FDM 11-55-1 Boat Ramps

December 30, 1993

1.1 Site Layout

The layout of facilities such as access roads, parking lots, ramps, piers, etc., will depend greatly on the size, shape, and contour of the site, and on the location of existing vegetations. Each case will be different, but some general guides can be given.

One of the most desirable attributes of a site is its natural beauty. Ramps should be located and designed so as to blend in with and maintain the natural beauty of the shoreline. Parking lots should be set into the landscape so as not to disrupt it. Existing trees and shrubs should be preserved if at all possible. Before deciding to retain a tree, however, consideration should be given to the length of its remaining lifespan. Generally, protective islands can be employed to retain trees and shrubs in parking lots. It is not generally practical to plant or retain trees without these islands, because they are frequently hit by automobiles. Native trees or shrubs retained or planted along the shore, between the ramp or parking lot and other properties, and between the parking lot and any roadways that may be nearby will enhance the natural beauty of the access site and aid in controlling erosion.

It is recommended that a buffer strip of trees at least 40 feet wide be used between any parking lot and the shore (see Attachment 1.3 and Attachment 1.4).

In locating parking lots, sufficient room should be provided for future expansion. A typical method of doing this is shown in Attachment 1.1. In general, there should be no more than one car-trailer stall per ten acres of water to be served by the site. The aisle serving automobile and trailer parking should be aligned as straight as possible with the ramp to reduce the amount of turning required in backing up the rig. If this is not possible, the ramp should be offset to the left of the aisle, as one faces the lake. In this way the driver may back down the ramp while viewing the maneuver from the operator side of the car rather than from the blind side. When backing around corners is required, the corners should not turn more than 90 degrees. In placing the parking lot and ramp on the site, both should be centered as much as possible to provide an equal buffer zone for each adjacent property owner. Some typical layouts of access points are shown in Attachment 1.3 and Attachment 1.4.

1.2 Launching Ramps

A typical plan and profile view and typical cross sections of a launching ramp are depicted in Attachment 1.1 and Attachment 1.2, respectively. Several items are worth noting here.

For grades in excess of 15 percent it is difficult to obtain good traction on wet ramps; therefore, ramp grades should not exceed 15 percent. Desirably they should be at least ten percent or greater, especially for shorter boats. To aid in keeping the upper portion of the ramp as dry as possible, grades on the approach road or parking lot just above the ramp may be warped so as to prevent storm water from running down the ramp.

Quite often fill slopes, especially steep ones with light soils, will erode in heavy rains. As noted in Attachment 1.2, this can be minimized by inverting the ramp crown to eliminate runoff from the approach roadway. While this is contradictory to the previously mentioned consideration of keeping the water off the ramp, it should take precedence where erosion is a potentially serious problem. In some cases riprap or a similar type of protection can be provided at the toe or side of the ramp to prevent erosion.

In most cases it is advisable to surface the ramp and the ramp approach. The surface may consist entirely of coarse gravel, but a combination of P.C. concrete planking on the ramp and bituminous concrete on the approach is preferred. Bituminous concrete surfacing should not extend into the water but should end where the P.C. concrete planking begins. Details for P.C. concrete plank are given in Attachment 1.2. These details outline the dimensional and material characteristics of the preferred plank. However, where these are not readily available or a cost savings could be affected, comparable planks may be used at the designer's discretion.

Base course requirements are shown in the typical cross sections in Attachment 1.2. If the ramp is not surfaced, it is important to use a coarse material (maximum aggregate size of two inches) to prevent it from becoming too slippery when wet.

Piers should be provided where adequate maintenance is available and where ramp usage warrants them. The recommended placement of a pier with respect to a ramp is shown in Attachment 1.1. Where a high degree of resiliency is desired, wooden Piers are best. Details for two types of simple wooden piers (permanent

installation) are given in Attachment 1.2. Where ice damage is the primary consideration, a removable pier is recommended. Any of the various commercially sold floating piers with either a steel or wooden treadway would be best in this instance, but a semipermanent pier with removable supports and/or deck could be employed also. Floating piers can also be used to good advantage where water levels fluctuate greatly. Cleats and padding should be added to piers to protect the boats.

Ramps should be provided on the basis of approximately one per 20 parking spaces. The optimum width of top for a single-lane ramp is about 16 feet. This will permit the use of the standard 10 foot concrete plank with 3-foot gravel shoulders on each side. When a pier is included, this could be reduced to 14 feet as shown in Attachment 1.1, with a 3 feet shoulder on one side and a one-foot shoulder between the plank and the pier. When multiple installations are required, the recommended method is to build a series of single-lane ramps side by side with piers separating them in the manner depicted in Attachment 1.1. For the most part piers can then be used to service two ramps.

1.3 Parking Lots

It is preferable to pave parking lots whenever feasible, although gravel surfaces have proven satisfactory. The planting or retention of native trees and shrubs in the parking lot is optional but is very much preferred. Plantings that are susceptible to damage by turning vehicles should be protected with posts or enclosed with islands formed by a concrete curb at least six inches high. On a surfaced lot where plantings are omitted, required island areas can be adequately delineated with paint. Where there is a single row of car-trailer parking, it may be desirable to omit bumper blocks and permit the rigs to pull out the front of the parking stall; otherwise, bumper curbs of any acceptable material are recommended for delineating the front of vehicle parking spaces. Plastic and fiberglass curbs have been used but are not durable enough to withstand vehicle loading. Wood and concrete curbs are preferred. Since parking stalls cannot be easily delineated on gravel lots, their sizing and arrangement are more difficult to plan for. Somewhat wider stalls may be necessary under these conditions.

Desirable parking angles, aisle widths, and turning radii are all depicted in Attachment 1.1. An automobile requires a 10' x 20' parking space and an auto-trailer-boat combination requires a 10' x 40' area.

1.4 Miscellaneous Design

When practical, toilet facilities, picnic tables, grills, trash containers, and drinking facilities should be included as part of the access site improvement, especially if the site is remote from other such facilities. This should be conditioned, however, on the existence of adequate space and maintenance services. Toilet facilities are particularly desirable on many sites and possibly necessary on heavily used ones. In planning for them, a review should be made of DNR and Department of Health regulations.

Some projects will require only very short access roads. When longer ones are required, typical cross sections should be prepared to show the applicable significant requirements of the access roads. An example of a typical access road cross section is given in Attachment 1.2.

Since many of the items of work are not covered by the Standard Specifications, it will be necessary to include the description of work in the Special Provisions, listed as 90000 bid items. Some examples are Grade and Shape Parking lot, Grade and Shape Access Road, Grade and Shape Ramp, Install Concrete Ramp and Pier, Install Bumper Blocks, etc.

LIST OF ATTACHMENTS

Attachment 1.1	Boat Ramp Details
Attachment 1.2	Pier Details
Attachment 1.3	Boat Ramp Example Parking Layouts
Attachment 1.4	Boat Ramp Example Parking Layouts

FDM 11-55-3 Timber Management

June 18, 1999

WisDOT is committed to the preservation or proper management of trees within the highway right-of-way. As such, the designer is encouraged to regard the forest/timber as a resource having both aesthetic and commercial value.

Aesthetically, the existing trees and vegetation present an opportunity and basis for sculpting a pleasing and efficiently maintainable roadside. In this regard, the landscape architects in the Bureau of Highway Operations should be consulted.

When new right of way is acquired, the seller is compensated for the value of the marketable timber on that

property. The Department expects to recover that value in some form, nominally in the contractor's competitive bid. Unless otherwise specified in DOT contracts, the merchantable timber removed in clearing the right of way becomes the property of the contractor. The contractor is required to make the timber available for commercial or fuel use before disposing by other means. Contractors will generally make a good effort to market the timber and give consideration to anticipated revenue in preparation of their bid.

However, timber management in the form of advanced timber sale by the Department should be considered. This requires that right of way acquisition be completed sufficiently in advance of construction to allow for the sale and harvest; and that there be a desirable species of timber in sufficient concentration to be attractive to logging contractors.

Advance marketing of timber assures that the resource is properly utilized and, if properly undertaken, may expedite the construction contractor's operations. Active management also provides a response to the public, which occasionally perceives clearing operations as a waste of valuable resources.

FDM 11-55-5 Retaining Walls

March 28, 2014

5.1 General

Retaining structures are used to hold back earth where an abrupt change in ground elevation is required. They are useful in cases of restricted right-of-way or where existing features must be avoided.

The Bridge Manual (http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/strct/bridge-manual.aspx) contains guidance on all aspects of incorporating a retaining wall into a highway project. It is important that the designer be familiar with this guidance. That guidance will not be duplicated here, but will be briefly described:

Chapter 2 - *General*.

Section 2.5 (Bridge Numbers) shows the criteria for assigning structure numbers. Retaining walls receive R numbers which are assigned by the region in the same manner as bridge numbers. Only retaining walls with R numbers require structure survey reports. These are prepared using the Separation Structure Survey form and sent to the Structures Design Section. Also, as a rule, all retaining walls with R numbers will require a geotechnical analysis.

Chapter 14 - *Retaining Walls*.

Section 14.1.1.1 (Wall Numbering System) states the criteria for assigning an R number to a retaining wall.

Section 14.2 (Wall Types) lists the proprietary and non- proprietary wall systems considered for use on WisDOT projects.

Section 14.3 (Wall Selection Criteria) and Section 14.15 (Construction Documents) describe the process for selecting a suitable wall system for a given wall location and for incorporating the design for that wall into the construction contract documents respectively.

WisDOT may provide a complete design of one of the following types of walls on a project:

- Cast-in-place walls
- Gabion walls
- Post and panel walls
- Sheet piling walls

For a proprietary wall system (except as described below under "Minor Retaining Wall), WisDOT will provide a conceptual design including location (horizontal and vertical). The wall supplier is then responsible for the structural design and furnishing of complete design plans. Only one wall system shall be specified from the list of suitable systems.

All proprietary wall systems must be pre-approved by the Bureau of Structures (BOS) prior to being considered or used on WisDOT projects. Design all systems in accordance with the procedure specified by the WisDOT Bridge Manual and the appropriate Standardized Special Provisions (STSP 532-030 through 532-035, Item 90031) or Special Provisions (refer to BOS website) must be inserted into the contract. See the Approved Products List for pre-approval wall systems.

For proprietary walls (except as described below under "Minor Retaining Wall") BOS is responsible for reviewing the structural aspects of the design and construction plans provided by the wall company before construction can begin. Note that the structural design of proprietary wall systems is the responsibility of the wall supplier

(vendor).

Within 25 days after the award of the contract, the contractor must provide the region project engineer with the name of the vendor who will be supplying the proprietary wall system. A wall submittal package shall be submitted electronically to the project engineer and BOS no later than 30 days prior to beginning construction of the wall.

WisDOT will consider cost reduction incentive (CRI) proposals per the WisDOT Standard Specifications, provided the proposal is equivalent both functionally and aesthetically and does not violate any usage restrictions as stated in the WisDOT Bridge Manual.

Wall systems which are designed in compliance with the procedures specified by the WisDOT Bridge Manual are considered functionally equivalent. Aesthetic equivalence may vary from project to project because of public perception and site specifics and can best be determined by the designer involved in the project. See Chapter 14 of the WisDOT Bridge Manual for more details.

Bid each wall separately by the type of wall and either the R-X-XXX number or the sta.- sta. Limits, LT or RT. Include each wall in a list on the plan's miscellaneous quantity sheets.

Note: All retaining walls assigned an R number (such as R-XX-XXXX) are to be included in the 8.X sheet section of the plan set. Submit preliminary plans, final plans and shop drawings to BOS for review and acceptance.

5.2 Minor Retaining Wall

A "Minor Retaining Wall" is a proprietary MSE wall with a modular block face that is less than 5.5 feet tall or a proprietary modular block gravity wall that is less than 4.0 feet tall as measured from the bottom of wall or top of the leveling pad to the top of the wall.

Minor retaining wall details are to be included in the 2.X sheet section of the plan set and quantities in the 3.X sheet sections of the plan set under Miscellaneous Quantities". The minimum required details to be included in a minor retaining wall plan include: a plan view layout, an elevation view, estimated soil parameters, and a typical cross section view of the wall. See BOS LRFD Standard Detail Drawing 14.03 for a sample plan and WisDOT Bridge Manual 14.15.2 Special Provisions for bid items. This information constitutes a minor retaining wall plan.

Note: "Minor Retaining Walls" are not intended to support vehicle traffic or slopes equal to or steeper than 2.5H:1V. Additionally, tiered walls are not considered "Minor Retaining Walls" and should be assigned a structure number. In most cases, a geotechnical analysis is not required for "Minor Retaining Walls"; however, it is the designer's responsibility to determine if an analysis is required. Contact the BOS region liaison, regional soils engineer, or Bureau of Technical Services Geotechnical Unit for more information. Submit shop drawings to BOS for review and acceptance.

5.3 Barriers On Top Of Retaining Walls

When designing a retaining wall, determine if vehicles, bicycles, pedestrians or children are likely to be present near the top of the wall. Install a barrier at the top of any wall which is over 1 foot tall if the top of the wall is to be adjacent to a sidewalk, trail, parking lot or stairway landing. Walls located farther from human or vehicular activity may be higher before a barrier is considered necessary. In any case, provide a barrier if it is determined to be necessary, regardless of the height of the wall.

The barrier on top of a wall could be a fence, beam guard, or a railing. Coordinate the selection, location and installation details of a proposed barrier with the structural designer. Consider aesthetics of any barrier, especially in urban areas where the wall and barrier is located adjacent to private property.

5.4 Right-Of-Way Requirements

All segments of a retaining wall system must be under the control of WisDOT. This includes the area behind a MSE type wall containing the soil reinforcing elements. This area is considered part of the wall. Do not allow permanent improvements, including utility construction, in this area.

Fee simple purchase of the right of way is the best option. A permanent easement may be used, but this is not recommended. If sufficient right of way cannot be obtained for a particular type of wall, then specify a different type of wall.

Mature trees or structures on private property can also affect the choice of wall type. Wall types having tie backs may require clearing vegetation that would affect adjacent properties. Also, consider buildings that are near the right of way that could be undermined.

Sometimes a right-of-way estimate is needed before the wall type is selected. In these cases, estimate the R/W need at 6 feet from the back of the proposed wall, or use the height of the wall, whichever is greater. This

estimate is for planning purposes only. The exact distance must be determined after a geo-technical investigation is completed. This investigation may reveal the need for even more right-of-way at the site.

FDM 11-55-10 Cattle Pass Design

September 19, 2013

10.1 General

A stockpass is defined as any structure which allows domestic animals to cross a highway without interfering with traffic. In Wisconsin, the applicable domestic animal population ranges in size from sheep to llama to buffalo. While the general principles of this policy are applicable to all livestock, the policy will be directed and referenced to cattle and cattlepasses.

A cattlepass is generally considered to be either a land service facility or a highway service facility. The land service facility is for the benefit of a business or non-public land owner, whereas the highway service facility benefits highway users. FHWA generally considers a cattlepass to be a land service facility; therefore, it is up to the state to document that a proposed cattlepass is for the benefit of the traveling public.

Public funds designated for the improvement of highways are limited to that purpose. Highway funds used for the installation of a cattlepass and related appurtenances on the highway right of way must be in the public interest and for the benefit of highway users. The benefits accruing to the landowner or occupant whose stock uses these highway service facilities are considered incidental. A landowner may request that the Department provide a cattlepass for his convenience or safety (i.e., a land service facility). In such instance, the Department can reasonably recognize that any installation results in some benefit to the highway user (although likely not sufficient to justify the total cost of the installation). Highway funds could therefore participate to the limit of public benefit perceived, and the remaining cost would be the responsibility of the requester.

Refer to FDM 11-45-2.2 and FDM 11-45-2.6 for the definition of hazardous cross drain or cattle pass, treatment options, and warrants for various treatment options.

10.2 Criteria

Past, present, and potential future use of the lands may demonstrate the need to provide for or perpetuate the circulation of stock and therefore the need to provide for the safety and convenience of the highway user. Designers should meet with stock owners to discuss their need for and willingness to use the facility as well as any restrictions which require that the facility be used.

New construction, or reconstruction involving grading, allow the opportunity to design in safety features in a more cost effective manner. A retrofit situation, which would be initiated in response to a changed land use or evolving hazard, will likely be more costly and hence more difficult to justify, and may also probably provide less-than-ideal service.

10.2.1 On New Grading Sections

Highways warranting design standards A2 or above should provide cattlepasses at locations where herds of 20 or more will cross the highway on a regular (daily) basis.

On highways of lower volumes or function, cattlepasses may be considered if sight distance limitations make an at-grade herd crossing hazardous or if herd size causes lengthy delays to highway traffic. These installations must be justified and supported on the basis of cost effectiveness and safety.

The separation of livestock from designated freeways and expressways is always warranted regardless of conditions, by definition of the access. This restriction should be recognized during the real estate phase of project development, preferably through payment of damages or whole takings but also by land exchanges. A cattlepass on this type of facility would likely be of such length and size and resultant cost as to justify a change in land use.

Designers should note that if a cattlepass is provided as a real estate consideration, it becomes part of the value of the property and therefore cannot be taken away without compensation. Example; if lands are taken with payment based on acreage taken, and the remnant has diminished value due to severance, and that diminished value is not compensated with dollars but rather restored to value by a cattlepass, then the cattlepass becomes a compensable part of that property (until such time as ownership and use of the remnant changes or becomes unrelated to the rest of the property.)

10.2.2 Non-grading Situations:

The Department may respond to a request from an abutting owner for a cattlepass in the same manner as any other land service facility request.

Proper attention to visibility, adjusting the location of an at-grade crossing, and the use of advance warning

signs are often the most cost-effective and feasible treatment.

10.2.3 Documentation

Prior to committing resources to the design and construction of a cattlepass, the “Documentation for Cattlepass” worksheet (Attachment 10.1) should be completed, accepted by the designated region authority, and filed both in region and central office project files. The ‘Basis for Consideration’ portion of the worksheet is meant to identify such items as a private request, an identified safety problem, new construction of a high-volume facility, combination of the above or other. Note that the worksheet may also be used to document the decision not to include a considered, or to turn down a requested, cattlepass. The inclusion and location of each cattlepass should be discussed in the “Unique Features” section of the Design Study Report.

10.3 Design Guidelines

Cattlepasses, due to minimum size requirements, are expensive to construct and shield. The most expensive cattlepasses, however, are those that are not used due to inadequate design, or subsequently abandoned due to avoidable deterioration. Therefore, if a cattlepass is warranted, it should be sized and located to be attractive for use, and should be designed to avoid bog ends.

In most cases a structure should be built to accommodate either livestock or drainage, not both. In some cases, however, a combined facility may be unavoidable. This includes river crossings being lengthened to accommodate a stock path on the bank or in the case of a dry run or overflow structure. When a combined facility is being considered, it should be designed to carry water only when runoff exceeds that expected from a 10-year storm.

The cattlepass and its approach path should never be placed at a drainage low point; there must always be drainage away from the facility. In addition, aprons or paved walkways will aid in preventing bogs or mudholes. Placement and drainage influence the attitude of the user; a stockowner will make a greater effort to use a well drained structure than a poorly drained one. Bogs resulting from poor drainage conditions can become breeding grounds for disease, a factor which is critical to dairy farmers.

Placement of the cattlepass as high up in a fill section as possible, considering cover and clearzone, will result in the shortest length.

The longer a cattlepass is in relation to its size, the more hesitant stock are to pass through it. For that reason, the opening size may be varied, depending on cattlepass length and size of herd. A minimum usable opening of 4' x 6' may be acceptable for lengths up to 75 feet. Beyond that, sizes of 6'x 6' to a practical maximum of 7' x 7' can be considered, the larger for lengths in excess of 150 feet passing herds of more than 70 head.

The cattlepass should always have a minimum gradient of 1%, desirable 3%, sloped one way to allow flushing, but not so steep that the stock will slip. Gradients steeper than 5% should be textured.

Fences should be constructed to the highway right of way as part of the facility.

As with the consideration of necessity and location, the design of the facility should be discussed with the stockowner.

10.4 Other Considerations

As part of the highway, the physical facility on the right of way is maintainable by the state. To that end the installation should be designed, constructed, and maintained so that it is functional and serviceable, with due consideration to minimizing erosion, providing adequate drainage, and with walkways sufficiently stable to permit the passage of the livestock without undue soft and muddy conditions developing on the right of way.

The owner or occupant of the property served shall be required to maintain practical and serviceable fences along the stockpath approach with due regard to not impairing surface water drainage or the function of the structure. Such owner or occupant shall also be responsible for cleaning the structure floor and walkway approach.

An understanding of cooperation and responsibilities should be reached and documented for the protection of all concerned. It must be further understood that the state will have the right to gate or remove the facility at such time as it may no longer be needed for livestock operations or if the facility becomes a nuisance.

If the cattlepass is provided at the request of an abutting owner, the basis of participation should be included in the above agreement.

Existing cattlepasses within a proposed improvement project should be reviewed to determine usage and condition. If it is determined that a stockpass is unused, the property owner is informed by letter that the department proposes to either abandon or remove it. The property owner should be allowed ample time to respond. A desire on the part of the property owner to perpetuate the cattle pass should carry with it some

tangible evidence of legitimate future need. If no response is received from the property owner, it is assumed they have no further interest in the facility. Experience would suggest that a second notification effort is desirable to avoid misunderstanding.

If the cattlepass is to be perpetuated it should be evaluated for structural condition, improvements if needed, or replacement.

If no longer needed as a cattlepass, its condition and effect on safety is evaluated. If in good condition, it is normally abandoned by removing the end sections and filling with earth. If in poor structural condition, it must be removed. In instances where the stockpass also serves as a drainage facility, determination is made as to the cost effectiveness of retaining it for that purpose, or replacing it with a smaller, safer drainage pipe.

It is currently accepted that the presence or absence of a cattlepass has little bearing on the value of farm property as this item is only of value to a single use of the land. However, each cattlepass should be reviewed to determine that any action by the Department is appropriate, fair to the property owner, and to the benefit of the traveling public.

LIST OF ATTACHMENTS

Attachment 10.1 Documentation for Cattle Pass

FDM 11-55-15 Permanent Public Trails Crossing Rural Public Roads *October 5, 2011*

This portion of the FDM has been transferred to FDM 11-46-20.

FDM 11-55-20 Overhead Sign Structures *October 3, 2016*

Revise 11-55-20 (Overhead Sign Structures) to change name from overhead sign supports.

20.1 General

Sign structures are composed of overhead sign supports and sign bridges. Either type of sign structure can be configured to be a cantilever sign structure (one upright to arm) or a full-span sign structure (two uprights, one on each end of the span). Single (butterfly) is another type of sign bridge. Roadside sign supports are an exception to the above naming convention.

20.2 Overhead Sign Supports

Overhead Sign Supports are smaller sign structures carrying type II (smaller) directional signs, limited amounts of type I signs and small LED or changeable message signs. Type II sign depths have ranged from 3’-0” to 4’-0” deep for traffic directional signs, and up to10’-0” for small information type I signs. When a sign is larger than 10’-0” deep, the structure is to be designed as a sign bridge. Cantilever overhead sign supports accommodated up to 45 sq. ft. of sign area. Total sign areas accommodated on full span overhead sign supports range up to 300 sq. ft. These ranges are an approximate guide and can be more or less depending on variables such as span length, location of the sign with respect to the upright(s), the height of the upright(s), etc. Uprights are comprised of single column pole (round uniform or tapered pipe) for either the cantilever or full span overhead sign support. Arms on cantilever and the span on a full span overhead sign support are either one chord (round uniform or tapered pipe), or two chords with or without angle web members depending on the span length and sign depth. Due to the variability of factors that can influence the selection of structure type, designers are encouraged to contact BOS Structures Design Section for further assistance when sign areas fall outside of the above limits, or when structural geometry is in question. Overhead Sign Supports are normally bid by contractor and designed by a fabricator or by another party for a fabricator to construct. Typical structures with steel poles on standard concrete bases usually have the least plan detail associated with them and are normally depicted in the Construction Detail portion of the state contract plans. However, it is recommended that plan development for projects with multiple structures, such as major or mega projects, and structures mounted on non-standard supports to be prepared by structural engineers and placed in section 8 of the contract plans along with the sign bridge plans. A concrete base design is required to be shown in the contract plans for overhead sign supports.

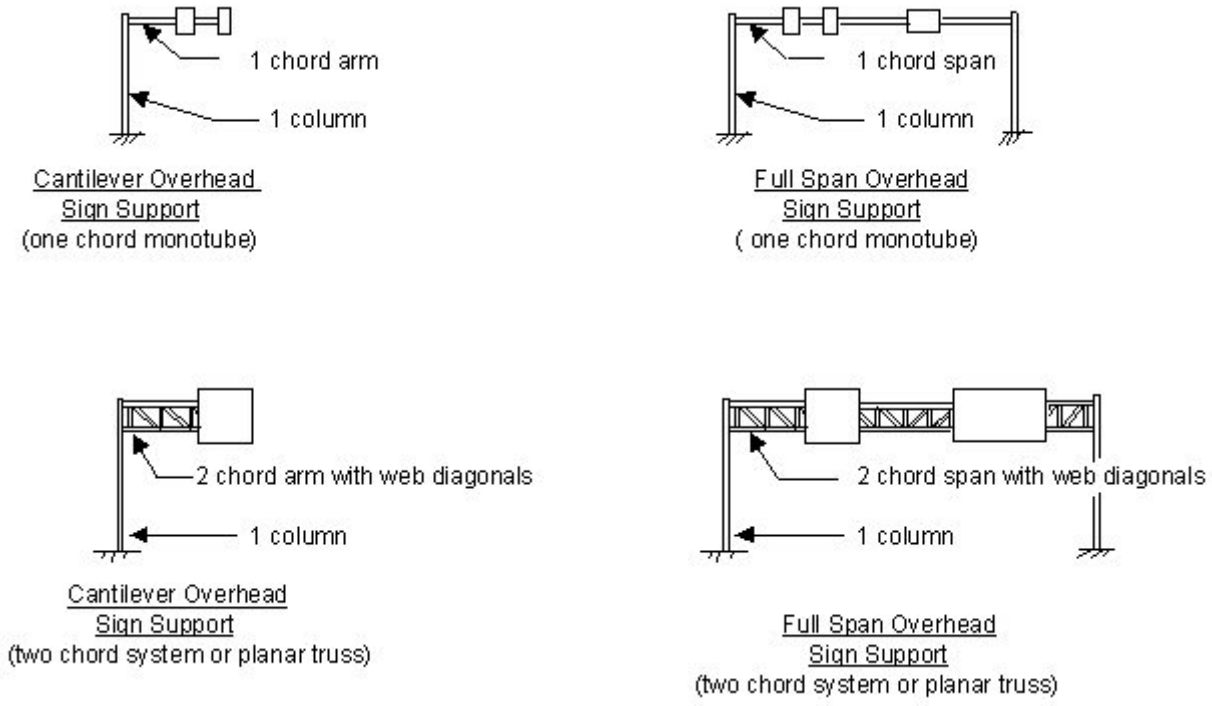

Figure 20.1 Overhead Sign Support Structures

If these structures are carrying type I and II signs and meet several criteria/limitations, the designer can use WisDOT-developed standard foundations. Standard detail drawings (SDDs) exist for cantilever overhead sign supports. These single shaft concrete bases for cantilever overhead sign supports vary in depth and range from 24" to 42" in diameter (SDD 15c22 thru SDD 15c25). Another SDD applies to full-span overhead sign supports and is 36" in diameter (SDD 15c15). The standard foundations shown in these SDDs were designed using slightly conservative soil design parameters. If the design criteria for these standard designs are not met, the SDDs cannot be used, the structure foundation must be fully designed and the unique details shall be done in accordance to the overhead sign support mounted on non-standard supports procedure described above. This involves determining the subsurface conditions as described in Subsurface Investigation and Information below.

20.3 Sign Bridges

Sign Bridges generally carry Type 1 Signs and occasionally Variable Message Signs (DMS). These are large sign structures with sign depths ranging from 5'-0" or less to over 18'-0" in the case of large diagrammatic signs. Butterfly sign bridges are limited to 218 sq. ft. of sign area per side. Total sign areas accommodated are up to 264 sq. ft. on cantilever sign bridges. Total sign areas accommodated on full span sign bridges range from 250 to over 1000 sq. ft. These ranges are for approximate guide only. Butterfly sign bridges consisted of either a single chord or double chord without web members. Other sign bridges generally have truss members consisting of four round chord and angle web members supporting signs on the span or arm (although some three chord structures have been used for full span sign bridges). Uprights are comprised of one column for a butterfly, cantilever and full span three chord sign bridges. Full span four round chord sign bridge uprights usually consist of two columns joined by angle web members at each end of the span. All Sign Bridges and their foundations are designed by the Bureau of Structures (BOS) or a consultant. Structure contract plans provide full details that a fabricator can construct the sign bridge. Refer to Chapter 39 of the WisDOT Bridge Manual (http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/strct/bridge-manual.aspx) for further guidance on the design of Sign Bridges.

20.4 Subsurface Investigation and Information

No subsurface investigation/information is necessary for any of the sign structures that meet the limitations for allowing the use of WisDOT standard foundations. Appropriate subsurface information is necessary for any of these structures that require individual designs.

There may be several methods to obtain the necessary subsurface soil properties to allow individual design of foundations, as described below:

- In areas of fill soils, the borrow material may be unknown. The designer should use their best judgment as to what the imported soils will be. Standard compaction of this material can be assumed.

Conservative soil design parameters are encouraged.

- The designer may have a thorough knowledge of the general soil conditions and properties at the site and can reasonably estimate soil design parameters.
- The designer may be able to use information from nearby borings. Judgment is needed to determine if the conditions present in an adjacent boring(s) are representative of those of the site in question.
- If the designer cannot reasonably characterize the subsurface conditions by the above methods, a soil boring and Geotechnical report (Site Investigation Report) should be completed. Necessary soil design information includes soil unit weights, cohesions, phi-angles and location of water table.

Designers should also beware of the potential of high bedrock, rock fills and the possible conflict with utilities and utility trenches.

20.5 Design Limitations

For Overhead Sign Supports with Type I or Type II Signs:

- The arm length (measured from the centerline of the pole upright to the end of the arm or outer most sign) is limited to a maximum of 40 feet in the case of a cantilever overhead sign supports.
- Use a full-span overhead sign support when the span needs to be more than 40 feet. Use double arms (chords) connected by web members if the span (with vertical uprights at each end) exceeds 75 feet in length.
- Use double arms (chords) connected by web members if the sign depth is more than 6’-0” regardless of span/arm length.

For overhead sign supports carrying smaller variable message signs such as a small LED or changeable message signs:

- The arm on a cantilever overhead sign support or span on a full span overhead sign support shall consist of two chords with web diagonals. Minimum distance center to center of chords is 4’ - 0”.
- The maximum size of the variable message sign allowed on a cantilever overhead sign support is 10’-3” x 4’-3” x 1’-3”. Maximum weight is 700 lbs.
- The maximum arm for a cantilever overhead sign support is limited to 20 feet for normal vertical upright heights (ground to center of arm attachment point approximately 19 to 21 feet). Use a full span overhead sign support when this arm limit is exceeded.
- The maximum size of the variable message sign allowed on a full span overhead sign support is 10’-3” x 6’-0” x 1’ – 3”. Maximum weight is 850 lbs. Maximum span for a full span overhead sign support is 70’ – 0”.

Consult with the Bureau of Structures when the above limitations are exceeded for variable message signs mounted on overhead sign supports.

20.6 Design Guidelines

- Check the available room at the installation site for the structure base. For example, check the proposed base diameter against the available room between a curb section and a sidewalk.
- Consider the distribution of signing in the case of full-span overhead structures. Do not leave a relatively large portion of horizontal span “unsigned” with signs only at the end of the span.
- See FDM 11-35-1 and WisDOT Bridge Manual chapter 39 (http://wisconsindot.gov/dtsdManuals/strct/manuals/bridge/ch39.pdf) for design considerations and requirements for vertical clearance.

See Attachment 20.1 for an example of how to select a base for a cantilever overhead sign support.

See Attachment 20.2 for how to check the adequacy of the WisDOT standard base design for a full span overhead sign support.

20.7 Roadside Design Guidelines

Provide shielding (e.g. crash cushion or barrier, transitions, end terminals, grading…) for an overhead sign installation when the design or off peak operating speed is 45 mph or greater. Shielding is required even if the overhead sign is placed outside the clear zone of the roadway because the consequences of a crash (not only for the individuals in the errant vehicle, but other users of the roadway network and pedestrians) are severe.

If the design or off peak operating speed are less than 45 mph but are greater than or equal to 35 mph it is optional to provide a shielding for overhead sign supports installed outside the clear zone. However, individual site analysis is required. If the design or off peak operating speed are less than 45 mph but are greater than or equal to 35 mph and the overhead sign support is within the clear zone, provide shielding unless individual site

analysis indicates otherwise.

For design or operation speeds that are less than 35 mph, shielding is not typically required, unless an individual site analysis indicates otherwise. Designers are required to perform an individual sight analysis for speeds less than 35 mph.

Individual site analysis includes:

- Review of existing crash data
- Review of the alignment and cross sectional elements near installation
- Traffic volumes
- Character of traffic
- Impact of installing barrier systems, (e.g. grading required, purchase of R/W, drainage needs…)
- Consequences of not installing barrier system, (e.g. Could the sign fall onto the road or pedestrians, if sign does not fall but is taken out of service, what is the impact to the road network?)

Some examples that would tend to lead designers to install barrier would be:

- Segment of roadway has run-off-road (ROR) flag in metamanager.
- Substandard alignment or cross sectional elements exist near the proposed installation.
- Installation is near or in a weave, merge or diverge section of roadway.
- Roadway violates driver expectation (e.g. hidden curves, entrance /exit ramps on left side of roadway).
- Installation is in areas where ROR crashes are more likely to occur (e.g. tapers, outside of curves…).
- High AADT in area of installation (i.e. High AADT increases the probability of a vehicle leaving the roadway).
- Majority of traffic is unfamiliar with the roadway.
- Impact to roadway and users if the overhead sign support was damaged or destroyed.

Some examples that would lead a designer to not install barrier are:

- Not possible to install barrier according to standards (e.g. LON would cause the closure of side streets)
- Accident history does not indicate a problem with ROR accidents.
- No substandard features are present
- Installation is on tangent section.
- Low AADT

Document decisions to provide or not to provide barrier or crash cushions at a given location. Provide barrier systems with appropriate Length of Need (LON), adequate deflection distance from barrier to front face of sign bridge support, appropriate end terminals and grading. Document why it is not possible to provide adequate LON, deflection distance, end terminals, and grading. Documentation is to include what other alternatives were reviewed, and why a particular alternative was selected.

See FDM 11-15-1, and FDM 11-20-1 for guidance on clear zones. See FDM 11-45-1 for guidance on barrier systems.

LIST OF ATTACHMENTS

Attachment 20.1	Sign Support Base Design Process
Attachment 20.2	Full Span Overhead Sign Support Base Adequacy Check

FDM 11-55-25 Ramp Gates

June 19, 2013

25.1 Background

WisDOT uses closure gates to restrict freeway access at key entrance ramps throughout Wisconsin. The ramp closure gate design is based on the NCHRP 350 crash tested gate, the details of which were originally developed by the State of Wyoming. This gate can be installed within the clear zone because the base is designed as a breakaway component and the above ground components are designed to rotate over the vehicle during an impact.

25.2 Deployment and General Considerations

The situations in which closure methods are to be applied are summarized below:

- *Barricades* - Type III barricades are recommended for deployment on entrance ramps along interstate corridors with an average annual daily traffic (AADT) along the mainline of less than 45,000. These barricades are to be safely stored within the freeway interchange when practical. Ramp closure barricade rack(s) (refer to STSP 662-015) shall be included for storing the barricades.
- *Ramp Closure Gates* - Ramp closure gates consistent with the gates currently used in Racine and Kenosha Counties are recommended for deployment on freeway entrance ramps along interstate corridors with mainline AADT of more than 35,000. These gates are manually operated.

The overlap in AADT ranges is intended to allow for flexibility in selecting which closure method to implement at a particular location. Deployment recommendations are based on AADT; however, other factors must be evaluated before prescribing the gate treatment.

Other Deciding Factors:

- *Site-Specific Conditions* - Site-specific conditions need to be considered when selecting a closure method. Some issues to consider include availability of a safe barricade storage location, expected personnel availability during a road closure event, crash rates in the area, and expected frequency of use. Also, some locations may require a combination of gates and barricades. For example, at signalized intersections a gate may be used to close the entrance of the ramp and barricades may be used to close left turn lanes that approach the ramp. In addition, closure devices must be placed in locations that do not trap vehicles. Engineering judgment must be exercised when selecting a closure method.
- *Corridor Consistency* - In some locations the AADT guidelines may not be followed in order to select a closure method that maintains consistency within a corridor.
- *Barricade Storage* - Barricades should be pre-positioned on-site when practical. Consideration must be given to placement outside of the clear zone, right of way availability, site topography, snow storage needs, and locations that do not obstruct sight lines. Steps should also be taken to limit weathering of the barricades' reflective sheeting.
- *Maintenance* - A maintenance plan must be followed to inspect barricades and ramp closure gates to ensure proper functionality. Barricades should be inspected a minimum of once per year, prior to the winter driving season. Special attention should be given to the condition of barricade stands and retro-reflective barricade/sign sheeting. Ramp closure gates and associated signing should be inspected a minimum of twice per year, prior to and after the winter driving season. Maintenance should follow the procedures outlined in the *Wisconsin Ramp Gates Maintenance and Inspection* graphic (refer to Attachment 25.1). A maintenance log for ramp closure gates should be kept on site inside the solar or hardwired gate cabinet.

Additional Considerations:

- *System to System Interchanges* - System to system interchanges should be closed with multiple devices brought to the site in accordance with procedures outlined in the MUTCD. Drop down gates and stored on-site barricades are generally not feasible to close system to system interchanges because of the higher vehicle speeds and resulting roadway geometries, both of which require greater closure visibility than a gate or small number of barricades can provide.
- *Roundabouts* - Roundabouts are generally amenable to closure with gates or barricades. However, each location is unique; refer to the Gate and Barricade Research Findings and Recommendations report for further discussion.
- *Signage* - Properly placed signs are an important tool in notifying the public of closures. Flip down signs should be installed in conjunction with drop down gates. For especially high volume areas, these signs could be augmented with active warning flashers to be made more effective. Refer to the "Other Design Considerations" section for additional guidance.

25.3 Gate Placement

Placing gates is a complex design process that must consider many, often competing, factors. These factors are listed below in relative order of importance, and are discussed in more detail in the remainder of this section.

- Grading
- Curb and Gutter
- Gate Knockdowns
- Vehicle Trapping
- Single vs. Multiple Gates
- Adjacent Roadway Features

- Pedestrians
- Sightlines and Driver Reaction Time
- Control Boxes and Power Supplies

25.3.1 Grading

Breakaway designs require the vehicle to properly engage the pole assembly. Proper engagement is dependent on the vehicle's bumper being close to its normal position during impact, and the mounting hardware/base being properly traversable. Place gates in locations that adhere to the following guidance:

Approach Grading:

Provide grading that is 10:1 or flatter within the approach grading area (refer to Figure 25.1).

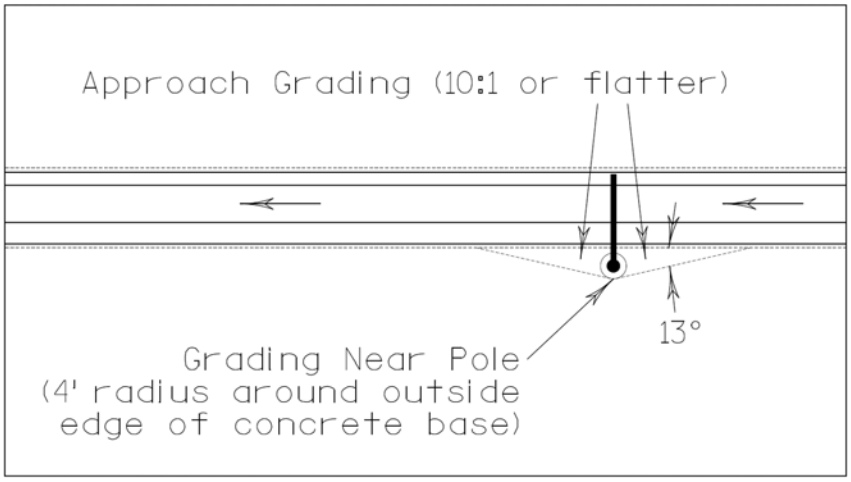

Figure 25.1 Horizontal Grading at Ramp Gate

Grading less than 10:1 may not allow for proper activation of the breakaway features of the pole or may cause the pole to contact the roof of the vehicle after initial impact. Figure 25.2 shows failure to properly break away when a vehicle did not engage a pole at the correct height.

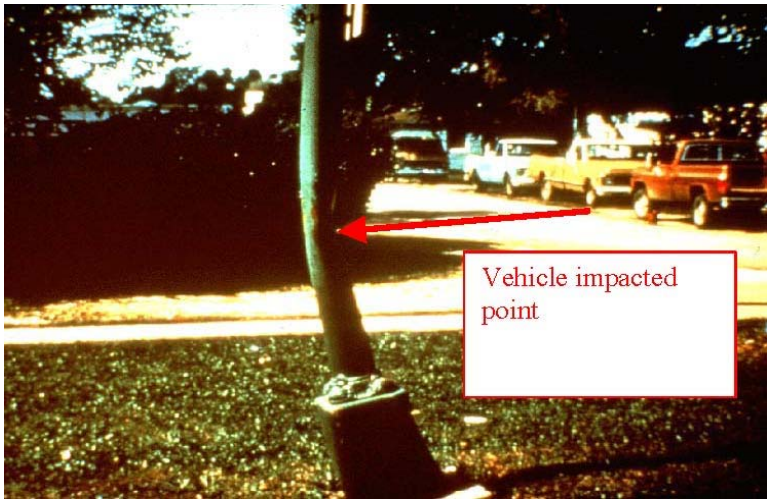

Figure 25.2 Improper Grading Causing Pole Not Breakaway [1]

Vertical Grading at Pole:

For a vehicle to effectively traverse the pole mounting hardware or concrete footing, the stub height of the gate's breakaway support is required to be less than 4" on a 5-foot chord (see Figure 25.3). If the stub height is greater than 4" on a 5-foot chord, a vehicle may decelerate too rapidly or be tripped by the stub. Provide 10:1 or flatter grades near the pole to make sure the vehicle does not snag on the stub or concrete footing.

[1] NHI Roadside Design Presentation, 2009

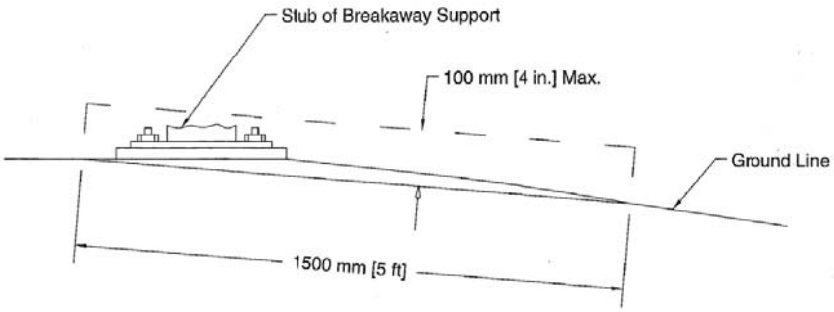

Figure 25.3 Grading Profile [2]

Figure 25.4 shows an installation where the concrete footings for a breakaway road sign are too far out of the ground, resulting in a roadside hazard even though the sign has breakaway hardware.

Figure 25.4 Improperly Installed Concrete Footing [3]

25.3.2 Curb and Gutter

After impact with a 6" high barrier curb, it is difficult to predict the vertical trajectory of a vehicle's bumper. Thus, impact with a curb increases the probability that a vehicle will not engage a ramp closure gate correctly. Crash testing has indicated that a distance of 8' is needed from the flow line of a curb and gutter to the face of rail so that a vehicle properly engages beam guard [4]. This crash testing serves as a basis for gate placement guidance in the presence of curb and gutter. In the area of approach grading shown in Figure 25.1, ensure the following conditions are met:

- For operating speeds ≥ 35 MPH - three options are recommended:
  - Place gate 8' from the flow line of the ramp curb and gutter (see Figure 25.5)
  - Remove curb and replace with mountable curb less than 2" high (driveway entrance curb, per SDD 8d1, less than 2" high is exempt from the 8' requirement)
  - Provide shielding per FDM 11-45
- For operating speeds < 35 MPH - there are no restrictions on the use of curb.

[2] AASHTO Roadside Design Guide, 2006
[3] NHI Roadside Design Presentation, 2009
[4] Zhu, L., Reid, J.D., R.K., Lechtenberg, K.A., Brenner, C.D. and Bielenberg, R.W., "Draft Performance Limits for 152-mm (6-inch) High Curb Placed in Advance of the MGS using MASH 08 Vehicles - Part 1: Vehicle-Curb Testing and LS-DYNA Analysis", TRP-03-205-08

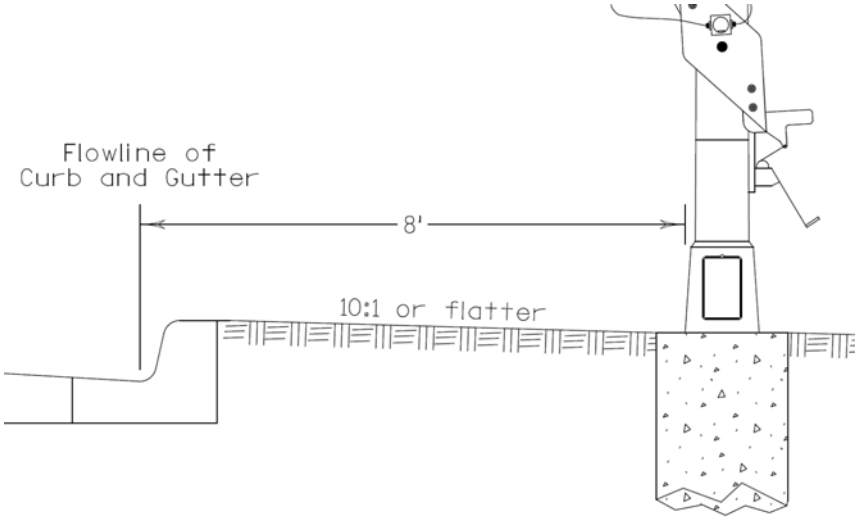

Figure 25.5 Footing

25.3.3 Gate Knockdowns

Special considerations should be made with regard to the potential for gate knockdowns from errant mainline vehicles and oversize vehicles, especially when the mainline roadway is a designated long truck route. To lessen the chance of a knockdown from an errant mainline vehicle, gates should be located outside the mainline roadway's clear zone. Locating gates at the edge of or outside mainline clear zones will also lessen the chance of an errant mainline vehicle spearing a deployed gate arm.

As previously indicated, place gates 8' from the flow line of a ramp curb and gutter (see Figure 25.5). In locations without curb and gutter, place gates 6' from the edge of ramp pavement (see Figure 25.6). Analysis of long truck turning movements indicates that gates located within the infield of a standard diamond interchange are less likely to be struck by a trailer than gates placed to the outside of the interchange. Thus, consider placing gates within the infield of a standard diamond interchange (see Figure 25.7). Make similar considerations for other types of interchanges.

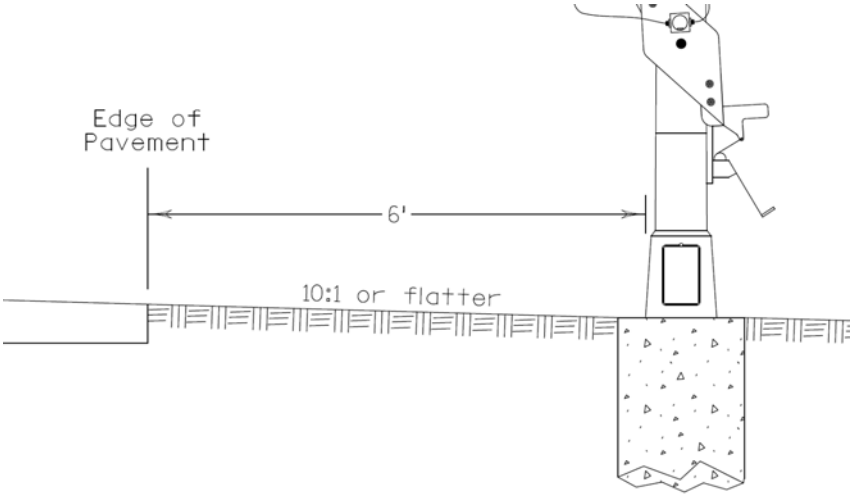

Figure 25.6 Footing

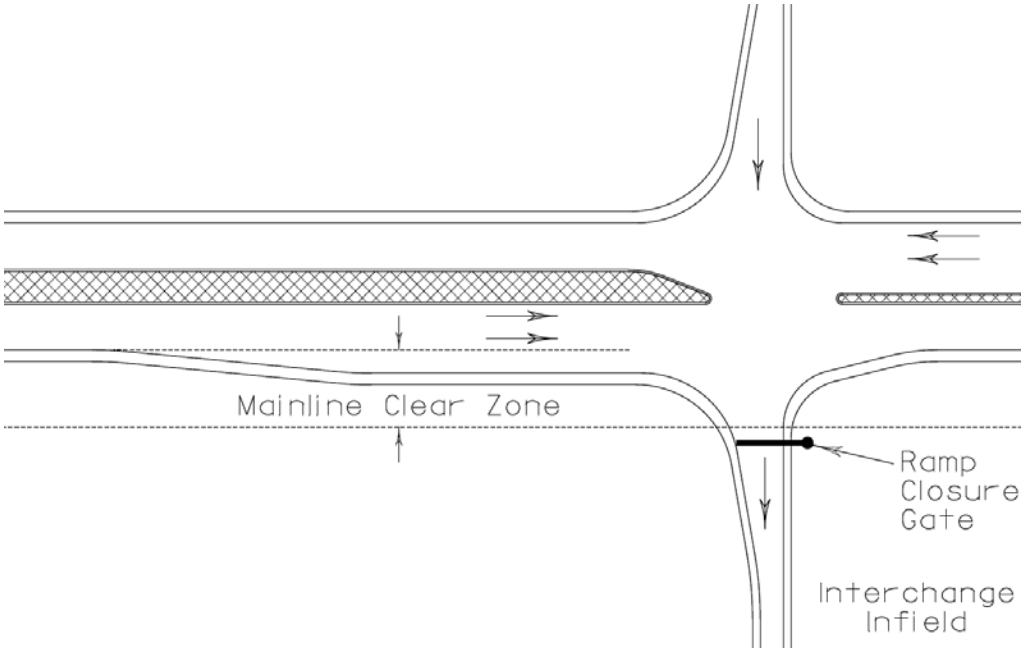

Figure 25.7 Ramp Gate Placement at Diamond Interchange (Typical)

25.3.4 Vehicle Trapping

If possible, gates should be located outside the mainline roadway's clear zone. However, gates should be placed close enough to the intersection to prevent "trapping" vehicles between the gate and the intersection. Gates located near the downstream ramp curb return (or a similar edge of pavement return for ramps without curb and gutter) will often put a gate outside the mainline roadway's clear zone while keeping the possibility of trapping vehicles to a minimum (refer to Figure 25.8).

25.3.5 Single vs. Multiple Gates

Using a single gate to close a ramp is highly desirable, as installation costs, maintenance costs and the possibility of a gate being struck all increase with the placement of multiple gates. Choose a gate arm length to cover at least the distance between the mounting pole and a point three feet from either the opposite side curb face or opposite side edge of shoulder to prevent drivers from maneuvering around the gate structure (refer to Figure 25.8). The minimum gate arm length is 24' while the maximum gate arm length is 40' (gate arm lengths are measured beginning at a point offset approximately 1.33' from the center of the mounting pole).

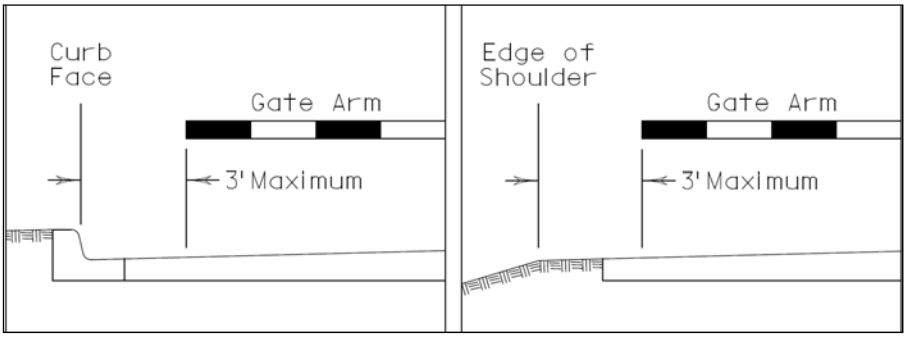

Figure 25.8 Ramp Gate Arm Lengths

25.3.6 Adjacent Roadway Features

If gates adhering to the above gate placement guidelines are in conflict with utilities, traffic signals, lighting, beam guard or other adjacent roadway features, shifting the gate location may be required. Increasing the offset from the ramp and moving a gate slightly downstream or to the opposite side of the ramp are the simplest measures for reducing conflicts with adjacent roadway features.

Always ensure that gates are not in conflict with the indications on traffic signal heads. Placing a gate along a ramp downstream from an adjacent traffic signal standard and mast arm should avoid such conflicts.

On a ramp lined with beam guard, place gates 6’ behind the face of the beam guard to allow for deflection (refer to Figure 25.9).

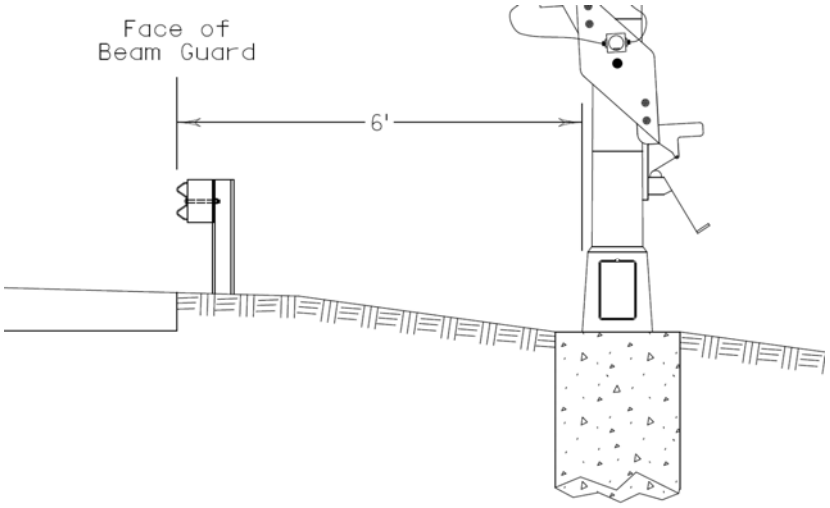

Figure 25.9 Ramp Gate Offset behind Conflict

Ensure the gate pivot assembly is installed at a proper height on the mounting pole so as to allow for free gate arm movement above the beam guard (see Figure 25.10).

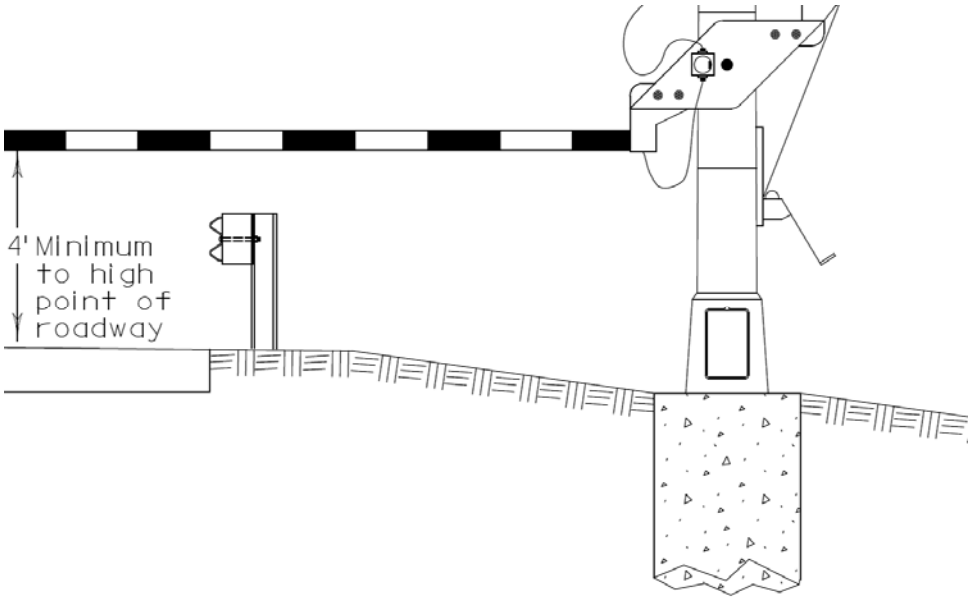

Figure 25.10 Ramp Gate Height behind Conflict

25.3.7 Pedestrian

Place gates so as to not block a pedestrian sidewalk or crosswalk when the gate arm is deployed.

If gates must be placed in areas of significant pedestrian traffic, the potential exists for pedestrian injuries due to a knockdown. Several options should be considered for mitigation:

- If possible, place the gate in an area where there is less pedestrian exposure
- Place the gate in an area where knockdowns are less likely
- As a last resort, provide beam guard shielding to prevent a vehicle from hitting the gate

If beam guard is needed to shield a gate, it is required that the barrier is of sufficient length to protect the gate (i.e. length of need), has appropriate end terminals and appropriate grading is provided for the barrier and end terminals.

25.3.8 Sightlines and Driver Reaction

Consider sightlines and driver reaction time when locating gates. Ideally, drivers would be able to observe a deployed gate arm far enough in advance to avoid entering a closed ramp and becoming trapped. If adequate sightlines and driver reaction time cannot be provided at a particular location, consider supplementing the gate with advance flasher assemblies.

25.3.9 Control Boxes and Power Supplies

Locate control boxes and power supplies (e.g. utility services, solar panels) outside of mainline and ramp clear zones.

25.3 Guideline Compliance Documentation

If it is not feasible to follow the aforementioned gate placement guidelines, document why a particular location was selected, what alternatives were reviewed and why a particular alternative was selected.

25.4 Other Design Considerations

25.4.1 Operating Speeds

Operating speeds on the ramp near a gate may be lower than the design speed used for the mainline roadway due to vehicles turning onto the ramp. Use acceleration tables from *AASHTO's A Policy on Geometric Design of Highways and Streets* to calculate operating speeds near a gate as this will influence run out length for barrier (if needed due to pedestrian concerns), clear zones and potentially grading leading up to a gate base.

25.4.2 Signing

The designer should supplement the visual cues of the ramp closure gate arm and attached flashers by installing WisDOT Standard Sign R11-54F (Folding "RAMP CLOSED USE ALT ROUTE") on or near each approach to the ramp to be closed by the gate to reinforce a closure. Include these details on the signing plan and in the signing quantities. This advance signing may be upgraded to a beacon assembly for an additional cue as described in the next section.

Guidance for the R11-54F sign installation:

- For two-lane rural crossroads, the folding R11-54F sign shall be placed at the ramp gate or barricade rack. If possible, a folding R11-54F sign should be placed in advance for traffic turning onto the ramp (see Attachment 25.2).
- For multi-lane crossroads, the folding R11-54F sign shall be placed at the ramp gate or barricade rack. Advance folding R11-54F signs should be considered at roundabout bypass lanes and look ahead left turn lanes, left turn lanes and right turn lanes (see Attachment 25.2).

25.4.3 Advanced Beacon Assembly

Evaluate and assess viable alternate routes, especially for heavy commercial vehicles, given the deployment of a gate arm. Install WisDOT Standard Sign R11-53 ("RAMP CLOSED WHEN FLASHING USE ALT ROUTE") with beacon if interchange geometrics prohibit a heavy commercial vehicle from turning around and going back from the direction it came or prohibit the use of a parallel route to mainline for accessing the next entrance ramp.

Also consider Advanced Beacon Assembles when sightlines are inadequate so as to not allow drivers enough time to observe a deployed gate arm and consider alternatives to the closed ramp. Select locations to enable use of an alternate route by placing them prior to a decision point for selecting an alternate route.

Connect beacon to the gate source of power, when available, and install such that beacons activate when the gate is lowered.

25.5 Identification Plaques

Ensure proper installation of structure identification plaques per SDD 12a4.

25.6 Barricades in Conjunction with Ramp Closure Gates

Where slotted turn lanes create the potential for a vehicle virtual trap, and ramp closure gate deployment is not feasible, type III barricades should be deployed (see Figure 25.11).

Refer to the "Deployment and General Considerations" section for additional barricade guidance.

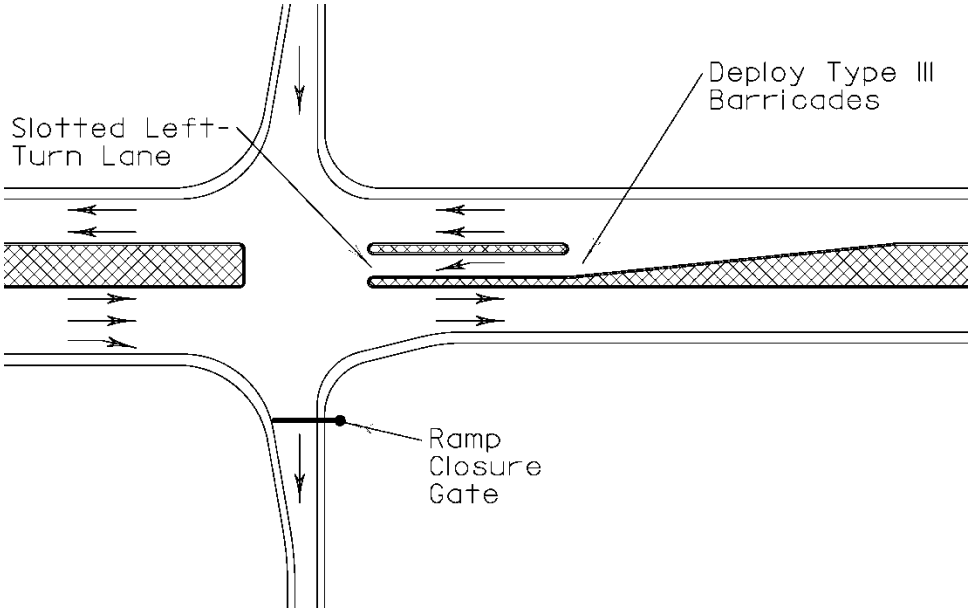

Figure 25.11 Barricades in Conjunction with Ramp Closure Gates

25.4 Additional Information

Designers should refer to standard detail drawings (SDD 15d34 (a-d), 15d35 (a-d) and 15d36) and standardized special provisions (refer to http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/tools/stsp.aspx) for solar and hardwired ramp gates and barricade racks.

LIST OF ATTACHMENTS

Attachment 25.1	Attachment 25.1 Wisconsin Ramp Gate Maintenance and Inspection Guideline
Attachment 25.2	Example Ramp Closed Use Alternative Route (R11-54F) Sign Details