The Tower of Garden: Vertical Neighborhood as Sustainable Housing Model for Metropolitan

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Abstract: Undoubtedly green structures are one of the most interesting concepts of new technologies that are being developed after introducing the renewable resources without environmental pollution and the introduction of environment friendly energy technologies. In comparison to the past, changes in urban lifestyle have been provided appropriate background for designing and construction of structures. Nowadays, Green Towers are being developed as a solution to problems related to the energy crisis, environmental degradation and population, and population growth. In these towers, the building adapts itself with the local climate and nature and supplies its required energy with applying innovative technologies in renewable energy, such as wind turbines, photovoltaic cells, geothermal energy, hydrogen, biomass, and many other methods, and even sometimes, injects the excess energy to the urban network. Due to increasing population, expensive land in the city centers, marginalization and environmental pollution, it seems that, the vertical expansion methodology and bioclimatic towers are the solutions for the future of our metropolises. In the present study, after initial studies and investigating several case studies, we will introduce tower garden project which seeks to provide a local tower garden model in order to establish a multilateral but vertical neighborhood to meet the needs of a neighborhood in a vertical fashion.
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1. Introduction

Increased polluter activities, poverty, and injustice in the late 20th century triggered environmental issues around the world. These attempts introduced the new approach of sustainability, i.e. using resources without harming the environment and preserving them for future generations and have formed new theories in architecture. This approach in architecture is known as green architecture, sustainable architecture, and ecological architecture aiming to increase sustainability of cities and buildings. One of the proposed methods in this field is developing cities vertically instead of horizontally.

According to the reports, urban population is growing from 6.1 billion in 2009 to more than 15.5 billion in 2025. The problem of providing food for this population and the need for arable land has suggested the vertical development approach.

Benefits of Vertical Cities are:

- Preserving arable lands for agricultural productions in order to supply the food for growing population in the future.
- Reducing environmental degradation due to the decline in in construction.
- Reducing transports within cities and energy consumption and pollution due to vertical development of the cities.
- Preventing the considerable growth of marginalization in large cities.

Researchers believe that, increase in urban population, the high price of land and the construction of skyscrapers are inevitable. However, what is important in this process is how to design skyscrapers. According to them, skyscrapers such as cars, at the present time, are the necessities of life and. With the development of cities, where there are at present, it is required to build skyscrapers. However, the coexistence of structures and landscapes or the environment is important in this process.

One of the key figures of designing environment friendly tall building is Ken Yeang. Yeang in his bioclimatic recommendations expressed one of the most important reasons of building green skyscrapers as low cost consumption and thus, reduced energy consumption of the building. He believes that, designing with regard to the bioclimatic conditions will reduce the energy consumption of the building up to 40 percent.

Yeang, in designing his bioclimatic skyscrapers, has considered the underlying principles of his general approach as follows (The skyscraper bioclimatically considered, yeang, Ken, 1993).

The position of the central facilities of tall building is one of the important factors that should be generally studied since their position determines the design of rest elements including pop-up spaces, service spaces and exterior coverage. There are three ways to design the location of central facilities of a skyscraper: as the central core of the central axis of

building, as double nucleus, and as a single unit alongside the building.

Designing vertical green landscape

By planting trees in the floors and using flower boxes on the balconies.

Natural ventilation and wind control

With a proper design, a negative factor in skyscrapers like the wind can be used to produce energy and natural ventilation.

The design of indoor spaces

Empty spaces inside the skyscrapers, are the main spaces that can control the movement of the wind within the building. Therefore, in designing process, factors such as the connections between pop up spaces, blank spaces, and ceiling and its canopy should be considered.

Design of exterior coverage and opening spaces

Opening spaces in buildings must be designed in a way to allow controlled entering of the sunlight into the interior area; the shape, color and material of the outer covering of a building is very effective in absorbing and loss of energy.

Structure and infrastructure

Feasibility studies on infrastructure are very important in constructing tall building projects.

Intelligent building systems

Adjustable vents on the shell section of building, direction of wind and sunlight, and smart lighting can greatly reduce energy consumption.

Geography of tall buildings

Because our country is susceptible to earthquakes, this factor is very important and new technologies in this field must be considered.

Figure 1: The EDITT Tower in Singapore, the idea of the spine and the Green plates, Ken Yeang

Vertical development is not limited to office and residential towers with green spaces.

Dragonfly skyscrapers, New York, America (a model for new urban agriculture), 2009

Among the commercial buildings and tall apartments, Vincent Callebaut a Belgian architect, redefined typical skyscrapers. His 132 floor complex in Roosevelt Island's south shore indicates the urgent need for environmental sustainability. This conceptual plan is focused on the creation of a totally self-sufficient organism in which, not only solar, wind and water energies will be used, but it will also eliminate the problem of food shortages. Mixed programs in Callebaut dragonfly tower are concentrated around two main towers. These symmetrically arranged towers allow vertically growth for Manhattan rather than horizontal development for bustling environment of Manhattan. The complex is organized so that, housing units and offices are scattered between pastures and farms. Glass and metal wings have been inspired directly from dragonfly's body.

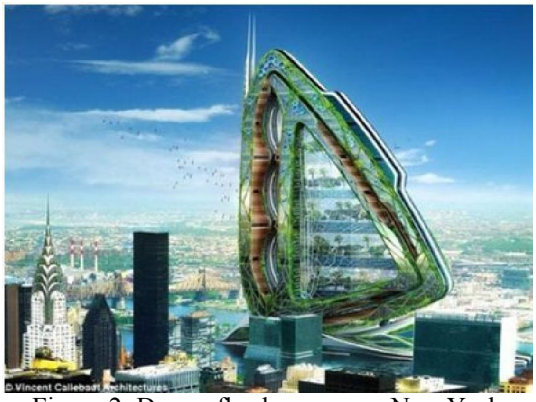


Figure 2: Dragonfly skyscrapers, New York

Gwangyo City center, Korea, 2011

Dutch architects of OMA group have designed a green city for Guangzhou, South Korea. This small town is being built in 35 kilometers of Seoul, South Korea. The town is expected to be completed in 2012 and can accommodate about 77 thousand peoples. The main parts of the city consist of two large centers with residential, cultural, administrative, commercial, recreational and educational areas. Modern hedges on their roofs will have a significant contribution to reducing energy and water consumption as well as improving ventilation system.

Figure 3: Guangzhou city center, South Korea, 2011

2. Material and Methods

The idea of Tower Garden was formed in a student project. Theoretical fundamentals of this project was acquired through field studies, library studies, analyzing global indicators, obtaining new techniques and modern methods, and through a feasibility study on this project in domestic projects considering high potentials of traditional and successful quarters.

2.1. The Tower of Garden

The Tower, in Main dictionary (a famous Persian dictionary), has been defined as long, cylindrical or cubical building to guard and watch. In addition to usual and customary buildings in Persian garden such as Pavilion, hall and porch, in the historic pictures of gardens or buildings adjacent to them, sometimes one can see tall buildings within or adjacent to gardens. The remaining historical texts call them as towers or edifice. In the aforementioned Moin dictionary, garden has defined as usually enclosed area where the trees and flowers are planted. Persian garden are beyond a green space and had lots of symbolic functions and meanings. In Tower Garden project, there is, more than what it is observable in green towers and palaces of the Persian gardens. In fact, it implies on the concept of sustainability in all climatic, economic, social, cultural and physical aspects in order to provide a local climatic model. The purpose of Tower Garden project is to achieve sustainable housing model for the future of our cities.

2.2. Project site

Due to the symbolic nature of the project, the city of Tehran was chosen and the western edge of the Chamran highway was selected for project site. These lands have a unique variety of both natural and artificial elements that could be benefitted in Tower Garden project.

2.3. Modeling spatial organization and physical structure of the project

Tower Garden project is looking for a solution to establish a multilateral but vertical neighborhood to meet current and future needs as well as the potential and function of traditional neighborhoods. This project (sets) is composed from three sets, each with various subsets. Three sets are residential area, administrative-commercial- recreational area, and the garden which has a functional role and connects two parts while separating them.

2.4. Course of urban design and architecture of Garden Tower project

The first issue was the height scale of the building towards surrounding tissue, which is very important. In fact, examining the status of urban design of the project is necessary. Therefore, the summary of project is as follows: A figure with stairs going back while increasing the height and gradually fading in the sky with a soft shrinkage, increased surface area (cross section), terraces and floors popped out in bottom floors that gently places the tower on the site. The tower will be placed in its western long wall and this placement in the valley causes the tower to respect people and the city while maintaining its solidity and becoming to an urban signs. Green space within the floors can appropriately fade the tower in green tissue.

As the tower can be seen from all sides, it must have different view from each side. These changes in facades are designed in perfect harmony with geographical directions and tower changes as a living creature. The main facade of the tower is towards south, and due to its 22.5 degrees rotation toward the east, the tower shows off itself while crossing the highway.

Tower Garden, due to its specific physical structure, as well as the height and surrounding location will become an urban symbol that should carry an urban message. Moreover, in a deeper layer, the tower connects to the city. This is a kind of being semantically native.

Garden design as an essential component in this project, starts from the site and continues to higher floors of the tower until the walls and roof. The garden separates two main areas of the project and connects them when entering to them and shapes the node of our neighborhood.

The spaces of the tower are organized based on the project's physical plan, public and private spaces, and on logic of most use of the best views so that, from top to down, it includes recreational areas, residential apartments, offices, and commercial areas, respectively (Fig. 4).

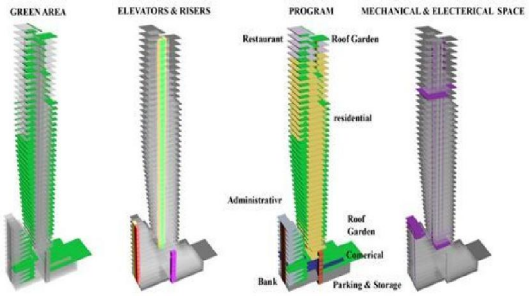


Figure 4: Diagram of the Tower Garden Project

The original use of the project, the residential area, is considered in the main and tall part of tower. The lower floors are considered for recreational and commercial use and the basement is parking lot. The administrative and service areas are located in western low heighted areas and their parking lots are in the corresponding basement.

As we go to higher floors, the surfaces of floors reduce gradually and the plan gets T like shape in order to create suitable condition for sunlight.

This form has the ability to meet the project's physical and climatic concept.

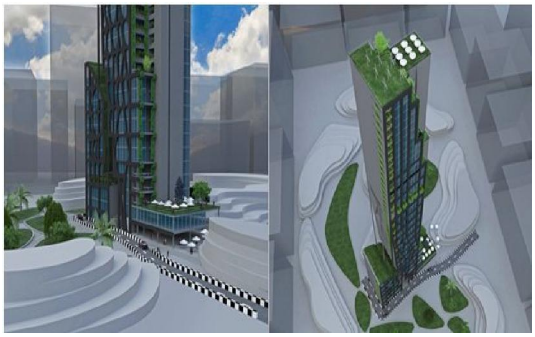
3. Results

The garden is located at the middle floors connecting two sections of the tower. As mentioned above, the garden plays the role of the nodes in the traditional neighborhoods. Restaurant, cafeteria, art gallery, and book stores are designed alongside the garden. Green spaces, stairs and ramps of this section grant mobility, porosity and freshness to these areas. The garden raises the continuity between communal public spaces, commercial and office complex of two towers and site collections.

At the top floors of the tower, which have step like shape for better use of sunlight, there is fitness saloon, sauna and whirlpool bath considered only for residents of the tower. The green project roof is a green and open area as well as flexible spaces that can be covered in cold seasons. This section is also only for residents and have a restaurant, a buffet and service spaces.

Internal green courtyards of apartments which are located in the southern section appropriately use the sunlight and have the background of the city. Northern windows and terraces with panoramic view of the northern mountains are considered in order to grant freshness for the interior areas of apartments.

Using windows glasses with variable energy transfer, solar collectors, and wind turbines are among the approaches to meet the power considerations of the project.



Figures 5 and 6: three-dimensional view of Tower Garden Project

4. Discussions

Although the design and construction of such structures are very expensive, but since in these structures, the per capita energy consumption decreases significantly, in long-term the investments will be returned. Furthermore, observation of environmental standards in these structures can be an effective step in reducing environmental pollution. If we pay more attention to environmentally friendly structures, we may expect to achieve effective approaches to save the world. Future researches in this area are required. Extensive studies in establishing food gardens on the rooftops of the project and investigating modern irrigation methods in order to optimize the bioclimatic of the tower are very effective.

Nowadays, the Municipality of Tehran city allows to build tower gardens in some gives Gardens. We hope that, they conduct comprehensive studies before performing such projects do not just imitate well known project by planting some trees and some green coverage.

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