

# THE KERKENES ECO-CENTER

## A REPORT ON THE 2003 PROGRAM



*Figure 1. (a) The Kerkenes Dağ with the ruins of the Iron Age city is seen in the distance behind the village of Şahmuratlı where the Eco-Building, a traditional mudbrick construction, was completed in the autumn of 2003. (03kejv0503)*

*(b) The mudbrick building was built to host the first activities of the Kerkenes Eco-Center project and will house the Şahmuratlı Village Association. (03kecn0605)*

# THE KERKENES ECO-CENTER PROJECT

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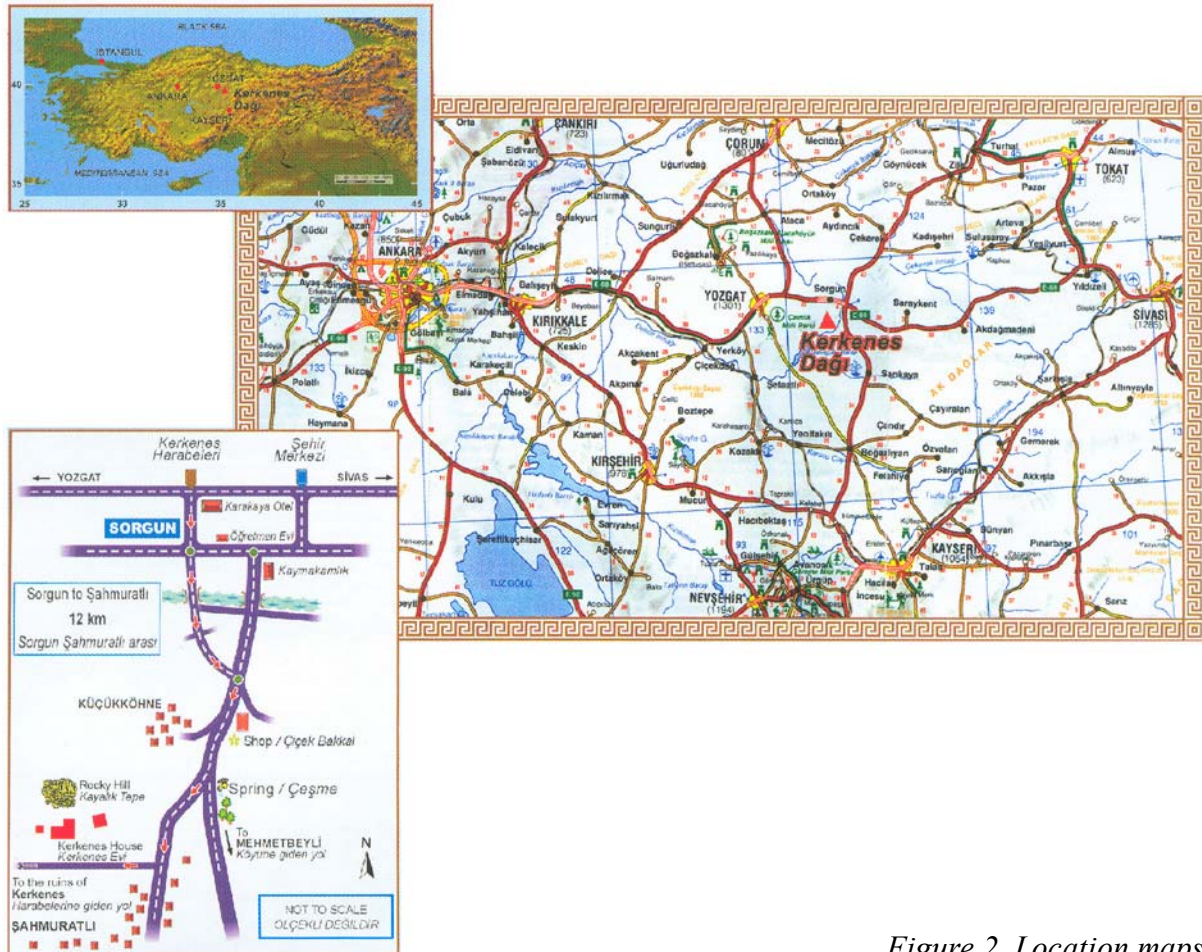


Figure 2. Location maps.

## ACKNOWLEDGMENTS

The first activities of the Kerkenes Eco-Center in the village of Şahmuratlı, Yozgat, were initiated during the 2002 summer season and pursued in 2003 as a result of support received from the Direct Aid Program (DAP) of the Australian Embassy. At the same time, a study of the 'Environmental Performance of Buildings', funded by the British Council Partnership Scheme for collaboration between the Architectural Association (London) and the METU Department of Architecture (Ankara), provides an opportunity for students to get involved in activities related to the new Eco-Center venture through the selection of case studies at the village of Şahmuratlı. The new Eco-Building, funded in 2003 by the DAP, was an ideal structure on which to focus these studies.

It has been very encouraging to have the continuous support of the *Vali* (Governor) of Yozgat and all the concerned local authorities working incessantly to improve the infrastructure and services on which the progress of the project depends. We are most grateful to the directors and staff of the *Köy Hizmetleri* (Rural Services), *TEDAŞ* and *Türk Telekom* for improvements made to the water supply, the electricity network and the telephone system thus facilitating both research and daily life activities. We also thank the *Sorgun Kaymakam* (District Governor) Meftun Dalı, and *Belediye Başkan* (Mayor) Ahmet Şimşek for their invaluable help. In August 2004, the Governor of Yozgat, Gökhan Sözer, visited Kerkenes with a large entourage, including the Director of Rural Services, Muharrem Şengül, who can be praised for the new tarmac road leading to the ancient ruins through the village of Şahmuratlı.

Building materials and help in kind have been provided by Yibitaş Yozgat Çimento / Yibitaş Lafarge, the *Sorgun Belediye*, Onduline, ODE, the British Embassy, the Burdens Charitable Foundation and the Ankara Hilton. Seedlings and trees were given by the *Yozgat Belediye*. Dr Şevket Bağcı continues to provide support in many ways. The Şahmuratlı villagers, the retiring *Muhtar*, Ali Erciyes, and his replacement, Osman Muratdağı, continue to extend traditional hospitality to both the Kerkenes Team and visitors. Osman Muratdağı has also made his minibus and services available to the project on more than one occasion. In Sorgun, Kamar Supermarket assists with shopping demands and has provided a refrigerator for the Kerkenes House.

The Kerkenes Project research activities at the Middle East Technical University (METU/ODTÜ) are funded by grants channeled through the METU Development Foundation. We are most grateful for donations from Lafarge Sağlık Eğitim ve Kültür Vakfı, Bell Helicopter, the Anglo-Turkish Association, Yenigün, MESA, AKG Gazbeton and Mr Erdoğan Akdağ. The METU Computer Center provides technical support and hosts the Kerkenes web page. METU Press publishes the project's annual newsletter, *Kerkenes News/Haberler*, reporting in English and Turkish on all the different aspects of research and activities taking place at Kerkenes. In 2004 the project was asked to vacate the office in the Faculty of Architecture and we are most grateful to the METU President's Office for providing new premises within the library building.

The project Web Page (Fig. 3), which disseminates results to a wide audience of professionals, students and lay public, contains details of the numerous sponsors, collaborating institutions and participants.



<http://kerkenes.metu.edu.tr>

Figure 3. The Kerkenes web page opens up three homepages, the most recent one (K-Eco) being dedicated to the Kerkenes Eco-Center and Environmental Studies.

## THE KERKENES ECO-CENTER PROGRAMME

The Eco-Center was founded on the platform provided by the Kerkenes Project, which started as the archaeological survey of the ancient city on the Kerkenes Dağ, Yozgat, in 1993 since when it has become a well-established multi-disciplinary research project. Results of the archaeological survey and excavations at Kerkenes, directed by Geoffrey and Françoise Summers and funded by the British Institute of Archaeology at Ankara, National Geographic Society, Rolex Award for Enterprise and many others (see <http://kerkenes.metu.edu.tr>), and the post fieldwork multidisciplinary studies carried out at the Middle East Technical University (METU) in Ankara, have received international recognition. The Kerkenes House, the expedition base, is in the village of Şahmuratlı (Fig. 4). Research and domestic facilities have improved over the years thanks to many generous sponsors.



Figure 4. The village of Şahmuratlı in the spring. (03dpjv)

Continuing efforts put into developing the Kerkenes Eco-Center (Fig. 5) involve the villagers of Şahmuratlı as well as staff and students from METU. The villagers benefit directly from the results while the project will be a means of spreading, through an educational institution, knowledge and convictions touching on the important issues of environment and sustainability. The project also provides enthusiastic staff and students from METU with opportunities to participate actively in environmental studies. This report focuses on the 2003 programme although activities extending into 2004 are also discussed.



Figure 5. Preliminary Site Plan for the Kerkenes Eco-Center showing how the existing facilities will be extended to provide the necessary infra-structure for development and extensions.

### General aims and objectives

The aims and objectives focus on the welfare of Şahmuratlı Village. They provide an opportunity for the development of a viable and sustainable framework and organization which will allow the activities proposed to become self-supporting in the long term. These activities will be initiated by the Kerkenes Eco-Center Project but, once firmly established, it is anticipated that the Eco-Center would become self-supporting and largely run by the local contingency. The Kerkenes Eco-Center will also demonstrate possible ways of striving for a sustainable and an environmentally friendly approach.

Drip irrigation, reuse of grey water, composting, use of renewable energy and alternative approaches to building can all demonstrate practical and sustainable ways of caring for the future of our planet. The first grants to support planned activities, awarded by the Australian Embassy in 2002 and 2003, can be seen to bear fruits (Fig. 6).



*Figure 6. Vegetables were successfully grown in the Kerkenes Eco-Center garden where techniques of watering the plants in a controlled manner were adopted. (03kecn0406)*

Other activities related to the choice of building materials in conjunction with studies on environmental building performance were also initiated through the participation of METU students and the British Council Partnership grant. Experiments with alternative building materials and a study of the results will be the first step in the construction of facilities for the Eco-Center. These activities also provide an opportunity for students to have 'hands on' experience on which to base their studies.

### The Kerkenes Eco-Center Initiative and the Village Association

Staff and students from METU have been working with the villagers of Şahmuratlı during the annual summer campaign and progress is followed up from Ankara all year round. The project will use its web page to report on the results and spread knowledge. Convictions touching the important issues of environment and sustainability can thus be voiced to a wide public.

The most significant recent development is the initiative taken by a group of villagers to set up the Şahmuratlı Village Association which has recently acquired its legal status under the name of:

***Şahmuratlı Köyü ve Kerkenes'i Tanıtma, Güzelleştirme, Yardımlaşma ve Dayanışma Derneği*** (Benevolent and Supportive Association for the Improvement and Promotion of Şahmuratlı Village and Kerkenes).

The head of the Association, Osman Muratdağı, is also the Village Headman (Muhtar). A commendable initiative came from Şahmuratlı villagers, both in Turkey and abroad, who have set up a web page and have put the village on the World Wide Web at:

**<http://www.sahmuratli.com>**

## THE 2003 PROGRAMME OF ACTIVITIES

### Ongoing Project Activities

Ongoing activities, around which further development continues to take place, can be classified as follows:

1. Controlled irrigation and reuse of grey water;
2. Recycling and composting;
3. Use of renewable energy;
4. Alternative building materials such as mud-bricks, pressed mud blocks, straw bales and papercrete;
5. Research and dissemination of information.

#### *Controlled Irrigation and Reuse of Grey Water*

Project activities initiated in 2002 continue to progress, the garden program (Fig. 7) having already yielded interesting results. Both the grey water scheme and the drip or controlled irrigation for the vegetable garden have successfully demonstrated that limited water resources can be stretched for a maximum yield. A new experimental system for controlled irrigation using ODE geotextile wrapped around perforated pipes was set up in 2004. Mehmet Ekmekçi and Harun Aydın from the Department of Hydrogeology at Hacettepe University have studied the water resources of the area and a scheme for the management of water and the use of wind pumps awaits funding. Geologist Tuygun Savacı from the *Yozgat Köy Hizmetleri* has conducted surveys in an attempt to resolve the seasonal water crisis in the village.



*Figure 7. Controlled irrigation provided by perforated pipes has stretched the limited supply of water during the summer months when there is a high demand from the crowded expedition compound and the rest of the village. (03kesl0231)*

#### *Recycling and Composting*

Solid waste is separated at Kerkenes. Organic waste is composted in a discrete feature within the garden while a shelter has been built to store bottles and cans for reuse in construction of walls. Plans to recycle paper in the village are being considered. It is to be noted that the lack of local recycling plants makes recycling impractical in many cases, as the waste collected has to be transported to remote facilities at great cost.

### *Use of Renewable Energy*

The advantages of using a solar water heater were clearly attested when the first unit was installed on the bathroom building roof in 2002. A second unit was purchased before the 2003 fieldwork season for installation above the roof of the main building to serve the kitchen and bathrooms within the house.



*Figure 8. The solar water heater, used to provide hot water for the showers, proved to be very efficient and economical. (03kejv0408)*

### *Alternative Building Materials*

Other activities included the production of mudbrick (Fig. 9), the recycling of waste (Fig. 10) and the construction of a small mudbrick building to house the Village Association and its first activities. The key to the success of the Kerkenes Eco-Center is its sustainability. It is anticipated that the center can become self-supporting through the activities and enterprise of the Şahmuratlı Village Association. Small-scale workshops with local labour would help regenerating the rural areas of Turkey. Şahmuratlı has the potential to be a shining example on a regional and even perhaps a national scale.



*Figure 9. Mudbrick made during the 2002 and 2003 summer seasons were used to build the Eco-Building completed in the autumn of 2003. (03jv0310)*



*Figure 10. Bottles and cans from drinks consumed during the summer season of archaeological fieldwork are recycled in the garden walls enclosing the expedition house compound.*

## Research and Dissemination of Information

During the 2003 fall semester, a poster (Fig. 11) on ‘Comparative Studies of Traditional and Contemporary Construction in Turkey’ was prepared for the PLEA (*Passive and Low Energy Architecture*) 2003 conference in Santiago, Chile. This presentation summarised the 2002/03 studies conducted by Françoise Summers, Nevin Gezer and Ömer Tuğrul Karagüzel from METU (Ankara) and Simos Yannas and Yasemin Somuncu from the Architectural Association (London). Ongoing studies are funded by the British Council Britain-Turkey Partnership Programme between the METU Department of Architecture and the AA Environment and Energy Studies Programme. In addition, a paper entitled ‘The Future of Rural Housing in Turkey: Back to Earth?’ was presented by Françoise Summers at the ‘*Modern Earth 2003*’ conference in Berlin. The Kerkenes Web Page is also used to disseminate results and information on the Kerkenes Eco-Center and associated environmental studies through the world wide web.

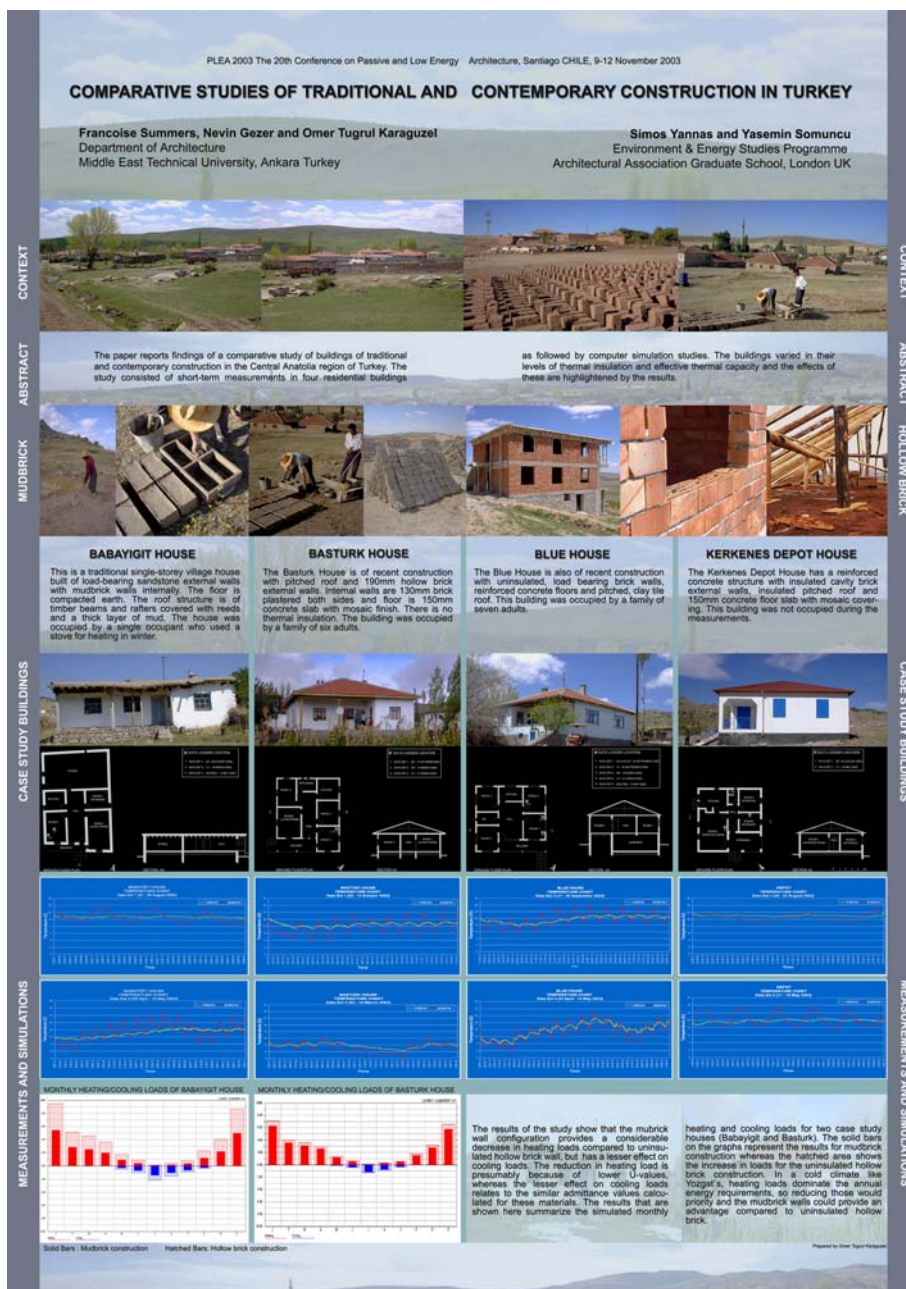


Figure 11. The poster prepared for the 2003 PLEA Conference.



## THE KERKENES ECO-BUILDING

### A One-Room Structure

It is thanks to the 2003 grant from the Australian Embassy Direct Aid Programme that construction of a small mudbrick structure within the Kerkenes Expedition House complex was undertaken in the autumn of that year as the first snow fell on the village (Fig. 12).

Timber posts and beams were incorporated within the mudbrick walls to provide stability against earthquake loads. The mudroof (Fig. 13), supported by a timber structure, has to be regularly rolled to ensure that it does not leak. A disadvantage of traditional mud walls and roofs is the need for regular maintenance but improvements can be made by the introduction of modern materials and techniques. Bitumen paper lined the roof while a Bituline waterproofing membrane, donated by Onduline, was applied to those parts of the walls that were constructed below ground level. Old car tyres were used as permanent formwork for pouring the concrete pillar on which the balcony posts and beams rest. Disused telephone poles, donated by Telekom, were sliced into blocks (Fig. 14) and set into the floor with a mixture of mud and lime (Fig. 15). The building was completed in November 2003 but the last coat of paint had to wait for the spring 2004.

New technologies can improve the performance of traditional materials and techniques, thereby combining the advantages of both. The project dynamically develops its research design so as to combine theoretical analysis with experimental studies in the field.



*Figure 12. The new mudbrick building is designed to demonstrate the advantages of indigenous building materials and traditional techniques. (03kejv0504)*

### Promoting Sustainability and the Development of Rural Settlements

The small structure, called the Eco-Building, houses the Şahmuratlı Village Association and will provide a meeting point for villagers to discuss and develop activities related to the welfare of the village. The Kerkenes Project has set up one of its computers, which awaits a modem for connection to the Internet. Future programmes will include workshops for both men and women, and educational activities for children. If the development of organic gardening attains a high level of success, it is envisaged that the Village Association would act as an outlet for the sale of the garden produce. It is also anticipated that the Association will eventually be able to provide facilities for guests and visitors attracted to the area by its rich cultural heritage, and in particular by the archaeological research undertaken at Kerkenes.



*Figure 13. The building has traditional mudbrick walls and a mud roof which has to be regularly rolled to ensure that it does not leak. (03kejv0609)*



*Figure 14. Disused telephone poles from Telekom have been recycled and used in the floor construction. (04kejv0509)*



*Figure 15. The floor consists of the timber blocks embedded in a mixture of mud and lime. (03kejv0601)*

## Environmental Studies

Consisting of a single room and a balcony, the new building (Fig. 16) with its traditional mudbrick walls and mud roof is an ideal structure for the ongoing study of indigenous building materials and traditional construction techniques because it is simple to configure for simulation studies. Once its physical properties have been recorded and a virtual 3D model created (Fig.17), the building material configuration and other parameters can be changed so that simulations (Fig. 18) can be produced and compared. Tinytag dataloggers are used to record temperature and relative humidity both outside and inside the building. This data is then used to check, and adjust if necessary, the virtual model. Extensive environmental studies on actual and theoretical data can thus be performed.

Temperature and humidity are recorded with dataloggers located inside and outside the building. When several dataloggers are available, simultaneous collection of data can be recorded for two or more types of buildings. In this way excellent data sets can be recorded thus permitting comparative studies of the environmental performance of traditional building materials with those of industrially produced ones.

Other structures have been planned and will be built as soon as resources become available. One material that the team is eager to test is the autoclaved aerated concrete (AAC) block. AKG Gazbeton, which has already supported the research programme, has promised to provide the material needed for the construction of an AAC structure roofed with aerated concrete slabs.



*Figure 16. The new building will not only accommodate the Kerkenes Eco-Center but also be a model used for environmental studies. (03kejv0611)*

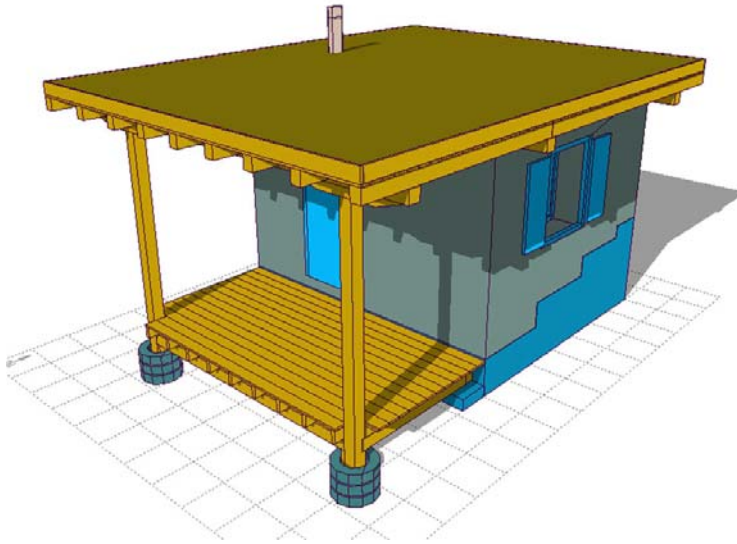
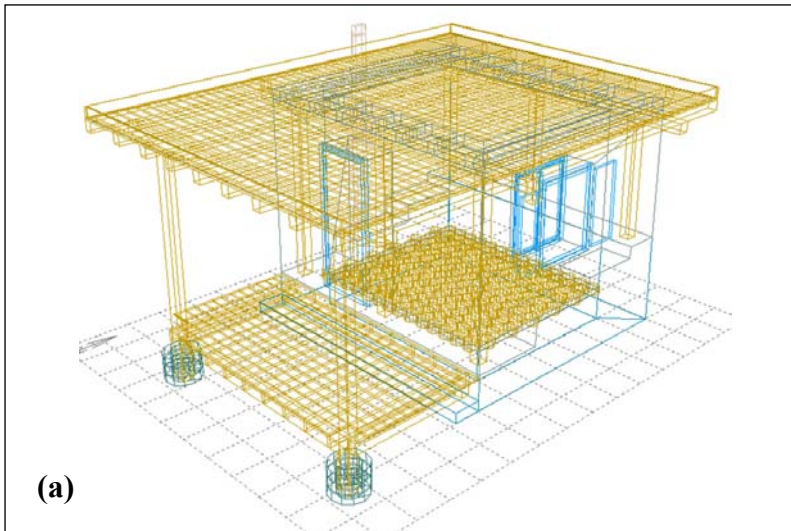
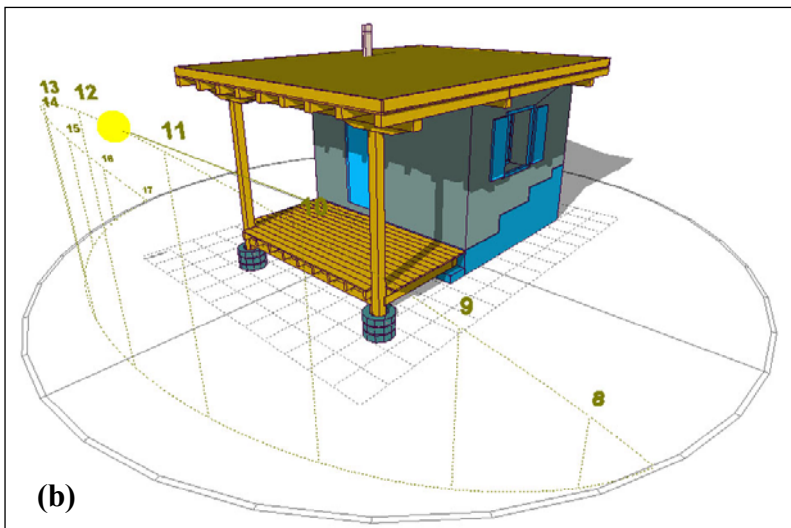


Figure 17. A 3D model can be tested with the environmental analysis software, Ecotect v.5.20.



(a)



(b)

Figure 18. The basic 3D model (a) is rendered and shaded (b) in Ecotect v.5.20 for a more realistic visualisation of the shading analysis. The sun-path diagram can be selected for any particular date and time in the chosen geographic location.

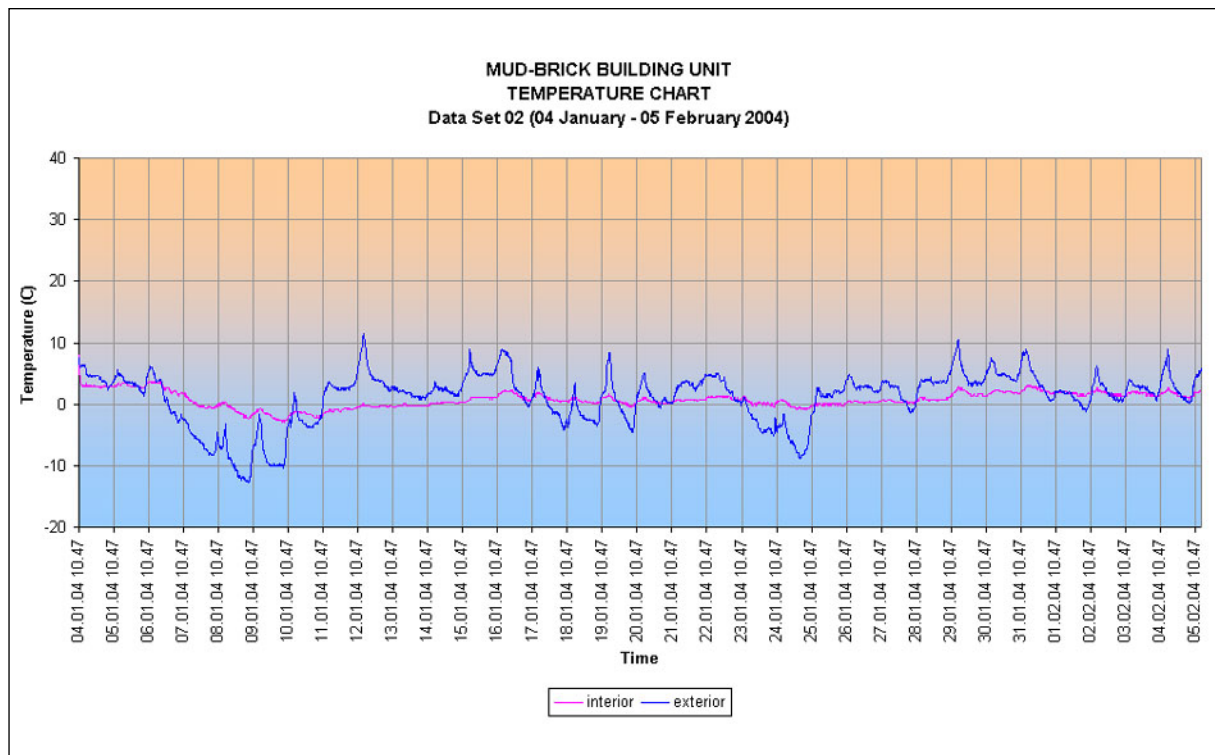
## Preliminary Results from Analysis

Environmental studies on the mudbrick building, conducted by Tuğrul Karagagüzel, not only provided valuable insights into its thermal performance (Fig. 19), but made it possible to compare the results from the computer model with the actual performance. This was done by matching the simulated dynamic thermal performance of the building with the real data. The building was neither occupied nor heated during this period. Actual temperature and relative humidity measurements collected by the Tinytag dataloggers for a one-month period were plotted together with the computer simulations made for the same period (Fig. 20). Graphs displaying both the real and calculated data can be used to judge the accuracy of the simulations and if discrepancies occur the given parameters can be checked and adjusted.

If the weather data (Fig. 21) for the given region is available simulations can be done for different times of the year. The model can be tested with the climatic data of other regions and the effect of building materials and climatic factors on thermal comfort inside a given building can be assessed.

It is possible to calculate the amount of energy required for space heating and cooling in order to maintain the ideal conditions for thermal comfort (Fig. 22). The environmental performance of traditional building materials (mudbrick, stone, timber frames, mud roofs) against those of contemporary ones (kiln fired bricks and tiles, cement blocks, and insulation materials) can be evaluated. Other parametric studies (Fig. 23) relating to building form and orientation or to window size, type and orientation can also be performed.

The graphs illustrated below represent a selection of results. It is hoped that the number of simulations performed can be enlarged for a better understanding of the environmental performance of all available building materials. The right choice of material for an efficient conservation of energy will bring long-term savings in fuel bills and help decrease the amount of carbon dioxide produced by our industrial society.



*Figure 19. The diurnal range of indoor temperature (pink line) for the mud-brick building was plotted against outdoor air temperature (blue line) for a one-month period between 04 January and 05 February 2004 during which the building was neither occupied nor heated.*

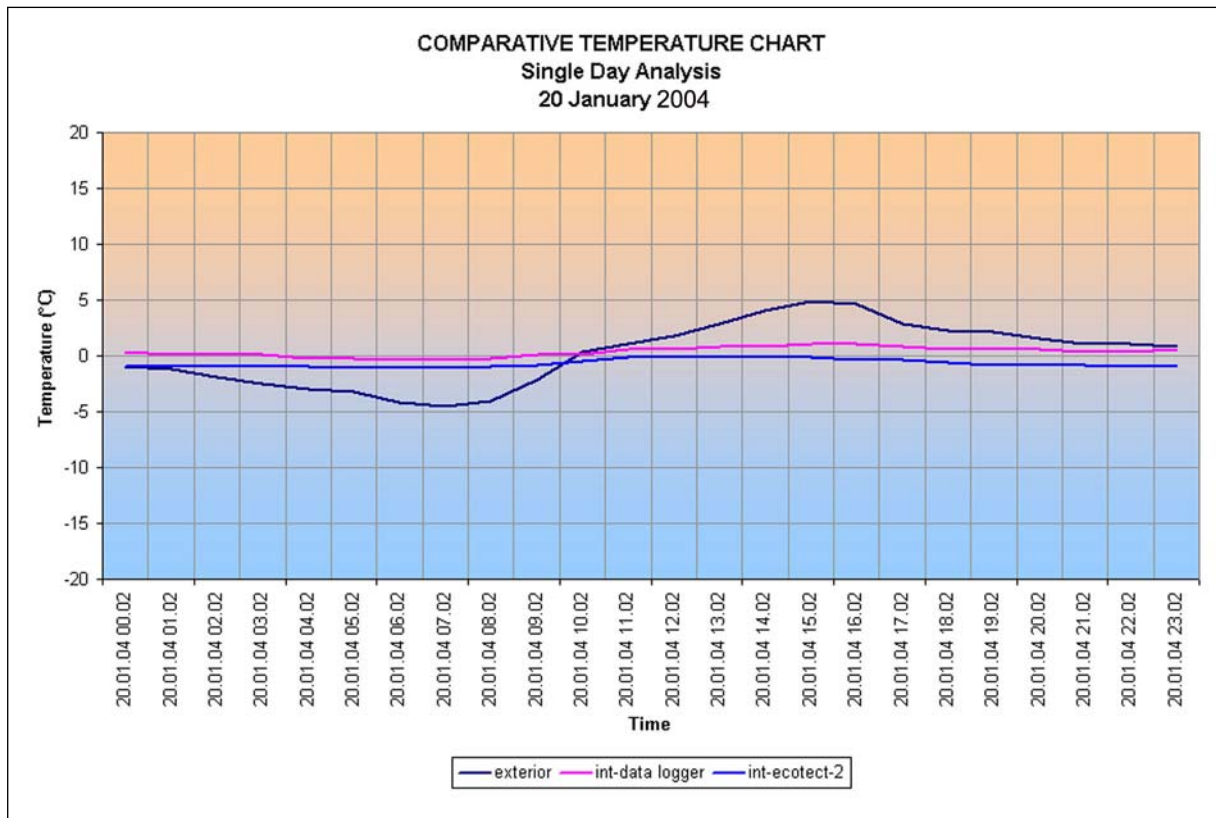


Figure 20. The hourly temperature profile for a single day analysis (20 January 2004) recorded by a datalogger placed inside the building (pink line) can be compared with the profile obtained from a computer simulation (blue line) performed in Ecotect v.5.20. The exterior air temperature recorded (dark blue line) is shown on the same graph.

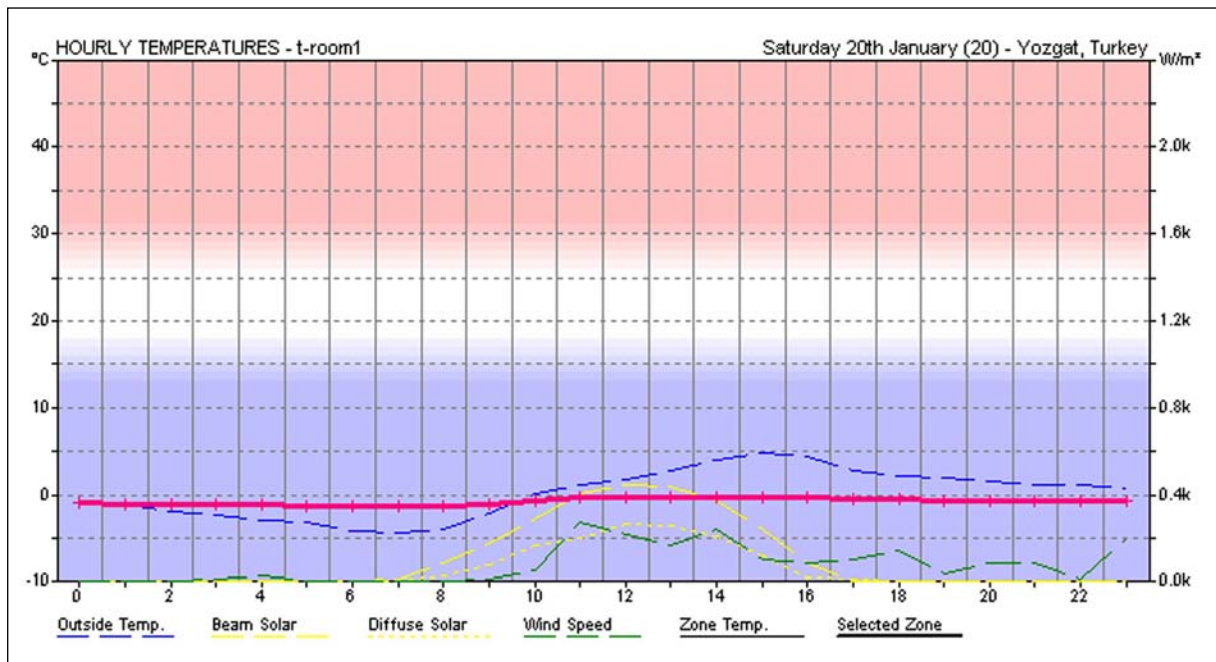


Figure 21. The hourly temperature profile inside the mudbrick building (pink line) on the 20th of January 2004 can be displayed in Ecotect v.5.20 against the weather data (5 years average) for Yozgat.

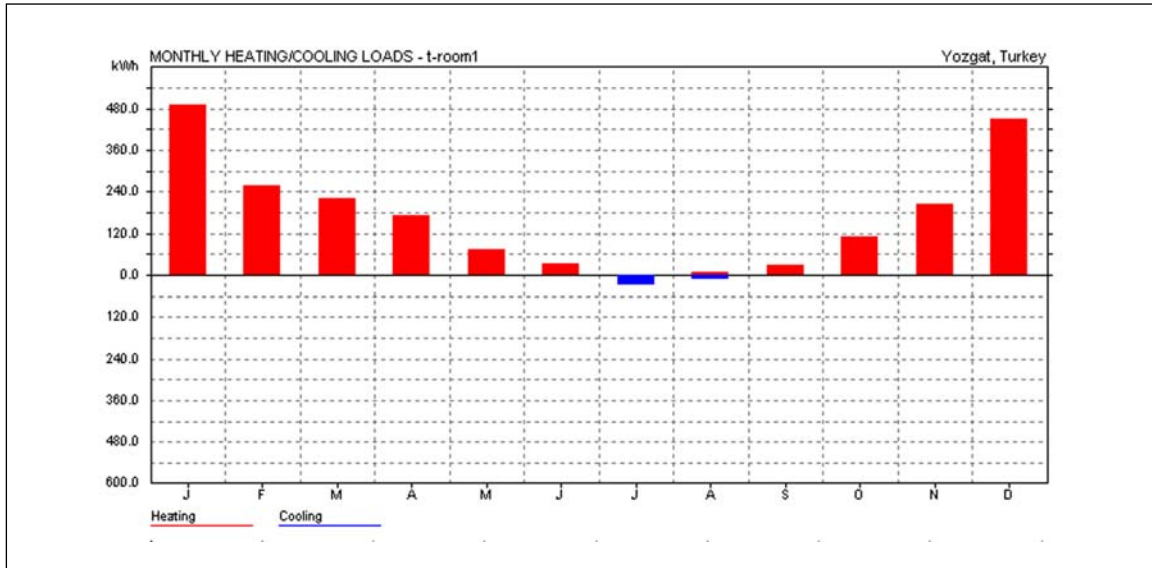


Figure 22. Monthly heating and cooling loads of an air-conditioning system assumed to be located in the mud-brick building as calculated by using the thermal analysis function of Ecotect v.5.20.

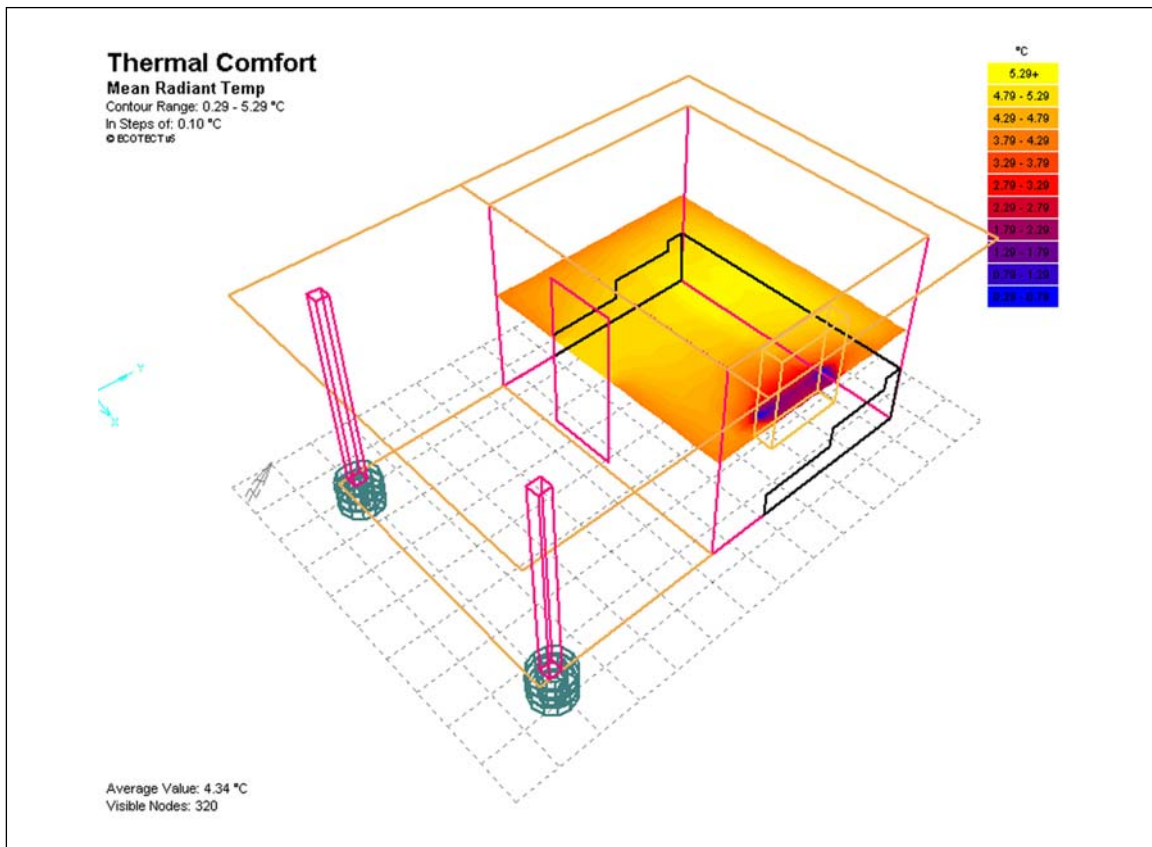


Figure 23. Results of the thermal analysis performed with Ecotect v.5.20 showing the mean radiant temperature levels (colour scale ranging from 5.29 °C to 0.29°C) on a grid inside the mud-brick building for the 20<sup>th</sup> of January 2004 under the climatic conditions of Yozgat. The building is assumed to be unoccupied and there is no air-conditioning system in operation.

## OVERVIEW

The 2003 programme for the Kerkenes Eco-Center Project was brought to a successful conclusion while paving the way for further development. The construction of the Eco-Building together with other on-going activities have demonstrated that the Kerkenes Eco-Center can advocate a sustainable and environmentally friendly approach to the development and improvement of rural settlements in Central Turkey. Official recognition of the Şahmuratlı Village Association in the summer 2004, after a lengthy round of bureaucratic procedures, was another significant milestone and has opened up more avenues for the implementation of future programmes.

The organic garden continues to be taken care of by Memiş Gençarşlan, the Kerkenes Project guard, who has experimented with different watering techniques (Fig. 24). It is hoped that support for the continuation of these activities and related research will be forthcoming. The grey water system also awaits improvements and would benefit from closer monitoring. Plans for a more detailed study of water resources management and the use of wind pumps and other renewable sources of energy will also be put forward in future proposals.

A most welcomed donation was a Parry Brick Press (Fig. 25), which arrived at Şahmuratlı in August 2004. During a trip to UK in November 2003, sponsored by the British Council Partnership Scheme, a visit was made to the Parry Workshop in Birmingham. The Parry News, Issue 37 ([http://www.parryassociates.com/NL37\\_jpa.htm](http://www.parryassociates.com/NL37_jpa.htm)) included an article on the activities related to the ongoing research. John Parry also introduced the Kerkenes Eco-Center Project to Anthony Burdens and we are extremely grateful to the Burdens Charitable Foundation for the purchase of a Parry Brick Press donated to the project.



*Figure 24. In the spring 2004 Memiş Gençarşlan set up a new experimental drip irrigation system, which uses geotextile wrapped up around the perforated pipes.*



*Figure 25. The Parry Brick Press arrived in the village of Şahmuratlı in August 2004 and our visitors, Hasan Çinar and Erkan Alemdar, were very keen to produce the first bricks.*



It is also encouraging to see great improvements to the infrastructure of the rural areas undertaken by the local authorities and we are all extremely grateful to everyone who has helped. The Yozgat Governor, the Directors and staff of the Yozgat Rural Services, TEDAS and Türk Telekom, the Sorgun District Governor and the Sorgun Mayor have continued to manifest their support for and interest in various aspect of the Kerkenes Project and should be thanked for responding to many requests coming from the village of Şahmuratlı.

In August 2004, the Governor of Yozgat, Gökhan Sözer, and his large entourage visited the Kerkenes Depot and Laboratory where the recent and most exciting new archaeological discoveries, including Phrygian inscriptions and a sculpture, were being restored. He also expressed interest in the Kerkenes Eco-Center activities (Fig. 26), which included strawbale construction. This provided Bora Topluoğlu, expert in straw bale construction, with the opportunity to explain how rural Turkey could benefit from the use of such building techniques, especially in earthquake zones.

The summer 2004 was when, once more, workers from Şahmuratlı village, students from METU and participants from other parts of Turkey and from distant places abroad, worked together to share knowledge and experiences. In August 2004 the construction of a small strawbale greenhouse (Fig. 27) was started under the expertise of Bora Topluoğlu who lives in Australia but regularly visits his native Turkey.



*Figure 26. In August 2004 we were honoured with the visit of the Governor of Yozgat accompanied by many local officials and press. This provided Bora Topluoğlu, expert in straw bale construction, with the opportunity to present the advantages of strawbales as a building material.*



*Figure 27. Workers from the Şahmuratlı village, students from METU and other participants learnt as much as possible from Bora Topluoğlu as they worked together to build the small strawbale greenhouse in August 2004.*

Finally, the most encouraging of all events was the acceptance of a proposal for the 2004 Kerkenes Eco-Center programme, focusing on the construction of a straw bale house and a small greenhouse at Kerkenes. This ongoing programme of activities has been generously funded by the Canada Fund of the Canadian Embassy. A full report on these exciting new initiatives will be prepared in due time. A few photos (Fig. 28) are provided below and progress can be followed on the Kerkenes web page at:

<http://www.metu.edu.tr/home/wwwkerk/keco/08photogal/04ph/index.html>



*Figure 28. The straw bale house construction was well advanced by the end of September 2004. (04kejv0904, 04kejv1307, 04kejv1317, 04kejv1319, 04kejv1401)*

## THE FUTURE

The future and success of the Kerkenes Eco-Center Project depends first of all on the support it gets from local officials, sponsors and friends. The Kerkenes team and the villagers of Şahmuratlı wish to express here their sincere thanks to all those who have provided support and encouragement and hope that many will be willing to sponsor the project until it reaches a viable level of sustainability. It is always a pleasure to invite everyone (Fig. 29) to visit us at Kerkenes.



*Figure 29. The villagers of Şahmuratlı greeted a large party of officials and members of the Supreme Court who accompanied the Governor of Yozgat on a visit to Kerkenes in April 2004. Gözleme, ayran and tea were being prepared for the visitors at the foot of the ancient city on the Kerkenes Dağ.*