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Fr. Conceicao Rodrigues College of Engineering

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SCIENCE, ENGINEERING AND TECHNOLOGY IN IKS: OTHER APPLICATIONS

भद्रायां सुमतौ यतेष |

-ऋग्वेद (६.१.१०)

Let us strive for the wisdom that leads to the welfare of all

Dr. Surendra Singh Rathod
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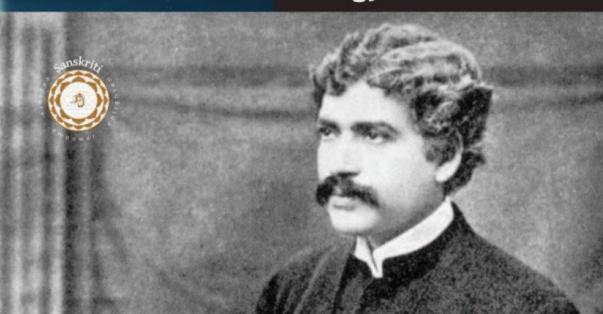
Moulding Engineers Who Can Build the Nation



Did you know.....?

Bharat Pioneered Wireless Communication Technology

www.sanskritimagazine.com



The first public demonstration of the use of radio waves for communication, however, was made by an Indian scientist, Jagadish Chandra Bose. Bose first demonstrated the use of radio in Calcutta, in 1895, two years before a similar demonstration by Marconi in England. More than a century after the feat, Bose has been belatedly credited for his achievement

Arent You Amazed!!!

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Indian maritime has a long-standing history. According to Roman historians, Tamil Pandya embassies were received by Augustus Caesar. It is therefore not surprising that shipbuilding is an age-old industry in India. What we see here is a model of a Chola (200–848 CE) ship's hull, built by the ASI, displayed in a Museum in Tirunelveli, Tamil Nadu.



Physical Structures in India

Sl. No.	World Heritage Site	Period	Short Description of the Site and its Importance
1	Rock Shelters of Bhimbetka, Madhya Pradesh	30,000 years	Five clusters of rock shelters with paintings in some of the shelters dated from 100,000 BCE to 1000 CE amidst dense forest has been discovered. Twenty-one villages surrounding them reflect the traditions displayed in the rock paintings.
2	Champaner-Pavagadh Archaeological Park, Gujarat	Prehistoric and 8th–14th Century CE	Largely unexcavated archaeological, historic and living cultural heritage properties which includes prehistoric sites, a hill fortress of an early Hindu capital, and remains of the 16th-century capital of the state of Gujarat.
3	Mahābodhi Temple Complex at Bodh Gaya, Bihar	3rd Century BCE to 6th Century CE	The first temple was built by Emperor Aśoka in 260 BCE around the Bodhi Tree. The oldest temple in the Indian sub-continent built during the Gupta period.
4	Sanchi, Madhya Pradesh	2nd Century BCE to 12th Century CE	A group of Buddhist monuments dated between 200 BCE and 100 BCE. The sanctuary has a plethora of monolithic pillars, palaces, temples and monasteries in different states of preservation.



5	Ajanta Caves, Maharashtra	6th–2nd Century CE	31 rock-cut cave monuments depict richly decorated fresco paintings, which are unique representations of the religious art of Buddhism.
6	Archaeological Site of Nalanda Mahāvihāra at Nalanda, Bihar	5th–12th Century CE	Archaeological remains of a monastic and scholastic institution. It includes stūpas, shrines, and vihāras (residential and educational buildings). The most ancient university of the Indian Subcontinent that functioned uninterrupted for a period of 800 years.
7	Elephanta Caves, Maharashtra	5th–8th Century CE	Consists of two groups of caves – the first is a large group of five Hindu caves containing rock cut stone sculptures, the second, a smaller group of two Buddhist caves.
8	Ellora Caves, Maharashtra	600 CE to 1000 CE	A mix of artistic creation of the ancient civilization of India depicting Buddhism, Hinduism and Jainism. 34 monasteries and temples sculpted contiguously into rock walls.
9	Mahabalipuram, Tamil Nadu	7th and 8th Century CE	About 40 monuments including the largest open-air bas-relief in the world carved out of rock.
10	Hill Forts of Rajasthan	7th–16th Century CE	Rajput forts at Chittor, Kumbhalgarh, Ranthambore, Gagron, Amer and Jaisalmer characterized by its mountain peak settings, utilising the defensive properties of the terrain.
11	Pattadakal, Karnataka	8th Century CE	Nine temples representing a fusion of <i>Nāgara</i> and <i>Drāviḍa</i> architectural features, as well as a Jain sanctuary. The Virūpākṣa Temple, is an outstanding architectural edifice.

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12	Khajuraho, Madhya Pradesh	950 CE to 1050 CE	The surviving monuments with striking fusion of sculpture and architecture and unique original artistic creation.
13	Chola Temples, Tamil Nadu	11th and 12th Century CE	Includes three great temples namely, the Bṛhadīśvara Temple, Tanjavūr, the Bṛhadīśvara Temple, Gangaikonda- Cholapuram and the Airāvateśvara Temple, Darasuram. The temples testify to the brilliant achievements of the Chola in architecture, sculpture, painting and bronze casting.
14	Rani ki vav (The Queen's Stepwell), Gujarat	11th Century CE	Famous for its size and sculpture. Most of the sculptures are in devotion to Vishnu. It also has an Apsara showcasing 16 different styles of make-up to look more attractive.
15	Qutub Minar, Delhi	Late 12th Century CE	A red sandstone tower of 72.5 metres height with a base of 14.32 metres reducing to 2.75 metres diameter at the top. This also houses the famous Mauryan time iron pillar.
16	Sun Temple, Konark, Odisha	13th Century CE	Built in the form of the chariot of Sūrya with 24 wheels, decorated with symbolic stone carvings.

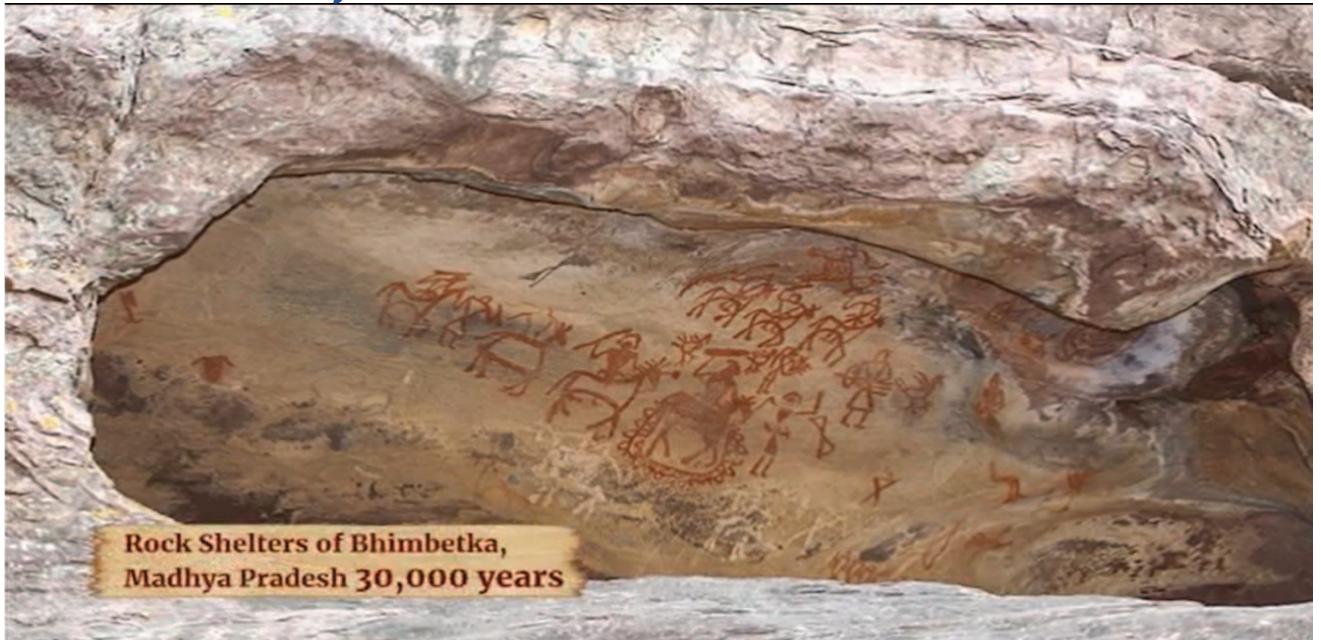
Source: Adopted from https://en.wikipedia.org/wiki/List_of_World_Heritage_Sites_in_India

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Physical Structures in India



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Physical Structures in India



This is a view of Cave 26, which is a Buddhist "Chaitya Griha" or prayer hall. Ajanta Caves in Maharashtra.



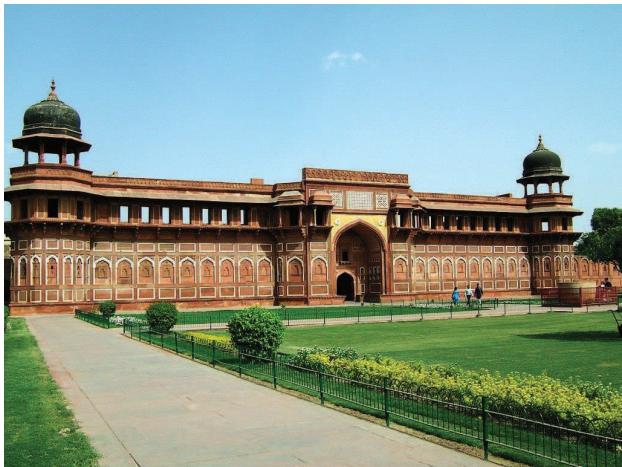
Cave 16 of Ellora, Kailasha Kailasa Kailashanath Hindu temple

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Physical Structures in India



Agra Fort Uttar Pradesh, Agra



The Taj Mahal main building



Physical Structures in India



Sun Temple Konarak



Shore temple in Mamallapuram gets its name because of its location next to the shore.



Physical Structures in India



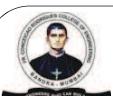
Churches and Convents of Goa



'Buland Darwaza' gate to Jami Masjid mosque, Fatehpur Sikri

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Physical Structures in India



Hampi, Karnataka



The Top Portion of Bṛhadīśvara Temple at Thanjavur

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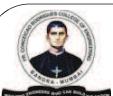


Physical Structures in India

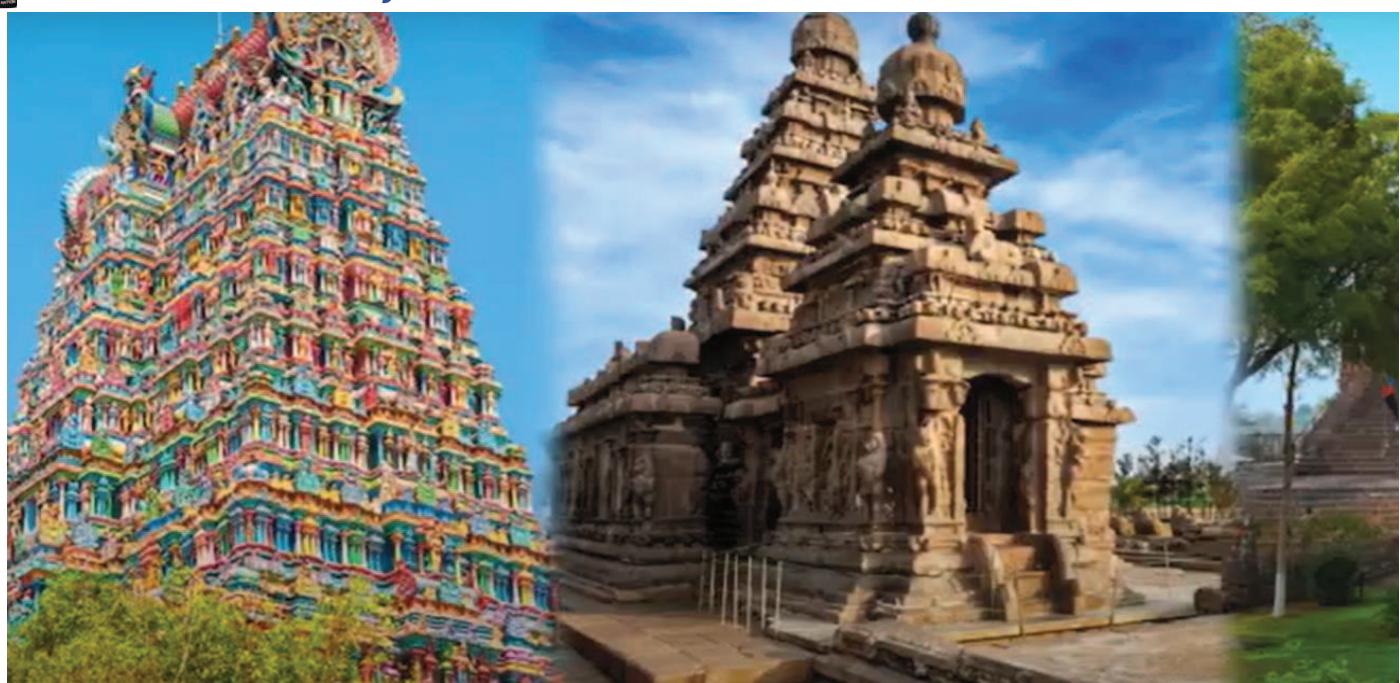


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Physical Structures in India



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Physical Structures in India

watch later Share

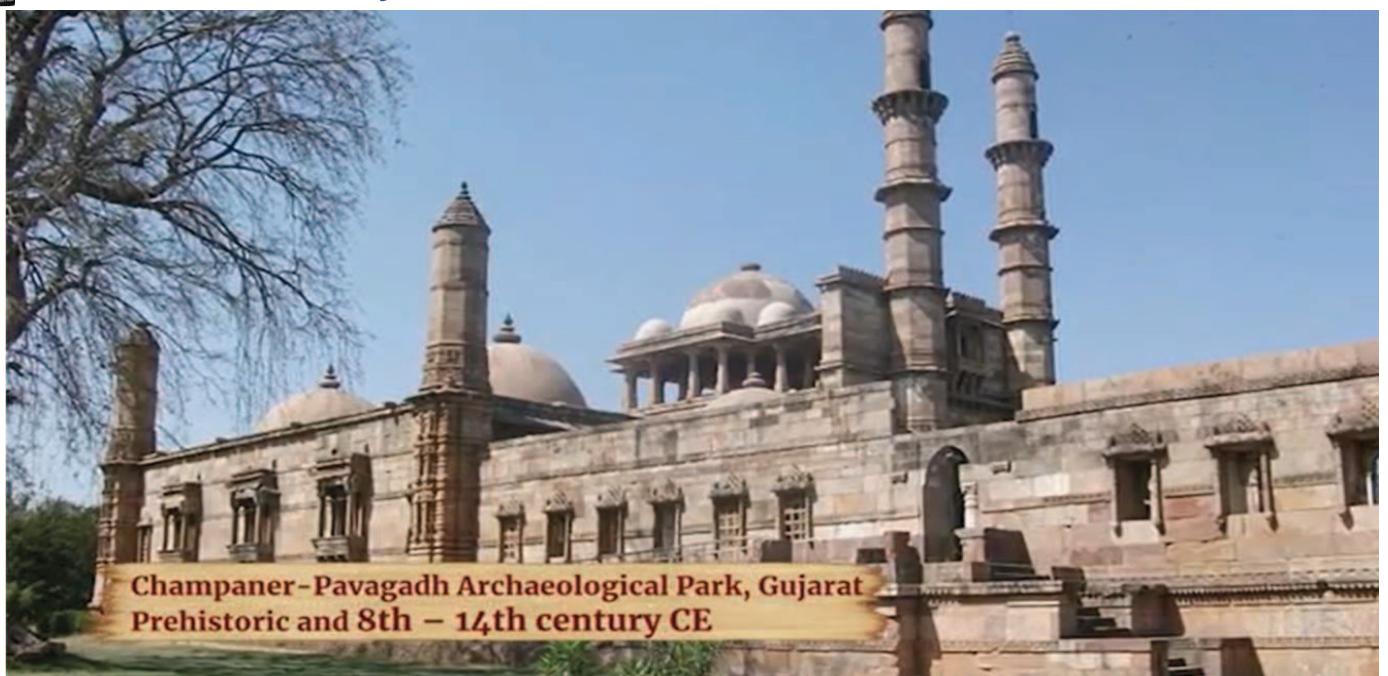


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Champaner-Pavagadh Archaeological Park, Gujarat
Prehistoric and 8th – 14th century CE

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Physical Structures in India



**Mahābodhi Temple Complex at Bodh Gaya, Bihar
3rd Century BCE to 6th century CE**

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Physical Structures in India



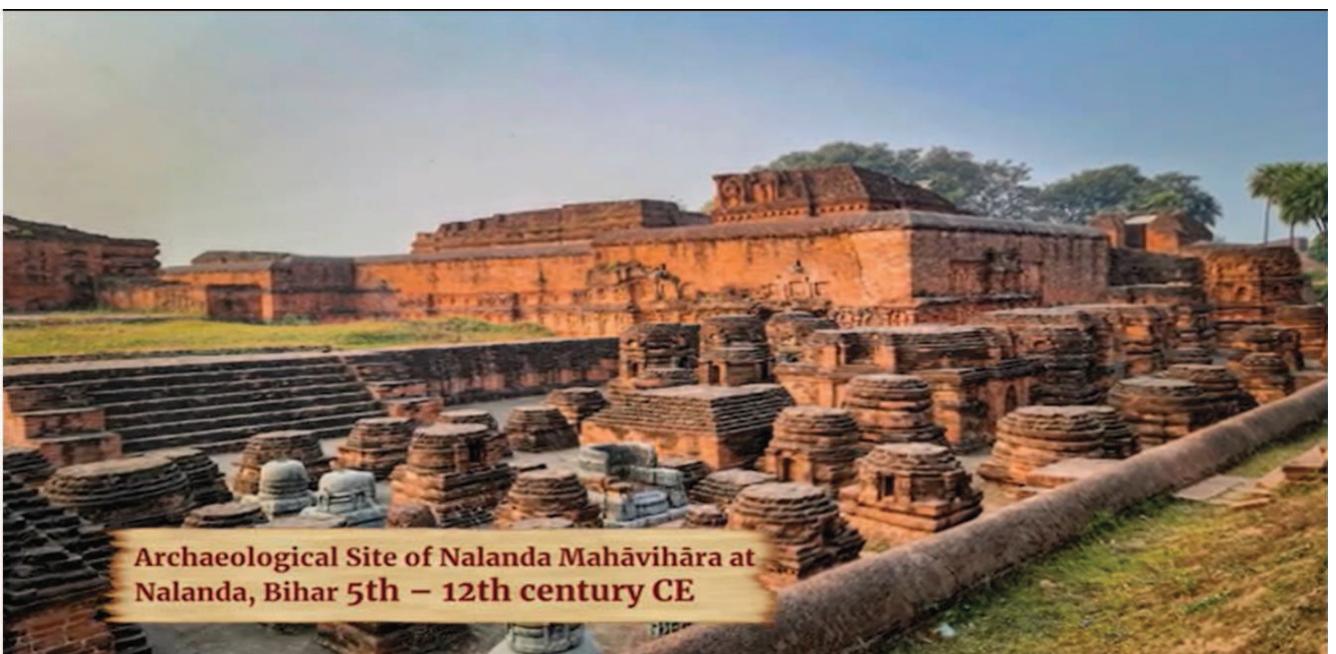
**Sanchi, Madhya Pradesh
2nd Century BCE to 12th Century CE**

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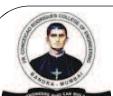
Physical Structures in India



Archaeological Site of Nalanda Mahāvihāra at
Nalanda, Bihar 5th – 12th century CE

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Physical Structures in India



Elephanta Caves, Maharashtra
5th – 8th century CE

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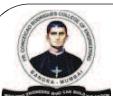


Physical Structures in India

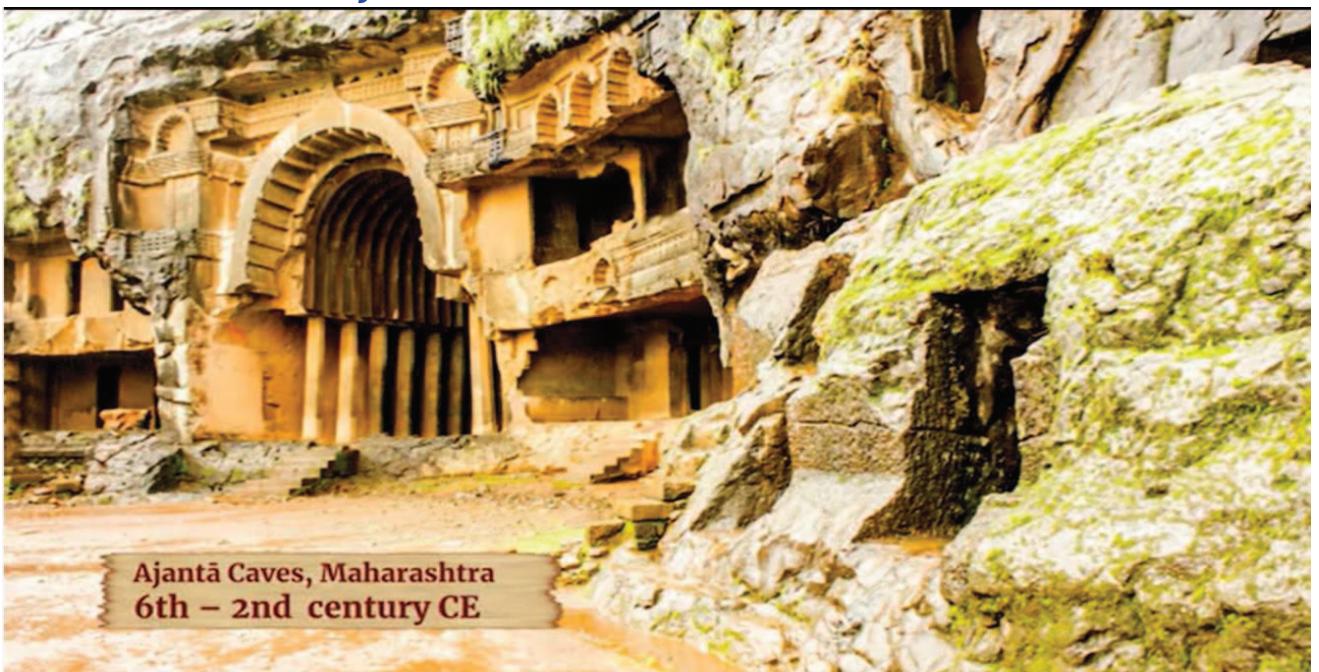


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Physical Structures in India

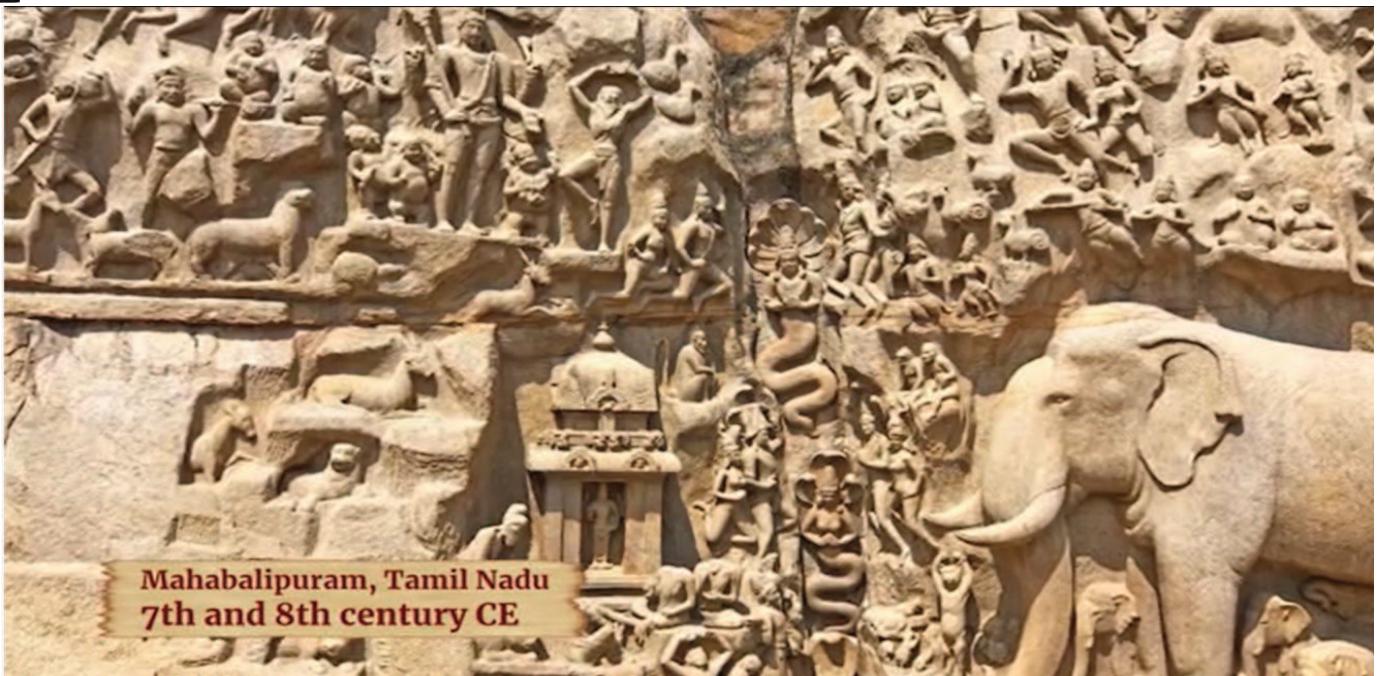


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Physical Structures in India



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Physical Structures in India



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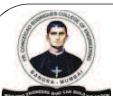
Physical Structures in India



Khajuraho, M.P.

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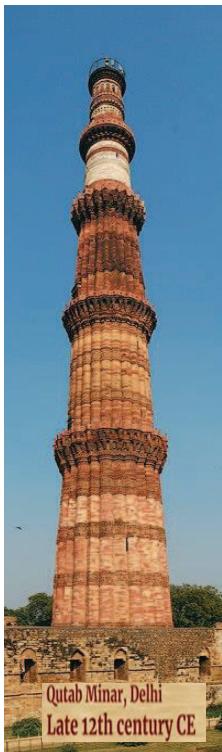


Physical Structures in India



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Physical Structures in India



Rani ki vav
(The Queen's Stepwell), Gujarat

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Physical Structures in India



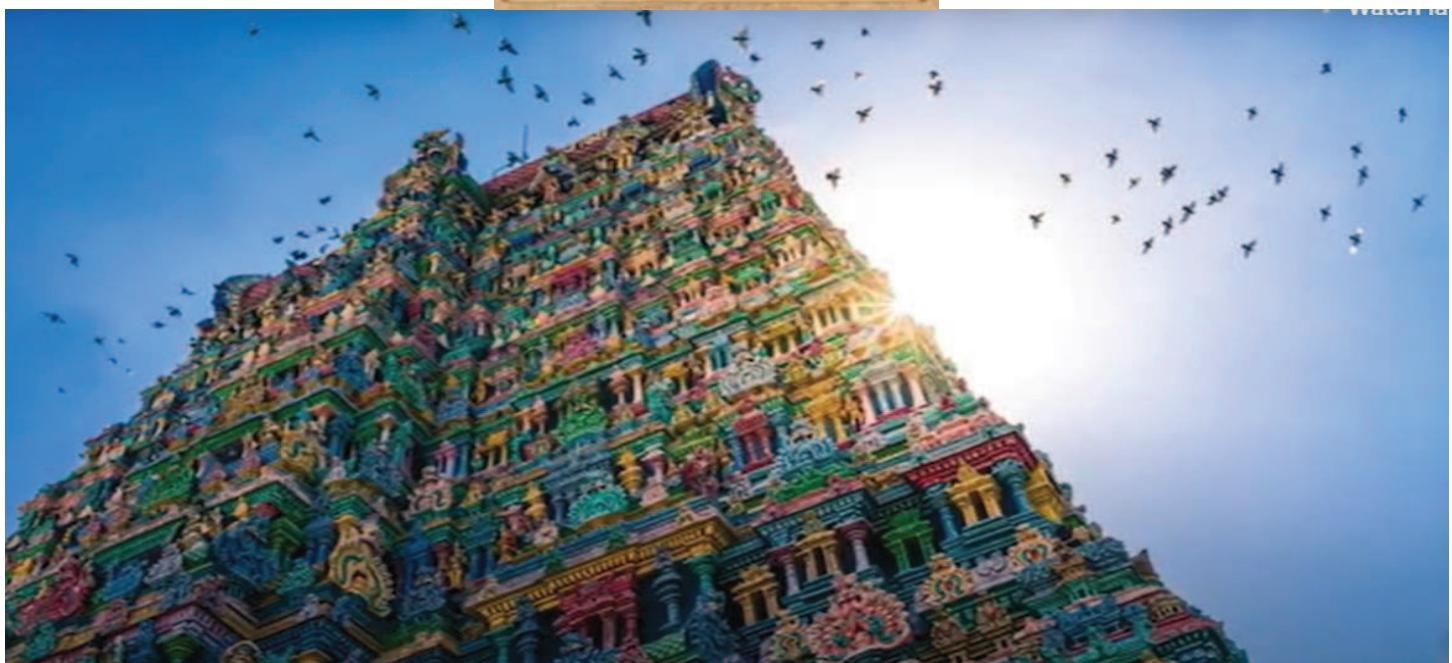
Sun Temple, Konark, Orissa
13th century CE

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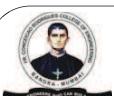
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South Indian Temples Technological Aspects



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South Indian Temples Technological Aspects



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Irrigation systems and practices in South India



Grand Anicut (Kallanai) –
World's Oldest 'Still in Use' Dam



Chand Baori, Rajasthan,
One of the Deepest and Largest Stepwells
(3000+ steps)

- Morel-Khurd
- Sonari
- Satdhara
- Andher



Irrigation systems and practices in South India





Irrigation systems and practices in South India



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Irrigation & Water Management: Stepwells



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Irrigation & Water Management: Stepwells



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Irrigation & Water Management: Stepwells

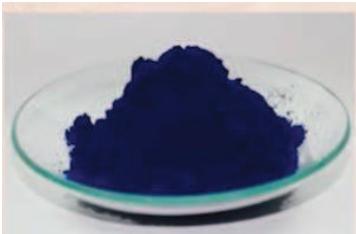


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Dyes and Painting Technology



Ancient Indians knew the art of selecting colours and mixing them to achieve different shades.



Dyes and Painting Technology



- **Indus Valley Civilisation:**
 - ✓ The spinning of wool and cotton
- **Mohenjo-Daro:**
 - ✓ Discovery of a fragment of a dyed fabric
- **Ajanta paintings** employed extracts of plants and minerals in preparing pigments.



Dyes and Painting Technology

○ Viṣṇu-dharmottara-purāṇa

- ✓ Discusses different aspects of painting in the third kāṇḍa
- ✓ Most common colors were white, red, yellow, black and blue

मूलरङ्गः स्मृताः पञ्च श्वेत-पीत-विलोहिताः ।
कृष्णो नीलश्च राजेन्द्र शतशोऽन्तरः स्मृतः ॥

mūlaraṅgāḥ smṛtāḥ pañca śvēta-pīta-vilōhitāḥ ।
krṣṇō nīlaśca rājēndra śataśō'ntarāḥ smṛtāḥ ॥



Dyes and Painting Technology



Kamasutra of Vatsyayana with
Jayamangala commentary →

नेत्रयोरञ्जनं कार्यम् अधरस्य च रञ्जनम् ।
दन्तानां विविधा रागाः चतुर्णि शुक्लता यथा ॥

nētrayōrañjanam kāryam adharasya ca rañjanam ।
dantānām vividhā rāgāḥ caturṇām śuklatā yathā ॥

Nātya-śāstra 21.28

Varṇikā-bhaṅga

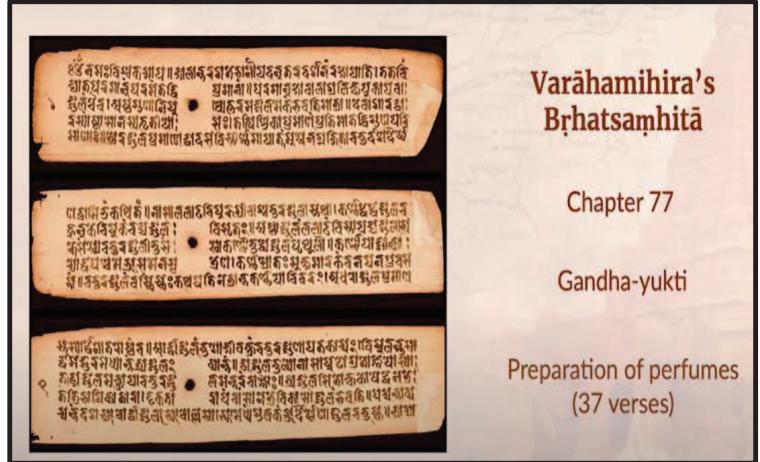
रूप-भेदः प्रमाणानि भाव-लावण्य-योजनम् ।
साहश्यं वर्णिकाभङ्गं षडेते चित्रभागकम् ॥

rūpa-bhedaḥ pramāṇāni bhāva-lāvaṇya-yojanam ।
sādṛśyam varṇikābhaṅgam shaḍete citrabhāgakam ॥



The Art of Making Perfumes

1. Šodhanam—This involves purification of the ingredients
2. Vāsanam—Scenting with the perfumes of flowers
3. Virecanam—The process of cleansing
4. Bhāvanā—Saturation of powder in fluid
5. Pāka—Ripening by preparing a decoction
6. Bodhanam—Revival of scents using certain reviving agents
7. Dhūpanam—Fumigating with perfumed vapours
8. Vedhanam—Further process of revival



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Surgical techniques

Surgical methods known as Šalya-tantra



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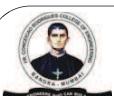


Surgical techniques



Moulding Engineers Who Can Build the Nation

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Surgical techniques

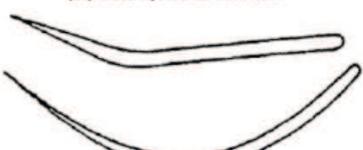
Some Sharp Instruments Mentioned in Suśruta-samhitā



(a) Karapatra-śastra



(b) Kuśapatra-śastra



(c) Sūci-śastra



(d) Triūrcaka-śastra



(e) Vetaspatra-śastra

- ◆ Suśruta is considered the father of Indian surgery.
- ◆ In Suśruta samhitā, he has provided a clinical approach to some major surgical operations.

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Moulding Engineers Who Can Build the Nation



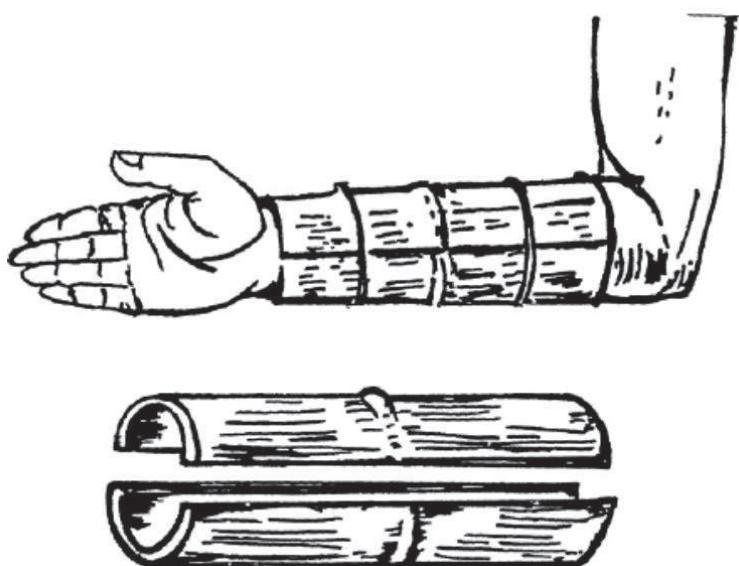
✓ **SuŚruta** has given a clear description of paracentesis of the abdomen in cases of ascites. After the complete outflow of the fluid, the abdomen should be firmly tied with a many-tailed bandage to prevent further accumulation of fluid.

- ✓ Similarly, the ancient surgical approach to remove the urinary calculi appears to be in no way different as worked out in the present era by modern surgeons.
- ✓ As per SuŚruta-samhitā, fumigation of the operation theatre could be done by Guggulu and other similar indigenous drugs to minimise the infection in surgical cases. *Modern surgery follows a similar practice of distempering the operation theatres.*



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Example of a Bamboo Splints for Treating a Fractured Hand

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Otoplasty (repair of the ear lobe) and Rhinoplasty (surgery to change the shape of the nose)

SuŚruta-samhitā: A procedure for repairing the nose that has been chopped off has been described in some detail:



- The portion of the nose to be covered should be first measured with a leaf.
- A piece of skin flap of the required size should then be dissected from the cheek or the forehead and turned back to cover the nose.
- The flap of the skin taken from the cheek or forehead must be properly preserved to ensure proper blood circulation in the repaired area.
- The part of the nose is prepared well by making it raw.
- The surgeons should join the two parts quickly but evenly and calmly and keep the skin properly elevated by inserting two tubes inside the nostrils, so that the new nose may look comely.



Surgical Procedure for Piles

Let us consider a large pile mass having a narrow pedicle, moist and projecting, which needs to be treated by surgery. The first step in the pre-operative procedure is to sedate the patient. He should then be seated on a flat plank or on a bed in a covered and clear place on a day with clear sky. The anus should face towards the Sun with the patient in the supine position, and the upper part of his body held in someone else's lap. The waist should be raised a little higher. The neck and the legs should be fixed firmly by a strap and held firmly by assistants. Thereafter, his anus should be lubricated with clarified butter and a sterilized well lubricated rectal speculum should be introduced in the rectum along its passage slowly while the patient is straining.

In this manner, the piles should be visualised and examined properly by the surgeon and the projecting pile mass should be clipped off with a knife and cauterized with fire to prevent bleeding. Thereafter, the pile mass should be mollified by the application of clarified butter mixed with madhuka and the instrument should then be taken out. Following the surgical operation, the patient should be made to get up and sit in warm water, whereas cold water should be sprinkled over him. He should then be taken into a room for post-operative care with proper instructions.

Caustic Application (Kṣāra)

Following the pre-operative procedure, the pile mass should be pressed by a probe, and after

wiping with a piece of cotton swab or a piece of cloth, caustic (Kṣāra) should be applied on it. Following this, the surgeon should cover by hand the opening of the instrument until the counting of one hundred (approximately one minute). Then after wiping, the procedure can be repeated for a few times depending on the severity of the disease. The application should be stopped when the piles show the colour of a ripe jambu fruit (Bluish black) and get depressed and shrivelled. Thereafter, the caustic should be washed away by sour gruel, curd, butter milk, vinegar or by the juice of citrus fruits. Then the pile mass should be mollified by the application of clarified butter, or any medicated soothing oil and the instrument should then be taken out.

The post-operative management of the patient should be maintained as described earlier. The remaining pile masses may be treated one by one at intervals of a week each. In case of multiple piles, the right one should be handled first; after the right, the left one and after the left the posterior one; lastly the anterior one should be treated in the same fashion. The post-operative management and the dietary regimen should be according to the instructions mentioned by Suśruta.

Source: Sharma, A.N. (1997). "Surgical Techniques", Chapter 4 [4.4] in History of Technology in India, Vol. I, A.K. Bag (Ed.), Indian National Science Academy, New Delhi, p. 329.



Shipbuilding



- ◆ There are several indications about the unique aspects of the Indian ships that travelled far and wide and conducted trade with several countries.
- ◆ Literary sources dealing with science, engineering and technology are not very detailed; substantive aspects of knowledge transmission continued in the oral tradition.

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Shipbuilding Sangam Period (before CE)

- In Tamil literature we find references to different names of ships, classes of ships, and their parts, and other relevant information connected with navigation.
- The Chola kings:
 - ✓ Raja Raja Chola I (985–1014 CE)
 - ✓ Rajendra Chola I (1014–1042 CE)carried maritime activities with the countries of the Far East and China
- Tamil Pandya embassies were received by Augustus Caesar
- **Pura-nānūru, Aha-nānūru, and Madurai-kāñci** delineated different types of seagoing ships

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Shipbuilding Buddhist Literature

- The **Jātaka stories** as well as Buddhist accounts and paintings show that Buddhists were involved in maritime trade.
- The caves of Ajanta, Aurangabad, and Ellora depict Bodhisattva Avalokiteśvara as a saviour of mariners in distressful conditions.
- The Pāli texts provide some information on Indian shipping. There are multiple references to the number of passengers that the ships carry, thereby giving us some idea of the size of the ships at that time.
 - ✓ Prince Vijaya sailed from Bengal in a fleet of ships carrying more than 700 passengers.
 - ✓ The ship in which the bride of Vijaya came to Ceylon is supposed to have carried nearly 800 persons.
 - ✓ The ship of the Janaka-Jātaka carried 700 persons besides the Buddha and that of the Valāhassa-Jātaka carried 500 merchants.

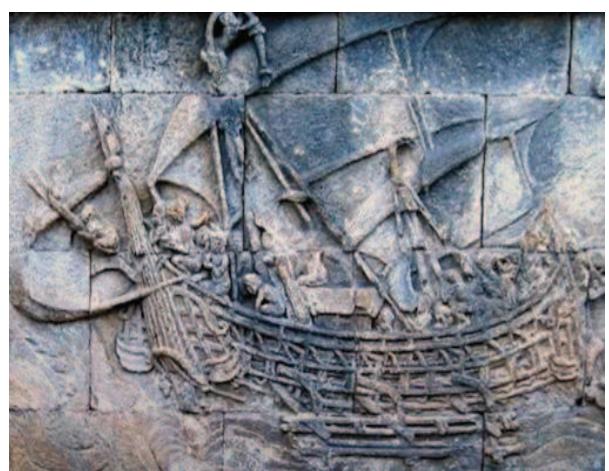
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Shipbuilding Buddhist Literature

- Measurements given of a ship of the **Sankha-Jātaka**:
 - ✓ 800 cubits (about 360 metres) in length
 - ✓ 600 (about 275 metres) in breadth
 - ✓ 20 fathoms (about 36.6 metres) in depth
 - ✓ Three masts.



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Shipbuilding



Three classes of water-routes (*Arthaśāstra*):

- the ordinary river routes as well as artificial waterways or canals, called **kulyā**
- the routes for coastal traffic carrying on inter-portal communications called **kulapatha**
- the ocean-routes called **samyānapatha**



Shipbuilding

*Different categories of ships (and boats) were mentioned (*Arthaśāstra*) while discussing how appropriate controls must be established in using the waterways. This includes:*

1. **Samyātya-nāva**, i.e. ocean-going vessels. It is mentioned that these ships had to pay tolls at the harbours at which they touched
2. **Pravahaṇa**, which is another name for sea-going vessels
3. **Śaṅkha-muktā-grāhiṇya-nāva**, which were boats used for pearl-fishing
4. **Mahānāva**, which were the larger vessels for use in the large rivers that were navigable throughout the year
5. **Kṣudraka-nāva**, which were smaller boats for use in small and shallow rivers that overflowed in the rains
6. **Himsaka**, pirate ships, and boats



Shipbuilding

A French writer, F. B. Solvyns (1811) (Flemish marine painter, printmaker and ethnographer), writes in his Lee Hindous, “*In ancient times the Indians excelled in the art of constructing vessels and the present Hindus can in this respect still offer models to Europe so much so that the English, attentive to everything which relates to naval architecture, have borrowed from the Hindus many improvements which they have adapted with success to their own shipping. The Indian vessels unite elegance and utility and are models of patience and fine workmanship.*”



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Shipbuilding

- ❖ The **Yukti-kalpataru** deals with certain aspects of ship-building
- ❖ According to Yukti-kalpataru, there are two broad categories of ships: *the ordinary and the special capable of seafaring.*

Different Types of Ships and Their Measurements given in Yukti-kalpataru

Ordinary (Sāmānya)				Special: Sea-going (Unnata)			
Name	Length	Breadth	Height	Name	Length	Breadth	Height
Kṣudrā (Diminutive)	4.57	1.14	1.14	Dīrghikā (Tall)	9.14	1.14	0.91
Madhyamā (Moderate)	6.86	3.43	3.43	Taraṇī (Moving hither and tither)	13.71	1.71	1.37
Bhīmā (Formidable)	11.43	5.71	5.71	Lolā (Moving hither and tither)	18.28	2.29	1.83
Capalā (Moving to and fro)	13.71	6.86	6.86	Gatvarā (Perishable)	22.85	2.86	2.29
Paṭalā (With covering)	18.28	9.14	9.14	Gāminī (Moving on)	27.42	3.43	2.74
Abhayā (Not dangerous)	20.57	10.28	10.28	Tari (Running swiftly)	31.99	4.00	3.20
Dīrghā (Tall)	25.14	12.57	12.57	Jaṅghālā (Running Swiftly)	36.56	4.57	3.66
Patrapuṭā (Like a folded leaf)	27.42	13.71	13.71	Plāvinī (Flowing over)	41.13	5.14	4.11
Garbharā (With inner compartments)	31.99	16.00	16.00	Dhāriṇī (Power of possessing)	45.70	5.71	4.57
Mantharā (Curved)	34.28	17.14	17.14	Veginī (Having velocity)	50.27	6.28	5.03

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Woods in Shipbuilding



Vṛkṣāyurveda:

- Mention of four types of wood

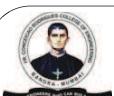
Yukti-kalpataru:

- The wood that is light, hard, and cannot be joined easily
- It cautions against using two different kinds of wood.

- ✓ There are specifications given for building ships with cabins.
- ✓ Cabins could be constructed for the entire length of the ship, at the front or in the middle. Each of them serves a different purpose. For example, a ship with a cabin extending from one end to the other is suitable for the transport of royal treasure, horses, and women.
- ✓ On the other hand, a ship having a cabin in the middle is suitable for use during the rainy season and pleasure trips of kings.
- ✓ A ship having a cabin in the front is convenient for the dry seasons, for long voyages, and naval warfare.
- ✓ Furthermore, a ship having a cabin less than half of its length is likely to be swift.

Moulding Engineers Who Can Build the Nation

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આભાર પ્રક્રિયાબાદ તુહાડા પેનવાસ નંત્રીધન્યવાદાલુ
 ધન્યવાદની ધન્યવાદ આભાર પ્રક્રિયાબાદ તુહાડા પેનવાસ
 નંત્રી ધન્યવાદાલુ ધન્યવાદ નીચેથી આભાર પ્રક્રિયાબાદ તુહાડા
 પેનવાસ નંત્રીધન્યવાદ ધન્યવાદ ધન્યવાદનીઓનીએ આભાર
 શક્રિયાબાદ તુહાડા પેનવાસ નંત્રીધન્યવાદાલુ ધન્યવાદનીઓ
 ધન્યવાદ તુહાડા પેનવાસ નંત્રીધન્યવાદાલુ ધન્યવાદનીઓ
ધન્યવાદ
 આભાર પ્રક્રિયાબાદ નાના તુહાડા પેનવાસ ધન્યવાદ
 નંત્રીધન્યવાદાલુ ધન્યવાદ ધન્યવાદની આભાર પ્રક્રિયાબાદ
 તુહાડા પેનવાસ નંત્રીધન્યવાદાલુ ધન્યવાદની ધન્યવાદ
 ધન્યવાદની આભાર પ્રક્રિયાબાદ તુહાડા પેનવાસ
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