REPUBLIQUE ALGERIENNE DEMOCRATIQUE ET POPULAIRE

MINISTERE DELEGUE A LA RECHERCHE SCIENTIFIQUE

STATION D'EXPERIMENTATION DES EQUIPEMENTS

SOLAIRES EN MILIEU SAHARIEN

SEES/MS

DE L'ENERGIE ET DE L'EAU

ENERSOLE 2001

LE 1ER SEMINAIRE SUR LA CONTRIBUTION DE L'ENERGIE SOLAIRE ET EOLIENNE DANS LE DEVELOPPEMENT DURABLE

Sous le haut patronage de Monsieur
Le Ministre Délégué Chargé de la Recherche Scientifique

ALGERIE, Adrar 30- 31 octobre 2001

Avec la participation de :

LA WILAYA D'ADRAR

CRSTRA · C.D.E.R · AIR ALGERIE · TECHNOSOLAR Systèmes · TOTAL ENERGIE

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***THEME C : IMPLICATION DE L'ENERGIE SOLAIRE ET EOLIENNE EN MILIEU* SAHARIEN**

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POSTERS

THE ROLE OF THE ENERGY-CONSCIOUS BUILDING RENOVATION IN THE DEVELOPMENT OF THE SAHARIAN HOUSING ESTATES IN ALGERIA

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KEY WORDS *Energy-conscious renovation, housing estates development, passive solar systems.*

ABSTRACT

Buildings and the Built environment have a considerable ecological issue. Buildings consume in construction and use some 50% of the energy used in UK, where built environments are also associated with about half the Carbon dioxide emission. But a building rarely occur in isolation, it must be viewed in its entirely as an interface between the interior atmosphere and the outer physical and climatic environment. The researchers at the CNRS and the Grenoble energy institute have estimated that, given a planed policy, all the housing built, in France, since 1975 and half that built earlier could be adapted to harness new forms of energy by 1985. The methods envisaged involve renovating the large subsidized housing complexes. According to this hypothesis, 20% of the energy-needs of 1,4 million apartments and 75% of 2,4 million for the individual housing could be ensured by solar energy. This hypothesis envisages new form of renovation which aims to improve the habitability, the energy saving and rent/heating reduction.

In 1998, a non-accomplished research work has been sketched at the Research unity of Batna University. The focus of this research work was the improvement of the energy performance of the research unity building, by integrating photovoltaic elements in addition to a passive solar system (i.e. greenhouse) (fig.02 & fig.03). This work allowed us to take the problem of energy conscious renovation in its whole context as a concept. In this:

How can the energy conscious based building renovation improve the ecological development process of the Algerian housing estates in the Sahara?

And what is its economical issue upon the energy consumption in construction and use of the built environment?

1 PREAMBLE

Housing is one of the basic human needs. Unfortunately, its situation is deteriorated in Algeria. This is not only due to the low priority given to housing development by the government in its development programmes, but also to other factors, among them: rapid urbanization which is a consequence of rural-urban migration, industrial expansion at an accelerated rate and a high population growth rate of 3,2%. The untimely deterioration of the apartment-blocks related to the bad quality of construction techniques and materials, allows us to ask a question about their future. The wish for **standardization** and for quickness of construction with minimum cost has produced a disaster in large high structures. The use of new technologies and materials has not been adequately tested and understood. Many were dangerous to health (i.e. : asbestos, cavity foam insulation,...) (fig. 01).

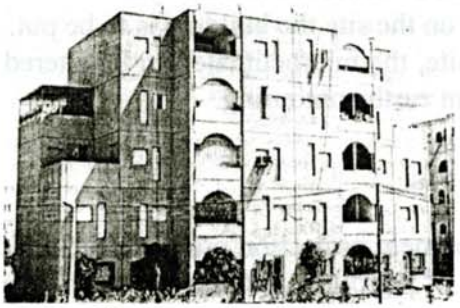

***Fig..1**: Apartment block.*

Recent propositions propound the idea of *renovating* these threatened housing estates, with unusual open spaces, composed of apartment-blocks built with prefabricated components, where there is not only a loss of traditional elements but also one of the bioclimatic values, usually respected in vernacular Architecture.

2 THE ENERGY-CONSCIOUS RENOVATION:

The concept of renovation is generally related to many definitions. **Hugh Prince** specifies that: "**Old buildings can be arranged to be of use to new functions and their appearance can be ameliorated by substituting the old parts; That is the Restoration. The old buildings can be protected and maintained in good repair; that is the preservation**". Renovation can be seen as being the process including the maintenance and the treatment of an existing building in order to stop or to slacken the future deterioration. At an energy-conscious scale, renovation focus will be one of building treatment in order to ameliorate its energy efficiency and to create new built environment.

3 A SKETCHED STRATEGY

The energy-conscious renovation of buildings is mainly based upon a succession of phases. From the macro scale to the micro one, the process of bioclimatic renovation interacts with different scales and variables.

3.1 – The micro-urban scale:

At a micro-urban scale, bioclimatic renovation is related to many concepts that mainly share the action on the microclimate:
Urban Renewal as a general concept of urban design. It is defined by **Chris Couch** as being: "**The physical change, or change in the use or intensity of use of land and buildings, that is the inevitable outcome of the action of economic and social forces upon urban areas**". In the **energy conscious based urban renewal**, energy efficiency principles will be carried out and managed along of the users participation in order to put into motion new building renewal and to transform positively the built environment.
Sustainability: A sustainable environment is one whose processes of construction and use could be continued forever. Energy efficiency will be further boosted when the buildings and urban spaces are resilient, able to adapt to different uses over time, rather than being wastefully torn down and rebuilt each time human aspirations change.
At a regional scale, every site has its own unique climate that is the result of local features modifying the regional climate. The factors affecting microclimate include: **topography**, **surface characteristics** (vegetation) and **local obstructions** (buildings, ...). The use of micro-climatic effects to improve local conditions is an important aspect of passive Architectural design. This can be achieved in 02 ways:
The correct choice of where on the site the building is to be put.
Having chosen the precise site, the microclimate can be altered mainly by the influence of vegetation and to some extent earth contouring.

3.2 - The building scale:

In front of the environment protection problem, the building sector is often accused because of its excessive use of petroleum products, whereas the building industry could be

a fertile area for putting ecological ideas into practice. In term of energy efficiency, 02 factors are important:
Minimizing the external energy needed to construct and use the building.
Maximizing the use of ambient -particularly solar- energy, rather than having to import it all from the outside.
These factors can be applied through energy collection techniques as well as through the positive building transformation (fig.02 & fig.03). In general, the use of solar energy is based upon the following scheme:

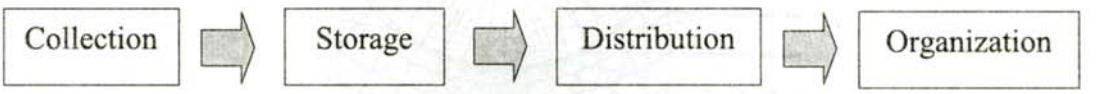

***Fig.02**: The research unity building.*

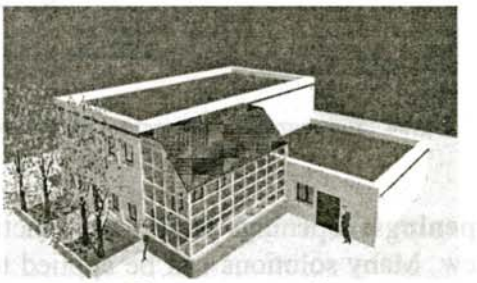

***Fig.03**: The integration of a new (the greenhouse).Architectural element*

Passive solar design measures minimize the use of mechanical systems and non-renewable fuels. The best time to incorporate passive solar systems is early in the design process, or when the addition is first conceived. Any renovation or addition to a building envelope offers opportunities for integration of passive methods. According to **Nicolas & Vaye**, passive solar systems can be classified into 03 main models:
Sun-space model: characterized by a direct and instantaneous heat gain (ex. Glass wall).
Sun-mass-space model: characterized by a progressive heat gain (thermal inertia concept) based upon a dynamical study of the Architectural form, an energy-based space organization and precise-dimensioned technical systems (ex. Trombe Wall, drum Wall,..).
Sun-collection-storage-space model: characterized by a heat gain storage/distribution by the use of collection and storage heat systems.
In arid zones, the energy-conscious renovation (building is viewed as an interface between the inside and the outside) will apply heating and cooling techniques based upon natural physical phenomenon, which will interact with other Architectural variables, i.e.: *form, appearance, and aesthetics*. These techniques are based on many principles including:
Thermal inertia: The exterior climatic factors influence upon the building mass does not occur simultaneously. Maximizing the wall thermal insulation by minimizing the solar heat gain factor (SHF) can be achieved through the correct choice of materials added to exterior walls (façades) in addition to the efficient calculation of their dimensions.
Morphological analysis (Form factor): By modifying the building form, we can reduce the loss of energy and minimize mechanical energy consumption.

$$R=S/V$$

R: Form factor.
S: Surface, V: volume

The sun factor: In arid climates, the sun represents the main heating source (fig.04). the energy-conscious renovation should take into account the importance of shading especially from adjacent buildings.

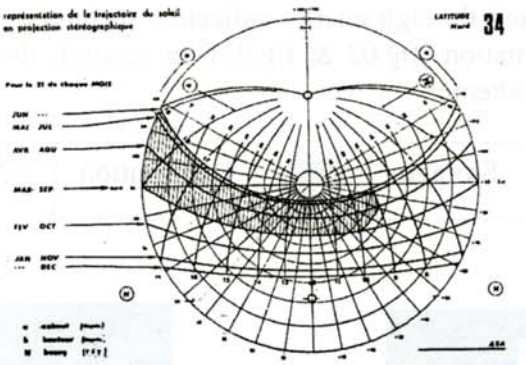

Fig.04 :Stereographic projection of the sun trajectory in the 21st day of every month, during the year (Biskra).

Openings: Openings play many functions related to natural ventilation, day lighting and view. Many solutions can be applied to equilibrate these conflicting functions and reduce the heat gain (ex. Shading devices, mashrabia, ...). Using transparent insulation materials (TIM), the passive use of solar energy at transparent areas can be improved, and can also be extended to the opaque part of the building.

Air movement: We can ensure natural air movement by the application of 02 possible principles. Firstly, the air movement by differential pressure principle (the wind factor) from high pressure zone to low pressure one (Claustrum, wind escape). Secondly, the air movement by convection principle (the sun factor), which allows us to ensure its movement using a continuous heat source (the sun) (ex. The courtyard).

The humidity factor (cooling by evaporation): Water has been used for cooling interior spaces. The latent heat of evaporation allows water to evaporate by contact of its exterior surface. As a result, its temperature will be minimized (fountains, Salsabil).

Vegetation: 02 vegetation models can be used. Firstly, The building within garden model, in which vegetation will protect the building. Secondly, the garden within building model, where vegetation will be integrated with other Architectural elements in order to ameliorate the interior micro-climate.

4 ECONOMIC ANALYSIS

Justifying decision to make changes that improve the energy performance or reduce the environmental impacts of a built environment requires close attention to the economics of the situation. There are several key economic analysis methods that allows us to make decisions and evaluate the building operating performance (OP), among them:

Life-Cycle Costing (LCC):

LCC analyzes building changes to include amortized system costs, maintenance and insurance costs, replacement costs, energy costs, and other significant costs over the assumed life of the measure. It combines all costs into a net annual cost and then reduces these annual costs to a net total cost, usually the Net Present Value.

Life-Cycle Analysis (LCA):

LCA is used to analyze the impacts of a single product, for example a type of paint or a variety of concrete, for its energy and environmental impacts. It is useful for understanding choices between products from an environmental point of view.

Life cycle analysis parameters
General study parameters:
Type of analysis: national, regional,..
Treatment of inflation: constant or current Dinars.
Base date: the dates to which all future costs are discounted.
Service date: the date at which the building will be renovated or system put into service.
Study period: usually the life of the building or product.
Discount rate: the investor's opportunity cost or the minimum acceptable return.
Applicable tax rates: for private sector analyses.
Other important costs:
Annual operating costs.
Non-annually recurring costs.
Energy costs.

5 CONCLUSION -Towards an ecological development policy -:

Through this short essay, we have tried to sketch the general outlines related to the concept of energy-conscious renovation as an ecological approach. Because of the importance of the built patrimony in Algeria, especially housing estates in the Sahara, any future green policy could not neglect the necessity to ecologically review this patrimony. A new vision concerning the bioclimatic renovation of these housing estates should be established according to their different scales (urban, micro-urban, building). A new generation of researches is very useful and should take into account the following points:

The study of the energy-conscious renovation feasibility.

The researches should be focused on the establishment of practical renovation solutions related to the building form, openings, shading devices, …

The best choice and use of new materials that may be applied to improve walls thermal inertia.

The establishment of a specific energy-conscious renovation rules, to be applied in future housing estates renovation processes.

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