

# Bridge Load Rating and LRFD Bridge Design Software



Virtis® and Opus® are state-of-the-art bridge load rating and design review systems released by AASHTO through its Cooperative Joint Software Development process. Powerful and easy to use, the two systems provide a wide range of features that fully support the engineering and business processes of bridge design and rating, including preliminary and final design, rating for posting and permitting, analysis of the effects of deterioration, and rehabilitation design. Virtis uses the AASHTO Standard Specification and Opus uses the AASHTO LRFD Specification.

Virtis and Opus were designed to meet the present needs of bridge designers and bridge load rating engineers while employing an architecture that will last for decades to come. Long-term system stability is accomplished by preserving the most important and valuable aspect of the design or analysis - the data - in a generic form that can support a wide variety of Third Party applications. Along with data preservation, the long-term viability of both systems is enhanced through an architecture that readily allows for changing rating and design specifications and computational procedures. Thousands of hours have been spent verifying and testing.



44'-6"

2" Overlay

4'-3"

3@12'-0" = 36'-0"

Spoo Check Detail for 5.9.4 Stress Limits for Concrete

PERFORMING AASHTO SPECIFICATION CHECKS -  
Point of Interest : 105.00  
Construction Stage: 2

Units: Stresses are in (ksi).

Stresses After Losses: DL + PS Only

Stress Comparisons for NEGATIVE

Location	Compressive Stress Limit
Slab	-2.400
Top Flange	-3.150
Bot Flange	-3.150

Notes:

2 3/4" Overlay

3@13'-0" = 39'-0"

Stress Graph: Composite Plate Girder

Distance [ft]	Stress [ksi]
14.0	1000.0
28.0	1000.0
42.0	1000.0
56.0	1000.0
70.0	1000.0
84.0	1000.0
98.0	1000.0
112.0	1000.0
126.0	1000.0
140.0	1000.0
157.5	1000.0
175.0	1000.0
192.5	1000.0
210.0	1000.0
227.5	1000.0
245.0	1000.0
262.5	1000.0
280.0	1000.0
297.5	1000.0
315.0	1000.0
328.0	1000.0
342.0	1000.0

Combined Load Case 1

Span	Location	Distance	MDL-s1-Combined Load Case 1	MDL-s2-Barr
1	0.00	0.00	-0.0	
1	14.00	14.00	822.8	12
1	28.00	28.00	1379.1	21
1	42.00	42.00		
1	42.00	42.00	1668.9	25

# System Capabilities

Virtis or Opus combine the ability to rate or design a variety of structure types and configurations. This simplifies the learning process and even allows the rating of a single bridge structure that is comprised of various structure types and configurations in one session. In the same way, but within a design scenario, the engineer may compare many designs using various material types, number of girders, and/or span arrangements.

## Virtis and Opus share the following structure types and capabilities:

- Simple spans, continuous spans, hinges (Steel and Reinforced Concrete);
- U. S. Customary and S.I. units;
- Girder-line analysis;
- Reinforced concrete frame analysis with superstructure rating;
- Reinforced concrete tee beams, slabs and I-beams;
- Prestressed concrete box and I-beams (precast, pretensioned continuity for live load);
- Harped strands and debonded strands
- Steel rolled beams (including cover plates);
- Steel built-up plate I-girders;
- Steel welded plate I-girders (including hybrid);
- Parallel, tapered and parabolic webs;
- Transverse and longitudinal stiffened;

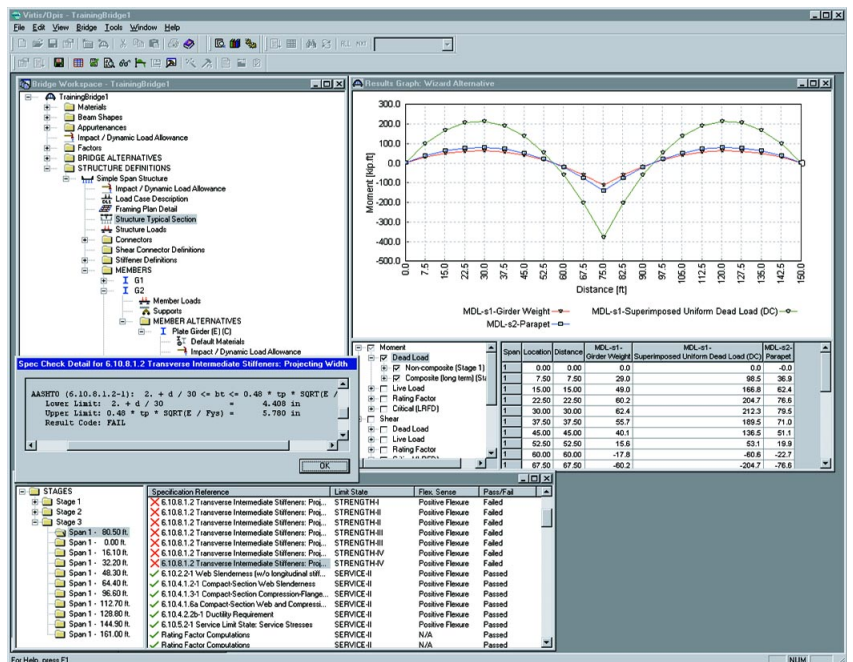
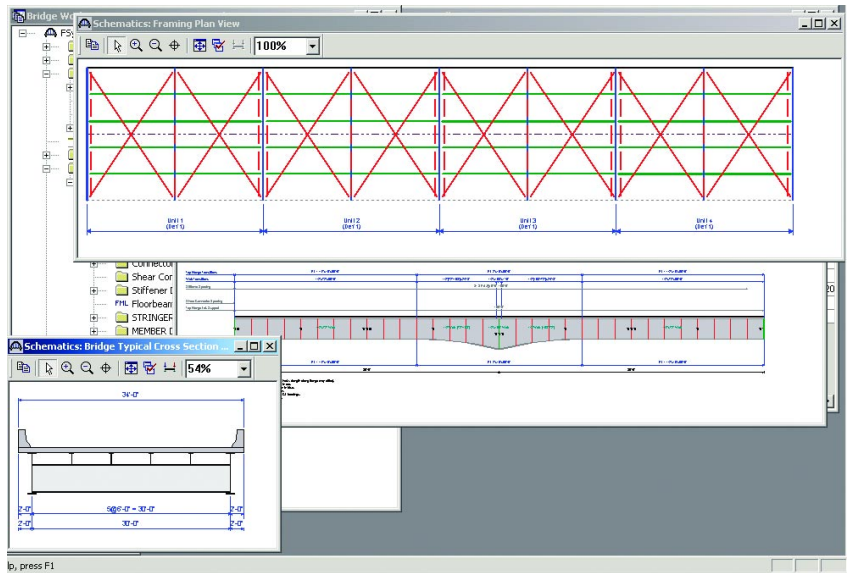
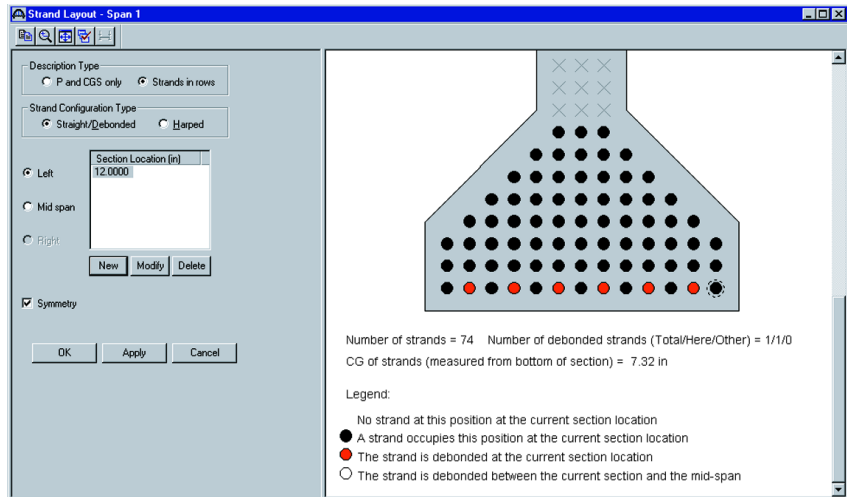
## Virtis-specific features:

- Load rate various structure units within a bridge;
- Load rate various members within a structural unit;
- Rate a user-defined group of bridges;
- Input definition and rating of deteriorated sections;
- Review rating history for groups of bridges and routing applications;
- BRASS-Girder<sup>1</sup> engine for LFD/ASD rating;
- Madero engine for ASD timber rating.
- Load rate timber decks.
- Load rate girder-floorbeam-stringer configurations.

## Opis-specific features:

- LRFD specification checking with detailed computation reporting (For example, failed specification or resistance checks can be examined with equation and article references including inputs, output and conclusions.);
- Design ratio graphs;
- Wizards for simplifying the design of steel and prestressed concrete bridges
- BRASS-Girder(LRFD)<sup>1</sup> engine for LRFD design review/specification checking.

<sup>1</sup>BRASS-Girder and BRASS-Girder(LRFD) are copyrighted by and licensed from Wyoming Department of Transportation. BRASS™ is a trademark of Wyoming Department of Transportation.



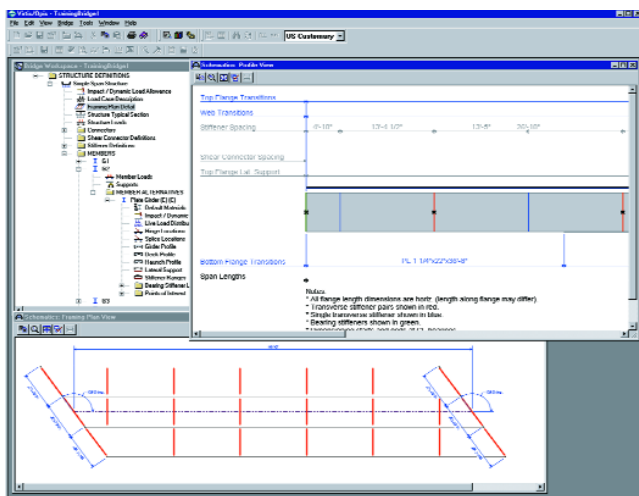


## User Interaction

In Virtis and Opis, the bridge is described generically, independent of the analysis process or specification that will be used for the load rating or design review process. After entering the structural description data, the engineer can use any number of compatible programs for design, rating, or many other purposes, drawing from the same data. For example, design calculations can be checked with an alternative analytical package, even using a different design specification. Virtis and Opis support rapid and accurate one-time data entry of structural characteristics, allowing the engineer to proceed quickly to productive and creative work using powerful features such as:

- Comprehensive reporting of analysis output, including tabular and graphical reports at various levels of detail. For example, in Opis each LRFD specification article is referenced and calculations can be examined and checked by the user based on powerful queries.
- User-defined reports.
- Validation checks of input to inform the user of possible data entry errors.
- Schematic diagrams of the cross section, profile and framing plan for visual verification.
- Graphing capability of analysis results.
- Bridge description reports.
- Rapid input features:
  - Libraries of materials, including AISC historical shapes, beam shapes, appurtenances and vehicles;
  - Copy and paste tools;
  - Bridge templates - set up models to use as a starting point . . . great for state specific and/or office practice features.

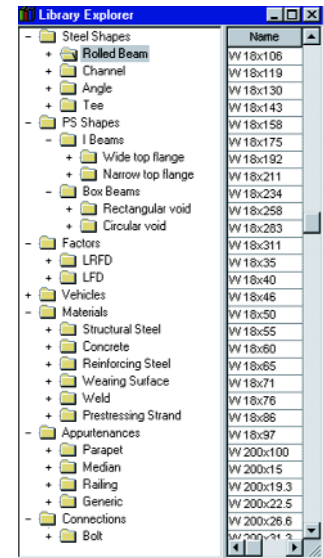
The bridge may be defined as one or more girder-lines or as a three-dimensional structure with a complete "framing plan" description.



## BRIDGEWare® Database

The BRIDGEWare database that includes the Pontis, Virtis and Opis databases offers several benefits including:

- **Complete Bridge Description** - A complete and detailed description of the entire bridge superstructure. These data are preserved over a lifetime of design, load rating, re-analysis, permit analysis and rehabilitation analysis. The database represents an enormous preservation of time, resources and costs to an bridge owner.
- **Expedites Checking** - Preservation of the bridge data and linking two different programs to it expedites detailed checking. This is particularly important when a new specification such as AASHTO LRFD is introduced.
- **Comparing Design Alternatives** - In the design process, the system allows the engineer to compare one design against multiple alternatives in the same or different materials or configurations of other similar bridges.
- **Permits Multiple Specifications** - Allows design using one method (such as LRFD) and load rating using another method (such as LFD) using the same data entered once.



## Data exchange features:

- AASHTO BARS import (Virtis only)
- Wyoming BRASS-Girder import (Virtis only)
- BRIDGEWare data exchange (transfer of data from one BRIDGEWare database to another)
  - Enables sharing of data between an agency and a consultant.

## Virtis/Opis Report Tool

A new tool was added to enable the user to very quickly define and format reports. When the tool is fully implemented, it will enable the user to prepare reports that include bridge description data, analysis results data, graphs of analysis results and schematics of the bridge description. Full implementation of the capabilities of the tool will require several releases. Capabilities currently implemented enable the user to prepare reports for the Bridge Workspace. The user selects bridge components, referred to as "Groups", and attributes of the groups to be added to the report. Report definitions can be saved and executed for any bridge in the database. The definitions can be modified and combined to produce a variety of reports for a subset of the bridge description or the entire description. The user does not have to understand the database or SQL to prepare the reports and use the tool. All units conversions and referential integrity are handled automatically by the tool.



## FUTURE PLANS

The five-year Bridgeware strategic plan is updated annually. The release dates of these new modules and features are dependent on the funding pool derived from annual license fees and the Opus substructure project<sup>2</sup>.

Truss Rating module	Virtis
Linkages to Pontis Document Management	Virtis/Opis
Report Writing Enhancements	Virtis/Opis
Analysis/Design of Piers <sup>2</sup>	Opis
Schedule-based Concrete, incl. Slabs	Virtis/Opis
Culverts and R/C Frames	Virtis
Post-tensioned Structures	Virtis/Opis
Seismic Design API	Opis
LRFR Specification Implementation	Virtis
Abutments and Retaining Walls <sup>2</sup>	Opis

## Software testing and validation process

Virtis and Opus testing procedures follow the rigorous standards prescribed in the AASHTOWare Standards and Guidelines Notebook. Bridge engineers in seven Transportation Departments and independent bridge engineers carry out the beta and acceptance testing phases. The NCHRP 12-50 software validation process is also used to test the software. Automated regression testing is performed using a test suite of over 800 bridges before each release of a new version of the software.



## Hardware and Software Requirements

Pentium 800mhz CPU  
 256 mb RAM  
 200 mb free disk space  
 (does not include the database)  
 250 mb virtual memory  
 Display capable of 1024 x 768 resolution or better  
 Windows 2000  
 Microsoft Internet Explorer 5.0 or later  
 (for Report Tool)  
 Sybase Adaptive Server or Oracle  
 (see our website for latest supported versions)  
 Microsoft Data Engine (MSDE)

## Licensing Information

Virtis and Opus are licensed annually as separate products from the American Association of State Highway and Transportation Officials (AASHTO). Unlimited licenses, single workstation, special consultant (with limited support) and educational licenses are all available. On-site training is also available.

## For more information, contact:

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**AASHTOWare™ Product Catalog:**  
[www.aashtoware.org](http://www.aashtoware.org)

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### Subcontractors:

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 Paul D. Thompson, Castle Rock, CO