STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

BEVERLY EAVES PERDUE
GOVERNOR

EUGENE A. CONTI, JR.
SECRETARY

January 13, 2010

MEMORANDUM TO: 2002 Design Manual Holders

FROM: Rodger D. Rochelle, PE
Director of the Transportation Program Management Unit

SUBJECT: 2002 Design Manual Revision No. 6

Please find attached revisions and new guidelines to Part I and Part II of the *2002 Design Manual*. Please insert these revisions in your Manual in the appropriate place. These revisions are effective immediately. This transmittal letter should be detached from the revision and inserted in front of the Manual for future reference. Please recycle discarded pages from your manual. The *2002 Design Manual* has been updated and is available on the web at:

http://www.ncdot.org/doh/preconstruct/altern/value/manuals/

If you have any questions and comments about this revision or the Design Manual, please contact Mr. Frankie Draper or Mr. Robert McKeithan of my staff at (919) 250-4234.

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LOCATION:
CENTURY CENTER COMPLEX
ENTRANCE B-1
1020 BIRCH RIDGE DRIVE
RALEIGH NC

REVISION NUMBER 6

Part I – Design Manual

1. Chapter 1-Section 3F PAVEMENT ALTERNATIVE BASE COURSE MATERIALS

Note: Changes to binder content percentage for PADC, type P-57 and S12.5D.

2. Chapter 1-Section 4N CLEAR ZONE DISTANCES

Note: Changes to the chart and frequently asked questions has been added.

3. Chapter 1-Section 7 RETAINING WALLS

Note: New Policies and permit review processes

4. Chapter 6-Section 14 FINAL CHECKLIST FOR COORDINATION OF ROADWAY AND STRUCTURE PLANS

Note: Changes to item number 8 on the checklist

5. Chapter 6-Section 15 SUBREGIONAL TIER GUIDELINES FOR BRIDGES

Note: Development of A Subregional Tier Guidelines for Bridges.

6. Chapter 7 Section 6 MEDIAN SEPARATION AT HIGHWAY/RAILWAY AT-GRADE CROSSING

Note: Guidelines were written to provide consistent guidance .

7. Chapter 9 Section 4 DIRECTIONAL CROSSOVER WITH MEDIAN U-TURNS

Note: Econocrete reference changed to concrete shoulder.

Part II – Roadway Design Manual

8. Chapter 3 Section 1E INDEX OF SHEETS AND TOTAL SHEET NUMBERS

Note: Changes to this section represent current state of the practice for Roadway Design processes and procedures.

9. Chapter 6 Section 1D PAVEMENT SCHEDULE

Note: Changes in percentage of asphalt binder used in Pavement mixes.

10. Chapter 6 Section 1D PAVEMENT SCHEDULE

Note: Changes to Layer Depth for D3 of the Pavement schedule.

11 Chapter 6 Section 1D GEOTEXTILE FOR PAVEMENT STABILIZATION

Note: Geotextile for Pavement Stabilization has been added to the Pavement Schedule

12. Chapter 21 Section 5 CORRIDOR PUBLIC HEARING MAPS

Note: New section added.

RDR/RM

Attachments

cc:
Mr. Jay A. Bennett, PE
Mr. Jimmy Travis, PE
Mr. Frankie Draper

COMPUTED BY: B. YOPP DATE: SEPT. 2005
CHECKED BY: T. BURNS DATE: SEPT. 2005

PROJECT REFERENCE NO.	SHEET NO.
R-0609A	3-R

NOTE: Earthwork quantities are calculated by the Roadway Design Unit. These earthwork quantities are based in part on subsurface data provided by the Geotechnical Engineering Unit.

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

SUMMARY OF EARTHWORK
IN CUBIC YARDS

* PAVEMENT STRUCTURE VOLUME 40,441 cu yds.
** FOR ALTERNATE PAVEMENT DESIGN 29,956 cu. yds.

LOCATION	UNCL. EXCAVATION	UNDERCUT	EMBT+%	BORROW	WASTE
SUMMARY NO. 1					
–L– 11+98.805 TO 19+00.000	163,668		2,638		161,030
–Y– 10+00.000 TO 13+40.000	3,850		554		3,296
–Y1– 10+00.000 TO 12+26.533	1,395		581		814
–Y1– 13+03.733 TO 14+20.000	507		107		400
–Y1 DET– 10+29.365 TO 14+16.948	2,827		4,504	1,677	
DETOUR REMOVAL			3,062	3,062	
SUMMARY NO. 1 TOTAL	172,247		11,446	4,739	165,540
SUMMARY NO. 2					
–L– 19+00.000 TO 26+17.519 L.B.	24,365		145,723	121,358	
SUMMARY NO. 2 TOTAL	24,365		145,723	121,358	
SUMMARY NO. 3					
–L– 25+77.880 L.A. TO 35+00.000	168,012	1,300	108,846		60,466
–Y2– 10+00.000 TO 13+07.000	5,013		6,870	1,857	
–Y2– 14+20.000 TO 17+39.078	768	600	24,275	23,507	600
SUMMARY NO. 3 TOTAL	173,793	1,900	139,991	25,364	61,066
SUMMARY NO. 4					
–L– 35+00.000 TO 44+00.000	343,420		35,086		308,334
–Y3– 10+00.000 TO 12+26.944	1,633		971		662
–Y3– 13+02.264 TO 14+54.746	1,097		690		407
–Y4– 10+00.000 TO 16+55.785	4,324		26,150	21,826	
–DET2– 12+37.210 TO 15+52.083	5,014		451		4,563
–DET3– 12+51.082 TO 12+95.313	84		0		84
SUMMARY NO. 4 TOTAL	355,572		63,348	21,826	314,050
SUMMARY NO. 5					
–L– 44+00.000 TO 53+00.000	396,205	9,200	54,924		350,476
–Y5– 10+00.000 TO 19+45.115	5,219	800	1,930		4,089
–RPB– 11+53.455 TO 15+26.124	21,810		27,978	6,168	
–RPC– 11+94.366 TO 14+94.366	543		32,014	31,471	
–LPB– 10+67.281 TO 12+51.310	0		62,292	62,292	
–LPC– 10+43.870 TO 12+30.352	5,399		30,923	25,524	
–FLY– 12+76.258 TO 18+50.963	45,289		151,585	106,296	
–Y6– 13+38.426 TO 20+85.589	12,910		17,308	4,398	
–Y6– 21+69.189 TO 28+00.000	25,899		47,316	21,417	
–Y6– 28+00.000 TO 36+00.000	25,504		47,426	21,922	
–Y6– 36+00.000 TO 45+00.000	9,727		106		9,621
–Y6– 45+00.000 TO 49+70.000	1,887		419		1,468
SUMMARY NO. 5 TOTAL	550,392	10,000	474,226	279,488	365,654

LOCATION	UNCL. EXCAVATION	UNDERCUT	EMBT+%	BORROW	WASTE
SUMMARY NO. 6					
–L– 53+00.000 TO 61+00.000	25,225		196,495	171,270	
–RPA– 11+14.406 TO 14+23.096	0		96,372	96,372	
–RPD– 11+30.762 TO 14+87.240	35,027		10,250		24,777
–LPA– 10+34.440 TO 12+28.790	0		56,563	56,563	
–FLY– 20+12.663 TO 21+45.365	48		57,430	57,382	
–FLY– 22+45.365 TO 27+05.599	28,653		124,396	95,743	
–Y6– 13+27.416 TO 20+92.218	26,713		11,202		15,511
–Y6– 21+75.818 TO 28+00.000	30,058		40,392	10,334	
–Y6– 28+00.000 TO 37+00.000	54,683		35,752		18,931
–Y6– 37+00.000 TO 45+80.000	10,026		632		9,394
SUMMARY NO. 6 TOTAL	210,433		629,484	487,664	
SUMMARY TOTALS	1,486,802	11,900	1,464,218	940,439	974,923
ADDITIONAL UNDERCUT		7,000	8,400	8,400	7,000
LOST DUE TO CLEAR. & GRUB.	–15,000			15,000	
ROCK WASTE IN LIEU OF BORROW				–13,524	–13,524
EARTH WASTE IN LIEU OF BORROW				–948,644	–948,644
ADJ. FOR ROCK WASTE			–2,705	–2,705	
SHOULDER MATERIAL			72,600	72,600	
PROJECT TOTALS	1,471,802	18,900	1,542,513	71,566	19,755
EST. TO REPLACE TOP					
SOIL ON BORROW PITS				3,578	
GRAND TOTALS	1,471,802	18,900		75,144	19,755
SAY	1,472,000			75,200	
PAV'T STRUCTURE VOLUME -L-	*40,441 Cu. Yds.				
EARTHWORK TOTALS FOR ALTERNATE PAV'T DESIGN					
SUMMARY TOTALS	1,486,802	11,900	1,464,218	940,439	974,923
ADJ. FOR ALT. PAV'T DESIGN	–16,000		10,122	10,122	–16,000
ADDITIONAL UNDERCUT		7,000	8,400	8,400	7,000
LOSS DUE TO CLEAR. & GRUB.	–15,000			15,000	
ROCK WASTE IN LIEU OF BORROW				–13,524	–13,524
EARTH WASTE IN LIEU OF BORROW				–932,644	–932,644
ADJUSTMENT FOR ROCK WASTE			–2,705	–2,705	
SHOULDER MATERIAL			54,450	54,450	
PROJECT TOTALS	1,455,802	18,900	1,534,485	79,538	19,755
EST. TO REPLACE TOP					
SOIL ON BORROW PITS				3,977	
TOTAL	1,455,802	18,900		83,515	
SAY	1,455,900	18,900		83,600	
PAV'T STRUCTURE VOLUME	-L- ** 29,956 Cu. Yds.				

CLEAR ZONE DISTANCES
(IN FEET FROM EDGE OF TRAVEL LANE)

DESIGN SPEED	DESIGN ADT	FORESLOPES			BACKSLOPES		
		1V:6H or flatter	1V:5H to 1V:4h	1V:3H	1V:3H	1V:5H to 1V:4H	1V:6H or flatter
40 mph or less	UNDER 750 750 – 1500 1500 – 6000 OVER 6000	7 -10 10 – 12 12 – 14 14 – 16	7 – 10 12 – 14 14 – 16 16 – 18	** ** ** **	7 – 10 10 – 12 12 – 14 14 – 16	7 – 10 10 – 12 12 – 14 14 – 16	7 – 10 10 – 12 12 – 14 14 – 16
45 – 50 mph	UNDER 750 750 – 1500 1500 – 6000 OVER 6000	10 – 12 14 – 16 16 – 18 20 – 22	12 – 14 16 – 20 20 – 26 24 – 28	** ** ** **	8 – 10 10 – 12 12 – 14 14 – 16	8 – 10 12 – 14 14 – 16 18 – 20	10 – 12 14 – 16 16 – 18 20 – 22
55 mph	UNDER 750 750 – 1500 1500 – 6000 OVER 6000	12 – 14 16 – 18 20 – 22 22 – 24*	14 – 18 20 – 24 24 – 30 26 – 32*	** ** ** **	8 – 10 10 – 12 14 – 16 16 – 18	10 – 12 14 – 16 16 – 18 20 – 22	10 – 12 16 – 18 20 – 22 22 – 24
60 mph	UNDER 750 750 – 1500 1500 – 6000 OVER 6000	16 – 18 20 – 24 26 – 30 30 – 32*	20 – 24 26 – 32* 32 – 40* 36 – 44*	** ** ** **	10 – 12 12 – 14 14 – 18 20 – 22	12 – 14 16 – 18 18 – 22 24 – 26	14 – 16 20 – 22 24 – 26 26 – 28
65 – 70 mph	UNDER 750 750 – 1500 1500 – 6000 OVER 6000	18 – 20 24 – 26 28 – 32* 30 – 34*	20 – 26 28 – 36* 34 – 42* 38 – 46*	** ** ** **	10 – 12 12 – 16 16 – 20 22 – 24	14 – 16 18 – 20 22 – 24 26 – 30	14 – 16 20 – 22 26 – 28 28 – 30

* Clear zone distances can be limited to 30 feet unless in a high accident rate area.

** Since 3:1 slopes are not recoverable, additional runout area must be provided at the toe of the slope. Please refer to figure 1 on sheet 1-4M.

BACKGROUND INFORMATION

From: http://www.fhwa.dot.gov/programadmin/clearzone.cfm

Clear Zone and Horizontal Clearance Frequently Asked Questions

1. **What is the definition of clear zone?**

The Roadside Design Guide defines a **clear zone** as the total roadside border area, starting at the edge of the traveled way, available for safe use by errant vehicles. This area may consist of a shoulder, a recoverable slope, a non-recoverable slope, and/or a clear run-out area. The desired minimum width is dependent upon traffic volumes and speeds and on the roadside geometry. Simply stated, it is an unobstructed, relatively flat area beyond the edge of the traveled way that allows a driver to stop safely or regain control of a vehicle that leaves the traveled way.

A **recoverable slope** is a slope on which a motorist may, to a greater or lesser extent, retain or regain control of a vehicle by slowing or stopping. Slopes flatter than 1V:4H are generally considered recoverable. A **non-recoverable slope** is a slope which is considered traversable but on which an errant vehicle will continue to the bottom. Embankment slopes between 1V:3H and 1V:4H may be considered traversable but non-recoverable if they are smooth and free of fixed objects. A **clear run-out area** is the area at the toe of a non-recoverable slope available for safe use by an errant vehicle. Slopes steeper than 1V:3H are not considered traversable and are not considered part of the clear zone.

2. **Where can I find information on clear zone dimensions?**

The current edition of the AASHTO *Roadside Design Guide* presents information on the latest state-of-the-practice in roadside safety. It presents procedures to determine a recommended minimum clear zone on tangent sections of roadway with variable side slopes and adjustments for horizontal curvature.

The AASHTO *A Policy on Geometric Design of Highways and Streets* (Green Book) enumerates a clear zone value for two functional classes of highway. For local roads and streets, a minimum clear zone of 7 to 10 feet is considered desirable on sections without curb. In the discussion on collectors without curbs, a 10-foot minimum clear zone is recommended. The general discussion on Cross-section Elements also indicates a clear zone of 10 ft. for low-speed rural collectors and rural local roads should be provided.

3. **What is the definition of horizontal clearance?**

Horizontal clearance is the **lateral offset distance** from the edge of the traveled way, shoulder or other designated point to a vertical roadside element. These dimensional values are not calculated, and are not intended to constitute a clear zone. They are intended to provide a roadside environment that is not likely to have an adverse affect on motorists' using the roadway. These lateral offsets provide clearance for mirrors on trucks and buses that are in the extreme right lane of a facility and for opening curbside doors of parked vehicles, as two examples.

4. **What are some examples of roadside elements requiring horizontal clearance?**

Curbs, walls, barriers, piers, sign and signal supports, mature trees, landscaping items, and power poles are primary examples of the type of features that can affect a driver's speed or lane position if located too close to the roadway edge. Other specific examples can be found in the Cross Section Elements, Local Roads and Streets, Collector Roads and Streets, Rural and Urban Arterials, Freeways, and Intersections chapters of the Green Book.

The AASHTO *A Policy on Design Standards - Interstate System* also contains a discussion on horizontal clearance in the section Horizontal Clearance to Obstructions.

5. **Is clear zone a controlling criterion?**

No. Controlling criteria are 13 items or elements in the NHS design standards that require a formal design exception when the adopted minimum value is not met on a project. The list of controlling criteria was developed to insure that deviations below the adopted value for a critical element were adequately considered in design of a project. When the original list was developed in 1985, clear zone was considered to be synonymous with horizontal clearance. Subsequently, in 1990, following adoption of the *Roadside Design Guide*, it was decided that clear zone width would no longer be considered as an element requiring a formal design exception. In the rulemaking to adopt the *Roadside Design Guide*, it was determined that clear zone width should not be defined by a fixed, nationally applicable value. The various numbers in the guide associated with clear zone are not considered as exact but as ranges of values within which judgment should be exercised in making design decisions. Objects or terrain features that fall within the appropriate clear zone are typically shielded so a design exception is not needed. The FHWA believes that a consistent design approach, guided by past crash history and a cost-effectiveness analysis is the most responsible method to determine appropriate clear zone width.

While clear zone is not a controlling criterion for purposes of applying the Green Book to the National Highway System, an exception to a clear zone for a project does need to be noted, approved and documented in the same manner as exceptions to other non-controlling criteria when the established value is not met. The documentation may be included in project notes of meetings or other appropriate means.

6. **Where is the appropriate location for above ground utility structures?**

FHWA policy is that utility facilities should be located as close to the right-of-way line as feasible. The Green Book, AASHTO *Highway Safety Design and Operations Guide, 1997*, (Yellow Book) and the AASHTO *A Guide for Accommodating Utilities within Highway Right-of-way*, all state that utilities should be located as close to the right-of-way line as feasible. The Yellow Book, recognizing that crashes are overrepresented on urban arterials and collectors, says this means as far as practical behind the face of outer curbs and where feasible, behind the sidewalks.

It is not always feasible to relocate all poles within project limits. Critical locations should be considered for improvement, such as those dictated by crash experience or in potential crash locations, such as within horizontal curves. Where poles cannot be relocated from critical locations, mitigation such as breakaway or shielding should be considered. Poles should not be installed in a location that could act as a funnel directing an errant vehicle into an obstacle (for example a roadside drainage ditch, that would also disrupt the hydraulics). Locating a pole as far as feasible from the traveled way improves sight lines and visibility, providing a safer roadside.

7. **What clear zone needs to be maintained behind a curb?**

The difference between a "clear zone" and horizontal clearance or "operational offset" has been a topic of much confusion. When the Green Book and the Roadside Design Guide were last updated, the AASHTO committees coordinated to dispel the misunderstanding that 2 feet (actually, 18 inches) behind a curb constituted a clear zone. Since curbs are now generally recognized as having no significant containment or redirection capability, clear zone should be based on traffic volumes and speeds, both without and with a curb. Realizing that there are still contradictory passages in various AASHTO documents, the Technical Committee on Roadside Safety has initiated a short-term project to identify all such inconsistencies and to recommend appropriate language corrections. This effort is underway. The fourth paragraph under Section 3.4.1 Curbs in the 2002 Roadside Design Guide correctly defines AASHTO's "position".

RETAINING WALLS 6-7

A retaining wall is a structure that retains or holds back a soil or rock mass. Retaining walls are used for many reasons including repairing landslides, minimizing right of way requirements, shortening bridges (abutment walls), widening roads, and providing property access. Retaining walls are typically high cost items and are only justified when other options such as purchasing right of way, constructing longer bridges or realignment are not feasible.

The specific type of retaining wall utilized is dependent on several factors, including whether it is in a cut or fill, the subsurface conditions in the area around the proposed wall, cost, aesthetics, etc. All potential retaining wall locations should be submitted to the Geotechnical Engineering Unit at an early stage of the project development process so that the Geotechnical Engineering Unit can determine the most feasible wall type and provide a preliminary cost estimate. The Project Engineer should initiate the retaining wall design process by submitting a request for retaining wall design to the Geotechnical Engineering Unit at the 25% plan stage. Please consult STARS to determine the actual due date for submitting the wall location(s) and envelope(s) to the Geotechnical Engineering Unit. In all cases, the request for retaining wall design should be submitted no later than six months prior to the scheduled Final Design or Combined Field Inspection to ensure that a preliminary wall design can be prepared and any design/construction issues can be discussed at the field inspection.

Retaining walls should be shown on the cross-sections as a vertical line one (1) foot thick. When referencing retaining walls on the roadway plans, each wall should be numbered sequentially along the -L- alignment (i.e., “Retaining Wall #1”, “Retaining Wall #2”, etc.). If walls are located on both sides of the roadway, the sequence should begin on the right side. If the wall is located along a -Y- alignment, the numbering sequence should be based on where the -Y- line crosses the -L- alignment. The Roadway Design Unit is responsible for showing the retaining wall(s) on the roadway plans and cross-sections.

Construction limits to determine right of way and/or easements will vary depending on the geometry and wall type. The Geotechnical Engineering Unit will provide Roadway Design with right of way and easement requirements in the roadway foundation recommendations. During preliminary design, right of way or permanent easement approximately 1.2 times the maximum wall height can be shown on the plans until the foundation recommendations are received.

Generally, retaining walls should be laid out straight for ease of design and construction. Curved walls may be used in order to maintain a constant offset from a survey line, but only in low degree curves. If a curved wall is specified, it is advisable to contact the Geotechnical Engineering Unit prior to preparing the preliminary wall envelope, in order to determine whether a specific wall alignment is feasible for your project.

If the wall is located within the clear zone, steel beam guardrail (Section 862 of the Standard Specifications), single-faced reinforced concrete barrier (Section 857 of the Standard Specifications) or a concrete barrier rail with a moment slab (Structure Pay Item) can be used to protect the hazard.

Steel Beam Guardrail (Top or Bottom of Wall)

Steel Beam Guardrail can be placed at the bottom or top of a wall to protect the hazard. Steel Beam Guardrail should be offset 5’-6” from the nearest wall surface when standard Steel Beam Guardrail (6’-3” post spacing) is specified. The minimum offset distance from the face of the guardrail to the nearest wall surface is 5’-6” at the top of the wall and 3’-6” at the bottom of the wall. When the offset distance from the wall surface to face of guardrail is between 3’-6” and 5’-6”, specify 3’- 1½” post spacing at a point 25 feet prior to the wall and carry the 3’-1½” post spacing throughout the length of the wall. If the offset distance at the bottom of the wall is less than 3’-6” specify single-faced concrete barrier. A special detail or notes on the guardrail summary and plan sheets should be added to clarify the areas where 3’- 1½” post spacing is required. Coordinate with the Geotechnical Engineering Unit to ensure guardrail posts do not conflict with the retaining wall design. Figure 1 illustrates the offset requirements for steel beam guardrail in relation to the wall.

Concrete Barrier Rail with a Moment Slab (Top of Wall Only)

If the offset distance at the top of the wall is less than 5’-6”, a concrete barrier rail with a moment slab is required. Concrete barrier rail with a moment slab should be located on top of the wall with no offset as illustrated in Figure 2. When a concrete barrier rail with a moment slab is required, coordinate with the Geotechnical Engineering Unit and the Structure Design Unit since the concrete barrier rail is a structure pay item. The details for the concrete barrier rail with a moment slab will be included as part of the retaining wall plans. Due to the high costs associated with a concrete barrier rail with a moment slab, they should only be used when no other options are available. If guardrail needs to be attached to the concrete barrier rail, the concrete barrier rail should extend the entire length of the wall. Guardrail with appropriate anchors can then be attached to the concrete barrier rail in accordance with the most current guardrail policies.

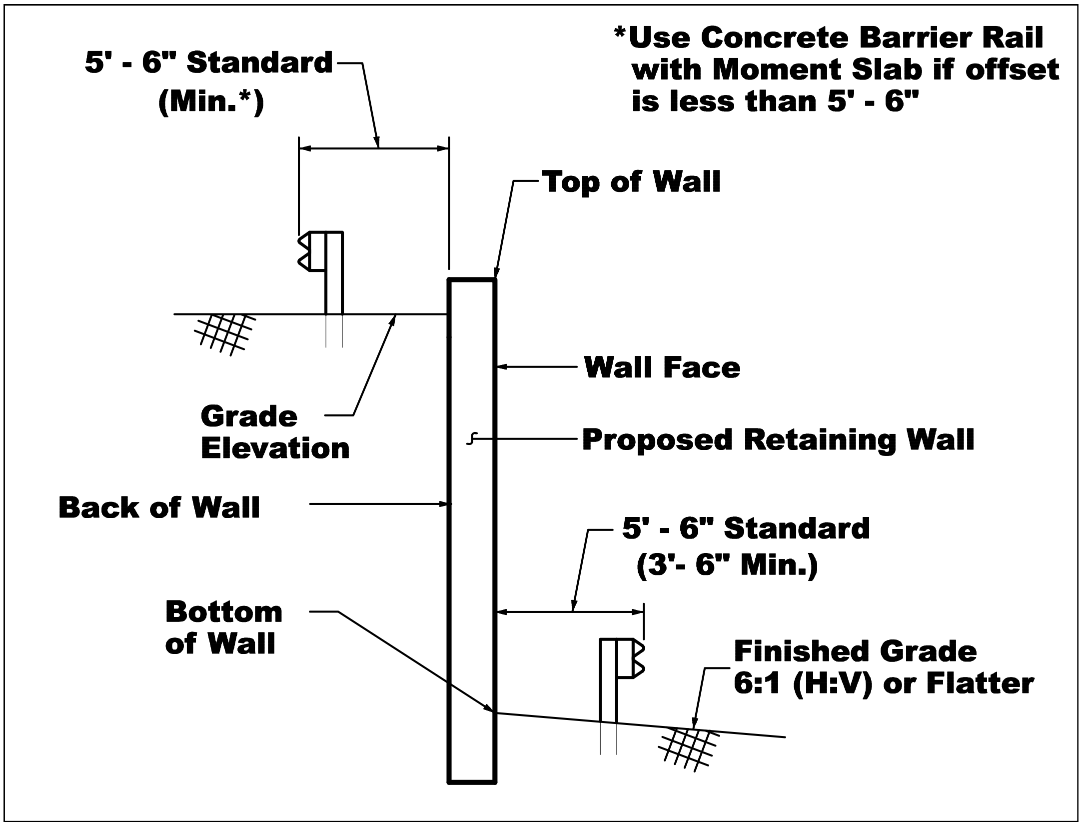


Figure 1

Single-Faced Reinforced Concrete Barrier (Bottom of Wall Only)

Single-faced reinforced concrete barrier can be located next to the wall face when placed at the bottom of the wall. If guardrail needs to be attached to the single-faced concrete barrier, the barrier should extend the entire length of the wall. Guardrail with appropriate anchors can then be attached to the single-faced concrete barrier in accordance with the most current guardrail policies. Figure 2 illustrates the offset requirements for single-faced concrete barrier in relation to the bottom of wall. In some cases, the placement of single-faced concrete barrier at the bottom of the wall can result in significant cost savings by reducing the wall height. If future widening is not anticipated in the vicinity of the bottom of wall, coordinate with the Geotechnical Engineering Unit to determine if the use of single-faced concrete barrier will result in any cost savings.

A typical section inset should be added to the roadway plans depicting the placement of the single-faced barrier or guardrail in relation to the retaining wall. The proposed offset distances, if any, should be clearly labeled on the inset.

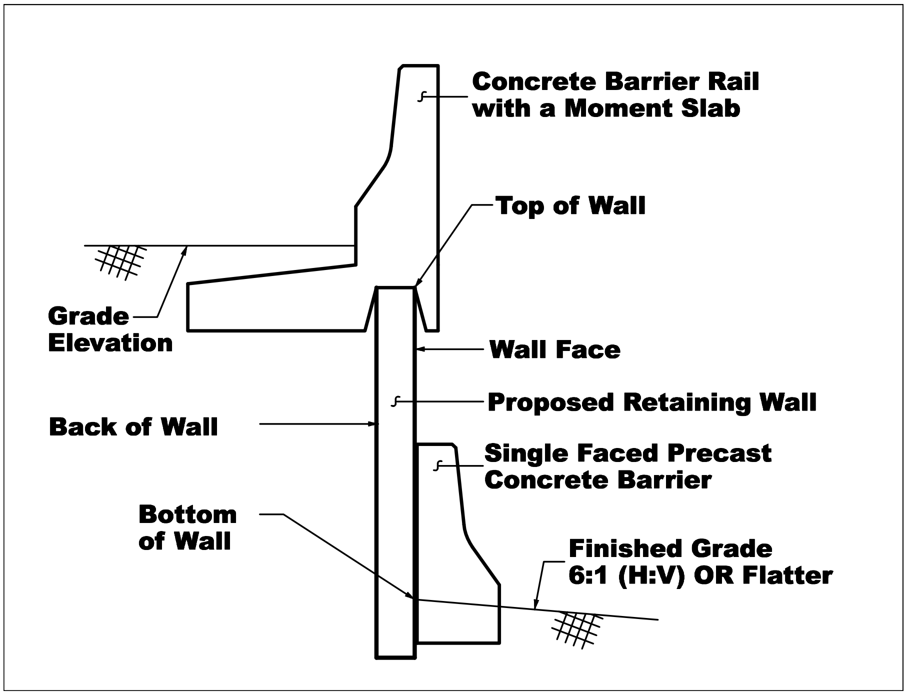


Figure 2

Fence or Handrail Placement

A fence or handrail should be placed when pedestrian traffic is anticipated in the vicinity of the top of wall. The Roadway Project Engineer should determine whether handrail or fence is appropriate, based on the height of the wall and the project conditions in the vicinity of the wall. It is preferred that fence or handrail be located no closer than one (1) foot from the back of wall. If a fence attachment is required on the wall, chain link fence should be specified.

When fence or handrail is attached to a wall, the Roadway Project Design Engineer should contact the Standards Squad Leader in the Contract Standards and Development Unit to prepare details for the attachment to the wall. The fence or handrail detail(s) should be incorporated into the roadway plans as 2-Series sheets. All chain link fence that is attached to a retaining wall should be shown in the appropriate fence summary and paid for under section 866 of the Standard Specifications as Chain Link Fence, ___" Fabric per linear foot. Standard chain link fence symbology should be used to denote the chain link fence on the roadway plans. A generic fencing pay item (SP) should be used to pay for any handrail that is attached to the wall. The Roadway Project Design Engineer should list the fence or handrail on their list of Special Provision items when they submit the final plans to the Contract Standards and Development Unit. Coordinate with the Geotechnical Engineering Unit when fence is warranted in the vicinity of a wall to ensure that fence or handrail posts will not be in conflict with the retaining wall design.

RETAINING WALLS (CONTINUED) 6-7

The maintenance of vegetation behind the guardrail, concrete barrier, fence, or handrail should be considered when placing these items in close proximity to the retaining wall. Asphalt or class "A" stone may be placed between the guardrail, concrete barrier, fence, or handrail and the wall to help manage vegetation in inaccessible areas. A typical section inset or detail will be needed if you are specifying asphalt or class 'A' stone to manage vegetation.

The Geotechnical Engineering Unit is responsible for coordinating the preparation of all retaining wall plans. The Geotechnical Engineering Unit will provide plans, special provisions, and pay item quantities for walls that they design. Retaining wall plans will be a part of the structure plans unless there are no other structures on the project. If there are no structure plans, the retaining wall plans will be placed in the roadway plans as W-series sheets.

TYPES OF RETAINING WALLS 6-7A

Most retaining walls are either fill walls or cut walls. Fill walls are generally constructed from the bottom up by placing material behind the wall. Cut walls are generally constructed from the top down by removing material from in front of the wall.

Fill Walls

The most common types of fill walls are (1) *Gravity Retaining Walls*, (2) *Mechanically Stabilized Earth (MSE) Retaining Walls*, and (3) *Cantilever Concrete Retaining Walls*.

(1) *Gravity Retaining Walls* are typically short walls (less than 10 feet in height) constructed of cast-in-place unreinforced concrete that develops stability from their own weight or mass. For additional information regarding standard gravity walls, please reference Geotechnical Standard Drawing 453.01 and Section 453 of the Standard Specifications for Roads and Structures.

(2) *MSE Retaining Walls* consist of facing elements connected to layers of soil reinforcement within the retained backfill. For permanent MSE walls, steel or geogrid reinforcements are used with facing elements consisting of precast concrete panels or segmental retaining wall units. For temporary MSE walls, steel, geogrid or fabric reinforcements are used and facing elements consist of fabric and wire forms.

(3) *Cantilever Concrete Retaining Walls* are constructed of cast-in-place reinforced concrete that is connected to a footing. Cantilever concrete walls partially develop their stability from the weight of the backfill over the footing. Cantilever concrete walls are more expensive than MSE walls and as a result, are normally used only when MSE walls are not feasible.

A permanent underground easement or right of way is required for the reinforcement length or footing width behind the wall. Fill walls can be used in cuts but require either temporary shoring or a temporary slope to construct and may also require additional construction easements.

Cut Walls

The most common types of cantilever cut walls are *Sheet Pile Retaining Walls*, *Soldier Pile Retaining Walls, and Pile Panel Retaining Walls*.

Sheet Pile Retaining Walls consist of interlocking sheet piles driven or vibrated into the ground. Sheet pile walls are common for temporary shoring. *Soldier Pile Retaining Walls* consist of steel H piles driven or placed in drilled holes and partially filled with concrete with either precast panels set in pile flanges or a cast-in-place reinforced concrete face connected to the front of the piles. A *Pile Panel Retaining Wall* is a type of soldier pile wall with H piles in drilled holes and concrete panels.

The depth of the piles below the bottom of the wall is called the embedment depth. The embedment depth for cantilever cut walls is typically about twice the wall height. For soldier pile walls, timber lagging is typically used for temporary support of the excavation during construction.

Cantilever cut walls can be constructed very close to the right of way since no part of the wall extends behind or in front of the wall. These walls are also commonly used in fill situations and usually do not exceed 13 feet in height.

The most common type of non-cantilever cut walls are (1) *Soil Nail Retaining Walls* and (2) *Anchored Retaining Walls*.

(1) *Soil Nail Retaining Walls* can only be used in cut situations (no fill) and develop stability from passive elements (non-tensioned) that resist applied earth pressure on the wall. Soil nails consist of steel bars grouted in drilled holes inclined at an angle below the horizontal. A soil nail wall consists of soil nails spaced at a regular pattern and connected to a cast-in-place reinforced concrete face with nail heads embedded in the concrete. Shotcrete is used for temporary support of the excavation during construction.

(2) *Anchored Retaining Walls*, also called "tieback walls", develop stability from tensioned anchors that resist applied earth pressure on the wall. Anchors consist of bars or strands in drilled holes at an angle below the horizontal that are pressure grouted and connected to steel piles. The piles are driven or placed in drilled holes filled with concrete below the bottom of the wall. The face is usually cast-in-place reinforced concrete and timber lagging is typically used for temporary support of the excavation during construction. Anchored walls can be used in partial cut and fill situations, but the anchors do not develop capacity in the unbonded length through the backfill.

A permanent underground easement or right-of-way is required for the nails and anchors behind the wall.

Figure 3 illustrates a typical retaining wall section. Key components have been labeled and definitions are provided.

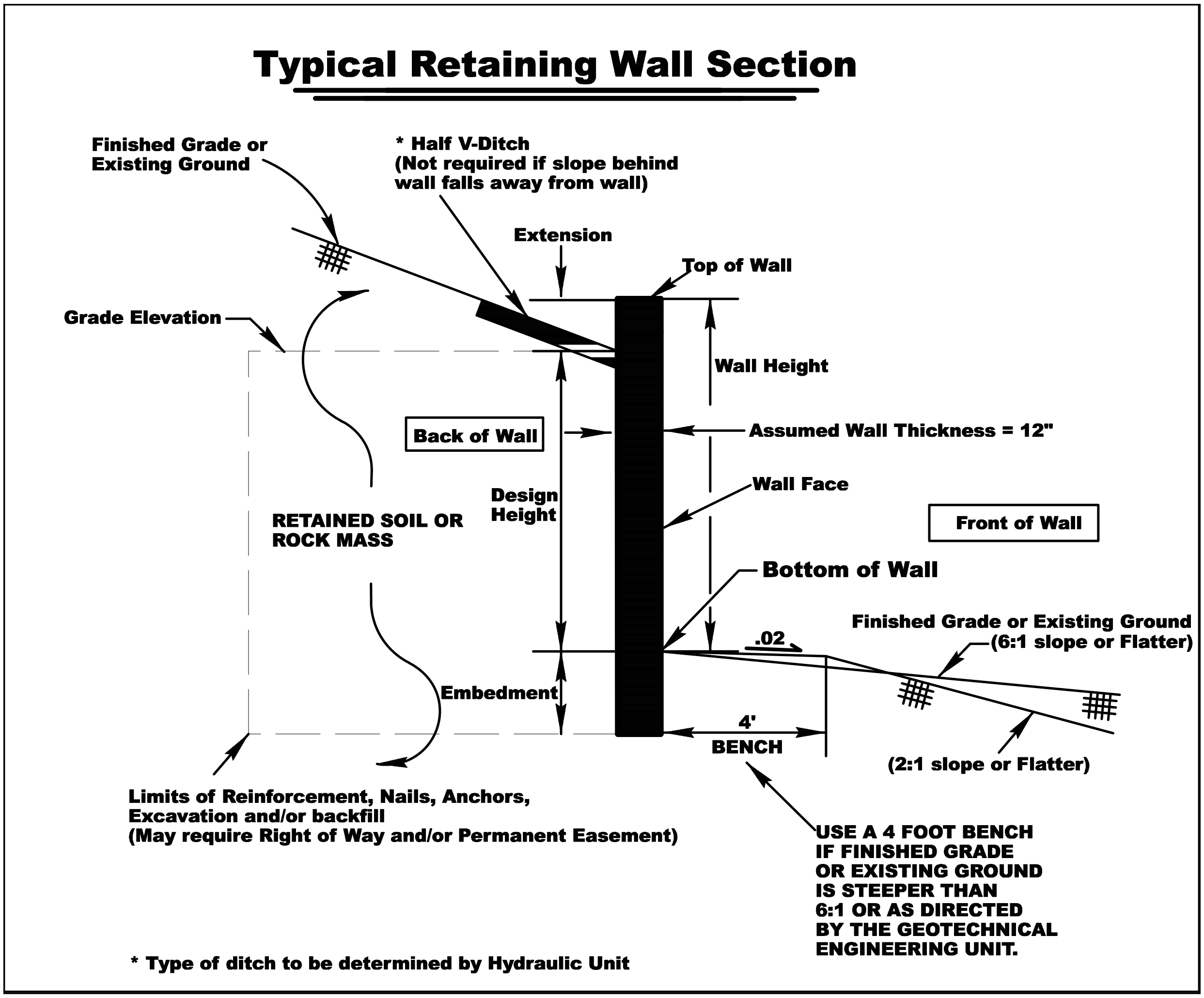


Figure 3

- **Bottom of Wall -** Where finished grade (typically cut walls) or existing ground (typically fill walls) intersects front of wall.
- **Design Height -** Difference between grade elevation and bottom of wall.
- **Embedment -** Difference between bottom of wall and bottom of footing, cast-in-place face or precast panels.
- **Extension -** Difference between top of wall and grade elevation.
- **Grade Elevation** - Elevation where finished grade (typically fill walls) or existing ground (typically cut walls) intersects back of wall.
- **Top of Wall** - Top of cast-in-place face or coping (or bottom of cap if abutment wall is part of end bent or embedded in cap).
- **Wall Face** - Exposed face of front of wall.
- **Wall Height** - Difference between top and bottom of wall (i.e., exposed height).

REQUEST FOR RETAINING WALL DESIGN 6-7B

In order to initiate the retaining wall design process, the Roadway Project Engineer must prepare a request for retaining wall design. A "Request for Retaining Wall Design" form letter can be downloaded by accessing the roadway form letters. The request for retaining wall design should be submitted to the Geotechnical Engineering Unit with the 25% plans. Please consult STARS to determine the actual due date for submitting the wall location(s) and envelope(s) to the Geotechnical Engineering Unit. The request shall be submitted no later than 6 months prior to the Combined or Final Design Field Inspection to ensure that a preliminary wall design can be prepared and any design/construction issues can be discussed at the field inspection. The following information needs to be provided with the request for retaining wall design:

(1) Plan Sheet(s), Profile Sheet(s), and Cross Sections in the location of the proposed retaining wall(s).
(2) Preliminary wall envelope(s)
(3) Any other factors that need to be taken into account in the design of the wall(s) (i.e., drainage, utilities, lighting, fence, guardrail, barrier, etc.)

Preliminary Wall Envelope

A wall envelope is a profile view of the exposed wall area. A wall envelope can be defined as a scaled plot of the grade elevations and bottom of wall elevations, the existing ground elevations (if it falls within the vicinity of the wall) and temporary grade elevations (if applicable) on some frequent station interval along the wall. Each elevation should be shown both graphically and numerically. All walls should be referenced using centerline stations and offsets. Please note that for some walls, the stations may be shown on the wall envelope in descending order, since the wall envelope depicts the wall face (the side of the wall that is exposed). In general, elevations should be provided every 25 feet along the centerline from the beginning to the end of each wall. Area calculations of the wall face should be included with your submittal. The following information should be included with the wall envelope:

- Station and Offset Distance from centerline every 25 feet along the wall face.

- The Grade Elevation every 25 feet along the wall face.

- The Bottom of Wall and Existing Ground Elevations every 25 feet along the wall face.

The wall envelope needs to show where the grade elevation intersects the existing ground (where the grade and existing ground elevations are equal, i.e. the wall height is 0). This will typically occur at the beginning and end of each wall. Station, offset, grade elevation, bottom of wall elevation, and existing ground line elevation will also need to be shown at each point where the wall alignment changes (i.e., the point where the wall alignment bends).

Walls that do not have a constant offset related to the centerline alignment and walls that are located in curves will not be depicted accurately on the wall envelope. For these cases, a note stating that "The wall envelope does not accurately depict the actual face of the wall" should be added to the wall envelope. All wall area calculations will need to be computed by hand, since the wall envelope will show a distorted view of the wall face.

Final Wall Envelope

A final wall envelope will need to be submitted to the Geotechnical Engineering Unit after the plans have been revised based on recommendations from the Geotechnical Engineering Unit and comments from the Combined or Final Design Field Inspection. The information shown on the final wall envelope will be the same as that shown on the preliminary wall envelope. The only difference between the preliminary and final wall envelopes would be minor changes to the stations and elevations brought about during the design of the wall. The Geotechnical Engineering Unit will provide Roadway Design with the information needed to prepare the final wall envelope. The final wall envelope will be shown in the retaining wall plans and should not be shown in the roadway plans. An exception would be if there are no structure plans for the project, then the retaining wall plans will be inserted in the roadway plans as W-series sheets.

For additional policy information regarding retaining walls, please reference the "Retaining Walls and Sound Barrier Walls" memo from the Highway Design Branch dated July 29, 2005.

TEMPORARY SHORING 6-7C

Temporary shoring is typically required to maintain traffic, but in rare cases may be used to protect wetlands, buildings, structures or for the removal of existing structures. Please reference the “Temporary Shoring” memorandum from Art McMillan dated January 17, 2007 for additional information regarding Unit responsibilities.

If temporary shoring is required for the maintenance of traffic, the Roadway Design Unit will show the temporary shoring on the roadway plans (plan view without stations) and reference the traffic control plans. If the temporary shoring is required at more than one location, the quantity for each location will be shown on the traffic control plans.

If the Roadway Design Unit is requesting the temporary shoring (rare), the temporary shoring location (stations and offsets), typical section(s) and notes will be shown in the roadway plans. If the temporary shoring is required at more than one location, the quantity for each location will be shown on the roadway plans.

If temporary shoring is required, the Geotechnical Engineering Unit may provide standard shoring details for insertion into the final plans. Depending on the project, 0, 1, 11, or 12 detail sheets may be included in the Roadway Plans. The standard shoring details should be placed in the roadway plans as 2-series sheet(s).

The following table can be used to help determine how many standard shoring detail sheets will be needed based on which shoring notes (if any) are referenced in the plans. The notes will be provided by the Geotechnical Engineering Unit and will typically be referenced in the traffic control plans when shoring is requested by the Work Zone Traffic Control Unit for the maintenance of traffic, but could be referenced in the roadway plans if the shoring is requested by Roadway Design.

NOTE A
“DO NOT USE STANDARD SHORING FROM STATION _____, _____ FT (m) _____, TO STATION _____, _____ FT (m) _____.”

NOTE B
“DO NOT USE STANDARD TEMPOARY SHORING FROM STATION _____, _____ FT (m) _____, TO STATION _____, _____ FT (m) _____.”

NOTE C
“DO NOT USE A TEMPORARY MSE WALL FROM STATION _____, _____ FT (m) _____, TO STATION _____, _____ FT (m) _____.”

Number of Temporary Shoring Details to be inserted into the Roadway Plans	Note(s) Specified in the Final Plans		
	A	B	C
0	YES	NO	YES
1	NO	NO	YES
11	NO	YES	NO
12	NO	NO	NO

FINAL CHECKLIST FOR COORDINATION OF
ROADWAY AND STRUCTURE PLANS

PROJECT NO. ______________________________ COUNTY ________________
I.D. No. ___________________

__1. Beginning and ending stations shown on Roadway Plans for bridge agree with Structure Plans.

__2. Pay items on Structure Plans agree with the pay items on the Roadway Plans (Example – If rip-rap is required, do not show the rip-rap on Structure Plans and dumped stone on Roadway Plans).

__3. Guardrail attachments on structure and roadway plans are attached at the same points and located on the same corners.

__4. Bridge widths on Roadway Plans (if shown) agree with widths on Structure Plans.

__5. Shoulder to shoulder widths beneath the bridge on a grade separation shown on the Structure Plans agree with widths shown on the typical sections in the Roadway Plans.

__6. Drainage Structures shown on the structure plans agree with Drainage Structures shown on Roadway Plans.

__7. Note shown stating that existing pavement shall be scarified in area of end-bent piles.

__8. Pay Items and Roadway Standard Drawings or details are included in the Roadway Plans for reinforced bridge approach fills or Subregional Tier bridge approach fills.

__9. Vertical and Horizontal Alignment on Roadway Plans agree with that shown on Structure Plans.

Checked By_________________________Date________

Checked By_________________________Date________

DIVISION OF HIGHWAYS
NCDOT

SUB REGIONAL TIER DESIGN GUIDELINES FOR BRIDGE PROJECTS

FEBRUARY 2008

Approved ______________________
State Highway Administrator

Approved ______________________
Federal Highway Administration

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

SUB REGIONAL TIER DESIGN GUIDELINES FOR BRIDGE PROJECTS

CONTENTS PAGE

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

SUB REGIONAL TIER DESIGN GUIDELINES FOR BRIDGE PROJECTS

PURPOSE

The Sub Regional Tier Design Guidelines for Bridge Projects establishes the controlling design elements for new and reconstructed bridges on the North Carolina Highway System designated as minor collectors, local and/or secondary roads. Engineering judgment must be applied during project development, while considering the site-specific conditions, to achieve desirable levels of service and assure safety of the traveling public. Each bridge project shall provide a safe and economical design, while maintaining or improving the operating conditions at the site.

If a bridge project is designed to the standards set forth in these guidelines, no formal design exception approval is required.

If a bridge project is designed to the standards set forth in these guidelines and does not match the current planning document, a memorandum to the project file shall be written to acknowledge that the Sub Regional Tier Guidelines for Bridge Projects was used. No formal design exception approval is required.

Formal design exception approval is required when standards set forth in these guidelines are not met. Project files shall fully justify and document the need for a design exception to the standards. Any anticipated design exception required for a project shall be listed in the environmental document.

BACKGROUND

These guidelines establish broad limits by presenting minimum values for design and allowing engineering judgment to be applied to achieve desirable levels of traffic service and safety appropriate to the social, economical and environmental controls applicable to the specific project. The North Carolina bridge inventory is aging at a rate, which exceeds the current bridge replacement program. In an effort to minimize the amount of approach work and to maximize the limited funds available for the bridge program, representatives from the Bridge Maintenance Unit, Construction, Operations, Planning, and Highway Design Branch Units evaluated the Department's bridge replacement program and established bridge replacement design criteria that maintains current operating conditions without compromising safety. These guidelines direct planners and designers to minimize changes in the vertical grade, structure length and width, approach roadway limits and right of way for each site.

PROCEDURE

The Project Development and Environmental Analysis Branch (PDEA) will prepare a planning document that includes appropriate consideration of the safety, social, economic and environmental impacts. On-site field reviews and scoping meetings must be held during the planning and design process. At a minimum, representatives from PDEA, Highway Design and the Division should be in attendance at these meetings.

PLANNING

PDEA's Bridge Project Development Unit will coordinate with Highway Design, Division and Traffic Engineering staff to provide, in the environmental document, decisions reached regarding applicable design criteria such as bridge approach travel speed, design speed, bridge width and lane and shoulder widths. These decisions will be based on traffic forecast and crash and severity rates when compared to the statewide average (provided by the Traffic Engineering and Safety Systems Branch) and whether the location is identified by North Carolina's Highway Safety Improvement Program.

The Bridge Project Development Unit will also coordinate with the Division and the Bridge Maintenance Unit on the possibility of removal of redundant bridges and options for rehabilitation instead of replacement where appropriate. Consideration shall be given to the use of accelerated construction techniques.

ROADWAY DESIGN (GEOMETRIC DESIGN CRITERIA)

The following geometric design criteria will be used based on the traffic forecast and whenever the crash and severity rates are below the statewide average (provided by the Traffic Engineering and Safety Systems Branch). Also, the project site shall not be at a location identified by North Carolina's Highway Safety Improvement Program.

Design Speed: The design speed shall be established after considering the topography, anticipated operating speed, the adjacent land use and the functional classification of the highway. The design speed selected for the project shall be identified and recorded in the environmental document. Once the design speed is selected, all of the pertinent highway features should be related to this speed to obtain a balanced design. All references to speed in this document are the design speed unless otherwise noted.

Lane and Shoulder Widths: R-R-R Guide, Table 2, Page 14.

Bridge Width:
20 year Design Volume Less than 4000 vehicle/day
Design speed of 45 mph and under: Bridge Deck Width (Minimum) = 24 feet
Design speed above 45 mph: Bridge Deck Width (Minimum) = 26 feet

20 year Design Volume Over 4000 vehicle/day
For all design speeds: Bridge Deck Width (Minimum) = 28 feet*
(* For current ADT over 3000 vehicle/day: use 30 feet)

In no case shall the bridge width be less than that of the approach roadway width (including paved shoulders).

Horizontal Clearance: Bridge Policy, Page 26. (Horizontal Clearances for Local System)

Vertical Clearance: Bridge Policy, Page 9. (Vertical Clearances)

Horizontal Alignment: An existing horizontal curve may be retained as is without further evaluation if the existing curve design, assuming correct superelevation is provided, corresponds to a speed that is within 10 mph of the design speed.

Vertical Alignment: An existing vertical curve may be retained if the curve's design speed is within 20 mph of the project's design speed and the design volumes are less than 1500 vehicles/day.

An existing vertical curve may be retained if the curve's design speed is within 10 mph of the project's design speed.

Stopping Sight Distance: Minimum stopping sight distance should be provided for the horizontal and vertical curve conditions as stated above (Horizontal and Vertical Alignment). Values are shown in Exhibit 5-2, page 381. [AASHTO, A Policy on Geometric Design of Highways and Streets (2004)].

Cross Slope: Pavement cross slope should be adequate to provide proper drainage. Normally, cross slopes range from 1.5 to 2 percent for asphalt pavements.

Superelevation: It is desirable to superelevate curves in accordance with AASHTO Guidelines. The curve should be signed and marked for the appropriate speed in accordance with the provisions of the "Manual On Uniform Traffic Control Devices For Streets And Highways" (MUTCD) if minimum superelevation rates can not be achieved.

Grades: The existing roadway grade may be retained. An appropriate minimum grade is typically 0.3%.

Guardrail: Transition guardrails to bridge rails should be provided on all four corners of an undivided two-way, two-lane bridge.

Design speed of 45 mph and under: The minimum length of guardrail required at the bridge approach is 50 feet (including the guardrail anchor units). This design utilizes a Test Level 2 (TL-2) Guardrail Anchor Unit Type 350.

Design speed above 45 mph: The minimum length of guardrail required at the bridge approach is 75 feet (including the guardrail anchor units). This design utilizes a Test Level 3 (TL-3) Guardrail Anchor Unit Type 350.

Engineering judgment must be applied during all stages of project development to achieve desirable levels of traffic service and safety, while considering site-specific conditions. At a minimum, current operating conditions shall be maintained and safety improved at documented and potentially hazardous locations.

For very low-volume local roads the Guidelines for Geometric Design for Very Low-Volume Local Roads (ADT 400 vehicles and less), AASHTO 2001 may be used in lieu of the Sub Regional Tier Design Guidelines for Bridges. “A very low-volume local road is a road that is functionally classified as a local road and has a design average daily traffic volume of 400 vehicles per day or less.”

HYDRAULIC DESIGN

FEMA: Identify project site locations that require FEMA Detailed Study or Limited Detail Study and design for compliance.

Non FEMA: Consult with the Division Office to establish Level of Service needs if the existing roadway is overtopped by the 25-year frequency storm or an event with a lower return period.

The minimum return period for design shall maintain the existing level of service.

The maximum return period for design is the 25-year frequency storm.

Where design frequency is less than the 25-year storm, the engineer will assess the property upstream and downstream of the highway rights of way for impacts to private property.

Hydraulics: The recommended structure type shall be considered in the following priority order: a) Pipe Culvert (circular or arch pipe), b) Box Culvert, c) Bottomless Culvert Structure founded in non-scourable rock (concrete or metal), d) Bridge.

Deck Drainage: There shall be no direct discharge of deck runoff into open waters with classification of WS-I or Outstanding Resource Water.

There shall be no direct discharge into open waters within one half (0.5) mile of Critical Area of WSII, WSIII, and WSIV.

There shall be no direct discharge in all other water classifications where storm water runoff gutter spread is not at risk for safety of the traveling public.

Gutter Spread: Avoid spread into travel lane for a 4 inches/hour rainfall intensity. Investigate steeper gutter slope, increase deck cross slope, eliminate super elevation, coordinate rail and deck drain details with Structure Design Engineer, etc. to reduce gutter spread when necessary.

Bridge Scour: The Hydraulics Engineer shall analyze scour for the 100-year or overtopping flood. Cone of influence for total scour to be shown as 1.4H: 1V on the bridge profile drawing.

Debris Assessment: Identify debris transport potential at the site. Where debris transport potential is low, the use of battered piles may be appropriate and should be noted under “Additional Information” on the Bridge Survey Report.

General Comments: Consider span arrangements that accommodate the use of cored slabs or box beams to facilitate top down construction, even if an interior bent is in the water.

GEOTECHNICAL DESIGN

AASHTO Load and Resistance Factor Design (LRFD) Specifications: Use higher resistance factors when subsurface conditions are appropriate. Use Importance Factor, η=0.95, for load factor.

Scour: Design to allow approach fill wash outs rather than constructing abutment walls, with foundations to remain standing. Scour Critical Elevations will be required at these end bents.

Utilize designed scour countermeasures in lieu of more costly foundation solutions.

Reinforced Approach Fills: Use reinforced bridge approach fills in all coastal plain areas. In all other areas, utilize alternate standard detail to ensure backfill material is retained in areas of end bent excavation.

Interior Bents: Use drilled-in piles with a Pile Driving Analyzer (PDA) in lieu of drilled pier foundations.

STRUCTURE DESIGN

AASHTO Load and Resistance Factor Design (LRFD) Specifications: Use Importance Factor, η=0.95, for load factor. Use empirical deck design method for cast in place decks of girder bridges.

Bridge Rail: Utilize Standard Flat Face rail to facilitate deck drain functionality and minimize bridge width. (Show plan details for an epoxy protective coating for exterior cored slab or box beam surfaces adjacent to deck drains.)

Use Standard 1-Bar Metal Rail or approved precast New Jersey shaped barrier rail as appropriate for posted or design speed of 45 mph or less.

For designated bicycle routes or on roadways where the need to accommodate bicycle safety has been identified in the environmental planning document, use of a 42" rail height is acceptable; however, the Standard 2-Bar Metal Rail (54” rail height) shall be utilized for bridges spanning waterways of 100 feet or more in width.

Design Lanes: Use the actual number of travel lanes on the structure for design of superstructure and substructure elements, in lieu of the number of lanes that can be accommodated by the clear roadway.

Approach Slabs: Detail 12 foot long approach slabs, with ends parallel to the skew.

Overlays: Except for low water bridges, show plan details for an asphalt overlay on cored slab and box beam superstructures.

Substructure: Limit cap, column and drilled shaft sizes to those required for load carrying capacity, while maintaining constructability.

Appendix

Table 2

Minimum Width Revisions Based on

(NCHRP Report 486, Table 4)

Minimum Lane and Shoulder Widths for R-R-R Projects

Design Speed	Current ADT	Arterial		Collector		Local	
		Lane Width	Shoulder	Lane Width	Shoulder	Lane Width	Shoulder
Under 50 mph (Level and Rolling Terrain)	0 - 1000	11	4	10	3	10	3
	1000-2000	11	4	10	3	10	3
	over 2000	12	6	11	6	11	6
50 mph and over (Level and Rolling Terrain)	0 - 1000	11	4	11	3	10	3
	1000-2000	12	6	11	4	11	3
	over 2000	12	6	11	6	11	6
Under 50 mph (Mountainous Terrain)	0 - 1000	10	3	10	3	10	3
	1000-2000	11	3	10	3	10	3
	over 2000	12	6	11	6	11	4
50 mph and over (Mountainous Terrain)	0 - 1000	11	3	11	3	10	3
	1000-2000	11	3	11	3	10	3
	over 2000	12	6	11	6	11	4

NOTES:

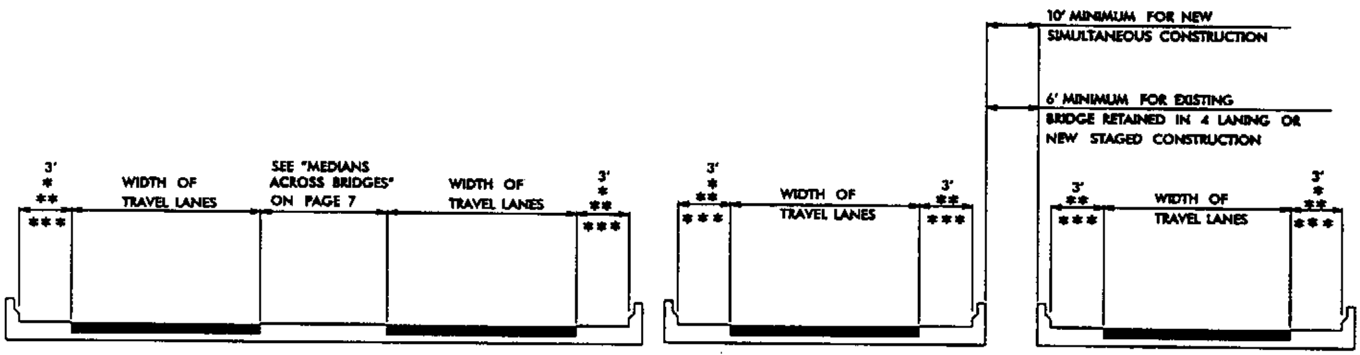
1. Shoulder dimensions indicate graded widths and include paved shoulder widths.
2. Where guardrail is to be installed, graded shoulder width must be increased by 3 feet.
3. Where truck traffic (TTST and Duals) volume exceeds 10% of current ADT, lane widths should be increased by 1' to a maximum of 12'. 12' lane width should be used on routes designated as part of the National Truck Network.
4. For current ADT less than 1000, paved shoulder should be considered. For current ADT between 1000 - 3000, 2' paved shoulders are recommended. For current ADT over 3000, 4' paved shoulders should be used.

LOCAL AND COLLECTOR SYSTEM

BRIDGE DECK WIDTHS
4 OR MORE LANES DIVIDED

SINGLE STRUCTURE

DUAL STRUCTURE



SHOULDER APPROACH

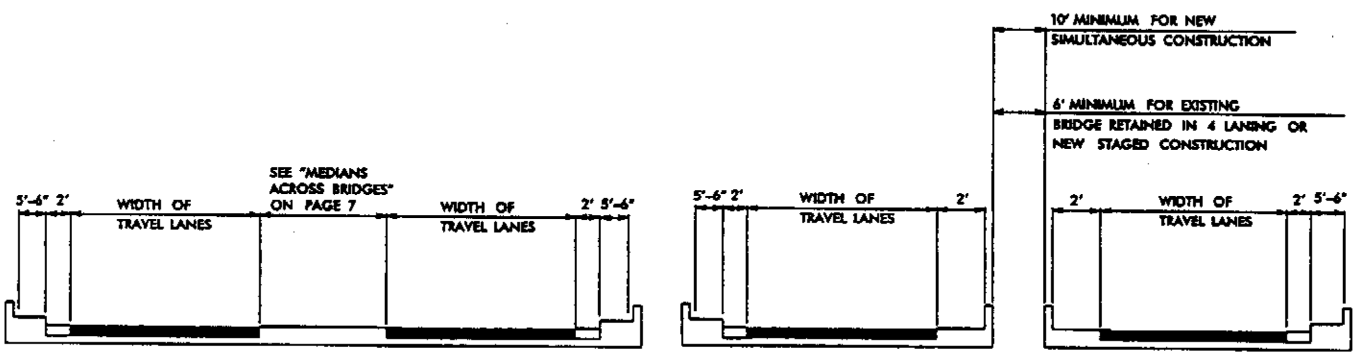
* MINIMUM SHOULDER WIDTHS OF 6' ARE DESIRED FOR STRUCTURES WHICH ARE LOCATED AT INTERCHANGES THE MINIMUM VALUES SHOWN ABOVE MAY BE USED IF THE REQUIRED SIGHT DISTANCE CAN BE ACHIEVED.

** FOR STRUCTURES OF 100' OR LESS IN LENGTH AND HAVING 1501 ADT TO 2000 ADT, USE 4' SHOULDERS, FOR OVER 2000 ADT USE 8' SHOULDERS.

*** FOR STRUCTURES OF 100' OR LESS IN LENGTH AND HAVING > 8000 ADT USE 4' SHOULDERS. THE OFFSET FOR BRIDGES WITHIN THE URBAN AREA BOUNDARY MAY BE INCREASED TO A MIN. OF 7'-6" TO ACCOMMODATE FUTURE SIDEWALKS.

SINGLE STRUCTURE

DUAL STRUCTURE



CURB AND GUTTER APPROACH

NOTE: SEE PAGES 6 AND 7 OF THIS MANUAL FOR ADDITIONAL INFORMATION ON SIDEWALK AND CURB AND GUTTER APPROACHES.

LEGEND

THROUGH TRAVEL LANES

VERTICAL CLEARANCES

Vertical clearances for new structures shall be designed above all sections of pavement including the useable shoulder. Future widening and pavement cross slope will be considered in design clearance.

Vertical clearances shall be as shown below. These clearances include a 6" allowance for future resurfacing. An additional 6" range is shown to allow for the flexibility necessary in the coordination of roadway grades with final superstructure depths.

Vertical clearances above these limits must be justified by economics or some vertical control.

1. Over Interstates and Freeways and Arterials
   Vertical Clearances – 16'-6" to 17'-0"

   Note: "17'-0" to 17'-6" vertical clearance is desirable for structures located over Interstates, Freeways, or Arterials constructed with portland cement concrete pavement. If the pavement type is not known during the preliminary design phase, then the desirable clearance range should apply to structures located over these facilities having design year average daily truck traffic of 5000 or greater."

2. Over Local and Collector Roads and Streets
   Vertical Clearance – 15'-0" to 15'-6"

3. Over all Railroads
   Vertical Clearance – 23'-0" to 23'-6" or less if approved by Railroads

4. Navigable Waters
   The U.S. Coast Guard permit determines the minimum clearances for navigable waters. Clearances over waters not regulated by the U.S. Coast Guard will be determined by negotiations and agreement with the appropriate interests.

5. Normal minimum clearance above design high water should be 2'-0" for all Interstates, Freeways, Arterials, and Secondary Crossings of Major Rivers, 1'-0" for all other roads. Where conditions warrant, less than the above may be permitted.

6. Pedestrian overpasses and sign structures vertical clearance – 17'-0" to 17'-6"

GUIDELINES FOR MEDIAN SEPARATION AT HIGHWAY/ RAILWAY AT-GRADE CROSSING 7-6

To protect the safety of the traveling public and the security and integrity of critical rail-highway at-grade junctures every effort should be made to discourage at grade rail crossings. The addition of travel lanes to existing at grade crossings should be avoided unless recommended by an engineering study. However, if after coordinating with the Rail Division, it is determined an at-grade crossing cannot be avoided or eliminated, and a median separation is deemed necessary and appropriate, the following guide should be used.

The intent of this guide is to establish the desirable conditions for the uniform and consistent layout and construction of median separations where it has been determined that a median separation is appropriate. This guide/design tool should be utilized with sound engineering judgment, sound design, and attention to costs.

The NCDOT Rail Division should be included in negotiations and decisions regarding at grade rail crossings. Decisions made regarding railroad crossings shall protect the traveling public, will be sensitive to the needs of the railroad and should be based on the best information and practices available.

Projects programmed in the Transportation Improvement Program (TIP) which may result in creating a new highway-railway at-grade crossing or affecting an existing crossing shall be coordinated with the Rail Division in the early project planning process. The Rail Division will be actively involved in all scoping meetings held by the Planning and Environmental Branch that have the potential to involve or affect an existing or proposed railroad crossing.

Division and local projects involving a railroad crossing will be coordinated with the Rail Division. It will be the responsibility of the Division Engineer to initiate contact and advise the Rail Division early in the process to determine the appropriate crossing treatment for the site conditions.

When an at grade railroad crossing is involved, it will be the responsibility of the Rail Division to research and obtain pertinent information from the railroad company such as number of trains, speed, and contact information for further coordination and provide it to the requesting party. It will also be the responsibility of the Rail Division to keep the appropriate Division Engineer informed of any railroad work being planned in their area even if it does not involve a TIP project. Within the limits of a TIP project, the Rail Division will assist the appropriate railroad company in making decisions concerning the appropriate improvements to the rail crossing.

GUIDELINES FOR MEDIAN SEPARATION AT HIGHWAY/ RAILWAY AT-GRADE CROSSING (Continued) 7-6

Median separations can be used to physically discourage drivers from driving around crossing gates when it has been determined a median separator is the appropriate treatment based on an engineering evaluation.

- After the decision is made to add a median separation, the following details should be used/referenced as a guide for the consistent design layout and construction of the median separation treatment.

- The detail for median separation should be used in conjunction with the appropriate The American Railway Engineering and Maintenance of Way Association (AREMA) and The American Association of State Highway Transportation Officials (AASHTO) guidelines and standards for new construction on TIP projects or when additional improvements are warranted, recommended and justified (within program and site constraints).

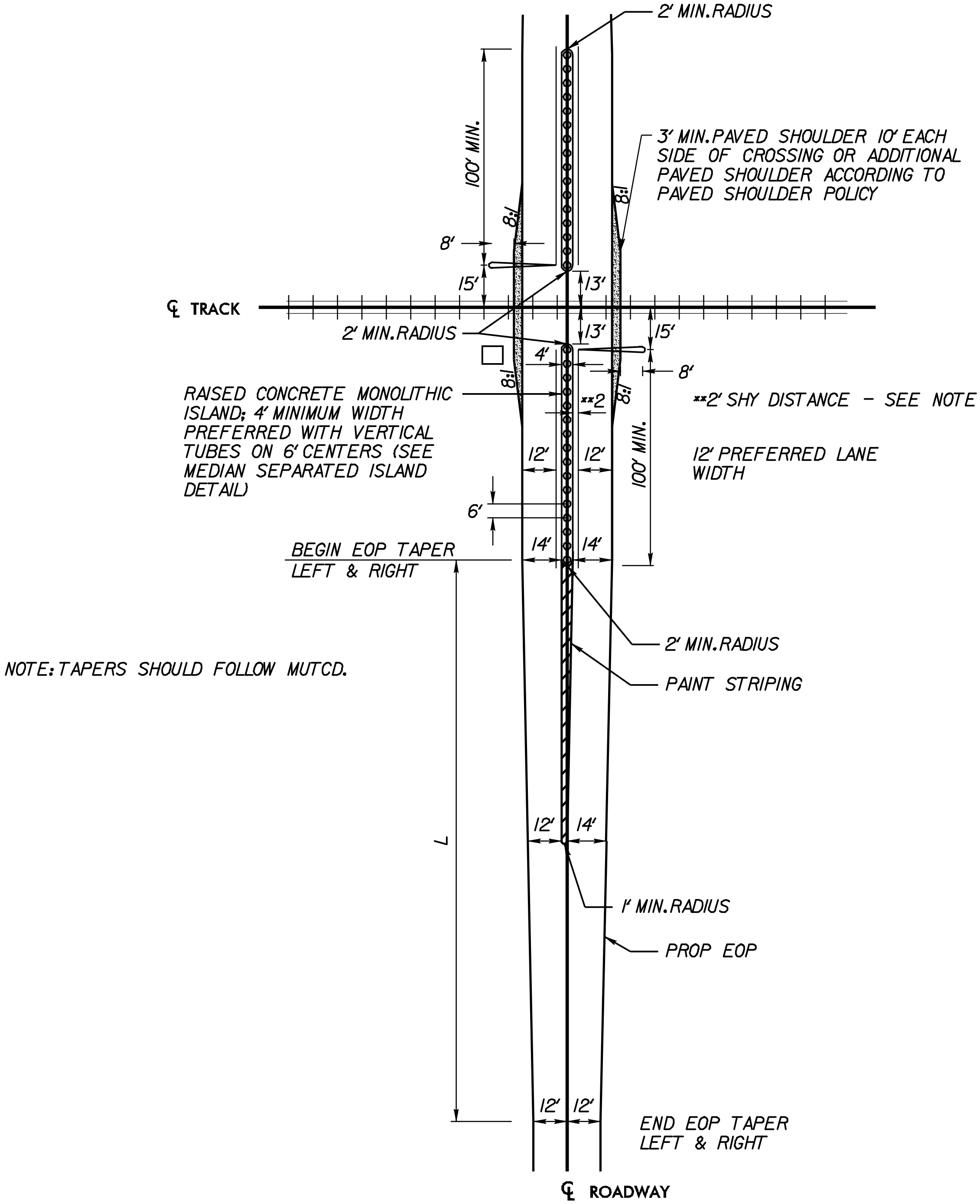
- If speeds exceed 40 mph, an advisory speed of 40 mph should be posted on the advance warning sign as deemed necessary and recommended by the Division Traffic Engineer. Cases involving speeds greater than 40 mph should be handled on a case by case basis and design features and advisories developed through coordination with appropriate Regional and Division Traffic Engineers.

- Shy distances should be increased beyond the minimal 2 foot offsets when variations in alignment (vertical/horizontal) introduce more navigational factors to the operators.

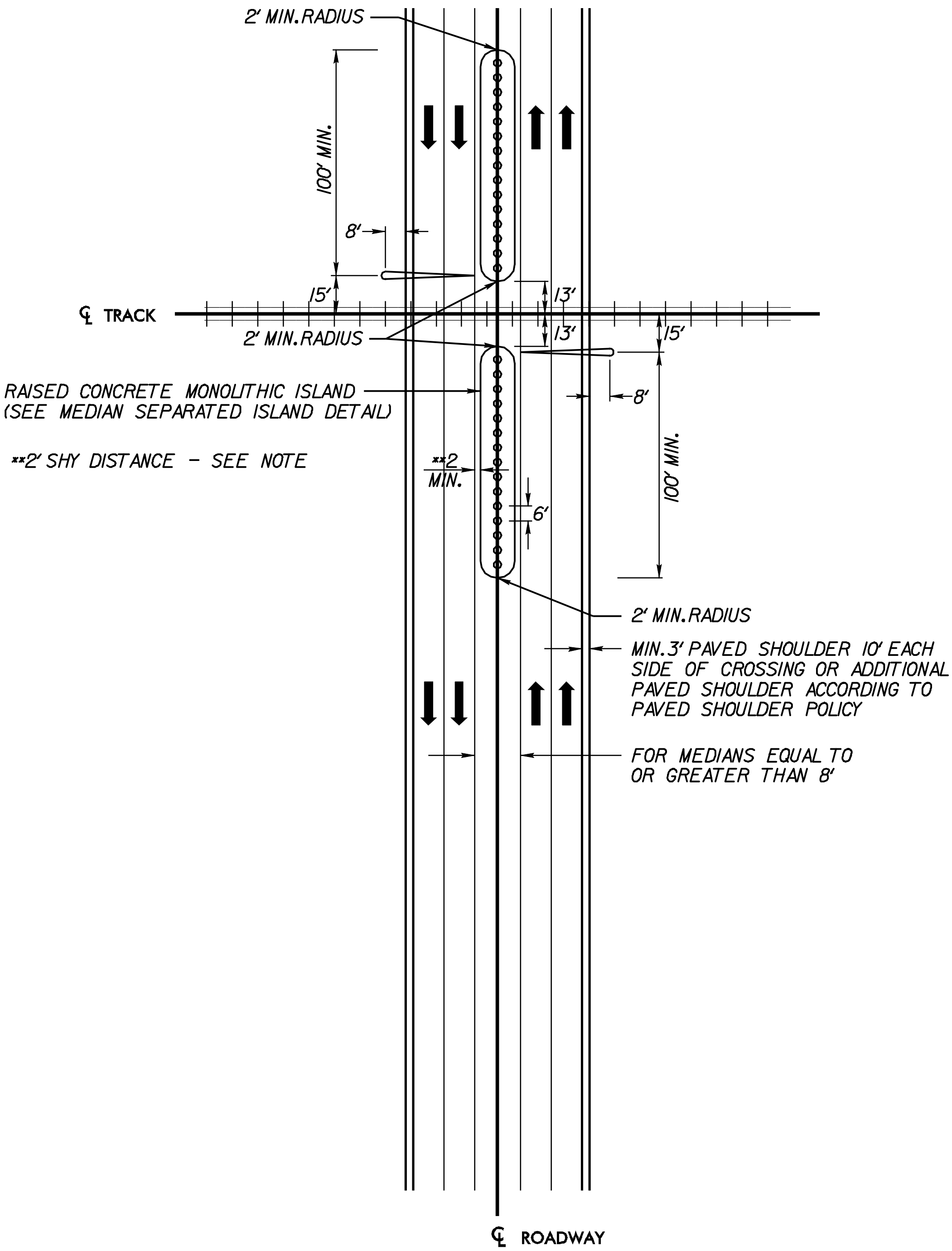
- Minimum Design Criteria should only be utilized when conditions physically restrict the use of recommended/preferred design criteria

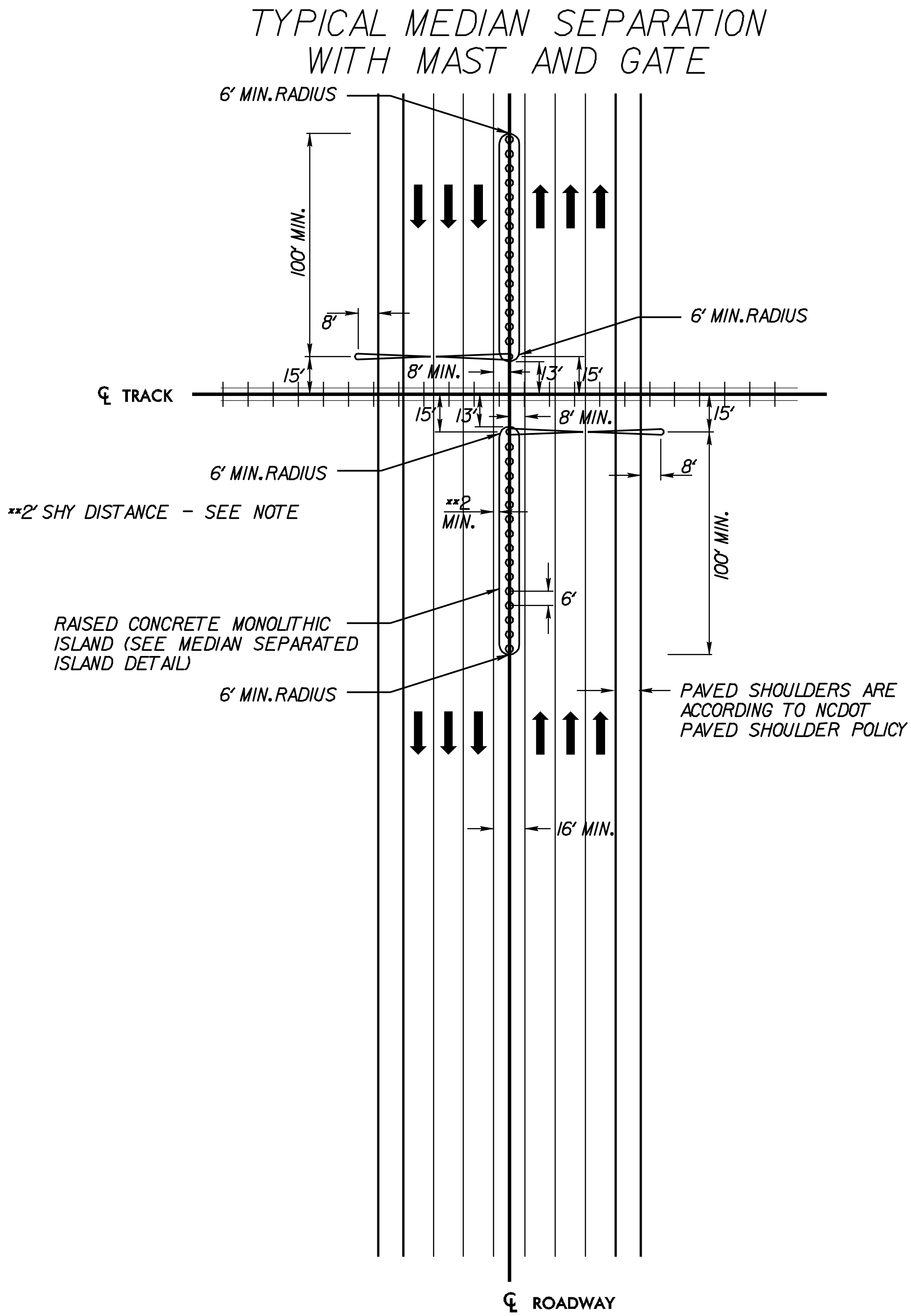
Please refer to the Rail Division's website http://www.bytrain.org/safety for additional information.

TYPICAL MEDIAN SEPARATION FOR TWO LANE RAILROAD CROSSING

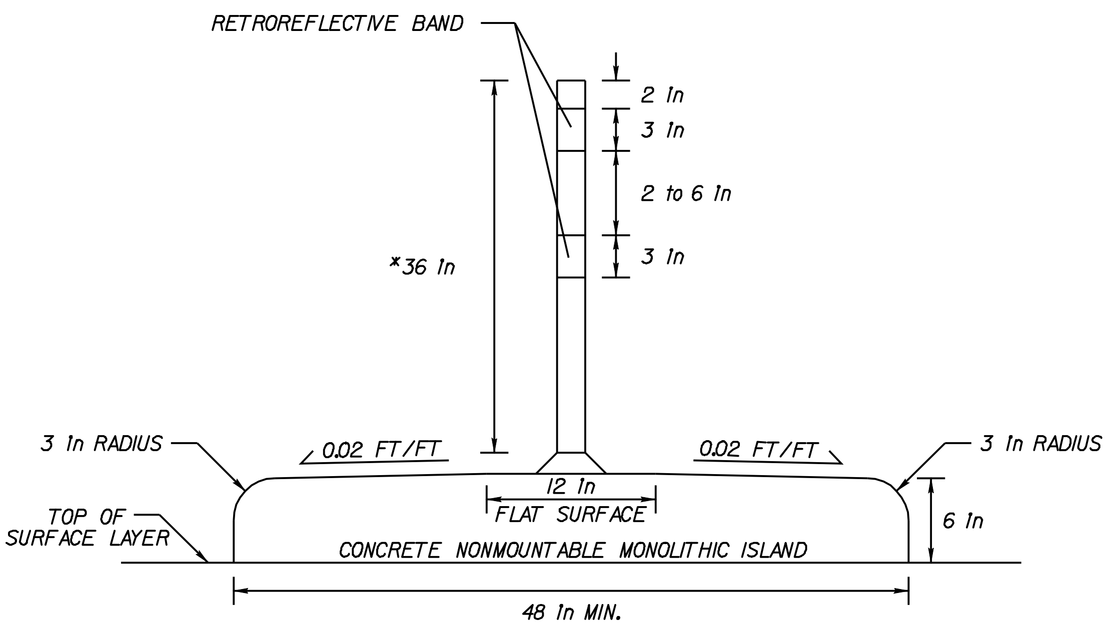


TYPICAL MEDIAN SEPARATION FOR FOUR/FIVE LANE RAILROAD CROSSING

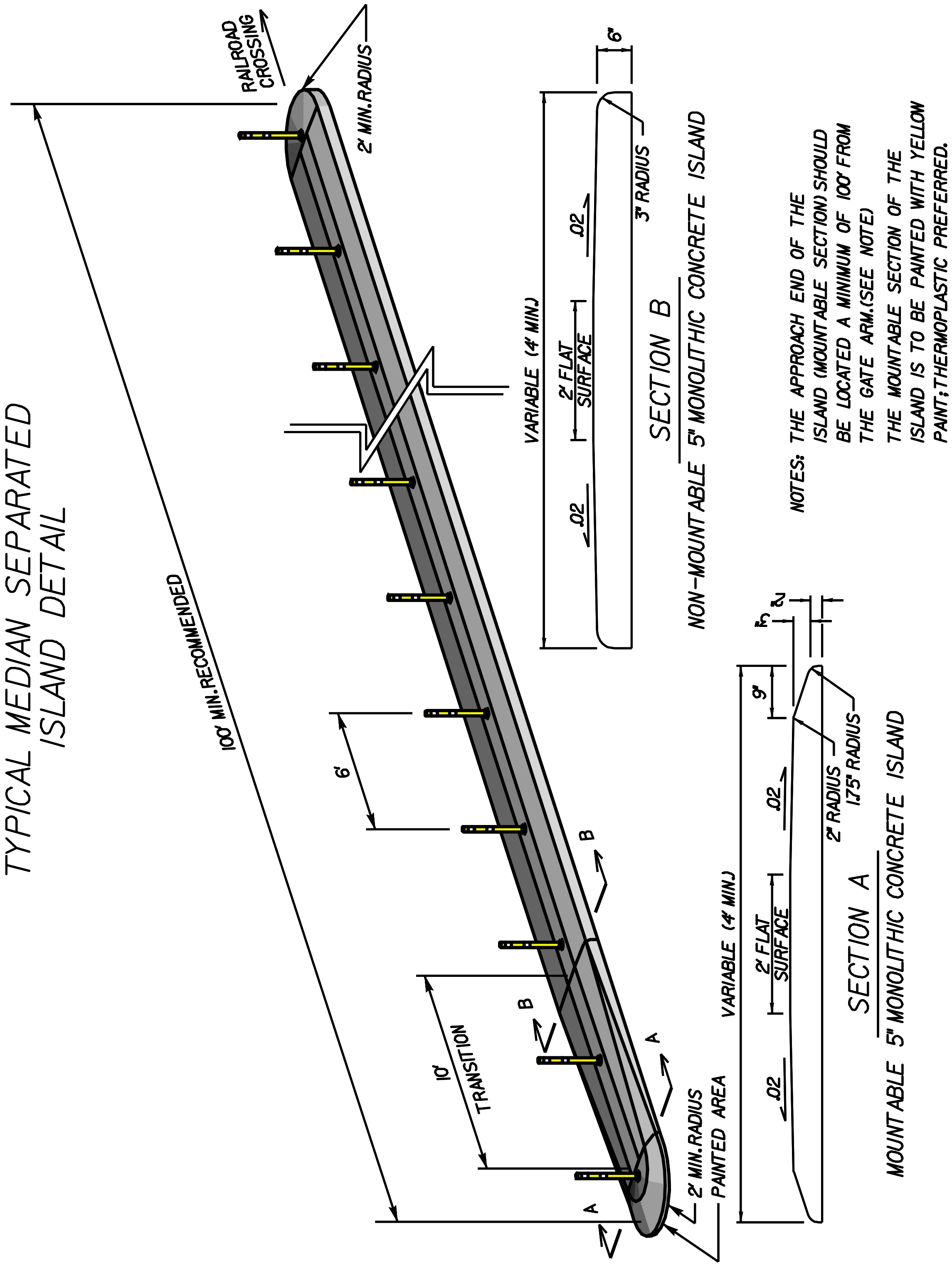



TYPICAL MEDIAN SEPARATION
WITH MAST AND GATE
6' MIN. RADIUS
100' MIN.
8'
15'
8' MIN.
13'
15'
℄ TRACK
6' MIN. RADIUS
**2' SHY DISTANCE - SEE NOTE
**2
MIN.
6'
RAISED CONCRETE MONOLITHIC
ISLAND (SEE MEDIAN SEPARATED
ISLAND DETAIL)
6' MIN. RADIUS
PAVED SHOULDERS ARE
ACCORDING TO NCDOT
PAVED SHOULDER POLICY
16' MIN.
℄ ROADWAY

TYPICAL TUBULAR MARKER



*36 In height may be reduced upon further coordination with the Rail Division if the crossing has a lot of use by oversized vehicles.


TYPICAL MEDIAN SEPARATED ISLAND DETAIL
RAILROAD CROSSING
2' MIN. RADIUS
100' MIN. RECOMMENDED
6'
10' TRANSITION
B
A
2' MIN. RADIUS
PAINTED AREA
VARIABLE (4' MIN.)
2' FLAT SURFACE
.02
6"
3" RADIUS
SECTION B
NON-MOUNTABLE 5" MONOLITHIC CONCRETE ISLAND
9"
2" RADIUS
1.75" RADIUS
SECTION A
MOUNTABLE 5" MONOLITHIC CONCRETE ISLAND
NOTES: THE APPROACH END OF THE ISLAND (MOUNTABLE SECTION) SHOULD BE LOCATED A MINIMUM OF 100' FROM THE GATE ARM.(SEE NOTE)
THE MOUNTABLE SECTION OF THE ISLAND IS TO BE PAINTED WITH YELLOW PAINT; THERMOPLASTIC PREFERRED.

Notes

Per Federal Railway Administration Code of Federal Regulations (49 CFR Appendix A to Parts 222-229) "Medians or channelization devices must extend at least 100' from the gate arm, or if there is an intersection within 100' of the gate, the median or channelization device must extend at least 60 feet from the gate arm."

The preferred island length is 100' from the gate; however higher traffic volumes or higher truck traffic may warrant that the island's length be increased to a logical termination point such as the next intersection, drive etc. Any deviation below this minimum will be coordinated with the Rail Division.

The recommended and preferred island width is 4' minimum. If coordinated with the Rail Division, the width may possibly be reduced to 2' with vertical markers when improvements are warranted but there are constraints that prevent using the preferred width. When the island is less than 4' wide, the island should be keyed in on the last layer of pavement surface course. When the island is 4' wide or greater, it can be surface mounted on top of the pavement using spikes in accordance with the current Roadway Standard Drawings.

The minimum shy distance is 2' as referenced in AASHTO. This should be increased to desirable/recommended values as conditions beyond minimum are encountered.

In multilane situations, where signals and gates are required in the median, the island width should be a minimum of 12' with the appropriate shy distances.

A keep right sign shall be used on islands greater than or equal to 4'. Where 4' is not available, a divided highway advisory sign should be placed on the approach shoulder.

To improve night visibility and navigation around the island, it is recommend using 3 reflective markers on the end cap of median or painting the end cap of median.

Drainage issues in conjunction with the island should be addressed according to design policy.

Resurfacing will reduce the effective island height. It may be necessary to readjust island to preserve non mountable 6" face.

GUIDELINES FOR MEDIAN SEPARATION AT HIGHWAY/RAILWAY AT-GRADE CROSSING (Continued) 7-6

Minimum Lane and Shoulder Widths for Railroad Crossing Improvements*

Use the following chart in conjunction with the above details when improvements are recommended, but funds are not available to improve the existing highway to the geometric standards desirable for reconstruction and new highway construction.

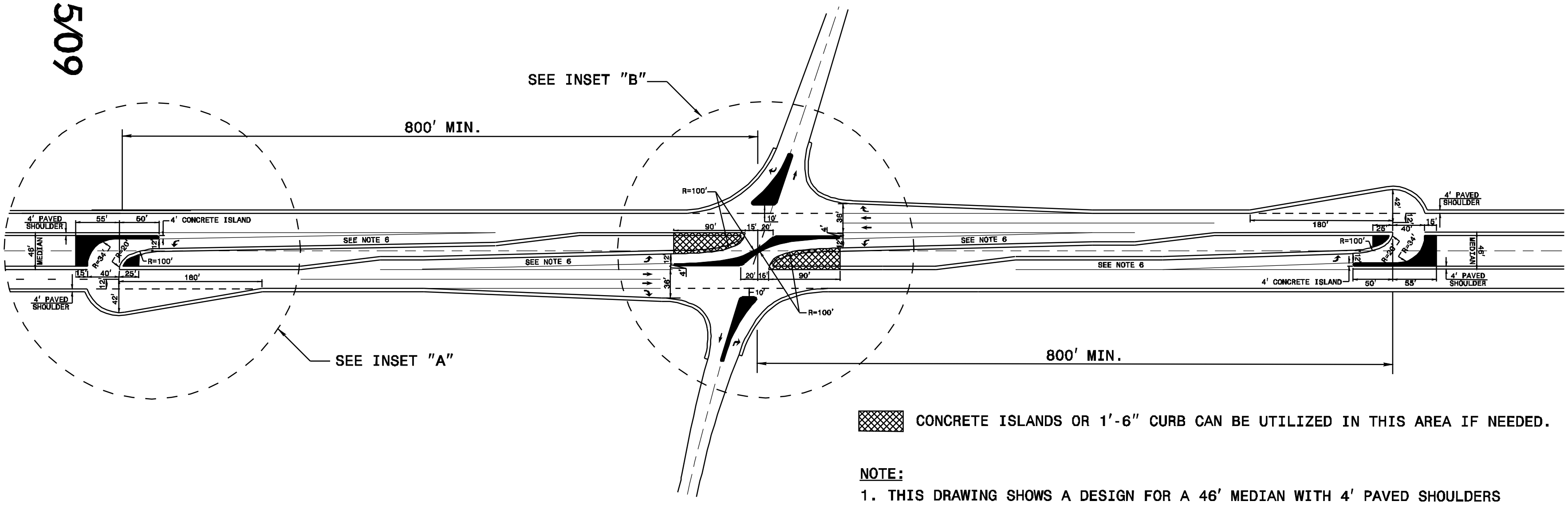
Design Speed	Current ADT	Arterial		Collector		Local	
		Lane Width	Shoulder	Lane Width	Shoulder	Lane Width	Shoulder
Under 50 mph	0 - 1000	11	4	10	3	10	3
(Level and	1000 - 2000	11	4	10	3	10	3
Rolling terrain)	over 2000	12	6	11	6	11	6
50 mph & over	0 – 1000	11	4	11	3	10	3
(Level and	1000 –2000	12	6	11	4	11	3
Rolling Terrain)	over 2000	12	6	11	6	11	6
Under 50 mph	0 – 1000	10	3	10	3	10	3
(Mountainous	1000 –2000	11	3	10	3	10	3
Terrain)	over 2000	12	6	11	6	11	4
50 mph and over	0 – 1000	11	3	11	3	10	3
(Mountainous	1000 –2000	11	3	11	3	10	3
Terrain)	over 2000	12	6	11	6	11	4

NOTES:

1. Shoulder dimensions indicate graded widths and include paved shoulder widths.
2. Where guardrail is to be installed, graded shoulder width must be increased by 3 feet.
3. Where truck traffic (TTST and Duals) volume exceeds 10% of current ADT, lane widths should be increased by 1’ to a maximum of 12’. 12’ lane width should be used on routes designated as part of the National Truck Network.
4. For current ADT less than 1000, paved shoulders are not recommended. For current ADT between 1000 – 3000, 2’ paved shoulders are recommended. For current ADT over 3000, 4’ paved shoulders should be used.

*See Division of Highways, RRR Guide, April 2004, Page 14

DIRECTIONAL CROSSOVER WITH MEDIAN U-TURNS



CONCRETE ISLANDS OR 1'-6" CURB CAN BE UTILIZED IN THIS AREA IF NEEDED.

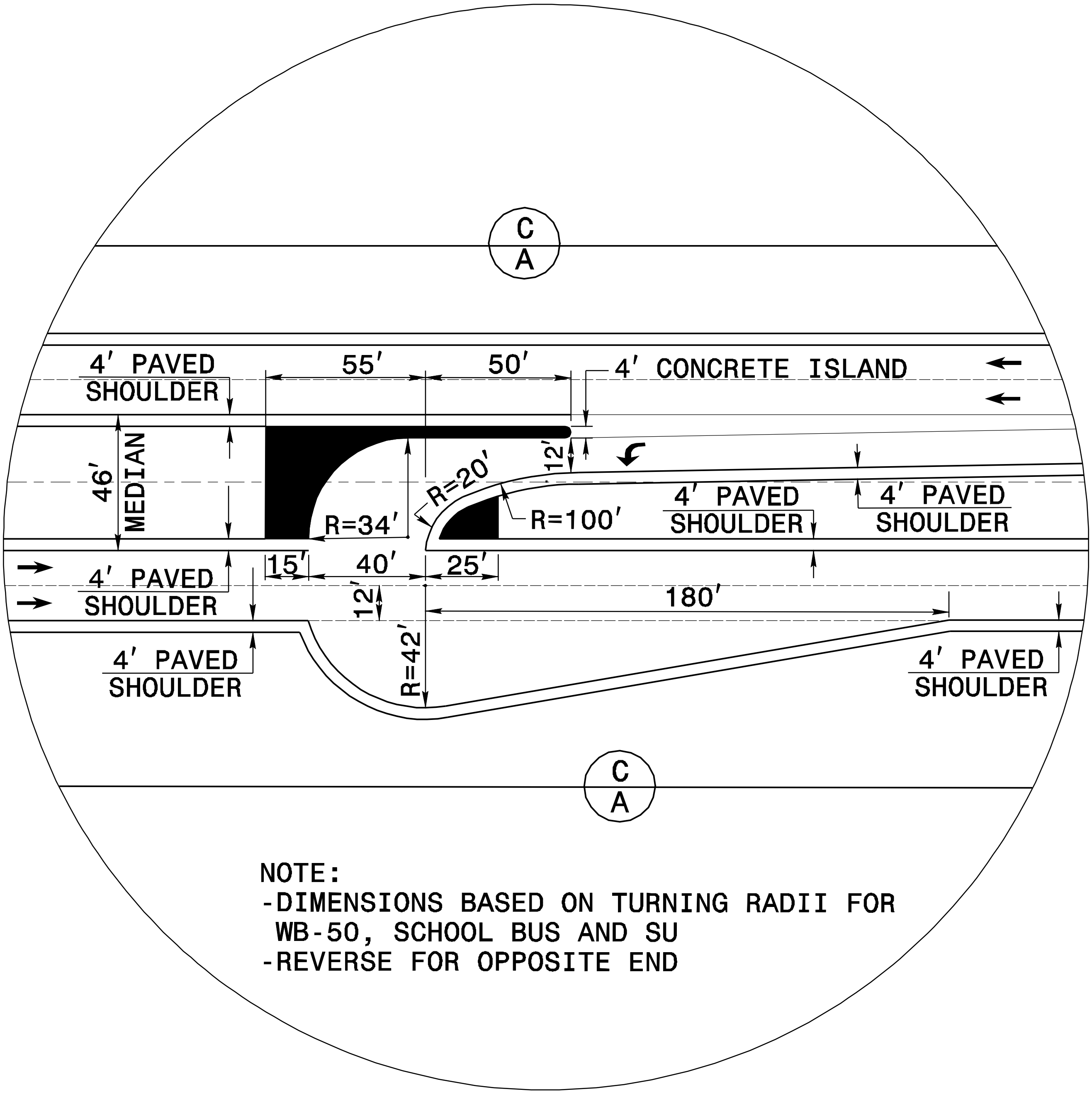
PLAN

NOTE:

1. THIS DRAWING SHOWS A DESIGN FOR A 46' MEDIAN WITH 4' PAVED SHOULDERS (MEDIAN AND OUTSIDE) ASSUMING A 55 MPH POSTED SPEED. WHEN OTHER MEDIAN WIDTHS, PAVED SHOULDERS, AND POSTED SPEEDS ARE USED, ENGINEERING JUDGEMENT SHOULD BE USED TO ESTABLISH APPROPRIATE GEOMETRY.
2. AT -Y- LINES ONLY PASSENGER CAR U-TURNS ARE ACCOMMODATED.
3. DESIGN BULB OUTS TO ACCOMODATE WB-50. IN AREAS WHERE THERE ARE R/W OR ENVIRONMENTAL CONSTRAINTS, BULB OUT DIMENSIONS MAY BE REDUCED.
4. ALL DIMENSIONS ARE SUBJECT TO FIELD CONDITIONS.
5. FULL CONTROL OF ACCESS SHOULD BE OBTAINED THROUGHOUT LIMITS OF THE BULB OUT ON BOTH SIDES OF ROADWAY.
6. USE 575' MINIMUM LENGTH FOR ALL LEFT TURN LANES (INCLUDES TAPER AND FULL STORAGE LENGTH).

REV. DATE : 02/05/09
REV. NO. 6

INSET "A"



NOTE:
- DIMENSIONS BASED ON TURNING RADII FOR WB-50, SCHOOL BUS AND SU
- REVERSE FOR OPPOSITE END

INSET "A"

REV. DATE : 02/05/09
REV. NO. 6

*3-Series (cont'd)	Parcel Index Sheet (Applicable to projects with more than one plan sheet.)
4	The first plan sheet will always be Number 4. All other plan and profile sheets shall be numbered to fit the project conditions.
TCP-1, TCP-2, etc.	Traffic Control Plans
PM-1, PM-2, etc.	Pavement Marking Plans
E-1, E-2, etc.	Electrical Plan
EC-1, EC-2, etc.	Erosion Control Plans
L-1, L-2, etc.	Landscape Plans
SIGN-1, SIGN-2, etc.	Signing Plans
SIG-1, SIG-2, etc.	Signal Plans
UC-1, UC-2, etc.	Utility Construction Plans
UO-1, UO-2, etc	Utilities by others Plans
X-1A, X-1B, etc.	Cross-Section Summary Sheet
X-1, X-2, etc.	Cross-Sections
C-1, C-2, C-3, etc.	Culvert Plans
S-1, S-2, S-3, etc.	Structure Plans

Do not show total sheet numbers on the plans.

The % and type of Asphalt Binder and rate to be used for calculation of quantities are as follows:

Mix Type	% Asphalt Binder	Asphalt Binder Grade	Rate Lbs/SY/in
FRICTION			
OGAFC, TYPE FC-1	6.3	PG 64-22	70 Lbs/SY
OGAFC, TYPE FC-1 MODIFIED	6.3	PG 76-22	70 Lbs/SY
OGAFC, TYPE FC-2 MODIFIED	6.0	PG 76-22	90 Lbs/SY
Surface			
S4.75A	7.0	PG 64-22	100
SF9.5A	6.5	PG 64-22	110
S9.5B	6.0	PG 64-22	112
S9.5C	6.0	PG 70-22	112
S12.5C	5.5	PG 70-22	112
S12.5D	5.0	PG 76-22	112
Intermediate			
I19.0B	4.7	PG 64-22	114
I19.0C	4.7	PG 64-22	114
I19.0D	4.7	PG 70-22	114
Base			
B25.0B	4.3	PG 64-22	114
B25.0C	4.3	PG 64-22	114
PADC, TYPE P-57	2.3	PG 64-22	90
PADC, TYPE P-78M	3.0	PG 64-22	90

NOTE: It is suggested that like pavement mixtures be grouped together in the Pavement Schedule.

PAVEMENT SCHEDULE(continued) 6-ID

CODE SAMPLE DESCRIPTION F-1

Al 9″ Portland Cement Concrete Pavement

A2 8″ Continuously Reinforced Concrete Pavement

B Prop. Open-Graded Asphalt Friction Course, Type FC_____, at an Average Rate of ____lbs. per sq. yd.

For Surface Course

C1 Prop. Approx. _____″Asphalt Concrete Surface Course, Type S_____, at an Average Rate of _____ lbs. per sq. yard.

C2 Prop. Approx. _____″ Asphalt Concrete Surface Course, Type S_____, at an Average Rate of _____ lbs. per sq. yard in each of two layers.

C3 Prop. Var. Depth Asphalt Concrete Surface Course, Type S_____, at an Average Rate of ____lbs. per sq. yard per 1″ depth to be placed in layers not to exceed _____″ in depth.

For Intermediate Course

Dl Prop. Approx. _____″ Asphalt Concrete Intermediate Course, Type I19.0_____, at an Average Rate of _____ lbs. per sq. yard.

D2 Prop. Approx. _____″ Asphalt Concrete Intermediate Course, Type I19.0_____, at an Average Rate of _____ lbs. per sq. yard in each of two layers.

D3 Prop. Var. Depth Asphalt Concrete Intermediate Course, Type I19.0_____, at an Average Rate of 114 lbs. per sq. yard per 1″ depth to be placed in layers not less than 2 1/2″ or greater than 4″ in depth.

For Base Course

El Prop. Approx. _____″ Asphalt Concrete Base Course, Type B_____, at an Average Rate of _____lbs. per sq. yard.

E2 Prop. Approx. _____″ Asphalt Concrete Base Course, Type B_____, at an Average Rate of _____ lbs. per sq. yard in each of two layers.

E3 Prop. Var. Depth Asphalt Concrete Base Course, Type B_____, at an Average Rate of 114lbs. per sq. yd. per 1″ depth, to be placed in layers not greater than _____″ in depth or less than _____″ in depth.

F1 Asphalt Surface Treatment, Mat and Seal.

F2 Asphalt Surface Treatment, ________________________

G Prop. Approx. 8″ Cement Treated Base Course (Plant Mixed)

or

Prop. 8″ ABC with the top 7″ to be Cement Treated (Road Mixed).

J1 Prop. 8″ Aggregate Base Course

J2 Prop. 10″ Aggregate Base Course

J3 Prop. Var. Depth Aggregate Base Course

K Base to be treated with Lime to a depth of 8″, at a rate of 20 lbs. per. sq. yd. as directed by the Engineer.

or

Base to be treated with cement to a depth of 7″, at a rate of 55 lbs. per. sq. yd. as directed by the Engineer.

or

Base to be treated with aggregate at a rate of 250 lbs. per. sq. yd. and cement at a rate of 55 lbs. per. Sq. yd. to a depth of 7″ as directed by the Engineer.

L Base to be stabilized with 200 to 400 lbs. per sq. yard of Stabilizer Aggregate mixed with the top 3″ of subgrade soil at locations directed by the Engineer.

M1 Prop. 8″ Soil Type Base Course, Type A
M2 Prop. 10″ Soil Type Base Course, Type _____

N Geotextile for Pavement Stabilization

P1 Prime Coat at the rate of .35 gal. per sq. yard.

P2 Prime Coat at the rate of .50 gal. per sq. yard.

R1 2′-6″ Concrete Curb and gutter

R2 1′-6″ Concrete Curb and Gutter

CORRIDOR PUBLIC HEARINGS 21-4

This type of hearing is typically held on new location projects where various corridor alternatives are studied. Generally, a Corridor Public Hearing is held after the completion of a Draft Environmental Impact Statement (DEIS) document. However, some new location projects may be studied under an Environmental Assessment (EA) Document and a Corridor Public Hearing may be needed or beneficial. In these cases, the Project Development Unit and the Human Environment Unit of the Project Development and Environmental Analysis Branch (PDEA) and Roadway Design should discuss when the hearing should be held in relation to the completion of the EA document and the Design Public Hearing.

The primary purpose of a Corridor Public Hearing is to inform the public of the alternatives under consideration and to obtain public input. Therefore, these corridors should reflect a design that avoids and minimizes impacts to the extent practicable. Also, the main focus of the Corridor Public Hearing Map is not only the design details and how individual property owners are impacted, but how each potential highway corridor benefits and impacts the region from a transportation systems perspective.

The Corridor Public Hearing Map is prepared on orthophotography (aerial photography) and is based on the functional design. The map consists of multiple corridor bands that include certain minimal design features as defined in the section entitled PREPARATION OF CORRIDOR PUBLIC HEARING MAPS.

PREPARATION OF CORRIDOR PUBLIC HEARING MAPS 21-5

(2) Mapping Requirements

(J) Use orthophotography and preliminary mapping (Note – if older than 3 years evaluate the need for updated mapping)

(K) Projects that are relatively short in length (5 miles or less) use scale of 1”=200’.

(L) Projects that are longer than 5 miles use scale of 1”=500’.

(2) Label On CORRIDOR HEARING MAP (all text in bold, black and capital letters):

(A) Show North arrow, graphic scale of map and map legend at each end of maps.

(B) State Lines (according to legend)

(C) County Lines (according to legend)

(D) City Limits and Town Limits (according to legend)

(E) Label city and town names in bold, visible letters in a white box.

(F) Creeks, Rivers, Lakes, and Streams (according to legend)

(G) Label Railroads.

(H) Landmarks such as Hospitals, Parks, Appalachian Trail, Indian Reservations, Military Bases, Subdivision Names, Churches, Cemeteries, Schools, etc. (Label in bold, visible letters in a white box).

(I) Historic Properties and Boundaries – with orange hatch lines. Historic Districts and properties will be labeled with the same linestyle. Add the label "-HPB-" for historic property boundaries or "-HDB-" for the historic district boundaries along the line. (according to legend)

(J) Show Wetland Boundaries (labeled as WLB) in blue color with marsh symbols within the boundaries. (according to legend)

(K) Show all existing right of way lines of public roads within the project limits.

(L) Show property lines (according to legend). Show property owners names for the large tracts only.

(M) Show the road/street route number with common name in bold, black letters in a white box.

(N) Show destination of main roads to a city or town.

(O) Show buildings with brown color.

(3) Design Features & Information To Be Shown On CORRIDOR HEARING MAP:

(A) "PRELIMINARY PLANS - SUBJECT TO CHANGE" labels need to be on the map.

(B) Show a box with the Functional Classification of the proposed mainline; Design Speed; Maximum Superelevation chart used for the horizontal alignment; and the date and a mission number of the orthophotography.

Example:

DESIGN DATA	
Functional Class.= Arterial	
Design Speed	**= 60 mph**
Max. Superelev.	**= 0.06**
ORTHOPHOTO DATA	
Flight Mission	**= M-6721**
Flight Date	**= 04-03-07**

(C) Show Begin and End TIP project in a white box with white leader lines and arrows.

Example: **BEGIN TIP PROJECT R-9999**
ALTERNATIVES 1, 2 & 3

END TIP PROJECT R-9999
ALTERNATIVES 1, 2 & 3

(D) Show a corridor band for each alternative using a different color for each.

(E) Label the corridor width in bold, visible letters in a white box. The width of the corridor bands are generally 1000 feet. Around interchange locations the corridor area should expand to contain the area of the potential interchange configuration. Along existing roads and/or new two lane facilities, the corridor width may be less than 1000 feet, i.e. 400 to 500 feet.

(F) Corridor bands should extend down –Y- lines as appropriate to identify potential construction and C/A limits in these locations. This is beneficial not only to the public and potentially affected property owners, but it assists with the screening process to make sure all possible environmental features are identified, i.e. wetlands, streams, historic properties, etc.

(G) Show only the centerline alignment for the mainline. ***Do not show stations, bearings and curve data.***

(H) Show the proposed edges of travel lanes and slope stakes within each corridor. ***Do not show concrete medians, paved shoulders, sidewalks; and curb & gutter.***

(I) Show proposed right of way requirements including control of access limits within each corridor.

(J) Show existing and proposed major structures (R.C. box culverts, box culvert extensions and bridges) within each corridor band according to legend.

(K) Show Noise Sensitive Areas with red hatch lines.

(L) Show Existing Traffic Signals. ***Do not show Proposed Traffic Signals.***

(M) Show only the mainline typical section with lane usage.

(N) Show the current and design year ADT for each corridor.

(O) Show the following project identification (16"x6" box) on the inside of each hearing map and a smaller version of the identification (8"x3" box) on the outside of both ends of the Corridor Public Hearing Map to be read while map is rolled up.

- Corridor Public Hearing Map
- State WBS Element and Federal Project Numbers with TIP Identification Number
- County
- Route Number and Location Description
- Seal of North Carolina
- Seal of NCDOT

(P) A Directional Crossover with Median U-turn detail should be shown in an inset on the hearing map, if applicable.

(Q) Add a block to the Corridor Hearing Map with a note describing the type of control of access anticipated for the project.

Partial Control of Access

"Partial Control of Access is defined as one access point per parcel. For properties with large road frontages (for example, 2000 feet or more), an additional access point may be considered. For properties that have access, such as via a side road, access to insert mainline name (e.g. US 601) **may be eliminated."**

Limited Control of Access

"Limited Control of Access is defined as a connection to a facility provided only via ramps at interchanges (major crossings) and at-grade intersections (minor crossings and service roads). No private driveway connections allowed."

Full Control of Access

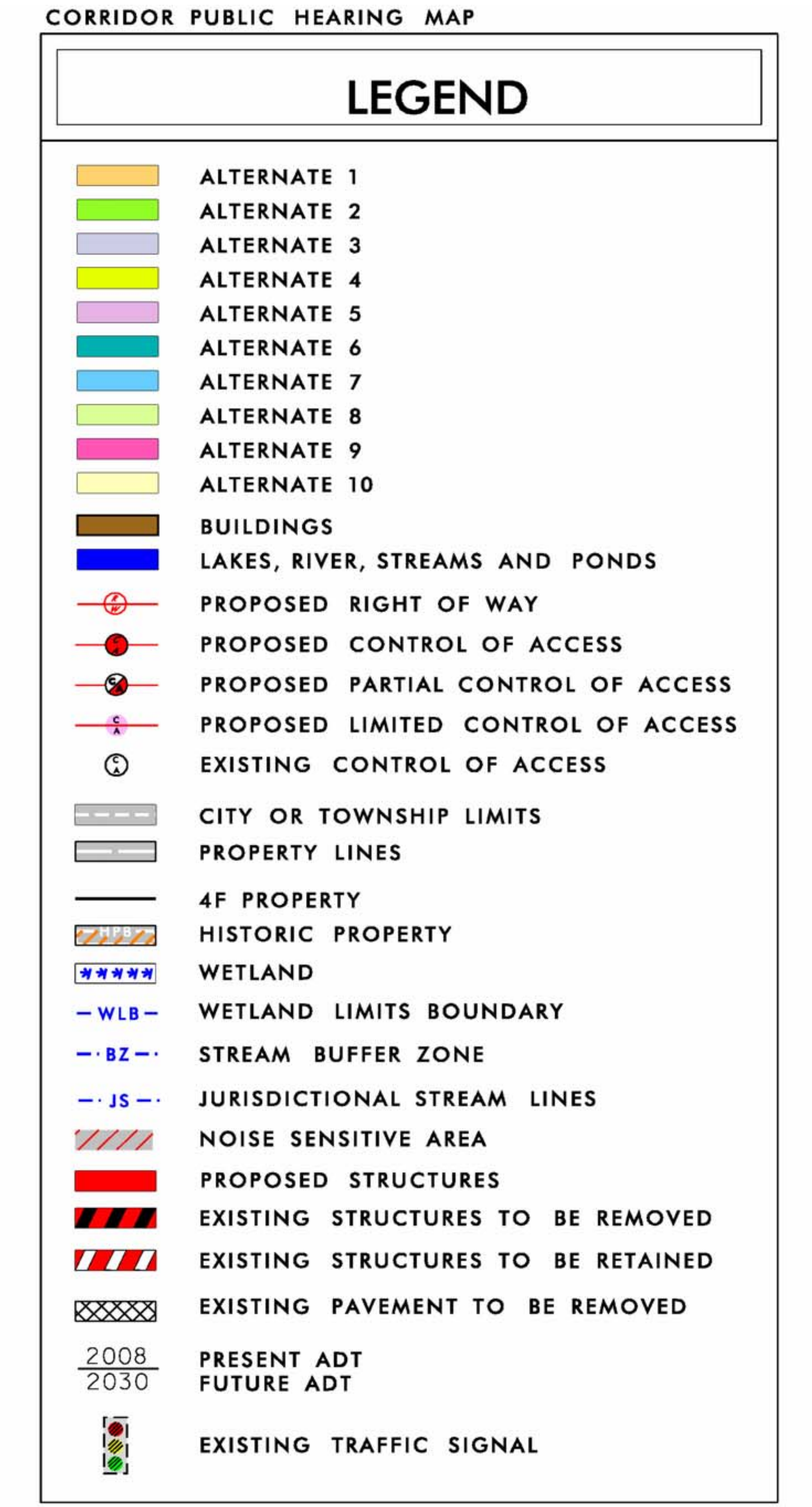
"Full Control of Access is defined as a connection to a facility provided only via ramps at interchanges. All cross-streets are grade-separated. No private driveway connections allowed."

(4) Key Map

Consider making a "Key Map" for projects with multiple maps and corridors. The map should be clearly labeled as "Key Map" in the project identification box. The purpose of a key map is to display all the corridors under consideration and to clarify the orientation of multiple corridors. This map should include:

(A) The orthophotography
(B) All corridor color bands
(C) All road/street route numbers with common names
(D) Begin and end TIP project
(E) North arrow
(F) Project scale
(G) Legend showing each alternative color

Do not show preliminary mapping and any functional design features in a key map.


CORRIDOR PUBLIC HEARING MAP
LEGEND
ALTERNATE 1
ALTERNATE 2
ALTERNATE 3
ALTERNATE 4
ALTERNATE 5
ALTERNATE 6
ALTERNATE 7
ALTERNATE 8
ALTERNATE 9
ALTERNATE 10
BUILDINGS
LAKES, RIVER, STREAMS AND PONDS
PROPOSED RIGHT OF WAY
PROPOSED CONTROL OF ACCESS
PROPOSED PARTIAL CONTROL OF ACCESS
PROPOSED LIMITED CONTROL OF ACCESS
EXISTING CONTROL OF ACCESS
CITY OR TOWNSHIP LIMITS
PROPERTY LINES
4F PROPERTY
HPB
HISTORIC PROPERTY
WETLAND
WLB
WETLAND LIMITS BOUNDARY
BZ
STREAM BUFFER ZONE
JS
JURISDICTIONAL STREAM LINES
NOISE SENSITIVE AREA
PROPOSED STRUCTURES
EXISTING STRUCTURES TO BE REMOVED
EXISTING STRUCTURES TO BE RETAINED
EXISTING PAVEMENT TO BE REMOVED
2008
2030
PRESENT ADT
FUTURE ADT
EXISTING TRAFFIC SIGNAL