



Bridge Design Course: Concrete and Steel Superstructures, Bearings and Substructures



Bridge Design Course: Concrete and Steel Superstructures, Bearings and Substructures

Introduction:

The Bridge Design Course on concrete and steel superstructures, bearings and substructures is a 2-week course for bridge design engineers, design consultants and infrastructure owners' engineers that ends with a Preliminary Bridge Design Package for a case crossing. Road, rail and large infrastructure programmes lose time and budget when bridge type, span arrangement, bearings and foundations are fixed late or checked against the wrong load model. Nominees already carry out structural calculations at work, and they learn through case studies built on realistic crossings, design calculations and erection schemes. CoreConcept Training Center delivers this bridge design course using AASHTO LRFD principles.

Course Objectives:

- Select a bridge type and span arrangement for a road, rail or waterway crossing using a documented type study and design basis
- Apply AASHTO LRFD limit states, the HL-93 live load model and railway loads to derive governing force effects on a bridge deck
- Design precast prestressed concrete girders, deck slabs and post-tensioned box girders for flexure, shear and prestress losses
- Proportion steel plate girders and composite decks, including shear connectors, cross-frames and fatigue-sensitive details
- Size bearings, movement joints, piers, abutments and pile foundations for the forces and movements the superstructure delivers
- Plan an erection method such as incremental launching, balanced cantilever or span-by-span construction and check its construction stages

Target Audience:

- Engineers responsible for preparing bridge design calculations and drawings for road and rail crossings
 - Design consultancy staff responsible for bridge type studies, design basis reports and design checks
 - Owner and programme engineers responsible for reviewing bridge designs submitted by consultants and contractors
 - Contractor design team members responsible for erection engineering and construction stage checks of bridge decks
 - Structural engineers moving from building design who are responsible for new bridge and viaduct packages
-

Course Outline:

Day 1: Bridge Type Selection, Span Arrangement and Design Basis

- Span Length Ranges for Slab, Girder and Box Decks
- Crossing Constraints Survey for Roads, Rail and Waterways
- Bridge Type Study Matrix Comparing Cost and Constructability
- Design Basis Report Contents and Design Criteria Sheet
- Superstructure Depth to Span Ratios for Preliminary Sizing

Day 2: AASHTO LRFD Limit States and Bridge Loads

- AASHTO LRFD Strength, Service, Fatigue and Extreme Event Limit States
- HL-93 Design Truck, Tandem and Lane Load Model
- Dynamic Load Allowance and Multiple Presence Factor Application
- Railway Live Load Models with Braking and Traction Forces
- Wind, Temperature Gradient, Creep and Shrinkage Load Effects

Day 3: Structural Analysis of Bridge Decks

- Live Load Distribution Factors for Girder Moments and Shears
- Influence Lines for Continuous Span Moment Envelopes
- Grillage Model Set-Up for Skewed and Curved Decks
- Line Girder Versus Three-Dimensional Finite Element Deck Models
- Load Combination Tables and Governing Force Effect Extraction

Day 4: Concrete Deck Slabs and Prestressed Girder Design

- Empirical and Traditional Deck Slab Reinforcement Design Methods
- Precast Pretensioned I-Girder and Bulb-Tee Section Selection
- Prestress Losses from Elastic Shortening, Creep and Relaxation
- Flexural and Shear Resistance Checks for Prestressed Girders
- Continuity Diaphragms for Made-Continuous Precast Girder Spans

Day 5: Case Study Two-Span Prestressed Girder Overpass

- Overpass Case Design Criteria and Girder Spacing Layout
 - Overpass Case Distribution Factor and Moment Envelope Calculation
 - Overpass Case Strand Pattern and Debonding Layout Check
 - Overpass Case Deck Slab and Haunch Detailing Review
 - Week-One Design Calculation Peer Check and Findings Log
-

Day 6: Steel Composite Girders and Post-Tensioned Box Girders

- Steel Plate Girder Proportioning and Web Stiffener Design
- Shear Connector Design for Composite Steel and Concrete Decks
- Cross-Frame Layout and Lateral Torsional Buckling During Deck Pour
- Fatigue Detail Categories for Welded Steel Bridge Girders
- Post-Tensioned Box Girder Tendon Profile and Section Design

Day 7: Bearings, Movement Joints, Seismic Design and Design Checking

- Laminated Elastomeric Bearing Design for Shear Strain and Rotation
- Pot and Spherical Bearing Selection for High Vertical Loads
- Movement Joint Gap Sizing from Thermal and Creep Movements
- Seismic Isolation Bearings and Response Spectrum Analysis
- Independent Design Check and Category Check Procedures

Day 8: Piers, Abutments and Foundation Design

- Pier Column and Pier Cap Design for Combined Actions
- Integral and Semi-Integral Abutment Design Concepts
- Cantilever Abutment Earth Pressure and Approach Slab Design
- Pile Group Design for Pier and Abutment Foundations
- Vessel and Vehicle Collision Loads on Bridge Piers

Day 9: Erection Methods, Construction Staging and Design Review

- Incremental Launching with Launching Nose and Sliding Pads
- Balanced Cantilever Construction with Form Travellers and Closure Pours
- Span-by-Span Erection with Launching Gantries and Precast Segments
- Construction Stage Analysis and Camber Control Tables
- Design Review Meeting Agenda with Contractor and Owner Engineers

Day 10: Case Study Capstone Preliminary Bridge Design Package

- Case Crossing Constraints and Bridge Type Selection Review
 - Preliminary Superstructure Sizing and Live Load Analysis
 - Bearing Schedule and Substructure Concept Drawing Set
 - Erection Method Statement and Construction Staging Plan
 - Preliminary Bridge Design Package Presentation to Review Panel
-

Skills You Will Gain:

- Bridge Type and Span Selection
- Bridge Live Load Modelling
- Prestressed Girder Design
- Composite Steel Girder Design
- Bearing and Movement Joint Sizing
- Pier and Abutment Design
- Erection Method Planning
- Construction Stage Analysis

Why Attend This Course:

- Produce a Preliminary Bridge Design Package for a case crossing that the design manager and the owner's review engineer can use as a starting point
- Decide between precast girder, steel composite and box girder options for a given crossing on documented evidence
- Avoid late redesign caused by undersized bearings, missed construction stage effects or the wrong live load model
- Brief colleagues on the distribution factor, bearing sizing and erection staging methods practised in the case studies

Conclusion:

Back at work, the participant hands the Preliminary Bridge Design Package to the design manager and the owner's review engineer. They use it to confirm the bridge type, span arrangement, bearing schedule and erection method before detailed design is commissioned, and to set the design criteria that consultants and contractors must meet. After its first use on a live crossing, the unit should compare the preliminary girder sizes, bearing loads and staging assumptions with the detailed design and record where the early estimates needed correction.

Frequently Asked Questions FAQ:

What should engineers know before joining a bridge design course on concrete and steel superstructures?

Participants should already perform structural calculations for beams, slabs or frames and understand reinforced concrete and steel member design. Prior bridge experience helps but is not needed, because the first days cover bridge types, AASHTO LRFD limit states and bridge live load models.

How does a bridge design course differ from a bridge inspection and rehabilitation course?

This course designs new bridges, from type selection and live load analysis to girder, bearing, pier and erection design. An inspection and rehabilitation course assesses existing bridges, rates their remaining capacity and plans repair or strengthening work.

Why does bridge design of superstructures and substructures include erection methods?

Incremental launching, balanced cantilever and span-by-span construction place loads on a deck that differ from its final state. Designing for these construction stages early sets tendon layouts, camber and temporary supports and avoids costly changes once the contractor is appointed.

What do participants take back from the bridge design course on concrete and steel superstructures?

Participants take back a Preliminary Bridge Design Package for a case crossing, with a type study, design criteria, live load analysis, girder sizing, bearing schedule, substructure concepts and an erection method statement.
