

# R&D Briefing:

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## **FAST/Heavy Axle Load Study**

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### **STUDY SITE:**

Transportation Test Center, Association of  
American Railroads, Pueblo, Colorado

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### **PURPOSE:**

Quantify behavior of track components and  
rail cars under extremely heavy axle loads.

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### **METHOD:**

Comparison of current testing of 125 ton (39 kip  
wheel load) to data from earlier 100 ton (32 kip  
wheel load) test program. At test completion, a  
minimum of 160 million gross tons of traffic will  
have passed over the 2.7 mile, high tonnage  
loop at Pueblo.

# Carrying a heavy load.

In an effort to maintain a competitive edge in the shipping industry, U.S. railroads are investigating the feasibility of increasing axle loads by 20%, thus allowing greater amounts of freight to be hauled

As to be expected, such an increase has raised some concerns about the effects on the performance and stability of track components, including wood ties.

In response to these concerns, the AAR and FRA are currently conducting a critical study that will quantify the effects of heavier car loads on track structures and on rail cars.

Started in August of 1988, the \$ 10 million, 16-month Heavy Axle Load (HAL) program will help determine the change in track deterioration rate and the costs that accompany a 20% increase in static axle loads.

By the end of the program, at least 160 million gross tons (MGT) of traffic will have been placed on the 2.7 mile track loop by a train of high-sided gondola cars, loaded with 125 tons of simulated freight. There is also a strong possibility that the program will be extended for an additional 100 MGT.

The following preliminary observations regarding ties and fasteners are based on about 15 weeks of operations, and 10,880

A total of 46.5 MGT had passed over the track at observation time, although much of the data available from AAR represented the initial 30 to 40 MGTs.

## Wood tie and fastener performance.

In general, wood ties appear to be performing satisfactorily. No evidence of unusual plate cutting was noted. The fact that

with no remarkable occurrences indicates that these ties are meeting standard requirements.

A measurable amount of tie movement has been noted, particularly where the combination of cut spikes and anchors are used, in sections 3, 7, and 25. Some longitudinal rail movement has also been noted in the same areas.

In the very early stages of the test, all elastic rail fastening systems provided greater lateral rail stiffness and restraint against gage-widening than did cut spikes. However, one system had to be removed from softwood ties due to



After 5 MGTs, two types of synthetic tie plugs provided greater resistance to spike pull-out than wood plugs, and two types provided less.

Two types of elastic rail fasteners also exhibited some loss of toe load. One type had

*By the end of the program, at least 160 million gross tons of traffic will have been placed on the 2.7 mile track loop...*

**Concrete tie and Fastener performance.**

According to AAR Research Highlights of May 1989, four concrete ties had developed surface cracks at or near the center. Fastening systems were performing satisfactorily

**Results and reports.**

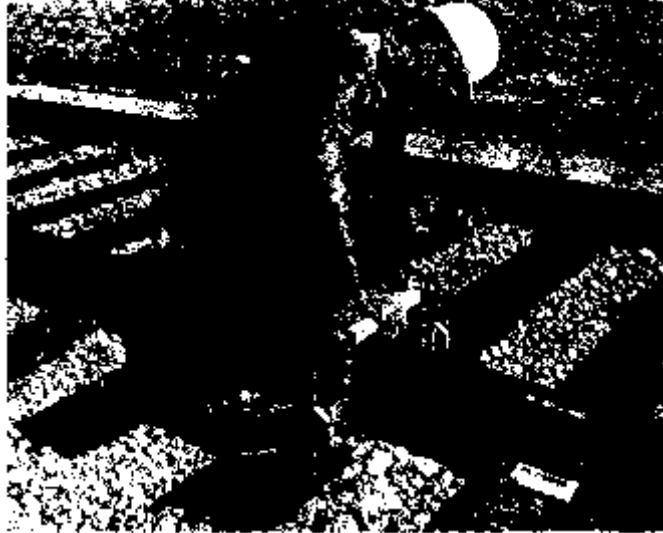
The above findings are based on preliminary findings at approximately 35 MGT. Additional interim reports regarding the FAST/HAL study will be made available after 80-100 MGTs. A formal FAST report covering wood ties and fasteners and numerous other experiments will be issued by the AAR at the conclusion of the program (April 1990).

To receive these reports, fill out and return the accompanying reply card. The Railway Tie Association will send you the reports as soon as they are available.

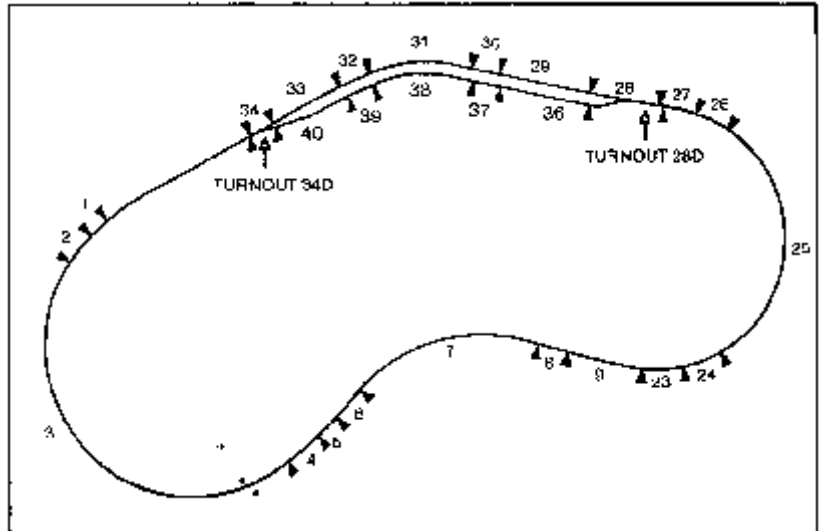
**Note:**

The 1000 creosote treated wood ties for this program were donated by the Railway Tie Association (RTA). All of the direct fixation fastening systems were donated by respective manufacturers/suppliers.

These observations come from a combination of AAR reports and RTA-sponsored inspections.



Technician using a tie plate



High tonnage loop (HTL)



Fasteners used in the FAST/HAL study included (from left to right) two conventional cut spikes, three cut spikes, double

# R&D Briefing:

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## Des Plaines Task Group C & NW study

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### STUDY SITE:

C & NW Main Line  
Des Plaines, Illinois

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### PURPOSE:

Evaluate performance of various configurations  
of crosstie spacing and sizes.

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### METHOD:

Performance study of eight test sections,  
consisting of 3,449 creosote treated ties of  
varying sizes and spacings.

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# Over twenty years of service

In summer of 1967, a test section of crossties was installed on the 0 & NW main line as part of a joint project between the AAR, the RTA and the C & NW.

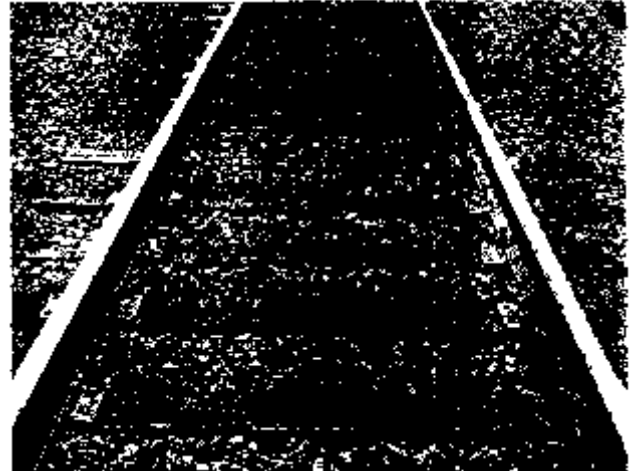
Ties of various sizes and lengths were placed at different spacings. Eight different test sections were created with respect to the spacing and sizes of the crossties.

## Tie length

Tie length does not appear to be a significant factor. Ten foot ties, however, appear to offer slightly improved performance over the 8 1/2' and 91 ties.



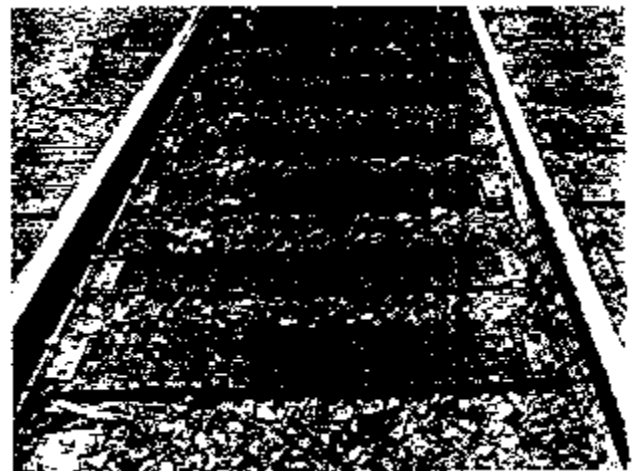
Measuring gage



7"x9"-8'6" ties on

## Tie cross-section

Ties with a cross sectional area of 7" x 9" are performing better than 6" x 8" ties. Dowel laminated ties, with their large cross sectional area, appear to be performing somewhat better than the standard 7" x 9" ties.



7" X 12 "-8'6" two-

## Tie spacing

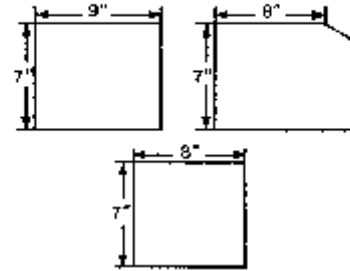
An increase in spacing of 7" x 9" crossties reduces the performance of the tie. Similarly increased spacing of dowel laminated ties also reduces tie performance.

## Descriptions of test sections:

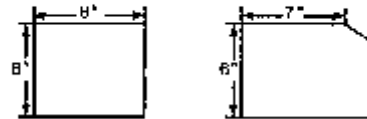
| Section | Crosstie Size | Crosstie Spacing |
|---------|---------------|------------------|
| 1       | 6x8x9'        | 19½"             |
| 2       | 7x9x10'       | 19½"             |
| 3       | 7x9x9'        | 19½"             |
| 4       | 7x9x8.5'      | 19½"             |
| 5       | 7x9x8.5'      | 23⅜"             |
| 6       | 7x9x8.5'      | 27½"             |
| 7*      | 7x12x8.5'     | 29¼"             |
| 8*      | 7x12x8.5'     | 23⅜"             |

It should be noted that sections 7 and 8 consist of dowel laminated 6" x 7" crossties examined at two different tie spacings.

7" Grade crossties.



6" Grade crossties.



Size categories for 7" and 6" crossties.

## Wood tie

In determining tie performance, the following factors are carefully considered:- plate cutting, wood deterioration, movement of rail, holding of gage, holding of line, creeping, wear of rail, pulverization of ballast, and drainage.

## Results and reports.

Throughout the test period, inspections have been conducted at various intervals, with reports being issued by the AAR and by RTAs research and product development committee. The above results are provided by RTA's research and development committee, and are based on the May 1988 inspection. At that time 941 ties were marked for replacement for various reasons. Many of these ties will be analyzed by AAR as part of the experimental tests. Additional reports on the Des Plaines study will be available in coming months.

To receive a copy of these reports, fill out and return the enclosed reply card. The RTA will forward the reports as they become available.

## Note:

The 3,449 creosote-treated wood crossties used in the Des Plaines study were donated by members of the Railway Tie Association.



Tagging for tie

# R&D Briefing:

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## **Borates as Pre-treatment Preservative Enhancers.**

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STUDY SITE: University laboratories and field sites throughout the United States.

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### **PURPOSE:**

Evaluate the potential for using borates to protect wood crossties from insects and decay fungi during air seasoning. Also, determine the potential for using borates to improve service life of creosotetreated ties by increasing resistance to insects and decay fungi through lowering susceptibility to iron degradation and the subsequent loosening of spikes (spike kill).

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### **METHOD:**

Ongoing laboratory and field research projects. Of particular note are studies conducted by Mississippi State University (MSU) researchers in cooperation with The Association of American Railroads (AAR) and The Railway Tie Association (RTA).

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# Research spawns more research.

In the Late 1970's the borate research related to forest products concentrated on testing boron compounds for protecting imported tropical hardwoods. The results of those initial studies led to expanded U.S.-based research on borates for wood preservative enhancement.

Today, borate wood treatment research encompasses a number of ongoing programs including the evaluation of borates plus chemical additives, and the treatment procedures for the protection of unseasoned hardwood lumber from damage by fungi and insects. The AAR in cooperation with the RTA, The Santa Fe Railway, Norfolk Southern Corporation, and several tie producers and chemical suppliers, is sponsoring research on the development of methods for improving the life of wood crossties and has included borates in the program.

## Treatment effectiveness.

Laboratory tests have demonstrated that borate treatments are effective in preventing decay by both brown-rot and white-rot fungi in wood that is under going air-seasoning. Tests have also shown that the level of borates, in those, treatments is in excess of the required lethal dose for lyctid beetle larvae.



Prior to conventional creosote treatment, unseasoned ties were dipped in a borate solution.



Crossties completely submerged in a borate solution bath.

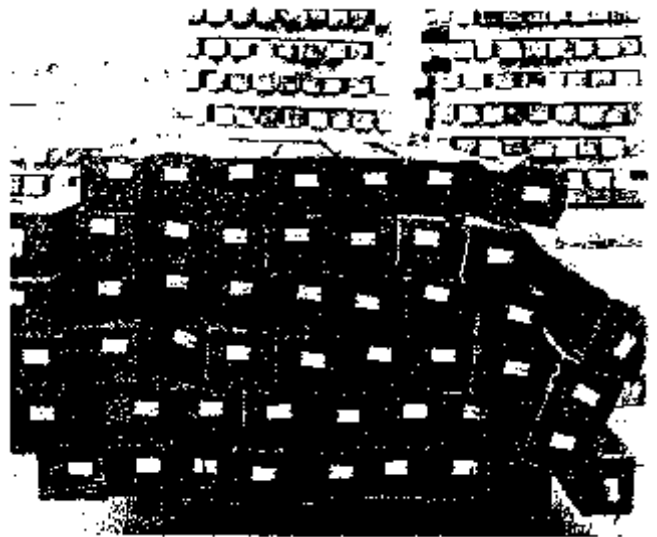


After being removed from the borate solution bath, crossties went on to be dried by conventional air-drying methods, or by a six-week covered storage then air-drying or vapor drying.

## Treatment of wood crossties with borate prior to air seasoning.

Fresh unseasoned ties of white oak, red oak and gum were utilized to determine if borates would protect the ties from deterioration prior to conventional preservative treatment.

The crossties were dipped in a borate solution prior to air seasoning. Some crossties were dipped, stacked and air dried according to usual practices. Other ties were bulk-stacked and covered with



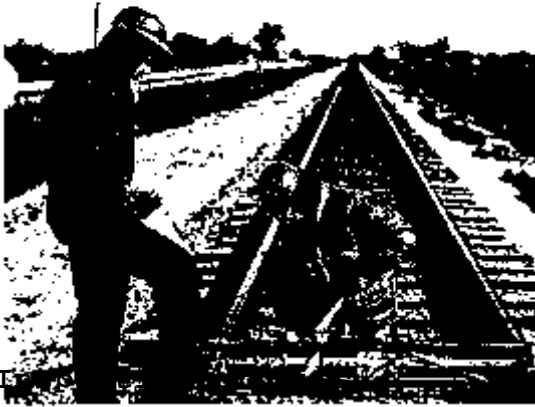
Creosote-treated crossties that first were dipped in borate solution.

a tarp for six weeks of covered storage, allowing the borate solution to diffuse through the tie. After six weeks, most of the bulk-stacked ties were restacked for air-drying, while others were vapor dried

Increment cores, taken from these pre-treated crossties, were studied- All ties were subsequently treated with creosote. After treatment, additional increment cores were taken for an alysis of creosote penetration and retention.

Treated crossties from these tests were placed in track and are inspected annually to determine differences in checking, splitting or spike loosening.





**Treatment of ties in service.**

Sections of track on the Santa Fe system were chosen for this study. The study consisted of 100 ties that axe 1-10, 10-20 and 20-30 years old

Crossties in these treatment test studies were either sprayed with borate or copper naphthenate solutions, or drilled and fitted with borate rods.

Sample cores were taken at each inspection and were examined for decay The amount of spike loosening was also recorded.

A wood preservative paste consisting of a borate and a cobioicide is also being tested to determine its effect in pro in-service wood crossties. In conjunction with rail replacement, this paste has been applied under tie plates on conventionally treated crossties to determine its ability to protect the rail seat area from decay

Additional experimentation, utilizing non-borate products to protect this area of the ties, is in preliminary stages.



Adzing ties prior to experimental in-place treatment

**Results and reports.**

Results showed. that, while significant cant amounts of borates are lost from crossties seasoned by vapor drying before treating with creosote, very little borate is lost during air-seasoning of similar ties. It is hoped that oil-borne preservatives will enhance borate retention in the ties and that the combination will provide protection at the center of the ties as checks and splits expose wood beyond. the oilborne preservative protected. zone.

The potential effect of borate treat, ments in reducing spike kill is also being studied. The steel spikes and plates used with wood ties produce iron oxide which contributes to iron degradation of wood. In turn the iron degraded wood contributes to the further degradation of steel. It is hoped that the combinations of borate solutions and oil-borne preservatives may retard that destructive process thereby reducing the occurrence of spike kill.

Approximately 1400 additional unseasoned ties have been treated with borates and subsequently treated with creosote as part of the study sponsored jointly by the AAR, Santa Fe and the RTA. These ties axe now undergoing long-term evaluation in track on the Santa lb and Norfolk Southern



Spraying borate on test track.



Borate rod being inserted in the tie plate area.

The indications and results stated above are based on evaluations conducted at various laboratories and field sites. An interim report describing the ongoing borate research will soon be available. In coming months, the RTA will have further updates of ongoing research efforts available upon request.

Additional information can be obtained by filling out and returning the enclosed reply card.

# R&D Briefing:

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## Hardwood Stake Tests

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### STUDY SITE:

Mississippi State University, Forest  
Products Laboratory - 10-acre plot of  
forest land

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### PURPOSE:

Evaluate the performance of several  
hardwoods for use as crosssties. Also  
determine the rate of depletion of boron and  
creosote preservatives when used together to

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### METHOD:

Five-year field exposure of treated hardwood  
stakes, 18 " X %," buried nine inches in the  
ground. Three stakes per year for each  
combination of species, preservative and  
retention will be , removed after one, three and  
five years and analyzed for gradient at above-  
ground and groundline areas. Comparison of  
preservative retention will also be performed.

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# Taking a hard look at hardwoods.

**F**or more than 100 years, wood has overwhelmingly been the best choice for cross-ties. And there is little doubt that wood will continue to be the predominant cross-tie material.

However, only certain species of wood have been approved for ties. Other species, not formally tested and approved, have been used but only sparingly.

Now, with the increasing availability of such hardwoods as red maple, and with the development of new treatment methods and more sophisticated production methods,



MSU Forest Products



the need to examine the possibility of expanding the listing of approved hardwoods is significant.

Recognizing this need, the RTA has commissioned Mississippi State University to conduct a five-year study of treated hardwoods and the rate of preservative depletion within those woods. The R&D Committee of RTA will oversee the project and ensure appropriate input from RTA.

## Use of borates - the key to - one-step treatment?

Typically, more permanent oil-borne preservatives like creosote only coat wood cell walls instead of penetrating them. Therefore, heartwood doesn't receive much penetration.

On the other hand, generally less permanent water-borne preservatives like borates can penetrate the cells of the heartwood. And, because creosote does contain some water, borates can be dissolved in it, possibly providing a one-step treatment to maximize the benefits of both preservative types.



Stake

## The wood.

Hardwoods used in the stake test are red maple, sweet (red) gum, sugar hackberry and tupelo gum.

As a control, stakes of red oak and pine have also been included as part of the testing.



Stake

## Treatments.

All woods have received various degrees of creosote treatment. Treatment increments include none (for control), 2 lbs/ft<sup>3</sup>, 4 lbs/ft<sup>3</sup>, 7 lbs/ft<sup>3</sup>, and 10 lbs/ft<sup>3</sup>.

To determine the feasibility of a one-step, co-biocide treatment, all woods have been treated in three different manners. One set has been treated with straight creosote. A second set has been treated with borates, dissolved in creosote. The third set received the borate treatment and was then pressure treated with creosote.

## Results and reports.

During the test period, samples will be analyzed at yearly intervals of one, three and five years. Reports will be issued by Mississippi State University and by the RTA. Reports will be made available to you as they are completed.

Note: Funding for this program is being provided by the Railway Tie Association. Some of the wood for this test program was also donated by the Railway Tie Association.