ECOLOGICAL VILLAGES AS SUSTAINABLE SETTLEMENT MODELS

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ABSTRACT

ECOLOGICAL VILLAGES AS SUSTAINABLE SETTLEMENT MODELS

Environmental problems are at a threatening level for human life. This has led to the development of sustainable perspectives to protect the ecological system balances. It became important to research the settlements with small ecological footprint, which maintains and develops the environment. Considering ecological, social and economic sustainability as a whole, damage to natural resources may be prevented, energy efficiency may be established, waste management may be utilized and use of acclimated, renewable natural resources may be promoted.

Ecological footprint, is defined as the amount of resources required to balance the effects of human activities on the natural environment. It provides a measure for the effect of buildings, products or cities on the ecology.

As an alternative solution to the contemporary urban developments (except a few major initiatives); three different settlement types have been evaluated according to ecological footprints as sustainable settlement models. These alternatives include sustainable city models, traditional villages and ecological villages. Ecological villages can be accepted as successful models for sustainable life forms. Within the scope of this research it has been aimed to keep a guide feature by examining the criteria that forms ecological villages and details of layout and settlement.

In the first chapter, purpose, scope and method of the thesis is determined by examining sustainable settlement models, ecological villages and studies on this subject and mentioning about the process of appearance of sustainable architecture concept.

In the second chapter, factors behind pollution generated by cities and pollution within cities have been studied within the context of ecologic footprint, the effect of cities on

ecology is described and required measures to be taken because of the negative consequences are studied.

In the third chapter, the deficient on sustainable modeling are specified through studying the concept of ecological village and its historical formation. The distinction from traditional villages that have ecological living is made based on an evaluation of their ecological footprint. The output of the chapter is a structured analysis of successful ecological villages, their settlements and architectural features.

In the fourth chapter, criteria of ecological villages are created using the output from chapter three. Details of ecological residential units and relevant construction details, characteristics that should be in ecological residential units and construction details are described.

In the fifth chapter, in order to assist ecological village design development in our country a synthesis is provided in the form of an ontology of various criteria and relevant design cheklists. Reasons behind failures of ecological villages are expliciated. At the end of this study, evaluating successful examples abroad, some suggestions for ecological village initiatives in Turkey are made.

As a result, a synthesis has been developed based on the ecological layout of settlements in different scales. Output of this research is a list of ecological settlement criteria and a design guide for ecological villages which may guide designers to transform existing settlements or develop new ones with a systemathic approach.

ÖZET

SÜRDÜRÜLEBİLİR YERLEŞİM MODELLERİ OLARAK EKOLOJİK KÖYLER

Çevre sorunlarının sürekli artması ve tehdit edici boyutlara gelmesi, ekolojik sistem dengelerini korumaya yönelik sürdürülebilir bakış açıları geliştirilmesine yol açmıştır. Ekolojik, sosyal ve ekonomik sürdürülebilirliği bir bütün olarak görüp çevreyi koruyup geliştiren, doğal kaynaklara zarar vermeyen, iklimle uyumlu, yenilenebilir enerji kaynaklarını kullanarak daha az enerji harcayan, atık yönetimine sahip ekolojik ayakizi küçük yerleşimlerin araştırılması önem kazanmıştır.

İnsani faaliyetlerin etkilerinin doğal çevre üzerinden dengelenebilmesi için gerekli kaynakların miktarını belirleyen ekolojik ayakizi, yapıların, ürünlerin veya kentlerin ekoloji üzerindeki etkisinin ölçümlenmesini sağlayabilmiştir.

Kentler için çözüm alternatifi olarak üç farklı yerleşim birimi sürdürülebilir yerleşim modeli olarak ekolojik ayakizine göre değerlendirildi. Çıkan sonuçlardan ekolojik köylerin sürdürülebilir yaşam biçimi olarak başarılı modeller kabul edilebileceği görülüp ekolojik köyleri oluşturan kriterleri, yerleşim ve yapılaşma detayları incelenerek rehber niteliği taşıması amaçlandı.

Birinci bölümde, sürdürülebilir mimarlık anlayışının ortaya çıkış sürecine değinilerek sürdürülebilir yerleşim modelleri ekolojik köyler ve bu konuda yapılan çalışmalar irdelenerek, tezin amacı, kapsamı ve yöntemi belirlenmektedir.

İkinci bölümde, kentlerin oluşturduğu kirlilik ve kentlerdeki kirlilik irdelenerek kentlerin ekoloji üzerindeki etkisinin değerlendirildiği ekolojik ayakizi açıklanıp, olumsuz sonuçlardan ötürü alınması gerekli önlemler araştırılmaktadır. Sürdürülebilir yaşam ve yerleşim birimlerinin oluşturulmasının gerekliliğinden ötürü çözüm model olarak sürdürülebilir kentler incelenmektedir.

Üçüncü bölümde ekolojik köy kavramı, tarihsel oluşumu, ekolojik yaşama sahip olan geleneksel köyler incelenip ekolojik ayakizine göre değerlendirilerek sürdürülebilir model olmaları yönünde eksikleri belirtilmektedir. Ekolojik köyler ile geleneksel köyler arasındaki farklar incelenerek sürdürülebilirlik açısından incelenmektedir. Başarılı ekolojik köyler araştırılarak yerleşim ve mimari özellikleri incelenmektedir.

Dördüncü bölümde araştırılan başarılı ekolojk köy örneklerinden ekolojik köy kriterler oluşturulup tespit edilmektedir. Ekolojik yerleşim birimi ve yapılaşma detayları ele alınarak ekolojik yerleşim birimlerin sahip olması gereken özellik ve yapılaşma detayları açıklanmaktadır.

Beşinci bölümde ekolojik köylerin ülkemizde de gelişip yayılabilmesi amacıyla yerli ekolojik köylerin neden başarısız olduğu açıklanmaktadır. Bu çalışmanın sonucunda yurtdışındaki başarılı örnekler değerlendirilerek Türkiye'de ekolojik köy girişimleri için önerilerde bulunulmaktadır.

Sonuç olarak farklı ölçeklerde ekolojik yerleşim ve yapılaşmalar incelenerek sürdürülebilir model olan ekolojik köylerde ekolojik yereşim kriterleri tespit edilerek yeni oluşturulacak yada mevcut yerleşim yerlerinin dönüşümünde rehberlik edebilecek sistematik bir yaklaşım oluşturmaktadır.

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1. INTRODUCTION

Ecological footprint expresses the sum of the resources required to sustain life. Urban development is a major source of pollution. In terms of ecolgical footprint, existing resources of the world are insufficient to eliminate the impact of affuliance and population over the ecologic cosmos of the world. As a result the natural frame that forms the ecosystem fails to satisfy the needs of the human life.

Development of sustainable settlements and relevant research is one of the high priority topics. Sustainability can only be established by taking social, economic and ecological solutions as a whole. However, most of the examples developed as sustainable cities are mostly optimised for modern life which the qualtiy of life is defined mostly with contemporary industrial and technological development rather than permaculture which the quality of life is defined based on being “self sufficient”. These measures are inadequate in terms of reducing the ecological footprint.

In industrial societies, one of the major residential units which have the ecological footprint at lower levels are traditional villages. However, even in these areas, energy needs of electricity as well as fuel are provided by the facilities that cause pollution which are offered by central administrations. Chemical methods applied instead of abandoned traditional methods in mass agricultural production. This causes soil and nutrient pollution and disturbs the biological balance. Traditional villages depart from the model of sustainable living due to these adverse conditions, whereas they can be turned into the form of sustainable living faster than that of cities.

An alternative exists which establishes a minimum – in rare cases negative ecological footprint. These residential units have distinct diffrences in terms of social structure, economic base and initiation. Ecological villages have been selected as a good laboratory to learn about permaculture and as one of the most sustainable settlement pattern in industrial societies providing a level of social balance and with unique economic solutions to sustain life.

First examples of ecological villages began to be built in 1960s. In written literature, the first time they were named as ecological village was in 1991 [1, 2]. In parallel to the world libertarian political movements in the world in 1960s and 1970s, alternative living for the future started to be formed with space searching. Although first formations resulted in failure because of not being considered within the context of economic sustainability. Ecological village founded by the academia in Tennessee has been one of the successful examples that has maintained so far (Page 18).

Within the scope of this research an analysis have been made over 561 ecologic villages over the world including Turkey. Global Ecovillage Network (GEN) is a worldwide association which provides accrediation to eco-villages and the relevant list have been extracted from the list of GEN. The GEN website provides basic criteria for the comparison of Eco-Villages. Within the scope of this research only data related with the selected cases have been included. The rest of the data is available on the GEN web site. As an ourput of this analysis, a general deficiency related to common values to create reference to ecological village have been established.

Although there have been examples of ecological village initiatives in Turkey, it was observed that most of them were failed. Criteria which would enable the sustainability of these settlement can be identified with the analysis of successful ecological village examples. A guide then may be prepared in accordance with these criteria would help to lead ecological villages to be established in the future. In this study, it is aimed to develop a systematic approach to the model of ecological village.

1.1. PROBLEM DEFINITION

Solution alternatives for ecological architecture and layout have been encountered mainly in two areas: villages and cities. Whereas for cities, many data related to resource, sample, measurement and evaluation is available from the conception of sustainable city, for the village example no aim mechanism to benefit from such feedbacks is available.

1.2. PURPOSE OF THE STUDY

The purpose of the study is to develop a guide to be used by future initiatives for ecological villages development. To reach that goal an analysis is required to identify the background factors both for failed and successful eco-village examples of the past. A comparison of ecological villages which are compatible with the ecological balance for nature and human health with other sustainable settlements will be made. In this way, this guide would also be useful as a sustainable settlement area model proposal for Turkey.

In order to explain the ecological village concept, a checklist shall be created for analyzing the values of ecological village and determining the criteria of successful ecological villages by studying successful examples abroad from the point of structure, energy, ecology and social environment and for viewing requirements related to ecological residential unit and settlement.

Features and settlement details that ecological residential units should include, shall be explained with the issues such as prevention of energy losses, use of renewable energy sources, social and ecological sustainability issues.

1.3. METHODOLOGY

This thesis has been structured under three main criteria; design criteria, social criteria and construction technique criteria.

The methodolgy implied includes various levels of analysis and synthesis steps. First of all ecological footprint of various settlements shall be reviewed, in which sustainability issues can be evaluated. Then, sustainable cities that were developed as a sustainable model and their criteria shall be reviewed. Outputs of these analysis shall be compared against those of traditional villages. Within the synthesis progress the outputs of these analysis shall be classified according to relevant ecological footprint data.
The sustainable features of the selected examples shall be evaluated based on a three value scale. Finally, ecological villages as settlement units shall be reviewed and ecological footprint data shall be compared with traditional villages and sustainable cities. In the light

of data and results obtained, ecological village design criteria shall be created with a systematic approach for the design of ecological villages.

The synthesis output shall also include an ontology of ecological village criteria; control lists and a building design guide related to construction techniques. The design decision criteria will be based on a set of data considering the parameters such as ecological sustainability, locality and reserve of low-carbon emission, which are the common values of ecological architecture.

1.4. RELEVANT RESEARCH

Ecological design principles have been reviewed in the scope of PhD thesis of Ovalı titled as „*Türkiye İklim Bölgeleri Bağlamında Ekolojik Tasarım Ölçütleri Sistematiğinin Oluşturulması "Kayaköy Yerleşmesinde Örneklenmesi*" [3].

Ecological architecture features of isolation, material, heating/cooling, ventilation, hot water, renewable energies, waste management has been reviewed. Accordingly, the principle of provision of minimum energy loss for minimum energy requirement is approved. Settlement to benefit from passive energy, providing of energy from renewable sources, selecting material from local and nearby surroundings in order to keep material carbon footprint at lower level, isolation in each detail and from natural materials, filtering and recycling of wastes and less waste generates the construction principles [4, 5].

Solution suggestions on minimizing of ecological footprint of cities have been reviewed in the scope of PhD thesis of Ercoskun titled as „*Sürdürülebilir Kent için Ekolojik-Teknolojik (Eko-Tek) Tasarım: Ankara-Güdül Örneği*" [6]. Suggestions for prevention of other constructional energy losses getting under control of energy requirement by automation systems are considered.

Studies related to ecological footprint and ecological settlements: ecological footprint definition, calculation and methods have been reviewed in the scope of study of Rees and Wackernagel titled as „*Our Ecological Footprint; Reducing Human Impact on the Earth*" [7].

Sustainable cities and ecological footprints have been reviewed in the scope of book of Tallon titled as „*Urban Regeneration in the UK*“. As a result, cities cannot be sustainable according to assessments of ecological footprint [8].

Sustainable cities criteria have been reviewed in the scope of study of Jabareen titled as “*Sustainable Urban Forms: Their Typologies, Models and Concepts*”. He suggested the city models that sustainable in theory according to these criteria [9].

Studies related to social and economic dimensions of sustainability: comparison of social dimension of successful and unsuccessful samples have been reviewed in the scope of book of the founders of Global Ecologic Network connected with ecological villages, including ecological village experiences titled as “*Ecovillage Living: Restoring the Earth and Her People*” [10].

Social, economic, ecological suggestions for cities to be sustainable, sustainable city definitions and decisions taken have been reviewed in the scope of book of Newmann and Jenning titled as “*Cities as Sustainable Ecosystems*“ [11].

Analyzing the ecological villages of Findhorn Ecovillage, Auroville Ecovillage, Siebenlinden Okodorf, The Village; social, architectural, economic, ecological characteristics, which led them grow successfully have been reviewed. In these villages, which were evaluated as successful modern ecological villages according to Global Ecovillage Network, it has been tried to create ecological village criteria by reviewing the common values [12 - 15].

Study related to ecological villages, which attempt to built in Turkey, has been reviewed in the scope of article of Ayman titled as “*Turkey's Chances of Ecological Settlements*“. Accordingly, it is seen that the reason for failure concerning Hocamköy that attempted to be built in Kırıkkale was unclarifying of social participation and objectives [16].

In the ecological villages of Güneşköy and İmeceevi, existing and developing ecological villages in Turkey have been reviewed [17, 18].

2. GLOBAL WARMING, ECOLOGICAL FOOTPRINT, SUSTAINABILITY AND SUSTAINABLE CITIES

Today, in modern cities, environmental pollution and lack of natural areas affect human health negatively. In addition, for the individuals, not being able to be involved in the process of making decisions and informing concerning their environment and themselves implies barrenness of social life as well. Within the framework of sustainability, modern cities largely cause consuming of natural resources of which the future generations have the right to use greenhouse gas emission (carbon diffusion) and create a snafu vicious circle with environmental waste, air, water, soil namely environmental pollution.

2.1. GLOBAL WARMING

Fossil fuels such as coal, natural gas and fuel are the organic substances that are very rich in carbon dioxide content and formed under high pressure. As a result of use of these fuels, CO2 gas mixes into the atmosphere.

Normally, this event, which is part of the carbon cycle causes to increase the amount of CO2 in the atmosphere higher levels with the increase of use in fossil fuel. Two main components of the air, oxygen and nitrogen gases reflect the sunlight in visible wavelength and absorb some of the ultraviolet radiation. Sunlight reaches on the surface of the earth is converted to heat through absorption by the Earth. This heat causes vibration and infra-red radiation of the atoms on the Earth. This infra-red radiation is not absorbed by oxygen or nitrogen gas. However, CO2 and CFC (chlorofluorocarbon) gases in the air absorbs some part of infra-red radiation and prevents the removal out of the atmosphere. This absorption event leads to atmosphere to be heated. As a result, the Earth heats up like inside of a car parked under the Sun. This effect is known as the “greenhouse effect”. As it changes the average temperature of the Earth's surface, the greenhouse effect can cause serious problems such as changes in climates, melting of icebergs, shifting of the seasons and becoming infertile of agricultural fields in the long term. The Earth must give energy to the space as much as it takes from the sun in the long term [19].

Solar energy reaches the earth as short wavelength radiation. Some part of the radiation that arrived is reflected back by the surface of the Earth and atmosphere. But a large part of it heats up the Earth through the atmosphere. Earth avoids this energy with long wavelength, infrared radiation. Most of the infrared radiation released up by the surface of our planet is absorbed by water vapor, carbon dioxide and other "greenhouse gases" in atmosphere that occurs naturally. These gases prevent the energy to pass directly into space in the same way as it comes from the Earth. Many interactive process (including radiation, air flows, evaporation, cloud formation and rain) carries the energy to the higher layers of atmosphere and energy is transferred into the space from there. This slower and indirect process is a chance for us; because, if surface of the Earth transmits the energy into space burden less, then the Earth would be cold with no life, bare and desolate planet like Mars. Due to atmospheric gases are permeable towards the received Sun radiation while they are far less permeable towards back-oscillating long wave-earth radiation, this natural process provides Earth to be heated more than expected and regulates heat balance is called the greenhouse effect [19].

2.2. ECOLOGICAL FOOTPRINT

The ecological footprint is that the sum of the areas efficient biologically and needed to provide renewable resources for people where the water was found. In addition, this includes the infrastructure and space needed for flora to provide absorption of CO2.

Ecological footprint is calculated by comparing the competing human demands on biosphere with the adapting capacity of the planet. Ecological footprint is obtained by adding fields required for infrastructure and waste disposal, supplying of renewable resources.

The only waste included in current calculation is CO_2. Ecological footprint has been doubled between 1961 and 2007. Carbon footprint increased 3 times in the last 10 years that means it is more than half of the ecological footprint. In 2007, the total ecological footprint of mankind was 18 billion global hectares (gha), i.e. it was 2,7 gha per person. Biological capacity of the world was only 11.9 billion gha i.e. it was 1, 8 gha per person. Continuing in this way; we will need 2 planets in 2030 and 2.8 planet in 2050 [20].

According to the ecological footprint concept, it is stated that cities are unsustainable [8].

2.3. SUSTAINABILITY

Sustainability was first defined in 1987 by the World Commission on environment and development as "meeting the needs of the present generation without eliminating the ability of future generations to meet their needs". It has three aspects as ecological sustainability, social sustainability and economic sustainability. It is emphasized that these three aspects need to be considered as a whole.

Sustainable settlements are defined as the settlement of people who are a part of limited nature with protecting and enhancing the nature [21].

2.4. SUSTAINABLE CITY

Cities are that in which the carbon dioxide oscillation (GHG impact) is aimed to minimize. It is emphasized that natural area to absorb the emissions and social welfare is required in these cities. These are the kind of areas that current and future needs of the housings have been considered, a good quality of life have been supported with environmental awareness [9].

2.4.1. The Criteria of Sustainable City

To reduce energy consumption, it contains passive solar design and transportation.

Compact model is targeted to compact cities, keep all necessary services close and combined and minimize the need of using transportation. In a compact city, distances for transportation of energy, water, material, products, and people are minimized [9].

Sustainable transport supports hiking, biking and effective public transportation as both urban form and scale. Transportation vehicles which are the product of different technologies determine today’s city forms. Sustainability in current cities is also defined as reduction of negative influence of both mobility and traffic. Besides sustainability, it also provides social interaction in compact city. Less energy consumption and less environmental pollution is targeted with new state-of-the-art public transportation vehicles [9].

Density is calculated by the ratio of people (or housing) and land. Supply of interaction forming that generated the city is the number of people in the field, determining the association with character of city is just density. Integrated land use with high density does not only protect resources, but also creates compact model that also provides social interaction [9].

Mixed zone usage provides compatible zone usage by getting service centers close and reduces the distances between activities. Use of mixed zone enables different functions such as commercial, residential and industrial areas getting together. Because work, commercial centers and spare time activities are being together in mixed zone, cars are used less for commuting, shopping, spare time activities.

Diversity is required for sustainability of cities. Lack of an intensive diversity draws people to use their cars again for their needs. People prefer to walk in urban areas which are intense and having diversity rather than suburban and grey areas. In fact, people who arrives this intensive zone by their cars even prefer to walk [16].

Passive solar design is located in the centre of sustainable city form. The general aim is to reduce energy demand and to provide passive energy according to special design criteria in sustainable ways. This criterion affects settlement as sun-oriented. Design, fitting, orientation, dimensions, plans of the construction can reduce the amount of energy to spent on traditional methods for spatial heating and cooling and using of maximum level of solar energy or renewable energy can be possible [9].

Greening of city or green city concept is important for sustainable city forms. Nature is integrated into the city. This makes city more enjoyable and pleasant. With greening many more advantages are handled; supports bio-diversity, protects nature and natural habitat. It is effective on absorption of air pollution, waste conversion, climate of city, public health [9].

2.4.2. An Example of Sustainable City: RIESELFELD / Freiburg

The city providing mixed settlement, sustainable transportation, central heating, use of renewable energy resource, green fields, and availability with social participation consists of low-energy buildings aimed minimum carbon emission [22]. Characteristics of the city:

- For population of up to 10,000-11,000, 3-5 storey buildings. Barrier-free, area with short routes by a majority.
- 1000 persons can be employed, mixed usage area for services and commerce, metro.
- Low-energy houses, central heating system, priority rail system, streets on which travelling by 30 km speed, use of rain water, natural life protected area.
- Custom made buildings mixed with state made ones, various housing form and dimensions, pre-prepared projects, small subdividing and multiple structure typologies, diversity on target market and building types, some barrier-free housings.
- Primary school with sports hall, high school, sports hall, forest school, rail system, meeting space for youth and children, children's areas, church, shopping facilities, private service sectors, fire station, gastronomy, spare time in high quality, public green areas, green areas in public custom blocks, rest areas 1km away, sport and free time fields, the possibility of living nature, free time field.

Figure 2.1. Rieselfeld, a. between city and forest, b. mixed constructions, c. transportation network, d. social fields, courtyards, e. field distributions, f. social sites, g. pedestrian areas, h. renewable-energy [22]

3. ECOLOGICAL VILLAGE

They are the ecological settlements created by the community organized by people gathered around the same idea and keep living without harming and try to support the effective ecological environment [1]. In the ecological villages there are models of balanced and healthy environment, economy, agriculture, transportation, energy, architecture and persons.

In the ecological villages that are compatible with nature, people try to compensate the damage that was brought to nature, aim to increase diversity with protecting it, meet around same opinions, care about the necessity of taking place at the stage of decision making, use sustainable energy and material, aim to provide recycling by producing waste at minimum with waste management and some issues such as various ecological criteria, ecological design principles, permaculture, ecological settlement, green production, alternative energy, social settlement practices are integrated [2].

Not only in the environmental context but also social and economic sustainability is sampled. Ecological village principles can be applied to both cities and villages. For maintenance and protection of the natural environment, they emphasize the importance of communities in this scale. They aim to reduce the ecological footprint based on the simple principle „you should not take more than you give".

In the past, while the concept of ecological village was a marginal dream for the privileged few, today it has gained speed and has been adopted by a large number of people around the world. They have created a sustainable community model, which developed the ecological village ecole, integrated modern needs and living formats [23].

Residential and settlements are seen, which is compatible with the ecosystem and created by the concerns of being healthy for living creatures architecturally and sustainable in environmental way. Settlement plan in selected region is limited by ecological environment with specifying of the number of participants that are less at the beginning, enlargement decisions futures, settlement around social central depending on contact of ecological village, settlement as groups or singular settlements. Although architectural configurations are subjected to people, they are formed according to local material usage, minimum energy needs, prevention of the energy loss, principles of waste, recycling, alternative energy, passive energy settlement and residential.

In ecological villages in which the needs of modern life are also met, ecological balance is protected, architectural and economic structures are created accordingly, the most important feature of social structure is to make a consensus on fundamental issues. In ecological villages individual participation is cared and decisions are taken together and also the exact boundaries and decisions related to social settlement are determined first in order to achieve social sustainability (See Page 56).

Their economic configurations do not include the models to cover the entire village. Besides people can work and reside in the village, they can also practice their professions in larger-scale nearby settlements and they can reside in the village. Social needs such as health and education is provided in traditional villages and in larger-scale settlements as well (See Page 83).

3.1. FIRST ECOLOGICAL VILLAGE FORMATIONS

In the 1960‘s and 1970‘s, in parallel with libertarian political movements they started to occur with searching an alternative life space for the future. The first formations failed as economic sustainability was not taken into consideration. At first, as a result of the experiences in 1971, the ecological village established in Tenessee by people from some academia has been maintained. Continuation determination under difficulties has built up the basis of this success. The idea of taking part in a world-wide important formation motivated them. Centre of American ecological village network pride in over 40 professions today. They shared the experiences that they have gained by writing, therefore they supported other ecological villages in a way of to be formed. They gave trainings to people who want to learn more about ecological villages by establishing training centre and provided money income with other trainings in time [2].

In the article of Robert Gilman's published *In Context* magazine issued of 29, in 1991 named as "Being a Planetary Villager“" the term of "eco-village" has been used first. Eco-village was a general synthesis and definition is as follows [2]:

- Humanistic scale
- Fully equipped residential area
- To integrate human activities with natural world in a harmless way
- To support the development of healthy people
- That can be continued until indefinite future

Ecovillages and Sustainable Communities report published in 1991. In the report it is concluded that in large number and variety of sustainable community was available, but there was no any existing ecovillages properly yet. This result was more important than a compilation in which current communities was listed and characteristic determination was made. The report also showed the intellectual effort that determined the theory of characteristic and nature of the eco-village, which was not fully realized yet [2].

A meeting was hold in 1991 to determine the development strategy of eco-villages. The meeting took place with the participation of important social philosopher of the period and led to provide communication and link between people coming together.

In 1995 in a meeting of "Eco-villages and Sustainable Communities: Living Models for 21st century", utopic eco village opinion became the real social and environmental formations that was internationally accepted in the light of 20th century with going beyond the concept of a good idea.

As a result of this conference, they were invited to "Human Settlements Conference" in Istanbul in 1996. They were selected as "best practices" along the sustainable living spaces in the United States officially for the first time in 1998. Village design courses were taught in the best villages of eco village network [2].

3.2. TRADITIONAL VILLAGES

These are the smallest settlements in countryside, which provide a living from agriculture and livestock, have common neighborhoods, created together with vineyards and orchards and fields. Their population is under 2000 and they have a texture of collective or dispersed settlement. Taking into account a number of factors such as security, transportation, natural environment, drinking water as well as population, state's approval is taken for a new village formation.

3.2.1. Values That Describes the Traditional Village

- Their populations are small and occupy less space
- Government is mukhtarate.
- They have borders and common properties.
- The economy is based on agriculture and livestock
- Collaboration and social solidarity is strong

3.2.2. Villages according to their fabric

*Collective village*s are where the houses are located all together. The streets are narrow, houses are usually adjacent. Fields are separate from farmers' houses and far away. Benefits of the collective villages are that having the opportunities of high rated social relationships, to benefit from investments totally and security etc. However, there are many disadvantages of collective village type: Difficulties of going and returning to the fields, working far away from the family, spreading of epidemic diseases easily and etc. The main regions of collective settlement in our country are Central Anatolia, Southeastern Anatolia and the Eastern Anatolia districts.

Dispersed villages are where the houses are scattered around at certain distances (50m – 100m or even more) consist of „dwellings" in one each, two each and sometimes more.

This village type occupies large areas. Best examples of this type settlements that seen at rugged and mountainous terrains are viewed in Black Sea Region. Disadvantages of dispersed village type are as follows: difficulties of going and returning to work, security problems, difficulties on installation of fittings and networks, not being able to benefit from public investments entirely, increase in public expenditure etc.

3.2.3. Assessment of Ecological Footprint of Traditional Villages

Villages where the daily life is compatible with nature, local and renewable resources are used, less waste is created and recycling is made, keep the carbon emissions caused by transportation etc. at lower levels by comparison with the traditional settlements according to the current regulations and standards as they can balance carbon emissions by natural areas in which they present.

Today, in traditional villages energy needs such as electricity and fuel are provided by the facilities offered by central governments and they cause pollution. As collective agricultural production was abandoned, chemical methods applied instead of the traditional methods cause soil and nutrient pollution and disturb the biological balance. While traditional villages can be turned into sustainable live format faster than cities, due to these negative conditions they get away from becoming sustainable live model.

3.3. DIFFERENCE BETWEEN THE ECOLOGICAL VILLAGE AND TRADITIONAL VILLAGE

Differences are considered in the context of social structure, economic structure, energy, architecture and ecology:

- *Social structure;* as in traditional villages, a traditional social structure born into and maintained does not exist. They have an egalitarian, participatory decision-making mechanism consisted of the people gathered around the same idea.
- *Economy;* unlike the traditional villages, their livelihoods are not just limited to agriculture and/or livestock. People earn from such as professions performed independently (art, architecture, education and so on), trainings in which ecological village experiences is shared, ecological tourism.

- *Energy;* as in use of renewable energy sources, with use of technologies or sources benefit from new and renewable sources they can form a model.
- *Architecture;* in the ecological villages in which modern structures can exist, it is built in accordance with principles of ecological architecture with considering of different professions and the needs.
- *Ecology;* ecological sustainability such as protecting and increasing of biodiversity is taken into consideration. Traditional methods in agriculture should be tried to apply and it should be avoided from chemicals that cause pollution.

3.4. TYPES OF ECOLOGICAL VILLAGE

Nowadays there are many and different types ecological villages. While sustainable living in some ecological villages for forty years is experienced, many new formations appear as well. A lot of ecological villages in the past were seen as marginal and idealistic settlements. Now, new ecological village ecoles which ecological village principles are adapted to, lifestyles and expectations are formatted according to flow of life, having people in different professions and different resumes and different ages lived together, having shared or private properties, houses rental or for sale, common areas or private gardens can be viewed [23].

According to the purposes:

Environmentalist villages are work of design with considering the parameters affecting the environment less and regard the enhancement of the world. Working on landscape, making analysis of the sustainable agriculture, forming of future village model compliant with nature is considered. While making sustainable agriculture design exposing the sun and wind power, collecting and using of rain water, aggregated water capacity etc. is taking into consideration. That is decided upon taking into account of arrangement and architecture of the houses and other ecological principles. Processes of food production activities, power generation, water conditioning, waste management, green works are decided on the basis of these issues.

Crystal Waters (Australia) can be a sample for the sustainable agriculture-based ecological villages. This village has been established based on protect and enhance the environment widely (Figure 3.1). Many village projects in North America have taken sustainable agriculture as a basic principle.

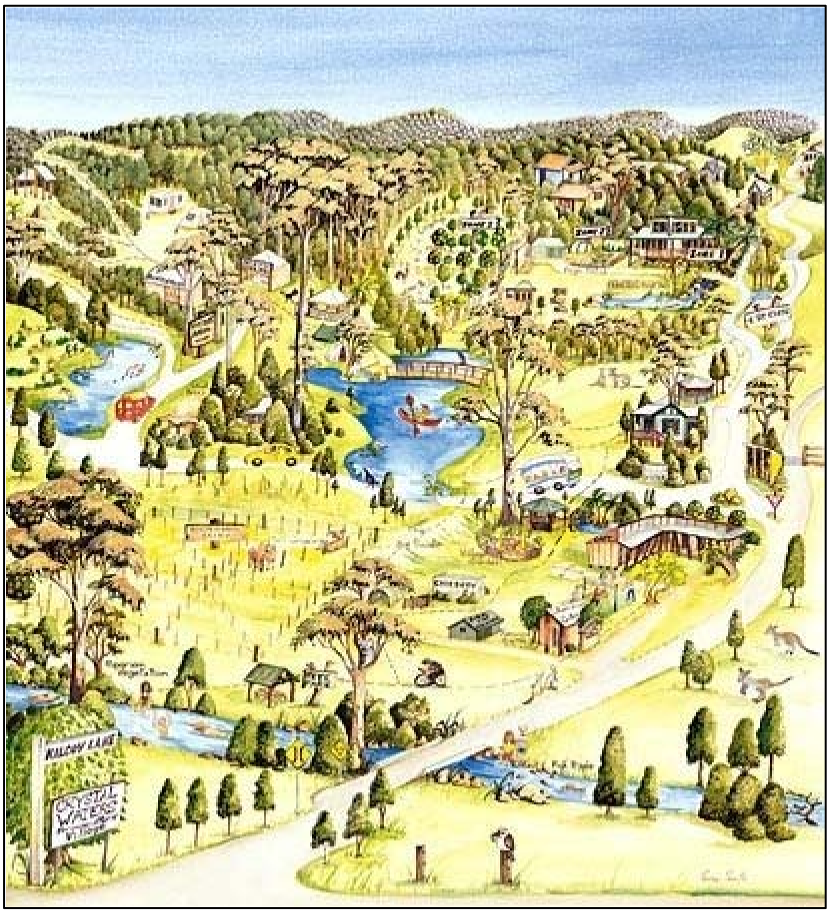

Figure 3.1. General view of the Crystal Waters ecological village

Social villages are the housing cooperatives that placed their common usage areas in their centers. Living areas have been close one another on a street or placed around their common usage areas. Generally houses have been partitioned as groups and it is aimed more interaction and socialization among the groups. A common parking place for cars has been allocated at the entrance of eco-village. Houses are usually not higher than one or two storey. Social-oriented eco villages are usually built to contain other concepts but on similar principles.

Design of village Hertha in Denmark has been established on a kind of social structure that adults become integrated with handicapped young people. Social fields such as theatres, meeting halls and houses have been located around youth hostels. A bio-dynamic farm, a bakery, a silver workshop and Steiner research lab are located in Hertha. Hertha is also the Liaison Office of Ecology Association of Denmark. This village which was established for producing income to the population can be an example for an economical set-up working very well with the effect of social structure on village. However, the village Zegg in Germany is famous for the social experiences. Women in Zegg make a study of spirit of woman life in society. This village is also focused on children life in society. Sister village Tamera (Portugal) is focused on the theme of health and peace processes [23].

Cultural or spiritual villages as in Huehuecoyotl, Mexico, they may choose to build a hall to perform a theatre or dance, music or seasonal celebrations in the centre of the village. A central meeting space is usually available in traditional eco villages located on the southern half. A tree, a monument or a celebration hall that adults give advices to young people, stories from generation to generation are told, celebrations are held on. A church, a meeting room and a reception area are available next to a pool or water well in traditional Scandinavian villages. A meditation hall every individual can easily reach in the centre of the village as well as Auroville (Figure 3.2) may be available. Some spiritual groups such as Maharishi considered building their village in the form of a Mandala. Vastu Sastra (Indian architecture) traditions, Feng Shui or other similar systems were taken into account in building of most villages [23].

Figure 3.2. Meditation center located in the center of spiritual themed ecological village Auroville and settlement around [15]

3.5. ECOLOGICAL VILLAGE DESIGN

Ecological villages that established for different purposes and can be available in a variety of themes are formed in the order as follows:

1. Social community comes together for the same purpose and they take the construction decision.
2. Trainings are received to be informed about the technical rules related to ecological villages (general design, permaculture, and production).
3. Evaluating the environmental conditions it is carried into practice [2].

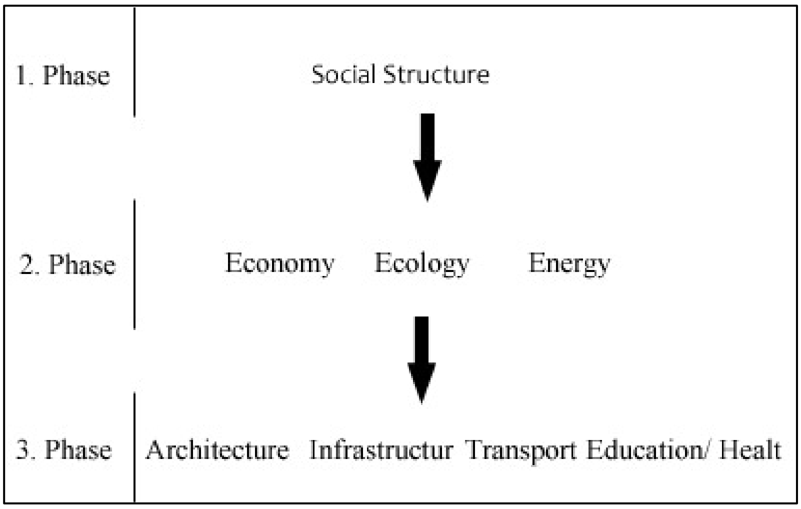

Figure 3.3. Stages in establishing ecological village

Process starts by coming together and making the decision of a social environment getting started with a small number of people and increasing over time with the same understanding. Through finalization of the decision for establishing ecological village, ecological villages are examined in depth, training are received and then carried into planning. The most important thing to remember before planning of each project is to identify priorities of the project clearly [23].

Permaculture principles are adopted in planning of ecological village settlement as basic principle. Permaculture is related to design of sustainable human settlements. It is a high efficient system that brings a philosophical and practical approach on integrating of living area with regional climate, plants, animals, soil, water management and human needs. Permaculture means that planning carefully about the environment, resources used and how to meet the needs. It aims to create systems not just to live in the present but also to protect our future. Permaculture is a right design, which was built on right values. It is used worldwide for planning of buildings, farms, gardens and villages and in the business world for educational, industrial, organizational and social designs [23].

While planning, theory of zones is used, which is separated in sectors primarily and then in vectors again. Zoning basically aims to settle the most heavily used activities to the nearest places to the houses and least used ones to the furthest places. For example, zone structure of the ecological village Crystal Waters as follows [23]:

- Zone 1: Houses and food gardens
- Zone 2: Indoor social fields and fruit gardens
- Zone 3: Larger open spaces and public gardens
- Zone 4: Backups, fuel forests, wind barriers etc.
- Zone 5: Wild life corridors, natural plant shelters

Basically sustainability is used as base in every sense. It is aimed to build an economic environment for new established life space to be sustainable. In this stage local and foreign ecological living spaces are separated. There is no concern related to economic sustainability at the farms formed by single families or the villages formed by very few people, in Turkey. Ones that have concern used it as new commercial presentation, marketing style for their hotels or farms. Some criteria such as maintain the economical earnings at overseas, children's schools, infrastructure, traffic etc develop the formation of village.

3.6. THE COMMON FEATURES OF SUCCESSFUL ECOLOGICAL VILLAGES

A total of 561 ecological village registered on the network is present in 2012 (number of registered ecological villages from Turkey are 7) [1]. Common features of the ecological villages of Findhorn Ecovillage, Auroville, Crystal Water that grow with increasing demands since their establishment and proved their successes with applying new ecological living principles are listed below:

- Having an equitable, participatory decision-making background and having proved the decision-making mechanism significantly from the beginning
- Well planning and application of ecological village building system
- Having growth plans
- Creation of integrated live with renewable source technologies and products
- Keeping ecological footprint and carbon footprints lower as balanced
- Use of local resources and facilities
- To be integrated with neighborhood settlements and existing ecology system.

3.7. ASSESSMENT OF ECOLOGICAL VILLAGE SAMPLES

Total of four samples is selected and analyzed from our country and around the world according to the following five criteria. Villages are discussed in terms of the purposes, developments from beginning to the present, layout plans, examples of structure, economic and social configurations, their compliance with the ecological system. Evaluated ecological villages were selected based on the following criteria:

- Supplying of social, economic and ecological sustainability
- Maintaining the modern society life
- Building energy efficient buildings by applying local and modern architecture
- Being compatible with neighborhood texture and placements
- Continue to grow successfully

Findhorn (Scotland) and Auroville (India) from the world and Güneşköy (Ankara) from our country have been analyzed. At the end of this study, some assessments have been carried out, which would be useful for the ecological villages in Turkey started out as good faith efforts but was not able to be develop as examples in the world.

3.7.1. Findhorn Ecovillage

It takes place in the scope of modern ecological villages which started as a caravan park in order to experience the sustainable living model in 1962 and today are the examples of these type of settlements with their modern ecological structures. It was selected as a life model with the lowest ecological footprint among the communities around the industrial world in 2007 by GEN (Global Ecovillage Network) and Sustainable Development Research Centre (SDRC). Ecological footprint is about half of the UK average. According to the UK average, energy and food consumptions are below the average in ratios respectively 21 per cent and 38 per cent. Trainings on sustainable living and residential units are offered to about 3000 people per year and approximately 14000 visitors from 50 countries are accepted through the Findhorn foundation that supports all activities and founded in 1982. It was awarded the UN habitat best settlement unit in 1985.

Figure 3.4. View of ecological village Findhorn

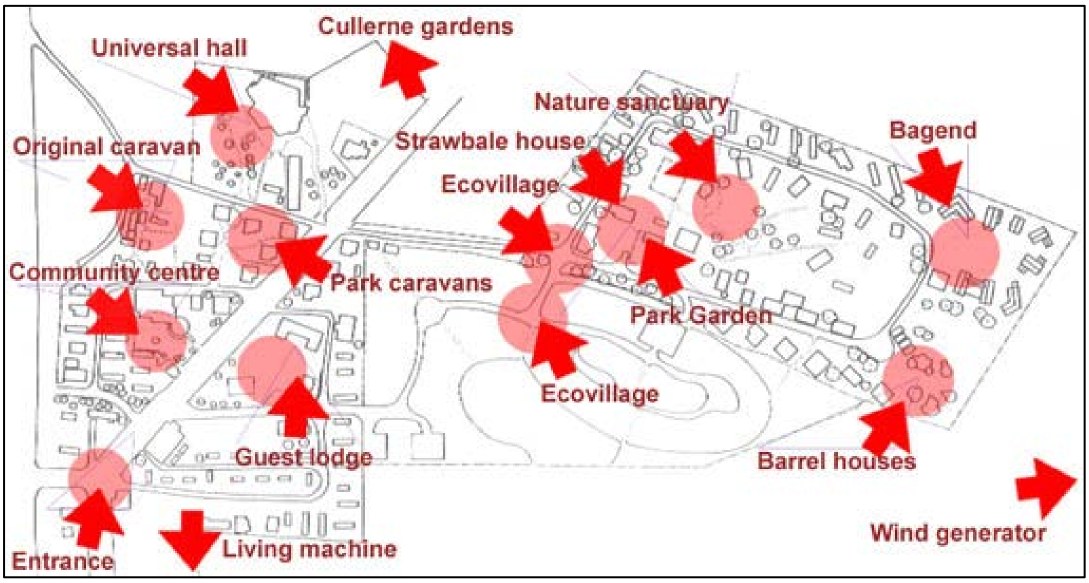

Figure 3.5. Site plan of ecological village Findhorn [24]

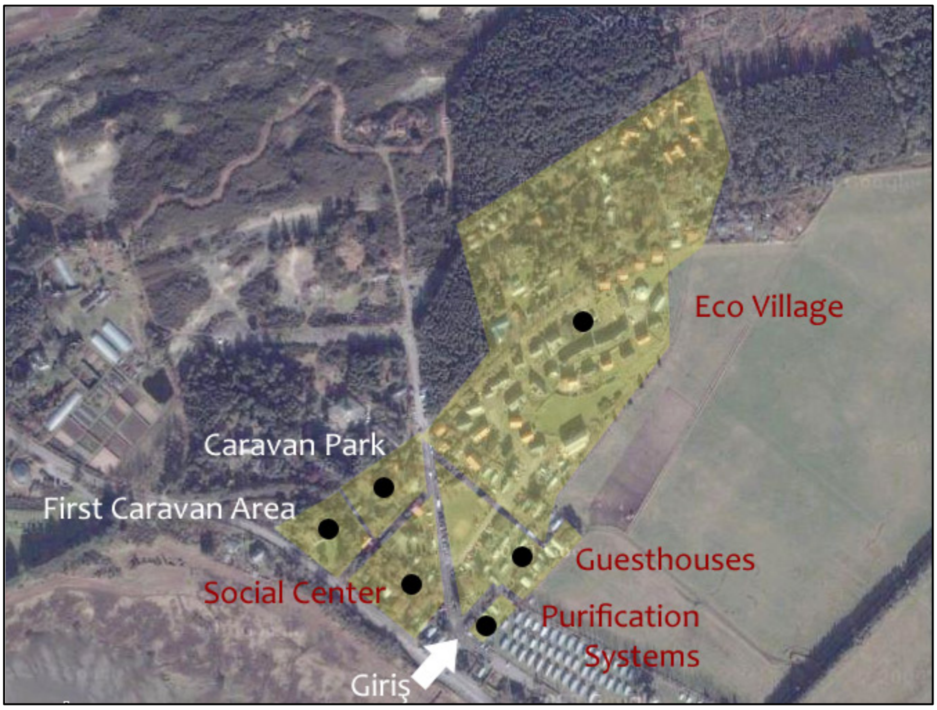

Figure 3.6. Layout plan ecological village Findhorn

Architecture: There are 61 pieces of ecological structure. Buildings are built based on zero carbon principle. They have environmental and energy efficient system, which was developed over the years. With use of natural and non-toxic ingredients, interaction that balances air quality and humidity ratio at buildings is provided. Technologies that contain new and environmental innovative solutions are used with the use of hay bale as material and waste car tires for recycling.

Four wind tribunes, Living Machine®, waste treatment system, agricultural system, banking and currency systems, job opportunities up to 60 are available.

Britain's first ecological house technical booklet was created as a result of the experiences obtained here. Here, rich source of information about environmental experiences is aimed to extend with trainings. This is one of the important economic inputs.

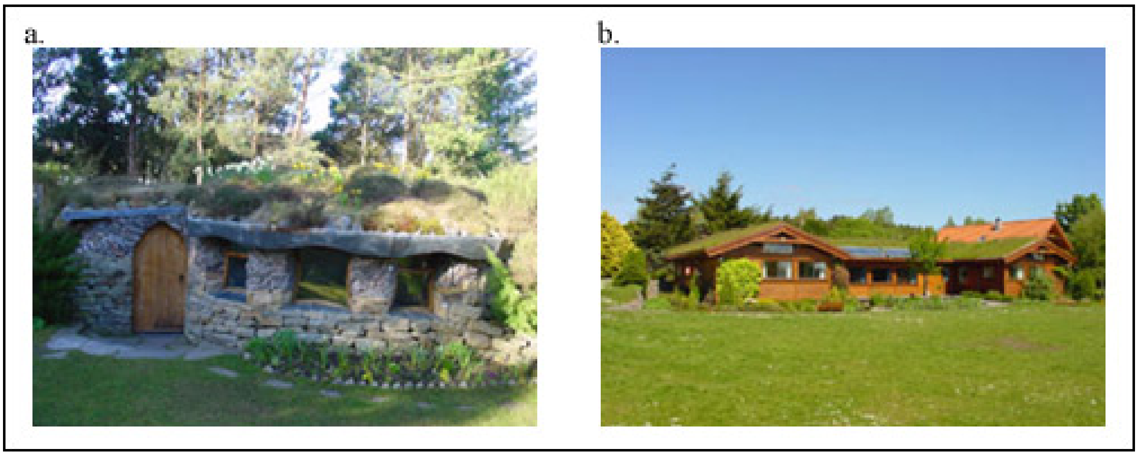

Figure 3.7. Findhorn, a. meditation house, b. a modern home

Ecological details in their buildings: use of passive air conditioning principles, use of solar panels for hot water, central heating system, use of super insulation, insulation low energy lamp, use of three layer glasses, cellulose insulation from recycling papers, use of non-toxic organic paint, wood coating with non-toxic adhesives, use of local wood and stone, roof covering with clay tiles, innovative „breathing walls“ provides air and moisture exchange, removal of radon gas coming from bottom by ventilation space through making wood flooring of ground floor and blocking to enter into the building, to reduce the electromagnetic field stress, isolating of electrical circuits, water saving, collection of rain water and usage in garden, use of common space (bathroom, kitchen dining rooms), simple wood-frame systems for those who want to apply their own, and use of the details [14].

Example structures Meditation Hall

Figure 3.8. Meditation hall

Table 3.1. Datas of meditation hall

Area	20m ²; it has a circular plan fit for purpose, recycled materials have been used
External wall	Curved, externally coated
Roof	Garden roof
Insulation	From stone wool
Heating	It is realized with "heat storage at night" system

Figure 3.9. House example I

Table 3.3. Datas of Example House I

Area	149m ²
Structure	Column-beam construction
External wall	From raw black pine
Roof	The roof is natural coated
Insulation	Heating is from ground with water, boiler works with LPG have sound-proofing at bedrooms, but does not exist between other rooms
Heating	It is realized with "heat storage at night" system

Figure 3.10. House example II

Table 3.4. Datas of Example House II

Area	175m², four room house, in the form of octagonal
Structure	Steel framed timber construction
External wall	Wooden
Roof	Zinc-coated
Insulation	From paper
Heating	Sith wood stove at the centre, hot water is from solar panels at roof
Features	Sound insulation and corner sink is not good

Figure 3.11. House example III

Table 3.4. Datas of example house III

Area	110m², 155m², 85m²; bedrooms three, three, two
Structure	Wooden construction
External wall	External walls are pine coated
Roof	Zinc-coated
Insulation	Wood boiler, central heating, solar thermal panels
Heating	Wood stove and solar
Features	Sound insulation is not good in spite of structuring is according to the passive air conditioning, insulation and heating systems are resolving good.

3.7.2. Auroville

They won the award of "sustainable energy" on Ashden Awards the known as the Green Oscar due to the projects they performed on renewable energy and forestation activities.

Town was designed by French architect Roger Anger before its establishment in the 1960s. Then a reconstruction plan for the city of 50 000 people was prepared. The symbol of "conversion" was used on the city design. Towns were created upon surrounding of 13 villages. Matrimandir District was located at the central point of city. Matrimandir is a structure with gold color coating and contains a crystal ball of 70 cm inside. This symbolic structure in the middle of the city is also called as "Peace Area".

Figure 3.12. Houses

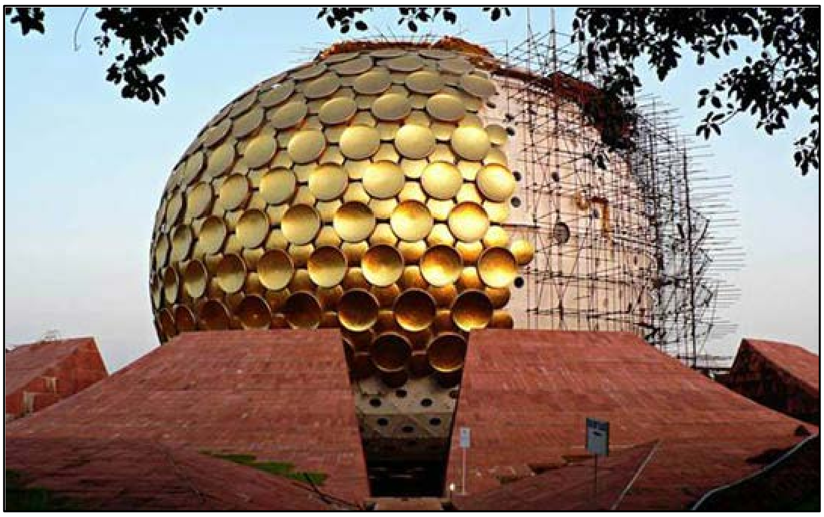

Figure 3.13. Matrimandir [25]

Town is consisted of four zones as residential zone, industrial zone, cultural and educational zone, international zone.

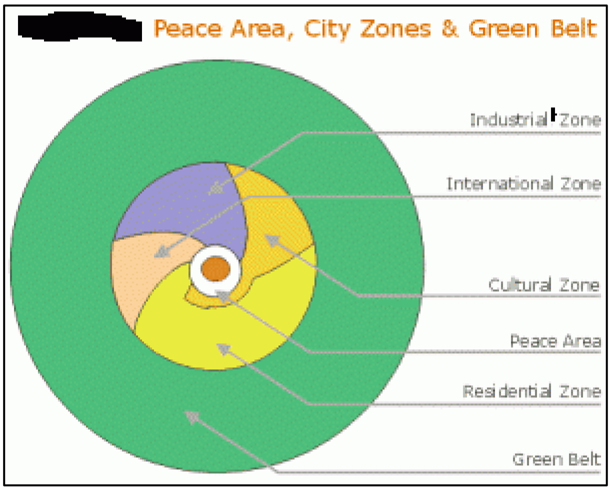

Figure 3.14. Thematik layout [15]

A green belt in thickness of 1.25 km was created with forestation. In this way, negative effects of the other cities or plants around to the ecosystem of the town are prevented. Kuilapalayam Zone has been used as social central region in design. Health centre, guest houses, shops were founded in this region.

Figure 3.15. Aurovill site plan [15]

In construction of individual houses, community houses, apartment and hostels located in town, various local and natural materials as well as reinforced concrete components are used. Various living spaces for individuals or families in the community areas and kitchen for common use in many places to create a collective awareness is available.

Large part of the energy need of town is provided by electricity generated from renewable energy sources. Photovoltaic solar power systems established at houses and open spaces provides alone a total renewable energy production which is almost 15 per cent of India's through a variety of renewable energy applications such as parabolic focusing thermal solar tower, wind energy systems, methane gas collection units, solar and wind powered pump irrigation system, solar ovens that are installed in public. Energy need of more than 150 houses is provided by photovoltaic solar energy systems and wind tribunes of more than 30 are available in town.

A model of integrated urban planning concerning not only energy, but also consumption and disposal has been sited. Systems that recycle utility water, collect and prepares for reuse of rain water, which are encountered frequently in modern eco-friendly buildings are available. Often facing the world; use the juices back into, the rain water that collects and prepares. Undoubtedly that there is a treatment plant in a village so large. However, wetland model natural living treatment systems that not required of million dollar investments are available in this treatment plant. In this way, a large part of the water is recycled and compost production is possible from organic household wastewater.

Transportation is mostly provided by cycling. Paths for cycling and hiking are largely arranged in urban planning. Goods needed by town are produced in various production centers. Practices of natural agriculture in large areas as well as organic agriculture in some areas are performed. The barren and neglected area before the town was constructed today has been converted into a large forest [26].

Figure 3.16. Arati house III

Table 3.5. Datas of arati house III

Area	Ground + two
Structure	RCC frame
External wall	Cement plastered brick, hollow clay bricks
Features	Vermiculite fill with cavity walls is available for thermal insulation in north, east and west walls. Sound insulation is on the intermediate floors. Anutone sound panels are available for sound insulation at balcony exits. Rubber padded clamps at all bottom pipes are available for sound insulation. CPVC, copper for long life tooth with PVC pipes. Waste water system: treated water for ventilation integrated turbulence with anaerobic treatment system. Irrigation pipe network for usage of treated water. Rainwater collecting: Passive rain collection, flow routing into seepage ponds.

Figure 3.17. Swayam residences

Table 3.6. Datas of swayam residences

Structure	resistant to third grade earthquake zone, local, sustainable and less energy-intensive
Roof	terra-cotta roof elements
External wall	dike and filling floor
Features	design and orientation for maximum ventilation and natural light

3.7.3. Güneşköy

Güneşköy Cooperative was founded in Ankara on September 21, 2000. It has 84 decare lands in Hisarkoy located in Kirikkale Province, Yahsihan County. The number of members is nine. Güneşköy is a member of the European Eco-villages Network (GEN-Europe). It is a non-profit organization. It aims to develop and share living experiences that are sustainable and compatible with nature in the countryside.

Workspaces of Güneşköy as follows:

- It is engaged in ecological agriculture and generalizes, uses the local seeds and lets it to be shared.

- It makes studies for the use of renewable energy sources.
- It implements ecological architectural design and applications compatible with nature.
- It works for the development of ecological transport systems.
- It works for the repair of damaged natural structures.
- It works for rebuilding of corrupted natural balances.
- It works for efficient use of resources by improving recovery systems.

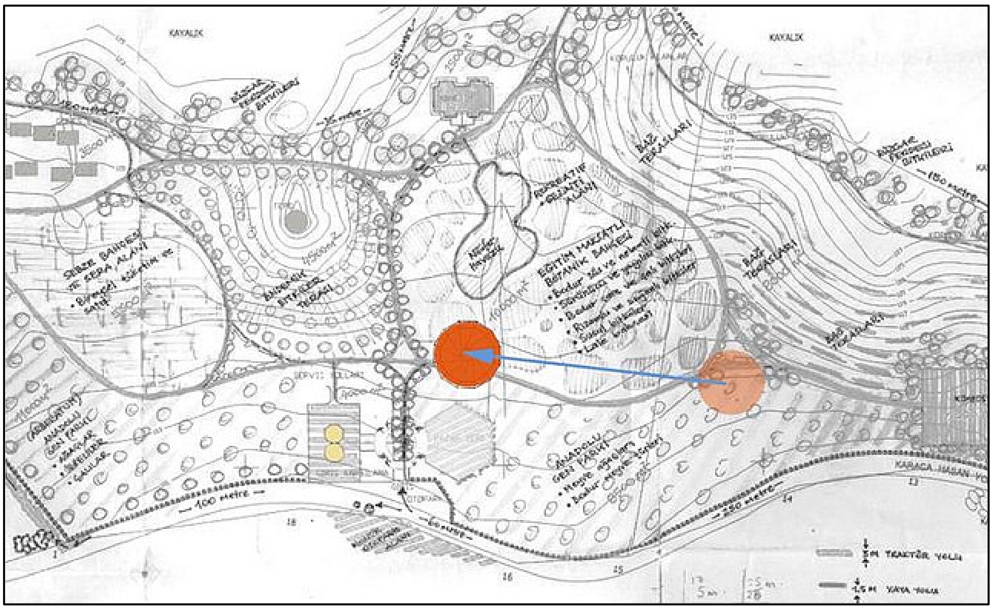

Figure 3.18. Güneşköy meeting room layout

1. Enhances natural life; it makes scientific studies in every field such as philosophy, styles and technology and organizes events " to enhance the way of life in accordance with nature". It enhances a lifestyle at peace with nature. It makes social life compatible with nature. It raises awareness of living together with nature by teaching individuals and communities. It enhances and implements practice of social life for this purpose. It enhances natural treatment methods such as herbal, solar rays and bio-energy, performs protective health applications. It performs natural, cultural and artistic activities. It supports and enhances original inventions necessary for natural life. It helps the development of natural arts. It arranges social, philosophical,

artistic, educational activities to promote the ecological life. It establishes and operates cultural centers with the aim of improving the natural life and.

2. It produces and markets natural food, makes ecological sample agriculture, organizes activities for the storage and if necessary for marketing of the products: It produces clean, healthy, hormone-free, chemically uncontaminated organic food and products, it sets up appropriate agricultural, social and economic systems for sample production. It makes production of fruit and vegetables with ecological agriculture and it evaluates products with ecological methods. It enhances fighting systems to pests and natural fertilizer in agriculture and provides the necessary tools and equipments. It opens promotion and sales locations of ecological products, promotes, can make import and export.
3. It enhances and implements renewable energy systems: To prevent environmental pollution, it makes researches related to solar energy and its variants (wind, biomass, water), develops technologies. It raises awareness of avoiding unnecessary energy consumption to partners and society. It takes advantage of solar energy in buildings. It uses solar energy systems to provide heating, cooling, lighting, ventilation, hot water for buildings. It sets up solar, wind, biomass, water (hydraulic) systems for electric power generation. It benefits from natural energy methods in cultivation, drying and storing for long term consumption. It develops, produces technologies related to energy, makes scientific studies, makes them done and commercializes.
4. It creates Healthy Living Environments: It creates natural and healthy environments against contaminated environments. It provides or creates land to accomplish this goal. Nature makes layouts compatible with the nature. It enhances the opportunities of utilization from solar energy in maximum. It uses natural materials in buildings. It takes advantage of the solar powered natural heating and cooling systems. It performs and implements sample layout and projects. It establishes and operates project consultancy and implementation units.
5. It enhances the natural transportation systems: It uses natural transportation systems as far as possible rather than artificial transportation systems that make noise, pollute the environment, poison the atmosphere. It forms settlement according to the principles of natural accessibility. It takes prohibitive measures to enter the contaminant motor vehicle into the settlement, produces solutions. It gives priority to

use of pedestrian, bicycle and public transportation. It exhibits the solutions produced, aims to create positive examples.

6. It Refreshes Nature Again: It makes the necessary works for the re-establishment of natural balances deteriorated. It makes sample works to regenerate and transfer to the next generations the original types of plants and animals disappeared. For this purpose, it implements and operates Botanical Park and Plantation. It efforts to protect national and local plant and animal genes.
7. It Enhances Recycling Systems: It takes precautions against polluter systems. It enhances and implements the systems of recycling and re-usage.

Figure 3.19. Construction stages of the meeting room

Table 3.7. Datas of meeting room

Area	20m ²
Structure	Timber frame
Roof	Wooden
External wall	Hay bale
Insulation	Adobe finish

Table 3.8. Comparison of two ecological villages from Global Ecovillage Network and one ecological village from abroad in the context of ecological village criteria, ••• good •• reasonable • fail

	Güneşköy	Findhorn	Auroville
Social Structure	•••	•••	••
Architecture	••	•••	••
Energy	•••	••	•••
Ecology	•••	•••	•••
Transportation	••	••	••
Waste	••	•••	••
Education/Health	•	•••	••
Economy	•••	•••	•••

Although settlement and living purposes of local and overseas examples are similar according to ecological criteria, all of local settlements have been established and maintained with a singular family or a small number of volunteers.

4. ECOLOGICAL VILLAGE CRITERIA

4.1. SOCIAL STRUCTURE CRITERION

The social aspects of eco-villages involves the creation of an environment that supports the desire to spend more time with each other and the development of the individuals both individually and as a part of the group. Eco-village is an environment that is small enough for everyone to feel authorized. In the Western world, the voice of the individual is usually not heard among the industrial matters, excessive communication and colossal political plans. In an eco-village, this voice is quite strong and clear. People can participate in every decision that will effect their lives and their society that they can monitor clearly. Eco-villages provide a loving environment for children where they can be included in daily tasks such as gardening and construction. Therefore, children gain experience that makes them gain various competences. Acting as a responsible member of society reminds them of their position in the society. Usually eco-villages promote a balance between the personal freedom of people and their responsibilities to others. It enables people to learn creating free and goal-oriented creations and to meet the needs of the society they live in as well as individual's own needs. [23].

The meaning of the society is:

- To be aware of other people and be in a relationship with them
- To share common resources and mutual aid
- To learn to make right decisions and to solve conflicts
- To give special attention to the mental and preventive health implementations
- To provide meaningful work and satisfaction to all members of the society
- To let the integrated life to be provided for the children and adults
- To assist the development of lifelong education
- To encourage the unity and integrity by respecting diversity
- To encourage the expression of cultures
- To implement green economy

4.2. ARCHITECTURAL CRITERION

In this section, alternatives to reduce the ecological footprint in terms of the construction technique are analyzed. Insulation and passive design measures to reduce energy needs, energy needs are met from sustainable sources, recyclable, natural, and in close vicinity to the use of materials obtained from the environment by reducing carbon emissions impact and thus to reduce the ecological footprint applications are examined.

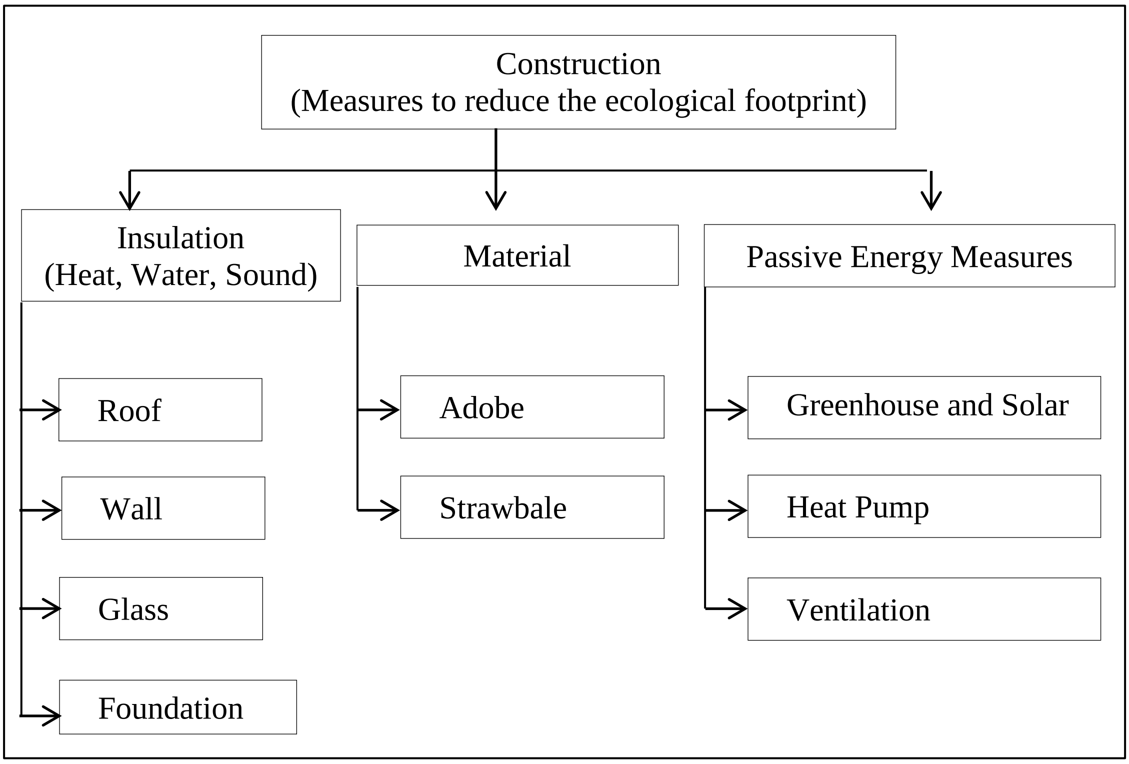

Figure 4.1. Systematics of constructional measures to reduce the ecological footprint

4.2.1. Isolation

These are the applications done to protect the building against the negative effects of heat, sound, water, to prevent the spread of harmful radon gas and to take precautions against fire. Up to 50 per cent energy can be saved in buildings with better insulation [4]. This means less greenhouse gas emission.

In our country, since 2010, it is obligatory to get energy identification certificates for the buildings according to the legislation on energy performance in the buildings. Today the energy consumption used in white goods also applied to similar buildings buildings' heating, cooling, domestic hot water and lighting purposes, depending on the efficiency of energy use A, B, C. carrying values of certain documents, such as classes that are organized. For example, a Class A document means that the building is energy-efficient and with low greenhouse gas emission. For the construction permit of the new buildings, Energy Identification Document is required. Construction permit is not given for the buildings without a Energy Identification Certificate. Buildings with good notes such as A and B in these reports given to the buildings shall have advantages. Immediately begin implementation of Energy Performance Certificates in new buildings, existing buildings up to the May 2nd 2017 are required to have Energy Performance Certificate. Energy Identification Certificates are given by the energy-efficiency consultant companies. Insulation is obligatory for all buildings other than the detached buildings smaller than 100 m^2 [30]. In a building, 60-30 per cent of the energy is used for heating and cooling [27]. Warming up for people to spend a minimum of energy, space available in the form of heat lost and heat bridge is intended to avoid interruption of heat insulation. Heat bridge is transfer of heat from an environment to another by building elements connected to each other without insulation as in figure 4.2..

Technically, thermal insulation is applied to reduce the passage of heat between two media of different temperatures. a comfortable living; 20-22 ° C temperature and relative humidity of 50 percent may be possible in environments that have a value. Energy losses in the winter, in summer the unwanted energy gains occur. In order to obtain the desired comfort in the building, the lost heat in winter must be compensated with a heating system and the heat gained in summer months must be transferred from the inside to outside with a cooling system. Both the heating and cooling processes consume energy. The process to limit the heat loss and gain in the buildings and facilities is called the "thermal insulation".

Thermal insulation of the building to extend the life by making the user a healthy, comfortable spaces and buildings provide the biggest gains in the use phase is possible to supply the fuel and energy spent on cooling [28].

On the one hand by increasing insulation, windows and other passive measures by selecting the appropriate reducing heat loss by taking the other hand, more efficient boilers, better control systems, thermostatic valves and reduce fuel consumption by using more efficient Equipment [29].

Thermal insulation project, the building materials used in the surface of the heat lost, in the sequence are elements of these materials, thicknesses, staff areas and the "U (heat transmission coefficient)," values must be specified. Heat loss, heat gain, gain/loss rate, gain utilization factor, the size of the monthly and annual heating energy demand, given TS.825 standard "building specific heat loss" and "annual heating energy requirement" should be given the form of charts, calculating the annual heating energy requirement indicated as appropriate. The type of the glass and frames used in the windows systems of the exterior, each window area for each direction and "U" values must be stated. Wall-window, wall-ceiling, wall-floor joints must be shown with drawings [30]

To provide thermal comfort, the temperature difference between the ambient temperature and the wall inner surface temperature should be lowered. This difference must be maximum 3°C for a comfortable environment.

Table 4.1. The effect of the temperature differences between indoor environment and the internal surface temperatures

ti-tiy	Comfort Status
2	Very comfortable
3	Comfortable
4	Not very comfortable
6	Not comfortable
8,5	Cold
>8,5	Very cold

If the internal surface temperature is low, the transfer of the heat in the environment to the cold surfaces create air currents. Water vapor produced in the internal environment has the potential to damage the buildings. Water vapor moves in the same direction with the heat current because of the pressure difference, passes through the pores of the building element and tries to reach the outer environment. During this passage of water vapor through the building element, if it is in contact with a surface with the saturation or a lower temperature, some of the vapor evaporates and becomes water. It accumulates in the construction elements and impairs our comfort. Condensation may occur in the inner surface or in construction elements.

Absence of condensation is provided by the protection of the construction element from external climate conditions, i.e. exterior thermal insulation systems. Thus, it is ensured that the construction components stay on the warm side of the thermal insulation and above the condensation temperature. Therefore, the harmful effects of condensation (shedding, blistering, rust, wood rot, etc.) are prevented [28].

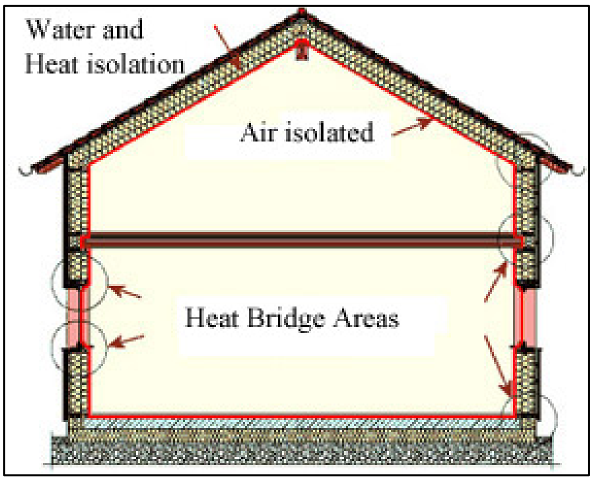

Figure 4.2. Thermal bridge forming areas [31]

In the buildings where thermal insulation is applied in a way not to create a heat-bridge (Passivhaus), precautions are taken in order to prevent the loss of current heat by ventilation. Heat recovery ventilation units with heat for comfort and fresh air enters and taking the temperature of exhaust air from seeping into the content are provided for entry (Figure 4.2) [32].

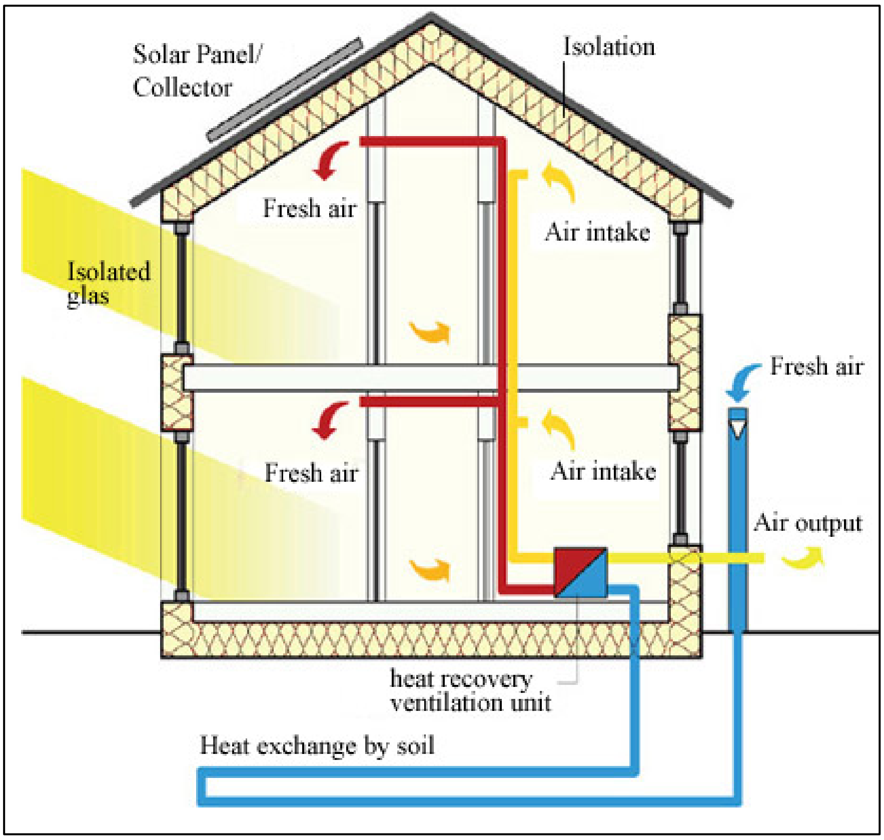

Figure 4.3. The active ventilation [32]

4.2.2. Material

Two materials that are widely used in eco-villages and for which the resource is low:

- *Adobe*; even though it is the traditional construction material in our country, the use has decreased however it is seen that in many areas the suitable soil is available and that it is used with the modern technology.
- *Straw bale*; even though its use as a construction material is not older than 100 years, it is widely used as it has many advantages.

4.2.2.1. Adobe

In Anatolia, there are buildings constructed with "adobe" whose raw material is the soil. The use of this traditional soil construction materials still remains today and it is still being used in the buildings with its useful features that consumes low energy in its production and use.

Figure 4.4. An example of a modern building constructed with adobe in Turkey [33]

Preparation of adobe: it is prepared by mixing soil with water and adding binders such as straw or aggregates. The mixture is crushed into a mud mud is poured into the wooden molds in adobe shape. The mud must be compressed thoroughly after it is poured into the molds. The upper part of the compressed mud is leveled and excessive mud is removed. Then the mold is pulled out and the mud will stay in a flat place. It is left preferably in the shade first and then in the sun. To dry both sides of the adobe, the sides left in the sun should be changed every now and then [34].

Figure 4.5. Preparing the adobe mixture and pouring it into the molds [35]

Properties of the adobe soil: the use of soil as adobe is possible only when its granulometrical, mineralogical and chemical structure is known. The features of the clay, which is the binder for adobe and its particle size ratio are important. Examination of the material used in the building of the most important features of adobe, compressive strength, water resistance and loosening effects of the atmosphere.

TS 2514 at an average compressive strength of adobe 1 N/mm2, TS 537 at the cement-adobe should be given 1 to 2.1 N/mm2. In general, compressive strength of adobe, adobe soil type, water content, rates of herbal supplements, molding methods (compression), drying time, changing the amount of substance used as a binder. If compared to the physical properties of materials determined by a variety of adobe masonry, good for heat insulation and lightweight, water is under the influence to obtain favorable outcomes in terms of dissolution [36].

Features of adobe:

- Adobe balances the humidity of the environment
- It is positive in terms of thermal insulation and lightness.
- As the humidity does not exceed a certain percentage, insects do not live in that environment.
- Adobe cleans the interior air.
- There is no need to use fossil fuels to create adobe, its energy consumption is low.

- Adobe has no radioactivity.
- Adobe does not pollute the nature.
- As adobe is produced in the construction area, there is no transportation expense.
- Adobe preserves the wood.
- In the adobe construction system, rules of the piling construction methods are applied.
- As adobe is not durable against water and humidity, necessary precautions must be taken [33].

Traditional adobe construction materials are adobe bricks and mud plaster.

Adobe brick: at the end of time that the mud can hold itself, the mold is pulled off and the mud remains on a flat surface. Cut adobe is left in the sun. To dry both sides of the adobe, the sides left in the sun should be changed every now and then. Ensured that it is dried quickly. In this way, the adobe is laid in the sun. Once the front side is dry, it is turned to dry each side. The process to cut adobe is finished and the adobe is ready to use in 5-6 days depending on the weather. This should not be done in the rainy season. Impaired parts are renewed every year [33].

Although there are differences according to the regions, the most widely used adobe dimensions are:

- Length: 30-35 cm, width: 15-17 cm, height: 10-12 cm.
- Sometimes the half-size adobe is produced as well:
- Length: 30-35 cm, width: 15-17 cm, height: 10-12 cm.
- Bigger ones are called mother and the smaller ones are called the lamb [37].

Mud plaster: it is the soil diluted with water to product mud. It is applied as a thin layer on the adobe wall. It is such a thin layer that the texture of the brick wall can be seen through the plaster. It is protected by the application of lime whitewash. Plaster and whitewash must be renewed every year [35].

Industrial adobe construction materials are adobe panels, mud plaster, rough cast, fine plaster, rough plaster, mortar plaster, compression adobe wall, adobe brick block.

Adobe panels: it is applied in the interior divider walls, suspended ceiling applications, wall coverings, as an interior wood and steel beam structure coating material, ceiling and roof coverings.

Figure 4.6. Adobe panel walls [38]

Mud plaster: today, the use of mud plaster has increased because of its effect of the mud plaster on the climate of the environment and aesthetic concerns. The mud plaster balances the humidity in the air by exchanging and remove the odour in the environment. In order to provide this effect, its width must be at least 1,5 cm. In general, the new plaster is applied over the old plaster. The wet mud plaster must be well ventilated or must be dried by machine after its application. They are produced in different colours as shown in Figure 4.6.

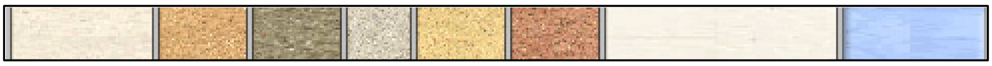

Figure 4.7. Mud plaster colors [38]

Rough cast - with straw: it is the traditional and the healthiest plaster for the air in the environment. Construction mud consists of straw (30mm) and sand. It is applied to a thickness of 35mm. ;

Fine plaster - with straw: has a rough upper surface. The top coating can be applied after that. Construction mud consists of straw (10mm) and sand. Applied to a thickness of 7mm-10mm.

Rough plaster-with flax: it is the topcoat application material. In general, it can be applied over many plasters. It consists of construction mud, sand and fine flax to strengthen. Flax cannot be seen on the upper surface. It is applied at a thickness of 2mm-3mm.

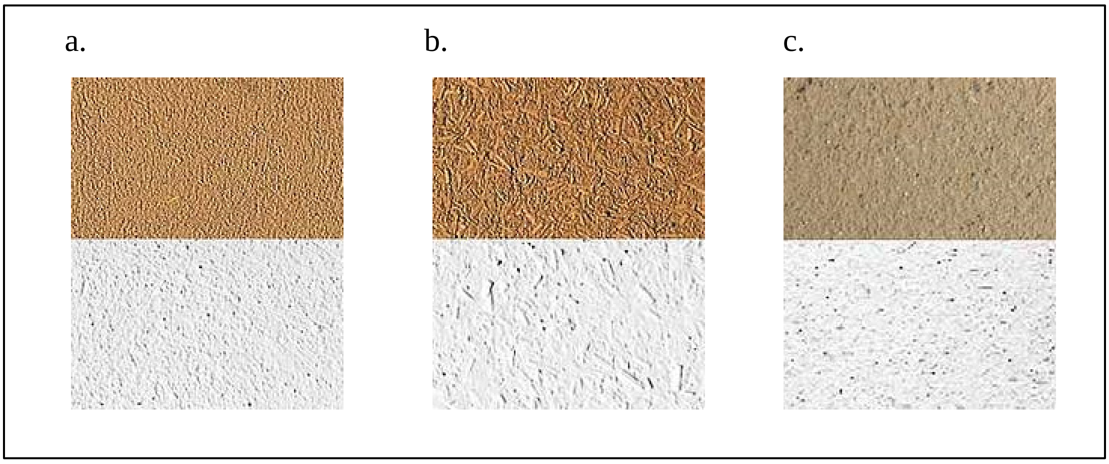

Figure 4.8. a. rough cast with flax, b. rough cast with straw, c. mortar plaster [41]

Mortar plaster: it is the ceiling and floor mortar. Mud plaster and mortars used in the interior is the pure soil converted to the construction material. It makes the interier look natural, provides a warm atmosphere and it has positive effects on the ventilation of the interiors. It is prepared by adding washed and/or crushed sand with the construction mud. It is applied at a thickness of 5mm-20mm on the floor and between 5mm-10mm on the ceiling.

Compression adobe walls: compressed form of heavy brick and block walls, brick walls, the effect is not disputable aesthetic and architectural re-use of modern building material and is provided as a design Ogres.

Figure 4.9. Compressed adobe wall [38]

Coloured surfaces with different textures are produced from the colour of the soil, without any additional colour. Again, aggregates used in this texture can be seen. Natural white, yellow, red, gray and natural clay colours are available [38].

Figure 4.10. Samples of natural adobe colour [38]

Adobe brick blocks are unbaked bricks.

Figure 4.11. Adobe brick blocks [38]

Alker (Gypsums Adobe): it is a type of adobe with 10-20 per cent gypsum added to the adobe soil. Its physical and mechanical properties are superior to the normal adobe. The gypsum added to Alker sets quickly and allows it to have the sufficient stiffness when the mold is pulled off. In practice, it allows the opportunity to be used without the need for labour and time period for drying and the allocation of a drying place. By quickly setting the gypsum, the shrinkage and cracks and changes in the shape are prevented.

In this study, which cost at least plaster, mud brick cement matrix formed easily seen attended by more easily, and also easy to be produced easily be anywhere in the plaster with gypsum as an additive to encourage the use of this material have been determined. In addition, experiments in pure mud bricks plastered shrink when dry than, disintegration and dissolution in water less, move more power, and to dust that was a much smoother surface. In this way, there is no need to add fibrous materials such as straw [39].

Plastered mud-brick construction of the wall can be used as a material (alker) in terms of building physics, climatology and structure meets the required level expected of an insulating material that does not need an additional opportunity to provide healthy construction material alone [39].

Measures to be taken for adobe: adobe material will not perform well when it is not used properly. That is why some of the design criteria for the correct use of this material is inevitable to take into account.

- It must be ensured that the building is simple square or rectangular and not have many indentations and protrusions.
- Carrier for at least 50 cm in the exterior walls, bearing internal partition walls, the thickness of 30 cm, 15 cm in non-bearing partition walls should be fine.
- Longitudinal and transverse load-bearing walls in the plan should be constant. The length of the single-span load-bearing wall should not exceed 5 m.
- The cavities in the exterior wall must start in 150 cm in the first and second-degree seismic zones and 100 cm in the third and fourth seismic zones.
- The door and window width must not exceed 100 cm even if the reinforcing cage is used. The share of seats should be at least 50 cm in the wall lintels.
- Full sections between the gaps must be at least 60 cm.
- It is useful to make wide eaves for the protection from rain. If it is planned to make the roof flat, it must be ensured that the ceiling beams must overflow the wall at least 40 cm. Other rules regarding the design and construction must meet the adobe construction standards, TS 2514 and 2515.
- In piling construction method, it is possible to use the adobe material or the alker on the walls as a carrier block or plaster and on the floors. However, for a successful application it is obligatory to know and fulfill the usage information.
- As adobe is not resistant against water or humidity, stonewalls are suggested as the base material. A wall must be put with adobe bricks with a cage of about 10 cm on a base of at least 50 cm long from the floor.

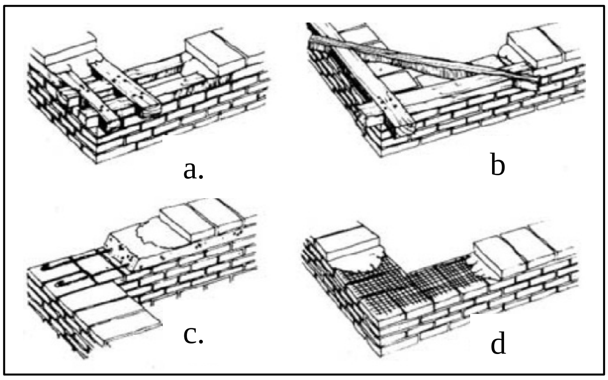

Figure 4.12. Examples of cages, a. half interlocking, b. half interlocking wooden cages at the corner connection, c. reinforced concrete cages, d. wire cages [39]

- Subbasement level of seismic zones in the corners and walls of reinforced concrete beams or joints to walk round a very good connection with the use of the wooden beams are essential for the stability of the walls.

It is the most important matter to protect the adobe used in the exterior wall from humidity. With this principle, the basic precaution to take for protecting from the water is to plaster every wall. Against floor dampness, the isolation application should be considered with the subbasement level cage. In addition, sloping the soil level to the opposite direction to block water from the wall, will extend the physical life of the adobe.

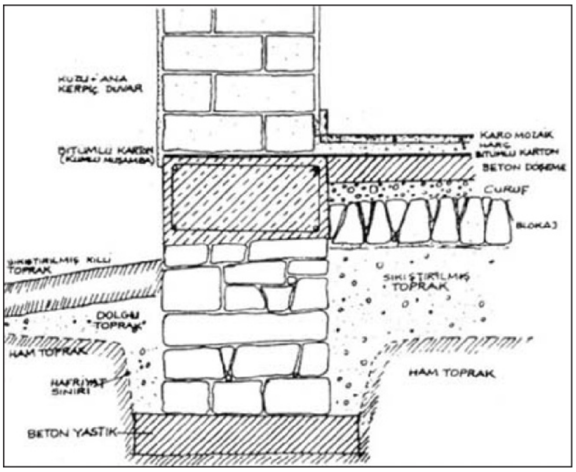

Figure 4.13. Compressed sand and stone on the top of foundation wall the wooden cages [39]

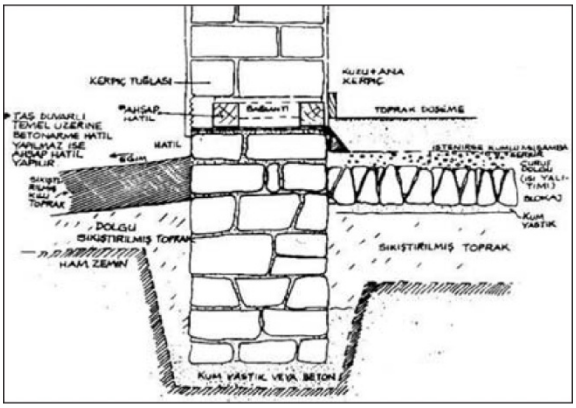

Figure 4.14. Reinforced concrete beams at the top of the stone foundation wall, and correction [39]

There are two ways to build an adobe wall:

1. At the most common component level, the production of wall blocks by molding adobe clay
2. Wall production is conducted at the personnel level as on-site pouring. Arrangement system is very important in building with the adobe blocks produced at a component level. To build load-bearing walls, 1 brick mother, 1x1 brick lamb or l,5 mother-lamb. Lattice with a brick-thick brick walls of a number of other no-1 as well as the arrangement of the bond brick. Brick size for the series bricks in the arrangement with a width of 1 brick must begin with ¾ brick length. Switch to the corner stud walls and cross-connections should be checked properly.

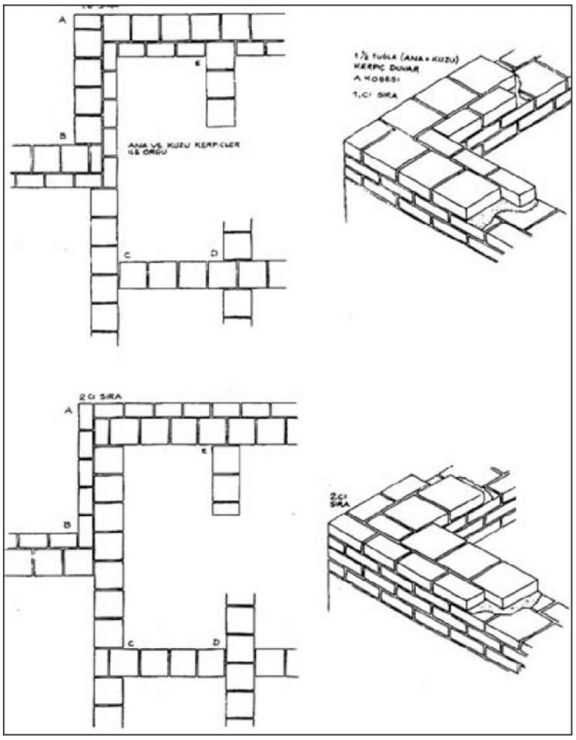

Figure 4.15. Example of adobe wall arrangement and corner view [39]

- Clay plaster on the exterior plaster applied to brick walls, plaster types of soil suitability should be tested and then covered with limewater should be protected from over. The high adhesion amount of the plaster to be applied on the wall depends on the clay amount in the soil plaster. Both for the proper adhesion of the plaster to the wall and to prevent the capillary crack that may occur, fine straw, cotton waste, gypsum, gypsum-lime or cement may be added to the soil. In addition, the interior surfaces may be plastered with lime or a mixture of gypsum-lime. A mixture of mud plaster wall plaster to adhere well to be good not only in the surface grinding plaster should be prepared at the same time; brick wall built of blocks, the joints will be beneficial for a small amount is left blank, but the good adhesion of the plaster made of mud brick wall casting method will open the holes spaced, flat crashed stone or tile fractures is necessary to create an uneven surface.
- In joinery, creating a gap in the window above and below the window, creating a gap in the door of reinforced concrete or wooden lintels above the door and even put them into a continuous flanks are essential for the stability of the structure. Wooden flanks must be connected with at least 10x10 cm square timber, cement flanks with

15 cm length 4xØ10 - 4xØ8 iron equipment and min. 25-40 cm spaced Ø6'lık reinforcement binders.

- As the walls made with adobe are thick, it is possible to place the window-door frames
- In the interior-exterior and middle of the wall according to the climate conditions. For opening holes for the windows and doors, the earthquake and adobe construction standards must be followed.
- If a ferroconcrete or wooden flooring is going to be made, ferroconcrete/wooden cages must be placed on the adobe/alker cages. Water in the flooring of the wet volumes must be accumulated in a place further from the wall outside the building and water leakage in the flooring-wall junctions must be prevented. Cement-like soil plaster must be used for the tiling and such applications on wet volumes to be made on the wall tiles in wet areas and used a clay plaster.

Roof arrangement over the adobe wall could be made in a traditional or a modern system. Concrete or wooden frames could be placed on a wall made with compressed alker (Figure 8). While making the roof, measures must be taken to prevent the rainwater impair the wall surface One of these measures is to increase the roof flooring and create a parapet wall. In Anatolia, parapet wall is also called enticer wall. In addition to the measures to be taken during construction of the roof against water, a gargoyle could be made to get the water flow from a certain point. The gargoyle mouth must start at a point a bit further than the parapet wall and the gargoyle water must be transferred to a very far point from the wall [39].

4.2.2.2. Straw Bale

Straw buildings are constructed with ecological materials. As local facilities are used, the transportation expense is low and it causes less air pollution. It is a source that can be found in plenty numbers in our country, in the grain production areas, from the stems of products such as wheat, oats, rice, barley and that can re-grow every year and is a renewable resource [40].

Features: A wall made of straws can be fixed very easily. Being able to build a house easily even by someone who is not a professional without the use of tools, promotes creativity. Buildings built with straw bale are described as "breathable". And this is an important feature in terms of structural biology and the quality of interior life. As it can be applied easily and quickly, it is preferred in the aftermath of a disaster, especially in rural areas. In this technique, buildings are usually built in as one-story. There are also examples of multiple-stories. Instead of transferring the shock of an earthquake to the roof, straw bale wall can absorb the most of the shock. Plaster strengthened with wire also contributes to this seismic tolerance [41].

*Construction techniques;*basement floor is not built in houses made of straw bale.

*Piling;*blocks of tightly packed straw bales enables the construction of multiple stories without the need for horizontal and vertical supports (frames and pillars). Exterior of the straw bale walls are usually plastered with a cement plaster and the interior is plastered with lime plaster. It is usually square or rectangular planned. The advantages of this system can be summarized as that the design and construction is very easy and that it is possible to save on money, time, material and labour. But the design constraints (unavailability of a very heavy roof cover), the necessity of a flat and dense straw bales, walls, roof without plastering, waiting to get used to the load requirement, are among the disadvantages of this system.

Frame structure; in this technique used in the construction of large areas, straw bale is used as the filler material of the system, which consists of frames and bays. In the skeleton built to support the roof, straw bales carry only themselves. Wooden structured frame carries the entire weight and transfers to the base. A well-established framing system allows for a multi-story straw bale structure. Upset over the system of two ties to be available in low-density bales, sizes, locations and openings to easily set the number of bales can be made, like the weight of the roof to be independent of other design constraints are among the advantages of this system. But the time, money, labor, materials spend to build the skeleton and also the requirement for the complex base system to carry the bale filled walls are the disadvantages of this technique.

Mixed system; in the structural mixed system, wide bale walls and walls/framing systems built with different materials carry the upper coat. By using two wall types as combined in a design, the designer and the implementer can be saved from a series of disadvantages and limitations [40].

In all three systems, the straw bale wall must be protected from water and humidity. For this reason, the size of the roof must be big enough to protect the wall from the rain and the waterproofing in the junction places of the base must be done well. Protection against humidity, fire and insects is provided by plastering.

Figure 4.16. Application of straw bale, a. the basic construction of stone, b. preparation of the basic top frame, c. basic surface water insulation, d. plaster over straw, e. straw bale placement, f. gaps in doors and windows [42]

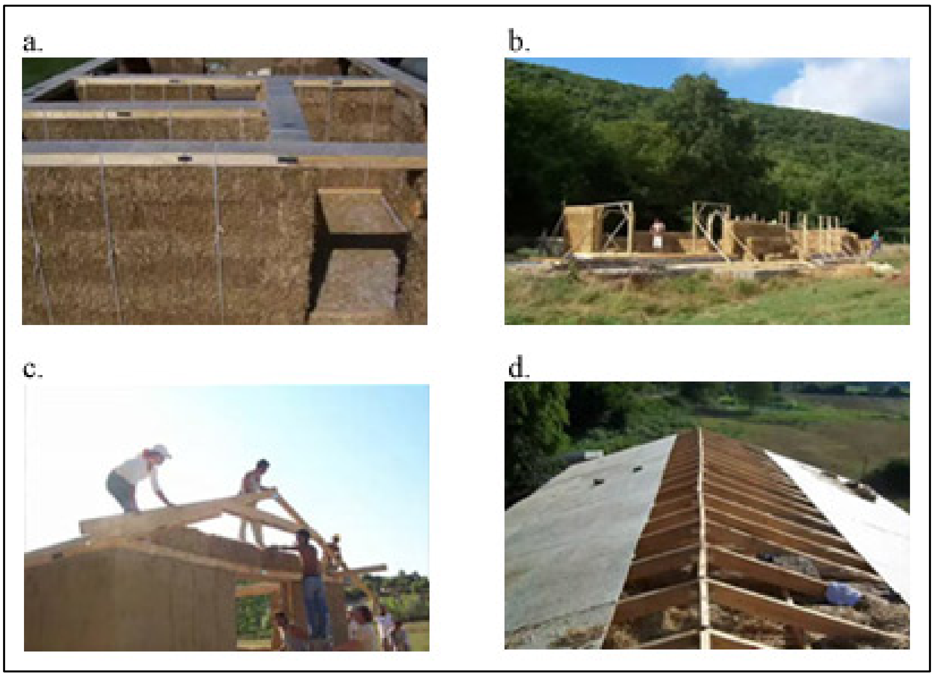

Figure 4.17. Application of straw bale, a. lintel, b. straw walls, c. roof truss layout, d. under roof straw insulation [42]

4.2.3. Heating/Cooling (Solar Architecture)/Ventilation in Passive Systems

It is possible to group design criterion for increasing "energy gain" and reducing "energy loss". In terms of energy gain, these factors come to the forefront:

- Location
- Positioning them towards south
- Using materials that store heat
- precautions for protecting from sun
- surface design that enables gaining solar power

As for reducing energy loss, these factors play an important role;

- Compact form
- Heat transfer coefficient of construction elements used in transparent and opaque surfaces (u-value) [43].

4.2.3.1 Greenhouse and Solar Walls

Some vegetables can be grown for household needs in the greenhouse part, added to the southern front of the house. At the same time, air coming from lower vent-hole will warm up, rise and returns to the house from upper vent-hole inside, therefore enables this place, that is warmed by solar effect quickly, to warm up even quicker (Figure 4.29). If upper vent-hole outside is open and the one inside is closed, this time air is drifted with chimney affect and absorb cool water from pipe ways on the southern front and therefore decrease room temperature.

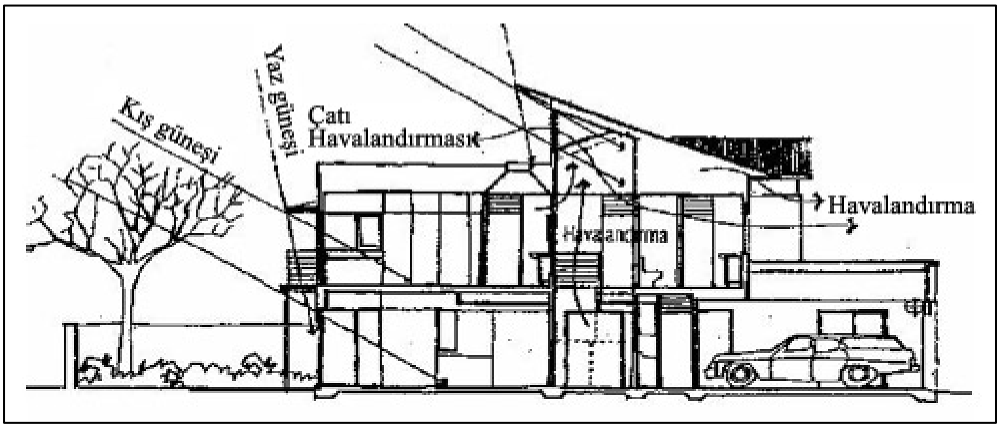

Figure 4.18. Natural acclimatization in Sydney Olympic village [44]

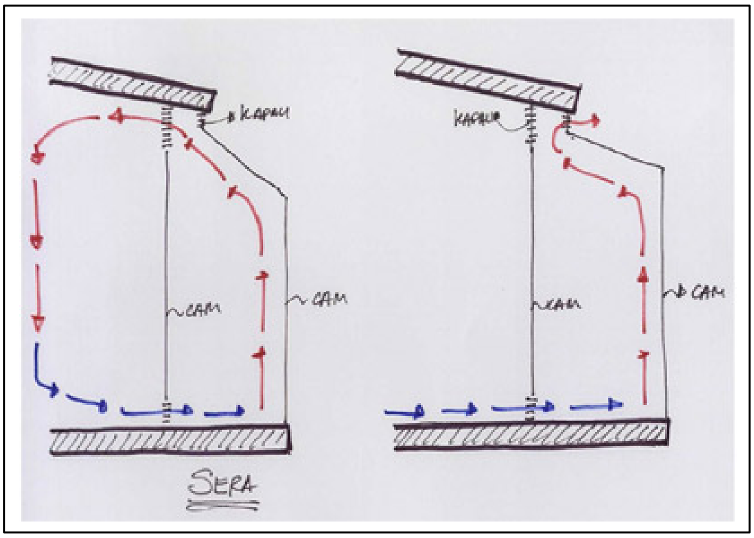

Figure 4.19. Air current in greenhouses [45]

Acclimatization during summer will be maintained with ivy and trees defoliating during wintertime that overshadow this area (Figure 4.18). Trombe walls used on the southern and western fronts will produce energy with the same setup. For instance, considering over heating effect of the wall during summer time, sand is used as thermal block and moved beyond isolated wall (Figure 4.20) [46].

Figure 4.20. Trombe walls of Diyarbakır solar house [46]

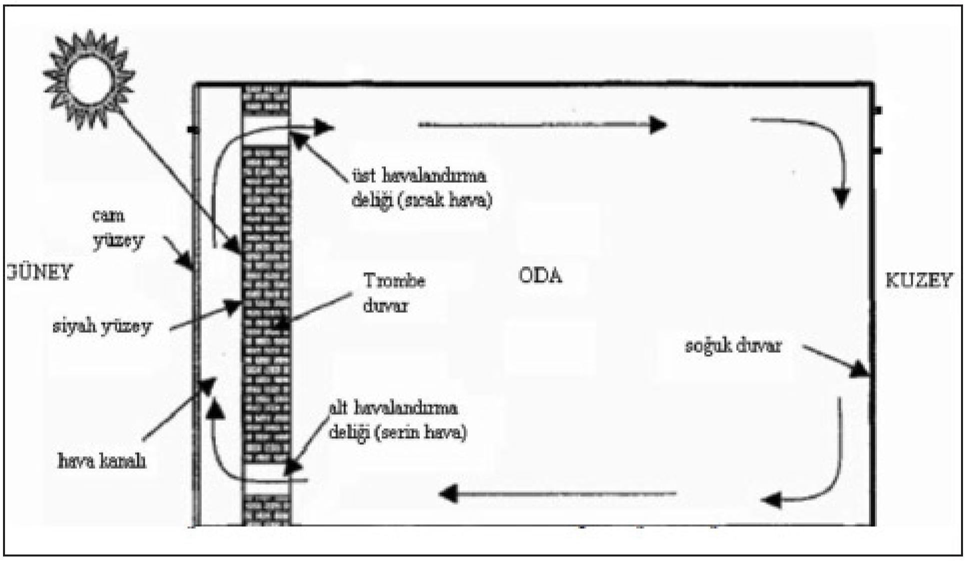

Figure 4.21. Operation manner of trombe wall in winter time

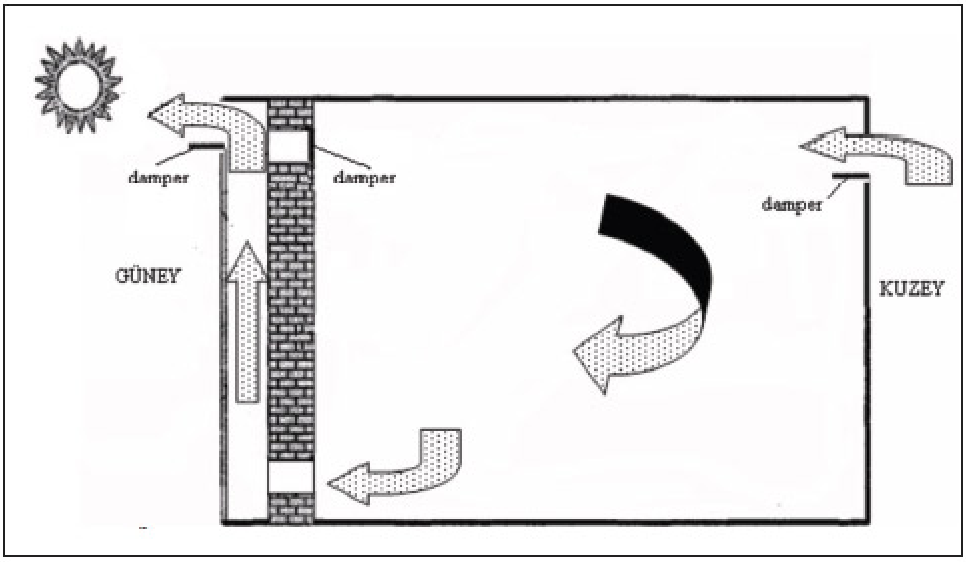

Figure 4.22. Working order of trombe wall in summer time

4.2.3.2 Heat Pump

Heat pump is a system that basically transmits thermal energy from one location into another, using electricity [47]. In terms of energy, heat pumps have great advantages. A minimum of 70 per cent of the heat requirement is supplied by renewable heat source. In other words, power consumption rate of energy to be used should not be more than 30 per cent. Soil maintains a source higher temperature during heating season and lower temperature during summer time for cooling, and, relatively, it has a stable temperature throughout the year [48].

Underground geothermal systems, using stable heat as a source, benefit from stable temperature and perform heating and cooling tasks. This system heats locations with low temperatures using stable temperature underground, and has a cooling effect by transferring heat to the surface during hot summer months.

In these systems, heat-exchanging pipes are laid underground that enables effective temperature change. This piping system is a must for an effective heating and cooling process. Liquid is pumped into this system, as a heat transmission tool must pass through this system and exchange temperature with soil.

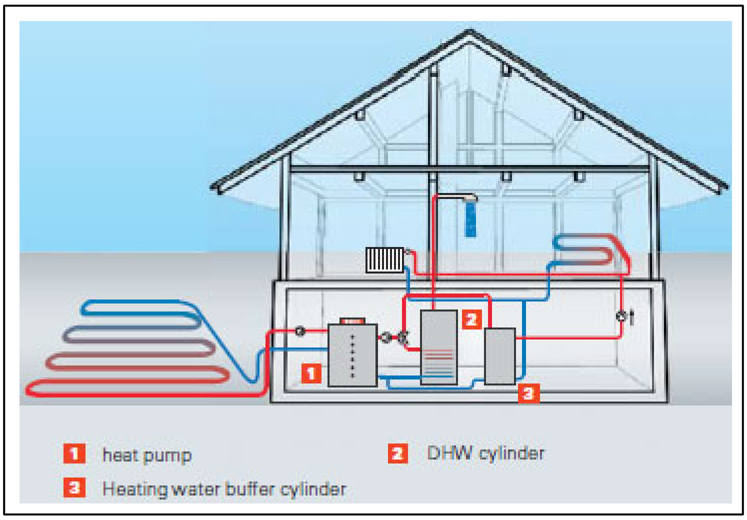

Figure 4.23. Absorbing heat from the soil with soil collectors

Pump system gives motion to the liquid inside the pipes transmitting heat and transfers them to indoors. It is used for both cooling and heating processes. Hot or cool air is taken from indoors and moved outside of the location (to the underground) through a series of heating channels. Therefore air filters and unblocked ventilations are very important. A clogged filter or blocked outlets cause a serious decrease in system's efficiency. Heat pump systems not only provide heat for indoors, but they are also used in hot water systems. A component named desuperheater transfers excess heat to water tank in geothermal heat pump system. This is an only one-season application since system cannot produce heat during hot months [49].

Heat pumps use four main sources. These are air, soil, water and solar power. First three of these can be used separately, and solar power is generally used as a complementary source.

Air is a universal, cheap and plentiful source of heat for heat pump. In addition to being plentiful, the biggest advantages are being used in every setting, reasonable size of equipment and low operation and facility costs. Two of the biggest disadvantages of air-born heat pumps are temperature change and icing problem. Frost formation occurs on heat converting surfaces at temperatures 0 ºC or below. It must be defrosted periodically.

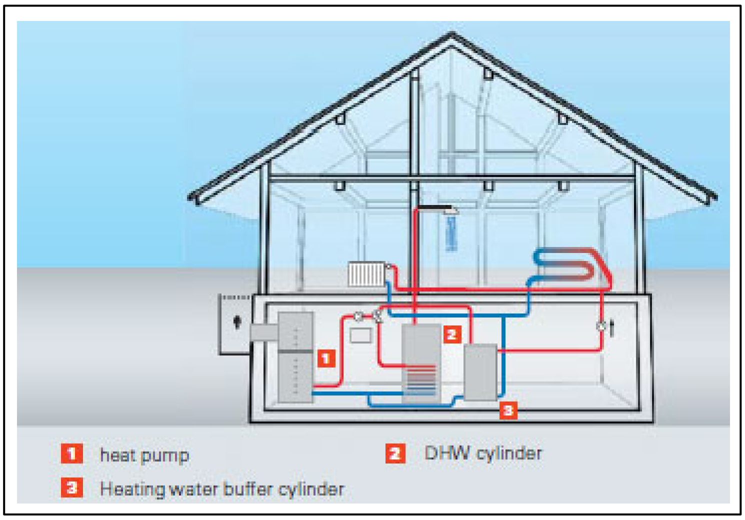

Figure 4.24. Producing energy from ambient air [50]

Air flows into evaporator through a channel and evacuated after absorbing the heat. Modern air/water heat pumps can perform heating even at outside temperature of -20°C. However, it does not supply heating by its own. On very cold days, heating water, preheated by heat pump, can be adjusted to the desired temperature with the help of electrical heater.

*Water*s heat change of underground in depths of 10m and more is minor throughout the year. Average temperature is 10 ºC. Depending on the location of wells and state of stocks, underground water temperature is between 8-12 ºC in wintertime and 10-14 ºC in summertime. An advantage of using water as a source is that level of heat transmission is higher in heat exchangers. However, heat exchangers must be made more efficient and compact.

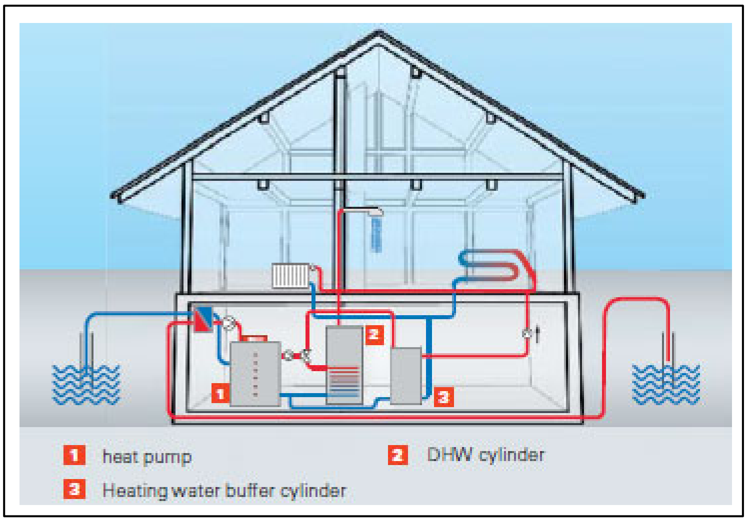

Figure 4.25. Generating energy from underground water [50]

Soils temperature change is no major throughout the year (in 1-2 m depth)

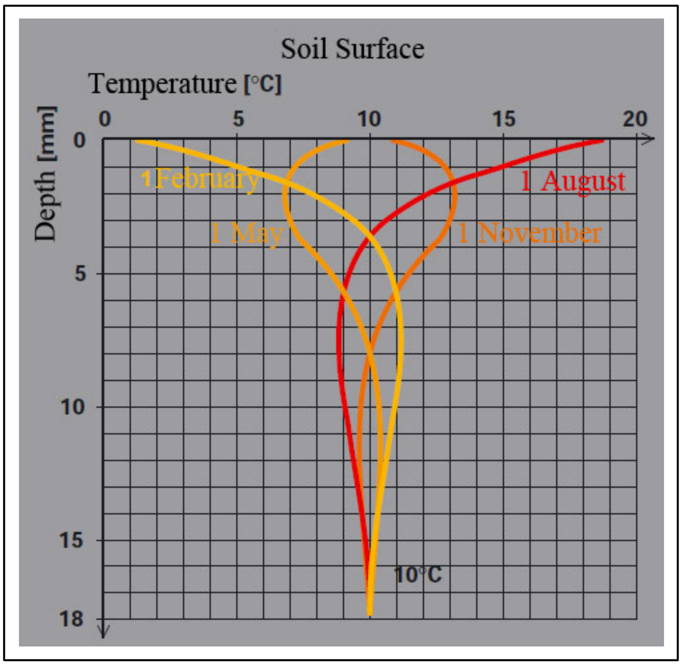

Figure 4.26. Annual underground temperature changes [51]

Solar power is the source of heat, as sunbeams are stored by soil throughout the year. Coolant or brine (which is more common since it is low-cost) are run through pipes laid underground. These heat-transmitting surfaces (soil heat exchangers) are positioned vertically or horizontally.

Figure 4.27. Producing heat with horizontal soil collectors [51]

Soil properties change depending on the time one of the reasons that create difficulties for project planning. Changes of soil properties from the moment the same way, the heat pump is running. For example, if the heat pump is made by heating the soil near the heat exchanger and the soil temperature drops. Therefore, the amount of moisture, and soil properties in this region varies. The return water temperature decreases, and that the same reason, both the capacity of the heat pump and directly affects the coefficient of the heating effect. Cold regions, the heating period, the average heat input, at least enough in the soil during winter because of heat transferred from the soil constantly, and threatened to freeze the soil.

Heat pump and cooling as well as some of the cooling or heating can heat pumps. Two methods are used to make heat pump cooling.

- *Two-way operations* of heat pump function is cooled completely, such as refrigerators are allowed to run.

- *Direct cooling* is anti-freeze or throw out the groundwater medium heat away. This function (called Natural Cooling) heat pumps, control panels and circulating pumps, except closed.

Sun's solar energy to utilize there are two systems. These are the direct and the most direct systems. In direct systems, evaporators are directly placed on the solar collector. In the most direct systems, water or water vapour is passed between the collectors and these are used as the source. However, like in the air source, as there is limited solar energy on the days when the heat is needed, an additional heating facility is needed or the heat must be stored, and this causes the system which is already expensive, to get more expensive.

YKIP (ground sourced heat pumps) has many benefits such as creating alternatives t the conventional heating and cooling methods, contributing to local air quality, helping to solve the problems of energy supply, reducing energy costs, providing design flexibility. On the other hand, it has some disadvantages such as the initial investment being higher and that the performance depends on the soil heat exchanger and the equipment [48].

It is divided into two; active and passive. Active systems consist of the collector, heat exchanger, the carrier fluid (water, air), the flow network (pipe or channel system), storage, circulator (pump, fan), and regulatory and control elements. Active systems are also connected with the external network. Obtains electrical energy from the outside when needed.

And passive systems are defined as the utilization of the solar energy by direct saving or storing the solar energy in the construction elements and utilization when needed.

Table 4.2. Source heat pumps in the design stages [48]

Selecting the building layout	Heat loss / gain of each zone is calculated. Zones of the building are grouped centrally or according to the multiple ground heat exchangers. In the design conditions, a heat pump is selected for each region based on the capacity and efficiency.

Table 4.2. Source heat pumps in the design stages [48] (continue)

Equipment selection	Discharge height, temperature range, unit type, volume, service status are taken into consideration. If applicable, water-borne water heating and cooling system is chosen. Elements of the ventilation system such as the channel, heat recovery, pre-conditioning serpentines are chosen.
3a. Ground sourced Heat pumps	Soil characteristics are determined (the test holes are made). Pipe type, size, hole separation, filling material are determined. Required hole diameter is calculated. Exterior collectors are designed. Air venting system is designed.
3b. Underground water Sourced Heat pumps	Of groundwater availability / quality is determined. The required flow rate of wells is determined. Out of the water is determined by the method of administration. Determined by the underground water-water heat exchanger.
3c. Sea water Sourced Heat pumps	Reserve flows, depth and temperature (high / low) are available. The size and type of serpentine are determined The required serpentine length is calculated. Exterior collectors are designed. Air venting system is designed. Reservoir discharges, depth and temperature (high / low) are available.
Designing the piping system of the building	The advantages of the central ground heat exchanger will be compared to the multi-heat exchanger. The line is determined to allow minimum loss of pressure and piping systems are designed. Heat pumps and separation valves on / off flow control are provided.
Determining the pumping and control method	The advantages of the central pump (pumps) will be compared to the multiple separate pumps. According to the pump characteristic curve, pumps (pumps) are selected to operate the pumps at almost the maximum yield. Uncontrolled, open / close control, multi-speed (or multi-pump), such as variable speed pump control options are reviewed. If it is greater than the 10 per cent of the total claim, the cycle pump power will be calculated and the system will be designed.

Table 4.2. Source heat pumps in the design stages [48] (continue)

Evaluation of other options.	to reduce the size of the required soil heat exchanger, more high-efficient heat pumps are used. To reduce the size of the cycle, cooling tower or fluid cooler is used. Vertical separation of drilling holes, or increasing or decreasing the length of the serpentine tube. Review costs of multiple cycles and pumps including the control costs, compared to the central cycles and pump.

4.2.3.3. Ventilation

By establishing a proper natural air cycle and building, ventilation could be provided that would not deteriorate the user health, would not consume energy, would not pollute the air and would not increase the costs. An active natural ventilation in the building is provided by getting the fresh air into the building, cycling through the building and removal of the dirty air from the building [52].

Wind scoops and Venturi funnels are simple units that can be used in every building from houses to the industrial facilities. The wind increases its speed when it is passing through a venturi like chimney with a narrow entry. It is ensured that this wind gets in the interior through the channel as clean and cool hair. And the warmed up and rose dirty air in the interior environment is removed from the venturi chimney by vacuuming. All the culverts in the tromp, greenhouse and venturi chimney can be manually opened and it could also be connected to the automation systems via the sensors tracking the air temperature and the wind [46].

Thermal insulation is applied to the rooftops, exterior or the walls facing the unused parts such as the garage, a warehouse of the building, to the soil, flooring dividing the apartments, plumbing pipes and to the the ventilation ducts. In addition, by using windows with special coated insulation units and insulated joinery, the heat loss through the windows is reduced in winter and in summer solar heat is limited to enter the building. Thus, the energy spent on heating and cooling is saved.

To fully take advantage of the benefits of thermal insulation, the walls and flooring facing the cold parts in winter and hot parts in summer and the roof must be insulated and qualified windows must be used. Thermal insulation is done by the application of insulation materials or construction elements to the exterior of the building from the base to its roof or the surfaces facing the parts that are not used [28].

Isolation is available from the base to the roof in order to prevent heat loss [53]. In the thermal camera recordings where the heat losses in buildings can be seen, thermal bridge blocked shots, three-layer structure with insulating glazing (Passivhaus) the outer surfaces of the heat losses can be seen in the comparison of an older structure. According to this, while the old structure has a surface temperature of 9 degrees, the outer part of the insulated house is almost as cool as the balcony railings that are not exposed to any heat (Figure 4.30).

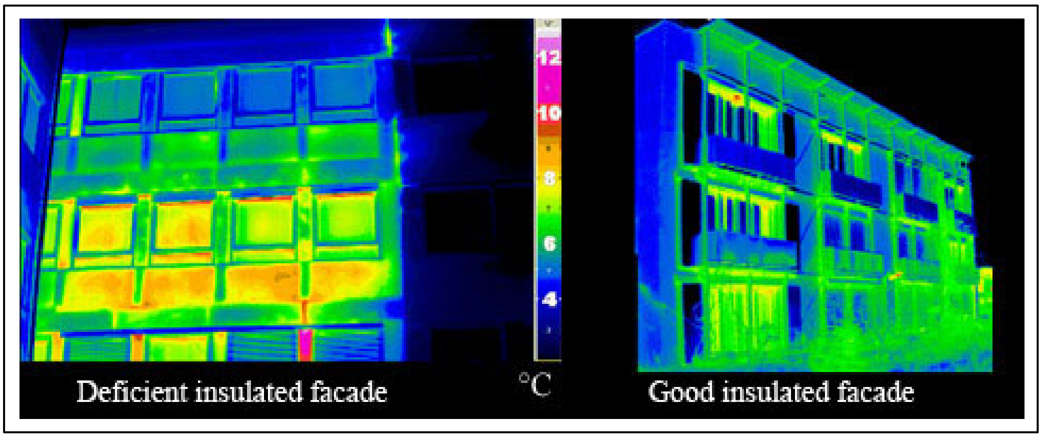

Figure 4.28. Comparison of the heat losses of the outer surface by using the thermal shots of the insulated and non-insulated buildings [54]

Radon-resistant homes are also resistant to the humidity and heat leakage. For this reason, protective measures are easy and cheap. Ventilation of the houses is required to prevent accumulation of radon at home [55]. Radon gas spreads in the house via the construction elements such as concrete or stone from the soil and stone sources [56].

The base is insulated for water (capillarity) and heat losses. To prevent the accumulation of radon gas into the place, a ventilation gap must be left under the floor and the vents must be opened on the basement walls to prevent accumulation of radon in air and humidity (Figure 4.29) [57].

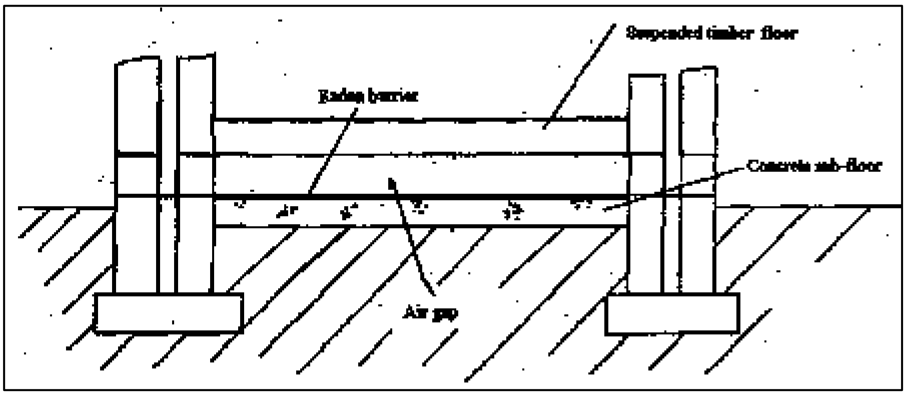

Figure 4.29. Ventilation space under the floor for radon gas discharge [57]

All the concrete elements in the exterior surfaces must be insulated to prevent the formation of heat-bridges. To prevent heat loss and the heat bridge, it must be known that the concrete is a heat carrier and precautions must be taken while choosing the concrete. The contact between the concrete and the soil must be avoided.

Sound insulation can be done in order to prevent noise and vibrations in the buildings such as the flow-induced noise and fan installations, pump elements. To prevent the transfer the vibrations the machines create to the main construction, the floating base details and vibration isolators are used. Special precautions must be taken to prevent the vibrations where the installation pipes pierce the construction elements such as walls and floors. In addition, insulated clamps must be used for the plumbing pipes hung on a vibrating surface structure to prevent the noise.

4.3. ENERGY CRITERION (ACTIVE SYSTEMS)

Using sustainable energy resources to generate the energy needed in the houses provide harmony with nature, to create energy-efficient houses and to reduce or prevent the carbon emission. There are two ways to generate the electricity needed for the heating and cooling systems in the houses and electrical energy production:

Passive systems making use of design features and using appropriate materials, solar energy and its heat energy is taken into the building and obtaining heat energy. There are three types:

- Solar windows (direct saving),
- Solar walls (indirect saving),
- Winter gardens / greenhouse (direct saving) [43].

Active systems are the mechanical and electronic systems used to convert the solar, wind, soil or water's energy to obtain electrical energy. If it is included in the design phase, impairment of the aesthetics is prevented in case of a subsequent modification. There are two systems:

- Electrical energy generating systems (photovoltaic systems, wind turbines)
- Systems generating hot water from solar energy (solar collectors) [58].

Figure 4.30. Diyarbakır solar house, a successful application; generates own energy [46]

4.3.1. Solar Panels (Photovoltaic Panels)

These are mechanisms that can produce electrical energy from the limitless source of power, the sun. Photovoltaics absorb solar power electrically, and convert photons of luminous energy into electrical energy photoelectrically [59].

They are usually installed as a separate mechanism on the roofs; however they can also be integrated into the buildings, namely used as a constructional element.

Figure 4.31. A photovoltaic panel on the roof [60]

Integrated Photovoltaic Panels have been gaining more importance in producing electrical energy, and they can be implemented to all of the residential and commercial buildings. Main purpose of using these panels instead of constructional elements is to produce electrical energy of the building and saving on constructional materials such as tile, asphalt shingle, roof membrane and surfacing. In addition, photovoltaic panels can be used as a constructional element in other places like sunshade, balcony, closed hallway and garage. These roofing elements both protect roofs from weather conditions and enable them to produce electricity [60].

Photovoltaic systems have 3 main components, which are:

- Solar panels,
- Inverter,
- Battery and charge controller.

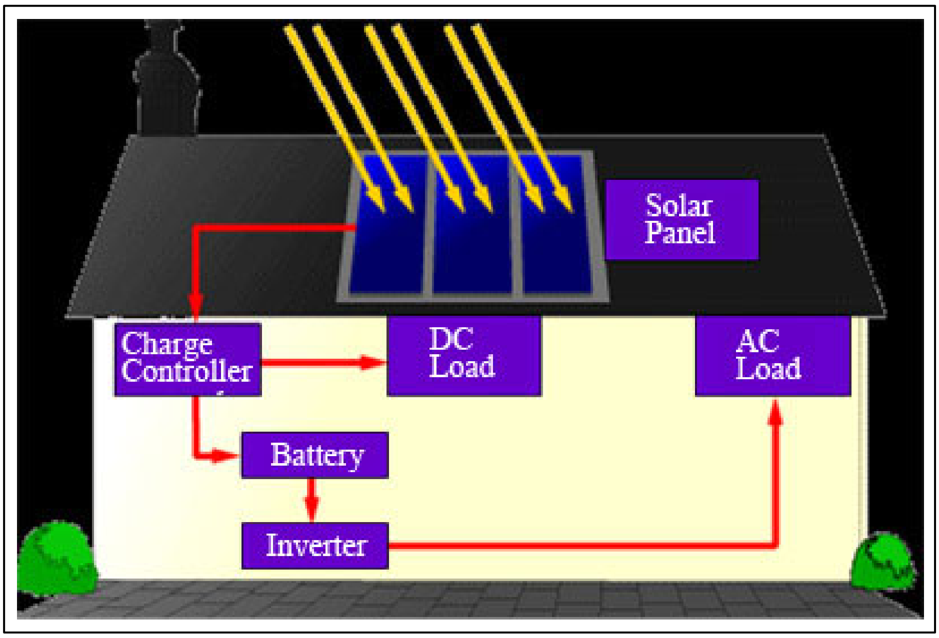

Figure 4.32. Components of photovoltaic systems and their functions [49]

Solar panels convert solar power into electrical power. Solar panels are produced by using different technologies. These technologies have a direct effect on price, size and durability of a solar panel. New technologies have higher performance in producing solar power. In other words, they produce more energy from same sized panel. But this feature causes a price increase.

There are three types of solar panel cells:

1. *Mono-crystalline silicon*:; works at highest efficiency and smallest of all solar panels.
2. *Poly-crystalline silicon*; this type has the second highest efficiency after mono-crystalline silicon, and this type is usually preferred on the basis of price/efficiency ratio.

3. *Thin-fil;* these type of panels have lowest level of silicon. Therefore, these panels are low in efficiency. They are both low in efficiency and take up a lot of space.

Figure 4.33. Rooftop sidings with mono and poly crystalline photovoltaic panels [60]

Inverter converts direct current energy produced by solar panels into alternating current that comes from grid. There are 2 types, based on preferences of electricity supply from grid; synchronized inverter for solar systems connected to grid: These inverters transmit energy to distribution box from grid. Thus, this energy can be used indoors normally. In addition, these inverters enable selling energy produced by solar panels to grid.

Independent inverter for solar systems disconnected to grid is type of inverter that transmits energy from solar powers to power outlets at home directly, in case there is no grid or energy from grid does not want to be used.

Batterys of Photovoltaic systems are for storing produced electrical energy. Therefore, power stored throughout the day can be used at any time.

Charge controller is placed between solar panel and battery. So it adjusts amount of charge transmitted to battery from solar panel. If battery is full, it disconnects battery from solar panel and prevents battery from being overcharged and going out of order, and also prolongs battery life.

4.3.2. Wind Turbines

Wind turbines can produce electrical energy from wind, which is a renewable and sustainable source. Small wind turbines are more cost-effective compared to other renewable energy systems (solar, geothermal, biodiesel), and they do not cause environmental pollution. They are used in different practices, including pumping water in homesteads. Using these systems have some advantages listed as follows:

- Saving on electricity costs between 50-90 per cent,
- Decrease in losses caused by transmission lines,
- Variety of sources [61].

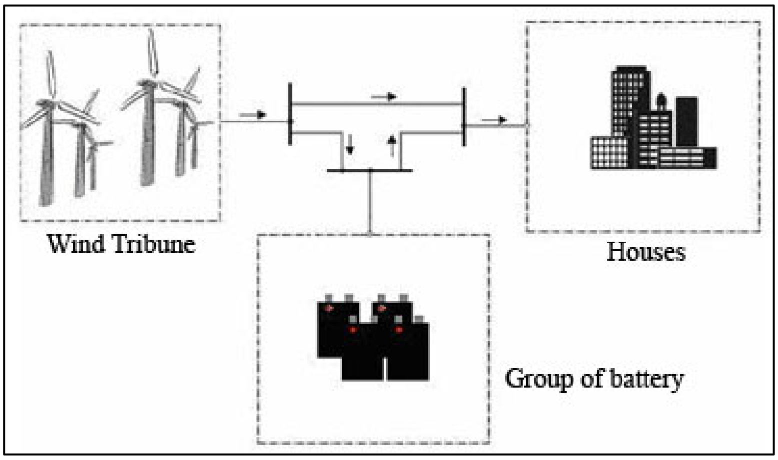

Figure 4.34. Schematic diagram of a wind power production system [62]

Being used in household type applications, wind turbines mostly have a nominal power of 1 to 20 kW, rotor diameter of 4 to 8 m, and they are installed upon a tower with height of 10 to 36 m. Minimum annual average of wind velocity for small wind turbines with no connection to grid is 4m/s, and 4.5 m/s for small systems connected to grid.

Points to take into account while choosing field for installing wind turbine :

- Finding a field with good wind velocity (there should be a minimum of 4 to 4,5 m/s wind velocity for a small scaled wind turbine installed on households and farms in order for it to be affordable),
- Setting height of wind turbine (fort his, wind turbine should be chosen based on annual energy need),
- Deciding on whether it will be connected to grid,
- Field must be at least a land measure of about 920 square metres,
- Whether there is a previous application of wind turbine on chosen field,
- Wind turbines must be installed at least 250 to 300 m away from residential area.

Wind velocity and direction can be measured with handhold anemometer or automatic measuring devices. Anemometer and direction sensors are used for measuring wind. Handheld anemometer a portable device used for measuring wind velocity and direction to be measured directly. Besides of wind velocity and direction, some other meteorological parameters should also be measured. Taking air density and turbine corrosion into consideration, measurements should be made using temperature, humidity and pressure sensors.

Secondly, evenness or plant cover of the field where turbine is to be implemented should be examined. Because plant cover and other geographical factors can cause major changes in wind power in short term.

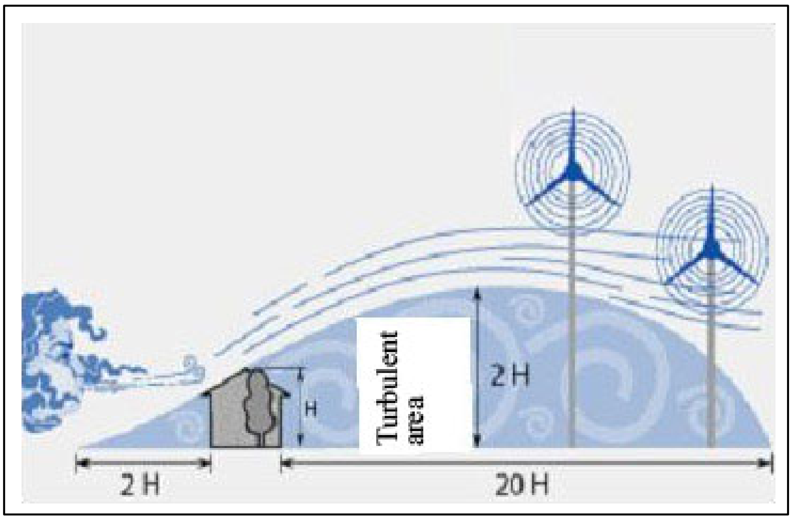

Figure 4.35. Effect of tree or building height on wind power [61]

Operation of wind turbine systems are grid-connected or independently (stand-alone).

Grid-connected systems are installed close to each other or consisted of more than one turbine to create a wind farm. These systems must have a license from energy market regulatory authority.

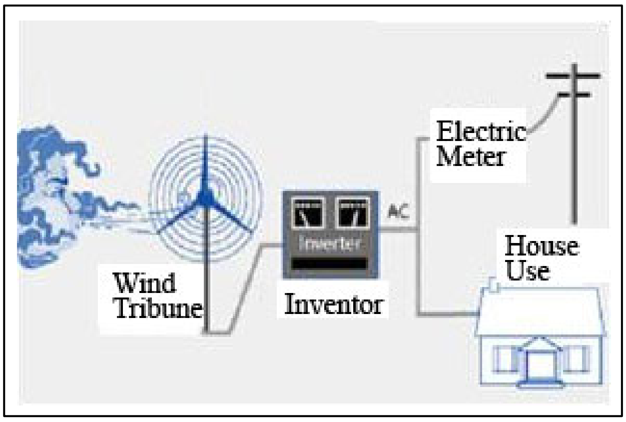

Figure 4.36. Grid-connected system [61]

Stand Alone systems allows one or more load to supplie without being connected to the grid. It is used for agricultural water pumping, drying or cooling products, operating heaters, water purification, air conditioning and supplying electricity for small-scaled residences.

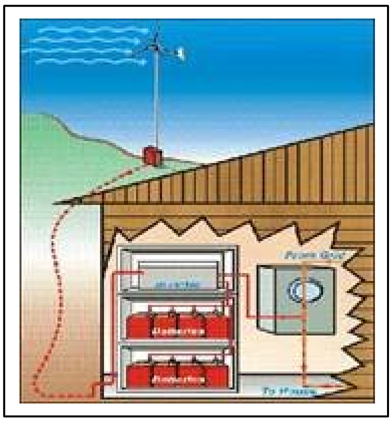

Figure 4.37. Stand alone system [61]

Small "Hybrid" solar and wind electricity systems are small wind electricity systems that can be used with other energy producing systems (such as small solar electricity systems and hybrid power systems). Hybrid wind power systems can be used in households, farms and areas away from transmission line [61].

It is impossible to supply electricity for a household solely from wind if wind is discontinuous. Wind battery hybrid system is used to overcome this problem and provide electricity continuously. However, if area has a low potential of wind, it is not cost-efficient due to the number and cost of batteries to be used for hybrid system. [62].

4.3.3. Solar Collectors

It absorbs solar power thermally. Flat-surfaced thermal solar collectors are used for heating utility water and it utilizes direct sunbeams. Operating temperature is below 100˚c. These collectors do not have to follow direction of the sun; they are placed facing south and sloping on an angle that sunbeams hit perpendicularly on them, which should be adjusted seasonally. These are the type of collectors used in solar water heaters. Such collector is consisted of absorbing panel, heat insulation, upper transparent (glass or plastic) cover and outer case [59].

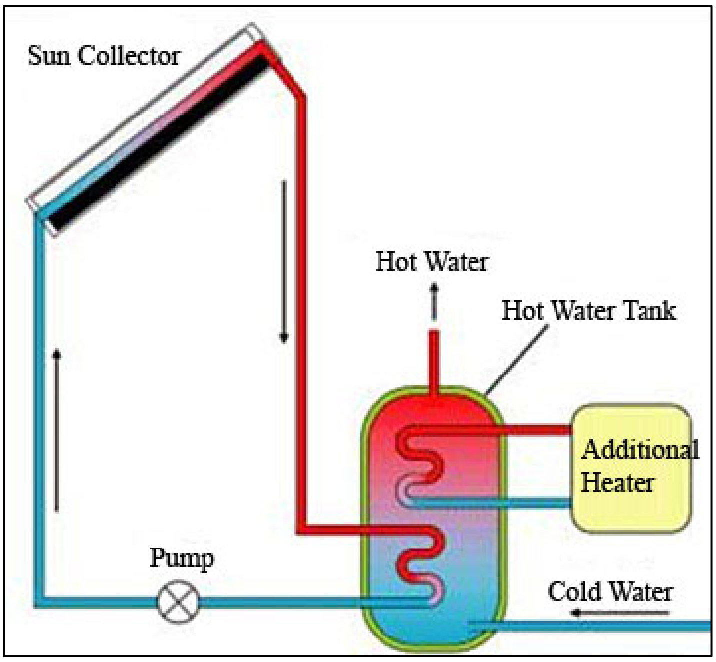

Figure 4.38. Schematic diagram of solar collector operation [59]

4.4. ECOLOGICAL CRITERION

It has a variety of approaches towards ecology such as balancing low carbon emissions, increasing biological diversity, doing agriculture for one's need for nourishment, keeping water, soil and air unpolluted, protecting environment, using renewable energy, doing organic agriculture and supporting ecological working principles.

4.5. INFRASTRUCTURAL CRITERION (SOLID WASTE, BLACKWATER, GREYWATER, GREENWATER)

The purpose of waste management is producing cost-efficient and affective solutions by disposing wastes in production-logistics-consumption system and therefore minimizing their effects on environment. Easiest way of achieving this goal is decreasing the amount of waste naturally. Implementing 4R rule, which is a hierarchical system, in waste management is adopted:

- Reduce
- Reuse

- Recycle
- Recover
- Disposal

Waste management system is the most cost-efficient system with the least damage on environment, and the least amount of waste is produced in this system. It has become obvious that zero waste approach must be accomplished considering European Union's ban on storing organic, fermentable and recyclable waste that had been implemented gradually until 2005 [63].

Preventable domestic waste:

- Water
- Cesspit/compost toilets
- Organic kitchen waste

Using processed greywater as utility water can contribute to protecting water sources, and it will also have positive effects on water balance in nature. Doing so, amount of drinking water used in graywater recycling facilities can also be reduced. As a consequence, negative effects of obtaining and distributing drinking water (such as energy and chemical necessities, decrease in underground water etc.) will be increased [5].

Water is divided into three categories, which are greywater, greenwater and blackwater. Drain water from bathroom, bathtub, basin and kitchen drain is called greywater. It includes refinable substances such as detergent, oil, human skin and hair. These constitute 80 per cent of drain water. Since greywater can be drained and used in watering gardens, toilet tanks and cleaning, approximately 50 per cent of water used will be provided by this system. There are some technologies that do not need adding chemicals and efficient in terms of energy and maintenance, which are:

- Biological systems
- Bioreactor
- Membrane technology (MBR)

- Combined technologies.

Green water is collected rainwater. Reused for watering gardens, washing machines and toilet tanks.

Black water is drain water from toilets. It costs higher than others to separate. Thus, it is collected without separation through cesspit or converted into manure with compost toilet.

Kitchen waste it can be garnered in a designated area of garden and converted into fertile manure to soil with help of oxygen.

4.6. EDUCATION/HEALTH CRITERION

Administrations propose that kindergartens can be established in itself but remaining education should be given by public schools. There are forest kindergartens that provide Montessori education, engaged with nature as allowed by local conditions throughout the year and days, which also welcome those who are not enrolled.

They benefit from government for social facilities such as education and health. This requires using transportation vehicles for routine doctor visits or going to school.

4.7. TRANSPORTATIONAL CRITERION

Biogas is a renewable source produced by gas or plant seeds obtained from renewable synthesized animal waste, and it is preferred as an alternative to fossil fuel. However, in order to reduce carbon emission, there is a tendency of carpooling or, better, planning transportation needs to use a minimum of vehicles.

Even if fuel is renewable and carbon emission is balanced, there is carbon footprint of vehicle itself, caused by its production process.

4.8. ECONOMICAL CRITERION

Their economies are dependent on global economy. There are a few exceptions that are completely independent, such as Sieben Linden Eco-village; but still, they depend on global economy for construction materials and transportation vehicles.

Economic setup of an eco-village is designed for building a structure that supports social and family life, in which financial needs are reduced and there is a change in life standards. An individual shortens the time spent on transportation and working hours spent outside by living closer to workplace at the cost of earning less. Therefore, there is more time to spend with social life and family, and local jobs are created. This setup usually enables adopting a simple lifestyle voluntarily, combining work and social life and creating income-generating jobs within the society. When self-sufficiency gained from local food and energy production is combined with strong communication within the society, individuals' sense of security increases and it also brings courage to change their understanding of economy. In many cases, creating alternative economy systems enables eco-village to be more independent and durable. Alternative economies are usually based on gift giving and exchanging principles. Therefore, it is proportional to social parameters and values [23].

Economic principles support eco-villages as follows:

- Complementary currencies (LETS systems, friendly gestures, eco-village currency)
- Alternative banks
- Voluntarily simplified lifestyle
- Activities creating local income sources (consultancy, green works)
- Generalized daily economy (foods, services used communally)

5. ASSESSMENT OF LOCAL ECOLOGICAL VILLAGES IN THE CONTEXT OF THE CRITERIA

Upon the studies performed regarding the reasons of failure on ecological villages established in our country in the past, it was seen that the main reason was based on three basic issues: social, cultural and economic.

At first, although it was acting in good faith, these unplanned enterprising movements caused some social conflicts over time and finally they inevitably disrupted. To prevent the social conflicts that are the most important reason of the failure, some measures have to be taken.

It was aimed to accept and implement the idea of eco-village abroad on the settlements attempted to be built so far. These imported models did not meet Turkey’s needs. Local enterprises have basically the same intention with the eco-villages abroad. People who live in many villages in Turkey like the ecological villages abroad named as "Intentional Communities" are in search of a solution on the issues such as climate change, pollution of nature, loss of social and moral values and have the same intention. First, we must be aware of the knowledge of the traditional "eco villages" that in progress already and the people who live in these villages. It is a fact that social and ecological principles are in progress in the eco-villages that have not lost traditional knowledge and fought for survival like all other eco-villages in the world. The first step may be taken by exploring but not conquering the Anatolian villages and providing them service with contributing. An eco village model can be created through the contributions of urban people by participating in their life. At the same time, this can be possible with being aware of this the capacity of the region, moving there within the extent of the capacity, being a part of daily life with their own economical situation too. It can be participated by understanding and adopting the existing things and converting their selves. Because there is a running balance in actually existed villages and difference of the people who search alternatives is that their awareness of their needs for such a life. Actually, they are not familiar and experienced with an ecological life. In this regard, there is a lot to be taken from existing traditional structure [64].

Local entrepreneurs have usually the financial possibility to set up this kind of formation. Therefore, it is not considered to get financial gain in ecological villages. Generally, it is engaged in agriculture which is enough for the people. However, it is not achieved to the dimensions that would cause to make profit.

Ecology is the most important issue in terms of sustainable healthy future on the planet. They aim to live in an environment that has healthy air, water, soil and food and to sustain that in future generations. In Turkey, ecology aimed to live without damaging in conformity. It is engaged in agriculture which is enough for them.

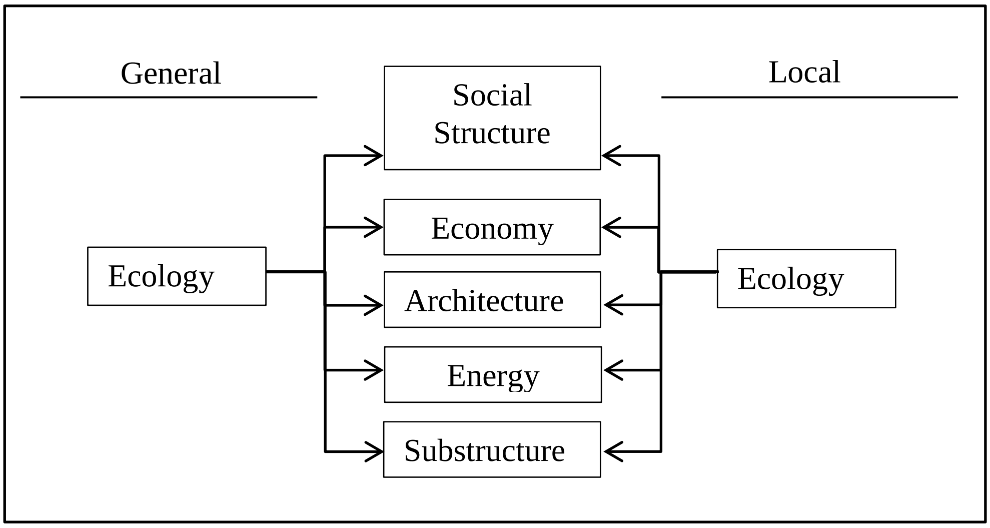

Figure 7.1. Criteria related to ecology

Ecological dimensions of the eco villages emphasize mainly the connection of people and the earth such as soil, water, wind, plants and animals. It clearly refers to a vision starting from energy conservation and waste recycling to be dedicated to a life which is environmentally-conscious, less polluter, village-based energy systems integration, water conditioning plants, restoration of the world, sustainable agriculture and ecological buildings. The meaning of ecology is as follows [65]:

- To grow organic foods within the biological fields of eco-village community as much as possible,

- To create the living spaces in which natural and local materials are used and local architectural traditions are applied,
- To use renewable integrated energy systems based on village,
- Ecological business principles (local green business),
- To appreciate the life cycles of products used in eco-villages with an approach of social/spiritual and ecological.
- To keep water, air and soil clean by applying the convenient energy and waste management
- To preserve and promote the biological diversity, to preserve rural areas.

Energy in renewable form is being used in ecological villages due to fossil fuel consumption used for the energy production which is an important factor in disruption of the ecological balance.

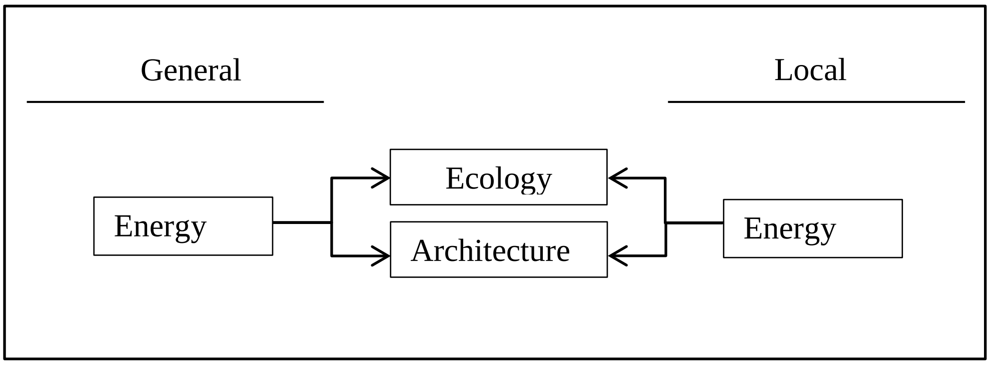

Figure 7.2. Criteria related to energy

Economic setup of an eco-village is designed as creating a structure to support social and family life through shifting of the life standard by reducing the financial needs. People shorten the travel time by getting house closer to office at the risk of earning less. Thus, it is created opportunity for keeping more time for social life and family and for setting up local business. This setup causes to be adapted in a simplified life willingly, integration of private life with business life and creation of income-generating jobs in the community. When self sufficiency obtained by production of local food and energy is combined with strong communication in the community, sense of security of the individuals and groups increases. It also causes people to dare of changing their economical concepts. Creation of alternative economic systems in many cases enables eco village to become more resistant and more independent from the global system. Alternative economies are generally based on the principles of giving gift and exchange. For this reason, they are proportional to the social parameters and values.

- Economic principles support the eco-villages in the following way [65];
- Alternative banks
- Simplified life willingly
- Local revenue sources manufacturers activities (consultancy, green jobs)
- Generalized daily economy (public meals, services)

Architectural: constructions that generated based on the ecological construction criteria, compatible with nature, take care of the ecological balance, pay attention of lower ecological footprint, take care of using local materials, applies also passive architectural criteria are taken into consideration.

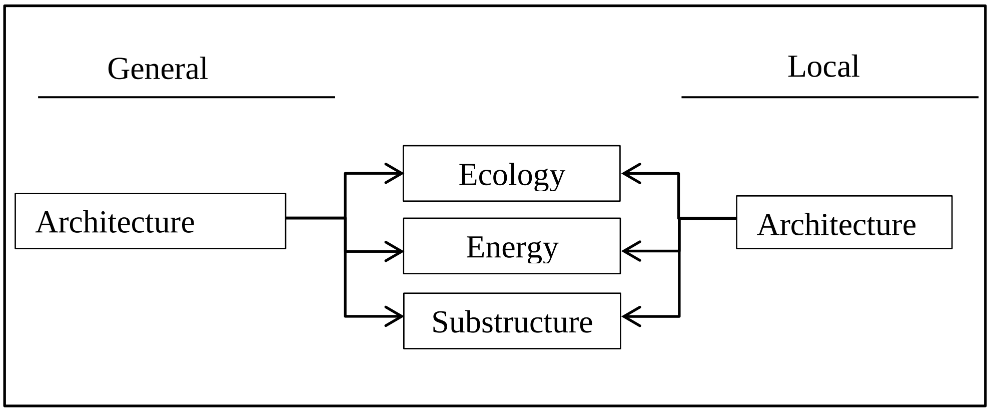

Figure 7.3. Criteria related to ecology

Substructure; distilled waste water and used again for watering of gardens, it is taken care of not producing of non-recyclable solid waste.

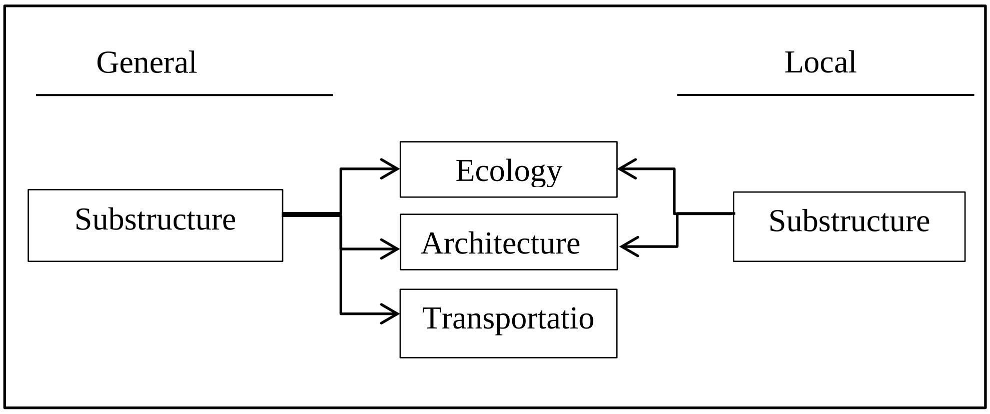

Figure 7.4. Criteria related to substructure

Education/health depend on state or private organizations located outside of the village for education and health requirements. The state does not allow a kindergarten education legally. But ecological villages share the information they gained from experiences with training courses. This is one of the partial economical inputs of the ecological villages.

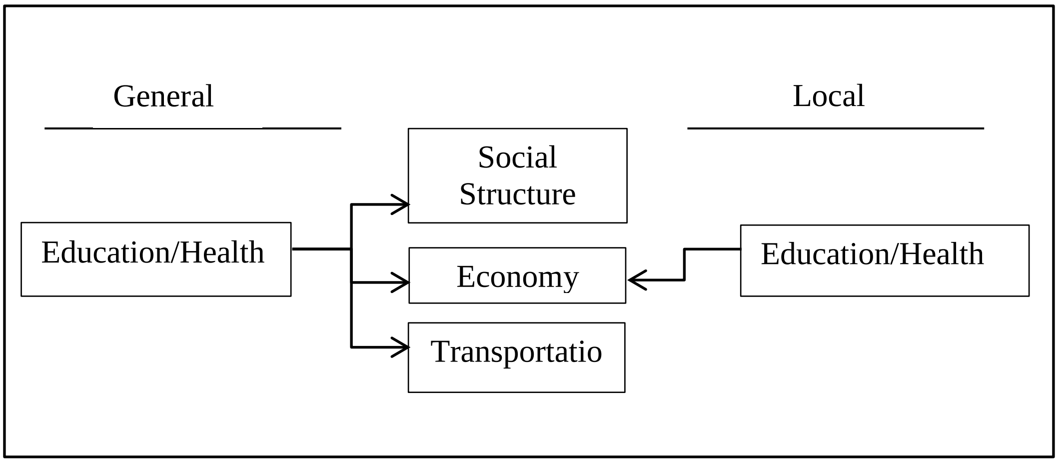

Figure 7.5. Criteria related to Education/Health

Transportation; biogas production, which obtained from seeds and usage is available. Apart from that, bicycle is preferred as an alternative. Keeping vehicle usage at minimum level, it is aimed to keep waste generation at minimum level as well.

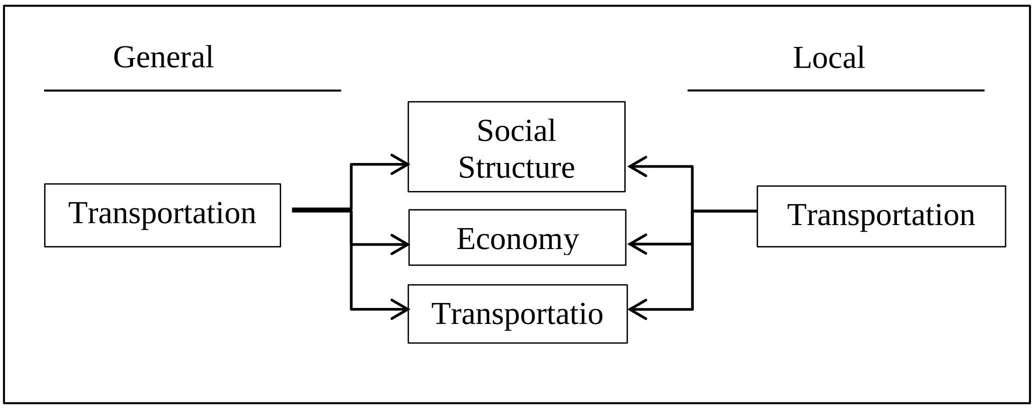

Figure 7.6. Criteria related to transportation

Diagram of criteria of ecological village during the forming stages from decision-making process to settlement and settling is shown in Figure 7.9.

Eight criteria necessary for the sustainability of ecological villages and relationship between them is shown in Figure 7.8.

Güneşköy, which is a successful initiative of ecological village and aim to provide expansion of the innovative technologies with measuring of their applicability, thus aim to contribute traditional villages, is assessed in the context of the ecological criteria in table 7.1.

Table 7.1. Güneşköy ecological village checklist

	Good	**Should be improved**	**None**
Social Environment	•		
Architecture		•	
Insulation		•	
Heat Insulation		•	
Waterproofing		•	
Sound Insulation			•
Material (Local)	•		

Table 7.1. Güneşköy ecological village checklist (continue)

Material (Ecologic)	•		
Heating Cooling (Passive)		•	
Heating Cooling (Mixed)		•	
Ventilation (Passive)		•	
Ventilation (Mixed)		•	
Energy	•		
Solar Panels	•		
Wind Turbines			•
Solar Collectors	•		
Ecology	•		
Preserving	•		
Increasing Diversity	•		
Agriculture (Permaculture)	•		
Substructure/ Waste		•	
Water		•	
Solid Waste		•	
Transportation	•		
Education/Health		•	
Economy	•		
Tourism			•

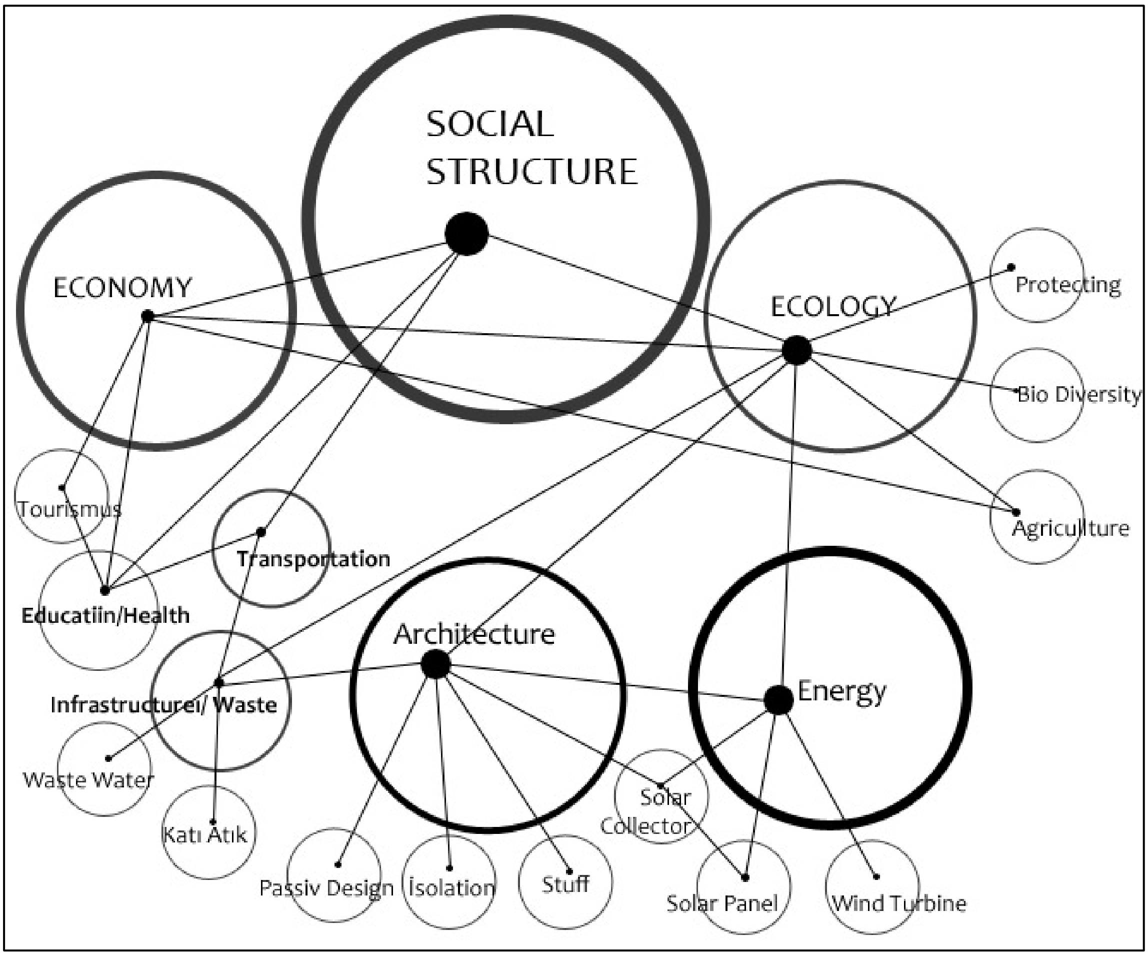

Figure 7.8. Healthy interrelationships of the criteria of ecological village

Relationship of the criteria of ecological village samples failed in Turkey is shown in Figure 7.2 . Accordingly, lack of the relationship between social structure and economy, disconnection between transportation and education can be seen clearly.

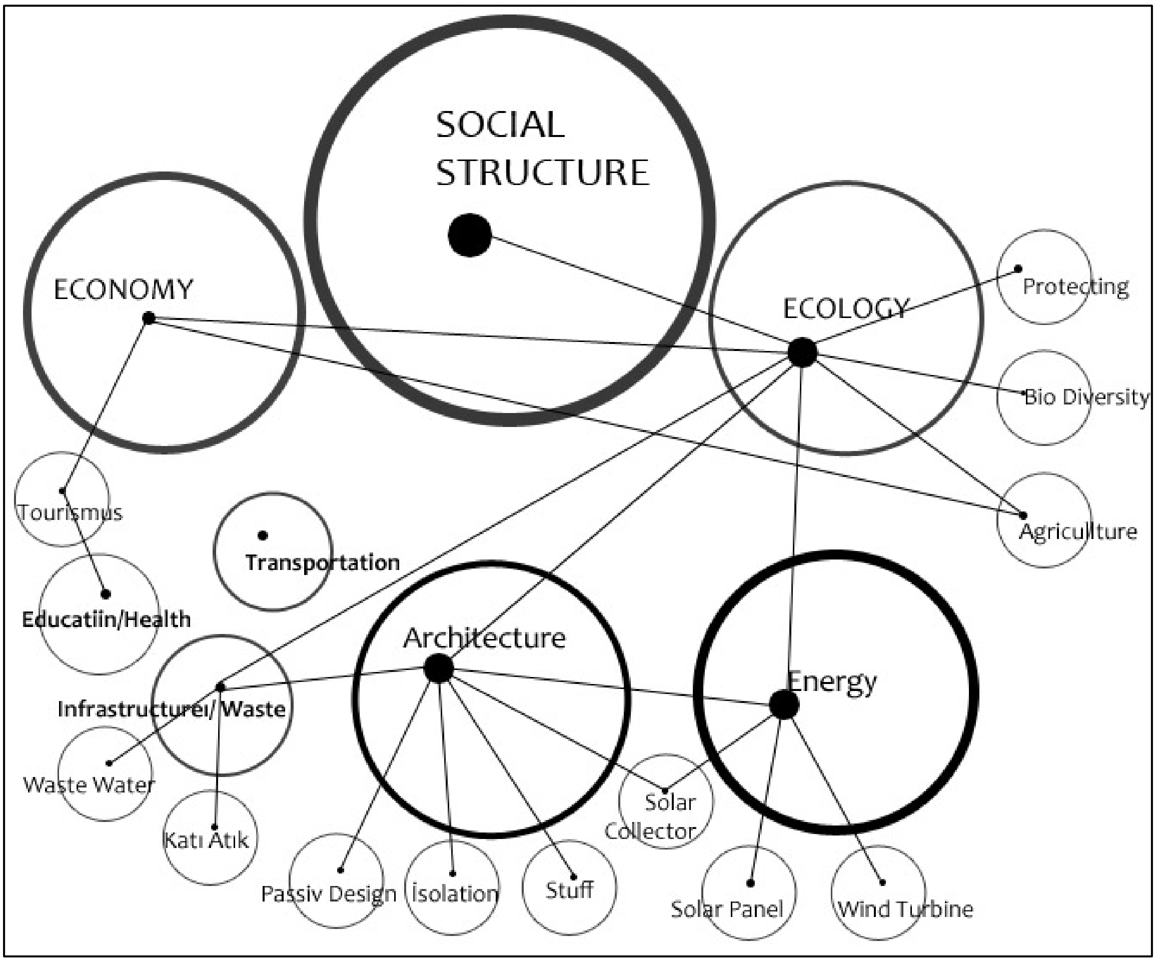

Figure 7.9. Interrelationships of the criteria of local ecological villages

Accordingly, criteria having the most important deficiency is that the social environment.

Social environment; formation of the eco-village Hocamkoy near Kirikkale Hasandede district, which launched in good faith effort and initiatives ended before it commenced**.** Their objective was creating a sustainable rural life model together with the local people by blending traditional knowledge of the Anatolian people along with the academic information, creating a model compatible with nature in any aspect of life from agriculture to energy, from architecture to meeting other needs in daily life, in a self-sufficient economic structure as far as possible. In Hocamkoy, ecological house and life to be established around has been limited to short-term experiences.

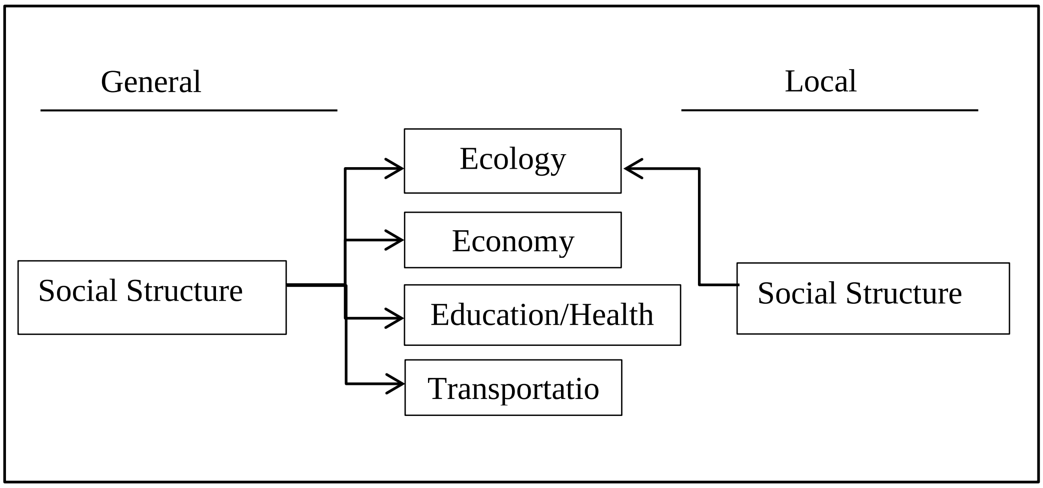

Figure 7.10. Criteria related to social structure

6. CONCLUSION

It is determined that the residential units that have lowest ecological footprint within industrial societies were ecological villages. In that case, the ecological villages can be considered as a successful model to “learn from” among alternatives of sustainable settlements. Ecological villages are the residential units that possess low carbon footprint, successful social participation, a healthy ecology and are in harmony with the nature. Use of renewable energy resources, use of local resources, support of recycling, implementation of waste management, improvement of biodiversity are some of the factors that reduce the ecological footprint of these ecological villages. Their setup operations are in still progress in many countries due to their harmonuous and participatory social configurations, solid economic structures, attitude on improving nature and diversity, ecological settlements and configurations.

Traditional villages can be converted into sustainable settlement areas faster in comparison with existing cities because of their ecological life format. However, they can not be a sustainable settlement model as they provide their energy needs by the centralized solutions, use chemicals in collective agriculture thus the ecosystem was affected negatively. To be possible of implementing of this model in cities, techniques need to be developed.

It is considered that the criteria of ecological village that compiled and described within the scope of this study would be beneficial for the residential units to be built up or for planning work related to the residential units to be converted. One will be able to identify vital factors which brings the initiative to success and failure; and gather required knowledge to develop an eco-viallge and sustain it with the possible smallest ecological footprint

To improve successful samples of ecological village formations in our country, mainly social principles need to be clarified, economic planning need to be performed and ecological sustainability policies need to be adopted. As 25 percent of our population live in the villages, it is possible to find technical knowledge on this subject.

The sustainability and success of ecological villages and thus their communities need significant level of demochracy and a lean management compatible but not isolated with the environment through maintaining their organic bonds, to be participative, to be conformist and to be well planned in economic formation.

Further research is required to contribute cultural and regional aspects to this research. These regional aspects include agricultural, climatic and biodiversity factors. The design and construction guide, criteria ontology and relevant checklists developed within this research provide only Meta-level information. It is important that one should benefit from other research of which major ones listed in Section 1.4 to etablish a better result. While the information in this study may provide reasonable assistance for design development, and brings together invaluable information which cannot be found in a package elsewhere, there are many economic and social factors and criteria for the successful implementation of an eco-village implementation which have been kept out of the scope of this research.

Eco-villages may be evaluated as laboratories to learn about permaculture and to extract knowledge necessary to heal the problems and negative impact of big cities. A knowledge management process must be developed to measure the performance of permaculture and extract and reuse the learnings to improve the quality of life in bigger settlements. The more we understand about nature the more we benefit from the gifts of it. Eco-villages are important and required to let our children learn about their major home, mother earth and to teach them about the concept of self sufficiency, about how to protect their future and maintain the sustainability their generations

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