Why FRP (Fibre Glass) Dish Antenna for Satellite & Internet Communications

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Introduction

The development of satellite communication has been existing for antenna engineering. Many types of antenna have been invented and developed for earth stations and satellites. Satellite communication has made remarkable progress since the world's first communication satellite **(Echo-1**) was launched in 1960. Today the whole world is interconnected by satellite communication networks.

A satellite is usually linked to an earth station by a microwave signal, which is transmitted and received through parabolic dish antennae, thus dish antennae plays a key role in the progress of satellite & internet communications. The purpose of this article is to present the comprehensive knowledge and techniques on satellite communication antenna technology through Fibre Glass Dish Antenna.

I am presenting briefly this article mainly describes the antenna technology for space tracking, internet and telecomm and very large antenna technology for space research and radio astronomy.

I like to give a brief historical review is given with emphasis on the progress of antenna technology. The advent of the world's first satellite came in 1957 and a satellite equipped with the first active repeater of the present type was launched in 1962. The history satellite communication antennae began at that point. In those days, satellites were launched in low and medium height orbits of several hundreds to thousands of kilometers, and the attitude of a satellite as seen from an earth station changed from moment to moment.

Under those circumstances, the antenna on a satellite was omni-directional, which had a quasi-isotropic radiation pattern, on uniform radiation pattern in the equatorial plane of a spin- stabilized satellite. Then, in addition to the low gain of an omni-directional antenna, the transmitting power of a satellite was low due to limited electric power generation, and hence the equivalent isotropically radiated power (EIRP) was very low.

To meet this situation, large siged, high-gain, and low-noise antennae were used for satellite communications. Those antennae were also required to track moving satellites. The Cassegrain reflector antenna was developed in 1963, was recognized as the most suitable among several types used for satellite communication experiments. Protecting antenna systems from wind, blowing sand, snow, ice, rain, ultra violet sun light, temperature, fungus and corrosion the FRP Dish Antennae are the better options for ever. In particular, wind, snow and ice loads place stringent demands on the structural properties of the Antennae. To support these environmental forces, FRP structures are composed of panels, which when assembled form a truncated spheroid. To enable adjacent panel assembly, each panel is surrounded by a flange, which creates a framework characteristic of the different panel shapes. To minimize electromagnetic, RF degradation, the structural strength must be compromised against the demands for better RF performance. To enhance RF performance, this balancing act between a stronger structure with heavy-duty sized members and RF performance determines that the FRP Antennae are designed with minimal structural safety factors.

Wind Speed and Pressure Dynamics on Radomes

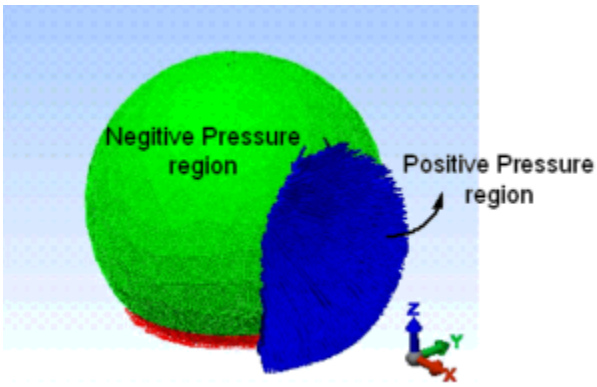


Figure 1. Turbulent wind pressure over radome surface.

Any dynamic structural analysis must take into account wind turbulent fluid flow over the antenna and the complex nature of the pressure model.

Wind flow over truncated spheres is itself a complicated subject. The characteristic type of fluid flow is determined by a property known as the Reynolds Number, $Re=VD/v$, where V is the wind velocity, D the antenna diameter and v is the wind fluid viscosity. Depending on azimuth angle with respect to the wind direction, as shown in Figure 1, wind force pressure both pushes and pulls on the antenna surface. Such a force distribution over the antenna surface plays a significant role by decreasing the general buckling failure wind speed.

Applying composite fiberglass, sandwich composite and other materials as a means of solving electromagnetic structural problems. These unique problems have led to products which range from 2 to 14 foot diameter (composed of feed, horn launcher and composite foam core reflector all enclosed), parabolic and offset dish antennas to 7 meters diameter, radomes---solid laminate, sandwich composite foam core and dielectric space frame to 140 foot diameter, specialized TEMPEST, flyaway modular shelters, microwave components and feed systems including the space qualified OMT recently placed aboard the TDRSS satellite and launched from the Atlantis Space shuttle, to Tallguide ®, an ultra low loss waveguide transmission line from 5 Ghz to 120 Ghz. Several million square feet of conical horn radomes alone have been delivered to the exacting demands of AT&T, the Bell operating companies, MCI, Sprint etc.. C-130 Fly-Away shelters to 30 feet---equipped with TEMPEST design, double RF doors, CIPHER locks and security systems have been a part of several classified programs. And two days before the air war started in the Gulf, AFC trained a US Army team and air shipped via C-141 a 68 foot dielectric space frame radome to Saudi Arabia. AFC supplies GOES 3.7, 5 and 7 meter diameter antennas with fixed, motorized and hand-crank pedestals to NASA, the US Military and prime contractors.

Repeated heavy snowfalls will stretch the panels of mesh and perforated dishes, reducing the accuracy of the reflective surface. Particularly heavy snowfalls will cause the panels to pop out of the channels, and can actually bend the mounts. The added weight of snow puts unnecessary stress on the actuator and motor, and can cause premature failure of either or both. A Satellite Dish Cover will prevent a heavy accumulation of snow and avoid these problems.
A Satellite Dish Cover provides a more vertical surface, and the slick material combines with the effect of gravity to slide snow off the cover. Meanwhile, the satellite signal is allowed to pass through the material and properly focus on the feed horn. A collection of pine needles, leaves or other debris in the dish will, when wet, have the same effect as snow.

Metal dishes, particularly mesh ones are especially susceptible to hail damage. A Satellite Dish Cover is tough but flexible and will absorb the force of most hail storms and leave the antenna unscathed.

In all dishes, a certain amount of the sun's heat and ultraviolet rays are focused back at the feedhorn, raising the temperature of the LNB, causing unwanted noise or interference in your picture, and thus accelerating the UV breakdown of the components. In light colored fiberglass antennas or solid metal antennas from which the paint has peeled this concentration of heat and UV is even worse. In extreme cases, the heat can actually melt the feedhorn components.

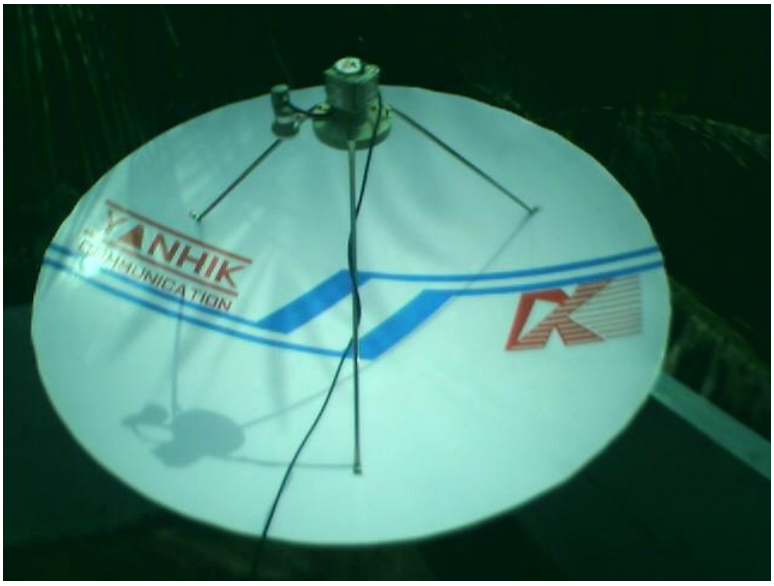
So, lets set one myth straight …. no amount of reduction in the noise temperature of your LNBC is going to be able to compensate for the option of using FRP Dish Antennae.

The sun is also brutal on the reflective surface of fiberglass antennas, oxidizing the protective coating and eventually turning the fiberglass to powder.

With a Satellite Dish Cover installed, the sun's energy is reflected directly back toward the sun and is not allowed to focus on the electronics while the satellite signal is allowed to pass through the cover and focus as it is intended. A Satellite Dish Cover takes the brunt of the sun, eventually wearing out because of it, but saving the antenna in the process at a fraction of the cost of a new satellite.

As a Communication Medium, satellites have the unique capability of providing multiple communication system in different field. The Parabolic Antennae are the major part of transmission and receiving signals for satellite communications. The satellite reception of India is received mostly by the aluminium (mesh) made parabolic dish antenna, whereas in European and other developed countries are mostly using the dishes which is made of Fiber (Glass/Carbon) Reinforced Plastic (FRP). The most important properties of FRP dish antenna like *Power Gain, Directivity, Efficiency and Equivalent Noise Temperature* are comparatively better than aluminium (mesh) dishes. The FRP dishes have a good ratio of G (gain) to T (temperature), excellent sidelobe performance and an ability to reject unwanted signals (Terrestrial Interference-TI) on the same frequency band. Therefore, the FRP prime/offset focus dish antennae is suggested for use in areas having substantial microwave traffic.

The ipso facto use of fiberglass, of course, does not guarantee a good antenna and there are a few antennae manufacturers who have "missed the boat" on techniques, which means there are poor quality fiberglass antennae, just there are poor quality metal antennae, out there. Remember that all parabolic antennae, regardless of the material used, must first and foremost, provide a precision reflecting surface.



Facts About Hydrophobic Polysthenic Coating (HPC) :

Hydrophobic Polysthenic Coating (HPC) is a coating material used on selected antenna surfaces. The material is a solvent based formulation that repels water from whatever surface it is applied. The chemical and physical properties of the material are such that drops of water are actually separated from the antenna surface by a visible layer of air. By providing actual contact with the surface, the water cannot adhere and falls away. HPC actually improves system performance under rain conditions by repelling water from the antenna surface. The phenomenon of 'Rain-fade' is well documented and is a reality for Ku-band (9.75-10.6 GHz) frequencies. The presence of HPC both on the antenna surface itself, as well as the feeding signals measurably improves system performance under moderate to heavy rain conditions. Over the past 10 years YANHIK has observed a number of testing programs to understand the outdoor durability of HPC coating. The programs have incorporated laboratory tests and outdoor exposure testing.

A HPC coated antenna will provide the user with additional operating margin under adverse weather conditions. It will provide an additional factor of safety that could keep your site on-line when weather conditions would indicate otherwise.

The ***Important Uses of FRP Antennae*** in different fields, which is replaced by the existing Aluminium (mesh) antennae are:-

1) National Informatics Center Network (NICNET)
2) Television Utilization (Uplinking & Downlinking)
3) Radio Networking

4) Mateorogical Applications (ESMA)

5) Satellite Aided Search & Rescue

6) Microwave Repeater

7) Remote Area Business Massage Network (RABMN)

8) Satellite Based Rural Telegraphy Network (SBRTN)

9) Data Transfer/ Communication for Railway Utilisation

10) Data Transfer/ Communication for Defense Utilisation

There are two types YANHIK fiberglass reflectors, each using a completely different construction technique. Antennas used for terrestrial communications, i.e., point-to-point microwave, are of a one piece construction, that is, they are formed as a single unit on a mold the same to same as the reflector. On the other hand are of a segmented construction, the segments being high-pressure compression molded. These segmented antennae can be shipped in reduced volume, it offer significant saving for the customer in freight costs and are particularly easy to handle on site, reducing overall installation costs.