The information contained in Chapter One: Design Standards, dated July 2006, has been updated to reflect the December 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 occurring since the latest publication of this chapter.

Chapter One
Design Standards

1. DESIGN STANDARDS

Design standards have been developed to provide a systematic means of achieving quality roadway design in a uniform manner. They incorporate basic design considerations and design controls, described in later sections, for the various functional classes of roadway and types of improvements to be made.

This manual and the Nebraska Minimum Design Standards, (Ref. 1.1), are the primary sources of roadway design standards for **NDOT.** These state standards are based on guidelines from **AASHTO,** the **Federal Highway Administration (FHWA)**, the **Occupational Safety and Health Administration (OSHA)**, the **Access Board**, and others. On projects in municipal areas, designers may also need to comply with local codes and street standards. For additional information, the following sources may be consulted:

NDOT Publications

The following is a partial listing of pertinent **NDOT** publications:

- Nebraska Department of Transportation Bridge Office Policies and Procedures, (BOPP Manual) (http://www.roads.nebraska.gov/media/2912/bopp-manual.pdf)
- Access Control Policy to the State Highway System (http://www.roads.nebraska.gov/media/3460/access-control-policy.pdf)
- Standard/Special Plans Book (http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/)
- State of Nebraska Department of Transportation Standard Specifications for Highway Construction (http://roads.nebraska.gov/media/6897/specbook-2007.pdf)
- Nebraska Department of Transportation Standard Item List (http://www.roads.nebraska.gov/business-center/business-opp/hwy-bridge-lp/item-history/)
- Nebraska Department of Transportation Construction Manual (http://roads.nebraska.gov/business-center/contractor/contruction-manual/)

AASHTO Publications

The following is a partial listing of applicable **AASHTO** publications:

- A Policy on Geometric Design of Highways and Streets (latest edition)
- Roadside Design Guide
- A Policy on the Accommodation of Utilities Within Highway Right-of-Way
- A Policy on the Accommodation of Utilities Within Freeway Right-of-Way
- Guide for the Development of Bicycle Facilities
- Guide for Erecting Mailboxes on Highway

Federal Highway Administration (FHWA) Publications

(http://www.fhwa.dot.gov/index.html)

The **Federal Highway Administration (FHWA)** sets forth specific policies and procedures for projects on the National Highway System (NHS), (See Section 5.A). **FHWA** manuals, bulletins, notices and technical advisories are available for guidance. Examples of some of their publications are:

- A User's Guide to Positive Guidance, FHWA-TO-81-1
- Federal Aid Policy Guide (http://www.fhwa.dot.gov/legsregs/directives/fapg/cfr0470a.htm)
- New Methods for Determining Requirements for Truck Climbing Lanes, FHWA-IP-89-022
- Manual on Uniform Traffic Control Devices (http://mutcd.fhwa.dot.gov/kno_2009r1r2.htm)
- Traffic Control Devices Handbook

The Access Board

(http://www.access-board.gov)

The **Access Board** is an independent Federal agency devoted to accessibility for people with disabilities. Guidelines developed under the Americans with Disabilities Act (ADA), which covers access to a wide range of facilities in the public and private sectors and under the Architectural Barriers Act (ABA), which requires access to certain federally funded facilities may be found at: (http://www.access-board.gov/guidelines-and-standards)

2. NEBRASKA MINIMUM DESIGN STANDARDS
(http://dot.nebraska.gov/media/5593/nac-428-rules-regs-nbcs.pdf)

The Nebraska Minimum Design Standards, (Ref. 1.1) are developed by the **Board of Public Roads Classifications and Standards**. Included are design standards for rural and municipal state highways, municipal streets and rural roads. These standards generally represent minimum values; higher values should be used within reasonable economic and environmental limits. To ensure uniform practice on a statewide basis, designs not meeting the minimum design standards may not be used without a design relaxation (See Appendix H, "Application of Standards"). Deviations from minimum design standards to save established slopes, trees, wetlands or right-of-way items (e.g., wells, windmills, towers, cemeteries, etc.) will require design relaxation approval.

The designer should follow these steps to use the Nebraska Minimum Design Standards (Ref. 1.1):

1. Review the engineering review statement and recommendations from the **Project Development Division**.
2. Request projected traffic data from the **Traffic Analysis Section** in the **intermodal Planning Division**.
3. Determine the roadway segment's national functional classification, (See Section 5.B).
4. Determine if the project roadway is on the priority commercial system, (See Section 5.B).
5. Determine whether the terrain is level or rolling, (See Section 6.D).
6. Enter the Nebraska Minimum Design Standards (Ref. 1.1) to determine the design number and other design information.
7. Compare the minimum design standards requirements with the recommendations from the engineering review statement. If there is a discrepancy, the designer should discuss it with his/ her **Roadway Design Unit Head** to determine if changes can be made. If changes cannot be made, follow the design relaxation procedures (See Appendix H, "Application of Design Standards").

2.A New and Reconstructed Projects

New and reconstructed projects generally consist of: construction of a new road, relocating an existing route on new alignment, major widening (adding lanes) on an existing road, or reconstruction of an existing route on old alignment. New and reconstructed projects also include projects in which the principal activity is building a new bridge or rehabilitation consisting of bridge widening. New and reconstructed projects shall be considered when:

- Significant existing geometric deficiencies are to be corrected.
- Significant grading is to be done that requires major right-of-way to be acquired and/ or major utility relocations.

3. MAINTENANCE PROJECTS

The **Board of Public Roads Classifications and Standards** has also established minimum maintenance standards for each functional classification roadway ("Procedures for Classifications and Standards", Ref. 1.4). Maintenance projects are programmed for bringing the roadway surfacing back to its' original condition.

3.A Maintenance Project Policy Guidelines

Design guidelines for projects to be designed under "Maintenance Projects" are as follows:

1. "Maintenance Projects" shall consist of resurfacing work and shoulder work only. If there are deficiencies, other than surfacing, a future project should be programmed to correct them.
2. Maintenance projects are for 24 ft. or less in width only, except:
    A. For roadways with existing surfaced shoulders, resurfacing of the existing surfaced shoulders will be allowed if the **Materials and Research Division** determines that a grade raise of more than ½ in. at the edge of the pavement is needed.
    B. 28 ft. widths will be allowed on roadways with an existing 28 ft. top.
3. No surface widening work will be allowed, except:

    When the **Materials and Research Division** has determined that the surfacing strategy will be an in-place recycle of the existing asphalt surface to a certain depth, then a lowering of the grade to a lesser depth will be accomplished by trench widening up to 2 ft. in width on each side. A resurfacing of the entire surfaced roadway width will then be made with up to a 2 ½ in. overlay. The total existing roadway width, outside edge of shoulder to outside edge of shoulder, does not change. This surface widening is a direct result of this type of maintenance strategy rather than the result of a planned surface widening to meet 3R Minimum Design Standards, thus the **NDOT**, in its sole discretion, has determined that any maintenance project with this type of strategy may remain classified as a maintenance project.

4. A grade raise of up to 2 ½ in. is acceptable; a grade raise of more than 2 ½ in. at the edge of the pavement will be the exception and will require justification by the **Materials and Research Division** documented to the project file. Up to a ½ in. grade raise at the edge of the pavement will require NO shoulder or guardrail work. A grade raise of more than ½ in. at the edge of the pavement will require an investigation for the need of guardrail work.
5. Surfacing will be feathered out at intersections and driveways.
6. Surfacing will be milled out at bridge approaches so that there is no grade raise at bridges.
7. If more than a 2 in. depth is placed at the centerline a city agreement may be required.
8. If the grade is raised and the contractor does the shoulder work, the **District Engineer** will determine if suitable earthwork material is available within the right-of-way.
9. The "10 ft. straightedge, 1/8 in. variation limit, in the longitudinal direction, and at the discretion of the Engineer" version of a smoothness specification will be used on all maintenance projects.
10. No guardrail, new mailbox turnout, or superelevation correction work will be allowed.
    A. If guardrail work is required the project will be reclassified to a 3R project.
11. Curb ramps will be built where needed when surfacing overlays of 2 in. or more are placed (2 in. total lift even if the surface is milled first). A city agreement may be required.

4. OTHER TYPES OF PROJECTS

4.A Safety Improvement Projects

Safety improvement projects are projects that are usually located at specific high accident sites. The **Highway Safety Division** identifies the high accident locations and the **Safety Committee** then evaluates individual projects on a case-by-case basis. **District Engineers** may also request study of individual locations. Usually safety improvement projects are designed with 10-year traffic forecasts. These projects may include intersection projects, adding left turn lanes, minor radii improvements, sight distance improvements, etc.

4.B Off-System Urban Projects

The federal STP provides funds on an annual basis for all cities of the first class in Nebraska. The funding split is 80% federal and 20% city. Eligible projects under this program include:

- Construction, reconstruction, resurfacing, restoration and rehabilitation and operational improvements for highways and bridges on any public road rated higher than a minor collector, including work to accommodate other transportation modes.
- Capital costs for transit projects and publicly owned bus terminals and facilities.
- Carpool projects, parking facilities and non-recreational bicycle and pedestrian facilities.
- Highway and transit safety improvement programs, rail-highway grade crossings and projects to mitigate hazards due to wildlife.
- Capital and operating costs for traffic monitoring, management and control facilities.
- Transportation control measures listed in Section 108 of the Clean Air Act, (Ref. 1.5) (http://www.ehso.com/ehshome/caa2.php)
- Wetlands mitigation efforts.

4.C Secondary Roads - Off-System Rural Projects

The **Local Projects Section** of the **Materials & Research Division** deals with all off-system rural roads for which local road standards have been developed. For further information see Part Two of the Nebraska Minimum Design Standards, (Ref. 1.1).

5. HIGHWAY SYSTEM CLASSIFICATION

The roadway system has been classified for identification, prioritization and funding purposes for planning, design, traffic operations, and administration of the highway program. Classification relates to network, function, roadway location, access, traffic volume, trip purposes and length. In turn, classification designation dictates the standards that should be used for roadway design.

5.A Federal Classification

The National Highway System (NHS) is an interconnected system of principal arterial routes that serves major population centers, international border crossings, ports, airports, public transportation facilities, other intermodal transportation facilities and other major travel destinations. NHS highways also meet national defense requirements and serve interstate and interregional travel (Ref. 1.7).

The Surface Transportation Program (STP) is a funding program that includes public roads not functionally classified as minor rural collectors, local roads, or streets. It includes some collector routes that were not previously on the federal-aid system. In addition to being a funding source for these routes, the STP specifies some set aside funds for obstacle elimination projects and for transportation enhancement activities (See Section 4.B).

5.B Nebraska National Functional Classification
(http://www.roads.nebraska.gov/travel/map-library/func-by-county/)

Functional classification is the grouping of highways by the character of service they provide. It basically considers the level of access and mobility the roadway is to provide. The Nebraska National Highway Functional Classification (NNFC) Map identifies four roadway classes:

1. Interstates and freeways.
2. Principal arterials.
3. Minor arterials.
4. Major collectors.

These classes are based on **American Association of State Highway and Transportation Officials' (AASHTO)** functional classes found in A Policy on Geometric Design of Highways and Streets (Ref. 1.9).

The intended purpose of a roadway determines its design. Functional classification is a means of identifying the travel purposes to be served. The Nebraska National Highway Functional Roadway Classes on the map are:

- Interstate: a national defense highway system established to connect most cities of 50,000 or more population in the U.S., with complete access control and a minimum of two 12 ft. lanes in each direction, divided in most instances by wide medians.
- Principal Arterials: corridor movement with trip length and density compatible with significant statewide or interstate travel. There is usually a high operating speed and level of service with some degree of access control through limiting intersection spacing and direct property access.
- Minor Arterials: routes to provide linkage of cities, towns and other traffic generators, integrating interstate and inter-county service, usually at relatively high speed and minimum interference to through movement.
- Major Collectors: serve a dual function of property access and feeding arterials, generally for shorter trip lengths. They will have lower speeds and levels of service than arterials. In urban areas, collectors are usually designed to discourage through traffic in residential areas by following indirect and discontinuous alignment.

All other roadways are local roads and streets.

5.C Nebraska State Functional Classification
(http://www.roads.nebraska.gov/travel/map-library/func-by-county/)

By act of the **Nebraska Legislature,** the **Board of Public Roads Classifications and Standards** has established a state functional classification. The state functional classification is defined for rural and municipal areas. EXHIBITS 1.1 AND 1.2 identify characteristics of roadway types in rural and municipal settings, respectively. Rural highways consist of all public highways and roads outside the limits of any incorporated municipality. Municipal streets are all public streets within the limits of any incorporated municipality. Municipal areas are further subdivided by population size: over 50,000 (urban areas), 5,001-49,999 (small urban areas), and 1-5,000 (villages and cities of the second class) (See “Procedures for Classifications and Standards”, Ref. 1.4). Municipalities of 5,001 and over population are cities of the first class.

Functional Classification	General Characteristics
Interstate	- The Federally designated National System of Interstate and Defense Highways.
Expressway	- A group of highways following major traffic desires in Nebraska which rank next in importance to the National System of Interstate and Defense Highways. The expressway system is one that ultimately should be developed to multilane divided highway standards.
Major Arterial	- The balance of routes that serve major statewide interests for highway transportation. This system is characterized by high-speed, relatively long-distance travel patterns.
Scenic-Recreation	- Highways or roads located within or which provide access to or through state parks, recreation or wilderness areas, other areas of geographical, historical, geological, recreational, biological, or archaeological significance, or areas of scenic beauty.
Other Arterial	- Highways of less importance as through-travel routes that serve places of smaller population and smaller recreation areas not served by higher systems.
Collector	- Highways that pick up traffic from many local or land-service roads and carry it to community centers or to the arterial systems. They are the main school bus routes, mail routes, and farm-to-market routes.
Local	- All remaining rural roads except minimum maintenance roads.
Minimum Maintenance	- (a) Roads used occasionally by a limited number of people as alternative access roads for areas served primarily by local, collector, or arterial roads, or (b) roads which are the principal access roads to agricultural lands for farm machinery and which are not primarily used by passenger or commercial vehicles.

Exhibit 1.1 Nebraska State Rural Highway Functional Classifications (Source: Ref. 1.8)

Functional Classification	General Characteristics
Interstate	- The Federally designated National System of Interstate and Defense Highways.
Expressway	- (a) Extensions of rural expressways within some urban areas and (b) some additional routes serving very high volumes of local traffic within urban areas.
Major Arterial	- Extensions of rural major arterials that provide continuous service through municipalities for long-distance rural travel. They are the arterial streets used to transport products into and out of municipalities.
Other Arterial	- (a) Municipal extensions of rural other arterials and (b) arterial movements peculiar to a municipality's own complex, that is streets which interconnect major areas of activity within a municipality, such as shopping centers, the central business district, manufacturing centers, and industrial parks.
Collector	- A group of streets which collect traffic from residential streets and move it to smaller commercial centers or to higher arterial systems.
Local	- The balance of streets in each municipality, principally residential access service streets and local business streets. They are characterized by very short trip lengths, almost exclusively limited to vehicles desiring to go to or from adjacent property.

Exhibit 1.2 Nebraska State Municipal Streets Functional Classification (Source: Ref. 1.8)

5.D Priority Commercial and Expressway Systems

5.D.1 Priority Commercial System

The Priority Commercial System, initiated in 1988, provides a continuous network of routes that are designed to carry higher traffic volumes, especially larger volumes of commercial vehicles.

This system, which includes the rural expressway system, was established at 3,303 miles. As with all state systems, there may be variances in exact mileage from year-to-year as highway alignments change and as municipal boundaries are altered. It directly serves all of the first class (5,001 – 100,000 population) and larger cities, directly serves 80 of the 115 second class cities (800 – 5,000 population), and comes within 10 miles of another 18 second class cities.

For additional information, see NDOT policy DES 17-01, “Priority Commercial System: Shoulder Width”

5.D.2 Expressway System

As part of the 1988 Needs Study, Department engineers reviewed Nebraska socioeconomic data. This data included population and demographic trends, general economic activity as reflected in sales tax revenue, agricultural production, employment data, and other information relative to economic trends. The initial review precipitated the development of an expanded Expressway System of approximately 600 miles.

Factors included in the development of the system were: 1) to connect urban centers of 15,000 population or greater to the Interstate System, 2) to add those routes which have an average daily traffic of 500 or more heavy commercial vehicles, and 3) to add additional segments for continuity.

The Expressway System is being constructed as multi-lane divided highways. Interchanges may be built where an Expressway intersects with high volume highways. Access other than at public roads will be limited. Whether the system will directly serve developed areas, or whether bypass routes will be constructed, will be decided on a case-by-case basis. The Expressway System currently consists of some two-lane highways that will ultimately be constructed to multilane divided highway standards.

6. DESIGN CONTROLS

Once the type of roadway improvement is determined and the functional classification of the roadway known, several basic factors serve as design controls. They are determinants for other geometric design standards. See the Nebraska Minimum Design Standards, (Ref. 1.1) and A Policy on Geometric Design of Highways and Streets, (Ref. 1.9).

6.A Design Year Forecast Traffic

The ADT for the design year, the year twenty years after the initial construction of the project, is used as a target in design for New and Reconstructed projects. See Chapter Seventeen for the design year for 3R projects. For additional information, see the Nebraska Minimum Design Standards, Ref. 1.1.

Traffic projections on individual project segments must be compared to the priority commercial system map for design standard compliance.

6.B Design Speed

The desirable design speed for a roadway project is 5 mph greater than the anticipated posted speed limit for the roadway. The minimum design speed is the design speed from the Nebraska Minimum Design Standards, (Ref. 1.1). An exception to the above would be in the instance where the design speed from the Nebraska Minimum Design Standards is greater than the anticipated posted speed; in this case the minimum design speed from the standards will be used. For example, if the design speed from the Nebraska Minimum Design Standards is 60 mph and the anticipated posted speed of the roadway is 50 mph, a design speed of 60 mph will be used.

Rural roadway projects should be designed to *one* design speed. If a rural project has a posted speed of 65 mph, the desirable design speed is 70 mph; but if one section of the roadway can only be designed to 65 mph, the *entire* project should be designed to 65 mph in order to meet driver expectations.

Deviation from the established design speed will require **Assistant Design Engineer** approval while **Board of Public Roads and Classifications** approval will be required to design to less than the statutory design speed from the Nebraska Minimum Design Standards, (Ref. 1.1).

6.C Sight Distance

Sight distance is the length of roadway that is visible to the driver in various situations including stopping sight distance, passing sight distance, and intersection sight distance. For further discussion of sight distance see Chapter Three: Roadway Alignment, Section 1.

6.D Terrain

Terrain is a design control affecting alignment. Two basic types of terrain are found in Nebraska:

- Level: the condition where highway sight distances, as governed by both horizontal and vertical restrictions, are generally long or could be made to be so without construction difficulty or major expense.
- Rolling: the condition where the natural slopes rise above and fall below the road or street grade and where occasional steep slopes offer some restriction to normal horizontal and vertical roadway alignment.

6.E Access Control

Access control effectively increases roadway capacity by restricting the number and location of access points along the highway. This provides a safer environment for the roadway user, increases the efficient movement of through traffic, and reduces roadway accidents by minimizing the number of conflict points located along the highway (See Chapter Fifteen: Right-of-Way, Section 3).

6.F Lateral Obstacle Clearance

Lateral obstacle clearance is the roadside area starting at the edge of the travel lane available for the safe use of errant vehicles. It may consist of the shoulder, a recoverable slope, a non-recoverable slope and/ or a clear runout area. The required lateral obstacle clearance will vary depending upon the design roadway standard (DR) (See Nebraska Minimum Design Standards, Ref. 1.1). Chapter Six: The Typical Roadway Cross-Section, Section 9, discusses this further.

6.G Urban/ Rural

Separate design standards have been developed for rural areas and urban (municipal) areas. In addition, typical cross-sections differ depending upon rural/ urban location. In general, urban design standards reflect lower design speeds and restricted rights-of-way for the higher traffic volumes more common in urban areas while rural design standards reflect higher design speeds and the more flexible right-of-way opportunities possible in rural areas.

7. DESIGN ANALYSIS AND EVALUATION

7.A Capacity Analysis

NDOT's goal is to provide a transportation system to meet the needs of the forecast design year traffic. Providing unlimited capacity to handle any amount of traffic is not fiscally responsible. Good design must provide sufficient roadway capacity, providing acceptable levels of service to motorists without undue burden on the resources of the state. The principal objective of capacity analysis is to estimate the maximum amount of traffic that can be accommodated by a given facility while maintaining predetermined operational quality, or level of service.

Capacity analysis provides the necessary information to evaluate improvement alternatives. The designer should work with the **Traffic Engineering Division** to ensure that the design typical section and alignment contained in the project file would provide the intended capacity and level of service for the project roadway.

7.B Economic Analysis

In general, the designer should follow the design standards unless the estimated cost of doing so is exorbitant. When a design relaxation is to be requested, the designer needs to substantiate the specific estimated costs associated with following versus deviating from the minimum design standards The **Construction Division Cost Estimating Unit** provides assistance as requested by the designer for determining cost estimates of different design alternatives (See Chapter Twelve: Cost Estimating & Funding, Section 1.B).

7.C Accident Analysis

Project improvements typically are evaluated on the basis of accident analyses. High accident location analyses are performed to prioritize projects and also to evaluate project alternatives. The **Traffic Engineering Division** performs accident analyses.

8. REFERENCES

1.1 Board of Public Roads Classifications and Standards, Nebraska Minimum Design Standards, Current Edition. (http://dot.nebraska.gov/media/5593/nac-428-rules-regs-nbcs.pdf)

1.2 Nebraska Department of Transportation, State Highway Inventory Report.

1.3 American Association of State Highway and Transportation Officials, Roadside Design Guide, Washington, D.C., 2011.

1.4 The Board of Public Roads Classifications and Standards, "Procedures for Classifications and Standards," Current Edition.

1.5 The Clean Air Act: 23 U.S.C. 109(1) as amended, 42 U.S.C. 7401-7428 (http://www.ehso.com/ehshome/caa2.php)

1.6 23 Congressional Federal Register 625 (https://www.gpo.gov/fdsys/granule/CFR-2011-title23-vol1/CFR-2011-title23-vol1-part625)

1.7 "Intermodal Surface Transportation Efficiency Act: The National Highway System, The Backbone of America's Intermodal Transportation Network," U.S. Department of Transportation, Federal Highway Administration, Washington, D.C., December, 1993. (https://www.fhwa.dot.gov/infrastructure/backbone.cfm)

1.8 Nebraska. Laws, Statutes, Etc., Nebraska Highway and Bridge Law; Consisting Of Chapter 39, Highways and Bridges; Sections 49-801 And 49-802, Definitions And Rules Of Construction; Article 6 Of Chapter 60, Nebraska Rules Of The Road. Revised Reissued Statutes Of Nebraska, Current Edition

1.9 American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, D.C., 2011.

Nebraska Department of Roads

Roadway Design Division - Policy Letter

Policy Number: **DES 09–01** **Page 1 of 1**

Approval Date: 04/17/09 Approved By:

Approval Date: 04/17/09 Approved By:

Roadway Design Manual chapter affected by this policy letter:

Chapter One: Design Standards
Section 8. Design Controls/ 8.A: Design Year Traffic

Chapter Two: Design Process
Section 5 Preliminary Roadway Design/ 8.D.: Request Information from Other Divisions

Effective Date: Immediately for all 3R projects that have not completed functional design. Projects in final design may continue with the traffic furnished.

Subject: Design Year Traffic Determination

The 2008 Minimum Design Standards (MDS) for Resurfacing, Restoration, and Rehabilitation (3R) projects, allow the use of the life of the pavement for the determination of the design year and subsequently the design year traffic.

Note (1) on page 7 of the MDS, referring to design year traffic, states "(1) "Design Year" shall be the year of initial construction plus the expected life of the surfacing up to 20 years."

The NDOR has established an average life of ten years for 3R projects constructed with hot-mixed asphalt pavement and twenty years for 3R projects constructed from Portland Cement Concrete pavement.

The Planning and Project Development Division is responsible for providing traffic projections for all projects as necessary.

When requesting the traffic volumes, include in your request the year of initial construction and the ending year of the expected life of the surfacing.

Sent to: NDOR Roadway Design, NDOR "Distribution B", and selected consultants.

Nebraska Department of Roads

Roadway Design Division – Policy Letter

Policy Number: **DES 15–01**

Approval Date: 8/13/15 By: _____ Roadway Design Engineer

Approval Date: 8/17/15 By: _____ Construction Engineer

Approval Date: 8/21/15 By: _____ Materials & Research Engineer

Approval Date: 8/25/15 By: _____ FHWA Division Administrator

VALUE ENGINEERING

Purpose

Federal Regulations require that State Transportation Agencies (STAs) develop a policy for governing a Value Engineering (VE) Program. The purpose of this document is to create the required policy establishing the Nebraska Department of Roads' (NDOR) Value Engineering Program. This policy provides guidance for conducting a VE analysis on applicable Federal-aid highway projects.

NDOR establishes this policy along with procedures, functions, and guidance to monitor, assess, and report on the performance of the VE program. The NDOR shall ensure that its sub-recipients conduct VE analyses as indicated in this policy.

Definitions

Bridge project: A bridge project shall include any project where the primary purpose is to construct, reconstruct, rehabilitate, resurface, or restore a bridge.

Final design. Any design activities following preliminary design and expressly includes the preparation of final construction plans and detailed specifications for the performance of construction work.

Major Project. Based on the *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU),* signed into law on August 10, 2005, a Major Project is defined as "a project with a total estimated cost of $500 million or more that is receiving financial assistance." The FHWA also has the discretion to designate a project with a total cost of less than $500 million as a Major Project. The FHWA may choose to do so in situations where the projects require a substantial portion of the STA's program resources; have a high level of public or congressional interest; are unusually complex; have extraordinary implications for the national transportation system; or are likely to exceed $500 million in total cost.

Project. The term "project" means any undertaking eligible for assistance under Title 23 of the United States Code. The limits of a project are defined as the logical termini in the

Sent to: NDOR Roadway Design, NDOR "Distribution B", and selected consultants.

environmental document and may consist of several contracts, or phases of a project or contract, which may be implemented over several years.

Total project costs. The estimated costs of all work to be conducted on a project, including the environment, design, right-of-way, utilities and construction phases.

Value Engineering (VE) analysis. The systematic process of reviewing and assessing a project by a multidisciplinary team not directly involved in the planning and development phases of a specific project that follows the VE Job Plan and is conducted to provide recommendations for:

- Providing the needed functions, considering community and environmental commitments, safety, reliability, efficiency, and overall lifecycle cost;
- Optimizing the value and quality of the project; and
- Reducing the time to develop and deliver the project.

Value Engineering (VE) Job Plan. A systematic and structured action plan for conducting and documenting the results of the VE analysis. While each VE analysis shall address each phase in the VE Job Plan, the level of analysis conducted and effort expended for each phase may be scaled to meet the needs of each individual project.

Value Engineering Program

The NDOR hereby establishes, and through this policy, sustains a VE program under which VE analyses are identified conducted and approved VE recommendations implemented on applicable projects. NDOR has designated the Roadway Design Engineer in general and the Roadway Design Standards Engineer in particular as NDOR's VE Program Coordinator to coordinate VE program activities and functions. The VE Coordinator's responsibilities include establishing and maintaining the NDOR's VE policies and procedures; facilitating VE training; ensuring VE analyses are conducted on applicable projects; monitoring, assessing, and reporting on the VE analyses conducted and VE program; participating in periodic VE program and project reviews; submitting the required annual VE report to the FHWA; and supporting the other elements of the VE program.

Applicable Projects

A VE analysis shall be conducted prior to the completion of final design on each applicable project that utilizes Federal-aid highway funding. The applicable Assistant Roadway Design Engineer (ADE) shall notify the Roadway Design Standards Engineer when an applicable project has been identified.

Applicable projects requiring a VE analysis include the following:

- Each project located on the National Highway System (NHS) with an estimated total project cost of $50 million or more that utilizes Federal-aid highway funding;
- Each bridge project located on the NHS with an estimated total project cost of $40 million or more that utilizes Federal-aid highway funding;
- Any major project, located on or off of the NHS, that utilizes Federal-aid highway funding in any contract or phase comprising the major project;
- Any project where a VE analysis has not been conducted and a change is made to the project's scope or design between the final design and the construction letting which

results in an increase in the project's total cost exceeding the thresholds identified in this section; or

- Any other project FHWA determines to be appropriate that utilizes Federal-aid highway program funding.

An additional VE analysis is not required if, after conducting a VE analysis required under this part, the project is subsequently split into smaller projects in the design phase or the project is programmed to be completed by the letting of multiple construction projects. However, the NDOR may not avoid the requirement to conduct a VE analysis on an applicable project by splitting the project into smaller projects, or programming multiple design or construction projects.

NDOR may recommend a VE analyses to be conducted for projects falling below the required thresholds identified in this section where there is a high potential for the project to benefit from a VE analysis. Applicable projects may include the following:

- Complex projects on or off the NHS that have a total project cost of $25 million or more;
- Complex Bridge Projects on or off the NHS with an estimated total project cost of $20 million or more;
- Any other complex, difficult, or high cost project as determined by NDOR.

The ADE shall review projects where a delay occurs between when the final plans are completed and the project advances to a letting for construction to determine if a change has occurred to the project's scope, design, or estimate where a VE analysis would be required to be conducted.

Conducting the VE analysis

A VE analysis should be conducted as early as practicable in the planning or development of a project, preferably before or during the Plan-In-Hand field review. The VE analysis should be closely coordinated with other project development activities to minimize the impact approved recommendations might have on previous agency, community, or environmental commitments; the project's scope or schedule; and the use of innovative technologies, materials, methods, plans or construction provisions. At a minimum, the VE analysis shall be conducted prior to completing Final Design.

The ADE, in coordination with the VE Coordinator and the NDOR Divisions and Districts, shall put together a multidisciplinary VE team not directly involved in the planning or design of the project, with at least one individual who has training and experience with leading VE analyses. NDOR or local public agencies may employ qualified consultants to conduct a VE analysis. The consultant shall possess training and experience with leading VE analyses. A consulting firm or individual shall not be used to conduct or support a VE analysis if they have a conflict of interest. VE team members would generally include members from Roadway Design, Traffic Engineering, Environmental (PPD), Pavement Design (M&R), Central Office Construction Division, District Construction Office, Bridge Division, Federal Highway Administration (FHWA), and potentially Bridge or Roadway Design Hydraulics. VE Team members shall be selected

based on their ability to add value to the analysis. Typically, the VE Team will consist of Section heads, and other individuals with the experience and knowledge to discern practicable cost effective proposals.

The VE Analysis will result in a formal written report. The report will consist of at least the following:

- A summary of necessary project information which includes the purpose and need for the project, a project description, location map, and overview of the geographic features of the area
- Identification of the VE analysis team including members of the VE team, contributing individuals, the Standards Engineer, and the other project stakeholders.
- Background and supporting documentation, such as information obtained from other analyses conducted on the project (e.g., environmental, safety, traffic operations, and constructability); these documents may include project time allowance, accident report, pavement condition report, DR-73 Scoping Report, and project estimates.
- Document the stages of the VE Job Plan including life-cycle cost analysis, if appropriate, that were analyzed which includes and documents seven phases:

1. *Information Phase:* The VE Team will gather project information including project commitments and constraints. This may also include a site visit, orientation meeting, and/or a presentation of the current state of design. This meeting is held prior to the start of the VE Study to acquaint the team members with the project.

2. *Function Analysis Phase:* The VE Team will analyze the project to understand the required functions for the project. Required functions could vary based on the project, but may include the designated purpose and need for the project, NDOR goals, and project based goals.

3. *Creative Phase:* The VE Team will generate ideas on ways to accomplish the required functions which improve the project's performance, enhance its quality, and lower project costs. Ideas generated from this phase may not qualify for future evaluation, but may provide additional insight or project enhancements to consider prior to final design.

4. *Evaluation Phase:* The VE team will evaluate ideas from the Creative Phase and select feasible alternatives for development based on their apparent advantages and disadvantages.

5. *Development Phase:* The VE Team will develop the feasible alternatives into fully supported proposals. These proposals are developed through technical analysis. This can be performed by functional areas of the VE team (Roadway, Earthwork, Environmental, etc.), and supported through cost-effectiveness analysis.

6. *Presentation Phase:* The VE Team will present VE proposals to the project stakeholders. Project Stakeholders would typically include the Director, Deputy Director – Engineering, Deputy Director – Operations, District Engineer,

Roadway Design Engineer, Construction Engineer, and those Divisions or Sections affected by the VE Proposal or delivery of the project.

7. *Resolution Phase:* The project stakeholders shall evaluate all presented proposals for acceptance, rejection, or require further study by the VE Team. For proposals requiring further study, the VE Team, or other subject matter experts, shall further evaluate until the Project Stakeholders can either, approve or reject the proposal. A second VE presentation for review and to vote at the VE Final Recommendation meeting is recommended to occur at least one week after the Presentation Phase.

- Summary of the analysis conducted;
- Document the proposed recommendations and approvals received at the time the report is finalized; and

For bridge projects, in addition to the requirements above, the VE analyses shall:

- Include bridge substructure and superstructure requirements that consider alternative construction materials; and
- Be conducted based on:
  1. An engineering and economic assessment, taking into consideration acceptable designs for bridges; and
  2. An analysis of life-cycle costs and duration of project construction.

The final report will be provided to the Design Standards Engineer and the appropriate ADE, and placed in the NDOR document management database to be retained for at least three years after the project has been completed.

The ADE shall coordinate the VE analysis for applicable projects and ensure that approved practicable recommendations be included in the project's plans, specifications and estimates prior to FHWA authorizing the project for construction. Since the VE recommendations and analysis are reviewed at a cursory level during the VE study, additional study and review of the assumptions and practicability during final design may show that the approved recommendation is not practicable or prudent. If it becomes apparent that the recommendation cannot be incorporated into the project, a decision document stating the reasons why it cannot be incorporate shall be attached to the final VE study report for the subject project.

VE Change Proposal (VECP)

A VECP is a construction contract change proposal submitted by the construction contractor based on a VECP provision in the contract. These proposals may improve the project's performance, value and/or quality, lower construction costs, or shorten the delivery time, while considering their impacts on the project's overall lifecycle cost and other applicable factors.

NDOR's Standard Specifications for Highway Construction provide for the contractor to consider changes reduce the project's overall costs without adversely affecting the long term performance of the project. The basis for NDOR or a local public agency to consider a VECP is the analysis and documentation supporting the proposed benefits that would result from implementing the proposed change in the project's contract or project plans.

Proposals to accelerate construction after the award of the contract will not be considered a VECP and will not be eligible for Federal-aid highway program funding participation. Where it is necessary to accelerate construction, NDOR and local public agencies are encouraged to use the appropriate incentive or disincentive clauses so that all proposers will take this into account when preparing their bids or price proposals.

The Construction Division shall provide the Standards Engineer with the VECP's and the net savings between NDOR and the contractor.

VE for Local Public Agencies

The Local Projects Section of the Materials & Research Division shall ensure that a VE analysis has been performed on each applicable project administered by sub-recipients, and shall ensure approved recommendations are implemented into the project's plans, specifications, and estimates prior to the project being authorized for construction. The final report and VE recommendations shall be placed in the NDOR document management database sent to the Design Standards Engineer. The report shall be retained for at least three years following final completion of the project.

VE Program Reporting

The Design Standards Engineer shall monitor and assess NDOR's VE Program, and provide an annual report to the FHWA consisting of a summary of all approved recommendations implemented on applicable projects requiring a VE analysis, the accepted VECPs, and VE program functions and activities;

The Design Standards Engineer shall facilitate training for NDOR's VE program as the need arise.

References include the following

- Title 23, United States Code (U.S.C), Section 106(e)
- Moving Ahead for Progress in the 21st Century (MAP-21, Section1503 (a)(3)
- Title 23, Code of Federal Regulations (CFR), Part 627
- Title 23 U.S.C., Section 101(a)(23)
- The Office of Management and Budget's (OMB) Value Engineering Circular A-131
- 2007 NDOR Standard Specifications for Highway Construction, Section 104.03

Sent to: NDOR Roadway Design, NDOR "Distribution B", and selected consultants.