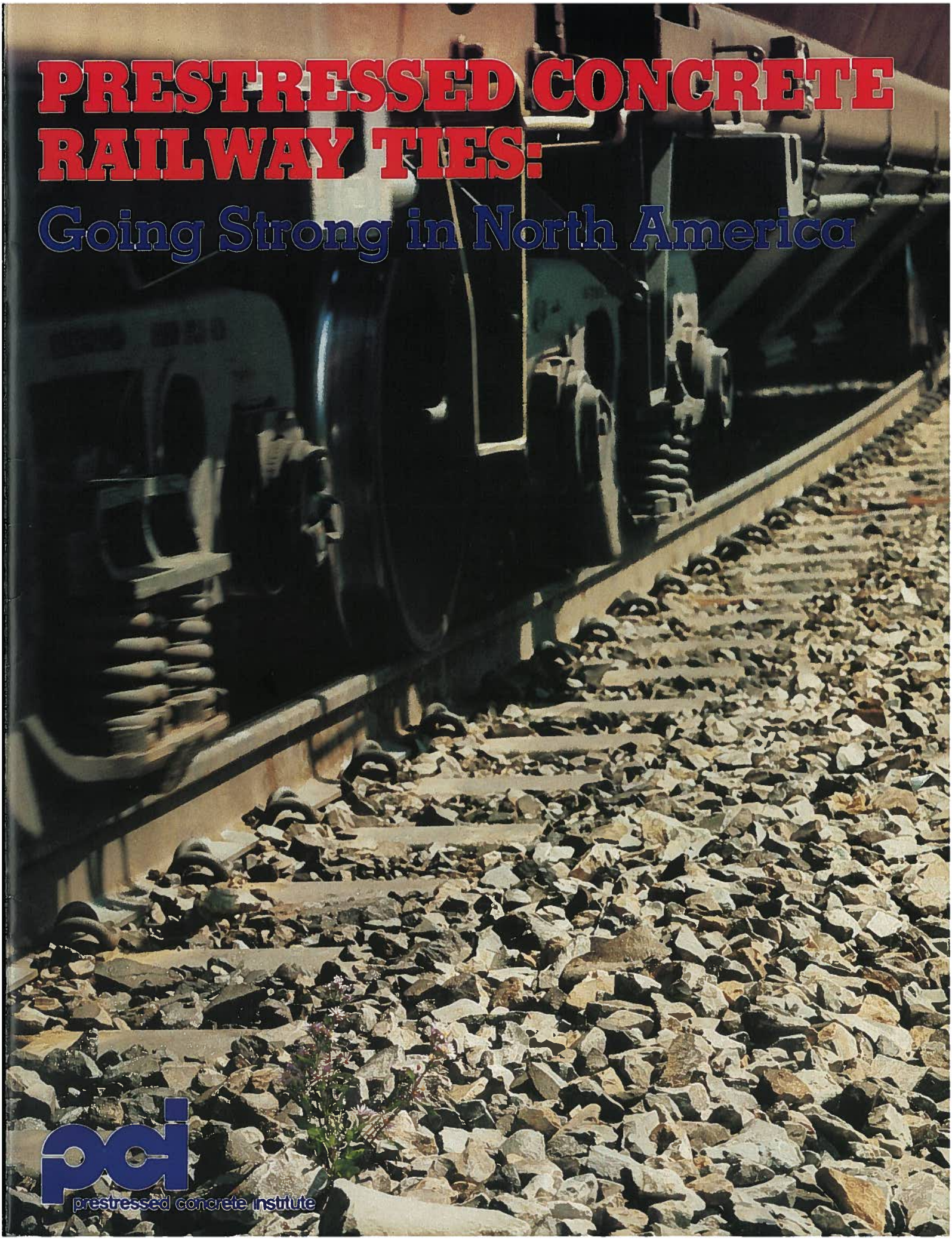
PRESTRESSED CONCRETE RAILWAY TIES:

Going Strong in North America



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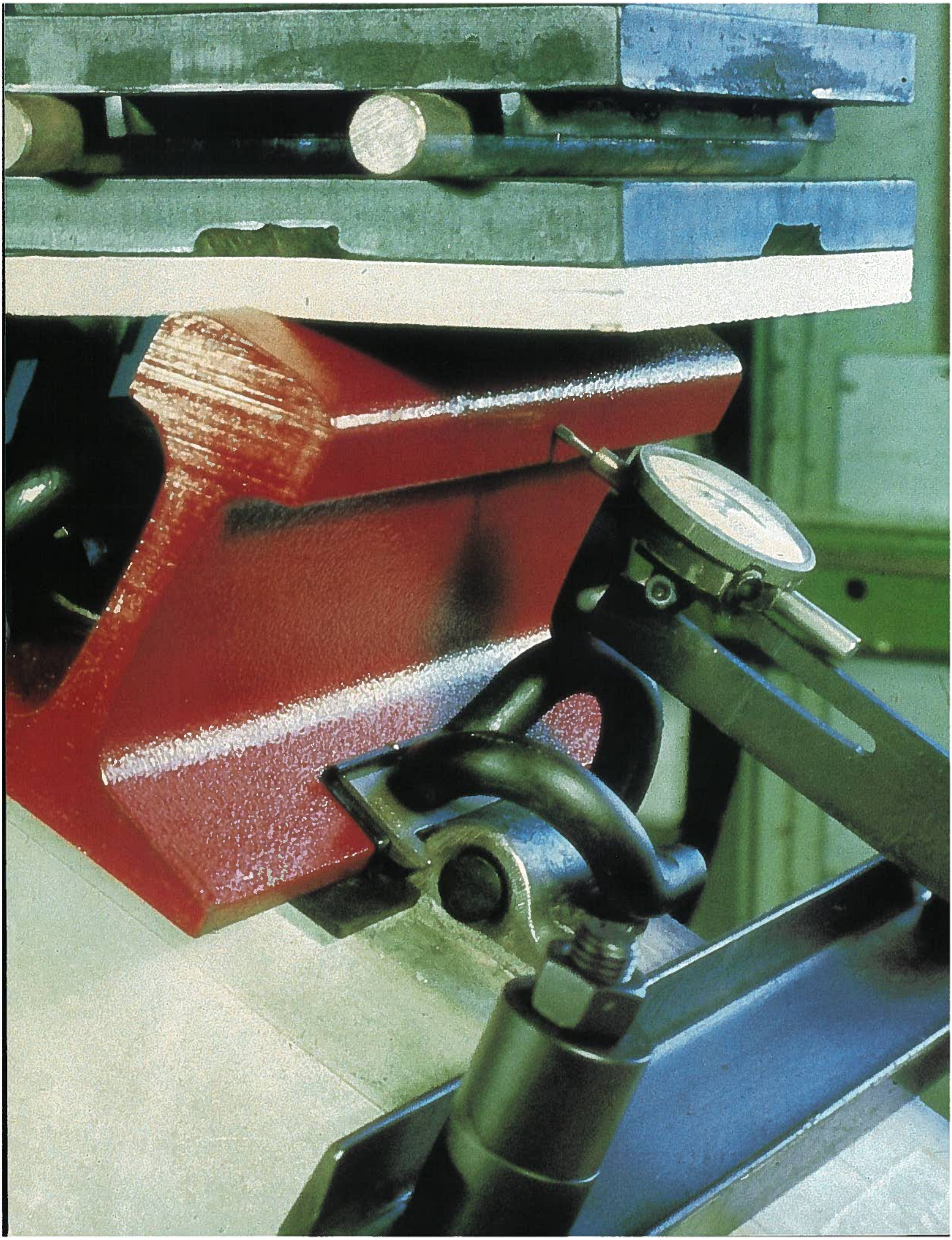


MOVING WITH THE TIMES:

North America Reaps the Benefits

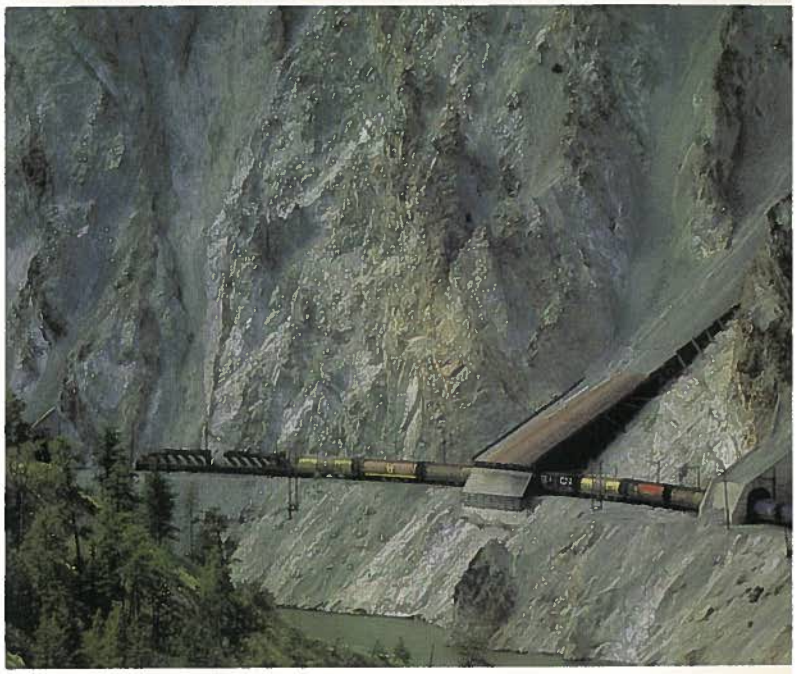
A new era has arrived.

Ushered in by the widespread acceptance of prestressed concrete monoblock railway ties, North America's transportation industry has taken a giant step forward.

The evolution of concrete ties has long since passed the experimental phase. Progressive transportation managers now consider concrete a practical, economical solution. They no longer look to Europe, which has used concrete ties since the 1940s, as a frame of reference. Concrete ties have been tested—and proven—under North American conditions. An industry base has been established in both the United States and Canada to design, supply and install concrete tie systems.

The word "system" has become a critical industry term, because the tie itself is only one element. An effective system incorporates integrated components: drainage, ballast, fasteners, pads, insulators, rail, lubrication and the cars and locomotives themselves. All work together to create a high-performance system for today's traffic.

Every concrete tie system is tailored to meet a diverse range of operational and environmental conditions. As the following pages demonstrate, each railroad or transit authority chose a concrete tie system in response to specific needs. These operators have entered a new era. And they're reaping considerable benefits.



Opposite:
Before being accepted for installation, all components of the concrete tie track system undergo rigorous laboratory trials including dynamic and fatigue testing. Photo courtesy of Portland Cement Association.

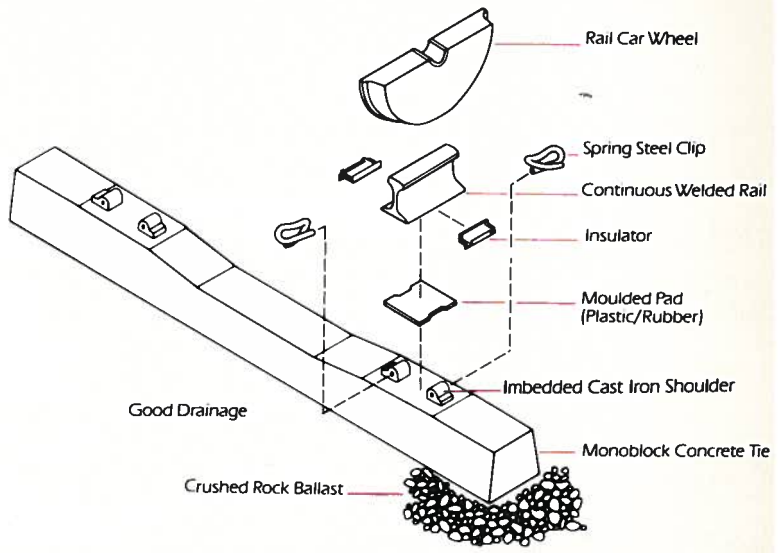
Right:
Concrete ties have proven particularly beneficial in meeting the challenges of severe climates, heavy tonnage, and multi-curved territory. Photos courtesy of Canadian National Railways.

Concrete Tie Systems: The Benefits

Perhaps the most significant advantage concrete tie systems have over wood is economy. Numerous comparative life-cycle costing studies have demonstrated concrete's distinct competitive edge in certain areas.

Specific research data is readily available through individual concrete tie suppliers. In general terms, however, the following benefits contribute to the overall cost-effectiveness of concrete tie systems:

- Durability — 45 to 50 years or more
- Consistent gauge holding
- No plate cutting
- Greater vertical and lateral stiffness
- No spike kill
- Consistent and reproducible quality
- Fewer ties per mile—2,640 concrete vs. 3,110 to 3,240 wood (dependent upon wood tie centers)
- Easier, quicker rail transposition
- Improved ride quality
- Longer rail life
- More uniform settlement
- Extended surface alignment cycles
- Reduced derailment frequency
- Less maintenance—more time to run revenue trains
- Reduced rolling resistance cuts fuel consumption by at least three percent
- No environmental problems




Key Concrete Tie System Installations
in North America
355
355
Amtrak
Amtrak

THE FRONT RUNNERS:

Committed to Progress

In the early stages of concrete tie development in North America, several main line railroads made a firm commitment to the new system. Working with the concrete tie industry, these forward-thinking railroads played a pioneering role in advancing the applications of concrete ties. They've never looked back.

The first major and continuous North American installation of concrete ties began in 1965 on the **Florida East Coast Railway.** Initial results prompted the company to adopt the flatbottomed concrete tie rather than the V-shaped tie. To date, 1,064,000 concrete ties have been installed, spanning 403 miles of FEC's main line and passing tracks.

AMTRAK's concrete tie system was designed to handle a combination of high-speed passenger trains and heavy freight traffic. Improved rider comfort and safety was a priority. AMTRAK currently has 1.1 million concrete ties installed along 400 miles of the Northeast Corridor between Boston, New York and Washington, and has ordered an additional 300,000. At present, 128 miles of track are suitable for 120-mph operation; eventually this section will be extended to 265 miles.

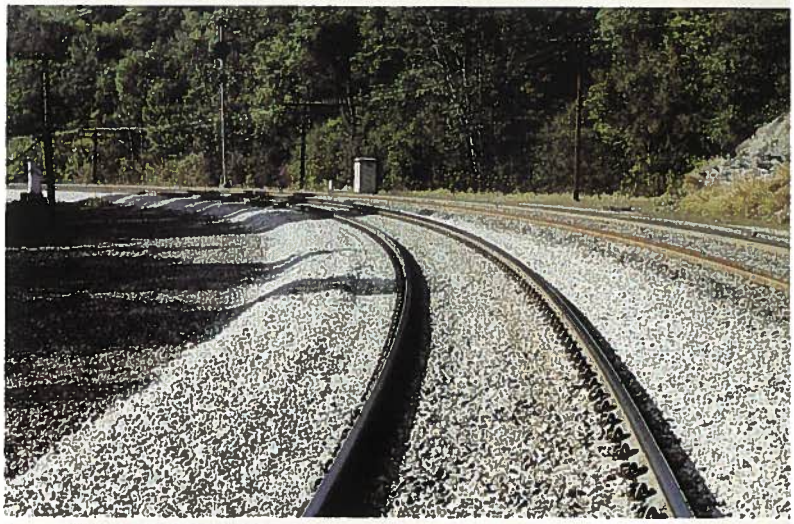
The operator of a 22,500-mile main line, **Canadian National Railways** launched an extensive program of testing different types of concrete ties and fastenings in 1961. Concrete's major opportunity came in 1972. Faced with a continuing insufficient supply of 7" x 9" wood ties required for a large program of main track renewals and new construction, CN installed 10,000 concrete ties near Jasper, Alberta. This four-mile section near Yellowhead Pass in the Rocky Mountains includes a number of four- and six-degree curves.

By 1975, wood ties were no longer in such short supply, but it was evident concrete ties would have further benefits in reducing track deterioration and derailments caused by rail deterioration and loss of gauge. Program results and careful economic analysis convinced CN to embark on a major installation program. With three million ties installed, CN's present system tackles challenges typical of North American operations. Current criteria for concrete ties are a minimum 20 MGT per year; a high proportion of 100-ton cars in unit trains; and frequent curves two degrees and over.

Chessie System Railroads commenced its concrete tie program in 1968. There are now four sections utilizing six types of prestressed concrete ties and a variety of fastening systems. Seaboard Coast Line, a partner in the CSX system, has also used prestressed concrete ties. Based on in-house research, Chessie has estimated the service life of its concrete ties to be 45 years.

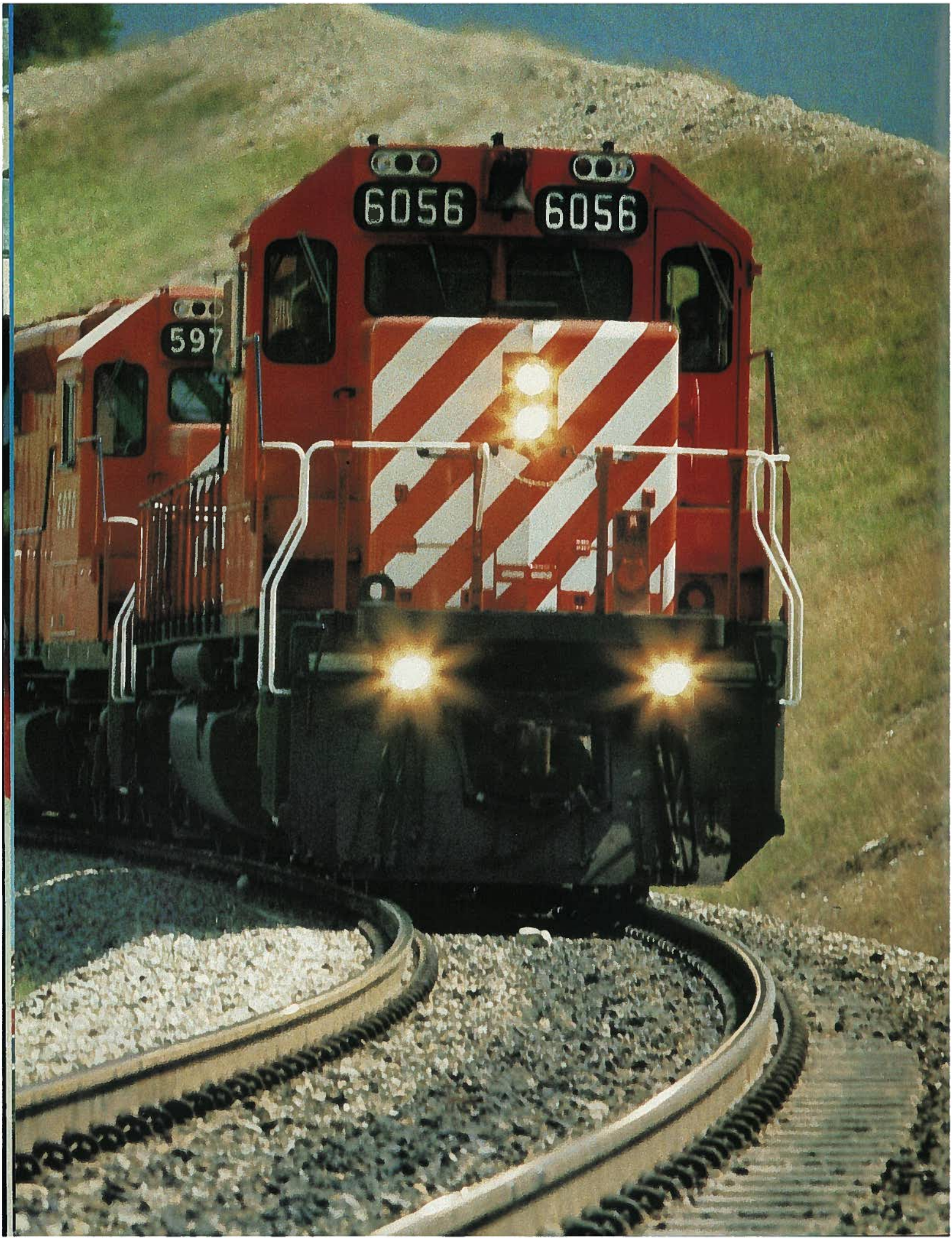
Kansas City Southern has a regular concrete tie installation program. Its line includes 165,000 concrete ties, some of which are interspersed with wood.

The **National Railways of Mexico (NdeM)** now have six million prestressed postensioned ties in their mainline track and production is continuing at the rate of one million per year.



Top to bottom:
Florida East Coast Railway
Canadian National Railways
Chessie System Railroads
Kansas City Southern

Opposite:
Photo courtesy AMTRAK.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MAIN LINES ON THE MOVE:

Landmarks and Frontiers

Many main line railways have recently entered the concrete tie testing arena. The key players are doing more than confirming the merits of concrete. They're breaking new ground, enhancing system technology, and contributing up-to-date information to the wealth of test data.

In conjunction with Project Lifesaver, which involves the relocation of a transcontinental railroad out of the center of Elko, Nevada, **Southern Pacific Transportation Company** is making history with a parallel track testing program. While more than 100 test tracks have been installed in North America, none has offered a wood/concrete comparison based on identical speeds, traffic, weather, track curvature and grades. Southern Pacific seized the opportunity to create a test platform that would generate precise data unique to their conditions. Installation of the track was completed in 1983, and capacity speeds (60 mph) are now being achieved. Southern Pacific's assessment period will span ten years.

Since 1974, **Canadian Pacific** has installed 6,500 test ties, focusing research on an evaluation of tie/fastener combinations in a range of high-traffic, heavy-curvature locations. Three fasteners — Pandrol e-2009, Portec Sidewinder and McKay Safelok — recently underwent rigorous testing at the Illecillewaet River site. This test section has a two percent descending grade with loaded traffic on a curve of 11 degrees. Though a derailment occurred, tie damage was minimal and there was no loss of gauge. CP now feels the concrete tie has proven itself, and the company is now installing a further 24,000 on the new Rogers Pass diversion.

Engineers at **Union Pacific Railroad** are currently monitoring their first concrete test section at Crestline, Nevada. Weighing 750 pounds each, some 3,170 ties were installed along this mountain pass, on a line serving heavy freight traffic. UP engineers intend to keep a close watch on tie durability, fastener performance, and the effects of heavy wheel loads on the rail.

On the **Quebec North Shore and Labrador Railroad**, 5,000 concrete ties have been installed on seven- to eight-degree curves, and six different fastening systems are on trial. Making the testing ground exceptionally rigorous is the fact that the QNS&L is a heavy haul railway. Loaded unit trains of 260 cars, carrying 100 metric tons, move iron ore through 550 miles of rugged, inhospitable terrain. The line often carries in excess of 50 MGT per annum and, to date, concrete ties have been in service for more than 350 MGT.

The **Apalachicola Northern Railroad** in Florida has a regular concrete tie installation program with more than 75,000 concrete ties, currently interspersed with wood ties.

Top to bottom:
Southern Pacific Transportation Company
Union Pacific Railroad
Quebec North Shore and Labrador Railroad
Apalachicola Northern Railroad

Opposite:
Canadian Pacific Railway

URBAN TRANSIT:

Concrete Ties go to Town

Concrete tie systems are having a dramatic impact on urban transit. System dynamics provide for optimum rider safety and comfort. Maintenance costs are low. More importantly, reduced maintenance requirements mean service work can be scheduled conveniently and with minimal disruption to local residents, employees and train schedules.

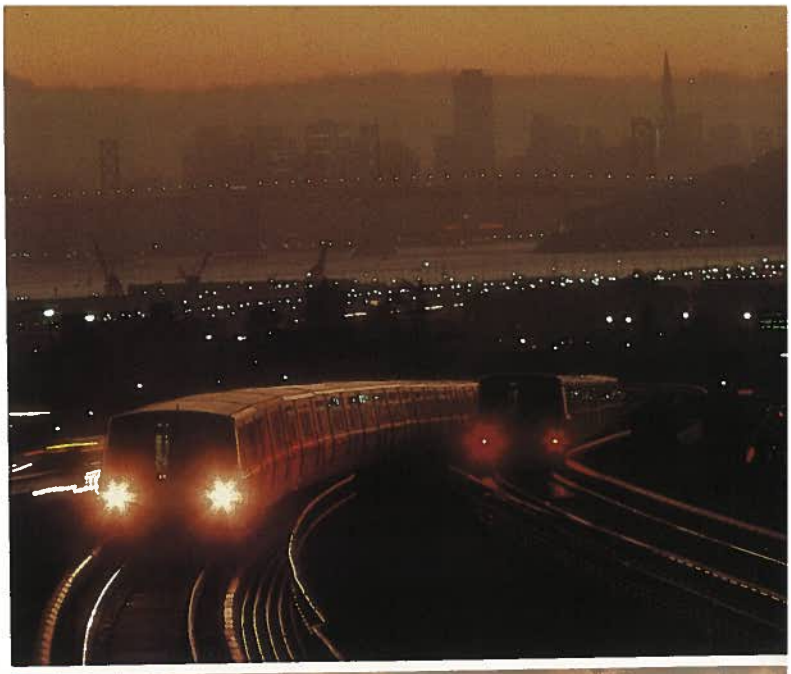
BART, California's Bay Area Rapid Transit network, first utilized concrete ties on 28 miles of track in 1972. All 72 miles of the computer-controlled heavy rail system now include concrete ties. BART's annual passenger traffic count was 60 million in 1984, an eight percent increase over the previous year.

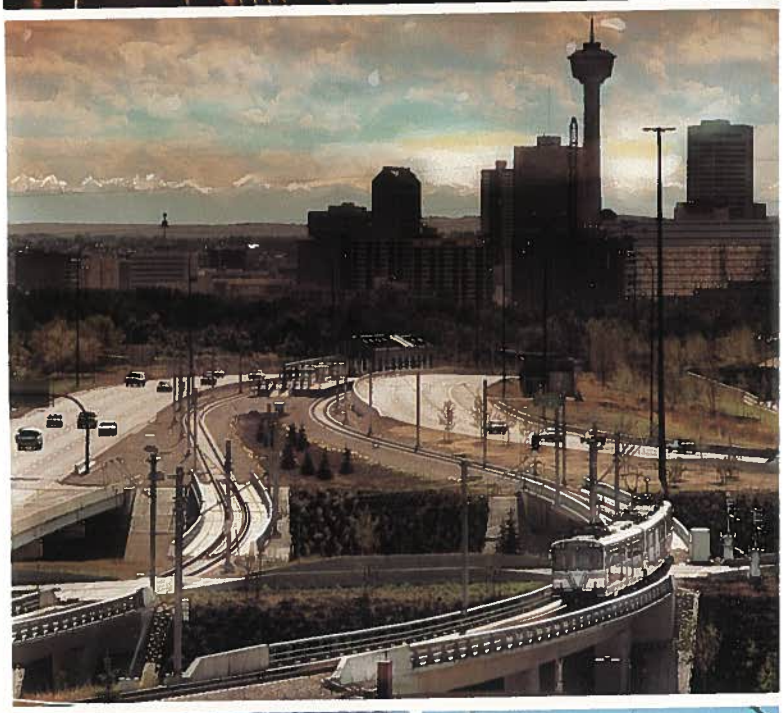
In Calgary, Alberta the transit authority was primarily concerned with passenger comfort and safety when planning the **C-Train** system. Unaccustomed to the concept of using public transportation on a regular basis, Calgary's citizens had to be persuaded that light rail transit could offer all the comforts of a private vehicle. Planners selected a concrete tie system for the initial 7.5-mile installation, and Calgarians were not disappointed. The C-Train's popularity is evidenced by the fact that the system has already been expanded by six miles. Concrete ties are incorporated into the current 8.5-mile extension and will be used in the new northwest extension.

The Massachusetts Bay Transportation Authority, **MBTA,** serves annual urban and commuter traffic totalling more than 165 million passengers (1983). Modernization of this massive and complex transportation network has been ongoing since 1965. Thirty-eight miles of concrete ties have been installed to date. Engineers are pleased with the performance characteristics of the concrete ties.

MARTA, the Metropolitan Atlanta Rapid Transit Authority, began installing its urban transit system in 1975. Planners chose concrete ties for the project, which was completed on time and on budget. Presently accommodating 50 million passengers per year, the 25-mile system is now being extended a further 25 miles, with concrete ties again being chosen for the installation.

More recently Baltimore and Miami have adopted concrete ties for their new transit systems.





Top:
BART, San Francisco.

Middle:
C-Train, Calgary.

Bottom:
Left to right: MARTA, Altanta; MBTA, Boston.

AT THE CROSSROADS:

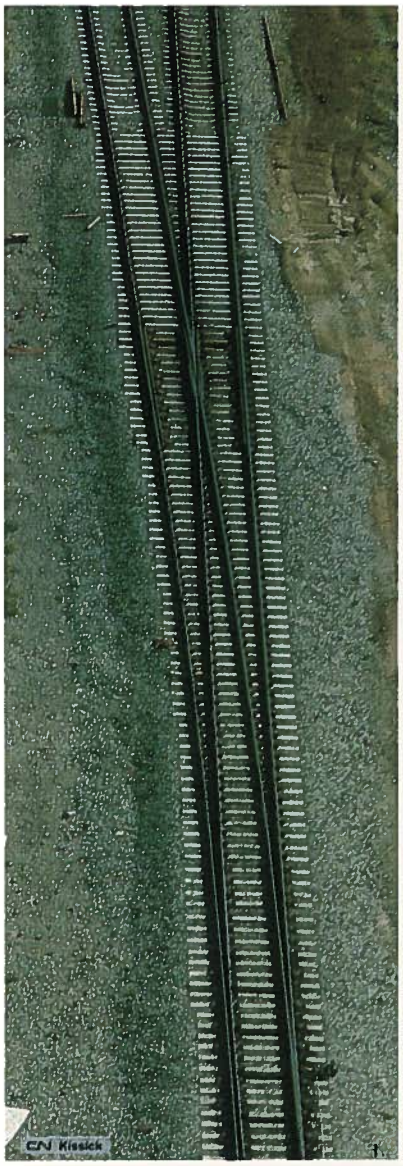
Bridge, Crossing and Turnout Ties

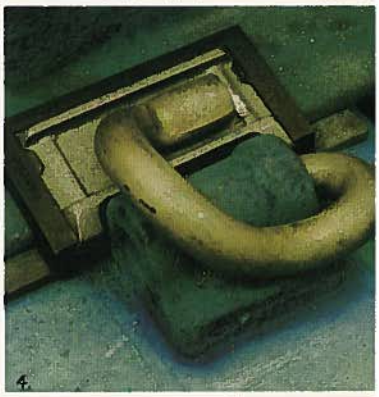
It is likely that, in the near future, North America will see a major increase in the number of installations of concrete ties at open deck bridges, crossings and turnouts. At present, the systems are in a transition period. Transportation managers are just beginning to appreciate concrete's versatile nature and suitability in these applications.

Concrete **bridge ties** are gaining acceptance as a replacement for heavy timber bridge ties on open deck bridges, especially where fire might be a hazard. Canadian National, Canadian Pacific and the Florida East Coast Railway have all utilized concrete ties on open deck bridges. FEC has also made significant progress in the development of special rectangular concrete **crossing ties** designed to work in conjunction with precast concrete slabs. Automobile and truck traffic runs directly over the slabs, with the ties incorporating a stable slab location and resilient support system.

Though concrete **turnout ties** have been tested in Sweden, Britain and Australia, the first North American installation did not take place until 1984. The concrete switch assembly, a CN project, involved 117 heavy-duty concrete ties set in a No. 20 turnout configuration. Shortly after, FEC installed concrete switch ties at Jacksonville on a No. 10 turnout. These milestones are expected to pave the way for other main line upgrading projects.

1. No. 20 left-hand turnout installed on the CN main line in July, 1984.
2. FEC bridge tie installation.
3. Crossing ties developed by FEC for crossings at grade.



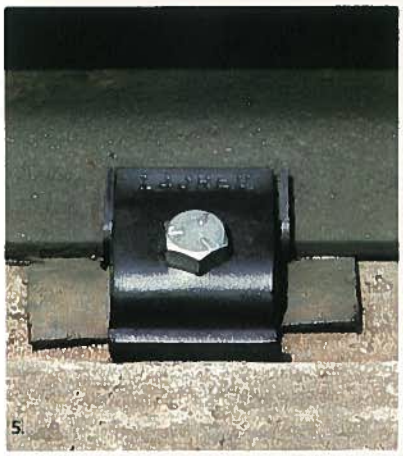


FASTENERS:

Making the Right Connection

Because the fastener must make a strong, but resilient connection, much research has centered around this key component of the concrete tie system. Major manufacturers such as McKay, Pandrol, Portec and True Temper have developed a variety of fasteners in response to the demands presented by a range of operating and environmental conditions. A bolt type fastening system has been used effectively by the Florida East Coast Railway. Recently, elastic fastening systems offering greater gauge control in heavily trafficked, curved territory have been developed.

Fasteners:
4. Pandrol e-2009
5. True Temper Cliploc
6. Portec Sidewinder LPC
7. McKay Safelok
8. True Temper Lineloc



GEARING UP FOR A CHANGE:

Installation Techniques

Installation techniques, whether for track renewal or new construction, depend on the project's scope and budget. Smaller installations may use a gantry or panel method. On a large-scale operation, the Canron P-811 series of tracklaying trains is generally the most cost-effective.

Both CN and AMTRAK have track renewal experience with the P-811, which uses gantries mounted on tracks fitted to special rail cars to unload and feed ties to the tracklaying machine. As new ties are placed, old ties are picked up simultaneously and fed back by the gantries to empty cars. An average production rate of 3,400 ties per eight-hour workblock can be achieved, provided follow-up equipment can keep pace.

With preassembled concrete tie systems, installation is swift and economical. When CN installed North America's first switch tie assembly, the entire turnout was factory preassembled, disassembled for transport to site, then reassembled and placed with a hydraulic jack system. The transfer was made during a 10-hour period.

Top to bottom:
Geismar gantries used when existing rail is jointed.

The P-811 tracklaying system.

Canadian National Railways' preassembled, 110-ton, No. 20. turnout installation. Photo courtesy of Canadian National Railways.

ON TRACK WITH CONCRETE:

North America Comes of Age

The ballots have been cast, and the results are positive. Concrete tie systems are going strong. North America stands ready to take its place as a progressive member of a global transportation network. Together, the nations of the world have installed more than 420 million prestressed concrete ties. Some chose concrete because wood supplies were short. Others sought greater gauge-holding power and increased rail life. Many wanted improved riding quality, better track stability and longer service. And most were encouraged by economy through low maintenance and fuel efficiency.

Whatever the reasons, those who have kept pace with our changing industry face a bright future. There is no doubt that in the years to come, concrete tie systems will have broader and enhanced applications and benefits. For now, though, there is ample evidence proving their capability under today's conditions. Industry leaders have already accepted concrete tie systems as a fact of life. They have recognized that technology brings opportunity. The opportunity for growth—and with it—a higher level of profitability.

Get in Touch with Technology

For details and technical information on prestressed concrete tie systems and applications, please contact:

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Telephone: 312-346-4071

Canadian inquiries should be directed to:

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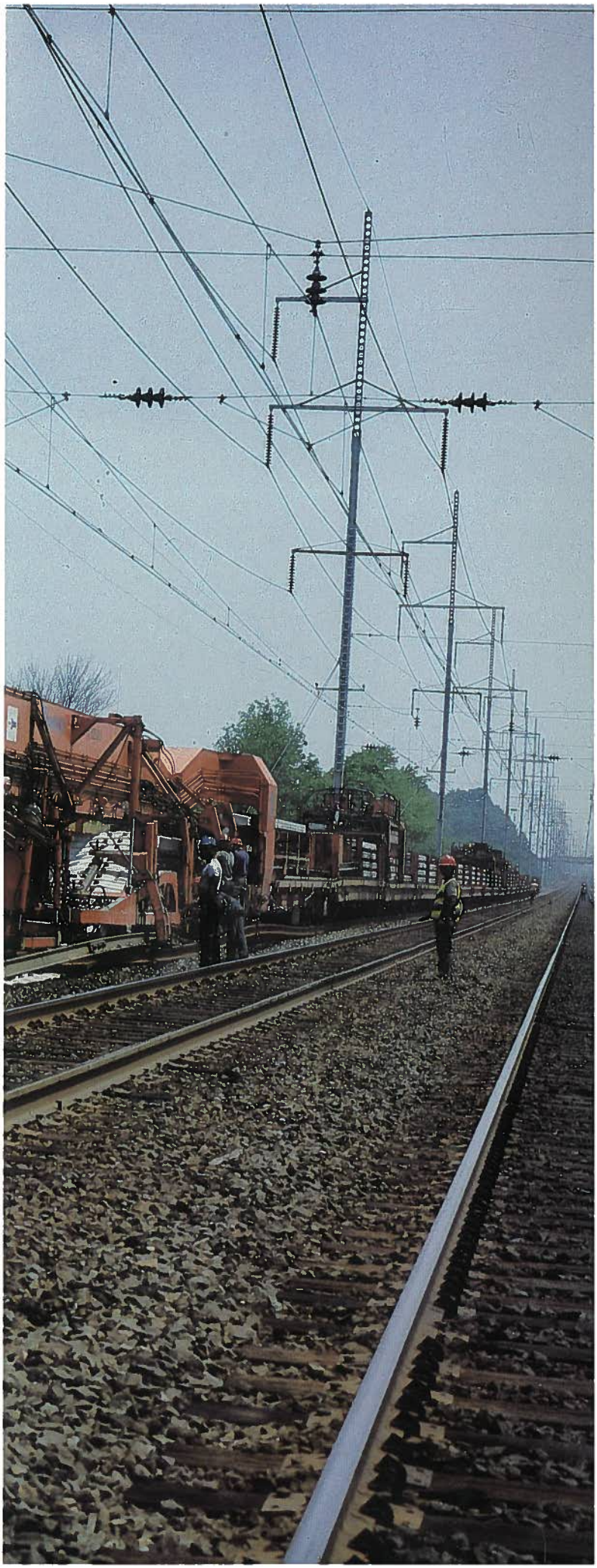
Ottawa, Ontario K1P 6A4
Telephone: 613-232-2619



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