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Passive and Low Energy Housing by Optimization

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1. Introduction

The house is not only a roof, but also a home, the place where it is formed the moral climate and on which lasts the family spirit. UN has classified habitat settlements and identified 10 general functions that every habitat should have. (Recreations and interpretation, Preparing the foods, Eating, Relaxing and Sleeping, Study ,WC, Hygienic necessities, Cleaning, Circulation and storage, Exterior circumstances). Housing is a human right is a multi-platform documentary portrait of the struggle for home. The house, being a product of the human work, a long time user product, like any other product it has not only to be produced but also to get the user's disposal. A house is a home, shelter, building or structure that is dwelling or place for habitation by human being. Sustainable design's principles of energy and healthy architectural spaces and material durability help make a home affordable. Presently becomes incorrect work manner when we take the building phenomenon such as (passive and low energy building), detached from the large concept of architecture. (Amjad Almusaed 2004). The passive and low energy housing represents one of the most consistent concepts of sustainable building and brings with consideration of energy saving concept. Presently becomes incorrect work manner when we take the building phenomenon such as (passive and low energy building), detached from the large concept of architecture. The architectural product, being a product of the human work, a long time user product, like any other product it has not only to be produced but also to get the user's disposal. The human comfort is a vital aim of architecture, and it classified such variable level. The interaction always appears between the energy such abstract act and human comfort such human feeling. The balancing condition is extremely complex.

2. Between architectural and building concepts

Sustainable building design involves a wide range of complex issues within fields of building physics, environmental sciences, architecture and marketing. Sustainable building design views the individual building systems not as isolated entities, but as closely connected and interacting with the rest of building and a large sphere of environments (Robert Hastings & Maria Wall 2009). The Passive and low energy house idea is both easy and very tricky. It represents one of the most consistent concepts of sustainable building and brings with consideration of energy saving concept. Sustainable architecture is more than energy efficient or zero-emission building. It must adapt to and respect its environment in the broader context of "milieu". This encompasses the natural, ecological, bio-economic, cultural and social setting (Robert Hastings & Maria Wall 2009). A high quality of sustainable building brings comfort primarily up-to-date and durable products to the building user with lowest current energy costs.

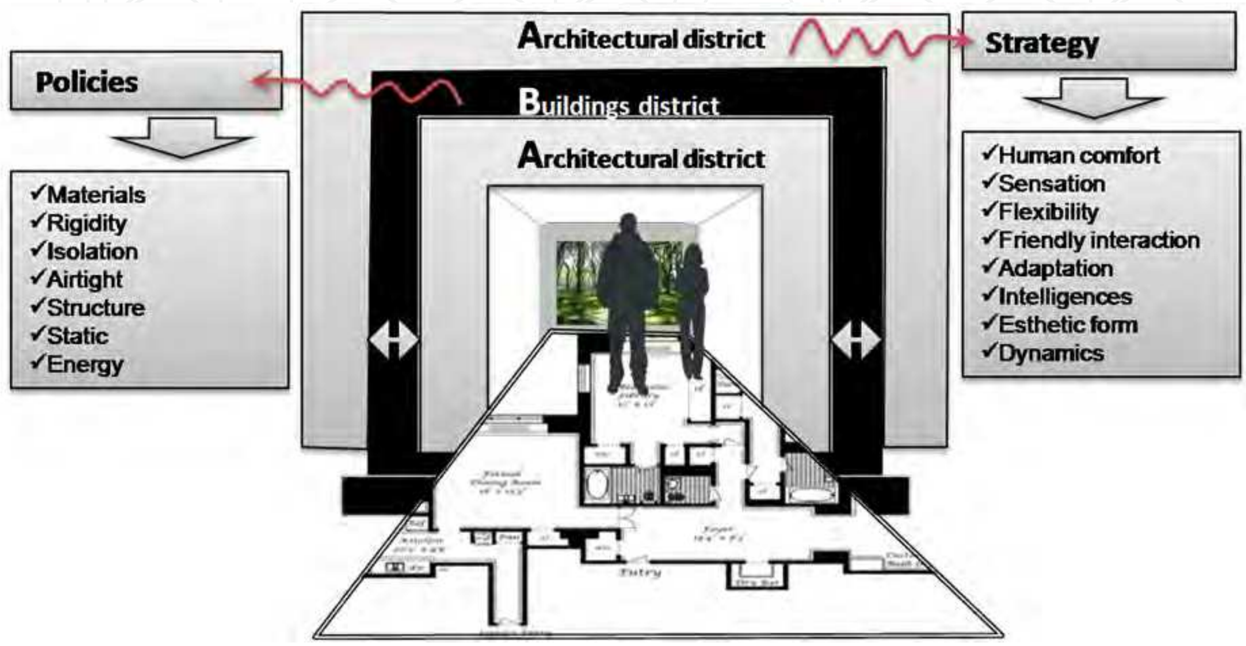

Fig. 1. Building and architectural concepts differences

As soon as we talk about passive and low energy housing, many suppose that we talk about a machinery-house concept, a building without human sentiment. Others believe that passive and low energy housing is an ugly creature. A lot of engineers, designers, agriculturists, etc. wrote about sustainable, passive or low energy buildings, green buildings, etc. Although a small, part of them reached the right concept of passive and low energy housing in concordance with architectural theory. Therefore, we can identify the technical nature of these concepts written by them. It is a big difference between the term of "Building" such a policy and the term of "Architecture" such strategy. "Building and its component" is a policy on human design, which accepts the terms of passive and low energy concepts, while "Architecture" is a strategy, which includes a large diversion of policies (Amjad Almusaed 2010).

3. The reasearch area

The main object of this research is to build a housing strategy, which integrated the concept of passive and low energy building in architectural theory; this can be occurred by generate a measurable architectural concept that includes all variables and constants factors. The interaction is between the house affordable concept, passing through a maximum healthy, comfort and esthetically along with a less uses of energy and then more economically.

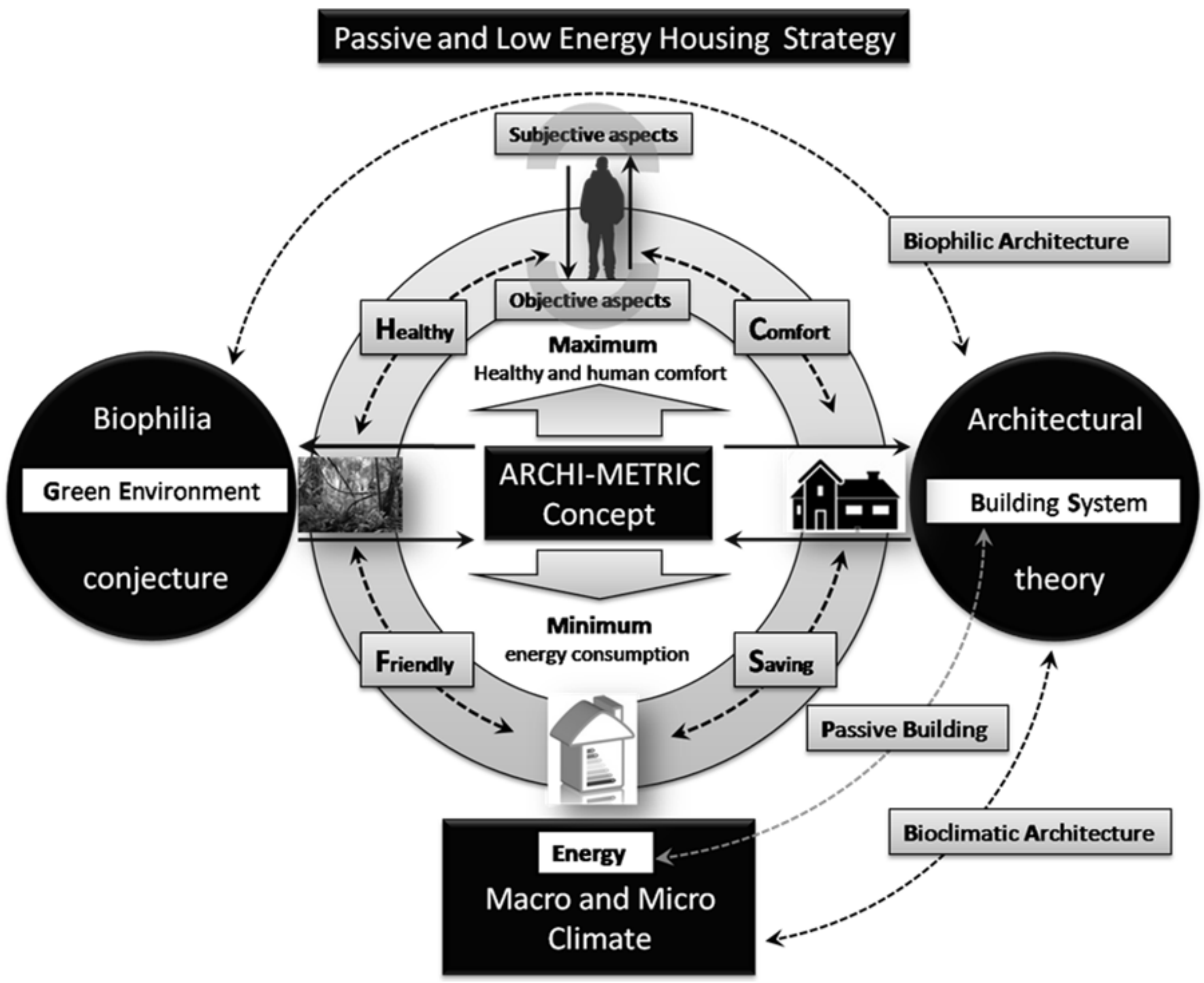

Fig. 2. The interactions of factors which intervene in passive and low energy strategy

Presently becomes incorrect work manner when we take the building phenomenon such as (passive and low energy housing), detached from the large concept of architecture. In our research we need to build a selective conception of housing, where all factors takes in evidence, environment, biophilia, energy and microclimate.

4. Invistigations method

Investigate will lucid two means:

4.1 Archi-Metric method

One of the significant objectives of optimized concept is to create a balancing system of a large size of factors, elements and concepts. We have to labor with energy efficiency, human comfort and economy, which, provides us with the opportunity to reach extremely low levels of energy consumption by employing high quality, cost-efficient measures to general building components. Our assignment is to repatriate human requirements on buildings ability, by means of maximum advantage, minimum disadvantage and optimal solution. "Archi-Metrics" method is a model, which, aids in converse all architectural phenomenon topics to be measurable with numerical characters, by using of mathematical models of

"Operation Research" science. The "Operation Research" is a mathematical method that transforms the human phenomenon and behaviors to logic mathematical models. It labor with the maxim advantage, which can acquire from different variants, and the minimum disadvantage of a negative environment action resulting from factors. At last we have to find the optimal solution between many variables and constant such an intersection point of a many variables curves. Several algorithms are available which can be used for the method of nonlinear programming problems. The problem is a nonlinear optimization problem with nonlinear constraints and cannot be solved using standard optimization methods such as linear programming or quadratic programming. Improved move limit method of Sequential linear programming (Rekha Bhowmik (4. april 2008)).

4.1.1 The problem formulation by LP technique

The simplex method for resolving Linear Programming problems is extremely influential. Therefore, a number of techniques for resolving nonlinear programming problems are supported by converting them to LP problems. An initial solution is to be selected to supply a base for the determination of the tangents of the constraints and of the objective. Consider a finite set of variables $x1, x2, \ldots, xn$. The unit cost coefficients for the main constructional elements, namely, walls, windows, building materials, thermal insulation, etc, are assumed and the construction, negative acting or cost function, $f(x)$ is to be minimized. This is generally a nonlinear function of the variables (Rekha Bhowmik (4. april 2008)).

Thus, the problem is:

minimize $f(x)$

subject to $g\,j(x) \leq 0$ j = 1,2, … , n

where x is the vector of design variables which represent the optimum layout problem, n is a set of inequality constraints of the form $g\,j(x) \leq 0$ ($j=1, 2, \ldots, n$), and $xi \leq 0$ ($i=1,2, .., k$), where k is a set of decision variables.

4.1.2 The objective function

The problem is to determine the optimum values of the variables:

- Windows (relation hollow – full in façade)
- Functional house corresponding dimensions and areas
- Building materials
- Thermal insulation (types, placing and thickness)

Covering of these variables can minimize the overall building cost, energy used, while satisfying the planning constraints, given the construction costs of the walls, windows, building materials, thermal insulation, house function, etc. The values of the variables provide the housing and cost and comfort. With the procedure described in the previous sections, the problem of generating the geometry has been solved. Thus, given a topology, the dimensions of a layout can be obtained which satisfies a number of constraints while minimizing the construction cost. Improved Move Limit method of Sequential Linear Programming provides a convenient and efficient method to solve dimensioning problems which are nonlinear programming problems (Rekha Bhowmik (4. april 2008)).

4.2 The main involvement factors

4.2.1 Enhancement of outdoor energy allocate by ameliorate of local microclimate

The first step towards a passive and low energy housing strategy is to create a competent and suitable local microclimate, which can be supported by handling the power of a negative climate variety (Georgi NJ, Zafiriadis (2006)). Existing winds, sun, noise and sources of pollution all can affect the environmental comfort level of user of open spaces and architectural spaces. Every residential site is a site definite as to its location, organisms, vegetation, solar access, and its microclimate (D. Pearlmuttere1993).

4.2.2 Interior energy allocate in the house by assign it such as cascade

We have to create a cybernetic system to calculate energy in the house to be an efficient and employ such cascade. Energy in the building must be allocate throughout regarding of thermal zones in the building by utilized the energy in diverse house functional spaces such as cascade.

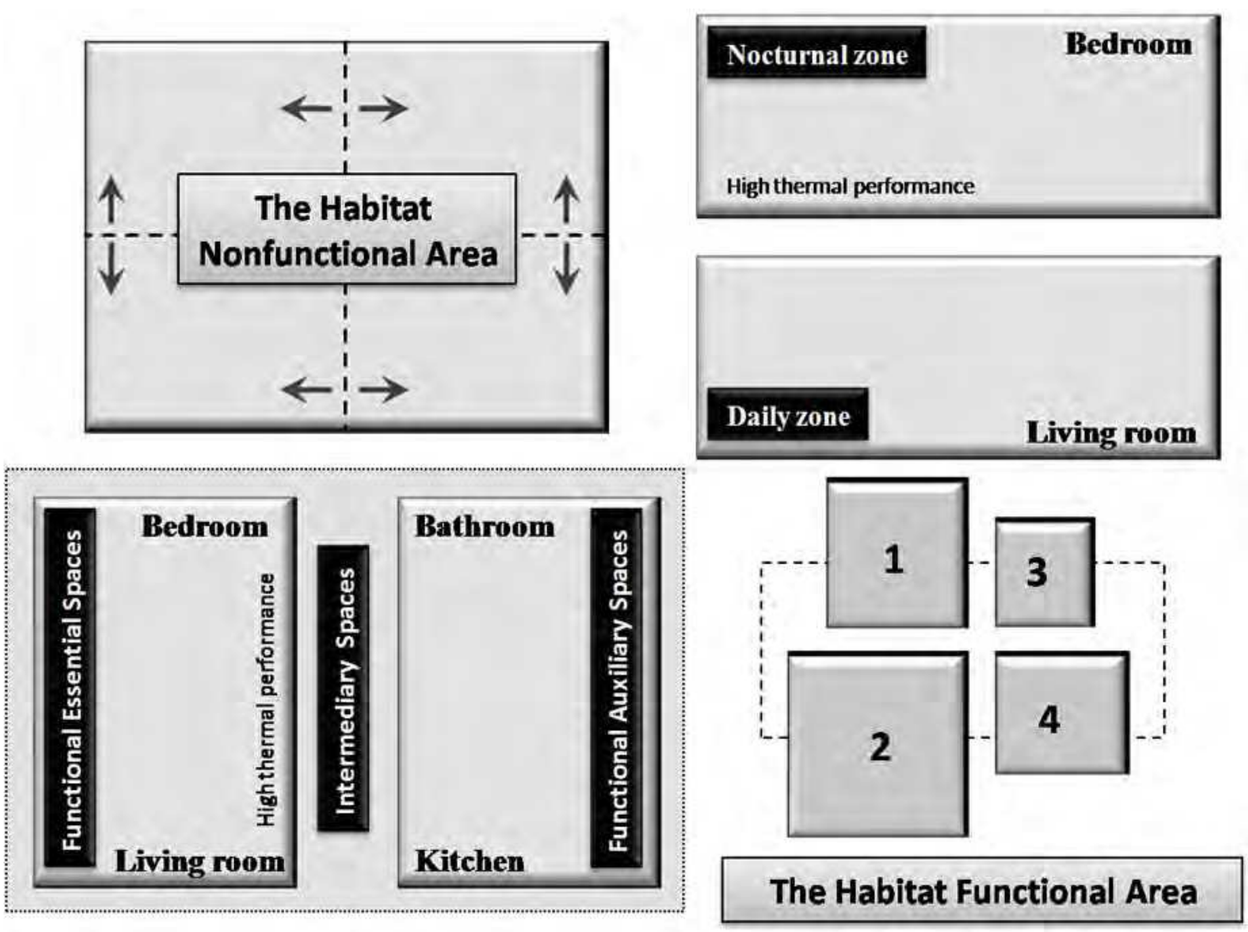

Fig. 3. The idea of house functional zoning

The vital step on passive and low energy housing is to reflect the energy distribution on the building form and volume, wherever the energy distribute be obliged to correspond the function and activity in those spaces.

4.2.3 Passive and low energy upon thermal house zone

There are three interior thermal zones;

4.2.3.1 Functional fundamental zone

This zone includes living space (bedrooms and living rooms). The optimal comfort temperature for these zones is between 22 -28 °C. The best place for functional essential spaces is in extremely center of the building.

4.2.3.2 Functional auxiliary zone

This zone includes kitchens and bathrooms. The optimal temperature for this zone is between 18- 28 °C. That means a 28°C for bathrooms and 18 °C for kitchen. This zone is modest warm and can locate in the periphery of the house plane for creates a natural ventilation. To be beside functional essential spaces for create of radiant heat corresponding building functional schema.

4.2.3.3 Intermediary zone

This zone includes storage rooms, buffer spaces, transit spaces, such as loggers, balconies, terraces, basements, etc. The optimal temperature for this zone is less than 10 °C. House thermal zones represent an enclosed space in which the air is free to flow around and whose thermal conditions are relatively consistent. Sometimes temperatures in different parts of large spaces can vary. (Watson. D. Labs, K. 1983). Well-organized passive and low energy housing recognizes these differences and creates thermal zones for the different building functional spaces. Thermal zoning tries to ensure the best match possible between the distribution of room and the distribution of the available energy.

4.2.4 Human body and thermal comfort

The amount of heat our bodies produce depends on what we are doing. The human body operates as an engine that produces heat. Our bodies turn only about one-fifth of the food energy we consume into mechanical work. The other four-fifths of this energy is given off as heat or stored as fat. The body requires continuous cooling to give off all this overload heat. When that person is sitting at a desk, the heat generated rises to about that of 100-W. Buildings provide environments where people can feel comfortable and safe. To understand the ways building systems are designed to meet these needs, we must first look at how the human body perceives and reacts to interior environments (Corky Binggeli 2003).

4.2.5 Thermal comfort for healthy habitat

- Under a healthy habitat indoor environment, must have the following recommended thermal comfort where activities are easy ≈ (70 W/m2 = 1.2 MET).

4.2.5.1 In winter conditions (heat required)

- Assuming a dress with a clo-value of 1 (0.155 m2 • K / W), obtained following conditions:
- Operational temperatures have to be between 20 - 24 ° C.
- The difference in the vertical air temperature between 0.1 m - 1.1 m above the floor (ankle and head-height) should be less than 3 ° C.

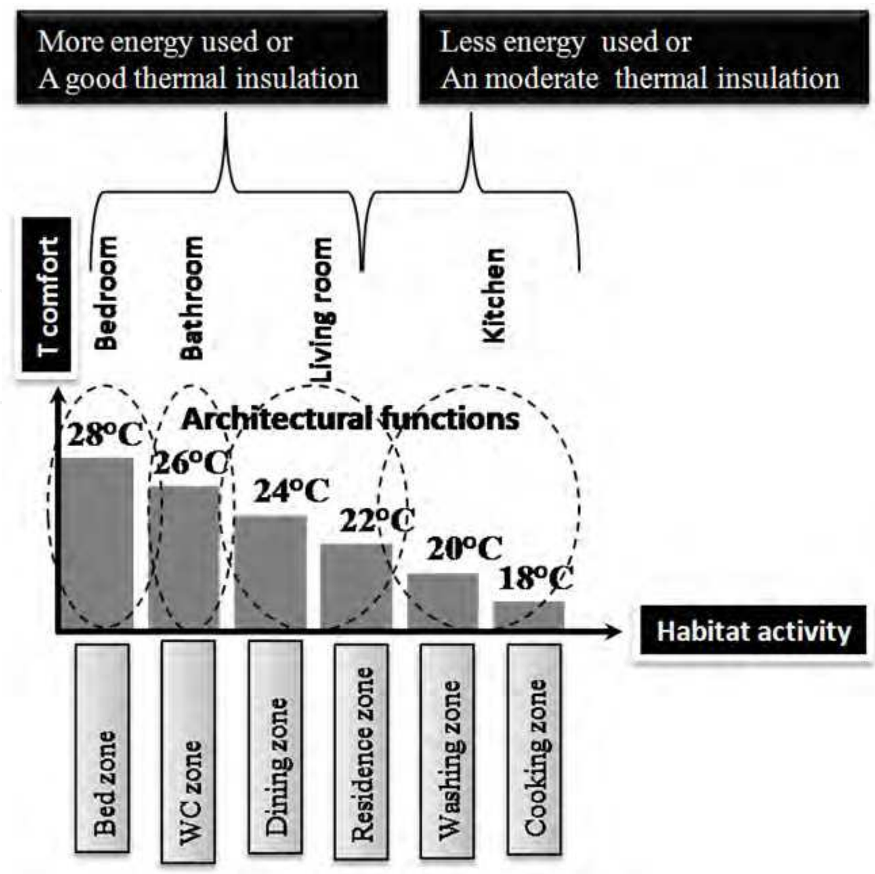

Fig. 4. The energy hierarchy allocates in a habitat functions

- The floor surface temperature should be between 19 - 26 ° C (floor heating systems can be sized for 29 ° C).
- Indoor Ambient air velocity should be less than 0.15 m / s.
- Radiation temperature by asymmetry form in which come from windows and other cold vertical surfaces should be less than 10 ° C (relative to a small vertical plane 0.6 m above floor).
- Radiation temperature asymmetry due to a hot (heated) ceiling should be less than 5 °C (relative to a small horizontal plane 0.6 m above the floor).

4.2.5.2 In summer conditions (cool required)

Assuming a dress with a clo value of 0.5 (0.078 m2 • K / W), obtained following conditions:

- Operational temperatures have to be between 23 - 26 ° C.
- The difference in the vertical air temperature between 0.1 m - 1.1 m above the floor (ankle and head-height) should be less than 3 ° C.
- Ambient medium speed should be less than 0.25 m / s.

The building envelope is the transition between the outdoors and the inside, consisting of the windows, doors, floors, walls, and roof of the building. The envelope encloses and shelters space. It furnishes a barrier to rain and protects from sun, wind, and harsh temperatures. Entries are the transition zone between the building's interior and the outside world. (Corky Binggeli .2003).

Habitat function	Thermal care level
Living room	80% of the area needs high thermal care
	20% of the area needs middle thermal care
Bed room	85% of the area needs high thermal care
	15% of the area needs middle thermal care
Kitchen	20% of the area needs high thermal care
	80% of the area needs low and middle thermal care
Bath room	80% of the area needs high thermal care
	20% of the area needs middle thermal care

Table 1. The requirement of a thermal care in different habitat functions

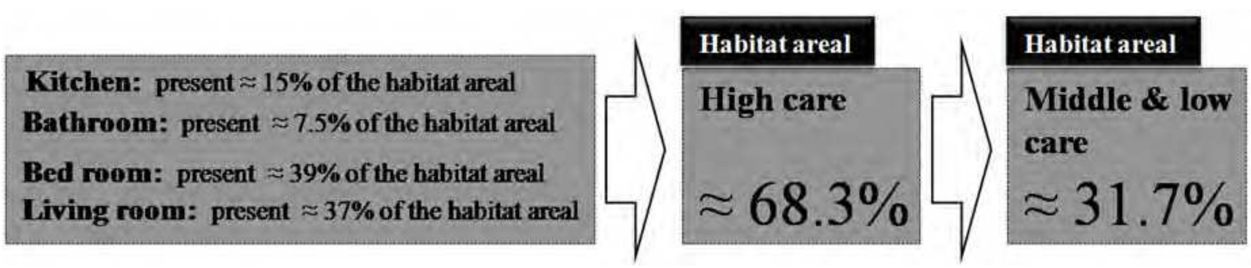

Fig. 5. The resulting of an optimal habitat thermal care requirement

68.3% of a habitat area needs a "*high thermal care*" to get an optimal human functions performance.

4.2.6 Energy and human metabolism and activity

The energy is used for growth, regeneration, and operation of the body's organs, such as muscle contraction, blood circulation, and breathing. It enables us to carry out our normal bodily functions and to perform work upon objects around us. The normal internal body temperature is around 37°C. (Ashley F. Emery 1986) The internal temperature of the human body can't vary by more than a few degrees without causing physical distress. The architect and engineer can establish the propose conditions by listing the variety of acceptable air and surface temperatures, air motions, relative humidifies, lighting levels, and background noise levels for each activity to take place in the housing. A schedule of operations for each activity is also developed.

4.2.7 Clothing and thermal comfort

In the greater part of cases, building inhabitants are inactive or slightly active and be dressed in classic indoor clothing. Clothing, through its insulation properties, is a vital modifier of body heat loss and comfort. See fig 6

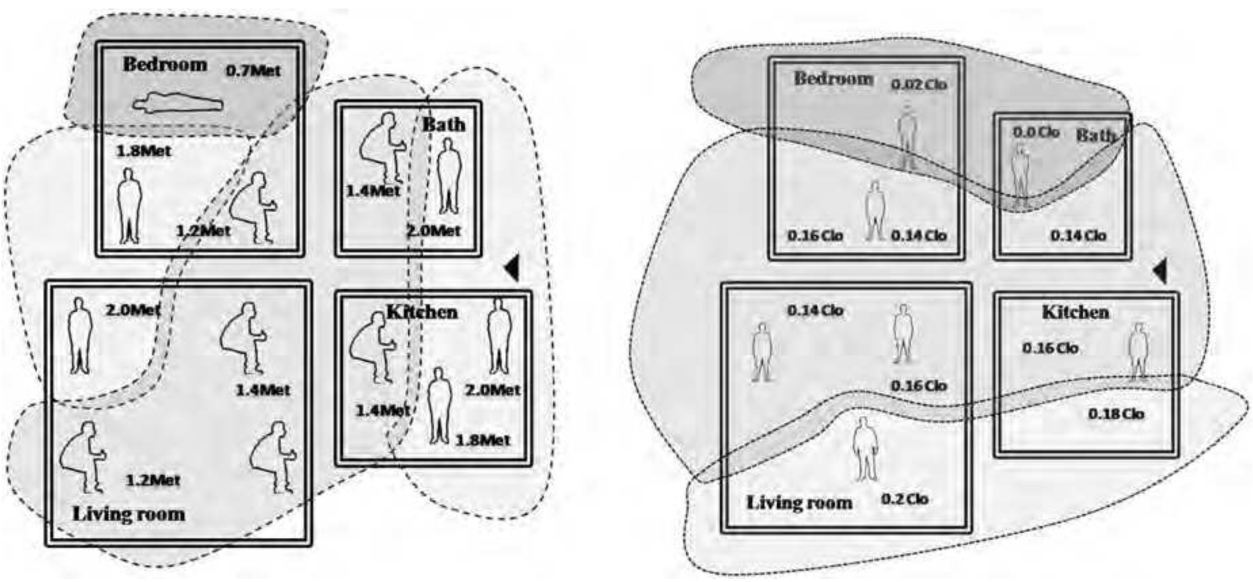

Fig. 6. House typical activity and clothing and functional zoning

The insulation belongings of clothing are a cause of the small air pockets alienated from each other to prevent air from migrating through the material (Freeman III; A Myrick 1993). In the same way, the well, soft down of ducks is a poor conductor and traps air in small, restricted spaces. In general, all clothing makes employ of this standard of trapped air within the layers of cloth fabric. Clothing insulation can be explained in terms of its *clo* value. The clo value is a numerical symbol of a clothing ensemble's thermal resistance. (1 clo = 0.155 m^2_°C/W).

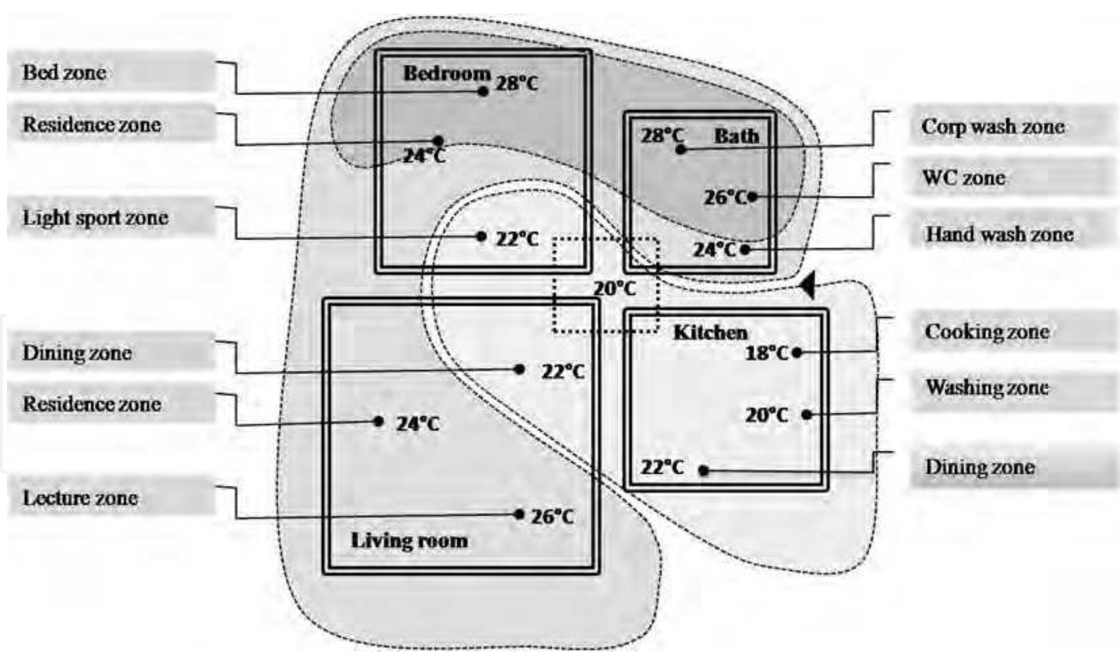

Fig. 7. Thermal analysis and house functions allocate

4.3 Human activity, clothing, human comfort, and architectural program

Each of us has our own preferred temperature that we consider comfortable. Most people's comfort zone tends to be narrow, ranging from 18°C to 24°C during the winter. Our body's internal heating system slows down when we are less active, and we expect the building's heating system to make up the difference. The design of the heating system and the quality of the heating equipment are major elements in keeping the building comfortable. Air movement and drafts, the thermal properties of the surfaces we touch, and relative humidity also affects our comfort. (Corky Binggeli .2003).

The human body has three mechanisms to preserve this fine temperature range. The first is heat generated inside the body, the second is by acquisition heat from surroundings, and the third is by gaining or losing heat to the surroundings. The body automatically makes constant changes to manage these three mechanisms and control body temperature.

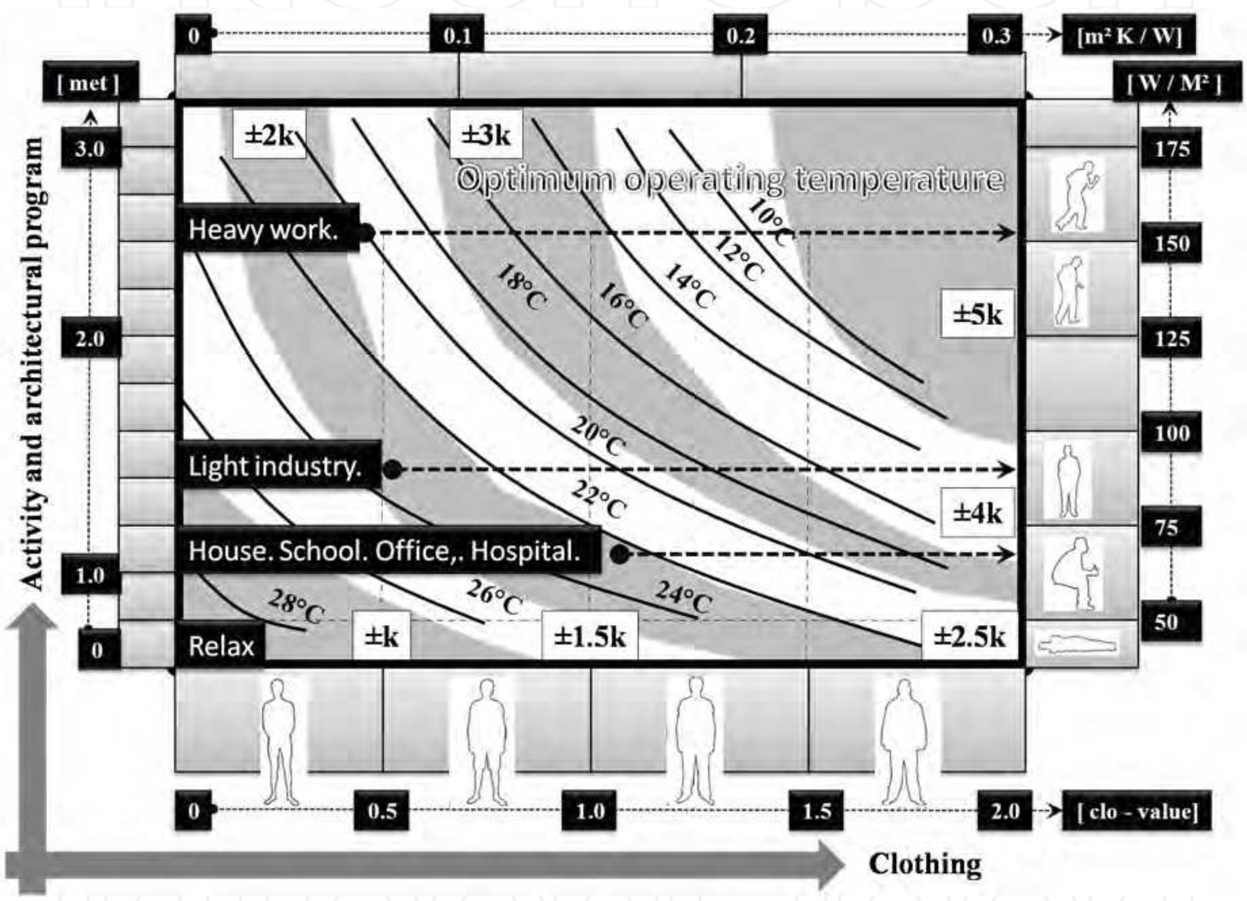

Fig. 8. The interaction between energy, activity, human comfort and architectural programs (Archcrea instate)

4.3.1 Surfaces temperature in comfortable habitat

For determination the Interior T in comfortable habitat

$$1.\ \mathrm{MRT} = \frac{\sum T + \theta}{360} \quad = \frac{T1\theta1 + T2\theta2 + T3\theta3 + +Tn\theta n}{360}$$

Where;

T = surface temperature
θ = surface exposure angle (relative to occupant) in degrees.

Actor Position	House Functions			
	Living room	Kitchen	Bath room	Bedroom
A	23°C	19.33°C	25°C	23.3°C
B	23.6°C	20°C		24°C
C	23.58°C			

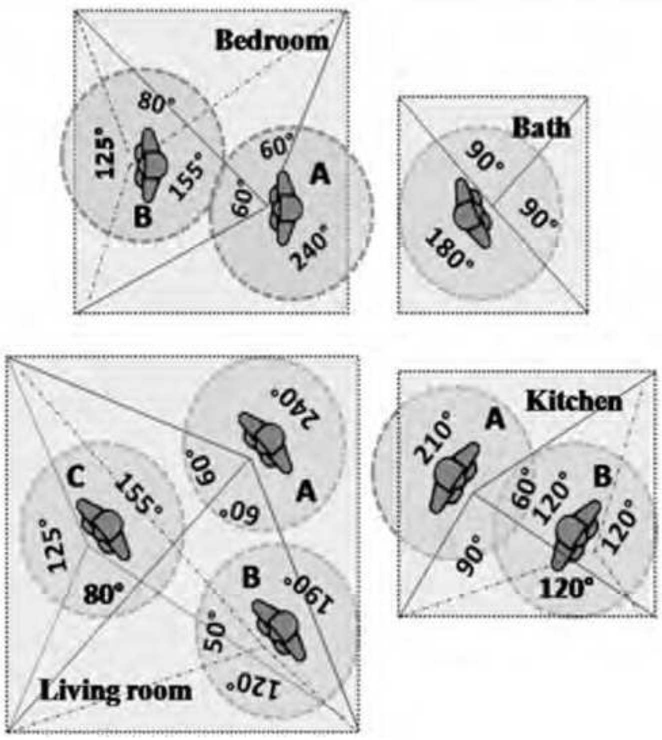

Table 2. The surface temperature for different actor position in thermal comfort spaces

The trends of how people spend their own time change from year to year. However, it contains broadly the same ingredients: a chance to escape from the city, to be alone or to be with other people, to be close to nature, and to relax and enjoy oneself (Jensen, C.R. and Guthrie, S.P. 2006). The oxford dictionary of science define adaptation such as "any change in the structure or functioning of an organism that makes it better suited to its environment". It is the evolutionary process whereby a population becomes better suited to its habitat (Bowler P.J. 2003). A human is adapted to the surroundings of the habitats in which he live. This process takes position over several generations, (Patterson C. 1999) and is one of the vital phenomena of biology.

This may be defined as a variable system of functional (structural) complexes and coordinates. The human body has three mechanisms to preserve this fine temperature range. *The first* is heat generated inside the body, *the second* is by acquisition heat from surroundings, and *the third* is by gaining or losing heat to the surroundings.

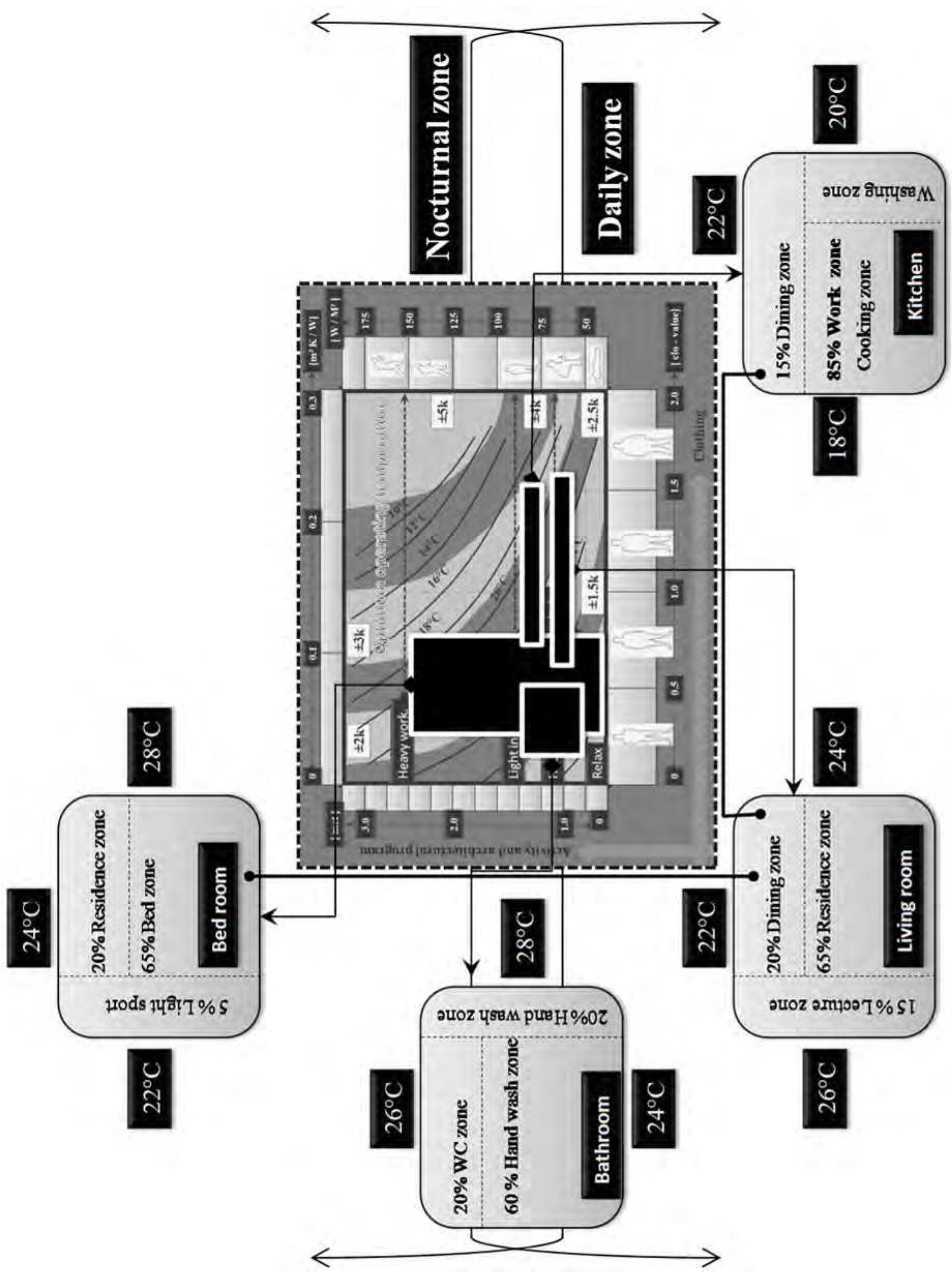

Fig. 9. Energy distribution in different habitat functions (Archcrea institute)

The body automatically makes constant changes to manage these three mechanisms and control body temperature.

4.3.2 Passive bioclimatic housing model

4.3.2.1 Windows

a. Passive window

Window plays a vital role in passive buildings classification in two ways:

- It diminish heat loss in spite of their a huge areas of glazing
- It permits the sunlight to create extra heat through the glass

We turn out to be aware of a modest loss of light-transmission and a slight brown tinting of the light due to the second layer of LE coating. (Craig A. Langston, Grace K. C 2001). Today, we can see the new models of energy low windows with 0.7 W/m² °C.

a.1. Energy manipulate on window

That represent regulates of the input and output energy, where the window's layers must be sufficient to limit the heat transfer in a dynamic system or limit the temperature change, with time, in a static system. The uncomfortable change of energy in temperate climate is in the winter in direction inside outside. In general, heat always flows from warmer to cooler. This flow does not stop until the temperature in the two surfaces is equal. Heat is "*transferred*" by four different means: conduction, convection, radiation and infiltration. Insulation decreases the transference of heat. Well designed and protected windows improve comfort year round and reduce the need for heating in winter and cooling in summer. In reality, the serious lighting designer cannot take any notice of the energy implications of window choices. New technologies help to resolve the historic problem of the transaction between windows that reflect unwanted solar gains in the summer and those that admit a maximum quantity of useful light. Well designed windows and shading devices allow solar heat gain in winter and shade and ventilation in summer while providing enough day lighting. Solar gain achieved by heaving 60% of the building's windows orientated correctly can reduce the heating load of a building by ≈22%. Shutters can be used to control the amount of heat (and light) transferred through the glass, and box pelmets and long wide curtains can limit air movement over the glass and prevent draughts (Assad Z. K. Almssad 2005).

a.2. Thermal window's functions

The surface temperature of single-glazing, for example, will be extremely bad insulating to external temperatures. That is to say interior surface temperature of double glazing will be much warmer but still significantly lower than interior temperature. Frames, which can take an area 10-30% of a typical window, also have perceptible effects; surface temperatures of insulating frames will be much warmer than those of highly conductive frames. Warmer glass surface temperatures translate into more comfortable spaces or occupants during the winter because comfort is a function of radiant heat transfer among people and their surroundings.

For optimal thermal treatment of windows we must know the components of windows that play a thermal role correlated to energy exchange interior exterior in cold winter and contrary in summer. These are pane glass and frames. By perceptive how windows control thermal comfort, windows designer can create an optimal resolution of windows, which collaborated welcoming with environment. Windows in residential building consume approximately 2% of all the energy used in industrials countries. Well organized windows can greatly improve the thermal comfort on houses during both heating and cooling seasons. Therefore Windows play significant role in the design strongly affect their energy use. Condensation on the windows may be a sign of heat loss. A damp area around the window from the exterior is another sign of heat loss. During the winter, a typical window loses up to 10 times more heat than an equivalent area of an outside wall or roof. Windows can account for up to 30 % of the heat loss from a conventional building, adding significantly to heat cost. Drafts, window condensation and mould can also affect our comfort and indoor air quality. Sustainability is a wise approach to the way we live. And using energy in a more sustainable way is a part of this approach (Assad Z. K. Almssad 2005).

b. Bioclimatic windows(sizing, orientation and habitat functions)

For getting an optimal lighting, which is very important for passive and low energy housing, the house functional orientation must matches precisely the activity level on this spaces which keep up a correspondence with the better lighting for specifically function. The lengthiest window dimension is for activity in which needs more precision, such as study and living area

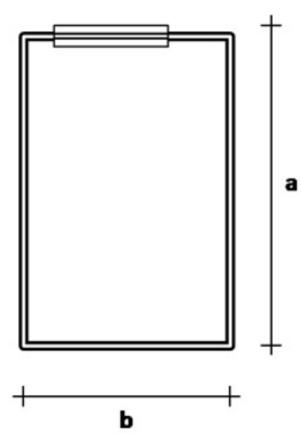

Fig. 10. Functional space dimensions

c. Improvement of windows thermal and optical functions

Heat loss in winter is a severe problem in which architects, engineers, must get basically explanation, for the thermal part of windows problems, in the following part of this research we will try to describe these problems and suggest the best solution.

- Air such as intermediary thermal layer

Energetic role of intermediary thermal layer is between cold exterior spaces and comfortable interior living spaces, therefore the essential role of intermediary layer is such a thermal buffering. For the parent building, a thermal intermediary layer represents a reduction in heat loss/gain through the windows. This is because these elements lose/gain heat to a space which is at a higher or lower temperature than the outdoors. The magnitude of the

The house functions		The best orientation		Relation Length (a) – width (b)	Minimum window length (meter)	Maximum window length(meter)
main function	sub function	Specifications	Overall			
Living room	Residence zone	East, south, south west	South, South-west South-vest East	a < b	0.11 (a x b)	0.17 (a x b)
	Dining zone	South and South west		a = b	0. 12 (a x b)	0.18 (a x b)
	Lecture zone	East, south, south East		a > b	0.13 (a x b)	0,19 (a x b)
Bedroom	Bed zone	East, South – east	South South-east East	a < b	0.080 (a x b)	0.105 (a x b)
	Residence zone	South-east, east, south		a = b	0.085 (a x b)	010 (a x b)
	Light sport	South, south – east, east		a > b	0,90 (a x b)	0.12 (a x b)
Kitchen	Cooking zone	North, North - east	North North-east	a < b	0.070 (a x b)	0.95 (a x b)
	Dining zone	South west, North		a = b	0, 075(a x b)	0.10 (a x b)
	Washing zone	North, north-west		a > b	0.078 (a x b)	0.11 (a x b)
Special bathroom	Wishing hands and body	North, North west		a , b	0.36 m²	0.72 m²
Service zone, and other auxiliary functions	Circulation, stores, recreations	North, South, West, South-West, North – west	North for temperate climate and South for hot climate	a , b	0.01 m²	0.36 m²

Table 3. The optimal windows orientation, length in bioclimatic house
(Archcrea institute 2010)

heat loss/gain reduction depends on the temperature of the intermediary space. The optimal temperature for this layer is around 8ºC for buildings in winter season. The air in intermediary thermal layer must have a higher temperature than exterior on winter and reverse on summer.

- Heating recovery system

This system consists of two separate air management systems, one collects and exhausts stale indoor air, and the other draws in fresh outdoor air and distributes it right through the house. That means using of stale indoor air eliminate in air refreshing process and charging the outdoor fresh air set up with optimistic energy these process can be present by using mechanical ventilation. The incoming air can also heat or cold the internals spaces of a building in passive buildings, thus resulting in technically simple solutions for cool/heat provide system.

- Window's Light shelves

The light shelf itself is a simple device that is installed inside the window. In most applications, it must be combined with other devices to avoid glare from sunlight incoming the lower portion of the window. The glare problem is avoided by this system that limits the use of diffusers to make use of day lighting through windows. It also provides the unique advantage of variable the light from the window so that it comes from a more overhead direction, humanizing the quality of illumination. For an efficient function of light shelf system, it requires direct sunlight. The windows should face towards the sun for a large portion of the time that the space is occupied. Tinted or reflective glazing may very much reduce the potential benefit of light shelves, or make them uneconomical. These types of glazing typically block about 70-80% of incoming sunlight. In some cases the system may be used with glazing at lower heights where people cannot get close to the glazing. As with

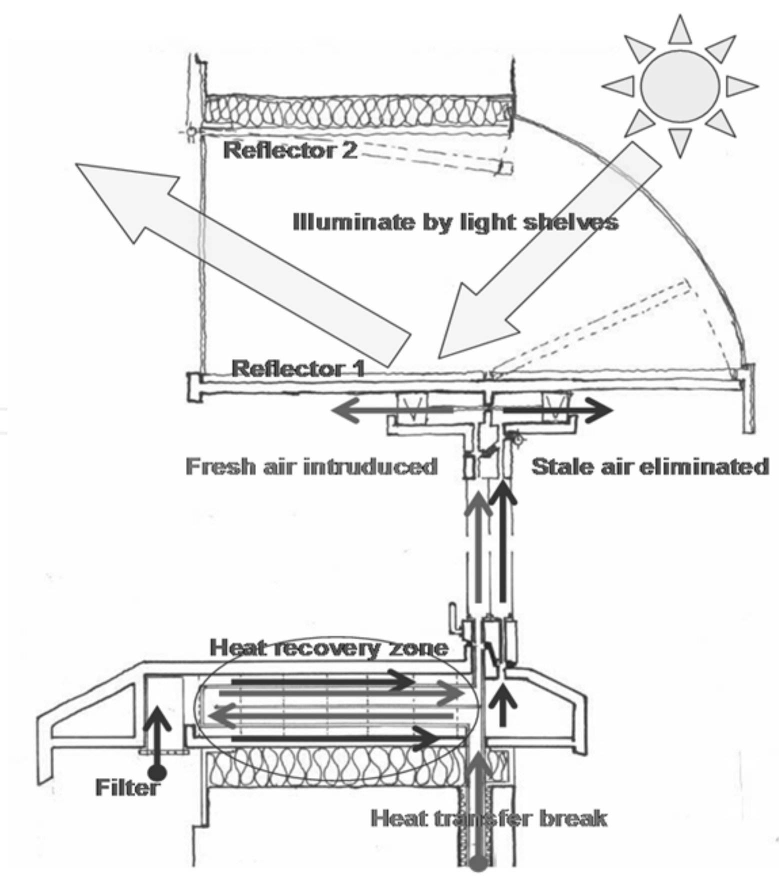

Fig. 11. Optimal window function

any kind of day lighting, the electric lighting must be arranged and controlled so that it can be turned off to exploit the daylight provided by the light shelf system. The location is apparent for tall windows, where the light shelves can provide deeper penetration than day lighting that achieved by shading windows. This is because light shelves can throw all the energy of direct sunlight into the space. In contrast, using shading to tame sunlight for day lighting leaves most of the potential day lighting energy outside the building. For a well-organized function of light shelf system that needs;

- The good treatment of windows. A window must be exposed to direct sunlight to be an applicant for a light shelf. Effective day lighting by any method is still infrequency. It is impossible to communicate the visual effect of day lighting by words or figures.
- The simplest materials and function of light shelf such reflector. It could be as simple as aluminum foil taped to a piece of cardboard.
- The distribution function of day lighting is from the portion of the window that extends above the light shelf. The window must face towards the sun for a large part of the time, and it cannot be shaded by outside objects. If the window glazing is tinted or reflective, the day lighting potential is reduced substantially.
- The ceiling is another manner of light distributor, where it can receive from light shelf. The height and orientation of the ceiling and the diffusion characteristics of the ceiling distributes the daylight.

4.3.2.2 Insulations upon house climatic screens

a. External doors

Insulating or replacing external doors can assist to diminish draughts and heat loss at building. The typical door for a low energy building has a U-value of 1.0 W/m² C°. This can be improved by adding an extra internal door swinging into the room. Otherwise doors with U-value of 0.8 W/m² C° must be sourced (ECN).

b. Walls

A wall is a frequently solid structure that describes and sometimes protects an area.

c. Roofs

The thick roof takes away too much headroom except in the widest building type with increased roof pitch. The passive upgrade consists of special cold-bridge free roof truss without vertical enforcements. U-value 0.082 W/m² C° (Amjad Al-musaed 2004)

4.3.3 Other thermal assignment

4.3.3.1 Thermal bridging effects

Thermal bridges are divisions through the material of significantly inferior thermal resistance than the rest of the building. These happen chiefly in the region of openings and at joint of walls- floors and walls roofs. Building element intersections: The linear thermal transmittance to exterior has to be below 0.01 W/m K°. (Sugawara, M. and A. Hoyano. 1996).

4.3.3.2 Air tightness

Tight buildings reduce energy costs by keeping in the comforted air conditioned air. But tight buildings without adequate ventilation catch humidity and pollutants so they feel unventilated, aggravate allergies and source general discomfort for house occupants. Moisture damage to windows and other parts of the house covering can result when humidity is excessively high. New houses, additions and even remodeling projects are far more airtight than they used to be. Building a tight house to today's standers can engrave the overall heat gain/loss by 25-50%. This is progress; a tight house is more comfortable, because it is less drafty and less expensive to cool/heat, because the energy man pay for stays in the house longer. on the other hand, a tightly constructed house needs also a mechanical ventilation to keep the air inside fresh and stop the buildup of indoor air pollutants such as excess moisture, carbon dioxide, formaldehyde and various volatile organic components found in buildings materials, paints, furnishing, cleaning products and smoke.

Air tightness is a concept of control of the ventilation airflow rates. It creates achievable to minimize energy use while maintaining a high-quality indoor environment. All windows and doors are required to meet the required air-leakage values. < 0.6 air changes /h at n 50pa. The total energy performance of a passive building is, to a large degree, needy on how airtight the building is (Sugawara, M. and A. Hoyano. 1996).

4.3.3.3 Underground thermal inertia

Using of the underground constant temperature can be useful for architects and designer because the temperature is between 8 °C – 13 °C, and 3 m above the earth, can help us to find a controlled thermal flux from underground to building elements by means of a determinant tube canals. (Amjad Al-musaed 2004).

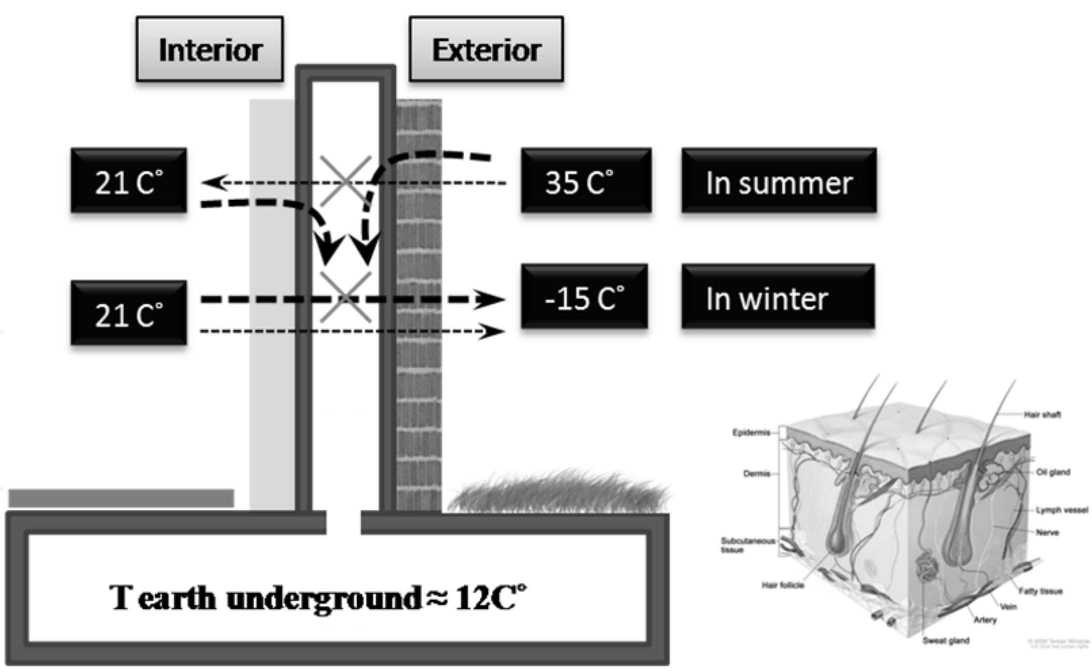

Fig. 12. The earth °C underground (using model)

4.3.4 Passive heating systems and strategies

The systems can be (direct- indirect). Passive heating strategies in particular make use of the building components to collect, store, and distribute solar heat gains to reduce the requirement for space heating. We have to create a variety of systems of solar heating systems and a clear description of a passive heating strategy.

Fig. 13. Passive heating process

Passive heating systems correspond to an environmentally friendly method of a human healthy building.

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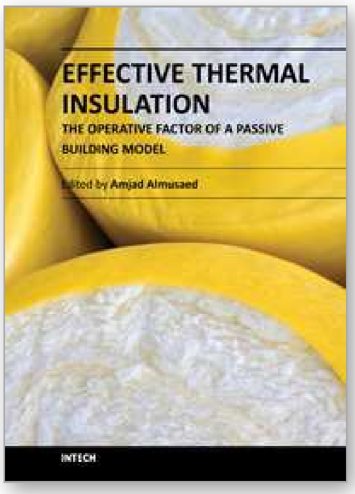

Effective Thermal Insulation - The Operative Factor of a Passive Building Model
Edited by Dr. Amjad Almusaed

ISBN 978-953-51-0311-0
Hard cover, 102 pages
Publisher InTech
Published online 14, March, 2012
Published in print edition March, 2012

This book has been written to present elementary practical and efficient applications in saving energy concept, as well as propose a solitary action for this category of topics. The book aims to illustrate various methods in treatment the concept of thermal insulation such as processes and the attempt to build an efficient passive building model.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Amjad Almusaed and Asaad Almssad (2012). Passive and Low Energy Housing by Optimization, Effective Thermal Insulation - The Operative Factor of a Passive Building Model, Dr. Amjad Almusaed (Ed.), ISBN: 978-953-51-0311-0, InTech, Available from: http://www.intechopen.com/books/effective-thermal-insulation-the-operative-factor-of-a-passive-building-model/passive-and-low-energy-housing-concept-

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