PROGRAMMING CITY STREET IMPROVEMENTS

Clyde E. Williams,

City Engineer, South Bend

Three years ago Mayor Jesse I. Pavey and the Board of Public Works and Safety undertook, with the assistance of the City Engineering Department, a detailed study of the South Bend street system. The principal objectives were to determine the extent to which the city’s streets needed rebuilding or repairing and the feasibility of street work as a public works project to give employment to heads of families on direct relief.

Early in the study it became evident that street construction could be readily adapted to the Work Projects Administration program. However, not until the conclusion of the survey did South Bend officials fully realize the possibilities offered by extensive improvement of many of the city’s main thoroughfares and residential streets.

One of the major findings of the study was that the city had approximately 40 miles of rough and generally decadent brick-surfaced streets. There were many additional miles of obsolete gravel, dirt, and flexible-type streets badly in need of reconstruction. Here, then, was a situation that was bound to affect adversely the city’s future financial structure. These many miles of old streets had long since proved a vexing maintenance problem and promised in the future to become an even more serious threat to sound fiscal policy, not to mention their unfavorable appearance and the added car-operating costs to motorists.

A street reconstruction program appeared to be the answer to employment for relief workers and insurance against future excessive inroads on city funds for street upkeep. Accordingly, the City Engineering Department was authorized to proceed with a plan of reconstruction. This decision was taken early in 1939.

CONCRETE SELECTED

The program was started and has since continued without serious interruption. During the past three years, the city has replaced many of its worst streets with a total of 234,295 square yards of concrete pavement, the equivalent of about 22 miles of 18-foot highway. It should be noted that concrete was selected because it met, more than any other paving material, the city’s need for permanent streets and gave the assurance of minimum maintenance for many years to come.

About two-thirds of the concrete yardage resulted from rebuilding of the old brick-surfaced streets, among them a number of the city’s busiest arteries, such as a section of Wash-
ashington Street in the business district, and Jefferson Boulevard and South Street. In this work, the old bricks are salvaged and crushed to convenient size to serve as part of the pavement aggregate, thus making a distinct saving in materials to the city. The remaining one third of the yardage consists of standard concrete pavement built, for the most part, on residential streets.

It is a matter of record that the three-year improvement program is the largest street-paving program in the city’s history. The great need for systematic repaving throughout the city is seen in the fact that in the decade prior to 1939 practically no reconstruction of streets was done. Reconstruction now is by no means complete, but much has been accomplished. Present plans call for continuance of the work in succeeding years.

Perhaps the greatest single contribution to efficiency in the current concrete-paving program has been the city’s central mixing plant. At the start of operations, the central plant was set up on convenient, rent-free property, and the city acquired a 27-S stationary mixer, a 3-bin weighing batcher, a brick crusher, trucks, and all other necessary equipment. All this has been purchased by the city.

**USE OF SALVAGED BRICKS**

In the financing of the broken-brick aggregate streets, the WPA supplied all the labor and part of the materials, while the city furnished the remainder of the materials and paid for the equipment in installments.

In this part of the paving program, crews removed the brick, piling up the best ones along the sides of the street. The imperfect bricks, or culls, were trucked to the central mixing plant for crushing to the desired size in preparation for mixing with sand, cement, and gravel. Thus, the crushed culls were returned to the streets in the form of new pavement, and the best bricks were relaid as parking strips on either side of the concrete lanes.

On streets under 24 feet in width, the practice has been to pave the entire width with concrete. Streets more than 24 feet wide are paved with concrete lanes in the center of the roadway and with brick parking strips ranging from six to eight feet in width. Parking-area bricks are laid on a gravel base and held together with cement grout.

Shortly after some of the old brick streets had been replaced with new concrete pavement and brick parking strips, numerous property owners approached city officials about getting residential streets paved in the same manner. Because there was not enough crushed brick available for use as part of the materials, the Board of Public Works and Safety conceived a plan whereby standard concrete pavements could be
built if property owners contributed $1.00 per square yard of paving. Property owners have responded enthusiastically to this plan.

**STANDARD CONCRETE PAVEMENTS**

In constructing the standard concrete pavements, the WPA furnishes the labor, the property owners' contributions are used to buy cement, sand, and gravel, and the city pays for the equipment rental, as in construction of the "brick-concrete" streets. Property owners contribute their share of the cost before the projects start.

The standard concrete jobs are easily carried on simultaneously with the "brick-concrete" paving, as it is a simple matter to change from one kind of concrete mix to the other at the central mixing plant. In both types of paving, the concrete lanes have a center thickness of six inches with eight-inch thickened edges. Dummy contraction joints are spaced every 20 feet between expansion joints, which are 100 feet apart. All the pavements are hand-finished and the surfaces are hand-broomed to add to the anti-skid characteristics of the concrete.

The central mixing plant has proved to be a model of efficiency and a credit to the WPA labor and management. With crushed brick, gravel, sand, and cement close at hand, it is possible to mix 160 batches of concrete in an eight-hour day, or one batch every three minutes. The paving crews also have attained a high degree of efficiency and are able to place 1,000 lineal feet of 9- or 10-foot lanes in eight hours.

Because the street projects are widespread throughout the city, the central mixing plant has been found ideal for preparing the concrete batches. Efficient and economical operation is seen in the fact that concrete may be hauled to one or more streets while one crew is tearing up a section of brick street and another is placing forms and preparing the street bed for paving. As many as four streets have been paved at one time. With the central mixer, the paving of lanes of varying widths is easily accomplished. These lanes range from 8 to 12 feet in width. In addition, the central mixer makes possible the paving of short sections of streets, or the paving of one side of a street while the other side remains open to traffic, and motorists thus are not inconvenienced for long periods.

**SPECIFICATIONS**

Indiana State Highway Commission specifications for portland cement concrete pavement provide for a 40-60 combination of No. 2 and No. 5 coarse aggregate. Washed gravel meeting Indiana State Highway Commission specifications for No. 5 aggregate is available from a local plant, but No. 2 or "U" aggregate is available only as crushed stone shipped by
rail at a much higher price F.O.B. South Bend. Thus, the obviously economical course was to produce a crushed-brick aggregate conforming as nearly as possible to the grading requirements for No. 2 aggregate but without the expense and waste of material involved in screening after crushing.

With the crusher set to meet maximum-size requirements, it was found that there was some excess of the smaller sizes from 1/2" to 1", but sieve analysis and experiment with various combinations showed that a 50-50 combination of crushed brick with the local gravel produced a combined aggregate well within the limits of a 40-60 combination of No. 2 and No. 5. This is demonstrated by the following chart:

<table>
<thead>
<tr>
<th>Material</th>
<th>Total Percentages Retained on Sieves Having Square Openings</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>2&quot;</td>
</tr>
<tr>
<td>Crushed Paving Brick No. 5 Aggregate Local Source</td>
<td>3.2</td>
</tr>
<tr>
<td>50-50 Combination of above</td>
<td>4.5</td>
</tr>
<tr>
<td>40-60 Combination of No. 2 and No. 5 State Highway Commission Specifications</td>
<td>1.6</td>
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</tbody>
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This combination is necessarily considered on a volume basis because of the difference in specific gravity between paving brick and stone or gravel. With proper allowance for this difference in specific gravity and after some experiment as to yield and workability, the following batch has been established as a satisfactory mix for portland cement concrete pavement:

Cement 1.75 bbls.
Water 40 gals.
Sand 1,600 lbs. = 38.8% by volume of total aggregate
Gravel 1,260 lbs. = 50-50 combination by volume of coarse aggregate
Crushed Brick 945 lbs.

The yield of the above batch is 1 1/6 cubic yards, or 1.5 barrels of cement per cubic yard of concrete in place.

Under this scheme of operation, all labor is furnished by WPA, and truck expense to haul brick to the crusher is no greater than hauling to a dump if the brick is wasted. Thus
the cost to the city for the crushed brick (50 per cent of the coarse aggregate) is only that of crusher operation.

Abrasion tests of the crushed brick aggregate were made by the University of Notre Dame Engineering Department, using the Los Angeles Abrasion Machine in accordance with A.A.S.H.O. Method T-96. The percentage of wear by this method was found to be 37.2 per cent. Similar tests of other local concrete aggregates by the same method gave results up to 50 per cent of wear.

In the Public Roads magazine of September, 1935, a comparison of A.A.S.H.O. Methods T-4 and T-96 for abrasion tests of aggregates is given as follows:

<table>
<thead>
<tr>
<th>Aggregate</th>
<th>T-4</th>
<th>T-96</th>
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<tbody>
<tr>
<td>Vermont Granite</td>
<td>2.6%</td>
<td>33%</td>
</tr>
<tr>
<td>Michigan Limestone</td>
<td>3.4%</td>
<td>33%</td>
</tr>
<tr>
<td>Wisconsin Dolomite</td>
<td>4.1%</td>
<td>34%</td>
</tr>
</tbody>
</table>

From the above data, it is concluded that 40 per cent or less of wear by the T-96 method is acceptable.

Cores of brick-aggregate pavement have been taken and show satisfactorily the thickness of slab and physical characteristics of the mix; but the mechanical condition of the coring machine is such that clean-cut cores suitable for strength tests have not been obtained.

CEMENT-BOUND MACADAM ALLEY PAVEMENTS

Harry Overesch,
City Engineer, Lafayette

My subject is supposed to be "Cement-Bound Macadam Alley Pavements," but what I am about to describe is—an orphan. As a prominent cigarette maker says, "Something new has been added." If it doesn't prove out, I suppose I'll be called the orphan. The reason for its being runs like this: One day the Street Commissioner said, "What am I going to do with this alley? It is too far gone to patch. The property owners don't want to pay for materials, and I don't blame them much as the utilities tore it up and our own waterworks was one of the chief offenders." It had been built probably 50 years ago of 4" to 6" cobblestones laid on a sand cushion with the voids filled with sand. We have several miles of the same construction built before concrete or brick came into general use. Well, if the city has to pay for all the cost of materials, naturally you lie awake a few nights (no city engineer has any time in the daytime to think) wishing you were a magician or that you had the golden key to the treasure chest.