Design Manual Revision Highlights

The following compilation will serve as a summary of presentation and policy changes that have been incorporated into the Design Manual effective January 25th, 1999.

PRESENTATION

The presentation and format of the Design Manual have undergone numerous enhancements. They are as follows:

The Design Manual is now a dual unit manual. The metric values are considered primary and the English units are presented parenthetically throughout the text. The metric figures are provided at the end of each chapter and the English figures are contained within Appendix A. The metric figures and the English figures are numbered identically.

All plan notes within the manual are accented in bold text, italicized, and indented from the body of the text.

The text of the manual is printed on both sides of the paper. The chapter title now appears on each page. The figures are still presented on only one side to maintain clarity and reproducibility. Generally, the figures are numbered sequentially as they appear in the text.

The previous Chapter 1 ABBREVIATIONS has been deleted. Chapters 2 through 8 have been renumbered accordingly. A new Chapter 8 REHABILITATION has been added to consolidate all material pertinent to bridge rehabilitations and widenings. The previous Chapter 9 RETAINING WALLS has been incorporated into Chapter 12 and Chapters 10 through 13 have been renumbered accordingly.

The section reference system has been revised to eliminate lengthy section and subsection numbers. Pagination of the manual occurs per chapter rather than continuously through the manual.

A new preface, table of contents, and list of figures has been developed. The list of figures is now disassociated from the table of contents and includes all page numbers throughout the manual from which each figure is cited.

The GENERAL DRAWINGS, SUPERSTRUCTURES, and SUBSTRUCTURES chapters have undergone substantial reorganization. The reorganization includes, but is not limited to, the presentation of text and figures in a more logical order and a reduction of redundancy in the text.

A more comprehensive index has been developed with multiple cross references.

POLICY

Numerous policy changes, corrections, and clarifications have been incorporated into the Design Manual. These policy changes include all those that have been distributed via memoranda since the last Design Manual revision. Additional policy changes have also been included in the new manual and are effective as per the distribution memorandum.

The following policy changes are summarized below according to chapter. The number of the page on which the revision appears is located at the left margin, when applicable. Numbers followed by the designation "(f)" indicate that this revision applies to the figure, rather than the page.

Formerly **Chapter 1 ABBREVIATIONS**

This chapter has been deleted.

Chapter 1 PLAN PREPARATION (Formerly Chapter 2)

- Deleted figure for lettering guide.

1-3(f) Added drafting scales for MicroStation.

1-4(f) Added level symbology for MicroStation.

Chapter 2 DESIGN DATA (Formerly Chapter 3)

- Deleted Article 3-1-16, exception to AASHTO Standard Specification requiring that slip critical connections be designed as a Class 'C' surface.
- Moved Section 3-1-6 "Minimum Design Loads for Piles" to Chapter 7.

2-2 Revised embedment table to clarify "pier caps" and to correct embedment depths as per memoranda dated April 27th and 28th, 1999.

2-4 Added discussion of temporary construction loads required in the design of steel beams and girders and as per EDS memorandum dated May 29th,1997.

2-5 Revised weight of one bar metal rail with concrete parapet.

2-5 Added weight of two bar metal rail with concrete parapet.

2-6 Revised minimum equivalent fluid pressure for retaining wall design as per the request of the Soils and Foundation Section.

Chapter 3 MATERIALS (Formerly Chapter 4)

3-1 Corrected the required grade of reinforcing steel.

3-2 Clarified the table of chromated copper arsenate treatment for timber piles.

Chapter 4 PRELIMINARY DRAWINGS (Formerly Chapter 5)

- Deleted rod sounding data from General Drawing requirements.
- Removed note regarding metallized surfaces from the Preliminary General Drawing requirements.
- Deleted Article 5-1-6, “Method of Development”.

4-6,4-7 Replaced Sections 5-3 “Defense Department Drawings” and 5-4 “Navigation Lighting Sketches” with one section entitled “Coast Guard Permit Sketches”.

4-4(f) Replaced figure as an example culvert construction limit sketch as per errata memorandum dated May 27th, 1997.

Chapter 5 GENERAL DRAWINGS (Formerly Chapter 6)

- Deleted all duplicate requirements already itemized in Chapter 4, “Preliminary Drawings”.
- Compiled all General Drawing notes and provided brief descriptions of proper application.
- Removed qualification for payment of Unclassified Structure Excavation as per memorandum dated April 14th, 1998. The method of payment is no longer dependent upon the quantity shown on the plans.
- Removed notes regarding “Footings Subjected to Substantial Lateral Loads”.
- Deleted note pertaining to HS 15 loading.
- Introduced new examples of General Drawings.

5-1 Added verbiage to encourage the creation of a sound Preliminary General Drawing that can be easily transformed into the General Drawing.

5-3 Clarified that the “Strength Design Method” note shall be applied to all structures, rather than steel structures only.

5-3 Revised note to reference sheet SNSM for design data for metric projects.

5-5 Added note requiring all mild reinforcing steel in the deck to be epoxy coated in highly corrosive areas as per memorandum dated October 13th, 1997.

5-5 Revised note to disallow the use of Class AA concrete in drilled piers as per memorandum dated February 4th, 1998.

5-7 Revised computed foundation load for spread footings as per memorandum dated November 4th, 1998.

5-8 Added drilled pier notes regarding bearing capacity, skin friction, and tip bearing as per memorandum dated November 4th, 1998.

5-9 Added standard note to be used when temporary shoring is required and is to be included as a Structure pay item.

Chapter 6 SUPERSTRUCTURE (Formerly Chapter 7)

Numerous revisions have been made in this chapter and are therefore presented as related to the following general topics:

GENERAL

6-1 Added paragraph encouraging the use of continuous or continuous for live load structures. The use of joints is discouraged wherever practicable.

6-1 Added discussion on the elimination of bridge shoulder piers as per memoranda dated June 4th and June 16th, 1998.

6-1(f) Added figure for the "Bridge Superstructure Depth" chart as provided to the Roadway and Hydraulic Units as per memorandum dated June 4th, 1998.

DECK

6-2 Clarified that the grooving of approach slabs is only required for those approach slabs without an asphalt overlay.

6-5 Added direction that precast panels are not to be used with temporary barrier rail that must be positively attached or with sidewalks with drains.

6-5 Revised standard note regarding the use of precast panels for various skewed end conditions.

6-12 Added direction that a pour sequence should be specified for all continuous steel structures, regardless of pour quantity.

6-12 Added the requirement for a pour sequence for continuous for live load structures.

6-13 Added direction to space AASHTO Type V, VI , and Bulb Tee girders at 1830 mm (6 ft.) in lieu of 1220 mm (4 ft.) for closure pour or staged bays.

6-22 Provided guidance for the design of deck reinforcement for continuous for live load bridges with stay-in-place metal forms.

6-2(f) through 6-5(f):

Introduced new slab design charts to include the AASHTO Types V, VI , and Bulb Tee girders as per memorandum dated July 13th, 1998.

Revised slab design charts to ensure BBU depths occur in ¼" increments as per memorandum dated October 10th, 1997.

6-6(f) Added the maximum allowable overhangs for the AASHTO Types V, VI , and Bulb Tee girders.

6-11(f) Revised the skew limit charts for precast panels to include the AASHTO Types V, VI , and Bulb Tee girders.

6-41(f) Figure was added to provide the pour sequence and required construction joints located adjacent to the bent diaphragm for continuous for live load bridges.

6-73(f) Revised figure 6-73 to render the reinforcing steel cutoff points independent of the inflection points.

6-74(f) Added figure to facilitate the detailing of deck reinforcing steel for continuous for live load bridges detailed with stay-in-place metal forms.

MISCELLANEOUS

- Reduced seal weld size for numerous expansion joint cover plate details to reduce distortion as per Standard Drawing transmittal dated July 17th, 1998.
- Moved content of Section 7-2-2 "Approach Pavement Brackets" to Chapter 8.
- Revised the thickness of metallization on numerous expansion joint cover plate details as per memorandum dated July 2nd, 1997.
- Dispersed content of Section 7-2-8 "Medians on Bridges" to applicable new sections.
- Dispersed content of Section 7-2-11 "Deck Protection Systems" to applicable new sections.
- Deleted Section 7-4-3, "Composite Cast-in-Place Slab" intended for bridge widenings using cored slab units.

6-6 Added verbiage for bridge scuppers as required by the Hydraulics Unit and as per memorandum dated July 13th, 1998.

6-7 Clarified the reinforcing steel and dowel requirements in sidewalks.

6-20 Added statement that top of slab construction elevations for approach slabs should be determined at the top of the concrete surface for those approach slabs with an asphalt overlay.

6-12(f) Revised figure to include the weight of 22.23 mm (7/8") diameter bolts.

6-15(f) Revised metric dimensions for drain connector details to coincide with existing English dimensions.

6-16,17(f) Added figures for bridge scuppers as required by the Hydraulics Unit and as per memorandum dated July 13th, 1998.

BARRIER RAILS

- Deleted statement that Traffic Engineering is responsible for detailing the anchorage method for positively anchored temporary bridge rails.
- Deleted the reference to the Special Provision for epoxy coated reinforcing steel from multiple barrier rail figures.
- Deleted Figure 7-1, 6 of 10, as these details are duplicated in other figures.
- Deleted Figure 7-10 to disallow optional anchor assembly for one bar metal rail as per Standard Drawing Transmittal dated July 17th, 1998.

6-11,12 Revised the types of guardrail anchorage to be consistent with the new Roadway Standard Drawings. A discussion is provided that describes the most typical use of each type of guardrail anchorage.

6-35(f) Revised figure to replace the five bolt with a seven bolt guardrail attachment for the one bar metal rail.

6-35(f) Revised figure to allow an additional 45 mm (1½") outside parapet to facilitate slipforming.

EXPANSION JOINTS

- Clarified the selection process for expansion joint seals.

6-17,18 Added notes to reference Special Provisions for expansion joint seals, strip seals, and modular expansion joint seals.

PRESTRESSED CONCRETE GIRDERS

- Deleted discussion of strand release procedure for prestressed concrete girders.
- Deleted Section 7-3-7, "Girder Depths". In supporting the aim for continuous for live load bridges, girder sizes should not be stepped down unless necessary.

6-20 Added statement encouraging the routine use of concrete strengths up to 55.1 MPa (8,000 psi).

6-20 Added AASHTO Types V, VI , and Bulb Tee girders as available for design.

6-21 Added statement requiring the presence of two straight strands between the neutral axis and 150 mm (6") from the bottom of concrete girders as per memorandum dated October 11, 1995. Clarified that this requirement only applies to the AASHTO Types II, III, and IV girders.

6-21 Added standard note for reporting excessive uplift forces due to the presence of draped strands.

6-22 Provided recognition that stirrup extension from the top of prestressed concrete girders may have to be increased to accommodate larger anticipated cambers.

6-22 Decreased the minimum allowable buildup over prestressed concrete girders supporting metal stay-in-place forms from 65 mm (2½") to 50 mm (2").

6-68(f) Revised metric dimensions of the AASHTO Types II, III, and IV girders to more accurately match those of the English figures.

6-69(f) Revised metric dimensions of the AASHTO Types V, VI, and Bulb Tee girders dimensions to more accurately match those of the English figures.

6-70(f) Revised to match the details of the standard drawings.

6-71(f) Revised to match the details of the standard drawings.

6-76(f) Added depth of end bent diaphragms for AASHTO Types V, VI , and Bulb Tee girders.

6-78(f) Increased distance between the centerline of bearings at continuous for live load bents as per memorandum dated February 18th, 1998.

6-78(f) Added centerline bearing to bearing dimension for AASHTO Types V, VI , and Bulb Tee girders.

6-82(f) Increased diameter of formed hole for tie rod from 51 mm (2") to 76 mm (3") in prestressed concrete girders. The diameter of the washer was revised from 102 mm (4") to 127 mm (5") as per the memorandum dated February 18th, 1998.

STEEL GIRDERS

- Moved cover plate detail for rolled beams to Chapter 8 and added direction that this detail should only be considered when attempting to match existing beams on a bridge widening project.
- Dispersed the contents of Section 7-5-11, “Beam and Girder Depths”.

6-28 Clarified and expanded on the guidelines for economical design of welded plate girders as per memorandum dated October 1st, 1997. In particular, flange widths should be uniform within a field section whenever possible.

6-29 Added direction to encourage uniformity in diaphragm and connector plate sizes throughout a structure or project.

6-29 Revised policy that interior bent diaphragms shall be placed along the skew for skews between 70° and 110°. For all other skews, these diaphragms shall be placed perpendicular to the girders engaging a bearing stiffener as a connector plate.

6-30 Added direction that all intermediate diaphragms shall be placed normal to the girders regardless of skew.

6-30 Added standard note offering an optional diaphragm to the contractor as an option for deep girders erected over traffic.

6-31 Added direction that when bearing stiffeners are employed as connector plates, the plates should be detailed mill to bear at the bottom flange with fillet welds at both flanges. The fatigue stress range of this Category 'C' detail should then be checked as per memorandum dated January 13th, 1998.

6-31 Suggested that consideration be made for using a bent connector plate for skews outside the range of 45° and 135°.

6-32 Added section entitled "Bolted Field Splices" that designates the class of slip-critical connections to be used per grade of structural steel.

6-98(f) and 6-102(f) through 6-106(f):

Revised metric diaphragm figures to show a 9 mm connector plate.

6-95(f) through 6-97(f) and 6-101(f):

Revised clip dimensions in metric figures to match those of the English figures.

6-107(f) Added the optional diaphragm to be added to plans including plate girders greater than 1525 mm (60") in depth when traffic must be maintained beneath a bridge during its construction.

6-112(f) Omitted reference to tension and compression flanges in accordance with memorandum dated January 13th, 1998.

6-116(f) Added figure to provide bolted field splice details.

BEARINGS

6-38 Corrected the preformed bearing thickness under masonry plates from 2 mm to 5 mm.

6-38 Added direction to use 32 mm (1¼") sole plate unless a bevel or fill plates are required.

6-39, 40 Encouraged the use of 60 durometer hardness for elastomeric bearings and added an applicable standard note when 50 durometer will not suffice. The use of elastomeric bearings for steel girders is encouraged. The use of a fixed bearing assembly may be used in concert with elastomeric bearings when the design values for the elastomeric bearings are only exceeded at the fixed bearing locations.

6-40 Added requirement that both bearings within a continuous for live load bent diaphragm be detailed as fixed.

6-41 Added lateral load requirements for pot bearings as per memorandum dated February 24th, 1998.

6-41	Added statement that the bevel for pot bearing sole plates be indicated directly above the sole plate.
6-41	Added note requiring that the contractor adjust girder buildups to accommodate the 13mm (½") maximum permissible variation in pot bearing depth.
6-43	Corrected reference to standard drawings for anchor bolt gage for steel girders on elastomeric bearings.
6-43	Revised anchor bolt projection calculation for pot bearings.
6-43	Added statement requiring that the anchor bolt projection be consistent for each bent, presuming the calculated required projections do not vary by more than 30 mm (1"). This requirement does not apply to pot bearings.
6-44	Added section entitled "Field Welds" encompassing details for welding bearing plates.
6-112(f)	Omitted reference to tension and compression flanges in accordance with memorandum dated January 13th, 1998.
6-119(f)	Corrected total height of pot bearings to include 5 mm preformed bearing pad.

Chapter 7, "SUBSTRUCTURE" (Formerly Chapter 8)

7-1, 2	Clarified the requirements for anchor bolt and bearing plate clearances from the edge of bent caps and bridge seats.
7-1, 2	Deleted note regarding the need for the contractor to revise bridge seat elevations based on actual pot bearing depths as per memorandum dated October 8th, 1997.
7-3	Clarified the guidelines for the use of stepped up main reinforcing steel versus "shadow" steel.
7-4	Provided additional guidance for the application of sloped bent caps.
7-5	Clarified that the end bent layout worksheets of Figures 7-3 through 7-8 are accurate for tangent alignments and should be modified for curved alignments.
7-6	Added standard note to be used with reinforced bridge approach fills.
7-7	Added 508 mm (16") prestressed concrete pile to minimum cap width table.
7-7	Deleted table of minimum longitudinal reinforcement for 914 mm (3 ft.) diameter columns.
7-7	Deleted reference to and figures for the saddle cap bent section.
7-8	Added larger ties to be used in larger columns in Seismic Category 'B'.
7-8	Added statement relaxing the maximum column spacing of 6 m (20 ft.) when drilled piers are used.

7-10	Added 508 mm (16") prestressed concrete pile to minimum design loads table. The values for steel piles were also revised as per memorandum dated April 16th, 1998 and subsequent discussion with the Soils and Foundation Section.
7-10	Deleted 3 m (10 ft.) maximum pile spacing for pile bents.
7-10	Deleted reference to the plate load test intended when the Soils and Foundation Section is uncertain of the foundation type.
7-13	Added new section entitled “Pile Caps” intended to set the bottom of footing elevation for major coastal structures as per the memorandum dated October 13th, 1997.
7-14	Added discussion regarding the application of permanent steel casing for drilled piers as per memorandum dated November 3rd, 1997.
7-15	Added instruction to not detail spiral reinforcing steel with an extra 1 m (3 ft.) of length in drilled piers in accordance with the memorandum dated January 12th, 1998.
7-15	Added standard note informing the contractor that 1 m (3 ft.) of extra length has been added to the drilled pier longitudinal steel as per memorandum dated May 29th, 1997.
7-15	Revised standard note to remove 1 m (3 ft.) penetration of drilled pier into hard rock as per the request of the Soils and Foundation Section.
7-2(f)	Clarified intent of the use of stepped steel versus “shadow” steel.
7-9(f)	Revised part plan view to be consistent with text for anchor bolt and bearing plate clearances from the edge of bridge seats.
7-13(f)	Eliminated #10 (#4) hairpin ‘S’ bars from top of wings.
7-19(f)	Revised figure to show backwall and include 508 mm (16") prestressed concrete pile.
7-20(f)	Revised figure to show backwall and include 508 mm (16") prestressed concrete pile.
7-21(f)	Added figure to show alternating batter pattern for interior pile bents with one row of piles.
7-22(f)	Added figure to show batter pattern for interior pile bents with two rows of piles.
7-24(f)	Revised to require larger ties for large columns in Seismic Category ‘B’.
7-25(f)	Clarified that 1½ extra turns is not intended at the column/drilled pier interface.
7-27(f)	Corrected number of strands in pile to match Standard Drawings.
7-34(f)	Added figure to provide reinforcing details at juncture of column and median pier protection. Guidance is provided to set the top of drilled pier elevation to the bottom elevation of the median pier protection.

Chapter 8 REHABILITATION

This chapter was initiated to include all reference to bridge widenings and rehabilitations that were previously contained elsewhere in the manual.

8-1 Added standard note to require contractor to submit a plan for the removal of slabs on full deck rehabilitations of prestressed concrete girder bridges.

Chapter 9 R. C. BOX CULVERTS (Formerly Chapter 10)

The content of the previous Chapter 9, "Retaining Walls" was moved to Chapter 12, "Miscellaneous".

9-5 Revised the calculation of the location of weep holes.

9-5 Deleted text that was duplicated for precast box culverts.

9-6 Corrected minimum wall thickness to 205 mm for culvert extensions.

9-7 Added instruction and standard note to direct the installation of filter fabric behind the construction joints between the wings and the culvert walls.

9-9 Combined standard notes regarding the removal of unsuitable material.

9-9 Added standard note regarding culvert diversion channels as per memorandum dated June 3rd, 1997.

Chapter 10 REINFORCING STEEL (Formerly Chapter 11)

All figures were revised to reflect the "soft" metric reinforcing steel designations and characteristics.

- Dispersed contents of Section 11-4-5, "Hooks".
- Deleted Section 11-6, "Detailing Aids".

10-1 Updated reinforcing steel chart to provide "soft" metric bar designations.

10-2 Added direction that beam bolsters should be detailed to ¼" increments as per the memorandum dated October 10th, 1997.

10-3 Added new table summarizing concrete cover requirements for all reinforcing steel applications for both highly corrosive areas and other parts of the state.

10-3 Added the condition that if a drilled pier extends directly into a bent cap without a reduction in diameter, then the concrete cover may be reduced to 100 mm (4").

10-5 Revised the discussion on the use of epoxy coated reinforcing steel to include the requirements of the memorandum dated October 13th, 1997.

10-6(f) Deleted one repetitive chart.

Chapter 11 BRIDGE LAYOUT (Formerly Chapter 12)

11-1 Added statement giving general guidance in the preliminary determination of end slopes.

11-3 Added reference to the AASHTO Guide Specifications for Design of Pedestrian Bridges.

Chapter 12 MISCELLANEOUS (Formerly Chapter 13)

- Moved Section 13-1-4, “Drains” to Chapter 7.

12-3 Revised the 250 mm (10") curb height for approach slabs of cored slab bridges to be a minimum dependent on the wearing surface required on the bridge.

12-4 Updated the requirements for the title sheet if drawn by the Structure Design Unit.

12-6 Deleted the statement that filter fabric for riprap is a Roadway pay item if roadway work is included in the project.

12-8, 9 Updated procedure for inclusion of temporary shoring on plans.

12-11 Added standard note regarding the design of prestressed concrete girders in highly corrosive areas as per the memorandum dated October 1st, 1998.

12-12 Revised policy such that if any prestressed member is within 4.5 m (15 ft.) of the water surface than all like members in the structure shall be treated similarly.

12-12 Added direction, formerly contained in Chapter 7, that weathering steel shall not be used on low level water crossings or “tunnel-like” structures.

12-9(f) Added to figure to show details of attachment of approach slab to shoulder berm gutter.