



# Definition of Concrete Segmental Bridges

# Definition of Concrete Segmental Bridges

Requirements for Inclusion in the ASBI Segmental Bridge Database  
Maintained by the American Segmental Bridge Institute, ASBI

## Overview

The purpose of this document is to provide definitions and descriptions of the types of bridges and their attributes that are included in the Segmental Bridge Database maintained by the American Segmental Bridge Institute, ASBI.

The FHWA *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nations Bridges* (FHWA-PD-96-001) provides a way to identify segmental bridges under item numbers 43a (main span design) and 44a (approach span design) by selecting “Segmental Box Girder”. However, not all segmental bridges are “coded” this way. As a result, there are a number of bridges and unique structure types that are recognized by the industry as being built by the segmental method but are not reflected as such in the National Bridge Inspection (NBI) data.

## Database Eligibility

For inclusion in the ASBI Segmental Bridge Database, the bridge must:

- 1) Be comprised of concrete superstructure elements.
- 2) Have been placed into service after 1973. (This is the year the first concrete segmental bridge in the U.S., recognized by ASBI, was placed into service.)
- 3) Have been verified as having been built using one of the methods of construction outlined below.

The verification of the method of construction can be either from as-built plans, journal articles, site visits or other sources of documentation. The use of Streetviews or photographs are usually insufficient to make the distinction between segmental and other methods of construction such as cast-in-place box girders built on falsework.

While ASBI recognizes the segmental method can be applied to substructure elements, since this attribute is not identified in the NBI data, only bridges with segmental superstructure elements will be include in the ASBI database. In addition, precast spliced girders are also not included at these are not considered to be segmental since they do not meet the General Definition below.

## General Definition

Concrete Segmental bridges are defined as those having the following attributes:

Fabrication and erection of a structural element (superstructure) using individual elements, which may be either precast or cast-in-place. The completed structural element acts as a monolithic unit under some or all design loads. Post-tensioning is typically used to connect the individual elements. For superstructures, individual elements are typically short (with respect to the span length) box-shaped segments with monolithic flanges that comprise the full width of the structure (see ASBI Construction Practices Handbook, Chapter 2: Terminology).

## Methods of Construction Recognized as Concrete Segmental

### Precast Concrete Segmental Span-by-Span

In span-by-span construction, an entire span of precast segments is erected, posttensioned, and becomes self-supporting before the next span is erected. A means to support the span is required, typically a temporary erection truss/gantry, during the erection and post-tensioning process. This is illustrated in the photo of the Lesner Bridge in Virginia Beach, Virginia.



*Precast Span-by Span, Lesner Bridge, VA  
(Courtesy RS&H)*

## **Precast Concrete Segmental Balanced Cantilever**

Precast concrete balanced cantilever construction uses individual precast units that are placed using a process where erection progresses outwards from a central pier, on alternating sides of the pier, until the cantilever is complete. Adjacent cantilevers are then constructed until a span is completed via a mid-span concrete closure. This is illustrated by the construction photo of the Marc Basnight Bridge over the Oregon Inlet on the Outer Banks of North Carolina.



***Precast Balanced Cantilever, Bonner Bridge, NC  
(Courtesy of RS&H)***

## **Cast-in-Place Concrete Segmental Balanced Cantilever**

Cast-in-place (CIP) concrete balanced cantilevered construction refers to a process where segments are progressively cast at their final position in the structure, cantilevered on alternate sides of a central pier. The use of form travelers to construct the structure is a primary indicator of the method as shown in the photo below of the Gulf Intracoastal Waterway bridge in Matagorda, Texas.



***Cast-in-Place Balanced Cantilever  
the Gulf Intracoastal Waterway Bridge in Matagorda, TX  
(Photo Courtesy of ASBI)***

## **Cast-in-Place Concrete Segmental Incremental Launching**

Cast-in-place concrete segmental incremental launching involves construction of segments, one at a time, in a casting bed at one or both abutments. The entire completed span is then launched ahead across the piers by means of hydraulic jacks. This process is repeated until the span is complete. One of the few known examples in the U.S. is the Bellaire Causeway in Florida as pictured below.



*Incremental Launch, Belliare Beach Bridge, FL  
(Photo Courtesy of VSL)*

## **Moveable Scaffolding System (MSS)**

A movable scaffolding system (MSS) is a special-purpose self-launching form used with segments or spans that are cast in place. The movable scaffolding system is used to support a form while the concrete is cured; once the segment is complete, the scaffold and forms are moved to the end of the new segment and another segment is poured. The approach spans to the Long Beach International Gateway Bridge (Gerald Desmond Bridge replacement) in Long Beach were built using this technique.



***Long Beach International Gateway Bridge  
(Gerald Desmond Bridge Replacement), Long Beach, CA***



## Precast Full Span

Precast full span segmental is a variation on span-by-span construction whereby entire spans of precast segments may be constructed on the ground, or on barges, and then lifted into position. The Jamestown Verrazzano Bridge in Rhode Island was built using this technique.



*Lifting an Entire Span, Jamestown Verrazzano Bridge, RI  
(Photo Courtesy of FIGG Engineering Group)*



## Precast Progressive Placement

In precast segmental progressive placement, segments are typically erected in cantilever in one direction only, from one pier to the next, using either temporary intermediate piers or cable stays (or both) to support the advancing cantilever. The most iconic of this construction technique is the Linn Cove Viaduct on the Blue Ridge Parkway.



*Progressive Placement, Linn Cove Viaduct, Blue Ridge Parkway, NC  
(Photo Courtesy of FIGG Engineering Group)*

## **Precast and Cast-in-Place Concrete Segmental Cable-Stayed Bridges**

A cable-stayed bridge has one or more towers (or pylons), from which cables support the bridge superstructure. A distinctive feature are the cables or stays, which run directly from the tower to the superstructure, normally forming a fan-like pattern or a series of parallel lines. The superstructure, not just the deck, must be comprised of concrete elements for inclusion in the ASBI database. The Sunshine Skyway Bridge in Florida is the most iconic example in the U.S. as pictured below.



***Concrete Segmental Cable-Stayed Bridge, Sunshine Skyway Bridge, FL  
(Photo Courtesy of FIGG Engineering Group)***

## **Precast and Cast-in-Place Extradosed Bridges**

An extradosed bridge employs a structure that combines the main elements of both a concrete box girder bridge and a cable-stayed bridge. Similar to cable-stayed bridges only in an Extradosed bridge, the towers are lower, there are typically fewer cables which, as a result of the shorter towers impart more of a compressive force into the superstructure than for a comparable cable-stayed bridge. The superstructure, not just the deck, must be comprised of concrete elements for inclusion in the ASBI database. The Pearl Harbor Memorial bridge, in New Haven, Connecticut, pictured below is one example.



***Extradosed Bridge, Pearl Harbor Memorial Bridge, in New Haven, CT  
(Photo Courtesy of Connecticut Department of Transportation)***

## **Precast and Cast-in-Place Finback Bridges**

These bridges of which there are believed to be only two examples in the U.S. are very similar to an extradosed bridge and are sometimes referred to as such. However, unlike an extradosed bridge where the supporting cables are external, in a finback bridge the cables are encased in a concrete wall or, fin, creating the finback name. Finback bridges must be comprised of concrete superstructure elements for inclusion in the ASBI database. The Selmon West Extension, pictured and the Barton Creek Bridge in Austin, Texas are the only two known examples.



***Precast Finback Bridge, Selmon West Extension, Tampa, FL  
(Photo Courtesy of Sarah Lesch)***

## Precast Segmental Arch Bridges

This method of construction is a variation on incremental launching. Match-cast precast concrete segments are used to create the arch ribs and spandrel columns. Precast segments are also commonly used for the pier columns. The O'Callaghan-Tillman Memorial Bridge between Clark County, NV & Mohave County AZ shown below is an example of this type of construction in the U.S.



*Precast Segmental Arch Bridge, O'Callaghan-Tillman Memorial Bridge  
Clark County, NV & Mohave County AZ  
(Photo Courtesy of FHWA)*