High Rise Buildings and How They Affect Countries Progression

Dr. Akram Farouk, Assistant Professor
Ain Shams University
Faculty of Engineering
Department of Architecture
airoC,Egypt

High – rise buildings (Towers) investment projects represent a component of the country's economy power & a sign of advantage to the country. So many countries have sought to achieve their progress through encouraging preparation of comprehensive plans to establish high rise investment projects to prove its economic power & prestige. Such cities like (Hong Kong, Malaysia, UAE, Qatar, others). Where financing such projects is an important element for its success. Large & varying investments are directed after the preparation of serious feasibility studies to ensure that such projects achieve the target gain at the state & economic level of the investors. Such studies are made through accurately studying the planning, architectural, financial and marketing aspects. This is done under specific laws & regulations governing all stages of investment with appropriate guarantees to promote investors & capitals.
And in Egypt not so many high rise projects were constructed, these projects did not exceed five projects (such as Nile city towers, First Tower and tower of Faisal Islamic bank), these projects are considered of the most important projects ever built in Egypt.

However, with the beginning of the twenty first century there have been some attempts to develop a comprehensive plan for the city of Cairo development under the name of (Cairo 2050).
And so far these plans haven't been studied or approved causing the delay in catching up with the global evolution through high rise buildings investment projects.
This research paper aims to study the standards and principles to prepare a comprehensive plan to develop the city of Cairo to promote the high rise investment projects. And set recommendation to encourage sources of capital & investors in such project.

Introduction:
Country's progress is achieved through economic, urban and planning progress; they are the most important reasons that encourage technological progress by seeking the use of the latest materials & systems. All these elements help to attract sources of capital to the country. With the end of the twentieth century many countries began to achieve progress through the preparation of comprehensive plans to establish high rise building investment projects with the development of many standards and principles to ensure the success of these schemes. Most of the Arabic gulf countries, Malaysia and Hong Kong started such steps in order to promote the country at various levels. Where feasibility studies played a major role in studying all factors and elements affecting the project and the level of success of the investing companies. Such feasibility studies have been developed through the concerned authorities in these countries. Such feasibility studies had a

significant impact on the success of high rise buildings projects in these countries. With the end of the twentieth century and the beginning of the twenty first century Egypt witnessed the construction of only few investment projects such as (The Nile City towers, First Tower, and the tower of Faisal Islamic Bank). And there have been some attempts to develop a comprehensive plan to Cairo (Cairo 2050) in an attempt to encourage the establishment of investment projects with high rise buildings. But no progress was achieved in such attempts, and they did not receive the appropriate support to approve them and to encourage the construction of such projects.

The aim of this paper:
This paper aims to study the principles and standards for the preparation of a comprehensive plan for Cairo and the construction of high rise building investment projects. Also this paper gives recommendations related to encouraging capitals & investors to invest in such projects.

Definition of a high rise building:
A high rise building (Tower) is defined to be a building which total height exceeds 36m or more than 12 floors and its use varies between residential, administrative or as a hotel. Except for height is always a relative matter and a building can't be defined using the term of height only, where judging on a building depends on the conditions of the surrounding environment, so it's not possible to set a precise definition to high rise buildings. But from the structural point of view it can be defined as the building that its height will be affected by lateral forces resulting from earth quakes & wind forces to the extent that such forces will play a major role in the process of design.

Why high rise:
High rise buildings have always fascinated the minds of people since the start of its construction in the ancient times. The construction of such buildings began in the ancient times for defensive purposes or religious purposes (roman temples, pharaonic, churches……). But in the modern era construction of such project began in the eighties of the nineteenth century for the purpose of either residential or administrative, then it became to meet the requirements of hotels & other touristic needs as well.

Reasons for taking the trend of constructing high rise buildings (Towers): (1)
There are many reasons to establish a high rise building investment project. And they are as follows:

- Rapid growth of population in urban communities, and therefore the constant pressure of the limited land area affected the evolution of building.
- Expensive land prices.
- Restriction of random expansion in major cities adjacent to agricultural land.
- The high cost of setting up infrastructure for new cities.
- Expression of progress and civilization.

And there are many other factors, for example the city of Rio de Janeiro & Hong Kong, they had other specific reasons such as terrain's conditions or the lack of land area like the United Arab Emirates and others.

The development of high rise buildings: (2)

High rise buildings started in ancient Rome with its four storey wooden residential buildings. Then such residential buildings were constructed using bricks. In North America in the ninetieth century, the monad nock building in Chicago) 1891 was constructed out of sixteen storey's using the bearing walls construction system. And with the advancement of the construction methods, buildings continued to increase in height till it reached the height of 60 storey's in year 1913 with the construction of the Woolworth building in New York (fig. no. (1) Shows the Chicago building of the home insurance co. 1883) (fig. no. (2) Show the Woolworth building in New York 1913).

fig. no. (1) Shows the Chicago building of the home insurance co. 1883

fig. no. (2) Show the Woolworth building in New York 1913

fig. no. (3) Show the Empire State building in New York

The year 1931 was the golden age for skyscrapers with the completion of the Empire State building a 102 storey land mark. It is a 381 meters tall mega structure.

High rise buildings remained an attraction to builders throughout the ages. With its exceptional presence in the built environment, high rise buildings have special importance and a visual advantage, due to its height, obviousness and dominance over the other elements of the scene. Also high rise buildings play a major role in creating a panoramic view of the city where the building lies.

As well as high rise buildings are easy to be located.

And such buildings depend on many technical & engineering factors in the country.

The following are some examples of high rise buildings (Towers) and how they developed over the recent years:

Siemensstadt building 1928

Chrysler building 1930

Empire state building 1931

Lake shore drive apartment building 1950

Phoenix building – Rheinrohr, Germany 1952

Chase bank tower, Chicago 1969

World financial center, Shanghai, 2008.

Northeast Asia Trade tower, South Korea, 2006.

Burj Al Arab, Dubai 1999.

China bank tower, Hong Kong 1990.

Jin – Mao tower, Shanghai,

High rise buildings construction conditions:

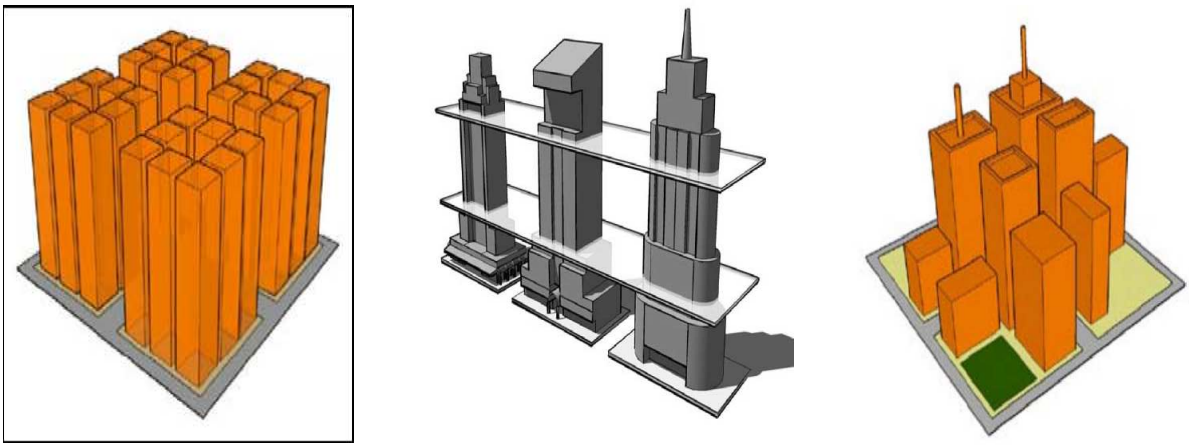
There are many construction conditions that must be applied when constructing high rise building, and they are as follows:

- Architectural building conditions.
- Electromechanical systems
- Safety & security building conditions (civil defense requirements).
- Building conditions for car parking and the surrounding areas.
- Compliance with all building codes related to earth quakes & lateral wind forces on high rise buildings.

High rise buildings (Towers) design standards:

There are many building design standards that must be taken into consideration when design high rise buildings, and they are as follows:

- Location & surrounding building planning (high rise buildings gathering forms) (fig. no. 4).
- Project's scale and the general view.
- Keeping an open city view.
- Environment (handling wind issues – shadows – other environmental issues).
- Transportation & car parking.
- On the level of ground floor policies.
- Infrastructure, energy efficiency & sustainable development.
- Management & operation.
- Safety and security and building standards.



(Fig. no. 4 shows methods of gathering high rise buildings)

Principles & design standards related to use construction systems are as follows: (3)

- The building must achieve all building laws related to internal spaces.
- The building must apply modern technological systems.
- The building must constructed using suitable structure systems.
- The building should have a distinctive.
- Application of all civil defense requirements related to safety and fire fighting.
- Provision of all services (car parking – fire fighting water tanks – water supply tanks, etc).
- Fire escape stairs should consist of 2 flights each flight must not be less than 90 cm wide.
- Fire escape staircase must connect to outside of the building.
- Ease of access of all floors to civil defense units.
- The building must be constructed out of fire resistant materials (or materials with a high rate of fire resistance).
- The main stair case flight must not be less than 135 cm wide.
- The main staircase & elevators should be present in every main core of the building.
- Provision of sufficient parking slots to the number of the building users & designing the Basement floors with all the suitable systems to the required use.

Elements that affect the buildings height & growth:

- There are many elements that encourage the construction of high rise buildings, and they are as follows:
  - Available construction materials and structural technology to implement the construction.
  - The advancement of the required services for building uses such as mechanical systems (Elevators, HVAC, etc.)

Eco-friendly high rise buildings design standards: (4)

Environmental standards must be applied when designing high rise buildings. As most of the countries nowadays seek to achieve sustainable buildings to maintain the efficiency of the building through applying the following:

- Use of renewable energies.
- Use of eco-friendly construction materials.
- Water rationalization inside the high rise building.
- Air Quality inside the high rise building.
- Proper lighting inside of the building.
- Color selection philosophy.
- Acoustic design.
- Building security issues and its design.
- Environmentally compatible architectural style.

High rise buildings (Towers) Economics: (5)

Economic feasibility studies are considered one of the most important success elements in the investment projects. These studies focus on all the affecting elements in the project and all funding capabilities. Buildings economic studies have developed greatly especially after the technological progress and the advancement of construction materials variety, and construction methods.

Feasibility studies have achieved an advanced level of precision in directing investments in terms of providing the necessary credits and completing goals within scheduled time limits and definitive investments with the lowest amount of modification to the project and its different components

- High rise buildings (Towers) are projects with huge investments and many varying components and systems. So its feasibility must be studied carefully through the application of value engineering in order to choose the most appropriate elements to use in

order to achieve the best outcome with the best construction materials, construction system and operation systems, without any compromises to the general outline or the objective of the project.

- So value engineering is considered an organized methodology aims to remove the unnecessary components that increases the cost and in the same time increases the quality of the final product. And through the value analysis that can be applied on all services & operations and materials related to the building in order to reduce the construction cost and increase the quality in the same time, without compromising the building's efficiency.

Main points of value engineering can be summarized into the following points:

- Functions Analysis.
- A Balanced evaluation between the three primary elements of any building (performance - cost - quality).
- Creating a multi-phase work plan (data collection – analysis – evaluation & development).
- Achieving better savings as a result to proper consumption of (materials – working hours – enhancing performance).

Cost reduction: (6)

Cost reduction can be defined as a method to lower expenses paid on procedures that result in lower quality or performance in order to decrease the needed budget, its elements can be summarized into the following:

- Cost study to all project elements in all different stages.
- Cost reduction to different operations of the project.
- Cost reduction by changing the final product to a better one that achieves the required efficiency.
- Studying all of the project stages and the time schedule.
- Achieving the general requirements of the projects elements.

Economic studies for a high rise building:

First: Primary studies, marketing and feasibility of implementation.
Second: Study of the design economics and other complementary studies.
Third: Contract economics and bidding.
Fourth: Implementation economics and organizational studies of the buildings construction stages.

First: Primary studies, marketing and feasibility of implementation:

This can be achieved through the identification of the following objectives as an economic study:

- Determination of the extent of the projects success in achieving the desired objectives.
- Determination of the project's viability in its planned location.
- The possibilities of the expected economic outcome from the project.
- Ensuring the integrity of the employed capital and other sources of fund.
- Assessment of the expected income from the project and the total cost of its operation.
- The overall scale of the project and the general situation in the market.
- Location of the project and its scale.
- Sources of funding.
- Studying the availability of raw materials, labor and the other equipment.

Second: Study of the design economics and other complementary studies:

This can be achieved by studying the following:

- The area of the required spaces.

- The expected finishing materials applied to the building's components.
- Project's components and how they relate.
- Number and categories of the users and their living standards.
- The general shape of the building and its impact on the building's economics, as it plays an important role, particularly in high rise buildings. Because the overall shape is one of the most important elements which could affect the economics of the building.

Third: Contract economics and bidding: (7)
This can be achieved by studying the following:

- Beneficial contract and its impact on the economics of the building.
- Repetition.
- The distribution of the facility's elements, spaces and internal links.
- Number of floors and vertical linking elements.
- Construction methods economics.
- Contract economics and bidding.
- Project management system.

Fourth: Implementation economic and organizational studies of the buildings construction stages:
Where the process of organizing and planning implementation procedures is considered one of the most important factors that helps in the organization of work in an economic way through the following:

- General implementation policy.
- Implementation time schedule.
- Organization and business conduction plans.
- Management and decision making.
- Funding and money flow.
- Project's labor wages.

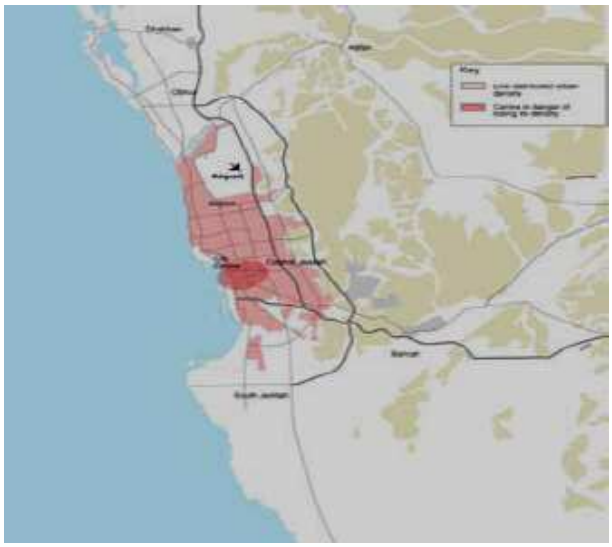
The location of high rise building and its impact: (8)
The location selection of high rise building is considered one of the most important elements affecting the success of the project and this can be shown as following:

1- The distinction of the projects layout to the city center.
2- The relationship between the layout and the surrounding main streets.
3- The relationship between the location and the surrounding buildings.
4- Site area.
5- The site's general determinants.
6- The project's location and the surrounding important buildings.
7- Vision angles and aesthetics deemed by the site.

And many other elements that became success factors such as Dubai's pearl in the Dubai's downtown (Al-Jumairah).
Fig. no. (5) shows the layout of Dubai's city and its futuristic projects. Fig. no. (6) shows the comprehensive plan to develop Jeddah's city. Fig. no. (7) Shows the master plan of Cairo and the schematics for the high rise district, these schematics haven't been approved or prepared for final drawings up till now that the Egyptian government doesn't encourage such projects.

Fig. no. (5) shows the layout of Dubai's city.

Fig. no. (6) shows the comprehensive plan to develop Jeddah's city.

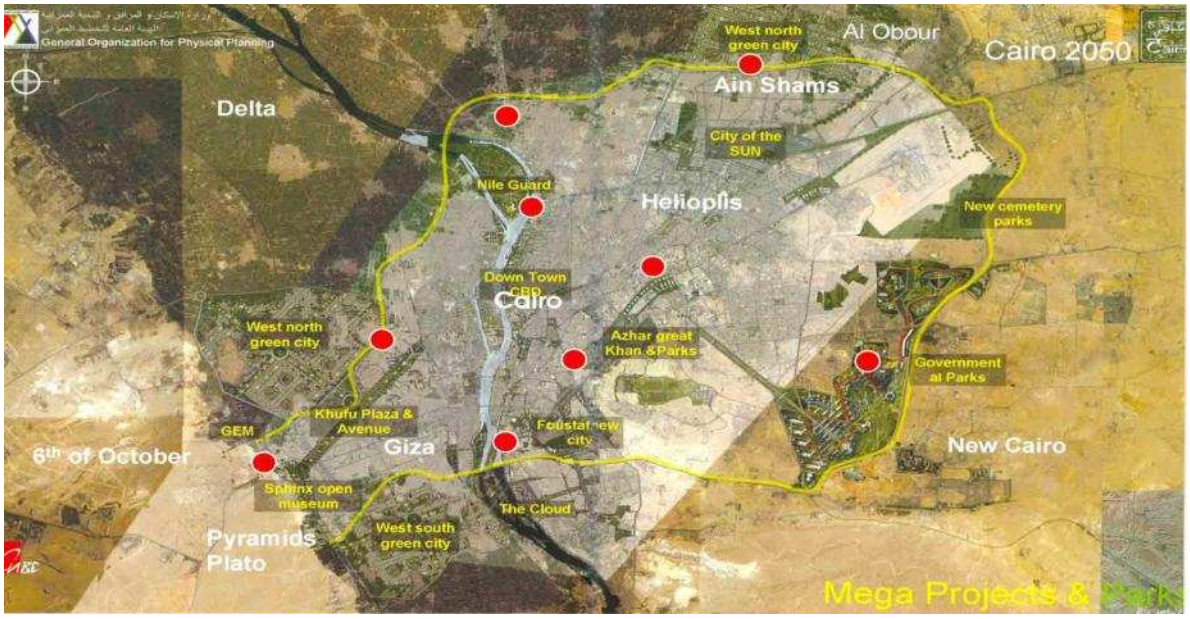


Examples for some high rise buildings in Egypt: (9)

Where some capitals have sought to establish high rise building projects in Egypt. Which was built under a special exception of the previous prime minister of the Egyptian government, As there was no mechanisms ors comprehensive schematics for such projects, as these projects where not placed on the government's plans for the advancement of the country.

And some of these examples can be reviewed, including:

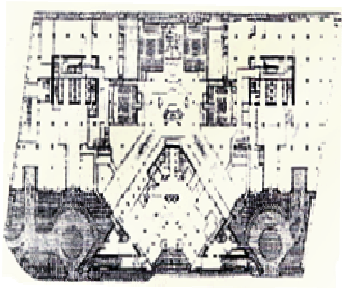
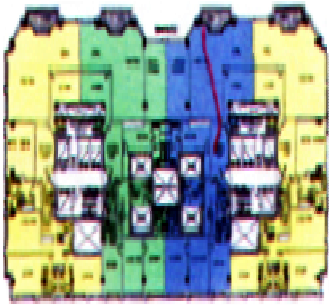
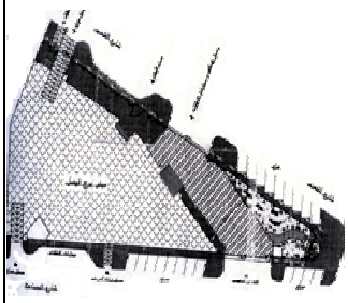
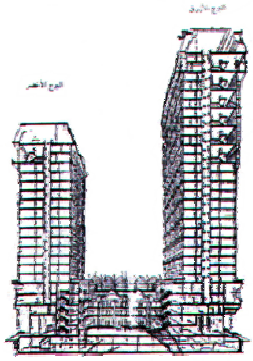
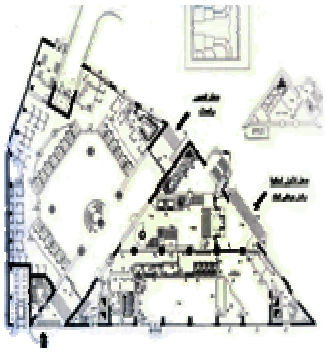
- Nile city towers – Egypt.
- First residential tower – Egypt.



- Faisal Islamic bank tower – Egypt.

Fig. no. (7) Shows the master plan of Cairo and the schematics for the high rise district

	Nile city towers	**First residential tower**	**Faisal Islamic bank tower**
			

Construction year	2000	1991	1990
Area	16000 m^2	7400 m^2	2800 m^2
Location	 Cairo city - Nile corniche	 Cairo city - Nile corniche	 Nile corniche
Project components	The project consists of 3 towers; the front tower is a five star hotel and hotel apartments. And the posterior towers are residential, investment purposes and administrative offices. 	The project consists of 2 separate towers and the space located between the 2 towers is used for a luxurious shopping center. 	The project consists of one main tower that has a triangular shape that features the best use of internal spaces and vertical & horizontal links. 
Total cost	250 million USD	125 million USD	30 million USD
About the project	It is considered one of the most important projects in Egypt and is characterized by the speed of implementation and this is due to: - Successful management. - Quality control management.	The project features luxurious and classic facades. Also good project management had a major role in constructing this building with high quality.	Considered one of the distinct projects in its general form and character although it faced many problems during implementation
About the design process	Egyptians did not participate in any aspects in the design process except for Prof. Mamdouh Hamza who participated in the structural design works	Some Egyptian architectural offices participated in design process like (space & durrah) with other foreign offices	The whole design was completed by Egyptian engineers

	only		
The Architectural style	It represents a trend of post modern architecture, the designer used some of the pharaonic and Islamic elements in the façade design.	It represents a trend of post modern architecture through classic modern facades with many modern elements in the façades	It reflects being the headquarters for an Islamic bank by using many Islamic elements in a modern way
The effect of the structural system	It is built on a skeleton structural system that uses an internal core and a flat concrete slab system	Steel sections were used inside the building's columns, which were used in a modern way that it was the first time to use such system (The built up box section) and a flat concrete slab system	Skeleton and flat concrete slab structural systems were used.
The impact of facades' design and other used aesthetics on the economics of the project	 There are many elements that affected the economics of the project: - The used architectural style - Using pharaonic and Islamic elements - Double glazed large size windows - Using many advanced modern construction materials which were imported from other countries - Increased expenses spent on training special workforce on such advanced materials. - Increased façade expenses because of all the details and special fittings used in the façade.	 The impact of the glass filled facades and double glazed windows. These areas cover more than 75% of the elevation. The building uses a high end glass in the windows, which required high technicalities in installation. Construction materials played a major role in the increased cost of the facades and the structural system, used building materials, using special cladding with high end specifications made from GRC.	 The architectural character and the façade increased the project's cost by 30% by the following: - The architectural character - Details and Islamic elements - Using verses from the Quran on GRC cladding to cover the external facades in a nontraditional way - Using materials and finishing with high cost that affected the economics of the building - The implementation of the project took a very long time which was another main element that increased the economic

			cost
Comparative study of the components of the economic aspects and their impact	The tower complex is characterized by obtaining the maximum height of 142 meters with 31 floors which created the distinct facades. Also the project overlooks directly the Nile and the main street. Also the project is surrounded from all sides with streets which increased the cost of elevations. The building's design was affected by the shape of the project's land as the building was designed on a trapezoidal shape.	The maximum height of the tower is 100 meters with 30 floors. The first tower overlooks the Nile and the second tower overlooks Murat street. The facades had a simple design that led to cost reduction. And the building was designed on a square plan. Also the towers had a semi-rectangular shape which had the greatest impact on increasing the façade area looking over the Nile.	The tower was designed according to the law of volumes so it reached the height of 90 meters with 28 floors. The project overlooks two streets and this was used to add an aesthetic cladding to the external façades which increased the cost of the project. The triangular shape used in designing the plan resulted in reducing the facades to 3 facades which was a reason to lower the expenses of finishing
Façade finishing materials	Curtain wall cladding system was used, which resulted in a huge increase in the cost of external finishing. Also GRC cladding and ornaments were used in the external facade	Curtain wall cladding, GRC panels and marble were used as external finishing materials which led to the increase of the economic cost of the project	GRC cladding was used in external finishing to create Islamic ornaments that were installed on the facade
Loss of function in the facades	There are no unused spaces in the elevations as all the spaces are used in internal lighting and exterior aesthetic forms	There are no unused spaces in the elevations as all the spaces are used in internal lighting and exterior aesthetic forms	There are no unused spaces in the elevations as all the spaces are used in internal lighting and exterior aesthetic forms
Finishing units modular system	GRC modular units were used, also curtain wall units were used to minimize the economic cost	GRC modular units were used, also curtain wall units were used to minimize the economic cost	The external ornaments weren't made on a modular system, and the shape of the units did not follow a grid which resulted in increased economic cost
Application of Modern technology	Using new technologies in the implementation of the tower's facades led to the reduction of the projects total cost	Using new technologies in the implementation of the tower's facades led to the reduction of the projects total cost	As the project went through two phases in implementation, these two phases were separated by a long time gap that led to a major change in technologies, this was a reason of a huge increase in the total cost of the project

Management and decision making	As a result of regular management of the project it was executed with speed and it reduced the total cost of the project	As a result of regular management of the project it was executed with speed and it reduced the total cost of the project	The lack of proper management resulted in increasing the implementation time period and increasing the total cost of the project

A Comprehensive plan study for the development of the city of Cairo: (10, 11)
(Cairo 2050) is a promising comprehensive plan that aims to achieve a great futuristic development to the city of Cairo. One of this plan's branches is the construction of high rise building investment projects to achieve development and welfare.
The fact is there have been many attempts to study these ideas furthermore, but under the absence of governmental support to such schematics, and with the absence of clear and obvious strategies, supported by decision makers. Egypt did not witness catching up with the global progress in the preparation of comprehensive plans and high rise investment project.
And by reviewing one of the schemes that aim to achieve progress and advancement in Cairo: Figures no. (8, 9, 10) show a set of proposals for a comprehensive plan to develop some of the key locations on the Nile. These proposals were prepared by the authority of urban planning. This authority is entitled to solve the problems of slums and other urban problems, where prosperity and progress can be achieved through solving these problems.

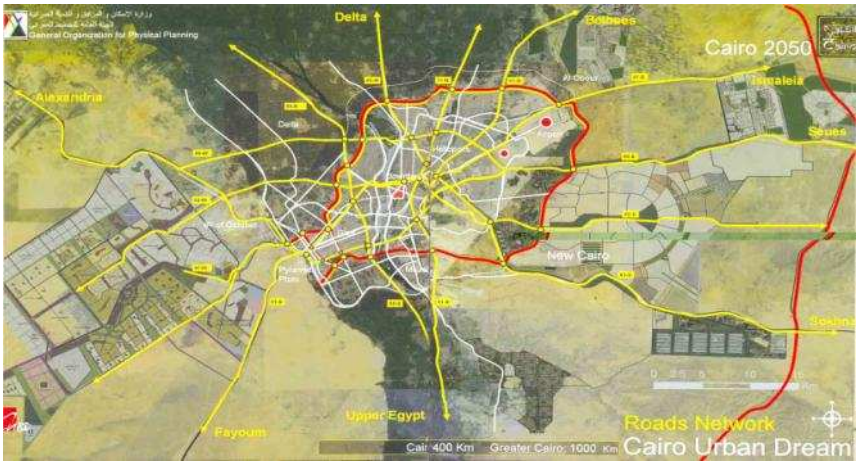


Fig. no. 8 shows the comprehensive master plan to develop the city of Cairo

Fig. no. 9 shows the different time stages for the development comprehensive plan implementation

Fig. no. 10 shows the general forms of gathering a high rise collection of buildings.

These figures show an idea of a comprehensive plan for the development of many areas in Cairo, in order to achieve a city with a distinct high rise building investment projects that will achieve economic progress among other countries.

Results and recommendations:

There are many results and recommendations, and they are as follows:

On the level of the state:

- A comprehensive plan for the development of Egypt must be adopted to draw implementation mechanisms and to create special strategies for the country's development. And implement these strategies on stages starting from Cairo to identify the targeted areas for investment.
- Encouragement of capital sources and the formation of investment entities in high rise buildings to achieve the targeted plans.
- Provide all possibilities and legislative needs to seek the start of a new generation of high rise towers.
- Formation of an engineering committee that sets standards and principles to achieve high rise buildings economics in order to attract capital.
- Building's heights laws must be restudied particularly in the cities of Cairo and Giza and other new cities.
- Encouraging capital in the direction of the construction of high rise buildings through incentives and facilities in the procedures.
- Removal of governmental routine obstacles and other Constraints. And the formation of dedicated committees responsible for such programs to facilitate the crediting period to accelerate the implementation of these schemes.
- The formation of dedicated committees responsible for approving and following up with these projects and schemes.
- Setting up plans for a five year implementation phase for these schemes to achieve a comprehensive development for the country during the next thirty years.

On the level of consultants:

- Formation of consultancy agencies to develop mechanisms for the implementation of these schemes and devise new strategies to ensure their implementation on the required level.
- The innovation of new architectural designs and integrated systems that fits a new high rise buildings.
- Study of the local and international market to meet to their needs.

- Taking into account all the social aspects when designing high rise buildings.
- Having the freedom to construct high rise buildings (within the designated areas).
- Using the help of administrative leaders who have good competencies in such projects to ensure the success of the project in the stage of implementation.
- Ensuring the success of the project's objectives.
- When designing a high rise building it's good to place a helipad on the roof of the building to ensure the principles of safety and security and the provision of essential services to high rise buildings.
- Studying the city panorama and skyline to achieve a distinct architectural view in the new cities.
- The formation of strong consultancy groups.
- The help of global experienced management to reduce the expected losses in such projects.
- The help of international consulting experiences in such projects.
- Work according to certifications and international credits, particularly to the environmental aspects certifications

Role of the designer:

- Facades must be distinct and able to achieve a good balance between form and economic cost
- Making a good use of local finishing materials and detail study and how they fit in the project
- The environmental standards and requirements must be applied when it comes to the selection of finishing materials used in external facades
- Selection of finishing materials that suit the efficiency and the competency of local employment
- Creating laws and principles governing high rise buildings construction in order to stimulate capital and investment in such projects

On the level of investors and capital owners:

- Encourage the formation of investment entities to finance such projects
- Formation of an investment committee to provide all the required economic studies to ensure the success of these projects
- Encouragement of foreign capital with good expertise in high rise projects.

References:

1- Mohammed Hassan Ahmed, "The economic dimension of advanced finishing materials and technology", Engineering Master
2- World of construction magazine, issue# 172, year 1998
3- Newman, O. "defensible space, people and design in the violenty". P 191
4- Nasha'at Ahmed Naser, PhD p (204-206). King Saud university 2003
5- Mohammed Hassan Nubian. Field study (The use of housing projects in high rise buildings assessments). 2007
6- Chotmar Ada, A. "Tall buildings in developing countries". P 158, 2001
7- Moharram, A. "Tall buildings in developing countries with special reference to cairo". P 227-228, 2001
8- Newman, O. 1 bid, p 29.
9- Word of construction magazine, (Tall buildings) issue# 87,88
10- http://www.hndasa.com/showthread.php.?t=1141
11- Ministry of housing and facilities and urban development – The general authority of urban planning