CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL

In the coastal regions of Tamil Nadu, many detailed studies have shown that vernacular architecture is multiform and valuable. Unfortunately, due to many fierce wars, the impact of state policies and natural disasters, much vernacular architecture in the coastal region of Tamil Nadu has been destroyed or has disappeared altogether due to age of the structures in reseeding shore line and impact of urbanisation. Today, those remaining are very modest in scale and form, but the architectural and environmental lessons that they provide are still considerable. To comprehensively and systematically review architectural strategies in the coastal region of Tamil Nadu, both scientific methods and respect for the natural and social context was essential. Many researchers investigated the climate responsive traditional architecture in their climatic regions. To make a wider knowledge in this area some of the important literatures were reviewed across the world and presented briefly and they were listed in references at the end of the report.

2.2 REVIEW OF LITERATURE

2.2.1 Research in Vernacular Settlement

Maria (2009) evaluated a sustainable Greek vernacular settlement and its landscape focusing on architectural typology and building physics. In
this study, various types of adobe dwellings were surveyed and their response to climate, in terms of site and building design, was evaluated. In addition, the techniques of creating microclimatic conditions by incorporating the existing environmental parameters into the design were considered. Bioclimatic design employs appropriate technologies and design principles based on a thoughtful approach to climate and environment. The layout of the buildings (orientation in relation to sun and wind, aspect ratio), the spacing (site planning), air movement, openings (size–position and protection), and the building envelope (walls: construction materials-thickness and roof construction detailing) were also considered. The study evaluated specific vernacular dwelling types and their response to climate based on passive design principles that can be adapted to current architectural practice in that area, in order to optimize the relationship between site, building and climate.

2.2.2 Research on Assessing Thermal Comfort in Traditional Buildings

Do-Kyoung Kim (2006) compared the natural environment control system of Korea with contemporary architecture. This study stressed that modern architecture does not have the capacity to control its environment without resorting to methods involving high energy consumption, and these have caused many environmental problems and hence architecture needs to recover its capacity to control its environment in an environmentally sustainable manner. This study also examined the methods used to control the architectural environment in Korean traditional architecture and compared them with Korean contemporary architecture.

Maniog Lu & Yılmaz (2008) had done an extensive research in energy efficient design strategies in hot dry area of Turkey. This study is based on a student workshop which was carried out for a hot dry area of
Turkey. This study showed similarities and differences of traditional housing principles from the climate responsive design point of view.

It also put forwards basic principles and their meaningful changes in usage that can be used in the sustainable housing designs of the future. In the study, design strategies in Mardin, a town situated in the hot-dry area of the south-eastern part of Turkey was examined and modern traditional houses were evaluated in terms of design criteria such as, selection of the area, distance between buildings, orientation, building envelope and building form. A thermal evaluation and comparison of a traditional house with a contemporary house was given by using only data derived from the measurements. This evaluation has been done via both measurements and questionnaires which were carried out for 100 buildings.

Nasser Al-Hemiddi et al (1997) evaluated the effect of a ventilated interior courtyard on the thermal performance of a house in a hot–arid region. An experiment was carried to investigate the effect of a ventilated interior courtyard on the thermal performance of a house in a hot–arid region. The site of the experiment was Al- Oyyena village, situated in the countryside around Riyadh, Saudi Arabia. Statistical analysis of data recorded during the summer of 1997 was carried out. The results indicated that the courtyard gave high efficiency in providing cool indoor air through cross-ventilation. A statistical module and its validation for natural ventilation were presented. The study estimated the indoor daily average dry-bulb temperature, as a function of outdoor temperature and wind speed.

Zhiqiang John Zhai & Jonathan Previtali (2010) studied ancient vernacular architecture such as its characteristics, categorization and energy performance evaluation. The study explored vernacular architecture, built by people whose design decisions were influenced by traditions in their culture, which have been gleaned through a long period of trial and error, ingenuity
of local builders who possess specific knowledge about their place on the planet, and thus are valuable in promoting climate-specific passive building technologies to modern buildings. The study introduced an approach to categorize distinct vernacular regions and evaluating energy performance of ancient vernacular homes as well as to identify the optimal constructions using vernacular building techniques. The research conducted an extensive computer energy modeling for a number of representative ancient vernacular architectural characteristics observed for different climatic regions. The vernacular test subjects were compared against those established according to the International Energy Conservation Code and those generated by the optimization software. The simulation results of the energy models suggested that, considering traditions seen in ancient vernacular architecture as an approach to improve building energy performance is a worthwhile endeavor and a scientific guidance can help enhance the performance. The study indicated that, although many vernacular dwells exist in the world, it is challenging (but desired) to package vernacular architecture traditions and quantitative design knowledge to modern building designers. The project was the first part of a much larger project that intends to create a knowledge base of vernacular building traditions that will include information about not only the energy performance of traditional building techniques, but also addresses areas of cost, material availability and cultural traditions.

Hadavand & Yaghoubi (2008) assessed the thermal behavior of curved roof buildings exposed to solar radiation and wind flow for various orientations which determined the air flow, solar radiation and heat transfer from a two dimensional curved roof with North-south and east west faced, the results were compared with flat roof for the same size and orientation. Comparison were performed for their corresponding roof surface temperature, heat flow for several roof rim angles and various wind flow velocities, as well as for different wind directions. Turbulence was modelled and solar
radiation distribution over the roof was determined based on an appropriate model applicable to hot arid regions of Iran. Solar radiation was calculated based on the summation of beam, diffuse radiation and ground reflected radiation. For certain inside roof temperature, over all heat transfer to the building was determined with day time for various wind flows and arc shapes and results were compared with flat roof. It was found that various wind flow condition over the vaulted roof makes substantial difference on the convection heat transfer coefficient and finally on the rate of heat transfer to the building with respect to flat roof. Heat transfer simulation, roof temperature, heat transfer convection coefficient and heat flow though the vault for different roof arrangement and flat roofs were determined and advantages of specific vault orientation and wind direction were specified.

Do-Kyoung Kim (2006) had examined and compared the Korean traditional architecture with Korean contemporary architecture. According to the study modern architecture does not have the capacity to control its environment without resorting to methods involving high energy consumption, and these have caused many environmental problems. Hence architecture needs to recover its capacity to control its environment in an environmentally sustainable manner. The research explored the systems developed in Korean architecture to control its environment in an environmentally sustainable manner from longstanding experience.

Oikonomou & Bougiatioti (2011) carried out the experimental investigation on architectural structure and environmental performance of the traditional buildings in Florina, NW Greece. The research presented various aspects, which characterized the traditional architecture in the town of Florina, North-western Greece, which are related to bioclimatic and environmental architecture. The study is based on the documentation and analysis of the architectural and bioclimatic aspects of a sample of forty
houses of 19th and the beginning of 20th century. Analysis of the architectural aspects concerns the building typology, form, materials and the construction techniques, whereas the analysis of bioclimatic aspects involves thermal behavior of the building shell, thermal and visual comfort conditions. The in situ Air Temperature measurements were conducted with Gemini Tiny tag Ultra data loggers which are placed in the main Living spaces of four representative houses. The study also aimed at documenting and assessing, both qualitatively and quantitatively, all the afore-mentioned aspects and draws conclusions concerning the principles, which characterized the architecture which can be integrated to the refurbishment of existing buildings or the design of new ones in traditional surroundings.

Kristina Orehounig & Ardeshir Mahdavi (2011) presented the results of collection and analysis of data pertaining to energy performance of traditional bath buildings ('hammams') in Egypt, Turkey, Morocco, Syria, and Algeria. The energy performance and thermal comfort conditions in five such buildings were studied and empirically calibrated; building performance simulation models of a number of objects were generated to predict the consequences of alternative thermal retrofit measures. The results provided an objective assessment of actual energy and indoor environmental performance of these buildings.

Engin et al (2007) assessed the climatic approaches that are evident in the architecture of the vernacular houses in the Eastern Black Sea region. The study aimed at providing information about the vernacular architecture in the Eastern Black Sea region and investigated the relationship between architectural products and climate that plays a very important role in the formation of the architecture. Thus, the effects of climatic factors, such as rain, wind, humidity and sunlight on vernacular houses were explained in topics as plan, external walls, roof and exterior of buildings.
Ozgur Dincyurek & Ozlem Olgac Turker (2007) did an extensive study in exploring the Island’s housing tradition which bears the opportunity to be learned and evolved into architectural solutions. The study investigated the possibilities of the traditional environment as a common architectural heritage of the Island which can be revitalized, besides developing new appropriate architectural solutions in the light of the natural and cultural context, for the sake of having a contemporary living milieu. The study also evaluated these values parallel to present discourse; sustainable identity that can be achieved by emphasizing especially the locality. The research also defined the appropriate design principles for the contemporary housing developments and ways of sustaining existing unique traditional patterns.

Jiapang Liu et al (2000) explored the indoor thermal environment of Yaodong, a representative of western China vernacular dwellings was found to be cool in summer and warm in winter. The study interpreted the characteristics of warm in winter and cool in summer in the dwelling by measuring the indoor, outdoor and wall’s temperatures in winter and summer. The human thermal comfort theory was used to evaluate thermal environment, and the periodic heat transfer mechanism was used to analyze the thermal transfer through the wall. The results showed that the Yaodong’s thick walls effectively damp the external temperature wave (periodic fluctuations in the heat fluxes entering the medium, that is, to the variability of the heat sources) and keep the inner surface temperature steady were the chief causes of warm in winter and cool in summer in Yaodong, which laid a scientific basis for low energy building design.

Anh-Tuan Nguyen et al (2011) conducted an investigation on climate responsive design strategies of vernacular housing in Vietnam. The study explores energy conservation issues and environmental problems in recent years that have increased interest in traditional architecture which is
well known for its energy saving designs. The study investigated vernacular housing designs and evaluated on the aspect of building physics. It proposed and applied a new research methodology which is adapted to the natural and social context of Vietnam. The process was carried out step by step, including: climate zoning, systematic analysis, in-situ survey and building simulations. The results of the study indicated that vernacular housing in Vietnam was creatively adapted to the local natural conditions and used various climate responsive strategies. The study also derived the most frequently used strategies and their effectiveness. It was also found that under extreme weather conditions, traditional designs might not be sufficient to maintain indoor thermal comfort.

Ahmed Muhaisen (2006) carried out the shading simulation of the courtyard form in different climatic regions. The study presented a modeling carried out into the effect of rectangular courtyard proportions on the shading and exposure conditions produced on the internal envelope of the form in four different locations. Kuala Lumpur, Cairo, Rome and Stockholm, were chosen to represent the climatic regions of hot humid, hot dry, temperate and cold climates, respectively. The study highlighted the effect of the climatic conditions on the suggested courtyard ratios and heights to achieve a reasonable annual performance in the examined locations. Also, it clarified the variation in the courtyard daily shading and exposure performances as a result of changing the location latitude and consequently the sun’s position in the sky. The study suggested guidelines and general rules for efficient courtyard design in the considered climatic regions. Furthermore, it stated the ranges within which the parameters of the form can be changed with minimum deviation from the optimum performance. The results showed that the shading conditions of the courtyard internal envelope are significantly dependent on the form’s proportions, location latitude and available climatic conditions.
Summer Lin Borong et al (2007) examined the thermal performance of the Chinese traditional vernacular dwellings based on the field measurements of the thermal environment parameters and a long-term auto-recorder of the indoor and outdoor temperature at four typical traditional vernacular dwellings at Wannan area in summer, some wrong viewpoints about Chinese traditional vernacular dwellings were clarified. Also, with the analysis of the fine structures design such as the dooryard, the structure of the double-pitched roof and the eaves by the measurements of temperature, wind velocity, etc. some design principles of the traditional vernacular dwellings in Wannan area were revealed, of which sun shading and insulation are of great importance while the natural ventilation is just considered as an auxiliary approach. So the strategy of ventilation design was to restrain the natural ventilation at daytime and to boost it at night. Moreover, the Thermal Sensation Votes (TSV) of the occupants and the Predicted Mean Votes (PMV) were compared and the evaluation standard in a naturally ventilated environment was also discussed.

Silvia Martín et al (2010) conducted an experimental investigation on thermal comfort inside rural houses of Navapalos (Spain). In the study they analyzed the environmental advantages of reusing abandoned rural buildings. Due to their thick exterior walls of high thermal inertia, the indoor environment inside them was found to be comfortable with less energy consumption than new buildings. They showed the monitoring results of three different houses, two traditional and one modern building, constructed of different building materials. The work analyzed and compared the thermal behavior of existing constructive solutions in a Spanish district, not to improve them. The field test results showed better indoor conditions inside the traditional houses. In summer, thermal comfort was achieved with no energy supply inside traditional houses but not inside the modern one. In winter, the indoor environment was found to be more stable inside the
traditional houses; however none of them were able to provide thermal comfort naturally. In the case studied, the only inhabitant of a small village lives in a prefabricated wooden house, and it was demonstrated that the indoor conditions of traditional houses in the same location are thermally comfortable than the modern buildings.

Tzikopoulos et al (2005) has done research on modeling energy efficiency of bioclimatic buildings. A sample of 77 bioclimatic buildings (including 45 houses) was collected, covering Greece, other Mediterranean areas and the rest of Europe. The results showed that the average energy efficiency varied from 19.6 to 100% with an average of about 68%. Environmental conditions included latitude, altitude, ambient temperature, degree days and sun hours; building characteristics consisted in building area and volume. Passive solar technologies included (among others) solar water heaters, shading, natural ventilation, greenhouses and thermal storage walls. They found that many passive technologies did not appear to make a difference on energy efficiency while thermal storage walls in fact seemed to decrease energy efficiency. The model developed can be used by architects, engineers and policy makers. Suggestions for further research was also included for obtaining more building information, investigating the effect of passive solar technologies and gathering information on the usage of building.

Omar & Syed-Fadzil (2011) assessed the passive thermal performance for a Penang heritage shop house. The study explored the possibility that the country's overall energy usage may be reduced, provided that steps are taken to minimize cooling loads in buildings via passive means. Considering Malaysia to be a country of hot-humid climate, many modern building designs have been observed to ignore the general characteristics of the region's vernacular architecture. The study discussed the thermal performance of a heritage shop house in Penang, Malaysia, which uses
passive cooling. Aspects which were looked at were the overall design of the buildings as well as recorded thermal data collected during a pilot study. The results showed that the building provided an indoor environment that is cooler than the outside. Suggestions were also made to further improve the indoor thermal environment.

Adil Al-Mumin (2001) discussed the suitability of the sunken courtyard concept in the desert climate using Kuwait as a case study. The study investigated three issues related to the concept: its ability to modify the harsh climate and to reduce the energy consumption, its construction costs compared to above ground building, and the occupants' attitude towards living underground. The results proved to be suitable for the desert climate of Kuwait. Its ability to provide annual savings in energy costs, to protect the building components from fast deterioration, and to have a cozy environment with extra free spaces for any possible future needs would make it an excellent sustainable design concept.

Ignacio Canas & Silvia Martín (2004) proposed the recovery of Spanish vernacular construction as a model of bioclimatic architecture. The study sets the bases of bioclimatic construction by learning from the traditional construction. The research focused on the information obtained from the classical authors of Spanish vernacular architecture. The study determined the design strategies used in vernacular constructions to adapt them to the environment which can be used in two different forms: (1) to make a proposal for the recovery of vernacular constructions with peculiar bioclimatic strategies; (2) to translate some of the bioclimatic strategies used in vernacular constructions to the present ones.

Mujgan Serefhanoglu Sozen & Gülay Zorer Gedik (2007) qualitatively evaluated the traditional houses in terms of building physics. Traditional Diyarbakır houses in southeast Turkey which are successful
examples of buildings adapted to a hot dry climate were studied. This was found to be achieved by conforming to an old style of living and by the requirements and the use of local materials. In the study, the general architectural properties of the traditional houses of Diyarbakır, their layouts, plan types, building envelope and façade elements were evaluated in terms of building physics criteria. The study showed that today, in spite of new technological advances, techniques and materials, identical buildings were still being built, and climatic design is not considered important in Diyarbakır. As a result these buildings do not provide shade and cool spaces, and thus cause thermal discomfort, or increase in the use of energy. The study emphasized the importance of the features of traditional buildings in terms of designing energy efficient, to provide appropriate buildings for the environment.

Miguel Angel Porta Gandara (2002) studied the economic feasibility of passive ambient comfort in Baja California dwellings and evaluated some passive thermal comfort techniques in order to compare long-term energy savings. A direct comparison was made of vernacular architecture, based on adobe walls, against modern, concrete brick building of low-income family housing in tropical, dry-climate conditions in La Paz, Baja California Sur, Mexico. The expected energy requirements of each type, for the same comfort level, are calculated by means of a calibrated mathematical model, and present value of each option was obtained by conventional means using 10% interest over 15 years. The results indicated that, in cases as those analyzed, the use of vernacular passive techniques is more comfortable and economic than present light buildings by a very wide margin.

Khaled Al-Sallal (2012) designed a sustainable house in the desert of Abu Dhabi. He derived an assessment method, and other documents (building code, standards, and design guidance), a sustainable house was
designed following an integrated process of design and performance evaluation. The design achieved considerable improvement over a typical Emirati house case; 59% reduction in the greenhouse gas emissions and utility bill. Such a methodology could be valuable to other building professionals in the UAE who might search for a clear application model.

H.O. Sugo (2009) has been involved in a wide range of experimental and analytical activities studying the thermal performance of various walling systems commonly used in Australian housing. He has done an extensive monitoring of the performance of four, full scale purpose built housing test modules incorporating typical walling systems - cavity brick, insulated brick veneer, insulated cavity brick and insulated lightweight construction. This research is concerned with a critical examination of the wall thermal resistance (R value) and its impact on thermal performance. Twelve months of experimental results are presented and used to explore the difference in thermal behavior of the modules incorporating the four walling types. The results showed that the wall thermal resistance is not the only factor influencing the thermal performance, indicating a potential deficiency in the current Australian building regulations which assumed that the thermal resistance (R) value of the wall to be the principal design parameter influencing thermal performance.

Or Aleksandrowicz (2012) studied the thermal performance of various typologies of Vernacular architecture to integrate certain building features that were developed in a long process of adaptation and adjustment and therefore may embody valuable solutions for maintaining desirable indoor conditions. The Central Hall House building type, which can be found in Lebanon, Israel, Syria and the Palestinian territories, is an example of an architectural vernacular that may prove to contain applicable design strategies in confronting the hot and humid climate of the region's coastal plain. This
research proposed a method for performing an indicative assessment of the environmental features of the Central Hall House building type in the Israeli coastal plain through the integration of architectural and historical survey with computer-aided simulation techniques

2.2.3 Research on Assessing Ventilation Techniques in Traditional Buildings

Chalermwat Tantasawasdi (2001) explored the potential of using natural ventilation as a passive cooling system for new house designs in Thailand. The characteristics of past and present Thai houses were analysed in terms of climate, culture and technology. Based on the thermal comfort requirements for the Thai people and the climate conditions in Bangkok, the study found that it is possible to use natural ventilation to create a thermally comfortable indoor environment in houses in a Bangkok suburb during 20% of the year. The study also developed comprehensive design guidelines for natural ventilation at both the site planning and individual house levels by using computational fluid dynamics.

Youngryel et al (2009) presented the influence of wind flows on thermal comfort in the Daechung of a traditional Korean house. The study characterized the wind flow measured at a Daechung to interpret the effects of the wind characteristics on thermal comfort. They measured 10-Hz turbulence data at the Daechung and partitioned the wind vector into two directions (i.e. backyard to Daechung and front yard to Daechung). Interestingly, the wind from the cool backyard flowing through the Daechung was of less frequency and shorter duration but had higher velocity compared to wind from the opposite direction, which can provide thermal comfort to the dwellers. The study suggested that the wind characteristics were determined by various aspects of the house’s design, such as its location and the degree of enclosure in front and backyards. The results showed that traditional Korean house
made use of a natural ventilation system during the summer. The principles of this system can be used in constructing environmentally friendly and sustainable residences.

Abdel-moniem El-Shorbagy (2010) presented a new technique for achieving natural ventilation in buildings using wind catchers. The study focused on the traditional architecture of Central Asia and the Middle East which is the product of land, the local climate, and people’s culture. The study demonstrated the value of wind-catchers and provides insight into the application of natural ventilation systems as an alternative to the inappropriate modern cooling system in hot climate regions. It also examined the theoretical status of wind-catchers and to identify its specific nature, its use and its function in the context of architectural practice and discourse, in the past, present and future.

Montazeri & Azizian (2008) conducted an experimental study on natural ventilation performance of one-sided wind catcher. Hydrodynamic performance of a one-sided wind catcher was investigated by experimental wind tunnel and smoke visualization testing. In this study a 1:40 scale model of Kharmani’s School Baud-Geer was employed and the induced air flow rate into the test room and the pressure coefficients around all surfaces of its channel were measured for different values of approaching air incident angles. In this study, a 1:40 scale model of an ancient one-sided wind catcher was employed. The experimental investigations were conducted in an open working section subsonic wind tunnel located in the thermodynamics laboratory of the school of mechanical engineering of Yazd University. This wind tunnel is designed for the experimental testing of natural ventilation devices and has a test section with height, width and length of 46, 46 and 360cm, respectively.
Using measured pressure coefficients, the theoretical values of ventilation air flow were estimated to evaluate ability of simplified models in natural ventilation studies. Due to placing of urban full-scale wind catchers in the boundary layer of atmospheric winds, the effect of this phenomenon was also examined. The experiments were conducted when the wind catcher model with adjoining house was placed in the wake of upstream objects, resembling neighboring buildings. It was found that for an isolated wind catcher model, the maximum efficiency is achieved at zero air incident angles. Also it was concluded that the angle of incidence of the wind (zero degree), the presence of an upstream building around the structure and blowing of atmospheric wind influence the pressure coefficients, the rate and the direction of ventilation air flow.

Omidreza Saadatian et al (2012) conducted a review of wind catcher technologies. The objective of the study was to review and provide a comprehensive literature on wind catcher system for space cooling and ventilation. The concepts were discussed according to the relevant parameters of wind catcher, i.e. wind catcher attributes, wind catcher configurations and wind catcher technologies. The pros and cons of this green architectural feature were highlighted and the future research need in this realm of study was proposed.

Montazeri et al (2010) evaluated the performance of the two-sided wind catcher using experimental, numerical and analytical modeling. They conducted experimental wind tunnel and smoke visualization testing as well as Computational Fluid Dynamics (CFD) and analytical modeling to investigate the performance of a two-sided wind catcher. Experimental investigations were carried out using an open-circuit wind tunnel and both the induced volumetric airflow into the building and the pressure coefficients around all surfaces of the wind catcher model were measured at various wind
angles. Furthermore, the CFD simulation was also used to evaluate the pressure coefficient distribution and airflow pattern around and through the wind catcher. Additional experimental tests and computational fluid dynamics simulation of the wind catcher in the wind tunnel were also conducted to assess the accuracy of measurement procedures and the uncertainty of experimental results. The study also represented a semi-empirical approach in which experimental data were used for a detailed analytic model, in order to provide an accurate estimate of the performance of wind catchers. It was found that for an isolated two-sided wind catcher model, the maximum efficiency was achieved at the angle of 90°. At this air incident angle the wind catcher efficiency increased approximately 20% more than the one at zero angle. The experimental investigations demonstrated the potential of two-sided wind catcher for enhancing the natural ventilation inside buildings. It can be seen that CFD simulation and analytical modeling results have a good agreement with the experimental results.

Nasser Al-Hemidi (2001) investigated the effect of a ventilated interior courtyard on the thermal performance of a house in a hot–arid region. The site of the experiment is Al-Oyyena village, situated in the countryside around Riyadh, Saudi Arabia. Statistical analysis of data recorded during the summer of 1997 was carried out. The results indicated that the courtyard gives high efficiency in providing cool indoor air through cross-ventilation.

Kim & Park (2011) evaluated the natural ventilation concepts in traditional Korean house. A natural ventilation opening was designed based on the traditional Korean opening to improve indoor environment on the contemporary house. The prototype of the opening was composed of three hanji papers and two air layers to improve airflow rate, and also to recovery heat lose. In the experiment the performance of the heat recovery and airflows of the prototype was measured in laboratory, and the CFD simulation was
used to verify its performance in the contemporary house. The result of the experiment showed that the prototype was capable of providing natural ventilation even at low wind pressure, and also that it prevented cold draft in heating period.

Omar Asfour & Mohamed Gadi (2008) proposed the results of the investigation of the vaulted roofs in improving wind-induced natural ventilation, using computational fluid dynamics. The parametric study was carried out considering different climatic and geometrical parameters. Using Fluent 5.5 program, natural ventilation performance were modeled and assessed according to the value of airflow rate, and the quality of internal airflow distribution. The study concluded that utilization of vaulted roofs for natural ventilation increases inflow rate of the building, and re-distribute internal airflow currents by attracting some of the air to leave through roof openings instead of walls openings.

Ben Richard Hughes (2011) evaluated the development of wind tower device and their integration into buildings, thus providing a comprehensive review of current and potential wind tower development. Numerous studies have investigated the effects of different configurations and components on the performance of wind towers. This study included the use of evaporative cooling device inside the tower to improve its thermal performance, the use of solar chimneys, courtyards and curved roofs to enhance the air movement inside the structure, and the use of volume control dampers and ceiling diffuser to optimize the fresh air flow rate and indoor conditions. The review further highlighted the different cooling techniques which can be integrated with wind tower systems to improve ventilation and thermal performance. The basic principles of each technique along with its corresponding capabilities were summarized along with their advantages, limitations, and applications.
Abbas Ali Elmualim (2006) has carried out the experimental wind tunnel and smoke visualization testing and also CFD modeling were conducted to investigate the effect of air flow control mechanism and heat source inside rooms on wind catchers/towers performance. For this purpose, a full-scale wind catcher was connected to a test room and positioned centrally in an open boundary wind tunnel. Pressure coefficients around the wind catcher and air flow into the test room were established. The performance of the wind catcher depends greatly on the wind speed and direction. The incorporation of dampers and egg crate grille at ceiling level reduces and regulates the air flow rate with an average pressure loss coefficient of 0.01. The operation of the wind catcher in the presence of heat sources will potentially lower the internal temperatures in line with the external temperatures.

2.2.4 Research on Assessing Building Materials in Traditional Buildings

Asan (2006) investigated the time lag and decrement factors for different building materials using numerical computation methods. For this purpose, one dimensional transient heat conduction equation was solved using the Crank–Nicolson scheme under convection boundary conditions. To the outer surface of the wall, periodic boundary conditions were applied. Twenty-six different building materials were selected and analyzed. The computations were repeated for eight different thickness of each material and the effects of thickness and the type of material on time lag and decrement factor were investigated. It was found that thickness of material and the type of the material have a very profound effect on the time lag and decrement factor. The results of the study were useful for designing more effective passive solar buildings and other related areas.
Soofia Elias-Ozkan (2006) focused on the environmental performance of selection of buildings in the typical Central Anatolian village of Şahmuratlı in Turkey. The objective was to search for affordable and energy-efficient construction techniques suitable for rural settlements and incorporating traditional cultural values in a semi-arid upland region characterised by long severe winters and hot, dry summers. This was pursued by analysing temperature and humidity measurements within buildings constructed from a variety of traditional and modern materials. The thermal behavior and comfort, the patterns of energy use and the appropriateness of the different building techniques and materials were analysed, compared and discussed. The study demonstrated how a building envelope reacts to outdoor conditions through graphic illustration and show ways in which the research can be extended by the creation of simulations using Ecotect software. This research contributed to the promotion of passive and low energy architecture towards a sustainable future.

Parinaz Keshtkaran (2011) has done an extensive study on Harmonization between climate and architecture in vernacular heritage. This paper described the principals and methods of vernacular architectural designs in Yazd, Iran, which is located in a dry and hot area that is one of the unique geographical and cultural regions of Iran. Design and technological considerations, such as sustainable performance of natural materials, optimum usage of available materials, and the use of wind and solar power, were studied in order to provide effective eco-architectural designs for this region. The goal of this paper is to provide the architectural criteria, issues, and insights that had to be addressed in order to provide acceptable levels of human comfort in this arid area. The architectural principals that were developed and used in this extreme climate zone will be beneficial to other architects in the design of architectural structures that provide human comfort in adverse climatic conditions.
2.2.5 Research on Thermal Comfort Survey in Traditional Buildings

Henry Feriadi & Nyuk Hien Wong (2004) presented the thermal comfort study for naturally ventilated houses in Indonesia. An extensive field survey conducted in residential buildings in Indonesia, 525 sets of data had been gathered. The data analysis revealed that the predicted mean vote equation had predicted warmer thermal perception as compared to what people actually felt. Interestingly, it was observed that under hot and humid tropical climate, people indicated preference to cooler environment as compared to what the neutral temperature has shown. The study also investigated the occupant’s adaptive control preferences in creating a more thermally comfortable living environment. The reciprocal effects of occupant’s thermal perception and behavioral adaptation were explored.

Ealiwaa et al (2004) reviewed the results from a field survey of thermal comfort within two types of buildings; old (traditional) and new (contemporary), in Ghadames oasis in Libya. The survey was undertaken in the summer seasons 1997 and 1998, which were typical of the hot dry climate of North Africa. The survey showed how the 237 residents responded to the environmental conditions. Questionnaires were collected from the residents of 51 buildings: 24 old buildings that employed natural ventilation systems with courtyards and 27 new buildings that employed air-conditioning systems. In addition the environmental parameters were measured in 11 buildings (5 old, 6 new) representing 50 subjects, to calculate the predicted mean vote value of the subject using Fanger's model as presented in ISO 7730 standard 1995. The survey showed that the measurements of predicted mean vote in new air-conditioned buildings provided satisfactory comfort conditions according to ISO 7730 and the occupants agreed by indicating a satisfactory actual mean vote. The equivalent measurements and survey results in old traditional buildings indicated that although the PMV, based on measurements and ISO
implied discomfort (hot), the occupants expressed their thermal satisfaction with the indoor comfort conditions. The study also investigated occupants overall impression of the indoor thermal environments; the results suggested that people had an overall impression of higher standard of thermal comfort in old buildings than in new buildings.

Rijal et al (2010) evaluated the seasonal and regional differences in neutral temperatures in Nepalese traditional vernacular houses by conducting two surveys of the thermal environment and thermal sensations were in the indoor and the semi-open spaces of traditional houses, during both summer and winter, in five districts of Nepal such as Banke, Bhaktapur, Dhading, Kaski & Solukhumbu. The surveys were carried out for 40 days, gathering a total of 7116 thermal sensations from 103 subjects. The results showed that residents were highly satisfied with the thermal condition of their houses, since they adjust well to the thermal conditions. The residents had higher neutral temperatures in semi-open spaces such as verandas than in indoor spaces. The findings revealed that people in the regions studied adapt well to the natural environment, as a result of which neutral temperatures are different in different climates. They were lowest in the cool climate, medium in the temperate climate and highest in the sub-tropical climate.

Henri Feriadi (2004) has done an extensive field survey conducted in residential buildings in Indonesia, 525 sets of data had been gathered. The data analysis revealed that the PMV equation had predicted warmer thermal perception as compared to what people actually felt. Interestingly, it was observed that under hot and humid tropical climate, people indicated preference to cooler environment as compared to what the neutral temperature has shown. The study also investigated the occupant’s adaptive control preferences in creating a more thermally comfortable living environment. The reciprocal effects of occupant’s thermal perception and behavioral adaptation
were explored. In tropical free-running buildings where the air temperature and humidity might not be modified easily without mechanical means, the people seemed to prefer higher wind speed.

2.2.6 Research on Assessing Day Lighting in Traditional Buildings

Belakehal et al (2004) qualitatively assessed the sun lighting and day lighting strategies in the traditional urban spaces and buildings of the hot arid regions. In hot arid regions, sun lighting is an essential consideration to achieve an environmentally conscious architecture. The study identified the sun lighting strategies and their resulting typology in some urban spaces, different types of buildings and constructional details as they have been developed in the hot and arid regions of the Islamic world.

Aineias Oikonomou (2006) proposed the results of the quantitative evaluation of day lighting conditions in traditional buildings of Florina in North-Western Greece during 19th century. In this study, the issues of thermal and visual comfort were approached from two distinct viewpoints: in-situ measurements and computer analysis. The temperature measurements were conducted in the main living spaces of the two levels of the house, throughout the summer using data logger. The computer thermal analysis was performed with the Ecotect software. The results of the computer analysis were compared with the recorded air temperature measurements. The day lighting measurements were conducted in the main living spaces of both the ground floor and the upper storey, on a date near the summer solstice at 09:00, 12:00 and 15:00 TST. The day lighting analysis and simulations were conducted using the Ecotect and the Radiance software. The results of these two approaches are compared.

Carlo Ratti et al (2003) assessed the building form and environmental performance of traditional buildings in an arid climate. They
selected six simplified urban arrays based on archetypal building forms. Then they analysed and compared the archetypes in terms of built potential and daylight criteria, eventually reaching the conclusion that courtyards perform best. Their results, which inspired a generation of designers, were briefly reviewed in the study and reassessed in environmental terms using innovative computer analysis techniques. Furthermore, the implications of their question, which to date has not addressed the link with climate, were explored using a case study in a hot-arid region.

Danny Li (2005) analyzed the Daylight Coefficient (DC) approach using RADIANCE lighting software in simulating the indoor daylight illuminance of a corridor. The interior daylight illuminance data measured in the corridor were compared with the simulated results based on the computer software. It was found that the DC approach could give satisfactory results especially for the sun-shaded surface and sun facing surface receiving a large amount of direct sunlight. Further, the daylight illuminance detected by the photo sensor was also simulated in conjunction with measured daylight illuminance, dimming ratio and electric lighting power to predict the lighting energy savings. The findings suggested that the measured and predicted data showed a good agreement when large electric lighting savings resulted.

2.3 NEED FOR RESEARCH

Various approaches were employed in the literature. Dili et al (2010) used long-term in-situ measurement method to evaluate the thermal environment in a traditional building in Kerala, India. Canas and Martin (2004) employed statistical method to gather data about vernacular Spanish buildings and categorized them into different bioclimatic strategies based on their locations. By doing so, they found the most frequently used strategies which correspondence to the building locations and local climate. Maria (2009) conducted a study to evaluate a sustainable Greek vernacular
settlement by using subsequent analysis, based on two major steps: (1) a study concerning the evolution of the built environment (typological analysis, site planning, construction materials and techniques), and (2) an evaluation of specific vernacular dwelling types and their response to climate, based on passive design principles. She has made it clear that the vernacular settlement demonstrates an economical use of local building resources, adapting to climatic conditions without using much energy and providing human comfort. Manio Glu & Yılmaz (1997) studied energy saving design strategies employed in ancient housing in Mardin, Turkey. They made a simplified thermal evaluation and comparison of a traditional house with a contemporary house by using in-situ measurement method and questionnaires which were carried out for 100 buildings. They found traditional houses performed better than their counterparts in providing human comfort and energy saving. In an intensive study in Japan, Hiroshi et al (2007) researched four traditional farmhouses using both in-situ measurement and computer simulation on a model house. Their findings revealed that cooling technologies of traditional buildings, such as solar shading by thatched roof, earthen floor and natural ventilation etc are effective for interior cooling.

Vernacular architecture is an outcome of many years peoples experimentation since mankind exists and hence it definitely has enormous solutions to the future as well as present to build and live green. However, this should not be taken as approved and must be systematically analyzed in different contexts and settings. The elements like Wind catcher, courtyard, tiled roof and clear storey houses are examples of an vernacular architecture that may prove to contain applicable design strategies in confronting the hot and humid climate of the region's coastal plain. As said in the introduction, this research proposes a method for performing an indicative assessment of the environmental features of various building typologies in the coastal plain.
through the integration of Architectural and historical survey with experimentation and computer Aided simulation techniques.

The climate of the coastal region in Tamilnadu is warm and humid. During the extreme months of May, June and July the average maximum temperature is 38degC and the RH is more than 90%. In the last two decades, these conditions has changed and invited artificial conditioning systems. The growing numbers of air conditioning system are responsible for the constant rise in electricity demand in Tamilnadu. Since we can assume that the climate was not essentially different before 100 to 150 years before. One way of devising energy efficient methods for maintaining Thermal Comfort in today’s buildings is to tap in to past experience where electricity based techniques for cooling and heating did not exist thus making it necessary to rely on the sheer Performance of the structure.

From the past research, it can be observed that there have been investigations on thermal comfort study in traditional buildings across all climatic zones using all the above-mentioned methods (in-situ measurement, statistical method, comparative study and computer simulation) in various countries. Their findings revealed the usage of solar passive concepts in their traditional buildings to make the traditional buildings thermally comfortable. However, research related to assessment of thermal comfort in coastal region traditional residences along with an overall assessment of visual comfort and acoustic comfort in these traditional buildings of coastal regions in Tamil Nadu is not done extensively. With these aim, the present study proposes a new approach for analyzing and evaluating vernacular dwellings in the coastal region of Tamil Nadu in terms of building physics (thermal comfort, visual comfort and acoustic comfort). It is expected that both qualitative and quantitative analysis included in this method will reinforce the findings from this study. This research is aimed at investigating the traditional architecture
in the coastal regions of Tamil Nadu in terms of finding and analyzing the heat-humidity, air movements, light and sound elements in the physical environment using a series of large scale experiments. The traditional houses in the coastal region of Tamil Nadu are typical examples of buildings adapted to warm humid climate. This study attempts to evaluate the various typologies of traditional buildings in terms of building physics criteria and find out the best and suitable one amongst these traditional residences of this coastal Tamil Nadu. The basic characteristics of traditional buildings in coastal region are presented, followed by an examination of the general architectural properties of the traditional houses and evaluation of the old houses in terms of physical environment elements such heat, humidity, air movements, light and sound. By doing so, the research findings would complement the building industry to look back the energy demand of each and every modern building at least, the residences to consider the olden available technology to make use in these contemporary structures to design low energy demanding residences.