the Novice Shack

Conducted by

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The question of the month is "Do vertical antennas have any advantage over horizontal ones for Novice and General-Class use on the amateur bands between 3.5 and 21.5 Mc?"

To establish a basis for comparison, most experienced amateurs will agree that all horizontal antennas used by amateurs have directional properties. Often, it seems that when one is erected in the only position possible, it transmits its strongest signal in the least desired direction and vice versa. A height of 35 feet is a good compromise for a "general-purpose" horizontal antenna, while a height of 50 to 70 feet is about optimum for a DX antenna.* A horizontal antenna requires two supports.

In contrast, a vertical antenna radiates equally in all compass directions. When it is mounted with its base near the ground and is less than ⅝-wavelengths long, maximum radiation occurs at a vertical elevation of zero degrees and gradually decreases as the angle is increased. Only one support is required.

Obviously, if practice and theory agree, the vertical antenna does have some important advan-

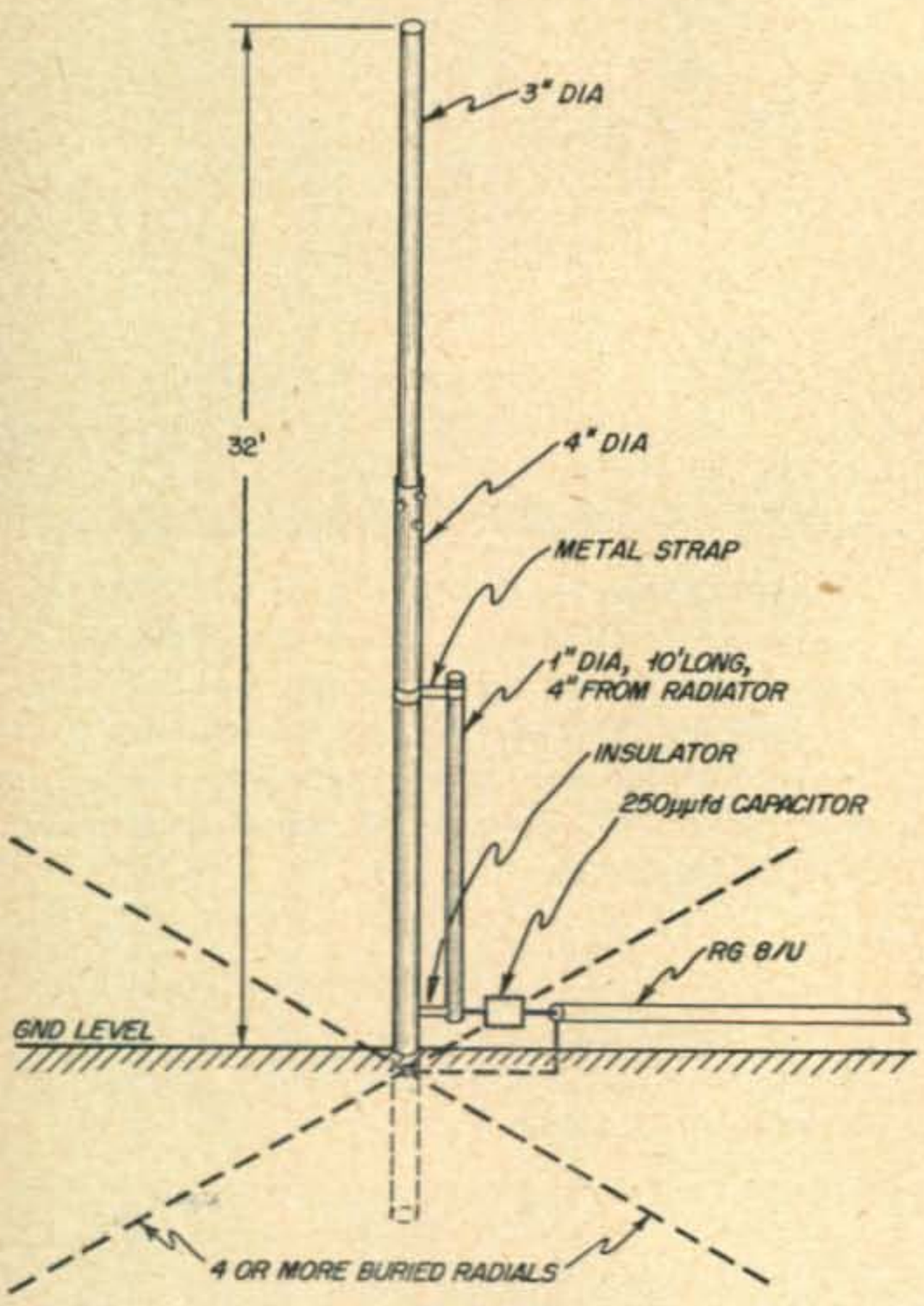

Fig. 1. Essential details of a simple, 40-meter vertical antenna, which will also work on 15 meters. It may be installed with its base a few inches from the ground and the ground radials buried a couple of inches under the surface of the earth. When its base and the radials are some distance above the ground and insulated from it as shown, a "ground-plane" vertical is formed. In either event, a minimum of four radials are recommended.

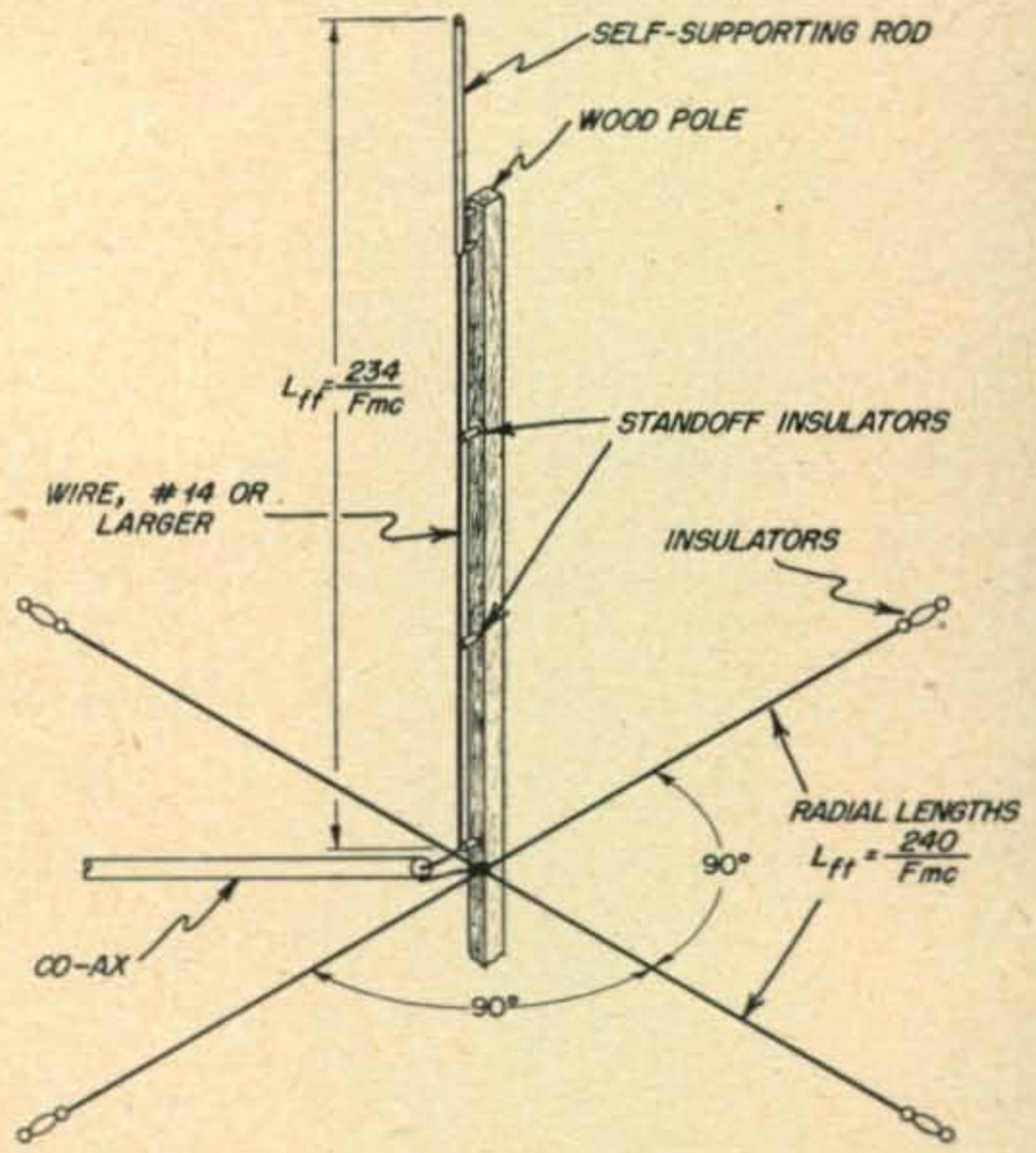

Fig. 2. A "shunt-fed," 40-meter vertical antenna. Because of the large diameter of the radiator, which may be aluminum "irrigation tubing" or galvanized rain pipe, its length is slightly less than that determined by the formula, $L_{ft} = 234/F_{Mc}$, usually used to calculate the resonant length of a ¼-wave antenna. The capacitor between the center conductor of the coaxial line and the matching bar may be made variable and adjusted for minimum line SWR.

*A height of 70 feet (½ wavelength at 40 meters) centers the lowest lobes of radiation at the following vertical angles: 40 meters, 32 degrees; 20 meters, 15 degrees; 15 meters, 10 degrees; 10 meters; 8-9 degrees. These are the measured, median angles at which DX signals are transmitted and received on these bands. Greater height would be optimum for an 80-meter DX horizontal.

tages. Combining a bit of research reading with some personal experience with verticals indicates the following:

On the average, a properly installed vertical antenna is a better "DX" antenna than is a simple, horizontal antenna 35 feet or less high. The horizontal antenna normally produces stronger signals over medium distances, especially on 80 and 40 meters.[1, 8]

As the height of the horizontal antenna is increased, the difference in DX results between the two types becomes less. The late W9LM, for example, reported that on 40 meters there was no essential difference in DX results between a ¼-wave ground-plane vertical antenna and a ½-wave dipole 67 feet high, except that the horizontal was an "S" unit or so better broadside than it was off the ends.[1]

On the debit side, it must be stressed that putting up an efficient vertical antenna entails a lot more effort than hanging a piece of wire from an upstairs window and tieing a feedline to it.

Designing A Vertical Antenna

To show what must be done, let us examine a 40-meter vertical more closely. This band was chosen, because the resulting dimensions are reasonable.

To halve the required height, we will operate the antenna against ground, making its length 32 to 33 feet. Besides being shorter, a grounded, ¼-wave vertical antenna differs in two characteristics, compared to a ½-wave one.

The point of maximum current is lowered from the center of the antenna to its base. As maximum radiation occurs from the part of the antenna carrying the greatest current, this means that maximum radiation will occur from the bottom of the antenna. Also, the percentage of power radiated at medium-high angles of elevation will be increased. A ½-wave vertical radiates little energy at angles above about 25 degrees, while the ¼-wave one radiates a fair amount at angle approaching 60 degrees.

Obviously, it becomes very important to install the ¼-wave vertical antenna where it is not surrounded by power-absorbing utility wires, rain gutters, metal-frame buildings, large, leafy trees, and the like. If this precaution is not observed, its efficiency will be quite low.

The power radiated at relatively high angles by a ¼-wave vertical is an advantage on 40 and 80 meters. Remember, you do not operate a broadcast station, from which you are primarily interested in maximum ground-wave range. It is entirely possible to obtain too low an angle of radiation from a ½-wave vertical antenna on these frequencies for best results.[1]

It is fortunate that extremely low-angle radiation is not required on the amateur bands up to about 25 Mc. On frequencies above about three Mc, all

Roy Griffin, (17), K4ABZ, Pinetops, N. C., a week before obtaining his 'General.' He runs about 25 watts to a home-built 80-meter transmitter and has a much-modified S-41G receiver.

Now that Steve Chase, WN7WSS, Vernal, Utah, has worked the 48 states and ten countries as a Novice, he is ready to try for his 'General.'

Sixty-five watts to a Globe Scout transmitter, abetted by an NC-98 receiver and a 75-foot antenna has earned Dave Corsair, KN2KHZ, Newark, New Jersey, 21 states and Canada in a few months on 80.

Ronald McCloud, WN1DVT, Shelburne Falls, Mass. His *Lettine* 240 transmitter and *Hallicrafter's* S-53A receiver gets him many contacts on 80 meters.

energy radiated by an antenna at angles much below 10 degrees is absorbed by the earth within a short distance from the antenna, anyway.

This is true whether the antenna is horizontal or vertical. But, as horizontal antennas do not radiate energy at such low angles, unless they are a couple of wavelengths high, it is seldom a factor with them. With verticals, however, the power so lost reduces the amount that can be radiated at more-useful angles. But, do not become too alarmed about it. Horizontals waste their share of power by radiating it at angles too high to be useful.

The Vertical Antenna Ground System

The value of a low-loss ground system for use with any vertical antenna cannot be overestimated. The feed-point (radiation) resistance of a ¼-wave grounded antenna is 35 ohms or less. If the ground resistance is also 35 ohms, and it can easily be more,[2, 3] only half of the power delivered to the antenna terminals can be radiated. The other half will be wasted in heating the earth around the ground connection.

Equally as important as the losses directly below the antenna are those in the earth surrounding it for a considerable distance, because they absorb r-f energy from the field around the antenna.

Undoubtedly, the best way to reduce both types of losses is to bury a number of wires, called *radials*, extending from the base of the antenna like spokes in a wheel. They should be ¼-wave long and be connected together under the antenna, to form the ground connection. They need be buried only deep enough to protect them from mechanical damage.

Broadcast stations use 90 to 120 buried radials. This many is not required in an amateur station. The rate of improvement goes down as the number is increased above four, equally spaced. Few amateurs use more than 20. A length of ¼-wave (35 feet at 40 meters) is recommended, but radials as short as 1/10th wavelength (15 feet at 40 meters) help. They may be constructed of No. 12 or larger, copper or aluminum wire.

The Ground-Plane Vertical

When the radials are exactly ¼-wavelength each and are mounted above the earth and insulated from it, the *Ground-Plane Vertical Antenna* is formed. Usually, four, equally-spaced radials are used in one. This configuration is useful when it is desired to raise the base of the antenna above power-absorbing objects by mounting it on a post or on the roof of a building. Doing so has little effect on the angle or radiation from the antenna. The radials can slant downward towards the ends 20 degrees or so, if necessary.

Feeding the Vertical Antenna

A simple and effective method of feeding a ¼-wave vertical antenna is with 52-ohm coaxial cable (RG-8/U), which may be buried. Connect its center conductor to the base of the antenna and the shield to the ground terminal or to the center of the radials.

In installations in which the antenna is a self-supporting metal tube with its base buried in the ground, it may be fed through a system similar to the *gamma* match used on rotary beams.[4] *Figures 1* and *2* give essential data on the two systems.

Using the Vertical Antenna on Several Bands

Basically, simple vertical antennas are one-band radiators; however, one designed for 40-meter operation usually does a pretty fair job on the 15-meter band. Extending operation to more bands becomes a matter of making the radiator a compromise length and adding loading coils or resonant circuits to it and similar expedients,[3, 5, 6, 7, 8] which I do not have room to discuss here.

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3. "The Truth About The Vertical Antenna," B. W. Griffith, W5CSU, *QST*, May, 1952, page 11.

4. "Mail Order Antenna," R. W. Johnson, W6MUR, *CQ*, November, 1953, page 38.

5. "How To Build An 80-Meter Midget Antenna," William I. Orr, W6SAI, *CQ*, November, 1952, page 31.

6. "A Four-Band DX Antenna," LCDR Paul Lee, USN, W2EWP, *CQ*, November, 1953, page 20.

7. "Three Bands, One Vertical," William Harrison, W6ULD, *Radio And Television News*, June, 1954, page 66.

8. "Vertical Multiband Antennas," L. L. Taylor, W8LVK, *QST*, May, 1955, page 19.

See also the antenna chapters in the ARRL and "Radio" Handbooks, *Radio Engineering*, F. E. Terman, and the *Antenna Book* (ARRL), and the *Antenna Manual*, Woodrow Smith.

News For and About Novices

Stephen Case, WN7WSS, RFD #1. Vernal, Utah, writes, "After you printed my last letter, I was swamped with offers for skeds. It appears that everyone needs Utah. I try to meet all offers.

"I worked my 48th state—North Dakota—last Sunday. He promised to QSL airmail, but I cannot seem to beg, borrow, or steal a card from my only New Hampshire contact.

"I agree 100% with your article on working DX in the March column. I don't spend too much time hamming, but what time I do spend, I spend listening, listening, listening. My DX on 40 meters is KV4BK, KH6, KL7, WP4, VE2,3,5,6,7. On 15, I picked up TI9MHB, JA8AQ, and KZ5. 73."

Bob Heroux, W9SQP, 220 South 17th Ave., Maywood, Ill., brings up an interesting question. "I was wondering if I was the first, or one of the first, former Novices to get an Extra Class license. I would sure like to hear from any others. 73."

An even shorter one from KN4CHK (Address in 'Help Wanted'): "Why not start putting the 'QSL of the Month' in the *Novice Shack*?"

Donn Fisher, KN6KRK, P. O. Box 344, Ft. Ord, Calif., had about the same experience with his first contact as most of us did. "I got my license yesterday and had my first contact last night. At the end of 45 minutes, I got the other fellow's name and QTH! The other fellow, KN6JZS, copied me solid.

"I'd appreciate a few pen pals, and I'd like to hear from anyone around Fort Ord or Salinas, Calif., who is interested in 2 meters. 73."

Chas. Morenus, KV4BK, P.O. Box 618, Christiansted, St. Croix, U.S. Virgin Islands, reports, "Since you published my letter in March, I have had lots of fun giving the Novice ranks their first KV4 or any DX at all. The comments in the letters and cards received has been very gratifying. However, there is one thnig that I think you should stress. Repetition after receiving an R5 report from the other fellow is not only unnecessary, it is downright tiresome to the other fellow. Only when the readability report is below R3 is it necessary to repeat (QSZ).

"As an example, this morning I called CQ WN KN at 0530 EST (just below the low-frequency end of the 40-meter Novice band—Herb) as usual. A KN4 answered me, calling KV4BK for a minute before signing his call for the first time! The band is very narrow, and it takes me only a few seconds to hear anyone calling. When he stood by at 0535, I gave him a 569X report. He replied with about a 6 X 6 call, 5 or 6 R's, Tnx several times, his name 6 times, name of town and state and U.S.A.! twice, all with punctuation marks thrown in for good measure. All the while, I was tapping the desk with my fingertips, waiting for him to finish; so that I could work a few more Novices before I went to work.

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