IN-HOUSE DESIGN & CHECKING PROCEDURES

The primary aim in both designing and checking is to produce a structure that will safely carry the anticipated loads.

The design team, consisting of the designers, checkers, and structural detailers, is responsible for developing a set of practical, clear, and concise design notes, plans, and specifications by the assigned due date with the allotted manpower.

The *BDM* provides standard details that are workable, serviceable, and reasonably economical. In addition, these details have been approved by FHWA for general use. Departure from these standards may result in delays caused by obtaining approval.

Design Calculations
The design calculations shall be prepared on 8½"x11" sheets. The cover sheet for the final design notes of record shall be stamped by the designer & checker, and shall be indexed with numbered pages. The design calculations of record shall be archived and returned to the designer/checker. A sample form for stamping the design calculations is shown on page A0.1. An electronic copy is available on the X:drive in the Bridge Design Aids folder.

Cost Estimate
To keep a closer track of the project cost during the design phase, a cost estimate with a contingency amount should be prepared at each milestone review. The intent of this requirement is to identify project cost increases at an early stage and allow for changes in the programming cost.
The following contingency amount is recommended;

TS&L	30%
S&L	15%
Pre-final	5%
PS&E	0%

Designer
The designer's primary responsibilities include:

- Design concept and layout
- Structural design
- Preparing complete and legible calculations
- Producing a complete set of plans and specifications
- Stamping contract plan sheets (if licensed as a professional engineer)
- Reviewing shop drawings
- Resolving construction problems
- Load rating new/replacement bridges and bridge rehabilitation projects in accordance with the latest version of the AASHTO *Manual for Bridge Evaluation* and the *ITD Manual for Bridge Evaluation*. See below for ITD load rating procedures.

The designer should advise and get concurrence from the Group Leader whenever deviating from approved office standards and practices.

The designer should inform the Group Leader of any areas of the design that should receive special attention during checking and review.

The designer's responsibilities also include the following project planning activities:

- Obtain roadway horizontal alignment, profile grade, and typical section
- Preparing a Design Time Estimate CPM Chart
- Identifying tasks and planning order of work
- Preparing design criteria for inclusion in the front of the design calculations
- Determining the number and titles of plan sheets
- Coordinating plan sheet detailing
- Coordinating computation of quantities and preparing the Bridge Summary Sheet for the Roadway plans.
- Preparing the Cost Estimate, Construction Schedule CPM Chart, and Special Provisions
  Any new or significantly modified Special Provisions shall be added to the X:drive SP BRIDGE folder.

Design Calculations
The following format shall be used in resolving the design checker's calculations comments:

A	Agree
P	Partially agree, need to discuss
D	Disagree

The designer and design checker shall meet and resolve comments.

Plans
The designer shall provide the detailer with a new set of red-line plans showing the resolved changes to be made.

Design Checker
The primary purpose of a design check is to ensure that the designer has not, through an error in mathematics, misunderstanding of the specifications, or other cause, produced an unsafe design.

The design checker's primary responsibilities include:

- Verifying the design theory and correct interpretation of the design code to the level of accepting responsibility for stamping the record design calculations if needed.
- Accuracy and completeness of the design calculations to confirm the structural adequacy of the components
- Design check using the BrDR software
- Independent check of all geometry and elevations
- Verifying the accuracy and completeness of the load rating
- Stamping the contract plan sheets if the designer is not a licensed professional engineer or if the design engineer is not available.

The design calculations should not be checked until the Situation Layout check is completed and any differences are resolved with the designer. If revisions are necessary, the designer should revise the design and details before the design checker proceeds.

The following format shall be used in reviewing/checking the design calculations:

AGREE	mark in yellow
CHANGE	show correction in red
CHECK	show comment in blue

The check notes shall be returned to the designer who will coordinate changes. After the comments have been resolved, the design checker shall verify all resolved changes have been made by using a blue check mark next to the comment √.

The design checker may perform an independent analysis by using a methodology different from the original design. For designs checked by an experienced engineer, the original calculation sheets may be initialed by the checker. For special designs or those done by inexperienced designers, the Group Leader may require a more complete design check by the design checker.

Plan Checker
The primary purpose of a plan check is to ensure plans meet ITD standards and are constructible, consistent, clear, and complete. The checker's responsibilities should include, but not be limited to, the following items:

Situation and Layout

- Make a complete check of the geometric layout, dimensions, and elevations. Conformance of grades, alignments, and other data between roadway and bridge plans should be checked.
- Check the Typical Section for conformance to the roadway width and bridge railing curb-curb requirements
- Check the girder spacing and type, and slab thickness for conformance to the Typical Section and office standards

Component Details

- Verify that the details are in agreement with the approved design calculations

The following format shall be used in reviewing the plans:

AGREE	mark in yellow
CHANGE	show correction in red
CHECK	show comment in blue

After the designer and plan checker have resolved all comments, the plan checker shall verify all resolved changes have been made by using a blue check mark next to the comment √.

Structural Detailer
The structural detailer's primary responsibilities include:

- Preparing neat, correct, and easy to follow plan sheets conforming to current detailing standards
- Drawing details to scale
- Assisting the designer/checker with verifying dimensions and elevations that have been calculated by the designer/checker
- Assisting the designer/checker with verifying dimensions and elevations that have been calculated by the designer/checker
- Assisting the designer/checker with verifying quantities that have been calculated by the designer/checker

The detailer shall indicate that the red-lined changes have been made by placing a green check mark next to the change √.

Group Leader
The Group Leader should work closely with the designer, design checker, and structural detailer during the design and plan preparation phases to help avoid major changes late in the design process.

The Group Leader's primary responsibilities include:

- Compatibility of design and details within the project
- Determining the level of checking required by considering the complexity of the structure and the skill of the designer
- Approving the design criteria prepared by the designer before start of design
- Monitoring the design and detailing process and providing guidance and assistance as required
- Reviewing the design calculations for completeness and for agreement with office criteria and practices
- Reviewing the plans for completeness, constructibility, and agreement with office criteria and practices
- Reviewing the PS&E data for completeness and for agreement with office criteria and practices

State Bridge Engineer
The Bridge Engineer's primary responsibilities include:

- Providing leadership to support quality structural design for bridge projects.
- Facilitating resolution of major project design issues.

IN-HOUSE LOAD RATING PROCEDURES

To maximize the efficiency of its operations, the Department has selected the AASHTOWare Bridge Design and Rating software (BrDR formerly known as VIRTIS) for load rating. The BrDR software shall be used to do the rating for the structure types listed below. For structure types not listed below, or structures with complex geometry, alternate rating software may be used, but needs to be approved in advance by the ITD Asset Management Office.

The Load Rating will be completed using Load and Resistance Factor Rating (LRFR) method and reported on a stamped LRFR summary form. The Load Rating will be run using the Load Factor (LFR) method and results will be reported on the LFR Summary Form. The LFR results are for information only and are not required to be signed and sealed. Coding instructions for the BrDR software are in Chapter 6 of the Idaho Manual for Bridge Evaluation. (http://itd.idaho.gov/Bridge/IMBEFirstEdition.pdf)

Structure types that shall be rated in AASHTOWare BrDR:

- Prestressed girders
- Steel rolled girders, plate girders, or built-up sections
- Curved steel girders
- Reinforced concrete girders
- Multi-cell conventionally reinforced concrete box girders
- Post-tensioned girder/floorbeam systems
- Timber girders
- Trusses
- Cast-in-place or precast box culverts and stiffleg culverts
- CMP or metal arch pipes with cover greater than span/8 as defined in the MBE

Load rating submittal shall include:

- AASHTOWare BridgeRating software file (XML electronic file only)
- Load Rating Summary Form (LRFR) Signed and Sealed by the Load Rating Engineer (PDF electronic file only)
- Load Rating Summary Form (LFR) (PDF electronic file)
- Excel Load Rating Summary Form (LRFR and LFR) (MS Excel electronic file only)
- Load Rating Supporting Calculations (Native file format and PDF electronic file)

New/Replacement Bridge Projects

Initial BrDR Load Rating Model

For all structure types except precast culverts, initial load rating models shall be based upon the plans for the Final Design submittal and shall be revised for any changes or comments and submitted with the PS&E package. The HL-93 LRFR inventory rating,including future loads, shall be 1.10 or higher for new bridges on the state system, unless approved by the Group Leader. Future loads (i.e. future wearing surface, future utilities) shall be input into the model at the final design and PS&E stage. The future loads shall be removed for the updated load rating completed at the end of bridge construction. The load rating model should be done by the Bridge Designer and checked by a Design Checker or a load rating engineer.

Once the load rating model has been checked and all the checkers comments have been resolved, the designer shall send an e-mail to the ITD Load Rating Engineer stating the model is ready for the Q/A process with a link to the location of the documents needed to perform a review.

Final BrDR Load Rating Model

The final load rating shall be completed within 90 days of opening the bridge to traffic.

Precast culvert load rating shall be done after approval of the shop drawings by the Engineer who approved the shop drawings.

At time of shop drawing approval the load rating file shall be revised if necessary in order to reflect changes that would affect the load capacity of the bridge such as the use of alternate prestressed concrete girders, strand size and location or for steel girders possible adjustments to flange thickness or stiffener spacing. The bridge designer is in the best position to know what changes have been made if any during shop drawing approval and whether the BrDR model needs to updated.

It is extremely rare that any other field adjustments during construction will affect the load rating, however the load rating is to be updated based on the data in the initial inspection report. The load rating at this stage is considered to be final and the designer shall send an email to the ITD Load Rating Engineer stating the model is ready for the Q/A process. If there are changes, the original checker should check the changes to the load rating and a link to the revised load rating files shall be emailed to the ITD Load Rating Engineer.
The approved shop drawings shall be included in the linked folder.

Bridge Rehabilitation Projects

Consistent with the opening statement of Article 0.04 that "The primary aim in both designing and checking is to produce a structure that will safely carry the anticipated loads", all bridge rehabilitations projects shall have their load ratings reviewed and updated as necessary.

Early in the bridge rehabilitation project development the designer should verify that a load rating file exists for the bridge that is to be rehabilitated. If a load rating file does not exist for the bridge, the designer shall contact the Bridge Asset Management Office to request preparation of the initial load rating file.

The load rating file should be updated to reflect the rehabilitation project changes, such as the addition of asphaltic waterproof membranes and asphalt wearing surfaces, bonded silica fume overlays and rail retrofits. It is not necessary to update the BrDR file for application of 3/8" epoxy overlays or healer/sealer treatments.

It is not necessary for the bridge designer to restamp the original Load Rating Summary Sheet. The purpose of the review and updating of the load rating and load rating file for rehabilitation projects is not to recreate or invalidate the existing load rating, but ensure that we have not substantially reduced the live load capacity of the bridge. The bridge designer will document changes made to the load rating file and email a copy of the documentation to the ITD Load Rating Engineer.

In regards to bonded silica fume overlays, historically the design practice has been to design for a minimum of 15 psf of additional future wearing surface in the original design (currently we design for 28psf of additional future wearing surface). The addition of a bonded overlay will not decrease the original design capacity. Changing the BrDR model to reflect the new deck thickness including the bonded concrete overlay will produce a conservative load rating and is acceptable practice.

The designer shall send an email stating the load rating file is ready for the Q/A process indicating no changes or an updated Load Rating Summary Sheet included at a linked folder location. If during the Q/A process the ITD Load Rating Engineer determines revisions are needed, comments will be sent to the bridge designer for resolution. This shall be completed no later than the PS&E submittal for the project.

Bridge widening, strengthening, or full deck or superstructure replacement rehabilitation projects shall be treated as new bridges for the purposes of load rating and all the provisions for load rating of new bridges will apply.

Revisions:

June 2006	Added paragraph for Design Calculations. Added preparation of design criteria in Designer's Responsibilities. Added paragraph for duties of Bridge Engineer.
April 2008	Added load rating responsibility for Designer
July 2009	Added requirement for microfilming check calculations.
Feb 2012	Added In-House Load Rating Procedures section
August 2012	Clarified In-House Load Rating Procedures section Added new heading and paragraphs for load rating of Bridge Rehabilitation Projects
June 2013	Added designer responsibility to obtain roadway line, grade, & typical section data. Added plan checker duty to verify conformance of grades and alignments between roadway & bridge plans when checking the situation layout.
May 2014	Revised notation of VIRTIS to BrR. Added reference to BrR coding instructions in Chapter 6 of the Idaho Manual for Bridge Evaluation.
Mar 2015	Deleted requirement to archive design check calculations.
Oct 2016	Changed Article number from 0.4 to 0.04.
Oct 2017	Added a paragraph on Cost Estimates. Clarified when precast culvert load ratings shall be done.
Sep 2020	Added "reviewing shop drawings" to Designer's primary responsibility. Added checking design in BrDR software to Design Checker's primary responsibility. Changed reference to AASHTOWare Bridge Rating software (BrR) to Bridge Design and Rating software BrDR). Added precast culvert final load rating shall be done by the Engineer who approved the shop drawings.
Sep 2021	Revised Load Rating procedures and submittal requirements.
June 2022	Added color format for reviewing/checking plans and calculations.
Oct 2023	Added stamping contract plans and preparing the Bridge Summary Sheet for the Roadway Plans to Designer's responsibilities. Changed format for resolving calculations to A, P, and D Revised Design Checker's responsibilities Revised Structural Detailer's responsibilities Revised duties of the Bridge Engineer. Added additional structure types to be load rated using BrDR. Revised Load Rating procedure to an electronic submittal format.