IDEAS FROM ABROAD

Eurotek

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Quarter-wave 'slopers' have been a cheap way to DX on the lower HF bands for some, but many could not make them work at all. **Karl H Hille, DL1VU,** has tried to take the guess-work out of the design. From **cq-DL** 4/93 by kind permission of DARC.

IT ALL STARTED with amateurs who already had a tower with one or more beams for 14MHz or higher but no space to add a good DX antenna for a lower band. The typical λ/4 or 'half' sloper for 7MHz would then consist of a 10m wire, attached to an insulator 10m up the mast and tied away at an angle of 45° to the vertical. The coax feeder would run up the tower with its core connected to the top of the sloper wire and the braid to the tower, see **Fig 1** [1].

With luck, a manageable SWR would result and the system would show a few dB of directivity in the direction of the slope. This luck was found to depend on many factors, among them the height of the tower and the attachment point, what else was mounted on the tower, the angle of slope, and the ground under the sloper [2]. Those with nothing else on the tower always seemed to be out of luck and those with a wooden mast with only the coax braid as a counterpoise fared even worse, whatever they tried in terms of sloper length and angle. [*Counterpoise* is the key word here, and DL1VU is an expert on that subject – see Eurotek, Feb '91 – *G4LQI*]

THE 7MHZ TEST SET-UP

TO SHED LIGHT ON THIS murky situation I raised in my garden a mast of 40mm OD aluminium tubing, 12.22m high. All cross trees, shrouds and stays were of non-conducting materials so as not to influence the measurements. The mast was erected on and strapped to a near-ideal earth mat consisting of a 50cm square aluminium plate with 48 evenly spaced 21.5m buried radials.

The coaxial cable from my shack [3], 34m of RG8/U, runs up the mast to a connector inside a rain shield (an aluminium box without a bottom) which is bolted to the mast 1.5m below its top. The half-sloper, initially 10.8m long, runs down at a 45° angle from a strain insulator which is attached to the mast between the rain shield and the top. A wire jumper connects the centre of the coax socket to the top of the sloper. An all-aluminium pulley is bolted to the top of the mast and a long bare stranded tinned-copper wire (I would have liked to avoid dissimilar metals but had no aluminium rope) was run over the pulley so that any desired length can be pulled away from the mast top as a counterpoise while the other end is wrapped around the mast and electrically becomes a part of it.

EXPERIMENTS

IN THE FOLLOWING TESTS, SWR was plotted against frequency throughout the 6.5 – 7.5MHz range for different lengths and slope of the counterpoise wire. Restricting the measurements to our narrow 7.0–7.1MHz band might have hidden important trends. [Using a noise bridge and a Smith chart, SWR can be established without transmitting – *G4LQI.*]

The first series of measurements was with the counterpoise also sloping down at 45° and in the direction opposite to the sloper (**Fig 2**). Starting with the counterpoise at zero-length and increasing it in steps, no reasonable SWR was obtained until the length was 8m. From there, the frequency of best SWR dropped by approx. 280kHz for every metre added to the counterpoise length until at approx 9.5m it fell in the 40m band with a 2:1 SWR bandwidth of 150kHz.

After shortening the sloper by 0.5m to 10.3m another series of measurements was done and now the best SWR was in the 7MHz amateur band with a 10m counterpoise, ie with sloper and counterpoise of nearly equal length.

The next question to be answered was that

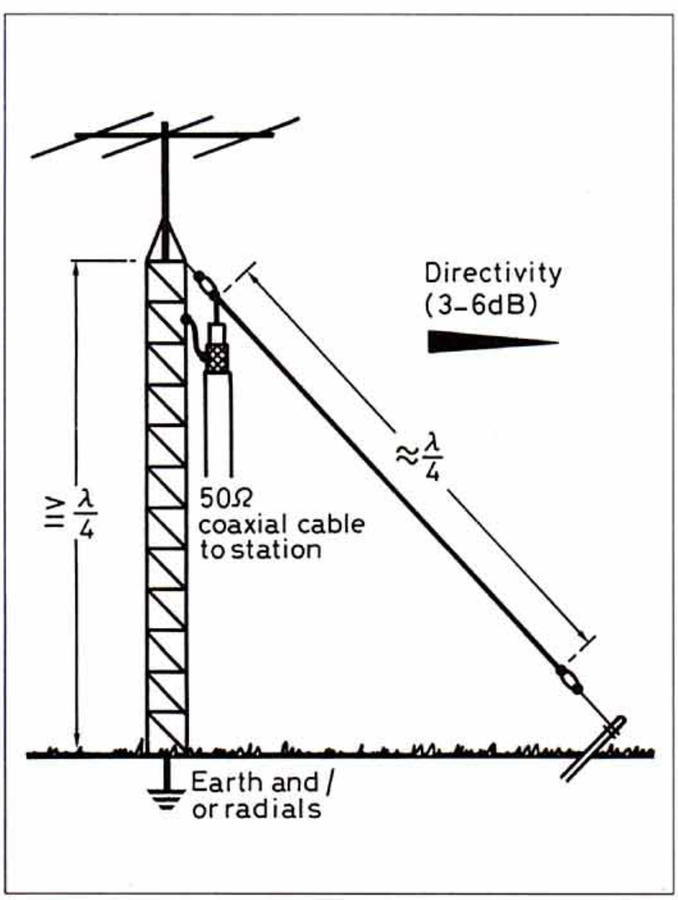

Fig 1: The half sloper as originally conceived – for some it works (from *ARRL Antenna Handbook*).

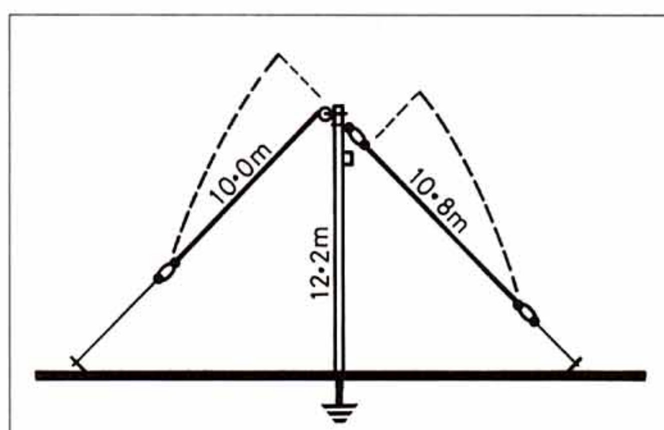

Fig 2: The 7MHz half sloper and sloping counterpoise – it works like an inverted-V. The mast, connected at the top and earthed at the bottom, does not affect the performance.

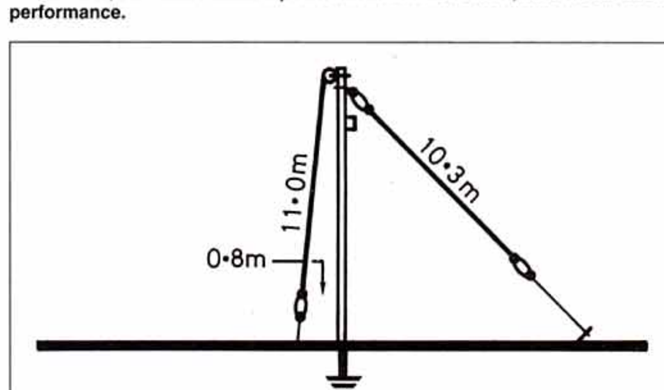

Fig 3: The 7MHz half sloper with non-radiating counterpoise.

of current and voltage distribution. Neon bulbs were connected to the lower ends of both sloper and counterpoise and 100W of 7MHz RF was applied. The two bulbs lit up with equal brightness, indicating roughly equal RF voltages at the voltage maxima, hence equal currents from the top and equal power being radiated by the sloper and the counterpoise. The conclusion: the system behaved like an inverted-V dipole and the mast did not figure in the result at all – a very usable antenna but not what was wanted!

Next, I tried to eliminate the radiation from the counterpoise. That was achieved by dropping the counterpoise down more steeply so that it ran almost parallel to the mast. **Fig 3**. That way, counterpoise and mast become a non-radiating λ/4 stub, open at the bottom and shorted at the top. With the spacing at the mast top fixed at 8cm by the pulley, the resonant frequency and its SWR could be manipulated by adjustment of the counterpoise length and its spacing from the mast at the bottom. I ended up with an 11m counterpoise spaced 80cm from the mast at the bottom with the line flat at 7025kHz. [As expected from what basically remains a dipole with an enclosed angle of only 45 degrees – *G4LQI*], the 2:1 SWR bandwidth had narrowed to 65kHz. **Fig 4**.

If the mast is not tall enough to accommodate the λ/4 counterpoise, the latter can be shortened by any of the methods commonly applied to antenna elements; this also applies to the half sloper itself. Bending, inductive loading and capacitive end loading are shown in **Fig 5**. [This does reduce the bandwidth even further and method 5b, with its easy ground-level adjustment, seems worth trying – *G4LQI*]

> **WARNING:** *The lower ends of the sloper and the counterpoise carry dangerous RF voltages.*

REFERENCES

[1] *The ARRL Antenna Hand Book,* available from RSGB.

[2] J S Belrose, VE2CV: 'The Half Sloper – Successful Deployment is an Enigma'. *QST*, 5/80.

[3] Photograph in *RadCom*, February 1993, page 15.

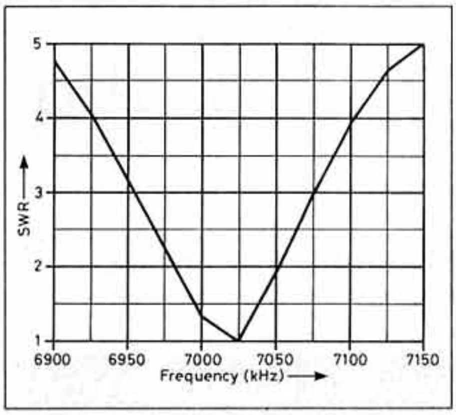

Fig 4: The SWR of the half sloper of Fig 3 was measured at 25kHz intervals. SWR-bandwidth is narrow.

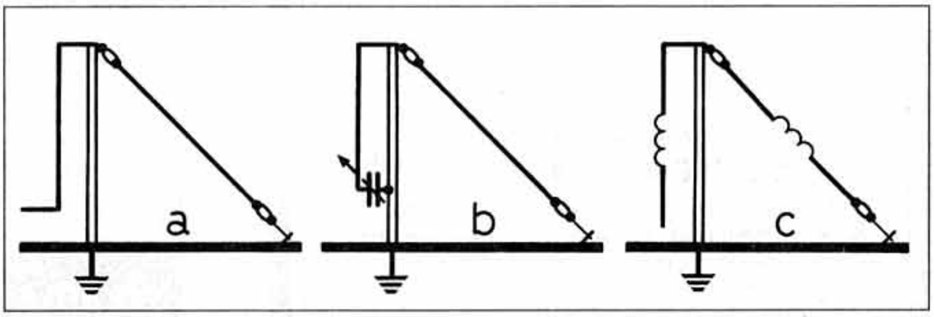

Fig 5: Suggestions for shortening the counterpoise if the mast is not tall enough: a) by bending the open end: b) by adjustable capacitive end loading: c) by inductive centre loading, here also applied to the half sloper itself. All these methods reduce the SWR bandwidth even more.