Paradox with Appendix P Section 8 field plot figures PhL 5.5.14

I don't think the red lines should be perfectly straight inside the wires in these plots, so I think something is wrong. [it turns out the just look straight but are not exactly straight, so no paradox]

First, here is the math from "the Surface Currents issue..doc" :

$$H_1(r_1) = (I/2\pi)[\ \theta(r_1>a_1)\ (1/r_1)\ + \theta(a_1>r_1)\ \ (r_1/a_1^2)]$$
$$H_2(r_2) = -(I/2\pi)[\ \theta(r_2>a_2)\ (2/r_2)\ + \theta(a_2>r_2)\ \ (r_2/a_2^2)]$$

$$H_x = -\ (y/r_1)H_1(r_1) - (y/r_2)\ H_2(r_2)$$
$$H_y = (x/r_1)\ H_1(r_1) + ((x-b)/r_2)\ H_2(r_2)$$

If I look only at H_y we get

$$H_y = (x/r_1)\ H_1(r_1) + ((x-b)/r_2)\ H_2(r_2)$$

$$= \ (x/r_1)\ [(I/2\pi)[\ \theta(r_1>a_1)\ (1/r_1)\ + \theta(a_1>r_1)\ \ (r_1/a_1^2)]]$$

$$+\ \ ((x-b)/r_2)\ [-(I/2\pi)[\ \theta(r_2>a_2)\ (2/r_2)\ + \theta(a_2>r_2)\ \ (r_2/a_2^2)]]$$

Now suppose we are close to the center of the left wire and we select using the Heavisides. Then we select the terms I show above as red

$$H_y\ = \ (x/r_1)\ [(I/2\pi)[\ \theta(a_1>r_1)\ \ (r_1/a_1^2)]]$$

$$+\ \ ((x-b)/r_2)\ [-(I/2\pi)[\ \theta(r_2>a_2)\ (2/r_2)]]$$

$$= (I/2\pi)\ \ [(x/r_1)\ (r_1/a_1^2)\ -\ \ ((x-b)/r_2)\ (2/r_2)]$$

$$= (I/2\pi)\ \ [x/a_1^2\ -\ \ 2\ ((x-b)/r_2^2)] \qquad\qquad r_2^2 = (x-b)^2 + y^2$$

Now suppose I look only at y = 0. This then says

$$H_y(x,y=0)\ \ = (I/2\pi)\ \ [x/a_1^2\ -\ \ 2\ ((x-b)/(x-b)^2)]$$

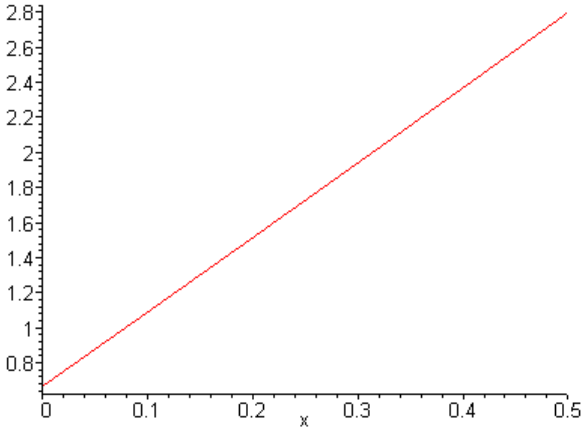
$$= \ (I/2\pi)\ \ [x/a_1^2\ -\ 2/(x-b)]$$

This function is NOT linear in x, but my plots show things as linear in x close to wire 1.
This is the paradox. With $a_1 = 1/2$ and b = 2 this says

$$= \ (I/2\pi)\ \ [4x\ \ -\ 2/(x-3)]$$

But OK, here is a Maple plot of this function:

```
plot(4*x-2/(x-3),x=0..0.5);
```



The first term is so dominant