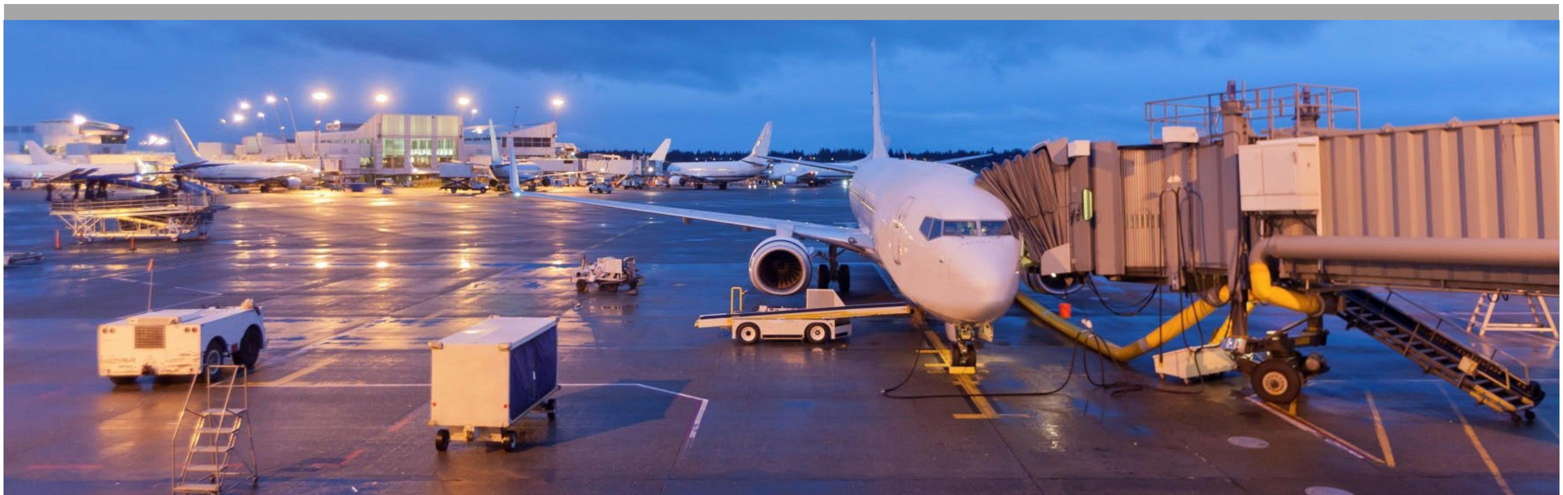
SAFE SKIES

# PARAS PROGRAM FOR APPLIED RESEARCH IN AIRPORT SECURITY



PARAS 0039 August 2022

# Security, Operations, and Design Considerations for Airside Vehicle Access Gates

**National Safe Skies Alliance, Inc.**

Sponsored by the Federal Aviation Administration

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## NATIONAL SAFE SKIES ALLIANCE, INC.

National Safe Skies Alliance (Safe Skies) is a non-profit organization that works with airports, government, and industry to maintain a safe and effective aviation security system. Safe Skies' core services focus on helping airport operators make informed decisions about their perimeter and access control security.

Through the ASSIST (Airport Security Systems Integrated Support Testing) Program, Safe Skies conducts independent, impartial evaluations of security equipment, systems, and processes at airports throughout the nation. Individual airports use the results to make informed decisions when deploying security technologies and procedures.

Through the POST (Performance and Operational System Testing) Program, Safe Skies conducts long-term evaluations of airport-owned equipment to track and document a device or system's performance continuously over its life span.

Through PARAS (Program for Applied Research in Airport Security), Safe Skies provides a forum for addressing security problems identified by the aviation industry.

A Board of Directors and an Oversight Committee oversee Safe Skies' policies and activities. The Board of Directors focuses on organizational structure and corporate development; the Oversight Committee approves PARAS projects and sets ASSIST Program priorities.

Funding for our programs is provided by the Federal Aviation Administration.

## PROGRAM FOR APPLIED RESEARCH IN AIRPORT SECURITY

The Program for Applied Research in Airport Security (PARAS) is an industry-driven program that develops near-term practical solutions to security problems faced by airport operators. PARAS is managed by Safe Skies, funded by the Federal Aviation Administration, and modeled after the Airport Cooperative Research Program of the Transportation Research Board.

Problem Statements, which are descriptions of security problems or questions for which airports need guidance, form the basis of PARAS projects. Submitted Problem Statements are reviewed once yearly by the Safe Skies Oversight Committee, but can be submitted at any time.

A project panel is formed for each funded problem statement. Project panel members are selected by Safe Skies, and generally consist of airport professionals, industry consultants, technology providers, and members of academia—all with knowledge and experience specific to the project topic. The project panel develops a request of proposals based on the Problem Statement, selects a contractor, provides technical guidance and counsel throughout the project, and reviews project deliverables.

The results of PARAS projects are available to the industry at no charge. All deliverables are electronic, and most can be accessed directly at www.sskies.org/paras.

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## SUMMARY

Airside vehicle access gates provide critical control points that allow access to the airside for the necessary movement of vehicles and goods. Vehicles that enter the airside have access to active taxiways, runways, aircraft, terminals, control towers, and other critical structures. Controlling which vehicles enter, ensuring that individuals in the vehicles are authorized, and inspecting vehicles and their contents are the central purposes of airside vehicle access gates.

This report addresses all aspects of vehicle access gates, including gate layout, gate and barrier types, signage and signals, area security and access control measures, vehicle inspection technologies, gate operations and staffing strategies, training and testing, design and implementation, and project management and procurement. The table of contents will assist the reader in finding specific topic information.

An exhaustive literature review was conducted to discover relevant published information. The sources are included in the References section. The research approach included dozens of interviews across the country and case studies at six airports. The information shared by airports includes lessons learned and considerations based on their experiences. Key points are highlighted in call-out boxes throughout the document, and in-depth case studies of gate installations and operations are in the appendices.

## PARAS ACRONYMS

| | |
|---|---|
| **ACRP** | Airport Cooperative Research Program |
| **AIP** | Airport Improvement Program |
| **AOA** | Air Operations Area |
| **ARFF** | Aircraft Rescue & Firefighting |
| **CCTV** | Closed Circuit Television |
| **CFR** | Code of Federal Regulations |
| **DHS** | Department of Homeland Security |
| **DOT** | Department of Transportation |
| **FAA** | Federal Aviation Administration |
| **FBI** | Federal Bureau of Investigation |
| **FEMA** | Federal Emergency Management Agency |
| **FSD** | Federal Security Director |
| **GPS** | Global Positioning System |
| **IED** | Improvised Explosive Device |
| **IT** | Information Technology |
| **MOU** | Memorandum of Understanding |
| **RFP** | Request for Proposals |
| **ROI** | Return on Investment |
| **SIDA** | Security Identification Display Area |
| **SOP** | Standard Operating Procedure |
| **SSI** | Sensitive Security Information |
| **TSA** | Transportation Security Administration |

# ABBREVIATIONS, ACRONYMS, INITIALISMS, AND SYMBOLS

| | |
|---|---|
| **ACS** | Access Control System |
| **ASP** | Airport Security Program |
| **ASTM** | American Society for Testing and Materials |
| **ATLAS** | Advanced Threat Local Allocation Strategy |
| **CPTED** | Crime Prevention through Environmental Design |
| **DAL** | Dallas Love Field Airport |
| **DBU** | Date of Beneficial Use |
| **DoD** | Department of Defense |
| **FLIR** | Forward Looking Infrared |
| **LAX** | Los Angeles International Airport |
| **LED** | Light Emitting Diode |
| **LEO** | Law Enforcement Officer |
| **LPR** | License Plate Recognition |
| **MCO** | Orlando International Airport |
| **PIDS** | Perimeter Intrusion Detection System |
| **PTZ** | Pan-Tilt-Zoom |
| **RFI** | Request for Information |
| **RFID** | Radio Frequency Identification |
| **RFQ** | Request for Qualifications |
| **ROA** | Roanoke-Blacksburg Regional Airport |
| **SAFETY** | Support Anti-Terrorism by Fostering Effective Technologies (Act) |
| **SAT** | San Antonio International Airport |
| **UFC** | Unified Facilities Criteria |
| **UPS** | Uninterrupted Power Supply |
| **UVIS** | Under Vehicle Inspection System |

# SECTION 1: INTRODUCTION

Airports are designed primarily to accommodate the movement of aircraft and their passengers, but aircraft are far from the only vehicles that operate within the airport. Ground vehicles of many kinds support the operational needs of the airport and its stakeholders, and often require access to sensitive areas such as the AOA or Secured Area.

Despite the necessity of vehicles in these areas, they can pose a significant threat to the operations and security of the airport. Vehicles can be used to conceal people with malicious intent, smuggle contraband, or conceal IEDs, and the vehicles themselves can be used as battering rams to disrupt operations, damage aircraft or facilities, or harm airport employees or passengers.

To mitigate these threats, every airport required to have an Airport Security Program (ASP) is also required to control vehicular access to the AOA and Secured Area. This control is typically achieved through a combination of security strategies, operational protocols, physical layout, and equipment and technology.

The information in this report, developed through literature research, airport and vendor interviews, and site visits to airports across the US, will assist the readers in designing new or upgrading their existing vehicle gate areas and functions. In addition to the information contained in the main body of this report, the case studies in the six appendices present examples of problems addressed that the reader may find useful while working through specific vehicle gate access issues at the airport.

# SECTION 2: LAYOUT

For the purposes of discussion throughout this document, the vehicle access gate is subdivided into three zones—Approach Area, Access Control Area, and Departure Area—which helps compartmentalize vehicle gate functions and components. These terms are based on the Department of Defense (DoD) Unified Facilities Criteria (UFC) system, though they are altered slightly to minimize confusion with other airport operational areas.[1]

## 2.1 Vehicle Gate Approach Area

The Vehicle Gate Approach Area is the area between the nearby roadway network and the Access Control Area, where the gate or barrier is installed and inspection and ID verification operations occur. All vehicles must pass through the Vehicle Gate Approach Area to use the gate.

The Approach Area should sort traffic by vehicle type (especially at frequently used gates), and provide adequate stacking distance for vehicles awaiting inspection. The Approach Area design should also prevent oncoming traffic from accelerating to ramming speed and breaching the vehicle gate. There are multiple strategies that can be used to accomplish this function:

**Distance** – A shorter distance between the road exit point and the vehicle gate or barrier reduces the length of roadway that a vehicle can use to accelerate.

**Inclines** – Placing vehicle barriers at the peak of an incline may prevent some vehicles from gaining the acceleration needed to breach the barrier. This also has the benefit of reducing standing water around the barrier. However, vehicle gates on inclines are not ideal for many vehicle gate solutions. Swinging gates installed on inclines show faster wear and tear on the hinges of the gate and may need to be realigned, or even replaced, more frequently. The grade may also facilitate erosion along the Vehicle Gate Approach Area and around the Access Control Area.

**Raised curbs and medians** – Adding raised curbs and medians along the Vehicle Gate Approach Area may prevent vehicles from driving off the roadway to bypass barrier arms or roadway curves and turns.

**Curves and turns** – Curves and/or turns within the Vehicle Gate Approach Area require the driver to reduce their speed. This strategy is best when used with raised curbs and medians.

**Speed bumps or dips** – These can be used to help slow approaching vehicles on roadways that are longer or that cannot be designed in a serpentine fashion. Speed dips will require a grade or slope to facilitate water drainage. No participating airport indicated using speed bumps or dips at their vehicle gates.

### 2.1.1 Lane Configurations

The most common lane configuration at airport vehicle gates is one ingress lane and one egress lane with individual gates or barriers. Airports of all sizes and traffic demands utilize this configuration and, in most applications, it seems to be the most operationally efficient.

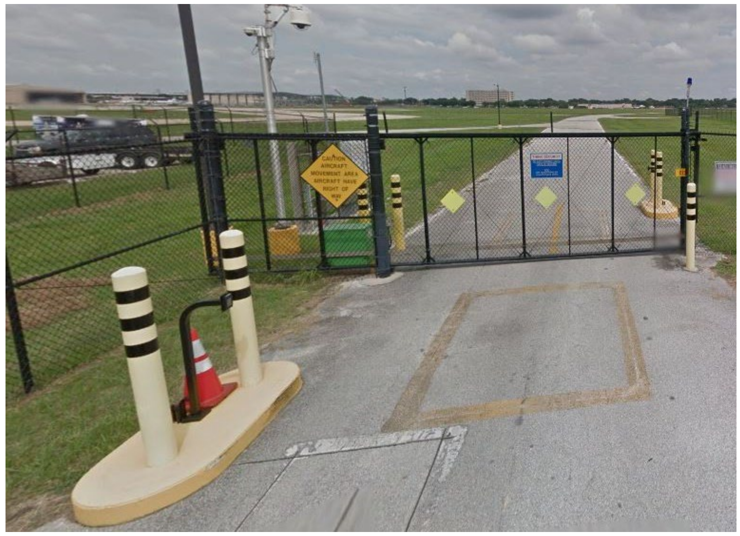
[1] The DoD UFC describes the planning, design, construction, sustainment, restoration, and modernization criteria that are required for all military departments, defense agencies, and DoD field activities. UFC 4-022-01, 27 July 2017.

The second most common configuration is one lane for both ingress and egress. This is typical at gates with infrequent traffic. With this configuration, an unauthorized vehicle may be able to drive through the gate as another vehicle exits.

Another common lane configuration is two ingress lanes and one egress lane with individual gates or barriers. This is ideal for vehicle gates with high traffic demand, as the gates can operate independently of each other.

Less common gate configurations include extra wide lanes for oversized vehicles and aircraft, and one-way entrance or exit for specially designated areas.

**Figure 2-1. Single Lane Gate with Two Access Control Panels at a CAT I Airport**



Source: Google Maps

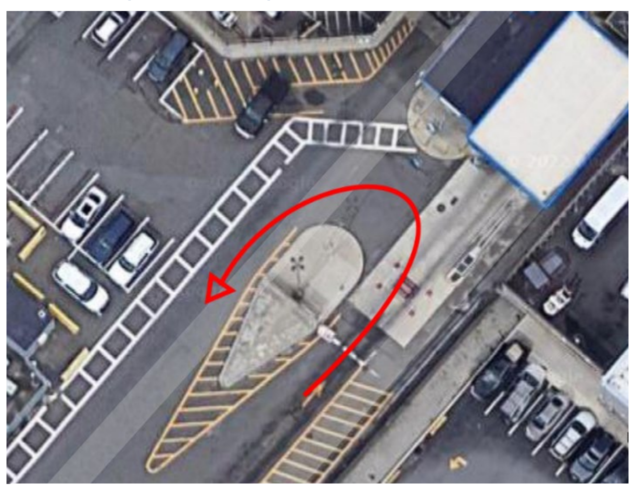
### 2.1.2 Rejection Lanes

The need to include a rejection or inspection lane in the entry layout should be considered during planning.

In Figure 2-1, above, the single-lane entry would require a rejected vehicle to either back up or enter the secure area to turn around. These two options create security, safety, and operational issues. Letting the vehicle pass into the restricted side of the gate creates a security issue since it could continue into the controlled area. Gate staff could escort the vehicle, but this does not provide an adequate level of control. Another option is to have the vehicle reverse away from the gate, which could require other vehicles behind it to move to allow the maneuver.

Rejection lanes are the most space-efficient way to avoid these scenarios. Airports should consider providing rejection lanes, if space allows, for gates that typically have more than one vehicle in queue at a time. Rejection lanes should also be considered for gates with a high probability of rejecting vehicles or where unauthorized vehicles may accidentally arrive.

**Figure 2-2. Rejection Lane (Red Arrow) at a CAT X Airport**



Source: Google Maps

As a side benefit, rejection lanes can also be used for inspection purposes, whether on a routine or random basis. This will allow for additional security measures to be carried out without impacting the gate operation.

Consideration for rejection lanes should occur early in the planning process with input from the security and operations stakeholders. It would be difficult to reconfigure a gate to provide the space needed for a rejection lane later in the design process or after the gate is constructed.

## 2.2 Vehicle Gate Access Control Area

The Access Control Area is the most active part of the vehicle gate. This area may include guard facilities, inspection equipment, access control panels, vehicle barriers, and the physical gate.

### 2.2.1 Inspection Areas

Most airports reported that their inspection areas are located inside the Access Control Area near the vehicle barrier, and most often in the ingress lane. Usually, this is a result of the limited space allocated for the vehicle gate system. Very few airports reported having a designated inspection area outside of the main ingress lanes.

Some airports with multiple ingress lanes have the ability to designate one lane for inspections while the second allows for exempt vehicles to quickly bypass the queue. At some airports with two ingress lanes, both lanes are utilized for inspections at busy gates.

> One airport has stationed the inspection area and the staging area for waiting cars about 500 feet away from the vehicle barrier on the nearby public roadway. This allows the airport to control traffic entering the secure area and control the flow through the inspection process. However, it should be noted that when the queue for inspection becomes too large, it can impede the flow of public traffic.

### 2.2.2 Sally Port Gates

Sally port vehicle gates are typically an automated two-gate or barrier system in which the first gate opens while the second remains closed. Once the vehicle passes the first gate and stops, the first gate is closed, and the vehicle remains "trapped" between the two gates.

**Figure 2-3. Sally Port at a CAT X Airport**


This gate system has multiple benefits. First, the design prevents tailgating. The space between the two gates should not be much longer than one vehicle length when using the longest authorized vehicle as the reference; two vehicles should not be able to physically fit between the gates. Also, the gates should be programmed to never open simultaneously without manual override.

Second, the space between the gates is an excellent location to conduct vehicle inspections, as the inspectors do not need to be concerned with interference from other vehicles. Typically, the vehicle stops in front of the first gate to have their badge and access verified with the first guard. The vehicle then proceeds to the area between the gates, where a second guard performs the vehicle inspection. Once that process is complete, the second gate is opened, and the vehicle is permitted to enter the restricted area.

Lastly, the second vehicle gate provides additional security against ramming attacks or attempts to breach the barrier.

This operation appears to be the most safe and secure method of inspecting vehicles. However, it requires purchasing and maintaining two gates and gate systems. It also requires at least two guards to effectively manage the flow of vehicles and inspections. Ground loops or other sensor technology is recommended to assist with closing the gates (see Section 3.2.11). A means for rejected vehicles to exit the gate area must also be provided (see Section 2.1.2).

### 2.2.3 Equipment Locations

Automatic vehicle gates require a mechanized gate operator, which is often housed in a small enclosure to protect its gears, motors, and chains. These gate operators should always be positioned on the restricted side of the gate to prevent tampering. Mounting poles for cameras and lights, as well as manual override mechanisms should also be installed on the restricted side of the gate.

Other equipment and climbable structures, such as a guard facility, should meet the airport's clear zone requirements to prevent gate and fence climbers.

### 2.2.4 Protective Overhead Covering

Many airports indicated that they have added, or would like to add, a protective overhead covering over the Access Control Area and ingress lane(s). These structures offer shelter from the elements for guards and drivers, as well as overhead mounting space for lighting, signage, and cameras. Similar structures are built over gas station pumps and are designed to withstand most environmental elements, but high winds could cause damage to the structure or equipment mounted to it. Lightning protection may also be considered.

A small number of airports have coverings that extend a few feet from the guard facility or stretch across the ingress lane. Some airports that do not have the space or the budget to build a guard facility have installed a small overhead structure for the guards to rest under.

**Figure 2-4. Overhead Covering at a CAT X Airport**


Source: Google Maps

Airports wanting to add an overhead covering to their vehicle gate should ensure that the covering is high enough for the tallest vehicle to pass underneath without hitting any structures, signage, or equipment. Cameras should be mounted under the covering to ensure a clear line of sight, avoiding any mounted signage and lighting.

> One airport has a tenant that utilizes mobile facility consisting of a small trailer with a guard building on it during seasonal operational needs. This trailer is staged at the nearby vehicle gate during use and stored when not needed.

### 2.2.5 Guard Facilities

Most airports with full-time guards provide facilities for shelter and to store tools and equipment. Providing guards with shelter against high heat and inclement weather encourages consistently thorough inspections in all weather conditions.

Most guard facilities are large enough to accommodate one to two guards, a workstation with seating, and storage areas. The example in Figure 2-5 shows an above-average sized guard facility.

**Figure 2-5. Guard Facility at a CAT X Airport**


These facilities are often protected with ballistic glass and bollards, and built with reinforced concrete or other hardened material. The glass typically wraps all the way around the building to offer a 360-degree view of the surroundings. Some airports also indicated that their guard facilities were built on raised medians to offer protect against threats, provide better sight lines, and prevent flooding.

#### AMENITIES

Most airports provide either a restroom inside the guard facility or portable restroom near the guard facility. Airports reported that restrooms inside the guard facility block some of the visibility around the vehicle gate.

Many facilities are equipped with air conditioning and heating that can be controlled by guards. Some airports also added a small overhang to the outside of the facility for guards to seek shelter from rain, snow, and hail.

> One airport is designing their future guard facilities with a ballistic film wrapped around the bathroom walls to create a safe space for the guards to shelter in place.

#### TECHNOLOGY

While most CCTV cameras monitor the vehicle gate, a few airports have also installed cameras inside the guard facility to help monitor blind spots.

Phones and radios are typically provided to contact the operations or security departments.

Guard facilities should have a reduced level of interior illumination to enable the guards to see better, increase their ability to adapt to light changes, and to avoid highlighting them as a potential target.

> One airport has installed an indoor shot detection system just outside the guard facility. Indoor systems are not designed for outdoor use, but the short detection range covers the inside of the guard facility and the area immediately surrounding it. If the system is triggered, an alert is sent to the security center and access to the vehicle gate is prohibited for most security clearance levels. The airport installed the system for the safety of the guards as well as to secure the vehicle gate.

#### DURESS ALARMS

Many airports with guard facilities at vehicle gates installed duress alarm buttons or switches inside the building. This allows the guards to notify law enforcement or security of an issue at the gate easily and surreptitiously. It is important to have clear policies on what it means when duress alarms are activated so that the proper response is made.

#### MONITORS

Some airports provide their guards with monitors that show camera footage and output from under vehicle inspection technology, gate cameras, and access control systems. This allows the guards to maintain situational awareness of all aspects of the gate area.

Some airports use monitors in the guard facility to display badge information after the badge is swiped at the access control panel. This gives the guard a clearer image to compare the badge picture to the person in the vehicle. This also eliminates the need for the guard to handle the badge, which became a health consideration during the COVID-19 pandemic.

### 2.2.6 Pedestrian Gates

Interviews with airports indicated that most vehicle gates do not have an adjacent pedestrian gate. For more information on pedestrian gates and the operations that occur at them, please refer to PARAS 0019: *Employee/Vendor Physical Inspection Program Guidance*.

## 2.3 Vehicle Gate Departure Area

The Vehicle Departure Area is the area immediately after the physical gate or vehicle barrier. Very few, if any, operations occur in this area. Most airports use the Vehicle Departure Area for vehicles to stop and wait for the automatic gate to close behind them before continuing into the restricted area. Buried cable sensors or ground loops are typically installed in this area to signal to the gate when it is safe to close.

# SECTION 3: GATES AND BARRIERS

Vehicle gates may be designed for one or a combination of three types of operations: routine, maintenance, and irregular. Each gate should be designed specifically for its operational demand and operational purpose.

**Routine** – These are the airport's primary gates and typically are the most used. They often support continuous high throughput and should be designed for high activity, long life span, and to minimize delays.

**Maintenance** – Some gates are designated for use by the airport, tenants, and federal partners to perform maintenance on the grounds or equipment (lawn services, utility service, equipment maintenance, etc.). If this is the gate's only function, airports may be able to leave the gate unstaffed but monitored or controlled with an access control system or padlocks and cameras.

**Irregular** – This is a catchall group for operations that occur infrequently, such as emergency response, construction, or special events. Gates designated for irregular operations should be carefully designed to accommodate the vehicles and demand for that location. For example, construction gates may require special roadway material to support the weight of large construction vehicles. Staffing requirements at these gates will depend on several factors:

- *Vehicle type* – construction vehicles may require inspection while a fire truck responding to an emergency will not.
- *Demand level* – active construction gates may require a full-time guard; rarely used emergency gates may be sufficient with cameras.
- *Demand type* – emergency vehicles responding to an emergency are exempt from inspections and would not necessarily need a guard stationed for ingress; however, special events such as VIP access or tenant events may require a guard during a specific time frame.

Some airports reported that irregularly used gates typically stand unattended with a padlock or cipher lock, while more frequently utilized gates may be equipped with an access control system and an automatic gate that may not require a guard to be stationed at all times. Gates designated for emergencies often use remote openers to quickly open automatic gates without requiring intervention from a guard.

See Section 9 for more information on vehicle gate operations and staffing strategies.

## 3.1 Crash Ratings

All vehicle barriers in place at airports should follow the American Society for Testing and Materials (ASTM) F2656 *Standard Test Method for Vehicle Crash Testing of Perimeter Barriers for Impact Resistance*. The certification standards for ASTM are shown as M-ratings. The DoD also has a crash rating designation, shown as K-ratings. Table 3-1 outlines the ratings for each testing method.

**Table 3-1. K and M Crash Ratings**

| Rating | Vehicle Weight | Vehicle Speed | Penetration Rating |
|---|---|---|---|
| M30 / K4 | 15,000 lbs | 30 mph | *L1, L2, L3 / **P1, P2, P3 |
| M40 / K8 | | 40 mph | *L1, L2, L3 / **P1, P2, P3 |
| M50 / K12 | | 50 mph | *L1, L2, L3 / **P1, P2, P3 |

*L1 = 20-50 ft; L2 = 3-20 ft; L3 = 3 ft or less
**P1 = ≤ 3.3 ft; P2 = 3.31-23.0 ft; P3 = 23.1-98.4 ft
Source: ASTM Standard F2656-18

ASTM has expanded the crash ratings to include vehicle types that may be used in restricted access locations, such as airports and other industrial facilities. These ratings are presented in Table 4-2, below.

**Table 3-2. Vehicle Type Crash Ratings**

| Vehicle Type | Vehicle Weight | Penetration Rating |
|---|---|---|
| Small Passenger Car (SC) | 2,430 lbs. | SC30 (30 mph) |
| | | SC40 (40 mph) |
| | | SC50 (50 mph) |
| | | SC60 (60 mph) |
| Full Size Sedan (FS) | 4,630 lbs. | FS30 (30 mph) |
| | | FS40 (40 mph) |
| | | FS50 (50 mph) |
| | | FS60 (60 mph) |
| Pickup Truck (PU) | 5,070 lbs. | PU30 (30 mph) |
| | | PU40 (40 mph) |
| | | PU50 (50 mph) |
| | | PU60 (60 mph) |
| Heavy Goods Vehicle (H) | 65,000 lbs. | H30 (30 mph) |
| | | H40 (40 mph) |
| | | H50 (50 mph) |

Source: ASTM Standard F2656

Preference should be given to barriers that have been field tested for their crash rating. Some products may have been engineered to meet a particular standard, but they have not been physically tested by an accredited testing laboratory.

It is important to consider that gates are more easily breached than solid fence lines, as they are designed to be opened. Using the crash ratings will help airports design more secure vehicle gates.

## 3.2 Vehicle Gates

It is critical to select the appropriate vehicle gate, operators, and supporting components such as barriers. The vehicle gate is the component that will get the most use. A failure of the gate to stop vehicles or frequent malfunction of the gate will have significant consequences.

### 3.2.1 Rolling or Sliding Gates

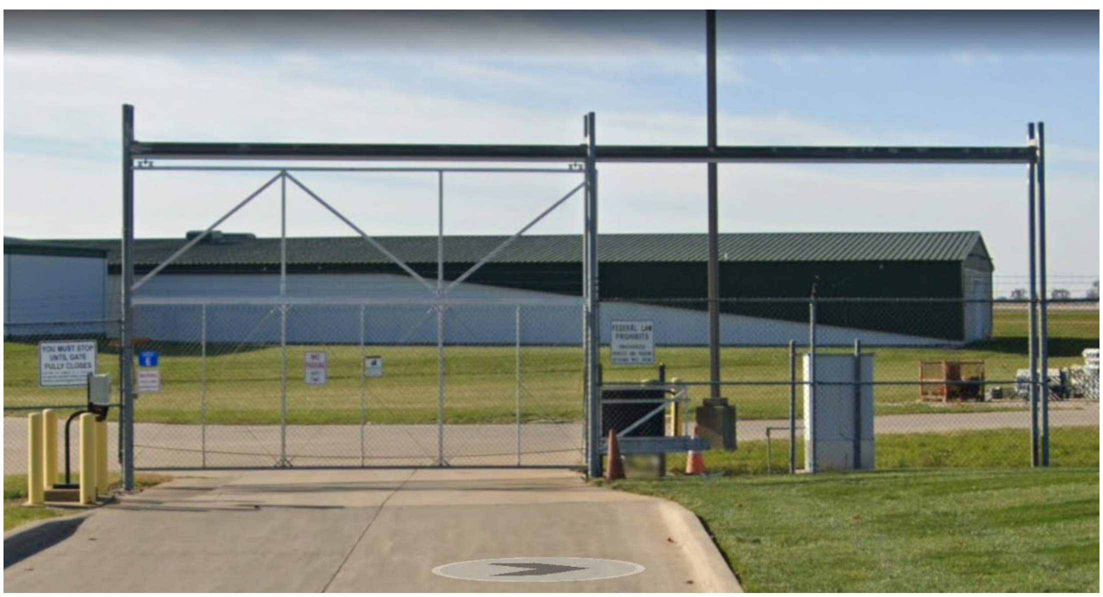
Typical rolling or sliding gates are designed to travel along a path or track using rollers. When open, the gate is stowed along the fence line.

Sliding gates are one of the more common gate types due to their cost and ability to be customized. Airports needing wider gate options will often use sliding gates for their long-term reliability. Double sliding gates are uncommon at airports.

Sliding gates are not ideal for areas with frequent heavy snow, as it can quickly build up along the track or gate path and cause the gate to get stuck or off track. The ground under the gate will also need to be graded to ensure a level pathway and limit the size of the gap underneath the gate. Uneven or sloped roads could cause the gate to jump off the track or path or cause unnecessary strain on the gate operator. The rollers are also prone to wear and tear and may need to be replaced regularly.

One alternative to the typical gate that slides along the ground is an overhead sliding gate. This type of gate runs on a track system supported across the top of the gate opening (Figure 3-1), which offers the benefits of a slightly suspended gate, like a cantilever gate but without the large footprint and space requirement. Overhead sliding gates are uncommon at airports because of the height restriction for vehicles passing under the overhead support (typically a maximum of 16 feet).

**Figure 3-1. Overhead Sliding Gate at a CAT II Airport**



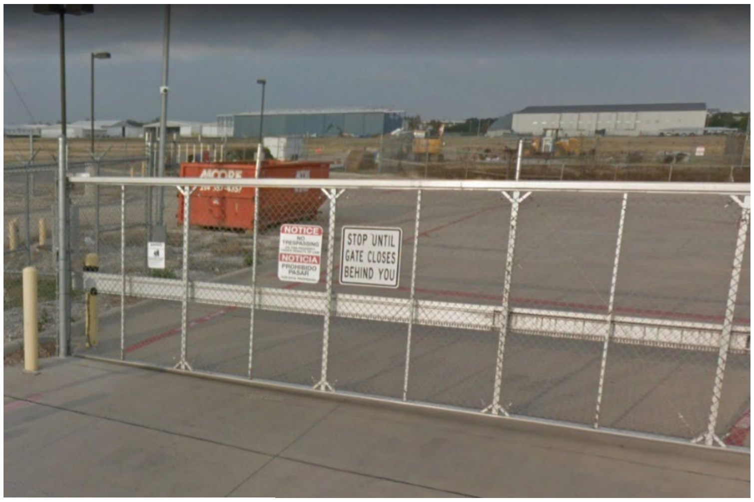
Source: Google Maps

### 3.2.2 Cantilever Gates

Cantilever gates (Figure 3-2) are similar to sliding or rolling gates in that they slide open and closed across the opening and are stowed along the fence line. Unlike typical sliding gates, cantilever gates are slightly suspended above the ground by elevated rolling supports. This slight suspension allows cantilevers to function over most terrain types, and reduces the maintenance that is typically needed for sliding gates. Because of the small gap under the gate and no tracks for rollers, snow build up, standing water, and debris are less of an issue for cantilever gates.

These types of gates do have some drawbacks. The entire gate system will take up much more space than a typical sliding gate due to the counterbalance needed to offset the weight of the gate and

**Figure 3-2. Cantilever Gate at a CAT I Airport**




Source: Google Maps

mounting post. Cantilevers need to be at least 50% longer than the gate opening to accommodate this counterbalance. Gates near buildings or permanent structures may not have the room needed for operation.

The gap between the gate and the ground also allows for items to be slid under the gate, which can be a major security vulnerability. The gates are also much heavier than sliding gates and cost more because of the robust support system needed for them to operate.

One airport noted an incident in which TSA personnel were able to slide a metal trash can lid through this gap under the gate, triggering the buried cable loops to open the gate.

### 3.2.3 Pivot Gates

Vertical pivot lift gates—also called tilt gates—open by rotating upward at one lower corner and pivoting 90 degrees upward, resting on a side edge when fully open (Figure 3-3). These gates offer the benefit of a small footprint, and may be a good solution for uneven or sloped gate openings. They also open faster than slide and swing gates.

Pivot gates may be designed to fit over curbs and road elevations when fully closed, allowing the gate to fit and secure almost any space. They also have fewer issues with operating in heavy snow, but tend to act as a windcatcher in high winds.

**Figure 3-3. Pivot Gate at a CAT X Airport**


Source: Google Maps

### 3.2.4 Swinging Gates

Swinging gates are attached to the fence line with a hinge, similar to a standard pedestrian gate, and swing open or closed in an arc. These are uncommon for primary gates due to the large clearance space needed to operate. When designing swing gates, airports should consider the clearance space as well as the direction of travel (toward the Vehicle Gate Approach Area or toward the Departure Area) to prevent injury or vehicle damage.

Automatic swing gates should be supplemented with ground loop sensors for safety, and should be designed with signage in mind. Lines on the road or signage notifying drivers of the gate's swing clearance are important to reduce injury and vehicle damage.

The hinges of swing gates should not be the lift-off type to prevent the gates from being easily removed at the hinges. Automatic swing gates should never be used as pedestrian gates as safety loops are not designed to detect the presence of humans.

### 3.2.5 Lifting Gates

Vertical lifting gates are designed to move up and down, as shown in Figure 3-4. The system requires twin lifting supports placed on either side of the gate opening. This style of gate is one of the most compact and space-efficient vehicle gate designs, so it may be a good choice for airports with a small vehicle gate footprint or limited space.

**Figure 3-4. Lifting Gate**


Source: Tymetal

Airports considering vertical lifting gates should ensure that the clearance height is enough for the tallest vehicle authorized to use the gate. These gates also act as large windcatchers when raised, so may not be good options for airports that experience high winds.

Some drivers will find the tall lift gate columns imposing, and many people find passing under a raised gate unsettling. These gates will likely not work for airports concerned with the aesthetics of the vehicle gate.

### 3.2.6 Bi-Fold Gates

Bi-fold gates have hinged panels that fold forward and backward, similar to a closet door or accordion. The greatest benefits to the bi-fold style are the small footprint and operating speed. These gates do not require adjacent fence length to retract, like a rolling or cantilever gate, and they do not require space to swing open. Instead, the gate folds neatly back to the edge of the gate opening, allowing for twice the opening width in half the space.

**Figure 3-5. Bi-Fold Gate at a CAT X Airport**

Source: Google Maps

Due to flexibility at their hinges, bi-fold gates are less affected by high-winds than their more rigid counterparts. They also have the added benefit of being able to operate on slopes and grades where swinging gates could not be installed. These gates typically operate much faster than other gate types.

Bi-fold gates have some drawbacks. Many models require a top bar track to keep the gate rolling and folding smoothly during operation. There will be a height limitation to versions with the top bar, but this can be customized for the airport. Some vendors have created models without this top track; the gates use rollers or a bottom track instead. There are also some models that are completely trackless.

During heavy snow, the bi-fold gate's entire opening and operating area will need to be shoveled or swept to ensure the gate can open and close properly.

### 3.2.7 Magnetic Gates

High velocity magnetic vehicle gates use electromagnetic technology to slide the gate to the side. The gate is slightly suspended above the ground, making it ideal for uneven or sloped roadways. The electromagnetic motor eliminates moving drive components (chains, gears, and belts), hydraulic fluids, and lubricants.

Magnetic gates are known for opening and closing much faster than slide or cantilever gates. Airports that use them indicated that, since installation, they have seen fewer incidents of vehicles driving away before the gate was fully closed. This appears to be due to the shorter dwell times required to wait for the gate to close. However, at least one airport noticed that the gate initially closed too quickly. Airports that install magnetic gates should configure the gate's opening and closing speeds to minimize the risk of injury or property damage.

### 3.2.8 Manual Gates

Manual gates have no gate operator. Many airports maintain manual gates that are secured with padlocks or cipher locks. Typically, manual gates are not used as primary gates with high throughput. They are more likely to be located at remote locations or near tenant facilities than near terminal buildings.

Airports rarely station guards at manual gates. The most common staffing strategy is just-in-time staffing, with a guard being dispatched to open the gate or perform an inspection as needed. Keys to the padlock should only be given to persons with the access authority to pass through the gate.

Padlocks and chains are still common methods of securing manual gates. Lock boxes—small, mounted safes that can store keys or other access media—are occasionally used on emergency gates to provide first responders with a nondestructive entry method.

Cipher locks with programmable keypads are becoming more popular among airports that maintain manual gates. Airports using cipher locks indicated that reprogramming the locks is much easier, faster, and cheaper than updating individual padlocks.

Some models offer the ability to track last-person access. A controlling smart card can be used to pull the data from the cipher lock for the last person to use the lock. This can be useful to identify the individual who left a gate unlocked or committed other vehicle gate violations.

### 3.2.9 Virtual Gates

In some cases, installation of a physical gate may not be practical (e.g., when a vehicle roadway overlaps with an aircraft taxiway). Some airports have investigated the possibility of implementing a virtual gate composed of sensors, signals, and high-resolution video cameras to monitor and control vehicle access. Such a gate would require careful coordination with TSA as well as robust training for authorized drivers. The solution would also require a well-crafted response plan for vehicles that fail to observe proper gate procedures.

### 3.2.10 Gate Operators

Gate operators are the mechanisms that physically open and close automatic gates. There are three types of gate operators currently used at airports: hydraulic, electronic, and electromagnetic.

**Hydraulic operators** – These are the most common type at airports as they are powerful and better suited for large, heavy gates. These operators use hydraulic fluids and high-pressure tubing to create the power needed to open and close the gate. Hydraulic operators have fewer moving parts than electronic operators, which means they are less likely to break down from wear and tear and are easier to maintain. However, when repairs are necessary, they can be more complex than electronic operator repairs; many airports maintain a maintenance contract. Equipment vendors and airports stated that they have never encountered a hydraulic system that did not leak.

**Electronic operators** – These can have a long life span if periodic preventative maintenance is performed. Electronic operators are silent and can be run on battery backup. However, with more working components, they are more likely to fail from wear and tear.

**Electromagnetic operators** – These use no moving parts, hydraulic fluids, or lubricants, making them much easier to maintain and more environmentally friendly to operate. They are designed to be faster than hydraulic and electronic operators. Few airports currently use electromagnetic operators because the technology is still relatively new, and the cost is much greater than the other operator types. See Section 3.2.7 for more information.

The vehicle gate design should include ample space for the operator and its housing on the secured side of the gate.

### 3.2.11 Ground Loops

Vehicle ground loop sensors are embedded in the roadway to detect metallic objects that pass over or near the sensors. Typically, these systems are placed in front of and behind automatic gates and signal to the gate operator when a vehicle is within a certain distance of the barrier. If the vehicle triggers the detection system, the gate will not close for safety.

## 3.3 Anti-Ram Barriers

Anti-ram or pop-up barriers are designed to stop and/or disable vehicles that may pose a threat to the security of the airport or damage the gate or perimeter fence. There are a variety of system designs for both sides of the gate. Adding anti-ram barriers to the vehicle gate will provide an extra layer of security to a vulnerable area but will also incur additional cost and maintenance requirements.

It should also be noted that buried barriers, such as pop-up wedge barriers, may incur damage from heavy vehicles driving over them. Consideration should be given to the number of heavy vehicles that will be using vehicle gates with these types of barriers.

**Stop bars** – These are steel beams attached to the secure side of the gate with twin concrete bollards on either side of the opening. When a vehicle impacts the gate, the steel beam hits the bollards, and the gate is prevented from opening. Stop bars a are good option for vehicle gates with a short Vehicle Gate Approach Area, as the footprint of the system is small and on the restricted side of the gate. See Appendix A for a case study discussing this barrier.

**Crash beams** – These are most commonly seen at parking lot structures, railroad crossings, or high vulnerability areas such as roadways on top of dams. The most common type is a vertical pivoting beam, but some versions have the beam sink into the ground. Crash beams usually have reflective elements or lights attached to them to help drivers see them in darkness. Most crash beams are only fully effective when they are in the locked position, since that is the only way both ends are solidly anchored.

**Bollards** – These are typically concrete or steel pillars that are buried in a block of concrete and spaced several feet apart to prevent vehicles from ramming the gate, perimeter, guard facility, or access control panel. These are the most common type of anti-ram barrier at airport vehicle gates as they are relatively inexpensive and easy to install. There are also bollard types that retract into the ground, either hydraulically or manually. Airports will most often place stationary bollards around the access control panel and on either side of the gate opening (both on the secure and non-secure sides) to protect the gate from damage as the vehicle passes through the opening. Many airports also place them around guard facilities to protect the guards, and between the ingress and egress lanes to prevent piggybacking through the egress lane.

**Cable guardrails** – These are heavy steel cables strung through concrete or steel posts that are buried in concrete. The cable is rated for highway traffic impacts and can occasionally be seen along highways and roadways. Some airports have created a secondary perimeter of cable guardrails in front of the standard perimeter fencing as a first line of vehicle breach prevention and to protect the fence from damage.

**Concrete barriers** – These are concrete blocks that can come in a variety of shape and sizes, including concrete planters and furniture. It is a common practice to harden sections of perimeter fencing with concrete barriers known as Jersey barriers or K-rails. At some airports, wedge-shaped concrete diverters protect the gatehouse from being rammed. However, many airports dislike the aesthetics of plain concrete fixtures.

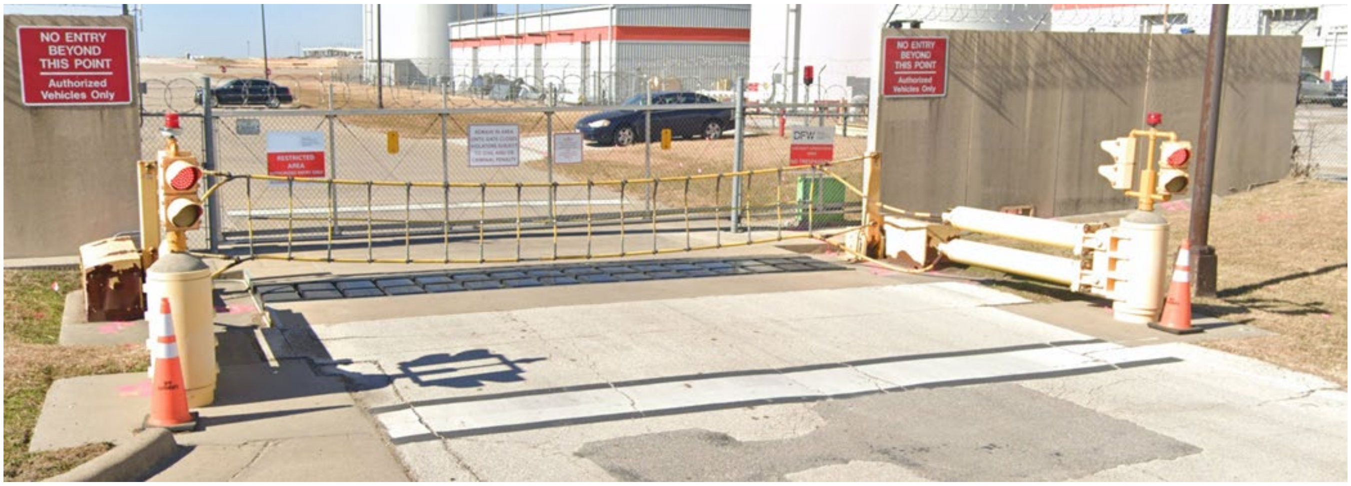
**Wedge barriers** – These barriers consist of a hydraulic motor that lifts a heavy steel ramp from a horizontal ground-level position to an angled position (Figure 3-6). While effective at preventing a vehicle ramming attempt, they must be replaced after an impact. This equipment requires quite a lot of maintenance because it is installed in the ground; debris and frozen parts can damage the device or prevent it from working. They are also not designed to frequently raise and lower, which makes them unsuitable for operating at high-traffic gates. However, the barriers are useful at gates with low traffic or non-operational hours.

**Figure 3-6. Wedge Barriers at a CAT X Airport**


Source: Google Maps

**Net barriers** – These active barriers deploy a net that is designed to tangle in a vehicle's wheels to stop the vehicle from breaching the restricted area (Figure 3-7). Net barriers come in a variety of models. Some are mounted in the ground and pop out. This type is often used as a final barrier at military checkpoints. Others retract into an above-ground rubber mat that can be safely driven over. Some versions are hydraulic, and others are electric. Many models can be fully deployed in three to five seconds, and most have high crash ratings. Although a ground-retractable version will require similar maintenance to any other underground-mounted equipment, net barriers do not require major repairs or replacement after an impact. Net barriers often have an option to include a heat trace in their stowage system to eliminate ice that may interfere with operation.

**Figure 3-7. Net Barrier at a CAT X Airport**




Source: Google Maps

## 3.4 Fencing

Control of airport perimeters has been a long-standing requirement for both operational and security reasons. Fencing is the most common method of controlling open areas on airport perimeters.

For more information on perimeter control and fencing please refer to PARAS 0015: *Guidance for Airport Perimeter Security* and PARAS 0028: *Recommended Security Guidelines for Airport Planning, Design, and Construction.*

Most of the airports interviewed indicated that their perimeter fence was constructed out of 6 to 10-foot chain-link fencing with a barbed or concertina razor wire topper to meet federal standards and recommendations.[2] This style of fencing is the most cost-effective option to meet the minimum recommendations outlined by the FAA, and it is relatively easy and inexpensive to replace if it is damaged. In environments where corrosion is more likely, such as near salt water, a plastic-coated material may be desirable.

> One airport installed a brick wall with fencing along the top. The airport indicated that the brick was chosen for aesthetic purposes, but also serves to suppress some of the noise traveling to nearby neighborhoods, as well as reduce sightlines into restricted areas of the airport.

Some fencing options can include specialized technology posts that enable the airport to add cameras, perimeter lighting, sensors, and other technology along the perimeter.

A secondary layer of fencing provides additional protection from intruders on foot or in a vehicle. A double-layered set up can be configured with fencing and other barriers, such as vehicle arresting systems.

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[2] FAA AC 150/5370-10H Part 10

### 3.4.1 Anti-Climb Options

When choosing a type of fence, consideration should be given to including anti-climb characteristics.

**Small link** – Chain link fences with smaller than average links (sometimes called mini-mesh) make the fence difficult to grab with hands and feet.

**Vertical bars** – This fence type (Figure 3-8) reduces an intruder’s ability to pull themselves up and over the fence. Increasing the distance between horizontal bars and using diagonal bars instead of horizontal will also decrease an intruder’s ability to climb the fence. This type of fencing is often considered decorative and, as such, is more expensive than chain link.

> One airport has deployed vertical wrought iron fencing around the perimeter to increase the visual appeal of the airport. The project to replace the original chain link fence is ongoing; the airport is replacing the fence a section at a time to help with budget restrictions.

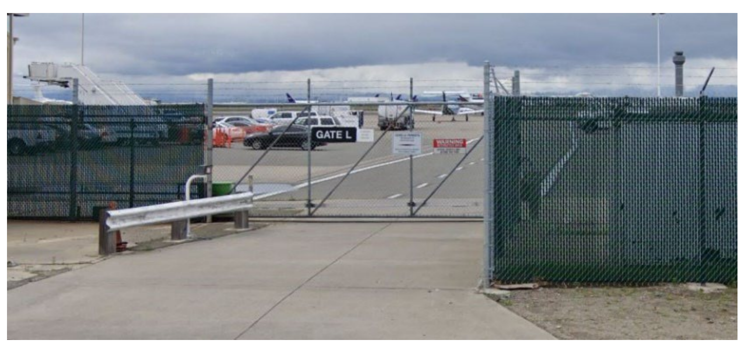
**Figure 3-8. Vertical Bars on a Gate at a CAT I Airport**


Source: Google Maps

**Outwardly curved fence topper** – This feature provides similar anti-climb capabilities to barbed wire toppers, but with a more decorative and aesthetically pleasing look. These toppers are typically connected with vertical bar fencing and can cost around 10–15% of the total cost of the fence.

**Anti-climb mesh** – This is a special type of tightly woven wire mesh that is mounted to the fence to prevent intruders from finding hand and footholds on the fence (Figure 3-9). Typically, this mesh is used for chain-link style fencing, but could be attached to any type of fencing (including brick walls and vertical fencing).

**Figure 3-9. Anti-Climb Mesh at a CAT I Airport**




Source: Google Maps

### 3.4.2 Anti-Tunneling Options

When designing a perimeter fence, some consideration should be given to anti-tunneling characteristics.

**Mow strips** – Typically, these are partially buried concrete barriers underneath the fencing. These barriers protect the fence from damage caused by lawn maintenance activities and can create a cleaner look. The barriers can also help reinforce areas prone to erosion.

**Reinforced railing** – Adding reinforced railing to the bottom of the fence will help prevent access under the fence. A metal bottom rail through the chain link mesh will help prevent the fence fabric from being bent or warped to create a crawl space underneath.

**Animal fencing** – This is a short, mesh fencing that is partially buried and attached to the fence (an example is highlighted by the red square in Figure 3-10). It is designed to keep wildlife from digging under the fence or bending the fence in order to crawl underneath, but also acts as a deterrent to intruders.

**Figure 3-10. Animal Fencing at a CAT X Airport**

> One airport discovered a blind spot when a TSA inspector auditing the vehicle gate managed to sneak past the guard performing a vehicle inspection because of a culvert in front of the perimeter fencing. The culvert was necessary for water drainage, but it also prevented the addition of a secondary fence. The airport placed water-filled barrels in the space to prevent pedestrians from sneaking through the area while not hindering the water drainage. The barrels also act as an additional crash barrier for vehicles.

# SECTION 4: SIGNAGE, SIGNALS, AND WAYFINDING

Having a clear understanding of what is expected of drivers at airside vehicle access gates assists in the smooth operation of those gates and can prevent unintentional breaches. Aside from the required TSA and FAA messaging, many gate areas have signage to describe policies, relevant state or local laws, safety and warning messages, and gate designation.

**Figure 4-1. Traffic Signals at a CAT X Airport**

Source: Google Maps

Wayfinding signs and signals should provide consistent and clear instructions to drivers with a minimal number of words and duplication. As much as possible, airports should reduce and consolidate signage, and ensure that the signage is consistent across all vehicle gates to minimize confusion and sign fatigue.

**Figure 4-2. Light Signals at a CAT X Airport**

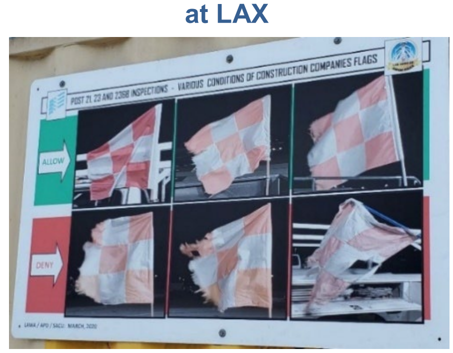

Source: Google Maps

## TRAFFIC SIGNALS AND MARKINGS

Some airports have added traffic signals to their vehicle gates to indicate the gate's different states, such as open, closed, and/or error. These are most commonly two-light systems, with a green light indicating "go" or "open" and a red light indicating "stop" or "closed" depending on the traffic signal's configuration (Figure 4-1). Though not often used in airport traffic signals, yellow usually indicates error states. Another signal option uses lighted arrows to direct vehicles to the correct lane (Figure 4-2).

It is a common practice at airports to paint lines on the roadway to indicate the location of the ground loops on both sides of the gates. Often, the vehicle needs to clear the ground loops before the gate will open or close, as a safety measure. Outlining the boundaries of the ground loops can reduce dwell times for vehicles waiting for the gate to close before driving away. It should be noted that snow buildup could conceal painted traffic signage, including ground loop boundary lines. Airports could assign their guards or maintenance/facilities teams to sweep or plow these lines during their rounds, or other signage could be added to indicate the boundaries. It should also be noted that painted markings will fade over time and must be routinely repainted.

**Figure 4-3. Photographic Signage at LAX**




## ACCESS REFERENCES

Some airports post signage indicating the badge colors of individuals authorized to use the gate. If the airport utilizes color-coded badges, this would be an easy method to quickly determine if a driver is not authorized to use the gate.

Photographic signage may also be used to provide drivers and guards a clear reference to permissible conditions for vehicles entering the airport property.

> At LAX, construction vehicles are required to display flags when driving within the restricted areas. The airport has posted signage (Figure 4-3) that indicates the amount of wear that is considered acceptable before a flag must be replaced.

### LOCATION IDENTIFICATION

Some airports reported using cardinal directions to help identify their vehicle gates. Gate identification often looks like a letter representing the direction and a number assigned, as shown in Figure 4-4 (S for South).

> One airport stated that they assigned addresses to their vehicle gates. The airport worked with the county and the gates are now searchable on navigation and map applications and services. In part, this was done for emergency response; the ability to provide an address instead of directions to a gate has shortened emergency response times.

### PLACEMENT

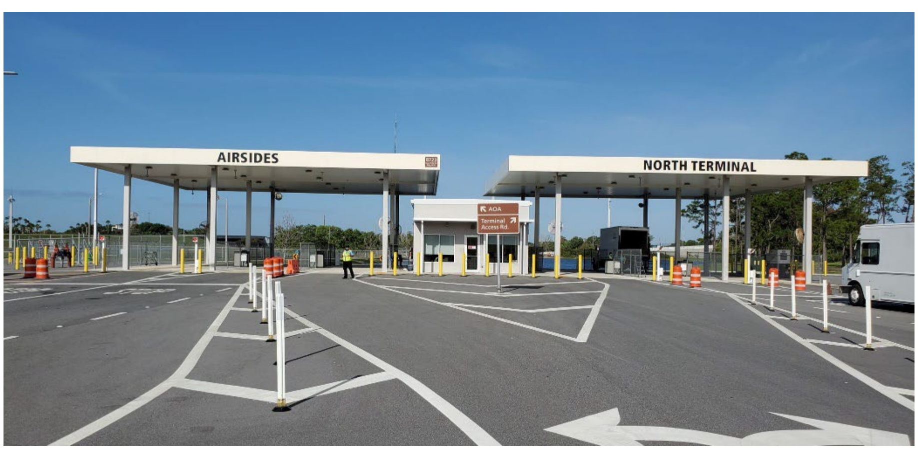
Signage may be placed almost anywhere at the vehicle gate, including:

- Hanging on the moving parts of the gate
- Hanging on the adjacent perimeter fence
- Mounted on guard facilities or other permanent structures
- Mounted on a pole to the side of the road (traffic signs and signals)
- Mounted overhead (under a covered structure or on a traffic pole)
- Painted on the roadway and curbs (traffic markings; Figure 4-5)

**Figure 4-4. Cardinal Direction Signage at a CAT X Airport**


Source: Google Maps

**Figure 4-5. Common Traffic Markings at a CAT X Airport**



Signage placement is an important part of the vehicle gate design. Placing too much signage on the moving parts can weigh down the gate and put unnecessary strain on the gate operator. Signage also acts as a windcatcher and can knock gates off their tracks. Wherever possible, it is better to place signage on stationary fixtures.

Overhead signage should be carefully designed to ensure it will not be hit by tall vehicles, and that sight lines to the sign are not blocked by the overhead structure.

# SECTION 5: AREA SECURITY MEASURES

Implementing security measures in the areas in and around the vehicle access gates helps detect and deter unauthorized activity, and ensures the safety of personnel guarding and accessing the gates.

## 5.1 Lighting

Security lighting is a fundamental tool to support situational awareness. A well-designed system deters intrusion attempts and supports camera-related technologies by providing consistent illumination and enabling detection and recognition of intruders. There are several types of security lighting design:

**Continuous lighting** – This is the most common form of lighting at airports. It consists of light sources arranged with overlapping cones of illumination. For vehicle gates, continuous lighting may also be provided via a single, large lamp that provides enough light to illuminate the entire vehicle gate area.

**Figure 8-1. Moveable Lightsource Used as a Continuous Lightsource at LAX**

**Standby lighting** – This type of design is used to provide additional illumination when needed. Lights may be automatically turned on as a result of a tripped sensor, or controlled by security personnel or another system.

**Moveable lighting** – Consists of manually operated, moveable light sources, such as search lights, and is used to supplement continuous or standby designs. This is more commonly seen at high security facilities such as correctional facilities and border control locations. Many airports use them as temporary lighting at construction gates.

**Emergency lighting** – This design is used for periods of main power failure or other emergencies. Emergency lights should be on an alternate power source such as a generator or battery backup. See Section 8.2 for more information on redundant power supplies.

**Infrared lighting** – Used to enhance infrared camera performance in areas where standard camera performance at night is inadequate.

Light poles or units, and security lighting controls, switches, and panels should be located within the restricted areas to prevent tampering. They should also be weatherproofed, and protected to prevent unauthorized access. They should be readily accessible to security and maintenance personnel, and inaccessible from outside the perimeter. The lighting cables should be protected by tamper-resistant conduits and preferably buried. If burying the cables is not an option, they should be high enough to reduce the possibility of tampering.

Lighting should be positioned above the perimeter fence line to provide illumination to both sides of the perimeter. Whenever possible, the cones of illumination should overlap to reduce shadows and provide coverage in the event a bulb burns out.

When designing lighting around the vehicle gate, airports should ensure the area has minimal shadows. The lighting should not cause temporary blindness to guards, cameras, or drivers, or affect nearby aircraft. Effects on aircraft can be mitigated by ensuring the cone of illumination points downwards.

Lesser used gates and unstaffed gates should have the same degree of continuous lighting as the perimeter in the immediate area. Standby and mobile lighting may be used to provide additional lighting when the gate is staffed or used.

Light-emitting diode (LED) bulbs are the most common bulb types used at airports. They are long-lasting and provide sharp contrast and color rendition. They also consume less power than other bulb types.

No airports reported using special or enhanced lighting at their vehicle gates. However, upgrading or improving lighting is a low-cost strategy to enhance the security footprint of the vehicle gate. Increasing the level of illumination in the area could improve camera functions without the need to replace cameras. Illumination can be increased by installing higher wattage bulbs; bulb technology such as LED, metal halide, or high-pressure sodium vapor; or additional lighting fixtures.

Excessive fog or smoke may diffuse the ambient lighting in an area, requiring alternate strategies to maintain the same level of visual security. When the ambient light in an area cannot be improved, selective use of thermal cameras (see Section 5.2.1) or additional guards may be more appropriate.

Airports constructing new gates with overhead coverings often opt to integrate lighting in the covering. This provides the added benefit of shielding the lights from nearby aircraft movement areas where the light could be distracting to pilots. Gates located near airfield taxiways will need extra care to ensure that the enhanced lighting does not affect the aircraft.

The Illuminating Engineering Society of North America Recommended Practice (RP) 33-99 *Lighting for Exterior Environments* provides guidelines, recommendations, and best practices for designing exterior lighting.

## 5.2 Cameras

Cameras allow monitoring of areas throughout the airport, including airside vehicle gates. It is important to select cameras that have necessary features and can operate in all weather and lighting conditions. Trained staff should be available to monitor the cameras and to respond to areas if needed. Video storage capacity should also be considered for forensic purposes in the event of an incident.

Airports designing camera systems should consider several factors:

- Cameras with pan-tilt-zoom (PTZ) features provide the ability to monitor a larger area of detection as well as some tracking abilities
- Outdoor cameras need to function correctly in daylight and darkness
    - Weather conditions can drastically affect visibility, at times requiring additional lighting; certain weather conditions can also create visibility challenges due to reflections
- Cameras should be mounted at a safe height to prevent equipment damage or tampering, and should provide a good field of view
    - Whenever possible, cameras should be mounted on the restricted side of the vehicle gate to prevent tampering
    - The mounting mast should be stiff enough to prevent motion by wind or the camera's PTZ movement
- Camera housing should be provided to protect the equipment from extreme environmental conditions and thrown objects

- Headlights at night can blind cameras and hinder vehicle classification, license plate recognition, and other security functions
    - Cameras can be tilted to minimize this blindness but may require several attempts to find the most appropriate angle

No airports reported using camouflaged cameras as part of their security program since obvious cameras may provide a deterrence factor.

### 5.2.1 Thermal Cameras

Thermal imaging sensors (also known as Forward-Looking Infrared [FLIR]) detect radiated heat from vehicles, people, and objects instead of depending on illumination. They are not commonly used at airports due to the preference for standard cameras and the higher cost associated with thermal equipment.

Thermal cameras provide detection capabilities regardless of light conditions. They are suited for nighttime and darkness applications, including zero light conditions, making them ideal for remote and lesser used gates. They also have significant advantages over standard cameras due to their ability to function effectively in the presence of vehicle and aircraft headlights, direct sunlight, reflections off water, and other difficult lighting situations. These cameras are also less susceptible to weather and dust than standard cameras.

Airports considering thermal cameras for their vehicle gate security system should determine the best locations for deployment. They require a clear line of sight, and those equipped with analytics are subject to nuisance alarms from nearby heat sources and features such as running water. Thermal cameras also have low resolution and have challenges identifying objects at or near ambient temperature.

### 5.2.2 Video Analytics

Video analytics is the use of real-time video imaging and processing algorithms to detect triggering events. Some capabilities of video analytics include:

- Motion detection – detects and tracks moving targets within a defined area
- Trip wire – detects when objects or people cross a defined boundary
- Counter flow or wrong-way detection – detects an object moving in the opposite direction of defined traffic flow
- Abandoned object detection – detects when an object has been left unattended for a defined period of time
- Tailgating/piggybacking detection – detects unauthorized vehicles moving through a vehicle gate following an authorized vehicle
- License plate recognition – reads vehicle license plates; may include the ability to capture images and reference those images against a database (see Section 7.3)
- Facial recognition – allows for identification of a person by their unique facial features
- Overspeed detection – detects vehicles approaching the vehicle gate faster than a defined speed; commonly used at military bases

Most video analytic software is camera agnostic, so airports may be able to use it with existing cameras as long as the video footage is clear and sharp.

Airports have reported large numbers of nuisance alarms when first deploying video analytics. However, several rounds of configuration will reduce most of these nuisance alarms.

Some airports have suggested that video analytics could be used to bolster security at gates that are used infrequently.

### 5.2.3 Video Storage

Airports should consider how and for how long their video footage is stored, and ensure that storage is secure and robust enough to maintain the airport's video data.

Video storage can be expensive and a design challenge. Technology in this area is constantly evolving, so airports should work closely with their IT department to ensure the storage design will meet current demand while including modularity to add or replace elements in the future.

There are three common types of storage used at airports, each with the capability to expand storage space if necessary:

**Direct Attached Storage** – This is a storage device that is attached directly to the workstation or local server, such as a PC with internal and/or external drives. This type of storage is best for airports with small systems or systems where sharing over a network is not necessary.

**Network Attached Storage** – These are network devices that act as file servers with file sharing software. These are designed to share video across a network and often contain multiple disk drives. These are good options for small systems but have limited storage expandability.

**Storage Area Networks** – These devices provide dedicated storage for enterprise-level networks. They are the most versatile of the storage types and allow for large amounts of storage expansion in the future.

Currently, there are no federal mandates or requirements for security video footage storage airports. Any requirements, such as the duration that video footage needs to be stored, are typically imposed by the airport's residing state.

## 5.3 Perimeter Sensors

Perimeter sensors can be used at and near vehicle gates to detect suspicious activity and intrusion attempts. There are numerous sensor technologies available with varying detection modes and performance characteristics. See PARAS 0015 – *Guidance for Airport Perimeter Security* for in-depth discussion of sensor types and deployment considerations.

To maximize effectiveness, the perimeter sensors selected should be suitable for the site characteristics (e.g., layout, topography) and typical activity at the gate. Airports should presume that the sensors will be subject to frequent authorized vehicle movements, gate motion, and vibration from both the gate and vehicles. To avoid excessive nuisance alarms, any sensors deployed should be insusceptible to these types of signals, be capable of filtering them, or support zoning of the detection field to enable smart deactivation. Alarm filtering is typically achieved via digital signal processing or analysis. Zones can be configured in conjunction with the access control reader or gate controller to temporarily deactivate a portion of the detection field, enabling the vehicle to pass through without generating an alarm.

Perimeter sensors should be complemented with cameras to aid in alarm resolution and target tracking. Many sensor systems can be integrated with PTZ cameras to enable automatic slew-to-cue on sensor alarms.

# SECTION 6: ACCESS CONTROL TECHNOLOGY AND STRATEGIES

Access control technologies and strategies enable airports to quickly determine if persons that present themselves at airside vehicle access gates are authorized to enter the airport.

## 6.1 Access Control Equipment

It is important that the components selected for an access control system (ACS) can operate in a wide range of environmental conditions and can also integrate with other ACS components in use throughout the airport.

### 6.1.1 Access Control Readers

Some airports require multiple access control panels to maintain an unimpeded flow through the vehicle gate. This is useful for vehicle gates that experience heavy vehicle traffic. Airports with multiple ingress lanes will typically install an access control panel at each lane to allow exempt vehicles to bypass the inspection process.

**Figure 6-1. Bi-Level Access Control Panel**

Bi-level, dual access control panels are useful for vehicle gates that accommodate vehicles of diverse sizes, such as a sedan compared to a concrete mixer truck. This system consists of two access control panels installed one on top of the other, as shown in Figure 6-1. This configuration ensures that drivers do not need to exit the vehicle to reach the access control panel, which is especially convenient for locations with extreme weather.

The traffic signal color system can also be used to indicate ID verification status. Some access control panels have small lights to indicate access authority. Typical color associations for the lights are green for valid, red for invalid, and yellow for error. Monitors inside guard facilities can also flash colored notifications to quickly alert guards to authorization status.

Access control readers are often collocated with PIN entry pads and, in some cases, cameras and intercom systems to facilitate communication between a driver and security officer or operations center. Some access control panels have small, built-in speakers to play an alert when an invalid card or PIN is entered into the access terminal. Guard facilities could also be equipped with a duplicate speaker to alert the guard of status notifications.

### 6.1.2 Mobile Card Readers

Mobile access control readers are becoming more popular at airports. Some airports reported utilizing a mobile card reader in addition to the stationary access control panel when verifying multiple badges at once, such as a passenger van full of people. The readers require a wireless connection to interface with the ACS and provide real-time updates. If the wireless connection to the ACS fails, alternate policies should be used, such as stop lists.

The devices have limited storage space. For large airports, this may become an issue if the badge information for a larger badged population exceeds the amount of data that can be stored on the device.

### 6.1.3 Remote Openers

Remote openers are small booster devices, similar to a garage door opener, that send information to the automatic vehicle gate operator when an authorized and valid badge is inserted into the opener device. The devices cannot activate the gate operator on their own, which offers some protection against theft. Airports that use them have indicated that they work well, especially for less frequently used gates, but recommend installing a pedestal-mounted card reader for redundancy.

## 6.2 Biometrics

Biometric access control systems allow for a dual authentication process. Common types of biometrics at airports include fingerprint, handprint, and facial recognition.

When determining a suitable biometric system for use at a vehicle gate, airports should consider the system's weather resistance, reliability in varying moisture and lighting conditions, and ease of use from inside a vehicle.

It should be noted that some city and state privacy laws may affect an airport's ability to deploy facial recognition systems. Airports should work with their local authorities and legal department to determine whether facial recognition is a viable option.

## 6.3 Access Control Strategies

Having clear access control strategies and procedures that are well documented and reinforced helps ensure that staff operate effectively.

### 6.3.1 Remote Identification

Several airports use cameras to verify identity and to monitor their gates. It is most commonly seen at airports and gates with low traffic demand. This strategy could be used to eliminate staffing requirements at certain gates. There are two common methods:

**Using the access control panel activates the camera** – When the driver uses the access control panel, the verification camera activates or sends a notification to the operations center so that the camera operator can verify that the person driving the vehicle matches the access control data log. The camera operator then opens the gate for the authorized vehicle.

**Approaching the Access Control Area activates the camera** – When a vehicle approaches the Access Control Area and triggers a sensor, the camera is activated or a notification is sent to the operations center. When the driver swipes their badge on the access control panel, the camera operator verifies that the driver matches the access control data log and opens the gate.

To be effective, this strategy requires the use of high-resolution cameras that must be positioned for a clear view of view inside the vehicle. Vehicle sensors such as ground loops may be necessary as well.

### 6.3.2 Badge Authentication

By checking the validity of badges of the driver and all passengers, guards can ensure that everyone in the vehicle is permitted in the restricted areas or is appropriately escorted. If not all the passengers are badged but the driver is permitted to escort, the inspector can log the passengers' driver's licenses or other identification information to enable review if there is an incident.

If large numbers of people carpooling through the vehicle gate is a common occurrence, airports should consider installing multiple access control readers or using mobile readers to help expedite the authentication process.

> One airport has added a driver's license reader system that checks the licenses of unbadged individuals being escorted through the vehicle gate. This reader is tied to an internal airport stop-list as well as the TSA's selectee and No-Fly lists.

#### TWO-BADGE ACCESS

Some airports require two badge swipes to activate and open the vehicle gate. This strategy is most commonly used at vehicle gates with guards. Typically, the first badge swipe enables the guard to verify the person's identity and authority to pass through the gate, and the second swipe opens the vehicle gate. Multiple airports reported using this strategy at their vehicle gates.

> At one airport, the guard examines the badge and confirms its authenticity before swiping the badge in an access control reader, which only verifies that the badge is active and the badge holder is authorized to use the gate. The guard then swipes their own badge to open the vehicle gate. This creates accountability on the part of the guard as the two access card swipes will show up in the data logs and identify the guard who approved access in the event of an incident.
>
> At another airport, the guard swipes the driver's badge in a badge reader located in the guard facility. This swipe calls up the badge information to a monitor in the guard facility, which allows the guard to compare the larger badge holder portrait to the driver of the vehicle. Once verified, the badge is returned to the driver, and the driver swipes the badge in a separate reader to open the vehicle gate.

### 6.3.3 Stop Lists

Stop lists are spreadsheets or databases that list people who are prohibited access to the restricted area. Typically, these stop lists are published daily and are provided to guards in case the access control reader is not functioning. The lists include the badge holder's name and badge number.

Some airports that use stop lists reported difficulty in maintaining the lists daily. Some Identity Management Systems can generate and send stop lists automatically.

# SECTION 7: VEHICLE INSPECTION EQUIPMENT

Successful conduct of physical inspections at vehicle access gates requires a range of inspection equipment and well considered policies.

In general, pedestrians are not permitted to use vehicle gates, and drivers and their passengers are not required—and often not permitted—to exit their vehicle. The small number of airports that perform inspections on individuals at the vehicle gates focus on the individual's personal belongings (e.g., backpack) and perform a visual inspection of the items. Inspectors may use a metal detection wand to check the individual, but this is uncommon. A badge check is always required.

Traditionally, inspection equipment at airside vehicle access gates has consisted of a flashlight and a mirror on a pole. However, there is now a growing list of technologies that can greatly enhance the inspection process.

For more information on inspection equipment and operations, please see PARAS 0019: *Employee/Vendor Physical Inspection Program Guidance*.

## 7.1 Under and Over Vehicle Mirrors

Under vehicle mirrors are common inspection equipment at airports and other secure facilities. These are mirrors attached to the end of a pole to enable the inspector to examine under the vehicle for IEDs and other suspicious objects.

Portable pole camera systems are similar to under vehicle mirrors, except a camera is mounted on the bottom of the pole instead of a mirror, and a small display screen (often a tablet device) is mounted on the top of the pole. The major advantage to using a camera over a mirror is the ability to enlarge the image of suspicious areas.

Overhead mirrors are less common at airports but are seen at other secure facilities. These are mirrors that are mounted overhead to provide inspectors with a view of open-top vehicles such as construction and garbage trucks. Mounted cameras can provide this same top-down view. Several airports require open-bed garbage trucks to be empty to pass through the vehicle gates. This prevents any prohibited or dangerous items from being buried under the refuse. Compliance is confirmed via an overhead mirror.

## 7.2 Under Vehicle Inspection Systems

Under vehicle inspection systems (UVIS) are camera systems that are mounted in the ground to view the underside of vehicles as they pass over. They are uncommon at airports, usually due to the cost of the equipment and frequent maintenance requirements. However, many airports indicated that they would like to add UVIS to their primary vehicle gates to enhance the vehicle inspection process.

Most UVIS use a ground loop or other sensor ahead of the camera system to detect an approaching vehicle and activate the camera. Another sensor behind the camera detects when the vehicle has cleared the camera and deactivates it.

Typically, these systems will send the video or photographic footage to a monitor in the guard facility or the operations office. Some systems include analytic software that compares the video footage to previous images of that vehicle or to vehicles of the same model to identify inconsistencies and potential threats.

For some systems, vehicles driving too slowly over the system (typically less than five miles per hour) may create stretched and distorted images. Traffic management equipment (speed signs, traffic signals, etc.) or posting personnel to direct traffic can help manage this issue.

Permanently installed UVIS require extensive roadway work to seat the cameras in the ground and seal the system from the weather. Water or debris in the camera compartment could obstruct the camera's view or damage the equipment. These systems may require electrical and fiber cabling to be installed if that infrastructure is not already in place. Some vendors offer portable UVIS solutions that look like small speed bumps and can be installed semi-permanently above ground.

UVIS cameras, whether permanently installed or temporary, must be adequately protected from vehicles. Some airports reported that they installed custom-built heavy plates because the vendor-supplied plates were observed to flex excessively under some loads (e.g., concrete trucks, ARFF equipment). These plates were either procured from the UVIS vendor or manufactured in-house.

UVIS are most effective when deployed under a canopy to prevent dirt and precipitation from coating the sensors. Condensation on the cameras may occur in some conditions, such as cold or high humidity. The canopy will also assist with lighting management as the ambient lighting changes throughout the day. Other causes of image distortion that could be minimized with a canopy include light blooms, water or dirt on the lenses, and reflections from nearby objects. If the system cannot be mounted under a canopy, it will need to be periodically cleaned, sometimes as often as daily, to help provide clear images.

## 7.3 License Plate Recognition

License plate recognition (LPR) refers to camera systems that read and identify vehicle license plates. The cameras take an image of the plate and analysis software compares the plate numbers to a database.

Mounted cameras offer the airport the opportunity to identify potentially unauthorized vehicles before they arrive at the vehicle gate or other sensitive areas. To benefit vehicle gate security, LPR cameras should be positioned to monitor vehicles as they travel through the Vehicle Gate Approach Area to provide actionable information to the guards or security/operations center before the vehicle is permitted beyond the gate. If paired with analytics software, these cameras could identify traffic patterns to assist with staffing and scheduling, and alert operators to suspicious vehicle movements.

> One airport indicated that they use hand-held LPR devices to take an image of the license plate and compare it to an internal database. This process has replaced the airport's need for sticker permits.

## 7.4 Ladders and Platforms

To inspect taller vehicles, such as garbage and fuel trucks, one airport worked with their Safety Department to implement the use of ladders that the inspectors can climb to see the top of the vehicles. Another airport uses staired platforms (Figure 7-1) for viewing inside taller vehicles from a stable location to increase officer safety.

While these are low-cost solutions, airports should weigh the safety of their inspectors against the potential security threat. Overhead mirrors or cameras may be a safer alternative.

**Figure 7-1. Platform Ladder at a CAT X Airport**

## 7.5 Vehicle X-Ray

Many airports interviewed indicated that they would like to add vehicle x-ray technology to their vehicle gate system. Currently, this technology is only used in the US at border crossings; it is also used at borders and military facilities outside the US.

These devices use high-energy x-ray penetration to detect organic and inorganic materials based on the material's atomic number. Using customized filters, the image operators are able to quickly identify narcotics, explosives, weapons of mass destruction, contraband, and radioactive materials. The high-energy x-rays can penetrate up to twelve inches of steel. Combining the x-ray with a separate backscatter component will also allow the system to detect contraband concealed behind less dense materials (e.g., fiberglass).

An additional feature of these systems is the limited ability to verify delivery manifests. This is a customized option that can count pallets and identify bulk items. Vendors indicated that they are working on a system that would use radio frequency identification (RFID) readers with optical character recognition to link the vehicle to the manifest and create automatic flags for items not on the manifest.

Vehicle x-ray systems typically consist of an x-ray portal or multiple portals through which the vehicle is driven. They can be customized to fit nearly any space, but it should be noted that even the smallest current model still has an approximate footprint of 40 x 40 feet. Systems utilizing multiple x-ray portals will have a much larger footprint, up to 100 feet or longer. Most of these systems will require concrete shielding, which will add to the footprint as well. Placing the portals near existing buildings is not recommended; guard facilities may need to be moved to accommodate the system. These systems are designed to accommodate large cargo trucks and can be modified to fit the needs of the airport. However, it should be noted that the x-ray penetration level will be limited based on how far the overhead x-ray tube is from the generator.

Some vehicle x-ray systems are capable of screening the truck cab and driver at a lower radiation level.[3] A radiation survey will be necessary as part of the installation, and an annual radiation survey will be needed to comply with federal requirements.

Throughput will depend on the system chosen; drive-through options will offer a much higher throughput than systems that move over the vehicle while it is stationary. Depending on the system configuration and number of portals used, the throughput can be as high as 100–120 trucks per hour.

The systems are designed to function in -30° to 115° Fahrenheit, but can also be equipped with add-on hot and cold kits for extended periods of extreme temperatures.

Maintenance of these systems is significant. The vendors recommend a full-service annual and preventative maintenance contract with monthly preventative maintenance visits. Specialized canine units are also recommended for periods when the system is out of service. The system's sensors,

[3] The Health Physics society states that vehicle x-ray systems that comply with applicable safety standards (e.g., ANSI) deliver x-ray doses that are well within safe limits: https://hps.org/publicinformation/ate/q11239.html

detector, and cameras will need to be cleaned and realigned monthly. A spare parts contract is recommended for these components. X-ray generators can be very expensive to replace, but they typically have a three- to five-year expected life span.

The cost for a vehicle x-ray system will vary greatly depending on the type and number of portals procured, concrete shielding installation, and any trenching needed for cabling or under-vehicle systems. The vertical concrete shielding will be one of the more expensive requirements for this system as it must be built to specifications on-site.

Vendors recommend at least one supervisor, two image operators, and a traffic controller to effectively operate the multi-portal system. Use of additional traffic management equipment (such as barrier arms and traffic lights) and remote image operators could reduce this staffing requirement.

# SECTION 8: MAINTENANCE AND REDUNDANCY

Regular maintenance, having adequate spare components on hand, and building in redundancy helps ensure that mechanical systems have fewer breakdowns. But when breakdowns occur, there should be measures in place to maintain necessary security.

## 8.1 Maintenance

There is no substitute for a solid vehicle gate maintenance program. Properly carried out, it will result in consistently high levels of operation, which will prevent the need to use alternative methods that may have higher risk of breaches or substantial operational impacts, such as longer wait times at the gates.

Regular preventive maintenance of equipment promotes a longer life span and reduces critical repairs. Ongoing scheduled maintenance will help keep vehicle gate equipment in effective and continuous operation. Additionally, the cost of regular maintenance is often lower than the cost to replace a component that has fallen into disrepair. Necessary preventative maintenance will vary based on several factors:

- Type of gate (sliding, swing, lifting, etc.)
- Equipment material (galvanized steel, aluminum, concrete, etc.)
- Equipment usage
- Equipment age
- Ground stability
- Local weather and environmental factors (salty air, ice and snow, flooding, etc.)
- Frequency of preventative maintenance

When creating a maintenance schedule, airports should consider how long that maintenance may take. For example, landscaping maintenance around the gate and adjacent perimeter will likely take longer than greasing gate operator gears. The time of year and frequency of upkeep may also affect the amount of time needed to address the maintenance needs of each gate. Some airports may need to clear snow buildup at each gate multiple times a day, while once a day may be enough for other airports.

The maintenance schedule should address each vehicle gate at the airport, and consideration should be given to only scheduling one full gate maintenance per day to allow for unexpected delays or repairs.

Most airports reported that their in-house maintenance or facilities department is responsible for maintaining their vehicle gates. These personnel should be trained to care for the gate equipment without damaging or disrupting any security sensors. They should also be trained in maintaining the environment around the gates, such as landscaping to keep grass from triggering nuisance alarms, and clearing snow without disrupting operations.

> At least one airport disables vehicle gate operations for an entire day while the gate is cleaned and maintained.

See Section 13.4 for information about system warranties and developing a maintenance contract.

### 8.1.1 Equipment Life Span

Equipment life span is typically determined by the vendor and/or manufacturer, and will be affected by weather and usage. However, there are some general life span measurements that may help airports plan for equipment replacements or upgrades.

Moving parts—such as PTZ camera mounts, gate operators, and barrier arms—have a typical life span of about four years. Freezing temperatures often slow down these parts and shorten their life spans.

Batteries, such as uninterrupted power supplies (UPS) and control panel batteries, have a typical lifespan of one year. This may be shortened by extreme temperatures and salty air, which can corrode certain types of batteries.

High usage electronic devices, such as network switches and hard drives, have a life span of about five years.

The life span of barriers, such as fences and gates, vary greatly based on the barrier's frequency of use; environmental factors such as salty air and extreme temperatures; manufacturing and installation quality; level of preventative maintenance; and damage, such as twisting and bending.

Most airports reported that their maintenance or facilities department maintained an inventory of spare parts for gate components that tend to wear out the fastest, such as gears and belt drives in the gate operator. As the spare parts are used, the maintenance department orders more to replace the inventory.

Airports should discuss spare part recommendations with their vendors.

> One airport indicated that they keep spare gates on property to replace gates that have been hit by vehicles. These spare gates are stored near the existing gate for convenience.

### 8.1.2 Gate Inspections

Guards, law enforcement officers (LEO), operations, security, and/or maintenance or facilities personnel should be tasked to regularly inspect the gates for damage to sensors, damage to the fence or gate, standing water, snow/ice, debris, and overgrowth of vegetation, and report these findings for maintenance. Many airports indicated that LEOs perform push/pull tests on the gate to ensure that the gate will not open under force.

## 8.2 Redundancy

Building redundancy into the design of the vehicle gate will help prevent disruption of the system's operation in the event of equipment failure or power outage. Redundancy may be addressed with the addition of features or equipment, such as multiple cameras pointed at the vehicle gate area, or by creating policies and procedures to account for certain failures in the system, such as resorting to manual gate operations during power failures.

It is recommended that backup power solutions provide at least two hours of power to continue gate operations. Suggested security devices to supply with backup power include:

- Access control panels
- Cameras
- Buried and fence-mounted sensors

- Communication systems
- Security lighting
- Mechanized gate operators

Many airports indicated that their primary vehicle gates have backup power supplies. In the event of power failure or failure of the mechanized gate operator, the gates without a backup power supply could be opened and closed manually; stop lists will be used if the access control system are not functioning. Some airports position a vehicle in front of the gate during these periods to help control access.

No airport indicated that operations would be halted completely due to power failure. The only events that appear to shut down vehicle gate operations entirely are lightning strikes near the airfield or physical damage to the gate or adjacent area.

Backup power is supplied by generators and batteries/UPS. There are advantages and disadvantages to each source, and the technologies are constantly evolving. When determining the appropriate backup solution, airports should consider the solution's energy storage, modularity, and scalability.

Typically, generators are used for long-term power outages. They are reliable and are used in nearly all industries and facility types. Generators should be tested on a regular schedule. These devices often operate with diesel, and thus are often not environmentally friendly. Some airports may be subject to restrictions or limitations on their use due to local or state environmental laws.

Batteries are mostly used for short-term outages, although technology advances are lengthening the potential duration. Batteries can be used as a UPS to provide power until the backup generators can take over or the essential equipment can be shut down properly. Batteries are more environmentally friendly than generators, but often have a short lifespan and will need to be replaced more often. Some batteries are rechargeable and can be equipped with solar panels to create a greener solution. They also have a smaller footprint.

As a rule of thumb, the larger the battery, the longer the duration of power the battery will provide. However, the type of battery also has a significant impact on the battery's capabilities. Lead-acid batteries are the most common and cheapest battery solutions. Lead-acid is a mature technology that is widely available. The power duration is moderate, often around 15 minutes, but depends on the energy density (energy storage capacity for its size) and the battery's age. Lead-acid cannot compete with generators in energy density and output. Additionally, lead-acid batteries have a short lifespan: about three to five years under ideal conditions. Heat, cold, and frequent use can shorten the battery's life. Many airports indicated they stopped using battery backups because the number of uses of the battery backup was not worth the frequency and cost of replacing the batteries.

Lithium-ion batteries are becoming more popular due to their long lifespan and power duration. These batteries require fewer replacements than lead-acid batteries, and have a lifespan that is two to three times longer (approximately seven to fifteen years). The batteries are more energy dense and have greater efficiency for recharging and energy output. Lithium-ion batteries have historically been more expensive than lead-acid. However, their costs have been decreasing, making them more comparable to lead-acid.

The major downside to lithium-ion technology is that it can pose a fire hazard. These batteries have been reported to explode or catch fire under certain conditions (mainly heat), and the resulting fires are difficult to extinguish. Lithium-ion batteries used in UPS devices are designed differently to those in laptops and mobile devices, but many insurance companies require installation of a fire suppression system, depending upon the usage. Underwriters Laboratories (UL) 9540A outlines the codes to prevent thermal runaway fire propagation and limits how lithium-ion batteries can be used.

Alternatives to lithium-ion and lead-acid are available, but they are not as widely adopted or cost-effective. Nickel-zinc has nearly the same energy density as lithium-ion but does not need a cooling system and is not susceptible to thermal runaway fires, which makes these batteries more acceptable to fire marshals and insurance companies. However, nickel-zinc is not widely utilized and does not have the proven efficiencies of lithium and lead-acid. Sodium-ion shows huge potential as a battery backup system, but the technology is still in its early stages and not currently available for large capacity solutions.

Each of these battery types will need to be disposed of properly to reduce their impact on the environment. Lead-acid and lithium-ion batteries require special disposal handling.

Some generator and battery models may be able to connect to a solar panel to help passively build and store power. Like any solar-powered system, direct sunlight is needed for maximum efficiency; airports that frequently experience overcast skies may have limited success with solar power sources.

# SECTION 9: GATE OPERATIONS AND STAFFING CONSIDERATIONS

Vehicle gates often go through operational changes depending on the time of day, time of year, weather, and construction schedules. Airports may need to schedule staffing, recalibrate systems and restructure operations to address these changes to maintain a consistent level of security. Planning for these changes will help to mitigate potential security vulnerabilities. Airports should develop contingency plans to address how vehicle gate operations may change during all types of events , including unexpected events and emergency response.

Factors that may influence and impact operations and staffing schedules include:

**Building Occupancy** – Changes in occupancy of buildings that are near a gate may affect traffic at that gate.

**Construction** – Construction projects generate traffic at designated gates and often require an inspector. Long-term construction projects may warrant the construction of a temporary gate.

**Restricted area designations** – Altering the demarcation of restricted areas (AOA, Secured, etc.) may change the traffic flow to affected gates and the authorization levels required at the gates. For example, during large construction projects, requirements for the construction area may be lowered to reduce demand for inspection resources and badging requirements.

**Unscheduled daily activity** – Some airports experience unscheduled but frequent activities that impact the gate operations and require adapting equipment, staffing, or policies. For example, at San Antonio International Airport, a vehicle gate that is in close proximity to an aircraft gate must stop operations to allow aircraft to taxis into or out of the area (see the case study in Appendix B for more information.)

**Irregular operations** – Special events, VIP access, and accidents may impact vehicle gate operations.

**Threat levels** – Security at vehicle gates may need to be adjusted in response to changes to the national or local threat level.

## 9.1 Operational Necessity

Reducing the number of vehicle gates to an operational minimum has been a requirement of many security directives since 9/11. It is currently required by National Amendment 12-03B, is recommended in TSA Information Circular 15-01 (Insider Threat), and has also been a long-standing recommendation from the Aviation Security Advisory Committee.

All vehicle gates should be periodically reassessed for their operational need, and any gates that are unnecessary should be deactivated to enhance the overall security of the airport. To assess the vehicle gate's operational necessity, airports need to understand the composition and volume of traffic that is utilizing the gate and consider the vulnerabilities and risks associated with that gate's location. This can be done with time and motion studies, as well as analyzing access control data and camera footage.

## 9.2 Designated Vehicle Gates

Designating vehicle gates for specific operations or stakeholder groups allows the airport to tailor the equipment and guard staff for the type of traffic that will pass through the gate. For instance, gates designated for larger vehicles, such as fuel and garbage trucks, can deploy overhead mirrors, taller access control panel(s), and stronger roadway materials to withstand the weight of the vehicles. Most airports have designated gates for emergency vehicles, vendor deliveries, construction, and/or dedicated tenant gates.

Designated vehicle gates also separate specific traffic types from the primary vehicle gates, relieving traffic congestion and allowing vehicles with time-sensitive schedules or contents, such as wet concrete, to get to their destination faster.

## 9.3 Gate and Staffing Schedules

Most airports with a guard staff have a 24/7 staffing operation. However, many airports staff the vehicle gates only at scheduled times. Typically, this style of operation is supplemented with a schedule for either the gate operations (e.g., open 6 am – 6 pm) or for the vendors and concessionaires (e.g., deliveries only permitted between 4 am – 10 am).

Regardless of the staffing strategy (24/7 versus scheduled), airports should consider rotating their guard staff by assigning them for a few hours at one location and then moving them to another location or duty during their shift, or by assigning them to different gates for each shift. This strategy helps relieve boredom or exhaustion, which could lead to less thorough inspections or observations. It also minimizes the ability for the guards to become overly friendly with the badge holders they are meant to inspect and observe. While some familiarity allows guards to notice behavior and pattern changes, it also presents the opportunity for a badge holder to conspire with a guard to breach security.

In extreme temperatures, guards should rotate regularly between outside and inside duties.

More information on scheduling strategies is discussed in PARAS 0019: *Employee/Vendor Physical Inspection Program Guidance*.

> One airport uses a separate card reader inside the guard facility to act as a timesheet. The guard swipes their badge at the start of their shift and swipes again at the end of their shift. Between one guard swiping at the end of their shift and the next guard swiping at the beginning of their shift, the gate is put into a high security state with only the highest clearance level permitted to access the gate.

## 9.4 Staffing Strategies

Airports have reported using several staffing strategies to meet the TSA's requirements for vehicle inspections. These include random inspections, constant inspection while stationed, just-in-time inspections, and continuous random inspections.

Airports were split on their strategies for staffing their vehicle gates. Larger airports (CAT X and I) were more likely to staff their primary vehicle gate(s). Smaller airports, due to their lower traffic volumes, were more likely to conduct identity verification via cameras and use just-in-time inspections.

Security violations, such as piggybacking, are less likely to occur at staffed vehicle gates than unstaffed gates. Guards are better able to monitor and control the flow of traffic and mitigate security violations. However, guards can be a large expense for airports.

At unstaffed gates, technology may be used to monitor activities at the gate and alert operations and security to suspicious or criminal activity.

For more information on staffing considerations at the vehicle access gate, please refer to PARAS 0019: *Employee/Vendor Physical Inspection Program Guidance.*

## 9.5 Guards and Inspectors

Airports have indicated they use the following types of guards and inspectors. There does not appear to be one type of guard used more often at airports, and there are advantages and disadvantages to each type.

- Airport authority employees, typically security, or operations personnel
- Third-party guard force
- Trained concessionaires and other tenants
- LEOs and sworn civilians
- Canine teams

For more information on using these resources, please refer to PARAS 0019: *Employee/Vendor Physical Inspection Program Guidance*.

When hiring inspectors and guard staff, some airports give preference to applicants with a military or police background under the presumption that they have more experience conducting inspection activities and have some threat- and risk-recognition training.

### ATLAS PLAYS

Some airports indicate that they coordinate with the TSA's Advanced Threat Local Allocation Strategy (ATLAS) teams to perform inspections at their vehicle gates. However, ATLAS teams are not deployed at all airports.

# SECTION 10: TRAINING AND TESTING

It is important that vehicle gate staff and responders are properly trained and regularly tested. Likewise, it is important that the drivers with badges authorizing access have also been properly trained and tested.

## 10.1 Guard Training

Guards stationed at or responding to vehicle gates should be fully trained on security regulations and procedures required to perform their responsibilities, including inspection procedures. The guards can also be trained to perform general troubleshooting tasks and minor repairs on the vehicle gate equipment, as well as some preventative maintenance activities (e.g., cleaning debris).

## 10.2 Badge Holder Training

All badge holders with authorized access to the vehicle gate must be trained in the regulations and procedures associated with that access. This should include expected and prohibited behaviors, as well as the consequences for failing to follow the regulations and procedures. This training should be thorough and clear, and should include any special or unique policies or procedures associated with using the vehicle gates.

Regular retraining should be required as part of the badge renewal process and as a consequence of any violations. Frequent retraining reminds staff of the responsibility they accept as a badge holder, and it can act as a refresher for some of the policies or situations that are not commonly encountered.

The most common violation seen at airports with automatic gates is the failure to stop and wait for the vehicle gate to close. Many airports with automatic gates have buried safety loop cables that detect when the vehicle has crossed the gate boundary. Sometimes, the vehicle will fail to cross the safety loop when waiting for the gate to close, which will keep the gate open indefinitely. Drivers may get frustrated and drive off before the gate is closed. More commonly, drivers will fail to wait until the gate has fully closed before driving away. Strategies for combatting these types of violations include:

- Stationing guards to monitor the gate and direct vehicles
- Painting lines on the ground to identify the boundaries of ground loops
- Installing sensors and cameras to detect and notify staff of drive-off violations
- Installing traffic lights to indicate when to proceed when the gate is opened or closed
- Increasing the closing speed of the gate to minimize wait times (note that faster speeds must be balanced to ensure the safety of people, structures, and vehicles)
- Posting signs to remind drivers to stop and wait
- Using CCTV to moniter compliance

A small number of airports have configured their access control to link to their training system. This enables the airport to prevent access to certain areas of the airport for individuals who have not completed the appropriate training modules, such as AOA driver training.

## 10.3 Enforcement and Penalties

Most airports use a tiered system of penalties for security violations. Violators are assigned increasing consequences for repeated or additional infractions. Many airports have a fine or fee structure associated with their penalty system. However, some local and state jurisdictions prevent or limit the collection of fines. Airports should work with their legal department before implementing a penalty system.

More information on enforcement and penalty policies can be found in PARAS 0019: *Employee/Vendor Physical Inspection Program Guidance*, and PARAS 0020: *Strategies for Effective Airport Identification Media Accountability and Control*.

## 10.4 Program Testing

Performing regular tests of the vehicle gate program allows the airport to test the guard's inspection effectiveness and situational awareness, as well as correct mistakes on the spot. TSA and ATLAS teams frequently test the vehicle gates. At airports with less TSA testing, airports should consider regularly testing the vehicle gate and guard's ability to deter, detect, delay, deny, and respond to potential threats. By conducting testing, the airport can also ensure the proper operation of its equipment (ACS, CCTV, barriers) and condition of the guard facility.

# SECTION 11: VEHICLE PERMITS AND ESCORTING

Due to the security risks posed by vehicles on the airfield, it is important for stringent vehicle and driver permitting requirements to be in place, and for escorted vehicles to be easily identified.

## 11.1 Permit Requirements

Airports indicated using the following requirements for their vehicle permits:

- Individual registering the vehicle must have an airport badge with appropriate access authority
- Vehicle must be registered by the individual requesting the permit or company leadership
- Permit request form must be signed by the appropriate Authorized Signatory
- Vehicle (and/or driver) must be insured to drive in the restricted areas
- Badge holder requesting the permit must have attended the appropriate driver and security trainings
- Permit fee to partially recover costs and high enough to reduce over-permitting (ranging from $15–$100 per vehicle)
- Decals on the vehicle's doors to easily identify the company or organization responsible for the vehicle (some airports require permanent markings; others allow magnetic placards)
- Annual vehicle inspection
- Letter of justification from an individual with authority

Permits may be requested and renewed by an individual for the vehicle assigned to them, or by an organization's leadership. Vehicle permits should not be valid longer than two years; ideally, they should be reissued annually. Airports have several methods for scheduling permit expirations.

- Expiration based on vehicle's registration date
- Expiration for all vehicles with permits on the same month
- Expiration on driver's birth month
- Expiration based on driver's license expiration
- Expiration based on the driver's badge renewal date

## 11.2 Identification Types

Nearly all airports require a vehicle permit for vehicles requesting access to restricted areas. These permits often have a visual identifier, such as a sticker on the windshield, a license plate, or a placard such as a hanger on the rearview mirror or a sign to be placed on the dashboard.

Ideally, these stickers and placards are color coded to match the access authority of the badge holder or some other visual classification system for easy identification. For instance, the sticker may be red to identify vehicles permitted to enter the SIDA and blue to enter the AOA. Or construction vehicles may have a yellow placard while concessionaire delivery vehicles have a green placard.

Most airports use a unique number for each permit, which is logged into a database. This database can be used to confirm access authority of the vehicle and track vehicles entering the restricted areas. A small number of airports indicated that the placards were not always returned when the vehicle permits expired, creating a security risk for the airport. Using unique identification numbers logged into the database can help determine if a driver is attempting to use a missing vehicle permit.

Expiration dates should be easy to read from other vehicles, as well as for the guards at the vehicle gate.

A small number of airports are looking to implement RFID tags as a supplement to the permit stickers. Using a mounted or handheld RFID reader, the tag can be scanned to ensure that the vehicle is permitted in a restricted area and that it has no flags in the access control or permit system prohibiting access. The tags can be activated or deactivated or have flags/alerts placed on them (for instance if the vehicle is reported stolen).

> One airport changes the vehicle permit colors each year to identify expired permits more easily. Another airport indicated that each authorized vehicle's license plate acts as a permit. The airport verifies access authority by using handheld LPRs to scan vehicle plate numbers and compare them to an internal database. Drivers are required to apply to be entered into the database and follow similar requirements to other airports.

## 11.3 Escorting

Most airports use a placard or temporary signage to identify vehicles being escorted through the vehicle gates. The most common method is a magnetic "top hat" that is secured to the roof of the vehicle, but some airports use a hanger on the rearview mirror or signage on the dashboard.

Typically, airports will check the escorted individual's driver's license against a stop list or a database such as the National Crime Information Center database or the TSA selectee and No-Fly lists. Additionally, badged individuals with escort authority may not escort a vehicle while driving or riding in it.

> One airport has a "Vehicle Under Escort" form that must be completed and displayed on the dashboard.

# SECTION 12: DESIGN AND IMPLEMENTATION CONSIDERATIONS

Airports have many factors to consider when designing vehicle gate solutions, including the physical and environmental conditions at the gate site, roadway materials, legacy systems and infrastructure, and current and future operational demand. Crime Prevention through Environmental Design (CPTED) should also be considered.

## 12.1 Greenfield Considerations

It is most likely that the airport will already know where a new vehicle gate is needed based on the operational demand. But if the airport has the flexibility to determine the optimal location, below are important design elements to consider. Note that many of these considerations may not be applicable if planning a gate between the AOA and SIDA.

- Will hills and slopes need to be graded to accommodate equipment and structures?
- Are the surrounding areas swamps, wetlands, or bodies of water prone to flooding during heavy rain?
- Does sandy ground or permafrost create unstable surfaces for equipment?
- Are there areas prone to erosion or standing water, and is planning required for proper drainage?
- Is the distance between the nearest roadway and the perimeter fence/vehicle gate area adequate?
- Are infrastructure elements such as fiber and electrical cabling available?
- Is the distance from nearby buildings and parking lots appropriate?
- Is distance from aircraft movement areas adequate?
- Is the distance from frequent vehicle and pedestrian traffic appropriate?
- Does the location provide adequate access from nearby roadways?
- Is the available width space for gate equipment, structure, and movement adequate, e.g., will the gate and approach roadway support turning radius of vehicles accessing the gate?
- Will the approach roadway provide adequate queuing area for vehicles furing peak operating times?

## 12.2 Roadway Surface Materials

Choice of roadway surface materials directly affect the structural support, environmental impact, and safety of the road. The selection of materials will depend on the availability and cost of materials, and the road's usage. It is important to account for the weight of the vehicles using the road leading to and from the gate access area. Heavy vehicles such as fuel tankers and construction trucks may cause severe depressions, cracks, and potholes if the proper roadway surface and base materials are not used.

Roadway materials may also affect future vehicle gate operation solutions, as some must be buried in the road (e.g., ground loops, UVIS, wedge barriers).

The four most common types of roadway materials are native soil, crushed aggregate, asphalt, and concrete (or some combination of these four).

For low-volume, remote roads, native soil and crushed aggregate are the most common materials and are typically sufficient to meet the airport's needs. Native soil is the cheapest option but is often the least effective due to natural erosion. Airports using native soil for the roadways leading to the vehicle gate should consider reinforcement methods to improve the soil properties, including density, strength, moisture resistance, and reduced potential for swelling. This may require compacting, limiting road use during wet periods, replacing some of the soil with other materials, or reinforcing the soil with layers of concrete or asphalt. Airports should also consider using a dust control method, such as a diluted asphalt emulsion, to reduce the costs associated with grading maintenance, decrease aggregate loss, and reduce dust in buildings and on vehicles.

The necessary structural thickness of the soil and aggregate will depend on the soil type, vehicle weight, and the amount of traffic using the road. Table 8-1 gives general best practices for different types of soil.

**Table 8-1. Compacting Practices for Different Soil Types**

| Soil Type | Volume of Traffic | Thickness Recommendation | Compacting Recommendation |
|---|---|---|---|
| Most granular soils | Light | 4”–6” layer of soil is sufficient | Vibrating compactor<br>Vibratory rubber tire rollers |
| Soft, clay rich soils | Light to moderate | 8”–12” aggregate layer is common | Kneading compactor (sheepsfoot roller)<br>Vibratory rubber tire rollers |
| Moisture-sensitive, silty soils | Light to moderate | 8”–12” aggregate layer is common | Vibrating compactor<br>Vibratory rubber tire rollers |
| Soft soils | Heavy | 12”–24” or more aggregate layer may be necessary | |
| Very weak soils | Light to heavy | Reinforcement and separation may be needed to reduce aggregate thickness – can be cost efficient | |

Crushed aggregate is another common surface material for low to moderate traffic volume. This is a mixture of large and small rocks and fine, granular materials such as dirt and sand, typically layered on top of the native soil. The aggregate should be well graded and a good mix of fine and coarse particles to maximize the density of the material without losing the strength of the rock. Wet climates may need more fine material or more frequent repairs due to erosion. This material often comes from quarries or borrow pits; on-site borrow pits or nearby quarries may help the airport save money.

Asphalt is used for all traffic levels, but especially for heavily trafficked roads. Asphalt is a naturally occurring viscous liquid or semi-solid form of petroleum used as a binder with other materials. The three most common types of asphalt mix are described below:

- *Mix-type* asphalt is a combination of various aggregates and emulsions.
- *Perpetual pavement* asphalt consists of multiple layers of durable materials. The bottom-most layer is a strong, flexible layer to help prevent cracks in the surface material. The intermediate layer(s) are made from strong materials. The top layer consists of an asphalt mixture. This layering creates a durable, smooth, and long-lasting roadway material.
- *Porous* asphalt is designed to allow water to pass through the surface to the soil below. This mix is good for roadways in wet climates, or in areas prone to running and standing water, as it can reduce water runoff.

Asphalt can be more expensive than native soil or crushed aggregate during the initial paving, but repair strategies are often less expensive than with other surface materials. The repairs do not require large amounts of time to conduct and do not require major traffic disruption. The average life span of an asphalt road is about ten years.

Concrete roads are very common at airports because they are used for runways, taxiways, and gate areas, and airports often have their own concrete plants on site. It is a composite material made of fine and coarse aggregate mixed with cement. It is more expensive than asphalt but will last much longer.

Concrete offers several advantages over asphalt to compensate for the cost disparity:

- Concrete can last two to four times the lifespan of asphalt, about 20–40 years on average.[4]
- Concrete holds up better to heavy vehicles, reducing the number of repairs needed over its lifespan.
- Concrete is easier to stamp and color, making it simple to paint traffic markings.
- Concrete is a more environmentally friendly material; it creates less environmental pollution during its creation, and it can be crushed into gravel and recycled.
- Concrete is more resistant to the freeze-thaw cycle.

However, asphalt has some advantages over concrete.

- Asphalt often has a lower initial cost and is easier to repair.
- Asphalt is ready to drive on as soon as it has been compacted by a roller; concrete can take seven days or longer to cure (depending on weather conditions).
- The dark color of asphalt enables it to warm up faster, helping to clear snow and ice.
- Salt used for snow removal can degrade concrete, but not asphalt.
- Asphalt is more skid-resistant than concrete.

## 12.3 Climate and Weather

Weather, climate, and environmental characteristics will have a great influence on the design of the vehicle gate. This can include:

- Type of gate (sliding gates are better for wider openings but are difficult to operate in snowy conditions)
- Gate material and coatings (salty coastal air can accelerate corrosion)
- Lighting design (foggy or misty conditions diffuse light and make it difficult for cameras and guards to monitor the area)
- Video analytics and sensors (running water can create nuisance alarms)
- Signage placement (signage acts as a windcatcher and may damage the gate or fence)

### RAIN, FLOODING, AND STANDING WATER

All airports indicated that heavy rain causes issues at vehicle gates. These can range from making it difficult for guards to conduct effective operations, to flooding buried systems and damaging equipment. Sensors may trigger more nuisance alarms and cameras may have limited visibility. Water may get into

[4] Based on highway traffic data gathered by the states' Department of Transportation; concrete roads at airports may see a longer lifespan due to the lower traffic.

mechanical or electrical components, causing damage or power outages. Sensitive components should be housed in weatherproof containers or enclosures.

Running water from flooding or heavy rains can cause erosion of the ground around the gate and perimeter fence. Elevating structures and carefully planning drainage can help control potential erosion, as well as redirect water away from sensitive components.

### MIST, FOG, AND MOISTURE

Moisture in the air can cause significant damage to equipment if it gets in mechanical or electrical components. Several airports indicated that morning mist would condense on the safety sensors, causing the gate to operate incorrectly. Their vehicle gate vendors provided special covers to mitigate this issue.

Marine environments suffer the most from moisture damage, as the salty air leads to faster corrosion and rusting of gate components. Aluminum gates are resistant to rusting and have the added benefit of being lightweight. Galvanized steel is also resistant to corrosion. Airports in especially humid climates would find the longest lifespan in aluminum and galvanized steel components, or elements with a protective coating.

### SNOW AND FREEZING TEMPERATURES

Snow buildup can knock sliding gates off their track of cause them to get stuck. Ice can form inside gate operator housings, causing the mechanisms to slow down and lock up. In extreme cold, access control card readers can fail to read media properly, and mechanical buttons on panels can freeze. Batteries also degrade much faster in freezing temperatures. Most gate vendors offer cold weather kits to help prevent the buildup of ice and snow on the mechanical components. Climate-controlled housings are another option to protect the system.

Airports that experience heavy snow should consider the best method to clear snow buildup around the vehicle gate. This may mean snowplows scheduled for regular snow removal, or maintenance teams dispatched to sweep away snow. Maintenance crews operating around the vehicle gate should be properly trained to prevent damage to equipment or misalignment of sensors.

Ice is another major problem for airports, as drivers may lose traction and collide with the gate. Snowplows and road deicing can help with this problem. Bollards or other anti-ram barriers could be stationed around the gate, access control panel, and guard facility to protect them from damage due to sliding vehicles.

Some airport vehicle gates are built on ground that is subject to an annual freeze-thaw cycle that causes problems when the ground shifts. Structures may move and barriers can be damaged in this seasonal movement. Airports should work closely with vendors to identify equipment and strategies for mitigating the damage due to the freeze-thaw cycle. Airports should also monitor the roadway for corrosion due to heavy vehicles and salt.

### LIGHTNING

When lightning strikes are detected within five miles of an airport, the FAA and International Air Transport Association recommend that all movement on the airfield come to a halt for at least 15 minutes. Airports may stop all access through the vehicle gates while the guards take cover inside their designated shelter.

Some vendors have designed lightning protection systems that could enable vehicle inspection operations to continue, but airports have been reluctant to allow their use.

> At least one airport has implemented lightning-activated alarm systems to alert guards to halt operations and find shelter.

#### WIND

Airports that experience high winds should design vehicle gates to reduce their effects. Signage on fences, gates, and barriers have the potential to catch the wind and move anything not securely fixed in place. When open, vertical lift gates and pivot gates will catch more wind than sliding or cantilever gates. However, they may require more maintenance to prevent or repair warping than other types of gates. Poles used to mount signage, traffic signals, cameras, and other equipment should be rigid and stable to prevent swaying.

The Airport Emergency Procedures will cover the airport's response to situations such as tornadoes and hurricanes. The manual should include methods for alerting guards stationed at the vehicle gate of an impending storm and where to seek shelter. The plans should also cover procedures for securing the vehicle gate during irregular operations. This may require placing the gate in lockdown mode and posting temporary barriers to indicate that the gate is off-limits.

Unless specifically designed to withstand extreme wind conditions, guard facilities should not be used to shelter from storms; guards should be given ample warning to leave their post safely.

## 12.4 Legacy Equipment and Infrastructure

Airports should consider the integration of any legacy solution with new technology and equipment to save on equipment and installation costs. Ideally, vehicle gate solutions should have a modular design to allow for simple upgrades or replacements without needing to modify existing infrastructure elements or create or procure software patches.

When deciding upon procuring, upgrading, or integrating technology for vehicle gate operations, airports will want to consider working with multiple stakeholders to create a standard for what systems should be integrated and address operational benefits gained. Stakeholders such as police, fire, operations, IT, engineering, and business departments may have valuable input in the decision-making process.

Whenever possible, airports should utilize existing infrastructure (electrical conduits, fiber optic cables, telecommunications cables, perimeter fencing, gate location) for new solutions in the gate area to minimize new infrastructure costs and installation. This includes ensuring that new barrier components are compatible with available power sources, perimeter intrusion detection systems (PIDS), CCTV, and ACS.

Creating a standardized integration path during the procurement and design phases will enhance vehicle inspection operations and reduce costs associated with operating the vehicle gate. Considerations for creating an integration path should include:

- Ensuring open architecture of new software for existing or new systems, including CCTV, ACS, PIDS, etc.
- Verifying that legacy system capacity is adequate or can be expanded to support the new technology
- Determining maintenance costs of new hardware and licensing fees for software

- Ensuring the ability to expand technology to other airfield areas that may be redeveloped at a later date
- Facilitating enhanced and efficient vehicle inspections
- Maximizing efficiency of vehicle gate operations by integrating solutions and minimizing staffing costs to conduct the operations
- Developing a standard for tenants who have agreements to operate and secure their own vehicle gates to utilize when making upgrades
- Incorporating as part of an Airport Security Capital Program project

Airports should work with their chosen vendor and their IT department to facilitate the integration of new technology with legacy technology.

Removal and disposal of legacy technology and equipment may require additional resources and possibly additional costs. Some equipment may need special disposal to comply with environmental regulations. It may save the airport effort and money to leave legacy elements in place, unless they will interfere with the new solution.

## 12.5 Scalability for Future Growth

Airports should consider designing a vehicle gate solution with scalability for future capacity and demand. Scalability will also be useful for airports that experience fluctuations in demand throughout the day or year.

Modularity and above-ground access to components are important factors in designing scalable vehicle gates. Other strategies include utilizing more guards, expanding the detection zone of perimeter sensors, adding video analytics, or networking systems together.

A sound vehicle gate design requires a fundamental understanding of the traffic volumes the gate must accommodate on the date of beneficial use (DBU), as well as a reasonable planning horizon of DBU plus 15 years (DBU+15). It is typical in the aviation industry to plan a new design to handle the peak-hour demand that occurs on the average day of the peak month for the most extreme planning horizon.

The best approach to forecasting the vehicle volume that must access the vehicle gates is to extrapolate traffic volumes through the future vehicle gate(s) using the most recent average day of the peak month. To extrapolate the vehicle demand data to the future, good practice would include correlating the vehicle volume observed on the average day of the peak month with the Official Airline Guide flight schedule.

Once the total vehicle traffic forecast is completed, the expected vehicle demand at each gate can then be extrapolated using the applicable airport growth report in the airport's master plan forecast (or the FAA Terminal Area Forecast). This will be required for designing access to the vehicle gate, as well as assessing what is required to accommodate potential vehicular queues that may develop during busy periods. Design solutions should accommodate these queues safely and without blocking traffic on the public roadway. It is possible that this information is available from the airport as part of a recent Master Plan initiative. Alternatively, traffic studies can be executed with tube counters.

## 12.6 Crime Prevention through Environmental Design (CPTED)

CPTED is an approach to security in which an area is specifically designed to discourage criminal activity. The approach suggests that careful design can create a location where the perceived risk of being caught is greater than the potential reward. The approach was developed in an effort to create safer neighborhoods and urban environments, but many of the principles can be applied to airports. CPTED principles are discussed below.

### NATURAL SURVEILLANCE

Natural surveillance refers to the perception that the threat can be seen by patrols, guards, LEOs, and other airport personnel. This requires creating clear lines of sight by clearing areas of obstructions and maintaining and designing landscaping with few trees or hedges that could provide coverage for people and objects.

Obvious cameras are another method to increase natural surveillance. If an intruder believes their actions are being recorded, they may be less likely to attempt criminal actions. Most airports reported that their cameras were obvious to anyone looking for them.

Sufficient lighting also assists with natural and technical surveillance by enhancing the ability to easily observe activities occurring in the area. This helps reduce the possibility of a person or object entering the restricted areas undetected, as well as facilitating the apprehension of potential threats. When upgrades to physical or technical security features are not possible, upgrades to the lighting systems may provide increased security capabilities. Lighting is discussed in more detail in Section 5.1.

### NATURAL ACCESS CONTROL AND TERRITORIAL REINFORCEMENT

The most basic principle of territorial reinforcement is to clearly distinguish public spaces from restricted spaces while highlighting authorized access points. This is often coupled with natural access control, which involves the careful design of entrances, exits, and perimeters to create obviously acceptable pathways.

Considering these principles, vehicle gates should be distinguishable in such a way that the authorized ingress point along the perimeter is clear to drivers. This can be done with lighting and signage that clearly highlights where drivers are permitted to drive and identifies operations at the vehicle gate.

If the airport does not have pedestrian gates adjacent to the vehicle gate, nearby sidewalks should be eliminated to discourage pedestrians from walking near the restricted area.

Airports should eliminate, as much as possible, features on the public side that may be used to access building roofs or enable a person to climb over the perimeter fence, such as maintenance ladders, windowsills, and drainage pipes. If these cannot be removed, locks and anti-climb features should be implemented to discourage their use by unauthorized persons.

### DIRECTIVES AND SOCIAL MANAGEMENT

Directives can be most accurately described as the airport's rules and regulations. They dictate who is allowed access to a vehicle gate and under what circumstances. Directives must be clearly communicated to visitors through posted signage and messaging. In addition, sufficient training must be provided to guards, LEOs, and other airport workers to ensure rules are enforced appropriately, and to easily identify noncompliance.

Social management serves to create employee ownership in the security of the airport. In aviation, this is most often described as "security culture." ICAO defines security culture as "a set of norms, beliefs, values, attitudes and assumptions that are inherent in the daily operation of an organization and are reflected by the actions and behaviors of all entities and personnel within the organization."[5] Creating a

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[5] **ICAO.int:** https://www.icao.int/Security/Security-Culture/Pages/default.aspx

strong security culture at the airport helps to ensure compliance with rules and regulations, and increases the likelihood of workers recognizing and reporting potential threats or concerns.

> One airport experienced reoccurring incidents with public drivers mistaking the vehicle gate approach area for a roadway to the terminal building. The airport reduced these occurrences by installing “Restricted Access” signage with solar-powered lights that would flash to alert drivers.

#### CPTED WITH TRADITIONAL SECURITY

While the focus of CPTED is to provide security features naturally through design and culture, traditional physical and technological measures are still needed at vehicle gates. The list below shows the correlation between CPTED and traditional security features as they relate to perimeter security goals of deter, detect, delay, deny, and respond.

- **Deter** – This function begins at the farthest point away from the location of the assets—in this case, the vehicle gate. Deterrence measures include physical barriers such as fencing, walls, and bollards; lighting; visible monitoring equipment such as CCTV; and signage. Natural access control, territorial reinforcement, and directives also contribute to deterrance.
- **Detect** – Includes the ACS, intrusion sensors, and camera systems designed to detect unauthorized behavior. Natural surveillance and social management also contribute to detection.
- **Delay** – This function includes the physical security measures used to delay an intruder’s attempt to breach the restricted area. Strategies include target hardening, and compartmentalizing assets, such as positioning the gate operator on the restricted side of the gate. Creating obstacles such as double fences, anti-climb features, and serpentine roadways will force vehicles and intruders to slow down and give security time to respond to the threat. Natural access control and territorial reinforcement also contribute to delaying access.
- **Deny** – This feature has some overlap with delay, in that the physical features are often enough to deny access to intruders, objects, and vehicles. This feature includes anti-ram barriers, diverters, and access control, and guards staffing the gates. Territorial reinforcement and social management also contribute to denying access.
- **Respond** – This function includes response from airport operations/security and LEOs, but it also includes situational awareness and performing after-action reviews. CCTV systems and patrols, as well as a communication system to contact LEOs quickly, are part of this function. Directives and social management also contribute to response.

## 12.7 Updating Policies and Procedures

Airports should ensure that policies and procedures are updated to address changes to the vehicle gates. Most airports do not add specifics in the ASP on vehicle gate procedures. Typically, this information is maintained in the airport’s policies and procedures. Many airports reported the need to develop SOPs, most often for use by contract security or airport staff. SOPs given to contract security are typically called post orders, and copies are often kept in the guard facilities.

Airports that utilize contract security staff may change security companies and will need to ensure continuity of procedures in accordance with their ASP. The information in the post orders is usually included in the new employee training of contract security staff.

The post orders typically include instructions on the steps for operating the gate equipment such as in-ground barriers, communication procedures for reporting emergencies, vehicle inspection procedures to include any exemptions for authorized airport vehicles, verification of airport ID badges, escorting procedures, etc. Post order also identify gates that only allow certain types of vehicles or activities, such as VIP events, escorting of non-airport vehicles, construction activities, catering vehicles, fueling vehicles, etc.

Some airports allow tenants to control access to the airside utilizing their own contract security staff. The airport may provide specific instructions or require the guard's post orders be referenced in an Airport Tenant Security Program.

# SECTION 13: PROJECT MANAGEMENT AND PROCUREMENT

Creating new or upgrading airside vehicle access gates should involve a qualified project team and all impacted stakeholders, as well as a well-defined selection process to select the best systems, manufacturers, and installers for the project. See Section 12 for discussion of design and implementation considerations.

## 13.1 Project Management

It is critical to the success of a project that the project goals are well defined, the team is composed of individuals with a wide range of disciplines and expertise, and all impacted stakeholders are involved.

Building an appropriate project team is key to successful development and implementation of a solution. This team may consist of airport department heads or their designees as appropriate (e.g., engineering, finance, legal, law enforcement, fire, operations, trades, maintenance, concessions, and C-suite members), airlines, TSA, FAA, the solution's vendors and/or manufacturers, project experts (excavators, electricians, etc.), and any other airport stakeholders who are affected by the new solution.

Many airports have created customized vehicle gate solutions, sometimes called engineered solutions, which require the collaboration of multiple vendors, manufacturers, service providers, and in-house elements. These types of solutions are designed to exactly meet the airport's needs, but can come with various challenges, such as:

- Multiple warranties, agreements, and schedules to negotiate and manage
- Integration of several technologies, including new and legacy equipment
- Preventative maintenance responsibility
- Component failure responsibility
- Training time and cost
- Installation/implementation scheduling and cost for each element

Airports that have created customized solutions typically work with a consultant to manage the procurement and deployment of the technologies and equipment, often as part of a larger airfield renovation project. Working under existing on-call contracts, architects and engineers may be able to support airports by finding appropriate vehicle gate solutions to meet the airport's needs and then filling in the architectural gaps (e.g., building roadways, installing fences).

Airports should also ensure that the parties who assist in the project are familiar with the airport environment and the solutions being deployed. If the airport cannot use experts for installation and project management, a quality control person from the airport should be assigned to supervise the project.

> One airport indicated that the project leaders on their vehicle gate project had never worked on a similar project at an airport. This led to the access control panel being installed on the wrong side of the gate.

Stakeholder involvement in the initial project planning is also critical to ensuring project success. For each stakeholder who will use the vehicle gate, the project team must understand the operational requirements that are essential for the stakeholder to continue high quality, cost-effective practices. The planners' responsibilities are to integrate the business requirements of all stakeholders in a fair manner, ensuring that the design solution addresses all stakeholder essentials.

Airports may need to work with tenants to install greenfield vehicle gates on tenant-leased land, or work with vendors to create delivery schedules.

TSA may be included in the procurement and design phases to help alleviate any security concerns and to gain the agency's acceptance of the solution before the equipment is purchased and installed.

## 13.2 Procurement Options

In general, there are three formal options for airports to obtain product information from potential vendors: Request for Information (RFI), Request for Qualifications (RFQ), or RFP.

RFI or RFQ is the most appropriate choice for airports that are still in the research phase and not committed to procuring equipment. These contracting vehicles allow the vendor to provide information on their products and services in a standard format so that the airport can compare options without the obligation to choose any of them. Some airports will issue an RFI or RFQ and then invite qualified vendors from that pool of bidders to respond to an RFP, or the airport will contract with the most qualified vendor.

Airports should include relevant airport standards and requirements in the requesting document to ensure that the proposals received provide the appropriate information. The procurement documents should be detailed and specific but flexible. Details that may be included in the procurement document include:

- Minimum vendor qualifications
- Vendor's installation experience at airports, particularly integrating with relevant legacy systems
- Solutions capability requirements
- Physical constraints to the area (permanent structures, utilities)
- Airport IT standards and existing architecture
- Applicable legacy equipment and technology
- Applicable operational policies
- Preventative maintenance requirements (snowplow considerations, drainage)
- Expected throughput demand
- Vendor support requirements (business hours, emergency hotline)
- Training required
- Project schedule
- Final acceptance test requirements
- Equipment and technology costs
- Warranty and maintenance agreement options and support
- SSI requirements

It is recommended that airports exclude testing requirements from procurement documents to prevent the documents from becoming SSI. Many airports have a process during the procurement phase that defines what documents (e.g., maps, security protocols) will be considered SSI during the project.

Airports often include a Non-Disclosure Agreement in the contract to be signed by the contractor to protect this information.

Some vendors maintain a SAFETY Act Designation or Certification. The Support Anti-Terrorism by Fostering Effective Technologies (SAFETY) Act of 2002 provides legal liability protection for providers of Qualified Anti-Terrorism Technologies products, software, services, or a combination of these. Airports should give more weight to solutions with a SAFETY Act Designation or Certification when comparing options. The DHS maintains a searchable database of technologies with a Designation or Certification at www.safetyact.gov.

When considering different solutions and solution providers, airports should give more weight to those that have been successfully deployed at US airports. These solutions are more likely to comply with US regulations and have fewer unforeseen issues. Additionally, technology that has been deployed previously will have the most accurate lifespan estimates.

Airports should reach out to other airport operators to schedule visits to view and discuss their vehicle gate solutions, especially those at which the solution under consideration is being utilized. Airport conferences and industry events are great places to talk to multiple airport operators at once. These events often feature vendor exhibits as well.

It is also recommended that airports use manufacturer-certified installers and technicians to ensure that the solution has been installed to the manufacturer and ASTM specifications.

## 13.3 Costs and Funding

The costs associated with vehicle gate solutions vary greatly depending on the solution chosen by the airport and the construction mode (i.e., a vehicle gate renovation, a new airfield build, or a technology procurement). Other factors that may affect the cost of the vehicle gate solution include:

- Greenfield locations versus updates to existing locations
- Standalone project versus part of an airfield project
- Warranties and maintenance contracts
- Training (type of training, number of people trained, and hours to train)
- Spare parts inventory
- Software licenses or updates
- Media storage (e.g., servers, hard drives, cloud-based storage)

Airports rely on a variety of funding sources to finance their capital improvement projects. The six primary funding vehicles are:

- Bonds
- Passenger Facility Charge revenue
- AIP grants
- Airport-generated revenue
- Other federal, state, and local grants
- Alternative funding options

Airports often need to combine multiple funding options to finance their projects. These sources may be federal, public, or private, but they will all have specific requirements and restrictions for using the funds. The airport's ability to utilize the different options depends on the airport's size, the type of project being funded, and the airport operator's local and state options and restrictions. Airports seeking several funding options should be careful to review these constraints and their impact on other funding sources.

It is important to note that some of these financing options may not be used to fund maintenance contracts.

## 13.4 Warranties and Maintenance Contracts

Airports should consider purchasing extended warranties and maintenance contracts for all parts of the vehicle gate system, but especially for the mechanical and moving parts of the system that will likely need the most frequent maintenance, repair, and replacement. An extended warranty may be necessary for vehicle gate solutions that will have high traffic throughput and frequent use.

Consideration should be given to the length and type of warranty offered by the manufacturer, the availability of critical/spare parts, and the ability to keep adequate numbers of spare parts on hand to facilitate speedy repairs. Airports in more isolated areas, further from approved vendors and maintenance service providers, should consider keeping multiple spare parts on hand to limit the need for a third party to perform maintenance or repairs on the vehicle gates.

Most maintenance contracts outline recommended maintenance schedules and procedures to support continuous operation of the vehicle gate. Manufacturers also offer recommendations for spare parts and their supply sources.

When developing a maintenance contract, detailed specifications should be addressed. These may include:

- Routine preventative maintenance inspections
- Minor and major adjustments
- Preventative maintenance cleanings
- Pressure checks on hydraulic systems
- Replacement of worn parts
- Safe plowing practices
- Salt and sand application requirements to avoid damaging components

Note that hydraulic systems are known for their difficulty to repair and should be left to experts or certified vendors.

## 13.5 Project Timeline

The type of solution chosen will determine the timeline of the installation, testing, and deployment. The timeline may be affected by:

- Procurement activities (releasing RFQs/RFPs, signing contracts)
- Timeline of other construction projects
- Equipment manufacture and shipping (especially if the product is manufactured overseas)
- Scope of the project and system design
- Equipment installation (including time to secure access to a crane for gate installation)

- Staff training (guards, maintenance, IT, and badge holders)
- Testing
- Airport and manufacturer's approval and project sign-off activities
- Amending the ASP and obtaining subsequent TSA approvals
- Writing SOPs

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# APPENDIX A: CASE STUDY – DAL: CABLE LOOP VEHICLE ARRESTING SYSTEM

## WHAT WAS THE CHALLENGE?

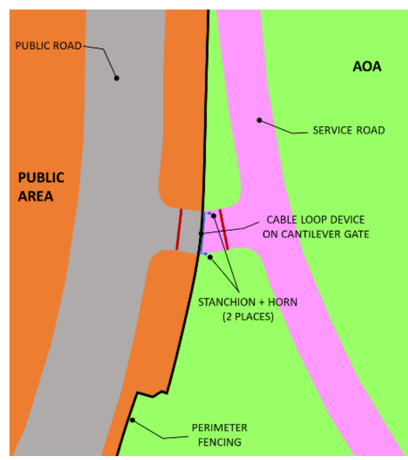
As an urban airport, Dallas Love Airport (DAL) faces the challenge of city streets that extend to the border of airport property (Figures A-1 and A-2).

**Figure A-1. Typical Perimeter Gate from Public Road to AOA**


Vehicle access gates that are near public streets need to be hardened against intrusion, whether intentional (e.g., vehicle ramming) or inadvertent (e.g., drunk drivers).

In 2010, a driver involved in a police chase breached the DAL perimeter. Due to this incident, the airport determined that their perimeter gates needed to be upgraded to prevent future breaches, but they did not want to significantly increase the footprint of the gates due to the limited Vehicle Gate Approach Area.

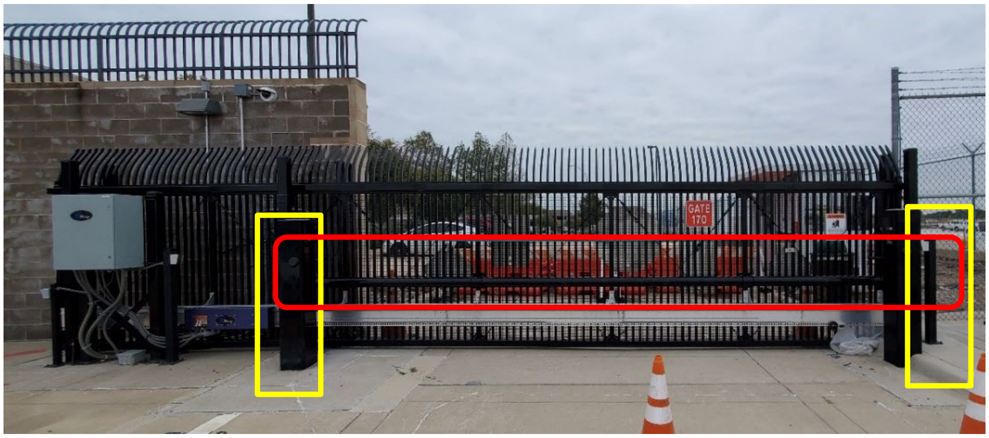
**Figure A-2. Layout Schematic**




## HOW WAS THE CHALLENGE ADDRESSED?

DAL retrofitted some of their existing gates with a cable loop barrier. These K- and M-rated beam-and-cable barriers attach directly to the gates, as shown in Figure A-3, hardening them against breaches while maintaining a similar gate footprint.

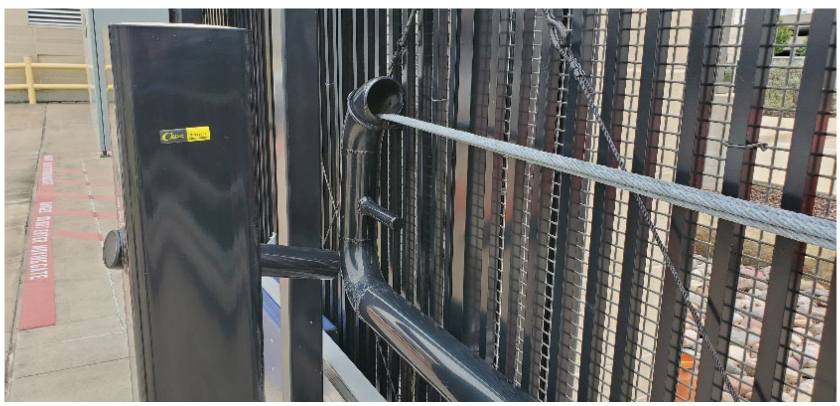
Figure A-3. Cable Loop Device (Red) and Stanchions with Horns (Yellow)



The system attaches to the existing gates by U-bolts (Figure A-4) and moves with the gate during normal operations. If a vehicle attempts to breach the gate, the cable loop is caught by "horns" on ground anchors (Figure A-5) and the vehicle is stopped.

Figure A-4. Attachment via U-Bolts

Figure A-5. Detail of Cable Loop Device and Stanchion with Horn



Because the cable loop could provide footholds for a person attempting to climb the gate, anti-climb mesh was also added to the outside of the gate (Figure A-6).

Figure A-6. Anti-Climb Mesh

### WHAT BENEFITS ARE OFFERED BY THE CHOSEN SOLUTION?

The gates are hardened against brute-force intrusion by unauthorized vehicles.

In the event of a vehicle crash, the barrier arms provide full protection to the gates, eliminating the need to replace a gate if a car rams into it.

Anti-climb mesh adds an additional layer of security.

### WHAT COSTS OR EFFORTS WERE REQUIRED TO IMPLEMENT THE CHOSEN SOLUTION?

Anchor posts had to be installed on both ends of each gate, and the cable loop hardware had to be attached to the gate.

Prior to installation, the airport needed to determine whether the existing mechanized gate operators could function with the additional weight of the cable loop hardware.

Because the cable loop added potential footholds, anti-climb mesh was also added to the exterior side of the gate.

### WHAT OTHER SOLUTIONS WERE CONSIDERED?

Full replacement of the gates was determined to be cost prohibitive.

Addition of crash barriers would have required significant expansion of the gate footprint.

# APPENDIX B: CASE STUDY – SAT: GATE-FREEZING OPERATIONS

## WHAT WAS THE CHALLENGE?

A new airline needed terminal gate space at San Antonio International Airport (SAT). There was a decommissioned gate that could be put into operation, but its proximity (approximately 100 feet) to a vehicle access gate presented challenges. The airline was concerned that vehicles entering or leaving through the gate during ground operations would present an unacceptable risk to their ground personnel and aircraft. Vehicles entering the area could interfere with aircraft gating operations, and vehicles queued to exit the area could interfere with aircraft push-back.

Figures B-1 and B-2 illustrate the airline gate location in reference to the vehicle gate.

**Figure B-1. Layout Schematic**

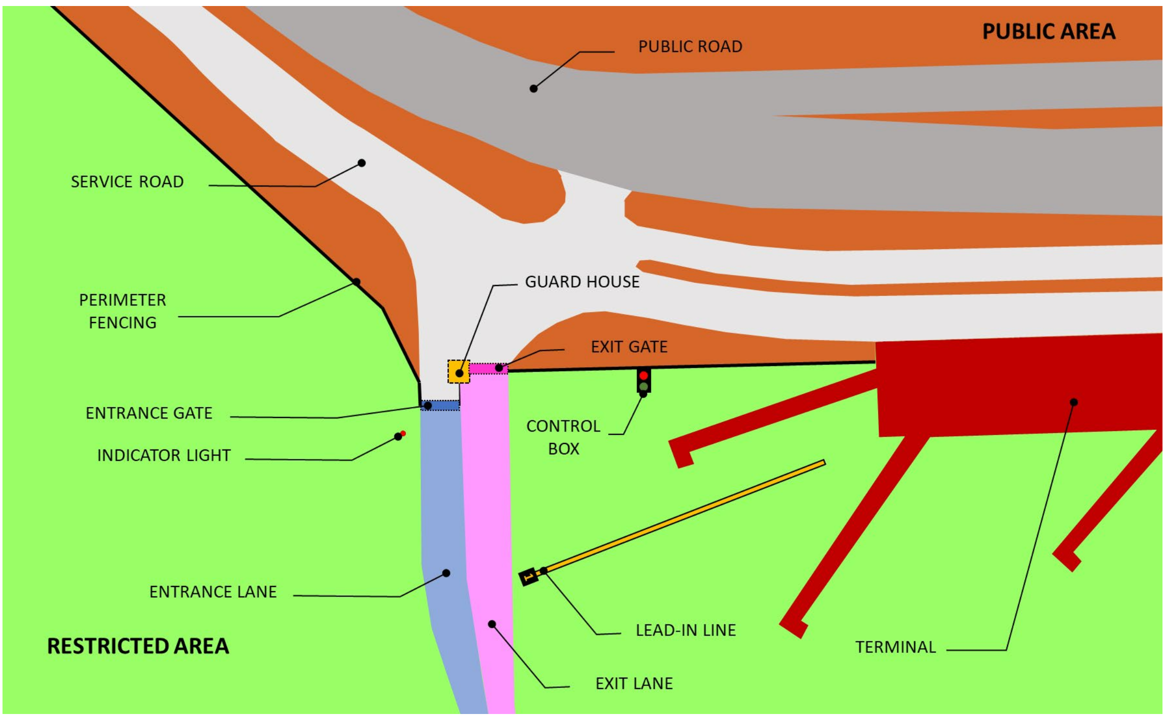



**Figure B-2. Proximity of Gated Aircraft (right) to Vehicle Access Gate (left)**

## HOW WAS THE CHALLENGE ADDRESSED?

A system had once been installed to detect pedestrians approaching a crosswalk inside the vehicle access gate. Upon detection of an approaching pedestrian, the system would "freeze" the gate until the pedestrian cleared a sensor on the far side of the crosswalk. The airport determined that this now unused system could be reworked to address the airline's concern.

Control of the gate freeze was moved from the automatic sensors to a button panel near the aircraft gate (Figure B-3). A configurable timer was installed so that the entrance gate would "unfreeze" after a certain amount of time had elapsed (Figure B-4). The airport set this timer at five minutes, which was determined to accommodate the gating of an arriving aircraft and pushback of a departing aircraft. A gate arm and indicator light from the previous pedestrian system were reused in the new system to provide additional visual cues to drivers as to when the entrance gate is frozen (Figure B-5).

**Figure B-3. Controls**


**Figure B-4. Configurable Timer**

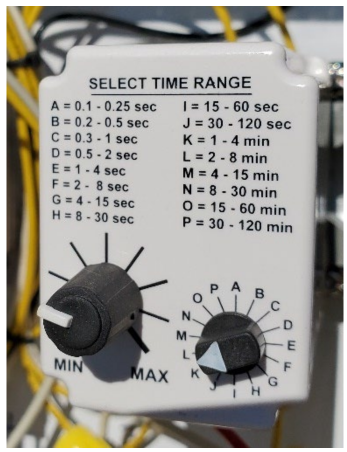



**Figure B-5. Gate Arm and Indicator**

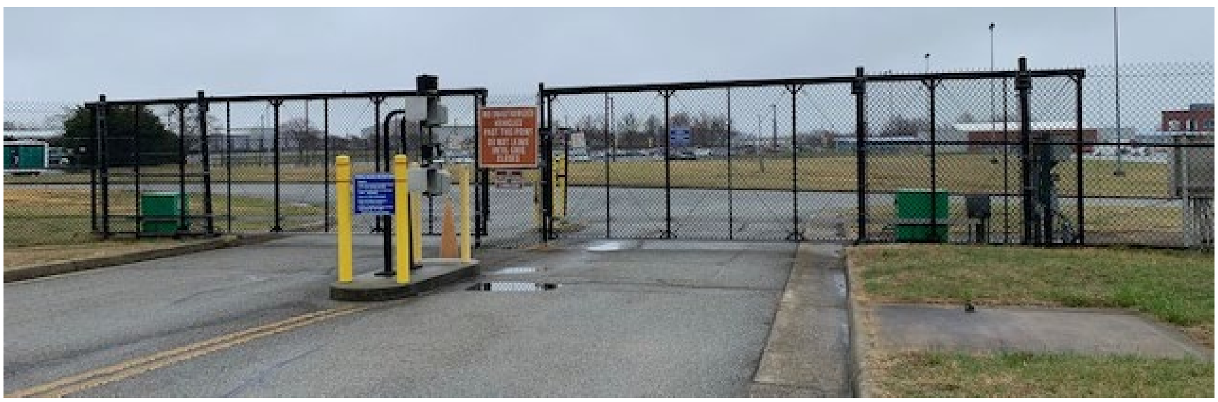
# APPENDIX C: CASE STUDY – ROA: VEHICLE GATE REMOTE OPERATING SYSTEM

## WHAT WAS THE CHALLENGE?

Roanoke-Blacksburg Regional Airport (ROA) needed to upgrade and replace its aging access control system (ACS), enhance its capabilities for monitoring access to the airside, and include a new ID badging software.

The airport has a primary airside vehicle access gate used by airport terminal tenants. This location is used for deliveries and at times for construction projects. Due to its low volume of activity, the gate is not staffed, and airport operations or police staff respond as needed to conduct vehicle inspections. With a new ACS, the airport's desire was to enhance its current capabilities to monitor airfield vehicle gate access remotely while ensuring compliance with CFR 1542.207.

**Figure C-1. ROA Vehicle Access Gate**



The airport wanted a system that would integrate with the current infrastructure, and they did not want to change or upgrade the existing airside vehicle gates or roadway entrances. The system needed to be a complete package and have an open architecture platform to incorporate multiple features.

The ACS needed to meet the following requirements for all facility access points and airside vehicle access gates:

- Include new badging software
- Integrate with a new video management system
- Include fingerprint biometric technology
- Integrate with new badge reader hardware
- Integrate with the existing cameras, ground sensor safety loop, and traffic light
- Utilize existing equipment stanchions at the vehicle gates
- Be scalable for future enhancements
- Improve business efficiency
- Operate airside vehicle gates remotely

### HOW WAS THE CHALLENGE ADDRESSED?

The selection team identified its operational requirements, and the airport issued an RFP.

The system selected included many additional features that ROA may elect to utilize in the future, such as perimeter security. At the same time, the airport purposed an existing room to create a new Dispatch Center with a new video management system for live monitoring of all vehicle gate access.

Figure C-2. ROA's New Dispatch Center

### WHAT BENEFITS ARE OFFERED BY THE CHOSEN SOLUTION?

The new access control system at the primary airside vehicle gate requires multiple verification methods, including a proximity badge reader with a PIN and fingerprint biometric. There are two card readers at different heights to accommodate drivers in both cars and trucks. These are placed in such a manner that the driver does not have to leave their vehicle. A fisheye camera above the card reader provides the dispatch operator with good camera views of the driver and any other vehicle occupants. Additionally, a call button allows dispatch to verbally address any issues with the badge holder. The system integrator was able to install all these components on an existing pedestal.

Figure C-3. Two-Tiered Access Control Panel with Camera and Fingerprint Reader

The dispatch operator can utilize the new video management software to monitor the badge holder at the primary vehicle gate and identify if a vehicle inspection is required. If necessary, dispatch notifies airport operations or police staff to respond to the gate.

Some of the benefits include better utilization of airport staff, remote monitoring that eliminated the need to install a guard facility, and enhanced monitoring and verification of badge holders.

### WHAT COSTS OR EFFORTS WERE REQUIRED TO IMPLEMENT THE CHOSEN SOLUTION?

The airport had to install new fiber for the new security system and its associated hardware.

# APPENDIX D: CASE STUDY – GATE EQUIPMENT OPERATIONAL PERSPECTIVES

Despite handling an average of 1,300 to 1,500 vehicles each day, ranging from passenger sedans to heavy construction equipment, this CAT X airport has significantly reduced their number of vehicle access gates to limit access to sensitive areas of the airport.

The airport operates two vehicle gates (Figures D-1 and D-2), only one of which is open 24/7 due to staffing limitations. Among the two gates, the airport has installed a variety of equipment including UVIS, hydraulic wedge barriers, crash arms, bi-fold gates, and tilt gates. They have also implemented design features to improve the security of the vehicle gates and to protect equipment.

**Figure D-1. Gate A Overview**

**Figure D-2. Gate B Overview**

### GATE AREA LAYOUT

Both vehicle access gates are located at the end of short roadways (Figures D-3 and D-4), minimizing the distance a vehicle has to build momentum that could be used to ram the gate or guard facility.

**Figure D-3. Gate A Layout**

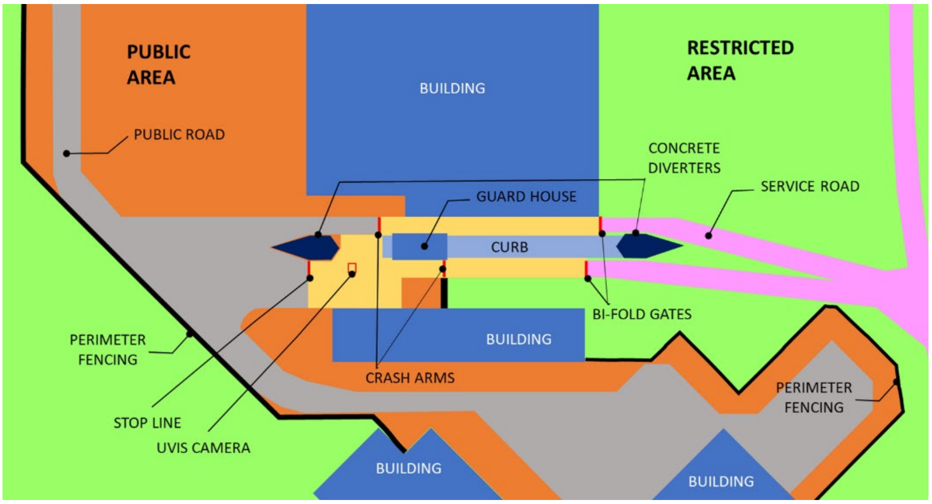
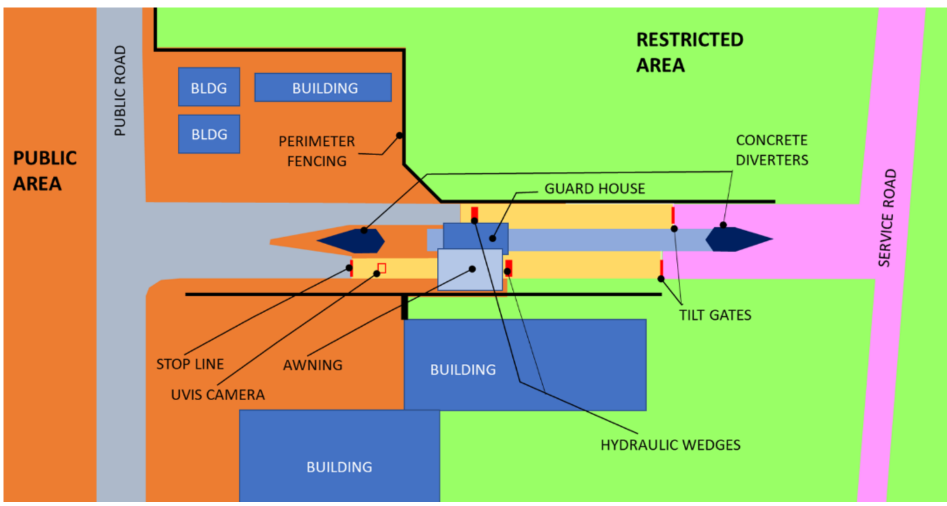
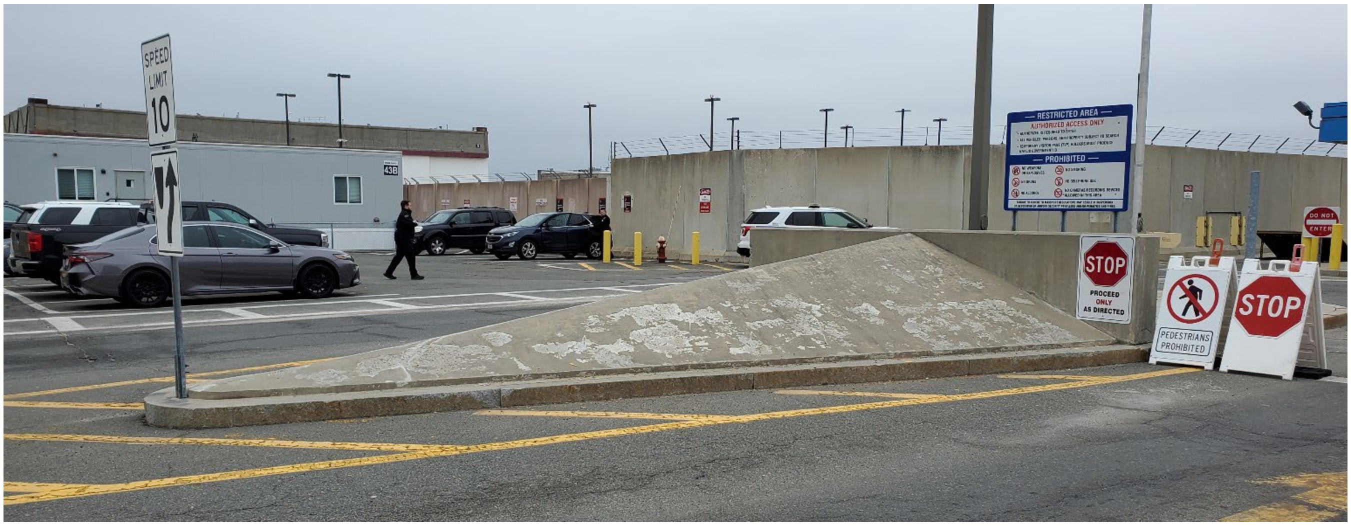



**Figure D-4. Gate B Layout**




In addition, the guard facilities are protected by angled concrete wedges (Figure D-5) that are designed to divert any vehicle attempting to ram the structure.

Figure D-5. Concrete Vehicle Diverter




### UVIS

Both vehicle access gates have permanent UVIS installations. Vehicles approach a stop line and wait until directed to drive over the camera unit. Once space is available for the vehicle to drive completely across the camera, the driver is signaled to slowly move forward so that the UVIS camera can scan and capture an image of the undercarriage (Figure D-6). To better protect the UVIS cameras from heavy vehicles, the airport's in-house machine shop fabricated a cover plate from one-inch steel (Figure D-7).

Figure D-6. UVIS Scanning a Vehicle Undercarriage

Figure D-7. UVIS Camera Cover Plate

An LPR camera records the vehicle's license plates as it drives over the camera; both front and rear plates are read for redundancy and cross-validation. The license plate number is used to determine whether a previous undercarriage image of the vehicle exists in the system. If an image exists, the current image is compared with it to identify areas of change that should be inspected more closely.

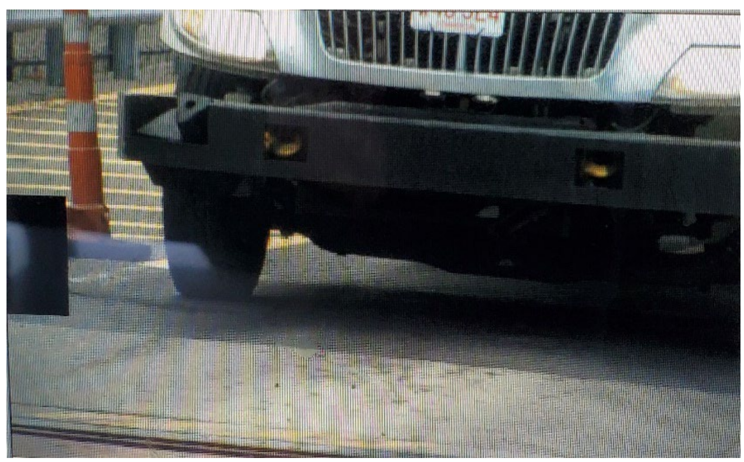
The UVIS offers security officers a view of the complete undercarriage of each vehicle in more detail than can be achieved with mirrors and the naked eye. Areas of interest can be enlarged on the display for additional scrutiny.

The UVIS camera can be obstructed by debris or snow, which must be removed for it to function properly. Additionally, when the temperature drops, condensation forms on the UVIS camera cover and degrades the captured images, as shown in Figure D-8, and renders the automated comparison feature less effective.

**Figure D-8. UVIS Image Degraded by Condensation on Camera**

If a vehicle has its license plate mounted especially high or in a non-standard location, it may be out of the field of view of the LPR cameras, as shown in Figure D-9. In most cases, only one of the vehicle's plates is out of view and the LPR can read the second plate. However, if both plates are out of view, the vehicle only has one license plate, or one of the LPR cameras is not functioning, the UVIS may not be able to determine if a prior image of the vehicle exists. The system supports manual entry of the license plate in these situations.

**Figure D-9. Vehicle License Plate Out of LPR View**



The UVIS in its default configuration stores every image of every vehicle it scans, which has resulted in server storage space issues. The airport would prefer to configure the storage settings to only retain a set number of images, automatically deleting the oldest images as new images are stored.

## GATE A SOLUTION

### Crash Arms

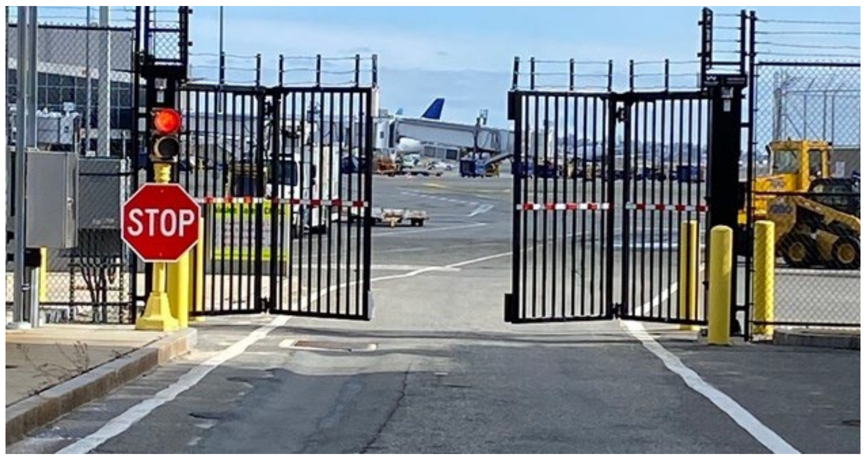
In addition to the UVIS, Gate A includes crash arms. The arms operate more rapidly than the hydraulic wedges at Gate B, and they provide the same degree of crash protection with fewer maintenance issues.

Figure D-10. Crash-Rated Arm Barrier, Lowered and Locked

## Bi-Fold Gates

Gate A uses a bi-fold gate, which operates more quickly and reliably than the tilt gate at Gate B, and requires less maintenance. Its design does not require a track above or below the gate. However, it requires a clear path of approximately four feet on each side of the gate. In addition to the larger operating footprint, this gate requires that larger areas be cleared of snow.

Figure D-11. Bi-Fold Gate in Motion




### GATE B SOLUTION

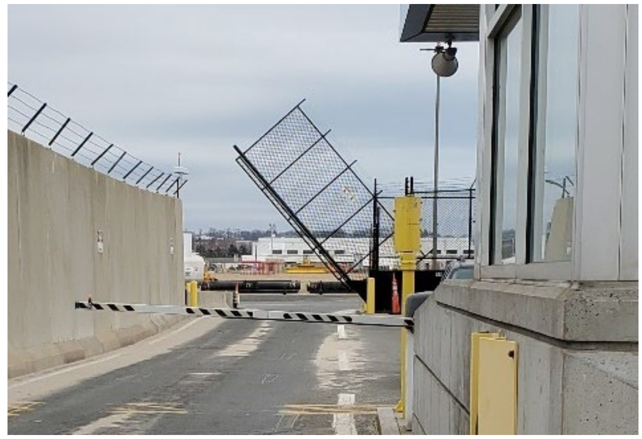
## Wedge Barriers

Gate B uses hydraulic wedge barriers. The wedges are typically in the deployed position to prevent unauthorized entry (Figure D-12). While effective, the wedges have experienced issues due to hydraulic system leakage and accumulation of debris and water/snow/ice in the wedge pit.

Figure D-12. Hydraulic Wedge Barrier in Deployed Position

**Tilt Gates**
Gate B uses a vertical tilting gate (Figure D-13). The greatest benefit of this design is that it requires less snow removal than the bi-fold gate at Gate A. The drawbacks of the tilting gate are that it operates more slowly than the security staff would like, it catches the wind when in the open position, and the automated gate operator requires more maintenance.

Figure D-13. Tilt Gate in Operation



**Other Features**
A simple wedge fabricated in-house from an aluminum plate is installed in front of the gate control panel (Figure D-14). This has prevented damage to the panel by vehicles driving too close (Figure D-15).

Figure D-14. Wedge Protecting Control Panel

Figure D-15. Damaged Wedge, Undamaged Control Panel

In some areas, in-ground “pucks” are used to detect vehicles (Figure D-16), rather than using the more common wire ground loops. The pucks required less cutting of the road surface to install.

Figure D-16. Sensor Puck

# APPENDIX E: CASE STUDY – LAX: AIRPORT NEW GATE DESIGN

To better accommodate vehicle traffic without impacting the local roadways, Los Angeles International Airport (LAX) is building a new vehicle gate complex (Figure E-1).

**Figure E-1. New Vehicle Access Gate During Construction**

While it is not operational as of the publication of this report, its sally port operational design, integrated lighting and shelter, and vehicle reject gates may be of interest to other airports.

Vehicles will enter the gate complex and queue for inspection. Each vehicle will pass over an in-ground UVIS camera before arriving under a shelter with integrated lighting (Figure E-2) for inspection by security officers. Vehicles that pass inspection will then enter the outer sally port gate where another officer will validate the credentials of the driver and any passengers before opening the inner sally port gate.

**Figure E-2. Shelter with Integrated LED Lighting Strips**

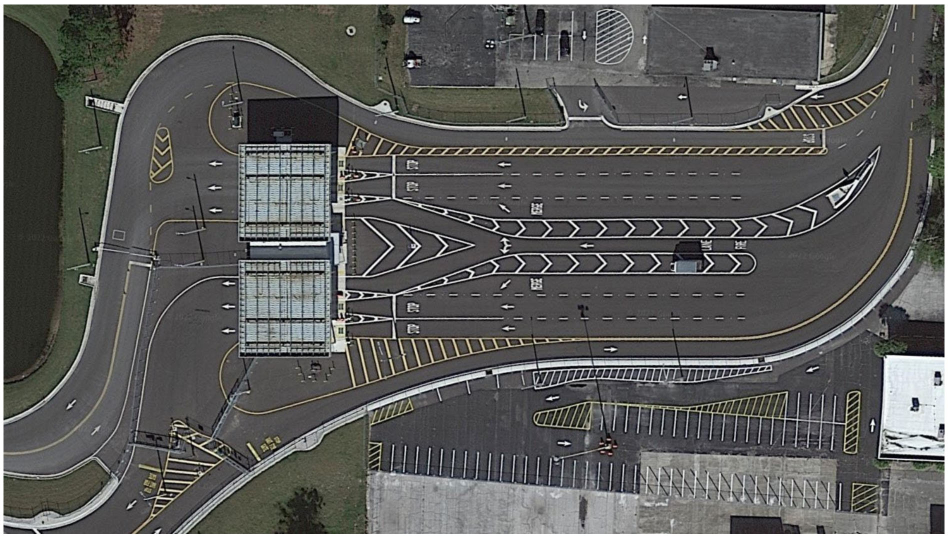
If a vehicle is refused entry, officers will open one of two reject gates to allow the vehicle to exit (Figure E-3). The reject gates and roadways are sized to allow vehicles of all sizes to exit without requiring complicated maneuvers.

**Figure E-3. Vehicle Reject Gate**

# APPENDIX F: CASE STUDY – MCO: GATE LAYOUT, MULTI-CONTRACTOR SCREENING OPERATIONS, PORTABLE UVIS, MOBILE X-RAY TRAILER

Because of its hub and satellite design, the Orlando International Airport (MCO) has four terminals, each with its own airside. These terminals are connected via an automated people mover train, but the airsides are not connected for vehicle traffic. This results in a large number of access points, but most traffic is funneled to a small set of primary vehicle access gates (Figure F-1).

**Figure F-1. Gate Area Layout**



Source: Google Maps

The gate approach area provides multiple ingress lanes, including inspection bypass lanes for vehicles that are exempt from inspection. Additional lanes are provided for vehicles awaiting their escorts so that they do not obstruct the flow of traffic. Clear signage indicates that one set of ingress lanes is for terminal access while the other set is for airside access (Figure F-2). Each set of ingress lanes has a reject lane for vehicles that are refused entry. Reject lanes provide sufficient space for vehicles of all sizes to exit without the need for complicated maneuvering.

**Figure F-2. Gate Approach Area**

The overhead shelter at each gate was split into two smaller portions since the guard facilities were already enclosed (Figure F-3). The two smaller shelters were less expensive to construct than a single larger one.

Figure F-3. Split Overhead Shelter

The pillars supporting the overhead shelters are protected from vehicles by sacrificial energy-absorbing barriers (Figure F-4). These barriers use relatively inexpensive, replaceable components that are designed to crumple and deform as they absorb the energy of a vehicle impact.

Figure F-4. Sacrificial Energy-Absorbing Crash Protection

To protect security officers and limit distractions in the inspection area, only drivers remain with vehicles during inspection. The drivers are asked to open all vehicle compartments. Passengers are directed inside for screening and then placed in a separate holding area (Figure F-5) until security staff direct them to re-enter their vehicle.

Figure F-5. Post-Screening Hold Area for Passengers

MCO currently employs multiple contractors to perform screening and inspections. One contractor performs mandated regulatory inspections while the other handles airport board-directed driver and passenger screening. Using separate contracts for each allows the airport to make adjustments if regulations or board directives change without affecting the other contract.

In addition to the new gate construction, MCO employs portable inspection equipment, including speed bump–style UVIS cameras (Figure F-6) and property x-ray trailers (Figure F-7). The portable nature of this equipment allows it to be deployed at nearly any vehicle access gate around the airport, which adds an element of unpredictability to the airport's security posture.

**Figure F-6. Portable UVIS Installation**

**Figure F-7. Mobile Property X-Ray Trailer**