Pavement Widening and Resurfacing in Idaho

L. F. ERICKSON, Materials Engineer, and
PHILLIP A. MARSH, Assistant Materials Engineer
Idaho Department of Highways

● DURING World War II construction of Idaho highways was at a standstill and maintenance was greatly curtailed. As a result, at the close of the war, many miles of high type pavement both asphaltic and portland-cement concrete, structurally inadequate and too narrow, were in need of immediate reconstruction.

Reconstruction to the desired standards could not be accomplished as rapidly as road conditions required and need to take immediate action to accommodate traffic and reduce maintenance costs prompted the Idaho Department of Highways to initiate a program of widening and resurfacing.

DESIGN

The majority of the pavements which were resurfaced were constructed in the late twenties and early thirties generally 18 feet wide and with shoulders three to four feet wide. These pavements were resurfaced to 24 foot width, with three to six foot shoulders. Additional right-of-way was purchased for these projects only when absolutely essential, and shoulder widths were therefore sometimes limited by the existing right-of-way widths.

A condition survey was made of most projects to determine the thickness and quality of pavement and existing base, shoulder material, and the type of subgrade soil. The condition of the existing roadway was carefully noted. Samples of existing base and shoulder gravel were submitted to the Materials Laboratory for determination of quality. Subgrade soil samples were tested and evaluated for total ballast thickness requirements using the same criteria as for construction of new highways with comparable traffic. In a few instances where no failures had occurred and the road appeared structurally adequate, no subgrade soils samples were taken.

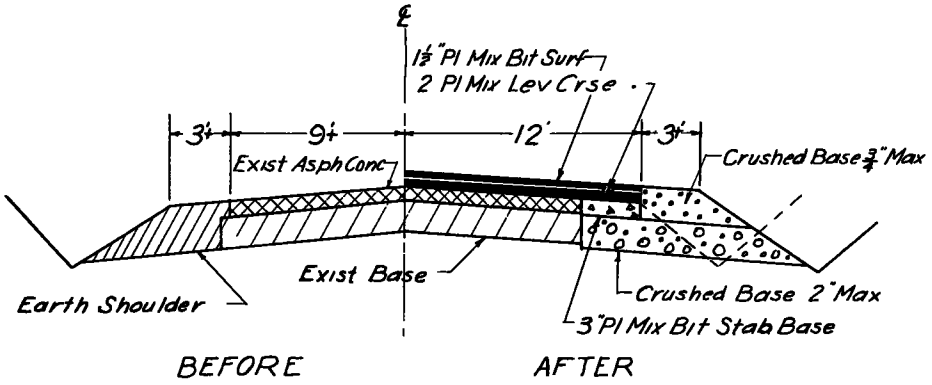
Nearly all of these projects had earth shoulders with the base and pavement placed in a trench section. The earth shoulders were removed to subgrade elevation and reconstructed, using clean, permeable crushed gravel base. Idaho discontinued the use of the "trench" section during the mid-thirties and has since constructed all base and subbase courses full width.

Roads paved with asphaltic concrete and structurally adequate but requiring widening and minor correction of the riding profile, were treated as in the typical section of Figure 1. The earth removed from the shoulder was used to widen the roadbed. Crushed gravel base and plant mixed bituminous stabilized base in courses not exceeding 3 inches compacted was placed to form a base for pavement widening. A tack coat was applied to the surface and edges of the existing pavement at a maximum rate of 0.15 gal. per sq. yd. with an RC-0 asphalt further fluxed with 25 percent naphtha. The plant mix pavement was constructed 3½ inches in thickness in two courses. The bituminous plant mix consisted of a ¾-inch maximum crushed gravel and SC-6 liquid asphalt, or 120-150 or 200-300 penetration asphalt cement.

Roads paved with asphaltic concrete which were structurally inadequate, were widened and reinforced as shown in Figure 2. The earth shoulders were removed to a depth equal to the thickness of the existing base or subbase and backfilled with compacted crushed gravel base. Additional base was then placed full width of the roadway over the newly constructed shoulders and the old pavement. A prime coat of MC-1 was applied at approximately 0.30 gal. per sq. yd. and plant mix surfacing was applied in a single 2½-inch course.

Portland-cement concrete pavements that were structurally adequate were widened and resurfaced as shown in Figure 3. Subsealing of slabs or cleaning of cracks was not required. Scaled areas were patched with bituminous surfacing before paving. The existing concrete pavement was tacked at a maximum rate of 0.15 gal. per sq. yd. with RC-0 further fluxed with 25 percent naphtha. The 3½-inch plant mix surfacing was laid over the existing pavement and widening in two courses.

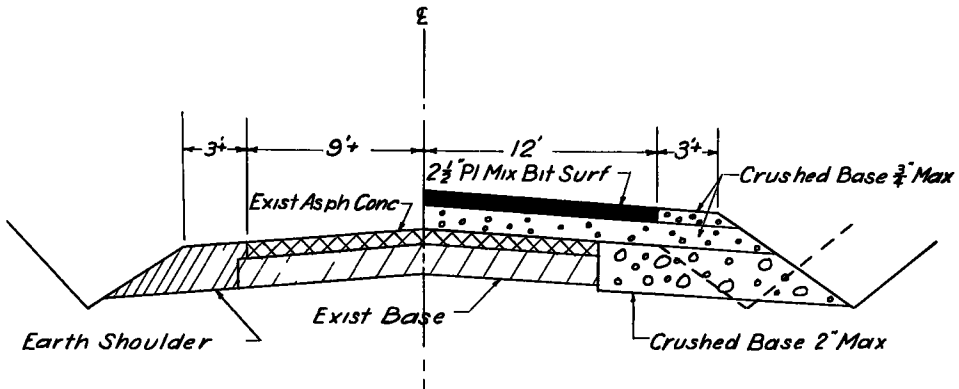
Badly broken portland-cement concrete was resurfaced as shown in Figure 4. Shoulders were removed and replaced with crushed base; additional base was placed full width over the concrete pavement and shoulders and resurfaced with a single 2½-inch course of bituminous surfacing.



RESURFACING WITHOUT REINFORCING BASE

Figure 1. Widening and resurfacing asphaltic concrete pavement.

All of the resurfacing projects were given a seal coat not sooner than ten days after laying the pavement. The seal coat consisted of MC-5 or RC-5 liquid asphalt applied at the rate of 0.25 to 0.30 gal. per sq. yd. with ½-inch to No. 10-mesh cover coat material applied at approximately 30 lb. per sq. yd.



RESURFACING WITH REINFORCING BASE

Figure 2. Widening and resurfacing asphaltic concrete pavement.

CONSTRUCTION

The earth shoulders were removed with a motor patrol and the excavated material bladed outward to widen slopes and fill the existing ditch, or carried ahead to widen embankments. Safety of the traveling public dictated that no trench be left open at night and therefore the specifications required all open trenches to be completely backfilled and compacted by sundown each day. Courses of crushed base for widening were deposited on the existing pavement by trucks dumping into an adjustable orifice type windrow placing device. This windrow of base was then bladed into the trench by motor patrol, leveled off with a special attachment bolted on the blade, and compacted.

Crushed base for the widening and the bituminous stabilized base was compacted with a pneumatic tired truck roller and a steel wheel roller. The specifications for the truck roller provided for a truck of three-ton minimum capacity loaded with five tons of ballast. The truck was equipped with dual tires on the rear wheels, each tire having a width of contact with the pavement of not less than 7½ inches.

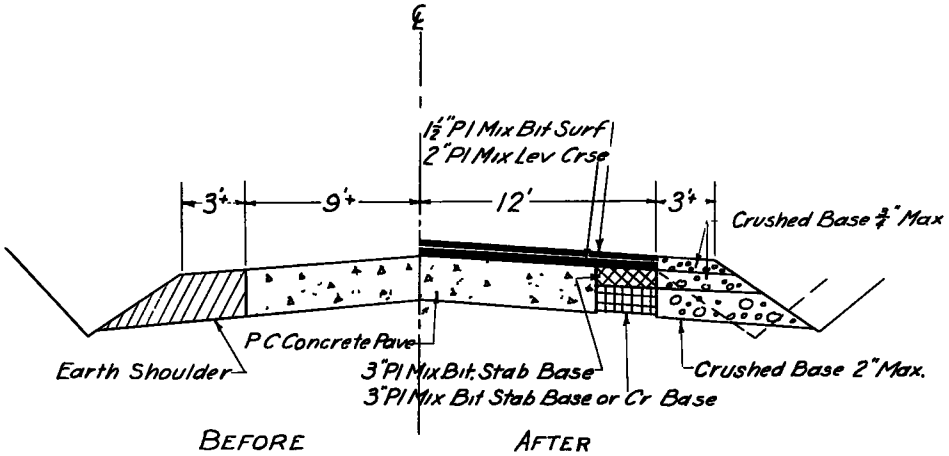


Figure 3. Widening and resurfacing portland-cement concrete pavement.

The bituminous stabilized base was placed in the same manner with sufficient material used so that ¼-inch to ⅜-inch was left above the existing pavement after truck compaction to permit the full weight of the steel roller to be borne by the widened section. Pavements were thoroughly cleaned, all old unstable patches removed, and other failed areas patched with plant mix before applying the tack coat. Where the existing pavement was rough or badly warped, a leveling course of plant mix was laid

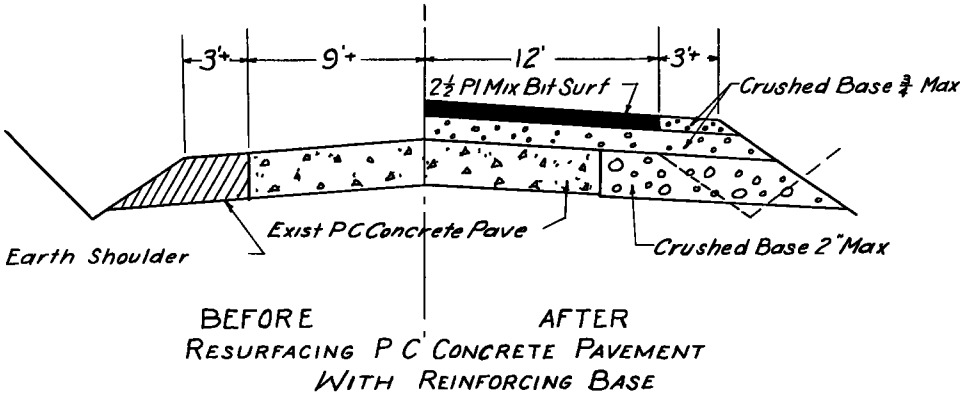


Figure 4. Widening and resurfacing portland-cement concrete pavement.

with a motor patrol. The plant mix level course and surface course were then placed by the conventional pavers.

One rough asphaltic concrete pavement which had been planed and sealed a year previous to resurfacing had failures develop immediately after planing. The following spring it was decided that the project had to be resurfaced that summer. This project was given an additional course of ¾-inch base as shown in Figure 2. No detour was available and the usual prime coat was considered inadequate to carry the heavy traffic

TABLE 1

PERFORMANCE OF RESURFACED PAVEMENTS

Project	Year Constructed	Type Resurfacing Figure No.	Miles Length	Additional Base Overlay	Traffic Count A.D.T. 1954	Performance					
						Pavement Cracks			Compaction of Widening	Subgrade or Base Failure	Riding Qualities
						Transverse	Long on Centerline	Long Edge			
SA 17(4)	1946	3	5.289	None	2250	Yes[1]	Mod[2]	Mod	None	None	Good
SA 161(2)	1946	1	8.804	None	4168	Yes	---	Mod	None	None	Fair
Misc 1458	1946	1	0.800	None	3854	Yes	---	Mod	None	None	Good
Sa 253(1)	1947	3	5.577	None	5670	Yes	Yes	Yes	Yes	Yes	Poor
"	"	4	0.39	4-inch	"	Yes	Yes	Yes	Minor[3]	Yes	Poor
SA 253(2)	1948	1	10.804	None	5180	Yes	---	Yes	None	None	Good
"	"	2	3.695	4-inch	"	Yes	Yes	Mod	None	None	Good
"	"	3	4.754	None	"	Yes	---	Yes	Yes	None	Poor
F 23(10)	1948	2	5.112	6-inch	2498	Mod	---	None	None	None	Good
F 27(3)	1948	1	2.84	None	4900	Yes	---	Yes	None	Minor	Good
SA 64(6)	1949	1	8.364	None	1106	Mod	---	---	None	None	Good
SA 253(3)	1949	2	16.88	4-inch	4940	Yes	---	Mod to Minor	None	Minor	Good
SA 17(5)	1949	1	6.861	None	2250	Yes	Mod	Yes	None	None	Good
SA 275	1949	1	6.101	None	3140	Yes	---	None	None	None	Good
SA 9(18)	1950	3	4.22	None	3015	Yes	Yes	Yes	None	None	Good
"	"	4	1.31	6-in.+	"	None	None	None	None	None	Good
SA 4114	1951	1	5.97	None	2169	Minor	---	None	None	None	Good
"	"	1[4]	2.83	None	"	Minor	---	None	None	None	Good
SA 3281	1951	4	4.546	4-inch	6433	Yes	Mod	Yes	Mod	Mod	Good

[1] Yes—Predominant characteristic nearly 100 percent.
[2] Mod—Occasional occurrence but not predominant. Less than 20 percent.
[3] Minor—Infrequent or rare occurrence.
[4] 3-inch Bituminous Stabilized plant mix overlay plus 2-inch Bituminous Plantmix resurfacing.

(5,000 v.p.d.) during paving operations. A two-course surface treatment was therefore substituted for the prime coat. This consisted of applying 0.30 gallon of MC-2 per square yard and immediately covering with 30 lb. per sq. yd. of ¾-inch surfacing to secure an inverted penetration. After curing five days a second similar application was made, except that MC-3 liquid asphalt was used. Paving was started in late September and completed during early November. This surface treatment aided materially in providing a dust free surface for the heavy traffic volume.

PERFORMANCE

These resurfaced projects have benefited the state materially by providing smooth and structurally sound roads of reasonably adequate width at low cost. The cost ranged from $12,000 to $33,000 per mile. These projects are still being used and many will continue in service for an additional five to ten years. The lone exception is a resurfacing of portland-cement concrete pavement which should have been subsealed to stabilize rocking slabs, and overlaid by a gravel base of at least six inches in thickness. Table 1 lists these projects and gives information regarding performance.

The resurfacing and widening of asphaltic concrete pavements without base reinforcement appears successful, but surface transverse cracks in the old pavement appear to be reflecting. (see Figure 5). Some longitudinal edge cracking has occurred,

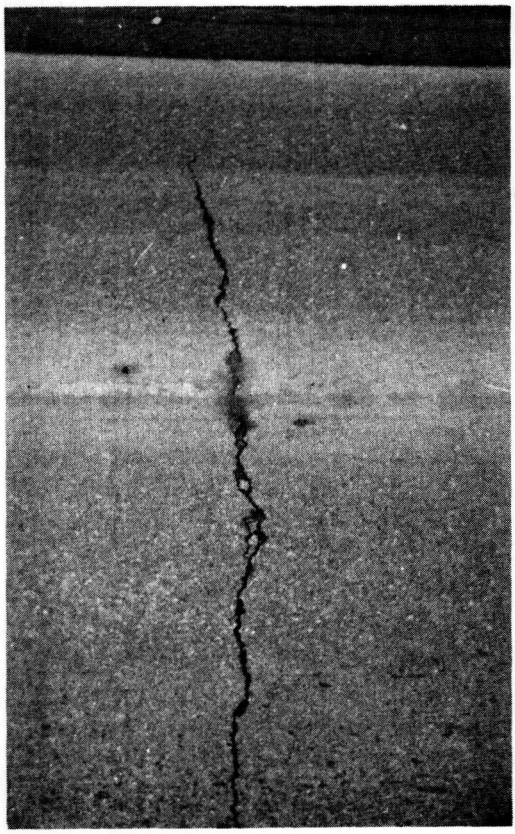


Figure 5. Reflected transverse crack in resurfaced asphaltic concrete pavement.

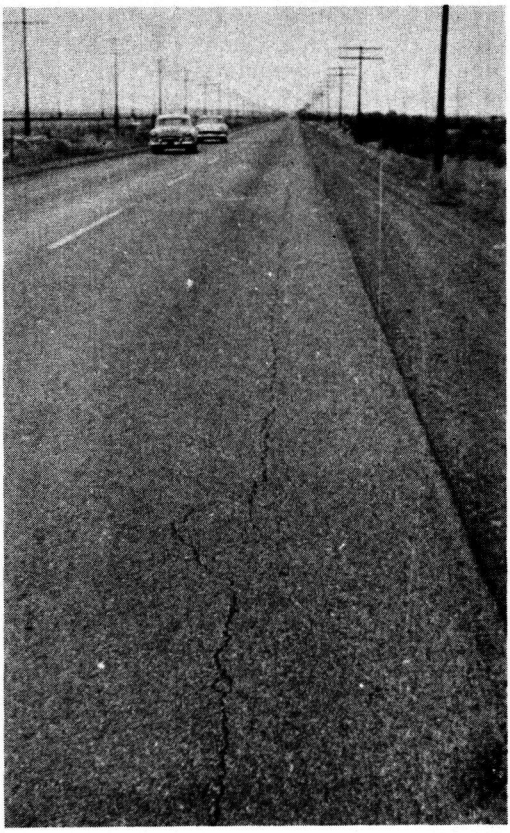


Figure 6. Longitudinal crack over old asphaltic concrete pavement edge.

although apparently only after about five years. Heavy trucks are observed to drive with the outer wheels near the pave-

Figure 7. Longitudinal and transverse cracking over asphaltic concrete pavement.

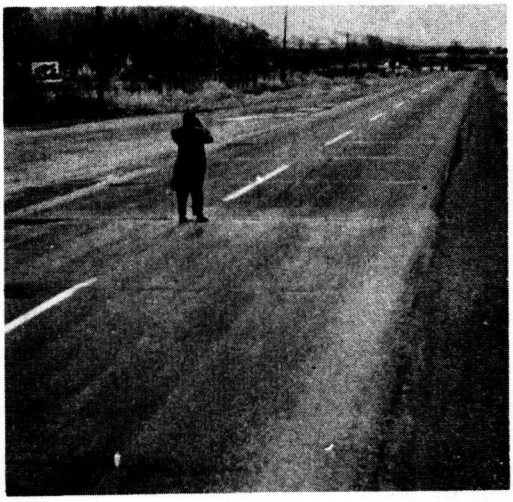


Figure 8. Reflected joints in resurfacing of portland-cement concrete pavement, no base added.

ment edge, and where base widening apparently was not compacted sufficiently, a longitudinal crack reflecting the old pavement edge occurs. (see Figures 6 and 7). However, these pavements still exhibit good to excellent riding qualities.

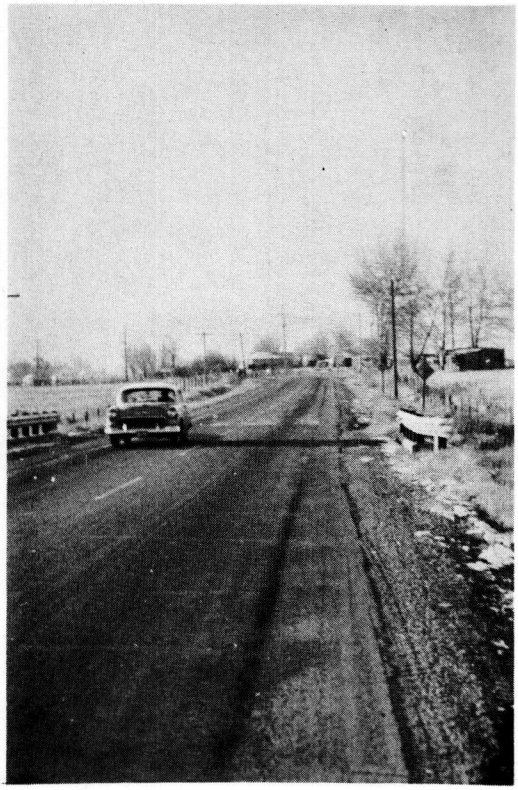


Figure 9. Traffic compaction of widened section, portland-cement concrete pavement, no base added over old pavement.

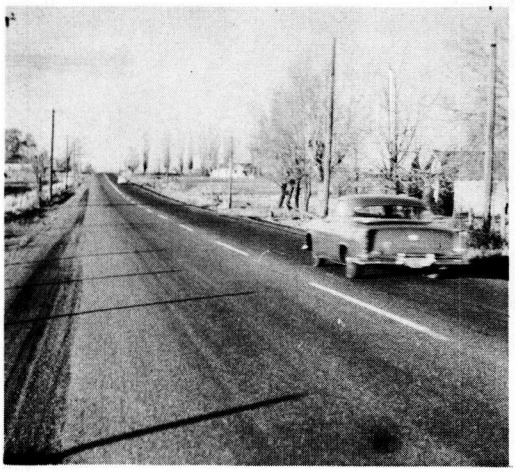


Figure 10. Resurfaced portland-cement concrete pavement with six inches of base added, in perfect condition seven years later.

The resurfacing of asphaltic concrete pavements with base reinforcement has given excellent service. Some longitudinal cracking over the old pavement edge, and some transverse cracking has occurred, although much less than where no base was added. The transverse cracking appears to be a reflection of cracks existing before resurfacing, since cracks were known to exist even though no definite location survey was made.

The resurfacing of portland-cement concrete pavements without the addition of base overlying the old pavement results in reflection of nearly all dummy and expansion joints and other cracks. (see Figure 8). The edge of the concrete pavement also reflects through the new pavement by the appearance of longitudinal cracks. Where compaction apparently was lacking in the base beneath the widened section, traffic compacted the pavement with the result that a groove was formed. (see Figure 9). The riding qualities of these pavements are generally fair but one pavement is definitely poor. All transverse and edge cracks have had to be sealed.

Our first resurfacing project was accomplished using six inches of bituminous stabilized base course for widening and is still one of our better pavements, both from overall appearance and riding quality. The next project had the stabilized base for widening reduced to three inches with the remainder consisting of compacted crushed gravel. This is our poorest pavement considering edge compaction and riding qualities. It is our opinion however, that the subgrade soils of these projects differed sufficiently to cause part of this difference in performance. The pavement on the silty soil probably continued to pump and the slabs to rock. The pavement constructed over sand or sand-silt soils which are generally free draining shows little distress.

One pavement with a layer of crushed gravel base three inches thick laid over the old pavement reflects dummy and expansion joints. The reflection has not become serious and does not impair the riding quality. The base used, however, has a plasticity index of about three, and exhibits the familiar alligator or hexagonal crack pat-

tern immediately over the concrete pavement. Our experience indicates this much plasticity can be detrimental more often than not.

A pavement constructed in 1951, with a 6-inch base overlaying a portland-cement concrete pavement is still in excellent condition and does nor reflect cracks, joints or the edge of the old pavement. Adjacent sections without the crushed gravel base exhibit reflection cracking of the usual type. (see Figures 10 and 11).

Figure 11. Resurfaced portland-cement concrete pavement with no added base.

RECOMMENDATIONS

It is recommended that the added base and stabilized base be compacted equal in density to the existing base and pavement. This should reduce grooving and possibly reflections of the old pavement edge. The use of bituminous stabilized base a distance of one foot or more outside the finished pavement would possibly help reduce pavement edge reflection cracks by increasing edge support. Also in line with our present practice, paving the shoulder full width to the same thickness, and with the same material as the pavement would help to an even greater extent. The value of paved shoulders was proven on part of the pavement in the WASHO road test.

Stabilizing of the crushed gravel base widening with portland cement to eliminate compaction of the aggregate by traffic would in our opinion be the best treatment. Stabilization of the widened base should be for the full depth.

Portland-cement concrete pavements should have all rocking and loose slabs mudjacked to prevent movement. It is our observation that a minimum of six inches of crushed gravel base over the old pavement is required if reflection cracks are to be eliminated. A uniformity of section full width is of major importance to riding qualities.