# The Concrete Resurfacing of Existing Asphalt on I-30 in Rockwall County, Texas

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ABSTRACT

Interstate 30 is a controlled access freeway that has deteriorated to such an extent that it has become a maintenance problem. Before this highway could be restored to a first-class facility, however, there would be problems with the design of the pavement structure, traffic control, and construction. The existing highway was built over expansive clays. After considering several designs including bituminous pavement, the design was chosen of sealing the existing asphalt, overlaying with a level-up asphalt, and resurfacing with 11 in. of concrete pavement. The methods of offsetting the longitudinal contraction joint 2.5 ft onto the shoulder and using concrete shoulders were incorporated to lower maintenance costs and better distribute heavy wheel loads near pavement edges. Traffic control would be accomplished by reconstructing the south frontage road, diverting eastbound traffic to it, and constructing an eastbound freeway. The westbound traffic could then be diverted to the newly constructed eastbound pavement and the westbound pavement could then be constructed. However, there were problems with the at-grade intersections of the frontage road, the alignment and typical section of the frontage road, and the areas of the frontage road that are prone to flooding. The 38-ft pavement is being constructed full-width in one pass. The production is controlled by the plant capacity and not the placing operation. The full width pass slows the speed of concrete placement along the highway enough to cause problems with finishing and texturing.

Interstate 30 (I-30) is a 4-lane, controlled access freeway with 12-ft lanes, 4-ft inside shoulders, and 10-ft outside shoulders. Construction began in May 1982 and the estimated completion date is December 1985. This $27 million project is 10.8 mi long and begins just east of the Dallas, Texas, metropolitan area within the city limits of Rockwall (population 5,939) continuing northeast through a mostly rural area. The existing highway was constructed between 1955 and 1958 and has deteriorated to such an extent that it has become a maintenance problem. Before this highway could be restored to a first-class facility, there would be problems with the design of the pavement structure, traffic control, and construction.

## GENERAL PAVEMENT DESIGN

The original roadway section was 11 in. of sandstone base, 9 in. of limestone base, and 2 in. of asphaltic concrete pavement built over a subgrade of Taylor Marl and Houston Black clays. These clays have high plasticity indexes (one sample of the Taylor Marl was 82) and are poor subgrades. The base is primarily in good condition but the top 2 in. contain cracks. The addition of subsequent asphalt overlays and seal coats have increased the asphalt thickness to approximately 8 in. The asphalt is soft and cracked and deflects considerably when loaded. There is transverse and diagonal cracking of the pavement throughout the entire project, and portions of the roadway as deep as 24 in. have had to be removed and repaired by maintenance crews.

An asphaltic pavement design was considered; however, the cracked, deteriorated surface with the cracks in the base underneath would cause reflective cracking through the flexible overlay and would only be a short-term solution. The proposed design was to first cover the existing highway with a seal coat, then level-up the pavement with an asphaltic concrete overlay and, finally, to place 11 in. of portland cement concrete pavement over the asphalt to provide two lanes of traffic in each direction with concrete shoulders (Figure 1). Although the initial cost is higher, this design would best utilize the existing base and pavement structure. The final base and pavement structure would thus be deeper, resulting in a higher safety factor and lower maintenance.

This project has three overpasses, two underpasses, and two sets of bridges (eastbound and westbound) across major streams. The three overpasses, being of steel beam design, were reconstructed and raised approximately 2 ft to accommodate the higher pavement and to provide additional clearance underneath. The stream crossing bridges, however, being similar to a rigid concrete design, could not be readily raised, and therefore the approaches were designed to be lowered, thus undercut, as were the freeway lanes under the two underpasses (Figure 2).

The concrete pavement is of the contraction design. It has load transmission devices at contraction joints, but does not have reinforcing steel. The load transmission devices are 1.375-in. dowels at the transverse joints and tiebars at the longitudinal joints (Figure 3). (This design was chosen over reinforced concrete because of its normally lower price and better past performance in the Dallas area.) The inclusion of concrete shoulders is essential to the overall design. For virtually the same cost as flexible shoulders, the concrete shoulders would not only provide lower maintenance and better distribution of heavy wheel loads near pave-

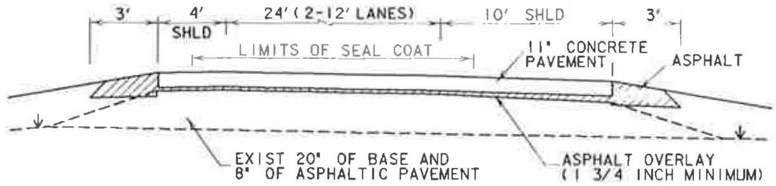


**FIGURE 1** Typical overlay section.

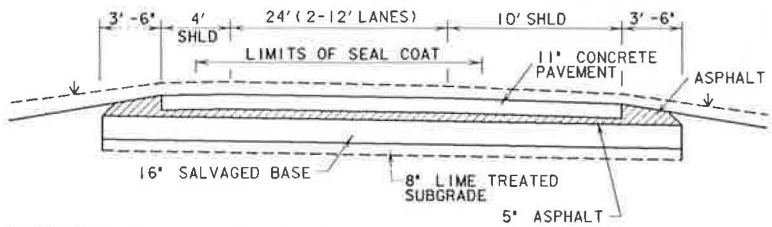


**FIGURE 2** Typical undercut section.

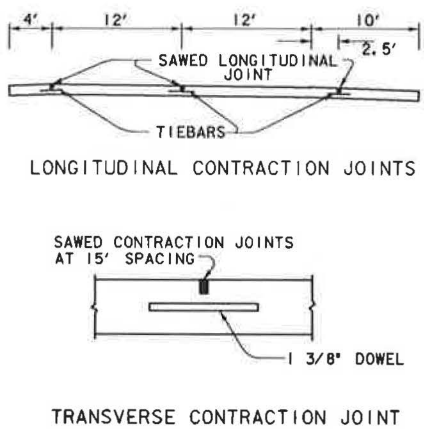


**FIGURE 3** Contraction joints.

ment edges, but also would be conducive to future expansion.

Another design feature incorporated to better distribute the wheel load was that of offsetting the sawed longitudinal joint between the outside lane and the shoulder (Figure 3). It was offset 2.5 ft onto the shoulder, but the striping for the edge line is at the normal lane line. This offset removes the joint and possibly a water source from the wheel load thereby reducing pavement deflection and the possibility of a pumping problem.

One of the questions that arose from the idea of using concrete shoulders was "What should be used to backfill the vertical edge of the concrete shoulders?" If earth embankment is used adjacent to the shoulder and any erosion occurs, a vertical face would remain and be a hazard for traffic. If material other than earth is used, how far out should it be taken--partial extension or the full extension of the slope (Figure 4)? On this project, it was decided to use asphalt on a 6:1 cross-slope for a distance of 3 ft on a typical overlay section (Figure 1) and 3 ft-6 in. on a typical undercut section (Figure 2). The full extension would have allowed the use of conventional rollers, but the cost would be considerable. The 3-ft dimension was a compromise that would not only produce a 6:1 slope, but the first couple of lifts would serve as a platform for the paver.

The basic problem with the 3-ft asphalt extension is compaction. The narrow width and the 6:1 cross-slope will not allow normal rollers to be used. A small vibratory roller and a modified tractor (Figures 5 and 6, respectively) were used on the lower lifts with the addition of a pneumatic roller finishing the top lift. The speed of the small roller was slow because the steep cross-slope required lateral support. Normally, two workmen were required to maintain its position on the asphalt.

One interesting note is that all the asphaltic pavement used on the freeway is a recycled mix containing 40 percent reclaimed bituminous pavement and 60 percent virgin materials. Most of the reclaimed material was recovered from various asphaltic overlays that had been previously placed in thin mats throughout the Dallas area. The mats had been placed over concrete pavement and were removed by coldmilling and then stockpiled. By blending AC-5 asphalt with the existing reclaimed asphalt, a suitable asphaltic pavement design was produced. Future highway contracts in the Dallas area are proposing both the full asphalt extension and the use of earth embankment so, hopefully, the solution to these problems will be obtained in the near future.

## TRAFFIC

The average daily traffic for 1983 was 22,000 vehicles per day and projected traffic for 1997 is

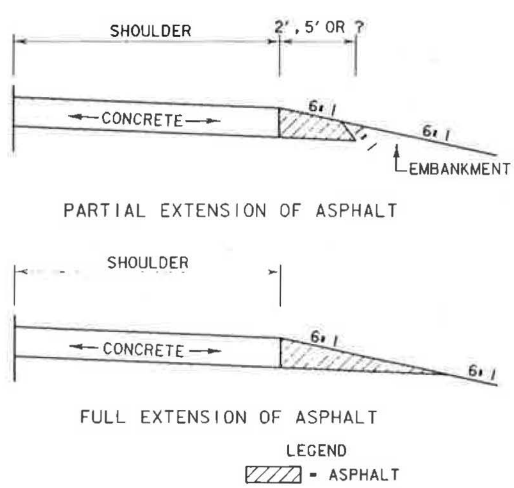


**FIGURE 4** Shoulder edge.

FIGURE 5 Small roller.

FIGURE 6 Modified tractor.

47,000 vehicles per day. A traffic analysis by state forces revealed that a large percentage of trucks (20.3 percent) used the roadway.

TRAFFIC CONTROL

There were two primary methods of traffic control considered for this project. One was to leave freeway traffic on the freeway at all times and the other was to detour freeway traffic to the frontage road while constructing the freeway.

To leave the freeway traffic on the freeway, the lanes would have to be reduced from two to one, day and night, for long periods of time. The 1983 average daily traffic was 22,000 vehicles per day resulting in a design hourly volume of 1,975 vehicles per hour, which is almost capacity for one lane. This means that 1-lane-traffic operating speeds will be low during the peak traffic periods and could be hazardous at night unless barricades, lights, and signs are placed and maintained properly. Because of the inconvenience to traffic and the dangerous situation that would result by restricting traffic to one lane, the freeway traffic was detoured to the frontage road.

The basic sequence of proposed construction is as follows:

1. Reconstruct the south frontage road on existing alignment.
2. Divert eastbound freeway traffic to the south frontage road and reconstruct the eastbound freeway including the eastbound half of overpasses.
3. Divert westbound traffic to the completed eastbound freeway and then construct a westbound freeway.

The existing south frontage road has operated as two-way traffic and had to be reconstructed (Figure 7) and changed to one-way to accommodate the eastbound freeway traffic. Because the frontage road has no area for stalled vehicles to park due to the lack of shoulders, and it was not known whether the pavement would hold up to traffic, the detoured traffic was limited to approximately 2-mi sections. There

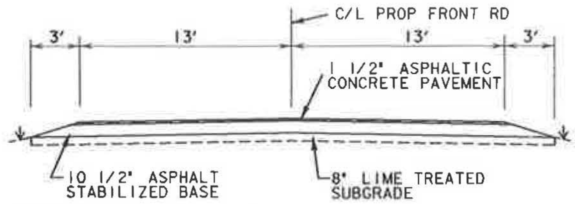


FIGURE 7 Frontage road typical section.

was, however, a provision to enable the engineer to combine two particular sections due to their rural nature if the pavement in the previous sections had withstood the traffic. Consequently, because the frontage road has held up well under the traffic, the two sections were combined.

The length of time the traffic was detoured to the frontage road was also a primary consideration. In this contract, each of the 2-mi sections had a maximum number of working days allowed to construct the highway and return traffic to its normal operation. This maximum varied between 52 and 104 days. To insure expediency, the contractor would be charged $1,000 in liquidated damages for each day the traffic remained detoured to the frontage road past the allotted time.

ACCIDENTS

There have been primarily two causes of major accidents attributed to the use of the frontage road as a detour. The first was the addition of traffic signals and the second was the alignment of the frontage road.

The problem with the addition of traffic signals is that they are located where none previously existed and the frontage road was changed from two-way to one-way. Even though the one-way operation had been in effect for a month before the signal was installed, several accidents a day would occur when traffic in the right lane would attempt left turns and collide with through traffic in the left lane. This type of accident occurred for a couple of months after the installation of the signal.

The alignment of the south frontage road consisted of several reverse curves that were of adequate radii to accommodate the posted speed limit of 40 mi per hr but not much faster. Because of the rural nature of some stretches of this highway, the average traffic speed tended to be much faster than this despite efforts of law enforcement agencies. The lack of shoulders, higher speed, and alignment combined to cause many accidents. Because of the higher speed, the cars would begin to "cut the corner" of the curvature causing a tire to roll just off the edge of the pavement. When the tire regained traction, the driver usually had oversteered. This caused the car to dart to the opposite side of the frontage road and the driver to lose control. Some of these accidents were fatal. In addition, there have been several instances where the lack of shoulders has resulted in stalled vehicles remaining parked in the right lane instead of pulling off onto the earthen side slope. Thus far, this has not caused any major accidents.

Two sections of the proposed frontage road detour are through areas prone to flooding. One such area inundated the frontage roads nine times in 1983 with an average duration of almost a half-day. Although construction has not yet reached these areas, an emergency plan has been prepared to maintain traffic flow during these periods. The plan is to close the inside lane of the westbound traffic and divert the eastbound, detour traffic to the closed lane, creating one lane in each direction. To accomplish this, emergency ramps connecting the south frontage road and the westbound traffic would have to be constructed prior to detouring traffic and barricaded until needed.

It should be noted that the contractor is required to select an early warning system to enable him to complete all traffic changes prior to the flooding of the detour. As of this writing, the system has not been proposed.

## GENERAL CONSTRUCTION METHODS

The H.B. Zachry Company constructed a central-mix concrete plant within the project limits. A paving train with a 50-ft Gunter-Zimmerman slipform paver was brought in and modified to handle the cross-slope break at each shoulder edge. This modification would enable it to place the concrete pavement the full 38-ft width in one pass. The placing operation began by leaving out the center section of the dowel baskets to leave room for the dump trucks to back up and discharge (Figure 8). The final dowel basket was placed after sufficient concrete was ahead of the paver to pass that particular transverse joint (Figure 9).

By using this technique, many people would think that the placing operation would control the speed of operation. However, this was not the case. The batching time at the ready-mix plant controls the operation speed. The specifications for this project require a minimum of 50 sec of actual mixing and a mixing time of 55 sec was actually used. By the time all the material is conveyed to the drum, the total time between batches is almost 2 min. The paving

FIGURE 9 Placing dowel basket.

operation has been averaging between 25 and 30 batches an hour with a good day's production of approximately 2,000 $yd^3$. The batch size is limited to 6.5 $yd^3$ by the legal load limits on this project because the trucks have to haul over existing highways. With the plant capacity at 9 $yd^3$ and the trucks limited to 6.5 $yd^3$, there is a loss of production of more than 35 percent--a major disadvantage in resurfacing existing highways.

The main advantages to paving full width are that it is quicker and usually cheaper. It is quicker because of the deletion of the curing time between adjacent slabs and the larger volume of concrete that can be placed per man-hour worked. It is usually cheaper because of (a) the same reasons, (b) no delays in equipment use, and (c) a higher volume per man-hour. The cleaning and straightening of tiebars between adjacent slabs are also eliminated, and although there is no difference by the specifications, the slumping edge of a slipform paver is not as critical on the outside of the shoulders as it would be between adjacent slabs. One of the disadvantages, however, is that the paver would have to be modified to the particular typical section designed for each project. This modification cost $20,000 on this project.

Because of the higher volume of concrete, the speed of the operation along the roadway is much slower. On I-30, the speed needed to maintain a pace of approximately 100 ft per hr during warm weather (to assure proper finishing and texturing) would create problems with the texturing, as would delays.

The type of texture used on the surface was produced by dragging .125-in metal tines spaced every .5-in. transversely across the pavement (Figure 10).

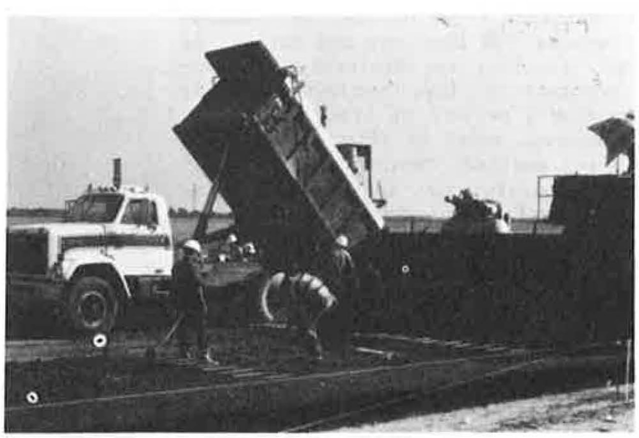

FIGURE 8 Placing operation.

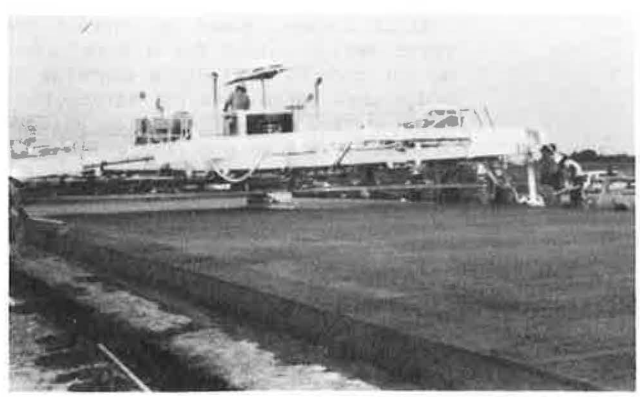

FIGURE 10 Texture operation.

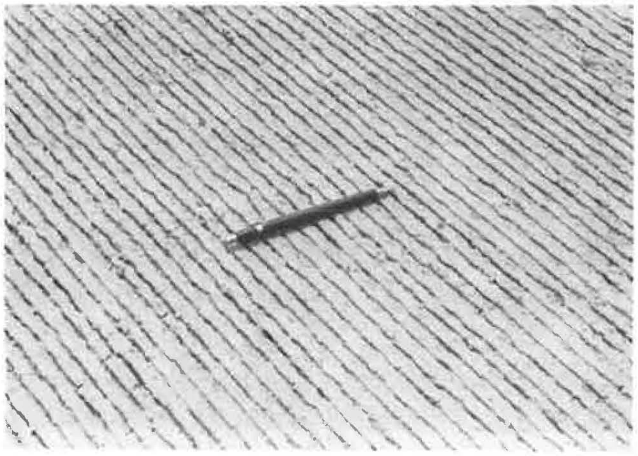

FIGURE 11 Finished texture.

This type of texturing would increase skid resistance and reduce hydroplaning by allowing the water to drain across the pavement inside the grooves. To produce the desired texture required by the specifications, the average depth of the grooves would have to be nearly .250-in. deep with a minimum depth of approximately .188 in. When these depths were reached, a harsh surface developed because of pulled aggregate. Statewide research was ordered. After the result of this research was analyzed, the texture depth was lowered by field change to produce a texture similar to Figure 11.

This project was the first concrete resurfacing project in the Dallas area. Because several similar projects have been proposed, it is hoped that the information gained from the work on I-30 will benefit those projects.

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# Portland Cement Concrete Pavement Overlay Over a Bituminous Pavement

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ABSTRACT

The initial stage construction completed in 1970 on Interstate 70 in western Kansas consisted of a 10-in. asphaltic concrete pavement. At the time of the second stage, 10 years later, the pavement exhibited signs of load and nonload associated cracking. A 3-in. second stage overlay had been planned during the initial design. Based on current conditions, traffic, and distress, a structural design called for a 5-in. asphaltic concrete overlay. Overlays generally do not control reflective cracking for appreciable periods of time. Therefore, additional rehabilitation strategies were proposed. Based on life cycle costs, a Value Engineering Committee selected an 8-in. portland cement concrete pavement to be placed over the existing asphaltic concrete base. That 10-mi overlay was constructed in 1983 and an additional 17 mi were let to contract in 1984.

The interstate pavement structure in Kansas was built using bituminous pavement in the western half of the state and portland cement concrete pavement (PCCP) in the eastern half of the state. The primary reason for those choices was close proximity to available resources (i.e., limestone and cement in the east and sand, gravel, and oil in the west). The initial design term for the pavement structure for the Interstate Highway System was set at 20 years. Minor imperfections such as raveling, rutting, polishing, and flushing of asphaltic concrete pavement, however, usually required that an overlay be placed