SikkerhedsBranchen

GUIDELINES ON

Vehicle security barriers

PHYSICAL BARRIERS AND METHODS OF PROTECTION AGAINST VEHICLE ATTACKS

2024

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Contents

Foreword

The aim of a vehicle security barrier (VSB) is primarily to mitigate the risk of a vehicle borne attack or accident. *See ISO 22343-2 section 4.1* Vehicle security barriers can reduce the risk of death and injury in an attack carried out with one or more vehicles against pedestrians, a public event, or a facility. This places considerable demands on the placement, installation, design, and performance of the chosen vehicle security barrier(s).

The purpose of this technical specification is to form the basis for a standardized methodology for design, installation and documentation of vehicle security barriers, their functionality, and capabilities with reference to the following standards ISO 22343-1[(1)] and ISO 22343-2[(2)]. In a Danish context this technical specification provides advice and guidance to secure outdoor locations based on the general threat assessment (VTD) drawn up by the Danish law enforcement intelligence authorities, PET (Police Intelligence), and guidelines issued by the authorities as regards protection against vehicle as a weapon attacks (VAW). *See ISO 22343-2 section 5.1. The threat- Identify and quantify the threat.*

Responsibility for the protection of assets against terrorist attacks lies with developers as well as owners and tenants/users. *See ISO 22343-2, section 6.2. Identification of interested parties.* See also SikkerhedsBranchen's guide to protection from terrorist attacks.

The owner of automated vehicle security barriers must implement policies and procedures for the handling, activation, control of the barriers and safeguards for bypassing the control system. Automated barriers are also subject, as a minimum, to annual inspections. There should be a method of reporting of issues with the barrier and recording actions undertaken.

There are several members of SikkerhedsBranchen providing advice on appropriate protection against terrorist attacks.

In the same way, it is important to mention here that organizers of temporary events have responsibilities in relation to evaluation of the threat, the selection and installation of vehicle security barriers. If the audience/guests/citizens become victims of a vehicle as a weapon attack against a crowd, it is their liability and they should be aware that they hold the residual risk, that has been identified through the Operational Requirements process. *See ISO 22343-2, section16. Operational requirements.*

The end user of vehicle security barriers should be aware of the need for the provision and installation of solutions that were identified by a suitably qualified engineer, *ISO 22343-2, section 9.1*, following a Vehicle dynamics assessment (VDA), *ISO 22343-2, section 9.2.2*, have a suitable impact test performance classification to ISO 22343-1 (or its equivalent, such as ISO IWA 14-1, PAS 68) and are installed as tested and for which they achieved the performance classification (*Performance Rating, ISO 22343-1, section 7*).

(1) ISO22343-1: Performance requirements, vehicle impact test method and performance rating

(2) ISO 22343-2: Application

Where protective measures in the urban space are required, street furniture can be utilized, to create standoff from assets and provide a safe haven for the citizen and importantly prevent vehicles from gaining and there are a number of products including benches, planters, bicycle stands, bins, lamp posts, that have been impact tested and hold a performance classification.

See ISO 22343-2 section 12.10 Examples of VSB's – Steet furniture.

To some extent, it will be possible for the urban architect to design an urban environment which meets local and national planning requirements and blending this with the need for crime prevention using VSB's as well as more traditional, but non-tested street furniture. However, in such cases it is highly recommended to consult a suitable qualified engineer. *See ISO 22343-2, section 7.5.1.*

Urban space furniture may take up more space than traditional items such as a bench and will often require a foundation or method of fixing. As with more traditional VSB's the needs for pedestrian access, wheelchair users, cyclists, street cleaning machines and the rescue and emergency services need to be considered. The predicted flow of people in and out of the area - especially if the area is sometimes used for events where large crowds gather – must be taken into consideration, as well as blend measures, which meet the requirements of the local planning to put your own architectural mark on these solutions. However, it is always necessary to enquire with the individual manufacturer/supplier about what is possible in order to avoid compromising the certified solution. In this regard, it is highly recommended to consult a suitable qualified engineer. *See ISO 22343-2, section 7.5.1.*

See ISO 22343-2, section 7.3 Site survey and section 7.4. Traffic survey

There will often be variations between VSB performance, when under controlled vehicle impact test conditions compared to the actual site of installation. The final site conditions will not be the same and in order to ensure that the Performance classification for the VSB is retained a civil works review should be undertaken by a suitably qualified HVM engineer. *See ISO 22343-2, section 7.5.1 Variations between VSB performance under vehicle impact test conditions and site conditions.*

1. Reference terms

Here are definitions of a number of technical terms and concepts used in this technical specification.

Standards

Following the increased risk from evolving terrorism threats BSI developed an impact test standard suited to the vehicle type found within the United Kingdom and Europe using the BSI Publicly Available Specification route to rapidly develop an Impact test standard **PAS 68-2005**. This standard was supported by a full range of impact testing and the co-operation of the manufacturing industry to develop cost effective vehicle security barriers, which were not previously available.

It was recognized that there was a need to provide guidance to the end user in determining suitable products for their application, resulting in the publication of **PAS 69-2006 Guidance for the selection, installation, and use of vehicle security barriers**.

The need to ensure that this work could be recognized within Europe led to the development of **CEN CWA 16221-2010 The standard for Vehicle security barriers. Performance requirements, test methods and guidance on application**. This was a CEN workshop agreement which combined the details from PAS 68 (Gaining a VSBs resistance Performance rating by a uniformed crash test) and PAS69 (selections and planning for the application of VSBs in order to provide a reliable level of protection in line with a sites operational requirements) into a single document.

It was recognized that due to the global requirement for vehicle security barriers that there should be a single document to which products should be evaluated. In order to do this an international working group was facilitated by BSI to develop **ISO IWA 14-1: 2013 Performance requirement, vehicle impact test method and performance rating.**

This document combined both PAS 68 and ASTM F2656 into a single test document and that by working with ASTM the changing landscape of international vehicle types, location, and deployment of VSB's would be accounted for in the test method.

The development of the IWA was mirrored in the ASTM F2656 with the inclusion of European vehicles in the standard.

A similar exercise was undertaken by the international working group with PAS 69, as there were no equivalent guidance documents at the time, and it resulted in **ISO IWA 14-2: 2013 – Vehicle security barriers: application**.

The cost of undertaking a full-scale impact test is extremely high and the need for a lower cost, repeatable impact test was recognized, particularly for those system where VSB's, generally bollards are used to delineate pedestrian and vehicle spaces at locations such at supermarkets and other areas where bollards are used. The majority of such bollards have never been tested for impact, as there was no standard available.

PAS17O-2017: Vehicle Security barriers – Low speed impact testing: Part 1 Trolley impact test method for bollards was developed using a standard vehicle impact trolley to address this issue.

The standard restricts the trolley mass to 2500kg and impact speeds to 16 or 32 km/h and gives the manufacturer the opportunity to develop a bollard and or foundation to a point where they can be taken through to a full-scale impact test under ISO 22343-1 as well as potentially undertaking multiple tests in a single day.

ISO 22343-1: 2023 Security and resilience – Vehicle security barriers Part 1: **Performance requirements vehicle impact test method and performance rating** has replaced PAS 69, CEN 16221 and IWA14-1 which have been withdrawn by the relevant national standards bodies. *Note that ASTM F- 2656 is a privately funded standard and not a standard operated by a national standards body and therefore is still available.*

ISO 22343-2:2023 Security and resilience- Vehicle security barriers Part 2: **Application** has replaced PAS 69, CEN 16221 and IWA 14-2 which have been withdrawn by the relevant national standards bodies.

Tested products

The development of the previously mentioned impact test standards has been ongoing for more than 35 years and there is a large range of products that the end user can choose from, and which will have been tested against versions of these standards. Attention should be taken in choosing the product, reviewing the performance classification, and reading the original report against the parameters identified (site survey, operational requirements and VDAs) for the requirement of the measures before final selection is made.

Numerical modelling

Manufacturers and designers have been using drawing packages which enable them to review potential areas of stress or failure in their design and those involved in the development of blast models have used computer modelling for the describing the effect of blast on buildings. Evaluation of impact test performance using numerical models such as DYNA has been considered and with the increase in computer power is the subject of research programs such as the following at the European Joint Research Centre.

(*https://publications.jrc.ec.europa.eu/repository/bitstream/JRC136541/JRC136541_01.pdf, section 9.3.)*

As with any form of modelling there is the need to obtain data from full scale testing in order to calibrate such models and caution should be taken when purely using such models for the selection of VSB's and their performance. This is why the use of FEA modelling is not accepted as a standalone tool for the design of a VSB without validation of the final design against a full-scale impact test. *ISO 22343-2, section 9.7 Design Method.*

Testing organizations

The following are some of the ISO 17025 accredited test organizations that are registered by their national Standards Body to undertake vehicle impact testing to either ISO 22343-1 and or ASTM F-2656.

Horiba -MIRA - based in the UK previously the Motor Industry Research Association undertakes testing internationally.

CTS - based in Germany.

Transpolis - based in France.

DEKRA - based in Germany (only testing surface placed VSBs).

Texas A&M Transportation Institute - Also the USA lead in the development of ASTM F-2656.

Calspan - USA.

APPLUS IDIADA – Previously KARKO based in USA.

Lead organizations

PET

Danish Police Intelligence who has issued four guidance's on securing different sites.

Threat assessment

PET (Police Security and Intelligence Service) is the authority in Denmark that determines the general level of threat against Denmark. The PET publication is called VTD; Assessment of the Terror threat to Denmark. *This VTD has been published in March 2023*.

FE

Military Intelligence who has issued FKOBST 358-1 on securing military sites containing requirements that are also relevant to securing civilian sites.

NPSA

UK National Protective Security Authority (NPSA)

See www.npsa.gov.uk/hostile-vehicle-mitigation-hvm.

Terms and Definitions

Vehicle Dynamics Assessment (VDA)

Following the general threat assessment, a number of technical analyses need to be carried out.

Before starting the purchase, placement, and installation of vehicle security barriers, a **VDA (**Vehicle Dynamics Assessment) needs to be undertaken. See ISO 22343-2, section 9.2.1. and 9.2.2. Vehicle Dynamics Assessment.

The VDA does not specify the security level. The result of a VDA is a speed at the specified. Using a range of tools including swept path analysis, vehicle type, impact mass, vehicle speed (as defined in ISO 22343-1) an optimized trajectory (path of the vehicle) can be established. This enables the planner to appraise the locations individual performance ratings, in order to plan the location of the physical barriers and choose the barrier type for the chosen threat vehicle and calculated impact speed.

There are a number of tools developed by specialist HVM consultants as well as one from the JRC under the European Commission have developed an automatic tool V-SPEED to do this calculation.

The VDA and the determination of the security level should be done by a professional adviser or team.

HVM
Hostile vehicle mitigation - *See ISO 22343-2, section 4 – Introduction to Hostile Vehicle Mitigation.*

VSB
Vehicle Security Barrier - *See ISO 22343-1, section 3.1. – VSB definition.*

VACP
Vehicle Access Control Point. The point where your VSB or check point is established. *See ISO 2234-2, section 13.*

2. References to national rules and regulations

National laws.

In Denmark, we have no legislation in this area, unlike Norway. There are also no rules placed in the building code or elsewhere. From the authorities, only the guidance documents of PET and FE are available.

However, there are requirements for the functioning and inspection under the Machinery Directive of VSB's which are operational such as automatic bollards, rising kerbs etc.

PET Guidance Documents.

PET has published four guidelines on terrorism protection for different locations. They primarily deal with the risk analysis and do not delve deeper into the technical solutions.

3. General requirements

In Denmark, the authorities only impose few requirements regarding protection from terrorist attacks. In addition, there may however be indirect requirements, for example:

- How many persons may be gathered in connection with an event, considering the National Police's "Guidance on drawing up a security plan for major outdoor music events, etc." and the Ministry of Justice's and the Ministry of Culture's "Guidance on the safety of outdoor music events etc."?
- International maritime and aviation security in the form of port security and related measures. Known as the International Ship and Port Security (ISPS), an EU Directive and two Danish guidelines from the Danish Transport Authority (Maritime Directorate).
- Project-specific recommendations by PET or FE for critical infrastructure or where there may be a need for a higher level of security than usual.
- The CER directive (Critical Entities Resilience) which is in force will be implemented into Danish legislation during 2025.
- The Ministry of Children's and Education's Guide Security and Emergency Preparedness – Council and guidance for schools and educational institutions

4. Design and installation

4.1 Risk, vulnerability, and consistency

The installation of vehicle security barriers must be based on an overall risk assessment, a specific location assessment and a VDA. Caution should be given from the outset to distinguish soft targets from hard targets, since the hazards and collateral effects of the vehicle borne threats differ significantly.

4.2 Risk reduction through vehicle security barriers

If correctly planed and applied, vehicle security barriers are an effective way to reduce the extent of damage and loss of life. No means of protection provide 100 % protection against vehicle borne attacks, but choosing the right solutions, as well as the way the solutions are used and implemented, is crucial to significantly reducing the extent of damage and injury or loss of human life. The assessment and acceptance of a residual risk should always be part of a risk assessment and vulnerability analysis.

4.3 Consideration of installations in the ground prior to the choice of vehicle security barriers

4.3.1 Installation

In general, assembly and installation should always be carried out by, or in co-operation with, a specialized contractor/installer in order to consider all relevant on-site conditions and product performance requirements.

VSB's are rated according to ***ISO 22343-1 section 7- Performance rating***. In **Table 6** you find an example of a specific (VSB) product performance rating showing the parameters that go into the rating.

Performance Rating Explanation

Product type

Test type (Vehicle impact test)

Test vehicle mass

Vehicle classification

Impact speed

Impact angle

Vehicle penetration distance beyond the VSB datum line

Major debris - The furthest point that major debris, greater than 2 kg landed beyond the VSB datum line.

Where the penetration (dynamic or static) is greater than 25 m, the VSB shall not be awarded a performance rating.

8 Product information

Before placement, final installation and choice of vehicle security barriers, the following should be assessed:

- Foundation.
- Existing cables, supply lines and other obstacles in the ground.
- Drainage of water.
- Traffic restrictions/challenges.
- Entry into operation (commissioning) and handover.

4.3.2 Foundation

Before selecting and placing vehicle security barriers, the size of the product's foundation should be considered. *See **ISO 22343-2, section 12.4 Foundation type** Including **section 7.5.3. Foundations** and **12.9.2** and **12.10.2**.*

Fixed bollards are often tested in a row of three. If an installation requires a smaller number of bollards, the foundation must often remain the same size as for three bollards. A change to the foundation will require a new test or a calculation from a specialized engineer. For changes to the tested configuration of the VSB please refer to ISO 22343-2 Annex C.

4.3.3 Existing cables, supply lines etc. in the ground.

In many urban areas, underground installations are very close to the surface, often passing through the areas for which protection is sought. In these locations, surface mounted products or products with low built-in depth should be considered.

4.3.4 Surface water drainage

In order to avoid water accumulation in underground installations – e.g., automatic bollards – drains should be established from and/ or around the installation. Automatic bollards often have an outlet to drain at the bottom of the casting box. It is recommended that this be connected directly to sand trap/sewer. Alternatively, a drain may be established in the area from which the water is discharged. If the terrain is designed in such a way that larger amounts of surface water will pass through the installation, a line drain should be considered. Alternatively, the installation and the area surrounding it may be slightly raised compared to the rest of the terrain.

4.3.5 Groundwater drainage

In areas with high groundwater levels, solutions can be delivered with integrated pumps.

4.3.6 Frost and snow

Cold and snow may, in the case of surface and groundwater, destroy or prevent the functioning of the vehicle security barrier. One option is to install heating elements in the solution. **See ISO 22343-2, section 9.5.4 - Environmental conditions**.

4.3.7 Traffic restrictions

The location of vehicle security barriers can have a major impact on daily traffic in the area. Both for cars and pedestrians and other types of traffic. The following points could usefully be considered in the planning process:

- Emergency services (e.g., Police, Fire and rescue)
- Delivery of goods
- Parking
- Flows of persons or cars in general (also in the case of transits, where higher security requirements indicate less flow)
- Number of passengers, flow rate, guard control, etc.

*See **ISO 22343-2 section 13.5.2 - Traffic throughput**, but also section 9.5, Operational performance and section 9.5.2, Speed of legitimate access.*

The figure below shows examples of effects on vehicle traffic of different types of vehicle stopping measures.

Table 1 – Example of potential effect on traffic throughput for a number of different VACP configurations

VSB	**Estimated vehicle transit time** Seconds (+ 25 %)	**Vehicles per minute** (± 25 %)
No control	1	60
Visual pass check (no VSB)	4	15
Hands-on pass check	8	7
Single line of VSBs	19	3
Multi-vehicle interlocked VSBs	20	3
Single-vehicle interlocked VSBs	30	2
Final denial VSB	4 to 8	7 to 15

VACP = Vehicle Access Control Point

4.3.8 Protection versus safety and convenience

In the case of locations where the access route is through a vehicle security barrier, consideration should be given to how the operation and, where appropriate, the wish to ensure that the product does not close/does not trap or even lift a vehicle, while maintaining the desired protection.

4.3.9 Entry into operation and delivery

In addition to requiring the documentation of testing and certification of the vehicle stopping measure in the tender, documentation for installation/foundation drawings, cable diagrams, checking diagrams for correct installation, operation and maintenance manuals should also be provided as a minimum at the handover. ***See ISO 22343-2, section 10 - Procurement***, specifically ***section 10.5 - Commissioning and handover***.

4.3.10 Location in relation to buildings, etc. - Standoff distancing solutions

Bollards are also used to create distance from the façade of buildings to VBIED's (Vehicle Borne Improvised Explosive Devices) preventing them from coming close to the protected asset, thereby reducing blast effects on the buildings. ***See ISO 22343-2, section 9.4.3 - Standoff distance***.

The correct distance from the bollards to the building or other asset is established by pressure and construction damage analysis. Here too, one should combine this analysis with a VDA, so that it is considered how far vehicles carrying improvised explosive devices may penetrate the perimeter and thus come closer to the buildings than otherwise calculated. Pressure and design damage analysis must be carried out by specialized blast consultants and advisors.

The same applies to major debris dispersion in relation to highly vulnerable soft targets (PALs). Thorough assessments must be carried out to determine a PALs off-limit areas at which aggregation of people should be avoided.

4.3.11 Prepare future installations - Electricity, lighting and cabling

It is recommended to consider future needs and possibilities, especially when installing fixed bollards. Automatic bollards usually have lights and cabling installed, so that electrical work is inherent for such an installation.

When installing fixed bollards, piping for any future installation of light and possibly internet should therefore be fitted. The Internet can be used for future screen solutions on the bollards. For instance, with the application of a bollard-screen cover that can be used for emergency or general information for citizens or just advertising. This may be relevant in the future in the transport and sport/event sector such locations as stations, stadiums, etc.

5. Types of vehicle security barriers

There are certified solutions of virtually all types of barriers, such as static, automatic, manually operated, and mobile/temporary solutions. Just as there are countless solutions for the individual vehicle stopping measure, there are also various combination solutions. These may be automated solutions, for example with access control, semi-automatic solutions where a guard or an ARC (control center) remotely controls the vehicle security barrier and finally manual solutions to remove the bollard using a key.

Choice of solution depends on requirements such as security level, function/purpose, design, terrain, etc. ***See ISO 22343-2 section 12 - Types of VSB***.

5.1 Fixed/static barriers

5.1.1 Fixed bollards

A fixed/static bollard is a bollard which is anchored in the ground via a steel and/or concrete foundation. The bollard cannot lower or slide off its position. However, certain types (plug-out bollards) can be manually removed from the foundation, should there be a need for it. The bollard can be supplied with different sleeves made of different materials and types, with lights, reflectors or urban furniture that may be installed on top of or surrounding the bollard.

As mentioned, there are some static bollards that are manually removable, the bollards are fitted into a console/casing, and can be lifted away. They may use a traditional foundation or be based on a shallow mount foundation (having shallow foundation depth). These bollards can be operated by hand or using machines. While they are not automatic, they may well use hydraulics.

5.1.2 Fences

Fences are available on the security market, which are a combination of common perimeter fences and fences with vehicle stopping capability. These HVM fences have been tested and are certified to the same standards as bollards, gates, road blockers and urban street furniture, as mentioned above.

5.1.3 Embankments, bund and berm, flood protection, stairs, terrain-level differences

For terrain change/adjustments, see Chapter 8 of Forsikring & Pensions Supplementary Security Catalogue (only available in Danish).

Embankments and moats can be used as VSB's. Examples of this can be seen in rising water protection and storm surge protection projects. In this context, it is very important to seek advice and guidance from advisors/suppliers who have insight into the Armed Forces' methods for establishing field fortifications, or who have insight into NPSA (National Protective Security Authority, UK) instructions on the use of terrain obstacles, including embankments, moats, stairs, ledges, etc.

5.2 Automatic barriers

5.2.1 Automatic bollards

Automatic bollards can move up and down (or from side to side) on their installation base. They are available as standard raising/lowering bollards, telescopic bollards, collapsible bollards, and side-running bollards.

Automatic bollards are installed primarily to provide access for vehicles, etc. through an integrated perimeter security solution. They provide easy passage for pedestrians and cycling but keep unwanted vehicles out.

Automatic bollards are supplied with different forms of coating or sleeves using various materials and types, lights and reflectors can also be fitted. Automatic bollards work by using hydraulic, electric, or compressed air systems which ensure that the bollards can move up and down. The bollard system can be operated via any control device such as a card reader, tag, mobile phone, remote control, key, etc.

Automatic bollards are often tested as a single unit and as such the foundation will in general be larger and at greater depth than for static bollards with the same performance rating and end users should be aware of this when comparing similar products. The foundation varies between 30 and 200 cm below ground depending on the solution chosen. When installing automatic bollards, it is among other issues important to deal with the drainage of water and the positioning of the pump, switch box and technical cabinet.

5.2.2 Road blockers

Road blockers, often built into a steel fabricated box containing all the mechanical equipment which is then installed into a concrete reinforced foundation. A road blocker is a full width steel plate that is level with the road surface when in the open position and which rises in the barrier closed position and is often termed a rising kerb or wedge.

Caution should be given to the hazard of road blockers' risk of contusion and amputation of limbs. Hence, when installing road blockers people flow must be physically separated from the road blockers.

5.2.3 Beam barriers

A beam barrier has a delimiting and traffic-regulating effect and can be used to mark a line that should not be crossed.

A beam barrier can be managed by a person who allows passage and ensures the opening and closing of the beam. Similarly, the beam movement can be automated and connected to an access control system, which opens and closes the beam when certain conditions are met.

Beam barriers designed to stop vehicles can have different configurations, such as vertical lift, rising or swing beams. The width of such barriers is often limited to 4-10 meters, depending on the security level and type of beam.

5.2.4 Gates

Vehicle stopping gates are available as sliding gates, swing gates and folding gates. These gates are tested and certified to the same standards as bollards, road blockers and urban street furniture, as mentioned above.

Sliding gates for stopping vehicles can be on guide rails or cantilevered.

Swing gates are available as both manual and automatic gates. Swing gates will be single leaf, as it requires a solid pillar both sides of the gate to withstand the large forces from a vehicle ramming the gate.

Folding gates are automatic and available as both single-leaf and double-leaf. Depending on the security level and the manufacturer, they will be either free-running or rail-guided.

5.3 Temporary/mobile solutions

Temporary/mobile vehicle security barriers are primarily used in events such as sports, music, VIP, or events during holiday-periods (e.g., Christmas markets). Like the fixed and automatic barriers, these should be impact tested to the level of ISO 22343 -1 or equivalent impact standard and have a performance classification and designated as temporary vehicle security barriers, designed to withstand even heavy vehicles, without foundation.

The vast majority of temporary VSB's are surface placed and thus rely on the penetration into a certain type of surface (mostly asphalt/tarmac or softer) to function. Special attention must be given to the mode of interaction between the surface placed VSB and the surface it is placed on. It is recommended to consult a suitably qualified engineer before planning to deploy portable VSBs other than "as tested".

Temporary barriers are installed manually or with the help of machines/cranes, and can be installed so that access for pedestrians, cyclists, wheelchair users is retained, as well as access points for service and emergency service vehicles in specially secured sections. Access points can be operated manually or by automatic means (hydraulic).

Installation of temporary barriers must be carried out by trained personnel, and it is important that the solution is quality-assured according to the standards the systems are tested against. Particular attention should be paid here to the security level, which is an expression of how far away the barriers must be from the audience/guests/citizens, in the event of a collision with the barriers. *See **ISO 22434-2 section 9.4 Vehicle penetration distance and major debris distance.***

5.4 Road and road furniture

A supplement to the hostile vehicle mitigation measure is speed-reducing road and lane furniture. The principle is to make the access path towards the vehicle security barrier as varied as possible, for example by changing the lane so that the attacking vehicle has to to turn one or more times, thereby reducing the speed. Other options are strong road bumps that forcibly reduce speed. There are many different solutions that are particularly relevant where the access route is easily accessible and the where the speed of the attacking vehicle can be very high. Road layout and speed reduction features are described in further detail in ***ISO 22343-2, section 9.2.3 and 9.2.4.***

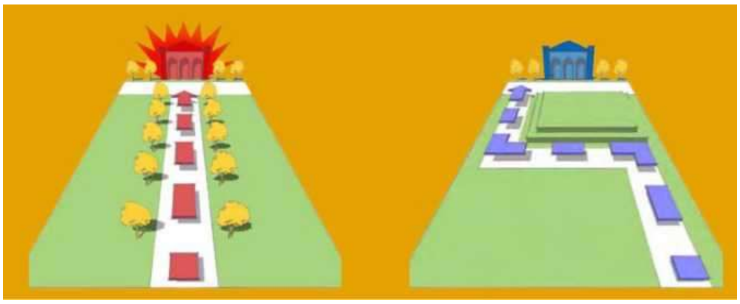

Illustration from: Integrated Security – A Public Realm Design Guide for hostile Vehicle Mitigation – Second Edition, p. 23

6. Service and maintenance

The owner of a moving/automated vehicle security barrier must have a plan for routine inspection, maintenance, and repairs. Regular review of the operation and security of the system shall be carried out at least once a year. The owner can advantageously choose to delegate the task to a third party (service partner). Care should be taken to ensure that the third party has the necessary skills and training to maintain and repair the installation. ***See ISO 22343-2, section15 – maintenance, service, and inspection.***