



Society of St. Francis Xavier, Pilar's  
**Fr. Conceicao Rodrigues College of Engineering**  
Fr. Agnel Technical Education Complex Bandstand  
Bandra (West) Mumbai -400 050

## SCIENCE, ENGINEERING AND TECHNOLOGY IN IKS: TOWN PLANNING AND ARCHITECTURE

ब्राह्मे मुहूर्ते उत्तिष्ठेत् स्वस्थो रक्षार्थमायुषः।

brâhma

muhûrte

uttîṣṭhet

svastho

rakṣârthamâyusâh

A healthy individual should wake up in Brâhma Muhûrta (96 minutes before sunrise) to protect and improve one's health. Brahma means knowledge. The time to seek knowledge is called as Brâhma Muhûrta

Source: Ashtanga Hryudam Sutra 2.1

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1

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## Perspective of Arthaśāstra on town planning

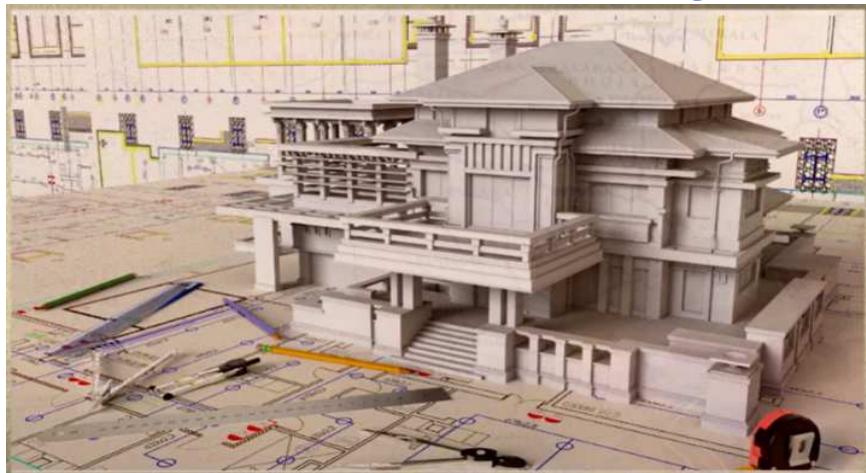


2

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## What is Town Planning?



Town planning is a collective set of processes, ideas, and methods to deploy the available land for human habitation and other uses in the most efficient way.

3

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## Town Planning

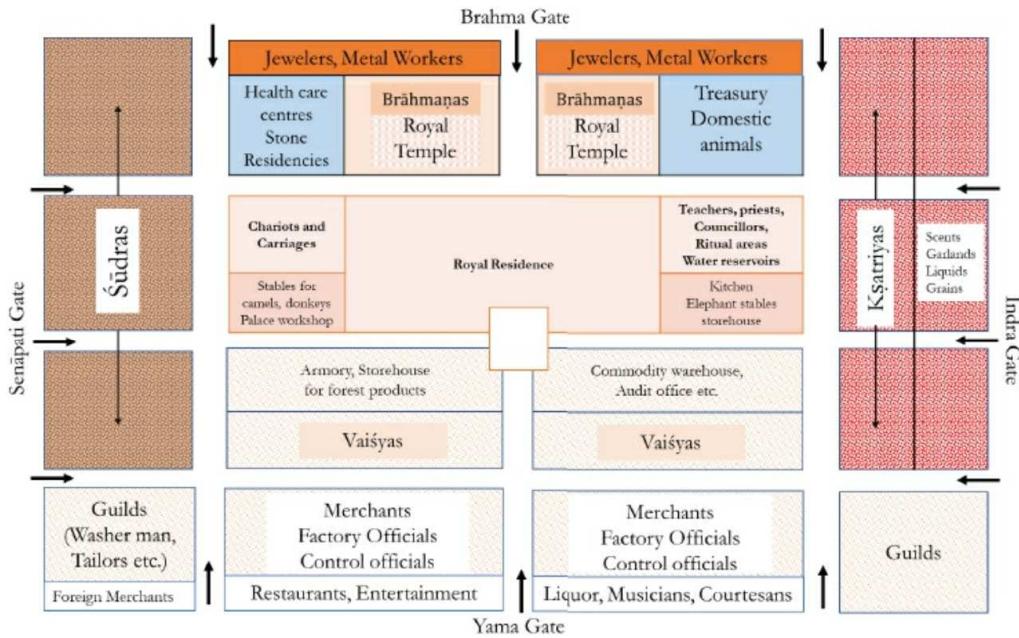


4

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## A Schematic Representation of Kauṭilya's Plan for the Fortified City



\* The crematoriums are outside the city at designated places (not shown in the figure)

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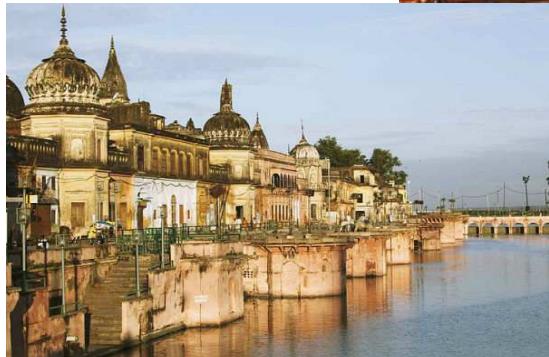
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- ◆ Archaeological exploration of the Sindhu–Sarasvati civilization points to a well-developed town planning in ancient times.
- ◆ Harappa was a planned city with the streets generally oriented along with the cardinal directions.

6

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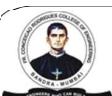
Kingdom of Ayodhya



The golden abode of King Ravana

7

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वसन्ति प्राणिनः यत्र इति वास्तु  
Vasanti prāṇināḥ yatra iti vāstu

## Issues Discussed in Vāstu-Śāstra

### Town Planning

- Site selection
- Design of towns, villages, capital city
- Land use patterns (Zoning)

### Civil Architecture

- Palace
- Houses
- Forts
- Public buildings
  - Theatre
  - Library
  - Other public infrastructure

### Temple Architecture

- Temples
- Components of a temple
- Iconography (idol making)

### Artistic

- Paintings
- Furniture, doors
- Sculptures

### Others

- Qualification of a Sthapati
- Choice of building material, wood, etc.
- Site planning (Vāstupuruṣa-maṇḍala)

8

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## Selected Vāstu-Śāstra Texts and Issues Covered

Sl. No.	Text	Topics Discussed
1	Kāśyapa-śilpa	Treatise on architecture and iconography. Prescriptions of the building of the temples, rules for making images of the deities
2	Nārada-śilpa-śāstra	General roads, Water resources, Village and town planning, Fourteen types of towns, Fortification, Palace complex, Interior planning, Superstructure, Residences, Palaces, Furniture, Law courts, an Arts Gallery, Theater, Temple, Iconography, and Paraphernalia
3	Viśvakarma-prakāśa	The orientation of sites, Men and materials to be employed in Vāstu Examination of the different kinds of lands, regions, and soils, Leveling of site, placing the foundation box, The planning of villages, towns, forts, and roads, streets, lanes, Planning of temples, icons of gods, Planning of arsenals, Residential houses
4	Mānasāra	System of measurement, Classification of Architecture, Examination, and Selection of soil, The ground plan (Pāda-vinyāsa), Village Planning, Towns and Ports, Pillars, Entablature, Roof Wood-joinery, One to twelve storied buildings
5	Mayamatam	A treatise on dwelling, deals with all the facets of gods' and men's dwellings, from the choice of the site to the iconography of the temple walls, Descriptions of villages and towns, temples, houses, mansions, and palaces, Selection of proper orientation, right dimensions, and of appropriate materials
6	Samarāṅgaṇa-sūtradhāra	Town planning, house architecture, temple architecture, and sculptural arts, mudrā, the canons of painting, the art of mechanical contrivances – the yantra. Land/Soil examination, Units of measurement, planning of the King's Abode, houses with one, two and four chambers, the definition of the door, pedestal, wall, the art of wood planking and defective or deficient buildings, Definition of temples, etc., Pavilion, Allocation of specific parts to the land
7	Manuṣyālaya-candrikā	Seven chapters covering the following architectural themes: Investigation and selection of land, Site analysis, Houses, Parts of a house, Elements of roof, Ancillary structures

9

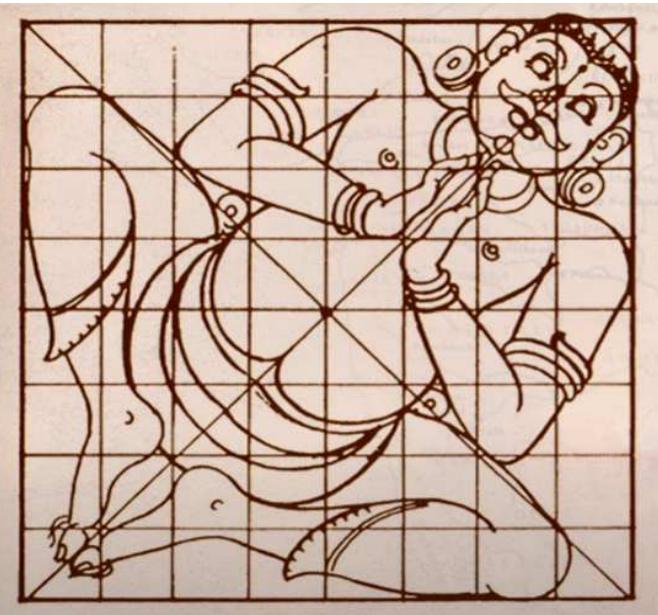
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## Town Planning

### Kāśyapa śilpa:

- ✓ Treatise on architecture and iconography
- ✓ Prescriptions for building temples
- ✓ Rules for image making of the deities



### Nāradaśilpaśāstra:

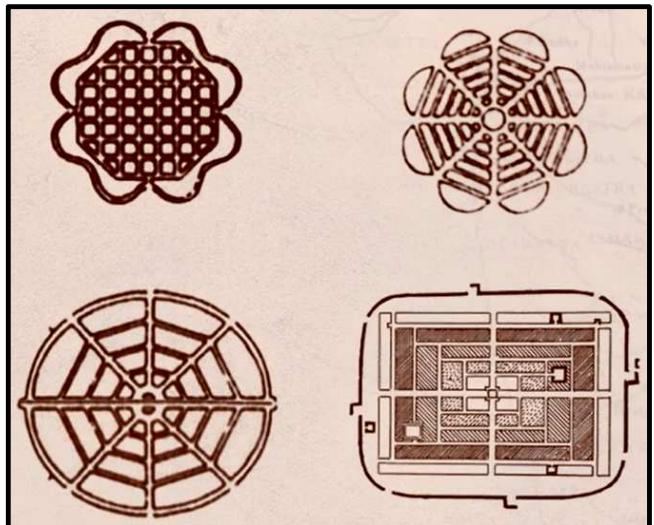
- ✓ Description of general roads, water resources, village and town planning
- ✓ Fourteen types of towns
- ✓ Fortification, palace complex, Interior planning

10

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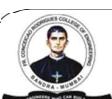


## Town Planning

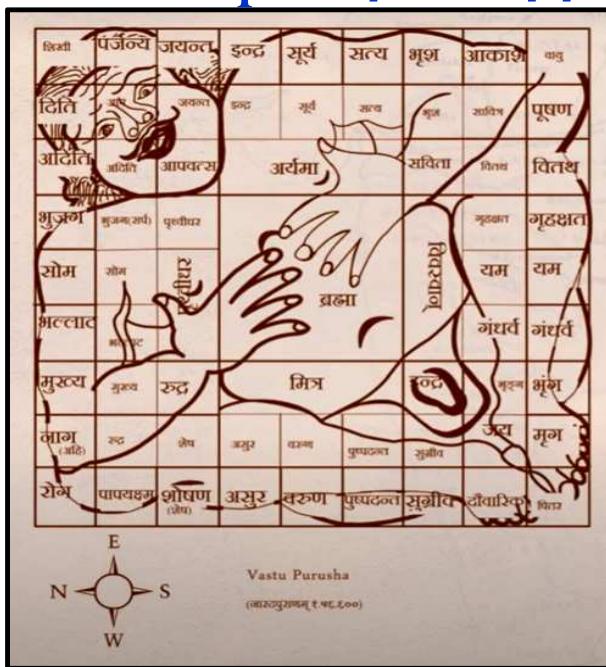


11

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## Vāstu-puruṣa-Maṇḍala

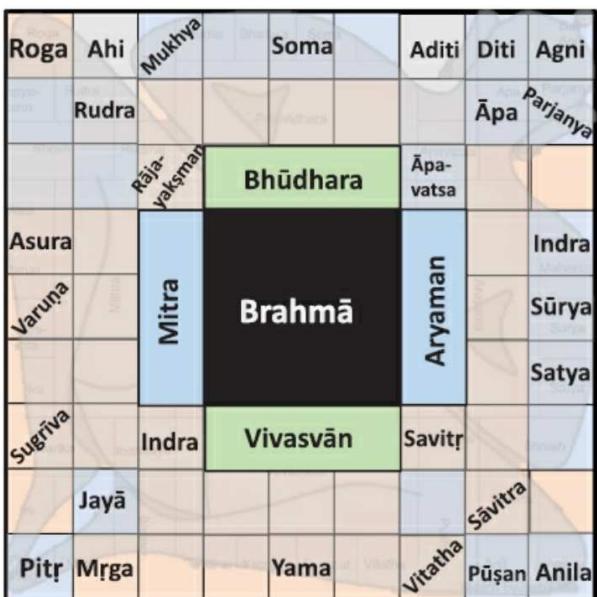


12

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## The Vāstu-puruṣa-Maṇḍala (9 × 9 Grid)



### Division of a Site into Alternative Sizes and Squares

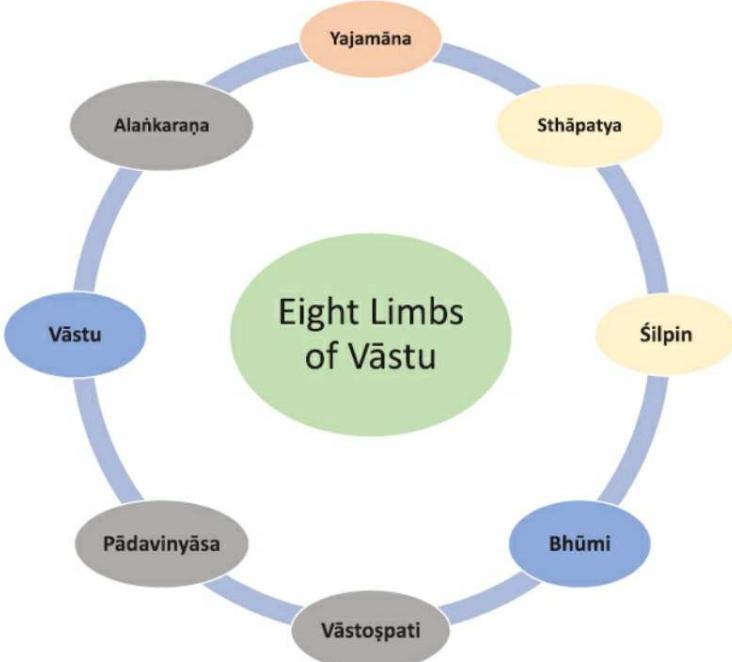
Sl. No.	Type of Division of the Site	No. of Squares
1	Sakala	One (1×1)
2	Pecaka	Four (2×2)
3	Pīṭha	Nine (3×3)
4	Mahā-pīṭha	Sixteen (4×4)
5	Upa-pīṭha	Twenty-Five (5×5)
6	Ugra-pīṭha	Thirty-Six (6×6)
7	Sthāndila	Forty-Nine (7×7)
8	Mandūka	Sixty-Four (8×8)
9	Paramasāyika	Eighty-One (9×9)
10	Āsana	Hundred (10×10)

13

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## Eight Limbs of Vāstu



14

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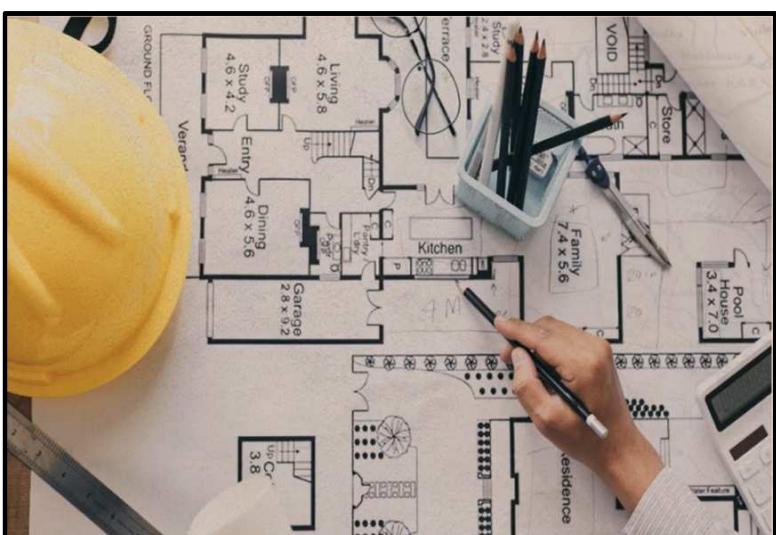
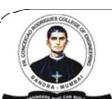


## Yajamāna (Host)

The core objective of Vāstu-śāstra is to provide satisfaction, peace of mind, and prosperity for a dweller or the owner

15

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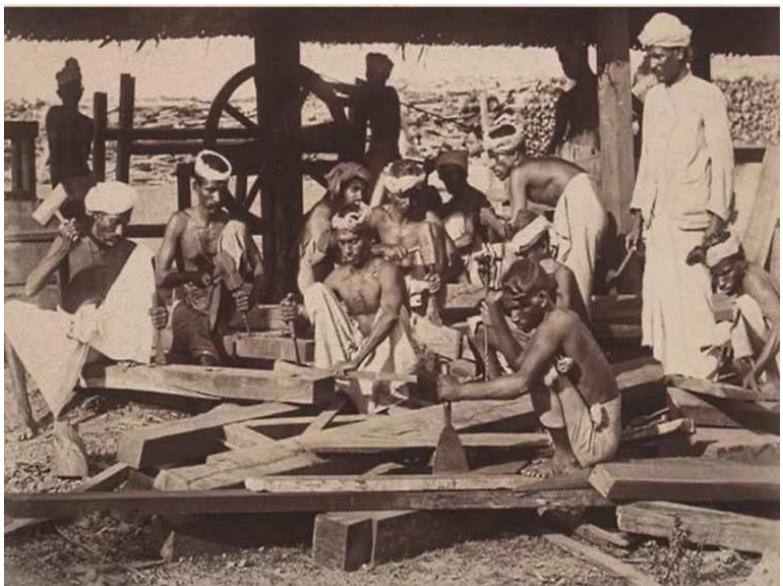


## Sthāpatyam (Architecture)

- Structural design,
- Developing detailed specifications,
- Cost estimation,
- Unique styling come under sthāpatyam in vāstu śāstra

16

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## Śilpi (Technicians)

According to Mayamatam, four types of technicians (śilpis) work on a building

17

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## Bhūmi (Land)

This involves ascertaining the suitability of the site for the proposed construction and an examination of soil & soil conditions

18

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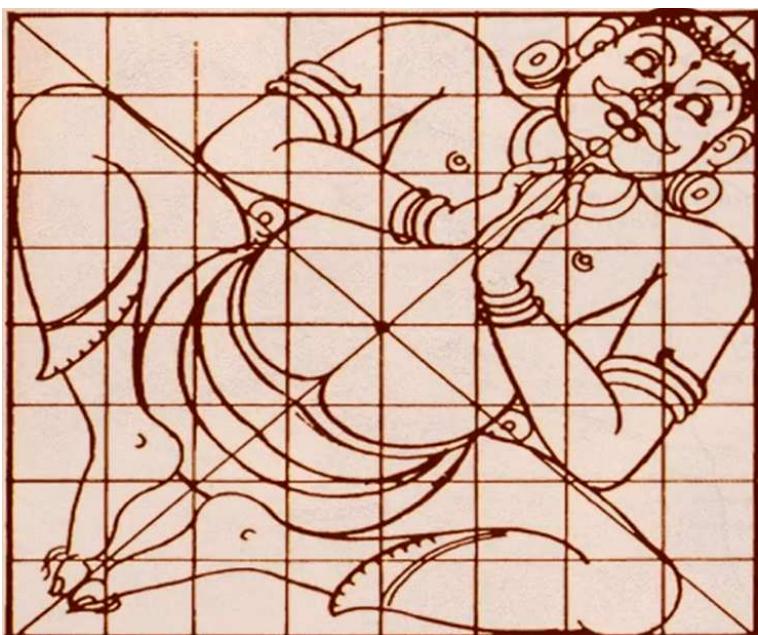


## Vāstośpati (Offerings)

The beginning of an architectural endeavour has two activities: Vāstu-pūjana and bali-dāna, in which certain offerings are made and the gods, spirits, and demons are bid to leave

19

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## Pādavinyāsa (Site layout)

The approach to site layout or design for the proposed construction based on the Vāstu-puruṣa-maṇḍala

20

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### Vastu (Materials)

Deals with the materials used and processing of those materials as required for the construction in detail

21

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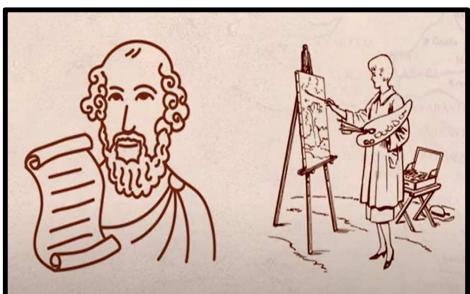


### Alaṅkaraṇam (Renovations & Decorations)

In Vāstu deals with two aspects: interior and exterior design of a building and repairs and modifications

22

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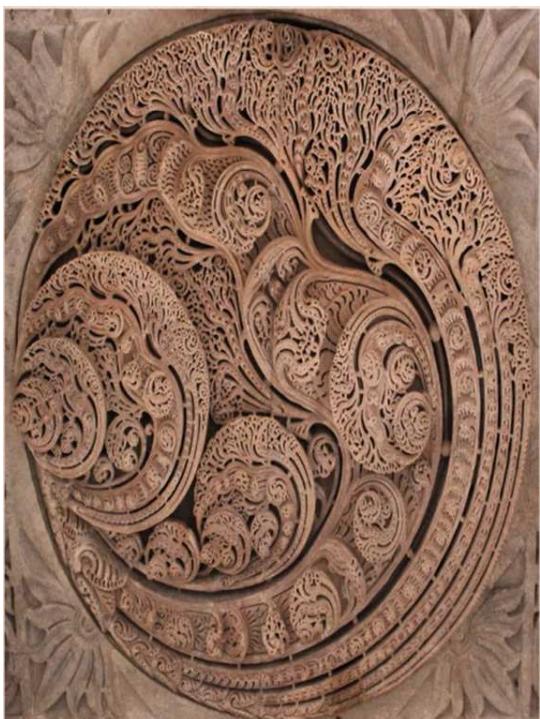


### Sthapati - The Master Architect

- Skills in intricate design
- Carpentry
- Building (using bricks, etc)
- Artworks on stone
- Artificially creating new things out of existing material and gold
- Flawless execution of the plan

#### Skills for Sthapati (The Master Architect):

1. **Śāstra** – knowledge of the technical details of the craft
2. **Karma** – Practical experience in the application of the knowledge, making him a skilled craftsman
3. **Prajñā** – Intuitive insight which endows him with an imaginative mind and artistic orientation
4. **Śīla** – Righteous character, which will ensure that he will succeed in all his endeavours with the right attitude and orientation.



### Four Types of Other Technicians (Śilpis)

Team consisting of: Sthapati (head), Sūtragrāhin, Takṣaka, and Vardhakin

- Sūtragrāhin is the draftsman, who does the layout using the cord (sūtra) for all measurements for the building
- Takṣaka carves stone, wood, and clay
- Vardhakin adds to his work by joining parts and finishing their surfaces



## Classification of Villages and Towns:

- Based on the area,
- Based on the location,
- Based on the street plan,
- Based on the types of residences,
- Based on the protective moat,
- Temple,
- Composition of social groups

### Nārada Śilpaśāstra:

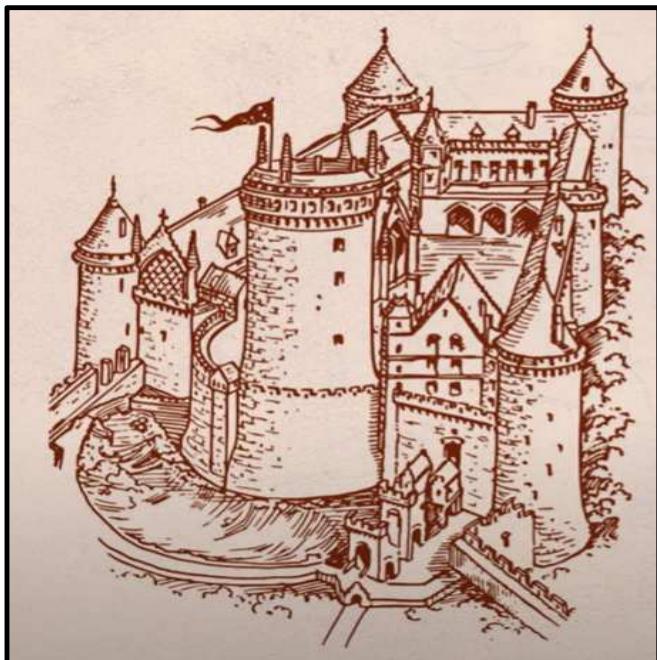
14 different types of towns are described



## Different Categories of Towns Mentioned in Vāstu Texts

Sl. No.	Category of Town/Village	Brief Description
1	Rājadhānī – Capital city	Primary abode of the king, has a sabhā at the centre of the city
2	Pattana/Puṭabhedana	Second residence of a king, a commercial centre
3	Dronamukha	Situated on a riverbank, frequented by traders from distant places
4	Durga	A fortified town, 12 types of forts have been discussed
5	Sthāniya	Fortress at the centre of 800 villages
6	Śākhānagara	Subsidiary town
7	Kārvatīka	Situated at the centre of 200 villages
8	Kheṭa	Smaller town mainly of labour class
9	Nigama	Market mainly of artisans
10	Grāma	Smaller than Nigama
11	Matha or Vihārā	A residential University village

Compiled from: Kumar, P. (1998). Bhoja's Samarāṅgaṇa Sūtradhārā, Vol. I, New Bharatiya Book Corporation, Delhi.



## Rājadhāni - Capital City

*Primary abode of the king, has a sabhā at the centre of the city*

27

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## Paṭṭana/ Puṭabhedana

*Second residence of a king, a commercial centre*

28

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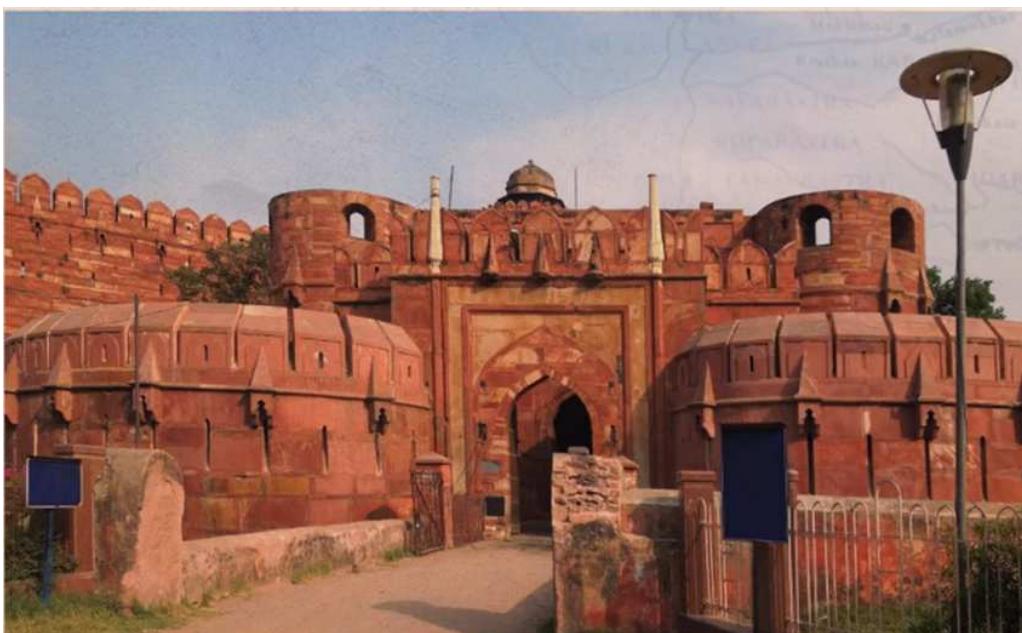
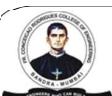


## Dronamukha

*Situated on a riverbank, frequented by traders from distant places*

29

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## Durga

*A fortified town,  
12 types of forts*

30

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**Sthāniya**  
Fortress at the centre of 800 villages

**Śākhānagara**  
Subsidiary town  
**Kārvatika**  
Situated at the centre of 200 villages

**Kheṭa**  
Smaller town mainly of labour class

31

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**Nigama**  
Market mainly of artisans

32

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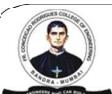


**Grāma**

*Smaller than Nigama*

33

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**Maṭha or Vihārā**

*A residential University village*

34

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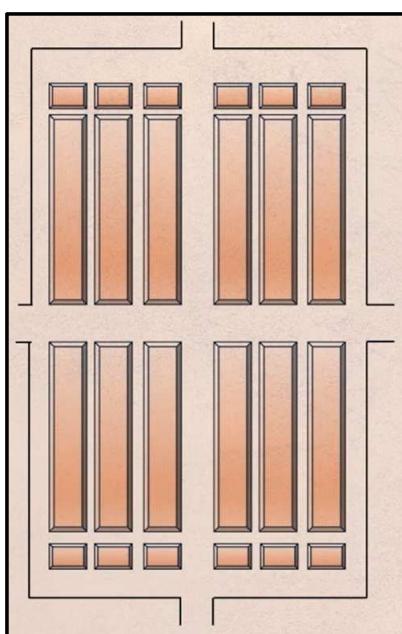


## Alternative Designs for Town Planning Found in Mānasāra

Nature of Designs			
Design	Shape	Street and Roads	Other Details
Dandaka	Stick/staff/ phalanx	Parallel set of straight streets (one to five) crossing each other at right angles.	Good for priests, Sages, intellects, etc. No. of houses: 12–300.
Nandyāvarta	Square or oblong	It should have one to five carriage roads together with the surrounding street. Internal roads have one footpath and the outer two footpaths.	
Sarvatobhadra	Square or oblong	Number of car streets varies from 1 to 5.	Town/village is secured by a wall and ditch with four large gates on the sides and as many on the corners.
Padmaka	Lotus shaped	Length and breadth are equal while the enclosing walls can be circular, quadrangular, hexagonal, or octagonal. There are 4 to 8 streets lined with the houses.	According to Mayamata, there are five varieties of this design. Gates are placed in four cardinal directions.
Svastika	Svastika	Two streets passing through the center. Traversing streets are planted in the clockwise direction. The outermost roads should be lined with a single row of houses and other streets with a double row of houses.	Temple at the center, has eight gates (two each on every side).
Prastara	Square or oblong	Space needs to be divided into 4, 9, 16 wards by a network of streets. Roads to be constructed like a chessboard system.	The village needs to have enclosed walls and ditches with four principal gates on the south and subsidiary ones in the corners.
Kārmuka	Semi-circular like a bow	2 car streets, 1 principal street. The number of traverse streets can be from 1 to 5. Houses range on both sides of the streets.	This type of design is best for a seashore. The number of gates is optional.
Caturmukha	Square or oblong	4 car streets on four sides. Two large streets crossing at right angles in the center dividing the whole site into four blocks. Each ward must have four smaller roads.	It is specially meant for traders.

35

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### Dandaka

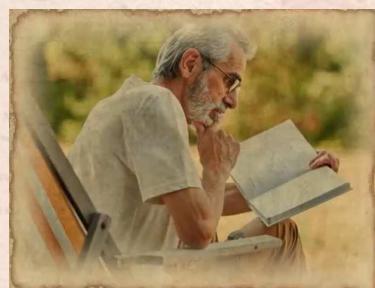
**Shape:**  
**Stick/Staff/ Phalanx**

**Street & Roads:**

**Parallel set of straight streets (one to five) crossing each other at right angles**

**Other details:**

**Good for priests, sages, intellects, etc. No. of houses: 12–300**



36

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## Nandyavarta

**Shape:**

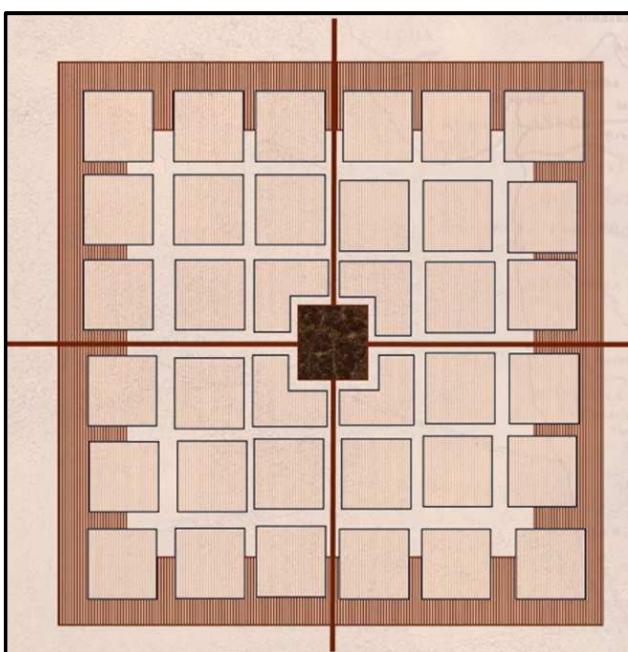
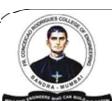
**Square or oblong**

**Street & roads:**

*One to five carriage roads together with the surrounding street. Internal roads have one footpath and the outer two footpaths*

37

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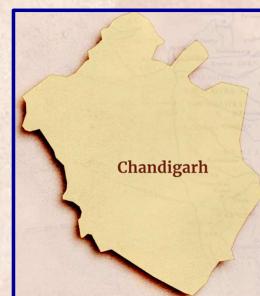
## Sarvato-bhadra

**Shape:**

**Square or oblong**

**Street & roads:**

*Number of car streets varies from 1 to 5*



**Other details:**

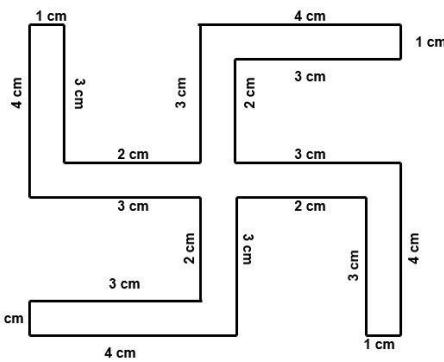
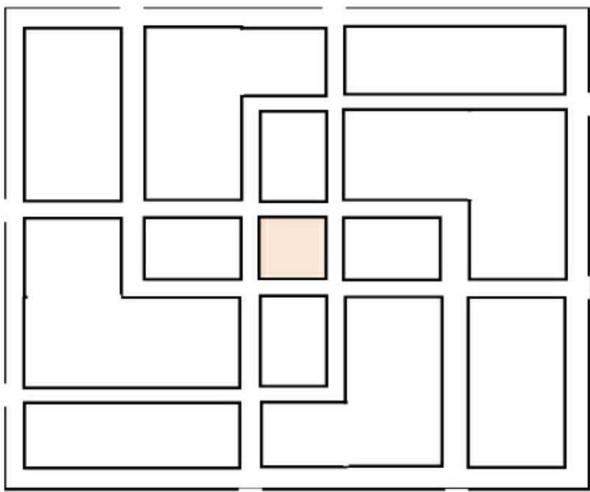
*Own/village secured by a wall and ditch with four large gates on the sides and on the corners*

38

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## Simplified representation of the swastika model



### Different Categories of Roads and Their Widths

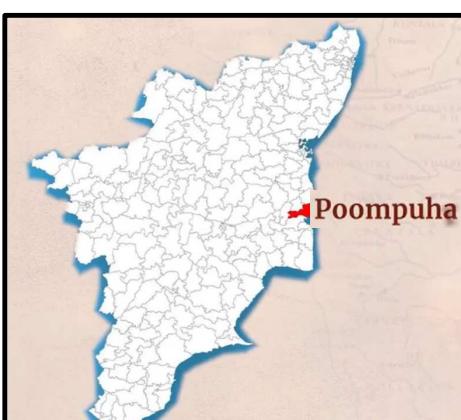
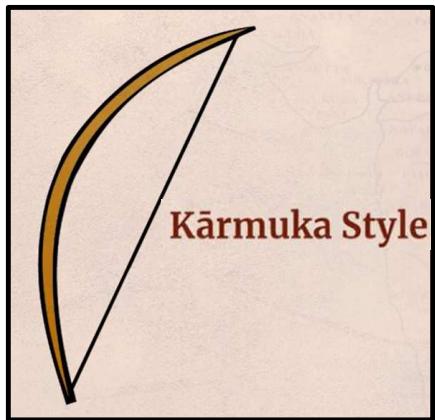
Sl. No.	Type	Width of the Road (Feet)		
		Jyestha	Madhya	Kaniṣṭha
1	Rājamārga	36	30	24
2	Mahārathyā (highway)	18	15	12
3	Yānamārga	6	6	6
4	Jaṅghā pathas	4½	3¾	3

39

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- Padmaka
- Svastika
- Prastara
- Kārmuka
- Caturmukha

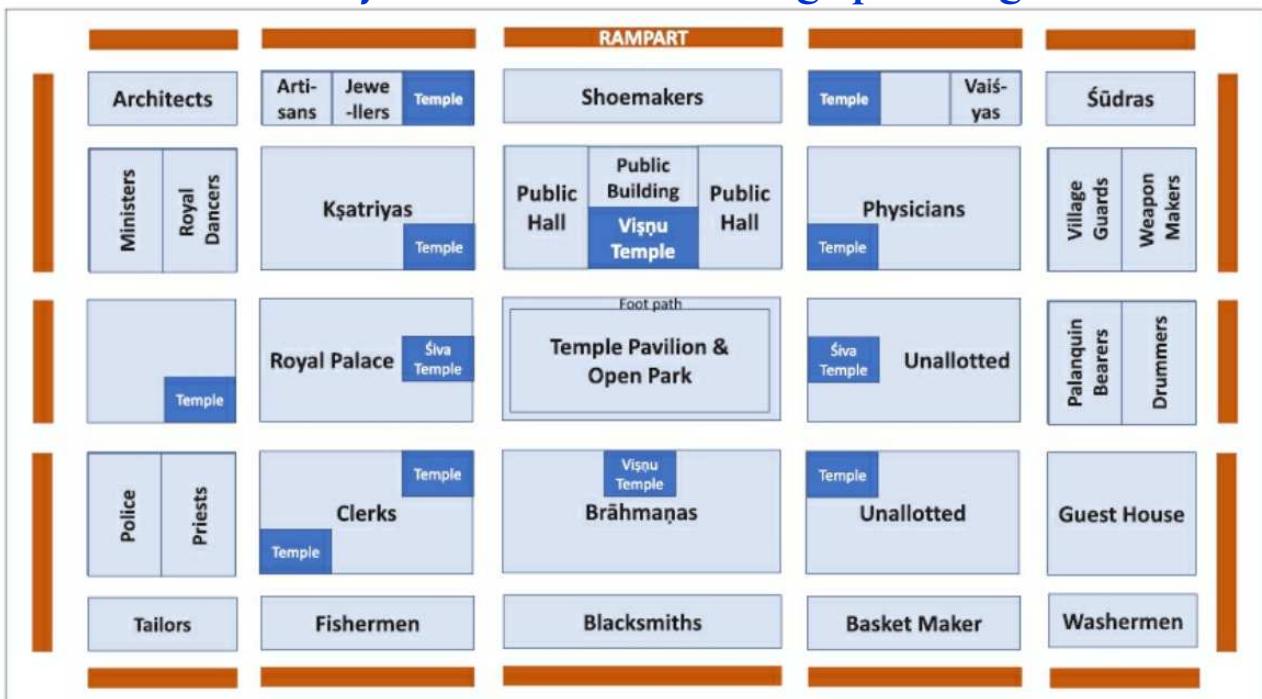


40

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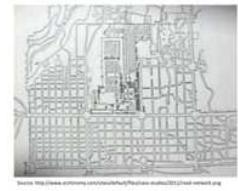
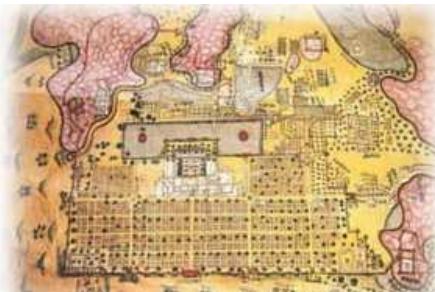
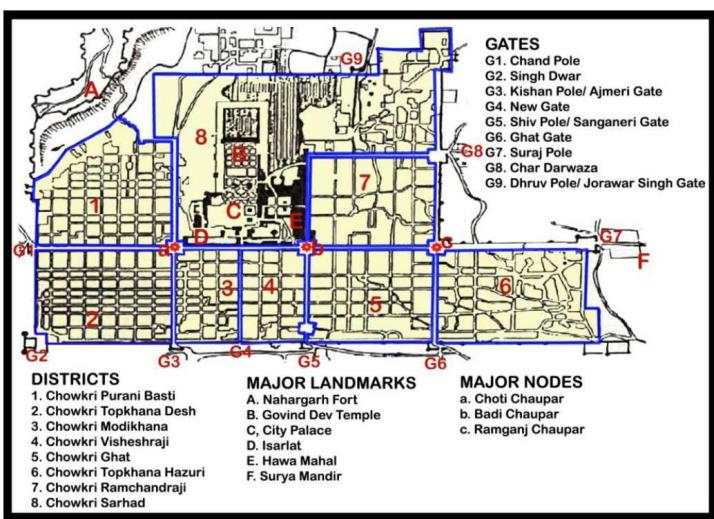


## Nandyāvarta model for village planning



41

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42

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## Residential Buildings

### Type of house:

- ✓ Depends on the stage of life that one is in (Āśrama)
- ✓ Different strata of the society (Rich and poor)
- ✓ Houses for the working class

### Samarāṅgaṇa-sūtradhāra

- ✓ Five chapters on residential buildings
- ✓ There are 108 one-roomed houses, 52 two-roomed houses, and 72 three-roomed houses
- ✓ Multiple variations of bigger houses (five-roomed up to ten-roomed) in a modular fashion
- ✓ Other related topics such as courtyards, balconies, windows, and other parts of the residential houses

43

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## Royal Palaces.....Assembly Hall (Sabhā)

Samarāṅgaṇa-sūtradhāra, eight different types of designs have been proposed for sabhā construction.



44

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## Royal Palaces.....Assembly Hall (Sabhā)



45

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## Royal Palaces.....Assembly Hall (Sabhā)

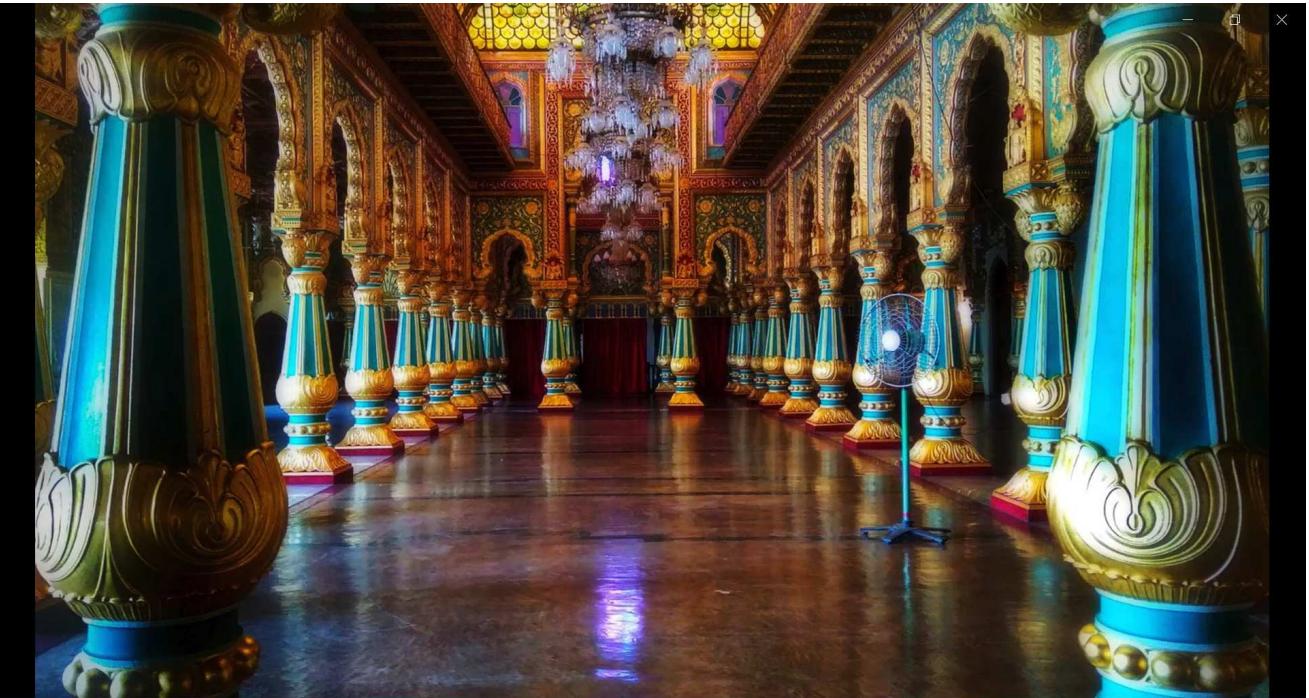


46

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## Royal Palaces.....Assembly Hall (Sabhā)



47

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## Assembly Hall (Sabhā)

Mayamatam describes *nine types of halls* (sabhā) with details of the length, breadth, and the number of main pillars and peripheral pillars. Also different types of *square-shaped and rectangular-shaped pavilions* (*mandapa*).



48

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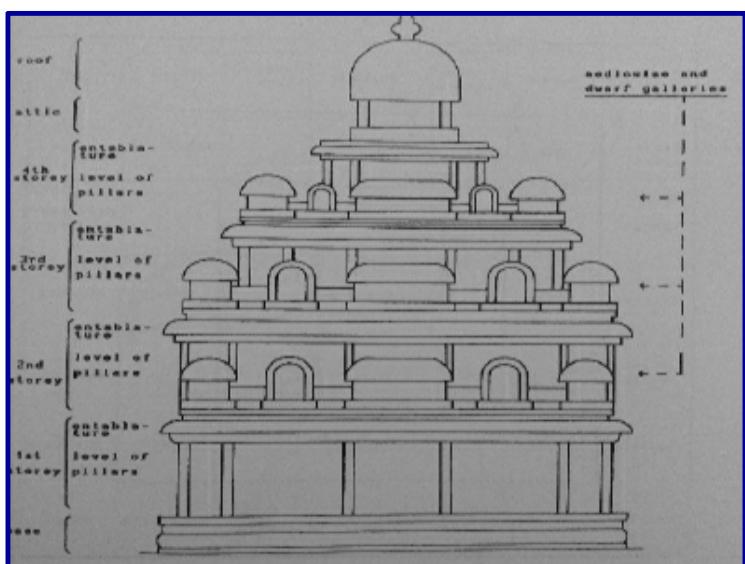
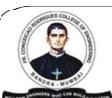


## Identify the building?



49

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Town planning and architecture is the logical extension of the basic instinct of every living being, to protect self from the weather and other living beings. That also led to the creativity in the field of construction resulting in several incredible temple structures. The figure is the architectural design for a four-storey temple (Subhadraka type) proposed in Mayamatam, one of the Vāstu-śāstra treatises.

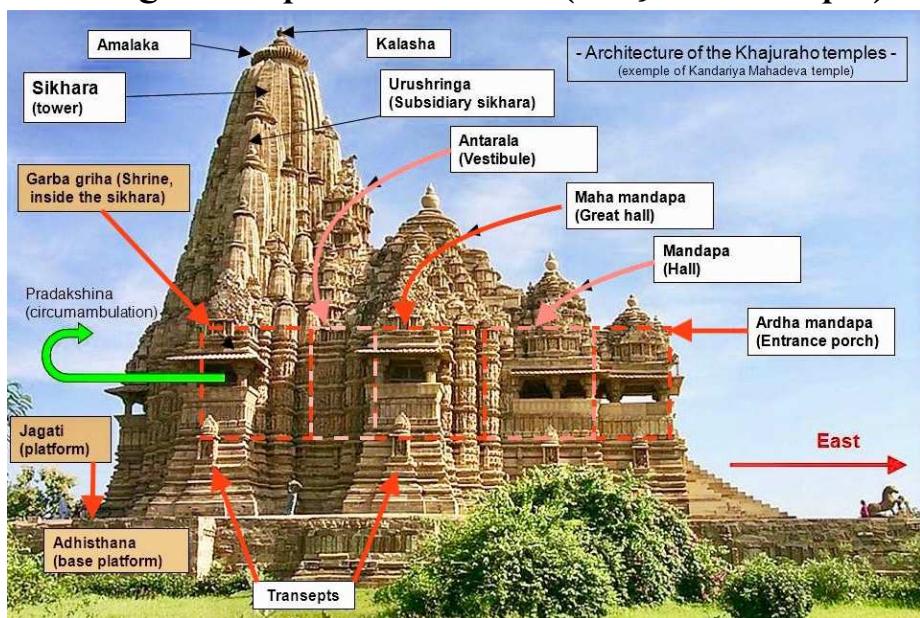
50

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# Temple architecture in India

## Nāgara Temple Architecture (Khajuraho Temple)



51

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## Certain Aspects of Temple Architecture in Ancient India

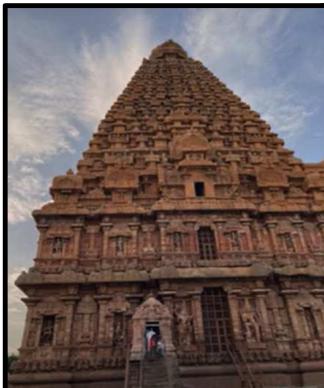
Sl. No.	Criterion	Remarks
1	Components of temple architecture	Womb (Garbhagriha), Front pavilion (Mukha-mandapa), Entry Pavilion (Ardha-mandapa), Base (Adhiṣṭhāna), Pillars (Stambha), Entablature (Prastara), Superstructure (Śikhara), Finial (Stūpi)
2	Types of temples	Drāvida – Has tall gopurams and pillared (108 to 1008) halls, huge passageways for pradakṣiṇa (circumambulation) Nāgara – Śikhara gradually inclines inwards in a convex curve, using a concentric rotating-squares and circles
3	No. of storeys	1–12 storeys in South Indian (Drāvida) temples 1–16 storeys in North Indian (Nāgara) temples
4	Shapes of the Vimāna	Square (Vairāja), Circular (Kailāsa), Rectangular (Puṣpaka), Elliptical (Māṇika), Octagonal (Triviṣṭapa)

52

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## Temples in India



**Time:**  
✓ 1000 Years  
(in 2010)



**Material Used:**  
✓ Granite



**Design:**  
✓ 16 X 16 (Padma-garba-mandala)

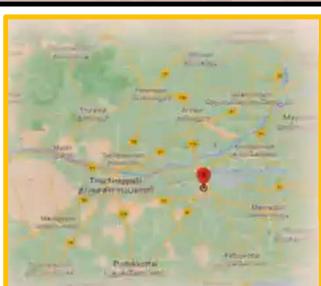


### Vimāna (tower):

- ✓ 99-feet in height
- ✓ Tallest in South-India

### Śikhara (Superstructure):

- ✓ Dome weighting of 25 tons
- ✓ Resting upon single block of granite
- ✓ Weighting 80 tons, atop the tower



### Supply of Granite:

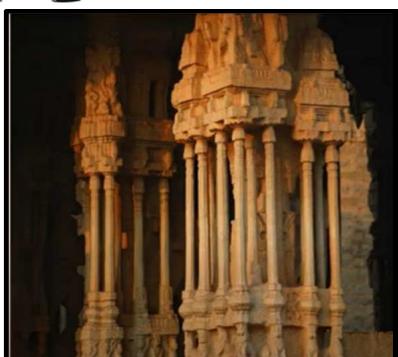
- ✓ Nearest possibility is 60 Km
- ✓ Supply chain management

53

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## Temples in India



### Musical Pillars in Indian Temple:

- ✓ Thanjavur Temple
- ✓ Vijay Vittala Temple, Hampi
- ✓ Nellaiappar Temple, Tirunelveli
- ✓ Meenakshi Temple, Madurai
- ✓ Alwar Tirunagari Temple



**Timing:**  
✓ 1250 CE



**Design:**  
✓ Gigantic chariot dedicated to Sun God



**Symbolism of Wheels:**  
✓ 24 Wheels ~24 pakṣas in a year  
✓ Each of about 12 feet diameter  
✓ Wheels are sundials  
✓ Used in calculating time

54

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## Temples in India

### Kailasa Temple Elora



#### Architecture for Eternity:

- ✓ Most spectacular monument
- ✓ Largest cut-rock structure
- ✓ Built by Kṛṣṇa I
- ✓ Notable for its vertical excavation, carvers started from top to downward



#### Unique Structure:

- ✓ Three-storey vimāna (tower)
- ✓ Octagonal dome



#### As per UNESCO Report:

- ✓ Most remarkable cave temple in India
- ✓ Decorated with the boldest and finest sculpture
- ✓ Preservation of beautiful paintings from two different periods

55

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## Temples in India

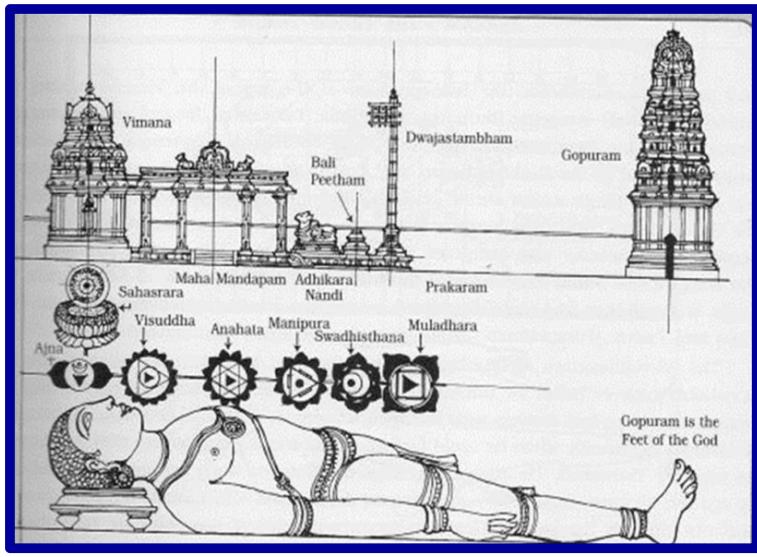
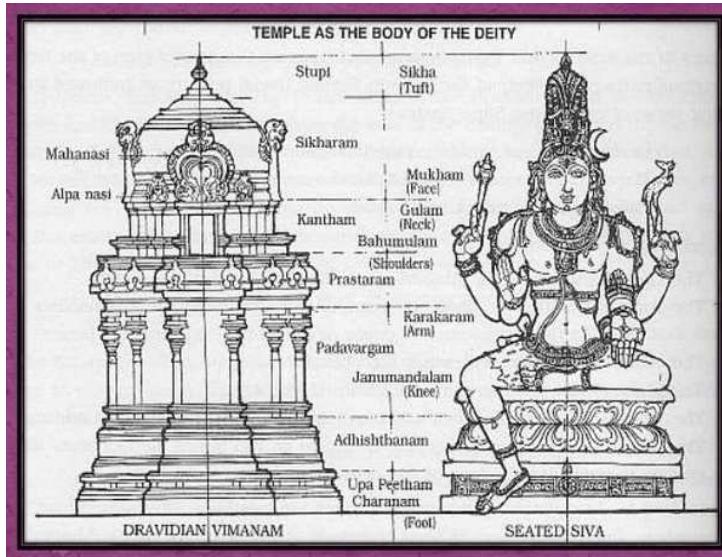


56

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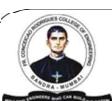


## Temple Architecture and Symbolism of Human Body

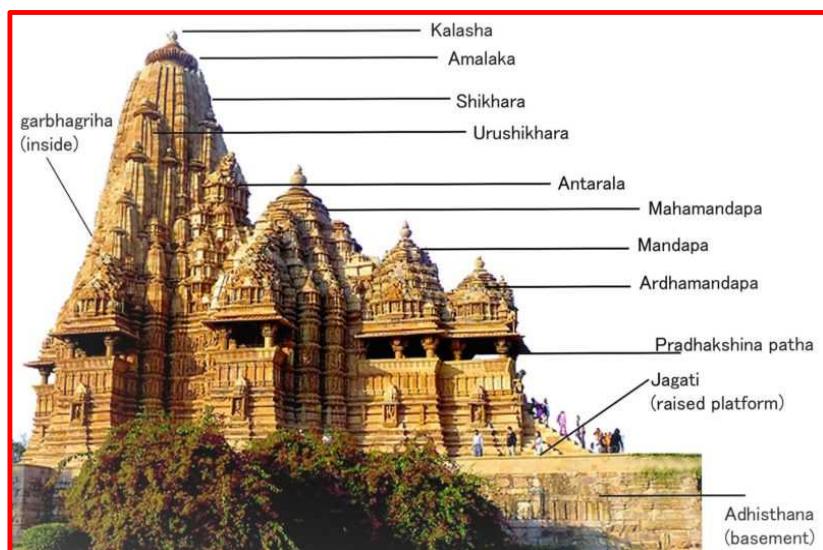
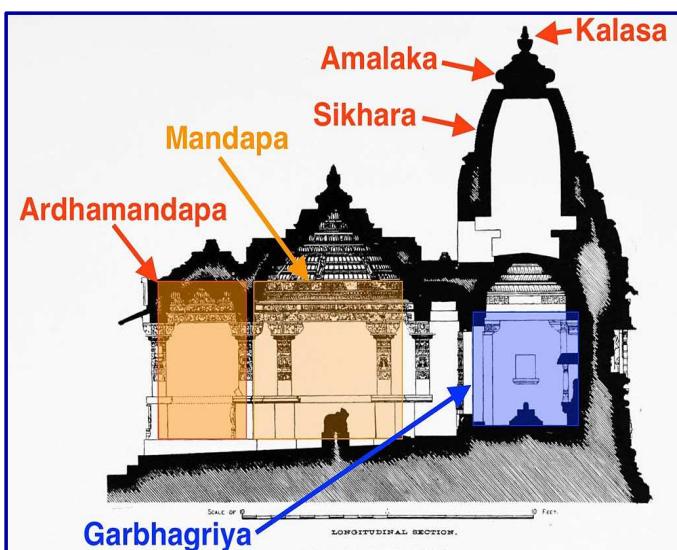


57

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## Temples in India



58

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## Temples in India

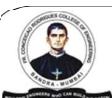
### Garbhagṛha:

- ✓ The womb or epicentre of the temple
- ✓ The sanctum sanctorum (Deities position)
- ✓ Established using the Vāstu-puruṣa-maṇḍala.



59

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## Temples in India



### Maṇḍapa:

- ✓ Pavilion structure in front of garbhagṛha
- ✓ Types of Maṇḍapa
  - Mukha-maṇḍapa (entry pavilion)
  - Ardha-maṇḍapa (front pavilion)
  - Mahā-maṇḍapa (main pavilion)
- ✓ Pillared structure of varying numbers and sizes

60

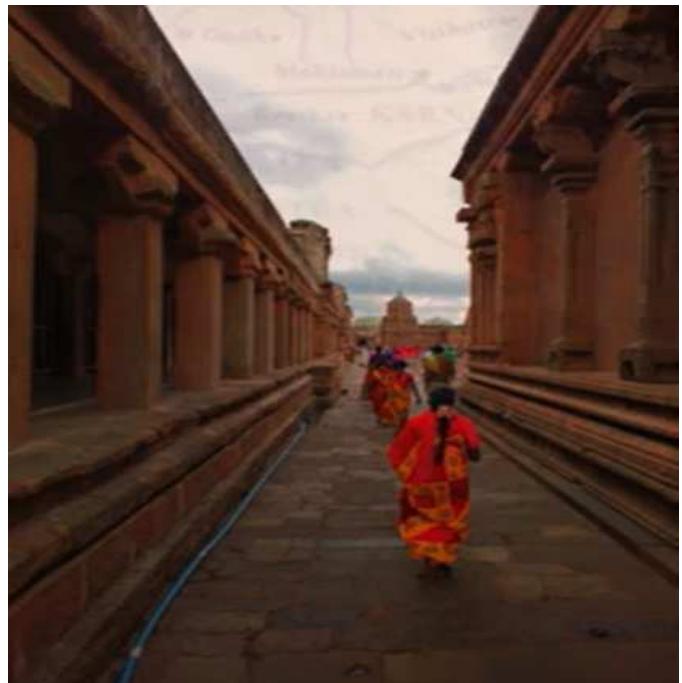
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## Temples in India

### Prāhāra:

- ✓ Open space for circumambulation (pradakṣīṇa) around the garbhagrha
- ✓ Depends upon the overall size and the span of the temple superstructure



61

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## Temples in India

### Adhiṣṭhāna:

- ✓ Foundation on which the entire superstructure rests
- ✓ Various designed have been proposed in the vāstu texts



62

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## Temples in India

### Stambha:

- ✓ Set of pillars that support various structures
- ✓ Basis for the elevation for the temple



63

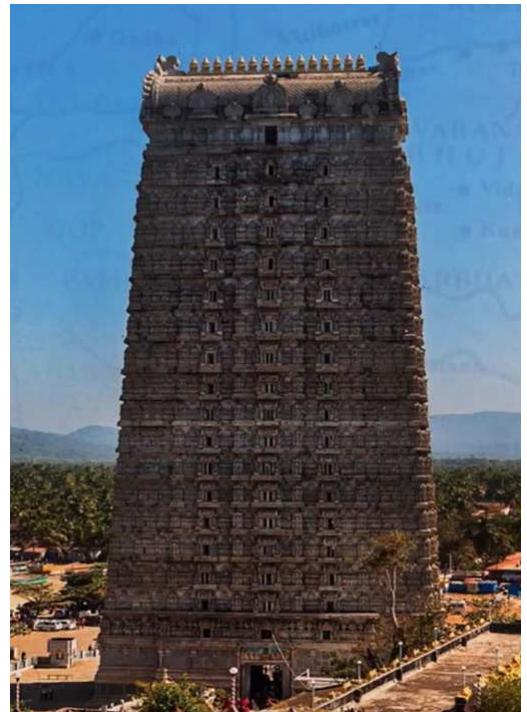
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## Temples in India

### Prastara:

- ✓ Entablature in the temple structure
- ✓ Temples are multi-storeyed (up to 16 storeys)
- ✓ Contributes to the substantive part of this
- ✓ The ground floor is the only habitable storey



64

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# Temples in India

## **Śikhara:**

- ✓ The superstructure, a tower-like infrastructure built above the garbhagrha
  - ✓ Forms the main elevation to the temple
  - ✓ The superstructure over the garbhagrha is called Vimāna
  - ✓ The dome-shaped cupola at the top of it is called Śikhara



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# Temples in India



## Stūpi:

- ✓ The finial to the structure

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66



# Temples in India

## Iconography



### Principles for Relative proportion:

- ✓ Different parts of the image include eyes, ears, chin, neck, forehead, and limbs.
- ✓ For both Males and Female
- ✓ Five principles particular for men
- ✓ Similar for women too



# Temples in India....summary

### Components of Temple Architecture:

- ✓ Womb (Garbhagṛha)
- ✓ Front pavilion (Mukha-maṇḍapa)
- ✓ Entry pavilion (Ardha-maṇḍapa)
- ✓ Base (Adhiṣṭhāna)
- ✓ Pillars (Stambha)
- ✓ Entablature (Prastara)
- ✓ Superstructure (Śikhara)
- ✓ Finial (Stūpi)

### No. of Storeys:



1-12 Storey in South India (Drāviḍa) temples



1-16 Storeys in Northern India (Nāgara) temples

### The Shape of the Vimāna:



Square (Vairāja)



Circular (Kailāśa)



Rectangular (Puṣpaka)



Elliptical (Māṇika)



Octagonal (Triviṣṭapa)



આભાર પેશીશન્યવાદ તુહાડા પેન્વાસ નંનું રીધન્યવાદલુ  
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પેન્વાસ નંનું રીધન્યવાદ ધન્યવાદ ધન્યવાદનીઓ  
**ધન્યવાદ**  
આભાર પેશીશન્યવાદ તુહાડા પેન્વાસ ધન્યવાદ  
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નંનું રીધન્યવાદ

**Thank you**

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