THE KERKENES ECO-CENTER

2002 to 2016

An Overview of its Development in Fourteen Years

Figure 1. The Kerkenes Eco-Center provides facilities for students and visitors. The Iron Age capital on the Kerkenes Dağ forms a backdrop while at the Erdoğan Akdağ Center for Research and Education solar cookers and a bioclimatic straw bale greenhouse demonstrate how renewable energy can be used for sustainable rural development. (08kenc2217)

INTRODUCTION

The Kerkenes Eco-Center and the village of Şahmuratlı are in an ideal location in the Anatolian Plateau for the promotion and spread of the sustainable energy in both local and national scale. Şahmuratlı Village possesses a world class cultural heritage site, probably ancient Pteria, an Iron Age mountain-top city founded on the Kerkenes Dağ. The Kerkenes Eco-Centre has piloted schemes for renewable energy and appropriate technologies against a background of climate change, socio-economic inequality and rapid depopulation of rural areas in favor of urban growth.

Launched in 2002, the many-faceted Kerkenes Eco-Center Project has covered extensive ground. The purpose of the Kerkenes Eco-Center is to promote sustainability through environmental studies and experimental researches. It is established as a demonstration center and focuses and the education and public awareness through the following objectives:

- To advocate the use of renewable sources of energy (and especially solar energy);
- To demonstrate the benefits of recycling, waste treatment, water consumption reduction;
- To act as a stimulus and a catalyst for environment-friendly building with appropriate materials (mostly local and natural materials) and energy efficient designs based on central Anatolia climate;
- To act as a dynamic experimental base for testing designs, materials and activities suitable for viable and sustainable village life through the involvement of villagers, students and researchers.

With its focus of activities on the promotion of renewable energy and law carbon society the Eco-Center is expected to become a model for sustainable rural development initiatives. It is aiming to make Şahmuratlı Village a showcase for environmentally friendly, energy sensitive and self-sufficient development in rural environments, promoting the use of renewable energy for a low-carbon economy and a sustainable future.

From its establishment in 2002 to 2014, several buildings have been built or renovated in Kerkenes Eco-Center including 3 straw-bale buildings, a solar building, 2 mud-brick houses, an AAC (autoclaved aerated concrete) and the former school of the village. The construction have been made by groups of people including students and researchers of METU, villagers, masters and workers, volunteers from ecological organizations in order to share and spread the knowledge and the experience of the Kerkenes team.

Currently, the Kerkenes Eco-Centre experiments with appropriate building materials and energy efficient designs, drip irrigation for organic gardens, solar energy, solar drying and cooking, recycling, stimulating and creating income generating activities for both men and women. Moreover, Kerkenes Eco-Center team at METU, Ankara, monitors the performance of the buildings with data loggers and uses available climate data with modelling and simulation software to improve the energy efficiency of buildings; several conference papers have been published on findings of this research.

Achievements of the Kerkenes Eco-Center Project are summarised below.

1. Productive research on appropriate design and materials through monitoring of buildings and production of alternative materials has been conducted and published by the team in 5 articles or conference papers on the subject and 3 buildings have been designed and/or renovated.

2. Educational sessions on ecological construction have been organised and METU students have enrolled in hands-on courses. A total of over 150 students have taken part in the sessions run every semester.

3. Improvements to the standard of living of the villagers have been achieved through their participation in schemes to demonstrate how improvements in thermal comfort in terms of using natural materials and solar water heaters can be obtained and how to optimize agricultural approaches by introducing drip irrigation and organic farming.

4. The Eco-center facilities have been made available to different groups of researchers, students and visitors. The Eroğan Akdağ Center for Education and Research is an invaluable asset which is built with AKG Gazbeton blocks and roof panels thus remaining thermally efficient in summer as well as in winter. The archeological research team uses it during the annual excavation periods when up to 30 researchers and students work at Kerkenes.

Role of Support for the Project

Sustained private sector interest in Kerkenes and small-scale energy projects has been demonstrated by the willingness of several companies to sponsor the Kerkenes Eco-Center and related activities. Since 1999, the Kerkenes Project has received generous help in kind as well as grants channeled through the METU Development Foundation (ODTÜ Geliştirme Vakfı). Amongst these are AKG Gazbeton, Erdogan Akdag Foundation, MESA Housing, Votorantim Cimento (previously a Lafarge-Yibitaş joint venture and then Cimpor-Yibitaş), Torreador and Yenigün. The project was awarded grants from several international institutions, embassies and some foreign organisations as can be see on the Kerkenes Eco-Center web page:

http://kerkenes.metu.edu.tr/keco/02spons/index.html

Since 2012, several METU students enrolled in the Master or PhD program have received a monthly allowance that provided essential financial assistance during their studies. Students receiving this scholarship help with both the educational and research activities at the Kerkenes Eco-Center and METU. Ongoing monthly donations from AKG, Votorantim and Yenigün contribute significantly to research activities that has gained international recognition through presentation at international conferences such as PLEA or TERRA and publications in recognized scientific journals.

Local authorities have also been most supportive to both the archeological research and the Eco-Center and provided help in kind as well as funding for building repair and maintenance.

Sponsors

We are grateful to all the sponsors (Fig. 2) that allowed the Kerkens Eco-Center project to build and renovate several buildings, promote renewal energy and sustainable rural devlopment as well as assist students in their research activities.

Figure 2. The Kerkenes Eco-Center Project Sponsors since 2002 (http://kerkenes.metu.edu.tr/keco/02spons/index.html)

OVERVIEW OF PAST ACTIVITIES

The Kerkenes Eco-Center Project was initiated in 2002 in Şahmuratlı village (Sorgun/Yozgat) as a social center for village and local development in the wake on the archeological excavation on Kerkenes Mountain. Rural economies on the Anatolian Plateau are underdeveloped; gender inequality is rampant while opportunities for young people are limited. Development of sustainable, environmental friendly, rural economies supported by renewable energy would provide a reduced rural population with acceptable levels of comfort (appropriate dwellings) and economic security. A first study was carried out by METU researchers and students in collaboration with a team from the Architectural Association in London and under a British Council Partneship scheme (Fig. 3).

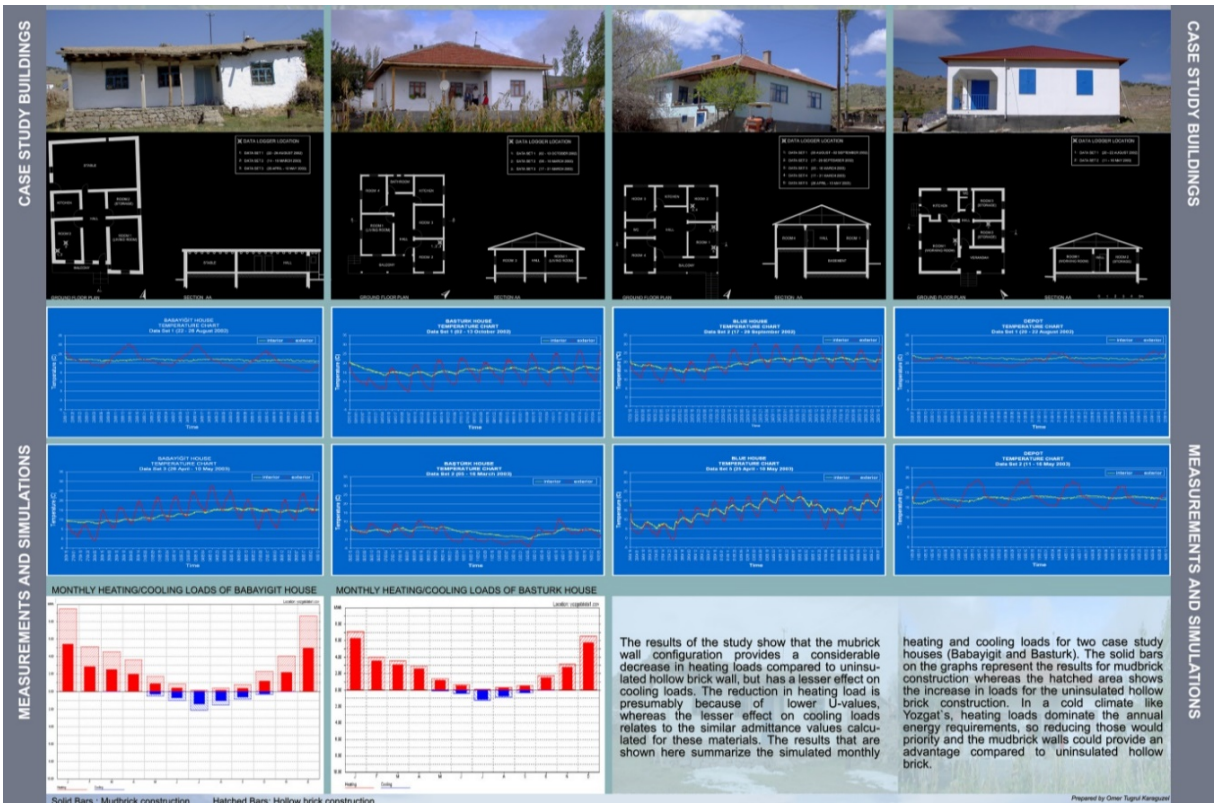

Figure 3. Design for energy efficient buildings (extract of a poster presented in 2003 for the PLEA conference)

In the light of this idea the concept of establishing an Eco-Centre was generated and the first stone of the creation of this Eco-center was the construction of a demonstration mud-brick building (Fig. 4) and a survey on the comfort of traditional and modern houses in the village. This was established to assess the fact that modern and expensive materials are not adapted to all climatic conditions.

By 2003 the concept of establishing an Eco-Centre devoted to research into and promotion of renewable energy and sustainable village life was developed. Advocating an environmentally friendly approach to the development and improvement of rural settlements, the project worked closely with ŞAHDER (The Kerkenes and Şahmuratlı Village Association for Public Relations, Prosperity, Help and Support) and teams of researchers from METU (Middle East Technical University) in Ankara. The Kerkenes Eco-Center Team in collaboration with ŞAHDER conducted a very successful program for the promotion of solar energy, a drip irrigation scheme for organic gardens and pursued other ongoing programs, including solid waste separation for composting and recycling, reuse of grey-water and promotion of appropriate materials and design for energy efficient buildings.

In 2004 and 2005, with generous funding from the Canada Fund and additional funds from the Tyche/ArcheoCommunity Foundation (USA), Burdens Charitable Foundation (UK), New Holland Trakmak (Turkey), MESA, AKG and Mr Erdogan Akdag as well as help in kind from the Yozgat Governorate, The Directorate of Rural Services and the Municipality of Sorgun, the Kerkenes Eco-Center completed its first straw-bale buildings i.e. straw house and a greenhouse (Figs 5 and 6) and pursued other ongoing programs, including simple drip irrigation for organic gardens (Fig. 7), solid waste separation for composting and recycling, reuse of grey-water, and promotion of appropriate materials and design for energy efficient buildings (Fig. 8).

a ***b*** ***c***

Figure 4. (a) and (b) Ecomud building built in 2002; (c) the roof was redone using AKG Gazbeton blocksduring a Hands-on session with METU students in 2012.

a ***b***

Figure 5. (a) Straw bale house built in 2004 and (b) completed in 2005.

a ***b*** ***c***

Figure 6. (a) and (b) Greenhouse built with straw bales in 2004. (c) Seedlings in the spring.

a ***b***

Figure 7. (a) and (b) Introduction of drip irrigation in Şahmuratlı Village.

During 2005 to 2008, two important buildings were constructed in Kerkenes Eco-Center; Akdağ center and solar house. The Erdogan Mustafa Akdag Foundation sponsored to build a center for Research and Education, with aerated concrete provided by AKG and roofing material by Onduline, to host visitors, village activities, regional events and dynamic displays on the archaeological and ecological activities of the Kerkenes Project (Fig. 8).

a ***b***

Figure 8. (a)Erdoğan Akdağ Center built with AAC blocks in 2005 and (b) completed.

A landmark at the Kerkenes Eco-Center is the solar house which played a significant role in establishing an economically viable production of ecologically processed food products using solar power (Fig.9). The roof of solar house was repaired in 2011 however, unfortunetly due to poor workmanship and harsh winter in 2014 the waterproofing of the roof had to be replaced. The roof was renovated in 2015 thanks to donations. Major repairs included a new rubber sheet and the replacement of interior beams and rafters damaged by water infiltration. The ACC blocks were preserved as this innovative use of the material improves the enegy efficiency of the building (Fig. 10).

a ***b***

Figure 9. The Kerkenes Solar House built in 2006 and (b) used to promote solar energy.

a ***b***

Figure 10. Solar house roof repair in 2015 and 2016.

During the same time efforts were made to develop the solar energy by implementing the first solar water heater, developing solar dryers, testing design of solar cookers and promoting solar processed food from the village into different occasions. Villagers were involved into those projects through ŞAHDER and some international grants. Solar cookers were distributed and a free access to the facilities of the Eco-center was granted to the villagers to produce their own solar processed products (Fig. 11).

Figure 11. Solar dryers, solar cookers and hot water collectors at the Kerkenes Eco-Center.

From 2008 to 2011 meetings were made with housewives in the village to help them understand their needs and aspirations. The suggestion of using solar energy for cooking and domestic water heaters was well received. Ways of taking advantage of this renewable source of energy for income generating activities were also discussed (Fig. 12).

Figure 12. Meetings and presentations for villagers.

Meanwhile panels, national and international visits and workshops aiming to disseminate information and provide training for inhabitants of Şahmuratlı and neighbouring villages, local school pupils and other youth groups were organized (Fig. 13); one example worth to mention was the visit of group of students from local school as part of an EU project program (Fig. 14). Moreover, various kermesses were held to promote ecologically prepared Kerkenes products such as the solar cooked jams, solar dried fruit and vegetables and similar items all produced in the Kerkenes Eco-Center (Fig. 15). It must be mentionned that garden products from the Kerkenes Eco-Center, cooked in a special Kerkenes fashion, were much appreciated by the team and visitors.

Figure 13. Kerkenes Festival and other events attracting national and international visitors (2008-2011).

Figure 14. Local school students visiting the Eco-Center and making mud bricks in 2011.

Figure 15. Kermesses and events at different venues in Ankara and Yozgat (2008-2011).

Figure 16. Kermess and presentations at METU (2009-2011).

One result of those events was an increased consciousness of the importance of the Kerkenes Eco-Center Project as a model for a low carbon high growth economy as a major component in sustainable rural development. Public outreach was extended through the distribution of posters, leaflets and reports together with updating of the much-visited the Eco-Centre web page. Another crucial result was the establishment of contacts with interested parties in a wide range of administrative, corporate, academic fields as well as NGOs and foreign embassies. Collaboration with and between many of these parties, stakeholders and individuals is ongoing

Promotional events were also organised in Ankara, at the Middle East Technical University (METU), Faculty of Architecture where the Kerkenes Project Team has an all year round base for research, public outreach and publication. METU event included presentation and discussion issues related to renewable energy, low-carbon economy and sustainability and an exhibition and kermess promoted the Kerkenes Eco-Center activities and products (Fig. 16). On all these occasions, the Kerkenes Eco-Center was presented as a model for low-carbon high-growth rural economy that can be replicated regionally and even nationally.

From 2012 to 2016 together with meetings, local, national and international group visits and promotion of Kerkenes products two main programs were followed regularly at Kerkenes Eco-Center i.e. experimental activities and research projects. Experimental activities have been made with different materials including reused aluminum cans and bottle, mud, straw, pine-needle, lime, paper, AAC, car tyres, etc. Research projects include academic research on environmental studies, local materials and their properties (mud bricks and their additives, building with lightweight loam and pine-needles) as well as studies on evaluation of thermal performance of different buildings in terms of energy efficiency.

Students and researchers from METU had a great role in development of Kerkenes Eco-Center. METU hands-on building course, held regularly each year, has offered several experimental sessions to the students. Students were responsible for building new facilities and furniture for the Eco-Center together with villagers, masters and workers. A review of the conducted projects during past five years proofs the efficiency of the program in terms of experience for students and development for Eco-Center. Figures 17 to 26 present a summary of accomplished projects during hands on building course from 2012 to 2016 together with promotion of Kerkenes products.

Academic research in Kerkenes Eco-Center started in 2006 and has been followed by METU researchers regularly from 2012. Main research ideas aimed to search for affordable and energy-efficient construction techniques with local and reused materials suitable for rural settlements (Fig. 25-26), to test and enhance the properties of natural materials by appropriate additives (Fig. 27), to experiment different type of plasters suitable for straw-bale buildings (Fig. 28) and to compare the thermal performance of buildings of traditional and contemporary construction (Fig 29).

All these research and projects have been made possible with the support of several national and international companies, their trust into the benefits of this project and the grants associated to some particular realizations.

Figure 17. Repair of Eco-mud building roof and construction of geodesic dome (2012).

Figure 18. Kerkenes products and Kermess in METU (2012).

Figure 19. Şahmuratlı Village school before refurbishment (2013).

Figure 20. Şahmuratlı Village school after refurbishment (2013).

Figure 21. Insulation with AAC; rocket stove construction; building arch with AAC blocks during hands on course (2013).

Figure 22. Kerkenes products and Kermess (2013).

Figure 23. Vault with AAC blocks; sunspace wall; geodesic dome construction during hands on course (2014).

Figure 24. Construction of sunspace along south façade of former school (2014-2015).

Figure 25. Hands on activities (2015).

Figure 26. Hands on activities (2016).

Figure 27. Working with local and reused materials (2005-2009).

Figure 28. Experiment on efficiency of rocket stove for space heating in two different buildings (2014).

Figure 29. Academic research on local materials and their properties (mud bricks and their additives, 2008, building with lightweight loam and pine-needles, 2013)

Figure 30. Research on different type of plasters suitable for straw-bale walls (2015-2016).

Figure 31. Experiment on thermal performance of the building using data loggers and sensors (2015-2016).

FUTURE PERSPECTIVES

Since it was initiated in 2002, the Kerkenes Eco-Center has played a major role in promoting rural development and arousing awareness on the importance of an environmental approach in everyday life for a sustainable future. The project could not have existed without friends, volunteers and sponsors and yet its role is of utmost importance in securing a sustainable future for our planet. It has been a model for others to initiate such ventures in the region, şn Turkey and even beyond the borders of Turkey. The aim is to reach all sectors of our society and to make everyone conscious that as indviduals we have a role to play and for the sake of our children and gran children we need to take things in hand. It remains here to ask those who have supported the Kerkenes Eco-Center Project and those who may consider to do so in the future, to help us develop further this ambitious project and support both research, educational and promotional activities.

THANK YOU!

APPENDIX

National and international publications and conference proceedings related to the Kerkenes Eco-Center

2016. Farzin Moghaddam, M., Farhoudi, M.; Elias Ozkan, S. T. and Summers, F. Refurbishing for thermal comfort: The rehabilitation of an abandoned village school building. In: *Conference on Passive and Low Energy Architecture (PLEA)*, Los Angles, 11-13 July.

Abstract This paper presents details of a refurbishment project carried out on an abandoned school building, in a Turkish village, that was converted into a multipurpose facility for the Kerkenes Eco-Center, to hold workshops and university courses, and to house the participants. The refurbishment was aimed at maximizing thermal comfort conditions and reducing energy loads by using solar energy for water and space heating. To this end thermal insulation was added to the roof and to the part of the wall facing north; solar water heaters were installed; and a sunspace was built along the southern façade. This space was divided into three areas: solar drying of fruits and vegetables on one end; a greenhouse for growing vegetables on the other end; and a dining area in the middle. Funding for the refurbishment project was provided by the local government and the university students were involved in its construction. Temperature and humidity data were recorded before renovations, after refurbishment, and after adding the sunspace; while the building was also modelled to simulate its energy consumption. All collected data were analyzed and the results show that the building has become thermally comfortable after refurbishment and its performance has increased further after adding the south facing sunspace.

2016. Pedergnana, M. Post-occupancy evaluation of straw-bale buildings in Turkey. In: *Natural Building in the 21st Century International Straw Building Conference.* Methven 3-9 March.

2015. Summers, F., Elias Ozkan, S.T. & Pedergnana, M. The kerkenes eco-center: a show-case for appropriate housing and sustainable development in rural Turkey. In: *Conference on Passive and Low Energy Architecture (PLEA)*, Bologna, 9-11 September. September.

Abstract Lightweight loam is an improved traditional mud-based building material consisting of slip clay mixed with a large amount of natural aggregates or fibers that have good heat insulating properties. Amongst the ingredients commonly used are agricultural by-products such as straw, waste such as wood chips, and porous mineral aggregates such as expanded clay. This alternative building material is therefore an appropriate choice when aiming for sustainable building materials and technique: it is available locally, has low embodied energy, and provides an opportunity for self-built construction. The material itself is light (with a density less than 1200 kg/m3) and has good thermal properties. The type of fibers in lightweight loam construction varies depending on their availability. Since organic by-products are now more widely used as a source of energy and their price is increasing, research on new types of fibers for construction with lightweight loam should be initiated. One suggestion is to experiment with pine needles that are used traditionally as fibers for cob and mudbrick in Latin-American countries as well as in Turkey. Pine needles can thus be used as an alternative in lightweight loam construction. Since lightweight loam construction is not load-bearing and is noted for its good heat insulating properties, the main concern is to test the material for shrinkage and water absorption. Experiments were conducted to determine the most appropriate mix of pine and wet loam. Samples were dried in a controlled

environment. Other samples were produced with a manual block press in order to facilitate production with equipment that would be easily available and affordable to the self-builder. Different ratios of pine needle to wet loam were tested for their thermal performance and water resistance properties. The experiments have showed that the production of lightweight loam with pine needles is viable. This paper presents results in hand and recommendations for developing further this building technique.

2015. Pedergnana, M. Straw-Bale Buildings in Turkey. In: *European Strawbale Gathering*. Paris 20-25 August.

Abstract During the past 20 years, less than 20 straw-bale buildings have been built in different regions of Turkey despite a world-wide recognition of the quality of these buildings. Most of those buildings have been built for experimental or research purposes and a few by people leaving the cities to build another life. Most of the experiences were successful and the buildings appreciated by its owners but the low level of communication between the different actors prevent the knowledge on this technique to spread. Moreover, these first buildings have been built without a deep knowledge on natural material and energy efficiency, but just for the sake of using straw-bales. Since a few years, through ecological building workshops and different actions around ecological construction and life-style, a small informal network has been created and is looking forward to improve the quality of straw-bale and natural buildings. Not only the usage of straw and other fibers is aimed but also the development of more comfortable and resilient houses with designed based on local knowledge as well as modern techniques such as solar passive techniques. This presentation will introduce this informal movement and its aims through some previous examples of straw-bale and natural buildings in different regions of Turkey. The results of the different workshops and their actors will be presented as well as the last realizations of some of their participants. The focus will be made on two non-finished buildings that are representative of the problems and solutions existing in the non-existing Turkish straw-bale "network".

2013. Aslan, E & Pedergnana, M. Preliminary Study on Lightweight Pine Needles Loam. In: *International Conference on New Generation Earthern Architecture: Learning from Heritage.* Istanbul Aydin University, 11-14 September.

Abstract Lightweight loam is an improved traditional mud-based building material consisting of slip clay mixed with a large amount of natural aggregates or fibers that have good heat insulating properties. Amongst the ingredients commonly used are agricultural by-products such as straw, waste such as wood chips, and porous mineral aggregates such as expanded clay. This alternative building material is therefore an appropriate choice when aiming for sustainable building materials and technique: it is available locally, has low embodied energy, and provides an opportunity for self-built construction. The material itself is light (with a density less than 1200 kg/m3) and has good thermal properties. The type of fibers in lightweight loam construction varies depending on their availability. Since organic by-products are now more widely used as a source of energy and their price is increasing, research on new types of fibers for construction with lightweight loam should be initiated. One suggestion is to experiment with pine needles that are used traditionally as fibers for cob and mudbrick in Latin-American countries as well as in Turkey. Pine needles can thus be used as an alternative in lightweight loam construction. Since lightweight loam construction is not load-bearing and is noted for its good heat insulating properties, the main concern is to test the material for shrinkage and water absorption. Experiments were conducted to determine the most appropriate mix of pine and wet loam. Samples were dried in a controlled

environment. Other samples were produced with a manual block press in order to facilitate production with equipment that would be easily available and affordable to the self-builder. Different ratios of pine needle to wet loam were tested for their thermal performance and water resistance properties. The experiments have showed that the production of lightweight loam with pine needles is viable. This paper presents results in hand and recommendations for developing further this building technique.

2013. Elias Ozkan, S. T. and Summers, F. Thermal performance of three different strawbale buildings at the kerkenes eco-center. *Journal of Green Building*, 8 (4): p. 110-116.

Abstract Traditional building materials in rural Turkey are rapidly being replaced by hollow extruded clay blocks (*blok tuğla*) and reinforced concrete. Skills developed and perfected over many generations are now being lost and forgotten. The properties of modern materials are not fully considered and if advantages are understood, disadvantages remain unchallenged. The noticeable difference between the insulating properties of a single leaf wall built of 19 cm wide extruded clay blocks, and those of a 50 cm thick mudbrick wall is ignored and as a result a significant amount of heat is unnecessarily dissipated. An initial saving in the capital cost of buildings results not only in high heating costs but also creates conditions that remain well below the expected standards of comfort. If capital cost is a critical issue and the rural population of Turkey is unable to invest in the initial extra expense to provide adequate insulation to their newly built houses, alternatives should be suggested. Is the return to traditions and local materials the solution? An ongoing study1 conducted at the Middle East Technical University in Ankara focuses on documenting the rapidly disappearing traditional buildings, materials and techniques and making comparative analysis of the environmental performance of buildings, traditional and contemporary, with the help of computer simulation studies. Alternative and appropriate building materials are to be proposed and tested.

2011. Korkusuz, E.A., Mutaf, G., Çakmaklı, B. & Summers, F. A sustainable local development model: Improvement of the solar powered devices in yozgat şahmuratlı village. In: *9th national congress of environmental engeenering*, Samsun, October 05-08.

Abstract. Within the project called "The Demonstration and Promotion of Solar Energy Uses in Şahmuratlı Village" (TUR-05-14, which was financed mainly by the United Nations Global Environment Facility's Small Grants Programme (UNDP-GEF) and implemented by the Kerkenes project office and Şahmuratlı Association between 2006-2007, the concept of using solar power and solar-powered designs (solar cookers, solar dryers and solar box ovens) has been introduced to the villagers and several practices have been held. Since the villagers have participated to both to the trainings and design works during the applications of the solar-powered designs, they have gained mastery on these topics. However, within time, villagers have encountered a number of difficulties while using the solar-powered designs (e.g. the need to replace frequently the reflective adhesive paper on the cookers, the heaviness of the cast iron cooker and the low efficiency of the solar drier). To overcome those problems, a new project called "Improvement of the Solar Powered Devices and Branding Infrastructure in Kerkenes, Sorgun", which has been developed by the Kerkenes project office and Şahmuratlı Association and supported by the UNDP-GEF, has been applied between 2008 to 2010.

2011. Summers, F., Elias Ozkan, S.T. and Cakmakli, B. The Kerkenes Eco-Center. In: *Ekoyapi* 6, August-September pp: 112-116.

Abstract An overview of Kerkenes Eco-Center project from 2002 to 2008.

2011. Summers, G., Summers, F., Elias-Ozkan S.T. &. Weber, G.-W. The Kerkenes Eco-Center Project. OR Meets Archaeology, Architecture and Engineering for Science and the Improvement of Living Conditions in Rural Anatolia. In: *Problem of nonlinear analysis in engineering systems*, 17: 156-158.

Abstract A background on stablishing Kerkenes Eco-Center and its development

2009. Elias-Ozkan, S.T., Summers, F & .Taner, O. (2009). Energy efficiency of buildings with a solar space: two case studies from the Anatolian plateau. In: *The* 26th *Conference on Passive and Low Energy Architecture (PLEA),* Quebec, 22-24 June.

Abstract This paper discusses two case studies on the energy efficiency of buildings with south facing solar spaces. The study was conducted on buildings located on the Anatolian Plateau, a semi-arid upland region of Central Turkey where the harsh climate is characterized by long severe winters and hot, dry summers. One is an experimental hollow-brick building on the edge of Ankara, the capital city, and the other is a mud-brick building at the Kerkenes Eco-Center located in a traditional village in the Yozgat region. Findings of this study have demonstrated that solar spaces added to both structures have a positive influence on the thermal performance of these buildings by reducing the annual heating loads by almost 10%.

2008. Elias Ozkan, S. T., Summers, F., Karaguzel, T. and Taner, O. Analyzing environmental performance of AAC blocks, strawbales and mud-plaster in hybrid wall construction. In: *The 25th Conference on Passive and Low Energy Architecture (PLEA)*, Dublin, 22-24 October/

Abstract The aim of this study was to compare the thermal performance of three buildings which are located at the Kerkenes Eco-center in Yozgat, Turkey. The first of these was constructed with strawbales rendered with mud plaster; the second with aerated autoclaved concrete (AAC) blocks and cement plaster; and the third with strawbales rendered with mud plaster inside and a layer of thin AAC blocks on the outside. The last type of hybrid wall construction has been tried for the first time, in order to take advantage of the thermal-insulation property of straw, combined with the humidity-regulating property of mud plaster inside and weather resistance property of AAC outside. Temperature and humidity data were collected in these three buildings for certain time periods, concurrently. These data have been compared to elicit the degree of variance in the performance of the three types of constructions. Additionally, computer models of these buildings have also been simulated with Ecotect v5.5 for a comparison of their total energy loads.

2006. Elias Ozkan, S. T., Summers, F., Surmeli, N. and Yannas, S. A comparative study of the thermal performance of building materials In: *The 23rd Conference on Passive and Low Energy Architecture (PLEA)*, Geneva, 6-8 September.

Abstract This study focuses on the environmental performance of a selection of buildings in the typical Central Anatolian village of Şahmuratli in Turkey. The objective was to search for

affordable and energy-efficient construction techniques suitable for rural settlements and incorporating traditional cultural values in a semi-arid upland region characterized by long severe winters and hot, dry summers. This was pursued by analyzing temperature and humidity measurements within buildings constructed from a variety of traditional and modern materials. The thermal behavior and comfort, the patterns of energy use and the appropriateness of the different building techniques and materials are analyzed, compared and discussed. Aspects of this ongoing study, initiated by a British Council Partnership Program, are presented in this paper which focuses on a traditional mudbrick structure, a straw bale house and an aerated concrete building. We demonstrate how a building envelope reacts to outdoor conditions through graphic illustration and show ways in which the research can be extended by the creation of simulations using Ecotect software. This research contributes to the promotion of passive and low energy architecture towards a sustainable future.

2006. Summers, F. The Kerkenes Eco-Center and associated studies, *International Study Visit to the Straw-bale Energy Efficient Housing Project*. 9th-15th July People's Republic of China.

Abstract A presentation of the purpose of the Kerkenes Eco-Center and ongoing activities including village studies in central Anatolia, building with traditional materials and techniques, recycling and studies on environmental performance of buildings

2006. Summers, F. & Elias Ozkan, S. T. *Advanced seminar on bioclimatic architecture in the Mediterranean countries,* within the framework of the AZAHAR Program, organized by the Spanish Agency for International Co-operation (AECI) and the Catalan Agency of Co-operation to Development, with the collaboration of the Catalan Institute of Energy Barcelona, 8-14 June.

Abstract Presenting case studies from Turkey for bioclimatic design

2003. Summers, F., Gezer, N. and Karaguzel, O. T. Comparative studies of traditional and contemporary construction in Turkey. In: *The 20th Conference on Passive and Low Energy Architecture (PLEA)*, Santiago, 9-12 November.

Abstract The paper will report on the findings of a study of comparative thermal performance of buildings of traditional and contemporary construction in the Central Anatolia region of Turkey. The study combined short-term temperature and humidity measurements with a series of parametric studies using a computer simulation model. Measurements were taken in four single-story, detached buildings in the village of Sahmuratli in Yozgat, Central Anatolia (latitude 40N). The climate of the region is characterized by cold winters and warm summers. Winter temperatures are near or below freezing in December and January. In summer, outdoor air temperatures rise to peaks above 30C in July and August, and display a considerable daily fluctuation. Thus for summer, in addition to solar control, this climatic profile suggests the need for high thermal capacity in the building structure, acting as interim heat sink, with night-time ventilation or radiative cooling as the permanent heat dissipation mechanisms. In winter thermal insulation is clearly the critical parameter so that solar and internal gains can lead to meaningful temperature rises whilst the thermal capacity of the structure controls temperature fluctuations.

2003 Summers, F. The future of rural housing in Turkey: Back to earth? In: *Peter Steingass (ed) Moderner Lehmbau*, Berlin 24-26th October. Fraunhofer IRBVerlag, Germany: 174-182.

Abstract Traditional building materials in rural Turkey are rapidly being replaced by hollow extruded clay blocks (blok tuğla) and reinforced concrete. Skills developed and perfected over many generations are now being lost and forgotten. The properties of modern materials are not fully considered and if advantages are understood, disadvantages remain unchallenged. The noticeable difference between the insulating properties of a single leaf wall built of 19 cm wide extruded clay blocks, and those of a 50 cm thick mudbrick wall is ignored and as a result a significant amount of heat is unnecessarily dissipated. An initial saving in the capital cost of buildings results not only in high heating costs but also creates conditions that remain well below the expected standards of comfort. If capital cost is a critical issue and the rural population of Turkey is unable to invest in the initial extra expense to provide adequate insulation to their newly built houses, alternatives should be suggested. Is the return to traditions and local materials the solution? An ongoing study1 conducted at the Middle East Technical University in Ankara focuses on documenting the rapidly disappearing traditional buildings, materials and techniques and making comparative analysis of the environmental performance of buildings, traditional and contemporary, with the help of computer simulation studies. Alternative and appropriate building materials are to be proposed and tested.

Workshops

2005. The British Council Britain Turkey partnership programme. Workshop on Environmental Performance of Buildings; Discussions on the use of simulation software, Ecotect and Energy 10 and Appropriate Building Materials. 30th June- 1st July. METU.

The Kerkenes workshop on sustainability (2008). December 04th, METU.