GR15_HM02 Vernacular and climate sensitive architecture

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[1]Building Energy Modeling and Envelope Design

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Figure 1: Sites location - Cordoba,Spain & Timisoara, Romania

Introduction:

The approach takes into account the main factors of environmental integration, namely: orientation and location; greenhouse and shading effect; natural ventilation; thermal insulation, heating and thermal inertia; ground utilization as thermo-insulator, plantation as a sunshine moderating factor. Bioclimatic vernacular houses is considered as a basic concept for the future architecture in Romania and Spain. There is also a few design strategies proposed in order to minimize the energy needs for heating, cooling, ventilating and even illuminating the indoor spaces in the two different assigned climates.

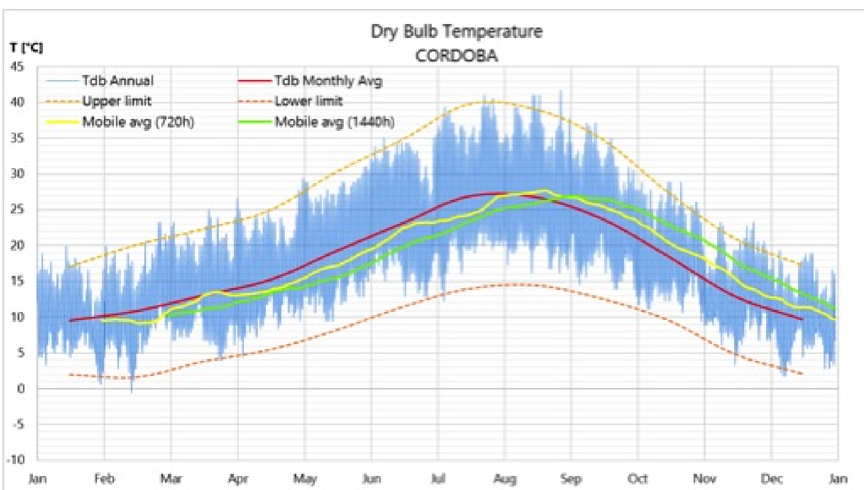

Figure 2: Cordoba - Spain

Chapter 1: Vernacular Architecture

· **Examples of vernacular architecture in Romania and Spain**

In this chapter examples of vernacular architecture related to Romania and Spain is presented and analyzed. Obviously every climate influenced on our ancestors approach in building houses. According to Köppen climate classification, Timisoara/Romania is classified under Temperate continental climate/Humid continental climate with mild temperatures in the winter and moderate summer temperatures. while Cordoba/Spain

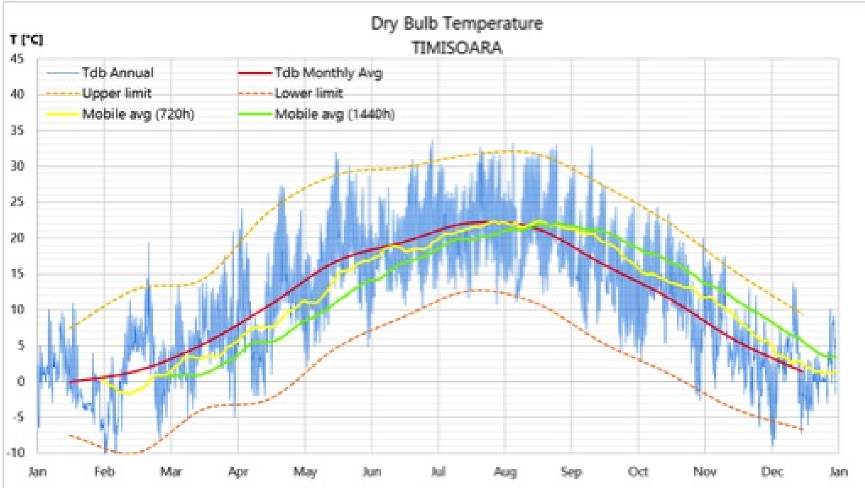

Figure 3: Timisoara - Romania

is classified as warm Mediterranean climate which has the highest summer average daily temperatures in Europe.

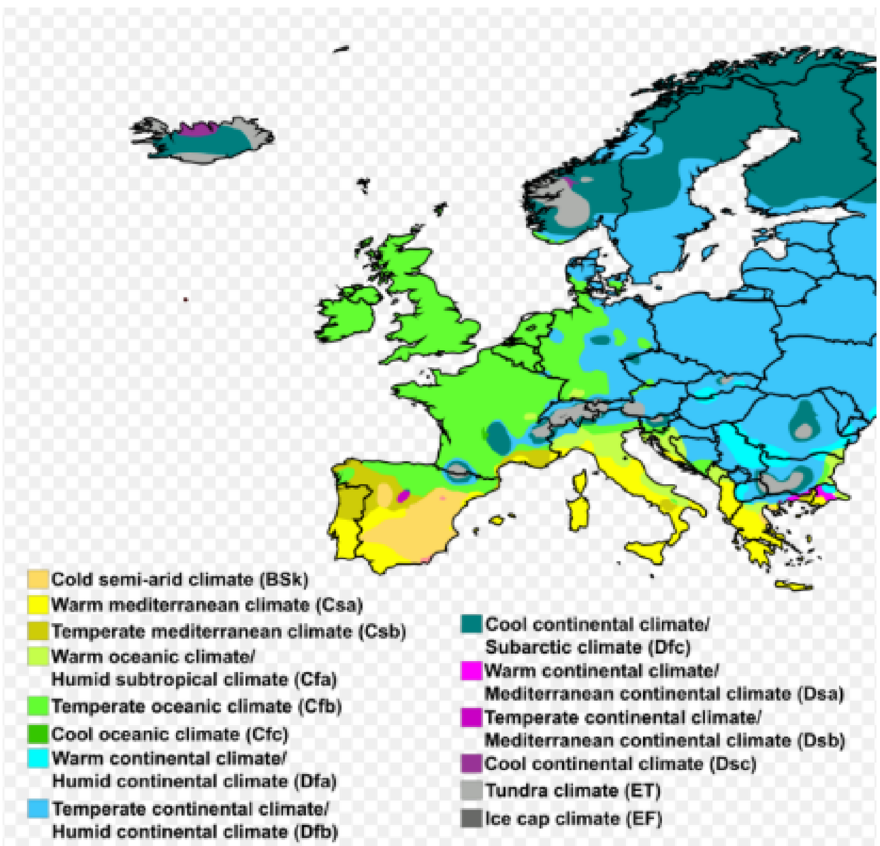

Figure 4: Europe map of Köppen climate classification (source:https://www.britannica.com/science/Koppen-climate-classification)

· **Romania**

The traditional rural houses in Romania are the product of two main factors: the natural environment with an excessive continental climate – frosty winters and torrid summers – and the human creative nature. Romania is under the influence of the dominant winds from the north-west, which, in contact with the humid air of Mediterranean origin, determines snowstorms. The climatic differences between different regions are not essential. However, the Carpathian mountain chain induces some climatic differences between the region of the sub-Carpathian hills and the lowlands as well as between Moldova, the Danube Plains and the Transylvanian Plateau.

Figure 5: Traditional Romanian housing prototype classified by region(source: http://www.romanianmonasteries.org/)

Vernacular architecture refers to folk and non-professional architecture, including that of the peasants. At this figure we observe Traditional Romanian house up in the mountains of Transylvania. Colonizers established settlements in the plains and lower plateaus while Romanians had settlements higher in the mountains according to their pastoral life. In the Carpathian Mountains and the surrounding foothills, wood and clay are the primary traditional building materials.

The majority of houses in this area have traditionally been a single-storey or two storey rectangular plan; a gable or hipped roof; one or two rooms with small volumes with small window surface areas; a traditional clay oven or central chimney in clay may be existed which goes through the gable roof and keeps it warm. In the late 19th century two types of construction predominated, horizontal log construction, and frame and fill construction. Log walls were common in areas where wood was available. In places with very poor timber

Figure 6: ‘’ Casa lui Closca” (Closca’s memorial house) – Romanian peasant who fought for the civil rights of oppressed Romanians in Transylvania. The memorial house, located in Rosia Montana, has a traditional rock foundation and front porch.(source: https://www.romaniadacia.wordpress.com/2014/10/28/traditional-rural-houses/casa-lui-closca-carpinis-rosia-montana-romania-carpathians-carpathian-mountains-beautiful-eastern-europe-landscapes-traditional-romanian-houses)

Figure 7: One or two storey floor houses with rectangular plan https://blupaint.deviantart.com/art/Traditional-Architecture-RO-166173455

or with an extreme timber shortage post and sill or wattle and daub techniques could also be used. For

Figure 8: https://romaniadacia.wordpress.com/2014/10/28/traditional-rural-houses/

Figure 9: https://romaniadacia.wordpress.com/2014/10/28/traditional-rural-houses/

horizontal log construction, logs needed to be notched in order to hold together. The simple saddle notch is the easiest and therefore common. Dovetailing is used by people with more experience in woodworking.

Materials used were those that could be procured locally, including wood (usually oak), mud, straw, field-stone, lime, and animal dung. Roofs in densely wooded and hilly areas are typically clad in wooden shakes or shingles, while flatter and more open areas have traditionally used rye straw.

The ground floor is used for storage facilities for cereals, food products, wood and domestic animals. This is due to benefit from heat emitted by animal down the floor; if sheds are built separately, the ground floor

Figure 10: Roofs are made of local reed or wooden shakes or shingles- wooden, plastered and lime washed exterior walls (source: https://www.polyvore.com/romania/collection?id=4210011)

may be residential as well. In mountainous areas where stone or rock be available, first floor is usually made of this material due to higher thermal inertia and resistance against rain, also stone is less disposed to formation of pest and insects. In the picture bellow, relation between length of overhang and sun ray in summer and winter is shown.

The porch (veranda) is an ever-present element in all Romanian rural houses. It is often times decorated either with flowers, or covered by vineyard leaves. During cold season residence of the house may cover the porch with carpets or rugs to avoid heat losses(this solution reduces air speed around windows which are more significantly located toward the porch. It is obvious that in summer time when weather is pleasant a lot of activities happen at this semi-open space which is surrounded by gardens with flowers, homegrown fruits, vegetables, vineyards etc.

Inside the house has also typical characteristics, living rooms has usually wider openings toward south, south-east or east. Although the roof has a high slope from outside which is due to a better resistance under common precipitation of the region, inside is flattened and has a very low ceiling height. the ceilings with visible wooden girders are also specific to Romanian rustic houses.

In typical Romanian houses, walls are covered by handmade costumes and rugs from inside, this is due to both decoration, and also in order to decrease heat transfer by conduction and convection from inside to outside. This helps to avoid humidity inside the walls effects on effective temperature of onside.

Many peoples in this area plaster their log homes inside and out to keep out moisture, improve insulation, to hide imperfections in construction, and for general aesthetic value. Traditional plaster is made of clay, water, dung, and straw or chaff. Several coats may be applied to create a smooth finish, and then coated with lime and water to produce a pleasing white color and protect the clay from the rain

Figure 11: ground floor in areas with access to stone (source: http://naturalhomes.org/vernacular.htm)

· **Cordoba**

under the Köppen Climate Classification ,Cordoba lays in “dry-summer subtropical” climates or “Mediterranean”. This climate zone has an average temperature above 10°C in their warmest months, and an average in the coldest between 18 to -3°C. Summers tend to be dry with less than one-third that of the wettest winter month, and with less than 30mm of precipitation in a summer month. Many of the regions with Mediterranean climates have relatively mild winters and very warm summers.

Around 10,000 cave dwellings are dotted throughout almost the whole of Andalusia (where Cordoba is located as well), 95% of them concentrated in the provinces of Granada and Almería but the typology of the dwelling in this region follows the same strategies as they do in Cordoba.

They can be found in the dale of **Guadix**, the high plateaux of **Baza** and **Huéscar**, and the valleys of Andarax and Almanzora, which are hollows surrounded by mountain areas which possess two fundamental

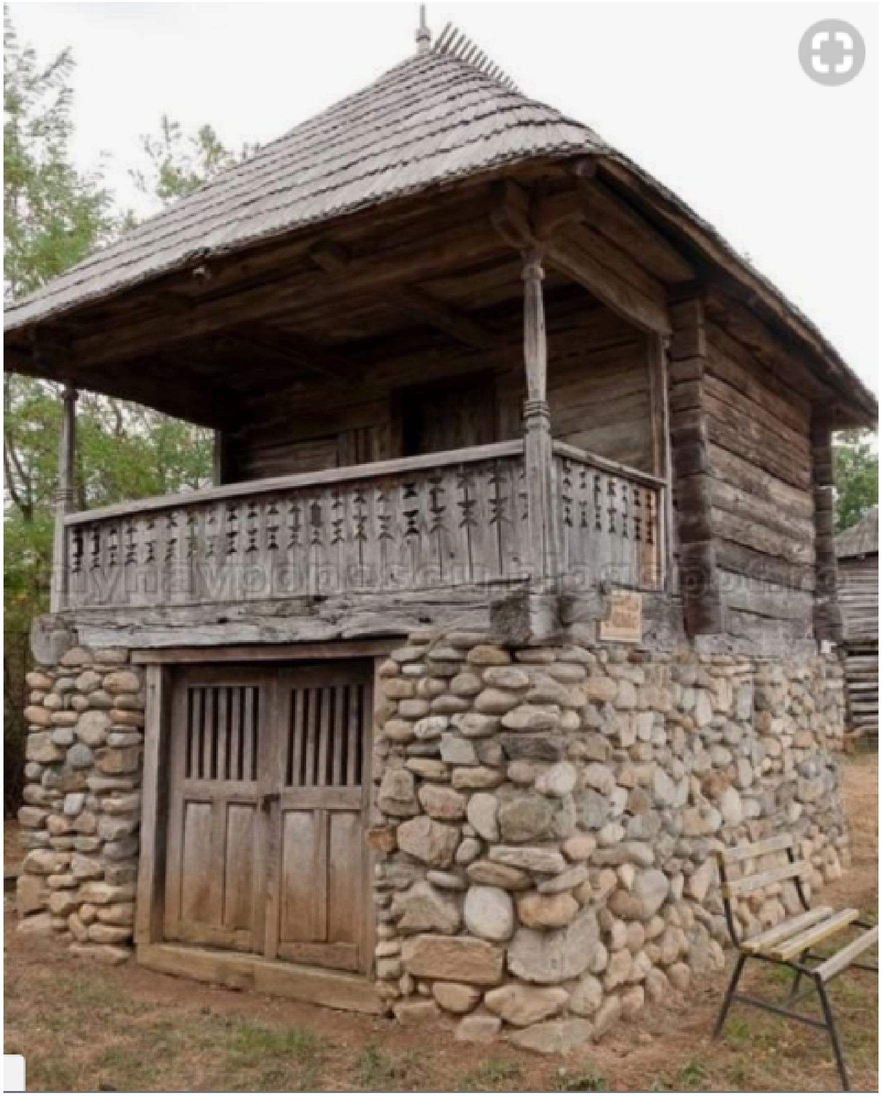

Figure 12: ground floor in areas with access to stone (source: http://naturalhomes.org/vernacular.htm)

characteristics: consistent, impermeable land which is easy to excavate and a dry, sometimes arid climate with sharp thermal variations.

The caves are situated on hill and mountainsides or around small hillocks and are usually built around one square-based room. Facades and chimneys, whose lime or colour contrast with the ochre colour of the earth, comprise their external appearance. Additional pieces are often added to the facades, either attached or free-standing, and a porch made of plants or construction materials is sometimes built on, marking out a complementary space to the cave called the "placeta", the little square.

Inside, the problems of ventilation and lighting are solved by skylights. This cave architecture, which goes far back into history, became considerably more popular in the last century as a result of agricultural and

Figure 13: ground floor in areas with access to stone (source: https://romaniadacia.wordpress.com/2014/10/28/traditional-rural-houses)

Figure 14: ground floor in areas with access to stone (source: https://romaniadacia.wordpress.com/2014/10/28/traditional-rural-houses)

mining developments, and the last spurt of cave digging on a large scale occurred in Guadix in the 50s. The photography show a vertical clearstory placed in the flat roof of a building. The aim of this element is

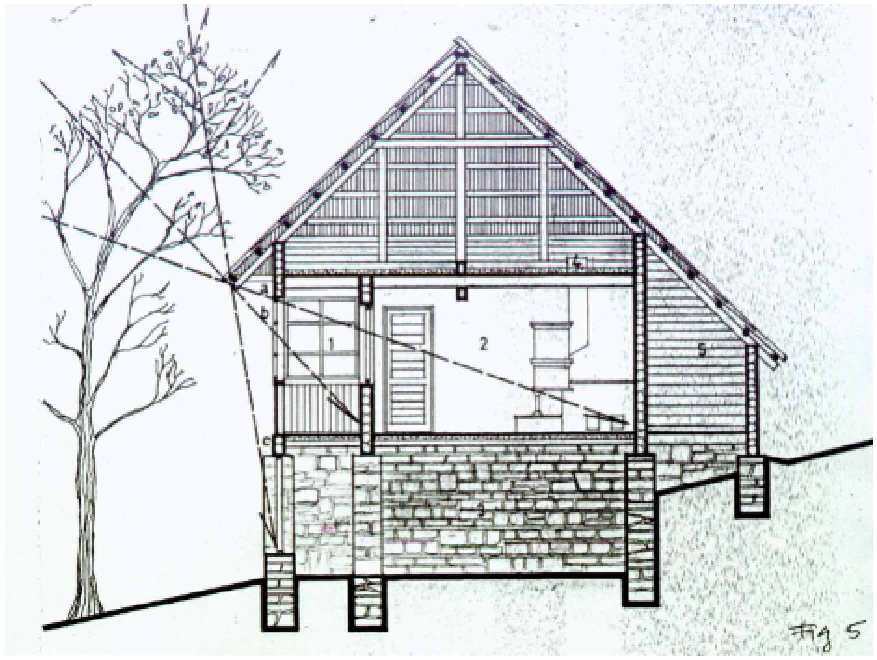

Figure 15: sun behavior and over hangs (Nicolae Petrasincu and Laurentiu Fara, Bioclimatic elements for traditional Romanian houses, Romanian Solar Energy Society – Romanian Section of ISES c/o. Physics Dept., Polytechnic University Bucharest)

Figure 16: Porch an common element in Romanian rural houses (source: https://www.polyvore.com/romania/collection?id=4210011)

Figure 17: section of a rystic traditional house from Maramures (source: http://www.romanianmonasteries.org/)

the protection against solar radiation. This vertical clearstory provides light and ventilation to the interior of the building but not allows the penetration of the direct solar rays.

Here can be seen that houses are excavated below ground level. This is a very effective strategy both for the thermal properties of the ground which have very high thermal inertial but also because it is possible to control solar radiation in such a way that openings are facing mainly North direction. also having a small private yard makes it possible to grow greens plants which ends in humidification of the space and also as this yard is mostly laying under shadow of adjacent buildings, a cool atmosphere will be created where makes a pleasant air current enters across the dwelling.

Studying dwellings in cities nearby where they are not excavated inside the ground ended in some similarities as well, such as light color of the external surfaces, low area of openings, natural or artificial shading system,. . .

The bioclimatic element is the system to collect the rain water. This system is formed by a gutter arriving from the roof and a cistern joint to the building where the water is stored. Besides the saving on water consumption this systems can provide evaporative cooling effect in summer.

Figure 18: low ceiling- exposed wooden girders-decoration – (source: http://muzeul-satului.ro)

Figure 19: low ceiling- exposed wooden girders-decoration – (source: http://muzeul-satului.ro)

This building due to its cubic form, white color, and prevalence of wall on openings, contrast with the environment in a positive way. This characteristics of the building are designed to fight the high solar radiation received in the island.

In this buildings, there are wooden lattice in the windows as elements to avoid the solar radiation. These elements are employed also in non-popular buildings as in La Alhambra in Granada. Besides the lattice the

Figure 20: low ceiling- exposed wooden girders-decoration – (source: http://muzeul-satului.ro)

Figure 21: THE CAVES. GRANADA AND ALMERIA (source: www.andalucia.org/enroutesthe-caves-granada-and-almeria)

Figure 22: Caves of Sacromonte (source: www.andalucia.org)

Figure 23: a porch made of plants or construction materials - materials - http://www.sciencedirect.com/science/article/pii/S0360132304001295#TBL1

building has the walls whitewashed and bars in the windows; this is an example of the typical Andalusian building.

Figure 24: Flat roof of a popular housing in Nıjar (Almerıa) http://www.sciencedirect.com/science/article/pii/S0360132304001295#TBL1

Later on, by growing villages and emerging the cities, excavation was not efficient any more, in result picture of the cities changed. Material were still mainly made of soil with high thermal inertia, but constructions turned into 2-storey buildings. A court yard in shade with green plants and flowers were placed in the middle and white colored buildings with porches and balconies were formed around it. Internal height of the buildings increased. Also more window area was considered, to benefit from cross current.

Chapter 2: Design Strategies:

· **Climate analysis:**

In order to study and consider different possible passive strategies, with the final aim of assuring physiological comfort, we have to first study and understand the climate where we will be working. First it is important to understand that climates vary depending on multiple factors, such us, altitude with respect to the sea level, distance from the equator, inclination of the earth, sun position etc. . . , with this in mind, it's possible to identify 4 main climate zones:

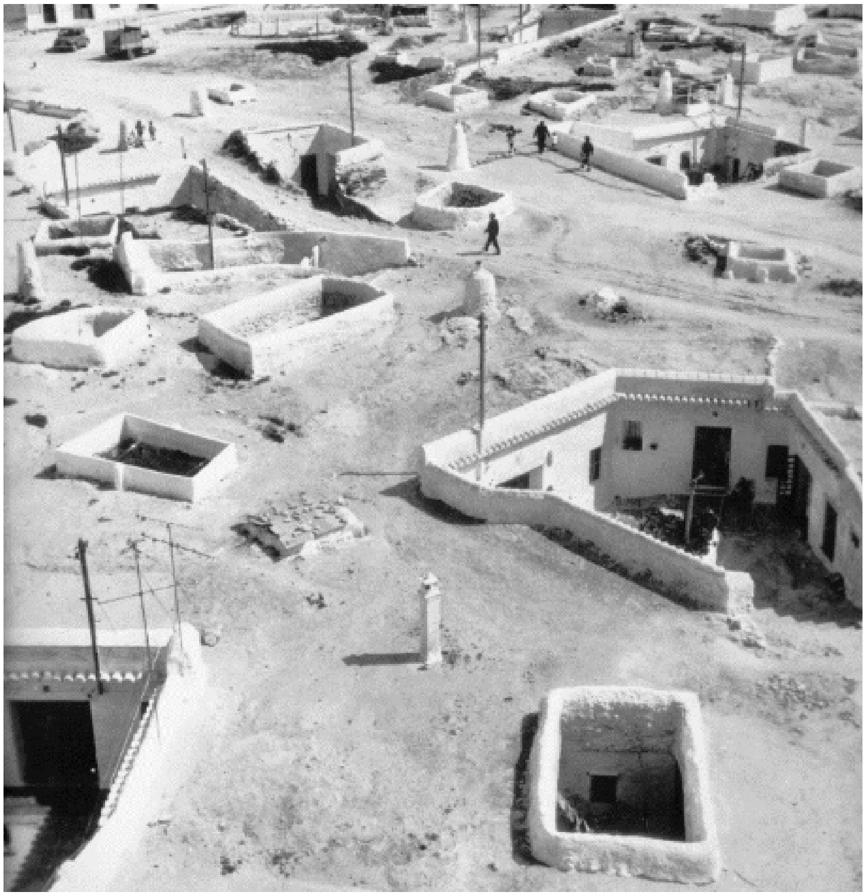

Figure 25: Subterranean housing in Benimamet (Valencia) http://www.sciencedirect.com/science/article/pii/S0360132304001295#TBL1

· Torrid zone: "Central" parts of the earth, surrounding the equator. High angle of incoming sunlight

· Temperate zone: Just after the Torrid zone. Angles of sunrays start decreasing.

· Frigid zone: At the two poles of the earth. Very low, if any, sun radiation.

Having defined these macro climate zones is not enough to fully understand though the local climate of a city, reason why within each zone we can identify multiple different climates. To do so, knowing that both Timisoara and Cordoba set inside the temperate zone, we can look at the charts shown below and try identify our geographic position.

As we can see, Cordoba and Timisoara, even though do not differ very much in terms of distance from the equator, they have very different climates. In particular, The first can be consider to be a Mediterranean temperate mesothermal climate, identified with the color light yellow and the latter a warm, humid continental climate identified with the color light blue. By looking at hte psycometric charts it can be seen that Cordoba is able to reach higher persentage of hours (79%) under comfort zone by means of passive strategies with respect to Timisoara (52%) where lot of energy is still needed for heating.

In the Mediterranean coasts (Mediterranean climate) the main problem is the hot and dry summer. The strategies should be employed are the protection against solar radiation (systems of shading and small

Figure 26: This is a Popular house in San Luis (Menorca) caption http://www.sciencedirect.com/science/article/pii/S0360132304001295#TBL1

Figure 27: Popular housing in Lanzarote (Canarian Islands) http://www.sciencedirect.com/science/article/pii/S0360132304001295#TBL1

openings) as well as strategies for the saving of water consumption or for the collecting of rainfall

In Continental climate, due to the fluctuation in temperatures along the year, strategies against cold temperatures in winter as well as against solar radiation in summer must be employed. By using the cases of vernacular architecture as a model, in this area of continental climate the new building should be designed with:

–high thermal mass to use its damper effect,

–protection of the entrance,

–strategies against cold temperatures in winter: compact built form, appropriate thickness of insulation, use of solar radiation in the northern interior part and protection against solar radiation in the southern interior part of Spain.

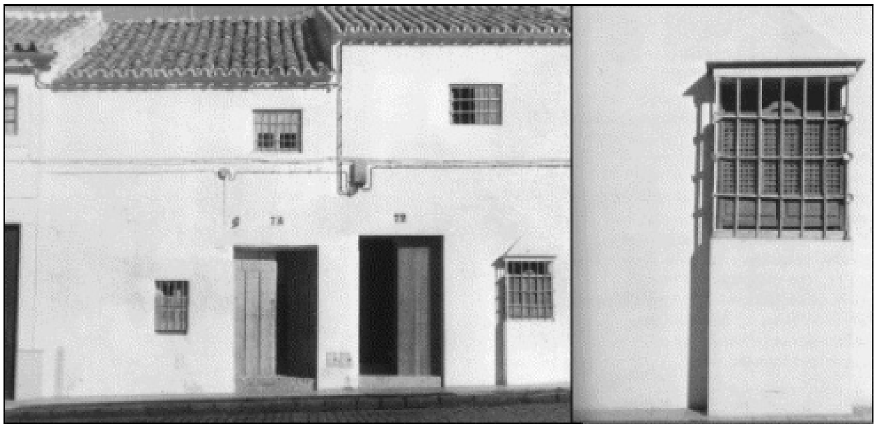

Figure 28: Popular house in Osuna (Sevilla) http://www.sciencedirect.com/science/article/pii/S0360132304001295#TBL1

Figure 29: Historic center of Cordoba-yuripetrovsky.wordpress.com

- **Watson&Lab matrix: Timisoara**
- **Watson&Lab matrix: Cordoba**

Chapter 3: Climate responsive architecturesf

- **Timisoara, Romania**

Marasescu Residence, Bucharest, Romania-2008

Proket Team: Mario Kuibus, Roxana Dumitriu, Irina Plesnila, Cornelia Zaharia

The expansion and construction of upper floors at a house in Bucharest, finally led to a total re-thinking of

Figure 30: White colored facades, courtyards with greens, traces and porches, common elements in Cordoba -yuripetrovsky.wordpress.com

the old structure, which led to the removal of a large part the roof. A house affording comfort, confidence and cultural «safety» was, in part, the theme received. If we analyze house archetypes anywhere, we will realize that in many cultures, old or new, here or anywhere, houses are perceived as «friendly», «human», «safe» when conceptually there is a stone pedestal overtopped by an upper wooden structure.

It was realized that this was the answer that had to given to the theme proposed: a house with a «stone» pedestal and an upper «wooden» structure. It was found a simple scheme, which also allowed to give meaning to things: stone in the «day» area of the house and wood in the «night» one. As for the rest, everything went «normally»: spaces expanded vertically, from the semibasement to the uppermost floor, compartments marked by graphically customized glass, the atrium-greenhouse at the uppermost floor as a transitory space towards the couple's bathroom, a skylight over the staircase, with windows in astral colors (violet, yellow, orange etc.), and the like, things that are culturally «safe»…

Inside takes advantage of indirect day light due to roof mounted windows, in this case using colored window reminds us traditional decoration in modern way and also absorbs more heat through sun.

Dual purpose overall windows are able to be closed and produce greenhouse effect during winter and be opened during summer to let air current happens.

Bucharest Apartments in Romania

Design: ADN Birou de Arhitectură

Location: Str. Dogarilor 26–30, București / 26–30, Dogarilor Street, Bucharest, Romania

One of the most important and problematic aspects of nowadays Bucharest is the fast densification of the central area. While the architects believe that density can, and many times must be seen as a form of sus-

Figure 31: Arches and patterns on ceramics-influence of Islamic architecture in Cordoba-yuripetrovsky.wordpress.com

tainability, they also admit that the often fragile relationship between habitation within an old neighborhood and the increase of density could many times alter the place and reduce its existing qualities. The project is looking for an appropriate answer to this problem. It tries to mediate between different sizes and densities, in a quite central neighborhood characterized by small streets, long, narrow plots and a puzzle of old and new buildings of all types and scales. The building searches to preserve, at its own scale, the porosity and "profoundness" of the deep, narrow plots, while also trying to capture part of the "collage"-like appearance of the surroundings.

The architects have also tried to mediate between the continuous alignment required by the urban regulation and the specific of the street and of the surrounding urban fabric, characterized by fragmentation.

At the same time, the project proposes a type of habitation which the architects consider suitable for the center of the contemporary city: a place where the relatively small spaces and the density are complemented by diversity and wider common spaces.

Most of the apartments are different from one another, not only in size, but especially in typology: they range from studios to four-bedroom apartments – each one of them laying on one, two or even three floors and having private courtyards, balconies or terraces of different sizes.

They all are complemented by several indoor and outdoor common spaces (terraces, party room, large halls etc.), while the ground floor offers several commercial spaces and ateliers to rent, towards the street and the inner courtyard.

The apartments are conceived by ADN Birou de Arhitectură in such way as to allow a great deal of flexibility, making it possible to connect (horizontally or vertically) two or more small units into a larger one. Such

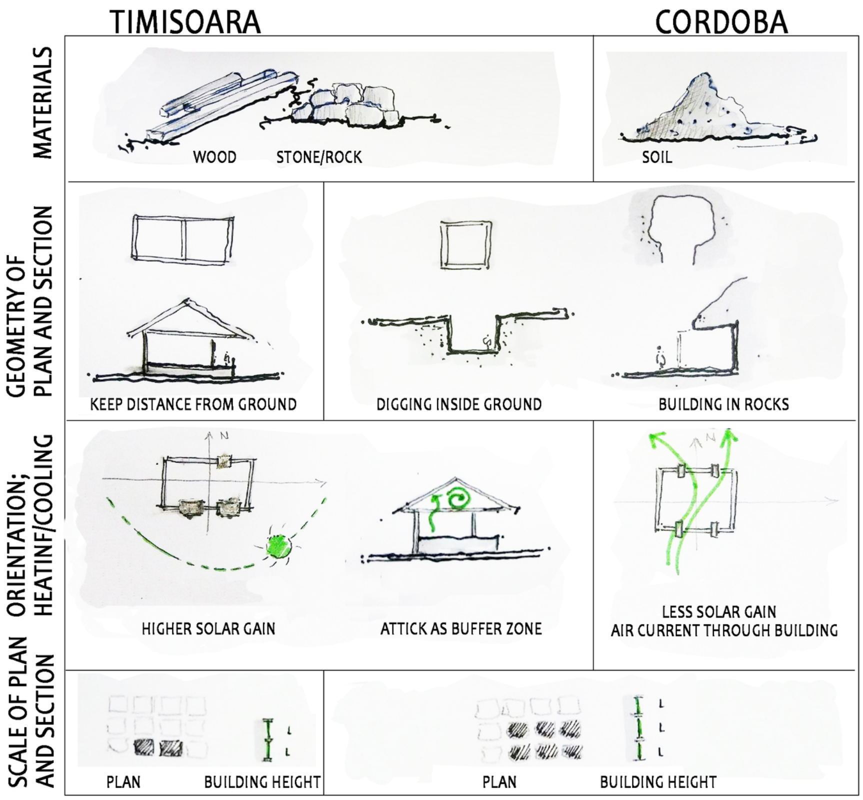

Figure 32: A general comparison between the two given cities (source: hand drawing by group 15)

changes have occurred all along the construction process, leading, in the end, at a building consisting of 77 residential units offering approx. 50 types of apartments.

The Egg House, Baneasa, Bucharest, Romania

Project team: Mario Kuibus, Anca Pop, Claudiu Bica Structure design: Icipe 1 A Installation design: Roinstar Execution: Scorillo, Suki, Strial, Bel

Profile Area: 980 sqm

Year of completion: 2005

Also called The Egg Villa, the house would be more than a perfect dome, indifferent to the main natural landmark, the wood and to the cardinal points. It is closed towards the street, opening towards the main light source and providing insights of the forest and the key points of the house. The concept starts from two primary volumes growing out of the land – one covered in stone ant the other one in wood – and sheltered by its protective dome, like a technologic umbrella. The stairs, main compositional component, connects the two natural volumes as a technological binder in metal and glass. The illumination intercepts and stresses the volume, while the dome absorbs the shadows and their games.

Continental Climate

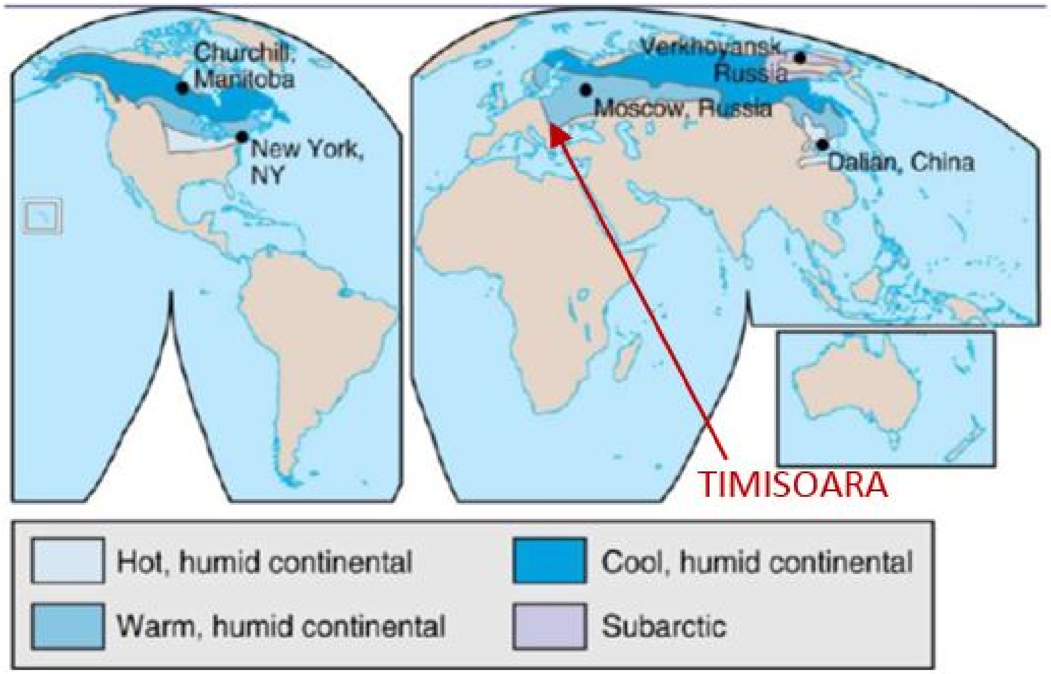

Figure 33: Word map - continental climate

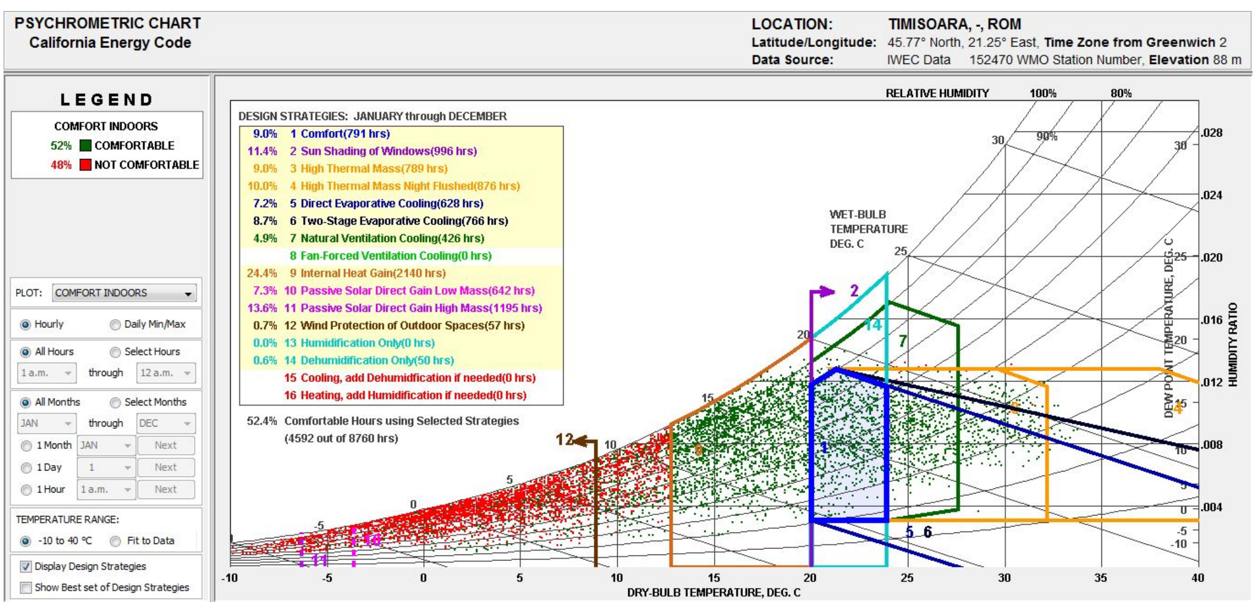

Figure 34: Pscrometic chart - internal comfort through passive strategies - Timisoara

Temperate (mesothermal) climate

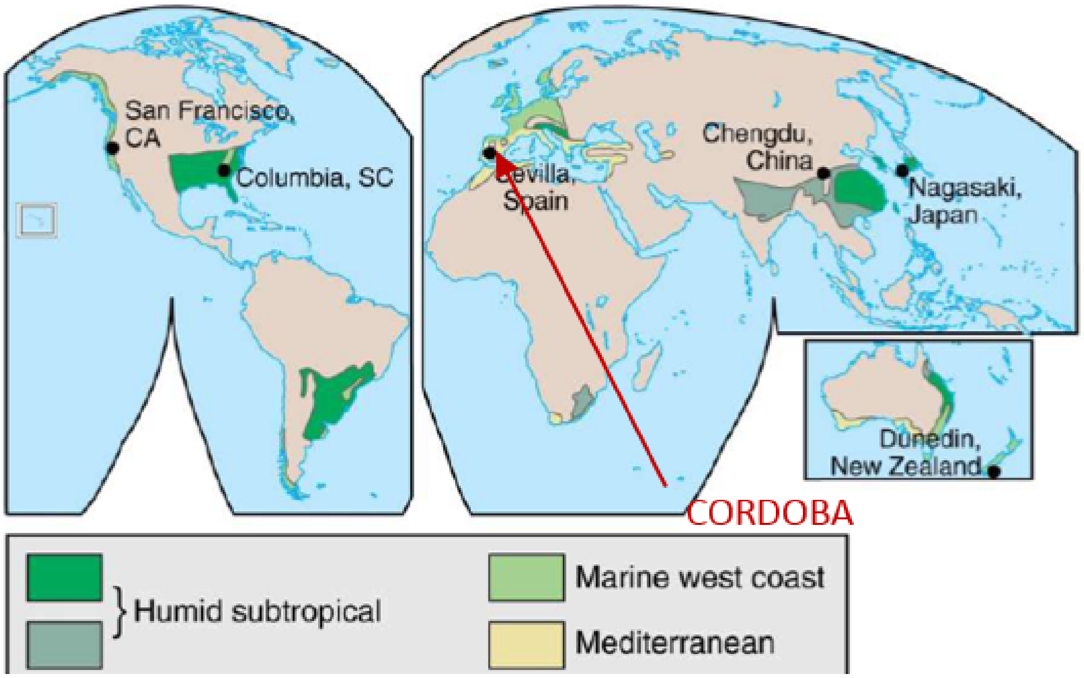

Figure 35: Word map - Temperate climate

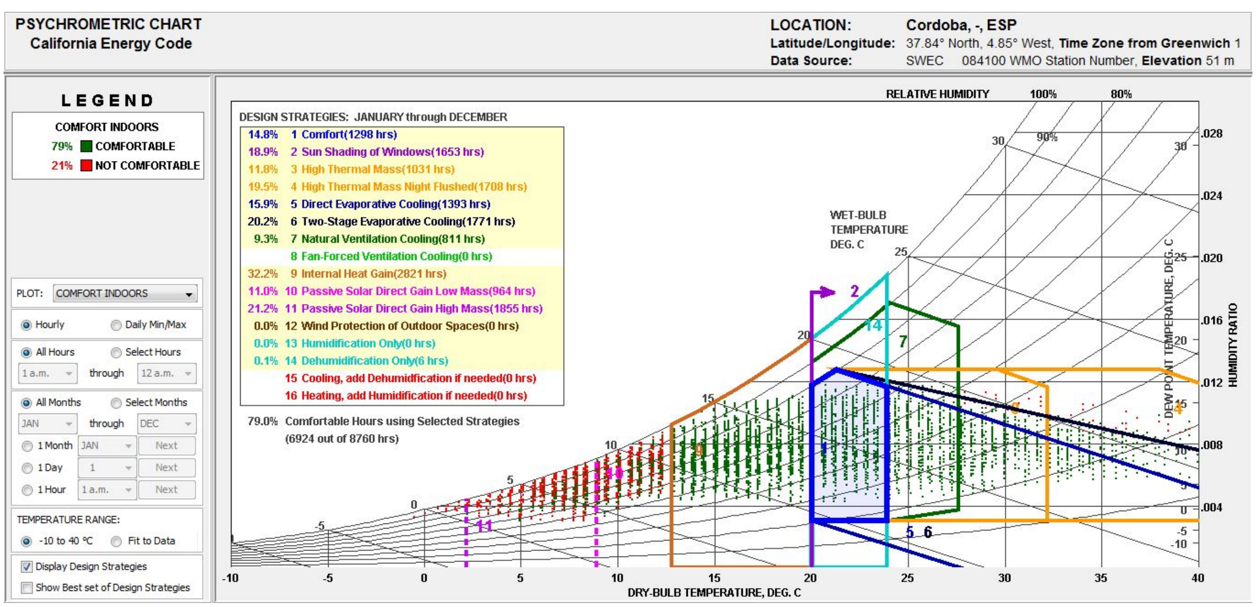

Figure 36: Psycometric chart - internal comort through passive strategies - Cordoba

		HEAT SOURCES			
	Main Strategies	Conduction	Ventilation	Radiation	Moisture transf.
WINTER (cold season)	Increase heat gain	To devide the spaces in smaller volumes-Use of building materials with high thermal inertia whith appropriate heat release time lapse-keeping domestic animals under the sitting floors to benefit from their heat(rural houses).	Green house effect, using fully glazed balconies or porches, in the way that can be closed and be able to create a temperate microclimate inside. during winter this mild air can be lead inside the house for air change and ventilation.	Higher ratio of volume/external wall area	/
				Deciduos vegetation	
				Orientation of the building-use of windows facing south which receives maximum radiation during winter- At north windows are favourable for sake of natural illumination.	
	Reduce heat loss	Use of highly insulated envelope and materials with high thermal inertial-houses devided in small volume rooms	Using double skin attics which can be passage of hot water pipes and chimeny, in this way this area works as a buffer zone	In case radiant plants are used, strategies in term of least heat reduction must be applied.	/
SUMMER (hot season)	Reduce heat gain	using movable or fixed over hangs or balconies in order to control sun rays reaching the envelope or inside the building. Use of highly insulated envelope	Form and geometry/Natural ventilation during the night can be exploited	Use of effective shading systems especially in East and West facades	/
				Use of vegetation on the roof and on balconies to reduce as much as possible the transfer of solar radiation	
		Use of green roof due to constant temperature of soil and reflection and absorbtion by vegetables.	Use of double envelope/ ventilated façade and semi-open spaces	Use of clear white material's colours for the facade or the roof	
				Openings with smaller areas in East and West facades and larger in North and South	
	Increase heat loss	Using materials with high thermal capacity which absort heat	Form and geometry/Ability of producing natural current cross the building	having more external area faced toward the sky	Use of dehumidification / evaporative cooling by ceiling fans

Figure 37: Watson&Lab matrix - Timisoara

House in Romania : Free Form Buildings

Romanian Residence, Ciboteni – design by Portik Adorján Architects

Location: Ciboteni, Romania

Area: 320 m2 Function: Single-family house

The building is designed for a five member family. It contains – next by the living area – five bedrooms and two bathrooms. The internal spaces are arranged in the living area in a high ground-floor, the bedrooms and the service areas on two levels. The garage and an external storage forms a separate volume.

This project is the first application of the „Free Form Buildings" construction system.

The significant parameters are:

– patent nr. and tite: P 1000399, Polyhedral surfaced, celled, space dividing structure;

– by the method we are able to build multi curved structures;

<table>
<tr><td></td><td></td><td colspan="4">HEAT SOURCES</td></tr>
<tr><td></td><td>Main Strategies</td><td>Conduction</td><td>Ventilation</td><td>Radiation</td><td>Moisture transf.</td></tr>
<tr><td rowspan="5">WINTER (cold season)</td><td rowspan="4">Increase heat gain</td><td rowspan="4">Use of building materials with high thermal inertia which are able to store solar radiation during the day and release it during night</td><td rowspan="5">Doors and windows should be air tightened / mainly mechanical ventilation should be exploidet</td><td>Use of the ground as heat storage since 51% os the solar radiation which reaches the surface is absorbed by land and oceans</td><td rowspan="4">Vegetation and water paths could be used to humidify furing the winter</td></tr>
<tr><td>Vegetation can be used in such a way that loosing leaves in winter allows radiation to go in</td></tr>
<tr><td>Use of southern facade with warmer colors in order to maximise solar energy ebsorption</td></tr>
<tr><td>Use of windows facing south which receives maximum radiation during winter / orientation of the building</td></tr>
<tr><td>Reduce heat loss</td><td>Use of highly insulated envelope and materials with high thermal inertial</td><td>/</td><td>/</td></tr>
<tr><td rowspan="5">SUMMER (hot season)</td><td rowspan="4">Reduce heat gain</td><td rowspan="2">Use of highly insulated envelope / reduce heat storage and reduce heat transfer from outside to in</td><td rowspan="2">Natural ventilation during the night can be exploited</td><td>Use of effective shading systems especially in East and West facades</td><td rowspan="4">/</td></tr>
<tr><td>use of vegetation on the roof and on balconies to reduce as much as possible the transfer of solar radiation</td></tr>
<tr><td rowspan="2">Use of green roof / materials with high thermal capacity</td><td rowspan="2">Use of double envelope/ ventilated facade</td><td>Use of clear white material's colours for the facade or the roof</td></tr>
<tr><td>Use of aperture with smaller areas in East and West facades and larger in North and South</td></tr>
<tr><td>Increase heat loss</td><td>Use of thick highly insulated envelope / increase heat transfer from in to out</td><td>Buildin and its envelope should be desined in such a way that warm air can easily exit. For example by means of stuck effect or through internal partitions such as doors</td><td>/</td><td>Use of dehumidification / evaporative cooling</td></tr>
</table>

Figure 38: Watson&Lab matrix - Cordoba

– components: oriented standard board (OSB) panels, wood slats;

– the internal cells are fulfilled with thermal insulation;

– the structure works as the thermic shell of the building

The external coverings of the shell – for the current application- are wooden boarding and zinc membranes, as well other covering materialls are appliable. The application of this construction system – next by the low cost of the building- facilitates the energy consumption of the use of the building.

The project is corresponding the passive house requirements of 15 kWh/m^2 per year, with a full width of the external wall of 55cm, in a medium of +6 annual degree C. The heating is supplied by air to air heat recovery and ground heat exchanger ventilation

- **Cordoba**

Figure 39: **Marasescu Residence**, Bucharest, Romania (source:https://www.e-architect.co.uk/architects/re-act-now-architects-Photo: Andrei Margulescu)

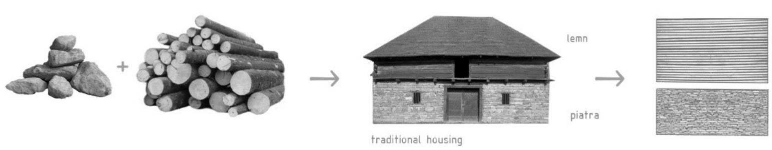

Figure 40: Production scheme

Energy-Efficient Residence in Spain, Villa EntreEncinas

Location: Villanueva de Pría, Spain

Duque y Zamora Arquitectos completed the design for a generously-sized modern home in Villanueva de Pría, Spain. The residence pays tribute to energy efficiency and sustainability. Part of a joint project that includes three other houses, Villa EntreEncinas consists of a compact volume, partially hidden in the steep terrain. To the south, there is a solar collector, which sits on the flat area of the plot. Its height does not

Figure 41: **Marasescu Residence**, Bucharest, Romania (source:https://www.e-architect.co.uk/architects/re-act-now-architects-Photo: Andrei Margulescu)

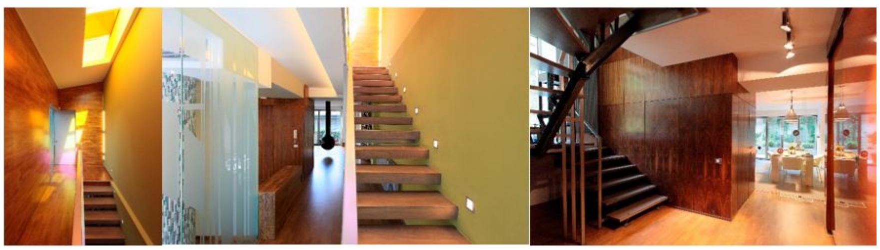

Figure 42: Decoration, eat and light inside / greenhouse effect

exceed that of the surrounding treetops

From the 1st floor, the view is not interrupted and the light shines with greater intensity and duration. This was the perfect place to position the living room, kitchen and bathroom. The private areas are located on the ground floor. According to the architects, the materials used for the construction were non-toxic, with a low environmental impact for a healthy indoor environment, mostly of organic origin and 100% renewable: *"laminated wood for prefabricated structures, insulation cork for façade and roof, cellular glass insulation under slab, piping, wiring and electrical equipment polypropylene lime plaster facade, roof garden, PVC curtains and blinds, and natural limestone flooring and bamboo*".

As it can be seen, two very different strategies were adopted for the facade. respectively, facing south we have the use of large windows which serves to trap as much sun energy as possible during the winter months, facing east, which receives sun mainly during the morning we also encounter fairly large windows, but only on the second level since the first one is below ground.On the other hand west and north facades have minimal apertures.

High exploitation of sun energy is made by means of greenhouse effect on the southern facade.

Lush green walls sandwich pioneering net-zero energy building in Spain

Location: Málaga, Spain

Parts of Europe have passed legislation that will require all new buildings built after 2020 to adhere as closely as possible to net-zero energy designs. Spanish architecture firm EZAR and architect Juan Blázquez demonstrated the potential beauty of such designs through the CSI-IDEA Building in Málaga, Spain, which

Figure 43: https://www.e-architect.co.uk/romania/bucharest-apartments-in-romania

Figure 44: Architectural intergation with surrounding buildings

has a green face and generates more energy than it needs to run.

The CSI-IDEA Building makes use of passive design, including its unique shape, to reduce the overall energy load. Solar thermal energy generated on site provides heat, with a design that ensures the building generates more energy than it utilizes. Efficient air conditioning and lighting also reduce energy consumption.

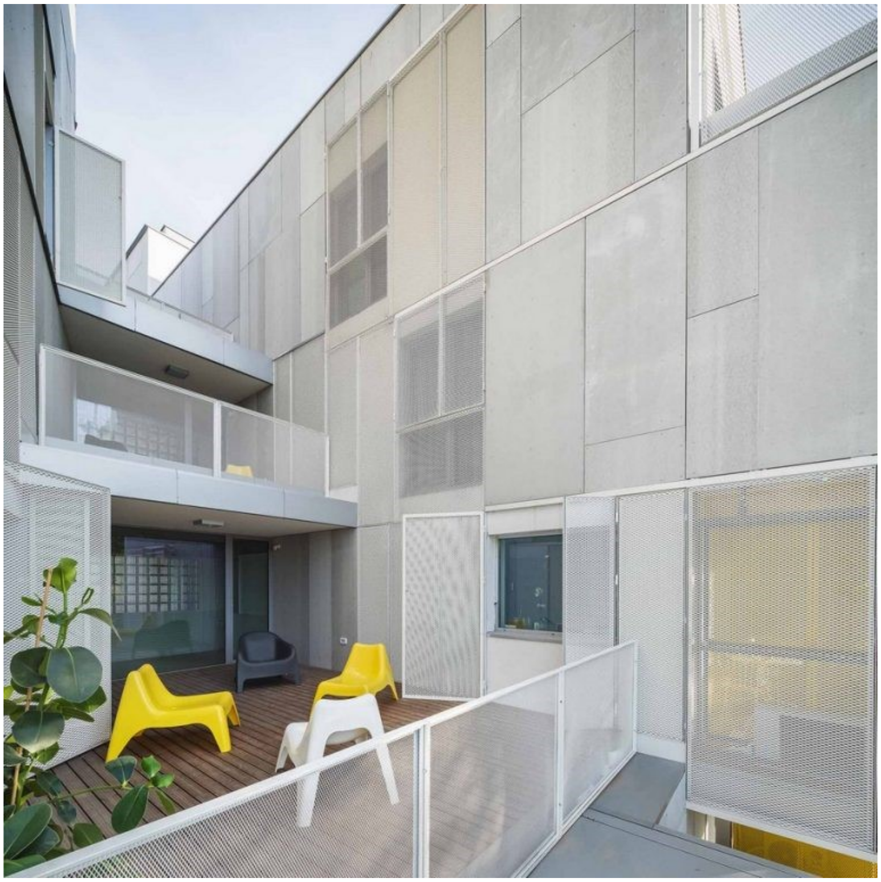

Figure 45: Internal courtyard

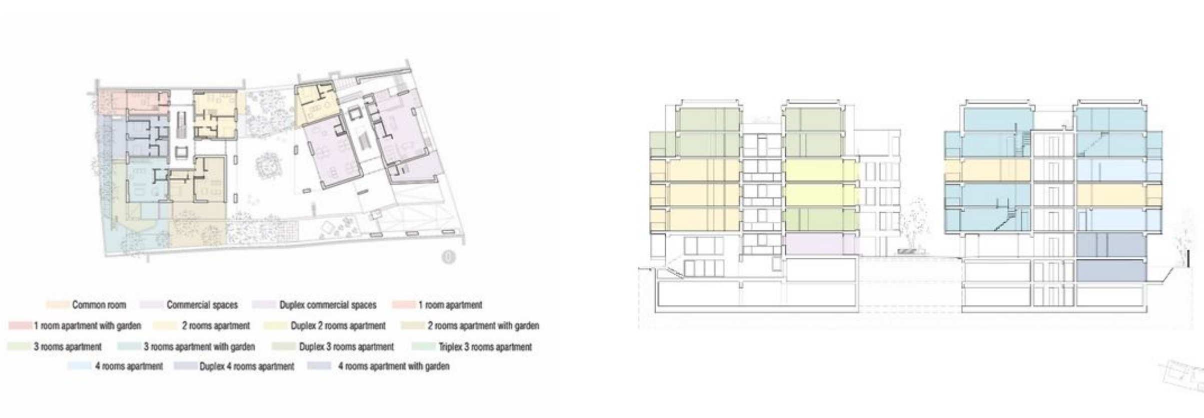

Figure 46: Internal distribution

Energy efficiency isn't the only sustainable feature of the CSI-IDEA Building. The materials used also play a part in reducing its environmental impact. EZAR used both recycled materials and those that can be recycled in the future in the construction, with an emphasis on low toxicity materials and finishing. Further, each end of the building includes a wall of vegetation, which adds to the elegance of the design and blends

Figure 47: Photos of the interiors

Figure 48: Andrei Margulescu- (https://www.e-architect.co.uk/architects/re-act-now-architects)

Figure 49: This is a caption

Figure 50: Renderings

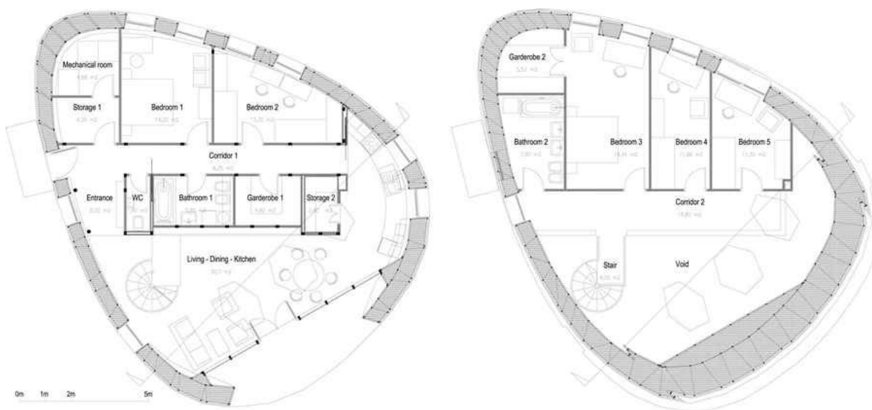

Figure 51: Architectural plan

Figure 52: Villa EntreEncinas https://freshome.com/2012/11/16/energy-efficient-residence-in-spain-inspiring-healthy-modern-living/

the building in beautifully with the surrounding community.

Figure 53: Different facade strategies https://freshome.com/2012/11/16/energy-efficient-residence-in-spain-inspiring-healthy-modern-living/

Figure 54: Greenhouse effect https://freshome.com/2012/11/16/energy-efficient-residence-in-spain-inspiring-healthy-modern-living/

EZAR reports the project will result in reduced carbon emissions and less energy and water consumption. Thanks to this and rainwater harvesting, CSI-IDEA uses 50 percent less water than a typical building. It is also designed to recycle 75 percent of all waste generated in the building.

EZAR also concerned themselves with the health of the building's occupants, with lighting and acoustics designed to provide natural comfort. According to EZAR's design brief, "The architecture of the building itself guarantees the quality of life of users while preserving their health.

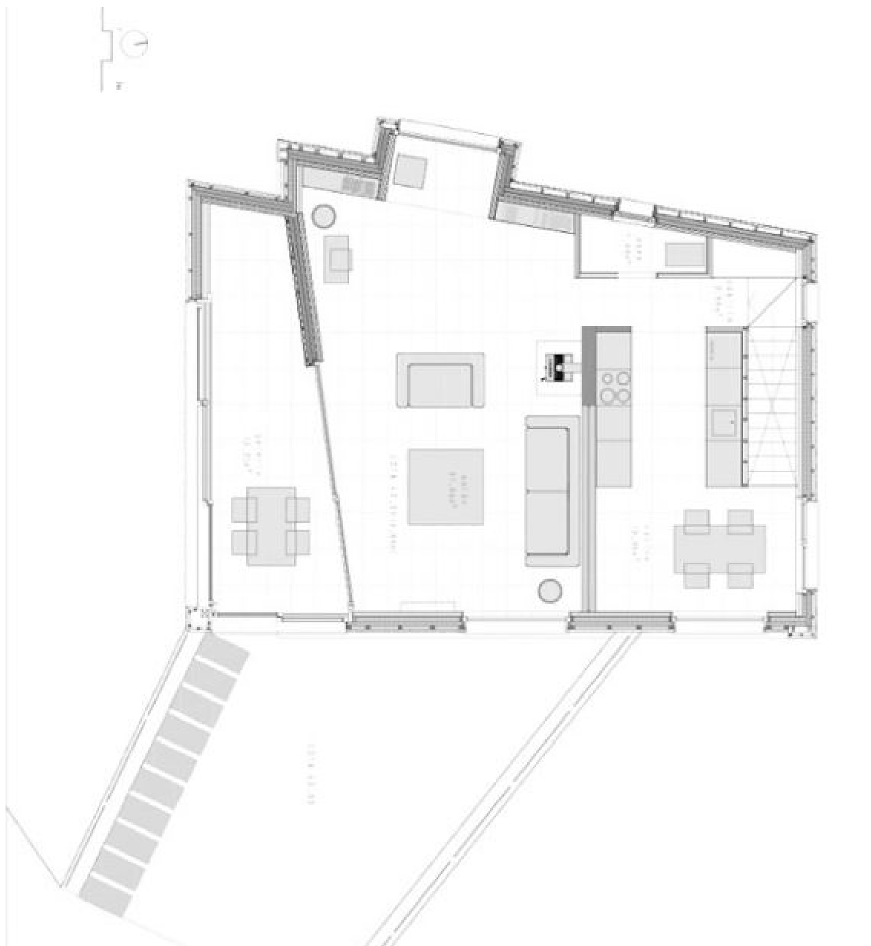

Figure 55: Internal plan and exposition https://freshome.com/2012/11/16/energy-efficient-residence-in-spain-inspiring-healthy-modern-living/

Figure 56: https://inhabitat.com/lush-green-walls-sandwich-pioneering-net-zero-energy-building-in-spain/

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Figure 60: This is a caption