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# Loud noises make the world a safer place

**Wrightstyle, based in Devizes, is one of Europe's most innovative steel glazing specialists. Lee Coates is the firm's technical manager and here explains how the company has made a major breakthrough in blast-proof glazing.**

The village of Gilsland doesn't quite know where it is. One half of it is in Northumberland, the other half in Cumbria. Sir Walter Scott, the author, once visited the area, fell in love and, after a whirlwind romance, proposed marriage. She accepted. Since then, except for a local hotel burning down in the mid-19th century and, more recently, the roof blowing off the village bus shelter, nothing much has happened in Gilsland.

Estate agents wax eloquent about its beauty. It lies at the edge of the Kielder forest on the line of Hadrian's Wall. Built by the Romans to keep out the marauding Scots, the wall crops up in local gardens. Visitors to the village can sometimes be surprised by distant explosions.

Three miles north of the village is RAF Spadeadam, the largest RAF station in the UK and only one of two electronic warfare ranges in Europe. It opened in the late 1950s and was the test site for Britain's Intermediate Range Ballistic Missile (IRBM), the ill-fated Blue Streak. Launch pads for the missile system are now listed monuments.

Not that many people get to see them as it is a secure Ministry of Defence site. What visitors it does get are there strictly by prior agreement.

Inside the RAF base is a test site belonging to Advantica, a global engineering consultancy that provides services, software and consultancy to the gas, water and energy sectors. The company, with its heritage in the former British Gas, now operates in over 60 countries across the globe.

The Advantica Spadeadam Test Site specialises in large scale test work of a hazardous or potentially hazardous nature. Part of its work involves tests with explosives which, conversely, also means making the world a safer place. For example, the company conducted simulation tests following the Piper Alpha rig disaster in the North Sea, the results of which have made oil and gas exploration safer.

In May 2006, for Wrightstyle, Advantica set off the largest explosive device they are prepared to detonate on their site, to simulate what would happen to a glazing system if a lorry packed with high explosive was detonated nearby. That is 500 kg of TNT-equivalent explosive, up to ten times the size of a car bomb, and many, many times more powerful than a single suicide bomber.

Advantica self-regulate the tests they conduct and work with the Meteorological Office to predict the sound levels in the local area to endeavour to keep the noise level below 120 dB outside the RAF range for all tests. Although noise levels can reduce rapidly with distance, for the Wrightstyle test ear defenders were mandatory even at a distance of several hundred metres from the explosive charge. The villagers of Gilsland, unaware of what was being tested, wouldn't have been aware that the world had once again become a better place. What happened to the steel glass and glazing system? Precisely nothing.

To understand the significance of nothing, it's important to remember that in a terrorist attack in an urban area - in other words, virtually

every attack - between 80-85 per cent of all secondary blast injuries are caused by flying glass.

Amid the carnage caused to the Federal Building in Oklahoma City over ten years ago, 200 victims suffered from glass injuries. The atrocity was a compelling reminder that glass can be both a friend and an enemy. The same lesson was learned in the UK with devastating terrorist attacks in Northern Ireland, London and Manchester.

A leading US expert on blast injury at the Department of Emergency Medicine, Carolinas Medical Centre, wrote after Oklahoma: "Secondary blast injury is responsible for the majority of casualties in many explosions. The glass facade of the Alfred P Murrah Federal Building shattered into thousands of heavy glass chunks that were propelled through occupied areas of the building with devastating results."

The findings of the Applied Research Association Inc backs that fact. "Historically, the major contributor to injuries due to terrorist explosion in urban environments is the glass fragment hazard generated by breakage of windows."

Understanding why glass breaks isn't difficult. After detonation, a bomb produces gases at very high temperatures. This in turn leads to rapid expansion and the creation of a shock wave travelling at speeds of up to twenty times the speed of sound. The shock wave lasts only a few millionths of a second and is then followed by an equally sudden but longer-lasting drop in pressure. It's the enormous impact of the shock wave that shatters glass.

The pressures involved and the speed of the shock wave depend, quite obviously, on the size of the bomb and the distance it is from its target - the so-called 'stand-off' distance. The closer a building is to a bomb, the greater the shock wave it will be subjected to. Hence, lesson one in protecting a sensitive building is to prevent cars or lorries getting close to it. However, that isn't always possible and, in any case, what about the buildings next door?

The issue of proximity is important. After the Oklahoma outrage, glass fragments were found six miles from the site of the detonation. In New York, 15,500 windows were damaged within a mile of Ground Zero - nearly 9,000 within half that distance. In other words, it isn't just high-security or sensitive buildings that are at risk: every building in the vicinity of an explosion is in danger.

In the aftermath of Oklahoma, researchers from the Glass Research and Testing Laboratory at Texas Tech University found that damage to property and person could have been reduced if laminated glass had been used in the buildings that also surrounded the Federal building.

The day after the Oklahoma bombing, the US President instructed the Department of Justice to see what conclusions could be drawn in terms of protecting federal buildings. One of the DOJ's key findings was "to provide for the application of shatter-resistant material to protect personnel and citizens from the hazards of flying glass."

The US National Academy of Engineering

also noted that "a more proactive approach to creating better new buildings is to develop glazing materials that meet aesthetic and functional design objectives but do not contribute to the explosion-induced projectile hazard."

In that statement lies the significance of the very large Wrightstyle test detonation, because all architecture involves compromise, the architect balancing what is practical or aesthetic against what is possible. Nowhere are those compromises more significant than in the design of a building against terrorist attack.

The loud explosion in the Cumbrian hills has removed much of that compromise because the lorry bomb was set off adjacent to a multi-panel steel glazing system - a system that, aesthetically, looks no different from any other glass frontage. The independent test proved that the glass didn't shatter into deadly shards and the steelwork holding the multiple panes in place remained immovable.

Significant? Absolutely. Most tests of this kind use only a single module of glass, not a multi-panel large span assembly. Most blast systems are chunky, ours has a slim 60 mm profile width.

It now means that the design balance has tipped more favourably back to architects. They are once again able to design sensitive buildings that don't look like bunkers, with small windows. They can once again use the panorama of their imaginations to build buildings that look visually stunning.

A report from the Commission for Architecture and the Built Environment (CABE), a UK statutory body that advises on architecture, urban design and public space, says that the increasing sophistication of technology in the building sector will allow developers to concentrate on the aesthetics of urban environments and could usher in a new urban renaissance.

I believe that to be the case. Companies such as Wrightstyle are at the forefront of that quiet revolution in taking glass out of the hands of terrorists. We have invested a great deal of money to design the future and, more importantly, we have tested it. Many companies only use computer modelling to anticipate how a glazing system will perform. In addition, we also try to blow it to bits - and only if we fail to blow it to bits do we know it's safe, to ISO/DIS, GSA and ASTM standards.

A passing visitor to Gilsland would only have had a short time to enjoy the renewed peace and quiet of the village before hearing another distant bang. Having blown up a simulated lorry bomb, we moved in closer to the same test assembly and set off a simulated car bomb. It might have been a smaller explosion but, being closer to the test rig, it generated a more intense shock wave.

Our tourist wouldn't have known it but, once again, the world had just got safer. Because, as before, our glazing system performed as we'd hoped it would. In a real situation, the people behind the glass would have been safe.

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