TO ENERGY-EFFICIENT BUILDINGS USING PASSIVE DESIGN -CASE OF ALGERIA-

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Abstract

With the growing interest in sustainable development and the fight against climate change, it is becoming urgent to reduce energy expenditure in buildings in order to meet the requirements for reducing GHG emissions. Accommodation buildings in particular hotel establishments present a real threat to the environment through their high-energy consumption, Moreover, during the last decade, we are witnessing in Algeria a multiple implementation of hotel infrastructure projects, which are not subject to an environmental, and the energy regulatory requirement, which leads to energy-intensive buildings. This can be explained by the lack of scientific knowledge by the architects in the field of bio-climatic design and the control of the energy performance of the building. This research aims to study the impact of passive strategies on energy performance of the building using energy simulation by varing design parameters.Finally,recommendations and design solutions for energy-efficient hotels have been suggested which may play a fundamental role in the choice of the right strategies that can lead to successful projects.

Keywords Energy performance, passive strategies, hotels, bioclimatic design, energy saving.
Word Count: 2511

Introduction

-In a context of reduced energy resources and targets for reducing greenhouse gas emissions, the building sector represents not only an important area of energy saving, but also an opportunity to protect the environment by reducing the impacts of these emissions. Today, tourism is one of the main drivers of employment and development and contributes significantly to local economic growth and social well-being. “Tourism is also responsible for 5 to 10% of global CO2 emissions, of which 2-7% is attributable to hotels” [1] ,In Algeria, this sector is one of the main service activities “Algeria is the 4th tourist destination in Africa in 2013, with 2.7 million foreign tourists in 2013”[2] and despite its undeniable economic role, the sector has a negative ecological footprint (CO2 projects emissions, water and energy consumption, waste generation, etc.), particularly through its hotels.) It seems that during the last decade, we are witnessing in Algeria a multiple and intense realization of hotel infrastructure. which are not subject to an environmental and energy regulatory requirement The principles of design are functional and architectural and the environmental and energy dimension of the project is not always expressive, which leads to energy-intensive buildings, In a building energy consumption is influenced by several parameters such as:the shape of the building, its orientation, its building materials, etc. A good influence of these parameters ensures the energy performance of the building. Bioclimatic architecture is one of the solutions that uses passive processes and does not require special techniques . Thus the amount of energy consumed can be reduced by the integration of passive energy efficiency strategies in buildings such as hot strategy, cold strategy, lighting strategy.

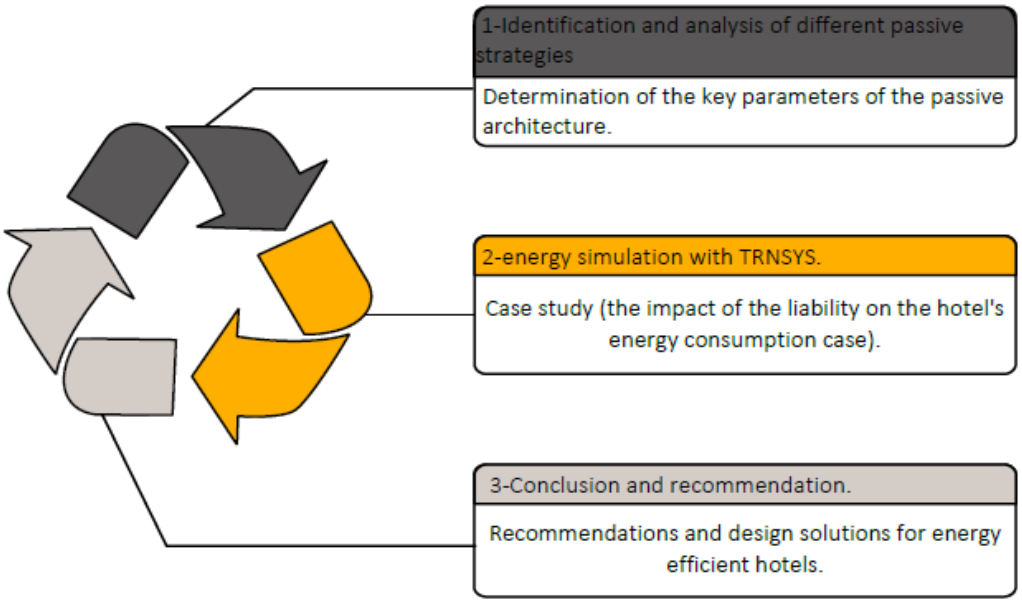
Thermal energy simulations allow to purify the design of the building and to study and compare the different solutions in order to achieve a high-performance building . The aim of this work is to improve the energy performance

of a hotel in Algiers by studying the effect of certain passive strategies on its energy consumption.

The research approach

In order to achieve the objective defined above, it is a question of combining a theoretical part in order to identify and analyze the various passive strategies which are intended to ensure energy efficiency and a case study has involved an energy simulation in order to study the impact of these strategies on the hotel's energy consumption.

The research approach:



Passive architecture: definitions and concepts.

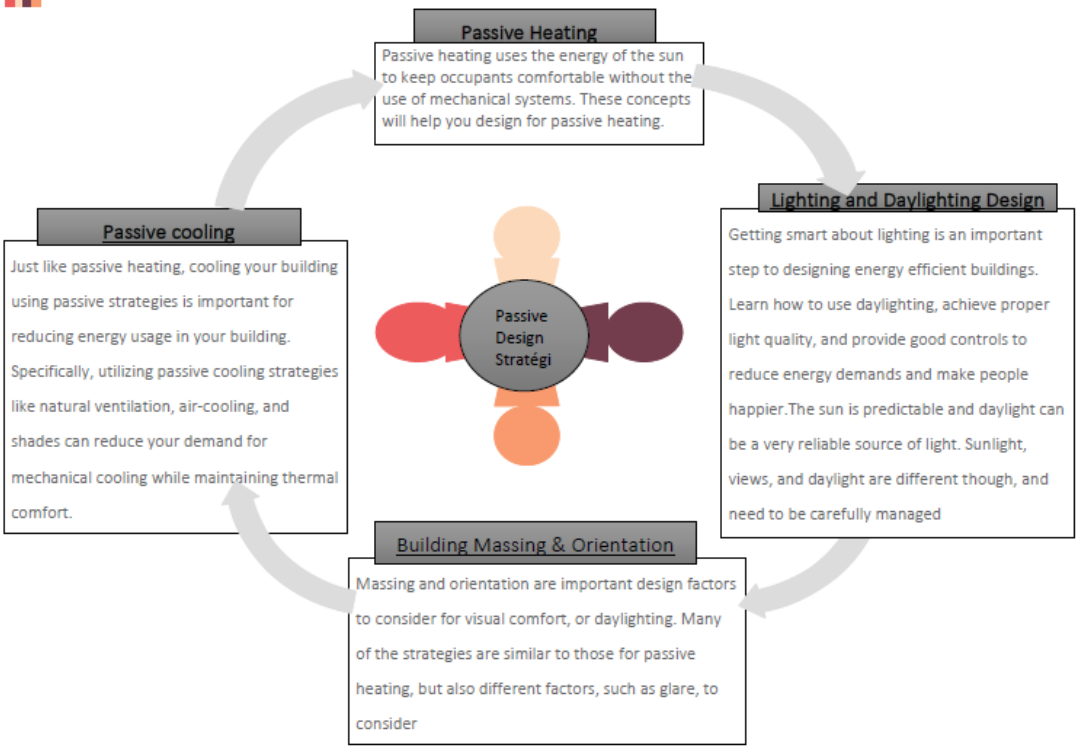
Passive solar architecture is defined as the art of building a home by taking advantage of solar radiation for heating or cooling purposes, The concept of passive building ("Bpas") was developed from the 1970s to produce buildings that are energy efficient and comfortable to use and livable[3]

Today, passive housing is based on: a very low-power construction concept, based on the use of heat input from the sun, a very strong insulation of the walls and windows, , lack of thermal bridges, high air tightness and ventilation control, The most important principle of passive solar architecture is to minimize the energy consumption of a building. This architecture is based on the judicious exploitation of natural phenomen such as climate and solar radiation. According to the Passivhaus Institut, a passive house must consume a maximum of 15 kWh / m² per year for its heating needs[4]

The main parameters of passive architecture.

The design of a passive building requires the fulfillment of certain essential criteria. The most important is the choice of the ground on which the building will be built after the choice of its orientation and form. Once all these parameters are determined, one thinks of its insulation, sun protection, internal arrangement and the arrangement of the openings, so it is important that the builder takes into account and keeps these criteria in mind:

The different strategies of passive design:



Building Massing & Orientation

1.Form of building:

The optimum shape of a passive building is one that will allow us to gain maximum heat in cold periods and a minimum during warm periods.

2.Orientation to the south:

A factor often underestimated is the orientation of the building on its ground: a passive building must have an important facade to the south, the main orientation of the building should not be the north-south axis, but the east-west axis[5]

Passive Heating

1.A good insulation

In a new modern building, architects, project managers and technicians must confront the issue of insulation. In general, 12 to 16 cm of insulation is sufficient. Rock wool, expanded polystyrene, cork, cellulose (from recycled paper) are used [6]

2.A good windows

Without the considerable progress made over the last ten years in the field of windows, passive technology would not be available today , or at least not so affordably accessible[7]

We used triple-glazed windows for which two of the six faces of the windows are equipped with a coating that captures the heat. The principle is simple: the light we see enters the hotel room through the windows and is there, like all light, transformed into heat when it reaches an object. This heat is nothing but infrared radiation. The coverings of our windows capture this heat which is trapped in the hotel room.

Thus, even in winter, the sun can heat the rooms: we can say that we live in a solar collector.

3.Sun protection: In hot weather, it is necessary to think about the sunscreens, in order to avoid having an uncomfortable housing because overheated. The principle is to stop direct and indirect heat inputs that are used in cold weather. These fixed or removable shades, artificial or natural, often play on the race of the sun to be “transparent” in winter and effective in summer[8]

Horizontal awning

The horizontal canopy is an exterior projection located above the window. It makes it possible to obscure the rays of the summer sun when they are very inclined.

Store:

The blind is the sun protection most used. Mobile, it can be vertical or horizontal. The advantage of this process is that it can adapt perfectly to the position of the sun.However, it must be operated manually unless an automation is installed. Another weak point, being movable and / or textile material, is used more quickly in time than an awning.

Natural trellis The natural trellis is a solar protection made with climbing plants clinging to a trellis.Generally horizontal, the trellis is located above the bay windows located full South.Its main advantage is that the vegetation develops according to the seasons, ensuring shade in summer, and allowing the light to pass in winter.

Sun blocker

Sun breezes can be horizontal or vertical. They use the difference in inclination of the rays of the sun thus letting pass the winter rays but not those of summer.

shading

Vegetation judiciously planted near the dwelling can serve as natural shade.Most often trees or "hardwood" shrubs are used. They have the advantage of masking the solar radiation of summer, and of letting pass that of winter.

Passive Cooling

The ventilation system : When walls, windows, floors and ceilings are well insulated, the heat losses caused by the use of ventilation become even more evident as well as losses in non-leaky locations (even if these losses play a role in indoor air renewal). In general, these heat losses via air account for 10 to 20% of the total losses of a dwelling. In a passive construction, it is very important that these losses are minimized and that at the same time there is a sufficient supply of air to breathe well. For this purpose a controlled mechanical ventilation (VMC) is used coupled to a heat exchanger [9]

Lighting and Daylighting Design

Getting smart about lighting is an important step to designing energy efficient buildings. Learn how to use daylighting, achieve proper light quality, and provide good controls to reduce energy demands and make people happier. The sun is predictable and daylight can be a very reliable source of light. Sunlight, views, and daylight are different though, and need to be carefully managed[10]

energy-saving lamps (fluorescent lamps or LEDs) can save up to 50% more energy than incandescent lamps (but they do not create heat like these incandescent lamps).

Consider turning off electrical appliances, Avoid Undue Lighting, Turn off the light when you leave a room, enjoy the daylight, regulate the temperature naturally

Before leaving, turn off the heater and close the windows in winter (curtains or shutters in summer, example while using air conditioners by closing all openings). 1 ° C less, 7% less energy consumption, use of low-consumption lamps can give the feeling of less brightness, but it is only a matter of time, they are more economical, for the air conditioning in think of the thermal insulation (reinforced external insulation not to leave the space heated).

Study of the impact of passive design on the energy efficiency of an urban hotel in Algiers

The case study

The building consists of a 3-star urban hotel located in the city of Algiers, built in 2008, built on the ground and facing south-west on a surface of 440m².

The hotel energy requirements are simulated using the TRNSYS version 16 software. We have calculated the energy requirements of the hotel in the current state then we have incorporated some parameters (passive strategies):

orientation of the hotel, integration of solar protection, use of triple glazing, insulation of roof, floor, walls with 10 cm polystyrene. At the end a comparison was made between the two results obtained before and after the integration of these passive strategies.

Simulation software:

TRNSYS is a dynamic simulation environment that can simulate very finely the behavior of a complex system, such as a building; ; it has been available since 1975

Simulation process: from the architectural data and the thermo-physical properties of the material, an analysis of the thermal behavior of the samples is carried out using the "TRNSYS V 16" software [11].

The course of the simulation took as follows:

1.The first step: the detailed description of the hotel case in the software (wall surfaces, openings surfaces, type of glazing, materials that make up walls, type of ventilation, number of people ... etc).

2. The second step: simulation and reading results using Excel.

Results

Hotel Case

1-The following table presents the results obtained before the integration of the passive strategies (current state):

The case	Energy requirement (useful energy) (KWh)		
Urban hotel in Algiers	Heating	Air conditioner	Total
	20450	22750	43200

Board . Hotel energy needs case (current)
(Source: Author 2017

Energy saving after the integration of different passive strategies:

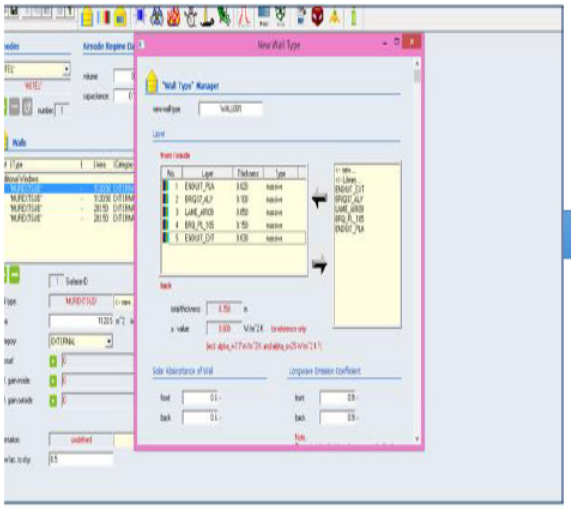


Fig. The materials that make up the walls in the current state (Source: Author 2017).

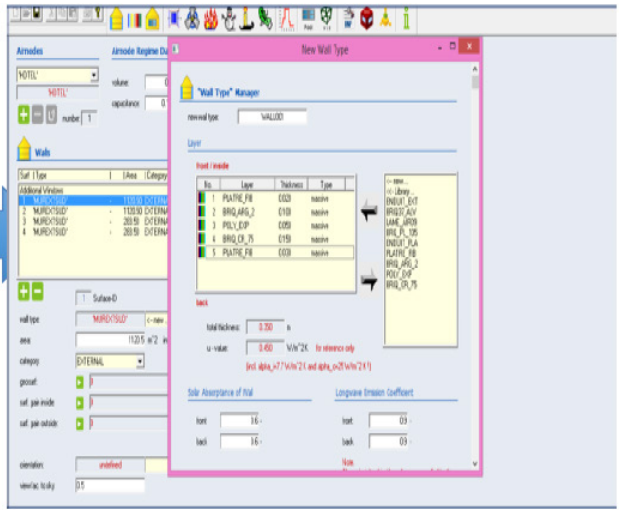


Fig. The layers that make up the walls change the materials. (Source: Author 2017)

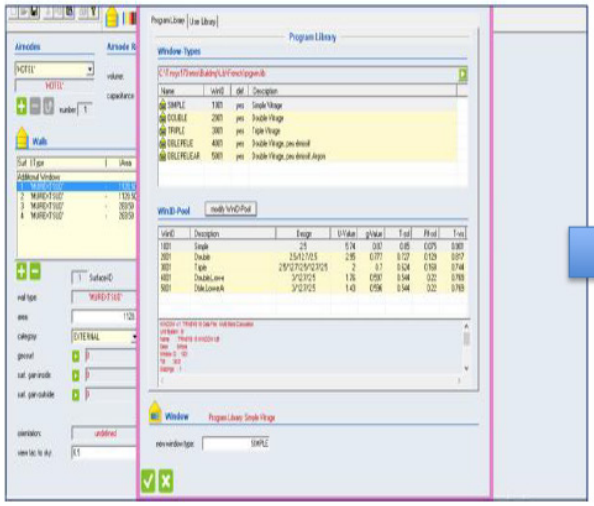


Fig Type of glazing in the current state (Source: Author 2017).

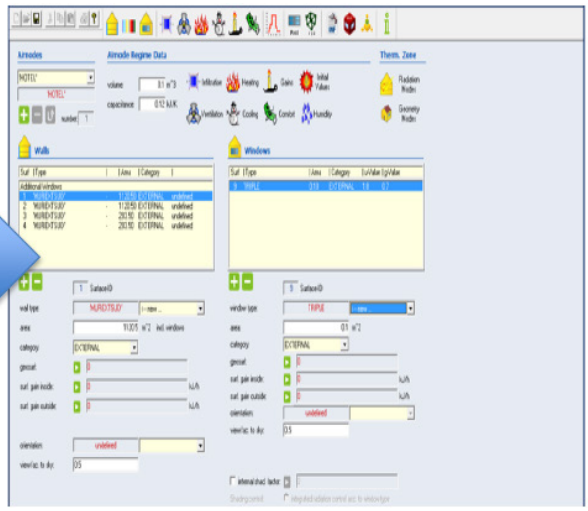


Fig change of type of glazing using triple (Source: Author 2017).

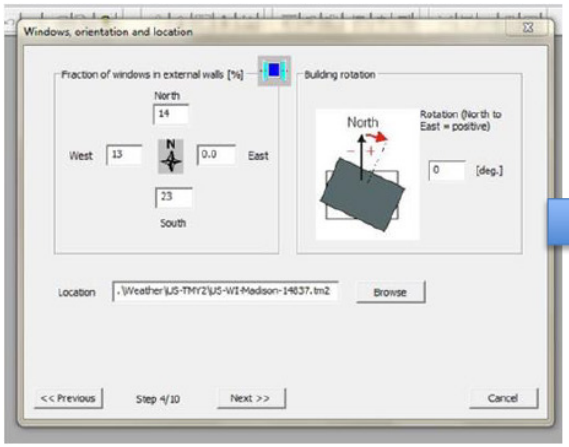


Fig. Orientation and distribution of openings in the current state.(Source: Author 2017).

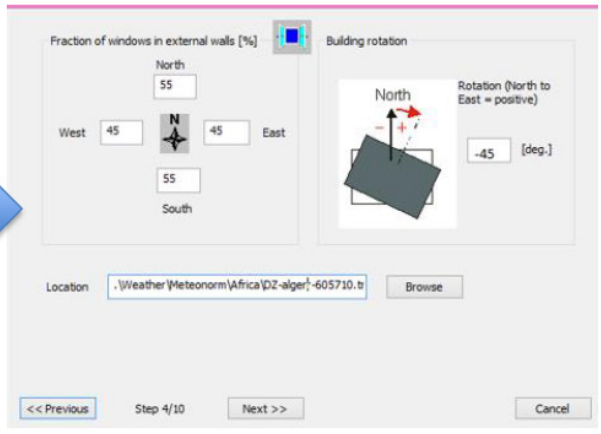
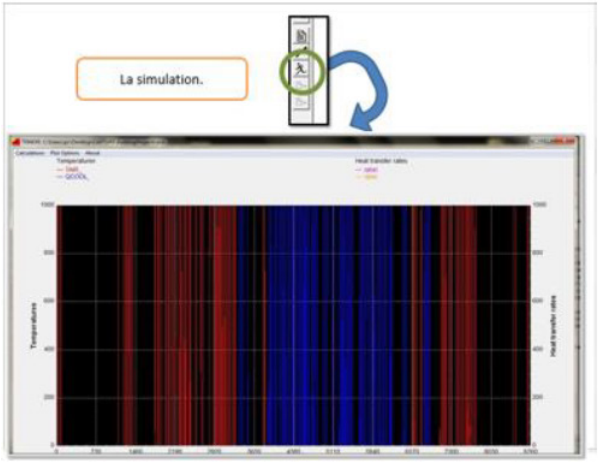
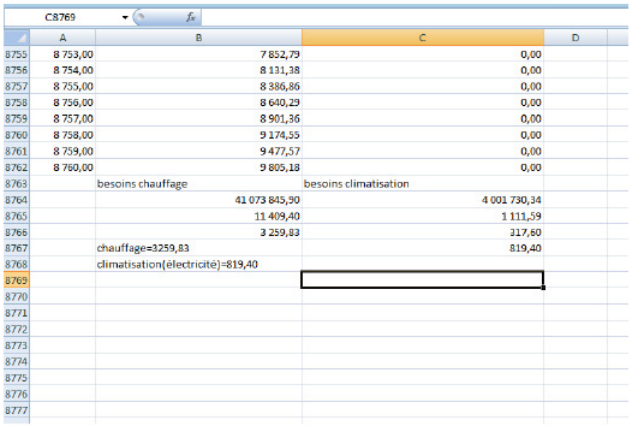


Fig South orientation and new distribution of openings. Source: Author 2017).





	A	B	C	D
8755	8 753,00	7 852,79	0,00	
8756	8 754,00	8 131,38	0,00	
8757	8 755,00	8 386,86	0,00	
8758	8 756,00	8 640,29	0,00	
8759	8 757,00	8 901,36	0,00	
8760	8 758,00	9 174,55	0,00	
8761	8 759,00	9 477,57	0,00	
8762	8 760,00	9 805,18	0,00	
8763		besoins chauffage	besoins climatisation	
8764		41 073 845,90	4 001 730,34	
8765		11 409,40	1 111,59	
8766		3 259,83	317,60	
8767		chauffage=3259,83	819,40	
8768		climatisation(électricité)=819,40		
8769				
8770				
8771				
8772				
8773				
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8775				
8776				
8777				

-The following table presents the results obtained after the integration of the passive strategies:

The case	Energy requirement (useful energy) (KWh)		
Urban hotel in Algiers	Heating	Air conditioner	Total
	3259.83	819.40	4079.23

Table. Hotel energy case (after integration of passive strategies).

The results of the simulations after the integration of passive strategies show: that the integration of some passive strategies such as the south orientation of the hotel using triple glazing; ; the use of materials of good thermal insulation red brick a thickness of 15 cm outside, the insulation of the roof and floor walls with the expanded polystyrene with a thickness of 10 cm reduces the heating and cooling needs.

Conclusions & Discussions

The mode of development of our cities massively produced greenhouse gases (GHG), due mainly to the concentration of activities on the one hand, and the release of polluting gases (CO2) by industry and domestic equipment on the other hand. Thus, the act of planning and building is an act having a strong impact on the environment, fossil energy hungry and a major emitter of CO2, Algeria faces a real challenge where it must participate even more in contributions related to sustainable development and fight against climate change, and in particular to the construction of energy-efficient buildings, especially as at present.

the building designer must take into account a set of parameters from the beginning of the design in order to realize the expected energy savings. Le non maitrise de ces paramètres et le manque des savoirs faire conduit a des bâtiments énergivores les hôtels sont parmi ces bâtiments , the integration of passive strategies helps to reduce the heating and cooling energy requirements, the aim of this work is to study the impact of passive strategies on the energy performance of the building and explores the energy conservation potential in the design of hotels for a chosen climatic zone using building energy simulation by changing design parameters, the results of the simulation suggest that the reduction of energy consumption in hotels can be achieved by a combination of the parameters that must be integrated into the design of the hotels, thus improving energy performance can be achieved by :

- the removal of the simple walls, and the use of material of good thermal insulation as in our case we used the red brick.

-The insulation of a building has a serious impact on the reduction of its energy requirement by using the expanded polystyrene with a thickness of 10 cm.

-the increase of the ventilation rate to better cool the structure in summer.

-protective effects have a significant impact on reducing energy consumption, according to our study, when choosing orientation without maintaining the importance of solar protection, a low energy impact has been obtained. sunscreens are provided this reduces consumption.

-the location of the openings in the north makes it possible to promote lighting and natural ventilation in order to limit the return to artificial lighting and ventilation.

So you have to know that in order to reduce the energy needs of a hotel, it is possible to play several parameters, namely the building itself by the location and orientation of the building, its architecture and its envelope: choice of materials, window, type of glazing, breezes suns.

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