

**1.**  
***INTRODUCTION***

This section contains general information about the manual along with a general description of the Bridge Office and its procedures.

***1.1 Overview of  
Manual 5-392***

This manual contains Mn/DOT Bridge Office policies and procedures for the design, evaluation, and rehabilitation of bridges. Except where noted, the design provisions herein employ the Load and Resistance Factor Design (LRFD) methodology set forth by AASHTO.

Mn/DOT utilizes a decimal numbering system to classify documents. The "5" before the hyphen represents a publication related to engineering. The "300" series of documents is assigned to the Bridge Office; the "90" series indicates that this is a "Manual". The last digit "2" specifies that the subject matter of the document is "Design".

The original bridge design manual, numbered 5-392, provided guidance for the design of highway structures in Minnesota in accordance with allowable stress design methods. Subsequently, it has received periodic updates as design methods have changed. This version of the Bridge Design Manual contains significant changes. It presents Mn/DOT's design practices in conformance with a new design methodology, Load and Resistance Factor Design (LRFD), and also contains fifteen comprehensive design examples.

Use of this manual does not relieve the design engineer of responsibility for the design of a bridge or structural component. Although Bridge Office policy is presented here for numerous situations, content of the manual is not intended to be exhaustive. Therefore, use of this manual must be tempered with sound engineering judgment.

***1.1.1 Material  
Contained in  
Manual 5-392***

After this introductory material, the manual contains material arranged around the following section headings. To simplify locating material, section numbers correspond to those used in the LRFD specifications:

- 1) Introduction
- 2) General Design and Location Features
- 3) Loads and Load Factors
- 4) Structural Analysis and Evaluation
- 5) Concrete Structures
- 6) Steel Structures
- 7) Reserved
- 8) Wood Structures
- 9) Decks and Deck Systems
- 10) Foundations
- 11) Abutments, Piers, and Walls

- 12) Buried Structures
- 13) Railings
- 14) Joints and Bearings
- 15) Ratings  
    Memos

### ***1.1.2 Updates to Manual 5-392***

This manual will be updated multiple times each year as procedures are updated and new information becomes available. Current files for each section of the manual are available on the Bridge Office Web site at: <http://www.dot.state.mn.us/bridge/> .

### ***1.1.3 Format of Manual References***

Each section of the manual contains general information at the start of the section. Design examples (if appropriate) are located at the end of each section. The general content is divided into subsections that are identified with numerical section labels in the left margin. Labels for design example subsections are identified with alphanumeric labels in the left hand margin. The left hand margin also contains references to LRFD Design Specification Articles, Equations, and Tables. These references are enclosed in square brackets.

Within the body of the text, references to other sections of this manual are directly cited (e.g. Section 10.1). References to the LRFD Specifications within the main body of the text contain a prefix of: LRFD.

## ***1.2 General Bridge Information***

A bridge is defined under Minnesota Rule 8810.8000 Subp. 2 as a structure "having an opening measured horizontally along the center of the roadway of ten feet or more between undercopings of abutments, between spring line of arches, or between extreme ends of openings for multiple boxes. Bridge also includes multiple pipes where the clear distance between openings is less than half of the smaller contiguous opening."

In accordance with Minnesota Statute 15.06 Subd. 6, the Commissioner of Transportation has delegated approval authority for State Preliminary Bridge Plans, and State, County and City Final Bridge Plans to the State Bridge Engineer. Plans for all bridge construction or reconstruction projects located on the Trunk Highway System, and plans on County or City highways funded fully or in part by state funds shall be approved by the State Bridge Engineer.

### 1.2.1 Bridge Office

The Bridge Office is responsible for conducting all bridge and structural design activities and for providing direction, advice, and services for all bridge construction and maintenance activities. The responsibilities include:

- Providing overall administrative and technical direction for the office.
- Reviewing and approving all preliminary and final bridge plans prepared by the office and consultants.
- Representing the Department in bridge design, construction and maintenance matters with other agencies.

The Office is under the direction of the State Bridge Engineer. It is composed of sections and units as shown on the organizational chart (Figure 1.2.1.1). Each of these subdivisions with their principal functions is listed as follows:

#### 1) Bridge Design Section

Responsible for the design, plans, and special provisions activities for bridges and miscellaneous transportation structures.

##### a) Design Unit

- i) Designs and drafts bridge design plans for new bridge construction or in-place bridge repairs.
- ii) Reviews bridge plans prepared by consulting engineers.
- iii) Prepares special provisions for bridge plans.
- iv) Designs and drafts plans for miscellaneous transportation structures.
- v) Provides technical assistance, designs, and plans for special bridge and structural problems.
- vi) Assists the Districts and other offices in solving bridge and other structure construction issues.

##### b) Bridge Evaluation Unit

- i) Provides review of fracture critical inspection reports and recommends reevaluation of rating as needed.
- ii) Performs design or rating for special non-bridge structures.
- iii) Analyzes unusual or atypical bridge structures.
- iv) Responds to and prepares plans for repairs and retrofits to bridges damaged by bridge hits.

##### c) State Aid Bridge Unit

- i) Assists local agencies in the planning, designing, and construction of bridge projects.
- ii) Reviews preliminary and final bridge plans for counties, townships, and municipalities within the State of Minnesota which receive State and/or Federal Aid Funds for bridge construction. The bridge plan reviews are conducted to assure they comply with AASHTO LRFD Design Specifications,

- Mn/DOT LRFD Bridge Design Manual, applicable Mn/DOT Technical Memorandums, Mn/DOT Standard Specifications for Construction, applicable Mn/DOT Bridge Special Provisions, and all Mn/DOT policies.
- iii) Serves to assist in the planning and review of miscellaneous structures for local agencies. These structures include, but are not limited to, pedestrian bridges, boardwalks, retaining walls, culverts, parking ramps, park buildings, skyways, and stair towers.
  - iv) Provides technical assistance to local agencies and their consultants in the implementation of new, innovative, efficient and cost effective bridge systems.
  - v) Provides assistance as requested by the local agencies and/or their consultants, with the preparation, setup, and delivery of local bridge training. The training can encompass all aspects of local bridges, such as planning, design, construction, load rating, and inspection.
- d) LRFD Unit
    - i) Maintains LRFD Bridge Design Manual.
    - ii) Provides support to office and consulting engineers concerning LRFD issues.
  - e) Design/Build Unit
    - i) Prepares procurement documents for design/build projects.
    - ii) Provides design oversight for design/build projects.
- 2) Standards, Research, and Automation Section  
Responsible for development of standards and design aids, managing research studies pertaining to bridges, and supporting computing needs in the office.
- a) Bridge Standards Unit
    - i) Provides design aids and standards for the office and for consultants, counties, and cities.
    - ii) Provides oversight for research projects, which involve the Bridge Office.
  - b) Information Resource Management Unit
    - i) Coordinates the development of computer programs with data processing systems.
    - ii) Supports computer users throughout the office and manages the local area network.
    - iii) Maintains design and drafting software and provides support to users in the office.

### 3) Bridge Planning and Hydraulics Section

Responsible for program, cost estimates, preliminary bridge plan activities for Trunk Highways and review of state aid bridges. Also, responsible for providing statewide hydraulic engineering services that include design, construction and maintenance activities. In addition, the section provides leadership in the development and implementation of hydraulic automation technology, establishes policy pertaining to hydrology and hydraulics, prepares design aids, provides client training, participates in research projects, and represents the department on state and national committees.

#### a) Agreements and Permits Unit

- i) Selects and negotiates with consulting engineers and administers engineering agreements for the preparation of bridge plans.
- ii) Provides liaison between the Bridge Office and the consulting engineer retained to prepare bridge plans.
- iii) Coordinates public and private utility requirements for bridges.

#### b) Preliminary Plans Unit

- i) Conducts preliminary studies from layouts and develops preliminary bridge plans.
- ii) Provides liaison with District and Central Office road design through the design stage.
- iii) Obtains required permits from other agencies for bridges.

#### c) Hydraulics Unit

- i) Develops and maintains Drainage Manual, standards and specifications related to drainage design and products for use by Mn/DOT and other agencies.
- ii) Provides technical assistance to Districts on all aspects of drainage design.
- iii) Provides bridge and culvert waterway designs for trunk highway projects. Conducts channel surveys for requested waterway bridges.
- iv) Analyzes and evaluates bridges for scour, monitors bridges for scour during floods, and provides training and support for scour monitoring.
- v) Provides technical assistance to counties and municipalities upon request.
- vi) Provides training in hydrology and hydraulics.
- vii) Reviews and prorates cost of storm drains on the municipal and county state aid system.
- viii) Develops, implements, and supports a hydraulic information system to facilitate the sharing of hydraulic data among all users and stakeholders.

- d) Programs and Estimates Unit
  - i) Prepares preliminary, comparative, and final cost estimates.
  - ii) Maintains and provides current program and plan status records.
- 4) Bridge Construction and Maintenance Section

Responsible for bridge construction and maintenance specifications, and bridge construction and maintenance advisory service activities to the office and to the job site.

  - a) Construction and Maintenance Unit; North, Metro and South Regions
    - i) Provides construction and maintenance advisory service to bridge construction and maintenance engineers in the field.
    - ii) Writes bridge construction and maintenance specifications, manuals and bulletins.
    - iii) Writes and maintains the file of standard current special provisions for bridge construction and maintenance.
    - iv) Performs preliminary, periodic and final review of bridge construction and maintenance projects and makes recommendations.
    - v) Reviews bridge plans and special provisions prior to lettings and makes constructability recommendations.
    - vi) Aids municipal and county engineers with bridge construction and maintenance problems, upon request.
    - vii) Provides foundation design including selection of pile type, length, design load, and foundation preparation.
    - viii) Reviews bridge rehabilitation, improvement, and preservation projects and prepares recommendations for scope of work.
    - ix) Aids the Districts in prioritizing upcoming bridge related projects.
    - x) Develops and provides bridge construction trainings for District, county, and municipal bridge construction inspectors.
  - b) Bridge Ratings Unit
    - i) Makes bridge ratings and load postings analysis for new and existing bridges and maintains the records.
    - ii) Reviews and approves special load permit requests.
  - c) Structural Metals Inspection Unit
    - i) Provides inspection services for structural metals, fabrication and assembly to ensure conformity with plans and specifications.

- d) Fabrication Methods Unit
  - i) Reviews and approves structural metals shop drawings submitted by fabricators.
  - ii) Provides fabrication advisory service to designers, fabricators and field construction and maintenance personnel.
  - iii) Provides overhead sign design services to the Office of Traffic Engineering, including the design of bridge-mounted sign trusses.
- e) Bridge Data Management Unit
  - i) Maintains inventory and inspection data for the 19,600 bridges in Minnesota. Works with all agencies to make certain appropriate data is collected.
  - ii) Responsible for implementing bridge management systems to provide information on bridges for maintenance, repair, rehabilitation and replacement.
- f) Bridge Inspection Unit
  - i) Provides expert assistance to the Districts in organizing and conducting inspections of complex bridges, special features, and fracture critical bridges.
  - ii) Conducts quality assurance inspections of all agencies responsible for bridge inspections in Minnesota.
  - iii) Reviews, recommends and provides bridge inspection training for District, county, and municipal bridge inspectors.

For more information, visit the Bridge Office Web site at:  
<http://www.dot.state.mn.us/bridge/>.

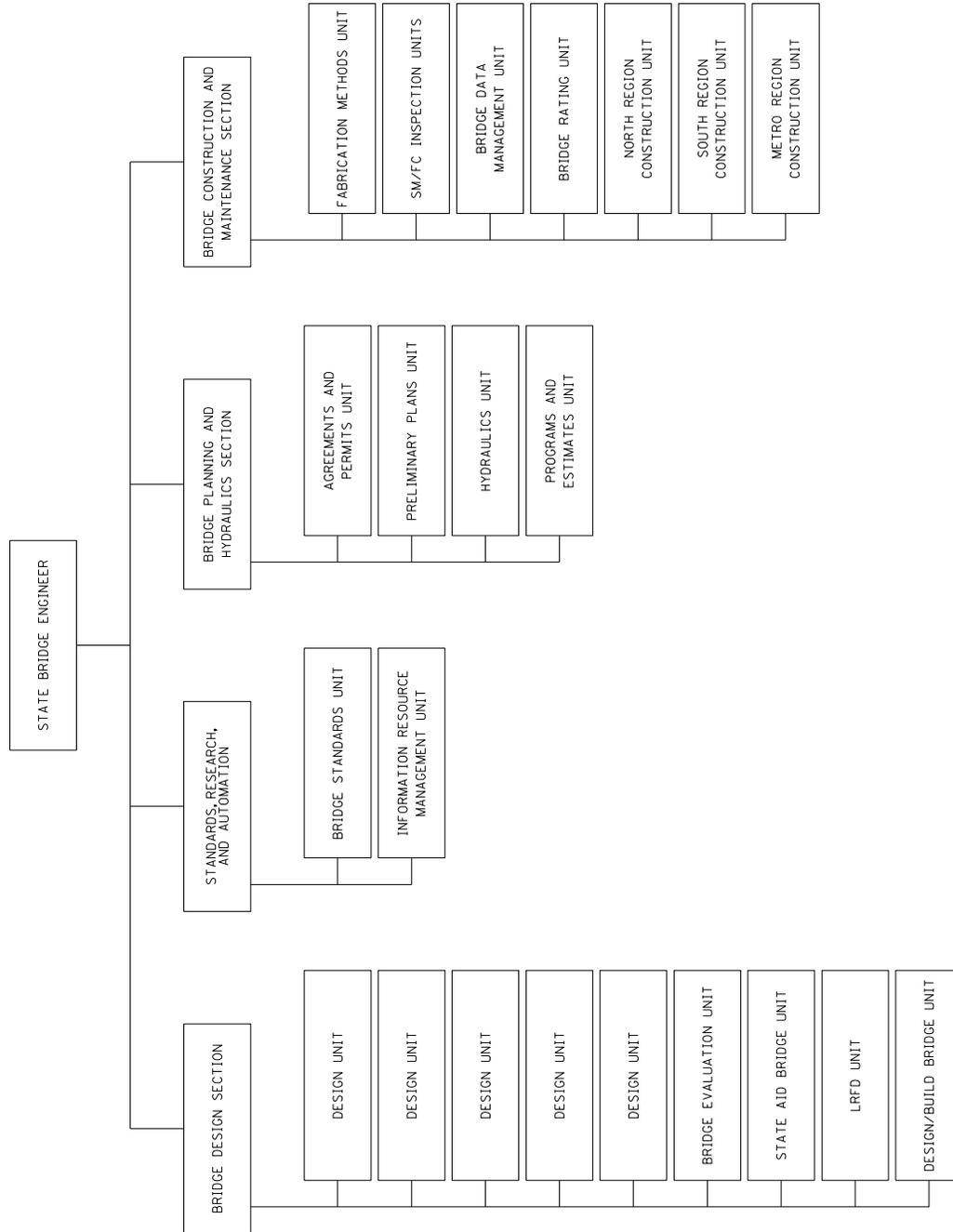


Figure 1.2.1.1  
Mn/DOT Bridge Office Organization Chart



Mn/DOT BRIDGE OFFICE ORGANIZATION CHART

BRIDGE OFFICE



### **1.2.2 Highway Systems**

Highways throughout the nation are divided into systems. These system designations are important to know because design standards can vary between the systems. The various highway systems are classified according to the Agency that has responsibility for their improvement, maintenance and traffic regulation enforcement. Listed below are the jurisdictional divisions in Minnesota:

1) Trunk Highway System

The Trunk Highway System consists of all highways, including the Interstate routes, under the jurisdiction of the State of Minnesota. These routes generally are the most important in the state, carry the greatest traffic volumes, and operate at the highest speeds.

2) County Highway System

The County Highway System is made up of those roads established and designated under the authority of the county board. They generally are the more important routes within a county that are not on the Trunk Highway System.

3) Township Road System

The Township Road System is made up of the roads established under the authority of the town board. They generally are of local importance.

4) Municipal Street System

The Municipal Street System is all roads within a municipality not designated as a trunk highway or county road. They are generally of local importance.

### **1.2.3 Bridge Numbers**

All publicly owned bridges, either on or over a trunk highway, that are 10 feet or more in length measured along the centerline of the highway, are assigned a number for identification and cost accounting purposes.

The numbering scheme followed in assigning bridge numbers depends on the time of construction. With few exceptions, the numbering procedure is as follows:

1) Prior to about 1950, all bridges were numbered consecutively from 1 to 9999 as they were constructed. The 8000 series was used for culverts over 10 feet in length (measured along the centerline of the highway). The 7000 series was reserved for county bridges at trunk highway intersections. Five-digit bridge numbers beginning with L or R designate bridges in local bridge systems.

2) Since about 1950, a five-digit number has been assigned to each bridge as it was constructed. The first two digits coincide with the county number (01-87) in which the bridge is located (99 refers to temporary bridges). The last three digits are assigned consecutively using the following guidelines:

- a. 001-499 are used for regular trunk highway bridges.
  - b. 500-699 are used for county bridges.
  - c. 700-999 are used for interstate bridges (any bridge on or over the interstate system).
- 3) In 1991, additional numbers were required for bridges on the state aid system in Hennepin County and for interstate bridges in Hennepin County. To allocate more numbers for bridges on the local system an alpha character is used as the third character of the bridge number. For example, the next bridge number after Bridge No. 27699 will be Bridge No. 27A00. Note that this happens only after 500 and 600 series have been exhausted.

To allocate more numbers on the Interstate road system, the 400 series of numbers will be used along with the 700, 800, 900's presently used. For a bridge number *XXYZZ*, the following now applies:

- XX = County identification number (99 = Temporary Bridge)
- Y = 0, 1, 2, 3, or R, T, U (for Trunk Highway Bridges)
- Y = 4, 7, 8, 9, or V, or W (for Interstate Bridges)
- Y = X and Y (Trunk Highway or Interstate Culverts)
- Y = 5 or 6 or A through H (for non-trunk highway Bridges)
- Y = J through N, and P, Q (for non-trunk highway Culverts)
- ZZ = Sequence number (00 through 99)

As of September, 2006, the following numbering scheme was added for:

- Bridges or culverts without a highway over or under (e.g. pedestrian trail over stream)
- Existing bridges that have not been assigned a bridge number
- Skyways and other miscellaneous structures such as conveyors, pipelines, or buildings

Use the format **RZZZZ** where:

- R = A literal character
- ZZZZ** = Sequence number (0000 thru 9999)

- 4) In cases of twin bridges, a westbound or southbound lane bridge is generally assigned a lower number than an eastbound or northbound lane bridge.

All bridge numbers are assigned by the Bridge Office. A complete listing of all numbered bridges is available in computer printout form entitled "Minnesota Trunk Highway Bridge Log- Statewide Listing". See Table 1.2.3.1 for a listing of the county identification numbers.

**Table 1.2.3.1 Minnesota County Identification Numbers**

County No.	County Name	District
01	Aitkin	1 & 3
02	Anoka	Metro
03	Becker	4
04	Beltrami	2
05	Benton	3
06	Big Stone	4
07	Blue Earth	7
08	Brown	7
09	Carlton	1
10	Carver	Metro
11	Cass	2 & 3
12	Chippewa	8
13	Chisago	Metro
14	Clay	4
15	Clearwater	2
16	Cook	1
17	Cottonwood	7
18	Crow Wing	3
19	Dakota	Metro
20	Dodge	6
21	Douglas	4
22	Faribault	7
23	Fillmore	6
24	Freeborn	6
25	Goodhue	6
26	Grant	4
27	Hennepin	Metro
28	Houston	6
29	Hubbard	2
30	Isanti	3
31	Itasca	1, 2 & 3
32	Jackson	7
33	Kanabec	3
34	Kandiyohi	8
35	Kittson	2
36	Koochiching	1 & 2
37	Lac Qui Parle	8
38	Lake	1
39	Lake of the Woods	2
40	Le Sueur	7
41	Lincoln	8
42	Lyon	8
43	McLeod	8
44	Mahnomen	2 & 4

County No.	County Name	District
45	Marshall	2
46	Martin	7
47	Meeker	8
48	Mille Lacs	3
49	Morrison	3
50	Mower	6
51	Murray	8
52	Nicollet	7
53	Nobles	7
54	Norman	2
55	Olmsted	6
56	Otter Tail	4
57	Pennington	2
58	Pine	1
59	Pipestone	8
60	Polk	2
61	Pope	4
62	Ramsey	Metro
63	Red Lake	2
64	Redwood	8
65	Renville	8
66	Rice	6
67	Rock	7
68	Roseau	2
69	St. Louis	1
70	Scott	Metro
71	Sherburne	3
72	Sibley	7
73	Stearns	3
74	Steele	6
75	Stevens	4
76	Swift	4
77	Todd	3
78	Traverse	4
79	Wabasha	6
80	Wadena	3
81	Waseca	7
82	Washington	Metro
83	Watonwan	7
84	Wilkin	4
85	Winona	6
86	Wright	3
87	Yellow Medicine	8

**1.2.4 Limit States to Consider in Design**

Bridge designs shall typically consider Strength, Service, Extreme Event, and Fatigue limit states. The limit state checks will vary with the component under consideration. Not all elements will require consideration of all limit states. For example, the fatigue limit state need not be considered for concrete deck slabs in multigirder applications.

**1.3 Procedures**

This section covers the Bridge Office procedures for checking of bridge plans, scheduling of projects, and revising or creating standards.

**1.3.1 Checking of Mn/DOT Prepared Bridge Plans**

The general practice of most engineering offices is to require that designs they produce be checked before they are reviewed and certified by the "Engineer in Responsible Charge". Although this practice has always been required for structures designed for Mn/DOT, it is recognized that the quality of the checking process often varies according to time restraints, confidence in the designer, and the instructions given to the checker. Therefore, in order to maintain a consistent design checking process the following guidance is given for routine bridge designs.

For more complex or unusual designs, the checker is advised to discuss additional requirements with the design unit leader. Also, the checking process described is not meant to apply to the check or review functions required for Mn/DOT review of consultant plans (see Section 1.3.2.) or for construction false work reviews. (See the Bridge Construction Manual.)

Three types of design checking will apply:

- 1) An independent analysis of the completed design.
- 2) A check of original design computations for mathematical accuracy, application of code, and accepted engineering practice.
- 3) A review of drafted details for constructibility and accepted engineering practice.

Generally, an independent analysis to confirm the adequacy of the complete design is preferred. Significant differences should be discussed and resolved before the plan is certified. The separate set of calculations should be included with the design file as a record of the completed design check.

When circumstances prevent a complete independent analysis, as a minimum, an independent analysis shall be completed for the following:

- 1) Live and dead loads
- 2) Controlling beam lines
- 3) A pier cap

- 4) A pier footing
- 5) Main reinforcement for high abutments
- 6) An abutment footing

However, for the elements not independently analyzed, the original computations should be checked for mathematical accuracy of original design computations, applications of code, and accepted engineering practice. Checked computations should be initialed by the checker, and the independent analysis should be included in the design file.

When doing a separate analysis, the checker may make simplifying assumptions to streamline the checking process. However, when major differences are found, results must be discussed and resolved with the designer. For instance, for normal piers, piling might be analyzed for dead and live loads only if lateral loads appear to have been reasonably applied in the original computations or the "AISC Beam Diagram and Formula Tables" may be used to approximate pier cap moment and shear.

Whether the check is a completely independent analysis or a minimal analysis combined with a computations check, some details, such as the reinforcing details in a wall corner, also require review by the checker. Often referencing old bridge plans with similar details allows the checker to compare the current design to details that have performed well in the past.

### ***1.3.2 Checking of Consultant Prepared Bridge Plans***

Consultant prepared bridge plans are created by private engineering firms through contracts with the Department or other government agencies. The finished plans are complete to the extent that they can be used for construction.

The Engineer of Record is responsible for the completeness and accuracy of the work. Final design calculations and plan sheets must be completely checked and reconciled prior to submittal. Review comments from the State do not relieve the Engineer of Record of the responsibility for an accurate and complete bridge plan.

Since these plans receive the signature of the State Bridge Engineer, there must be assurance that the plans are geometrically accurate and buildable; structural design is adequate and design codes have been correctly applied; proper direction is given to the construction contractor; and all construction costs are accounted for. Plan errors may cause costly construction delays or safety may be compromised by an inadequate design.

To keep consultant plan reviews consistent and timely, a procedure was developed as a guide that assigns priority to specific items in the plans. The overall review includes "a Thorough Check" and "Cursory Review" of various items. The distinction between "Thorough Check" and "Cursory Review" is as follows:

Thorough Check refers to performing complete mathematical computations in order to identify discrepancies in the plans, or conducting careful comparisons of known data and standards of the Project with values given in the plan.

Cursory Review refers to a comparative analysis for agreement with standard practice and consistency with similar structures, all with application of engineering judgment. Mathematical analysis is not required, but may be deemed necessary to identify the extent of a discrepancy.

The review procedure is listed on the CONSULTANT BRIDGE PLAN REVIEW form following this section. Headings on this list are defined as follows:

**PARTIAL PLAN:** In order to assure that the consultant is proceeding in the right direction, an early submittal of the plan is required. This submittal usually consists of the General Plan and Elevation sheet showing the overall geometry of the structure and the proposed beam type and spacing; the Bridge Layout Sheet; the Framing Plan sheet; and the Bridge Survey sheets. Errors and inconsistencies found in this phase can be corrected before the entire plan is completed. For example, a framing plan, including the proposed beams, must be assured as workable on the partial plan before the consultant gets deep into the design of the remainder of the bridge.

**FINAL PLAN:** A final plan should be complete in all areas to the extent that it can be certified by the designer, although a certification signature is not required for this phase.

**THOROUGH CHECK:** Items indicated for checking on the consultant's partial plan must be correct. Given geometry must fit the roadway layout. Most of this information can be checked using data from the approved preliminary plan. Approval of the partial plan will indicate that Mn/DOT is satisfied with the geometry and proposed structure, and the consultant may proceed with further development of the plan. For the final plan, obvious drafting and numerical errors should be marked to

point out the errors to the consultant; however, the reviewer should not provide corrections to errors in the consultant's numerical computations. Checking on the final plan should be thorough to eliminate possible errors that may occur, such as the pay items in the Schedule of Quantities. Plan notes and pay items can be difficult for a consultant to anticipate because of frequent changes by Mn/DOT. Pay items must be correct because these are carried throughout the entire accounting system for the Project. Plan (P) quantities must also be correctly indicated.

**CURSORY REVIEW:** Normally, a cursory review would not require numerical calculations. This type of review can be conducted by reading and observing the contents of the plan in order to assure the completeness of the work. The reviewer should be observant to recognize what looks right and what doesn't look right. Obvious errors or inconsistencies on any parts of the plan should be marked for correction.

Although structural design is usually the major focus of any plan, most consultants are well versed in design procedures and should need only minimal assistance from the Bridge Office. A comparison of the consultant's calculations with the plan details should be performed to assure that the plans reflect their design and that the applicable codes are followed. An independent design by the Bridge Office is time consuming and is not recommended unless there is a reasonable doubt as to the adequacy of the consultant's design.

**NO REVIEW:** A thorough review of these items would be time-consuming and may not produce corrections that are vital to construction; therefore, it is recommended that little or no time be spent on the listed items. Numerous errors can occur in the Bills of Reinforcement and quantity values. However, checking this information is also time-consuming, hence the burden of providing correct data should be placed on the consultant.

## CONSULTANT BRIDGE PLAN REVIEW

Br. No. \_\_\_\_\_ RTE \_\_\_\_\_ DATE: PARTIAL PLAN REC'D. \_\_\_\_\_ DATE FINAL PLAN REC'D. \_\_\_\_\_  
 DESIGN GROUP \_\_\_\_\_ CONSULTANT \_\_\_\_\_  
 No. OF SHEETS IN PLAN \_\_\_\_\_ DESCRIBE COMPLEXITY \_\_\_\_\_  
 EST. REVIEW TIME BY DESIGN GROUP \_\_\_\_\_(hrs.) ACTUAL REVIEW TIME \_\_\_\_\_(hrs)

PARTIAL PLAN		FINAL PLAN	
THOROUGH CHECK		THOROUGH CHECK	
	Horizontal and vertical clearances		Pay items and plan quantities
	Stations and elevations on survey line		Project numbers
	Deck and seat elevations at working points		Design data block & Rating on GP&E sheet
	Deck cross-section dimensions		Job number
	Working line location and data		Certification block
	Coordinates at working points and key stations		Standard plan notes
	Substructure locations by station		Concrete mix numbers
	Framing Plan		Construction joint locations
	Conformance to preliminary plan		Prestressed beam design if inadequate design is suspected
	Design loads		Bridge seat elevations at working points
			Utilities on bridge
			Existing major utilities near bridge
		<b>CURSORY REVIEW</b>	
			Steel beam splice locations and diaphragm spacing; flange plate thickness increments (enough to save 800+ # of steel)
			Abutment and Pier design to be checked against consultant's calculations
			Conformance to foundation recommendations.
			Pile loads and earth pressures. Check against consultant's calculations.
<b>CURSORY REVIEW</b>			
	Proposed precast beams [per p.5-29]		Rebar series increments (min. 3")
	Precast conformance to industry standards		Interior beam seat elevations
	Proposed steel beam sections		Bottom-of-footing elevations (for adequate cover)
			Railing lengths and metal post spacing (check for fit)
			Use of B-details and standard plan sheets
			Conformance to aesthetic requirements
			Notes – General, construction, reference, etc.
			Quantity items on tabulations
			Precast beam design (Check against consultant's calculations)
		<b>NO CHECK OR REVIEW REQUIRED</b>	
			Diagonals on layout sheet
			Figures in Bills of Reinforcement
			Bar shapes and dimensions
			Rebar placement dimensions
			Bar marks on details against listed bars
			Quantity values (including total of tabulations)

**1.3.3 Peer Review  
for Major or  
Specialty Bridges**

Major bridges are generally defined as bridges containing spans 250 feet and greater in length. A major or specialty bridge may be determined by its type of design, including overall size (length, width, span length, or number and configuration of spans), cost, complexity, feature crossed, security concerns, pier size or shape, or unusual site or foundation conditions. Additionally, the Bridge Design Engineer may elect to require a peer review for unique bridge types. The bridge type will be evaluated by the Preliminary Plans Engineer and the Bridge Design Engineer to determine if it should be considered a major or specialty bridge. Upon concurrence with the State Bridge Engineer, a notation of "Major Bridge" or "Specialty Bridge" will be indicated on the approved preliminary plan. For major bridges designed by consultants, Mn/DOT will require an independent peer review of the design by a second design firm.

Peer review requirements will be described in the Request for Proposal for consultants.

An exception to this requirement is steel plate girder bridges, where review will continue to be performed by in-house design units. See the Bridge Design Engineer for consultation on these requirements.

Once the determination has been made that a particular bridge falls into the category of "Major Bridge" or "Specialty Bridge," an independent design review will be required as part of the original design. This design review may be performed by either in-house Bridge Office staff qualified to review the particular type of design, or by a consultant. Specific design elements for review will be detailed in each contract.

The Engineer of Record is responsible for the completeness and accuracy of the work. Final design calculations and plan sheets must be completely checked and reconciled prior to submittal. Review comments from the State or Peer Reviewer does not relieve the Engineer of Record of the responsibility for an accurate and complete bridge plan. The Engineer of Record will cooperate with the Peer Reviewer as part of the project team.

The Peer Reviewer will participate as part of the project team from the beginning of design to understand the assumptions and develop a relationship with the Engineer of Record.

The following stages of design will be reviewed by the Peer Reviewer for concurrence:

- Design and Load Rating Criteria: Design specifications, construction specifications, design loads and load combinations, construction loads for design, materials and allowable stresses, foundation type, factored pile resistance and resistance factors, and permit trucks.
- Concept Design: Bridge geometrics, typical sections and dimensions, component sizes, framing plan, location and type of expansion joints, location and type of bearings, computer models for girder design, construction staging, construction sequence, river foundation report, vessel impact study, and outline of special provisions.
- Superstructure Final Design: Independent calculations and design; method of analysis (line girder or three dimensional); modeling assumptions; composite and non-composite section properties, member capacities, dead load and live load moments, shears, and stresses at 1/10th points along girder lines, all primary connections and other points of interest; dead and live load deflections; deck design; deck stresses; and deck pour sequence.
- Substructure Final Design: Independent calculations and design, assumptions, points of fixity, cofferdam design, and pier design and details.
- Constructability: Shipping limitations, erection sequence and stability issues, crane sizes and boom lengths, construction overhead clearances, interference/restrictions on construction due to site conditions, shoring tower locations, falsework review.
- Plan: adequacy of construction plans and specifications provided to contractor.
- Load Rating: Independent load rating analysis, rating for moment and shear at 1/10<sup>th</sup> points and any other points of interest of each span.

For each of the stages of design listed above, the Peer Reviewer will submit a Summary of Review Comments, which will be kept by the Peer Reviewer and will verify that the design is feasible and adequately incorporates the Design and Load Rating criteria and Concept Design parameters. The Peer Reviewer may recommend modifications that improve cost-effectiveness or constructability of the design along with Summaries of Review Comments for Design and Load Rating criteria and Concept Design.

The Peer Reviewer will perform reviews at the 30% (Concept Design), 60% (Final Design), and 95% (Plan/Constructability and Load Rating) completion stages using independent design computations as required.

The Peer Reviewer will conduct the final design review without the aid of the original design calculations. The Peer Reviewer will use structural design/analysis software different than that used in the original design—when available—by the Engineer of Record. This will result in a separate set of design calculations—performed by the Peer Reviewer—that will be documented in a report that will be certified. The report will then be compared to the original design performed by the Engineer of Record. The Peer Reviewer will note any changes or recommendations and provide the results to Mn/DOT for review.

The results of the peer review will determine that the design and plans are in compliance with design standards and the established design criteria. The Bridge Design Engineer will resolve issues with the Engineer of Record and Peer Reviewer.

**1.3.4 Schedule for Processing Construction Lettings**

To meet the Department’s schedule requirements for construction lettings, the following schedule for processing bridge plans, special provisions and estimates must be followed. This schedule applies to all projects: Federal Aid, State Funds and Maintenance. In general, processing of bridge plans, special provisions, and estimates for lettings shall be given priority over all other work, and every effort must be made to complete the processing in advance of the times shown, which are deadlines.

**Table 1.3.4.1  
Schedule and Deadlines for Bridge Project Submittal**

Schedule and Remarks	Deadline Time Before Letting Date		
	Federal Project (Full Oversight)	Federal Project	State Project
Final plan and special provisions to 95% completion level.	14 Weeks (Friday)	14 Weeks (Friday)	12 Weeks (Friday)
Preliminary bridge pay items, special provisions, and quantities to Bridge Estimates Unit	13 Weeks (Friday)	13 Weeks (Friday)	11 Weeks (Friday)
Bridge special provisions review complete (by Bridge Construction Unit)	13 Weeks (Friday)	13 Weeks (Friday)	11 Weeks (Friday)
Bridge special provisions completed and sent to Special Provisions & Final Processing Unit (Technical Support)	12 Weeks (Friday)	12 Weeks (Friday)	10 Weeks (Friday)
Bridge plans certified and given to Information Resource Management Unit for dating and distribution to Office of Technical Support	12 Weeks (Friday)	12 Weeks (Friday)	10 Weeks (Friday)
Final bridge pay items and quantities to Bridge Estimates Unit	12 Weeks (Friday)	12 Weeks (Friday)	10 Weeks (Friday)
Final Engineer’s estimate to Cost Estimation Unit (Technical Support)	during 10th week	during 8th week	during 8th week
Latest date for final bridge plan to Special Provisions & Final Processing Unit (Technical Support)	9½ weeks (Tuesday)	8 weeks (Friday)	8 weeks (Friday)

**Table 1.3.4.1  
Schedule and Deadlines for Bridge Project Submittal (Continued)**

Schedule and Remarks	Deadline Time Before Letting Date		
	Federal Project (Full Oversight)	Federal Project	State Project
PS&E package for authorization request to Division Office FHWA	8 <sup>1</sup> / <sub>2</sub> weeks (Tuesday)	7 weeks (Friday)	N/A
Final advertisement	5 Weeks (Friday)	5 Weeks (Friday)	5 Weeks (Friday)
Sale of plans and proposals	4 Weeks (Friday)	4 Weeks (Friday)	4 Weeks (Friday)
Last date for mailing letter addendums by Special Provisions & Final Processing Unit (Technical Support)	10 days (Wednesday)	10 days (Wednesday)	10 days (Wednesday)

**1.3.5 Bridge  
Project Tracking  
System**

Completing a bridge design project for contract letting is a multiple step process that involves input from a variety of work units and personnel. Projects are tracked by Mn/DOT using the Program and Project Management System (PPMS). Within PPMS, projects are divided into activities and the activities are further divided into work tasks. For example, Activity 1260 is "Preliminary Structure Plans" and Work Task 2 of Activity 1260 is "Draft Preliminary Bridge Plan". Progress of the work tasks on active bridge projects is updated monthly.

Following are tables that list work tasks for the major bridge activities within PPMS. Table 1.3.5.1 contains a listing of the PPMS work tasks for Activity 1260, "Preliminary Structure Plans". Tables 1.3.5.2 and 1.3.5.3 contain listings of the PPMS work tasks for Activity 1270, "Final Structure Plans".

For more information on activities and work tasks within PPMS, refer to the PPMS Activity Manual located on the Mn/DOT internal web site at <http://ihub.ots/projdev/pmu/ppms/>.

**Table 1.3.5.1  
PPMS Work Tasks for Mn/DOT or Consultant Prepared Preliminary  
Bridge Plans (Activity 1260)**

Number	Work Task	Percent of Activity Completed
1	Receive and review information (grades, alignment, surveys, layout, Hydraulics report, Project Design Memo., Environmental report)	15%
2	Draft Preliminary Bridge Plan	60%
3	Check Preliminary Bridge Plan	75%
4	Prepare Aesthetics Recommendation	80%
5	Receive and Plot Borings	85%
6	Receive Foundation Recommendations from Regional Bridge Construction Engineer	88%
7	Obtain State Bridge Engineer's Signature	90%
8	Distribute Signed Plans & Distribute Responses on Need for Signs, Lighting, TMC	91%
9	Preliminary Estimate and District Letter	95%
10	Obtain FHWA Approval	99%
11	Turn Over and Meet with Final Design	100%

**Table 1.3.5.2  
PPMS Work Tasks for Mn/DOT Prepared Final  
Bridge Plans (Activity 1270)**

Number	Work Task	Percent of Activity Completed *
1	Receive Preliminary Bridge Plan, Final Repair Recommendation, or Special Structure Request	5%
2	Receive District Design Information (Signal, Lighting, Signing, TMS, etc.)	10%
	Receive Utility Information	
	Receive Stage Construction Sheets	
3	Establish Geometrics	20%
4	Conduct Analysis and Design, Including Check	45%
5	Draft and Check Plan Sheets	75%
	Incorporate Standard Detail Sheets	
6	Construction Unit Review	80%
7	Figure Quantities	85%
8	Send Informational Copies to FHWA and District	88%
9	Final Check of Plan Set by Unit Leader	90%
10	Frame Special Provisions	95%
11	Final Revisions and Check of Plan Set	99%
12	Obtain State Bridge Engineer's Signature	100%

\* May vary by job complexity.

**Table 1.3.5.3  
PPMS Work Tasks for Consultant Prepared Final  
Bridge Plans (Activity 1270)**

Number	Work Task	Percent of Activity Completed
1	Consultant Kick-Off Meeting	25%
2	Partial Plan Delivery and Review	45%
3	Final Plan Delivery and Review	85%
4	Submit for Signature	100%

A listing of the work type codes used in PPMS is given in Table 1.3.5.4.

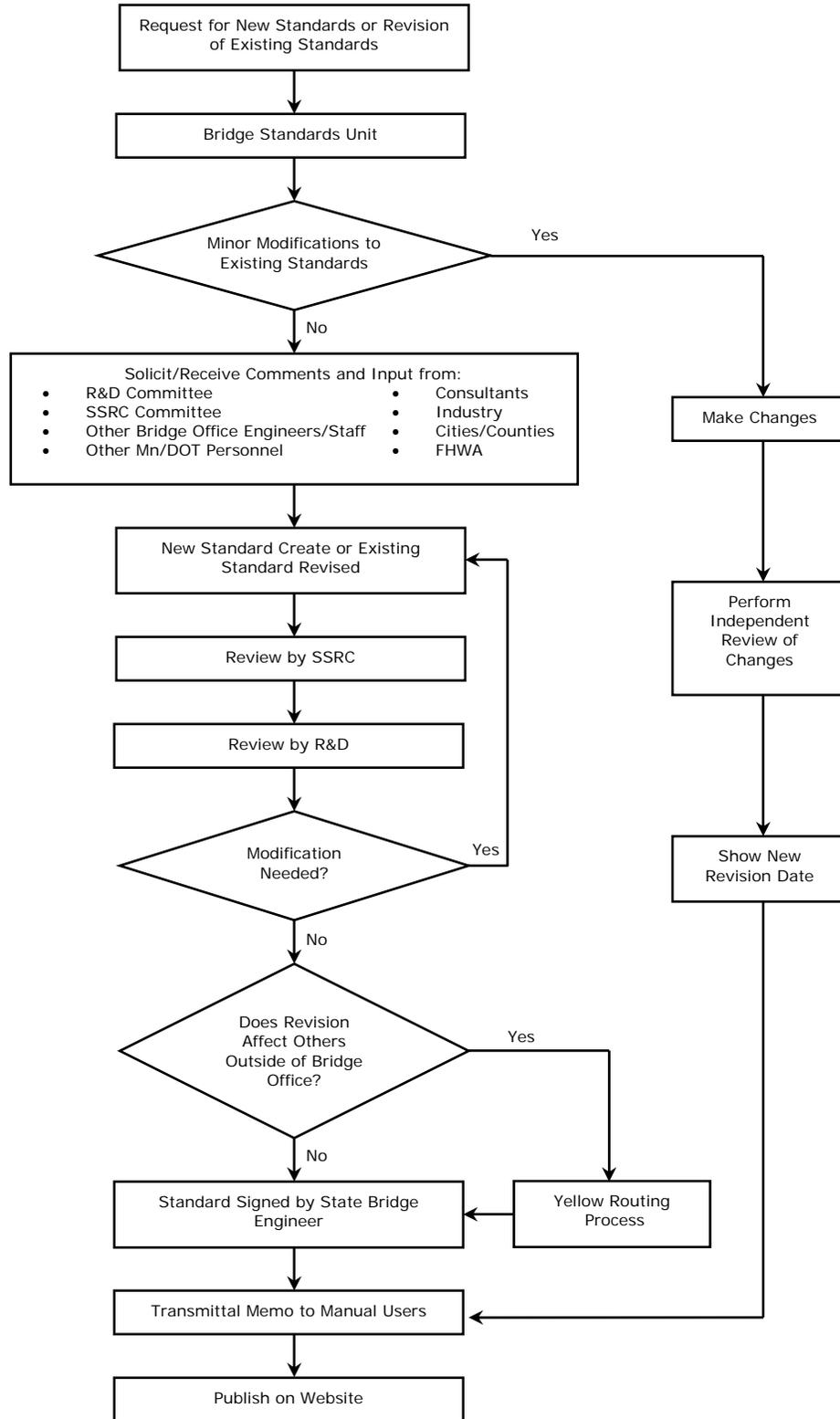
**Table 1.3.5.4**  
**PPMS Bridge Work Type Codes**

<b>Work Type</b>	<b>Description</b>
01	New Bridge
1A	New Bridge (Phase 1) (Early Steel or Stage Construction)
1B	New Bridge (Phase 2)
02	Culvert
2X	Culvert Extension
2B	Concrete Arch
03	Temporary Bridge
04	Pedestrian Bridge
05	Renovation
06	Widen w/Substructure Work
6A	Widen w/Substructure Work (Phase 1) (Early Steel or Stage Constr.)
6B	Widen with Substructure Work (Phase 2)
6T	Temporary Widening
07	Widen without Substructure Work
08	Bridge Length/Short
09	Replace Deck
10	Deck Overlay
11	Replace Railing or Median Barrier
12	Bridge Painting
13	Substructure Repair
14	Remove Bridge
15	Miscellaneous
16	Raise Bridge
17	Replace Superstructure - No Preliminary Plan Required
18	Repair Railing or Median Barrier
19	Replace Joints
20	Deck Repair
21	Rehab or Replace
23	Widen without Substructure Work & Replace Deck
24	Widen without Substructure Work & Deck Overlay
25	Widen without Substructure Work, Deck Overlay & Paint
26	Widen without Substructure Work & Other Minor Work
27	Widen without Substructure Work & Paint
28	Replace Deck & Paint
29	Replace Deck & Other Minor Work
31	Deck Overlay & Replace Railing or Median Barrier
32	Deck Overlay, Replace Railing or Median Barrier & Paint
33	Deck Overlay & Other Minor Work

**Table 1.3.5.4**  
**PPMS Bridge Work Type Codes (Continued)**

<b>Work Type</b>	<b>Description</b>
35	Deck Overlay & Paint
37	Replace Railing or Median Barrier & Paint
38	Replace Railing or Median Barrier & Other Minor Work
39	Paint & Other Minor Work
40	Repair Railing or Median Barrier & Replace Joints
41	Widen without Substructure Work, Replace Deck & Paint
42	Replace Railing or Median Barrier & Replace Joints
44	Deck Repair & Replace Joints
45	Deck Overlay & Repair Railing or Median Barrier
46	Deck Overlay, Repair Railing or Median Barrier & Replace Joints
47	Deck Repair - Rail Rehab
48	Minor Work (Deck Repair, Paint, & Repair Railing or Median Barrier)
49	Deck Overlay, Paint & Repair Railing or Median Barrier
50	Retaining Wall
51	Parking Garage
52	Repair Concrete Arch
54	Riprap
58	Paint & Replace Joints
60	Widen with Substructure Work & Replace Deck
61	Widen with Substructure Work & Deck Overlay
62	Widen with Substructure Work, Deck Overlay & Paint
63	Widen with Substructure Work & Paint
64	Widen with Substructure Work, Replace Deck
66	Widen with Substructure Work & Replace Superstructure
68	Widen with Substructure Work & Replace Railing or Median Barrier
69	Miscellaneous Major
71	Deck Overlay & Replace Joints
91	Probably Bridge
92	Probably Culvert
98	Bridge Scoping
99	Bridge Study

**1.3.6 Approval Process for Standards**



**Figure 1.3.6.1**  
**Flowchart for Revising Bridge Standards (includes B-Details and Standards)**