

FROM  
REFUSE  
TO  
REUSE

# RAILWAY TRACK AND STRUCTURES



WILLIAM C. THOMPSON AND WILLIAM H. MOORHEAD

Scrap rail released for sale after sorting at reclamation facility (left); other track material can also be recycled (right).

**R**ailroad companies and transit operators have recycled major portions of their track structure to an extent not widely known outside the rail industry. Most railroads have maintained high-quality track structure in part through effective use of secondhand materials. When heavy-use freight track is rebuilt and upgraded, much of the material is used to rebuild track or for relay programs on lower-density lines. Tracks serving industry rely on the continual reuse, relay, and recycling of rail and good track material. For example, the Union Pacific Railroad Company has developed specifications for the return of more than two dozen trackwork materials into active use.

Most railroads and transit agencies participate in community programs to recycle paper, plastics, and other waste. Such partnerships continue to grow as communities along railroad corridors expand their recycling programs.

## RAIL AND OTHER TRACK MATERIAL

Union Pacific recycles all of the rail it removes from mainlines, as do most other railroads and transit agencies. As rail approaches its fatigue or

wear life, and risks associated with continued heavy use increase, it is removed, moved, and reinstalled on lower-risk secondary lines, branch lines, and yard tracks. Rail that has served its full useful life in lower-tonnage, lower-risk trackage or is worn out or damaged to the point that it cannot be reused is sold to scrap dealers or steel mills, which remelt or reheat the steel to roll it into other products such as fence posts. Rail steel is desirable scrap because of its low copper content and good material uniformity. Most domestically produced rail includes some recycled scrap rail as raw material.

Fasteners, tie plates, spikes, and anchors—used to hold the conventional wood-tie system together—are designated as other track material (OTM). The industry reuses or recycles all of its OTM. Union Pacific reuses and recycles much of this material during the rail installation process. As a track crew relays rail or replaces ties, the material is collected, sorted, and placed along the track. Rear equipment in the consist finishes the project by retrieving the material for reuse in other track. The operation may include special equipment to support the reuse. Reuse of material within the production process reduces the costs of handling

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William C. Thompson is director of engineering research, Union Pacific Railroad Company.  
William H. Moorhead is vice president, Iron Horse Engineering Company.

(storage, transport, and distribution) and of infrastructure maintenance. When the bulk of the track material does not meet on-site reuse specifications, it is collected and shipped to a facility to be sorted. The limited amount of good material is separated for later reuse and the remainder sold as scrap. Railroads or brokers sell this scrap directly to steel mills with remelt facilities.

Recycling practices vary among railroads and transit agencies. Some organizations simply collect all used material from alongside the track and load it into gondolas for shipping to a reclamation facility. At the facility a contractor unloads and sorts the material according to its integrity and expected remaining life. Some material may be sorted into several levels or grades based on quality and condition. The value of different grades of material may vary in periods of high demand. This type of facility also offers recyclers and bargain hunters the opportunity to inspect material for remanufacture.

## WOOD TIES

Recyclable ties that meet certain minimum criteria for condition are often repaired by filling holes with a chemical plugging compound and are shipped to secondary lines or yards. Some used ties are sold to dealers who in turn resell to companies that repair industry tracks and other fixed facilities. Ties that cannot be recycled are often sold for use as parking bumpers, landscape material, fence posts, and retaining walls. Only the very worst treated-wood ties are sent to landfills. Landfill disposal costs have increased as space has decreased.

Several railroad and transit companies have entered into agreements with power and heat generating facilities to dispose of worn-out ties. Wood ties typically are chipped and then mixed with coal or burned by themselves in special bed boilers. The heat released by incineration of the wood, creosote, and oils used to treat the timber is recovered and used to produce steam. Creosote, itself a waste by-product of coal-tar manufacturing, kills the bacteria in wood and forms a protective coating.

## CONCRETE AND PLASTIC

Reinforced concrete ties are relatively new to the North American railroad and transit industry. Union Pacific, which has been using concrete ties in track since 1987, installs about 200,000 each year. Because these ties will be serviceable for many years, Union Pacific has not had to dispose of significant quantities of reinforced concrete. Ties that must be replaced because of damage are

disposed of in landfills. Technology allowing the economical removal of reinforcements from ties would make it possible to recycle both. The use of reinforced concrete for railroad structures is also relatively new—most such structures have been in service for less than 20 years—and recycling the materials in these structures is not yet a priority.

As the use of concrete ties increases, so does the use of plastic and other petroleum-based material for fastening systems. These components wear out more quickly than concrete, prompting the development of secondary-use markets for them, such as using them to make parking bumpers. Plastic rail-tie components currently are taken to landfills, but this practice will end as new markets develop.

Recycled plastics, particularly low-density plastic waste, are being manufactured and sold as lumber and as molded or extruded shapes that can be used for property-marking signs, drainage-structure details, fencing, crossing warnings and gates, and possibly cross ties. Recycled plastic cross ties for some applications are now under development.

The commuter railroads will likely be able to use plastics in seating components and amenities, signage, third-rail cover boards, pedestrian grade crossings, and weather-protection shelters.

## RUBBER

Railroads also use recycled materials from other transportation modes. Recycled rubber, principally from tires, is used by several manufacturers to make the interior filler for molded, full-depth rubber grade-crossing panels. Early tests of the potential for incorporating rubber into hot-mix asphalt cement indicate favorable results. Hot-mix asphalt concrete is increasingly used as a subgrade reinforcing layer in the form of an underlayment below the ballast section of track; rubber could be integrated into this application, possibly in higher percentages than is currently suitable for road asphalt because wet traction and abrasion resistance are not important in underlayments. Installation of hot-mix asphalt concrete under track is not easy, and high-production equipment is not currently available for the task.

Masticated recycled rubber is used extensively for bridge- and grade-crossing tie pads. Other applications have been tried by railroads, such as pads in main-ballasted tracks on wood ties, and on bridge decks, but use has been limited. Further research on masticated recycled rubber is needed to determine its potential for improving tie or structure life.



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Other track material such as spikes, joint bars, and tie plates is sent for sorting.

Other existing and potential uses for recycled rubber in track support systems are noise reduction devices in vibration-sensitive, populated areas; support pads for direct-fixation slab track; flangeway fillers in grade crossings; and shop or unloading tracks, especially where there is pedestrian or bicycle traffic.

### BALLAST, SUBBALLAST, AND SUBGRADE

Much of the rock used for ballast underneath main-line track structure has been in place for many years. Track-structure geometry problems that develop from anomalies in the track surface or alignment can be corrected by placement of additional ballast, using automated machinery. In areas without clearance restrictions, old ballast is left in the track. The infrastructure ballast section is continually built on top of the old material, usually by raising the track elevation between 10 to 76 millimeters (0.4 to 3 inches) with a device called a tamper.

Use of ballast-shoulder cleaners and ballast-cleaning undercutters is common throughout the world. Ballast is cleaned to remove fines and small broken pieces, which reduce the ballast's effectiveness in supporting track turnouts and also inhibit drainage. The used ballast is vibrated on a large double screen, similar to what is used in quarries to separate materials. The properly sized ballast is then returned to the track. The fine material—high-quality, well-graded, and easily compacted—

is sometimes collected and reused on roads by local government agencies or on service roads by railroads. Ballast suitable to be placed back in track beds typically accounts for 60 percent of the material cleaned, and is supplemented with new stone from quarries. The cleaned and replenished ballast will improve track performance by providing better drainage.

Stone generated on railroad property by track and ballast removal is generally put to good use. For example, when the Greater Cleveland Regional Transit Administration in Ohio recently purchased an abandoned railroad embankment for use in a line extension project, the agency transferred ballast and fill material from the old facility to the new right of way, saving both money and time.

Low-value glass, mixed plastic, and other solid waste may also have potential for incorporation into subgrade improvement layers. New construction on high-tonnage lines is increasing the demand for economical subgrade materials for the new infrastructure.

### OTHER STEEL AND STRUCTURAL COMPONENTS

Switch stands, joint bars, switch plates, and other steel components used in or alongside track are all fully recyclable. They can be rebuilt or sold to dealers, who rebuild them for sale as refurbished material. Dealers may sell these items back to the original owner or to short lines that need lower-cost products.

Steel girders and associated structural components often are rehabilitated and reused directly in replacement structures. Other smaller steel components, usually from defective or inferior structures, are sold to scrap dealers. Treated timber from bridges and other structures removed from abandoned track are often reused similarly to wood ties.

### CONSTRUCTION AND DEMOLITION DEBRIS

The first generation of structures and roads incorporating portland cement and asphalt cement have reached the end of their useful lives. As they are reconstructed, massive amounts of debris must either be used or discarded. The incorporation of construction debris in railroad embankments and other earthworks was limited in the past, largely because of aesthetic considerations, design requirements, and economics. New high-quality granular materials are becoming more expensive to purchase and transport, however, so the use of concrete debris from construction is becoming more

attractive. Research is needed to determine the life expectancy of new construction built with this material, and whether its use has any problematic side effects.

In addition to its potential incorporation into hot-mix asphalt concrete, properly graded concrete debris has potential value as subballast, fill, rip-rap, gabion filler, and an embankment strengthener. Because the disposal of this type of debris can be expensive for demolition contractors, railroads and transit agencies have an opportunity to avail themselves of readily available materials at little or no cost.

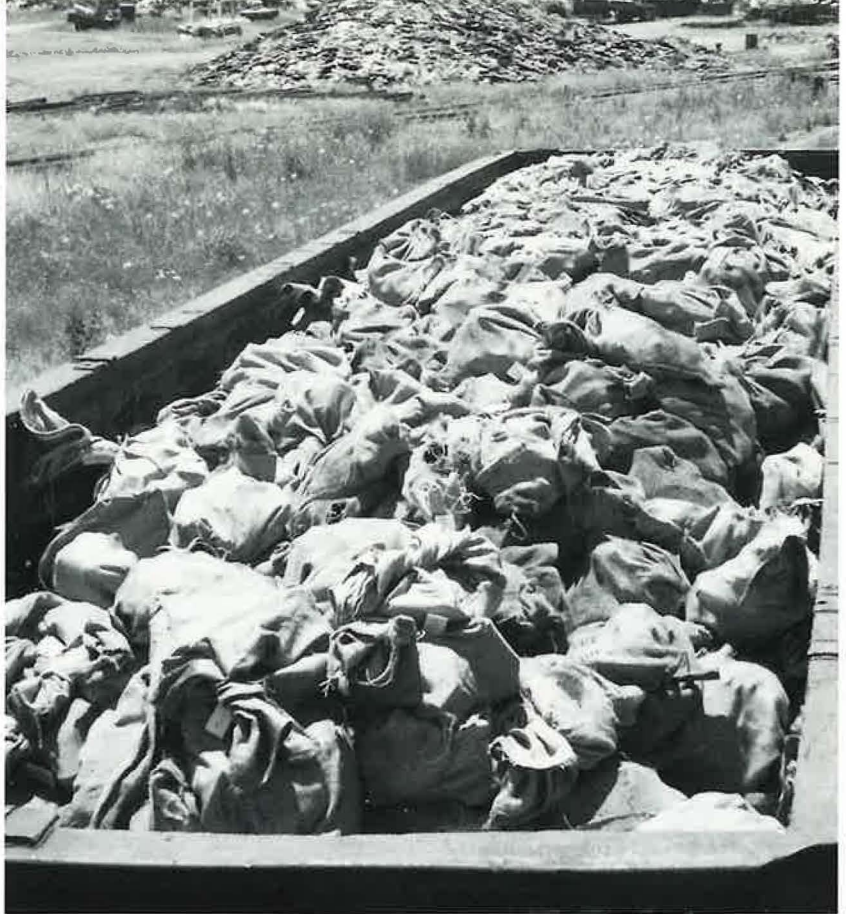
## CONCLUSION

Most major North American railroads and rail transit agencies have large and efficient scrap-recycling facilities, representing a significant capital investment that pays a good return. Few other industries have their recycling process as well organized. Because the railroad infrastructure is almost totally recyclable, an entire industry of suppliers, dealers, resellers, and manufacturers of second-hand track material is available to railroad and transit operations, a network that helps to lower the cost of rail transportation.

Union Pacific spends more than \$500 million annually on its infrastructure through rail, tie, and ballast renewal programs. Costs would be significantly higher if reuse were not an option. Material recycling is necessary to industry survival and greatly reduces the environmental impact of track maintenance and operation.

Decisions on product use should be driven by both economic and environmental considerations. Waste materials from outside the industry should also be evaluated and considered for use alongside those found on railroad and transit properties.

The recycling network is needed to deal economically with products that will become part of the railroad track of the future. The list of current and potential products diverted from the waste stream for use in railroad design is lengthy, but not all designers are aware of these materials and sources available to them, nor are they comfortable with products for which performance criteria have not been established. Research will help to safely and economically integrate recycled products into transit or railroad design if the results are disseminated among designers and specifiers in a timely fashion.



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Secondhand rail anchors are sorted, bagged, and loaded for shipment to track-renewal projects (top). Damaged or worn switch stands that have been sorted and unloaded will be rebuilt by a contractor and returned to use in main track (bottom).