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DEPARTMENT OF PHYSICS
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ASSESSMENT OF ENERGY CONSERVATION ACHIEVED IN RESIDENCES USING NEOTEX S.A. N-THERMON® 9mm IN MOSCOW

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1 Abstract

The purpose of this study is the assessment of energy conservation achieved in residential buildings in areas with similar climatic data as those of Moscow with the application of N-THERMON 9mm, extruded polystyrene (XPS) thermal insulation plate, in the interior of the building both on walls and the ceiling, manufactured by NEOTEX S.A.

A characteristic case of a one story detached house was studied. All calculations were done having considered that the house did not have any thermal insulation. The effect of application of NEOTEX S.A's N-THERMON 9mm on such house was studied and final consumption of primary energy was assessed.

Application of N-THERMON 9mm in the interior of the building, both on walls and the ceiling, lead to conservation of primary energy consumption.

2 Introduction

The purpose of this study is the assessment of the application of NEOTEX S.A's N-THERMON 9mm in primary energy consumed in residences in areas with similar climatic data as those of Moscow.

For this reason a reference residential building (one story detached house) was chosen and primary energy consumption was assessed prior and after application of the product suggested by NEOTEX S.A.

This study was conducted by the Group of Building Environmental Studies, University of Athens, Department of Physics, Sector of Applied Physics.

3 Climatic Data

For calculation of thermal and cooling loads hourly values of the following climatological factors for each climatic zone were used:

- Total solar radiation on the horizontal level,
- Diffuse radiation on the horizontal level,
- Dry bulb temperature,
- Relative humidity,
- Wind speed,
- Wind direction,
- Soil Temperature.

Tables containing mean, maximum and minimum monthly values of the above factors, as such are given by METEONORM software, are given below.

Table 1. Mean monthly values of climatological factors. (55.5N, 37.4E)

Month	Solar radiation on horizontal (kWh/m^2)		Wind Temperature (°C)	Relative Humidity (%)	Wind Speed (m/sec)
	Total	Diffuse			
January	15.0	13.0	-9.3	81.0	4.1
February	36.0	24.0	-7.7	79.0	3.9
March	77.0	46.0	-2.2	74.0	4.0
April	100.0	67.0	5.8	68.0	3.2
May	162.0	85.0	13.1	66.0	3.6
June	155.0	93.0	16.6	67.0	3.4
July	157.0	92.0	18.2	67.0	3.2
August	126.0	76.0	16.4	70.0	3.1
September	70.0	52.0	11.0	73.0	3.3
October	38.0	31.0	5.1	77.0	3.6
November	16.0	14.0	-1.2	82.0	3.4
December	10.0	9.0	-6.1	83.0	4.1

4 Description and energy status of the building

4.1 Division into thermal zones

For estimation of energy requirements the building was divided into four (4) zones. In the image that follows the zones used for study of the thermal behavior of the building as well as their use are shown in detail. (Image 1).

Image 1 Thermal zones of the detached house

Table 2. Zones' use and area

Zone	Area m^2	Use
1	13.6	Kitchen
2	44.8	Living Room
3	5.2	WC
4	12.9	Bedroom

4.2 Interior Benefits

Given the use of the building the interior benefits come mainly from the people and artificial lighting. Interior thermal benefits from other devices and appliances are considered small. Two tenants were considered to live in the residence.

Artificial lighting in the living areas is considered to be attributed to a percentage of 60% as radiation and 40% as sensible heat.

In the table that follows the timetable considered for the tenants' presence and operation of artificial lighting are given.

Table 3. Timetable of tenants' presence and operation of artificial lighting

Day	Schedule	Persons	Lighting
Monday to Sunday	00:00 – 18:00	100%	5%
	18:00 – 24:00	100%	100%

4.3 Ventilation

Ventilation (natural) of spaces was considered according to the Technical Chamber of Greece Technical Guidelines (TOTEE) 20701/2010, 15m^3/h/person. Building air penetration was considered equal to 0.4 ACH.

4.4 Desirable Conditions of Thermal Comfort

The desirable conditions of thermal comfort are given in the following table and are in accordance to TOTEE 20701/2010.

Table 4 desirable conditions of thermal comfort

Use	Temperature (°C)	Relative Humidity (%)
Heating	20	40
Cooling	26	50

4.5 Heating and Cooling

Heating was considered to be achieved through use of an old technology furnace with COP-0.8.

Correspondingly, cooling was considered to be achieved through use of old technology air-conditioning units with COP = 1.5.

Conversion rates to primary energy are in accordance to Building Energy Efficiency Regulations (KENAK) and are the following:

ENERGY SOURCE / KENAK	**RATE OF CONVERSION TO PRIMARY ENERGY**
HEATING OIL (PETROL):	1.10
ELECTRIC POWER:	2.90

Table 5 Timetable for operation of heating and cooling system

Day	Schedule
Monday to Sunday	24 hours a day

4.6 Structural Elements & Windows

The characteristic features of the reference building are presented in the following table.

Table 6 Structural elements for the reference building

	Description	u-value $W/(m^2K)$	SR
Load Bearing Structure	Reinforced Concrete. Without insulation.	2.57	0.35
Exterior Masonry Wall	Single masonry wall build of clay bricks and plastering on both sides. Without insulation.	2.75	0.35
Interior Masonry Wall	Single (stretcher bond) and plastering on both sides.	2.75	
Roof	Non-insulated concrete, cement mortar surface. Without insulation.	3.01	0.25
Windows	Single glass windows	5.68	

4.7 Shading

A shading coefficient equal to 0.8 during summer months and 0.2 during winter months was considered.

5 Primary Energy

Primary energy for the building was calculated prior to and after application of NEOTEX SA's N-THERMON 9mm.

The structural elements, as such are optimized after use of NEOTEX S.A. products, are described in the following table.

Table 9 Annual consumption of primary energy as well as percentile change in such prior to application of the products.

	Primary energy KWh/m^2	% primary energy change
Reference building	1441.7	
N-THERMON 9mm	1167.7	-19.0%

6 Conclusions

A characteristic case of a detached house having one story was studied, it having no thermal insulation having been considered a given. The impact made on such by applying NEOTEX SA's N-THERMON 9mm was assessed. Conservation in consumption of primary energy is 19.0% (Table 10).

Table 10 Annual consumption of primary energy as well as percentile change in such prior to application of the products.

	Primary energy KWh/m^2	% primary energy change
Reference building	1441.7	
N-THERMON 9mm	1167.7	-19.0%