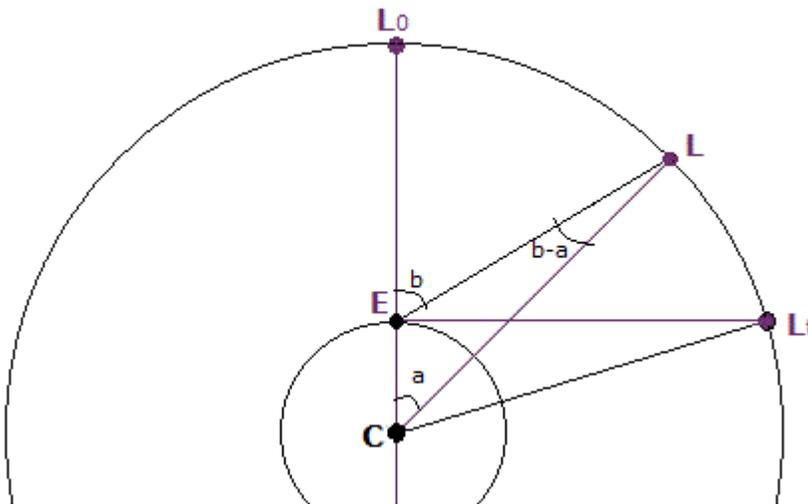


As I understand, now  $f = \text{Maiden/Ogre} = r/R$ . (Indeed, it is more convenient.) I suggest, let's make the lake a unit circle to dispense with  $R$  and  $r$  as well. Then  $R = 1$  and  $r = f$ .

Suppose,  $\sin(b-a)$  does represent an incremental Maiden/Ogre ratio. Thus, for as long as it is smaller than calculated  $f$  to a given point  $L$ , that point may be moved clockwise, for it is not the optimal.

There is an easier way to study the angle  $(b-a)$ , by observing an **equal angle** between straight segments drawn to a landing point as shown on the diagram:



$C$  is the center of the lake;  $E$  marks the escape point;  $L$ -s are possible landing points.

Starting at  $L_0$ , the  $\sin(b-a)$  increases from zero to  $\sin(b-a) = r/R = f$  at the landing point  $L_t$ . The increase is continuous. Note the increments in angles  $a$  and  $b$  between points  $L$  and  $L_t$ . Using plane geometry it is easy to deduce that the incremental angle for  $b$  ( $LEL_t$ ) is greater than the incremental angle for  $a$  ( $LCL_t$ ). Therefore the angle  $(b-a)$  and  $\sin(b-a)$  increase continuously as landing point slides clockwise.

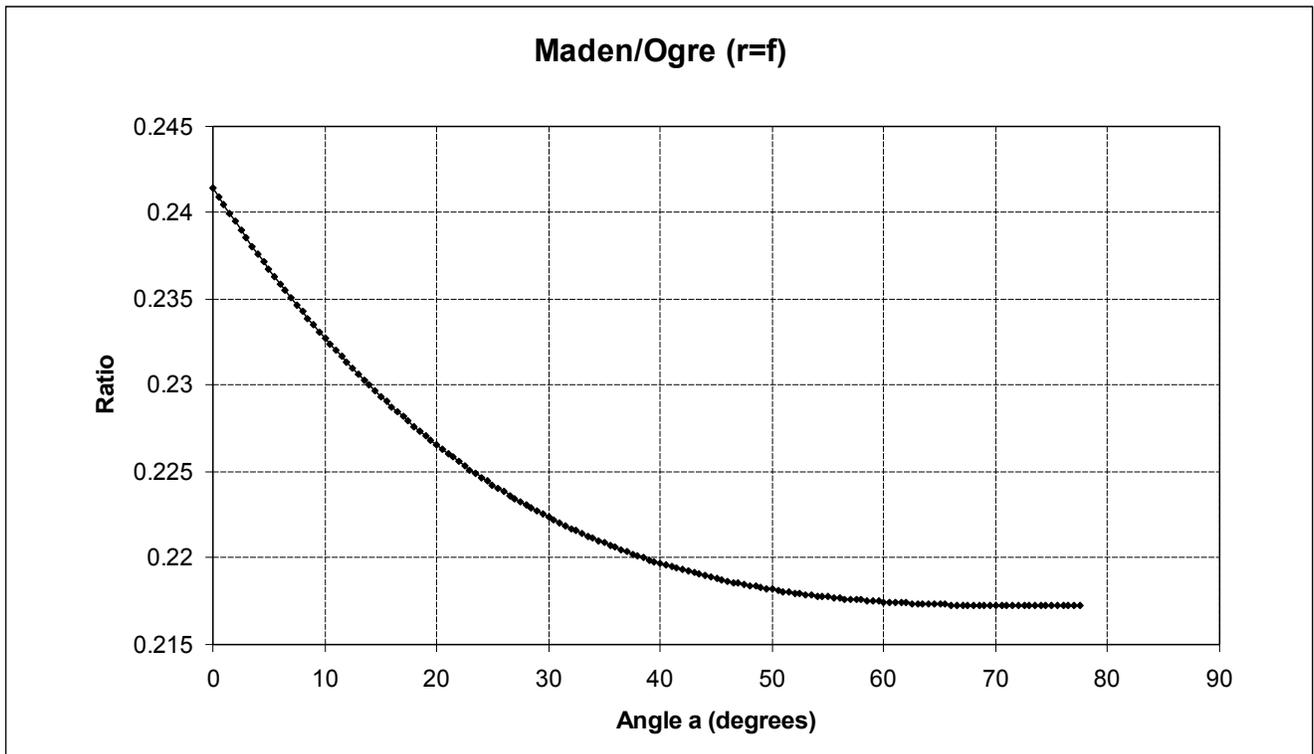
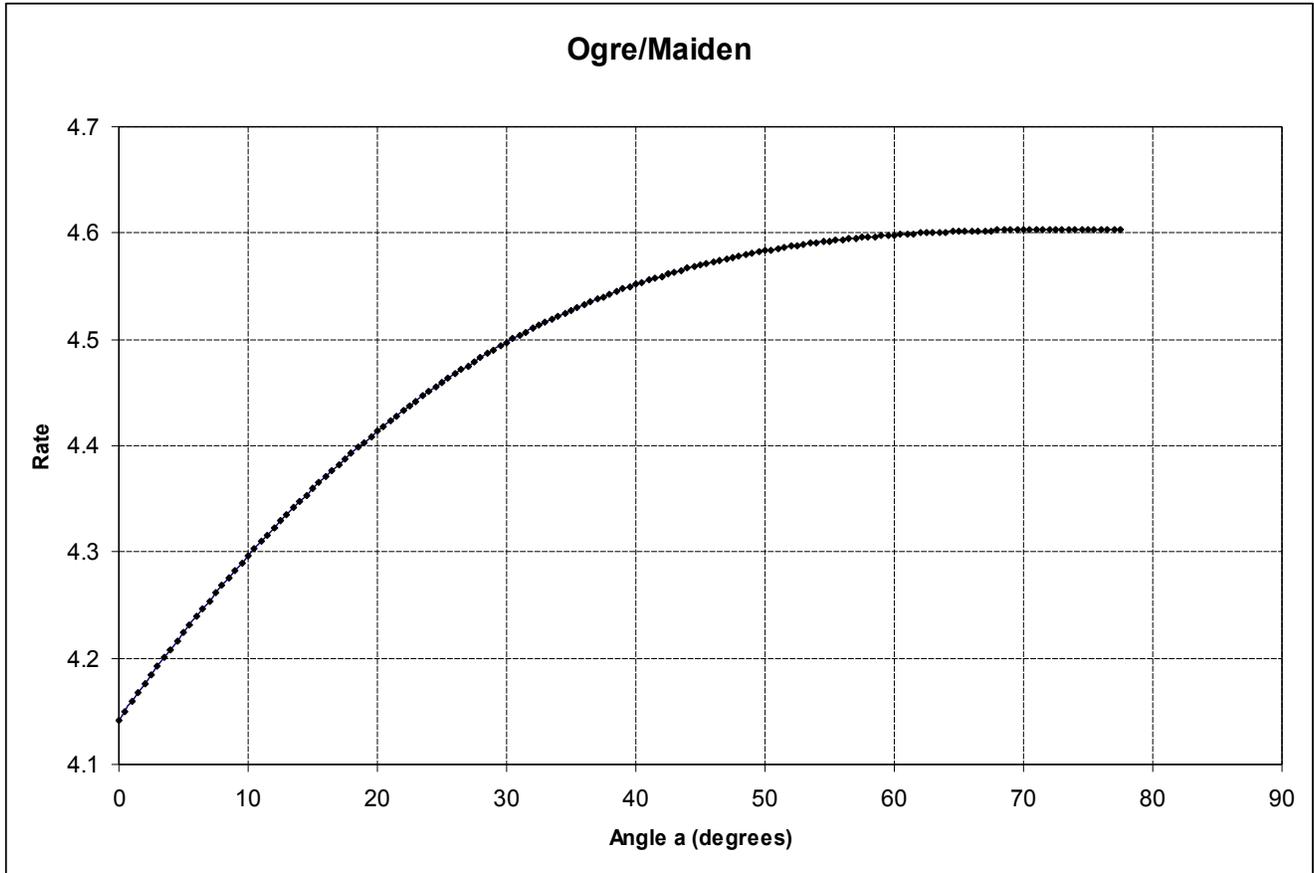
The actual formula for  $f$  as a function of  $a$  is not all that difficult to derive using Pythagorean theorem to build a quadratic equation, which can be solved by liberally raising things to power and gratuitously dismissing any negative roots. The function for the Ogre/Maiden rate as I have posted already:

$$\cos(a) + \sqrt{(\pi + a)^2 - \sin^2(a)}$$

It is an inverse for our new improved  $f$  (Maiden/Ogre), which now becomes:

$$f = \frac{1}{\cos(a) + \sqrt{(\pi + a)^2 - \sin^2(a)}}$$

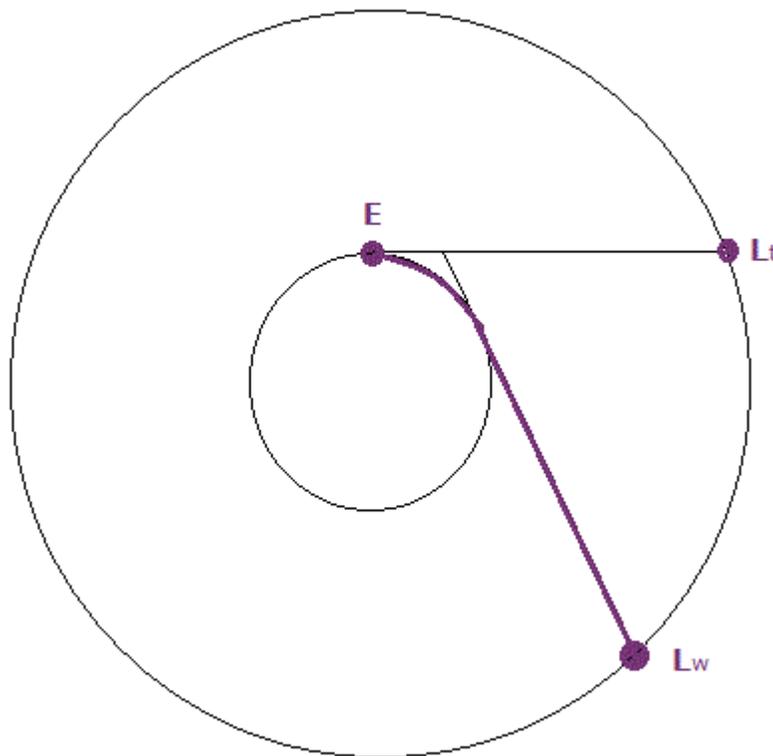
The graphs for the above functions are like so:



We could use first derivative to study that function. But we already have with the **sin(b-a)** analysis.

I see no point in analyzing any landing points past the "tangential escape." The reason being:

- 1). The maiden tends to go on a shortest possible path to a landing point, rather than taking a scenic route. The shortest path between two points is a straight line.
- 2). Where straight line path is not available, the shortest path is around the small circle perimeter until straight line to the landing point becomes possible. (That rides on my assumption that  $\tan(x) > x$  for  $0 < x < \pi/2$ .) Whereas such path is exactly tangential escape with the point **E** and Ogre positions slightly rotated.



Past the tangential escape point, no valid path different from tangential may be constructed. So there is no path to analyze.

In conclusion, the solution to Ogre-Maiden problem is a solution/approximation method for  **$\tan(x) = x + \pi$** .

That is the real purpose behind all that commotion on the lake.