Antenna Concealment Solution for Wireless Industry

Improve Aesthetics of Your Network and Cell Sites with Artistic Look and Utilize Tower Space for Advertisement without Compromising Technical Requirements

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***Abstract*— This paper presents the development of an Antenna Concealment Design with different aesthetics design and appropriate RF transparent material to be used as camouflage the antenna cell site. The antenna with self supported feed is relatively compact, circular symmetric and with low cross polarization. To achieve camouflaging/ concealment without compromising the technical needs over the different frequency band is necessary. This paper also represent the different types of camouflaging structure with necessary requirements according to cell sites. Using the antenna concealment one can make the network and cell site with good aesthetics looks and generates the revenue.**

***Key words*—Antennas, Metamaterials, Antenna Concealment.**

I. INTRODUCTION

A rigid antenna support structure is designed and prefabricated to rest on two or more existing support foots normally found on a roof or similar structure. The antenna support structure, to which antennas are attached, possess mounting brackets associated with the exterior of the structure configured to accept a plurality of Vertical support members composed of a substantially RF transparent material. Attached to the Vertical support members are a number of horizontal support members thereafter forming a concealment assembly skeleton. Pluralities of RF transparent panels are then connected to the horizontal support members so as to form a concealment assembly that conceals the antenna support structure and antennas. The concealment assembly is environmentally and aesthetically pleasing, and retains RF transparency so as to not to attenuate the RF signals being sent to or originating from the antennas housed within. A structure for concealing and/or camouflaging emitters and/or receivers of electromagnetic radiation such as, for example, telecommunication antennas is disclosed. The structure may be formed from a panel comprising a light Weight, substantially RF transparent poly-vinyl-chloride ("PVC") foam material. The structure can be fabricated in many Ways and in different configurations to hide a variety of telecommunication antennas such as, for example, cellular, Omni, and PCS antennas. The structure can be used in varying configurations and sizes. Configurations of the structure can be glued, bolted, and or screwed to it or other substrates that do not impede RF signals while maintaining different overall appearances, textures, and shapes to hide or camouflage the emitters and/or receivers of electromagnetic radiation.

II. METAMATERIAL CLASSIFICATION

The response of a system to the presence of Electromagnetic field is determined by the properties of the materials involved. These properties are described by defining the macroscopic parameters permittivity å and permeability µ of these materials. By using permittivity å and permeability µ the classification of metamaterials as follows, the medium classification can be graphically illustrated as shown in fig. 1.1.

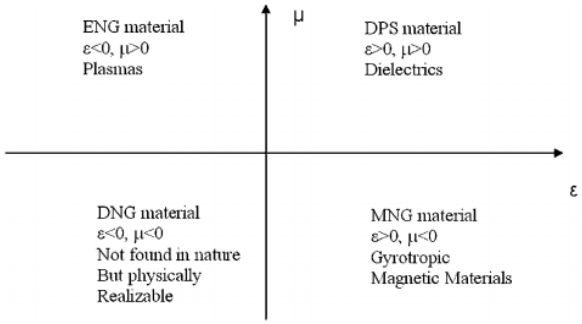

Fig. 1.1: Metamaterial Classification

A medium with both permittivity & permeability greater than zero (ε > 0, μ > 0) are called as double positive (DPS) medium. Most occurring media (e.g. dielectrics) fall under this designation.

A medium with permittivity less than zero & permeability greater than zero (ε < 0, μ > 0) are called as Epsilon negative (ENG) medium. In certain frequency regimes many plasmas exhibit this characteristics.

A medium with both permittivity greater than zero & permeability less than zero (ε > 0, μ < 0) are called as Mu negative (MNG) medium. In certain frequency regimes some gyrotropic material exhibits this characteristic.

A medium with both permittivity & permeability less than zero (ε < 0, μ < 0) are called as Double negative (DNG) medium. This class of materials has only been demonstrated with artificial constructs.

III. ANTENNA CONCEALMENT/ CAMOUFLAGING

As per as the dictionary meaning concealment means to hide something. Here as a technical meaning of antenna concealment is to hide the antenna or cell site using RF Transparent material. Materials for concealing antennas proper RF performance. Some materials provide satisfactory insertion loss when used for lower frequencies but perform poorly when used for higher frequencies.

The materials which are generally used as a RF Transparent material is known as "metamaterial". Metamaterials are artificial materials engineered to have properties that may not be found in nature. They are assemblies of multiple individual elements fashioned from conventional microscopic materials such as metals or plastics, but the materials are usually arranged in periodic patterns. Metamaterials gain their properties not from their composition, but from their

exactingly-designed structures. Their precise shape, geometry, size, orientation and arrangement can affect the waves of light or sound in an unconventional manner, creating material properties which are unachievable with conventional materials. These metamaterials achieve desired effects by incorporating structural elements of sub-wavelength sizes, i.e. features that are actually smaller than the wavelength of the waves they affect.

A. TYPES OF CONCEALMENT STRUCTURE

There are many types of antenna concealment structure are available. One can make the concealment according to available cell site and also it is depends on the surrounding of the cell site. So, people can make the custom design for the cell site. The available camouflaging structures are as follows:

- Chimneys
- Cupolas
- Louvers
- Screen Walls
- Clock Towers
- Corrugated Panels
- Wind Mills
- Flag Poles
- Custom Tower Concealment

These structures are shown accordingly in the figure.

Fig.1 Chimney

Fig.2 Cupolas

Fig.3 Louvers

Fig.4 Screen Walls

Fig.5 Clock Towers

Fig.6 Corrugated Panels

Fig.7 Wind Mills

Fig.8 Flag Poles

Fig.9 Custom Tower Concealment

IV. CONSEALMENT DESIGN

In any concealment design, the design methodology should meet balance criteria that include cost effectiveness, structural integrity, RF transparency, and cosmetic appeal. To achieve these balance criteria, the design considerations are as follow:
A. Type of concealment
B. Concealment Structure Design requirement

A. Types of concealment design

As Describe above the concealment design is depends on which kind of structural design we can use according to surroundings. For example, chimney, cupolas, louvers, etc.

B. Concealment Structure Design Requirements

- Requirement of local laws: It is differing from state to state and/or nation to nation. It may involve aesthetics, structural etc. requirements. And also local city laws to be complied.
- Electromagnetic Requirements: The requirements are Antenna Size, Azimuth Angle, Height of Tower, No. of Antennas, Beam Width, Operating Frequency, Attenuation and Types of Antenna. This all are the electromagnetic criteria is checked while concealing the cell sites.
- Mechanical Requirements**:** The requirements are wind load, temperature humidity and other environmental condition such as snow, rain fall etc.
- Multiuse of Concealment Structure: Concealment structure is generally costly and long term investment. There is a practice world over to utilize high cost infrastructure for:
    - Advertisement on Concealment Structure
    - Light pole as a part of concealment structure
    - Flag pole on concealment structure
    - Beautification Structure along with concealment, etc.

V. CONCLUSION

Using the different type of RF Transparent materials an engineer can conceal the cell site with good aesthetic and structurally sound according to environmental conditions and local rules and regulations.
Using the concept of Antenna Concealment Design one can improve aesthetics of the network and cell Sites with artistic look and utilize tower space for advertisement without compromising technical requirements and generates the revenue.

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