ABSORB AND DISSIPATE

Dr Rachael Hazael *reconsiders blast protection and the role plants can play in modern security design*

When multiple plants are arranged in controlled densities, with specific spacing and containment, the collective response becomes more effective

For decades, blast protection in public and sensitive environments has followed a familiar visual language. Steel barriers, concrete blocks, reinforced facades and hostile vehicle mitigation measures have become synonymous with security preparedness. Their presence signals resilience and deterrence, but also reminds occupants and visitors that risk is ever present. As threats have diversified and urban density has increased, there's now a question over whether protection must always be visible, heavy duty and psychologically imposing.

At the same time, the pressures on security professionals have expanded well beyond immediate risk reduction. Regulatory scrutiny has increased, particularly around crowded places. Climate resilience, environmental responsibility and public wellbeing have become part of the security conversation. In this context, it's timely to examine whether alternative forms of physical mitigation – less industrial in appearance, and more integrated into the built environment – can complement traditional approaches.

For some years, I've been exploring the use of engineered vegetation as a passive protective measure against blast effects. At first glance, the idea appears counter intuitive. Plants are typically associated with vulnerability rather than resilience, valued for how they look and their environmental benefits rather than their mechanical functions. Yet findings from experiments I have conducted suggest that certain plant structures, when arranged deliberately, can absorb and dissipate energy in ways that we can apply to blast and impact mitigation.

This research sits at the intersection of materials science, explosive engineering and urban design, and it raises important questions for security practitioners. Not whether vegetation can replace traditional protective structures – it of course isn't a straight swap – but whether it might play a role in creating layered defensive strategies.

This is something we are actively developing through Blast EcoShield, which was recently on display at the RHS Chelsea Flower Show, winning two awards. Bringing theory and practice together, our spin-out company – recently highlighted as an example of university best practice for spin-outs – is developing engineered plant systems to protect people and infrastructure by reducing the impact of explosive events.

Modern security planning increasingly focuses on environments that must remain accessible. Transport hubs, entertainment venues, conference centres and civic open spaces are designed to encourage movement and congregation, yet these same characteristics make them difficult to secure discreetly. Visible fortification can undermine the very purpose of a space, creating friction between safety and openness.

The introduction of legislative frameworks such as the UK's Terrorism (Protection of Premises) Act has sharpened this dilemma. Duty holders are required to assess risk and implement "reasonably practicable" mitigation, but the legislation is not prescriptive about how that mitigation should appear. As a result, security teams are under pressure to demonstrate compliance while avoiding solutions that are socially disruptive or commercially damaging.

Traditional blast and impact barriers remain essential in many scenarios, particularly where intelligence-led threat assessments indicate a high likelihood of attack. However, there is growing recognition that not all protective measures need to project security overtly. Passive systems – those that operate continuously without active interventions or a conspicuous presence – are becoming more attractive, particularly in lower-profile but high-footfall locations.

It is within this context that interest in nature-based mitigation has developed, not as an aesthetic exercise, but as a practical exploration of how organic structures behave under extreme loading.

The research underpinning this approach starts with a question familiar to any protective design specialist: how do materials respond to sudden energy transfer? In blast mechanics, protection is often achieved by forcing energy to disperse over time and space rather than allowing it to be transmitted directly to a target. Flexible materials, layered systems and sacrificial components are commonly used to achieve this effect. Interestingly, many biological structures that evolved to survive wind loading, impact and pressure changes, exhibit similar characteristics.

Certain plant species combine flexibility with tensile strength. Their stems and leaves deform under load, absorbing energy before returning – partially or fully – to their original form. In isolation this behaviour is insufficient to provide meaningful protection, but I've found that when multiple plants are arranged in controlled densities, with specific spacing and containment, the collective response becomes far more effective.

Running over 50 experiments, my research has shown that plant assemblies can disrupt blast waves and limit debris projection when compared with unprotected surfaces. This does not mean that vegetation 'stops' a blast. Rather, it can influence how blast energy propagates, contributing to reduced impact in a measurable way.

For security professionals, the relevance lies not in the novelty of using plants, but in the underlying principle: energy dissipation through distributed, flexible structures. This is a concept already familiar in fields such as personal protective equipment, and automotive crash designs.

One of the persistent challenges in security innovation is translating laboratory and fieldwork findings into deployable solutions. In the case of vegetated blast mitigation, practical considerations quickly come to the fore. These include durability, maintenance, predictability of performance and integration with the existing infrastructure.

ARRANGED CORRECTLY SOME PLANT STRUCTURES CAN ABSORB AND DISSIPATE ENERGY

Unlike steel or concrete, living materials change over time. Growth cycles, seasonal variation and environmental stressors all influence structural behaviour. For a protective system to be credible, these variables must be understood and managed. Part of my research in this area has therefore focused on identifying species with consistent mechanical properties, and on developing modular containment systems that control geometry regardless of plant growth.

From a security planning perspective, predictability is critical. Passive mitigation measures must perform as expected without requiring real-time human decision-making. This requirement has driven design approaches where vegetation is treated less like landscaping and more like a functional component within a defined envelope.

There is also the question of placement. Living mitigation systems are not proposed as perimeter defences against high-energy vehicle-borne threats, where hardened solutions remain essential. Instead, they are being explored for use in building façades and pedestrian areas, locations where incremental reductions in blast impact can translate into meaningful reductions in injury risk.

Security measures influence behaviour as much as they control risk. Highly visible fortification can reassure some users while unsettling others. In environments such as cultural venues, university campuses and public squares, overt security architecture may conflict with organisational values or visitor expectations.

Living barriers offer a different psychological profile. As part of a broader design strategy, they can blend into their surroundings, contributing to place-making rather than defensive signalling. For security practitioners, this raises an interesting question: does reduced visibility undermine deterrence?

The answer is context dependent. Deterrence relies not only on visibility, but on uncertainty. When protection is embedded rather than advertised, adversaries may find it harder to assess vulnerabilities

Picture credit: Margo Evardson

accurately. This aligns with wider trends in security design that favour ambiguity over overt demonstrations of strength.

Moreover, passive mitigation does not preclude visible security measures elsewhere. It can operate as part of a layered approach in which different elements serve different purposes, from deterrence and detection to protection and resilience.

LIVING BARRIERS OFFER A DIFFERENT PSYCHOLOGICAL PROFILE TO MORE OVERT SECURITY

One of the distinguishing features of my research into vegetated blast mitigation is its alignment with broader environmental objectives. While security requirements cannot give way to sustainability goals, there is increasing recognition that infrastructure decisions must address multiple risk domains simultaneously.

Climate change is altering the threat landscape for security planners. Factors like heat, flooding and air quality are no longer peripheral concerns; they affect crowd behaviour, system reliability and emergency response. Vegetated infrastructure can contribute to cooling, water management and environmental comfort, indirectly supporting operational resilience.

This convergence of security and environmental thinking reflects a shift in how risk is thought about. Rather than treating threats in isolation, planners are increasingly looking at how interventions can mitigate multiple hazards at once. Living mitigation systems sit within this template, offering partial blast impact reduction while contributing to climate adaptation strategies.

It is important to avoid overstating the capabilities of nature-based mitigation. No responsible security professional would advocate entirely replacing engineered barriers with plants in high-threat scenarios. Over confidence in unconventional solutions carries obvious ethical and professional risks.

There is also a danger that green mitigation could be misinterpreted by non-specialists as a cost-cutting substitute for established security measures. Clear communication is therefore essential. Living systems should largely be positioned as additions to, not replacements for, conventional protection, deployed where they make technical and contextual sense.

In addition, confirming performance remains critical. Any mitigation solution, regardless of how benign it appears, must be subject to rigorous testing and validation. The security sector has learned hard lessons from interventions that looked promising in theory but failed under real-world conditions, such as airport 'puffer' machines.

For those responsible for designing and managing protective environments, the value of this research lies less in immediate adoption and more in expanding the conceptual toolkit available for risk mitigation. It challenges assumptions about what constitutes a 'security material' and encourages cross-disciplinary thinking.

As threats continue to evolve, security professionals are being asked to balance protection with openness, resilience with wellbeing and compliance with public acceptance. Solutions that address only one of these dimensions are increasingly difficult to justify.

Living blast mitigation systems will not transform the sector overnight, nor should they. However, they offer a glimpse of how future security design might integrate protection more subtly into everyday environments. In a security landscape where adaptability is as important as strength, re-examining the protective potential of the natural world may prove less radical than it first appears ●

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Picture credit: Ecoshield