Rice students invent slingshot-driven test for Air Force

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From left, Rice University students Autumn Allen, Tremayne Kaseman and Duncan Eddy test the slingshot that powers their impact-testing device, developed for the Air Force. (Credit: Rice University)

What do you get when you combine a slingshot, a fish tank, a stack of 2-by-4s and five engineering students determined to help the United States Air Force?

For Team CADET at Rice University, the answer is a device to stop high-velocity projectiles without destroying them. With the Air Force's current methods, artillery shells are destroyed beyond recovery. The Air

Force wants to know more about their behavior as they accelerate and decelerate.

"The challenge was to simulate high-acceleration impacts in a nondestructive way," said Duncan Eddy, a junior in mechanical engineering and member of the Controllable Acceleration-Deceleration Equipment Tester design team. "The problem turned out to have a hands-on, mechanical engineering focus."

The other team members, Autumn Allen, Tremayne Kaseman, William Li and John Stretton, recently earned their degrees in mechanical engineering from Rice. Their adviser is Andrew Dick, assistant professor of mechanical engineering.

Currently, the Air Force simulates deceleration by firing cannons into walls. The strategy is expensive and the sensor module and target are typically destroyed in the process. Team CADET's goal was to sustain deceleration for at least 10 milliseconds, and without destruction. They machined a cylinder of aircraft-gauge aluminum and sealed a digital accelerometer inside. Next, they built a 14-foot wooden frame to hold a track fashioned from angle iron.

On one end, they attached a slingshot made from surgical tubing; on the other, above the track, they fitted a 20-gallon fish tank with transparent plastic. Into the bottom of the tank they drilled a line of 40 holes and sealed them with a removable rubber sheet.

When the cylinder holding the accelerometer is fired with the slingshot, reaching a maximum velocity of about 50 miles per hour, the sheet is pulled off and the water is released from the tank. The falling water slows the cylinder, and the rate of deceleration is measured and recorded on the digital device. The cylinder and its contents remain undamaged and the test can be repeated indefinitely.

"Nothing is destroyed. You just fill the tank with water again and reload the slingshot," said Eddy, who stressed that the prototype can be scaled to any size.

"We started last fall with a ton of different ideas but ended up with a plan that is simple and inexpensive, and the scale can easily be changed – a bigger tank, more water, more holes, a longer track, a bigger slingshot," Eddy said.

In April, the team visited Eglin Air Force Base in Florida and met with members of the Munitions Directorate of the Air Force Research Laboratory, which commissioned the project. The team presented a video demonstration and PowerPoint explanation, and submitted their 65-page final report.

"They liked what they saw and said they were interested in exploring the idea further. We know we've created something entirely new. The parts are not new but the combination is. Also -- and this is important -- we came in under budget," Eddy said.

Provided by Rice University