EVALUATION OF EXPERIMENTAL RAILROAD-HIGHWAY GRADE CROSSINGS IN LOUISIANA

FINAL REPORT
(1970-1985)

By

STEVE G. BOKUN
SPECIAL STUDIES RESEARCH GEOLOGIST

And

ALFRED F. MOORE
ENGINEERING SPECIALIST III

Research Report No. 183

Research Project No. 80-1SS

Conducted by
LOUISIANA DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT
Louisiana Transportation Research Center
In Cooperation with
U. S. Department of Transportation
FEDERAL HIGHWAY ADMINISTRATION

APRIL 1986

ABSTRACT

This report concludes formal evaluation of forty-one experimental high-type railroad-highway grade crossing surfaces installed throughout Louisiana between 1970 and 1984. These crossings were composed of various types of rubber, high-density polyethylene (HDPE), precast concrete or steel plate construction and were installed under varying ADT situations. Six interim reports profiled construction techniques, durability of proprietary surface crossing materials, rideability characteristics, effectiveness of drainage, track rehabilitation procedures and included statistical rail and traffic data. Performance evaluations were conducted examining criteria necessary for establishing departmental policies, procedures and specifications with regard to railroad-highway grade crossings and determining the materials' suitability for inclusion on the Qualified Products List (QPL).

METRIC CONVERSION FACTORS*

To Convert from	To	Multiply by
Length		
foot	meter (m)	0.3048
inch	millimeter (mm)	25.4
yard	meter (m)	0.9144
mile (statute)	kilometer (km)	1.609
Area		
square foot	square meter (m^2)	0.0929
square inch	square centimeter (cm^2)	6.451
square yard	square meter (m^2)	0.8361
Volume (Capacity)		
cubic foot	cubic meter (m^3)	0.02832
gallon (U.S. liquid)**	cubic meter (m^3)	0.003785
gallon (Can. liquid)**	cubic meter (m^3)	0.004546
ounce (U.S. liquid)	cubic centimeter (cm^3)	29.57
Mass		
ounce-mass (avdp)	gram (g)	28.35
pound-mass (avdp)	kilogram (kg)	0.4536
ton (metric)	kilogram (kg)	1000
ton (short, 2000 lbs)	kilogram (kg)	907.2
Mass per Volume		
pound-mass/cubic foot	kilogram/cubic meter (kg/m^3)	16.02
pound-mass/cubic yard	kilogram/cubic meter (kg/m^3)	0.5933
pound-mass/gallon (U.S.)**	kilogram/cubic meter (kg/m^3)	119.8
pound-mass/gallon (Can.)**	kilogram/cubic meter (kg/m^3)	99.78
Temperature		
deg Celsius (C)	kelvin (K)	$t_K=(t_C+273.15)$
deg Fahrenheit (F)	kelvin (K)	$t_K=(t_F+459.67)/1.8$
deg Fahrenheit (F)	deg Celsius (C)	$t_C=(t_F-32)/1.8$

*The reference source for information on SI units and more exact conversion factors is "Metric Practice Guide" ASTM E 380.

**One U.S. gallon equals 0.8327 Canadian gallon.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (CONTINUED)

INTRODUCTION

By the fall of 1968, recurring instances of user dissatisfaction with the performance of railroad-highway grade crossings in Louisiana prompted the Department of Transportation and Development (LA DOTD) to embark upon a comprehensive program to investigate the causes and recommend solutions. Towards that end, several high-type rubber pad (elastomeric) crossings were installed and evaluated in order to find an alternative to the conventional asphalt or timber materials prevalent in use at that time. In 1972, results of that preliminary investigation were used to develop policies, procedures and materials to be utilized in conjunction with future railroad-highway grade crossing projects. Subsequently, there were forty-one high-type crossings installed under the Federal Highway Administration's (FHWA) "Experimental Construction - Category II" Program. These crossings encompassed most of the popular materials and brand names available at the time and utilized the latest construction techniques during their installation.

Performance evaluations of these crossings were conducted by the Department's Research and Development Section, whose coordinated efforts with the New Products Evaluation Committee provided a means of updating the Department's Qualified Products List (QPL). Since 1970, thirteen crossings experienced distress or failures that prompted their removal and replacement or required extensive and costly renovation. Overall performance characteristics of all experimental crossings installed throughout Louisiana between 1970 and 1984 are presented. Also addressed is the relative performance of the newer elastomeric or high-type header boards and six sectional treated timber grade crossings evaluated for comparative analyses only.

Only generalized adjectives were used to describe the overall performance characteristics of each crossing (i.e., good, excellent, fair, marginal, poor). This was necessary when considering the magnitude of variables encountered during the on-site evaluations. These included, but were not limited to, subbase treatment, rail and traffic volume, percent trucks, drainage, rideability, approach pavement type and condition, header board performance, alignment, visibility, signalization and others. Premature failure of proprietary products could be caused by virtually any combination of these variables. Conversely, a poorly designed product might not have been recognized by a dissimilar combination of those variables. Because of these circumstances, Louisiana's findings may not necessarily parallel similar evaluations conducted by others.

Previous findings were reported periodically in six interim reports, the most recent having been Louisiana Highway Research Report No. 165, Evaluation of Experimental Railroad-Highway Grade Crossings in Louisiana - Interim Report No. 6, August 1983. This final report serves only to augment and update the findings, recommendations and conclusions previously reported. It covers eleven new crossings not previously cited and reviews problem areas encountered and corrective measures implemented or attempted.

PURPOSE

The purpose of this research study was to provide a means of furnishing the Department with the information necessary to formulate and implement its own "Railroad-Highway Grade Crossing Policy" and supplemental specifications. It further insured that only high-type (elastomeric) grade crossing materials of the highest caliber would be maintained on its "Qualified Products List."

SCOPE

This final report provides the results of comprehensive performance evaluations conducted on forty-one experimental high-type railroad-highway grade crossings installed in Louisiana between 1970 and 1984. The on-site evaluations consisted of periodic visual observations, photo-documentation, statistical rail and highway traffic data, ride characteristics, and location and installation specifics. To the maximum extent feasible, researchers were present throughout construction to observe and document the entire construction process.

METHODOLOGY

Site Selection

Individual sites for installation of new or additional experimental proprietary features were determined by the Department's office of the project control engineer and were further approved by the FHWA for installation under its Experimental Construction - Category II program. Subsequent issuance of the "Project Notice" further indicates specific subbase treatment, type of experimental high-type feature to be installed, drainage requirements, weight of rails, signalization, etc. Generally constructed by the respective railroads' maintenance forces, considerations were often extended to comply with individual company policies and requirements. Sites were limited to those requiring replacement on a priority basis and scheduled for renovation. This resulted in the placement of experimental features in virtually every geographic region of Louisiana, as might be noted in Figure 1. While this makes periodic evaluations somewhat more difficult, it has been beneficial in subjecting these crossings to a multitude of diverse conditions that test the versatility of their application.

Materials Evaluated

High-type proprietary features designated for experimental installation can usually be classed as one of the following predominant basic categories of materials:

1. Rubber panels (solid, steel-reinforced, shimmed, etc.)
2. Linear polyethylene (HDPE) panels (solid or shimmed)
3. Precast concrete slabs or panels (steel-reinforced)
4. Other: sectional-treated timber, asphalt, epoxy and ground rubber tires, timber-and-asphalt, unconsolidated. (These are not generally considered experimental.)

Virtually all major manufacturers were represented by first or second generation design of their respective offerings.

Interim editions of this final report provided in-depth individual performance evaluations of the first thirty grade crossings completed between 1970 and 1982. This report provides insight into eleven additional installations not previously covered and updates the findings, recommendations and conclusions of the last interim report (August 1983). Major redesign of previously accepted products occasionally prompted re-evaluation for addition to the QPL. Older or no longer available products were either dropped or left on the QPL with minor restrictions if subsequent performance problems developed.

Field Installation

Actual field construction was generally accomplished by the respective railways' maintenance forces or, occasionally, independent contractors under the auspices of a departmental project engineer. District maintenance crews often provided or augmented necessary detours, barricades and signing in accordance with the Louisiana Manual of Uniform Traffic Control Devices (LA MUTCD). Departmental inspectors were on hand throughout construction to insure compliance with the Department's "Railroad-Highway Grade Crossing Policy" (Appendix) and to document expenditures for payment on force account agreements. Likewise, research personnel were also available for all experimental construction in order to compile information for these reports and provide recommendations to the New Products Evaluation Committee for consideration.

Performance Evaluations

Actual field performance of newly constructed experimental proprietary features were conducted by the Department's Research and Development Section, Special Studies Unit. These periodic, generally semi-annual, on-site evaluations provided a photo-documented history monitoring the new feature's ability to withstand the abuses that rail and traffic induce under varying conditions. The soft, underlying soils and high annual rainfall in Louisiana provided far less than adequate support and often caused premature subbase failures in spite of precautions taken during construction. These factors occasionally contributed to the premature failure of many of the experimental installations.

Other considerations include rideability, approach pavement condition, tie-in apron, header-board performance, panel integrity, rail damagae, ADT, percent trucks, drainage, etc. Normal evaluation periods were accelerated when signs of premature failure such as broken panels or subbase failures were in evidence. This often provided the impetus for subsequent removal or retrofitting of entire crossings with materials then current on the QPL. Since the Department began its own evaluation of railroad-highway grade crossings in 1970, thirteen crossings have had to be replaced due to premature failures. Many of these failed within a year of installation.

Once designated as experimental construction, each crossing was assigned a sequentially numbered project identification number for quick reference. These numbers, in addition to more specific location descriptions and essential statistical data, are found in Table 1 (Appendix). Geographic locations are found in Figure 1. Individual, in-depth performance evaluations were provided for crossings 1 through 30 in Interim Reports Nos. 5 and 6. Current status of these crossings may be noted under <u>1985 Overall Performance</u> in Table 1. Only crossings not previously mentioned will be contained in the Performance Evaluations of this report.

P E R F O R M A N C E

E V A L U A T I O N S

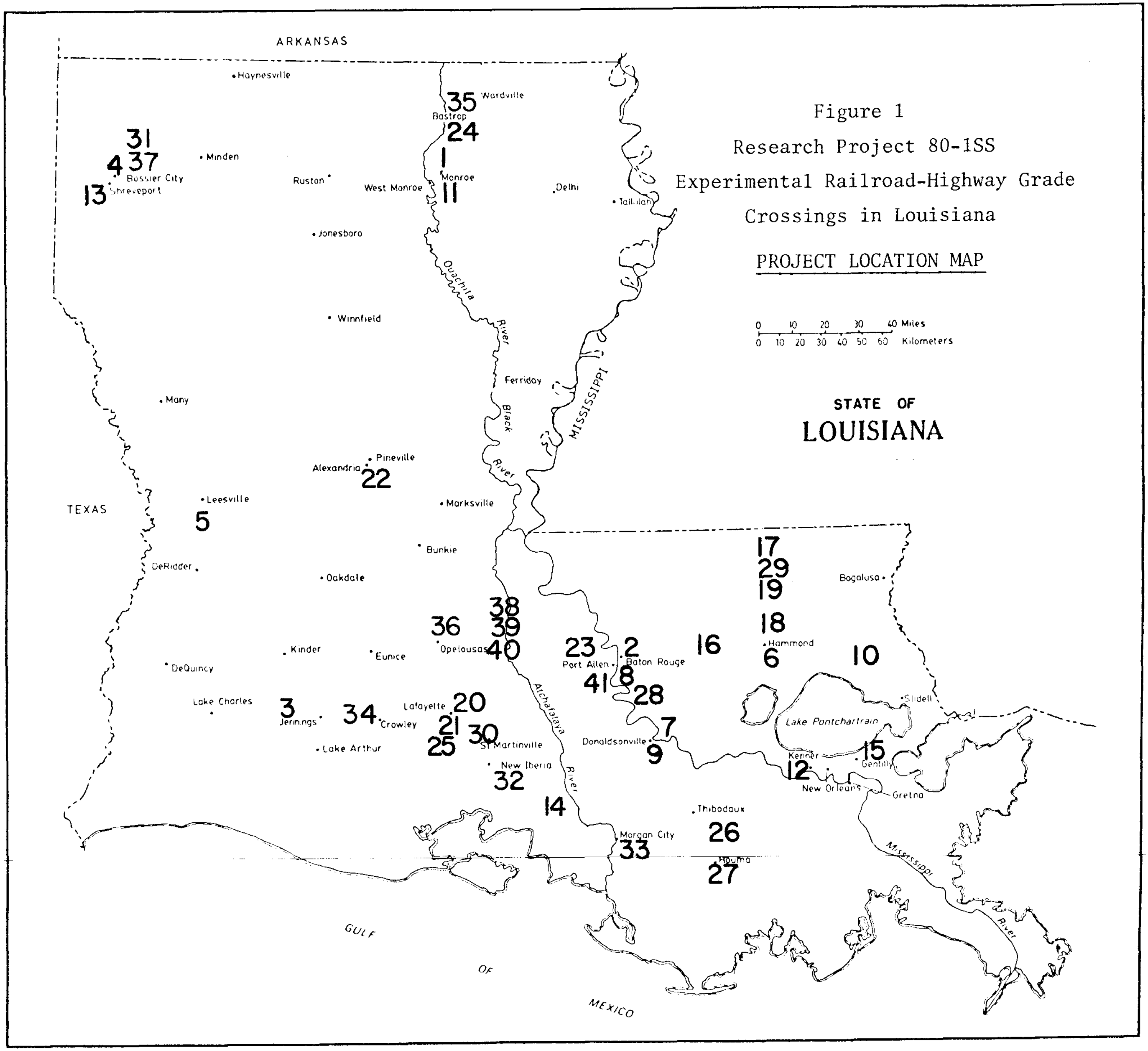


Figure 1

Research Project 80-1SS

Experimental Railroad-Highway Grade Crossings in Louisiana

PROJECT LOCATION MAP

No. 31

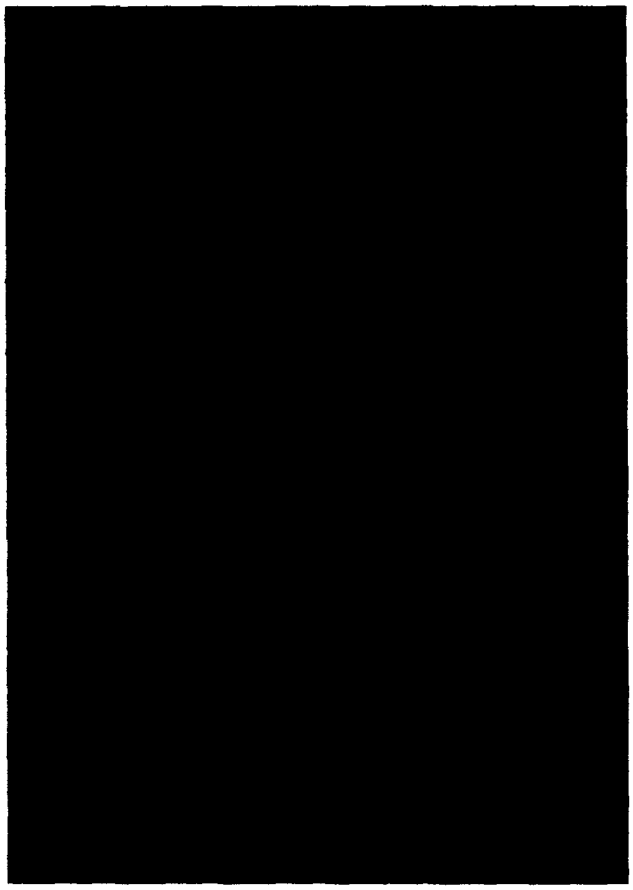
State Project No. 44-01-25
Federal Aid Project No. RPS-37-07(008)
General Tire "GEN-TRAC II" Rubber Panel Crossing
La. 3 (Benton Road) at Bossier City

Installed in March 1983, this 72-foot-long crossing is a busy two-lane divided asphalt city street (Figure 2). With a 1985 ADT of 24,045 with 18% trucks, this single main-line track carries two freight trains per day at approximately 10 mph.

GEN-TRAC II Rubber Panel Crossing on Benton Road in Bossier City

FIGURE 2

After only two years, however, it is already showing signs of distress. The most readily apparent indication of this is in the field side panels adjacent to the rail (Figure 3). This condition was precipitated by the heavy rail traffic. Figure 3 also depicts a more subtle variation of failure as the reflection cracks in the rubber indicate internal fracturing of the steel substructure.



Indication of Internal Fracturing or Failure

FIGURE 3

This type of failure was predominant in a similar GEN-TRAC II crossing at Patoutville, Louisiana. There are also many places where the rubber is delaminating from the steel substructure in the wheelpaths.

Overall, the installation is still structurally sound at this time, with good to excellent rideability. However, early indications of failure preclude its being considered for addition to the QPL at this time. It is apparent that its productive life in heavy ADT situations would be questionable. Radiographs of seemingly sound panels removed from Patoutville revealed extensive internal metal fatigue in progress. Once initiated, this stress cracking tends to propagate rapidly. At both locations, the track structure and drainage are in excellent condition with no indication of subbase failure which might contribute to this deterioration. There are no plans for future installations in Louisiana at this time.

No. 32

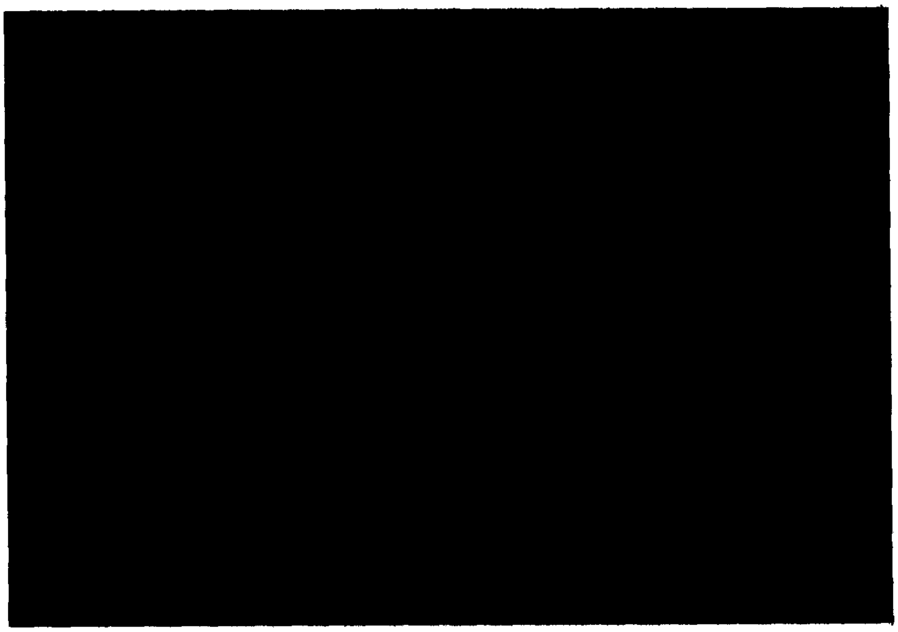
State Project No. 424-04-14
Federal Aid Project No. RRS-11-04(001)
General Tire "GEN-TRAC II" Rubber Panel Crossing
La.-U.S. 90 at Patoutville

Installed in June 1983, only three months after the installation in Bossier City, Louisiana, this GEN-TRAC II crossing had two panels experience complete failure in the wheelpaths prompting their removal in June 1984. Figure 4 depicts the extensive surface damage in evidence one month before failure.

GEN-TRAC II Crossing at Patoutville at Ten Months

FIGURE 4

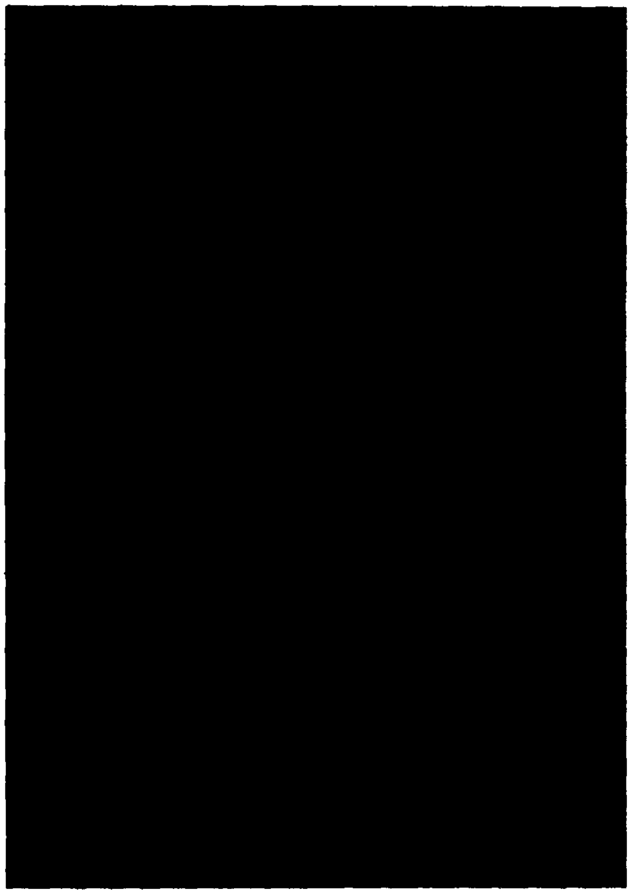
In June 1984 the panel shown in Figure 4 fractured completely, strewing metal and rubber all over the highway. Temporary asphalt backfill was installed and the panel pieces were returned to the lab. Figure 5 shows a portion of the failure.



Broken Pieces of Panel

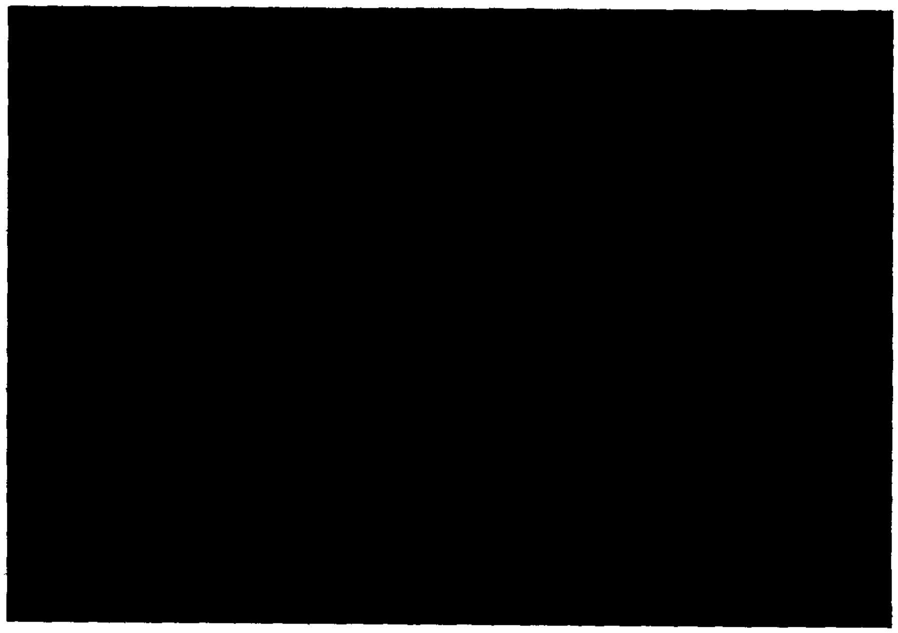
FIGURE 5

In order to determine the cause of failure, a seemingly sound panel was removed from which samples were taken using a band saw for radiograph analysis. The radiographs revealed myriad internal fracturing in progress, propagating from the edges of all cutouts (Figure 7) where the mild steel substructure was bent.



GEN-TRAC II Panel Band-Sawed Apart for Closer Examination

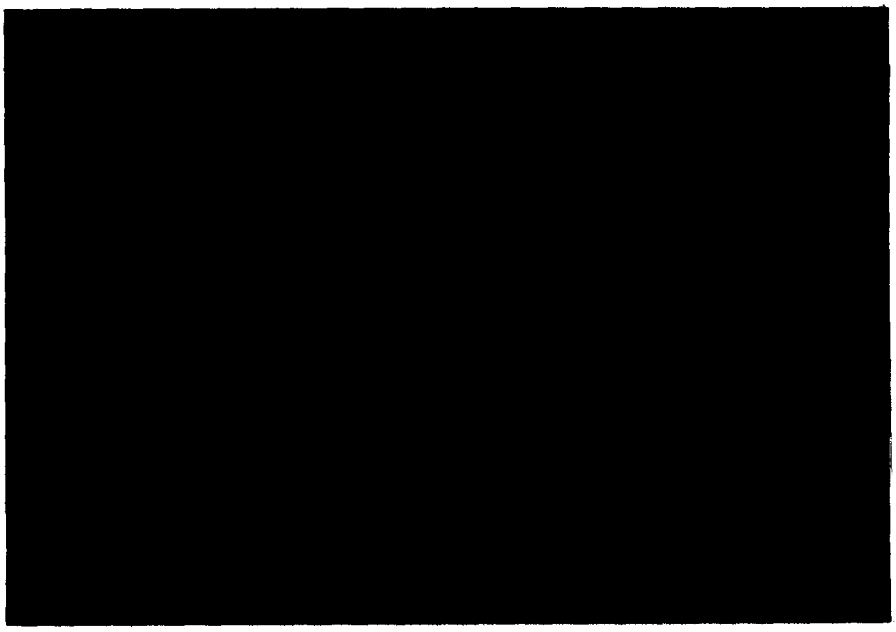
FIGURE 6



Internal Fracturing Propagating From Cutouts

FIGURE 7

The cyclic loading action of traffic caused the encapsulated steel to rock and bend (Figure 8), allowing the rubber to fatigue and separate.

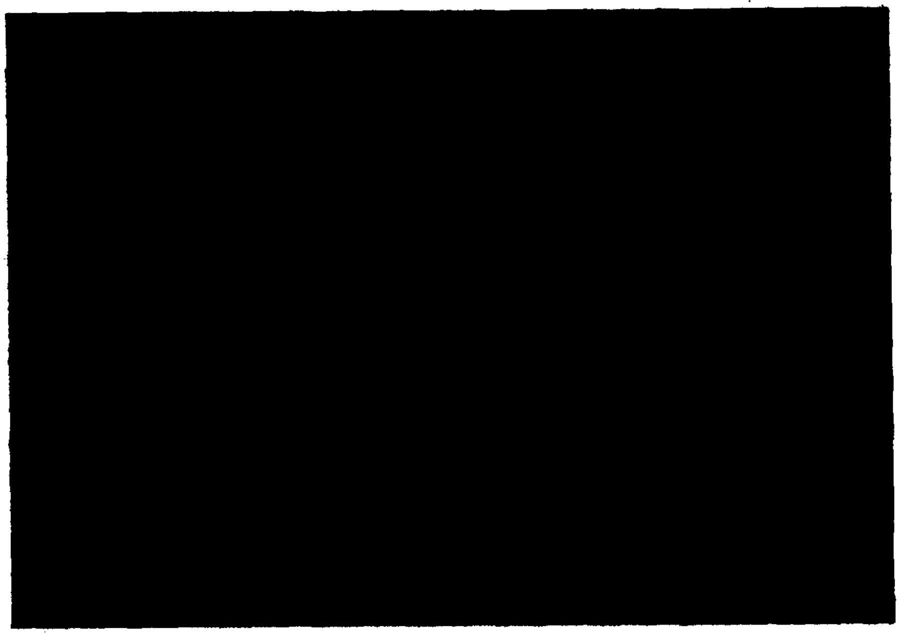


Rocking and Bent Steel Causing Delamination

FIGURE 8

As the rubber separated, it permitted moisture to reach the steel, allowing oxidation and rust to form (Figure 7). Once started, panel deterioration was rapid and could be readily detected from the surface. Because of the one-foot concrete subbase and all new track structure, no movement or rocking of panels or shims was noted. Neither the installation nor subbase condition was considered a contributory factor in the rapid deterioration of the product.

It was decided to leave the temporary asphalt backfill in place rather than replace the panels (Figure 9) at this time. This was done in order to observe future developments before making a decision whether to remove the broken panels only or replace the entire crossing.

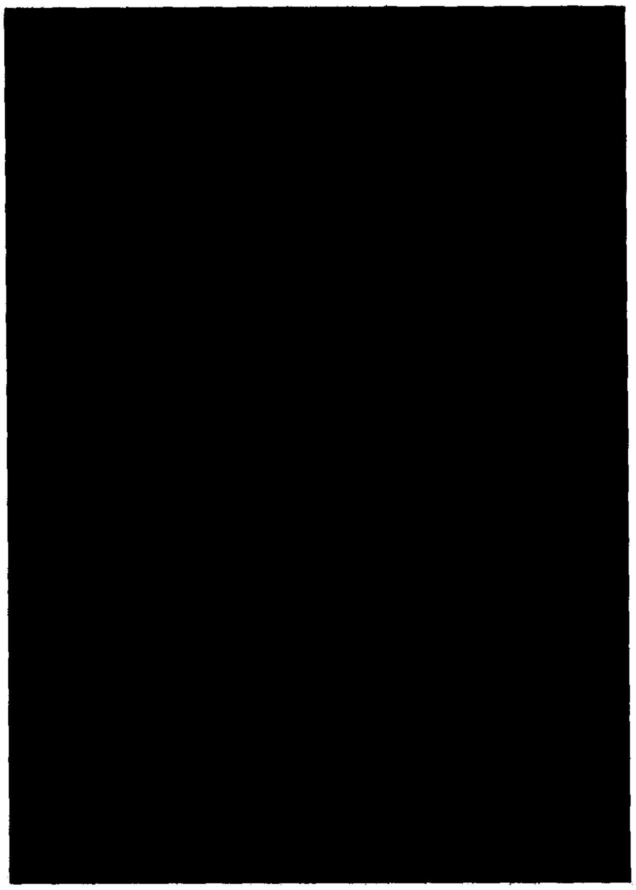


Present Condition with Temporary Asphalt Backfill in Place

FIGURE 9

Situated on La.-U.S. 90 near Patoutville, the 1985 ADT was 18,058 with 19% trucks. This major north-south concrete highway is separated by a wide median, while the single spur line carries only very limited, seasonal rail traffic. Based upon these findings, it was decided not to permit any further installations of GEN-TRAC II in Louisiana at this time.

During the reconstruction of this industrial spur line, two sectional treated timber crossings were installed simultaneously on the service roads at this location (Figure 10). Due to the very light rural traffic, they are both in excellent condition after two years of service.



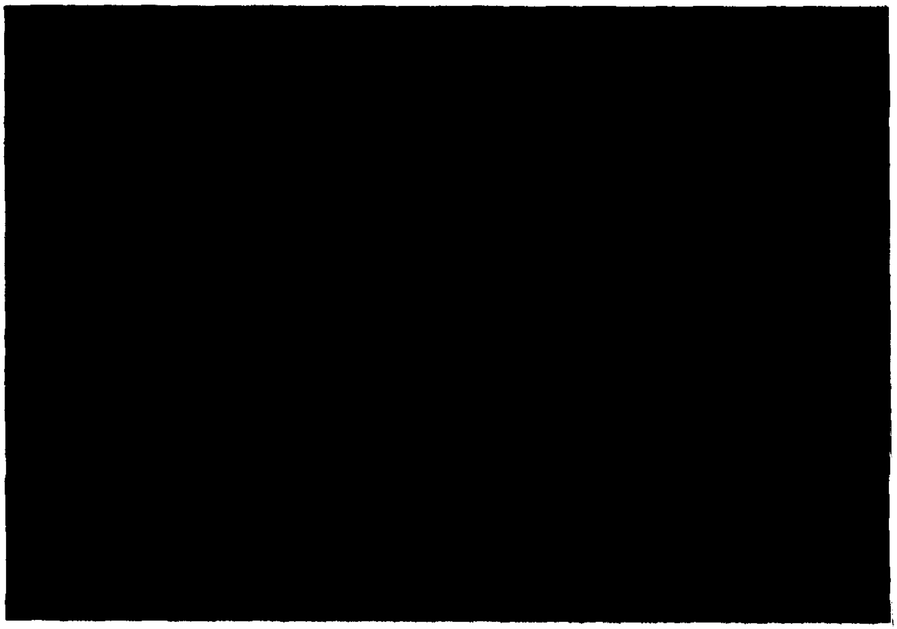
Low ADT Service Road After Two Years

FIGURE 10

No. 33

State Project Nos. 5-01-57, 5-02-37 and 5-03-15
SAF & DRI (Model C) Rubber Panel Crossing
Bayou Ramos-Port Gibson Highway in Morgan City

Completed in June 1982, this site marks the first installation of Structural Rubber Products SAF & DRI (Model C) in Louisiana. Researchers were not notified of this installation and were not on hand during construction. It was approximately one year old when evaluation was initiated and several panels were found to be loose and rocking. Figure 11 shows its condition after two and one-half years of service.



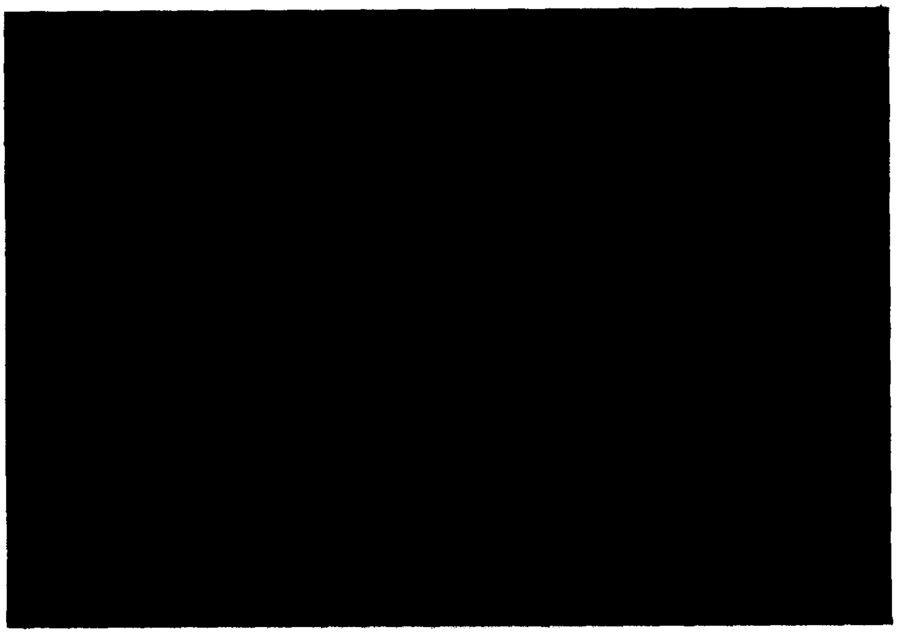
SAF & DRI (Model C) of Morgan City
2½ Years After Installation

FIGURE 11

Protruding spike heads and broken and sunken panels belie subbase or shim failure. By April 1985, approval was granted for total reconstruction. What follows are pictures and comments relative to that reconstruction.

Situated adjacent to the Intracoastal Canal in Morgan City, Louisiana, this lightly used industrial spur line is traversed by La.-U.S. 90 (Bayou Ramos-Port Gibson Highway), a heavily traveled two-lane, undivided asphalt highway. The 1985 ADT was 26,934 with 11% trucks. A large portion of these are very heavily laden tankers serving this oil city's many refineries. Under these conditions and the abuse they afford, researchers would have recommended SAF & DRI's Model "S" rather than "C". Model S is constructed of heavy steel box beams filled with concrete and have never failed under similar conditions. The lighter, thinner Model C tends to bend, flex and eventually break under these traffic loads. In this case there are a multitude of possible contributory factors that will be pointed out. Not having seen the initial installation, most of these observations are merely the authors' opinion based upon previous experiences.

Figure 12 shows the split and broken gage shims that allowed the panels to settle, flex and eventually break off. It was unusual to find evidence of excessive pumping and clogged ballast on such a relatively new crossing.

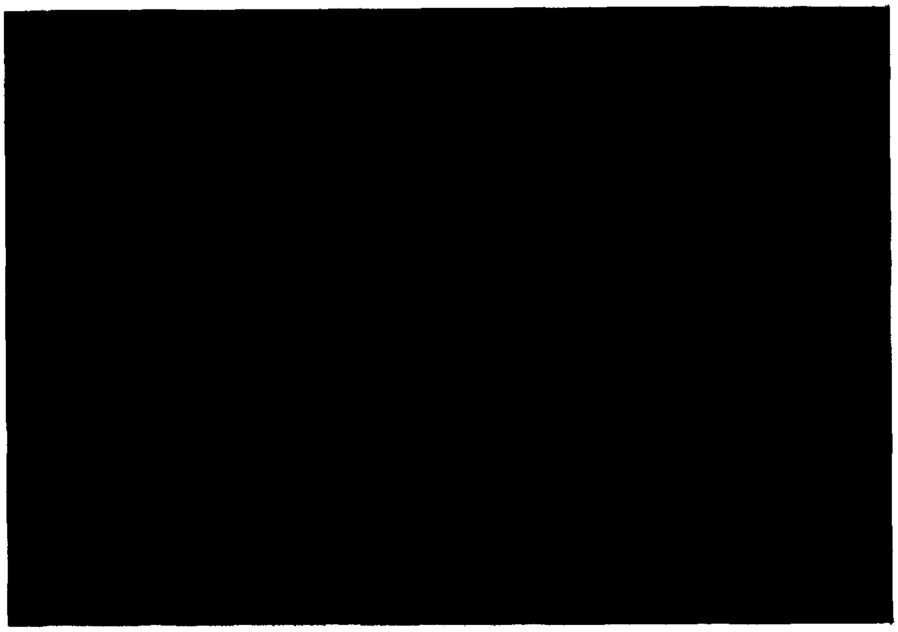


Broken Shim(s) and Excessive Pumping

FIGURE 12

Closer inspection failed to reveal any type of drainage pipe or filter cloth. Ditches were searched for a discharge and probing failed to indicate any. Without filter cloth, even French drains could not have been formed. Unless the fines were pumped from under the roadway during the frequent showers prevalent in this area, the ballast may have contained excessive deleterious material during initial reconstruction.

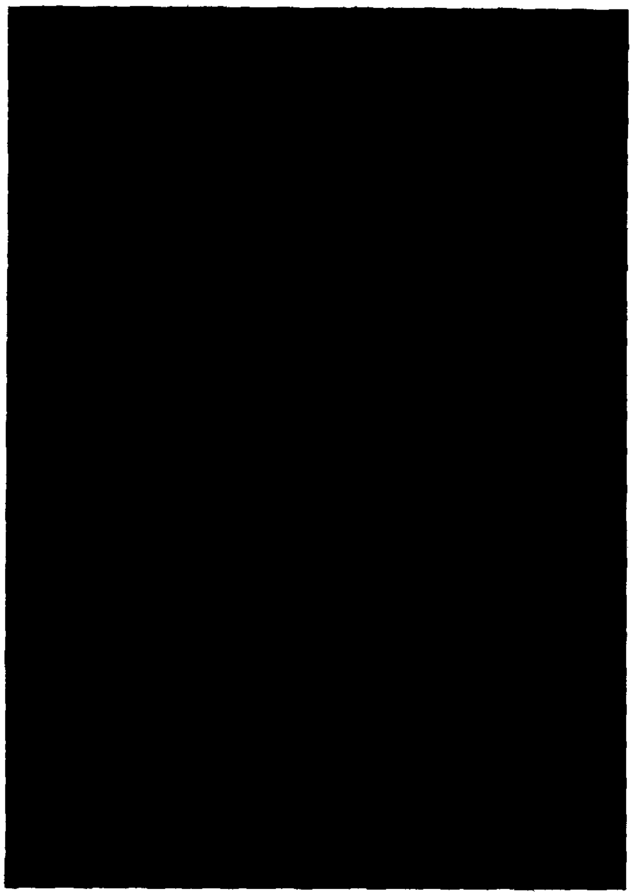
Figure 13 shows the underside of a failed gage panel. It can be noted how the narrow corrugations of the encapsulated steel substructure provide very little bearing area.



Failed SAF & DRI Model C Gage Panel

FIGURE 13

The previous figure reveals how severely the movement of these panels abraded the shims. It is unknown if the shims were installed with such heavy splitting in evidence or if it developed with age. An indication of similar occurrences may be the addition of one-quarter-inch carriage bolts installed by the factory on the ends of the new replacement gage shims (Figure 14).



Aligning the New Replacement Gage Shims

FIGURE 14

The fresh, clean ballast in the foregound is misleading as it extends only six inches deep. The original track structure was raised approximately six inches, new ballast added and a large, rail-mounted vibrator used for consolidation. It will not take long, however, for the excessive fines and dirt (Figure 15) of the original, underlying ballast to clog the new ballast and create more pumping action. At the authors' suggestion, the new replacement and sound, reusable panels were reinstalled 18 inches off-center of their original position. The pin configuration of these panels allows approximately 50 percent of the drive pins to get a fresh "bite" in a previously unspiked tie, whereas the rest were driven into previously used holes that were plugged. Designers should bear in mind that should track work or replacement be necessary, it would be beneficial if panels could be staggered or reversed to avoid reuse of spike-killed ties.

The Underlying Ballast of the Original Structure

FIGURE 15

As previously mentioned, a problem common to all high type crossings utilizing shims is the tendency of wooden shims to split under the rocking movement of traffic. This was addressed by SAF & DRI with the introduction of a dense, solid rubber field side shim (Figure 16).

New Solid Rubber Field Side Shims

FIGURE 16

This marks the first installation of these shims in Louisiana. They appear to be a logical solution to a common problem and could be adapted to other brand panels as well. Their moderate cost is justifiable when considering the fact that they should not be as prone to splitting, cracking or rotting as their wooden counterparts.

At this point, with all new shims tacked in place, panel replacement was initiated with new gage and field side panels being utilized in the wheelpaths. Sound, reusable panels were selected for the balance of the crossing. While the original crossing was affixed with square-head drive pins, the new panels and shims were supplied with square-head, spiral lag screws. Those lag screws were met with mixed emotions concerning their corrosion resistance, holding ability, reuse, etc. This crossing, however, will probably provide little to prove or disprove these concerns. With the panels in place, 1/2-inch pilot holes were drilled for all drive pins (which were reused) and lag screws (used on the new panels only) alike. After experiencing minor difficulties with the pneumatic drill and portable air compressor, all but two were pounded in with mauls. The drive pins visibly rotated slightly with each blow whereas the lag screws went straight in with no rotation observed. The lag screws secured the new panels in the wheelpath that previously failed completely.

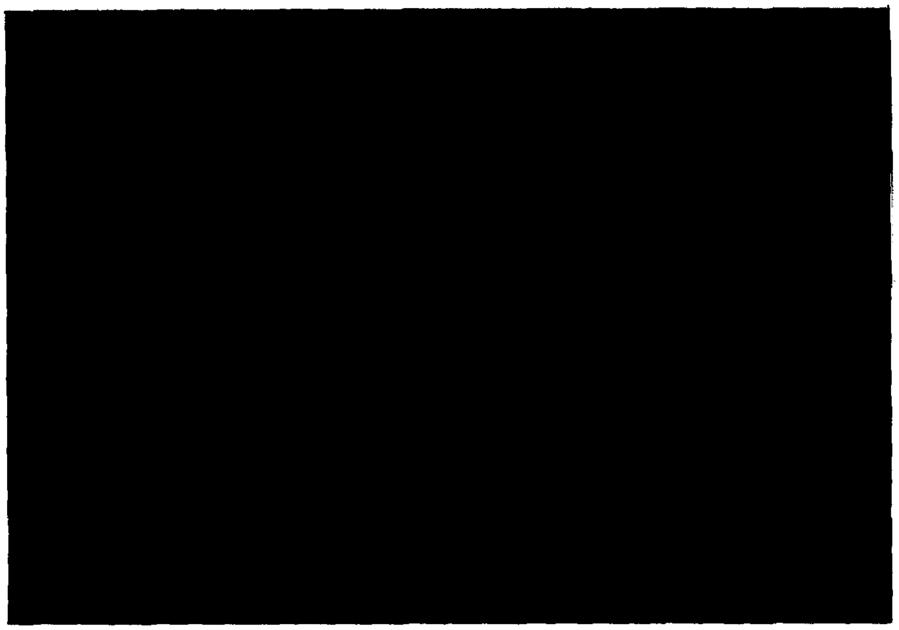
With the panels in place, the thin, flexible header boards were dropped loosely in place. These can be seen in the photographs, as well as the narrow gap at the pavement juncture that prevented their being affixed to the shims or ties in any fashion. At this point, asphalt aprons were installed, traffic was diverted onto the crossing, and the other half of the crossing was rehabilitated in a similar fashion.

In summation, it is anticipated that this crossing will experience some sort of failure within a few years. Because of the high ADT and annual rainfall, settlement of the track structure due to poor drainage and pumping will probably be the first indication. If settlement is not uniform, shims may rock and cause panels to loosen up. When that occurs, the cyclic loading action of heavy traffic could allow panels to bend and flex again. Based upon the aforementioned observations, failure of the proprietary features or their components would be difficult to ascertain definitely. Interim Report No. 6 profiled four other Model C installations (Nos. 25, 26, 27 and 30), while this final report addresses this and two additional crossings (Nos. 35 and 36). As those crossings approach five years of age, district traffic engineers and R&D will be asked to make recommendations for possible inclusion on the QPL and, if so, with what, if any, restrictions. In the interim period, additional installations may be permitted only with the Chief Engineer's approval.

No. 34

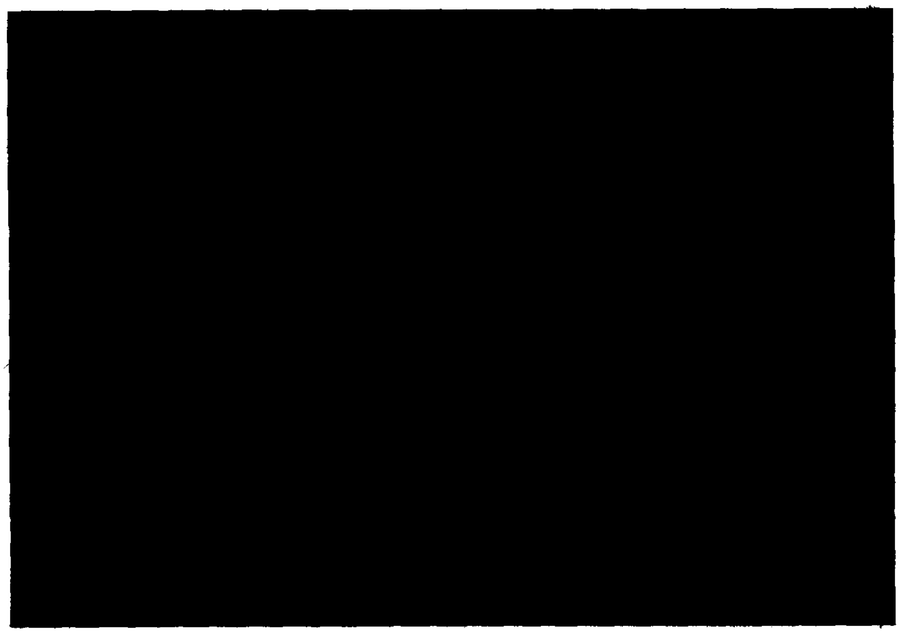
State Project No. 3-09-22
Federal Aid Project No. RRS-000S(033)
Strail "HI-RAIL" Rubber Panel Crossing
U.S. 90 in Crowley

Constructed in May 1984, this was Louisiana's first installation utilizing Strail "HI-RAIL" rubber panels. These dense, full-gage rubber panels require no shims and are not affixed to the track structure in any way. Joined by interlocking flanges, they are easily popped in place, jacked together and restrained on either end with steel gooch plates (Figures 17 and 18).



Strail "HI-RAIL" Rubber Panel Crossing
Shortly After Installation at Crowley

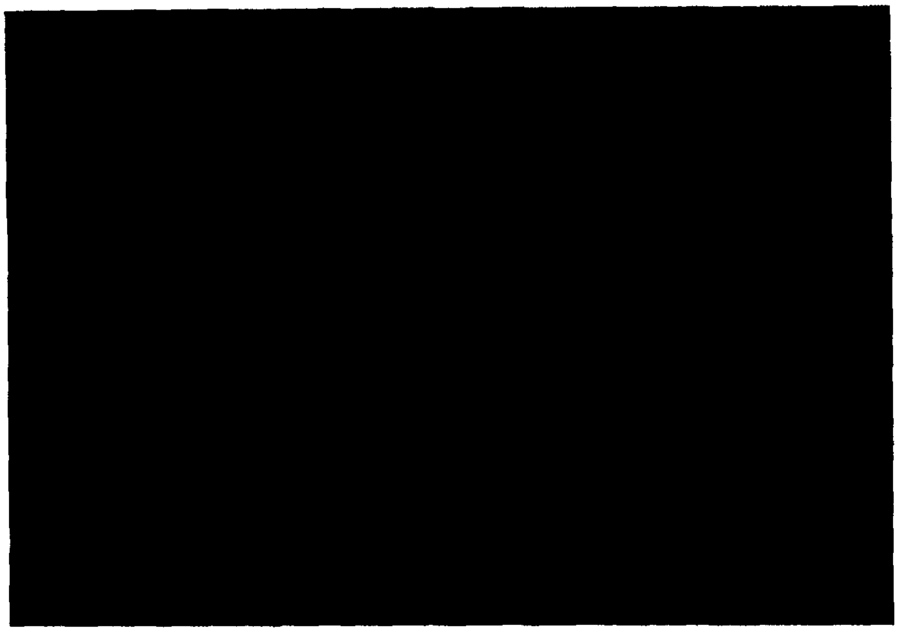
FIGURE 17



Steel Gooch Plates Used to Restrain the Full-Depth Rubber Panels

FIGURE 18

The full-depth field side panels require no header boards and are held in place only by the wedging action of the asphalt pavement juncture material. This non-destructive method of attachment permits rapid installation or removal in the event that track work should be required. The only deficiencies noted to date were when traffic forces tended to wedge the panels tighter, creating a one-inch separation in the panels (Figure 19). There was also minor rocking of the field side panels that was not considered detrimental.



Separation Caused by Traffic Forces

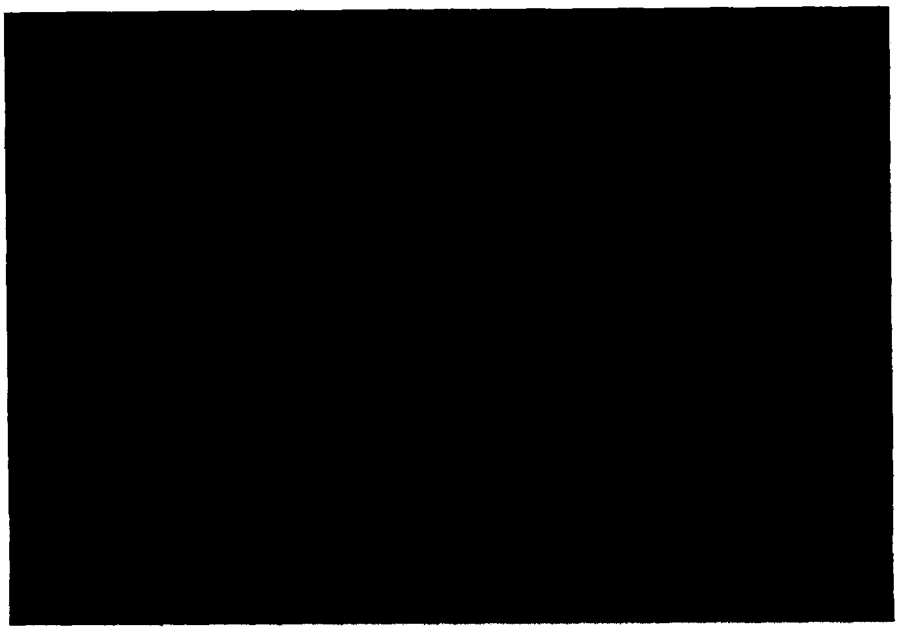
FIGURE 19

Situated at an angle to the roadway, this minor urban two-lane asphalt highway is located on the outskirts of Crowley, Louisiana. It had a 1985 ADT of 3,064 with 9% trucks. The spur line carries less than two freight movements per day and has excellent drainage. The recently rehabilitated highway provides excellent rideability and is extremely quiet. It was recommended that the panels be retightened and the gooch plates repositioned in order to minimize moisture and debris intrusion.

No. 35

State Project No. 38-03-16
Federal Aid Project No. RRS-47-01(003)
SAF & DRI (Model C) Rubber Panel Crossing
La. 139 in Bastrop

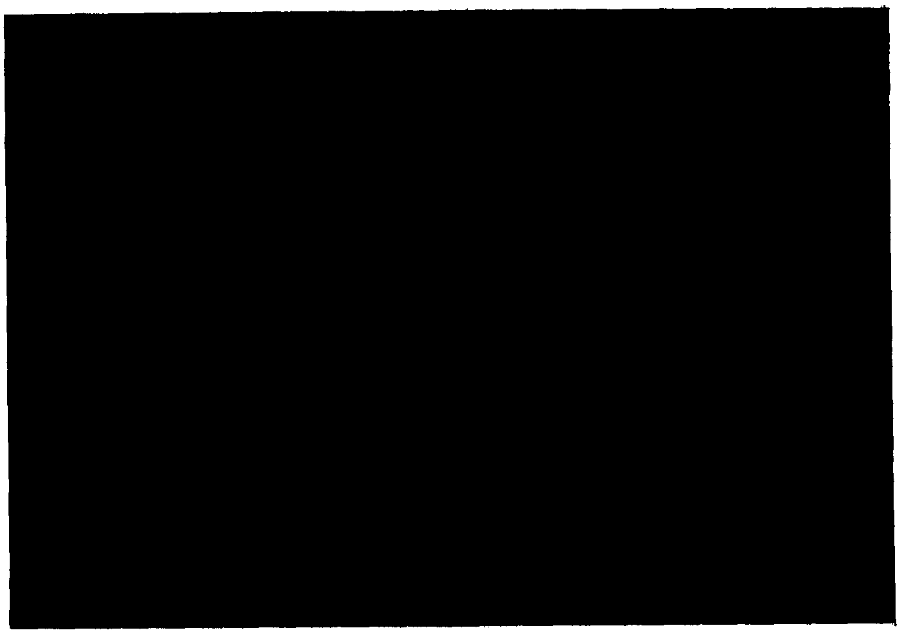
At this location, La. 139 is a four-lane, undivided asphalt highway with a 1985 ADT of 5,758 with 18% trucks. Completed in September 1983, there is an excessive accumulation of debris and evidence of minor panel warpage noted in the wheelpaths (Figure 20). The industrial spur line is rarely used.



SAF & DRI Model C in Bastrop
After Approximately Two Years

FIGURE 20

Rutting is developing in the wheelpaths, providing for a slightly harsh ride (Figure 21). This is created by extremely heavy logging and agricultural truck traffic.



Rutting in Wheelpaths

FIGURE 21

Minor panel warpage is attributed to the heavy loads and settlement of the track structure. With these exceptions, this crossing is structurally sound and performing well at this time.

No. 36

State Project No. 66-08-08(31)
Federal Aid Project NO. F-FG-66-01(005)
SAF & DRI (Model C) Rubber Panel Crossing
La.-U.S. 167 (Ext.) in Nuba

Completed in March 1983, during the construction of La.-U.S. 167 (Ext.) where it provides an alternate north-south route pending completion of I-49, this SAF & DRI (Model C) crossing (Figure 22) is performing well after two years.

SAF & DRI Model C Rubber Panel Crossing
At Nuba Two Years After Completion

FIGURE 22

With a 1985 ADT of 6,870 and 10% trucks, this well-established roadbed has excellent drainage. The seldom used old main line is scheduled for abandonment, at which time the crossing will probably be removed. In the interim period, the only shortcoming of this crossing was in the pavement relief juncture (Figure 23) which is in need of rejuvenation. At present, it provides for a somewhat harsh ride.

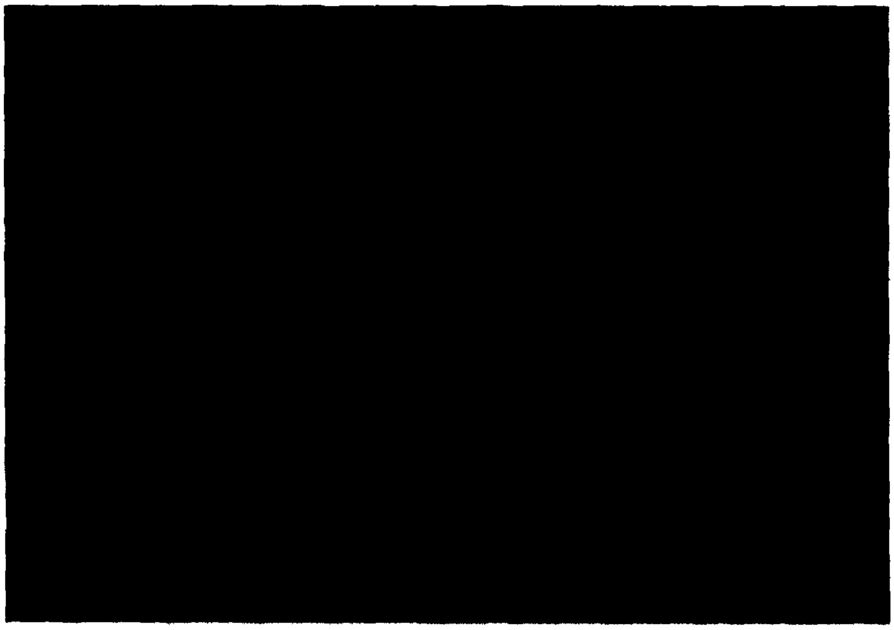
Poor Condition of Pavement Relief Juncture

FIGURE 23

No. 37

State Project No. 10-31-11
Federal Aid Project No. RRS-6072(003)
Strail "HI-RAIL" Rubber Panel Crossing
La. 72 in Bossier City

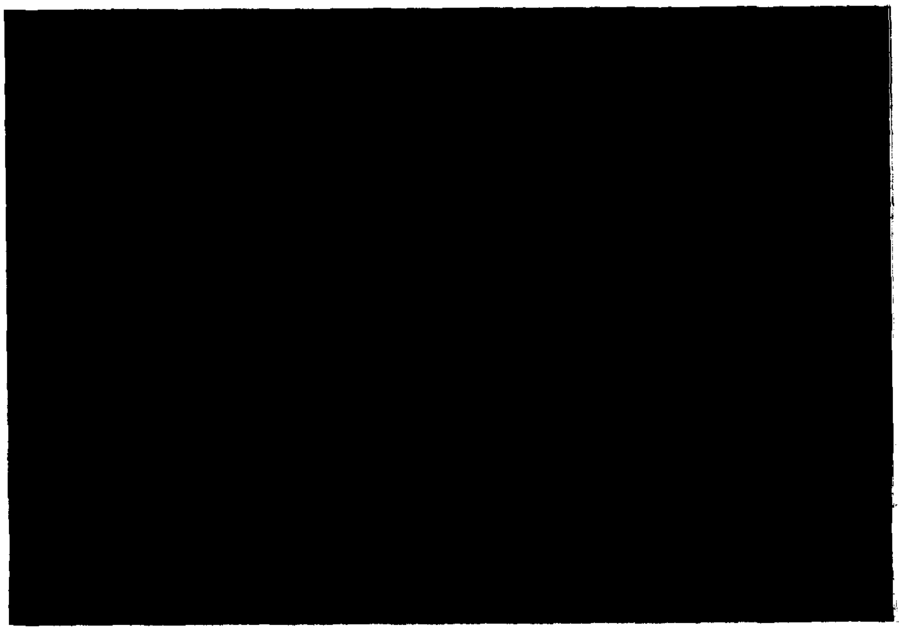
Figure 24 depicts the badly deteriorated wooden crossing on La. 72 in Bossier City that was replaced in July 1984 with a Strail "HI-RAIL" rubber panel crossing.



Wooden Crossing in June 1984
Prior to Replacement

FIGURE 24

In connection with this reconstruction, it was necessary to raise the track six inches in order to restore the integrity of this heavily traveled main line that hosts 4 freight trains per day at approximately 25 mph. The 1985 ADT was 10,310 vpd with 11% trucks. After total reconstruction, panel installation was completed within three hours and the asphalt paving operation initiated (Figure 25).



Spreading the Second Lift of Asphalt
For the Approach Pavement Tie-in

FIGURE 25

In addition to providing a smooth approach, the asphalt provides the only method of restraining the field side panels to the crossing other than the gooch plates on either end.

With the possible exception of a front-end loader to facilitate moving the heavy, full-depth rubber panels, no other mechanical equipment is required for installation. The "HI-RAIL" panels can be installed or removed using only common hand tools and are not affixed to the track structure in any fashion. They are restrained only by the asphalt, tension and steel gooch plates on either end. Figure 26 shows the finished product with excellent rideability still in evidence after one year of service.

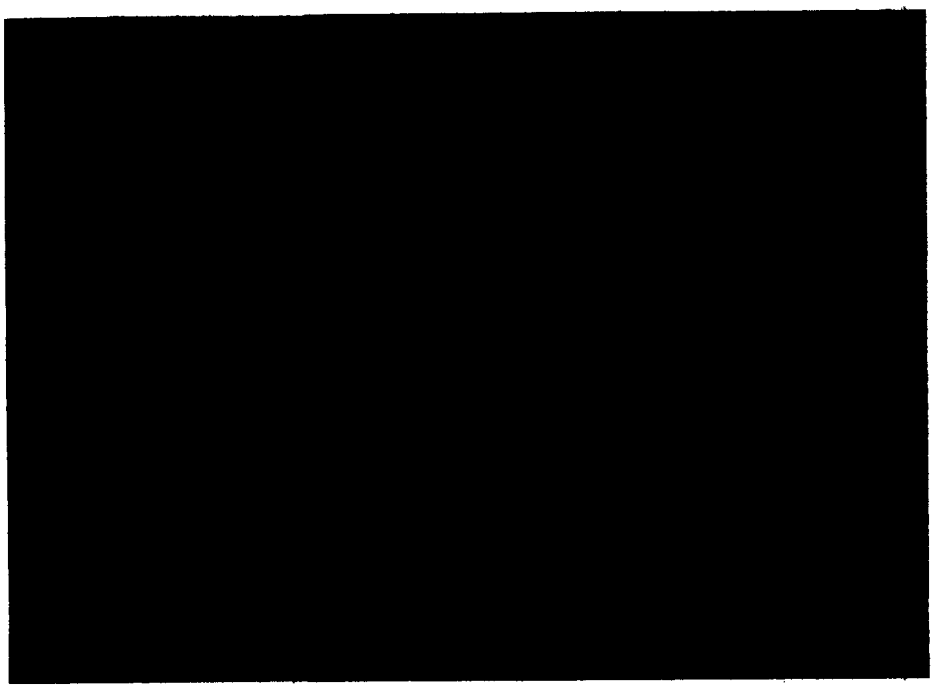
Excellent Rideability After One Year

FIGURE 26

Nos. 38, 39 and 40

State Project No. 849-40-05(31)
UNI-8 Steel Panel Crossing - No. 38
Red Hawk Rubber Panel Crossing - No. 39
"HI-RAIL" Rubber Panel Crossing - No. 40
La. 3173 (Ninth Street) in Krotz Springs

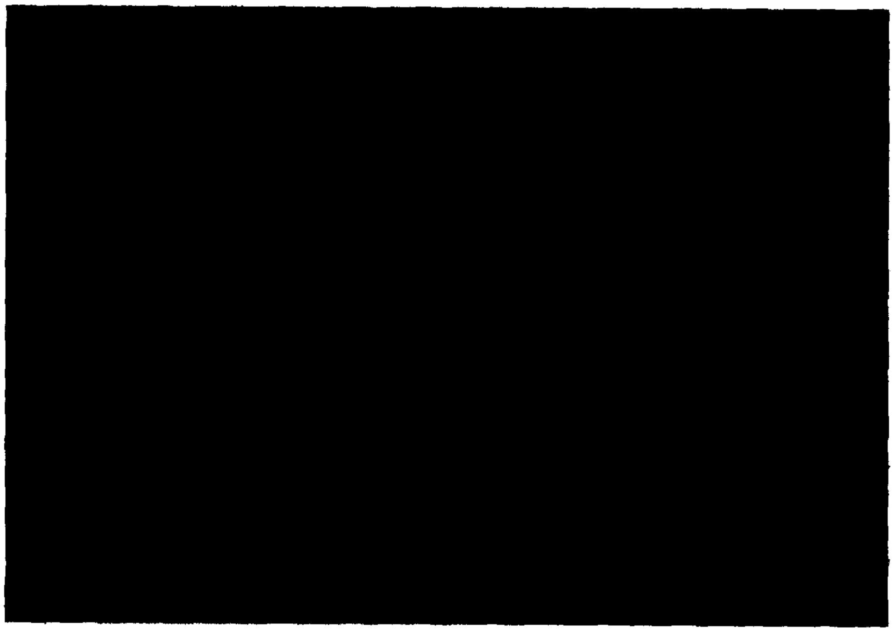
In August 1984 Louisiana was afforded the opportunity to install three experimental crossings simultaneously. This marked the first installation utilizing UNI-8 full-depth, solid steel plate panels (Figure 27) and the new Red Hawk rubber panels, as well as the previously installed Strail "HI-RAIL" solid rubber panels.



UNI-8 Steel Plate Crossing
Six Months After Installation

FIGURE 27

Figure 28 shows the counterboring and installation of the recessed head timber screws unique to the Red Hawk rubber panels. Rubber abrasion pads are utilized on top of all shims.

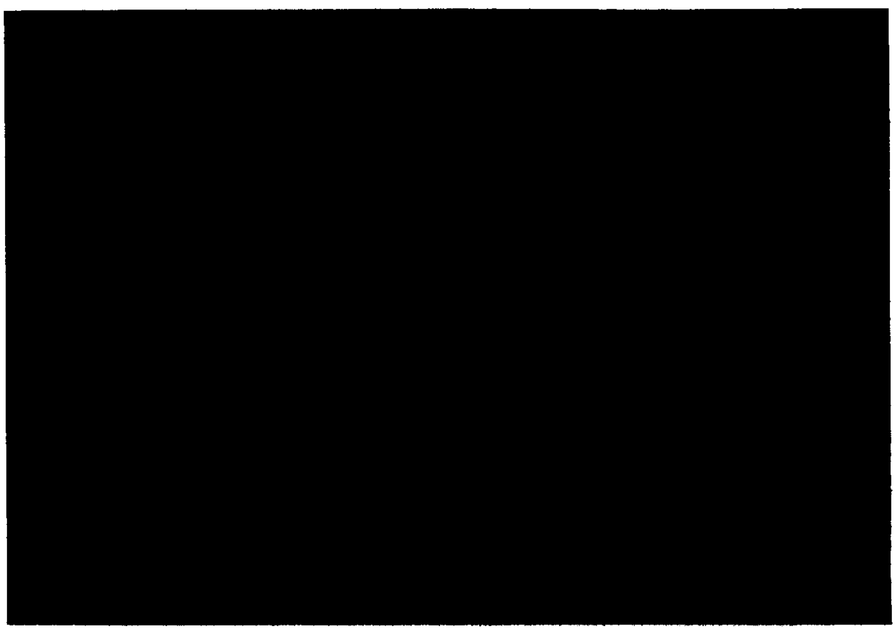


Red Hawk Rubber Panels and Timber Screws

FIGURE 28

In the background the single-spiked, double-shoulder tie plates can be seen with the new rail and ties. The Department would prefer double-spiking and encourages the use of tie pads, at least within the crossing proper. The logic behind this train of thought is the vibration dampening effect and realization of the inability to tighten loose spikes or ties once the panels are in place. Unlike rail traffic, which can distribute the load, the cyclic loading of vehicular traffic, especially heavy trucks, tends to place loads on the ends and center of individual ties. In spite of the best efforts to fully consolidate the ballast during construction, the cyclic loading of traffic almost always vibrates it further, loosening spikes and/or creating tie settlement.

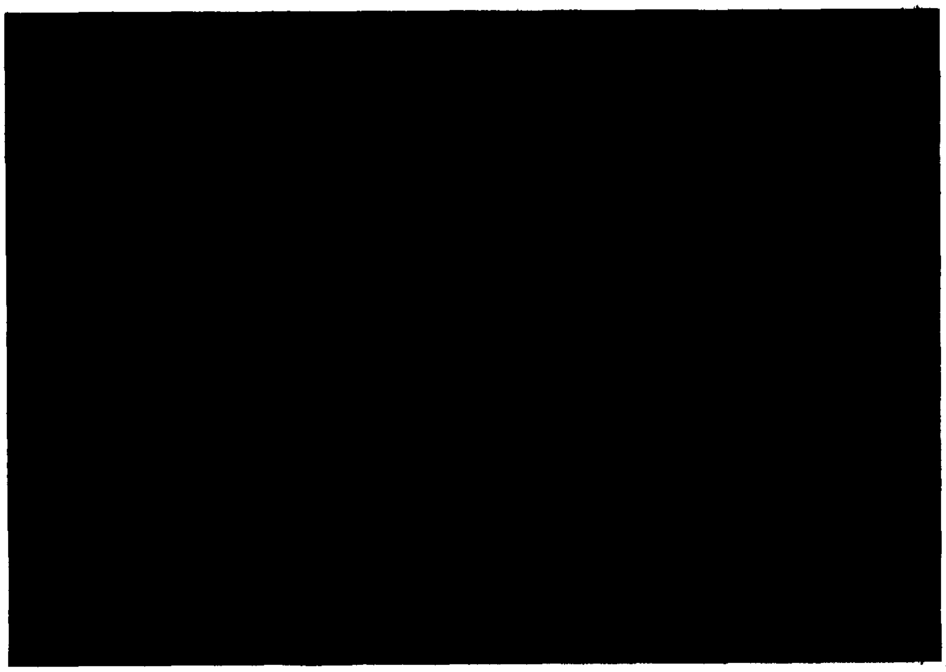
The failure of any high-type crossing material is often a reflection of a combination of practices wherein inferior materials such as these ties are used (Figure 29). If wooden shims of similar quality are added, and numerous drive pins or timber screws inserted, the constructive life of the crossing can be greatly diminished.



Typical Example of Ties

FIGURE 29

Early indications of the ballast consolidation and, perhaps, tie settlement, can be noticed in the asphalt next to the Strail "HI-RAIL" crossing adjacent to the Red Hawk rubber in Figure 30. Although not affixed to the ties, some rocking of the field side panels was noticed. This photo was taken approximately six months after installation.



Asphalt Rutting or Ballast Settlement?

FIGURE 30

These three crossings are subjected to a rigorous daily workout by the heavy refinery tankers, agricultural and log trucks that frequent this small, rural city street. The three spur lines experience only infrequent switching movements and dead-end nearby.

The 1985 ADT was 1,714 vpd with 58% trucks. After approximately one year of service all three crossings are performing satisfactorily Rideability is excellent in spite of early rutting of the asphalt approach pavement and transition zones. All crossings were afforded the benefit of a one-foot-thick asphalt base with fresh, clean ballast and excellent drainage. Newer, heavier rails and ties (with the stipulations provided herein) were installed to the railroad maintenance supervisors' satisfaction in accordance with their company policy.

No recommendations relative to inclusion on the QPL for any of the crossings were made due to insufficient time for evaluation. R&D will be called upon for comments and recommendations as necessary by the New Products Evaluation Committee. Interim approval for further experimental installations of any of the proprietary features must be approved by the Chief Engineer.

No. 41

State Project No. 230-01-14
Federal Aid Project No. RRS-000S(016)
Semprit-Bodan Precast Concrete Crossing
La. 3066 at Plaquemine

Completed in June 1984, this installation using Semprit-Bodan Precast Concrete panels (Figure 31) marked the second application of this type crossing in Louisiana. The first was a triple-track installation at Independence (No. 29) and was introduced mistakenly in Interim Report No. 6 under the trade name of "DOW-MAC". Litigation between DOW-MAC and Semprit-Bodan failed to materialize and Semprit-Bodan retained its copyright.

Semprit-Bodan Precast Concrete Panels

FIGURE 31

Installation particulars surrounding this crossing are unavailable as R&D was not notified of its existence until it was three months old. On-site inspection revealed no evidence of any installation discrepancies. It has a one-foot concrete base and is very neat with good rideability considering its elevation. This two-lane, rural city street carried 4,442 vpd in 1985 with 19% trucks. Too recent to render an opinion, it is performing well with no signs of deterioration after one year. No further installations of this type were projected at the time of this report.

SUMMARY OF FINDINGS AND DISCUSSION OF RESULTS WITH CONCLUSIONS

An analysis of performance characteristics of high-type railroad-highway grade crossings installed experimentally in Louisiana between 1970 and 1985 would seem to indicate that:

1. Regardless of the high-type crossing material to be installed, the singular, most important considerations are proper subbase, drainage and thorough track structure rehabilitation. There is yet to be manufactured a proprietary crossing material that does not reveal poor track preparation within a few seasons. Conversely, a poorly designed product will be revealed in time to prevent costly repetitive installations of inferior quality materials.

2. Because of the premature failure of many new, recently installed proprietary products, it is imperative that skilled, qualified factory representatives of these features be on hand throughout construction. Only by these means can the Department be assured that no failure would be attributed to faulty installation or slipshod preparatory practices. All on-site, post-construction discrepancies documented and reported to the designated Project Engineer by those representatives would be given every consideration during the specified evaluation periods for new or redesigned materials. The alternatives lend themselves only to speculation and conjecture as to the cause and effect of the premature failure of priorietary products.

3. All formal evaluation of Goodyear "Super Cushion" rubber panel crossings was terminated in 1983. Properly installed, they have proven to be sound, durable and aesthetically pleasing railroad-highway grade crossings. Their solution to the wooden header boards was a stiff rubber in an inverted "L" configuration. It has peformed in an excellent manner and could be adapted to other brands as well. They recently introduced a combination

header board/extension panel to accommodate nine-foot ties that looks very promising. None have been installed to date in Louisiana. Of the 24 crossings evaluated between 1970 and 1983, the only failure noted was precipitated by numerous train derailments causing extensive panel damage. It was replaced in 1984. Properly installed, Goodyear "Super Cushion" rubber panels and other track components can be utilized without regard to ADT for any local or industrial application.

4. Structural Rubber Products manufactures SAF & DRI Model "S" and Model "C". The time-proven Model S consists of heavy steel box beams filled with concrete and encased in durable rubber. The 80-inch-long panels feature interlocking tabs and utilize shims. Although their massive weight can make installation awkward, once installed they have proven to be virtually indestructible. Louisiana can recommend their use, without reservation, for any application.

   Exception must be taken, however, to the newer, 36-inch-long Model C rubber panels. Of the eight installations in Louisiana, constructed between 1981 and 1983, one has experienced failure under heavy ADT application and three others are showing early signs of distress. It is too early to make recommendations as to their suitability other than to specify Model S for heavy ADT or industrial use. Meant to be more economical and easier to install than Model S, the lighter Model C panels lack the durability for excessive loads. Further installations in Louisiana will be permitted only on an experimental basis, and future consideration for allowing it to be placed on the Qualified Products List (QPL) will not be tendered if an ADT restriction must be imposed.

5. General Tire and Rubber Company manufacture both "GEN-TRAC I" (18-inch panels) and "GEN-TRAC II" (72-inch panels) rubber panel crossing surfaces. GEN-TRAC I is a full-depth, steel-reinforced

rubber panel, while GEN-TRAC II requires shims. Although formal evaluation of two GEN-TRAC I crossings situated in low volume rural ADT locations provided the impetus for inclusion on the QPL, the performance of another in a moderate ADT (12,000 vpd) situation was such that it had to be replaced completely five years after installation. Informal observations of similar crossings (not experimental) revealed the narrow panels rocking and abrading the ties, which, in turn, created alignment problems and precipitated failure.

The longer GEN-TRAC II rubber panel crossings, installed in higher ADT locations, reflected myriad fracturing of the metal substructure and had panels fail in the wheel paths within one year of construction. Radiographs of seemingly sound panels displayed steel fracturing and propagating rapidly. There are no plans for further installations in Louisiana at this time.

6. Park Rubber Company produces a uniquely designed "PARKCO" rubber panel crossing that is held in place with longitudinally placed steel cable stays. There were two basic designs, both featuring arched steel plate reinforcing. The "Old Design" lacked the additional support of a longitudinal steel bar for the invert of the arch (New Design) and experienced failure in moderate ADT (12-13,000 vpd) applications. Low ADT situations with Old Design panels are relatively new but performing well. New Design installations in moderate ADT areas are doing well after two years. Added conditionally to the QPL in 1983, it will be deleted if the New Design panels experience collapse or show signs of distress noted in Old Design crossings.

Positive aspects of the PARKCO design are the non-destructive method of attachment to the rail structure, ease of installation/removal for track work, and positive, interlocking panels that minimize water and debris intrusion. The flexible rubber header boards, however, attached to protruding bolts cast into the field side panels are susceptible to rock intrusion and generally tend to cause spalling of the HMAC pavement relief junctures. The other drawback is inherent in all crossings that utilize wooden shims, in that they often tend to split and rock, precipitating premature failure of the proprietary products.

7. Although originally manufactured in Germany and presently enjoying widespread use throughout Europe, the Krailburg/Hi-Rail Corporation's Strail "HI-RAIL" full-depth rubber crossing is relatively new to Louisiana. Three installations completed in 1984 are performing well under varying ADT situations. These full-depth rubber panels are readily installed with minimal manpower and equipment. The interlocking tongue-and-groove panels are restrained only by metal gooch plates on either end and field side panels by the HMAC pavement juncture materials. This non-destructive method of attachment permits easy removal for subsequent track work and, properly installed, provides a tight, moisture- and debris-resistant crossing. Periodic inspections of these crossings will continue until sufficient time has elapsed to make recommendations to the New Products Evaluation Committee. Further installations will require approval of the Chief Engineer.

8. Louisiana's experience with Szarka Enterprises' prefabricated, reinforced-concrete panel crossing, FAB-RA-CAST, was limited to one installation. Installed in December 1974, it experienced failure almost immediately and was removed. A second retrofit in April 1977 at the same location failed in a similar manner and was replaced with a rubber crossing in 1979. Installed in a high-density, industrial ADT location, this crossing was not afforded the benefit of any special track preparation. In spite of this, it was concluded that FAB-RA-CAST concrete crossings were inadequate to meet Louisiana's needs and no further installations have been permitted.

9. Two installations utilizing Semprit-Bodan precast concrete panel crossings are performing well after one and three years, respectively. Unlike the FAB-RA-CAST, these crossings are in very low ADT rural situations and were afforded complete track rehabilitation during construction. There are no further installations scheduled at this time. Evaluation of these crossings will continue on an informal basis and results forwarded to the New Products Evaluation Committee as required.

10. Three experimental crossings were fabricated utilizing FEL-PRO's "Track-Span", a combination of ground-up rubber tires and a two-component epoxy that produces a full-width, full-depth, watertight, cast-in-place crossing. A coarse rubber batch is mixed on-site and cured in-place approximately two inches shy of final grade. Once cured, a finer rubber "wearing course" mix is likewise poured and troweled smooth. This has proven to be satisfactory when utilized in proximity of "frog" or switch mechanisms where conventional rubber panels cannot be adapted. It has proven to be very costly and inappropriate when applied to entire crossings. Cast-in-place, it cannot be removed should subsequent track work be necessary, it cannot be re-used, the wearing course has been prone to delamination, and longitudinal shrinkage cracks develop where expansion joints are not provided for during installation. There are no plans for further applications scheduled in Louisiana at this time.

11. A preliminary investigation was conducted into the feasibility of establishing a structural number or index that might identify those railroad-highway grade crossings that merited priority replacement. Analysis of existing statistical and historical data maintained on file revealed little, if any, insight into the actual physical condition of the crossings' present integrity other than the hazard index. Inspection often revealed that factors other than in-situ physical condition of the crossings were responsible for the high

incidence of accidents and other variables that comprise the hazard index formula. The investigation was dropped after several districts experimented with an on-site checklist that proved all variables entered thereon averaged or obscured the true physical condition of the crossings examined.

12. Although not experimental, six sectional treated timber crossings were monitored for possible revisions to Louisiana's policy specifying their use wherein there are less than 1,000 vpd. After approximately five years, three were considered to have failed and three were still serviceable. There was insufficient data to recommend altering the present policy.

13. A portion of the evaluation process was to have been rideability characteristics utilizing the Mays Ride Meter. After many attempts with various district ridemeters, it was determined that too many inconsistencies existed to use the results for any conclusive indication of crossing performance. It was impossible to isolate the 8-1/2 to 9-foot crossing surface area from the approach pavement/header board juncture condition. Newly installed crossings in excellent condition rated only fair to poor because of poor approach aprons or tie-ins, elevation, skew to the roadway, loose rails, etc. Grouping crossings with similarities in order to "factor out" the variables demonstrated little, if any, repeatability. The Mays Ride Meter was considered ineffectual in depicting the true condition of in-situ railroad-highway grade crossings and its use was discontinued in 1983. Rideability characteristics reported herein are the results of on-site inspections combined with researchers' subjective opinion after several passes in various vehicles at the posted speed limit. This was accomplished in order to prevent discrediting high-type proprietary features because of inadequate or faulty approaches, header board deterioration, rutting, elevation, etc. Rideability ratings were conceived from the viewpoint that the crossings presented to the motoring public.

RECOMMENDATIONS

1. The Department should continue to specify and enforce complete track structure rehabilitation prior to the installation of any type of railroad-highway grade crossing improvement, especially experimental features.

2. The Department should not permit the installation of any experimental proprietary railroad-highway grade crossing feature without the benefit of a skilled, qualified factory representative or technician being on hand throughout construction.

3. Consideration should be given towards the development of a Post-Construction Liability Agreement outlining material replacement, manpower and equipment responsbilities to be implemented for timely corrective measures in the event of premature failure of proprietary products.

4. A Research Advisory Committee (RAC) composed of qualified engineers and technicians should be established to determine the significance of major design changes (i.e., second-, third-, or fourth-generation revisions) of proprietary railroad-highway grade crossing features presently on the Qualified Products List (QPL). Their purpose would be to determine if continued applicablity would be in order or to make recommendations for experimental installation only.

5. With respect to installation of new or significantly redesigned railroad-highway grade crossing features, it is recommended that they be limited to five undergoing the prescribed five-year evaluation for inclusion on the QPL at any given time.

6. In view of the circumstances that prompted the aforementioned recommendations and constantly changing qualified departmental inspector personnel, it is suggested that consideration be given towards developing a comprehensive, photo-documented Typical Railroad-Highway Crossing Installation and Renovation Procedural Manual. While manufacturers of high-type grade crossing materials generally provide comprehensive installation manuals for their products, a poorly prepared foundation serves to drastically reduce the constructive life of the crossing and greatly increases the maintenance costs to the Department.

A P P E N D I X

DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT OFFICE OF HIGHWAYS **ENGINEERING DIRECTIVES AND STANDARDS MANUAL**	EDSM NO. II.2.1.2

VOLUME II CHAPTER 2 SECTION 1 DIRECTIVE 2	DATE November 1, 1979 SUBJECT Construction of At-Grade Railroad-Highway Crossings

1. BACKGROUND. Louisiana Revised Statute 45:841 provides, among other things, that "The owner. . . of any railroad. . . crossing any public road. . . to construct and maintain a suitable and convenient crossing over such public road. . . in accordance with the standard specifications furnished by the Department of Highways. . .;" also, Louisiana Revised Statute 48:382 provides, among other things, that ". . . the owner of the facility or utility shall provide a means of crossing the highway which, in the opinion of the Chief Engineer, is appropriate and adequate. . .".

   In view of a past history of highway user dissatisfaction in at-grade railroad-highway crossings, in general, and a lack of uniformity in at-grade crossing construction among the railroads, the Department conducted a study of a rubber pad type of at-grade railroad-highway crossing construction. The study culminated in a Highway Research Report "Evaluation of Railroad Rubber Pad Crossings", dated May, 1972.

   The Board of Highways, on September 7, 1972, recognizing the need for a policy decision on the above subject and acting under authority vested by Louisiana Statutes above, adopted a "Railroad-Highway Grade Crossing Policy".

2. POLICY. Therefore, the DOTD, Office of Highways' policy will be as follows:

   (a) The Office of Highways will require use of rubberized crossings of railroads on all new construction where ADT is 1000 vpd or over, and the Department is responsible for all costs. Where ADT is less than 1000 vpd and the crossing is not subject to vehicles stopping on the crossing, full width timber crossings shall be used, except that if the crossing is at an angle of 45 degrees or less, measured from the centerline of the highway, rubberized crossing may be used. If the crossing is subject to vehicles stopping on the crossing, rubberized crossings shall be used.

(b) All permits by railroad companies to cross hard surfaced highways will require rubberized or timber crossings as outlined above.

(c) The Office of Highways will embark on a program of improving existing crossings. The railroad companies will be required to pay the equivalent of their current standard crossing. The Department will pay the difference between the standard crossing and the rubber or timber crossing as outlined above.

(d) Under special conditions and upon approval of the Chief Engineer, concrete crossing may be used in lieu of the rubberized or timber crossings.

(1) Rubber Pad Type Railroad Grade Crossing

(a) The rubber (elastomeric) pad type of railroad grade crossing shall be used under either of the following conditions:

+ When highway ADT is 1000 vpd or over at the railroad highway crossing; or

+ When the crossing is subject to vehicles stopping on the crossing.

(b) The rubber (elastomeric) pad type of railroad grade crossing may be used in lieu of the other approved types of at-grade crossing construction when the railroad-highway crossing is at an angle of 45 degrees or less, measured from the centerline of the highway.

(c) The rubber (elastomeric) pad type of railroad grade crossing shall conform to Standard Plan RM-42 and to specifications therefor, see copy attached.

(d) In specifying rubber (elastomeric) pad railroad grade crossing the requirements under "General Requirements", hereinafter, shall be followed.

(2) Timber Panel Railroad Grade Crossing

(a) The timber panel railroad grade crossing shall be that designated in the Board of Highways' policy as full width timber crossing. Timber panel railroad grade crossing shall be used for all at-grade railroad-highway crossings where the highway ADT is less than 1000 vpd and where the crossing is not subject to vehicles stopping on the crossing.

(b) When the railroad-highway crossing is at an angle of 45 degrees or less, measured from the centerline of the highway, the engineer's discretion shall be used in designating timber panel railroad grade crossing in lieu of rubber pad railroad grade crossing.

(c) The timber panel crossing shall conform to Standard Plan RM-43 and to the specifications therefor, see copy attached.

(d) In specifying timber panel railroad grade crossing the requirements under "General Requirements", hereinafter, shall be followed.

(3) <u>Concrete Railroad Grade Crossing</u> - At the writing of this directive no acceptable standard concrete railroad grade crossing has been designated.

(4) <u>General Requirements</u>

(a) Railroad grade crossing shall extend for the full width of the highway to the edge of surfaced shoulders or a minimum of 3 feet outside the edge of traveled way or back of curbs. (See standard plan.)

(b) When applicable, the railroad grade crossing shall be constructed by the Railroad Company. The bituminous filler and the header shall be the railroad's responsibility; <u>unless</u> highway contract operations include placing of bituminous material, then the Project Engineer will negotiate for placing of bituminous material by the highway contractor against the header board. (See standard plan.)

(c) The edge of pavement and gutter and the crown on either side of the railroad crossing shall be adjusted to fit the grade of the railroad track by use of liberal transition curved surfaces. The height of any curb adjacent to railroad tracks shall be reduced to one (1) inch at a point of 4-feet from the near edge of grade crossing by standard transitions unless otherwise provided on the plans.

(d) Exceptions to this directive must be approved by the Chief Engineer.

3. <u>OTHER ISSUANCES AFFECTED</u>. This directive supersedes EDSM NO. II.2.1.2, dated January 1, 1977. All directives, memoranda or instructions issued heretofore in conflict with this directive are hereby rescinded.

4. <u>EFFECTIVE DATE</u>. This policy will become effective on November 1, 1979.

Dempsey D. White
DEMPSEY D. WHITE
CHIEF ENGINEER

LOUISIANA
DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
SUPPLEMENTAL SPECIFICATIONS

RAILWAY-HIGHWAY GRADE CROSSINGS

DESCRIPTION: This work consists of furnishing and constructing railway-highway grade crossings at locations shown on the plans in accordance with American Railway Engineering Association (AREA) specifications, railway company requirements and these specifications.

MATERIALS:

(a) Subbase: Subbase materials shall conform to the following Sections or Subsections of the Standard Specifications as amended elsewhere in the project specificatons:

Selected Soils	203.06
Asphaltic Concrete	501
Portland Cement Concrete	902
Portland Cement	1001.01
Portland-Pozzolan Cement	1001.02
Water	1018.01
Calcium Chloride	1018.02

(b) Ballast, Ties, Shims, Rails, Plates and Hardware: These materials shall meet AREA specifications as approved by the railway company.

(c) Elastomeric Crossings: Elastomeric assembly units shall be an approved product on the Qualified Products List. The elastomeric assembly shall consist of elastomeric units, elastomeric headers, creosote treated timber shims (as may apply), end plates, washers and plugs, steel washers, metal spikes and galvanized lag screws.

Crossing pads shall be steel reinforced molded elastomer with an acceptable non-skid pattern on the riding surface. A manufacturer's analysis and certification shall be furnished stating the composition of steel and elastomer used.

(d) Treated Timber Crossings: Crossing sections shall be made of fine-grained red oak or gum. Gum shall be one of the following, stated in order of preference: black gum, tupelo gum or sweet gum. Shims shall be of the same material. Timber shall be treated with creosote or creosote coal-tar in accordance with AREA specifications.

Intermediate sections shall be in lengths which are multiples of the track tie spacing. Center sections of crossing shall be of such width that 2 of them will make up the portion between rails, allowing sufficient flangeway opening. Depth of the section shall be such that the top surface of crossing will lie in the plane of the tops of rails with the bottom of the section resting on cross ties.

(e) Perforated Pipe: This shall be perforated bituminous coated corrugatd steel pipe conforming to Subsection 1007.04.

(f) Geotextile Fabirc (Plastic Filter Cloth): This shall conform to Subsection 1018.15

CONSTRUCTION REQUIREMENTS:

(a) General: Operations shall be conducted in accordance with Subsection 107.08. Grade of tracks and crossing pads may be a maximum of 1 1/2 inches above finished highway grade to provide for settling under rail and highway traffic. Temporary asphaltic ramps shall be placed for highway traffic until settling of tracks and crossing pads have stabilized. Asphaltic ramps shall then be removed to provide a smooth surface through the grade crossing.

(b) Removing Track Structure: Existing track structure (including rails, hardware, ties, ballast and subbase materials) shall be removed as necessary to accommodate the new crossing. Removed materials shall be disposed of as directed.

(c) Subbase:

(1) Type A: Type A subbase shall consist of selected soils placed in accordance with the following. The subgrade shall be shaped to the specified section and uniformly compacted by approved methods to the satisfaction of the engineer. Selected soils shall be placed in layers not more than 12 inches thick (loose). Each layer shall be uniformly compacted by approved methods to the satisfaction of the engineer prior to placing a subsequent lift. The final lift of soil shall be shaped to the specified section.

(2) Type B: Type B subbase shall consist of soil cement, asphaltic concrete or portland cement concrete with calcium chloride additive.

a. Soil Cement: Soil for soil-cement shall be selected soils. Soil materials shall be combined with portland or portland-pozzolan cement and water, mixed, shaped, uniformly compacted and cured by approved methods to the satisfaction of the engineer. The required percentage of cement will be determined in accordance with DOTD Designation: TR 432 prior to mixing.

b. Asphaltic Concrete: Asphaltic concrete shall be constructed in accordance with Section 724. Spreading, finishing and compaction of asphaltic concrete shall be such that the surface of the mixture after compaction is smooth and meets slope and profile requirements.

c. Portland Cement Concrete: Portland cement concrete shall be Class A with a 1-inch slump and calcium chloride added to the mix in the mixer at the crossing site in the amount of 1 lb. of calcium chloride per sack of portland cement at air temperatures of 70°F and above, or 2 lbs. of calcium chloride per sack of portland cement at air temperatures between 40 and 70°F. Concrete shall be placed, shaped, consolidated and cured as directed.

(d) Underdrains: Underdrains shall consist of 16-gage perforated bituminous coated corrugated steel pipe (6" or 8") wrapped with plastic filter cloth or french drains consisting of ballast wrapped with plastic filter cloth. Underdrains shall be placed on completed subbase prior to or during placement of ballast.

(e) Ballast: Plastic filter cloth shall be placed on the completed subbase prior to placing ballast. Ballast shall be placed and satisfactorily compacted by approved mechanical methods.

(f) Track Structure: The track structure (ties, tie plates, spikes, rail anchors, joint bars, etc.) shall be placed in accordance with AREA specifications as approved by the railway company.

(g) Crossing Units:

(1) Treated Timber: Sections shall be installed in accordance with the manufacturer's recommendations. Bored holes shall be filled with creosote before lag screws are placed.

(2) Elastomeric: Elastomeric units shall be installed in accordance with the manufacturer's recommendations.

(h) Asphaltic Filler: Asphaltic filler material shall be hot or cold asphaltic mixture acceptable to the engineer. The material shall be satisfactorily compacted and the finished surface shall be level with pavement surface.

TABLE 1

Research Project Number 80-1SS

Experimental Railroad - Highway Grade Crossing
Performance Evaluation & Stastical Data (June 1985)

Proj. I.D.	Nearest City	Location Description	Subbase Treatment	Crossing Material	Age (yrs)	(1985) ADT	% TRKS	RR ADT	Max. Speed Hwy.	Max. Speed Rail	Overall 1985 Performance
1	Sterlington	La. 2 0.1 mi. S. of Quachita Bridge	None	Goodyear Rubber Super Cushion	15	5,127	19%	1	30	10	Good
2	Baton Rouge	US 190 0.5 mi. E. of Miss. River Bridge	None	Goodyear Rubber Super Cushion	14*	19,553	11%	4	55	20	Failed/Removed** (August 1984)
3	Welsh	La. 99 (N. Adams St.) 0.5 mi. S. of I-10	None	Goodyear Rubber Super Cushion	9	3,319	14%	17	35	25	Good
4	Bossier City	La. 3105 0.1 mi. S. of Interstate I-20	None	Goodyear Rubber Super Cushion	9	17,887	8%	9	35	45	Good
4A	Bossier City	La. 3105 2.1 mi. S. of Interstate I-20	None	Sectional Treated Timber (Not Exp.)	9	17,887	8%	6	35	45	Good
5	Pickering	La. 10 0.1 mi. E. of US 171 @ Fort Polk	None	Goodyear Rubber Super Cushion	10	7,457	3%	8	55	35	Good
6	Hammond	US 190 0.1 mi. E. of of US 51	None	Goodyear Rubber Super Cushion	11	15,636	4%	15	25	30	Good
7	Burnside	La. 44 0.8 mi. S. of La. 22 near River Rd.	None	Szarka Enterprises FAB-RA-CAST (Conc.)	2*	17,009	6%	6	55	40	Failed/Removed (April 1977)
8	Baton Rouge	La. 30 at Jct. of La. 42 @ LSU	8" Sa/Sh	True Temper T-Core (HDPE)	4*	19,621	5%	1	45	10	Failed/Removed (August 1981)
9	Donaldsonville	La. 3089 0.5 mi. S. of La. 18 @ Sunshine Br.	None	True Temper T-Core (HDPE)	2*	3,028	8%	2	55	10	Failed/Removed (April 1978)
10A	Abita Springs	La. 59 4.0 mi. N. of Interstate I-12	None	SAF & DRI Model "S"	8	3,960	22%	1	25	25	Excellent
10B	Abita Springs	La. 59 1.0 mi. N. of Interstate I-12	None	General Tire Gen-Trac I	8	3,960	22%	1	55	25	Excellent
11	Monroe	~~US 165 2.7 mi. N. of~~ Junction US 80	~~None~~	~~Goodyear Rubber~~ Super Cushion	8	~~28,498~~	18%	6	45	15	Excellent
12	Kenner	La. 49 0.1 mi. S. of Junction US 61	None	Goodyear Rubber Super Cushion	8	23,417	10%	9	40	20	Good

* Approximate age at the time of removal or replacement

** Failure was due primarily to numerous train derailments

TABLE 1 (CONTINUED)

Research Project Number 80-1SS

Experimental Railroad - Highway Grade Crossing
Performance Evaluation & Stastical Data (June 1985)

Proj. I.D.	Nearest City	Location Description	Subbase Treatment	Crossing Material	Age (yrs)	(1985) ADT	% TRKS	RR ADT	Max. Speed Hwy.	Rail	Overall 1985 Performance
13A	Shreveport	La. 3132 0.5 mi. S. of Junction La. 1 North	None	Goodyear Rubber Super Cushion	7	17,142	4%	7	45	50	Good
13B	Shreveport	La. 523 (Ellerbe Road)	None	Goodyear Rubber Super Cushion	7	7,297	7%	5	45	40	Good
14	Baldwin	La. 83 0.2 mi. SW of Junction La. 182	None	Goodyear Rubber Super Cushion	7	807	9%	20	55	40-60	Good
15	Chalmette	La. 47 (Paris Rd.) 0.1 mi. S. of La. 46	None	Goodyear Rubber Super Cushion	7	3,157	5%	1	35	10	Excellent
16A	Walker	La. 1029 (Corbin St.) 0.2 mi. N. of US 190	Type A	True Temper T-Core (HDPE)	6	865	8%	6	40	25	Poor/Pending Replacement
16B	Walker	La. 1029 (Corbin St.) 0.2 mi. N. of US 190	Type A	RR Friction Products Cobra (HDPE)	6	865	8%	6	40	25	Poor/Pending Replacement
17A	Greenlaw	La. 1054 0.2 mi. E. of Junction La. 51	Type A	True Temper T-Core (HDPE)	6*	929	11%	20	55	25-79	Failed/Removed (March 1984)
17B	Greenlaw	La. 1054 0.2 mi. E. of Junction La. 51	Type A	RR Friction Products Cobra (HDPE)	6*	929	11%	20	55	25-79	Failed/Removed (March 1984)
18	Natalbany	La. 1064 0.6 mi. E. of Junction La. 51	4" HMAC	SAF & DRI Model "S"	7	3,598	13%	15	55	60-79	Excellent
19	Independence	La. 1065 0.1 mi. E. of Junction La. 51	4" HMAC	General Tire Gen-Trac I	7	5,993	11%	15	30	60-79	Excellent
20	Lafayette	US 90 (Mudd St.) 0.2 mi. W. of US 167	12" PCC	Park Rubber PARKCO (Old Design)	5*	11,145	9%	16	35	25	Failed/Removed (April 1985)
21A	Lafayette	US 90 (Mudd St.) 0.2 mi. W. of US 167	12" PCC	General Tire Gen-Trac I	5*	11,145	9%	2	35	5	Failed/Removed (April 1985)
21B	Lafayette	US 90 (Mudd St.) 0.2 mi. W. of US 167	12" PCC	FEL-PRO Products Track Span (Epoxy)	5	11,145	9%	2	35	5	Very Good/Installed in Switch Only
22	Alexandria	La. 1 (Main St.) 0.1 mi. W. of Red River Br.	12" PCC	FEL-PRO Products Track Span (Epoxy)	5	8,462	11%	2	25	5	Poor/Delaminating Wearing Course **

* Approximate age at time of removal or replacement

** Track was abandoned in 1985, crossing remains in-place

TABLE 1 (CONTINUED)

Research Project Number 80-1SS

Experimental Railroad - Highway Grade Crossing
Performance Evaluation & Stastical Data (June 1985)

Proj. I.D.	Nearest City	Location Description	Subbase Treatment	Crossing Material	Age (yrs)	(1985) ADT	% TRKS	RR ADT	Max. Speed Hwy.	Speed Rail	Overall 1985 Performance
23	Erwinville	La. 413 0.1 mi. S. of Junction US 190	18" HMAC	Park Rubber PARKCO (New Design)	5	2,416	9%	4	45	60	Excellent
24A	Bastrop	US 165 (E. Jefferson St.) 0.1 mi. N. of La. 139	4" HMAC	Park Rubber PARKCO (New Design)	5	12,743	18%	4	40	5	Good
24B	Bastrop	US 165 (E. Madison St.) 0.1 mi. N. of La. 139	4" HMAC	Park Rubber PARKCO (New Design)	4	12,743	18%	4	40	5	Excellent
24C	Bastrop	US 165 (E. Jefferson St.) 0.1 mi. N. of La. 139	4" HMAC	FEL-PRO Products Track-Span (Epoxy)	4	12,743	18%	4	40	5	Good
25	Lafayette	US 167 (Johnson St.) 0.2 mi. W. of US 90/94	12" PCC	SAF & DRI Model "C"	3	17,557	7%	15	40	25	Excellent
26	Raceland	La. 3199 (Mill St.) 0.2 mi. N. of La. 308	12" PCC	SAF & DRI Model "C"	2	9,222	15%	2	35	25	Good/Shims Fair-Panels Loose
27	Houma	La. 57 2.4 mi. S. of Junction La. 24	12" PCC	SAF & DRI Model "C"	3	25,708	12%	2	35	10	Good/Shims Fair-One Panel Loose
28	St. Gabriel	La. 74 @ Jct. La. 30	Type "A"	Park Rubber PARKCO (New Design)	3	2,922	6%	8	35	40	Fair/Subbase Pumping
29	Independence	La. 40 (Third St.) @ Junction US 51	Type "A"	Semprit-Bodan Pre-Cast Concrete	3	1,535	9%	15	35	60-79	Excellent
30	Broussard	La. 731 (Spur) 0.2 mi. W. of Junction US 90	12" PCC	SAF & DRI Model "C"	2	1,955	19%	16	35	40	Excellent
31	Bossier City	La. 3 (Benton Road) @ Junction of Shed Road	12" PCC	General Tire GEN-TRAC II	2	24,045	18%	2	45	10	Fair/Reflection Cracking in Rubber
32	Patoutville	La.-US 90 1.8 mi. S. of Junction La. 85	12" PCC	General Tire GEN-TRAC II	2*	18,158	19%	1	55	10	Failed/Removed (August 1985)
33	Morgan City	US 90 0.2 mi. W. of Bayou Ramos Bridge	12" PCC	SAF & DRI Model "C"	3	26,934	11%	1	45	10	Failed/Renovated w/Rubber Shims
34	Crowley	US 90 2.0 mi. W. of Junction La. 13	12" HMAC	STRAIL "HI-RAIL"	1	3,064	9%	2	45	10	Excellent/Panels Loose

TABLE 1 (CONTINUED)

Research Project Number 80-1SS

Experimental Railroad - Highway Grade Crossing
Performance Evaluation & Stastical Data (June 1985)

Proj. I.D.	Nearest City	Location Description	Subbase Treatment	Crossing Material	Age (yrs)	(1985) ADT	% TRKS	RR ADT	Max. Speed Hwy.	Max. Speed Rail	Overall 1985 Performance
35	Bastrop	La. 139 2.0 mi. N. of Junction La. 13	12" PCC	SAF & DRI Model "C"	2	5,758	18%	1	55	10	Good
36	Nuba	La.-US 167 (Ext.) at Junction La. 10	12" PCC	SAF & DRI Model "C"	2	6,870	10%	1	55	10	Excellent
37	Bossier City	Minden Road at Junction La. 72	12" HMAC	STRAIL "HI-RAIL"	1	10,310	11%	4	45	25	Excellent
38	Krotz Springs	La. 3173 (Second Street) @ Junction La. 3174	12" PCC	RR Crossing, Inc. "Sq. 8 Uni-Panels"	1	1,714	58%	1	30	5	New/Under Evaluation
39	Krotz Springs	La. 3173 (Second Street) @ Junction La. 3174	12" PCC	Red Hawk Rubber "Red Hawk"	1	1,714	58%	1	30	5	New/Under Evaluation
40	Krotz Springs	La. 3173 (Second Street) @ Junction La. 3174	12" PCC	STRAIL "HI-RAIL"	1	1,714	58%	1	30	5	New/Under Evaluation
41	Plaquemine	La. 3066 0.1 mi. W. of Junction La. 1	Type "A"	Semprit-Bodan Pre-Cast Concrete	1	4,442	19%	22	25	20	New/Under Evaluation

NOTE: Refer to Interim Reports No. 5 (April 1980) and No. 6 (August 1983) for individual perspectives of Crossings No. 1 through 30. This report contains in-depth profiles only on those crossings not previously covered (Nos. 31 through 41).

TABLE 2

Research Project Number 80-1SS

Sectional Treated Timber
(June 1985)

Project I.D. No.	Nearest City	Subbase Treatment	(1985) ADT	% Trucks	Age (Years)	Approach Pavement	Rideability	Crossing Performance
"A"	Livonia	None	861	1	8	Fair	Fair	Good
"B"	Lottie	None	298	1	5	Fair	Fair	Poor
"C"	McCall	None	220	10	5	Poor	Poor	Poor
"D"	Soniat	None	1,144	11	5	Fair	Poor	Poor
"E"	Choctaw	None	1,604	17	5	Fair	Fair	Good
"F"	Crowley	None	1,220	5	4	Fair	Good	Good

Note: These low volume rural grade crossings were monitored infrequently only for comparative durability purposes (as opposed to high-type rubber or polymeric-type surface treatments). Ironically, the three crossings in poor condition were subjected only to farm-to-market traffic. Failures were due primarily to separations in proximity of the annular rings of the timbers, resulting in thin (1-2") planks "slapping" on the crossings' surface. Burnishing and polishing of the surface timbers created by traffic were responsible for a "slick" condition when wet. Evaluations were not "in-depth" and no revisions to the present policy concerning sectional treated timber crossing applications (Appendix) were recommended.

TABLE 3

Research Project Number 80-1SS

Experimental Elastomeric Header Boards
(June 1985)

Project I.D. No.	Nearest City	State Project Number	DOT Number	Date Completed	Manufacturer of Header Board	Type or Configuration of Header Board	Header Board Performance
HB-1	Harvey	826-38-06	743-849X	April 1981	Goodyear	Rubber Inverted "L" Shape	Excellent
HB-2	Lafayette	80-02-20	767-758K	April 1982	SAF & DRI	Rubber with Bulb Foot	Good
HB-3	Lafayette	80-02-210	767-758K	April 1982	Fabricated-on-Site	"Z" Shaped Galvanized Tin	Excellent
HB-4	Abbeville	396-30-04	744-276U	March 1982	Fabricated-on-Site	"Z" Shaped Galvanized Tin	Good
HB-5	New Iberia	235-01-04	757-835F	November 1981	Goodyear	Rubber Inverted "L" Shape	Excellent
HB-6	Houma	246-01-39 (31)	757-668J	March 1982	PARKCO	1-1/2" Thick Polymeric-Flat	Fair*
HB-7	Labadieville	804-15-13	757-541V	October 1981	Goodyear	Rubber Inverted "L" Shape	Excellent
HB-8	Boutte	845-03-09	758-001D	October 1983	Unknown	3" Thick Treated Timber	Good
HB-9	Bayou Sale	243-02-68	757-683L	October 1982	Goodyear	Rubber Inverted "L" Shape	Excellent
HB-10	Centerville	243-02-68	767-494S	October 1982	Goodyear	Rubber Inverted "L" Shape	Excellent
HB-11	Patoutville	424-04-14	757-756U	June 1983	Gen-Trac	1/8" Flangway Seal Used	Poor
HB-12	Bouef	804-23-14	758-081Y	October 1983	SAF & DRI	1/2" Rubber w/Cord Reinf.	Fair

*"Fair" rating is due to missing and broken header boards. See Performance Evaluation No. 27, Interim Report No. 6, August 1983.