East Boundary Double Target

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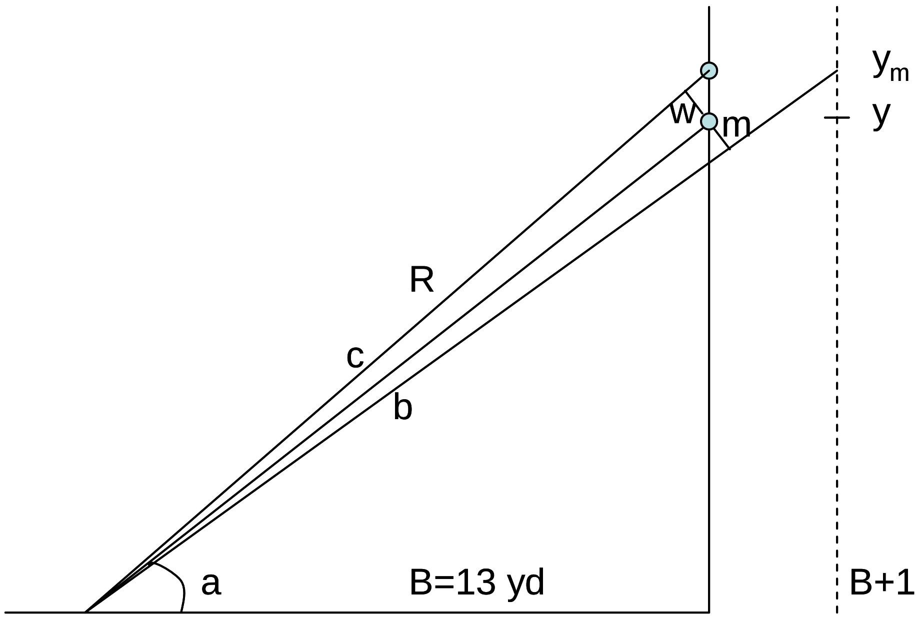

For a standard opening, it is possible to shoot at an East-boundary ball. We ask, "what is the optimal distance such that a miss on the right will leave a perfect double target once brought back into the lawn?" The diagram relates the geometry, and we have the following system of equations:

$$\tan a = \frac{y_m}{B+1} \quad (1)$$

$$\tan(a+b+c) = \frac{y_m}{B} \quad (2)$$

$$\tan(a+b) = \frac{y}{B} \quad (3)$$

Using (1) and (2), we eliminate y_m to get

$$(B+1)\tan a = B\tan(a+b+c) \quad (4)$$

Typically, we can approximate the tangent of small angles (b and c) by the angle itself. For terms involving the angle a, however, we use an identity:

$$\tan(u+v) = \frac{\tan u + \tan v}{1-\tan u \tan v} \quad (5)$$

Manipulation of (4) reveals a quadratic expression in tan(a):

$$\tan^2 a - \frac{\tan a}{(B+1)(b+c)} + \frac{B}{B+1} = 0 \quad (6)$$

The tangent identity can again be used starting with (3) to give:

$$\tan a = \frac{y - Bb}{B + yb} \quad (7)$$

The small angles can be approximated by:

$$b = \frac{m}{R},\ c = \frac{w}{R} \quad (8)$$

The distance or range to the target is constrained to lie on the east boundary:

$$R^2 = B^2 + y^2 \qquad (9)$$

We thus have a system of equations (7), (8), (9), (10) which needs only a few assumed values:

$$m = w = 2D, D = 3\frac{5}{8}\text{inch}, B = 13\text{ yards} \qquad (10)$$

Mathematica (see http://www.quickmath.com) is useful for the actual computations of the solution, which rather conveniently turns out as y=6.0 yards. **The optimal position for the target ball is level with hoop 4!**