

# **Energy saving and passive solar thermal applications in rehabilitated municipal buildings in the town of Volos (Greece/Thessaly)**

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## **Abstract**

In the framework of the THERMIE programme the Demekav/Rect was funded for the realization of energy saving applications in rehabilitated municipal buildings. Four industrial buildings of a reputed historical brick and tile factory ("Tsalapatas" factory) and one grain sanitation building were transformed in modern high energy efficiency bioclimatic buildings satisfying public purposes (museum, cinema, exposition hall, video wall room, Regional Energy Center, etc.). Direct solar thermal applications, solar water heating collectors, insulation, summer shading, passive solar ventilation (e.g. solar chimneys), double glazing, light penetration enhancement, etc. are some of the applications realized. All construction works, finished in 2000 and energy-monitoring is on-going or just starting. Partial energy savings of up to 70% are expected compared to the initial state of the buildings. A very important replication effect is also expected from those applications, because of the experience gained by local engineers and of the very high demonstrative value of the buildings in which they have been realized.

## **Introduction**

This presentation concerns energy saving interventions realized in the following four rehabilitated buildings of the municipality of Volos:

- Three buildings of an old brick and tiles factory (' Tsalapatas' factory). Two brick drying stores and the Kiln.
- An ex grain sterilization hangar of the Ministry of Agriculture.

Both cases had some particular interest. The three industrial buildings of the old factory, were subject to restrictions by the Ministry of Culture, since they have been characterized as parts of our Cultural Heritage. The fourth building was interesting because its initial state and use were by far incompatible to the final ones and a lot of imagination was needed.

## **The old brick and tiles factory**

### **Initial state of the site**

The brick & tiles factory “Tsalapatas” is situated in the neighborhood of Palaia, west side of the castle of the city of Volos. It was established in 1925 from Tsalapatas brothers and operated until 1975.

It includes a group of industrial buildings of 7600 m<sup>2</sup> and shed places of 4900 m<sup>2</sup>, in a land of 22,65 thousand m<sup>2</sup> inside the urban area of the city (fig. 1). It is a very rare sample of preserved industrial complex of its kind in Europe. Has a unique kiln Hoffmann type and preserved elements of production methods from steam engines to electricity of today. The Ministry of Culture in Greece preserves the whole complex as Culture Heritage.

### **Rehabilitation**

The municipality of Volos planned to transform the factory in an industrial museum and rehabilitated the buildings. Precisely, parts (8, north half), (13) and (13a) of the old drying rooms (fig. 1) were transformed to a cinema, a library and a video wall room, respectively. The new drying rooms (fig. 1, (12)) is transformed in handcraft shops. The inside of the kiln (fig. 1, (9)) is used as an exposition hall while a restaurant is created in a part of the attic of the kiln. Buildings (6), (7), (11) and (14) are renovated and used only by the museum. A tsipouradiko is installed in the place of the old loam mil (fig. 1, (4)) and in the place of the rain protection shedders (2) and of the old loam milling rail conveyors (3) stores selling traditional local products are installed.

### **Energy saving applications**

In the framework of this project the following applications were realized, among others:

- *in the kiln → exposition hall and restaurant.*
  - Insulation of the roof and of the floor
  - Construction of roof windows to enhance direct solar thermal gains and lighting
- *in the old brick drying rooms → cinema, library and video wall room*

- Rehabilitation of the old chimneys to solar chimneys to enhance natural ventilation (fig. 2)
- Installation of solar water heating collectors on the old chimneys.
- Installation of double glazed sidewall windows to enhance direct solar gains.
- Insulation of the floor and of the roof.
- *in the new brick drying rooms → handcraft shops*
  - Installation of glazed wall, with glass bricks, to enhance direct solar gains and natural lighting.
  - Insulation of the whole shell of the building and of the floor.
  - Installation of electronic light modulators.
  - Adaptation of a solar atrium connecting the old and the new brick drying rooms.

The total cost of the above-mentioned interventions was about 750 thousand Euro and was funded by the THERMIE programme (32%) and by the Municipality of Volos (68%).

## **Energy saving**

The construction of the buildings was accomplished by the end of March 2001 and the energy-monitoring period will start in April 2001. Thus, the first real energy consumption data are expected by the end of 2001.

However, the expected energy saving from the above-mentioned interventions in the old and new brick drying rooms and in the kiln, are shown in figures 3, 4 and 5, respectively.

## **The old grain sanitation building**

### **Initial state of the site**

The grain sanitation building is located in the south-west part of the city and was owned by the Ministry of Agriculture. Sanitation was realized by fumigation using methyl bromide. The operation of the site ceased in 1975 and remained closed for 20 years. Finally in 1995, the building was granted to the Municipality of Volos, for 20 years, in the state shown in figure 6(before).

## Rehabilitation

The building was in such a state that it could not be imagined that it could serve any other purpose. However, the imagination of local architects and engineers transformed this building to the state shown in figure 6 (after), incorporating in it several elements of modern bioclimatic design.

From August 2000, the bioclimatic building of a total of 530 m<sup>2</sup>, shown in figure 7 (after), hosts the Regional Energy Center of Thessaly and a total of 16 persons are now working in it.

## Energy saving applications

Some of the bioclimatic design and construction features of the new building, are listed below:

- *The orientation of the roof was adjusted so that to maximize direct incident solar radiation in order to host photovoltaic panels*
- *The height of the building was increased and ventilation openings were fitted on the sidewalls just below the roof in order to favor natural draft ventilation.*
- *The relative position and dimensions of the sidewall windows and of the roof was calculated in such a way to maximize the penetration and diffusion of natural light during winter and to provide shade during the summer.*
- *Double standard insulation was installed around the building and in selected places additional external insulation was added serving the architectural esthetic of the building as well.*
- *Double glazed windows and patio doors were installed to increase thermal insulation of the building.*

The total cost of the above-mentioned interventions was about 300 thousands Euro and was funded by the THERMIE programme (32%) and by the Municipality of Volos (68%).

## **Energy saving**

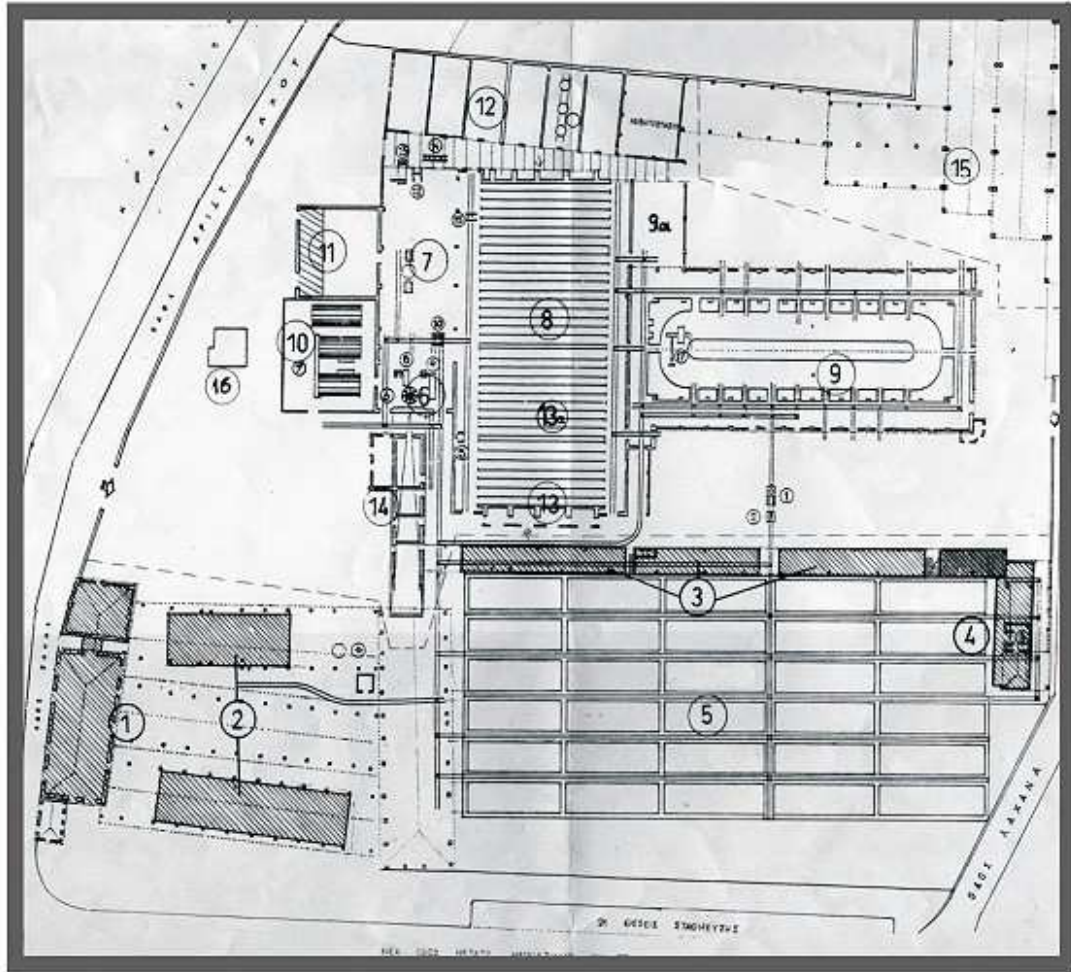
The building was finished in 1999 and was occupied by the Regional Energy Center of Thessaly in August 2000. Energy-monitoring monitoring is on-going and the first real energy consumption data are expected by the end of 2001.

The first observations of the occupants of the building, indicate that an important energy saving is realized, since the building functioned with out needing any supplementary cooling energy during August 2000 and with very low heating energy consumption during winder 2000 – 2001.

## **Conclusions & perspectives**

Four completely different buildings were rehabilitated in the framework of this project. Three old industrial buildings were transformed to satisfy public cultural purposes (i.e., museum, cinema, library, video wall room, exposition hall) and an old useless grain sanitation building was transformed to a live bioclimatic building.

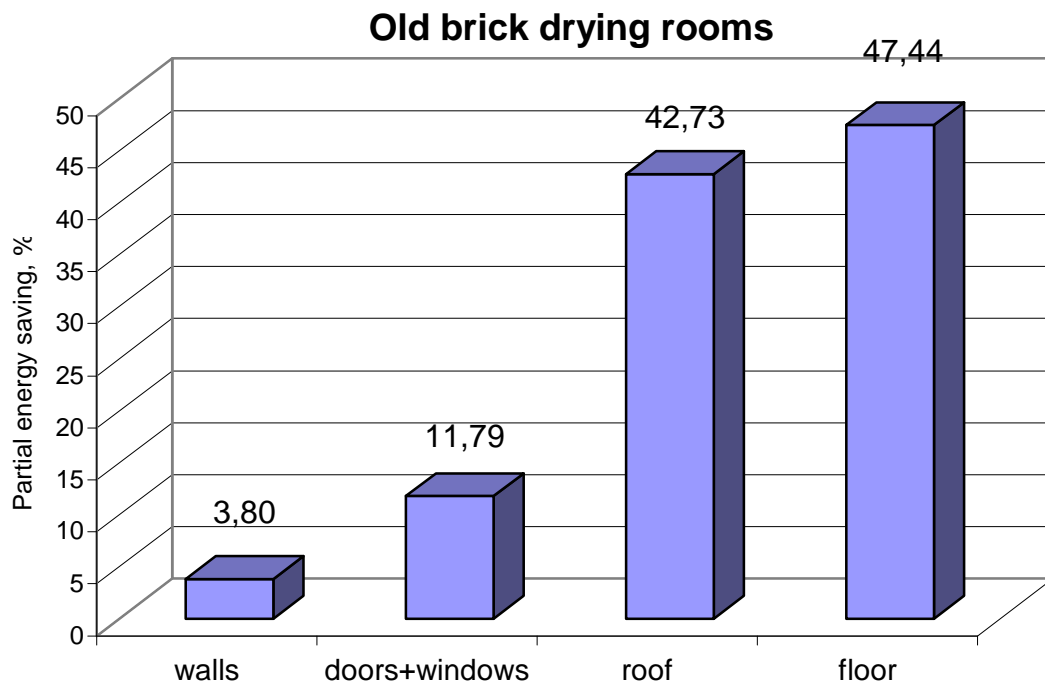
Several energy saving applications were incorporated in those buildings and energy monitoring is just starting. The expected energy savings can be up to 70% in some cases. However the most important gain from those applications is the experience gained by the local engineers and important long term benefits are expected from the replication of such application in other municipal and private buildings.



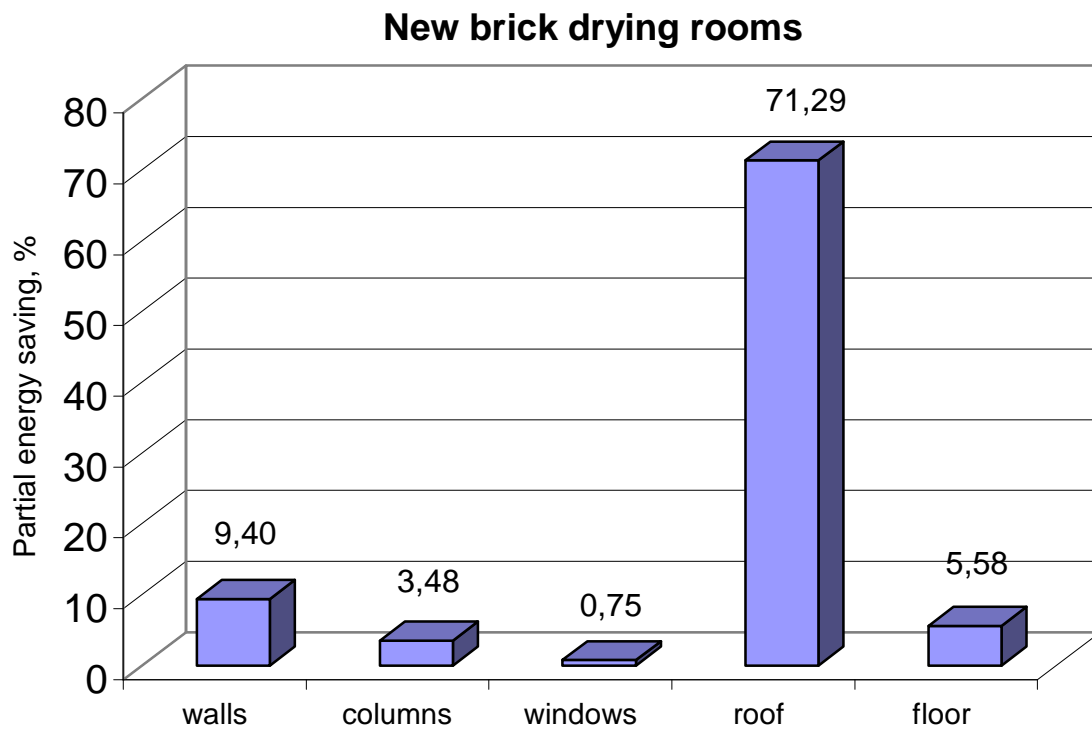
**Figure 1.** The block of buildings of the brick and tiles factory ‘Tsalapatas’. (1): Turnery, (2): Rain protection shadders for loam storage, (3): Old loam milling rail conveyors, (4): Old loam mil, (5): Solar driers, (6): New loam mil, (7): Brick & tiles molding, (8): Old drying rooms, (9): Kiln (Hoffmann type), (9a): Workers room, (10): Steam engine generators, (11): Control room, (12): New drying rooms, (13 & 13a): Old drying rooms, (14): New loam milling belt conveyors.



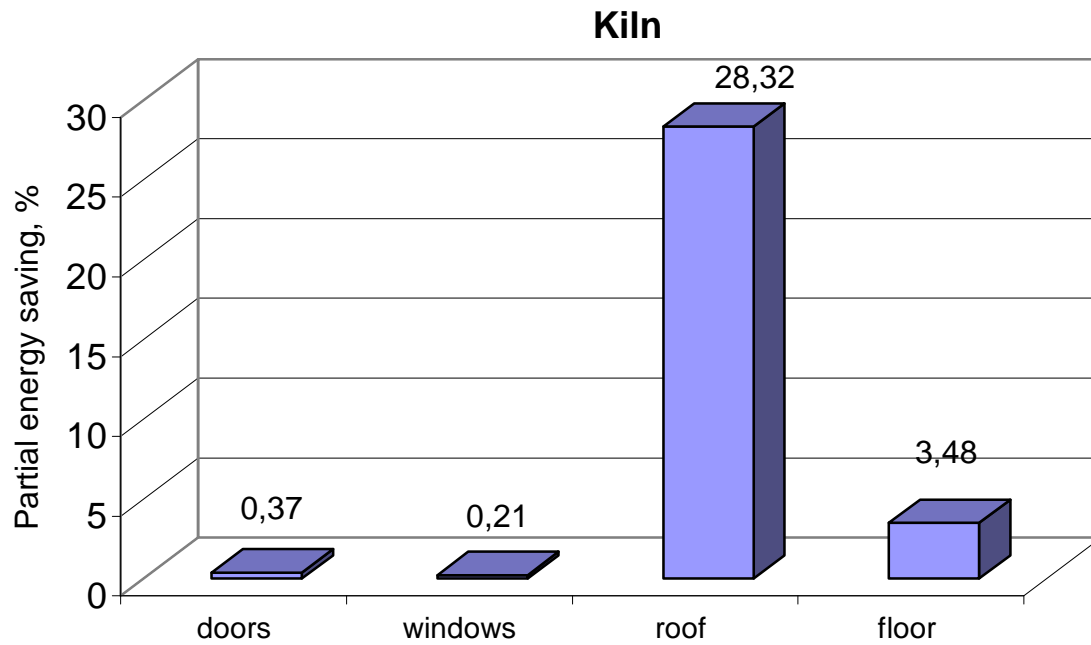
**Figure 2.** Chimneys of the old drying rooms before and after the rehabilitation. The rehabilitated chimneys function as solar chimneys for natural ventilation. The way the solar water heating collects were incorporated in the base of the chimneys, is also shown.



**Figure 3.** Expected energy saving in the old brick drying rooms due to the interventions realized, compared to the initial state of the building.



**Figure 4.** Expected energy saving in the new brick drying rooms due to the interventions realized, compared to the initial state of the building.



**Figure 5.** Expected energy saving in the kiln due to the interventions realized, compared to the initial state of the building.



**Figure 6.** The old grain sanitation building (before) transformed to the new bioclimatic building hosting the Regional Energy Center of Thessaly (after).



**Figure 7.**