A102 What's New on the Water Front

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After attending this presentation, attendees will learn about the minimum depth of water necessary to allow a 9mm bullet to ricochet without touching the submerged substrate, and at what angle the bullet has departed the water as a factor of incident angle

This presentation will impact the forensic science community by revealing the dangers inherent in bullet ricochet off of water, will offer the calculation used to make this determination, and will examine the parameters necessary to have a successful water ricochet.

A bullet can ricochet off of many different surfaces. These surfaces may be categorized based upon how the bullet interacts with them. Hard surfaces traditionally remain intact after low angle bullet ricochet because they will not yield to the bullet's impact. Materials such as concrete, steel or automobile glass fall into this category. Bullet ricochets off of hard unyielding surfaces tend to have ricochet angles that are less than the incident angle. Soft surfaces will not remain intact, but instead will deform or deflect, yielding to the bullet's impact. Materials such as sand, gypsum wallboard, or water are examples of surfaces that fall into this category. Bullet ricochets off of relatively soft yielding surfaces tend to have ricochet angles that are greater than the incident angle. When a bullet is fired at either of these materials, there is an angle at which a ricochet will no longer occur, but instead the bullet will either break apart into fragments after hitting the surface, or it may remain intact, to either penetrate (imbed but not exit) or perforate (enter and exit) the material.

This research was a continuation from earlier work involving the study of 22 caliber bullets that were ricocheted off of water. It was discovered that 22 caliber bullets could successfully ricochet off water that was just under half the diameter of the bullet and still not come into contact with the floor of the water tank. This was counter-intuitive, as it was expected that at such a shallow depth, the bullet would scrape the floor of the tank leaving traces of that interaction behind, and that the bullet would take with it some of the paint from the tank's floor. Careful inspection of the tank's floor revealed that no such interaction between the two had taken place, which was confirmed by recovery of the bullets and microscopically examining them for transfer as well. The next obvious question was whether larger bullets, such as 9mm, could also ricochet off shallow water and not contact the floor of the tank.

The witness panel set-up was down range and was used to determine if the bullets were in stable or de-stable flight and to generate a measuring point for angle calculations. The same water tank from the 22 caliber work was used for these experiments. High-speed photography was used to aid in determining the location of bullet impacts to the water. Trigonometry was applied for the calculation of ricochet angle. Incident angle was recorded using an angle finder directly affixed to the barrel of the firearm. Using this method, the angle at which 9 millimeter full metal jacket bullets did not ricochet at all (the critical angle) was determined to be approximately eight degrees. At angles greater than eight degrees, the bullets entered the water and remained submerged. Shots were then fired at an incident of two degrees into the water tank. The water depth was incrementally lowered until the bullet finally scraped along the floor of the tank. Recovered bullets, examined microscopically, confirmed the interaction had taken place. Not until the water level was lowered to less than the diameter of the bullet (0.36 inches) did the bullet hit the tank floor when the incident angle was only two degrees.

Ricochet, Bullet, Water