

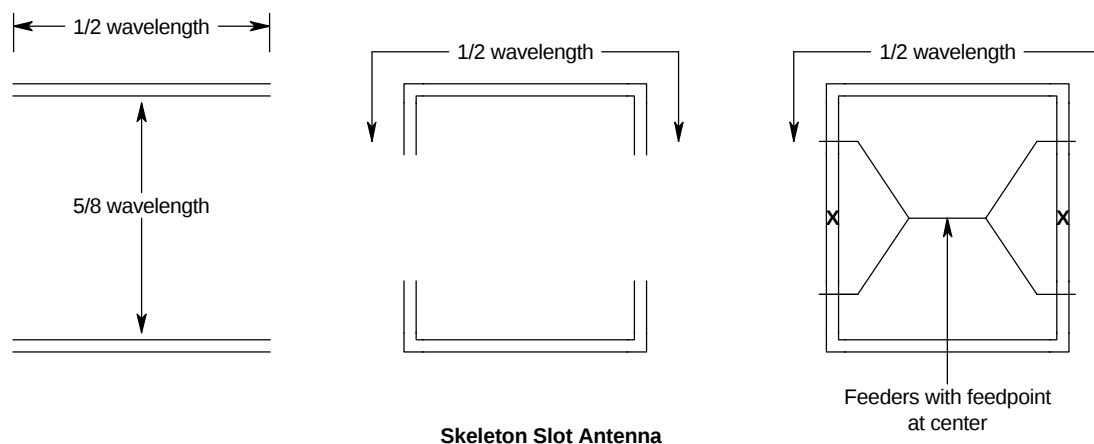
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The Skeleton Slot Antenna Revisited by Bobby Brainwave, N3VGS+

Having received correspondence about the skeleton slot antenna featured in the article "combination and hybrid antennas" in a recent issue of the QRN, I felt the necessity of revisiting this particular array and taking a closer look at its properties. It was brought to my attention by Howard, WA3EOQ, that this antenna is not a combination of yagi and quad designs. It is an array of stacked yagis but the driven element is not one wavelength in circumference or fed at a current point as a quad element would be. Although the driven element resembles a slot radiator in appearance and feed point, there are no other similarities between the two. First let's look at the properties of a slot radiator. See also the article "The Slot Radiator Antenna" in this issue.

The slot radiator is as its name suggests, a slot cut in an infinite conducting plane. The slot is a multiple of half wavelengths at the desired operating frequency and current fed with balanced transmission line at the center. It appears electrically to be two shorted quarter wave transmission lines with no radiation possible. Currents circulating through the conducting plane about the slot cause a radiation pattern that is perpendicular to the slot. In other words, a vertical slot radiator is horizontally polarized and vice versa. There is no radiation at the slot ends. Studies were done to reduce the conducting plane from infinite proportions to a wire slot to determine when properties of a slot radiator disappeared. It was found that when the conducting plane was reduced to less than one half wavelength from the slot, radiation quickly deteriorated. Therefore the skeleton slot driven element is not a slot radiator at all except in appearance.

Dimensions for the skeleton slot driven element have been developed by experiment. Best performance is obtained with slot sides of $5/8$ wavelength and top and bottom of $5/24$ wavelength. If the skeleton slot is not a true slot radiator then how does it work? Consider two half wave dipoles separated by $5/8$ wavelength. Since the current portion of a dipole does the radiating, bend the voltage ends toward the opposite dipole. This gives an advantage that will be mentioned later. This end bending has a slight efficiency loss that is more than offset by stacking efficiency. Next, the bent ends of both dipoles are joined together by high impedance feed lines and fed at their centers for equal currents to the dipoles. This high impedance feed point is connected to transmission line with a tapered matching section or delta match.



The electrical differences between the skeleton slot and slot radiator are as follows: Radiation from the skeleton slot is from the slot ends and not the middle; the skeleton slot requires two sets of parasitic elements instead of one for the true slot; skeleton slot feedpoint is high impedance and requires matching while the true slot feed is low impedance. Both antennas exhibit wide bandwidth and a single feedpoint.

The other advantage that the skeleton slot driven element brings to a stacked yagi array is due to the bending of the radiating dipole elements. In a yagi antenna the impedance of a split dipole driven element varies greatly with spacing and quantity of the parasitic elements, often being reduced to below 20 ohms and difficult to match to coaxial cable. This is due to capacitive coupling between the voltage ends of the driven and parasitic elements. With the skeleton slot driven element these voltage ends are bent down and away from the plane of the other elements. Therefore, the feed impedance does not vary as much with element spacing or number of directors yielding a much wider bandwidth at a slight loss of gain.

This type of array gives almost equivalent gain to two stacked yagis but exhibits wider bandwidth and a single feed point. These are necessary qualities for operators who need an antenna to cover an entire ham band or are using wide bandwidth modes such as FM or amateur television. Another great advantage is when vertically polarized, the support mast if metallic does not interfere with the antenna pattern since each yagi portion is side mounted. Physical size limits this array to 6 meters and higher in frequency. Its popularity goes back over thirty years and is not difficult to construct as a home-brew project.

Thanks again to Howard, WA3EOQ for correcting me and supplying information for this article, including the dimensions for the delta match I needed to complete my home-brewed 2 meter skeleton slot antenna. In the next issue we will look at horizontally polarized omnidirectional antennas such as the halo or squalo, S dipole, wheel types, and turnstiles. Another type of horizontal omni antenna is the Alford Slot covered in "The Slot Radiator Antenna" also in this issue of the QRN.