

Accelerated Service Testing of Prestressed Concrete Railroad Spans

by Duane Otter, Transportation Technology Center Inc.

Precast, prestressed concrete bridge spans are highly popular for railroad bridge construction. They are an economical choice for short-span bridges and generally require little structural maintenance.

The Transportation Technology Center Inc. (TTCI) is currently testing two ballasted-deck concrete bridges at the Facility for Accelerated Service Testing (FAST) in Pueblo, Colo. FAST is a railroad test track with train cars that have a gross rail load of 315,000 lb per car, about 10% heavier than the revenue service standard. The test train at FAST applies traffic at about three times the rate of a typical main line, providing accelerated testing of railroad track and structural components.

The two prestressed concrete bridges installed at FAST in late 2003 have accumulated more than 1400 million gross tons of traffic (about 9 million load cycles). This is comparable to nearly 30 years of traffic on many revenue service lines.

Figure 1 shows the two-span conventional concrete bridge, with 24- and 32-ft-long double-cell, box girder spans. Double-cell box girder spans are commonly used in North America. The spans were provided from railroad inventory stock. Figure 2 shows the cross section of one-half of a typical double-cell box girder span. The double-cell design features an integral deck and ballast curb. Two of these units are set side by side to form a span with four cells and ballast curbs to the outside.

These precast concrete units are well-suited for replacing existing timber bridges with work windows of only a few hours between trains. Once new foundations are in place (typically driven piles with concrete caps), old spans can be cut out and new spans can be placed quickly.



Figure 2: End view of a half-section of a precast, prestressed concrete, double-cell box girder span.



Figure 1: Two-span, conventional concrete bridge. All photos: Transportation Technology Center Inc.



Figure 3: Three-span, precast concrete bridge built using high-performance concrete.

Track panels and ballast can be set in place, rails connected, and track surfaced, all within a matter of hours. Work can progress a few spans per day as traffic allows, with minimal interruption to service schedules. In case of an unplanned service outage, a new concrete trestle can be constructed in a matter of days.

Figure 3 shows the three-span, state-of-the-art concrete bridge. It features a 42-ft-long center span made with high-performance concrete (HPC). This is one of the first documented uses of HPC for a railroad span. The railroad that provided this span chose HPC for its improved freezing and thawing resistance on lines in northern climates. The 42-ft-long double-cell, box girder HPC span is flanked by a 15-ft-long slab span and a 30-ft-long double-cell, box girder span, both designed to a common standard used by two large North American railroads. These are some of the first spans built to that standard.

Use of standard designs for spans provides a host of benefits; the engineering for each bridge generally requires little more than a foundation location plan. Production costs are minimized with large quantities. It is practical to maintain an inventory of spans that can be used in emergencies. If budget priorities change, spans cast for one job can be used on another job.

While the testing at TTCI has included structural performance, the primary research effort has been to reduce track maintenance requirements on concrete bridges.

The structural performance of these prestressed concrete spans has been excellent to date. No maintenance has been required and no significant defects have been noted. 

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