATER HARVESTING



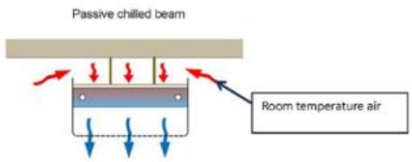
SKY GARDEN



ONYX SOLAR GLASS



DOUBLE GLASS FACADE



CHILLER BEAMS

EARTHQUAKE CONSIDERATIONS
The behavior of a building during an earthquake depends on its overall shape, size and geometry in addition to how the earthquake forces are carried to the ground. Major causes of earthquake are long building lengths subjected to differential ground vibrations & unsymmetrical plans susceptible for torsion.

PLANNING CONSIDERATIONS
1. The plan must be symmetrical as far as possible with respect to two orthogonal axis.
2. The ratio of the height to min width must be less than 2.5.
3. The ratio of length to width must be less than 2.
4. Plans should not have protruding portions more than 20% of plan area.

Total opening area should not be greater than 20%. Another technique which can be used is Rubber Padding in foundation. The building is constructed on top of flexible pads that isolate the foundation from the ground. When an earthquake hits, only the base moves while the structure remains steady.

BUILT IN FIRE FIGHTING SYSTEM

Wet riser cum down commer system
Wet riser: It is a vertical pipeline (dia. depends on the floor area of the building) connected to a bottom tank (underground water tank).
Down Commer: It is a vertical pipeline (dia. depends on the floor area of the building) connected to the overhead tank.
FIRE: Effective fire safety in building requires a systematic & diligent approach on the part of the architect to fire prevention, protection from fire, & fire control in all aspects of building design.
Fire Exit: A way out leading from exit access with or without panic bar provided on the door.
Fireman's Lift: A lift or a group that are installed to enable fire services personnel to reach different floors with minimum delay.
Pressurization: The establishment of a pressure difference across a barrier to protect exit, stairway, lobby, exit passageway or room of a building from smoke penetration.
Refuge Area: An area within the building for a temporary use during egress. It generally serves as a staging area which is protected from the effect of fire and smoke.

CHAPTER 7.0 AREA ANALYSIS

SITE

Total Site area (m2)	34,584
Proposed built-up area	138,000+338
F.A.R.	4
Ground Coverage	20% (6912 sq.m)
Proposed number of floors	3 Basement+Podium+48 Floor+4 Mechanical floor
3 Basements	Parking + Services
Podium	Recreational
1th-6th floor	Retail
7th-12th floor	Office
	Mechanical Floor
13th-24th floor	Office
	Sky Lobby
	Mechanical Floor
25th-36th floor	Office
	Mechanical Floor
25th-36th floor	Hotel
48th floor	Observatory and Fine-dine

Retail: 1022-Person Total
Office: 5726-Person Total
Hotel: 315 keys
Observatory: 200 approx.
Total: 7263
Male=4842 Female=2421

Parking: 1:33/1835 car
Area required: 58,720sq.m

RETAIL

	Area required
Back Office (General admin, Record room, Meeting, Staff room, Director's cabin)	25% on 1 floor
Departmental store	100m2X20
	50m2X15
Anchor shops	0.5(floor plate) X3
Shopping arcades	150m2 eachX23
Food court	2/3 floor
Restaurant	2/3 floor
Cinema for 300X4	1080m2+200m2 (Ticket counter, lobby & food court)

WASHROOMS

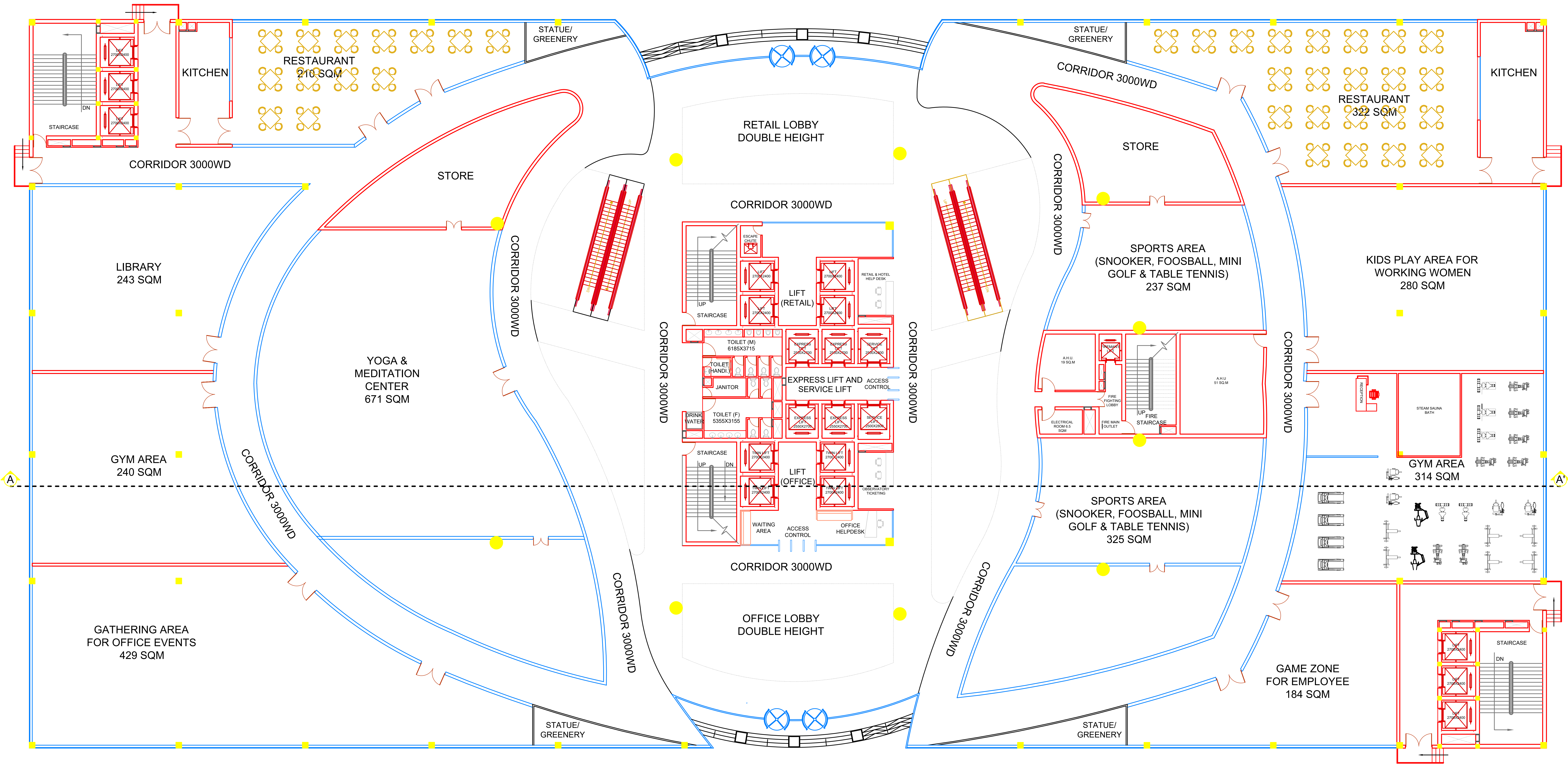
	NBC 2005	MALE	FEMALE	TOTAL
WC	1 IN 25(M) 1 IN 15(F)	194	162	**356**
URINALS	1 IN 25	194	-	**194**
WB	1 IN 25	194	97	**291**
DRNKING WATER FOUNTAIN	1/FLOOR	-	-	**48/FLOOR**
JANITORS	1/FLOOR	-	-	**48/FLOOR**

HOTEL

	Area Required per room (m2) (Neufert 3rd edition)	**Total area required (m2)**
Hotel area	**39.75**	**12521**
Corridor, lifts & stairs	**13.95**	**4394**
Service	**1.05**	**330**
Total per room	**54.75**	**17246**
Entrance area including lifts for personal & service	2.7	850

Reception, WC, Reservations, Telephones, Luggage, Cloakroom	0.6	189
Administration	0.6	189
Restaurant	0.9	283
Bar	0.6	189
Lounge	0.45	141
Toilets	0.45	141
Shops	0.3	94.5
Total entrance/Guest area	**6.6**	**2079**
Kitchen	3.75	1181
General stores	1.35	425
Workshops/maintenance	0.6	189
Laundry/Linen store	1.05	330
Staff dining room, WC, Changing room	1.65	520
Personal rooms, accounts, supervision, caretaker	0.75	236
Circulation areas, service lifts	1.35	425
Total Hotel service area	**10.5**	**3307**
Total area required	**71.85**	**22632**
Built up area proposed for hotel	35880	
Approx. number of hotel rooms	**315**	

CHAPTER 8.0 DRAWINGS



FLOOR PLATE: 6912 S.QM.

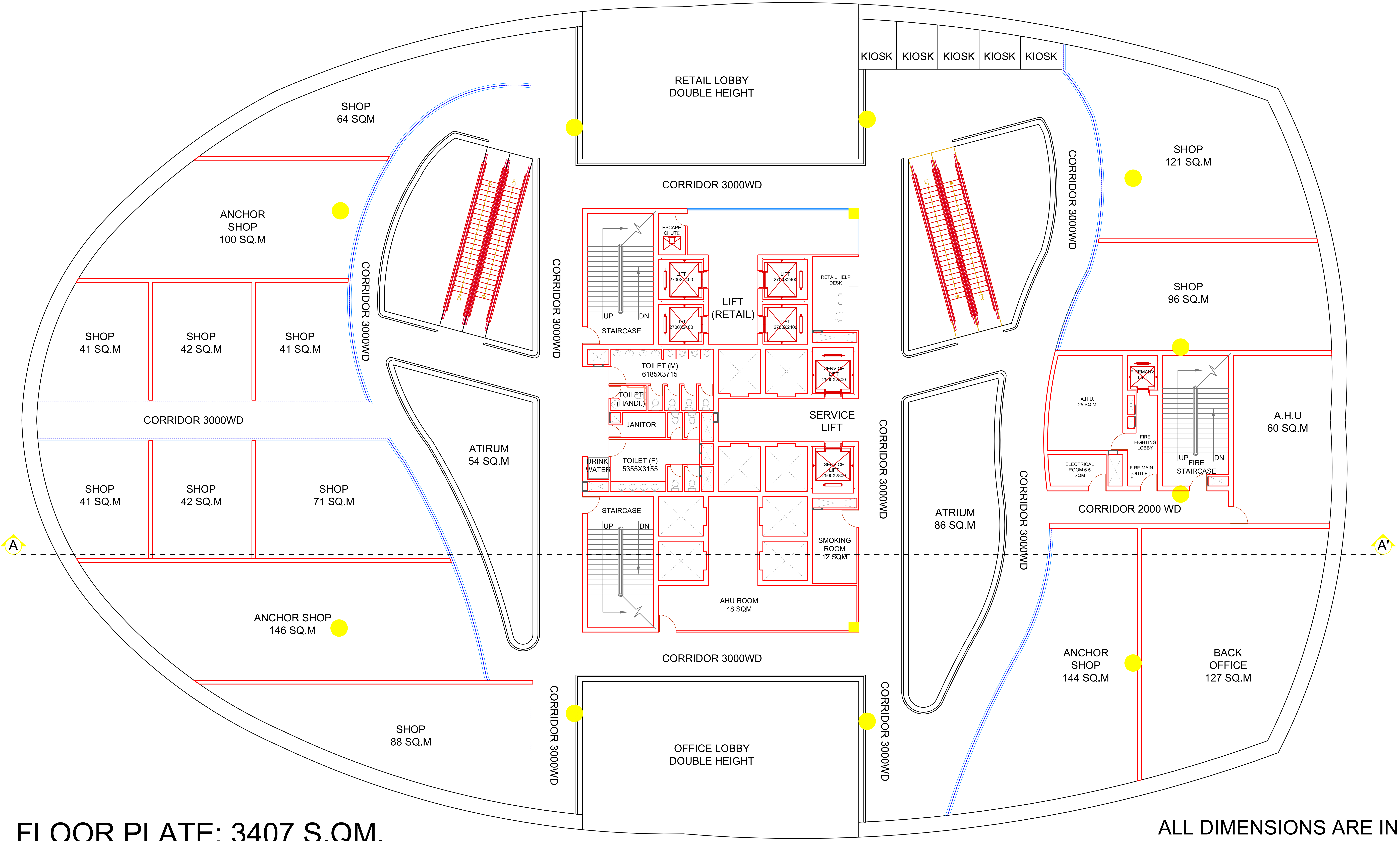
ALL DIMENSIONS ARE IN MILLIMETERS

ICONIC TOWER AT KARKARDHOOMA

PODIUM FLOOR PLAN

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



FLOOR PLATE: 3407 S.QM.

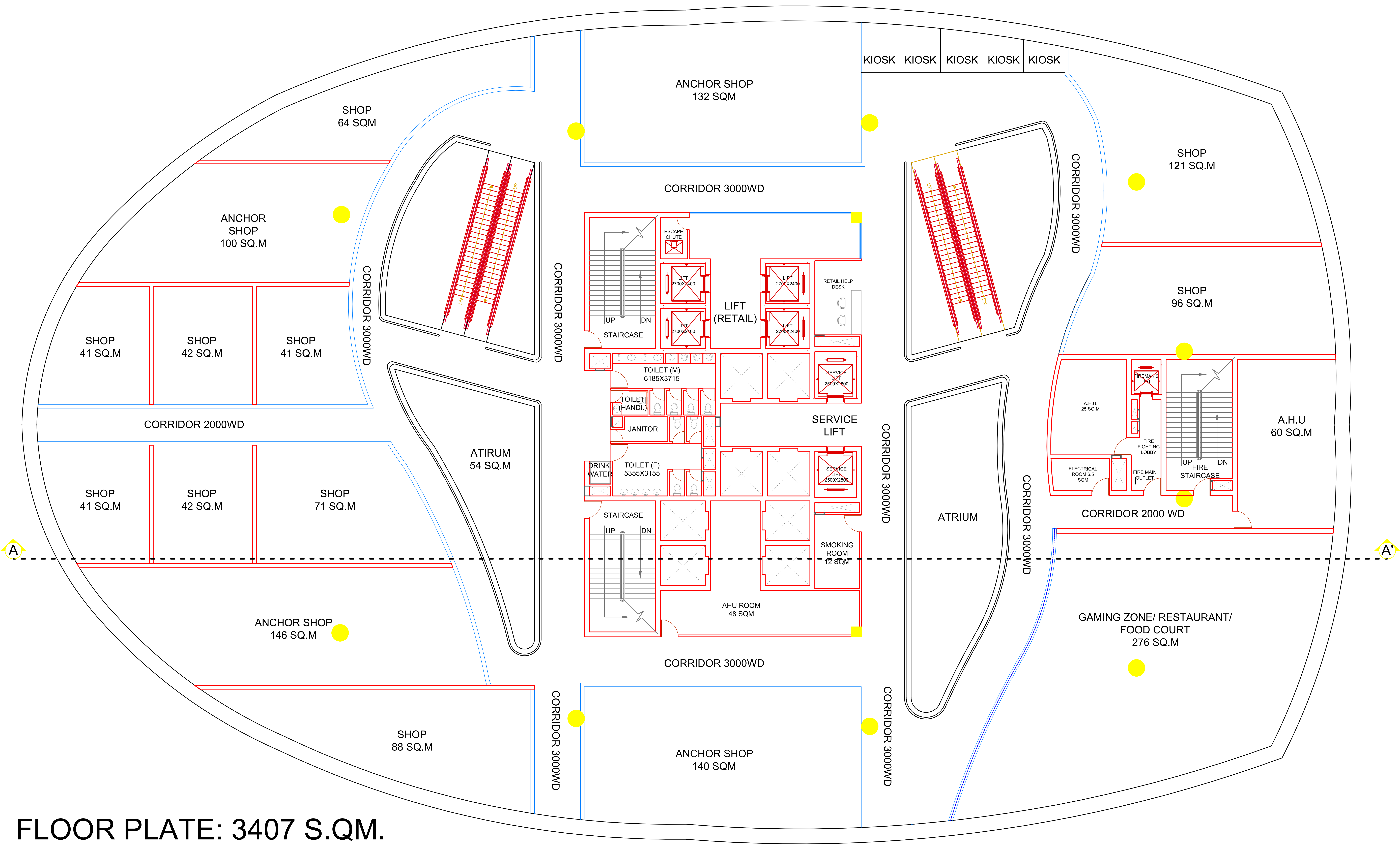
ALL DIMENSIONS ARE IN MILLIMETERS

ICONIC TOWER AT KARKARDHOOMA

1ST FLOOR PLAN (RETAIL)

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



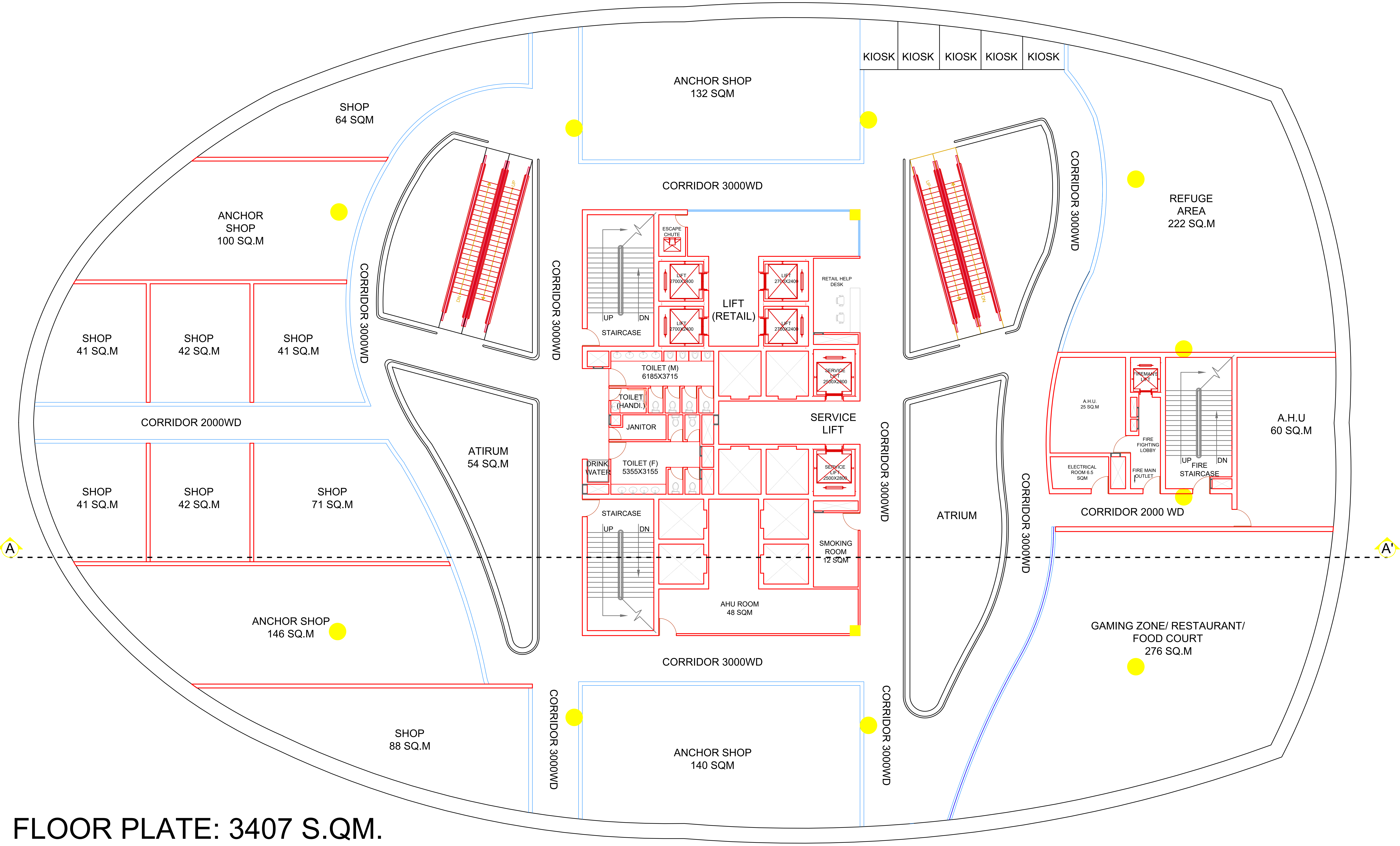
ICONIC TOWER AT KARKARDHOOMA

2ND-5TH TYPICAL FLOOR PLAN (RETAIL)

N

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



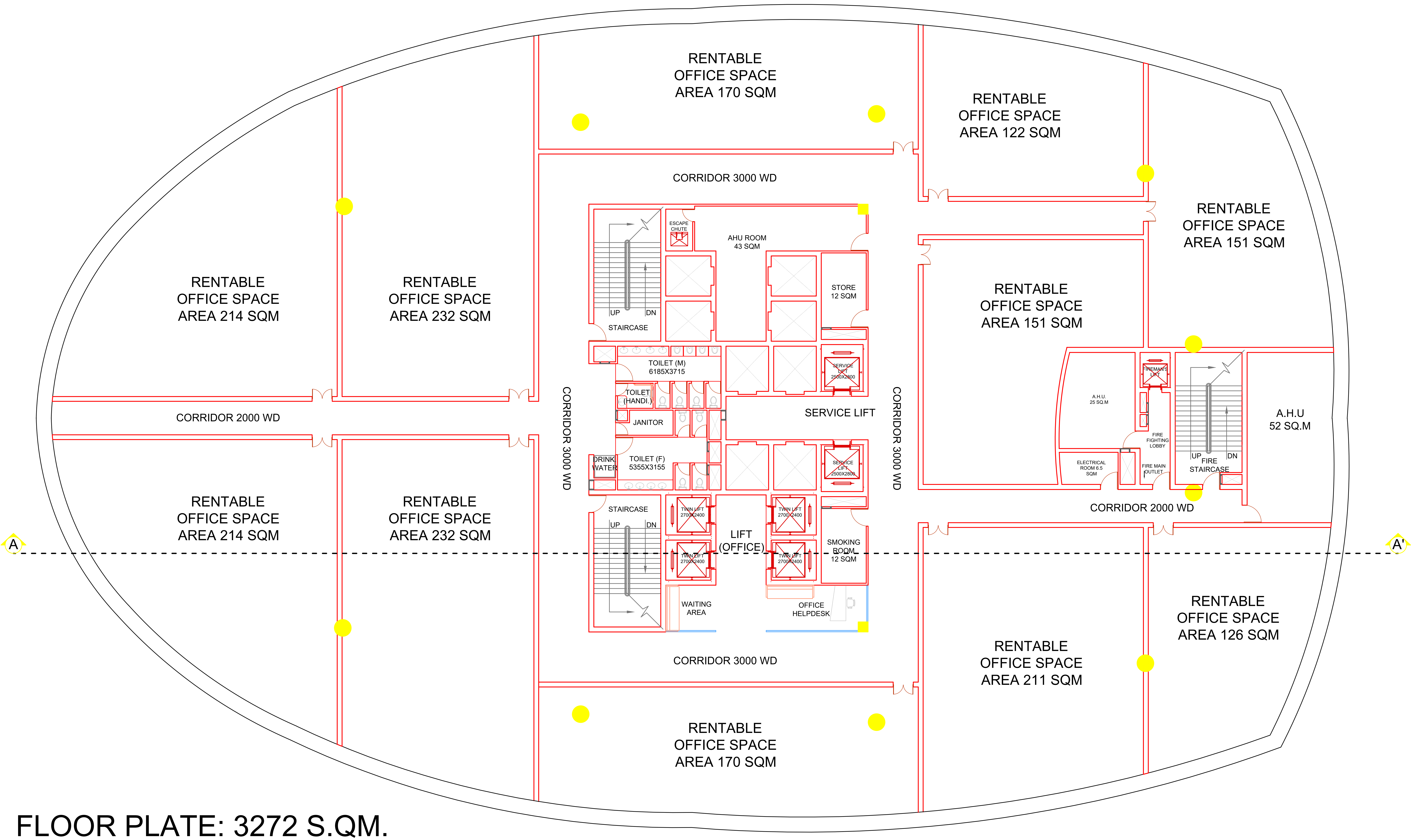
FLOOR PLATE: 3407 S.QM.

ICONIC TOWER AT KARKARDHOOMA

6TH FLOOR PLAN
WITH REFUGE AREA
(RETAIL)

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



FLOOR PLATE: 3272 S.QM.

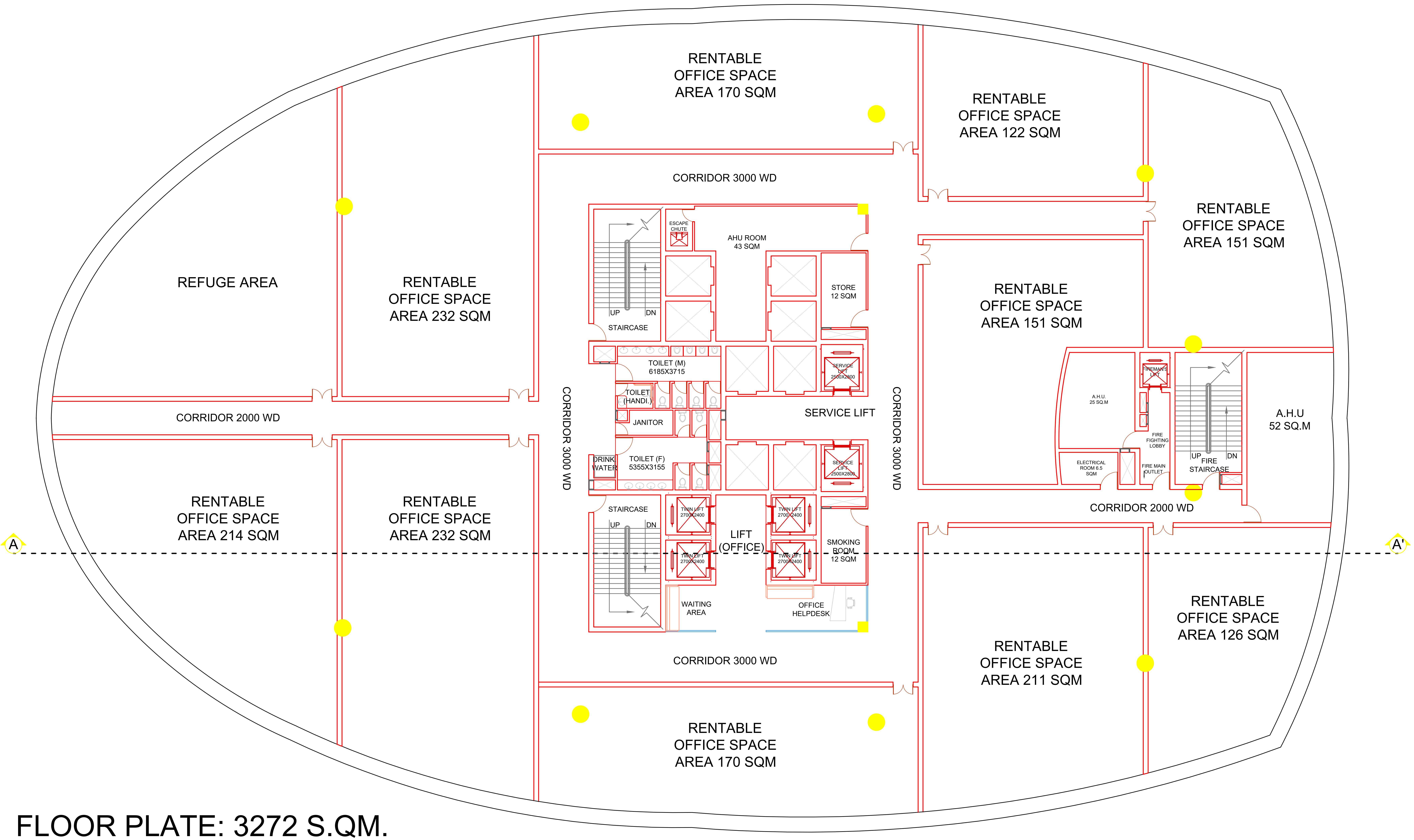
ICONIC TOWER AT KARKARDHOOMA

7TH,8TH,9TH, 11TH & 12TH
TYPICAL FLOOR PLAN
(OFFICE)

N

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



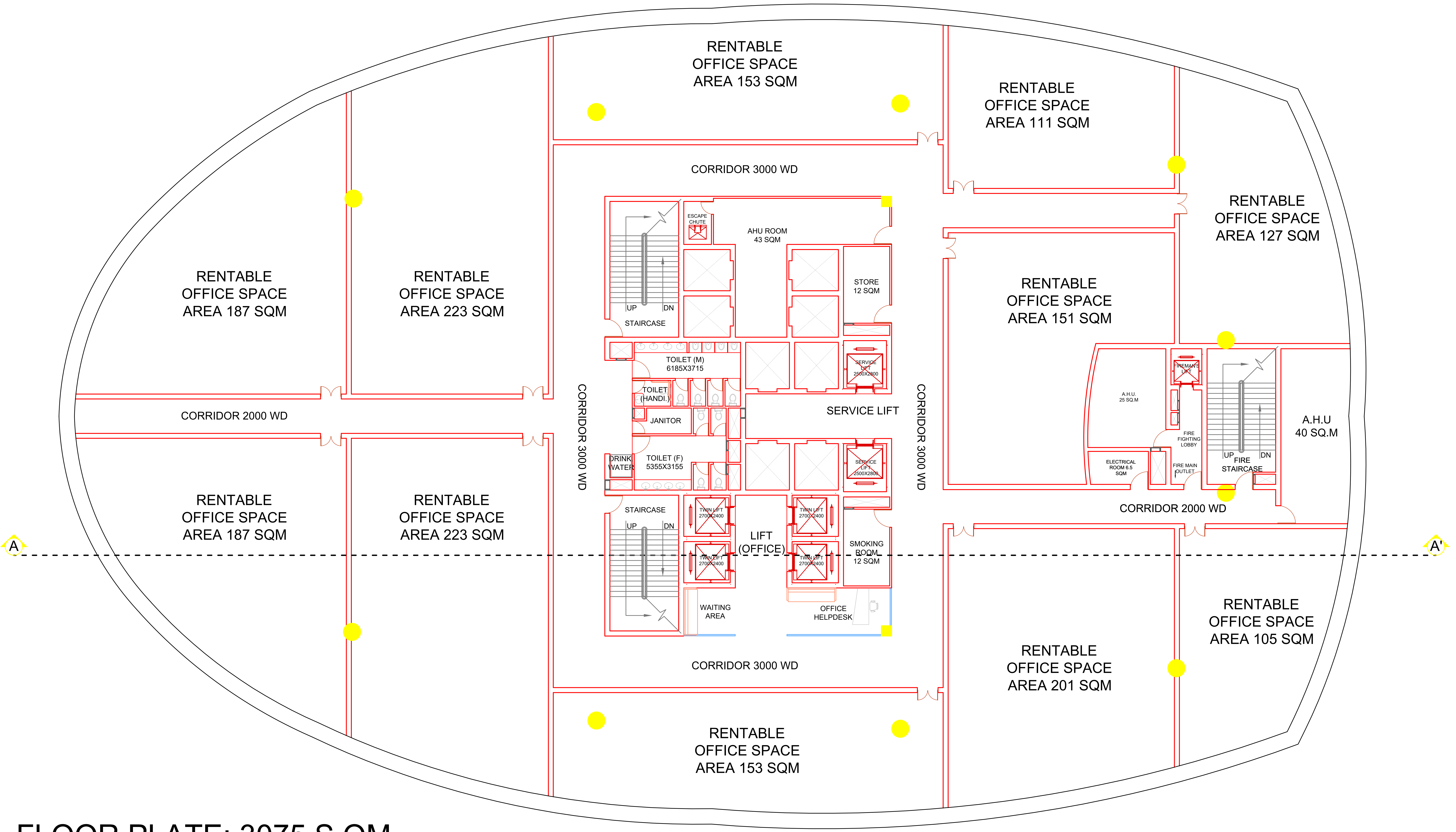
FLOOR PLATE: 3272 S.QM.

ICONIC TOWER AT KARKARDHOOMA

10TH FLOOR PLAN WITH REFUGE AREA (OFFICE)

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



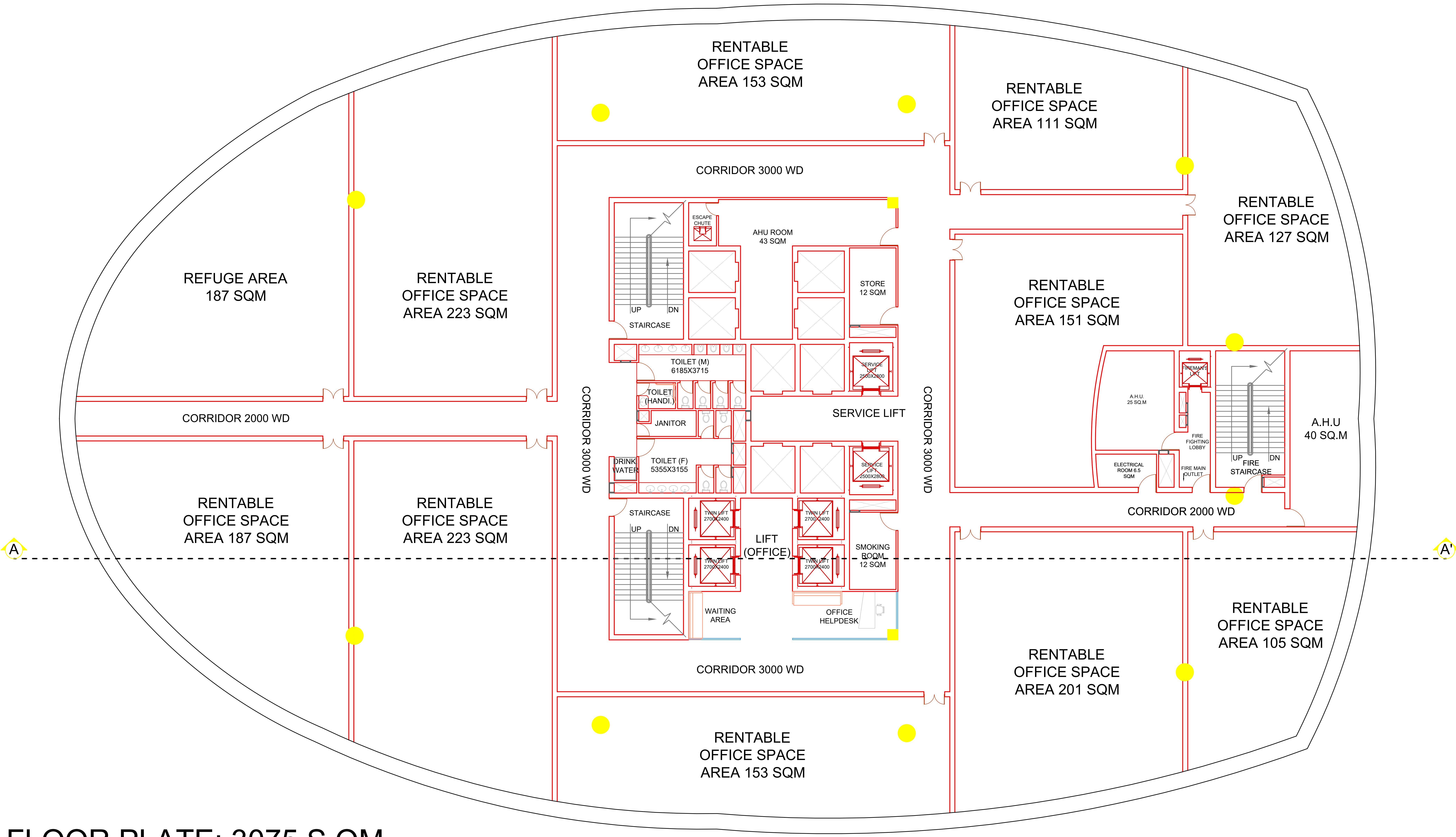
FLOOR PLATE: 3075 S.QM.

ICONIC TOWER AT KARKARDHOOMA

13TH,15TH,16TH &17TH
TYPICAL FLOOR PLAN
(OFFICE)

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



FLOOR PLATE: 3075 S.QM.

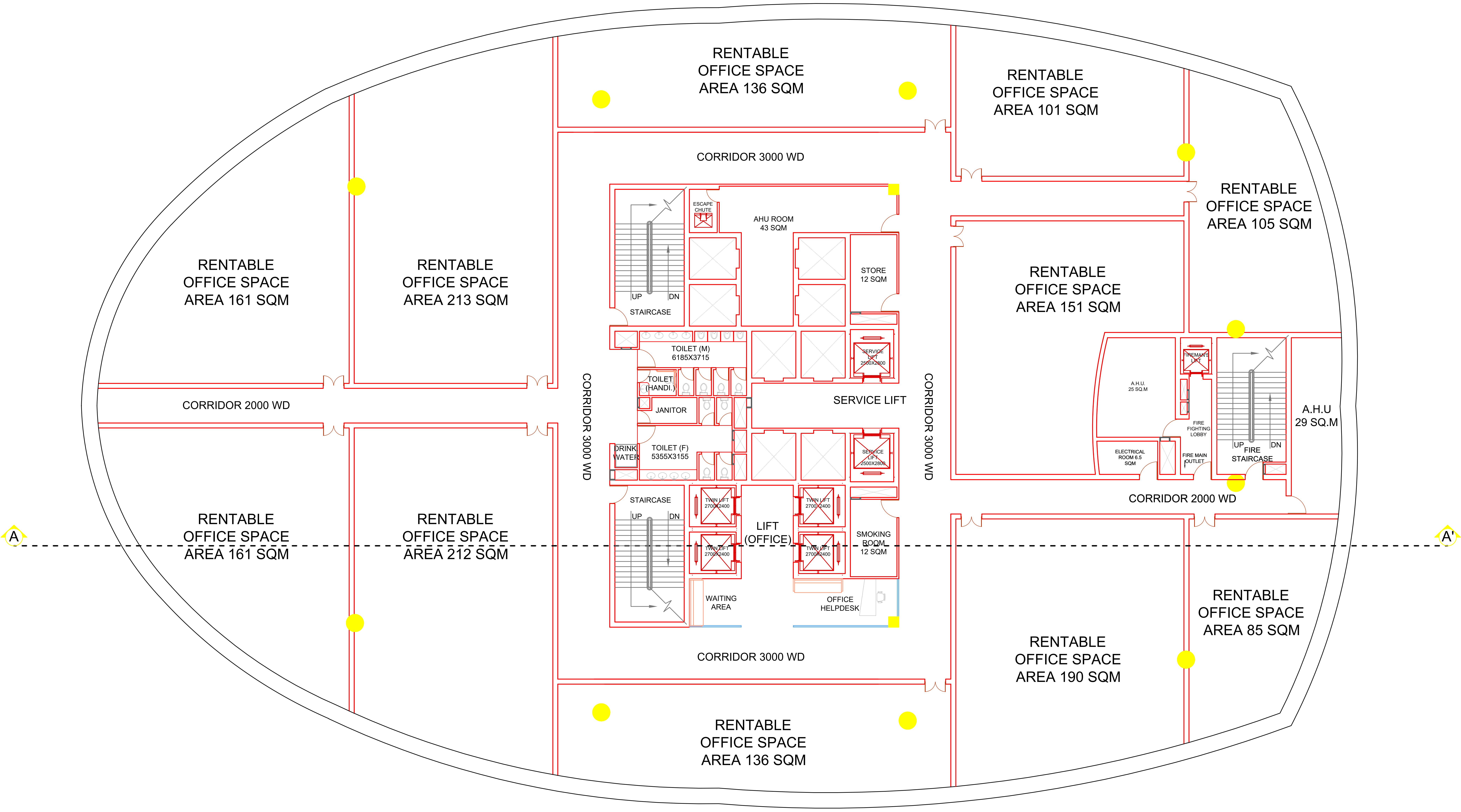
ICONIC TOWER AT KARKARDHOOMA

14TH & 18TH TYPICAL FLOOR PLAN (OFFICE)

N

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



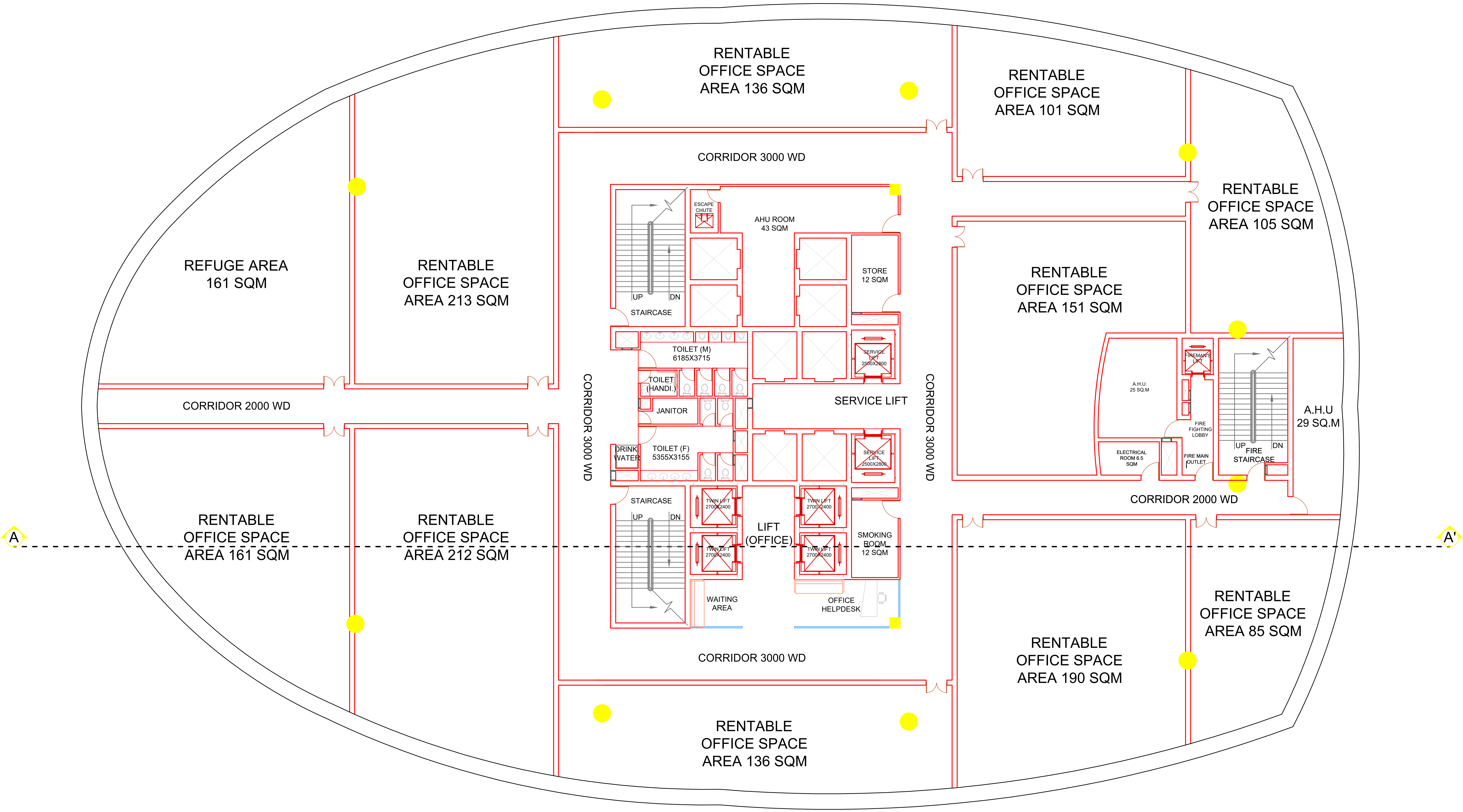
FLOOR PLATE: 2883 S.QM.

ICONIC TOWER AT KARKARDHOOMA

19TH,20TH,21ST, 23RD & 24TH TYPICAL FLOOR PLAN (OFFICE)

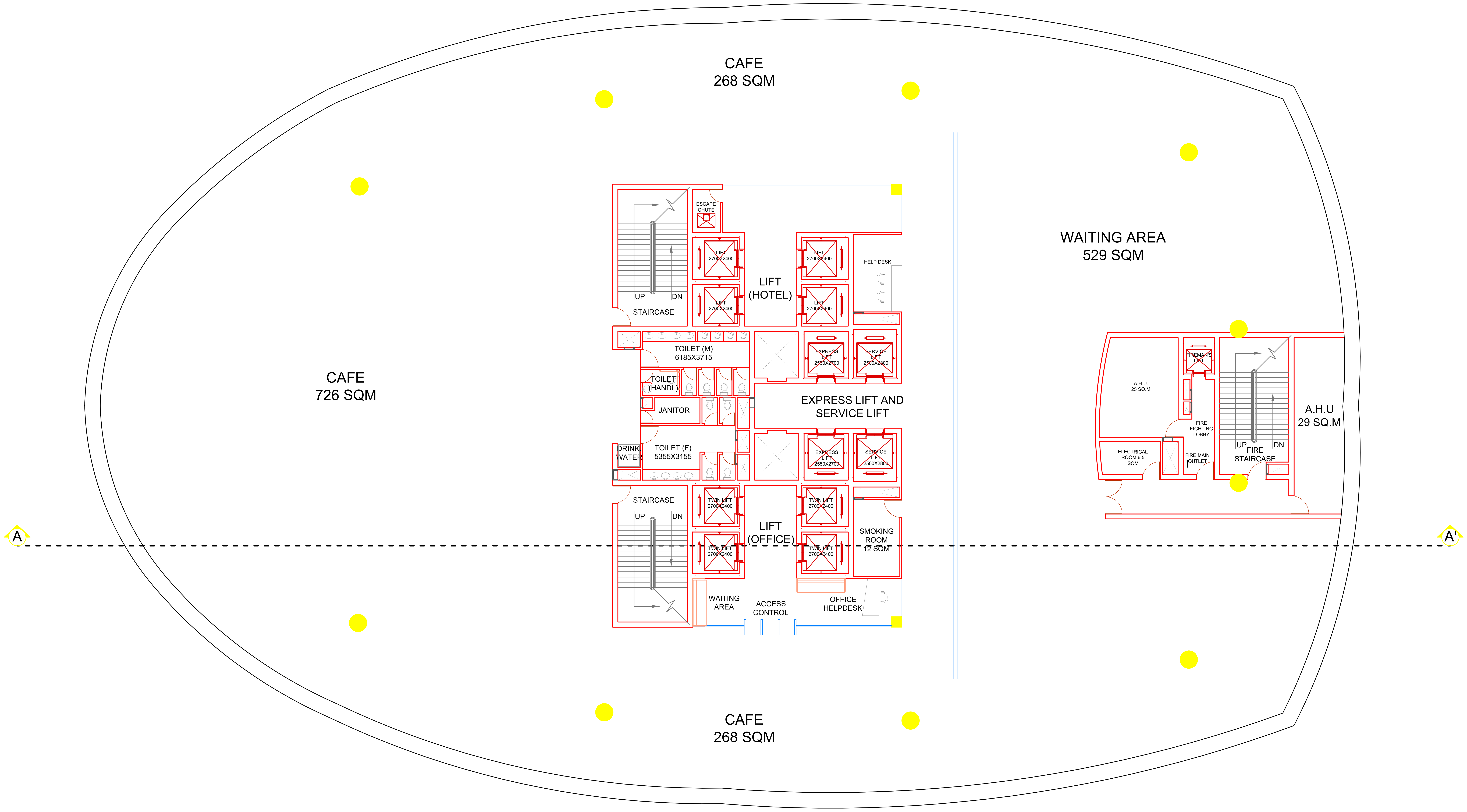
SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



FLOOR PLATE: 2883 S.QM.

ICONIC TOWER AT KARKARDHOOMA	22TH FLOOR PLAN WITH REFUGE AREA (OFFICE)	SCALE- NTS	JANHVI P. SINGH 5th YEAR 10th SEM. B.ARCH 2019-20 ARCH. DESIGN B.B.D.U

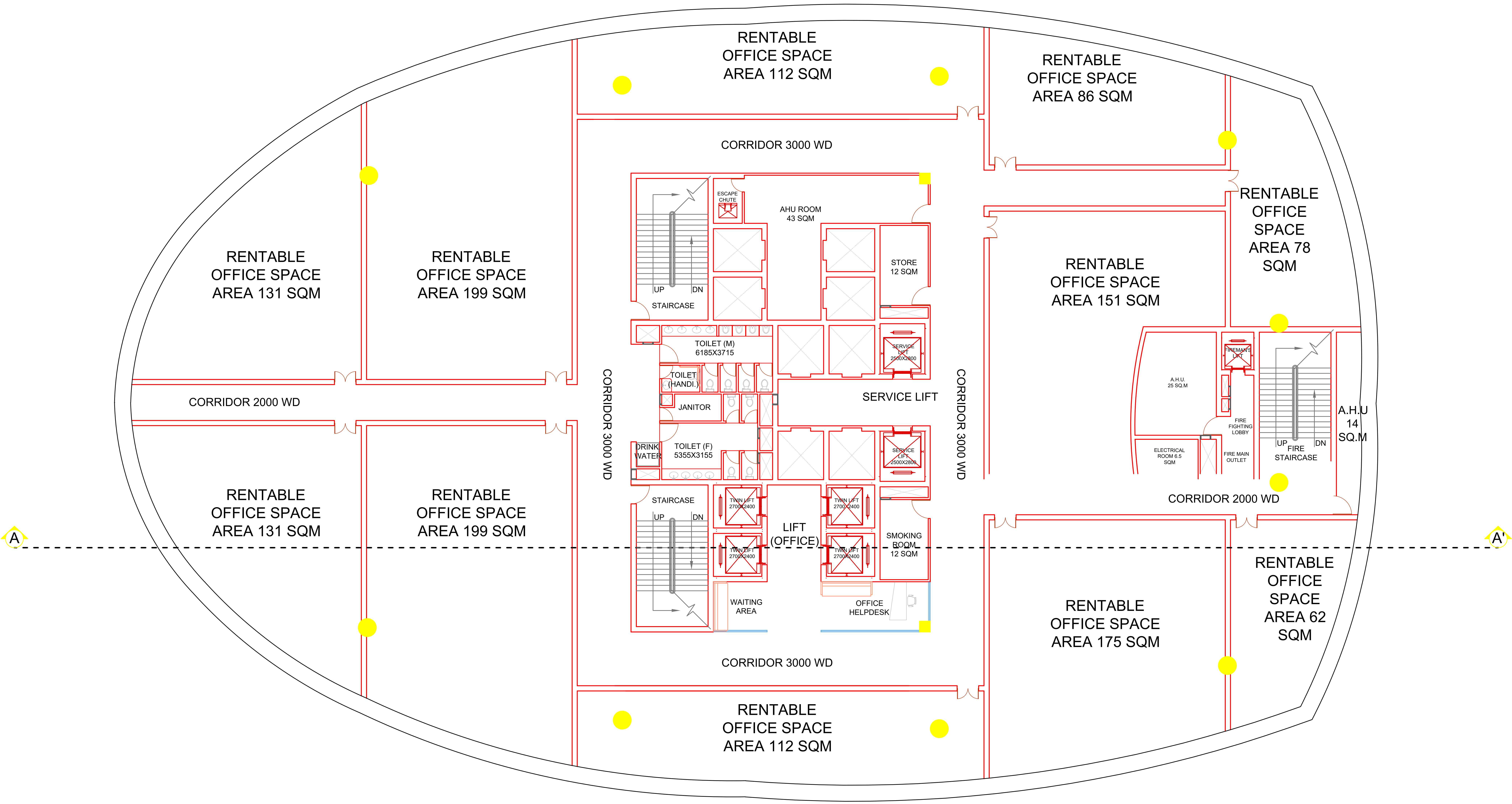


ICONIC TOWER AT KARKARDHOOMA

SKY LOBBY

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



FLOOR PLATE: 2638 S.QM.

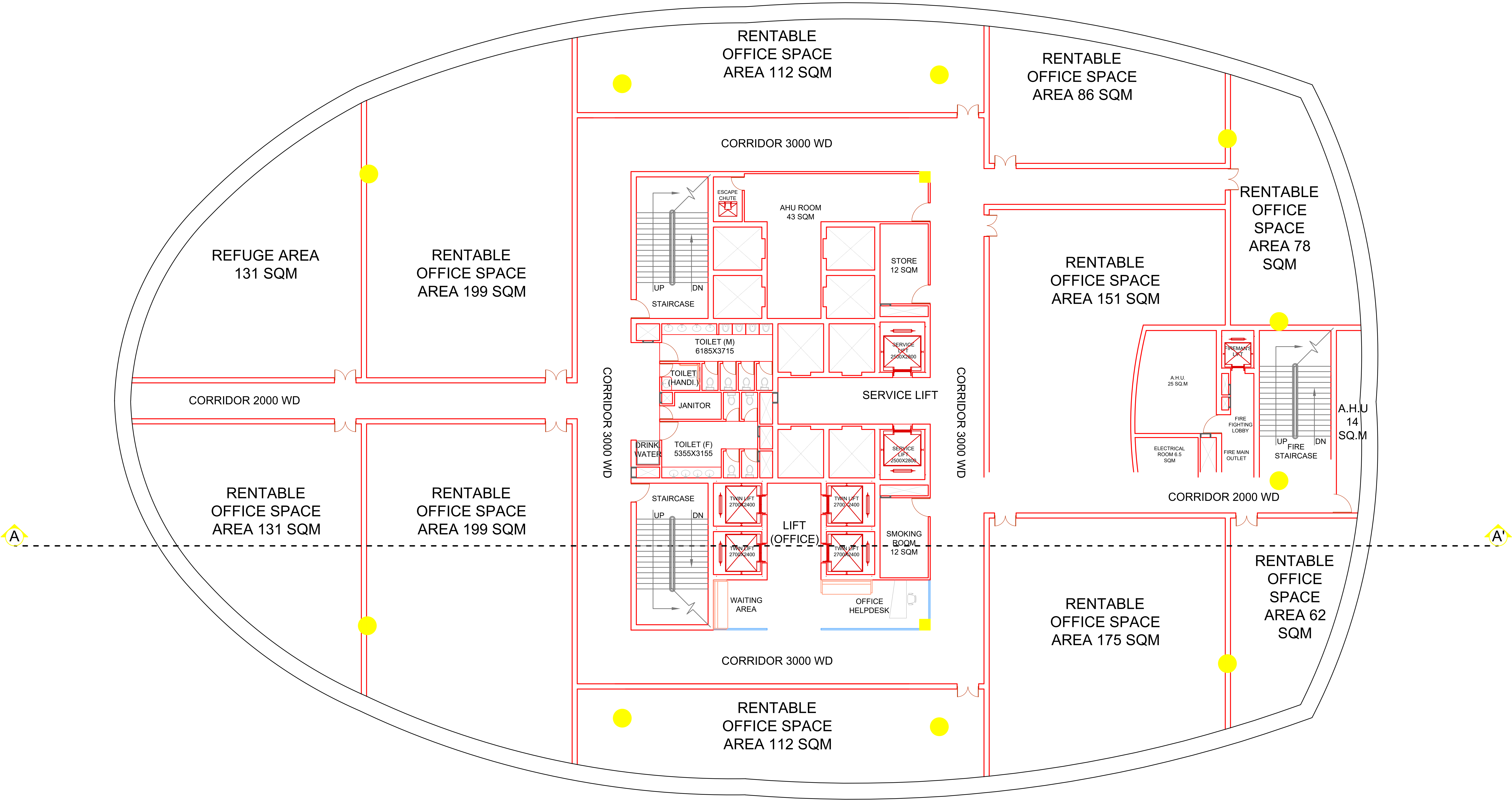
ICONIC TOWER AT KARKARDHOOMA

25TH, 27TH,28TH, 29TH
TYPICAL FLOOR PLAN
(OFFICE)

N

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



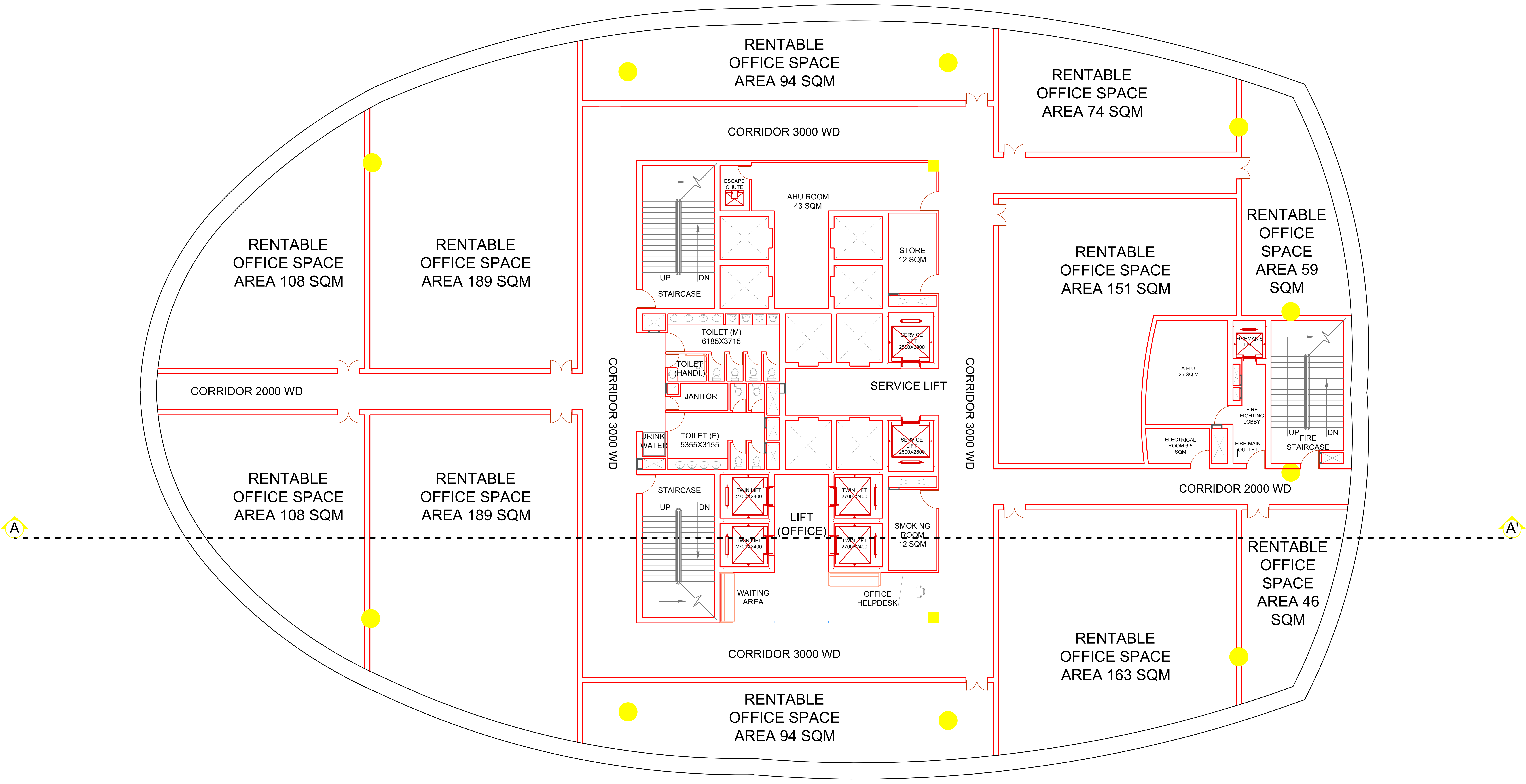
FLOOR PLATE: 2638 S.QM.

ICONIC TOWER AT KARKARDHOOMA

26TH & 30TH TYPICAL FLOOR PLAN WITH REFUGE AREA (OFFICE)

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



FLOOR PLATE: 2450 S.QM.

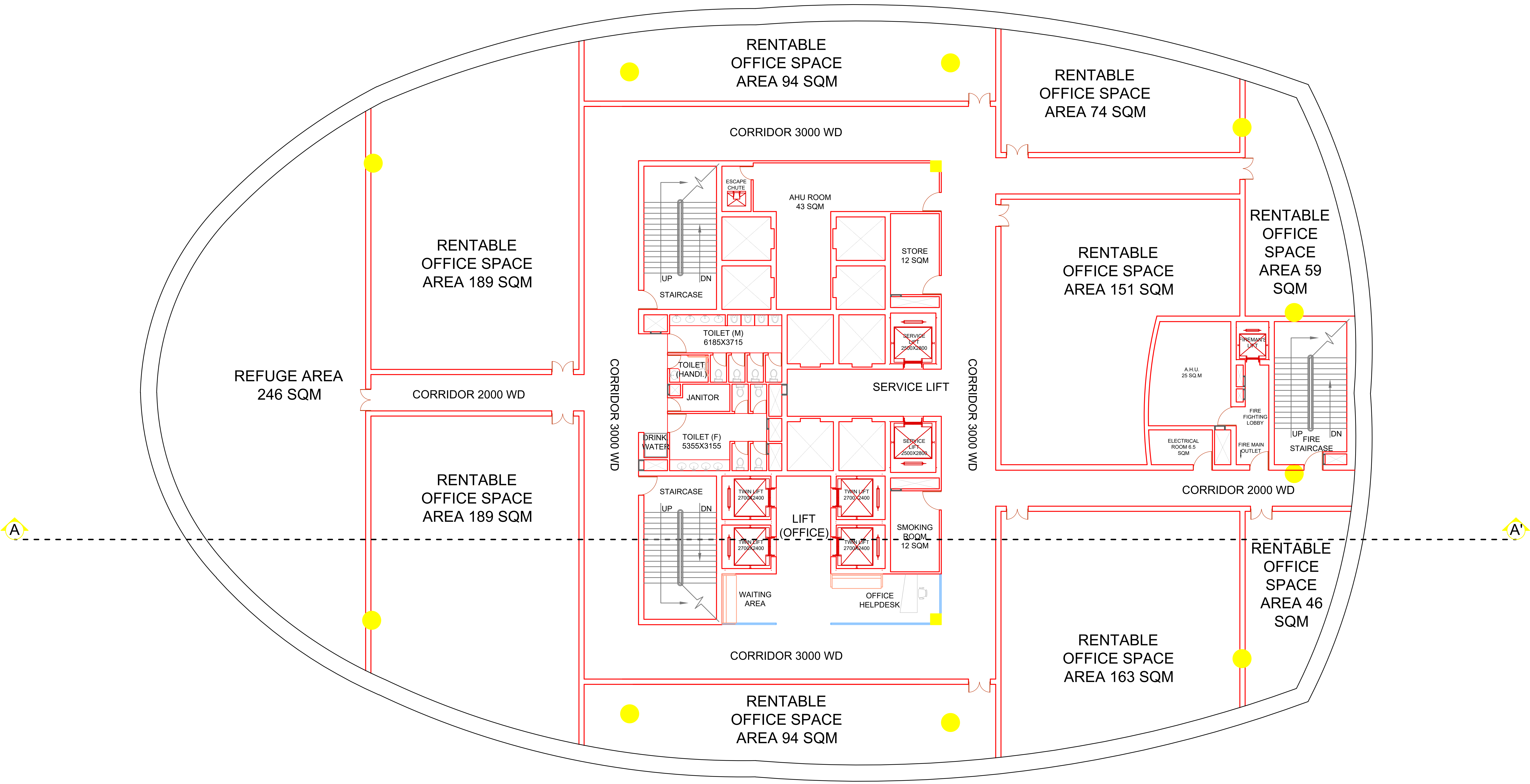
ICONIC TOWER AT KARKARDHOOMA

31TH,32TH, 33TH,35TH AND 36TH TYPICAL FLOOR PLAN (OFFICE)

N

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



FLOOR PLATE: 2450 S.QM.

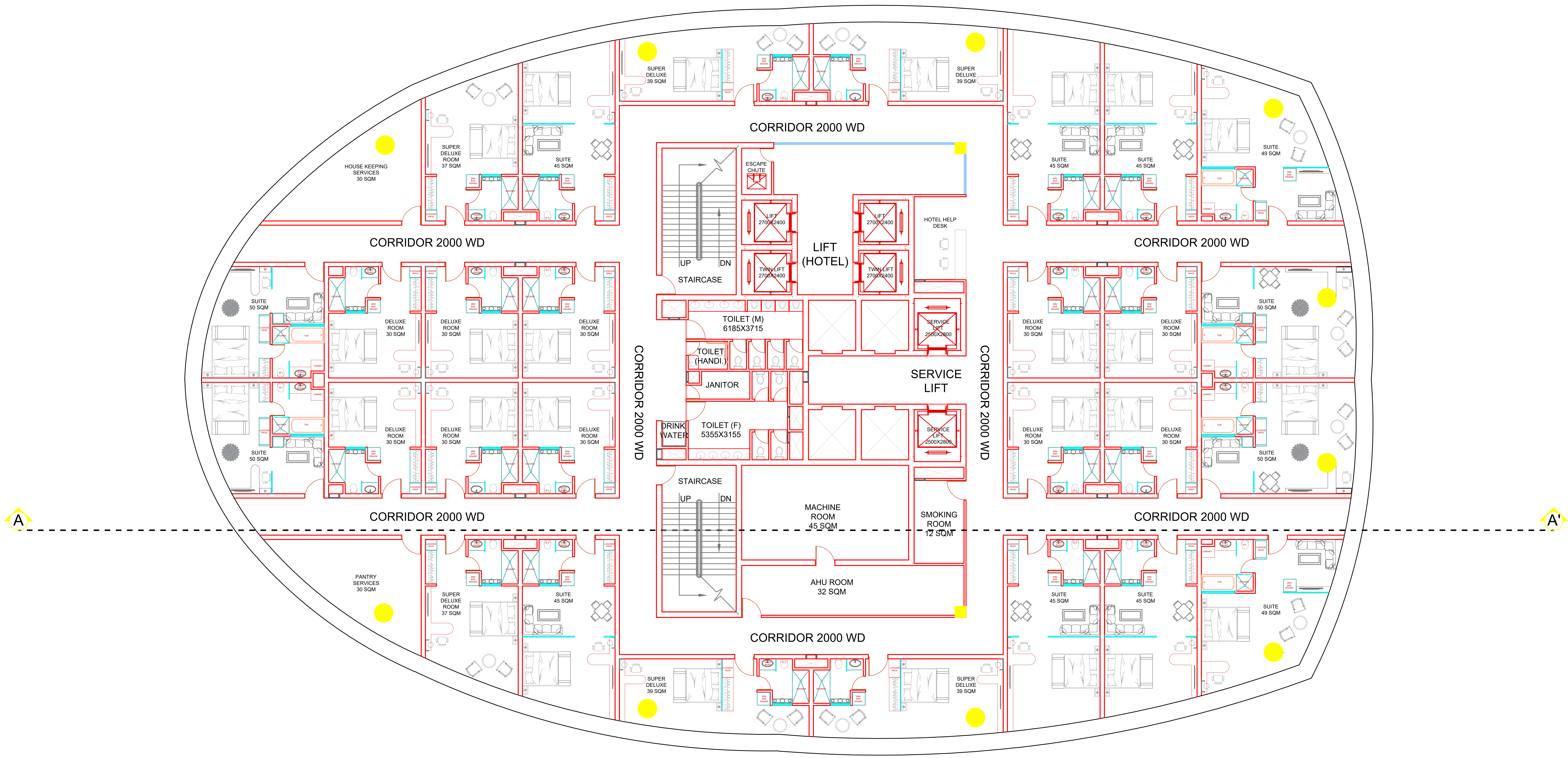
ICONIC TOWER AT KARKARDHOOMA

34TH FLOOR PLAN
WITH REFUGE AREA
(OFFICE)

N

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



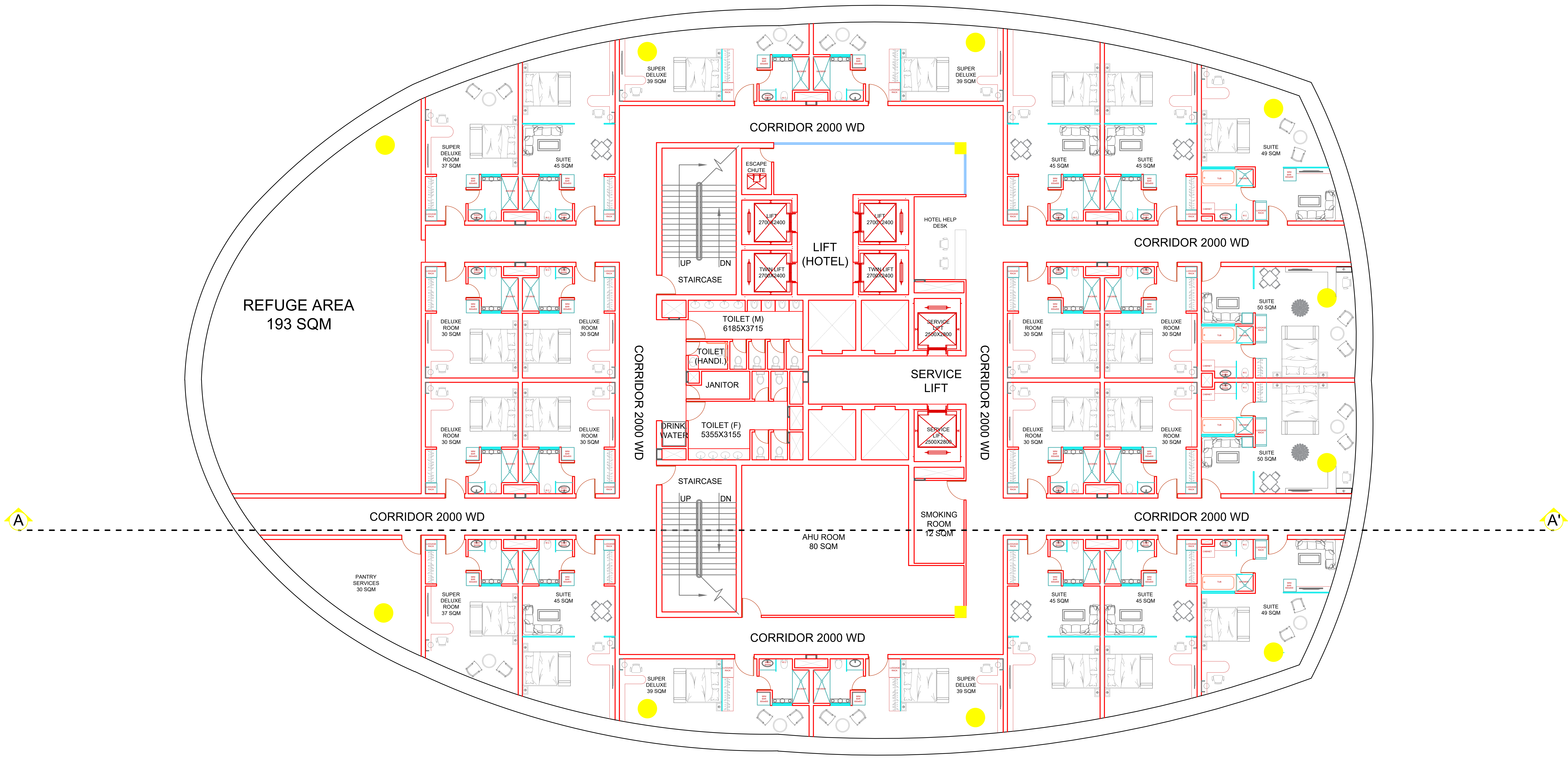
FLOOR PLATE: 2180 S.QM.

ICONIC TOWER AT KARKARDHOOMA

37th FLOOR PLAN
(HOTEL)

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



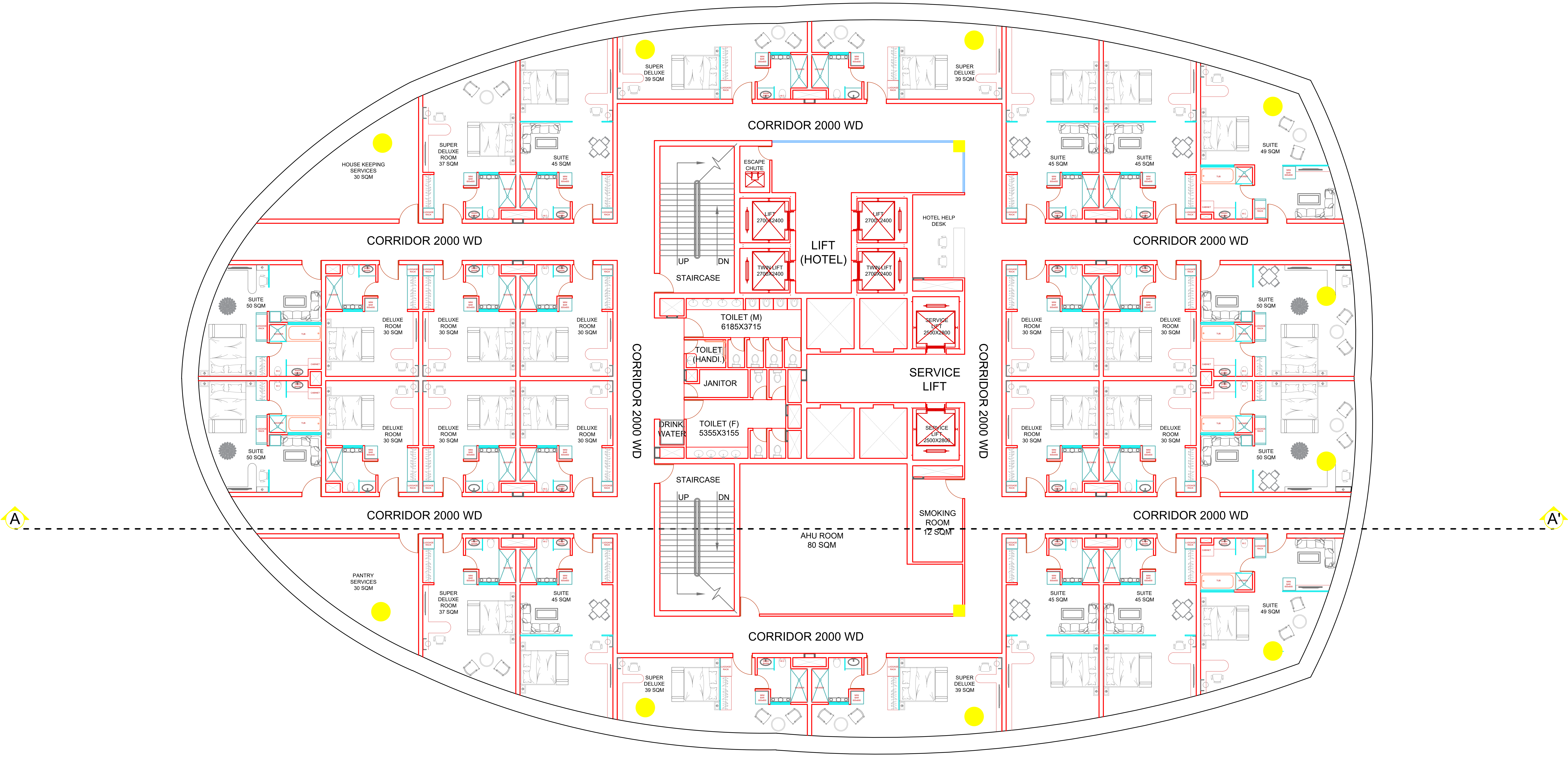
FLOOR PLATE: 2180 S.QM.

ICONIC TOWER AT KARKARDHOOMA

38th & 42th FLOOR PLAN WITH REFUGE AREA (HOTEL)

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



FLOOR PLATE: 2180 S.QM.

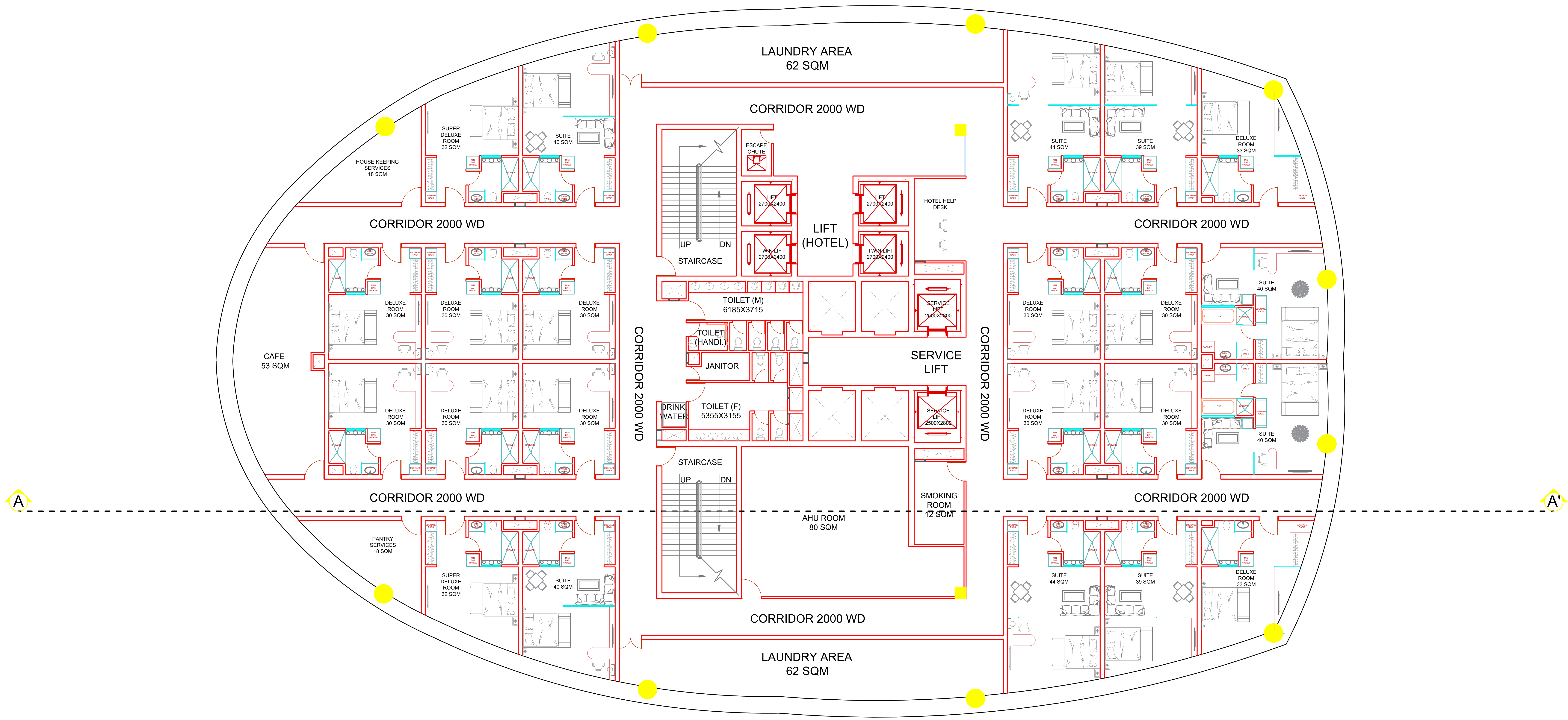
ICONIC TOWER AT KARKARDHOOMA

39TH,30TH,41TH TYPICAL FLOOR PLAN (HOTEL)

N

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



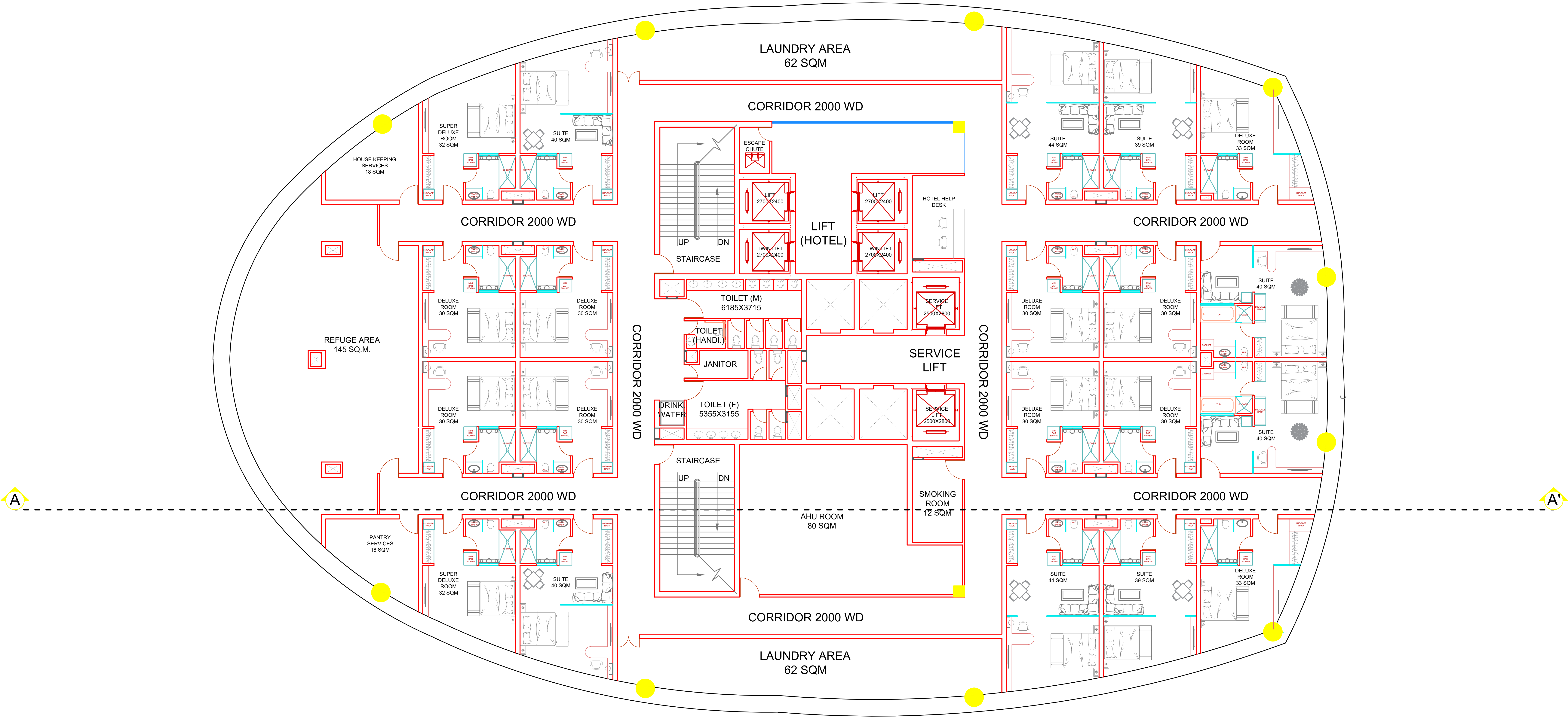
FLOOR PLATE: 1968 S.QM.

ICONIC TOWER AT KARKARDHOOMA

43TH,44TH & 45TH TYPICAL FLOOR PLAN (HOTEL)

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



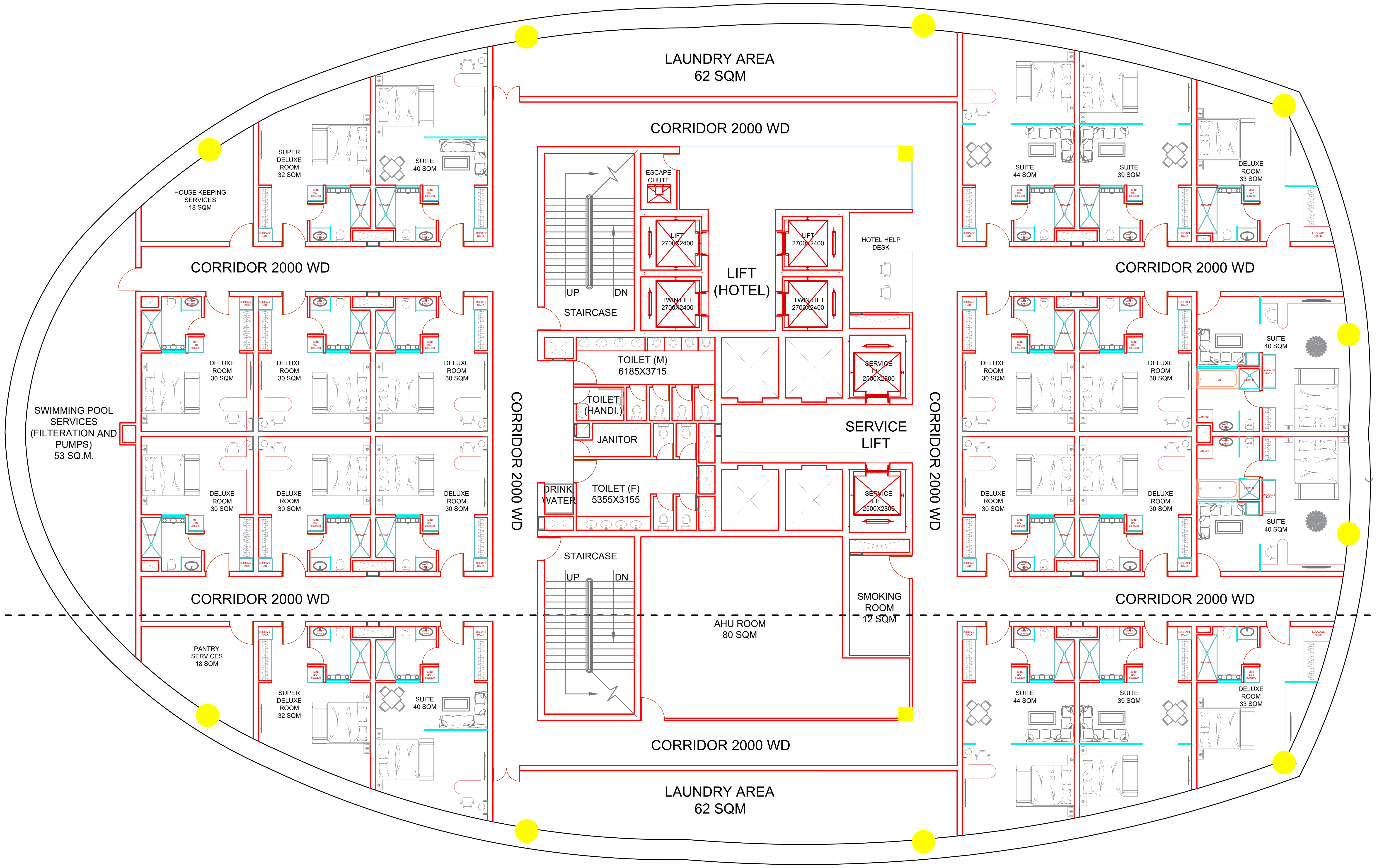
FLOOR PLATE: 1968 S.QM.

ICONIC TOWER AT KARKARDHOOMA

46th FLOOR PLAN WITH REFUGE AREA (HOTEL)

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



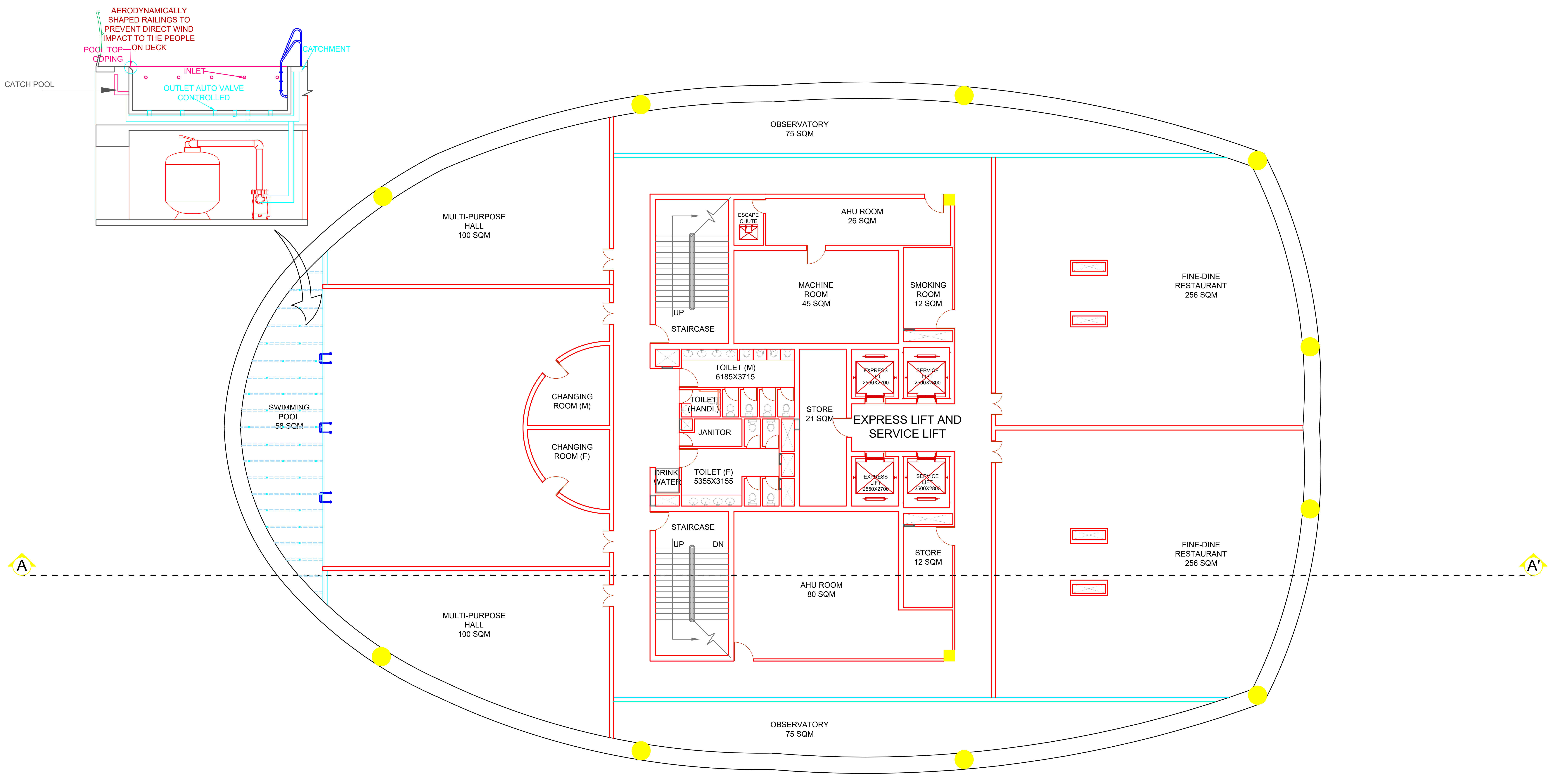
FLOOR PLATE: 1968 S.QM.

ICONIC TOWER AT KARKARDHOOMA

47th FLOOR PLAN
(HOTEL)

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



FLOOR PLATE: 1916 S.QM.

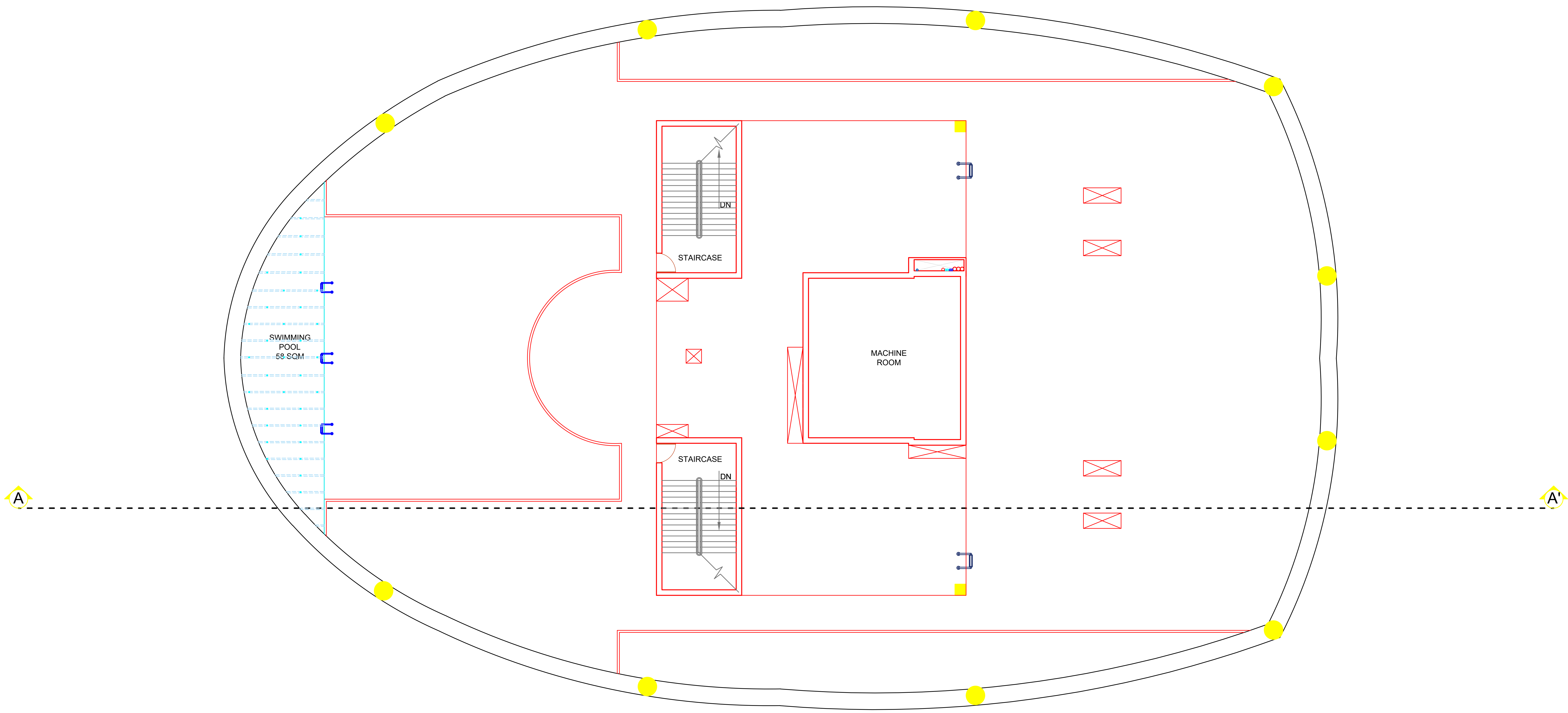
ICONIC TOWER AT KARKARDHOOMA

48TH FLOOR PLAN (OBSERVATORY)

N

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



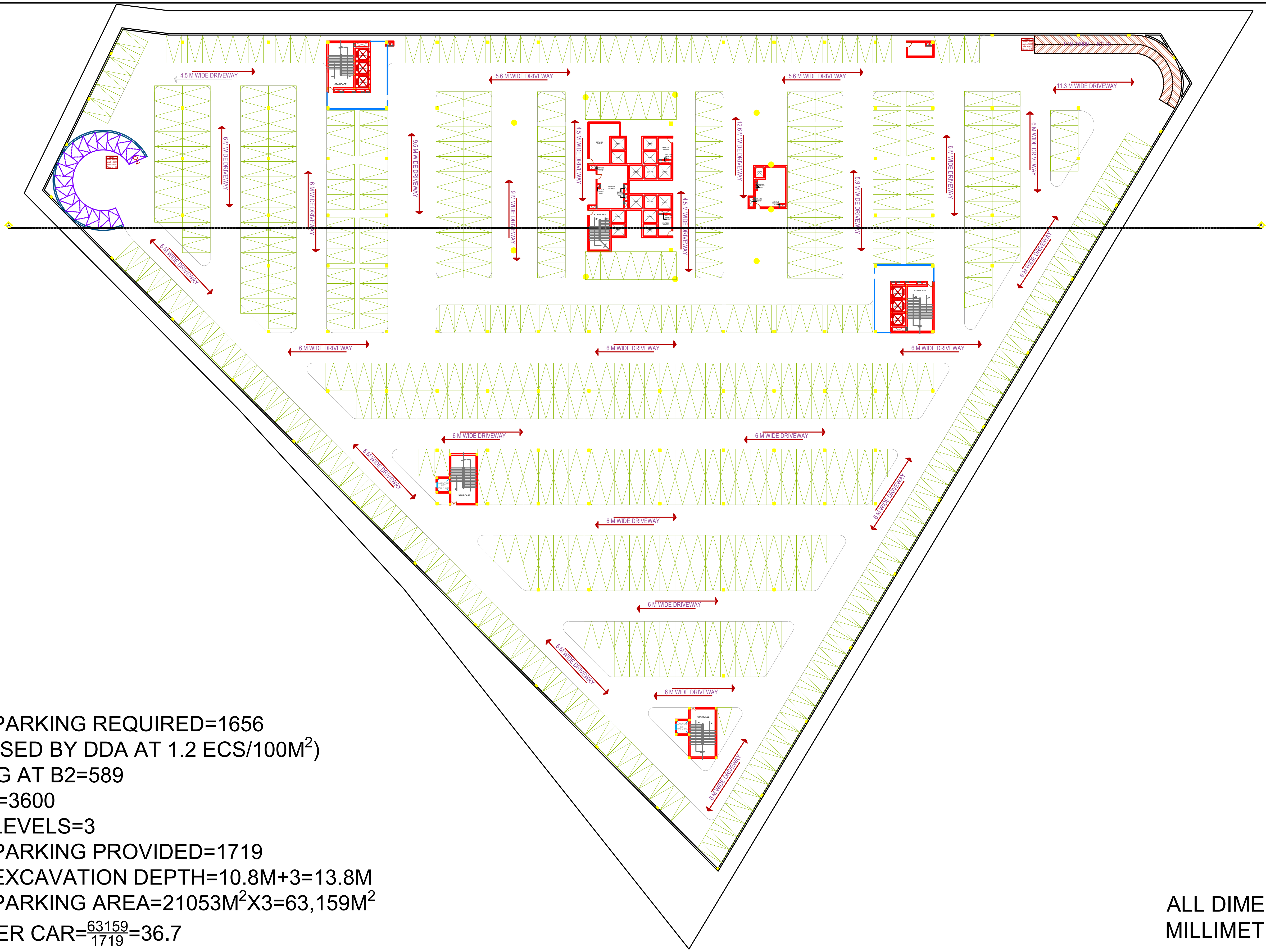
FLOOR PLATE: 1916 S.QM.

ICONIC TOWER AT KARKARDHOOMA

TERRACE PLAN

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



TOTAL PARKING REQUIRED=1656
(PROPOSED BY DDA AT 1.2 ECS/100M^2)
PARKING AT B2=589
LEVELS=3600
TOTAL LEVELS=3
TOTAL PARKING PROVIDED=1719
TOTAL EXCAVATION DEPTH=10.8M+3=13.8M
TOTAL PARKING AREA=21053M^{2}X3=63,159M^2
AREA PER CAR=$\frac{63159}{1719}$=36.7

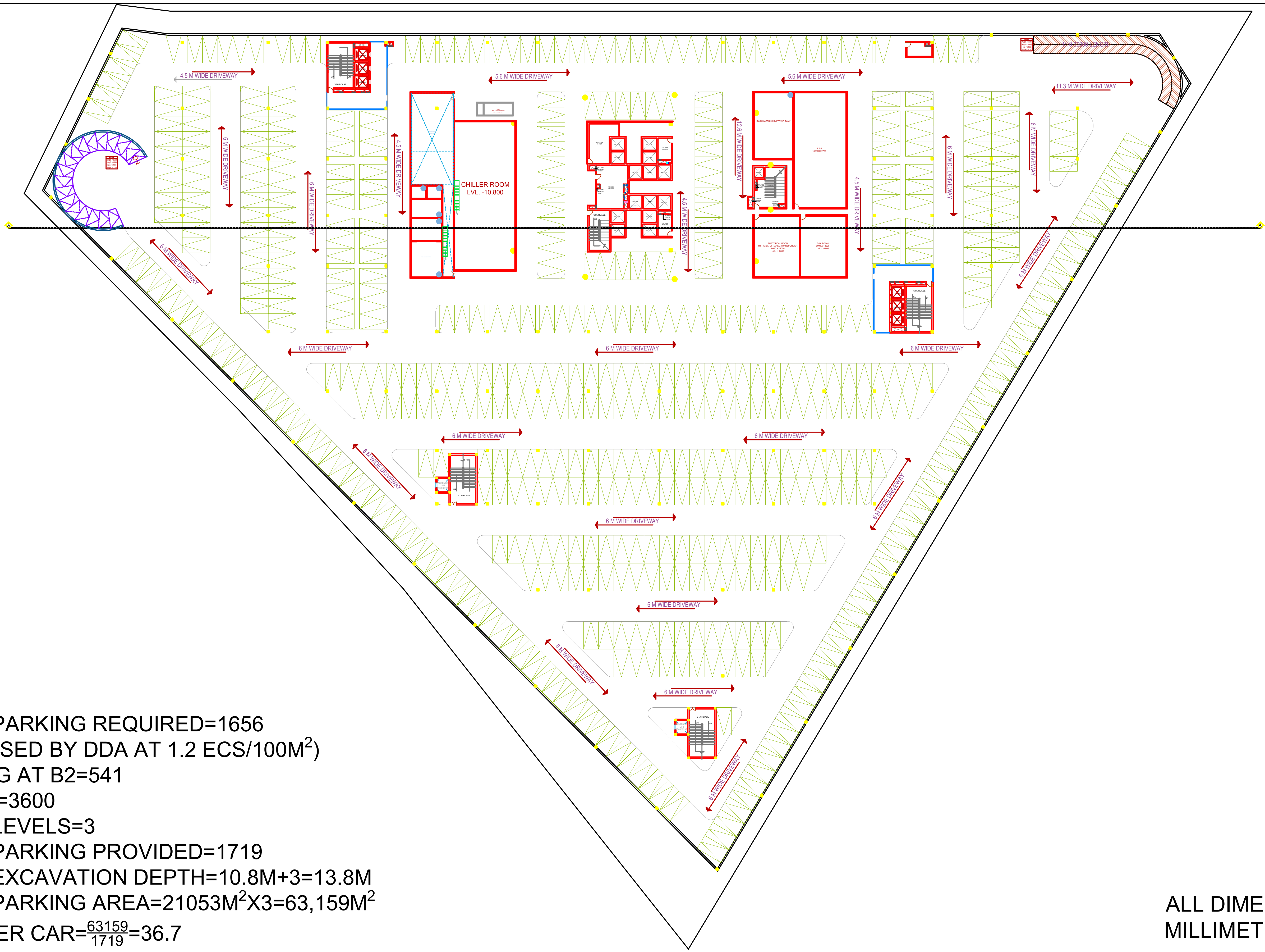
ALL DIMENSIONS ARE IN MILLIMETERS

ICONIC TOWER AT KARKARDHOOMA

BASEMENT (B1 & B2) FLOOR PLAN

SCALE- NTS

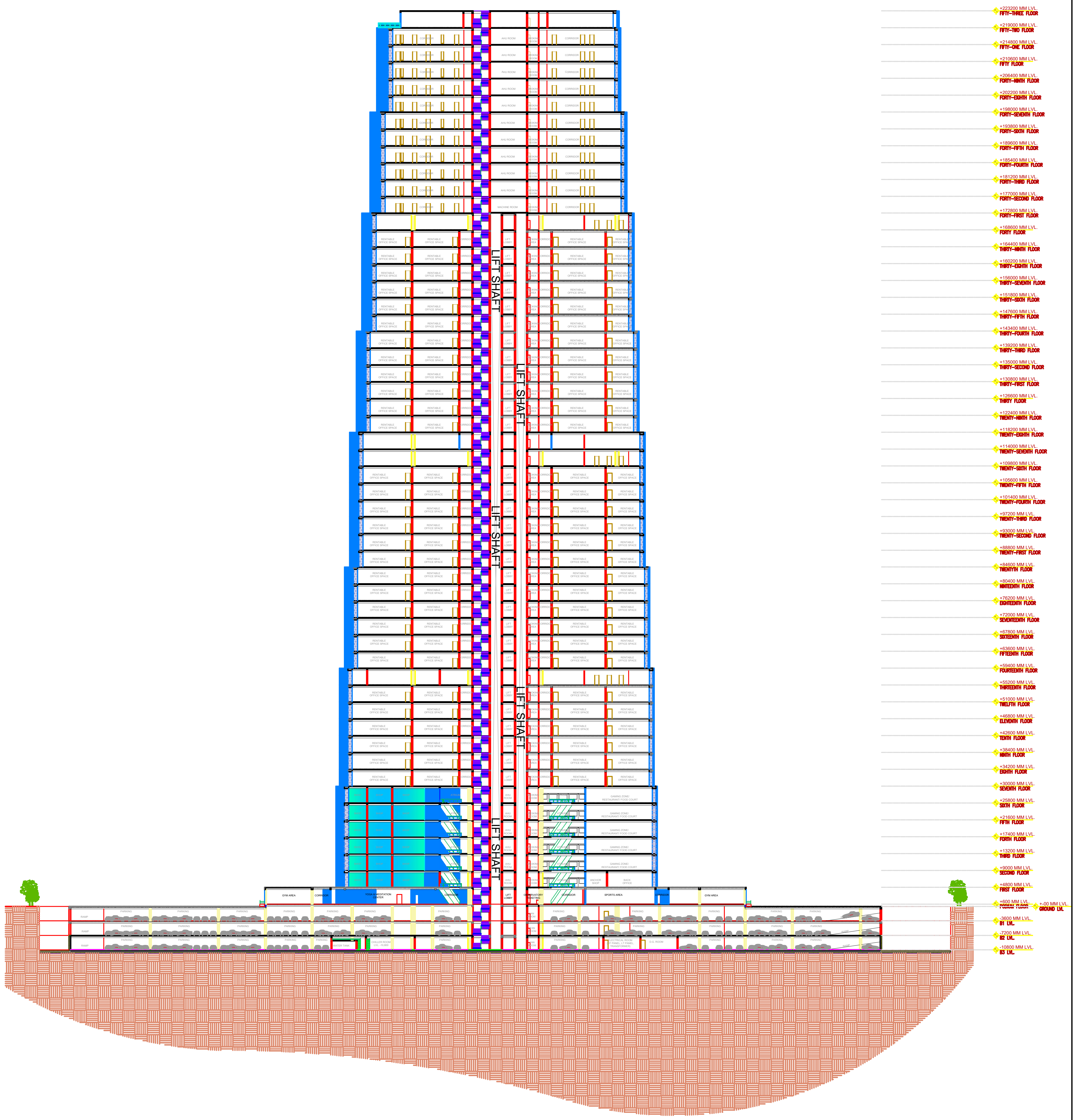
JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



TOTAL PARKING REQUIRED=1656
(PROPOSED BY DDA AT 1.2 ECS/100M^2)
PARKING AT B2=541
LEVELS=3600
TOTAL LEVELS=3
TOTAL PARKING PROVIDED=1719
TOTAL EXCAVATION DEPTH=10.8M+3=13.8M
TOTAL PARKING AREA=21053M^{2}X3=63,159M^2
AREA PER CAR=$\frac{63159}{1719}$=36.7

ALL DIMENSIONS ARE IN MILLIMETERS

# ICONIC TOWER AT KARKARDHOOMA	B3 BASEMENT PLAN	N	JANHVI P. SINGH 5th YEAR 10th SEM. B.ARCH 2019-20 ARCH. DESIGN B.B.D.U
		SCALE- NTS	



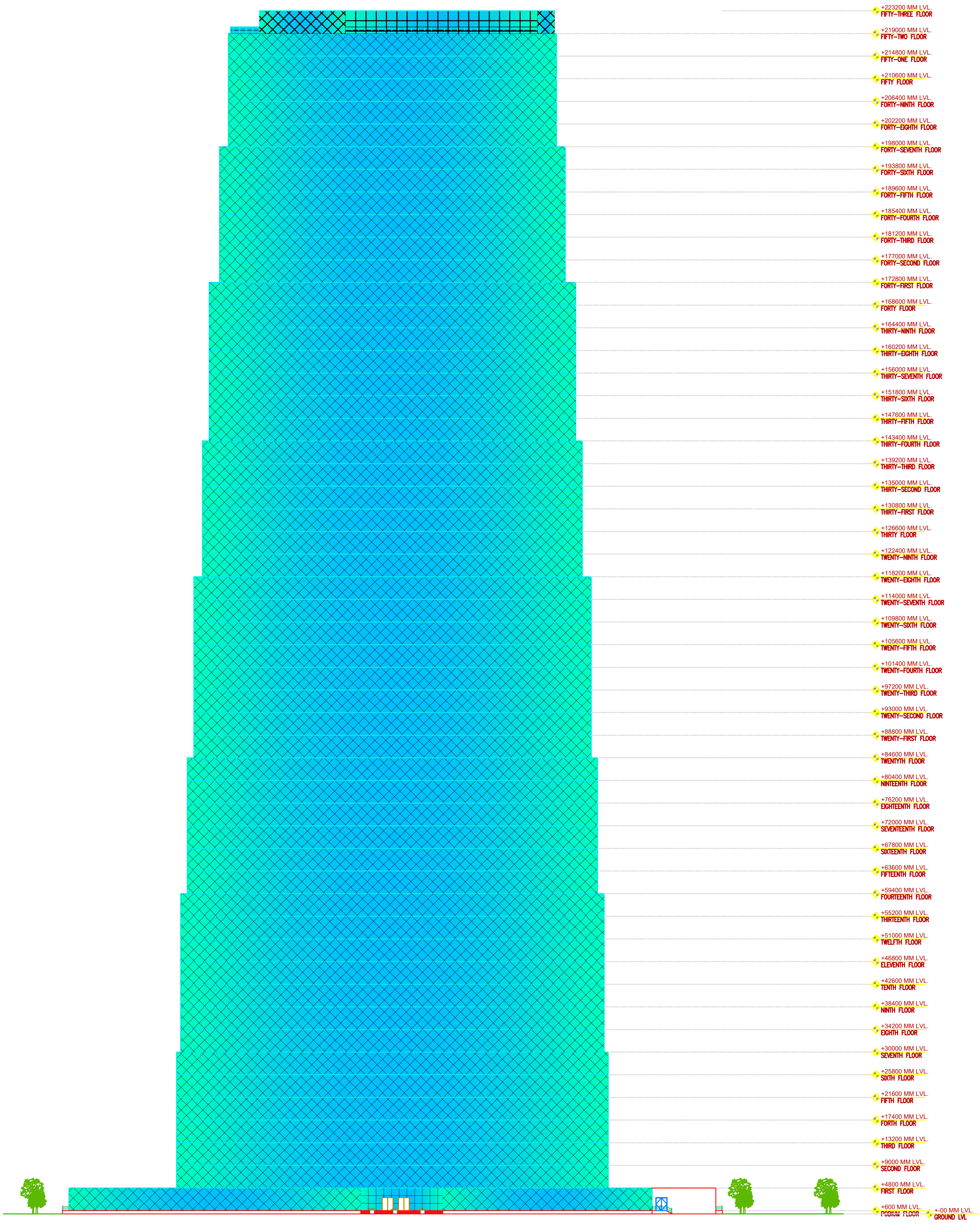
ALL DIMENSIONS ARE IN MILLIMETERS

ICONIC TOWER AT KARKARDHOOMA

SECTION AT A-A'

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



ALL DIMENSIONS ARE IN MILLIMETERS

ICONIC TOWER AT KARKARDHOOMA

ELEVATION

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U

LEGEND

	ASSAM RUBBER FICUS ELASTIA	33	SPREAD (12 -18) HEIGHT (12 -15)
	MANGO TREE	18	SPREAD (12 -16) HEIGHT (12 -15)
	CLIMBERS-CHINESE TRUMPET CLIMBING HYDRAGEA	382	SPREAD (1.5 -2) HEIGHT (12 -15)
	DOUBLE CHANDNI	7	SPREAD (2 -4) HEIGHT (3 -4)
	JUNCUS EFFUSUS	10	SPREAD (2 -4) HEIGHT (3 -4)
	PAPAVER COMMUTATUM	28	SPREAD (0.5 -1) HEIGHT (0.5 -1)
	BEGONIAS	36	SPREAD (2 -4) HEIGHT (4 -6)
	TAMARIND / IMLI TAMARINDUS INDICA	1	SPREAD (10 -12) HEIGHT (13 -15)
	BUXUS SEMPERVIRENS	8	SPREAD (5 -15) HEIGHT (5 -15)
	BOUGAINVILLEA SPECTABILIS	81	SPREAD (2 - 4) HEIGHT (1 -12)
	PALM TREE ROYSTONE REGIA	15	SPREAD (2 - 4) HEIGHT (12 -15)

ALL DIMENSIONS ARE IN MILLIMETERS

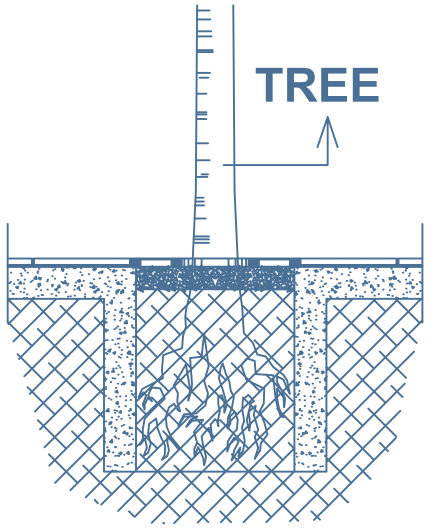
ICONIC TOWER AT KARKARDHOOMA

LANDSCAPE PLAN

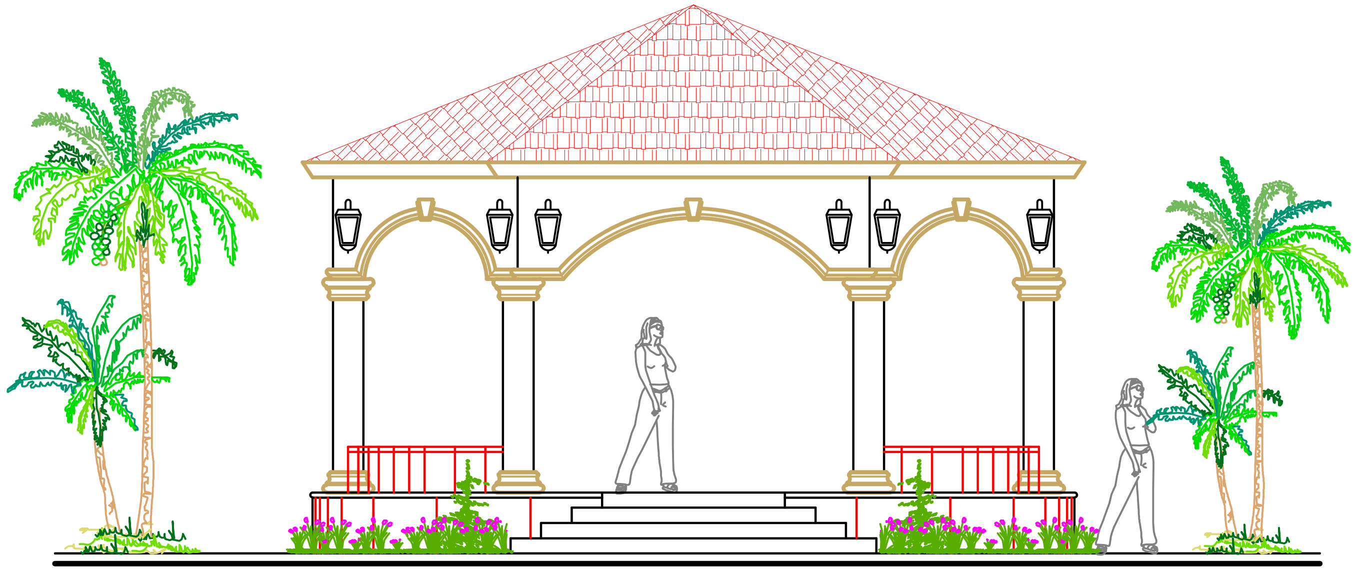
N

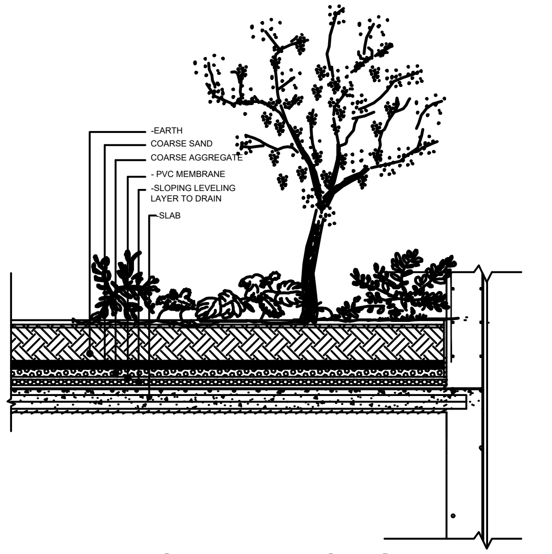
SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U

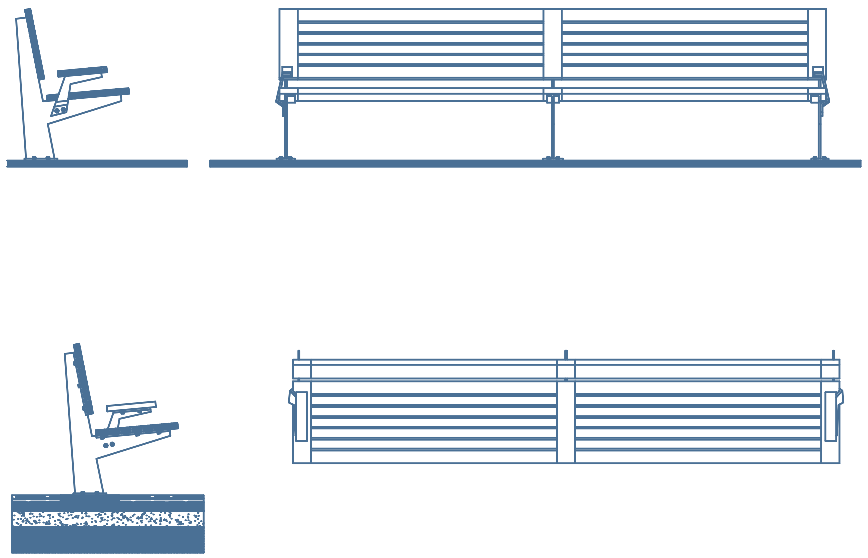


PLANTER DETAIL

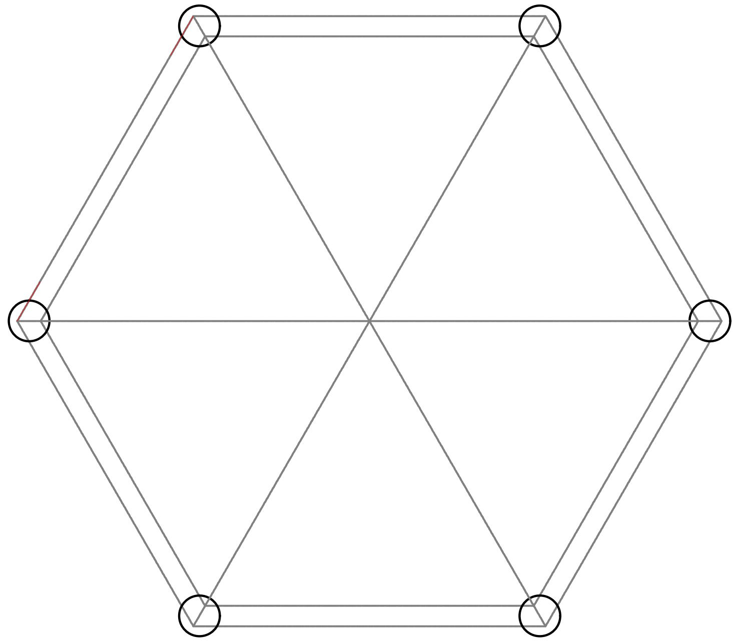


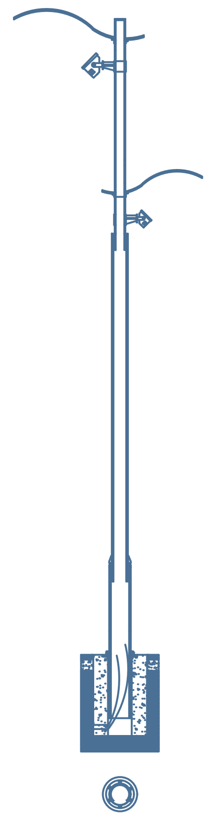


DETAIL OF TERRACE GARDEN



BENCH DETAIL

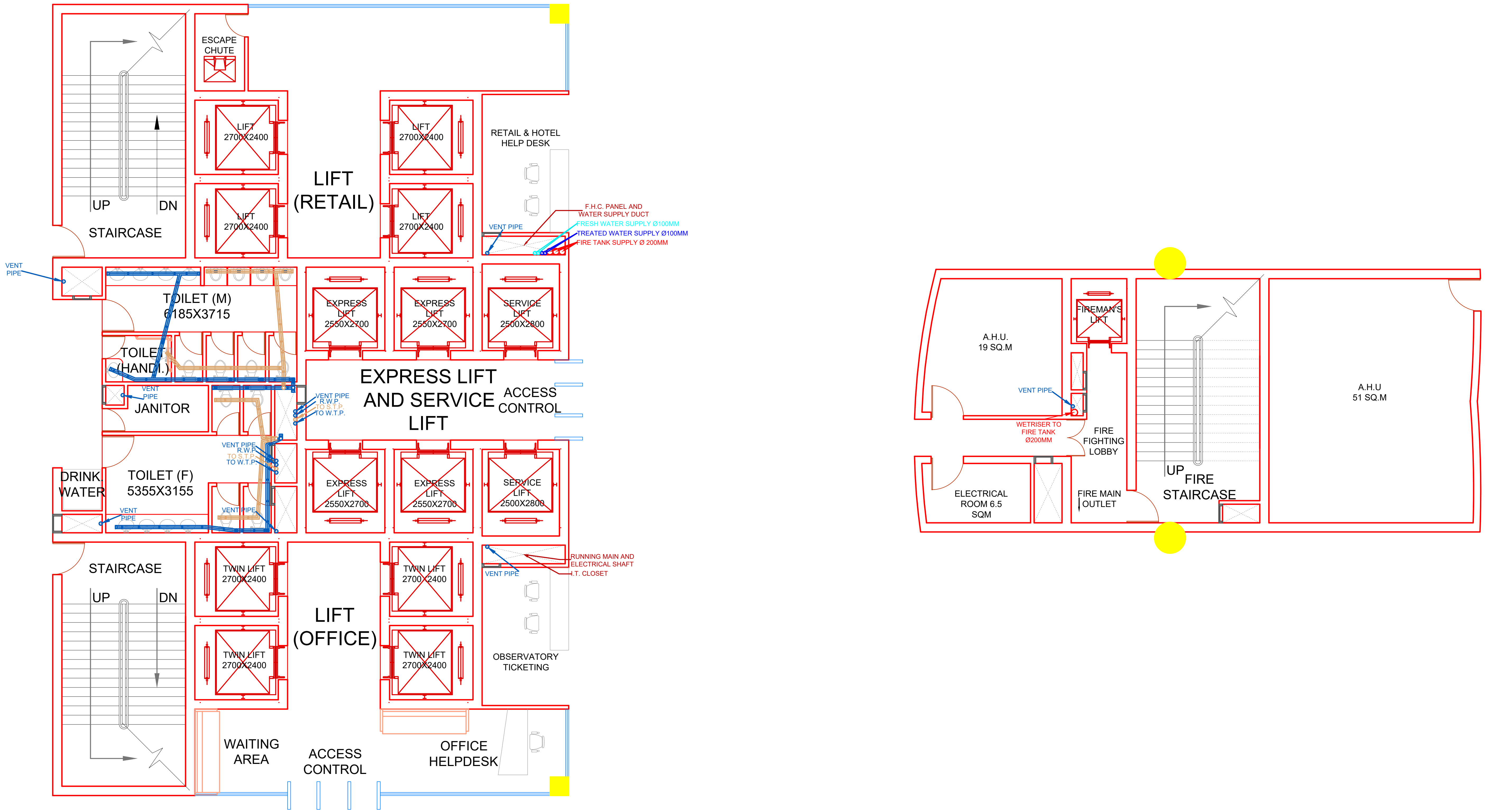




LIGHTING POST DETAIL

ALL DIMENSIONS ARE IN MILLIMETERS

ICONIC TOWER AT KARKARDHOOMA	LANDSCAPE DETAILS	N	JANHVI P. SINGH 5th YEAR 10th SEM. B.ARCH 2019-20 ARCH. DESIGN B.B.D.U
		SCALE- NTS	

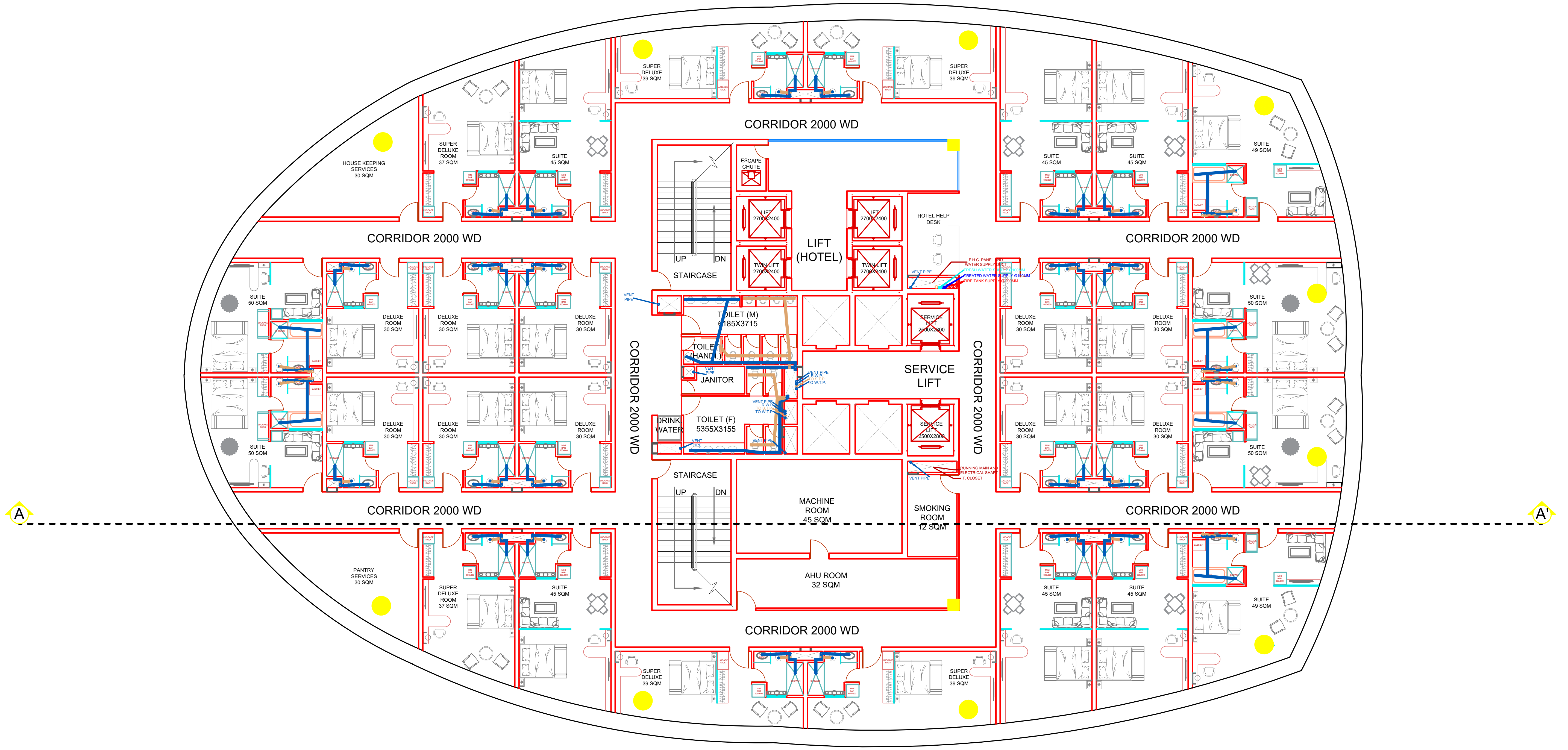


ICONIC TOWER AT KARKARDHOOMA

TYPICAL CORE PLUMBING LAYOUT (RETAIL & OFFICE)

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U

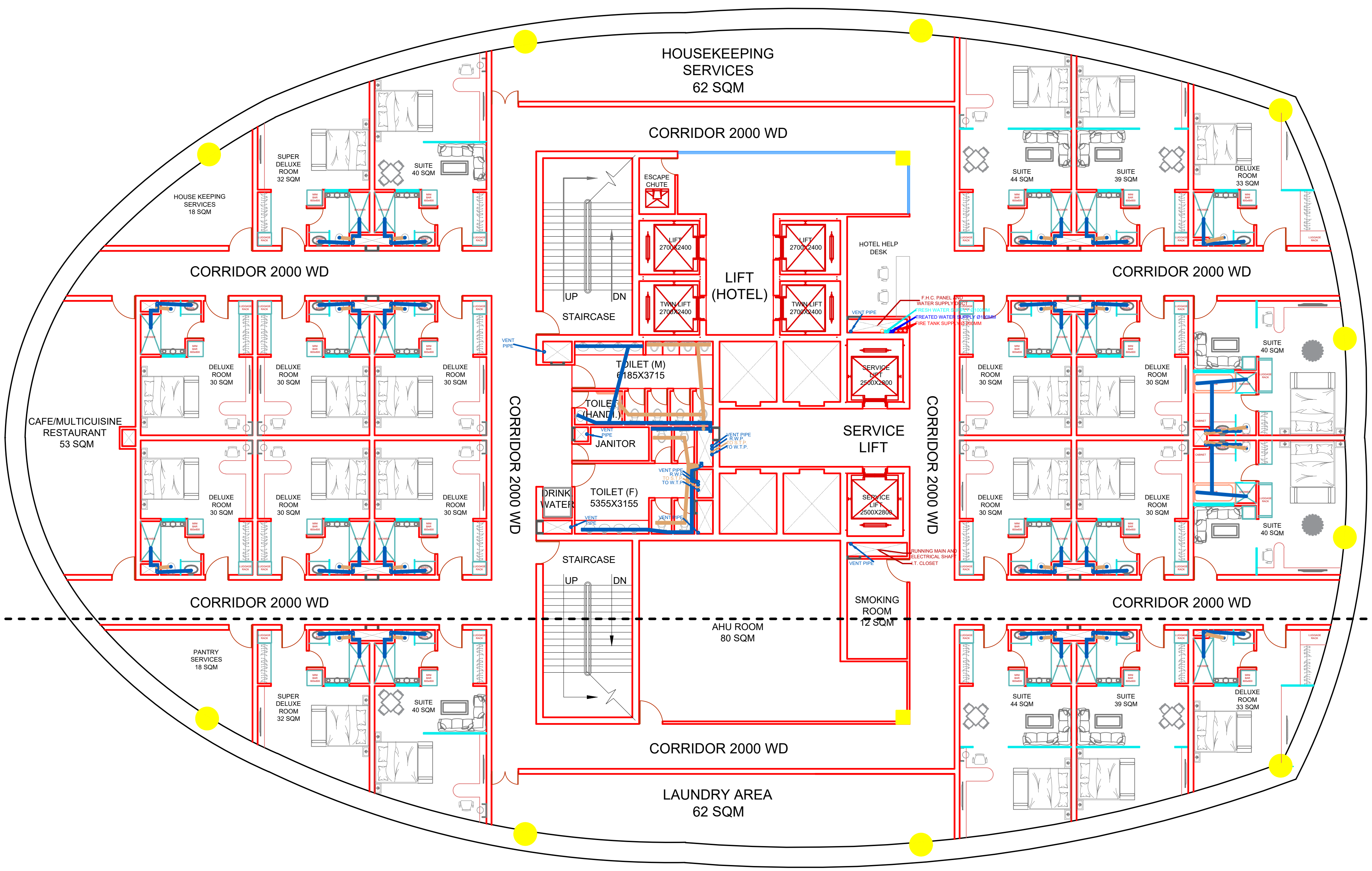


ICONIC TOWER AT KARKARDHOOMA

37th-42th FLOOR PLUMBING LAYOUT (HOTEL)

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U

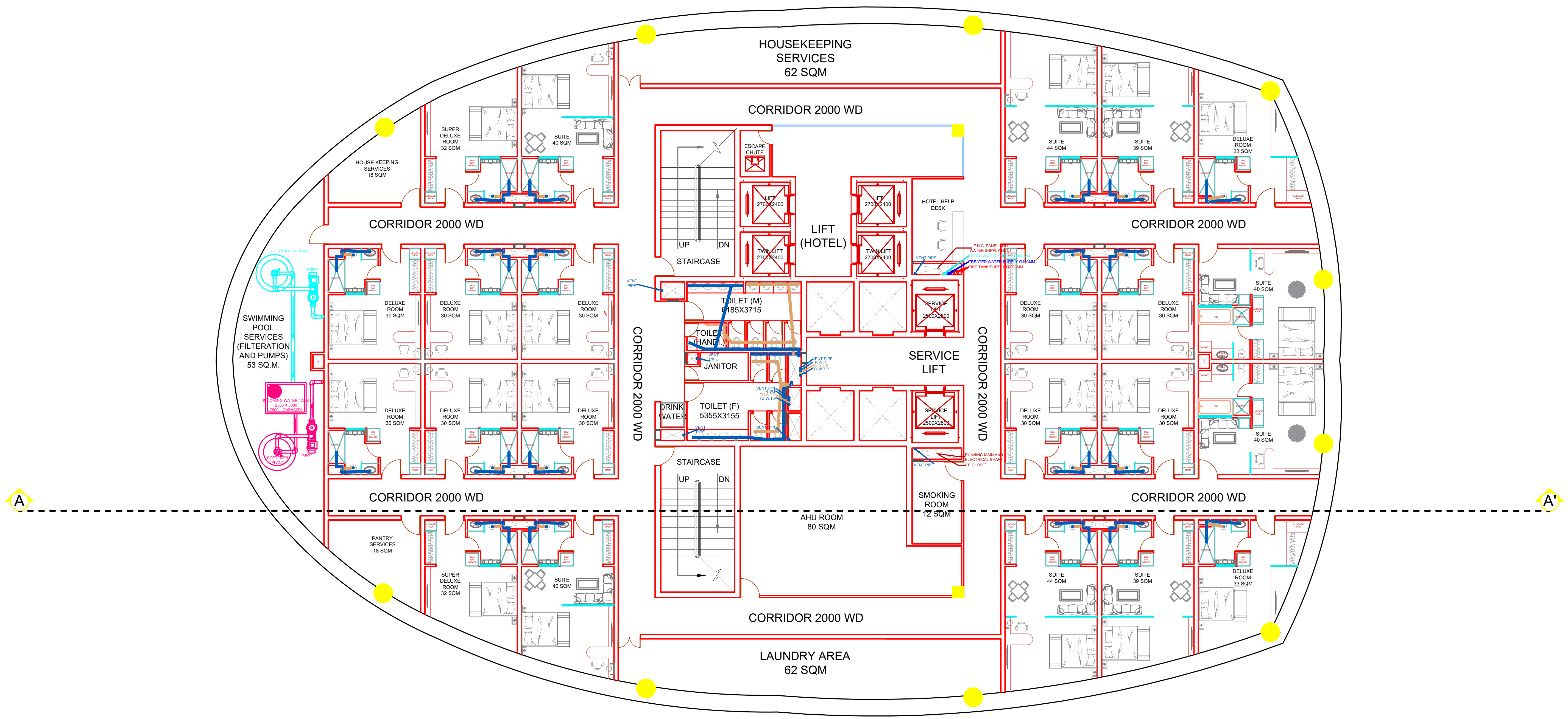


ICONIC TOWER AT KARKARDHOOMA

43th-46th PLUMBING LAYOUT(HOTEL)

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U

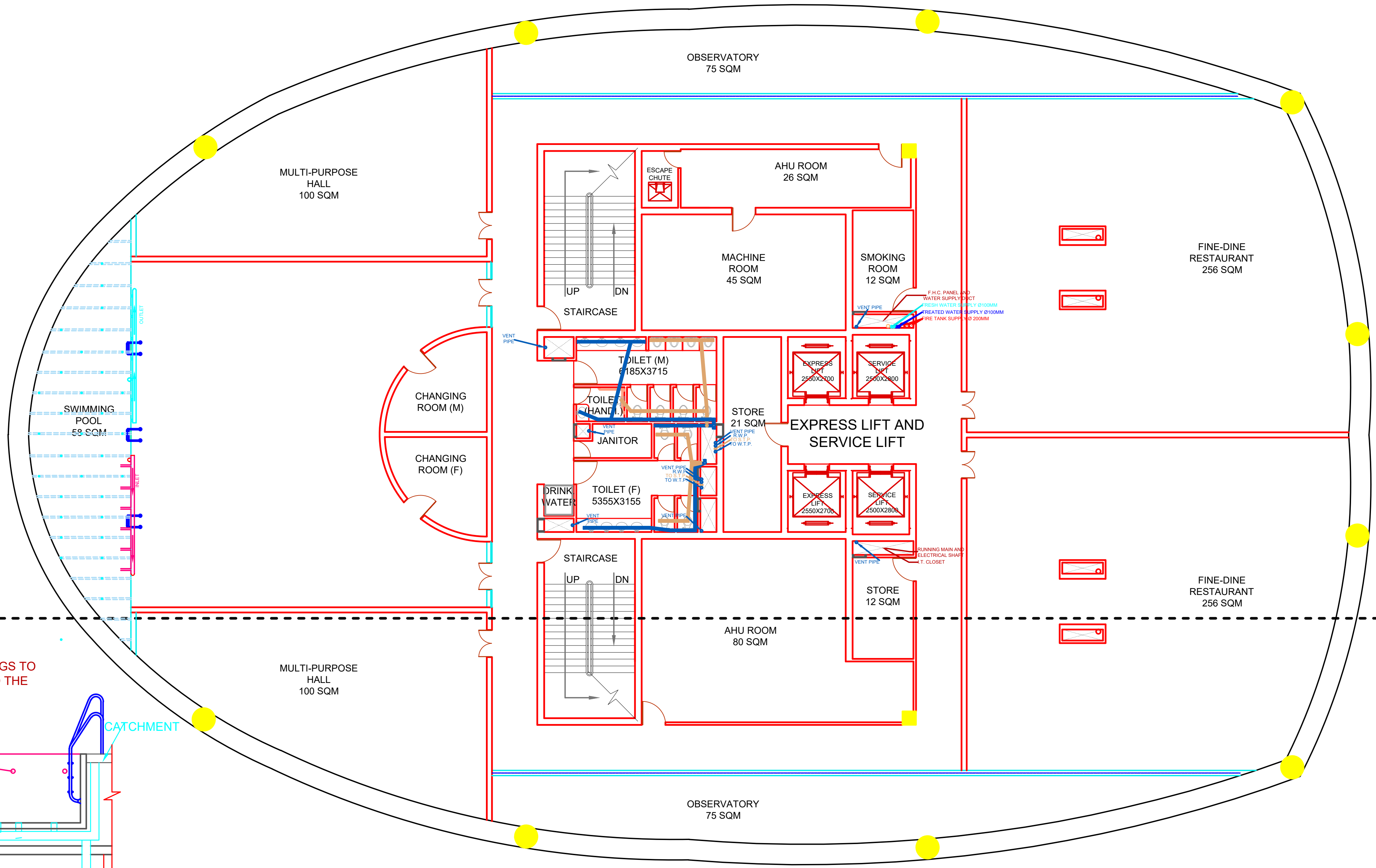


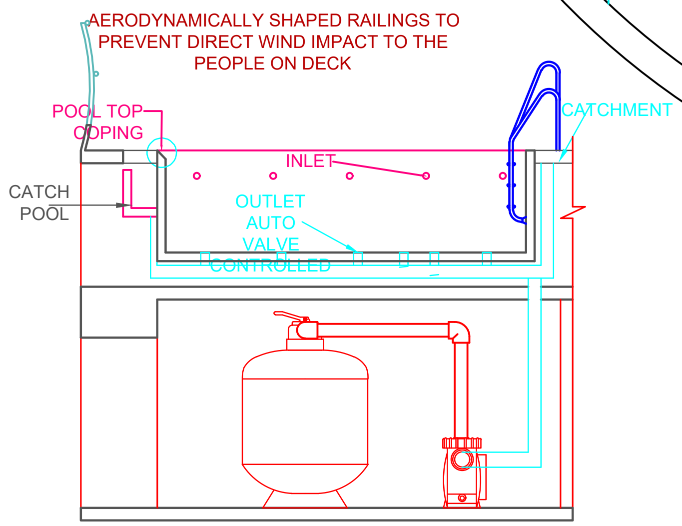
ICONIC TOWER AT KARKARDHOOMA

47th PLUMBING LAYOUT (HOTEL)

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



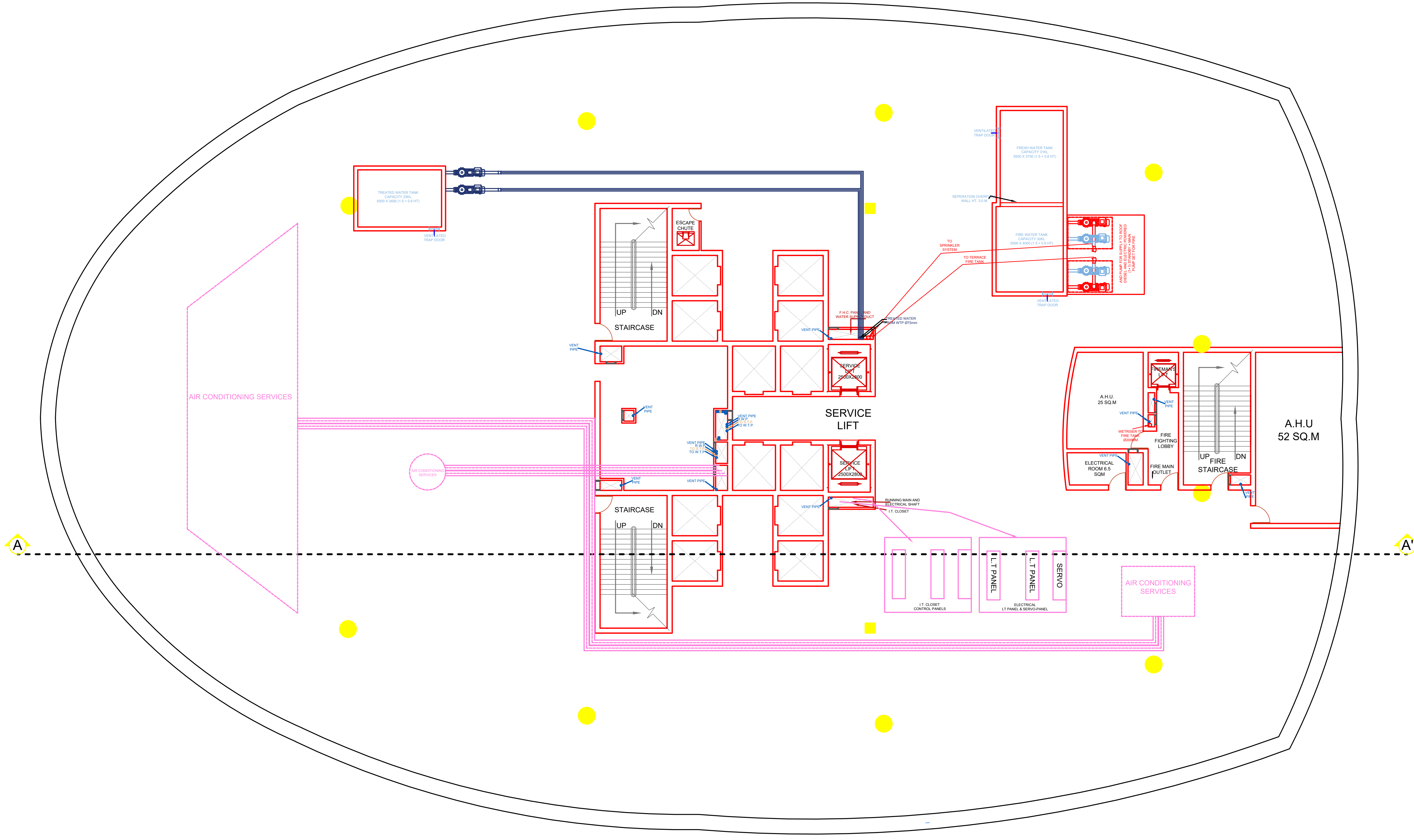


ICONIC TOWER AT KARKARDHOOMA

48TH PLUMBING LAYOUT (OBSERVATORY)

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U

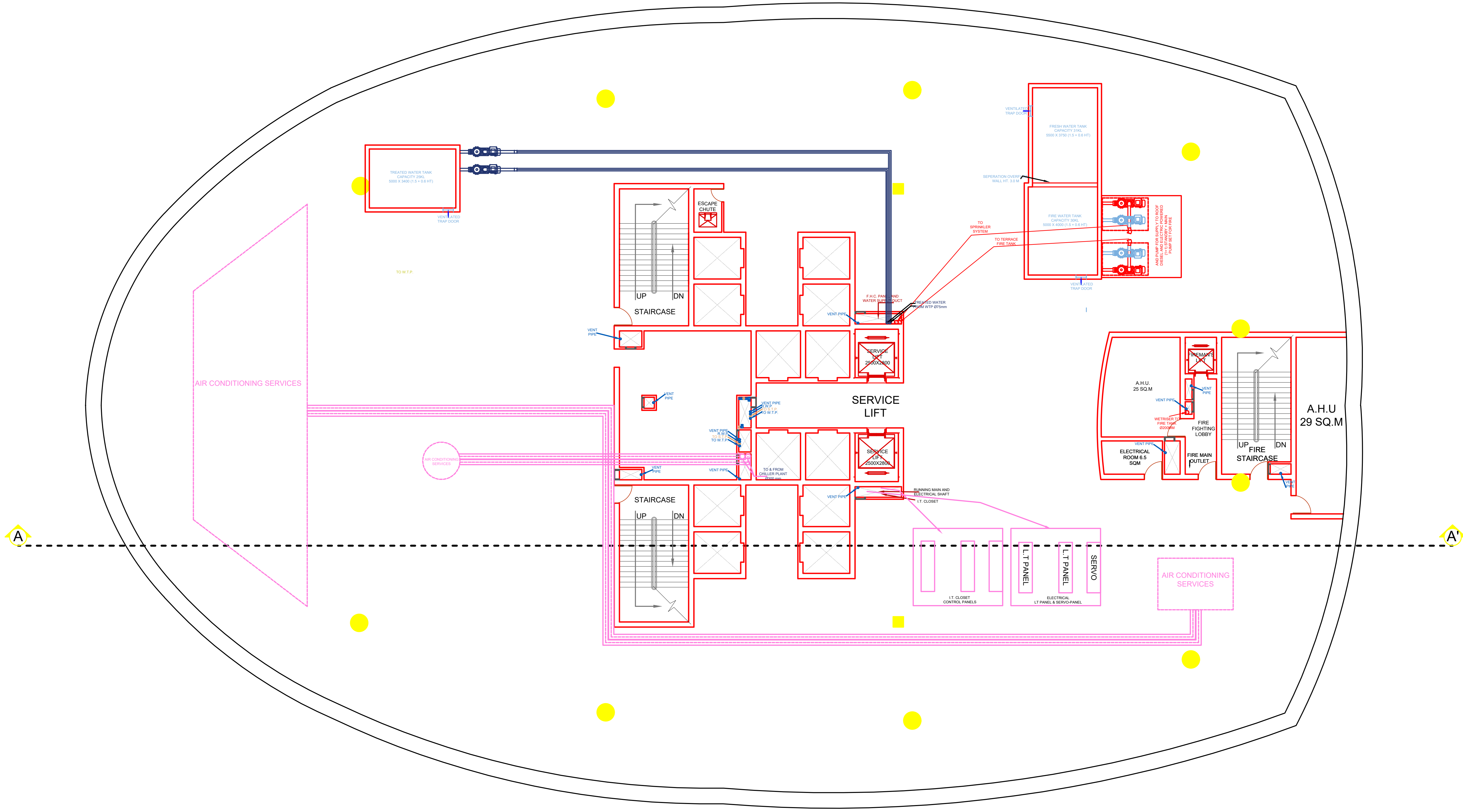


ICONIC TOWER AT KARKARDHOOMA

12M MECHANICAL FLOOR

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U

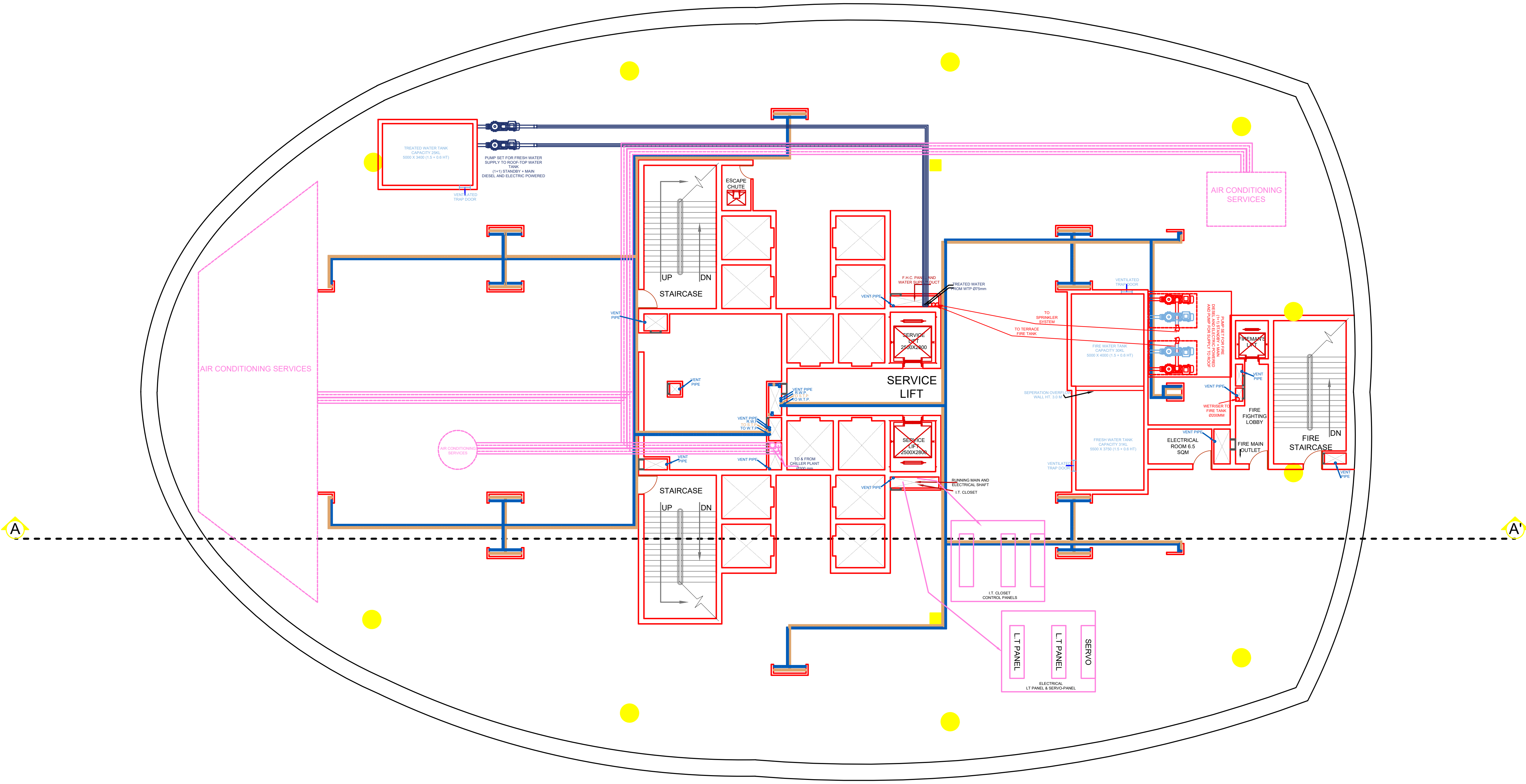


ICONIC TOWER AT KARKARDHOOMA

24M MECHANICAL FLOOR

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U

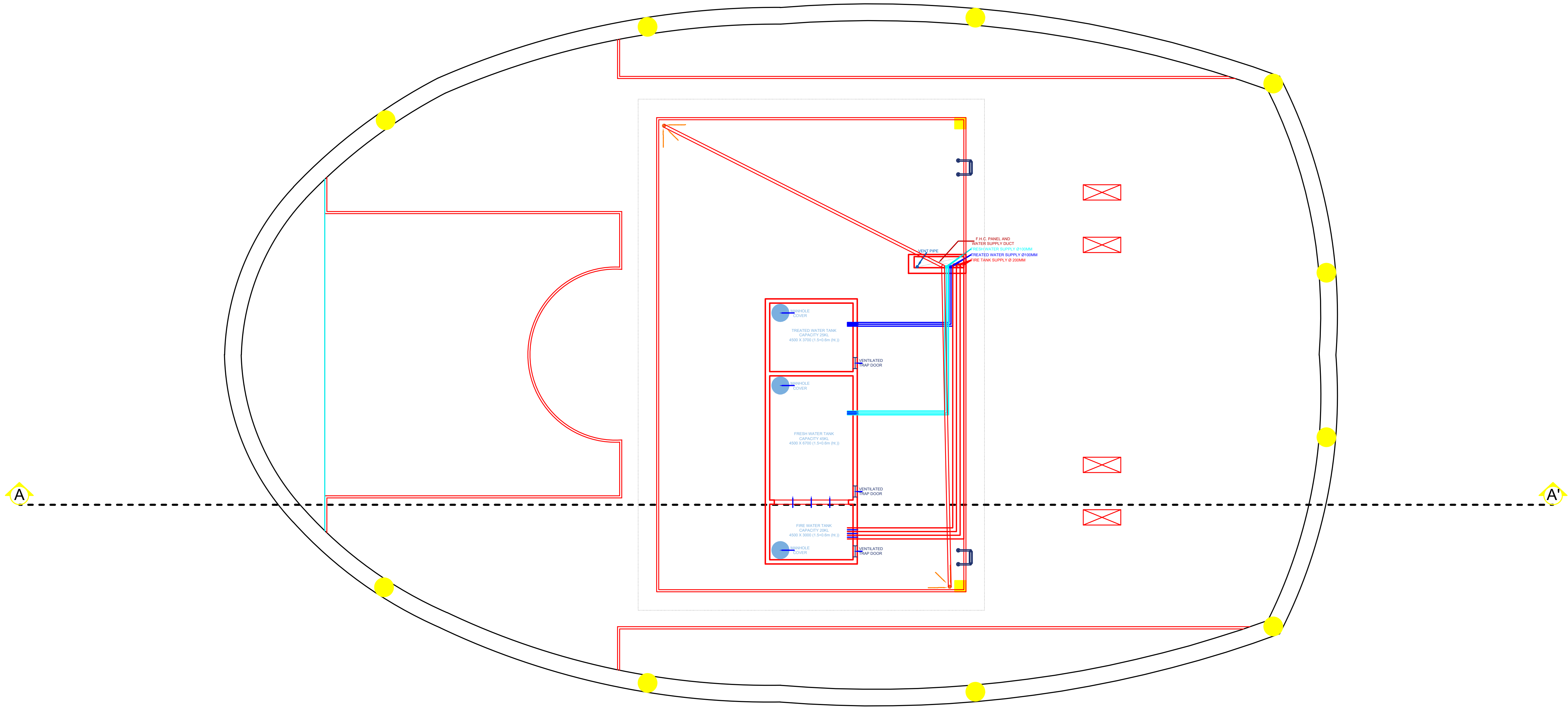


ICONIC TOWER AT KARKARDHOOMA

36M MECHANICAL FLOOR

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U

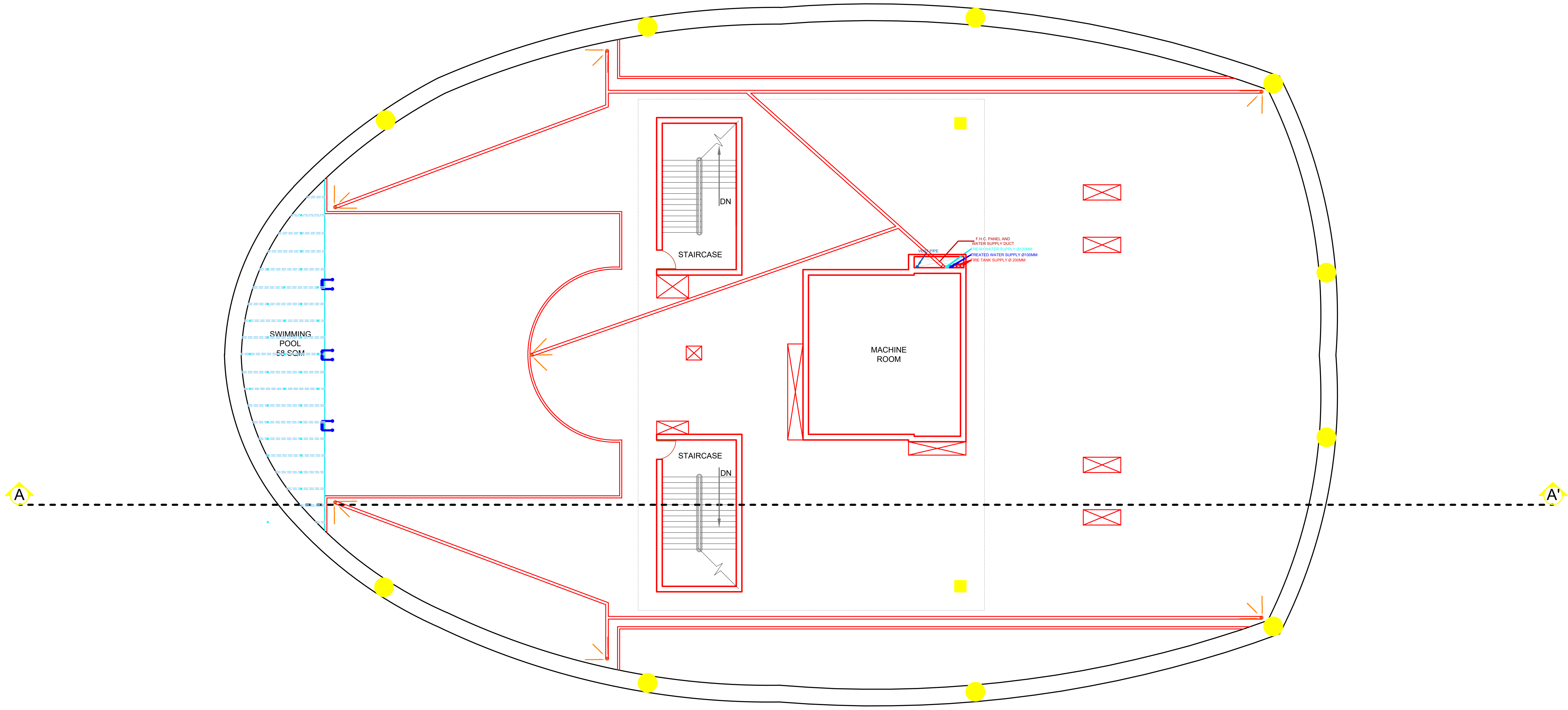


ICONIC TOWER AT KARKARDHOOMA

TERRACE PLUMBING LAYOUT (OBSERVATORY)

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



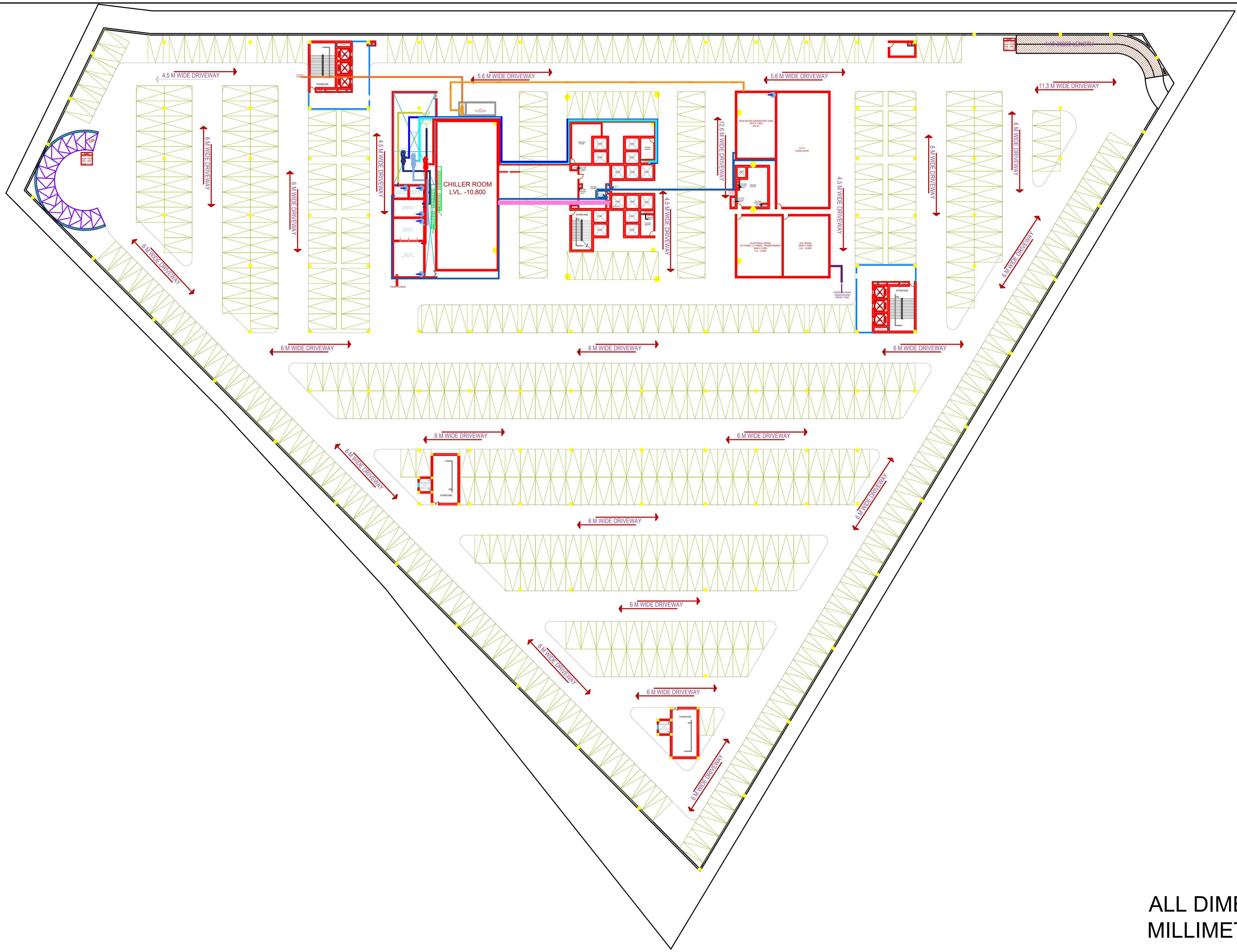
ICONIC TOWER AT KARKARDHOOMA

TERRACE PLUMBING LAYOUT (OBSERVATORY)

N

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U



ALL DIMENSIONS ARE IN MILLIMETERS

ICONIC TOWER AT KARKARDHOOMA

B3 BASEMENT PLUMBING LAYOUT

SCALE- NTS

JANHVI P. SINGH
5th YEAR 10th SEM.
B.ARCH 2019-20
ARCH. DESIGN
B.B.D.U