# Obelisk Sector Antenna for 2.4 and 5.8 GHz Wireless LAN

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**Abstract**
In this article I will present simple and easy way to build sector antenna for wireless LAN access points with wide horizontal and narrow vertical radiation angle. Antenna is a derivative of two antennas: 3D Corner Reflector (3DCR) antenna and Shaped End Radiator (SER) antenna.

## Introduction

Access points in wireless networks use omni-directional or sector antenna with radiation diagrams which give them wide horizontal angle of coverage.
Vertical diagrams have to be very narrow to enable considerable gain of antenna. Antennas with these radiation diagrams usually require large number of radiators stacked vertically. Depending on antenna polarization and type of used radiators always there is considerable problem of proper feeding and phasing of great number of radiators. This problem is emphasized by relatively high operating frequencies of wireless LAN.
Dealing with 3DCR antenna and very interesting SER antenna I decided to try to mix their simplicity and good radiation diagram characteristics.

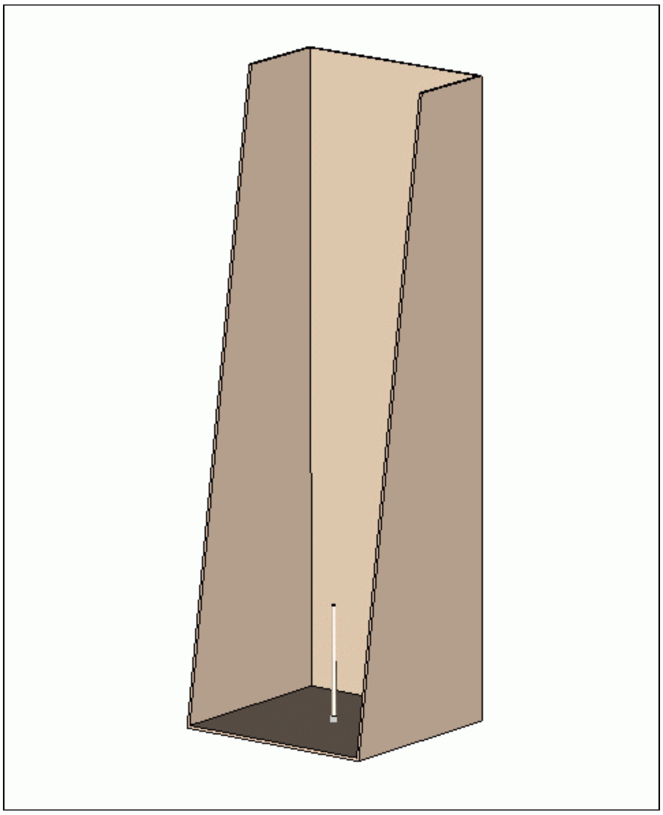

*Fig. 1. Obelisk antenna*

**Obelisk antenna for 2.4 GHz**
Antenna has one active element and suitable shaped reflector around it.
Reflector is similar as two 3DCR antennas stacked and overlapped side by side and connected to perform as one solid cast reflector. This gives reflector with four planes instead of three planes as in 3DCR antennas.
Radiator positions for both 3DCR antennas are also overlapped. As result we got three side reflector planes and one ground plane with monopole at its center, as can be seen on Fig.1.
By increasing reflector height we got narrower vertical diagram and higher gain of antenna. Specific shape of two side reflector planes widen horizontal radiation diagram and also improved side lobe suppression in vertical plane.

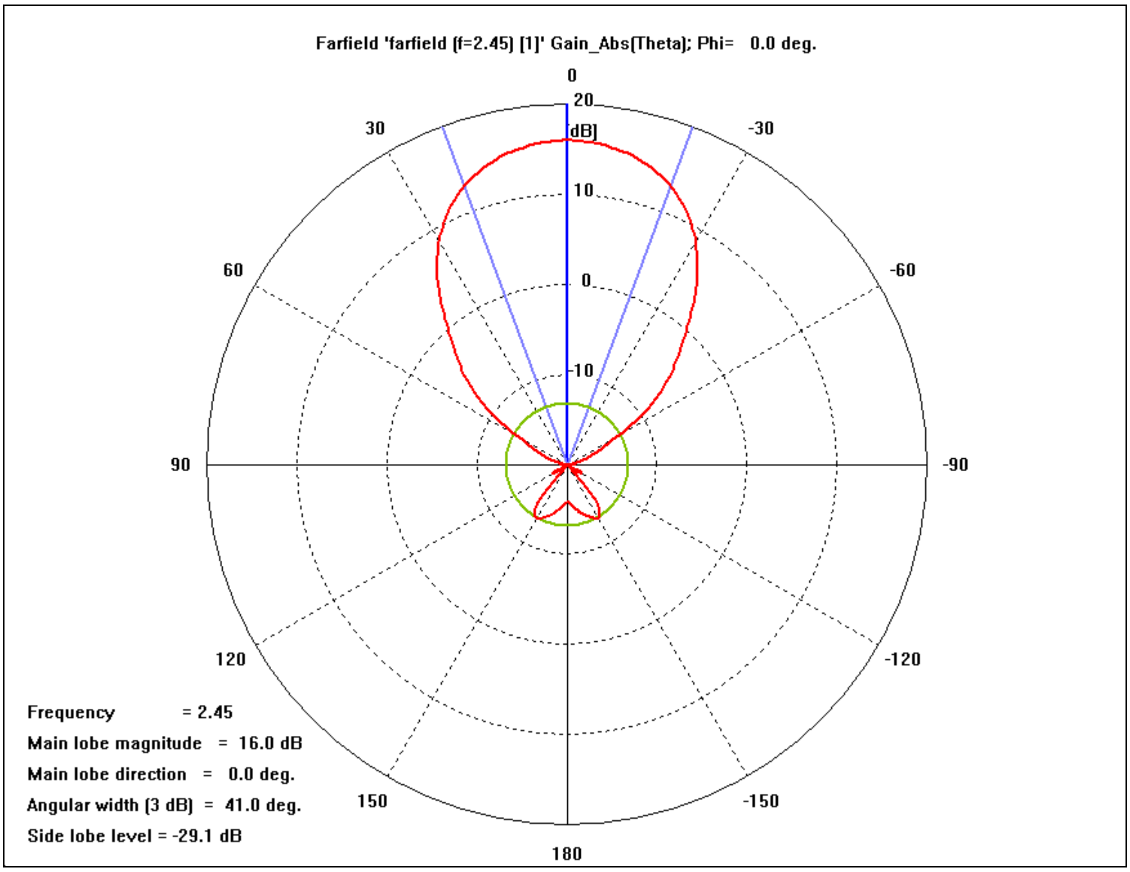


***Fig. 2. Obelisk antenna for 2.4 GHz horizontal radiation diagram.***

With such reflector construction antenna has widen its horizontal radiation diagram to 40 deg. which is almost double compared to 3DCR antenna. Due to wider horizontal diagram, gain decreases for about 2 dB comparing to 3DCR antenna.
Vertical diagram is also changed but not so much except it becomes more elevated then in 3DCR antenna. In 3DCR antenna vertical diagram is elevated about 45 deg, but in Obelisk antenna this elevation angle of main lobe increased to 54 deg.

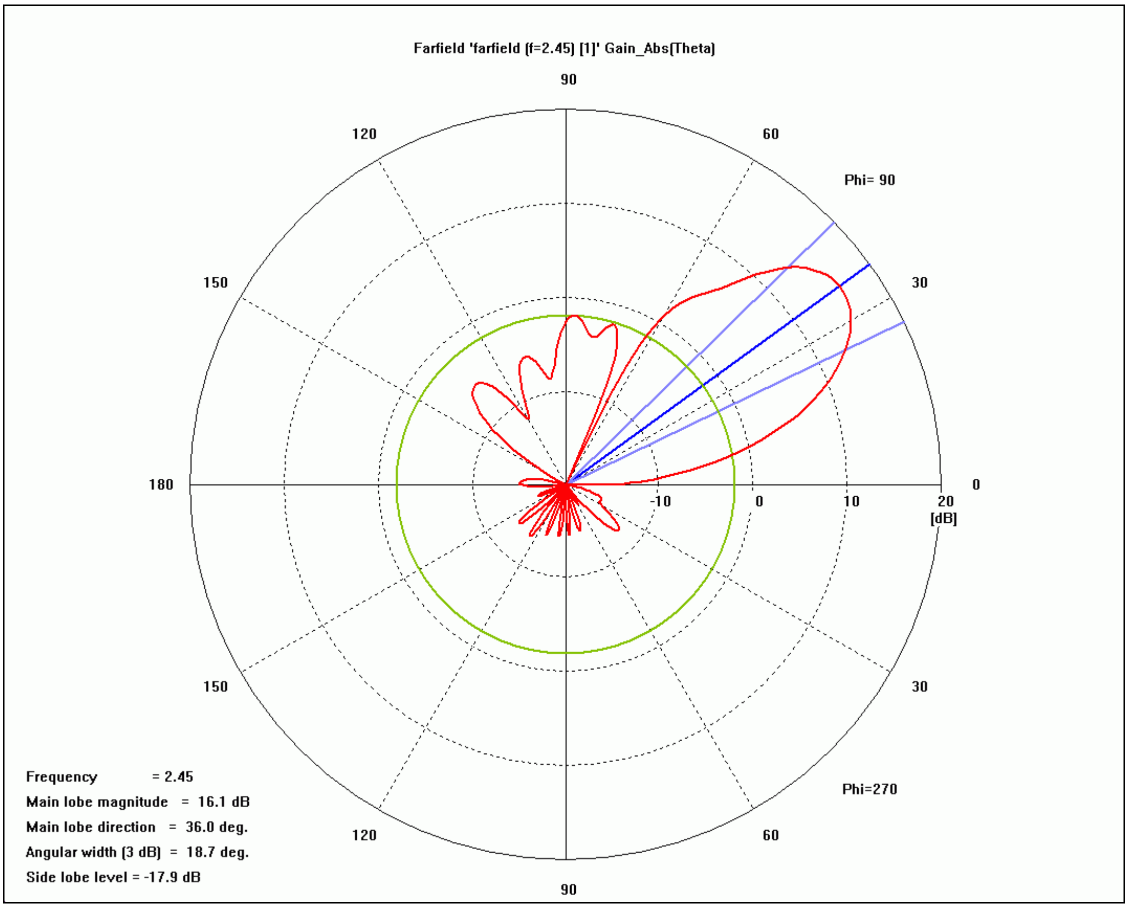


*Fig. 3. Obelisk antenna vertical radiation diagram.*

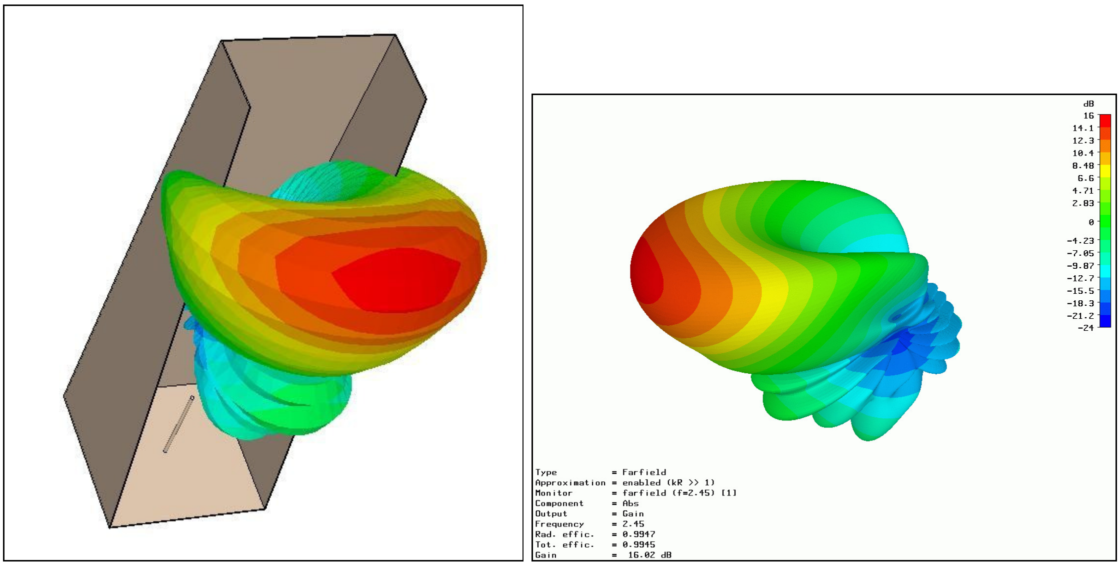


*Fig. 4. Obelisk antenna 3D radiation diagram.*

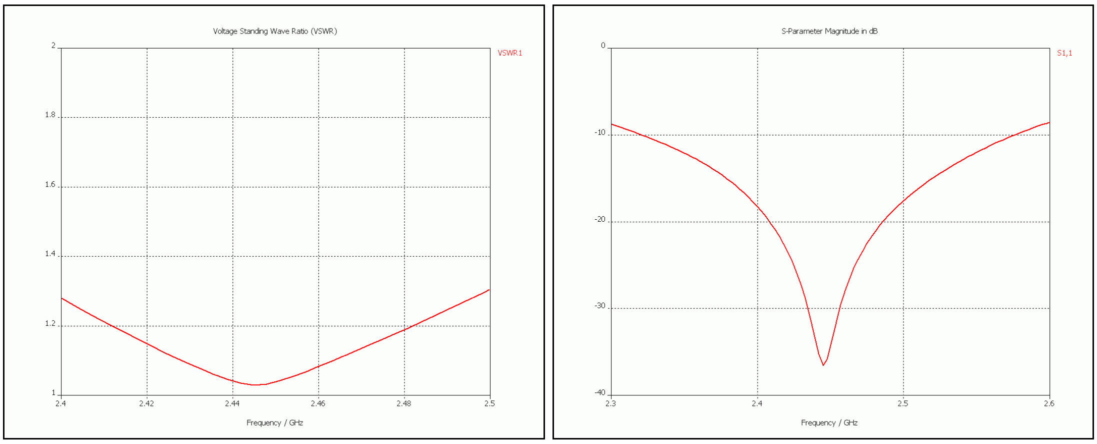


***Fig. 5. Obelisk antenna input SWR and S11 parameter in dB for 2.4 GHz.***

Antenna constructed on this way become similar with SER antenna except that there is no piece of waveguide as in SER antenna. As a consequence radiation characteristics and input impedance of antenna changed in relation to both 3DCR and SER antennas.
To get optimum radiation diagram, gain and working bandwidth it was necessary to perform reflector shape optimization. Given final dimensions are the best compromise between electrical properties and mechanical size of Obelisk antenna.
Antenna mounted to radiate vertical polarization wave has horizontal radiation diagram of about 40 deg. for -3 db and vertical diagram of about 19 deg for -3dB, elevated 54 deg in relation to radiator ground plane.
Radiator is simple monopole made of 0.74 wavelength long copper wire.
Input impedance is 50 ohms and return loss and SWR diagrams are given for both Wireless LAN bands.
Antenna gain is about 16 dBi with clear diagram and relatively high side lobes suppression.

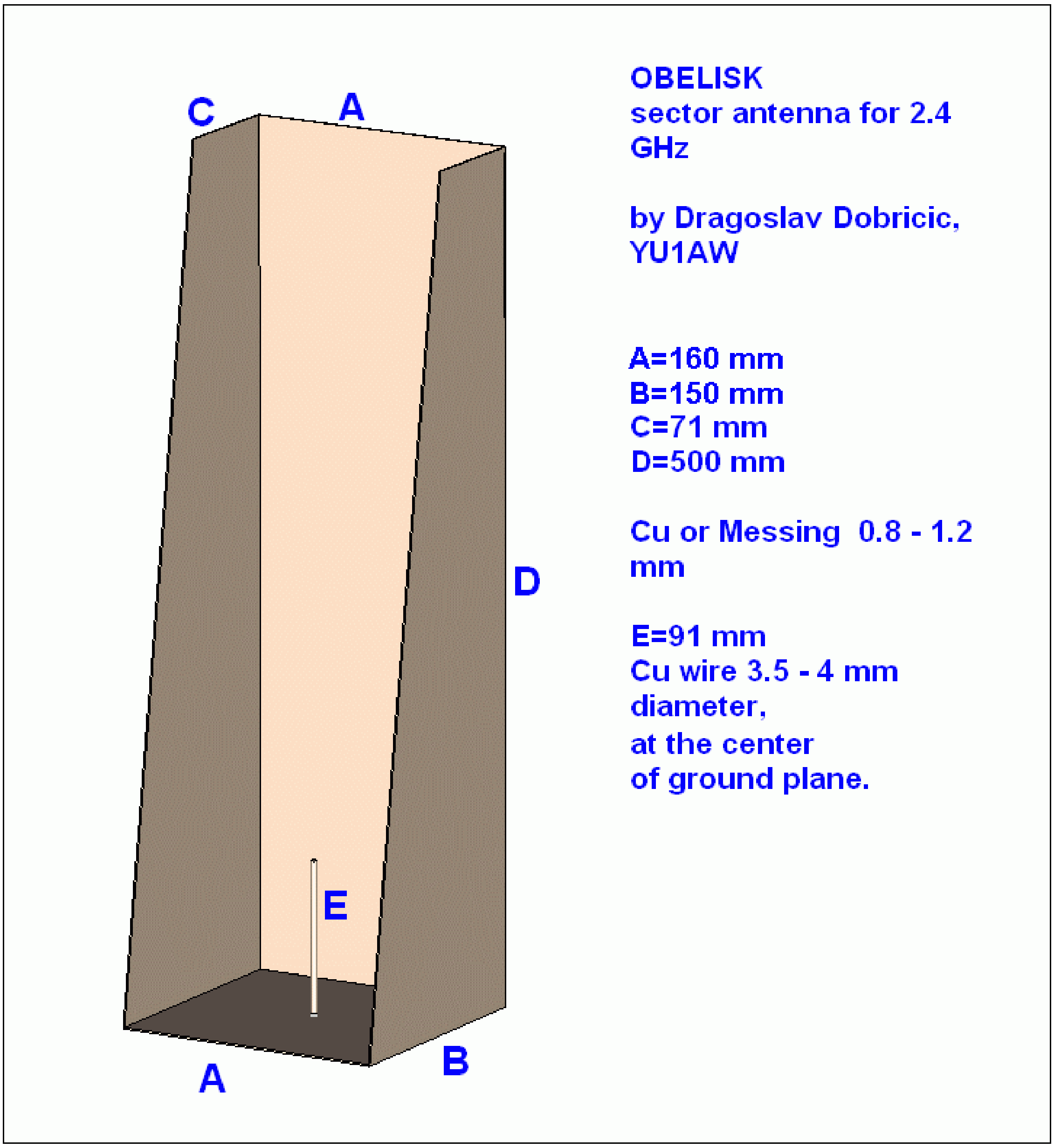


*Fig. 6. Dimensions of Obelisk antenna for 2.4 GHz fequency.*

**Mechanical construction**

Obelisk antenna reflector is built from copper or brass tin. Whole reflector can be cut out from one piece o tin according to cut scheme given at Fig.2 and folded perpendicular along dashed lines. Dimensions of reflector are given on Fig3

After cutting and bending it is necessary to connect horizontal ground plane with side planes by soldering connection at the outer side of the antenna.. That means that entire reflector surface in all four planes must behave as continuous surface with good electric contact along the whole length at connections between each reflector surfaces. It is very important to have good electric contact between plates because of currents which flow

over reflector surface parallel with radiator axis. If contact between plates is weak, reflector surface currents are broken and antenna works poorly. The reflector surface of the antenna must be built almost as it is cast solid!
Some builders made it from aluminum but with special attention to good connection provided by aluminum L profile and large number of pop-rivets as it is shown on pictures of built Obelisk antenna.
At the center of ground plane is mounted female N or SMA connector. At the center pin of female connector is soldered monopole made of copper wire. Dimensions of monopole are given on Fig. 9.

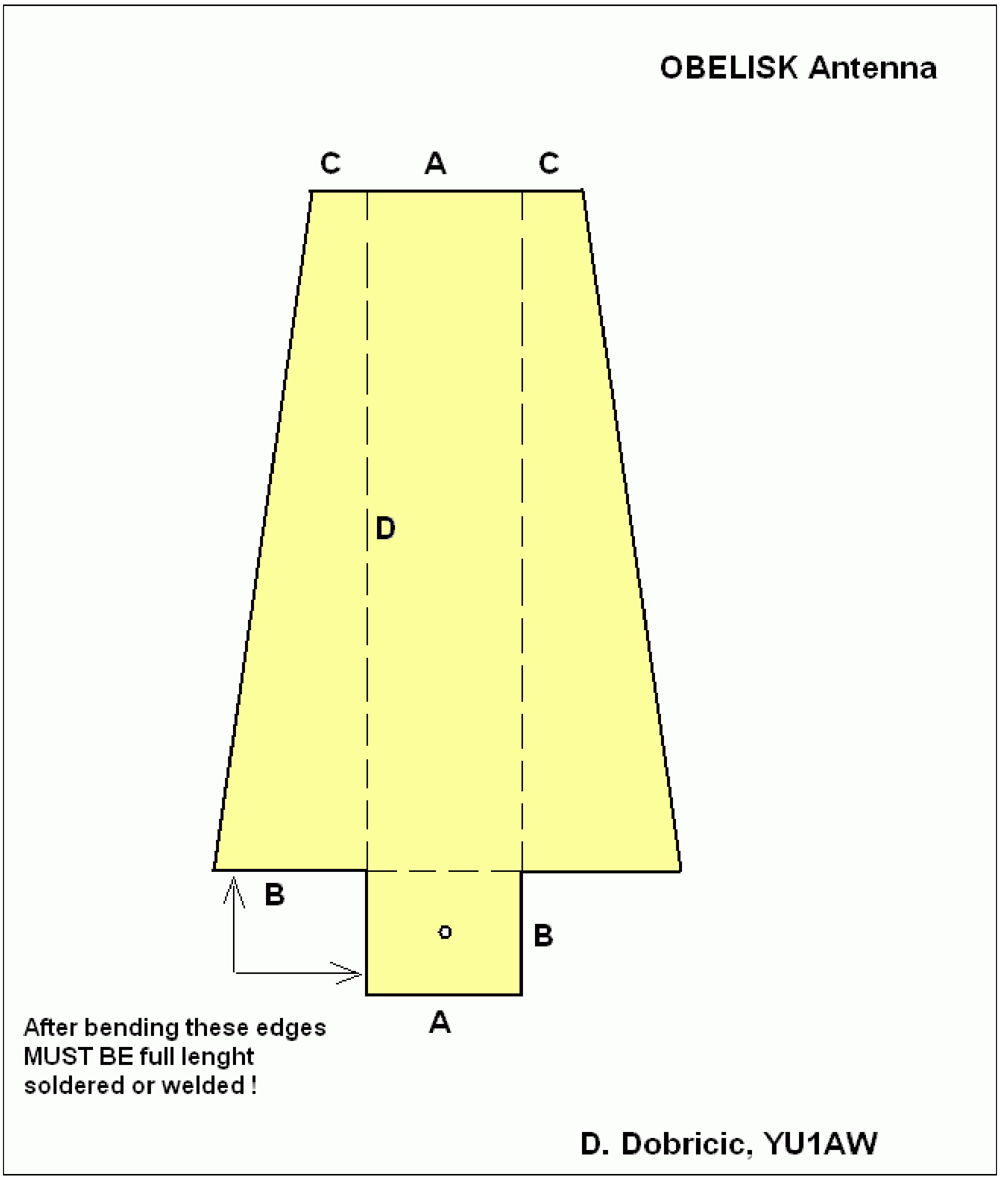


*Fig. 7. Shape and dimensions of cut for Obelisk antenna for 2.4 GHz.*

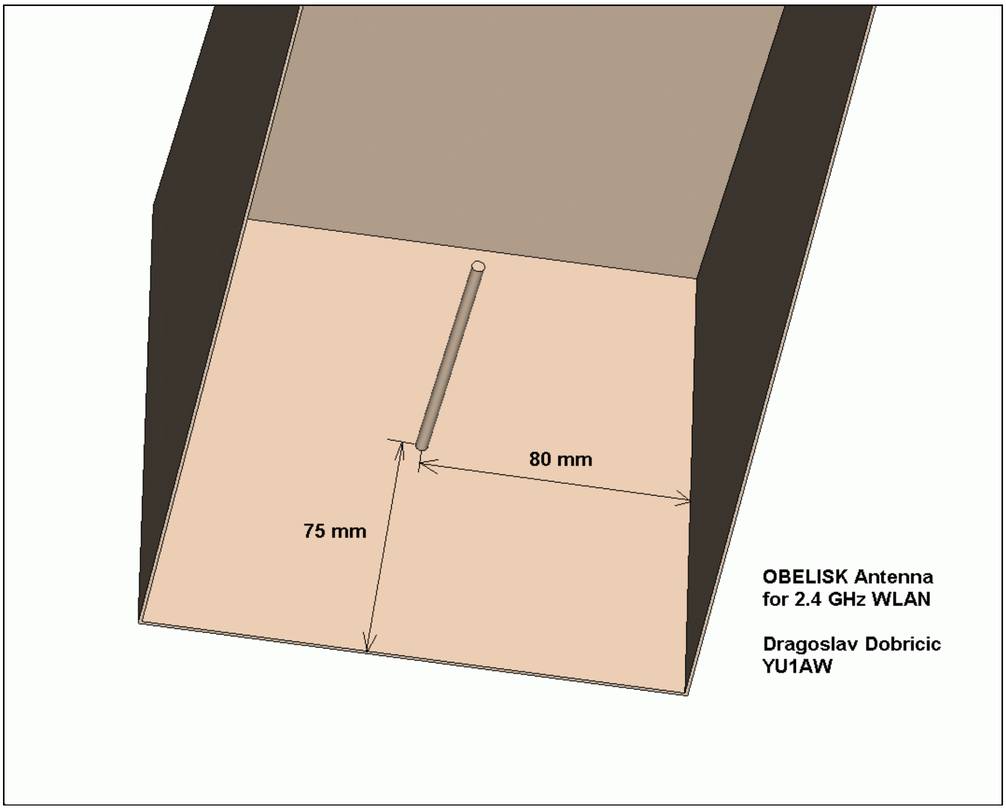

*Fig. 8. Dimensions of Obelisk antenna monopole position for 2.4 GHz.*

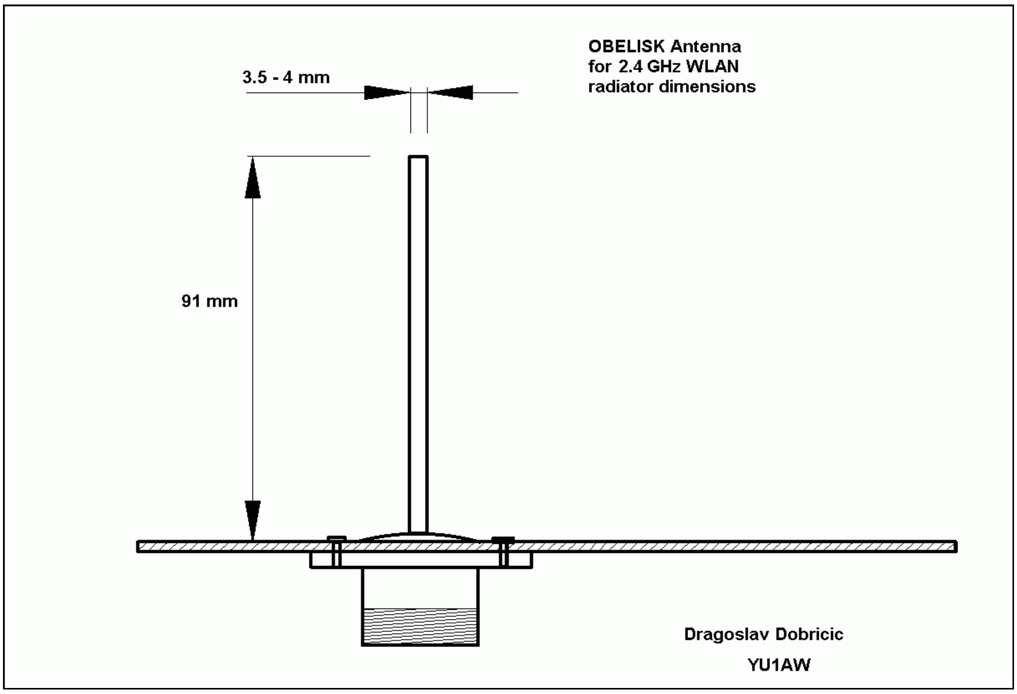

*Fig. 9. Dimensions of Obelisk antenna monopole for 2.4 GHz.*

**Weather protection**
Reflector surface and driver monopole are protected from corrosion by thin layer of varnish which is evenly deposited using spray.
It is important to do that before corrosion start to change bright color of metal parts.
Soldering point of monopole and connector cross section can be protected from weather by thin film of melted polyethylene deposit.

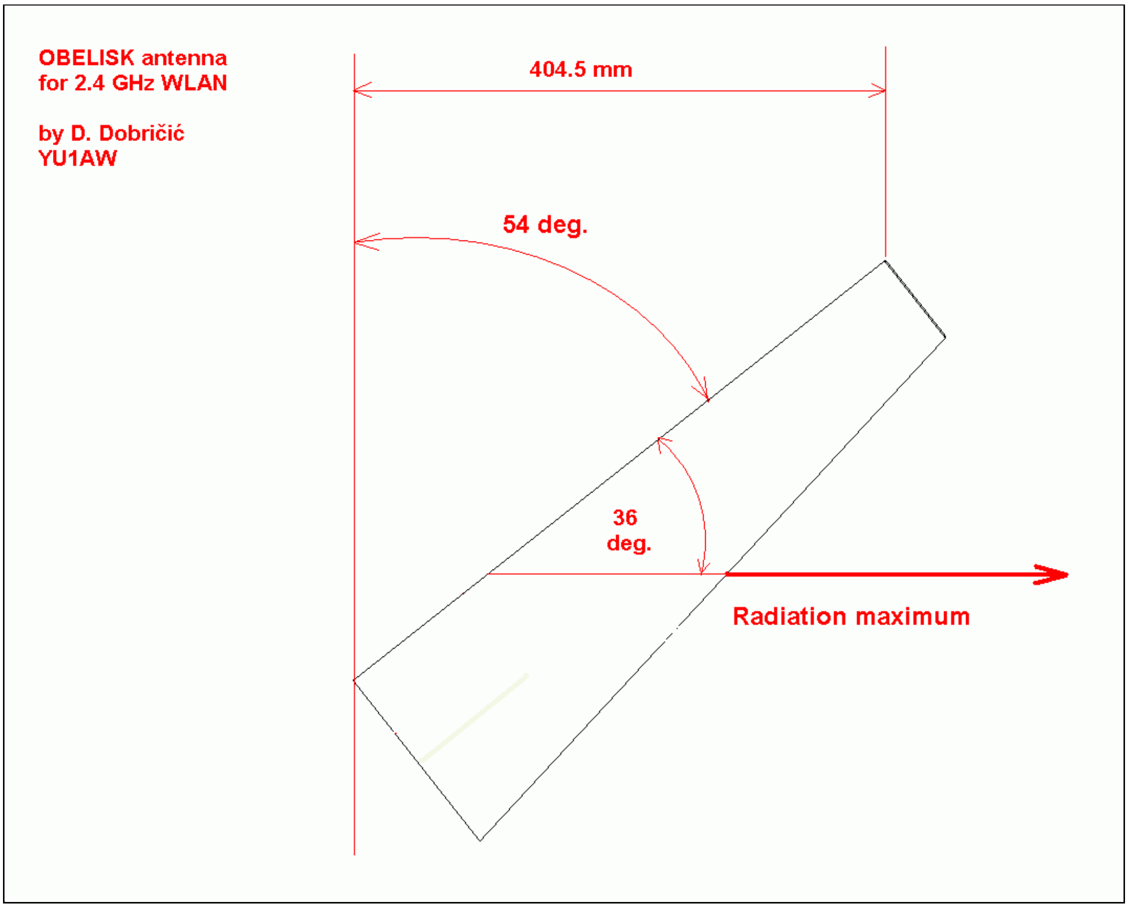


*Fig. 10. Mounting of Obelisk antenna with dimensions for 2.4 GHz.*

**Antenna mounting**
Similar as 3DCR the unusual thing while using this antenna is its aiming.
Obelisk antenna has elevated vertical diagram and mounting of antenna have to be done on such way that this elevation would be compensated in order to have radiation toward horizon. The easiest way to do that is to mount antenna as shown on Fig.5.
Such antenna mounting improve protection from collecting rain and snow inside antenna structure.

**Obelisk antenna for 5.8 GHz**

Simplicity and good characteristics of Obelisk antenna looked promising for 5.8 GHz band. Only problem I saw was very wide working band and I was not sure if Obelisk antenna could cover whole band with acceptable SWR.

After some minor optimization I got acceptable SWR over whole 5.8 GHz band as can be seen on Fig. 11.

Antenna construction is very tolerant to dimension errors and that is quality which is important for successful antenna building at high frequencies.

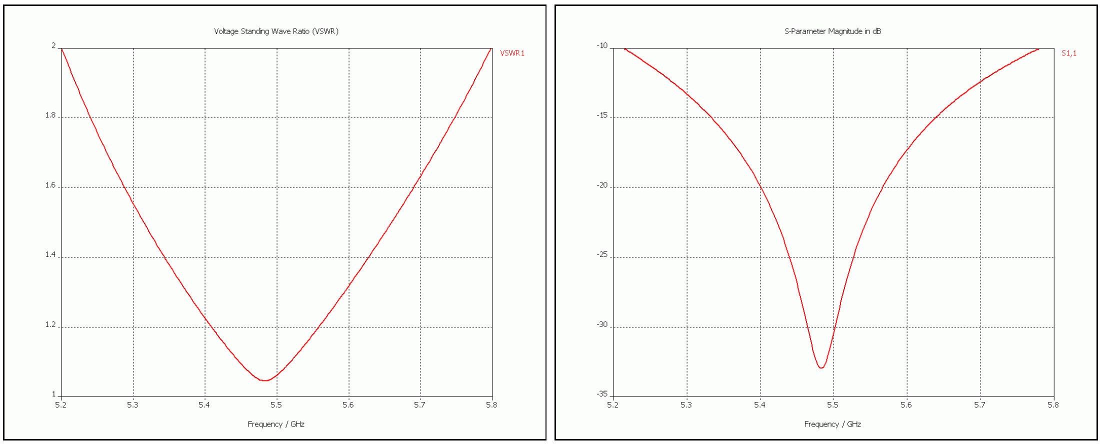


*Fig. 11. Obelisk antenna input SWR and S11 parameter in dB for 5.8 GHz.*

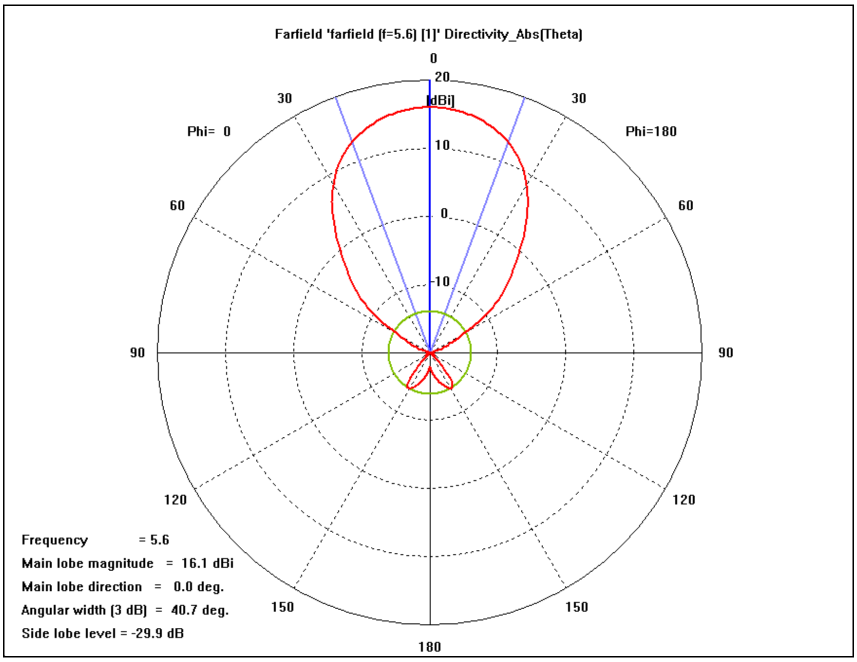


*Fig. 12. Horizontal radiation diagram of Obelisk antenna for 5.8 GHz.*

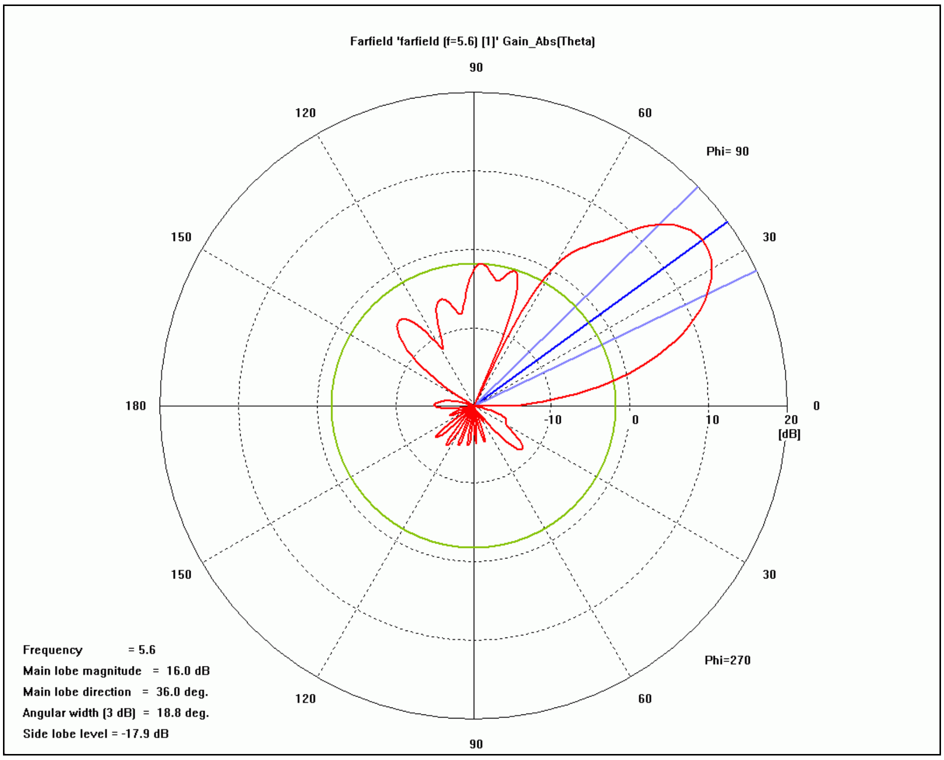


*Fig. 13. Vertical radiation diagram of Obelisk antenna for 5.8 GHz.*

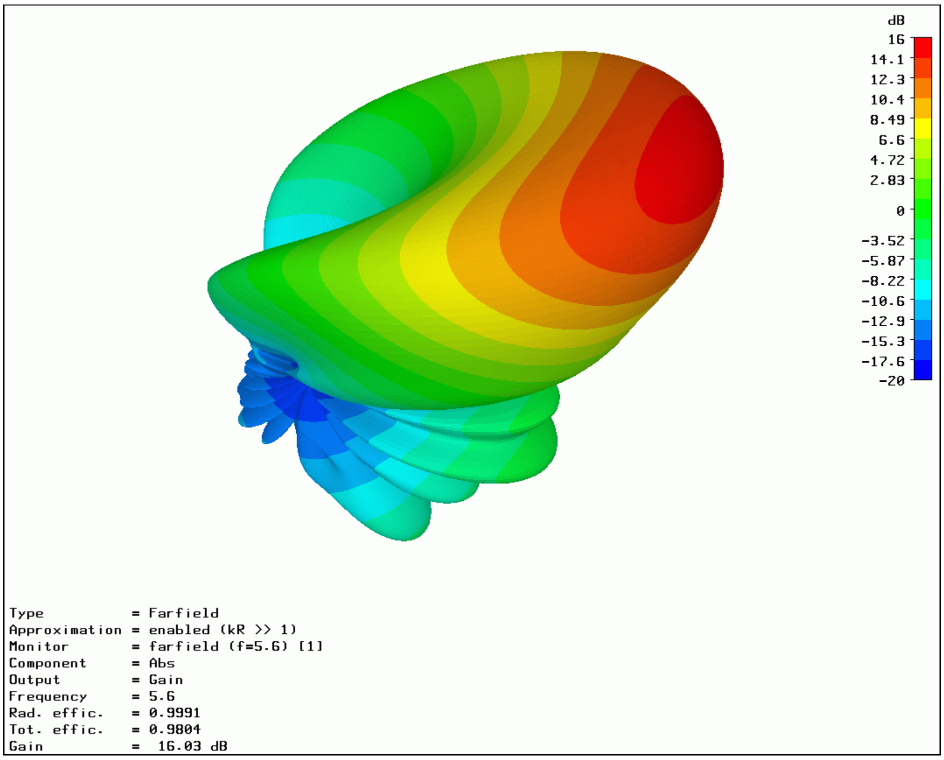


*Fig. 14. 3D radiation diagram of Obelisk antenna for 5.8 GHz.*

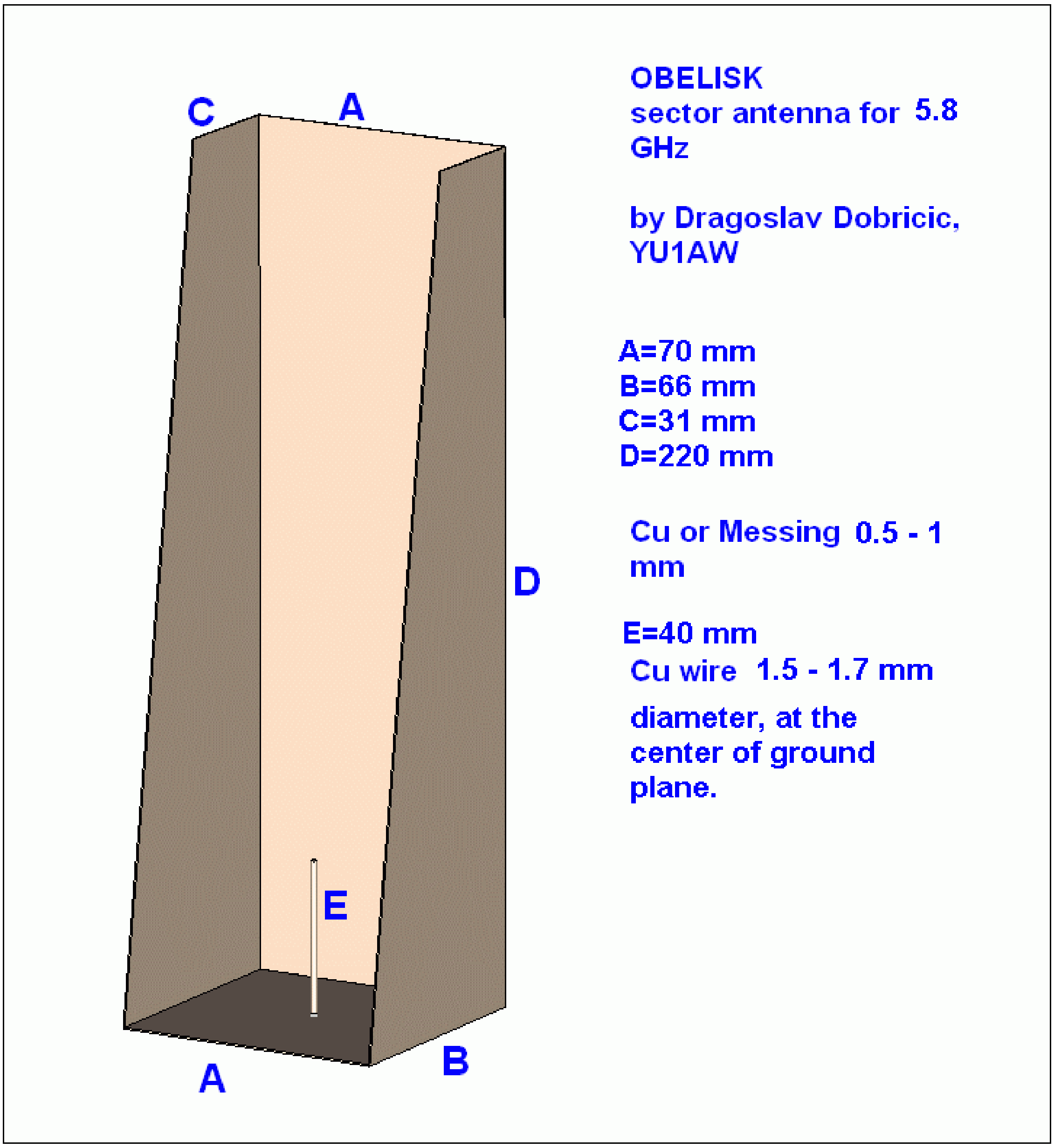


*Fig. 15. Dimensions of Obelisk antenna for 5.8 GHz frequency.*

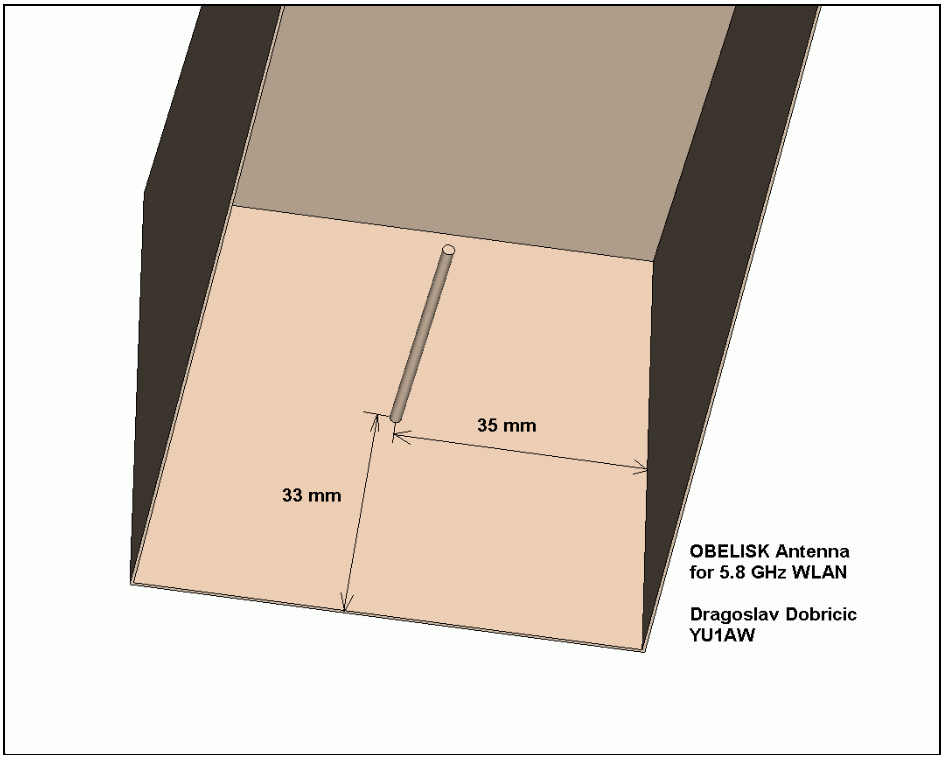


***Fig. 16. Dimensions of Obelisk antenna monopole position for 5.8 GHz.***

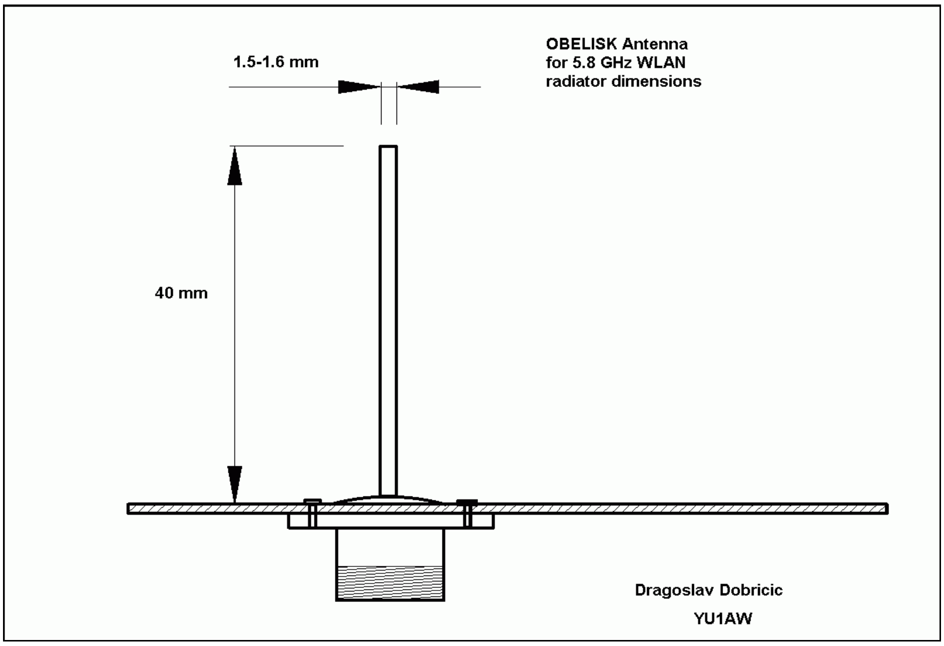


***Fig. 17. Dimensions of Obelisk antenna monopole for 5.8 GHz.***

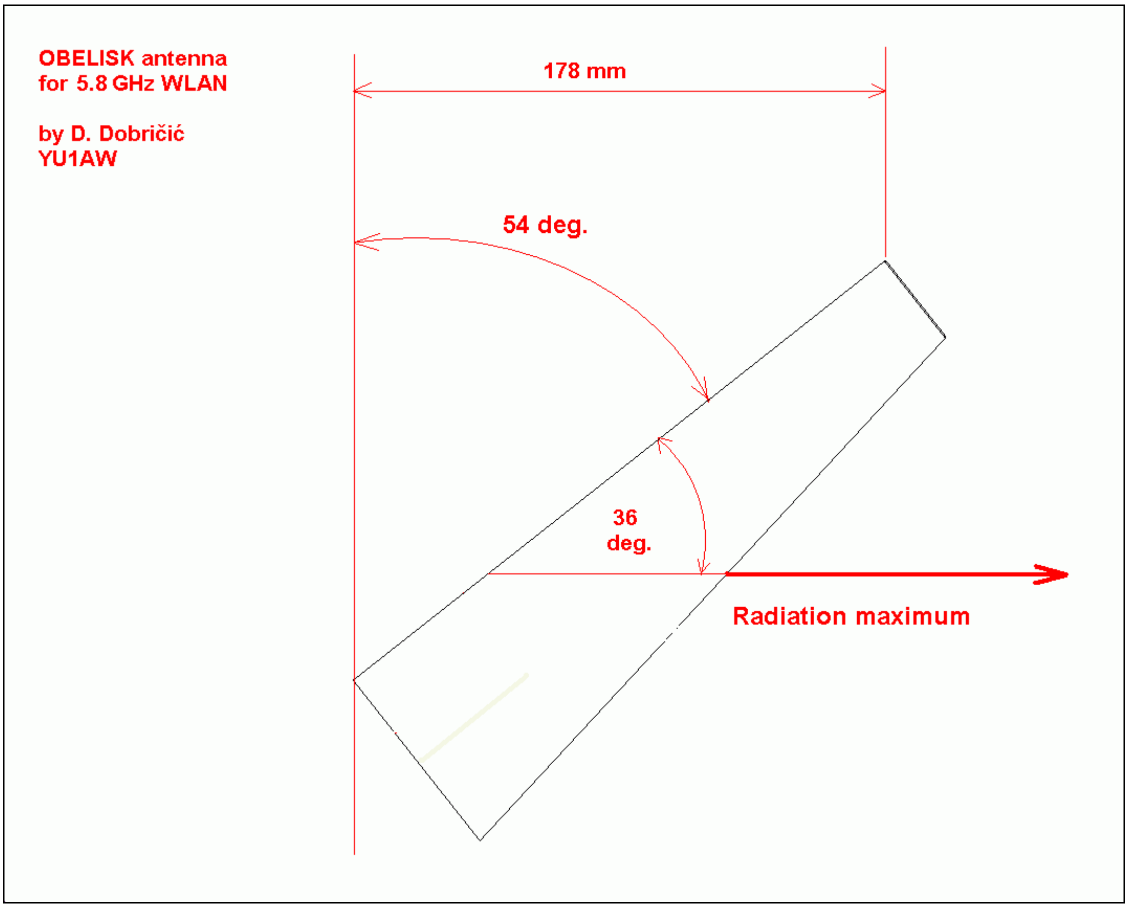


*Fig. 18. Mounting of Obelisk antenna with dimensions for 5.8 GHz.*

**Conclusion**

Obelisk antenna, according to results, justified its ability to serve as good access point antenna in Wireless LAN on frequencies of 2.4 and 5.8 GHz. Its simplicity and tolerant design gives promising building.

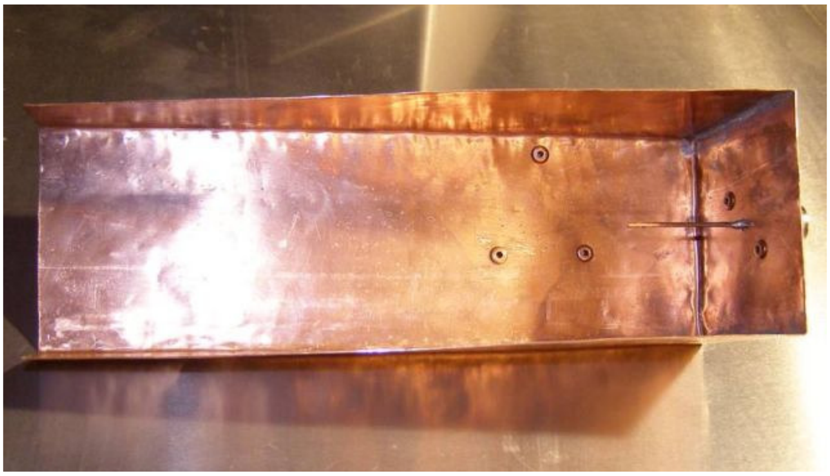

*Fig. 19. Obelisk antenna for 5.8 GHz made of copper.*

*Fig. 20. Obelisk antenna for 2.4 GHz  made of brass with mounting acessories.*

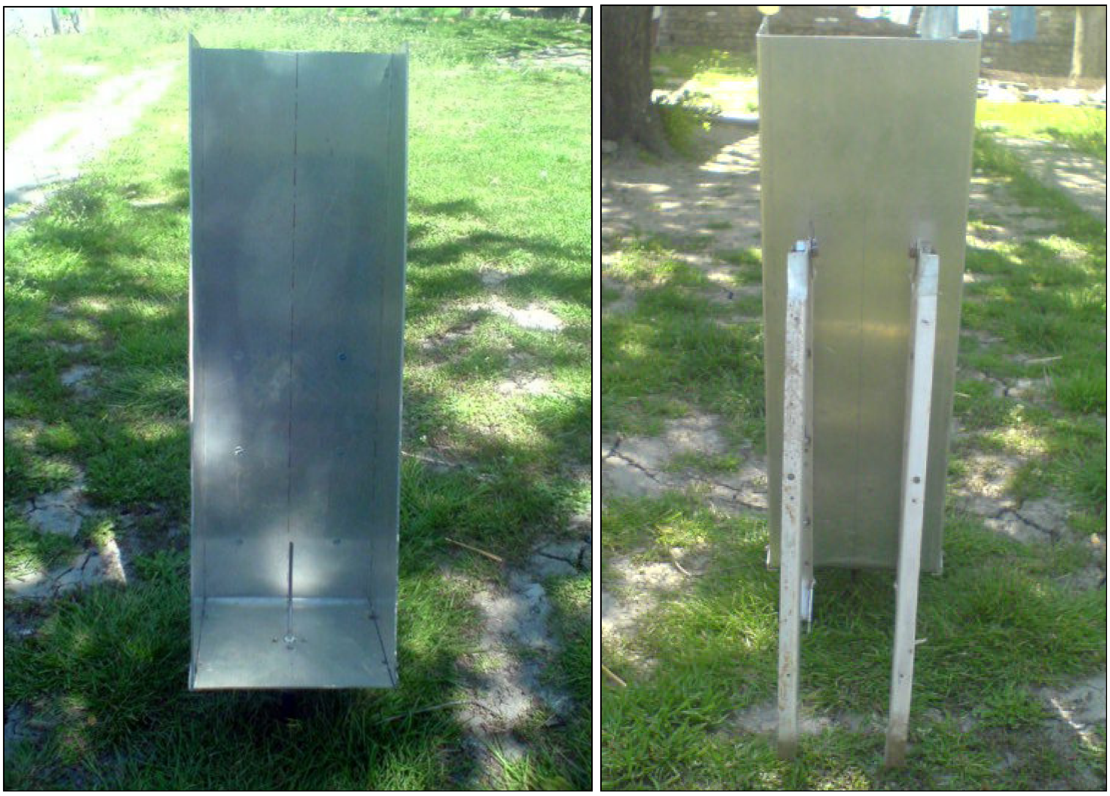

*Fig. 21. Obelisk antenna for 2.4 GHz  made of aluminium with mounting acessories.*

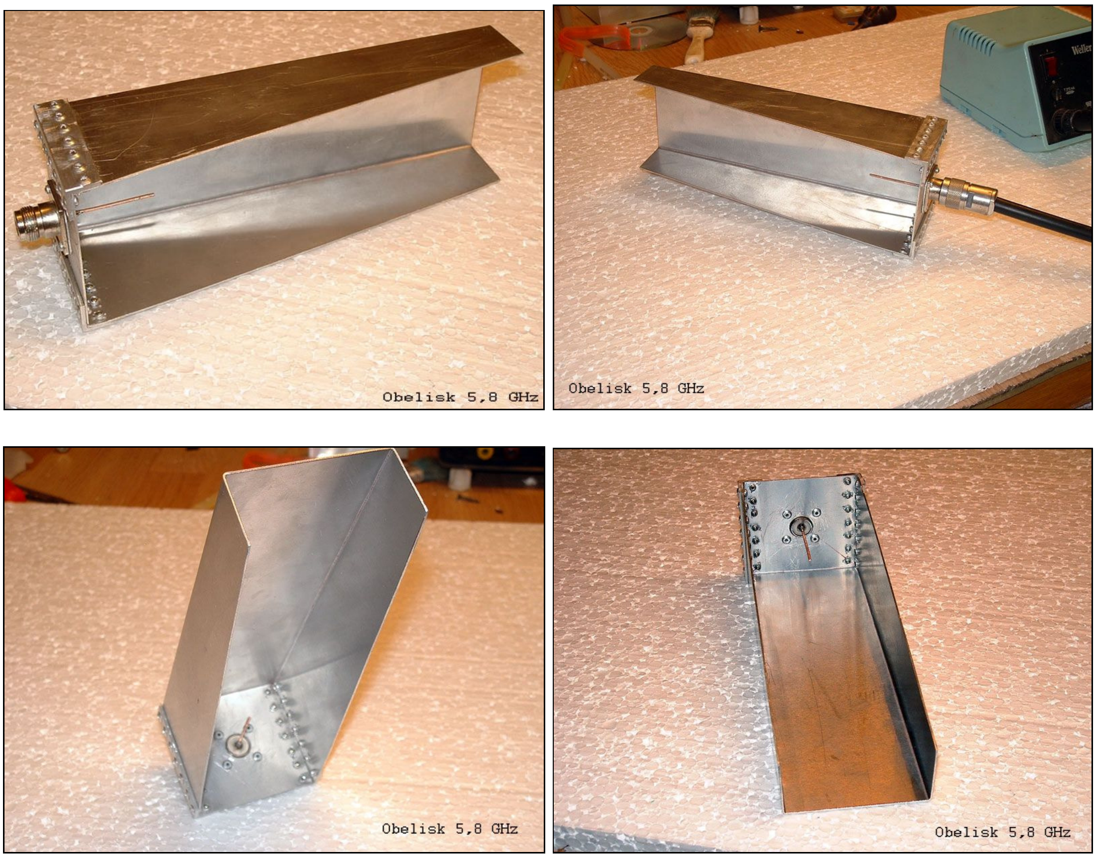


*Fig. 22. Obelisk antenna for 5.8 GHz  made of aluminium.*

**Reference**


1. Shortened 3D corner reflector antenna (antenneX, issue number 125)
2. 3D corner reflector antenna feed for 5.8 GHz (antenneX, issue number 126)