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Rethinking Tradition - Principles of Vastu Shastra or Modern Building Science

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Abstract: ***Vastu Shastra is an ancient byelaw written by the sages and great architects of the ancient time. It has the guidelines for the planning and construction of the structure by which we can achieve, balance, & harmony between nature and god. Vastu shastra is scientific and logical which can be useful for modern building science industry. Modern building science and Vastu shastra have similarity in their goals but the reason given for Vastu seems more religious but their result is beneficial. Therefore, use of Vastu shastra with modern building science may will increase the value modern building guidelines. In this paper we have tried to study about the Vastu Shastra principles which can be useful for the modern building science and to revitalize the ancient principles of planning and construction of institutional building.***

Keywords: Vastu Shastra, byelaws, planning and construction, scientific and logical, modern building science, revitalize, ancient principles

I. INTRODUCTION

Indian culture and religion are one of the oldest developments. Our ancient development is highly influenced by religion, culture, & natural phenomena. In the modern era, we have modern techniques and various kinds of guidelines for design, construction, and management. We are dependent on it. Thus, in the absence of technology and guidelines, Vastu Shastra came into the existence during the Vedic period and it deals with the design, construction techniques, and management. Vastu Shastra is the consequence of the Indian culture, religion, and natural phenomena which is responsible for the well beings of the human. According to the Vastu Shastra, everything which is living in this universe holds positive and negative energies. And it affects nature as well as who is living in it. So Vastu Shastra is the principle that stabilizes the universal forces. There are four 'Vedas'- Rig Veda which underlines the path of 'Gyan' or Knowledge, the 'Yajur' Veda shows the path of 'Karma' or Action, and 'Saama' Veda which illuminates the way of 'Bhakti' or Devotion. 'Atharva' Veda represents a synthesis of the above three. Vastu Shastra, literally meaning "the science of designing a space to reside in" was formulated as a part of the 'Stapatya' Veda and is a rule-based system of architecture. Vastu Shastra contains the guidelines and principles to design our environment in such a way that becomes appropriate to the universal forces. Vastu governs on the concept of Panchbhootas (air, water, fire, sky, and earth.) when all these 5 elements will be at their suitable place according to the Vastu Purush it will be auspicious for the inhabitant. (PATRA, 2006) But in the presence of modern technology and science, we are not giving respect to the 5 elements of the earth which are required for every living thing. So due to the ignorance of the natural elements and dependency of the mechanical means cause a serious problem in our built environment. (shruti soni, 2019). These 5 elements have different values and their effect which is associated with the life of every living thing. Thus, in this paper, I have tried to analyse the Vastu Shastra principles who is responsible for the environmental approach.

II. BRIEF HISTORY OF VASTU SHASTRA

Vastu Vidya or the knowledge of ancient architecture belongs to the period of 1000-1500B.C its traces can be seen from the Rig Veda where we have the evidence of (Vastospati) protector of home invoked. Vastu Shastra is the part of Sthapatya Veda and subordinate to Atharva Veda. Vastu shastra evolved throughout at least 2500 years and have several texts like Kashyapa Shilpa Shastra, Brihat Samhita, Brihad Vaastumala, Vaastu vidya, Rajavallabha of Mandana Sutradhara, Viswakarma Vaastu Shastra, Samarangana Sutradhara, Vishu Dharmodhare, Purana Manjari, Manasara, Mayamata, Aparajitapccha, Silparatna Vaastu Shastra, etc. Brahma, Narada, Brihaspati, Bhrigu, Vasistha, Vishwakarma, Maya, Kumara, Anirudha, Bhoja, and Sukra are some great sages, scholar, and preachers of Vaastu Shastra. Architecture is explained in the text like Vedas, Sutras, Puranas, Tantras, and Vastu Vidya, up to the 15th century AD. Some of the materials from the 6th century B.C to 6th century A.D is not available. Vastu shastra has the two-stream of architecture Nagra style and Dravida style. (Patra, 2008). The use of Vastu Shastra principles and rituals can be seen in the ancient architecture of India.

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In our epics of Ramayana and Mahabharata, have evidence of the use of Vastu Shastra principles to design and construct the structures. Mayasabha in Mahabharata was built by the Maya who is known as the scholar of Vastu Shastra while Indraprasth and Dwarka were built by the Vishwakarma itself. The word Vastu came from the word "vas" which means "to dwell". And shastra means the text literature. Thus Vastu Shastra deals with the design and construction guidelines for a different type of structure and art like residential, religious, military, market place, town planning, bridges roads, well, tank, dams, furniture design, the layout of the gardens, etc. (Patra R. T., 2017). Many cities like Jaipur, Chandigarh are the example of the Vastu Shastra in the modern era while Mohenjodar and Harappa are the examples of old town planning layout inspired by the Vastu principles. Hindu temples and palaces of the Vedic period also show the evidence and use of Vastu Shastra During the medieval period first time Vastu Purusha Mandala was adopted for town planning whose evidence is mentioned in the Arthashastra. Vastu Purusha Mandala is a geometrical pattern which gives the auspicious directions which are responsible for the creation of a balance between 5 elements (sky, water, earth, fire, space). (Patra R. T., 2017)

III.FUNDAMENTAL PRINCIPAL- PANCHBUTAS OF VASTU SHASHTRA

Panchbutaas means the 5 basic elements of nature which hold the different values and is written in the Rig Veda. These elements are very essential to live on Earth. It has the constant linkage between 5 elements of nature and the elements of the body. Balance of these 5 elements is essential which leads to the prosperity, health & wealth for better life style and sustainable living. According to the Vastu shastra earth is a living organism and all the other things which is living on the earth hold the energy. This energy is responsible for the living of the human being. (shruti soni, 2019)

A. Five Elements of Panchbhutaas

1) Earth (Bhumi)
2) Sky (Aakash)
3) Fire (Agni)
4) Water (Jal)
5) Air (Vayu)

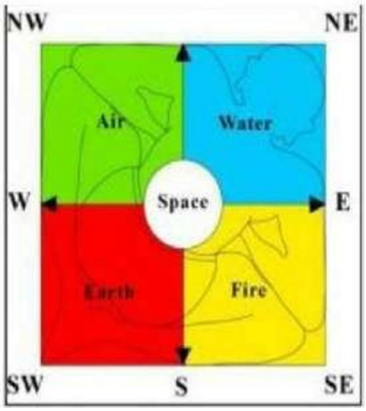

Figure 1- five element of Panchbhutaas (Source-Author)

IV. FUNDAMENTAL PRINCIPLE OF VASTU SHASHTRA

Vastu shastra is the guiding principle and effect of the five-element which is the basic need of the living creature in this universe. Their balance of these elements leads to prosperity and happiness with the occupants. These principles apply to different residential, commercial, temples, and town planning. They are (Patra R. , 2008)

1) The doctrine of orientation (Dik Nirnaya)
2) Site planning (Bhu Pariksha)
3) The proportionate measurement of building (Maana)
4) The six canons of Vedic architecture (Ayaadi Sadvarga)
5) The aesthetics of the building.

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A. The Doctrine of Orientation

In Vastu Shastra or the ancient architecture use of natural renewable resources can be seen easily in almost every building during the Vedic period. Indian culture is well associated with the worship of sun and building orientation also depends on it. Cardinal directions (east, west, north, south, south east, northwest, south west, and north east) have the different significance. These eight cardinal directions have the different deities they play significant role in terms of the orientation and day lighting and ventilation. By the use of specific directions buildings can have the maximum solar radiation and day lighting, and this theory of orientation is still in used by the designers. (Patra R. , 2008)

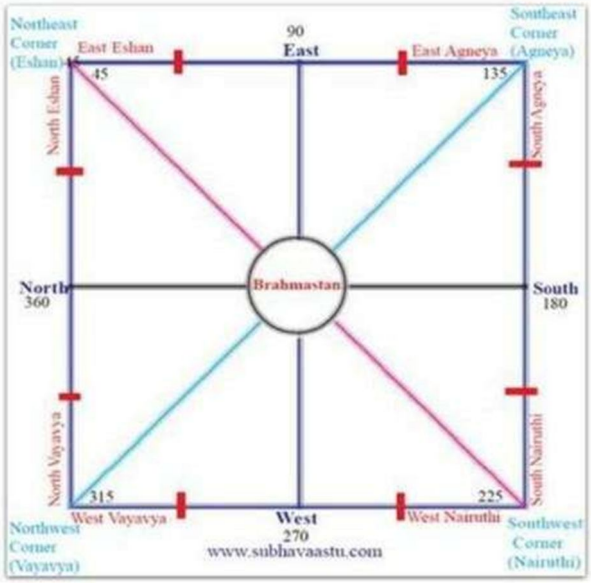

Figure 3-Cardinal directions (shruti soni, 2019)

East (poorva) West (Paschima) North (Uttara) South (Dakshina) North-East (Eeshanya) North-West (Vaayavya) South-West (Nairuthya) South-East (Aagneya)

B. Site Planning

Vastu Shastra have the so many guidelines for the site planning. It includes the approach to the site, site size, shape, soil examination, vegetation, smell, and natural resources present at site or near to the site. Thus after examination of land on the above criteria site is selected. After that we can start construction. This can be implemented for house, village, industry, town, fort etc. (Patra R. , 2008)

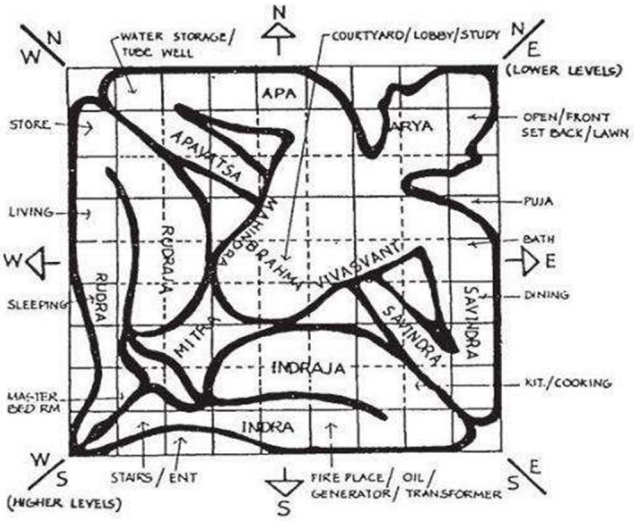

Figure 4-Vastu purusha mandala

Vastu Purusha Mandala is oldest model for architectural design and planning. After selection of the land a building blueprint is prepared on the basis of grids of Vastu Purusha Mandala. It clearly divides the area according to their activity. Vastu Purusha means the man of universe who hold the pure energy, soul or consciousness. Mandala is the diagram which relates the orientation of the building according to the sunrises and sunset. (Patra R. , 2008) Mandala are square in plan and divided into the 9x9 grid which keep balance of Panchbhutaas, (shruti soni, 2019) and which is the fundamental of the ancient architecture. Square can be easily converted into the triangle, hexagonal, circle of the equal area. Square is also beneficial for construction and it became economical also. After orientation is established, Vastu purusha Mandala form is superimposed to finalize the planning of the building. Vastu Purusha Manadala principles can be easily implemented to the different type of the buildings. It represents the entire solar system and their effect. (Patra R. , 2008)

C. The Proportionate Measurement of Building (Maana)

The proportionate measurement of the building is calculated by the Ayaadi formula. By these formulas we can decide the length, breadth, height, circumference and other building dimensions. Ayaadi calculations are have the 6 formula, Aaya, Vyaya, Yoni,

Raksha, Vara and Tithi. These are used to determine the building dimension and the conformance of building. Orientation of the building is determined by the reminder obtained by using these formula. Hasta and Angula are the measuring units (one Hasta is equal to the 24 Angulas). (shruti soni, 2019) According to the study done by Niranjan Babu “those days the units of measurement were not uniform in different regions. The units of measurement were Angula and Hasta. However, the value of Hasta and Angula were different in different regions due to the different proportion of human body.

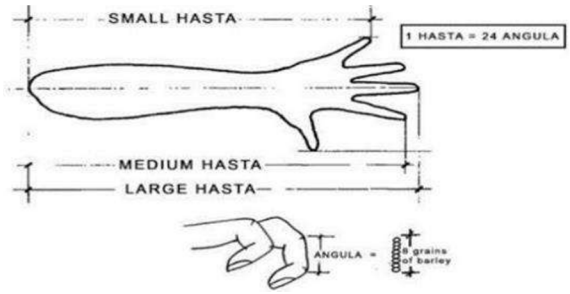

Figure 5-Ayadi unit of measurement

Aaya	=	Reminder of	Lengthx8 12
Vyaya	=	Reminder of	Breadth x 9 10
Raksha (nakshatra)	=	Reminder of	Length x 8 27
Yoni	=	Reminder of	Breadth x 3 8
Vara	=	Reminder of	Height x 9 7
Tithi	=	Reminder of	Height x 9 30

Table 1-Ayadi formulas

D. The six canons of Vedic architecture (Ayaadi Sadvarga)

There are six main components of a building, base (Aadhistaana), column (Paada or Stambha), entablature (Prastaara), ear or wings (Karna), roof (Shikara) and dome (Stupi). The Ayaadi formulas1 are some of the aspects analysed to assess the qualities of the house (Guna). In short, Aaya means measurement of building = length × breadth (Patra R. , 2008)

E. The Aesthetics of The Building

Aesthetic of the building deals with the nature of physical and cultural elements associated with the elevation of the building. It depends upon the spatial planning, structural integrity, cost, building material. To achieve the aesthetic, ornamentation, texture, symmetry, color, solemnity, use of sunlight and shadows to create harmony. In traditional Indian culture beauty is considered as Chanda (moon). On the basis of the traditional principles buildings have the different forms. These buildings never seems identical view from one to other. They also reflect the different class and satisfy the function of the building. As a result it is considered that Vastu Shastra has developed and modified with the time. And these principles has given the different titles. (shruti soni, 2019)

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V. ANALYSIS OF VASTU PURUSHA MANDALA AND ZONING (IN CONTEXT OF CLIMATE AND SUN ORIENTATION)

In Indian culture sun is worshiped because of their nourishing morning light and the universal source of light. According to the Veda and the human perform their activity according to the time. Our ancient Vastu pundits divided the 24 hours into the 8 parts (pahar). They represent the eight-cardinal direction. Orientation of the building according to the cardinal directions and placement of opening helps to gets maximum day light and nourishing morning rays at different time. Thus planning of building according to the sun direction is helpful in reducing the active strategies like fan, and lights etc. which can help to reduce the energy consumption and make building sustainable. (shruti soni, 2019)

1) According to the Vastu Shastra in Vastu Purusha Mandala it can be divided into the 9x9 grid. Central part of the Vastu Purusha Mandala should be dedicated to the sky element and known as the brahmas than. Therefor it should be kept open to maintain the continuous flow of air and proper ventilation.
2) Sun rise from east and morning lights are always good for us. Due to which main door should be planned in the east to get morning rays. It will decay the bacteria that would have multiplied during night. This strategy can also be helpful for reducing the energy consumption and can save unnecessary use of electricity.
3) Lots of opening should be in north direction. Due to which diffused light would enter into the building.
4) South is the direction which gets light from 9am to the noon and this is the time of working. Therefor this can be the best place to plan office and can gets maximum natural layout almost throughout the day time.
5) Intensity of the heat increases by the noon therefore south and west are the best direction to plan store room, bathroom, and toilets which should be water proof. These spaces will also act as the buffer space and will reduce the effect of heat. Therefore according to the Vastu (south west is known as nairuthya) wall should be high and thick enough that can reduce the heat penetration into the building.
6) West direction gets heated up more because of the hot infra-red rays by afternoon. Therefore trees should be planted in this direction to provide shade and minimize the effect of heat. Therefor west should also have massive wall and less openings.
7) In India, (being in the northern hemisphere near the equator), North gets constant diffused light throughout the year. Hence there can be open space in this direction, so that the light should not obstructed.
8) South –east gets early morning light from 7:30 am to 9:0 am. Therefore, according to the Vastu Shastra pantry/canteen should be in the south east. In morning this time is good for preparing and cooking food. The UV rays of the sun will keep the kitchen counter free from germs also.
9) North –West is the direction dedicated to air (Panchbutaas) this direction could have the space for guest room, parking or septic tanks. (shruti soni, 2019)
10) North –East is the direction good for yoga, meditation or prayer, because it gets fresh air and light from 3am to 6am. So, in this direction there could be meditation room/ prayer room etc.

VI. MATERIALS

A. Building material used at that time was timber, stone and bricks. Timber and stones were divided into the 3 type (male, female and neuter).
B. Most favorable material was according to the availability and climate study.
C. Recommended joints should be with the same trees. (Male –male) it would be strong.
D. Only matured trees were used for the construction.
E. Stone are also divided like the tree.
F. Selected stone should be dense, smooth, and embedded in earth in eastward or northward orientation.
G. Mature stone should be used at the construction site.
H. Aged stones have the rough skins, flaws and spots and it should not be used.
I. The material which is sustainable at that particular area should be used.
J. Bricks should be made from the red and swollen, mixed with white sand and free from babbles, gravels and bones.
K. It should be pleasing in color and uniform in size.
L. Inferences from all the above point is that nature of the material is one aspect to decide which material would be used. Availability of the material is also the economical and sustainable factor for selection of it. According to it material of same quality and nature should be used this should be the first priority. Material who has the same nature will give best result in aesthetics as well as in strength. (Chakrabarti, 1998)

VII. ANALYSIS OF VASTU SHASTRA WITH MODERN BUILDING SCIENCE

S.NO	ASPECT	VASTU SHASTRA	According to The Modern Building Science
1	Shape of Plot	Square and rectangular plots square measure the most effective. Rectangular plots with longer sides on east, west and shorter on north, south square	Due to scarcity of the land shape of the plot may vary.
		measure higher. Polygonal shape and polygon plots are sensible. Elliptical, Semicircular triangular and egg formed plots square measure inauspicious. Solely rectangular or sq. building is nice on a circular plot.	
2	Shape of Building	Rectangular, square, Circular, hexangular and cow long-faced (Less broad within the front and additional broad on the rear side) area unit thought of smart. Triangular, long bar formed, bow formed & oval area unit thought of dangerous.	Any shape accepted to break monotony. Modern architecture science doesn't bound to specific shape. Shape may be according to the climate conditions and surroundings.
3	Abutting Roads	A plot having roads on all sides is the best	A plot having roads on all sides is the best as it allows enjoying of natural agencies more. (but not necessary)
4	Position of well, tube well, underground tank & septic tank	North-east is the most auspicious corner for underground tank. Water storage in east is also good. Well in south, east-south, south-west, west-north is very bad. North and east side are also good. South-west should be higher than north-east. Septic tank should never be built adjacent or very close to the four boundary walls or walls of the home. There must be a gap of at least one foot. Septic tank should be built in south-east & north-west. Water tank in the west is supposed to be the best.	Direction not specified in most of the local authority byelaws extraction of ground water is prohibited.
5	Open spaces, setbacks around the building.	The main buildings ought to be made such a lot of open area remains on north and east i.e. building ought to be made in south-west. The buildings within the middle are smart. There shouldn't be any construction on the four corners of a plot.	No restriction of direction but setbacks should be according to the local authority norms.
6	Preservation of soil, vegetation, and natural features	Before construction bhoo-pariksha should be done to ensure site environment. Examination of the site helps to make planning and construction strategy.	Mandatory for environmental aspect. Or as per the local authority norms.

7	Trees and Lawns	Green space ought to be in east, west, north and north east. Mango, Neem, Coconut, Ashok, offer sensible results, no matter could also be the direction. Banana,chameli and champa trees ar auspicious. Babool, Ber don't seem to be sensible. Peepal, Banyan and Goolar mustn't be in east, west, north severally.	Deciduous trees like Mahagony, sheesham, and teak ought to be planted. Because the leaves of such trees fall in season & new leaves seem in spring that facilitates sun rays in winter and obstructs sun rays in summer.
8	Water body	North –East	Location of water body may depend upon the slope of the site and climate.
09	Door /window location	Entrance Door should be in the middle of side. Desirable direction east Window should be in north & east.	Windows should be in north & east or where required. Window opening should not be less than 10% of the floor area of the room.
10	Orientation	It should be according to the Vastu Purusha Mandala. North east to the longer axis.	North east orientation to the longer axis for composite climate.
11	Height of building	The height of the structure should be adequate to 1/116th a part of the breadth and four hands (from elbow to finger that is close to eighteen inches). If house has a pair of or a lot of story the peak of the higher story ought to be less by 1/12th half than	Height of the structure is the matter of F.A.R(floor area ratio). Or building height should not be more than the 1.5 times the width of the abutting road plus front open space.
		that of the lower story.	Height restriction according to the local authority norms.
12	Slope of land	Land having slope in east, north and north-east is considered good. The flow of rain water must be towards north-east. Land having slope in west and south is not considered good.	No such recommendation but drain water should be connected to storage tank.
13	Projection of plot	Projection in north-east, north and east is good. Projection in any other direction is not auspicious.	Projections can be in other direction also because it helps to get diffused light

Table 2-showing comparative analysis of Vastu philosophy with modern building science (Gupta, 2016)

VIII. LITERATURE STUDY

A. Vedic Nalanda Mahavihara Bihar

Nalanda Mahavihara is situated in Nalanda district of Bihar where kingdom of Magadh once was. Nalanda Mahavira was the oldest learning center in the world, it had the unique status since its emergence in 5th century to 12th century. Initially it had the setup and center for Buddhists learning philosophy, anatomy, alchemy and mathematics. This residential university had the scholars and students from the central and East Asia such as Korea, China, Mongolia, Tibet and Turkey. It had a rigorous test for taking admission into the university. At its peak Nalanda university accommodated 10000 students and 2000 teachers. (India)

B. Site Planning and Facilities

1) Site was spread over two square kilometers.
2) It has waterbody on the periphery of the mahavihara.
3) Stupa act as the focal point for the orientation of the vihara.
4) It had linear site planning. East direction is dedicated to the vihara while West direction dedicated to Chaitya segregated by central pathway.

5) University had three major buildings entirely devoted to the biggest library of that time. This library was known as the Dharm Gunj and had the repository of Hindu and Buddhist literature. Apart from academic excellence it was an architectural wonder.
6) No one knows the exact form of ancient Nalanda University.
7) Use of thick red brick for construction as the major construction material.
8) Thick walls also help to insulate the interior from the local climate.
9) Extensive drainage system
10) Stucco plastered walls, ornamentation and sculptures are the masterpieces. (India)

a) Site Plan

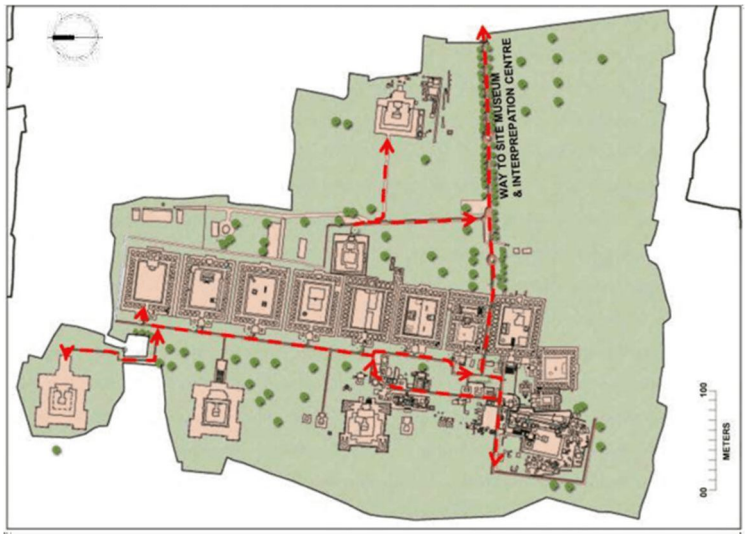


Figure 6-site plan of nalanda university ruins shown with circulation (India)

b) Component Parts of Excavated Site

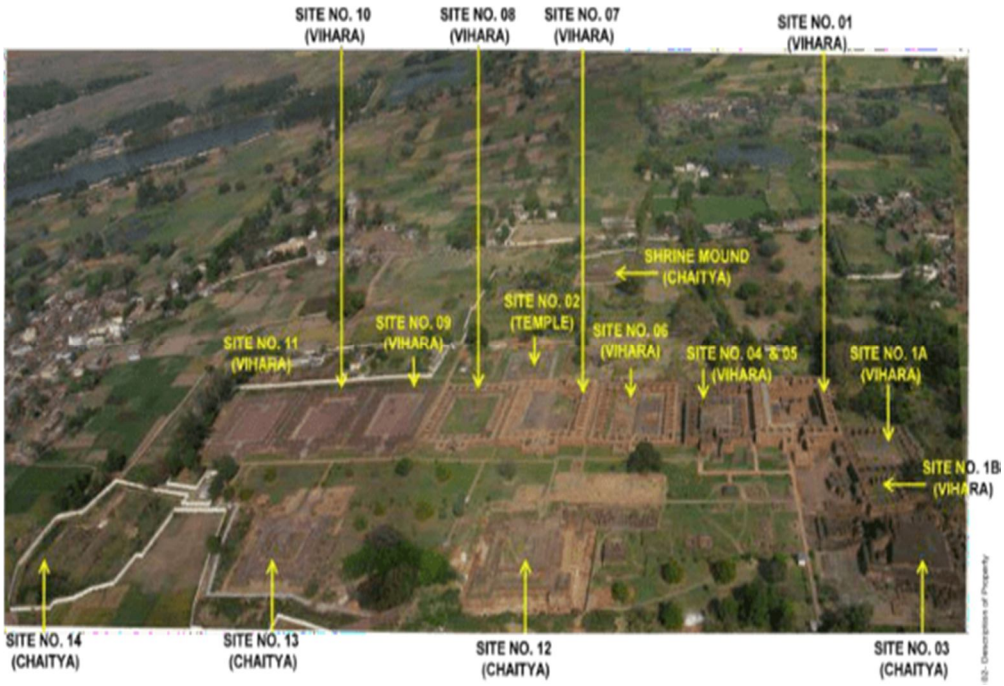


Figure 7-Showing Component Parts of Mahavihara (India)

c) Elements of Planning System

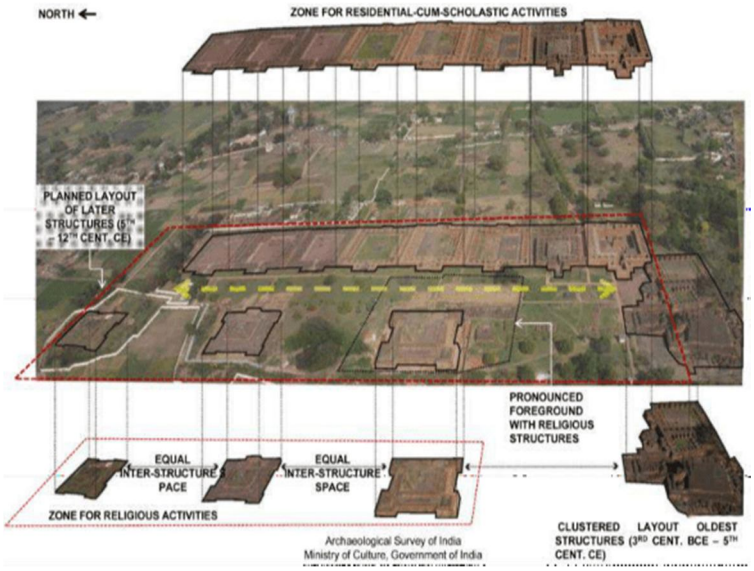


Figure 8-elements of planning system (India)

d) Planning of Vihara (Residential Cum Educational Use)

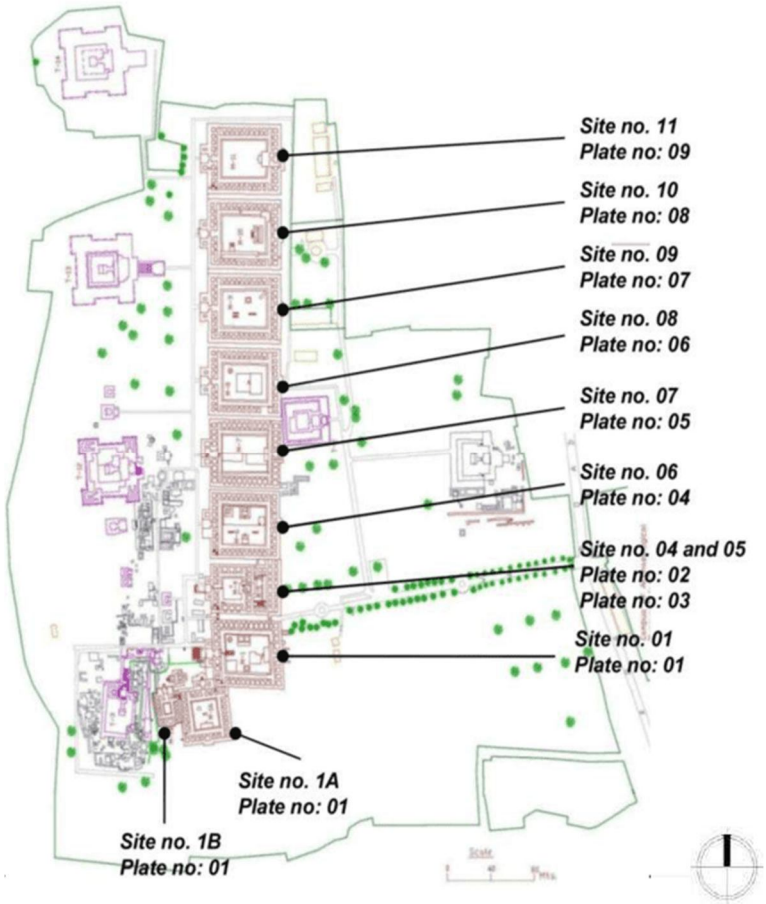


Figure 9-showing site plan of Nalanda Mahaviharaa (India)

- The built layout shows the shift from cluster layout to the linear layout.
- Classrooms have Rectangular in plan with central courtyard in center.
- Design principles changes due to change in rituals and way of performing it.
- Cluster layout have modest number of accommodation facility.
- Quadrangular in form measuring 10 x175 feet with rooms of average dimension of 9'3"x9'and a clear height of 11', aligned.
- Opening of the rooms into a common verandah.
- South west direction has the staircase.
- Central courtyard for educational activity like debate, lectures and class.
- Equal inter structure space between the religious structures and zones. This shows the equal respect for Hindu as well as Buddhist temples. (India)

e) Palnning Parts of Vihara: Vihara is the defined as the residential cum educational use space which was allotted to the students to perform daily rituals in the campus and of course for living purpose also. Vihara is rectangular in plan and having niches on the four side. Niches having some of them have storage facility also. All living space have the common opening into the courtyard. This courtyard whereas maintain the light and ventilation into the Vihara and also useful for the students for debates and for the purpose of the lecture space. (India)

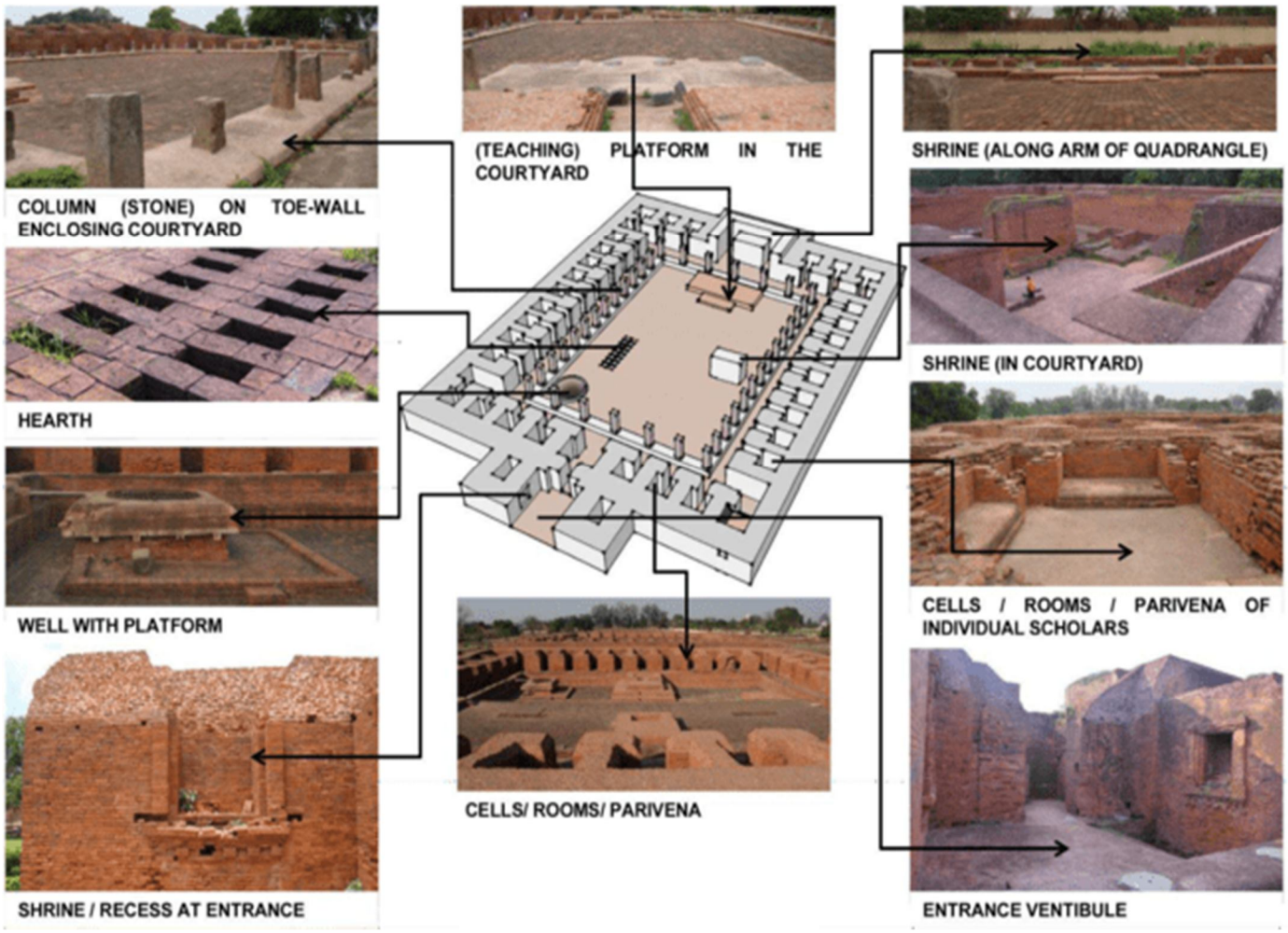


Figure 10-parts of Vihara

f) Planning-Panchayatan Chaitya (Sacred Structure)

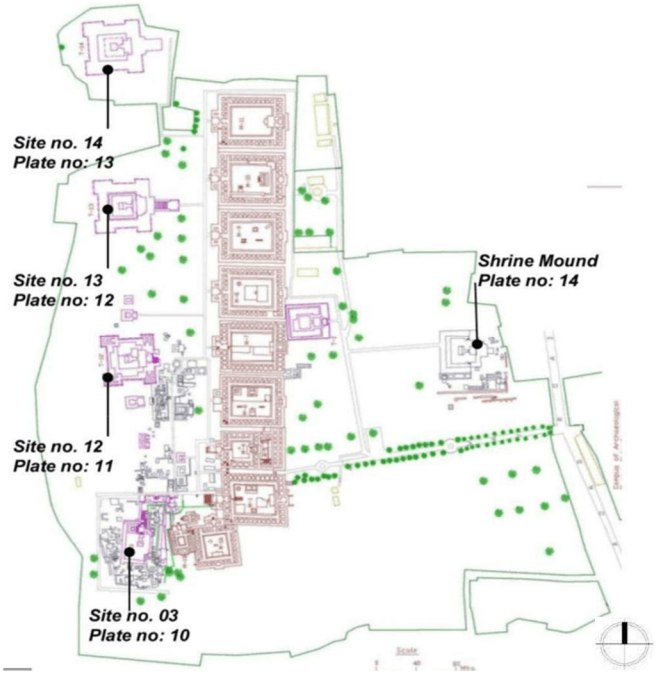


Figure 11-site plan of vihara (India)

- Chaitya (quincunxial form, or cruciform) consists of high plinth base with principle shrine at the center while subsidiary shrines on the four corners.
- Pradakshina path (peripheral path) to the principle shrine connecting to subsidiary shrines also.
- To the north & south of the chaitya had the several votive stupas in circular form decorated with niches and moldings, and images of stone and stucco.
- Main Chaitya is oriented to north-south.
- Sacred structures are placed at the equal distance. Entrance from east direction. (India)

g) Planning- Parts of typical Panchayatan Chaitya (Sacred Structure)

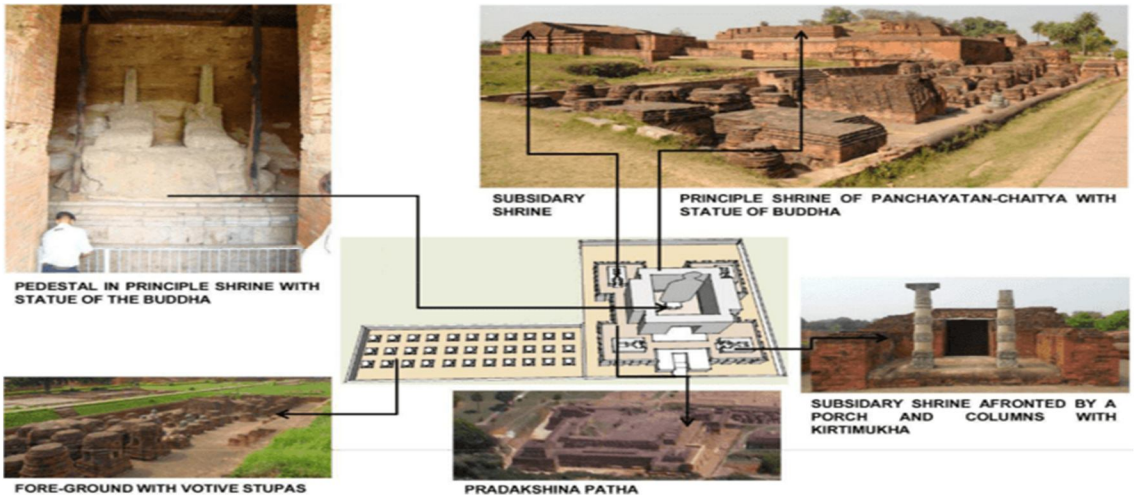


Figure 12-parts of Panchayatan chaitya (Sacred Structure) (India)

C. Vikramshila Mahavihara Bhagalpur Bihar

Vikramshila University was the one of the oldest learning centers of ancient time. This site of ASI is situated at Antichak in Kahalgaon sub-division, thirty-eight kilometer from **Bhagalpur, Bihar.** The university was established by the King Dharmpala. It was built in late 8th or late 9th century A.D and collapsed in 13th century. It was the competitor of the Nalanda University. (india, 2021

1) *Purpose:* Vikramshila University had more than 100 teachers and 1000 students. It produced eminent scholars who were responsible for the spread of Buddhist learning, culture and religion to foreign. Metaphysics, grammar, philosophy, logics etc. were subjects of study but Tantrism was the most important branch of this learning center. (india, 2021)
2) *Site Planning*

a) Monastery with monolithic pillars
b) Tibetan and Hindu temple
c) Monastery with stupa
d) Fortress (with cells)
e) Library
f) Water reservoir

Figure 13-site plan of Vikramshila University

3) *About Site Planning*

a) Site is spread over an area of 100 acres.
b) Structure is spread toward North-South.
c) Mahvihara had 6 main gates, used by the “Dwarpandit” to conduct severe test for admission.
d) Huge square monastery in plan measuring 330mtr. Measurements. 52 cells (4.15x4.15 sq mtr.) on four sides of square (total 208 cells) opening into a common verandah.
e) 7.8 mts. height monolithic columns are used for support at entrance.
f) Underground chamber in few cells maybe for mediation purpose. (india, 2021)

Figure 14-showing monastery (india, 2021)

Image showing the pillared structure made up of stones and central platform is the main structure of monastery dedicated to the lord Buddha. (india, 2021)

Figure 15-showing main stupa from front (N-W)

- Cruciform stupa in the center of the monastery. It is 15 meters high from the ground level accessible from the north side through flight of steps (india, 2021).
- Passage is connected by the 3 stone staircase.
- High sill door give access to the big platform which is projected to the inner courtyard (roofed). While lower inner courtyard can be accessed through flight of steps. (india, 2021)
- Central main stupa has 4 chambers in all direction in which clay image of Buddha is installed. (india, 2021)
- South west corner was dedicated to the library which was rectangular in shape and attached to the monastery through narrow passage. (india, 2021)
- Air-conditioned library by cooled water from reservoir through range of vents in back wall.
- To the north number of scattered structures with Hindu and Tibetan. (india, 2021)

4) Material

a) Brick work with mud mortar. (india, 2021)

b) Wood, (india, 2021)

c) Metal, stones for art work and decoration (india, 2021)

IX.JAWAHAR KALA KENDRA, JAIPUR

1) Architects: Charles Correa Associates

2) Location: Jaipur, Rajasthan, India

3) Client: Government of Rajasthan

4) Built-up Area: 9.5 acres

5) Construction: 5 Years (1986 – 1991)

6) Typology: Cultural Architecture / Museum

7) Project Year: 1991

Jawahar Kala Kendra is an arts and crafts center located in the city of Jaipur and dedicated to the late Prime Minister Jawahar Laal Nehru. Its aim is to preserve the Rajasthani art and craft. Building is well designed and reflect the art and tradition of Rajasthan (jawhar kala kendra /charles correa, 2020).

A. Site & Surroundings

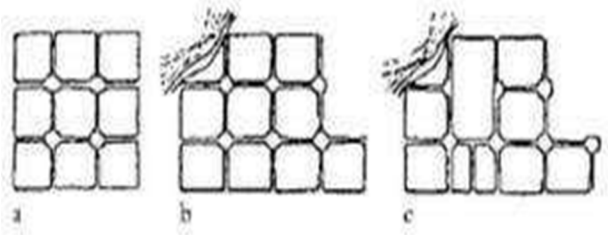
Site is located in Jaipur and well connected by three-sided road. Jawahar Laal Nehru Marg from east and Shaheed Abhimanyu Singh Marg from south. East side of the site has the huge vegetation and university of commerce. Site is square in plan and has the built-up area 9.5 acre. (archinomy, 2020)

Figure 16-site plan of Jawahar Kala Kendra

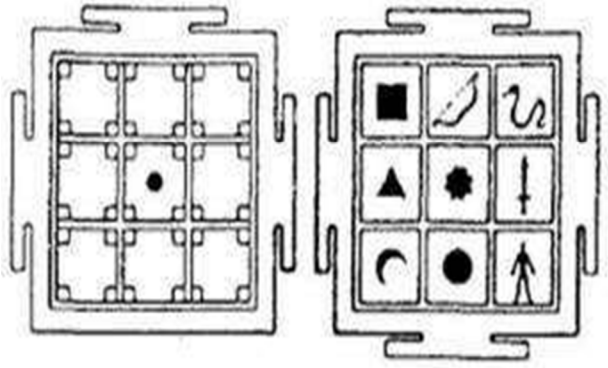
B. Concept

Planning is inspired by the layout plan of the Jaipur city drawn by the Maharaja Jai singh in the 17th century. He is took guidance from the shilp shastra and it was inspired from the ancient Vedic Mandala of nine square (Navgraha) which represent nine planets. Due to the presence of the hill one square shifted to the East of nine house Mandala form.

Correa took inspiration from the Navgraha Mandala and planning concept of Jaipur city layout and planned accordingly. He divide the zones according to the nature of the planet.



The plan of Jaipur city based on the nine square Yantra in which one square is displaced and two central squares combined.



Ground plan of the Nāt-Mandir in Konarak (left), corresponding to the divisions of the Yantra of the Nine Planets or *Navagraha* (right). The symbols of the yantra are: square = Venus; bow = Mercury; snake = ketu; triangle = Mars; lotus = the sun, at the centre; sword = Rahu; crescent = the moon; circle = Jupiter; man = Saturn. Based on the Mandala Sarvasva.

Figure 17-showing distribution of space

C. Planning

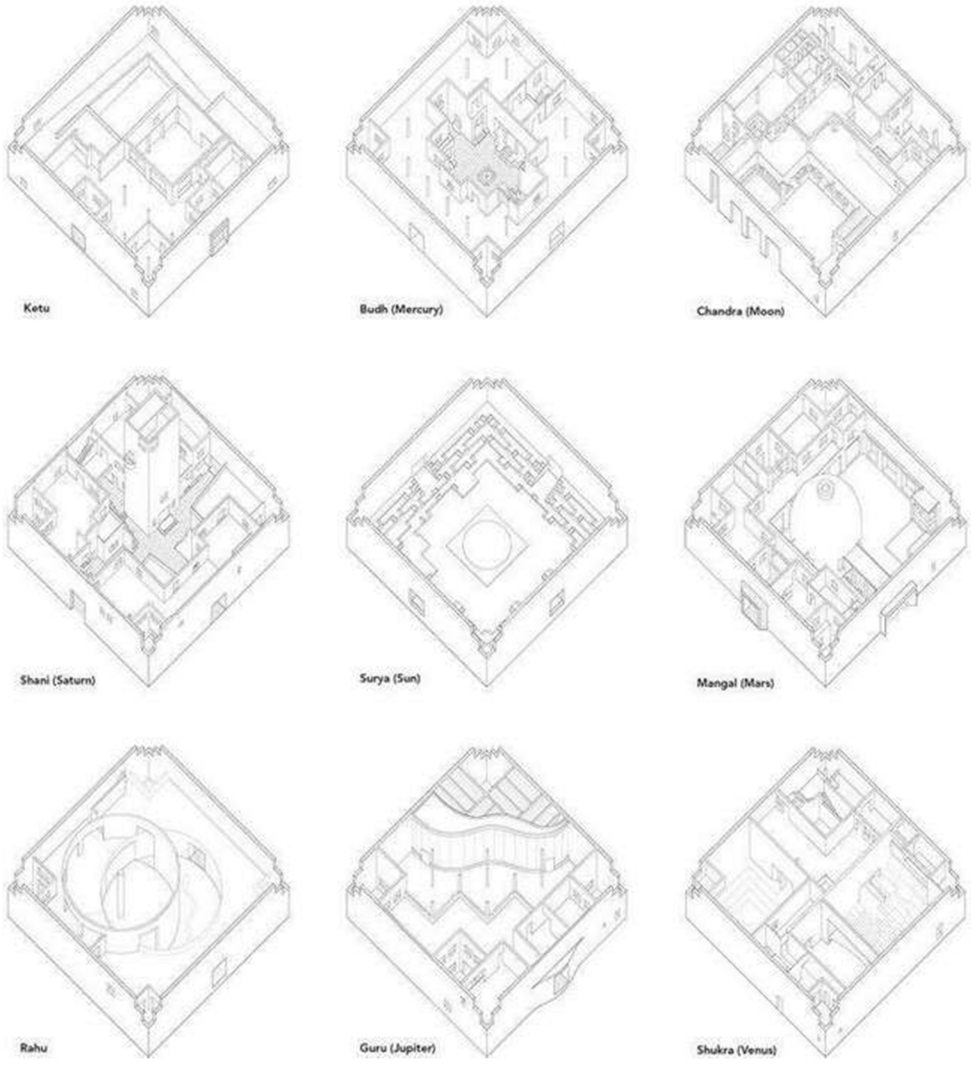


Figure 18-showing distribution of space according to the nature of Navgraha Mandala (jawhar kala kendra /charles correa, 2020)

D. Layout According to Mandala

Building program is divided into the nine squares according to the mythical nature of the planet. These nine squares are grouped by the 8-meter-high wall representing the fortification of the Jaipur city. (archinomy, 2020)

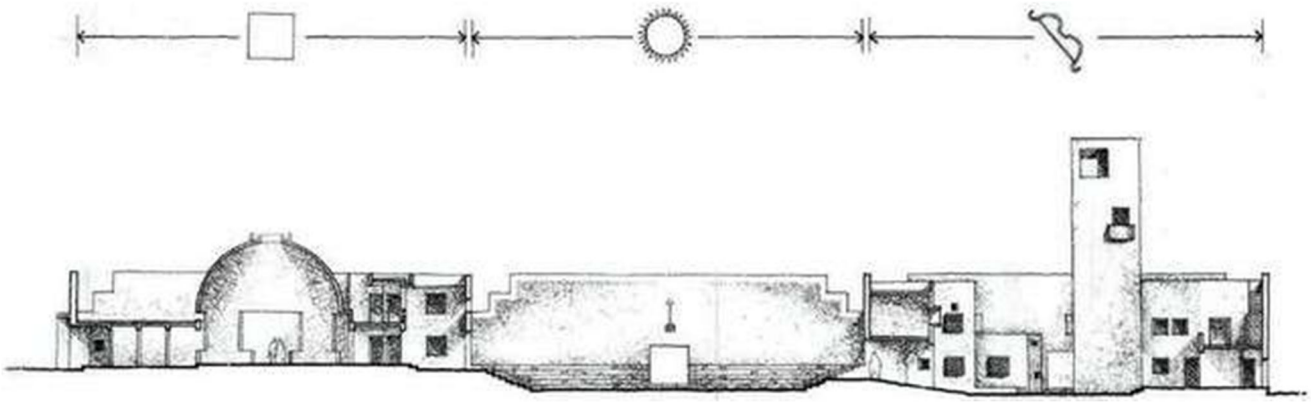


Figure 19-section showing the distribution of space (archinomy, 2020)

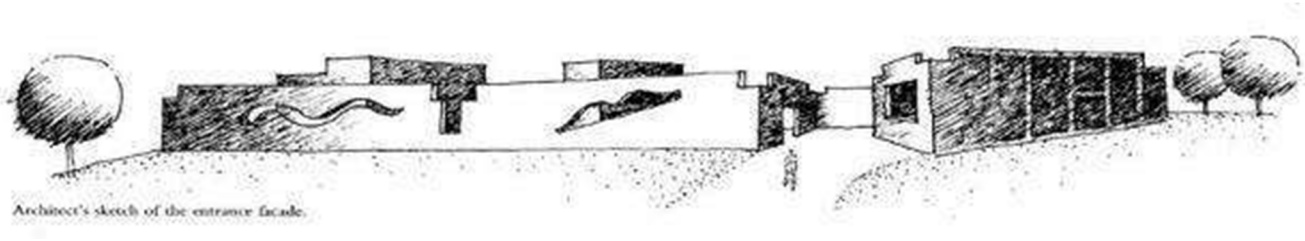


Figure 20-elevation (archinomy, 2020)

1) Library is located in the square of Mercury which traditionally represents knowledge.
2) House of Venus is dedicated to the theatres because Venus represent arts.
3) Central Square is dedicated to the open space as specified in Vedic Shastras. Flooring pattern of this square represent the sun. Due to which building gets the light and ventilation.
4) Mars house is dedicated to the administration because it represent the symbol of power.
5) Astrological symbol of nine planet is expressed on the exterior surface of the building.

Planet	Colour	Quality	Function
Venus	white	Art	Drama
Jupiter	Lemon yellow	Knowledge	Library/Meditation
Rahu (ascending node)	iridescent		Documentation
Saturn	Earth red	Knowledge	Museum II
Ketu (descending node)	Brown and black	Anger	Museum II
Mercury	Golden yellow	Education	Lok Kala Kendra
Moon	Milky white	Heart	Cafeteria
mars	Red	Power	Administration

Table 3-showing distribution of space according to the nature of the Navgraha Mandala (archinomy, 2020)

E. Layout Plan

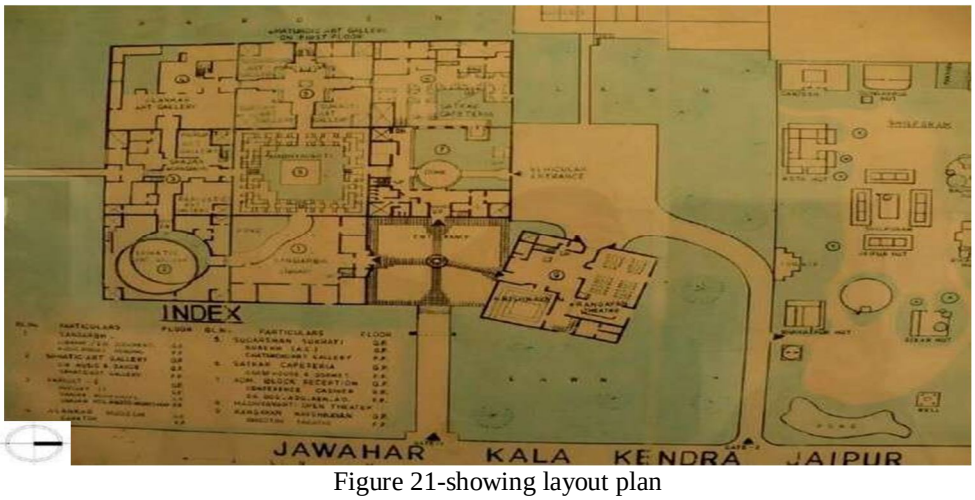


Figure 21-showing layout plan

F. About Planning

Central Square is used as display and exhibition centre for local arts and artist. Annual classical dance and music workshops host at the central courtyard. This central courtyard is dedicated to the art lovers and art exhibitions and inspired from the step wells of Rajasthan. (archinomy, 2020)

G. Response to Cliamte

1) Red sand stone and white marble is used as the finishing material with punctures in exterior wall for ventilation. Interior is finished with the vibrant colours. (archinomy, 2020)
2) Light shaft have the step profiles with marble capping at every corner of the unit. (archinomy, 2020)
3) Central courtyard brings light and make continuous flow of air. (archinomy, 2020)
4) North east has the water body covered with pergola in library. (archinomy, 2020)

X. CENTRE OF ENVIRONMENTAL SCIENCE ENGINEERING BUILDING 'IIT KANPUR'

1) CESE building on IIT Kanpur in UP is fully compliant with energy conservation building code. (kanpur, 2020)
2) The architectural design has been optimized as per climate and sun path analysis. (kanpur, 2020)
3) Sustainable site planning has been integrated to maintain favorable microclimate. (kanpur, 2020)
4) Centre of environmental science building has been conceptualized, designed and constructed as a' building in the garden' that is sustainable and environmentally friendly. (kanpur, 2020)
5) It is certified by GRIHA (5 star rated) (kanpur, 2020)

Figure 22-master plan of iit Kanpur

A. Site

Figure 23-showing centre of environmental science & engineering building

1) Site is surrounded by other institutional buildings of campus.
2) Cluster planning principle adopted
3) Roads are crossing at 90-degree angles.
4) This building is well connected with the other building blocks and central library in south west.
5) North side of the block have the water body and heavy vegetation.
6) Microclimate created at the site.

B. *Layout Plan*

1) This building is present in north (According to Vastu institutions should be in north.) side of the campus. Because north direction considered as the cool zone according to the Vastu as well as modern building science because of the sun orientation. (kanpur, 2020)
2) Due to the presence of the surrounding building it has some benefits like exemption from the solar heat gain. (kanpur, 2020)
3) A water body in north helps to convert hot air into cool air which passes through it. Water body or healthy environment should be in north or east. So this space allocation of it is also similar to the modern building science. (kanpur, 2020)
4) Orientation of the building is east-west to the longer axis.
5) Each blocks are aligned in such a way to forms shades and get diffused day light air cool air through series of windows making cross ventilation. (kanpur, 2020)
6) North west side parking (north west should be parking)
7) South, south west and west is surrounded by trees and building blocks. Afternoon sunrays are harmful and intense in nature so that by this feature it helps to protect the building from direct solar light and from noise pollution also. (kanpur, 2020)
8) Total plinth area: 2240 Sq-m
9) Total working area: 4240 Sq-m

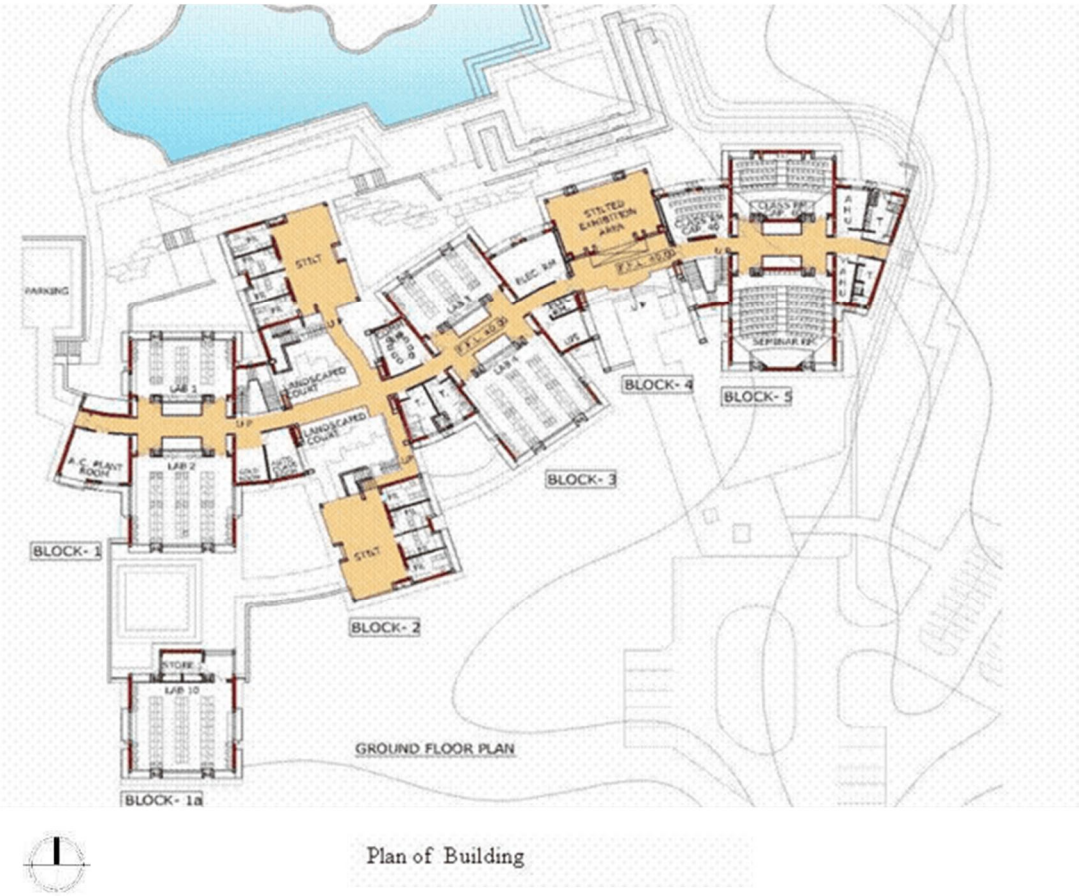


Figure 24-layout plan (kanpur, 2020)

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C. Features (Efficient Lighting System)

1) Efficient HVAC system with controls has been adopted.
2) 30% of internal lighting demand is fulfilled by the renewable energy source such as photovoltaic panels.
3) Outdoor lighting demand also full filled by solar energy.
4) Integrated day lighting by efficient lighting system and controls.
5) Facility follows the ECBC (Energy Conservation Building Code)
6) 85% of the building area is ventilated by day light in the day time. (TERI proposes a minimum requirement of75%- day lit area).
7) Motion sensors has been used in places to control usage of light. (kanpur, 2020)

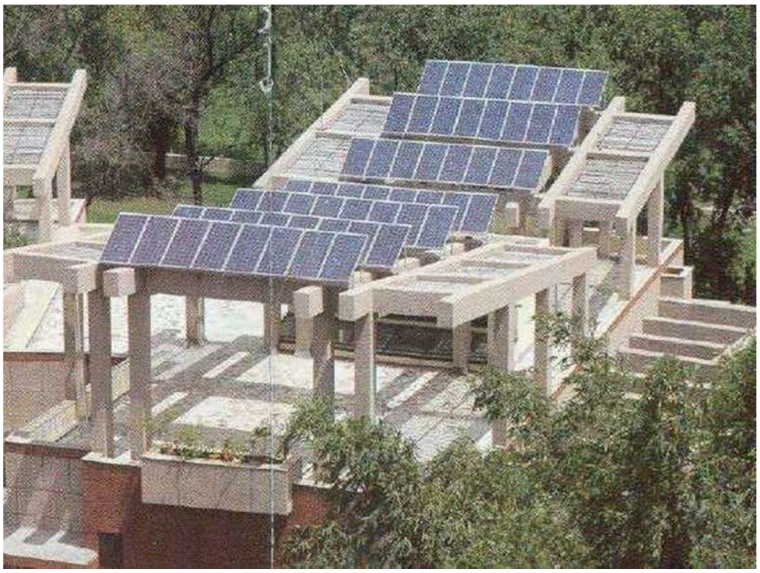

Figure 25-showing use of solar panel (kanpur, 2020)

D. Air-Conditioning Requirements and Ventilation

1) Thermal comfort in non-air-conditioned spaces has been achieved more than 90%.
2) Passive strategies such as Thermal storage and Earth Air Tunnel provided to reduce the energy consumption for conditioning the building. (kanpur, 2020)

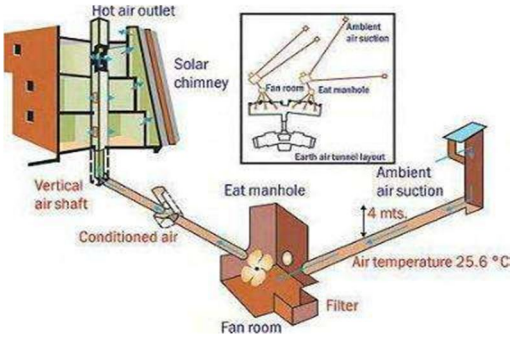

Figure 26-showing method of air conditioning adopted (kanpur, 2020)

3) By the use of this technique, it maintains constant room temperature throughout the year.
4) In this technique, a tunnel is dug four meters below the surface (as temperature four meters below the ground remains almost constant irrespective of the outside seasonal fluctuations) and all air coming inside the building passes through his tunnel.
5) Image is showing the method adopted to solve the purpose of air conditioning. This type of system was in use from the ancient time to facilitate the air conditioning service. Use of natural element and conservation of them is always recommended by the Vastu shastra.

E. Noise Reduction by Plantation

1) The trees are planted on the periphery with the purpose of reducing incoming noise disturbance.
2) The floor has been cushioned to reduce noise transmission to the lower floor.
3) The walls of seminar and class rooms are all covered with sound absorptive panes hence reducing the transmission of sound. (kanpur, 2020)

F. Water Conservation

1) Use of efficient fixtures to reduce water demand.
2) Grey water used for horticulture after treatment from sewage plant which is dedicated to the site.
3) Rain water collected from the building and surrounding area routed through a sedimentation tank to water body for air conditioning cooling.
4) Overflow outlet is connected with groundwater recharge pit.
5) During construction, the water requirements were kept to a minimum by storing and reusing water in make-shift water holes.
6) 20 solar collector panels are installed to meet hot water requirement. (kanpur, 2020)

S. No	Name	Nalanda mahavihara	Vikramshila mahavihara	Jawahar kala Kendra	CESE building –IIT Kanpur
1	Orientation	North –south (longer axis)	North –south (longer axis)	North –south (longer axis)	East-west (longer axis)
2	Climate	Composite	Composite	Hot and dry	Composite
3	Area /student (mtr sq.)	200	404.68	96.11	
4	Site Area (acre)	494.21	100	9.5	
5	Material	Mud brick ,mud mortar, stone, stucco etc.	Mud brick ,mud mortar, stone, stucco etc.	Red sand stone and modern building material	Modern building material and sand faced plaster in elevation, exposed brick, bamboo etc.
6	Planning	Linear planning /cluster planning	Linear planning /fortress like structure	Planning inspired from mandala form and Navgraha.	
7	Provision of brahmasthan (courtyard)	open courtyard with sacred structure	open courtyard with sacred structure	open courtyard	Central courtyard
S. No	Name	Nalanda mahavihara	Vikramshila mahavihara	Jawahar kala Kendra	CESE building – IIT Kanpur	As per vastu
8	Staff room	In every direction	In every direction	north	west	North west
9	Class rooms	In open court yard east-west (longer axis)	In open court yard	South	North south (smaller axis)	east
10	library	South	South	east	South west	west
11	Principles office			north	South west	South west or south
12	Meeting room	Central courtyard	Central courtyard	north	east	North
13	Open play ground	Central courtyard and north	Central courtyard and north	Central courtyard	North and south	east
14	Teaching platforms	Class has the teaching platform	Class has the teaching platform	West direction/ yes slightly raised	Yes	Recommended

Table 4-Comparative analysis of literature study

XI. CONCLUSION

All guidelines of Vastu shastra do not match with the modern building science while some principles and planning concept of the Vastu shastra seems scientific and logical. Some principles of the Vastu shastra cannot be applied everywhere if there is any building norms, we have to follow it like floor area ratio, setbacks, & building height etc. some concept like courtyard planning, height of building and concept of Panchbhootas etc. can be implement these principles are very scientific and can be beneficial for the modern architecture. Architecture should always have the senses of belongingness. This principle is recommended by the Vastu shastra in the fundamental of the Vastu called Bhoo-pariksha. Recommendations according to the mandala form which work on the sun movement and suggest the space according to it. This is applicable to from ancient time to till. Planning according to the sun movement ensure the thermal comfort and human psychology. That is why planning according to sun movement is always recommended and said auspicious. Courtyard planning for the composite climate is must for better ventilation and day lighting. Modern era has different way of living and it evolve with time therefore our requirement and way of living also changes so it cannot be implemented same as it was in ancient time.

It is hard to implement all the principles in which major reason is scarcity of the land, changing way of living etc. but we can use the mix of Vastu Shastra principles with modern building science which will give the psychological effect to the user as well as the traditional feeling under the roof of the structure.

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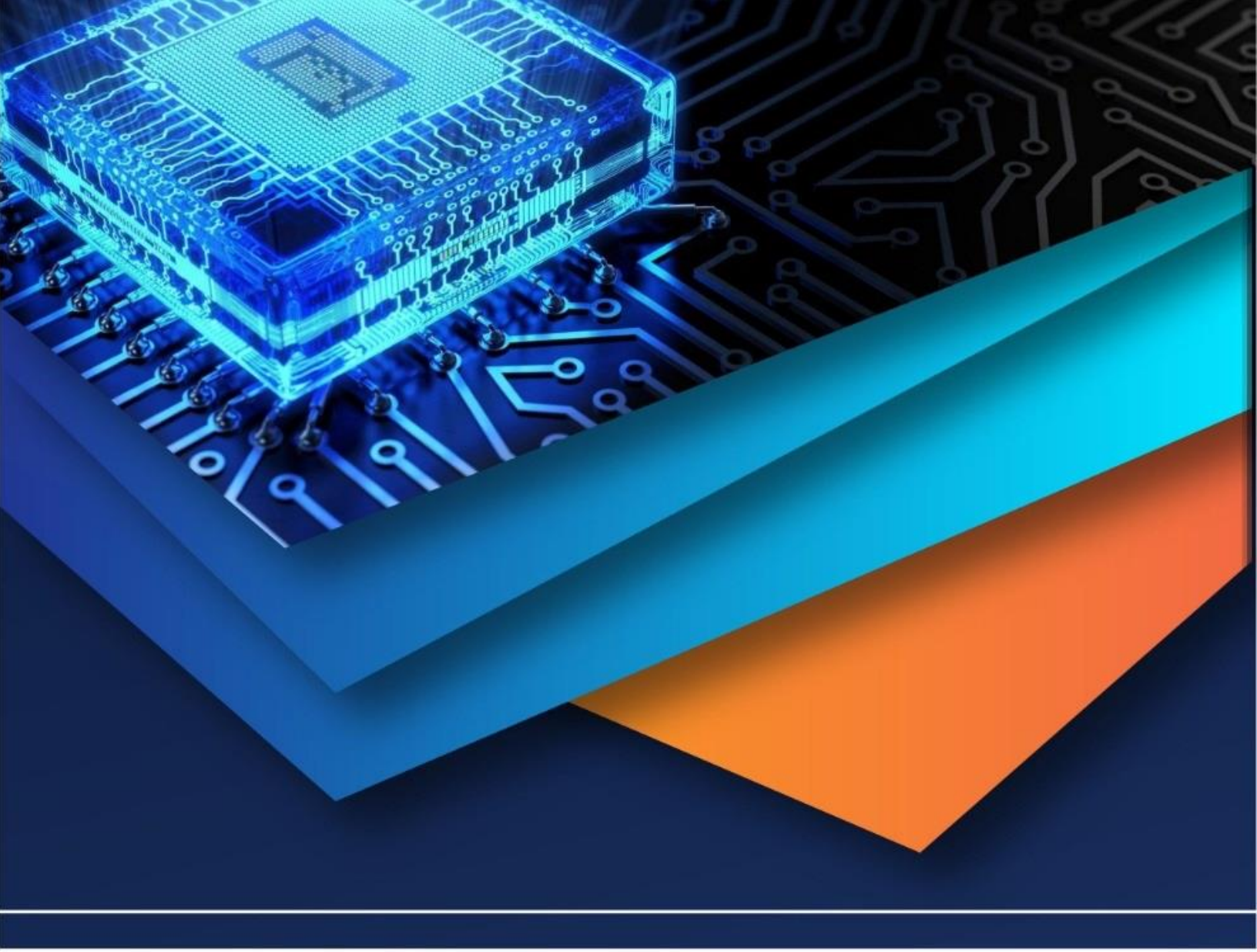

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