QUICK-FIX, FAST-TRACK ROAD CROSSING RENEWALS USING
PANELIZED ASPHALT UNDERLAYMENT SYSTEM

by

Jerry G. Rose, Ph.D., PE
Professor of Civil Engineering
161 OH Raymond Building
University of Kentucky
Lexington, Kentucky 40506-0281 USA
(859) 257-4278  (859) 257-4404 (Fax) jrose@engr.uky.edu

Paul M. Tucker
Superintendent Network Operations
CSX Transportation
1319 Warrington Street, J500
Jacksonville, Florida 32254 USA
(904) 381-2173 paul_tucker@csx.com

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QUICK-FIX, FAST-TRACK ROAD CROSSING RENEWALS USING PANALIZED ASPHALT UNDERLAYMENT SYSTEM

Jerry G. Rose

Replacing and rehabilitating highway crossings represent a major track maintenance expense for the U.S. railroad industry. Substantial numbers of crossings deteriorate at a more rapid rate than the abutting trackbed due to excessive loadings from heavy truck traffic and difficulty with maintaining adequate drainage within the immediate crossing area. Others are replaced during out-of-face system maintenance activities such as tie and rail renewals and surfacing operations. At many crossings the disturbed track does not provide adequate support and the replacement crossings soon settle and become rough for vehicular and even train traffic.

The ideal highway crossing system is one that will maintain a smooth surface and stable trackbed for a long period of time reducing disruptions to rail and highway traffic. It will not require frequent rehabilitation and ideally, will not have to be renewed (replaced), but merely skipped, during major scheduled out-of-face track maintenance activities.

CSX Transportation and University of Kentucky researchers in cooperation with local highway agencies have developed the technology for rapidly renewing highway crossings using a panel system and premium materials. The procedure involves complete removal of the old crossing panel and trackbed materials and replacing them with an asphalt underlayment, a compacted ballast layer, a new track panel, and a new crossing surface. Numerous documented performance evaluations indicate this design provides a long-life, smooth crossing for heavy rail/highway traffic applications.

The project schedule is for the railroad to be out-of-service for a maximum of four hours and for the highway to open later in the day, typically after eight to ten hours. The importance
of the cooperative effort between the railroad and local highway agency is stressed. The objective is to minimize disruption to both railroad and highway traffic during the renewal process.

Earth pressure cells have been imbedded at various locations in selected crossings to monitor trackbed pressures within the track structure under both railroad and highway loadings. Pressures vary within the crossing structure. Peak dynamic pressures develop directly below the tie/rail interface. These are typically less than 20 psi (140 kPa) at the underside of the compacted ballast layer for the 36 ton (33 metric ton) axle loads. The results of these tests and evaluations are presented in detail.

The desirability of using a high modulus, waterproofing layer to properly support the ballast layer/track panel/crossing surface within the track structure is discussed. The desirability for and proper installation of transition zones along the track and highway approaches are stressed. Also described is the benefit of pre-compacting the ballast to reduce subsequent settlement and maintain smooth crossings. Numerous case studies are presented, based on long-term performance evaluations, which indicate this practice ensures long life, economical, smooth crossings for improved safety and operating performances.

Key Words: asphalt underlayment, rail/highway crossings, trackbed pressures, fast-track
INTRODUCTION

The primary purpose of the at-grade railroad-highway crossing is to provide a smooth surface for the safe passage of rubber-tired vehicles across the railroad. The crossing surface and trackbed (rail, ties, and ballast/subballast) replace the highway pavement structure within the jointly used crossing area. The crossing surface represents a significantly expensive special portion of the railroad and highway systems.

Crossings are likely to deteriorate at a faster rate and require reconstruction at more frequent intervals than the pavement (or railroad) adjacent to the crossing. In addition, crossings often provide a low ride quality, due to settlement soon after reconstruction, and the driving public must tolerate this annoyance until funding for reconstruction is available.

The crossing structure must provide adequate structural integrity to support the imposed loadings. Typical crossing designs only provide for the crossing surface to be placed beside the rails and above the ties. Only unbound granular materials and possibly a geosynthetic are placed under the ties. The open granular trackbed permits surface water entering along the rail and the joints within the surface to penetrate and subsequently saturate the underlying subgrade/roadbed, thus lowering the structural integrity of the structure. Groundwater, if present due to inadequate drainage, further lowers the structural integrity of the trackbed support layer.

Crossing structures having inadequate structural support provide excessive deflections under combined highway/railroad loadings, which increase effective impact stresses and fatigue on the crossing components. The surface deteriorates prematurely. Permanent settlement occurs within the crossing area imparting additional impact stresses and fatigue from both highway and railroad loadings.
Periodically, the trackbed on both sides of the crossing will be raised with additional ballast and surfaced. The crossing becomes a permanent low spot in the railroad profile, which further increases impact stresses from the railroad loadings. In addition, the low spot serves to collect water, and the impaired drainage further weakens the underlying structure.

When the roughness and deterioration of the crossing adversely affect the safety and reasonable traffic operations across the crossing, the crossing must be removed and replaced at tremendous cost and inconvenience to the traveling public and railroad operations. Typically, the crossing is replaced using similar materials and techniques, thus assuring a similar series of events.

The typical crossing renewed with conventional granular materials often isn’t structurally adequate to withstand the combined highway/railroad loadings. A high-quality substructure (or base) is needed below the trackbed to provide similar load carrying, confining, and waterproofing qualities to the common crossing area as exists in the abutting pavement sections.

**ASPHALT UNDERLAYMENT APPLICATION**

During the past twenty years in the United States the utilization of hot mix asphalt as an underlayment (or subballast) layer during the construction, rehabilitation, and renewal of rail/highway crossings has steadily grown. The primary function of the asphalt layer is to provide a strong impermeable base to adequately support the imposed loadings from both the railroad and highway in the jointly used area. Crossings containing asphalt underlayment have remained smooth and serviceable for fifteen years or more (1, 2).

The primary benefits of the asphalt base under crossings have been documented (3). It basically provides:
• A strengthened support layer within the common crossing area to uniformly distribute reduced pressures to the roadbed (subgrade),

• A waterproofing layer and confinement to the underlying roadbed, providing consistent load-carrying capability for the crossing and track structure even on roadbeds of marginal quality,

• An impermeable layer to divert water to adjacent ditches and to essentially eliminate roadbed (subgrade) moisture fluctuations, which effectively improves and maintains underlying support,

• A consistently high level of confinement for the railroad ballast so it can develop high shear strength, maximum density, and uniform pressure distribution,

• A resilient layer between the ballast and roadbed to reduce the likelihood of subgrade pumping without substantially increasing track stiffness, and

• An all-weather, uniformly stable base for placing the crossing and track superstructure.

The underlayment procedure involves placing the asphalt layer directly on either new subgrade or old roadbed, and subsequently placing a layer of typical ballast on the asphalt. This procedure represents little change from normal track construction practices since the asphalt layer merely serves as a subballast (or sublayer) and is used in place of a granular subballast. A typical cross-section is shown in Figure 1.
ASPHALT UNDERLAYMENT MIXTURE AND DIMENSIONAL DESIGNS

The asphalt mixture commonly used is similar to a dense-graded highway base mix as specified by the state or local highway agency. The maximum aggregate size is normally 1.0 to 1.5 in. (25 to 37 mm). It is desirable to increase the asphalt cement content of the mix by about 0.5% above that considered to be optimum for a highway base mix. This mix is easier to densify. Rutting or bleeding of the mix are not concerns.

Long-term monitoring and tests of open-track in-service trackbeds indicate that this low-voids, impermeable mix undergoes minimal oxidation from the effects of air and water and minimal volume changes and temperature extremes in the insulated trackbed environment. This provides a layer with a reasonably consistent stiffness modulus that is stable but remains slightly resilient. The tendency for the mix to rut or bleed in hot weather and crack in cold weather is significantly reduced, ensuring a long fatigue life for the mix. Furthermore, the in-situ moisture contents of old roadbed/subgrade materials directly under the asphalt layer remain very close to optimum values for maximum strength and density of the respective materials (3).

The asphalt layer should extend 1.5 to 2.0 ft (0.45 to 0.60 m) beyond the end of the ties. This normally requires a 11 to 12 ft (3.4 to 3.6 m) wide layer on single-track installations. It should extend a specified distance beyond ends of the crossing to provide a transition zone so that subsequent track surfacing operations will not infringe on the crossing area. A minimum distance of 25 to 100 ft (8 to 30 m) is typical (4).

The thickness of the asphalt layer will vary depending on the quality of the roadbed (subgrade) support, traffic loadings, and type of installation. A 5 to 6 in. (125 to 150 mm) thick layer is normally specified for average conditions. For unusually poor roadbed support conditions, a minimum of 8 in. (200 mm) thickness is specified. The roadbed should be
reasonably well compacted, well drained, and capable of accommodating the hauling and spreading equipment without excessive rutting or deformation. A slight crown or side slope is desirable.

Quantities of asphalt underlayment are based on a compacted density of 140 lb/ft³ (2250 kg/m³). A 6 in. (150 mm) layer thickness that is 12 ft (3.7 m) wide will require 0.42 ton/track foot (1.25 metric ton/track meter). If the cost of the asphalt ranges from $30 to $50 per ton ($33 to $55 per metric ton), depending on local conditions, access, and project size, the cost of a 6 in. (150 mm) thick mat will range from $13 to $21 per track foot ($41 to $69 per track meter). This normally increases the total crossing renewal costs by about three percent.

GOALS

The goals for the ideal rail/highway crossing renewal process are to:

- Provide a quality, cost effective rail/highway crossing that will remain smooth and serviceable for both highway and rail traffic for a minimum of ten years with minimum annual cost,

- Accomplish the complete renewal (trackbed and crossing surface) in a minimum of time without significant disruption to rail and highway traffic (maximum 4-hour train curfew and 8 to 12-hour highway closure), and

- Utilize a cooperative approach involving both the railroad (and its contractor, if applicable) and the local governmental/highway agency.

Typically the local highway agency is better equipped and experienced to provide certain activities more economically than the railroads. These include—asphalt paving (underlayment, trenches, and approaches), traffic control, and advising public of road closures and detours.
Normally the railroad company, or its contractor, performs all activities directly related to the trackbed and crossing surface.

**TYPICAL FAST TRACK RENEWAL PROCESS**

In order to install a quality crossing within a minimum of time, proper planning of activities prior to and during the installation process is a necessity. Typical preparatory activities include the following:

- Notify public of road closure and obtain railroad curfew,
- Cut rails—specified distance beyond immediate crossing surface,
- Saw pavement—7 ft (2 m) from rail on both sides,
- Deliver track panel, ballast, and crossing surface materials,
- Assemble equipment, labor forces, and miscellaneous supplies,
- Arrange for delivery of asphalt at prescribed times, and
- Arrange for highway traffic control—flagging, detour, etc.

Normally these activities will be shared between the railroad company and the local highway agency. Planning should begin several weeks in advance of the actual work.

Table 1 contains a sequential listing of activities for a typical renewal of a rail/highway crossing. The times are indicative for a typical two-lane highway crossing having a replacement track panel ranging from 75 to 100 ft (24 to 30 m) long and a crossing surface ranging from 40 to 70 ft (12 to 22 m) long. Normally the railroad will be open to traffic within 3 to 4 hours after trackwork begins. The highway is typically opened to traffic within 6 to 12 hours after closure depending on the extent of the paving required for the approaches.
As noted in Table 1, the basic processes involve removing the existing crossing surface and track panel, excavating the contaminated trackbed material for a selected distance below top-of-rail, and replacing with a compacted layer of hot mix asphalt, a compacted layer of ballast, a new track panel, adding cribbing ballast, surfacing, and raising (if desired) the track, placing the crossing surface and paving the trenches and highway approaches. Figure 2 depicts the various operations.

The equipment utilized will vary depending on the length of the crossing, availability, and site conditions. A hydraulic excavator (trackhoe) is extremely versatile and can assist with practically all phases of project activities. An additional trackhoe or crane is desirable for longer crossings. A backhoe or two is necessary to assist the trackhoe and provide loading capability. Removal of the old crossing and trackbed spoils can be accomplished simultaneously provided that a loader and trucks are available. A steel wheel roller is necessary to compact the subgrade, asphalt, and ballast. After the asphalt underlayment is compacted, the ballast can be dumped immediately on the hot compacted mat.

In order to accomplish a crossing renewal of this magnitude within the limited time frame it is imperative that the activities be sequentially planned so that there is no wasted time. Many activities can proceed simultaneously. In addition, it is important to have the proper equipment adequately sized to provide the production rates necessary to complete the work in the allotted time. Most of the labor is involved with assembling the track and crossing surface.

Various types of crossing surfaces have been installed. These include: full width pre-cast concrete, partial width pre-cast concrete, full-depth rubber, rubber seal and asphalt, rubber header and asphalt, full width asphalt, full width timber and experimental composite surfaces. The relative ease of the installation of the surface impacts the project time schedule.
TRACKBED PRESSURE DISTRIBUTIONS UNDER CROSSINGS

Two heavily traveled rail/highway crossings being rehabilitated with asphalt underlayment were instrumented to measure vertical pressures within the track structure under both railway and highway loadings. Geokon model 3500-2 earth pressure cells were installed on top of the compacted asphalt underlayment at four locations in each crossing prior to placing the ballast. Figure 3 depicts the cells on the asphalt prior to placing ballast.

The hydraulic cells are composed of two, 9 in. (225 mm) diameter circular plates welded together at their periphery and separated by a void filled with de-aired hydraulic fluid. As a vertical load (pressure) is applied to the plate, it is transferred to the fluid. The fluid under pressure moves through the stem and transmits the pressure to a semiconductor strain gauge transducer, which converts the pressure to an electrical signal that can be recorded with a laptop computer and a Snap-Master data acquisition system. The cells were calibrated by the manufacturer and checked prior to arrival. Initial readings were taken after the cells were positioned prior to loading in order to account for the effects of ambient temperature, barometric pressure, and elevation above sea level.

The two crossings instrumented for pressure measurements are located on CSX Transportation mainlines at Richmond in central Kentucky and Lackey in eastern Kentucky. Pertinent information for the two sites is given in Table 2. Specific locations for the cells are shown in Figure 4. The cells were strategically positioned to monitor pressures under the rail, tie, and crib areas.

Richmond

Pressure cells were initially installed at the Richmond crossing during its complete renewal in September, 2000. It was decided to locate cells under both the rail and center of the track and
under both the ties and crib areas as depicted in Figure 4. The purpose for distributing the cells at various locations was to determine the location(s) of maximum pressures under both railway and highway loadings. The cells were positioned on the compacted asphalt mat prior to adding the ballast (Figure 3).

Surveys were used to precisely locate the exact positions for the cells. Ballast was carefully placed in the vicinity of the cells so that the cells’ locations would not be altered and the cells would not be damaged during the compaction process.

During the past two years pressure measurements have been taken numerous times for loaded and unloaded coal, intermodal and mixed freight trains. In addition, measurements have been taken for a variety of highway vehicles. The pressures have remained very consistent for given magnitudes of loadings and locations within the crossing.

Figure 5 is a typical plot of pressure readings from the four cells in the real time trace for a loaded coal train having two 6-axle 390,000 lb (177 metric ton) locomotives and the initial two loaded 263,000 lb (119 metric ton) coal cars. Note the pressures directly under the rail/tie (location RT) intersection are about 14 psi (100 kPa) or about three times greater than the pressures under the center of the track. Pressures under the rail/crib area are about 8 psi (55 kPa).

Figure 6 is typical plot for a manifest loaded auto train having one 6-axle 390,000 lb (177 metric ton) locomotive, one 4-axle 286,000 lb (130 metric ton) locomotive, and the first two loaded auto carrier cars. Note that stress levels under the rail/tie intersection (RT) for the locomotives are about 14 psi (100 kPa), which is the same as that for the locomotives shown in Figure 5. The lightweight loaded auto carrier cars only exert about 10 psi (70 kPa) maximum pressure. Pressures under the crib areas and center of the track are significantly lower.
Figure 7 is a pressure trace for a 80,000 lb (36 metric ton) loaded concrete truck with a dual axle on the rear. The pressure under the rail/tie interface (RT) is about 5 psi (35 kPa), or about one-third of that produced by a locomotive. Pressures recorded by the other three cells are significantly lower, relative in magnitude to railway loading trends (Figures 5 and 6). Pressures for passenger cars and small trucks are typically 0.5 psi (3 kPa) and lower.

**Lackey**

Four cells were installed on the asphalt underlayment during the renewal of the Lackey crossing in June 2001. Based on the measurements and findings from the Richmond crossing, it was decided to place three of the cells directly under rail/tie interfaces. Unlike the Richmond crossing, the Lackey crossing is on a 12° curve with 3.75 in. (95 mm) of superelevation. Two of the cells were located under the rail/tie on the high side of the curve and the other one was under a rail/tie on the low side of the curve. The remaining cell was placed under a tie in the middle of the track for comparison purposes. The location of the cells is depicted in Figure 4.

Figure 8 is a pressure trace for a portion of a loaded coal train. The two 6-axle locomotives and the initial two cars are shown. The three cells under the rail/tie (510, 511, & 207) record the highest pressures. This was expected. The pressure under the center of the track was significantly lower, as expected based on the data obtained at Richmond. Cells 510 and 511, under the high rail, record about 13 psi (90 kPa), slightly lower than those at Richmond. Cell 207 under low side rail/tie interface consistently measures higher pressures than the cells under the high side rail. This is expected since the trains normally negotiate the curve at a speed less than the balancing speed for the superelevation. This provides increased loading on the low rail and thus higher pressures distributed through the rail, tie, and ballast.
Figure 9 is the trace for a portion of an empty coal train. The two 6-axle locomotives and the initial two unloaded 263,000 lb (119 metric ton) cars are shown. The pressures from the locomotives under the rail/tie locations are about 14 psi (100 kPa) and similar to that shown in Figure 8. Pressures exerted by the empty cars are about 3 psi (20 kPa) under the rail and only 2 psi (15 kPa) at the center of the track. These values are close to those obtained at the Richmond crossing.

Flat wheels can significantly affect pressures in the trackbed. Figure 10 is a pressure trace for an empty coal train having major flat wheels on several of the cars. This is depicted by the pressure spike. The pressure due to the impact loading can be about eight times that of a smooth wheel.

The effects of loaded coal trucks have also been evaluated at the Lackey installation. The crossing receives several hundred dump truck and tractor/trailer loads of coal each day. These loaded trucks reportedly exceed 90 tons (82 metric tons) and have tire pressures at the surface in excess of 100 psi (690 kPa). Figure 11 shows a typical tractor/trailer crossing the tracks. In order to accurately monitor the pressure under highway vehicles, it is necessary for the tires to pass directly over the sensor. Figure 11 also contains a typical pressure trace for a loaded tractor/trailer load traversing the crossing. The peak pressure is about 5 psi (35 kPa), or about one-third that for a loaded coal train. This crossing is very smooth with minimal impact loading.

**TRACKBED TEMPERATURE MEASUREMENTS**

The pressure cells also contain a thermistor. The electrical resistance measurement from a voltmeter can be used to calculate the temperature at the top of the asphalt layer. The ballast is expected to insulate the asphalt from extreme ambient temperature fluctuations. Figure 12 shows
the temperature measurements throughout the year for both crossings. Note that the temperature extremes range from 88°F to 43°F (31°C to 6°C) in the insulated trackbed environment. The normal maximum and minimum temperatures for the central Kentucky climate also are shown on the plot. Similar data has been obtained previously at open track sites (3, 5).

FINDINGS AND CONCLUSIONS

1. Both crossings have remained very smooth and serviceable under heavy tonnage rail and highway traffic during the evaluation periods. These observations are consistent with documented performances of numerous crossings over the past twenty years containing asphalt underlayment. The asphalt underlayment layer appears to provide adequate support for maintaining a smooth and level crossing surface.

2. The crossing track structures were completely renewed in a minimum of time and the subgrade, asphalt underlayment, and ballast layers were compacted prior to positioning the new track panel. Crossings can be renewed in a minimum of time provided the activities are properly planned.

3. A cooperative effort between the railroad and the local highway/governmental agency is highly desirable. This will assure that a quality project is completed with minimal disruption to railway operations and the traveling public.

4. Vertical pressures transmitted through the track structure under rail and highway loadings are not uniformly distributed below the ballast (top of asphalt underlayment). Peak pressures develop under the rail/tie interface; pressures recorded under the cribs and center of the track are significantly lower.
5. Peak pressures developed on the asphalt layer under large 4-axle and 6-axle locomotives and loaded 263,000 lb (119 metric ton) and 286,000 lb (130 metric ton) coal cars range from 15 to 30 psi (100 to 200 kPa). Considerably lower peak pressures develop under empty cars and lightly loaded auto carrier cars, typically in the 3 to 10 psi (20 to 70 kPa) range.

6. Flat wheels can increase pressures by up to eight times that of smooth wheels. This is due to the added impact of the flat wheel.

7. Higher pressures are recorded under the low rail for trains negotiating a curve at speeds less than that for balancing the centrifugal forces. This is expected since additional force is exerted on the low rail as compared to the high rail.

8. Peak pressures developed under heavily loaded coal trucks are typically around 5 psi (35 kPa) for the exceptionally smooth, well-supported asphalt underlayment crossings. Passenger cars exert 0.5 psi (3 kPa) or lower.

9. Temperature extremes in the asphalt underlayment are minimized in the trackbed environment thus assuring minimal volume changes and a long fatigue life for the asphalt layer and a more consistent stiffness modulus for the asphalt as compared to highway environments.

10. Previous studies have revealed that the moisture content of the subgrade/roadbed under the asphalt layer in a trackbed remains uniform and near optimum for maximum load carrying capacity and to minimize settlement and permanent deformation.

11. Long-term monitoring and tests of in-service trackbeds indicate that a low voids, impermeable asphalt mix undergoes minimal oxidation from the effects of air and water in the insulated environment. The expected life of the asphalt layer in the insulated
trackbed environment should be several times that of a similar mix exposed to the environmental effects of highway applications.

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<table>
<thead>
<tr>
<th>Time (hours)</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑ 2.0 – 2.5</td>
<td>Remove existing crossing surface and track panel (panel will be longer than crossing surface)</td>
</tr>
<tr>
<td></td>
<td>Excavate trackbed material to approximately 29 in. (750 mm) below top-of-rail</td>
</tr>
<tr>
<td>↓</td>
<td>Evaluate subgrade support, determine action—</td>
</tr>
<tr>
<td></td>
<td>No additional activity needed, subgrade is firm and compact</td>
</tr>
<tr>
<td></td>
<td>Compact subgrade to densify it</td>
</tr>
<tr>
<td></td>
<td>Add ballast and compact subgrade if subgrade is soft</td>
</tr>
<tr>
<td>↑ 1.0 – 1.5</td>
<td>Dump, spread, and compact 6 to 8 in. (150 to 200 mm) of asphalt underlayment</td>
</tr>
<tr>
<td>↓</td>
<td>Dump, spread, and compact 8 to 10 in. (200 to 250 mm) of ballast to grade</td>
</tr>
<tr>
<td></td>
<td>Position new track panel on compacted ballast and bolt or weld joints</td>
</tr>
<tr>
<td>↑ 1.0 – 2.0</td>
<td>Add cribbing ballast, tamp, raise (if desired), and surface track</td>
</tr>
<tr>
<td>↓</td>
<td><strong>Railroad Open</strong></td>
</tr>
<tr>
<td>↑ 2.0 – 3.0</td>
<td>Place crossing surface</td>
</tr>
<tr>
<td>↓</td>
<td>Pave asphalt trenches along both sides of track</td>
</tr>
<tr>
<td>↑ 0.0 – 3.0</td>
<td>Pave asphalt highway approaches the same day (optional)</td>
</tr>
<tr>
<td>↓</td>
<td>Highway Open <em>(pave highway approaches the following day if required)</em></td>
</tr>
<tr>
<td>6.0 – 12.0</td>
<td>Highway Open <em>(no further paving required)</em></td>
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TABLE 2. Test Sites on CSX Transportation in Kentucky

<table>
<thead>
<tr>
<th>Crossing Site</th>
<th>Richmond, KY Main Street (US 25/421)</th>
<th>Lackey, KY KY 550</th>
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<tr>
<td>Subdivision</td>
<td>CC</td>
<td>E&amp;BV</td>
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<tr>
<td>Milepost</td>
<td>OKC 118.8</td>
<td>CMO 18.2</td>
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<tr>
<td>Traffic</td>
<td>30 trains/day coal and mixed freight</td>
<td>14 trains/day coal</td>
</tr>
<tr>
<td>Tonnage</td>
<td>71 MGT (64 MGt)</td>
<td>26 MGT (24 MGt)</td>
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<tr>
<td>Geometry</td>
<td>Tangent</td>
<td>12º curve, 3 ¾ in. (95 mm) superelevation</td>
</tr>
<tr>
<td>Ballast Thickness</td>
<td>10 in. (250 mm)</td>
<td>10 in. (250 mm)</td>
</tr>
<tr>
<td>Asphalt Underlayment Thickness</td>
<td>6 in. (150 mm)</td>
<td>6 in. (150 mm)</td>
</tr>
<tr>
<td>Date Renewed</td>
<td>September 2000</td>
<td>June 2001</td>
</tr>
<tr>
<td>Crossing Surface</td>
<td>Full-Width Precast Concrete</td>
<td>Center – Precast Concrete Sides – Asphalt</td>
</tr>
<tr>
<td>Highway Traffic</td>
<td>17,000 vpd (high % of trucks)</td>
<td>4,000 vpd (several hundred loaded coal trucks per day)</td>
</tr>
<tr>
<td>Track Panel</td>
<td>Wood Ties, 136 RE Rail</td>
<td>Wood Ties, 136 RE Rail</td>
</tr>
</tbody>
</table>
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Positioning wood tie panel

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10 psi = 69 kPa
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P-Cell 510 Beneath Rail and Tie

10 psi = 69 kPa
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