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**COURSE NAME : TAMILS & TECHNOLOGY**

**I YEAR/ I SEMESTER**

**UNIT –2 DESIGN & CONSTRUCTION TECHNOLOGY**

**TOPIC COVERED**

**Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram.**

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**TOPIC 1: Building Design (Houses) in Sangam Age or Plot Design:**

The residences referred to in the Sangam literature as Manai were designed with the structures of Thinnai, Pillar, Base, Courtyard, Staircase, Window, Gate and Maadam. These designs were featured during the development of residential architecture of higher-class people.

**Plot Description**

The word 'Manai' in Sangam literature means dwelling house, family, cowshed, wife, life.

Settlements arranged in a systematic and orderly structures are referred to as manai in Sangam literature.

***Proof:***

*i) Nattrinai 79:2*

*ii) Iyngurunooru 324:3*

*iii) Akananooru 384:13*

*iv) Nattrinai 40:1*

**Classification of Houses or Plots:**

Two types of houses are generally mentioned in Sangam literature.

1. Sirtil

2. Peril

**1. The Design of Sirtil**

In the Tamil dictionary, the meaning of Sirtil is given as 'little house', 'small house', 'small mud house' built by girls for playing. The literature refers to houses with miniature designs as Sirtil.



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**Proof:**

1. *Purananooru 56:1*

Houses with Pillared structures as Curved Legs.

2. *Agananooru 394: 9-10*

Entrance is designed with fence and Pandhal Structure. It had small houses covered with red sand called Sevvaai Sirtil.



## **2. The Design of Peril**

The Sangam literature refers to houses that were designed on a large scale. A large number of houses were in a dilapidated condition with decaying elements of habitable houses and damages caused by termites.

**Proof:**

*Purananooru 261:1*



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### **Design and Use of Parts of House:**

#### **1.Munril:**

Munril means the front part of the house, that had abundant use. Sangam literature speaks of munril , as a part of Kurambai, Kudil, Plot, House and Palace.

During the developing stage, this area is also called 'Muttram. It was found in Kurinji Land Residence seen as open spaces.



Plants and vines like **Neem and Jasmine grow** and spread like a tent, in front of the house, making it suitable for **sleeping and taking rest** in Natural Environment.

#### ***Proof:***

*i) Purnanooru 320:1-2*

*ii) Natrinai 77: 4-6*

*iii) Akananooru 78:7*

#### **2. Iraippai Structure**

The descending portion of the corridor is called the Iraippai indicated as Irai, Iravanam. It's design as Kurambas. According to the land tenure, the roof structures are narrow.



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***Proof:***

*i) Purananooru 129:1*

*ii). Natrinai 207:2*

In **ancient** times, the irappai was a place where some useful items were inserted. The multisectioned lofts have been the resting places for the Pigeons.

***Proof:***

*Purananooru 315:4*

### **3. The Structure of PIAL**

The place that is set up like a platform in front of the house is called the pial. It is also referred as Thinnai, Thettri, Vedhigai and Peedigai. It can be considered as an extension of the courtyard (Munril). It is a system designed based on the different purposes such as sitting, sleeping, resting and playing.

***Proof:***

*Purananooru 283:1-2*



## **TOPIC 2: CONSTRUCTIONS DURING THE SANGAM PERIOD**

It is mentioned in Sangam literature that even before 1000 years, Tamilians were experts in architectural techniques in the construction works. Architecture emerged as an art in



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their development. They built houses for people to reside, Palaces for kings, places of worship and public buildings were built.

All these many buildings were built of perishable materials and were destroyed.

*(Climate Adaptation Framework]*

The life style of early Tamilians was in harmony with nature. Their houses were built suiting to the climate. The upper floors of the houses **were roofless in order to dissipate the heat** in summer.

The interior of the houses had a multi-panel system (many windows) to ventilate the house. During the winter season, people used to close the multi panel system.

**Proof:**

*Nedunalvadai 66-63 by Chandra*

In palace-like residences of kings, the entrance was raised high like a hill. There are double doors equipped with handles, latches and devices called Iyavi.

**The Primitive Man's House**

In Dharmapuri district, there are many stone houses on morel rocks. Each loft is 10 ft by 10ft slabs of 9 inches of thickness. Only one end is stopped to rest against the next board. A stone is placed in the middle to fit the correct size. Above these four walls, there is a capstone. It measures about 12' x 12'. A stone weighs about 6 or 7 tons. It is astonishing that such construction work was done by our Sangam people 10,000 years ago.

**TOPIC 3: General Elements of Construction Art and Construction Technology**

The following elements are commonly found in Tamil Architecture. They are

- 1 Kadaikkal
2. The bearing platform (or) Asthivaaram



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3. Wall

4. Vimanam (Tower or Roof)

### **1. Kadaikkal:**

First of all, there was a custom of erecting the base structure prior to the construction of the buildings. Kadaikkal is a hole dug in the earth at a particular place at a specific time. This is used for laying foundation.

### **2. Foundation or Bearing (Asthivaaram):**

Adequate evidences revealed *solid foundation* structures were laid during the Sangam period. It was the first element erected over earth in the early period. Materials like lime and karuppatti were used for that. There were no engineers during that time to set up kadaikkaal ever, but they have built structures that can stand for 1000's of years because they made proper use of materials that were easily available naturally in the environment .

### **3. The wall**

A wall is usually a structure that protects a place. Walls are generally vertical structures. It divides the space inside the building into different rooms and separates the interior of a building from the exterior.

4. Vimanam or Tower

A tower is a tall man-made structure. They are taller than their width and length.

### ***Constructions on Rocks (or) Pallava Architecture:***

Pallava period architecture is very important. It is classified into 3 types.

1. Temples built by digging the rocks of big hills(Kudavarai).

2. Kartali





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### 3. Constructed Temples

#### 1. Kudaivarai Temples (built digging the rocks of big hills):

Temples built on the top of big hills are called 'Kudaivarai Temples'. It is believed that the buildings were designed using wood, bamboo, straw, grass which did not last long. The rocks should be carved, Starting from a certain point of the rock, according to the construction design. Acoustic tests were carried out to ensure the stability of the stones that no cracks were formed.



#### 2. Katrali

In the Tamil Architectural art, 'Katrali' is a temple structure built from the top to bottom on the outer side of the rock or mound protruding from the ground.







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### **3. Constructed Temples**

As early as the 7th Century, stone-built temples were erected. The chief among them is the Mamallapuram Beach Temple. 45 feet high construction temples are the examples of the Tamil Construction technique.



### **Topic 4: CONSTRUCTION MATERIALS DURING THE SANGAM PERIOD**

During the Sangam period, about 6000 years ago, flint, wood, suthai, bamboo, straw, grass and bricks were used in construction. There are still traces of houses, royal places, commercial establishments and public places built like that. About 6000 years later, black stones(karungal) were used in construction and buildings.

#### **Major Building Materials:**

##### **1. Tree**

Wood was an **excellent** early construction material. For thousands of years, wooden building materials have been used.

Timber framed buildings have long-lasting stability. There are three types of trees.

- ❖ Male tree



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- ❖ Female tree
- ❖ Eunuch tree

***(I) Male Tree***

Male trees should be selected to make door posts, pillars, balcony, etc., in the house.

***(ii) Female Tree***

For uthiram, vittam, arch, porch and bearing beam, female trees are suitable.



***(iii) Eunuch Tree***

Eunuch trees are used for small vittam, frame, handrails, fence

**2. Hot Sand**

Hot sand is the solid building material made from clay that is dried and heated in a kiln(soolai)-like structure.



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### 3. Suthai

Wooden sticks and lime were used that was in practice for centuries. Later, cement was used instead of lime. Iron bars were used in place of wooden sticks.

### 4. Bamboo

Bamboo constructions were strong and lightweight building material. Bamboos were used as a whole or in the broken form.

### 5. Straw

Straw is one of the oldest building materials that was very strong. It was used to withstand heavy loads.

### 6. Brick

The term brick refers to a unit made of clay, sand and limestone. Heated bricks are one of the most durable and strong ancient building materials. Brick is used to make walls and other elements in construction.

#### ***Analysis of Kizhadi Excavation:***

Analysis of the samples of bricks, lime mortar(saandhu), roof tiles and limestone casing well lining found at **Kizhadi** were researched at the **Vellore University of Technology**, confirmed the presence of minerals such silica clay, lime, iron, aluminium and magnesium Their combinations are as follows,

- (i) Bricks and roof tiles: > 80% Silica
- (ii) As Binding Factor : > 7 % lime
- (iii) Lime Mortar : >97% lime



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By this We know, High quality construction materials and the presence of 97% limestone made the building to be existed strong even after several years.

### **TOPIC 5:HERO STONE (OR) NADUKKAL/VEERAKARKAL:**

It is an ancient Tamil tradition to offer final tributes to the dead soldiers, deceased persons and worship after erecting stones. The stones erected in this way are called 'Nadukal' or 'Hero Stones' representing Stone of Courage. This practice has been existing in many parts of the world since the Stone Age.



#### ***Proof:***

*Tholkapiyam*

#### **The Location of the Erected Stones & Other Names:**

Mostly These stones are found outside the town. Two or More Erected stones found at same place. It is also placed for many warriors in same common place.

1. Three Hero stones were found at Puliman Gombai (Theni district) by the Tamil University department of Epigraphy and Archaeology. Its period is 3rd Century BC.
2. The Hero stones were also found during the reign of King Athiyaman who ruled places like Sengam and Dharmapuri.



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3. In Tamil Nadu during the Chera, Chola and Pandiya periods not only the men who died in the battle, but also for the war rooster, statues were engraved with the image of the rooster

### **Other Names:**

The Hero stones are Vediappan Stone (or) Vediappan Temple, Vedar, Krishnarappan, Meenarappan , Sanyasiappan, Anjaneya Stone, Siraimetan Temple, Oomai Vediappan, Irattai Vediappan, Savumettu Vediappan, Naththamettu Vethiappan

### **The Structure of the Hero Stone**

The arrangements of Hero stone were made in the following ways.

- i) On the epitome there is a figure of a warrior in combat posture, holding a bow and arrow or with a sword and shield.
- ii) Many epitomes also show the hero with many arrows piercing his body.
- iii) Mostly, a long cloth is also tied around the warrior's waist. There is no clothing on top of the body. Some players are found with long braids.
- v) Some Hero stones are seen with image of hero, fighting with a tiger. in a town called Modhakkal.
- vi) Chicken Stones: Hero stones are also found for the dead chickens in chicken fights.



g. 2.4 Hero stone showing the hero fighting with tiger and elephant



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### **Inscriptions on the Hero Stones**

The period of king's rule, year, the name of the martyred hero and the news about him, the battle, recovering cattle are engraved on the Hero stone. The epitomes also circular letters and some Tamil letters.

#### **Proof:**

1. The stone erected for Pedutheeyan Anthavan who died in the Aakol fight held at Koodal town.
2. Another Hero stone erected for Padhavan from Vel town.
3. (i) Iynkurunooru. 352, (ii) Akananooru 297.

### **Method of worshipping the Hero Stone**

There was a custom of offering flowers and smoke to the Hero stones every day. It was called 'salutation to the Hero stone' (Nadukkal Vanakkam). Stones were placed around the Hero stone to make a hoard (padhukkai). It is called 'Vallan Padhukkai God'. They would beat udukai, perform pooja with Thoppi, a kind of liquor. They also sacrificed animals.

#### **Proofs:**

Purananooru, Silapathikaram, Malaipadukadaam

i) Purananooru

Next to Sitroor, at the dawn, they poured fresh water to the planted stone and performed pooja lighting a ghee lamp. Puranaanooru tells, that the smoke produced by lighting the ghee lamp rose like a cloud and smelt in the street.

ii). Auvaiyaar says that Athiyaman Nedumananji stones were performed pooja with peelisootti liquor.



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iii) Silapathikaaram says that Senkuttuvan appointed Kannagi's friend, Devanthi to worship the Hero stone erected for her.

### **TOPIC 6: DESIGN OF THE HOUSEHOLD MATERIALS IN THE SANGAM PERIOD**

#### **1. Aariyakkal or Enthiram**

A tool which is called enthiram (apparatus) is the grinder that is found in every house in the villages of Tamil Nadu. Aariyam is a stone tool used to grind ragi into powder. Whole grams can be broken into two. Plant crop, gram, green gram can be easily broken.



#### **Shape**

The lower part of the Aryakkal is a fixed round stone. There is a sprout in the middle of it. A movable round stone with a hole is present at the top. It revolves around the sprout. There is also a sprout to hold the top stone in order to move it around.

When the stone rotates, the grain or the crop placed in the circular hole of the upper stone is grind and is broken and made to fall out.

This instrument is found in all parts of India. There are many evidences, that this instrument was used in every house even during the Sangam period.

#### **2. Ural-Plunger**

Ural is a very simple tool. This tool is used to remove the husk of paddy, to remove the skin of rye (KAMBU) and to clean the corn.





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*Fig. 2.6 Ural – Plunger*

### **Shape**

The shape of the ural is like a udukkai. It is made of black stone and wood. It is also called Kunthani, which is made of wood. The upper part of the Ural is like a flat ring with a circular pit in the middle. A plunger is a cylinder-like elongated wooden block with an iron rod attached at both ends.

### **Application**

During the Sangam period, to remove the paddy husk, it was pounded with a plunger. Ural has been used to measure the rainfall in rural areas. If the ural has got rainwater in full, it is called a 'plough rain' (Uzhavu Mazhai). A village ural pit was filled with water and measured.

The researchers found that it was equivalent to nearly an inch of rain. Other than the urals at houses, Ural holes were carved in stone rocks in the forest areas.

### **Proof:**

- ❖ *Samana Munivar Cave located at Jampaik karat, Thirukovilur., Villupuram district. It has an inscription of Athiyaman Nedumaananji ural is carved in front of this cave.*

### **4.Grinding Stone (or) Aatural (or) Sekku:**

Grinding Stone is device used during the sangam period for grinding rice flour for making Idly, Dosa and Chilli Mortar.



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**Fig. 2.7 Grinding Stone**

**Shape:**

A hole is present in the middle of the stone. A Handle will be there for holding and turning the stone.

**Application:**

Sangam people prepare Pongal in forest temples away from town. Sacrifice of animals is Customary. They cook and eat them after pooja. At that time these Aaatural are used for grinding chilli paste. Philanthropists provide it with their names engraved on them.

**Proof:**

1. Kalvarayan Forest Temple in Salem
2. Manaloorpet Temple in Tirukovilur; 7<sup>th</sup> Century; Words (Srisalavan Perinaranath)-written inscription is present here.
3. 12<sup>th</sup> Century letters are found in Rasipuram forest at Salem.

**4.Ammi:**

The Ammi and Kuzhavi are used to grind Chilli Paste.

**Shape:**



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The Base part is Flat. Rolling kuzhavi is on the top can be placed on the base. Turmeric and Ginger are placed on base stone and crushed with Kuzhavi. Then it is grinded as paste by rolling and pulling the kuzhavi.



*Fig. 2.8 Ammi with Kuzhavi*

**Proof:**

Ammi present at Ayyanar Temple, Chingee in Villupuram District of Sambuvarayar period.

**5.Oil Sekku:**

Sekku is tool to press Sesame, Groundnut and Coconut to extract oil.

**Structure:**

It is made up of Wood. Kuzhavi is made up of iron, wood or Black Stone. The Compressive Force is supplied by Kuzhavi. Two Cattles are locked to go round the sekku. This process of rotating the sekku is called 'Kaanam'



*Fig. 2.9 Oil Sekku*



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***Proof:***

1. There is a stone sekku in the town called Ennairam village at Villupuram circle.
2. There is also a town named Marakkanam.

### **6. Sugar Factory:**

Sugar Factory is the place where devices are found to squeeze out sugarcane juice.

**Structure:**

About 50 years ago, wooden rollers were installed and even the toothed wheels that transferred the force were made of wood, The rollers were rotated by being pulled by cattle. The sugarcane is inserted in the middle of the cylinder and the juice is squeezed out and comes out as solid residue. During the Sangam period, it was called a locking device. Poets sing that the sound of lock-clang is always heard.



**Fig. 2.10 Sugar Factory**

***Proof:***

1. Song about Ruler of Thirukoviloor , Veliyarkon Veethi Vidangan.
2. Scene in Perumbaanaatrupadai describes the sound of sugarcane juicer on Mountainside is similar to the trumpeting of elephant attacked by yaali.



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## 7. Telescope

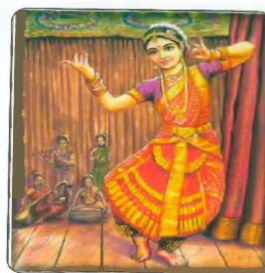
The Bosala Kings ruled the state of Karnataka. Uralpeedu is the best among the Bosala cities. The twin temples have many beautiful sculptures. Many Mahabharata scenes are also found. It was built in the 9th Century AD. In one of the sculpture scenes, his charioteer 'Sanjayan' holding a telescope in his hand, looking at the battlefield and narrates the scene to Thirutharashtiran. That telescope is a long tube.



*Fig. 2.11 Telescope*

## **TOPIC 7: PLATFORM STRUCTURE AIN SILAPPATHIKAARAM:**

About 2000 years ago, Elango Adigal mentions about the details of setting up of Theatre. Madhavi had curly hair and begin to learn dance at the age of 5. She came to Chola Court to stage her performance at the age of 12.



*Fig. 2.12 Platform Structure in Silappathikaram*



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### **Platform Structure:**

- 1.They chose a suitable land for the performing dance suggested by learned Sculpture writer.
2. Bamboo are fetched and were used to build dance stages. Bamboo stick was about 4 feet.

### **Installation of Upper Board:**

Pillars were erected on the four sides of the platform and upper board was fixed on them. A Board was also installed on the floor of Arena. Between these two boards, they placed a space of 16 feet high.

### **Entrance to the Arena**

They arranged two entrances for the performers to enter as (veil as to exit on the top floor of the arena. They painted images of the four types of Varuna Bhudaas for everyone to worship.

### **Installation of Entrance Lights**

They placed illuminant lamps so that the shadow of the pillars did not fall on the stage and the hall.

### **Ezhinival (or) Screens**

The screens are of three kinds.





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***1. One Side Pulling Screen:***

A curtain that so that it is drawn on one side of the build stage is called a single curtain.

***2.Porumuga Ezhini:***

A Screen that overlaps in the middle , so that it can be put from either side of the stage called Porumuga Ezhini.

***3.Karanthuvarai Ezhini:***

A Screen that descends when needed from the top of platform is called Karanthuvarai ezhini.

**8. Canopy and Festoons .**

They also erected a canopy with paintings. All over the stage, the famous pearl garlands like Sari, Thooku and Thamam were hung beautifully. They built a dance hall with such artistic works.

***Thalaikol (Degree for the Students of Drama)***

The women who perform well in the dance are given the titles 'Thalaikols'. Thalaikol was made from the hammock of a beautiful silver umbrella taken from him in a battle with a rival king of great renown, who had been defeated.

**TOPIC 8:Mamallapuram Sculptures and Temples:**

Mamallapuram or Mahabalipuram temple was built by Rajasimma Pallavar. When the King Narasimmha Mamallan went to picnic with his father. He drew a picture on the rock. On Seeing this, his father got an idea to build immortal temples on the rocks. Rajasimhan named the temple after his son Mamallan.

**Cave Temples:**

There are 9 cave temples in Mamallapuram.





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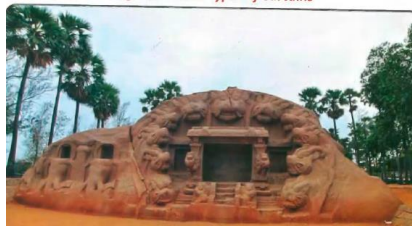


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**1.Tiger Cave:**

Saluvan Kuppam cave temple has yaali carving with 16 heads. It was erected for the Kotravai goddess.



**2.Athiranasanda Pallaveswara Kirugam:**

An inscription found in mandapa mentions that Lord Shiva stays with Umai and Gagan.

**3.Archuna Penance:**

The rock sculpture Archuna penance, a 90 feet rock depicts Archuna's penance to Lord Shiva for Pasupathai Astra during mid-day in summer.

**4.Krishna Mandapam:**

According to the legend, Kannan lifted the Govardhana Hill as an umbrella to protect Gokula shepherds, goats and cows from the rains and storms caused by Indra. The Pallavas have sculptured the same. This is Adhivaraga Cave Temple.



*Fig. 2.17 Krishna Mandapam*



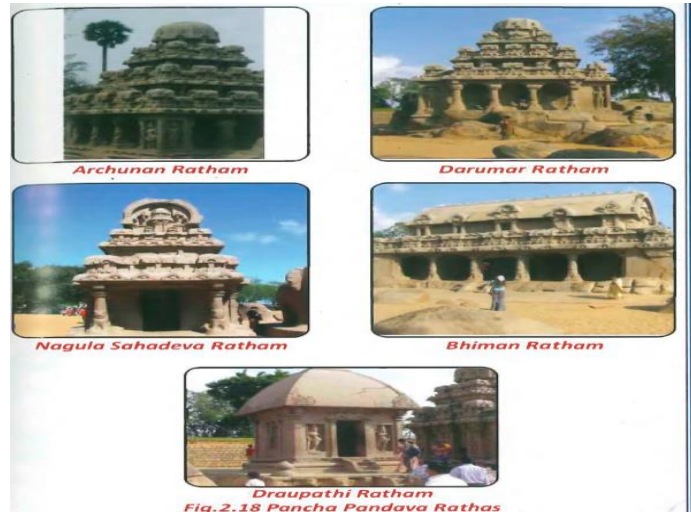
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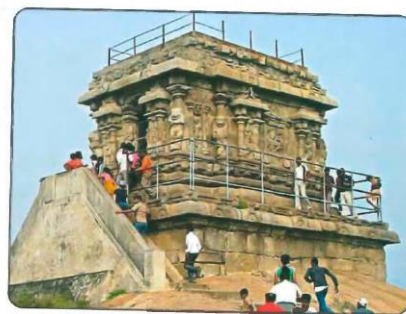
### 5.Pancha Pandava Rathas:



In our tradition, if five elements are together, they are associated with Pancha Pandavas and so the temples are called as 'Panchapandava Rathas'. There are various stone sculptures carved on five chariots namely Dharmar Ratham, Bhimar Ratham, Archunan Ratham, Nagula Sahadeva Ratham and Dhraupathi Ratham.

### 6.Ulaganeswarar Temple:

It's a 7<sup>th</sup> Century Stone Temple. The lamp lit in this temple was the harbour during Pallava Period.



*Fig. 2.19 Ulaganeswarar Temple*



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### **7.Mahishasuramarthini Cave:**

In this Carved temple, there is a sculpture of the goddess who destroyed Mahisasuran. Sculptures such as Somaskandar Sculpture and Anandha Perumal Sculpture are present. The goddess seated on lion facing Mahisasuran with ten hands and fighting with Bow and Arrow.

### **8.Ramanuja Hall:**

It was carved for shiva with three sanctorums Shiva, Brahma and Thirumal. Later Carving of shiva was destroyed and only Perumal carving existed.



### **9.Varaha Hall:**

On the wall of this carving, sculptures of Varahamurthy, Thirumagal, Kotravai and Ulagalandha Perumal existed.

### **10.Ganesha Ratham:**

This is currently remaining temple with the carving of Ganesa Ratham done on Single Rock.

### **11.Embossed Sculptures:**

It have 3 dimensional structure and can be seen from all four sides.They are attached to the wall.

### **12.Beach Temple:**

This temple was first constructed in Tamilnadu with height of 45 feet. Thalasyana Perumal in Sleeping Posture and Somaskandar in Linga form are found.