

# Bridge Design Calculations

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## 1. Dead Load Calculation

Concrete Deck:

The concrete deck is assumed to be 0.6m thick, and the density of concrete is 2.4 tons/m<sup>3</sup>.

We calculate the weight of the deck:

- Volume of concrete deck:

$$V_{\text{concrete}} = 60 \text{ m} \times 18 \text{ m} \times 0.6 \text{ m} = 648 \text{ m}^3$$

- Weight of concrete deck:

$$W_{\text{concrete}} = 648 \text{ m}^3 \times 2.4 \text{ tons/m}^3 = 1,555.2 \text{ tons}$$

Thus, the total dead load due to the concrete deck is 1,555.2 tons.

Steel Girders:

For multi-girder construction, assume that the steel girder weight per 30m span is around 100 tons.

For 60 meters, with girders spaced at 3m intervals, the number of girders is:

- Number of girders =  $60 / 3 = 20$  girders

- Total weight of steel girders =  $20 \times 100 \text{ tons} = 2,000 \text{ tons}$

Thus, the total dead load from the steel girders is 2,000 tons.

## 2. Live Load Calculation (AASHTO LRFD or Eurocode)

The HL-93 live load is used in AASHTO design, where the combination of truck loads and lane loads is considered:

- Lane load: 640 pounds per linear foot (equivalent to 2.84 kN/m per lane).

- Width of bridge = 18m; assuming 2 lanes:

$$\text{Live load per lane} = 2.84 \text{ kN/m} \times 18 \text{ m} \times 2 = 102.24 \text{ kN}$$

Additionally, an impact factor (usually 1.25) is applied for dynamic loading:

$$\text{Live load with impact} = 102.24 \text{ kN} \times 1.25 = 127.8 \text{ kN}$$

Thus, the live load is 127.8 kN per lane.

## 3. Shear Force Calculation at Support

The shear force at the support for a simply supported beam under a uniform load is given by:

# Bridge Design Calculations

**Howard F. Topping**



## **Bridge Design Calculations:**

*LRFD Bridge Design* Tim Huff, 2022-02-23 This book examines and explains material from the 9th edition of the AASHTO LRFD Bridge Design Specifications including deck and parapet design load calculations limit states and load combinations concrete and steel I girder design bearing design and more With increased focus on earthquake resiliency two separate chapters one on conventional seismic design and the other on seismic isolation applied to bridges will fully address this vital topic The primary focus is on steel and concrete I girder bridges with regard to both superstructure and substructure design Features Includes several worked examples for a project bridge as well as actual bridges designed by the author Examines seismic design concepts and design details for bridges Presents the latest material based on the 9th edition of the LRFD Bridge Design Specifications Covers fatigue strength service and extreme event limit states Includes numerous solved problems and exercises at the end of each chapter to illustrate the concepts presented LRFD Bridge Design Fundamentals and Applications will serve as a useful text for graduate and upper level undergraduate civil engineering students as well as practicing structural engineers

**Verification of LRFD Bridge Design and Analysis Software for Indot** Amit H. Varma, Jungil Seo, 2009-08-15 NCHRP Process 12 50 was implemented to evaluate and verify composite steel I girder bridge design software used commonly in Indiana A test bed of twenty one bridges was developed with the guidance from an Indiana Department of Transportation appointed research advisory panel RAP The test bed included five simple span and sixteen multi span bridge superstructures More than 80 parameters were required to define a bridge and they include bridge span girder spacing number of beams section type steel strength girder sections and other required bridge parameters Some of these parameters were initially selected by INDOT and practitioners An indigenous computer program PURDUE CSBD was developed to implement the bridge design calculations specified in the AASHTO LRFD specifications which is currently endorsed by the INDOT bridge design manual Both MERLINDASH and PURDUE CSBD were used to generate design calculation results for the complete test bed of bridges The output from both computer programs is compared to identify assumptions and discrepancies between MERLIN DASH and the AASHTO LRFD specifications These comparisons indicate excellent agreement between the results from both programs for 1 moments 2 shears 3 stresses 4 deflections 5 flexural strength and all relevant parameters 6 shear strength and all relevant parameters and 7 shear connector related parameters The test bed of bridge structures and the PURDUE CSBD program are recommended for evaluating and verifying other bridge design software

**Bridge Calculation and Design** David Young Hill, 1962 *The Design of Highway Bridges and the Calculation of Stresses in Bridges Trusses* Milo Smith Ketchum, 1908

**Innovative Bridge Designs for Rapid Renewal: ABC Toolkit** TRANSPORTATION RESEARCH BOARD, **LRFD Bridge Design** Tim Huff, 2022-02-23 This book examines and explains material from the 9th edition of the AASHTO LRFD Bridge Design Specifications including deck and parapet design load calculations limit states and load combinations concrete and steel I girder design bearing design and

more With increased focus on earthquake resiliency two separate chapters one on conventional seismic design and the other on seismic isolation applied to bridges will fully address this vital topic The primary focus is on steel and concrete I girder bridges with regard to both superstructure and substructure design Features Includes several worked examples for a project bridge as well as actual bridges designed by the author Examines seismic design concepts and design details for bridges Presents the latest material based on the 9th edition of the LRFD Bridge Design Specifications Covers fatigue strength service and extreme event limit states Includes numerous solved problems and exercises at the end of each chapter to illustrate the concepts presented LRFD Bridge Design Fundamentals and Applications will serve as a useful text for graduate and upper level undergraduate civil engineering students as well as practicing structural engineers Manual of Bridge Design Practice ,1963 *The Design of Steel Mill Buildings and the Calculation of Stresses in Framed Structures* Milo Smith Ketchum,1921 **Collapse of I-35W Highway Bridge, Minneapolis, Minnesota, August 1, 2007** United States. National Transportation Safety Board,2008 In the early afternoon construction equipment and construction aggregates sand and gravel for making concrete were delivered and positioned in the two closed inside southbound lanes The equipment and aggregates which were being staged for a concrete pour of the southbound lanes that was to begin about 7 00 p m were positioned toward the south end of the center section of the deck truss portion of the bridge and were in place by about 2 30 p m About 6 05 p m a motion activated surveillance video camera at the Lower St Anthony Falls Lock and Dam just west of the I 35W bridge recorded a portion of the collapse sequence The video showed the bridge center span separating from the rest of the bridge and falling into the river *Bridge Engineering* Demetrios E. Tonias,Jim J. Zhao,2007 Aimed at US audience architects 113 000 civil engineers 228 000 and universities and colleges offering structural engineering programs This work reflects the bridge design code changes and the newest ASCE American Association of Civil Engineers design methods It uses SI units throughout for international usage **The Design of Highway Bridges of Steel, Timber and Concrete** Milo Smith Ketchum,1920 Safety and Reliability of Bridge Structures Khaled Mahmoud,2009-09-21 Recent surveys of the U S infrastructure s condition have rated a staggering number of bridges structurally deficient or functionally obsolete While not necessarily unsafe a structurally deficient bridge must be posted for weight and have limits for speed due to its deteriorated structural components Bridges with old design features that cannot *Bridge Design & Engineering* ,2001 **Bridge and Structural Design** William Chase Thomson,1910 *Bridge design. 1st ed. 1894* Mansfield Merriman,Henry Sylvester Jacoby,1894 **Report [and Plans] Also Report on Design of Quebec Bridge** Canada. Royal Commission on Quebec Bridge Inquiry,1908 *Report [and Plans] Also Report on Design of Quebec Bridge: Minutes of proceedings and printed exhibits* Canada. Royal Commission on Quebec Bridge Inquiry,Henry Holgate,1908 Design of a Railway Bridge Pier Charles Derleth (Jr.),1907 **Final Report on Bridge Design in Connection with the Third Locks Project** Howard F. Topping,1943 **The Design of Highway Bridges and the Calculation of Stresses in Bridge**

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## **Table of Contents Bridge Design Calculations**

1. Understanding the eBook Bridge Design Calculations
  - The Rise of Digital Reading Bridge Design Calculations
  - Advantages of eBooks Over Traditional Books
2. Identifying Bridge Design Calculations
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Bridge Design Calculations
  - User-Friendly Interface
4. Exploring eBook Recommendations from Bridge Design Calculations
  - Personalized Recommendations

- Bridge Design Calculations User Reviews and Ratings
- Bridge Design Calculations and Bestseller Lists
- 5. Accessing Bridge Design Calculations Free and Paid eBooks
  - Bridge Design Calculations Public Domain eBooks
  - Bridge Design Calculations eBook Subscription Services
  - Bridge Design Calculations Budget-Friendly Options
- 6. Navigating Bridge Design Calculations eBook Formats
  - ePub, PDF, MOBI, and More
  - Bridge Design Calculations Compatibility with Devices
  - Bridge Design Calculations Enhanced eBook Features
- 7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Bridge Design Calculations
  - Highlighting and Note-Taking Bridge Design Calculations
  - Interactive Elements Bridge Design Calculations
- 8. Staying Engaged with Bridge Design Calculations
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Bridge Design Calculations
- 9. Balancing eBooks and Physical Books Bridge Design Calculations
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Bridge Design Calculations
- 10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
- 11. Cultivating a Reading Routine Bridge Design Calculations
  - Setting Reading Goals Bridge Design Calculations
  - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Bridge Design Calculations
  - Fact-Checking eBook Content of Bridge Design Calculations

- Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
- 14. Embracing eBook Trends
  - Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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