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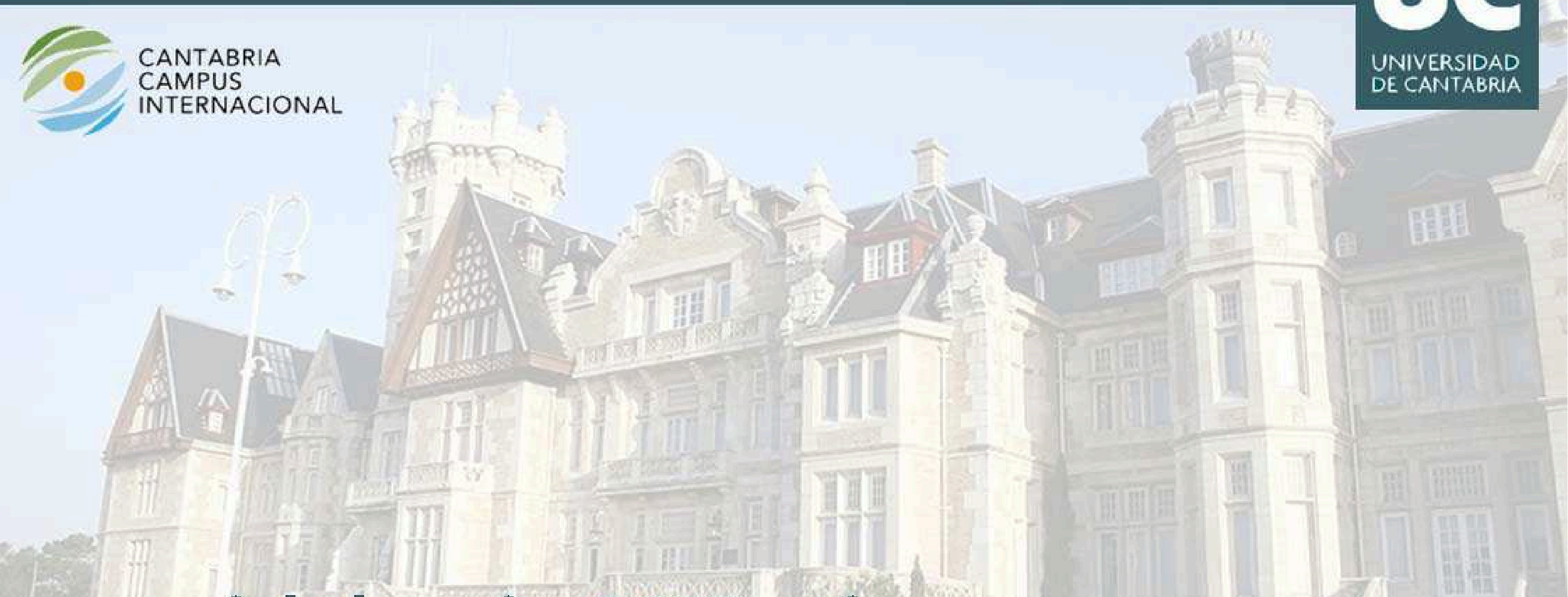

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37th IAHS World Congress on Housing:

"DESIGN , TECHNOLOGY, REFURBISHMENT AND MANAGEMENT OF BUILDINGS"

Santander (Spain) 26-29 October 2010

International Association for Housing Science

GRUPO DE TECNOLOGÍA DE LA EDIFICACIÓN.
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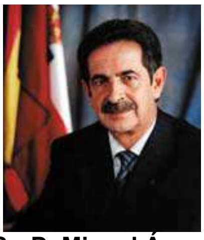

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2. INTRODUCTION

The International Association for Housing Science (IAHS), this year 2010, is celebrating the 37th Congress. They are a tradition and annually, held in a different country. Last Congress was held in Kolkata, India. Before it, it was Melbourne, Australia.

As the issues related to human habitat are important and global, IAHS dwells on these issues, identifies them, searches knowledge based solutions to them. These congresses are the effectice way to gather competent experts on various fields, to join together and create an environment for discussions. The outcome of these deliberations are published in the IAHS Journal and the Congress Proceedings.

IAHS was established at the University of Missouri, USA in 1972 as a Non-Profit Scientific Organization. It is a member of the United Nations as a Non-Governmental organization with accreditations in New York, Geneva, Vienna.

The IAHS Motto is: Progress through interdisciplinary cooperation and research. This emphasizes the importance of the expansion of knowledge based actities to help improve the global shelter problems. People wants better homes and better environment for their families. This is a correct and continuous aspirations. A genuine concern, fom our part, is mandatory and necessary to find ways to help. IAHS is in this venture for good. And it is doing its share.

The University of Cantabria (UC) – Spain, through its R & D Group of Building Technology (GTED), was invited to co-organize and manage this Congress at the beginning of 2009. UC welcomed this project with great interest and saw it as an important challenge: In fact, it affects and strengthens the strategic goal of internationalization of our university, in line with the honor and award of “Cantabria International Campus” that we have achieved in 2009.

From the beginning, three Administrations decided to promote this Conference: The Government of Spain, the Government of Cantabria and the City of Santander. Also, the Professional Associations linked to the multidisciplinary Building field and other Entities of the Region added their support: The combination of all these forces has made possible to reach the target.

Also, for the UC School of Civil Engineering, aimed in teaching and research in the world of Construction in general and, therefore, in the Building in particular (which means, in Spain and Europe, approximately 75% of the construction sector) and for its R & D Group of Building Technology, the celebration of this Congress is an important milestone in our history of more than 40 years. In fact, it reinforces our project of giving a specific universitary degree in the Building field.

Finally, IAHS and UC are deeply grateful to all who have made this 37th Congress possible: Sponsors, Collaborators Entities, Keynote speakers, Scientific Committee, Authors who have submitted their Papers and Congressmembers in general. Thank you very much, again, everybody.

Prof. Oktay Ural
President of the International Association for Housing Science (IAHS)

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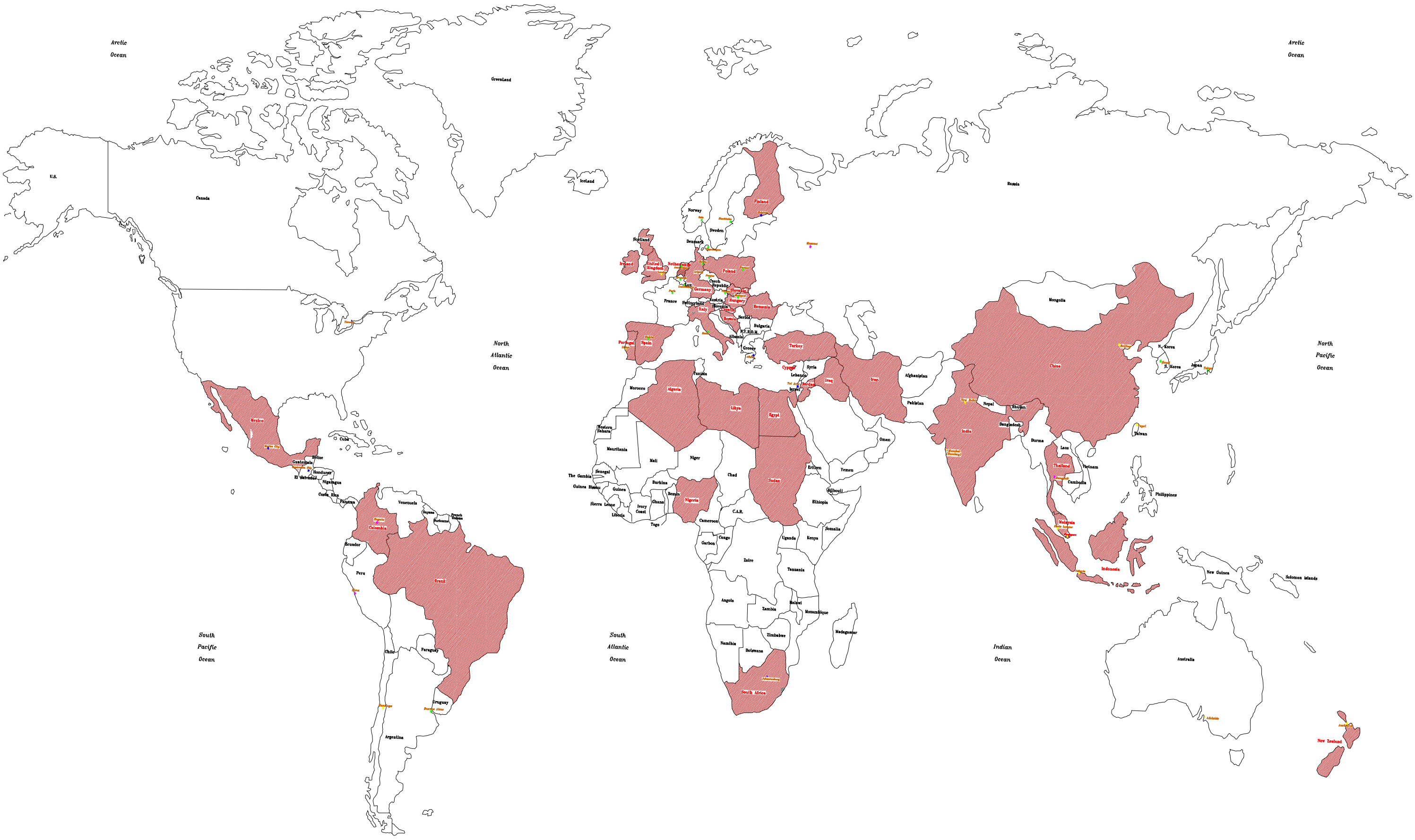
7. PAPERS - STATISTICS

Papers in the 37th IAHS World Congress of Housing: Stder.SPAIN, Oct. 2010

CONTINENT	COUNTRIES that send Papers	Nº total of Papers received	Country	Nº Papers
EUROPE	**16**	**269**	Spain	135
			Portugal	45
			Italy	39
			Turkey	15
			Slovakia	11
			Others	24
AFRICA	6	19	Egypt	6
			Nigeria	6
			Others	7
AMERICA	3	10	Brasil	5
			Mexico	4
			Colombia	1
ASIA and OCEANÍA	10	16	India	4
			Irak	2
			Iran	2
			Indonesia	2
			Others	6
TOTAL	**35**	**314**		



8. TOPICS - STATISTICS

TOPIC I: MATERIALS AND METHODS OF CONSTRUCTION
New materials and composites
Old materials with new uses
Wood. Factories of stone and brick.
The traditional methods of construction
Innovating methods of construction
Use of local materials

TOPIC II: DESIGN FOR SUSTAINABILITY AND REFURBISHMENT
Criteria of design
Use of the renewable energies
Buildings of low power consumption.
Using natural resources
Refurbishment policies in cities
Environmental studies.

TOPIC III: SOCIOCULTURAL ASPECTS OF HOUSING PROJECTS
Social buildings
Financing systems
Participation of users
Supply of houses

TOPIC IV: HEALTH, COMFORT AND SAFETY POLICIES
The quality of the air in the interior
Inner microclimate
Systems of protection against fires
Toxicity of the construction equipments
Use of the power natural resources in the house
Control of the atmospheric contamination

TOPIC V: DESIGN FOR HOUSE PROJECTS
Criteria of design
Methods and materials
National and international legislation
Earthquakes resistant buildings

TOPIC VI: URBAN AND CITY PLANNING. TRANSPORT POLICIES.
Mountainous zones.
The urban infrastructure. Water resources management.
Planning of the sustainability
Topographic systems
Ecological establishments
Policies of house of the European Union
Policies and programs of house for construction of the nation.
Transports in cities.

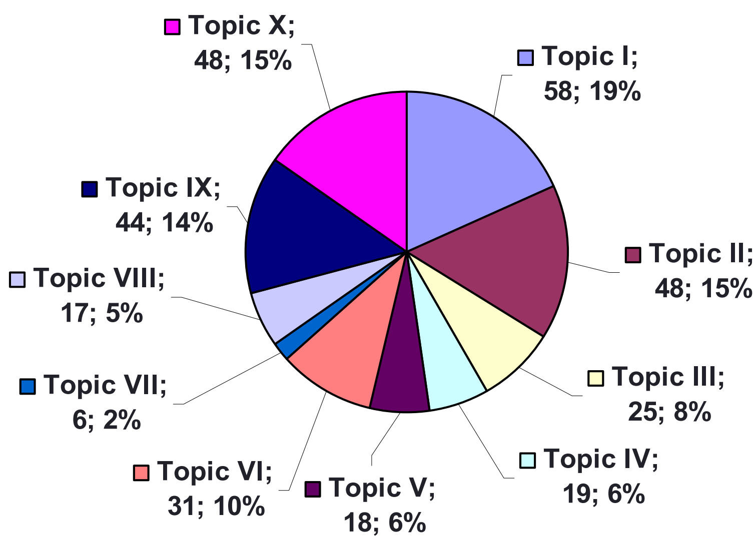
TOPIC VII: ECONOMY AND FINANCING POLICIES
Measures of support to the private economy
Governments supporting the economy
Public and deprived companies
Investment funds.

TOPIC VIII: MANAGEMENT SCHEMES AND MAINTENANCE
Criteria of design
Management of the maintenance
Management of facilities
Management of the constructive process
Quality, Environment and Prevention of Labor Risks
Techniques, equipment and materials
Renovation and new ideas of management

TOPIC IX: BUILDING TECHNOLOGY AND CONSTRUCTION: STRUCTURES, SERVICES AND CLADDINGS.
Technological bases and concepts.
Evolution of the technology in the construction.
Industrialization and precast solutions. Intelligent buildings.
Technology of structures and geotechnic.
Services, equipment and facilities: Heating, air conditioning, lifts, electrical, plumbing, sewage, telecommunications, etc.
Technology of claddings and finished closings.

TOPIC X: PATHOLOGY AND REHABILITATION
Historical and archaeological studies of the patrimony.
Pathology of the construction
Technologies in the refurbishment.
Investigation and diagnose of damaged constructions.
Non destructive technologies in the buildings investigation

Figure:
PAPERS FOR EACH TOPIC
(Topic i; nº papers; %papers/total)



CODE: 256

NATURAL STONE IN ARCHITECTURAL DESIGN. THERMAL PERFORMANCES EVALUATION.

Chiara Cicero, Grazia Lombardo

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Key words: natural stone, masonry, thermal performances, architectural design, sustainability

Abstract

Sustainability concept in building is mainly based on a limited employment of energetic resources in construction phase of the building and during its life. It's therefore very important to return to the building's envelope its thermal control function.

From this point of view it's necessary to modify building's envelope to the aim to reduce the thermal system's use.

New scientific researches recently conducted in various parts of the world have been based about the thermal mass role in building's massive envelopes. The use of massive envelopes, in fact, is favored thanks to the typical thermal mass ability to accumulate heat and to give back it slowly.

The study of vernacular architectures shows that the use of materials and shapes optimizes the relation between the environment and solar energy.

Within this problematic a search has been started with the objective to know better the massive envelope's performances. The results obtained, in a comparison between thermal performances of building's envelope realized in three different materials, show good performances of natural stone masonry.

This paper shows results obtained in a research whose objective it is to know natural stone's influence as thermal accumulation in architectural design. In particular this study will be interested in:

- wall's thickness;
- relation between glass surfaces and natural stone surfaces;
- natural stone's position inside building.

TOPIC II

204. Model of House Design responsive to Hot-Dry Climate

209. Design approaches for the conversion of historic residential buildings

212. Design for Healthy and Sustainable Building

213. Abandoned methods of passive solar design in traditional cyprus architecture

220. Chronic space to the settlement enviromental of ammatoa kajang, in traditional area, regency of Bulukumba, South Sulawesi

221.The Traditional House Harmonious Concept between Sustainable Environment, Affordable Housing, and Needs (Case Study : The Fisherman House in Aeng Batu Village, Takalar)

223. Apartments for elderly people in a building designed as a retirement home

226. Rehabilitation and retrofit: Sustainable futures in Romania's Saxon Villages

228. Innovative technologies for Smart-Eco buildings in 2030

229 Multidisciplinary design process: urban,architectural and technological analyses for energy-efficientresidential buildings in Northern Italy.

230. Net Zero Energy REvolution: criteria, strategies and tools to design a NZE House in temperate climate. An integrated approach to residential case studies

233. Tool design as a strategy for architectural design

235. Optical and thermal design and modelling of architectural shading systems

236. Photovoltaic system support for the heat pump

237. Implementing the concept of sustainable development in thermal rehabilitation of residential buildings in Romania

241. Dificulties for the development of green roofs in Spain and actuation proposals

242. Tht myths and facts of sustainable development. Applied method to building design processes

243..Functional limitations associated with housing environmental problems among community-living older people

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XXXVII IAHS – Natural stone in architectural design. Thermal performances evaluation.

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Key words: natural stone, masonry, thermal performances, architectural design, sustainability

Abstract
Sustainability concept in building is mainly based on a limited employment of energetic resources in construction phase of the building and during its life. It's therefore very important to return to the building's envelope its thermal control function.
From this point of view it's necessary to modify building's envelope to the aim to reduce the thermal system's use.
New scientific researches recently conducted in various parts of the world have been based about the thermal mass role in building's massive envelopes. The use of massive envelopes, in fact, is favored thanks to the typical thermal mass ability to accumulate heat and to give back it slowly.
The study of vernacular architectures shows that the use of materials and shapes optimizes the relation between the environment and solar energy.
Within this problematic a search has been started with the objective to know better the massive envelope's performances. The results obtained, in a comparison between thermal performances of building's envelope realized in three different materials, show good performances of natural stone masonry.
This paper shows results obtained in a research whose objective it is to know natural stone's influence as thermal accumulation in architectural design. In particular this study will be interested in:
- wall's thickness;
- relation between glass surfaces and natural stone surfaces;
- natural stone's position inside building.

1 Introduction

In the last years, with the aim of reducing energy requirement, many European countries began to utilize software for buildings energetic certification. Certainly, the emanation of the European Directive on the energy performance of buildings (2002/91/CE) has promoted the diffusion and the use of these software.

Major part of European countries is characterized by a cold climate. Because of this, these countries have the objective of reduce energy requirement for heating. Other European countries as Italy, Spain, Greece and Portugal are characterized by a tempered climate. These have the objective of reduce also energy requirement for cooling. In Italy in 2006, for cooling, electric consumptions have been higher than the electric consumptions for heating [1].
In Mediterranean area, traditional architecture is influenced by seasonal climate changes. Buildings are realized by massive masonries that have good characteristics of insulation and thermal inertia. Solar energy is captured by buildings directly, through windows, and indirectly, through massive envelopes.
Therefore, in architectural design, it's necessary to define specific standards with the purpose of optimize thermal comfort. To do this, massive elements, with function of thermal accumulation, must be carefully projected and distributed in space [2].
Within these issues in Mediterranean area, this paper shows first results of a research whose aim is to know the influence, in architectural design, of natural stone elements with function of thermal accumulation. In particular this study focuses on:
- wall's thickness;
- relation between glass surfaces and natural stone surfaces;
- position of natural stone inside building.

2 Method of research

This paper shows the results of thermal analyses. These have been conduct with computer simulations to assess thermal comfort (hourly temperature profile) and energy requirements of a specific building [3]. It is a two floors residential unit (Fig. 1). On the first floor there is living room, dining room, kitchen and a bathroom. On the second floor there are four bedrooms, a bathroom and a laundry.

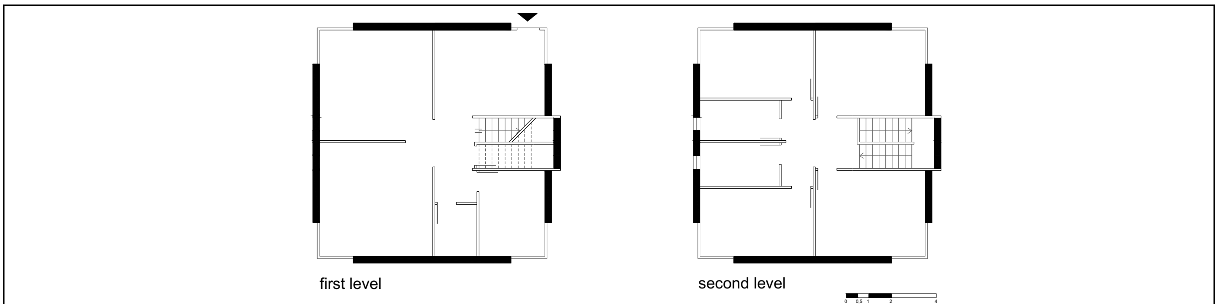

Figure 1: Studied building, first and second level.

The research has been developed in three phases:
1) this first phase analyzes the influence of wall's thickness in a building that is characterized by a massive and box-shaped envelope. The envelope will be characterized by different thickness (40, 30, 20 and 10 cm);
2) in the second phase, the relationship between glass surfaces and natural stone surfaces will be studied. To do this the building considered in first phase will be modified to reach a configuration that has a fully glazed envelope;
3) in the third phase, the building completely glazed will be analyzed. In particular the influence of natural stone, with function of thermal accumulation, will be valuated changing its function inside the building:
   - interior walls;
   - floor;

- interior walls and floor.

In Italy, new rules on energy saving impose a larger use of heat insulation. After this, an effective reduction of energy consumption for heating has been registered but also a bigger increase of energy use for heat insulation production [4]. Moreover, in summer time, the heat insulation produces peaks in temperature and overheating of the rooms creating conditions of discomfort [5, 6, 7, 8]. Previous researches [7, 8] have shown good thermal, economic and environmental performances of basalt stone masonry in a comparison between different materials as brick and concrete.
Based on this, in this research the building's envelope is realized in basalt stone without insulation.

3 Results

3.1 First phase

This phase has valuated thermal performances of the studied building changing massive envelope's thickness (40, 30, 20 and 10 cm). The characteristics of the envelopes and the analyses results are showed on the following tables.

Tables 1- 4: Characteristics of the envelopes T40, T30, T20 and T10.

T40		
Thickness	cm	40
U-value	W/mqK	3,28
Decrement	hours	10,85

T30		
Thickness	cm	30
U-value	W/mqK	3,62
Decrement	hours	8,53

T20		
Thickness	cm	20
U-value	W/mqK	4,03
Decrement	hours	6,24

T10		
Thickness	cm	10
U-value	W/mqK	4,56
Decrement	hours	3,74

Tables 5-8: Results of thermal analyses for cases T40, T30, T20 and T10.

T40			
summer	T_{mid}	°C	23,5
	T_{max}	°C	29,4
	Cooling	kWh/m²	1,1
winter	T_{mid}	°C	15,3
	T_{min}	°C	11,3
	Heating	kWh/m²	80,6
	$\Delta_{mid}T$	°C	0,9
	PER	kWh/m²	95,9

T30			
summer	T_{mid}	°C	23,5
	T_{max}	°C	29,4
	Cooling	kWh/m²	1,1
winter	T_{mid}	°C	15,3
	T_{min}	°C	11,4
	Heating	kWh/m²	87,2
	$\Delta_{mid}T$	°C	0,9
	PER	kWh/m²	103,7

T20			
summer	T_{mid}	°C	23,5
	T_{max}	°C	29,6
	Cooling	kWh/m²	1,3
winter	T_{mid}	°C	15,3
	T_{min}	°C	11,3
	Heating	kWh/m²	100,2
	$\Delta_{mid}T$	°C	1
	PER	kWh/m²	119,2

T10			
summer	T_{mid}	°C	23,5
	T_{max}	°C	30,2
	Cooling	kWh/m²	2
winter	T_{mid}	°C	15,4
	T_{min}	°C	11
	Heating	kWh/m²	129,2
	$\Delta_{mid}T$	°C	1,6
	PER	kWh/m²	154,0

Legend:
Tmid: middle temperature;
Tmax: maximum temperature;
Cooling: loads for cooling;
Tmin: minimum temperature;
Heating: loads for heating;
ΔmidT: medium thermal shock;
PER: primary energy requirement.

It's necessary to observe that the loads represent the necessary energy to heat or cool. Instead, primary energy is calculated, depending on the performance's conditioning systems, after calculating loads for heating and cooling. In this research, a conditioner and a heater have been used for cooling and heating.

Decreasing thickness it's possible to observe that thermal comfort doesn't suffer substantial variations (Graph 1). In particular T40, T30 and T20 have very similar results. But it's also possible to observe that:

- cooling loads doesn't change (Graph 2);
- heating loads increase (Graph 2);
- primary energy requirement is higher when wall's thickness is 10 cm (Graph 3).

Considering necessary energy for natural stone extraction, work and masonry construction it's possible to prefer envelopes with 20 cm thickness.

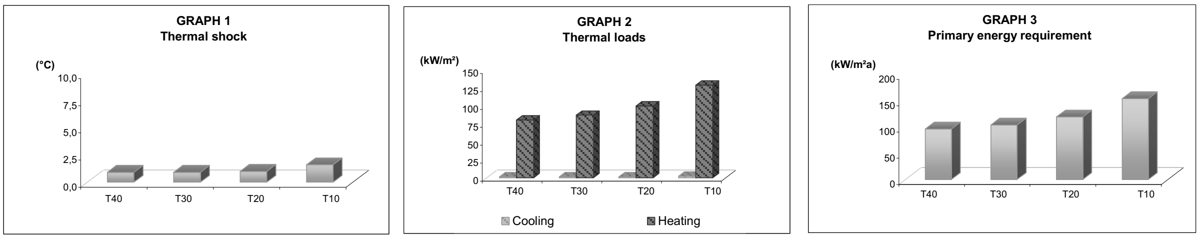

Figure 2: Graphs of Thermal shock, Thermal loads and Primary energy requirement for cases T40, T30, T20 and T10.

3.2 Second phase

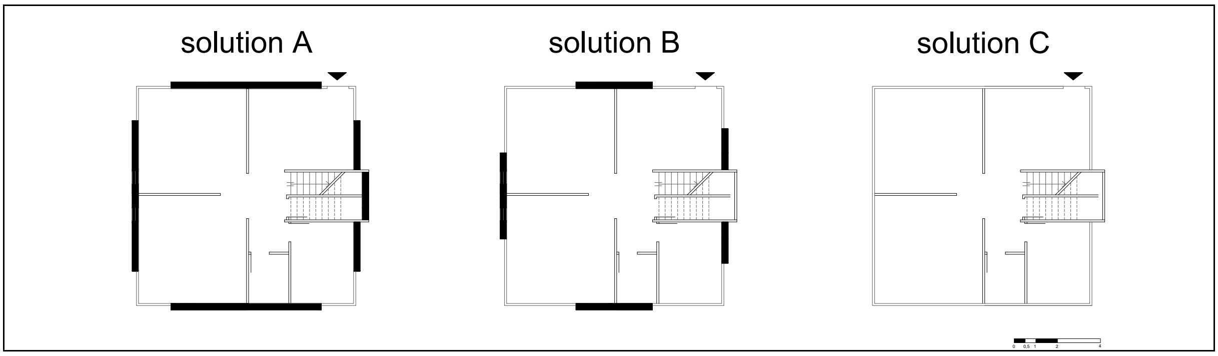

Figure 3: Studied building. Cases A, B and C.

In this phase, buildings are characterized by envelopes with different relationship between glass surfaces and natural stone surfaces of 20 cm.

Tables 9-11: Results of thermal analyses for cases A, B and C.

A			
summer	T_{mid}	°C	23,5
	T_{max}	°C	29,6
	Cooling	kWh/m²	1,3
winter	T_{mid}	°C	15,3
	T_{min}	°C	11,3
	Heating	kWh/m²	100,2
	$\Delta_{mid}T$	°C	1
	PER	kWh/m²	119,2

B			
summer	T_{mid}	°C	23,6
	T_{max}	°C	32,5
	Cooling	kWh/m²	26
winter	T_{mid}	°C	15,4
	T_{min}	°C	10,7
	Heating	kWh/m²	77
	$\Delta_{mid}T$	°C	4,8
	PER	kWh/m²	116,6

C			
summer	T_{mid}	°C	23,8
	T_{max}	°C	35,1
	Cooling	kWh/m²	70,8
winter	T_{mid}	°C	15,6
	T_{min}	°C	10,1
	Heating	kWh/m²	71,8
	$\Delta_{mid}T$	°C	8
	PER	kWh/m²	155,3

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