

Mobile Networks Stations and Towers and Their Relationship with the Building General Form

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ABSTRACT

The communication field evolved in many aspects since the beginning of the 21st century, especially in the field of mobile-phones, and the severe struggle between telecommunication companies to attract more numbers of subscribers through expansion of coverage. Therefore mobile station towers have been constructed by the three mobile companies operating in Egypt on top of building roofs or land spaces around it, where 500 to 600 stations are constructed annually. Mobile network stations became a visual pollution elements to the overall shape of the building, so the problem is the relation between mobile towers location on top of the building & the roof parapet which forms a visual problem due to the lack of architectural studies and special standards & provisions to provide visual solutions, where this research paper aims to study the relationship between mobile network stations on top of buildings & the general form of the building.

KEY WORDS: Mobile network stations, building laws, relay towers, Environmental requirements, and Architectural solutions.

INTRODUCTION

In the age where mobile phone technology became a reality and in constant development to keep in pace with the need & applications, personal telecommunication will dominate in the 21st century, where Egypt tries to keep pace with these global changes to allow new technologies to be used to cope with the demands of globalization era which the whole world live and through this service the expected benefit was achieved in various aspects (economic, social, scientific) where the latest international statistics show that the numbers of mobile phone users are increasing around the globe and especially in Egypt. as the number of subscribers in 1990 was 11 million, the number became 54 millions, in 1994 with increasing rate of 85% until it become nearly 400 million with the beginning of year 2000 and this number represent 27.5% of the total number of regular used phone lines in the world, which reached 700 million subscribers globally at year 2002, which will lead to a total change in the economies of operation of telecommunication networks in the world.

Types & forms of mobile phone network stations:

Mobile phone network stations range from large to small station as follows:

1. Mobile network stations in the empty space and place in occupied lands or parks or public open spaces where the station consists of : (1)
 - Transmission tower. Including many shapes: (steel tower, concrete column, or elements that suit the surrounding space are used like palm shape, tree, etc..) to maintain the aesthetic form and to reduce the visual pollution which was caused by the metal tower or the concrete one. Fig. no. (1) Shows the metal tower. Fig. no. (2) Shows the concrete column. Fig. no. (3) Shows artificial trees & palms.

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Fig.(1). Shows the metal tower



Fig. (2). shows the concrete column.



Fig. (3). shows artificial trees & plans.

2. Mobile network stations on top of building roofs used in densely populated areas where there isn't any empty public space where steel towers are used on the corners of the building with height not less than 6m, placing the mobile network stations on top of a building, and the station itself constructed from aluminum or steel sections on top of the building. Fig. no. (4) Shows mobile network stations on top of buildings.



Fig. (4). shows mobile network stations on top of building.

The idea of mobile stations:

The idea in mobile phones operating within a mobile station range that each mobile phone has unique codes built into it and it operates through them, these codes are used to identify the mobile phone, the owner, and the service provider. (2)

Also it relies on a wireless connection between the mobile phone & the nearest transmission station which exist on top of building roofs or on poles in open spaces. Fig. no. (5) shows the idea of mobile network.

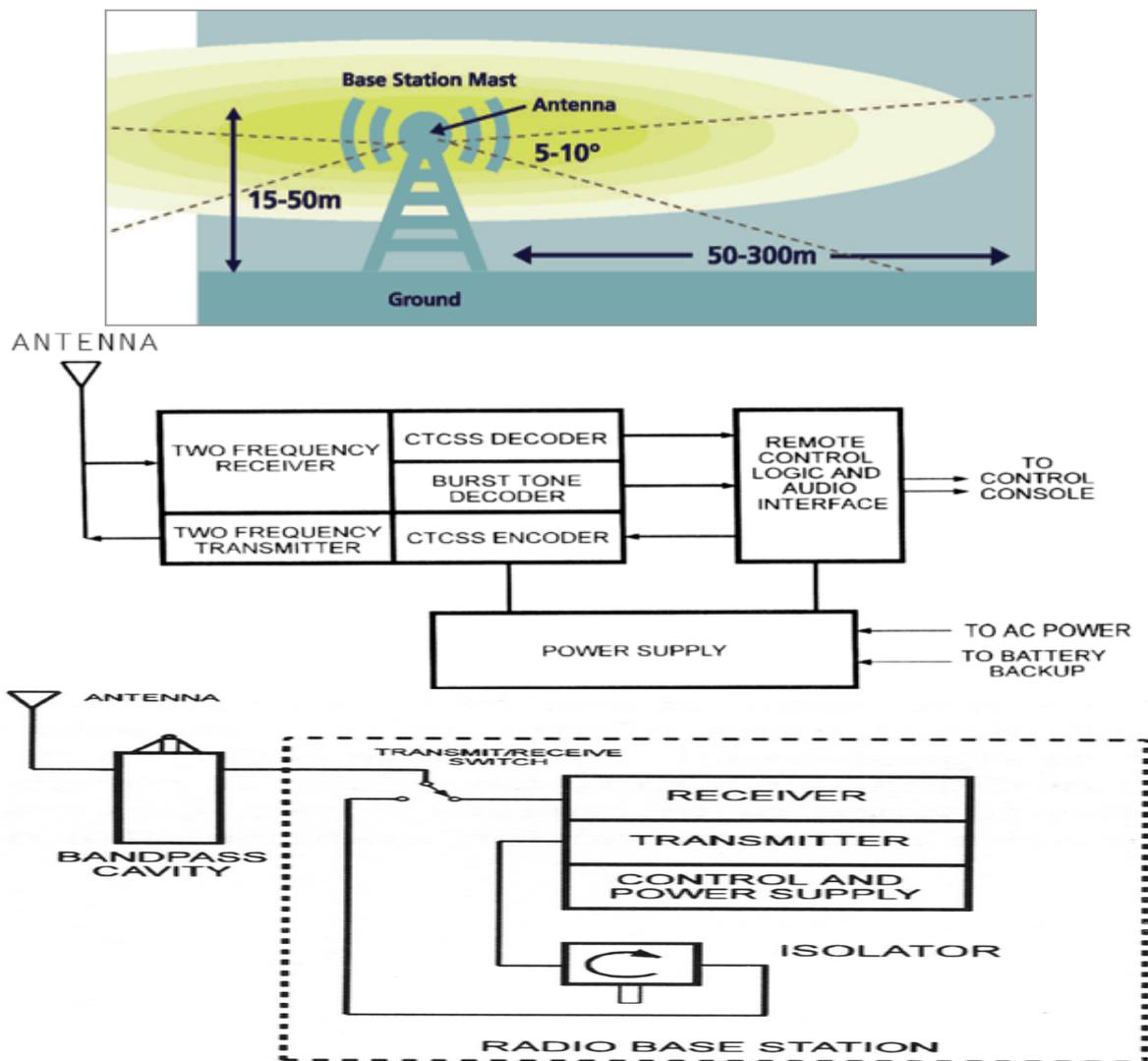


Fig. (5). shows the idea of mobile network.

Each group communicates with each other and also with land lines telephone network, as well as the outside world.

Where transmission stations are deployed in the desired area to cover it using cellular system, each cell has a transmission station in its center, the smaller the cell, the more the number of used cells, which lowers the emitted energy from the stations so the quality of the phone call increases.

Therefore all seminars & scientific reports recommended increasing the numbers of mobile network stations on the roofs of buildings to reduce the used energy and thus reducing the emitted waves from these stations, also these station cause visual pollution to the areas they exist in as they are considered visually undesired element on buildings roofs. Fig. no. (6) shows multiple forms of transmission antennas & stations on rooftops.

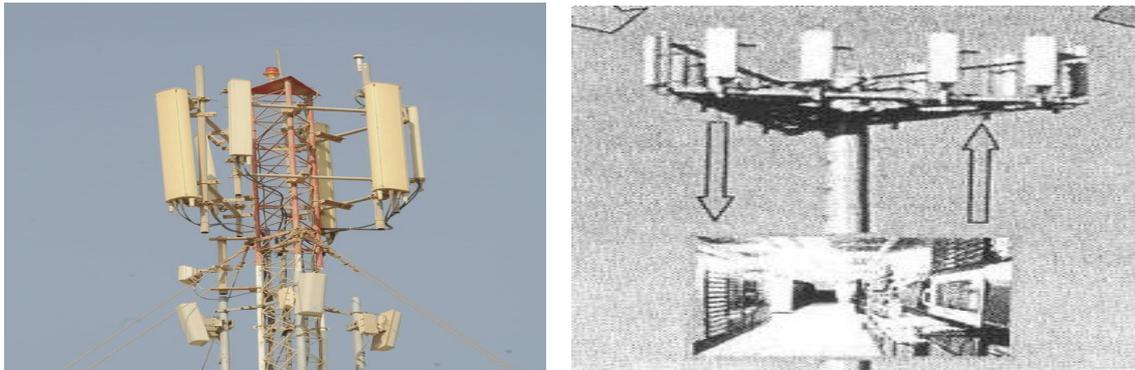


Fig.(6). Shows multiple forms of transmission antennas & stations on rooftops.

Regulating laws & implementation mechanisms: (3)

The principles and rules governing the mobile stations distribution & construction didn't reach the rank of a law. They are just protocols issued by the ministries of communication & health and the state ministry for the environmental affairs, the first version of the protocol was issued in August 2000, after more than 3 years of the start of mobile phone service in Egypt, which led to the expansion in the mobile market with amazing speed before the issuance of the protocol governing it.

Environmental requirements for the installation of mobile network stations:

the results of studies & experiments and research that was carried out by scientific institutions, that humans living under the roof which the station is built on are safe if they are exposed to the electromagnetic field caused by the mobile network transmitter without any need of architectural solutions to manage it or any other aesthetic aspects and the general form of the building, and that in condition of compiling with standard specifications to radiation density the human can be exposed to plus taking into consideration the following conditions: (4)

1. Height of the building where the antenna would be installed must not be less than 15 meters (minimum) to 50 meters (maximum) from ground level, and within the residential block, and in case that such height was not available the antenna should be installed on a steel tower or a pole to raise the height of the antenna from 15 to 50 meters. Fig. no. (7) Shows places & methods to install mobile network antennas on top of residential buildings.

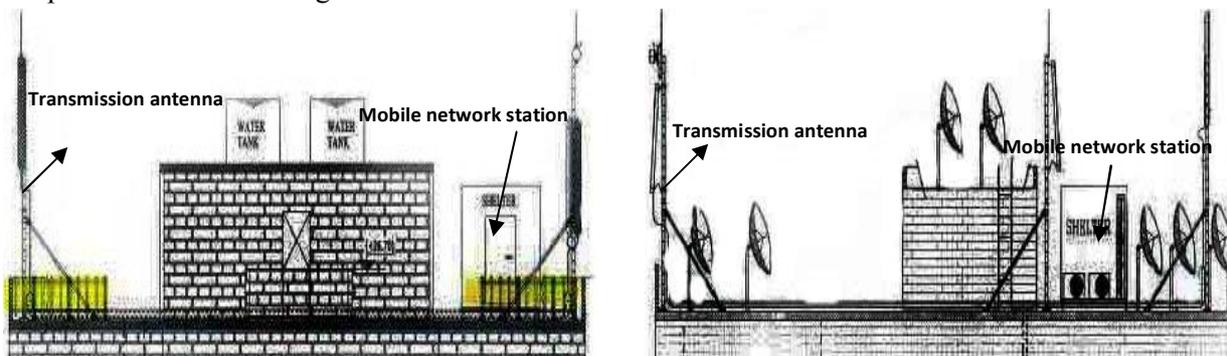


Fig.(7). Shows place & methods to install mobile network antennas on top of residential buildings.

2. The height of mobile network station relay antenna must be higher than the surrounding building in a sphere with a minimum radius of 10 meter.
3. The roof of the building where the antenna is to be installed must be made of reinforced concrete.
4. It's not allowed put more than 1 transmitter on the same pole, and the antennas must be on height not less than 6m from the building roof, on the condition that transmitting antennas installed on the tower (3 receiving antennas).
5. Distance between any 2 relay towers on building roofs must not be less (12 meters).
6. When installing the antenna the distance between it & the human element must not be less than (6 meters) in the direction of the main beam.
7. Installation must not be allowed on balconies without reinforced concrete roof.
8. To ensure no one approaches the antennas, its placed within a metal fence at a distance (6 meters) from the tower and 2 meters away from any other direction from the pole.
9. Obligation for the mobile network operator when installing main stations on the top of the buildings in residential areas to comply with the international specifications related to its radiation, and according to each of the international society of electrical & electronic engineers (IEEE) Institute of Electrical & Electronic Engineers, (ANSI) American National Standards Institute, which states that the maximum Specific Absorption Rate (SAR) human beings can be exposed to is 0.40 mW/cm^2 .(5)
10. Placing non-metal barriers from all directions.
11. The mobile network operator must provide a certificate with its (SAR) values and it must not exceed 0.40 mW/cm^2 .
12. Antennas must not be directed towards children schools.
13. Enforcing periodic checkup policy for mobile network stations.

There also have been some issued decisions to ban installations of some mobile network stations or any of its parts on building roof in the following cases:

1. If the building was issued a demolition order to it or to any part of it, or restoration works.
2. If the result of installation of the station or the tower or the pole means exceeding the heights assessed by civil aviation law.
3. If the building height was less than 15 meters.
4. If the building has a horizontal distance less than 20 meters away from children schools, nursery's, primary schools, hospitals and medical clinics.
5. Installing more than 1 station or tower or antenna on the same roof of the same building.

Negative effects of mobile networks stations when placed on the top of buildings:

- There are many negative effects for placing the stations on building roofs and they are as follows:
 1. On the environmental aspects:

The mobile network stations are considered a source of electromagnetic & environmental pollution, as it affects the health of building users in case safety specification are not applied, and considered an area for garbage to pile up around the station. (6)
 2. On the aesthetic aspect:

The station affects on the general form & shape of the building where no engineering studies were made for the station to be designed on top of a building roof and its relation with the building, as the studies were limited on the technical aspects related to the operating system also transmission towers on top of the building is considered a visual pollutant & harms the aesthetic form of the building.
 3. Regarding health aspects: (7)

Mobile network stations are considered one of the sources affecting public health, and those who work on it, or gets close to it to a distance less than 6 meters from the antenna on building roofs, so it is recommended to put barriers and warning signs on building roofs to prevent people from entering the closed area around the station, especially that there are some areas who their inhabitants live on building roofs.
 4. On the aspect of safety factors & security:

Where mobile networks stations are considered factors affecting safety negatively, especially that these stations need special lightening poles that the residential building wasn't designed to support it

with the presence of power stations dedicated to each mobile network station which represents an element of lacked security & safety.

In the situation of current buildings they weren't implemented with taking into account the existence of mobile network stations on its top roof, causing additional electrical & structural loads on the roof without considering the aesthetic form of the building.

The current situation for selecting the mobile station is based on finding the highest building in the area and in case of the existence of a conflict between the building's owner & the mobile operator on the annual rent fees, for the building roof, they move to the next lower building in height & so on there are no rules or principles binding or governing, particularly in new cities, to specify the targeted buildings for mobile network stations construction to have it studied during the process of design, especially that the transmission towers are placed near the roofs parapet, it is certain that it will become a problem especially in new cities that have above average residential building like the fifth community & 6th of October and others.

The increasing rate of low-rise housing will show many visual, aesthetic & environmental problems in the targeted communities.

Types of buildings that are dealt with when installing mobile stations: (8)

1. Existing buildings with an existing mobile network station, and there must be an architectural solution to fix the overall shape of the building.
2. Existing buildings and targeted to build a mobile network station on it, as it doesn't have one already existing station, many studies concerning the general form & environmental aspects must be prepared.
3. New buildings, target plan studies must be approved, presented by mobile operators to define location & the type of the expected future station.

Methods to achieve integration (consistency) between the mobile station and the building:

Appropriate solutions to the general shape of the mobile station & the building can be found through providing some architectural solutions that can be clarified as follows: (9)

1. Constructed buildings with an existing mobile station constructed on its roof. Where some architectural solutions are suggested to improve the overall shape of the building through:
 - Considering raising the height of the roof parapet to cover the tower according to angle of vision.
 - Using external coatings (aluminum, GRC, etc...).
 - Redesign the transmission towers shape.
 - Re-studying the locations of the antennas and its relationship with the roof level, through restudying the tower level and dimensions of building limits & the outer wall of the building.
2. Constructed buildings without a mobile network station built on its roof where some architectural solutions are proposed as follows: Fig. no. (8) Shows the possibility of re-studying the positions and the heights of the transmission towers.

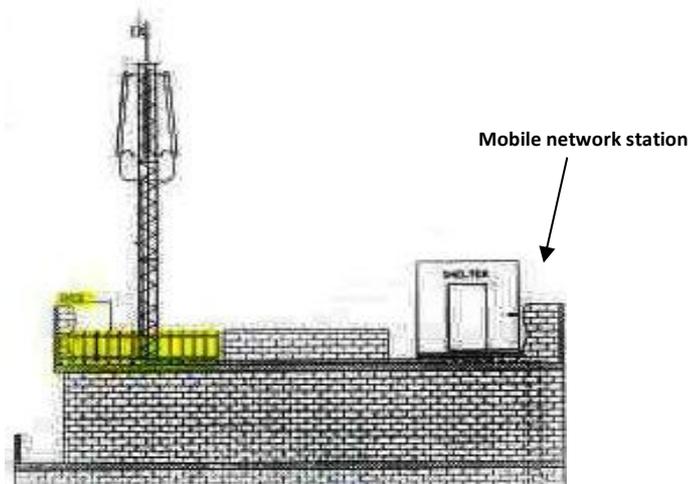


Fig. (8). shows the possibility of re-studying the positions and the heights of the transmission towers.

- Preparation of a design study to the expected positions to the station's elements, and the building roof limits to study different relationships and levels so that elements can be placed in appropriate places without affecting the general form.
- Obligating mobile operators to bear finding architectural solutions and aesthetic forms with its commitment to bear all expenses for that.

Using external coatings with aesthetic forms.

3. New buildings: a specialized engineering committee should be formed and to study & approve the expected towers to be constructed in new cities and areas, which through this committee the selected building owner is obligated to enforce finding good architectural solutions for the mobile network station on the roof when preparing building's drawings to have the drawings approved by this committee before obtaining licenses with the commitment of the mobile operator to bear all the a additional expenses related or construction of the station or aesthetic forms to cover the station. The following shapes demonstrate some architectural solutions that can be applied to benefit on how to treat the shape of the building and the station built on its roof. (Fig. no. (9) Shows one of the architectural solutions for the roof parapet. Fig. no. (10) Shows that multiple solutions can be used either by creating inclined parapet by a calculated angle or by using a suitable material as a coating. Fig. no. (11) Demonstrates that solutions can be found using architectural elements as a visual barrier using aluminum sheets in an aesthetic form to cover the relay towers.)

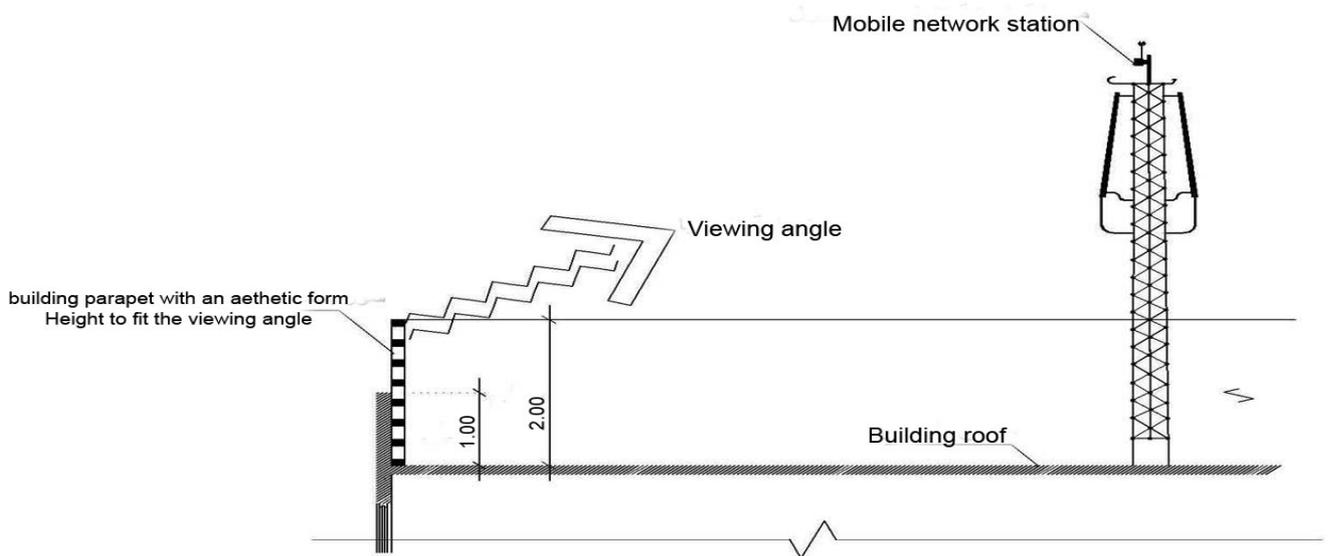


Fig. (9). shows one of the architectural solutions for the roof parapet.

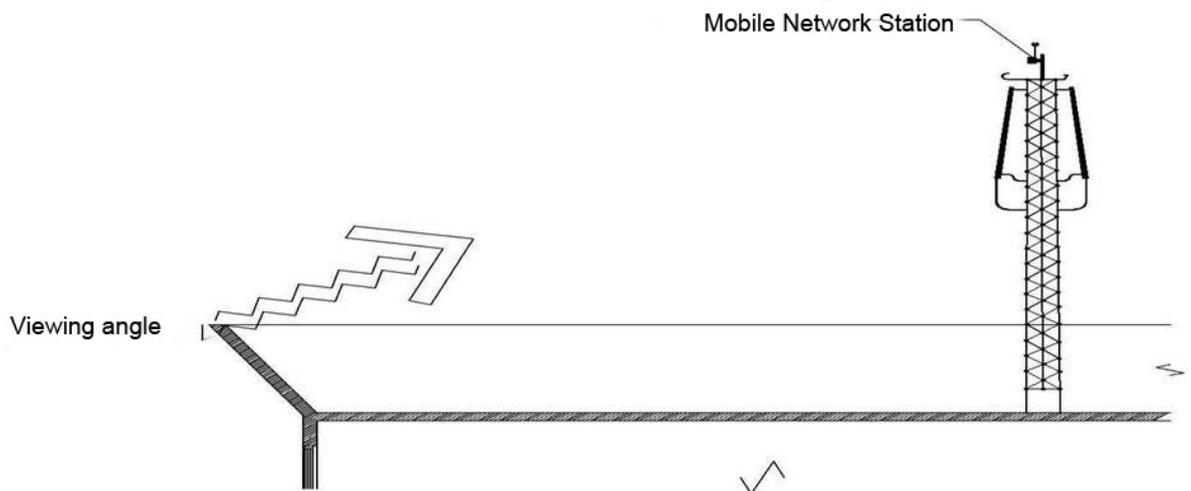


Fig. (10). shows that multiple solutions can be used either by creating inclined parapet by a calculated angle or by using a suitable material as a coating.

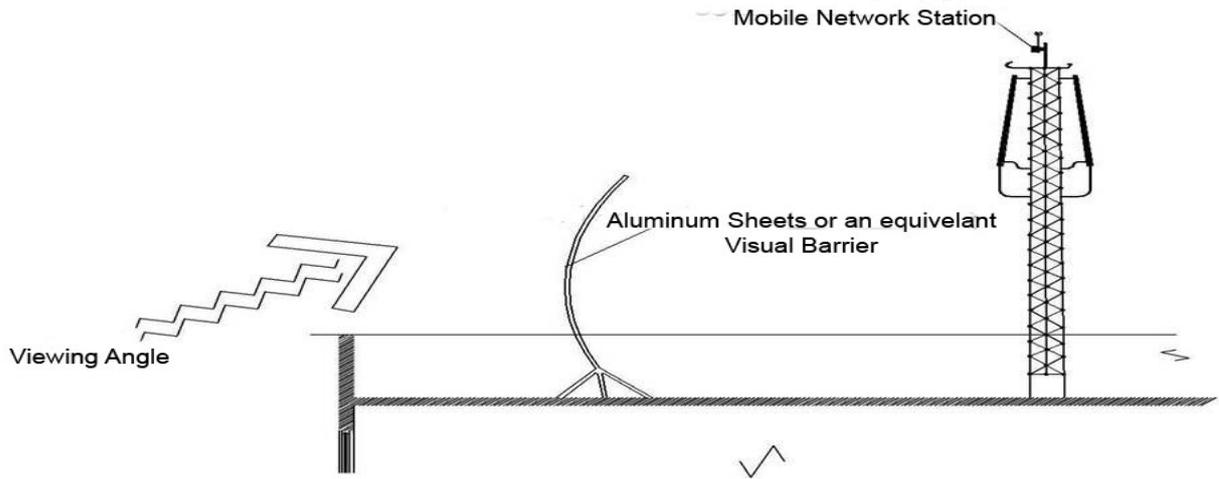


Fig. (11). demonstrates that solutions can be found using architectural elements as a visual barrier using aluminum sheets in an aesthetic form to cover the relay towers.

And the mobile stations towers industry has evolved greatly to add an aesthetic form on the surrounding space according to fig. no. (12,13,14) show some architectural solutions to the mobile stations tower.

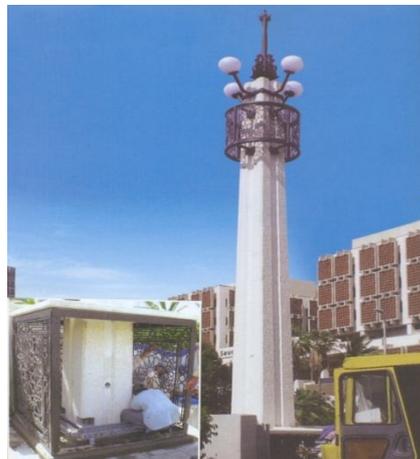


Fig. (12). Shows the new microcell tower in a roundabout in Jeddah



Fig. (13). Shows the relay towers built in open spaces



Fig. (14). Shows the mobile network station components

Results & Recommendations:

It is clear from this paper that the mobile network stations have become a burden on the general shape of the building & we must find a solution to make a consistent relationship between them especially with the increasing growth of these stations on the building roof.

And therefore many recommendations regarding this case must be taken, and they could be clarified as follows:

1. Role of the government:
 - Obligating mobile operators when installing new stations on the building roofs in residential areas to comply with international specifications and standards in addition to finding other solutions to be applied when constructing new residential building.
 - Forming a consultancy committee in each district specialized in making decision & following up applying the terms and solutions appropriate for each residential building.
 - Issuing a law that preserves the visual environment by making laws obligating the building owners to find the suitable architectural solution that the specialized committee recommends to suit the general character and the surrounding environment, and supervising the implementation to preserve the environment.
 - Requiring issuance of building permits including towers in future buildings to ensure finding suitable architectural solutions in elevations and approving the architectural solutions that fit the recommendations of the specialized committee.
2. Role of the mobile operators:
 - Approval of the master distribution plan of the future mobile stations by the related authorities to obligate property owners to issue licenses for the building to include the architectural solution.
 - Holding competitions between architects & fine arts graduates for aesthetic ideas that suit the nature of the building.
 - Preparation of personnel & solutions that can apply the aesthetic forms on residential buildings to cover the mobile stations on top of it with no effect on the visual aspect.
 - Finding modern technological methods that suit the aesthetic forms that do not get in the way of the aesthetic target of the residential building.
3. Role of the locals:
 - Formation of a specialized committee to follow up the implementation of the proposed solution for residential buildings in each district and the imposition of financial penalties if necessary.
 - Continuing the selection of the required residential building needed for such objective to determine the necessary specifications of the building and determining the proposed solution for mobile station coverage.
 - Banning the extraction of building permits in the future without approving an architectural solution to the stations on top of the buildings.
4. Role of the property owner:
 - Commitment to implement what necessary to cover mobile stations on the roof of the property he owns, as this roof is rented to the mobile operator and should implement the suggestions the district's special committee gave.
5. Role of the engineers & specialists in the field of real estate:

To satisfy the need to design a building that will contain a mobile network station by taking into account in the design process the architectural, structural, electro mechanical aspects and safety measures.

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