A SunCam online continuing education course

Fundamentals of Site Grading Design

by

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A. Introduction

This course is developed to identify the fundamentals of site grading design to those who are not experienced with site grading design, as well as a refresher to anyone who has worked in Civil Engineering and/or Land Development. Site grading is an important skill for any Civil Engineer to master associated with their required drainage design.

B. Basics

Background:

Site grading is an important part of the Land Development process. Over time the Zoning and Land Development approval processes have become more refined. Planning Boards/Commissions have become more astute in terms of their power and authority, and the entitlement process in order for an owner seeking Building permits to obtain Zoning Approval has become more difficult. Site Plan Approval is and continues to be more and more difficult to obtain.

Most sets of Site Plan documents are multi sheet plan sets that will include among other plans, a Grading and Drainage plan. If the scale of the project is large enough, those two sub-disciplines may be broken into separate sheets with a standalone Grading Plan and a separate yet related Drainage Plan. This is typically divided at the discretion of the engineer, but may be a requirement of the Authority Having Jurisdiction's standards.

In the case of separate grading and drainage design plans, the Drainage Plan will typically identify the information (rim/grate elevations, invert elevations (bottom of pipe)) associated with the inlets (catch basins), storm manholes, flared outlet structures, permanent erosion protection, and outlet control structures. Discussion of the Drainage Plan in further detail is outside of the material covered in this course.

The Grading Plan defines the information that the proposed surface will exhibit post construction.

Site grading, and grading in general is not a required subject for many Civil Engineering Curriculum's, and as such, often times the entry level engineer must learn the fundamentals of grading as a "trial by fire", on the job. This course will identify the basics, and the student should be able to use this course as a basis for approaching site grading with confidence.

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Existing Conditions:
When approaching the grading of a site, the engineer must first be provided with a document that defines the existing conditions, including the topography. This document is typically referred to as a Topographic Survey or "survey". If the survey is received with adequate information for the purposes of re-grading a site by design, it will identify the existing surface features, spot elevations or "spot grades", and contour lines. There may also be outfall elevation information surrounding the site so the drainage system can be connected if and as needed.

Contour Lines:
Contour lines identify all of the areas on the site that are at a certain elevation and how they connect to each other. The contour lines can be reflected at various intervals, for example USGS Quadrangle Maps identify 10' interval contour lines. Typically for a land development project in the United States, the ideal contour interval is 1'. At a minimum, 2' contours provided on the survey can be adequate, but the design should typically be in 1' intervals at a minimum. Contour lines as shown on surveys and proposed grading plans are frequently shown distinctly and referred to as "major" and "minor" contour lines, meaning that the 1' contours are shown differently than the 5' interval contours (i.e. 100, 105, 110, and 115 will have a bolder appearance than the 101, 102, 103, 104, and the 106, 107 and 108 respectively). Existing contour lines are often shown as "dashed" or "hidden" line types, while proposed contour lines are typically shown as solid line types. (Refer to Figure F-1)

Spot Elevations / Spot Grades:
Spot grades identify the exact elevation of a point on the surface, or of a level flat area located upon the surface. Typically spot grades are taken to and shown as to the nearest tenth (0.1') or hundredth (0.01') of a foot (ft.). There are several ways for this information to be reflected. The precise location of the existing spot grades are typically identified with an "x" with the elevation identified in numerical form adjacent. The location that the engineer wants the proposed spot grade to be might be noted with a line from the noted numerical elevation, or perhaps with a "+" mark next to the elevation. (Refer to Figure F-1)

Other Standard Annotations:
Spot grades at curbs and retaining walls are typically noted with two elevations, one associated with the top of the curb/wall, and one at the base. This will typically be

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shown with a TC:XXX.XX and BC:XXX.XX, or a TW:XXX.XX and BW:XXX.XX respectively.

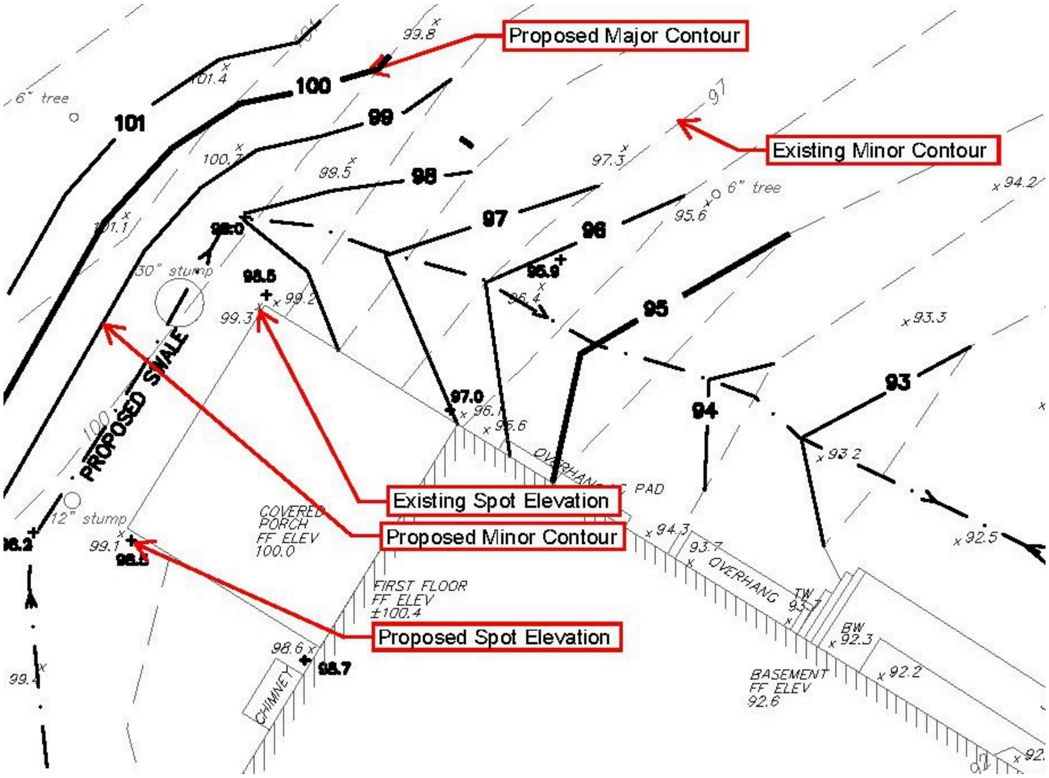

Figure F-1
(Example of Contours and Spot Grades)

Slope

In order for an engineer to grade the site, they must have an understanding of "slope". The mathematical definition of slope is expressed in Equation E-1:

$$S = \frac{Rise}{Run} = \frac{(change\ in\ elevation)}{(change\ in\ distance)}$$

EQUATION E-1

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Slope is often represented in terms of a percentage, in which case S x 100 = S%.

A simple example of this calculation is located in Problem P-1 (Refer to Figure F-2 for a graphic of slope):

P-1) What is the slope between a point 50' away that is 3' higher in elevation?

Solution:

$$S = \frac{Rise}{Run} = \frac{3}{50} = 0.06 \; or \; 6\%$$

Problem P-1

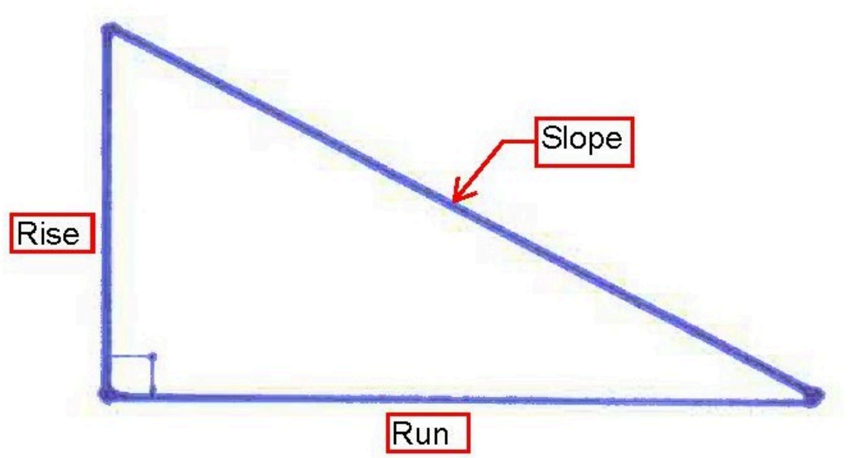

Figure F-2
(Graphical Depiction of "Slope")

Steeper slopes are also frequently identified in terms of the ratio of horizontal to vertical. For example a 3:1 slope indicates that the every rise of 1' is separated by a distance of 3'. This is noted in Horizontal to Vertical, or H:V.

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This slope can also be expressed in terms of percent by performing the same equation noted above in Equation E-1. A sample of this is calculated in Problem P-2:

P-2) What is the percent slope of a 4:1 slope?

Solution:

4:1 = H:V,

therefore vertical rise = 1 and horizontal run = 4

$$S = \frac{Rise}{Run} = \frac{1}{4} = 0.25 \; or \; 25\%$$

Problem P-2

Plan Setup

The most appropriate way to start site grading is to overlay the proposed site plan layout (also referred to as a “Horizontal Control Plan”) on top of the survey. This is typically done with electronic conversion (i.e. in AutoCAD) of the survey to the engineering team’s graphical standards, and overlaying an xref of the conceptual proposed plans in top of it. From there the engineer is able to start the process of working through the site grading process.

Limit of Disturbance / Transition between Existing and New Grades

Although it is not typically graphically required to show the Limit of Disturbance (LOD) on grading plans, the LOD is often times the point on the proposed grading plan where the proposed contour lines will intersect with the existing contour lines. Sometimes the surface is disturbed and the grading does not change. In these cases, the LOD goes beyond the proposed work. Often times the engineer with trace the existing contour lines with new contour lines just to show a disturbance has taken place. Either graphical method is acceptable. The bottom line is, the points at which the engineer wants the existing grade to meet the proposed grade must have the two contour lines (existing and proposed) meeting/intersecting on the proposed grading plan.

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The Inverse Slope/Contour Calculation Method

Once the engineer begins to become comfortable with slope calculations and how to graphically reflect contours, it becomes apparent, fairly quickly, that there is a simple way to calculate the distance between contour lines (assuming non variable slope). By taking the inverse of the slope (in non variable sections of slope), the engineer is provided with the distance between the minor 1' contour lines. This works itself out as follows, say for example the engineer wants to show the contour lines of a parking field that is sloped at 2%, they can quickly calculate 1 / 0.02 = 50. So they know to place the contour lines apart by 50'. In a similar fashion, if the engineer wants to show a 3:1 slope, they just show each contour separated by 3' since the 3' horizontal corresponds to the 1' vertical rise.

As will be noted below, there are maximum and minimum slopes that the engineer needs to be aware of. Therefore they can also quickly check slope by looking at the distance between the contour lines and taking the inverse. For example, if on a parking lot design, the junior engineer separated the 67 and 68 contour lines by 120', the reviewing engineer could measure this distance with a scale and quickly determine that the slope of the parking lot was designed at 0.83%. This is calculated as follows: 1/120 = 0.0833 x 100 = 0.83%

The inverse slope/contour calculation method is a useful tool for the grading engineer to understand.

C. Design Parameters and Other Limitations

Design Parameters

The engineer may have developed their own design standards based on their professional experience and practice, and/or they may refer to textbooks or the Internet to determine the various parameters that they will utilize in design. However, it is always best practice to refer to the Authority Having Jurisdiction's Land Development Ordinance and/or Engineering Design Standards to determine if there are any requirements of the municipality. Additionally the engineer should confirm if the client has any specific design criteria that must be followed. After determining the specific design parameters required, the engineer is ready to start grading the site. The engineer must determine the existing elevations at the interfaces between the existing work and the proposed work, such as the proposed driveway entrance to the existing road.

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Positive Drainage

The primary goal of any civil engineers grading design is to make sure that stormwater flows off of the site in a safe efficient manner. As noted above, grading goes hand in hand with drainage, and the engineer goal must be to avoid standing water ("standing water" by definition refers to water that has no place to go, and is therefore only dissipated by evaporation). As a result the primary design parameter of all grading designs is to maintain positive drainage ("positive drainage" by definition means that the water always has an ability to flow away from where it is).

One might argue that a detention basin and/or a wet pond contain standing water, and while this is true, these are intentional drainage features that serve a purpose beyond the scope of this course. If the engineer finds that they cannot avoid a low spot that will cause standing water, they must put some sort of drainage structure into the design so that the water can flow away via the subsurface pipe network designed associated with the drainage design.

Rules of Thumb

There are several reasons for some of the basic rule of thumb parameters that engineer's generally follow. The following will describe some of those parameters and some of the reasons they exist:

Maximum Access Drive Slope: 8%

It is a good practice to keep the slope of the main access drive less steep than 8%. This is typically driven by the goal of not causing cargo being transported by truck traffic to shift excessively.

Maximum Parking Lot Slope: 5%

It is good practice to keep the slope within the parking field of any large commercial or retail parking lot flatter than 5%. There are at least two (2) significant reasons for this parameter:

1. A slope much steeper than 5% increases the frequency of "runaway" shopping cart left by shoppers. This can cause damage to vehicles as well as the shopping carts.

2. A slope steeper that 5% had traditionally began to create difficulty in keeping the vehicle door open when parked perpendicular to the slope with the door on the

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high side. Additionally it begins to be more difficult when parked perpendicular to a 5% slope for a passenger to close the vehicle door when the door is opened on the low side of the vehicle.

Many retail establishments have their own criteria that require the parking fields in front of their stores to be even flatter, as low as 3% in some cases.

Maximum Slope in Maintainable Grassed Landscaped Areas 3:1

It is good practice to keep the slope within grassed areas no steeper than 3:1 or 33%. The generally cited reason for this is that this is the maximum "maintainable" slope. The term maintainable refers to the maintenance of the lawn by the landscaper. Landscapers have difficulty remaining stable on riding mowers when cutting the grass while driving parallel with slopes steeper than 3:1. It is not to say that it can't be done, but ideally the best practice is to accommodate maintenance. Additionally, mulch beds placed on 3:1 slopes do not typically "erode" from storms of relatively strong intensity.

Maximum Slope in Stabilized Landscaped Areas 2:1

If the engineer needs to achieve slightly steeper slopes in landscaped areas, but also want to minimize cost, the maximum slope best practice is 2:1. As noted above, this exceeds the maximum "maintainable" slope. As a result, the engineer must stabilize the slope with vegetation that anchors the top soil, yet requires minimal maintenance in terms of needing to be cut by the landscaper. A common vegetation that is used for this purpose is "Crown Vetch" which has the genus and species name of Securigera Varia. Crown Vetch grows 1 to 2 feet tall and bears small clusters of 1/2-inch pink and white flowers from early summer to late fall. Crown Vetch is a tough, aggressive spreading plant that is well suited to sunny banks. Crown Vetch will grow indefinitely with little maintenance. It has deep, tenacious roots, and thick, fern-like leaves that provide excellent soil erosion and sediment control when it is used as a ground cover. (Refer to Figure F-3 for a picture of Crown Vetch)

Seeding and planting rates associated with grasses and Crown Vetch specification is beyond the scope of this course, and if needed, the engineer should seek the consulting of a qualified landscape architect familiar with the project region.

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Figure F-3
(Picture of Crown Vetch in a field)

Slopes exceeding 2:1

Slopes exceeding 2:1 should be stabilized with materials that do not erode, such as rip rap (stone erosion control), gabion baskets, paved or concrete finished slopes, or other kinds of retaining walls. Refer to the section below on other grading features for a more in depth discussion on retaining walls.

Minimum Slope of Asphalt: 1.5%

When designing the grade of the parking field, if it is an asphalt parking lot, maintaining a 1.5% minimum slope in the parking lot is a good goal. It is reported that it is difficult for any paving contractor to maintain any flat slope consistently over a long distances due to the nature of the installation and compaction process. So while means and methods are not usually the concern of the engineer, it is likely that an asphalt field much flatter than 1.5% will have small puddles and ponds developing throughout the parking field due to undulations that occur. If 1.5% is maintained as a minimum, water is less likely to be caught in the undulations and draining to the designated inlets and/or catch basins is maintained.

Minimum Slope of Concrete: 0.75%

When designing the grade of a large concrete area, be it the sidewalk in front of the building, or a large “garden center” area, maintaining a minimum slope of 0.75% should

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be the intent. The work associated with installing concrete can be much more precise in terms of formwork and how finishing occurs. As a result, the engineer has a little more discretion in terms of allowing these areas to be flatter.

Minimum Slope of Concrete Curb: 0.75%
When designing the slope of the curb adjacent to inlets (i.e. curbs that stormwater flow is directed toward), the best practice is for the slope to be no flatter that 0.75%. The absolute minimum of 0.5% may be permitted to occur in extreme circumstances, but just like the reason cited for the absolute minimum slope of concrete slabs and asphalt fields, it is difficult over long distances for the contractor to install the curb and asphalt abutting up to it to this precise slope for the entire length. As a result, regardless of how much care the contractor takes, due to slight undulations and variations in the install, puddling and ponding up against the curb will likely occur. Refer to Figure F-4 for a picture of an installation of curb that did not meet the minimum guideline.

It is worthy to note that the curb along the high side of a parking field can be proposed to be installed level if it suits the design. Sometimes new land development / civil engineers misunderstand this parameter, and try to keep a curb slope of 0.75% on the high side of the lot, which has no practical purpose.

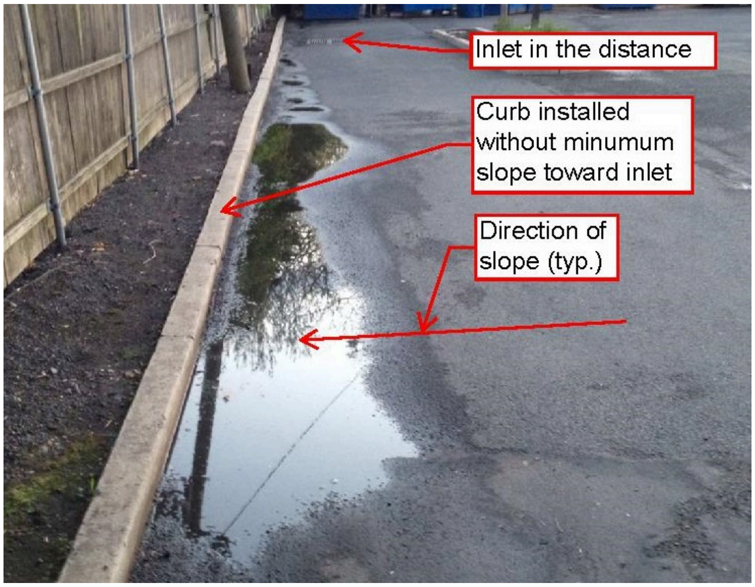

Figure F-4
(Picture of Curb Installed Without Minimum Slope)

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Loading Dock grading: 2.0% for 60'

When designing the grade at a loading dock, the intent should be for the bed of the delivery vehicles to be relatively flat as they meet up with the dock. Since the majority of these vehicles is 60' or less, it is a good practice to keep that first 60' at 2%. If the slope is too steep coming into the dock, there have been reported cases of the top of the delivery vehicle colliding with the building above the loading dock door causing damage. Additionally, there should be minimal to no cross pitch in a loading dock so that the dock and the vehicle bed can be flush the whole width of the vehicle. This is why a significant number of loading docks are designed with trench drains at the end of the dock, and not a drain in the corner. Always consult with the owner for standards.

ADA Requirements

The engineer should always refer to the requirements of the Americans with Disabilities Act Standards for Accessible Design to confirm the grading requirements for their project. At the writing of this course, the maximum cross slope in any accessible area is 2%. As a result, corner to corner, all spot grades of the Handicap Parking spaces proposed should be identified so that the installing contractor is given appropriate guidance. The maximum slope of the path of travel is 12:1, or 8.33%. Additionally the slope is limited to 30' in length (due to the requirement being that no ramp may rise more than 30") prior to a landing being required, which must be 60"x60", with the exception of the bottom landing which must be 72" in the direction of travel. Refer to the ADA guidelines for a comprehensive description of the requirements.

Cut-Fill Analysis

An important parameter that the engineer must consider is referred to as a "Cut-Fill Analysis" or earthwork calculation. Performing a Cut-Fill Analysis is beyond the scope of this course, however it is an important topic to understand because of the cost implications. The proper grading plan will attempt to minimize:

1. The amount of earthwork required on site.

2. The amount of net import or export to or from the site.

These two topics are somewhat related, but the strategy to minimize each is attempting as much as possible to follow and maintain the existing topography of the site. Sometimes the engineer will have to compromise minimizing proposed earthwork in order to reduce the amount of import or export of soil required. This could require a

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large cut, the soil from which is utilized on another low lying area of the site resulting in a balanced site. Typically setting the finished floor elevation of the proposed buildings on site is done after considering the proposed elevations of a balanced site and then working from there.

On an exceptionally “steep” site, the engineer must look at the maximum slopes between the entrance to the site and the proposed building location, and then also work into the grading strategy a Cut-Fill Analysis to try to cost effectively balance all of the limitations.

Rock Ledge walls

One final topic which is related to several of the above parameters is the topic of rock ledge walls. If the geotechnical report indicates that the sub-surface consists of rock, and the geotechnical analysis supports it, the grading design can incorporate rock ledge walls into the design. Rock ledge walls can be proposed virtually vertically as well as at any positive slope the engineer may determine appropriate. In order for these to be installed, costly rock excavation and/or blasting may be required. As a result, the engineer should consider the cost implications of proposing such features rather than trying to solve grading challenges in other less costly ways.

D. Other Grading Features

There are several other features that the design engineer will have available to them to accomplish the grading goals on the site. These include, berms, swales, ridgelines, and retaining walls. These features are described in further detail below.

Berms

Berms are “mounds” of soil, or small hills that may be proposed in order to direct flow in a certain direction or around an area for some purpose. Often, berms are merely proposed as a screening feature, or part of a buffer, in order to accommodate the landscaping and create a partial screen. Berms can be a useful place to “lose” excess soil in the engineer’s attempt to maintain a balanced site. Refer to Figure F-5 for a cross section of a constructed berm, and Figure F-6 for some pictures of berms.

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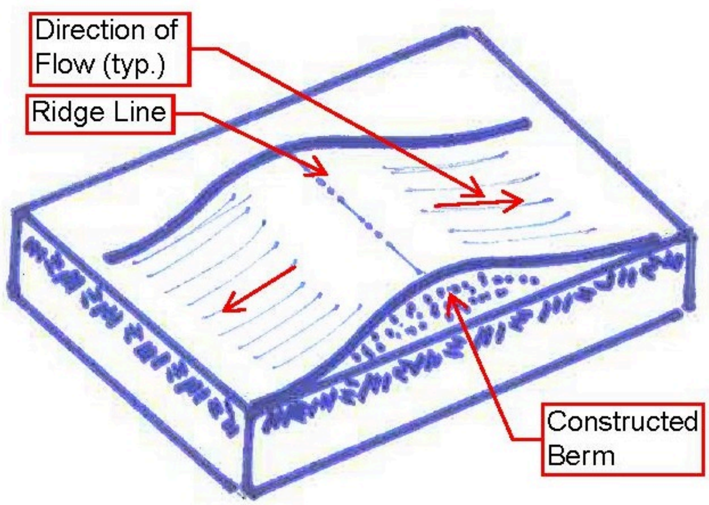

Figure F-5
(Cross Sectional Diagram of a Constructed Berm)

Figure F-6
(Some Pictures of Berms)

Swales
Swales are valleys or linearly defined low lines that are used to convey flow in some direction. Sometimes a swale can be used just to divert a portion of flow, and sometime they can be used in order to save on another inlet and the associated branch pipe. If the required slope in the valley of a swale becomes too steep, additional stabilization

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measures may be appropriate. If the area of surface flow contributing to a swale is large enough, the engineer may need to define the swale as a channel, in which case, channel flow calculations and stabilization details beyond the scope of this course will be applicable to incorporate into the design. Refer to Figure F-7 for a cross section of a swale, and Figure F-8 for some pictures of swales.

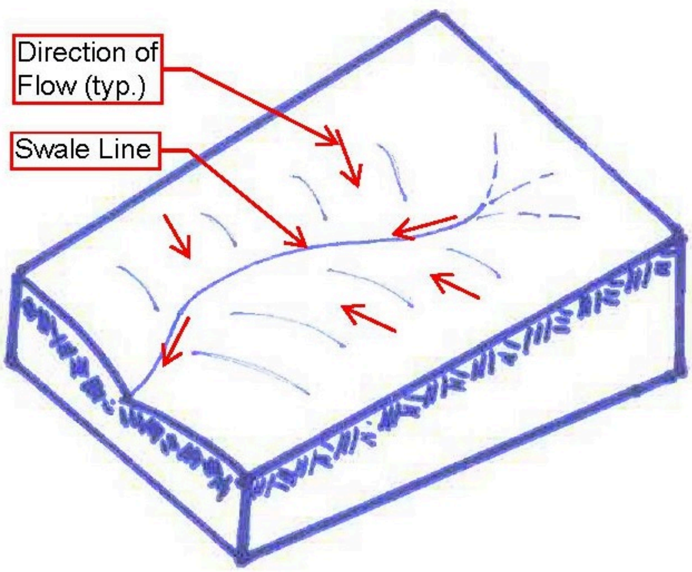

Figure F-7
(Cross Sectional Diagram of a Swale)

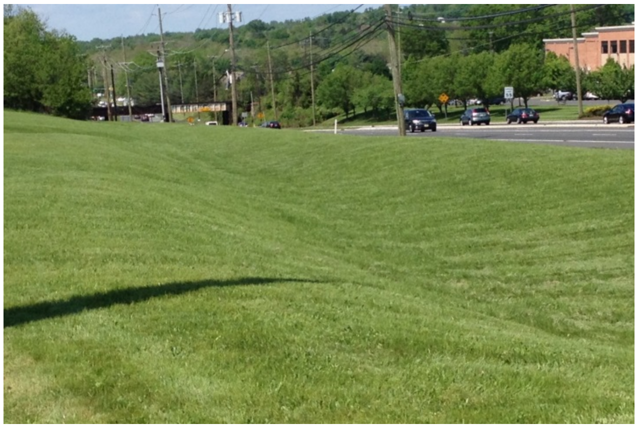

Figure F-8
(Some Pictures of Swales)

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Ridge Lines
Ridge lines are linearly defined high points. An appropriate practice for an engineer to incorporate in grading design is to clearly delineate ridge lines by noting the location of the line as well as providing identification of the spot grades at either end of the ridge line. In large parking fields, the plan may become too "busy" or cluttered if every ridge line is proposed, so at their discretion the engineer may define the ridges with high point spot grades and the appropriate contour lines.

Large flat sites may have a significant number of ridge lines since the entire site needs to undulate, rising away from the inlets, and returning down to the next row of structures. If the site was to be designed to continue to rise, excessive earthwork would be required, as well as the need for costly import. With experience this is virtually self-evident, however worth noting in a course on fundamentals.

Retaining Walls
Retaining walls are an important tool for the engineer to propose when grading will require slopes exceeding 2:1 in order to accomplish the site grading goals. There are several types of retaining walls available (such as pre-cast, cast in place concrete, modular block, and timber) that are beyond the scope of this course. Additionally there are methods of reinforcing proposed "steep/vertical" soil embankments such as methods involving soil nails, etc. that serve the same purpose as retaining walls. Unfortunately each of these "retaining wall" methods, including basic modular block retaining walls, are expensive when compared to natural grading. As a result, the engineer must take care to minimize the amount of proposed retaining walls on a project. However, there is no doubt that as developers continue to develop challenging sites, the need to large retaining walls will continue.

The rule of thumb is that small retaining wall less that 4' in height can be detailed by the civil engineer with little or no geotechnical analysis. However if a retaining wall greater than 4' in height is required, the engineer is well served to consult with a structural engineer who will analyze the geotechnical report and issue signed and sealed retaining wall drawings that have structural calculations to support the wall design. Refer to Figure F-9 for some pictures of retaining walls.

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Figure F-9
(Pictures of a Modular Block and a Timber Retaining Wall)

It is worth noting that many modular retaining wall system vendors will provide signed and sealed wall design calculations and drawings at no cost if their system is specified.

E. Problem Areas and Other Locations of Importance

Landscaped Islands and Peninsulas
Since the parking lot it typically a large field of asphalt, the small curbed in landscaped areas that contain, grass, trees, shrubs, and mulch are referred to as “Islands”. Additionally, there are often landscaped areas at the end of the row of parking spaces that accommodate a tree, but are connected back to the main lawn outside of the parking field. These mid-course “end caps”, if connected back to the main lawn, are referred to as “peninsulas”.

Islands and peninsulas can be considered grading “problem areas” because they require a little extra attention to detail. If one is not careful, the intent of the surrounding grading, plus the detail that calls out for the height of the exposed curb face to be 6” can put an installing contractor in a grading dilemma. If the contractor does not pick up on the situation and send in a Request for Information, the installed condition may be areas that are too flat and/or areas that collect water that should not. (Refer to Figure 10 for pictures of puddling adjacent to an island)

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Figure F-10
(Picture of Puddling Adjacent to Landscaped Island)s

The best practice is for the engineer to identify spot grades at the islands and peninsulas so that there is no confusion.

ADA Parking Spaces

Since ADA compliant /"Handicap" parking is mandated by the federal government, there can be legal implications associated with non-compliance. Therefore the engineer should always take care to address these areas with great detail.

Longitudinal Islands with Sidewalks

Longitudinal Islands are islands that run the length on many parking spaces down the "spine" of the parking bay. Often times when a large parking field is proposed, the longitudinal island is a great location to achieve a grade change in the direction perpendicular to the circulation (i.e. parallel to the store fronts). During the iterative process of design, sometimes it is decided to add a sidewalk to these islands. When this occurs, the engineer should take care to reassess and confirm there was not a significant change in elevation across the island, and the assumed/required maximum 2% cross slope of the sidewalk may cause a discrepancy that cannot be easily remedied by the time it is recognized.

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Figure F-11
(Picture of Apparent ADA Non-Compliance in Longitudinal Island Sidewalk)

This happens because the curb installer is not looking at the sidewalk detail. It is only the engineer and possibly the prime contractor who is in a position to be aware of the conflict. The engineer should always take care in making sure all facets of the grading design works. Refer to Figure F-11 for a picture of a condition that appears to be exceeding the ADA maximum cross slope of 2% with a cross slope that may exceed 16%.

Flush Ramps

Flush Ramps can be a problem when grading because often times when the surrounding grades were initially developed by the engineer, the fact that a ramp would be proposed was not considered. As a result, sometimes detailed grading associated with the ramp is not provided. As another consequence, the installing contractor may not recognize that a potential puddle is going to occur.

One scenario where this occurs frequently is when the sidewalk is oriented up a modest grade, and the ramp is cut into the curb with relatively flat surrounding grades, but directed toward the curb that the ramp is cut into. Since the curb has dropped 6” down

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to the depressed/flush location, suddenly a low spot where water will gather is introduced.

<u>Figure F-12</u>
<u>(Pictures of Puddle Located on a Flush Ramp Condition)</u>

Unfortunately this is the worst place for a puddle to occur. Refer to Figure F-12 for some examples. The major purpose in many cases for installing the flush ramp is to accommodate those with disabilities, and in northern climates especially, what has been introduced instead is a small, yet potentially dangerous patch of ice.

It is not difficult to overcome the risk of this in design with a few additional proposed spot grades, but left undetailed a puddle may exist in the post constructed condition. The engineer should always analyze proposed flush ramp locations so that they can provide the extra spot grades and/or other detailing if warranted.

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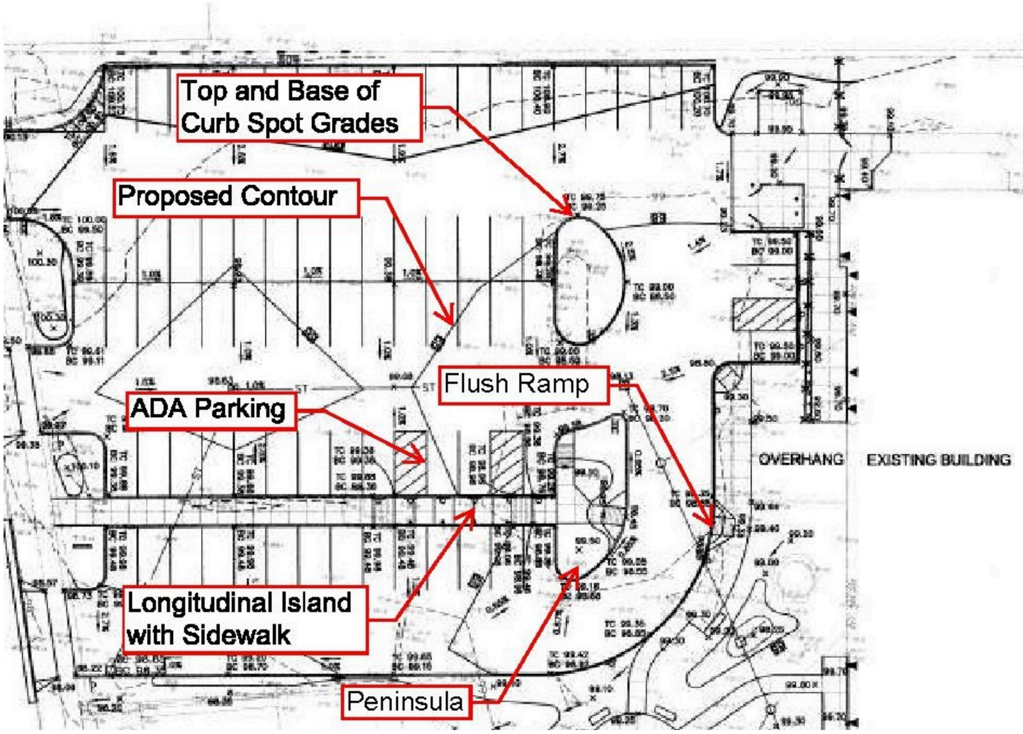

Figure F-13
(Sample Site Plan with Some Problem Areas Noted)

Property Line grading
Grade changes at the property line can be a problem, and is often overlooked. However, it is important that the engineer consider the existing grading characteristics following onto and off of the site at the property line.

Assume for example an existing condition where a large meadow is situated such that stowmwater will flow onto the site, perpendicularly across an undulating property line. In the proposed condition, a new parking lot or building only several feet off the property line is being proposed. If accommodations are not made to address the flow coming onto the potentially unrecognized low spot that is made, this could create standing water, which could lead to water in the building or groundwater into the basement. Perhaps the finished floor is a slab and is set high enough to remove that risk, but without a swale or other drainage structures placed in the area, the yard may develop standing water and become muddy for long seasonal periods. Muddy conditions makes

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the property less desirable and usable, and standing water fosters mosquito breeding and disease.

Further, the conditions could lead to the development of hydric soils which are one of the three parameters needed for protected wetlands to develop. Wetlands delineation is beyond the scope of this course, but as any property owner knows, the existence of wetlands on site typically reduces the value of the property, and the engineer should never intentionally create a scenario that could lead to protected wetlands in the future unless that is part of their intention and goals related to the sites development.

Drainage Outfall Location

Typically the drainage of the site will flow toward the existing low end of the site. Establishing how low the surface grade can be at the lowest portions of the site requires taking several things into account, for example: Where will the outfall of the outlet control structure be tied into? What type of detention basin is being proposed, and are there adequate clearances in order to achieve the drainage goals? What is the seasonal high groundwater elevation in the area of the anticipated basin? Much if this is beyond the scope of this course, but the beginning grading engineer should be aware that they may need to take these topics into account.

Setting the Finished Floor Elevation

Setting the most appropriate finished floor elevation is one of the most challenging aspects of site grading. Besides all of the various parameters that must be met associated with creating a vehicular accessible site and building, and a pedestrian accessible route from the parking lot to the building, maximizing the balance of the earthwork can be significantly impacted by the elevation that the building is set. The engineer should always make sure to set the finished floor elevation of the buildings on site based on good practices and by working within the guidelines established by the Authority Having Jurisdiction. As is important with any engineering discipline, check and recheck the figures prior to submitting the design. Inverting two digits on a grading design, for example FFE 510 when FFE 501 was intended can mean disaster. (See Figure F-14)

On rare occasions, the FFE of the building along some portion may need to be set below the surrounding proposed grade. In such cases, the engineer must notify the architect so that special treatment of the wall in this location can be made.

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In all cases, the surface grade should pitch away from the structure, and the engineer should investigate and become aware of any code required minimum slopes away from buildings.

Figure F-14
(Pictures of a Poor Grading Design on a Residential Project)

F. Summary and Conclusion

This course has identified the basics of site grading, identified some of the reasons for many of the parameters that the site grading engineer must design within, and has identified some problem areas that require extra attention.

The student of this course should now be able to approaching site grading with confidence that they have been exposed to the basics.

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