



Security Fencing Considerations Guide

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Foreword

The Security Fencing Considerations Guide is an UNCLASSIFIED publication, issued under the authority of the Royal Canadian Mounted Police Lead Security Agency for Physical Security (RCMP LSA).

This is a Government of Canada publication to serve as a guide for the design and selection of security fencing for departments, agencies and employees of the Government of Canada.

Suggestions for amendments and other information can be sent to the RCMP Lead Security Agency RCMP.LSA-GRC.POSM@rcmp-grc.gc.ca.

Effective Date

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Record of Amendments

Amendment No.	Date	Entered By	Summary of Amendment

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1. Introduction

The RCMP, as the Lead Security Agency (LSA) for physical security for the Government of Canada (GC) is responsible for providing advice and guidance on all matters relating to physical security. This includes what should be taken into consideration after it has been determined that security fencing is required for a specific location or application.

1.1. Purpose

The purpose of this guide is to provide GC employees with information on the appropriate selection and procurement of fence systems. It also provides considerations in the selection of alternate fence solutions.

1.2. Applicability

This guide is for use by all GC employees who design and/or specify security fencing. It is intended to be updated regularly to capture new guidance or update existing information as technologies evolve.

1.3. Information Technology Considerations

With the constantly evolving threat landscape, and the convergence of physical and information technology (IT) security, the requirement to assess the risk of any application and/or software connected to a network to operate and support equipment in Government of Canada controlled buildings is critical. Some examples of these control systems could be for items such as, but not limited to, security lighting, perimeter gates, doors, HVAC etc.

Before implementing any applications and/or software that will control and/or automate certain building functions, your departmental security requires the completion of a Security Assessment and Authorization (SA&A). This will ensure that the integrity and availability of the components the applications and/or software controls are maintained and that any risks highlighted will be mitigated. Starting the SA&A process early is highly recommended to ensure project delivery schedules are not affected. For more information on the SA&A process, please consult your departmental Security.

2. Contact Information

For more information, please contact:

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3. Glossary

Term	Definition
Biometrics	Identification using a physical feature of the person. E.g. fingerprint, iris print, facial recognition, hand geometry, retinal print, etc.
CCVE / CCTV	Closed Circuit Video Equipment / Closed Circuit Television
Compound	A site or campus with multiple structures secured as a single entity.
Delay	The time to defeat a security layer after detection of the attempt.
Deter	The ability to prevent an attack on a security layer due to perceived difficulty and/or threat of a response.
Fabric	The material between fence posts. Most commonly chain link, but includes other panels and mesh materials.
HVM	Hostile Vehicle Mitigation. Protective measures installed around a building or compound to prevent hostile vehicles from coming into close contact.
M-Rating (K-rating)	A vehicle security barrier rating based on the mass and speed of the attacking vehicle.
Man-trap (Interlock)	An interlocked set of personnel gates or doors that prevents simultaneous access between a secured and a less or unsecured area with sequential access through an intermediate area.
Perimeter	A continuous security line surrounding a secured zone.
Protected compound	A compound where the building(s) and/or assets require additional security controls for protection of the information or assets.
Sally port	A secured or controlled entry point through the security layer of a perimeter fence or wall.
Security Fence	A perimeter fence that is intended to have a deterrent and/or delay function related to the security of the contained buildings and/or assets.
Setback	Outer: The distance between the property line and the security layer. Inner: The distance from the security layer to the nearest building.
Stand-off	The distance between a potential threat and the asset.

4. Acronyms

Acronym/Abbreviation	Meaning
AHJ	Authority Having Jurisdiction
AWG	American Wire Gauge
CPTED	Crime Prevention Through Environmental Design
GC	Government of Canada
LSA	Lead Security Agency
PVC	Polyvinyl Chloride
TRA	Threat and Risk Assessment

5. Security Fencing

The need for a perimeter fence starts with a Threat and Risk Assessment (TRA) to determine who or what the fence(s) will deter or delay. Fences provide protection against threats; may have safety related functions and can provide both deterrent and delay functions. In order to increase fencing effectiveness, there should to be a detection element(s) included in the design.

A perimeter is not the only place a security fence can be installed. Within a given compound or area, there may be different security requirements or different security levels which may require sub-dividing the fencing elements. They can divide a compound into separate zones or create protected pathways for travelling between buildings. Higher security levels may require the use of multiple layers of security fencing to provide the appropriate security in depth.

The security fence design should consider; gates, barriers, and sally ports to control who or what may pass through the perimeter, as well as the alternatives if the system is breached. The use of Security Guards or electronic access control devices will help speed up the entry and exit process for authorized users. Reducing complications encountered when entering and exiting can make a significant difference by reducing congestion, especially for legitimate or frequent users.

All fencing installations are subject to criteria from the Authority Having Jurisdiction (AHJ). Provincial or municipal laws or bylaws may restrict, limit or demand certain construction standards for fences.

6. Protected Compound

The starting point for security fences is to determine the perimeter that is to be enclosed. Some of the possible elements requiring protection from a perimeter fence could include:

- Single or multiple building compounds;
- Single or multi-tenant buildings or compounds;
- Parking areas;
- Training areas;
- Utility infrastructure (exterior storage areas, gas, electric, water, and sewer); and
- Transportation hubs such as; ports, train yards or stations, airports.

The main challenge to defining a perimeter is the length of fencing required. A large perimeter is expensive and more elaborate to design. Questions to consider during the design phase are:

- Do all elements in the compound require the same protection level or is there a requirement for multiple layers of protection?
- Does the security fence encompass one or more buildings as part of the perimeter and will the fence butt against, go around (encircle) or go over the building(s)?
- Does the security fence need to be supported or reinforced with other security controls such as bollards, detection equipment, guards etc?
- Is a perimeter inside the property boundary possible or even acceptable?
- What types of locations/conditions are adjacent to the perimeter?
 - Unrelated buildings;

- Open, forested or overgrown areas;
- Shorelines (fresh/salt water);
- Highways and roads, pedestrian paths or public areas; or
- Environmental concerns such as weather, seismic activity etc.
- Is a wall or fence required to protect the boundaries of the property?
 - A TRA should be conducted to determine what type of barrier is required.
 - A fence is defined as a freestanding structure preventing movement or access across a boundary. A wall is a vertical structure, solid along the entire length, which defines and may protect an area.

7. Access

Access points through a security fence require significant planning. Considerations must be made for the type of access (pedestrian/vehicular), the frequency of use, and the number of access points required.

Most compounds will require at least two separate access points for vehicles, taking into consideration operational needs and fire safety. Vehicular access points can operate as secondary emergency exit points for pedestrians.

Other access point considerations include:

- Who/what requires access?
- How many, and what type(s) of pedestrian and vehicular access points are required?
 - Do all access points require the same security features?
 - Is access for cars, trucks, trains, boats?
 - Is there a need for separate entry and exit lanes?
 - Is there a need for a tertiary access point for redundancy/safety?
- How secure do the access points need to be?
 - Single gate/door/barrier;
 - Turnstiles (consider safe egress options if using turnstiles);
 - Vehicular inspection area;
 - Interlocked gates/doors; or
 - An occupied gatehouse;
- How much oversight or audit capability is required for the access point?
 - No verification (access verified at building entry points);
 - Self-identification (key, card reader, biometric, other credentials);
 - Identification by security personnel.
- Was the UL 325 standard utilized when installing an automated gate?
 - Maintain walkways and directional signage for pedestrian foot traffic to ensure a to separate or designated walk-through entrance.
 - Display warning signs clearly on both sides of the gate at vehicle access points.
 - All access control mechanisms should be mounted a minimum of 6 feet from moving parts.

8. Threats

The threats identified in the TRA inform the choices required in fence construction. Portions of the perimeter may have different threats based on the access point, type and adjacencies. Considerations must be made given the application; vehicular entrances which may require crash prevention design options for both the gate and fence while security fences adjacent to a forested area may require a different detection technology than one adjacent to a road.

8.1. Threat Classifications Rating

Threats to fenced areas may fall into two categories, pedestrian and vehicular.

Pedestrian threats are motivation, skill and tool based, and are rated as follows:

- **Low:** Low skilled, non-motivated single or small group of assailants using basic implements found in the vicinity (sticks, branches, rocks);
- **Medium:** Medium skilled, single or small group of motivated or non-motivated attackers equipped with hand tools (small ladders, hammers, cutters);
- **High:** Highly skilled, motivated attackers working in groups or alone, equipped with portable battery-powered tools (grinders, saws, cutters); and
- **Very High:** Extremely motivated, highly skilled attackers working in groups or alone, equipped with high performance power tools (gas-powered tools, torches, chainsaws, and hydraulic units).

8.2. Crash Rating

Vehicular threats are based on the amount of kinetic energy delivered to the barrier device ($F = \frac{1}{2} mv^2$). The results of this formula created the K-rating, now outdated. M-ratings have since replaced K-ratings, as the primary certification given based on how far the payload from a 15,000lb vehicle travels past the barrier. ASTM F2656 (American Society for Testing Materials) details the requirements for the Hostile Vehicle Mitigation measures required to limit damage caused by vehicle as a weapon attacks.

Although this section deals with crash ratings for vehicles, security practitioners should note that vehicle threats are not only concerning from an impact perspective. Vehicles can also be used to pull-down the fence.

ASTM ratings are based on the mass and velocity of the vehicle hitting the barrier device. The primary goal of this rating system is to assess the strength of perimeter barriers (fencing) and gates when hit by vehicles of different masses and at varying speeds. Security fencing can also have a ballistic or blast mitigation rating based on the resistance to projectiles and explosions. The level of protection required by the fence/barrier will depend on a number of threat factors such as the size of the vehicle and payload (explosive) and the setback and standoff distances. A TRA is required to determine these threats and inform the ratings required to protect the assets. ASTM has developed crash certifications for different types of vehicles. They are as follows:

- **C – Ratings:** small passenger car (2430 lb.);
- **PU – Ratings:** pickup truck (5070 lb.);

- **M – Ratings:** medium-duty truck (15,000 lb.); and
- **H – Ratings:** heavy goods vehicle (65,000 lb.).

ASTM F2656 contains a complete list of ratings however below is an example of what the required product rating would be supposing a vehicle hit a barrier at different speeds and a mass of 15,000lb (6,800kg) or M-rating:

- **M30 (K4)** – vehicle at 48 km/h (30 mph);
- **M40 (K8)** – vehicle at 64 km/h (40 mph); and
- **M50 (K12)** – vehicle at 80 km/h (50 mph).

As was stated, ASTM F2656 base the certification on how far the payload travels past the barrier. These are P-ratings expressed as P1-P4 and Security Practitioners should note there is no limit to how far the vehicle can travel past the barrier to be certified. A P4 rating is given to any vehicle that travels beyond 98.41'. The P-ratings are as follows:

- **P1** – less than 3.3' (1m);
- **P2** – 3.31' – 23' (1.1m – 7m);
- **P3** – 23.1' – 98.4' (7m – 30m); and
- **P4** – 98.41' (30.1m) and more.

Using the above information: If a TRA recommended protecting against a vehicle threat for a 15,000lb (6,800kg) vehicle travelling at 40mph (64km/h) and requiring that vehicle to travel no further than 5' beyond the barrier, you would need to install a product with the following ASTM rating: **M40 P2** - M40 (15,000lb vehicle) P2 (3.31'-23')

9. Design Considerations

9.1. Setback

Setback is the distance from the property line to the fence (outer setback) plus the distance from the fence line to the buildings or other assets protected inside the fenced area (inner setback).

An outer setback reduces the total area enclosed within the fence and thus reduces the overall cost of the security fence. This outer setback area is often cleared and trimmed to provide visibility into the external area adjacent to the fence. This cleared area also allows responding personnel better visibility to observe any attackers and eliminates areas or obstacles where threats may be present. The use of Crime Prevention Through Environmental Design (CEPTED) principles are important in this area.

The inner setback can be an area for parking adjacent to a building. It can also provide a method of blast reduction by forcing any vehicle-borne explosive to be kept away from the main building. Blast pressure falls off with increased standoff; therefore making small increases in the setback distance can be very effective at reducing building damage. Inner setbacks should be kept clear of any obstructions; providing clear sight lines and good illumination aids security responders.

Using a back-filled retaining wall inside the perimeter provides two advantages. It increases the effective height of the fence on the attack side and, it provides a solid vehicular barrier. Similar advantages can be achieved using drainage ditches or berms where the slope angles can be designed to stop or slow attacking vehicles.

If there are large volumes of pedestrian traffic, it may be beneficial to use larger, more robust vehicular security barriers such as bollards, large planters or rocks. Planters and rocks, when properly anchored, provide protection while appearing aesthetically pleasing. Crime Prevention Through Environmental Design (CPTED) principles can assist security practitioners to deter attack through exposure and discovery, by removing hiding places, encouraging the proper use of the area, and improving overall visibility.

9.2. Watercourses

Watercourses are often subject to environmental restrictions from various levels of government. Diversion and burying of the fence fabric are preferred choices if possible. If the watercourse is seasonal, it may be possible to place a fence across it; however, the fence will likely be a collection point for sticks, leaves, and anything else that washes down with the water. The main challenge for a watercourse is to find an effective sensor that works through all the seasons and changing water levels.

Alternative methods are to fence both sides of the watercourse or bury the water run. If the run is buried, it should be buried for the complete distance through the compound, or the culverts or other water carriers need to be small enough to prevent passage by threats. Multiple, parallel pipes can be used in the immediate vicinity of the fence. The use of a culvert requires regular maintenance to remove any accumulated materials that could block the water and cause local flooding.

9.3. Shorelines

Shorelines are similar to watercourses. The challenge is to provide effective protection along the boundary. If the shoreline is a harbor or other area with a manmade breakwater or pier, then there is a solid base upon which to deploy a fence. The method of securing a shoreline with a fence will often call for the fence to be set well back from the water's edge to provide a solid location for the post foundations.

If the shoreline is a salt-water body, the choice of fencing materials needs to consider the threat of corrosion from salt mist and coastline erosion.

9.4. Aesthetics

Aesthetics are a contributor to the fencing choices, especially for organizations that have public access. It can also be driven by municipal (AHJ) or architectural requirements. Often the major factor will be the fence height limit. The priority of this consideration varies greatly between projects. The use of a retaining wall to raise the interior ground level can alleviate some AHJ concerns.

9.5. Delay

Although a fence does have some effect psychologically, the physical delay factor is essentially zero if there is no sensing equipment deployed capable of detecting an attack (discussed further in paragraph 9.6). The evaluation of the delay factor for a security fence relates to the threat and the most effective defeat method for that threat. The style of security fence used will drive the defeat options, which may include:

- **Climbing** (going over);
- **Tunneling** (going under);
- **Pulling or pushing down** the fence; and
- **Through the fence fabric** (either physically or visually).

Climbing can be deterred by (often combined):

- Addition of a fence topping (barb wire, concertina wire, razor tape);
- Fence overhang;
- Anti-climb or no-grip fence (small mesh chain link/welded mesh fabric $\frac{1}{2}$ "– $\frac{3}{4}$ ""); or
- Vertical slat panel fence.

Tunneling can be deterred by (often combined):

- Bottom rail for mesh fencing;
- Burial of the fence fabric, posts and pickets into the ground;
- Sidewalks, concrete or paving adjacent to or under the fence; or
- Buried anti-dig wall.

Pulling or pushing down attacks can be deterred by (often combined):

- Stronger, narrowly placed fence posts;
- Enhancing or reinforcing the fences footings or foundation;
- Fabric that breaks in small localized sections only (weld mesh);
- Anti-climb or no-grip fence (small mesh chain link/welded mesh fabric $\frac{1}{2}$ "– $\frac{3}{4}$ "");
- Truncated corners (reduces effective pull/push angles and hinder climbing); or
- Ditches/berms (limit vehicle proximity to the fence).

Through the fence fabric (physical or visual) attacks can be deterred by (often combined):

- Heavy vertical slats (slower for power tool attacks);
- Fine mesh fabrics (reduces visibility and takes longer to cut the fabric); or
- Heavier gauge fabric (requires stronger tools).

9.6. Detection Equipment

Detection is a necessary part of a fence system that acts as more than a cursory deterrent. The detection system needs to be integrated with an assessment and response system that will drive a response to any attack. A reliable sensing system that limits false positive and nuisance detections is essential. A robust system encourages a thorough assessment of any alarms and limits the complacency of responders.

Different types of sensing equipment have different methods of defeat. They will also act differently under specific situations, which may make them less reliable. Detection is more reliable when combining more than one type of sensing technology.

Detection equipment can be placed in one or more locations relative to the fence line and is explained in more detail below:

- **Approach detection** – senses the area before the fence;
- **Fence proximity detection** – detects persons close to the fence;
- **Fence disturbance detection** – detects noise from fence motion; and
- **Fence deflection detection** – detects stress on the fence from a climber.

Approach detection may include the following technologies:

- Thermal cameras with analytics;
- Video cameras with proper lighting and analytics;
- Buried volumetric sensors;
- Buried fiber-optic vibration sensors;
- Microwave sensors;
- Infrared sensors; and
- Infrared beam sensors.

Fence proximity detection includes the following technologies:

- Capacitive proximity sensing;
- Infrared beam sensors; and
- Microwave sensors.

Fence disturbance detection includes the following technologies:

- Fiber optic vibration sensors;
- Loose core coax vibration sensors; and
- Accelerometer vibration sensors.

Fence deflection detection may include the following technologies:

- Taut wire sensors.

9.7. Detection Assessment

A valid detection assessment requires properly functioning detection equipment and adequate lighting to be effective. The assessment could involve a responding security officer or some electronic surveillance such as a CCVE or thermal camera. The designed delay time required by the fence against the identified threat is part of determining the total assessment and response time.

Part of assessment is the ability to locate the threat as quickly as possible. If the threat has not yet breached the fence, the ability to see through the fabric is a prime consideration. It may also be a consideration if the perimeter has active patrols. The design of the fence may include privacy requirements to prevent or restrict the view into the enclosed area. This will affect the ability to assess and respond and may require the fence to be treated like a wall.

10. Construction Considerations

Upon review of the specific TRA recommendations, the design requirements for the construction of a fence become clear. The construction process involves:

- Selecting among all available and required fence features to determine a final configuration for construction; and
- A survey of the entire perimeter should be conducted to ensure that any adjacent

features which may aid in scaling the fence can be removed/relocated (if not possible modification in the design may be required);

- The process also includes considerations for:
 - Height;
 - Fencing Layers;
 - Fencing or fabric/construction materials;
 - Fence topping;
 - Posts and Foundations;
 - Gates;
 - Lighting;
 - Detection equipment;
 - Signage; and
 - Ground preparation.

10.1. Height

Increasing the height of a fence increases the psychological and physical delay effects. It increases the time required to climb and may increase the difficulty of reaching the top of the fence to defeat any security features (such as the anti-climb topper). The height should be consistent considering terrain and other topographical features of the area.

Fences with a height of 2 meters or less should not be referred to as security fencing as they provide little delay. Most adults can reach and clear the top quickly and easily, even if topped with barbed wire. A 2-meter high fence is little more than a passive deterrent, as the barbed wire strands can easily be reached and defeated with wire cutters. The minimum height for a security fence should be 2.4 meters. High security installations should consider fences of at least 3.6 meters.

Even when deploying electronic security features, a 2-meter fence can be defeated using a short stepladder. Climbing the ladder and jumping over the fence without contacting the fence itself it is relatively simple and carries a minimal risk of harm on landing. Higher fences force the use of more obvious tools/ladders and a much higher risk of harm on landing.

The topping and the fabric choices will also increase the delay time to climb the fence. It requires mentioning again that if the fence does not include detection equipment, the effective delay time is zero. In addition, simply using CCVE, whether intermittent or even continuous video surveillance of the fence is not an effective method of detection. A combination of various types of equipment is much more effective.

10.2. Multiple Fencing Layers

As with single layer fencing, multiple fencing layers require maintenance, including in between the layers. Access between the layers should be limited to points where gates already pass through the perimeter. The access points must be large enough for maintenance equipment including snow clearing, maintenance and lift trucks for lighting and other repairs, and response vehicles.

If incorporating multiple fencing layers, design the space between fences to be resistant to the growth of vegetation. This space is also ideal for secondary detection systems. The space between the layers must be wide enough to prevent jumping or bridging between the layers with a ladder or other material. The recommended spacing is at least twice the fence height.

10.3. Fabric/Panel Material

Fence fabrics can consist of individual slatted or solid panels that connect between posts or continuous fabrics that stretch over longer distances. Always apply continuous fabrics to posts and rails on the attack side, the fabric then covers the posts and the rails, preventing their use as a climbing aid. Attach continuous fabrics to each post, and to the top and bottom rails. Middle rails are not recommended as they provide additional climbing points.

The fabric used on a fence provides the fence's aesthetics. It is usually galvanized metal protected with zinc-coating, paint, or wrapped with polyvinyl chloride (PVC). Any of these protective coatings will extend the life of the fabric by reducing corrosion. The largest American Wire Gauge (AWG) wire with a PVC coating is often smaller than that available with a galvanized or paint finish. PVC is subject to breakdown from the sun's UV rays.

The choice of fabric must consider the ability of the responders to have visibility through the fence. When selecting the fence design, it is important to assess visibility looking parallel to the fence line. When deciding on the fencing fabric or whether a blocking material will be needed, the sensitivity of the protected compound or the need to visually monitor through the fence will need to be considered. In addition, factors such as local guidelines and heritage considerations may also determine the type of fencing material permitted input from AHJ may be required.

Previously it was noted that the fence fabric can be buried, extending below ground level. Given the climate conditions in most of Canada, this is problematic due to frost heaving the ground. Burying also increases fabric corrosion, and possibly reduces the sensitivity of the detection technology.

10.3.1. Chain Link

Chain Link is the most common fabric for fence construction. It has five parameters for selection considerations:

- Mesh size – 2 3/8" to 3/8";
- Wire gauge – 14 AWG to 6 AWG excluding coating;
- Wire finish – galvanized, zinc coated, painted, PVC coated;
- Fabric width – 3' to 12'; and
- Edge finish – Knuckle or Twist top.

Galvanized coatings are available in two variations. Coatings are applied to the wire before creating the fabric resulting in exposed wire ends as the fabric is manufactured – or – they may be applied after manufacturing where it can leave gaps at the wire contact points that are exposed by fabric flexing.

There are several things to consider if choosing a chain link fabric. Costs increase as

the mesh size decreases and as the AWG decreases (gets thicker). A decrease in the size of the mesh openings and the thicker wire also reduce the visibility through the mesh, which makes it harder for the responding personnel to view through the fence. A smaller mesh size provides an inherent anti-climb function and makes manual tool attacks more difficult and power tool attacks slower. Large diameter (thicker) wire provides increased resistance to vehicle attacks and helps to slow tool attacks.

Continuous fabrics like chain link use tension bars inserted into the end of the fabric with straps that attach the bars to the stain or corner post. The standard method of attaching the straps to the tension bar is to use a carriage bolt and nut. The nuts must be on the secure side of the fence to prevent the attacker from undoing the straps.

If chain link fabric is used, the choice of knuckle versus twist is part of the fence top selection. Knuckle means the wires at the top edge of the fence are bent down after being twisted together. Knuckle is the only choice available for fences under 2-meters. Twist means the wires at the top edge of the fence remain pointed up. This effectively prevents straddling the top of the fence. Twist top is redundant if the fence has razor or concertina wire.

If using multiple fence layers and the only effective way to move the snow is with a snow blower, the mesh size is important. Smaller meshes will catch snow while a larger mesh will allow most of it to pass through. Panel fabrics using weld mesh have the same concerns as continuous fabric meshes. Most slat panels will not let snow from a blower pass through.



Chain link knuckle edge



Chain-link twist edge

Alt Text - Figure 1 depicting a chain knuckle edge where the top edges of the fence are bent down and twisted together

Alt Text – Figure 2 depicting a chain link twist edge fence where the wires at the top edge of the fence remain pointing upwards and are twisted together to form points.

10.3.2. Other Fabrics

Panel fabrics are usually made of welded mesh or vertical metal slats. These panels have connection points at each post that their effectiveness to deal with a vehicle impact. Continuous fabric materials spread the impact load over a greater area along the length of the fabric as they stretch. Where possible, design fences perpendicular to vehicular attack angles or limit the available space so the vehicular approach speeds are low.

Panels are available in both aluminum and steel configurations. Aluminum is much lighter and may have a longer life due to lack of corrosion. These are acceptable for a pedestrian-only threat; steel is required to handle vehicle threats. In higher threat locations or locations, which require heightened security, the fence panel should be buried and anchored below ground.

Panel fabrics can achieve the necessary HMV requirements however; the construction of the posts requires secure foundations. These panels often include integral crash beams or cables that make them much heavier than the equivalent mesh fabric. All vehicle resistant fences require proper foundations to absorb the impact. The impact load requires spreading along the perimeter with continuous cables or beams, or bracing into the ground.

Panels with vertical slats are aesthetically pleasing, excellent for resisting most tool attacks if closely spaced, and provide fair anti-climb capabilities. This is a good choice for shorter fences in an urban setting such as between adjacent buildings.

The design of panel fabric fences will often include a continuous base wall that is 30 to 45 cm above ground. This provides a partial vehicular security-barrier function, especially against lower sitting vehicles such as cars, pickups, and vans. Continuous fabrics with a topping may remain intact after a low energy vehicle impact. The top of the continuous base wall should not extend beyond the fabric fence on the attack side as this may offer a foothold for an attacker.

High security fences using continuous fabric should use 9-AWG wire to tie the fabric to the posts and rails. The maximum spacing between tie points should be not more than 300mm.



Panel fabric with deep vertical bars and concrete extended base



Panel fabric with extended base

Alt Text – Figure 1 depicting a fence outside a building with vertical metal fencing bars or slats of varying heights that extend passed the concrete wall below the fence.

Alt Text – Figure 2 depicting a fence outside a building with vertical metal fencing bars or slats that are anchored to concrete structures vertically and horizontally.

10.4. Fence Top

Posts used in fencing must have some cover to keep precipitation out of the inside of the post. Rainwater, snow, and water that freezes and thaws will corrode or crack the posts and the foundation from the inside. This is problematic as there is little warning in advance of weakening or failing. Fence post covers are the mounting point for any fence topper such as barbed wire, concertina or razor wire. Caps must connect solidly to the post to be an effective mounting point. Bolts or attachment mechanisms must be on the secure side of the fence.

Most fence tops can be defeated with thick fabric (blankets or rugs). These spread the load of the climber and limit penetration of the topper material. Fence height and an overhang created by the topper material make climbing more difficult. To help complicate climbing, the fence topper should overhang on the attack side, as the climber must move away from the fence to clear the fence topper. Three-strand barbed wire has been a standard fence topper for many years. It is not appropriate for higher security fences as it is easily defeated with hand tools but it can be used as a stringer wire to hold various other topper material (concertina coils or razor wire) in position while providing some further deterrence.



Close-up of a barbed wire barb



3-wire barbed wire installation with twist end fabric and strain post

Alt Text – Figure 1 depicting a close up of a barbed wire barb which is constructed of 2 strands of wire with small sharp pieces of twisted wire pointing outward at short intervals.

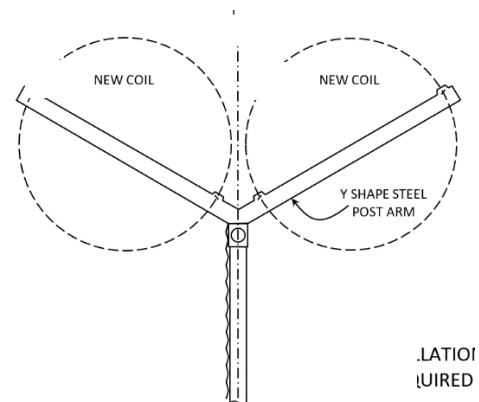
Alt Text – Figure 2 depicting a 3 wire barbed wire fencing installation with 3 layers/single strands of barbed wire on top of a section of twist end fabric fence attached to a fence post at one end, and a strain post at the other end with a post running horizontally along the top and in the center of the section of twist end fencing.

Concertina wire is not fully effective unless the spacing of the coils is correct. Clip all loops to the adjacent loops to limit the loop spacing when stretched. Place a single wire coil on the attack side of the fence and, where possible, a second coil on the secure side. Two coils force an attacker to drop from height instead of climbing down the fabric.

The use of a tensioning wire at the top of the fencing, when barbed or concertina wire cannot be used may be considered and it should be noted that this would make the fence harder to scale, but more susceptible to being pulled down by a vehicle.



Helical concertina supported by barbed wire



Two concertina coils in a fence line

Alt Text – Figure 1 depicting concertina wire wrapped in spiral shapes running horizontally on top of 2 separate pieces of barbed wire attached to a section chain link knuckle edge fencing by a steel post arm.

Alt Text – Figure 2 depicting 2 spiral shaped coils of concertina wire attached to a "Y" shaped steel post arm extending above a fence line. The "Y" shaped post arm is fastened to the fence post at the top of the fence line.

10.5. Posts/Foundations

A fence may use a variety of post sizes depending on the location of the post such as:

- Line posts;
- Corner posts;
- Tension posts;
- Gate posts; and
- Intersection posts.

Line posts are usually the smallest posts on a fence; most of the other posts are under higher stress and as such require a larger diameter. High fences require larger diameter posts with deeper foundations to offset the increased load. The spacing of posts is important for fence's overall effectiveness. Ideally, posts should be spaced no more than 2.5m apart and strain posts not more than 60m apart. The recommended post sizes for a high security fence are:

- Line posts: 73mm O.D.;
- Strain posts: 114mm O.D.;
- Corner posts: 150mm O.D.; and
- Rails: 42mm O.D.

Foundations for the posts are the most important component for the longevity of the fence. The foundation provides much of the strength for vehicle resistance and keep the fence in the correct position during winter frosts. A constant sized installation is sufficient as long as it goes below the frost line. If the installation cannot go below the frost line, the use of a pear-shaped foundation will result in the frost forcing the post down instead of up.

When choosing fencing or foundations, conduct a TRA to determine the type of fencing (barrier), post or foundation needed to meet the requirement.

10.6. Gates

The selection of a gate must consider the largest object passing through it. There must be sufficient clearance height for emergency vehicles, particularly fire trucks. When selecting the appropriate gate configuration, one needs to decide whether vehicle access and pedestrian access can be together or need separation. Gates are typically the weakest portion of any fence without the addition of security features. A gate is a break in the continuous fabric and could be wider than the spacing between line posts. Considerations should be made for any National or municipal building code requirements.

If a vehicle threat is present, the first choice to protect a gate is to limit the approach speed of a vehicle. These methods cause the approaching vehicle to make direction changes and may include having the approach road run parallel to the fence until reaching the gate. The installation of an "S" curve or chicane requires vehicles to slow down in order to maneuver through fixed obstacles. If it is possible to reduce the speed of the vehicle by half, the impact force is then reduced to one quarter of the original.

It will need to be determined if gates should have integrated or separate crash barriers and

what (if any) HVM measures are required. This is determined based upon the type of threat identified in the TRA. Types of barriers include:

- Bollards (moveable or fixed);
- Wedge/ramp barriers;
- Locking arm; and
- Cable barriers.

Proper installation of these barriers is critical to their operation. If delay to personnel is required, this consideration should inform the choice of equipment selected. Many vehicle gate systems are used for vehicle only entrances and operated from a guard post providing little delay for pedestrians.

In order to maintain the strength of a gate when closed, it needs to latch at multiple points, approximately every four feet of vertical height. If multiple latches are not present, the gate can be "scissored" around the single attachment point such that a person can pass through the opening. The threats expected at the location will determine the rating of the gate required. Consideration should be given to select equipment that has been tested and certified to the rating level required for the application.

Passing through the gate at high security installations usually requires authentication and/or inspection activities. For added security, configure gates interlocked in pairs such as a sally ports, or mantraps. The use of multiple layers improves the resistance to attack, as both layers need to be defeated. The gate on the unsecured side usually requires the highest resistance to attack. (i.e. a crash barrier would only be added to the exterior gate)

Motorized vehicle gates that operate on rails or guides should have the rails heated to ensure proper operation under winter conditions. Drainage for water should also be considered. A thorough maintenance plan is required to ensure proper functionality especially in winter. Barriers at gate positions should be in the block position when not in use and restored to the blocked position immediately after a vehicle passes in or out.

All electronically controlled gate systems should be supported by backup power source that has a manual over-ride in case of mechanical failure. The gaps under and around the gate should be limited so a pedestrian cannot gain access in this manner.

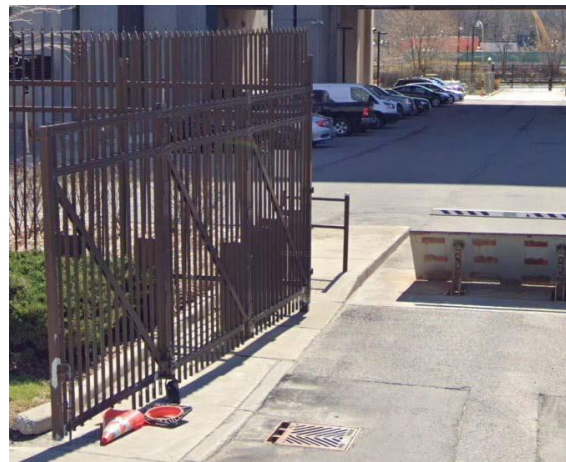
Consideration should be given to securing all fastening and hinge hardware by peening or welding to prevent disassembly of fencing and gate components where warranted by the required level of protection.



Panel fabric with narrow vertical poles, extended base, and vehicle stop behind the gate. Figure 1



Panel fabric fence and gate with vehicle security barrier and external bollards. Figure 2



Panel gate backed with vehicle security barrier. Figure 3

Alt Text – Figure 1 depicting a fence with an access gate at the Royal Canadian Mint. The panel fabric is constructed of narrow poles that are fastened to the concrete and there is an extended base on the gate. There is a vehicle stop behind the gate.

Alt text – Figure 2 depicting an open gate to a parking area. The panel fabric fence is attached to the open gate and a hydraulic vehicle barrier is in an upright position with external bollards behind the gate.

Alt text – Figure 3 depicting a closed gate with a green and red traffic light. Behind the closed gate is a vehicle security barrier with control arm.

10.7. Lighting

Lighting on the fence line will often have limitations from various AHJs. Light pollution onto adjacent properties is a challenge. Lighting along fence lines should use LED luminaries, which require low power, provide long-life, allow for high color rendition index lighting, and good control of light spill. Lighting levels should consider the needs of response personnel and electronic detection equipment such as CCVE. Aim towards the unsecured side, which will illuminate attackers while leaving the responders less discernable in the light's glare.

Configure lighting for operation during dark hours to automatically illuminate in response to an alarm, or be controlled manually by security personnel. Locate photoelectric light sensors well away from the perimeter and shielded from any ground level light sources. This prevents "spoofing" of the sensor with a light source. These sensors also provide continuous adjustment to the changing sunrise/sunset times and automatically handle any situation, which changes ambient light levels. Continuous illumination can act as an effective deterrent and "triggered" lighting can let attackers know that they were detected.

10.8. Detection Equipment Considerations

Detection equipment must work in all weather conditions. Select the type of equipment considering heat and cold, rain, fog, and snow conditions. Place detection equipment in two possible zones, the approach area and on the fence itself. The equipment choices depend on the threats and must be evaluated along with the expected deployment environment. Evaluate no-go areas near the fence determine if it is adjacent to a public area, road or sidewalk.

There may be situations that make certain types of sensing unreliable. Vibration sensors may not work well in proximity to an active railroad line. Buried sensors do not work optimally in all soil conditions. Line of sight technologies do not work in situations with uneven terrain. Taut wire sensors require seasonal recalibration caused by temperature swings affecting the tension. If snow collects against the wires, false alarms might occur when the snow melts and pulls on the lower wires.

Microwave sensors provide volumetric sensing and are a good choice for use between fence layers in a no-go area. The overlapping of individual transmitters and receivers is important so that there are no coverage gaps at the ends of each microwave field. Since they are a line of site technology, the deployment area must be flat with no depressions or ridges. These sensors are immune to most weather conditions, but can have reduced sensitivity in heavy precipitation. Microwave sensors have no location information along the sensing field.

Fence disturbance sensors are resistant to all weather conditions. They provide effective coverage year-round. Significant tension is required in the fence fabric in order to propagate vibrations through the mesh. Like snow removal, the higher the ratio of mesh to open areas, the more the wind will cause fence vibrations. This can generate false alarms if the sensitivity is too high or be ineffective at detecting an attacker if the sensitivity is too low. Newer vibration technology will detect if the disturbance is along most of the fence or localized and will automatically adjust the sensitivity reducing false alarms.

Infrared beam sensors have problems with fog and heavy precipitation. They must be overlapped to provide continuous coverage and only provide minimal location capabilities usually isolated to a single field. If the ground is uneven, a buried, terrain following detection system would be more useful.

10.9. Signage

Signage is subject to AHJ rules such as Heritage requirements. There may be specific requirements for the frequency, size and positioning of signs regarding trespassing and video surveillance. Signs on the secure side of a fence could act as a guide to response personnel and identify specific sectors or zones.

Wind may act upon a fence sign, and could adversely affect sensing equipment. Affix signs tightly to the fence fabric so they do not move independently and generate extraneous movement in wind.

10.10. Ground Preparation

The preparation of the ground for a fence is important in making the final product effective. Fence installations can provide dig resistance by either using a continuous foundation going several feet below ground level or adding a concrete or asphalt sidewalk adjacent of the base of the fence so that digging requires a long tunnel. Either of these methods require construction that is resistant to movement from frost heaving.

The ground along the fence line should drain well by ensuring the ground slopes away from the bottom of the fence. This area should be properly maintained as vegetation such as plants and shrubs can hide attackers. A surface that resists plants establishing themselves is ideal. The ground on either side of a fence without an anti-tunneling barrier should have compacted gravel to a depth of 300mm and extending at least 900mm on either side. This should eliminate the possibility of erosion or heaving of the fence and posts and prevent gaps from developing under the fencing. This is especially important where the fence fabric cannot be buried due to environmental conditions.

11. Supporting Content

11.1. References

- Policy on Government Security – <https://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=16578>.
- ASTM F2656 / F2656M – 20 – Standard Test Method for Crash Testing of Vehicle Security Barriers.
- PAS 68:2013 – Impact test specifications for vehicle security barrier systems.
- ISO/IWA 14-1:2013 Vehicle Security Barriers—Part 1: Performance requirement, vehicle impact test method and performance rating.
- CWA 16221:2010 – Vehicle security barriers. Performance requirements, test methods and guidance on application.
- UL 325 Gate automation - [UL 325 Safety Standards - Information | USAutomatic Gate Openers](#)

12. Promulgation

Reviewed and recommended for approval

I have reviewed and hereby recommend GCPSG-009 (2022) Security Fencing Considerations Guide for approval.

Shawn Nattress,
Manager
RCMP Lead Security Agency

Date

Approved

I hereby approve GCPSG-009 (2022) Security Fencing Considerations Guide

André St-Pierre,
Director, Physical Security
RCMP

Date