TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

PULCHOWK CAMPUS

Thesis No: 076/MArch/002

Apporaches to the Use of Geometry in Modern Architecture " A Study of Its Development in a Nepalese Context"

by

Aditi Jaiswal

A THESIS

SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR

THE DEGREE OF MASTERS IN

ARCHITECTURE (M. Arch.)

DEPARTMENT OF ARCHITECTURE
LALITPUR, NEPAL

SEPTEMBER, 2022

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DECLARATION

I hereby declare that the thesis entitled "**Approaches to the Use of Geometry in Modern Architecture: A Study of It Development in a Nepalese Context "** which is submitted to the Department of Architecture, Pulchowk Campus, Institute of Engineering, Tribhuvan University. In partial fulfillment of the requirements for the degree of Masters in Architecture (M.Arch.) is a research work carried out by me, under the supervision of Assoc. Prof. Dr. Sanjaya Uprety. I declare that the work is my own and has not been submitted for a degree of another University.

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Aditi Jaiswal
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The undersigned certify that they have read, and recommended to the Institute of Engineering for acceptance, a thesis entitled **"Approaches to the Use of Geometry in Modern Architecture: A Study of It Development in a Nepalese Context "** submitted by **Aditi Jaiswal** (076M.Arch002), in partial fulfillment of the requirements for the degree of Masters in Architecture.

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ABSTRACT

Geometry, as a science of measurement and properties of space has its origins in human observation and the need to measure land. In architecture, the study of geometry led to development of new mathematical tools which was made applicable to design of buildings. Modern architecture is a growing field with a number of sub-genres that have evolved over time. Classifications vary according to style and philosophy. One common characteristic among modern architects is the use of geometry not only for aesthetics but also for structure. This article provides insight into how geometry played an important role in shaping the formative idea of early Nepali modern architecture in terms of shaping formative idea in which the concepts of plane and solid geometry are used to determine built form. The objective of this research was to examine the use of different geometry in shaping early Nepali modern architecture in terms of determining the form in a given social political context. Qualitative research method was used to investigate he use of geometry context in selected buildings design in a given socio-political since 1950sThe method mainly included the study of drawings, documents and record along with literature review. The study finds that formative idea in Bauhaus which was help to identifies and describes formal archetypal patterns or formative ideas from which architecture might evolve. The study concludes that the post 50s buildings were designed mainly by foreign trend architects with not only strong Bahuas influence but also the history which acts as determinant or characteristic in buildings along with drawing from local architectural context.

Keywords: Geometry, modern context, shaping

ACKNOWLEDGEMENT

At first, I would like to thank my thesis supervisor **Assoc. Prof. Dr. Sanjaya Uprety** for his continuous guidance, inspiration and support on M.Arch. thesis. His regular feedbacks and invaluable insights had helped to shape my thesis to this extent expressing the information cogently and with clarity under my thesis topic and objectives.

I am grateful to M.ARCH coordinator **Assoc. Prof. Dr. Ashim Bajracharaya** for his support on creating learning environment. I am also greatly indebted to **Prof. Dr. Sushil Bajracharya and Prof. Dr. Sudha Shrestha** for their feedback.

This study wouldn't have been completed without the help of Respected Teachers and Senior Architect for their valuable time for the interviews. My immense gratitude to my supervisor and Professional senior architect for providing data and information as well as their valuable guidance.

Aditi Jaiswal

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CHAPTER 1. INTRODUCTION

1.1 Introduction

According to Jonner Kepler, Geometry is the archetype of the beauty of the world. Geometry (from the Ancient Greek: Geo- “Earth”, Metron “Measurement” is a branch of mathematics concerned with questions of shape, size, relative position of figures, and properties of space. Geometry plays a role in Architecture in many ways.

It is a tool for Architect, it can be adopted to be imposed over the landscape and create monumental structures with the spirit of leaving an imprint. It can also emerge out of the conditions of being and conditions posed by the surroundings.

The two parallels create very contrasting examples of architecture, The Temple and The Cottage. The Temple lies in Ancient Greece or in India and Nepal, both ideally aim to create monuments, create physical spaces inspired from abstract ideals. The humble Cottage has their own set of constraint which can be met by the use of geometric tools. Geometry is as relevant in Architecture today as it was in Classical Antiquity. It is being used to make buildings which stand for power and solve the crisis of Low-cost housing. Circles, squares, triangles, pyramids, cones, radii, spheres, diameters, and other geometric shapes are suggested by these notions, which are taught in schools. These have several functions in architecture; as ideal geometric abstractions, they may force their perfection on the world's physical structure to serve as a locus of identity. They may even appear as a result of limitations or the environment.

More so, This Geometric way of thinking can be traced from classical antiquity in the form of books and teachings all the way to a Modern context. In the sense that the components of geometry join together to generate a grammar of meaning for a complete architectural composition, this research will examine how geometry transforms into a language of architect's design. A building in its pure form is not geometrical or totally justifies its pure form, but every construction is geometrical in the transition from completely pure forms of geometric buildings. This will be examined using several examples. How many architectural styles employ various geometrical shapes. How Geometry may or may not have an impact on other design or construction considerations.

The research will also try to trace this idea of Geometrical thinking through buildings and documents scripted to set in stone abstract ideas by imposing them on the modern architecture. These geometries can also be quantified by dimensionally analyzing the building mentioned also try to identify and list manifestation of geometric ideas and traces their transference in an effort to establish their usefulness as tool in architectural practice of present time.

1.2 Background

In the study of geometry, which is a branch of mathematics, visual thinking is king as it relates to measures, forms, and shapes. Geometry invented by man. Human language is geometric and is used in many different ways. From the beginning to the end, geometry is a crucial component of design.

In addition to creating intricate architectural designs, architects utilize geometry to analyses and divide space. Geometrical concepts are used by engineers and builders to design safe constructions. Geometry is used by designers to create visually pleasant interior environments, together with color and size. Geometry must always be used in design.

A visual dictionary of architecture as defined by Francis D.K. However, the various uses of geometry have yielded many additional meanings. This gives the structure continuity. Geometry is a tool invented by people to perceive the outside world and represent the inside world. Geometry is the "common language" of planets. Geometry is the basis of life and the basis of tangibles that create symbols that represent us as complete and divine beings. Geometry is a point of mathematics on shape, shape and measurement, and visual accidents are the most common mathematics field. Geometry is an important part of architecture because most visual thinking is most. In the architecture, both design and design include vision, and architects often use geometry. The only geometric system that has been successfully applied to reality for more than 2,000 years is geometry, a topic that belongs to more than just mathematics.

Various forms of geometry, including spherical and bin curves, have been found to be applicable to 19th-century reality. Additional forms of geometry that have evolved over

time include perspective, decomposition form, projection geometry, trigonometry, topology differential geometry, fractal geometry, etc. My publications I would like to see a connection between the geometric principles of architecture and the application of architectural design. Architects employ geometry in a number of ways when it comes to design. An inherent grasp of geometry and structure served as the inspiration for the igloo shape. The smallest surface of the closed, stable dome was exposed to the wind.

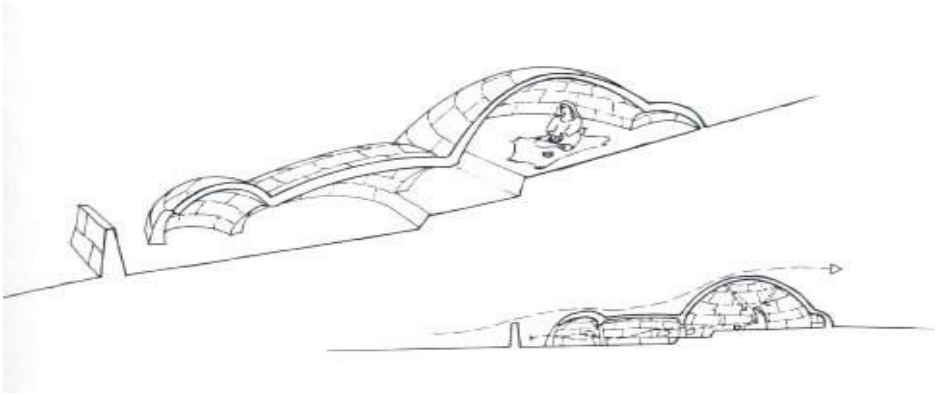
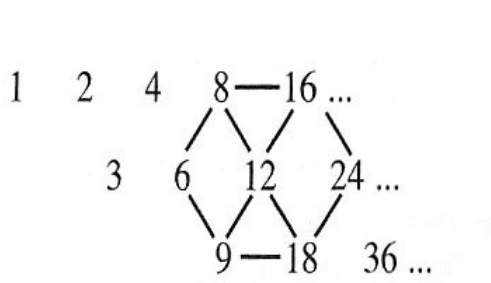


Figure 1: The Igloo. The dome shape of the igloo reduces the exposed surface area. (Norman Crowe, Nature and the Idea of a Man-Made World, 1995).

The dome of medieval architecture suggested symbolic meaning. His form has found that he symbolized heaven and suitable for churches. Renaissance architect emphasized the percentage of views from the perspective of views as well as Alberti. Le Corbusier emphasized the modular ratio using the modular expression according to the gold relationship

(Sharp, 2002).



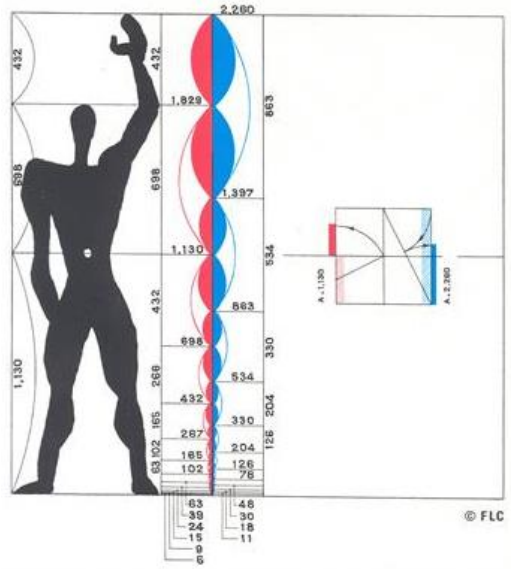


Figure 2: Alberti's system of musical proportions and Le Corbusier's The Modular

The Bauhaus's emphasis on early childhood education and the use of descriptive geometry in architectural education had an impact on the modern movement. Digital technologies developed towards the end of the 20th century employed the concepts of the Cartesian coordinate system and descriptive geometry to construct images of objects. Choosing the angles and spacing of components like windows, doors, and fittings is one of the most typical uses of geometry in architecture. Other applications of geometry include the construction of green buildings, where solar angles are utilized to assess if a structure can receive natural sunshine.

The direct relationship between geometry and architecture is what architects are looking for. The way repeating modules are used now reflects the idea of a three-dimensional grid in space. This grid and the one produced by the three coordinate axes in Cartesian geometry might be compared. Architects employ geometry in a variety of ways, and there are several connections between how architects approach geometry and geometry (Srinivasan, 2009). Perspective, descriptive geometry, projective geometry, Cartesian geometry, non-Euclidean geometry, fractal geometry, and differential geometry are among the types of geometry.

1.3 Need for Research

A period of development of geometry, a branch of mathematics concerned with shapes, forms, and measurement, and which prevailed in intuitive thinking. In architecture, visualization is used for both design and construction, and architects often use geometry. Therefore, a considerable study of the approaches to using geometry in studying the development of geometry in modern architecture is needed. Architects can imagine forms that cannot be seen in everyday life. Some architects say that although the complex shapes are related to Euclidean geometry, the spaces we encounter are still Euclidean (Srinivasan, 2009). Designed to Discuss Modern Identity in Perspective.

This study is intended to draw parallels between geometric principles and architectural uses. The variation of a particular approach to geometry can be determined by the way the architect uses to treats form and space, and the geometry uses the architecture. Architects more unconsciously and intuitively. With the envelope of architecture on the role of Nepalese context and geometry of modern architecture.

This study will shed light on the current identity of architecture by creating a new, modern local identity, building on imported values and ideologies without sacrificing relationships. Ultimately, this study will identify a new defining element of the modern identity of Nepalese architecture, and the architects show that the architects were unable to come up with the right concepts. New concepts, as well as the form and spatial approach of architecture. That is the development of denial.

1.4 Importance of Research

A completely new universal is currently open for designers and artists and can easily describe Euclidian and structure. Since the current stage is called the golden period of geometry, architects can be considered time to break new lands compared to the perspective of point of geometry and method. According to (Charles Jenks), persuading the current post architect must create a new vocabulary that reflects this new vision of the world (Jenks, 1997).

Many major main architectures are available for curved buildings and complex conflicts such as twisted grids, curved buildings and postmodernisms of the world. Geometry is still used by architects in this context. Demand for complex geometric geometrics in

the light of modern geometric representatives raises questions about the relationship between geometry and architecture. Different approaches for geometry of architecture throughout history, as well as similarities exist between geometry and architecture. In this way, I think we can put the current situation in which the architects operate in the historical context.

1.5 Problem Statement

Spaces and buildings have undergone changes over the past two decades, and emerging modern building types symbolize changing environments and behaviors expressed in new forms of identity, aspirations and aesthetics (Sengupta & Upadhyaya, 2016, pp. 94-102). Changes in the architectural style of buildings also affected the role of modern architects to the extent that the loss of form, space, aesthetics, function, and volume could be seen. Architects use geometry because they are more unconscious and intuitive when designing. Because fresh geometric ideas are rarely developed by architects. It was also found that Euclidean geometry continued to be employed in architecture despite the fact that newer ideas like Euclidean geometry were unable to be used as tools in the field.

Architecture depends just as much on geometry as language does on letters. A triangular object's form could be of interest to architects. Architects almost ever communicate these theoretical principles, even if it could be important for them to replicate these forms in their designs. "The architect just uses geometry; he or she does not create it." As a result, there is a considerable difference between the theoretical elements of geometry and the pragmatic applications of geometry for architects.

1.6 Rationale of the Research

This study aims to learn how geometries approach the architecture throughout history and investigate the correlation between geometry and architectures. In this process, in the process of establishing the context of the current historical and modern perspective. The aims to avoid the philosophical context. The main purpose of this study is to understand what type of style, form, shape, or approach in Nepal has been used in Nepal in the geometry of the conventional context and construction of modern architecture

and design and construction of construction. Despite the fact that modern architects comply with general principles when creating designs, most have had a variety of architectural expressions.

The purpose of this study is to ensure that the current architects and the planners and confirm the conformity that can mix new ideas in the context and construction of the modern buildings of Nepal.

The scope of this study can create a perception of the disclosure of the number of politicians and the importance of the building, and in the form of geometry of architecture, this study will help you find answers related to your answers. "What are the necessities for developing a building in modern architecture, depending on what geometry is used as a surrounding environment?" This will help us to understand the changes that can be made in a timely manner, not only the current country scenario and architect can bring a relaxing life as well as a suitable location of the construction skills and designs. This study will be concluded by general analysis. Rather, the conclusion will conclude that the role played by geometry in the Nepal context of modern architecture and will be concluded.

1.7 Research Questions

This study aims to establish the context of the current historical and modern perspective. The main purpose of this study is to understand what type of style, form, shape, or approach in Nepal has been used in the geometry of the conventional context and construction of modern architecture.

a) How geometric approach to the architecture at different points in history and investigate its correlation between geometry and architecture type of style, form, shape or approach in Nepal?
b) Necessities for developing modern architecture, depending on what geometry is used as surrounding environment?
c) Role played by geometry in the Nepal context of modern architecture?

1.8 Research Objectives

To answer the research questions, following research objectives are identified:

Main Objective:

- To examine the role of Geometry in shaping early Modern Architecture of Nepal.
- To understand the perception of architect on the influence of geometry in modern architecture gauzing awareness.

1.9 Scope and limitations

The research will be limited to detailing of a few the most relevant attributes for study of Geometry in modern architecture used in Kathmandu. The study is centered on parameters from theoretical realm, which will be tested upon Case 1 i.e., **Saraswati Sadan (Bed Prasad Lohani, 1892)**. Case 2 i.e., **Lumbini Museum (Kenzo Tange, 1960)** (Early modern in Kathmandu). Also, in-depth interview with professional and educator, is another source of data for the research.

1.10 Expected output

This research is projected to provide architectural evolution in the Kathmandu valley a new dimension. The goal of the study is to discover geometric principles that have been employed as qualities and that should be examined in the context of Kathmandu's modern architectural development. As a result, the outcomes of this study might serve as a benchmark for future architectural development that focuses on influencing variables.

CHAPTER 2. LITERATURE REVIEW

2.1 Background of Architectural Design in Geometry

2.1.1 Historical Development of Geometry

Geometry is a branch of mathematics that deals with the study of points, lines, surfaces, and solids. Undefined components, assumed relations, unproven claims, and proved statements are the foundations of all mathematical systems. Different geometries result from different sets of assumptions (Yilmaz, Evolution of the Architectural Form Based on the Geometrical Concepts, 1999).

Greek terms for "measure" and "earth" are the origin of the word geometry. Over 15,000 years ago, geometric forms first emerged. These geometric designs are used to decorate ceramics and as architectural shapes. Geometry has always been popular as a subject of study. Egypt, Sumer, and Babylonia, for example, studied geometry in the ancient world. These civilizations explored the empirical aspect of geometry in order to improve their construction. The Greeks improved it by making it more demonstrative. Polygons, circles, and three-dimensional forms were the core subjects of Greek geometry.

The first broad geometric theorems are attributed to Thales. Pythagoras tried to use counting to quantify everything in the universe. Geometrically arranged collections of objects served as the representation for Pythagoras' counting numbers. Another philosopher who gave geometry top priority in his curriculum was Plato. He explained the scientific phenomena of the cosmos using the five regular polyhedrons. Aristotle discovered the rules of logical reasoning as a student of Plato. The mathematics of Euclid were organized into a logical framework. Even now, many people still consider the geometry of Euclid's elements to be true geometry (Yilmaz, Evolution of the Architectural Form Based on the Geometrical Concepts, 1999).

Modern geometry continues to address old issues, although it is no longer limited to Euclid's plane. In current geometry, there are novel progressions, such as elliptic geometry, where all lines meet, and hyperbolic geometry, where a line through any point has an endless number of parallels. The fact that there is no longer a straight line between two locations is another oddity of this time period. Fractals are further

employed in Modern Geometry to combine many subjects. Only a handful of these include mathematics, biology, meteorology, and art.

2.1.2 Geometry Types adopted in Architectural Design

The most well-known mathematical geometries include Euclidean geometry, Non-Euclidean geometry, analytic geometry, projective geometry, differential geometry, fractal geometry, descriptive geometry, and, topology.

When you apply the projection to geometry, you get projective geometry. Calculus is used to transform geometry into analytical geometry. It results from the blending of algebra and geometry. In descriptive geometry, planes and elevations are produced by orthogonal projecting solid objects onto a set of planes that are perpendicular to one another. It makes the design or building process go more smoothly. Calculus is used in differential geometry to examine the characteristics of curves and surfaces. Non-Euclidean geometry is created by substituting one of Euclid's competing forms for the parallel postulate. The study of an object's characteristics that are unaffected by stretching or bending is known as topology. After algebra and geometry, it is now recognized as the fourth branch of mathematics. Among these geometries, the following are those that are often utilized in architectural design:

2.1.2.1 Euclidean Geometry

The study of points, lines, planes, and other geometrical structures using a modified set of Euclid's premises is known as Euclidean geometry. The history of Euclidean geometry may be traced back to at least 10,000 BC and up to the twentieth century. The ancient Greeks used it to create structures and survey land, therefore it was quite useful. Even now, we continue to utilize it. (Encyclopedia Grolier)

The geometry in the Elements was founded on 10 assumptions and was a logical system. The other five assumptions were referred to as postulates, and the first five were referred to as common conceptions. A model for deductive reasoning was created as a result of the logical framework. This logical approach has a significant impact on all academic fields. Depending on whether we're discussing two- or three-dimensional space, the foundation of Euclid's geometry is either an axis system or a plane.

- Set of geometric proportions that may be deduced using strict logical processes from Euclid's five postulates in his elements. The following are the five postulates:
    1. Any two points can be connected by a straight line.
    2. Any piece of a straight line can be stretched forever.
    3. Any point may be used to create a circle of any radius.
    4. Equal right angles exist.
    5. The two straight lines will ultimately meet on the side with the smaller inner angles if a straight line contacts two additional straight lines, producing interior angles on the same side that are less than two right angles.

- The Euclid's Elements also provide several definitions in addition to these postulates. These definitions are most frequently used:
- A line is length without width; the extremities of a line are points.
- The ends of a line are called points because they are length without breadth.
- A point is something which has no components or no magnitude.
- A straight line is one that is uniformly spaced apart from its extremities.
- A superficies is a plane with simply length and width, and lines at its extremities.
- A planar surface is one in which, given any two locations, the straight line connecting them lies entirely within the surface.
- The inclination of two lines in a plane that intersect but are not parallel to one another is known as a plane angle.
- A planar rectilinear angle is the inclination of two straight lines that cross but are not on the same straight line (a graphic survey of perception and behaviour for the design professions)

2.1.2.2 Analytic Geometry

Points are defined in terms of a coordinate system, such as Cartesian coordinates, in the area of mathematics known as analytical geometry. This geometry makes it possible to

solve algebraic problems geometrically and geometric problems algebraically. Analytical geometry methods have been extended to four dimensions or more and combined with other mathematical fields. (Concise Columbia Electronic Encyclopedia, published by Columbia University Press in 1994)

Euclidean Geometry was unable to provide certain models in the 17th century. More knowledge about ellipses was necessary in mathematics than Euclidean geometry could provide. A more flexible approach of altering these curves was also necessary. Analytic geometry finally satisfied such demands at the time.

In analytical geometry, plane points stand in for pairs of integers. The locations of points that move in accordance with equations are thought of as lines and curves. While the ordinate relates to the y-axis, the abscissa corresponds to the x-axis. The entire field of Euclidean geometry is known as analytical geometry. Analytic geometry is based on the three-dimensional Cartesian system, where the axes are labelled x, y, and z. Working in a three-dimensional environment is made simpler by the Cartesian system. In addition, analytic geometry includes a variety of curve- and surface-based objects that are not included in Euclidean geometry.

The most often used architectural components are three-dimensional conic shapes and shells. They were tough to build in ancient times. Antiquity's elements were formed of stone blocks that had to be cut to the appropriate shape regardless, while current constructions are mainly made of concrete, which necessitates the use of a framework. Such components may be readily molded after being moulded, thanks to the benefits of analytic geometry. By means of analytic geometry, shells, ruled surfaces, and doubly ruled surfaces are often utilized as structural components in architecture.

2.1.2.3 Fractal Geometry

A relatively recent mathematical idea is fractal geometry. It represents a radical break from Euclidean geometry. It refers to systematic analysis of mathematical forms that develop in an endless, self-similar, wandering detail, from huge to minute proportions. This suggests that when these items are magnified, their component parts appear to be the same as the whole. In other words, with the parts of the parts and so on, the similarity goes on forever. Fractal geometry is the study of non-integer dimensional patterns seen

in nature, such as rivers, which have a fractal dimension of about 1.2, and mountains, which have a fractal dimension of about 2-3.

Natural rhythms and structures like leaves, trees, mountain ridges, river flood levels, wave patterns, and nerve impulses can all be considered as examples of this cascading action. Fractal principles may be found in a variety of fields, including physics and music creation. The application of this relatively new mathematical tool can aid architecture and design, which are concerned with rhythm management and fractal notions like the evolution of shapes from a distant view down to the intimate details. A special example of a technique that goes to the core of design composition and allows the architect or designer to show a profound understanding of nature is fractal geometry. (Bovill, 1996)

According to Mandebrot, Euclidean Geometry cannot be used to describe the objects observed in nature. From this perspective, he demonstrated that Fractal Geometry may be used to define all natural things. He asserted that modern mathematics, music, painting, and architecture appear to be linked. He also demonstrated how this geometry is used in architecture. Euclidean geometry describes a Mies van der Rohe building, yet fractal features abound in Beaux-Art structures.

Fractal geometry has also been utilized to create planning grids that aid in the coordination of a building's layout. These grids have traditionally been Euclidean. In the case of Villa Rotunda, the structure was planned utilizing a fractal planning grid and fractal distribution. The arrangement of the building is coordinated by grids of lines. The lines establish symmetrical rhythms in both directions. In this example, fractal rhythms have been used to build planning grids that draw inspiration for the layout from natural rhythms.

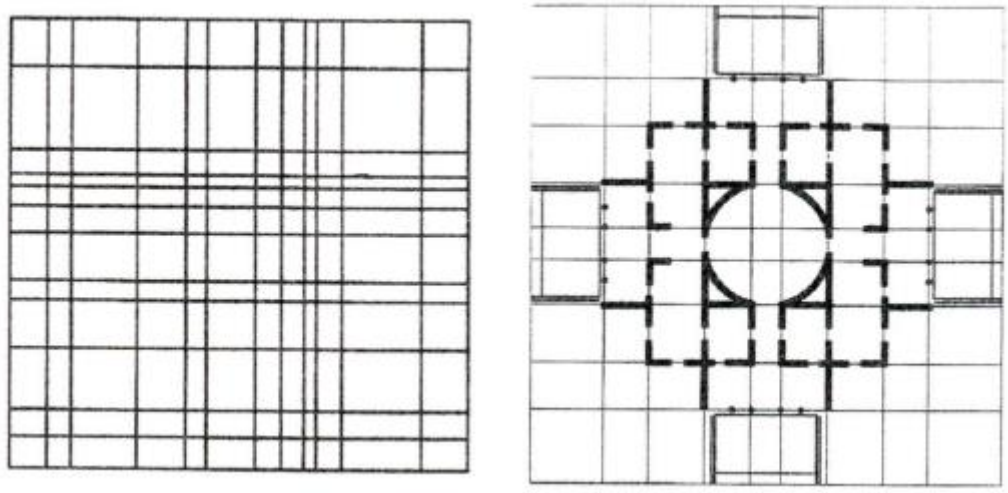


Figure 3: Grid for fractal planning for Villa Rotunda based on the fractal rhythm

2.1.2.4 Non-Euclidean Geometry

Most individuals find it challenging to understand non-Euclidean geometry. People have vague ideas about it. Non-Euclidean geometry is a branch of mathematics that deals with abstraction, to put it another way. It illustrates how two parallel lines may come together at a point even if they never meet. Within the bounds of this geometry, the top and bottom of a sphere are where two parallel lines intersect. Spherical and hyperbolic geometry are products of non-Euclidean geometry. Up until now, most geometry operations have been carried either on flat surfaces or in plan geometry. Mathematicians now face additional obstacles and uncertainties as a result of the concepts of spherical and nonlinear geometry. Depending on the sort of surface they were on, distances and degree sums in triangles may no longer be taken for granted. (Carter, 1996).

2.1.2.5 Descriptive Geometry

One of the most practical Non-Euclidean geometries is hyperbolic geometry, which was crucial to the development of Einstein's general theory of relativity. In addition, hyperbolic geometry is very important in topology. It's a "curved" area. Proofs, theorems, postulates, and definitions are all part of an axiomatic system, and hyperbolic geometry may help us grasp them. The feature of Hyperbolic Geometry is that lines

that start in the same direction move further and more apart. Elliptic Geometry is another important Non-Euclidean Geometry. The feature of elliptic geometry is that lines that start out in the same direction come closer and eventually intersect.

The first to present a wholly synthetic process that could be used in any kind of art or craft was Monge. As a result, descriptive geometry developed into a comprehensive theory and method for the operations brought about by the intersection of planes, line, and surfaces in space. Perspective, fortification, carpentry, and stonecutting were all covered. In addition, it dealt with mathematics, which included three-dimensional space. The fundamental ideas of descriptive geometry may be shown analytically. Three-dimensional objects can also be flattened into two-dimensional space using this technique.

In Journal Polytechnique, Gayverman stated that an architect could only determine the precise shape and composition of his projects and their parts after researching how descriptive geometry is used in other forms of art and craft. Monge highlighted that descriptive geometry allowed for knowledge of the shapes of the many sections included in all types of buildings, which were related to the stability and ornamentation of the structures. This was stated in a separate volume of the same journal.

2.1.3 Definition of Geometry Based on the Fundamental Conceptual Elements

Prior to defining geometry in architecture, it is important to clarify its functions in architectural design.

- Geometry allows us to readily materialize geometrically created forms.
- By resolving the issues with the geometry of shapes, it has given us sets of pre-made forms that may be altered in a number of ways. It allows us to define form precisely.
- Simply having the unmistakable and flawless geometric shapes present may give someone a sense of divinity. *(Antoniades, 1992)*

Point, plane, line, fundamental geometric forms (circles, squares, and triangles), angles, solids (cubes, spheres, and cones), and other topics are all of importance to geometry. These components are crucial to the creation of architectural form in architectural design. In accordance with organizational principles, architects created things and created building shapes using these fundamental components. The elements that have

just been mentioned are also pure and abstract geometric shapes. They are occasionally believed to have a symbolic or aesthetic influence on design. These components may be thought of as a language utilized to create more intricate architectural designs. These fundamental components have been employed by architects throughout the history of geometrical theory. The use of architectural design components to create architectural form will be demonstrated further.

Geometric solids and forms have been employed in building throughout history. These fundamental geometric components give building its pleasant appearance through proportions. The abilities of the structures are also improved by the advancement of the fundamental geometric forms. Regular polygons are the simplest basic forms, whether used single or in combination. They serve as the foundation for many other architectural elements, including pyramids, patterns, and prisms. Equilateral, equiangular, and symmetrical describe regular polygons. The most popular ones are those of sides three, four, and five as well as their first truncations. By trimming the comer back, a form can be altered by truncation. Rectangles, right triangles, and isosceles triangles may be found in all regular polygons. The cornerstone of the triangles is the right triangle. The right triangle's height is equal to the polygons' radii. The regular polygon may turn into a prism if height and thickness are added to it (Yilmaz, 1999).

To construct another geometric form, the patterns can be overlapped, transposed, rotated, interlaced, and interlocked with other shapes. One of the most popular techniques in architectural design is the innovative use of basic forms as a formative generator. Through the manipulation of forms drawn from numerous fundamental geometrical shapes, more intricate arrangements are made feasible. For instance, the approach most typically employed in architectural design is grids. Modular grids that are square, rectangular, triangular, or circular have been utilized by architects to expand them into three dimensions. Grids may be combined and manipulated to create more complicated architectural shapes by rotating, translating, and overlaying them like simple geometric objects.

The ancient Egyptian pyramids and tombs were constructed utilizing triangles, rectangles, and squares as geometric shapes. The roofs of the churches and palaces were also built using cones, prisms, pyramids, and other designs. In addition to these, arches,

stone monuments, and amphitheaters were built using circles and semicircles. The circles are combined with rectangles to create a curve in the applications that follow.

The small diameter of the temple columns served as the basis for a proportional system created by Greek architects. The measurements of masses and the spatial intervals were calculated by multiplication and division. Based on the dimensions of the cathedrals, mediaeval architects utilized it. Equilateral triangles and squares were often employed by architects to create structures throughout the Gothic era.

Ancestors used squares, triangles, and circles to build their homes and barns. The lines separating these forms vanished when they were combined to become a structure. The two forms merge into one. Squares and triangles were the primary construction materials. The architects and builders add or remove squares and triangles to alter the shape and appearance of the buildings. For instance, they would construct another square and top it with a triangle to create a shed that was linked to a barn. A house might be expanded by taking away a square from the current structure to make room for a porch. Every structure was composed of either free space or forms. The doors and windows in the open area are formed by the forms (Yilmaz, 1999).

2.1.4 Geometric System of Proportions in Architectural Design

Throughout the history of construction, proportional systems have helped meet a design's technical and aesthetic objectives. These proportional systems must ensure that a few important ratios recur throughout the design, have additive features that allow the whole to equal the sum of its parts, and be adaptable enough to meet the technical abilities of the architect.

P.H. Scholfield examines three theories of architectural proportion in his book, The Theory of Proportion in Architecture.

- Leon Battista Alberti created the concept of musical proportions employed during the Renaissance.
- A system in operation throughout the Roman era,
- Le Corbusier's Modulor, a twentieth-century architect

The Modulor is based on the Golden Mean, as opposed to the Roman method, which is based on irrational numbers. Integer series may also arbitrarily nearly resemble both of these systems, making it possible to build the systems with little error.

The link between numbers and architecture in Alberti's designs was close. Because architectonic measures correlate to the divine numbers of Pythagorean and Neoplatonic thinking, Alberti's building displayed an exceptional harmony and melody. A whole musicality reflects nature, the cosmos, and god. (Music that can be heard and music that is etched into architecture.) According to Alberti, mathematical order serves as the foundation for both the divine order and any order that may be attained in the physical world. Apart from that, he believed that a system of a few mathematical connections might include all values for the building's principal dimensions (Hasan & Tiwari, 2018).

2.2 Characteristics of Architectural Form

2.2.1 Golden Section

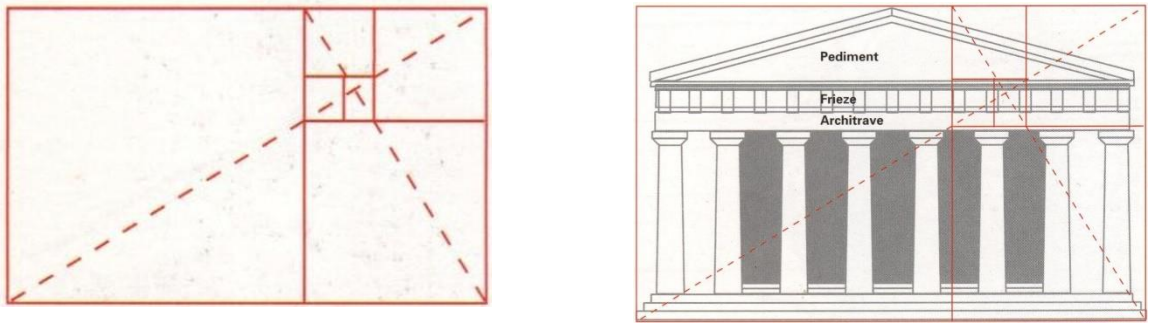
The golden section demonstrates a basic harmonic concept that is drawn from nature and used in music, art, and architecture. The concept of the golden section demonstrates the harmony between composition and geometry. This notion travels extensively through architectural history. In his study of the pentagon and the relationship between its edge length and diagonal, Hipparcos of Metapont (450 B.C.) discovered it. The first person to clearly define the golden section as a continuous division was Euclid (325–270 B.C.). The golden sector was thereafter regarded as the perfect ratio and the pinnacle of harmony and aesthetics.

Harmonic proportions were based on geometric relationships in art, architecture, and music, particularly in the Renaissance. In Florence, Santa Maria del Fiore was built in 1296 by Filippo Brunelleschi using the golden section and the Fibonacci calculations. The "Modulor" by Le Corbusier is an example of an architectonic notion of planning and producing according to geometric laws in contemporary architecture, although it is nevertheless constrained by the traditional conception of harmony (Leopold, 2006).

2.2.2 Architectural Proportions

In the same manner that human proportions were expressed in a module reflecting the length of the head or feet, Vitruvius is credited with establishing the notion of the module. He proposed for temple construction to be based on the properly proportioned human form. The Parthenon in Athens is an example of the Greek proportional system (Elam, 2001).

- Relationship of Architecture to the Golden Section Golden section proportions are examined using the golden section construction schematic.



- Golden Section Harmonic Analysis of the proportions of the golden section as shown in the diagram of the golden section harmonic analysis.

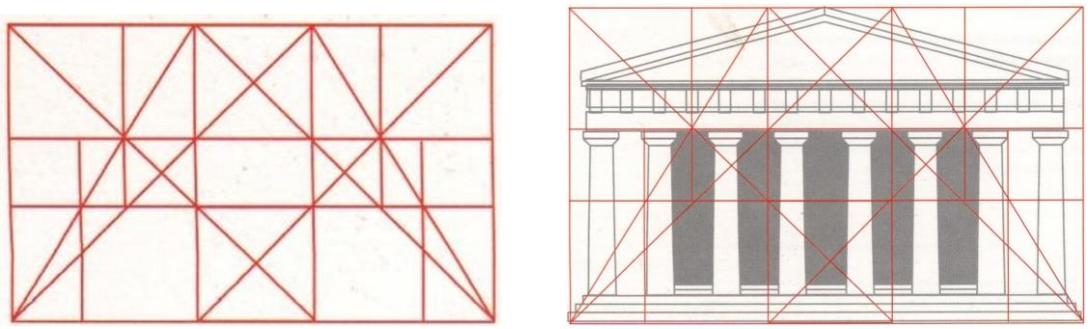


Figure 4: Golden Section Architectural Proportions

Le Corbusier mentions the function of the square and circle in the proportions of the front of the Parisian Cathedral of Notre Dame in Towards a New Architecture. One-fourth of the diameter of the circle engraved on the square is the ratio of the clerestory window (Elam, 2001).

- The golden section rectangle is used to analyse proportions and regulating lines. The facade as a whole has a golden rectangular proportion. The golden rectangle's square encloses the bottom part of the facade, while the towers are encircled by the opposite golden rectangle's square. The lower part of the facade

may also be separated into six separate pieces, each with an own golden rectangle (Elam, 2001).

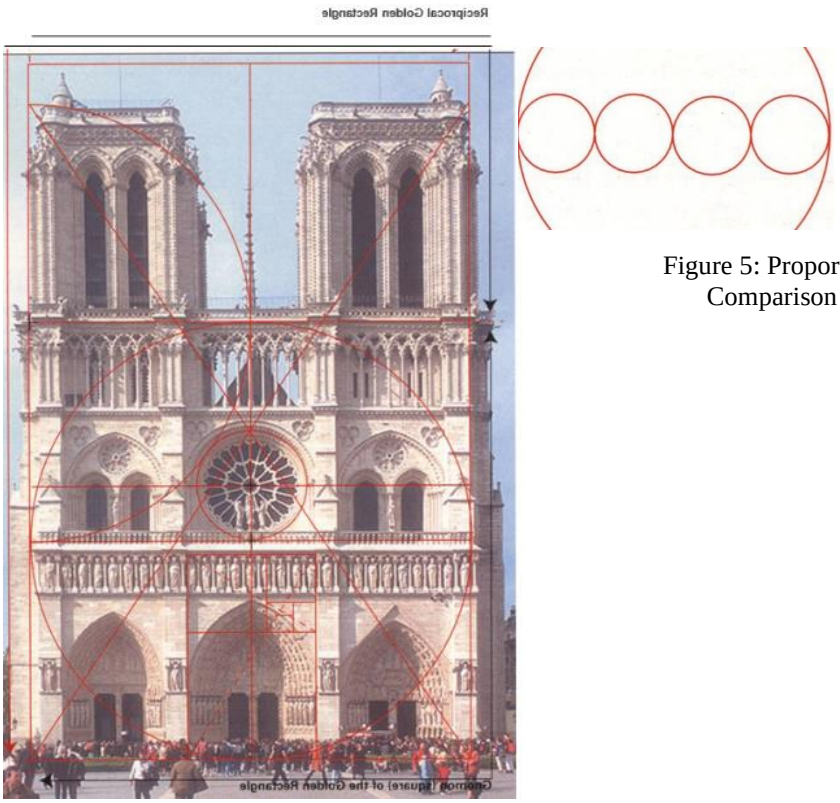


Figure 5: Proportion Comparison

2.2.3 Le Corbusier's Regulating Lines

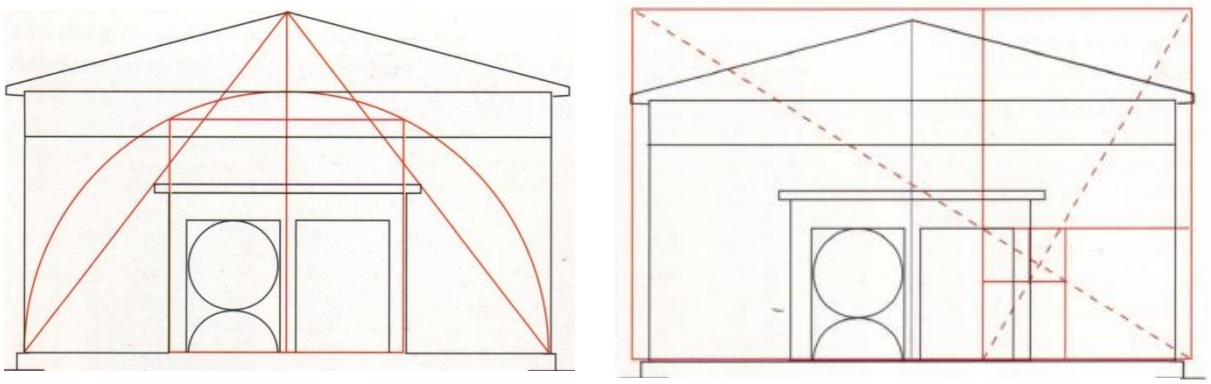


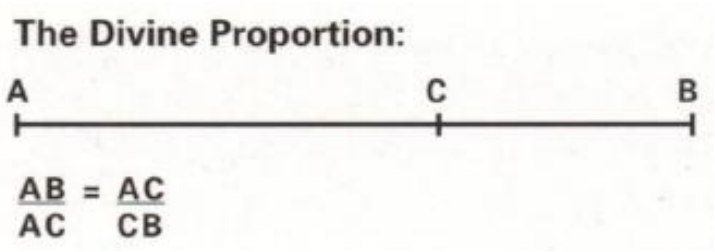
Figure 6: Facade of the Arsenal of the Piraes. Le Corbusier, Towards a New Architecture, 1931

Le Corbusier's 1931 book, toward a New Architecture, claims "an essential component of architecture is the need of structure. The governing line protects against willfulness. The knowledge is made more satisfying. The regulating line is not a recipe; it is a tool for achieving a goal. An essential component of architectural production is its decision and the modes of expression provided to it ". Le Corbusier writes on the necessity of

regulating lines as a way to bring order and beauty to building in his book Towards a New Architecture. Even the most ancient and prehistoric of architects learned to employ a regulating unit of measurement, such as a hand, foot, or forearm. (Elam, 2001).

2.2.4 Construction of the Golden Section Rectangle

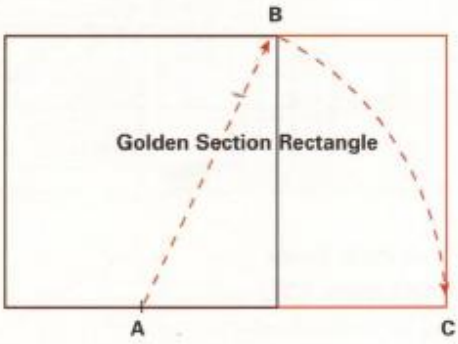
A ratio of the Divine Proportion is represented by the golden section rectangle. A line segment is divided into two segments by the divider so that the entire segment, AB, is the same as the longer portion, AC, to the shorter part, CB. This results in a ratio of around 1.61803 to 1. (Elam, 2001).



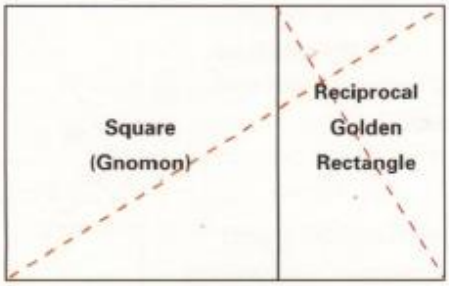
Golden Section, Square Construction Method

1. Begin with a square.

2. Draw a diagonal from the midpoint A of one of the sides to an opposite corner B. This diagonal becomes the radius of an arc that extends beyond the square to C. The smaller rectangle and the square become a golden section rectangle.



3. The golden section rectangle can be subdivided. When subdivided the rectangle produces a smaller proportional golden section rectangle which is the reciprocal, and a square area remains after subdivision. This square area can also be called a gnomon.



4. The process of subdivision can endlessly continue, again and again, producing smaller proportional rectangles and squares.

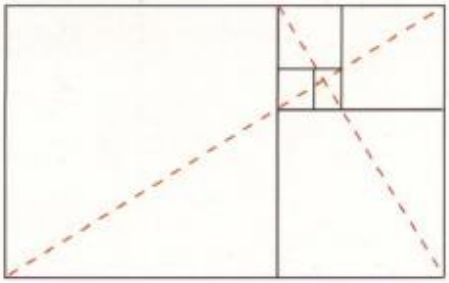
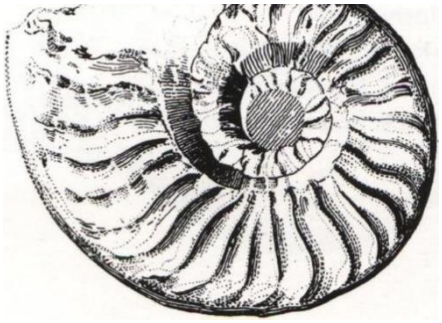


Figure 7: Golden Section Square



A special kind of tangle is the rectangle with the golden section. Its reciprocal is a smaller proportional rectangle when divided, leaving a square as the remaining area. Use a radius equal to the length of the square's sides to create a spiral from the correspondingly shrinking squares. (Elam, 2001).

- A golden section spiral may be created by utilizing the golden section subdivision diagram. The radius of a circle should be calculated using the dimensions of the squares in the subdivisions. Draw arcs across each square in the diagram and link them (Elam, 2001).

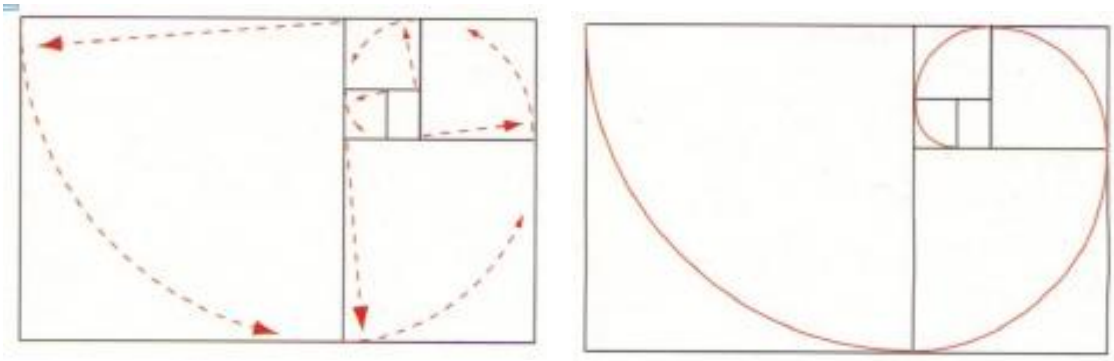


Figure 8: Golden Section Spiral

- Proportional Squares

The squares from the diagram of the subdivision of the golden section are in relation to one another in the golden section. (Elam, 2001).

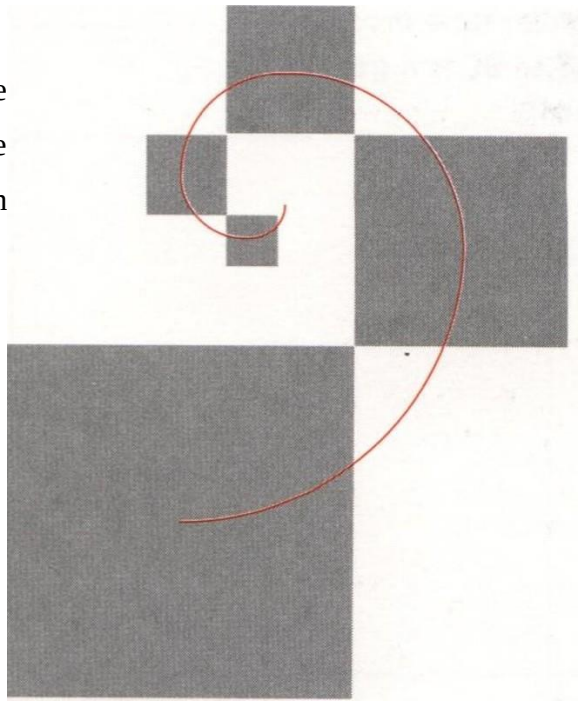
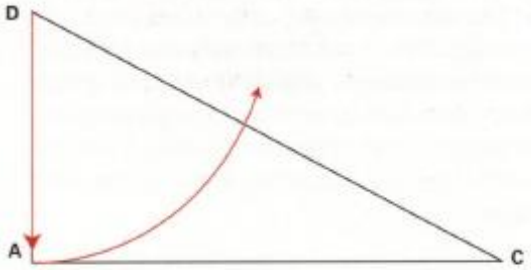


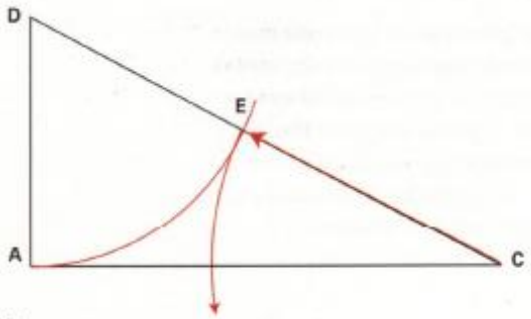
Figure 9: Proportional Squares

Golden Section Rectangle, Triangle Construction Method

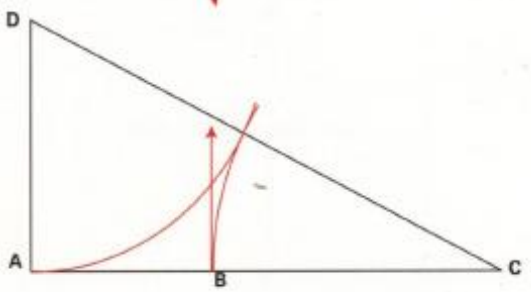
1. Begin with a right triangle whose sides are in 1:2 proportion. Draw an arc from D using DA as a radius, that crosses the hypotenuse.



2. Draw another arc along the hypotenuse from C using CE as a radius to intersect the base line.



3. From point B where the arc intersects the base line draw a vertical that touches the hypotenuse.



4. This method produces golden section proportions by defining the length of the sides of the rectangle, AB and BC. The subdivision of the triangle yields sides of a rectangle in golden ratio proportion, since the ratio of AB to BC is a golden section ratio of 1:1.618.

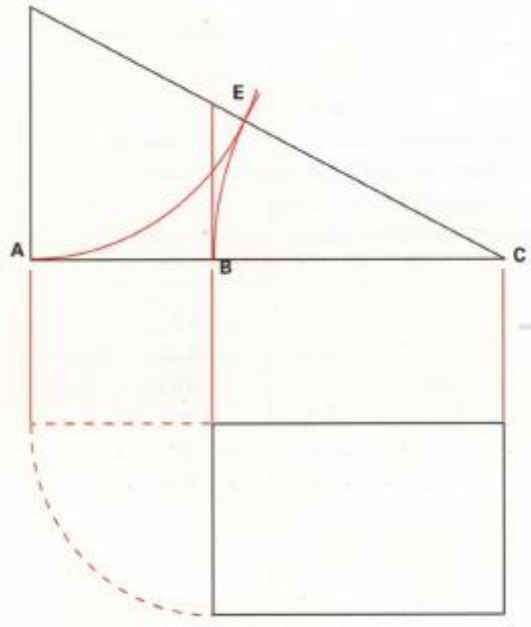
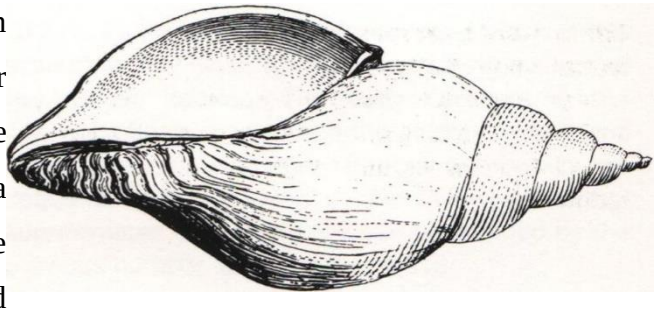


Figure 10: Golden Section Rectangle, Triangle

2.2.5 Golden Section Proportions



The golden section approach can result in a collection of squares or circles that are arranged in the manner seen below. The sides of a rectangle with a golden section are produced by the divisions and proportions of the triangle technique of construction, and it is also possible to make arbitrary shapes like a pentagon (Elam, 2001).

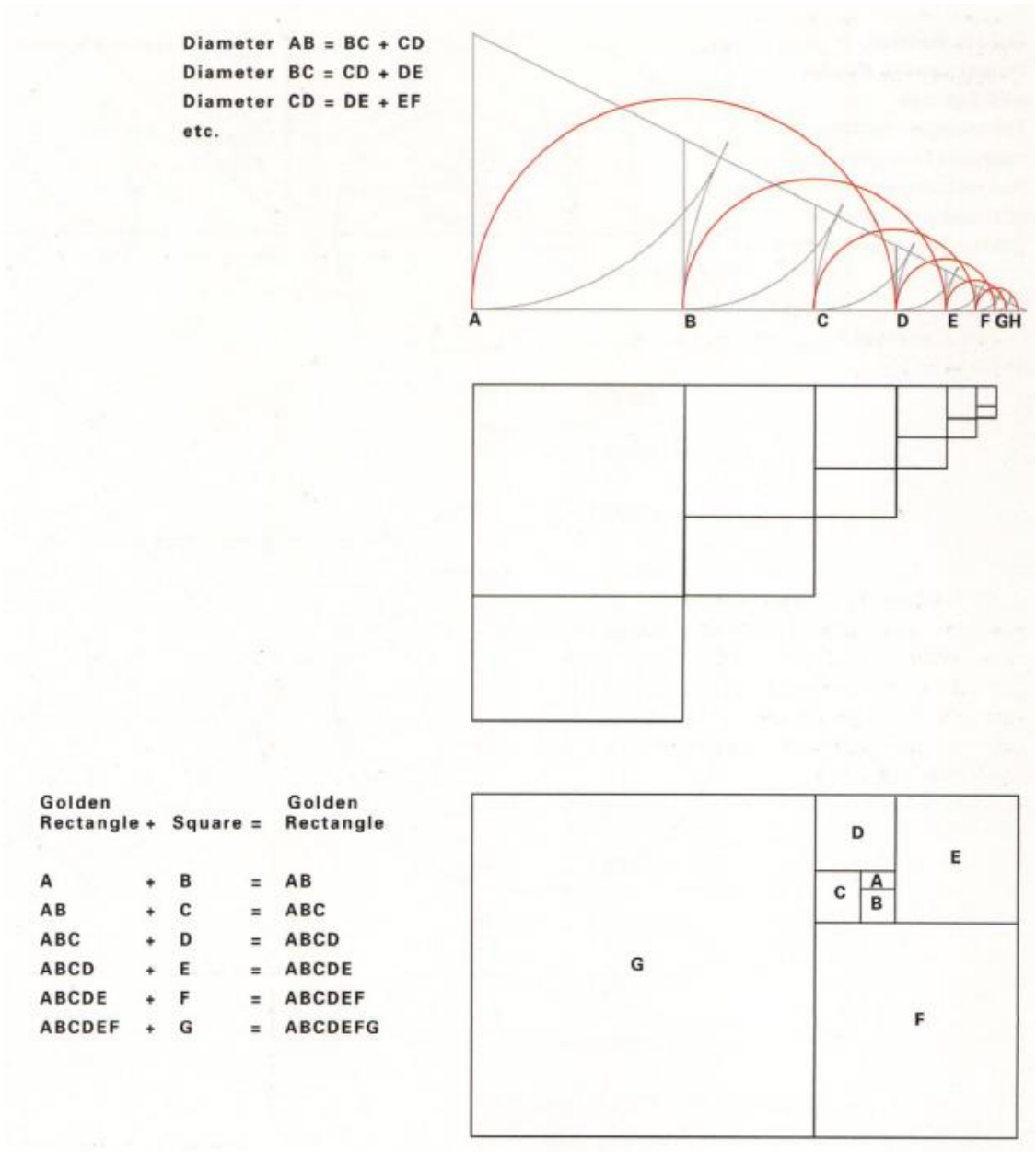


Figure 11: Golden Section Proportions

- Golden Section Proportions in Circles and Squares

The triangle construction method of the golden section will also yield a series of circles or squares in golden section proportion (Elam, 2001).

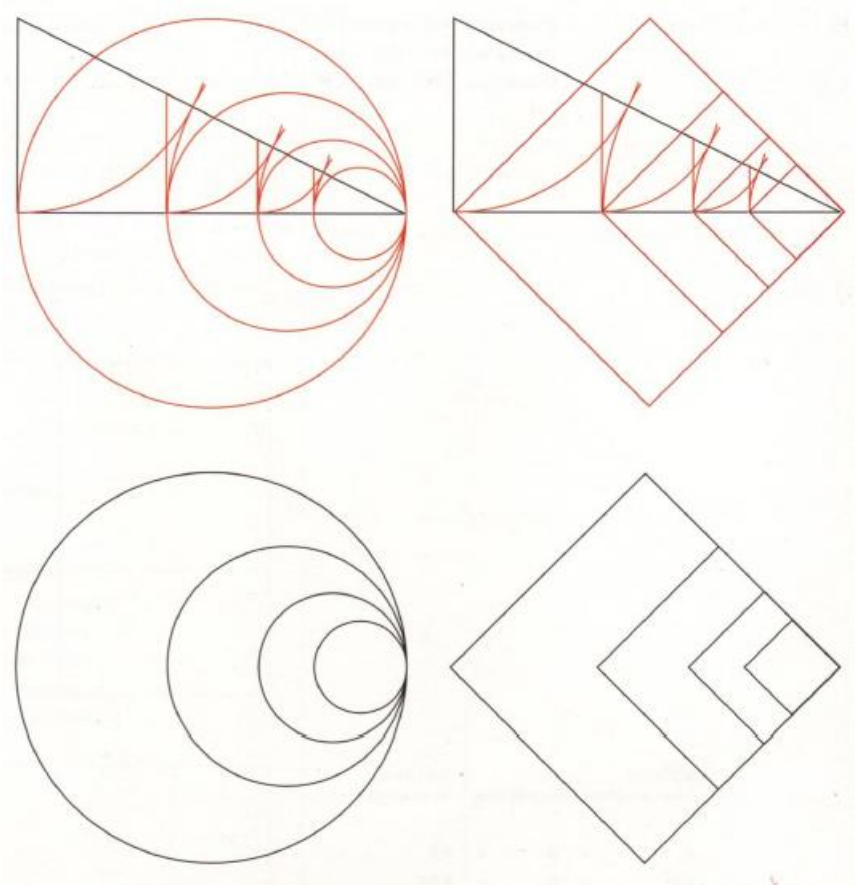


Figure 12: Golden Section Proportions in Circles and Squares

2.2.6 Golden Section and the Fibonacci Sequence

The Fibonacci sequence, so named after Leonardo of Pisa, who brought it to Europe along with the decimal system some eight hundred years ago, closely resembles the unique proportioning qualities of the golden section. This is due to the fact that each number in the sequence after the fifteenth gets divided by the number after it. This system's proportioning pattern is quite similar to the golden section's proportioning pattern (Elam, 2001).

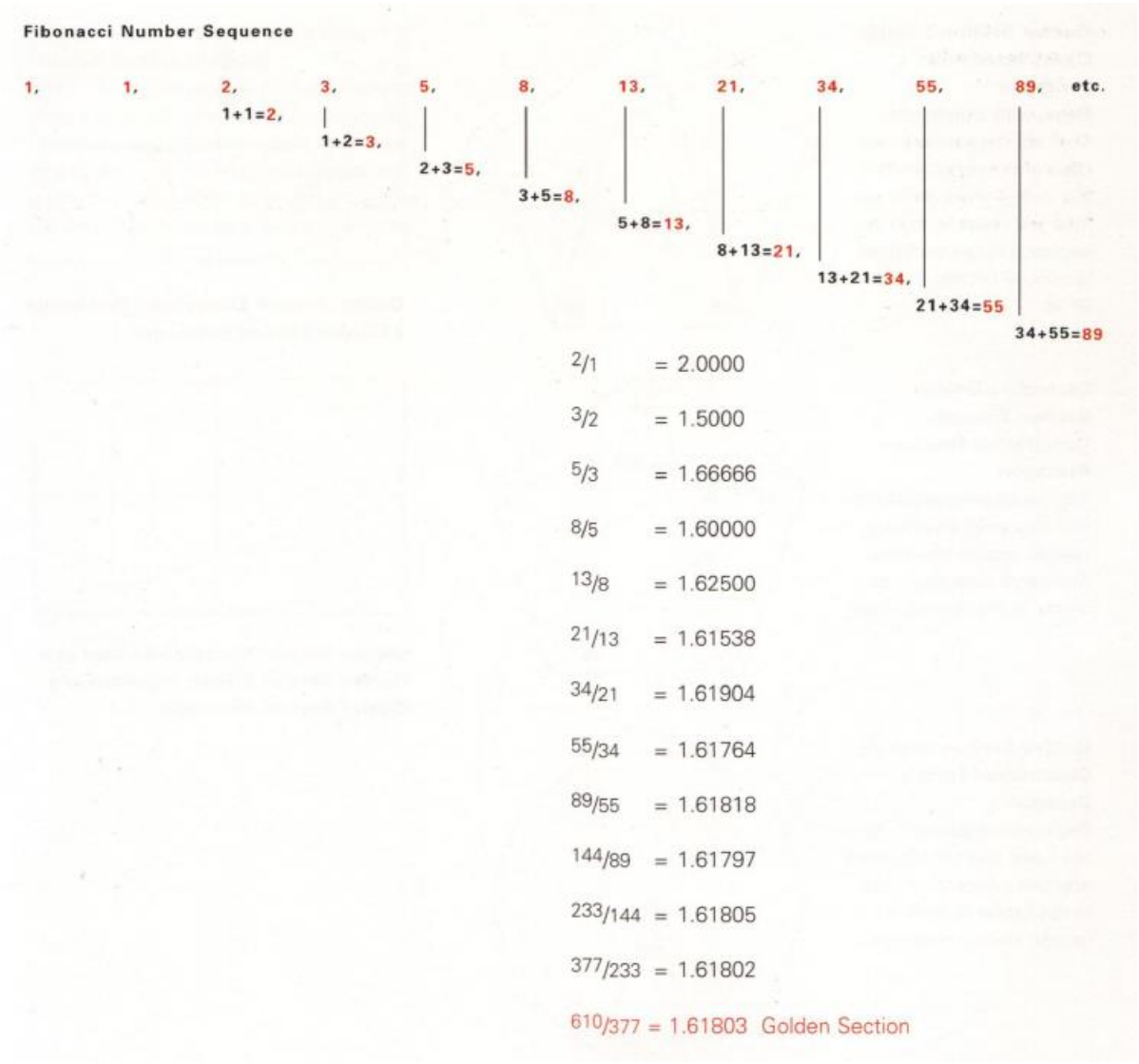


Figure 13: Fibonacci Sequence

2.2.7 Golden Section Dynamic Rectangles

It is relatively easy to divide a dynamic rectangle into many harmonic subdivisions. When split, dynamic rectangles yield an infinite number of appealing surface ratios. The process involves striking diagonals from opposite corners and then building a network of parallel and perpendicular lines (Elam, 2001).

- Golden Section Dynamic Rectangles

Graphs from The Geometry of Art and Life show various harmonic subdivisions of rectangles with a golden section. The golden section rectangle construction is depicted

by the little red line rectangle on the left. Rectangles with black lines only display the harmonic subdivisions (right). (Elam, 2001).

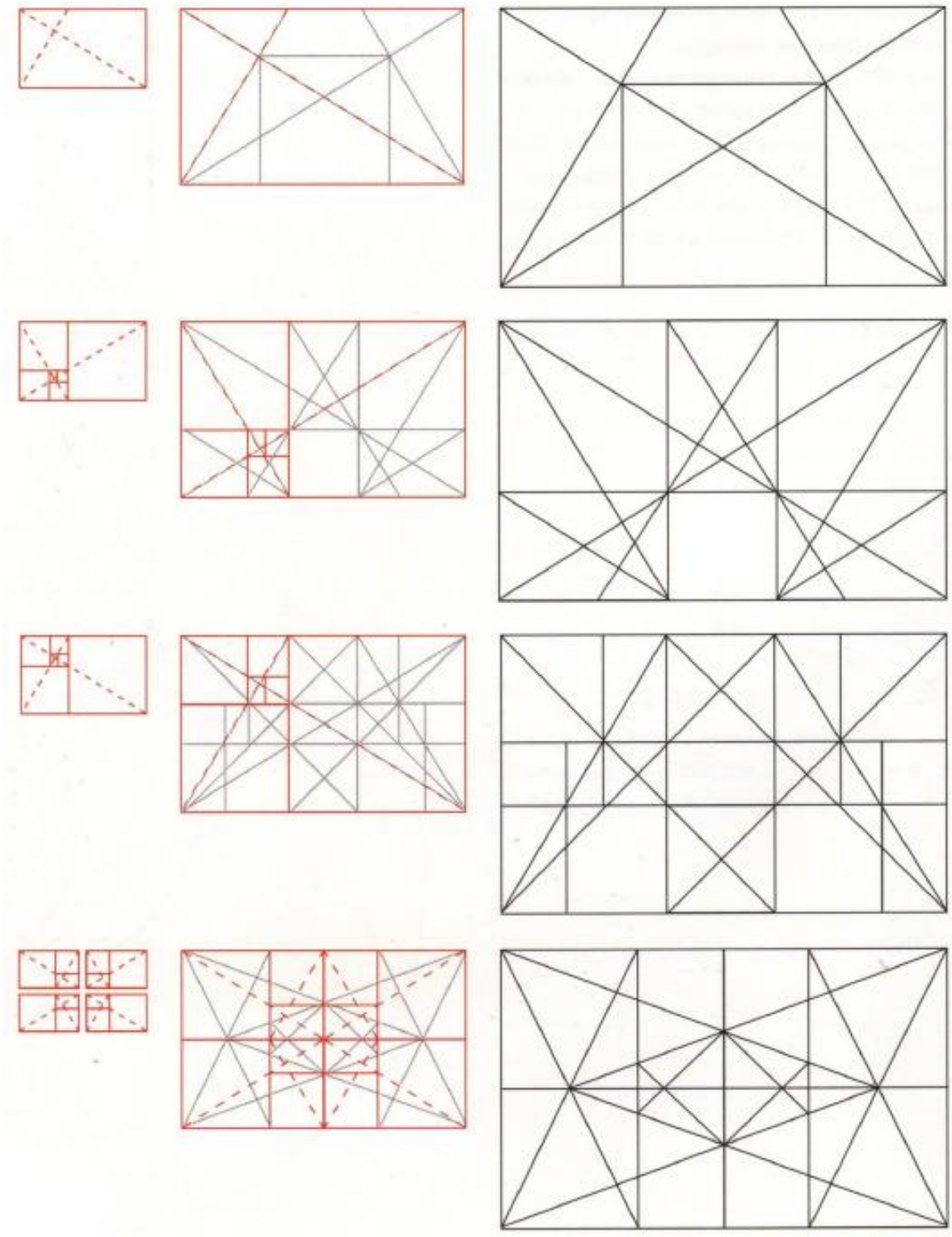


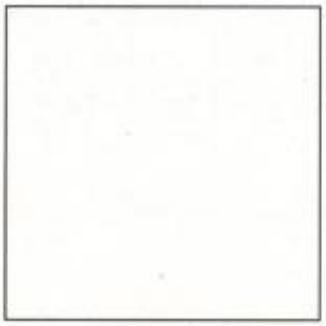
Figure 14: Golden Section Dynamic Rectangles

2.2.8 The Root 2 Rectangle Construction

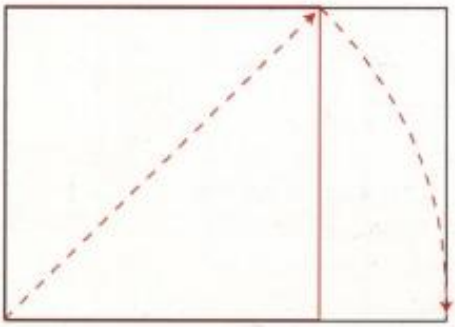
Rectangles with a root 2 have the ability to split indefinitely into smaller rectangles in the same proportion. The root 2 rectangle's ratio roughly resembles the proportions of a golden section. Golden section proportions are 1.618 and root 2 proportions are 1:1.41.

Root 2 Rectangle Construction, Square Method

1. Begin with a square.



2. Draw a diagonal within the square. Use the diagonal as an arc that touches the square base line. Enclose a rectangle around the new figure. This is a root 2 rectangle.



Root 2 Subdivision

1. The root 2 rectangle can be subdivided into smaller root 2 rectangles. Subdivide the rectangle in half via a diagonal creating two smaller rectangles. Again subdivide the halves into smaller root 2 rectangles.

2. This process can be repeated endlessly to create an infinite series of root 2 rectangles.

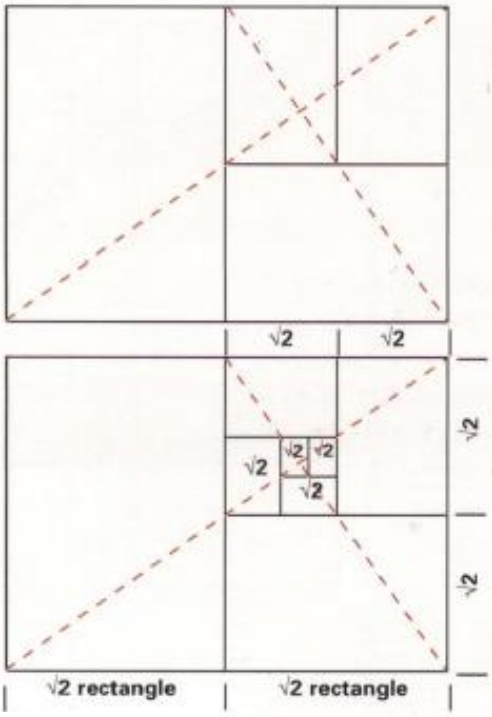
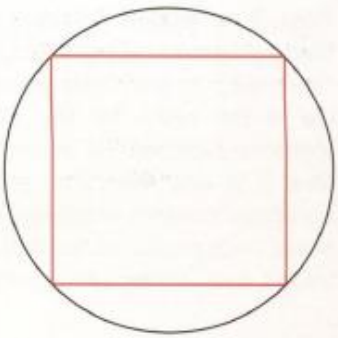


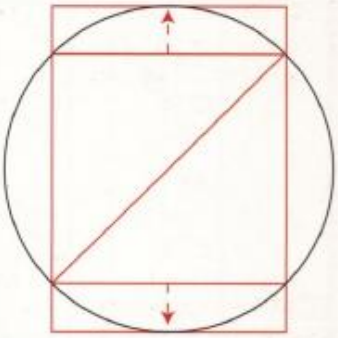
Figure 15: Root 2 Rectangle Construction Square Method

Root 2 Rectangle Construction, Circle Method

1. Another method of constructing a root 2 rectangle is by beginning with a circle. Inscribe a square in the circle.

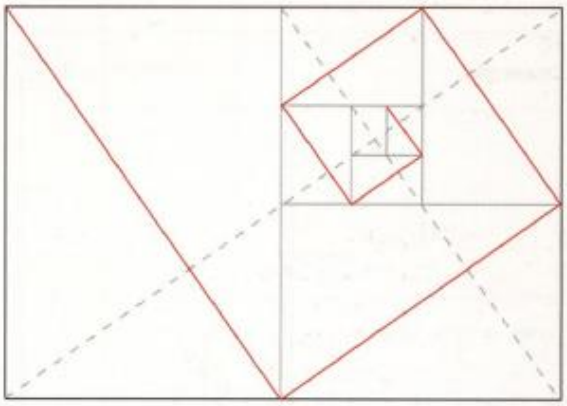


2. Extend the two opposite sides of the square so that they touch the circle. The resulting rectangle is a root 2 rectangle.



Root 2 Diminishing Spiral

A root 2 diminishing spiral can be created by striking and connecting diagonals on reciprocal root 2 rectangles.



Root 2 Proportional Relationships

Subdividing a root 2 rectangle continuously produces smaller proportional root 2 rectangles.

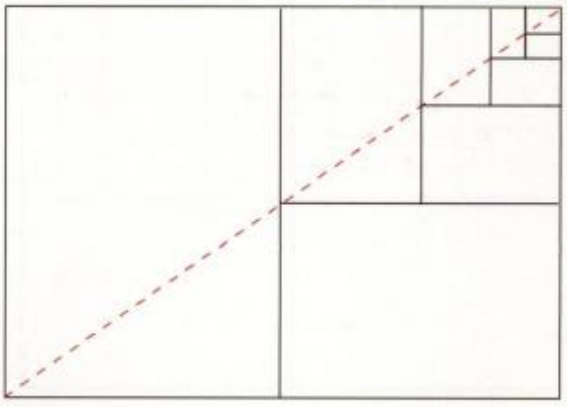


Figure 16: Root 2 Rectangle Construction Circle and Spiral Method

2.3 Characteristics of Architectural Form

2.3.1 Definition of Architectural Form

Architecture's form encompasses more than only the use of space and the activities that take place there. The shape also serves as a symbol or a vehicle for message. In addition, architectural form is influenced by the components themselves, their combinations and arrangements (syntax), their meanings (semiotics), and their impact on humans (pragmatics). As a result, form cannot be limited to only the selection of the pieces and their placement. Both forms cannot be viewed as merely a means of conveying message. This makes it feasible to evaluate the architectural shape using one of three frameworks:

1. A distinguishing aspect of space (related to use)
2. A symbol (related to arrangement, significance, and effect)
3. Organization (dependent on the laws of static and the strength of materials)

2.3.2 Theories of Architectural Form

In the ancient era, the notions of architectural form initially surfaced. Plato was influential in the formation of form theories at that period. He believed that the idea of form had a variety of interpretations, including those that were metaphysical, aesthetic, epistemological, logical, and ethical. All of these meanings were associated with the idea of form in Plato's philosophical framework.

The form paradigm that was unique to the Renaissance was also represented in the architectural form. In contrast to the Platonic Idea, the Renaissance Notion is a concept in the mind of the artist rather than an essence existing in its own unique reality. The epistemological and aesthetic implications of form are stressed by this emphasis on the intellect, which has the effect of dividing the various significances of procedure that were united by the Platonic Idea (Yilmaz, 1999).

The epistemic meaning of shape overrides the aesthetic one in the centuries after the Renaissance. The perception of form in the aesthetic sense and the perception of form in the epistemological sense had already been compared by the seventeenth century. The concept has to be understood immediately, at the first glimpse, as the aesthetic experience demands. Geometric shapes like cubes and cylinders are the ones that are easier to comprehend. Consequently, the architectural shape become increasingly

angular. As a result, the significance of architectural form was primarily epistemological.

Type took the place of Idea as the prevailing form paradigm throughout the transition from the eighteenth to the nineteenth century. Then, the last of the form's aesthetic meanings vanished. Almost solely, Type represented the epistemic significance of Form. The idea of an interior shape covered in adornment was how the architectural form was conceptualized in the nineteenth century.

Beginning in the early 20th century, the psychology of form proposed a relationship between the real shape of an item and an objective form (constructs in the mind). Le Corbusier's theories and constructions are equally reflective of this identity in perception and conceptualization. Not only did Le Corbusier see the Greek temple's columns as cylinders, but he also imagined his own structures as being constructed of the same geometric solids.

Form started to leave the world of the mind in the 20th century. The concept of structure communicates a sense of form that is more procedural than epistemic. Artificial models may now be produced using the design process thanks to the development of computers. A shape that is represented digitally expresses a universal from which an endless amount of examples or variants may be produced (Yilmaz, 1999).

2.4 Generation of Architectural Form

There are two groups of components in the formal design:

- The conceptual elements (point, line, plane, and volume)
- The visual elements (shape size, color, texture, etc.)

Conceptual aspects are regarded as being there even when they are not physically there. The visible visual components of a design make up its overall look.

2.4.1 Conceptual Elements of Architectural Form

Points, lines, planes, and volumes make up the four element kinds that make up architectural shapes and spaces. Architectural components are typically three-dimensional volumes with edges, vertex, and segment definitions (planes). The four-element kinds have inherent qualities when applied to architecture. Lines indicate

boundaries, major endpoints (at the line's end), and direction (along the line). Line intersections show the third point with further information than endpoints. This information may be viewed as the intersection that serves as the starting point for calculations of the intersection's distance and angle.

An idea for a three-dimensional design can exist in the mind before taking physical form. As a result, the following conceptual components determine the design:

A. Point:

In geometry, a point is both the primary source of form and the primary component of form's language. A point lacks any dimensions. It has no length, breadth, or depth conceptually. Its characteristics include stagnant, aimless, and centralized. A position in space is indicated by a point. They are used to designate a location on the ground plane or in space. A point in the architecture can be seen as a vertical linear element (columnar element) on the plan. In other words, a point may be projected into a column, obelisk, or other vertical linear structure. In the plan, a point is represented by a columnar element.

The point has several significant functions in geometry as a primary generator of shape. A line may be considered as a conjunctive element that joins many places. Thus, two points establish two directions—through their centers or between them—and serve to indicate the two endpoints of a line. In addition, the point can be used to indicate a line junction or a line meeting at a plane or volume's corner (Figure 7).

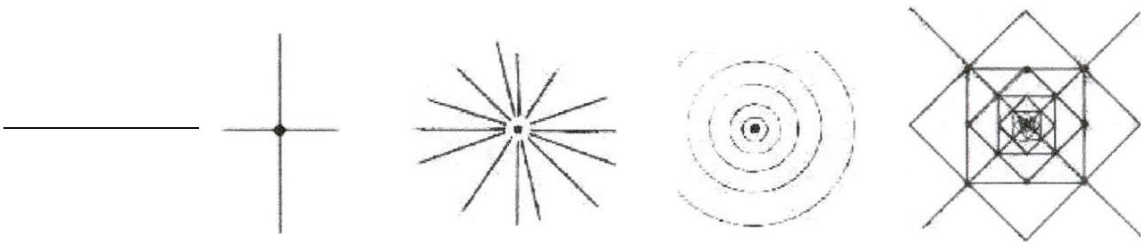


Figure 17: Various point locations as a primary component of the language of form

The point serves as a marker at the middle of a field even if it is invisible. They have created centers for formational groupings. The defining of center is the main function of points. Points are often limited and finite. We will start with a point that is equal to all other directions as we analyses the importance of geometry in building. (Yilmaz, 1999).

B. Line:

In geometry, the second generator of form is the line. According to geometric definition, a line is a one-dimensional object that may be infinitely stretched in both directions. It may be thought of as a transformative connection between the two sites. In other terms, it is possible to think of a point that has been moved or translated in space as a line. In geometry, a line has just one dimension conceptually—its length—and neither width nor depth. In the creation of visual creations, a line is crucial. For instance, lines create the boundaries of solids and planes as well as the connections between these components. These lines play a significant part in compositional components that control the shapes and patterns in a work of art. In addition, they support the form's expressive capabilities. If the linear extension predominates over the breadth and depth of the design, it will appear as a plastic line in space. One of line's aesthetic characteristics is that it serves as the main way to define space. In other words, they efficiently bound volumes and spaces.

A linear element is rarely employed in architecture on its own. They often work with solids and planes as the pattern's structural components. Such linear features may be seen connecting, encircling, and supporting the other visual aspects in the area. Apart from that, these lines are used to form and characterize the margins of planes. As a result, the main function of lines is to define an edge or perimeter. They are distinguished by both their range of application and their capacity to draw lines of demarcation between opposing viewpoints. (Yilmaz, 1999)

C. Plane:

The third component in geometry that creates shape is a plane. One may say that two lines depict a single, straight plane that joins them. In other words, a line that extends in a direction different from its inherent dimension is the plane. A straight line that entirely resides on the flat surface can geometrically connect any two places on it. A plane in geometry just has length and breadth; it has no depth. According to this interpretation, the plane is a two-dimensional, unbounded surface that may go on forever in all directions.

A plane's main distinguishing feature is its form. It is established by the shape of the line defining the plane's edges. We can only see a plane's genuine shape when looking at it from the front because perspective distorts how we perceive its shape. A plane is used in the production of visual construction to indicate the borders or limitations of a volume. The plane becomes a crucial component of the language of architectural design since architecture, as a visible art, specifically works with the formation of three-dimensional volumes of form and space.

A flat surface has little effect on spatial activity by itself. It doesn't have an interior or an exterior. Just an aircraft, that's all. However, when it is curved, it provides a different answer. The plane has a distinct outward expression on the convex side. Strong interior expression may be seen on the concave side. It signifies a positive shaped and sized space volume. If we employ an S-curved plane, the two expressions are blended. There are aspects of inside and outer spatial activity on both sides.

Without thickness, it cannot be described as a plane in space. It must be a physical substance. A plane and a solid differ relative to one another. The shape is seen as a plane if the length and width predominate over the thickness.

In architecture, planes play a significant role in defining three-dimensional form volumes. They often stand in a vertical, horizontal, or inclined posture and depict the surface of an item. The types of planes used in architectural design include the base plane, wall plane, and overhead plane. These planes' combined arrangement in an architectural design will be used to characterize the building's overall shape and massing (Yilmaz, 1999).

D. Solid

The fourth element in geometry that produces a shape is solid. A solid has three conceptual dimensions: length, breadth, and depth. A cube or other rectangular prism results by dragging a plane through space. It could be hollow like terra cotta, solid like a block of stone, or solid like a structure.

E. Cone

A straight line with one fixed point is rotated around one closed, curved base line to create the cone's curved surface. In addition, a cone may be thought of as a solid produced by the rotation of a right triangle around one of its sides.

F. Sphere

Every point on the surface of a sphere is equally spaced from a central point, making it a unique type of solid. The end product is an uninterrupted, curving surface without edges. The sphere and the plane that intersects it at its center create a great circle on the sphere. The sphere intersects a plane that does not travel through its center, creating a tiny circle. Another way to create a sphere is to rotate a semicircle, whose surface is evenly spaced from the center at all points, about its diameter. A sphere is a centered and concentrated shape by nature. It centers itself and is often steady in its surroundings.

G. Cylinder

A straight line is moved around two closed curves that serve as the baselines to create the curved surface of the cylinder. This line is parallel in all directions to the axis of the cylinder. From a different viewpoint, it may be seen as a solid produced by the rotation of a rectangle around one of its sides. It revolves around an axis that connects the centers of its two circular sides.

H. Pyramid

Having a triangular, square, or polygonal base and three triangular sides that come together at a point, the pyramid is a geometric solid. The number of edges on the base determines how many sides there are. If the base is a regular polygon and the axis is parallel to it, the image is a right pyramid with congruent triangles for its sides. The characteristics of the pyramid are comparable to those of the cone among the solids. Except that the lateral surfaces have a flat plane. Therefore, the pyramid is somewhat rigid and angular, but the cone has a soft form.

I. Cube:

The simplest rectangular solid is the cube. There are six surfaces on it, and each one is a square that is the same size as the other five. A right angle is formed by any two adjacent faces. The cube is a static shape since its dimensions are all equal.

2.4.2 Visual Elements of Architectural Form

When seen from various angles and distances, under various lighting conditions, or with various colours or textures, three-dimensional shapes seem differently. The factors listed below can be seen as being unaffected by such unstable circumstances:

- Shape

Shape is the distinctive contour of a flat figure or the arrangement of a volumetric form's surface. It may be a three-dimensional form's external appearance and the primary way to identify its kind. Because of this, several two-dimensional forms may be used to represent a three-dimensional object on a flat surface. The circle and the many numbers of regular polygons that can be encircled by it are examples of regular forms in geometry. The main shapes—the triangle, circle, rectangle, and square—are the most important of these (Yilmaz, 1999).

- The Circle:

The most fundamental form used in two dimensions is the circle. The circle is the easiest shape to draw on a piece of paper or the ground. This geometric shape is the smallest. It only has one dimension, the radius or diameter, and is only present in its center. There are no comers, beginnings, or ends in a circle. Additionally, it lacks direction. Another way to think of a circle is as a regular polygon with many sides. The features of a polygon get closer to those of a circle the more sides it has. The strongest two-dimensional form is the circle. Semicircles are employed in arches for the very same purpose. Amphitheaters, arches, and the fronts of buildings all have semicircles in their architecture. From a distance, it gives the structures a disappearing aspect. The circle can only be divided in one or two ways, unlike the square and the rectangle, which may be divided in a wide number of ways. This restricts how the circle may be used. A circle, however, may be split into twelve equal pieces. Due of its remarkable versatility for building, the circle. This enables the architect to alter the circle's look while still utilizing its power (Yilmaz, 1999).

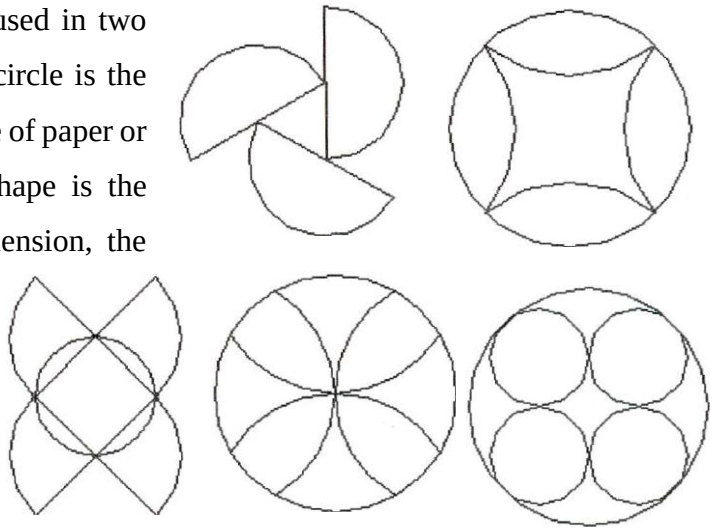


Figure 18: Compositions of Circle s and Circular segments

- The Triangle

Isosceles triangles have been utilized for roof sloping and frame houses. The most common and useful isosceles triangle is the equilateral triangle. They have solid contours. When the buildings are arranged in a grid, this stiffness aids in rotation and

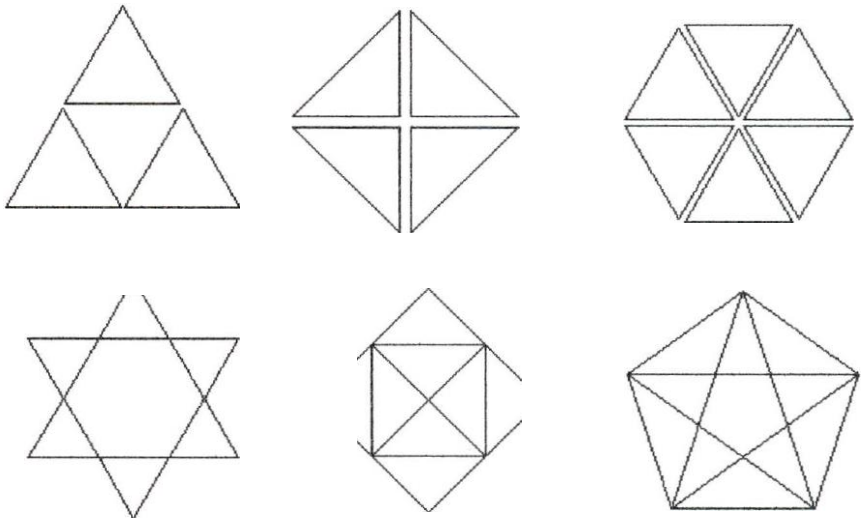


Figure 19: Compositions of triangles and triangular segments

flexibility among the structures. The right triangle is yet another crucial geometric and architectural form. It is employed for designs and patterns. These patterns and layouts provide the appearance of depth. The corners of the structures are square as a result of the right triangles. Buildings can be supported by right triangles. All regular and irregular polygons, pyramids, prisms, and solids are built upon right triangles. The three-four-five right triangle is the one that architects use the most frequently for roof slopes and staircases. The greatest slope permitted by construction regulations is shown by this triangle. In addition to providing support, the right triangles may be utilized to create patterns in the constructions that are interesting. The architects can create a hexagonal building by truncating equilateral triangles. It is possible to create new structures from the progressions of threes by using this understanding of triangle truncation (Yilmaz, 1999).

- The Square

The square is the other main form. It is perhaps the shape that is utilized the most in architecture. The majority of structures are constructed from squares to which additional forms are added or subtracted. Many architectural foundations are built on squares. They serve as the basis for pyramids, cubes' surfaces, and prisms' walls. Seven

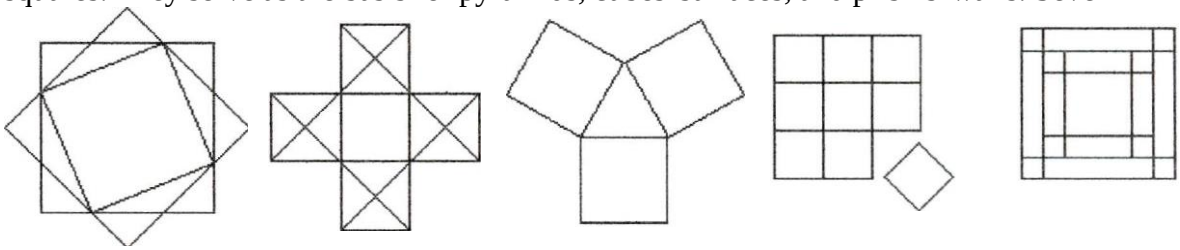


Figure 20: Compositions of squares and square segments

of the thirteen semi-regular solids have squares with parallel sides. Rectangles are centered on the square. Despite being most effective in a square, the perimeter is proportion less. It is not often the ideal rectangle for architecture because of this. Rectangles are flat squares in architecture. The architects create an octagonal pattern with little squares in the open areas by trimming the square. Architecture can be used with any regular polygon whose number of sides divides equally by four. The fourths progression is the name of this series. Take squares, octagons, and dodecagons as examples. These forms will share lines with an enclosing square when joined in groups of four. As the number of sides grows, the form in the center is constantly changing. The square and this sequence have an analogous relationship (Yilmaz, 1999).

- The Rectangle

The rectangle is yet another crucial form. The majority of architectural scenarios have utilized it. It appeals to architects since it is simple to modify for human requirements. Windows, doors, rooms, and the complete building's construction all employ rectangles in one structure. The correct angles at the corners are essential to a rectangle. The architect's sight determines the length and width. No one rectangle can meet all of an architectural need. It might be argued that rectangles have a significant role in architecture. There are several uses for rectangles that are out of square or that may be split into even squares. The most cost-effective building for the architects to construct is a rectangle with the smallest perimeter surface. The number of different forms that may be employed increases as the perimeter length increases (Yilmaz, 1999).

- Texture

The size and arrangement of the particles that make up surfaces determine the texture. In other words, the components' arrangement, size, shape, and proportions are what determine a surface's aesthetic and, in particular, tactile qualities. It establishes how much incident light is reflected or absorbed by a form's surfaces. As a result, texture refers to the material's surface properties that were utilized in the design. It may be plain by nature or have undergone specific treatment.

The terms hard-soft, rough-smooth, opaque-transparent, dull-shiny, iridescent, and metallic, all of which are derived from tactile experience, describe the distinctive visual texture. These factors may lead to a texture that is subtle and highlights two-dimensional surface adornment or is stronger and highlights three-dimensional tactility. A common illustration of a visual texture is white. They seem white because of the way they scatter light. Contrast in any of the tonal or visual texture characteristics causes a distinct visual field to be produced. This is generally acknowledged to be the fundamental precondition for shape perception.

Due to its variety of shapes and high potential for evoking a direct emotional response, texture is one of the most crucial components a designer can utilize to generate scale in structures. In addition to being a significant component to the architectural experience in and of itself, texture has a significant impact on visual weight. For instance, people frequently perceive things or planes with smooth surfaces as being lighter than those with rough ones (Yilmaz, 1999).

- Light

In order to emphasize the character of shape, light is crucial. The way that light interacts with objects also greatly affects how texture is perceived. Additionally, it has a significant impact on how interior space is perceived. Building designs frequently undergo adaptation to some geographical differences. Hard-edged shapes tend to rule in areas when the sun is high and the sky is bright. The form seems softer when the sun is often weak and low, and strong colors are required to produce a strong definition.

One of the primary principles of architecture is the need to illuminate the interior area. In several instances of structures throughout architectural history, light has been exploited as a design element. It is acknowledged that light is an element that directly

influences how architectural shapes and spaces are created. For instance, in concentrated areas, it might be utilized to gather people towards the focal point of that place (CenterPoint). Additionally, in longitudinal spaces, it might be utilized to focus human perception toward the end of the architectural space or to guide human transitions in that direction. Such a conceptual use of light in architecture greatly organizes space.

- Color

The characteristic that most obviously separates a shape from its surroundings is color. It influences the perceived weight of a form and may be natural or manufactured. The color wheel is generally regarded as a reliable tool for matching colors, however some designers find it constricting. The study of color psychology is a difficult and extremely personal subject.

- Size and Scale

Size is defined as a form's actual length, breadth, and depth. While a form's proportions are established by these measurements, its scale is determined by how big it is in relation to other forms in the context. Size is more than just enormous or little, long or short, which are only quantifiable by comparison. Size is another type of concrete measurement that may be determined by its length, width, and depth in any three dimensions, from which its volume can be estimated. Our emotional response is significantly and directly influenced by the scale of a structure and its components, including its entrances, windows, and internal spaces. It also has an impact on how much visual weight we assign to objects, which is crucial for aesthetic appraisal and our emotional reactions to feelings of harmony and balance.

Scale is a percentage that has its origins in the development of mankind. The shapes must be constructed while taking into account human demands and physical characteristics. If not, a person may suffer some physical harm. Both between a building and its surroundings and between a building and a person might be discussed. A structure's size and its components can be determined by comparing it to either another building or an object in the distance.

The scale is based on how big things appear in relation to other things. You can gauge how big or little something else is by comparing it to the human body. In other words, whether looking at the outside of the structure or the inside area, a building is measured in relation to the human body.

2.4.3 Conceptual Design Strategies used in Architectural Design

Design strategies are crucial for improving the idea of "whole" at every level of the design process. It aids in organizing components one at a time or one at a time while also taking into account how they relate to one another. It also contributes to how fundamental geometrical components are arranged, including how form and space are used. Both two-dimensional visual planes and three-dimensional architectural creations can use these design techniques.

1. Unity: All of the components on the visual plane seem to be a single, well-rounded entity.
2. Balance: equal distribution of visual weight
3. Contrast: the reverse of unity, contrast is produced by different parts
4. Harmony: the combination of similarity and difference that creates a pleasant visual whole.
5. Rhythm: The pace of a piece of visual art
6. Proportion: the amount of one thing to another

2.5 Architectural Form and Geometric Operations throughout the Modern Era

Many architects of the 20th century used ideal geometry to give their plans, sections, and elevations more sense and integrity. Some people have explored with intricate arrangements that layer one geometry over another, maybe becoming bored of fundamental connections.

At this time, direct links between Ledoux's strictly mathematical solids and Le Corbusier's or the Bauhaus chess pieces were put out. These traits are considered to be antecedents of twentieth-century architecture, along with stark simplicity, the lack of

classical orders, and the utilization of platonic solids and fundamental geometric forms in plans and elevations. (Hasan & Tiwari, 2018).

Even in a poem by Louis Kahn, the architectural worth of Boullee and Ledoux is likened to that of Bach and the sun.

The majority of architects in the Modern and Postmodern Movements used Euclidean geometry and geometric concepts to create and articulate form. Mies Van der Rohe, Le Corbusier, and the designers of the De Stijl, Russian Constructivist schools, and Russian Suprematist saw abstractions as the sources of architectural elements, two-dimensional abstractions, and abstract solids. A small group of architects and artists sought to develop an imaginative concept of space that used experimental psychology as its creative framework.

All of the Modern Movement's architects, including Mies, Corbusier, and Wright, viewed space as a logical state in which geometry, general volumes, and accommodated objectives occurred via integrated interrelationships, enhancing and respecting each other's integrity. Solids respected solids, functional areas respected functional areas, and none of them intruded into another without abiding by the game's rules, which are dictated by the geometric order.

2.6 Concept of Geometry in Architecture

The foundation of architectural design is geometry. One of the fundamental elements or concepts of design is geometry. Each design has its own language. Language of making, language of forms, and language of construction The language of architecture is heavily influenced by geometry.

In the history of architecture, basic shapes and forms, proportions, and symmetry have all been used as design tools. Natural phenomena displayed fundamental geometrical proportions and shapes. The harmony in the building was produced by these ratios. The utilisation of space and shape in a design may also be considered an element of geometry. Pure geometrical forms like circles, triangles, and squares in three dimensions are examples.

In addition to being used in building design, geometry also contributes to the structure's aesthetics. The concept of geometry has occasionally been questioned as a result of postmodern ideas. (Hasan & Tiwari, 2018).

2.6.1 Geometric Ideas

Geometry is used in architecture in a variety of ways. Simon Unwin claims that Geometry may be found in architecture in the following ways.

Geometry, as a school topic, conjures up images of circles, squares, triangles, pyramids, cones, spheres, diameters, and radii, among other things. These are important in that they may be imposed on the world's physical fabric as a way of identifying location. Geometries, on the other hand, come through our interactions with the environment as a way of defining location. But geometries develop from our interactions with the word as well; geometry may be related with both an attitude of acceptance and an attitude of control. The identification of locations is inextricably linked to geometries of being (Hasan & Tiwari, 2018).

2.6.2 Circles of Presence

Buildings, people, and even items, by just existing, add geometry into the environment. Everybody has a 'circle of presence' about them, which contributes to their own sense of location. When a body interacts with another, their circles of presence have an impact on one another. A body's circle of presence is likewise contained and maybe shaped when it is placed in an enclosure or cells. The vast circle of sight, the intimate circle of

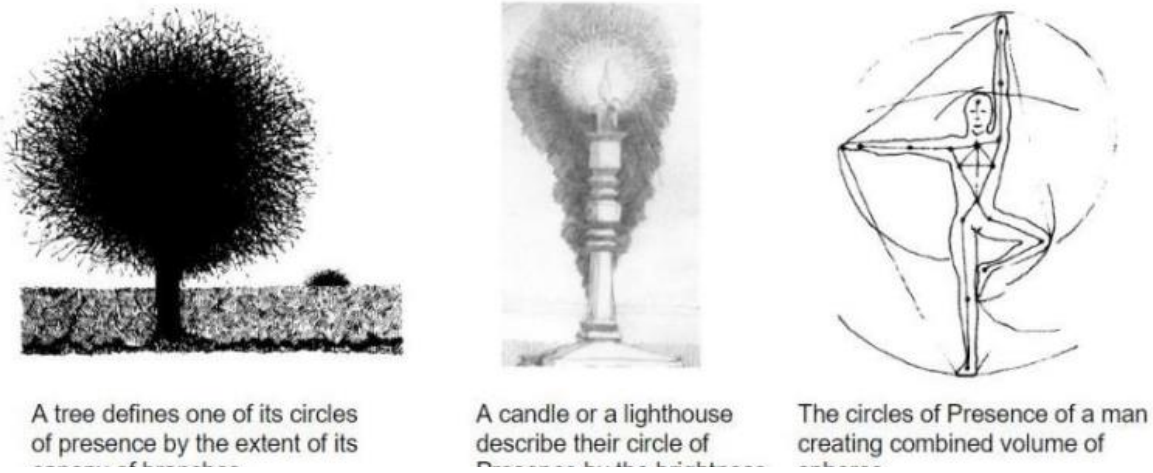


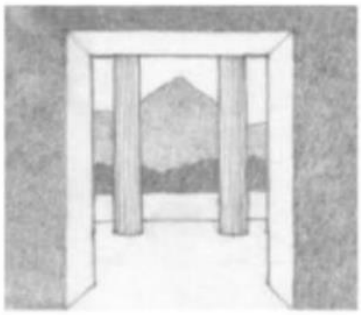
Figure 21: Circles of presence exerted by a tree, a candle, a human body respt

Source: (Unwin, 2009)

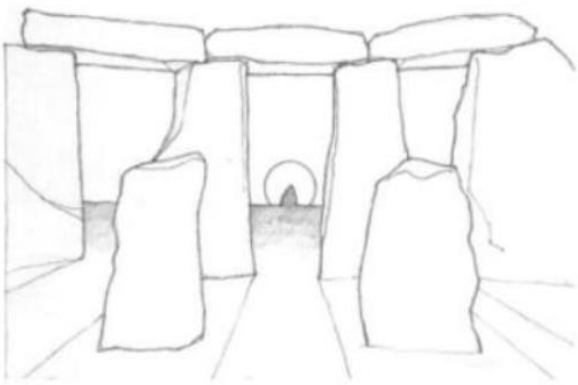
touch ability, and the intermediate circle of location are all used in architecture. From prehistoric times to the present, most architectural work has focused on asserting, defining, and amplifying, sculpting, or managing circles of presence (Hasan & Tiwari, 2018).

2.6.3 Line of Sight

The fact that we see in straight lines appears to interest us as humans. This curiosity may be seen in the way one could unconsciously line up the toe of one's shoe with a spot on the carpet, or more consciously when one uses the end of a finger to point out a faraway item. In architecture, too, there is a fixation with lines of sight. A line of sight makes interaction between locations when thinking of architecture as place identification. It was one of the ways that builders in the ancient world connected locations to the world around them, establishing them as sections of matrix focused on certain sacred sites. It is a significant force in the design of performance spaces, as the players' and spectators' participation is dependent on sight. It's especially significant in the design of art museums, as lines of sight may impact display placement (Hasan & Tiwari, 2018).



The Castelvecchio in Vicenza, Carlo Scarpa would draw lines of sight onto his plans. Emanating from particularly important points in the building— the entrance, or a doorway— these would influence his deliberations on the positions of exhibits, or pieces of landscaping.



The Hele stone aligned the centre of Stonehenge with the sun rising on the Summer Solstice

Figure 22: Lines of Sight in making Doors, Windows and in the Stonehenge

Source: (Unwin, 2009)

2.6.4 Line of Passage

Unless they are changed by some "force," lines of passage are typically thought of as being straight. A reasonable person often travels in a straight line from one straight point to another in order to reach a goal, unless there is a barrier that renders this impractical or impossible. Architecture creates a path of travel between the locations it

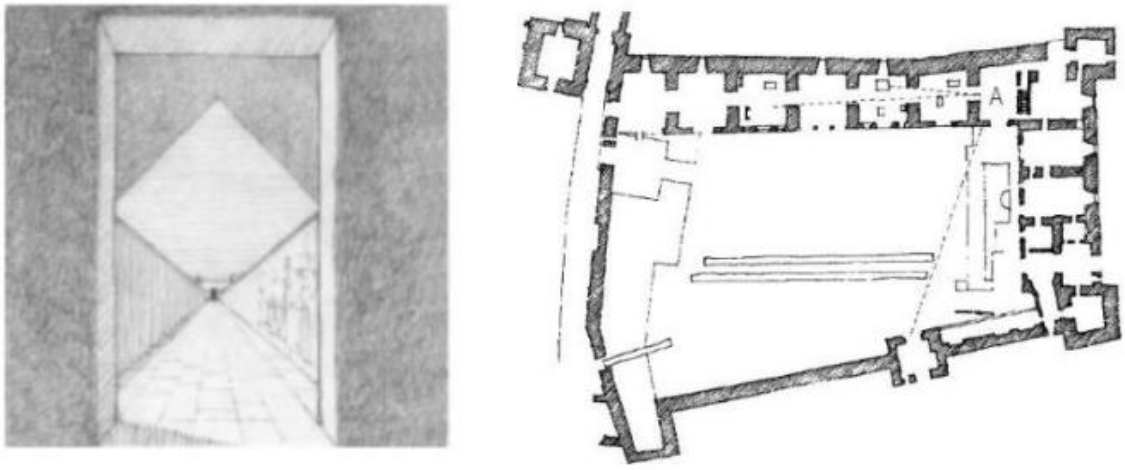


Figure 23: Lines of Passage in Plans (Source: (Unwin, 2009))

has divided the world into, employing them as components of serial experiences.

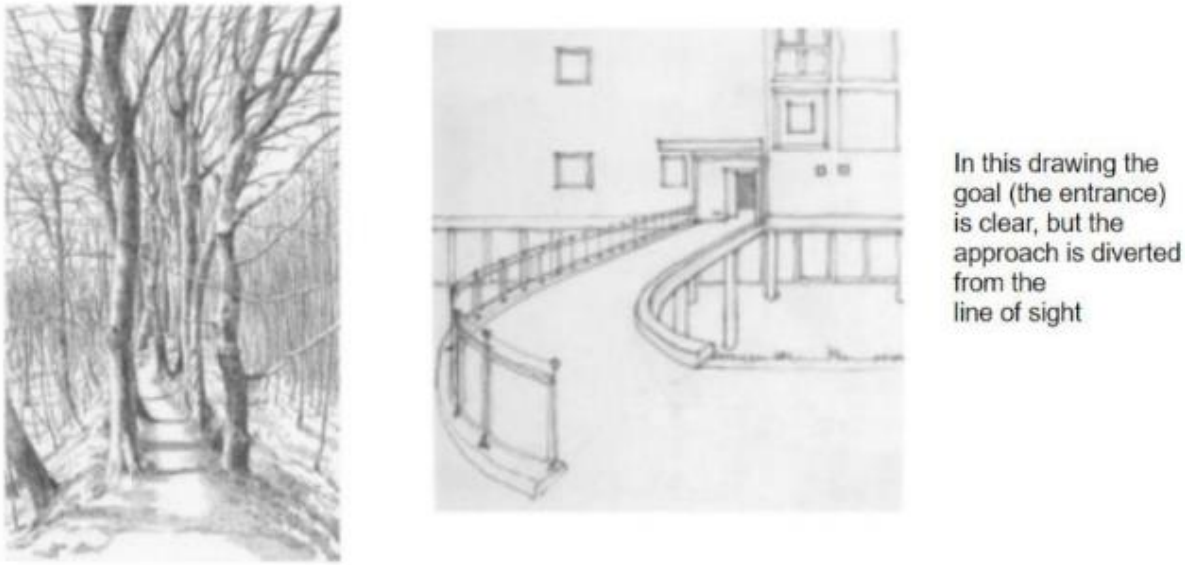
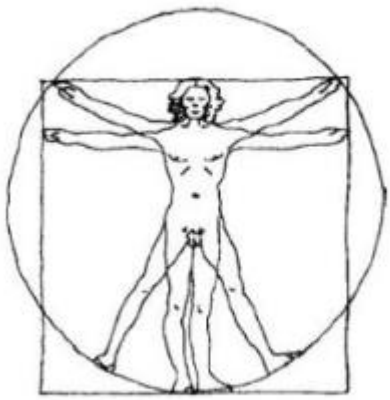


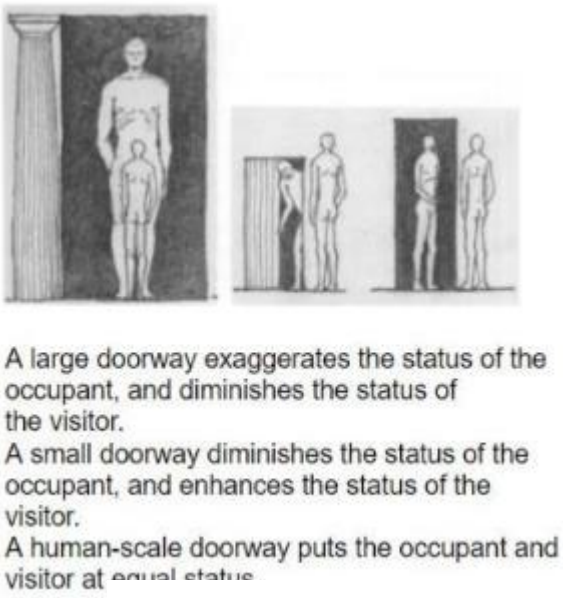
Figure 24: Lines of Passage in making things interesting

Source: (Unwin, 2009)

2.6.5 Measuring

Measuring the world is a necessary part of existence; individuals do it all the time and in a variety of ways. One of such methods, and an artificial one, is measuring using a ruler or tape measure. People's bodies are one of the more direct ways they measure the world. When this is done, the concepts of scale and proportion become apparent (Hasan & Tiwari, 2018).

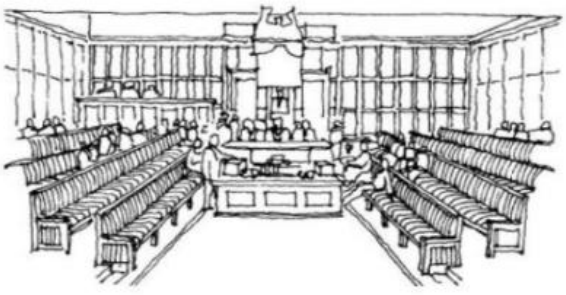




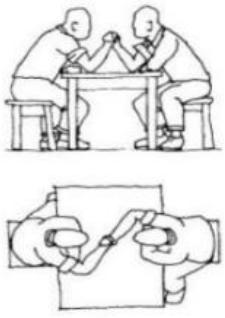
Source: (Unwin, 2009)

Figure 25: Human Body Measurements effect our Perception of

2.6.6 Social Geometry



The social geometry of the British House of Commons is a manifestation of the procedural relationship between the Government and the Opposition.



...and to the space of confrontation.

Figure 26: Social Geometry affecting Furniture in Buildings

Source: (Unwin, 2009)

People alter their environment, reconfiguring them as they see fit, resulting in a Geometry that influences the shape and form of enclosure. When individuals cluster, they create unique identities for themselves. They accomplish it by overlaying a social geometry that brings them together. This is architecture in and of itself as a process of place identification, but its existence is fleeting since it is made up entirely of humans. Architectural creations may react to social geometries, organize them, and strengthen their physical embodiment. Similarly, Schoolboys create a circle while they watch a playground altercation between two of their peers. When there is a formalized out between two boxes, the location of their disagreement is marked by a rectangular platform with rope barriers around the edge. The fighters' encounter is symbolized by their holding of opposite corners, despite the fact that the ring is square. Around a bonfire in a park, people could gather in a rough circle. That social geometry is turned into a rectangle in an Arts and Crafts inglenook, providing lodging inside the framework of the house's fabric.

The ancient Greeks artistically adapted the radial organization of spectators on the valley slopes viewing sports or dramatic events to amphitheater, with its layout, which is more than semi-circular and has several layers of concentric seating stairs. Although it is not an example of social geometry, the grid pattern of graves in a cemetery results from the geometry of the human frame and how the rectangular form of the space it requires may be tessellated across the ground. People who are bickering sit across from one other, whereas friends sit next to each other. Both can take on architectural forms.

The speaker (or debate chairman) sits on the axis between the benches facing each other across the chamber, representing the opposition, and the benches facing the government. Some discussion chambers are created for communal conversation rather than arguing and opposition. This is sometimes reflected in their design. Meeting rooms adjacent to cathedrals and monasteries are known as chapter houses.

They frequently feature a circular, or possibly polygonal, layout that is non-hierarchical and non-confrontational structurally. Even the vaulted ceiling's center column appears to prohibit direct, diametrical opposition throughout the space (Hasan & Tiwari, 2018).

It is controversial if such architectural arrangements affect how members of parliament or chapters behave. Even if just for symbolic reasons, several countries have decided to hold their legislative discussions in circular rather than confrontational debating chambers. J.S. Siren, for instance, created the discussion room of the Finnish parliament in Helsinki, which was built in 1931. One of the most effective representations of human civilization is the circle; from an architectural standpoint, it seems to allude to a shared worldview. It is a pattern that is produced by people seated at a picnic table conversing, watching a dramatic or ceremonial event, and sitting around a picnic table.

Figure 27: Seating Arrangement of the Finnish Parliament

Source: (Unwin, 2009)

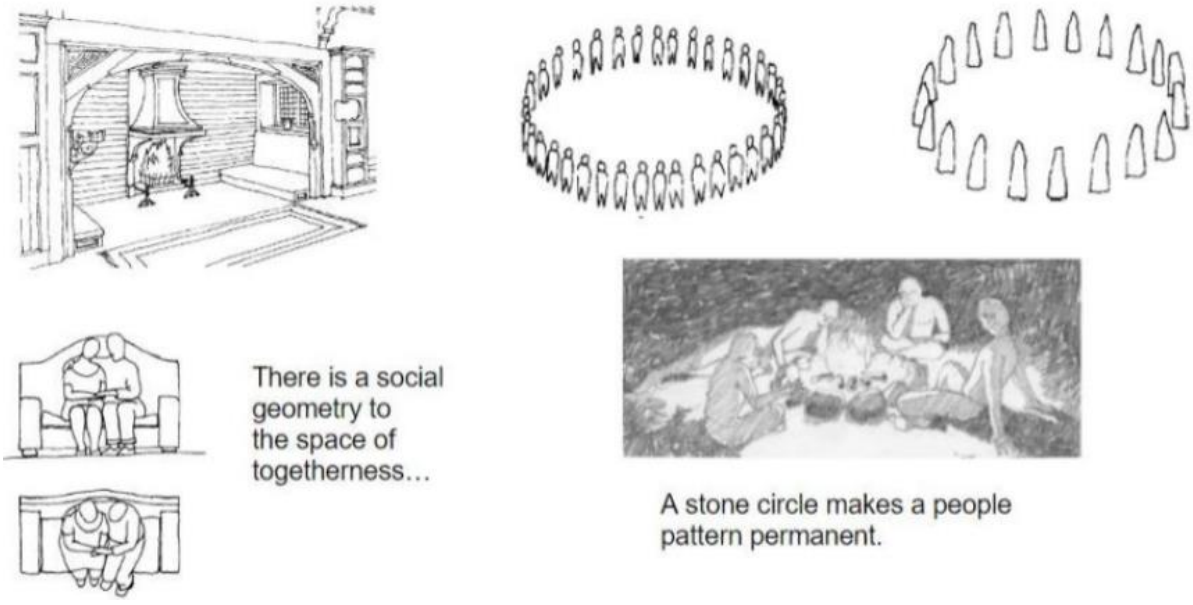


Figure 28: The Idea of Social Geometry

Source: (Unwin, 2009)

Figure 29: Mohrmann House - Hans Scharoun : An Asymmetric House With A Circular Dinfng Area (Circular] Plan And View Respt.

Source: (Unwin, 2009), (yantramstudio, 2017)

Similarly, Even the German architect Hans Scharoun, who evaded many other sorts of geometry in his designs, recognized the circle's suitability as a framing for the social occasion of a meal. The dining room, which was built in 1939 and has a circular table in the middle of a semicircular bay window between the kitchen and the living room, is the only space in the Mohrmann House with a regular geometric shape.

2.6.7 Geometry of Making

The geometry or structure, such as the steel structure of a microelectronics facility or the timber structure of a mediaeval high-resolution remote sensing, is part of the geometry to build. Although it may seem that there are an infinite number of ways to build a structure to span a particular area, some are considered efficient if they use material well and without adding superfluous pieces, while others offer an additional quality known as beauty.

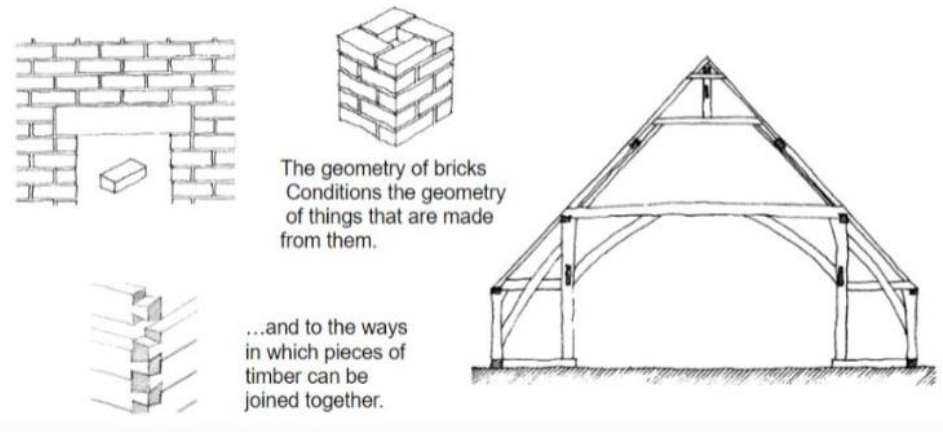
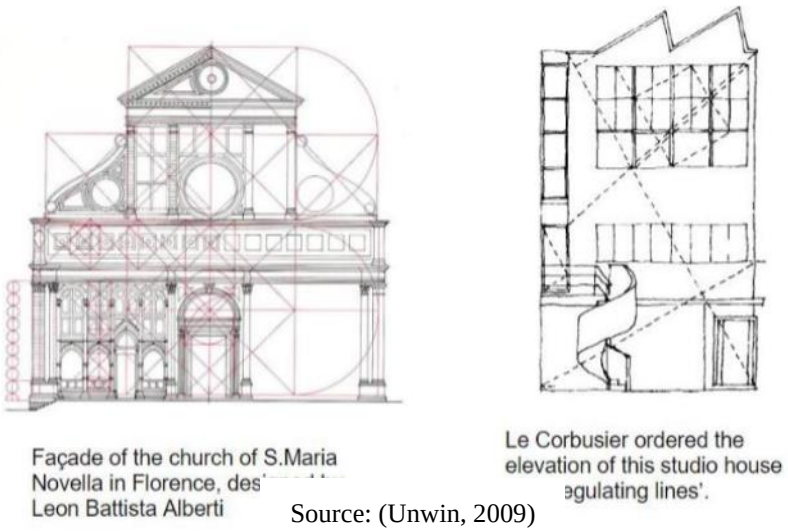


Figure 30: Geometry of making in Building Blocks and Structural Members

Source: (Unwin, 2009)

2.6.8 Ideal Geometry



Source: (Unwin, 2009)

Figure 31: Idea Geometry Affecting Facades

The Circle and Square, as well as their 3D shapes, may derive from societal or manufacturing geometry, but they are also pure, abstract figures. They are regarded to have a symbolic or aesthetic value. Architects utilize them to infuse a discipline in their work that is unaffected by the varied geometries of being. The circle and square, as well as their three-dimensional forms—the cube and the sphere—are all part of ideal geometry. It also contains exceptional proportions such as 1:2, l:3, 2:3, and more complicated ratios like l:2, as well as the Golden Section, which is about 1: I.6l8. In relation to the Parthenon, these ideal geometric principles will be discussed further in the ensuing publications (Hasan & Tiwari, 2018).

2.7 Contemporary Ideas

Modern architectural concepts relate to those from the twentieth and twenty-first centuries. The zeitgeist (the spirit of the period) has a big impact on architecture, although it responds more slowly to the zeitgeist than, say, art, design, or technology. It is common for a significant structure or public monument to take ten years or more to be designed, developed, and built. Even smaller, domestic-scale structures aren't usually immediately apparent, yet they are frequently representative of the manner of life and fashion of their time.

2.7.1 Universal Principles and Ideas

There are some fundamental principles and ideas that apply to all types of architecture in various ways regardless of style or period. Geometry, shape, and route have been divided under these three categories. The majority of architecture may be defined or described within each of these divisions.

- Geometry

Geometry here refers to the arrangement and structuring of **spaces** in accordance with geometrical rules. Plan, elevation, and section of a structure, as well as specific components like doors and windows, can all be impacted by geometry. An organizational principle known as symmetry revolves an elevation or plan around a main axis or line. Axis controls objects like windows and doors by connecting two or more clearly defined points (which will affect experiences such as views and vistas, and the entrance to and exit from buildings). The connection between pieces and a whole is described by **proportion**. The link between scale and the hierarchy of a building or structure's parts to its overall shape is known as the proportion in architecture.

- Form

Simple phrases that describe the form or shape of a structure can be used to describe architectural principles. Some shapes are dynamic, sculptural, and heavily impacted by the structures outside look. This type of design concept is known as "function following form." Depending on the interior operations or function of the structure, several

architectural types are more useful. These concepts can be categorized as "form follows function" notions.

Louis Kahn used the phrase "servant serviced" to characterize the many types of spaces in a building, whether it was a little home or a massive municipal structure. Storage areas, restrooms, and kitchens are examples of servant spaces that provide a practical purpose and are necessary for a structure to operate well. The places that the servant areas service are the living, eating, or workplace spaces. This idea offers a very helpful approach to comprehend how a structure is organized.

2.8 Geometrical Principles in Architecture

The relationship between history and design is demonstrated by the growing interest in architectural history and historic architectural examples. As architects, our knowledge of history is mostly limited to names, dates, and style identification when it comes to understanding our place in a continuum or in a strictly scholastic sense of knowing the past. History may be a rich source for architectural design if it is understood within and outside the layers of historical styles that are frequently used to categorize and exhibit building. The investigation of an architectural concept revealed by a theory that transcends the present. Buildings may be carefully inspected and analyzed with the use of the research approach. The development of theory to provide concepts for architectural design is the intended outcome.

A concept that may be used by a designer to shape or influence a design is known as a formative idea. The formative ideas identify and define the formal archetypal patterns or formative concepts that might lead to the development of architecture that give means to plan choices, establish order, and intentionally produce shape. It present the examples of the idea's general manifestations allows for the definition and exploration of each notion (Clark & Pause).

Observable patterns can be seen to endure throughout time without clearly relating to a specific location. buildings that span many eras, functions, locations, or architectural types and styles, as well as architects who serve as examples of radically different approaches to design. The commonalities can be categorised into overarching themes

or defining concepts that may have been applied in the creation of the building designs (Clark & Pause).

2.8.1 Structure

The structure is a fundamental component of all buildings since, at its most basic level, it is associated with support. In a more practical sense, the structure is columnar, planar, or a mix of these, which a designer might purposefully utilize to support or materialize concepts.

The ideas of frequency, pattern, simplicity, regularity, unpredictability, and complexity may be used to conceptualize columns, walls, and beams in the situation. Because of this, the structure may be utilized to construct composition and modulations, define space, form units, articulate circulation, and convey movement. The qualities and thrill of architecture are therefore intrinsically tied to the same components that give rise to them. The problems with natural light, unit-to-whole connections, and geometry might all be made worse by this analytical problem. Additionally, it may improve the concept of symmetry, balance, and hierarchy as well as the link between circulation and how space is used (Clark & Pause).

2.8.2 Natural Light

The term "natural light" refers to the way and places where daylight penetrates a structure. The amount, nature, and colour of the light all influence how we perceive mass and volume. Light is a medium for expressing shape and space. A building's elevation and sectional design choices may have an impact on how much natural light is introduced. As a result of filtering, screening, and reflecting, daylight may be thought of in terms of qualitative variations.

The light that enters a location from the side and is altered by a screen is distinct from the light that comes in straight from above. From the light that enters the area after being reflected within the building's shell, both examples are very different. The ideas of surface material, texture, and colour; frequency of opening; size, placement, form, and alteration before, during, or after entering the building envelope are all pertinent to light as a design notion. Natural lighting may support the links between the unit and the

whole, the repetitious and the unique, and the circulation and utilization of space (Clark & Pause).

2.8.3 Massing

Massing refers to the three-dimensional configuration of a building that is perceptually dominating or most frequently observed. More than just a building's silhouette or elevation is massing. It is the overall perception of the structure. Although massing may incorporate, approach, or occasionally parallel either the contour or the height, to confine massing to this is excessively restrictive. For instance, the fenestration of a building's elevation may not in any way change how the building's volume is perceived. Similar to the silhouette, it could be excessively generic and fail to highlight useful differences in shape.

The effect of decisions taken on issues other than the three-dimensional layout can affect massing, which is seen as a byproduct of designing. Massing may be assessed in connection to notions of context, collections and patterns of units, single and multiple masses, and major and secondary elements when seen as a design concept. The use of massing in architecture may help to express circulation, define and articulate external areas, accommodate site, designate entrances, and emphasize important elements. As a problem in the analysis, massing can reinforce the concepts of unit to whole, repetitive to unique, plan to section, geometry, additive and subtractive, and hierarchy (Clark & Pause).

2.8.4 Plan to Section or Elevation

Conventions like plan, section, and elevation are used to simulate all building layouts both horizontally and vertically. Plan configuration and vertical information may be related as a result of judgments made about other difficulties, just like any other design concept in the research. The plan may serve as a tool for organising activities, serving as a form-generating mechanism. It might include information on a variety of topics, such as the difference between passage and rest.

Since the elevation and section are similar to approaching a structure from the front, they are frequently thought to be more directly tied to perception. However, using a

plan or section notation assumes that the reader understands volumetrics, which means that a line in either assumes a third dimension. Design decisions may be made using the reciprocity and dependency of one on the other, as well as using this as a design approach. Through the ideas of equality, likeness, proportion, and difference or opposition, considerations in the plan, section, or elevation might affect the configurations of the other.

The size at which the plan and elevation or section are connected might range from a single room to an entire building. It is possible to analyze the relationship between the plan and each component in order to establish the concepts of geometry, balance, massing, hierarchy, additive and subtractive design, relationships between the unit and the entire structure, as well as the repetitive and unique design. As a result, it is possible to connect the plan with the section or elevation using a percentage by ratio connection. In spite of their various scales, this establishes the plan and section as the entirety of the other. The ratios 1: 2, 2: 3, and 1: 5 are a few examples. It is possible to establish a part-to-whole link between the plan and the section. (Clark & Pause).

2.8.5 Circulation to Use Space

In all structures, circulation and utilization of space are fundamentally the most important dynamic and static elements. When it comes to function, user space is the main consideration for architects, and circulation is the method used to carry out that design work. The articulation of the circumstances for mobility and stability forms the fundamental components of a construction. Since circulation affects how a person views a building, it may be a tool for comprehending concerns like structure, natural light, unit definition, repeating and distinctive features, geometry, balance, and hierarchy. Circulation may be explicitly specified in a place designated solely for mobility or inferred in user space. It can therefore be made distinct from, pass through, or end up in the use areas; it can also designate sites for the entry, the center, the terminal, and the important points.

Any amount of a free or open layout may be indicated as use space. In a room, for example, it may be discreet. The pattern formed by the interaction of the primary use areas is implicit in the study of this problem. These patterns could be an indication of

centralized, linear, or clustered organizations. It is also possible to infer the circumstances of connection and privacy from the interaction between circulation and usage space. Using this dilemma as a design tool requires an understanding that the configuration given to circulation or usage directly affects how the relationship to the other takes place (Clark & Pause).

2.8.6 Unit to Whole

The relationship between a unit and a whole look at buildings as units that may be connected to one another. An identifiable entity that is a component of a building is called a unit. Buildings can be made up of groups of units or merely one unit that is equivalent to the total. Units can be physical or conceptual objects that represent use-spaces, structural parts, massing, volume, or groups of these components. Independent of these problems, units can also be produced.

When using this concept as a design approach, it is important to take into account the nature, identity, expression, and relationships of individual components to one another and to the total. Units are viewed as overlapping, distinct, neighboring, or less than the total in this context. Structure, massing, and geometry can support the connection between the unit and the whole. It can help with problems with symmetry, equilibrium, geometry, hierarchy, addition, subtraction, and the link between the repetitious and the unique (Clark & Pause).

2.8.7 Repetitive to Unique

The study of spatial and formal aspects for characteristics that produce repeated and unique elements as numerous or singular entities is necessary to understand the relationship between these two types of elements. When elements within a class are compared, the characteristics that distinguish the unique element can be found, assuming uniqueness is regarded to represent a difference within a class or type. Through the shared reference frame of the class or type, this difference connects the repetitious and the unique worlds. In essence, the domain of one defines the sphere of the other. Through the lack or presence of qualities, components' repetitiveness or uniqueness is assessed in this context.

It helps to distinguish between repeated and unique patterns using the concepts of size, orientation, placement, form, configuration, color, material, and texture. The research concentrates on the dominating relationship even when recurring and distinctive aspects exist in structures in diverse ways and at various scales. When this issue is analyzed, evidence is produced that strengthens or supports the concepts of structure, massing, units connected to the whole, plan related to section, geometry, and symmetry or balance. (Clark & Pause).

2.8.8 Symmetry and Balance

Since the beginning of architecture, symmetry and balance have been important design principles. Balance in architecture is achieved by the employment of formal or spatial elements, which is a basic compositional concern. Perceptual or conceptual equilibrium is the state of balance. A specific type of balance is symmetry. When referring to compositional balance in terms of equilibrium, the balance of weights is implied, where a certain number of units of "An" are equivalent to a different number of units of "B." The existence of a link between the two and the ability to locate an inferred line of balance are both established by the components' balance. In order for balance to exist, it is necessary to identify the fundamental nature of the interaction between the two components. To do this, one component of a structure must be equal to another component in a manner that can be known. The perception of recognizable qualities within the components determines the equivalence. When a part is assigned more significance or worth by a person or group, conceptual equilibrium might result. Smaller holy spaces, for instance, can be balanced by considerably larger secondary or support spaces.

Symmetry arises when the identical unit is present on both sides of the balancing line, as opposed to balance, which is generated via variations in qualities. This may be accomplished in architecture in three distinct ways: reflected, rotated around a point, and translated or moved along a line.

At the level of a structure, component, or room, symmetry and balance can coexist. It is possible to distinguish between global and local symmetry and balance when scales shift. Its usage as a formative notion involves taking into account its size, direction,

placement, articulation, arrangement, and value. All of the aforementioned analysis-related concerns could be influenced by balance and symmetry (Clark & Pause).

2.8.9 Geometry and Grid

Architecture is shaped by the concept of geometry, which incorporates the principles of both solid and plane geometry to specify created form. The recurrence of the fundamental geometries through multiplication, combination, subdivision, and manipulation is highlighted as the source of grid development in this issue.

Since the very beginning of architectural history, geometry has been employed as a design tool. The one factor or feature that applies to structures the most frequently is geometry. It may be used on a wide variety of spatial or formal levels, including the usage of basic geometric forms, numerous form languages, proportional systems, and complicated form produced by sophisticated geometric manipulations. Geometry has a certain measuring and quantification world that it may use to generate architectural forms. The ideas of size, position, shape, form, and proportion serve as the analyses' main points of concern. Additionally, it focuses on how combinations, derivations, and manipulations of fundamental geometric configurations lead to consistent changes in geometry and form languages. Grids are scrutinized for their regularity, configuration, intricacy, consistency, and variety. All of the problems employed in the study can be strengthened by geometry, which is a prevalent characteristic of structures (Clark & Pause).

2.8.10 Additive and Subtractive

The processes of adding, aggregating, and deleting constructed form to build architecture are where the foundational concepts of additive and subtractive are established. The ability to perceive the building is necessary for both. The sections of the building become prominent when additive is utilized to produce the constructed shape. When someone uses additive design, they see the structure as being made up of separate, recognizable components. When applied to architecture, subtractive creates a structure where the entire takes center stage. When someone views a subtractive plan, they perceive the structure as a recognizable whole from which parts have been

removed. Typically, the formal concepts of additive and subtractive can have an impact on spatial relationships.

When both concepts are used in the same way to create a constructed form, richness might result. For instance, a whole can be created by adding units together, and then pieces can be subtracted from that whole. A building might also be made by taking apart a recognizable whole, adding the taken away components back together, and then creating the original entire again.

The way the structure was put together as a whole, as well as the way the shapes were shown, were crucial to the analysis. This was accomplished by keeping an eye on changes in material, colour, massing, and volume. The massing, geometry, balance, hierarchy, linkages between the unit and the whole, the repetition to the uniqueness, and the plan to section may all increase or reinforce additive and subtractive ideas (Clark & Pause).

2.8.11 Hierarchy

As a basic concept, hierarchy is the physical representation of the rank ordering of one or more qualities in architectural design. The attribution of relative worth to a variety of characteristics is embodied in this idea. This requires knowing that for a certain property, qualitative deviations within a progression can be found. In a hierarchy, conditions are changed in a rank-ordered manner, using categories like major-minor, open-closed, simple-complex, public-private, sacred-profane, served-servant, and individual-group. With these ranges, the rank order may take place in formal, spatial, or both contexts.

The research looked at patterns, size, configuration, geometry, and articulation to analyses hierarchy in terms of dominance and importance within the constructed form. As markers of importance, people utilized things like quality, wealth, intricacy, ornamentation, and unique materials. As a design concept, hierarchy can be connected to and support any of the other problems examined in the study (Clark & Pause).

2.8.12 Reduction

Reproduction of a configuration inside a building at a reduced size is known as reduction, and it is a formative idea. Both little to enormous and part of the whole are examples of this miniaturization. In the first form, the smaller portion is often placed adjacent to the bigger unit rather than inside of it. Understanding one component of a large-to-small type reduction may reveal information about another section but not the total. The town meeting space in Alvar Aalto's Town Hall in Saynatsalo is an example of how the smaller component is more significant (Clark & Pause).

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CHAPTER 3. RESEARCH METHODOLOGY

3.1 Conceptual Framework

The research's primary focus is on how architects utilize geometry. It also looks at any connections that can exist between various notions of geometry in Nepal and architectural design. An architect's use of form and space can also influence how they approach various aspects of geometry. This research also mostly focuses on the architectural trend that has to be adopted in the context of Nepal. The research paradigm in which the research belongs is Pragmatism believes that reality is where realism is constantly renegotiated, debated, interpreted, and therefore the best method to use is the one that solves the problem and research through design. This method is mixed-method design-based research. So, this research is based on non-exact science.

Ontology and ontological assumptions describe the nature of reality, its existence, and the way they are related (Blaikie & Priest, 2018). The ontological claim of the research is the role geometry played in the Nepalese context of contemporary architecture. The growing architectural trend in Nepal is the result of a complex confluence of developments occurring both internally and externally.

Epistemological assumptions are based on the adequacy and legitimacy of different kinds of knowledge that are possible (Blaikie & Priest, 2018). This research intends to produce knowledge about the geometry and the architectural trend that has to be adopted in the context of Nepal, and architectural designs and buildings in the development of contemporary modern architecture.

Accordingly, this research has proposed to look into the geometry used in the architecture of Nepal which had almost all the features.

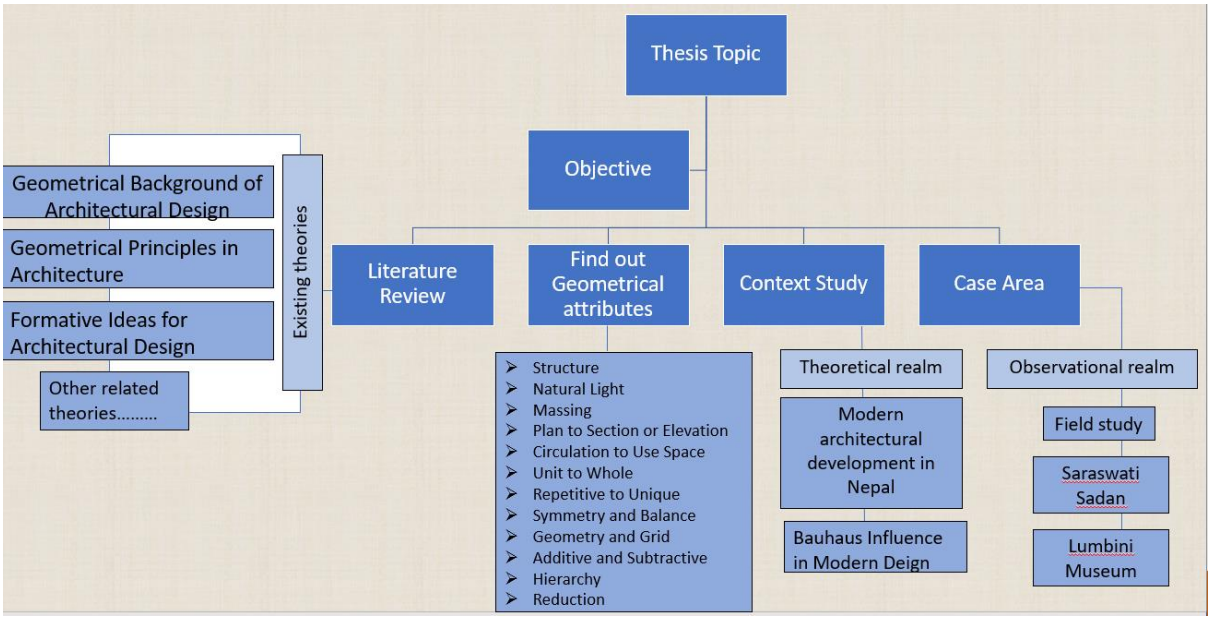


Figure 32: Conceptual Framework

3.2 Research Methodology

This study falls under the category of qualitative research, which emphasizes the use of natural settings, interpretation, and meaning, as well as viewing the subject through the eyes and ideas of others. This study falls under the category of qualitative research, which gathers and examines non-numerical data to comprehend ideas, viewpoints, or experiences (Bhandari, 2020). In order to collect information for qualitative research, the researcher may use participant observation, interviews, focus groups, open-ended questionnaires, participant observation, recordings recorded in natural settings, documents, and artefacts. In this study, the opinions of the participants are studied in order to gain an understanding of the concept of geometry in modern architecture in context of Nepal. This study falls under the category of grounded theory, where the goal of research is to generate theories. The goal of grounded theory's methodological techniques is to develop middle-level ideas simply through data analysis (Temple University, 2021). This research uses grounded theory to understand the opinions on modern architecture which varies according to people based on their experiences and knowledge level. Grounded theory identifies potential analytic categories that arise in the collection of data, compare them and consider how categories are linked together. Since this research intends to develop a basic idea or theory regarding the context of

modern architecture, grounded theory in qualitative research has been found the most appropriate strategy.

The main agenda required a qualitative evaluation for development of a conceptual theory on how Geometry has been approach in modern architecture that defined in the context of Nepal. Therefore, qualitative analysis with participant interviews was done using open ended questions. The questions related to modern architecture and contemporary architecture in Nepal, also to understand perception of architect on the influence of geometry also to examine the role of geometry in shaping the modern architecture of Nepal were used to obtain answers to the questions mentioned in the scope and limitations of the research. This assessment was based on the grounds of information obtained from interviews with the participants. The participants were selected through convenience sampling with regards to the time and resource constraints. Convenience sampling is a type of non-probability sampling strategy that relies on data collection from population members who can easily participate in the study (Dudovskiy, 2012).

3.3 Research Method

The logical approach for the research was inductive approach that starts the research with observation and the end result of research is a theory (starts with specific observations and ends with broader generalization).

The steps followed for this research can be seen through the following chart.

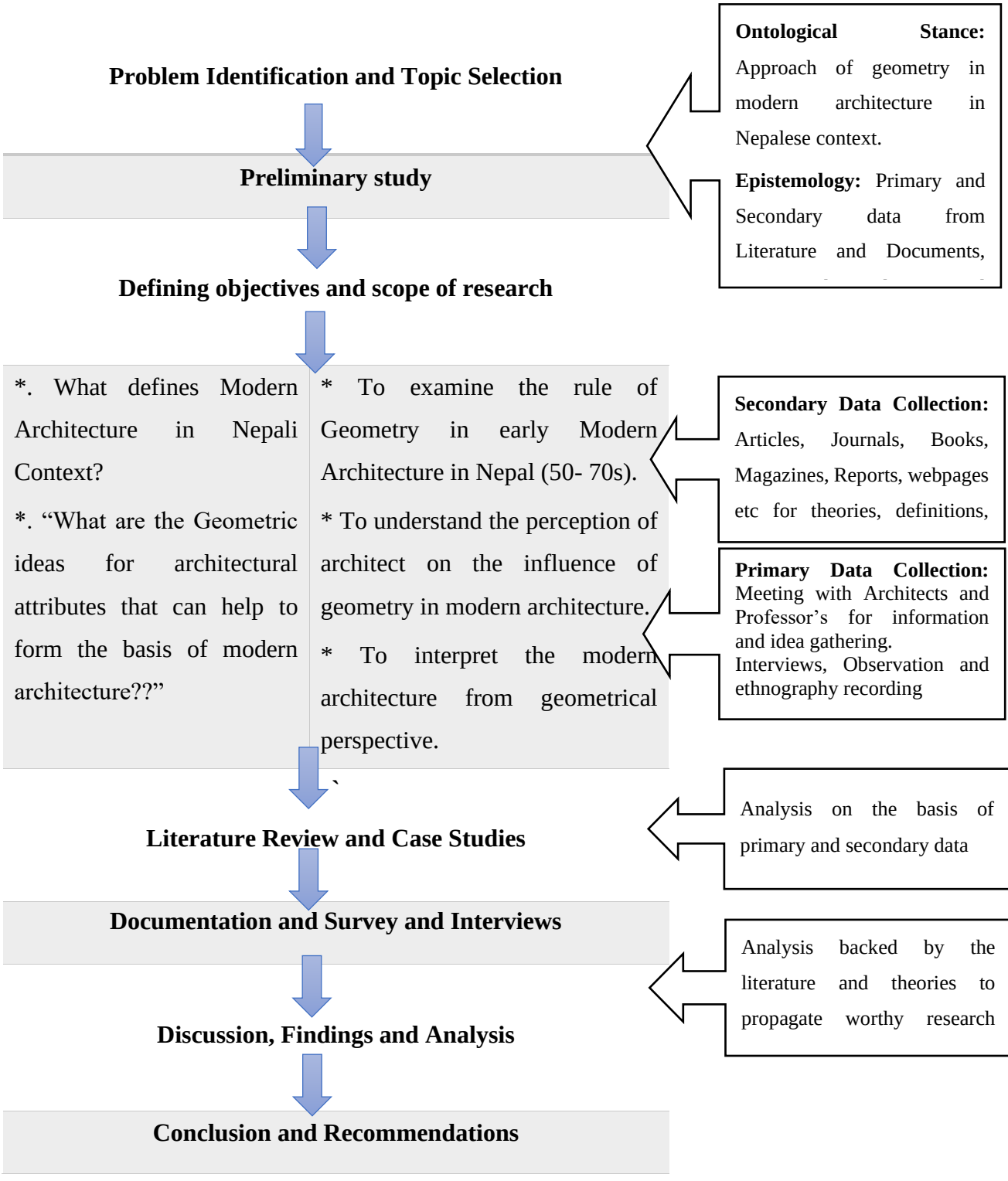


Figure 33: Research Framework

3.3.1 Documentation and Survey

Carrying out documentation and survey analysis on some of the hallmarks of modern architecture building as well as latest/modern buildings to compare and analyze the changes that have taken place over a while which vary Nepali contemporary architecture and with valley honest context consulting with senior professor and researcher, professional architects.

3.3.2 Case Study

Since the type of research is issue based and deals with problem identification, instrumental case study needed to be done, taking two or more cases. "The case study technique "investigates a real-world, current bounded system (a case) or many bounded systems (cases) over time, using thorough, in-depth data collecting incorporating numerous sources of information... and provides a case summary and case topic" (Creswell, 2013, p. 97). An instrumental case study is the study of a case (e.g., person, specific group, occupation, department, organization) to provide insight into a particular issue, redraw generalizations, or build theory(Mills, Durepos et al. 2010).

- **Research question:**

Interviews the case study was designed, based upon the main research question**: "What are the Geometric ideas for architectural attributes that can help to form the basis of modern architecture??"**

- **Proposition:**

Based on theories, following are the architectural attributes that can form the basis of appropriate modern architecture.

- Lack of Ornamentation
- Authentic Materials
- Sleek Visuals
- Structural appeal
- Geometric Accents
- Modern Aesthetics
- Form Follows Function

These parameters extracted from theoretical realm which has been looked upon the selected modern geometry architectural case. Bauhaus by Walter Gropius is taken as case.

- **Unit of analysis:**

In Nepali context, Modern architecture can be defined according to the **Principle of Geometry**, characterized by:

- Building Plan
- Structure
- Site context
- Authentic Materials

These three parameters are selected to determine whether the selected cases criticize or evaluate an established theory. Two cases are taken.

Case 1: Saraswati Sadan (Bed Prasad Lohani, 1892): The significant architectural structures that were originally built during the early modern period which would span from the 1940s through the 1960s. These buildings are largely defined by the early use of reinforced cement concrete and greatly influenced by architectural and engineering designs that go beyond historicity. Have elements of "modern" architecture, is a good example of architecture from the early modern period. Saraswati Sadan is the milestone in the history of modern architecture in Nepal as it is the first concrete structure to be built in Nepal. It was built using new and innovative materials and technology including reinforced concrete and reinforced brick concrete.

Case 2: Lumbini Museum (Kenzo Tange, 1960):

The Lumbini Cultural Centre includes the Lumbini International Research Centre and Lumbini Museum, as well as the proposed U Thant Auditorium. The Lumbini Cultural Centre is located at the northern end of the project area, near the New Lumbini Village and envisioned entrance to the complex. The design of the buildings of the Lumbini Cultural Centre is based on a barrel vaulted cylindrical modular style, inspired by the early vaulted Buddhist monasteries of Central Asia. The modules follow the same structural principle. These wide arches and vaults create higher floor height and

clerestory windows, allowing more natural light and ventilation, which is particularly important in this hot climate area. The configuration of each module is placed in such a way that it forms courtyard allowing cross ventilation.

- **Data linking:** Pattern matching is done, which entails comparing a theoretically expected pattern to an empirically observed pattern. The pattern-matching strategy employed in case-study projects has a lot in common with "mixed-methods" research, which categorises qualitative and quantitative data collecting and analysis methodologies as complementary or sequential triangulation (Teddlie & Tashakkori, 2009).
- **Explanation:**The goal isn't to prove or disprove the thesis; rather, it's to provide reasons for whether and why the patterns are matched or not, which leads to increased validity and support or modification of the study's theory or conceptual framework.

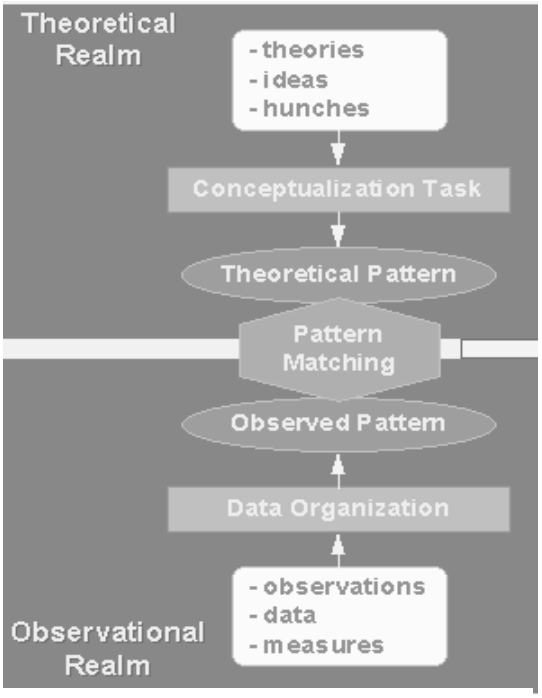


Figure 34: Pattern matching process

Source: Research Methodology (SanjayUprety)

3.3.3 Interviews

Interviews would be conducted with some of the Architects and knowledgeable people to create intellectual opinions to carry out regarding the present architecture scenario, emphasizing the design and its context. Critical analysis and proper ordering of the collected data and information would be done in order to arrive at the final interpretations or findings.

Some sample questions are:

1. What is Role of geometry in architecture?
2. What is your view on use of geometry in modern architecture in context of Nepal?
3. As I am doing my case studies research on building such as Saraswati sadan by Bed Prasad Lohani and The Lumbini Museum by Kenzo Tange, so in your view does those building shows strong influence of geometry?
4. In your view what is the important determinant one should focus to create a good composition of geometry in designing?
5. Do you see in today's context a meaningful define building in perception of geometry in Nepal. If yes which building do you feel?

CHAPTER 4. CONTEXT OF THE STUDY

4.1 Introduction of Nepal

Nepal is a multi-ethnic and multi-cultural country with an ancient history. The history of Nepalese architecture is so rich and full of colour, which is because of its people. The country speaks more than102 dialects and it has a big strength of community it has more than 100 different ethnic groups scattered around. This means, there are great architectural variations by culture. This country's landscape is also very vivid, the lowest parts sit at 250m above sea level and the highest part culminates at the pinnacle of the world that is Mount Everest. This means, there are also architectural variations by geography and climate.

4.2 The Timeline of Modern Architectural Influences in Nepal

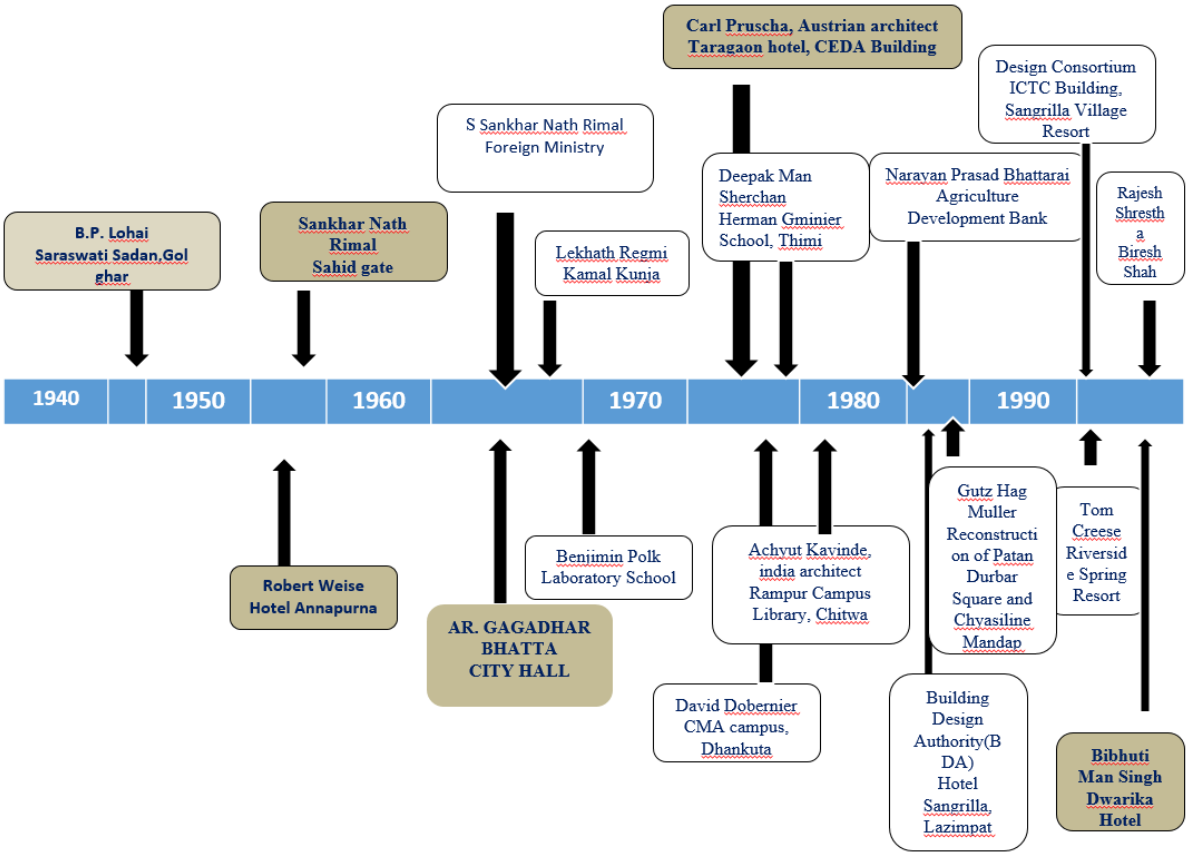


Figure 35: Timeline of Modern Architectural Influences of Nepal to Modernism

4.3 Modern architectural development in Nepal

Architectural designs from the nineteenth and twentieth centuries that combine various components from earlier historical styles to produce something fresh and innovative. These elements in architecture and interior design can be structural elements, furniture, decorative motives, distinctive historical ornaments, traditional cultural motifs, or styles from other nations. The combination is typically chosen based on how well it fits the project and how attractive it is as a whole. Each building might be primarily or completely consistent with the style chosen, or it could be an eclectic blend. The styles were generally revivalist.

Nepal has kept a variety of architectural styles, all of which are united by a common constructional pattern and material palette and are brought together by a single function. Bricks were frequently employed, and they were artistically carved into the windows and doors in addition to being sun and kiln burned on timber posts and beams. It was recommended to use symmetry, such as axial and radial symmetry. Eclecticism appeared in Nepal after the Rana prime minister's trip to Europe. The Rana started building their palaces in European architectural styles as a result of their love of European art.

During the modern age, European architecture began to influence architecture. Western monumental art from the 19th century was first brought to Nepal during the Rana Period. Most palaces were built using neo-classical architecture, which was influenced by ancient Greek and Roman design. Kishor and Kumar Narsingh Rana were the two most influential engineers at the time.

Nepal is a nation with a long history that is multi-ethnic and multicultural. When discussing the history of Nepalese architecture, it is evident that the country's inhabitants are the reason why it is so rich and colourful. The nation has more than 102 dialects spoken, and there are more than 100 different ethnic groups dispersed throughout. This indicates that cultural differences in architecture are significant. The scenery of this nation is also highly colourful; the lowest points are 250 metres above sea level, while the highest points reach Mount Everest, the highest point on Earth. This implies that architectural styles vary according on geography and climate.

Over the course of its evolution, the Kathmandu Valley, which has a history dating back over two thousand years, has continued to be a significant urban hub in the area. Several dynasties, notably the Lichchhavi and Malla kings, ruled the valley during the ancient and mediaeval ages (Hutt 1994). More than 600 years and the Shah invasion in the latter half of the year 1700 AD marked the end of the Malla Dynasties' golden period in Nepalese traditional architecture. Because it has a solid cultural foundation, Newari architecture, which was created by Malla kings, plays a significant role in defining Nepalese traditional architecture to the outside world. There were three separate Durbar Squares in Kathmandu during the Malla era, which is when Kathmandu's architectural expression reached its pinnacle in terms of history. That would be the Durbar Squares at Bhaktapur, Patan, and Kathmandu. Although this era also had some impact on Shikara architecture, which may be seen in Patan's Krishna Mandir. But in terms of Pagoda architecture, this era could provide us a really unique architectural statement. The pagoda shape is highly attractive; it usually begins with a square base and rests atop a pedestal. As it rises, the Pagoda shape grows smaller until it reaches its peak. This represents the relationship with God in heaven, which has many similarities to a mountain. The workmanship in the form of wood or metal, which can be seen in the Pagoda's overhang or in the façade's details at the entrance levels, makes up the remaining components of this architectural statement. Therefore, these few fundamental shapes provide a very distinctive heritage (or, perhaps more accurately, the expression of Nepalese architecture) that still inspires a great deal of passion and conveys a sense of maturity when we consider the people, artisans, and considerateness of the emperors who ruled the nation at that time (Bhattarai 2012).

The settlements in the valley were conquered by Prithvi Narayan Shah and the Malla kings in 1769, making the valley the capital of the broader Nepal. Traditional Valley architecture was in vogue up to that point. The Malla architectural style appears to have persisted into the late 18th century. A few modifications were made, such as when the palace towers in Basantapur and Nuwakot were built. Beginning to emerge were regional influences from nearby areas. Therefore, it may be claimed that "Early modern architecture" finally arose from post-Malla architecture. However, it wasn't until the early 19th century that a whole new architectural language was developed. A totally new architectural style was found as Nepal expanded, especially in the western

Himalayas. This appears to have been viewed as a potential way for the rulers, including Bhimsen Thapa but also other generals, to adopt a foreign architectural style that set them apart from the local identity. (Nepal 2020).

However, the Shah's control came to an end in 1845 when Nepal was placed under the de facto rule of the Rana Prime Minister (104 years), who held political power. It was a time of seclusion from the outside world and strict restrictions on who may enter the valley, both Nepalese and foreigners (Shah and Pant 2005). Even though the British did not occupy Nepal, the Ranas promoted European Neo-Classical architecture, which evolved into early modern buildings and spread throughout the valley. The two most important engineers at the time were Kishor Narsingh Rana and Kumar Narsingh Rana. In 1951, the Shah rulers were reinstated to the throne, introducing democracy to the nation and ending the period of imprisonment. As a result, Nepal became more receptive to contemporary development. Nepal embraced modernism at a time when the west was becoming tired with uniform modernity.

The Saraswati Sadan, a significant building in the history of modern architecture in Nepal, was constructed around the time that modern architecture in Nepal officially began. It was created by Bed Prasad Lohani, who was responsible for introducing concrete buildings in Nepal. Another illustration is Ranjana Hall (2009 B.S.). In his structures, he experimented with several components including domes, RCCs, and RBCs. His constructions are simple, useful, and structurally sound. Prabhinga Man Singh Pradhan, Shankar Nath Rimal (a civil engineer who graduated from Calcutta University in 1957), Ganga Dhar Bhatta (the first Nepali architect who received a B. Arch degree from India in 1961), and Bhubaneswor Lal Shrestha are other people who have made significant contributions to the growth of modern architecture in Nepal.

The classic pagoda temples' pyramidal roofs served as the inspiration for the new architectural form. The mandapa constructed in 1956 for King Mahendra's coronation was the first allocation. Although there is little written evidence of the outside pavilion, it is not unexpected that the King, who wanted to appear to be endowed by God, imitated the religious jargon. The pyramidal roof soon extended into contemporary Nepalese architecture, displacing temples as the dominant architectural feature. One of the first Western architects to arrive in Kathmandu, Robert Weise, adopted the roof as

his own trademark and included it into all of his works. Armed forces hq, hotels (Hotel Annapurna, Fishtail Lodge, Hotel Yellow Pagoda), and libraries (Gandhi Bhavan Library) were all crowned with a distinctive dome.

The outside of Nepalese buildings from the 1950s and 1960s frequently featured a whitewash, which was both a continuation of the Rana regime's earlier neoclassical palaces and a lingering hallmark of early Modernism that was well-known to international architects. This preference started to shift in the early 1970s when historical preservation and urban redevelopment initiatives brought brickwork back into the public consciousness. The Bhaktapur Development Project, sponsored by West Germany between 1974 and 1986, was one such significant endeavour. The effort was later abandoned due to scope creep and entanglements in local politics, although it was effective in boosting tourism and emphasising Nepal's masonic legacy (Lauzon n.d.). Thus, there are four distinct time periods that may be used to chronologically classify Kathmandu's contemporary architectural development:

Category -1	**Category -2**	**Category -3**	**Category -4**
Early 19th century defined by the introduction of Islamic elements during the Shah period. This was largely defined by Bhimsen Thapa and the various buildings built during his reign as Prime Minister.	The late-19th up to mid-20th century defined mainly by European neoclassical styles. These were introduced by the Rana Prime Ministers and are often called Rana Style buildings.	The early modern buildings which would span from the 1940s to the 1960s, largely defined by the early use of reinforced cement concrete.	The contemporary era focusing mainly on 1970s and 1980s but could include more recent buildings if considered to be representative of the period, of outstanding quality and influencing the architecture field. This would include the designs of international and national Masters.

- **Kirtipur Tower (late 1770s)** - Hanumandhoka Palace, Kathmandu

Kirtipur Tower is a unique pavilion on the fifth floor and north-west corner of the building encompassing Lohan Chowk, part of the Hanumandhoka Palace complex. The tower architecture was introduced to Nepal after Prithvi Narayan Shah's victory over Kathmandu Valley.

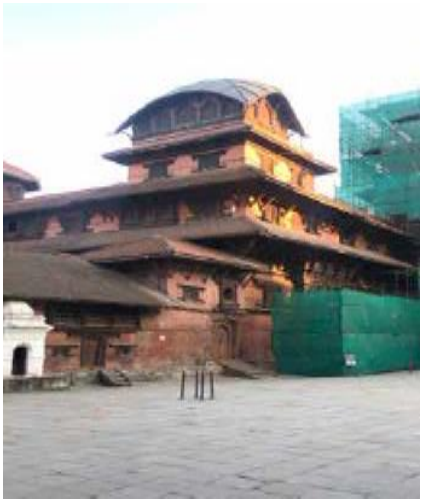


Figure 36: View of Kirtipur Tower from Nasal Chowk, 2019

Source: (Nepal 2020)

Modern approach:

- The pavilion exhibits the complex roof form of Indo-Islamic Architecture which carefully merges with traditional timber technology of Kathmandu Valley - **Cultural Harmony**
- Its uniqueness lies in its curvilinear roof form borrowed from a Bangla roof style and it is said to have been constructed by craftsmen from Kirtipur. Timber rafters and purlins were crafted into curved pieces for the frame of the roof structure. - **Experimentation with form**
- The roof rests on the timber structure provided with arched windows and traditional lattice. The intricate carving technique in wood was a traditional skill developed in Kathmandu Valley, however, the use of the motif of images of peacock and snakes in the struts signifies the adaptation of foreign motifs, mainly Persian and Islamic, during this period – **Respect for historic**

Figure 37: Decorative struts with snake motif supporting curve roof, 2019 and Wooden frame structure supporting the roof, 2017

Source: (Nepal 2020)

Figure 26: Kirtipur Tower with Bangla roof style, 1973

Source: (Nepal 2020)

- **Baithak of Paltan Ghar (1777- to be confirmed)** - Ason, Kathmandu

At first glance, the Paltan Ghar in Asan appears to be just another fascinating ancient structure in the Valley that need urgent maintenance. Hugging one of the six alleyways that lead to Asan Chowk, this avant-garde 240-year-old structure may have been one of the most famous parts of ancient Kathmandu if it weren't covered in dust or hidden by the brass pots that adorn its walls. It was the residence of Kaji Abhiman Singh Basnyat, one of the prominent Commander-in-Chiefs of Unified Nepal army —following the sacking of Kathmandu in 1768. This two-storey building on the main street used to lead to seven connected courtyards among which only three are accessible today. The front building used to serve as a bhaithak area where national and international delegates used to meet, and the inner houses were living quarters.

Modern approach:

- Amalgamation of both Mughal and Newari styles of architecture in this building complex which showcases a unique character within the streetscape - **Cultural Harmony**
- The mural of miniature soldiers on the frieze displays military power and its importance to the national defence during 18th century Nepal – **Ornamentation as per building function**
- The opulent Baithak in this edifice, which was finished in 1777, was decorated with seven stained-glass windows with Mughal influences, making it the first private dwelling in the nation. – **Glass, new material in fenestration**

Figure 27: Street facade with the long windows of the Hall and shops on the ground floor. *Guruju Paltan* marching during Seto Macchinra Jatra

Source: A Postcard from Paltan Ghar (kathmandupost.com)

Figure 38: The elaborate decoration on the window posts and bracket and unique army parade

Source: (Nepal 2020)

- **Bahadur Shah hall (1790s)** - Patan Durbar, Lalitpur

Following his return from Benares, the regent Bahadur Shah built the Bahadur Shah Hall structure in the northern part of Patan Durbar. For the majority of the 19th century, the structure served as an arsenal. It was home to the Earthquake Loan Branch after the 1934 earthquake, a neighbourhood office tasked with lending money to individuals impacted by the disaster. Adarsha Kanya Niketan Girl's School leased it in 1973.

Modern approach:

- The design was influenced by the Anglo-Indian style already prevailing in India at that time - **Cultural Harmony**
- The rectangular structure has two lower storeys above a towering reception area (baithak). The Bahadur Shah Hall is the first structure of its sort in the nation because of the reception hall's expansive interior space, high ceilings, and fireplace, which differ drastically from other interior spaces from earlier times. – **Building scale as per function**
- Regularized fenestration controls the façade's design, with a two-story high gate in the middle allowing elephants to access the stables in the backyard. – **Addressing functional need**
- The long projecting wooden balcony along the hall – **In contrast to overhang with slope in traditional architecture**
- The wooden beams on ceiling of hall are supported by the projecting brackets (Reinterpretation of brackets of traditional *Tham* as structural element) - **Respect for historic knowledge**

Figure 29: Front facade of Bahadur Shah Hall building (The long projecting wooden balcony along the hall and two-storey high gate at the center to allow elephants to enter)

Source: (Nepal 2020)

Figure 39: The Bahadur Shah hall (wooden beams, supported by the projecting brackets)

Source: (Nepal 2020)

- **Chhauni Durbar (National Museum) (1819) -** Chhauni, Kathmandu

Chhauni Durbar is one of the only existing palace complexes built by Bhimsen Thapa. The building served as an arsenal and the top floor was used as a private retreat from the city. Later Bir Shumsher used it as a private museum for weapons and guns and was turned into Chhauni museum by Chandra Shamsher.

Modern approach:

- The symmetry prevailing in the traditional architecture of the Kathmandu Valley has been retained on its façade, however, at the time; the scale of the building completely changed the skyline – **Contrasting building scale with traditional architecture**
- On the main facade the traditional three-bay windows flank the central French windows that are separated by Corinthian columns. The elaborate use of the ogee arches, column pilasters on the facade and use of round wooden columns dominating the façade, indicate the change in the architectural style prevailing in palaces during the early 19th century Nepal – **New architectural form in contrast to Traditional Malla palaces**

Figure 40: Front facade of Chhauni Durbar with arched french windows and corithian column, 1975

Source: (Nepal 2020)

- **Dhukuti(1820s) -** Hanumandhoka Palace, Kathmandu

Dhukuti, the old Royal Treasury building within the premises of Hanumandhoka Palace complex is built around two courtyards with a single opening on theexterior façade, which is the main entrance door.

Modern approach:

- The facade towards the courtyard reflects the influence of Mughal architecture with the use of cusped arches and pilasters in the openings - **Cultural Harmony**
- The building is significant for its vaulted roof supported by massive 1.5-meter-thick brick masonry walls. Suspended flooring has been provided with air vent ducts - **New roof form**
- The interior spaces are slightly illuminated by natural light using stone lattice windows. For security the wooden doors are provided with metal straps/nails and the door jambs, lintels and threshold are made of stone – **Material use as per building function**

Figure 44: Panaromic view of one of th courtyards in Dhukuti, 2019

Source: (Nepal 2020)

Figure 43: The stone jamb, lintel and threshold for the doors along with cusped arch and pilaster

Source: (Nepal 2020)

Figure 42: Museum Gallery inside Dhukuti with its vaulted roofing, 2017

Source: (Nepal 2020)

Figure 41: The wooden door panels are provided with metal staps and nails, 2017

Source: (Nepal 2020)

- **Sisha Baithak (1826)** - Hanumandhoka Palace, Kathmandu

Sisa Baithak, the northern wing of Nasal Chowk of the Hanumandhoka Palace, used to be the audience chamber of Malla kings. Later, during the reign of King Rajendra Bikram Shah, it was renovated.

Modern approach:

- Mughal architectural elements were introduced during renovation by King Rajendra Bikram Shah. The building, particularly on its southern façade, showcases the extraordinary details of Mughal Architecture merged with the traditional Newari architectural scale - **Cultural Harmony**
- The ground floor has an open hall with series of cylindrical double columns with decorative arches and floral patterns from where the cultural events on the Nasal chowk were observed – **Direct indoor-outdoor relation**
- The long facade of the first floor with a series of windows with glass is believed to be the first wing with glass in Hanumandhokha Palace, hence its name that translates to 'glass hall' – **New material in fenestration**
- The regularity continues on the top floor with a long verandah provided with wooden columns and brackets with motifs influenced by Mughal architecture - **In contrast to overhang with slope in traditional architecture**

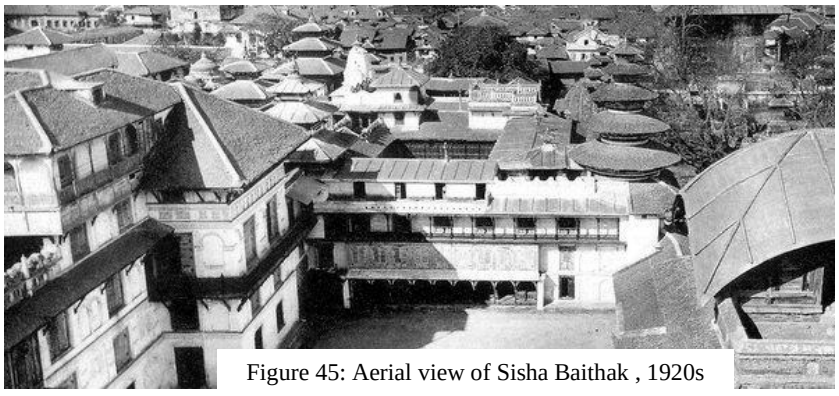


Figure 45: Aerial view of Sisha Baithak , 1920s

Figure 46: Ground floor open hall gives view to the Nasal chowk, 2019

Source: (Nepal 2020)

Figure 47: Southern facade of Sisa Baithak with large window panel and mougal influence

Source: (Nepal 2020)

Category -2

- **Singha Durbar (Parliament) (1903) -** Ramshah Path, Kathmandu

Figure 48: Front facade Singha Durbar with garden early 1900

Source: (Nepal 2020)

Singha Durbar, which was commissioned by Chandra Shamsher, is always remembered for its grandeur in scale and ornamentation. It is believed to have been the largest palace building in the early 1900 in entire South-east Asia, with more than 1000 rooms built around seven courtyards. Only the western wing remains after a fire in 1973 engulfed most of the palace.

Modern approach:

- **Palace architecture -** Singha Durbar, which stands in axial alignments with the Dharahara (Bhimsen Stambha), is the epitome of monumentality in palace construction. With the notions of façade as an entity with space of its own right, an entity in which a distinct border is difficult to ascertain due to the interaction of light and shade over the columns. The outside façade of "Singha Durbar" is marked by a dramatic central projection and lavish ornamentation (finished in stucco and marble), which is in keeping with the baroque style of architecture, which originated in Italy (Tandukar n.d.).
- The engineering team of Kishore and Kumar Narsingh Rana created the palace, which has 1700 rooms and 7 courtyards. The method seems to fit the Kathmandu valley's microclimate well with its courtyard planning. – **Climatic response**
- The central part consists of the State Hall with elaborate interiors of marble, crystals and glass which is still one of a kind in Nepal – **New materials**
- This grand structure built in brick masonry has been provided with metal ties and I-sections and adaptation of local craftsmanship can be seen in the interiors through imitation of stucco plaster in wood and stone – **Respect for local knowledge**

- Human proportions are outsized by the palace, which was possibly done on purpose to demonstrate their supremacy or to appease their British colleagues. – **Grandeur building scale**

Figure 49: Elaborate stucco decor used in interior of the state hall, 2019
Source: (Tandukar n.d.)

- **Gaddhi Baithak (1908) -** Basantapur, Kathmandu

Gaddi Baithak is the latest addition to the Hanumadhokha Palace complex. It was commissioned by Chandra Shamsher to receive the foreign delegates visiting the palace. During Indra Jatra foreign delegates were invited to observe the Kumari chariot festival, a tradition that still continues.

Figure 50: Interior of Gaddhi Baithak, illuminated by natural light
Source: https://kathmandupost.com/

Modern approach:

- The colonnaded balcony on the southern façade, which used to have in its original design a large stairway leading to the main hall from the square, exemplified the grandeur of the hall - **Grandeur building scale**
- The decors from Greek and Roman architecture are reflected in the motifs used in the exterior as well as interior of the building – **Historic Western architectural style**
- The hall is embellished with pressed tin ceilings and appliqués on the wall, along with crystal chandelier, Venetian mirrors, a stained-glass door as well as an elaborately carved wooden showpiece – **New materials**
- The hall is well illuminated by natural light through double height large windows – **Natural light**

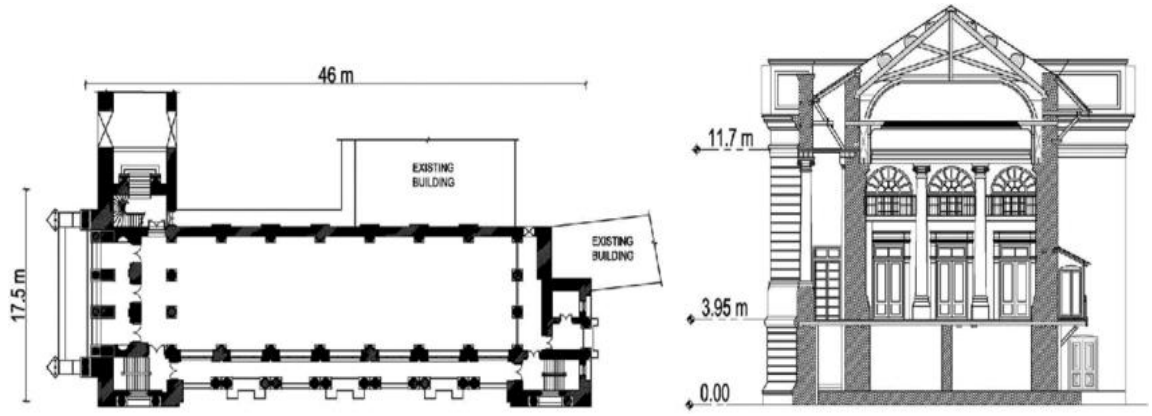


Figure 53: Gaddi Baithak Palace plan (left) and section (right)
Source: (Sonda, Miyamoto et al. 2018)

Figure 52: West facade of Gaddhi Baithak

Source: https://www.flickr.com/

Figure 52: South Facade of Gaddhi Baithak

Source: https://www.flickr.com/

- **Gallery Baithak (1937) -** Naxal, Kathmandu

This historic two storied building was the theatre hall within the Singha durbar premises, built by Juddha Shamsher.

Modern approach:

- Juddha Shamsher has experimented on the use of hybrid ornamentation. The traditional elements of Newari architecture, Mughal architecture and western architecture have been integrated in the interior and exterior of the building, which indicates the changing political circumstances in the mid-20th century. The Greek key, Kalasha and cusp arches all in one building is rare to find, which is unique to this building

- The front facade is dominated by the neoclassical ornamentation and a large glass and metal canopy.
    - Largely remodeled in 1937 with the innovative skylight in the hall area. For its novel lighting effect, it was also called the "Lighthouse"

Figure 54: The Gallery Baithak

Source: https://www.dw.com/

Figure 56: Metal canopy on front façade

Source: (Nepal 2020)

Figure 55: The hall lit naturally by the use of skylight

Source: (Nepal 2020)

Category -3

- **Saraswati Sadan (Bed Prasad Lohani 1892) -** Ranipokhari, Kathmandu

As the country's first concrete building, Saraswati Sadan represents a turning point in contemporary architecture in Nepal. Reinforced concrete and reinforced brick concrete were among the brand-new, cutting-edge materials and technologies used in its construction. The main architectural structures were initially constructed between the 1940s and the 1960s, during the early modern period. These structures are highly inspired by architectural and engineering ideas that transcend beyond historicity and are mostly defined by the early usage of reinforced cement concrete. Are a good example of early modern architecture and contain aspects of "modern" architecture.

Figure 57: Saraswati sadan

Source: (Nepal 2020)

Modern approach:

- Due to its curving front facade, it is also known as Golghar. The Lohani design is **straightforward, practical, and structurally sound**.
- **Large spans** have been provided by using strong walls and **deep beams**. The balconies' **free-floating cantilever** look is achieved by using **inverted beams** as well.
- Lohani has also made an effort to **experiment with levels and lig**ht in the design.
- The structure has been equipped with **clerestory windows and skylights** to let in diffused natural light.
- Built using new and **innovative materials and technology** including reinforced concrete and reinforced brick concrete.
- Design is **simple, functional, and structurally stable**. Saraswati Sadan is said to have a hanging portico to prevent rain splutters.

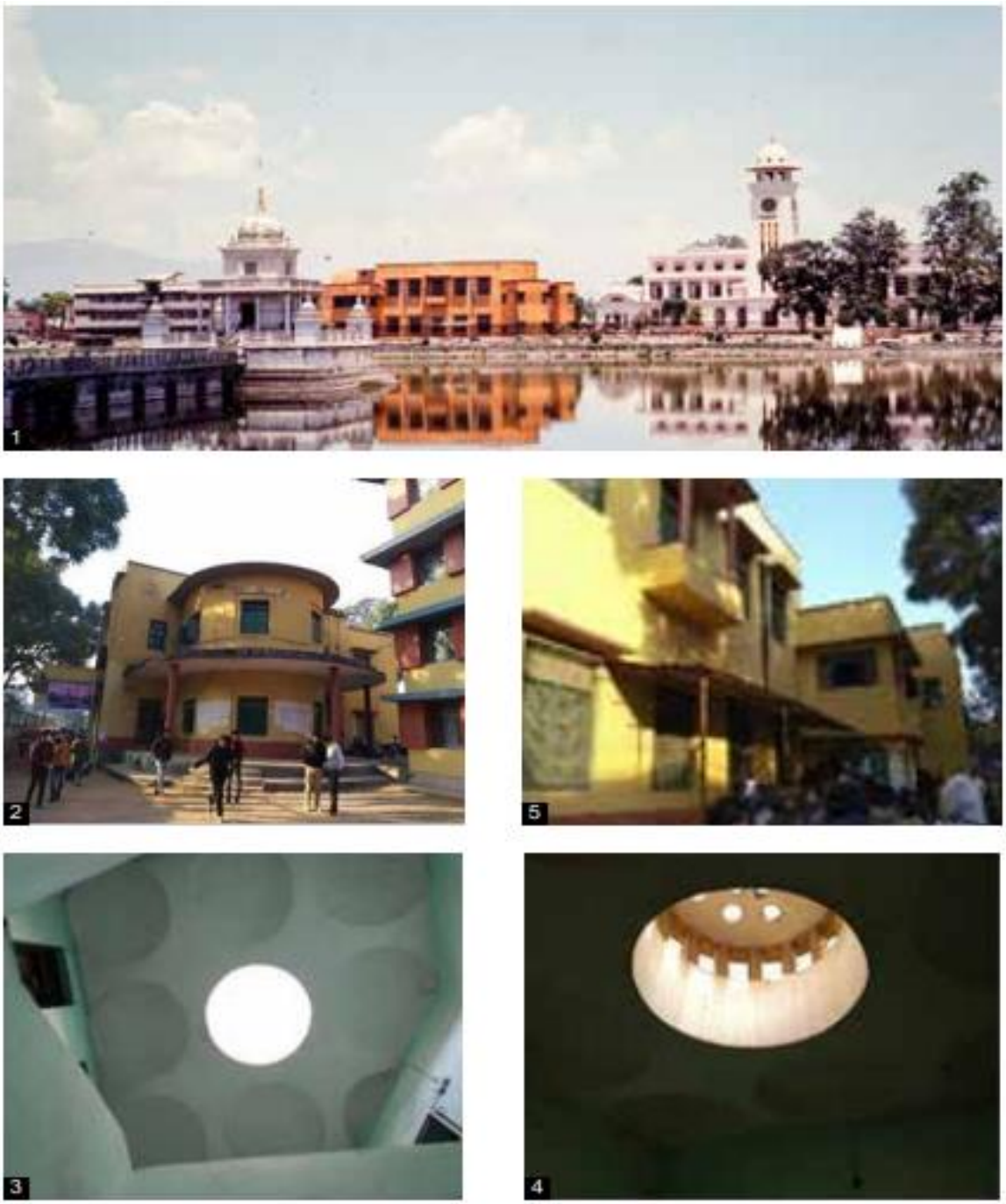


Figure 58: view of Saraswati sadan behind Ranipokhari , projecting concrete slab, use of skylight and the ceiling design in the lower lobby of the northern wing with cantilever balconies and projections

Source: (Nepal 2020)

- **Tribhuwan University Central Library (Robert Weise 1963) -** Kirtipur

The first library building built within the premises of the Tribhuvan University Campus contributed largely to education in Nepal. The architecture blends the local architecture of various region of Nepal contrasted by the brise-soleil.

Modern approach:

- The use of stone as building material represents the hilly region of Nepal, whereas the strut and window designs were borrowed from traditional Newari architecture.
- Building reflects a wonderful balance between traditional and modern styles. The quality of workmanship for the casting of the RCC brise-soleil is commendable along with the use of the metal sections for the doors and windows.
- The two-storey central block was separated from the original single-storey side wings with construction joints. The later extension on the terrace blends well with the original design; however, the quality of construction is less robust.

Figure 59: The central Library building, 1970s
Source: (Nepal 2020)

- **Hotel Soaltee– original block (Ganga Dhar Bhatta and Shankar Nath Rimal 1966)** - Kalimati, Kathmandu

The Soaltee Kathmandu is Nepal's top 5 Star Deluxe hotel, and it is authentically Nepali in character and has a spectacular view of the Himalayas. The hotel is situated in a lush green 12 acres of manicured territory and offers 285 exquisitely decorated rooms, a diverse selection of great dining options, and magnificently constructed conference spaces, making it the perfect place for business, pleasure, and all festivities.

However, the original block of Hotel Soaltee is the first international style tall building within the skyline of Kathmandu.

Modern approach:

- The modernist cube design with plastered façade, represented the international style – **Totally in modern approach**

- The construction systems of reinforced cement concrete framed structure with a basement and raft foundation were introduced to create this modern building **- Innovative building construction systems at that time**
- Refurbishment of the building in the 1990s introduced brick cladding and sloped roofing, to show Nepaliness in building – **Respect for culture???**

Figure 61: The regular modern facade of the hotel Soaltee, circa 1966

Source: (Nepal 2020)

Figure 60: The building after the facade relifting in 1990s

Source: (Nepal 2020)

Figure 63: The original Soaltee hotel building, 1972

Source: (Nepal 2020)

Figure 62: Block 2, Nepali in style

Source: https://www.tripadvisor.com/

➢ **Rastriya Sabha Griha (Ganga Dhar Bhatta 1967)** - Pradarsani Marga, Kathmandu

Rastriya Sabha Griha (National Assembly Hall) also known as City Hall is the first public assembly building for indoor functions built in Kathmandu. Designed by Ganga Dhar Bhatta (First architect of Nepal), the function is clearly reflected in its form, with the massive curved façade enveloping the main hall.

Modern approach:

- The building fully satisfies its function – **Modern building for modern function**

- He took into consideration three separate groups of people: first, pedestrians, for whom he created a large staircase linking the ground floor and first floor; second, vehicles; and third, performers, for whom he provided a porch and a lobby on the ground level.
- The front façade of the city hall reflects the modern architectural style with the use of pure geometrical form, cantilever slabs and clean horizontal & vertical line - **Totally in modern approach**
- The use of reinforced concrete for the auditorium hall, cantilevered curved slab, the grand frontal stair, as well as the main entry gateway to the premises reflects the versatility of this modern material – **Modern material and its flexibility**

➢ The floor to ceiling transparent façade creates openness to the exterior in the lobby area, signifying publicness of the building – **Simultaneity in architecture**

Figure 65: Construction of Rastriya Sabha Griha, 1967

Source: (Nepal 2020)

Figure 64: Rastriya Sabha Griha

Source:https://spacesnepalblog.wordpress.com/2018/06/12/nepals-first-architect/

Figure 66: The stairs leading to the first floor lobby supported on the RCC frame

Source: (Nepal 2020)

Figure 67: Rastriya Sabha Griha with creative use of forms

Source: (Nepal 2020)

- **Narayan Hiti Royal Palace (Benjamin Polk 1969) -** Durbar Marg, Kathmandu

The original royal palace of the Shah Kings after they conquered Kathmandu Valley was at Hanumandhoka. It was towards the end of the 19th century that the Rana Prime Ministers moved the King outside the old city to Narayanhiti Durbar, a neo-classical Rana period building. Once King Mahendra got to power in the 1950s, he quickly worked towards creating a new national image for Nepal. The design of a new palace block within the Narayanhiti Palace complex reflects the new vision of modern Nepal projected by late King Mahendra.

Figure 68: Narayan Hiti Royal Palace

Source: (Nepal 2020)

Modern approach:

- Two-tiered pagoda roof dominates the central structure as a reminiscent of the past, while the design of the nearby modern tower represents the future. The plastered towers rise out of a plinth in exposed brickwork.
- Utilized a mixture of horizontal lines, hipped roofs, horizontal bands of windows, and large overhanging eaves.
- The shikhara shape and the tall building on its left were expertly arranged to capture the formal Nepali spirit.
- The entire shape features structural shear walls in some areas and is planned as a frame structure overall.
- OPC used for structural works along with mild steel for RCC also use of machine made bricks

Designing the exterior

Mahendra requested ideas for his new castle from a number of international architects. It's unclear whether these invites overlapped (creating an unofficial competition) or if each connection was made separately. The functional needs of the palace appear to be more clearly expressed when compared between a Robert Weise sketch design and the actual structure, since both depict a comparable distribution of space between guest, state, and private activities. A second contrast, this time between the final design by Polk and the concept sketch by Robert Weise, demonstrates a definite symbolic departure from the neo-classical Rana past. The Ranas adopted the neo-classical design to set themselves apart from their community and represent their symbolic pursuit of equality with the British (Weiler 2009). When compared, the designs of Robert Weise and Benjamin Polk reveal that the shape of the palace façade (of a contemporary Hindu ruler) was forced to borrow from traditional (Newar) forms since they both used a tiered pagoda roof as a defining feature.

Following Polk's personal visit to the king in 1961, the designs by Benjamin Polk (1916–2001), a Californian with a commercially successful joint practise in Calcutta (1957–64), were approved. Polk stated that he wanted to "feel why the ancient structures were as they were, to comprehend the people, and to work anew" when he was creating the palace (Polk 1993a: 9). In the 1960s, there was a focus on capturing the essence of a location, and one of the main purposes of buildings was to orient us—to tell us where we are. It raises issues with authority over what is authentic and, of course, authenticity itself: "The Palace would be a remembrance - about which may cohere visually once again a Nepali purpose - a will that is needed to address today's long-term difficulties and to sustain independence from its two huge neighbours," the author said (Polk 1993a: 8). Polk placed a strong emphasis on the palace as a means of bridging the past and the present, and it is clear from his writings that he was aware of both the Panchayat rhetoric and King Mahendra's notion of monarchy. He only travelled to Nepal for business engagements, though, and it appears that he did not venture far from the Kathmandu Valley in his hunt for the real. In 1964, he and his wife Emily left to travel to the United States, putting government engineer Shankar Nath Rimal in charge of managing the palace's development. Polk claims that he provided continuity, but it would be more appropriate to see him as putting pieces of an existent

world into an imagined one using what he had on hand and following the directions of the King. A team led by Prince Gyanendra oversaw construction, which started in 1964. Shankar Nath Rimal served as the committee's intermediary throughout Benjamin Polk's conversations over the palace's design, which he thought to be a difficult procedure. The committee authorised design revisions such using brick (a material linked with tradition) as a face material rather of marble and hiring anti-Rana nationalist artist Bal Krishna Sama to create the ceremonial entry gateway to the main reception area (Whitmarsh n.d.).

- **Ministry of General Administration (Shankar Nath Rimal 1960s)** - Singha Durbar, Kathmandu

Experimentation with new architectural expression was being undertaken in the late 1960s. The design of the Ministry of General Administration building.

Modern approach:

- The building emphasizes the purity of form represented by superimposed cubes – **Pure geometric form**
- Ground floor represents the brick expressionism whereas large glass openings in first floor gives floating effect to upper second floor horizontal white cuboid. Introduction of reinforced cement concrete made it possible for taller buildings to be built and this is expressed in the tower-like structure with large glass facades of the Ministry of General Administration building – **Material selection**
- The expression of minimalism and harmony without symmetry, created by a composition of forms, is unique to this building – **Minimalistic design**

Figure 69: The modernist minimalistic facade of the Ministry of General Administration

Figure 70: The tower with large glazing façade

Source: (Nepal 2020)

Soon after, the valley became accessible for contemporary development, and a number of projects providing technical support from different nations and international organizations arrived. Many different foreign architects have worked on and contributed to the architectural design of Nepal because of the country's comparatively limited experience in creating modern building types. Involvement with Nepali projects over the past 50 years has taken many different paths, and the architecture created by these foreign architects as a result is consistent with the nature and characteristics of these paths as determined by the scope, complexity, funding, and intended use of the projects. Four categories may be used to group their works.

Category -4

It's possible to characterize the 1970s and 1980s as an era of growth. In the Kathmandu Valley, a lot of planning was done in the 1970s. Soon after, the valley became accessible for contemporary development, and a number of projects providing technical support from different nations and international organizations arrived. Due to Nepal's relatively limited expertise with developing modern building types, a wide range of international architects have worked and contributed to the architectural design of the nation. Involvement with Nepali projects over the past 50 years has taken many different paths, and the architecture created by these foreign architects as a result is consistent with the nature and characteristics of these paths as determined by the scope, complexity, funding, and intended use of the projects. Four categories may be used to group their works.

The 1st Stream: Foreign Practitioners in Kathmandu	**The 2nd Stream:**
For the early foreign architects like Carl Pruscha, Robert Weise, David Dobereiner, Gotz Haagmueller and John Sanday, the The ancient towns of the Valley, which were surrounded by vast stretches of lush green paddy fields, flowing rivers, and the bizarre baroque garden palace compounds constructed at the start of the previous century, must have been a wonderful sight to see. They were drawn to the rich traditions of this place and created design concepts that reflected the culture rather than propagating preconceptions from their home nations.	Belongs to the creations of well-known architects who were hired by foreign humanitarian organisations or agencies to develop certain structures or complexes in Nepal. Most of these only included one project over a brief period of time, and they seldom ever show the architects' original efforts in novel, difficult contexts. The Master Plan of Lumbini, the birthplace of the Buddha, was created by Kenzo Tange.

The 1st Stream: Foreign Practitioners in Kathmandu	**The 2nd Stream:**
In addition to them, countless other international architects have contributed to the planning and development of a variety of community-based projects throughout Nepal, including schools and hospitals/health centres, which were sponsored by outside sources years ago. (Shah 2016). Office buildings, hotels, and apartments were all created by Robert Weise. He is praised with bringing back the regional architectural scale and the sloping roof shapes, which are two extremely important aspects of the Valley's traditional architecture. Projects include the Nepal Army Headquarters, The Yellow Pagoda Hotel, and The Annapurna Hotel. In the late 1960s, Carl Pruscha was hired by the UNDP to create the Valley's first urban development plan. He also oversaw the creation of the Valley's first inventory of its cultural sites. Other noteworthy constructions are the Tara Gaon Hotel	the Louis I. Kahn-designed Family Planning Center. The renowned Japanese architect Tadao Ando created a Women's and Children's hospital in Butwal, which was funded in the 1990s by the Japanese charity organisation AMDA. The new Narayanhiti Royal Palace was built by American architect Benjamin Polk.

The 1st Stream: Foreign Practitioners in Kathmandu	**The 2nd Stream:**
and the Tribhuwan University Institutional Building CEDA. Austrian architect Gotz Haagmueller settled in Bhaktapur after arriving in Kathmandu in the 1970s to work on the GTZ-backed Bhaktapur Development Project. His work has focused on rehabilitating various historically significant structures. He has also used his extensive expertise and understanding of the Valley's traditional architecture to develop architectural innovations in the adaptive re-use of ancient buildings in Patan, Bhaktapur, and Kathmandu. His notable accomplishments include the Patan Museum, the Keshar Mahal Gardens, and his own home in a Bhaktapur courtyard. These projects provide as examples of the numerous contemporary design options available when renovating historic structures.	

The 3rd. Stream:	**The 4th Stream: Architecture; For Private Sector:**
Large and programmatically complex building complexes that were constructed	The most recent wave of works by foreign architects is focused on massive,

The 3rd. Stream:	**The 4th Stream: Architecture; For Private Sector:**
as technical aid projects are the subject of work by international architects. To guarantee a certain standard in design and construction, the bilateral agencies who carried out these projects brought their own consortia of architects and experts. The majority of these projects called for designing and constructing unique building types that had never been done before in the Valley. Its influence on modern architecture has thus been quite little.(Shah 2016). To build the Teaching Hospital Campus, the Sano Thimi Tuberculosis Center, and the Disaster Mitigation Center, JICA, consortiums of Japanese architects, were hired. Government architects from India completed the General Post Office building, the telecommunications structures, and medical projects such as the Bir Hospital, the BP Koirala Institute of Medical Sciences in Dharan, and most recently the New Trauma Centre at the Bir Hospital. Although it would be challenging to prove that these designs had any outstanding architectural value, they show a certain level of design and	privately marketed construction projects that are driven by commerce. Large hotel developments include the Fulbari Resort, Yak & Yeti, Taragaon Hyatt Regency, Soaltee, and Radisson. Foreign architects have worked on projects in this category for clients headquartered in Nepal that have been financed by Nepalese banks, built mostly by Nepalese contractors, and given the go-ahead from Nepalese authorities. As a result, these programmes have involved local stakeholders considerably more than earlier technical assistance/grant projects did. However, the architecture was not properly integrated with the Nepali environment. Although the Taragaon Hyatt Regency Hotel asserts to have included the fundamental spatial and formal elements of the traditional built environment, the results appear to be considerably unlike from this assertion. The design's two most crucial elements, the conventional building form and the size and space composition, were poorly taken into account.(Shah 2016).

The 3rd. Stream:	**The 4th Stream: Architecture; For Private Sector:**
detailing discipline as well as an awareness of the municipal context. The Birendra International Convention Centre and the new Civil Employees' Hospital were designed by Chinese government architects, on the other hand. Both projects occupy prominent locations, yet their architecture doesn't seem to be trying to interact with the city in any way. A few other ongoing projects include the International Terminal Building at Tribhuwan Airport, the US Embassy Complex, the Japanese Embassy, the Ambassador's Residence, and the new Indian, Chinese, Russian, and Danish embassies. Embassy buildings don't seem to be very successful in this regard, despite providing a significant opportunity for the nation to display its cultural identity. Norwegian architect Kristin Jarmund designed the Norwegian Embassy. Before the project was developed in Kathmandu, Nepalese architects assisted in its architectural development. Intentionally blending into and enhancing the urban fabric, the design idea also intends to introduce us to modern Scandinavian aesthetics.	

The emerging architects in Nepal may learn a lot by being exposed to the range of architectural creation within the framework of progress produced by these international architects. This might be quite helpful in establishing Kathmandu's architectural design goals and objectives. However, the valley experiences damage and the extinction of tradition rather than modernization and transformation was overlooked owing to increased urbanisation because of economic and political upheavals. Kathmandu's architectural environment was unable to convey the depth and genuine meaning of modernism.

4.4 Modern Design in Nepal evolved from geometry in various Eras during the 19th- 20th centuries

- **OBJECTIVE:** To establish a formative notion in which the architectural shape is determined by the concepts of flat and solid geometry. The diagrams are drawings that represent fundamental traits and connections in a building in the form of abstractions. As a result, the diagrams emphasise certain physical characteristics that enable comparison of that characteristic between buildings regardless of style, kind, function, or time.

4.4.1.1 Category -1

The significant architectural structures that were originally built during the early Shah period in the first half of the 19th century defined by the introduction of Islamic elements. Many of these buildings were commissioned by Bhimsen Thapa during his reign as Prime Minister or by his close family and confidents.

- **NATIONAL MUSEUM, CHHAUNI:**

- **GENERAL INFORMATION:**

  Established: 1938 as a public museum

  Location: Chhauni, Kathmandu

  Land Type: Flat

  Style: Mix of Neo-Classical and Malla Architecture

Figure 71: Front facade of National Museum
National Museum, Chhauni

The National Museum of Nepal is housed in the residential palace of the first Prime Minister of Nepal Bhimsen Thapa. The complex has two more structures serving the gallery purpose besides the palace itself. The Chhauni Museum's large amount of open space is one of its most notable features. structures with a variety of architectural styles, especially those with Neo-classical and Malla influences. The building's design will incorporate elements of post-Victorian, traditional Nepalese, and Indian architecture. Its form is rectilinear.

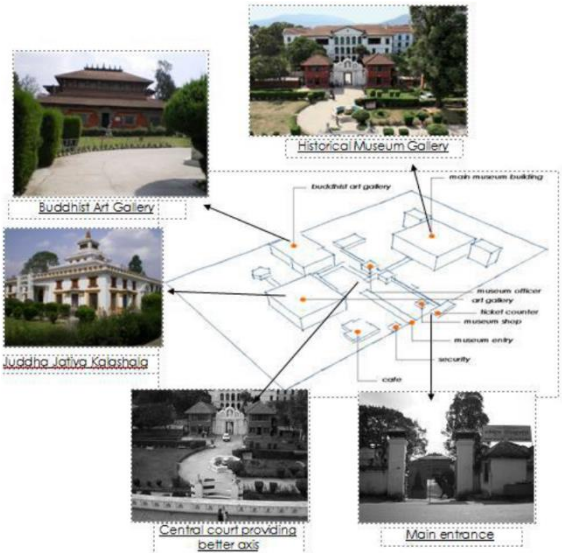


Figure 72: Volumetric Form of Building

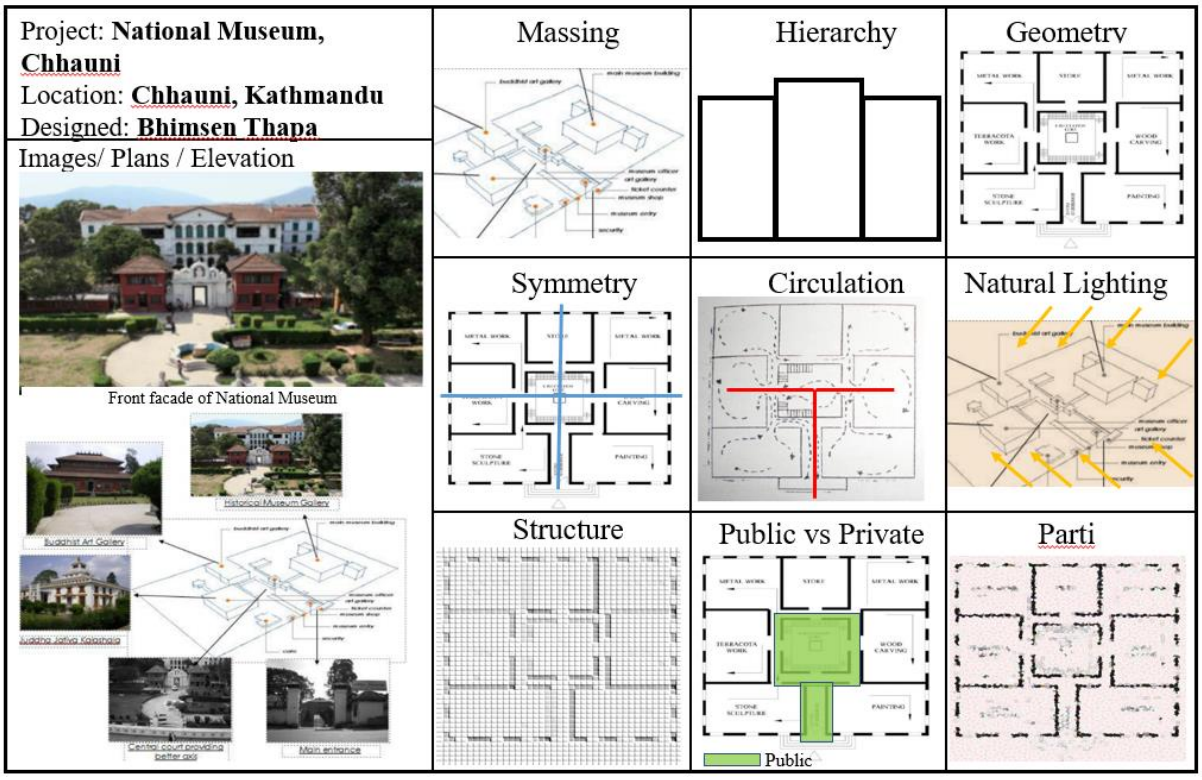


Figure 73: Precedents of National Museum Building, Analysis diagrams & Formative ideas

The plan, elevation, and section for the building are all rendered at the same scale in the study's analysis section. It aids in recognizing and outlining formal archetypal patterns or foundational concepts from which architecture may develop. The building

is an abstraction used to represent the fundamental qualities and connections of the structure. Building diagrams also demonstrate the distinct physical characteristics that may be compared amongst buildings, regardless of style, kind, purpose, or period. The square and rectangle are two common geometric shapes that are used to specify a building's shape. When a unique unit is confined and surrounded by several equal units, repetitive components are present. Larger areas created by the repeating construction pieces have unique aspects.

4.4.1.2 Category -2

The significant architectural structures that were originally built during the late-19th up to mid-20th century defined mainly by European neo-classical styles. These were introduced by the Rana Prime Ministers and are often called Rana Style buildings.

- **GADDHI BAITHAK (1908) -** BASANTAPUR, KATHMANDU

Gaddi Baithak is the latest addition to the Hanumadhokha Palace complex. It was commissioned by Chandra Shamsher to receive the foreign delegates visiting the palace. During Indra Jatra foreign delegates were invited to observe the Kumari chariot festival, a tradition that still continues.

Figure 74: South Facade of Gaddhi Baithak

Source: https://www.flickr.com/

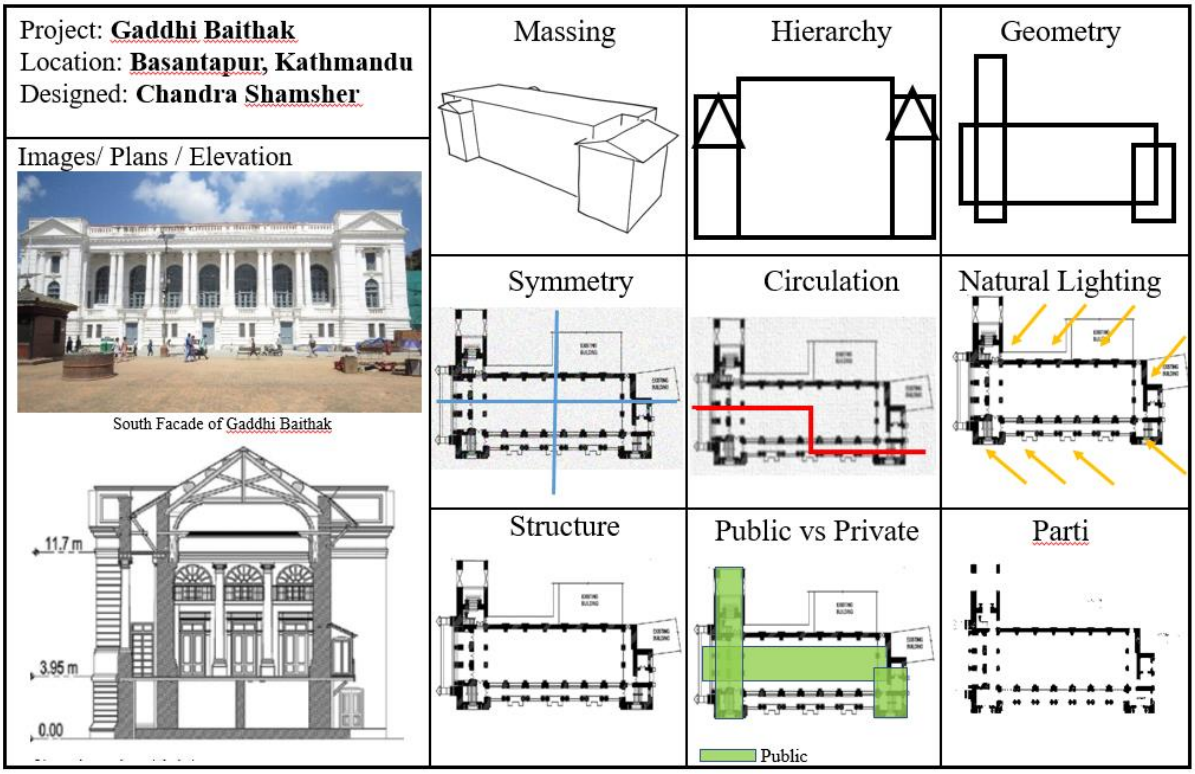


Figure 75: Precedents of Gaddhi Baithak Building, Analysis diagrams & Formative ideas

The plan, elevation, and section for the building are drawn at various scales in the study's analysis section. Building diagrams also demonstrate the distinct physical characteristics that may be compared amongst buildings, regardless of style, kind, purpose, or period. The square and rectangle are two common geometric shapes that are used to specify a building's shape. The plan and section or elevation are totalities of one other in the proportional plan to section connection, although there is a dimension shift in just one direction.

4.4.1.3 Category -3

The significant architectural structures that were originally built during the early modern period which would span from the 1940s through the 1960s. These buildings are largely defined by the early use of reinforced cement concrete and greatly influenced by architectural and engineering designs that go beyond historicity. The buildings are designed by professional engineers or architects.

- **RASHTRIYA SABHA GRIHA**

"CITY HALL" OR "NATIONAL ASSEMBLY HALL"

Nature is Omniscient and all including- each thing, each elements and each nooks and crannies created carry a function. This is the possibility and role of organic architecture. An organic architect is an architect who looks forward and backward, above and below to find out what nature needs. First public edifice for indoor functions. Rashtriya Sabha Griha was a welcome addition for the locals such a venue for speeches, exhibitions, cultural presentations.

Figure 76: City Hall

- **GENERAL INFORMATION:**

Location : Exhibition Road, Kathmandu

Area: 13,589 Sq.m

Centrally located in Kathmandu Valley

Land Feature: Relatively flat with some trees

Architect: Gangadhar Bhatta

- **PURPOSE:**

To create a Landmark in the modern architecture in Nepal

- **DESIGN CONCEPT:**

There are three categories of people: He initially provided a large stairway linking the first level and ground floor for people. Second, a porch and ground-floor lobby were made available for vehicles. Third, a new entrance was made available for performers. Wide stairs for simple entry and departure.

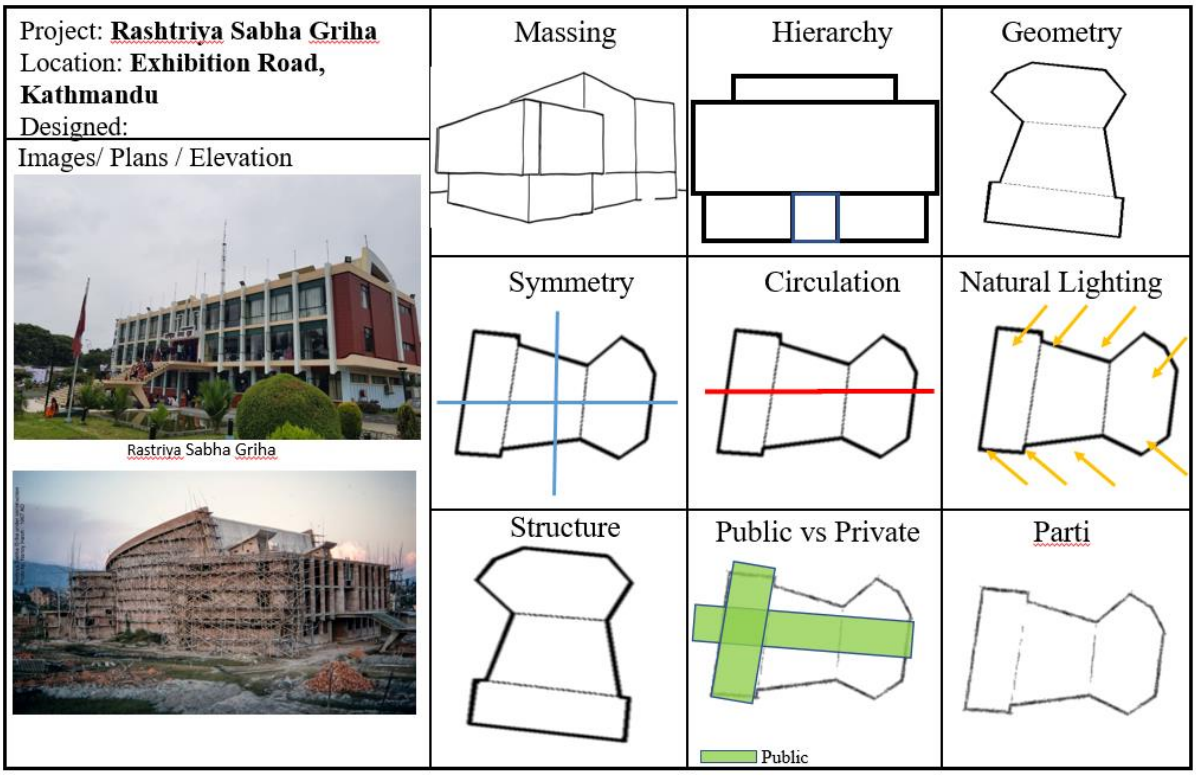
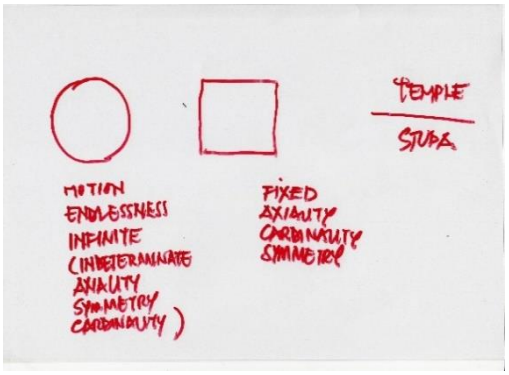


Figure 77: Precedents of Rastriya Sabha Griha Building, Analysis diagrams & Formative ideas

The plan, elevation, and section for the building are drawn at various scales in the study's analysis section. The building diagrams also display the distinct physical characteristics that may be used to compare one structure to another, regardless of their style, kind, function, or period. The rectangle and hexagon are two of the fundamental geometric arrangements that are utilised to specify a building's shape. Through combination, division, and utilisation of the pieces, fundamental geometries have given rise to a myriad and variety of shapes. Basic geometries may be modified by rotating, moving, and overlaying in order to generate constructed shape.

4.5 Symbolism and Proportion in Nepalese Architecture

4.5.1 Symbolism



The primitive Hindu temple form symbolized Mount Meru, the center of the world inhabited by the gods. The concept of pyramids on a circular lake gave rise to the concept of circumnavigation as the first step in worshiping a deity in a temple. It is theorized that devotees worshiped by absorbing the radiant energy emanating from the center while circling the temple. The temple was not facing north. This was because it symbolized people living in the South. The temple building, with its central axis pointing to the heavens, symbolized the heavenly movement of divine energies temporarily lodged in the temple so that people could worship it on earth.

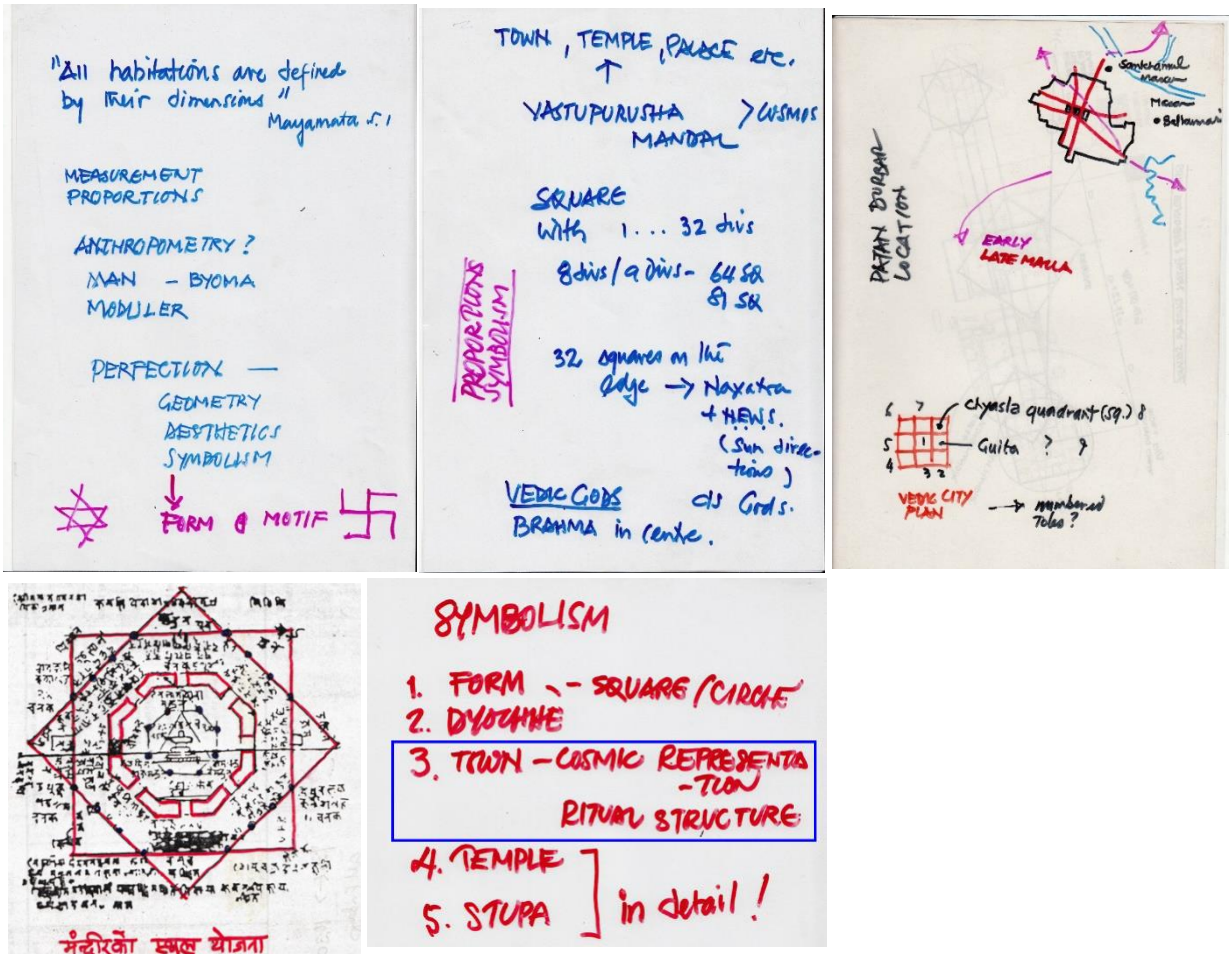
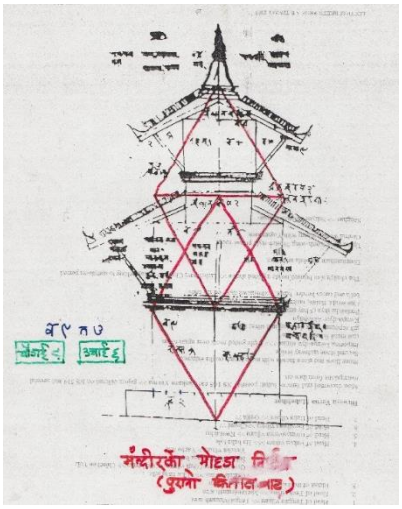


Figure 78: concept of Symbolism and Proportion in Nepalese Architecture

Therefore, without worshipers, the temples would not be visited by the gods. Temple Grounds features a white naga subterranean formation representing water. According to ancient Indian scriptures, when the temple was built, the ground was divided into squares representing the divine Nagas who lived underground. The central figure of the Torah was the god of the temple, whether Hindu or Buddhist. The expanse of the temple symbolizes the expanse of the lake.

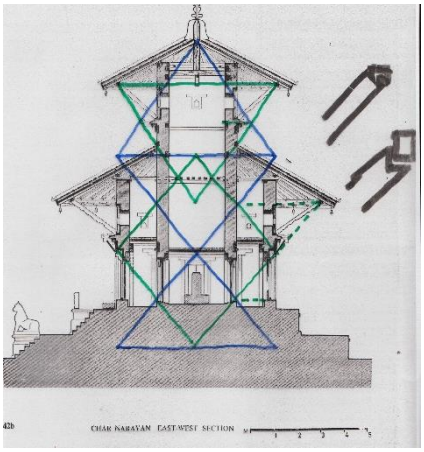
4.5.2 Proportions

Odd numbers are also evident in temple plans, where odd numbers of bays are chosen, usually between 3 and 5 (Tiwari, 1989). The temple design module (Mandala Pada) is determined by dividing the outer dimensions of the temple by 2n-1. Where n is the number of temple steps, if odd, or the number of bays in the bottom core. It is the same when it comes to stages. The default design module determines the size of the temple core and roof above it.



Source: Prof. Sudarsan raj Tiwari (Lecture)

In determining the ideal height of the temple, the Nepalese builder dictated his Matsyapurana decree that the overall height of the temple should be two or three times his width of the plan of the temple. Seems to have followed an ancient manuscript outlining the procedures for the repair and maintenance of temples shows that he used three proportional triangles to determine the height of the key element of height. Roof



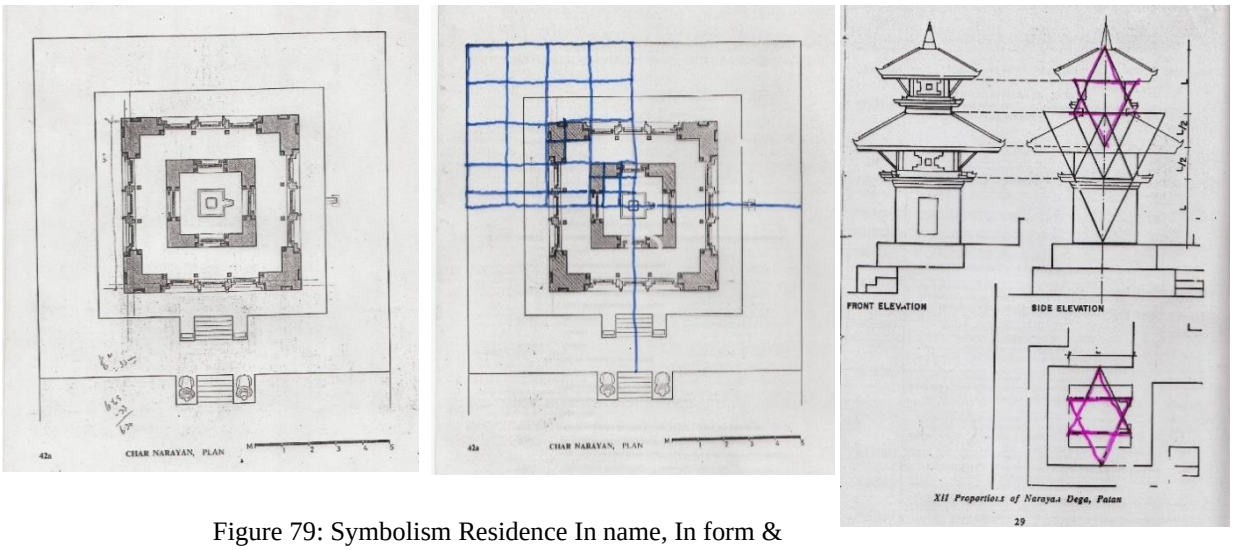
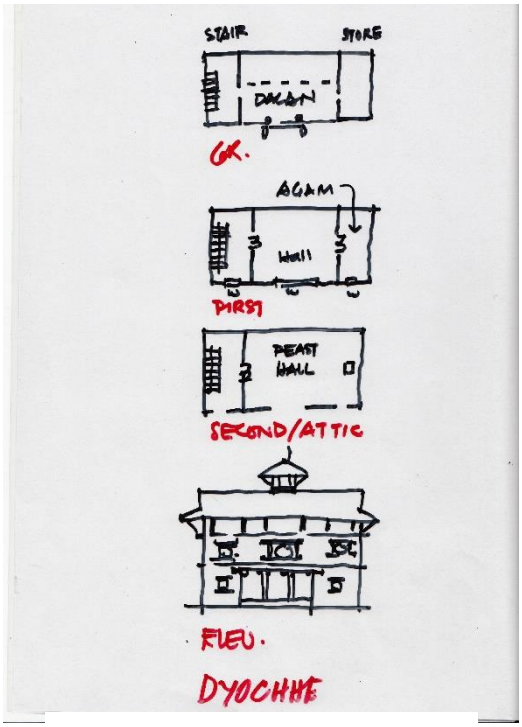


Figure 79: Symbolism Residence In name, In form & In space organization

Eaves Height, Lion's Face Collar Height (Simhamvah), Junction Level between Lower Roof and Upper Core Wall. If the height of the proportional triangle is H, the stirrup height is 3H. At the Lingam temple, the base of the triangle coincides with the plane of Jalahari (Tiwari, 1989). Plan ratios vary from 5:9 in Jayabageswari, Bhuvaneswari and Bhagbairav to 5:7 in Barkmari (Patan), 5:6 in Bhagawathi Temple in Nala and 3:4 in Bhimsen Patan.

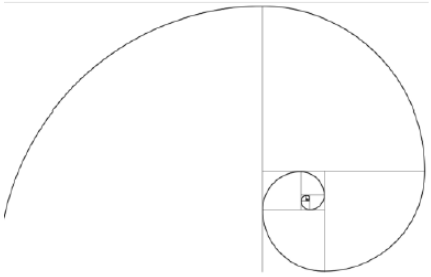
Source: (Prof.Tiwari Lecture)

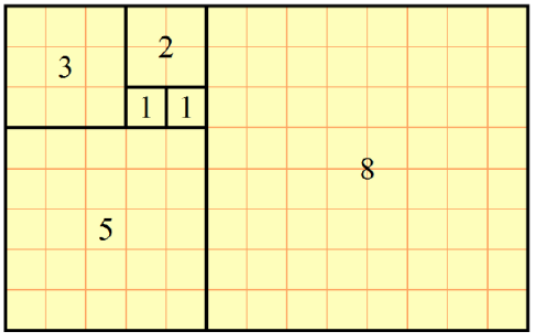


Source: Prof. Sudarsan raj Tiwari (Lecture)

4.5.3 Proportion, Scale & Order

- Frequently used in buildings as a human scale.
- Scale and proportion are not the same though related. Scale is relative but proportion is mathematical relationships between dimensions. Which can usually be expressed in terms of ratio.
- A proportion is a relationship between the measurements of each component of a full work and between the whole and a standard component. The symmetry principles emerge from this. If there is no specific relationship between its members, such as in the case of those of a well-shaped man, then there cannot be principles in the construction of any temple.
- In architecture, the whole is not just a building, but the surroundings and surroundings of the place. One of the things that makes a building and its place "beautiful" is its orientation with respect to the reality of the terrain it stands on. Light, shade, wind, height, choice of materials, etc. should all be related to the criteria, showing what constitutes it and what makes it different.





Source: (Prof.Tiwari Lecture)

4.6 The Timeline of Architectural Influences From western

The foundation of design and creativity is precedent, as well as previously developed ideas and concepts. The architecture utilizes historical antecedents from social and cultural contexts to modern buildings, shapes, and structures. Because it enables a link between the material, physical, and formal advances that have already been explored by past architects, having an awareness of the historical history of buildings is a crucial component of architectural design. The fundamental driving force behind architectural progress has been responding to or reacting against these ideals (Farrelly, 2007).

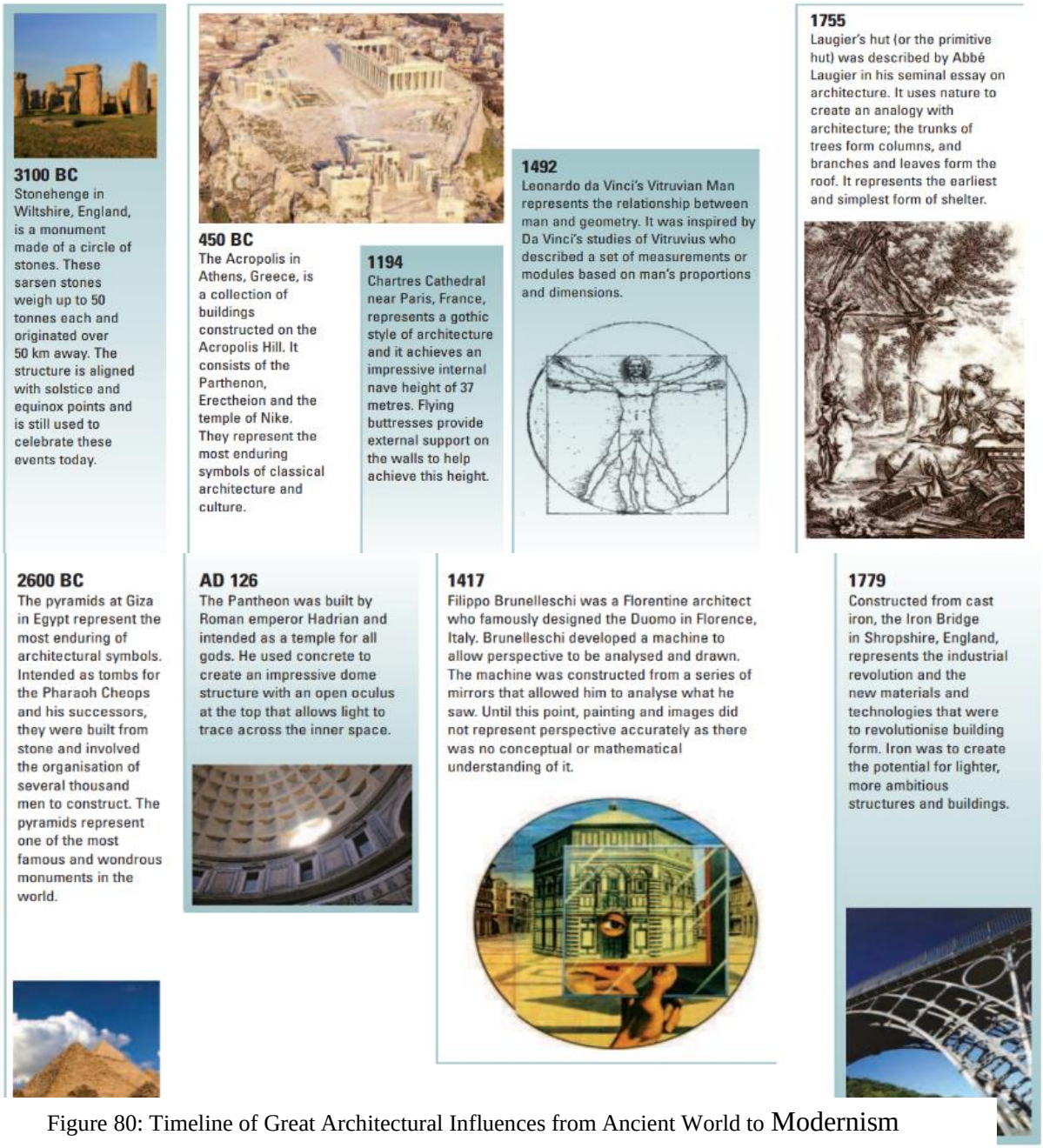


Figure 80: Timeline of Great Architectural Influences from Ancient World to Modernism

Figure 81: Timeline of Great Architectural Influences from Ancient World to Modernism

Source: (The_Fundamentals_of_Architecture, 2007)

4.7 Modernist Architecture: The Bauhaus and Beyond

The contemporary aesthetic, which may be defined as "Plain geometric shapes," is the distinguishing trait of modern architecture. Modern architecture may be traced back to the Industrial Revolution, when architects were experimenting with new materials like steel and reinforced concrete. Building design is no longer influenced by religion or classicism, but rather by architecture inspired by technology.

We are so accustomed to the modern aesthetic that it is impossible to comprehend the debate that surrounded its creation. However, it took decades for this style to mature and obtain widespread recognition, which it did in the early twentieth century (under the leadership of Bauhaus).

A brand-new, experimental style of architecture began to appear in the 1920s. New building techniques relying on steel, concrete, and glass, influenced by Modernist ideas - open interiors and a lack of adornment - and the teachings of the Bauhaus school, replaced traditional materials of stone, brick, and wood.

4.7.1 The Bauhaus

Let us together desire, conceive and create the new building of the future, which will combine everything — architecture and sculpture and painting — in a single form…

Figure 82: Bauhaus

Staatliche's Bauhaus, or simply Bauhaus, was a German school of art founded by Walter Gropius in 1919 with the goal of combining craft and method. Despite only being in existence for 14 years, the school had a lasting impact on all types of art; we will focus on its architectural effects. The architecture was designed first and foremost for the people, therefore utility was essential.

The goal of the Bauhaus movement was to combine the arts and crafts to produce a brand-new industrial aesthetic, currently known as design. The Bauhaus represents

modernity and inventiveness in art. Modern design was born at the Bauhaus. Walter Gropius claims to have dreamt that architecture will, like in the Middle Ages, constitute the culmination of the synthesis of the arts. In Weimar, Germany, in 1923, during the first significant Bauhaus exhibition.

Bauhaus was a response to the machine aesthetics and functionalism of the 20th century. The structure also acted as a billboard advertising items covered by the Bauhaus patent. It is not regarded just for its visual appeal or its technical proficiency in the case of crafts. In harmony, Bauhaus brought together the arts and crafts.

With a key idea of "truth to materials," Bauhaus architecture valued utility over everything else. Materials were employed in Bauhaus architecture in their most natural state, with nothing in the way of adulteration. This was designed to be a direct response to industrialization, mass production's coldness, and materialism. A Bauhaus-style structure would use materials in their natural, unadulterated condition, honouring them as part of the overall design rather than as something to hide. Bauhaus structures are frequently made of industrial materials such as concrete, glass, and steel.

Perfectly symmetrical buildings were considered as part of the industrialised world, evocative of factories, warehouses, and other shapeless structures, hence Bauhaus design strives to establish balance through asymmetry.

Bauhaus architecture is characterised by the use of simple, practical shapes such as squares, triangles, and circles, with minimum ornamentation. Many Bauhaus structures are strikingly geometric, with flat roofs and streamlined facades; if abstract shapes are employed for adornment, they are used sparingly. Because Bauhaus was an architectural movement rather than a clearly defined style, you can encounter Bauhaus buildings with curved lines and softened corners rather than harsh angles.

4.7.2 Bauhaus Philosophy:

Taking advantage of the cultural climate to explore arts and design in new direction.

- First philosophy absence of ornamentation get rid of the things that doesn’t matter.
- Harmony of Function and Form: Function before Form, Form before Function no more as Bauhaus allowed us to unite these two designs is form and function.

- Harmony of craftsmanship and mass production: Bauhaus also brought us the unity of quality craftsmanship with the ability to mass produce, make it work by making design part of the entire process.
- Minimal isn't an aesthetic: Bauhaus didn't kept things simple because it was pretty, but they kept things simple because it was a holistic. View of the entire production process design isn't something we can add it's the whole things from start to finish.

4.7.3 Bauhaus architecture major characteristics

- Lack of Ornamentation

Bauhaus is about simplicity and clean lines at its core, yet it doesn't imply the building lacks style. A clean, unfussy style was obtained thanks to the creative usage and positioning of geometric elements, which also functioned well when applied to mass manufacturing and constructing practical structures for everyone.

- Authentic Materials

Authentic materials that are faithful to their original shape and have not been changed in any manner have always been stressed in the Bauhaus style of thinking. As a result, steel, concrete, glass, and organic materials that haven't been unduly handled or sculpted are frequently used to cover the building.

- Sleek Visuals

Linear design is one of the most well-known characteristics of Bauhaus architecture. Because the aesthetics are designed to be as simple as possible, polished, smooth lines are essential. This can be seen in every aspect, from the steps to the windows, and everything in between.

- Flat Roofs

Flat roofs are common in Bauhaus architecture to coincide with this linear motif; in some cases, the idea is for people to walk on them. However, large overhangs are uncommon.

- Geometric Accents

Cubism was a trend in art that began in the early twentieth century and was known for its use of geometric forms and cubes. This style is particularly prevalent in Bauhaus architecture, which has both curved and squared outlines. Even today, the shape of these structures makes them appear new and modern.

- Modern Aesthetics

Bauhaus design, when it comes to modern aesthetics, is still relevant today, more than a century later. Designing for the people while giving art and attention to detail was a unique concept at the time.

- Form Follows Function

Founder Walter Gropius adhered to a design philosophy that paralleled that of fellow architect Frank Lloyd Wright, who said, "Shape and function are one." The use of economical, realistic materials, as well as the fact that mass manufacturing (followed by style) was top priority in Bauhaus architecture, demonstrate this (Bauhaus Architecture – An In-Depth Look at Bauhaus Building Styles, 2022).

4.7.4 Key Elements of Bauhaus Architecture

Every Bauhaus building is unique. They may have curved balconies and rounded edges, or they could be straight and angular. However, they all have the following salient characteristics in common:

- Avoiding adornment in favor of straightforward, logical, and practical design
- Simple geometric shapes like the triangle, square, and circle are emphasized.
- Asymmetry is preferred to symmetry. Modern materials like steel, glass, concrete, flat roofs, glass curtain walls, and
- smooth façades are used.

4.7.5 Bauhaus Influential in Modern Design

Bauhaus influences may still be found in today's design trends:

- It marked the beginning of the "modern" period. Design styles including the Victorian style, colonial style, and art deco were immensely ornate and

extravagant before and throughout the expansion of the Bauhaus school. Bauhaus revolutionised the field of design at the time by emphasising straightforward, effective buildings and furniture. Modernist architecture, Scandinavian minimalism, mid-century modern design, apartment buildings, and office buildings are only a few examples of the current art and design that still bears these influences.

- It increased the appeal of industrial materials. The use of glass, steel, and concrete in contemporary interior design is said to have been influenced by the Bauhaus school. The Bauhaus redefined these materials as sleek, simple, and beautiful in their function, when they had previously been perceived as utilitarian or aesthetically unpleasant. Ribbon windows, glass curtain walls, and tubular chairs—all of which were influenced by the Wassily chair built by the Bauhaus—are examples of architecture that bears the Bauhaus stamp.

- It affected how students were educated in schools today. The curriculum at the Bauhaus was distinctive. Workers (or "preliminary course") classes for first-year students covered subjects including color theory and design principles. After finishing the basic course, students would move on to more complicated technical courses like glassmaking or furniture design. This class structure has been embraced by several architectural and design institutes across the world. In order to support students studying experimental design, the German federal government formed the nonprofit Bauhaus-Dessau Foundation in 1994.

4.7.6 Bauhaus Today

We can learn from Bauhaus in terms of innovation, sustainability, and user experience. All things are designed, some better than others, but whether it's a sofa or a spatula, design must be taken into account from all angles. These are today's buzzwords and concepts in design, yet they are exactly what Bauhaus was teaching 90 years ago. It's not simply about how something appears; aesthetics is only one factor. Although it may be attractive to the eye, that is not design. Design is the way that anything comes to function as a unit in harmony with its look.

To comprehend the structure, one must first comprehend the materiality of the many design pieces and how they operate. Bauhaus requires mobility to be understood since it cannot be grasped from a single aspect. In response to numerous requirements, a global style of architecture arises with broad surfaces and varied heights.

4.8 Bauhaus Influence in Geometry of Modern Design

Bauhaus architecture prioritized function above all else, with a core principle of "truth to materials". Many Bauhaus buildings are geometric, with flat roofs and streamlined facades. This was meant as a stark rebuke of industrialization, the coldness of mass production, and consumerism.

Figure 83: Bauhaus Building

It is distinguished by its strict economic sensitivities, geometric design, and reverence for useful materials. It still has an impact on us now, as seen by how frequently historical components are incorporated into contemporary environments. influenced weaving, typography, furniture, and architecture.

The Bauhaus building is a significant historical monument in architecture. The outside of the workshop wing is defined by the glass curtain wall suspended in front of the load-bearing framework, which also clearly displays the building materials. This design adheres to the idea of unadorned functionality.

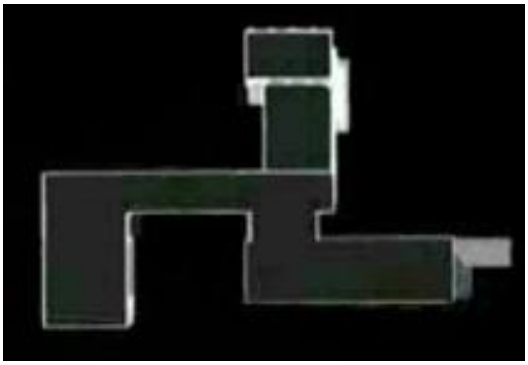


Figure 84: Top View of Bauhaus Building

The Bauhaus's three linked wings or bridges make up its planning. The majority of Bauhaus structures are cube-shaped, emphasizing straight angles, however others have

rounded corners and balconies. Building characteristics are dependent on Simple rectangular shapes with minimal surface ornamentation and a lot of glass are used. a concentration on basic geometric shapes like triangles, squares, and circles.

The plan, elevation, and section for the Bauhaus building are all rendered at the same scale in the study's analysis section. It aids in recognising and outlining formal archetypal patterns or foundational concepts from which architecture may develop. The illustrations are useful because they serve as abstractions meant to explain the fundamental traits and connections of the structure. The illustrations also display the precise physical characteristics that enable comparisons of the characteristics of buildings regardless of their design, kind, function, or period. The diagrams were created using the building's three-dimensional shape and space layouts.

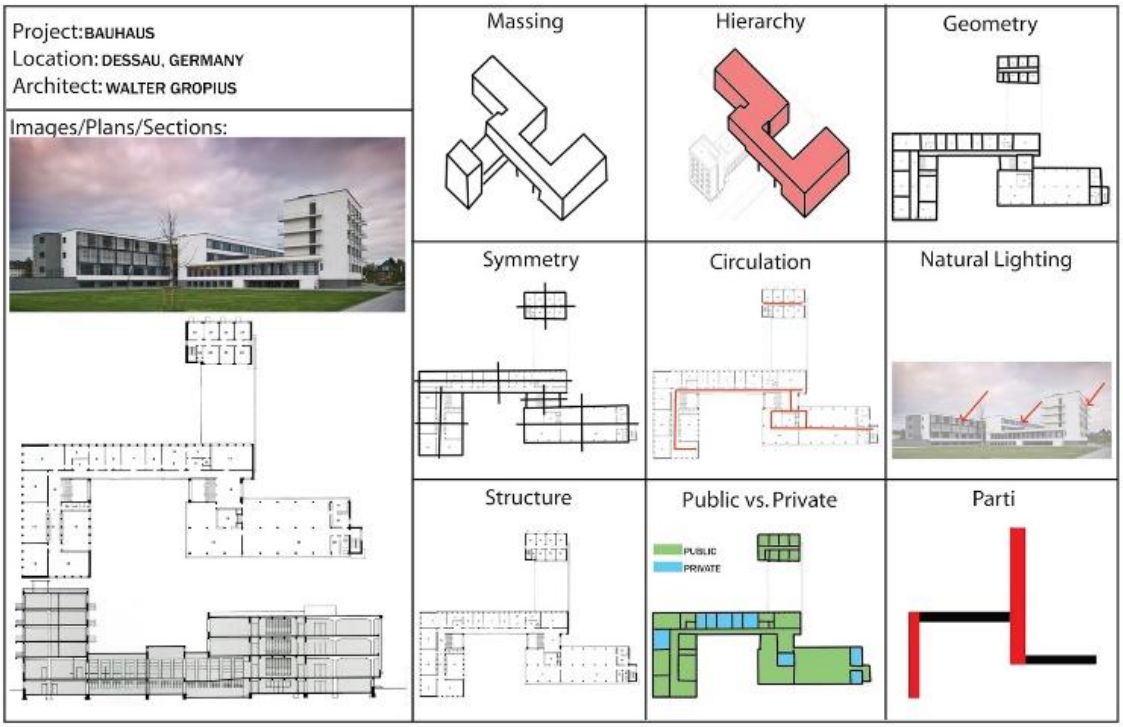
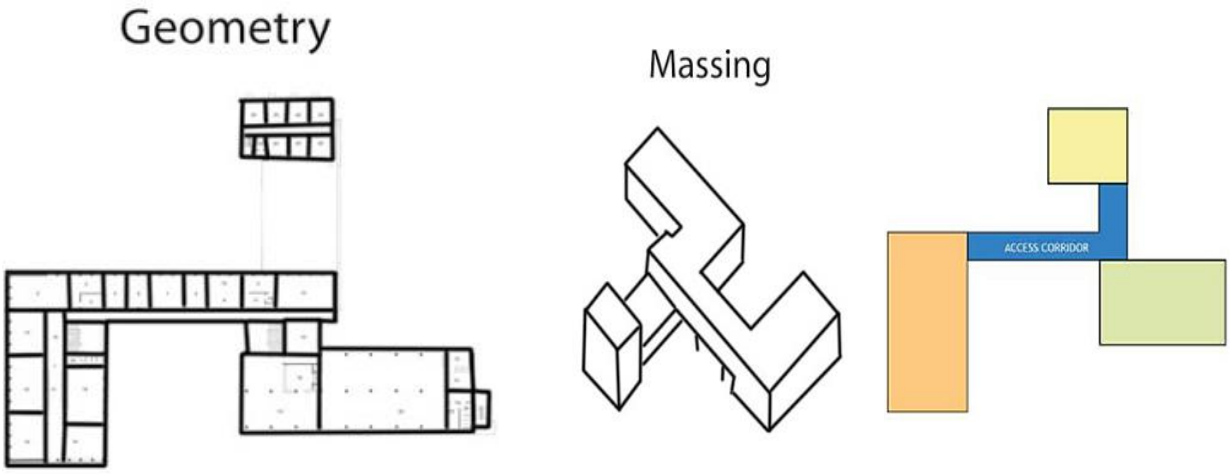


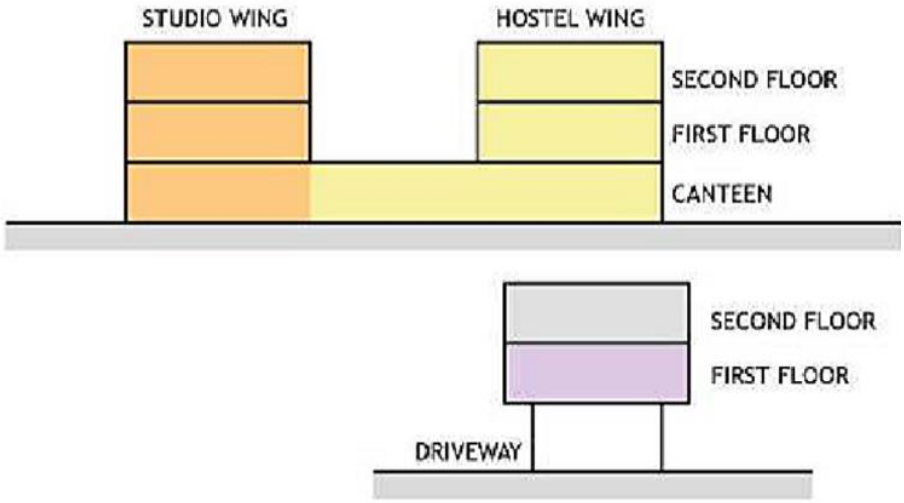
Figure 85: Precedents of Bauhaus Building, Analysis diagrams & Formative ideas

The basic geometric configurations that used to determine a building's form that include the square and rectangle as used in Bauhaus. Two adjacent squares directly determine the limits of the plans, two adjacent squares have a common side along with it help to set the limits of the total plan configuration. Two squares has also been overlap to create

a special condition of the common area. Rectilinear grids occur in the Bauhaus which is coincident with structure.



The Bauhaus building's massing may also be used to convey circulation, stress importance in architecture, fit site, define and articulate outdoor areas, and meet site needs.



- Similar Functions housed in separate wings
- Corridors connecting different wings
- No central point in the layout
- Provides decent flexibility and expandability
- An outward looking complex
- Separate wings are designed as separate

- buildings housing specific functions
- Strong separation between wings imposes certain restrictions on planning flexibility
- Use of glass intended to create a feeling of lightness to structure
- Absence of ornamentation to the building was prevalent in practice during the period

4.9 Conclusion

When one rethinks about Architecture as a profession that builds the reality for people to live in, rather than just a means to a goal, the Geometric notions alluded to here with regard to Literature studies might be constructed in one's own mind. Geometry therefore becomes a tool for constructing space, constructing ideologies, and monumentalizing ideas and ideals. These geometric notions may be employed by architects to make our structures more nature-like, more dynamic, to solve functional needs more effectively, and to regulate intangibles such as human sensations while designing a constructed environment. They are actually instruments for us to employ in order to make the world a better place.

CHAPTER 5. CASE AREA

5.1 Saraswati Sadan, Bed Prasad Lohani, 1892

5.1.1 Introduction

Figure 86: Saraswati Sadan, Trichandra College

Starting from scratch on the challenging landscape of time, technology, and critical awareness. Due to his bravery, tenacity, honesty, and patriotism, he must stand higher in terms of his ability to contribute to our nation. All of these factors combined to create a multifaceted personality in him; as an educator, he was one of the two co-founders and one of the two teachers of Nepal's first engineering school, which opened its doors on May 25, 1945. He was also a technical man, a planner, an industrialist, an administrator, and a spiritual thinker.

Eventually, the university at Pulchowk expanded into the Institute of Engineering. He wrote a geometry book while he was teaching, which was another first for Nepal. He was also the first Nepali to bring reinforced semen concrete construction technology to this nation; the first RCC structure in Nepal was constructed in 1946. He also constructed an RCC building outside of Nepal, in India.

After he abdicated in March 1948, it was for Padma Shumsher to reside in and use as his home. In addition to hundreds of other RCC structures, he also constructed Nepal's first RCC cinema hall in 1953. He also served as one of the founding members of Nepal's first planning commission, which Mohan Shumsher personally headed and launched on September 26, 1948, as the National Economic Planning Committee.

On December 6, 1948, he signed an agreement for the supply of the machinery for the cement factory that he was building in Hetauda on behalf of his company and Jessie Warner on behalf of Alice Chamber Manufacturing Company of Milwaukee, Wisconsin. This was the first time that Nepal had business relations with the United States of America. At a period when 100 rupees could purchase a ropani, or plot of

valuable land inside the Kathmandu city, 5625 square feet of money was handed to them up front for the manufacturing of the machinery in the amount of 6000 rupees.

The deal was formally signed during a ceremony with all of Mohan Shumsher's men present in the gallery baithak. Likewise, when Monarch Mahendra made his famously lengthy excursions to the east and west of Nepal every month, the government secretary spent more time with the king (ICOMOS, April 2020).

Finally, he spent more than 20 years on a spiritual quest, teaching others about Srimad Bhagavata at various Nepalese temple grounds. A country's history is not only a chronology; it also tells the tale of the unnamed architects and engineers who cherished the nation that they helped to create. It is their love-filled whistling, which is blending with the soil's dust as they breathe in the rhythm of the earth.

In contrast, they are the creators of a nation's history; their tale is a fragment of Nepali history that is not included in any history books but is yet brimming with the vitality and inventiveness of a master builder (The Built Culture, 2021).

5.1.2 Design Inspirations context

- First person to introduce concrete in Nepal.
- Playing with a variety of elements in his buildings like RCC, RBC, dome etc.
- Designed Saraswati Sadan, Ranjana Hall, Ashok Hall, Nepal House or Raja Rani Kothi for Padma Shumsher (Ranchi, India) and more.
- His signature design is what we see: the round portion in almost all the buildings he has designed.

5.1.3 Design context

The Saraswathi Sadan's building in 2000 B.S. was a crucial turning point in the evolution of modern architecture in Nepal. It was developed by Bed Prasad Lohani, who brought concrete construction to Nepal. a different building is Ranjana Hall (2009 B.S.). He experimented with a variety of elements in his constructions, including domes, RCCs, and RBCs. His constructions are clear, practical, and sound structurally.

As the country's first concrete building, it represents a turning point in contemporary architecture in Nepal. Constructed with cutting-edge technology and materials, such as

reinforced concrete and reinforced brick concrete. Due to its curving front facade, it is often referred as as golghar. The design is straightforward, practical, and structurally sound. According to legend, Saraswati Sadan has a hanging portico to stop rain splutters (The Built Culture, 2021).

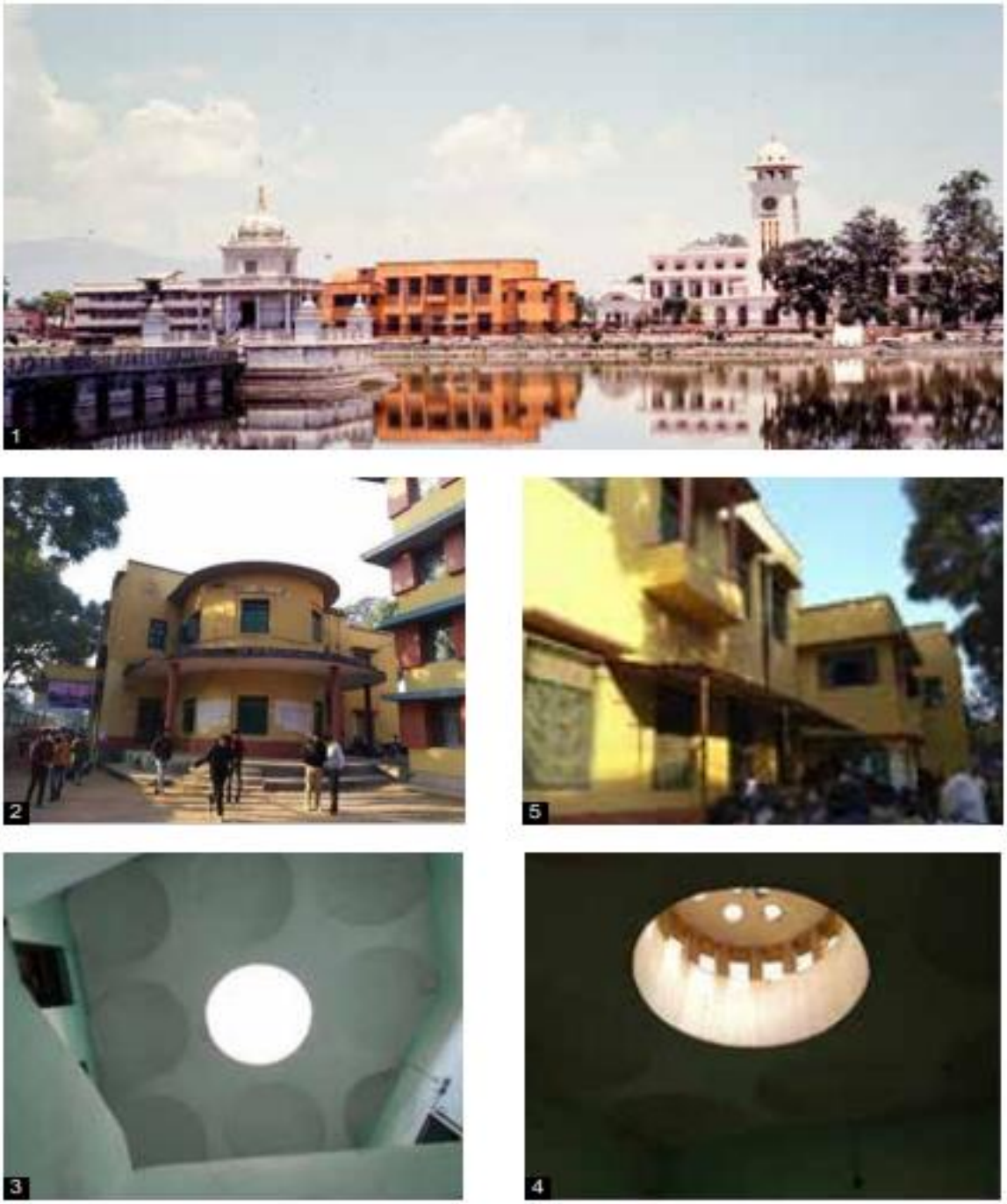


Figure 87:View of Saraswati sadan Interior and Exterior

Source: (Inventory of 19th and 20th Century Architectural and Industrial Heritage of Nepal

5.1.4 Planning and building form

Large spans have been achieved by using thick beams and strong walls. The balconies' free-floating cantilever look is achieved by using inverted beams as well. In the design, he wanted to experiment with levels and light. The structure has been equipped with clerestory windows and skylights to let in natural, diffused light (ICOMOS, April 2020).

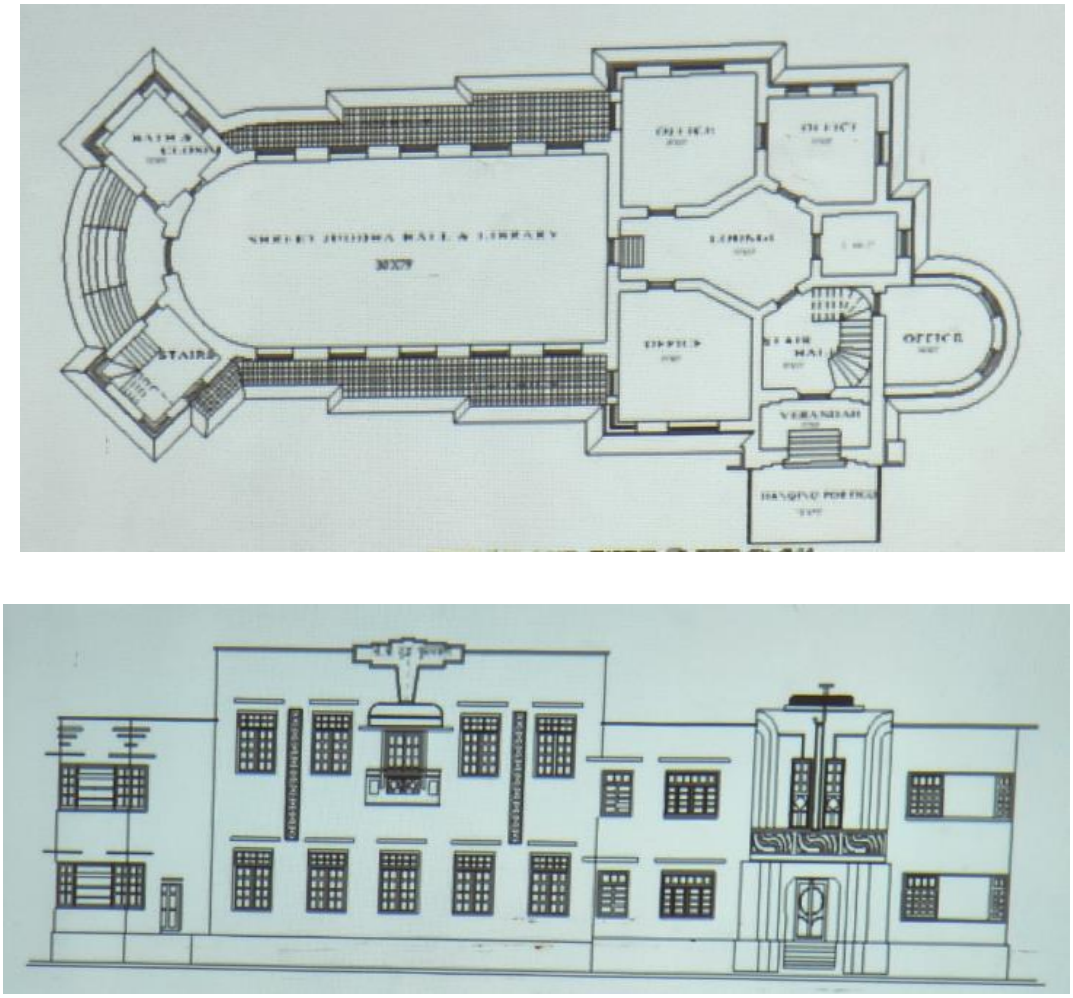


Figure 88: Saraswoti Sadan Juddha Library Trichandra College Plan and Elevation

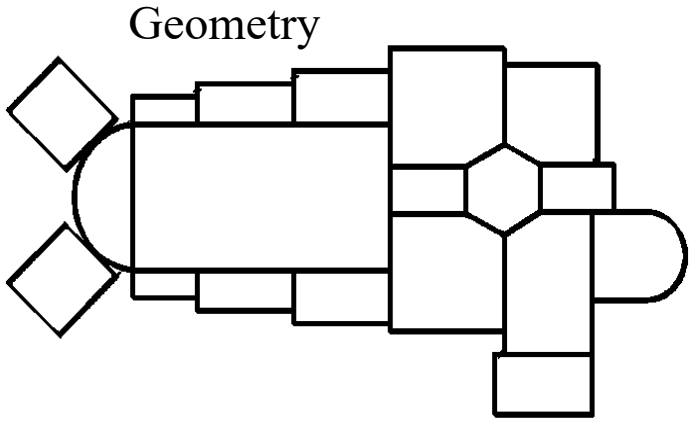
Source: (Bed Prasad Lohani: A conversation on him and his works, Talk Program)

5.1.5 Analysis of Planning

1. Public functional buildings
2. New Aesthetics using new materials and technology
3. The Rotunda and the built form
4. Courtyard is discarded
5. Round, Curves, Straight lines angles in form of geometry is used
6. Internal Volume
7. Surface Detail and elevation
8. New concept of staircase design
9. Windows at corner and long vertical new concept
10. Small pieces of Glasses as for design along with nouveau style

5.1.6 Influence of Geometry with Modern Design

The constructions are clear, practical, and sound structurally. It represents a turning point in contemporary architecture in Nepal. It is constructed with cutting-edge technology and materials, such as reinforced concrete and reinforced brick concrete. Large spans have been achieved by using thick beams and strong walls. The balconies' free-floating cantilever look is achieved by using inverted beams as well. In the design, it has been experimented with levels and light. The structure has been equipped with clerestory windows and skylights to let in natural, diffused light (ICOMOS, April 2020).



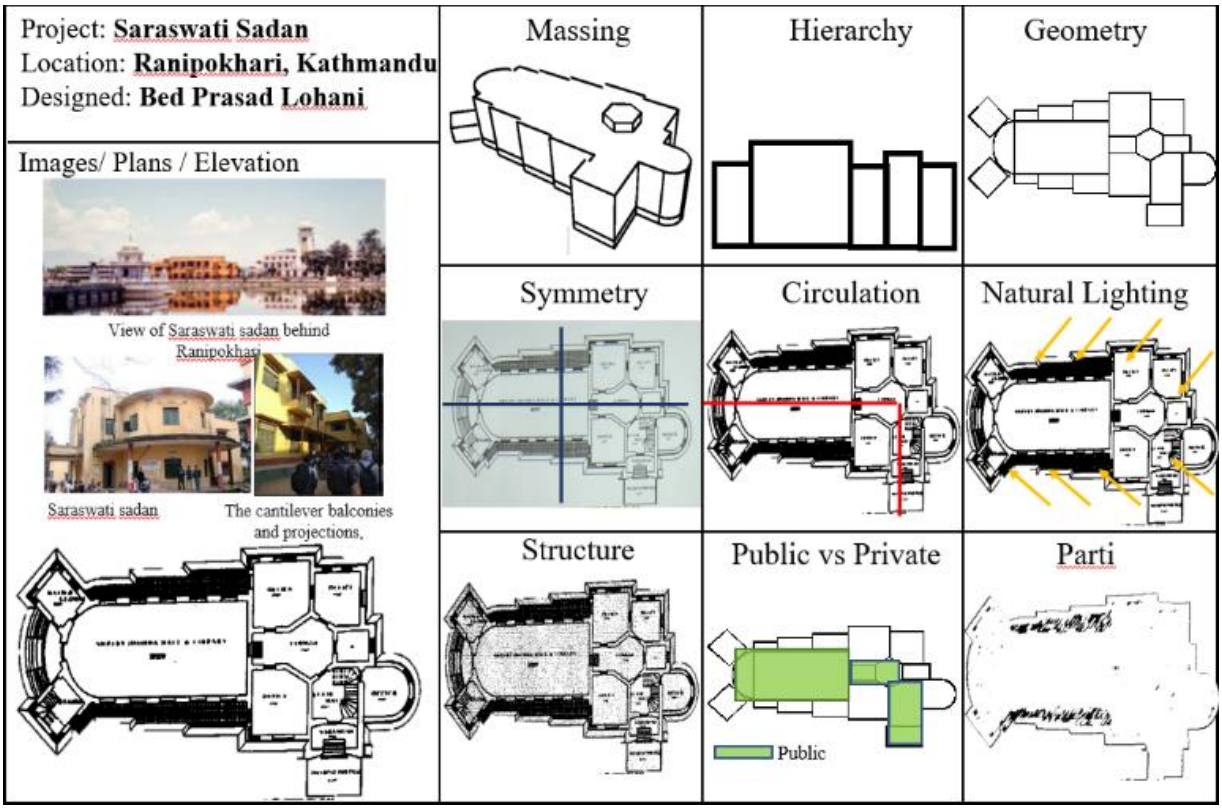
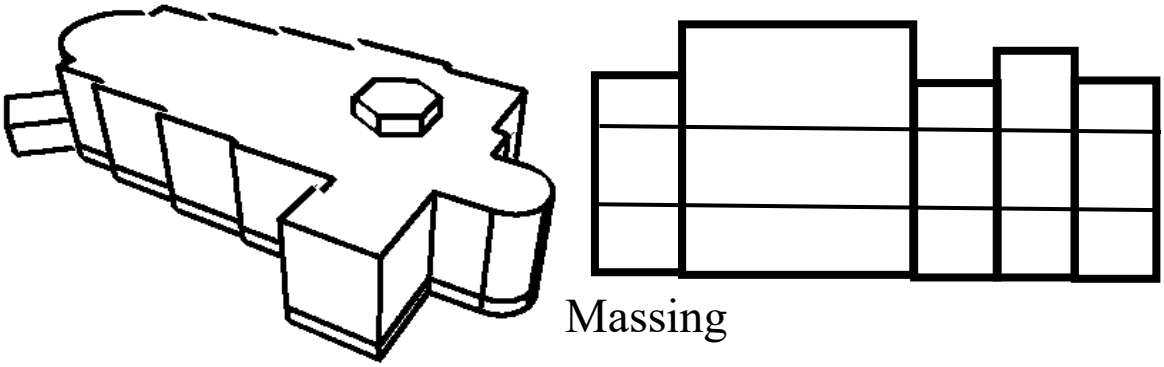


Figure 6: Precedents of Saraswati Sadan Building, Analysis diagrams & Formative ideas

The basic geometric configurations that used to determine a building's form that include the square, rectangle, Semi circle, hexagon as used in Saraswati Sadan. To make each basic form as observable as an entire figure, more than two additional basic forms have also been joined. Although each form has been hinted, it is not necessary that it really exist. It is now feasible to identify a geometry within, next to, or overlapping another within the domain of combinations, such as in a rectangle, square, or semicircle. Because one geometry lies within another, the inner geometry was used to represent an item, a room, a courtyard, a predetermined area, or an inferred space.



Massing

Similarly, massing of the Saraswati Sadan building has the potential to define and articulate exterior spaces, accommodate site, identify entrance, express circulation, and emphasize importance in architecture.

The visually dominant or most prevalent three-dimensional configuration of a structure is shown as its massing. It displays the perception of the structure as a whole. In many instances, the center space, although appearing to be dominant from the outside, functions as a hub for circulation and an organizer of surrounding areas. The notion of linear configurations, which separates circulation from user space, has been used to spine or corridor organisations. The exact geometric combination of the building's massing is a rectangle covered by a semicircle.

5.2 Lumbini Museum, Kenzo Tange, 1960

5.2.1 Introduction

In Osaka, Japan, Kenzo Tange was born in 1913. He succeeded in becoming one of the greats despite growing up in a farmhouse with a thatched roof. The five Corbusier points of architecture were influenced by Villa Savoye, designed by Le Corbusier in 1931. The use of slender "piloti" columns, roofs that could be utilised as gardens or terraces, expansive internal spaces with little load-bearing walls, horizontal windows, and muted faça 1951-1990).

Figure 89: Lumbini Museum

Source: (Inventory of 19th and 20th Century Architectural and Industrial Heritage of Nepal)

When a 15-nation International Committee of the United Nations asked the famed Japanese architect Kenzo Tange to design a masterplan for Lumbini in the early 1970s, he had just finished his renowned designs for the Hiroshima Peace Memorial and Tokyo Olympic Park. He had also just won the Pritzker Prize for his work on these two iconic projects. Lumbini holds a particular place in Tange's heart. He imagined the region as a Universal Centre for Peace, where world leaders may convene to envision and construct a future devoid of suffering and conflict. As a result, his concept spreads the Buddha's worldwide message of openness and peace throughout the three square miles of the Sacred Garden (The Lumbini Museum).

Kenzo Tange, particularly his inspiration and subsequent annoyance in creating the memorial garden and monument to recognise the Buddha's birthplace at Lumbini, Nepal. The goal of this location was to create an ecumenical park where Buddhists from all backgrounds may foster peace and respect among one another. In his speech congratulating Kenzo Tange on receiving the Pritzker Prize, the highest honour in contemporary international architecture, renowned architect Fumihiko Maki noted that

Tange's "ability to distil the very essence of the modern spirit is wedded to a deep understanding of traditional Japanese culture." Traditional Japanese shapes and the most daring structural innovations were combined by Tange. According to an another brief biography, he "combined the present ideas and customs of the western world with the architectural traditions of his own Japan." Travel writer Augusto F. Villalon wrote of Tange's creation of the colossal park to the Buddha's birthplace in Nepal, "The subconscious experience is the core of Buddhism."

Japanese or Buddhist labels for Tange's art. The architect of the Lumbini Sacred Garden in Nepal, Tange, however, appears to have been a hesitant Buddhist and outright disregarded "traditional Japanese" architecture in the majority of his work. His plan for Lumbini illustrates the difficulty of categorising an architectural undertaking along the lines of religion or secularism, public or private. In addition to being a study of how spaces are complex adaptive systems whereby material and people coevolve through time, Tange's attempts to construct a park and memorial for the Buddha's birthplace serve as examples of how Buddhist leisure and ecumenical places might be created. The "conversation spaces" of Italian plaza design, which captivated Kenzo Tange, subsequently influenced his design of the garden and park honoring the Buddha's birthplace in Lumbini, Nepal (The Lumbini Museum).

Prof. Tange's master plan for Lumbini is divided into three main construction-conservation zones running from north to south in an area of around three sq. miles radius, with the first one sq. mile dedicated to the sacred garden and the temple of Mayadevi; the second radius as monastic and cultural zone and the last region as a commercial zone. Tange drafted the first plan in the acquired three square miles land and the structural part of eight buildings, symbolic pavilions and central link bridges was assigned to Er. Shanker Nath Rimal. According to Rimal, the first plan for the museum was rather simpler one in comparison to the later plans he presented in a short while, which had extensive use of arches and huge arched cantilevers in brick. Another interesting part of the story is that it had to be designed to be earthquake resistant for a life span of 500 years, which was indeed a big challenge to Rimal.

5.2.2 Design Inspirations context

- Tange’s personal architectural philosophy, which came to be known as “Metabolism.” He believed that architecture in the past had been functionalist, dealing with the need for human work places, living places, and recreational places. However, he wanted to structure the “process of coupling these functional units.
- The Tange Method of Design in architecture changed the need from box-like shapes to structures that express human feeling.
- He viewed buildings as nodes of energy couplings rather than as solitary monuments or useful constructions
- He created spaces where people could share knowledge while they were working, playing, or eating. In order to facilitate growth and change through time, he also included purposeful "voids" in his design. Additionally, he intended buildings and courtyards to have movable walls and facades so that they could adapt to the needs of the people who would be using them.
- In accordance with Kenzo Tange's design philosophies, architecture must have an element that touches the human heart, but even then, its fundamental shapes, spaces, and outward manifestations must make sense. Today's creative work embodies the fusion of technology and humanity.

5.2.3 Architectural Expression

Kenzo Tange arranged and cross intersected the cylindrical brick volumes giving birth to a modern architecture in an ancient city of Lumbini. The design is symmetrical and it has a water body that shows reflection of the museum as well. The structure is beautiful with brick clad surfaces and the series of vault roofs are externally coated with bitumen solution to avoid water leakage through the roof slab. Why did Kenzo Tange use the cylindrical vault? Dr Christoph Cueppers of LIRI mentioned that he had seen some photographs of early Buddhist structures in Central Asia which had used cylindrical vaults. It appears Kenzo Tange used ‘symbolism’ in his design gaining the inspiration for the form from the chaityas.

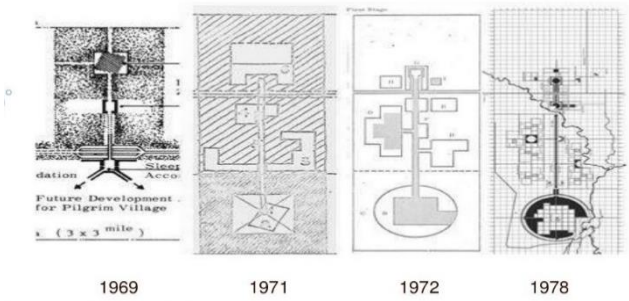
Figure 90: Photograph of Chaitya from the museum (Left) & A rectangular cylindrical monolith Buddhist (Right)

The museum’s most unique elements are the huge equal sized cylindrical volumes intersecting each other at right angles, at a height where the horizontal diameter of the lower cylinders is horizontally tangential to the upper cylinders at its lower quadrant point.

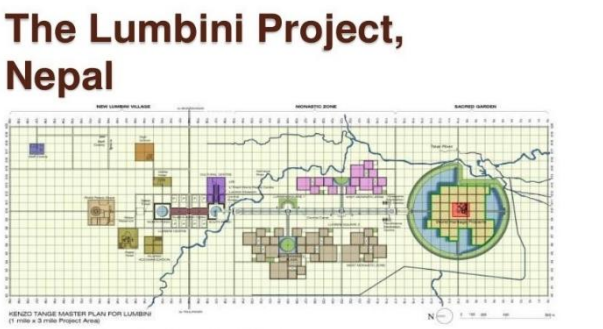
Similarly, the building also exhibits massive brick vaults without any uncomfortable negative spaces anywhere. The perfect blend of strength, durability and aesthetics proves its firm existence as a structure with good taste. The Lumbini museum building is an interesting contemporary design, with a series of brick cylindrical blocks fitted with large round windows. The brick exposure, use of big vaults and large inviting openings, black semi-circular series of roof and proportionately large scale volumes and exhibit spaces are characteristic features set to be an example of modernism and a step forward in the contemporary building scenario of Nepal.

5.2.4 Design context

Kenzo Tange's design for the Buddha's Birthplace memorial monument and park at Lumbini, which included discussion areas and zones of activity, as well as planned open space to permit future development, was in fact most influenced by his philosophy, not Buddhist notions. The central plaza concept, together with public structures like auditoriums and commercial areas, may be observed in his design for Lumbini, which has more in common with the idea of the plaza and the promenade than with traditional Buddhist architecture.



1969: First sketch
1971: Preliminary design
1972: Final outline design
1978: Final design of the Lumbini Master Project approved



•Conceptualization in 1972.
•Finalized and approved in 1979.
•5X5 miles of Lumbini area with the central square mile being the sacred garden.
•Objectives- Respect for universal value of Lumbini

Tange was probably influenced by Carl Prushca's earlier work in Nepal when it was constructed as part of the Lumbini Master Plan. As the only modern museum dedicated to the Buddha and his birthplace, the Lumbini Museum will bring to life these holy tales that provide a window into the depth and breadth of Buddhist doctrine. The Lumbini Museum will serve as the focal point and enhance tourists' experiences at Nepal's holiest destination.Few locations in the entire globe are as venerated and hallowed as Lumbini. The most famous archaeological, historical, cultural, and spiritual landmark in Nepal is the Sacred Garden of Lumbini. In this backdrop, the Lumbini Museum, a cutting-edge institution, is being built inside the Sacred Garden Area for the first time.

Preservation of cultural heritages and the display of metaphysical design patterns.

Based on Buddhist symbolism of geometric forms and the way to enlightenment, this particular detail. In the centre connection, a canal connects the three master plan zones.

The Master Plan's geometric interpretation is centered on religious symbolism, with the central 5x5-mile Mandala and Sacred Garden serving as its focal point. Kenzo Tange advocated integrating the Master Plan into the larger economic framework to have a good influence on the economy through service facilities such high schools, medical facilities, and cultural institutions in addition to tourism. Even now, there is still more to be done.

5.2.5 Planning and building form:

Tange wanted the pilgrim's personal journey in Lumbini to reflect the Buddha's own journey: starting in the physical world (Hotels and Guesthouses), we journey to a repository of knowledge and wisdom (Museum and Library), then through the monastic zones with temples built by various nations, and finally to the inner sanctum at Maya Devi Temple, which represents enlightenment. Tange thus placed the Lumbini Museum and Lumbini International Research Institute near to the starting point of the journey (The Lumbini Museum).

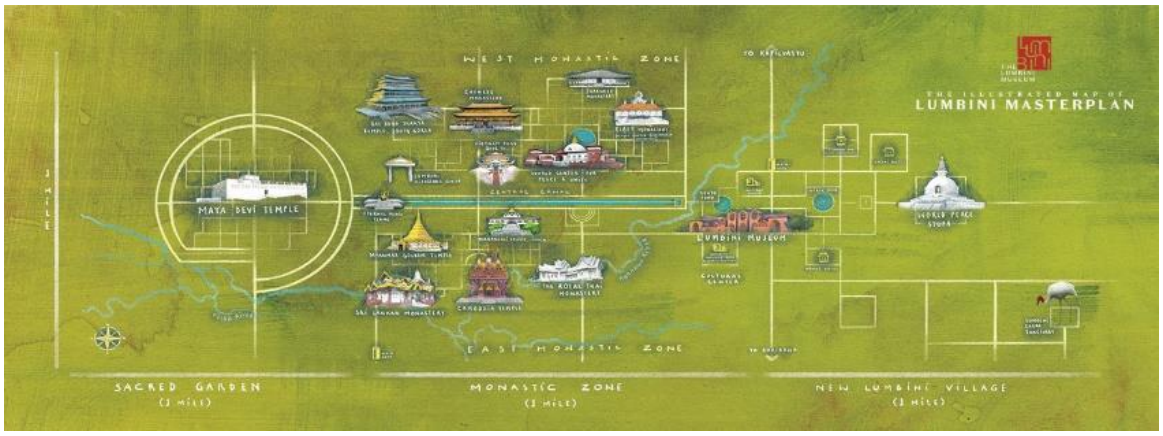


Figure 92: Sacred Space

Source: Picture: Lumbini International Research Institute

Figure 91: The Museum

Source: Lumbini International Research Institute

Tange wanted the pilgrim's personal journey in Lumbini to resemble the Buddha's own journey: starting in the physical world (Hotels and Guesthouses), we journey to a place of learning and wisdom (Museum and Library), then through the monastic zones with temples built by different nations, and

finally to the inner sanctum at Maya Devi Temple, which symbolises enlightenment. Tange thus placed the Lumbini Museum and Lumbini International Research Institute near to the starting point of the journey.

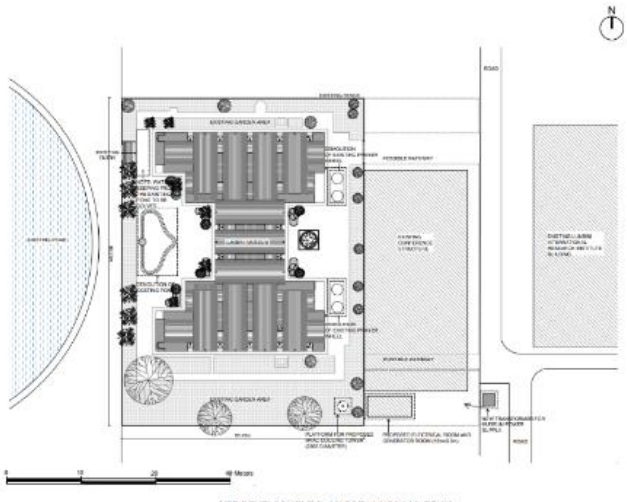
Restoration and reinvention of the Museum for a modern experience are part of **Phase 1**, along with the inclusion of temporary galleries, an orientation room, a cafe, a gift shop, and a sculpture garden with spaces for meditation and display. **Phase 2** will involve erecting a brand-new addition next to the Tange building. The expanded Museum space will tell a unified account of the Buddha's early life and the development

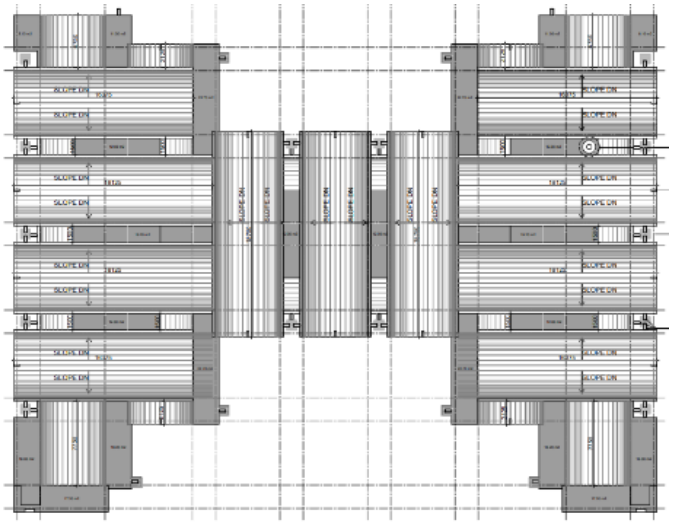
of Buddhism.

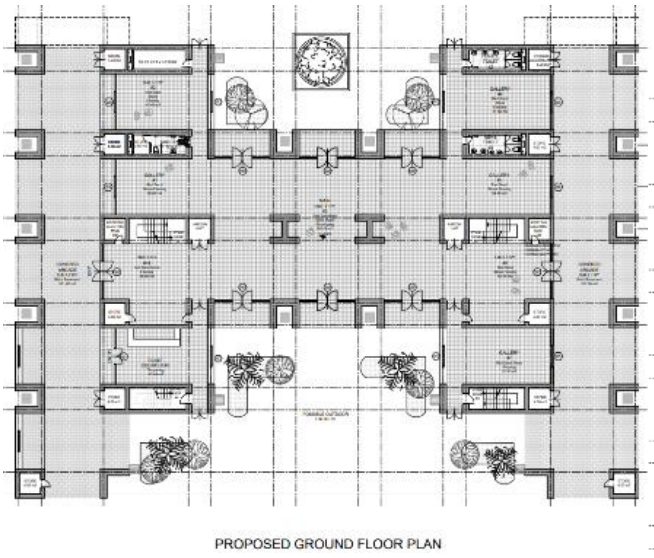
Along with the projected U Thant Auditorium, the Lumbini Cultural Centre also houses the Lumbini International Research Centre and Lumbini Museum. The New Lumbini Village and the proposed entrance to the complex are both close to the Lumbini Cultural Centre, which is situated at the northernmost point of the project area.

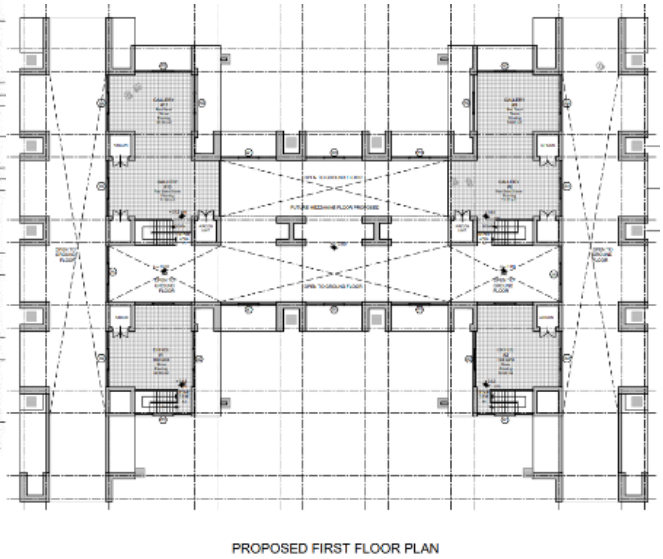
The early vaulted Buddhist temples of Central Asia served as inspiration for the barrel-vaulted cylindrical modular architecture used in the Lumbini Cultural Centre's structures. The modules all adhere to the same structural idea. More natural light and ventilation are made possible by these large arches and vaults, which also raise the floor height and provide clerestory windows. These features are crucial in this hot temperature region. Each module is arranged in such a way as to create a courtyard that allows for cross ventilation.

5.2.6 Analysis of Planning









Source: Wonaw Architect

- Building plan is in a grid form
- Form is strikingly similar to that of Kimbell art museum
- Use of brick cylindrical blocks fitted with large round windows reminds of vaults used in Kimbell
- Exposed brick masonry construction reflects essence of his work in the interplay of mass and void
- Light plays an important factor in the interior adding drama to the place similar to the magnificent interiors of Kimbell art museum.

5.2.7 Analysis of Form

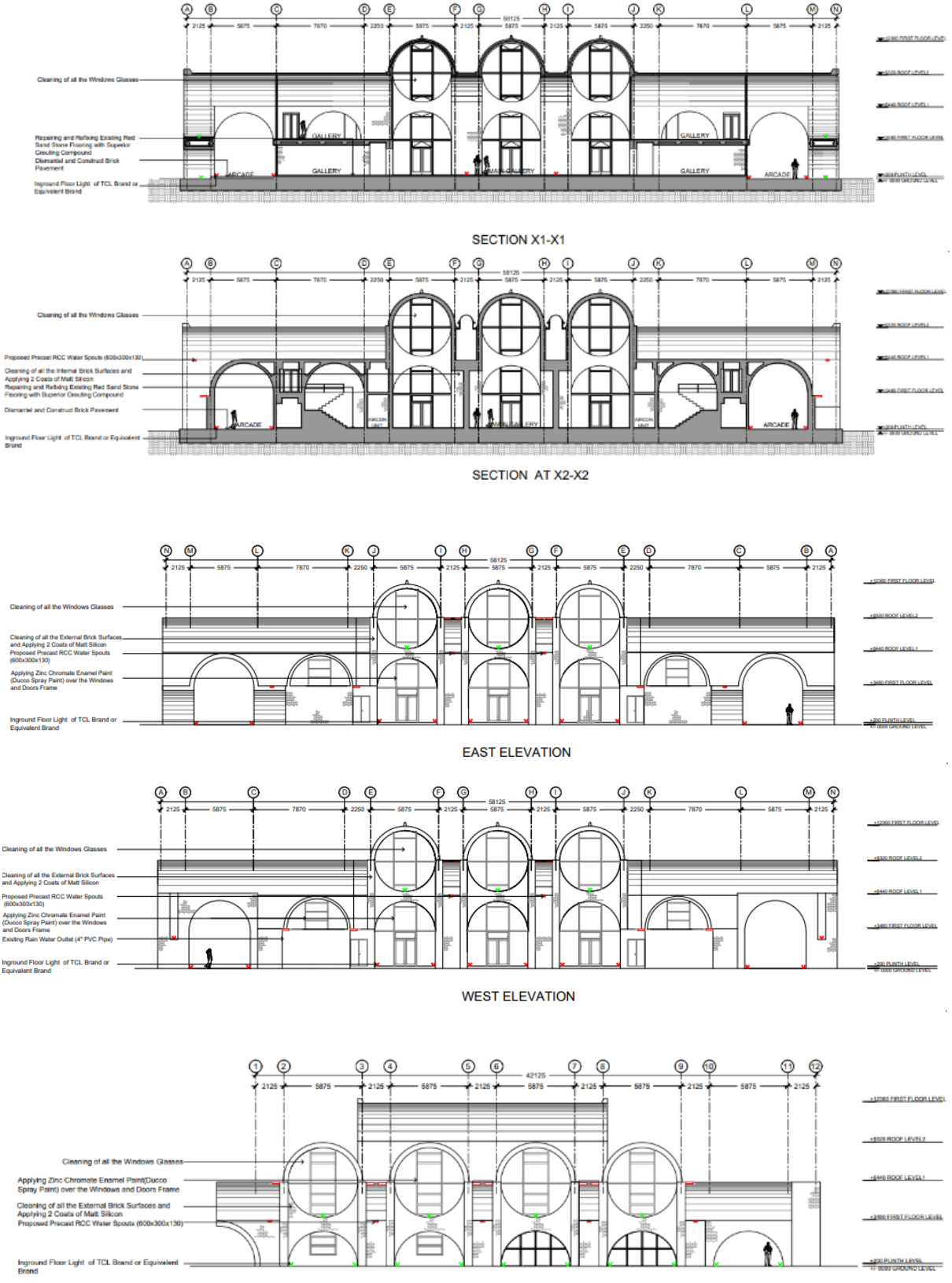
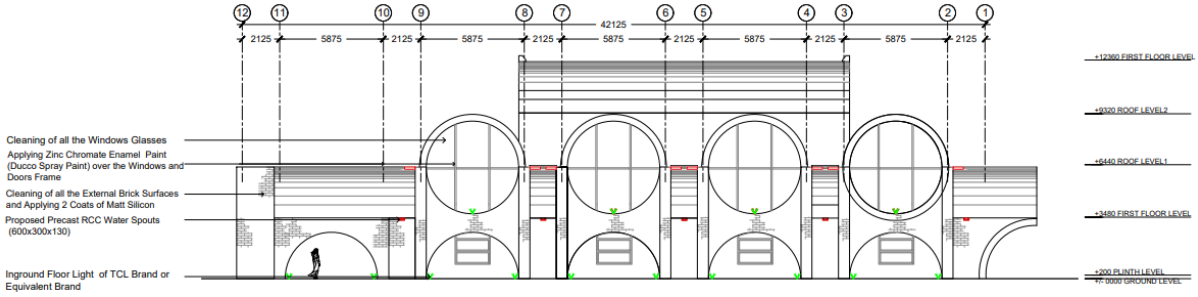


Figure 94: Section and Elevation of Lumbini Museum



SOUTH ELEVATION

1. Large welcoming courtyard (water pool)
2. Centrally placed water bodies
3. Balances external temperature
4. High degree- human comfort- outdoor
5. Use of arch, vault, curve, circle as form of geometry
6. Whereas my experience of Lumbini has been that of relatively open, flat spaces, Bijoy-ji opened my eyes to a very different possibility of Lumbini, in which Kenzo Tange's vaulted brick structures peek out of a lush, verdant forest, rather than monolithically (and somewhat mournfully) rising from it.
7. Space is transformed into a state-of-the-art museum.
8. Buddhist concepts are given form and personal expression through art practice.

5.2.8 Influence of Geometry with Modern Design

Kenzo Tange arranged and cross intersected the cylindrical brick volumes giving birth to a modern architecture in an ancient city of Lumbini. The design is symmetrical and the structure is beautiful with brick clad surfaces and the series of vault roofs are externally coated with bitumen solution to avoid water leakage through the roof slab. The most unique elements are the huge equal sized cylindrical volumes intersecting each other at right angles, at a height where the horizontal diameter of the lower cylinders is horizontally tangential to the upper cylinders at its lower quadrant point.

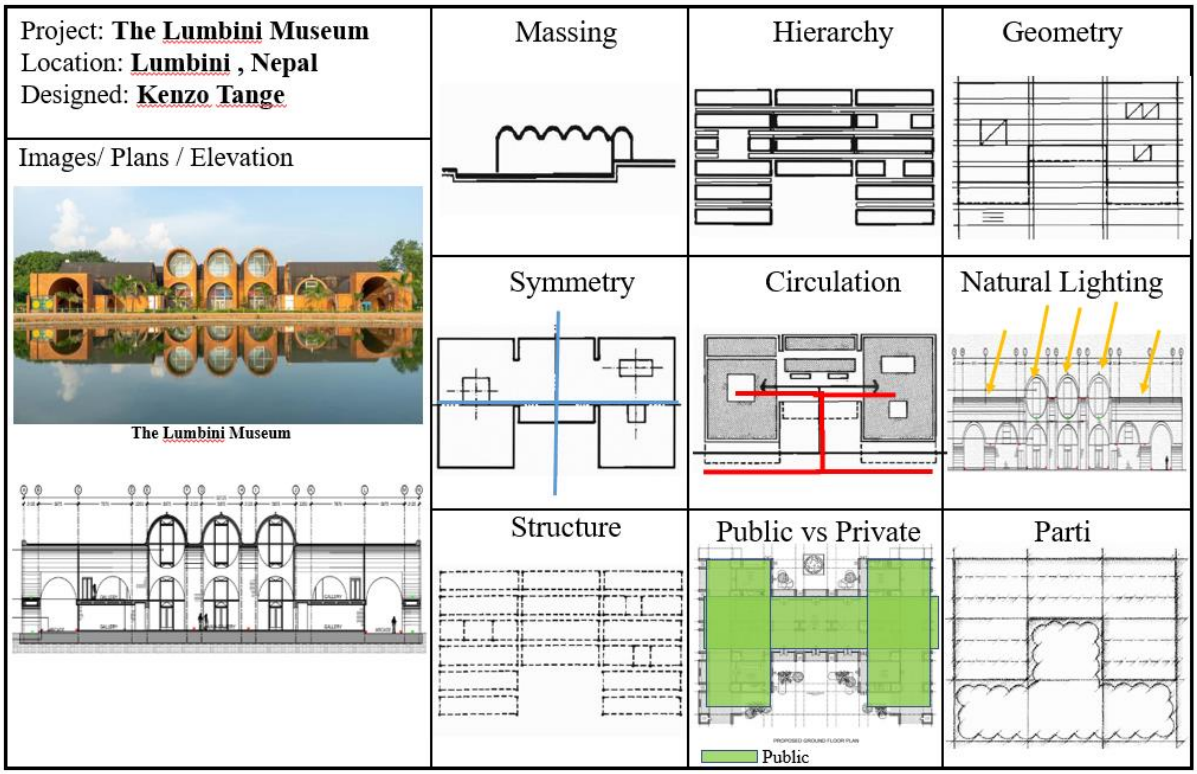


Figure 95: Precedents of Lubmini Museum Building, Analysis diagrams & Formative ideas

A structure's massing is represented as the most prominent or visually dominating three-dimensional arrangement of that structure. It reveals how the structure is viewed as a whole. A singular element can break apart a field or network that is made up of equal units connected in a predictable way. The distinctive features in the Lumbini Museum are open courts that break up the structural structure. Grids are created by repeating the fundamental geometries, and examples of these grids include simple grids.

5.3 Summary

	Saraswati Sadan	Lumbini Museum
Intro	**Bed Prasad Lohani** • Born: September 2, 1995 • Death: Tuesday, April 8, 2003 • An educationist and a technical man • A planner, and an Industrialist • An administrator and a spiritual thinker	**Kenzo Tange** In Osaka, Japan, Kenzo Tange was born in 1913. He went on to become one of the greats despite growing up in a farm home with a thatched roof. Le Corbusier's 1931 Villa Savoye and his five principles of architecture served as inspiration. The use of slender "piloti" columns, roofs that could serve as gardens or terraces, spacious interior spaces with few load-bearing walls, horizontal windows, and muted façade were the five points.
Design Inspirations	• First person to introduce concrete in Nepal. • Playing with a variety of elements in his buildings like RCC, RBC, dome etc. • Designed Saraswati Sadan, Ranjana Hall, Ashok Hall, Nepal House or Raja Rani Kothi for Padma Sumsher (Ranchi, India) and more.	• Built as a component of the Lumbini Master Plan, Tange was likely inspired by Carl Prushca's earlier work in Nepal • The Museum, the first modern museum dedicated to the Buddha and his birthplace, will serve as the focal point for visitors' experiences at Nepal's holiest site.

	Saraswati Sadan	Lumbini Museum
	• His signature design is what we see: the round portion in almost all the buildings he has designed.	• These revered tales will be brought to life by Lumbini Museum, offering a window into the breadth and depth of Buddhist doctrine.
Design Context	• The significant architectural structures that were originally built during the early modern period which would span from the 1940s through the 1960s. • These buildings are largely defined by the early use of reinforced cement concrete and greatly influenced by architectural and engineering designs that go beyond historicity. • Have elements of "modern" architecture, Is a good example of architecture from the early modern period.	• Few locations in the world are as regarded and hallowed as Lumbini. • The most famous archaeological, historical, cultural, and spiritual landmark in Nepal is the Sacred Garden of Lumbini. • In this backdrop, the Lumbini Museum, a cutting-edge institution, is being built inside the Sacred Garden Area for the first time.
Building Plan	• Curved front facade. • Design is simple, functional, and structurally stable. Have a hanging portico to prevent rain splutters.	• Design of the buildings is based on a barrel vaulted cylindrical modular style
Form	•Playing with a variety of elements in his buildings like RCC, RBC, dome etc.	• Inspired by the early vaulted Buddhist monasteries of Central Asia as the modules follow the same structural principle.

	Saraswati Sadan	Lumbini Museum
	•The round portion has designed. • Played with levels and light in the design	• Wide arches and vaults create higher floor height and clerestory windows, allowing more natural light and ventilation, which is particularly important in this hot climate area. • The configuration of each module is placed in such a way that it forms courtyard allowing cross ventilation.
Function	•Massive walls and deep beams have been used in order to give large spans. •Inverted beams have also been used to give a free-floating cantilever effect to the balconies. •He has tried to Play with levels and light in the design. •Skylights and clerestory windows have been used in order to allow natural diffused light to enter the building. • Light plays an important factor in the interior adding drama to the place	• The concept of a central square for social interaction, as well as public spaces like auditoriums and business areas. • There are more associations with the idea of the plaza and the promenade than with traditional Buddhist architecture. • purposefully incorporated "voids" into the architecture to permit growth and alteration throughout time, • Buildings and courtyards should have movable walls and facades so they can adapt to different uses as needed. • To adapt to future change, conversation areas, activity zones, and planned open space are provided.
Material	• Constructed with cutting-edge technology and materials,	Since many centuries, Chinese kiln-fired red bricks have replaced Dachi brick as the

	Saraswati Sadan	Lumbini Museum
	such as reinforced concrete and reinforced brick concrete • Use of reinforced cement concrete • New and innovative materials and technology • Design is simple, functional, and structurally stable	primary building material, giving the Kathmandu valley its distinct position among other Asian towns. Barrel vaults are made up of one brick on edge. Stone paved paths and courtyard Exposed brick masonry construction reflects essence of his work in the interplay of mass and void Use of brick cylindrical blocks fitted with large round windows reminds of vaults

CHAPTER 6. FIELD WORK - INTERVIEW

A. Topic: Approach of use of Geometry in modern architecture: A Study of its in Nepalese Architecture

Question for the Interviews:

Q.1.What is Role of geometry in architecture?

Q.2.What is your view on use of geometry in modern architecture in context of Nepal?

Q.3. As I am doing my case studies research on building such as Saraswati sadan by Bed Prasad Lohani and The Lumbini Museum by Kenzo Tange, so in your view does those building shows strong influence of geometry?

Q.4.In your view what is the important determinant one should focus to create a good composition of geometry in designing?

Q.5.Do you see in today's context a meaningful define building in perception of geometry in Nepal. If yes which building do you prefer?

6.1 Interview: Prof. Sudarshan raj Tiwari

Time Stamp: 2.00 P.M. – 5:15 P.M

Date: 05-07-2022

Prof. Sudarshan Raj Tiwari is an Architect & Co-Chair of Academic Council. Prof. Dr. Sudarshan Raj Tiwari, a senior conservation Architect has over 38 years of teaching experience in various subjects of architecture and urban planning. He also has experiences of occasional consultancies for UNDP and World Bank on project planning and supervision on education, health and environment. He has contributed several research and publications on history of Nepali architecture, urban development and culture. Education: PhD (in Culture from TU, 1995), M. Arch (in Tropical Architecture from Univ. Hawaii, 1977); B. Arch. (Univ. Delhi, 1973).

Approach to use of geometry in modern architecture coming from Vastu sastra and the traditional architecture. As all **architecture is defined from its dimension-measurements- (size, shape, proportion)**.

Immortals- Temple- glow energy went- never dies- so try to make a building it last long.

Mortal- it did not need to last long.

The building last longer-lasting- Nepalese architecture- temple.

Foreign- pyramid

God kings- 14th century- god-kings idea= they themselves god- so his house- strong- dimension aspect-

Mention in Vastu sastra about that temple- do not change its dimension. Even if Proportion is not perfect than it is used to believe in that god doesn't reside. It's just building not a temple.

How come geometry become such part in aesthetics?

Use of square- Egyptian, Maya civilization. **Circle and square such basic shape**. If we look at the sky all are circles. Planet, sun, moon

Philosophy of square- all architecture- perfect building-

Axiom- it is true. Since it is there so it is true. No need to prove it.

Mathematics form has been considered from the movement of universe. As observation and imagination are disputable. But mostly observation. From Circle to square axially has form. For Infinite, roundness good form and for the Finite - square form has been developed. As proportioning theory has been derived from- square. In Theory- it was already there. And to Observe. Physics- its physical phenomenon.

Inside Vastu sastra, **in geometry there is time and space theory**. While in designing one should consider space and time both while designing time exist from before we just observe.

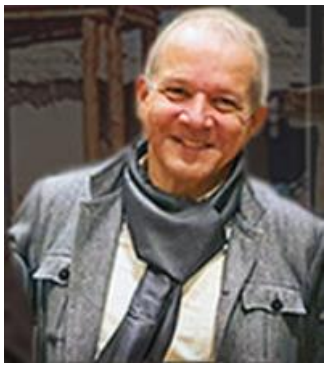
In universe- 1) earth space, 2) time 3) heaven one should always design and consider for three element which will fit in it. Modern architecture-geometry- **aesthetics**. Element as a character. **Architect- aesthetic appeal, functional appeal, structure appeal**

Geometry mainly does not mostly depend on **functionality but Structure and aesthetic appeal** do depend. Time, space, and heavenly arrangement are different. 25,920 special number.

6.2 Interview: Ar. Prabal Thapa

Time Stamp: 3:00 P.M. – 5:00 P.M

Date: 07-07-2022



Founder of Prabal Thapa Architect's which was establised in 2002. He has integrates sustainable design solutions, passive solar designs, with energy effectient and cost effective soultions in all projects. He has specializes in Rammed Earth Construction.

According to Ar. Prabal Thapa sir, **Material has influence the geometry in defining any Shape, Form, Scale and Proportion.** Talking about the Saraswati Sadan different from **the traditional**

Architecture but use of traditional material which is brick for the form which directly has define the geometry in context of form, shape etc. which also represent the **new modern architecture with the use of new modern technology and material** such as glass, concrete, inverted beam etc. RCC as a structural material influence during the period.

According to his opinion, to create a good composition **Geometry should be related to mainly proportion than scale, site context which should ultimately blend into surrounding whereas Shape and form are important for the traditional architecture.**

In his view now a day while designing for any building, surrounding or using any modern concept one should consider the carbon emission, climate and sustainability of the project.

6.3 Interview: Ar. Deepak Pant

Time Stamp: 3.00 P.M. – 5:30 P.M

Date: 08-07-2022

In architecture, there has always been an important role of geometry as ultimately everything depend on it. Abstraction has its limited value because it either historically deals with Vastu-Sastra along with geometry and architecture. Traditionally Geometry has been used differently, likewise Temple are in square form, as comparative more perfection which mainly depend on Square and Circle. Such as in Buddhism use of circle it has Spiritual value as before use as segregate geometry. Now- a- days anything that has been seen is used.

In present scenario, **Geometry not used directly but in biomimicry or use in natural form, use of geometry can be seen less.** Geometry is used ultimately in past, present and also be use in future. Certain measurement is always used in construction will always be followed. **Site Shape has mainly define geometry in context while following secular architecture where shape help to guide**. It helps how build form has guide the site context which response as the main factor.

Normally, the guiding factor will be site context and then internal planning and form. Geometry cannot be separated by building. In traditional settlement, use of abstraction of geometry were used like in Nepal context such as malla period, medival period etc. As for example, as in Patan which was considered as circular was indirectly has the concept of radial road whereas as of bhaktapur has square concept. Likewise, during the Lichhavi period, square of 9 square has been used which is as design along with the site context.

Topography can change the use of geometry as CEDA building is the example. Likewise, **Material also consider geometry**. Mostly to learn about the **Geometry, Islamic architecture will be the best to study as they have experimented different form, shape along with the scale and proportion to create a beautiful architecture** such as development of motif, decoration are been develop by floral, nature which can also be said ultimately guided by geometry which shows strong geometry. From the Islamic Architecture pattern which hence can be studied as complex geometry as arch came from Mughal whereas from Hindu came square and symmetry form.

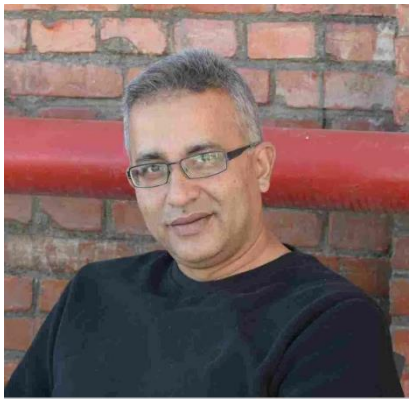
Traditional architecture very importantly depend upon proportion and scale. Apparently, talking about the Bed Prasad Lohani has shown a courage to build building as first concrete which has 9 feet cantilever as he has knowledge to carry the experiment and play with circular, rectangular form and shape structurally. So, it can also be said that during the time of pre early modern, architecture, there knowledge regarding concrete also brought to design with different form.

Before as due to knowledge of new material, new structure etc. gave the architect in pre early modern age gave freedom to express and experiment in context of geometry too. Use of new idea as bay window in concrete which also bring the material, technique which intend to bring new concept of vault, arch along with the use of strong sense of geometry too. In his view, Geometrical composition depend mainly on material and site context has it has help to emerge new form such as hexagonal, octagonal etc. which is possible with structural and material as structure knowledge and material has given freedom to the use geometry. Likewise, during the Lichhavi period, square of 9 square has been used which is as design along with the site context.

6.4 Interview: Ar. Arun Dev Pant

Time Stamp: 4.00 P.M. – 6:00 P.M

Date: 10-07-2022



Architect Arun Pant is the Owner of, Design Cell Pvt. Ltd. Design Cell Pvt. Ltd. was established by architects and planners having over 20 years of experience in the field. His firm was set up with the aim of bringing forth creative yet practical solutions to the architectural, interior design and planning scene. Contemporary building practice in most developing countries tends to relegate aesthetics to a secondary position - as priorities and focus are on the basic functions.

In Saraswati sadan, use of geometry definitely can be seen. As **symbolically geometry has played strong role**. But in **Nepali Architecture due to inherited, it is organic. So it is not defined by geometry but with site.** Geometry can be seen predisposed, forcefully done on site. In traditional geometry it can't be define as because it's too small but not too dominants. City growth are organic so it's limited. Nepali form and feel of geometry define by its Site but not strictly followed but in case of contemporary design, due to the large scale geometry come automatically.

Geometrical form are strongly seen in temple such as in Durbar Square where it is strongly portrait. Vertical geometry especially known as European geometry which is a reductionist such as clean circle, square, cube are not the perfect form of Nepali geometry. These contemporary buildings will not look good if we bring such as Carl Pruscha work like vault or as Kenzo Tange will not work. It is good for experiment on use form in contemporary basis to put them all in single line but it will be good in open area in order to make a good blend in space. Individual building can be done as they can be rectilinear bur cannot see rigid geometry but can break or fragmented.

Placement plays very important role in terrain whereas Scale is also more important than geometry putting in terrain with perfect edges geometry with the acrobatics open with the rigid type of geometry which imposition of pure geometry are avoided. It can

be done where is highly symbolic such as lumbini can be done but geometrical acrobatic are not possible or it's too disturbance to eye.

Human scale, proportion are the importance of geometry. According to Arun dev sir, whenever it is possible one should go for horizontally rather than vertically while designing. As Scale and proportion come from plan so it is directly dependent to plan, but functionally it can be possible to depend on vertically whenever it is considered whereas horizontally it depend upon the project.

After seeing settlement plan or else city plan than we can see fragmentation more than geometry which is the pure rigid geometry for the composition. Site and boundary such as terrain is contextualize to break the geometry. Architecture design cannot be possible if tried to design as classical because system depend upon the geometry which will fail to design.

If we can serialize our vision in context, than each vision component should be equally good that will help to define separate form and mass that should in the context. In western context we can visual the purest form of geometry but as if they also needed variety and they are breaking the form.

Lumbini Museum is the iconic building, international project that had to be iconic in Plan, Form, Scale which depend upon the site area. In modern context, normally to some extent improvement in Bishal bazar, Lalitpur Labim mall has contextually has done a good job as a composition to visualize modern building as design as non- air conditional along with the visual glimpse of interior and form which are appreciative which shows the concept of contemporary architecture. Kathmandu existing pressure and challenges has played a very important role on urban form, spaces for the development because of its anti-pure geometry. This is the contemporary example which shows how it has made pressurized on already built building for add on future building which depend upon or guided by site.

CEDA building design by Carl Pruscha in context of geometry is the best example as it has shown the pure form to feel comfortable. Where as in Lumbini Museum by Kenzo Tange has design in large open space in which pure geometry can be seen where as in clustered space which is close space pure geometry to be break in order to get good composition. Generally, **"Site context can play an important role or can be place**

regarding pure geometry regarding place making. But in context of urban infrastructure or urban scale breaking pure geometry will be best, overall from visual to function, consciously breaking of geometry."

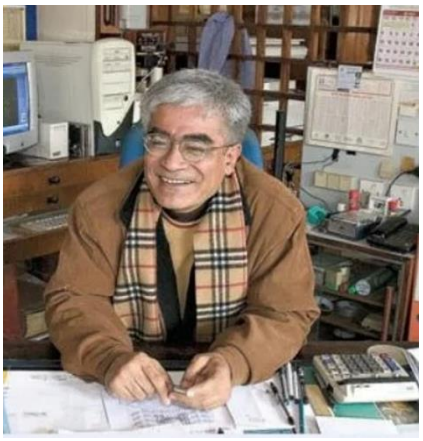
So we can study the building to understand the beauty, form and architecture of pure geometry. Similarly the fragmentation in the Taragaon Museum design by Carl Pruscha is more applicable to urban fabric. Eventually Geometry destroy the urban fabric of the building. This type can be played and design in open area but avoid to further proceed in heritage core area. In retrospect it been consider to avoid to do in large scale which is especially in contextual site. In his view mostly it Possibility of trying to blend with landscape the use of geometry.

Lastly in his view, Responsible architecture recognized the fact that don't depend upon geometry but anti geometry is most probability, as Nepal traditionally followed as per the pure form is concern.

6.5 Interview: Ar. Bibhuti Man Singh

Time Stamp: 4.00 P.M. – 5:55 P.M

Date: 10-07-2022



Source: spacesnepalblog.wordpress.com

Ar. Bibhuti man Singh best quoted line is "MY NEXT PROJECT WILL BE MY BEST ONE." Bibhuti man Singh was Graduated from the West Pakistan University of Engineering and Technology. He is the Chief Architect of Technical Interface. He was also the Former president of the Society of Nepalese Architects (SONA). Some of his famous design project are Park Village Resort, Budhanilkantha , Club Himalaya at Nagarkot, Himalayan Pavilion, Germany ,Hotel Dwarika, Battisputali etc.

"I didn't really do anything. All I did was to fit in the ancient pieces, collected over the years, in appropriate places, so that the Dwarikas hotel would have all required modern facilities; while at the same time retain traditional exteriors. But I do not take all the credit for the work done there; that goes to the client. Without his collection of artifacts, it would not have been possible. The 'body parts' of the design was ready, like old windows, door and century – old columns, which were a part of the traditional architecture." - Bibhuti man Singh

Talking about Role of Geometry in architecture, as all our Classical, Nepali Architecture are geometrical likewise classic shape such as Square, Circle etc. Basically come from square and circle. As **Circle is related to the earth natural shape, square is a man-made form of symbol**. Original **symbolism as define as square is essentially where temple in built form, circle are represented as stupa as stup which mean circle**. Likewise there are octagone and hexagone.

Especially, in temple post that we can see has started from square than to octagon and move upward as it can be seen converted to circle. Philosophically it mean Square turning into circle through the octagon. There is limited use in classical nepali architecture other than this square and circle shape been used. More over it is use in

international architecture and mostly in his context Louis I kahn design building can be seen use of geometry in its pure form.

Geometrical shape which are seen in form of vault, arch in building of taragaon museum which doesnot match our traditional architecture, its stark geometry shape. In context of Nepali Architecture, as far as in temple architecture is concern or budhhist architecture in stupa, circle in plan form can be seen including elevation, section can be seen.

Circle is used as an architype form which mean primitive and permiable form. So it is attractive such as dome, vault as its architype form.In building design by Kenzo Tange, Lumbini museum circle, arch, vault is not just following buddhism or spritual concern by it was fore most natural, universal symbol. As circle of even before the budhha, so was as a universal symbol representation, so it is an architypal shape. As circle is denoted as pure geometry. Circle is define as maximum area can be enclosed by minimum perimeter. Where as in Bed Prasad Lohani design not only in saraswati sadan building but also in ranjana hall, circular lobby new concept which was a strong attractive and implementation can be seen.

Dome, circular plan and the way main staircase is designed main inspired by classical form. Thr start of modernism can also be seen which can also said as departure from the temple architecture. As he was moreover attracted to square circle and also might be influence by the form. Geometry in his view doesnot have to depend upon site context or site surrounding.

Whereas in Lumbini museum, main circle which is 800 diameter is very powerful form along if seen by aerial image and the square which is 80 x 80 sq.m grid which is type of our human anatomy interpretation which has been emitted. As by looking for the functional purpose it was done to control flood that the river was running through. Its concept was to make a distinct view of square , grid , pond and circle to be visible.

Saraswati sadan plan form and mostly in lumbini can distinctly can see as they were inspire by pure form of geometry more than functional requirement and also moreover inspire from design in form.Good Geometrical composition on his view can be use of Architypal shape, form etc . Along with the most important part of human psychic and permiable form. It predets buddhism, hindusim etc everything is part of our biology.

The use of the architype most of square and circle is the most powerful, common that we can imagine. Ecludiean shape can be use to create a good architecture where functional requriement are made to meet so that a creative composition can be built or come out.

The building in present context which define a **good geometrical composition define** in his context is **the use of architypes and aslo inspire by architype** which is design in the Lumbini, where local architect also got chance to design or work during 1978 or 1979 as pilgrims accomodation, finance by srilanka for the tourist accomodation which has been designed by using architypal form of square and circle.To explain about the chronological order for the process of architecture style or from which it started seem to be as default. Defining about the traditional architecture, the materials such as brick, wood, tile etc when there was no choice. So it came by default. Similarly modern architecture is also seem to come as default.

According to his point of view **signature style for any architect is just unethical**, that seems ignoring context that is what architecture are not mean to be for. Always design should response to context as context has so many phases. **One should never ignore the physical context while designing such as contour, topography, shape of site because it play a strongest determitator or form for development country**.

According to him, one should always follows three principle while designing any building that are **Ecological Responsiveness, Civic Aim and Cultural Reference.**

6.6 Analysis

6.6.1 Codes for Analysis

Theme	Geometry	Structure	Material	Site Context	Planning
Code	Circle	Dimension	Aesthetic	Site surrounding	Vastu Sastra
	Square	Measurement	Technology	Topography	Modern Architecture

	Form	Function	Brick	Good Composition	Traditioanl Architecture
	Shape	Circulation	Traditional material	Open area	Space
	Basic Geometry	Inverted Beam	Embodied energy	Landscape	Fragment
	Proportion	Scale	Glass	Site Shape	Abstract
	Space	Cantilever	Concrete	Terrain	Secular Architecture
	Scale	Experiment	RCC	Contour	Inner Planning
	Fragment	Circular	Bay window	Site Boundary	Islamic Architecture
	Abstract	Rctangular	Visual	Open Space	arch
	Symbolic	Vault		Urban Fabric	Hexagonal
	ArchiType	rigid Geometry		Natural Shape	Octagonal
	Grid	urban Infrastructure		Physical Context	Organic
	Ecludiean shape	Dome			Contemporary Design
		Human Antomy			Placement
		Grid			Settlement Plan
		human psychic			

6.6.2 Coding From Interview

6.6.2.1 Interview 1: Prof. Sudarshan raj Tiwari

Code	Description
Basic Geometry	• Circle and square such basic shape • Mathematics form has been considered from the movement of universe. • For Infinite, roundness good form and for the Finite - square form has been developed. As proportioning theory has been derived from- square • Vastu sastra, in geometry there is time and space theory. • Designing one should consider space and time
Structure	• Architecture is defined from its dimension- measurements- (size, shape, proportion). • Element as a character. Architect- aesthetic appeal, functional appeal, structure appeal • Geometry mainly does not mostly depend on **functionality but Structure and aesthetic appeal** do depend.
Material	• Modern architecture-geometry- aesthetics
Site Context	……
Planning	• Vastu sastra and the traditional architecture. • The building last longer-lasting- Nepalese architecture- temple. • Mention in Vastu sastra about that temple- do not change its dimension • Designing one should consider space and time • In universe- 1) earth space, 2) time 3) heaven one should always design and consider for three element which will fit in it

6.6.2.2 Analysis from Interview 1

Interviewee	Geometrical Attributes		Pattern		Total
	Theme	**Code**	**Appreciate**	**Criticize**	
Prof. Sudarshan Raj Tiwari	**Geometry**	Circle	4		16
		Square	3		
		Form	1		
		Shape	2		
		Basic Geometry			
		Proportion	3		
		Space	2		
		Scale	1		
		Fragment			
		Abstract			
		Symbolic			
		ArchiType			
		Grid			
		Ecludiean shape			
	Structure	Size	1		7
		Dimension	2		
		Measurement	1		
		Function	2		
		Circulation			
		Inverted Beam			
		Scale	1		
		Cantilever			
		Experiment			
		Circular			
		Rctangular			
		Vault			
		Rigid Geometry			
		urban Infrastructure			
		Dome			
		Human Antomy			
		Grid			
		human psychic			
	Material	Aesthetic	1		2
		Technology			
		Brick	1		
		Traditional material			
		Embodied energy			
		Glass			
		Concrete			

		RCC			
		Bay window			
		Visual			
	Site Context	Site surrounding	1		1
		Topography			
		Good Composition			
		Open area			
		Landscape			
		Site Shape			
		Terrain			
		Contour			
		Site Boundary			
		Open Space			
		Urban Fabric			
		Natural Shape			
		Physical Context			
	Planning	Vastu Sastra	2		5
		Modern Architecture	1		
		Traditioanl Architecture	1		
		Space	1		
		Fragment			
		Abstract			
		Secular Architecture			
		Inner Planning			
		Islamic Architecture			
		arch			
		Hexagonal			
		Octagonal			
		Organic			
		Contemporary Design			
		Placement			
		Settlement Plan			

6.6.2.3 Interview 2: Ar. Prabal Thapa

Code	Description
Basic Geometry	• geometry in defining any Shape, Form, Scale and Proportion. • use of traditional material which is brick for the form • geometry in context of form, shape • Geometry should be related to mainly proportion than scale • Shape and form are important for the traditional architecture.
Structure	• use of new modern technology • inverted beam etc. RCC as a structural material
Material	• Material has influence the geometry in defining any Shape, Form, Scale and Proportion. • use of traditional material which is brick for the form • use of new modern technology and material
Site Context	• site context which should ultimately blend into surrounding • designing for any building, surrounding or using any modern concept one should consider
Planning	• Saraswati Sadan different from the traditional Architecture • new modern architecture with the use of new modern technology and material • Shape and form are important for the traditional architecture.

6.6.2.4 Analysis from Interview 2

Interviewee	Geometrical Attributes		Pattern		Total
	Theme	Code	Appreciate	Criticize	
Ar. Prabal Thapa	Geometry	Circle			10
		Square			
		Form	1		
		Shape	1		
		Basic Geometry	2		
		Proportion	3		
		Space			
		Scale	3		
		Fragment			
		Abstract			
		Symbolic			
		ArchiType			
		Grid			
		Ecludiean shape			
	Structure	Size			2
		Dimension			
		Measurement			
		Function			
		Circulation			
		Inverted Beam			
		Scale	2		
		Cantilever			
		Experiment			
		Circular			
		Rctangular			
		Vault			
		Rigid Geometry			
		urban Infrastructure			
		Dome			
		Human Antomy			
		Grid			
		human psychic			
	Material	Aesthetic			7
		Technology	2		
		Brick	1		
		Traditional material	1		
		Embodied energy			
		Glass	1		
		Concrete	1		

		RCC	1		
		Bay window			
		Visual			
	Site Context	Site surrounding	1		3
		Topography			
		Good Composition			
		Open area			
		Landscape	1		
		Site Shape			
		Terrain			
		Contour			
		Site Boundary			
		Open Space			
		Urban Fabric			
		Natural Shape	1		
		Physical Context			
	Planning	Vastu Sastra			4
		Modern Architecture	2		
		Traditioanl Architecture	2		
		Space			
		Fragment			
		Abstract			
		Secular Architecture			
		Inner Planning			
		Islamic Architecture			
		arch			
		Hexagonal			
		Octagonal			
		Organic			
		Contemporary Design			
		Placement			
		Settlement Plan			

6.6.2.5 Interview 3: Ar. Deepak Pant

Code	Description
Basic Geometry	• In architecture, there has always been an important role of geometry • Temple are in square form, • perfection which mainly depend on Square and Circle • Buddhism use of circle it has Spiritual value • Geometry not used directly but in biomimicry or use in natural form • Shape has mainly define geometry in context • Islamic architecture will be the best to study as they have experimented different form, shape along with the scale and proportion to create a beautiful architecture • it has help to emerge new form such as hexagonal, octagonal etc.
Structure	• Certain measurement is always used in construction will always be followed • first concrete which has 9 feet cantilever as he has knowledge to carry the experiment and play with circular, rectangular form and shape structurally • Use of new idea as bay window in concrete which also bring the material, technique which intend to bring new concept of vault, arch along with the use of strong sense of geometry • structural and material as structure knowledge
Material	• Material also consider geometry • knowledge regarding concrete also brought to design with different form • Use of new idea as bay window in concrete which also bring the material, technique which intend to bring new

Code	Description
	concept of vault, arch along with the use of strong sense of geometry • Geometrical composition depend mainly on material and site context • material has given freedom to the use geometry.
Site Context	• build form has guide the site context which response as the main factor. • guiding factor will be site context and then internal planning and form • Topography can change the use of geometry • Geometrical composition depend mainly on material and site context • square of 9 square has been used which is as design along with the site context
Planning	• historically deals with Vastu-Sastra along with geometry and architecture • Traditionally Geometry has been used differently, • In traditional settlement, use of abstraction of geometry were used like in Nepal context • Islamic Architecture pattern which hence can be studied as complex geometry as arch came from Mughal whereas from Hindu came square and symmetry form. • Traditional architecture very importantly depend upon proportion and scale

6.6.2.6 Analysis from Interview 3

Interviewee	Geometrical Attributes		Pattern		Total
	Theme	Code	Appreciate	Criticize	
Ar. Deepak Panta	Geometry	Circle	1		13
		Square	1		
		Form	3		
		Shape	2		
		Basic Geometry	1		
		Proportion	2		
		Space			
		Scale	2		
		Fragment			
		Abstract			
		Symbolic			
		ArchiType			
		Grid	1		
		Ecludiean shape			
	Structure	Size			7
		Dimension			
		Measurement	1		
		Function			
		Circulation			
		Inverted Beam			
		Scale	2		
		Cantilever			
		Experiment	1		
		Circular	1		
		Rctangular	1		
		Vault			
		Rigid Geometry			
		urban Infrastructure			
		Dome			
		Human Antomy			
		Grid	1		
		human psychic			
	Material	Aesthetic			6
		Technology			
		Brick	1		
		Traditional material	1		

		Embodied energy			
		Glass	1		
		Concrete	1		
		RCC			
		Bay window	1		
		Visual	1		
	Site Context	Site surrounding	1		7
		Topography	1		
		Good Composition	2		
		Open area	1		
		Landscape	1		
		Site Shape			
		Terrain			
		Contour			
		Site Boundary			
		Open Space			
		Urban Fabric			
		Natural Shape	1		
		Physical Context			
	Planning	Vastu Sastra	1		13
		Modern Architecture	1		
		Traditioanl Architecture	3		
		Space	1		
		Fragment			
		Abstract			
		Secular Architecture	1		
		Inner Planning	1		
		Islamic Architecture	1		
		arch	1		
		Hexagonal	1		
		Octagonal	1		
		Organic	1		
		Contemporary Design			
		Placement			
		Settlement Plan			

6.6.2.7 Interview 4: Ar. Arun Dev Pant

Code	Description
Basic Geometry	• Saraswati sadan, use of geometry definitely can be seen. • symbolically geometry has played strong role. • Nepali form and feel of geometry • Geometrical form are strongly seen in temple such as in Durbar Square where it is strongly portrait • circle, square, cube are not the perfect form of Nepali geometry • Human scale, proportion are the importance of geometry • form which are appreciative which shows the concept of contemporary architecture. • urban form, spaces for the development because of its anti-pure geometry • geometry is the best example as it has shown the pure form to feel comfortable • the building to understand the beauty, form and architecture of pure geometry
Structure	• Vertical geometry especially known as European geometry which is a reductionist • good for experiment on use form in contemporary basis • Individual building can be done as they can be rectilinear but cannot see rigid geometry but can break or fragmented • one should go for horizontally rather than vertically while designing • functionally it can be possible to depend on vertically whenever it is considered whereas horizontally • vision component should be equally good that will help to define separate form and mass that should in the context.

Code	Description
	• visual the purest form of geometry • But in context of urban infrastructure or urban scale breaking pure geometry will be best, overall from visual to function, consciously breaking of geometry • Geometry destroy the urban fabric of the building
Material	…….
Site Context	• it is organic. So it is not defined by geometry but with site • Geometry can be seen predisposed, forcefully done on site • Nepali form and feel of geometry define by its Site • Placement plays very important role in terrain • geometry with the acrobatics open with the rigid • Site and boundary such as terrain is contextualize to break the geometry. • Plan, Form, Scale which depend upon the site area. • design in large open space in which pure geometry can be seen • Site context can play an important role or can be place regarding pure geometry regarding place making. But in context of urban infrastructure or urban scale breaking pure geometry will be best, overall from visual to function, consciously breaking of geometry • design in open area but avoid to further proceed in heritage core area • Possibility of trying to blend with landscape the use of geometry
Planning	• symbolically geometry has played strong role. • Nepali Architecture due to inherited, it is organic • traditional geometry it can't be define as because it's too small but not too dominants

Code	Description
	• contemporary design, due to the large scale geometry come automatically. • Scale and proportion come from plan so it is directly dependent to plan • settlement plan or else city plan than we can see fragmentation more than geometry which is the pure rigid geometry for the composition • contextually has done a good job as a composition to visualize modern building as design • clustered space which is close space pure geometry to be break in order to get good composition

6.6.2.8 Analysis from Interview 4

Interviewee	Geometrical Attributes		Pattern		Total
	Theme	Code	Appreciate	Criticize	
Ar. Arun Dev Panta	Geometry	Circle	1		36
		Square	1		
		Form	7		
		Shape	3		
		Basic Geometry	1		
		Proportion	5		
		Space	1		
		Scale	7		
		Fragment	8		
		Abstract			
		Symbolic	2		
		ArchiType			
		Grid			
		Ecludiean shape			
	Structure	Size			12
		Dimension			
		Measurement			
		Function	1		
		Circulation	1		
		Inverted Beam			
		Scale	5		

		Cantilever			
		Experiment	1		
		Circular			
		Rctangular	1		
		Vault			
		Rigid Geometry		2	
		urban Infrastructure	1		
		Dome			
		Human Antomy			
		Grid			
		human psychic			
	Material	Aesthetic	1		3
		Technology	1		
		Brick			
		Traditional material			
		Embodied energy			
		Glass			
		Concrete			
		RCC			
		Bay window			
		Visual	1		
	Site Context	Site surrounding	2		15
		Topography	1		
		Good Composition			
		Open area	2		
		Landscape			
		Site Shape	1		
		Terrain	2		
		Contour			
		Site Boundary	1		
		Open Space	1		
		Urban Fabric	2		
		Natural Shape	2		
		Physical Context	1		
	Planning	Vastu Sastra			21
		Modern Architecture	2		
		Traditioanl Architecture	4		
		Space	2		
		Fragment	8		
		Abstract			
		Secular Architecture			
		Inner Planning	1		

		Islamic Architecture			
		arch			
		Hexagonal			
		Octagonal			
		Organic	1		
		Contemporary Design	1	1	
		Placement			
		Settlement Plan	1		

6.6.2.9 Interview 5: Ar. Bibhuti Man Singh

Code	Description
Basic Geometry	• Nepali Architecture are geometrical likewise classic shape such as Square, Circle • square is a man-made form of symbol • symbolism as define as square is essentially where temple in built form, circle are represented as stupa as stup which mean circle • Square turning into circle through the octagon. • international architecture and mostly in his context Louis I kahn design building can be seen use of geometry in its pure form • Circle is used as an architype form • spritual concern by it was fore most natural, universal symbol • **circle is denoted as pure geometry** • distinct view of square , grid , pond and circle to be visible. • Ecludiean shape can be use to create a good architecture
Structure	• temple post that we can see has started from square than to octagon and move upward as it can be seen converted to circle

Code	Description
	• Geometrical shape which are seen in form of vault, arch in building • dome, vault as its architype form • Circle is define as maximum area can be enclosed by minimum perimeter • square which is 80 x 80 sq.m grid which is type of our human anatomy interpretation • inspire by pure form of geometry more than functional requirement • functional requriement are made to meet so that a creative composition can be built
Material	• materials such as brick, wood, tile etc when there was no choice. So it came by default
Site Context	• Circle is related to the earth natural shape • Geometry in his view doesnot have to depend upon site context or site surrounding • functional purpose it was done to control flood that the river was running through • signature style for any architect is just unethical, that seems ignoring context that is what architecture are not mean to be for • One should never ignore the physical context while designing such as contour, topography, shape of site
Planning	• Nepali Architecture are geometrical likewise classic shape such as Square, Circle • limited use in classical nepali architecture other than this square and circle shape been used

Code	Description
	• Nepali Architecture, as far as in temple architecture is concern or budhhist architecture in stupa, circle in plan form can be seen including elevation, section can be seen. • circular lobby new concept which was a strong attractive and implementation can be seen. • Dome, circular plan and the way main staircase is designed main inspired by classical form • modern architecture is also seem to come as default.

6.6.2.10 Analysis from Interview 5

Interviewee	Geometrical Attributes		Pattern		Total
	Theme	Code	Appreciate	Criticize	
Ar. Bibhuti Man Singh	Geometry	Circle	5		24
		Square	4		
		Form	4		
		Shape	3		
		Basic Geometry			
		Proportion			
		Space			
		Scale			
		Fragment			
		Abstract			
		Symbolic	3		
		ArchiType	5		
		Grid			
	Structure	Size			10
		Dimension			
		Measurement			
		Function	2		
		Circulation			
		Inverted Beam			
		Scale	1		
		Cantilever			
		Experiment			

		Circular	1		
		Rctangular			
		Vault	1		
		Rigid Geometry			
		urban Infrastructure			
		Dome	2		
		Human Antomy	1		
		Grid	1		
		human psychic	1		
	Material	Aesthetic	1		3
		Technology			
		Brick	1		
		Traditional material	1		
		Embodied energy			
		Glass			
		Concrete			
		RCC			
		Bay window			
		Visual			
	Site Context	Site surrounding			8
		Topography	1		
		Good Composition	2		
		Open area			
		Landscape			
		Site Shape	1		
		Terrain			
		Contour	1		
		Site Boundary			
		Open Space			
		Urban Fabric			
		Natural Shape	2		
		Physical Context	1		
	Planning	Vastu Sastra			6
		Modern Architecture	1		
		Traditioanl Architecture	3		
		Space			
		Fragment			
		Symbol			
		Secular Architecture			
		Inner Planning			
		Islamic Architecture			
		arch			

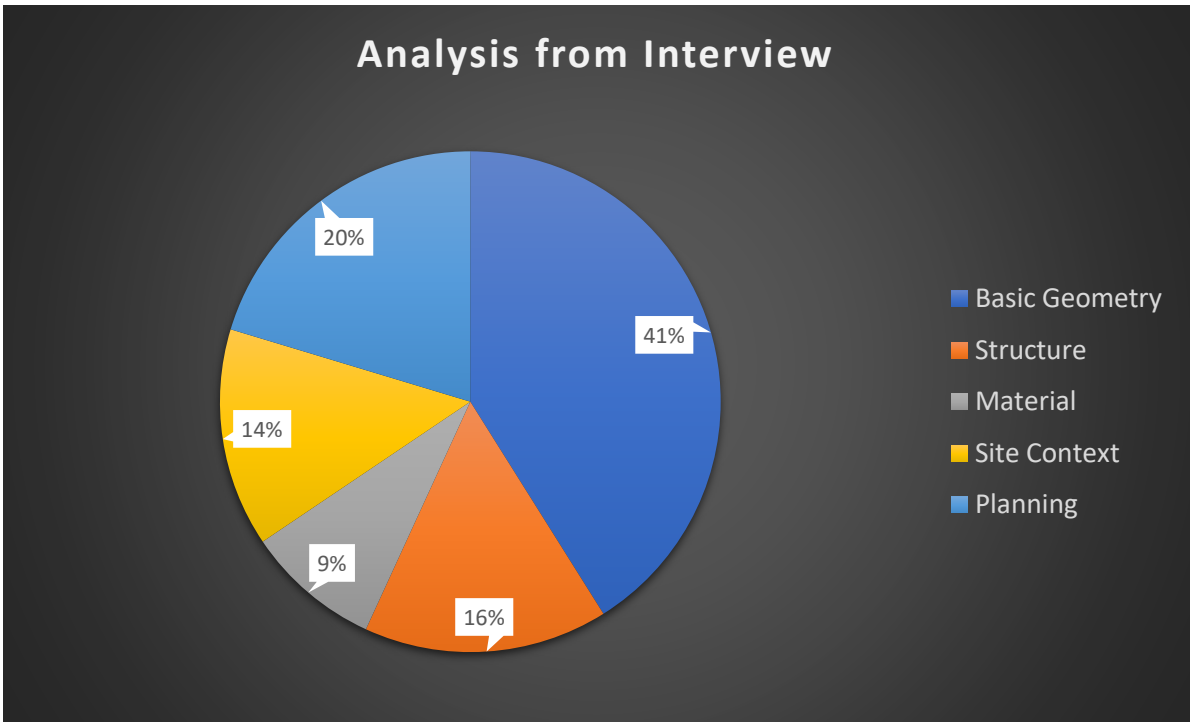
		Hexagonal	1		
		Octagonal	1		
		Organic			
		Contemporary Design			
		Placement			
		Settlement Plan			

6.6.3 Frequency Measure from Interview Review

Geometrical Attributes					
Interviewee	**Basic Geometry**	**Structure**	**Material**	**Site Context**	**Planning**
Prof. Sudarshan Raj Tiwari	16	7	2	1	5
Ar. Prabal Thapa	10	2	7	3	4
Ar. Deepak Panta	13	7	6	7	13
Ar. Arun Dev Panta	36	12	3	15	21
Ar. Bibhuti Man Singh	24	10	3	8	6
Total	99	38	21	34	49

6.6.4 Analysis from Interview Review

Geometrical Attributes	**Interview Review**	**Total**
Basic Geometry	41%	99
Structure	16%	38
Material	9%	21
Site Context	14%	34
Planning	20%	49
Overall Total		241



6.6.5 Coding From Literature Study

Code	Description
Basic Geometry	• Geometry gives us the ability to easily actualize geometrically designed shapes. • Point, line, plane, fundamental geometric forms (circles, triangles, and squares), angles, solids (cones, spheres, and cubes), and other topics are all of importance to geometry. • pyramids and tombs were constructed utilizing triangles, rectangles, and squares as geometric shapes. • The squares from the golden section subdivision diagram are in golden section proportion to each other (Elam, 2001). • Architecture's form encompasses more than only the use of space and the activities that take place there. • The majority of architects in the Modern and Postmodern Movements used Euclidean geometry and geometric concepts to create and articulate form.

Code	Description
	• proportions and symmetry along with basic shapes and forms, serves as basic tools for architectural design • The connection between pieces and a whole is described by **proportion**
Structure	• It can offer everyone a sense of divinity by the simple presence of the undeniable and perfection of the geometric shapes. *(Antoniades, 1992)* • occasionally believed to have a symbolic or aesthetic influence on design • The abilities of the structures are also improved by the advancement of the fundamental geometric forms • Serve as the foundation for many other architectural elements, including pyramids, patterns, and prisms. Equilateral, equiangular, and symmetrical describe regular polygon • The regular polygon may turn into a prism if height and thickness are added to it (Yilmaz, 1999). • To construct another geometric form, the patterns can be rotated, transposed, overlapped, interlaced, and interlocked with other shapes. • diameter of the temple columns served as the basis for a proportional system measurements of masses and the spatial intervals were calculated by multiplication and division • Equilateral triangles and squares were often employed by architects to create structures • Squares and triangles were the primary construction materials • systems of proportions have assisted the technical and aesthetic requirements of a design

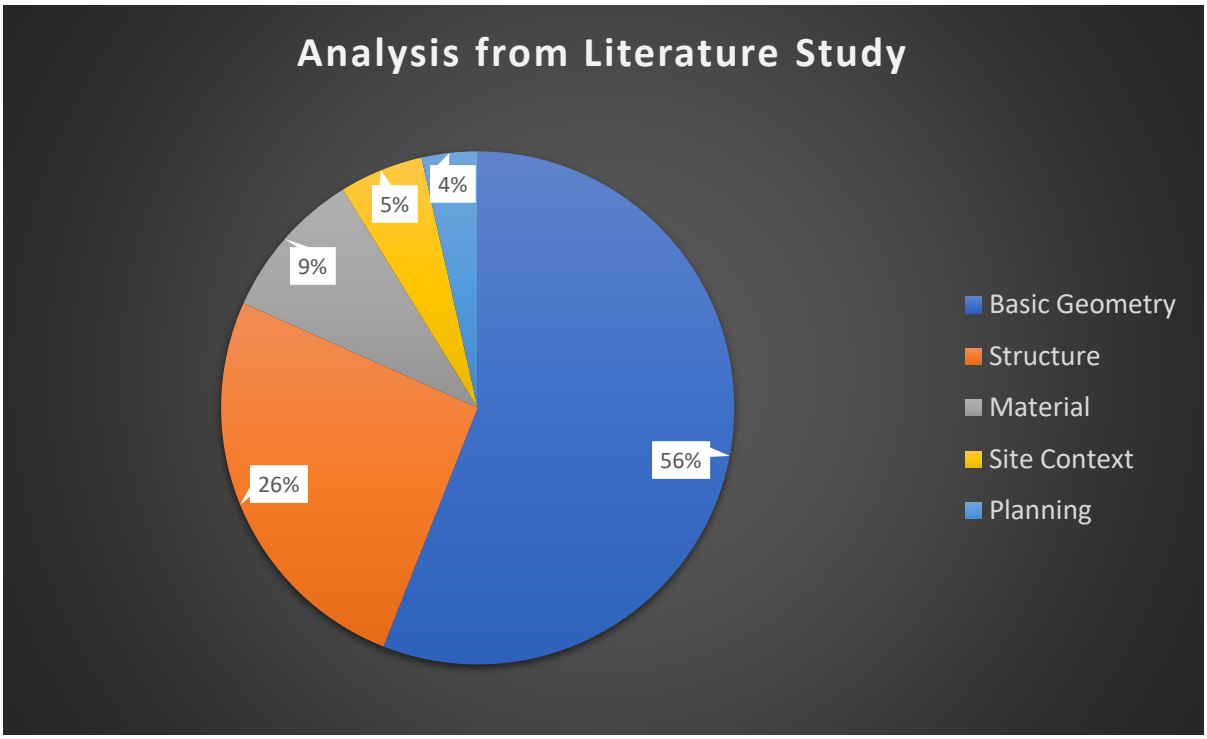
Code	Description
	• concept of structure communicates a sense of form that is more procedural than epistemic. • These planes' combined arrangement in an architectural design will be used to characterize the building's overall shape and massing (Yilmaz, 1999).
Material	• For evaluate the architectural shape Organization (dependent on the laws of static and the strength of materials) • A Stone Circle makes a people pattern permanent • geometry or structure, whether it is the timber structure of a medieval high-resolution remote sensing or the steel structure of a micro-electronics plant, is included in the geometry to make.
Site Context	• According to Alberti, mathematical order serves as the foundation for both the divine order and any order that may be attained in the physical world. • place of Idea as the prevailing form paradigm throughout the transition from the eighteenth to the nineteenth century • idea of an interior shape covered in adornment was how the architectural form was conceptualized • early 20th century, the psychology of form proposed a relationship between the real shape of an item and an objective form (constructs in the mind). • An idea for a three-dimensional design can exist in the mind before taking physical form. • A position in space is indicated by a point. They are used to designate a location on the ground plane or in space. • One of line's aesthetic characteristics is that it serves as the main way to define space.

Code	Description
	• plane is used in the production of visual construction to indicate the borders or limitations of a volume • Shape is the distinctive contour of a flat figure or the arrangement of a volumetric form's surface. • From Mies to Corbusier to Wright, all of the Modern Movement's architects treated space as a logical condition in which geometry, generic volumes, • Basic geometrical forms and proportions were seen in nature. • Geometries, on the other hand, come through our interactions with the environment as a way of defining location • A line of sight makes interaction between locations when thinking of architecture as place identification.
Planning	• In accordance with organizational principles, architects created things and created building shapes using these fundamental components • Modular grids that are square, rectangular, triangular, or circular have been utilized by architects to expand them into three dimensions • arches, stone monuments, and amphitheaters were built using circles and semicircles. • used squares, triangles, and circles to build their homes and barns • The architects and builders add or remove squares and triangles to alter the shape and appearance of the buildings. • Every structure was composed of either free space or forms. The doors and windows in the open area are formed by the forms (Yilmaz, 1999).

Code	Description
	• The "Modulor" by Le Corbusier is an example of an architectonic notion of planning and producing according to geometric laws in contemporary architecture, although it is nevertheless constrained by the traditional conception of harmony (Leopold, 2006). • Architecture's form encompasses more than only the use of space and the activities that take place there. • Geometry not only plays role in the designing of the building but also becomes a part of the aesthetics of the building.

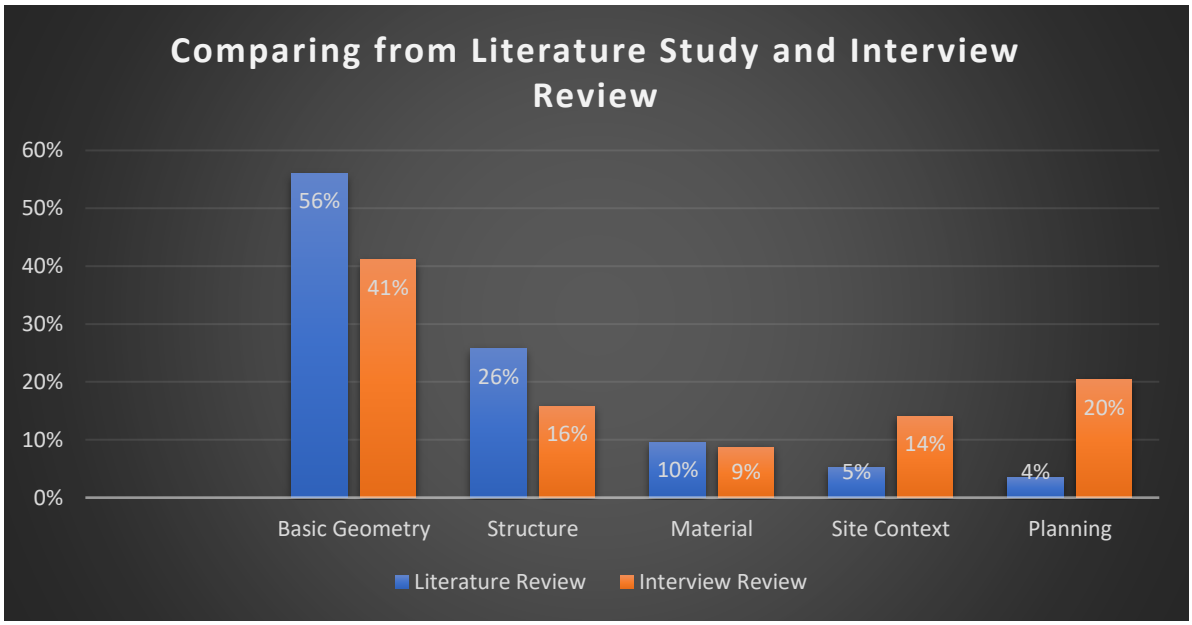
6.6.6 Analysis from Literature Study

Geometrical Attributes	Literature Review	Total
Basic Geometry	56%	159
Structure	26%	73
Material	10%	27
Site Context	5%	15
Planning	4%	10
Overall Total		284



6.6.7 Comparing from Literature Study and Interview Review

Geometrical Attributes	Literature Review	Interview Review
Basic Geometry	56%	41%
Structure	26%	16%
Material	10%	9%
Site Context	5%	14%
Planning	4%	20%



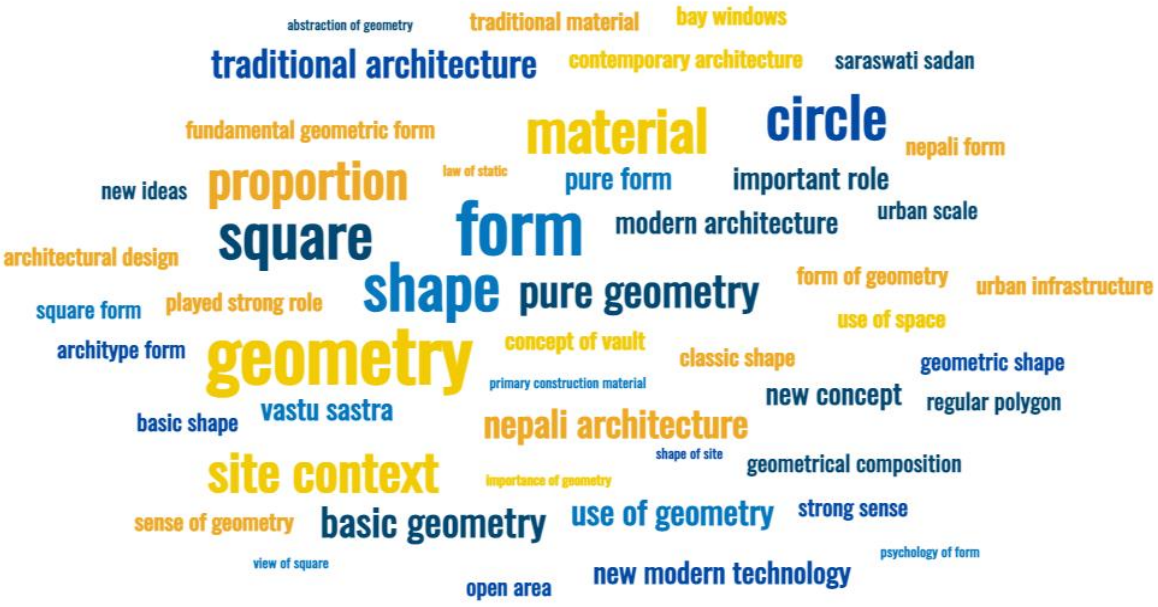


Figure 96: Word cloud generated from participant interview information and Literature Study

CHAPTER 7. FINDINGS AND DISCUSSIONS

7.1 Key Finding

- In context of case area study Lumbini Museum and in Saraswati Sadan, Geometry is used for taking intangible concepts and ideas and establishing them in built environment by the use of the Geometric Principals in the buildings.
- Geometry in Lumbini Museum and in Saraswati Sadan, is also used for pattern making for using Geometric forms and shapes in Plan/ Elevation development.
- Geometric Principals that are included in Lumbini Museum and in Saraswati Sadan, can be seen as the Space for an object / building / user such as built as library which is curved in front façade in saraswati sadan. Visual connection established by user and the environment in Lumbini Museum which is help by the site context and environment. Scale and proportion with reference to users and proportions of forms to one another in Lumbini Museum. Forms with reference to the function of the shape also depend upon the geometrical shape of symbolism in Lumbini Museum. Form development by material's also represent in Geometry which define as use of brick, vault and arch in Lumbini Museum and reinforced concrete and reinforced brick concrete and technology for the structure as inverted beam along with used to give a free-floating cantilever in Saraswati Sadan use of Proportions to achieve pleasing forms and shapes which has been considered by Kenzo Tange while designing The Lumbini Museum. Built Form can be developed with reference to material by using new and innovative materials and technology including reinforced concrete and reinforced brick concrete to define geometry in building in context of structural form as in saraswati sadan.
- From the analysis of the literatures and interviews, the concept of geometry in modern architecture in context of Nepal can be defined as a style of architecture that makes use of modern materials and technology along with the site context and shape. Architects seem to be not aware about geometry of design and also not yet being able to come up with unique geometric concept. The concept of modem geometry has potential value in describing and helping us to understand some of the geometrical relationships within buildings. While traditional

geometry offers a fixed system to describe everything in nature, in the modem geometry there is a gradual transformation of space from pure, static to composite and dynamic.

7.2 Discussion

The study demonstrates a correlation between the geometry in early modern architecture in Nepal using different types of material to create building that easily fits into surrounding along with site context, form and style. As Nepal has kept a variety of architectural styles, all of which are united by a common constructional pattern and material palette and are brought together by a single function. Bricks were frequently employed, and they were artistically carved into the windows and doors in addition to being sun and kiln burned on timber posts and beams. It was recommended to use symmetry, such as axial and radial symmetry. Architecture cannot only be functional, structural and aesthetical but can stand the test of time and thus be timeless.

Geometry is not used directly but in biomimicry or use in natural form, use of geometry can be seen less. Site Shape has mainly defined geometry in context while following secular architecture where shape help to guide as topography can change the use of geometry. Generally, traditional architecture depends upon proportion and scale.

Nepali Architecture due to inherited, is organic. So it is not defined by geometry but with site. Geometrical form are strongly seen in temple such as in Durbar Square where it is strongly portrait. Vertical geometry especially known as European geometry which is a reductionist such as clean circle, square, cube is not the perfect form of Nepali geometry. **"Site context can play an important role or can be place regarding pure geometry regarding place making. But in context of urban infrastructure or urban scale breaking pure geometry will be best, overall, from visual to function, consciously breaking of geometry."** Saraswati sadan plan, form and mostly in lumbini museum were inspired by pure form of geometry more than functional requirement and also inspired from design in form.

Prior to modern times, pure geometry was combined with many forms and shapes that were employed in conjunction with the material. The architect in the pre-early modern

era had the flexibility to express themselves and experiment with geometry because of knowledge of new materials, constructions, etc. Not only does geometry help define the building's form or shape, but it also has a significant impact on how the building's interior is organized. I believe that having a formal logic or geometry is essential for any architect since it allows for the development of aesthetics, formal ideas, and rhythm. Design is indeed based on geometry. Architectural design now incorporates geometry for extra aesthetic, symbolic, and philosophical value. Elements of geometry, in my opinion, are the most basic varieties of geometry, appearing from the earliest historical eras to the present.

CHAPTER 8. CONCLUSION

According to Jonner Kepler, Geometry is the archetype of the beauty of the world. It is a tool for Architect, it can be adopted to be imposed over the landscape and create monumental structures with the spirit of leaving an imprint. It can also emerge out of the conditions of being and conditions posed by the surroundings.

There is geometry in everything, whether it is in its purest form or not. Designing requires a thorough understanding of geometry. Each architect uses their own unique geometry in their projects. Contemporary geometric principles provided architects fresh suggestions for creating formal and spatial settings. In addition to defining the building's form or shape, geometry is crucial in defining the building's interior space. I believe it is essential for any architect to possess formal logic or geometry since it allows for the development of aesthetics, formal ideas, and rhythm. The foundation of design is geometry. Yet, architects only use geometry, and very rarely come up with new concepts in geometry. Architects do not produce geometry they only consume it. Architects seem to be not aware about geometry of design and also not yet being able to come up with unique geometric concept.

The study also helps to gather the idea about the use of geometry, which has also been used as design tool since the very beginnings of architecture. The study also concludes that the post 50s- 60s buildings were designed mainly by internal or foreign trend architects with not only strong Bauhuas Influence but also the history which acts as determinant or characteristic in buildings along with drawing from local architectural context. A formative idea which help to understand the concept which a designer has use to influence or give form to a design. The ideas offer ways to organize decisions, to provide order, and to consciously generate form. In order to communicate the analysis of the buildings and the formative ideas in this study, a diagram that are used, as abstractions that intended to convey essential characteristics and relationships in a building. As such, the diagrams help in focusing on specific physical attributes which allow for the comparison of that attribute between buildings independent of style, type, function, or time.

Lastly, it also serves as a new concept to future researchers in this field and all the architect to examine the use of different analysis technique that focuses on a way of

thinking about architecture that emphasizes what is in essence the same, rather than different and also hope to pursue archetypal ideas that might aid in the generation of architectural form.

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Annex I: IOE Graduate conference paper

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Date: September 25, 2022

To Whom It May Concern

This is to confirm that the paper titled "*Geometry and Postmodern Architecture in Nepal*" submitted by **Aditi Jaiswal** with Conference ID **12115** has been accepted for presentation at the 12th IOE Graduate Conference being held in October 19 – 22, 2022 at Thapathali Campus, Kathmandu.

Khem Gyanwali, PhD
Convener,
12th IOE Graduate Conference

IOE Graduate Conference
[Placeholder for Publication Information]

Geometry in Modern Architecture and Postmodern Architecture in Nepal

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Abstract
Geometry, as a science of measurement and properties of space has its origins in human observation and the need to measure land. In architecture, the study of geometry led to development of new mathematical tools which was made applicable to design of buildings. Modern architecture is a growing field with a number of sub-genres that have evolved over time. Classifications vary according to style and philosophy. One common characteristic among modern architects is the use of geometry not only for aesthetics but also for structure. This article sheds light on how geometry had a significant part in developing early Nepali modern architecture in terms of forming the formative notion in which the principles of plane and solid geometry are employed to establish architectural form. The objective of this research was to examine the use of different geometry in shaping early Nepali modern architecture in terms of determining the form in a given social political context. Qualitative research method was used to investigate he use of geometry context in selected buildings design in a given socio-political since 1950s.The method mainly included the study of drawings, documents and record along with literature review. The research highlights a initial notion from the Bauhaus movement that helped to define formal archetypal structures or formative concepts through which architecture may develop. The study concludes that the post 50s buildings were designed mainly by foreign trend architects with not only strong Bauhaus influence but also the history which acts as determinant or characteristic in buildings along with drawing from local architectural context.

Keywords
Geometry, modern context, shaping

1. Introduction

According to Jonner Kepler, Geometry is the archetype of the beauty of the world. Geometry (from the Ancient Greek: Geo- "Earth", Metron "Measurement" is a branch of mathematics concerned with questions of shape, size, relative position of figures, and properties of space [1]. Geometry plays a role in Architecture in many ways. It is a tool for Architect, it can be adopted to be imposed over the landscape and create monumental structures with the spirit of leaving an imprint. It can also emerge out of the conditions of being and conditions posed by the surroundings [2].

In Architecture Geometric ideas play a multifold role; as abstract ideas they belong in the category of ideal geometric their perfection can be imposed on the physical fabric of the world as a means for identifying place. They can even emerge, is a reaction to the landscape or constraints [3]. More so, This Geometric way of thinking can be traced from classical antiquity in the form of books and teachings all the way to a Modern context. This research will focus on how geometry is transformed into an architectural design language in such a way that it examines how the components of geometry combine to create a grammar of meaning for a complete architectural composition [1].

Geometry is a branch of mathematics that deals with shapes, forms, and measurements, and visual thinking predominates. Geometry invented by man. Human language is geometric and is used in many different ways. A visual dictionary of architecture as defined by Francis D.K. Geometry is a tool invented by people to perceive the outside World and represent the inside world. Different types of geometry, such as spherical

and bin curves, have been found to be applied to reality for the 19th century [4]. Perspective, Projection Geometry, Decomposition Shape, Trigonometry, Differential Geometry, Topology, Fractal Geometry, etc. are examples of additional types of geometry developed over time. Renaissance architect emphasized the percentage of views from the perspective of views as well as Alberti. Le Corbusier emphasized the modular ratio using the modular expression according to the gold relationship [1].

The necessity to define the relationship between history and design has been brought to light by the resurgence and growth of interest in architectural history and historic architectural examples.When we study history in the academic sense of understanding where we fit into a certain timeline or in the academic sense of understanding the past, we may end up knowing nothing more about the past as architects than names, dates, and recognized styles. If one can look through and outside of the layers of classical architecture, inside which architecture is frequently classified and presented, history may be a source of richness for architectural design.

In this work, a theory that goes beyond the present and discloses an architectural concept is sought after. Building inspection and analysis are the method used in this search. The development of theory to provide concepts for architectural design is the intended outcome [2].

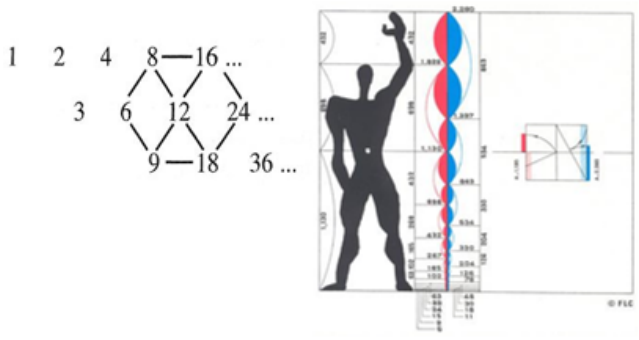

Figure 1: Alberti's system of musical proportions and Le Corbusier's The Modular

Today, the world is experiencing a huge shift in the way people live, think, and express themselves. This cultural phenomenon is known as postmodernism. While modernism was fairly rigid and focused on functionality, postmodernism introduced a more relaxed attitude, with an emphasis on self-expression and personal identity. In architecture, this new style has led to the use of non-traditional materials such as green windows, arches, domes, and even towers that are inspired by medieval or Gothic architecture. Post modernism was movement in architecture started in between 50's and 60's. Change occurs due to the need and interest of people and post modernism is no exception. Post-Modernists aimed to add more human characteristics to architecture by drawing inspiration from the past.

This article explores the emergence of these new architectural styles in Nepal and how it came influence by precedent of architecture. The need of research demand for complex geometric in the light of modern geometric representatives raises questions about the relationship between geometry and architecture. Nepalese Modern Architecture has been unconsciously being inspired by works seen in surrounding, magazines of internet sources like arch daily without being aware about geometry behind the work of architecture.

2. Literature Review

A concept that may be used by a designer to shape or influence a design is known as a formative idea. The concepts give means to plan choices, establish order, and intentionally produce shape. Using various ordering strategies might lead to varying outcomes. Presenting examples of the idea's general manifestations allows for the definition and exploration of each notion [5]. To establish a formative notion in which constructed shape is determined using the principles of plane and solid geometry , the following quality requirements are used:

- Structure
- Natural Light
- Massing
- Plan to Section or Elevation
- Circulation to Use-space
- Unit to Whole
- Repetitive to Unique
- Symmetry and Balance
- Geometry
- Additive and Subtractive
- Hierarchy

2.1 Concept of Geometry

Architecture is shaped by the concept of geometry, which incorporates the principles of both solid and plane geometry to define created form. The recurrence of the fundamental geometries through multiplication, combination, subdivision and manipulation is recognized as the development of grids in this issue. Since the beginning of recorded architectural history, geometry has been employed as a design tool. Buildings' most prevalent determining factor or feature is geometry. It may be used on a wide variety of spatial or formal levels, including the usage of basic geometric forms, numerous form languages, proportional systems, and complicated forms produced by sophisticated geometric manipulations. The area of measurement and quantification where geometry may generate architectural forms is relative. This analysis's main considerations include size, position, shape, form, and proportion. Additionally, it focuses on how combinations, derivations, and manipulations of fundamental geometric configurations lead to consistent changes in geometry and form languages. Grids are scrutinized for their regularity, configuration, intricacy, consistency, and variety. All of the problems employed in the study can be strengthened by geometry, which is a prevalent characteristic of structures [5].

2.2 Massing

Massing refers to the aspect of a building's three-dimensional layout that is most perceptually dominating or frequently experienced. More than only a building's elevation or silhouette make up its mass. It represents how the structure appears to the eye as a whole. It is too restrictive to think of massing as only this, even though it may encapsulate, resemble, or occasionally mirror the shape or the elevation. For instance, on a structure's elevation, fenestration might not have any impact whatsoever on how big the building appears to be. Similar to the silhouette, it might not accurately depict useful differences in shape and be overly broad [5].

Massing, which is viewed as a byproduct of designing, can be the outcome of choices made on matters other than the three-dimensional arrangement. Massing may be viewed as a design concept that is related to ideas of context, collections, unit patterns, both primary and secondary elements, and single and multiple masses. Massing has the power to express circulation, define and articulate external spaces, accommodate sites, designate entrances, and stress the significance of architecture. As a problem in the analysis, massing can reinforce the concepts of the section to plan, plan to section, geometry, additive and subtractive, and hierarchy [5].

2.3 Bauhaus

Bauhaus architecture prioritized function above all else, with a core principle of "truth to materials". Many Bauhaus buildings are geometric, with flat roofs and streamlined facades. This was meant as a stark rebuke of industrialization, the coldness of mass production, and consumerism.

It is distinguished by its strict economic sensitivities, geometric design, and reverence for useful materials. It still has an impact on us now, as seen by how frequently historical components are incorporated into contemporary environments. Influenced architecture, typography, furniture, and weaving [6].

Figure 2: Bauhaus-Building Dessau

Bauhaus building is the important landmark of architectural history. The outside of the workshop wing is defined by the glass curtain wall hung ahead of the load-bearing framework, which also clearly displays the building materials. This design adheres to the idea of unadorned functionality [6].

Planning of Bauhaus consist of three connected wings or bridges. The majority of Bauhaus structures are cube-shaped, emphasizing straight angles, however others have rounded corners and balconies. Characteristic of the building depends upon Simple geometry, rectangular featuring the elimination of surface decoration and extensive use of glass. A focus on simple geometric forms such as the triangle, square and circle [6].

The plan, elevation, and section for the Bauhaus

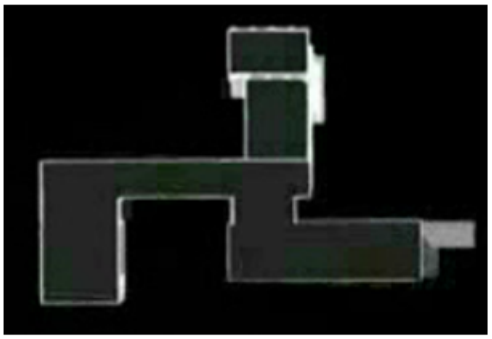

Figure 3: Top view of Bauhaus-Building Dessau

building are all rendered at the same scale in the study's analysis section. It aids in recognizing and outlining formal archetypal patterns or initial concepts from which architecture may develop. The drawings help, as abstractions that are intended to convey essential characteristics and relationships of the building. The drawings also display the precise physical characteristics that enable comparisons of the characteristics of buildings regardless of their design, kind, function, or period. The diagrams are created using the building's three-dimensional shape and space layouts [7].

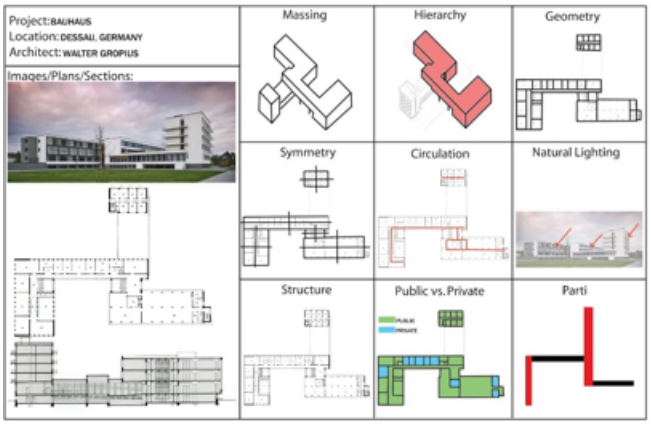

Figure 4: Precedents of Bauhaus Building, Analysis diagrams and Formative ideas

The basic geometric configurations that used to determine a building's form that include the square and rectangle as used in Bauhaus. Two adjacent squares with a shared side assist to identify the boundaries of the overall plan configuration and immediately determine the limits of the plans. Additionally, two squares were overlapped to produce a unique condition in the common region. Rectilinear grids occur in the Bauhaus which is coincident with structure.

The Bauhaus building's massing may also be used to convey circulation, stress importance in architecture, fit site, define and articulate outdoor areas, and meet site needs.

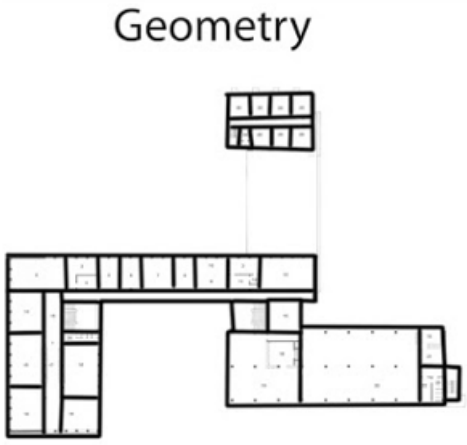

Figure 5: Geometric representation of Bauhaus Building

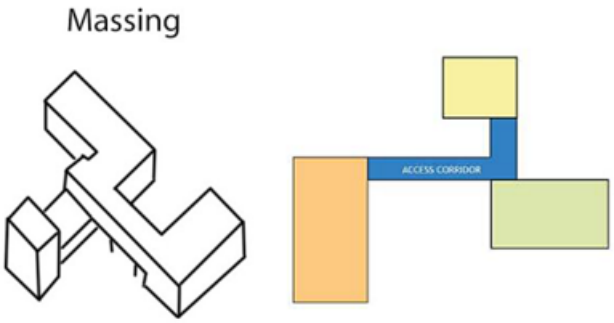

Figure 6: Massing representation of Bauhaus Building

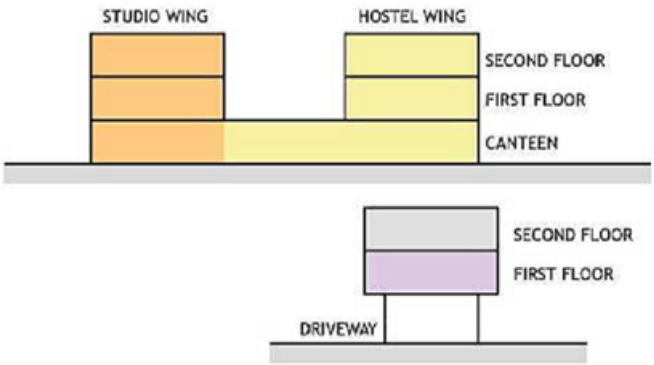

Figure 7: Massing elevation shape representation of Bauhaus Building

- Similar Functions housed in separate wings
- Corridors connecting different wings
- No central point in the layout

• Provides decent flexibility and expandability

• An outward looking complex

• Separate wings are designed as separate buildings housing specific functions

• Strong separation between wings imposes certain restrictions on planning flexibility

• Use of glass intended to create a feeling of lightness to structure

• Absence of ornamentation to the building was prevalent in practice during the period

3. Methodology

In this research, qualitative approach is used to explore, analyses and to understand the perceptions of use of geometry and the emergence of these new architectural styles in Nepal. A systematic qualitative research approach has been used to accomplish the goals of this research. There are three steps to the research methodology procedure. The literature review that starts the first step is done in order to create the research topics. It is followed by a preliminary map analysis of the building's structure, which gives rise to the notion for additional research into buildings and their comparable design concepts that can be found in many of the works of architects regardless of period, style, location, purpose, or kind of building. The commonalities can be categorized into overarching themes or formative concepts that may have been utilized to generate the architectural designs.

To compare and analyses the changes that have occurred over time that vary Nepali contemporary architecture and with valley honest context, carrying out documentation and survey analysis by studying the record of the drawing available.

A case study is a popular research technique in the social sciences. Case study research is chosen for the study because it calls for in-depth exploration of a particular person, organization, or event to examine the reason. An assessment of a person, organization, or event that is descriptive and exploratory is known as a case study. A case study investigation uses many sources of evidence, contains quantitative evidence, and gains from previously developed theoretical hypotheses.

4. Context of Study

Saraswati Sadan was designed by Bed Prasad Lohani in 1892. He was the country's first concrete building, Saraswati Sadan represents a turning point in contemporary architecture in Nepal. Reinforced concrete and reinforced brick concrete were among the brand-new, cutting-edge materials and technologies used in its construction. The main architectural structures were initially constructed between the 1940s and the 1960s, during the early modern period. These structures are highly inspired by architectural and engineering ideas that transcend beyond historicity and are mostly defined by the early usage of reinforced cement concrete. Are a good example of early modern architecture and contain aspects of "modern" architecture (Nepal 2020). It was developed by Bed Prasad Lohani, who brought concrete construction to Nepal. Experimented with a variety of elements in constructions, including domes, RCCs, and RBCs [8].

The constructions are clear, practical, and sound structurally. It represents a turning point in contemporary architecture in Nepal. It is constructed with cutting-edge technology and materials, such as reinforced concrete and reinforced brick concrete [8].

Figure 8: Saraswati Sadan in Kathmandu

Large spans have been achieved by using thick beams and strong walls. The balconies' free-floating cantilever look is achieved by using inverted beams as well. In the design, it has been experimented with levels and light. The structure has been equipped with clerestory windows and skylights to let in natural, diffused light [9].

The basic geometric configurations that used to determine a building's form that include the square,

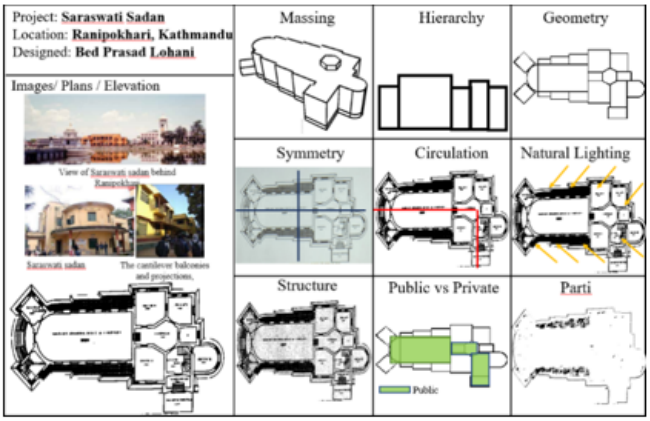

Figure 9: Precedents of Saraswati Sadan Building, Analysis diagrams and Formative ideas

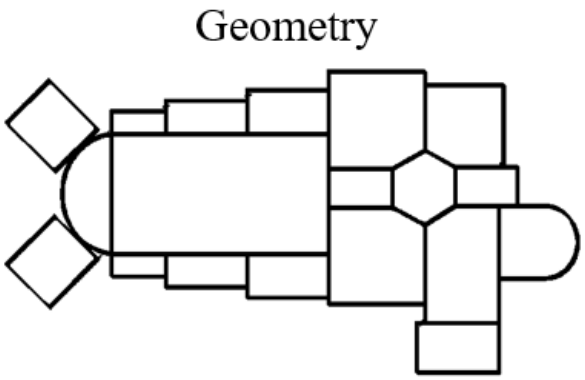

Figure 10: Geometric representation of Saraswati Sadan

rectangle, Semi circle, hexagon as used in Saraswati Sadan. To make each basic form as observable as an entire figure, more than two additional basic forms have also been joined. Although each form has been hinted, it is not necessary that it really exist. It is now feasible to identify a geometry within, next to, or overlapping another within the domain of combinations, such as in a rectangle, square, or semicircle. Because one geometry lies within another, the inner geometry was used to represent an item, a room, a courtyard, a predetermined area, or an inferred space.

The Saraswati Sadan building's massing might similarly define and articulate external spaces, fit site, designate entry, express circulation, and stress value in architecture. The visually dominant or most prevalent three-dimensional configuration of a structure is shown as its massing. It displays the perception of the structure as a whole. In many instances, the center space, although appearing to be dominant from the outside, functions as a hub for

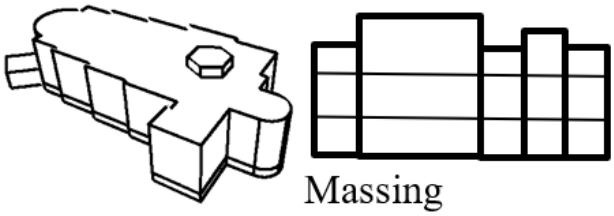

Figure 11: Massing representation of Saraswati Sadan

circulation and an organizer of surrounding areas. The notion of linear configurations, which separates circulation from user space, has been used to spine or corridor organisations. The exact geometric combination of the building's massing is a rectangle covered by a semicircle.

4.1 Comparison between Bauhaus and Saraswati Sadan

• Both buildings are the important landmark of architectural history

• Built using new and innovative materials and technology including reinforced concrete and reinforced brick concrete.

• Design is simple, functional, and structurally stable.Played with levels and light in the design.

• Use of Glass windows have been used in order to allow natural diffused light to enter the building.

• Absence of ornamentation

• Functionality predominates ornamentation and uses asymmetry and regularity versus symmetry

• characterized by geometric design, respect for practical material, and its severely economic sensibilities

• Continues to influence us today, where any modern environment often incorporates elements of the period. Influenced architecture, furniture, typography, and weaving

• Aim of Buildings constructed in different era help to gain independent access to the new innovations of crafts and industries

• Buildings are usually cubic, favor right angles, although some feature rounded corners and balconies

5. Analysis, Discussion and Findings

Geometry which is used for taking intangible concepts and ideas and establishing them in built environment by the use of the Geometric Principals in the buildings. Factual graphic information of Bauhaus and Saraswati Sadan represent a range of time, function and style which accompanied the detail analysis of the building.

Although the dominating patterns in this study have been established, that does not imply that there aren't any other patterns. The analysis of the buildings which represent the evolution of modern architecture investigate the formal and spatial characteristics of the buildings in each work in such a way that help to understand the building parti. Visual connection has been established by user and the environment in both the context study building.

Following are the key findings emerged from the Study:

• The fundamental principles of both solid and plane geometry, which are used to establish architectural form and include the square and rectangle, are embodied in the Bauhaus and Saraswati Sadan.

• Two squares were overlapped to produce a unique condition in the common region.

• Because of one geometry lies within another, the inner geometry was used to represent an item, a room, a courtyard, a predetermined area, or an inferred space.

• Building designs from different eras use massing to convey circulation, define and articulate external spaces, accommodate sites, and underline the importance of architecture.

• The notion of linear configurations, which separates circulation from user space in both the buildings.

6. Conclusion

This research paper helps to gather the idea about the use of different geometry, which has also been used as a design tool since the very beginnings of architectural design.

The study concludes that the post 50s buildings were designed mainly by foreign trend architects with not only strong Bauhaus Influence but also the history which acts as determinant or characteristic in buildings along with drawing from local architectural context. A formative notion aids in comprehending the idea that a designer may utilize to shape or impact a design. The concepts include strategies for planning choices, establishing order, and intentionally producing shape. The ideas cover methods for organizing decisions, creating order, and purposefully creating shape.

The diagrams highlight particular physical characteristics that enable a comparison of that characteristic between buildings regardless of style, kind, purpose, or time.

Finally, it serves as a new concept for future researchers of the field and for all architects. The use of various techniques of analysis that emphasize what is fundamentally the same, rather than different, in the way we think about architecture is also examined, and we want to explore archetypal notions that can aid in the production of architectural form.

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Annex II: Presentation Slide

Master In Architecture
Department of Architecture
Pulchowk Campus, Institute of Engineering
Tribhuvan University
Pulchowk, Lalitpur

M.Arch Thesis
ON
APPROACHES TO THE USE OF GEOMETRY IN MODERN ARCHITECTURE:
"A Study of Its Development in a Nepalese Context "

Submitted To:
Department of Architecture

Submitted By:
ADITI JAISWAL
076/M.ARCH/002

(Date: 2022/09/12)

Acknowledgement

I would like to thank my thesis supervisor **Assoc. Prof. Dr Sanjaya Uprety** for his continuous guidance, and inspiration and also his regular feedback and invaluable insights helped to shape my thesis in accomplishing this thesis. Also grateful to our coordinator **Prof. Dr Ashim Bajracharaya** for his support along with **Prof. Dr. Sushil Bajracharya and Prof. Dr Sudha Shrestha** for their feedback.

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Table of Content

3

Introduction

- According to Francis D.K.Ching's Geometry is defined as **"a branch of mathematics that deals with the properties, measurement, and relationship of points, lines, and angles".**
- Geometry (from the Ancient Greek: geo - "earth", - metron "measurement") is a branch of mathematics concerned with questions of shape, size, relative position of figures, and the properties of space.
- According to Jonner Kepler, **Geometry is the archetype** of the beauty of the world.
- Geometry is also the "common language" of the planet. It is the tool that humans have devised for perceiving the outside world and expressing the world within them.
- In architecture these **play a multifold role**; as abstract ideas, they belong in the category of ideal geometric.
- Their perfection can be imposed on the physical fabric of the world as a means for **identifying the place**.
- They can emerge, as a reaction to the landscape or constraints.

(Source: Sharp, 2002) 5

Background

- Renaissance architects, like **Alberti, emphasized proportions derived from perspective drawing. Le Corbusier emphasized modular proportions, using his modular, which was based on the Golden Ratio (Sharp, 2002).**
- Geometry plays a **multifold role in Architecture, It can be adopted to be imposed over the landscape.** It can also emerge out of the conditions of being and conditions of material and site.
- Sigfried Giedion has compared the simultaneous representations in Cubism to the Bauhaus architecture of Walter Gropius, which were **transparent and allowed different views of the same building to be simultaneously seen inside and outside at the same time through different windows.**
- **In architecture, both design and vision are included, and architects often use geometry as a tool**

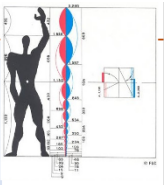

Figure 3: Le Corbusier's The Modulor

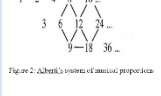

Figure 2: Alberti's system of musical proportions

(Source: Sharp, 2002) 6

Need of Research

- **Modern identity from a perspective, there may be parallels between principles of geometry and the use of geometry in architectural design.**
- To reveal the motives behind the rising of the use of geometry in architecture and **the role which has been played by geometry in establishing a new contemporary identity while designing.**
- In architecture, the study of geometry led to the development of new mathematical tools which was made applicable to the design of buildings. Identify the novel determinant of the modern contemporary identity of Nepalese architecture which represent Nepal.
- It will provide an insight into **how geometry played an important role in shaping the formative idea of early modern architecture.**
- How **geometry becomes a language of architect's design** in the sense and how the **elements of geometry come together to form the grammar of meaning full architectural composition.**
- Also, the **Transition of completely pure forms of geometric buildings** and approach in the sense how a **building being in its pure form is not geometrical or it justifies its pure form completely but every building is geometrical.**

(Source: Srinivasan, 2009)

Importance of Research

- **Geometry is an integral part of the design from start to finish.**
- Architects use geometry to study and divide space as well as draft detailed building plans. Builders and engineers rely on geometric principles to create structures safely. Designers apply geometry (along with colour and scale) to make them aesthetically pleasing spaces inside. Applying geometry in design is unavoidable.
- Post-modern sciences like fractals, chaos theory, nonlinear dynamics, and complexity theory portray a creative and complicated universe.
- The requirement for **complicated geometric forms raises questions about the connections between geometry and architecture.**
- For **analyzing the various approaches to geometry in architecture throughout history, as well as the parallels between them, we will be able to put them into historical context**
- According to Charles Jenks, architects can be considered time to break new lands compared to the perspective of points of geometry and form. The architect must create a new vocabulary that reflects this new vision of the world (Jenks, 1997).

(Source: Srinivasan, 2009)

Problem Statement

(Source: Sengupta & Upadhyaya)

- The **transition in architectural geometry in the building** has also made such an **impact on the role of the modern architect**.
- Nepalese Modern Architecture has been unconsciously being inspired by works seen in surrounding, magazines of internet sources like arch daily without being aware about geometry behind the work of architecture.
- There is a **huge gap between the theoretical aspects of geometry and the practical aspects that are more useful to architects.**
- **Architects are not being able to come up with geometric concepts because probably because they are not aware of the geometry of design**
- Modern building types symbolize changing environments and behaviours expressed in new forms of identity, aspirations and aesthetics.
- There is little evidence of any conscious use of the golden proportions or other incommensurable ratios that can be expressed geometrically. So, **lack of language of modern architecture in Nepal.**
- **Architects are not thinking in terms of geometry when they are dealing with space and form.**

Research Question

- This research will also help to find the answer related to answer about :

a) **How does the geometric approach to architecture at different points in history and investigate its correlation between geometry and architecture type of style, form, shape or approach in Nepal?**

b) **Necessities for developing modern architecture, depending on what geometry is used as the surrounding environment?**

c) **Did role play by geometry in the Nepal context of modern architecture?**

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Research Objective

❖ **Main Objective:**

- **To examine the role of Geometry in shaping the early Modern Architecture of Nepal.**
- **To understand the perception of architects on the influence of geometry in modern architecture gauzing awareness.**

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Validity of research

- Research highlighted that **geometry becomes a language of architect's design** in the sense and how the **elements of geometry come together to form the grammar of meaning full architectural composition.**
- Similarly, its **significance can also be realized in the context of Nepal** where many Geometrical Ideas and architectural attributes are in terms of Function, Form, Scale, Structure, etc.
- **Gap between the use of geometrical ideas and the globalized modernization >> necessity of Modern Architecture**
- **There is an area that has not been given due attention by the researchers in the context of Nepal. So, this research is intended to fill that gap.**

12

RESEARCH METHODOLOGY

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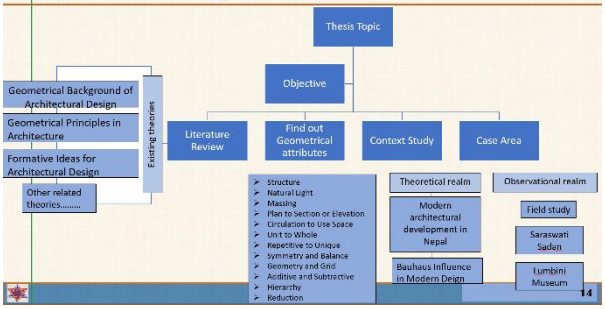
Theoretical & Conceptual Framework



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Research Methodology & Method

❖ **Research Methodology:**

- This research falls under qualitative research which has an emphasis on natural settings, focus on interpretation and meaning, and focus on the object through other eyes and mind.

❖ **Research Method:**

- **Documentation and Survey**: To analysis on some of the **hall mark of modern architecture building** as well as latest/modern buildings to compare and **analyze the changes that have taken place over a while which vary Nepali contemporary architecture** and with valley honest context consulting with senior professor and researcher, professional architects.
- **Case Study**: **To study of the Evolution of Geometry from History to Present Day, Emergence of modernism, works of renowned building by Architect**
- **Interviews**: **Interviews would be conducted with some of the Architects**, Architecture students pursuing Bachelor in Architecture and Engineers. Data and information would be **critically analyzed** and put into appropriate order to have for deriving the final interpretations or conclusions.

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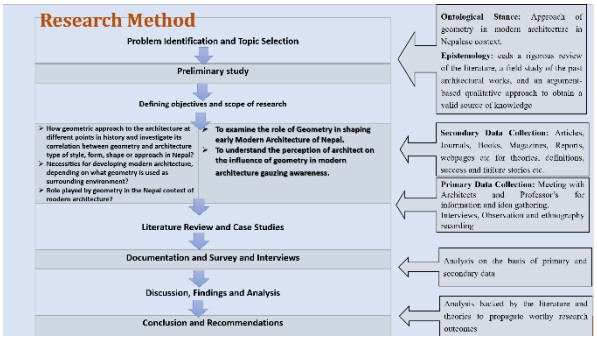
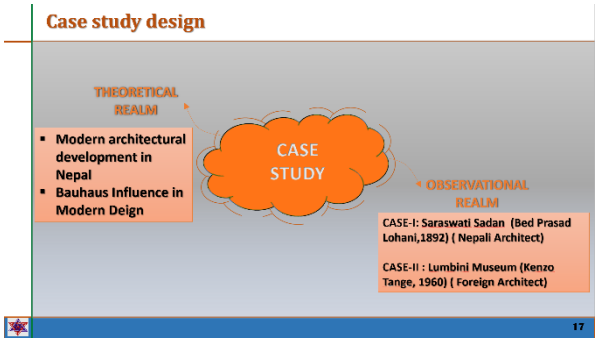
Research Method




Case study design
THEORETICAL REALM
Modern architectural development in Nepal
Bauhaus Influence in Modern Deign
CASE STUDY
OBSERVATIONAL REALM
CASE-I: Saraswati Sadan (Bed Prasad Lohani,1892) (Nepali Architect)
CASE-II : Lumbini Museum (Kenzo Tange, 1960) (Foreign Architect)
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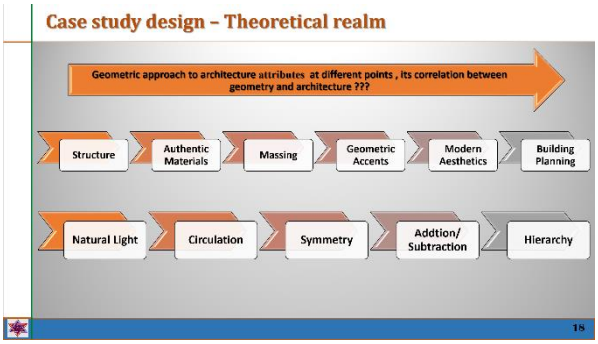
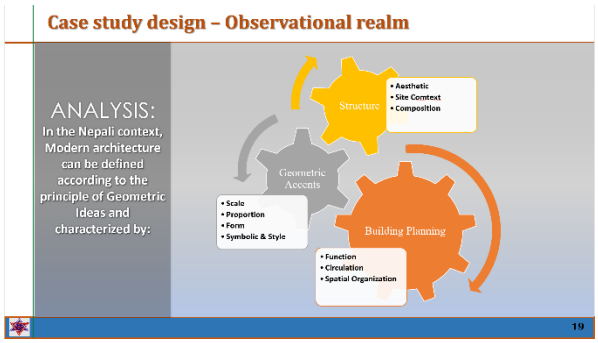
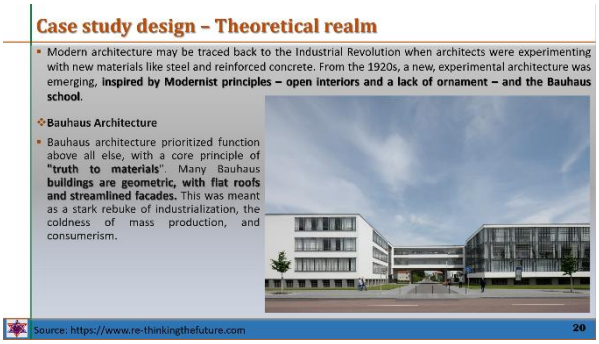
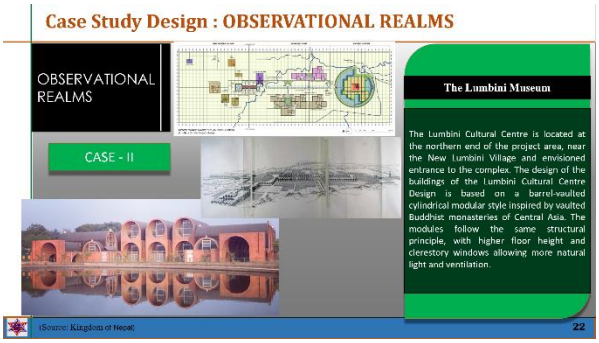
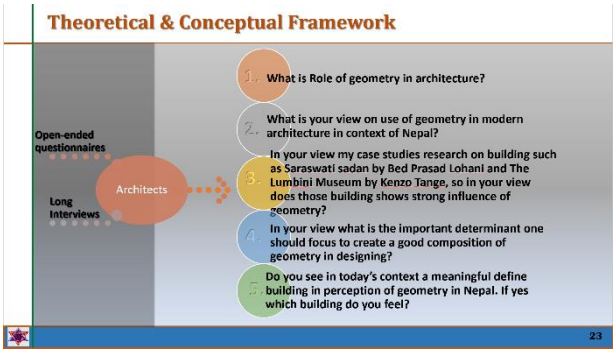

Case study design – Theoretical realm
Geometric approach to architecture attributes at different points , its correlation between geometry and architecture ???
Structure
Authentic Materials
Massing
Geometric Accents
Modern Aesthetics
Building Planning
Natural Light
Circulation
Symmetry
Addtion/ Subtraction
Hierarchy
18

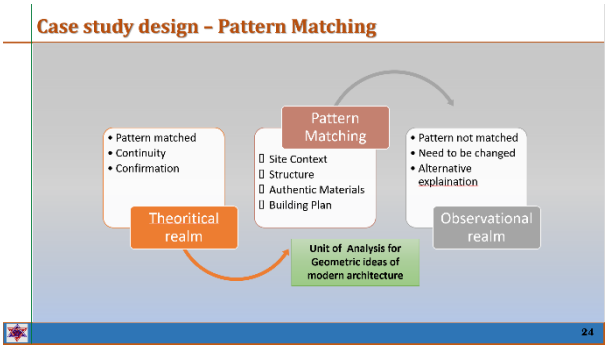

Case study design – Observational realm
ANALYSIS:
In the Nepali context, Modern architecture can be defined according to the principle of Geometric Ideas and characterized by:
Structure
Aesthetic
Site Context
Composition
Geometric Accents
Scale
Proportion
Form
Symbolic & Style
Building Planning
Function
Circulation
Spatial Organization
19


Case study design – Theoretical realm
Modern architecture may be traced back to the Industrial Revolution when architects were experimenting with new materials like steel and reinforced concrete. From the 1920s, a new, experimental architecture was emerging, inspired by Modernist principles – open interiors and a lack of ornament – and the Bauhaus school.
Bauhaus Architecture
Bauhaus architecture prioritized function above all else, with a core principle of "truth to materials". Many Bauhaus buildings are geometric, with flat roofs and streamlined facades. This was meant as a stark rebuke of industrialization, the coldness of mass production, and consumerism.
Source: https://www.re-thinkingthefuture.com
20


Case study design – Observational realm
OBSERVATIONAL REALMS
CASE - I
Saraswati Sadan
Saraswati Sadan is a milestone in the history of modern architecture in Nepal as it is the first concrete structure to be built in Nepal. It was built using new and innovative materials and technology including reinforced concrete and reinforced brick concrete. The buildings are largely defined by the early use of reinforced cement concrete.
21


Case Study Design : OBSERVATIONAL REALMS
OBSERVATIONAL REALMS
CASE - II
The Lumbini Museum
The Lumbini Cultural Centre is located at the northern end of the project area, near the New Lumbini Village and envisioned entrance to the complex. The design of the buildings of the Lumbini Cultural Centre Design is based on a barrel-vaulted cylindrical modular style inspired by vaulted Buddhist monasteries of Central Asia. The modules follow the same structural principle, with higher floor height and clerestory windows allowing more natural light and ventilation.
22


Theoretical & Conceptual Framework
Open-ended questionnaires
Long Interviews
Architects
1. What is Role of geometry in architecture?
2. What is your view on use of geometry in modern architecture in context of Nepal?
3. In your view my case studies research on building such as Saraswati sadan by Bed Prasad Lohani and The Lumbini Museum by Kenzo Tange, so in your view does those building shows strong influence of geometry?
4. In your view what is the important determinant one should focus to create a good composition of geometry in designing?
5. Do you see in today's context a meaningful define building in perception of geometry in Nepal. If yes which building do you feel?
23


Case study design – Pattern Matching
Pattern matched
Continuity
Confirmation
Theoritical realm
Pattern Matching
Site Context
Structure
Authentic Materials
Building Plan
Unit of Analysis for Geometric ideas of modern architecture
Pattern not matched
Need to be changed
Alternative explaination
Observational realm
24

Geometrical Background of Architectural Design

❖ **Historical Development of Geometry**

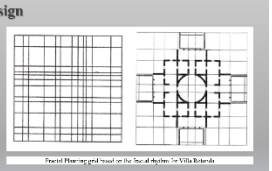
- Geometry is a branch of mathematics that **deals with the study of points, lines, surfaces, and solids. Different geometries result from different sets of assumptions.** Undefined components, assumed relations, unproven claims, and proved statements are the foundations of all mathematical systems.
- **Geometry comes from the Greek words for "earth" and "measure".** . Polygons, circles, and three-dimensional forms were the core subjects of ancient Greek geometry.
- Thales, Pythagoras, and Plato are credited with creating the first general theorems in geometry. Modern geometry addresses old issues, although it is no longer limited to Euclid's plane. There are novel progressions, such as elliptic geometry and hyperbolic geometry.
- **Modern geometry continues to address old issues, although it is no longer limited to Euclid's plane.**

(Source: *Grolier Encyclopedia*) 26

Geometrical Background of Architectural Design

❖ **Types of Geometry used in Architectural Design**

- Euclidean Geometry
- Analytic Geometry
- Fractal Geometry
- Non-Euclidean Geometry
- Descriptive Geometry



(Source: (Carter, 1996) (Gomez, 1994) (Bovill, 1996)) 27

Geometrical Background of Architectural Design

❖ **Geometry Based on the Basic Conceptual Elements**

- Geometry gives us the ability to **easily actualize geometrically designed shapes**. The point, line, plane, fundamental geometric forms (circles, triangles, and squares), angles, solids (cones, spheres, and cubes), and other topics are of importance to geometry.
- The use of architectural design components to create architectural forms
- offer everyone a **sense of divinity through the simple presence of the undeniable perfection of geometric shapes**. *(Antoniades, 1992)*
- Regular polygons are the simplest basic forms, whether used singly or in combination. They serve as the foundation for many other architectural elements, including pyramids, patterns, and prisms. The most popular ones are those of sides three, four, and five as well as their first truncations.
- Such as the ancient Egyptian pyramids and tombs were constructed utilizing triangles, rectangles, and squares as geometric shapes.
- Equilateral triangles and squares were often employed by architects to create structures throughout the Gothic era.
- The small diameter of the temple columns served as the basis for a proportional system created by Greek architects.

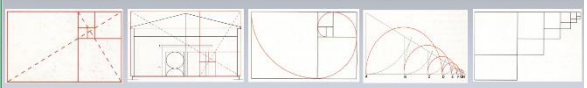
(Source: (Carter, 1996) (Gomez, 1994). 28

Concept of Architectural Ideas

❖ **Golden Section**

- The golden section **demonstrates a basic harmonic concept** that is drawn from nature and used in music, art, and architecture.
- The first person to clearly define the golden section as a continuous division was Euclid (325–270 B.C).
- The golden sector was later regarded as the perfect ratio and the pinnacle of harmony and aesthetics.

Architectural Proportions | Le Corbusier's Regulating Lines | Golden Section Proportions | Golden Section & the Fibonacci Sequence | Golden Section Dynamic Rectangles



(Source:(Geometry of Design Studies in Proportion and Composition, 2001) 29

Design Characteristics of Architectural Form

❑ **Definition of Architectural Form**

- Architecture's form encompasses more than only the **use of space** and the **activities that take place** there.
- The shape also serves as a symbol or a vehicle for the message. This makes it **feasible to evaluate the architectural shape** using one of three frameworks.

❑ **Theories of Architectural Form**

- All of these meanings were associated with the idea of form in Plato's philosophical framework.
- The form paradigm that was unique to the Renaissance was also represented in the architectural form.
- Almost solely, Type represented the epistemic significance of Form.
- **The concept of structure communicates a sense of form that is more procedural than epistemic.**

(Source: (Carter, 1996) (Gomez, 1994). 30

Conceptual Elements of Architectural Form

Point	Line	Plane	Sphere
• In geometry, a point is both the primary source of form and the primary component of form's language. • The point has several significant functions in geometry as a **primary generator of shape.**	• In geometry, the second generator of form is the line. • One of line's aesthetic characteristics is that it **serves as the main way to define space.**	• A plane's main distinguishing feature is its form. • It is established by the shape of the line **defining the plane's edges.**	• Every point on the surface of a sphere is equally spaced from a central point, making it a unique type of solid. • Another way to create a sphere is to rotate a
Solid	**Cone/Pyramid**	**Cube**	**Cylinder**
• Solid is the fourth element to generate a form in geometry. • It may be solid like a block of stone, hollow like terra cotta, or hollow like a building.	• A straight line with one fixed point is rotated around one closed, curved baseline to create the cone's curved surface.	• The simplest rectangular solid is the cube.	• This line is parallel in all directions to the axis of the cylinder.

31

Visual Elements of Architectural Form

Shape
- The main shapes—the circle, triangle, square, and rectangle—are the most important of these(Yilmaz,1999)

Texture
- The size and arrangement of the particles that make up surfaces determine the texture.
- White is a classic example of a visual texture.

Light
- In order to emphasize the character of shape, light is crucial.
- Such a conceptual use of light in architecture greatly organizes space.

Color
- Most designers consider the color wheel a sure guide to matching colors, but some find it restrictive.
- The psychology of color is a complex and highly subjective field.

Size and Scale
- Size is defined as a form's actual length, breadth, and depth.
- Directly influenced by the scale of a structure and its components, including its entrances, windows, and internal spaces.
- A structure's size and its components can be determined by comparing it to either another building or an object in the distance.

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Conceptual Design Strategies used in Architectural Design

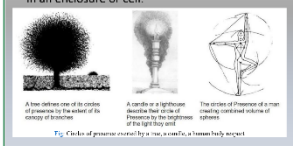
- **Unity:** All of the components on the visual plane seem to be a single, well-rounded entity.
- **Balance:** Equal distribution of visual weight.
- **Contrast:** The reverse of unity, contrast is produced by different parts.
- **Harmony:** The combination of similarity and difference creates a pleasant visual whole.
- **Rhythm:** The pace of a piece of visual art.
- **Proportion:** The amount of one thing to another.

33

Concept of Geometry in Architecture

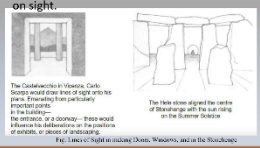
Circles of Presence

- Everybody has a 'circle of presence' about them, which **contributes to their sense of location.** When a body interacts with another, their circles of presence have an impact on one another. A body's circle of presence is likewise contained and maybe shaped when it is placed in an enclosure or cell.



Line of Sight

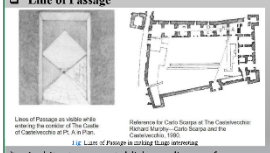
- In architecture and performance spaces, there is a fixation on lines of sight. A line of sight makes the **interaction between locations when thinking of architecture as place identification.** It was one of the ways that builders in the ancient world **connected locations to the world around them.** The design of performance spaces is dependent on sight.



(Source: (Unwin, 2009) 34

Concept of Geometry in Architecture

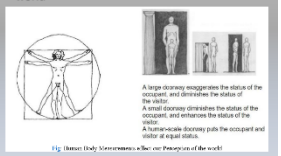
Line of Passage



- Architecture establishes line of passage between places, using them as ingredients of serial experiences. A sensible person usually moves in straight line between a straight point and a goal, unless there is some obstacle which makes this unwise or impossible. Architecture also **establishes 'habitats' for human experience.**

Measuring

- Geometry is derived from the Greek words geo (earth) and meto (measure) (metron). Measuring the world is a necessary part of existence; individuals do it all the time. People's bodies are **one of the more direct ways they measure the world.**

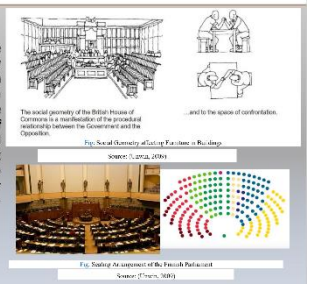


(Source: (Unwin, 2009) 35

Concept of Geometry in Architecture

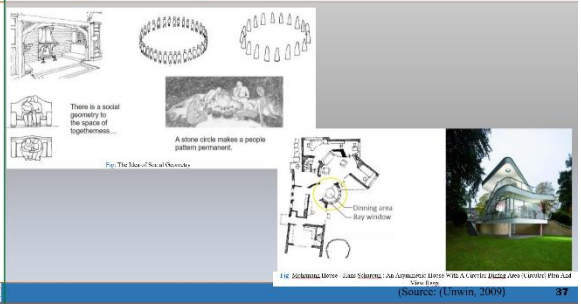
Social Geometry

- When individuals cluster, they **create unique identities** for themselves. They accomplish it by overlaying a **social geometry that brings them together.** This is architecture in and of itself as a process of **place identification, but its existence is fleeting since it is made up entirely of humans.** Some discussion chambers are created for communal conversation rather than arguing and opposition. Meeting rooms adjacent to cathedrals and monasteries feature a circular layout that is non-hierarchical and non-confrontational structurally.



(Source: (Unwin, 2009) 36

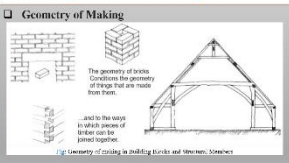
Concept of Geometry in Architecture



(Source: (Unwin, 2009) 37

Concept of Geometry in Architecture

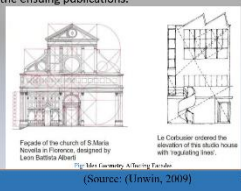
Geometry of Making



- The geometry or structure, whether it is the timber structure of a medieval high-resolution remote sensing or the steel structure of an electronics plant, is included in the geometry to make. Some structures are regarded to be efficient if they use material efficiently and without unnecessary members; others have an extra attribute known as elegance.

Ideal Geometry

- The Circle and Square are pure, abstract figures. **Ideal geometry contains exceptional proportions such as 1:2, 1:3, 2:3**, and more complicated ratios like 1:2. In relation to the Parthenon, these ideal geometric principles will be discussed further in the ensuing publications.



(Source: (Unwin, 2009) 38

Influential Geometrical Principles in Architecture Design

- The relationship between history and design is made clear by the growing interest in architectural history and historic examples.
- Understanding within and beyond the layers of historical styles, within which architecture is often classified and presented, may make history an enriching source for architectural design.
- **The investigation of an architectural concept is revealed by a theory that transcends the present.**
- **A concept that may be used by a designer to shape or influence a design is known as a formative idea.**
- The formative ideas identify and define the formal archetypal patterns or formative concepts that might lead to the development of an architecture that gives means to plan choices, establish order, and intentionally produce shape.
- Buildings that span many eras, functions, locations, or architectural types and styles, as well as architects who serve as examples of radically different approaches to design.

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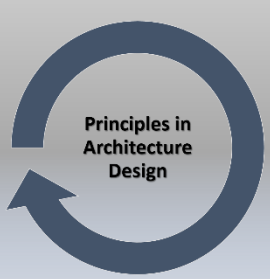
Influential Geometrical Principles in Architecture Design



- Structure
- Natural Light
- Massing
- Plan to Section or Elevation
- Circulation to Use Space
- Unit to Whole
- Repetitive to Unique
- Symmetry and Balance
- Geometry and Grid
- Additive and Subtractive
- Hierarchy
- Reduction

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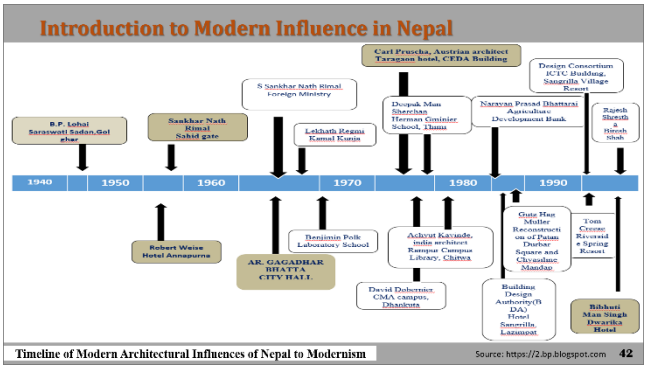
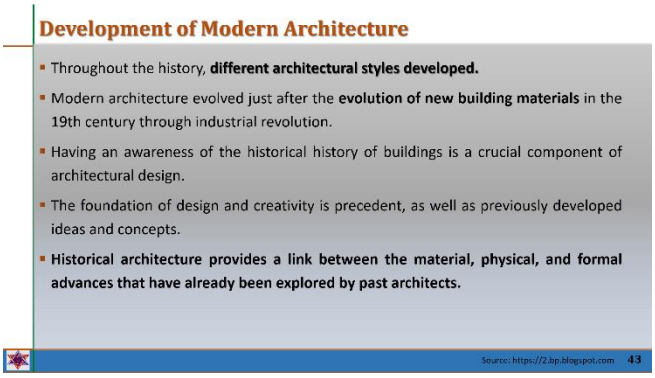
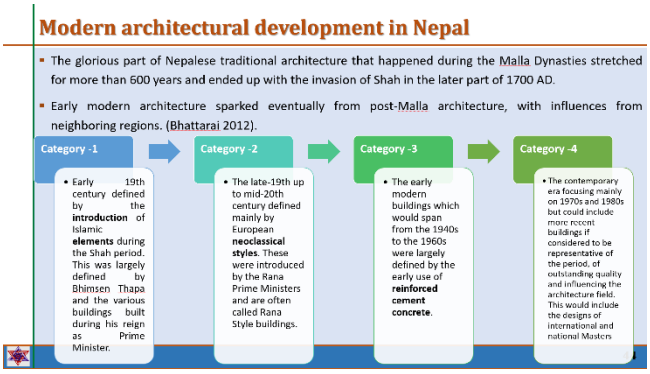
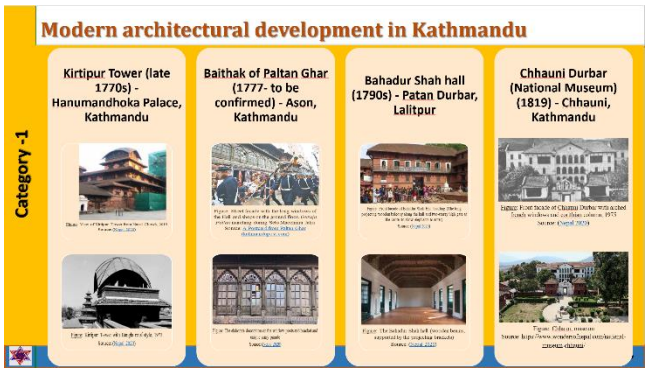
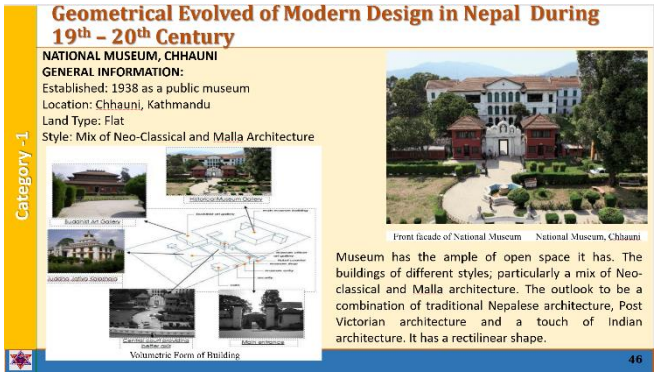
CONTEXT
STUDY
41

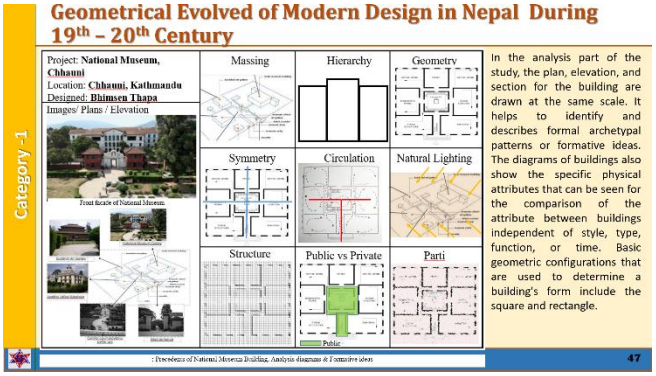

Introduction to Modern Influence in Nepal
1940
1950
1960
1970
1980
1990
Timeline of Modern Architectural Influences of Nepal to Modernism
Source: https://2.bp.blogspot.com
42

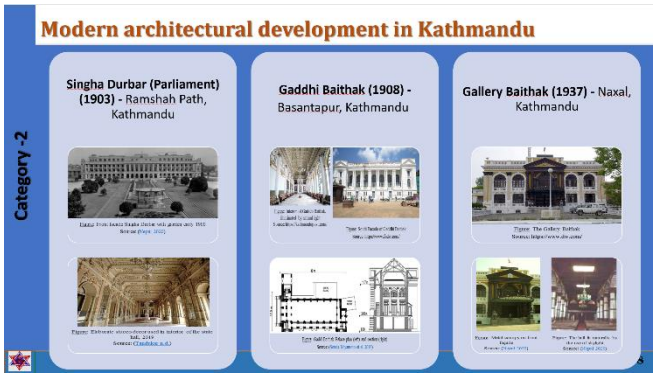

Development of Modern Architecture
Throughout the history, different architectural styles developed.
Modern architecture evolved just after the evolution of new building materials in the 19th century through industrial revolution.
Having an awareness of the historical history of buildings is a crucial component of architectural design.
The foundation of design and creativity is precedent, as well as previously developed ideas and concepts.
Historical architecture provides a link between the material, physical, and formal advances that have already been explored by past architects.
Source: https://2.bp.blogspot.com
43


Modern architectural development in Nepal
The glorious part of Nepalese traditional architecture that happened during the Malla Dynasties stretched for more than 600 years and ended up with the invasion of Shah in the later part of 1700 AD.
Early modern architecture sparked eventually from post-Malla architecture, with influences from neighboring regions. (Bhattarai 2012).
Category -1
Early 19th century defined by the introduction of Islamic elements during the Shah period. This was largely defined by Bhimsen Thapa and the various buildings built during his reign as Prime Minister.
Category -2
The late-19th up to mid-20th century defined mainly by European neoclassical styles. These were introduced by the Rana Prime Ministers and are often called Rana Style buildings.
Category -3
The early modern buildings which would span from the 1940s to the 1960s were largely defined by the early use of reinforced cement concrete.
Category -4
The contemporary era focusing mainly on 1970s and 1980s but could include more recent buildings if considered to be representative of the period, of outstanding quality and influencing the architecture field. This would include the designs of international and national Masters

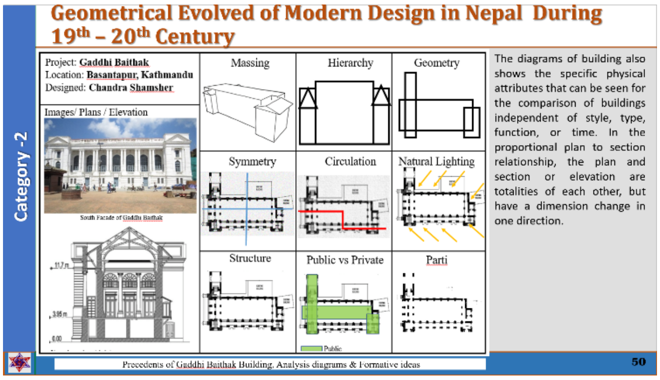

Modern architectural development in Kathmandu
Category -1
Kirtipur Tower (late 1770s) - Hanumandhoka Palace, Kathmandu
Baithak of Paltan Ghar (1777- to be confirmed) - Ason, Kathmandu
Bahadur Shah hall (1790s) - Patan Durbar, Lalitpur
Chhauni Durbar (National Museum) (1819) - Chhauni, Kathmandu

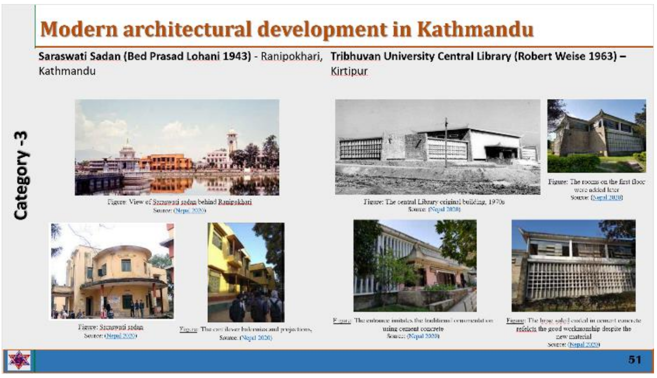

Geometrical Evolved of Modern Design in Nepal During 19th – 20th Century
Category -1
NATIONAL MUSEUM, CHHAUNI
GENERAL INFORMATION:
Established: 1938 as a public museum
Location: Chhauni, Kathmandu
Land Type: Flat
Style: Mix of Neo-Classical and Malla Architecture
Volumetric Form of Building
Front facade of National Museum
National Museum, Chhauni
Museum has the ample of open space it has. The buildings of different styles; particularly a mix of Neo-classical and Malla architecture. The outlook to be a combination of traditional Nepalese architecture, Post Victorian architecture and a touch of Indian architecture. It has a rectilinear shape.
46

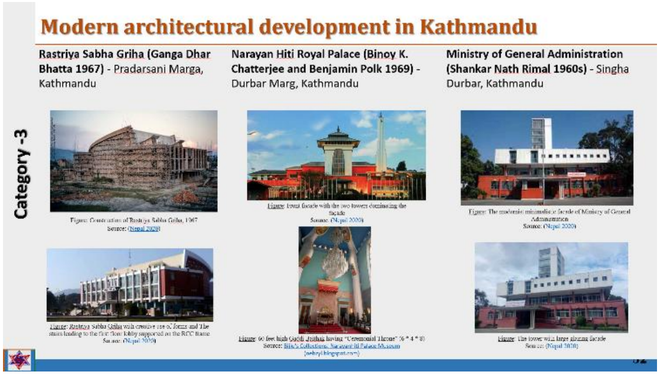

Geometrical Evolved of Modern Design in Nepal During 19th – 20th Century
Category -1
Project: National Museum, Chhauni
Location: Chhauni, Kathmandu
Designed: Bhimsen Thapa
Images/ Plans / Elevation
Front facade of National Museum
Massing
Hierarchy
Geometry
Symmetry
Circulation
Natural Lighting
Structure
Public vs Private
Parti
Public
In the analysis part of the study, the plan, elevation, and section for the building are drawn at the same scale. It helps to identify and describes formal archetypal patterns or formative ideas. The diagrams of buildings also show the specific physical attributes that can be seen for the comparison of the attribute between buildings independent of style, type, function, or time. Basic geometric configurations that are used to determine a building's form include the square and rectangle.
47


Modern architectural development in Kathmandu
Category -2
Singha Durbar (Parliament) (1903) - Ramshah Path, Kathmandu
Gaddhi Baithak (1908) - Basantapur, Kathmandu
Gallery Baithak (1937) - Naxal, Kathmandu

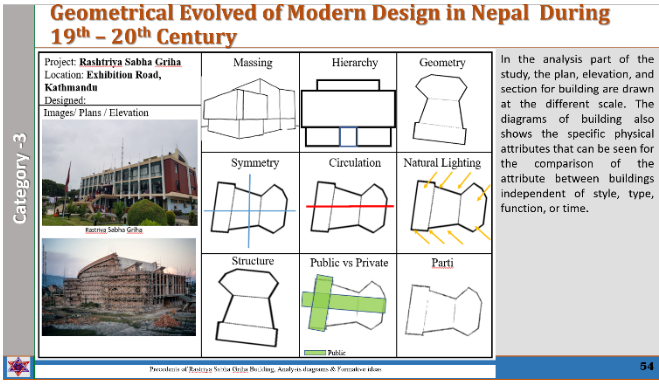

Geometrical Evolved of Modern Design in Nepal During 19th – 20th Century
Category -2
GADDHI BAITHAK
GENERAL INFORMATION:
Established: 1908
Location: Basantapur, Kathmandu
Land Type: Flat
Style: Mix of Neo-Classical and Malla Architecture
South Facade of Gaddhi Baithak
Source: https://www.flickr.com/
It was commissioned by Chandra Shamsher to receive the foreign delegates visiting the palace. During Indra Jatra foreign delegates were invited to observe the Kumari chariot festival, a tradition that still continues.
Source: https://kathmandupost.com/
49

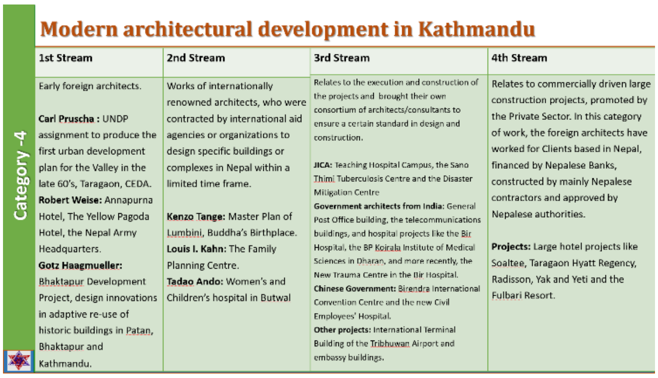

Geometrical Evolved of Modern Design in Nepal During 19th – 20th Century
Category -2
Project: Gaddhi Baithak
Location: Basantapur, Kathmandu
Designed: Chandra Shamsher
Images/ Plans / Elevation
South Facade of Gaddhi Baithak
Massing
Hierarchy
Geometry
Symmetry
Circulation
Natural Lighting
Structure
Public vs Private
Parti
Public
The diagrams of building also shows the specific physical attributes that can be seen for the comparison of buildings independent of style, type, function, or time. In the proportional plan to section relationship, the plan and section or elevation are totalities of each other, but have a dimension change in one direction.
Precedents of Gaddhi Baithak Building. Analysis diagrams & Formative ideas
50

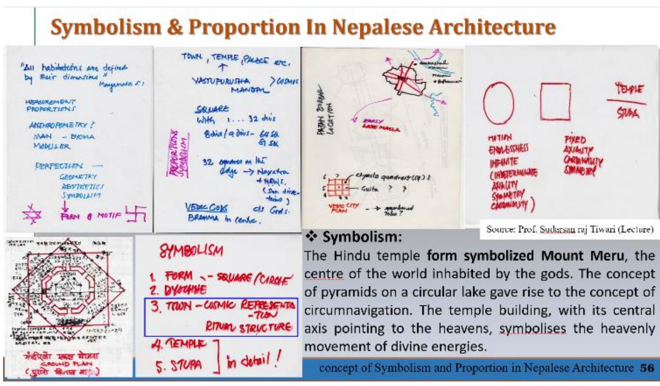

Modern architectural development in Kathmandu
Category -3
Saraswati Sadan (Bed Prasad Lohani 1943) - Ranipokhari, Kathmandu
Tribhuvan University Central Library (Robert Weise 1963) – Kirtipur
Figure: View of Saraswati sadan behind Ranipokhari
Figure: The central Library original building, 1970s
Figure: The rooms on the first floor were added later
51


Modern architectural development in Kathmandu
Category -3
Rastriya Sabha Griha (Ganga Dhar Bhatta 1967) - Pradarsani Marga, Kathmandu
Narayan Hiti Royal Palace (Binoy K. Chatterjee and Benjamin Polk 1969) - Durbar Marg, Kathmandu
Ministry of General Administration (Shankar Nath Rimal 1960s) - Singha Durbar, Kathmandu

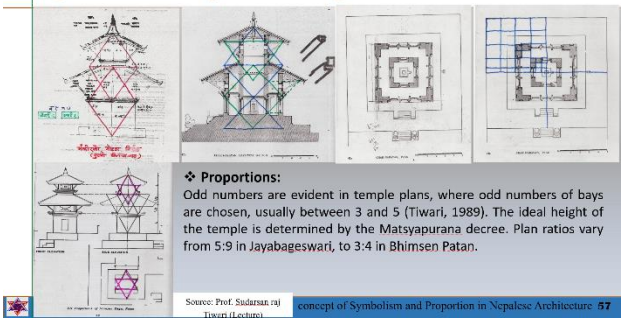

Geometrical Evolved of Modern Design in Nepal During 19th – 20th Century
Category -3
RASHTRIYA SABHA GRIHA (CITY HALL)
GENERAL INFORMATION:
Location : Exhibition Road, Kathmandu
Area: 13,589 Sq.m
Centrally located in Kathmandu Valley
Land Feature: Relatively flat with some trees
Architect: Gangadhar Bhatta
City Hall
Rastriya Sabha Griha with creative use of forms
Source: (Nepal 2020)
Considered three types of people: Firstly the pedestrians for whom he gave wide stair case connecting the ground floor and first floor, Secondly for Vehicular, porch was provided and lobby on ground floor -Lastly for performers, different entrance Wide Staircase for easy exit and entrance
53


Geometrical Evolved of Modern Design in Nepal During 19th – 20th Century
Category -3
Project: Rashtriya Sabha Griha
Location: Exhibition Road, Kathmandu
Designed:
Images/ Plans / Elevation
Massing
Hierarchy
Geometry
Symmetry
Circulation
Natural Lighting
Structure
Public vs Private
Parti
Public
In the analysis part of the study, the plan, elevation, and section for building are drawn at the different scale. The diagrams of building also shows the specific physical attributes that can be seen for the comparison of the attribute between buildings independent of style, type, function, or time.
54


Modern architectural development in Kathmandu
Category -4
1st Stream
Early foreign architects.
Carl Pruscha : UNDP assignment to produce the first urban development plan for the Valley in the late 60's, Taragaon, CEDA.
Robert Weise: Annapurna Hotel, The Yellow Pagoda Hotel, the Nepal Army Headquarters.
Gotz Haagmueller: Bhaktapur Development Project, design innovations in adaptive re-use of historic buildings in Patan, Bhaktapur and Kathmandu.
2nd Stream
Works of internationally renowned architects, who were contracted by international aid agencies or organizations to design specific buildings or complexes in Nepal within a limited time frame.
Kenzo Tange: Master Plan of Lumbini, Buddha's Birthplace.
Louis I. Kahn: The Family Planning Centre.
Tadao Ando: Women's and Children's hospital in Butwal
3rd Stream
Relates to the execution and construction of the projects and brought their own consortium of architects/consultants to ensure a certain standard in design and construction.
JICA: Teaching Hospital Campus, the Sano Thimi Tuberculosis Centre and the Disaster Mitigation Centre
Government architects from India: General Post Office building, the telecommunications buildings, and hospital projects like the Bir Hospital, the BP Koirala Institute of Medical Sciences in Dharan, and more recently, the New Trauma Centre in the Bir Hospital.
Chinese Government: Birendra International Convention Centre and the new Civil Employees' Hospital.
Other projects: International Terminal Building of the Tribhuwan Airport and embassy buildings.
4th Stream
Relates to commercially driven large construction projects, promoted by the Private Sector. In this category of work, the foreign architects have worked for Clients based in Nepal, financed by Nepalese Banks, constructed by mainly Nepalese contractors and approved by Nepalese authorities.
Projects: Large hotel projects like Soaltee, Taragaon Hyatt Regency, Radisson, Yak and Yeti and the Fulbari Resort.


Symbolism & Proportion In Nepalese Architecture
SYMBOLISM
1. FORM – SQUARE / CIRCLE
2. DYNAMIC
3. TOWN – COSMIC REPRESENTATION
RITUAL STRUCTURE
4. TEMPLE
5. STUPA
In detail!
Source: Prof. Sudarsan raj Tiwari (Lecture)
Symbolism:
The Hindu temple form symbolized Mount Meru, the centre of the world inhabited by the gods. The concept of pyramids on a circular lake gave rise to the concept of circumnavigation. The temple building, with its central axis pointing to the heavens, symbolises the heavenly movement of divine energies.
concept of Symbolism and Proportion in Nepalese Architecture 56

Symbolism & Proportion In Nepalese Architecture



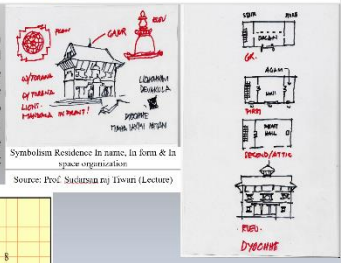
❖ **Proportions:**
Odd numbers are evident in temple plans, where odd numbers of bays are chosen, usually between 3 and 5 (Tiwari, 1989). The ideal height of the temple is determined by the Matsyapurana decree. Plan ratios vary from 5:9 in Jayabageswari, to 3:4 in Bhimsen Patan.

Source: Prof. Sudarsan raj Tiwari (Lecture)

concept of Symbolism and Proportion in Nepalese Architecture 57

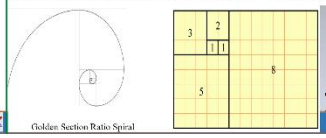
Symbolism & Proportion In Nepalese Architecture

❖ **Proportions, Scale & Order:**
In architecture, the whole is not just a building, but the surroundings and surroundings of the place. One of the things that makes a building and its place "beautiful" is its orientation with respect to the reality of the terrain it stands on. Light, shade, wind, height, etc. should all be related to the criteria, showing what constitutes it and what makes it different.



Symbolism Residence In name, In form & In space organization

Source: Prof. Sudarsan raj Tiwari (Lecture)



Golden Section Ratio Spiral

concept of Symbolism and Proportion in Nepalese Architecture

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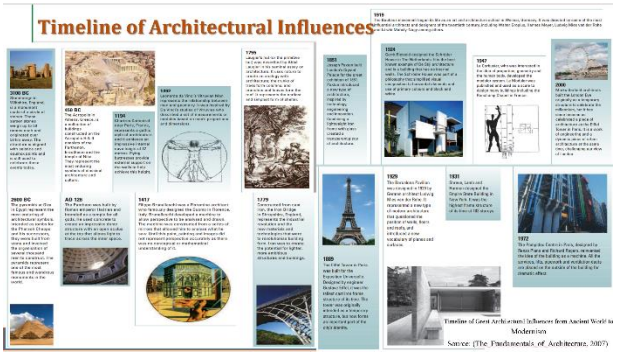
Timeline of Architectural Influences



Timeline of Great Architectural Influences from Ancient World to Modernism

Source: (The Fundamentals_of_Architecture, 2007)

Modernist Architecture: The Bauhaus and Beyond

- Modern architecture may be traced back to the Industrial Revolution when architects were experimenting with new materials like steel and reinforced concrete. From the 1920s, a new, experimental architecture was emerging, inspired by Modernist principles – open interiors and a lack of ornament – and the Bauhaus school.

❖ **Bauhaus Architecture**

- Bauhaus architecture prioritized function above all else, with a core principle of "**truth to materials**". Many Bauhaus buildings are **geometric, with flat roofs and streamlined facades**. This was meant as a stark rebuke of industrialization, the coldness of mass production, and consumerism.

Source: https://www.re-thinkingthefuture.com 60

Modernist Architecture: The Bauhaus and Beyond

- Modern architecture may be traced back to the Industrial Revolution when architects were **experimenting with new materials like steel and reinforced concrete.**
- From the 1920s, a new, **experimental architecture was emerging, inspired by Modernist principles – open interiors and a lack of ornament – and the Bauhaus school**.
- Bauhaus was a German school of art **founded by Walter Gropius** in 1919.
- The aim of the school was to reconcile arts and crafts **to create a new industrial aesthetic, that is now called design**.
- Bauhaus is characterized by the **use of simple, practical shapes such as squares, triangles, and circles, with minimum ornamentation**.
- Bauhaus architecture is characterized by the use of simple, practical shapes such as squares, triangles, and circles, with minimum ornamentation.
- It was designed to be a direct response to industrialization, mass production's coldness, and materialism. Bauhaus structures are frequently made of industrial materials such as concrete, glass, and steel.
- Because it was an architectural movement rather than a clearly defined style, you can encounter buildings with curved lines and softened corners rather than harsh angles.

Source: https://www.re-thinkingthefuture.com 61

Modernist Architecture: The Bauhaus and Beyond

❖ **Bauhaus Philosophy:**

- Taking advantage of the cultural climate to explore arts and design in a new direction.
  - First philosophy **absence of ornamentation** gets rid of the things that don't matter.
  - Harmony of Function and Form: **Function before Form, Form before Function no more** as Bauhaus allowed us **to unite these two designs is form and function**.
  - Harmony of craftsmanship and mass production: Bauhaus also brought us the **unity of quality** craftsmanship with the ability to mass-produce, and make it work by **Minimal isn't an aesthetic**: Bauhaus didn't keep things simple because it was pretty, but they kept things simple because it was holistic. View of the entire production process design isn't something we can add it's the whole thing from start to finish.

❖ **Key Elements of Bauhaus Architecture:**

- Not every Bauhaus **structure is the same.** They might be **straight and angular**, or they can have curving balconies and around corners.
- Eschewing ornamentation to **focus on simple, rational, functional design**
- A focus on **simple geometric forms** such as the triangle, square, and circle
- Asymmetry favored over symmetry
- Use of steel, glass, concrete, and other modern materials
- Flat roofs
- Glass curtain walls
- Smooth façades

Source: https://www.re-thinkingthefuture.com 62

Modernist Architecture: The Bauhaus and Beyond

❖ **Bauhaus architecture's major characteristics**

- •Structure
- •Massing
- •Planning
- •Authentic Materials
- •Geometric
- •Circulation
- •Symmetry

❖ **Bauhaus Today's**

1.Bauhaus Today

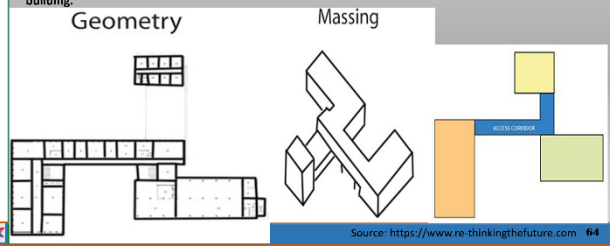
- User Experience
- Sustainability
- Innovation

Source: https://www.re-thinkingthefuture.com 63

Role of Bauhaus Influence in Modern Design

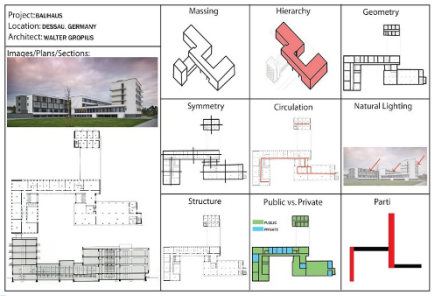
❖ Bauhaus influences may still be found in today's design trends as the building is an important **landmark of architectural history.**

- It is characterized by geometric design, respect for practical material, and severely economic sensibilities. The diagrams have been developed from the **three-dimensional form and space configurations of the building.**



Source: https://www.re-thinkingthefuture.com 64

Role of Bauhaus Influence in Modern Design



In the analysis part of the study, the basic geometric configurations used to determine a building's form include the square and rectangle as used in Bauhaus. Two adjacent squares directly determine the limits of the plans, two adjacent squares have a common side along with it. Two squares have also been overlapping to create a special condition of the common area. Rectilinear grids occur in the Bauhaus which is coincident with structure.

Precedents of Bauhaus Building, Analysis diagrams & Formative ideas

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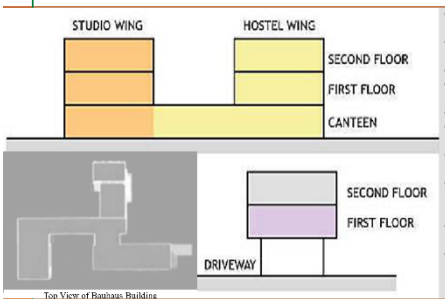
Role of Bauhaus Influence in Modern Design



Top View of Bauhaus Building

- Similar Functions housed in separate wings
- Corridors connecting different wings
- No central point in the layout
- **Provides decent flexibility and expandability**
- An outward looking complex
- Separate wings are designed as separate
- buildings housing specific functions
- Strong separation between wings imposes certain restrictions on **planning flexibility**
- **Use of glass intended to create a feeling of lightness to structure**
- **Absence of ornamentation** to the building was prevalent in practice during the period

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Conclusion

- When one rethinks about Architecture as a profession that builds the reality for people to live in, the **Geometric concepts mentioned might be constructed in one's own mind**.
- These geometric ideas may be **employed by architects to make our structures more nature-like, dynamic, and functional.**

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Case study design I – Observational realm

Saraswati Sadan

Saraswati Sadan is a milestone in the history of modern architecture in Nepal as it is the first concrete structure to be built in Nepal. It was built using new and innovative materials and technology including reinforced concrete and reinforced brick concrete. The buildings are largely defined by the early use of reinforced cement concrete.

Source: NSCU Library, goo.gl/e1LZ4Y
Source: Contemporary architecture in Nepal

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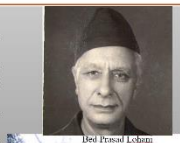
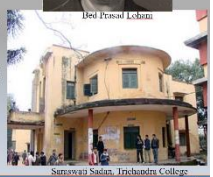
Case Studies - I : Saraswati Sadan

- **Bed Prasad Lohani, 1892**
- One of the founders and teachers of Nepal's first engineering school, which opened its doors on May 25, 1945.
- A technical man, a planner, an industrialist, an administrator, and a spiritual thinker. Due to his bravery, tenacity, honesty, and patriotism, he must stand higher.
- First Nepali to bring reinforced concrete construction technology to this nation.
- Also served as one of the founding members of Nepal's first planning commission, which he personally headed.
- On December 6, 1948, first time that Nepal had business relations with the United States of America. The deal was formally signed during a ceremony with all of Mohan's men.



Bed Prasad Lohani



Saraswati Sadan, Trichandra College

Source: Inventory of 19th and 20th Century Architectural and Industrial Heritage of Nepal

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Case Studies: Saraswati Sadan

Design Inspirations

- First person to introduce concrete in Nepal.
- Playing with a variety of elements in his buildings like RCC, RBC, dome etc.
- Designed Saraswati Sadan, Ranjana Hall, Ashok Hall, Nepal House or Raja Rani Kothi for Padma Shumsher (Ranchi, India) and more.
- Signature design is what we see; the round portion in almost all the buildings he has designed.

Design context

- The milestone in the history of modern architecture in Nepal as it is the first concrete structure to be built in Nepal.
- Built using new and innovative materials and technology including reinforced concrete and reinforced brick concrete.
- Curved front facade.
- Design is simple, functional, and structurally stable. Saraswati Sadan is said to have a hanging portico to prevent rain splutters.
- Massive walls and deep beams have been used in order to give large spans.
- Inverted beams have also been used to give a free-floating cantilever effect to the balconies.
- Played with levels and light in the design.
- Skylights and clerestory windows have been used in order to allow natural diffused light to enter the building.

Source: Inventory of 19th and 20th Century Architectural and Industrial Heritage of Nepal

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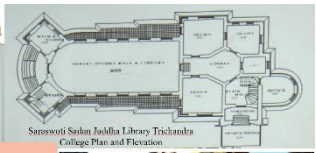
Case Studies: Saraswati Sadan



Saraswoti Sadan Juddha Library Trichandra College Plan and Elevation

Analysis of Planning

- Public functional buildings
- New Aesthetics using new materials and technology
- The Rotunda and the built form
- Courtyard is discarded
- Round, Curves, Straight lines angles in form of geometry is used
- Internal Volume
- Surface Detail and elevation
- New concept of staircase design
- Windows at corner and long vertical new concept
- Small pieces of Glasses as for design along with nouveau style

Source: Bed Prasad Lohani: A conversation on him and his works, Talk Program
Source: Inventory of 19th and 20th Century Architectural and Industrial Heritage of Nepal

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Geometry Influence in Modern Design in Saraswati Sadan

Project: Saraswati Sadan
Location: Ranipokhari, Kathmandu
Designed: Bed Prasad Lohani

Images/ Plans / Elevation

Massing | Hierarchy | Geometry
Symmetry | Circulation | Natural Lighting
Structure | Public vs Private | Parti

The basic geometric configurations used to determine a building's form that includes the square, rectangle, Semi circle, and hexagon as used in Saraswati Sadan. To make each basic form as observable as an entire figure, more than two additional basic forms have also been joined.

Precedents of Saraswati Sadan Building, Analysis diagrams & Formative ideas

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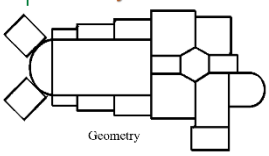
Geometry Influence in Modern Design in Saraswati Sadan



Similarly, massing of the Saraswati Sadan building has the potential to define and **articulate exterior spaces, accommodate site, identify entrance, express circulation, and emphasize importance in architecture.**

The **visually dominant or most prevalent three-dimensional configuration of a structure** is shown as its massing. It displays the perception of the structure as a whole.

In many instances, the center space, although appearing to be dominant from the outside, functions as a hub for circulation and an organizer of surrounding areas. The notion of **linear configurations, which separates circulation from user space, has been used to spine or corridor organisations.** The exact geometric combination of the building's massing is a rectangle covered by a semicircle.

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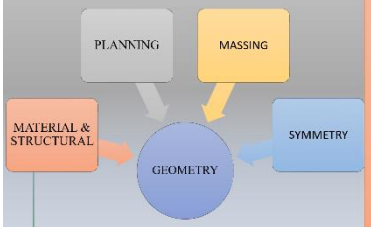
Case Studies - I: Saraswati Sadan

❖Unit of Analysis and its Attributes



MATERIAL & STRUCTURAL APPEAL

- Massive walls and deep beams have been used in order to give large spans.
- Inverted beams have also been used to give a free-floating cantilever effect to the balconies.
- New Aesthetics using innovative materials and technology including reinforced concrete and reinforced brick concrete

FORM & FUNCTIONAL APPEAL

- The Rotunda and the built form
- Courtyard is discarded
- Round, Curves, Straight lines angles in form of geometry is used
- Internal Volume
- Surface Detail and elevation

AESTHETIC APPEAL

- A new concept of staircase design
- Windows at the corner and a long vertical new concept
- Small pieces of Glasses for design along with nouveau style

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Case Study Design II: THE LUMBINI MUSEUM

INTRODUCTION

CASE - II

The Lumbini Museum

The Lumbini Cultural Centre is located at the northern end of the project area, near the New Lumbini Village and envisioned entrance to the complex. The design of the buildings of the Lumbini Cultural Centre Design is based on a barrel-vaulted cylindrical modular style inspired by vaulted Buddhist monasteries of Central Asia. The modules follow the same structural principle, with higher floor height and clerestory windows allowing more natural light and ventilation.

(Source: Kingdom of Nepal)

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Case Studies - II : Lumbini Museum

❖Kenzo Tange

- In Osaka, Japan, Kenzo Tange was born in 1913.
- One of the greats despite growing up in a farmhouse with a thatched roof.
- The five Corbusier points of architecture were influenced by Villa Savoye, designed by Le Corbusier in 1931.
- Tange has a special place in his heart for Lumbini.
- His idea infuses the 3-square-mile area of the Sacred Garden with the essence of the Buddha's universal message of openness and peace (The Lumbini Museum).
- Kenzo Tange, especially his vision and later frustration in designing the memorial park and monument to honor the birthplace of the Buddha in Lumbini, Nepal.
- Site was designed to be an ecumenical park where Buddhists from all cultures could build a culture of peace and mutual respect.
- Tange, the designer of the Lumbini Sacred Garden in Nepal, seems to have been a reluctant Buddhist and explicitly rejected "traditional Japanese" architecture in most of his work.
- Kenzo Tange was attracted to the "conversation spaces" that were part of Italian plaza design and that would later have an influence on his design of the garden and park memorializing the Buddha's birthplace in Lumbini, Nepal (The Lumbini Museum).

Source: Inventory of 19th and 20th Century Architectural and Industrial Heritage of Nepal

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Case Studies - II : Lumbini Museum

Design Inspirations

- Tange's architectural philosophy, which came to be known as "Metabolism."
- Believed that architecture in the past had been functionalist, dealing with the need for human workplaces, living places, and recreational places.
- Built purposive "voids" into his design to allow expansion and change in the design over time, and he wanted buildings and courtyards to have moveable walls and facades to accommodate change according to occupants.
- According to the design Philosophies of Kenzo Tange, Architecture must have something that appeals to the human heart, but even then, basic forms, spaces, and appearances must be logical.

Design context

- Kenzo Tange's design for the Buddha's Birthplace memorial monument and park at Lumbini, which included discussion areas and zones of activity, as well as planned open space to permit future development, was in fact most influenced by his philosophy, not Buddhist notions.
- The Lumbini Museum will bring to life these sacred stories that offer a glimpse into the wealth and profundity of Buddhist teaching as the world's only contemporary museum of the Buddha and his Birthplace.
- The most famous archaeological, historical, cultural, and spiritual landmark in Nepal is the Sacred Garden of Lumbini.

Source: Inventory of 19th and 20th Century Architectural and Industrial Heritage of Nepal

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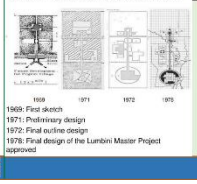
Case Studies - II : Lumbini Museum

The Lumbini Project, Nepal

•Conceptualization in 1972.
•Finalized and approved in 1979.
•5X5 miles of Lumbini area with the central square mile being the sacred garden.
•Objectives- Respect for universal value of Lumbini

According to Prof. Kenzo Tange, "The form of a circle enclosing a square is a mystical universal symbol of purity and simplicity. Architecturally no built structures are to be added to the garden except the essential forms like offices, meditation cells, utility blocks and restoration of Mayadevi Temple."



1969: First sketch
1971: Preliminary design
1972: Final outline design
1978: Final design of the Lumbini Master Project approved

- The Master Plan's geometric interpretation is centered on religious symbolism, with the central 5x5-mile Mandala and Sacred Garden serving as its focal point.
- Kenzo Tange designed the memorial park and monument to honour the birthplace of the Buddha in Lumbini, Nepal. Tange fused "traditional Japanese forms with the very latest in structural daring"
- Prof. Tange's master plan for Lumbini is divided into three main construction-conservation zones. The first one sq. mile is dedicated to the sacred garden and the temple of Mayadevi. The second radius is monastic and cultural zone and the last region is a commercial zone.

Source: Inventory of 19th and 20th Century Architectural and Industrial Heritage of Nepal

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Case Studies - II : Lumbini Museum

Fig :Sacred Space

Fig :The Museum

Planning and Building Form

- Tange intended for the pilgrim's personal journey in Lumbini to mirror the Buddha's own journey: beginning in the real world (Hotels and Guesthouses), we travel to a center of knowledge and wisdom (Museum and Library), then through the monastic zones with temples constructed by different nations, and finally to the inner sanctum at Maya Devi Temple, which symbolizes enlightenment.
- The expanded Museum space will tell a unified account of the Buddha's early life and the development of Buddhism.
- The early vaulted Buddhist temples of Central Asia served as inspiration for the barrel-vaulted cylindrical modular architecture used in the Lumbini Cultural Centre's structures.

Source: Picture: Lumbini International Research Institute

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Case Studies - II : Lumbini Museum

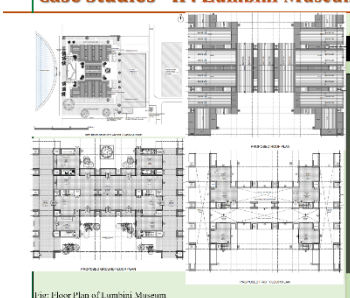


Fig: Floor Plan of Lumbini Museum

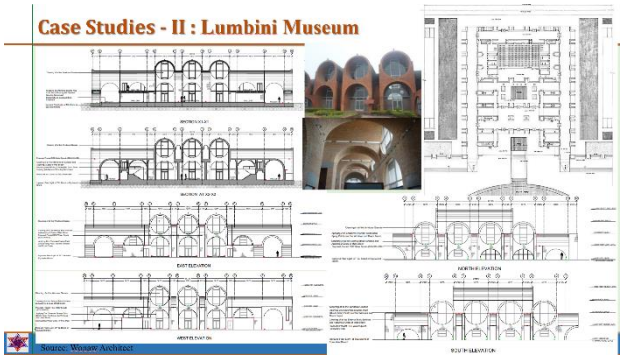
Analysis of Planning

- Building plan is in a grid form
- Form is strikingly similar to that of Kimbell art museum
- Use of brick cylindrical blocks fitted with large round windows reminds of vaults used in Kimbell
- Exposed brick masonry construction reflects essence of his work in the interplay of mass and void
- Light plays an important factor in the interior adding drama to the place similar to the magnificent interiors of Kimbell art museum.

Source: Picture: Lumbini International Research Institute

S1

Case Studies - II : Lumbini Museum



Source: Wisdom Architect

Case Studies - II : Lumbini Museum

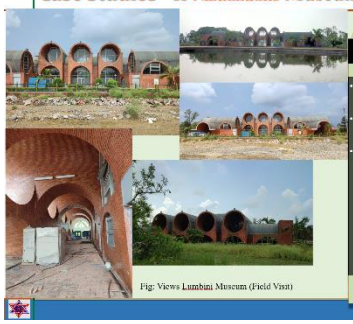


Fig: Views Lumbini Museum (Field Visit)

Analysis in Geometry Aspect

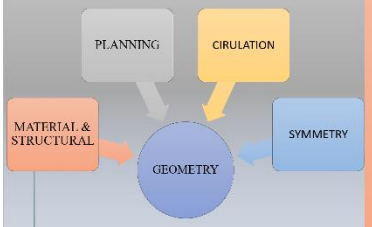
- *Circle – The most predominant and basic form in the Master Plan representing the six aspects of Buddhism.*
- *Square – Used along with the circle representing five aspects of Mahayana of Buddhism.*
- *Line –The main axis of the Master Plan joining the centre of the Sacred Garden to the Lumbini Centre, seems to provide a sense of hierarchy to the Master Plan. The Lumbini Centre, accommodating materialistic aspects (hotels, schools, hospitals), is envisioned as a sort of impurity and is kept well away from the Sacred Garden. Similarly, the Cultural Centre is a transitional space, a form of a buffer zone, and the Monastic zone is for diversity of the Buddhist understanding of knowledge, accommodating libraries, research centres and monasteries. The true crux of the Master Plan, the Sacred Garden representing enlightenment, is then approached, which is accommodated at the extreme end.*

Source: Picture: Lumbini International Research Institute

S3

Case Studies - II : Lumbini Museum

❖Unit of Analysis and its Attributes



- Large welcoming courtyard (water pool)
- Centrally placed water bodies
- Balances external temperature
- High degree- of human comfort- outdoor
- Use of arch, vault, curve, and circle as a form of geometry
- Whereas my experience of Lumbini has been that of relatively open, flat spaces,, in which Kenzo Tange's vaulted brick structures peek out of a lush, verdant forest, rather than monolithically (and somewhat mournfully) rising from it.
- Space is transformed into a state-of-the-art museum.
- Buddhist concepts are given form and personal expression through art practice

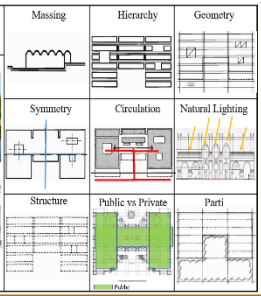
- Volumetric balance of built form
- Gives a touch of modern architecture.
- Symbolic and interesting architectural form
- New construction techniques.
- Good play of different volumes of interior spaces.

S4

Geometry Influence in Modern Design in Lumbini Museum

Project: **The Lumbini Museum**
Location: **Lumbini , Nepal**
Designed: **Kenzo Tange**

Images/ Plans / Elevation



Kenzo Tange created modern architecture in the ancient city of Lumbini. The most unique elements are the **huge equal-sized cylindrical** volumes intersecting each other at right angles. The design is beautiful with **brick-clad surfaces** and the series of **vault roofs are externally coated with bitumen** solution to avoid water leakage.

The visually dominant or most prevalent **three-dimensional configuration of a structure** is shown as its massing. It displays the perception of the structure as a whole. Open courts that interrupt the **structural system form the unique units in the structure**. Grids are developed from the repetition of the basic geometries where it has to exemplify plain grids.

Precedents of Lumbini Museum Building, Analysis diagrams & Formative ideas

S5

Summary

Title	Saraswati Sadan	Lumbini Museum
Intro	Bed Prasad Lohani • Born: September 2, 1995 • Death: Tuesday, April 8, 2003 • An educationist and a technical man • A planner, and an Industrialist • An administrator and a spiritual thinker	Kenzo Tange • Kenzo Tange was born in 1913 in Osaka. • Despite growing up in a thatched-roof farm house, he went on to become one of the great. • Inspired by Le Corbusier's 1931 Villa Savoye the five points of architecture Corbusier. • The five points included the use of thin "piloti" columns, roofs that could be used functionally as gardens or terraces, large interior rooms with minimal load-bearing walls, horizontal windows, and subdued facades.
Design Inspirations	• First person to introduce concrete in Nepal. • Playing with a variety of elements in his buildings like RCC, RBC, dome etc. • Designed Saraswati Sadan, Ranjana Hall, Ashok Hall, Nepal House or Raja Rani Kothi for Pedma Sumsher (Ranchi, India) and more. • His signature design is what we see: the round portion in almost all the buildings he has designed.	• Built as a component of the Lumbini Master Plan, Tange was likely inspired by Carl Peuhea's earlier work in Nepal • As the world's only contemporary museum of the Buddha and his Birthplace, the Museum will be the anchor that sets the stage and enhances a visitor's experience of Nepal's most sacred site. • Lumbini Museum will bring to life these sacred stories that provide a glimpse into the wealth and profundity of Buddhist teaching.

S6

Title	Saraswati Sadan	Lumbini Museum
Design Context	• The significant architectural structures that were originally built during the early modern period which would span from the 1940s through the 1960s. • These buildings are largely defined by the early use of reinforced cement concrete and greatly influenced by architectural and engineering designs that go beyond historicity. • Have elements of "modern" architecture, is a good example of architecture from the early modern period.	• There are few places in the world as sacred and as widely revered as Lumbini. • The Sacred Garden of Lumbini is Nepal's most iconic archaeological, historical, cultural and spiritual site. • It is in this context that, for the first time, a state-of-the-art institution—The Lumbini Museum—is being created inside the Sacred Garden Area.
Building Plan	• Rectangular axis with circular to give feeling of line of passage • Design is simple, functional, and structurally stable. Have a hanging portico to prevent rain splutters.	• Design of the buildings is based on a barrel vaulted cylindrical modular style
Form	• Playing with a variety of elements in his buildings like RCC, RBC, dome etc. • The round portion has designed with Curved front façade. • Played with levels and light in the design	• Inspired by the early vaulted Buddhist monasteries of Central Asia as the modules follow the same structural principle. • Wide arches and vaults create higher floor height and clerestory windows, allowing more natural light and ventilation, which is particularly important in this hot climate area. • The configuration of each module is placed in such a way that it forms courtyard allowing cross ventilation.

S7

Title	Saraswati Sadan	Lumbini Museum
Function	•Massive walls and deep beams have been used in order to give large spans. •Inverted beams have also been used to give a free-floating cantilever effect to the balconies. •Play with levels and light in the design. •Skylights and clerestory windows have been used in order to allow natural diffused light to enter the building. • Light plays an important factor in the interior adding drama to the place	• Central plaza for conversation between people from all social classes, and public buildings like auditoriums and commercial districts. • More connections to the notion of the plaza and the promenade than to Buddhist traditional architecture • Built purposive "voids" into design to allow expansion and change in the design over time, • Buildings and courtyards to have moveable walls and facades to accommodate change according to occupants • Conversation spaces, zones of activity, and planned open space to accommodate future change
Material	• Constructed with cutting-edge technology and materials, such as reinforced concrete and reinforced brick concrete • Use of reinforced cement concrete • New and innovative materials and technology • Design is simple, functional, and structurally stable	• Chinese kiln-fired red bricks >> instead of Dachi brick predominant building material since many centuries, giving • Barrel vaults are made up of one brick on edge. • Stone paved paths and courtyard • Exposed brick masonry construction reflects essence of his work in the interplay of mass and void • Use of brick cylindrical blocks fitted with large round windows reminds of vaults

S8

Analysis Field Work - INTERVIEW

Approach of use of Geometry in modern architecture: A Study of its in Nepalese Architecture

Q.1.What is the Role of geometry in architecture?

Q.2.What is your view on the use of geometry in modern architecture in the context of Nepal?

Q.3. As I am doing my case studies research on building such as Saraswati sadan by Bed Prasad Lohani and The Lumbini Museum by Kenzo Tange, in your view do that building shows the strong influence of geometry?

Q.4.In your view what is the important determinant one should focus to create a good composition of geometry in designing?

Q.5.Do you see in today's context a meaningful define building in the perception of geometry in Nepal? If yes which building do you prefer?

90

Analysis Field Work - INTERVIEWS

91

Analysis Field Work – INTERVIEW: 1

Time Stamp: 2.00 P.M. – 5:15 P.M
Date: 05-07-2022

- According to Prof. Sudarshan raj Tiwari, Approach to use of geometry in modern architecture coming from Vastu sastra and the traditional architecture. As all **architecture is defined from its dimension- measurements- (size, shape, proportion).**
- Use of square- Egyptian, Maya civilization. **Circle and square such basic shape. Philosophy of square- all architecture- perfect building**
- **Mathematics form has been considered from the movement of universe.**
- Circle to square axiality has form. For Infinite, roundness good form and for the Finite - square form has been developed.
- Proportioning theory has been derived from- square **In geometry there is time and space theory**
- Modern architecture-geometry- **aesthetics**. Element as a character. **Architect- aesthetic appeal, functional appeal, structure appeal**
- Geometry mainly does not mostly depend on functionality but Structure and aesthetic appeal do depend. Time, space, and heavenly arrangement are different.

"Prof. Dr. Sudarshan Raj Tiwari, Archaeological excavations at Mayadevi Temple in Nepal have revealed layers of construction up to various historical periods. The site has been of great importance throughout history starting from Lord Buddha's birth. Various stages of construction have been done taking place around the Nativity Sculpture.

92

Analysis Field Work – INTERVIEW: 1

Time Stamp: 2.00 P.M. – 5:15 P.M
Date: 05-07-2022

According to Prof. Sudarshan raj Tiwari, Approach to use of geometry in modern architecture coming from Vastu sastra and the traditional architecture. As all **architecture is defined from its dimension- measurements- (size, shape, proportion).**
Immortals- Temple- glow energy went- never dies- so try to make a building it last long.
Mortal- it did not need to last long.
The building last longer-lasting- Nepalese architecture- temple.
Foreign- pyramid
God kings- 14th century- god kings idea= they themselves god- so his house- strong- dimension aspect
Mention in **Vastu sastra** about that temple- do not change its dimension. Even if Proportion is not perfect than it is used to believe in that god doesn't reside. It's just building not a temple.
How come geometry become such part in aesthetics?
Use of square- Egyptian, Maya civilization. **Circle and square such basic shape.** If we look at the sky all are circles. Planet, sun, moon
Philosophy of square- all architecture- perfect building- Axiom- it is true. Since it is there so it is true. No need to prove it. **Mathematics form has been considered from the movement of universe.** As observation and imagination are disputable. But mostly observation. From **Circle to square axiality has form. For Infinite, roundness good form and for the Finite - square form has been developed. As proportioning theory has been derived from- square.** In Theory- it was already there. And to Observe. Physics- its physical phenomenon.
Inside Vastu sastra, in geometry there is time and space theory. While in designing one should consider space and time both while designing time exist from before we just observe.
In universe- 1) earth space, 2) time 3) heaven one should always design and consider for three element which will fit in it. Modern architecture-geometry- **aesthetics.** Element as a character. **Architect- aesthetic appeal, functional appeal, structure appeal. Geometry mainly does not mostly depend on functionality but Structure and aesthetic appeal do depend.** Time, space, and heavenly arrangement are different. 25,920 special number.

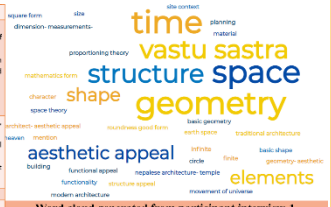
93

Codes for Analysis From INTERVIEWS

Theme	Geometry	Structure	Material	Site Context	Planning
Code	Circle	Dimension	Aesthetic	Site surrounding	Vastu Sastra
	Square	Measurement	Technology	Topography	Modern Architecture
	Form	Function	Brick	Good Composition	Traditioanl Architecture
	Shape	Circulation	Traditional material	Open area	Space
	Basic Geometry	Inverted Beam	Embodied energy	Landscape	Fragment
	Proportion	Scale	Glass	Site Shape	Abstract
	Space	Cantilever	Concrete	Terrain	Secular Architecture
	Scale	Experiment	RCC	Contour	Inner Planning
	Fragment	Circular	Bay window	Site Boundary	Islamic Architecture
	Abstract	Rctangular	Visual	Open Space	arch
	Symbolic	Vault		Urban Fabric	Hexagonal
	ArchiType	rigid Geometry		Natural Shape	Octagonal
	Grid	urban Infrastructure		Physical Context	Organic
	Eculidean shape	Dome			Contemporary Design
		Human Antomy			Placement
		Grid			Settlement Plan
		human psychic			

Coding from INTERVIEW: 1

Code	Description
Basic Geometry	• Circle and square such basic shape • Mathematics form has been considered from the movement of universe. • For Infinite, roundness good form and for the Finite - square form has been developed. As proportioning theory has been derived from- square • Vastu sastra, In geometry there is time and space theory . • Designing one should consider space and time
Structure	• Architecture is defined from its dimension- measurements- (size, shape, proportion) . • Element as a character. Architect- aesthetic appeal, functional appeal, structure appeal • Geometry mainly does not mostly depend on functionality but Structure and aesthetic appeal do depend.
Material	• Modern architecture-geometry- aesthetics
Site Context	.....
Planning	• Vastu sastra and the traditional architecture . • The building last longer-lasting- Nepalese architecture- temple. • Mention in Vastu sastra about that temple- do not change its dimension • Designing one should consider space and time • In universe- 1) earth space, 2) time 3) heaven one should always design and consider for three element which will fit in it



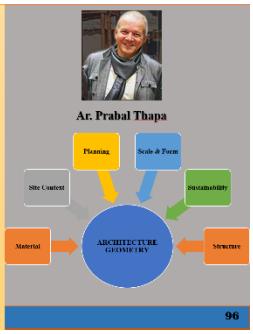
Word cloud generated from participant interview-1

95

Analysis Field Work – INTERVIEW: 2

Time Stamp: 3:00 P.M. – 5:00 P.M
Date: 07-07-2022

- According to Ar. Prabal Thapa sir, **Material has influence the geometry in defining any Shape, Form, Scale and Proportion along with scale and form of the building seems important to him.**
- Saraswati Sadan different from the traditional Architecture but use of traditional material which is brick for the form which directly has define the geometry in context of form, shape etc. which also represent the new modern architecture with the use of new modern technology and material such as glass, concrete, inverted beam etc. RCC as a structural material influence during the period.
- To create a good composition **Geometry should be related to mainly proportion than scale, site context which should ultimately blend into surrounding whereas Shape and form are important for the traditional architecture.**
- In his view now a day while designing for any building, surrounding or using any modern concept one should consider the carbon emission, climate and sustainability of the project.



96

Analysis Field Work – INTERVIEW: 2

Time Stamp: 3:00 P.M. – 5:00 P.M
Date: 07-07-2022

Founder of Prabal Thapa Architect's which was establised in 2002. He has integrates sustainable design solutions, passive solar designs, with energy effectient and cost effective soultions in all projects. He has specializes in Rammed Earth Construction.
According to Ar. Prabal Thapa sir, **Material has influence the geometry in defining any Shape, Form, Scale and Proportion.** Talking about the Saraswati Sadan different from the traditional
Architecture but use of traditional material which is brick for the form which directly has define the geometry in context of form, shape etc. which also represent the new modern architecture with the use of new modern technology and material such as glass, concrete, inverted beam etc. RCC as a structural material influence during the period.
According to his opinion, to create a good composition **Geometry should be related to mainly proportion than scale, site context which should ultimately blend into surrounding whereas Shape and form are important for the traditional architecture.**
In his view now a day while designing for any building, surrounding or using any modern concept one should consider the carbon emission, climate and sustainability of the project.

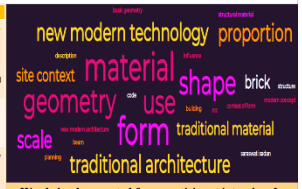
97

Codes for Analysis From INTERVIEWS

Theme	Geometry	Structure	Material	Site Context	Planning
Code	Circle	Dimension	Aesthetic	Site surrounding	Vastu Sastra
	Square	Measurement	Technology	Topography	Modern Architecture
	Form	Function	Brick	Good Composition	Traditioanl Architecture
	Shape	Circulation	Traditional material	Open area	Space
	Basic Geometry	Inverted Beam	Embodied energy	Landscape	Fragment
	Proportion	Scale	Glass	Site Shape	Abstract
	Space	Cantilever	Concrete	Terrain	Secular Architecture
	Scale	Experiment	RCC	Contour	Inner Planning
	Fragment	Circular	Bay window	Site Boundary	Islamic Architecture
	Abstract	Rctangular	Visual	Open Space	arch
	Symbolic	Vault		Urban Fabric	Hexagonal
	ArchiType	rigid Geometry		Natural Shape	Octagonal
	Grid	urban Infrastructure		Physical Context	Organic
	Ecludiean shape	Dome			Contemporary Design
		Human Antomy			Placement
		Grid			Settlement Plan
		human psychic			

Codes for Analysis Field Work – INTERVIEW: 2

Code	Description
Basic Geometry	• geometry in defining any Shape, Form, Scale and Proportion . • use of traditional material which is brick for the form • geometry in context of form, shape • Geometry should be related to mainly proportion than scale • Shape and form are important for the traditional architecture .
Structure	• use of new modern technology • inverted beam etc. RCC as a structural material
Material	• Material has influence the geometry in defining any Shape, Form, Scale and Proportion . • use of traditional material which is brick for the form • use of new modern technology and material
Site Context	• site context which should ultimately blend into surrounding • designing for any building, surrounding or using any modern concept one should consider
Planning	• Saraswati Sadan different from the traditional Architecture • new modern architecture with the use of new modern technology and material • Shape and form are important for the traditional architecture .



Word cloud generated from participant interview-2

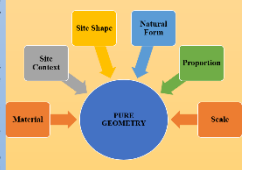
99

Analysis Field Work – INTERVIEW: 3

Time Stamp: 3.00 P.M. – 5:30 P.M
Date: 08-07-2022

- In architecture, there has always been an important role of geometry as ultimately everything depend on it.
- Temple are in square form, as comparative more perfection which mainly depend on Square and Circle. Such as in Buddhism use of circle it has Spiritual value as before use as segregate geometry. Now- a- days anything that has been seen is used.
- **Geometry not used directly but in biomimicry or use in natural form, use of geometry can be seen less.**
- Geometry has Certain measurement which is always used in construction will always be followed. **Site Shape has mainly define geometry in context while following secular architecture where shape help to guide.**
- **Topography can change the use of geometry and Material also consider geometry.**
- **Traditional architecture very importantly depend upon proportion and scale.**
- Bed Prasad Lohani has shown a courage to build building as first concrete which has cantilever and carried the experiment and play with circular, rectangular form and shape structurally
- Pure geometry can be seen as of now or present day combination of different form, shape for different composition is used along with material.
- New material, new structure etc. gave the architect in pre early modern age gave freedom to express and experiment in context of geometry too.
- Geometrical composition depend mainly on material and site context has it has help to emerge new form such as hexagonal, octagonal etc. which is possible with structural and material as structure knowledge and material has given freedom to the use geometry.

Ar. Deepak Pant



100

Analysis Field Work – INTERVIEW: 3

Time Stamp: 3.00 P.M. 5:30 P.M
Date: 08 07 2022

In architecture, there has always been an important role of geometry as ultimately everything depend on it. Abstraction has its limited value because it either historically deals with Vastu-Sastra along with geometry and architecture. Traditionally Geometry has been used differently, likewise Temple are in square form, as comparative more perfection which mainly depend on Square and Circle. Such as in Buddhism use of circle it has Spiritual value as before use as segregate geometry. Now- a- days anything that has been seen is used.
In present scenario, **Geometry not used directly but in biomimicry or use in natural form, use of geometry can be seen less.** Geometry is used ultimately in past, present and also be use in future. Certain measurement is always used in construction will always be followed. **Site Shape has mainly define geometry in context while following secular architecture where shape help to guide.** It helps how build form has guide the site context which response as the main factor.
Normally, the guiding factor will be site context and then internal planning and form. Geometry cannot be separated by building. In traditional settlement, use of abstraction of geometry were used like in Nepal context such as malla period, medival period etc. As for example, as in Patan which was considered as circular was indirectly has the concept of radial road whereas as of bhaktapur has square concept. Likewise, during the Lichhavi period, square of 9 square has been used which is as design along with the site context.
Topography can change the use of geometry as CEDA building is the example. Likewise, **Material also consider geometry**. Mostly to learn about the Geometry, Islamic architecture will be the best to study as they have experimented different form, shape along with the scale and proportion to create a beautiful architecture such as development of motif, decoration are been develop by floral, nature which can also be said ultimately guided by geometry which shows strong geometry. From the Islamic Architecture pattern which hence can be studied as complex geometry as arch came from Mughal whereas from Hindu came square and symmetry form.
Traditional architecture very importantly depend upon proportion and scale. Apparently, talking about the Bed Prasad Lohani has shown a courage to build building as first concrete which has 9 feet cantilever as he has knowledge to carry the experiment and play with circular, rectangular form and shape structurally. So, it can also be said that during the time of pre early modern, architecture, there knowledge regarding concrete also brought to design with different form.
Before as As due to knowledge of new material, new structure etc. gave the architect in pre early modern age gave freedom to express and experiment in context of geometry too. Use of new idea as bay window in concrete which also bring the material, technique which intend to bring new concept of vault, arch along with the use of strong sense of geometry too. In his view, Geometrical composition depend mainly on material and site context has it has help to emerge new form such as hexagonal, octagonal etc. which is possible with structural and material as structure knowledge and material has given freedom to the use geometry. Likewise, during the Lichhavi period, square of 9 square has been used which is as design along with the site context.

Codes for Analysis From INTERVIEWS

Theme	Geometry	Structure	Material	Site Context	Planning
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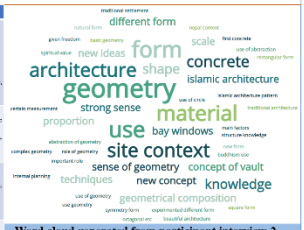
	Ecludiean shape	Dome			Contemporary Design
		Human Antomy			Placement
		Grid			Settlement Plan
		human psychic			

Codes for Analysis Field Work – INTERVIEW: 3

Code	Description
Basic Geometry	• In architecture, there has always been an important role of geometry • temple are in square form, • perfection which mainly depend on Square and Circle • buddhism use of circle it has Spiritual value • Geometry not used directly but in biomimicry or use in natural form • Shape has mainly define geometry in context • Islamic architecture will be the best to study as they have experimented different form, shape along with the scale and proportion to create a beautiful architecture • It has help to emerge new form such as hexagonal, octagonal etc.
Structure	• Certain measurement is always used in construction will always be followed • first concrete which has 9 feet cantilever as he has knowledge to carry the experiment and play with circular, rectangular form and shape structurally • Use of new idea as bay window in concrete which also bring the material, technique which intend to bring new concept of vault, arch along with the use of strong sense of geometry • structural and material as structure knowledge
Material	• Material also consider geometry • knowledge regarding concrete also brought to design with different form • Use of new idea as bay window in concrete which also bring the material, technique which intend to bring new concept of vault, arch along with the use of strong sense of geometry • Geometrical composition depend mainly on material and site context • Material has given freedom to the use geometry
Site Context	• build form has guide the site context which response as the main factor. • guiding factor will be site context and then internal planning and form • topography can change the use of geometry • Geometrical composition depend mainly on material and site context • square of 9 square has been used which is as design along with the site context
Planning	• traditionally deals with Vastu-Sastra along with geometry and architecture • Traditionally Geometry has been used differently, • In traditional settlement, use of abstraction of geometry were used like in Nepal context • Islamic Architecture pattern which hence can be studied as complex geometry as arch came from Mughal whereas from Hindu came square and symmetry form.



Word cloud generated from participant interview-2

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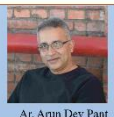
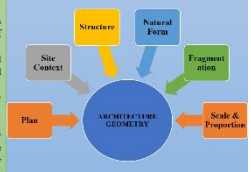
Analysis Field Work – INTERVIEW: 4

Time Stamp: 4.00 P.M. – 6:00 P.M
Date: 10-07-2022

- **Symbolically geometry has played strong role**. But in **Nepali Architecture due to inherited, it is organic. So it is not defined by geometry but with site.**
- Nepali form and feel of geometry define by its Site
- Geometrical form are strongly seen in temple such as in Durbar Square where it is strongly portrail. Vertical geometry especially known as European geometry which is a reductionist such as clean circle, square, cube are not the perfect form of Nepali geometry.
- Use form in contemporary basis to put them all in single line but it will be good in open area in order to make a good blend in space.
- Scale is also more important than geometry putting in terrain with perfect edges geometry with the acrobatics open with the rigid type of geometry which imposition of pure geometry are avoided. Human scale, proportion are the importance of geometry.
- Scale and proportion come from plan so it is directly dependent to plan, but functionally it can be possible to depend on vertically whenever it is considered whereas horizontally it depend upon the project.
- Settlement plan or else city plan than we can see fragmentation more than geometry which is the pure rigid geometry for the composition.
- Our vision in context help to define separate form and mass.
- **"Site context can play an important role or can be place regarding pure geometry regarding place making. But in context of urban infrastructure or urban scale breaking pure geometry will be best, overall from visual to function, consciously breaking of geometry."**
- Lastly in his view, Responsible architecture recognized the fact that don't depend upon geometry but anti-geometry is most probability as Nepal traditionally followed as per



Ar. Arun Dev Pant



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Analysis Field Work – INTERVIEW: 4

In Saraswati sadan, use of geometry definitely can be seen. As **symbolically geometry has played strong role.** But in **Nepali Architecture due to inherited, it is organic. So it is not defined by geometry but with site.** Geometry can be seen predisposed, forcefully done on site. In traditional geometry it can't be define as because it's too small but not too dominants. City growth are organic so it's limited. Nepali form and feel of geometry define by its Site but not strictly followed but in case of contemporary design, due to the large scale geometry come automatically.

Geometrical form are strongly seen in temple such as in Durbar Square where it is strongly portrait. Vertical geometry especially known as European geometry which is a reductionist such as clean circle, square, cube are not the perfect form of Nepali geometry. These contemporary buildings will not look good if we bring such as Carl Pruscha work like vault or as Kenzo Tange will not work. It is good for experiment on use form in contemporary basis to put them all in single line but it will be good in open area in order to make a good blend in space. Individual building can be done as they can be rectilinear but cannot see rigid geometry but can break or fragmented.

Placement plays very important role in terrain whereas Scale is also more important than geometry putting in terrain with perfect edges geometry with the acrobatics open with the rigid type of geometry which imposition of pure geometry are avoided. It can be done where is highly symbolic such as lumbini can be done but geometrical acrobatic are not possible or it's too disturbance to eye.

Human scale, proportion are the importance of geometry. According to Arun dev sir, whenever it is possible one should go for horizontally rather than vertically while designing. As Scale and proportion come from plan so it is directly dependent to plan, but functionally it can be possible to depend on vertically whenever it is considered whereas horizontally it depend upon the project.

After seeing settlement plan or also city plan than we can see fragmentation more than geometry which is the pure rigid geometry for the composition. Site and boundary such as terrain is contextualize to break the geometry. Architecture design cannot be possible if tried to design as classical because system depend upon the geometry which will fail to design.

If we can serialize our vision in context, than each vision component should be equally good that will help to define separate form and mass that should in the context. In western context we can visual the purest form of geometry but as if they also needed variety and they are breaking the form.

Lumbini Museum is the iconic building, international project that had to be iconic in Plan, Form, Scale which depend upon the site area. In modern context, normally to some extent improvement in Bishal bazar, Lalitpur Labim mall has contextually has done a good job as a composition to visualize modern building as design as non- air conditional along with the visual glimpse of interior and form which are appreciative which shows the concept of contemporary architecture. Kathmandu existing pressure and challenges has played a very important role on urban form, spaces for the development because of its anti-pure geometry. This is the contemporary example which shows how it has made pressurized on already built building for add on future building which depend upon or guided by site.

CEDA building design by Carl Pruscha in context of geometry is the best example as it has shown the pure form to feel comfortable. Where as in Lumbini Museum by Kenzo Tange has design in large open space in which pure geometry can be seen where as in clustered space which is close space pure geometry to be break in order to get good composition. Generally. **"Site context can play an important role or can be place regarding pure geometry regarding place making. But in context of urban infrastructure or urban scale breaking pure geometry will be best, overall from visual to function, consciously breaking of geometry."**

So we can study the building to understand the building to understand the beauty, form and architecture of pure geometry. Similarly the fragmentation in the Taragaon Museum design by Carl Pruscha is more applicable to urban fabric. Eventually Geometry destroy the urban fabric of the building. This type can be played and design in open area but avoid to further proceed in heritage core area. In retrospect it been consider to avoid to do in large scale which is especially in contextual site. In his view mostly it Possibility of trying to blend with landscape the use of geometry.

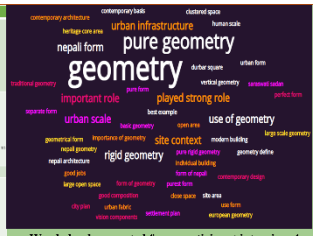
Lastly in his view, Responsible architecture recognized the fact that don't depend upon geometry but anti geometry is most probability, as Nepal traditionally followed as per the pure form is concern.

Codes for Analysis From INTERVIEWS

Theme	Geometry	Structure	Material	Site Context	Planning
Code	Circle	Dimension	Aesthetic	Site surrounding	Vastu Sastra
	Square	Measurement	Technology	Topography	Modern Architecture
	Form	Function	Brick	Good Composition	Traditioanl Architecture
	Shape	Circulation	Traditional material	Open area	Space
	Basic Geometry	Inverted Beam	Embodied energy	Landscape	Fragment
	Proportion	Scale	Glass	Site Shape	Abstract
	Space	Cantilever	Concrete	Terrain	Secular Architecture
	Scale	Experiment	RCC	Contour	Inner Planning
	Fragment	Circular	Bay window	Site Boundary	Islamic Architecture
	Abstract	Rctangular	Visual	Open Space	arch
	Symbolic	Vault		Urban Fabric	Hexagonal
	ArchiType	rigid Geometry		Natural Shape	Octagonal
	Grid	urban Infrastructure		Physical Context	Organic
	Ecludiean shape	Dome			Contemporary Design
		Human Antomy			Placement
		Grid			Settlement Plan
		human psychic			

Codes for Analysis Field Work – INTERVIEW: 4

Code	Description
Basic Geometry	Asia wide Asian, use of geometry definitely can be seen. Symbolically geometry has played strong role. Nepali Form and feel of geometry Geometrical form are strongly seen in temple such as in Durbar Square where it is strongly portrait. Vertical geometry especially known as European geometry which is a reductionist such as clean circle, square, cube are not the perfect form of Nepali geometry. These contemporary buildings will not look good if we bring such as Carl Pruscha work like vault or as Kenzo Tange will not work. Human scale, proportion are the importance of geometry Terrain is contextualize to break the geometry. Architecture design cannot be possible if tried to design as classical because system depend upon the geometry which will fail to design. Placement plays very important role in terrain whereas Scale is also more important than geometry putting in terrain with perfect edges geometry with the acrobatics open with the rigid type of geometry which imposition of pure geometry are avoided. It can be done where is highly symbolic such as lumbini can be done but geometrical acrobatic are not possible or it's too disturbance to eye. Lumbini Museum is the iconic building, international project that had to be iconic in Plan, Form, Scale which depend upon the site area. In modern context, normally to some extent improvement in Bishal bazar, Lalitpur Labim mall has contextually has done a good job as a composition to visualize modern building as design as non- air conditional along with the visual glimpse of interior and form which are appreciative which shows the concept of contemporary architecture. Kathmandu existing pressure and challenges has played a very important role on urban form, spaces for the development because of its anti-pure geometry. This is the contemporary example which shows how it has made pressurized on already built building for add on future building which depend upon or guided by site. CEDA building design by Carl Pruscha in context of geometry is the best example as it has shown the pure form to feel comfortable. Where as in Lumbini Museum by Kenzo Tange has design in large open space in which pure geometry can be seen where as in clustered space which is close space pure geometry to be break in order to get good composition. Generally. **"Site context can play an important role or can be place regarding pure geometry regarding place making. But in context of urban infrastructure or urban scale breaking pure geometry will be best, overall from visual to function, consciously breaking of geometry."** So we can study the building to understand the building to understand the beauty, form and architecture of pure geometry. Similarly the fragmentation in the Taragaon Museum design by Carl Pruscha is more applicable to urban fabric. Eventually Geometry destroy the urban fabric of the building. This type can be played and design in open area but avoid to further proceed in heritage core area. In retrospect it been consider to avoid to do in large scale which is especially in contextual site. In his view mostly it Possibility of trying to blend with landscape the use of geometry. Lastly in his view, Responsible architecture recognized the fact that don't depend upon geometry but anti geometry is most probability, as Nepal traditionally followed as per the pure form is concern.
Material	
Site Context	
Planning	



Word cloud generated from participant interview-4

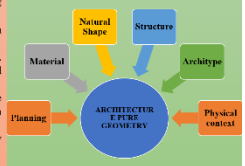
Analysis Field Work – INTERVIEW: 5

Time Stamp: 4.00 P.M. – 5:55 P.M

Date: 10-07-2022

- Role of Geometry in architecture in Nepali Architecture are basically come from square and circle.
- **Circle is related to the earth natural shape, square is a man-made form of symbol.**
- **Symbolically define as square is essentially where temple in built form, circle are represented as stupa as stup which mean circle.**
- Louis I kahn design building can be seen use of geometry in its pure form.
- Circle is used as an architype form which mean primitive and permiable form. So it is attractive such as dome, vault as its architype form. In building design by Kenzo Tange, Lumbini museum circle, arch, vault is not just following buddhism or spritual concern by it was fore most natural, universal symbol.
- As circle of even before the budhha, so was as a universal symbol representation, so it is an architypal shape. As circle is denoted as pure geometry.
- The circular plan, and the way main staircase is designed main inspired by classical form. In Ranjana hall, circular lobby new concept which was a strong attraction and implementation can be seen.
- Saraswati sadan plan form and mostly in lumbini can distinctly can see as they were inspire by pure form of geometry more than functional requirement and also moreover inspire from design in form.
- **Good geometrical composition define the use of architypes and aslo inspire by architype**
- **One should never ignore the physical context while designing such as contour, topography, shape of site because it play a strongest determitator or form for development country.**

Ar. Bibhuti Man Singh



Analysis Field Work – INTERVIEW: 5

Talking about Role of Geometry in architecture, as all our Classical, Nepali Architecture are geometrical likewise classic shape such as Square, Circle etc. Basically come from square and circle. As **Circle is related to the earth natural shape, square is a man-made form of symbol.** Original **symbolism as define as square is essentially where temple in built form, circle are represented as stupa as stup which mean circle.** Likewise there are octagone and hexagone.

Especially, in temple post that we can see has started from square than to octagon and move upward as it can be seen converted to circle. Philosophically it mean Square turning into circle through the octagon.

There is limited use in classical nepali architecture other than this square and circle shape been used. More over it is use in international architecture and mostly in his context Louis I kahn design building can be seen use of geometry in its pure form.

Geometrical shape which are seen in form of vault, arch in building of tarazaon museum which doesnot match our traditional architecture, its stark geometry shape. In context of Nepali Architecture, as far as in temple architecture is concern or buddhist architecture in stupa, circle in plan form can be seen including elevation, section can be seen.

Circle is used as an architype form which mean primitive and permiable form. So it is attractive such as dome, vault as its architype form.In building design by Kenzo Tange, Lumbini museum circle, arch, vault is not just following buddhism or spritual concern by it was fore most natural, universal symbol. As circle of even before the budhha, so was as a universal symbol representation, so it is an architypal shape. As circle is denoted as pure geometry. Circle is define as maximum area can be enclosed by minimum perimeter. Where as in Bed Prasad Lohani design not only in saraswati sadan but also in ranjana hall, circular lobby new concept which was a strong attractive and implementation can be seen.

Dome, circular plan and the way main staircase is designed main inspired by classical form. Thr start of modernism can also be seen which can also said as departure from the temple architecture. As he was moreover attracted to square circle and also might be influence by the form. Geometry in his view doesnot have to depend upon site context or site surrounding.

Whereas in Lumbini museum, main circle which is 800 diameter is very powerful form along it seen by aerial image and the square which is 80 x 80 sq.m grid which is type of our human anatomy interpretation which has been remilled. As by looking for the functional purpose it was done to control flood that the river was running through. Its concept was to make a distinct view of square , grid , pond and circle to be visible.

Saraswati sadan plan form and mostly in lumbini can distinctly can see as they were inspire by pure form of geometry more than functional requirement and also moreover inspire from design in form.

Good Geometrical composition on his view can be use of Architypal shape, form etc . Along with the most important part of human psychic and permiable form. it predets buddhism, hindusim etc everything is part of our biology. The use of the architype most of square and circle is the most powerful, common that we can imagine. Ecludiean shape can be use to create a good architecture where functional requriement are made to meet so that a creative composition can be built or come out.

The building in present context which define a **good geometrical composition define** in his context is **the use of architypes and aslo inspire by architype** which is design in the Lumbini, where local architect ubhai got chance to design or work during 1978 or 1979 as pilgrims accomodation, linance by srilanka for the tourist accomodation which has been designed by using architypal form of square and circle.

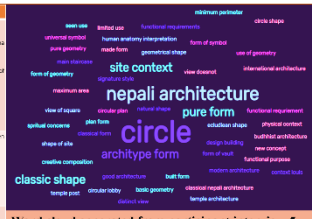
To explain about the chronological order for the process of architecture style or from which it started seem to be as default. Defining about the traditional architecture, the materials such as brick, wood, tile etc when there was no choice. So it came by default. Similarly modern architecture is also seem to come as default.

According to his point of view **signature style for any architect is just unethical,** that seems ignoring context that is what architecture are not mean to be for. Always design should response to context as context has so many phases. **One should never ignore the physical context while designing such as contour, topography, shape of site because it play a strongest determitator or form for development country.**

According to him, one should always follows three principle while designing any building that are **Ecological Responsiveness, Civic Aim and Cultural Reference.**

Codes for Analysis Field Work – INTERVIEW: 5

Code	Description
Basic Geometry	Nepali Architecture are geometrical likewise classic shape such as Square, Circle square is a man-made form of symbol symbolism as define as square is essentially where temple in built form, circle are represented as stupa as stup which mean circle Square turning into circle through the octagon. International architecture and mostly in his context Louis I Kahn design building can be seen use of geometry in its pure form Circle is used as an architype form spritual concern by it was fore most natural, universal symbol circle is denoted as pure geometry distinct view of square , grid , pond and circle to be visible. Ecludiean shape can be use to create a good architecture
Structure	temple post that we can see has started from square than to octagon and more upward as it can be seen converted to circle Geometrical shape which are seen in form of vault, arch in building dome, vault as its architype form Circle is define as maximum area can be enclosed by minimum perimeter square which is 80 x 80 sq.m grid which is type of our human anatomy interpretation Inspire by pure form of geometry more than functional requirement functional requirement are made to meet so that a creative composition can be built make also such as brick, wood, tile etc when there was no choice. So it came by default
Material	
Site Context	Circle is related to the earth natural shape Geometry in his view doesnot have to depend upon site context or site surrounding functional purpose it was done to cont rol flood that the river was running through signature style for any architect is just unethical, that seems ignoring context that is what architecture are not mean to be for One should never ignore the physical context while designing such as contour, topography, shape of site
Planning	Nepali Architecture are geometrical likewise classic shape such as Square, Circle limited use in classical nepali architecture other than this square and circle shape been used Nepali Architecture, as far as in temple architecture is concern or buddhist architecture in stupa, circle in plan form can be seen including elevation, section can be seen. circular lobby new concept which was a strong attraction and implementation can be seen. Dome, circular plan and the way main staircase is designed main inspired by classical form modern architecture is also seem to come as default.

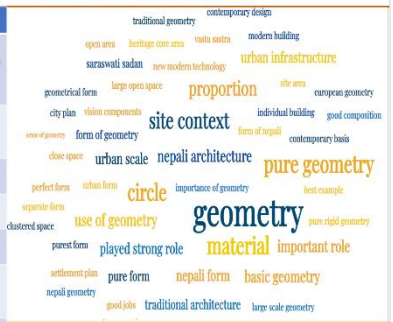


Word cloud generated from participant interview-5

Frequency Measure From – INTERVIEWS ANALYSIS

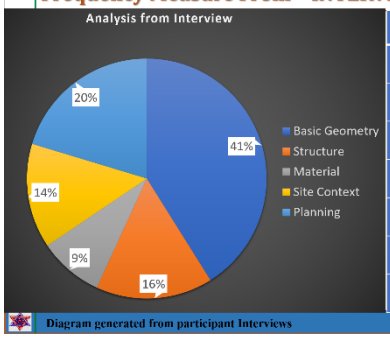
Geometrical Attributes

Interviewes	Basic Geometry	Structure	Material	Site Context	Planning
Prof. Sudarshan Raj Tiwari	16	7	2	1	5
Ar. Prabal Thapa	10	2	7	3	4
Ar. Deepak Panta	13	7	6	7	13
Ar. Arun Dev Panta	36	12	3	15	21
Ar. Bibhuti Man Singh	24	10	3	8	6
Total	99	38	21	34	49



Word cloud generated from participant Interviews

Frequency Measure From – INTERVIEWS ANALYSIS



Analysis from Interview Review

Geometrical Attributes	Interview Review	Total
Basic Geometry	41%	99
Structure	16%	38
Material	9%	21
Site Context	14%	34
Planning	20%	49
Overall Total		241

Diagram generated from participant Interviews 113

Codes for Analysis Field Work –LITERATURE STUDY

Frequency Measure From – LITERATURE STUDY

Analysis from Literature Study

Geometrical Attributes	Literature Review	Total
Basic Geometry	56%	159
Structure	26%	73
Material	10%	27
Site Context	5%	15
Planning	4%	10
Overall Total		284

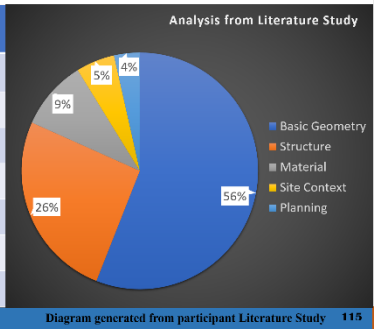
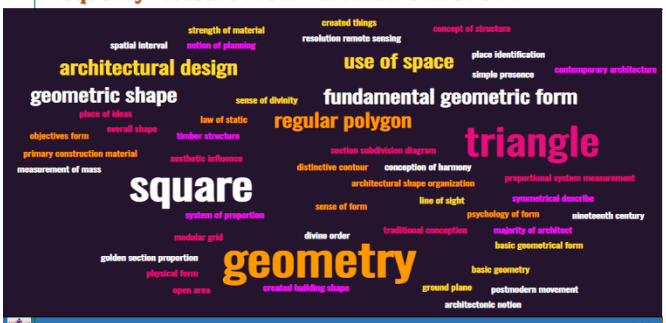


Diagram generated from participant Literature Study 115

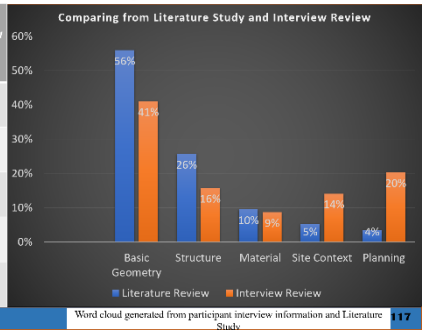
Frequency Measure From – LITERATURE STUDY



Word cloud generated from participant Literature Study 116

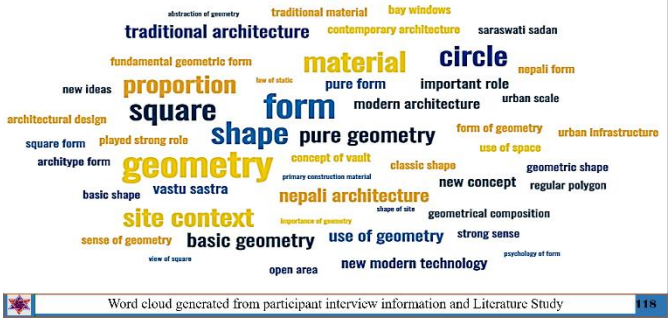
Comparing From Literature Study & Interview Review

Geometrical Attributes	Literature Review	Interview Review
Basic Geometry	56%	41%
Structure	26%	16%
Material	10%	9%
Site Context	5%	14%
Planning	4%	20%



Word cloud generated from participant interview information and Literature Study 117

Comparing From Literature Study & Interview Review



Word cloud generated from participant interview information and Literature Study 118

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FINDINGS

- In the context of the case area study **Geometry is used for taking intangible concepts and ideas** and establishing them in the built environment by the use of the Geometric Principals in the buildings.
- Geometry in Lumbini Museum and in Saraswati Sadan, is also **used for pattern making for using Geometric forms and shapes** in Plan/ Elevation development.
- **Visual connection is** established by the user and the environment in Lumbini Museum which is held by the **site context and environment**. **Scale and proportion with reference to users and proportions of forms to one another** in Lumbini Museum. Forms with reference to the function of the shape also depend upon the **geometrical shape of symbolism** in Lumbini Museum. **Form development by a material also represents** in Geometry which defines as the **use of brick, vault and arch** in Lumbini Museum and **reinforced concrete and reinforced brick concrete and technology for the structure as an inverted beam used to give a free-floating cantilever** in Saraswati Sadan **use of Proportions to achieve pleasing forms and shapes** which has been considered by Kenzo Tange while designing The Lumbini Museum.
- From the analysis of the literature and interviews, the concept of geometry in modern architecture, in the context of Nepal can be defined as a **style of architecture that makes use of modern materials and technology along with the site context and shape.** Architects seem to be **not aware of the geometry of design and also not yet able to come up with a unique geometric concept**. The **concept of modern geometry** has potential value in describing and helping us to **understand some of the geometrical relationships within buildings**. While **traditional geometry offers a fixed system to describe everything in nature, in the modern geometry there is a gradual transformation of space from pure, static to composite and dynamic**.

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DISCUSSIONS

- The study demonstrates a correlation between the geometry in early modern architecture in Nepal using different types of material to create a building that easily fits into the surrounding along with site context, form and style.
- **Nepal has kept a variety of architectural styles, all of which are united by a common constructional pattern and material palette. Bricks were frequently employed, and they were artistically carved into the windows and doors in addition to being sun and kiln burned on timber posts and beams. Saraswati sadan plan, form and mostly in the lumbini museum were inspired by the pure form of geometry more than the functional requirement and also inspired by design in the form. I believe that having a formal logic or geometry is essential for any architect since it allows for the development of aesthetics and formal ideas.**
- Architecture cannot only be functional, structural and aesthetical but can stand the test of time and thus be timeless.
- **Site Shape has mainly defined geometry in context while following secular architecture where shape help to guide as topography can change the use of geometry. Generally, traditional architecture depends upon proportion and scale.**
- Nepali Architecture due to inherited, is organic. So it is not defined by geometry but by the site.
- **"Site context can play an important role or can be placed regarding pure geometry regarding place making. But in the context of urban infrastructure or urban scale breaking pure geometry will be best, overall from visual to function, consciously breaking of geometry."**
- Saraswati sadan plan, form and mostly in lumbini museum were inspired by the pure form of geometry more than functional requirements and also inspired by design in the form. I believe that having formal logic or geometry is essential for any architect since it allows for the development of aesthetics and formal ideas.

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CONCLUSION

- ✓ According to Jonner Kepler, **Geometry is the archetype of the beauty of the world.**
- ✓ Designing requires a thorough understanding of geometry.
- ✓ The **foundation of design is geometry**.
- ✓ Architects seem to be not aware of the **geometry of design and also not yet able to come up with unique geometric concepts**.
- ✓ The study also helps to gather the idea about the use of geometry, which has also been **used as a design tool since the very beginnings of architecture**.
- ✓ **The study also concludes that the post-50s- 60s buildings were designed mainly by internal or foreign trend architects with not only strong Bahuas influence but also the history which acts as a determinant or characteristic in buildings along with drawing from local architectural context.**
- ✓ In order to communicate the analysis of the buildings and the formative ideas in this study, a diagram that is used, as an abstraction intended to convey essential characteristics and relationships in a building.
- ✓ Lastly, It also serves as a **new concept to future researchers in this field and all the architect to examine the use of different analysis technique** that **focuses on a way of thinking about architecture** that emphasizes what is in essence the same, rather than different and also hopes to pursue archetypal ideas that might aid in the generation of architectural form.

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