The information contained in Chapter Ten: Miscellaneous Design Issues, dated July 2006, has been updated to reflect the February 2018 Errata. The errata addresses errors, changes in procedure, changes in NDOT department titles, changes in other Roadway Design Manual chapters and other reference material citations which have occurred since the latest publication of this chapter.

Chapter Ten
Miscellaneous Design Issues

1. RAILROAD/HIGHWAY GRADE CROSSINGS

Railroad-highway crossing design must consider approach grades, sight distance, drainage, highway traffic volume and the frequency of train movements. The traffic volumes and frequency of train movements should be used as the basis for evaluating the exposure factor. If the current number of vehicles using the crossing multiplied by the number of trains per day is 50,000 or greater, grade separation should be considered. Existing railroad and site conditions will dictate whether an underpass or overpass should be used.

The ideal crossing geometry at railroad/highway grade crossings is a right angle intersection of track and highway, with slightly ascending grades on both highway approaches to reduce the flow of surface water toward the crossing. For general coordination of mainline alignment at railroad grade crossings, the following design considerations apply:

1. **Horizontal Alignment.** The highway should intersect the railroad at a right angle without intersections or driveways nearby. This configuration maximizes the driver's view of the tracks and minimizes conflicting vehicular movements from crossroads and driveways. Crossings should not be located on either highway or railroad curvature where practical. Highway curvature limits the driver's sight distance and may cause the driver to concentrate on negotiating the curve rather than looking for a train. Railroad curvature may inhibit a driver's view down the tracks. Superelevation also complicates a crossing on a curve and may result in maintenance and rideability problems.

If the intersection between track and highway cannot be made at right angles, the variation from $90^\circ$ should be minimized. At skewed crossings, motorists must look over their shoulders to view the tracks. Because of this awkward movement, some motorists may only glance quickly and not take the necessary precaution. Elimination, consolidation, relocation, realignment and signalization of crossings are all options that should be considered. Early coordination with the **Railroad Liaison Engineer** in the **Intermodal Planning Division** is required.

2. **Vertical Alignment.** Preferably, vertical alignment should be as flat as possible at railroad intersections to enhance sight distance, rideability, and braking and acceleration distances. Vertical curves should be of sufficient length to ensure an adequate view of the crossing. The roadway grade shall match the railroad grade. If the roadway crosses the railroad at a superelevated track section the roadway profile shall be designed to incorporate the railroad superelevation.
A Policy on Geometric Design of Highways and Streets, (Reference 10.2c), Chapter 9, Exhibit 9-102 recommends that the crossing surface be in the same plane as the top of rails for a distance of 2 ft. (0.6 m) outside of the rails and that the surface of the highway shall not be more than 3 in. (75 mm) higher nor 6 in. (150 mm) lower than the top of the nearest rail at a point 30 ft. (9 m) from the rail, unless track superelevation dictates otherwise.

In cases where a railroad company has a maintenance road parallel to the tracks, it may be necessary to provide access for railroad maintenance across the highway. Cases such as this, and those involving horizontal clearances, may require special consideration. The designer should contact and coordinate with the Railroad Liaison Engineer.

When railroads and highways parallel each other in close proximity there is a possibility that long vehicles will not clear the railroad tracks when stopped at an access road to a state highway. The designer should provide sufficient distance along the parallel state highway for truck storage in these cases. When the highway is on new alignment, it is desirable to have 85 ft. (25 m) to 110 ft. (35 m) of storage between the railroad stop bar and the edge of the highway shoulders. This translates to about 110 ft. (35 m) to 145 ft. (45 m) from centerline of the closest railroad track to the edge of the closest through highway lane.

Where parallel railroad tracks run within 200 ft. (60 m) of the edge of the pavement and are intersected by surfaced roadways (highway, county or other), it is preferable to pave to the tracks instead of stopping at the end of the return. Work of this nature can be accomplished by a special provision only, as prepared by the Railroad Liaison Office. For additional information see Chapter Four: Intersections, Driveways, and Channelization, Section 3.A and EXHIBIT 4.20.

Geometric design of the railroad-highway grade crossing should be done in concert with the determination of the appropriate traffic control devices (e.g., signs, pavement markings, flashing light signals and automatic gates). The Traffic Engineering Division should be consulted to coordinate design.

1.A Railroad/Highway Crossing Surfacing

Each rail line has specific crossing requirements. Some railroads prefer crossings with high tonnage main line tracks to have at least 10 ft. (3.05 m) of asphalt surfacing between the edge of a crossing and a concrete roadway surface (See EXHIBIT 10.1). This allows replacement or installation of concrete cross ties with on-track equipment without removing concrete roadway surfacing. At other locations the concrete pavement should end at least 6 in. (150 mm) from the edge of timber or concrete crossings (See EXHIBIT 10.2). This 6 in. (150 mm) gap is filled with asphalt to keep the expansion of concrete from moving track out of line and allows the railroad to replace crossing and timber cross ties.

Railroad crossings may be of various types, (such as timber, concrete or rubber), and widths. The railroad company will construct the railroad crossing. The designer should contact the Railroad Liaison Engineer to determine the type and width of railroad crossing to be used. For further information see Chapter Twelve: Cost Estimating and Funding, Section 1.E and Chapter Thirteen: Planning and Project Development, Section 5.G.
Exhibit 10.1 Railroad/Highway Grade Crossing
Contact the Railroad Liaison Engineer for the type and width of railroad crossing being used.

* If the railroad track is in a superelevated section, the highway grade line will match the railroad superelevation.

* Contact the Railroad Liaison Engineer for the type and width of railroad crossing being used.

**Exhibit 10.2 Railroad/Highway Grade Crossing**
2. BRIDGE STRUCTURES

The Federal Highway Administration defines a bridge as “A structure, including supports, erected over a depression or an obstruction, such as water, a highway, or a railway, having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 ft. between undercopings of abutments or spring lines of arches, or extreme ends of the openings for multiple boxes; it may include multiple pipes where the clear distance between openings is less than half of the smaller contiguous opening.”

If a multiple span concrete box culvert, as measured from the inside surface of the outer wall to the inside surface of the outer wall, is less than 20 ft. along the centerline of the roadway it is a culvert and shall be designed by the roadway designer, (See the Drainage Design and Erosion Control Manual, Reference 10.3). If a multiple span concrete box culvert measures more than 20 ft. along the roadway centerline it is a bridge and its design shall be referred to the Bridge Division Hydraulics Unit. The designer shall pay particular attention to the effect of a skew on a box culvert as the skew may increase the length of a multiple span concrete box culvert, as measured along the roadway centerline, to bridge length.

The design of horizontal and vertical roadway alignments must be carefully coordinated with any bridges or other structures located within the project limits. Proper coordination may eliminate undesirable bridge characteristics.

2.A Horizontal Curvature

If practical, horizontal curves and superelevation transitions should be avoided on bridges. However, safety is the primary consideration and introducing sharp horizontal curvature on approaches to avoid placing a curve on a bridge is not considered practical. Where a curve is required on a bridge, developing the superelevation on the approaching roadways and carrying the fully superelevated section continuously across the structure can simplify both bridge design and bridge construction. Due to the prevailing snow and ice conditions, the maximum superelevation rate permitted by NDOT on bridge structures is 6%.

In some cases superelevation transitions are unavoidable on bridges and, while less desirable, can still be properly designed and constructed. The designer should coordinate the superelevation design with the Bridge Division in the early stages of design (before bridge design is completed).

Superelevated roadways on bridges should not have a break in cross slope where the travel lane meets the shoulder. In other words, shoulder rollover is not permitted on bridge decks. If a break is provided between shoulder and roadway on the superelevated approach to the bridge, the section should transition to a continuous plane prior to the bridge structure.

See Chapter Three: Roadway Alignment, Section 2, for further information

2.B Skewed Structures

EXHIBIT 10.3 illustrates the method for defining the crossing angle or skew, between the mainline facility and the feature intersected (e.g., topographic anomalies, railways, waterways, etc.). When a bridge structure intersects a feature at a skew, the bridge abutments and piers are usually constructed parallel to the feature intersected to provide adequate horizontal clearances and reduce span lengths. Piers for structures over waterways are set parallel to the direction of the flood flow. Skewed intersections increase structure length, complexity and costs.
For bridge structures over roadways, railways and waterways, the maximum practical skew is 45°. Larger skews can be accommodated for facilities intersecting roadways and railways but require additional design and construction work. For culverts, the maximum desirable skew is 35°. The Standard/Special Plans Book, (Reference 10.4), provide details for concrete box culverts with skew angles ranging from 5° to 35°, in 5° increments.

Exhibit 10.3  Skew Angle Definition

2.C  Bridge Grades

Avoid vertical profile grades on bridges in excess of 5% to 6% as this can complicate the bearing design for certain types of bearing devices. Also, unanticipated movement can occur on bridges that are built to a steep grade. The grade line on bridge decks should preferably be tangent. For long bridges where drainage is confined to the bridge deck, a 0.5% grade is the desirable minimum.
2.D **Vertical Curvature**

Avoid placing bridges on crest and sag vertical curves with K values in excess of 143 U. S. Customary (43 Metric) as they may have an inadequate longitudinal slope to drain the bridge deck. Longitudinal drainage is not a significant concern for bridges with open, free-draining rail systems. See Chapter Three: Roadway Alignment, Section 3, for further information.

2.E **Vertical Clearances**

2.E.1 **Grade Separations**

Minimum vertical clearances for various conditions are shown in **EXHIBIT 10.4**. The minimum vertical clearance shall be measured from the high point of the roadway, including turf shoulders, which may or may not be at the profile grade point. For new structures it is desirable to include a 0.50 ft. allowance for future resurfacing. The values provided are intended for general guidance only. Final grade decisions should be coordinated with the **Bridge Division**.

Vertical alignment will need to be coordinated with structural requirements for superstructure depth to allow for proper clearance between grade separations. The **Bridge Division** will provide a preliminary estimate of superstructure depth for the types of structures to be used so that preliminary grades can be designed.

Where practical, the low point of a sag vertical curve for a roadway under a bridge should be located at least 100 ft. (50 m) from the limits of the bridge structure. This will help to reduce the need for drainage structures under the bridge and will reduce the ponding of water that may weaken the earth foundation beneath the bridge. Ice accumulation on the roadway would also be minimized since the low point of the sag vertical curve would not be located within the shadow of the bridge structure.

<table>
<thead>
<tr>
<th>Type</th>
<th>Minimum Clearance</th>
</tr>
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<tbody>
<tr>
<td>Structures over roadways</td>
<td>See the Minimum Design Standards (Ref. 10.5)</td>
</tr>
<tr>
<td>Roadway or pedestrian bridge over railroad</td>
<td>23.50 ft. (7.16 m) (1)</td>
</tr>
<tr>
<td>Roadway under pedestrian bridge</td>
<td>17.00 ft. (5.20 m) (2)</td>
</tr>
</tbody>
</table>

1. Measured above the plane of the top-of-rails. If the required vertical clearance cannot be met, a minimum vertical clearance of 23.00 ft. (7.01 m) may be used with the approval of the Assistant Bridge Engineer in the **Bridge Division**.
2. The pedestrian overhead structures require an additional margin of safe clearance because they are relatively light in weight and could be knocked down by vehicle impact. Such an occurrence may cause accidents as the structure could drop across traffic lanes.

Note: Minimum vertical clearances also apply to roadway shoulders.

**Exhibit 10.4 Minimum Vertical Clearances for Structures**
2.E.2 Stream Crossings

Bridges over meandering rivers, streams and other natural waterways preferably should not be located on a bend in the channel. This can result in less than desirable stream flow characteristics and may require excessive rock embankment to protect the structure from erosion and scour. Divided roadway facilities intersecting with a bend in a natural waterway may require construction of parallel bridges with different span configurations in lieu of the more desirable twin bridge configuration.

The vertical profile design in the vicinity of a stream crossing and the allowable overtopping frequency for the roadway dictate the required waterway opening for a bridge structure. The Bridge Hydraulics Section determines required waterway openings. Prior to preliminary design, the roadway designer will provide the Bridge Hydraulics Section with a very preliminary, “best guess” profile at bridge locations for use in hydraulic analysis. For some conditions required waterway openings may consist of the combined bridge opening and roadway overtopping. EXHIBITS 10.5 AND 10.6 illustrate the basic criteria used to establish bridge length and vertical profile for crest and sag or level profiles, respectively.

2.F Intersections

Avoid placing bridges close to intersections if possible, particularly where guardrail is required.

2.G High Embankments

Embarkment for grade separation structures should be of sufficient height to ensure that adequate vertical clearance is provided over the facility intersected. Excessive embankment height will increase span length thus increasing costs.
Exhibit 10.5  Vertical Stream Clearances for Crest Profile

- Profile grade should conform to the Q design.
- Profile grade is the overtopping frequency of the floodplain based on the allowable water surface elevation (AWS), whichever is more critical.
- Q is the frequency of a flood, and Q_100 is the frequency of a flood overtopping the embankment.
- The overall site risk assessment, economics, vertical and horizontal alignment, and scope of the project may dictate compromising on the minimum clearance shown.

* If roadway embankment is likely to be raised in the future, provide 1 ft. clearance based on the future embankment elevation.
Exhibit 10.6  Vertical Stream Clearances for Sag or Level Profile
3. AIRWAY HIGHWAY CLEARANCES

3.A Nebraska Division Of Aeronautics

An “Application for Permit to Build” must be requested from the NDOT Division of Aeronautics (NDA) for:

1. All new structures throughout the State which exceed 150 feet in height above ground level at the point of installation.
2. Increasing the height of existing structures which results in a final height exceeding 150 feet above ground level at the point of installation.

Instructions and the permit form may be found at http://www.aero.nebraska.gov/permittobuild.pdf. This form must be submitted to the NDA at least 60 days prior to the date that the construction or alteration is to begin.

3.B Federal Aviation Administration

The Federal Aviation Administration’s (FAA) regulations for airway highway clearances (http://www.faa.gov/airports/central/engineering/part77/) have been published as "Part 77, Federal Aviation Regulations". The Federal Aviation Administration requires written notification prior to construction in the vicinity of an airport in order to:

- Evaluate the effect of the proposed construction or alteration on the operation of the airport
- Determine the effect of the proposed construction or alteration on air navigation
- Identify mitigating measures
- Map the alteration

The FAA provides a “Notice Criteria Tool” to assist the designer in determining whether coordination with the FAA is required. This tool may be found on the internet at: (https://oeaaa.faa.gov/oeaaa/external/gisTools/gisAction.jsp?action=showNoNoticeRequiredTooIForm). All airports, both public and private, that are within a four-mile radius of a project should be identified prior to the plan-in-hand (EXHIBIT 10.7); an Airport Buffer KMZ may be found at \dofts\Design\Google Earth KMZ. Public airports may be identified using the airport layer in the NDOT “Preliminary Environmental Report”. There is no data base for private airports, they can be identified using Google Earth. As part of the plan-in-hand distribution, letters will be sent to any private airports within the study area stating where the project is located and the type of work to be done. Any comments received prior to the NEPA documentation will be included in the document.

If required, FAA Form 7460-1, “Notice of Proposed Construction or Alteration”, must be filed with the FAA at least 45 days before work starts and FAA coordination may take up to 6 months. If the designer does not receive a response within two weeks he should contact the FAA to verify that they have received the information and that it is complete. FAA Form 7460-1 should be filled out during the Plan-in-Hand Phase of the project (Clarity Task #5380). All modifications, both permanent and temporary, are subject to the notice requirement. The designer will transmit this form to the NDA for coordination with the FAA. This form may be found at (https://www.faa.gov/forms/index.cfm/go/document_information/documentID/186273).

The NDA should be consulted early in the design process for current regulations and notification requirements related to highway projects near civil and military airports and heliports and for information on future growth planned at the airport.
Conditions requiring the filing of FAA Form 7460-1:

- Any construction or alteration exceeding 200 ft. above ground level
- Any construction or alteration:
  - Within the four-mile envelope of the airport, which is constructed by swinging a four-mile arc from the center of each end of each runway and connecting the adjacent arcs by tangent lines (See Exhibit 10.7)
  - Within 10 miles of the end of the runway. This protected area is three miles wide, centered on the runway, extending for the entire 10 miles and includes a slope protection elevation which is delineated by 100:1 slope for three miles off the end of the runway, a level slope for four miles and a 100:1 slope for an additional three miles (See Exhibits 10.8 & 10.9)
  - Any highway, railroad, or other transverse way whose prescribed adjusted height would exceed that above noted standards
- When requested by the FAA
- Any construction or alteration located on a public use airport or heliport regardless of height or location

Examples of Permanent Construction or Alterations:

- Structures
- Elevated Signs
- Fences
- Light Fixtures
- Power and Cable Lines
- Roadways

Examples of Temporary Construction or Alterations:

- Construction Equipment (if construction equipment breaks the slope protection elevation, the contractor or NDOT can propose an amendment to the slope protection study.)
- Haul Routes
- Staging Areas
- Stock Piles
- Temporary Lights

Additional Submittals to the NDA:

- Plan of the proposed construction or alteration showing the relation to the nearest runway
- The perpendicular distance from the centerline of the nearest runway to the proposed construction or alteration
- The projected distance along the centerline of the runway to the proposed construction or alteration
- The ground elevation at the site of the proposed construction or alteration
- The height of the proposed construction or alteration
- Accurate geodetic coordinates conforming to NAD 83
3.C  NEPA Coordination

The **Roadway Design Division** will provide copies of all official correspondence with the **FAA**, **NDA**, private airport authorities, and/or the local airport authority including any responses or comments to the NEPA Specialist. This correspondence will be included in the NEPA document. The contractor commitment below will also be included in the NEPA document for all public airports. Private airports do not need specific commitments unless comments are received from the airport manager.

Commitments for public airports:

> Because of the proximity to the ------- Airport in -------, the height of any equipment used in the construction of the project (or any antennae installed on the equipment) shall not exceed the local airport’s Height Restriction Zoning. Any Contractor involved in the project shall use the Notice Criteria Tool available at [https://oeaaa.faa.gov/oeaaa/external/portal.jsp](https://oeaaa.faa.gov/oeaaa/external/portal.jsp). If required, the Contractor shall file a 7460-1 Form with the Federal Aviation Administration (FAA). The form shall be required if the Contractor uses any equipment over 200’ tall, or the equipment breaks a 100:1 slope from a public-use airport. This includes any trucks or equipment used during the construction of the project. NDOR’s Roadway Design Division shall verify clearance for permanent construction in the controlled zone from the Nebraska Department of Aeronautics (NDOA) and FAA. NDOR’s Roadway Design Division shall identify those contracts that shall require the special provision concerning the Contractor’s responsibility to gain FAA and NDOA clearance for temporary encroachments due to construction operations. NDOR’s Plans, Specification & Estimates (PS&E) / Contracts shall include the special provision in the appropriate project contracts. (Contractor)
Exhibit 10.7  Four Mile Airport Envelope
Exhibit 10.8  Runway Protected Area
Exhibit 10.9  Runway Slope Protection
4. **LANDSCAPING**

Landscaping is an ongoing and essential part of NDOT’s Six-Year Plan and is the responsibility of the **Project Development Division**. Landscaping includes, but is not limited to, plantings, scenic view development, use of retaining walls, median treatments, slope rounding, berms, aesthetic treatment for noise walls, and other treatments for environmental, functional or aesthetic purposes.

Landscaping provides many functional and aesthetic benefits that are as integral to good roadway design as are geometrics. Landscaping should enhance the visual quality of the roadway environment, thus reducing the impact of the roadway on the adjacent area. The goals of landscaping include:

- Enhance the safety of the roadway by maintaining recovery areas for errant vehicles.
- Accentuating the roadway features with appropriate plantings.
- Reduce maintenance costs by the use of living snow fences, erosion control, limited mowing, and the prompt removal of tree seedlings.
- Conserve, enhance and effectively display the natural environment and beauty of the roadway landscape, providing a pleasant driving experience for the traveler.
- Encourage wildlife conservation and habitat improvement, within the roadway right-of-way, through selected plantings and limited mowing.

Implementation of the landscaping policy includes the following activities:

1. During the development of major (normally not resurfacing, lighting, etc.) roadway projects, urban or rural, the **Roadside Stabilization Unit** in the **Project Development Division** will review and recommend an appropriate landscaping treatment for each project in accordance with the **AASHTO** manual *A Guide for Landscape and Environmental Design*, (Reference 10.6).
2. The **Roadside Stabilization Unit** involvement will begin at the engineering review or corridor study stage of project development to promote early identification of the potential for landscaping. Landscaping recommendations will be included in the engineering review report, corridor study report and in the design public hearing engineering statement.
3. The **Roadside Stabilization Unit** will review design plans prior to the plan-in-hand and will furnish written landscaping and erosion control recommendations to the roadway designer for evaluation during the plan-in-hand.
4. The **Roadside Stabilization Unit** will review the plan-in-hand report to estimate specific erosion control needs and to make further landscaping recommendations, as necessary.
5. Landscaping recommendations will be included in the design public hearing engineering statement.
6. The **Roadside Stabilization Unit** will review the limits of construction plans and forward final landscaping recommendations and specifications and final erosion control recommendations to the roadway designer.
7. Erosion control specifications will be sent to the roadway designer after a joint review of final cross-sections with the designer is completed.
4.A Tree Planting and Removal

Every effort will be made to minimize disruption to the surrounding environment. Where trees and other desirable flora can be saved, consistent with sound engineering judgment, they will be. Normally, trees and other flora located within the recovery area for out-of-control vehicles or the limits of construction will be removed, however, the retention of healthy trees and other desirable flora will be reviewed on a case-by-case basis by the Roadside Stabilization Unit in the Project Development Division and the District Engineer to determine appropriate action. Guardrail, retaining walls, and other alternatives may be considered before healthy trees are removed. The cost of protecting trees should not be the only determining factor when considering their removal. Tree removal may be a factor in determining the need for tree planting.

When a significant amount of additional right-of-way is required for a project that would not otherwise be classified as "major," the Roadside Stabilization Unit should review the project for appropriate landscaping treatment, even if the latter would require the purchase of additional right-of-way outside of the proposed construction limits. Right-of-way will not be acquired solely for tree planting, unless needed to comply with Section 404 Permit requirements, (See Chapter Thirteen: Planning and Project Development, Section 4.B.4).

A special provision is required for removing and resetting trees from the construction zone with the appropriate size tree spade. The Roadside Stabilization Unit will determine the feasibility of tree removal and tree spade size.

4.B Roundabout Landscaping

Landscaping for a roundabout should be selected and strategically placed to help improve the overall operation of the roundabout when possible. Plantings in the central island can help provide recognition of the roundabout by approaching drivers and aid in reducing their approach speeds. While allowing adequate sight distance to the left, these plantings help drivers make better judgments concerning the distance to approaching vehicles in the roundabout by filtering out other distracting movements.

All guidelines for intersection sight lines and roadside safety must be followed. The central island plantings must be of sufficient volume to be visible in advance of the intersection and reduce headlight glare across the roundabout, but not infringe on necessary sight distances for motorists and pedestrians. This is accomplished by deliberate positioning of plant material to maximize the view between vegetative elements and minimize the view of opposing vehicles. Plantings also need to address snow drifting concerns and shedding deciduous vegetation on the circulatory roadway. Plant types should be selected to limit excessive maintenance when possible.
5. SNOW CONTROL

Snow drifting may be a problem when the prevailing winds are from the north or west. Snowdrifts on roadways can be minimized by several different methods, including:

- Cross-section modification.
- Structural snow fencing, both temporary and permanent.
- Living snow fencing.

The District's input regarding the location of existing snow fences will help to identify locations susceptible to drifting snow. If aerial photos were taken in late fall or early winter they may show the location of existing snow fence. Designers are responsible for contacting the District Engineer to see if snow shots are desired for the plan-in-hand inspection. Snow shots are cut stations where the top of the backslope is less than 60 ft. (20 m) from the roadway centerline and the backslope elevation is greater than the centerline elevation.

Allowing a greater ditch area for the accumulation of snow at locations susceptible to drifting can minimize snowdrifts on roadways. Normally snowdrifts on a roadway occur at the ends of cut sections. Ditches may be widened to provide more area for snow accumulation. The backslope, especially at the ends of high cuts, should be laid back from its normal 3:1 slope.

Structural snow fencing is often used to reduce snow drifting. Annually, maintenance units will place temporary snow fence along the right-of-way in areas of known snow drifting. Along roadways with limited right-of-way, temporary snow fencing may be placed on private property. Permanent snow fencing panels may be needed where a cut section becomes a fill section. Living snow fencing may also be used to reduce snow drifting. If the right-of-way is sufficient, shrubs and trees can be planted along right-of-way or fence lines. Contact the Roadside Stabilization Unit for the possibility of using living snow fence at the right-of-way line.

6. FENCING

Generally interstates and freeways should be fenced and some expressways may be fenced. Chainlink fencing is used in urban, developing urban and suburban areas. When fencing is specified (as it is on Interstate and freeway projects), the fencing is run along the right-of-way line according to the Standard Specifications for Highway Construction (Spec Book), Section 910 (Ref. 10.13) [http://dot.nebraska.gov/media/10343/2017-specbook.pdf]. The following exceptions and criteria should be kept in mind:

- Where there is a frontage road, the fence is placed between the frontage road and the mainline
- Fences should tie into the ends of box culverts or cattle passes
- Fences should tie into the ends of existing fences and grade separation structures. Where the crossroad runs underneath, fences may run underneath the structure
- If a portion of a utility line within the right-of-way is left undisturbed, the access fence may be run just inside of the utility line
- At rural interchanges, fencing should extend 500 feet along the cross road from the ramp termini
Chainlink fencing is also used for pedestrian barriers on bridges, (the Bridge Division will provide details). The need for fencing expressway projects should be discussed at the plan-in-hand inspection. Refer to the Standard/Special Plan Book (Reference 10.4) for fencing details.

In rural areas, depending on the function and use of the adjoining property, barbed wire or woven wire fences will be erected. The responsibility for removing, resetting or rebuilding fences and cattle guards rests with the property owner, who is compensated by NDOT as necessary. Fencing is generally a right-of-way item and the roadway designer should contact the Right-of-Way Division for assistance. For further information see Chapter Fifteen: Right-of-Way, Section 7.C.

For additional information, see Section 8 for fencing adjacent to retaining walls and Chapter Sixteen: Pedestrian and Bicycle Facilities, Section 4.A for fencing behind sidewalks adjacent to steep slopes.

7. CATTLE PASSES

New cattle passes should be built if either of the following criteria is met:

- The appraised segregation damages equal or exceed the cost of constructing the structure.
- The property owner pays for the difference in the cost of the structure and any segregation damages.

Existing cattle passes should be perpetuated if either of the following criteria is met:

- The property owner's title or any other legal document indicates that the owner has a non-revocable right to use the existing structure as a livestock crossing.
- It is apparent that the structure was built to alleviate damage to a segregated property and is being used for a livestock crossing.

The design of cattle passes shall give the contractor the option of furnishing a precast unit, provided that the fill height is within the structural limits of the unit. It is important that cattle passes be designed without bends or grade breaks. If cattle cannot see out the other end of the passage, they will not enter it.

8. RETAINING WALLS

The need for a retaining wall may be determined during any of the following activities:

- Engineering review.
- Preliminary design.
- Plan-in-hand.
- Roadway design.

When a retaining wall with a height of 3 ft. (0.9 m) or greater is built in an urban area a chain link fence with a nominal height of 4 ft. (1.2 m) shall be erected adjacent to the retaining wall, (just behind it) on public right-of-way.

EXHIBIT 10.10 outlines NDOT’s basic procedure to be followed in the design of retaining walls.
Exhibit 10.10  NDOT Retaining Wall Design Guidelines

NDOT RETAINING WALL DESIGN GUIDELINES
From Conception thru Shop Plan Review

Step 1) Identify the need for a retaining wall during Activity 5202-Engineering Review.

Step 2) Project Development requests Preliminary Foundation Report-Activity 5603 from Materials & Research Division, Geotechnical Section.

Step 3) Confirm the need during Activity 5307 - Preliminary Roadway Design and order Final Foundation Report - Activity 5604.

Step 4) The Final Foundation Report shall be submitted to the Roadway Designer and Bridge Division.

Step 5) The Roadway Designer shall schedule a meeting with the Materials & Research Geotechnical Section and Bridge Divisions in order to select the appropriate wall type (i.e. MSE Panel; MSE Block; or conventional Cast-In-Place wall). Prior to the meeting, the Roadway Designer should have compiled all relative information, such as wall length, height, surcharge loading and other factors relative to the wall construction.

Step 6) If an MSE Panel or Block wall was selected, the Roadway Designer shall design the wall’s general characteristics to be incorporated into the bid plans, along with the appropriate generic Special Provisions. The approved wall vendors will be listed in the Approved Products List for Metric projects. As a minimum the wall plan should include:

- All wall geometrics - length, height, stationing, offsets, leveling pad elevations, etc.
- Traffic data
- Construction sequencing, if applicable
- Surcharge loading (due to traffic or embankment)
- Architectural notes
- The calculated “Established Quantities”:

  Concrete Face Panels (SF)  
  or  
  Wall Materials (SF) (for Modular Block Walls)

  Concrete Leveling Pad (LF)  
  or  
  Compacted Earth Leveling Pad (LF) (for Modular Block Walls)

  Coping (LF) (if applicable)

  Select Granular Backfill for Mechanically Stabilized Earth Structure (CY)

  18 in. Corrugated Metal Pipe (LF) (if applicable)

  Shoring for Mechanically (Lump Sum)  
  Stabilized Earth Structure
• All the “External Site Factors” per the ‘Design Requirements’ section of the generic Special Provision. These factors should be found in Materials & Research Geotechnical Section’s Final Foundation Report.

• Ensure the following note is placed on the plan near the “External Site Factors”:

  The Contractor, in conjunction with the MSE Wall vendor, shall determine the wet unit weight of the select granular backfill material used in the reinforced soil zone. The unit weight shall be shown on the wall shop plans.

• Utilities

• On metric plans, list wall vendors per the “Approved Products List”

If the MSE wall is to be used at a bridge location, submit MSE Wall Special Plan to Bridge Division for review. If a conventional wall was selected, the Bridge Division shall design the wall and submit the special plan and associated Special Provisions to the Roadway Designer.

Step 7) Advertise Project

Step 8) Bidding Contractors send MSE Wall plans and Special Provisions to the approved wall vendors (listed in Special Provisions or the Approved Products List) in order to secure bids.

Step 9) The awarded Contractor submits six sets of shop plans and working drawings (stamped by a Nebraska P.E.) to the Construction Division. The Construction Division shall place a REVIEWED Stamp on the first sheet of all six sets (similar to the one shown below).

**REVIEWED by:**

Roadway Design

Materials & Research Geotechnical Section

Bridge

Construction

Construction Division will then forward all six sets to the Roadway Designer.

Step 10) The Roadway Designer shall review the submitted plans for the wall geometrics and to ensure the plans reflect the bid plans. Corrections, deletions or concerns should be marked in red on all six sets. Sign and date the Reviewed stamp on the plans.

Step 11) The Roadway Designer shall then forward all six sets to Materials & Research Geotechnical Section to review the “External Stability” of the wall. After Materials & Research signs and dates the review stamp on all six sets, they will forward all six sets to Bridge Division.

Step 12) The Bridge Division shall review the structural aspects of the wall. Again marking corrections, deletions and concerns in red, on all six sets. After Bridge signs and dates the review stamp on all six sets, they will forward one set to Roadway Design, one set to Materials & Research Geotechnical Section and four sets to Construction.

Step 13) The Construction Division will then distribute one set to the District Office, and the remaining three sets to the Contractor.
9. **OLD ROAD OBLITERATION**

Once existing pavement on an abandoned alignment is no longer needed, (such as for phasing or property access), the pavement may be removed. The quantities of removed pavement shall be paid for by the sq. yd. (m²). The plans for old road obliteration should be put on 2-N sheets (See Chapter Eleven: Highway Plans Assembly, Section 4.G). The Standard/Special Plans Book, (Reference 10.4) illustrates cross-sections for old road obliteration.

10. **MAILBOX TURNOUTS AND SUPPORTS**

On one-way streets, mailboxes may be on the left side if designated by the local postmaster. Where a mailbox is located at a driveway, it shall normally be placed 17 ft. (5.2 m) beyond the driveway surfacing on the right hand side of the road in the direction of travel as designated by the local postmaster for each delivery route. A mailbox should not be located on urban roadways where through driving lanes are adjacent to the curb. **EXHIBIT 10.11** shows minimum clearance distances for mailboxes near intersections with county roads.

Asphalt surfacing shall be used for mailbox turnouts, if available. New and Reconstructed projects shall have a minimum 8 ft. (2.4 m) wide mailbox turnout (or a total of 20 ft. (6.0 m) of surfacing width from the centerline)). See Chapter Seventeen: Resurfacing, Restoration and Rehabilitation (3R) Projects for 3R project design guidance. The Standard/Special Plans Book (Reference 10.4) (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/) illustrates mailbox turnouts for various roadway types, (these plans provide surfacing quantities for typical mailbox turnouts, but additional surfacing will be needed for turnouts that have more than one mailbox support post).

No more than two mailboxes may be mounted on a single support structure, (See the Standard/Special Plans Book, Reference 10.4). **NDOT** provides mailbox supports to the contractor, so the roadway designer needs to have a mailbox support count. The plan build note shall include the number of supports, the mailbox location(s), and the required area of special mailbox surfacing.

For additional information see a Guide for Erecting Mailboxes on Highways (Reference 10.8) and the Roadside Design Guide (Reference 10.12).
## Exhibit 10.11  Clearance Distances for Mailboxes Near Rural Intersections

<table>
<thead>
<tr>
<th>Main Road Speed mph (km/h)</th>
<th>D1 in ft. (m)</th>
<th>D2 in ft. (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n), (Vc), (Vm) &lt; 4000</td>
<td>(n), (Vc), (Vm) &gt; 4000</td>
<td></td>
</tr>
<tr>
<td>40 (65)</td>
<td>65 (20)</td>
<td>200 (60)</td>
</tr>
<tr>
<td>&gt; 55 (90)</td>
<td>65 (20)</td>
<td>235 (71)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Main Road Speed mph (km/h)</th>
<th>Vc/(1.5n-0.5) &lt; 50</th>
<th>50 &lt; Va/(1.5n-0.5) &lt; 50</th>
<th>Vc/(1.5-0.5) &lt; 400</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 (65)</td>
<td>65 (20)</td>
<td>100 (30)</td>
<td>100 (30)</td>
</tr>
<tr>
<td>&gt; 55 (90)</td>
<td>150 (45)</td>
<td>150 (45)</td>
<td>200 (60)</td>
</tr>
</tbody>
</table>

**D3 in ft. (m)**
- Preferred: 100 (30)
- Minimum: 65 (20)

**D4 in ft. (m)**
- Preferred: 150 (45)
- Minimum: 100 (30)

Vc = Average Daily Traffic on Cross Road (VPD)
Vm = Average Daily Traffic on Main Road (VPD)
n = Number of Mailboxes at Mail Stop

**MINIMUM CLEAR DISTANCES TO MAILBOX NEAREST INTERSECTION**
11. ROADWAY LIGHTING

The Roadway Design Lighting Unit is responsible for ascertaining the need for roadway lighting for each project, and for the design of the lighting systems. Lighting will be considered at the plan-in-hand inspection. The Lighting Engineer shall be notified if the District Engineer determines that a project will include lighting in order to avoid right-of-way problems and utility, driveway and drainage conflicts.


Highway projects that have existing roadway lighting will continue to have roadway lighting. City agreements will need to include the operational and maintenance costs of the system. Requests for new lighting should be transmitted to the Lighting Engineer, who will conduct a study for each request. If the results of the study satisfy the conditions of one of the warrants in the following sections, NDOT may add lighting to a programmed project or schedule a lighting project to design and build a lighting system at the requested location (subject to the availability of funds). The Lighting Engineer will determine the type and style of the system. Even though a lighting request meets the appropriate warrants the state is not obligated to provide lighting. NDOT will own all lighting systems within state highway right-of-way.

11.A.1 Urban Lighting

11.A.1.a Warrants

- **Warrant I  Accident History (Continuous or Intersection):** The number of nighttime accidents (N) per year is greater than 2 times the number of daytime (D) accidents in a three year accident history study with more than 4 nighttime accidents per year per intersection or per mile (N > 2 x D, & N > 4).
- **Warrant II  Traffic Signals:** All intersections warranting traffic signals will also warrant roadway lighting.
- **Warrant III  Two Way Left Turn Lane (TWLTL):** Continuous lighting may be warranted with a two way left turn lane when there is 80% or more of commercial lighting along the state highway and more than 15 driveways per mile. Consideration will be given to continuous lighting when the mainline curves have a radius of less than 573 ft. (175 m) with a two way left turn lane.
- **Warrant IV  Local Responsibility:** If none of the previous warrants are met the local governing authority (city, town, village, or S.I.D.) can choose to install lighting if sufficient benefits are found in the form of convenience, safety, policing, community promotion, or public relations. The local governing authority will pay 50% of the installation cost and 100% of the operation and maintenance cost of the lighting system.

11.A.1.b Festoon Outlets

Festoon outlets (electrical outlets for holiday decorations) will be installed on urban projects as a project cost with a prior written request from the City/Village. Festoon outlets will only be installed in the core business area. If additional festoon outlets are requested, their cost will be the sole responsibility of the City/Village.
11.A.1.c Costs

When specifying lighting for an urban project be sure that local government officials are aware that the cost of maintaining and operating the system is a **City/Village** responsibility. Lighting cost estimates should be obtained from the **Roadway Lighting Section** and given to local officials, prior to the agreement signing, so that the **City/Village** may plan and budget for the expense. They should also be informed that the lighting system might include poles that are outside of corporate limits. A signed city covenant agreement is required before a public hearing can be scheduled.

Lighting Projects INSIDE the corporate limits meeting warrant I, II, or III and not installed as part of a “New and Reconstructed”, “3R”, or “Maintenance” project: The local governing authority will pay for 50% of the installation cost and 100% of the operation and maintenance costs of the lighting system.

Lighting Projects INSIDE the corporate limits meeting warrant I, II, or III and installed as part of a “New and Reconstructed”, “3R”, or “Maintenance” project: Installation will be a project cost. 100% of the operation and maintenance costs of the lighting system will be the responsibility of the local governing authority.

11.A.2 Rural Intersection Lighting

11.A.2.a Warrants

- **Warrant A Accident History:** The number of nighttime accidents per year is greater than one-third the number of daytime accidents per year and the average number of nighttime accidents per year is greater than three in a three year accident history study, or since the intersection was last modified (N > D/3, & N > 3).

- **Warrant B ADT/Topography/Geometrics:** A current ADT greater than 2500 vehicles/day at the intersection (combine all traffic ADT’s from all legs and divide by two, with a minimum 250 ADT at each leg) combined with two or more of the following conditions would be sufficient to warrant lighting:
  1. There are complex or unusual geometrics.
  2. The intersection sight distance is less than 660 ft.
  3. There is frequent pedestrian traffic (more than 200 per day).
  4. Adjacent development creates confusing background lighting.
  5. There are raised medians on the mainline highway.

- **Warrant C Traffic Signals:** All locations meeting warrants for traffic signals will warrant roadway lighting.

- **Warrant D Local Responsibility:** If none of the warrants A, B, or C are met the local governing authority (city, town, village, or S.I.D.) can choose to install lighting if sufficient benefit is found in the form of convenience, safety, policing, community promotion, or public relations. The local governing authority will pay for 50% of the installation cost and 100% of the operation and maintenance costs of the lighting system.

- **Warrant E 4-Lane Bypass:** Whenever a 4-lane highway bypasses a city, town, or village, access roads which intersect the bypass but do not meet lighting warrants may have lighting installed as a project cost if the local governing authority feels that such lighting is necessary. The local governing authority is responsible for 100% of the operation and maintenance costs of the lighting system.
11.A.2.b Costs

Lighting projects OUTSIDE of the corporate limits meeting warrant A, B, or C: The state will assume responsibility for the cost of installation, operation, and maintenance of lighting system.

11.A.3 Rural Continuous Lighting

Rural continuous lighting is only warranted when it is an extension of a continuous urban lighting system being installed as part of an urban project, and the lighting extension meets an urban lighting warrant. The installation of warranted lighting extensions will be a project cost and 100% of the operation and maintenance costs will be the responsibility of the state. If the extended lighting is at the request of the local governing authority, 100% of the operation and maintenance costs of the lighting system will be the responsibility of the local governing agency. NDOT will not pay for unwarranted rural continuous lighting located outside of the corporate limits and which was built at the request of the local governing authority.

11.A.4 Interchange Lighting

Warrants for interchange lighting on Interstates or Expressways will be determined using the warrants in An Informational Guide for Roadway Lighting (Reference 10.9). If the lighting is located in an urban area the local political subdivision will have the responsibility for 100% of the operation and maintenance costs of the lighting system.

12. PARKING

**EXHIBITS 10.12 & 10.13** provide parking stall dimensions for curb/street parking and for parking lot/parking garage designs for passenger cars. The designer should check local standards before designing parking facilities. Parking modifications should be discussed with local city officials, especially if existing parking is eliminated on the proposed facility. This should be done as early as possible in the design process. The designer should check with the Traffic Engineering Division if there is a need to provide for longer or wider vehicles. For further information see Sections 60-6, 164 and 60-6, 168 of Nebraska Bridge Law (Reference 10.10), [http://uniweb.legislature.ne.gov/laws/browse-chapters.php?chapter=39](http://uniweb.legislature.ne.gov/laws/browse-chapters.php?chapter=39).

12.A Accessible Parking

When the Nebraska Department of Transportation constructs or re-stripes parking spaces, it must provide accessible parking spaces as required by the Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities (Reference 10.7). Accessible parking spaces must be located to provide the shortest possible accessible route of travel to an accessible facility. Accessible parking spaces for automobiles must have a minimum 5 ft. (1.5 m) wide access aisle located next to the designated parking space and accessible parking spaces for vans require a minimum 8 ft. (2.4 m) access aisle. The access aisle must be level (2% maximum slope in all directions) and the same length as the parking stall(s) it serves. Access aisles may serve two parking stalls. Ramps will not extend into the access aisle. **EXHIBIT 10.14** shows a typical access aisle layout and the required minimum number of accessible stalls for a given number of parking spaces. The designer should check local standards and consult with the local city officials regarding the number of accessible parking spaces. Further information may be found at [http://www.access-board.gov](http://www.access-board.gov).
Exhibit 10.12a  Parking Stall Dimensions for Curb and Street Parking (English)
FOR CURB AND STREET PARKING

* The end stalls may be reduced in length to a minimum of 5.50 m.

1. All parking shall be a minimum of 6.10 meter from the crosswalk, 9.15 meter from the stop sign, yield sign or traffic signal, and 4.55 meter from a fire hydrant. For other situations see Section 60-6, 166 Nebraska Rules of the Road.

2. White paint shall be used for marking; a 100 mm width is recommended for marking lines.

N = Number of stalls  L = Usable curb length

Exhibit 10.12b  Parking Stall Dimensions for Curb and Street Parking (Metric)
Exhibit 10.13a Parking Stall Dimensions for Parking Lots and Garages (English)

1. To provide for vehicles larger than cars, use wider stalls and wider aisles.
2. White paint shall be used for marking; a 4 inch width is recommended for marking lines.
Exhibit 10.13b   Parking Stall Dimensions for Parking Lots and Garages (Metric)

FOR PARKING LOT AND GARAGE PARKING

45°
2.90 METER STALL WIDTH
N = \frac{L - 4.10}{4.10}

60°
2.90 METER STALL WIDTH
N = \frac{L - 2.75}{3.35}

90°
2.90 METER STALL WIDTH
N = \frac{L - 2.90}{3.85}

1. To provide parking for vehicles larger than cars, use wider stalls and wider aisles.
2. White paint shall be used for marking; a 100 mm width is recommended for marking lines.

N = Number of stalls      \quad L = Usable parking length
<table>
<thead>
<tr>
<th>Total spaces in parking area</th>
<th>Required minimum number of accessible spaces</th>
<th>Van accessible spaces (8 ft. min. aisle width)</th>
<th>Car accessible spaces (5 ft. min. aisle width)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 25</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>26 to 50</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>51 to 75</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>76 to 100</td>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>101 to 150</td>
<td>5</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>151 to 200</td>
<td>6</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>201 to 300</td>
<td>7</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>301 to 400</td>
<td>8</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>401 to 500</td>
<td>9</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>501 to 1000</td>
<td>2% of total</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1001 and up</td>
<td>20 plus 1 for each 100 over 1000</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

1 One of every 8 accessible spaces
2 7 of every 8 accessible spaces

13. REFERENCES


