4Nec2 Antenna Modeling Workshop Part 1

Why Model Antennas?

To understand how an antenna will radiate a signal

To determine the frequency of resonance, SWR curve, etc.

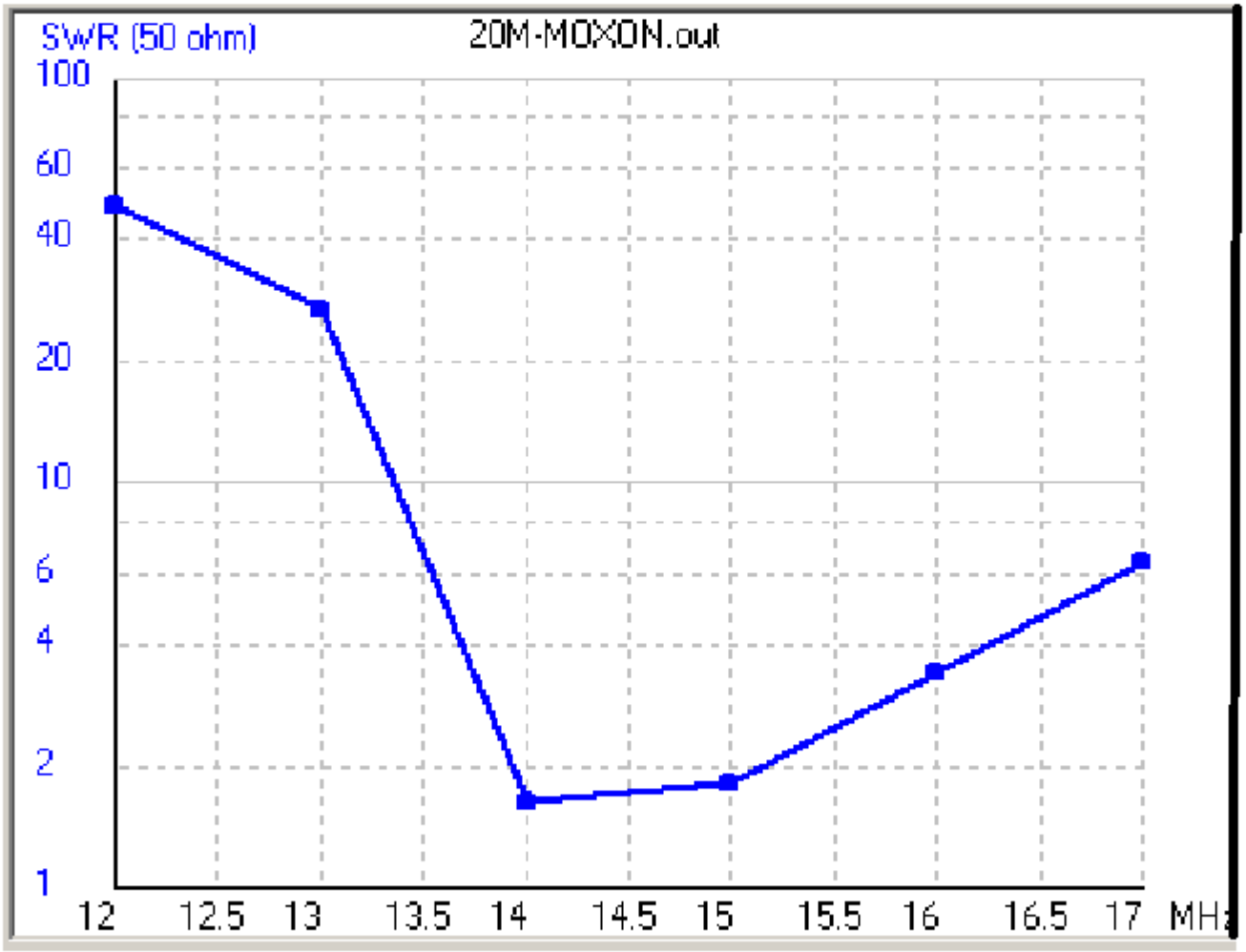
And all preferrably, BEFORE we actually build the antenna.

What can modeling software tell us?

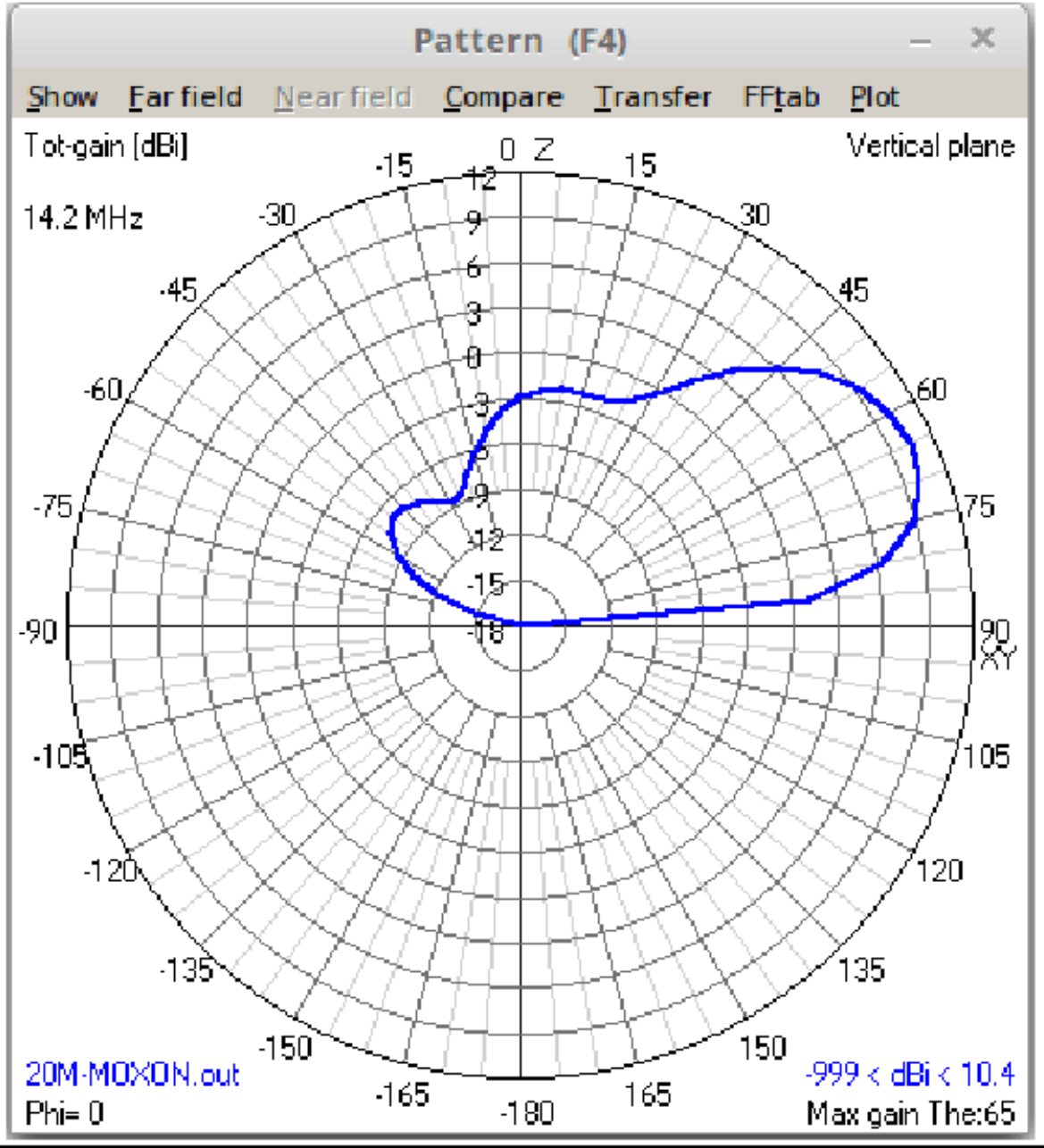
Radiation pattern, i.e., gain, front-to-back ratio, take-off angle.

These things can be quite difficult to measure empirically and, of course, to do empirical measurements means we have to build the antenna first.

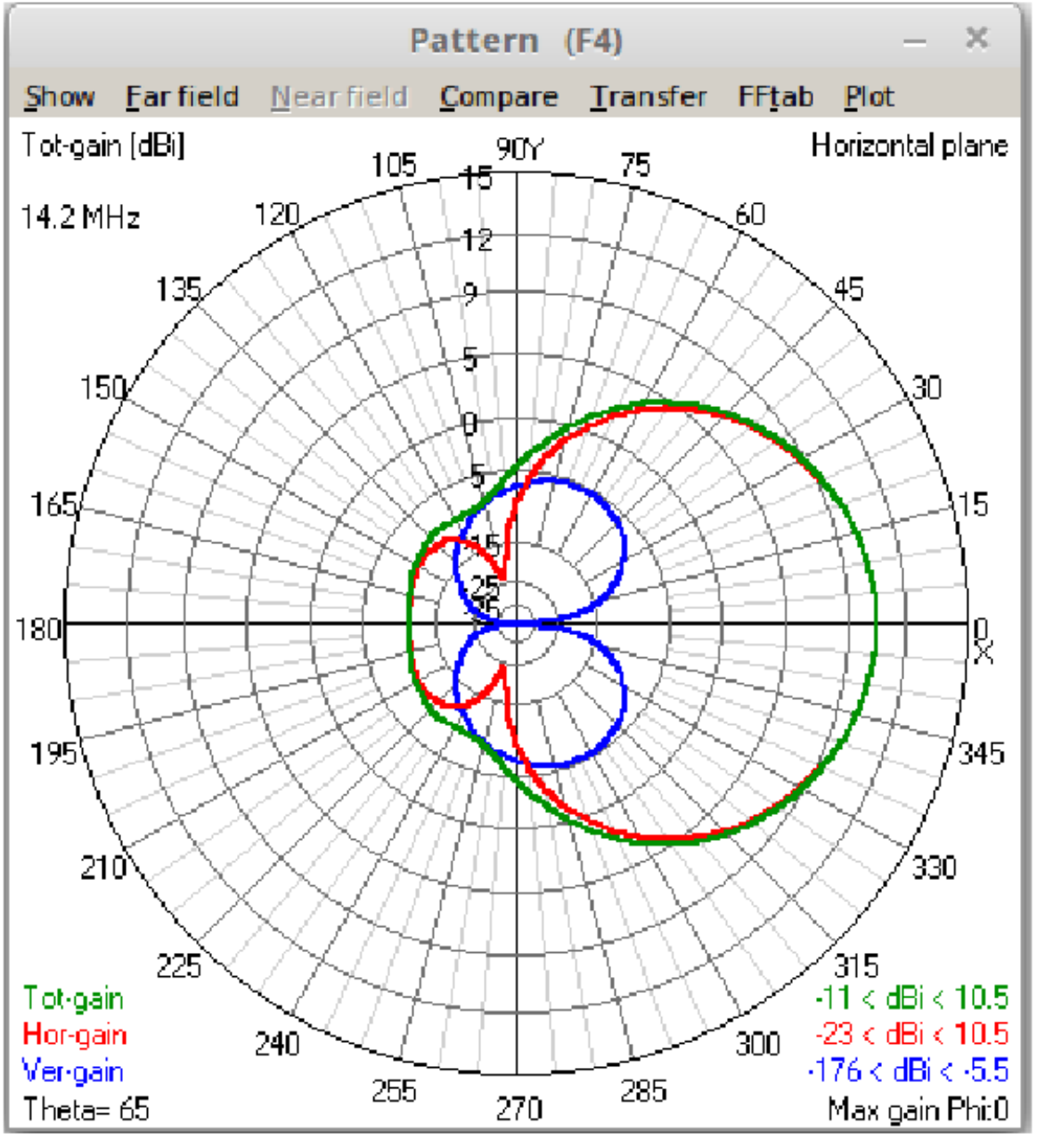
SWR Sweep


SWR (50 ohm)
20M-MOXON.out
100
60
40
20
10
6
4
2
1
12
12.5
13
13.5
14
14.5
15
15.5
16
16.5
17
MHz

Elevation Pattern (take-off angle)

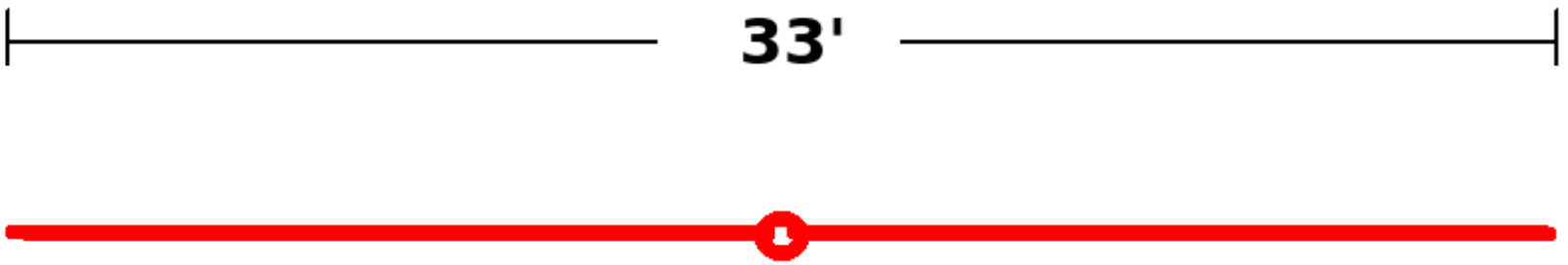


Azimuth (Horizontal) Pattern



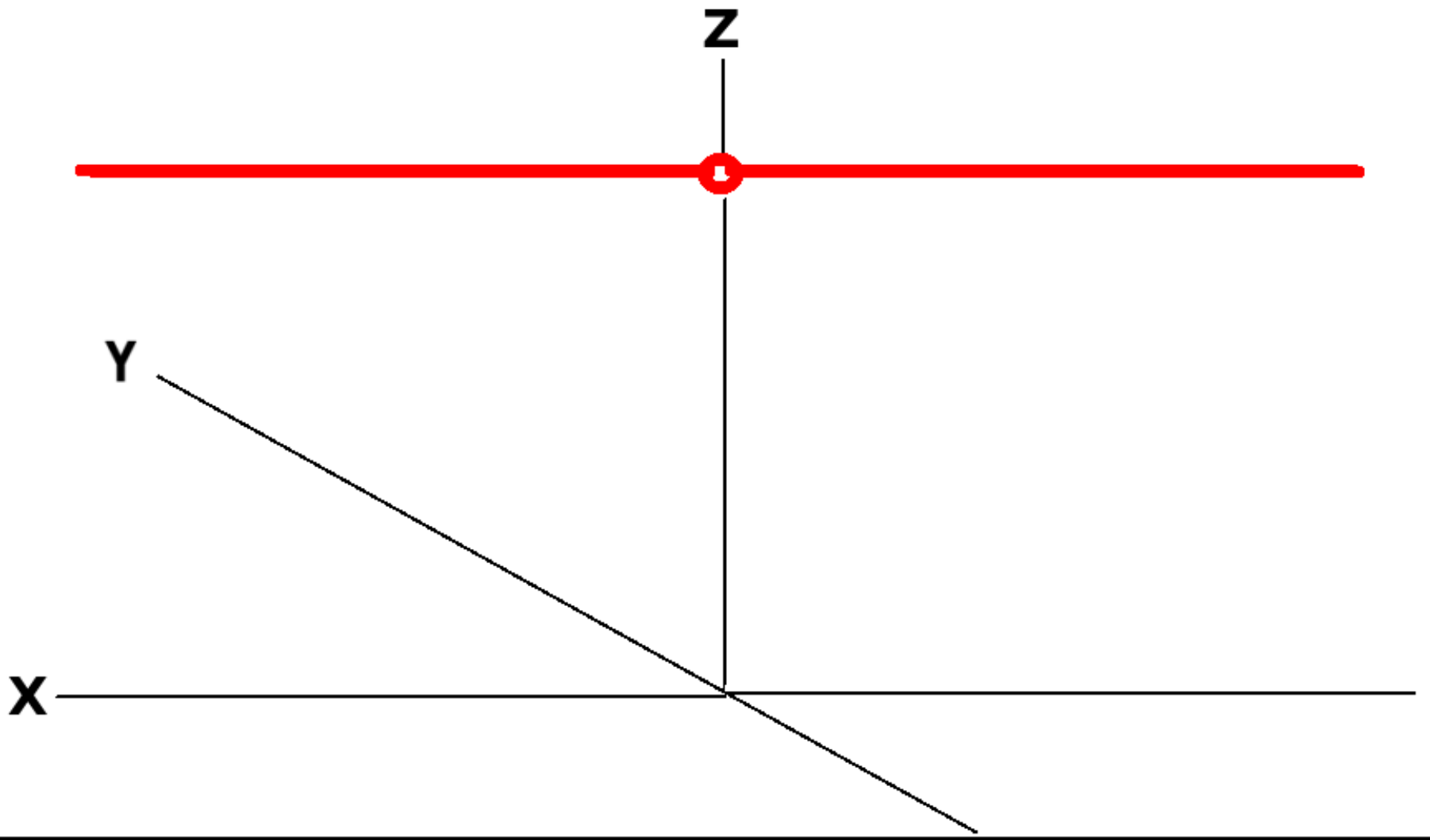
4Nec2
The basics:

Entering Data



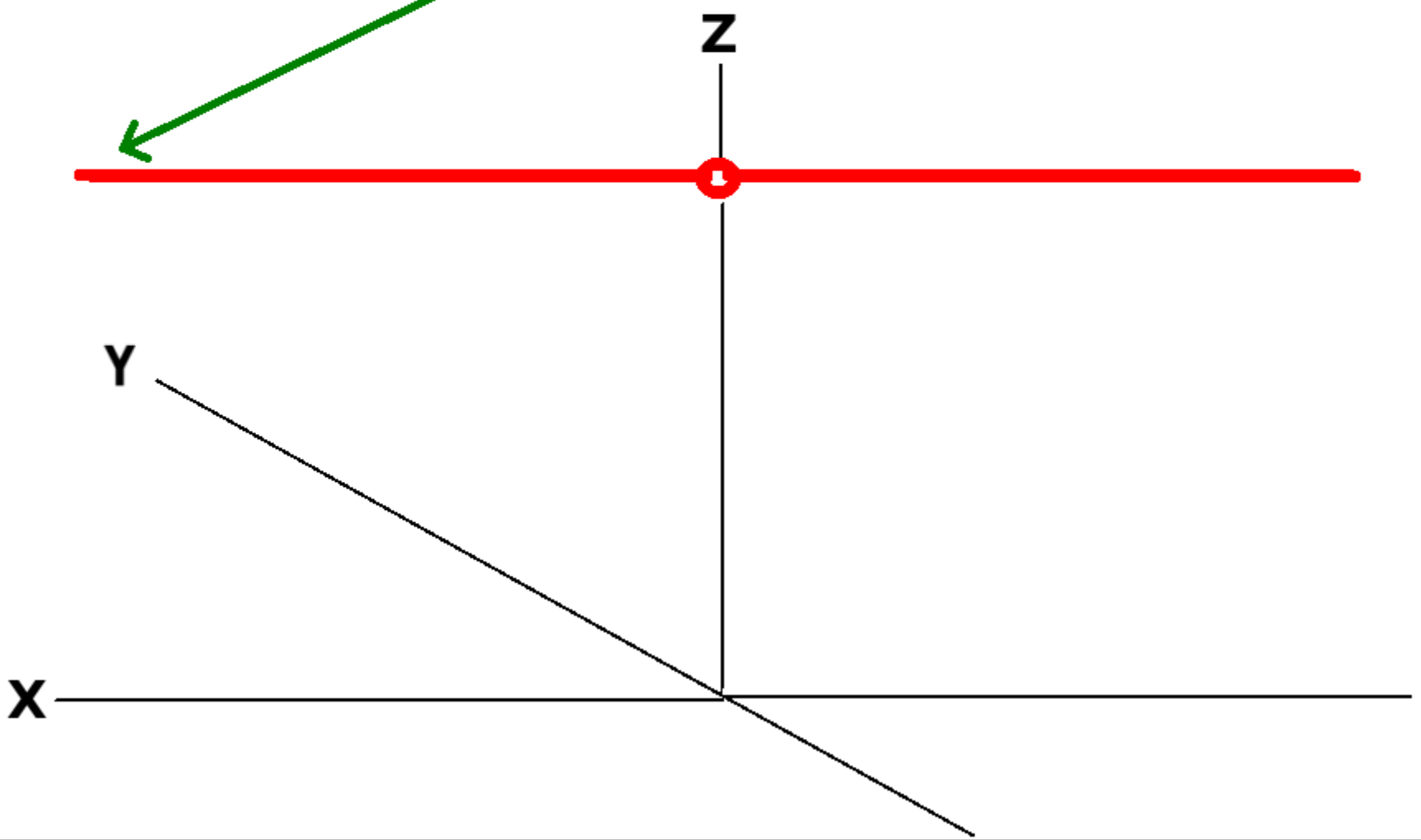
Half wave, center fed, dipole for 20 meters

Picture the dipole on a 3-dimensional grid (x,y,z)



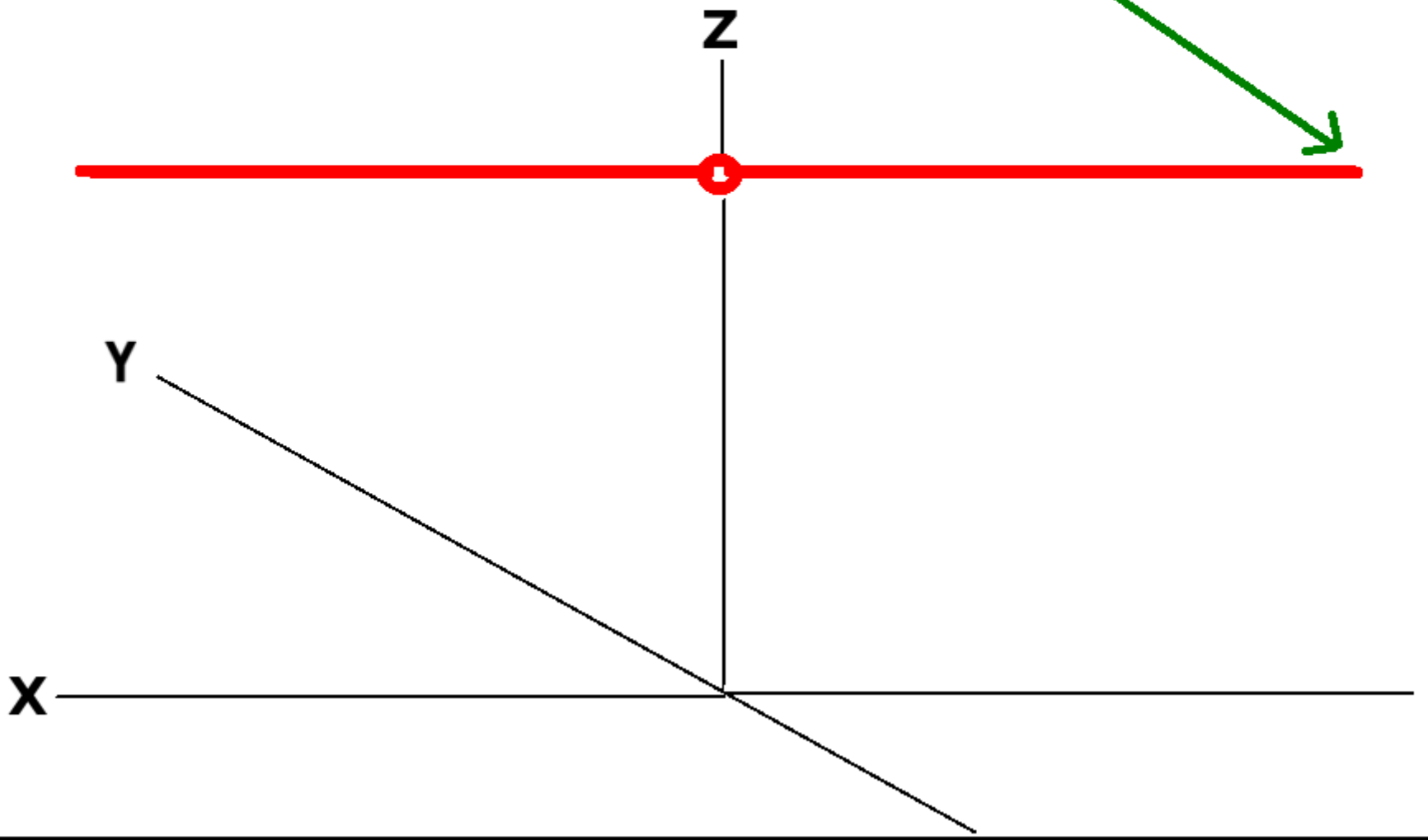
Describe the x, y and z coordinates of the left end of the dipole:

X= - 16.5
Y= 0
Z= 25'



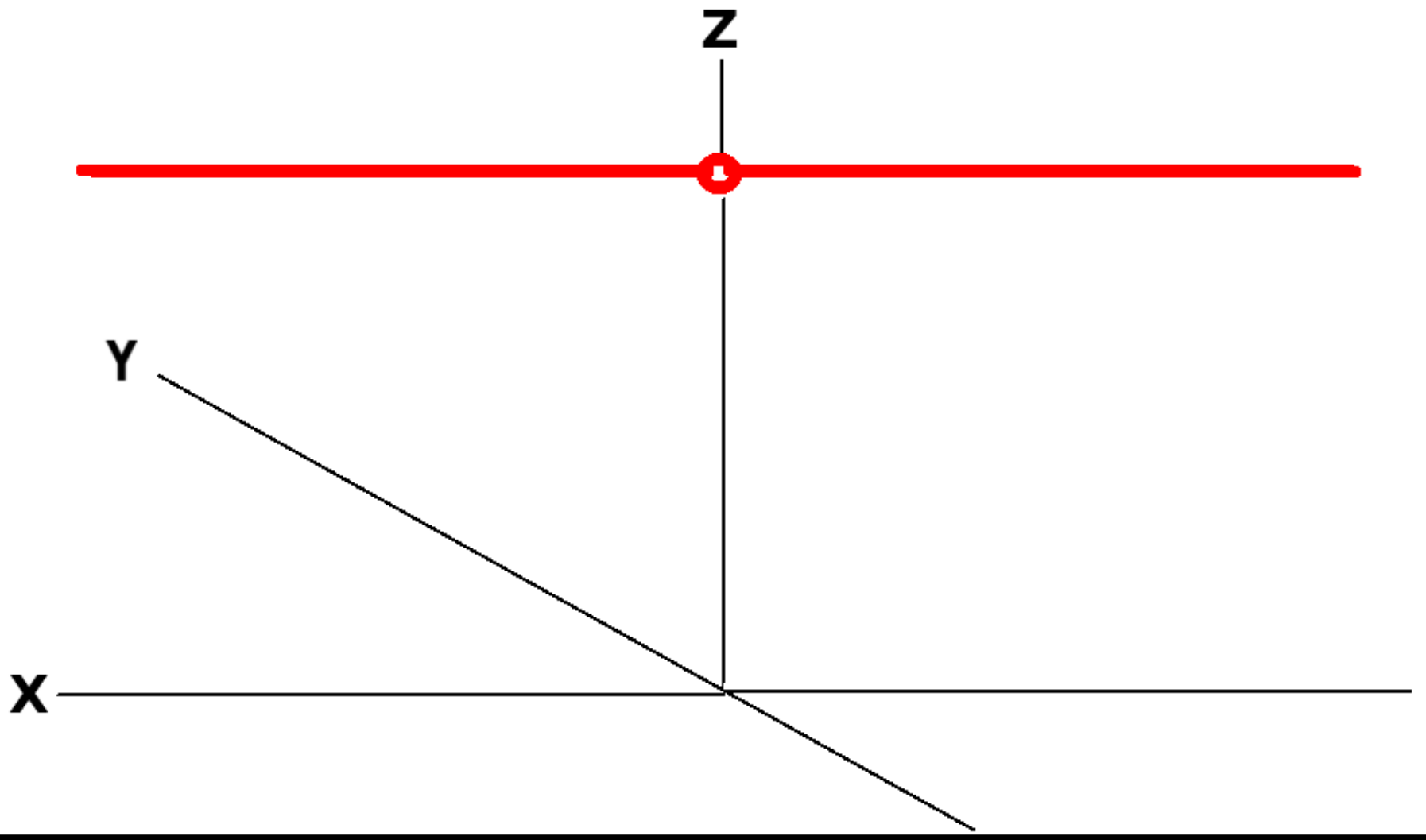
Describe the x, y and z coordinates of the right end of the dipole.

X= 16.5'
Y= 0
Z= 25'

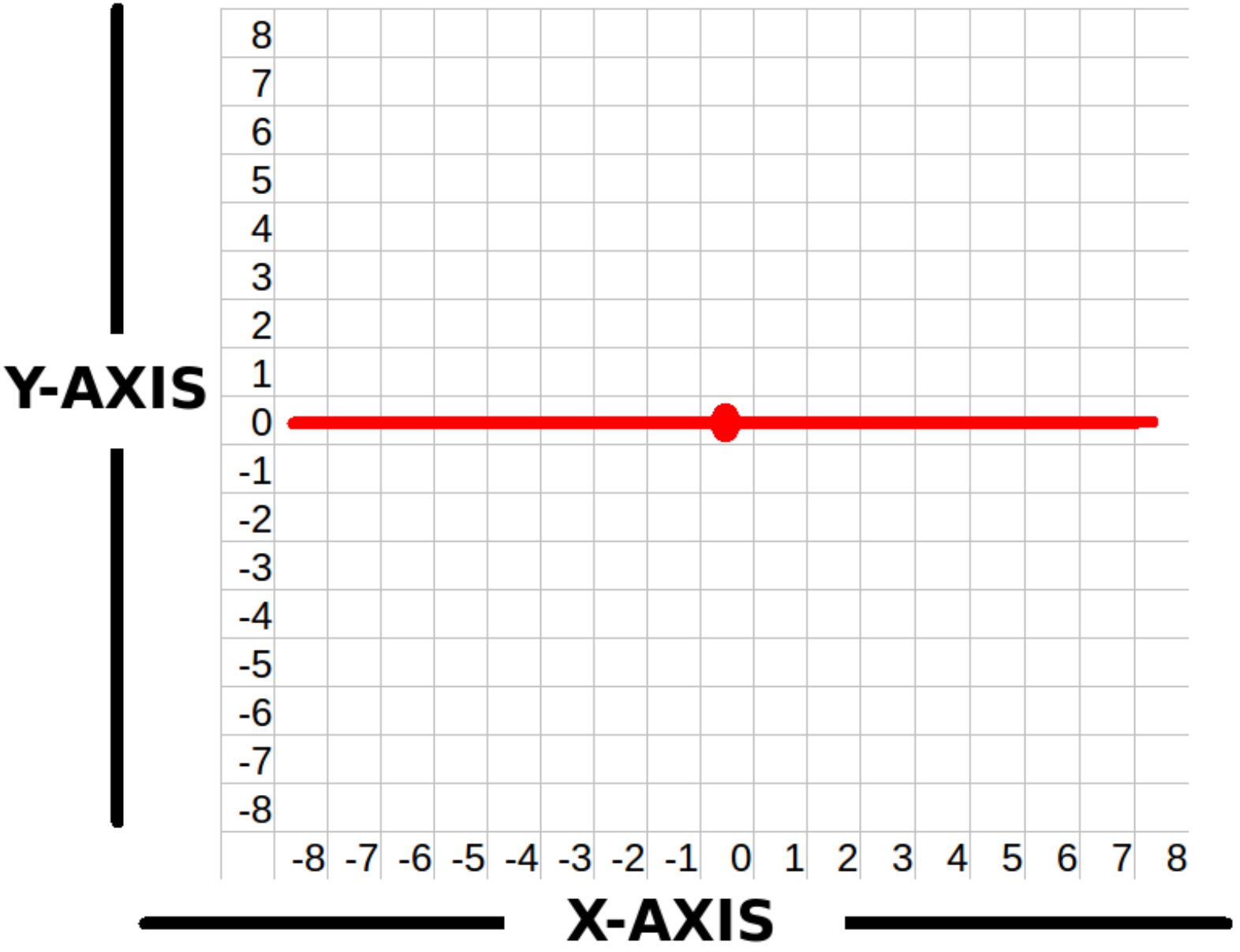


The dipole fully described:

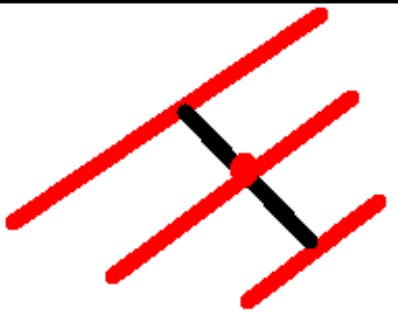
	End 1			End 2	
X	Y	Z	X	Y	Z
-16.5'	0	25'	16.5'	0	25'



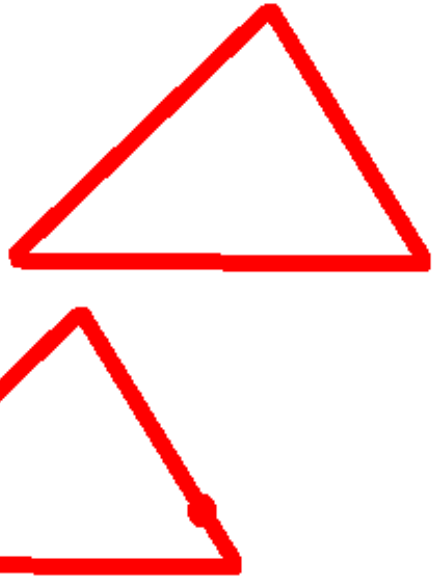
Many antennas can be visualized on a 1 or 2 dimensional grid (that's not cheating)



flat dipole: 1 dim.



yagi: 2 dim.



2-elem. Delta Loop: 3 dim.

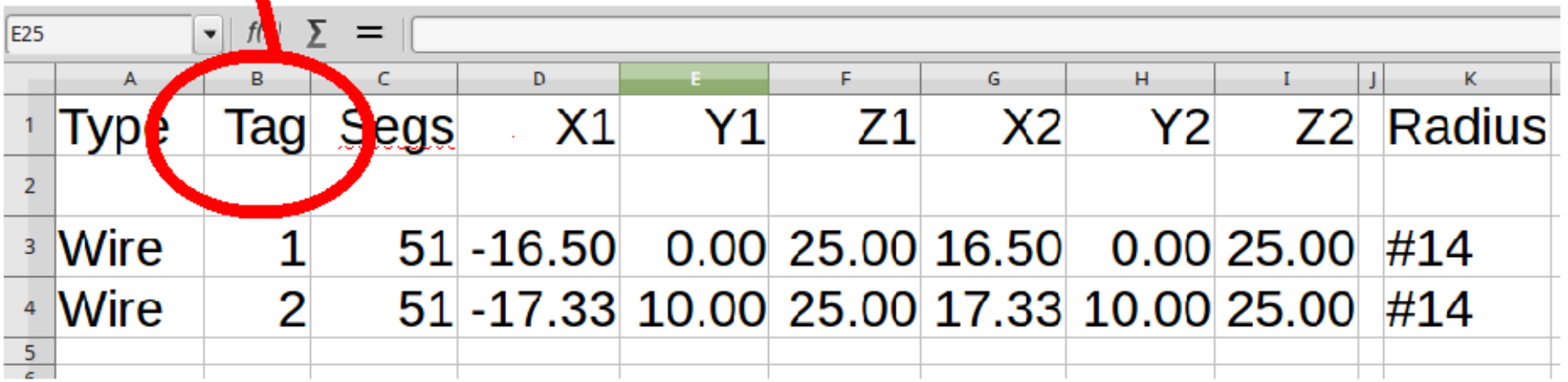
dipole in your attic: 3 dim.

The data entry screen looks very similar to your old friend the "spreadsheet" :

E25 f(x) Σ =

	A	B	C	D	E	F	G	H	I	J	K
1	Type	Tag	Segs	X1	Y1	Z1	X2	Y2	Z2		Radius
2											
3	Wire	1	51	-16.50	0.00	25.00	16.50	0.00	25.00		#14
4	Wire	2	51	-17.33	10.00	25.00	17.33	10.00	25.00		#14
5											

A "tag" is merely a unique identifier of each wire in the model.



E25

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1	Type	Tag	Segs	X1	Y1	Z1	X2	Y2	Z2		Radius
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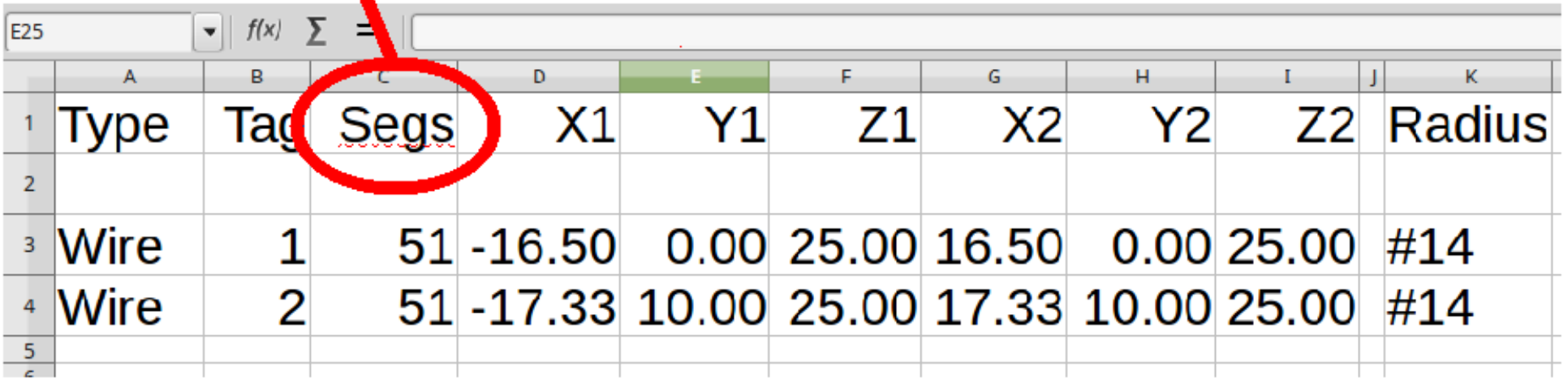
4	Wire	2	51	-17.33	10.00	25.00	17.33	10.00	25.00		#14
5											

"Segs" (or segments) divide each wire into small sections for the NEC engine to perform more accurate calculations on what's going on in any part of the wire.



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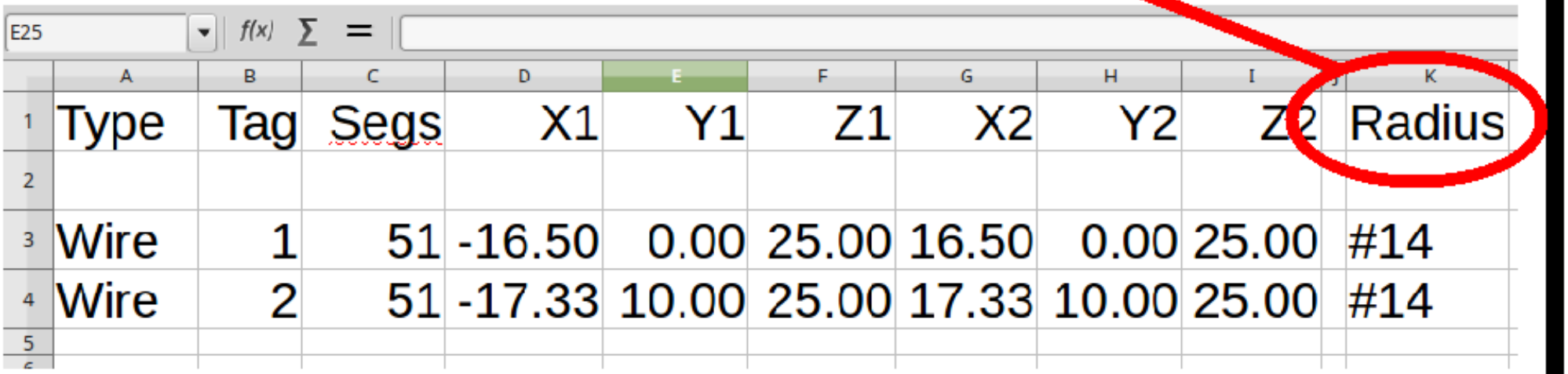
5											

Radius describes the width of the wire, typically in inches or millimeters for tubing, and AWG# gauge for wire.



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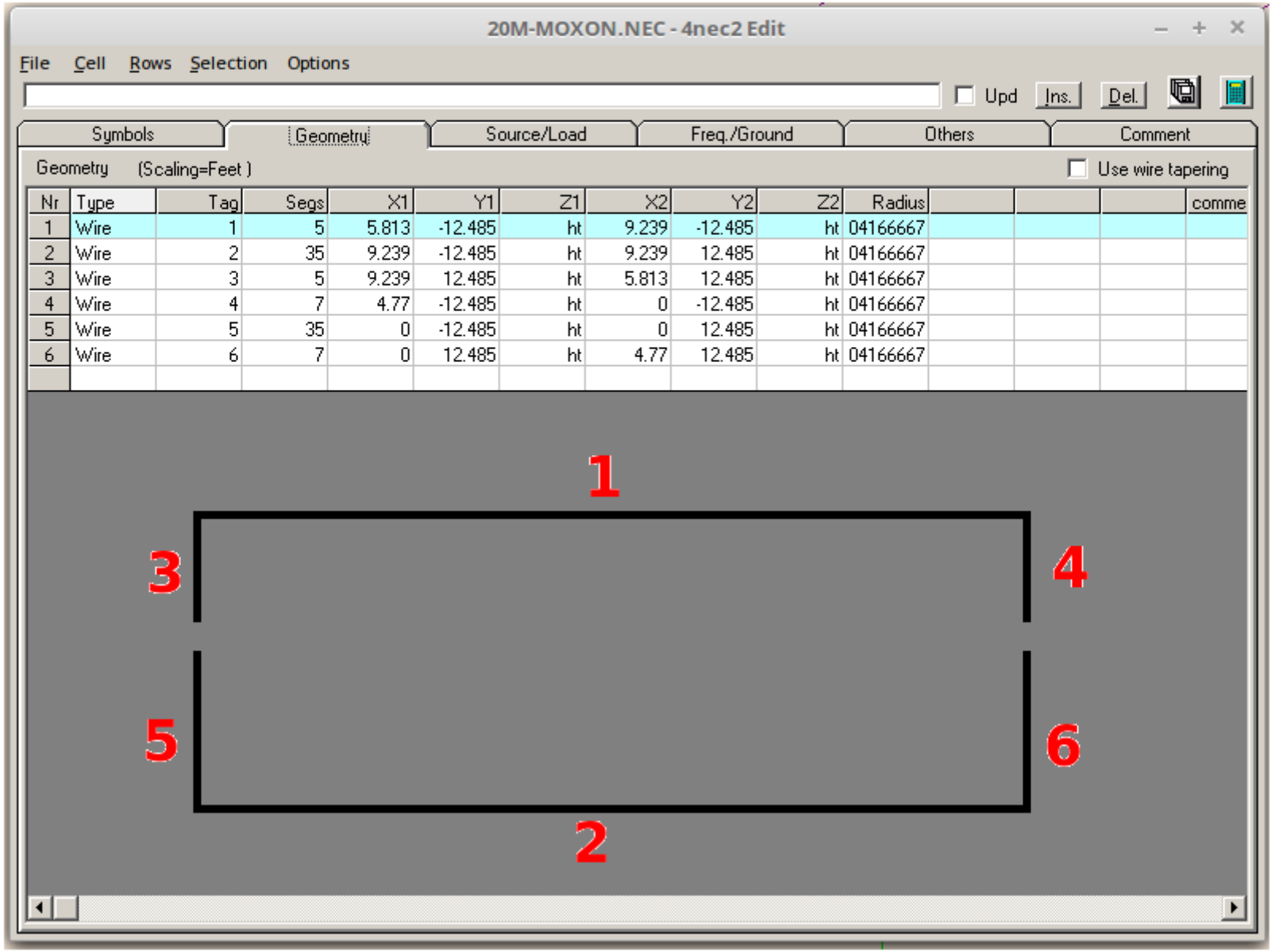
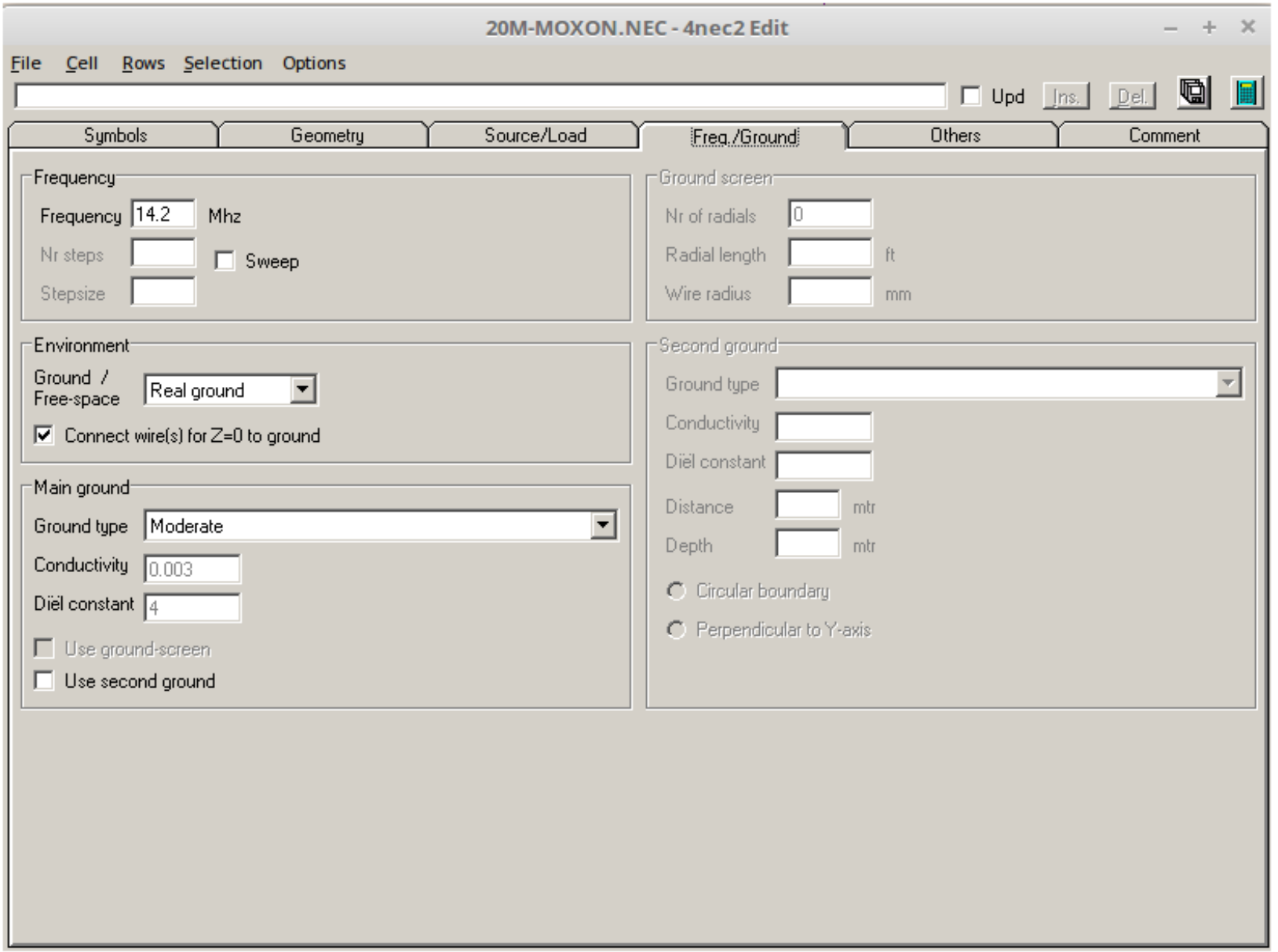
4	Wire	2	51	-17.33	10.00	25.00	17.33	10.00	25.00	#14
5										

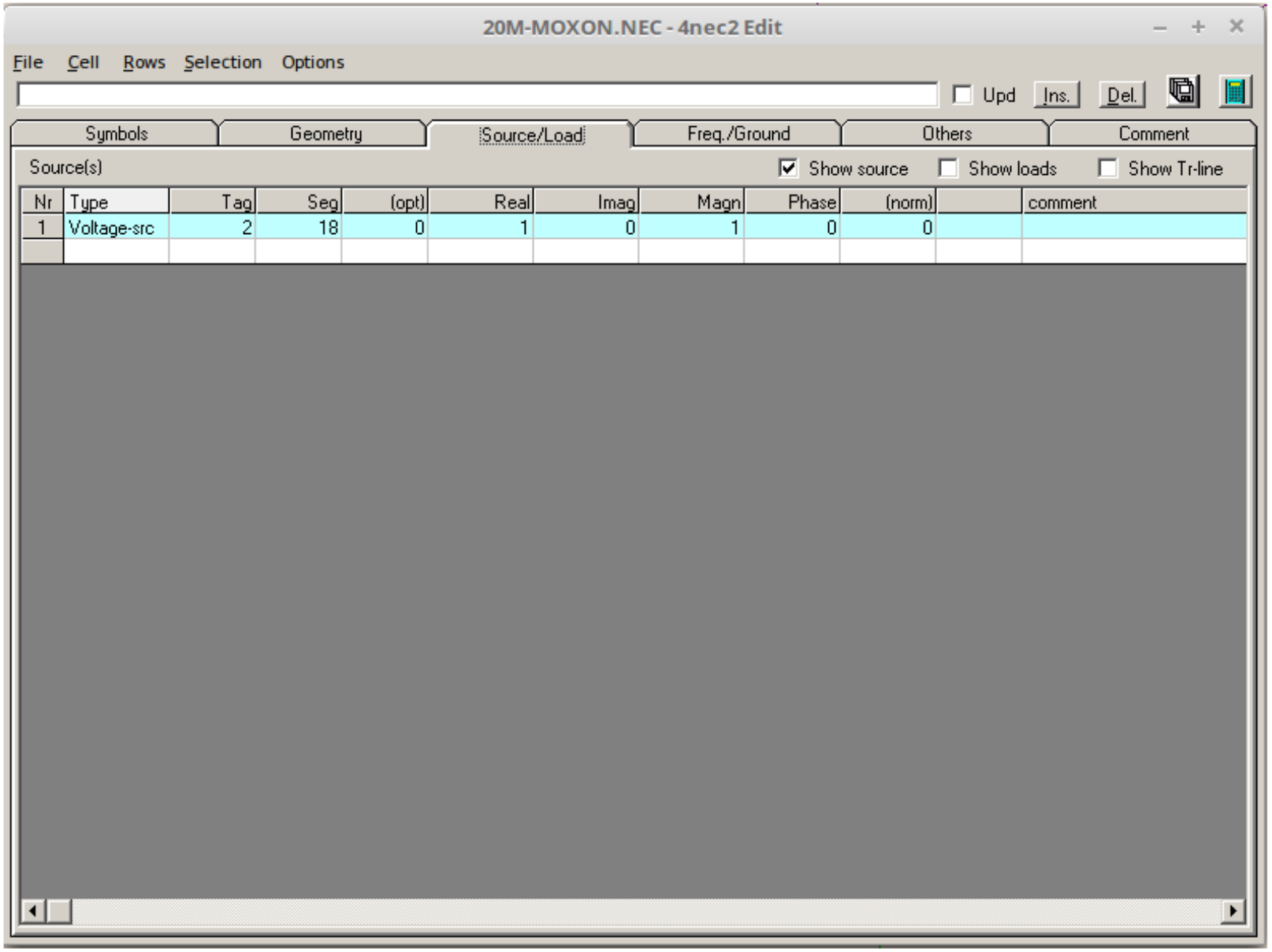
Entering the antenna's geometry



Specifying the ground and frequency



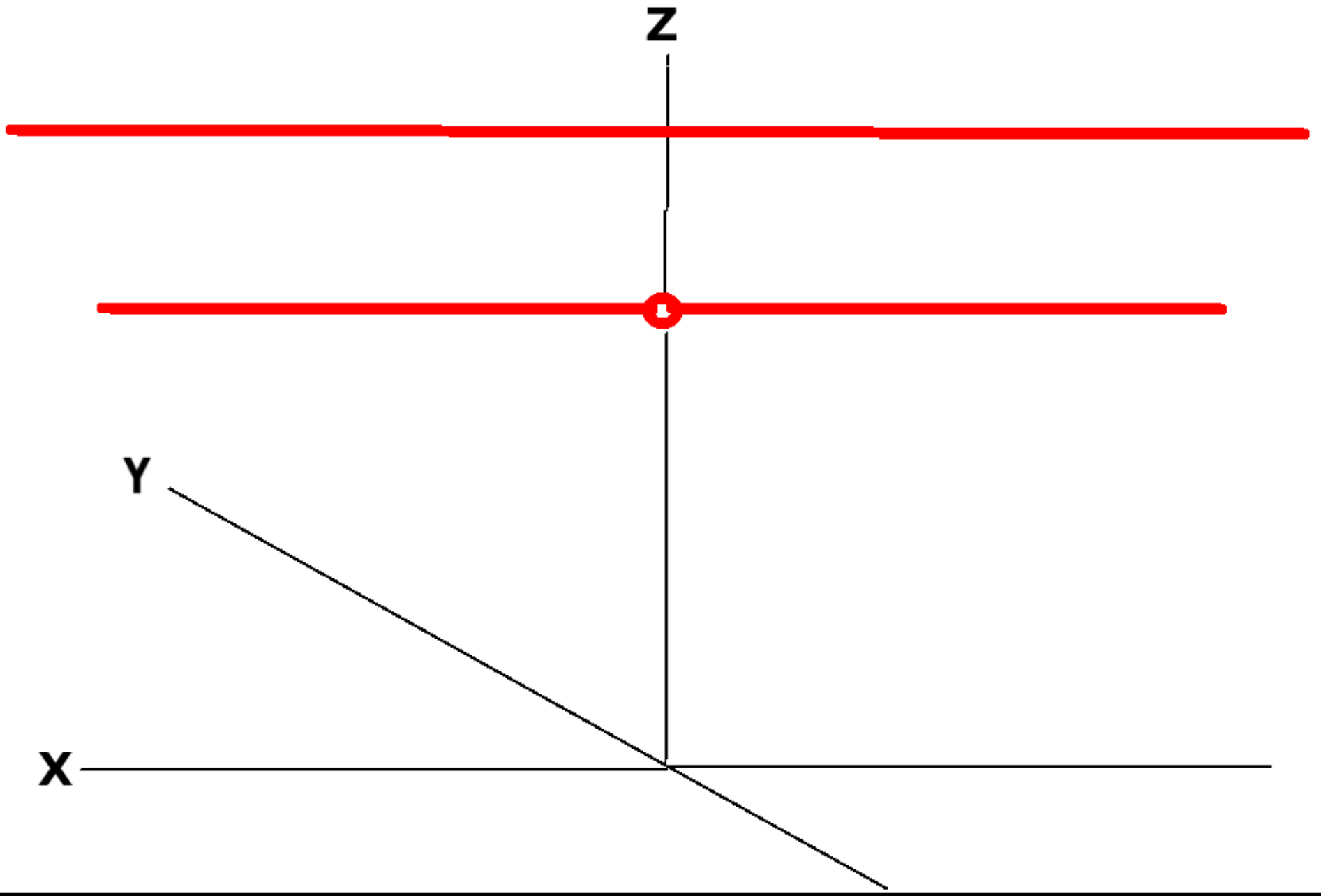
Specifying the feed point (source/load)



Okay...

Let's build your first model.

Add a reflector element 5% longer than the driven element...



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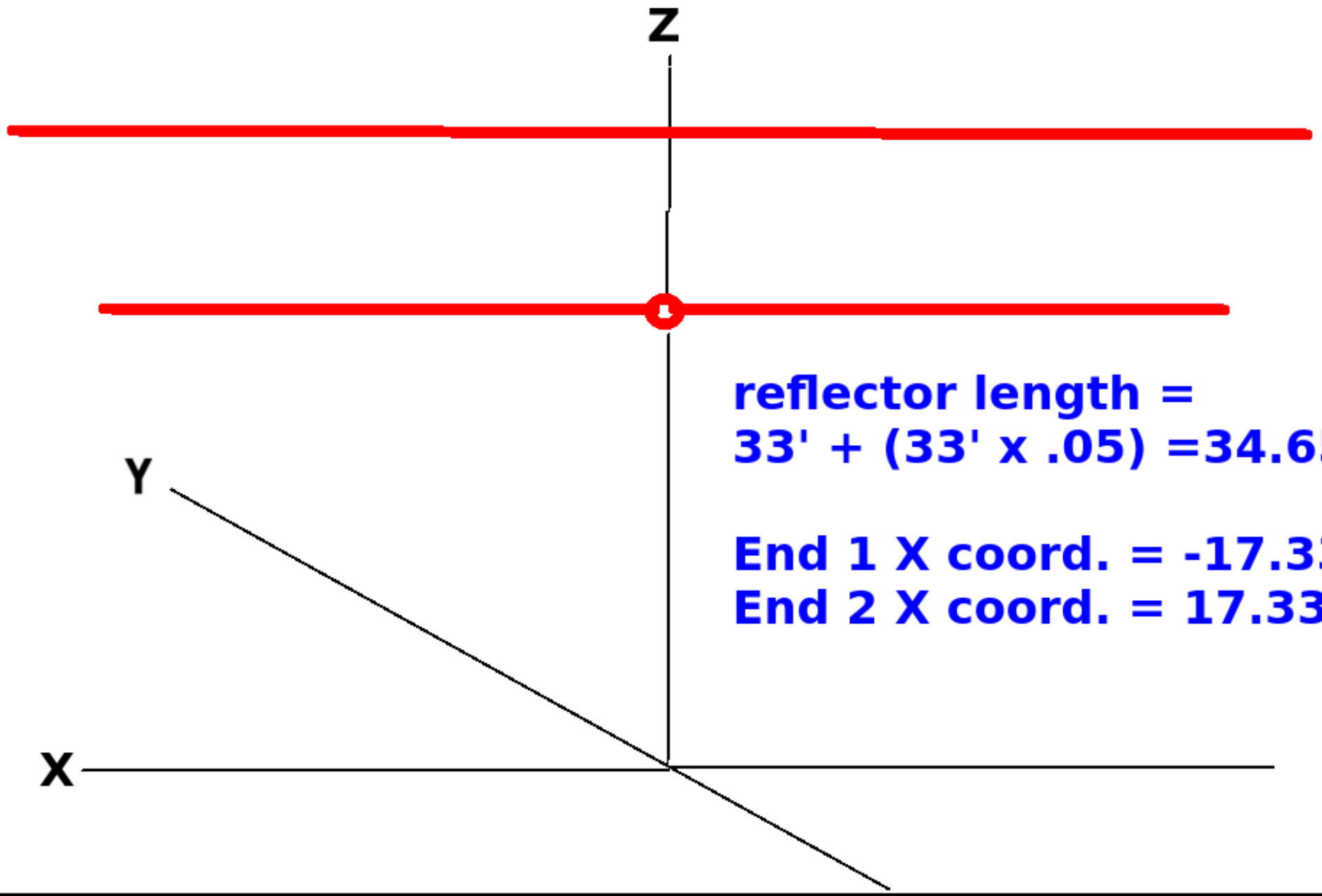
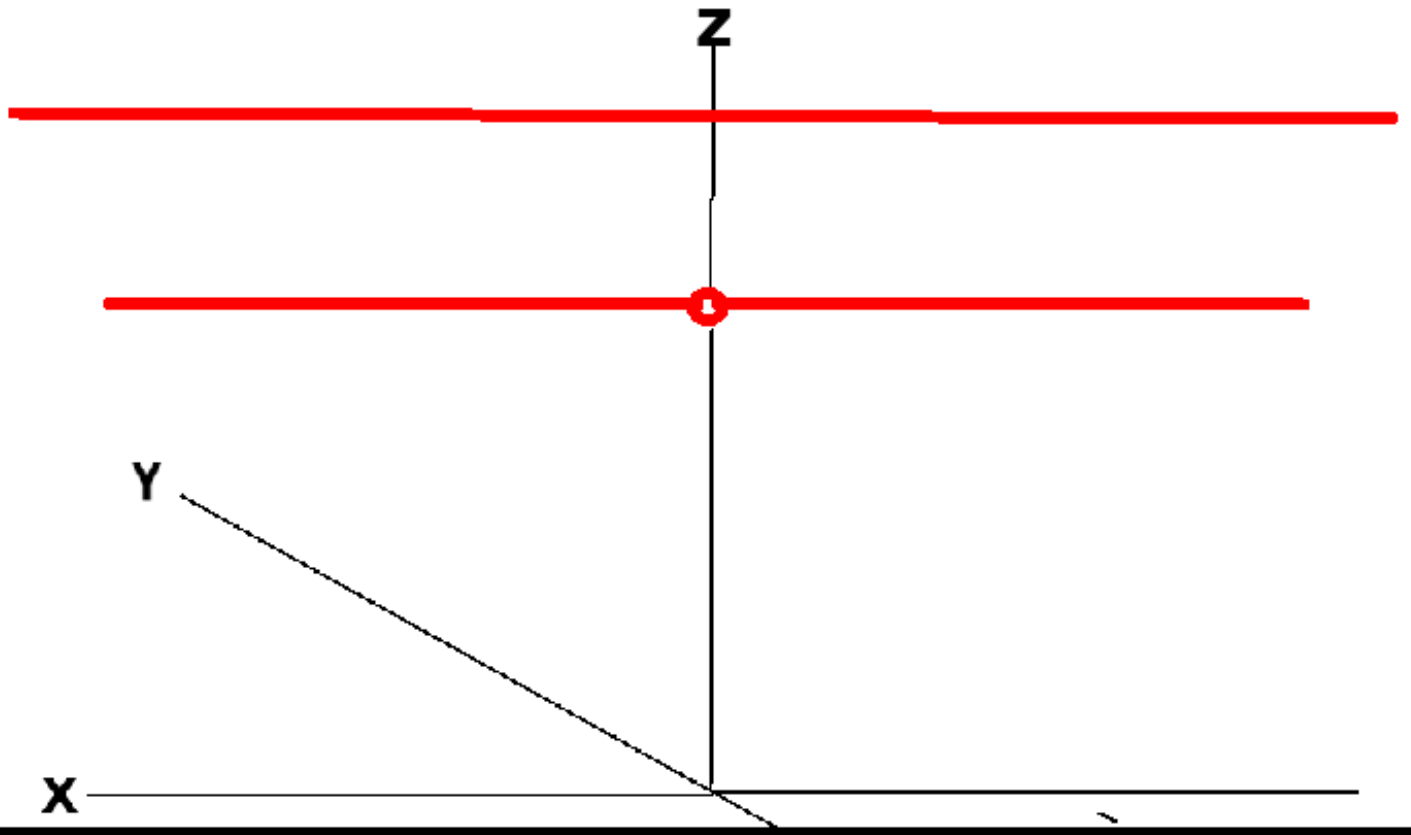


reflector length =
33' + (33' x .05) =34.65'

End 1 X coord. = -17.33'
End 2 X coord. = 17.33'

2 element yagi completely defined:

	End 1			End 2		
	X	Y	Z	X	Y	Z
wire #1	-16.5	0	25	16.5	0	25
wire #2	-17.33	10	25	17.33	10	25



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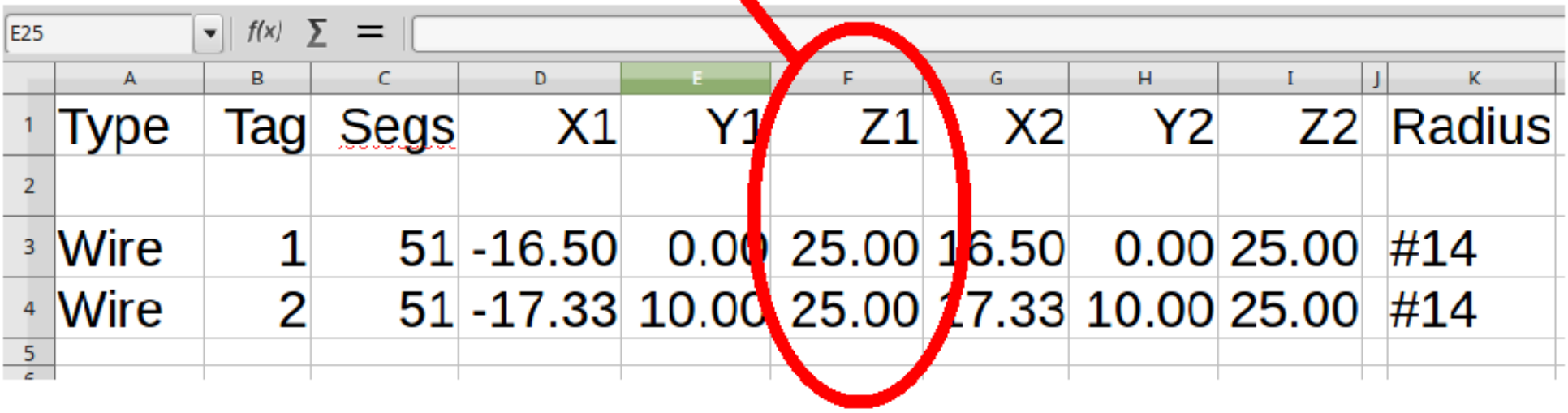
(slightly) more advanced topics

Replace the hardcoded 25' for the Z-axis with a variable, like "height"



E25

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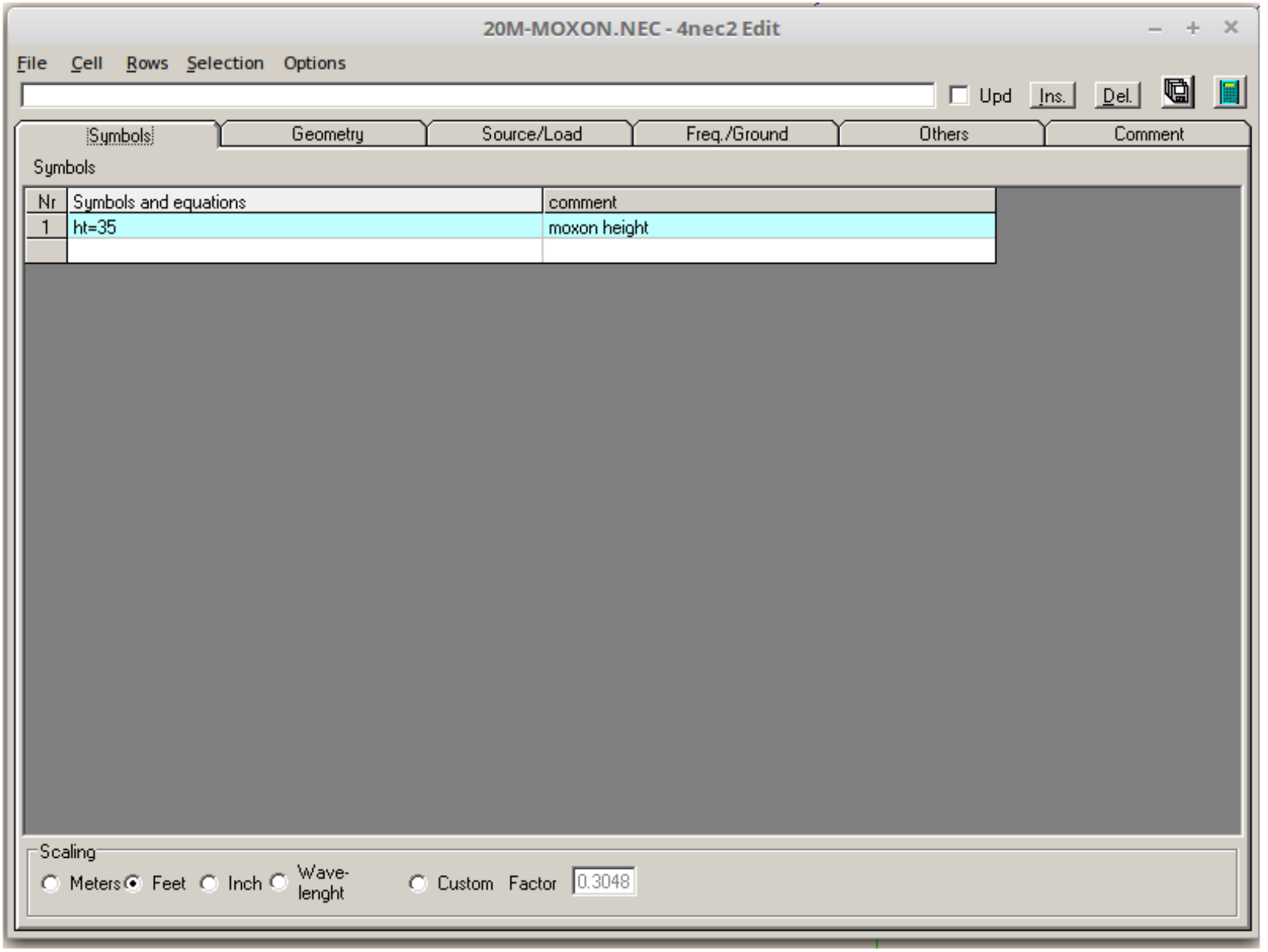
4	Wire	2	51	-17.33	10.00	25.00	17.33	10.00	25.00		#14
5											

Defining Variables



By using variables, the 4Nec2 Optimizer can run through a range of possible values, showing you the effects they have on things like f/b ratio, gain, take-off angle, and SWR.

In a sense, the 4Nec2 Optimizer is helping design your antenna, not merely modeling it!

More Advanced Functions of 4Nec2

- include inductors
- include traps
- include capacitors
- calculate the length of coaxial stubs (open, or shorted) to create 50 ohm matches.

Resources

YouTube Tutorials by "dx2hunt" are a series of several tutorials that take you through step-by-step how to use 4Nec2:

www.youtube.com/watch?v=bEIWUid_wio

PDF Tutorial by Gunthard Kraus:

www.qsl.net/4nec2/Tutorial_4NEC2_english.pdf