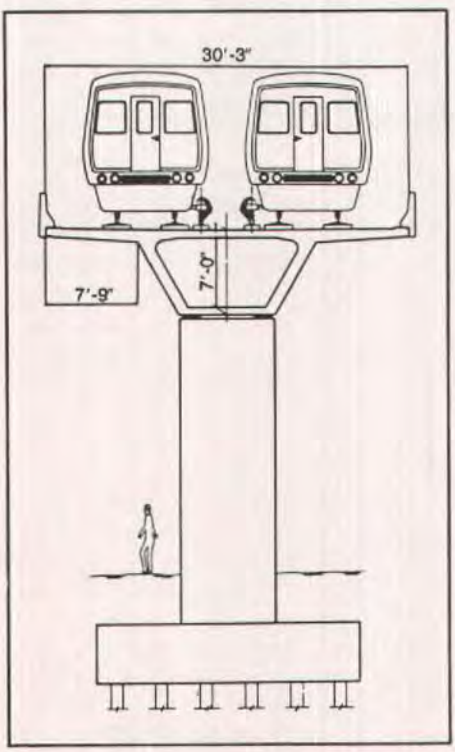
MARTA Rapid Transit Bridges

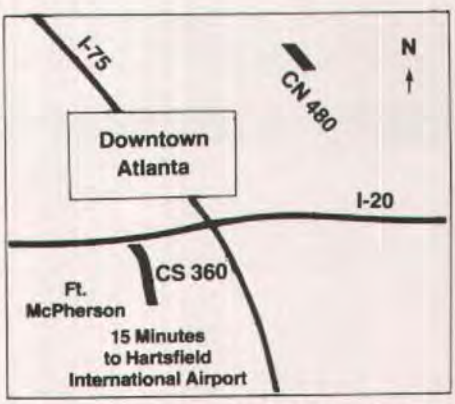
This precast segmental post-tensioned concrete project for the Metropolitan Atlanta Rapid Transit Authority demonstrates the ability of the segmental technique to economically solve bridge construction problems in heavily congested areas.

The MARTA rapid transit bridges are the first precast segmental concrete railway bridges built in the United States. They incorporate significant design and construction contributions which are expected to promote further development of rapid transit transportation systems throughout North America.

The Atlanta line was originally designed using a cast-in-place box system; however, contract documents allowed the contractor to submit a redesign of the project in segmental concrete. The redesign was based on precast segmental construction erected by the span-by-span method with external post-tensioning tendons. (The tendons are located within the box girder void, but are external to the concrete.)

The first elevated structure completed is 5230 ft (1594 m) in length, 158,200 ft^2 (14,713 m^2). At 30.35 ft (9.3 m) wide, it is designed to carry two trackways and consists of simple spans ranging from 70 to 100 ft (21.3 to





Above: Location of Atlanta's MARTA 360 and 480 rapid transit projects.

Left: Cross section schematic of Atlanta's MARTA rapid transit system. The 360 project comprises about 7000 ft (2135 m) of elevated railway bridges in precast segmental concrete. The construction method is very effective in heavily congested urban areas.

Panoramic view of Atlanta's MARTA 360 rapid transit project. Precast prestressed segmental construction (span-by-span method) enabled the contractor to place four spans of up to 100 ft (30.5 m) in length per week.

30.5 m) in length. The box girder superstructure segments are 10 ft (3 m) long, 7 ft (2.1 m) deep, and weigh approximately 30 tons (27 t).

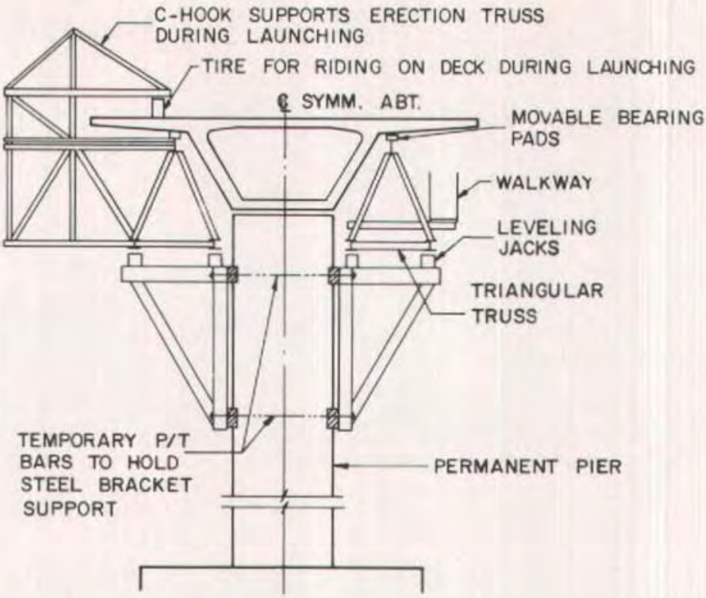
The second elevated structure is 1900 ft (579 m) long, 57,500 ft^2 (5347.5 m^2), with span lengths from 75 to 143 ft (23 to 43.6 m). Since it is similar to the first structure, the contractor was able to use the same casting and erection equipment. The major difference between the two structures is that the first bridge consists entirely of simple spans while the second bridge includes a four-span continuous unit.

Continuity in this unit was accomplished by modifying the post-tensioning patterns of the pier segments where the tendons are anchored. The outside concrete dimensions were not revised, allowing the use of the same side forms for both sections.

The new assembly truss concept developed for this project has proven successful for the construction of 70 to 140 ft (21.3 to 42.7 m) spans in highly congested urban areas. Instead of a single truss beneath the superstructure

Precast yard for the box girder segments was located two blocks from the first elevated structure. Long-line casting beds are first in the United States for full span.

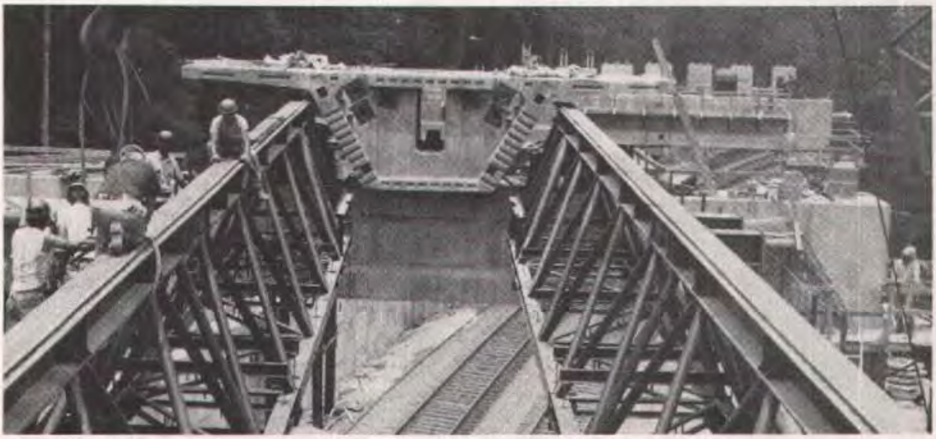
The wings of the segment rest on movable supports that are on the top flange of the trusses. Segments were winched into place in the span.



Cross section of twin triangular truss system.

Segment being placed on twin triangular trusses.

Overall view of span by span construction of precast superstructure.



One of the twin triangular trusses being moved. Spans are 70 to 100 ft (21 to 30 m) at this particular place in construction.

supporting the segments at the bottom slab of the box, twin triangular trusses are located on each side of the box section, supporting the box girder under the wings.

To accommodate the variety of span lengths, the truss was adapted with the addition of 40 ft (12.2 m), 8 ft 10 in. (2.4 m) or 5 ft (1.5 m) sections. A C-hook was added to facilitate the movement of the truss.

During the span-by-span erection process, the segments were placed on the trusses by crane. It took approximately 1 hour and 15 minutes to place all the segments for an 80 ft (24.4 m) span. The wings of the segments rested on movable supports that were on the top flange of the trusses. Use of this assembly method made it possible to complete one span per day—a major advantage over cast-in-place falsework which would have required 5 days per span.

Its track in place, the completed superstructure curves gracefully above and alongside the heavy rail track.

The first elevated structure runs parallel to a busy thoroughfare and railway line. Precast segmental construction with triangular trusses allowed construction to continue without interruption of traffic.

Approximately 370 ft (113 m) of the second elevated structure had to be built over an operational railway line.

The casting yard for the box girder segments was located two blocks from the project. Three long-line casting beds were set up—the first in the United States for full span segments—which produced up to 20 segments per week. Match casting of joints was achieved by moving side forms and a core form down the bed as the segments were cast.

A major advantage of this system is the removal of a high concrete strength requirement from the critical path before handling the segments. The segments can remain on the beds while the side forms are moved to the next segment. Also, the movable side forms were equipped with the steel frame on top, allowing the top slab to be transversely pretensioned.

To accomplish curvature, the bottom slab chorded the span length while the wings were adjusted to obtain the curvature necessary for the tracks. Thus, the bottom soffit became straight, allowing placement on the long line bed, and the wings were cast to the correct dimensions by adjusting the metal forms.

Credits

Engineer: Figg and Muller Engineers, Inc., Tallahassee, Florida.
Owner: Metropolitan Atlanta Rapid Transit Authority, Atlanta, Georgia.
General Contractors: J. Rich Steers, Inc., New York, New York.
Original Design: Parsons Brinckerhoff/Tudor, Atlanta, Georgia.