

Precast Concrete in Bridge Construction

OUTLINE

- **Introduction**
- **Applications**
- **Manufacturing Methods**
- **Design Procedures**
- **Installation**
- **Quality**



INTRODUCTION

Precast concrete has become a popular choice in modern bridge construction due to its efficiency, durability, and cost-effectiveness. Unlike traditional cast-in-place concrete, precast components are manufactured off-site in controlled environments and then transported to the construction site for assembly. This method offers several key benefits for bridge projects.

INTRODUCTION

1. Faster Construction

Since precast elements are produced ahead of time, on-site construction time is significantly reduced.

This leads to shorter project durations, minimizing traffic disruptions and lowering labor costs.

Bridges can be opened to the public sooner, improving infrastructure efficiency.

INTRODUCTION

2. High Quality and Durability

Precast concrete is made in controlled factory conditions, ensuring consistent quality and strength. The use of high-performance materials and precise curing processes results in longer-lasting bridge components that resist weathering, corrosion, and heavy traffic loads.

INTRODUCTION

3. Cost Savings

While the initial cost of precast elements may be higher than cast-in-place alternatives, the overall project savings come from reduced labor, faster completion, efficient design using minimum concrete cover, and lower maintenance expenses over the bridge's lifespan.

INTRODUCTION

4. Design Flexibility

Precast technology allows for innovative and complex bridge designs. Beams, decks, abutments, and parapets can be customized to meet structural and aesthetic requirements, supporting both standard and architecturally unique bridges.

INTRODUCTION

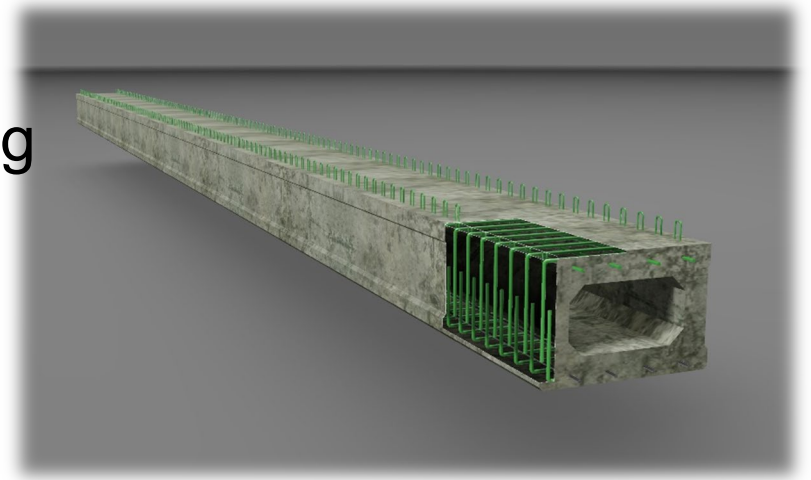
5. Reduced Environmental Impact

Precast construction generates less waste compared to traditional methods. Additionally, the controlled production process optimizes material usage, and some precast components can incorporate recycled materials and less carbon footprint.

Applications

1. Precast Beams and Girders

Precast beams and girders are among the most common uses of precast concrete in bridges. They provide strong, durable support for the superstructure and come in different shapes depending on design requirements:



Applications

NEBT (New England Bulb Tee)

Traditional and widely used for medium-span bridges.



Applications

Box Girders:

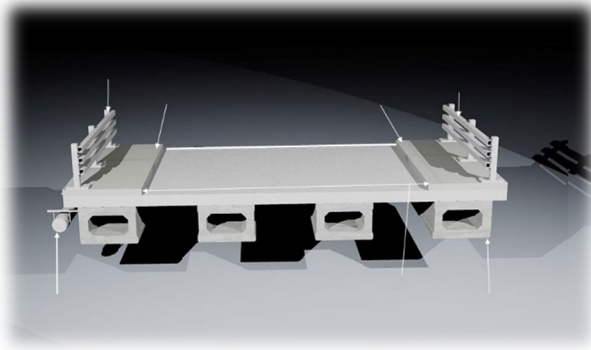
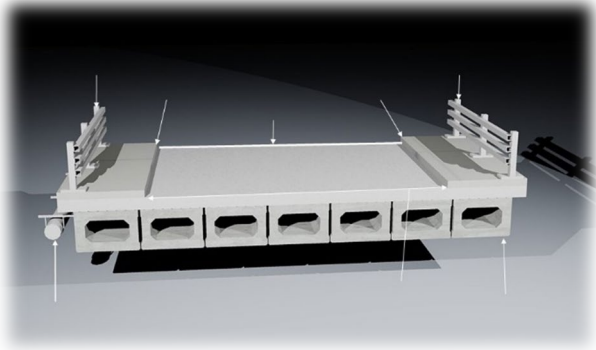
Hollow sections that offer high torsional strength, ideal for curved bridges or longer spans.



Applications

Spread /Adjacent Box Beams:

Adjacent Box beams are used in short spans over waterway that requires smooth bottom.



Applications

Next Beams (Northeast Extreme Tee)

An innovative, high-performance beam design that combines the benefits of bulb-tees and box beams for optimized structural efficiency.



Applications

2. Precast Deck Systems

Bridge decks are critical for distributing traffic loads, and precast concrete deck panels accelerate construction while ensuring durability. Common types include:



Applications

Full-Depth Precast Deck Panels:

Installed directly on girders,
eliminating the need for onsite
concrete pouring.



Applications

Partial-Depth Panels:

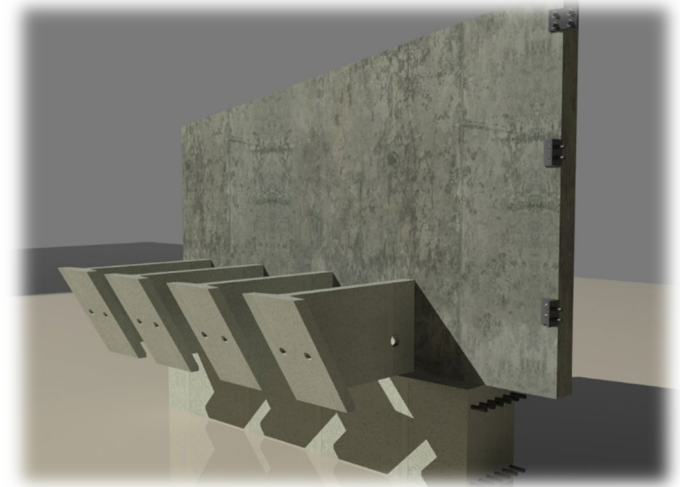
Used as a base layer, topped with cast-in-place concrete for a composite deck.



Applications

3. Precast Abutments and Wing Walls

Abutments support the bridge at its ends, transferring loads to the foundation. Precast abutments and wing walls offer:



Applications

Modular Precast Units:

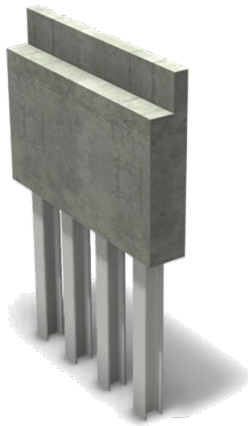
Prefabricated segments assembled on-site for rapid construction.



Applications

Integral Abutments:

Precast elements designed to minimize expansion joints, reducing long-term maintenance.



Applications

4. Precast Piers and Columns

Precast piers and columns are used for bridge substructures, providing vertical support for the superstructure. Applications include:

Applications

Single or Multi-Column Bents:

Precast columns connected with cap beams.

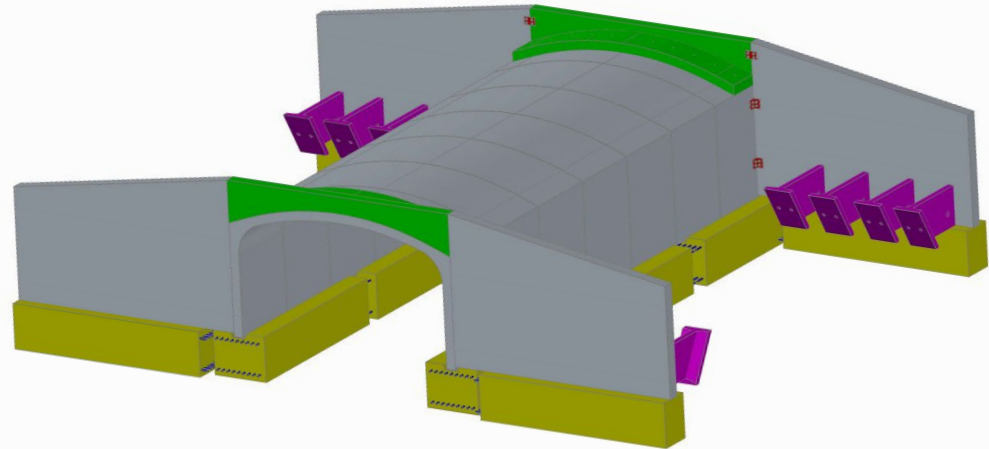
Pier Caps: Precast units placed atop columns to support girders.

Segmental Precast Piers: Used in large bridges where height and load requirements vary.

Applications

5. Precast Arch and Culvert Systems

For short-span bridges and culverts, precast arches and box culverts provide efficient solutions:



Applications

Precast Concrete Arches:

Used in scenic or urban bridges where aesthetics matter.



Applications

Box Culverts:

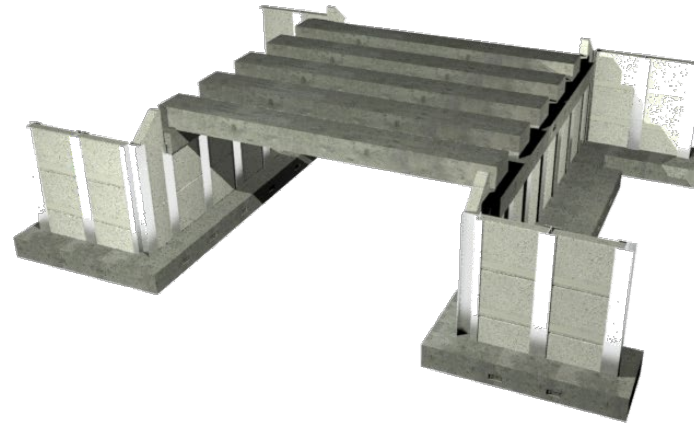
Modular units for stream crossings and underpasses.



Applications

6. Precast Modular Bridge Systems

For accelerated bridge construction (ABC), full precast modular systems are increasingly popular:



Applications

Precast Full-Span Bridge

Systems:

Entire bridge segments (deck and beams) are assembled off-site and installed using cranes or SPMT (Self-Propelled Modular Transporters).



Applications

Precast Bridge Replacement Systems:

Old bridges can be replaced in days rather than months using prefabricated units.



MANUFACTURING METHODS

Wet-Cast

- Concrete is poured into molds (forms) and vibrated to remove air bubbles.
- Cast with conventional concrete or self-consolidating concrete.
- Product cured in the form.
- Wet-cast is commonly used for large, custom-shaped elements like abutments, pier caps, and complex girders.

MANUFACTURING METHODS

Dry-Cast (High-Early-Strength Precast)

- A stiff, low-water concrete mix is compacted under high pressure.
- Common for repetitive elements like small beams, and modular blocks.
- The product is immediately stripped and the form is reused.
- Surface may appear textured due to manufacturing process.

Reinforcement and Post-Tensioning

A. Conventional Rebar Cage Construction

Steel rebar is pre-assembled in cages before concrete pouring.

Used for: Most precast bridge components.

Reinforcement and Post-Tensioning

B. Pretensioning

Steel strands are tensioned before casting; concrete bonds to them as it cures.

Used for: Prestressed I-beams, hollow-core slabs.

Reinforcement and Post-Tensioning

C. Post-Tensioning

Ducts are embedded in concrete, and strands are tensioned after curing.

Used for: Segmental bridge construction and long-span girders.

DESIGN

- **Designs are dependent on project specifications.**

DESIGN

List of common design standards.

- **AASHTO Standard Edition**
- **AASHTO LRFD**
- **PCI Precast Bridge Manual**
- **AREMA**
- **Local State Bridge Manual**

DESIGN – NOTES

Bridges are subject to:

- **Vertical loads from dead and live load**
- **Surcharge loads from nearby impact loads.**
- **Seismic loads where applicable.**

INSTALLATION

Transportation & Handling

Precast elements are transported from the plant to the site using:

- **Flatbed trucks** (for beams, deck panels).
- **Specialized trailers** (for long or heavy girders).
- **Self-propelled modular transporters (SPMTs)** (for full-span bridge modules).

.

INSTALLATION

Key Handling Considerations:

- **Use lifting loops, spreader beams, or nylon slings to prevent damage.**
- **Avoid impact loads during loading/unloading.**
- **Store units on level, stable ground with proper cushioning.**

QUALITY

- When purchasing and specifying box or three-sided precast concrete structures, you should specify certified plants.
- NPCA Certification program



CONCLUSION

The use of precast concrete in bridge construction spans nearly every structural component — from beams and decks to piers and full modular systems. Its benefits in speed, quality, and cost-efficiency make it a preferred choice for modern infrastructure projects. As technology advances, precast concrete will continue to play a pivotal role in building resilient, long-lasting bridges worldwide.