Hanson's Method

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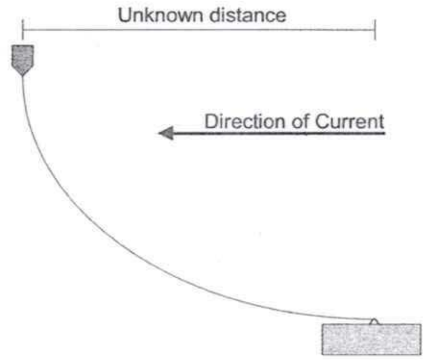
Have you ever thought to yourself: "How do you calculate the Horizontal Dilution of Precision?" Have you ever checked the formula in AAPS to ensure that the offsets are being correctly applied (mathematically speaking)? Do you get excited when the EO asks you to help him graph his engine maintenance hours?

Such is the curse of being a buoy tender skipper and a math geek. Do you want to know what has been robbing me of sleep lately? Well, I'm going to tell you anyway.

The Fraction of Watch Circle Radius method for estimating excursion doesn't accurately reflect how a buoy behaves in a current. Instead of finding the buoy hull at a distance 1/4, 1/2, or 3/4 of the watch circle away from the sinker, you should find it somewhere between the distances calculated by the 'L Method' and the 'Hypotenuse Method.' Please let me explain.

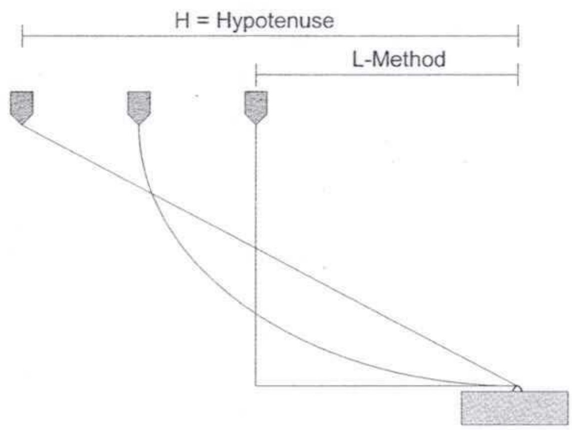
The current formula assumes that as the current gets lighter, the buoy will continue to move toward the sinker. Furthermore, it assumes that in an extremely light current, the buoy will be very close to being right over the sinker, down current of the sinker, in a predictable position. This may sound accurate, but let's think about it for a minute. When the buoy is directly over the sinker, what is holding it in place? The sinker? No. It is the weight of the chain on the bottom. In this case, the chain is not pulling on the sinker at all. So we have to ask ourselves: If the current is so light that the weight of the chain is holding the buoy in place, how do we know where the sinker is? We don't. If the weight of the chain can hold the buoy, the buoy could even be up current of the sinker. In fact, the buoy could be in any direction from the sinker. The furthest away from the sinker a buoy could get in this situation is calculated by the L-method, because anywhere outside of the L-method the chain will start to pull on the sinker. So, if we are in a situation that the current is so light that the buoy is being held in place by the weight of the chain, we are in a situation that we cannot accurately determine where the sinker is without pulling on the chain and using the L-method. When this is the case, the Fraction of the WCR method does not apply.

According to the NATON ANC-AP Workbook, the Fraction of the WCR method is to be used when the current is both strong enough and has held long enough that all the chain lies on the down current side of the sinker. So, when we are using the Fraction of the WCR method, we need to ensure that we are in a circumstance where the buoy is pulling on both the chain and the sinker with a steady tension. The buoy will look something like the figure on the next page.



The problem is that the current formula for the fraction of the WCR method often yields distances closer to the sinker than the distance calculated by the L-method. As discussed above, we should never be using the Fraction of the WCR method if the buoy is closer to the sinker than the L-method. Again, in this circumstance we cannot accurately predict the position of the sinker without pulling on the chain.

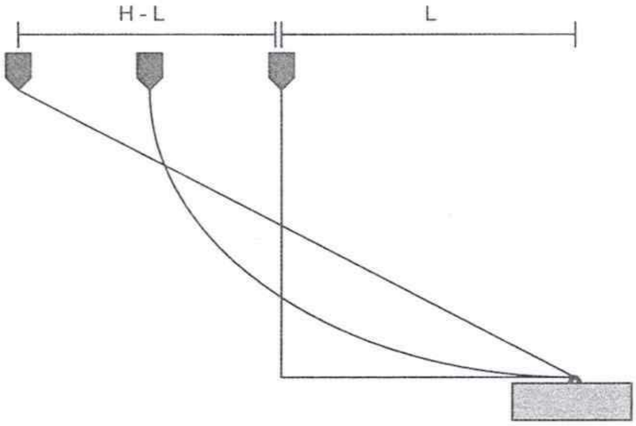
In order to come up with a more accurate formula, we must first understand what we already know. It is well established that the maximum a buoy can be from a sinker is calculated by the Hypotenuse Method. This condition only exists in an extremely strong current where the chain is pulled straight. This maximum distance is also known as the watch circle radius (WCR). As discussed above, the minimum this condition could be is calculated using the L method. This would be the lower limit and would be approached in only a very weak current. Any situation where the buoy is closer to the sinker than the L-method is a situation where we cannot accurately determine where the sinker is and must use the L-method.



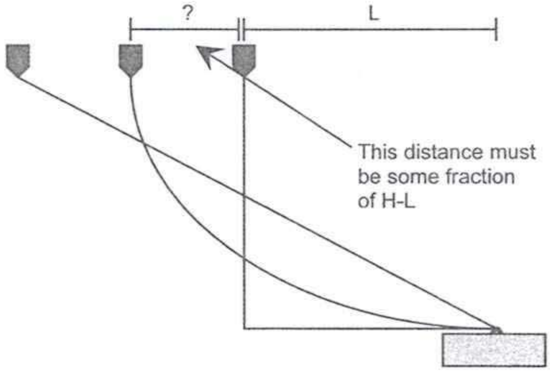
The current Fraction of the WCR Method formula establishes no minimum distance the buoy must be from the sinker. In the Fraction of the WCR Method, the WCR is multiplied by ¾, ½, or ¼ for a strong, moderate, or weak current, respectively. The problem is in most cases, ¼ x WCR is less than the distance found using the L-Method. In fact, it is possible for ¾ x WCR to be less than the L-Method. Although there are many cases in which this method is not accurate, I will demonstrate one instance which should be enough to show that there is a problem with the Fraction of WCR Method.

In the NATON ANC-AP Workbook, students are taught how to apply the WCR Method. The example given has a depth of water of 38 feet and 120 feet of chain. The WCR Method for strong, moderate and light current yield answers of 28.46, 18.97, and 9.49 yards, respectively. The L-Method yields an answer of 27.33 yards. So, according to the WCR method, in a moderate or light current, the buoy will be closer to the sinker than the L-Method. Also, in a heavy current, the buoy will be only one yard further away from the sinker than the L-Method.

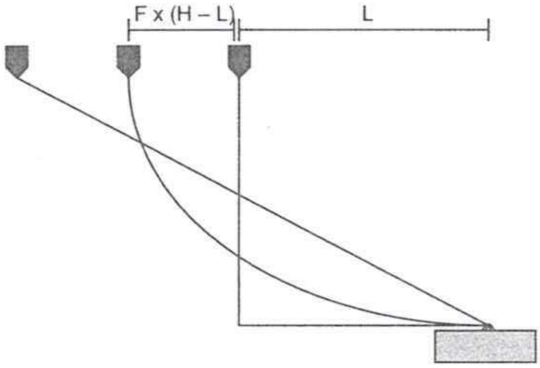
The solution is simple. The formula must incorporate the lower bound of the L-Method. We already have two distances that we know how to calculate using the Hypotenuse and L- Methods. The unknown distance is somewhere between the Hypotenuse method and the L-Method. The distance between these two methods is simply H – L:



Therefore the distance between the L-method and the unknown position is some fraction of this distance of H-L:



We can call the fraction F, which will clearly be determined by the strength of the current. I propose the most logical values of F would be ¾, ½, and ¼ for a strong, moderate and weak current, respectively.



The final formula would then be this estimated distance plus the L-method:

$$\text{Distance from MPP} = F \times (H-L) + L$$

I Like to call this formula HFFCEIASC (pronounced just as it looks), or Hanson's Formula for Calculating Excursion in a Steady Current.

Of course now we have a new question to answer: How do I know if the current is strong enough to be pulling on the sinker or if the weight of the chain is holding it in place? Well, don't look at me. I am a math geek, not a physicist. I recommend making that determination based on prevailing weather conditions and experience. If in doubt, pull on the chain to see.

That's it. I should sleep better now that I got that off of my chest. I know you were hoping for more. But like I said, that's what you get when you give a math geek Command of a Buoy Tender.

Oh yeah, did I mention that I am a fitness nut as well? Really, it's just my feeble attempt to look more like a football player than a math geek. Now that I have solved the conundrum of the Fraction of the WCR method, I often find myself thinking: "How can we increase our deck force's average bench press by 25 pounds?" or "How long does an MK2 have to run before he pukes?" Strange, but true. Anyway, stay tuned for my next article: "How to get buff on your buoy deck."

Editor's Note:

The standards for positioning floating aids to navigation are contained in the Aids to Navigation Manual – Positioning, COMDTINST 16500.1C. Positioning floating aids to navigation that are not at short stay present a special situation since the position of the sinker must be esti-

mated. The policy promulgated by COMDT does not dictate a method or protocol to be used in determining buoy excursion from the sinker due to the numerous factors and conditions that may be encountered while on-scene. The AtoN professionals on scene must estimate excursion based upon their judgment and experience, and indicate the method used in the remarks section of the Aid Positioning Record (APR).

The bottom line when we're talking about excursion: it's a guess. An educated guess, of course, but still a guess. We can't see the sinker, so we're making our best estimate as to where it is in relation to the hull. When we're doing this, some assumptions are necessary, but we do the best we can with what we know and what experience has taught us.

The Fraction of the Watch Circle Radius (FCWR) method is one of several frameworks that can be used to calculate excursion distance. Different methods apply to different on-scene conditions. The FWCR method can actually be used even when all the chain isn't on one side of the sinker. This is where knowing your AOR comes into play. If you know the current has just shifted direction, even if it's a strong current, the situation may call for 1/4WCR, because although it's a strong current, it hasn't had time to move all the chain to one side of the sinker, so it's likely only as far out as 1/4WCR. This is just one example, but keep in mind that the FWCR method can be used in many different situations, depending on how well you know your AOR and how comfortable you feel in selecting the applicable fraction based on the conditions.

The information in the article differs from what is currently taught at NATON School, and that's because a unit found a different way to do things particular to the conditions they experience. Units are certainly permitted to devise their own method of excursion that suits the particular conditions the unit encounters, provided the unit can explain their method and it reflects due care. Keep in mind, if the fix you obtained comes into question, you'll need to be able to explain the method you used and show that you were exercising due care. If you've developed a method at your unit, please share it with NATON so we have the option of providing our students with the different methods being used in the field.

In addition, we encourage units to test themselves for accuracy in positioning with excursion. To do this, position an aid you know you'll be positioning at short stay using excursion first. Get a found fix using whatever excursion method applies, and then compare the CWC to AP distance with the MPP to AP distance you get when you position it at short stay. If you do this, please send the data to NATON. If we can start tracking real data on excursion, maybe we can develop an even better method.