The Concept of Bioclimatic Design
Within the framework of sustainable Architecture - Extent of application in Khartoum

Prepare: Thowiba Abdalla Alageed - thowiba777@hotmail.com
Asma Osman Abdo Mohammed - asmaosmanabdo@gmail.com

Abstract
This study addressed the most critical problems that appeared in some of the architectural design techniques used in recent times in many Arab countries and cities. These buildings do not fit or are not compatible with the climatic environment of those cities. There is an inadequacy of modern buildings in the city of Khartoum in particular (the study area) to environmental factors and the climate, and the growing phenomenon of weak buildings that arise depending on the industrial air conditioning and lighting devices.

This study aims at clarifying the importance and the role of bio-climatic design in general and its importance in Khartoum, Sudan, in particular. The study also aims at trying to reach the standards of the design of eco-friendly buildings (sustainable buildings) in the dry tropics.

Depending on the approach inductive descriptive been studied, stages of historical and intellectual development of architecture which were formed on the general framework of the relationship of human and natural environment describe the study area (Khartoum) and the use of inductive analytical approach through the analysis of hot dry climate requirements to reach the standards for the design of eco-friendly (sustainable buildings) in the dry tropics, and when applied, we can achieve the objectives of the research in access to sustainable architecture compatible.

It is expected that the study concluded into several results. And it can be divided into three main levels:
- Results related to planning environments that are compatible in warm dry areas.
- Results related to urban design in warm dry areas.
- Results related to architectural design compatible in warm dry areas.

المستخلص:
تتناول هذه الدراسة أهم المشاكل التي نتجت في بعض أساليب التصميم المعماري المتبعة في الأونة الأخيرة في العديد من البلدان والمدن العربية وقد لا تتناسب هذه المنشآت مع البيئة المناخية لتلك المدن، وعدم ملائمة المباني الحديثة في مدينة الخرطوم بصورة خاصة (المنطقة المعنية بالدراسة) للعوامل البيئية و المناخية فيها، و إزدياد ظاهرة المباني المريضة التي تنشأ بالإعتماد على أجهزة التكييف والإضاءة الصناعية.

وتهدف هذه الدراسة لإيضاح أهمية دور التصميم الحيوي المناخي بصورة عامة وأهميته في السودان والخرطوم بصورة خاصة، وتهدف الدراسة أيضا في محاولة الوصول إلى معايير لتصميم المباني الصديقة للبيئة في المناطق الحارة الجافة.
An introduction:

Architecture is one of the tools that expresses conditions and the philosophy of the times and the place which they are originated, where numerous ideas that have relationship between architecture and the natural environment and human. Portal controllers have formed natural environmental factors and conditions that change from one location to other which react with the framework of external environment of the human. This reaction remained between the natural environment and human a major manifestation of human civilization or urbanization. This interaction is always accompanied with nature of internal calmness of man. Man is not going to ignore his nature at all, but he will try various means to cope with the elements while learning from them which serve him as a source of inspiration and emulation.

In light of changes that have occurred and technical possibilities, some erroneous conceptions for the relationship appeared. It points that human thought he cannot conquer nature, and environmental crises began emerging as a result energy loss and exploitation of natural resources. Human consumption has doubled the pace exceeded expectations. It also began the global warming, ozone layer depletion, pollution air, water and land. Its repercussion has negative impact on the natural environment and so, growing global interest in ways to address these negative phenomena in order to preserve the environment.

Research goals:

Overall, this research aims to contribute actively to find solutions to the problems of architectural installations and inefficiency of our buildings, and tries to take advantage of the natural data, and climatic factors in the Sudan (Khartoum) to adapt to warm dry climate and tries to come up with some compatible architecture standards environmentally in Khartoum.

1. It also demonstrates the importance and the role of bio-climatic design in general, and its importance in the Sudan (Khartoum) private.
2. It reviews and documents the most important ways and means provided by this trend (bio-climatic design) and sustainable design to conserve the environment and try to take advantage of them in practice.
3. It also tries to reach the standards for the design of green buildings in the hot dry Khartoum area.

Furthermore, the lack of research in this area and the lack of designs and buildings that are climatically and environmentally compatible in Khartoum, the research highlight the importance of the scientific feasibility of this research, which means adding new scientific approach to document the subject.

Research problem:

The problem of the research as the followings:

1. Inadequacy of the buildings in the city of Khartoum (the area of this research) with environmental factors and climate, and inefficient buildings to take advantage of the data environment.
2. The Growing phenomenon of weak buildings that arise from relying heavily on synthetic air conditioners with neglect of natural ventilation.
Lack of the fundamental knowledge of design and its operations by designers and negligence of the application of some of the environmental procedures in the dry tropics, which enables the achievement of environmentally friendly architecture.

**Research Methodology:**
The methodology used in this research depends on the scientific study and analysis and it also defends on the followings.
- Using a theoretical method to display information theory that contributes to clarify the subject of research in all its aspects.
- The use of the analytical method by clarifying the hot dry climate requirements, and analyze samples of study information.

All this is to get the strategies and standards for the design of eco-friendly in the tropics dry and apply them in the study area to be able to achieve the objectives of the research in the access to sustainable architecture compatible in the city of Khartoum.

**Definitions:**
- Climate: Is the form of atmosphere in the group cases of air on the place of the customary rotation.
- Bio-climatic design: Is an architectural design which cares about climatic factors surrounding.

**The most important structural compounds that are exposed to climatic factors are:**
- Firstly: ceilings: - These are the most constructive vehicles vulnerable to climatic factors, where it is most vulnerable to solar radiation horizontal surface in summer due to the impending elevation angle of the sun from the vertical angle.
- Secondly: the walls: - the walls contribute to large quantities from the impact of heat transfer; the walls must enjoy the requirements of resistance to heat transfer.
- Thirdly, windows and openings: - it appears that they have biggest role in the heat transfer through walls and play as foreign holes in them.

**The climate in Khartoum:**
- A higher degree of bony temperature in the month of May of 42.7, the lowest degree of bony temperatures in January is 31.
- The highest grade junior temperature in the month of May and the 28, and the lowest grade junior temperatures in February are 16.2.
- Prevailing winds in the Khartoum city generally is South West in summer and North East in winter, and the highest wind speed in November adding up to 10.8 mph.
- Khartoum prevails in most months of the year the hot dry desert climate and the least average annual rainfall in the Khartoum latitude 15 ° north on 200 mm.
- Relative humidity drops in the Khartoum city to below the 20% in the hot summer months (March to May) and go up to about 40%.

**The status quo in the of Khartoum city:**
- Use of building materials which are inappropriate to the climate of the city:
- Use of Binding deep-gloss aluminum which causes reflection of solar rays. as in the picture (1).
- The use of glass in the exterior mostly in cases uses the glass without processors in the western and southern façade. As in the picture (4-A) and in the eastern facade and the South as in the picture (4-b).
do not use design or architectural styles that make the building fits with dry prevailing warm climate in Khartoum, show buildings in the form of solid funds, making the adoption of residential buildings and service to adapt artificial organs as in the picture (6-a) and (6-b).

Proposed standards for the design of green buildings (sustainable) in the dry tropics

1. Adapt to the hot dry climate:
Design environmentally friendly buildings so that climate-sensitive and adapt to where it was after the completion of the building construction becomes a part of the environment becomes an exhibition of the same sun, rain and wind effects. Building sustainable building that can face weather problems, at the same time using all climatic and natural resources available is great in order to achieve human comfort inside the building so it is a balanced climate.

And this is the following:
1-1: Orientation:
1 / orientation of the building as a whole.
2 / orientation activities internal to the building.
3 / orientation vents, door and windows.
1-2: Using courtyard and head to the inside:
Where the opening to the inside on the dish; saucer or yard work as a regulator of temperature as the air passing through the top of the house does not fall into the dish and creates swirling in his realm and Buchner the yard and use the water element preserve the moisture. Through research in Egypt has found that homes with a yard less than the temperature by 5 degrees from home without a yard,

1-3: Design of the external openings:
Climate design vents (to resist radiation, temperature, wind speed and direction) which takes into account three basic elements:
Thermal insulation of slots - proper lighting - proper ventilation.
And it is using:
1 / Breakers horizontal and vertical sun.
2 / Mashrabiya.
3 / Use upper openings.
1-4: address the external walls of the building:
There are a range of treatments for external walls to adapt to the hot, dry climate, including:
- Increasing the thickness of the external walls of the exhibition of solar radiation.
- Exterior walls of the building painted in pastel colors or white to minimize the effect of directing the building on the degree of internal temperature.
- The use of double walls in the outer perimeter of the building.
- The use of protrusions and predatory in the exterior walls to throw shadows on the wall itself, which reduces the heat load of the show to him.

1-5: Using architectural composition and its components:
An analysis of the components of the building of walls and roofs found that more elements are exposed to radiation ceilings and facades South and West and can take as a base design for warm dry area.

Ceiling:
- Cover the upper ceiling reflective material to get rid of radiation or white color.
- Can leave the vacuum insulator or space between the upper surface and another
  Lower ceiling. Hence it arose the idea of building the roof of the two rows separate
- Planting surfaces.
- Walls: the cube method in the formation (Cubic in form) to resistance of direct
  reflection of the incoming sunlight.
  1-6: Use the corridors and shaded arcade:
  Arcades supplying the building and facilities in shades of the walls and create a
  relaxed atmosphere and a comfortable area around the buildings.
  2. Rationalization of energy consumption and the use of natural energies:
  Access to environmentally friendly buildings in the hot dry climate, this standard
  works on two principles:
  - Reduce the use of energy.
  - Use natural alternative energies such as solar, wind energy and bioenergy.

3. Technology of system & material

In order to be building environmentally friendly materials should be available in
several conditions:
  1. Not be a material of high energy consumption, both in the manufacturing
     phase or installation or even maintenance.
  2. Probability recycled for reuse.
  3. The properties of these materials are in terms of the absence or decrease the
     emitting elements or harmful gases or low degree of toxicity.

4. Air quality inside buildings:

And considerations, it is:
  - Control the dimensions of the air entering the openings of the building; shall be
    at the higher end the air exit slots be low (down).
  - The use of coordination around the building to create zones of high pressure
    and low again.

Design Method inside the building:
  1 / Use Almlagaf.
  2 / Fountains and waterfalls inside the building.

Design Method outside the building:
  1 / planting trees and bushes in the yard and around the building.
  2 / planting green areas around the building.

5. Appropriate lighting nature:

Natural lighting: The good design of the slots should include the:
  - To have all the space on at least two windows on two walls to avoid dizziness
    phenomenon.
  - Distribution of windows and selecting locations for the purpose of obtaining a
    greater amount of natural light and the reflected private and try to avoid direct light.
  - The allocation of open spaces such as courtyards building permit the use of x-
    rays, taking into account the privacy factor.
  - Use the lunar suit with a warm, dry climate

Industrial Lighting: When selection and artificial lighting units must take into
account two aspects, namely:
  - The type of lighting to be as close as possible to nature light.
- Use qualities provide the electrical power consumption.

6. The philosophy of the use of color:
The exterior color choice has important environmental and climatic effects. Brighter light or near-white color has a great ability to reflect solar radiation, choose colors on the bishop to be the most influential on the reflection or absorption of solar radiation.

7. Architectural style compatible with the environment:
And can be summarized factors that affect the architectural character of the two main groups: Group 1: is the natural environmental factors that determine the characteristics of the place and be the impact it directly over successive eras, they are therefore the effect constant good while, and a place on the architectural character of the climate like the factors and geographical and local building materials second. Group 2: are cultural factors that are the product of human interaction with the natural environment which includes the religious factor and the social, political and economic as well as philosophical ideas, scientific and technical.

Conclusions:
From the study of environmental and climatic factors in the dry tropics and its impact on man and his activities and the establishment of comfort and efficiency, and study the fundamentals of planning and design of the buildings those areas, the study concluded several results. These results divided into three main levels:
- Results relate to planning environmentally compatible in the dry tropics.
- Results related to urban design environmentally compatible in the dry tropics.
- Results related to architectural design environmentally compatible in the dry tropic
Results related to planning in tropical dry:
Must be given to the environmental dimension more “attention when the composition of the new urban cities or when treatment and re-planning to prepare the list of cities with the following:
1. Must choose the site of the city to suit the conditions and geological aspects of the natural surface.
2. It must fit the size of the city with development potential available site and limit excessive population growth and limit future expansion of entrusted inappropriate for housing.
3. Fabric helps traditional compact urban environment to provide suitable surfaces reduces Urban prone direct solar radiation.
4. Direction to the horizontal architecture oriented to the inside.
5. control of the streets and lanes network routing within the bloc Urban we can control the movement of air within the city and selecting the appropriate profile Urban we can guide the movement of air within the bloc for architectural or protect it from the impact of wind unwanted. The form of Urban Network lanes and streets of the Interior play an important role in shaping and changing air traffic trends.
6. The control in guiding Urban Spaces and buildings to allow for air movement inside the blanks and exposing all the buildings and condominiums for air movement and taking into account the lack of tall buildings put in wind direction prevailing even not working to change the air traffic, including not allowed to passed the rest of the buildings located behind her and put condominiums mileage the right to expose all elements of air traffic.
Results related to sustainable urbanization in the hot dry climate design:
1. Playing landscaping and water features within the city (an important role in reducing the direct and reflected solar radiation inside the Urban Spaces decreases convection within them and also "of great importance purify polluted air inside the city.
2. The use of trees and plants in the streets and footpaths, public squares.

Results related to architectural design in the hot dry climate:
1. You must choose building materials that fit with the atmosphere of the city of Khartoum (dry warm climate); and minimize the use the cladding high-gloss and thus a severe reflection, and always use glass processor.
2. The use of architectural profile on the interfaces and the use of horizontal and vertical panels have a clear impact on the provision of the shadows and reduce the heat leak into the building.
3. The use of landscaping and shrubs, and water elements (fountains) has a very influential role in improving air quality inside the building.

The most important recommendations:
- When reflect on our economic situation and our resources we need to recognize that the application and use of sustainable green architecture more than the developed countries.
- If the sun's rays, and its flame amounts and intensity of radiation in our area of the highest in the world, this provides us with a golden opportunity to take advantage of them to provide a major source of natural energy.
- The activation and application of sustainable architecture and urban design practices are not sustainable only by architects and engineers qualified in this area. This requires attention to architectural and engineering education in our universities so that our colleges become an incubator for those ideas and environmental solutions and their implementation in our house and our buildings to become more sustainable.
- and study and look at the Arab our house and architectural heritage is found made a smart environmental processors contributed significantly to the creation of an environmental agreement between the built environment, and these treatments address-based routing and application of the topography of the land and the use of internal courtyards and Larache and oriels and air Mlaagaf and forms of care and the size of widows thick walls and rely on local resources like clay, wood and exploitation of plant elements in the environment. the environmental and economic benefits achieved by domestic our house in the past is in the same image, innovative applications, the concept of sustainable architecture extent, so I would recommend attention to this type of architecture local development and dimension cry from imported architecture.

Extension Photo:
Image No.(1) shows: the use of gloss cladding. Source: researcher

Image No. (2): use cladding in residential buildings. Source: researcher

Image No. (3): the use of cladding + glass untreated. Source: researcher

Image (4-b)

Image (4-A): the use of untreated glass sizes in a wide interfaces. Source: researcher
Image (5) shows: the use of untreated glass in the windows of residential buildings. Source: 5

Image (6-a) Source: Researcher's (6-b) Source: 5

Image (6-a) (6-b) explains: reliance on artificial air-conditioning.
Sources:
Source (1) / Yahya Vaziri - Designing eco-friendly - Madbouli Library - Cairo i 2003

Source (2) / M. Waleed Khalid Latif - green architecture and sustainable intellectual and communication with traditional architecture - Master of Urban Planning - University of Mustansiriy

Source (3) / MD Abdullah Salman Saadoun al-Mamouri - humanitarian Arab Islamic architecture architecture between the need and requirements of the ideal endoscopy - University of Technology / Department of Architecture

Source (4) / M / Ayman Mohammed Fathi Abdul Rahman - technological trends and their relationship to architectural design - Cairo University Faculty of Engineering - PhD Thesis - Egypt

Source (5) / emotions Bahauddin - the evolution of architecture with the warm climate in Khartoum agree - Master -alsudan --2,014.

Source (6) / World Wide Web via the browser Google - www.google.com

Source (7) / site Wikipedia www.wikipedia.org/