**REPORT ON SIMULATION OF A HANDGUN**

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**Introduction**

Although the bullet from a gun fired vertically or nearly vertically into the air loses its linear velocity along the flight path, it continues to contain the kinetic energy that can penetrate the skull bone. As a result of hitting the human head area, it has the potential to cause fatal injuries by penetrating the skull bone and brain tissue. The wounding potential of the free-falling bullet, whose encounter rate and experimental study possibilities are very limited in daily life, was analyzed.

**Analysis Of the Effect of a Bullet from A .22LR Fired at Various Angles**

What happens when someone fires a .22LR round at an almost completely vertical angle of 88°? First, the bullet moves as a result of explosive acceleration - with a muzzle velocity of 1,280 feet per second. In just a half second, it reaches a height of 456 feet - double that of an average 20-story building.

Due to gravitational forces and air resistance, the bullet’s velocity decreases as it travels upwards. After two seconds, the .22LR bullet reaches the height of the Empire State Building (1,450 ft), but has slowed to a speed of 360 feet per second.

At nine seconds, the bullet reaches its maximum height - 2,362 feet, almost the height of the tallest building in the world, the Burj Khalifa. The velocity decreases to almost zero.

At this point, the bullet turns downwards, under the effects of gravity. On the way down, it picks up speed until the air resistance counterbalances the effect of gravity and the bullet reaches its terminal velocity.

After falling to 1,885 feet, the .22LR bullet reaches the velocity required to penetrate the skin, 148 feet per second. Even at this speed, the bullet has the potential to be deadly under the right set of circumstances.

At just under 600 feet from the ground, the bullet reaches a velocity of 200 feet per second - enough to penetrate a skull. To put that speed into perspective, that equates to just over 136 miles per hour.

Our bullet reaches the ground after 24 seconds. Even though it was fired at an almost perfectly vertical angle, the bullet lands 173 feet (53 meters) away from where it was fired - half the length of a football field.

At 45°, a .22LR bullet would travel 2,805 feet (855 meters) horizontally - the length of eight football fields.

* Next, let’s look at the ballistic trajectories for a 9mm bullet, one of the most popular handguns rounds in the world. It has a muzzle velocity similar to that of .22LR - 1,119 feet per second, but the projectile is larger and contains more kinetic energy when fired. A 9mm round would reach a height of 2,798 feet when fired at 88°.

With more powerful ammunition, bullets travel much higher in the air and return with greater speed and more kinetic energy. When fired at 88° a .30-06 bullet would reach 9,845 feet - nearly the height of mountain Fuji - and hit the ground at a speed of almost 400 feet per second - nearly 273 miles per hour.

According to these simulations, a victim could be standing thousands of feet away from the shooter and still be struck. At 88°, a .30-06 bullet could travel over 708 feet, the length of two football fields. At 80°, the distance stretches to the length of 6 football fields. Drop the shooting angle down to 45° and it could cover a distance of 11,500 feet - or the length of Central Park in New York City.

A bullet fired straight up on Earth, assuming there's no wind, might still be able to reach a maximum height of around three kilometers (about 10,000 feet), and will then fall back down to Earth. However, just like a human skydiver only accelerates for a few seconds before reaching terminal velocity, the air resistance acting on the bullet will prevent it from reaching speeds even close to muzzle velocity ever again.

Instead, a falling bullet comes back down with a speed of only around 150 miles-per-hour (241 kilometers per hour), which is just 10% of the speed it was fired with. Because of how energy works (proportional to your speed squared), a bullet that falls from high in the air only possesses 1% of the energy of a bullet newly fired from a gun: the equivalent of a brick dropped from a height of just 50 cm (about 20 inches) off the ground.

**Conclusion**

Depending on the angle it is fired, the speed of a falling bullet changes. A bullet fired nearly vertically will lose the most speed, usually falling at [terminal velocity](https://en.wikipedia.org/wiki/Terminal_velocity), which is much lower than its [muzzle velocity](https://en.wikipedia.org/wiki/Muzzle_velocity). Despite this, people can still be injured or killed by bullets falling at this speed. If a bullet is fired at other angles, it maintains its [angular ballistic trajectory](https://en.wikipedia.org/wiki/Trajectory_of_a_projectile) and is far less likely to engage in tumbling motion; it therefore travels at speeds much higher than a bullet in [free fall](https://en.wikipedia.org/wiki/Free_fall). Dense, small bullets achieve higher terminal velocities than lighter, larger bullets.

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