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Challenges to Design GREEN High-Rise Building in Iran

Assessing and analyzing usage of green building technology (case study: Residential Green Towers, Iran)

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Abstract

In recent years, the debate over tall buildings and their impact on the environment has been raised greatly. On the one hand, the need to build tall buildings for various reasons such as: economical, functional, and environmental and on the other hand, High consumption of resources because of tall buildings is a challenge. In recent years, there has been six main approach in the design of high-rise buildings[†]: High-tech, Monolithic, Kinetic, Scenography, Media tic and Ecological.

Ecological approach in the design of high-rise buildings, is realized by sustainable and green architecture. Ecological approach to architecture of high-rise buildings has led to not only the buildings less damage to the environment, but they also promote the quality of the environment. LEED standards at the late of twentieth century is used because of realization of these goals.

In spite of a favorable environment for the use of renewable energy in Iran, there are four factors to reach green design: cultural, economic, technological and legal. Also in this condition there are some necessities to build green in high rise: saving energy (by solar panels, wind turbine, GHP system, CCHP), usage of green space in high rise, recycling water, healthy material and sustained construction, double skin façade, site development (green transport). In a case study of green high rise in Iran, renewal energies decreased usage of energy in building from 290kwh/m2 to 75kwh/m2. Also economic factors shows the rise of 1.2-1.4% in cost but 30-35% reduction in energy costs in green high rises. Compared to a conventional building, usage of renewal energies has 17.5% increase in Mechanical costs, 17% in Architecture & 37.5% in green spaces. With double skin façade, total cost increases about 8.2%-8.4% and without 1.2%-1.4%. In maximum condition it is 10% rise in cost compared with a conventional building.

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† [1] Howler, 2003

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1. Introduction

In more than 30 countries, the usage of renewable energy is about 20% at least. Some countries have a long-term goal by 2030 or 2050 for a greater proportion of renewable energy into their work. For example, the rate of 100% for Denmark and Germany (60%) is predicted [2] (RGFR, 2013:15). In this situation, some countries are going to reach zero energy building standards [3] (Atanasiu, 2011). For instance, ZCB[3] building in is a famous and the first zero carbon building in Hong Kong. Even some cities are going to be zero (e.g., *Masdar city* in UAE).

As cities continue to grow, energy demand is increasing at an alarming rate. 17 % of water sources, 25 % of forestry products and 40 % of energy sources are consumed by the building sector [4] (Gultekin & Yavasbatmaz, 2013:450).

The Energy Information Administration estimates that energy consumption will increase by 50% between 2005 and 2030[4]. Emissions from fossil fuel derived energy sources threaten the health of our cities and intensify the environmental devastation caused by global warming. Although the building industry represents only 10% of the world economy, it is responsible for 50% of the total global CO2 emission, more than any other industry. Huge amounts of resources are consumed to build, operate, and maintain architecture. In accordance, architects have a great opportunity to monitor and reduce energy consumption through design. Decreasing the amount of energy needed by the building industry helps neutralize the harmful effects of our current energy systems and transition us towards a low carbon economy. In recent years trends to build high rise in Iran has been raised. A very important criticism to this kind of building is about environment. So this it is an important question:

"*Can the architectural profession rise to the challenge and create alternatives to tall buildings which address both the desire for the large scale and current pressing issues of environmental responsibility*?"

Also in recent years, the realization of indicators according to the new technologies is going better. New technologies such as: structural systems for maximum skylight openings, diagrid structures, reducing carbon compounds in the concrete, gray water recycling technology, green roofs and walls, Applications for renewable energy technologies such as solar panels, wind turbines, geothermal systems, advanced system controls the amount of pollutants, carbon and water use… all These issues have led to the construction of high-rise buildings are not only reduce harmful effects on the environment, but also to improve the quality of life to reach healthy environments [5] (Bauer et al, 2010).

Today, the first steps of green design and sustainable approaches in design both in universities and building industry is followed. But it is necessary to focus on different aspects and conditions of it. Certainly, all the ways in building sector lead to saving energy and sustainability as a very emergent category. About one decade, many developed countries have walked through this way and now we follow the same steps.

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[3] To evaluate and optimize ZCB's building environmental performance and operation, a custom-developed BEPAD (Building Environmental Performance Assessment Dashboard) system is provided. The system acts as a graphical user interface (GUI) for interactive display of real-time data and track records of building environmental performances as monitored by the BMS (Building Management System) using over 2,800 sensing points in the building. Building environmental performances of the following 6 categories are displayed: energy use (EU), site aspects (SA), indoor environmental quality (IEQ), material aspects (MA), water use (WU) and occupancy data (OC). Four outdoor weather stations have been installed within the site to collect microclimatic data that will inform and optimize the performances of building services systems. *www.archdaily.com*

[4] [6] KRGT report, 2014 & RGFR (2013)

(a)
Fig 1. (a) *ZBC, Zero Energy Building/ Source: www.archdaily.com*

2. Methodology

In this research, the first section is a literature review with a content analysis research method. In this case, different aspects of building green high rise is discussed. On the other side, a case study for verification of situation in Iran is analyzed to reach some issues in green high rise design. So, research method is a combination of case study and content analysis. Some research tools such as survey has been applied. Some cases have been visited by the author and analyzed by the facts and case study analysis has been done under supervision. For the case analysis, some professions have participated.

3. Transformation of tall buildings[5] design: from Chicago school to green high-rise

Evolution history of the skyscraper in the world can be divided into six periods:
Initial development of skyscrapers was formed in Chicago from 1880 to 1900, .The first generation of skyscrapers were flat and cubic in Chicago. Designers applied a variety of solutions retrieved from *Romanesque* and classic styles. *Auditorium Building* in Chicago is a good example of these. The second period began with construction of too high towers in New York. Combination of towers with urban and park was the aim.
The third period of skyscraper transformation was determined with the modern period. In this period, the commercial style of the first *Chicago school* high rise buildings continued. Again, the rectangular cubic buildings were made that have flat roofs. But this time it became a global model. There was not an emphasis on historical styles and a deal rationally with functional and technological reality Instead it was.
Fourth period of construction of skyscrapers, simultaneously with the advent of postmodernism and late modernism took shape. Fifth period is to consider high-tech and then eco-tech approach. Eco skyscrapers at the late 1980 have been raised to be environmental friendly. The last period focuses on formalism and aesthetics. The third millennium skyscrapers consider being such a dream.

[5]. Evolution of building mechanical systems, providing artificial lighting, ventilation, and finally heating and cooling systems, occurred in the parts of America until the 1920s, .The invention of the elevator eliminated the building height restriction to the fifth floor .this way the first real skyscraper was established in 1885. Life Insurance Company Building with 10 floors in Chicago Designed by William Le Baron Jenny was the first.(KRGT report)

If we believe that in the last years of the twentieth century, there are two main approaches of architectural design: 1. a space-based and 2. Climate-based, green design approach focuses on both aspects [7] (kamelnia, Mahdavinejad, 2014:125). In a general definition, **green architecture** is a building design approach that tries to reduce the harmful effects on human health[6], according to a healthy environment for living and provide it [8] (Yeang, 2011). A green architecture building uses new technologies in various sectors of architecture, construction, engineering, landscape and urban design and it can raises its standards also provides a suitable environment for the residents and the surrounding fabric [9] (Kubba, 2010). Sustainable and green design is a postmodernist movement but it is more related to two concepts such as "development" and "need". **Sustainable architecture**[7] is a set of factors, including factors related to socio-cultural, environmental, ecological and technical issues [10] (Maunsell, 2002). Sustainable architecture focus on both environmental and ecological and the technical issues (Eco-tech architecture) but green architecture try not to combine with social and cultural issues. Studies shows, Reduce the adverse effects of high-rise buildings in areas such as high energy consumption through ecological approach to design is possible[8].

Ecological approach to architecture of high-rise buildings has led to not only the buildings less damage to the environment, but they also promote the quality of the environment. LEED standards at the late of twentieth century are used because of realization of these goals.

LEED certification, which includes a rigorous third-party commissioning process, offers compelling proof to you, your clients, your peers and the public at large that you've achieved your environmental goals and your building is performing as designed. Getting certified allows you take advantage of a growing number of state and local government incentives, and can help boost press interest in your project. LEED[9] promotes a whole-building approach to sustainability by recognizing performance in key areas of human and environmental health [11, 9] (Kibert, 2013, Kubba, 2010). These are:

- Sustainable Site
- Water Efficiency
- Materials & Resources
- Energy & Atmosphere
- Indoor Environmental Quality
- Innovation & Design
- Regional Priority

[6] [5] Bauer et al, 2010 discuses about relationship between comfort level and performance ability.

[7] Six principles of sustainable architecture [9] (Kuban, 2010):

1 .Conservation of Energy: Every building must be designed and constructed in in such a way to minimize the need for fossil fuels.2. Work with climate: Buildings should be designed so that they are able to take advantage of climates and local energy resources.3. Reduced use of new resources every building must be designed to minimize the use of new resources.4. Respect for Members Green Architecture, respected to all those who use the building.

5. Respect for Site: Every building must be touch ground smooth and light.6. Holistic: All of green principles are requires the participation in the Holistic process to make the artificial environment.

[8] [12]Cory 2011, mentions the fifth elements in sustainable design:

1.Earth (brownfield, orientation, transportation, minimal footprint, urban fabric)2.Water(green roof, grey water, storm water, low water consumption and plants)3.Fire(energy saving, energy production, natural light, efficient artificial light)4.Air(acoustic, wind, air pollution, simulation)5.Education(adaptable, dynamic, eco-global, innovation, creative).

[9] [13] LEED, 2004

LEED[10] features can be used to improve the quality of high-rise buildings that look more comprehensive and beyond to satisfy the energy needs of the building. Incorporating features based on the LEED green architectural features could cause results to be useful in the design of a high-rise building[11]. The sustainable design of tall buildings is the design that makes the building operational at minimum cost by minimizing energy consumption and use of resources. The cost of energy and natural resources used by tall buildings at the stages of construction, use, and demolition, is higher when compared to low-rise buildings [4] (Gultekin, A. Yavasbatmaz, S, and 2013:451).

Today, almost 60 countries have or are developing green building assessment like [5] (Bauer et al, 2010:15). GBAS (china), HQE(France), IGBC(India), CASBEE(Japan) and BREEAM(UK) [11] (Kibert, 2013:2).

4. Paradigm changes in Green high rise buildings: From *Menara Mesiniaga* to *Bosco Verticale*

Malaysian architect *Ken Yeang* has written extensively about a bio-climactic approach to skyscraper design. Yeang`s integrated component of a local ecology [14] (Yeang, 2007). Yeang`s designs use both active and passive means to respond to a particular site include building configuration and orientation, the location of the service core, the design of the building envelope to incorporate sun shading, integrated planting, and the use of natural ventilation. *Menara Mesiniaga* is the first green skyscraper in the world that is built in the late 1980s [15] (Sirvailias, 2012:29). After a decade, new building technologies in facade design, mechanical systems, and new materials have impacted the design of ecological buildings. Architects have formed new collaborations with engineers to create integrated solution [10] (Maunsell, 2002).

(a) (b)

Fig. 2. (a) *Menara Mesiniage, the first green building in the world/ Source: Sirvailias, 2012:29;* (b) *Concept of biodiversity in Bosco Verticale, Milan*

They imagine an architecture that takes constant readings of local climatic conditions and adjusts itself accordingly, creating self-darkening facades, or facades that generating energy, or double skinned facades that generate heat in the cavity with the aid of solar radiation. The incorporation of these technologies, they

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[10] Development of new technologies in the field of architecture, construction, engineering, landscape has led to better take advantage of the high-rise buildings. In this respect the position of the technology has an important role in raising standards of production. Perhaps even without the use of modern technology, there is no possibility of some characteristic of the LEED. For example, *Taipei 101* building, using solar cells could generate 16 kilowatt hours of electricity, as well as save 20 to 30% water consumption and 30% reduction in energy consumption in all sectors is allocated to the degree Platinum LEED.

[11] [14,15] Mahdavinejad, et al(2011, 2014)

believe, will result in totally new solutions, and an aesthetics that it self-dynamic and changeable.
Environment refers to the interior environment as well as the exterior. *Norman Foster* has designed several buildings that employ double-skin curtain-wall systems and natural ventilation to provide ecologically sensitive office environments. Interior spaces have qualities that make them comfortable, naturally lit, and ventilated, encouraging a sense of community [11] (Kibert, 2013:12).

As urban populations increase and cities continue to grow, careful urban planning must accompany economic planning. It is clear that high-density cities will continue to be part of any urban future, and the skyscraper will continue to play a role in any city.
It is clear that the future of architecture will involve the integration of environmental concerns with architectural design. Recent projects demonstrate design driven by environmental concepts alongside formal and social concerns. Environmental design represents a consciousness towards issues.

The skyscraper as a discursive apparatus is a highly visible means to communicate an environmental consciousness. To balance the levels of biological diversity, three principles of the Development sustained construction industry should be adhered to conservation of biodiversity as follows[12]:

1. Sustainable use of biological resources:
the care must be taken that biological resources exploitation in systems where and how are used. they can be kept Sustained and Resources that can be quickly replaced can be used

2. The use of sustainable resources:
Reasonable use of sustainable resources not damage to the original source and it possible to replace it in nature and even the colour is applied should be from the material that is less harmful to the environment.

3. The conservation of biodiversity[13]:
Biological resources are well maintained and community participation is essential to the survival and biodiversity. The system is used so that all of its components are protector of set and people benefit properly the natural resources and they should be taught to use every product and resource in the right place and optimal. In recent years some project are going to conserve biodiversity. *Bosco Verticale* in Milan is a vertical forest with diversity. The two towers of 26 floors and 18 floors, have More than 900 trees. There is 8900 square meter terraces in the both towers. In this project a GHP system is used.

Fig. 3. (a) *Double skin façade in Agbar tower, Barcelona/ Source: Author*

[12] KRGT report
[13] "**Green Design**"-from theory to practice, Black Dog, London, UK.

5. High rise building design in Iran: Treat or Opportunity

In *Iran*, movement from courtyard houses into high-rise is going on So that up to 2014 more than 1,000 towers in *Tehran* has been built or are under construction up to now . Other cities such as *Mashhad*, *Kish*, etc. are the same. The main use of these high-rise buildings is residential and almost 80% of use that is most used by private builders [6] (KRGT, 2014). In recent years many debates about high rise building in Iran raised up. Some advantages and disadvantages by criticism are as followed [10] (Maunsell, 2002).

Table 1. Benefits and Disadvantage of tall buildings

Disadvantage of tall buildings	Benefits of tall buildings
High energy consumption	Optimal use of the land according to the concentration of population
Increase density and crowding	Reduce transportation
Shadow , wind effect	City View, outlook, private space
Eliminate Privacy	natural skylight space
Centralization, Vertical access	Centralization of services

Many studies believe that consumption of high ride building, is a good opportunity for application of renewal energies. Studies show that in Iran more than 40% of energy consumption[14] is in the building sector[15]. Iran is one of the richest countries in the world because of energy resources. It ranks third in the world in terms of volume of oil and gas reserves. Iran's annual share of oil and gas production to domestic consumption will. This is not only in Iran, but is also common in other oil-rich countries of the Middle East. But the share of renewables in electricity production capacity development projects in Iran, are only 0.3%. Today, political crises, economic issues such as limited fossil resources, environmental concerns, overcrowding, economic growth and consumption rates, and scientists thought they had to find appropriate ways to solve the energy problems of the world has shifted. Use of renewable energy in the country is still less than one percent of total energy consumption in the country. According to the fifth development plan, usage of renewable energy should be increased 5% up to 2015. However, the pace of foreign investment and foreign sanctions on Iran's development of renewable energy is reduced [6] (KRGT, 2014). The share of renewables in electricity production capacity development projects in the country is 0.3% but the world average share content is 10% and even 40% in developing countries. Many researches shows that some of renewal energies can be used in Iran:

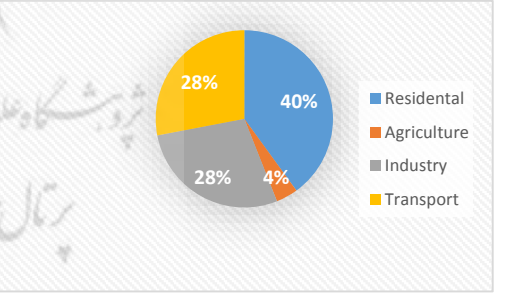
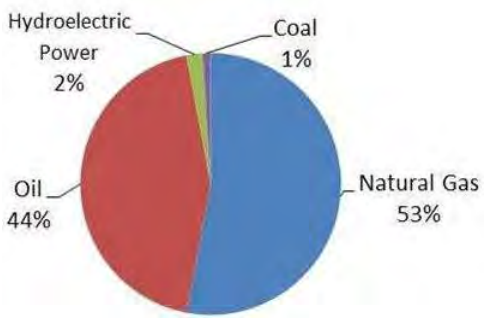


Fig 4. (a) *Distribution of energy/ Source: Author based on info @ www.tabnak.ir*

[14] In USA: residential (18%)-Commercial (18.2%)-Industrial (35.8%)-Transportation (28%). Kubba, 2010:3

[15] http://www.saba.org.ir

a. Hydropower: Because of the geography, the country is arid and semi-arid, with a rank of 38 among the different countries of the world in terms of a hydroelectric power.



(a)

Fig 5. Energy mix in Iran, *Source: www.citc.ir*

b. Quality energy: In Iran, the second largest source of electricity generation from renewable energy sources, wind energy is considered.
c. Solar energy: Iran is a country in the right direction of the sun, sunny days, temperatures in different areas with good exposure and wide area networks to transport electricity production of electrical energy from the sun.
d. Geothermal energy: Iran is among the countries which have significant reserves of geothermal energy for electricity generation.
e. Biomass[16]: 5 different major source of biomass in Iran are: waste, industrial waste, waste wood - Agriculture and livestock are separated. Iran has good potential in this case.

[16] http://www.suna.org.ir

6. Goals of green high-rise design in *Iran*

According to the potentials, there are some goals to reach green in high rise buildings in Iran:

6.1. SAVING ENERGY IN TALL BUILDINGS

Engineers and architects use equipment and energy to design comfortable, quiet, sanitary and safe tall buildings. The total energy consumption of the building is the total energy required to meet the demands of human activities in terms of comfort cooling, ventilation and lighting.

6.2. RECYCLING WATER

Water shortage in the country is a very serious matter. A green building can use gray water recycling them back into the cycle returns. A green high rise can reduce usage of water up to 25%. Water conservation include: rainwater, low flow wash hand, dual flow WC, dry urinals, gray water recycling [10] (Maunsell, 2002:51).

6.3. NATURAL VENTILATION IN TALL BUILDINGS

Despite the problems of wind power to the building, it can be used as a positive factor in indoor natural ventilation because of height. The use of natural ventilation in the building is desirable for several reasons:

- For more comfort in hot and humid air
- For healthy life and to prepare adequate oxygen emissions at an acceptable level
- To make a better impression on the residents of tall building
- To conserve energy by reducing the mechanical ventilation equipment

6.4. GREEN SPACES IN TALL BUILDINGS

Investigations of psychologists about the impact of plants on human behavior shows that the connection with nature and enjoy its beautiful sights, is a simple but important way to relax and a stylized the human spirit, and development of it in the collective biological complexes can be useful in reduce the incidence of violence, depression, suicide and ... .Also in winter, the building needed only an hour to warm up and heat stays in space the rest of the day and significantly reduce energy consumption. Plants, in addition to the balance of temperature and humidity, have large power in absorption of poisons and harmful and dangerous gases.

6.5. HEALTHY MATERIALS

The sustained construction is defined as: manage a clean and healthy environment is based on the exploitation of natural resources and the principles of "ecological" that sustained buildings are designed to reduce the harm on the environment, energy and natural resources.
A green building cannot contain any of the Red List materials[17] or chemicals (toxic materials[18]).

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[17] http://living-future.org

[18] Asbestos, Cadmium, Chlorinated Polyethylene and Chlorosulfonated Polyethlene, Chlorofluorocarbons (CFCs), Chloroprene (Neoprene), Formaldehyde (added), Halogenated Flame Retardants, Hydro chlorofluorocarbons (HCFCs), Lead (added)

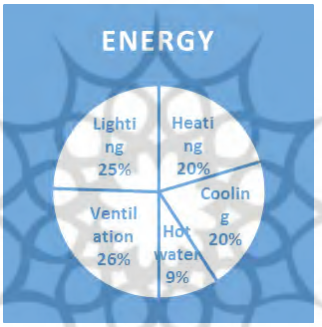
7. Application of renewal energies in green high rise design: case study[19] in IRAN

Good potential in climate and sunshine in most areas, and in most seasons there. Having a high potential of wind and geothermal energy production capabilities, and appropriate areas for the use and development of new clean energy provides in Iran. As a research and practice in a green high rise design case in Iran some significant issues were considered:

Table 2. Case study basic information

Building Type	Residential, Office, Commercial
Latitude	36°N- 60°E
Number of Floors	20
Total Area	70000 m2
Residential Area	32000 m2
Wall adjacent Exterior Area	35000 m2
Ceiling Area	1500 m2
Vertical Openings Area	15000 m2

Distribution of Energy in the building was[20]: Heating 20%- Cooling 20%-Hot Water 9%-Ventilation 26%-Lighting 24%.



(a)

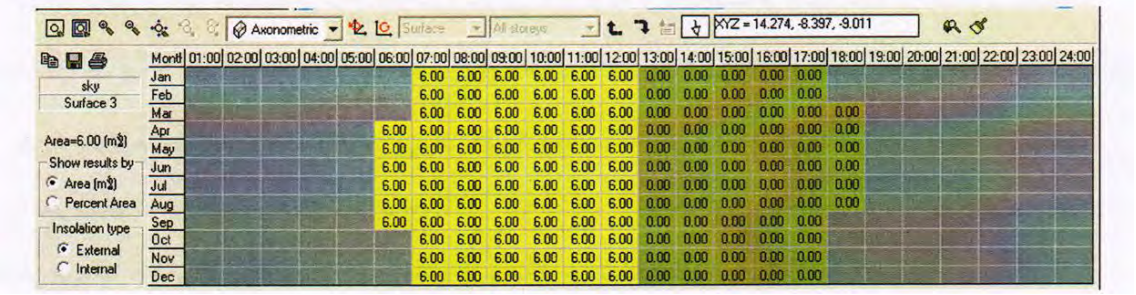
Fig 6. (a) *Distribution of energy in green building case.*

Generally, Iran is one of the world's sunny countries and average sunlight in its annual 5 to 6 kWh per day or more. In most parts of the country, the number of cloudy days with less than 5 consecutive days per year and the transparency of the air more than 60%. The better the quality of the surface illuminated by sunlight. In most areas, an average of 300 sunny days a year of 365 days. Limited fossil resources and the consequences of environmental change and global climate, the opportunity to compete with fossil fuels, solar energy is created.

Mercury, Petrochemical Fertilizers and Pesticides, Phthalates, Polyvinyl Chloride (PVC) and Wood treatments containing creosote, arsenic or pentachlorophenol(Kubba, 2010:226-245)

[19] This is borrowed from KRGT report (2012-2014): ***Architectural residential green towers***.in this research, the author was in corporation with La Villete School of architecture, Paris.

[20] Energy data analysis of case study has been done with *Mabna* Company- also Borrowed from Mechanical and Electrical report of KRGT-2012-2014



(a)

Fig 7. (a)Calculation of solar panel system with IES/ Source: Author (from KRGT)

Due to windy areas, construction of windmills in the past has been common in Iran. The use of wind energy, wind speed is the most important factor. Generally, the use of wind energy for electricity production when the economy that the average speed of 5 to 25 meters per second. Based on existing maps, we can see that the average wind speed of 6 meters per second, which is generally higher than the indicator of the attractiveness of the country.

In Iran, according to the atlas of geothermal energy is provided by the Renewable Energy Organization, approximately 10-14 locations prone to exploitation of geothermal energy has been determined. Another system in energy was **CCHP** (combined cooling, heat and power).

Studies show that energy consumption without the use of renewable energy is 290kwh/m2. But with energy consumption with 100 PV collectors, 2.4 kW wind turbine, GHP and CCHP system, Use of energy would be 75kwh/m2. It means that the building reach to A degree. Economic analysis shows IRR factor for wind turbine is -3% and Return on investment would be about 20 years. So, solar panels to provide hot water and CCHP system are completely economical but wind turbine and GHP are not so but works as a symbol. The results shows 18000 m3 natural gas saving and 40000 kg CO2 emissions avoid and 90% recycling water.

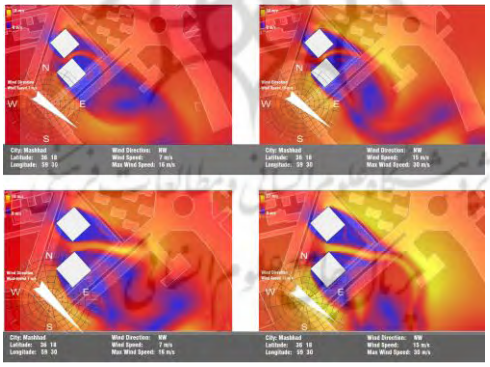
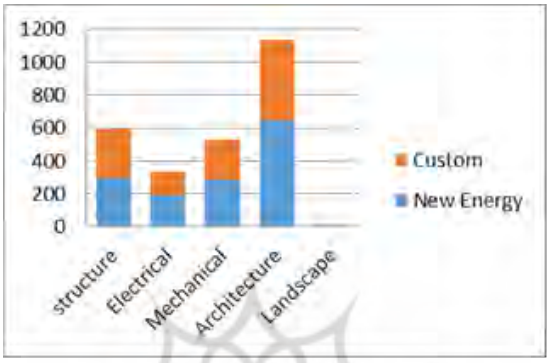


Fig 8. (a) *Wind analysis (venture effect) with Project Vasari/ Source: Author*

7.1. Cost analysis:

Compared to a conventional building, usage of renewal energies has 17.5% increase in Mechanical costs, 17% in Architecture & 37.5% in green spaces. With double skin façade, total cost increases about 8.2%-8.4% and without 1.2%-1.4%. In maximum condition it is 10% rise in cost compared with a conventional building.



(a)

Fig 9. (a) *Cost analysis between custom and new energy*

8. Effective factors on Green high rise design in IRAN

Challenges in the implementation of a high-rise building green in our country that can be given to them and to remove barriers to green building steps.

8.1. Internal Factors:

As case study shows, there are four internal building systems to build green: architecture, structure, mechanical and landscape. As following table shows, each factor has some sub issues.

Table 3. *Wind analysis (venture effect) with Project Vasari/ Source: Author*

Architecture	Structure	Mechanical	Landscape
Form, Program, Envelope, Core	Foundation, Framework Healthy Material	Elevator, HVAC(Solar, Wind Turbine, GHP, CCHP), Lighting, Telecom, Fire Protection, Water Supply, Waste Disposal	Green Roof & Yards

8.2. External Factors:

There are five external factor in green residential buildings:

a. Environmental:

Environmental factors, the most important factors for decision making for the use of renewable energy in the building and move towards a green building. Fortunately, very good in the field of environmental indicators is provided for this issue.

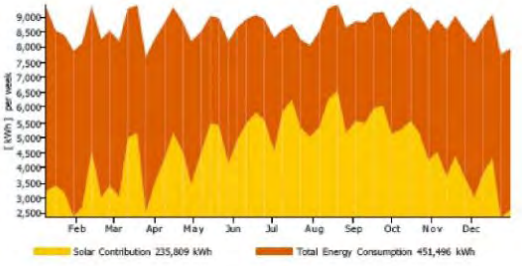


Fig 10. (a) *Solar energy analysis draft/ Source: Author (from KRGT)*

a. Economical:

Many people are worried about the high cost of energy use and maintenance of the new energy in buildings [9] (Kubba, 2010). Researches shows the average premium for green buildings is slightly less than 2% [21] [17] (Del Percio, 2004: 132). Equally compelling is that when Kats asked how much energy green buildings use compared with non-green buildings, he found a median direct energy cost reduction of 34%. So a green building costs less than a conventional building[22]. The USGBC reports that across its portfolio, green buildings: consume 26% less potable water, account for 33% fewer greenhouse gas emission, require 13% lower maintenance costs, yield 27% higher occupant satisfaction[23].

b. Technological:

Despite the use of renewable energy in the world, our country has come a long way in the field of technology and energy-generating tools. Many solar panels, wind turbines and equipment and geothermal systems to be imported. So, important issues are:

Renewable Energy Equipment shortage
Lack of experts (designer and contractor)
Maintenance systems

c. Cultural:

Unfortunately, there is waste of resources in Iran. Statistics show that the average per capita consumption of energy per person is about 3 times the global average. On the other hand, there is skepticism about the use of renewable energy and maintenance costs.

[21] ($3-5 per square foot).

[22] Kubba, 2010

[23] Green Building Costs Less Than Conventional Building, A report By: Stuart D. Kaplow, Esquire, June 2010

d. Legal:

Infrastructure and municipal regulations related to the occupation and density are architectural barriers to the implementation of high-rise green buildings. The green building should be about 25% of the floor area devoted to green space this amount is added to the underlying unit while it is apparently not and the costumer is not to pay it. Other issues such as the lack of incentive regulation, non-energy certification of buildings.

Of the 5 main factors affecting the implementation of green building, only to be found in Iran's potential environmental. Other factors need to be done.

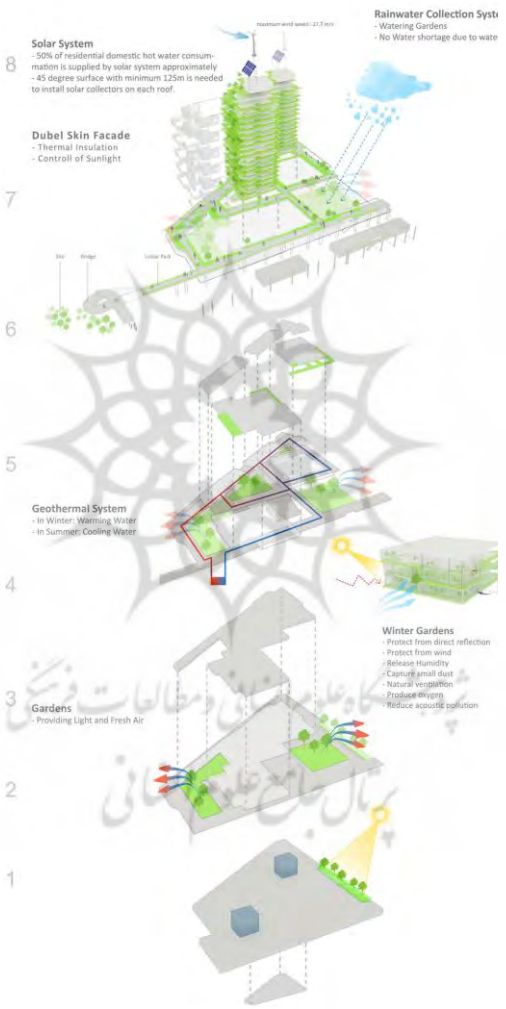


Fig 11. (a) *Application of renewal energies in a green high rise building/ Source: Author (from KRGT)*

9. Conclusion

A green building is to create green lifestyle and not only to use plants or trees: life beside the nature, healthy living environment, respecting the available resources, clean transportation (like bike), and respect to neighborhoods are some issues.

The high rise building offers a potential means to accommodate extreme growth in cities. In terms of sustainability, there is an inherent efficiency to high density. High rise buildings push this density to extreme, creating new vertical cities which can be argued help maintain public space, agricultural lands, and wildernesses by utilizing and invigorating the existing utility and transportation infrastructure. Integrating design ideas, energy saving features and formal expression helps reduce materials and increase the robustness of building. Understanding specific regional characteristics also helps the design team focus on application with the greatest return on investment, financial or environmental [18], [19].
Building form, orientation, and fenestration are components of every building. Proper building orientation alone can reduce a building is minimized with East facing windows. Proper fenestration, such as high performance glazing, and shading devices also protect the building from unwanted heat gain due to solar exposure during warm months, gain helping to lower cooling loads. Heavily isolated walls reduce heat gain or loss depending on the season.
Renewable technologies can make up a large portion of the high rise building power source and significantly reduce dependence on fossil fuels. Sun, wind and water provide alternative energy and can be harnessed to help supplement building`s energy consumption and promote conservation. Numerous strategies are available including day lighting controls, passive solar heating, thermal cooling and natural ventilation. Carbon-free, on site power generation can be achieved with wind, solar, and energy-yielding biological systems. An integrated multidisciplinary approach that views the building as a system made up of interdependent architectural and engineering components yields higher performance and optimizes the management of energy and resources within the high rise structure [20].

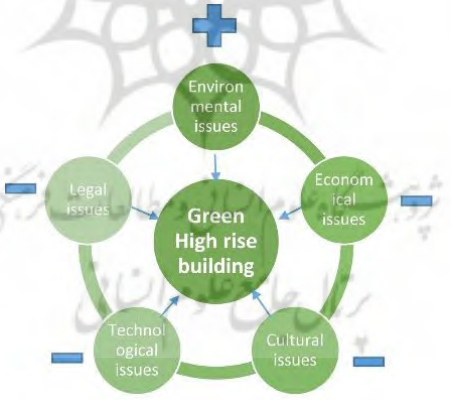


Fig 12. (a) Model of external factors affecting green high rise building/ Source: Author

Technologies, such as: double shading facades, double glazed windows and light absorbing radiation, solar panel, wind turbine systems, GHP, ventilation and fresh air supply, sewage treatment and recycling of gray water, green roofs and walls and terraces and courtyards cultivated in floors and roofs, green transportation

(solar), and the use of reinforced concrete with fly ash composition of samples in high-rise buildings are green.

The high-rise buildings using green approach can be useful for various reasons: High-rise buildings due to the use of wind and solar energy can be used to generate high energy. Since, other than buildings, high-rise buildings of higher technical potential and the possibility of new systems for the implementation and maintenance easier. Towards the cost of implementing new systems in high-rise buildings is far less than other buildings. Energy from waste, gray water recycling, using the kinetic energy of the elevators in high-rise buildings is implemented. Possible run for the water treatment plant and power plant (CCHP) project in there. At the all, in Iran, considering environment, green high rise building can be a respond both for urban growth and preserving environment.

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