BUILDING MODELING AND DESIGNING

A Major Project Report

Submitted to the Rajasthan Technical University

in partial fulfillment of requirements for the award of degree

Bachelor of Technology

in

Civil Engineering

by

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CERTIFICATE

This is to certify that the report entitled **Building Modeling and Designing** submitted by Ujjwal Jain (19ETCCE008.), to Department of civil Engineering in partial fulfillment of the B.Tech. degree in **Civil Engineering** is a bonafide record of the seminar work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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DECLARATION

I Ujjwal Jain hereby declare that the major project report **Building Modeling and Designing**, submitted for partial fulfillment of the requirements for the award of degree of Bachelor of Technology of the Rajasthan Technical University, Kota, Rajasthan is a bonafide work done by me under supervision of Jitendra Choubisa.

This submission represents my ideas in my own words and where ideas or words of others have been included, I have adequately and accurately cited and referenced the original sources.

I also declare that I have adhered to ethics of academic honesty and integrityand have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

Udaipur

20-04-2023

Ujjwal Jain

Abstract

Our aim is to be made a building which would deliver to the client with his complete requirements given by the client. We deliver the plan with respect to the vastu as well as engineering and architecture point of view. In which the circulation of fresh air and light would be absolute. And the building would be structurally strong, which can bear all loads and forces applied on the building.

The building can suffer in every kind of load failure type phenomena. Like earthquake, wind load, snow load, soil failure etc.

Acknowledgement

I take this opportunity to express my deepest sense of gratitude and sincere thanks to everyone who helped me to complete this work successfully. I express my sincere thanks to Rakesh Yadav, Head of Department, Civil Engineering, Techno India NJR Institute of Technology Udaipur for providing me with all the necessary facilities and support.

I would like to express my sincere gratitude to Jitendra Choubisa, department of Civil Engineering, Techno India NJR Institute of Technology, Udaipur for their support and co-operation.

I would like to place on record my sincere gratitude to my project guide Nishit Jain, Assistant Professor, Civil Engineering, Techno India NJR Institute of Technology for the guidance and mentorship throughout the course.

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Chapter 1

Introduction

AIM

Our main aim to complete a Multi-storey building is to ensure that the structure is safe against all possible loading conditions and to full fill the function for which they have built. Safety requirements must be met so that the structure is able to serve its purpose with the maintain cost. Detailed planning of the structure usually comes from several studies made by town planners, investors, users, architects and other engineers. On that, a structural engineer has the main influence on the overall structural design and an architect is involved in aesthetic details. For the design of the structure, the dead load, live loads, seismic and wind load are considered. The analysis and design for the structure done by using a software package STAAD PRO. In this project multistoried construction, we have adopted limit state method of analysis and design the structure. The design is in confirmation with IS456-2000.the analysis of one frame is worked out manually and simultaneously it has been checked using STAAD PRO. Therefore an attempt has been made to present the multistoried building for residential purpose in the busy city of Hyderabad. The complex consisting of five storeys the structure is design based on the theory of LIMIT STATE METHOD which provides adequate strength, serviceability and durability besides economy.

STATEMENT OF PROJECT

Salient Features : The design data shall be as follows.

1. Utility Of Buildings : Residential Building
2. Area of each floor : 9633 sqft.
3. No Of Storey : G+3
4. Shape of the Building : Rectangular
5. No. Of Staircases : One
6. No. Of Lifts : One
7. Types Of Walls : Brick Wall
8. Material Details

8.1 Concrete Grade : M25

All Steel Grades : HYSD REINFORCEMENT of Grade Fe415

9. Bearing Capacity of Soil : 200 KN/M2
10. Type Of Construction :R.C.C FRAMED structure

Chapter 2

Literature Survey

Major advances in both design and new material assisted roman architecture. Design was enhanced architectural developments in the construction of arches and roof domes. Arches improved the efficiency and capability of bridges and aqueducts (fewer supports columns were needed to support the structure), while domed roofs not only permitted the building of larger open areas undercover, but also lent the exterior an impressive. The social unit that lives in a house is known as a household. Most commonly, a household is family unit of a same kind, though households can be other social groups, such as single person, or groups of unrelated individuals. Settled agrarian and industrial societies are composed of household units living permanently in housing of various types, according to a variety of farms of lands tenure. English-speaking people generally call any building there routinely occupy “home”. Many people leave their houses during the day for work and recreation, and return to them to sleep or for other activities.

Chapter 3

ARCHITECTURE

Architecture is the art and science of designing buildings and structures. A wider definition would include within its scope also the design of the total built environment, from the macro level of creating furniture. In the field of building architecture, the skill demanded of an architect range from the more complex, such as for a hospital or stadium, to the apparently simpler, such as planning residential houses. Many architectural works may be seen also as cultural and political symbols, and /or work of art. The role of architect though changing, has been central to the successful design and implementation of pleasing built environments in which people live. Scope: Architectural is an interdisciplinary field, drawing upon mathematics, science, art technology, social sciences, politics, history and philosophy. Vitrifies states: “architecture is a science, arising out of many other sciences, and adorned with much and varied learning: by the help of which is judgment is formed of those works which are result of other arts”. Most modern-day definition of “good buildings” recognize that because architecture does not exist in a vacuum, architectural form cannot be merely a completion of historical precedent, fictional necessities ; and socially aware concerns, but most also be a trance dents synthesis of all of the former and a creation of worth in and of itself. As Nunziarodanini stated, “through its aesthetic dimension architecture goes beyond the functional aspects that it has in common with other human sciences…through its own particular way of expressing values, architecture can stimulate and influence social life without presuming that, in and of itself, it will promote social development. To restrict the meaning of formalism to art for art’s sake is not only reactionary; it can be a purposeless quest for perfection or originality which degrades fro, into a mere instrumentally” The term can be used to connect the implied architecture of abstract things such as music or mathematics the apparent architecture of natural things, such as geological formations or the structure of natural things such as geological formations or the structure of natural things such as geological formation or the structure of biological cells, or explicitly planned architectures of human made things such as software, computers, enterprises, and databases, in addition to buildings. In every usages an

architecture may be seen as subjective mapping fro, a human perspective (that of the user in the case of abstract or physical artifacts) to the elements or components. Architecture is both the process and product of planning designing and constructing space the reflects functional, social and aesthetic considerations. It requires the manipulation and coordination of material. Technology, light and shadow. Architecture also encompassed the pragmatic aspects of realizing designed spaces, such as project planning, cost estimating and construction administration. Architectural works are often perceived as cultural and political symbols and as work of art. Historical civilization is often identified with their surviving architectural achievements. Brunelleschi, in the building of the dome of Florence cathedral, not only transformed the cathedral and the city of Florence, but also the role and status of the architecture. With the consolidation of knowledge in scientific such as engineering and the rise of new building material and technology; the architect began to lose ground on the technical aspect of building. Therefore he concerned playing field that of aesthetics. There was the rise of the "gentlemen architect" who usually dealt with wealthy clients and concentrated predominantly on visual qualities derived usually from historical prototypes. In the 19th century, Cole des Beaux Arts in France, the training was toward producing quick sketch schemes involving beautiful drawings without much emphasis on context. The rise of profession of industrial design is usually placed here. Following this lead, the Bauhaus school, founded in Germany in 1919, consciously rejected history and looked at architecture as synthesis of art craft and technology. Architects such as Miens van Dee roe worked to reject the virtually all that had come before, trading handcrafted details and sentimental historic forms for a machine driven architectural geometry made possible by the Industrial Revolution. They felt that architecture was not a personal philosophical or aesthetic pursuit by individual rather it had to consider everyday needs of people and use technology to give a livable environment. That design Methodology Movement involving people such as chirrs Jones, Christopher Alexander started for more people-oriented designs. Extensive studies on areas such as behavioral, environmental, and social science were done started informing the design process. as many other concerns began to be recognized, complexity of buildings began to increase in terms of aspect to be recognized, and complexity of buildings began to increase in terms of aspect such as services, architecture started becoming more multi-disciplinary than ever. While the notion that structural and aesthetic consideration should be entirely subject to functionality, which met with both popularity an skepticism, it had the effect of

introducing the concept of “function” in the place of Vitruvius “utility”. “Function” came to be seen as encompassing all criteria of the use, perception and enjoyment of a building, not only practical but also aesthetic, psychological and cultural. “Now-a-day’s Architecture required a team of professionals in its making”. An architect is being one among the many and sometimes the leader. This I the state of the professional today, however, individually o still cherished and sought the design of buildings seems as cultural symbols – the museum of fine arts Centre has become a showcase for new experiments in style, tomorrow may be something’s else. In the late 20th century, a new concept was added to those include in the compass of both structure and function, the consideration of sustainability. To satisfy the contemporary ethos a building should be a constructed in a materials, its impact upon the natural and built environment of its surroundings area and the demands that it makes upon non-sustainable power sources for the heating, cooling water and waste management and lighting. When modern architecture was first practiced, it was an avant-garde movement with moral, philosophical, and aesthetic underpinnings. Modernist architects sought to reduce buildings to a pure form, removing historical references in favors of purely fictional structures. The column arches and gargoyles of classical architecture were dubbed unnecessary. Buildings that flaunted their construction exposing steel beams and concrete surfaces instead of hiding them behind traditional forms were beams and concrete surfaces instead of hiding them behind traditional forms were seen as beautiful in their own right. Architecture first evolved out of the dynamics between needs (shelter, security, worship etc.,) and means (available building material and attendant skills). As human culture evolved and knowledge began to be formalized through oral tradition and practices, architectures became a craft

Chapter 4

ARCHITECTURAL
LAYOUT DRAWINGS

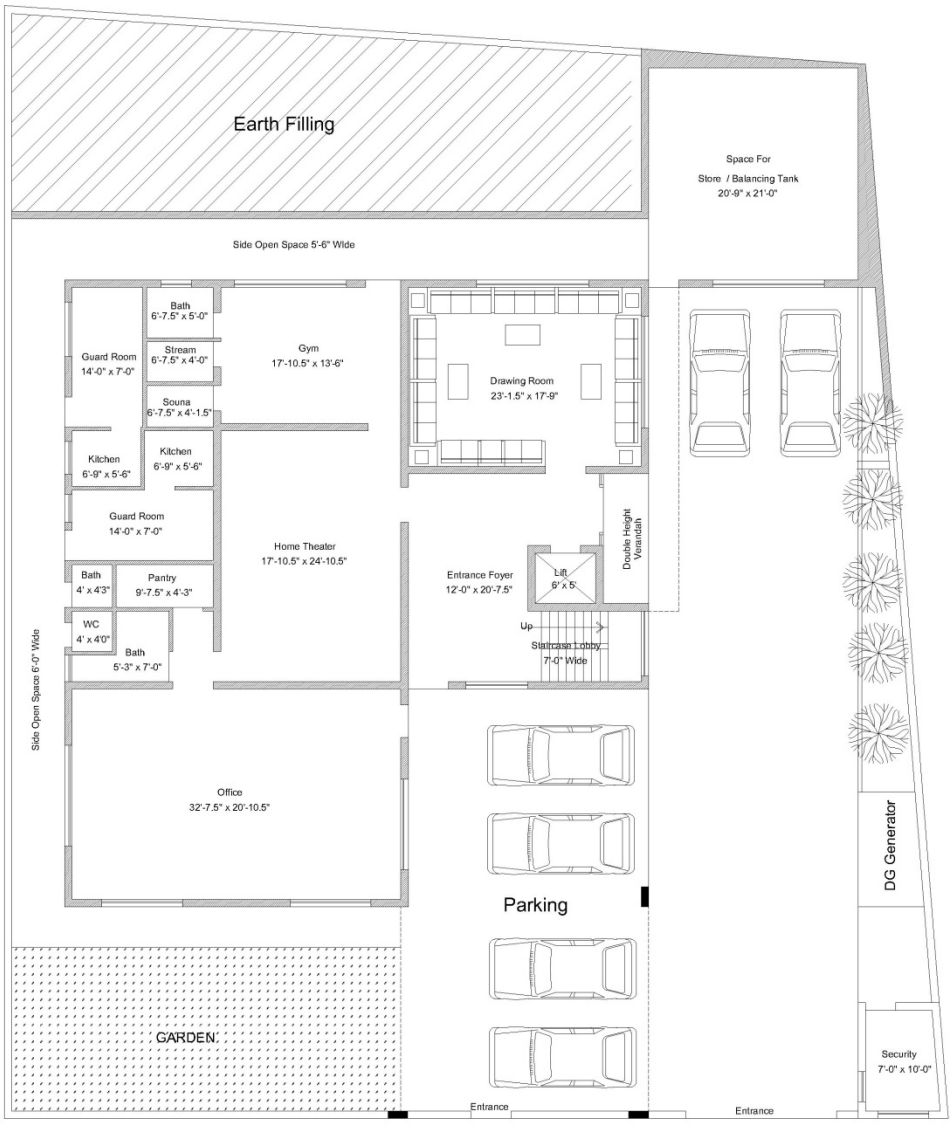


Figure 1 Ground Floor

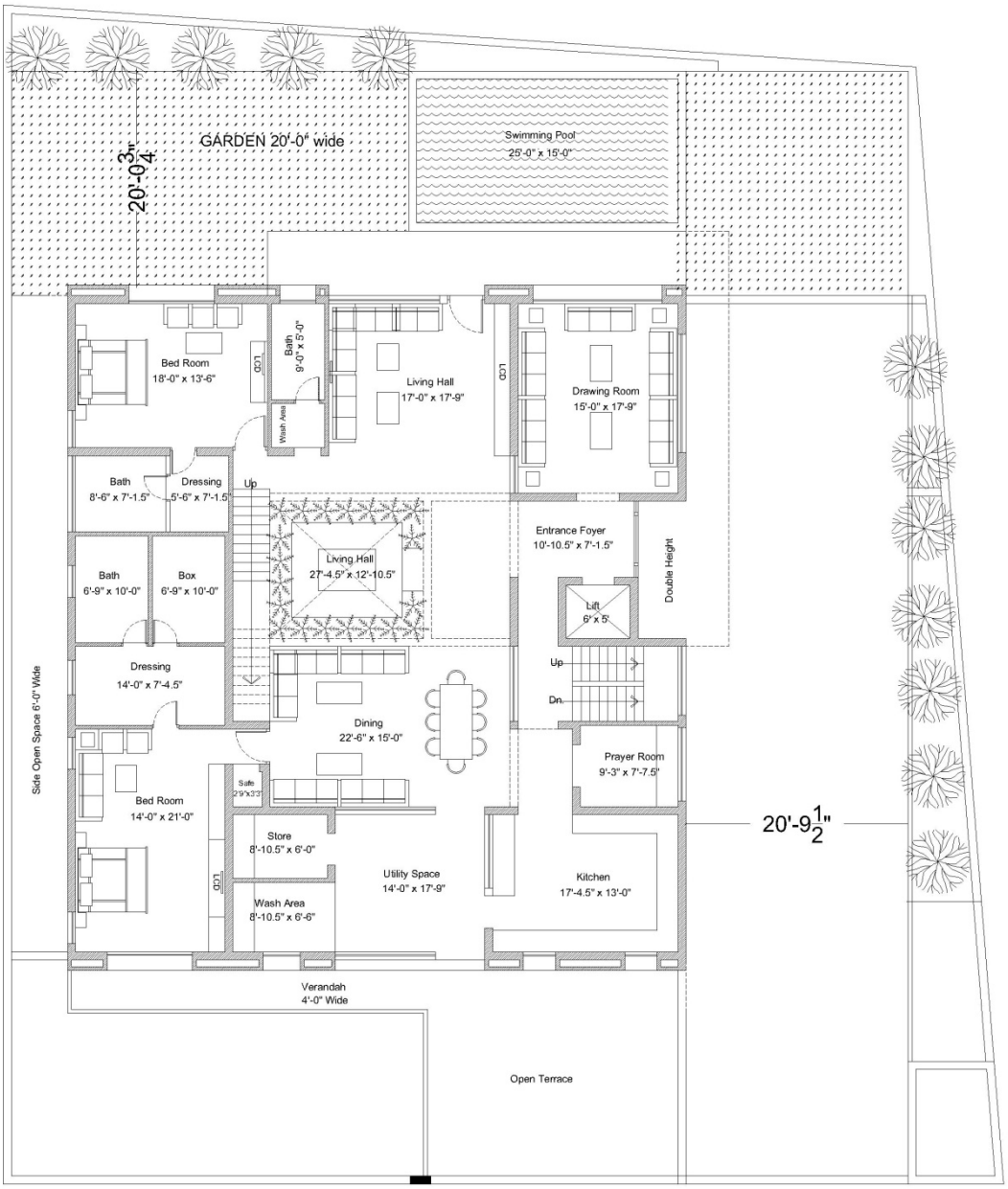


Figure 2 First Floor

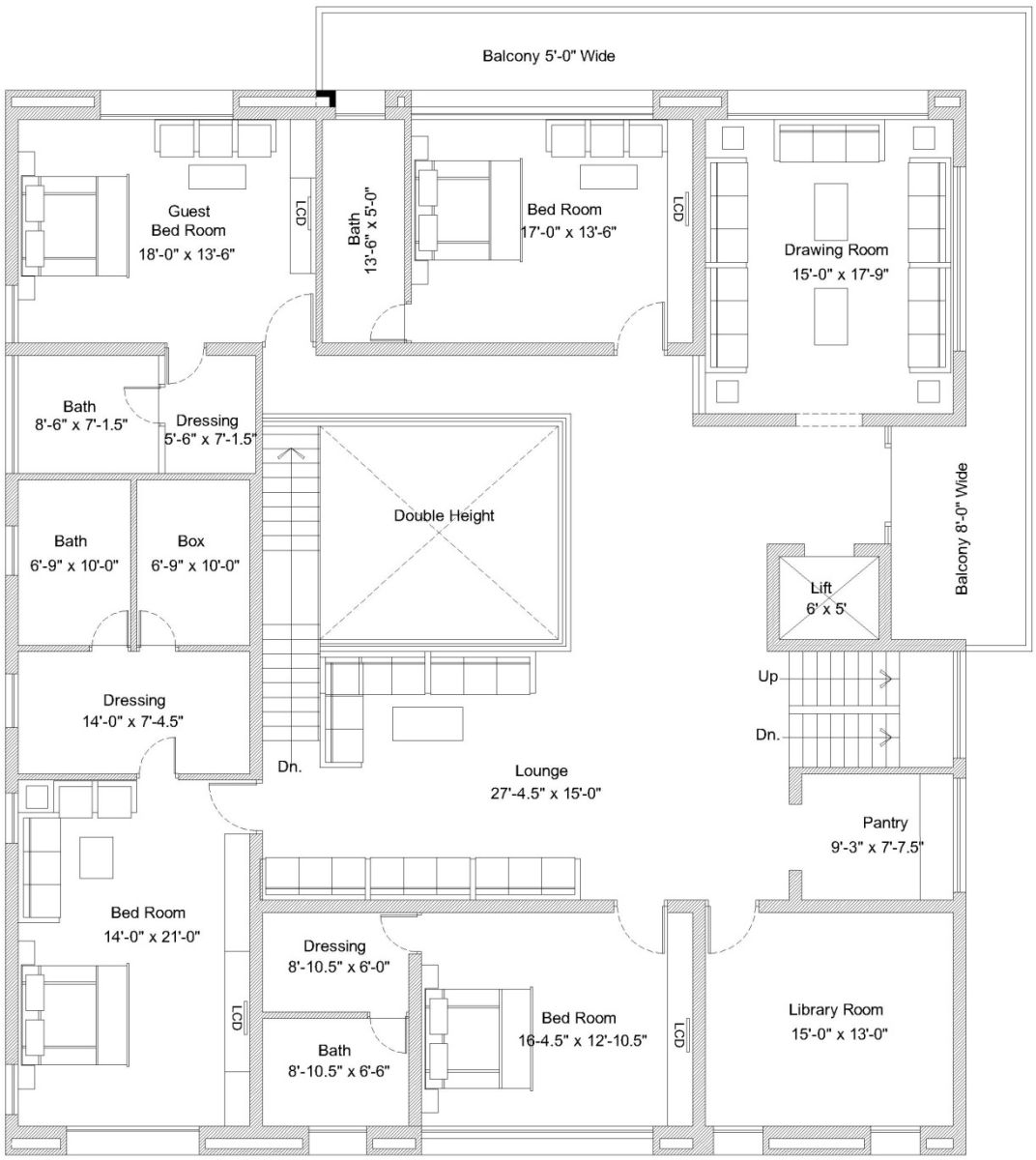


Figure 3 Second Floor

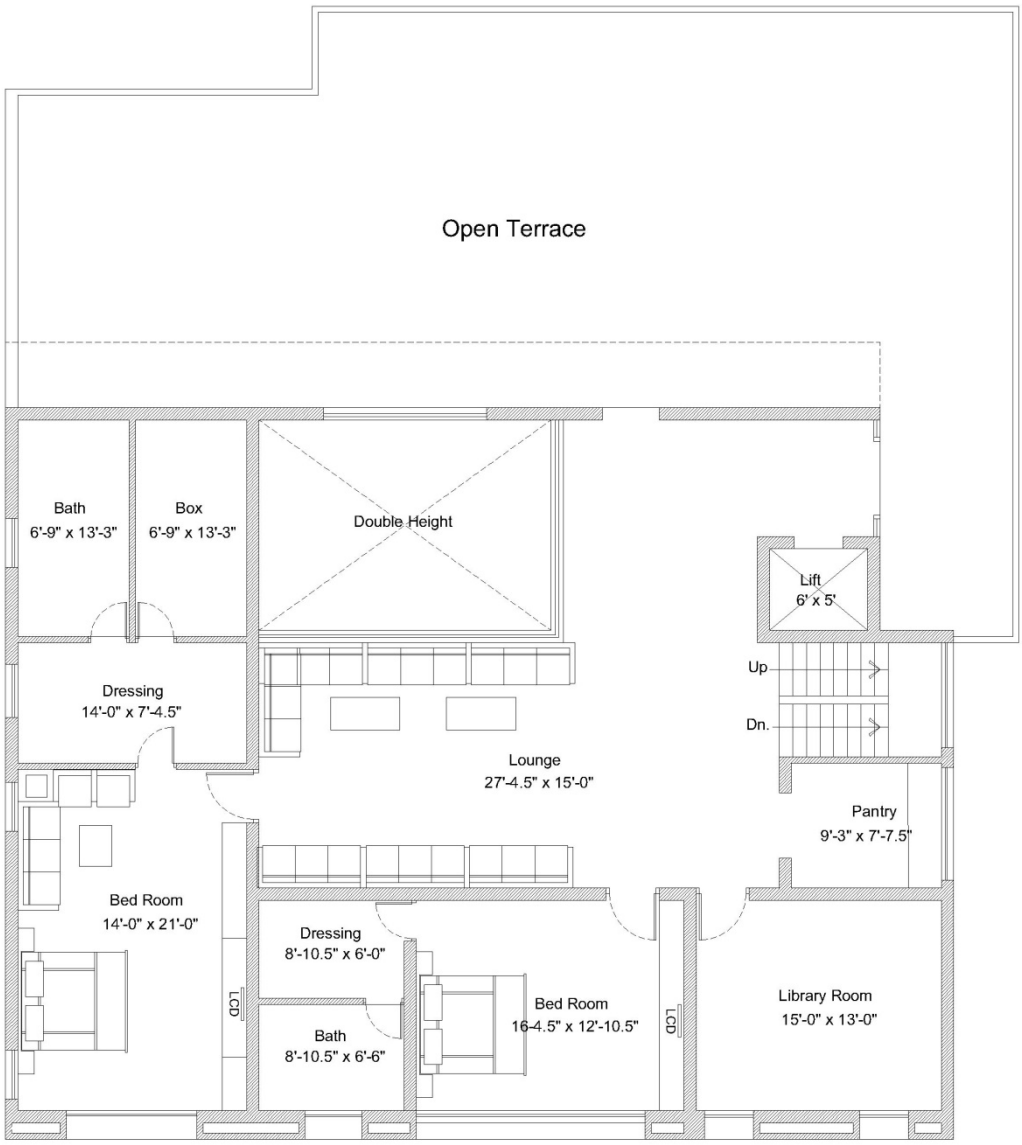


Figure 4 Third Floor

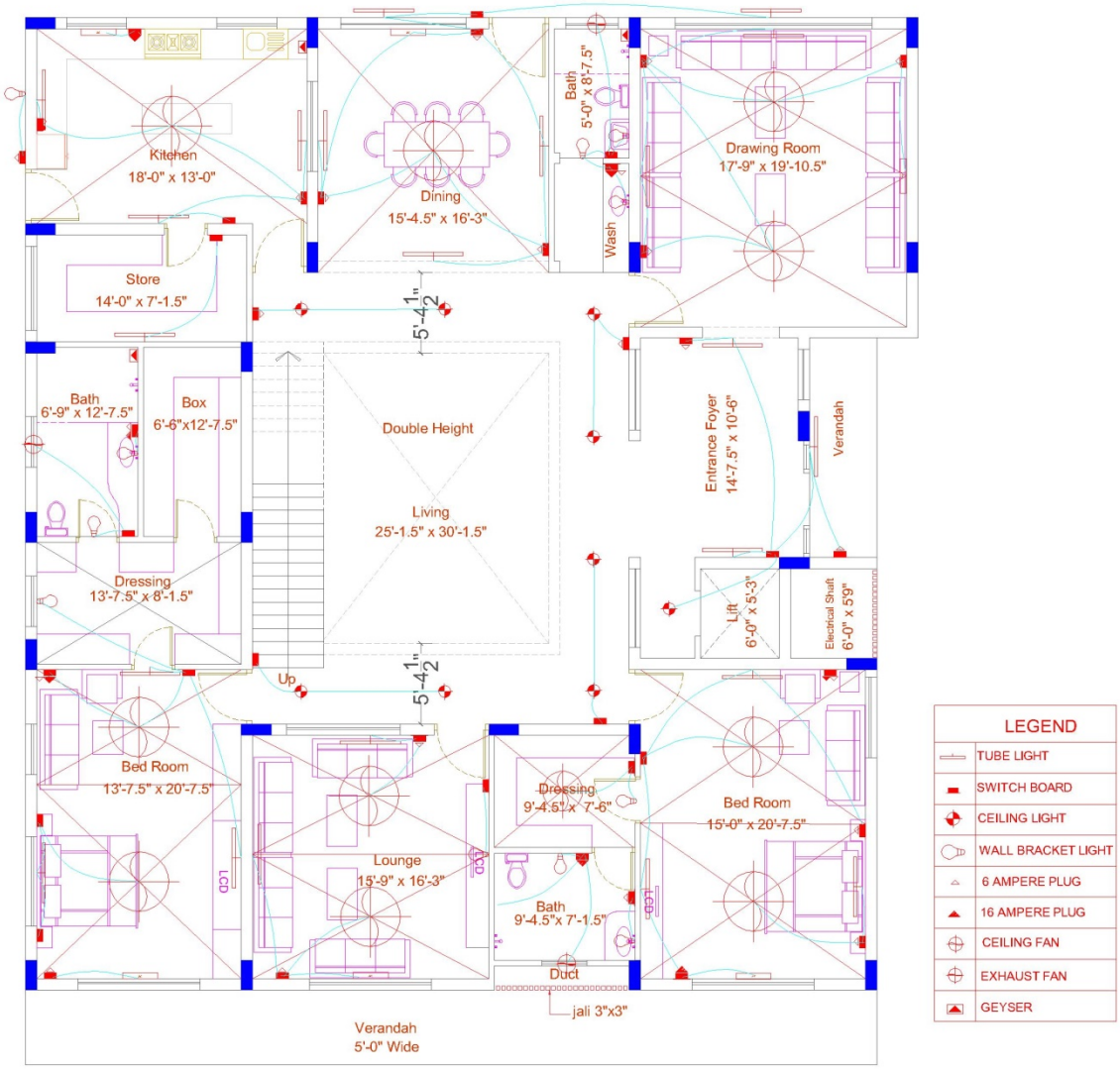


Figure 5 Ground Floor Electrical Plan

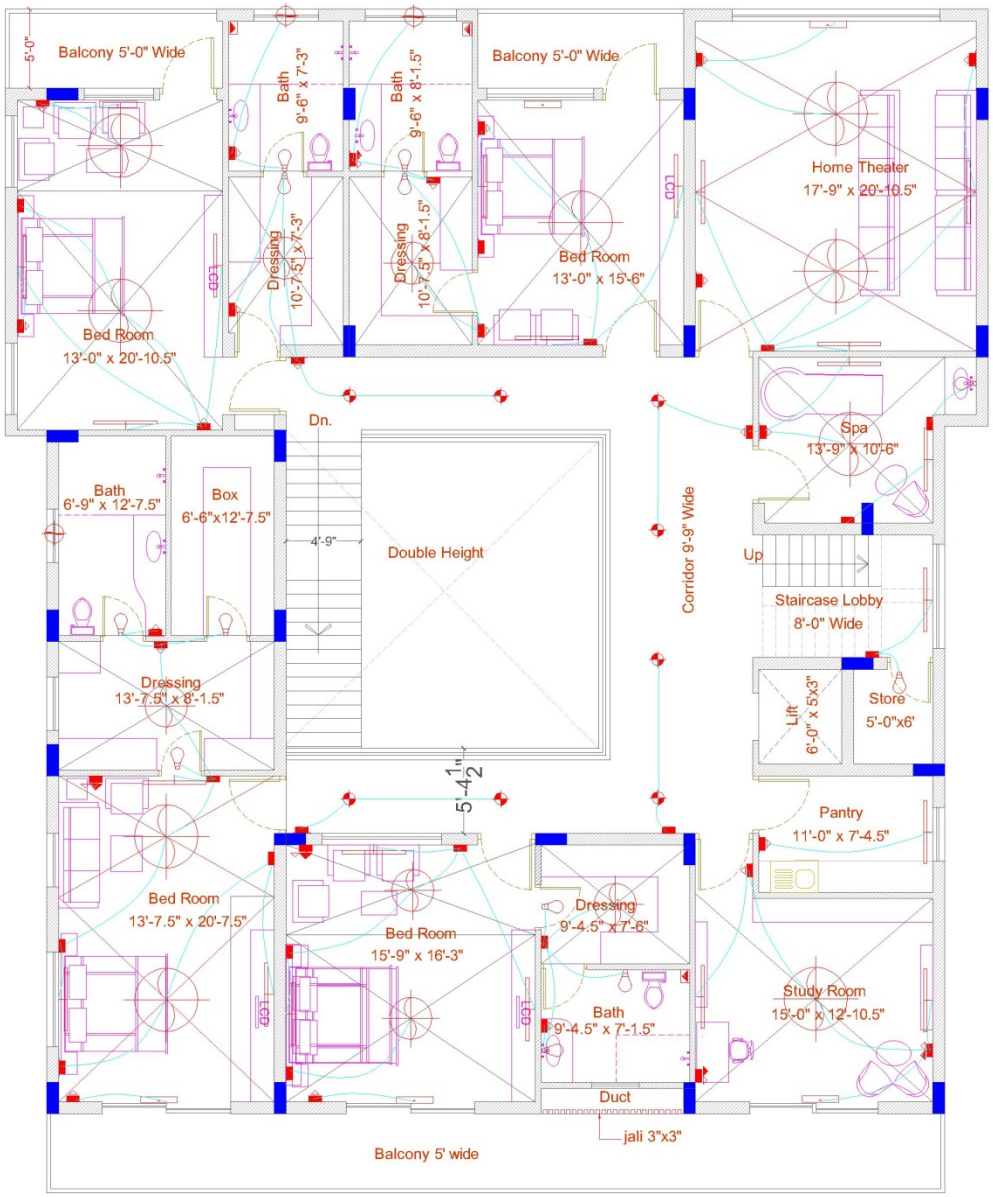


Figure 6 First Floor Electrical Plan

Figure 7 Elevation

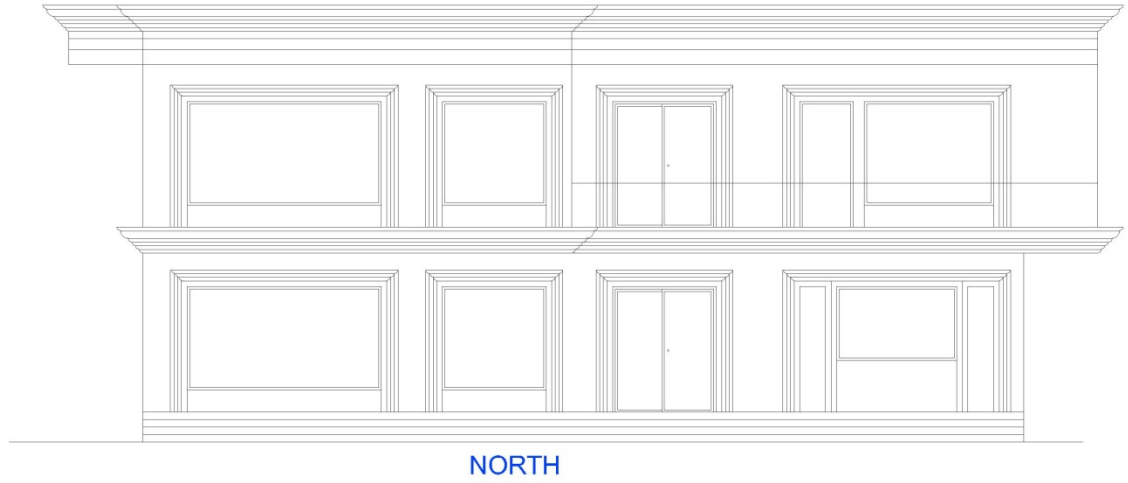


Figure 8 Elevation

Figure 9 Elevation

Figure 10 Realistic Front View

Figure 11 Perspective View

Figure 12 3D

Figure 13 3D

Chapter 5

VASTU AND ARCHITECTURE

Vastu Shastra, an ancient Indian science for designing and building, unifies science, art, astronomy and astrology. The goal of Vastu Shastra is to restore the balance between buildings and the universe so as to make the lives of the inmates better. Thus it makes sense to follow the Vastu guidelines for designing a house.

The surprising thing is that Vastu Shastra principles are applicable even today, though ancient India has changed from a largely agricultural society to an urban one. This is because the Scientific Vastu factors that impact humans namely the elements of nature, Sun's effects, Earth's magnetic field, cardinal directions and Earth's energy (Prana) have

not changed over the centuries. And Vaastu Shastra is essentially the science of manipulating the above-mentioned Vastu factors in a building, so that they are in harmony, which in turn will make the lives of the inmates happy and peaceful.

As an Architect, | have realised that these Vastu Shastra guidelines are wholly based on scientific principles and are very similar to the basic design rules that we are taught in Architecture school. So | have collated all the Vastu guidelines pertaining to the 'designing of a house' under the following three headings. | have explained each of these guidelines rationally and scientifically so that you have a choice and can decide what you want to follow or dom't instead of looking at Vastu as a superstition:

1. Selecting The Right Site

2. Applying Vastu Shastra principles

3. Vastu Shastra design of a house

1. Scientific Vastu Guidelines For Selecting The Right Site:

Selecting the right site is very important since the Site represents a fixed form, that will radiate positive as well as negative energies depending on its location, orientation, shape, slope and soil quality. Listed here are the five most important factors to be considered while selecting a Site.

- Location of site

According to Vastu Shastra, the location of the Site is very important. Some locations are very auspicious while some others are best to be avoided. Vastu Shastra lays down guidelines to aid you in the Selection of a Site with the best 'Location'.

The location of a site is as important as the slope and its direction. But it is must never be the only criteria for accepting or rejecting a plot. All the Vastu Shastra factors including the ideal location of the land must be taken into consideration before deciding on a site.

Since Vastu is a science, every guideline is based on logic and reasoning. As an Architect, I have attempted to explain these guidelines rationally and scientifically under the following headings, so that you can decide what you want to follow and what you don't, instead of blindly following them like a superstition.

WHAT IS VEEDI SHOOLA IN VASTU SHASTRA?

In plots that face T or Y intersections, the roads or lanes that run right into the face of the site from different directions are called Veedi (road) Shoolas (Poison Arrows) or Therukuthus. These roads thrust concentrated energy of enormous potency into the site. This energy can be positive or negative depending on the direction from which they come.

Since it is difficult to comment on the different permutations and combinations of roads, oncoming roads, directions that form the Veedi Shoolas, let us examine the basic considerations in naming them as good, not bad, bad and very bad.

(E—NE) If the oncoming road is from the East, and hits the North-East part of the Plot, it is considered a good site.

(N—NE) If the oncoming road is from the North, and hits the North-East part of the Plot it is considered a good site.

The Logic: In both the above cases, the North East is anyway to be kept open and so no one can directly look into your house. Also having a road in this corner is actually advantageous, as more light and fresh air can permeate the house from this direction.

(W —NW) If the oncoming road is from the West, and hits the North- West part of the Plot, it is considered as a not bad site.

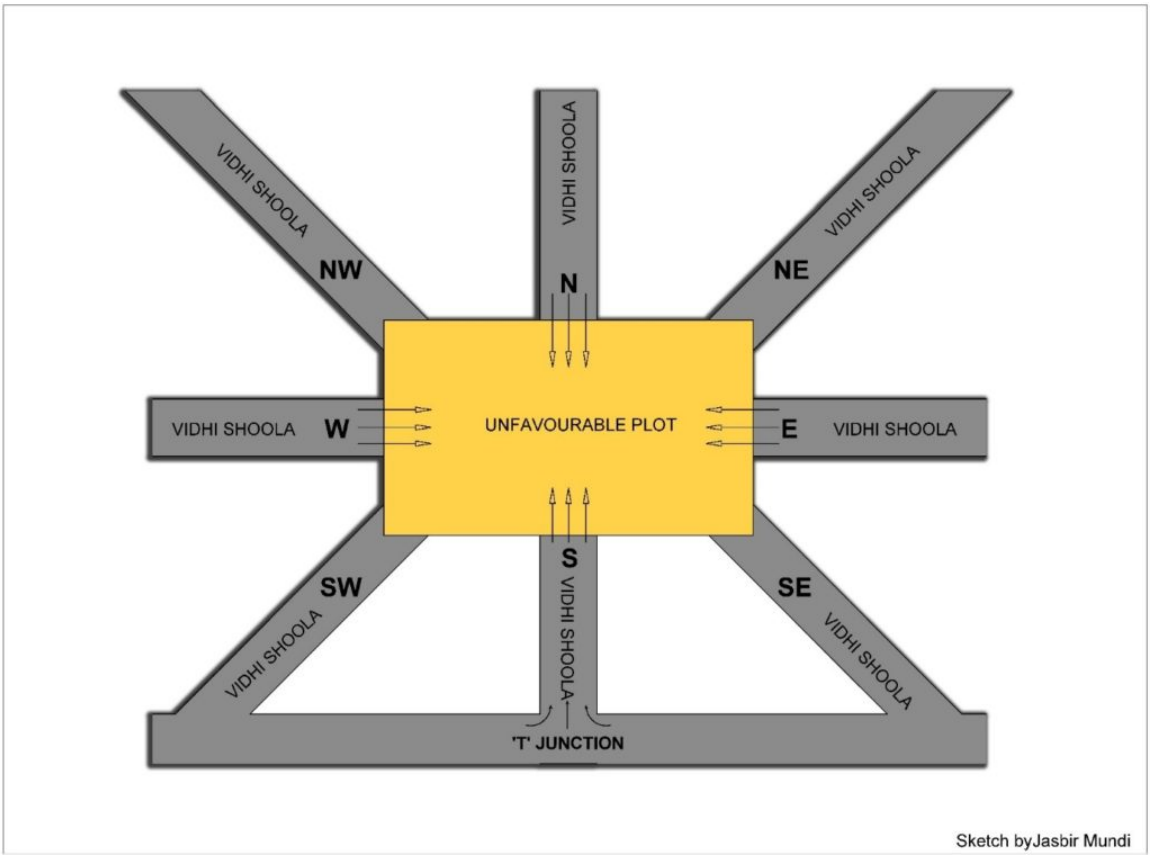
(S—SE) If the oncoming road is from the South, and hits the South- East part of the Plot, it is considered as a not bad site.

(E — SE) If the oncoming road is from the East, and hits the South- East part of the Plot, it is considered a bad site.

(N — NW) If the oncoming road is from the North, and hits the North-West part of the Plot, it is considered a bad site.

(W — SW) If the oncoming road is from the West, and hits the South-West part of the Plot, it is considered a very bad site.

(S — SW) If the oncoming road is from the South, and hits the South-West part of the Plot, it is considered a very bad site.



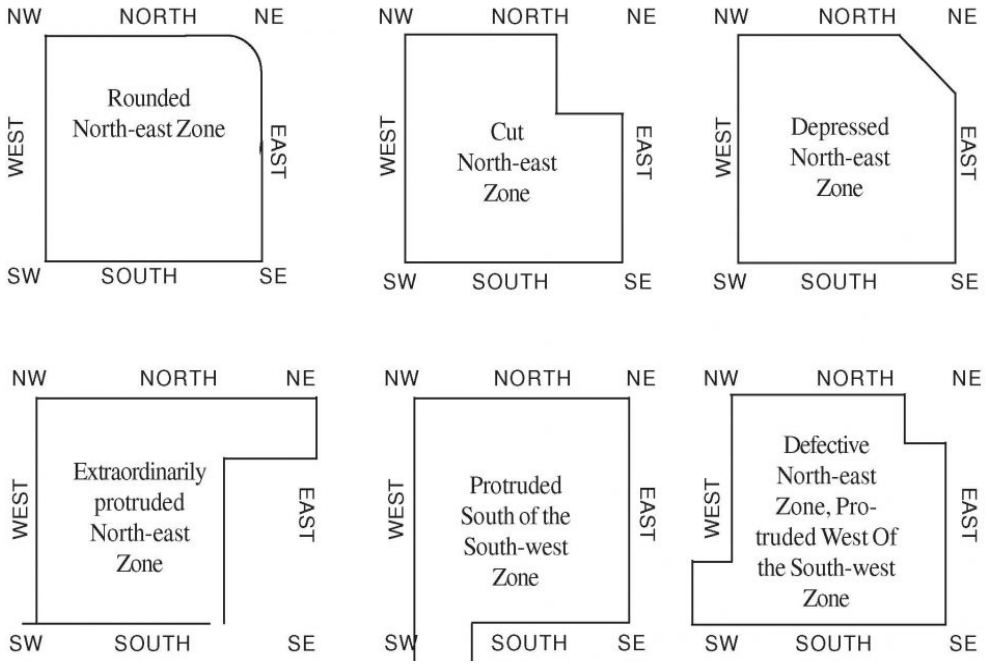
- Site shape

According to Vastu Shastra, the Site ‘Shape’ affects the well being of the inmates. Some shapes have a good effect, while others have a bad effect and some others can be used after making corrections by building a ‘Vastu’ compound wall in a suitable shape.

The shape of a site plays an important role in the overall energy balance of any plot but just the shape must never be the only criteria for accepting or rejecting a plot. All the Vastu Shastra factors including the shape of the plot must be taken into consideration before deciding on a site. Since Vastu is a science, every guideline is based on logic and reasoning. As an Architect, I have attempted to explain these guidelines rationally and scientifically under the following headings, so that you can decide what you want to follow and what you don’t, instead of blindly following

them like a superstition:

Figures of Vaastu & Cancer



- Site soil

According to Vastu Shastra, the Site soil decides the type of foundation for the building and therefore the cost. Some soils are good for holding a regular foundation while others may require specially designed (and more expensive) pile foundations.

ACCORDING TO VASTU SHASTRA, WHAT IS THE IDEAL TYPE OF SOIL IN A SITE?

Cultivable land: While purchasing land, it is best to buy land that can be cultivated, i.e., where vegetation can grow. *The Logic – There are different types of soil based on the colour– brick red, dark brown, white, red, yellow, black etc. Generally the soil which is good for cultivation like red, brick red, brown, yellow soil etc is also good for the foundation of a building. Whereas, black and clayey soil which is not good for cultivation is also not good for buildings as it retains water and can cause dampness to the foundation.*

Avoid a site with black and clayey soil: *The Reason – Black soil indicates soil that retains water and doesn't allow good drainage. It is best to avoid such a site because it will require special kind of foundation and water-proofing which will cost many times more than the usual foundation.*

Avoid rocky soil: Land with too many rocks and thorny trees is not considered good. *The Logic – This is because it may be an indication that there is rock below which will have to be blasted out before laying the foundation, resulting in unexpected expenditure.*

Avoid land with lot of worms: *The Logic – This may be an indication that the soil is very loose and will not support the foundation well.*

Avoid a Site in which a grave has been found while excavating: *The Logic – Psychologically, it can be very unsettling for the residents.*

ACCORDING TO VASTU SHASTRA, IS THERE ANY WAY OF CHECKING THE SUITABILITY OF THE SOIL FOR CONSTRUCTION?

According to King Bhoj, the ancient Indian Vastu Specialist, there are two simple tests to test the soil type.

Filling a pit with water: Dig a 2'x2'x2′ hole and fill it with water. If the time taken to absorb the water is more than an hour, it is good. After the water is absorbed, if there are many cracks in the hole then it is not good. *The Logic – If the water is absorbed readily, then the soil is too loose (sandy) and not firm enough for supporting the foundation. If there are cracks, it indicates clayey soil, which will retain water and hence, can cause dampness to the foundation. Sites with sandy or clayey soils will necessitate extra strong foundations with proper water proofing, which in turn will be more expensive.*

Refilling a pit with soil: Dig another 2'x2'x2′ hole and then fill it up again. If some soil is left over after filling, the land is good. If there is no soil left after filling up, it is average. If the hole is not fully filled, it is not good. *The Logic – This is the test to determine the soil's natural moisture, density and aeration. If the hole is not fully filled up, it means the soil is dense and clayey and hence will retain water which is not good for a building foundation.*

Surprisingly, even today we adopt the same method for testing the soil at a Site. In fact, it is the first thing an Architect instructs the Client to get done, so that the kind of structure can be decided and the structural engineer can design the structure and foundation accordingly.

This post was about the importance of Site Soil in the Selection of a Site. Read about another important Vastu Shastra consideration when Selecting a Site, namely.

- Site orientation

  According to Vastu Shastra, orientation of a Site is one of the most important criteria to be considered when selecting a Site. Vastu Shastra lays down guidelines to aid you in the Selection of a Site with the ideal 'Orientation'.

  Listed here, are some of the Vastu Guidelines for a Pooja room. Since Vastu is a science, every guideline is based on logic and reasoning. As an Architect, I have attempted to explain each of these guidelines rationally and scientifically under the following headings, so that you have a choice and can decide what you want to follow or don't instead of looking at Vastu as a superstition:

WHAT DOES 'SITE ORIENTATION' MEAN?

Site Orientation means the position of the Site with respect to the Cardinal directions (or the points of the Compass). The Site's orientation is identified by the direction that the front of the Site faces. When you stand in the Site and face the road, the directon you face is said to be the Site's orientation. So, a Site with a road in the North, is called a North facing Site.

WHAT ARE THE CARDINAL DIRECTIONS RECOGNISED BY VASTU SHASTRA?

Vastu Shastra recognises eight Cardinal directions, which are identifiable depending on the position of the Sun in the sky. They are:

East (poorva): It is common knowledge that the Sun rises in the East.

West (Paschima): The Sun sets in the West.

North (Uttara): When one faces the East, the direction to the left is the North.

South (Dakshina):When one faces the East, the direction to the right is called the South.

The corner where two Cardinal directions meet, is also significant since it combines the forces emanating from both the directions.

North-East (Eeshanya): This is where the North and East meet.

North-West (Vaayavya): This is where the North and the West meet.

South-West (Nairuthya): This is where the South and the West meet.

South-East (Aagneya): This is where the South and the East meet.

WHY IS ‘SITE ORIENTATION’ IMPORTANT IN THE SELECTION OF A SITE?

The Sun is very important to living things as it sustains life, is necessary for the synthesis of Vitamin D in humans and has germicidal properties. For this reason, when planning the layout of a building, the main aim of Vastu Shastra is to ensure that the inmates of a house are inadvertently exposed to the useful rays of sunlight, even if they are inside the house the whole day. But during a day, people perform different activities in different rooms at different times and the Sun’s position keeps changing with respect to the ‘cardinal directions’. So to ensure that the inmates get exposed to sunlight constantly, each room should be positioned in a specific cardinal direction so that it faces the Sun at the time of the day when it is most likely to be used by them.

Vastu Shastra prescribes an ideal plan called the Vastu Purusha Mandala, in which each room (depending on it's function) is located in a specific cardinal direction. But, depending on the Orientation of the Site, it becomes either easier or more difficult to design the layout of a house in line with the Vastu Mandala. This is why 'Site Orientation' is important in the Selection of a Site.

ACCORDING TO VASTU SHASTRA, WHICH IS THE BEST DIRECTION FOR A SITE?

Vastu Shastra lays down guidelines to aid you in the Selection of a Site with the ideal Orientation. These guidelines are based on Common sense, Scientific reasoning and logic, since Vastu is a Science and not a Superstition. According to Vastu Shastra:

All directions are considered good and each has it's own advantages. *The Reasoning- In any city or town, there are roads in all four directions and naturally there have to be houses on both sides of the roads. Also, the city looks more aesthetic if there are houses in all the four directions. Hence, according to Vastu, all plots are considered good. It is the pseudo Vastu pundits who say that South or West facing sites are not good.*

East facing Site: is good for scholars, philosophers, priests, professors, teachers etc. *The Logic- East (morning sun rays) is considered the source of enlightenment.*

North facing Site: is good for those in power, administration and those who work for government.

South facing Site: is good for business class and for those who work in business organisations.

West facing Site: is for those who provide supporting services to the society.

The Reasoning- The reason why Vastu attributes each direction to a different class of people, is because in ancient times, Indian society was divided into four classes of people, based on their occupations. But gradually these classes became castes and there was very little social mixing between the castes and so people of each caste preferred being with their own people. Hence their homes were grouped together.

In a Site that does not squarely face the cardinal directions: then it's axis is not parallel to the magnetic axis (North-South axis) of the Earth. In such a case, the house should be built on the Site facing the four directions. *The Reasoning- In order to benefit from the*

useful effects of the Sun and other natural elements, it is better if the house is built facing the cardinal directions.

2. SCIENTIFIC VASTU SHASTRA PRINCIPLES FOR A HOUSE:

The Vastu Shastra principle are a guide for designing and planning a proportionate, aesthetic and beautiful building with the right measurements and are very similar to the principles of Architecture taught in Architectural colleges all over the world today. Listed here are five important Vastu principles that can help elevate the appearance of your house.

- Site orientation – also called Diknirnaya.
- Site planning – also known as Vaastu Purusha Mandala.
- Proportions of the building – also known as Maana.
- Dimensions of the building– also called Aayadi
- Aesthetics of the building – also known as Chanda.

3. SCIENTIFIC VASTU PLAN OF A HOUSE:

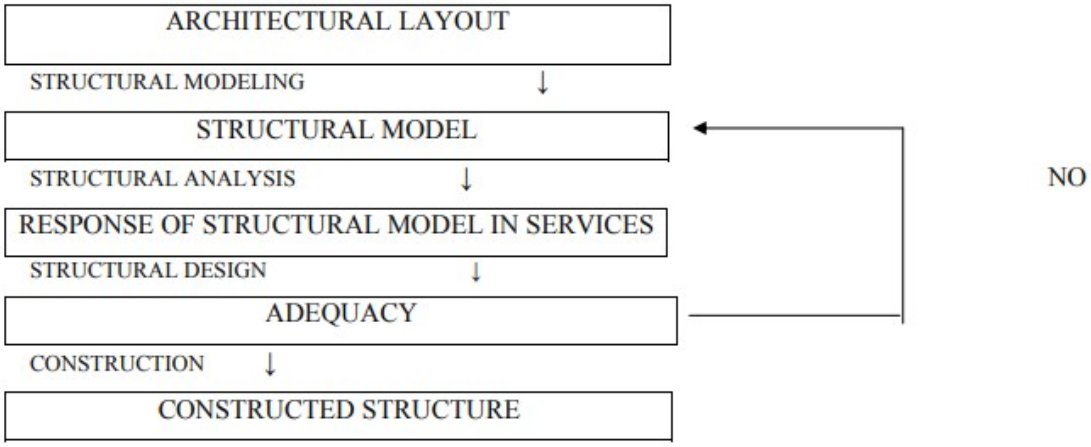
Vastu Shastra lays down guidelines on the 'design, location, direction and disposition of the Interior and Exterior spaces of a House' so that the inmates derive maximum benefit from the natural elements and are protected from their harmful effects. Listed here are the Vastu guidelines for all the interior rooms and exterior spaces that encompass a house.

These guidelines are based on scientific reasoning and common sense and when applied correctly create well-lit, well-ventilated, spacious, aesthetic, and well-designed rooms and House. A properly designed House will naturally create 'contentment', 'peace' and 'serenity' for the inmates and the Owner will be proud of and happy to live in it.

Chapter 6

STRUCTURAL DESIGN

The procedure of structural analysis is simple in concept but complex. In detail. It involves the analysis of a proposed structure to show that its resistance or strength will meet or exceed a reasonable expectation. This expectation is usually expressed by a specified load or the demand and an acceptable margined of safety that constitutes a performance goal for a structure. The performance goals structural design is multifaceted. Foremost, a structure must perform its intended function safely over its useful life.
The concept of useful life implies consideration of durability and established the basis for considering the cumulative exposure to time varying risks (i.e. corrosive environments, that performance is inextricably linked to cost, owners, builders, and designer must considers economic limit to the primary goal of safety and durability.
In the view of the above discussion, structural designer may appear to have little control over the fundamental goals of structural design except to comply with or exceed the minimum limits established by law. While this is generally true, a designer can still do much to optimize the design through alternative means and methods that can for more efficient analysis techniques, creative design detailing, and the use of innovative construction materials and methods. In summary the goal of structural design are defined by law and reflect the collective interpretation of general public welfare by those involved in the development and local adoption of building could.
It is advantageous when kinematic indeterminacy< static indeterminacy. Alex Bendex first formulated this procedure in 1914 based on the applications of compatibility and equilibrium of compatibility and equilibrium conditions.
This method derives its name from the facts that supports and displacements are explicitly computed. Set up simultaneous equation is formed from the solution of these parameters and the join moment in each or computed from these values.



ROLE OF STRUCTURAL ANALYSIS IN DESIGN PROCESS OF A STRUCTURE

Literature Reviews

Method of analysis of statically indeterminate portal frame.

1. Method of Flexibility Coefficients.
2. Slope Displacement Methods (Iterative Methods)
3. Moment Distribution Method.
4. Kani's Method (Approximate Method).
5. Cantilever Method.
6. Portal Method.
7. Matrix Method.
8. STADD Pro.

Chapter 7

STAAD PRO

This chapter reviews about some of the fundamental concepts of structural design and present them in a manner relevant to the design of light frame residential structures. The concepts from the basis for understanding the design procedures and overall design approach addressed in the remaining chapter of the guide. With this conceptual background, it is hoped that the designer will gain a greater appreciation for creative and efficient design of home, particularly the many assumptions that must be made.
The world is leading Structural Analysis and Design package for Structural Engineers.

- Starting the Program.
- Creating a New Structure.
- Creating Joints and Members.
- Switching On Node and Beam Labels.
- Specifying Member Properties.
- Specifying Material Constants.
- Specifying Member Offsets.
- Printing Member Information.
- Specifying Supports.
- Specifying Loads.
- Specifying the Analysis type.
- Specifying Post-Analysis Print Commands.
- Specifying Steel Design Parameters.
- Performing Analysis and Design.
- Viewing the Output File.

Verifying results on screen both graphically and numerically.
World's #1 Structural Analysis and Design software supporting Indian and major International codes.
The choice of 0.2 million Structural Engineers worldwide, STAAD pro is guaranteed to meet all your structural engineering needs.

STAADpro features state of the art user interface, visualization tools, powerful analysis and design engines with advanced finite element (FEM) and dynamic analysis and design to visualization and result verification STAADpro is the professional first choice.
STAADpro was developed by practicing engineers around the globe. It has evolved over 20 years and meets the requirements of ISO 9001 certification.
STADDpro has building codes for most countries including US, Britain, Canada, Australia, France, Germany, Spain, Norway, Finland, Sweden, India, China, Euro Zone, Japan, Denmark and Holland.

Structural Analysis And Design :

STAAD-III, the world's most powerful and popular structural analysis and design software is in use across the globe since 1980. Now it is available in the form of STAAD.Pro which consists of STAAD + STARDYNE +FEMkit + Visual Draw .STAAD.Pro is a comprehensive, general purpose software for integrated structural analysis and design.
STAAD.Pro may be utilized for analyzing and designing practically all types of structures - buildings, bridges, towers, transportation, industrial and utility structures.
STAAD.Pro implements the most modern technologies in today's Computer-Aided-Engineering.
It unifies leading-edge graphics and visualization techniques with proven and time tested analysis and design. A live, unified database provides seamless integration across all mission critical application — from concept design/analysis to detail design, simulation and visualization.

STAAD.Pro Overview:

- "Concurrent Engineering" based user environment for model development, analysis, design, visualization and verification.
- Pull down menus, floating toolbars, tool tip help.
- Flexible Zoom and multiple views.
- Isometric and perspective views 3D shapes.

- Built-in Command File Editor.
- Simple Command Language.
- Graphics/Text input generation.
- State-of-the-art Graphical Pre and Post Processor.
- Rectangular/Cylindrical Coordinate systems.
- Joint, Member/element, Mesh Generation with flexible user-controlled numbering.
- Efficient algorithm minimizes disk space requirements.
- FPS, Metric or SI units.
- Presentation quality printer plots of Geometry and Results as part of run output.

Graphics Environment:

1. Model Generation

- Interactive Menu-driven Model Generation with simultaneous 3D display.
- 2D and 3D Graphic Generation using rectangular or polar coordinate system.
- Segments of repetitive geometry may be used to generate complex structural models.
- Generate Copy, Repeat, Mirror, Pivot, etc, or quick and easy geometry generation.
- Quick/easy mesh generation.
- Comprehensive graphics editing.
- Graphical Specification and Display of Properties, Loadings, Supports, Orientations.
- Import AutoCAD DXF files.
- Access to Text Editor.

2. Model Verification

- 2D/3D drawings on screen as well as on plotter/printer
- 2D/3D drawings on screen as well as on plotter/printer
- Sectional views or views with listed members only.
- Isometric or any rotations for full 3D viewing.
- Display of properties, Loadings, Supports, Orientations, Joint/Member

numbering, Dimensions, Hidden line removed, etc.

- Plot manipulation according to the size, rotation, viewing origin and distance.

3. Analysis & Design:

- Static Analysis
- 2D/3D analysis based on state-of-the-art Matrix method to handle extremely large job.
- Beam, Truss, Tapered Beam, Shell/Plate Bending/Plane Stress.
- Full/partial Moment Releases.
- Member Offset Specification.
- Fixed, Pinned and Spring Supports with Releases. Also inclined Supports.
- Automatic Spring Support Generator.
- Linear, P-Delta Analysis, Non-Linear Analysis with automatic load and stiffness correction. Multiple Analysis within same run.
- Active/Inactive Members for Load-Dependent structures.
- Tension-only members and compression-only members, Multi-linear spring supports.
- CIMSTEEL Interface.

4. Dynamic/Seismic Analysis

- Mass modeling, Extraction of Frequency and Mode shapes.
- Response Spectrum, Time History Analysis.
- Modal Damping Ratio for Individual Models.
- Harmonic Load Generator.
- Combination of Dynamic forces with Static loading for subsequent desing.

5. Secondary Analysis

- Forces and Displacements at sections between nodes.
- Maximum and minimum force Envelopes.

Load Types and Load Generation:

- Loading for Joints, Members/Elements including Concentrated, Uniform, Linear,

Trapezoidal, Temperature, Strain, Support Displacement, Prestressed and Fixed-end Loads.

- Global, Local and Projected Loading Directions.
- Uniform or varying Element Pressure Loading on entire or selected portion of elements.
- Floor/Area Load converts load-per-area to member loads based on one-way or two-way actions.
- Automatic Moving Load Generation as per standard AASHTO or user defined loading.
- UBC 1997.AIJ/IS 1893/Cypriot Seismic Load Generation.
- Automatic Wind Load Generation.
- Factored Load Combinations including algebraic, absolute and SRSS combination schemes.

Finite Element Capabilities:

- Accurate and numerically Efficient Plate/Shell Element incorporating out-of-plane shear and in-plane rotation.
- Automatic Element Mesh Generation.
- Comprehensive Element Stress Output including in-plane stresses, out-of-plane shear, bending and principal stresses at nodal as well as user specified points.

Steel Design:

- Built-in steel tables including AISC, Australian, British, Canadian, Chinese, European, Indian, Japanese, Korean, Russian, and South African. Shapes include I- Beam with or without cover plates, Channels, Angles, Double Angles,/Channels, Pipes and Tubes.
- User-specified Design Parameters to customize design.
- Code Check, Member selection and Optimized Member Selection consisting of Analysis/Design cycles.

- Design codes include AISC (ASD and LRFD), AASHTO. Optional codes include ASCE52, BS5950, Canadian, Chinese, French, German, Japanese, Indian and Scandinavian.
- Weld design for all steel shapes.

Concrete Design:

- Design of Concrete Beam/Column/Slab/Footing as per all major international codes.
- Numerical and Graphical Design outputs with complete reinforcement details.
- IS 456-2000 for RCC design implemented.
- RC detailer as per IS 456-2000 has been implemented which has given a new dimension to RCC design never witnessed in STAAD before.

Result Verification:

- Result verification and display.
- Deflected and Mode Shapes based on Joint/Section Displacement for user-specified loading or mode shape number.
- Bending Moment and Shear force diagrams of individual members as well as the entire structures.
- User-controlled Scale factors for Deflected or Mode shapes.
- Force/Moment Envelope Plots as max/min for all loads.
- Stress contour plots.
- Code Performance Plots for Steel Design.
- Powerful on-line Query for analysis/design results.
- Animation of Deflected/Mode shapes, Stress Contours.

Special Features: Query and Report Generator:

- These powerful graphics based facilities provide on-screen result verification and customized report generation. User-friendly navigation and organization of data helps you get the information you need with a few simple clicks.
- Point and click on a member to obtain all the information on its Geometry,

Crosssectional properties, Forces, etc. even design information such as Allowable Stresses, Governing Code Criteria, Reinforcement layout are available.

Loads for Residential Buildings :

Loads are primary consideration in any buildings design because they define the nature and magnitude of hazards or external forces that a building must resist to provide reasonable performance (i.e.; safety and serviceability) throughout the structure's useful life.

The anticipated loads are influenced by a building's intended use (occupancy and function), configuration (shape and size) and location (climate and site conditions). Ultimately, the type and magnitude of the design loads affect critical decisions such has the material selection, construction details, and architectural configuration.

Thus to optimize the value (i.e. performance versus economy) of the finished product, it is essential to apply design loads realistically. While the building consider in this guide are primary single-family detached and attached dwellings, the principles and concepts related to building loads also apply to other similar types of construction, such as low-rise apartment's buildings.

In general, the design loads recommended in this guide are based on:

1. Dead load.
2. Live load
3. Imposed loads.

Dead Loads

This is the permanent of the stationary load like self weight of the structural elements. This include the following

- Self-weight
- Weight of the finished structure part.
- Weight of partition walls etc.

Dead loads are based upon the unit weights of elements, which are established taking in account materials specified for construction, given IS 1911-1967

Dead loads consists of the permanent construction material loads compressing the roof, floor, wall, and foundation system, including claddings finishes and fixed equipment. Dead load is the total load of all of the components of the building that generally do not change over time, such as the steel columns, concrete floors, bricks, roofing material etc.

Live loads

These loads are not permanent or moving loads. The following loads includes in this type of loading: imposed loads(fixed) weight of the fixed seating in auditoriums, fixed machinery, partition walls these loads through fixed in positions cannot be relieved upon to act permanently throughout the life of the structure.
Imposed loads (not fixed) these loads change either in magnitude or position very often such as the traffic loads, weight of the furniture etc.
Live loads are produced by the use occupancy of the building. Loads include those from human occupants, furnishings, no fixed equipment, storage, and constriction and maintenance activities. As required to adequately define the loading condition, loads are presented in terms of uniform are loads, concentrated loads, and uniform line loads.

Imposed loads:

Loads produced by intended use occupancy of a building including the weight movable portions distributed concentrated loads and loads that vibration and impact called imposed loads estimated by IS 456-2000.

Chapter 8

STRUCTURAL DRAWING

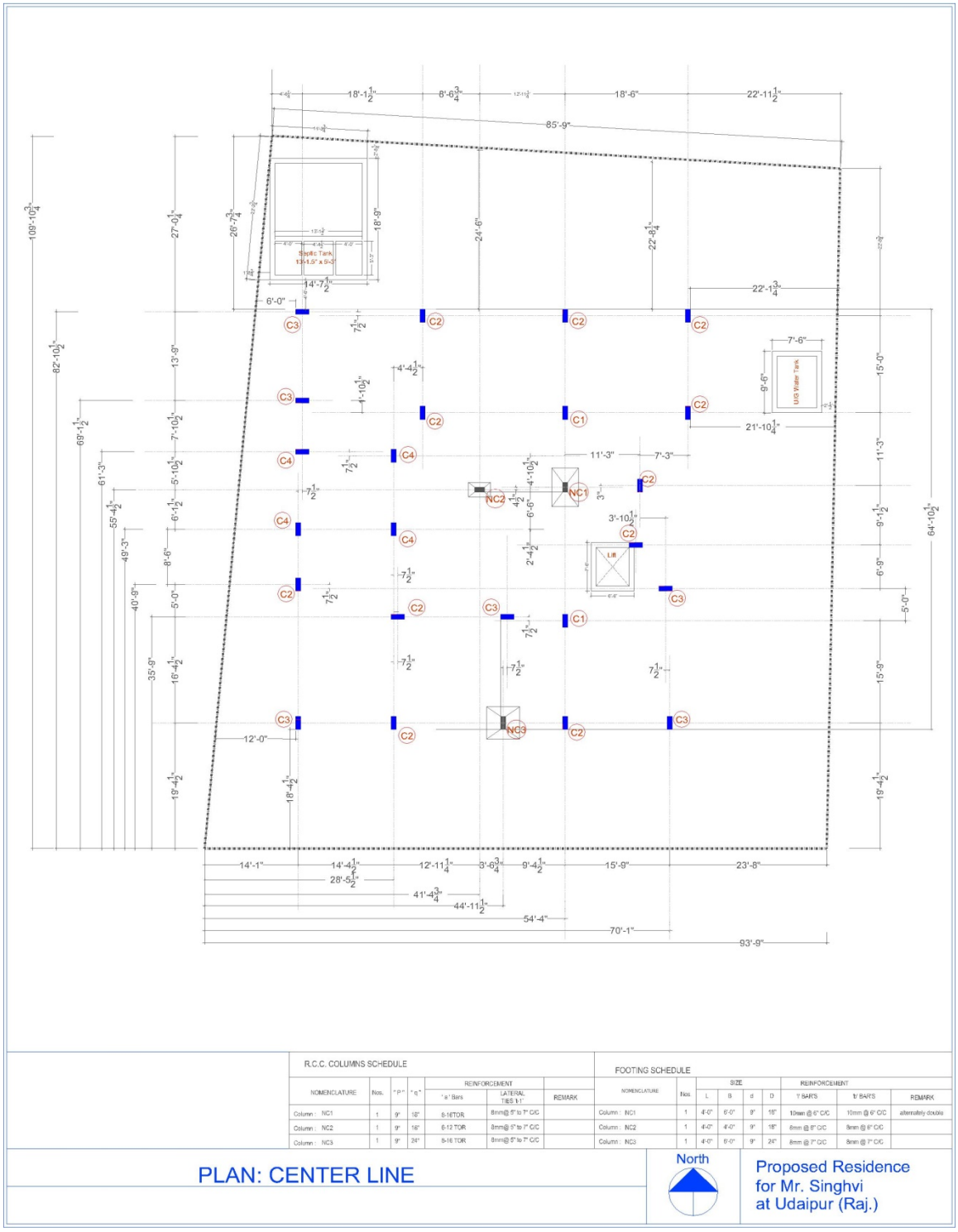
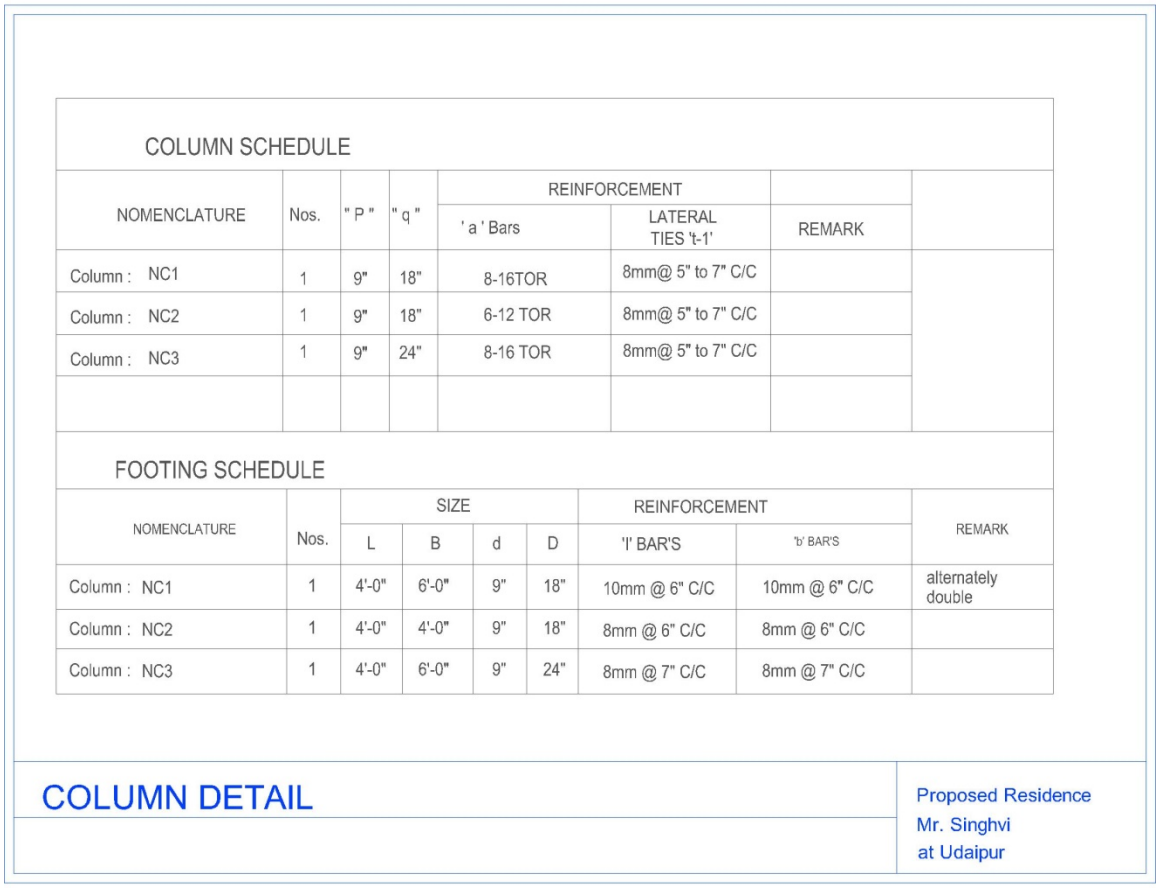


Figure 14 Center line Plan



COLUMN SCHEDULE

NOMENCLATURE	Nos.	" P "	" q "	REINFORCEMENT		REMARK
				' a ' Bars	LATERAL TIES 't-1'	
Column : NC1	1	9"	18"	8-16TOR	8mm@ 5" to 7" C/C	
Column : NC2	1	9"	18"	6-12 TOR	8mm@ 5" to 7" C/C	
Column : NC3	1	9"	24"	8-16 TOR	8mm@ 5" to 7" C/C	

FOOTING SCHEDULE

NOMENCLATURE	Nos.	SIZE				REINFORCEMENT		REMARK
		L	B	d	D	'l' BAR'S	'b' BAR'S	
Column : NC1	1	4'-0"	6'-0"	9"	18"	10mm @ 6" C/C	10mm @ 6" C/C	alternately double
Column : NC2	1	4'-0"	4'-0"	9"	18"	8mm @ 6" C/C	8mm @ 6" C/C	
Column : NC3	1	4'-0"	6'-0"	9"	24"	8mm @ 7" C/C	8mm @ 7" C/C	

Figure 15 Column Details

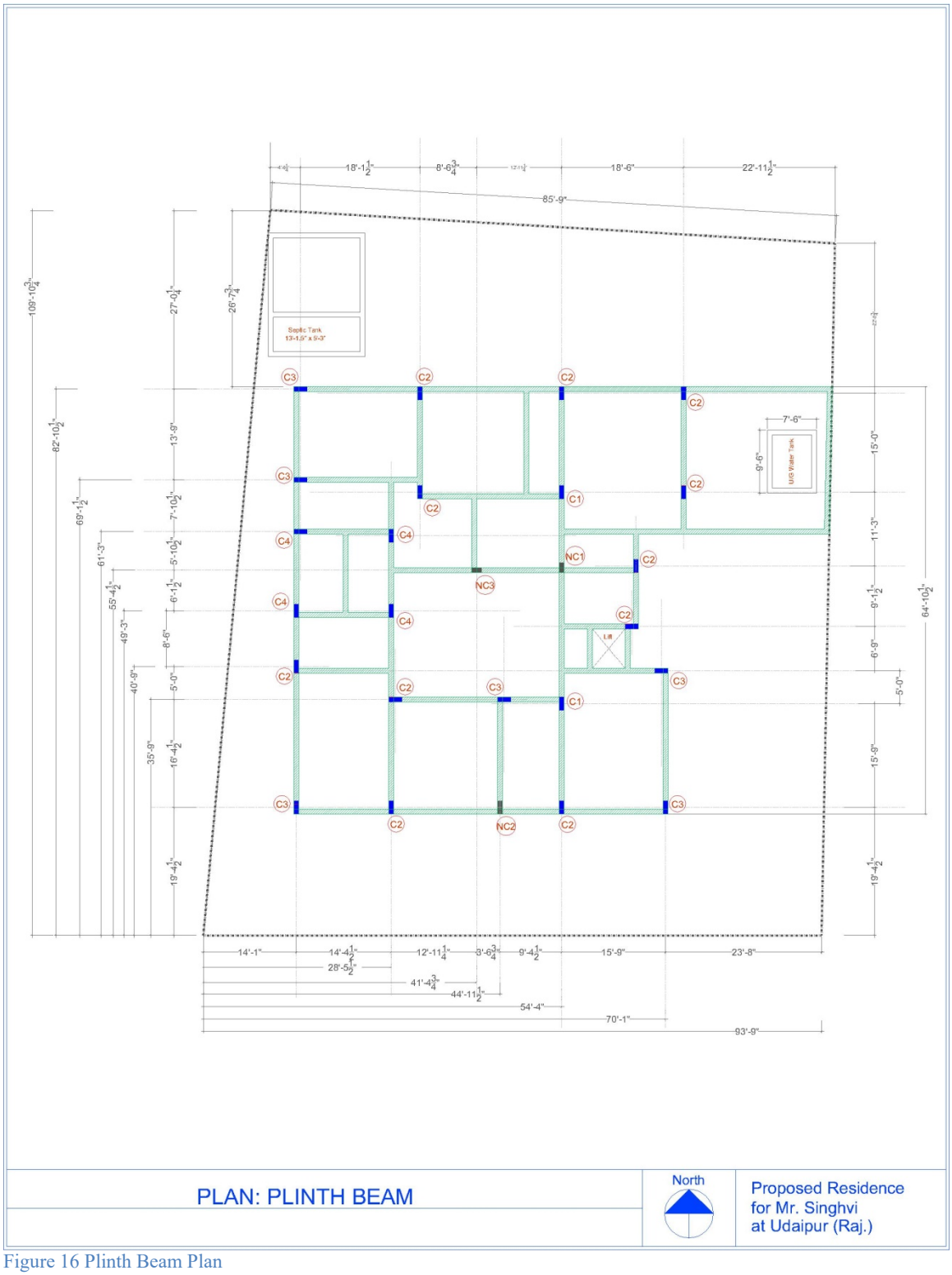
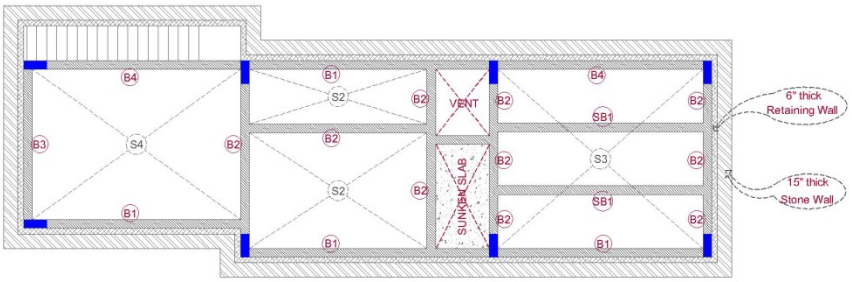


Figure 16 Plinth Beam Plan

Plan : Ground Floor to First Floor

Plan : First Floor to Second Floor

Figure 17 Staicase Detailing



FLOOR SLAB AT BASEMENT

RCC FLOOR	1 : 2 : 4	
THICKNESS	6"	
DETAIL	8 Φ @ 8" c/c	Bothways
RETAINING WALL	1 : 2 : 4	
THICKNESS	6"	
DETAIL		
Vertical Reinforcement	8 Φ @ 8" c/c	Alternately Placed
Horizontal Reinforcement	8 Φ @ 8" c/c	

ROOF SLAB AT BASEMENT

BEAM RCC DETAIL 1 : 1.5 : 3	
BEAM B1	
Size	9" x 15"
Top	2/16 Φ + 2/12 Φ EAS
Bottom	3/16 Φ + 2/16 Φ
Rings	8 Φ @ 7" c/c
BEAM B2	
Size	9" x 15"
Top	2/12 Φ + 2/12 Φ EAS
Bottom	2/16 Φ + 2/12 Φ Extra at mid span
Rings	8 Φ @ 8" c/c
BEAM B3	
Size	9" x 15"
Top	2/12 Φ + 1/12 Φ EAS
Bottom	2/12 Φ + 2/12 Φ Extra at mid span
Rings	8 Φ @ 8" c/c
BEAM B4	Inverted
Size	9" x 15"
Top	2/16 Φ + 2/12 Φ EAS
Bottom	3/16 Φ + 2/16 Φ
Rings	8 Φ @ 7" c/c
BEAMS ARE AT ROOF LEVEL ONLY	
EAS : Extra At Side	

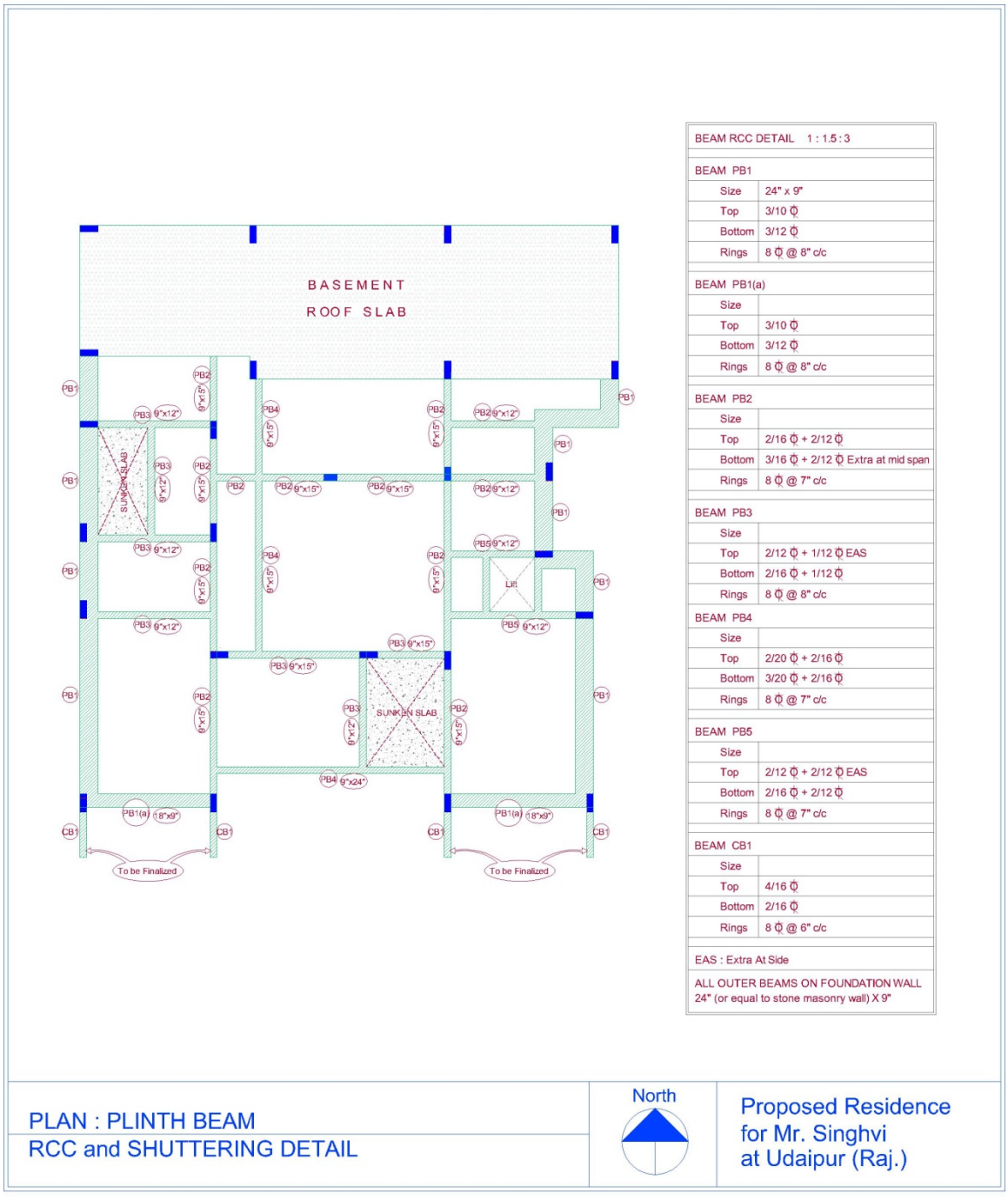
ROOF SLAB RCC DETAIL 1 : 1.5 : 3	
ROOF SLAB Thickness 5"	
SLAB S1	
Short Span	12 Φ @ 6" c/c ABU
Long span	8 Φ @ 8" c/c ABU
SLAB S2	
Short Span	10 Φ @ 6" c/c ABU
Long span	8 Φ @ 9" c/c ABU
SLAB S3	
Short Span	12 Φ @ 5" c/c
Long span	10 Φ @ 8" c/c
BEAM SB1	
Size	15" x 6"
Top	3/12 Φ
Bottom	3/16 Φ
Rings	8 Φ @ 8" c/c
ABU : Alternately Bent Up	
EAS : Extra At Side	

PLAN : BASEMENT FLOOR
RCC and SHUTTERING DETAIL

North

Proposed Residence
for Mr. Singhvi
at Udaipur (Raj.)

Figure 18



BEAM RCC DETAIL 1 : 1.5 : 3	
BEAM PB1	
Size	24" x 9"
Top	3/10 Φ
Bottom	3/12 Φ
Rings	8 Φ @ 8" c/c
BEAM PB1(a)	
Size	
Top	3/10 Φ
Bottom	3/12 Φ
Rings	8 Φ @ 8" c/c
BEAM PB2	
Size	
Top	2/16 Φ + 2/12 Φ
Bottom	3/16 Φ + 2/12 Φ Extra at mid span
Rings	8 Φ @ 7" c/c
BEAM PB3	
Size	
Top	2/12 Φ + 1/12 Φ EAS
Bottom	2/16 Φ + 1/12 Φ
Rings	8 Φ @ 8" c/c
BEAM PB4	
Size	
Top	2/20 Φ + 2/16 Φ
Bottom	3/20 Φ + 2/16 Φ
Rings	8 Φ @ 7" c/c
BEAM PB5	
Size	
Top	2/12 Φ + 2/12 Φ EAS
Bottom	2/16 Φ + 2/12 Φ
Rings	8 Φ @ 7" c/c
BEAM CB1	
Size	
Top	4/16 Φ
Bottom	2/16 Φ
Rings	8 Φ @ 6" c/c
EAS : Extra At Side	
ALL OUTER BEAMS ON FOUNDATION WALL 24" (or equal to stone masonry wall) X 9"	

PLAN : PLINTH BEAM
RCC and SHUTTERING DETAIL

North

Proposed Residence
for Mr. Singhvi
at Udaipur (Raj.)

Figure 19

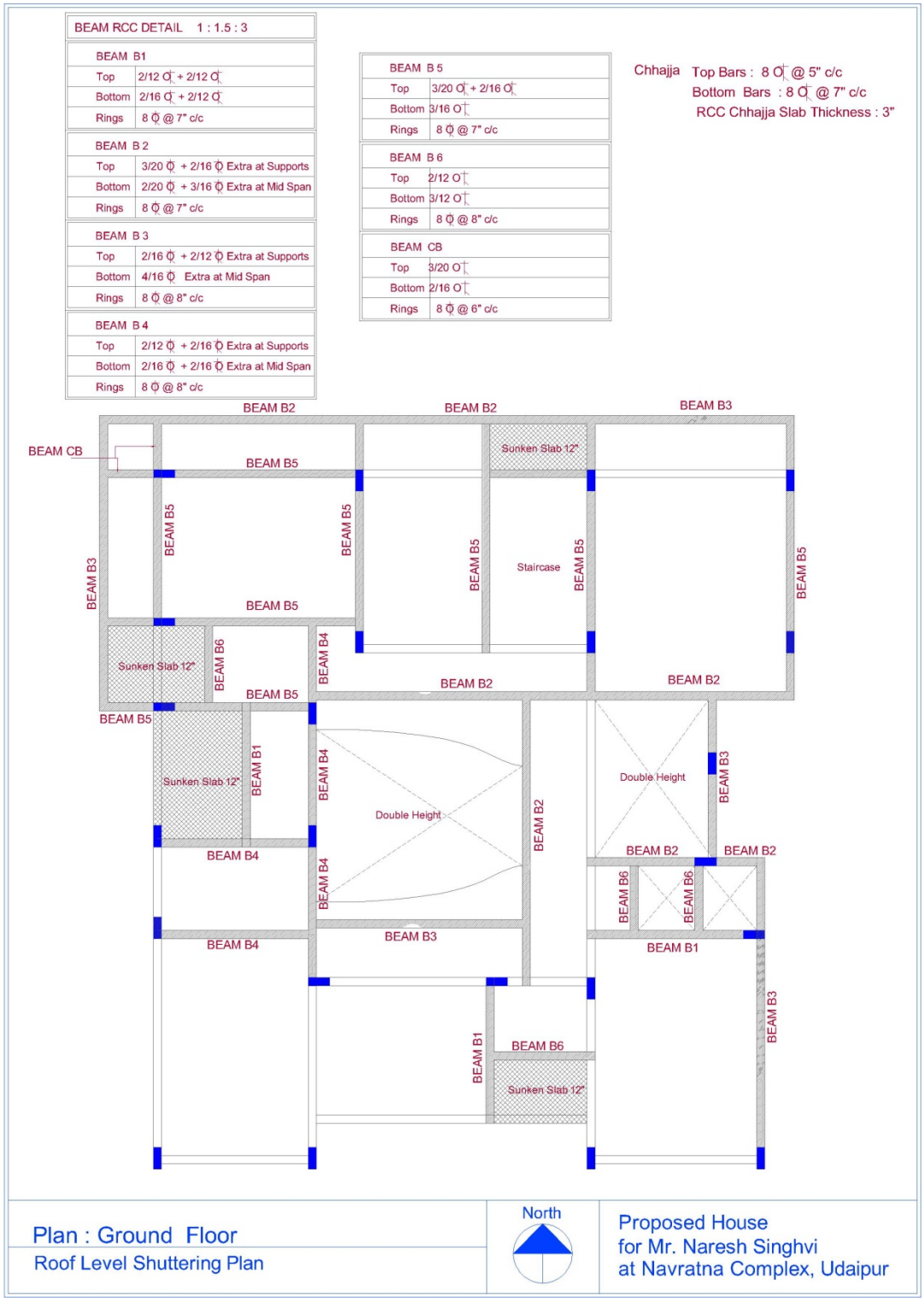

BEAM RCC DETAIL 1 : 1.5 : 3
BEAM B1
Top 2/12 Ø + 2/12 Ø
Bottom 2/16 Ø + 2/12 Ø
Rings 8 Ø @ 7" c/c
BEAM B 2
Top 3/20 Ø + 2/16 Ø Extra at Supports
Bottom 2/20 Ø + 3/16 Ø Extra at Mid Span
Rings 8 Ø @ 7" c/c
BEAM B 3
Top 2/16 Ø + 2/12 Ø Extra at Supports
Bottom 4/16 Ø Extra at Mid Span
Rings 8 Ø @ 8" c/c
BEAM B 4
Top 2/12 Ø + 2/16 Ø Extra at Supports
Bottom 2/16 Ø + 2/16 Ø Extra at Mid Span
Rings 8 Ø @ 8" c/c
BEAM B 5
Top 3/20 Ø + 2/16 Ø
Bottom 3/16 Ø
Rings 8 Ø @ 7" c/c
BEAM B 6
Top 2/12 Ø
Bottom 3/12 Ø
Rings 8 Ø @ 8" c/c
BEAM CB
Top 3/20 Ø
Bottom 2/16 Ø
Rings 8 Ø @ 6" c/c
Chhajja Top Bars : 8 Ø @ 5" c/c
Bottom Bars : 8 Ø @ 7" c/c
RCC Chhajja Slab Thickness : 3"
BEAM B2
BEAM B2
BEAM B3
BEAM CB
BEAM B5
Sunken Slab 12"
BEAM B5
BEAM B5
BEAM B5
Staircase
BEAM B5
BEAM B3
BEAM B5
BEAM B5
Sunken Slab 12"
BEAM B6
BEAM B4
BEAM B2
BEAM B2
BEAM B5
BEAM B5
Sunken Slab 12"
BEAM B1
BEAM B4
Double Height
BEAM B2
Double Height
BEAM B3
BEAM B4
BEAM B2
BEAM B2
BEAM B4
BEAM B6
BEAM B6
BEAM B4
BEAM B3
BEAM B1
BEAM B1
BEAM B6
BEAM B3
Sunken Slab 12"
Plan : Ground Floor
Roof Level Shuttering Plan
North
Proposed House
for Mr. Naresh Singhvi
at Navratna Complex, Udaipur

Figure 20

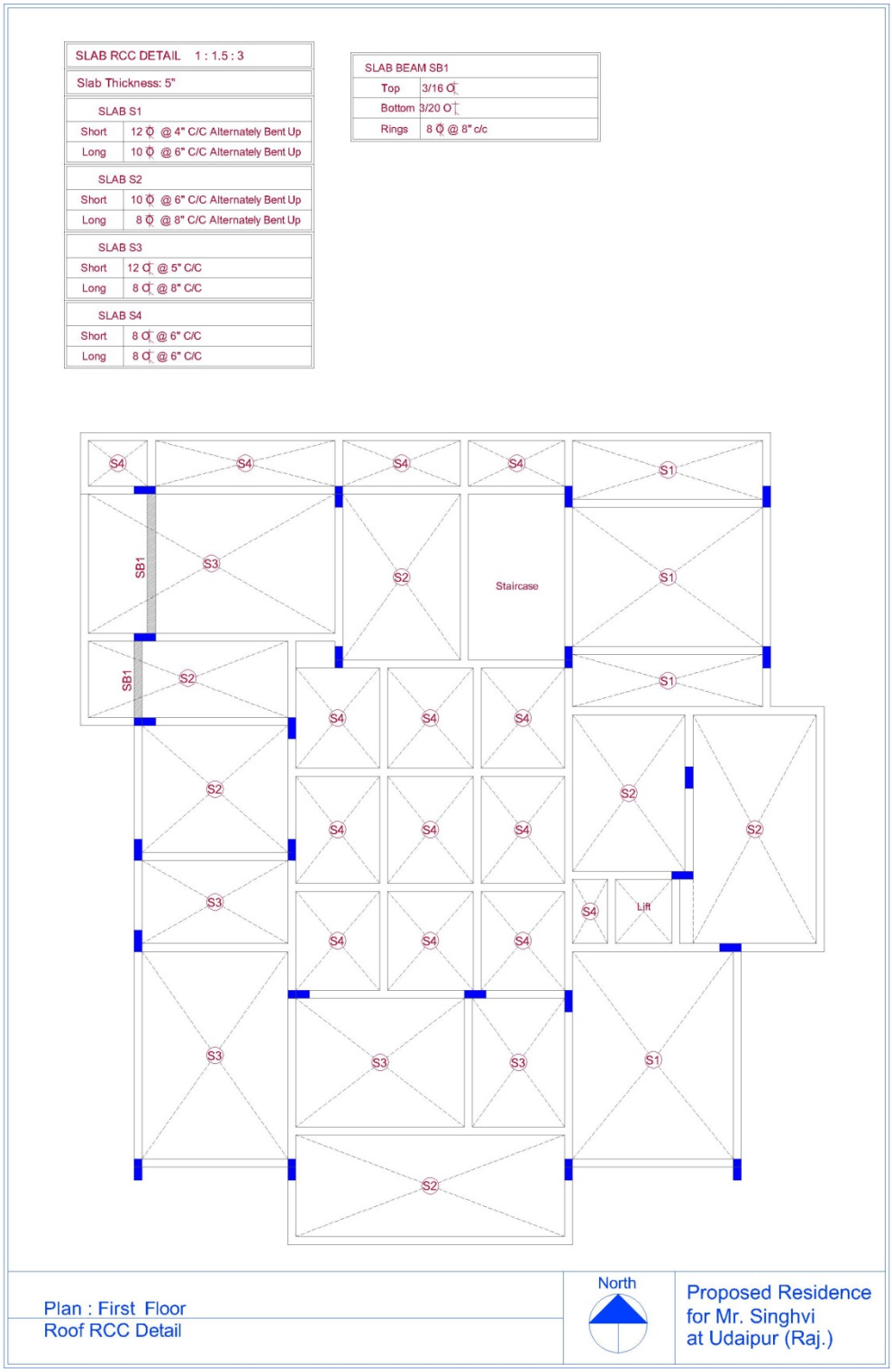

SLAB RCC DETAIL 1 : 1.5 : 3
Slab Thickness: 5"
SLAB S1
Short 12 Ø @ 4" C/C Alternately Bent Up
Long 10 Ø @ 6" C/C Alternately Bent Up
SLAB S2
Short 10 Ø @ 6" C/C Alternately Bent Up
Long 8 Ø @ 8" C/C Alternately Bent Up
SLAB S3
Short 12 Ø @ 5" C/C
Long 8 Ø @ 8" C/C
SLAB S4
Short 8 Ø @ 6" C/C
Long 8 Ø @ 6" C/C
SLAB BEAM SB1
Top 3/16 Ø
Bottom 3/20 Ø
Rings 8 Ø @ 8" c/c
S1
S2
S3
S4
SB1
Staircase
Lift
Plan : First Floor
Roof RCC Detail
North
Proposed Residence
for Mr. Singhvi
at Udaipur (Raj.)

Figure 21