A SunCam online continuing education course

A Review of Site Features

by

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A. Introduction

This course provides a refresher to site-civil engineers and introduces the topic to engineers of other disciplines who are not familiar with site work. The course identifies some nuances between various site features, and explains these distinctions. The course also identifies and explains some missteps associated with some site features and site feature detailing.

This course will benefit the experienced site development engineer who is looking for some reference or history associated with some site features, as well as those who may be inexperienced with land development. Understanding the basics of site features is important for any civil engineer who is involved in a property development project.

B. Background / History

Site features have evolved over time, and the terms used associated with the site features has changed. This course will identify a few of these changes in terminology, and will also identify how some features evolved.

There are regional distinctions as to how site feature are implemented by Civil Engineers. Often times the land development civil engineer will utilize the actual State Department of Transportation (DOT) details for use on the site, but this is often not the case. In general, the site feature details may originally be based on the standard details of the local state DOT, as modified by the engineering firm for their own use on client sites. Additionally many end user clients (especially national retail, restaurant, and banking chains) have their own standard details that they want implemented on every site they occupy in order to create a common customer experience among all their sites. These standards are also driven by the client's understanding of the economics of various features, and they want to make sure that the engineer that they hire does not design more robustly than expected, but also achieves a minimum standard that they expect.

This course will focus on details and features, and will generally not address layout strategies associated with site design.

C. Site Feature Categories

The categories that will be outlined in this course are:

- *Pavement*
- *Striping*
- *Curbs*
- *Sidewalks and Ramps*
- *Walls*
- *Fences*
- *Trash Enclosures*
- *Islands and End Caps*
- *Guide Rails, Bollards and Wheel Stops*
- *Signs*
- *Lights*
- *Drainage Features*
- *Utility Features*
- *Miscellaneous Features*

These categories will be reviewed at a high level with illustrations and photographs as appropriate to give a good understanding of the distinctions.

1. **Pavement** – There are various ways to "pave" a site. In the early days of development, quality pavement consisted of cobblestone, bricks, or other stone features. In many cases the pavement was just hard packed soil covered with compacted stone and possibly a tar and chip surface or derived by a "macadamisation" process. Over time pavement technology evolved and more durable and permanent options became available. Besides paver stones, there are generally two (2) types of pavement in common use today. These are both cementitious and can be referred to as flexible and rigid pavement respectively:

    a. *Rigid pavement* is created out of a mixture of sand, aggregate and Portland Cement Concrete (PCC) and other additives for various purposes. Portland cement is the medium that holds the aggregate together, and it derives its strength through a process referred to as hydration, which is a chemical reaction when Portland cement interacts

with water. After curing, the remaining product is a rigid structure similar to stone.

As a result in the industry, rigid pavement is often referred to as Concrete Pavement. This type of pavement is more durable, but also more costly to install and repair. As a result it is typically used in locations with high truck traffic such as in front of trash enclosures, in loading dock ramps, and at truck turnarounds. Based on the durability sought, the Concrete Pavement section will typically consist of a section of concrete cast over a base course of stone. Depending on the anticipated load or the existing sub-surface soil conditions, the concrete section may be detailed with some type of structural reinforcement.

Since the hydration process causes the volume of concrete to shrink over time, joints are needed to accommodate the contraction that will inevitably occur. Due to the fluid nature during installation, it is not usually considered ideal to install concrete on medium to steep slopes.

b. *Flexible pavement* is created out of a mixture of sand, aggregate, and asphalt cement technically referred to as asphalt cement concrete. Asphalt cement is a byproduct of the refining of oil. It is worth noting that this is different from “tar”, which is a naturally occurring substance (from as an example, tar pits) or a substance derived from the burning of coal. Asphalt cement is the “binder” that holds the aggregate together, and the compaction process makes the asphalt cement concrete durable and hard. Asphalt cement concrete is typically referred to as “asphalt” in the industry. Asphalt is properly pronounced “ass-fault”, but many people improperly pronounce it “ash-fault”.

   Although asphalt is durable, it is also easily installed over hills and on slopes as it is delivered somewhat “dry” and not fluid prior to compaction. A section of asphalt will typically consist of the top course (often referred to as the “surface course” or “wear course”, and a base course (often referred to as the “binder course”). Below the base course is typically a stone course. The thickness of each course in the section depends on the anticipated load and the existing sub-surface conditions.

It is worth noting that for some time a common name for flexible pavement including asphalt was macadam. This is rarely used any longer in the industry and peaked in the 1950's, however some land surveys may still refer to black top asphalt pavement as macadam. The name macadam actually comes from John L McAdam, an engineer who developed the "macadamisation" process in the mid-19th century incorporating and controlled particle sizes to create hard smooth surfaces in the construction of roads. Prior to the development of asphalt cement, an improvement to the macadamisation process was the incorporation of coal tar in the process. This is improvement created to the term "tarmac" (short for tar macadam), which is still used as a term, mostly associated with airport surfaces.

If the base sections are still intact, asphalt pavement is fairly easy to repair because there is a process referred to as *Mill and Overlay*, where by the existing top course is "milled" or ground down and removed, and a new top course is installed on top providing a fresh new surface. Sometimes a pavement section is just given an overlay and is built up over time. If the base section of pavement has cracking, this will reflect through an overlay fairly quickly.

c. *Stone base course* - In both rigid and flexible pavement sections there is typically a base course of stone. This is sometimes specified as a single size clean stone such as ¾" stone, but it is often has specified particle sizing properties and is referred to as the Aggregate Base Course, or ABC for short.

For a graphical pavement section of both a rigid pavement and a flexible pavement section, please refer to Figure F-1. It should be noted that site details would have the thicknesses of each section, and specifications would define the engineered composition of each course.

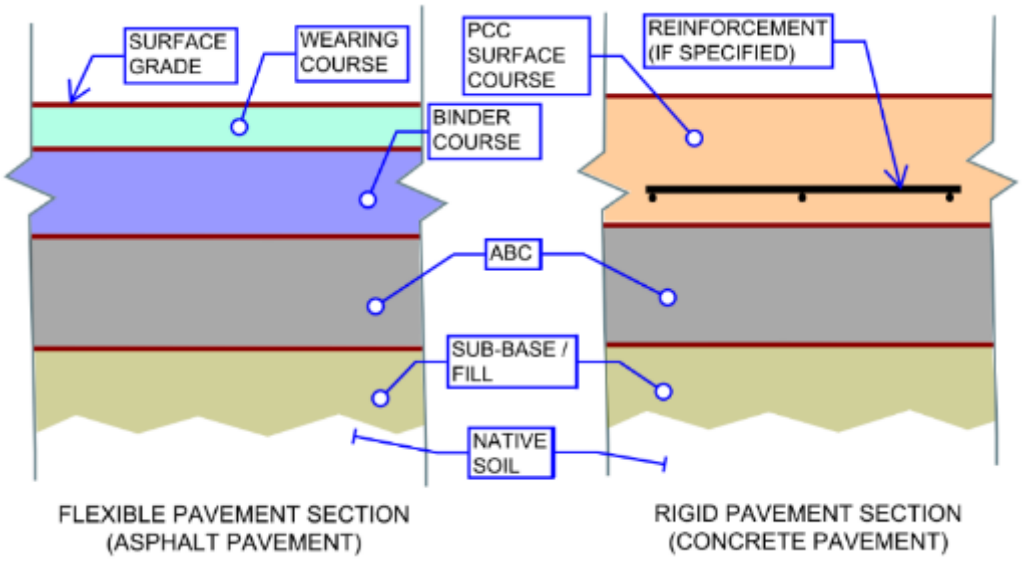


Figure F-1
(An Example of Pavement Sections)

2. **Striping** – A modern site will be laid out with "striped" parking spaces. The parking lot may have landscaping areas throughout which will be discussed later, however it may just consist of a "field" of pavement. The parking spaces will typically be painted onto the pavement. In in the industry this "painting" is referred to as striping.

   Besides the line work of the parking spaces themselves there are other components that may be striped on the site such as directional arrows, stop bars, crosswalks, aisle striping, ADA symbols, and fire lanes, etc. When "landscaped islands" are not proposed, often times the end caps to the parking bays are merely striped.

   Striping is typically specified in several standard colors; primarily white and yellow for parking spaces and aisle / circulation striping, blue for ADA striping, red associated with fire lane striping, and black for "deleting" existing striping. Striping can also be removed with grinding techniques.

   The paint specified for striping can be spray on or rolled on as a standard parking lot striping paint. There is also "thermoplastic reflective striping paint" which is a

more durable material used for striping typically on the features that require more prominence especially as night such as stop bars and cross walks. Thermoplastic paint is heated up in order to melt it for installation.

Parking spaces are typically striped with standard striping paint. This should be installed in at least two fresh coats. Parking stalls can be detailed to be installed as single line stripes or double / "U Shaped" parking space stripes.

For some pictures of various striping variations associated with parking spaces, refer to Figure F-2.

90 Degree Parking Spaces (1 Bay)

90 Degree Parking Spaces (2 Bays)

Angled Parking Spaces (2 Bays)

"U Shaped" Striping on
90 Degree Parking Spaces (2 Bays)

Figure F-2
(Various Parking Space Striping examples)

Directional Arrows

Pedestrian Crosswalk

Fire Lane Striping

Stop Bar and Text

Figure F-3
(Some Examples of Other Striping Features)

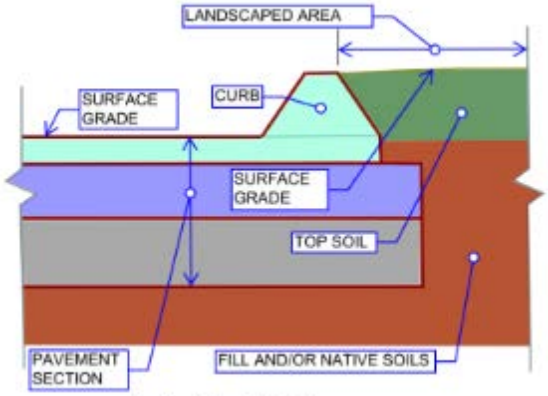
For more information associated with the various ways of striping parking bays (90 degree vs. angled spaces), please refer to the SunCam course “A Practical Introduction to Zoning and Entitlements”.

It is worth noting utility mark-outs that are painted onto the pavement are not referred to as striping.

3. **Curbs** – Curbs are structures that are intended to define the edge of pavement and contain the material installed behind it, as well as assist in directing the flow of stormwater as desired. There are several types of curbs and several curb materials. The following curb materials will be discussed: Asphalt Curb, Concrete Curb, Belgium Block Curb. Additionally, several curb sections will be

discussed such as: Standard, Mountable, Tapered, Flush, Depressed, and Extended Height Curb, as well as Curb and Gutter sections.

a. *Asphalt Curb* is a curb type created out of asphalt cement concrete and shaped is such a way as to create the small hump needed to create a clean edge between the parking lot and the landscaped area. Asphalt curb is the least expensive curb material, and it is also the least durable. Asphalt curb installations are often seen broken up and falling apart after just a few years. Figure F-4 shows a section/detail of an asphalt curb as well as a few pictures of some asphalt curb installations.



Asphalt Curb Detail


Asphalt Curb Repair


Asphalt Curb Island


Damaged Asphalt Curb

Figure F-4
(Asphalt Curb)

b. *Belgium Block Curb* is a curb type constructed by grouting pieces of Belgium Block in line together. Belgium Block is the most expensive curb type, and is also considered the most aesthetically pleasing type of curb. Figure F-5 shows a few pictures of some Belgium Block curb installations.

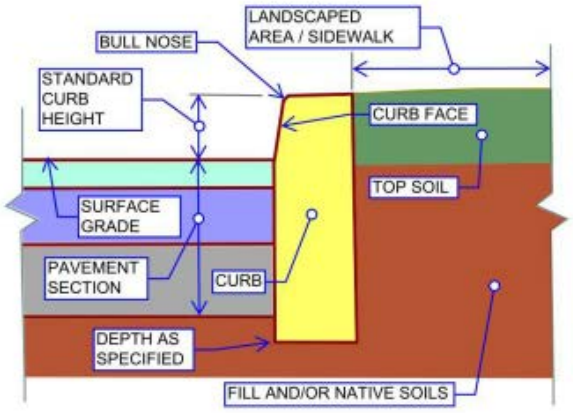
Belgium Block Curb on a radius

Straight section of Belgium Block Curb

Figure F-5
(Belgium Block Curb)

c. *Concrete Curb* is the most common curb type, constructed out of Portland Cement Concrete. Concrete curb is very durable. Concrete curb can be installed with forms but in many cases can be extruded in place. Curb extrusion is an especially fast and effective way to install curb and gutter, which will be discussed later. Figure F-6 shows a picture of a concrete curb.

d. *Curb Sections* – The following curb sections are relatively common:
   - Standard Full Height – A Standard Full Height curb will typically be designed with an exposed face of approximately 6", this curb section is very common. Some details place a "slope" on the face and a radius on the top front corner. If the adjacent pavement is given an overlay without being milled, a standard curb face will get smaller. Figure F-6 show a standard full height curb detail.



STANDARD CURB SECTION

STANDARD CURB

Figure F-6
(Standard Curb)

- Tapered – Tapered curb is a variable height exposed face, transition section, between a full height curb and a flush and/or depressed curb. Tapered curb can be installed over a short or longer distance, depending on the need. Figure F-7A show a tapered curb.

TAPERED CURB

TAPERED CURB ON RADIUS

Figure F-7A
(Tapered Curb)

- Mountable – Mountable curb is curb detailed in such a way so as to be able to withstand traffic. This is typically found on islands

installed at a site entrance or other locations where truck traffic may be expected to ride onto the curb due to turning radii. The typical detail would reveal a depressed face with a variable height from the front to the back of the curb section, the back being higher so as to contain the grade behind the curb. Mountable curb is commonly installed as a concrete or Belgium Block curb type. Figure F-7B show some variations on mountable curb.

MOUNTABLE CONCRETE CURB

MOUNTABLE CONCRETE CURB

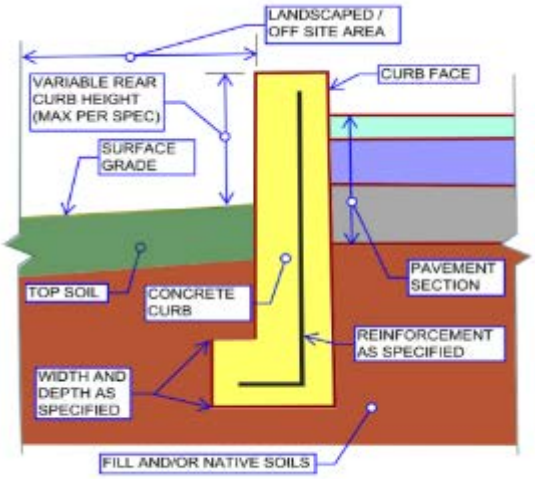
MOUNTABLE CONCRETE CURB

BELGIUM BLOCK CURB INSTALLED
IN A MOUNTABLE FASHION

Figure F-7B
(Some Pictures of Mountable Curb)

- Extended Height Curb – Extended height curb is usually used at locations where there is a grade challenge and the engineer would

like to avoid the use of a small retaining wall. The extended curb basically functions as a small retaining wall. Depending on if the face of the extended curb is facing toward or away from the parking lot side, the below grade section of the curb cut may be equipped with a small footing to overcome the turning moment forces of the soils being retained. Figure F-8 show some examples of Extended curb sections (Front and Rear) as well as a picture of each type installed in place.



EXTENDED CURB SECTION (REAR)

EXTENDED CURB (REAR)

Figure F-8
(Extended Curb)

- Depressed – The term “depressed curb” is commonly used interchangeably with “flush” curb, however there is a distinction. While a flush curb is a depressed curb, a depressed curb can be installed with a small lip to maintain the characteristics of the curb line during low flow stormwater conditions. Depressed curb is commonly seen at the driveway transition between the road and the site. Figure F-9 show a detail of a depressed curb.

- Flush – Flush curb is installed generally at the transition between the paved travel path and an accessible ramp, or at the transition between the paved surface and a surface runoff stormwater feature where the goal is to convey stormwater over the curb and onto a

surface drainage feature such as a swale or into a rain garden. Often times the landscaped side of a flush curb associated with a stormwater feature will have settled revealing the back side of the flush curb. Figure F-9 show a detail of a flush curb.

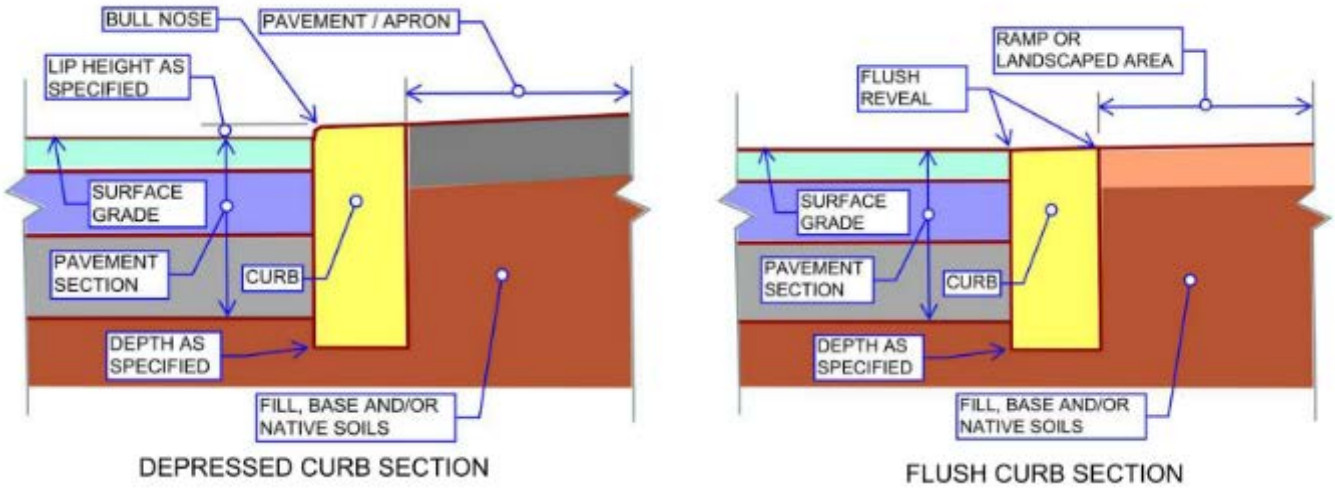


Figure F-9
(Depressed and Flush Curb sections)

- Curb and Gutter – A curb and gutter section integrates concrete onto the pavement side of the curb to create a monolithic piece of curb and gutter together. This is common in many areas of the country. The detail of a “low side” curb and gutter will be distinct from a “high side” curb and gutter since on the high side the intent is to allow stormwater to flow away from the curb, but the low side is meant to convey the stormwater along the curb. Figure 10 has some pictures of curb and gutter installed.

CURB AND GUTTER

CURB AND GUTTER ON A RADIUS

Figure F-10
(Some pictures of Curb and Gutter)

4. **Sidewalks and Ramps** – Sidewalks pathways for people to walk on. Originally installed adjacent to the roadway in a parallel path of travel (thus the use of the word "side" in the term, sidewalks can be installed in any direction relative to any other path of travel. Permanent sidewalks can be constructed out of several materials, most notably: Asphalt, Concrete, Paver stones, Bricks, and/or Slate. Often times an existing sidewalk of one material type is patched by another type. There are pros and cons to each type of sidewalk such as cost, ease of installation, durability, and aesthetics. Figure F-11 shows some pictures of various types of sidewalks:

Concrete Sidewalk

Concrete Sidewalk

Figure F-11
(Some Pictures of Sidewalks)

Asphalt Sidewalk

Paver Sidewalk

Slate stone Sidewalk

Brick paver Sidewalk

Figure F-11 - Continued
(Some Pictures of Sidewalks)

Sidewalk *Ramps* are sections of sidewalk that create a smooth transition between two elevations, avoiding a step. There are "delivery" ramps (which can be designed to achieve ease of moving a hand cart, etc.) that do not really have a constraint other than what is practical and available to install. There are also ramps that are intended for the public to travel on. Public ramps in the United States are required to comply with the constraints of the Americans with Disabilities Act (or ADA). The two most common ADA ramps are ramps at the curb down to the roadway (curb cut ramps), and ramps at a location of a flight of stairs or major rise in grade. Curb cut ramps are typically based on a 6" curb height and the ramp depth is as appropriate to meet the applicable standards. Curb Cut ramps are often seen installed with "detectable material" which will be discussed in further detail shortly.

The ramps installed at a location of stairs or major change in grade, i.e. at a location that exceeds 6", requires a landing at the top and bottom of the ramp, as well as a minimum 5' long level landing at distances allowing no further than 30' based on a maximum 2.5' of rise. The maximum rise allowed between landings is 1" in 1' or 1:12 slope (i.e. 8.3%). Additionally a hand rail installed per code is required at these ramp locations.

Some sample calculations associated with ADA ramp are as follows:

P-1) If an ADA ramp is installed for 20' at the maximum permitted slope, how high is the change in rise?

Solution:
20' distance at 8.33% slope =
20 x 0.0833 =
1.67' or 1' 8".
ANSWER: The rise is 1 foot 8 inches.

Problem P-1 (above)

P-2) If an ADA ramp is needed to go up 4'-3", how much linear distance is needed for the ramp?

Solution:
4'-3" rise at 8.33% slope =
4.25' / 0.0833 = 51' of slope
This requires one (1) landing at less than 30' within the ramp,
as well as a 5' landing at the top and the bottom of the ramp.
Therefore: 5 + 5 + 5 + 51 = 66'
ANSWER: the ramp requires 66 linear feet of distance to install a compliant ramp.

Problem P-2 (above)

Figure F-12 shows some pictures of ramps:

Ramp on a 45 degree to the sidewalk

Ramp at the end of a "penisula"

An Old Ramp With Detectable Material

A Ramp with Detectable Finish scored in Concrete

Figure F-12A
(Some Pictures of Curb Cut Ramps)

A long ramp near a loading area

A "switchback style" long ramp

Figure F-12B
(Some Pictures of Long Ramps)

Long ramp constructed of steel

A concrete long ramp with hand rail

Figure F-12B - Continued
(Some Pictures of Long Ramps)

A ramp is intended to be an accessible feature, as a result the owner of a facility that has a ramp should be careful to maintain the features consistent with ADA requirements. While many sites may have installations that are "grandfathered" from having to meet the requirements of ADA, the site may still have a liability if it does not maintain and remove tripping hazards and the like.

Figure 12C below shows an installation presumably where settlement around the ramp has caused the development of a tripping hazard. The owner of this facility should take steps to remove this tripping hazard.

Figure F-12C
(Tripping Hazard on an Existing Ramp)

As noted above, ramps will often by observed with detectable material. This is because the ADA requires detectable material at locations where there is a flush transition into the path of vehicular traffic. Detectable material is intended to be something that someone notices or "detects" when they walk on it. This is to provide ease of travel for someone in a wheelchair, while also providing a safe environment for someone with a visual imparity (i.e. blindness).

The visually impaired individual will be able to notice the detectable material with their walking stick or feet, and be able to seek assistance before crossing into the vehicular route.

Some engineers don't understand the intent of the detectable material as can be seen in Figure F-13:

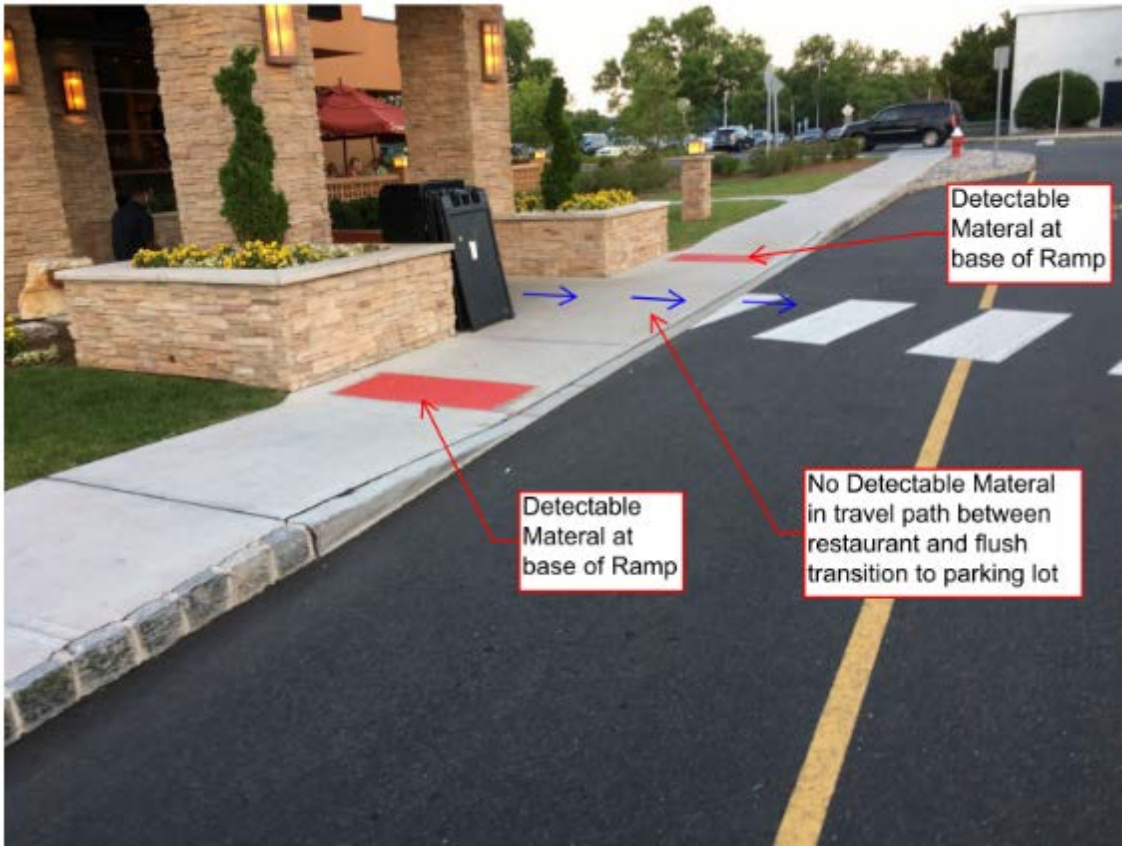
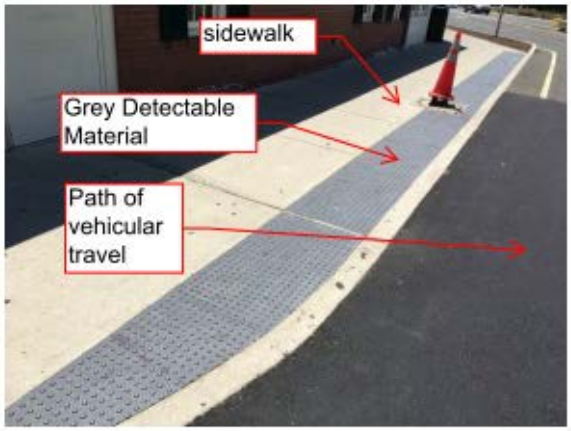


Figure F-13
(Misapplication of Detectable Material)

As can be seen in the figure above, the engineer did not properly orient the detectable material at the flush transition into the path of travel, but rather proposed it on the sidewalk ramps adjacent to the flush transition. This could theoretically be a lawsuit waiting to happen. Figure F-14 shows some appropriate installations of detectable material at locations of flush transition into the path of vehicular travel:



Detectable material along flush sidewalk edge

Detectable material along flush sidewalk edge

Detectable material at end of Penisula sidewalk

Detectable material at flush end of sidewalk

Figure F-14
(Detectable Material at Flush Transitions)

5. **Walls** – Walls are common on all sites. Generally walls are associated with the building structure, a “screen” or “privacy” wall (which may also provide sound attenuation), or with retaining steep slopes.

   Retaining walls come in several styles from timber to cast in place concrete to modular block to gabion basket style, as well as soil reinforced slopes/walls with an aesthetic outer surface. Retaining walls should typically have some sort of protection at the top to minimize pedestrians and vehicles from falling off the edge. For a more in depth review of the uses and benefits of retaining walls in

grading, review a course on site grading or earthwork. Figure F-15 shows a few pictures of retaining walls.

Modular Block Retaining Wall with Chain Link Fence at the Top

Timber Retaining Wall

Modular Block Retaining Wall with Split Rail Fence at the Top

Small Concrete Retaining Wall with Timber Guide Rail at the Top

Modular Block Retaining Wall with Steel Guide Rail at the Top

Modular Block Retaining Wall with Decorative Fence (Aluminum) at the Top

Figure F-15
(Retaining Walls)

Screen Walls also come in many different styles. Frequently depending on the municipal planning strategy, residential subdivisions are designed with an interior road, and the rear of the perimeter lots are against the right of way of the distributer / collector road network. In these cases walls and fences are used to provide sound and privacy from the traffic that is travelling on the outer road network.

Many times trash enclosures will consist of walls or fences. There is a section on trash enclosures below that will discuss this topic further.

Vegetative Screen Wall in a loading area

Concrete Screen Wall between adjacent lots

Figure F-15B
(Screen Walls)

6. **Fences** – Fences can be used to create privacy or for some level of security from people and/or animals. Fences can be considered protective features, but can also be used to delineate the limits of property, or they can be used just for decorative purposes. Among the many types of fences are: split rail fence, board on board (solid), board on board (semi-solid), chain link, chain link with vinyl slats, vinyl, decorative iron, decorative aluminum, and others.

   If added security is desired, fences often have barbed wire or razor wire affixed to the top of the fence. Refer to Figure F-15 which has some fence types shown, as well as Figure 16 which shows some additional examples of fences.

Board on Board Fence

Chain Link Fence with Barbed Wire

Chain Link Fence with Vertical Vinyl Slats

PVC / Vinyl Fence behind Timber Guiderail

PVC / Vinyl Split Rail Fence

Aluminum Decorative Fence

Figure F-16
(Fences)

7. **Trash Enclosures** – Trash Enclosures are structures that are intended to screen dumpsters and other containers that house the collection of garbage/refuse/trash, and recyclables. Trash Enclosures can be stand alone or integral to the building. They typically consist of a solid screen wall and gate, but some trash enclosures consist of fencing material or one sort or another.

   Refer to Figure F-17 which shows several types of Trash Enclosures.

Block Trash Enclosure with Steel Gate

Double Wide Steel Gate Timber Trash Enclosure Integral to Bulding

Double Wide Steel Gated Block Trash Enclosure with Concrete Apron

EAFS / Stucco style Trash Enclosure

Figure F-17
(Trash Enclosures)

Chain Link Trash Enclosure with Vinyl Slats

Timber Trash Enclosure

Figure F-17 - Continued
(Trash Enclosures)

8. **Islands and End Caps** –Islands and end caps (and "peninsulas") are site features located within a parking lot for the purpose of helping to delineate the various parking areas. These features can be striped or curbed. Curbed features may be filled with concrete or asphalt or with landscaping materials such as stone or grass and mulched plantings. Many ordinances require a break in a parking field with some degree of pervious greenspace, and/or the ordinance may require a certain number of trees or shrubbery located within the parking field. End caps, islands and peninsulas allow this requirement to be achieved.

   Islands are intuitively named such as they are completely surrounded by the parking lot material. Islands located at the end of a double row (or bay) of parking are referred to as end caps. While *End Caps* are located at the ends of rows of parking they can be integral to a longitudinal island. A *Longitudinal Island* is an island that runs the entire length of a bay of parking stalls. *Peninsulas* are features that are surrounded by the parking lot material on three sides. These are typically located along the perimeter of a parking lot and jut out into the parking lot between two parking stalls. Peninsulas can also be integral to an longitudinal island, breaking up the row of parking stalls as appropriate. .

   Refer to Figure F-18 to review several types of Islands, End Caps, and Peninsulas.

Asphalt Curbed Island

Concrete Filled End Cap with Concrete Longitudinal Island with Tree Openings

Diamond Shaped Island

Concrete Curbed End Cap Island with Landscaping

Belgium Block Curbed End Cap for Bay of Parking with Different Length Rows

Striped End Cap

Figure F-18
(Islands)

"Hybrid" Island partially striped for Truck Circulation Path

Belgium Block Curbed Peninsula with Sidewalk and Ramp

Figure F-18 - Continued
(Islands)

9. **Guide Rails, Bollards and Wheel Stops** – There are several "protective features" typically installed on a site. Three common ones are Guide Rails, Bollards, and Wheel Stops.

   Guide Rails are installed to protect site features, but also to "protect" vehicles from being able to drive into a dangerous situation such as off a steep bank or cliff. Guide rails are also often referred to as "guard rails" and while either term is acceptable, "guide rail" is often preferred as it implies its intent is to guide vehicles away from something rather than to actually protect anything. Guide rails are installed in a linear fashion with a solid material connected between multiple posts. Guide rails can be constructed of steel, timber, steel on timber posts or timber on steel posts. In the past cable guide rails were also common.

   Bollards are site features that are intended to protect other site features from damage for example a transformer, a generator, the gas utility manifold, or corners of the building. Bollards can be decorative or they can be utilitarian. Decorative bollards will often match other architectural features of the building, and may often be installed along the front of a building or store front. Utilitarian bollards can be as simple as being a 4" diameter pipe partially buried in the ground. Bollards can be concrete filled or a larger size pipe, making them more robust, but they can also consist of timber or PVC just to be present to provide direction. Bollards are often painted or covered with a decorative plastic cover. "U-bollards" are sometimes proposed at the end of gas station pump islands, or

the end of parking spaces along a store front. Bollards can also be “removable” for the purpose of allowing authorized traffic past them. Lighting bollards may also be present on site within or adjacent to a sidewalk, but these may be intended to provide light rather than to protect anything.

Wheel Stops are usually “portable” and typically pre-fabricated curbs that can be installed at the end of a parking space that has a flush transition to an adjacent sidewalk. Wheel stops can be made of concrete, plastic, or rubber.

There are other protective features that may be encountered on a site, such as strategically placed rocks and boulders, or a knee wall, or fences (as noted above). Refer to Figure F-19 to review several types of protective features.

Timber guide rail on top of a retaining wall

Steel cable style guide rail at the top of a hill

Lighting bollard on sidewalk

Steel guide rail (DOT style)

Figure F-19
(Protective Features – Guide Rails, Bollards, Wheel Stops)

A painted, concrete filled, steel tube bollard

Vinyl covered "decorative" bollards protecting a storefront.

Steel tube bollards protecting an equipment enclosure.

A steel tube "u-shaped" bollard protecting a storefront.

Rubber Wheel Stop

Concrete Wheel Stop

Figure F-19 - Continued
(Protective Features – Guide Rails, Bollards, Wheel Stops)

10. **Signs –** Most sites will have some sort of signage. Often times zoning code will restrict the size and placement of decorative and/or commercial signage. In addition to site signage, there are many kinds of building mounted signage. This section will not go into detail about building mounted signage. For more information about zoning restrictions and building mounted signs, consider reviewing a course on Zoning and Entitlements that may cover such a topic. This section will discuss, Freestanding signs (including pylon and monument signs), and traffic signage.

    Monument Signs are ground mounted signs that look like "a monument". They are often stone or block and are intended to identify the businesses on the property and possibly the address of the facility. They are typically subject to the zoning codes of the municipality, and may be limited in size, height and location. Monument signs are typically lower to the ground and located so as to be seen at the entrance to the site.

    In addition to monument signs, another type of sign that is subject to the zoning code are Pylon Signs. *Pylon* signs are a sign that is up high in the air, mounted to the top of a sizeable pole, often as high as 30, 50, and even 100' high. While Pylon signs are able to be observed from the entrance to the site as well, their intent is typically to identify the businesses on site from a distance, especially if there is a highway nearby. The intent is to alert passing motorists to the site prior to an off-ramp or exit from an "Interstate" type highway, and/or to provide awareness of the entrance to the site from a high velocity "US Route" highway business type road. Pylon signs are only permitted in zones that allow them.

    Traffic signs are directional signs intended to provide direction and safety to the pedestrians and motorists as they circulate the site. They identify restrictions to certain potential circulation routes as well as to parking. In the United States, traffic signs on roadways are detailed in accordance with the *Manual on Uniform Traffic Control Devices* (MUTCD standard) developed by the Federal Highway Administration. This provides consistency in lettering and coloring so that motorists develop a familiarity with the various types of signs and their purpose. While not necessarily required, it is a good practice to follow the MUTCD when detailing traffic control signs on site. In addition to be what motorists expect, these types of signs are available standard, which anticipates the price to be

lower than a custom sign. It is worth noting, some authorities having jurisdiction over site plans may require on site traffic signs to follow the MUTCD. Examples of Traffic signs are: Stop signs, Yield signs, One Way signs, Do Not Enter signs, Pedestrian Crossing signs, and Reserved Parking for Handicapped (HC) signs. Some traffic signs are equipped with "break away" posts allowing the base to stay intact so that if the sign is struck by a vehicle it can be easily replaced. Often times signs, such as HC signs, have the post embedded in a bollard.

Figure F-20 gives some examples of traffic signs.

Stop Sign

Do Not Enter Sign

One Way Sign

Pedestrian Crossing Sign

Figure F-20
(Traffic signs)

Figure F-21 shows an example of a Handicap parking space sign with a breakaway base, and one with the post encased inside of a bollard.

Reserved for Handicap Parking Sign
with breakaway base

Reserved for Handicap Parking Sign
in a bollard

Figure F-21
(Handicap parking signs)

11. **Lights –** There are several types of site lights used to provide site lighting. Of course there are bollard lights as seen previously for lighting pedestrian routes, and there are also architecturally aesthetic “lamp post style” lights also for sidewalks, and for sites that have an active pedestrian route. Lastly there are parking lot lights, which are typically set high on a pole, and are meant to cast light a long distance for the purpose of providing adequate light to a parking lot.

    In order to provide adequate site lighting, traditionally the engineer would typically utilize templates of the footcandle (fc) throw, which would typically identify the contour line associated with perhaps the 1.0 and 0.5 contours, and place an overlay of the contour lines for each light on the site plan for the purpose of laying out the lighting. Many municipal ordinances minimum and maximum standards of lighting that need to be met. Software is now available to model the photometric conditions provided by a proposed layout. These tools make it easier to develop and present approvable lighting plans.

    Of the many types available today, the most common and cost effective are “shoebox” type light fixtures. Since many ordinances today require the design to avoid light pollution, “full cut-off” light fixtures have been manufactured to avoid casting any light above horizontal. There are also different models which cut off lighting from casting behind for setting on property lines.

There is some confusion with respect to light fixture cutoff, and it is worth noting that just because a fixture is installed with a flat lens does not necessarily make it a full cutoff light fixture. Refer to Figure F-22A for some illustrations showing a no cutoff, full cutoff, and a flat lens fixture that does not qualify as a full cutoff fixture due to reflection off of the mounting structure. For more information on site lighting design, refer to the standards developed by the non-profit Illuminating Engineering Society of North America (IESNA).

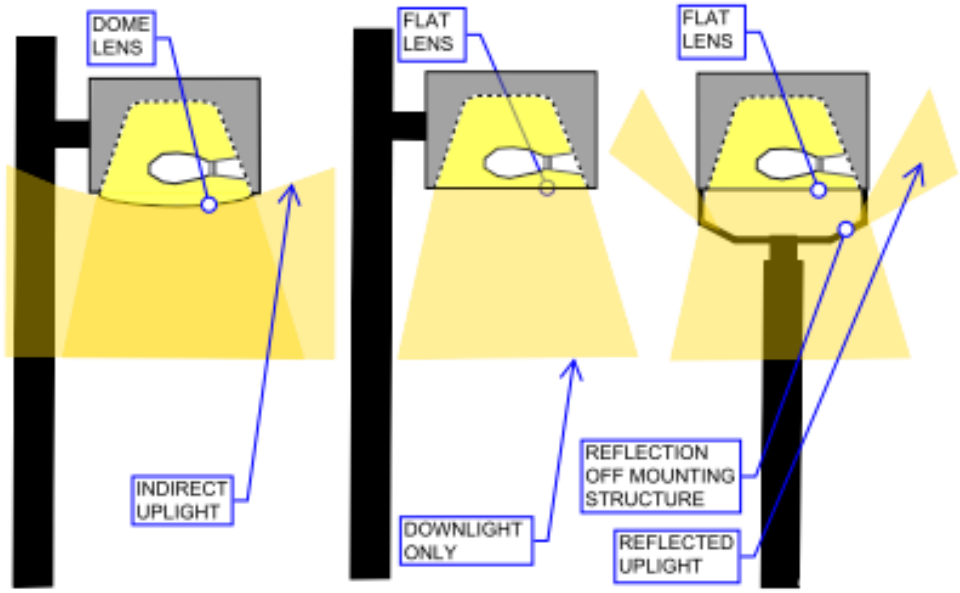


Figure F-22A
(Examples of Fixture Cutoff)

Parking lot lights in the recent past typically consisted of a metal halide filament, however more recently the technology associated with Light Emitting Diode (LED) fixtures have found their way into the market based on the efficiency and lower power costs associated.

When multiple fixtures are places on a pole, it can be referred to as a double or duplex configuration for two fixtures, and a quad configuration for four fixtures. There are many configurations of site lighting, including building mounted wall packs. Figure F-22B shows several examples of pole mounted site areas lights for parking areas.

A Decorative Type
Site Light

A Decorative Type
Site Light

A Decorative Type Site Light on a Brick
Paver sidewalk in the right of way

A Double "Street Light"
Type Site Light

A Single Centered Showbox
Type Site Light

A Single Offset Mounted Showbox
Type Site Light

Figure F-22B
(Pole Mounted Site Lights)

A Double Showbox
Type Site Light

A Quad Showbox
Type Site Light

A Single Slim Profile Site Light

A Single LED
Type Site Light

A Quad LED Type Site Light
(fixtures set at 45 degrees)

A Single Site Light with a second
"flooding" fixture added, offset, angled and tilted

Figure F-22B - Continued
(Pole Mounted Site Lights)

12. **Drainage Features –** In order to safely convey stormwater from a site there are many types of drainage features visible to the eye. Additionally there are sub surface features such as pipe that is not typically visible. The simplest drainage features are curb cuts to convey drainage off the parking lot. In order to gather stormwater from the parking area and convey it below the surface above there are visible features called *inlets or catch basins*. The detail of inlets and catch basins can vary by engineering firm, and by region, often based on the standards of the local state division of transportation, or other municipal standard details. Figure F-23A shows curb cuts and an associated inlet strategy.

Simple curb cut for drainage

Curb Cut with asphalt flume to yard inlet

Figure F-23A
(Drainage Curb cuts)

Some inlets are set flush to the pavement, and some are set into the curb, while others are a combination of the two. The inlet "grating" on a flush inlet can consist of a pattern of steel grating or a cast iron grate. Inlets can be in the parking lot, or in the grass or landscaped areas as needed in order to accomplish the drainage strategy on site.

Figure F-23B shows a few types of inlets.

A single cast iron inlet, flush to asphalt

A single steel bar grate inlet, with concrete apron flush to asphalt

A double cast iron grate inlet flush to asphalt

A double cast iron grate inlet in a grassed area

Figure F-23B
(Various types of Inlets)

Figure F-23C shows a few types of curbed inlets.

A concrete curb inlet with steel bar grate

A concrete curb inlet in line with curb and gutter

A cast iron grate curb inlet with mountable curb piece

A cast iron grate curb inlet with mountable depressed curb / driveway apron piece

Figure F-23C
(Some curbed Inlets)

A point of interest with respect to a certain cast iron grate style of grate still available from some vendors today is that while this specific type allowed for a good volume of flow, it had a cross section that a thin “ten speed” style bicycle tire could get wedged in, potentially causing a wreck and injuring the rider. This lead to the development of what was marketed as a “bicycle safe” grate for use in paved areas. One will still observe “non-bicycle safe” inlets in paved locations today.

Figure F-23D shows an example of bicycle safe vs. non bicycle safe cast iron grates on standard curb piece curb inlets.

A cast iron grate cast iron curb inlet with "non-bicycle safe" grate

A cast iron grate cast iron curb inlet with bicycle safe grate

Figure F-23D
(Some cast iron curbed Inlets with bicycle safe / non-safe grates)

In some jurisdictions, the requirement for “water quality” curb openings are being enforced on curb inlets. The term “water quality” refers to the intent that the curb opening restrict cans and soda/water bottles from floating in the stormwater and flowing from the parking lot and streets into the stormwater conveyance system and ultimately the streams and open waters.

Figure F-23E shows an example of a retrofit water quality plate for a curb opening as well as a standard water quality curb inlet.

A retrofit water quality plate installed on a standard cast iron curb opening inlet

A new standard water quality cast iron curb opening

Figure F-23E
(Example of water quality curb piece installations)

Long linear drains are referred to as “trench drains. Figure F-24 shows a few examples of trench drains.

A small 6" trench drain

A 12" trench drain with an area drain outfall

Figure F-24
(Trench Drains)

Manholes are also features seen from the surface. These are drainage structures typically proposed at required changes in direction in a run of pipe, or in locations where multiple pipe branches converge to out flow as a single pipe (typically larger). While stormwater manholes often have a solid lid, they can have a grated lid in order to allow stormwater to flow in. Manholes are usually

detailed with ladder rungs so that maintenance personnel man easily access the pipes near the lower portions of the structure. It is worth noting, in addition to "cleanouts", manholes are also the main visible feature of sanitary drainage systems.

With respect to a brief discussion about combined sanitary/stormwater conveyance systems, it is worth noting that in combined systems, the combined storm/sanitary pipes that convey flow to a treatment facility are typically at the lower parts of the structure, while the "overflow" pipes are installed at a higher elevation, and only direct the combined flow to the rivers when large amounts of rainfall inundate the treatment plant or the conveyance network. The great irony of combined systems is that during dry periods and small rainfall events, the rivers remain cleaner of sanitary waste then during a large stormwater event, which may seem counter intuitive to the lay person who may presume since there is so much "clean" rain, the rivers are safer to swim in from a contamination perspective. But when properly understood, it is recognized that quite the opposite is true.

Often the exterior of a manhole is visible where the structure is located in a flood plain, with the rim set above the flood plain elevation. Manholes are also used by other non-drainage utilities associated with providing access to their buried facilities.

Some examples of manholes and their components are shown in Figure F-25

A manhole with a solid lid
in a grassed area

A manhole with a grated lid
in a paved area

Inside of a manhole showing the ladder
rungs and the drainage pipes

A "concentric" sanitary manhole in a flood plain

Figure F-25
(Manholes and components)

Returning back to the topic of stormwater drainage in general, the conveyance system network of pipes may very well flow to a retention or detention "basin" that is intended to capture and slowly release the stormwater from the site. These basins can be above ground or hidden below ground or merely consist of oversized pipes in the conveyance network. Site civil engineers have many tools at their disposal in order to perform the calculations to prove the intent which is to release water from the site at a slower rate than was being released in the pre-construction condition. Although it is much more complicated than this since

there are varying requirements by the authorities having jurisdiction over site plan approval, this simple explanation is sufficient to describe why stormwater management *basins* exist.

Stormwater management basins can be “dry basins” (also often referred to as detention or retention basisn. Or if they are intended to be set below the water table they are often referred to as “wet ponds”. A wet pond will merely be a deeper pond during a storm, while a dry basin is only filled with water during and in the hours following a storm event.

The feature that allows detention basins to function in the manner designed by the engineer is the *Outlet Control Structure or OCS*. An OCS may have a series of orifices or small weir openings to allow the staging of different rates of flow out of the basin depending on the varying possible storm events. Emergency overflow is typically integral to the grading of the basin wall, ans may be grass, stone, or a concrete weir.

Many dry basins may have a *Low Flow Channel*, which is merely a linear concrete pan that is intended to keep the basin bottom from developing a muddy condition during low flow rainfall event. With the advent of newer “water quality” requirements in many jurisdictions, low flow channels are becoming a less frequent component of new basin designs since a critical component of many water quality strategies is infiltration of the storwater to the groundwater for at least all of the events that introduce lower volumes of rainwater to the site, and that same portion during larger events

An above ground detention basin will have pipes flowing water from the parking areas into the basin. On a basin with a gently sloped side, the pipes may transition to a last piece of pipe that “flares” out. This piece of pipe is referred to as a *Flared End Section or FES*. On a steeper or higher basin side slope, the pipe may need to tie into a structure referred to as a *Headwall.* If there are angled side walls to the headwall structure, these are often referred to as “wing walls”. If the basin has a retaining wall, a conveyance pipe flowing stormwater into the basin may merely penetrate the wall. It is worth stating that an FES or Headwall can also be installed to perform the intake function on the downstresm end of an intermediary basin in order to convey the water to a different section of a multi basin network.

Some examples of above ground detention basin and their components are shown in Figure F-26

A detention basin in a desert environment

A detention basin with a low flow channel

An outlet control structure with cages over the orifices and wing walls on the sides

A headwall with wing walls

Figure F-26
(Detention Basin components)

A Flared End Section (FES)

A pipe outfall through a retaining wall

Figure F-26 - Continued
(Detention Basin components)

Stormwater Management typically have areas of stone or Rip Rap which are installed for erosion control and stabilization. For more information of Rip Rap and conduit outlet protection, refer to a course on Erosion Control.

13. **Utility Features –** When observing the features on a site, one will invariably observe the Utility features. In general, Utilities are the infrastructure components required to bring and/or provide services to a site by outside purveyors. However to be clear, some Utilities can be provided for and maintained on site. The following are the major utilities that will typically be observed: Gas, Electric, Water, Sanitary sewer, and Communications (telephone and cable including fiber optic communications).

    Gas utility (Natural gas) is a fuel source used for heating and cooking. Natural gas is typically delivered to the building via an underground pipe that taps off the main conveyance pipe in the street. The system pressures of gas mains can vary and are taken into consideration when designing the building services that utilize it. Typically the features observes associated with gas service are a manifold containing components such as a meter, pressure regulator, shut off valves and the like. It is important to protect these features from vehicular damage when located in parking areas or adjacent to circulation or delivery drives. As stated above, each of the utility systems generally can be provided on site by other means; as relates to gas for example, as an alternate heating fuel,

oil or liquid propane stored in tanks and delivered to the site by vehicle can be the alternate source of “gas” service when the public gas utility is not available.

With respect to *Electric* utility, the power can come from the street conveyed via overhead or buried wires. The main feature that will be observed associated with the electric service to the site is the transformer. The transformer converts the voltage to something lower that can be used on site rather than the higher voltage used for long distance conveyance. Transformers are often “screened” with landscaping materials. A site may have some sort of cogeneration ability in which case the means to generate the electricity will come from another resource available on or delivered to the site. Additionally, some sites require standby or emergency power provided by a generator, in which case the generator enclosure might be observable on site.

Water utility is provided underground via water mains in the street. Water is required for both potable (drinkable) and non-potable purposes on-site, including fire suppression. Building fire suppression can often be supplemented by the fire department with the use of a Fire Department Connection. Fire Hydrants or common features on a site as well. Sometimes if there is not adequate pressure or flow in the public system, a fire water tank is required on site. The need for this is typically confirmed and calculated by the building engineering team rather than the site civil engineer. Water meters can be located inside the building, or in a pit located underground outside. If public water utility is not available, investigation on the feasibility of a well as a source of water can be explored. If the utility or fire department want visual indication of a valve position, *a Post Indicator Valve* can be installed, whereby “open” or “closed” is stated on the post.

Sanitary sewer is the system that conveys waste water to the public conveyance system that will bring the waste to the treatment facility. The features typically observed on site consist of cleanouts and manholes. If there is not public sewerage available, an extension of the main or a lift station (pump) is typically required. On-site disposal with septic tanks and the corresponding dispersion field can be explored, but typically on a large retail property, the size required makes this an unlikely alternative.

Figure F-27 shows some examples of utility components observed on-site.

A Gas Utility Manifold

A Gas Utility Manifold with Bollard protection

An Electric Utility Transformer
on a concrete pad

Two Electric Utility Transformers
with Bollard protection

An Electric Utility Transformer
with a board on board fence screen

An Electric Utility Transformer
with landscaping screening

Figure F-27
(Utility components)

A generator enclosure


A generator enclosure with Bollard protection


A Water Utility Valve Cap


A Post Indicator Valve

A building mounted "siamese" or dual/twin
Fire Department Connection (FDC)


A remote standalone
Fire Department Connection (FDC)

Figure F-27 - Continued
(Utility components)

A Fire Hydrant

A Fire Hydrant with Bollard protection

Figure F-27 - Continued
(Utility components)

14. **Miscellaneous Features –** There are many other miscellaneous features located on site. Many have not been discussed in this course. A few noteworthy features are as follows:

    Monitoring Wells are wells located for the purposes of testing for ongoing contamination related to a clean-up that may have been required by the developer in order to construct the facility. Gas stations often have monitoring wells related to the history and/or requirements of that type of facility. For more information review a course on environmental engineering focusing on contamination and clean-up. On a topographic survey a monitoring well will often have the symbol of the triangle in a circle.

    Cart Corrals are the names of the structures located in the parking lot of retail shopping centers for the placing of empty shopping carts. They are there to keep the parking lot tidy, and also to assist the people whose job it is to transfer the carts back to the store front.

    Car Ports are the names of the open structures that are intended to provide shade for vehicles parked on site. Many modern car ports are also dual purpose structures to support solar energy panels. This kind of car port is often referred to as a solar canopy.

Speed Bump/Speed Humps are traffic calming devices typically consisting of asphalt installed in such a manner so as to create a bump in the path of travel. In addition to being a common on site traffic calming method, speed bumps have gained popularity on public roads. Not all authorities having jurisdiction will allow speed bumps in the public right of way, but many have as a last resort when drivers disregard speed limits of specific roads. In the right of way a speed bump will often be wider so as to be able to accommodate a higher allowable speed of travel.

Tree Grates are there to protect trees in high traffic areas. These are typically located in the public right-of-way in urban environments, but they can also be used on private sites, and even located where there is no adjacent sidewalk.

Other: There are many other miscellaneous site features that one may observe on a project site. This course was intended to identify many and explain what they are and discuss interesting aspects as applicable. Figure F-28 shows some pictures of the miscellaneous features noted above.

A Monitoring Well Cap

A Cart Corral

Figure F-28
(Miscellaneous Features)

A Car Port / Covered parking structure

A Speed Bump/Hump

A Tree Grate in a pedestrian traffic area

A Tree Grate in a non-pedestrian traffic area

Figure F-28 - Continued
(Miscellaneous Features)

D. Summary and Conclusion

This course was developed to introduce the topic site features to non-civil site engineers and to provide a refresher to other engineers. It identified many nuances between various site features, and explained the distinctions. The course also identified and explained some missteps associated with certain site features related to design and detailing. The student of this course should now have a better understanding of site features and this will assist them if and when involved in a property development project.

