Two Sides of the Fence
Specifying ornamental fencing and gates

By Steven R. Miller, PE, CPP, PSP

Establishing and maintaining perimeter security is growing increasingly important for many public and private facilities, whether the concern is the safety of children at schools, theft or sabotage of key resources, disruption of business operations, or terrorism.

The initial impression visitors may have of a business or facility can come from the first things they see: the fence and gates. Does their appearance reflect the image the owner wants to portray to the public? For example, fences and gates appropriate for a high school may be totally unacceptable for a pharmaceutical manufacturing plant.

While there are various standards and resources for ‘high-security’ fencing used at military bases and similar facilities, there are not similar design guidelines for the specifier to apply to ornamental fencing and gates used at the more common commercial and industrial facilities. This article provides basic information about this subject, educating designers about what they should consider when detailing these forms of perimeter security.

There is a wide range of product—and cost—options when it comes to ornamental fencing. Products can be fabricated in a shop (possibly in a backyard) or manufactured with quality control procedures. They can be steel or aluminum, galvanized or not, and finished with paint, powder coating, or more exotic finishes. Panel assembly may rely on retaining rods, rivets, or welds, nuts and bolts. Construction at the jobsite could mean field-welding or different types of brackets.

The quality of manufactured fence results from a detailed quality control process. The method ensures:
- base metal quality (i.e. grade and thickness);
- consistent weld appearance and quality;
- proper preparation of the metal for coating; and
- coating thickness and type.

Small-shop fencing is typically hand-welded or riveted panels, which are then spray-painted since powder coating and dipping tend to require automated machinery. This type of operation may produce less consistency and lower performance than what is possible from larger operations.

Corrosion control

Steel is stronger than aluminum, but is also more subject to corrosion. Consequently, the metal coating process takes on increased importance with this steel. While aluminum is also subject to oxidation or corrosion (typically manifesting itself as pitting), it is generally a better solution for more aggressive environments such as coastal locations or industrial areas where chemicals are in use. Still, it is important to remember both steel and aluminum will degrade when the coating is damaged or missing.

Unprotected steel corrodes quickly when subjected to an electrolyte such as rain or sprinkler overspray. The simplest and most inexpensive way to slow the corrosion of
steel is to coat it with a thin layer of zinc—this galvanizing process can be done via electricity or dipping, and there are different weights of zinc coatings. Without getting too deeply into the chemical process, the zinc corrodes before the steel does, essentially sacrificing itself to save the material it envelops.

The single most important determinant of the fence’s appearance and lifespan is the metal finish. The quality and durability of a painted finish depends on the paint quality and type, proper surface preparation, and application of a primer and one or more coats of paint.

Surface preparation ensures the surface does not have any dirt, oil, grease, or rust that would prevent paint adherence. The primer and finish coats must then be applied to provide complete and uniform coverage. The end quality of a painted product ultimately depends on the skill and care taken by the painter. (Paint quality and types are almost infinite and beyond this article’s scope.)

Powder coating is an electrostatic process through which powdered epoxy and/or polyester is applied to the metal. The coated metal is then baked in an oven to fuse with the coating. With powder coating, there is no volatile organic compound (VOC) solvent that must evaporate into the atmosphere (unlike what happens with paint to varying extents).

A drawback for powder coating stems from the electrostatic application method. Without getting into detail on the physics involved, it is difficult to achieve uniform thickness on inside corners and outside edges. Powder coating, like paint, coats the outside of the hollow metal object so the inside surface is protected only by the galvanizing. As powder coating requires more sophisticated equipment than painting, it is not generally within the means of a small-shop fence fabricator.
Figure 2

This gate system readily accommodates numerous shift workers. The traffic pattern is clearly shown on the pavement. Large vehicles are screened separately from automobiles (near the top of the picture). One can also see the rejection lanes for vehicles and large trucks not having proper credentials.

Construction, warranty, and price

As mentioned, fences can be assembled with welds, nuts and bolts, rivets, brackets, retaining rods, and other lesser used methods. The process of assembly determines several things:

1. Whether the fence is rakeable (biasable). Can it go up and down in elevation with terrain changes or does it need to be stair-stepped?
2. How a damaged section gets replaced, and if repairing the fence requires a certified welder.
3. For field-welded fences, how the welds (especially if the fence is powder-coated) are treated to prevent corrosion. Welding destroys powder coating (and other coating surfaces) near the weld site, leading to future failure points.

Another important consideration is the manufacturer’s warranty—who stands behind the product, how long is the warranty, and what does it cover? Products backed by a long-term warranty from the manufacturer should provide more lifetime value to the owner. Still, the warranty is only as good as the company offering it; one must read the fine print. One must also determine whether the fence specification provides only the general contractor’s typical one-year materials and workmanship warranty.

There are different fencing prices when weighing various client needs. The following factors must be considered when choosing the appropriate fence:

- whether the client wants an inexpensive or best value solution;
- material and labour cost estimations, remembering the lowest material cost does not necessarily equate to the lowest labour cost for installation;
- long-term warranty value to the client;
- if specifying a long-term warranty will provide a better quality and better value end product;
• whether specifying a long-term warranty reduces professional liability exposure;
• if long-term warranty adds to the construction cost; and
• what level of quality will provide the best value for the client (then, let the marketplace sort out what that quality level will cost).

Gate design
A gate allows authorized people or vehicles to pass through the perimeter barrier. However, gates are frequently considered to be the weakest part of any perimeter security system.

The proper design and construction of gates should complement a security plan as well as enhance the facility’s daily operations. The first obvious question is whether it is for pedestrians or vehicles. Except for low-usage gates, vehicle gates should not be used for pedestrians because of safety concerns. It is imperative to separate the people and vehicles entering any facility.

The remainder of this article presents various questions that should be answered when designing gates. Since a wide range of security concerns is being covered, some of the questions or issues may not be applicable for all facilities. Clear communications between the facility owners and their design consultants is essential.

Figure 3

Plexiglass panels prevent people from reaching through the gate to activate the panic hardware.

General vehicle gates
The following questions have to do with broad issues about site plan layout, traffic flow, and the security level needed:
1. Does the facility have a security plan that clearly describes how the gates will be used?
A security plan, even if only a one-page document, is the essential first step. If the facility does not have a security plan, how does the architect or engineer know to what criteria the gate needs to be designed? What exactly does the facility owner or operator want to accomplish with the gates? The layout drawing in Figure 1 (page 2) shows how new vehicle gates, a pedestrian gate, and perimeter fence fit into an existing roadway.

2. How will the facility owner operate the gate system?
The gate specification will be impacted by criteria such as whether the gates are normally open or closed during operating hours, and if there are requirements for after-hours access.

3. Is there a requirement for an anti-ram gate?
Anti-ram gates are generally only used on facilities requiring a very high level of security, such as a military base. (These products are beyond the scope of this article.)

4. Will the gate be electrically or manually operated?
If the gate is electrically operated, is the operation of the gate clearly visible to the person controlling the gate? Where does the power come from?

5. What is the daily through-put?
The designers must be informed whether the gate is for frequent, infrequent, or emergency use. Knowing the traffic direction of vehicles (i.e. one-way or both) is also critical.
Gates can have hundreds of vehicles per day, a few vehicles, or just the occasional driver. If there are shift workers, there must be adequate room for vehicles to queue up without interfering with other traffic. The gate must also operate quickly enough to expeditiously move authorized traffic through.
Figure 2 (page 3) shows a well-thought-out gate system at a large industrial facility that readily accommodates a large number of shift workers. The traffic pattern is clearly shown on the pavement. Large vehicles are screened separately from automobiles (near the top of the picture). There are also rejection lanes for vehicles and large trucks not having proper credentials.

6. Is there a requirement to screen every vehicle entering the facility?
Should screening be a necessity, there are further considerations. Will a gate guard be checking the credentials of each driver or will drivers open the gate with passcodes or electronic devices? Other detection technologies, such as X-rays or under-carriage videos, may also be required to screen vehicles.

7. What is the maximum size vehicle (i.e. width, length, and height) that will pass through the gate?
This leads to other questions, such as whether there needs to be a separate gate for large truck traffic or if the roadway can accommodate the turning radius of a large truck or fire-
fighting equipment. Should the gate be used for the entry of special equipment, such as tall cranes, this too must be incorporated into the design.

8. **What does the local building code (or fire code) require for emergency entry by fire trucks?**
   When there is only one main gate on a facility, some building codes require the construction of a second that can be opened by the fire department. Is there adequate room for a large fire track to manoeuvre through?

9. **Do you need a rejection lane for vehicles that do not have the proper credentials for entry?**
   Rejection lanes allow a vehicle to exit a facility without impeding the flow of authorized traffic. Figure 2 (page 3) clearly shows these lanes—for this industrial facility, the rejected vehicles never enter the secure parts.

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*When considering the fence materials, it is important to weigh trade-offs. Steel is stronger than aluminum, but is more subject to corrosion*

**Individual vehicle gates**
The most common types of individual vehicle gates are: swing, rolling, cantilever, and pivot arm. Space constraints may determine which gate type can be used at a specific location, as discussed later in this article. Each of these gate types can be manually or electrically operated.

1. **How will the gate be locked or latched?**
   Electrically operated gates are automatically locked. Manually operated ones may be chained or padlocked in the closed position.

2. **Which way does the gate swing?**
   Swing gates can swing inward or outward—it is best for it to open in the direction of traffic.
3. **If it is a rolling gate, how will it be repaired and maintained?**

Rolling gates normally ride on steel rollers that mate with an inverted V-track installed across the driveway. This track can be recessed, but there will be a small bump in the road, which could be unacceptable for vehicles such as taxiing aircraft or forklifts. The track will also require periodic maintenance to remove accumulated debris or ice and snow.

These gate types can also come off the track. Is there a planned procedure to put the gate back on the track? How will vehicle traffic be handled while the gate is being repaired? Also, the rolling gate requires adequate space to fully retract in the open position.

4. **If it is a cantilever gate, is there enough room?**

Cantilever gates are similar to rolling gates, except the track(s) supporting the gate is located on the gate panel itself. This means there is no track in the driveway. This is particularly useful in areas where snow and ice can accumulate, and a snowplow could be used.

The cantilever gate panel is approximately 50 per cent longer than the gate opening. For example, if the gate opening is 6 m (20 ft), the total width of the gate panel is about 9 m (30 ft). There must be adequate room for the entire 9-m wide panel to retract in the open position. The cantilever gate also needs to be mounted fairly level.

5. **Is a pivot-arm gate required?**

Pivot-arm gates rotate in a vertical plane, making it advantageous where there are very tight space constraints. A common application is parking structures or tollbooths where the driver must stop to pay the parking fee or toll. A pivot arm gate is generally not an anti-personnel gate.

![One consideration with fence design is whether the barrier is rackable (bias able). Does it go up and down in elevation with terrain changes or must it be stair stepped?](image-url)
**Pedestrian gates**
The following questions have to do with broad issues about site plan layout, pedestrian traffic flow, and the level of security needed.

1. *Just like for vehicle gates, does the facility have a security plan that clearly describes how the pedestrian gates will be used?*
   Again, even a very brief security plan is the essential first step for the architect or engineer to know to what criteria the gate needs to be designed.

2. *How will pedestrians be screened for entry?*
   Will a guard check their ID cards? Will there be magnetic strip technology, a proximity card, or a pin code? Pedestrians must use their authorized credentials to enter, whether swiping a card or typing in a code. It must also be decided whether it is necessary to screen any accompanying luggage, briefcases, or backpacks for contraband, weapons, and drugs. Space needs to be allocated for this.

3. *Is it necessary to prevent tailgating (i.e. an unauthorized second person entering with an authorized person)?*
   If so, a turnstile works well for this application, allowing one-way movement.

4. *How will the gate system accommodate persons with disabilities?*
   A person requiring a wheelchair, crutches, or walker may not be able to use the common access gate. In these circumstances, arrangements must be made to bring these people into the facility through another means.

**Individual pedestrian gates**
The following questions are concerned with individual pedestrian gate design:

1. *Are the gates positioned to allow people to safely queue up while awaiting screening?*
   It is critical to ensure people are not on the street while they await their turn to enter.

2. *What is the purpose of the gate?*
   Whether it is for frequent access, infrequent use, or emergencies only will dictate the design. Frequency of use helps determine the type of latching hardware, as well as if the door needs to be alarmed.

3. *Is the gate for one-way traffic only?*
   If it is, there should be a closer on the gate to prevent counter-flow traffic. A series of swing gates with panic hardware and gate-closers can, for example, allow positive control over the flow of students from one part of a high school campus to another.

4. *Will the gate integrate with electronics for local or remote latching/unlatching or for entry control?*
   This leads to another question: how will power and low-voltage control wiring be brought to the gate?
5. What provisions are made to prevent unauthorized people from reaching through, under, over, or around the gate to activate the panic hardware to open the gate? People can be incredibly ingenious at testing any security system, including panic hardware. The pedestrian swing gate in Figure 3 (page 4) has panic hardware for emergency egress. The plexiglass panels are there to prevent someone reaching through the gate to activate the panic hardware. The cane bolt holds the gate in the open position during normal business hours.

6. Is the gate’s appearance consistent with the overall architectural theme of the perimeter fence? Maintaining an overall esthetic can be important to ensure the owner’s desired look is achieved.

7. Are the gate hinges and latches installed so the gate can not be easily lifted free? One must thoroughly review manufacturer’s literature to determine how the hinges and latches are attached to the gate and frame. They should not be easily unbolted or removed.

8. Will the gate materials and construction hold up to the use and abuse the gate will receive over its intended lifetime? The level of quality required should be specified; the bidding process will determine what this level of quality will cost.

9. Does the secure area of a facility need to encompass the employee parking lot? In some cases, it absolutely should. This requires every vehicle to be screened before entry. If the employee parking lot is outside of the secure area, pedestrians—rather than vehicles—are screened. This can dramatically decrease the quantity of perimeter barriers required while simplifying the entry control process.

Conclusion
Whether low- or high-security, the fence and gates specified have two primary purposes: safety and security. Some fences serve both purposes and one should look at if their design provides a long-term and appropriate solution to meet client needs for safety and/or security. Gates should help provide the level of security needed while, at the same time, enabling the rapid entry of authorized vehicles and personnel. When designing and specifying fencing, it is important to remember this is the first thing seen when approaching a facility. It should match the image the client wants to portray to the public. For example, a school wants to depict an image of safety and security—parents need to know their children are safe from harm. This, and other design criteria, is only known when one asks enough questions of clients to ensure the product solution matches their needs.

Steven R. Miller, PE, CPP, PSP, is the executive director for Ameristar Fence Products, a manufacturer of high-security fence and anti-ram vehicle barriers. He has worked in the construction and security industries for more than 30 years. Miller is retired from the United States Navy with the rank of Commander, having served around the United States.
and in several foreign countries. He was involved with security projects for the B.C. ferry system and facilities in Vancouver. Miller holds two master’s degrees in civil engineering and business administration. He can be reached via e-mail at smiller@ameristarfence.com.