

Satcom Antennas – A Question of Accuracy

At one time it was a rule of thumb that the accuracy of parabolic antennas was fine if there was no divergence from the profile by more than $1/10 \lambda$, or $1/20 \lambda$ if you wanted a really good antenna.

But now, better than $1/30 \lambda$ is often asked for.

Why?

Ans. Possibly the advent of Ka & higher communications bands

- For Ka band at 30 GHz requests for 0.3mm RMS or better surface accuracy are not uncommon, i.e. $\sim 1/33 \lambda$
- **Ruze's Equation (1965)** is now in vogue!

Loss in Gain = $685.81 (\delta/\lambda)^2$ dB

Where δ = RMS surface deviation

For 0.3 mm RMS, loss in gain would be 0.62 dB and for 0.5 mm RMS this increases to 1.71 dB

Ruze's Model used to test his Equation

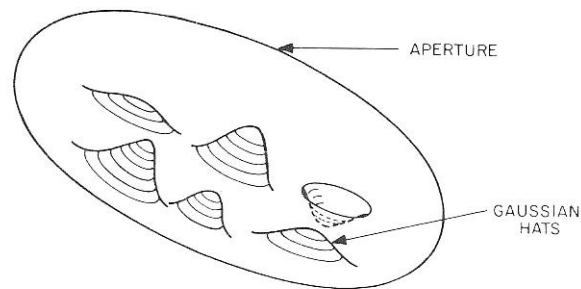


Fig. 4. Aperture subdivided into a number of hats.

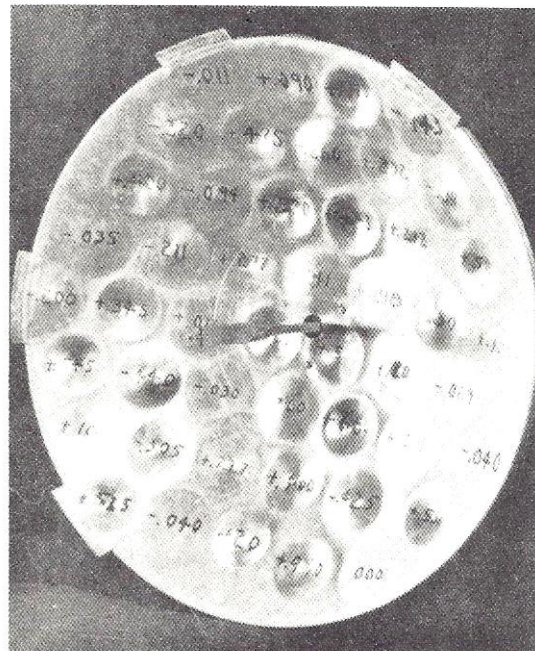


Fig. 5. Special model constructed to test theory.

Sources of profile errors

- Manufacture.
- Handling and fitting.
- Gravity.
- Temperature.
- Environmental.

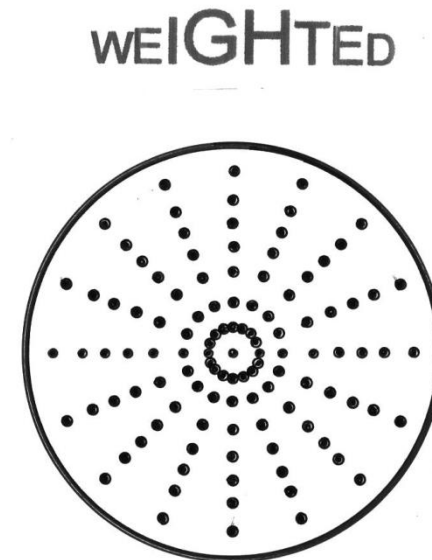
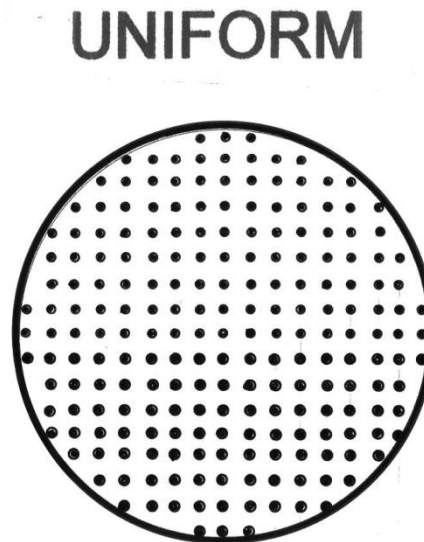
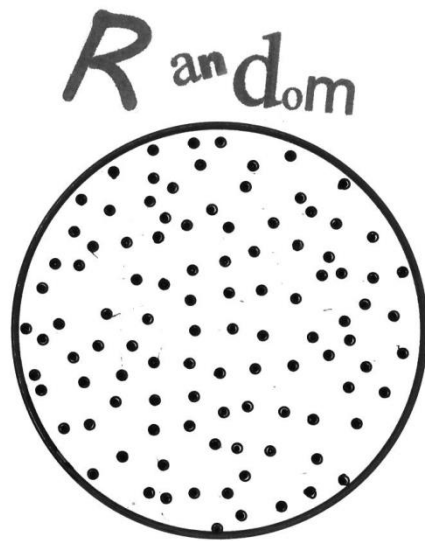
Qu 1. How should the surface error be measured?

- Laser, Optical Photogrammetry, Optically, Mechanically ?

Qu 2. How should the measuring points be distributed ?

- Randomly (Ruze), Uniformly or Weighted to the reflector R.F. Distribution ?

Distribution of measuring points



OTHER ?

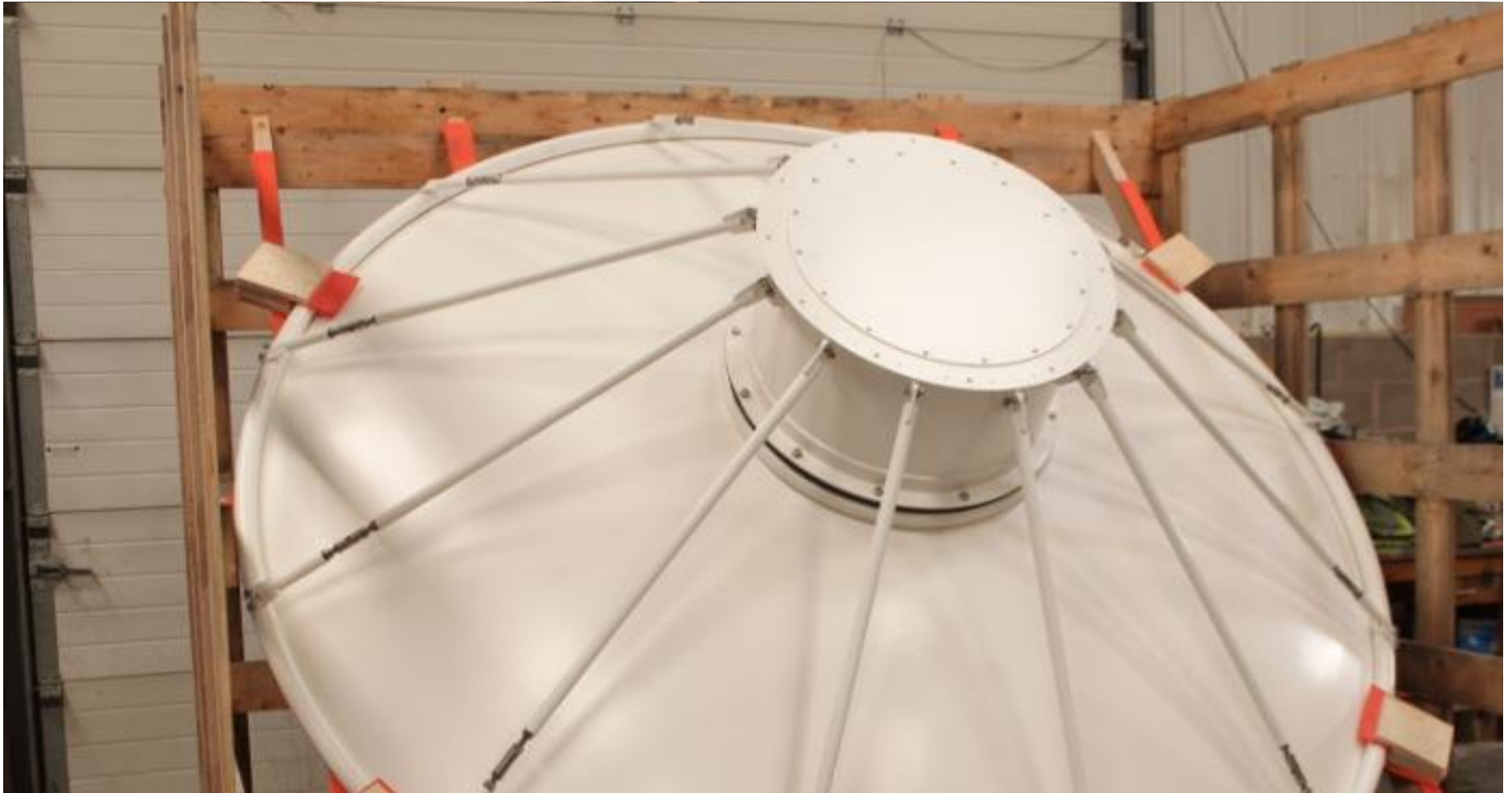
Cost of measuring antenna errors

- Typically it costs upwards of £1,600 / day to hire a metrology company to fully measure the surface profile of an antenna and then adjust the profile and confirm the final profile by remeasurement.
- Accurate antennas are expensive.

Elite's method to increase and maintain reflector accuracy

- By triangulation of the cross section of the antenna using a stiff rear drum with adjustable turn buckle struts to the rim of the reflector.
- Accuracies of better than 0.3mm RMS have been achieved with antennas of 3.5m and upwards.
- Environmentally a very robust structure.

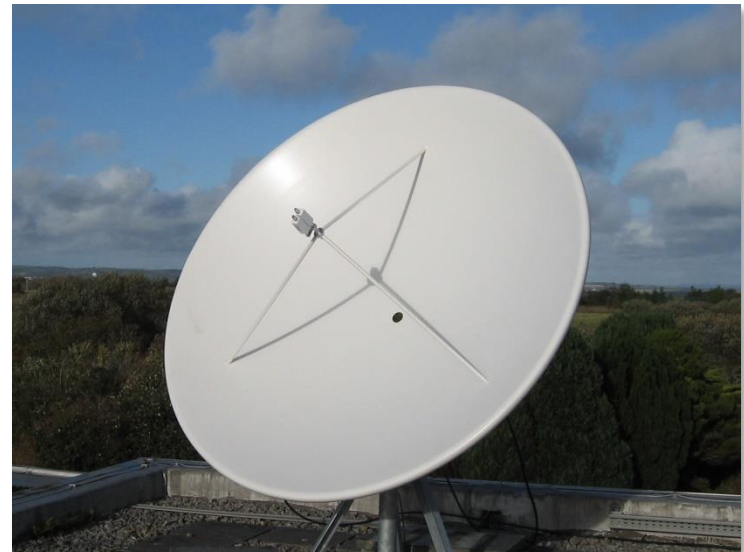
Ka-band antenna with adjusting struts and rigid central drum



Final thoughts and questions

- With so many loose ways of specifying reflector antenna accuracy how would you specify accuracy?
- As a user which is the most important criteria for you, Cost or Accuracy?
- Do you have the confidence that your antennas will maintain their accuracy?

Many thanks for listening



www.elite-antennas.com

