Precast Concrete Box Culverts

Industrial Fatigues and Its Causes
Part 2, Large Culverts (from 1500mm Span and Up to and Including 4200mm Span and 4200mm Height)
Standard Specification
Pipes and Box Culverts : Hydraulic Design Manual
Standard specification for precast concrete box culverts (metric units).
Precast Reinforced Concrete Box Culverts
DR 09064 Precast Reinforced Concrete Box Culverts - Part 1
Precast Reinforced Concrete Box Culverts. Part 1. Small Culverts (not Exceeding 1200 Mm Width and 900 Mm Depth).
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Finite Element Analysis of Precast Concrete Culverts
Field Performance Evaluation of Precast Concrete Box Culverts, Aluminum Culverts, and Galvanized Metal Arches and Pipe Arches
MRTS72 Manufacture of Precast Concrete Elements
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Transport and Main Roads Specifications
Durability Characteristics of Precast Concrete Box Culverts
CIGOS 2019, Innovation for Sustainable Infrastructure
A Guide to Site Practice
Precast Reinforced Concrete Box Culverts
Hydraulics of Precast Concrete Conduits
Australian Standard Specification for Precast Reinforced Concrete Box Culverts
Standard Precast Concrete Box Culverts

Transport and Main Roads Specifications
Concrete Pipe Design Manual
Concrete Pipe and Box Culvert Installation
Box Culverts
Division of Planning Research on Call, Agreement 34652
Precast concrete products - Box culverts
Design and Proof Test Requirements for Precast Reinforced Concrete Box Culverts
Proceedings of the 5th International Conference on Geotechnics, Civil Engineering Works and Structures
Precast Concrete Products. Box Culverts
Evaluation of precast concrete box sections installed without shear connectors
Part 1 : Small Culverts
Performance Based Design and Testing of Large Precast Reinforced Concrete Box Culverts
Specification for the Erection of Precast Reinforced Concrete Box Culverts

EVA DANIELA

Industrial Fatigues and Its Causes ASTM International
This specification suite applies to the manufacture of precast reinforced concrete elements other than box culverts, machine-manufactured pipes and pre-tensioned prestressed concrete members. It includes wet-cast steel-reinforced concrete pipes.
Part 2, Large Culverts (from 1500mm Span and Up to and Including 4200mm Span and 4200mm Height) iENGINEERING
"His specification covers joints for precast concrete pipe and box and other sections using preformed flexible joint sealants for use in storm sewers and culverts which are not intended to operate under internal pressure, or are not subject to infiltration or exfiltration limits. Joint material used in horizontal applications is intended to prevent the flow of solids through the joint."--ASTM International website.
Standard Specification ASTM International
This Specification suite applies to the manufacture of small and large precast reinforced concrete rectangular box culverts and other associated culvert components for the conveyance of stormwater, which does not place the culvert under internal pressure.
Pipes and Box Culverts : Hydraulic Design Manual Springer Nature
This study presents the experimental investigation of the shear capacity of four precast reinforced concrete box culverts. Each culvert was subjected to a monotonically increasing load through a 20-in x 10-in load plate, designed to simulate a standard HS 20-44 wheel footprint. Each box was instrumented with the following: strain gages, load cell, high-

resolution laser sensor, data acquisition hardware and software, and laptop computer. The tests were conducted on 1.22 m x 1.22 m x 1.22 m (4 ft x 4 ft x 4 ft) box culverts, with load being applied at the free spigot end. The location of the load plate in relation to the span varied for each test in order to induce maximum shear stresses. Results of physical load tests indicate that free culvert ends are adequate in shear without the use of edge beams. The results from each test detailed herein are intended to provide data for the verification and convergence of an analytical model currently under development.

Standard specification for precast concrete box culverts (metric units). Amer Society of Civil Engineers

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Precast Reinforced Concrete Box Culverts

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Box CulvertsPrecast concrete, Concretes, Culverts, Structures, Prefabricated parts, Construction materials, Reinforced concrete, Performance, Strength of materials, Dimensional tolerances, Test methods, Conformity, MarkingFinite Element Analysis of Precast Concrete CulvertsThe US Federal Highway Administration (FHWA) reports 230.000 of the 577.000 bridges in the United States as deficient functionally or structurally. The majority of the structurally deficient bridges are short-span, averaging less than 15 m (50 feet) in length. Within the past two decades, prefabricated culverts have become economical alternatives for replacing deteriorating short-span bridges and cast-in-place box culverts. These prefabricated structures include reinforced concrete arches, four-sided and three-sided reinforced concrete culverts, and metal box culverts. The most commonly used type is the precast reinforced concrete culverts due to its durability, minimal field construction time, and favorable cost. Several test programs have concluded that concrete box culverts of standard ASTM C850 are structurally conservative. The strain and deflection data from model testing were found to be in good agreement with field testing of prototypes. Ihe availability of the finite element analysis programs provide the engineer an opportunity to model the actual three-dimensional geometry and boundary conditions more accurately. This research will demonstrate the use of the finite element method in analyzing me structural behavior and stress distribution of four-sided and three-sided concrete box culverts subjected to various highway loadings. A finite element modeling technique will be recommended for use by engineers. The results will assist in modeling and predicting the actual strength and behavior of a particular ASTM C 850 section or a new culvert with larger opening. Thirteen four-sided and three-sided concrete culverts will be idealized using the finite clement structural package SAP90. The following element types will be considered: (a) plate bending and stretching (shell) elements; (b)eight-node brick elements. A mesh sensitivity analysis will be performed to select a proper finite element discretization of the culverts. The culverts will be loaded with AASHTO wheel load including impact effect. Simple supports will be used at the bottom side edges. The maximum deflection in the culvert will be computed as well as the maximum moment in the upper face. The stress distribution will also be investigated. The three-dimensional cases to be analyzed will be compared to the two-dimensional frame analysis approach proposed by AASHTO (1992), and to test results from prototype culverts.Precast Reinforced Concrete Box Culverts. Part 1. Small Culverts (not Exceeding 1200 Mm Width and 900 Mm Depth).Hydraulics of Precast Concrete ConduitsPipes and Box Culverts : Hydraulic Design ManualHydraulics of precast concrete conduitspipes and box culverts : hydraulic design manualIndustrial Fatigues and Its CausesSpecification for Precast Reinforced Concrete Box CulvertsPart 1 : Small CulvertsDR 09064 Precast Reinforced Concrete Box Culverts - Part 1Small Culverts (not Exceeding 1200 Mm Span and 1200 Mm Height) Via Standards Australia OnlineDivision of Planning Research on Call, Agreement 34652Evaluation of degradation of concrete box culverts and 3-sided culverts. Task 2The study presents an evaluation of the deterioration of reinforced concrete 3-sided culverts and reinforced concrete box culverts in Ohio. The Office of Structural Engineering (OSE) database for bridge size culverts (structures with a span length of 10 ft. or greater along roadway centerline) was provided to by Ohio Department of Transportation (ODOT). The database included a record based on culvert inspection data, such as general appraisal and overall culvert condition ratings. Using the provided data, Markovian deterioration models and Weibull survival analysis models were developed for cast-in-place and precast reinforced concrete 3-sided and reinforced concrete box culverts. The major findings of the study are: Data preprocessing and quality assurance should be planned and coordinated properly with a systematic procedure outlined to limit data manipulation; Markovian models can be modified to model non-standard transitions, which were encountered in the data, such as condition rating improvement and two condition ratings drop in one year; On average, cast-in-place culverts deteriorate slightly faster up to the half of the design life and maintain a slightly higher condition rating near the end of the design life compared to precast 3-sided and box culverts; On average, cast-in-place box culverts maintain a slightly higher condition rating throughout their design life compared to 3-sided cast-in-place culverts; Precast 3-sided and box culverts have a similar deterioration trend on average; The Weibull survival analysis can be highly sensitive to censored to uncensored data ratio and extreme values.Specification for the Erection of Precast Reinforced Concrete Box CulvertsPrecast Reinforced Concrete Box CulvertsPart 2, Large Culverts (from 1500mm Span and Up to and Including 4200mm Span and 4200mm Height)Experimental Investigation of Shear Capacity of Precast Reinforced Concrete Box CulvertsThis study presents the experimental investigation of the shear capacity of four precast reinforced concrete box culverts. Each culvert was subjected to a monotonically increasing load through a 20-in x 10-in load plate, designed to simulate a standard HS 20-44 wheel footprint. Each box was instrumented with the following: strain gages, load cell, high-resolution laser sensor, data acquisition hardware and software, and laptop computer. The tests were conducted on 1.22 m x 1.22 m x 1.22 m (4 ft x 4 ft x 4 ft) box culverts, with load being applied at the free spigot end. The location of the load plate in relation to the span varied for each test in order to induce maximum shear stresses. Results of physical load tests indicate that free culvert ends are adequate in shear without the use of edge beams. The results from each test detailed herein are intended to provide data for the verification and convergence of an analytical model currently under development.Box CulvertsDivision of Engineering Research on CallExterior protection of precast reinforced concrete culverts. Task #9Application of exterior coatings and membrane waterproofing on precast reinforced concrete box culverts, three-sided flat-topped culverts, and precast reinforced concrete arch and round sections is required by Ohio Department of Transportation (ODOT). Sealing and waterproofing limit the intrusion of ground water through the top of the joint and it protects the top and sides of the concrete surfaces from top-down chloride intrusion, thus extending the service life of the culvert. The intrusion of water through the joint, particularly in low cover applications, can lead to premature degradation of the reinforced concrete. This project investigated the suitability of the current exterior surface preparation of large-span reinforced concrete structures to eliminate water infiltration. Based on survey data from 24 state DOT agencies and precast concrete industry, literature review, and evaluation of ODOT's current waterproofing and joint treatment methods, successful practices are identified and recommended for repair and protection of precast concrete culverts.Australian Standard Specification for Precast Reinforced Concrete Box CulvertsDesign Automation for Box Culverts Using Web Based ApplicationOne of the fast and economical ways of putting tunnels or stream crossings under roadways is to use box culverts. Box culverts are structurally rigid, easy to construct, and easy to add length when needed. Because of their simple geometric configuration, precast concrete box culverts with various dimensions are commonly used in the U.S. In some cases, non-standard box culverts are also used, for which the design document has to be produced per project design specification. The design process of box culverts is relatively easy and repetitive because of their typical geometric configuration. In practice, engineers are following exactly the same process with different dimensions and loading conditions to design box culverts. Microsoft Excel spreadsheet is therefore often used to speed up this repetitive calculation process. In India, many designers use STAAD.Pro for the structural analysis of box culverts and bring the results of this analysis to a Microsoft Excel spreadsheet to carry out the remaining calculations. However, all these cases are dealt separately and a significant amount of time is used to come up with the final design. In addition, it has been challenging to keep all engineering calculations and drawings of a specific box culvert for its lifecycle. One of the solutions that one can come up with for this challenge is to automate the entire design process in one package and keep all design documents in one location. This study presents the Web-based application we developed to 1) automate the box culvert design process and 2) keep all design documents in one location. This Web-based application is developed based on Indian Standard codes (IS) and Indian road congress codes (IRC) using ASP.net. This study presents how this application was developed, how it is working, and how it improved the design process of box culverts in our tests. This study shows that results obtained from this application are very close to the traditional design process and can be successfully used for designing of box culverts in India. Also the study concludes that there is a significant amount of time saving in the design process when this application is used instead of traditional design process. The electronic version of this dissertation is accessible from http://hdl.handle.net/1969.1/155015Transport and Main Roads SpecificationsMRTS24 Manufacture of Precast Concrete CulvertsThis Specification suite applies to the manufacture of small and large precast reinforced concrete rectangular box culverts and other associated culvert components for the conveyance of stormwater, which does not place the culvert under internal pressure.Concrete Pipe Design ManualConcrete Pipe and Box Culvert Installation

Precast concrete, Concretes, Culverts, Structures, Prefabricated parts, Construction materials, Reinforced concrete, Performance, Strength of materials, Dimensional tolerances, Test methods, Conformity, Marking

DR 09064 Precast Reinforced Concrete Box Culverts - Part 1

The study presents an evaluation of the deterioration of reinforced concrete 3-sided culverts and reinforced concrete box culverts in Ohio. The Office of Structural Engineering (OSE) database for bridge size culverts (structures with a span length of 10 ft. or greater along roadway centerline) was provided to by Ohio Department of Transportation (ODOT). The database included a record based on culvert inspection data, such as general appraisal and overall culvert condition ratings. Using the provided data, Markovian deterioration models and Weibull survival analysis models were developed for cast-in-place and precast reinforced concrete 3-sided and reinforced concrete box culverts. The major findings of the study are: Data preprocessing and quality assurance should be planned and coordinated properly with a systematic procedure outlined to limit data manipulation; Markovian models can be modified to model non-standard transitions, which were encountered in the data, such as condition rating improvement and two condition ratings drop in one year; On average, cast-in-place culverts deteriorate slightly faster up to the half of the design life and maintain a slightly higher condition rating near the end of the design life compared to precast 3-sided and box culverts; On average, cast-in-place box culverts maintain a slightly higher condition rating throughout their design life compared to 3-sided cast-in-place culverts; Precast 3-sided and box culverts have a similar deterioration trend on average; The Weibull survival analysis can be highly sensitive to censored to uncensored data ratio and extreme values.

Precast Reinforced Concrete Box Culverts. Part 1. Small Culverts (not Exceeding 1200 Mm Width and 900 Mm Depth).

One of the fast and economical ways of putting tunnels or stream crossings under roadways is to use box culverts. Box culverts are structurally rigid, easy to construct, and easy to add length when needed. Because of their simple geometric configuration, precast concrete box culverts with various dimensions are commonly used in the U.S. In some cases, non-standard box culverts are also used, for which the design document has to be produced per project design specification. The design process of box culverts is relatively easy and repetitive because of their typical geometric configuration. In practice, engineers are following exactly the same process with different dimensions and loading conditions to design box culverts. Microsoft Excel spreadsheet is therefore often used to speed up this repetitive calculation process. In India, many designers use STAAD.Pro for the structural analysis of box culverts and bring the results of this analysis to a Microsoft Excel spreadsheet to carry out the remaining calculations. However, all these cases are dealt separately and a significant amount of time is used to come up with the final design. In addition, it has been challenging to keep all engineering calculations and drawings of a specific box culvert for its lifecycle. One of the solutions that one can come up with for this challenge is to automate the entire design process in one package and keep all design documents in one location. This study presents the Web-based application we developed to 1) automate the box culvert design process and 2) keep all design documents in one location. This Web-based application is developed based on Indian Standard codes (IS) and Indian road congress codes (IRC) using ASP.net. This study presents how this application was developed, how it is working, and how it improved the design process of box culverts in our tests. This study shows that results obtained from this application are very close to the traditional design process and can be successfully used for designing of box culverts in India. Also the study concludes that there is a significant amount of time saving in the design process when this application is used instead of traditional design process. The electronic version of this dissertation is accessible from http://hdl.handle.net/1969.1/155015

Standard Specification Precast Concrete Box Culverts

This book presents selected articles from the 5th International Conference on Geotechnics, Civil Engineering Works and Structures, held in Ha Noi, focusing on the theme “Innovation for Sustainable Infrastructure”, aiming to not only raise awareness of the vital importance of sustainability in infrastructure development but to also highlight the essential roles of innovation and technology in planning and building sustainable infrastructure. It provides an international platform for researchers, practitioners, policymakers and entrepreneurs to present their recent advances and to exchange knowledge and experience on various topics related to the theme of “Innovation for Sustainable Infrastructure”.

Draft of Final Report, Precast Box Culvert Study

Application of exterior coatings and membrane waterproofing on precast reinforced concrete box culverts, three-sided flat-topped culverts, and precast reinforced concrete arch and round sections is required by Ohio Department of Transportation (ODOT). Sealing and waterproofing limit the intrusion of ground water through the top of the joint and it protects the top and sides of the concrete surfaces from top-down chloride intrusion, thus extending the service life of the culvert. The intrusion of water through the joint, particularly in low cover applications, can lead to premature degradation of the reinforced concrete. This project investigated the suitability of the current exterior surface preparation of large-span reinforced concrete structures to eliminate water infiltration. Based on survey data from 24 state DOT agencies and precast concrete industry, literature review, and evaluation of ODOT's current waterproofing and joint treatment methods, successful practices are identified and recommended for repair and protection of precast concrete culverts.

Small Culverts (not Exceeding 1200 Mm Span and 1200 Mm Height) Via Standards Australia Online

AASHTO developed the LRFD Bridge Design Specification, with the intent of replacing the Standard Specifications for Highway Bridges with a reliability based code that provides more uniform safety for all elements of bridges. Although many provisions in these two codes are the same, there are important differences that can have a significant effect on the amount of reinforcement required for buried precast reinforced concrete box culverts under some conditions.

Standard Practice for Direct Design of Buried Precast Concrete Box Sections

This Standard covers the direct design of buried one-cell precast reinforced concrete box sections for the conveyance of sewage, industrial wastes, storm water and drainage, and to serve as tunnels. The design and analysis method accounts for the interaction between the box sections and soil envelope in calculating loads, pressure distributions, moment, thrust and shear in the box section, and includes a procedure for calculating the required reinforcement. Load effects are determined separately for each loading.

The structural design of one-cell precast reinforced concrete box sections is based on a limits state design procedure that accounts for strength and serviceability criteria and is consistent with the procedures outlined in Section 17 of the AASHTO Standard Specification for Highway Bridges. The design criteria include: structural aspects, such as flexure, thrust, and shear strengths; handling and installation; fatigue limits; and crack width control. The design of a one-cell precast reinforced concrete box section is based on the assumption that specified design bedding and installation requirements will be achieved during construction of the installation. Owners and ownersýýý engineers will find this Standard useful in preparing contract documents based on the direct design method.

Specification for Precast Reinforced Concrete Box Culverts

Three four-sided box culverts of different span lengths and fixed rise, haunches, wall and slab thicknesses, and width will be considered Every culvert size is analyzed using six different overburden soil covers with lateral and bearing pressures The lateral and bearing pressures are consecutively added to all culverts at later stage for reanalysis The effects of overburden, lateral, and bearing pressures on deflections and positive and negative bending in top slab of culverts are investigated A correspondent plane frame analysis as required by the American Association of State Highway and Transportation Officials (AASHTO) is performed The adequacy of A ASHTO plane frame to simulate the actual (3D) Finite element models is investigated.

Division of Engineering Research on Call

The US Federal Highway Administration (FHWA) reports 230.000 of the 577.000 bridges in the United States as deficient functionally or structurally. The majority of the structurally deficient bridges are short-span, averaging less than 15 m (50 feet) in length. Within the past two decades, prefabricated culverts have become economical alternatives for replacing deteriorating short-span bridges and cast-in-place box culverts. These prefabricated structures include reinforced concrete arches, four-sided and three-sided reinforced concrete culverts, and metal box culverts. The most commonly used type is the precast reinforced concrete culverts due to its durability, minimal field construction time, and favorable cost. Several test programs have concluded that concrete box culverts of standard ASTM C850 are structurally conservative. The strain and deflection data from model testing were found to be in good agreement with field testing of prototypes. Ihe availability of the finite element analysis programs provide the engineer an opportunity to model the actual three-dimensional geometry and boundary conditions more accurately. This research will demonstrate the use of the finite element method in analyzing me structural behavior and stress distribution of four-sided and three-sided concrete box culverts subjected to various highway loadings. A finite element modeling technique will be recommended for use by engineers. The results will assist in modeling and predicting the actual strength and behavior of a particular ASTM C 850 section or a new culvert with larger opening. Thirteen four-sided and three-sided concrete culverts will be idealized using the finite clement structural package

SAP90. The following element types will be considered: (a) plate bending and stretching (shell) elements; (b)eight-node brick elements. A mesh sensitivity analysis will be performed to select a proper finite element discretization of the culverts. The culverts will be loaded with AASHTO wheel load including impact effect. Simple supports will be used at the bottom side edges. The maximum deflection in the culvert will be computed as well as the maximum moment in the upper face. The stress distribution will also be investigated. The three-dimensional cases to be analyzed will be compared to the two-dimensional frame analysis approach proposed by AASHTO (1992), and to test results from prototype culverts.
Finite Element Analysis of Precast Concrete Culverts

Field Performance Evaluation of Precast Concrete Box Culverts, Aluminum Culverts, and Galvanized Metal Arches and Pipe Arches

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