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# Numerical Study of the effects of the Struts In a Cassegrain Antenna

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**Abstract**— This paper investigates the impact of strut geometry and location of the struts on gain and radiation pattern of cassegrain antenna at Ka band. The analysis has been carried out using GRASP software and is valid for perfectly conducting circular struts. The choice of optimal focal length was decided before carrying out any analysis.

**Index Terms**— Cassegrain Antenna, Strut Analysis, Struts Effect, Blockage due to Struts

## 1 INTRODUCTION

STRUTS are the parts of many reflector antennas and in case of the cassegrain antenna they are used for supporting sub reflector. Struts are usually made up of metal and are connected between subreflector and reflector rim or on the surface of the reflector. Struts thus cause blockage and scattering, which in turn result in deviation in the mathematical properties of the parabolic reflector antenna and deterioration in the far field radiation pattern antenna(efficiency and cross-polarization is degraded and the sidelobe level is degraded. Judicious choice of struts parameters (no. of struts, radius of struts and the location of the struts on the reflector),thus play vital role in designing of good reflector antenna from radiation as well as structural stability's point of view. The analysis has been carried out for 1.2m centre feed cassegrain antenna that is dual reflector antenna with focal length of .384m at Ka band using GRASP(General Reflector Antenna Software Package),with PO/PTD(Physical Optics Theory) chosen foe analysis. The analysis has been performed for two different geometries and for two different radii of the struts

## 2 STRUT SCATTERING MECHANISM

The three most important mechanisms by which the strut scattering influences the dual reflector antenna radiation are described below and shown in Figures:

1. The field radiated by the main reflector hits the struts and this scattered field is added to the nominal field.
2. The field from the feed directly hitting the struts and scattered to the farfield.

3. The field scattered from the subreflector, in addition to hitting the main reflector, also hit the struts, is scattered towards the main reflector, scattered by the main reflector and contribute to the field

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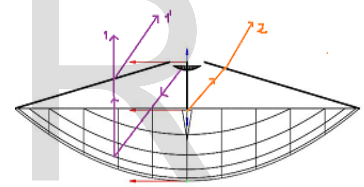

Fig 1 Strut scattering of type 1 and 2

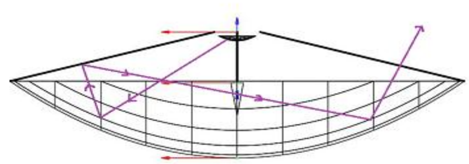

Fig 2 Strut scattering of type 3

## 3 STRUT CALCULATION STEPS

Below are the steps respectively in which strurt calculation is carried out in GRASP software:

Illumination of struts by direct feed, often referred to as Spherical Wave Scattering. Strut scattering mechanism 1.

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Illumination of the main reflector by subreflector and illumination from struts(currents on struts generated in last step). Referred to as Plane Wave Scattering. Struts scattering mechanism 2.

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Re-illumination of struts from reflector(currents on reflector generated in last step),referred to as Plane Wave Scattering. Struts scattering mechanism 2.

Flow Chart 1. Strut calculation steps

## 4 Radiation Pattern Analysis

The nominal radiation pattern (radiation pattern for the reflector without struts) depicts a gain of 51.59 dBi and a Side Lobe Level (SLL) of -23.895 dBi.

The analysis has been carried out for circular struts for two different radii (0.211 cm, quarter wave length and 0.422 cm, half wave length). The analysis has been carried out four struts with two different locations (on rim and on surface of the reflector at half of the radius), results of which are given as under:

Table 1. Comparing struts effects

| Geometry | Nominal | Rim(λ/2) Case 1 | Rim(λ/4) Case 2 | Inside(λ/2) Case 3 | Rim(λ/4) Case 4 |
|---|---|---|---|---|---|
| Gain(dB) | 51.59 | 51.42 | 51.5 | 51.384 | 51.484 |
| Sidelobe(dB) | 27.695 | 28.55 | 28.24 | 28.69 | 28.115 |
| SLL(dB) | -23.89 | -22.87 | -23.26 | -22.694 | -23.37 |

Figures below showing the above four cases

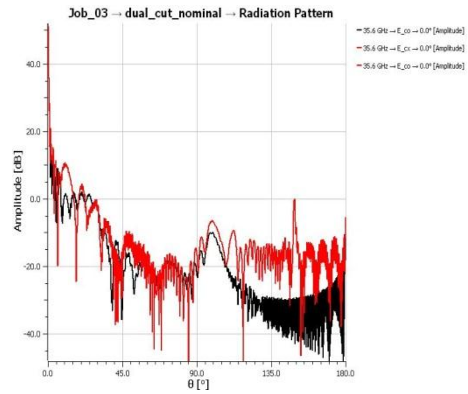


Fig 3. Case 1

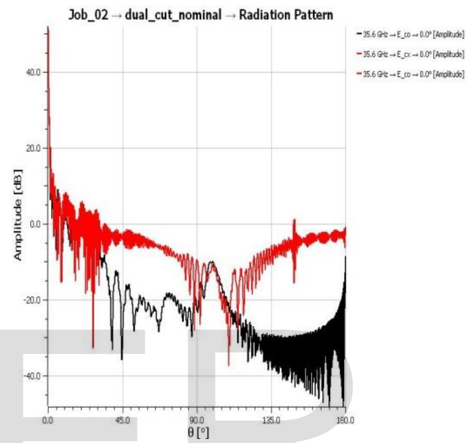


Fig 4. Case 2

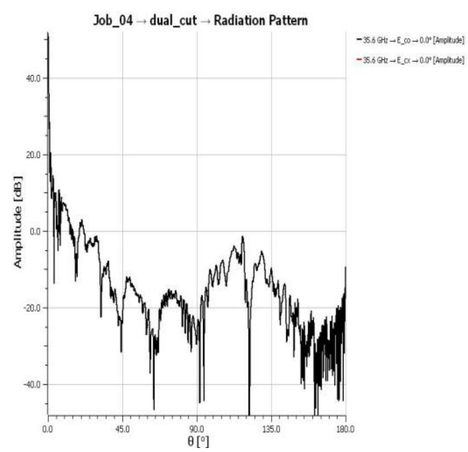


Fig 5. Case 3

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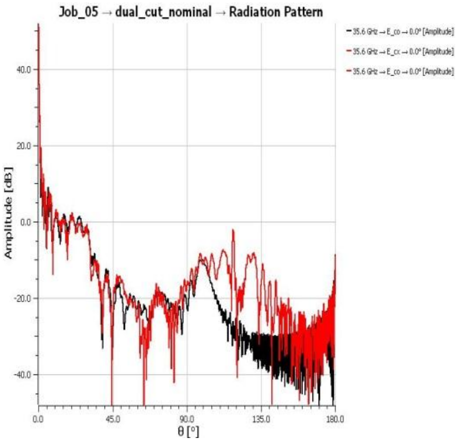


Fig 6. Case 4

## 5 CONCLUSIONS

It can be concluded on the basis of the above analysis that increasing the thickness of the struts results in overall increase in the side lobe level with the reduction in peak gain. It can also be concluded that inside arrangement of the struts result in more blockage of the radiated field than the struts on the rim of the reflector for the same struts of same radius.

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