

Solar passive techniques in the vernacular buildings of coastal regions in Nagapattinam, TamilNadu-India – a qualitative and quantitative analysis

R. Shanthi Priya^{a,*}, M.C. Sundarraja^b, S. Radhakrishnan^a, L. Vijayalakshmi^a

^a Department of Architecture, Thiagarajar College of Engineering, Madurai-15, Tamil Nadu, India

^b Department of Civil Engineering, Thiagarajar College of Engineering, Madurai-15, Tamil Nadu, India

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ABSTRACT

Bioclimatic concepts in vernacular architecture was developed and used through the centuries by many civilizations across the world. This study is carried out on the vernacular architecture of coastal regions. The vernacular architecture in the coastal belts of Nagapattinam is known for its use of natural and passive methods so as to create a comfortable indoor environment. However, so far, it has not been proved by a detailed quantitative evaluation method. The authors have conducted the qualitative and quantitative analysis to investigate the indoor environmental condition of a vernacular residential building in coastal region of Nagapattinam. The quantitative analysis has been done by continuously monitoring the indoor and outdoor thermal and environmental conditions using a custom made instrument called “Mini metrological Station known as Architectural Evaluation System”. The results of this study research shows that the solar passive techniques used in these vernacular residential buildings in coastal region provides comfortable thermal indoor environment irrespective of the outdoor climatic conditions.

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1. Introduction

Vernacular architecture is a term used to categorize methods of construction which use locally available resources to address local needs. Vernacular architecture evolves over a long time to reflect the environmental, cultural and historical context of that time period. It refers to that type of architecture which is indigenous to a specific time or place (not imported or copied from elsewhere). It is most often applied to residential buildings [1]. Vernacular architecture is the outcome of the traditional knowledge, based on trial and error approach. This type of architecture addresses the local climate constraints and shows maximum adaptability and flexibility. The traditional architecture had given us excellent techniques which are climate responsive in nature. The principles which were used in traditional buildings can very well be implemented in the modern buildings so as to produce energy less consuming buildings and if these principles are sensibly adopted in modern buildings it is possible to build sustainable buildings for future [2–4]. Any good building should relate and respond to the climate. Recent studies on vernacular buildings conclude that bioclimatism is an integral part of vernacular architecture and a deciding parameter

towards achieving sustainability of modern architecture [2,3] In the absence of precise temperature control measures, the role of the building design in mitigating the vagaries of wind and weather is extremely important in providing indoor thermal comfort [4,5]. Climatic design lessons can be learned and inspiration can be sought by observation of the long tradition of vernacular architecture [6,7]. These are important especially in the context of energy concerns from all around the world [8], and the alarming increase in air conditioning usage in the recent years [9]. Building energy consumption in India is the highest among all Asia Pacific partnership countries [10]. Traditional house reflects cultural heritage of peoples, also encapsulate traditional forms and values. The practice of drawing on traditional architecture to inform contemporary design has been promoted by many theorists and distinguished architects such as Hasan Fathy [9–11]. The principal purposes of this study were to: (1) Identifying architectural elements which evolved as a response to climate in Vernacular buildings and recommend appropriate solutions for current design and construction, aiming towards sustainable development and (2) assess the thermal comfort factors for preserving the vernacular housing and providing energy efficient design solutions for contemporary buildings in the coastal region of nagapattinam. This paper illustrates a detailed study on the qualitative and quantitative analysis of the solar passive techniques based on field experiments with emphasis on indoor thermal comfort in the vernacular architecture of the coastal regions of Nagapattinam.

* Corresponding author.

E-mail addresses: shanthipriyatce@gmail.com (R. Shanthi Priya), mcs@tce.edu (M.C. Sundarraja), rk.arch@yahoo.co.in (S. Radhakrishnan).

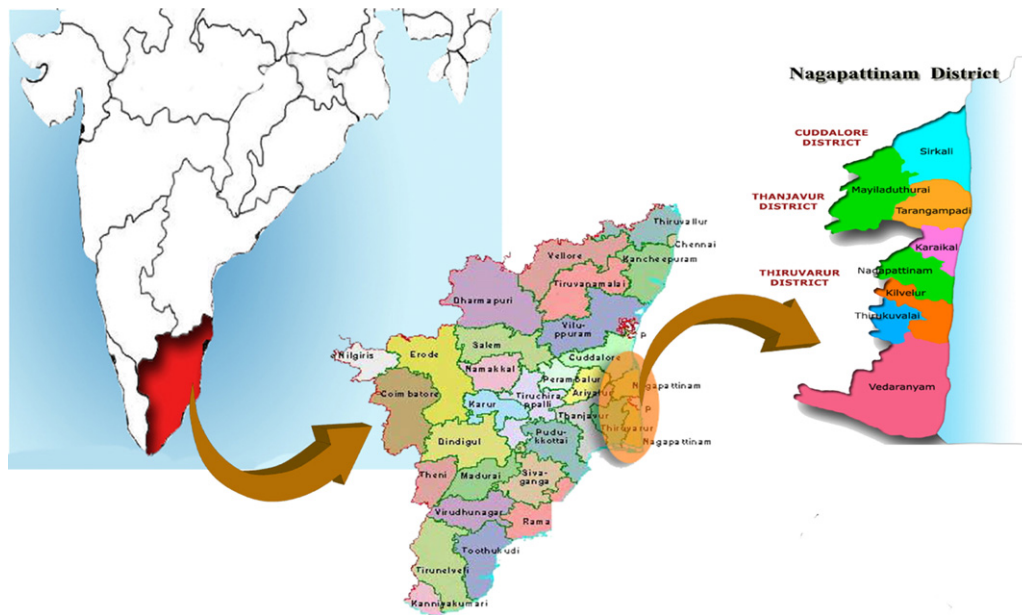


Fig. 1. Map showing coastal region of Nagapattinam in Tamil Nadu.

2. Coastal region of Nagapattinam in Tamil Nadu: topography and climate

2.1. Topography

Nagapattinam a land of religious harmony is known for its rich religious heritage lies on the East Coast of Tamil Nadu (Fig. 1). It is bounded by Thanjavur district and Thiruvarur district on the West, Cuddalore district on the North and the Bay of Bengal on the South and the East. This place lies between 10.25° and 11.4° north latitude and 76.49° and 80.01° east longitude. The general geological formation of the district is plain coastal. Cauvery and its tributaries are the principal rivers. The district occupies a major portion of the Cauvery river delta consisting of narrow strips of wet lands split by various rivers and Channels. The coastal land is generally plain except for a few sand dunes. Coastal town Nagapattinam was the historical headquarters of a region during the Chola period (12th century AD). The district Nagapattinam lies in the eastern (Bay of Bengal) Coast 350 km down south from the state capital Chennai (Fig. 2). The adult and the male population living in a coastal region of Nagapattinam were engaged in fishing.

2.2. Climate

The climate is warm-humid based on the climatic zone of India (Fig. 3). The main monsoon is North East monsoon (October to December) contributes about 60% of the total annual rainfall. The second one is the South West monsoon (June to September) contributes about 20% of the total annual rainfall. Nagapattinam has been experiencing the hot climate in summers with humidity and pleasant climate in winters. Summers (March to May) are hot with the temperature hovering around $28\text{--}41^{\circ}\text{C}$, as in the coastal region the cool breeze from the sea provides reprieve from the extreme hot. Monsoon period (June to September) offer temperate climate accompanied with mild to medium rain falls. The place looks pleasing in monsoons with fresh vegetations and flowers. Winters (December to February) are pleasant with moderate climate. During winters the temperature is in a range of $21\text{--}32^{\circ}\text{C}$.

The presence of high amount of moisture in the atmosphere for major part of the year causes thermal discomfort as there is less evaporation, resulting in sweating. The monthly normal climate of Nagapattinam is given in Table 1. Temperature vary from 21°C to 41°C (Fig. 4), relative humidity (RH) varies from 60% and will be



Fig. 2. Delineating the study area showing the base map of Nagapattinam. Source: Department of Town and country planning, Chennai.

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