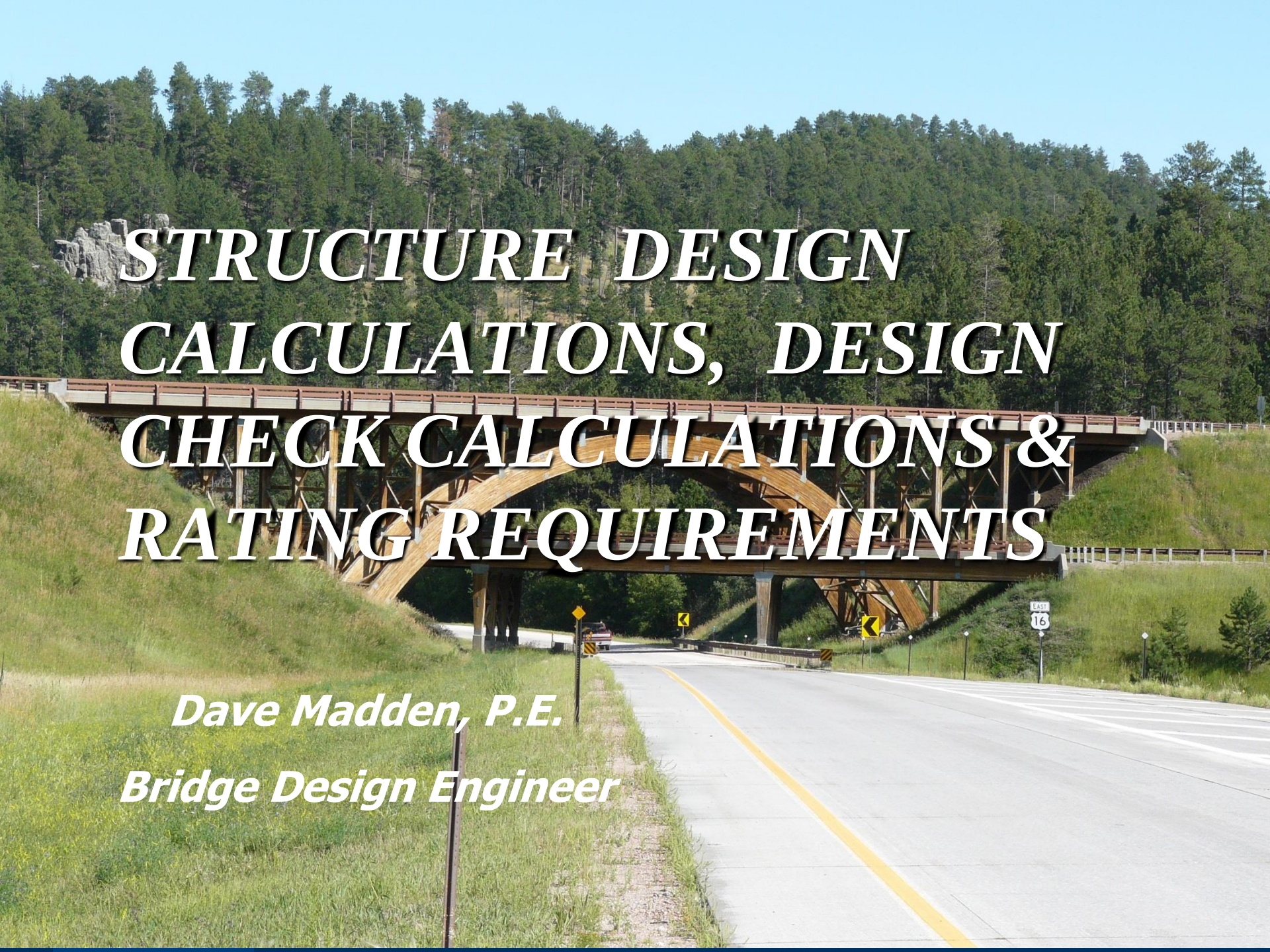


STRUCTURE DESIGN CALCULATIONS, DESIGN CHECK CALCULATIONS & RATING REQUIREMENTS

Dave Madden, P.E.

Bridge Design Engineer

Agenda

- 1. Opening statement on calculation
- 2. Technical requirements in Master Retainer Agreement
    a. QC/QA
    b. Design Specifications
    c. Calculations
- 3. Rating requirements

Statement

The SDDOT's Office of Bridge (OBD) has seen several incomplete sets of calculations over the last few years.

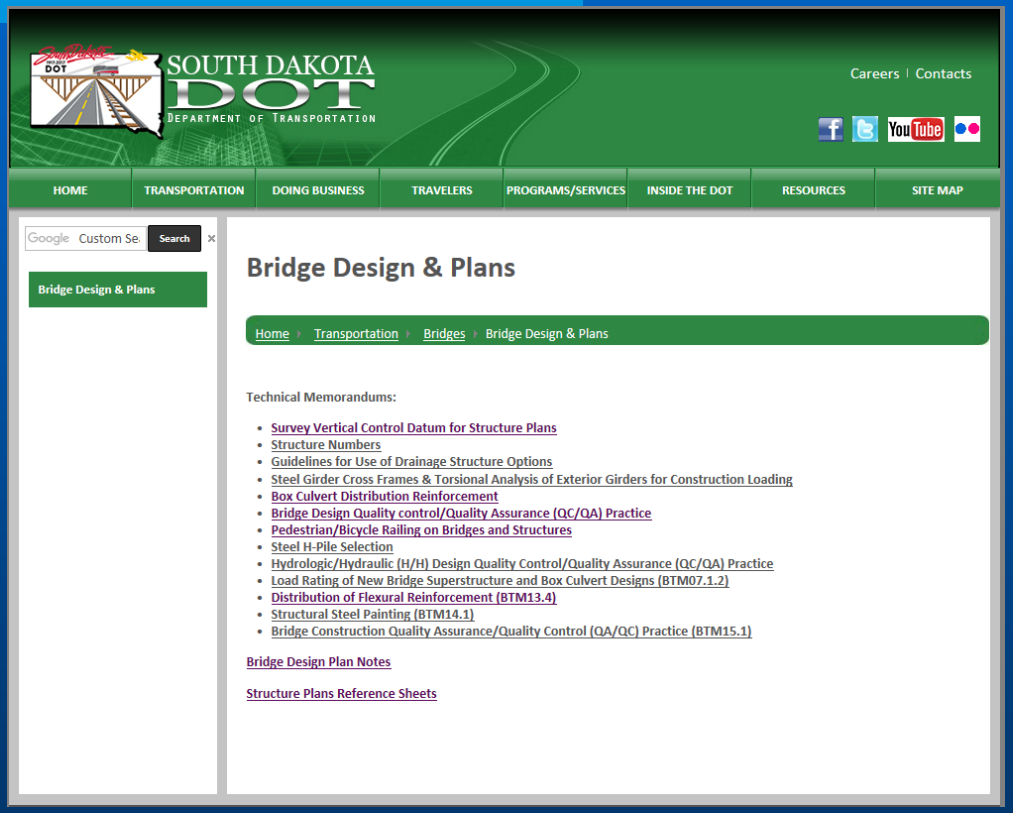
DOT900-T_Master Retainer Agreement

C. PRELIMARY ENGINEERING TECHNICAL REQUIREMENTS

5. STRUCTURE DESIGN. Unless otherwise modified by the Work Order, the CONSULTANT will meet the following requirements.

a. Prior to initiating design, the CONSULTANT will be required to submit the Quality Control/Quality Assurance (QC/QA) plan procedure to be followed for structure design to the DEPARTMENT for approval. The CONSULTANT may not begin design work until the QC/QA plan/procedure is approved and documented. If the CONSULTANT……..

OBD's QC/QA



www.sddot.com/transportation/bridges/docs/BTM12.1.pdf

DOT900-T_Master Retainer Agreement

C. PRELIMARY ENGINEERING TECHNICAL REQUIREMENTS

5. STRUCTURE DESIGN. Unless otherwise modified by the Work Order, the CONSULTANT will meet the following requirements.

b. The CONSULTANT will design bridges, box culverts, and miscellaneous highway structures in accordance with the edition of the "AASHTO LRFD Bridge Design Specifications", currently in place at the time of execution of the Work Order, except as modified by the DEPARTMENT'S design practices.

Clarification: Current AASHTO LRFD Specs

- **Specifications current at the time the contract is signed will be okay to use throughout the design of the project.**

DOT900-T_Master Retainer Agreement

C. PRELIMARY ENGINEERING TECHNICAL REQUIREMENTS

5. STRUCTURE DESIGN. Unless otherwise modified by the Work Order, the CONSULTANT will meet the following requirements.

e. The CONSULTANT will provide the DEPARTMENT a hard copy of design computations, independent check design computations, and load ratings, including computer output if applicable, with the final review set of drawings.

Reasons for a clear and concise set of calculations :

- **Ensures completeness**
- **Easier to review**
- **If needed in the future, can be followed**

Design and Design Check Calculations

- **Design Checker shall do independent calculations.**
- **Include: design criteria, design assumptions, individual member design calculations**

Office of Bridge Design Technical Memorandum

Technical Memorandum BTM12.1
Bridge Design Quality Control/Quality Assurance (QC/QA) Practice

Design and check design calculations should include the design criteria, design assumptions, loads, structural analysis and individual member design calculations, and computer program input and output. Calculations may be longhand calculations or computer generated design calculations; both are acceptable. All calculations, whether longhand or computer generated shall be marked with the project number, structure number if applicable, and dated. In addition, the designer and check designer must initial their calculations. For new bridge structures and major rehabilitation of existing bridge structures, calculations are generally broken into superstructure and substructure designs. For all structures, it is important that the above information be arranged in a logical order and be neat and orderly. Project correspondence (for example, hydraulic data sheets, roadway design correspondence, etc.) should not be copied and made part of the design calculations. A copy of consultant design and check design calculations shall be included with the final deliverables.

Design Content

- **Design Criteria**
- **Design Assumptions**
- **Analysis and individual member design calculations**

Clearly identify ALL critical sections

- **Box Culverts: all critical moment and shear sections for the Barrel Design and Wingwall Design**
- **Bridges: all critical moment, shear, and axial sections for all the superstructure and substructure components.**

Website examples/resource – prestressed girder design

LRFD Prestressed Girder Design Example

https://www.fhwa.dot.gov/bridge/lrfd/fhwanhi04043.pdf

https://www.fhwa.dot.gov/bridge/lrfd/pscustoc.cfm

Website examples/resource – continuous concrete slab bridge

LRFD Continuous Concrete Slab Bridge Design Example

http://www.fdot.gov/structures/StructuresManual/CurrentRelease_test_old/FlatSlabExample.pdf

LOAD & RESISTANCE FACTOR RATING - LRFR

- **Structures Designed after Oct. 2010**
- **Rate in accordance with the Manual for Bridge Evaluation, except rate all vehicles**
  - **Rating Level - Vehicles**
    - **Inventory**
      - **HL-93**
    - **Operating**
      - **HL-93**

LOAD & RESISTANCE FACTOR RATING (continued)

- **Legal**
  - **SD Type 3**
  - **SD Type 3-2**
  - **SD Type 3S2**
  - **Notional Rating Load**
  - **SU4**
  - **SU5**
  - **SU6**
  - **SU7**
  - **EV2 (if within 1 mile of Interstate access)**
  - **EV3 (if within 1 mile of Interstate access)**

LOAD FACTOR RATING

- Structures Designed before Oct. 2010
- Rate in accordance with the Manual for Bridge Evaluation
- Rating Level - Vehicles
  - Inventory
    - HS20
  - Operating
    - HS20

LOAD FACTOR RATING

- **Legal**
  - **SD Type 3**
  - **SD Type 3-2**
  - **SD Type 3S2**
  - **Notional Rating Load**
  - **SU4**
  - **SU5**
  - **SU6**
  - **SU7**
  - **EV2 (if within 1 mile of Interstate access)**
  - **EV3 (if within 1 mile of Interstate access)**

What to include with Load Rating

- **Load capacity analysis calculations**
- **For each vehicle show controlling member, location and loading.**
- **Provide a separate summary table of all load ratings to be included in the Bridge Inspection file.**

More Load Rating

- **Load ratings are required for all structures.**
- **If no plans are available**
  - **Steel Structures - Measure components (flanges, webs, etc.) and load rate.**
  - **Reinforced Concrete structures - without plans – Determine load Rating by "Field Evaluation and Engineering Judgement" (MBE 6.1.4)**

Questions?