Introduction to Prestress

Prestress concrete bridge girders, beams, and box culverts take the purposes of pipe to the next level. With higher strength and water capacity, prestressed bridges bring together the benefits of precast concrete for a lasting, efficient, and economical solution.

History

Both precast and prestressed products have been used extensively throughout the 1800s and early 1900s. The Walnut Lane Memorial Bridge (1950) was one of the first to utilize both technologies. This bridge has shown to be an effective solution for highways in its life cycle.

Image: structurae.com

How It Works

The theory capitalizes on the fact that Steel is strong in tension, and concrete is strong in compression.

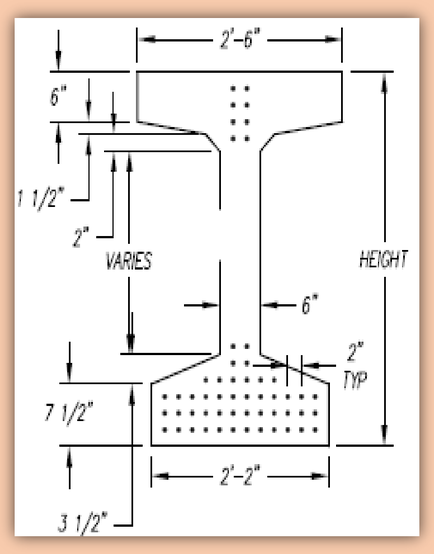
Steel strands, or cables, are stretched to apply tension, with the concrete being formed around the groups of strands.

This force puts the concrete in compression, which keeps the steel in tension once the cable is released, and increases the overall capacity of the beam.

Design

According to AASHTO, each bridge component needs to meet specified limit states for a project, while being constructible, safe, and serviceable.

With the high stresses that are applied in each cable, beams are limited to 44 strands, or a max load of 2 million lbs. Designers must choose which shape and strand array will fit the project best.



Manufacturing

Pretensioning is one of the most common ways of prestressing the beams. The cables are stretched up to 200 ksi in the casting beds. This can be an incredibly dangerous process, and safety measures should be in place.

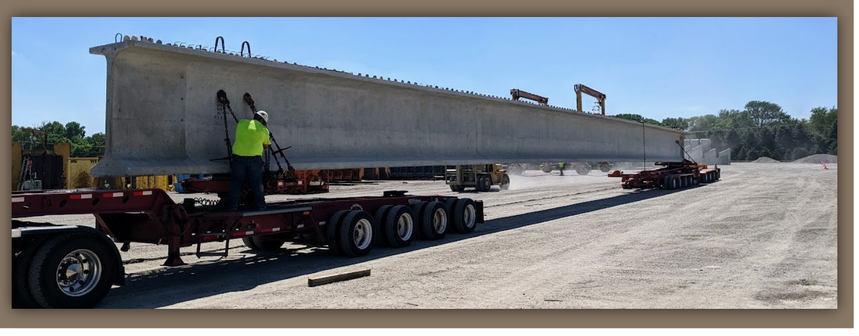
Various admixtures can also create higher concrete strengths.

Ever see concrete bend? Releasing the tension typically creates a camber.

Shipping

Skilled drivers, navigable intersections, and patient commuters are often essential to make this work.

Some traffic designs, such as roundabouts, can hinder shipping.



Summary

With the many products associated with prestress bridges, whether arch, deck, I-type girders, double Tee, or bulb tee, they are in turn suited for many applications to support our highways for years to come.

Installation

Compared to cast-in-place structures, prestress concrete beams can be installed faster with fewer requirements.

Beam installation must rest on the abutments with the required clearances and spacing tolerances. If too little of the beam is resting, the risk of failure increases.

While significant care must be taken during construction and shipping, the versatility in design, efficiency of installation, and resilience in use will benefit our communities for years to come.

Thank you.

Sources: AASHTO LRFD Bridge Design Manual, PCI Bridge Design Manual

PIPE SCHOOL