Calculating the Buoy's Watch Circle

The buoy is moored at the bottom by an anchor, followed by a mooring line, and a bungee. The total length of the mooring, during an un-stretched condition, is usually deployed as 2 times the depth of the deployment location. The 30 meter bungee can stretch up to 5 times its length. The watch circle radius, depth, bungee, and mooring, can be represented by:

![Diagram of buoy mooring system](image)

We can also define the stretch factor for the bungee, as the variable $S$. For our purposes, $S=5$, since the bungee stretches to 5 times its original length. Therefore, for a 2:1 (Length: Depth) scope, the mooring length is represented by:

$$\text{Mooring Length} = 2 \cdot D = (S - 1) \cdot L_b + 2D$$

Using the Pythagorean Theorem, the watch circle radius is represented by:

$$((S - 1)L_b + 2D)^2 = D^2 + R_c^2$$

Solving for $R_c$:

$$R_c = \sqrt{((S - 1)L_b + 2D)^2 - D^2}$$
For example, a buoy deployed at a 24 meter depth:

\[ D=24 \text{m} \]
\[ S=5 \]
\[ L_b=30 \text{m} \]
\[ \text{So:} \]
\[ R_c = \sqrt{(5 - 1) \cdot 30 + 2 \cdot 24)^2 - 24^2} \approx 166.2 \text{ m} \]

For a buoy deployed at a 200 meter depth:

\[ D=200 \text{m} \]
\[ S=5 \]
\[ L_b=30 \text{m} \]
\[ \text{So:} \]
\[ R_c = \sqrt{(5 - 1) \cdot 30 + 2 \cdot 200)^2 - 200^2} = 480 \text{ m} \]