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# Box Culvert Structural Design Example

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Hydraulic Charts for the Selection of Highway Culverts  
Design of Small Dams  
Recommended Design Specifications for Live Load Distribution to Buried Structures  
Winston-Salem Northern Beltway (Eastern Section), from US 52 North of Winston-Salem to US 421/I-40 Business East of Winston-Salem, Forsyth County  
Optimal Risk-based Design of Hydraulic Structures  
Design of Small Dams  
DESIGN OF BRIDGE STRUCTURES, Third Edition  
Capacity Charts for the Hydraulic Design of Highway Culverts  
Structural Concrete Textbook, Volume 4  
Earthquake Engineering for Nuclear Facilities  
Recommended Design Specifications for Live Load Distribution to Buried Structures  
Water and Wastewater Engineering, Volume 1  
Seismic Analysis and Design of Retaining Walls, Buried Structures, Slopes, and Embankments  
Hydraulic Design of Energy Dissipators for Culverts and Channels  
Fish Swimming in Turbulent Waters  
Culvert Design and Operation Guide  
Design of Small Canal Structures, 1974  
The Manual for Bridge Evaluation  
Design of Underground Structures  
Reinforced Concrete Structures Vol. II  
Design of Small Canal Structures, 1978  
Public Roads  
Culvert Design Manual  
Hydraulic Design of Improved Inlets for Culverts  
Reinforced Concrete Pipe Culverts  
Debris-control Structures  
Structural Design of Box Culverts  
Concrete Pipe and Box Culvert Installation  
Standard Specifications for Highway Bridges  
Asian And Pacific Coasts 2011 - Proceedings Of The 6th International Conference  
Hydraulics of Open Channel Flow  
Federally Coordinated Program of Highway Research, Development and Technology  
Winston-Salem Northern Beltway (western Section)  
Design of Small Canal Structures  
Soil Conservation  
Soil Mechanics and Foundations  
Handbook of Steel Drainage & Highway Construction Products  
CONCRETE PIPE AND THE SOIL-STRUCTURE SYSTEM

Concrete Pipe and the Soil-structure System  
Geotechnical Related Development and Implementation of Load and Resistance  
Factor Design (LRFD) Methods

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**NATHANIEL WERNER**

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*Hydraulic Charts for the Selection of Highway Culverts* Transportation Research Board

This report provides recommendations to revise the AASHTO LRFD Bridge Design Specifications relating to the distribution of live load to buried structures. The report details the development of simplified design equations (SDEs) for structural response based on three-dimensional (3D) analysis of 830 buried culverts. In addition, the report provides guidelines for conducting 2D and 3D modeling for design situations with conditions not covered by the SDEs. The material in this report will be of immediate interest to roadway and bridge designers.

**Design of Small Dams** CRC Press  
Discover the principles that support the practice! With its simplicity in presentation, this text makes the difficult concepts of soil mechanics and foundations much easier to understand. The author explains basic concepts and fundamental principles in the context of basic mechanics, physics, and mathematics. From Practical Situations and Essential Points to Practical Examples, this text is packed with helpful hints and examples that make the material crystal clear.

**Recommended Design Specifications for Live Load Distribution to Buried Structures** John Wiley and Sons  
WATER and WASTEWATER ENGINEERING  
The classic guide to water and

wastewater engineering returns Water and wastewater engineering is a crucial branch of civil engineering, dealing with water resources and with the challenges posed by water and wastewater. Generations of engineers have developed techniques for purifying, desalinating, and transforming water and wastewater, techniques which have only grown more critical as climate change and global population growth create new challenges and opportunities. There has never been a more urgent need for a comprehensive guide to the management of water and its various engineering subdisciplines. *Water and Wastewater Engineering: Hydraulics, Hydrology and Management*, 4th edition offers key fundamentals in a practical context to engineers and engineering students. Updated to address growing urbanization and industrialization, with corresponding stress on water and wastewater systems, this vital textbook has been fully revised to reflect the latest research and case studies. This volume focuses primarily with hydrology and hydraulics, along with chapters treating groundwater and surface water sources. Readers of *Hydraulics, Hydrology and Management* will also find: Coverage of water supply, water sources, water distribution, and more Detailed treatment of both sanitary sewer and urban stormwater drainage In-depth analysis of infrastructure issues with respect to water resources, pumping, and handling This textbook is ideal for advanced students in civil, environmental, and chemical engineering departments, as well as for early career engineers, plant managers,

and urban and regional planners.  
*Winston-Salem Northern Beltway (Eastern Section), from US 52 North of Winston-Salem to US 421/I-40 Business East of Winston-Salem, Forsyth County*  
 ASTM International

This publication adopts a whole-life approach to the design and operation of culverts, with a focus on asset management, reflecting changes that have occurred in the business of asset management over the past 10 to 15 years. It also addresses the management of culverts.

*Optimal Risk-based Design of Hydraulic Structures* Springer

This book provides a general review of the literature on underground structures, combined with new specifications, engineering case studies, and numerical simulations based on the authors' research. It focuses on the basic concepts, theories, and methods of the design of underground structures. After an introduction, it covers various topics, such as elastic foundation beam theory and numerical analysis methods for underground structures, as well as the design of shallow underground structures, diaphragm wall structures, shield tunnel structures, caisson structures, immersed tube structures, and integral tunnel structures. It also includes tables for calculating elastic foundation beam. This book is intended for senior undergraduate and graduate students majoring in urban underground space engineering, building engineering, highway engineering, railway engineering, bridge and tunnel engineering, water conservancy and hydropower engineering.

**Design of Small Dams** ASTM International

This report provides recommendations to revise the AASHTO LRFD Bridge Design

Specifications relating to the distribution of live load to buried structures. The report details the development of simplified design equations (SDEs) for structural response based on three-dimensional (3D) analysis of 830 buried culverts. In addition, the report provides guidelines for conducting 2D and 3D modeling for design situations with conditions not covered by the SDEs. The material in this report will be of immediate interest to roadway and bridge designers.

*DESIGN OF BRIDGE STRUCTURES, Third Edition* AASHTO

The second edition of the Structural Concrete Textbook is an extensive revision that reflects advances in knowledge and technology over the past decade. It was prepared in the intermediate period from the CEP-FIP Model Code 1990 (MC90) to fib Model Code for Concrete Structures 2010 (MC2010), and as such incorporates a significant amount of information that has been already finalized for MC2010, while keeping some material from MC90 that was not yet modified considerably. The objective of the textbook is to give detailed information on a wide range of concrete engineering from selection of appropriate structural system and also materials, through design and execution and finally behaviour in use. The revised fib Structural Concrete Textbook covers the following main topics: phases of design process, conceptual design, short and long term properties of conventional concrete (including creep, shrinkage, fatigue and temperature influences), special types of concretes (such as self compacting concrete, architectural concrete, fibre reinforced concrete, high and ultra high performance concrete), properties of reinforcing and prestressing materials, bond, tension

stiffening, moment-curvature, confining effect, dowel action, aggregate interlock; structural analysis (with or without time dependent effects), definition of limit states, control of cracking and deformations, design for moment, shear or torsion, buckling, fatigue, anchorages, splices, detailing; design for durability (including service life design aspects, deterioration mechanisms, modelling of deterioration mechanisms, environmental influences, influences of design and execution on durability); fire design (including changes in material and structural properties, spalling, degree of deterioration), member design (linear members and slabs with reinforcement layout, deep beams); management, assessment, maintenance, repair (including, conservation strategies, risk management, types of interventions) as well as aspects of execution (quality assurance), formwork and curing. The updated textbook provides the basics of material and structural behaviour and the fundamental knowledge needed for the design, assessment or retrofitting of concrete structures. It will be essential reading material for graduate students in the field of structural concrete, and also assist designers and consultants in understanding the background to the rules they apply in their practice. Furthermore, it should prove particularly valuable to users of the new editions of Eurocode 2 for concrete buildings, bridges and container structures, which are based only partly on MC90 and partly on more recent knowledge which was not included in the 1999 edition of the textbook.

*Capacity Charts for the Hydraulic Design of Highway Culverts* John Wiley & Sons  
Low-level river crossings, including culverts, are important for delivering a

range of valuable socioeconomic services, including transportation and hydrological control. These structures are also known to have negative impacts on freshwater river system morphology and ecology, including the blockage of upstream fish passage, particularly small-body-mass fish species. Given the enormous environmental problems created by road crossings, new hydraulic engineering guidelines are proposed for fish-friendly multi-cell box culvert designs. The focus of these guidelines is on smooth box culverts without appurtenance, with a novel approach based upon three basic concepts: (I) the culvert design is optimized for fish passage for small to medium water discharges, and for flood capacity for larger discharges, (II) low-velocity zones are provided along the wetted perimeter in the culvert barrel, and quantified in terms of a fraction of the wetted flow area where the local longitudinal velocity is less than a characteristic fish speed linked to swimming performances of targeted fish species, and (III) the culvert barrel is smooth, without any other form of boundary treatment and appurtenance. The present monograph develops a number of practical considerations, in particular relevant to box culvert operations for less-than-design discharges. It is argued that upstream fish passage capabilities would imply a revised approach to maintenance, in part linked to the targeted fish species. This reference work is authored for civil and environmental engineers, as well as biology and ecology scientists interested in culvert design. While the book is aimed to professionals, the material is also lectured in postgraduate courses and in professional short courses.

**Structural Concrete Textbook,**

**Volume 4** PHI Learning Pvt. Ltd.

This is a compilation of papers presented at the 6th International Conference on Asian and Pacific Coasts (APAC2011) held on December 14-16, 2011 in Hong Kong, China. It contains more than 200 articles addressing a wide spectrum of issues, ranging from conventional coastal engineering problems (such as wave hydrodynamics and sediment transport) to issues of contemporary interest (such as tsunami, coastal development, climate change and seawater level rise, shoreline protection, marine energy, nearshore ecology, oil spill, etc.). Authors present their experiences in tackling these problems, by means of theoretical modeling, numerical simulation, laboratory and field observations, with an aim to advance fundamental understanding of the controlling mechanisms, as well as to develop solutions for practical designs. This volume serves to promote technological progress and activities, technical knowledge transfer and cooperation on an international scale.

**Earthquake Engineering for Nuclear Facilities** fib Fédération internationale du béton

This manual has been developed to simplify and facilitate the structural design of box culverts and keep pace with developments in structural analysis technologies and employ them to reach the best use. It is considered as a practical book suitable for the current methods used in the design, and since the finite element programs have become a basic requirement for design in most of professional companies, it is necessary to link these programs to the manual solutions and understand the loads, analysis and outputs to reach the worst-case scenarios without forgetting the economic factors which is located in

the second place after safety. The author has relied on the basic AASHTO LRFD Bridge Design Specification, Seventh Edition (2014). For more details, please visit <https://centralwestpublishing.com> Recommended Design Specifications for Live Load Distribution to Buried Structures World Scientific

This report explores analytical and design methods for the seismic design of retaining walls, buried structures, slopes, and embankments. The Final Report is organized into two volumes. NCHRP Report 611 is Volume 1 of this study. Volume 2, which is only available online, presents the proposed specifications, commentaries, and example problems for the retaining walls, slopes and embankments, and buried structures. *Water and Wastewater Engineering, Volume 1* Springer

Since the publication of its first edition in 1999, 'The Hydraulics of Open Channel Flow' has been praised by professionals, academics, students and researchers alike as the most practical modern textbook on open channel flow available. This new edition includes substantial new material on hydraulic modelling, in particular addressing unsteady open channel flows. There are also many new exercises and projects, including a major new revision assignment. This innovative textbook contains numerous examples and practical applications, and is fully illustrated with photographs. Dr Chanson introduces the basic principles of open channel flow and takes readers through the key topics of sediment transport, hydraulic modelling and the design of hydraulic structures. ·Comprehensive coverage of the basic principles of key application areas of the hydraulics of open channel flow ·New exercises and examples added to aid understanding ·Ideal for use by students and lecturers

in civil and environmental engineering  
**Seismic Analysis and Design of Retaining Walls, Buried Structures, Slopes, and Embankments**

Transportation Research Board National Research

This book is a comprehensive compilation of earthquake- and tsunami-related technologies and knowledge for the design and construction of nuclear facilities. As such, it covers a wide range of fields including civil engineering, architecture, geotechnical engineering, mechanical engineering, and nuclear engineering, for the development of new technologies providing greater resistance against earthquakes and tsunamis. It is crucial both for students of nuclear energy courses and for young engineers in nuclear power generation industries to understand the basics and principles of earthquake- and tsunami-resistant design of nuclear facilities. In Part I, "Seismic Design of Nuclear Power Plants", the design of nuclear power plants to withstand earthquakes and tsunamis is explained, focusing on buildings, equipment's, and civil engineering structures. In Part II, "Basics of Earthquake Engineering", fundamental knowledge of earthquakes and tsunamis as well as the dynamic response of structures and foundation ground are explained.

Hydraulic Design of Energy Dissipators for Culverts and Channels Firewall Media

This synthesis report will be of interest to geotechnical, structural, and bridge engineers, especially those involved in the development and implementation of the geotechnical aspects of the AASHTO Bridge Code. The synthesis documents a review of geotechnical related LRFD specifications and their development worldwide to compare them with the current AASHTO LRFD Bridge Code.

Design procedures for foundations, earth retaining structures, and culverts are summarized and compared with the methods specified by the AASHTO code. This TRB report provides information designed to assist engineers in implementing the geotechnical features of LRFD methods. Information for the synthesis was collected by surveying U.S. and Canadian transportation agencies and by conducting a literature search using domestic and international sources. Interviews were also conducted with selected international experts. The limited available experience in the United States and information from international practice are discussed to understand the problems that have arisen in order that solutions may be found. Based on the studies reported here, suggestions for improving the code are identified.

**Fish Swimming in Turbulent Waters** Elsevier

This publication contains clear and concise guidelines for the hydraulic design of culverts and describes the hydraulic behaviour of culverts in as simple a form as is consistent with the complexities of their actual behaviour. *Culvert Design and Operation Guide* Transportation Research Board  
 This updated third edition of the textbook on design of bridge structures continues to provide comprehensive coverage of both theory and design practice within a single capsule. It is intended for undergraduate and postgraduate students of civil engineering. It is also considered useful for practicing civil engineers and designers who need a ready reckoner on important design aspects on bridges. This third edition comes with three recent topics in bridge engineering. Chapters on limit state method design of



concrete bridges, flyovers, and smart structural health monitoring of bridges, have been appended. The most distinguishing features of this edition comprise:

- Design of concrete bridges based on both working stress and limit state methods
- Detailed design drawings of bridges
- Detailed overview of flyovers
- Exposition to smart structural health monitoring of bridges

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**Design of Small Canal Structures, 1974** Transportation Research Board  
**The Manual for Bridge Evaluation**  
iENGINEERING

*Design of Underground Structures*

Reinforced Concrete Structures Vol. II